

Tibbo Programmable Hardware Manual

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Introduction

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[Legal Information](#)

[Manual Update History](#)

This Manual has the following sections:

- [Embedded Modules](#)
- [Boards](#)
- [Development Systems](#)
- [Tibbo Project System \(TPS\)](#)
- [External Controllers](#)
- [Companion Products](#)
- [Kits and Accessories](#)

Important notes:

- This manual should be used in conjunction with a "TIDE and Tibbo BASIC Manual" -- a separate manual that documents Tibbo BASIC, TIDE software, hardware "platforms", and everything else required for successful development of Tibbo BASIC applications.
- This manual does not include any information on fixed-function, non-programmable Tibbo devices, such as the original EM100 module or the DS100 serial device server. The data on these devices can be found in the "Serial-over-IP Solutions Manual" -- a separate document.
- Some Tibbo devices are dual-use in nature. Depending on the loaded firmware, any dual-use product can be a fixed-function, serial-over-IP device, or a BASIC-programmable controller. Dual-use devices are documented in the present manual as well as the "Serial-over-IP Solutions Manual". The present manual describes each such device as a BASIC-programmable one, while the "Serial-over-IP Solutions Manual" describes the same device as a serial device server.

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Embedded Modules

The following embedded modules are currently being offered by Tibbo:

- [EM500](#)
- [EM1000](#)
- [EM1202](#)
- [EM1206](#)
- [EM200*](#)

Use the [module comparison chart](#) to select the module that best suites your application.

** The EM200 module is a dual-use device. For best results, use the EM1000 and EM1202 modules based on the new T1000 ASIC developed by Tibbo.*

Module Comparison Table

Generation	2nd generation: Mature serial-over-IP platform, support for simple Tibbo BASIC applications		3rd generation: Full power of Tibbo BASIC programmability, support for serial-over-IP via available Tibbo BASIC application		
Device	EM200	EM203 (SoI manual)	EM1000	EM1202	EM1206
Highlights	Like the EM120, but with 10/100Base-T Ethernet	Member of x20x family, mates with the RJ203 jack/magnetics. Combined footprint only 31x19mm.	2.54mm (0.1") pin pitch – ideal for prototyping. New to Tibbo BASIC? Start your quest with this module!	Stacked design minimizes footprint, device width close to that of a standard RJ45 jack.	Member of x20x family, mates with the RJ203 jack/magnetics. Combined footprint only 34.5x19mm.

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Can work as a serial-to-IP device?	YES		YES, through the use of available serial-over-IP Tibbo BASIC application		
Ethernet port	10/100BaseT				
Ethernet magnetics	NO (External only)				
Wi-Fi port	NO		EXTERNAL, requires the GA1000 Wi-Fi add-on module		
Serial port(s)	1		4		
I/O lines	Up to 9	Up to 4	Up to 54	Up to 32	Up to 17

Flash memory	128KB, for SoI or Tibbo OS (TiOS) firmware, compiled T-Basic app.		512KB or 1024KB, for TiOS firmware, compiled Tibbo BASIC application and its data		
Flash disk (FD. object)	NO		YES, can take all free space in the flash memory (space not already occupied by TiOS firmware and Tibbo BASIC application)		

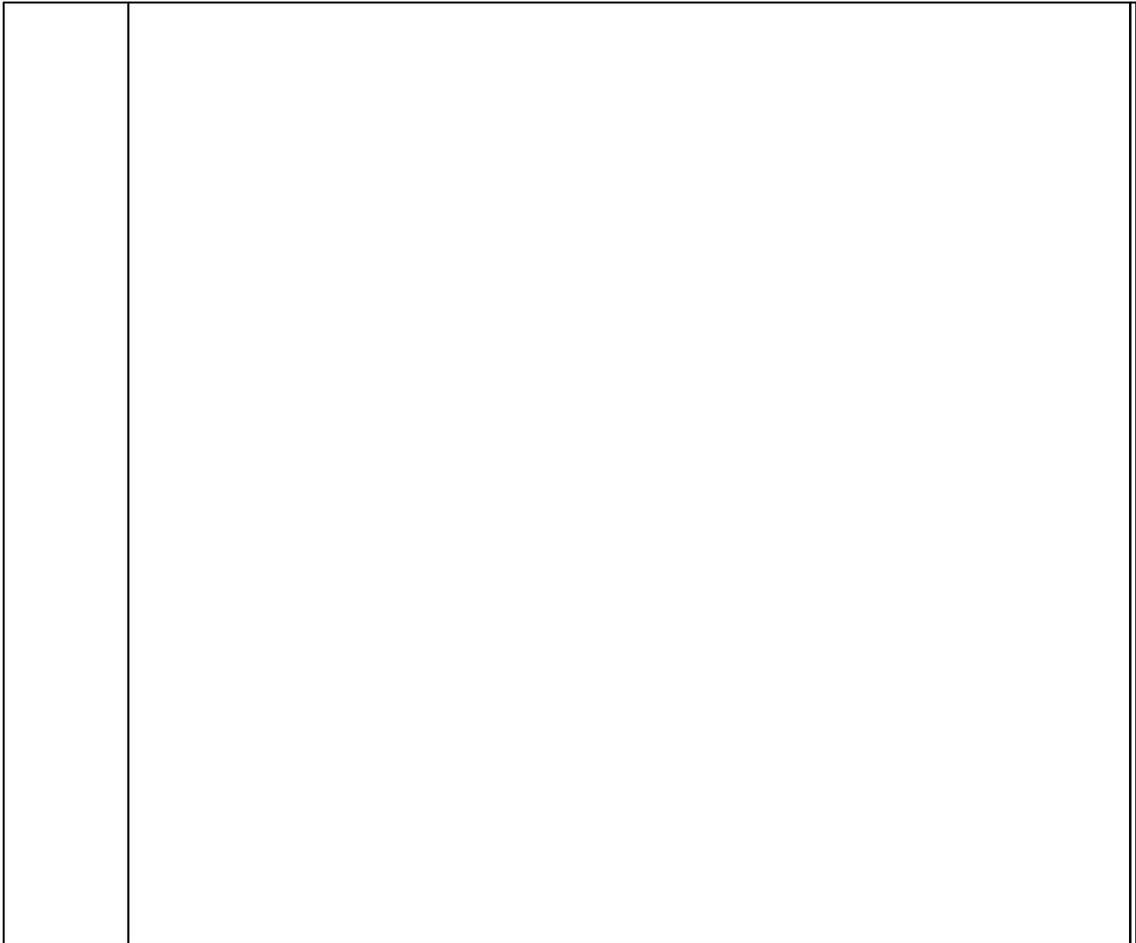
EEPROM	2048 bytes, used by SoI firmware to store settings, 2042 bytes available to store T-BASIC app. data	2048 bytes, 2042 bytes available to store Tibbo BASIC application data

RTC (RTC. object)	NO, but you can connect an external RTC	YES, with internal or external backup power source	NO, but you can connect an external RTC	YES, with external backup power source
Display support (LCD. object)	NO, but you can connect a simple text display	YES, supports several models of graphical displays, connected externally		

Keypad support (KP. object)	NO, but you can connect keys to I/O lines	YES, up to 64 keys depending on the availability of I/O lines and keypad configuration
Buzzer control output	NO	YES, programmable square wave output
System (a.k.a. MD) button line	YES	
Status LED control lines	2, for green and red status LEDs	

<p>Ethernet LED control lines</p>	<p>2, for link and speed mode indication</p>		
<p>PLL (speed) control</p>	<p>NO</p>	<p>YES, through hardware (jumper) or software</p>	<p>YES, through software only</p>
<p>Reliable onboard reset</p>	<p>NO, proper external reset circuit is required for correct device operation</p>	<p>YES, onboard power-up, brown-out detection, and watchdog circuit</p>	

Supply voltage (nominal)	5V		3.3V, I/O lines are 5V-tolerant		
Current consumption (max)	220mA, with 100BaseT link		230mA, with PLL on and 100BaseT link		
Dimensions (LxWxH)	32.1x18.5x7.3mm	30.1x18.1x5.5mm	38.4x28.4x5.5mm	19.1x17.1x14.6mm	33.2x18.1x5.5mm
Firmware upgrades	YES, through a serial port or network				



EM500 "MiniMo" BASIC-programmable Ethernet Module



Introduction

The EM500 "MiniMo"* device is a miniature stand-alone BASIC-programmable

embedded module, designed to be used in combination with a standard LED/magnetics RJ45 jack. The combined footprint of the EM500 and a standard jack is only 28.5x18.5mm.

The module's hardware mix, which includes 10/100BaseT Ethernet port, a serial port, and 8 I/O lines, has been carefully tailored to address the basic needs of lightweight network-enabled control devices. If your application has a need to store data, an [external flash IC](#) can be connected to the EM500. The EM500 also supports Wi-Fi communications (using the [GA1000](#) add-on board).

Compact dimensions, a space-saving "vertical slice" mechanical design, low power consumption, and innovative dual-function LED control lines make the module an excellent fit for miniature, cost-sensitive designs.

The EM500 is fully supported by TIDE software and a dedicated EM500 platform that covers all hardware facilities of the module (see "TIDE and Tibbo BASIC Manual"). For convenient testing and evaluation Tibbo offers the [EM500EV](#) development system.

The EM500 can be ordered standalone or in combination with an industry-standard RJ45 jack and/or other discrete components required to complete a working circuit.

Hardware features

- Based on a second-generation Tibbo ASIC (T2000).
- 10/100BaseT auto-MDIX Ethernet port (no magnetics).
- Optional Wi-Fi interface (requires [GA1000](#) add-on module to be [connected](#)).
- One serial port (CMOS-level):
 - Baudrates of up to 460'800bps;
 - None/even/odd/mark/space parity modes;
 - 7/8 bits/character modes;
 - Full-duplex mode with optional flow control;
 - Half-duplex mode with direction control;
 - Encoding and decoding of Wiegand and clock/data streams.
- 512KB flash memory; 256KB available for compiled Tibbo BASIC application; an external flash IC can be connected if data storage is required.
- 208 bytes of EEPROM space for data storage.
- 8 general-purpose I/O lines (including 2 interrupt lines) and excluding TX and RX lines of the serial port.
- Control lines for two external dual-function status LEDs.
- Additional control line for a dedicated Ethernet link LED.
- RST input for an external reset source (which is required).
- Power: 260mA @ 3.3V.
- "Vertical slice" construction; dimensions: 18.5x16.0x6.5mm.
- Firmware is upgradeable through the serial port or network (including "cold upgrade" firmware uploads through the network).

Programming features

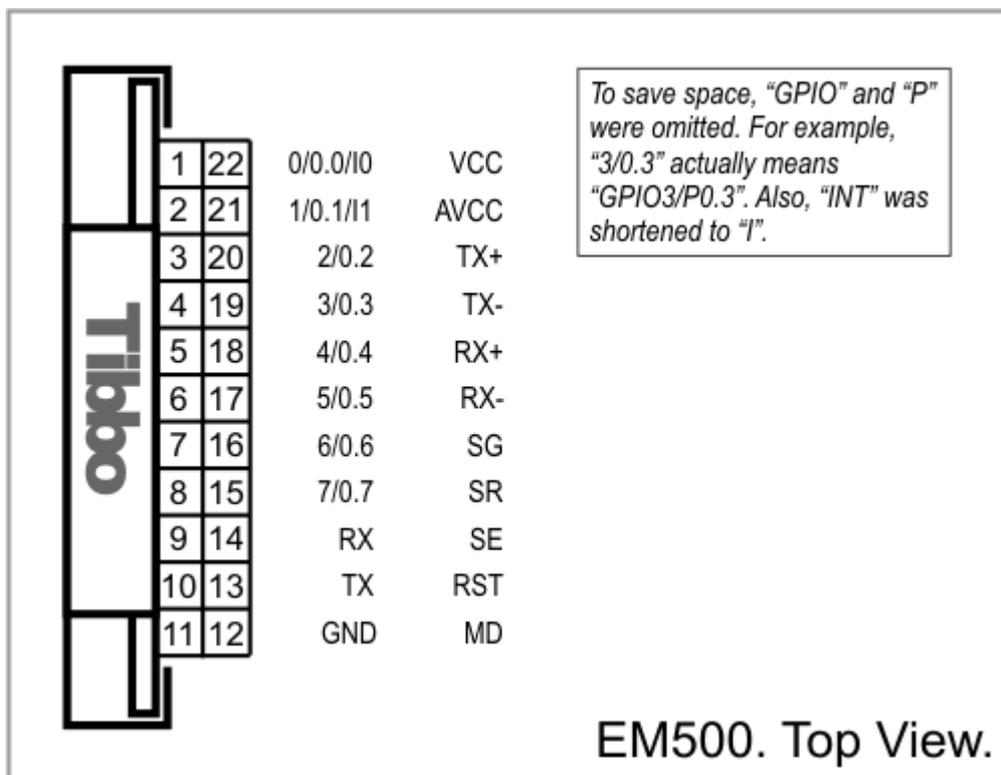
- Variable Types: Byte, char, integer (word), short, dword, long, real, string, plus user-defined arrays and structures.
- Function Groups: string functions (27 in total!), date/time conversion functions (8), encryption/hash calculation functions (RC4, MD5, SHA-1), and more.

- Platform objects:
 - Sock — socket communications (up to 16 UDP, TCP, and HTTP sessions);
 - Net — controls the Ethernet port;
 - Wln — handles the Wi-Fi interface (requires [GA1000](#) add-on module);
 - Ser — in charge of serial ports (UART, Wiegand, and clock/data modes);
 - Io — handles I/O lines, ports, and interrupts;
 - Fd** — manages flash memory file system and direct sector access;
 - Stor — provides access to the EEPROM;
 - Romfile — facilitates access to resource files (fixed data);
 - Pppoe — provides access to the Internet over an ADSL modem;
 - Ppp — provides access to the Internet over a serial modem (GPRS, POTS, etc.);
 - Pat — "plays" patterns on up to five LED pairs;
 - Button — monitors MD line (setup button);
 - Sys — in charge of general device functionality;

*MiniMo is a registered trademark of Tibbo Technology.

* Fully supported with the exception of *fd.copyfirmware*; requires an [externally connected flash IC](#).

I/O Pin Assignment and Pin Functions



See these topics for more information on various hardware facilities of the EM500:

- [Serial Port and General-purpose I/O Lines](#)

- [Ethernet Port Lines](#)
- [Flash and EEPROM Memory](#)
- [LED Lines](#)
- [Power, Reset, and Mode Selection Lines](#)

I/O pin assignment

Pin #	Function	Description
1 (1,2,3)	GPIO0/P0.0/INT0	General-purpose I/O line 0 (P0.0); interrupt line 0.
2 (1,2,3)	GPIO1/P0.1/INT1	General-purpose I/O line 1 (P0.1); interrupt line 1; for flash disk operation, connect to SI and SO of external flash.
3 (1,2)	GPIO2/P0.2	General-purpose I/O line 2 (P0.2).
4 (1,2)	GPIO3/P0.3	General-purpose I/O line 3 (P0.3); for flash disk operation, connect to CLK of external flash, also connect to 5.1K pull-up resistor to VCC (3.3V).
5 (1,2)	GPIO4/P0.4	General-purpose I/O line 4 (P0.4); for flash disk operation, connect to CS of external flash.
6 (1,2)	GPIO5/P0.5	General-purpose I/O line 5 (P0.5); for Wi-Fi operation, connect to DI and DO of GA1000.
7 (1,2)	GPIO6/P0.6	General-purpose I/O line 6 (P0.6); for Wi-Fi operation, connect to CLK of GA1000, also to reset-generating logic (NAND gates).
8 (1,2)	GPIO7/P0.7	General-purpose I/O line 7 (P0.7); for Wi-Fi operation, connect to CS of GA1000, also to reset-generating logic (NAND gates).
9 (1)	RX	RX, W1, and din input of the serial port.
10 (1)	TX	TX, W1, and dout output of the serial port.
11	GND	System ground.
12	MD	Mode selection pin.
13	RST	Reset input, active low. Proper external reset is a must.
14	SE	Link status LED control line.
15	SR	Dual-function red status LED control line.
16	SG	Dual-function green status LED control line.
17	RX-	Ethernet port, negative line of the differential input signal pair.
18	RX+	Ethernet port, positive line of the differential input signal pair.
19	TX-	Ethernet port, negative line of the differential output signal pair.
20	TX+	Ethernet port, positive line of the differential

		output signal pair.
21	AVCC	"Clean" power output for magnetics circuitry.
22	VCC	Positive power input, 3.3V nominal, +/- 5%, max. current consumption 260mA.

Notes:

1. This line is 5V-tolerant and can be interfaced to 5V CMOS devices directly.
2. This line can serve as an RTS/Wout/cout line of a serial port (provided that this does not interfere with any other function).
3. This line can serve as a CTS/W0&1in/cin line of a serial port (provided that this does not interfere with any other function).

Serial Port and General-purpose I/O Lines

The EM500 has eight general-purpose I/O lines GPIO0-7 grouped into a single 8-bit GPIO port P0, plus one serial port.

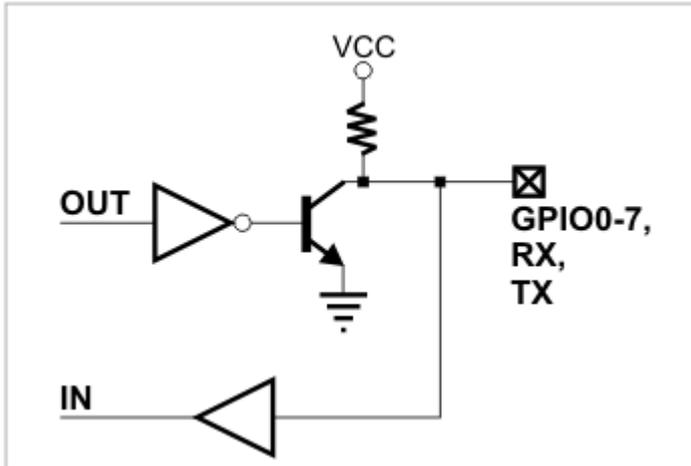
GPIO0 and GPIO1 lines double as interrupt inputs INT0 and INT1.

The serial port has four I/O lines: RX, TX, CTS, and RTS. TX and RX lines belong exclusively to the serial port and are separate from the GPIO lines. CTS and RTS lines do not exist independently. Rather, either GPIO0/INT0 or GPIO1/INT1 can be selected to serve as the CTS line, while any of the GPIO0-7 lines can be selected to serve as the RTS line.

The serial port of the EM500 can work in one of the three modes: UART, Wiegand, or clock/data. TX, RX, CTS, and RTS lines have different names and functions in the Wiegand and clock/data modes. Serial port operation is described in detail in the documentation for the serial (ser.) object found inside the "TIDE and Tibbo BASIC Manual". Additionally, see the Platform-dependent Programming Information section inside the EM500 platform documentation (same manual).

In total, the EM500 has ten I/O lines (GPIO0-7, TX, RX). The simplified structure of one such I/O line is shown on the circuit diagram below. All lines are "quasi-bidirectional" and can be viewed as open collector outputs with weak pull-up resistors. There is no explicit direction control. To "measure" an external signal applied to a GPIO line, set this line to HIGH first, then read the state of the pin. It is OK to drive the pin LOW externally when the pin outputs HIGH internally.

Each I/O line has a weak pull-up resistor that prevents the line from floating when the output transistor is closed. All I/O lines are 3.3V, CMOS, 5V-tolerant. The maximum load current for each line is 10mA.



I/O line control is described in detail in the documentation for the I/O (io.) object found inside the "TIDE and Tibbo BASIC Manual".

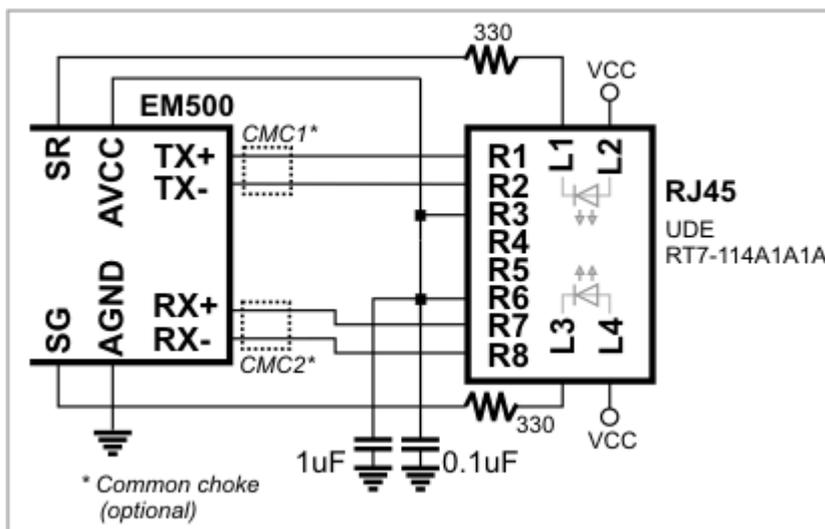
Ethernet Port Lines

The EM500 has a 10/100BaseT Ethernet port. The onboard electronics of the EM500 do not include Ethernet magnetics, so magnetics circuitry must be connected externally to pins TX+, TX-, RX+, RX-, and AVCC. The AVCC pin outputs clean power for the magnetics circuitry, which is very sensitive to noise.

Please, note the following:

- The AVCC is an output!
- Do not combine the AVCC with the VCC (main power) pin.

You can use either a standalone magnetics part, or an RJ45 jack with integrated magnetics (recommended). Here is a circuit diagram based on the UDE RT7-114A1A1A part:



It is important to make the PCB wire connections between the pins of the EM500 and RJ45 jack (magnetics circuitry) as short as possible. Making the wires too long may cause the noise level generated by your PCB surpass the maximum radiated emission limits stipulated by FCC/CE regulations. Additionally, longer Ethernet lines

on the PCB will make Ethernet operation less stable.

Note that the circuit above shows an RJ45 jack with two LEDs. Further information on the use of these LEDs can be found in the [LED Lines](#) topic.

Flash and EEPROM Memory

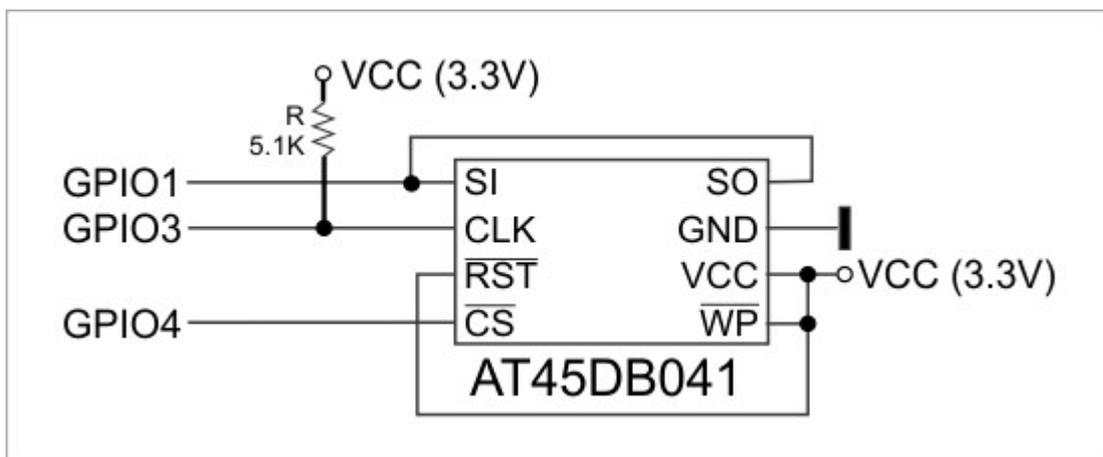
The EM500 has 512KBytes of internal flash memory and 208 bytes of EEPROM memory (see [Specifications and Ordering Info](#)).

A portion of the internal flash memory is used to store the TiOS firmware. When you are performing a firmware upgrade it is this memory you are saving the firmware binary into.

The rest of this flash memory is available to your Tibbo BASIC application. The internal flash memory **cannot** be used as a flash disk. The fd. object (see "TIDE and Tibbo BASIC Manual") requires an external flash IC.

As shown on the schematic diagram below, this flash IC is ATMEL AT45DB041. When connected, this flash IC is used exclusively by the fd. object and provides 1MB of storage.

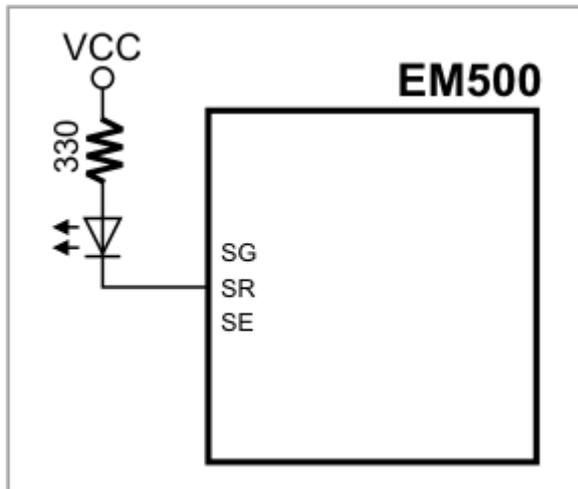
The 5.1K pull-up resistor is needed to "sharpen" SPI clock signal. EM500's [bidirectional GPIOs](#) allow interconnecting SI and SO lines (this saves one GPIO line!).



The EEPROM is almost fully available to your application, save for a small 8-byte area called "special configuration area". The EEPROM is accessed through the stor. object (see "TIDE and Tibbo BASIC Manual"). Details on the special configuration area are provided in the Platform-dependent Programming Information section inside the EM500 platform documentation (same manual).

LED Lines 1.4

The EM500 has three LED control lines -- SG, SR, SE. All lines have the same internal structure and the LEDs should be connected as shown on the schematic diagram below. The maximum load for each line is 10mA. For a small LED, a 330 Ohm series resistor will provide sufficient brightness.



The SG and SR lines are used to control two status LEDs found on Tibbo products. These LEDs can show various flashing patterns indicating current device state (see [Appendix 1: Status LEDs](#)). On the EM500, there is an added twist: the same pair of status LEDs also indicates current Ethernet link status through LED brightness.

When a "live" Ethernet cable is not plugged into the RJ45 jack, flashing patterns displayed by the status LEDs are "dimmed". That is, LEDs turn on at around 20% of their nominal brightness. When a "live" Ethernet cable is plugged into the RJ45 jack, flashing patterns are displayed at full brightness.

This dual functionality was designed into the EM500 for an important reason: Many popular RJ45 jacks have two internal LEDs. With the EM500, it is possible to use these LEDs both for the module state indication, and for Ethernet link indication. This eliminates the need for any additional LEDs.

The third LED control line -- SE -- is a separate line for Ethernet link indication. The SE LED will be on when the Ethernet interface is in the linked state.

There is no indication of the Ethernet link speed on the EM500. That is, there is no LED control line to indicate whether the link is established in the 10BaseT or 100BaseT mode. Many networked devices have such an LED, but its existence has become meaningless: it is actually very difficult to find any old-style 10Mb Ethernet equipment in active use these days.

Power, Reset, and Mode Selection Lines

The EM500 should be powered from a stabilized DC power supply with a nominal output voltage of 3.3V (+/- 5% tolerance). The module's current consumption is approximately 260mA. Providing an adequate power supply is very important -- a poorly built circuit may affect the EM500's operation. We recommend that you use a switching power supply. One example of such a circuit is shown below.

Proper external reset is a must! Reset pulse should be active LOW. We strongly advise against using low-cost RC circuits and other unreliable methods of generating reset pulses. Reset should be applied for as long as the power supply voltage is below 2.9V. We recommend using a dedicated reset IC, such as the MCP130-300 device from Microchip. This part has a trip point at ~2.95V -- perfect for the EM500.

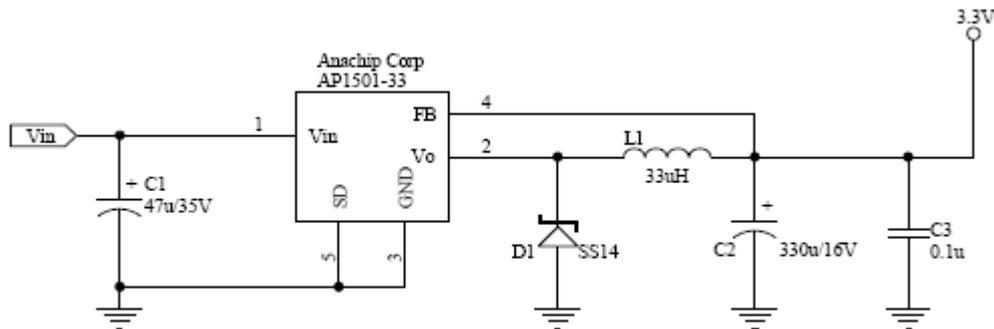
If the EM500 is to serve as a communications co-processor in a larger system that has its own CPU (microcontroller) it is also OK to control the RST line through a general-purpose I/O pin of this CPU. Reset pulses for the EM500 can then be generated programmatically, by setting the I/O pin of the CPU to LOW and then to

HIGH.

The function of the MD line is described in [Appendix 2: Setup Button \(MD line\)](#).

Power supply circuit

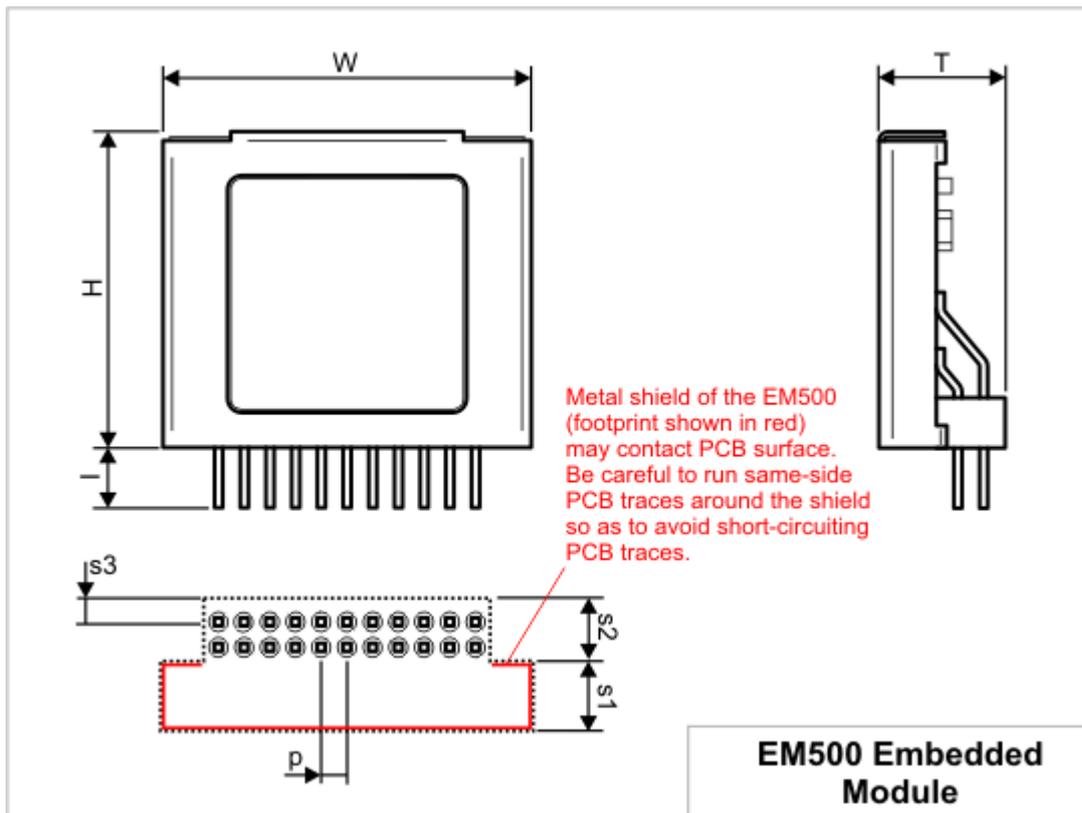
Many power supply circuits will work well. The one below is being used by Tibbo. This circuit can handle input voltages in the 9-24V range.



Notes:

- U1 (AP1501-33) is a popular power IC manufactured by Anachip (now Diodes Incorporated, www.diodes.com)
- C1 and C2 capacitors: Do not use SMD capacitors -- use regular through-hole aluminum capacitors. This really helps reduce the noise produced by the power supply.
- This is an analog circuit, so layout matters. Apply reasonable "good layout" effort.
- Ideally, one should use an oscilloscope to see what sort of "square wave" the power supply generates, both at low and high input voltages, as well as light and heavy loads. There are no recipes here -- just try and see what works for your circuit.

Mechanical Dimensions



H	Max.	16.0	Module height
W	Max.	18.5	Module width
T	Max.	6.5	Module thickness
I	Min.	5.5	Lead length
p	Aver.	1.27	Pin pitch
s1	Max.	3.7	Module footprint dimension
s2	Max.	2.8	Module footprint dimension
s3	Aver.	1.0	Module footprint dimension

Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

Ordering Info and Specifications

The EM500 "MiniMo"* device is only available in a single configuration and can be order as "EM500".

Hardware specifications

Ethernet interface	10/100BaseT Ethernet, Auto-MDIX, magnetics not built-in
Serial ports	1 port, CMOS-level.

UART capabilities	Baudrates up to 460'800bps; none/even/odd/mark/space parity and 7/8 bits/character.
Number of I/O lines	8 lines (this does not include the TX and RX lines of the serial port); all lines are 5V-tolerant; all 8 lines are combined into an 8-bit port; 2 lines can be used as interrupt lines.
Max. load current for each I/O line	10mA
Flash memory	512 KBytes, 320KBytes are available to store a compiled Tibbo BASIC application; this memory cannot be used as a flash disk.
EEPROM memory	208 bytes, 200 bytes are available to store application data
Nominal power supply voltage (VCC pin)	DC 3.3V, +/- 5%
Required external reset circuit trip voltage	2.9-3.0V
Operating current (VCC pin)	260mA
Operating temperature	-40 to +80 degrees C
Operating relative humidity	10-90%
Mechanical dimensions (excl. leads)	18.5x16.0x6.5mm
Pin diameter	0.4mm
Packaging	Tray, 30 modules/tray

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All specifications are subject to change without notice and are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

EM1000 BASIC-programmable Ethernet Module



Please be sure to read the following topic: [EM1000-00 and -01](#).

Introduction

The EM1000 is Tibbo's most powerful and versatile BASIC-programmable embedded module.

The module's hardware is a potent combination that includes 100Base/T Ethernet, four serial ports, onboard flash, EEPROM, RTC with onboard backup power, and abundant I/O lines (up to 54!) to interface with external LCD, keypad, buzzer, and card readers. Thus, the EM1000 is perfect for designing data collection and automation systems such as access control panels, time and attendance terminals, inventory control systems, factory floor automation terminals, and the like.

The EM1000 is also excellent for prototyping your projects -- its pin pitch is standard 2.54mm (0.1).

The EM1000 is fully supported by TIDE software and a dedicated EM1000 platform that covers all hardware facilities of the module (see "TIDE and Tibbo BASIC Manual"). For convenient testing and evaluation Tibbo offers [EM1000TEV](#) and [EM1000EV](#) development systems. The EM1000 can also support Wi-Fi communications (this requires [GA1000](#) add-on board).

Hardware features

- Based on a high-performance purpose-built 88-MHz T1000 ASIC.
- 10/100BaseT auto-MDIX Ethernet port (automatic detection of "straight" and "cross" cables). Standard Ethernet magnetics are **NOT** integrated into the module.
- Optional Wi-Fi interface (requires [GA1000](#) add-on module to be [connected](#)).
- Four high-speed serial ports (CMOS-level):
 - Baudrates of up to 921,600bps;
 - None/even/odd/mark/space parity modes;
 - 7/8 bits/character modes;
 - Full-duplex mode with optional flow control;
 - Half-duplex mode with direction control;
 - Encoding and decoding of Wiegand and clock/data streams.
- 512K or 1024KB flash memory for firmware, application, and data storage.

- 2KB EEPROM for data storage.
- RTC with dedicated backup power input (optional onboard supercapacitor).
- Up to 54 general-purpose I/O lines. Among them:
 - 8 interrupt lines;
 - Serial port lines;
 - 40 lines that are combined into five 8-bit ports;
 - Square wave output (6Hz - 22'1184MHz), which can be used to control external buzzer.
- Supports external LCD and keypad.
- Four control lines for status LEDs:
 - 2 lines for green and red status LED control;
 - 2 lines for Ethernet status LED control.
- Software- and hardware-controlled onboard PLL to select the clock frequency of the device: 11.0592MHz with PLL off, 88.4736MHz with PLL on.
- Reliable power-on/ brown-out reset circuit; no additional external reset circuitry required. Master reset input also provided.
- Power: 230mA @ 3.3V (100BaseT mode, PLL on).
- Dimensions: 38.4x28.4x5.5mm.
- Firmware and Tibbo BASIC application are upgradeable through the serial port or network.
- Tibbo BASIC application can be debugged through the network and no additional debugging hardware, such as in-circuit emulator, is required.

Programming features

- Variable Types: Byte, char, integer (word), short, dword, long, real, string, plus user-defined arrays and structures.
- Function Groups: string functions (27 in total!), date/time conversion functions (8), encryption/hash calculation functions (AES128, RC4, MD5, SHA-1), and more.
- Platform objects:
 - Sock — socket communications (up to 16 UDP, TCP, and HTTP sessions);
 - Net — controls the Ethernet port;
 - Wln — handles the Wi-Fi interface (requires [GA1000](#) add-on module);
 - Ssi — implements up to four serial synchronous interface (SSI) channels, supports SPI, I2C, clock/data, etc.;
 - Ser — in charge of serial ports (UART, Wiegand, and clock/data modes);
 - Io — handles I/O lines, ports, and interrupts;
 - Lcd — controls graphical display panels (several types supported);
 - Kp — scans keypads of matrix and "binary" types;
 - Rtc — keeps track of date and time;
 - Fd — manages flash memory file system and direct sector access;
 - Stor — provides access to the EEPROM;
 - Romfile — facilitates access to resource files (fixed data);
 - Pppoe — provides access to the Internet over an ADSL modem;
 - Ppp — provides access to the Internet over a serial modem (GPRS, POTS, etc.);

- Pat — "plays" patterns on up to five LED pairs;
- Beep — generates buzzer patterns;
- Button — monitors MD line (setup button);
- Sys — in charge of general device functionality.

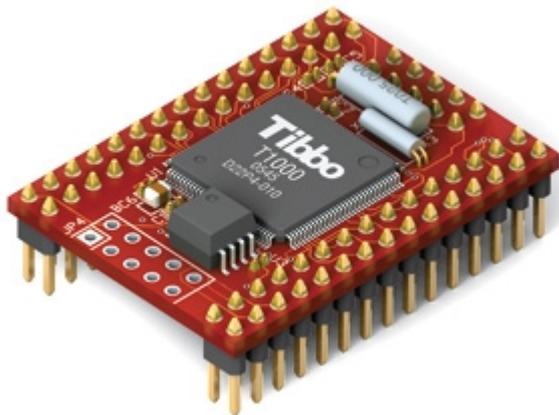
EM1000-00 and -01

Small hardware changes were made to the EM1000 since its first release. Currently Tibbo supplies version "-01" of the module. The first version ever produced was "-00". The main difference is in the Ethernet IC: the EM1000-...-00 used Davicom's DM9000 while the EM1000-...-01 features newer DM9000A. This change reduced module's current consumption and operating temperature. Unfortunately, this transition requires certain alterations to the way [Ethernet magnetics and RJ45](#) are wired to the module. Tibbo apologizes for any inconvenience caused!

Throughout this document, differences between hardware versions of the module are highlighted in pink. Please, note that from the programming standpoint there are no functional differences between the EM1000-...-00 and EM1000-...-01.

Pictures below show the original EM1000-...-00 and the EM1000-...-01.

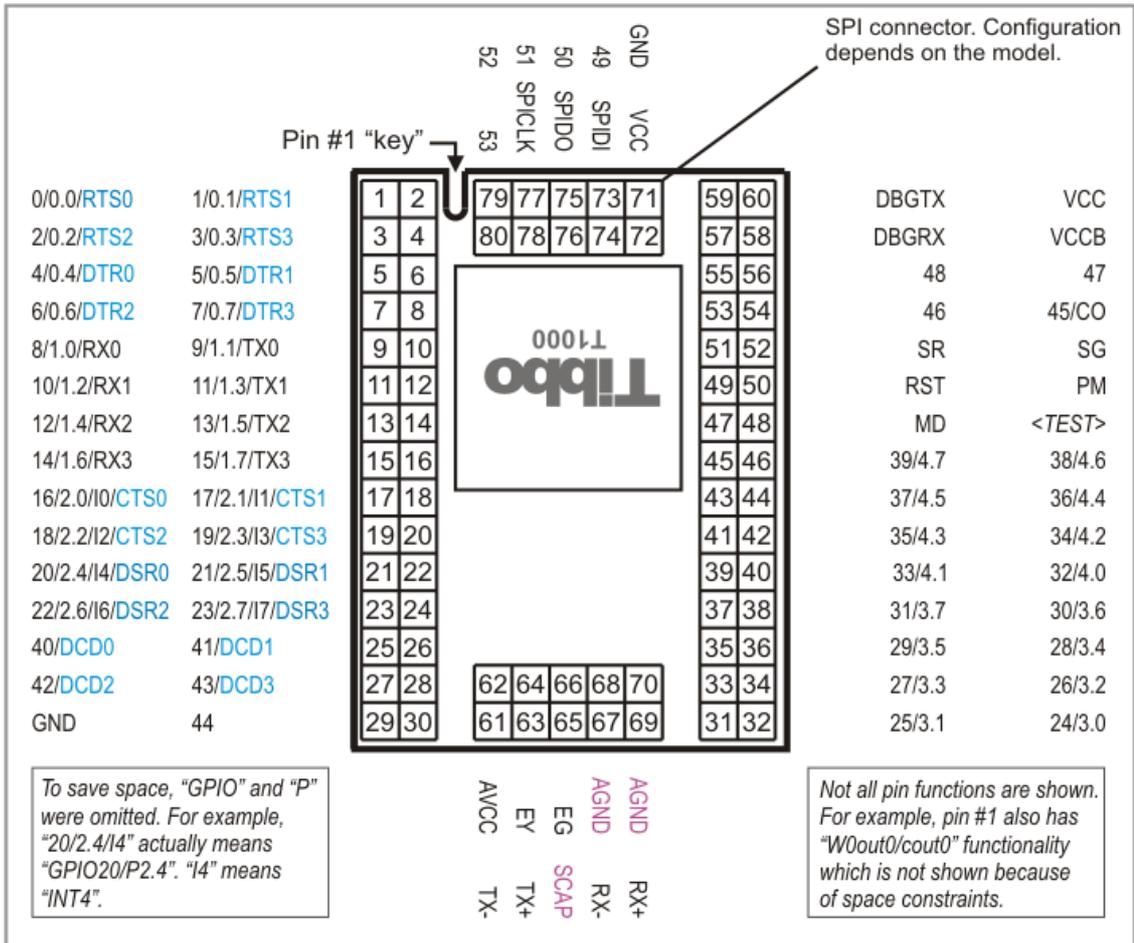
This is how the original EM1000-...-00 looks like:



And this is how the EM1000-...-01 looks like:



I/O Pin Assignment and Pin Functions



See these topics for more information on various hardware facilities of the EM1000:

- [General-purpose I/O Lines](#)
- [SPI Port Connector](#)
- [Ethernet Port Lines](#)
- [Serial Ports](#)
- [Square Wave Generator](#)
- [Flash and EEPROM Memory](#)
- [Real-time Counter](#)
- [LED Lines](#)
- [Power, Reset, PLL Control, and Mode Selection Lines](#)

I/O pin assignment

Pin #	Function	Description
1 ^(1,2)	GPIO0/P0.0	General-purpose I/O line 0 (P0.0).
2 ^(1,2)	GPIO1/P0.1	General-purpose I/O line 1 (P0.1).
3 ^(1,2)	GPIO2/P0.2	General-purpose I/O line 2 (P0.2).

4 (1,2)	GPIO3/P0.3	General-purpose I/O line 3 (P0.3).
5 (1,2)	GPIO4/P0.4	General-purpose I/O line 4 (P0.4).
6 (1,2)	GPIO5/P0.5	General-purpose I/O line 5 (P0.5).
7 (1,2)	GPIO6/P0.6	General-purpose I/O line 6 (P0.6).
8 (1,2)	GPIO7/P0.7	General-purpose I/O line 7 (P0.7).
9 (1,2)	GPIO8/P1.0/RX0	General-purpose I/O line 8 (P1.0); RX, W1, and din input of the serial port 0.
10 (1,2)	GPIO9/P1.1/TX0	General-purpose I/O line 9 (P1.1); TX, W1, and dout output of the serial port 0.
11 (1,2)	GPIO10/P1.2/RX1	General-purpose I/O line 10 (P1.2); RX, W1, and din input of the serial port 1.
12 (1,2)	GPIO11/P1.3/TX1	General-purpose I/O line 11 (P1.3); TX, W1, and dout output of the serial port 1.
13 (1,2)	GPIO12/P1.4/RX2	General-purpose I/O line 12 (P1.4); RX, W1, and din input of the serial port 2.
14 (1,2)	GPIO13/P1.5/TX2	General-purpose I/O line 13 (P1.5); TX, W1, and dout output of the serial port 2.
15 (1,2)	GPIO14/P1.6/RX3	General-purpose I/O line 14 (P1.6); RX, W1, and din input of the serial port 3.
16 (1,2)	GPIO15/P1.7/TX3	General-purpose I/O line 15 (P1.7); TX, W1, and dout output of the serial port 3.
17 (1,2,3)	GPIO16/P2.0/ INT0	General-purpose I/O line 16 (P2.0); interrupt line 0.
18 (1,2,3)	GPIO17/P2.1/ INT1	General-purpose I/O line 17 (P2.1); interrupt line 1.
19 (1,2,3)	GPIO18/P2.2/ INT2	General-purpose I/O line 18 (P2.2); interrupt line 2.
20 (1,2,3)	GPIO19/P2.3/ INT3	General-purpose I/O line 19 (P2.3); interrupt line 3.
21 (1,2,3)	GPIO20/P2.4/ INT4	General-purpose I/O line 20 (P2.4); interrupt line 4.
22 (1,2,3)	GPIO21/P2.5/ INT5	General-purpose I/O line 21 (P2.5); interrupt line 5.
23 (1,2,3)	GPIO22/P2.6/ INT6	General-purpose I/O line 22 (P2.6); interrupt line 6.
24 (1,2,3)	GPIO23/P2.7/ INT7	General-purpose I/O line 23 (P2.7); interrupt line 7.
25 (1,2)	GPIO40	General-purpose I/O line 40 (does not belong to any 8-bit port).
26 (1,2)	GPIO41	General-purpose I/O line 41 (does not belong to any 8-bit port).
27 (1,2)	GPIO42	General-purpose I/O line 42 (does not belong to any 8-bit port).
28 (1,2)	GPIO43	General-purpose I/O line 43 (does not belong to any 8-bit port).
29	GND	System ground.

30 (1,2)	GPIO44	General-purpose I/O line 44.
31 (1,2)	GPIO25/P3.1	General-purpose I/O line 25 (P3.1).
32 (1,2)	GPIO24/P3.0	General-purpose I/O line 24 (P3.0).
33 (1,2)	GPIO27/P3.3	General-purpose I/O line 27 (P3.3).
34 (1,2)	GPIO26/P3.2	General-purpose I/O line 26 (P3.2).
35 (1,2)	GPIO29/P3.5	General-purpose I/O line 29 (P3.5).
36 (1,2)	GPIO28/P3.4	General-purpose I/O line 28 (P3.4).
37 (1,2)	GPIO31/P3.7	General-purpose I/O line 31 (P3.7).
38 (1,2)	GPIO30/P3.6	General-purpose I/O line 30 (P3.6).
39 (1,2)	GPIO33/P4.1	General-purpose I/O line 33 (P4.1).
40 (1,2)	GPIO32/P4.0	General-purpose I/O line 32 (P4.0).
41 (1,2)	GPIO35/P4.3	General-purpose I/O line 35 (P4.3).
42 (1,2)	GPIO34/P4.2	General-purpose I/O line 34 (P4.2).
43 (1,2)	GPIO37/P4.5	General-purpose I/O line 37 (P4.5).
44 (1,2)	GPIO36/P4.4	General-purpose I/O line 36 (P4.4).
45 (1,2)	GPIO39/P4.7	General-purpose I/O line 39 (P4.7).
46 (1,2)	GPIO38/P4.6	General-purpose I/O line 38 (P4.6).
47	MD	Mode selection pin.
48	<TEST PIN>	<i>Leave this pin unconnected.</i>
49	RST	Reset line, active high.
50	PM	PLL control line (HIGH- PLL ON, LOW- PLL OFF).
51	SR	Red status LED control line.
52	SG	Green status LED control line.
53 (1,2)	GPIO46	General-purpose I/O line 46.
54 (1,2)	GPIO45/CO	General-purpose I/O line 45 (does not belong to any 8-bit port); square wave output line.
55 (1,2)	GPIO48	General-purpose I/O line 48 (does not belong to any 8-bit port).
56 (1,2)	GPIO47	General-purpose I/O line 47 (does not belong to any 8-bit port).
57	DBG RX	RX line of debug serial port (details to be published).
58	VCCB	Backup power for the real-time counter; connect to 3.3V through a 50 Ohm resistor.
59	DBG TX	TX line of debug serial port (details to be published).

60	VCC	Positive power input, 3.3V nominal, +/- 5%, max. current consumption 230mA (100BaseT, PLL on).
61	TX-	Ethernet port, negative line of the differential output signal pair.
62	AVCC	"Clean" power output for magnetics circuitry: EM1000-...- 00: 3.3V (not in production) EM1000-...- 01: 2.5V (currently in production).
63	TX+	Ethernet port, positive line of the differential output signal pair.
64	EY	Yellow Ethernet status LED control line.
65	EM1000-...- 00: --- EM1000-...- 01: SCAP	EM1000-...- 00: --- EM1000-...- 01: external supercapacitor input.
66	EG	Green Ethernet status LED control line.
67	RX-	Ethernet port, negative line of the differential input signal pair.
68	EM1000-...- 00: --- EM1000-...- 01: AGND	EM1000-...- 00: --- EM1000-...- 01: analog ground.
69	RX+	Ethernet port, positive line of the differential input signal pair.
70	EM1000-...- 00: --- EM1000-...- 01: AGND	EM1000-...- 00: --- EM1000-...- 01: analog ground.
71 ⁽⁴⁾	GND	System ground.
72 ⁽⁴⁾	VCC	3.3V power available on this pin. Do not connect to the power source. To avoid current loops, only use pin #60 to power the device.
73 (1,2,4)	GPIO49	General-purpose I/O line 49 (does not belong to any 8-bit port).
74 ⁽⁴⁾	SPIDI	SPI port, data in.
75 (1,2,4)	GPIO50	General-purpose I/O line 50 (does not belong to any 8-bit port).
76 ⁽⁴⁾	SPIDO	SPI port, data out.
77 (1,2,4)	GPIO51	General-purpose I/O line 51 (does not belong to any 8-bit port).
78 (1,2,4)	SPICK	SPI port, clock line.
79 (1,2,4)	GPIO52	General-purpose I/O line 52 (does not belong to any 8-bit port).
80 (1,2,4)	GPIO53	General-purpose I/O line 53 (does not belong to any 8-bit port).

Notes:

1. This line is 5V-tolerant and can be interfaced to 5V CMOS devices directly.
2. This line can serve as an RTS/Wout/cout line of a serial port (provided that this

does not interfere with any other function).

3. This line can serve as a CTS/WO&1in/cin line of a serial port (provided that this does not interfere with any other function).
4. This pin is on the SPI connector. "-A" option device modification has SPI connector header soldered in and "available" to the host PCB. "T" option devices have a female SPI connector. Other EM1000 versions do not have the SPI connector.

General-purpose I/O Lines

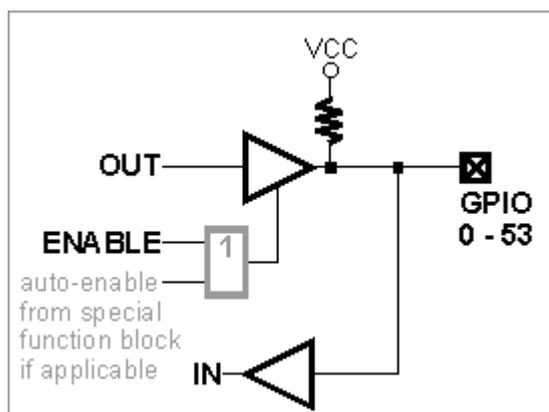
The EM1000 has 54 general-purpose I/O lines (GPIO0 - GPIO53). All lines are 3.3V, CMOS, 5V-tolerant lines. Maximum load current for each I/O line is 10mA. 49 of these lines are always present. Remaining 5 lines are located on the [SPI port connector](#). This connector is "available" to the host PCB only on option "-A" EM1000 devices.

40 of the I/O lines are combined into five 8-bit ports.

Simplified structure of one I/O line of the EM1000 is shown on the circuit diagram below. Each line has an independent output buffer control. When the EM1000 powers up all I/O lines have their output buffers tri-stated (in other words, all I/O lines are configured as inputs). You need to explicitly enable the output buffer of a certain I/O line if you want this line to become an output.

Many I/O lines of the EM1000 also serve as inputs or outputs of special function modules, such as serial ports. Majority of those lines need to be correctly configured as inputs or outputs -- this won't happen automatically. Several lines -- such as TX and RX lines of the serial port when in the UART mode -- are configured as outputs and inputs automatically when the serial port (or some other hardware block) is enabled. For details see "Platform-dependent Programming Information inside the EM1000 platform documentation ("TIDE and Tibbo BASIC Manual").

Each I/O line has a weak pull-up resistor that prevents the line from floating when the output buffer is tri-stated.



I/O line control is described in detail in the documentation for the I/O (io.) object found inside the "TIDE and Tibbo BASIC Manual".

SPI Port Connector

The SPI (serial peripheral interface) is a bus which can support several devices at the same time. The flash memory of the EM1000 is attached to this bus. Additionally, slave SPI modules (such as the [GA1000](#)) connect to the same SPI bus.

The SPI port of the EM1000 is located on a separate 10-pin connector. Depending on the EM1000 model, this connector may or may not be present.

The SPI port carries several standard signals -- clock (SPICLK), data out (SPIDO), and data in (SPIDI). Additionally, there are 5 [general-purpose I/O lines](#). These lines may be used independently or in conjunction with the SPI port to provide additional signals (such as CS) required by the SPI device.

EM1000 versions and the SPI port

Standard EM1000 devices do not have the SPI port connector and the "landing" PCB area for the connector is left empty.

Slave SPI modules, such as the [GA1000](#), can optionally be soldered into the SPI port pads of the EM1000. This is the case when the "EM1000G" ordering code is used to purchase a set of modules consisting of the EM1000 module and GA1000 module.

Option "-A" EM1000 devices feature a 10-pin SPI port pin header. The pins on this header are identical to all other pins of the EM1000 and, like the latter, face the host PCB. This way the SPI port of the EM1000 can be connected to some other circuitry on the host PCB. For example, instead of mounting the GA1000 module on top of the EM1000, the latter can be connected directly to the host PCB. Option "-A" EM1000 module is then required to facilitate a connection between the EM1000 and the GA1000.

Finally, option "-T" devices have a female SPI port connector soldered in. Slave SPI modules can be plugged into this female connector. EM1000 modules of "-T" variety are intended for convenient SPI slave module testing and are not recommended for use in production devices.

For further information on available EM1000 versions see [Mechanical Dimensions](#) and [Specifications and Ordering Info](#) topics.

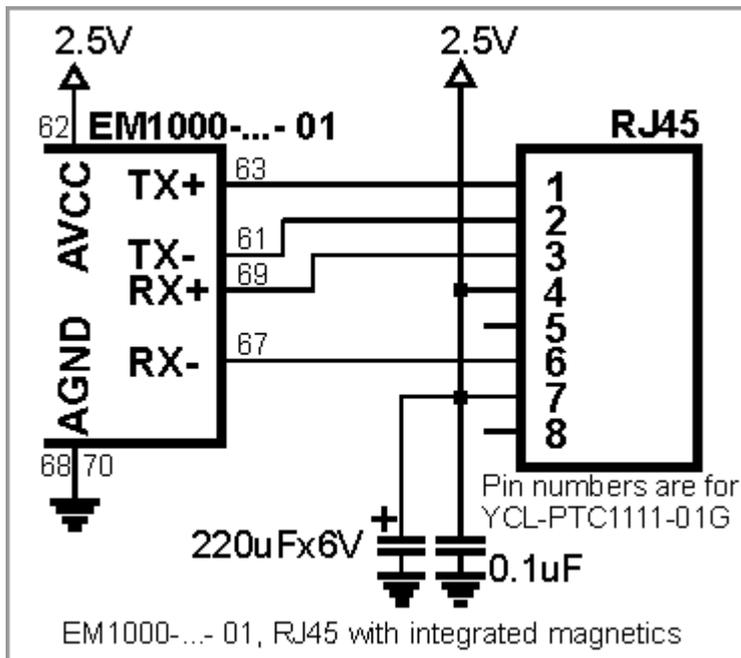
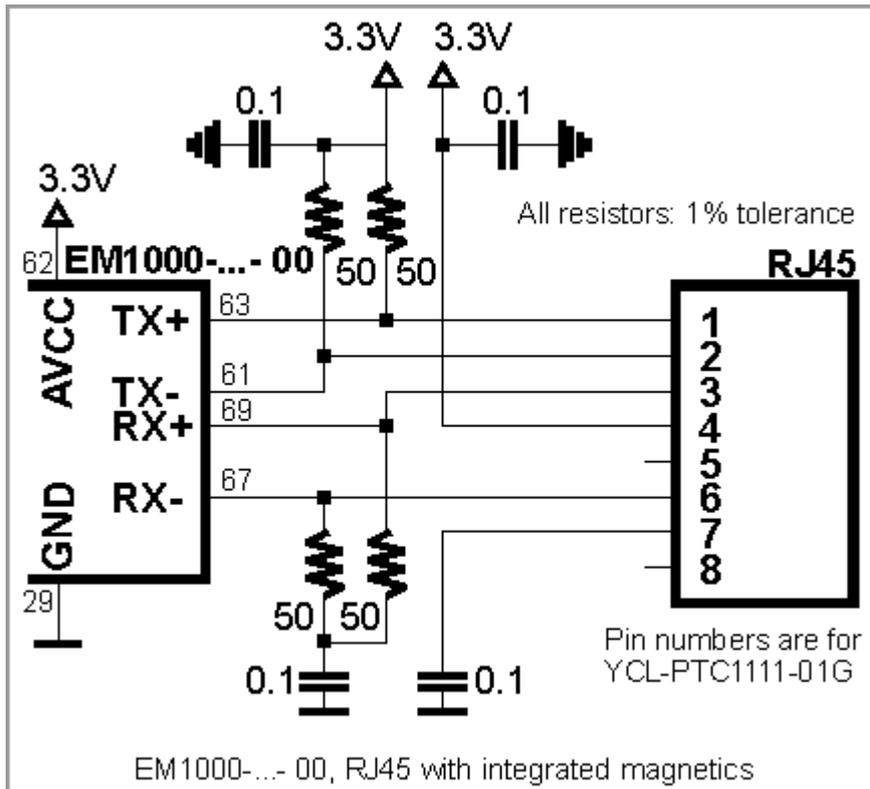
Ethernet Port Lines

ATTENTION! There are two different Ethernet magnetics arrangements: one for original **EM1000-...- 00**, another one -- for the **EM1000-...- 01**.

Ethernet port of the EM1000 is of 100BaseT type. Onboard electronics of the EM1000 do not include Ethernet magnetics, so magnetics circuitry must be connected externally to pins TX+, TX-, RX+, RX-, and AVCC. The AVCC pin outputs clean power for the magnetics circuitry, which is very sensitive to noise. The voltage on the AVCC depends on the EM1000 version: 3.3V for EM1000-...- 00, 2.5V for the EM1000-...- 01. Separate AGND analog ground pins have been added on the EM1000-...- 01. For the EM1000-...- 00 there is no separate analog ground. Please, note the following:

- The AVCC is an output!
- Do not combine AVCC with the VCC (main power) pin. On the EM1000-...- 00 this is counter-productive, and on the EM1000-...- 01 this will apply wrong voltage to the AVCC pin. Doing so appears to be causing no immediate permanent damage to the EM1000-...- 01, but the circuit will not work and the effects of prolonged over-voltage on the AVCC line are not known.

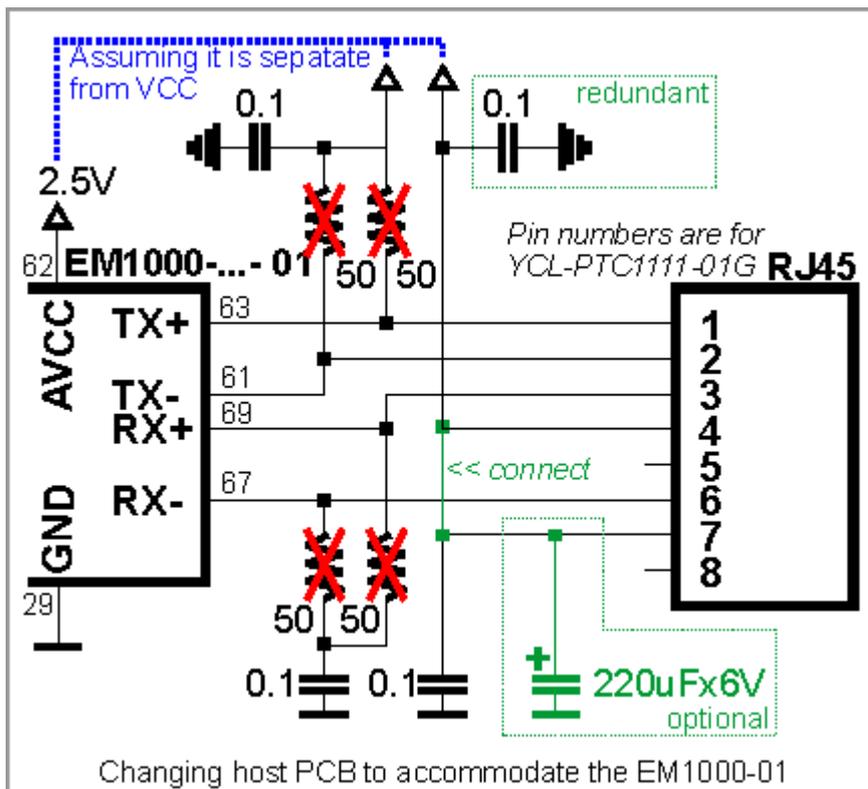
You can use either a standalone magnetics part (such as YCL-PH163112) or RJ45 connector with integrated magnetics (i.e. YCL-PTC1111-01G). Here are two connection diagrams based on the YCL-PTC1111-01G -- one for the EM1000-...- 00, another one - for the EM1000-...- 01.



Once again, the EM1000-...- 00 is a legacy part that has been replaced with the EM1000-...- 01. In case you have already made the PCB based on the EM1000-...- 00 specifications and are not willing to change it, you can easily modify it to accommodate the EM1000-...- 01 (see diagram below):

- Do not install four 50 Ohm resistors (they are crossed out on the diagram).
- Connect a wire between pins 4 and 7 of the RJ45 connector (pin numbers are for YCL-PTC1111-01G).

- If possible, find a way to install a 220uF capacitor. The circuit will still work even if you don't have this capacitor but you may have FCC/CE certification issues.
- Notice that one of the 0.1 capacitors becomes redundant but that's OK.
- All of the above is based on the assumption that your host PCB was designed correctly and the AVCC output of the EM1000 is not joined together with the main VCC line. If you erroneously had AVCC and VCC combined together then you will need to separate them as well: pin AVCC outputs 2.5V on the EM1000-...- 01 and this is different from the main power on the VCC pin, which is 3.3V. Applying 3.3V to pin AVCC of the EM1000-...- 01 appears to be causing no immediate permanent damage to the device, but the circuit will not work and the effects of prolonged over-voltage on the AVCC line are not known.



It is important to make the PCB wire connections between the Ethernet port pins of the EM1000 and external magnetics circuitry as short as possible. Making the wires too long may cause the noise level generated by your PCB to surpass the maximum radiated emission limits stipulated by FCC/CE regulations. Additionally, longer Ethernet lines on the PCB will make your board more susceptible to the damage from the ESD (electrostatic discharge).

The EM1000 also has two [Ethernet status LED control lines](#)- see here for details.

Serial Ports .4

The EM1000 has four serial ports that can work in one of the three modes: UART, Wiegand, or clock/data. All three modes are described in detail in the documentation for the serial (ser.) object found inside the "TIDE and Tibbo BASIC Manual". Additionally, see the Platform-dependent Programming Information section inside the EM1000 platform documentation (same manual).

Square Wave Generator

The square wave generator can produce a square wave output on pin GPIO45/CO of the EM1000. This output is primarily intended for generating audio signals using buzzer and is covered in the beep (beep.) object -- see the "TIDE and Tibbo BASIC Manual".

Flash and EEPROM Memory

The EM1000 has 512KBytes or 1024KBytes of flash memory and 2KBytes of EEPROM memory (see [Specifications and Ordering Info](#)).

The first 64KBytes of flash memory are used to store the TiOS firmware. When you are performing a firmware upgrade it is this memory you are saving the firmware binary into.

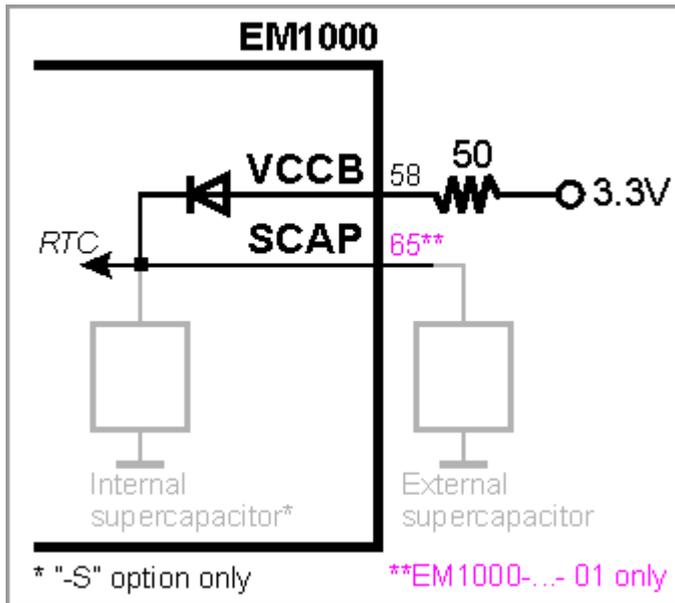
The rest of this flash memory is available to your Tibbo BASIC application and its data. Whatever memory space is left after the compiled application is loaded can be used as a flash disk (see fd. object documentation in the "TIDE and Tibbo BASIC Manual").

The EEPROM is almost fully available to your application, save for a small 8-byte area called "special configuration area". The EEPROM is accessed through the stor. object (see "TIDE and Tibbo BASIC Manual"). Details on the special configuration area are provided in the Platform-dependent Programming Information section inside the EM1000 platform documentation (same manual).

Real-time Counter

The real-time counter (RTC) of the EM1000 is a free-running 40-bit register that increments at a rate of 128Hz.

As a source of backup power, the EM1000 can rely on a supercapacitor. Option "-S" of the EM1000 (see [Specifications and Ordering Info](#)) has an onboard supercapacitor. To enable charging, connect 3.3V power to the VCCB pin of the EM1000, preferably through a current-limiting resistor (50 Ohm is a good value). A fully discharged supercapacitor creates a nearly short-circuit current inrush when it starts charging and this can damage the power supply of the host board.



The EM1000-...-S carries the supercapacitor on the bottom side of its PCB (see [Mechanical Dimensions](#)). With this supercapacitor present, it is impossible to solder the module into the host PCB directly and the module can only be installed on a socket. If this is not acceptable you can use a "plain" EM1000 (non- "-S") and connect an external supercapacitor to the SCAP pin of the EM1000. This option is only available on the newer **EM1000-...- 01** device (**EM1000-...- 00** does not have the SCAP input).

The supercapacitor has many advantages- it charges almost instantly and has virtually unlimited lifespan. The disadvantage is that the supercapacitor is only able to sustain the RTC of the EM1000 for several days at most (about 6 days for the 5F supercapacitor of the EM1000-...-S), which may appear to be insufficient. Remember, however, that the EM1000 is often used in a "connected" product. As such, it can always synchronize its clock with an Internet time server or a master clock on the main server of your system. Therefore, the role of the supercapacitor is to provide backup power during relatively short periods of power interruption, for example when the device is unplugged and moved to another location, or when the device is powered off over the weekend.

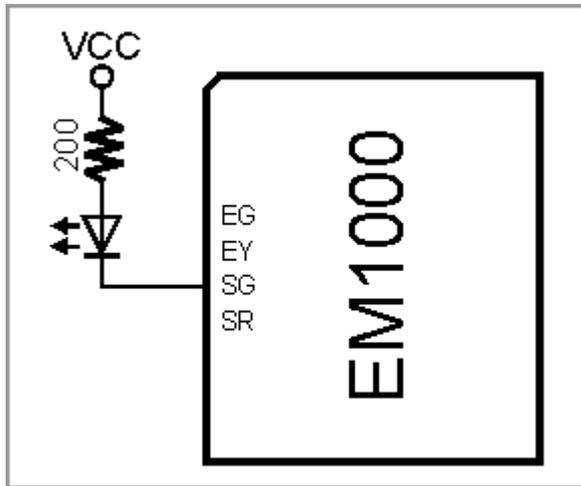
It is also possible to use a 3V lithium battery to power the RTC (in this case, do not use the EM1000 with "-S"). Connect the battery to the VCCB pin through a small Schottky diode. This diode is necessary to slightly reduce the voltage on the VCCB pin. You can calculate the time the battery will be able to sustain the EM1000 from the average backup current, which is $\sim 13\mu\text{A}$. Note that the VCCB pin consumes a much larger current ($\sim 1\text{mA}$) when the Vcc is applied and the EM1000 is running. Therefore, your battery-based backup circuit should be designed in a way that does not drain the battery while the Vcc is applied.

The RTC will continue to function with backup power on the VCCB pin as low as 2.2V. Make sure that the voltage on this pin does not exceed 3.3V. Failure to observe this limit may cause permanent damage to the EM1000.

Your Tibbo BASIC application can access the RTC through the RTC (rtc.) object, which is documented in the "TIDE and Tibbo BASIC Manual".

LED Lines, 2.8

The EM1000 has four LED control lines -- SG, SR, EG, and EY. All lines have the same internal structure and the LEDs should be connected to these lines as shown on the schematic diagram below. Maximum load for each line is 10mA.



Further information on status LEDs can be found in [Appendix 1: Status LEDs](#).

Power, Reset, PLL Control, and Mode Selection Lines

The EM1000 should be powered from a stabilized DC power supply with nominal output voltage of 3.3V (+/- 5% tolerance). This power should be applied to the pin #60. "-A" modification of the EM1000 has the second VCC pin -- #72. To prevent "current loops", only use either pin #60, or pin #72 to supply the power to the device.

Current consumption of the EM1000 is approximately 230mA (PLL on, 100BaseT mode). This does not include the power consumption of the slave SPI module, such as the [GA1000](#). The slave module, depending on its type, can add significantly to the power consumed by the EM1000. Therefore, providing an adequate power supply is very important -- poorly built circuit may affect EM1000 operation. We recommend that you use a switching power supply. One (but not the only) example of such circuit is shown below.

Please, do not forget that the VCCB pin should not be left unconnected (see [Real-time Counter](#)).

Proper external reset is not required. The EM1000 has a reliable power-on reset circuit with brown-out detection. Optionally, you can connect a reset button or some other reset-generating circuit to the RST pin of the EM1000. This will allow you to generate "external" resets. The RST line has active HIGH polarity. If you are not using the RST pin you can leave it unconnected.

The main clock frequency of the EM1000 is generated by the an 11.0592MHz crystal connected to the onboard PLL circuit. When the PLL is off, the EM1000 is clocked at 11.0592MHz. When the PLL is on, the main clock is eight times higher- 88.4736MHz. Naturally, with PLL turned on the EM1000 works 8 times faster and consumes more current (230mA with PLL on against 110mA with PLL off). Main clock frequency also affects the baudrates of [serial ports](#) when in the UART mode, as well as the frequency produced by the [square wave generator](#).

The PLL cannot be switched off and on while the EM1000 is running. This is because when the PLL mode changes its output needs some time to stabilize. For this

reason, the PLL mode of the EM1000 can only be changed on reset. A special internal delay circuit will hold the EM1000 in reset while PLL frequency stabilizes.

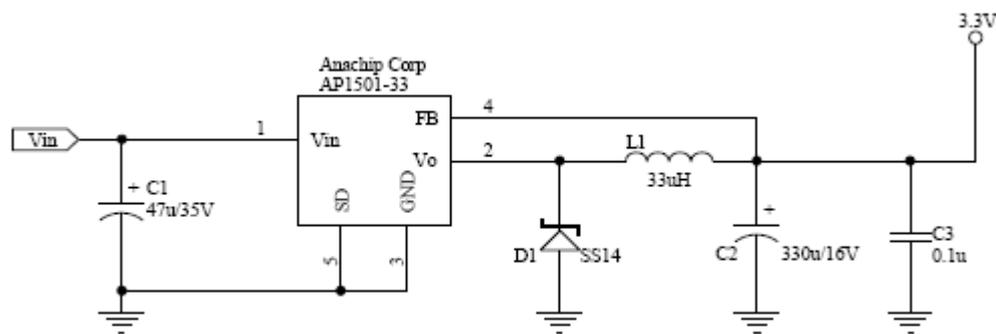
The state of the PM pin at power-on or external reset (i.e. reset pulse on the RST line) defines whether the EM1000 will run with PLL on or off. To have the PLL on, leave the PM pin unconnected. To disable PLL and run at lower clock frequency, ground the PM pin.

Your Tibbo BASIC application can also change the PLL mode programmatically. The Tibbo BASIC application can check the current PLL mode through the system (sys.) object (see "TIDE and Tibbo BASIC Manual"). If the PLL mode needs to be changed, the application can set new mode and then perform an internal reset (again, through the system object). The internal reset is identical to the power-on or external reset with one difference: the PLL mode is set basing not on the PM pin but on the PLL mode requested by the application prior to the reset.

The function of the MD line is described in [Appendix 2: Setup Button \(MD line\)](#).

Power supply circuit

Many power supply circuits will work well. The one below is being used by Tibbo. The circuit can handle input voltages in the 9-24V range.

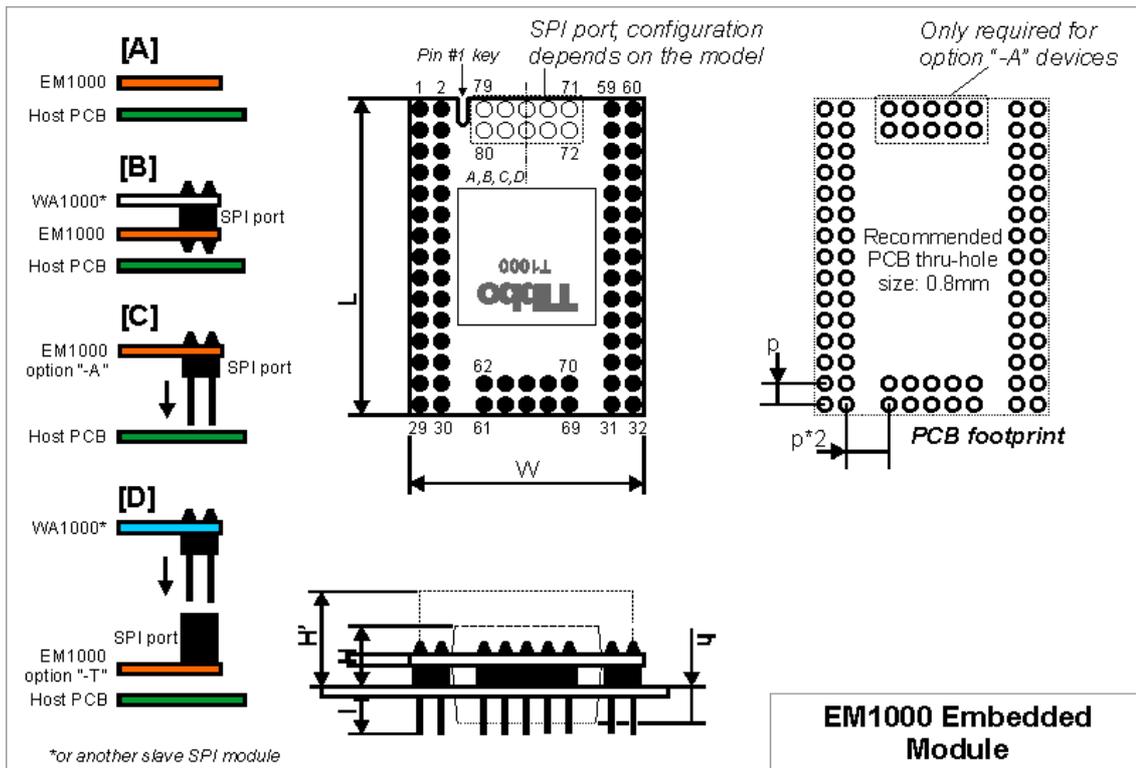


Notes:

- U1 (AP1501-33) is a popular power IC manufactured by Anachip (now Diodes Incorporated, www.diodes.com)
- C1 and C2 capacitors: Do not use SMD capacitors -- use regular through-hole aluminum capacitors. This really helps reduce noise produced by the power supply.
- This is an analog circuit, so layout matters. Apply reasonable "good layout" effort.

• Ideally, one should use an oscilloscope to see what sort of "square wave" the power supply generates, both at low and high input voltages, as well as light and heavy loads. There are no recipes here -- just try and see what works for your circuit.

Mechanical Dimensions



Notes:

Standard EM1000 devices do not have an [SPI port](#) connector and the "landing" PCB area for the connector is left empty (cross-section A).

Compatible slave SPI modules (such as the [GA1000](#) Wi-Fi module) can optionally be soldered into the SPI connector pads (cross-section B).

Option "-A" EM1000 devices feature a 10-pin SPI port pin header (cross-section C). The pins on this header are identical to all other pins of the EM1000 and, like the latter, face the host PCB. This way the SPI port of the EM1000 can be connected to some other circuitry on the host PCB. For example, instead of piggy-backing the GA1000 onto the EM1000, you can opt to place it on the host PCB. The EM1000 "-A" module is then required to facilitate a connection between the EM1000 and the GA1000.

Finally, option "-T" devices have a female SPI port connector soldered in. Slave SPI modules, such as the GA1000, can be plugged into this female connector. EM1000 modules of "-T" variety are intended for convenient slave module testing and are not recommended for use in production devices.

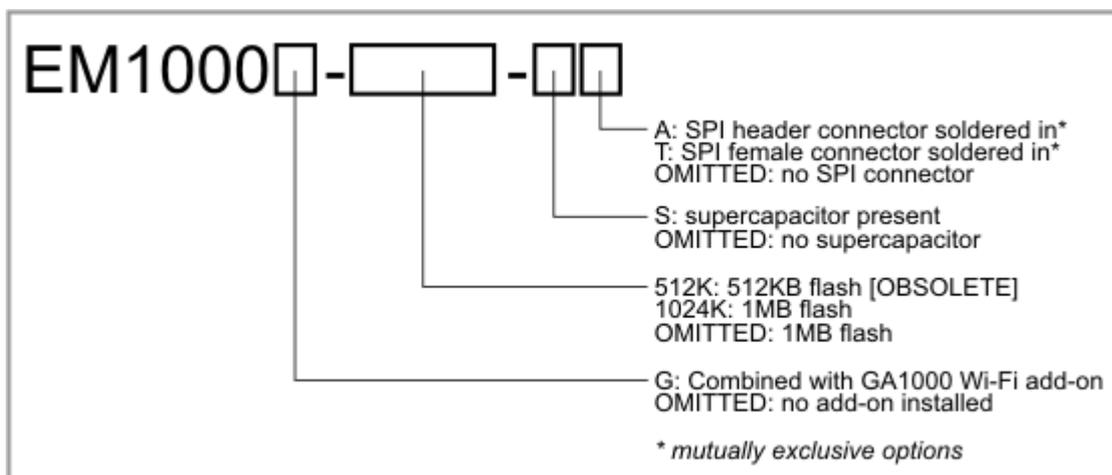
L	Max	38.4	Module length
W	Max	28.4	Module width
H	Max	5.5	Module height
H'	Max	11.0	Module height with the GA1000 module installed on top of the EM1000 module
h	Max	4	Additional height added by the supercapacitor ("-S" option

	.		devices only)
I	Min	6.0	Lead length
p	Ave r.	2.5 4	Pin pitch

Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

Ordering Info and Specifications

Device numbering scheme is as follows:



"A" and "T" versions are not standard and cannot be ordered from our online store. Contact Tibbo if you wish to order EM1000 devices with "A" or "T" options.

512K devices are no longer available.

If the flash memory size is omitted, 1024K option is implied.

To order the EM1000 in combination with the [GA1000](#) module, use the "EM1000G" ordering code. This code means that the EM1000 module will be supplied with the GA1000 module soldered into it (resulting mechanical structure is presented as "option B" on the [Mechanical Dimensions](#) drawing).

Examples of valid model numbers

Model number	Description
EM1000-512K	This is an obsolete device with only 512KBytes of flash memory
EM1000G-1024K-S	EM1000 module with GA1000 Wi-Fi add-on, 1024KBytes of flash memory and the supercapacitor (backup power source for the RTC)
EM1000T	EM1000 module with 1024KBytes of flash memory and SPI female connector soldered in

Hardware specifications

Ethernet interface	10/100BaseT Ethernet, Auto-MDIX, magnetics not built-in
Serial ports	4 ports, CMOS-level
UART capabilities	Baudrates up to 921'600bps; none/even/odd/mark/space parity and 7/8 bits/character
Number of I/O lines	"Regular" EM1000: 49 lines; option "-A" device: 53 lines; all lines are 5V-tolerant; 40 of I/O lines are combined into five 8-bit ports; 8 lines can be used as interrupt lines.
Max. load current for each I/O line	10mA
Square wave generator	6Hz - 22'1184MHz, primarily intended for buzzer control
Real-time counter (RTC)	40 bit, increments at 128Hz, has its own backup power input
RTC backup power source	Supercapacitor, supports RTC for app. 6 days ("-S" version only); alternatively, external supercapacitor or backup battery can be connected.
Clock frequency	11.0592MHz with PLL off 88.4736MHz with PLL on
Flash memory	512KBytes or 1024KBytes, entire memory minus 64KB is available to store Tibbo BASIC application and data
EEPROM memory	2048 bytes, 2040 bytes available to store application data
Nominal power supply voltage (VCC pin)	DC 3.3V, +/- 5%
Reset circuit trip voltage (VCC pin)	3.0V on power-up (i.e. when the voltage on VCC is rising) 2.9V on brown-out (i.e. when the voltage on VCC is dropping)
Operating current (VCC pin), not including hardware consumed by an add-on modules plugged into the EM1000	40mA with PLL off, Ethernet cable unplugged 50mA with PLL off, 10BaseT mode 110mA with PLL off, 100BaseT mode 160mA with PLL on, Ethernet cable unplugged 170mA with PLL on, 10BaseT mode 230mA with PLL on, 100BaseT mode
Backup power voltage range (VCCB pin) ⁽¹⁾	2.2V - 3.3V (option without "-S" only)
Backup current (VCCB pin)	1mA when the EM1000 is running (3.3V on VCC) 13uA when the EM1000 is not powered (0V on VCC)
Operating temperature	-20 to +70 degrees C
Operating relative humidity	10-90%
Mechanical dimensions	"Plain" EM1000: 38.4x28.4x5.5 mm

(excl. leads)	EM1000-...-S ⁽²⁾ : 38.4x28.4x9.5 mm EM1000W: 38.4x28.4x11.0 mm EM1000W-...-S ⁽²⁾ : 38.4x28.4x15.0 mm
Pin diameter	0.64mm
Packaging	EM1000-...-S and EM1000-...-T devices: tray, 30 modules/tray EM1000G module combination: tray, 30 modules/tray All other devices (without "-S" and "-T" options): tube, 10 modules/tube

Notes:

1. The RTC will not lose its data and will keep running as long as the backup voltage stays within this range.
2. The EM1000-xxxK-S device cannot be installed on the PCB directly. This is because it has a supercapacitor mounted on the bottom side of the module. This device must be mounted on a socket.

All specifications are subject to change without notice and are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

EM1202



Introduction

While occupying miniscule 19x17mm on your PCB, the EM1202 BASIC-programmable embedded module retains most features of the much larger EM1000 device. These

include 100Base/T Ethernet, four serial ports, onboard flash, EEPROM, and 24 I/O lines that can be used to interface with external LCD, keypad, buzzer, and card readers.

Thanks to its miniature dimensions, the EM1202 can be conveniently used as a network front-end in automation, security, and data collection systems.

The EM1202 is fully supported by TIDE software and a dedicated EM1202 platform that covers all hardware facilities of the module (see "TIDE and Tibbo BASIC Manual"). For convenient testing and evaluation Tibbo offers [EM1202EV](#) evaluation board. The EM1202 can also support Wi-Fi communications (this requires [GA1000](#) add-on board).

Hardware features

- Based on a high-performance purpose-built 88-MHz T1000 ASIC.
- 10/100BaseT auto-MDIX Ethernet port (automatic detection of "straight" and "cross" cables). Standard Ethernet magnetics are **NOT** integrated into the module.
- Optional Wi-Fi interface (requires [GA1000](#) add-on module to be [connected](#)).
- Four high-speed serial ports (CMOS-level):
 - Baudrates of up to 921,600bps;
 - None/even/odd/mark/space parity modes;
 - 7/8 bits/character modes;
 - Full-duplex mode with optional flow control;
 - Half-duplex mode with direction control;
 - Encoding and decoding of Wiegand and clock/data streams.
- 512K or 1024KB flash memory for firmware, application, and data storage.
- 2KB EEPROM for data storage.
- Up to 32 general-purpose I/O lines. Among them:
 - 8 interrupt lines;
 - Serial port lines;
 - 24 lines that are combined into three 8-bit ports;
 - Square wave output (6Hz - 22'1184MHz), which can be used to control external buzzer.
- Supports external LCD and keypad.
- Four control lines for status LEDs:
 - 2 lines for green and red status LED control;
 - 2 lines for Ethernet status LED control.
- Software- controlled onboard PLL to select the clock frequency of the device: 11.0592MHz with PLL off, 88.4736MHz with PLL on.
- Reliable power-on/ brown-out reset circuit; no additional external reset circuitry required. Master reset input also provided.
- Power: 230mA @ 3.3V (100BaseT mode, PLL on).
- Dimensions: 17.1x19.1x14.6mm.
- Firmware and Tibbo BASIC application are upgradeable through the serial port or network.
- Tibbo BASIC application can be debugged through the network and no additional debugging hardware, such as in-circuit emulator, is required.

Programming features

- Variable Types: Byte, char, integer (word), short, dword, long, real, string, plus user-defined arrays and structures.
- Function Groups: string functions (27 in total!), date/time conversion functions (8), encryption/hash calculation functions (AES128, RC4, MD5, SHA-1), and more.
- Platform objects:
 - Sock — socket communications (up to 16 UDP, TCP, and HTTP sessions);
 - Net — controls the Ethernet port;
 - Wln — handles the Wi-Fi interface (requires [GA1000](#) add-on module);
 - Ssi — implements up to four serial synchronous interface (SSI) channels, supports SPI, I2C, clock/data, etc.;
 - Ser — in charge of serial ports (UART, Wiegand, and clock/data modes);
 - Io — handles I/O lines, ports, and interrupts;
 - Lcd — controls graphical display panels (several types supported);
 - Kp — scans keypads of matrix and "binary" types;
 - Fd — manages flash memory file system and direct sector access;
 - Stor — provides access to the EEPROM;
 - Romfile — facilitates access to resource files (fixed data);
 - Pppoe — provides access to the Internet over an ADSL modem;
 - Ppp — provides access to the Internet over a serial modem (GPRS, POTS, etc.);
 - Pat — "plays" patterns on up to five LED pairs;
 - Beep — generates buzzer patterns;
 - Button — monitors MD line (setup button);
 - Sys — in charge of general device functionality.

8 ^(1,2)	GPIO5/P0.5	General-purpose I/O line 5 (P0.5).
9 ^(1,2)	GPIO4/P0.4	General-purpose I/O line 4 (P0.4).
10 ^(1,2)	GPIO3/P0.3	General-purpose I/O line 3 (P0.3).
11 ^(1,2)	GPIO2/P0.2	General-purpose I/O line 2 (P0.2).
12 ^(1,2)	GPIO1/P0.1	General-purpose I/O line 1 (P0.1).
13 ^(1,2)	GPIO0/P0.0	General-purpose I/O line 0 (P0.0).
14	<No connection>	This pin <i>must</i> be left unconnected.
15	GND	System ground.
16 ^(1,2)	GPIO30	General-purpose I/O line 30 (does not belong to any 8-bit port).
17	VCC	Positive power input, 3.3V nominal, +/- 5%, max. current consumption 300mA (100BaseT, PLL on).
18 ^(1,2)	GPIO29/CO	General-purpose I/O line 29 (does not belong to any 8-bit port); square wave output line.
19 ^(1,2)	GPIO31	General-purpose I/O line 31 (does not belong to any 8-bit port).
20	SG	Green status LED control line.
21	RST	Reset line, active high.
22	SR	Red status LED control line.
23	MD	Mode selection pin.
24 ^(1,2)	GPIO8/P1.0/ RX0	General-purpose I/O line 8 (P1.0); RX, W1, and din input of the serial port 0.
25 ^(1,2,3)	GPIO16/P2.0/ INT0	General-purpose I/O line 16 (P2.0); interrupt line 0.
26 ^(1,2)	GPIO9/P1.1/ TX0	General-purpose I/O line 9 (P1.1); TX, W1, and dout output of the serial port 0.
27 ^(1,2,3)	GPIO17/P2.1/ INT1	General-purpose I/O line 17 (P2.1); interrupt line 1.
28 ^(1,2)	GPIO10/P1.2/ RX1	General-purpose I/O line 10 (P1.2); RX, W1, and din input of the serial port 1.
29 ^(1,2,3)	GPIO18/P2.2/ INT2	General-purpose I/O line 18 (P2.2); interrupt line 2.
30 ⁽¹⁾	GPIO11/P1.3/ TX1	General-purpose I/O line 11 (P1.3); TX, W1, and dout output of the serial port 1.
31 ^(1,2,3)	GPIO19/P2.3/ INT3	General-purpose I/O line 19 (P2.3); interrupt line 3.
32 ^(1,2)	GPIO12/P1.4/ RX2	General-purpose I/O line 12 (P1.4); RX, W1, and din input of the serial port 2.
33 ^(1,2,3)	GPIO20/P2.4/ INT4	General-purpose I/O line 20 (P2.4); interrupt line 4.
34 ^(1,2)	GPIO13/P1.5/ TX2	General-purpose I/O line 13 (P1.5); TX, W1, and dout output of the serial port 2.

35 (1,2,3)	GPIO21/P2.5/ INT5	General-purpose I/O line 21 (P2.5); interrupt line 5.
36 (1,2)	GPIO14/P1.6/ RX3	General-purpose I/O line 14 (P1.6); RX, W1, and din input of the serial port 3.
37 (1,2,3)	GPIO22/P2.6/ INT6	General-purpose I/O line 22 (P2.6); interrupt line 6.
38 (1,2)	GPIO15/P1.7/ TX3	General-purpose I/O line 15 (P1.7); TX, W1, and dout output of the serial port 3.
39 (1,2,3)	GPIO23/P2.7/ INT7	General-purpose I/O line 23 (P2.7); interrupt line 7.
40	AVCC	"Clean" 2.5V power output for magnetics circuitry.
41	TX-	Ethernet port, negative line of the differential output signal pair.
42	EG	Green Ethernet status LED control line.
43	TX+	Ethernet port, positive line of the differential output signal pair.
44	EY	Yellow Ethernet status LED control line.
45	RX-	Ethernet port, negative line of the differential input signal pair.
46	AGND	Analog ground.
47	RX+	Ethernet port, positive line of the differential input signal pair.

Notes:

1. This line is 5V-tolerant and can be interfaced to 5V CMOS devices directly.
2. This line can serve as an RTS/Wout/cout line of a serial port (provided that this does not interfere with any other function).
3. This line can serve as a CTS/W0&1in/cin line of a serial port (provided that this does not interfere with any other function).

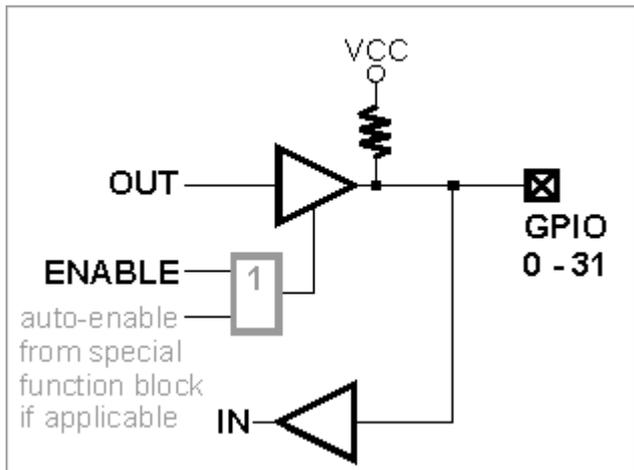
General-purpose I/O Lines

The EM1202 has 32 general-purpose I/O lines (GPIO0 - GPIO31). 24 of these lines are combined into three 8-bit ports. All lines are 3.3V, CMOS, 5V-tolerant. Maximum load current for each I/O line is 10mA.

Simplified structure of one I/O line of the EM1202 is shown on the circuit diagram below. Each line has an independent output buffer control. When the EM1202 powers up all I/O lines have their output buffers tri-stated (in other words, all I/O lines are configured as inputs). You need to explicitly enable the output buffer of a certain I/O line if you want this line to become an output.

Many I/O lines of the EM1202 also serve as inputs or outputs of special function modules, such as serial ports. Majority of those lines need to be correctly configured as inputs or outputs -- this won't happen automatically. Several lines -- such as TX and RX lines of the serial port when in the UART mode -- are configured as outputs and inputs automatically when the serial port (or some other hardware block) is enabled. For details see Platform-dependent Programming Information inside the EM1202 platform documentation ("TIDE and Tibbo BASIC Manual").

Each I/O line has a weak pull-up resistor that prevents the line from floating when the output buffer is tri-stated.



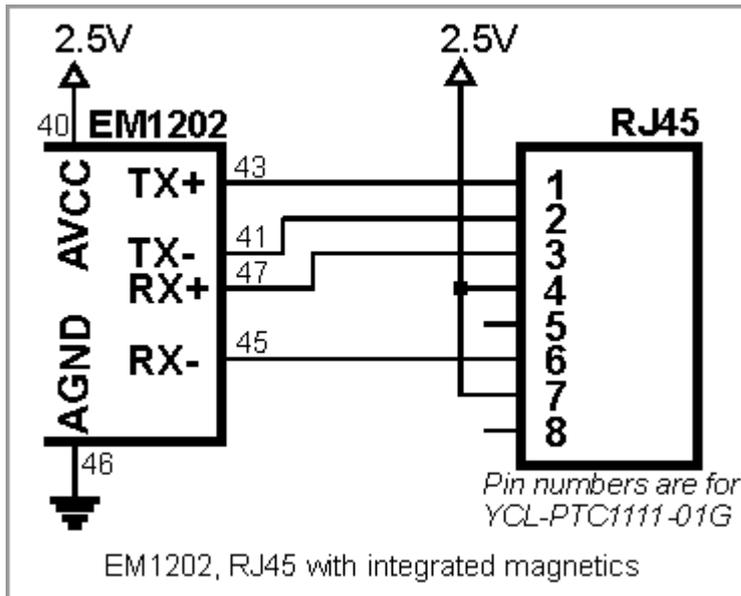
I/O line control is described in detail in the documentation for the I/O (io.) object found inside the "TIDE and Tibbo BASIC Manual".

Ethernet Port Lines

Ethernet port of the EM1202 is of 100BaseT type. Onboard electronics of the EM1202 do not include Ethernet magnetics, so magnetic circuitry must be connected externally to pins TX+, TX-, RX+, RX-, and AVCC. The AVCC pin outputs clean 2.5V power for the magnetics circuitry, which is very sensitive to noise. Separate AGND analog ground is also provided. Please, note the following:

- The AVCC is an output!
- Do not combine AVCC with the VCC (main power) pin. This will apply wrong voltage to the AVCC pin. Doing so appears to be causing no immediate permanent damage to the EM1202, but the circuit will not work and the effects of prolonged over-voltage on the AVCC line are not known.

You can use either a standalone magnetics part (such as YCL-PH163112) or RJ45 connector with integrated magnetics (i.e. YCL-PTC1111-01G). Here is a connection diagram for the YCL-PTC1111-01G jack with integrated magnetics.



It is important to make the PCB wire connections between the Ethernet port pins of the EM1202 and external magnetics circuitry as short as possible. Making the wires too long may cause the noise level generated by your PCB to surpass the maximum radiated emission limits stipulated by FCC/CE regulations. Additionally, longer Ethernet lines on the PCB will make your board more susceptible to the damage from the ESD (electrostatic discharge). Follow these three recommendations:

- Route TX+, TX-, RX+, RX- in such a way that they do not cross each other. Try to avoid using vias (keep on the same board side).
- Keep more or less uniform distance between "+" and "-" traces of each pair.

The EM1202 also has two [Ethernet status LED control lines](#)- see here for details.

Serial Ports.3

The EM1202 has four serial ports that can work in one of the three modes: UART, Wiegand, or clock/data. All three modes are described in detail in the documentation for the serial (ser.) object found inside the "TIDE and Tibbo BASIC Manual". Additionally, see the Platform-dependent Programming Information section inside the EM1202 platform documentation (same manual).

Square Wave Generator

The square wave generator can produce a square wave output on pin GPIO29/CO of the EM1202. This output is primarily intended for generating audio signals using buzzer and is covered in the beep (beep.) object -- see the "TIDE and Tibbo BASIC Manual".

Flash and EEPROM Memory

The EM1202 has 512KBytes or 1024KBytes of flash memory and 2KBytes of EEPROM memory.

The first 64KBytes of flash memory are used to store the TiOS firmware. When you are performing a firmware upgrade it is this memory you are saving the firmware binary into.

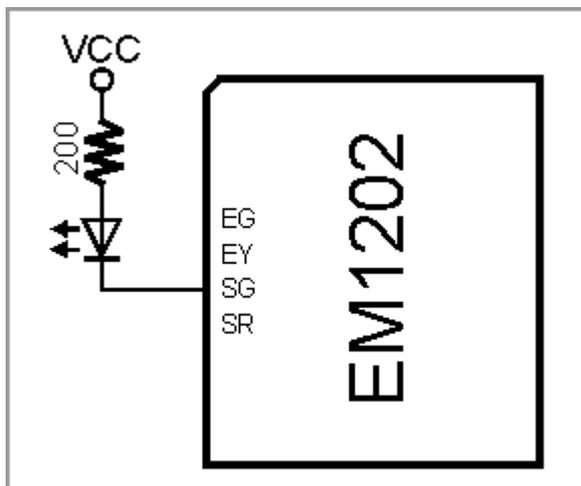
The rest of this flash memory is available to your Tibbo BASIC application and its

data. Whatever memory space is left after the compiled application is loaded can be used as a flash disk (see `fd.` object documentation in the "TIDE and Tibbo BASIC Manual").

The EEPROM is almost fully available to your application, save for a small 8-byte area called "special configuration area". The EEPROM is accessed through the `stor.` object (see "TIDE and Tibbo BASIC Manual"). Details on the special configuration area are provided in the Platform-dependent Programming Information section inside the EM1202 platform documentation (same manual).

LED Lines 1.6

The EM1202 has four LED control lines -- SG, SR, EG, and EY. All lines have the same internal structure and the LEDs should be connected to these lines as shown on the schematic diagram below. Maximum load for each line is 10mA.



Further information on status LEDs can be found in [Appendix 1: Status LEDs](#).

Power, Reset, and Mode Selection Lines

The EM1202 should be powered from a stabilized DC power supply with nominal output voltage of 3.3V (+/- 5% tolerance). Current consumption of the EM1202 is approximately 230mA (PLL on, 100BaseT mode). Providing an adequate power supply is very important -- poorly built circuit may affect EM1000 operation. We recommend that you use a switching power supply. One (but not the only) example of such circuit is shown below.

Proper external reset is not required. The EM1202 has a reliable power-on reset circuit with brown-out detection. Optionally, you can connect a reset button or some other reset-generating circuit to the RST pin of the EM1202. This will allow you to generate "external" resets. The RST line has active HIGH polarity. If you are not using the RST pin you can leave it unconnected.

The main clock frequency of the EM1202 is generated by an 11.0592MHz crystal connected to the onboard PLL circuit. When the PLL is off, the EM1202 is clocked at 11.0592MHz. When the PLL is on, the main clock is eight times higher- 88.4736MHz. Naturally, with PLL on the EM1202 works 8 times faster and consumes more current (230mA with PLL on against 110mA with PLL off). Main clock frequency also affects the baudrates of [serial ports](#) when in the UART mode, as well as the frequency produced by the [square wave generator](#).

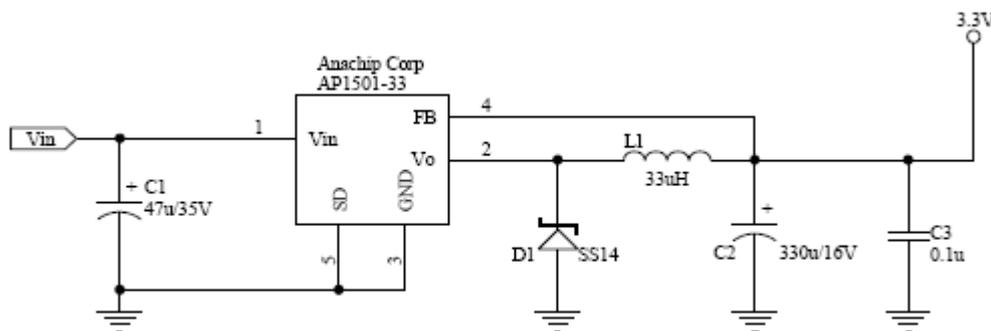
The PLL cannot be switched off and on while the EM1202 is running. This is because when PLL mode changes its output needs some time to stabilize. For this reason, the PLL mode of the EM1202 can only be changed on reset. A special internal delay circuit will hold the EM1202 in reset while PLL frequency stabilizes.

Unlike the [EM1000](#), the EM1202 does not have a hardware pin to control the state of the PLL. On power up, the PLL is always enabled. Your Tibbo BASIC application can change the PLL mode programmatically. The application can check the current PLL mode through the system (sys.) object (see "TIDE and Tibbo BASIC Manual"). If the PLL mode needs to be changed, the application can set new mode and then perform an internal reset (again, through the system object). The internal reset is identical to the power-on or external reset with one difference: the PLL mode will not default to "PLL on" but instead will be set as requested by the application prior to the reset.

The function of the MD line is described in [Appendix 2: Setup Button \(MD line\)](#).

Power supply circuit

Many power supply circuits will work well. The one below is being used by Tibbo. The circuit can handle input voltages in the 9-24V range.

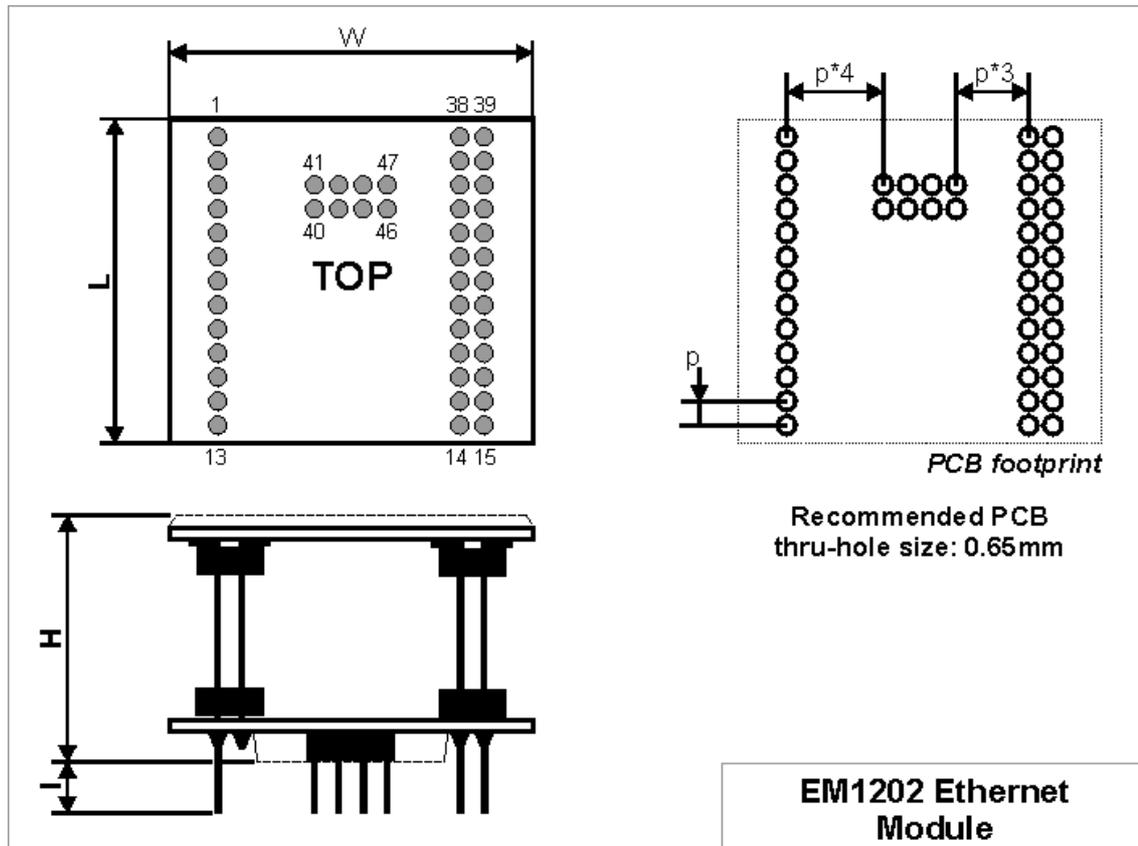


Notes:

- U1 (AP1501-33) is a popular power IC manufactured by Anachip (now Diodes Incorporated, www.diodes.com)
- C1 and C2 capacitors: Do not use SMD capacitors -- use regular through-hole aluminum capacitors. This really helps reduce noise produced by the power supply.
- This is an analog circuit, so layout matters. Apply reasonable "good layout" effort.

• Ideally, one should use an oscilloscope to see what sort of "square wave" the power supply generates, both at low and high input voltages, as well as light and heavy loads. There are no recipes here -- just try and see what works for your circuit.

Mechanical Dimensions

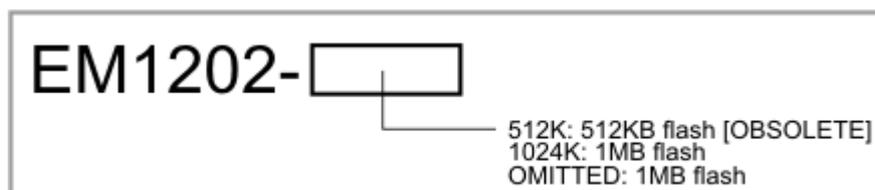


L	Max.	17.1	Module length
W	Max.	19.1	Module width
H	Max.	14.6	Module height (option without supercapacitor)
I	Min.	2.5	Lead length
p	Aver.	1.27	Pin pitch

Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

Ordering Info and Specifications

Device numbering scheme is as follows:



512K devices are no longer available.

If the flash memory size is omitted, 1024K option is implied.

Examples of valid model numbers

Model number	Description
EM1202-512K	This is an obsolete device with only 512KBytes of flash memory
EM1202-1024K	EM1202 module with 1024KBytes of flash memory
EM1202	EM1202 module with 1024KBytes of flash memory

Hardware specifications

Ethernet interface	10/100BaseT Ethernet, Auto-MDIX, magnetics not built-in
Serial ports	4 ports, CMOS-level.
UART capabilities	Baudrates up to 921'600bps; none/even/odd/mark/space parity and 7/8 bits/character.
Number of I/O lines	32 lines, all lines are 5V-tolerant; 24 of I/O lines are combined into five 8-bit ports; 8 lines can be used as interrupt lines.
Max. load current for each I/O line	10mA
Square wave generator	6Hz - 22'1184MHz, primarily intended for buzzer control
Clock frequency	11.0592MHz with PLL off 88.4736MHz with PLL on
Flash memory	512KBytes or 1024KBytes, entire memory minus 64KB is available to store Tibbo BASIC application and data
EEPROM memory	2048 bytes, 2040 bytes available to store application data
Nominal power supply voltage (VCC pin)	DC 3.3V, +/- 5%
Reset circuit trip voltage (VCC pin)	3.0V on power-up (i.e. when the voltage on VCC is rising) 2.9V on brown-out (i.e. when the voltage on VCC is dropping)
Operating current (VCC pin), not including hardware consumed by an add-on modules plugged into the EM1000	40mA with PLL off, Ethernet cable unplugged 50mA with PLL off, 10BaseT mode 110mA with PLL off, 100BaseT mode 160mA with PLL on, Ethernet cable unplugged 170mA with PLL on, 10BaseT mode 230mA with PLL on, 100BaseT mode
Operating temperature	-20 to +70 degrees C
Operating relative humidity	10-90%
Mechanical dimensions (excl. leads)	17.1x19.1x14.6mm

Pin diameter	0.4mm
Packaging	Tray, 30 modules/tray

All specifications are subject to change without notice and are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

EM1206



EM1206 module



EM1206 in combination with the [RJ203](#)

Introduction

The EM1206 is a miniature BASIC-programmable embedded module. This device is a member of the x20x family of embedded modules and takes full advantage of unique mechanical concept of x20x devices. The module can be used with any suitable jack and magnetics, or with our patent-pending [RJ203](#) jack/magnetics module. The combined PCB footprint of the EM1206 and RJ203 is only 34.5x19mm.

The module's hardware mix, which includes 100Base/T Ethernet, four serial ports, flash disk, EEPROM, and RTC, has been carefully tailored to address the typical needs of network-enabled control applications. This makes the EM1206 especially suitable for "connected" edge products such as sensors, network-enabled card readers, actuators, and other lightweight devices.

The EM1206 is fully supported by TIDE software and a dedicated EM1206 platform that covers all hardware facilities of the module (see "TIDE and Tibbo BASIC Manual"). For convenient testing and evaluation Tibbo offers the [EM1206EV](#) evaluation board. The EM1206 can also support Wi-Fi communications (this requires [GA1000](#) add-on board), as well as external LCD, keypad, and buzzer.

Hardware features

- Based on a high-performance purpose-built 88-MHz T1000 ASIC.

- 10/100BaseT auto-MDIX Ethernet port (automatic detection of "straight" and "cross" cables). Standard Ethernet magnetics are **NOT** integrated into the module:
 - Connect any suitable external jack and magnetics; or
 - Combine the EM1206 with Tibbo's patent-pending [RJ203](#) module to achieve minimal PCB footprint.
- Optional Wi-Fi interface (requires [GA1000](#) add-on module to be [connected](#)).
- Four high-speed serial ports (CMOS-level):
 - Baudrates of up to 921,600bps;
 - None/even/odd/mark/space parity modes;
 - 7/8 bits/character modes;
 - Full-duplex mode with optional flow control;
 - Half-duplex mode with direction control;
 - Encoding and decoding of Wiegand and clock/data streams.
- 512K or 1024KB flash memory for firmware, application, and data storage.
- 2KB EEPROM for data storage.
- RTC with dedicated backup power input.
- Up to 17 general-purpose I/O lines. Among them:
 - 8 interrupt lines;
 - Serial port lines;
 - 16 lines that are combined into two 8-bit ports;
 - Square wave output (6Hz - 22'1184MHz), which can be used to control external buzzer.
- Supports external LCD and keypad.
- Control lines for two external status LEDs.
- Four LEDs onboard:
 - Green and red status LEDs;
 - Green and yellow Ethernet status LEDs.
- Software-controlled onboard PLL to select the clock frequency of the device: 11.0592MHz with PLL off, 88.4736MHz with PLL on.
- Reliable power-on/ brown-out reset circuit; no additional external reset circuitry required. Master reset input also provided.
- Power: 230mA @ 3.3V (100BaseT mode, PLL on).
- Dimensions: 33.2x18.1x5.5mm.
- Firmware and Tibbo BASIC application are upgradeable through the serial port or network.
- Tibbo BASIC application can be debugged through the network and no additional debugging hardware, such as in-circuit emulator, is required.

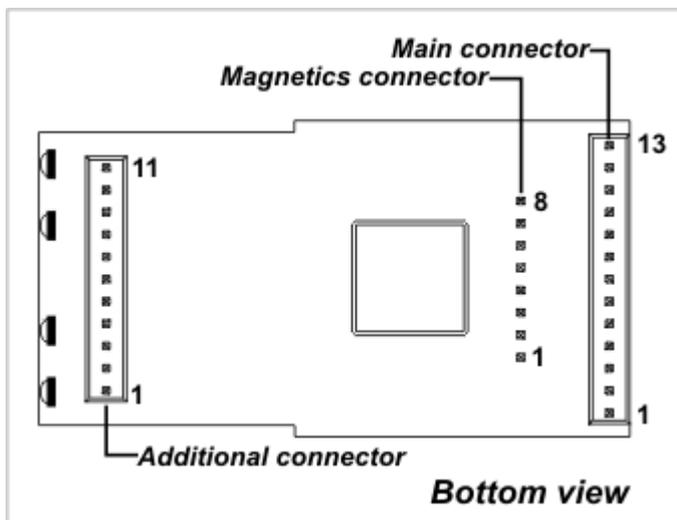
Programming features

- Variable Types: Byte, char, integer (word), short, dword, long, real, string, plus user-defined arrays and structures.
- Function Groups: string functions (27 in total!), date/time conversion functions (8), encryption/hash calculation functions (AES128, RC4, MD5, SHA-1), and more.
- Platform objects:

- Sock — socket communications (up to 16 UDP, TCP, and HTTP sessions);
- Net — controls the Ethernet port;
- Wln — handles the Wi-Fi interface (requires [GA1000](#) add-on module);
- Ssi — implements up to four serial synchronous interface (SSI) channels, supports SPI, I2C, clock/data, etc.;
- Ser — in charge of serial ports (UART, Wiegand, and clock/data modes);
- Io — handles I/O lines, ports, and interrupts;
- Kp — scans keypads of matrix and "binary" types;
- Rtc — keeps track of date and time;
- Fd — manages flash memory file system and direct sector access;
- Stor — provides access to the EEPROM;
- Romfile — facilitates access to resource files (fixed data);
- Pppoe — provides access to the Internet over an ADSL modem;
- Ppp — provides access to the Internet over a serial modem (GPRS, POTS, etc.);
- Pat — "plays" patterns on up to five LED pairs;
- Beep — generates buzzer patterns;
- Button — monitors MD line (setup button);
- Sys — in charge of general device functionality.

I/O Pin Assignment and Pin Functions

The EM1206 has three connectors: main connector, additional connector, and magnetics connector. Depending on the EM1206 [version](#), magnetics connector can be soldered facing up or down, as described in the [Mechanical Dimensions](#) topic.



See these topics for more information on various hardware facilities of the EM1206:

- [General-purpose I/O Lines](#)
- [Ethernet Port Lines](#)
- [Serial Ports](#)
- [Square Wave Generator](#)

- [Flash and EEPROM Memory](#)
- [Real-time Counter](#)
- [LED Lines](#)
- [Power, Reset, and Mode Selection Lines](#)

Main connector

Pin #	Function	Description
1	VCCB	Backup power for the real-time counter. Do not connect to 3.3V directly!
2	MD	Mode selection pin.
3	RST	Reset line, active high.
4 (1,2,3)	GPIO5/P0.5/TX2/ INT5	General-purpose I/O line 5 (P0.5); TX, W1, dout output of the serial port 2; Interrupt line 5.
5 (1,2,3)	GPIO4/P0.4/RX2/ INT4	General-purpose I/O line 4 (P0.4); RX, W1, din input of the serial port 2; Interrupt line 4.
6 (1,2,3)	GPIO6/P0.6/RX3/ INT6	General-purpose I/O line 6 (P0.6); RX, W1, din input of the serial port 3; Interrupt line 6.
7 (1,2,3)	GPIO7/P0.7/TX3/ INT7	General-purpose I/O line 7 (P0.7); TX, W1, dout output of the serial port 3; Interrupt line 7.
8	VCC	Positive power input, 3.3V nominal, +/- 5%, max. current consumption 230mA (100BaseT, PLL on).
9	GND	System ground.
10 (1,2,3)	GPIO0/P0.0/RX0/ INT0	General-purpose I/O line 0 (P0.0); RX, W1, din input of the serial port 0; Interrupt line 0.
11 (1,2,3)	GPIO1/P0.1/TX0/ INT1	General-purpose I/O line 1 (P0.1); TX, W1, dout output of the serial port 0; Interrupt line 1.
12 (1,2,3)	GPIO2/P0.2/RX1/ INT2	General-purpose I/O line 2 (P0.2); RX, W1, din input of the serial port 1; Interrupt line 2.
13 (1,2,3)	GPIO3/P0.3/TX1/ INT3	General-purpose I/O line 3 (P0.3); TX, W1, dout output of the serial port 1; Interrupt line 3.

Notes:

1. This line is 5V-tolerant and can be interfaced to 5V CMOS devices directly.
2. This line can serve as an RTS/Wout/cout line of a serial port (provided that this does not interfere with any other function).
3. This line can serve as a CTS/W0&1in/cin line of a serial port (provided that this does not interfere with any other function).

Additional connector

Pin #	Function	Description
1	SG	Green status LED control line.
2	SR	Red status LED control line.
3 ^(1,2)	GPIO16/CO	General-purpose I/O line 16 (does not belong to any port); square wave output line.
4 ^(1,2)	GPIO8/P1.0	General-purpose I/O line 8 (P1.0).
5 ^(1,2)	GPIO9/P1.1	General-purpose I/O line 9 (P1.1).
6 ^(1,2)	GPIO10/P1.2	General-purpose I/O line 10 (P1.2).
7 ^(1,2)	GPIO11/P1.3	General-purpose I/O line 11 (P1.3).
8 ^(1,2)	GPIO12/P1.4	General-purpose I/O line 12 (P1.4).
9 ^(1,2)	GPIO13/P1.5	General-purpose I/O line 13 (P1.5).
10 ^(1,2)	GPIO14/P1.6	General-purpose I/O line 14 (P1.6).
11 ^(1,2)	GPIO15/P1.7	General-purpose I/O line 15 (P1.7).

Notes:

1. This line is 5V-tolerant and can be interfaced to 5V CMOS devices directly.
2. This line can be assigned to serve as an RTS/Wout/cout line of a serial port.

Magnetics connector

Pin #	Function	Description
#1	RX+	Ethernet port, positive line of the differential input signal pair.
#2	RX-	Ethernet port, negative line of the differential input signal pair.
#3	AVCC	"Clean" 1.8V power output for magnetics circuitry.
#4	---	---
#5	---	---
#6	AGND	Analog ground.
#7	TX+	Ethernet port, positive line of the differential output signal pair.
#8	TX-	Ethernet port, negative line of the differential output signal pair.

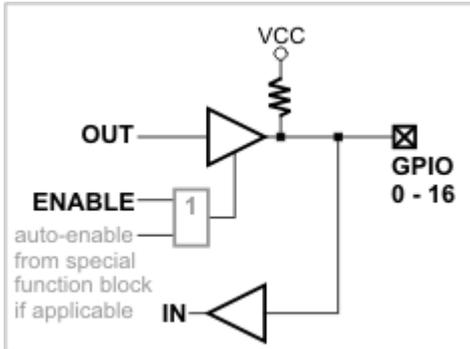
General-purpose I/O Lines

The EM1206 has 17 general-purpose I/O lines (GPIO0 - GPIO16). All lines are 3.3V, CMOS, 5V-tolerant. Maximum load current for each line is 10mA. Out of seventeen available lines, sixteen are combined into two 8-bit ports.

The simplified structure of one I/O line of the EM1206 is shown on the circuit

diagram below. Each line has an independent output buffer control. When the EM1206 powers up all I/O lines have their output buffers tri-stated (in other words, all I/O lines are configured as inputs). You need to explicitly enable the output buffer of a certain I/O line if you want this line to become an output.

Each I/O line has a weak pull-up resistor that prevents the line from floating when the output buffer is tri-stated. I/O line control is described in the io. object documentation ("TIDE and Tibbo BASIC Manual").



Many I/O lines of the EM1206 have alternative functions and serve as inputs or outputs of special function modules: On the EM1206, the special function modules are four [serial ports](#) and the [square wave generator](#). When any special function module is enabled, its I/O lines seize to work as inputs/outputs and are controlled by this special function module directly. Depending on the nature of an alternative function a given I/O line is to perform, your application may still have to manually configure this line for input or output. The table below details which special function module lines require manual configuration:

RX lines of serial ports	Automatically configured as inputs when a corresponding serial port is enabled, revert to previous state when this port is disabled.
TX lines of serial ports	Automatically configured as outputs when a corresponding serial port is enabled, revert to previous state when this port is disabled.
CTS lines of serial ports	Must be configured as inputs by your application. Note that CTS lines can be "remapped".
RTS lines of serial ports	Must be configured as outputs by your application. Note that RTS lines can be "remapped".
CO (square wave output)	Automatically configured as output when the square wave is being generated, reverts to previous state when the square wave output stops.

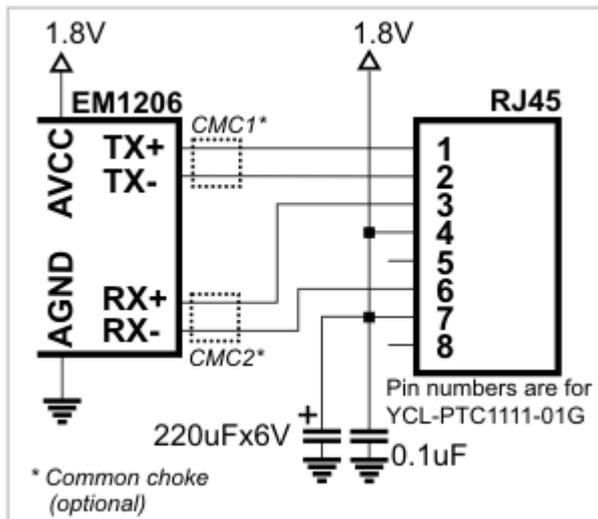
Ethernet Port Lines

Ethernet port of the EM1206 is of 100BaseT type. Onboard electronics of the EM1206 do not include Ethernet magnetics, so magnetic circuitry must be connected externally to pins TX+, TX-, RX+, RX-, and AVCC. The AVCC pin outputs clean 1.8V power for the magnetics circuitry, which is very sensitive to noise.

Separate AGND analog ground is also provided. Please, note the following:

- The AVCC is an output!
- Do not combine AVCC with the VCC (main power) pin. This will apply wrong voltage to the AVCC pin. Doing so appears to cause no immediate permanent damage to the EM1206, but the circuit will not work and the effects of prolonged over-voltage on the AVCC line are not known.

You can use either a standalone magnetics part (such as YCL-PH163112) or an RJ45 connector with integrated magnetics (i.e. YCL-PTC1111-01G). Here is a connection diagram for the YCL-PTC1111-01G jack with integrated magnetics.



Alternatively, you can use the EM1206 in combination with the [RJ203](#) jack/magnetics module. Unique patent-pending design of the RJ203 "tucks" the EM1206 under the RJ203 thus minimizing required host PCB space. For more information see RJ203 documentation (mechanical drawing of the EM1206+RJ203 module combination can be found [here](#)).

Serial Ports .3

The EM1206 has four serial ports that can work in one of the three modes: UART, Wiegand, or clock/data. All three modes are described in detail in the ser. object documentation ("TIDE and Tibbo BASIC Manual"). Additionally, see the Platform-dependent Programming Information section inside the EM1206 platform documentation (same manual).

Square Wave Generator

The square wave generator can produce a square wave output on pin GPIO16/CO of the EM1206. This output is primarily intended for generating audio signals using buzzer and is covered in the beep. object documentation ("TIDE and Tibbo BASIC Manual").

Flash and EEPROM Memory

The EM1206 has 512KBytes or 1024KBytes of flash memory and 2KBytes of EEPROM memory.

The first 64KBytes of flash memory are used to store the TiOS firmware. When you are performing a firmware upgrade it is this memory you are saving the firmware binary into.

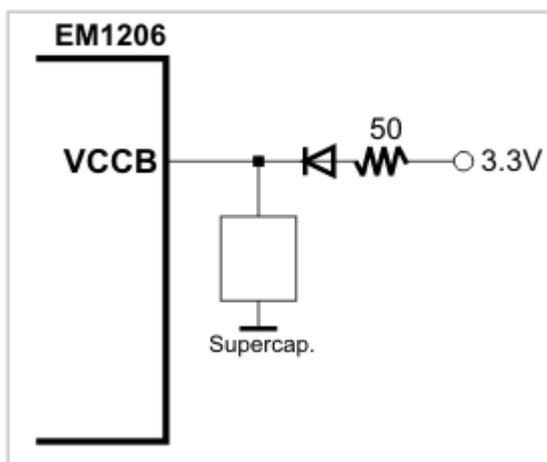
The rest of this flash memory is available to your Tibbo BASIC application and its data. Whatever memory space is left after the compiled application is loaded can be used as a flash disk (see `fd.` object documentation in the "TIDE and Tibbo BASIC Manual").

The EEPROM is almost fully available to your application, save for a small 8-byte area called "special configuration area". The EEPROM is accessed through the `stor.` object (see "TIDE and Tibbo BASIC Manual"). Details on the special configuration area are provided in the Platform-dependent Programming Information section inside the EM1206 platform documentation (same manual).

Real-time Counter

The real-time counter (RTC) of the EM1206 is a free-running 40-bit register that increments at a rate of 128Hz.

As a source of backup power, the EM1206 can rely on a supercapacitor. Suggested schematic diagram is shown below. The resistor is used for current limiting: a fully discharged supercapacitor creates a nearly short-circuit current inrush when it starts charging and this can damage the power supply of your host board.



The supercapacitor has many advantages- it charges almost instantly and has virtually unlimited lifespan. The disadvantage is that the supercapacitor is only able to sustain the RTC of the EM1206 for about 5-6 days, which may appear to be insufficient. Remember, however, that the EM1206 is a "connected" product. As such, it can always synchronize its clock with an Internet time server or a master clock on the main server of your system. Therefore, the role of the supercapacitor is to provide backup power during relatively short periods of power interruption, for example when the device is unplugged and moved to another location, or when the device is powered off over the weekend.

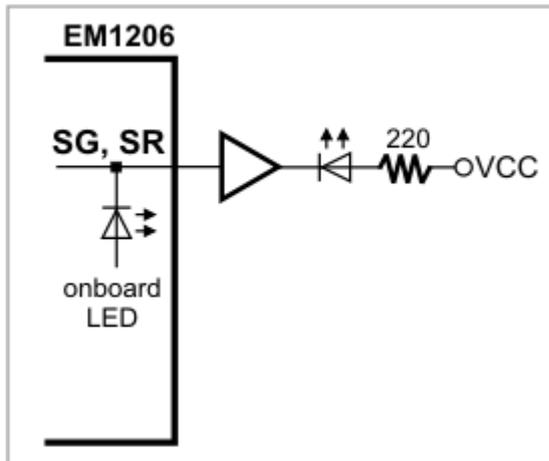
It is also possible to use a 3V lithium battery for backup power. Remember, however, that the voltage on the VCCB pin should not exceed 2.5V. Therefore, you need to use several diodes in series between the battery and the VCCB input. You can calculate the time the battery will be able to sustain the EM1206 from the average backup current, which is $\sim 13\mu\text{A}$. Note that the VCCB pin consumes a much larger current ($\sim 1\text{mA}$) when the Vcc is applied and the EM1206 is running. Therefore, your battery-based backup circuit should be designed in a way that does not drain the battery while the Vcc is applied.

Your Tibbo BASIC application can access the RTC through the `rtc.` object (see "TIDE

and Tibbo BASIC Manual").

LED Lines 1.7

The EM1206 has two LED control lines -- Status Green (SG), and Status Red (SR). Both lines have the same internal structure and the LEDs should be connected to these lines as shown on the schematic diagram below. The use of an external gate is recommended because the EM1206 has its own [onboard](#) status LEDs, and those are driven by SG and SR lines as well. The combined load of the internal and external LED on the same line is too "heavy".



Further information on status LEDs can be found in [Appendix 1: Status LEDs](#).

Power, Reset, and Mode Selection Lines

The EM1206 should be powered from a stabilized DC power supply with nominal output voltage of 3.3V (+/- 5% tolerance). Current consumption of the EM1206 is approximately 230mA (PLL on, 100BaseT mode). Providing an adequate power supply is very important -- poorly built circuit may affect EM1206 operation. We recommend that you use a switching power supply. One (but not the only) example of such circuit is shown below.

Proper external reset is not required. The EM1206 has a reliable power-on reset circuit with brown-out detection. Optionally, you can connect a reset button or some other reset-generating circuit to the RST pin of the EM1206. This will allow you to generate "external" resets. The RST line has active HIGH polarity. If you are not using the RST pin you can leave it unconnected.

The main clock frequency of the EM1206 is generated by an 11.0592MHz crystal connected to the onboard PLL circuit. When the PLL is off, the EM1206 is clocked at 11.0592MHz. When the PLL is on, the main clock is eight times higher- 88.4736MHz. Naturally, with PLL on the EM1206 works 8 times faster and consumers more current (230mA with PLL on against 110mA with PLL off). Main clock frequency also affects the baudrates of [serial ports](#) when in the UART mode, as well as the frequency produced by the [square wave generator](#).

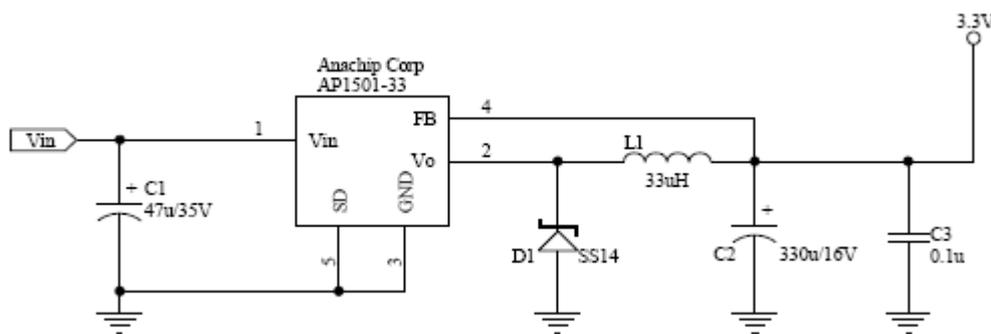
The PLL cannot be switched off and on while the EM1206 is running. This is because when PLL mode changes its output needs some time to stabilize. For this reason, the PLL mode of the EM1206 can only be changed on reset. A special internal delay circuit will hold the EM1206 in reset while PLL frequency stabilizes.

Unlike the [EM1000](#), the EM12062 does not have a hardware pin to control the state of the PLL. On power up, the PLL is always enabled. Your Tibbo BASIC application can change the PLL mode programmatically. The application can check the current PLL mode through the sys. object (see "TIDE and Tibbo BASIC Manual"). If the PLL mode needs to be changed, the application can set new mode and then perform an internal reset (again, through the sys. object). The internal reset is identical to the power-on or external reset with one difference: the PLL mode will not default to "PLL on" but instead will be set as requested by the application prior to the reset.

The function of the MD line is described in [Appendix 2: Setup Button \(MD line\)](#).

Power supply circuit

Many power supply circuits will work well. The one below is being used by Tibbo. The circuit can handle input voltages in the 9-24V range.



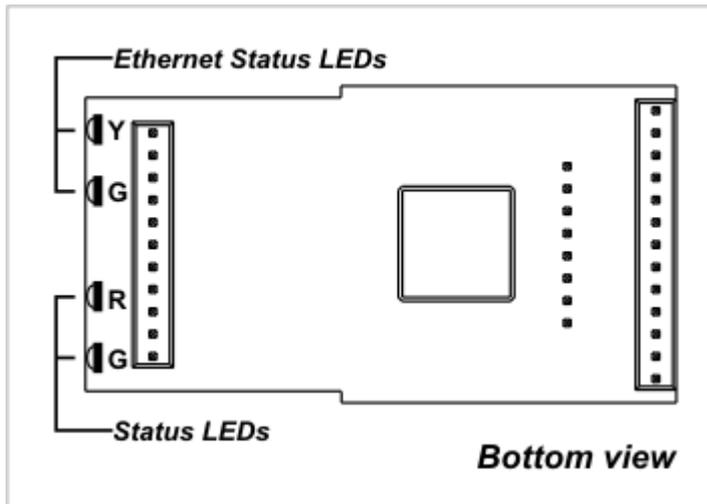
Notes:

- U1 (AP1501-33) is a popular power IC manufactured by Anachip (now Diodes Incorporated, www.diodes.com)
- C1 and C2 capacitors: Do not use SMD capacitors -- use regular through-hole aluminum capacitors. This really helps reduce noise produced by the power supply.
- This is an analog circuit, so layout matters. Apply reasonable "good layout" effort.

• Ideally, one should use an oscilloscope to see what sort of "square wave" the power supply generates, both at low and high input voltages, as well as light and heavy loads. There are no recipes here -- just try and see what works for your circuit.

Onboard LEDs

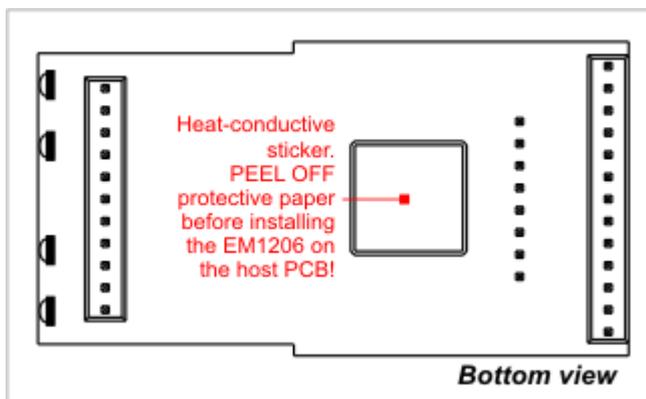
The EM1206 features four onboard status LEDs. The LEDs are strategically positioned on the edge of the module's board. Your product can have a small window or opening on its cover to make the LEDs of the EM1206 visible from the outside. When the EM1206 is used in combination with the [RJ203](#) module, the status LEDs are [visible](#) through a transparent portion of the RJ203's housing.



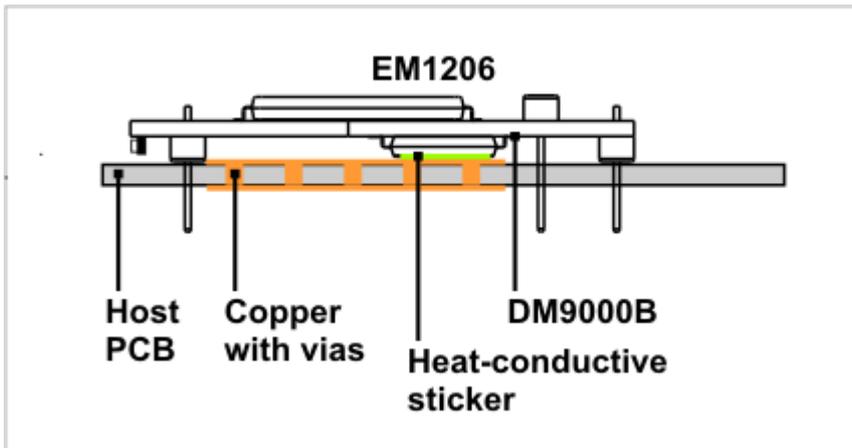
Further information on status LEDs can be found in [Appendix 1: Status LEDs](#).

Thermal considerations

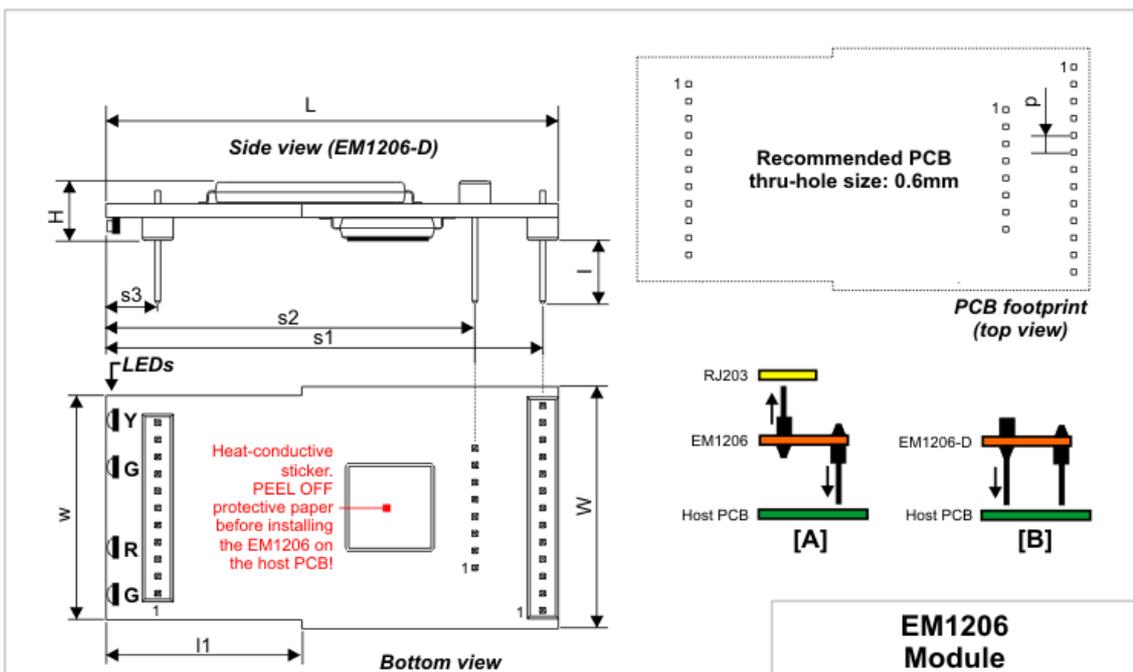
The DM9000B Ethernet controller of the EM1206 can become very hot during normal module operation. To aid the module in dissipating excess heat, a special heat-conductive sticker is applied to the top of the DM9000B. The protective paper of the sticker **MUST BE REMOVED** prior to installing the module on the host PCB.



To further lower the operating temperature of the EM1206 we advise you to arrange a copper area on the host PCB and in contact with the heat-conductive sticker. Best results are achieved when the copper area is larger, and also when two copper areas are provided on both sides of the host PCB and interconnected by a number of large vias.



Mechanical Dimensions



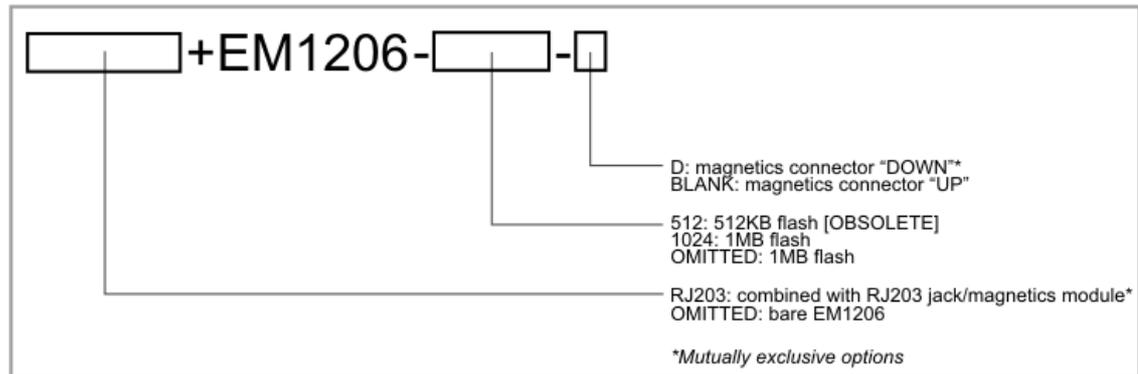
L	Max.	33.4	Length
W	Max.	18.1	Width
H	Max.	4.2	Height
l1	Aver	14.4	Length of the narrower part of the board
w	Max.	16.7	Width at the narrower part of the board
p	Aver	1.27	Pin pitch
s1	Aver	32.1	Distance from the edge of the board to the pins of the main connector
s2	Aver	27.2	Distance from the edge of the board to the pins of the magnetics connector
s3	Aver	3.8	Distance from the edge of the board to the pins of the additional

	.		connector
I	Min.	4.0	Connector pin length

All dimensions are in millimeters. Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

Ordering Info and Specifications

Device numbering scheme is as follows:



512K devices are no longer available.

If the flash memory size is omitted, 1024K option is implied.

To order the EM1206 in combination with the [RJ203](#) module, use the "RJ203 +EM1206" ordering code. This code means that the RJ203 and the EM1206 will come [pre-assembled](#) together.

Examples of valid model numbers

Model number	Description
EM1206-1024K	EM1206 with 1024KBytes of flash memory, configured for mating with the RJ203
RJ203+EM1206	EM1206 with 1024KBytes of flash, in combination with the RJ203
EM1206-D	EM1206 with 1024KBytes of flash memory, configured for mating with the host PCB

Hardware specifications

Ethernet interface	10/100BaseT Ethernet, Auto-MDIX, magnetics not built-in
Serial ports	4 ports, CMOS-level.
UART capabilities	Baudrates up to 921'600bps; none/even/odd/mark/space parity and 7/8 bits/character.
Number of I/O lines	17 lines, all lines are 5V-tolerant;

	16 lines are combined into five 8-bit ports; 8 lines can be used as interrupt lines.
Max. load current for each I/O line	10mA
Square wave generator	6Hz - 22'1184MHz, primarily intended for buzzer control
Real-time counter (RTC)	40 bit, increments at 128Hz, has its own backup power input
Clock frequency	11.0592MHz with PLL off 88.4736MHz with PLL on
Flash memory	1024KBytes, entire memory minus 64KB is available to store Tibbo BASIC application and data
EEPROM memory	2048 bytes, 2040 bytes available to store application data
Nominal power supply voltage (VCC pin)	DC 3.3V, +/- 5%
Reset circuit trip voltage (VCC pin)	3.0V on power-up (i.e. when the voltage on VCC is rising) 2.9V on brown-out (i.e. when the voltage on VCC is dropping)
Operating current (VCC pin), excluding hardware consumed by an add-on modules plugged into the EM1000	40mA with PLL off, Ethernet cable unplugged 50mA with PLL off, 10BaseT mode 110mA with PLL off, 100BaseT mode 160mA with PLL on, Ethernet cable unplugged 170mA with PLL on, 10BaseT mode 230mA with PLL on, 100BaseT mode
Nominal backup voltage (VCCB pin)	2.5V
Backup current (VCCB pin)	1mA when the EM1000 is running (3.3V on VCC) 13uA when the EM1000 is not powered (0V on VCC)
Operating temperature	-20 to +70 degrees C
Operating relative humidity	10-90%
Mechanical dimensions (excl. leads)	33.4x18.1x4.2mm
Pin diameter	0.4mm
Packaging	Tray, 30 modules/tray

* *Implemented in (supported through) firmware.*

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EM200



Important notices:

1. This device is also supplied with a non-programmable, fixed-function, ready-to-use serial device server firmware. Refer to the "Serial-over-IP Solutions Manual" for more information.

Introduction

The EM200 is a BASIC-programmable embedded module that can serve as a networking coprocessor of your "connected" device. The firmware of the EM200, called TiOS, features a virtual machine that executes your application written in Tibbo BASIC. The EM200 has no pre-defined functionality whatsoever -- programmability in Tibbo BASIC means that you can create your own unique EM200 applications!

Each hardware faculty of the EM200 is supported by a sophisticated programming "object" which you interact with from the Tibbo BASIC application. Together, objects form a "platform" that defines EM200 capabilities from the programming point of view.

The EM200 platform, along with the Tibbo BASIC language and TIDE software is described in the "TIDE and Tibbo BASIC Manual".

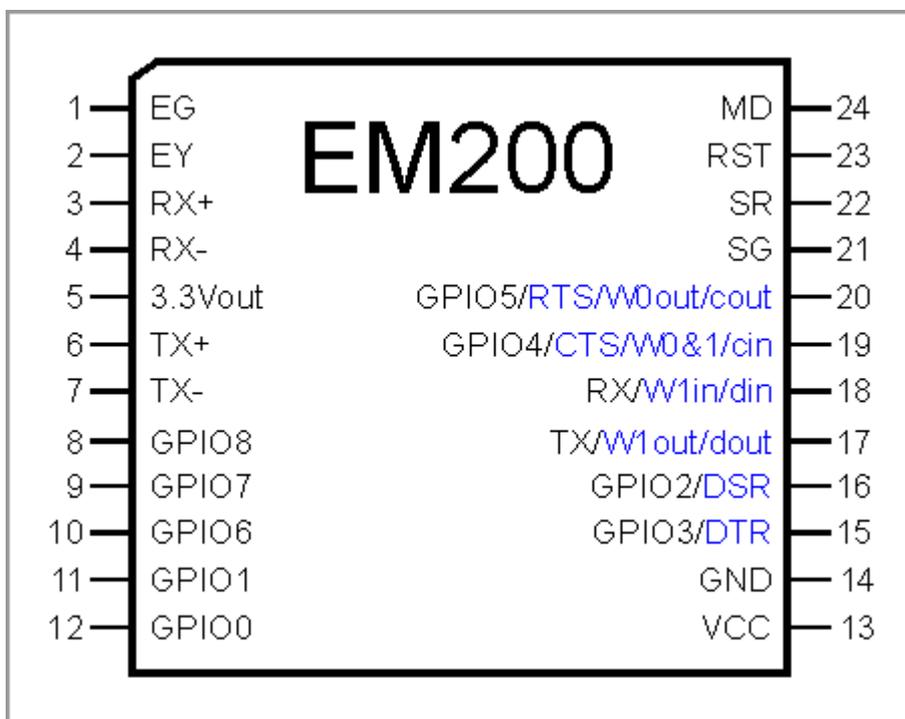
Hardware features

- Very compact dimensions (32.1 x 18.5 x 7.3 mm).
- One 100/10BaseT Ethernet port. Standard Ethernet magnetics are NOT integrated into the module.
- One serial ports (CMOS-level):
 - The port can work in the UART, Wiegand, or clock/data mode. Support of Wiegand and clock/data interfaces is a unique feature of Tibbo devices.
 - UART supports:
 - baudrates of up to 115'200bps;
 - none/even/odd/mark/space parity modes;
 - 7/8 bits/character modes;
 - full-duplex mode with optional flow control, half-duplex mode with automatic direction control.
- 128KBytes of flash memory. First 64KB are used to store device firmware (TiOS). The rest is available to your Tibbo BASIC application.
- 2KBytes of EEPROM memory.
- 9 general-purpose I/O lines.
- The following lines are additionally available:
 - 2 lines for green and red status LED control;
 - 2 lines for Ethernet status LED control;
 - 1 line to connect the "system" button.
 - External reset input.
- Device firmware can be upgraded through the serial port or Ethernet.
- Tibbo BASIC application can be uploaded and debugged through the Ethernet.

Programming features

- The following data types and related functions are supported:
 - Byte and char (occupy 1 byte);
 - Integer (word) and short (occupy 2 bytes);
 - String, can be up to 255 characters long;
- The following function groups are supported:
 - Conversion to and from strings: asc, chr, val, str, left, mid, right, len, instr, etc. (16 function in total);
- The following objects form the EM200 platform:
 - Sockets (sock.) object -- supports up to 16 simultaneous UDP or TCP connections, or HTTP sessions;
 - Ethernet (net.) object -- controls Ethernet interface;
 - Serial (ser.) object -- supports UART, Wiegand, and clock/data modes;
 - Input/output (io.) object -- handles I/O lines;
 - EEPROM (stor.) object -- facilitates access to the EEPROM memory;
 - ROM data (romfile.) object -- provides access to the fixed ("ROM") data of your Tibbo BASIC application;
 - LED pattern (pat.) object -- "plays" patterns on Green and Red Status LEDs;
 - System button (btn.) object -- handles special system (MD) button;
 - System (sys.) object -- controls general device functionality.

I/O Pin Assignment and Pin Functions



The information on various hardware faculties of the EM200 can be found in the following topics:

- [Ethernet Port Lines](#)
- [Serial Port and General-purpose I/O Lines](#)
- [Flash and EEPROM Memory](#)
- [LED Lines](#)
- [Power, Reset, and Mode Selection Lines](#)

I/O pin assignment

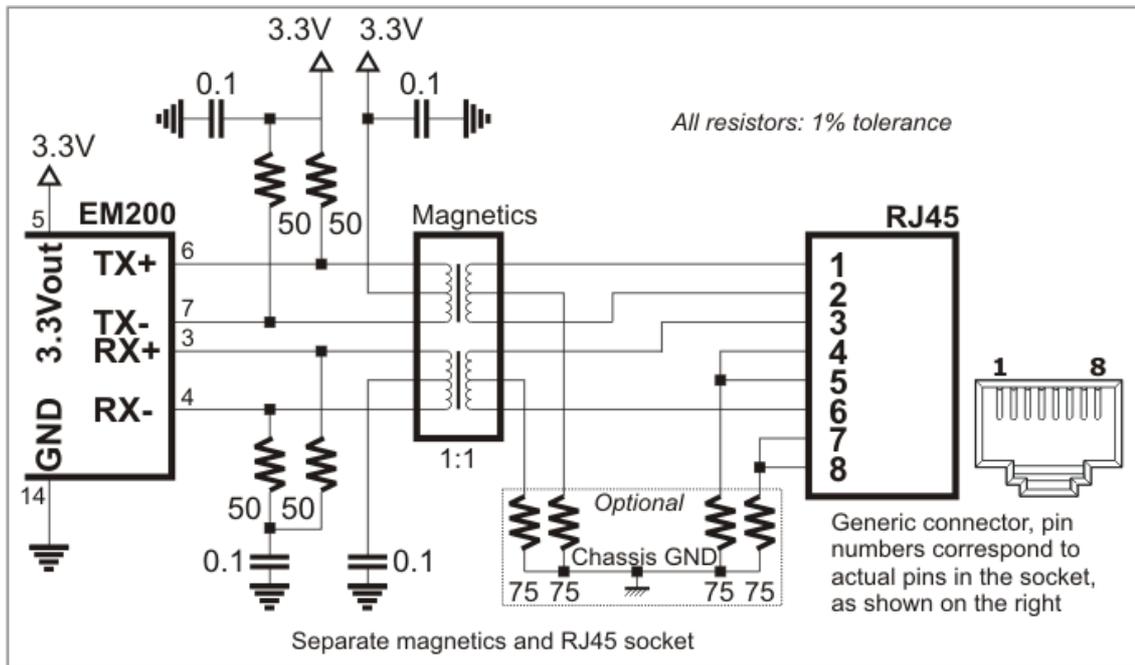
Pin #	Function	Description
1	EG	Green Ethernet status LED control line.
2	EY	Yellow Ethernet status LED control line.
3	RX+	Ethernet port, positive line of the differential input signal pair.
4	RX-	Ethernet port, negative line of the differential input signal pair.
5	3.3Vout	"Clean" 3.3V power for magnetics circuitry.
6	TX+	Ethernet port, positive line of the differential output signal pair.
7	TX-	Ethernet port, negative line of the differential output signal pair.
8	GPIO8	General-purpose I/O line 8.
9	GPIO7	General-purpose I/O line 7.
10	GPIO6	General-purpose I/O line 6.
11	GPIO1	General-purpose I/O line 1.
12	GPIO0	General-purpose I/O line 0.
13	VCC	Positive power input, 5V nominal, +/- 5%, max. current consumption 50mA
14	GND	System ground.
15	GPIO3/DTR ⁽¹⁾	General-purpose I/O line 3; <i>conventionally</i> also DTR output line of the serial port.
16	GPIO2/DSR ⁽²⁾	General-purpose I/O line 2; <i>conventionally</i> also DSR output line of the serial port.
17	TX/W1out/dout ⁽¹⁾	TX, W1, and dout output of the serial port.
18	RX/W1in/din ⁽¹⁾	RX, W1, and din input of the serial port.
19	GPIO4/CTS/W0&1in/cin ⁽¹⁾	General-purpose I/O line 4; also CTS, W0&1, and cin input of the serial port.
20	GPIO5/RTS/W0out/cout ⁽¹⁾	General-purpose I/O line 5; also RTS, W0, and cout output of the serial port.
21	SG	Green status LED control line.
22	SR	Red status LED control line.
23	RST	Reset line, active high.
24	MD	Mode selection pin.

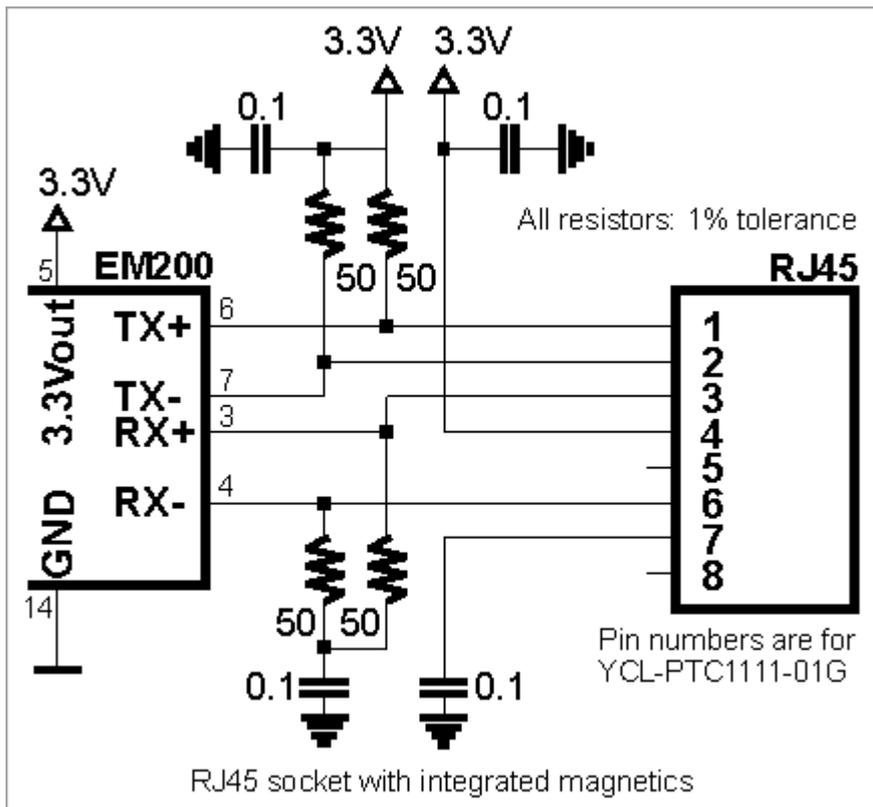
Ethernet Port Lines

Ethernet port of the EM200 is of 100/10BaseT type. Onboard electronics of the EM200 do not include Ethernet magnetics, so magnetic circuitry must be connected externally. You can use either a standalone magnetics part (such as YCL-PH163112) or RJ45 connector with integrated magnetics (for example, YCL-PTC1111-01G). Drawings below show circuit diagrams for both parts.

Please, note the following:

- The 3.3Vout is an output that provides clean power for the magnetics circuitry, which is very sensitive to noise.
- Do not combine 3.3Vout with the VCC (main power) pin. This is counter-productive and will cause FCC/CE certification issues.





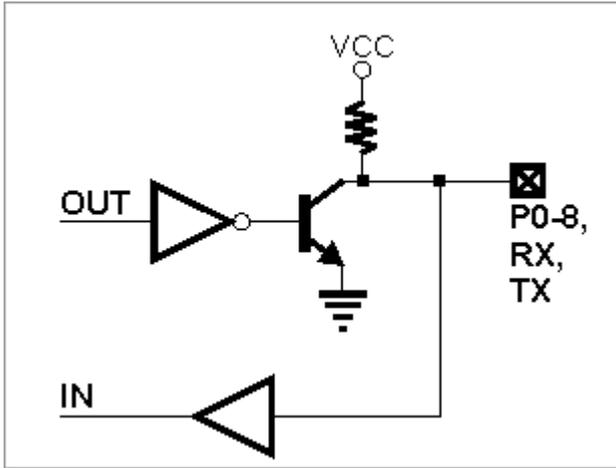
It is important to make the PCB traces connecting the Ethernet port pins of the EM200 to the magnetics circuitry as short as possible. Making the wires too long may cause the noise level generated by your PCB to surpass the maximum radiated emission limits stipulated by the FCC and CE regulations. Additionally, longer Ethernet lines on the PCB will make your board more susceptible to the ESD (electrostatic discharge) damage.

Serial Port and General-purpose I/O Lines

The EM200 features a serial port (RX, TX lines), plus nine general-purpose I/O lines (GPIO0-8). All of the above lines are of CMOS type. Maximum load current for each I/O line is 10mA.

The serial port of the EM200 can work in one of the three modes: UART, Wiegand, or clock/data. All three modes are described in detail in the documentation for the serial (ser.) object found inside the "TIDE and Tibbo BASIC Manual". Additionally, see the Platform-dependent Programming Information" section inside the EM200 platform documentation (same manual).

Simplified structure of EM200's I/O lines is shown on the circuit diagram below. All lines are "quasi-bidirectional" and can be viewed as open collector outputs with weak pull-up resistor. There is no explicit direction control. To "measure" an external signal applied to a pin the OUT line must first be set to HIGH. It is OK to drive the pin LOW externally when the pin outputs HIGH internally.



I/O line control is described in detail in the documentation for the I/O (io.) object found inside the "TIDE and Tibbo BASIC Manual".

Flash and EEPROM Memory

The EM200 has 128KBytes of flash memory and 2KBytes of EEPROM memory.

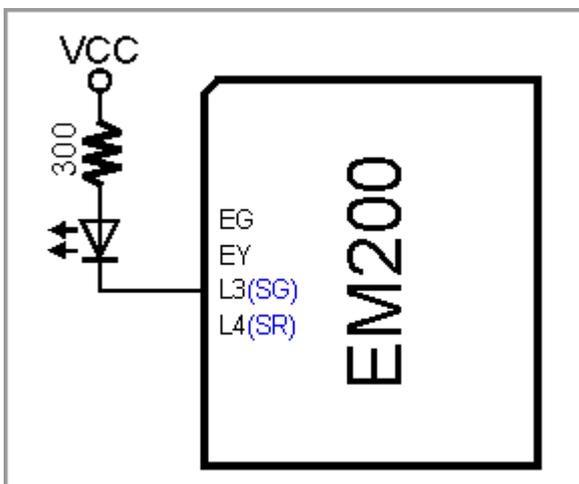
Half of the flash memory (64KB) is used to store the TiOS firmware. When you are performing a firmware upgrade it is this memory you are saving the firmware binary into.

The second half of the flash (64KB) is available to your Tibbo BASIC application.

The EEPROM is almost fully available to your application, save for a small 8-byte area called "special configuration area". The EEPROM is accessed through the storage (stor.) object (see "TIDE and Tibbo BASIC Manual"). Details on the special configuration area are provided in the Platform-dependent Programming Information section inside the EM200 platform documentation (same manual).

LED Lines, 1.4

The EM200 has four LED control lines -- SG, SR, EG, and EY. All lines have the same internal structure and the LEDs should be connected to these lines as shown on the schematic diagram below. Maximum load for each line is 10mA.



Further information on status LEDs can be found in [Appendix 1: Status LEDs](#).

Power, Reset, and Mode Selection Lines

The EM200 should be powered from a stabilized DC power supply with nominal output voltage of 5V (+/- 5% tolerance). Current consumption of the EM200 is approximately 220mA (in 100BaseT mode). Providing an adequate power supply is very important -- poorly built circuit may affect EM200 operation. We recommend that you use a switching power supply circuit. One (but not the only) example of such circuit is shown below.

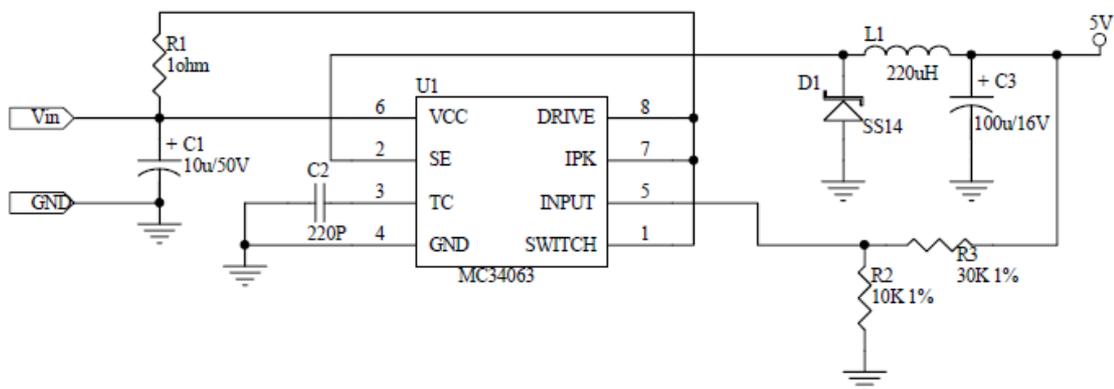
Proper external reset is a must! Reset pulse should be an active HIGH. We strongly advise against using low-cost RC-networks and other unreliable methods of generating reset pulse. Reset should be applied for as long as the power supply voltage is below 4.6V. We recommend using a dedicated reset IC with brownout detection, such as MAX810. Reset pulse length should be no less than 50ms, counting from the moment the power supply voltage exceeds 4.6V.

If the EM200 is used to serve as a communications co-processor in a larger system that has its own CPU it is also OK to control the RST line of the EM200 through a general-purpose I/O pin of the "host" microcontroller. I/O pins of many microcontrollers default to HIGH after the powerup and this means that proper reset will be applied to the EM200 when the host device is switched on. All the host microcontroller has to do is release the EM200 from reset at an appropriate time by switching the state of the I/O line to LOW.

The function of the MD line is described in [Appendix 2: Setup Button \(MD line\)](#).

Power supply circuit

Many power supply circuits will work well. The one below is being used by Tibbo. The circuit can handle input voltages in the 9-30V range.

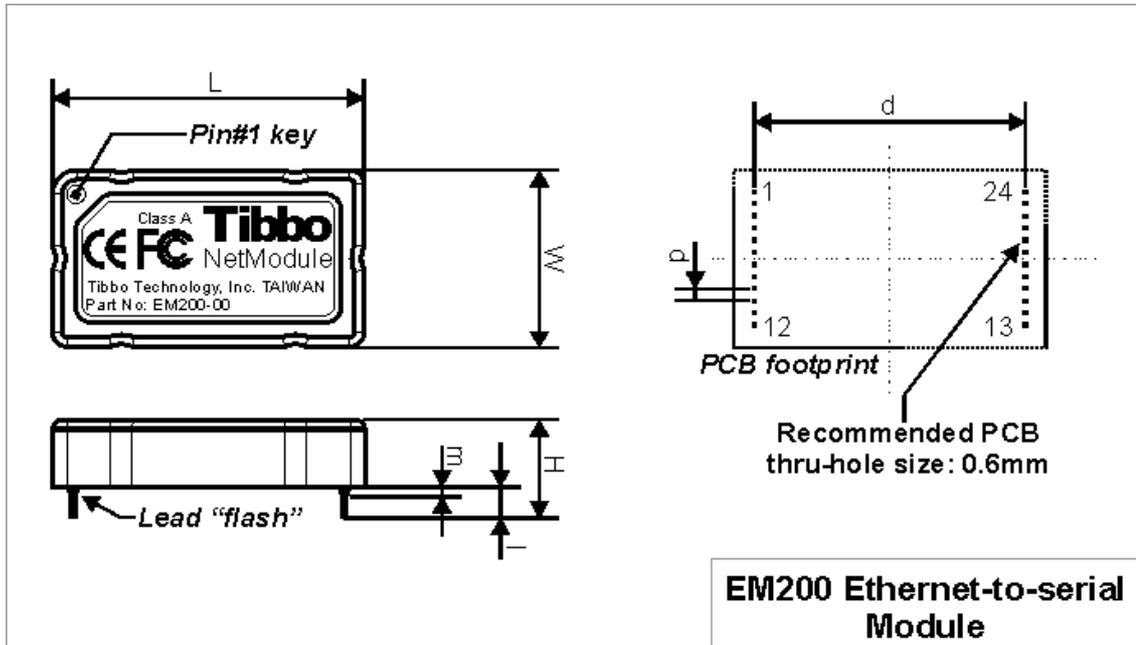


Notes:

- U1 (MC35063) is a very popular power IC manufactured by ON Semiconductor.
- R1 is very important. It is just 1 (one!) Ohm, but we really do not recommend the user to omit it.
- R2 and R3 are "1% tolerance" (high-precision) because they define the output voltage of the power supply.
- C1 and C3 capacitors: Do not use SMD capacitors -- use regular through-hole aluminum capacitors. This really helps reduce noise produced by the power supply.
- This is an analog circuit, so layout matters. Apply reasonable "good layout" effort.

Ideally, one should use an oscilloscope to see what sort of "square wave" the power supply generates, both at low and high input voltages, as well as light and heavy loads. R1 can be adjusted to achieve a better (cleaner) square wave signal on a particular PCB layout. There are no recipes here -- just try and see what works for your circuit.

Mechanical Dimensions



EM200 Ethernet-to-serial Module

L	Max.	32.1	Module length
W	Max.	18.5	Module width
H	Max.	7.3	Module height
I	Min.	2.2	Lead length
m	Max.	0.5	Lead "flash"
d	Aver.	28.0	Distance between lead rows
p	Aver.	1.27	Pin pitch

Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

Ordering Info and Specifications

The EM200 has two sub-models in circulation- the EM200-00 and EM200-01. The EM200-01 is a RoHS-compliant version of the EM200-00. There are no other differences between these two versions. Currently, only the EM200-01 is being manufactured.

Specifications

Ethernet interface	100/10BaseT Ethernet, magnetics not built-in
Serial ports	1 port; UART, Wiegand⁽¹⁾ , and clock/data⁽¹⁾ modes
UART capabilities	Baudrates up to 115'200bps; none/even/odd/mark/

	space parity and 7/8 bits/char.; full-duplex UART mode with optional flow control ⁽¹⁾ and half-duplex UART mode with automatic direction control ⁽¹⁾ ; RX, TX, RTS ⁽¹⁾ , CTS ⁽¹⁾ , DTR ⁽¹⁾ , and DSR ⁽¹⁾ lines provided.
Number of I/O lines	9 (TX and RX lines of the serial port are not included into this count)
Max. load current for each I/O line	10mA
Flash memory	128KBytes, 64KB available for your Tibbo BASIC application
EEPROM memory	2048 bytes, 2040 bytes available to store application data
Supported network protocols ⁽¹⁾	UDP ⁽¹⁾ , TCP ⁽¹⁾ , ICMP (ping) ⁽¹⁾ , and HTTP ⁽¹⁾ . Other protocols (such as DHCP) are implemented as Tibbo BASIC functions.
Number of simultaneous UDP or TCP (HTTP) connections ⁽¹⁾	16 ⁽¹⁾
Nominal power supply voltage (VCC pin)	DC 5V, +/- 5%
Max. operating current	220mA
Device temperature during operation ⁽²⁾	55 degrees C
Operating temperature	-10 to +70 degrees C
Operating relative humidity	10-90%
Mechanical dimensions (excl. leads)	32.1x18.5x7.3mm
Pin diameter	0.4mm
Packaging	EM200-01: tube, 10 modules/tube EM200-B-01: tray, 30 modules/tray

Notes:

1. Actually a feature of TiOS firmware.
2. Measured at 22 degrees C ambient temperature, in the non-enclosed environment.

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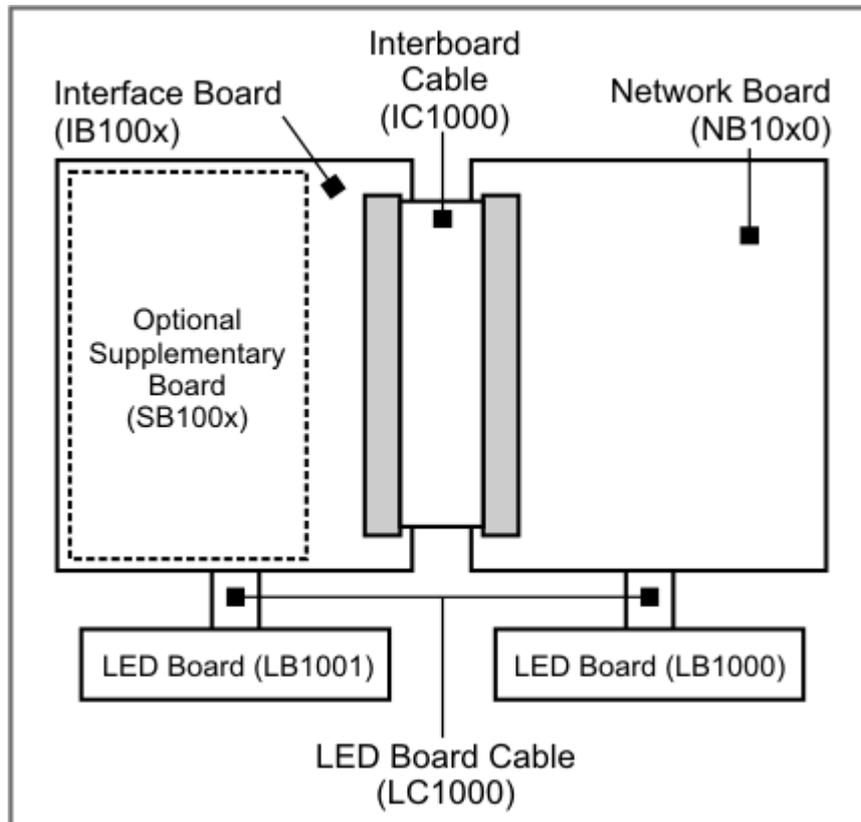
Boards

The following boards and board families are currently being offered by Tibbo:

- [NB10x0 and IB100x Boards](#)
- [DS1206N](#)
- [EM1202EV](#)
- [EM1206EV](#)
- [EM120/EM200-EV](#)

NB10x0 and IB100x Boards

The NB10x0 and IB100x boards offered by Tibbo allow you to quickly create a BASIC-programmable communication, control, or data acquisition system from a set of standard components. A pair of boards -- one [network board](#) ("NB"), and one [interface board](#) ("IB") -- form a complete system, as shown on the drawing below. Both boards have the same outline [dimensions](#).



The [network board](#) acts as a "connected brain" of your system. It also carries a 3.3V switching power regulator. This 3.3V power is provided to the interface board as well.

The [Interface board](#) implements all necessary I/O functionality. You can choose a standard board manufactured by Tibbo or create your own interface board containing just the right mix of I/O circuitry required for your project.

The network board and the interface board are joined together by an IC1000 [interboard cable](#). The wiring of this cable is standard and allows you to connect any "NB" board to any "IB" board. One IC1000 cable is provided with each "NB" board (but not with "IB" boards).

Where the required I/O components cannot fit on the interface board alone, a supplementary board ("SB") is used. The supplementary board sits on top of the interface board and can be almost as large as the latter (see [here](#) for mechanical spec). Connections (connectors) between the interface board and the supplementary board are not standardized and are implemented as needed for a particular "IB" + "SB" combination. There is no direct connection between the supplementary board and the network board.

To indicate various system states, there are [LB100x](#) LED boards. Each LB100x board accommodates up to 11 LEDs. A typical system uses two standard LED boards --

the [LB1000](#) on the "NB" side, and the [LB1001](#) on the "IB" side. LED boards connect to "NB" and "LB" boards by a flat [LC1000](#) cable. Network and interface boards have mounting holes for optionally attaching LB100x boards to them. A custom-made "brass offset" part BP1000 is used for the purpose. LED boards can also be mounted independently. Ordering any "NB" or "IB" board also gets you an LED board and LC1000 cable, which will come attached to said "NB" or "LB" board.

Tibbo NB10x0 and IB100x boards can be used "as is" or with a stylish, industrial-grade housing -- the [DS10xx series industrial controllers](#) are based on these boards as well. The [NB1000](#) and [IB1000](#) boards are also used in the [EM1000-EV](#) evaluation kit.

NB10x0 Network Boards

At the moment, two models of the network board are being offered:

- [NB1000](#) -- Ethernet interface only
- [NB1010](#) -- Ethernet interface plus optional Wi-Fi and GPRS interfaces

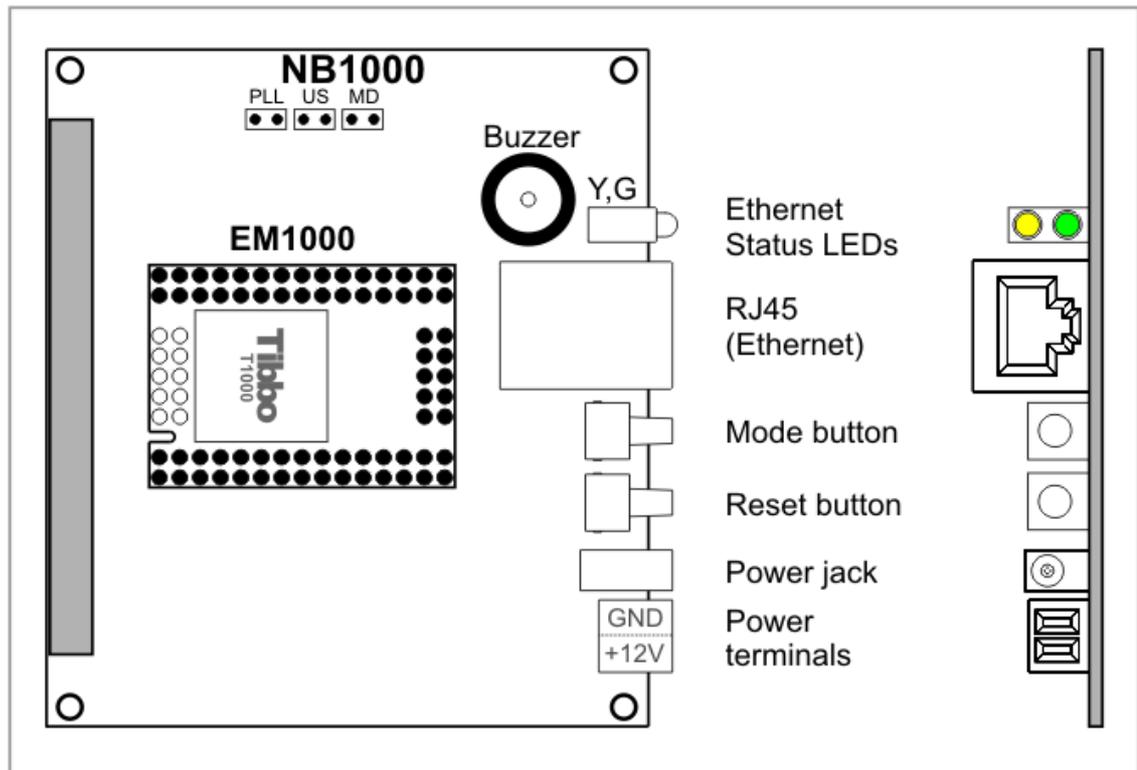
NB1000 Board



The NB1000 board is based on the [EM1000](#) embedded module. The board features Ethernet network interface. If you require Wi-Fi or GPRS interfaces, use the [NB1010](#) board instead.

The NB1000 product includes the [LB1000](#) LED board as well. The NB1000 and the LB1000 come assembled together and interconnected by the [LC1000](#) cable. Additionally, the NB1000 comes with the [IC1000](#) interboard cable. Therefore, you don't need to order the LB1000, LC1000, or IC1000 separately when purchasing the NB1000 board.

NB1000 Connectors and Controls



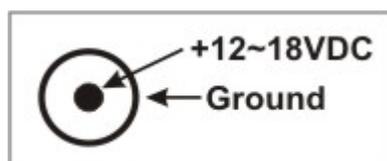
Refer to the following topics to learn more about the NB1000:

- [Power Jack, Terminals, and Power Regulator](#)
- [Ethernet Jack](#)
- [Jumpers, Buttons, and LEDs](#)
- [External LED Control](#)
- [Buzzer](#)

Power Jack, Terminals and Power Regulator

Power jack of the NB1000 accepts "small" power connectors with 3.5mm diameter. Use 12VDC/1A [APR-P0008](#) (APR-P0009, or APR-P0010) power adaptor supplied by Tibbo or similar adaptor. On the power jack, the ground is "on the outside", as shown on the figure below.

Another way to connect power is through the power terminals located next to the power jack. Ground and "+" terminal positions are shown on the NB1000 [drawing](#). Acceptable supply power range is 10-18VDC (12VDC nominal).



The NB1000 carries an onboard 3.3V switching power regulator that provides stabilized power to the NB1000 itself and to an [IB100x](#) interface board, connected to the NB1000 via the [IC1000](#) interboard cable.

Note, that the IC1000 interboard cable also has lines that carry "raw" input power (Vin lines). The IB100x board you are using may have its own power supply.

Ethernet Jack

RJ45 Ethernet jack has the standard pin assignment:



#1	TX+
#2	TX-
#3	RX+
#4	<No connection>
#5	<No connection>
#6	RX-
#7	<No connection>
#8	<No connection>

Jumpers, Buttons and LEDs

PLL jumper

Leave this jumper open if you want the [EM1000](#) onboard the NB1000 to run at full speed (88.4736MHz). Close the jumper if you want the EM1000 to run at 1/8th the full speed (11.0592MHz). Notice, that the jumper state is only recognized after the power-up or external reset (caused by pressing the reset button). The PLL mode can also be changed programmatically. For more information see [Power, Reset, PLL Control, and Mode Selection Lines](#) topic of the EM1000 documentation.

MD jumper and mode button

The function of the mode button is described in [Appendix 2: Setup Button \(MD line\)](#). On the NB1000 board, MD jumper is connected in parallel with the button.

US jumper

This jumper selects the serial port of the [EM1000](#) that will be used for firmware upgrades. When the jumper is opened, serial port 1 is used (TX0 (#17) and RX0 (#19) lines on the [IC1000](#) interboard cable). [Interface boards](#) typically implement serial port 1, thus making serial firmware upgrades possible.

When the US jumper is closed, debug serial port is used.

Reset button

This button is connected to the RST pin of the [EM1000](#). Pressing this button causes an "external" reset.

Ethernet Status LEDs

These are yellow and green LEDs connected to the **EY** and **EG** pins of the [EM1000](#). Further information on status LEDs can be found in [Appendix 1: Status LEDs](#).

External LED Control

The NB1000 is intended to be used with the [LB1000](#) board. This board provides:

- Green and red LED pair.
- Green and yellow LED pair.
- LED bar comprising five yellow LEDs.

Green and red LED pair -- system status indication

These LEDs are controlled by the **SG** and **SR** pins of the [EM1000](#). Further information on status LEDs can be found in [Appendix 1: Status LEDs](#).

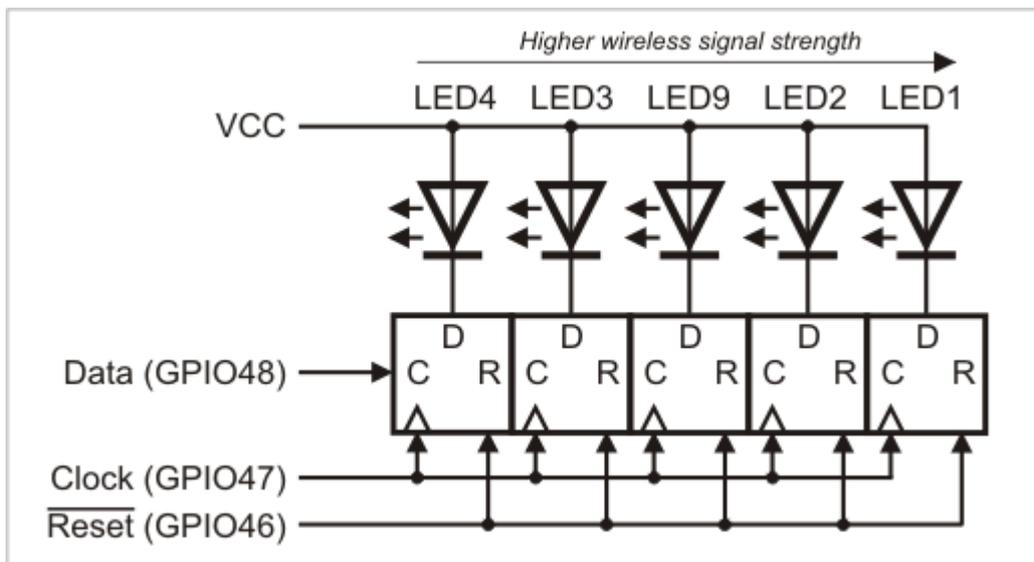
Green and yellow LED pair -- Ethernet status indication

These LEDs are connected to the same EG and EY lines of the [EM1000](#) that control green and yellow LEDs on the NB1000 board itself.

LED bar -- wireless signal strength indication

These LEDs are controlled through three GPIO lines of the [EM1000](#)- GPIO46, GPIO47, and GPIO48.

GPIO46 is the reset line of the LED bar. Clearing this line sets all five outputs to LOW and this turns all LEDs ON. GPIO47 is a clock line- a positive (LOW-to-HIGH) transition on this line "shifts in" the data on the GPIO48 line. The circuit that controls the LEDs is shown below. LED numbers correspond to numbers shown on the [LB100x drawing](#).



If you want to switch an LED ON then set the data line LOW. The data bit for the LED#1 (indicating the highest signal strength) is clocked in first. That's the short explanation. In further detail, we can say:

- GPIO 48 is the Data line; set it to the state that you wish the LED to be in, LOW

= ON, HIGH = OFF.

- When you then pull GPIO 47 (Clock line) from its normal state (HIGH) to LOW and then back to HIGH, the state of the Data line is read in and used for LED1.
- If you want to turn on LED2 (for example) you have to set GPIO 48 to LOW, toggle the clock once (HIGH-LOW-HIGH) which would set LED1 ON, set GPIO48 to HIGH (because you want LED1 off) and then just toggle the clock again (HIGH-LOW-HIGH). At this point, the state of LED1 would shift to LED2 (so LED2 would light up).

So assuming that all LEDs are OFF and each row means that we have toggled through one clock cycle:

Clock cycle	Data	LED1	LED2	LED3	LED4	LED5
1	LOW	ON	OFF	OFF	OFF	OFF
2	LOW	ON	ON	OFF	OFF	OFF
3	HIGH	OFF	ON	ON	OFF	OFF
4	LOW	ON	OFF	ON	ON	OFF
5	HIGH	OFF	ON	OFF	ON	ON

As you can see, each clock cycle sets a new state for LED1 which directly corresponds to the state of the Data line, and shifts all previous LED states.

Buzzer

The buzzer of the NB1000 is connected to the GPIO45/CO line of the onboard [EM1000](#).

Your application can control the buzzer through the "beeper" (beep.) object (see "TIDE and Tibbo BASIC Manual"). Recommended value for the beep.divider property is 21600.

Ordering Info and Specifications

Model number	Description
NB1000	The NB1000 board with the EM1000-1024K-S module, IB1000 interboard connector, and LB1000 LED board mounted on the NB1000 and connected to the latter with the LC1000 cable.

If you wish to have Wi-Fi or GPRS ports on the NB board, please order the [NB1010](#) product.

Hardware specifications

Ethernet interface	10/100BaseT Ethernet, Auto-MDIX
Supply voltage range	10-18VDC
Operating temperature	-30 to +80 degrees C
Operating relative humidity	10-90%

Board dimensions	76x85mm
Other details	See EM1000-1024K-S specification

All specifications are subject to change without notice and are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

NB1010 Board



Front (left) and back of the NB1010 board

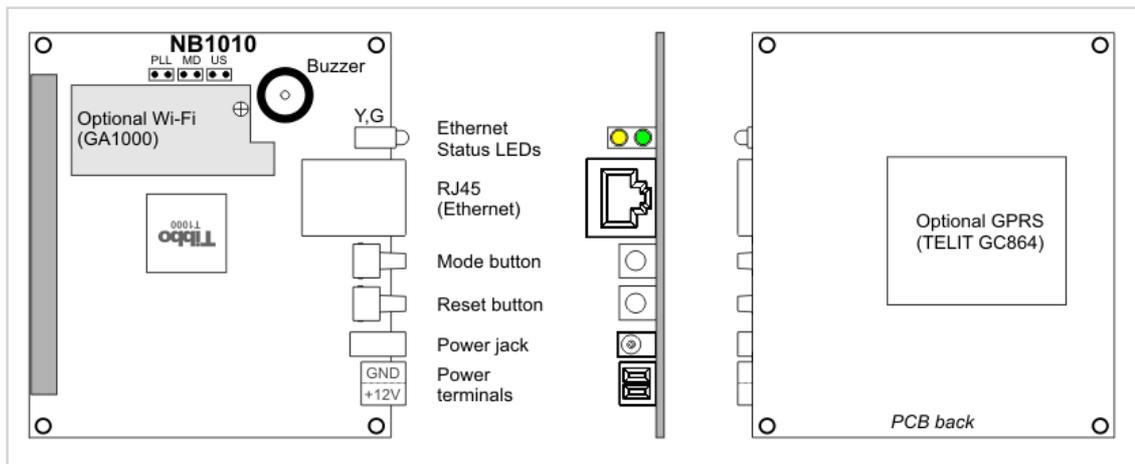
The NB1010 board is functionally equivalent to the [EM1000](#) embedded module. The board features Ethernet, as well as optional Wi-Fi and GPRS network interfaces. If

you only need the Ethernet interface, then you may use the [NB1000](#) board.

The NB1010 product includes the [LB1000](#) LED board as well. The NB1010 and the LB1000 come assembled together and interconnected by the [LC1000](#) cable. Additionally, the NB1010 comes with the [IC1000](#) interboard cable. Therefore, you don't need to order the LB1000, LC1000, or IC1000 separately when purchasing the NB1010 board.

! Read carefully the [explanation](#) about external antennas that should be used when the NB1010 is ordered with Wi-Fi and/or GPRS options.

NB1010 Connectors and Controls



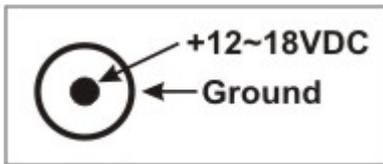
Refer to the following topics to learn more about the NB1000:

- [Power Jack, Terminals, and Power Regulator](#)
- [Ethernet Jack](#)
- [Jumpers, Buttons, and LEDs](#)
- [External LED Control](#)
- [Buzzer](#)
- [Optional Wi-Fi Interface](#)
- [Optional GPRS Interface](#)

Power Jack, Terminals and Power Regulator

Power jack of the NB1010 accepts "small" power connectors with 3.5mm diameter. Use 12VDC/1A [APR-P0008](#) (APR-P0009, or APR-P0010) power adaptor supplied by Tibbo or similar adaptor. On the power jack, the ground is "on the outside", as shown on the figure below.

Another way to connect power is through the power terminals located next to the power jack. Ground and "+" terminal positions are shown on the NB1010 [drawing](#). Acceptable supply power range is 10-18VDC (12VDC nominal).

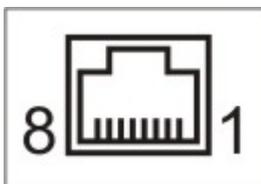


The NB1010 carries an onboard regulator that provides stabilized 3.3V power to the NB1010 itself and to an [IB100x](#) interface board, connected to the NB1010 via the [IC1000](#) interboard cable.

Note, that the IC1000 interboard cable also has lines that carry "raw" input power (Vin lines). The IB100x board you are using may have its own power supply.

Ethernet Jack

RJ45 Ethernet jack has the standard pin assignment:



#1	TX+
#2	TX-
#3	RX+
#4	<No connection>
#5	<No connection>
#6	RX-
#7	<No connection>
#8	<No connection>

Jumpers, Buttons and LEDs

PLL jumper

Leave this jumper open if you want the NB1010 to run at full speed (88.4736MHz). Close the jumper if you want the NB1010 to run at 1/8th the full speed (11.0592MHz). Notice, that the jumper state is only recognized after the power-up or external reset (caused by pressing the reset button). The PLL mode can also be changed programmatically.

MD jumper and mode button

The function of the mode button is described in [Appendix 2: Setup Button \(MD line\)](#). On the NB1010 board, MD jumper is connected in parallel with the button.

US jumper

This jumper selects the serial port of the NB1010 that will be used for serial firmware upgrades. When the jumper is opened, serial port 1 is used (TX0 (#17) and RX0 (#19) lines on the [IC1000](#) interboard cable). [Interface boards](#) typically implement serial port 1, thus making serial firmware upgrades possible.

When the US jumper is closed, debug serial port is used.

Reset button

Pressing this button causes an "external" reset.

Ethernet Status LEDs

Further information on Ethernet status LEDs can be found in [Appendix 1: Status LEDs](#).

External LED Control

The NB1010 is intended to be used with the [LB1000](#) board. This board provides:

- Green and red LED pair.
- Green and yellow LED pair.
- LED bar comprising five yellow LEDs.

Green and red LED pair -- system status indication

Further information on status LEDs can be found in [Appendix 1: Status LEDs](#).

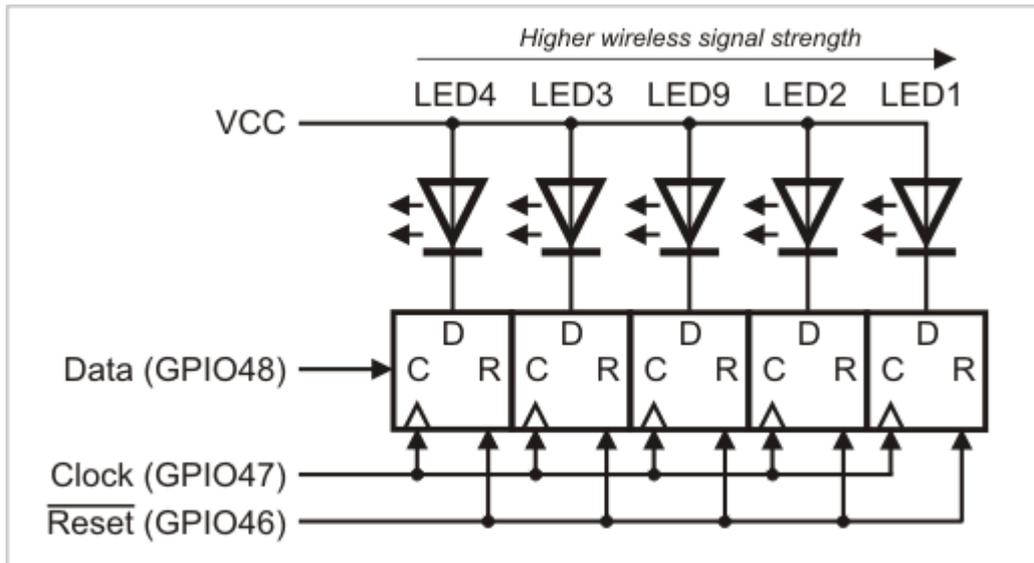
Green and yellow LED pair -- Ethernet status indication

Further information on Ethernet status LEDs can be found in [Appendix 1: Status LEDs](#).

LED bar -- wireless signal strength indication

Five yellow LEDs of the LED bar are intended primarily for the indication of the RF signal strength (i.e. when the [Wi-Fi](#) and/or [GPRS](#) options are installed). These LEDs are controlled through three GPIO lines 46, 47, and 48.

GPIO46 is the reset line of the LED bar. Clearing this line sets all five outputs to LOW and this turns all LEDs ON. GPIO47 is a clock line- a positive (LOW-to-HIGH) transition on this line "shifts in" the data on the GPIO48 line. The circuit that controls the LEDs is shown below. LED numbers correspond to numbers shown on the [LB100x drawing](#).



If you want to switch an LED ON then set the data line LOW. The data bit for the LED#1 (indicating the highest signal strength) is clocked in first. That's the short explanation. In further detail, we can say:

- GPIO 48 is the Data line; set it to the state that you wish the LED to be in, LOW = ON, HIGH = OFF.
- When you then pull GPIO 47 (Clock line) from its normal state (HIGH) to LOW and then back to HIGH, the state of the Data line is read in and used for LED1.
- If you want to turn on LED2 (for example) you have to set GPIO 48 to LOW, toggle the clock once (HIGH-LOW-HIGH) which would set LED1 ON, set GPIO48 to HIGH (because you want LED1 off) and then just toggle the clock again (HIGH-LOW-HIGH). At this point, the state of LED1 would shift to LED2 (so LED2 would light up).

So assuming that all LEDs are OFF and each row means that we have toggled through one clock cycle:

Clock cycle	Data	LED1	LED2	LED3	LED4	LED5
1	LOW	ON	OFF	OFF	OFF	OFF
2	LOW	ON	ON	OFF	OFF	OFF
3	HIGH	OFF	ON	ON	OFF	OFF
4	LOW	ON	OFF	ON	ON	OFF
5	HIGH	OFF	ON	OFF	ON	ON

As you can see, each clock cycle sets a new state for LED1 which directly corresponds to the state of the Data line, and shifts all previous LED states.

Buzzer

The buzzer of the NB1010 is connected to the GPIO45/CO line.

Your application can control the buzzer through the "beeper" (beep.) object (see "TIDE and Tibbo BASIC Manual"). Recommended value for the beep.divider property is 21600.

Optional Wi-Fi Interface

The NB1010 can optionally accommodate the [GA1000](#) Wi-Fi add-on module.

The following GPIO lines are used to control the GA1000:

GPIO line	Function	GA1000 pin
49	CS	3
50	DO ⁽¹⁾	5
51	RST	7
52	DI ⁽²⁾	9
53	CLK	10

Notes:

1. "Data out" line of the NB1010, connects to the "data in" on the GA1000.
2. "Data in" line of the NB1010, connects to the "data out" on the GA1000.

Wi-Fi data communications is the responsibility of the sock. object (see see "TIDE and Tibbo BASIC Manual"). Before such data communications can take place, the Wi-Fi interface must be properly configured. This is jointly achieved by the wln. object and WLN library (again, see "TIDE and Tibbo BASIC Manual").

Optinal GPRS Interface

The NB1010 can optionally accommodate the GC864 GPRS module manufactured by TELIT (www.telit.com).

The GPRS module is controlled through the serial port 4 of the NB1010. A dedicated GPIO line 54 is used for multiplexing this serial port:

- When the output buffer of the GPIO line 54 is disabled (default post-reset state), or the line is at HIGH, the serial port 4 is switched to the [interboard cable](#) connector (lines TX3 (#31), RX3 (#29), RTS3 (#7), and CTS3 (#39)).
- When the output buffer of the GPIO line 54 is enabled and the line is LOW, the serial port is switched to the GPRS module. In this state, your application can communicate with the GPRS module through the serial port 4 (and use flow control, too).

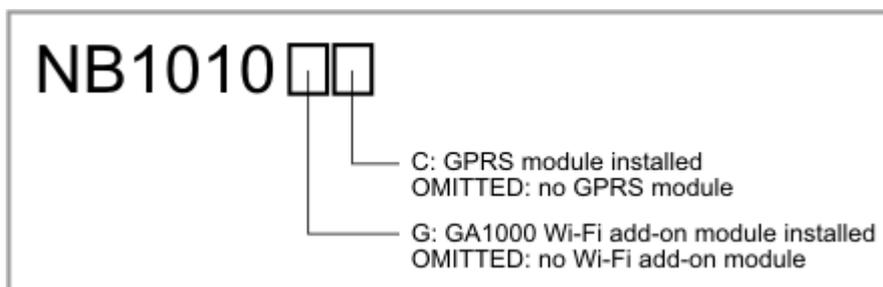
GPIO line 55 of the NB1010 is connected to the reset pin on the GPRS module. To put the module in reset, enable this line and set it HIGH. For reliable reset, keep the reset applied for at least 2 seconds. To release the module from reset, set the line

55 LOW. Note that the GC864 module may take up to 1 minute to boot, recognize the SIM card, and become operational.

GPIO line manipulation is performed using the `io.` object (see "TIDE and Tibbo BASIC Manual"). Another object `-- ser. --` is responsible for serial port communications. Actual data exchange via the GPRS module is the domain of the `sock.` object. Before such data exchange can take place, the GPRS interface must be properly configured. This is jointly achieved by the `ppp.` object and GPRS library (again, see "TIDE and Tibbo BASIC Manual").

Ordering Info and Specifications

Device numbering scheme is as follows:



All NB1010 boards are equipped with 1024KBytes of flash memory.

NB1010 devices without "G", "C", or "GC" options are not being offered by Tibbo. If you want to purchase Ethernet-only board (without any wireless options), then order [NB1000](#) instead.

Examples of valid model numbers

Model number	Description
NB1010GC	The board with Wi-Fi and GPRS interfaces
NB1010C	The board with GPRS interface

External Antenna

The Wi-Fi interface works better when equipped with an antenna. In the absence of Wi-Fi antenna, the Wi-Fi interface still works (relying on a small "chip" antenna on the [GA1000](#)), but the operating range is reduced. The GPRS interface can't work without the antenna at all. Therefore, consider purchasing necessary external antennas as required by your application.

Hardware specifications

Ethernet interface	10/100BaseT Ethernet, Auto-MDIX
--------------------	---------------------------------

Wi-Fi interface	Optional, uses GA1000 add-on module
GPRS interface	Optional, uses TELIT GC864 GPRS module (www.telit.com)
Serial ports	4 ports, CMOS-level.
UART capabilities	Baudrates up to 921'600bps; none/even/odd/mark/space parity and 7/8 bits/character.
Max. load current for each I/O line	10mA
Square wave generator	6Hz - 22'1184MHz, connected to buzzer
Real-time counter (RTC)	40 bit, increments at 128Hz
RTC backup power source	Supercapacitor, supports RTC for app. 6 days
Clock frequency	11.0592MHz with PLL off 88.4736MHz with PLL on
Flash memory	1024KBytes, entire memory minus 64KB is available to store Tibbo BASIC application and data
EEPROM memory	2048 bytes, 2040 bytes available to store application data
Power supply voltage	10-18VDC
Operating temperature	-30 to +80 degrees C
Operating relative humidity	10-90%
Board dimensions	76x85mm
Pin diameter	0.64mm

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IB100x Interface Boards

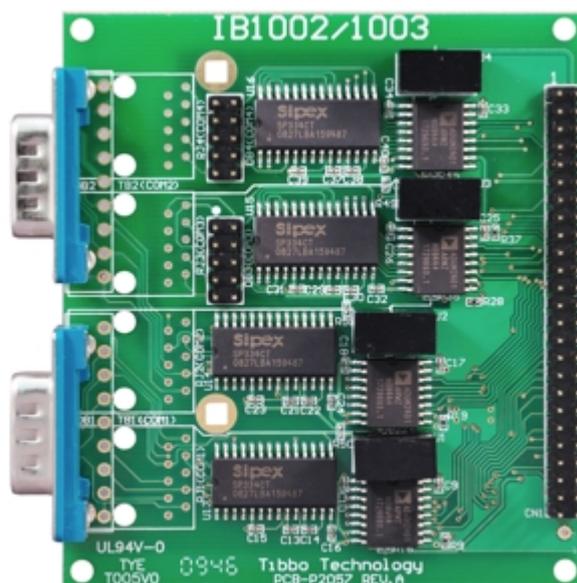
The following IB100x series interface boards are currently available:

- [IB1000](#) (4 RS232 ports)
- [IB1002](#) (4 RS232/422/485 ports)
- [IB1003](#) (4 isolated RS232/422/485 ports)
- [IB1004 + SB1004](#) (8 A/D inputs, 4 D/A outputs, 2 low-power relays, 1 RS232/485 port)
- [IB1005 + SB1005](#) (8 opto-isolated digital inputs, 6 high-power relays, 1 RS232/485 port)

IB1000, IB1002, and IB1003 (4 Serial Ports)

The IB1000, IB1002, and IB1003 interface boards provide 4 RS232 ports:

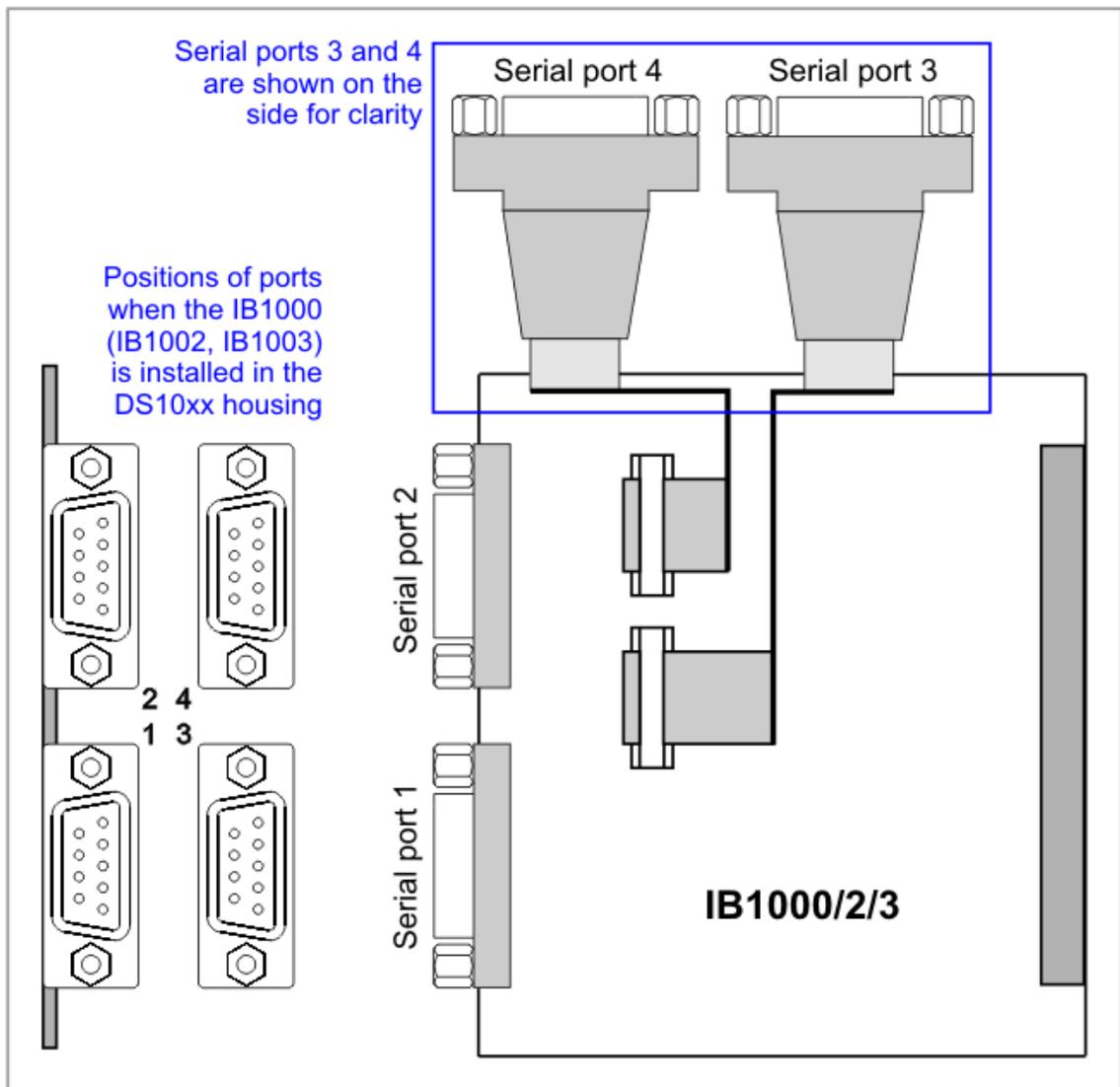
- The IB1000 has 4 non-isolated RS232 ports.
- The IB1002 has 4 non-isolated universal ports that can work in RS232, RS422, and RS485 modes.
- The IB1003 (shown below) has 4 electrically isolated universal ports that can work in RS232, RS422, and RS485 modes.



These boards can optionally be used with the [TB1000](#) terminal block adaptor.

Connectors and Headers

IB1000/2/3 boards carry two DB9-M connectors onboard. Two additional connectors attach (via cables) to two 2x5 pin headers located on the boards.



DB-9M connectors

Pin #	RS232 mode	RS422 mode (IB1002/3 only)	RS485 mode (IB1002/3 only)
1	---	RTS- (output)	---
2	RX (input)	RX- (input)	RX- (input)
3	TX (output)	TX+ (output)	TX+ (output)
4	DTR (output)	TX- (output)	TX- (output)
5	SYSTEM GROUND	SYSTEM GROUND	SYSTEM GROUND
6	DSR (input)	RX+ (input)	RX+ (input)
7	RTS (output)	RTS+ (output)	---
8	CTS (input)	CTS+ (input)	---
9	---	CTS- (input)	---

Pin headers

Pin #	RS232 mode	RS422 mode (IB1002/3 only)	RS485 mode (IB1002/3 only)
1	---	RTS- (output)	---
2	RX (input)	RX- (input)	RX- (input)
3	TX (output)	TX+ (output)	TX+ (output)
4	DTR (output)	TX- (output)	TX- (output)
5	SYSTEM GROUND	SYSTEM GROUND	SYSTEM GROUND
6	DSR (input)	RX+ (input)	RX+ (input)
7	RTS (output)	RTS+ (output)	---
8	CTS (input)	CTS+ (input)	---
9	---	CTS- (input)	---
10	---	---	---

Serial Ports

The serial ports of the IB1000/2/3 are controlled by the [EM1000](#) module (located on the [NB10x0](#) network board).

Tibbo BASIC application running on the EM1000 works with serial ports through a "serial" (ser.) object (see "TIDE and Tibbo BASIC Manual"). The object takes care of the data transmission through the TX line as well as data reception through the RX line. When the flow control of a serial port is enabled (ser.flowcontrol= 1- ENABLED), the serial object also handles RTS and CTS lines of this port automatically.

With flow control disabled, the CTS and RTS lines can be controlled by the application as general-purpose I/O lines (GPIO). The DTR and DSR lines of ports are always treated as GPIO, the serial object does not "touch" them. Actually, even TX and RX lines of each port can be controlled as GPIO lines, but this is only possible when the corresponding serial port is "closed" (ser.enabled= 0- NO). I/O line control is effected through another object called the "I/O" (io.) object.

The IB1002 and IB1003 boards have universal RS232/422/485 ports. Two interface selection lines -- HD/FD and RS_MODE -- are provided for each port and connected to GPIO lines of the EM1000:

- The HD/FD line selects half-duplex (LOW) or full-duplex (HIGH) mode for the serial port.
- The RS_MODE line selects "physical" signal mode: RS232 (LOW) or RS422/485 (HIGH).

To select RS232, RS422, or RS485 mode for a serial port, setup the HD/FC and RS_MODE lines as shown in the table below. Ser.interface property of the serial object must also be set correctly:

Mode	HD/FD	RS_MODE	ser.interface
RS232	HIGH	LOW	0- PL_SER_SI_FULLDUPLEX
RS422	HIGH	HIGH	0- PL_SER_SI_FULLDUPLEX
RS485	LOW	HIGH	1- PL_SER_SI_HALFDUPLEX

The RS485 mode is half-duplex, which means that only the transmission or reception

can occur at any given time. In this mode, the RTS line is used for direction control, which is handled by the EM1000 automatically. The RTS line should be LOW for data input, and HIGH for data output. This is achieved by setting the `ser.dircontrol= 0-PL_SER_DCP_LOWFORINPUT`.

Do not forget that all lines of the EM1000 are configured as inputs by default. Any line that should work as an output must be configured as such. This is done through the `io.enabled` property of the i/o object. The only exceptions are the TX and RX lines. The TX line automatically becomes an output, and the RX line automatically becomes an output once the serial port is enabled (`ser.enabled= 1- YES`).

The HD/FD and RS_MODE lines have pull-up and pull-down resistors respectively. On startup the HD/FD line defaults to HIGH (full-duplex mode), and the RS_MODE line defaults to LOW (RS232 mode).

Serial port 1

Line	Corresponding EM1000 I/O	IC1000 cable line
RX (input)	GPIO8/RX0	17
TX (output)	GPIO9/TX0	19
CTS (input)	GPIO16/CTS0	33
RTS (output)	GPIO0/RTS0	1
DSR (input)	GPIO20/DSR0	41
DTR (output)	GPIO4/DTR0	9
HD/FD*	GPIO32	30
RS_MODE*	GPIO33	28

**IB1002 and IB1003 boards only*

Serial port 2

Line	Corresponding EM1000 I/O	IC1000 cable line
RX (input)	GPIO10/RX1	21
TX (output)	GPIO11/TX1	23
CTS (input)	GPIO17/CTS1	35
RTS (output)	GPIO1/RTS1	3
DSR (input)	GPIO21/DSR1	43
DTR (output)	GPIO5/DTR1	11
HD/FD*	GPIO34	26
RS_MODE*	GPIO35	24

**IB1002 and IB1003 boards only*

Serial port 3

Line	Corresponding EM1000 I/O	IC1000 cable line
RX (input)	GPIO12/RX2	25
TX (output)	GPIO13/TX2	27
CTS (input)	GPIO18/CTS2	37
RTS (output)	GPIO2/RTS2	5
DSR (input)	GPIO22/DSR2	45
DTR (output)	GPIO6/DTR2	13

HD/FD*	GPIO36	22
RS_MODE*	GPIO37	20

**IB1002 and IB1003 boards only*

Serial port 4

Line	Corresponding EM1000 I/O	IC1000 cable line
RX (input)	GPIO14/RX3	29
TX (output)	GPIO15/TX3	31
CTS (input)	GPIO19/CTS3	39
RTS (output)	GPIO3/RTS3	7
DSR (input)	GPIO23/DSR3	47
DTR (output)	GPIO7/DTR3	15
HD/FD*	GPIO38	18
RS_MODE*	GPIO39	16

**IB1002 and IB1003 boards only*

LED Control

The IB1000 works with the standard [LB1001](#) LED board and controls the LEDs through 8 general-purpose I/O (GPIO) lines of the [EM1000](#) module (installed on the [NB10x0](#) network board). To turn the LED on, set the corresponding line LOW. Do not forget to configure LED control lines as outputs. This is done through the `io.enabled` property of the `.io` object (see "TIDE and Tibbo BASIC Manual").

LED #, color (LB1001)	Corresponding EM1000 I/O	IC1000 cable line
#8, red	GPIO24	46
#7, green	GPIO25	44
#6, red	GPIO26	42
#5, green	GPIO27	40
#4, red	GPIO28	38
#3, green	GPIO29	36
#2, red	GPIO30	34
#1, green	GPIO31	32

Ordering Info and Specifications

Model number	Description
IB1000	The IB1000 board and LB1001 LED board mounted on the IB1000 and connected to the latter with the LC1000 cable. The TB1000 terminal block adaptor is not included with this product.
IB1002	The IB1002 board and LB1001 LED board mounted on the IB1002 and connected to the latter with the LC1000 cable. Also included is the TB1000 terminal

	block adaptor.
IB1003	The IB1002 board and LB1001 LED board mounted on the IB1002 and connected to the latter with the LC1000 cable. Also included is the TB1000 terminal block adaptor.

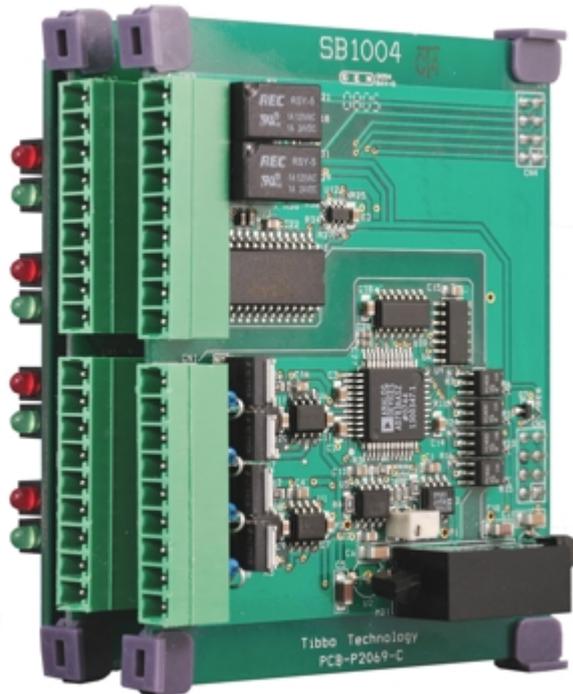
Hardware specifications

Serial port lines	RS232 mode: RX, TX, CTS, RTS, DSR, DTR RS422 mode (IB1002/3): RX+/-, TX+/-, CTS+/-, RTS+/- RS485 mode (IB1002/3): RX+/-, TX+/-
Baudrate	Up to 460800bps
Operating temperature	-30 to +80 degrees C
Operating relative humidity	10-90%
Board dimensions	76x85mm

All specifications are subject to change without notice and are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

IB1004 and SB1004 (Analog I/O)

Featuring 8 analog inputs and 4 analog outputs, the IB1004 + SB1004 board combination is ideally suited for industrial (building) control and data acquisition applications. Additional relays and the RS232/485 serial port further expand product capabilities. To improve reliability and conversion precision, the A/D and D/A portions each have their own power/ground domains that are fully isolated from the rest of the circuitry.



The IB1004 is the main board in the pair, and is connected to an [NB10x0](#) network board by the [IB1000](#) interboard cable. The SB1004 is a supplementary board, it exists because a single IB1004 would not be able to accommodate all required circuitry and terminal blocks. In the board pair, the IB1004 carries the A/D converter, while the SB1004 contains the D/A converter, RS232/485 port, and 2 low-power relays.

The IB1004 and SB1004 are not meant to be used separately and should always be [ordered together](#).

The IB1004 product includes the [LB1001](#) LED board. The IB1004 and the LB1001 come assembled together and interconnected by the [LC1000](#) cable. Therefore, you don't need to order the LB1001 and LC1000 separately when purchasing the IB1004 board.

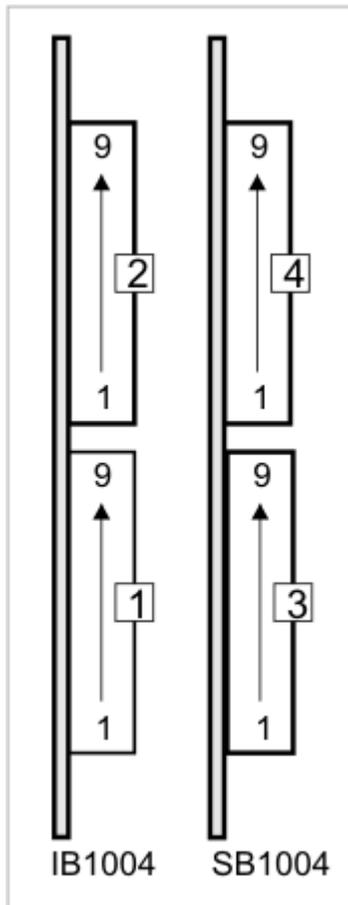
All I/O lines of the IB1004 + SB1004 are grouped into four [terminal blocks](#) (two per board), with 9 terminals in each block. The boards are [controlled](#) by the [EM1000](#) module located on the NB10x0 board. More information on specific IB1004 + SB1004 functionality is found in the [Detailed Information](#) section.

To simplify testing and evaluation of the product use the [TB1004](#) test board.

Terminal blocks

The IB1004 and the SB1004 have four terminal blocks in total, two on each board. There are nine terminals in each terminal block.

- All [A/D inputs](#) are grouped into terminal blocks 1 and 2.
- All [D/A outputs](#) are on terminal block 3.
- [Relay outputs](#) and the [serial port](#) are on terminal block 4.



Terminal block 1

Terminal #	Function
9	A/D channel 4, negative input (-)
8	A/D channel 4, positive input (+)
7	A/D channel 3, negative input (-)
6	A/D channel 3, positive input (+)
5	A/D channel 2, negative input (-)
4	A/D channel 2, positive input (+)
3	A/D channel 1, negative input (-)
2	A/D channel 1, positive input (+)
1	A/D GROUND (isolated from the rest of the device)

Terminal block 2

Terminal #	Function
9	A/D channel 8, negative input (-)
8	A/D channel 8, positive input (+)
7	A/D channel 7, negative input (-)
6	A/D channel 7, positive input (+)

5	A/D channel 6, negative input (-)
4	A/D channel 6, positive input (+)
3	A/D channel 5, negative input (-)
2	A/D channel 5, positive input (+)
1	A/D GROUND (isolated from the rest of the device)

Terminal block 3

Terminal #	Function
9	D/A channel 4, current output
8	D/A channel 4, voltage output
7	D/A channel 3, current output
6	D/A channel 3, voltage output
5	D/A channel 2, current output
4	D/A channel 2, voltage output
3	D/A channel 1, current output
2	D/A channel 1, voltage output
1	D/A GROUND (isolated from the rest of the device)

Terminal block 4

Terminal #	Function
9	Relay 2, normally opened line
8	Relay 2, normally closed line
7	Relay 2, common line
6	Relay 1, normally opened line
5	Relay 1, normally closed line
4	Relay 1, common line
3	Serial port: TX (RS232); TX/RX+ (RS485)
2	Serial port: RX (RS232); TX/RX- (RS485)
1	SYSTEM (COMMON) GROUND

Control Lines

The following lines of the [EM1000](#) module (located on the [NB10x0](#) network board) are used to control the IB1004 + SB1004.

In the tables below, "output" means an output of the EM1000, and "input" means an input of the EM1000.

A/D converter control

For more information see [A/D Converter](#).

Line	Function	Corresponding EM1000 I/O	IC1000 cable line
DI (input)	Serial data in	GPIO12	25

DO (output)	Serial data out	GPIO13	27
CLOCK (output)	Serial clock (LOW idle state)	GPIO2	5
C/D (output)	Register selection: HIGH - data register LOW - control register	GPIO40	6
RFS (output)	Receive frame sync (Active LOW)	GPIO32	30
TFS (output)	Transmit frame sync (active LOW)	GPIO33	28
CHS0 (output)	Channel selection, bit 0	GPIO41	8
CHS1 (output)	Channel selection, bit 1	GPIO42	10
CHS2 (output)	Channel selection, bit 2	GPIO43	12

D/A converter control

For more information see [D/A Converter](#).

Line	Function	Corresponding EM1000 I/O	IC1000 cable line
DATA (output)	Serial data out	GPIO11	23
CLOCK (output)	Serial clock (LOW idle state)	GPIO1	3
WR (output)	Data latch strobe (active LOW)	GPIO34	26
EN (output)	Output enable: HIGH (or input*) - disabled LOW - enabled	GPIO35	24

*GPIO line configured as input (default state)

Relay control

For more information see [Relays](#).

Line	Function	Corresponding EM1000 I/O	IC1000 cable line
RELAY1 (output)	Relay 1 control: HIGH (or input*) - relay off LOW - relay on	GPIO36	22
RELAY2 (output)	Relay 2 control: HIGH (or input*) - relay off LOW - relay on	GPIO37	20

*GPIO line configured as input (default state)

RS232/485 port control

For more information see [RS232/485 Port](#).

Line	Function	Corresponding EM1000 I/O	IC1000 cable line
RX (input)	Receive line of the serial port	GPIO8/RX0	17
TX (output)	Transmit line of the serial port	GPIO9/TX0	19
MODE (output)	Mode selection: HIGH - RS485 LOW (or input*) - RS232	GPIO44	14
DIR (output)	Direction control in RS485 mode: HIGH - output LOW - input	GPIO0/RTS0	1

*GPIO line configured as input (default state)

LED control

For all LED control lines:

HIGH (or input*) - LED off

LOW - LED on

For more information see [LED Control](#).

LED #, color (LB1001)	Corresponding EM1000 I/O	IC1000 cable line
#8, red	GPIO24	46
#7, green	GPIO25	44
#6, red	GPIO26	42
#5, green	GPIO27	40
#4, red	GPIO28	38
#3, green	GPIO29	36
#2, red	GPIO30	34
#1, green	GPIO31	32

*GPIO line configured as input (default state)

Detailed Information

The IB1004 + SB1004 include the following blocks:

- [A/D converter](#) (8 channels, 24 bits, based on the 24-bit AD7712 converter).
- [D/A converter](#) (4 channels, 14 bits, with separate voltage and current outputs, based on the 14-bit AD7836 converter).
- [Two low-current mechanical relays](#) (both normally-opened and normally-closed terminals are provided).
- [RS232/485 port](#) (RX/TX signals for the RS232, TX/RX+ and TX/RX- for the RS485).
- [Control lines for 8 LEDs](#) on the LB1001 board.

A/D Converter

The A/D converter is based on the Analog Devices' 24-bit [AD7712](#) chip and has 8 independent channels.

Each channel has two differential input lines. Maximum input range is +/-10V. The range can be adjusted to 1/2, 1/4, ... 1/128 of that by programming the internal gain of the A/D circuit to 2, 4, ...128. With the gain of 1 and with bipolar mode selected, applying +10V to the A/D input produces the conversion result of "all 1's". Applying -10V produces "all 0's". Applying 0V produces "1" followed by 0's (this is a "middle" value). Of course, this explanation is idealized as it doesn't take into account inevitable conversion errors.

The A/D converter is designed for relatively slow, but highly accurate measurements. With recommended configuration (see below), the converter will produce 250 measurements/second for any selected channel. Only one channel can be selected at any given time.

The A/D converter has full galvanic isolation from the rest of the IB1004 + SB1004 circuitry: the power for the A/D section is generated by an isolated switching power supply, all control lines use opto-couplers.

A/D inputs

The A/D converter inputs are available on terminal blocks 1 and 2.

Terminal block 1:

Terminal #	Function
9	A/D channel 4, negative input (-)
8	A/D channel 4, positive input (+)
7	A/D channel 3, negative input (-)
6	A/D channel 3, positive input (+)
5	A/D channel 2, negative input (-)
4	A/D channel 2, positive input (+)
3	A/D channel 1, negative input (-)
2	A/D channel 1, positive input (+)
1	A/D GROUND (isolated from the rest of the device)

Terminal block 2:

Terminal #	Function
9	A/D channel 8, negative input (-)
8	A/D channel 8, positive input (+)
7	A/D channel 7, negative input (-)
6	A/D channel 7, positive input (+)
5	A/D channel 6, negative input (-)
4	A/D channel 6, positive input (+)
3	A/D channel 5, negative input (-)
2	A/D channel 5, positive input (+)
1	A/D GROUND (isolated from the rest of the device)

A/D control lines

Nine lines of the [EM1000](#) (located on the [NB10x0](#) network board) control the A/D converter. In the table below, "output" means an output of the EM1000, and "input" means an input of the EM1000:

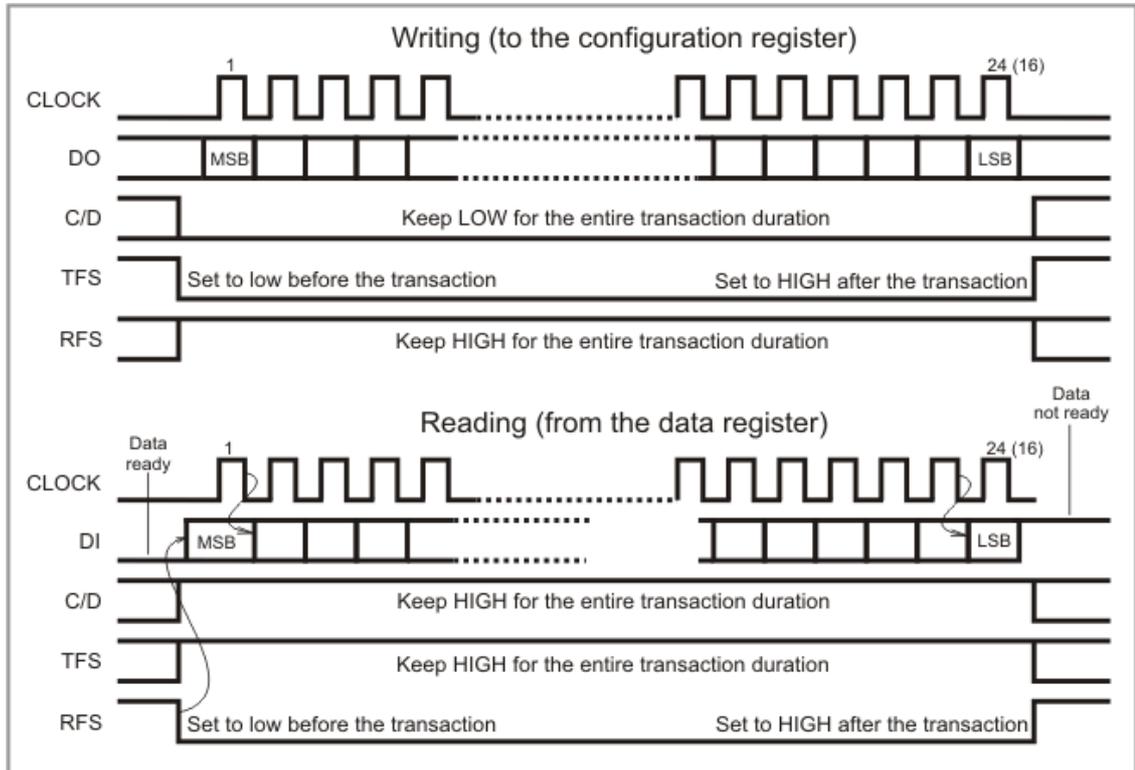
Line	Function	Corresponding EM1000 I/O	IC1000 cable line
DO (output)	Serial data out	GPIO13	27
DI (input)	Serial data in	GPIO12	25
CLOCK (output)	Serial clock (LOW idle state)	GPIO2	5
C/D (output)	Register selection: HIGH - data register LOW - control register	GPIO40	6
RFS (output)	Receive frame sync (Active LOW)	GPIO32	30
TFS (output)	Transmit frame sync (active LOW)	GPIO33	28
CHS0 (output)	Channel selection, bit 0	GPIO41	8
CHS1 (output)	Channel selection, bit 1	GPIO42	10
CHS2 (output)	Channel selection, bit 2	GPIO43	12

The A/D converter has a 24-bit configuration register, and a 24-bit data register that contains the A/D conversion result. These registers are accessed through the serial interface consisting of 5 I/O lines:

- Two lines -- RFS and TFS -- are used for selecting the transaction type. Inactive state for these signals is HIGH. The RFS line must be set LOW prior to the read transaction and remain LOW for the entire transaction duration. The TFS line must be set LOW prior to the write transaction and remain LOW for the entire transaction duration.
- The CLOCK line is used both for writing to and reading from the converter. The inactive state for this line is LOW. Each read and write "transaction" consists of 24 clock pulses, after which the clock returns to the LOW state. Alternatively, the IC can be programmed for 16-bit resolution, in which case each transaction will consist of 16 pulses.
- The DO line is for sending the data to the converter (writing to the configuration register). Each data bit must be placed on the DO line while the CLOCK is LOW. This means that the first, most significant bit, of data must be placed on the DO line before the first clock pulse of the transaction. Switching the CLOCK from LOW to HIGH will latch the bit into the converter.
- The DI line serves double purpose. Before the RFS line is brought LOW, the DI input indicates whether new measurement data is ready. The DI line is HIGH while the converter is not ready, and goes LOW when the new data becomes available. After the RFS line is brought LOW, the DI is used to receive the data from the converter (read the data register). The most significant bit of the readout is present on the DI line right after the RFS becomes LOW. The converter will output next data bit on every HIGH to LOW transition on the CLOCK line. We recommend that your application records the data while the CLOCK line is HIGH.

- The C/D line defines whether the data is exchanged with the configuration register (C/D is LOW), or data register that contains the conversion result (C/D is HIGH). The C/D line must remain stable (HIGH or LOW) for the entire duration of the transaction.

Read and write "transactions" are illustrated on the diagram below.



The A/D converter has 8 inputs and three control lines -- CHS2, CHS1, and CHS0 -- are used to select the channel. Only one channel can be selected at any given time.

Preparing to communicate with the A/D converter

Before you start exchanging data with the A/D converter you need to configure certain GPIO lines of the [EM1000](#) as outputs. These lines are CLOCK, DO, C/D, TFS, RFS, CHS0, CHS1, and CHS2. In other words, all lines except DI must be configured as outputs.

Writing to the configuration register

Follow these steps to write to the configuration register:

- Set the C/D line LOW to indicate that the configuration register access will take place.
- Set the TFS line LOW to indicate that this will be a write operation (RFS must remain HIGH).
- Place the value of the most significant bit of the configuration word on the DO line.
- Set the CLOCK line HIGH.
- Set the CLOCK line LOW. This will conclude the first clock pulse.

- Generate 23 additional clock pulses, every time setting the next bit on the DO line while the CLOCK is at LOW.
- Set the TFS line HIGH. The write is complete.

A/D converter initialization

If you refer to the data sheet for the AD7712 you will find that there are many configuration options. Without resorting to reprinting the data sheet, we provide the following brief info:

bit2 3	bit2 2	bit2 1	bit2 0	bit1 9	bit1 8	bit1 7	bit1 6	bit1 5	bit1 4	bit1 3	bit1 2
MD 2	MD 1	MD 0	G2	G1	G0	CH	PD	WL	X	BO	BU

bit1 1	bit1 0	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
FS1 1	FS1 0	FS9	FS8	FS7	FS6	FS5	FS4	FS3	FS2	FS1	FS0

- The MD2-0 field is set to 000 for normal operation or 001 for self-calibration. There are also other configuration modes available, but they are not supported by the IB1004.
- The G2-0 field defines the gain of the A/D. The signal measured by the A/D is pre-amplified according to this gain. Writing 000 will select the gain of 1, 001- the gain of 2,... 111- the gain if 128.
- The CH field selects the channel and has to be set to 1 for the IB1004 to work properly. This channel selection should not be confused with the IB1004 input channel selector described above.
- The PD power down bit should be at 0.
- The WL word length bit should be at 0 for 16-bit resolution (sufficient for most applications), or at 1 for 24-bit resolution.
- The BO burnout current bit should be at 0.
- The B/U bit should be at 0 to select bipolar operation.
- The FS11-0 filter selection bits that should be set according to the requirements of your application. We often use the value of 4E Hex. Read page 10 of the IC's datasheet and you will find out that this corresponds with the data rate of 250Hz (times/second) and the effective resolution of 15 bits. We choose this as a good compromise between the speed and resolution. We choose the resolution of 15 bits because the D/A portion of the product has the resolution of 14 bits.

To initialize the A/D converter, write the desired configuration word on startup. For the 15-bit effective resolution described above write the hex value of 22004E. This will set up the converter and kick-off a self-calibration process (see below).

Optional self-calibration

The A/D converter will operate at a better precision if you calibrate it first. Set bits MD2-0 of the configuration register to 001 to start self-calibration. Self-calibration, as the name implies, is an automatic process that does not require any external intervention. The calibration takes time. To determine when the calibration is over, poll the DI line after writing to the configuration register:

- Once the TFS line goes HIGH marking the end of the write transaction, the DI line starts indicating the status of the converter.
- The DI line will be HIGH while the converter is still busy.
- The DI line will become LOW when the calibration is finished.

There is no need to set MD2-0= 000 after the calibration -- this happens automatically. So, in effect, your entire A/D converter setup may consist of writing 22004E Hex (or other suitable configuration word) and waiting for the DI to become LOW.

Changing channels

Follow these steps to change the channel:

- If the desired channel is not selected yet, select it by manipulating control lines CHS2-0. Code 000 selects the channel 1, 001- channel 2, ... 111- channel 8.
- After the channel change, discard the results of the first conversion. This is because the channel change may result in the wrong measurement. The second measurement will contain correct data. Alternatively, your program can wait the time equal to two A/D measurement periods. Conversion period is related to the filter setting. For the filter set at 250Hz, the conversion period is $1/250\text{Hz}=4\text{ms}$. So, the application needs to wait for 8ms before correct data for the newly selected channel becomes available.

Receiving A/D conversion result

The data register of the A/D converter is updated at the conversion rate (for our recommended setting, $1/250\text{Hz}=4\text{ms}$). So, the new measurement result is available every 4ms. You are always reading the most recent conversion result.

The readout can only start when the A/D converter is ready. Starting the read transaction when the converter is not ready will produce invalid data (you will read "all zeroes" or "all ones"). Follow this algorithm to perform the read:

- While the RFS line is at HIGH, read the state of the DI line. If the line is HIGH, then the A/D converter is not ready and you need to wait.
- Keep polling the DI line until it becomes LOW. This will indicate that the read transaction can be started.
- Set C/D line HIGH to indicate that the data register access will take place.
- Set the RFS line LOW to indicate that this will be a read operation (TFS must remain HIGH).
- Set the CLOCK line HIGH and record the state of the DI line -- this is the value of the most significant bit.
- Set the CLOCK LOW -- this concludes the first clock cycle.
- Perform 23 or 15 more clock cycles (depending on the value you set in the WL bit of the configuration register), every time recording the state of the DI line when the CLOCK is it HIGH.
- Set the RFS line HIGH. The read is complete.

Remember that the "effective resolution" discussed above has nothing to do with the number of bits you are supposed to read from the converter. This number is either 24 or 16, depending on the WL bit of the configuration register.

Clock speed limitations

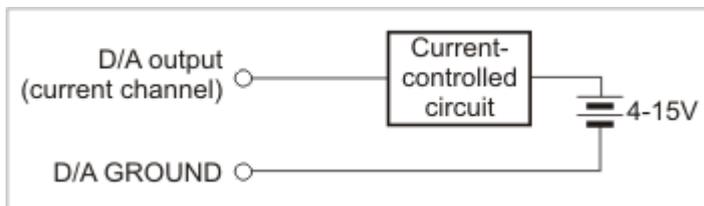
The A/D converter is optically isolated from the rest of the device, so there are opto-couplers on all interface lines. Opto-couplers are relatively slow devices. This imposes a limit on how fast the clock line can be toggled. The minimum clock period is 200us. Both half-periods must be at least 100uS long. This means, that the conversion result can be obtained in $200\mu\text{S} * 24 = 4.8\text{ms}$ or $200\mu\text{S} * 16 = 3.2\text{ms}$.

D/A Converter

The D/A converter is based on the Analog Devices' 14-bit [AD7836](#) chip and has 4 independent output channels with 14-bit resolution. Each of the four channels have independent voltage and current output lines (both can be used at the same time if needed).

Each channel has two outputs: one voltage and one current output. The voltage outputs have +/- 10V range (20mA max load). Writing all 1's (14 of them) into the D/A channel produces the maximum positive level on the voltage output (+10V nominal), writing all 0's produces the maximum negative level on the voltage output (-10V nominal). Writing a "middle" binary value of "10000000000000" (that's 1 followed by 13 zeroes) produces a 0V output. Of course, this explanation is idealized as it doesn't take into account inevitable conversion errors.

The output current range on the current output is 0-20mA. An external 4-15V power source is required for current outputs to work. Writing all 1's into the D/A channel results the maximum output current. Writing a middle value (10000000000000B) results in zero current. Writing any value below that still produces zero current. Hence, the actual resolution of the current output is not 14, but 13 bits.



The D/A converter has full galvanic isolation from the rest of the IB1004 + SB1004 circuitry: the power for the D/A section is generated by an isolated switching power supply, all control lines use opto-couplers.

D/A outputs

All D/A-related lines are available on a 9-pin terminal block #3:

Terminal #	Function
9	D/A channel 4, current output
8	D/A channel 4, voltage output
7	D/A channel 3, current output
6	D/A channel 3, voltage output
5	D/A channel 2, current output
4	D/A channel 2, voltage output
3	D/A channel 1, current output

2	D/A channel 1, voltage output
1	D/A GROUND (isolated from the rest of the device)

D/A control

Four lines of the [EM1000](#) (located on the [NB10x0](#) network board) control the D/A converter. In the table below, "output" means an output of the EM1000, and "input" means an input of the EM1000:

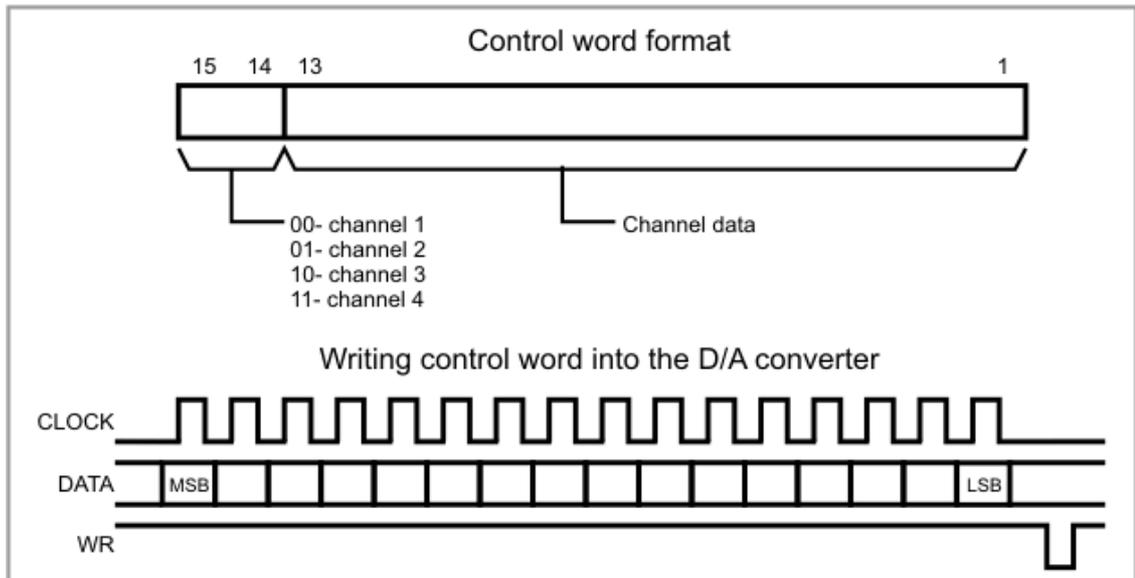
Line	Function	Corresponding EM1000 I/O	IC1000 cable line
DATA (output)	Serial data	GPIO11	23
CLOCK (output)	Serial clock (LOW idle state)	GPIO1	3
WR (output)	Data latch strobe (active LOW)	GPIO34	26
EN (output)	Output enable: HIGH (or input*) - disabled LOW - enabled	GPIO35	24

**GPIO line configured as input (default state)*

The D/A converter control cycle consists of the following steps. First, a 16-bit data word is serially clocked into the D/A circuit. Bits 15 and 14 of the data word select the output channel, remaining 14 bits carry desired output value. The word is sent most significant bit first.

Two lines -- CLOCK and DATA -- are used for sending the data word to the D/A converter. Inactive state for the CLOCK line is LOW. Each write transaction consists of 16 clock pulses. With each LOW-to-HIGH transition on the CLOCK line, the state of the DATA line is latched into the D/A converter. The process is illustrated below.

Once all 16 bits have been clocked in, the negative pulse on the WR line sets new data and the new analog value appears on the outputs of the corresponding D/A channel (provided that the EN lines is at low).



The EN line is used for enabling the analog outputs of the D/A converter. The system powers up with EN line pulled HIGH internally. This disables the D/A converter and produces 0V (0mA) on its outputs. Taking the EN line LOW will enable the D/A. Before that, your application should write the desired value into each D/A channel. Failure to do so will result in the unknown voltage (current) output levels once the EN line is set LOW.

Remember that you need to configured all four control lines of the [EM1000](#) as outputs.

Clock speed limitations

The D/A converter is electrically isolated from the rest of the device, so there are opto-couplers on all interface lines. Opto-couplers are relatively slow devices. This imposes a limit on how fast the clock line can be toggled. The minimum clock period is 200us. Both half-periods must be at least 100uS long. The minimum pulse width on the WR line is also 100uS. This means that the new value can be output to the converter in $200\mu\text{S} \times 16 + 100 = 3.3\text{ms}$.

Relays

The IB1004 + SB1004 has two low-power mechanical relays.

These relays can only handle relatively light loads -- they are rated for 24V/1A. If your load is inductive in nature, then the power the relays can handle may actually be several times lower.

Relay outputs

Relay outputs are on terminal block #4. Both normally closed and normally opened lines are provided for each relay.

Terminal #	Function
9	Relay 2, normally opened line
8	Relay 2, normally closed line
7	Relay 2, common line

6	Relay 1, normally opened line
5	Relay 1, normally closed line
4	Relay 1, common line
3	Serial port: RX (RS232); TX/RX+ (RS485)
2	Serial port: TX (RS232); TX/RX- (RS485)
1	SYSTEM (COMMON) GROUND

Relay control

Two lines of the [EM1000](#) (located on the [NB10x0](#) network board) control the relays. On power up, all EM1000 lines are configured as inputs and pulled up internally, keeping relays off. To turn the relay on, set the corresponding control line LOW. Naturally, you need to configure these GPIO lines as outputs in order to be able to control the relays.

Line	Function	Corresponding EM1000 I/O	IC1000 cable line
RELAY1 (output)	Relay 1 control: HIGH (or input*) - relay off LOW - relay on	GPIO36	22
RELAY2 (output)	Relay 2 control: HIGH (or input*) - relay off LOW - relay on	GPIO37	20

*GPIO line configured as input (default state)

RS232/485 Port

There is a simple serial port that supports both RS232 and RS485 modes. The port operates through two signal terminals. In the RS232 mode, these are RX and TX, in the RS485 mode -- RX/TX+ and RX/TX-. There is no provision for flow control (RTS and CTS lines are not present), or RS422 interface.

The serial port can be used, for instance, to connect to another IB100x board. In the RS232 mode, the serial port can also be used to update the firmware of the [EM1000](#) module located on the [NB10x0](#) board.

Port lines

Serial port lines are on terminal block #4:

Terminal #	Function
9	Relay 2, normally opened line
8	Relay 2, normally closed line
7	Relay 2, common line
6	Relay 1, normally opened line
5	Relay 1, normally closed line
4	Relay 1, common line
3	Serial port: TX (RS232); TX/RX+ (RS485)

2	Serial port: RX (RS232); TX/RX- (RS485)
1	SYSTEM (COMMON) GROUND

Serial port control

Four lines of the [EM1000](#) module (located on the [NB10x0](#) board) control the serial port:

Line	Function	Corresponding EM1000 I/O	IC1000 cable line
RX (input)	Receive line of the serial port	GPIO8/RX0	17
TX (output)	Transmit line of the serial port	GPIO9/TX0	19
MODE (output)	Mode selection: HIGH - RS485 LOW (or input*) - RS232	GPIO44	14
DIR (output)	Direction control in RS485 mode: HIGH - output LOW - input	GPIO0/RTS0	1

**GPIO line configured as input (default state)*

Do not forget to configure the TX, MODE, and DIR lines as outputs. A pull-down resistor on the MODE line ensures that the system boots up with the RS232 port selected.

LED Control

The IB1004 works with a standard [LB1001](#) board and controls the LEDs through 8 general-purpose I/O (GPIO) lines of the [EM1000](#) module (installed on the [NB10x0](#) network board). To turn the LED on, set the corresponding line LOW. Remember to configure all LED control lines as outputs.

For all LED control lines:

HIGH (or input*) - LED off

LOW - LED on

LED #, color (LB1001)	Corresponding EM1000 I/O	IC1000 cable line
#8, red	GPIO24	46
#7, green	GPIO25	44
#6, red	GPIO26	42
#5, green	GPIO27	40
#4, red	GPIO28	38
#3, green	GPIO29	36
#2, red	GPIO30	34
#1, green	GPIO31	32

**GPIO line configured as input (default state)*

Ordering Info and Specifications

Use the following model numbers to order the IB1004 and SB1004 boards. Normally, you will want to order both boards "in parallel":

IB1004	The IB1004 board and LB1001 LED board mounted on the IB1004 and connected to the latter with the LC1000 cable. Also included is the TB1004 test board.
SB1004	The SB1004 supplementary board. Order this board "in parallel" with the IB1004.

Note: the IB1004 and SB1004 plug into each other. No soldering is required to interconnect them.

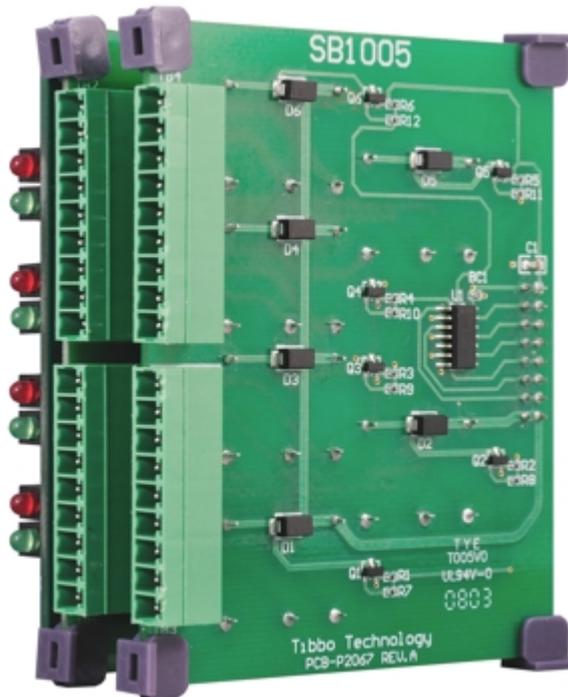
Hardware specifications

A/D channels	8 channels, 24-bit resolution
D/A channels	4 channels, voltage and current output, 14-bit resolution
Relays	2 relays, 24V/1A
Serial port lines	RS232 mode: RX, TX RS485 mode: RX+/-, TX+/-
Baudrate	Up to 460800bps
Operating temperature	-30 to +80 degrees C
Operating relative humidity	10-90%
Dimensions	76x85mm

All specifications are subject to change without notice and are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

IB1005 and SB1005 (Digital I/O)

Featuring 8 opto-isolated inputs and 6 relay outputs, the IB1005 + SB1005 board combination is perfect for automation, security, access control, and monitoring applications. An additional RS232/485 port further expands product capabilities.



The IB1005 is the main board in the pair, and is connected to an [NB10x0](#) network board by the [IB1000](#) interboard cable. The SB1005 is a supplementary board, it exists because a single IB1005 would not be able to accommodate all required circuitry and terminal blocks. In the board pair, the IB1005 carries isolated digital inputs and the RS232/485, while the SB1005 contains all relays.

The IB1005 and SB1005 are not meant to be used separately and should always be [ordered together](#).

The IB1005 product includes the [LB1001](#) LED board. The IB1005 and the LB1001 come assembled together and interconnected by the [LC1000](#) cable. Therefore, you don't need to order the LB1001 and LC1000 separately when purchasing the IB1005 board.

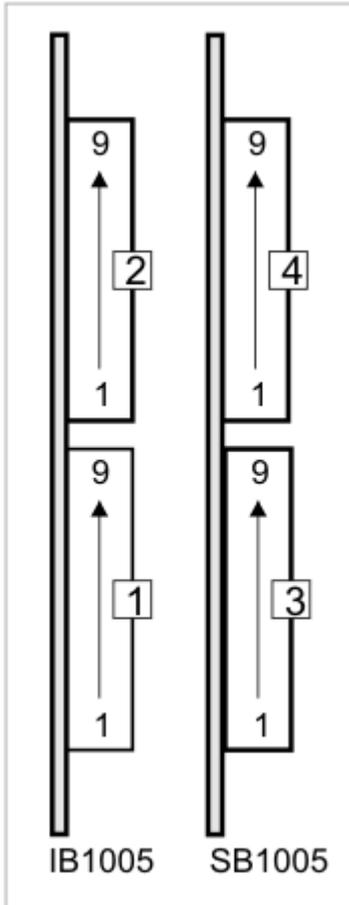
All I/O lines of the IB1005 + SB1005 are grouped into four [terminal blocks](#) (two per board), with 9 terminals in each block. The boards are [controlled](#) by the [EM1000](#) module located on the NB10x0 board. More information on specific IB1005 + SB1005 functionality is found in the [Detailed Information](#) section.

To simplify testing and evaluation of the product use the [TB1005](#) test board.

Terminal Blocks

The IB1005 and the SB1005 have four terminal blocks between them. There are nine terminals in each block.

- The [serial port](#) and [sensor input lines](#) are grouped into terminal blocks 1 and 2.
- All [relay outputs](#) are on terminal blocks 3 and 4.



Terminal block 1

Terminal #	Function
9	Sensors 3 and 4, positive line (+)
8	Sensor 4, negative line (-)
7	Sensor 3, negative line (-)
6	Sensors 1 and 2, positive line (+)
5	Sensor 2, negative line (-)
4	Sensor 1, negative line (-)
3	Serial port: RX (RS232); TX/RX- (RS485)
2	Serial port: TX (RS232); TX/RX+ (RS485)
1	SYSTEM (COMMON) GROUND

Terminal block 2

Terminal #	Function
9	Sensor 8, positive line (+)
8	Sensor 8, negative line (-)
7	Sensor 7, positive line (+)
6	Sensor 7, negative line (-)

5	Sensor 6, positive line (+)
4	Sensor 6, negative line (-)
3	Sensor 5, positive line (+)
2	Sensor 5, negative line (-)
1	Vin (connected to the power input of the NB10x0)

Terminal block 3

Terminal #	Function
9	Relay 3, normally closed line
8	Relay 3, normally opened line
7	Relay 3, common line
6	Relay 2, normally closed line
5	Relay 2, normally opened line
4	Relay 2, common line
3	Relay 1, normally closed line
2	Relay 1, normally opened line
1	Relay 1, common line

Terminal block 4

Terminal #	Function
9	Relay 6, normally closed line
8	Relay 6, normally opened line
7	Relay 6, common line
6	Relay 5, normally closed line
5	Relay 5, normally opened line
4	Relay 5, common line
3	Relay 4, normally closed line
2	Relay 4, normally opened line
1	Relay 4, common line

Control Lines

The following lines of the [EM1000](#) module (located on the [NB10x0](#) network board) are used to communicate with the IB1005 + SB1005.

In the tables below, "output" means an output of the EM1000, and "input" means an input of the EM1000.

Opto-isolated inputs

For more information see [Opto-isolated Inputs](#).

Line	Function	Corresponding EM1000 I/O	IC1000 cable line
I1 (input)	Data line for input 1 W0&1 input for Wiegand reader 1	GPIO17/ W0&1in1/	35

	Clock input for clock/data reader 1	cin1	
I2 (input)	Data line for input 2 W1 input for Wiegand reader 1 Data input for clock/data reader 1	GPIO10/ W1in1/ din1	21
I3 (input)	Data line for input 3 W0&1 input for Wiegand reader 2 Clock input for clock/data reader 2	GPIO18/ W0&1in2/ cin2	37
I4 (input)	Data line for input 4 W1 input for Wiegand reader 2 Data input for clock/data reader 2.	GPIO12/ W1in2/ din2	25
I5 (input)	Data line for input 5	GPIO40	6
I6 (input)	Data line for input 6	GPIO41	8
I7 (input)	Data line for input 7	GPIO42	10
I8 (input)	Data line for input 8	GPIO43	12
C1 (output)	Channels 1 and 2 mode: LOW - separate use or clock/data i/f HIGH - Wiegand i/f	GPIO1	3
C2 (output)	Channels 3 and 4 mode: LOW - separate use or clock/data i/f HIGH - Wiegand i/f	GPIO2	5

Relay control

For all relay control lines:

HIGH (or input*) - relay off

LOW - relay on

For more information see [Relays](#).

Line	Function	Corresponding EM1000 I/O	IC1000 cable line
RELAY1 (output)	Relay 1 control	GPIO32	30
RELAY2 (output)	Relay 2 control	GPIO33	28
RELAY3 (output)	Relay 3 control	GPIO34	26
RELAY4 (output)	Relay 4 control	GPIO35	24
RELAY5 (output)	Relay 5 control	GPIO36	22
RELAY6 (output)	Relay 6 control	GPIO37	20

*GPIO line configured as input (default state)

RS232/485 port control

For more information see [RS232/485 port](#).

Line	Function	Corresponding	IC1000 cable
------	----------	---------------	--------------

		EM1000 I/O	line
RX (input)	Receive line of the serial port	GPIO8/RX0	17
TX (output)	Transmit line of the serial port	GPIO9/TX0	19
MODE (output)	Mode selection: HIGH - RS485 LOW (or input*) - RS232	GPIO44	14
DIR (output)	Direction control in RS485 mode: HIGH - output LOW - input	GPIO0/RTS0	1

*GPIO line configured as input (default state)

LED control

For all LED control lines:

HIGH (or input*) - LED off

LOW - LED on

For more information see [LED Control](#).

LED #, color (LB1001)	Corresponding EM1000 I/O	IC1000 cable line
#8, red	GPIO24	46
#7, green	GPIO25	44
#6, red	GPIO26	42
#5, green	GPIO27	40
#4, red	GPIO28	38
#3, green	GPIO29	36
#2, red	GPIO30	34
#1, green	GPIO31	32

*GPIO line configured as input (default state)

Detailed Information

The IB1005 includes the following blocks:

- [Opto-isolated inputs](#) (8 in total, 4 can be used to connect two Wiegand or clock/data readers).
- [Six high-current mechanical relays](#) (both normally-opened and normally-closed terminals are provided).
- [RS232/485 port](#) (RX/TX signals for the RS232, TX/RX+ and TX/RX- for the RS485).
- [Control lines for 8 LEDs](#) on the LB1001 board (the board must be ordered separately).

Opto-isolated Inputs

The IB1005 features 8 opto-isolated input channels. Channels 1-4 are combined into two pairs. Channels of each pair have separate negative inputs and common positive inputs. These channels can be activated with voltages as low as 2V and accept voltages of up to 15V. Each channel pair can work as two independent sensor inputs or accept the data from an external Wiegand or clock/data card reader.

Channels 4-8 are independent and have separate negative and positive lines. These channels can be activated with voltage levels as low as 5V and accept voltages as high as 50V.

Sensor Inputs

All inputs are on terminal blocks 1 and 2.

For terminal block 1:

Terminal #	Function
9	Sensors 3 and 4, positive line (+)
8	Sensor 4, negative line (-)
7	Sensor 3, negative line (-)
6	Sensors 1 and 2, positive line (+)
5	Sensor 2, negative line (-)
4	Sensor 1, negative line (-)
3	Serial port: RX (RS232); TX/RX- (RS485)
2	Serial port: TX (RS232); TX/RX+ (RS485)
1	SYSTEM (COMMON) GROUND

For terminal block 2:

Terminal #	Function
9	Sensor 8, positive line (+)
8	Sensor 8, negative line (-)
7	Sensor 7, positive line (+)
6	Sensor 7, negative line (-)
5	Sensor 6, positive line (+)
4	Sensor 6, negative line (-)
3	Sensor 5, positive line (+)
2	Sensor 5, negative line (-)
1	Vin (connected to the power input of the NB10x0)

Working with inputs

The state of inputs is available on 8 general-purpose I/O (GPIO) lines of the [EM1000](#) module (located on the [NB10x0](#) network board). The EM1000 can check GPIO line state through the I/O (io.) object -- see "TIDE and Tibbo BASIC Manual" for details.

Line	Function	Correspondin	IC1000
------	----------	--------------	--------

		g EM1000 I/O	cable line
I1 (input)	Data line for input 1 W0&1 input for Wiegand reader 1 Clock input for clock/data reader 1	GPIO17/ W0&1in1/ cin1	35
I2 (input)	Data line for input 2 W1 input for Wiegand reader 1 Data input for clock/data reader 1	GPIO10/ W1in1/ din1	21
I3 (input)	Data line for input 3 W0&1 input for Wiegand reader 2 Clock input for clock/data reader 2	GPIO18/ W0&1in2/ cin2	37
I4 (input)	Data line for input 4 W1 input for Wiegand reader 2 Data input for clock/data reader 2.	GPIO12/ W1in2/ din2	25
I5 (input)	Data line for input 5	GPIO40	6
I6 (input)	Data line for input 6	GPIO41	8
I7 (input)	Data line for input 7	GPIO42	10
I8 (input)	Data line for input 8	GPIO43	12
C1 (output)	Channels 1 and 2 mode: LOW - separate use or clock/data i/ f HIGH - Wiegand i/f	GPIO1	3
C2 (output)	Channels 3 and 4 mode: LOW - separate use or clock/data i/ f HIGH - Wiegand i/f	GPIO2	5

When sufficient voltage is applied to the sensor input, the corresponding GPIO line of the EM1000 is turned LOW, otherwise the line is HIGH.

As was explained above, channels 1, 2, 3, and 4 form two input pairs that can optionally accept data from Wiegand or clock/data readers. These channels are wired into the serial ports 1 and 2 of the EM1000. The serial ports of the module have a unique ability to decode the Wiegand and clock/data streams so processing the reader data is very simple. More info can be found in the documentation for the "serial" (ser.) object ("TIDE and Tibbo BASIC Manual").

As the serial object documentation explains, accepting Wiegand data requires additional logic circuit to be connected to the EM1000. This circuit is located on the IB1005 board. Two control lines -- C1 and C2 (one for each input pair) -- enable Wiegand-compatible operation of the channels. For Wiegand readers, set the control line HIGH. For clock/data readers or independent operation of channels of the signal pair, set the line to LOW.

Note that C1 and C2 lines have to be configured as outputs.

Relays

The IB1005 + SB1005 have 6 mechanical relays. These relays are rated for 30VDC/16A or 250VAC/15A. If your load is inductive in nature, then the actual power the relays can handle may be several times lower.

Relay outputs

Relay outputs are on terminal blocks 3 and 4. Both normally closed and normally opened lines are provided for each relay.

For terminal block 3:

Terminal #	Function
9	Relay 3, normally closed line
8	Relay 3, normally opened line
7	Relay 3, common line
6	Relay 2, normally closed line
5	Relay 2, normally opened line
4	Relay 2, common line
3	Relay 1, normally closed line
2	Relay 1, normally opened line
1	Relay 1, common line

For terminal block 4:

Terminal #	Function
9	Relay 6, normally closed line
8	Relay 6, normally opened line
7	Relay 6, common line
6	Relay 5, normally closed line
5	Relay 5, normally opened line
4	Relay 5, common line
3	Relay 4, normally closed line
2	Relay 4, normally opened line
1	Relay 4, common line

Relay control

Six lines of the [EM1000](#) (located on the [NB10x0](#) network board) control the relays. On power up, all EM1000 lines are configured as inputs and pulled up internally, keeping relays off. To turn the relay on, set the corresponding control line LOW. Naturally, each relay line must be configured as output.

For all relay control lines:

HIGH (our input*) - relay off

LOW - relay on

Line	Function	Corresponding EM1000 I/O	IC1000 cable line
RELAY1 (output)	Relay 1 control	GPIO32	30

RELAY2 (output)	Relay 2 control	GPIO33	28
RELAY3 (output)	Relay 3 control	GPIO34	26
RELAY4 (output)	Relay 4 control	GPIO35	24
RELAY5 (output)	Relay 5 control	GPIO36	22
RELAY6 (output)	Relay 6 control	GPIO37	20

*GPIO line configured as input (default state)

RS232/485 Port

There is a simple serial port that supports both RS232 and RS485 modes. The port operates through two signal terminals. In the RS232 mode, these are RX and TX, in the RS485 mode -- RX/TX+ and RX/TX-. There is no provision for flow control (RTS and CTS lines are not present), or RS422 interface.

The serial port can be used, for instance, to connect to another IB100x board. In the RS232 mode, the serial port can also be used to update the firmware of the [EM1000](#) module located on the [NB10x0](#) board.

Serial port lines

Serial port lines are on terminal block 1:

Terminal #	Function
9	Sensors 3 and 4, positive line (+)
8	Sensor 4, negative line (-)
7	Sensor 3, negative line (-)
6	Sensors 1 and 2, positive line (+)
5	Sensor 2, negative line (-)
4	Sensor 1, negative line (-)
3	Serial port: RX (RS232); TX/RX- (RS485)
2	Serial port: TX (RS232); TX/RX+ (RS485)
1	SYSTEM (COMMON) GROUND

Serial port control

Four lines of the [EM1000](#) module (located on the [NB10x0](#) board) control the serial port.

Line	Function	Corresponding EM1000 I/O	IC1000 cable line
RX (input)	Receive line of the serial port	GPIO8/RX0	17
TX (output)	Transmit line of the serial port	GPIO9/TX0	19
MODE (output)	Mode selection: HIGH - RS485 LOW (or input*) - RS232	GPIO44	14
DIR (output)	Direction control in RS485 mode:	GPIO0/RTS0	1

	HIGH - output LOW - input		
--	------------------------------	--	--

**GPIO line configured as input (default state)*

Do not forget to configure the TX, MODE, and DIR lines as outputs. A pull-down resistor on the MODE line ensures that the system boots up with the RS232 port selected.

LED Control

The IB1005 works with a standard [LB1001](#) board and controls the LEDs through 8 general-purpose I/O (GPIO) lines of the [EM1000](#) module (installed on the [NB10x0](#) network board). To turn the LED on, set the corresponding line LOW. All LED control lines have to be configured as outputs.

For all LED control lines:

HIGH (or input*) - LED off

LOW - LED on

LED #, color (LB1001)	Corresponding EM1000 I/O	IC1000 cable line
#8, red	GPIO24	46
#7, green	GPIO25	44
#6, red	GPIO26	42
#5, green	GPIO27	40
#4, red	GPIO28	38
#3, green	GPIO29	36
#2, red	GPIO30	34
#1, green	GPIO31	32

**GPIO line configured as input (default state)*

Ordering Info and Specifications

Use the following model numbers to order the IB1005 and SB1005 boards. Normally, you will want to order both boards "in parallel":

IB1005	The IB1005 board and LB1001 LED board mounted on the IB1005 and connected to the latter with the LC1000 cable. Also included is the TB1005 test board.
SB1005	The SB1005 supplementary board. Order this board "in parallel" with the IB1005.

Note: the IB1005 and SB1005 plug into each other. No soldering is required to interconnect them.

Hardware specifications

Opto-isolated inputs	8 channels:
----------------------	-------------

	- channels 1-4: 2V-15V input range, can be used to connect card readers - channels 5-8: 5-50V input range
Relays	6 relays, 30VDC/16A or 250VAC/15A
Serial port lines	RS232 mode: RX, TX RS485 mode: RX+/-, TX+/-
Baudrate	Up to 460800bps
Operating temperature	-30 to +80 degrees C
Operating relative humidity	10-90%
Dimensions	76x85mm

All specifications are subject to change without notice and are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

LB100x LED Boards

The following LED boards are currently supplied as standard.

- [LB1000](#) (for [NB10x0](#) network boards).
- [LB1001](#) (for [IB100x](#) interface boards).

LB1000 1.3.1

The LB1000 is a standard LED board supplied with [NB10x0](#) network boards. Table below shows LED arrangement for this board. LED numbers correspond to the numbers shown on the [mechanical drawing](#) for the LB1000. LED control is described in the [External LED Control](#) topic of the NB1000 documentation.

LED #	Color	Series Resistor value (Ohm)	Function
#8	Green	0 ⁽¹⁾	Status LED, connected to the SG line of the EM1000 ⁽³⁾
#7	Red	0 ⁽¹⁾	Status LED, connected to the SR line of the EM1000 ⁽³⁾
#11	---	---	<not installed>
#6	Green	220	Ethernet status LED, connected to the EG line of the EM1000
#5	Yellow	220	Ethernet status LED, connected to the EY line of the EM1000
#10	---	---	<not installed>
#4 ⁽²⁾	Yellow	220	Signal strength bar, #1 (the lowest level).
#3 ⁽²⁾	Yellow	220	Signal strength bar, #2.
#9 ⁽²⁾	Yellow	220	Signal strength bar, #3.

#2 ⁽²⁾	Yellow	220	Signal strength bar, #4.
#1 ⁽²⁾	Yellow	220	Signal strength bar, #5 (the highest strength).

Note 1. This resistor's value is 0 because there is another resistor connected in series with the EM1000's I/O line and located on the NB10x0 board.

Note 2. This LED is controlled through an additional "LED bar" circuit, described in the [External LED Control](#) topic.

Note 3. Further information on status LEDs can be found in [Appendix 1: Status LEDs](#).

LB1001.1.3.2

The LB1001 is a standard LED board supplied with [IB100x](#) interface boards. The LEDs on the board are arranged into 4 groups, each group consisting of one green and one red LED. Although the LB1001 connects to IB100x boards, the actual control of the LEDs is effected from the [EM1000](#) module installed on the [NB10x0](#) board. To turn a certain LED on, set the corresponding general-purpose I/O (GPIO) line LOW. The line has to be configured as output. I/O line control is described in detail in the documentation for the "I/O" (io.) object found inside the "TIDE and Tibbo BASIC Manual". These LED's can also be used to play patterns generated by the ("pattern") .pat object. Correct "mapping" is required for this to work -- see object documentation for details.

Table below shows LED arrangement for this board. LED numbers correspond to the numbers shown on the [mechanical drawing](#) for the LB1001.

LED #	Color	Resistor value (Ohm)	Function
#8	Red	0 ⁽¹⁾	Controlled by the GPIO24 of the EM1000 (pin 46 on the interboard connector header).
#7	Green	0 ⁽¹⁾	Controlled by the GPIO25 of the EM1000 (pin 44 on the interboard connector header).
#11	---	---	<not installed>
#6	Red	0 ⁽¹⁾	Controlled by the GPIO26 of the EM1000 (pin 42 on the interboard connector header).
#5	Green	0 ⁽¹⁾	Controlled by the GPIO27 of the EM1000 (pin 40 on the interboard connector header).
#10	---	---	<not installed>
#4	Red	0 ⁽¹⁾	Controlled by the GPIO28 of the EM1000 (pin 38 on the interboard connector header).
#3	Green	0 ⁽¹⁾	Controlled by the GPIO29 of the EM1000 (pin 36 on the interboard connector header).
#9	---	---	<not installed>
#2	Red	0 ⁽¹⁾	Controlled by the GPIO30 of the EM1000 (pin 34 on the interboard connector header).
#1	Green	0 ⁽¹⁾	Controlled by the GPIO31 of the EM1000 (pin 32 on the interboard connector header).

Note 1. This resistor's value is 0 because there is another resistor connected in series with the EM1000's GPIO line and located on the NB10x0 board.

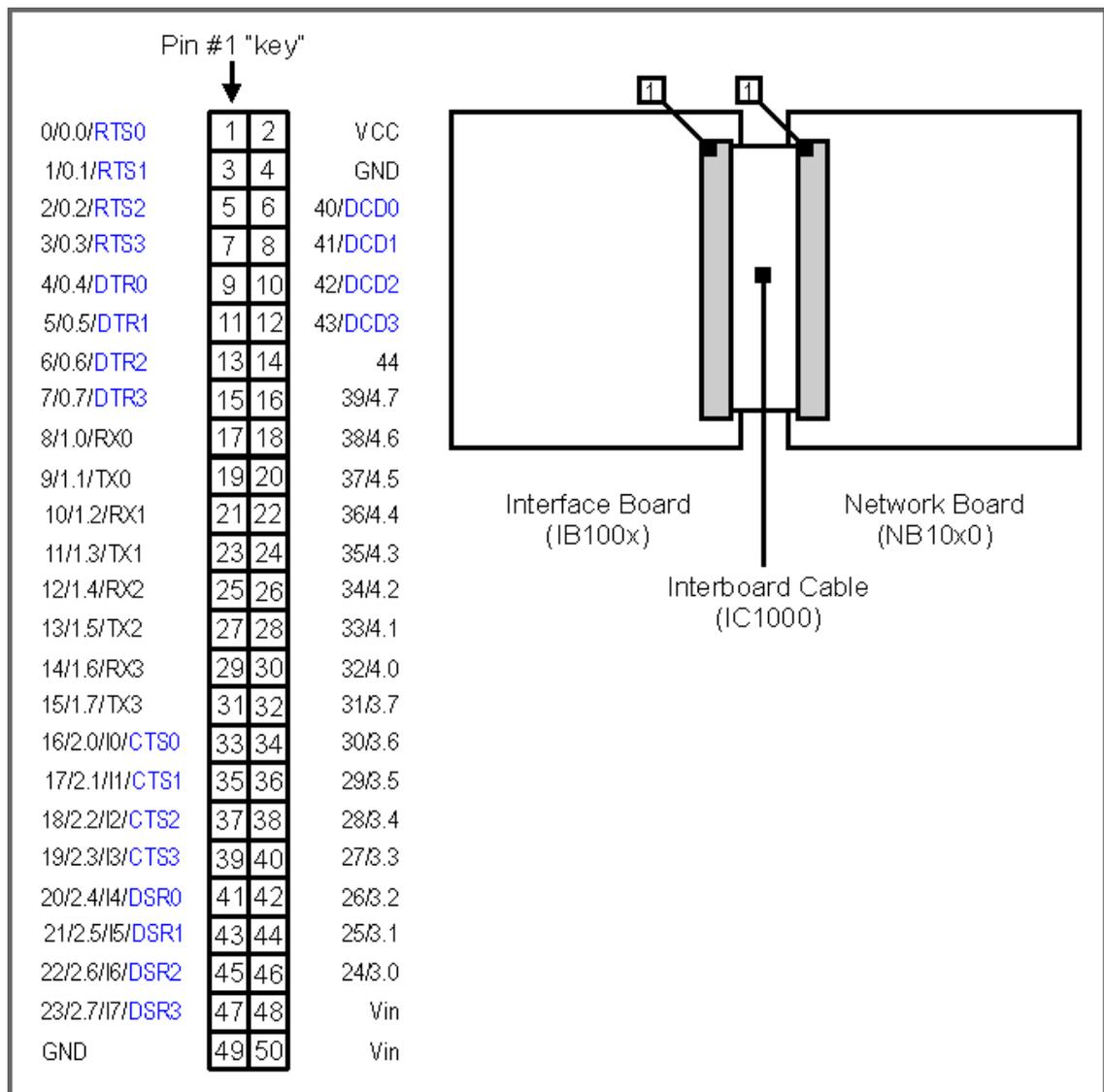
Cable data

The following standard cables are supplied:

- [IC1000 interboard cable](#)
- [LC1000 LED board cable](#)

IC1000 Interboard Cable

[NB10x0](#) and [IB100x](#) boards are interconnected by a 50-wire cable called the "interboard cable". This cable can be ordered as IC1000. There is a 50-pin header on each board to receive the cable end. The header type is 2x25, pitch=2.54mm. Connector pin assignment is shown below. The IC1000 length is approximately 40mm (as measured between the connectors). This cable is supplied with each NB10x0 board (but not with IB100x boards).



Note 1: indicated pin functions correspond to the pin functions of the [EM1000](#) module (installed on the [NB10x0](#) board). To save space, "GPIO" and "P" were omitted. For example, "17/2.1" actually means "GPIO17/P2.1". "I1" means "INT1".

Note2: not all pin functions are shown. For example, pin #2 also has "W0out/cout0" functionality which is not shown on the diagram above. Refer to [EM1000](#) documentation for complete pin function description.

LC1000 LED Board Cable

The LB100x LED boards connect to the network board ("NB") or interface board ("IB") via the LC1000 cable. There is a connector on the LB100x, as well as "NB" and "IB" boards. Connector pin assignment is shown below. LED numbers correspond to the numbers shown on the [mechanical drawing](#) of the LB100x. Pin #1 position of the connector is also shown on the drawing.

Pin #	Function	Description
1	VCC	3.3V power from the "NB" ("IB").
2	VCC	3.3V power from the "NB" ("IB").
3	LED8	Cathode (-) of LED #8.
4	LED7	Cathode (-) of LED #7.
5	LED11	Cathode (-) of LED #11.
6	LED6	Cathode (-) of LED #6.
7	LED5	Cathode (-) of LED #5.
8	LED10	Cathode (-) of LED #10.
9	LED4	Cathode (-) of LED #4.
10	LED3	Cathode (-) of LED #3.
11	LED9	Cathode (-) of LED #9.
12	LED2	Cathode (-) of LED #2.
13	LED1	Cathode (-) of LED #1.
14	GND	System ground.

Important note: For correct operation, a current-limiting resistor must be connected in series with each LED. Most I/O lines of the [EM1000](#) (installed on the [NB1000](#) network board) already have a current-limiting resistor, so the resistor onboard the IB100x is not always necessary. In this case, the 0 Ohm resistor is used. Documentation for [specific LB100x boards](#) provides necessary info.

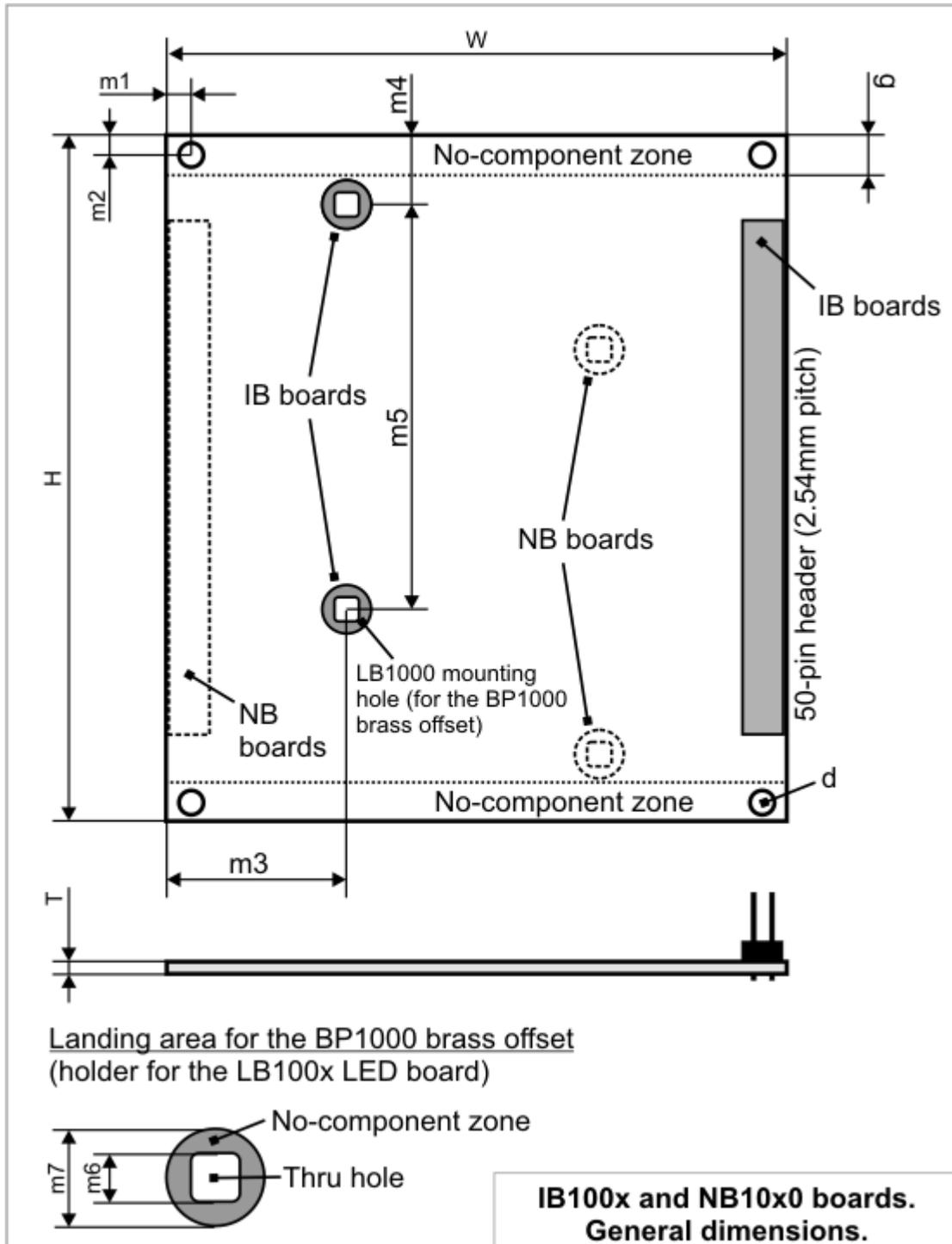
Mechanical data

The following drawings are provided in this section:

- [NB10x0 and IB100x board dimensions](#)
- [SB100x board dimensions](#)
- [LB100x board dimensions](#)

NB10x0 and IB100x Board Dimensions

The [NB10x0](#) and [IB100x](#) have the same outline dimensions. Both types of boards also feature identical 50-pin headers for the [IC1000](#) interboard cable, as well as mounting holes for the [LB1000](#) LED board. The only difference is that on the "IB" boards the 50-pin header is on the right, while the LB1000 mounting holes are on the left. On the "NB" boards, the pin header is on the left, while the mounting holes are located on the right.



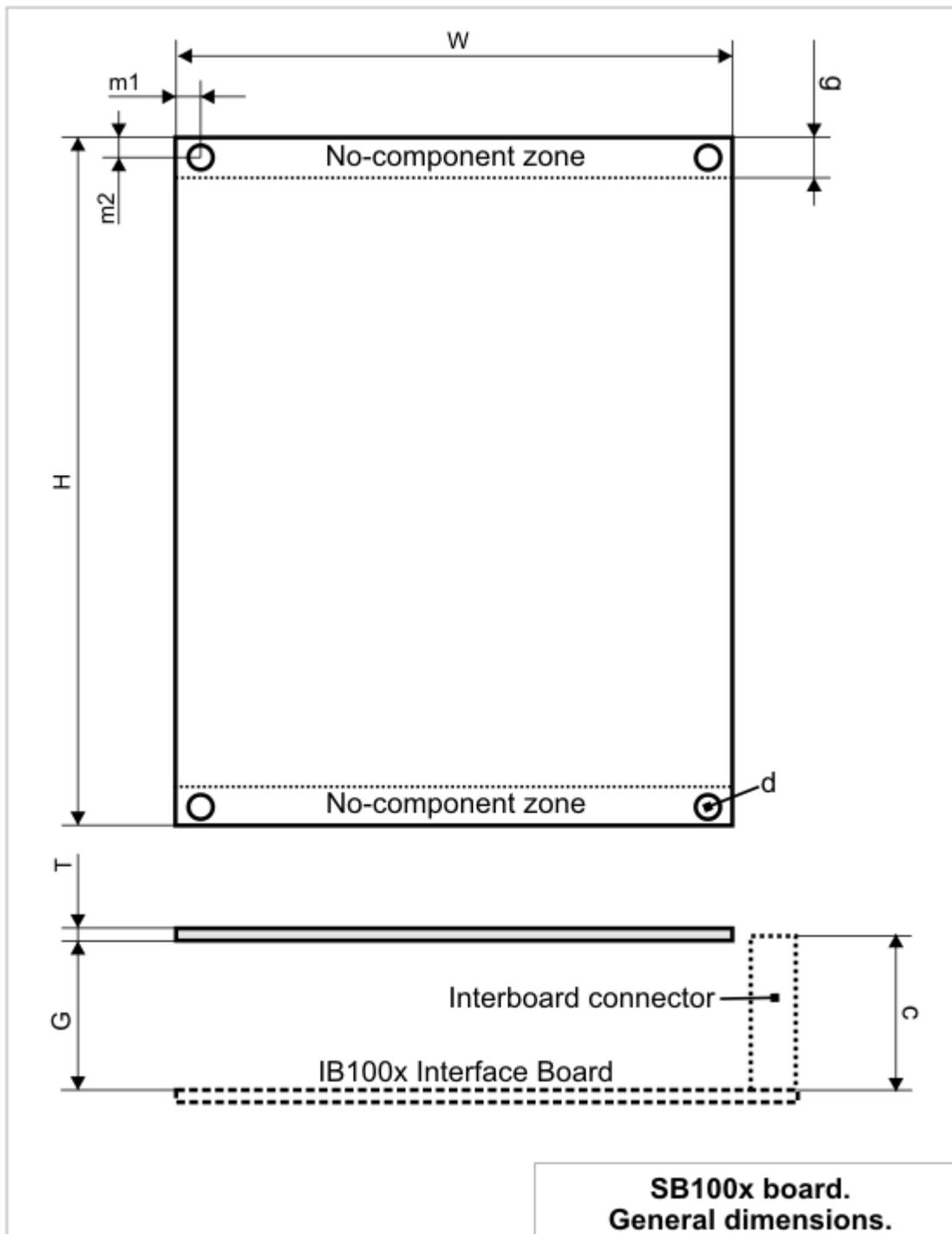
W	Max.	76.0	Board width
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H	Aver.	85.0	Board height
T	Aver.	1.6	Board thickness
g	Min.	5.0	No-component zone width
d	Aver.	3.0	Mounting hole diameter
m1	Aver.	3.0	Distance to the board mounting hole
m2	Aver.	2.5	Distance to the board mounting hole
m3	Aver.	22.0	Distance to the LB100x mounting hole
m4	Aver.	8.5	Distance to the LB100x mounting hole
m5	Aver.	50.3	Distance to the LB100x mounting hole
m6	Aver.	3.2	LB100x mounting hole dimension
m7	Aver.	6.0	LB100x mounting hole, copper area diameter

Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

SB100x Board Dimensions

The supplementary board ("SB") has the same height as the [interface board](#) ("IB"). The "SB" is narrower -- its maximum width is limited to 67mm. The limit is due to the [interboard connector](#) protruding from the side of the "IB". The "SB" does not have to have the maximum width -- it can be as short as permitted by the design.



W	Max.	67.0	Board width
H	Aver.	85.0	Board height
T	Aver.	1.6	Board thickness
g	Min.	5.0	No-component zone height
d	Aver.	3.0	Mounting hole diameter
m1	Aver.	3.0	Distance to the board mounting hole
m2	Aver.	2.5	Distance to the board mounting hole
c	Max.	19.0	Header & interboard cable connector height
G	Aver.	18.5	Gap between the IB100x and SB100x boards*

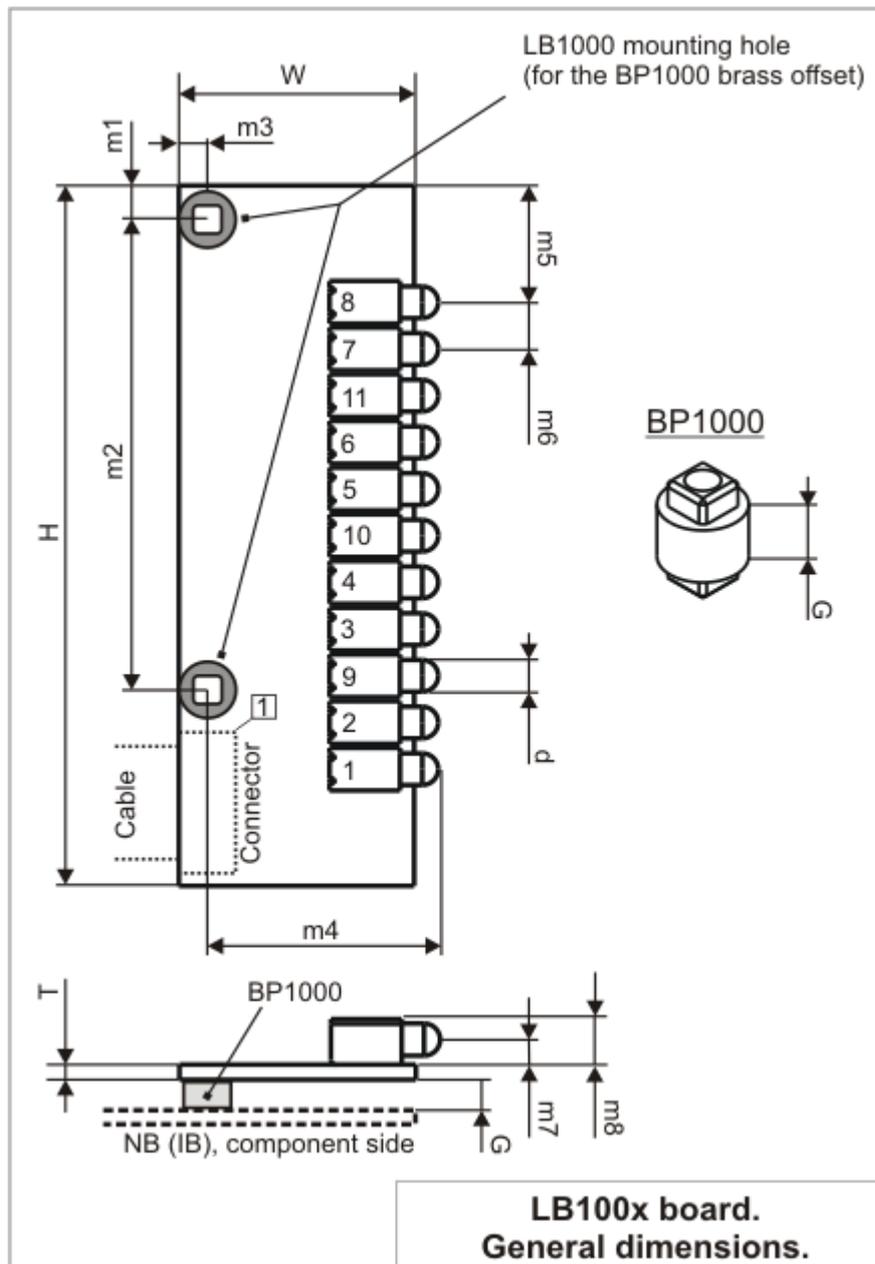
** This is the standard gap; it will "happen" automatically when the boards are used inside the [DS10xx](#) housing.*

Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

LB100x Board Dimensions

The LB100x LED board accommodates up to 11 LEDs. What LEDs are actually installed depends on the board version. See [LB100x LED Boards](#) for description of standard boards offered by Tibbo. The LB100x connects either to an [NB10x0](#) board or [IB100x](#) board. The [LC1000](#) flat cable is used for this.

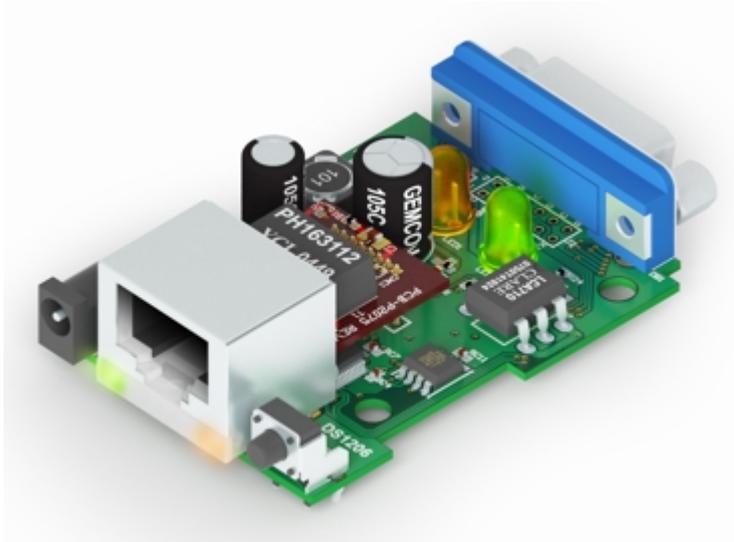
The LB100x can be mounted independently or attached to the "NB" ("IB") board. A custom-made "brass offset" part BP1000 is used for the purpose in the latter case. The BP1000 ensures precise 3.5mm gap between the LB100x and the "NB" ("IB") board.



W	Aver.	25.0	Board width
H	Aver.	75.0	Board height
T	Aver.	1.6	Board thickness
m1	Aver.	3.7	Distance to the board mounting hole
m2	Aver.	50.3	Distance between board mounting holes
m3	Aver.	3.0	Distance to the board mounting hole
m4	Aver.	24.6	Distance from the board mounting hole to the LED edge
m5	Max.	12.5	Distance from the LED edge to the center of the first LED
m6	Aver.	5.0	Distance between LEDs
m7	Aver.	2.6	Distance from the board surface to the LED center
m8	Max.	6.5	LED height with respect to the board surface
G	Aver.	3.5	Gap between the LB100x and the bottom side of the NB10x0 (IB100x)
d	Max.	3.0	LED diameter

Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

DS1206N



Introduction

The DS1206N is a BASIC-programmable board designed primarily for serial-over-IP and serial control applications. Being small enough to fit inside your product, the board offers a rapid development alternative to using [modules](#), which require making new host PCB.

The DS1206N features a multi-channel serial port. The board has a single serial port connector and is priced as a single-port product, yet it packs four independent serial channels. Have no use for those DSR and DTR lines? Turn them into RX and TX of an additional serial channel. Don't want CTS and RTS either? That's one more channel! In total, there are 15 different configurations to choose from.

The board is supplied in three versions offering various serial port and power options (see below).

The DS1206N is fully supported by TIDE software and a dedicated DS1206 platform that covers all hardware facilities of the board (see "TIDE and Tibbo BASIC Manual"). This product ships preloaded with a fully functional serial-over-IP application. Written in Tibbo BASIC, the application is compatible with Tibbo Device Server Toolkit software, comes with full source codes, and can be modified by the user.

Available models

The board is supplied in three modifications.

The DS1206N-RS is, essentially, a [DS1206](#) device without a housing. The board has a proper RS232 port (RS232 transceiver IC and DB9M connector), as well as the power regulator ("12V"-to-3.3V). There is also a power switch that controls "12V" power output on pin 9 of the DB9M connector.

The DS1206N-TM is different from the "-RS" version in that it has a TTL serial port and no power switch. The port is accessible through a 12-pin connector on the PCB. The power regulator of the board can be used to supply 3.3V power to the attached serial device as well.

Finally, the DS1206N-TS is like the "-TM" version but has no "12V"-to-3.3V power regulator. Instead, an attached serial device is supposed to provide stabilized 3.3V power to the board.

Available models and their features	DS1206N-RS (RS232)	DS1206N-TM (TTL master)	DS1206N-TS (TTL slave)
Setup button	YES		
Status LEDs	YES		
RS232 transceiver & DB9M connector	YES	NO	
TTL interface connector	NO	YES	
Power switch	YES	NO	
Power jack and "12V"-to-3.3V regulator	YES		NO

Hardware features

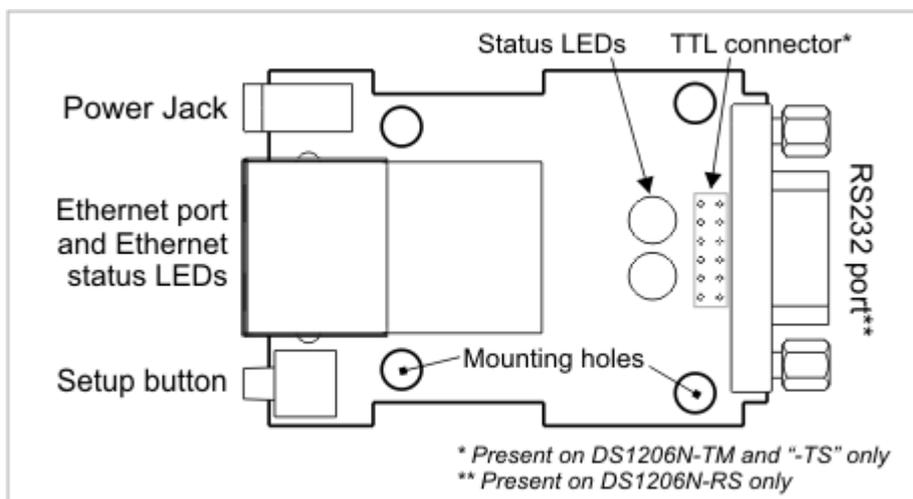
- Superior upgrade to the [EM1202EV](#) board.
- Based on a high-performance purpose-built 88-MHz T1000 ASIC.
- 10/100BaseT auto-MDIX Ethernet port (automatic detection of "straight" and "cross" cables).
- Up to 3.5 serial channels:
 - DS1206N-RS: RS232 port (DB9M connector);
 - DS1206N-TM and "-TS": TTL serial port (pin header);
 - Baudrates of up to 921,600bps;
 - None/even/odd/mark/space parity modes;
 - 7/8 bits/character modes;
 - Full-duplex mode with optional flow control;
 - DS1206N-TM and "-TS": half-duplex mode with direction control;
 - Flexible mapping with 15 different options, such as:
 - A single channel: RX, TX, CTS, RTS, DSR, and DTR lines;
 - 3.5 channels: RX, TX, RX2, TX2, RX3, TX3, and RX4 lines.
 - DS1206N-RS: optional "12V" power output on DB9M connector (software-controllable);
 - DS1206N-TM: optional "12V" power input from the serial port (instead of supplying power through the power jack).
- 512KB or 1024KB flash memory for firmware, application, and data storage.
- 2KB EEPROM for data storage.
- Four LEDs:
 - Green and red status LEDs on top of the device;
 - Link and speed Ethernet status LEDs on the RJ45 jack.
- Software-controlled onboard PLL to select the clock frequency of the device: 11.0592MHz with PLL off, 88.4736MHz with PLL on.

- Power:
 - DS1206N-RS and "-TM": onboard regulator, 10-24V input range (12V nominal);
 - DS1206N-TS: direct 3.3V input (must be regulated to +/- 5%).
- Board dimensions: 52.6x38.0mm.
- Firmware and Tibbo BASIC application are upgradeable through the serial port or network.
- Tibbo BASIC application can be debugged through the network and no additional debugging hardware, such as in-circuit emulator, is required.
- Also available as a [DS1206](#) (DS1206N board with housing).

Programming features

- Variable Types: Byte, char, integer (word), short, dword, long, real, string, plus user-defined arrays and structures.
- Function Groups: string functions (27 in total!), date/time conversion functions (8), encryption/hash calculation functions (AES128, RC4, MD5, SHA-1), and more.
- Platform objects:
 - Sock — socket communications (up to 16 UDP, TCP, and HTTP sessions);
 - Net — controls the Ethernet port;
 - Ser — in charge of serial channels;
 - Io — handles I/O lines, ports, and interrupts;
 - Fd — manages flash memory file system and direct sector access;
 - Stor — provides access to the EEPROM;
 - Romfile — facilitates access to resource files (fixed data);
 - Pat — "plays" patterns on green and red status LEDs;
 - Button — monitors the setup button;
 - Sys — in charge of general device functionality.

DS1206N Hardware

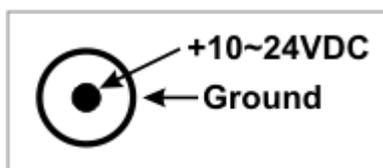


Click on one of the links provided below to learn more about the DS1206N:

- [Power arrangement](#)
- [Ethernet port](#)
- [Multi-channel Serial Port](#)
- [Flash and EEPROM Memory](#)
- [Status LEDs](#)
- [Setup button](#)

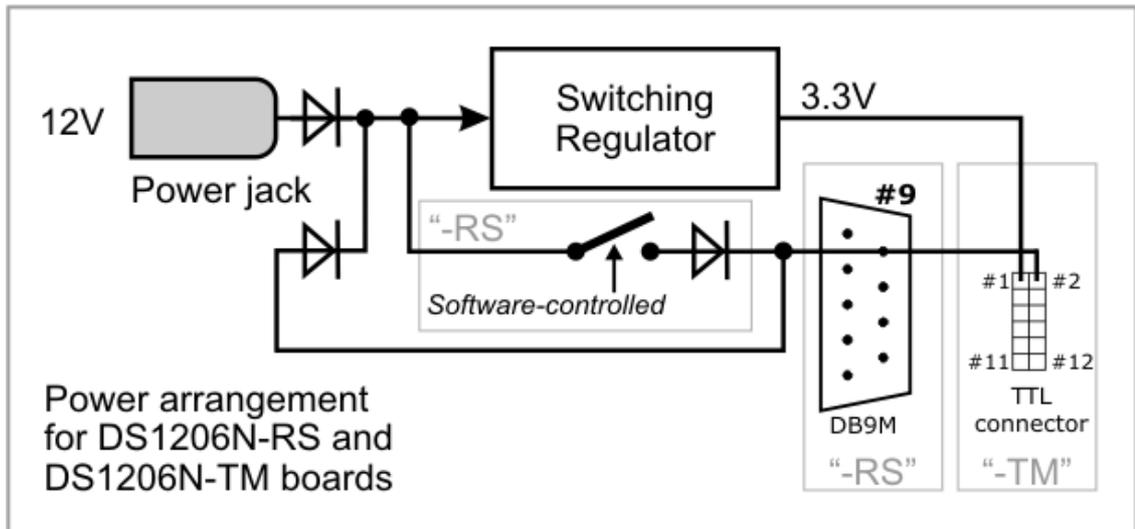
Power Arrangement

The DS1206N-RS and "-TM" devices have "12V"-to-3.3V switching regulator onboard. Conventionally, the power is supplied through the power jack. The Power Jack of the DS1206N accepts "small" power connectors with 3.5mm diameter. Use [APR-P0011](#), [APR-P0012](#), or [APR-P0013](#) power adaptor supplied by Tibbo or similar adaptor with 12V nominal output voltage. Adaptor current rating should be at least 500mA. On the power jack, the ground is "on the outside", as shown on the figure below.



Alternatively, the DS1206N-RS can be powered through pin 9 of the DB9M (RS232) connector, while the DS1206N-TM can be powered through pin 2 of the TTL interface connector. Two internal diodes combine power jack and pin 9 (pin 2) inputs into a single line, which goes to the internal regulator of the DS1206N.

On the DS1206N-RS, pin 9 of the DB9M connector can also be used to provide "12V" power to an attached serial device. "12V" actually means "input power on the power jack", which is not necessarily stabilized. The power line of the jack passes through a software-controlled switch and is then connected to pin 9 through a Schottky diode (shown on the diagram below). Therefore, the voltage on pin 9 is close to the input voltage on the power jack.



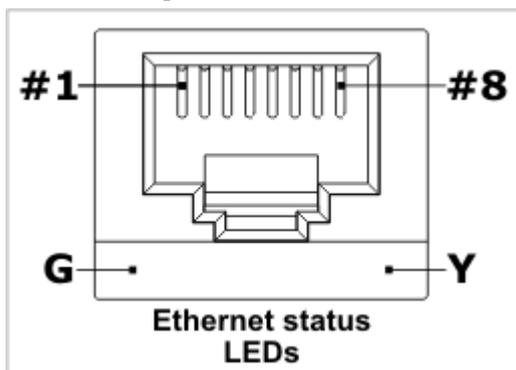
Tibbo serial-over-IP application supplied with the DS1206N has a dedicated "PS" ("Power on pin 9") setting to control the power switch. To turn the power switch on from within your Tibbo BASIC application, enable (configure as output) line PL_IO_NUM8_PWRROUT and then set this line to HIGH. Additional programming information can be found in "TIDE and Tibbo BASIC Manual" (see i.o object and DS1206 platform documentation).

If you want to use pin 9 to power an attached serial device, then you must power the DS1206N-RS itself through the power jack. We know you understand this, but we still had to mention it.

The DS1206N-TS board does not have "12V"-to-3.3V regulator at all. 3.3V power required for board operation must be supplied by the external device through pin 1 of the TTL interface connector.

The DS1206N-TM and "-TS" boards do not have the power switch.

Ethernet Port!



Ethernet port of the DS1206N is of 10/100BaseT type.

Connector is of RJ45 type, pin assignment is as follows:

#1	TX+
#2	TX-
#3	RX+
#4	<No connection>

#5	<No connection>
#6	RX-
#7	<No connection>
#8	<No connection>

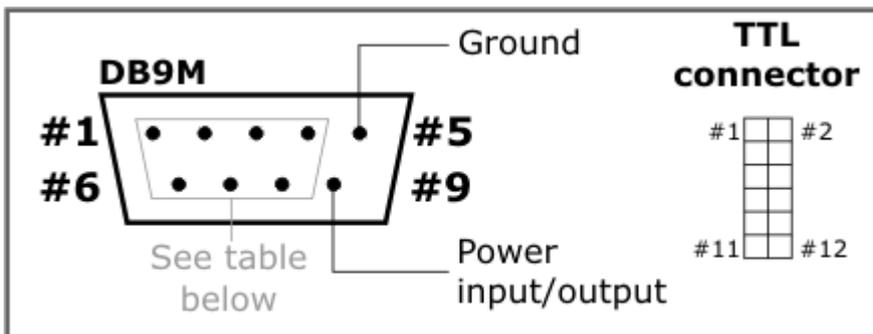
The Ethernet port of the DS1206N incorporates two [Ethernet status LEDs](#).

Multi-channel Serial Port

The DS1206N has four serial ports internally. The DS1206N-RS has an RS232 port with DB9M connector, while "-TM" and "-TS" devices have TTL serial port available through a TTL interface connector, which is a standard pin header with 2mm pitch.

The DS1206N-RS implements three outputs and four inputs. Each of the three outputs can be used as a TX line of a serial port, or as a control output such as RTS or DTR. Each of the four input lines can be used as an RX line of a serial port, or as a control input such as CTS or DSR.

With three outputs and four inputs, the DS1206N can be said to offer 3.5 serial "channels". We say "3.5 channels" and not "four channels" because one channel will only have RX line and no TX line (remember, there are four inputs but only three outputs).



TTL interface connector pin assignment is as follows:

Pin	Name	DS1206N-TM	DS1206N-TS
#1	3.3V	Output to external device	Input from external device
#2	Power	Power input/output	Not used
#3	GND	Ground	
#4	RST	Reset input, active low, use open collector driving circuit	
#5	MD	Setup line input, active low, use open collector driving circuit	
#6-12		Lines of TTL serial port, see mapping table below	

For more information on serial ports and I/O lines of the DS1206N see ser. and io. object manuals ("TIDE and Tibbo BASIC Manual").

Serial-over-IP application offered by Tibbo defines 15 "mapping options", or ways in which available I/O lines are utilized. These are presented in the table below:

Mapping	Available signals	Pins on the DB9M connector of the DS1206N-RS	Missing

option		# 2								line
Option 0	RX/TX/CTS/RTS/ DSR/DTR	RX	TX	CT S	RT S	DS R	DT R	---	---	---
Option 1	RX/TX/CTS/RTS/ DSR/DTR + RX/tx	RX	TX	CT S	RT S	DS R	DT R	RX 4	tx4	tx4
Option 2	RX/TX/CTS/RTS + RX/TX + RX/tx	RX	TX	CT S	RT S	RX3	TX 3	RX 4	tx4	tx4
Option 3	RX/TX/CTS/RTS + RX/TX/CTS/rts	RX	TX	CT S	RT S	RX3	TX 3	CT S3	rts3	rts3
Option 4	RX/TX/CTS/RTS + RX/TX/DSR/dtr	RX	TX	CT S	RT S	RX3	TX 3	DS R3	dtr3	dtr3
Option 5	RX/TX/DSR/DTR + RX/TX + RX/tx	RX	TX	RX2	TX 2	DS R	DT R	RX 4	tx4	tx4
Option 6	RX/TX/DSR/DTR + RX/TX/CTS/rts	RX	TX	RX2	TX 2	DS R	DT R	CT S2	rts2	rts2
Option 7	RX/TX/DSR/DTR + RX/TX/DSR/dtr	RX	TX	RX2	TX 2	DS R	DT R	DS R2	dtr2	dtr2
Option 8	RX/TX + RX/TX + RX/TX + RX/tx	RX	TX	RX2	TX 2	RX3	TX 3	RX 4	tx4	tx4
Option 9	RX/TX/CTS/rts + RX/TX + RX/TX	RX	TX	RX2	TX 2	RX3	TX 3	CT S	rts	rts
Option 10	RX/TX/DSR/dtr + RX/TX + RX/TX	RX	TX	RX2	TX 2	RX3	TX 3	DS R	dtr	dtr
Option 11	RX/TX/CTS/RTS + RX/tx/CTS/RTS	RX	TX	CT S	RT S	CT S4	RT S4	RX 4	tx4	tx4
Option 12	RX/TX/CTS/RTS + RX/tx/DSR/DTR	RX	TX	CT S	RT S	DS R4	DT R4	RX 4	tx4	tx4
Option 13	RX/TX/DSR/DTR + RX/tx/CTS/RTS	RX	TX	CT S4	RT S4	DS R	DT R	RX 4	tx4	tx4
Option 14	RX/TX/DSR/DTR + RX/tx/DSR/DTR	RX	TX	DS R4	DT R4	DS R	DT R	RX 4	tx4	tx4
Mapping option	Available signals	# 1 2	#1 1	#1 0	#9	#8	#7	#6	Missing line	
Pins on the TTL connector of the DS1206N-TM and "-TS"										

"Available signals" column shows a particular combination of I/O lines for each option. For example, option 0 defines the standard serial port arrangement with RX, TX, CTS, RTS, DSR, and DTR lines. Option 2 gives you one channel with RX, TX, CTS, and RTS lines, one more channel with just RX and TX lines, and yet another channel with a single RX line. The TX line is "missing" because, once again, there are only three outputs available. This is why this line is shown in grey lowercase (tx).

Notice that on the DS1206N, pin 9 of the RS232 port can be used to power the DS1206 or provide power to an attached serial device. See [Power Arrangement](#) for details.

Flash and EEPROM Memory

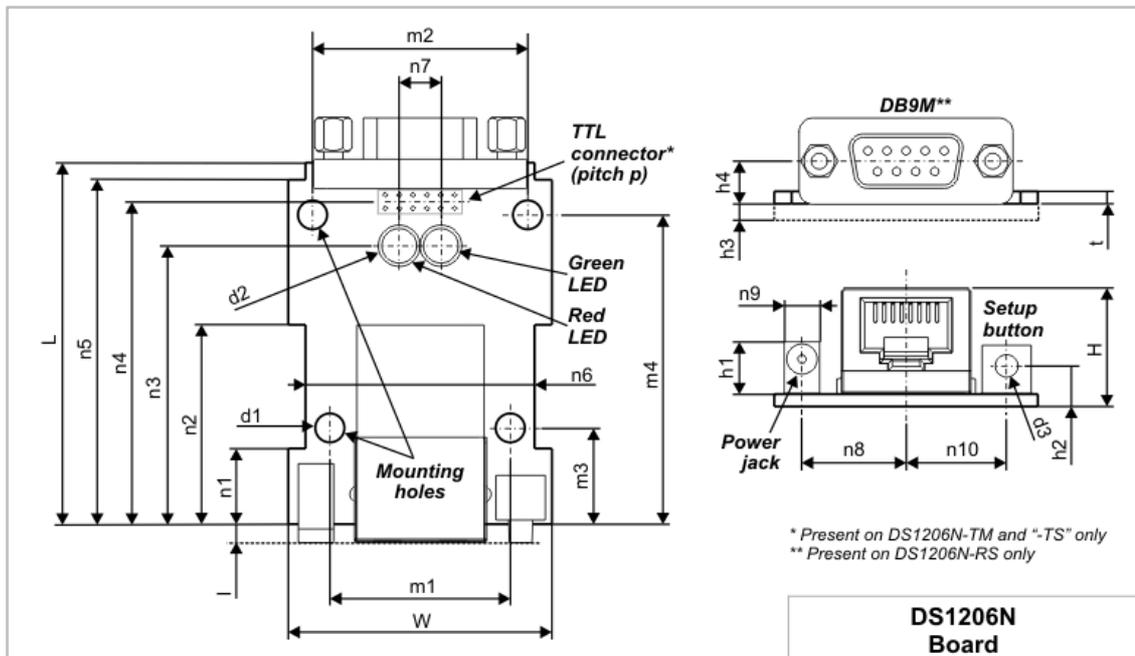
The DS1206N has 512K or 1024KBytes of flash memory and 2KBytes of EEPROM memory.

The first 64KBytes of flash memory are used to store the TiOS firmware. When you are performing a firmware upgrade it is this memory you are saving the firmware binary into.

The rest of this flash memory is available to your Tibbo BASIC application and its data. Whatever memory space is left after the compiled application is loaded can be used as a flash disk (see fd. object documentation in the "TIDE and Tibbo BASIC Manual").

The EEPROM is almost fully available to your application, save for a small 8-byte area called "special configuration area". The EEPROM is accessed through the stor. object (see "TIDE and Tibbo BASIC Manual"). Details on the special configuration area are provided in the Platform-dependent Programming Information section inside the DS1206 platform documentation (same manual).

Mechanical Dimensions



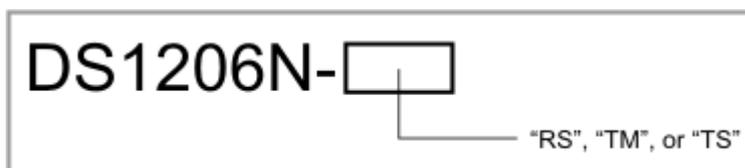
L	Max.	52.6	Board length
W	Max.	38.0	Board width
l	Aver	2.6	Distance from the front edge of the PCB to the front surface of the RJ45 jack, power jack, setup button
H	Max.	17.2	Board height with components installed on the top side of the board
t	Aver	1.6	PCB thickness
d1	Aver	3.6	Mounting hole diameter
d2	Aver	5.0	LED diameter
d3	Max.	3.5	Setup button diameter

m1	Aver.	26.0	Horizontal distance between the mounting holes (first pair)
m2	Aver.	31.0	Horizontal distance between the mounting holes (second pair)
m3	Aver.	14.0	Distance from the front edge of the PCB to the first pair mounting holes
m4	Aver.	45.0	Distance from the front edge of the PCB to the second pair of mounting holes
n1	Aver.	11.0	PCB outline dimension
n2	Aver.	29.0	PCB outline dimension
n3	Aver.	40.5	Distance from the front edge of the PCB to the LEDs
n4	Aver.	47.0	Distance from the front edge of the PCB to the horizontal centerline of the TTL interface connector (present on the DS1202N-TM and "-TS" only)
n5	Aver.	50.1	PCB outline dimension
n6	Aver.	33.0	PCB outline dimension
n7	Aver.	9.0	Horizontal distance between LEDs
n8	Aver.	15.0	Distance from the vertical centerline of the PCB to the vertical centerline of the power jack (present on the DS1206N-RS and "-TM" only)
n9	Max.	5.1	Power jack width (the power jack is present on the EM1206N-RS and "-TM" only)
n10	Aver.	14.5	Distance from the vertical centerline of the PCB to the vertical centerline of the setup button
h1	Max.	7.5	Power jack height (the power jack is present on the DS1206N-RS and "-TM" only)
h2	Aver.	5.5	Distance from the bottom surface of the PCB to the center of the setup button
h3	Max.	2.5	Height of the tallest component on the bottom side of the PCB
h4	Aver.	6.2	Distance from the bottom surface of the PCB to the centerline of the DB9M connector (present on the DS1206N-RS only)
p	Aver.	2.0	TTL pin header pin pitch (present on the DS1206N-TM and "-TS" only)

Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

Ordering Info and Specifications

Device numbering scheme is as follows:



All DS1206B boards are equipped with 1024KBytes of flash memory.

- "RS" version: "true" RS232 port on the DB9M connector, power jack and "12V"-to-3.3V power regulator, optional "12V" power on pin 9 of the DB9M (software-controllable).
- "TM" version: TTL serial port on the pin header connector, power jack and "12V"-to-3.3V power regulator.
- "TS" version: TTL serial port on the pin header connector, direct 3.3V power input.

"TM" and "TS" versions are not standard and cannot be ordered from our online store. Contact Tibbo if you wish to order DS1206B devices in "TM" or "TS" configurations.

Examples of valid model numbers

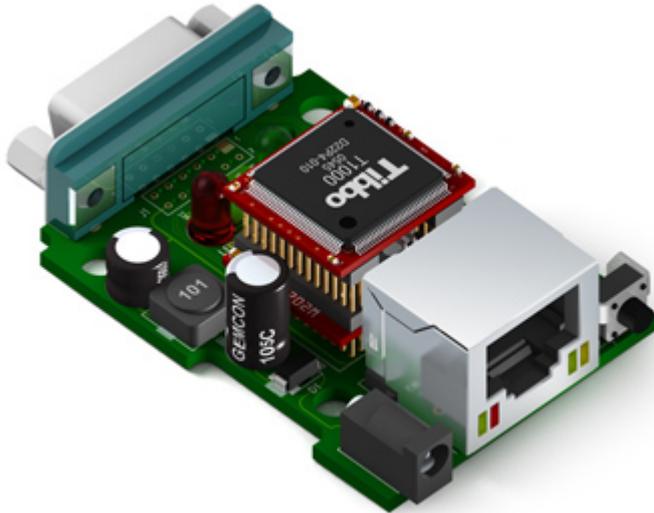
Model number	Description
DS1206N-RS	DS1206N device with 1024KBytes of flash memory, "-RS" version
DS1206N-TM	DS1206N device with 1024KBytes of flash memory, "-TM" version

Hardware specifications

Ethernet interface	10/100BaseT Ethernet, Auto-MDIX
Serial ports	One serial port with 3.5 serial channels (four inputs and three outputs), optional "12V" power output on pin 9 DS1206N-...-RS: RS232 port on the DB9M connector DS1206N-...-TM, DS1206N-...-TS: TTL serial port on the pin header connector
UART capabilities	Baudrates up to 921'600bps; none/even/odd/mark/space parity and 7/8 bits/character.
Clock frequency	11.0592MHz with PLL off 88.4736MHz with PLL on
Flash memory	512KBytes or 1024KBytes, entire memory minus 64KB is available to store Tibbo BASIC application and data
EEPROM memory	2048 bytes, 2040 bytes available to store application data
Supply voltage range	DS1206N-...-RS, DS1206N-...-TM: DC 10-24V (12V nominal) DS1206N-...-TS: DC 3.3V (+/- 5%)
Operating temperature	-5 to +70 degrees C
Operating relative humidity	10-90%
Board dimensions	52.6x38.0mm

All specifications are subject to change without notice and are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

EM1202EV



Introduction

The EM1202EV is a BASIC-programmable board designed primarily for serial-over-IP and serial control applications. Being small enough to fit inside your product, the board offers a rapid development alternative to using [modules](#), which require making new host PCB. The EM1202EV can also be used to evaluate and test the [EM1202](#) module it is based on.

The EM1202EV features a multi-channel serial port. The board has a single serial port connector and is priced as a single-port product, yet it packs four independent serial channels. Have no use for those DSR and DTR lines? Turn them into RX and TX of an additional serial channel. Don't want CTS and RTS either? That's one more channel! In total, there are 15 different configurations to choose from.

The board is supplied in three versions offering various serial port and power options (see below).

The EM1202EV is fully supported by TIDE software and a dedicated DS1202 platform that covers all hardware facilities of the board (see "TIDE and Tibbo BASIC Manual"). The EM1202 platform can be used with the board as well. This product ships preloaded with a fully functional serial-over-IP application. Written in Tibbo BASIC, the application is compatible with Tibbo Device Server Toolkit software, comes with full source codes, and can be modified by the user.

Available models

The board is supplied in three modifications.

The EM1202EV-RS is, essentially, a [DS1202](#) device without its housing. The board has a proper RS232 port (RS232 transceiver IC and DB9M connector), a power jack and a power regulator ("12V"-to-3.3V), a pair of [status LEDs](#) on top of the board, and a [setup button](#).

The EM1202EV-TM is different from the "-RS" version in that it has a TTL serial port

and no status LEDs on top of the board. The port is accessible through a 12-pin connector on the PCB. The power regulator of the board can be used to supply 3.3V power to the attached serial device as well.

Finally, the DS1206N-TS is like the "-TM" version but has no power jack and no "12V"-to-3.3V power regulator. Instead, an attached serial device is supposed to provide stabilized 3.3V power to the board.

Available models and their features	EM1202EV-RS (RS232)	EM1202EV-TM (TTL master)	EM1202EV-TS (TTL slave)
Setup button	YES		
Status LEDs (on top of the board)	YES	NO	
RS232 transceiver & DB9M connector	YES	NO	
TTL interface connector	NO	YES	
Power jack and "12V"-to-3.3V regulator	YES		NO

Hardware features

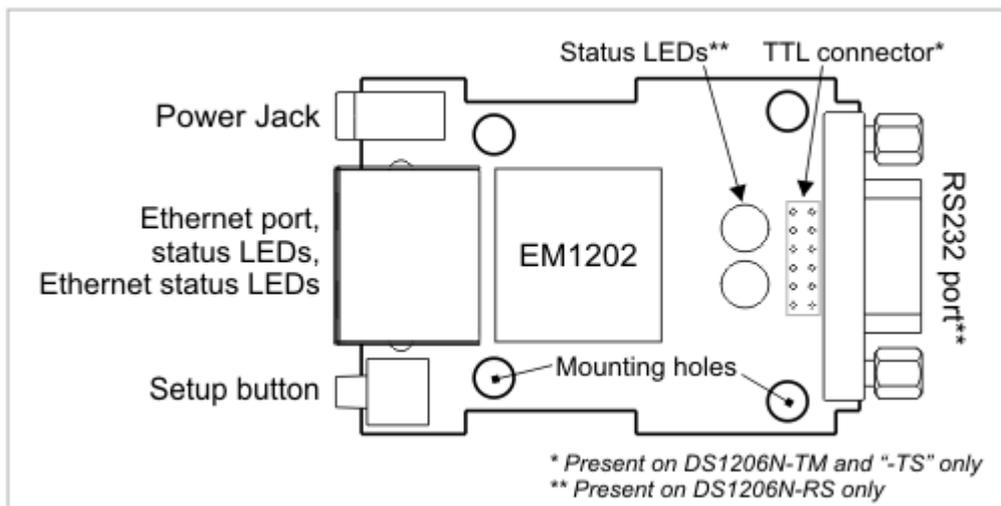
- Based on the [EM1202](#) BASIC-programmable embedded module.
- 10/100BaseT auto-MDIX Ethernet port (automatic detection of "straight" and "cross" cables).
- Up to 3.5 serial channels:
 - EM1202EV-RS: RS232 port (DB9M connector);
 - EM1202EV-TM and "-TS": TTL serial port (pin header);
 - Baudrates of up to 921,600bps;
 - None/even/odd/mark/space parity modes;
 - 7/8 bits/character modes;
 - Full-duplex mode with optional flow control;
 - EM1202EV-TM and "-TS": half-duplex mode with direction control;
 - Flexible mapping with 15 different options, such as:
 - A single channel: RX, TX, CTS, RTS, DSR, and DTR lines;
 - 3.5 channels: RX, TX, RX2, TX2, RX3, TX3, and RX4 lines.
- 1024KB flash memory for firmware, application, and data storage.
- 2KB EEPROM for data storage.
- Up to six LEDs:
 - EM12-2EV-RS: Green and red status LEDs on top of the device;
 - Green and red status LEDs on the RJ45 jack;
 - Link and speed Ethernet status LEDs on the RJ45 jack.
- Software-controlled onboard PLL to select the clock frequency of the device: 11.0592MHz with PLL off, 88.4736MHz with PLL on.
- Power:
 - EM1202EV-RS and "-TM": onboard regulator, 10-24V input range;

- EM1202EV-TS: direct 3.3V input (must be regulated to +/- 5%).
- Board dimensions: 52.6x38.0mm.
- Firmware and Tibbo BASIC application are upgradeable through the serial port or network.
- Tibbo BASIC application can be debugged through the network and no additional debugging hardware, such as in-circuit emulator, is required.
- Also available as a [DS1202](#) (EM1202EV-RS board with housing).

Programming features

- Variable Types: Byte, char, integer (word), short, dword, long, real, string, plus ser-defined arrays and structures.
- Function Groups: string functions (27 in total!), date/time conversion functions (8), encryption/hash calculation functions (AES128, RC4, MD5, SHA-1), and more.
- Platform objects:
 - Sock — socket communications (up to 16 UDP, TCP, and HTTP sessions);
 - Net — controls the Ethernet port;
 - Ser — in charge of serial channels;
 - Io — handles I/O lines, ports, and interrupts;
 - Fd — manages flash memory file system and direct sector access;
 - Stor — provides access to the EEPROM;
 - Romfile — facilitates access to resource files (fixed data);
 - Pat — "plays" patterns on green and red status LEDs;
 - Button — monitors the setup button;
 - Sys — in charge of general device functionality.

EM1202EV Hardware



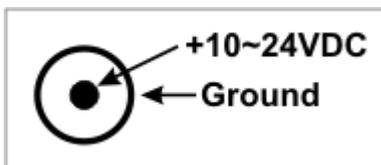
Click on one of the links provided below to learn more about the EM1202EV:

- [Power arrangement](#)
- [Ethernet port](#)

- [Multi-channel Serial Port](#)
- [Flash and EEPROM Memory](#)
- [Status LEDs](#)
- [Setup button](#)

Power Arrangement

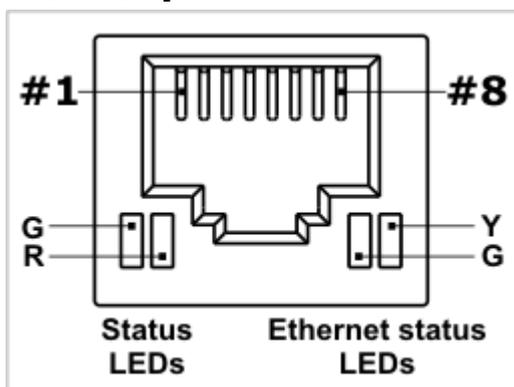
The EM1202EV-RS and "-TM" devices have "12V"-to-3.3V switching regulator onboard. The power is supplied through the power jack. The power jack of the EM1202EV accepts "small" power connectors with 3.5mm diameter. Use [APR-P0011](#), [APR-P0012](#), or [APR-P0013](#) power adaptor supplied by Tibbo or similar adaptor with 12V nominal output voltage. Adaptor current rating should be at least 500mA. On the power jack, the ground is "on the outside", as shown on the figure below.



Stabilized 3.3V power used by the EM1202EV-RS and "-TM" is also available on pin 12 of the TTL interface connector. This can be used to provide power to an attached serial device.

The EM1202EV-TS board does not have "12V"-to-3.3V regulator at all. 3.3V power required for board operation must be supplied by the external device through pin 12 of the TTL interface connector.

Ethernet Port



Ethernet port of the EM1202EV is of 10/100BaseT type.

Connector is of RJ45 type, pin assignment is as follows:

#1	TX+
#2	TX-
#3	RX+
#4	<No connection>
#5	<No connection>
#6	RX-
#7	<No connection>

#8	<No connection>
----	-----------------

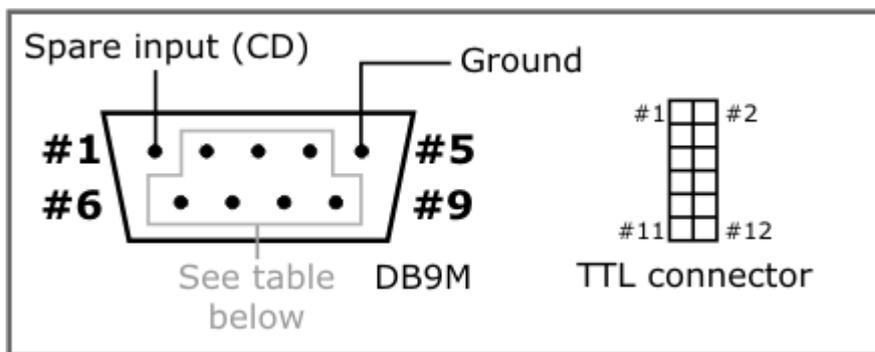
The Ethernet port of the EM1202EV incorporates [four LEDs](#) (two status LEDs and two Ethernet status LEDs). The EM1202EV-RS has another pair of status LEDs located on top of the board. Two status LED pairs work in parallel.

Multi-channel Serial Port

The EM1202EV has four serial ports internally. The EM1202EV-RS has an RS232 port with DB9M connector, while "-TM" and "-TS" devices have TTL serial port available through a TTL interface connector, which is a standard pin header with 2mm pitch.

The EM1202EV implements three outputs, four inputs, and one "spare" input (CD). Each of the three outputs can be used as a TX line of a serial channel, or as a control output such as RTS or DTR. Input lines can be used as an RX line of a serial channel, or as a control input such as CTS or DSR. The spare input cannot work as an RX line. This input is not used by the serial-over-IP application supplied by Tibbo and will be largely omitted from further discussion. Your Tibbo BASIC application can always use this extra input if you require it.

With three outputs and four inputs, the EM1202EV can be said to offer 3.5 serial "channels". We say "3.5 channels" and not "four channels" because one channel will only have RX line and no TX line (remember, there are four inputs but only three outputs).



DB9M connector pin assignment:

Pin	Name	EM1202EV-RS
#1	CD	Spare input*
#2-4, 6-9		Lines of the RS232 port, see mapping table below
#5	GND	Ground

**Not used in Tibbo serial-over-IP application. Your Tibbo BASIC program can use this line if needed.*

TTL interface connector pin assignment:

Pin	Name	EM1202EV-TM	EM1202EV-TS
#1	CD	Spare input*	

#2-8		Lines of TTL serial port, see mapping table below	
#9	MD	Setup line input, active low, use open collector driving circuit	
#10	RST	Reset input, active low, use open collector driving circuit	
#11	GND	Ground	
#12	3.3V	Output to external device	Input from external device

**Not used in Tibbo serial-over-IP application. Your Tibbo BASIC program can use this line if needed.*

Serial-over-IP application offered by Tibbo defines 15 "mapping options", or ways in which available I/O lines are utilized ("spare" input is not used or shown). These are presented in the table below:

Mapping option	Available signals	Pins on the DB9M connector of the EM1202EV-RS							Missing line
		#2	#3	#8	#7	#6	#4	#9	
Option 0	RX/TX/CTS/RTS/DSR/DTR	RX	TX	CTS	RTS	DSR	DT	---	---
Option 1	RX/TX/CTS/RTS/DSR/DTR + RX/tx	RX	TX	CTS	RTS	DSR	DT	RX4	tx4
Option 2	RX/TX/CTS/RTS + RX/TX + RX/tx	RX	TX	CTS	RTS	RX3	TX3	RX4	tx4
Option 3	RX/TX/CTS/RTS + RX/TX/CTS/rts	RX	TX	CTS	RTS	RX3	TX3	CTS3	rts3
Option 4	RX/TX/CTS/RTS + RX/TX/DSR/dtr	RX	TX	CTS	RTS	RX3	TX3	DSR3	dtr3
Option 5	RX/TX/DSR/DTR + RX/TX + RX/tx	RX	TX	RX2	TX2	DSR	DT	RX4	tx4
Option 6	RX/TX/DSR/DTR + RX/TX/CTS/rts	RX	TX	RX2	TX2	DSR	DT	CTS2	rts2
Option 7	RX/TX/DSR/DTR + RX/TX/DSR/dtr	RX	TX	RX2	TX2	DSR	DT	DSR2	dtr2
Option 8	RX/TX + RX/TX + RX/TX + RX/tx	RX	TX	RX2	TX2	RX3	TX3	RX4	tx4
Option 9	RX/TX/CTS/rts + RX/TX + RX/TX	RX	TX	RX2	TX2	RX3	TX3	CTS	rts
Option 10	RX/TX/DSR/dtr + RX/TX + RX/TX	RX	TX	RX2	TX2	RX3	TX3	DSR	dtr
Option 11	RX/TX/CTS/RTS + RX/tx/CTS/RTS	RX	TX	CTS	RTS	CTS4	RTS4	RX4	tx4
Option 12	RX/TX/CTS/RTS + RX/tx/DSR/DTR	RX	TX	CTS	RTS	DSR4	DT	RX4	tx4
Option 13	RX/TX/DSR/DTR + RX/tx/CTS/RTS	RX	TX	CTS4	RTS4	DSR	DT	RX4	tx4
Option 14	RX/TX/DSR/DTR + RX/tx/DSR/DTR	RX	TX	DSR4	DT	DSR	DT	RX4	tx4
Mapping option	Available signals	#6	#5	#4	#3	#7	#8	#1	Missing line

n		Pins on the TTL connector of the EM1202EV-TM and "-TS"	
---	--	---	--

"Available signals" column shows a particular combination of I/O lines for each option. For example, option 0 defines the standard serial port arrangement with RX, TX, CTS, RTS, DSR, and DTR lines. Option 2 gives you one channel with RX, TX, CTS, and RTS lines, one more channel with just RX and TX lines, and yet another channel with a single RX line. The TX line is "missing" because, once again, there are only three outputs available. This is why this line is shown in grey lowercase (tx).

Additional Information on Serial Port Lines

This topic contains information related to programming of the EM1202EV. It assumes that you are familiar with Tibbo BASIC and the concept of "platforms". Everything you need to know regarding this can be found in "TIDE and Tibbo BASIC Manual".

You can create Tibbo BASIC applications for the EM1202EV using two different platforms -- the "DS1202" platform and "EM1202" platform. The DS1202 platform can be used because the EM1202EV is, essentially, a [DS1202](#) device without the plastic housing. The EM1202 platform can be used because the board is based on the [EM1202](#) module.

Generally speaking, the EM1202 platform offers "more". It addresses every hardware faculty of the EM1202. The DS1202 platform is much more limited and only includes features that can be used when the EM1202 module is mounted on the EM1202EV board (inside the DS1202 device).

The biggest difference between the two platforms is in how the I/O lines are wired. The EM1202 platform defines 32 I/O lines. Half of these are not used on the EM1202EV, and the remaining lines are interconnected. Each line of the serial port (save for the "spare" line discussed previously) is connected to *two* GPIO lines of the EM1202. This was done to ensure more flexible mapping (see [Multi-Channel Serial Port](#)). Care should be taken to avoid enabling both outputs of the same serial port line simultaneously! This can permanently damage the EM1202. We suggest that you use GPIO8/P1.0/RX0 - GPIO14/P1.6/RX3 for actual input/output and use GPIO16/P2.0/INT0 - GPIO19/P2.3/INT3 as interrupt inputs only.

The DS1202 platform "looks" at the same hardware differently and defines fewer I/O lines. Each of the physical line pair is represented by a single GPIO line. GPIO lines of the EM1202 that are unused are not defined at all.

GPIO lines of the EM1202 platform -- two lines are connected to each serial port line, except in the case of the "spare" input		GPIO lines of the DS1202 platform	DB9M pin and its conventional function ("-RS")	TTL connector pin ("-TS", "-TM")
GPIO8/P1.0/RX0	GPIO16/P2.0/INT0	PL_IO_NUM_0_RX0_INT0	#2 (RX input)	#6
GPIO9/P1.1/TX0	GPIO20/P2.4/INT4	PL_IO_NUM_1_TX0_INT4	#3 (TX output)	#5
GPIO10/P1.2/RX1	GPIO17/P2.1/INT1	PL_IO_NUM_2_RX1_INT1	#8 (CTS input)	#4
GPIO11/P1.3/TX1	GPIO21/P2.5/INT5	PL_IO_NUM_3_TX1_INT5	#7 (RTS output)	#3
GPIO12/	GPIO18/P2.2/	PL_IO_NUM_4_RX	#6 (DSR	#7

P1.4/RX2	INT2	2_INT2	input)	
GPIO13/ P1.5/TX2	GPIO22/P2.6/ INT6	PL_IO_NUM_5_TX 2_INT6	#4 (DTR output)	#8
GPIO14/ P1.6/RX3	GPIO19/P2.3/ INT3	PL_IO_NUM_6_RX 3_INT3	#9 (RI input)	#2
---	GPIO23/P2.7/ INT7*	PL_IO_NUM_7_INT 7	#1 (CD input)*	#1*

* Spare input (see above).

Flash and EEPROM Memory

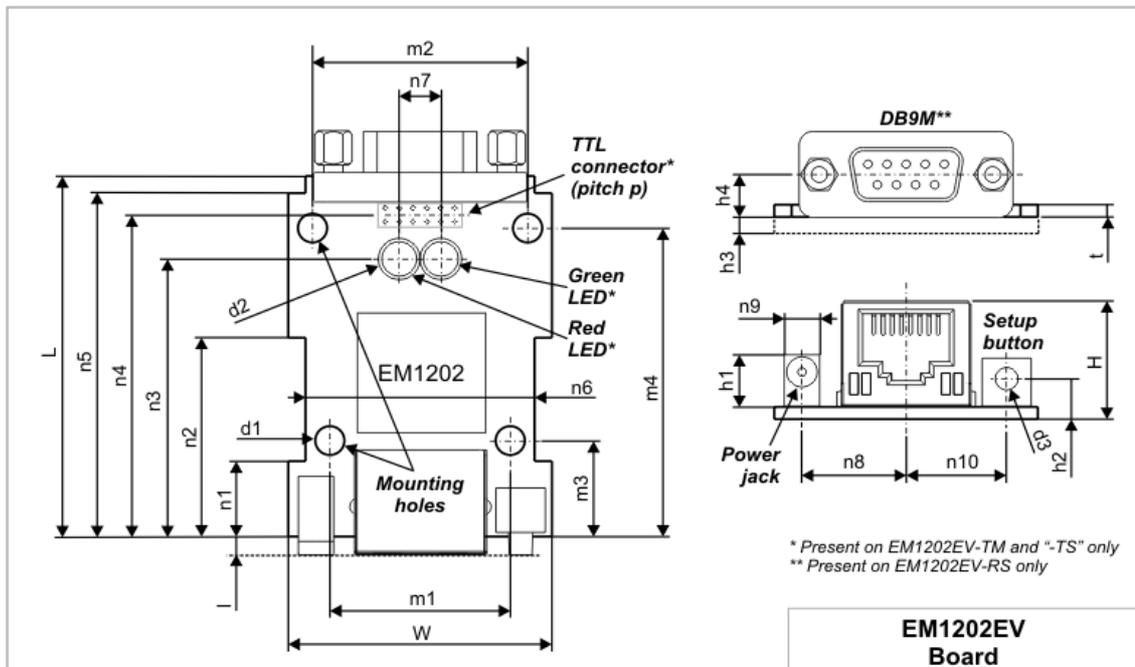
The EM1202EV has 1024KBytes of flash memory and 2KBytes of EEPROM memory.

The first 64KBytes of flash memory are used to store the TiOS firmware. When you are performing a firmware upgrade it is this memory you are saving the firmware binary into.

The rest of this flash memory is available to your Tibbo BASIC application and its data. Whatever memory space is left after the compiled application is loaded can be used as a flash disk (see fd. object documentation in the "TIDE and Tibbo BASIC Manual").

The EEPROM is almost fully available to your application, save for a small 8-byte area called "special configuration area". The EEPROM is accessed through the stor. object (see "TIDE and Tibbo BASIC Manual"). Details on the special configuration area are provided in the Platform-dependent Programming Information section inside the EM1202 and DS1202 platform documentation (same manual).

Mechanical Dimensions



L	Max.	52.6	Board length
W	Max.	38.0	Board width

l	Aver .	2.6	Distance from the front edge of the PCB to the front surface of the RJ45 jack, power jack, setup button
H	Max.	17.2	Board height with components installed on the top side of the board
t	Aver .	1.6	PCB thickness
d1	Aver .	3.6	Mounting hole diameter
d2	Aver .	5.0	LED diameter (these LEDs are present on the EM1202EV-RS only)
d3	Max.	3.5	Setup button diameter
m1	Aver .	26.0	Horizontal distance between the mounting holes (first pair)
m2	Aver .	31.0	Horizontal distance between the mounting holes (second pair)
m3	Aver .	14.0	Distance from the front edge of the PCB to the first pair mounting holes
m4	Aver .	45.0	Distance from the front edge of the PCB to the second pair of mounting holes
n1	Aver .	11.0	PCB outline dimension
n2	Aver .	29.0	PCB outline dimension
n3	Aver .	40.5	Distance from the front edge of the PCB to the LEDs (present on the EM1202EV-RS only)
n4	Aver .	47.0	Distance from the front edge of the PCB to the horizontal centerline of the TTL interface connector (present on the EM1202EV-TM and "-TS" only)
n5	Aver .	50.1	PCB outline dimension
n6	Aver .	33.0	PCB outline dimension
n7	Aver .	9.0	Horizontal distance between LEDs (present on the EM1202EV-RS only)
n8	Aver .	15.0	Distance from the vertical centerline of the PCB to the vertical centerline of the power jack (present on the EM1202EV-RS and "-TM" only)
n9	Max.	5.1	Power jack width (the power jack is present on the EM1202EV-RS and "-TM" only)
n10	Aver .	14.5	Distance from the vertical centerline of the PCB to the vertical centerline of the setup button
h1	Max.	7.5	Power jack height (the power jack is present on the EM1202EV-RS and "-TM" only)
h2	Aver .	5.5	Distance from the bottom surface of the PCB to the center of the setup button
h3	Max.	2.5	Height of the tallest component on the bottom side of the PCB
h4	Aver .	6.2	Distance from the bottom surface of the PCB to the centerline of the DB9M connector (present on the EM1202EV-RS only)
p	Aver .	2.0	TTL connector pin pitch (connector present on the EM1202EV-TM and "-TS" only)

Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

Ordering Info and Specifications

Device numbering scheme is as follows:



- All EM1202EV boards are equipped with 1024KBytes of flash memory.
- "RS" version: "true" RS232 port on the DB9M connector, power jack and "12V"-to-3.3V power regulator.
- "TM" version: TTL serial port on the pin header connector, power jack and "12V"-to-3.3V power regulator.
- "TS" version: TTL serial port on the pin header connector, direct 3.3V power input.

"TM" and "TS" versions are not standard and cannot be ordered from our online store. Contact Tibbo if you wish to order DS1206B devices in "TM" or "TS" configurations.

Examples of valid model numbers

Model number	Description
EM1202EV-RS	EM1202EV device with 1024KBytes of flash memory, "-RS" version
EM1202EV-TM	EM1202EV device with 1024KBytes of flash memory, "-TM" version

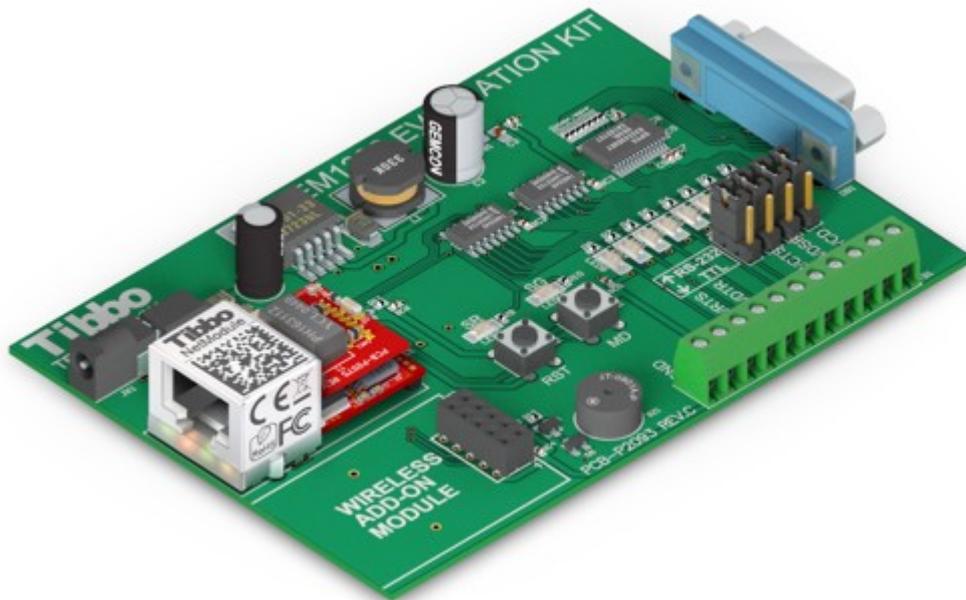
Hardware specifications

Ethernet interface	10/100BaseT Ethernet, Auto-MDIX, magnetics not built-in
Serial ports	One serial port with 3.5 serial channels (four inputs and three outputs) DS1206N-...-RS: RS232 port on the DB9M connector DS1206N-...-TM, DS1206N-...-TS: TTL serial port on the pin header connector
UART capabilities	Baudrates up to 921'600bps; none/even/odd/mark/space parity and 7/8 bits/character.
Clock frequency	11.0592MHz with PLL off 88.4736MHz with PLL on
Flash memory	1024KBytes, entire memory minus 64KB is available to store Tibbo BASIC application and data

EEPROM memory	2048 bytes, 2040 bytes available to store application data
Supply voltage range	DS1206N-...-RS, DS1206N-...-TM: DC 10-24V (12V nominal) DS1206N-...-TS: DC 3.3V (+/- 5%)
Operating temperature	-5 to +70 degrees C
Operating relative humidity	10-90%
Board dimensions	52.6x38.0mm

All specifications are subject to change without notice and are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

EM1206EV



The EM1206EV Evaluation Board offers a convenient way to test the [EM1206](#) BASIC-programmable Ethernet module.

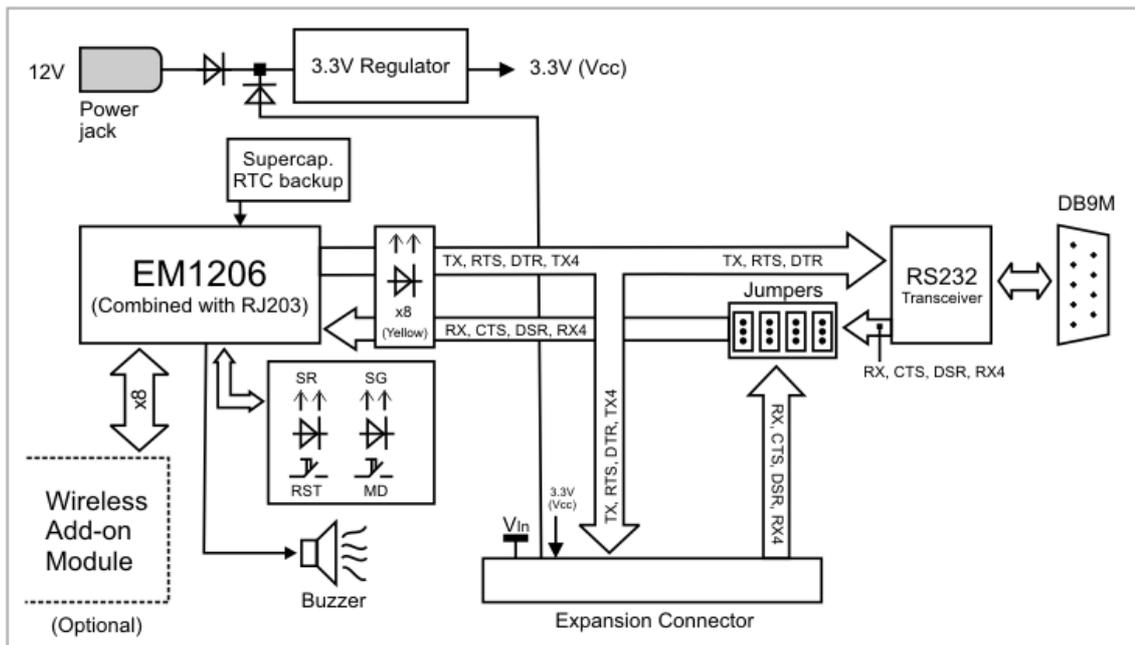
The board features the following components:

- The [EM1206](#) and [RJ203](#) modules (assembled together and soldered into the EM1206EV board).
- [Connector](#) for a wireless add-on module, such as the [GA1000](#) Wi-Fi device (purchased separately).
- [Power jack](#) and a switching power regulator.
- [Multi-channel RS232 port](#) with three RS232 outputs and four RS232 inputs.
- [Expansion connector](#) with GND, 3.3V (Vcc), 12V (Vin), and 8 TTL I/O lines.
- Eight yellow LEDs to indicate the status of I/O lines (see [RS232 port and Expansion Connector](#) topic).
- Four jumpers to select between RS232 port and expansion connector (see [RS232](#)

[port and Expansion Connector](#) topic).

- Two buttons: [setup](#) (connected to the [MD](#) line of the EM1206), and reset (connected to the [RST](#) line).
- Green and red status LEDs (connected to [SG and SR](#) lines of the EM1206). Further information on status LEDs can be found in [Appendix 1: Status LEDs](#).
- Buzzer (connected to the [CO](#) line of the EM1206).
- [Supercapacitor](#) (backup power source) for the [RTC](#) of the EM1206.

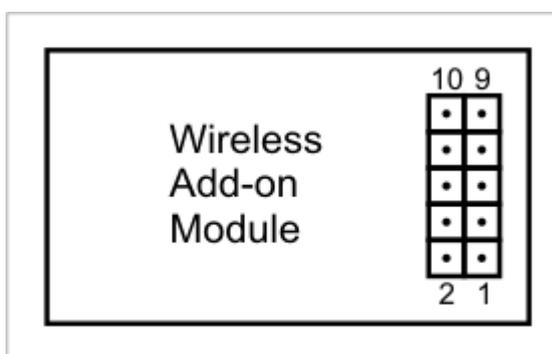
Board structure is further illustrated by this block diagram:



Wireless Add-on Connector

This connector is used to plug in an optional wireless add-on, such as the [GA1000](#) Wi-Fi module, as well as other add-on modules that may be released by Tibbo in the future.

The connector has 10 pins, as shown on the drawing below. Apart from the ground and Vcc (3.3V) lines, there are eight I/O lines that are connected directly to port 1 (GPIO lines 8-15) of the [EM1206](#).

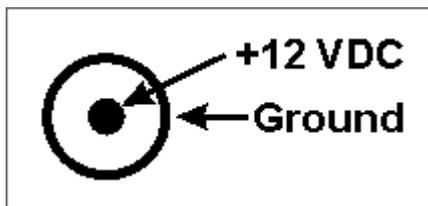


Pin	EM1206 line	GA1000 line
#1	GND	GND
#2	Vcc (3.3V)	Vcc (3.3V)
#3	GPIO15/P1.7	CS
#4	GPIO10/P1.2	---
#5	GPIO13/P1.5	DO
#6	GPIO9/P1.1	---
#7	GPIO11/P1.3	RST
#8	GPIO8/P1.0	---
#9	GPIO12/P1.4	DI
#10	GPIO14/P1.6	CLK

It should be noted that GPIO lines 8-15 can be used for any desired I/O purpose, not just to control a wireless add-on board. You can use this connector for your own control purposes.

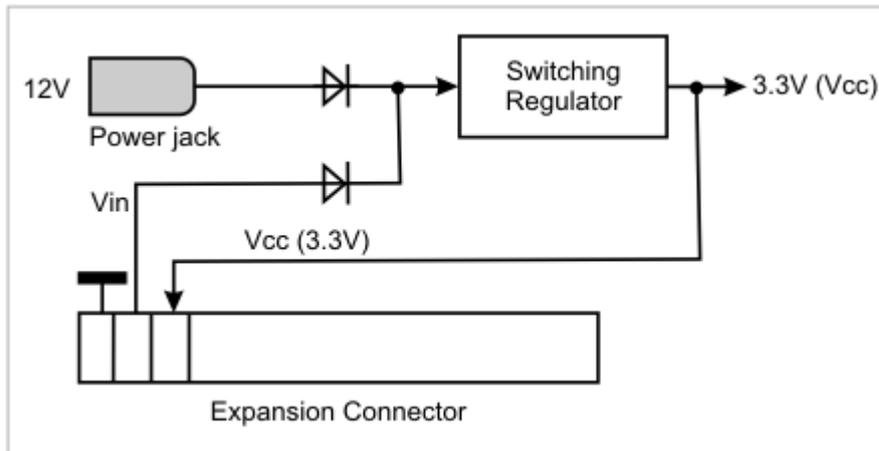
Main and Backup Power

The power jack of the EM1206EV accepts "small" power connectors, 3.5mm in diameter. Use [APR-P0011](#), [APR-P0012](#), or [APR-P0013](#) power adaptor supplied by Tibbo or a similar adaptor with 12V nominal output voltage. Adaptor current rating should be at least 500mA. On the power jack, the ground is "on the outside", as shown on the figure below.



Alternatively, you can power the board through the Vin line on the [expansion connector](#). Two onboard diodes combine power jack and Vin inputs into a single line, which goes to the switching regulator. Clean 3.3V output produced by the regulator is used to power the EM1206EV board itself, the [EM1206](#) module, and optionally an add-on board plugged into the [wireless add-on connector](#). This 3.3V power is available on the expansion connector as well.

The following drawing illustrates this power arrangement:



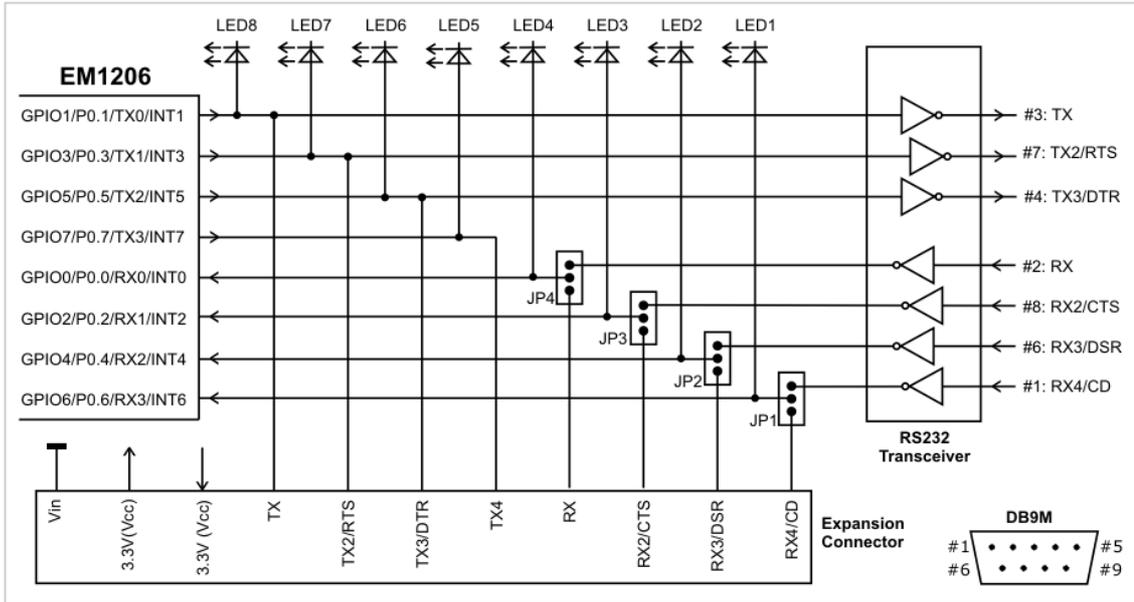
The EM1206 module features an [RTC](#) and a dedicated VCCB input for providing backup power when the EM1206EV is off. On the EM1206EV, the backup power comes from a supercapacitor located on the bottom side of the board. The supercapacitor charges almost instantly and, in the absence of main power, supports the RTC for about a week.

- Notice that the supercapacitor is not connected to the Vcc line directly. The VCCB pin "expects" the backup power to have a nominal voltage of 2.5V. See the [Real-time Counter](#) topic of the EM1206 manual for details.

Multi-channel RS232 Port and Expansion Connector

The [EM1206](#) module has four serial ports (four pairs of RX and TX lines). Each of those lines can also be used as general-purpose I/O. Hence, each line can serve as a CTS, RTS, DSR, or DTR line; or play another role which is unrelated to the function of the serial port.

The I/O lines of the EM1206 module are bi-directional: each line can be programmed to work as an output or input line. On the RS232 port of the EM1206EV, however, each line has a fixed direction defined by the RS232 transceiver IC. The IC used on the EM1206EV board implements three outputs and four inputs. Therefore, only seven I/O lines of the EM1206 are connected to the RS232 port of the EM1206EV board.



Out of these seven lines, each of the three outputs can be used as a TX line of a serial port, or as a control output such as RTS, DTR, etc. Each of the four input lines can be used as an RX line of a serial port, or as a control input such as CTS, DSR, CD, etc. It can be said that the RS232 port of the EM1206EV offers 3.5 serial "channels". We say "3.5 channels" and not "four channels" because one channel will only have RX line and no TX line (remember, there are four inputs but only three outputs).

Note that all four inputs of the serial port are connected to the EM1206 module through jumpers. Jumpers are necessary to select between the RS232 port inputs and expansion connector terminals. Putting a jumper "up" selects an input from the RS232 transceiver, putting a jumper "down" selects an expansion connector line.

All eight lines are available on the expansion connector as TTL signals. When the expansion connector is used, any of these eight lines can be used as an input or output.

You can conveniently see the state of I/O lines on a bank of yellow LEDs. An LED is ON when a corresponding TTL line is HIGH. Notice that the RS232 transceiver IC inverts the signal on each line. For example, if the GPIO1/P0.1/TX/INT1 pin of the EM1206 is HIGH then the TX pin on the DB9M collector is LOW.

For more information on serial ports and I/O lines of the EM1206 see ser. and io. object manuals ("TIDE and Tibbo BASIC Manual").

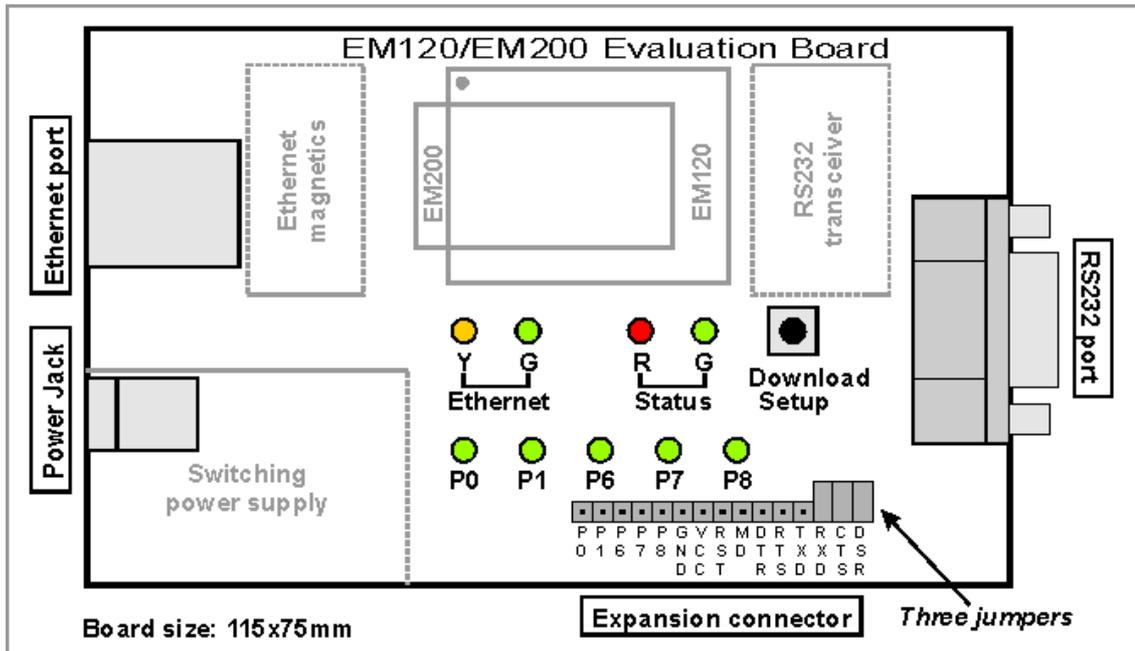
Serial-over-IP application offered by Tibbo defines 15 "mapping options", or ways to utilize the available I/O lines. These are presented in the table below:

Mapping option	Available signals	Pins on the DB9M connector							Missing line	
		#2	#3	#8	#7	#6	#4	#1		
Option 0	RX/TX/CTS/RTS/DSR/DTR	RX	TX	CTS	RTS	DSR	DT	DR	---	---
Option 1	RX/TX/CTS/RTS/DSR/DTR + RX/tx	RX	TX	CTS	RTS	DSR	DT	DR	RX4	tx4
Option	RX/TX/CTS/RTS +	RX	TX	CT	RT	RX3	TX	RX		tx4

n 2	RX/TX + RX/tx			S	S		3	4	
Option 3	RX/TX/CTS/RTS + RX/TX/CTS/rts	RX	TX	CTS	RTS	RX3	TX3	CTS3	rts3
Option 4	RX/TX/CTS/RTS + RX/TX/DSR/dtr	RX	TX	CTS	RTS	RX3	TX3	DSR3	dtr3
Option 5	RX/TX/DSR/DTR + RX/TX + RX/tx	RX	TX	RX2	TX2	DSR	DTR	RX4	tx4
Option 6	RX/TX/DSR/DTR + RX/TX/CTS/rts	RX	TX	RX2	TX2	DSR	DTR	CTS2	rts2
Option 7	RX/TX/DSR/DTR + RX/TX/DSR/dtr	RX	TX	RX2	TX2	DSR	DTR	DSR2	dtr2
Option 8	RX/TX + RX/TX + RX/TX + RX/tx	RX	TX	RX2	TX2	RX3	TX3	RX4	tx4
Option 9	RX/TX/CTS/rts + RX/TX + RX/TX	RX	TX	RX2	TX2	RX3	TX3	CTS	rts
Option 10	RX/TX/DSR/dtr + RX/TX + RX/TX	RX	TX	RX2	TX2	RX3	TX3	DSR	dtr
Option 11	RX/TX/CTS/RTS + RX/tx/CTS/RTS	RX	TX	CTS	RTS	CTS4	RTS4	RX4	tx4
Option 12	RX/TX/CTS/RTS + RX/tx/DSR/DTR	RX	TX	CTS	RTS	DSR4	DTR4	RX4	tx4
Option 13	RX/TX/DSR/DTR + RX/tx/CTS/RTS	RX	TX	CTS4	RTS4	DSR	DTR	RX4	tx4
Option 14	RX/TX/DSR/DTR + RX/tx/DSR/DTR	RX	TX	DSR4	DTR4	DSR	DTR	RX4	tx4
Mapping option	Available signals	RX	TX	RX2/CTS	TX2/RTS	RX3/DSR	TX3/DTR	RX4	TX4
		Terminal blocks of the expansion connector (as marked on the EM1206EV)							

"Available signals" column shows a particular combination of I/O lines for each option. For example, option 0 defines the standard serial port arrangement with RX, TX, CTS, RTS, DSR, and DTR lines. Option 2 gives you one channel with RX, TX, CTS, and RTS lines, one more channel with just RX and TX lines, and yet another channel with a single RX line. The TX line is "missing" because, once again, there are only three outputs available on the RS232 port. This is why this line is shown in grey lowercase (tx). This line, of course, is present and available on the expansion connector.

EM120/EM200-EV

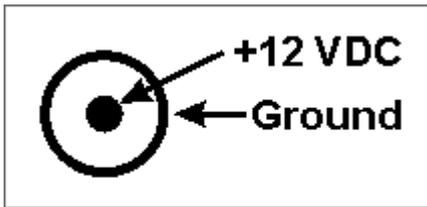


The EM120/200-EV Evaluation Board offers a convenient way of testing the EM120 (which is no longer supported as a programmable device) and [EM200](#) embedded modules. The board features the following components:

- A socket for EM120 or EM200 installation
- [Power jack](#) and a switching power regulator (12VDC-->5VDC, adaptor current rating must be no less than 500mA)
- [RJ45 connector](#) and 10/100BaseT Ethernet Magnetics (EM120 and EM200 do not have built-in magnetics)
- [DB9M RS232 connector](#) and RS232 transceiver (supported signals are RX, TX, RTS, CTS, DTR, DSR)
- Setup button (connected to the [MD](#) line of EM120/EM200)
- Two Ethernet LEDs and two status LEDs (connected to [LED lines](#) of EM120/200). Further information on status LEDs can be found in [Appendix 1: Status LEDs](#).
- Five additional LEDs connected to lines [P0, P1, P6-8](#) of the EM120/EM200
- [15-pin expansion connector](#) provides access to EM120/EM200's serial and general-purpose I/O pins (therefore, all I/O lines on this connector are of TTL type)

Power Jack

Power Jack of the EM120/EM200-EV accepts "large" power connectors with 5.5mm diameter. Use [APR-1014](#), [APR-1015A](#), or [APR-1018A](#) power adaptor supplied by Tibbo or similar adaptor with 12V nominal output voltage. Adaptor current rating should be at least 500mA. On the power jack, the ground is "on the outside", as shown on the figure below.



Ethernet Port Pin Assignment

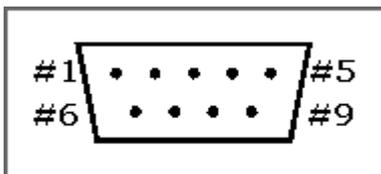
RJ45 Ethernet connector has the following pin assignment:



#1	TX+
#2	TX-
#3	RX+
#4	<No connection>
#5	<No connection>
#6	RX-
#7	<No connection>
#8	<No connection>

RS232 Port Pin Assignment

DB9M RS232 connector has the following pin assignment:



#1	<No connection>
#2	RX (input)
#3	TX (output)
#4	DTR (output)
#5	Ground
#6	DSR (input)
#7	RTS (output)
#8	CTS (input)
#9	<No connection>

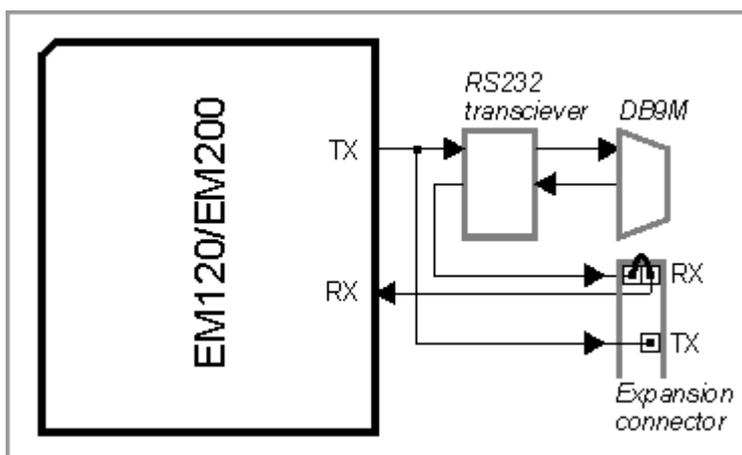
Expansion Connector Pin Assignment

15-pin expansion connector has the following pin assignment:

P0	Connected to pin P0 of EM120/EM200
P1	Connected to pin P1 of EM120/EM200
P6	Connected to pin P6 of EM120/EM200
P7	Connected to pin P7 of EM120/EM200
P8	Connected to pin P8 of EM120/EM200
GND	Ground
VCC	+5V from the EM120/EM200-EV board. Available "spare" current about 50mA
RST	Reset (active high) from the EM120/EM200-EV board. The signal is generated by an onboard reset IC. The same signal is applied to pin RST of EM120/EM200
MD	Connected to the download/setup button on the EM120/EM200-EV board. The signal is connected to pin MD of EM120/EM200
DTR	Connected to pin P3(DTR) of EM120/EM200
RTS	Connected to pin P5(RTS) of EM120/EM200
TX	Connected to pin TX of EM120/EM200
RX	Connected to pin RX of EM120/EM200
CTS	Connected to pin P4(CTS) of EM120/EM200
DSR	Connected to pin P2(DSR) of EM120/EM200

Output signals that are present both on the DB9M and expansion connectors (DTR, RTS, TX) need not be switched. So, for example, the TX (output) line from the EM120/EM200 is connected to the RS232 transceiver IC and to the expansion connector. For input signals (RX, CTS, DSR) there must be a way to disconnect the RS232 transceiver IC from the EM120/EM200. Three jumpers (combined with pins RX, CTS, DSR of the expansion connector) serve this purpose.

For example, when the RX jumper is closed the RX pin of the EM120/EM200 receives a signal from the RS232 transceiver. When the jumper is opened you can use the RX pin on the expansion connector to supply a TTL RX signal from your own external board. Figure below illustrates this.



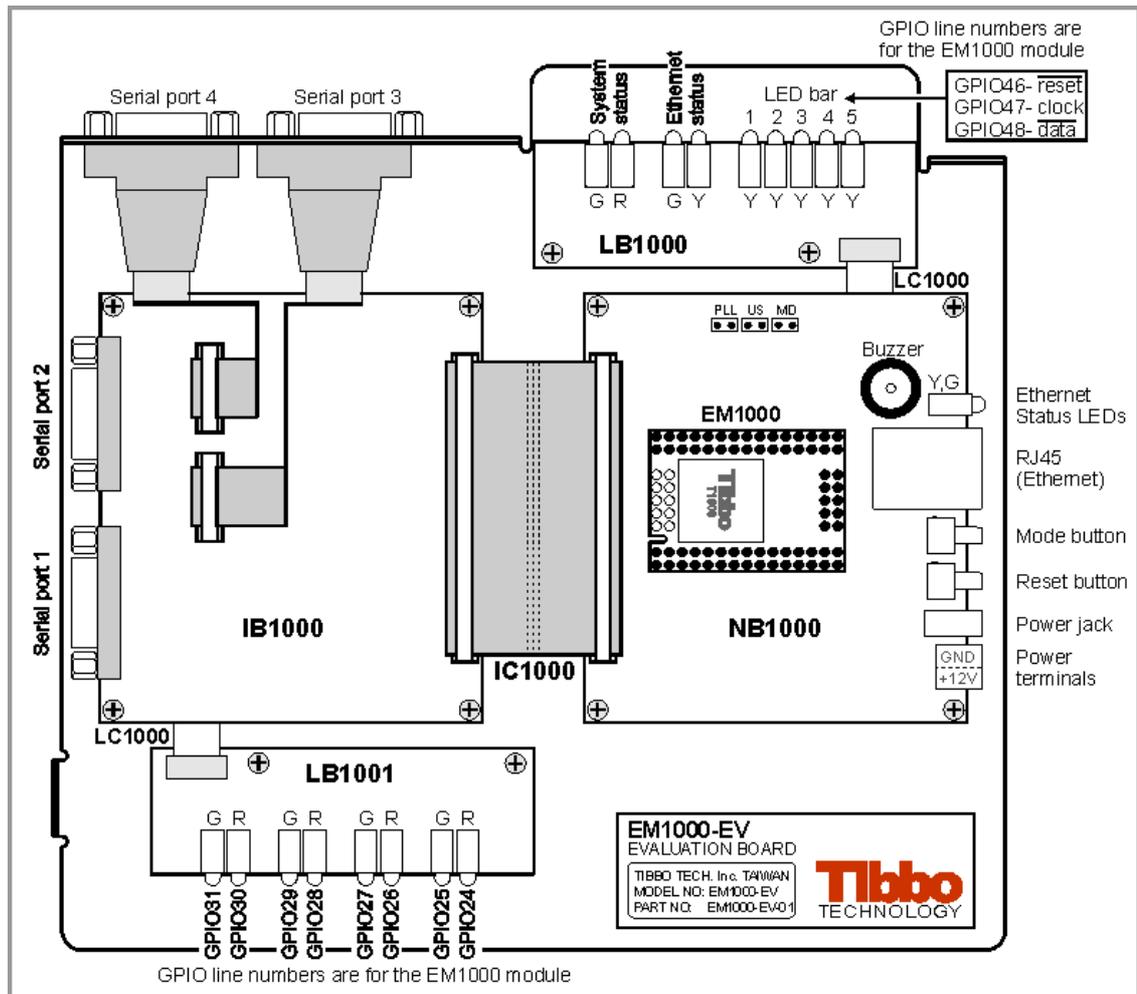
Maximum load for all CMOS-type lines (P0, P1, ... RX, TX...) is 10mA.

Development Systems

The following development systems are currently being offered by Tibbo:

- [EM1000EV](#)
- [EM1000TEV](#)
- [EM500EV](#)

EM1000EV

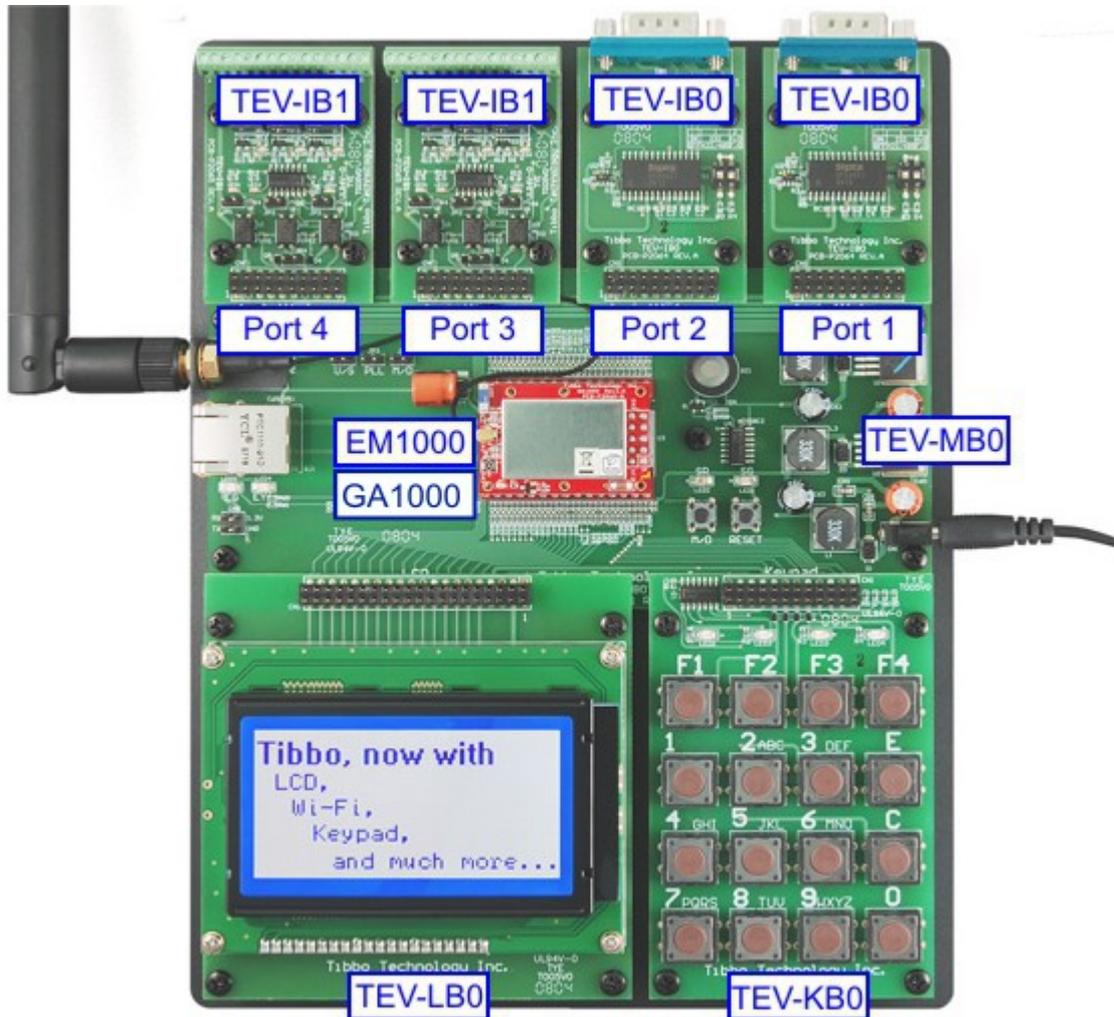


The EM1000-EV Evaluation System offers a convenient way of testing the [EM1000](#) BASIC-programmable embedded module. The board features the following components:

- Metal base.
- The [NB1000 network board](#) with the [EM1000](#) module ([EM1000-512K-ST](#)) installed on a socket.
- The [IB1000 interface board](#) with four RS232 ports.
- The [IC1000 interboard cable](#) interconnecting the NB1000 and the IB1000.
- The [LB1000 LED board](#), which is connected to the NB1000 by the [LC1000 LED board cable](#).
- The [LB1001 LED board](#), which is connected to the IB1000 by the LC1000 cable.

The EM1000-EV requires 12VDC/0.5A power adaptor.

EM1000TEV



The EM1000-TEV development system has been designed to aid you in developing data terminals, data collection devices, and control equipment based on the [EM1000](#) embedded module. Hence, the abbreviation: "TEV" stands for "terminal evaluation".

The EM1000-TEV includes the following boards:

- [TEV-MB0](#) motherboard with EM1000-512K-ST module. The EM1000 can optionally have a [GA1000](#) Wi-Fi slave module installed on top of it.
- [TEV-KB0](#) keypad board with 16 keys and 4 LEDs.
- [TEV-LBx](#) display board. Three different display boards are currently supplied:
 - [TEV-LB0](#) (shown): carries 128x64, black/white WINSTAR WG12864A LCD panel (SAMSUNG S6B0108 controller);
 - [TEV-LB1](#): carries 128x96, 4-bit RITDISPLAY RGS13128096 OLED panel (SOLOMON SSD1329 controller);
 - [TEV-LB2](#): carries 176x220 AMPIRE AM176220 TFT panel (HIMAX HX8309

controller).

- **TEV-IBx** interface boards. Four boards can be installed at the same time, and two board kinds are currently supplied:
 - [TEV-IB0](#): RS232/422/485 serial port board (each EM1000-TEV system has two of them);
 - [TEV-IB1](#): 3 x opto-input/ 3 x relay output board (each EM1000-TEV system has two of them). Opto-inputs can optionally be used to connected a Wiegand or clock/data reader.

You can choose what display board will be installed on your EM1000-TEV. See [Ordering Info](#) for details.

The EM1000-TEV is supplied with a sophisticated Tibbo BASIC "terminal" demo application that demonstrates the use of all hardware facilities of this development system. The application implements a hypothetical data collection terminal complete with onscreen setup menus, browser interface, event log, etc. The latest version of the application can be obtained from Tibbo website.

TEV-MB0

The TEV-MB0 is a motherboard that has the [EM1000](#) module ([EM1000-512K-ST](#)) installed on it. The EM1000 is installed on a socket. Schematic diagram of the TEV-MB0 board can be found on Tibbo website.

The TEV-MB0 motherboard also features the following:

- A switching regulator with 5V output. 5V power is provided on all connectors to other boards of the EM1000-TEV system.
- A switching regulator with 3.3V output. 3.3V power is provided on all connectors to other boards of the EM1000-TEV system and also powers the EM1000.
- MD button and jumper. Connected to the MD input of the EM1000. See [Appendix 2: Setup Button \(MD line\)](#) for details.
- RESET button. This is a master reset for the EM1000 module.
- Status LEDs -- for details see [Appendix 1: Status LEDs](#).
- U/S jumper. Leave it opened.
- PLL jumper. Powering up with this jumper closed causes the EM1000 to run with the PLL off. For normal operation leave this jumper opened.

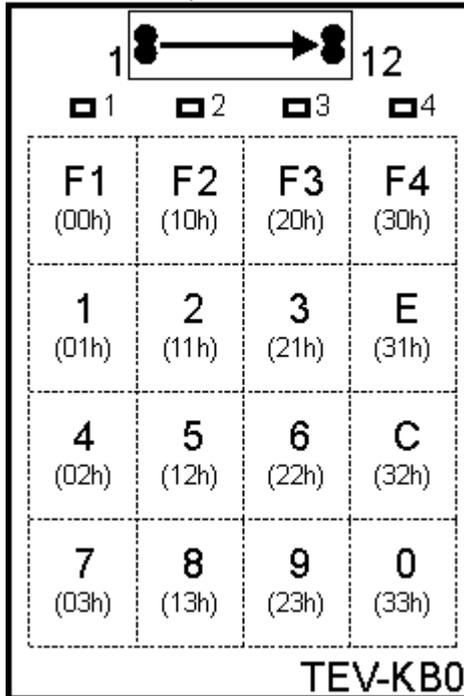
TEV-KB0

The TEV-KB0 board carries 16 keys and 4 green LEDs. The keys are arranged as a 4x4 matrix, with 4 scan lines and 4 return lines. Each scan line additionally controls one green LED. Schematic diagram of the TEV-KP0 board can be found on Tibbo website.

TEV-LBx Board Connector

The TEV-KB0 board is connected to the [TEV-MB0](#) motherboard through a 2x12-pin connector. Each two pins of the connector are combined together for better electrical contact. Therefore, the connector effectively has 12 lines.

Each two pins count as one



Pin #	Function	Keypad
1	VIN (12V)	
2	5V	
3	3.3V	
4	GND	
5	GPIO24*	Scan1, LED1
6	GPIO25*	Scan2, LED2
7	GPIO26*	Scan3, LED3
8	GPIO27*	Scan4, LED4
9	GPIO28*	Return1
10	GPIO29*	Return2
11	GPIO30*	Return3
12	GPIO31*	Return4

* I/O pins of the [EM1000](#) module

Required initialization code in Tibbo BASIC application

This section assumes that you are familiar with Tibbo BASIC and TIDE software. These are documented in the "TIDE and Tibbo BASIC Manual".

For correct board operation, click Project-> Settings, and select "EM1000" or "EM1000G" platform. Additionally, click Customize to open a Customize Platform dialog. In the dialog, double-click the Keypad (kp.) Object line and choose "Enabled".

The following initialization code should also be added to your project:

```
kp.scanlinesmapping=" 24,25,26,27"  
kp.returnlinesmapping=" 28,29,30,31"  
  
io.num=PL_IO_NUM_24  
io.enabled=YES  
  
io.num=PL_IO_NUM_25  
io.enabled=YES  
  
io.num=PL_IO_NUM_26  
io.enabled=YES  
  
io.num=PL_IO_NUM_27  
io.enabled=YES  
  
kp.enabled=YES
```

All key-related events are served in the event handler for the `on_kp()` event. The `key_code` argument carries the code of the key. Keycodes of each key are indicated in parentheses on the drawing above. For example, key <5> has the code of 12Hex.

Each scan line of the keypad also controls one LED. To turn the LED on, set the corresponding scan line LOW. This will not affect the operation of the keypad.

TEV-LBx Boards

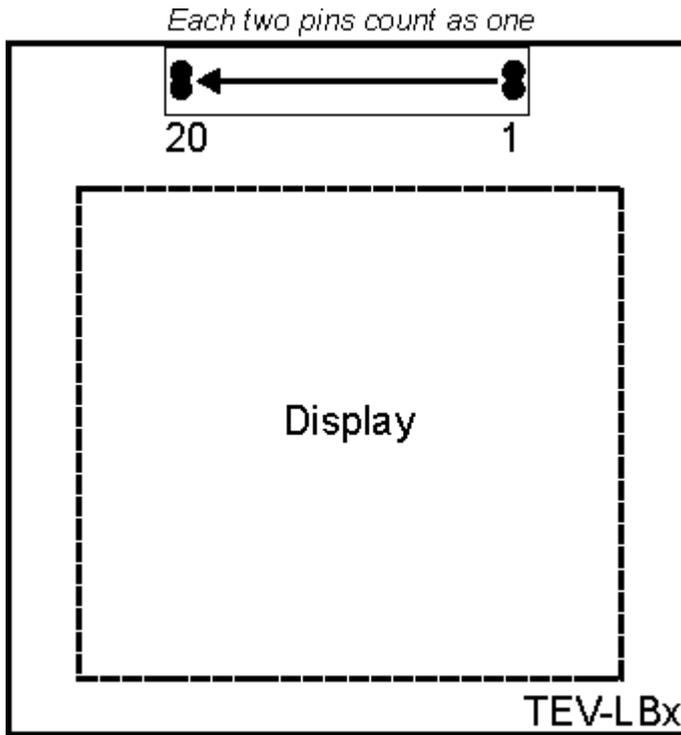
The TEV-LBx boards carry display panels. Three boards are currently supplied by Tibbo:

- **TEV-LB0**: carries 128x64, black/white WINSTAR WG12864A LCD panel (SAMSUNG S6B0108 controller).
- **TEV-LB1**: carries 128x96, 4-bit RITDISPLAY RGS13128096 OLED panel (SOLOMON SSD1329 controller).
- **TEV-LB2**: carries 176x220 AMPIRE AM176220 TFT panel (HIMAX HX8309 controller).

You can choose what display board will be installed on your EM1000-TEV. See [Ordering Info](#) for details.

TEV-LBx Board Connector

The TEV-LBx boards are connected to the [TEV-MB0](#) motherboard through a 2x20-pin connector. Each two pins of the connector are combined together for better electrical contact. Therefore, the connector effectively has 20 lines.



Pin #	Function
1	VIN (12V)
2	5V
3	3.3V
4	GND
5	GPIO48*
6	GPIO47*
7	GPIO46*
8	GPIO39/P4.7*
9	GPIO38/P4.6*
10	GPIO37/P4.5*
11	GPIO36/P4.4*
12	GPIO35/P4.3*
13	GPIO34/P4.2*
14	GPIO33/P4.1*
15	GPIO32/P4.0*
16	GPIO44*
17	GPIO43*
18	GPIO42*
19	GPIO41*
20	GPIO40*

* I/O pins of the [EM1000](#) module

TEV-LB02.3.1

The TEV-LB0 board carries a 128x64, black/white WINSTAR WG12864A LCD panel. This panel is based on a SAMSUNG S6B0108 controller (there are two controllers on one panel). The WG12864A does not have the contrast control, so the contrast control circuit is added externally. Additionally, there is a control line for the LCD panel's backlight. The image displayed on the panel is not visible unless the backlight is turned on.

Related datasheets, as well as the schematic diagram for the TEV-LB0 board can be found on Tibbo website.

Interconnection between the EM1000 and the panel/ contrast control/ backlight control

Pin # ⁽¹⁾	EM1000 I/O line	Panel
5	GPIO48	CTRST_SET ⁽²⁾
6	GPIO47	BL ⁽³⁾
7	GPIO46	EN
8	GPIO39/P4.7	D7
9	GPIO38/P4.6	D6
10	GPIO37/P4.5	D5
11	GPIO36/P4.4	D4
12	GPIO35/P4.3	D3, CTRST3 ⁽²⁾
13	GPIO34/P4.2	D2, CTRST2 ⁽²⁾
14	GPIO33/P4.1	D1, CTRST1 ⁽²⁾
15	GPIO32/P4.0	D0, CTRST0 ⁽²⁾
16	GPIO44	RST
17	GPIO43	D/I
18	GPIO42	R/W
19	GPIO41	CS2
20	GPIO40	CS1

⁽¹⁾ Pin number on the TEV-LB0 connector.

⁽²⁾ The line of the contrast control circuit, not the LCD panel itself.

⁽³⁾ Backlight control line.

Required initialization code in Tibbo BASIC application

This section assumes that you are familiar with Tibbo BASIC and TIDE software. These are documented in the "TIDE and Tibbo BASIC Manual".

For correct panel operation, click Project-> Settings, and select "EM1000" or "EM1000G" platform. Additionally, click Customize to open a Customize Platform dialog. In the dialog, double-click the Display Panel Type line and choose "Samsung S6B0108 (Winstar WG12864A)".

The following initialization code should also be added to your project:

```
lcd.iomapping="44,46,40,41,43,42,4" 'RST,EN,CS1,CS2,DI,RW,data_bus
```

```
io.num=PL_IO_NUM_46
io.enabled=YES

io.num=PL_IO_NUM_44
io.enabled=YES

io.num=PL_IO_NUM_40
io.enabled=YES

io.num=PL_IO_NUM_41
io.enabled=YES

io.num=PL_IO_NUM_42
io.enabled=YES

io.num=PL_IO_NUM_43
io.enabled=YES

lcd.width=128
lcd.height=64
lcd.rotated=NO
lcd.inverted=NO
lcd.enabled=YES
set_lcd_contrast(11)
```

The `set_lcd_contrast()` procedure should be called *after* the panel initialization. The procedure sets the contrast level in 16 steps -- the contrast control hardware only has 4 data lines. Therefore, the contrast level of 16 is equal to the contrast level of 0.

Here is the suggested code for this function:

```
Sub Set_lcd_contrast(level As Byte)
'Contrast control shares the data bus with the LCD. Initialize LCD first,
'then set the contrast (before LCD initialization the bus may be driven
'by the LCD)

'enable port, output data
io.portnum=PL_IO_PORT_NUM_4
io.portenabled=255
io.portstate=level

'generate strobe for the data register (on the LCD PCB)
io.num=PL_IO_NUM_48
io.enabled=YES
io.state=HIGH
io.state=LOW

'disable port
io.portenabled=0
End Sub
```

Use the following code to turn on the backlight:

```
io.num=PL_IO_NUM_47 'backlight
io.enabled=YES
io.state=LOW
```

TEV-LB12.3.2

The TEV-LB1 board carries a 128x96, 4-bit RITDISPLAY RGS13128096 OLED panel. This panel is based on a SOLOMON SSD1329 controller.

Related datasheets, as well as the schematic diagram for the TEV-LB1 board can be found on Tibbo website.

Interconnection between the EM1000 and the panel

Pin # ⁽¹⁾	EM1000 I/O line	Panel
5	GPIO48	---
6	GPIO47	---
7	GPIO46	---
8	GPIO39/P4.7	D7
9	GPIO38/P4.6	D6
10	GPIO37/P4.5	D5
11	GPIO36/P4.4	D4
12	GPIO35/P4.3	D3
13	GPIO34/P4.2	D2
14	GPIO33/P4.1	D1
15	GPIO32/P4.0	D0
16	GPIO44	RST
17	GPIO43	D/C
18	GPIO42	R/W
19	GPIO41	E
20	GPIO40	CS

⁽¹⁾ Pin number on the TEV-LB1 connector.

Required initialization code in Tibbo BASIC application

This section assumes that you are familiar with Tibbo BASIC and TIDE software. These are documented in the "TIDE and Tibbo BASIC Manual".

For correct panel operation, click Project-> Settings, and select "EM1000" or "EM1000G" platform. Additionally, click Customize to open a Customize Platform dialog. In the dialog, double-click the Display Panel Type line and choose "Solomon SSD1329 (Ritdisplay RGS13128096)".

The following initialization code should also be added to your project:

```

lcd.iomapping="44,43,42,41,40,4" 'RST,DC,WR,RD,CS,data_bus
'(W is marked "R/W" on the schematic diagram, RD is marked "E")

io.num=PL_IO_NUM_40
io.enabled=YES

io.num=PL_IO_NUM_41
io.enabled=YES

io.num=PL_IO_NUM_42
io.enabled=YES

io.num=PL_IO_NUM_43
io.enabled=YES

io.num=PL_IO_NUM_44
io.enabled=YES

lcd.width=128
lcd.height=96
lcd.rotated=NO
lcd.inverted=NO
lcd.enabled=YES

```

TEV-LB2.3.3

The TEV-LB2 board carries a 176x220 AMPIRE AM176220 TFT panel. This panel is based on a HIMAX HX8309 controller. There is also a control line for panel's backlight. The image displayed on the panel is not visible unless the backlight is turned on.

Related datasheets, as well as the schematic diagram for the TEV-LB2 board can be found on Tibbo website.

Interconnection between the EM1000 and the panel/ backlight control

Pin # ⁽¹⁾	EM1000 I/O line	Panel
5	GPIO48	---
6	GPIO47	BL ⁽²⁾
7	GPIO46	---
8	GPIO39/P4.7	D7
9	GPIO38/P4.6	D6
10	GPIO37/P4.5	D5
11	GPIO36/P4.4	D4
12	GPIO35/P4.3	D3
13	GPIO34/P4.2	D2

14	GPIO33/P4.1	D1
15	GPIO32/P4.0	D0
16	GPIO44	RST
17	GPIO43	DC
18	GPIO42	WR
19	GPIO41	RD
20	GPIO40	CS

(1) Pin number on the TEV-LB2 connector.

(2) Backlight control line.

Required initialization code in Tibbo BASIC application

This section assumes that you are familiar with Tibbo BASIC and TIDE software. These are documented in the "TIDE and Tibbo BASIC Manual".

For correct panel operation, click Project-> Settings, and select "EM1000" or "EM1000G" platform. Additionally, click Customize to open a Customize Platform dialog. In the dialog, double-click the Display Panel Type line and choose "Himax HX8309 (Ampire AM176220)".

The following initialization code should also be added to your project:

```
lcd.iomapping="44,43,42,41,40,4" 'RST,DC,WR,RD,CS,data_bus

io.num=PL_IO_NUM_44
io.enabled=YES

io.num=PL_IO_NUM_43
io.enabled=YES

io.num=PL_IO_NUM_42
io.enabled=YES

io.num=PL_IO_NUM_41
io.enabled=YES

io.num=PL_IO_NUM_40
io.enabled=YES

lcd.width=176
lcd.height=220
lcd.rotated=NO
lcd.inverted=NO
lcd.enabled=YES
```

Use the following code to turn on the backlight:

```
io.num=PL_IO_NUM_47
io.enabled=YES
io.state=LOW
```

TEV-IBx Boards

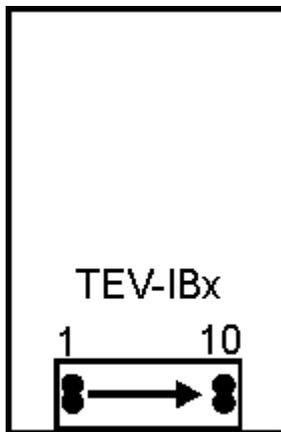
The TEV-IBx are interface boards. Two boards are currently supplied by Tibbo:

- **TEV-IB0:** RS232/422/485 serial port board (each EM1000-TEV system has two of them);
- **TEV-IB1:** 3 x opto-input/ 3 x relay output board (each EM1000-TEV system has two of them). Opto-inputs can optionally be used to connected a Wiegand or clock/data reader.

TEV-IBx Board Connector

The TEV-IBx boards are connected to the [TEV-MB0](#) motherboard through a 2x10-pin connector. Each two pins of the connector are combined together for better electrical contact. Therefore, the connector effectively has 10 lines.

Each EM1000-TEV system has four interface boards and each board is controlled through one of the four serial ports of the [EM1000](#) module.



*Each two pins
count as one*

Pin #	Port 1	Port 2	Port 3	Port 4
1	VIN (12V)			
2	5V			
3	3.3V			
4	GND			
5	GPIO8/RX0*	GPIO10/RX1*	GPIO12/RX2*	GPIO14/RX3*
6	GPIO9/TX0*	GPIO11/TX1*	GPIO13/TX2*	GPIO15/TX3*
7	GPIO16/INT0/ CTS0*	GPIO17/INT1/ CTS1*	GPIO18/INT2/ CTS2*	GPIO19/INT3/ CTS3*
8	GPIO0/RTS0*	GPIO1/RTS1*	GPIO2/RTS2*	GPIO3/RTS3*
9	GPIO20/INT4/ DSR0*	GPIO21/INT5/ DSR1*	GPIO22/INT6/ DSR2*	GPIO23/INT7/ DSR3*
10	GPIO4/DTR0*	GPIO5/DTR1*	GPIO6/DTR2*	GPIO7/DTR3*

* I/O pins of the [EM1000](#) module. Not all pin functions are shown. See EM1000 documentation for full description.

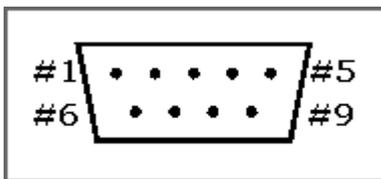
TEV-IB0.2.4.1

The TEV-IB0 implements one RS232/422/485 serial port. The port is built around SIPEX SP334 multi-protocol transceiver IC. A small PIC10F200 microcontroller from MICROCHIP is also used. This microcontroller replaces discrete logic that would be needed to control the SP334 in different operating modes. Related datasheets, assembly program for the microcontroller, as well as the schematic diagram for the TEV-IB0 board can be found on Tibbo website.

Two switches are provided on the board for protocol selection. Switch 1 selects between RS232 and RS422/485 signal levels. Switch 2 selects half-duplex or full-duplex mode of operation. Note that these switches only control the operation of the SP334. Serial ports of the [EM1000](#) must be correctly preset for desired communication mode as well.

For your convenience, each TEV-IB0 board is supplied with a [TB100](#) terminal block adaptor.

DB-9M connector pin assignment



Pin #	RS232 mode	RS422 mode	RS485 mode
1	---	RTS- (output)	---
2	RX (input)	RX- (input)	RX- (input)
3	TX (output)	TX+ (output)	TX+ (output)
4	DTR (output)	TX- (output)	TX- (output)
5	SYSTEM GROUND	SYSTEM GROUND	SYSTEM GROUND
6	DSR (input)	RX+ (input)	RX+ (input)
7	RTS (output)	RTS+ (output)	---
8	CTS (input)	CTS+ (input)	---
9	---	CTS- (input)	---

Required initialization code in Tibbo BASIC application

This section assumes that you are familiar with Tibbo BASIC and TIDE software. These are documented in the "TIDE and Tibbo BASIC Manual".

Correct preset of serial ports falls outside the scope of this manual. This section will only remind you that you need to set a correct serial port mode matching the mode selected by the switches of the TEV-IB0. For RS232 or RS422 mode, set `ser.interface=PL_SER_SI_FULLDUPLEX`. For the RS485 mode set `ser.interface=PL_SER_SI_HALFDUPLEX`.

Do not forget that all lines of the EM1000 are configured as inputs by default. Any

line that should work as an output should be configured as such. This is done through the "I/O" (io.) object. The only exception is the TX line that becomes an output automatically once the serial port is enabled.

TEV-IB1.2.4.2

The TEV-IB1 board contains three relays and three optically isolated inputs. Common, normally closed, and normally opened lines of each relay are available on the terminal block. Six status LEDs located on the board indicate the state of relays and opto-inputs.

The relays can switch loads of up to 24V/1A. This rating is for non-inductive loads only! For inductive loads, the maximum allowed current falls to about 200mA. Status LEDs 4-6 indicate the state of relays. An LED will be ON when a corresponding relay is activated.

Each optically isolated input has a pair of (+) and (-) contacts with a 330 Ohm series resistor and a LED of the photo-couple between them. The input is activated at a differential voltage of around 4V, and can accept input voltages as high as 24V. Both (+) and (-) inputs are isolated from the rest of the system. Status LEDs 1-3 indicate the state of inputs. An LED will be ON when the current is flowing through a corresponding input and the input is "triggered".

You can use inputs 1-3 to connect to external sensors. Alternatively, inputs 1 and 2 can be used to attach a Wiegand or clock/data card reader. See below for details.

Related EM1000 I/O lines

Pin # ⁽¹⁾	EM1000 I/O line ⁽²⁾	Function
1	TX	Relay1 ⁽³⁾
2	RTS	Relay2 ⁽³⁾
3	DTR	Relay3 ⁽³⁾
4	RX	Input1 ⁽⁴⁾
5	CTS	Input2 ⁽⁴⁾
6	DSR	Input3 ⁽⁴⁾

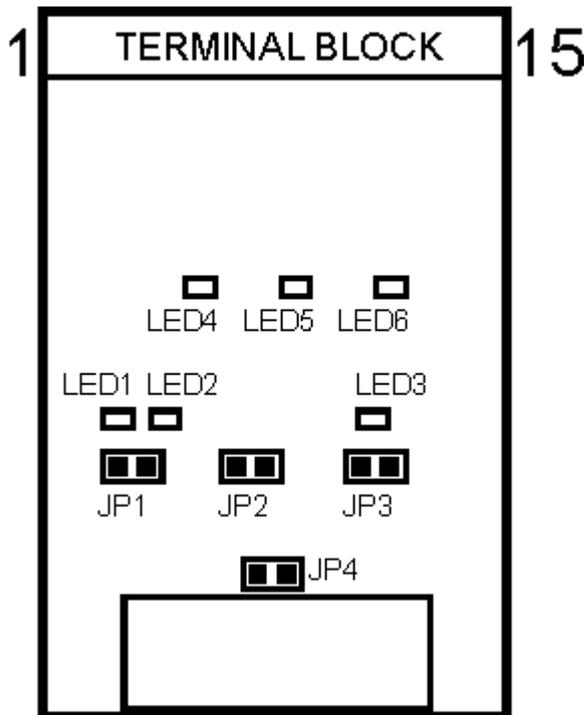
⁽¹⁾ Pin number on the TEV-IB1 connector.

⁽²⁾ There are four ports, so lines are independent for each port. For example, "TX" means "TX0" for port 1, "TX1" for port 2, etc.

⁽³⁾ Set GPIO line of the EM1000 LOW to activate the relay (do not forget to configure this line as an output).

⁽⁴⁾ The GPIO line of the EM1000 will be LOW when the current is flowing through the input.

Terminal block



Terminal # ⁽¹⁾	Function
1	Relay1, common
2	Relay1, normally closed
3	Relay1, normally opened
4	Relay2, common
5	Relay2, normally closed
6	Relay2, normally opened
7	Relay3, common
8	Relay3, normally closed
9	Relay3, normally opened
10	Input1, positive line (+)
11	Input1, negative line (-)
12	Input2, positive line (+)
13	Input2, negative line (-)
14	Input3, positive line (+)
15	Input3, negative line (-)

Connecting a card reader

Ability to handle a Wiegand or clock/data reader output is a unique feature of the serial ports of the EM1000. For more information, see "TIDE and Tibbo BASIC Manual" ("Serial" (ser.) object documentation).

When connecting a clock/data reader, attach the reader's DATA output to the positive line of the input 1 of the TEV-IB1 board. Attach the CLOCK output to the positive line of the input 2. Combine negative lines of inputs 1 and 2 together and connect them to the ground line of the reader. Leave JP4 jumper opened.

When connecting a Wiegand reader, attach the reader's W0 output to the positive

line of the input 1 of the TEV-IB1 board. Attach the W1 output to the positive line of the input 2. Combine negative lines of inputs 1 and 2 together and connect them to the ground line of the reader. Close the jumper JP4.

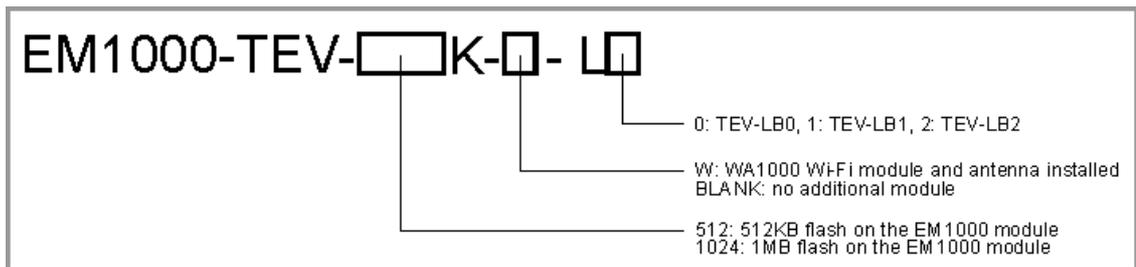
Most Wiegand readers have open-collector outputs, which means you may need to install pull-up resistors on their W0 and W1 outputs.

The function of the JP4 is to combine the signals W0 and W1 -- this is required for the EM1000's serial port operation in Wiegand mode.

Jumpers JP1-3 should be left open.

Ordering Info

The EM1000-TEV has several versions available. The numbering scheme is as follows:



The following is included into each EM1000-TEV:

- The [TEV-MB0](#) board with the EM1000-512K-ST or EM1000-1024K-ST module (see [EM1000 Ordering Info](#) for details).
- Additionally, the [GA1000](#) Wi-Fi module and antenna are installed if option "G" is specified.
- The [TEV-KB0](#) keypad board.
- The [TEV-LBx](#) display board of your choice.
- Two [TEV-IB0](#) boards, installed on ports 1 and 2.
- Two [TEV-IB1](#) boards, installed on ports 3 and 4.
- Two [TB100](#) terminal block adaptors.
- One [12V/1A power adaptor](#).
- One [WAS-1499](#) "straight" Ethernet cable. Good for crossover connections as well, since the EM1000 supports Auto-MDIX.
- One [WAS-P0005\(B\)](#) serial cable. Can be used for firmware upgrades through the serial port.

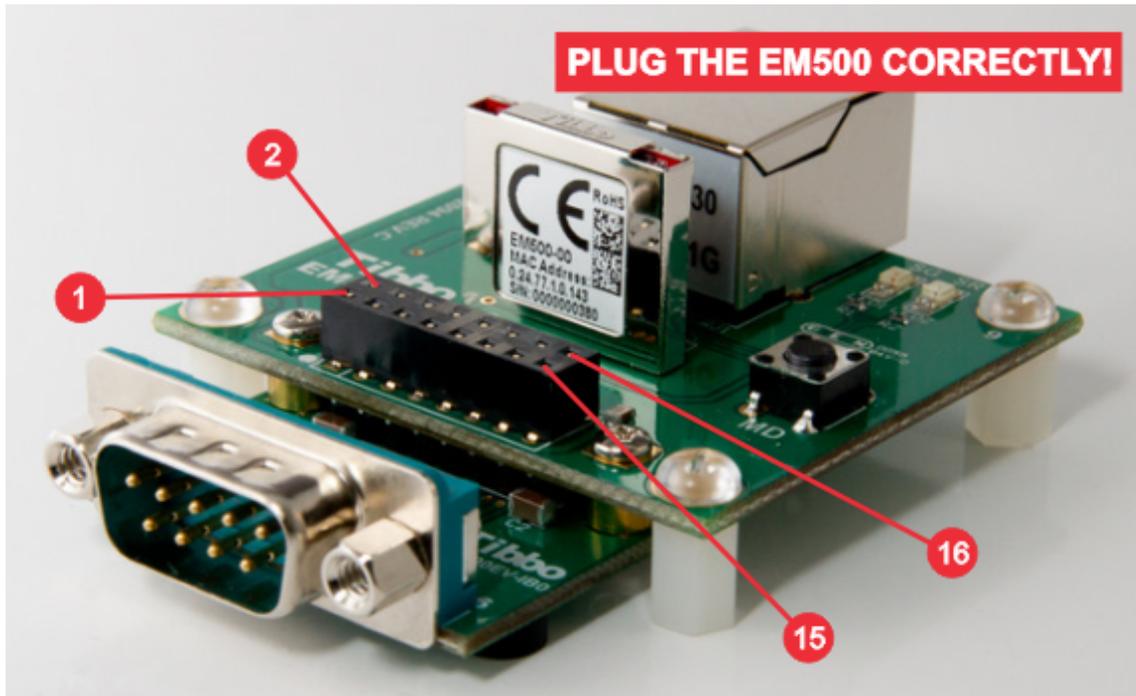
Additionally, any board or accessory from the EM1000-TEV system can be purchased separately.

DSR, and DTR lines.

- The [EM500EV-IB1](#) board provides a connector for the [GA1000](#) Wi-Fi add-on module, 1024KBytes of flash memory, and a limited RS232 interface (RX, TX, CTS, RTS).

Tibbo BASIC offers a fully functional serial-over-IP application that can be tested on the EM500EV. Written in Tibbo BASIC, the application is compatible with Tibbo Device Server Toolkit software, comes with complete source code, and can be modified by the user.

EM500EV-MB0



The EM500EV-MB0 motherboard comes with the [EM500](#) module (installed on a socket). A schematic diagram of the EM500EV-MB0 board can be found on Tibbo website.

- ❗ It is physically possible to plug the EM500 module into the EM500EV-MB0 in reverse. Doing so may irreversibly damage the device.
Plug the EM500 as shown on the picture above.

The TEV-MB0 motherboard also features the following:

- A power jack and a switching regulator with 3.3V output. This 3.3V power is supplied to the EM500 and is also provided on the interface board connector (see below).
- An [MD button](#), which is connected to the MD input of the EM500.
- Green and red dual-function [status LEDs](#). The term "dual-function" refers to the fact that these LEDs are also used for Ethernet link status indication.

Interface board interface

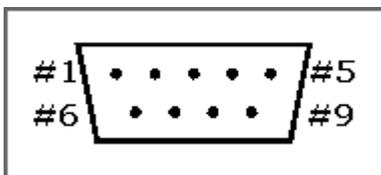
The EM500EV-IB0 RS232 interface board is connected to the EM500EV-MB0 through a 16-pin connector. Connector pin assignment is as follows:

Pin #	Function
1	Vcc output (3.3V)
2	GND
3	RX ⁽¹⁾
4	TX ⁽¹⁾
5	GPI00/P0.0/INT0 ⁽¹⁾
6	GPI01/P0.1/INT1 ⁽¹⁾
7	GPI02/P0.2 ⁽¹⁾
8	GPI03/P0.3 ⁽¹⁾
9	GPI04/P0.4 ⁽¹⁾
10	GPI05/P0.5 ⁽¹⁾
11	GPI06/P0.6 ⁽¹⁾
12	GPI07/P0.7 ⁽¹⁾
13	MD ⁽¹⁾
14	RST ⁽¹⁾
15	GND
16	VIN (12V)

⁽¹⁾ Directly connected to the corresponding pin of the EM500.

EM500EV-IB0

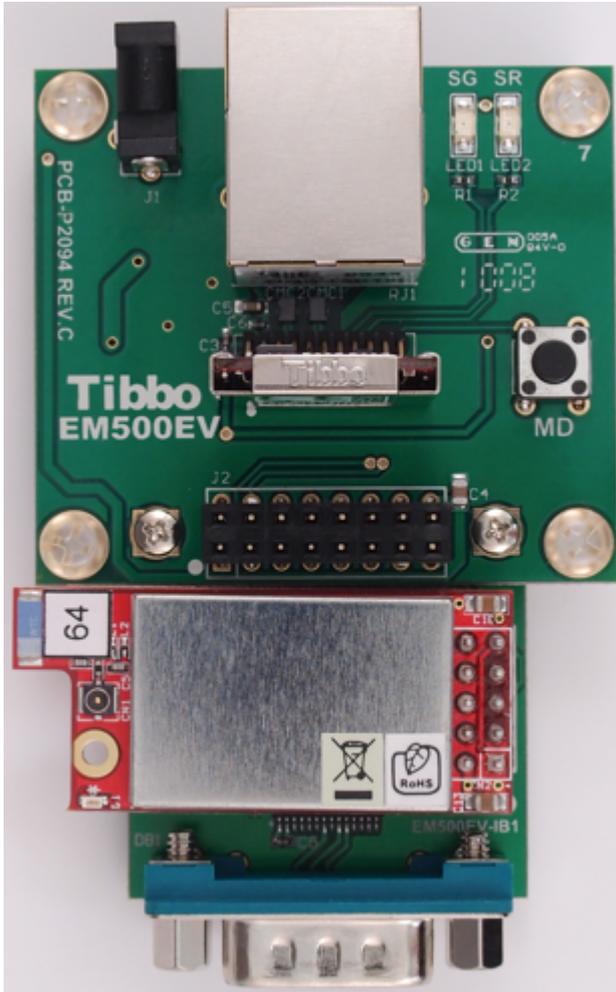
The EM500EV-IB0 RS232 interface board implements one RS232 serial port. The port is built around SIPEX SP3243 RS232 transceiver IC. RS232 interface lines are available on a standard DB-9M connector:



Pin # (DB-9M)	R232 line (DB-9M)	EM500 control line
1	CD (input)	GPI04/P0.4
2	RX (input)	RX
3	TX (output)	TX
4	DTR (output)	GPI03/P0.3
5	SYSTEM GROUND	
6	DSR (input)	GPI01/P0.1/INT1

7	RTS (output)	GPIO2/P0.2
8	CTS (input)	GPIO0/P0.0/INT0
9	---	

EM500EV-IB1



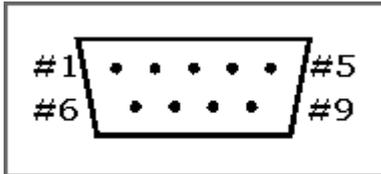
The EM500EV development system with the IB1 interface board.
Notice the orientation of the [GA1000](#) module.

The EM500EV-IB1 features a connector for the [GA1000](#) Wi-Fi add-on module, 1024KBytes of flash memory, and a serial port with limited functionality (RX, TX, CTS, and RTS lines only).

Connection to the GA1000 is implemented according to the schematic diagram C presented in the [Connecting GA1000 to Tibbo Devices](#) topic.

Connection to the flash memory is implemented according to the schematic diagram presented in the [Flash and EEPROM Memory topic](#) (of the EM500 documentation).

RS232 interface lines are available on a standard DB-9M connector:



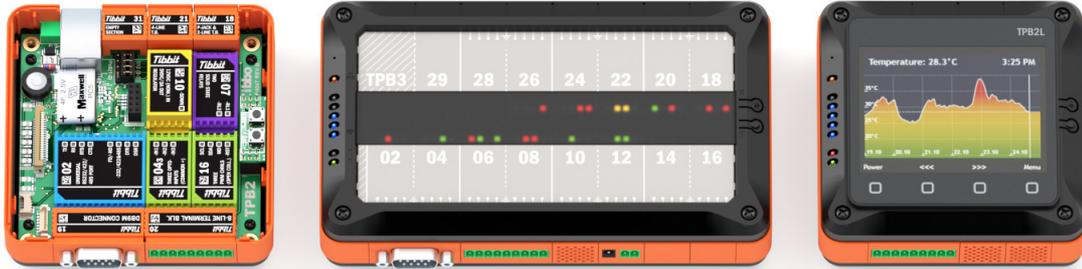
Pin # (DB-9M)	R232 line (DB-9M)	EM500 control line
1	---	---
2	RX (input)	RX
3	TX (output)	TX
4	---	---
5	SYSTEM GROUND	
6	---	---
7	RTS (output)	GPIO2/P0.2
8	CTS (input)	GPIO0/P0.0/INT0
9	---	

Ordering Info

Model number	Description
EM500EV	Development system, includes: <ul style="list-style-type: none"> The EM500EV-MB0 motherboard with the EM500 module on a socket. The EM500EV-IB0 interface board. One 12V/0.5A power adaptor. <i>No cables or other accessories are supplied with this development system.</i>
EM500EV-G	Development system, includes: <ul style="list-style-type: none"> The EM500EV-MB0 motherboard with the EM500 module on a socket. The EM500EV-IB1 interface boards. Wi-Fi antenna with cable. One 12V/0.5A power adaptor. <i>No cables or other accessories are supplied with this development system.</i>
EM500-IB0	The EM500EV-IB0 interface board.
EM500-IB1	The EM500EV-IB1 interface board.

To have both the IB0 and IB1 boards, order the complete development system with one of the IB boards, and in addition order the second IB board separately.

Tibbo Project System (TPS)



Tibbo Project System (TPS) is a highly configurable and affordable modularized automation platform.

The TPS comprises three major components:

[Tibbits](#)

Tibbits (as in "Tibbo Bits") are blocks of prepackaged I/O functionality housed in brightly colored rectangular shells.

Want an ADC? There is a Tibbit for this. 5V power supply? Got that! RS232/422/485 port? We have this, and many other Tibbits, too.

[Tibbo Project PCB \(TPP\)](#)

Tibbo Project PCBs are motherboards that accommodate Tibbits. Depending on the size, each TPP can fit up to 12 or 28 Tibbits! Like our [EM1000](#) module, Tibbo Project PCBs are programmable in Tibbo BASIC and carry the T1000 CPU, Ethernet port, flash memory, and the EEPROM. Unlike the EM1000, a TPP doesn't need a host board to plug into. The TPP *is* the host board.

[Tibbo Project Box \(TPB\)](#)

Most projects require an enclosure. Designing one is a tough job. Making it beautiful is even tougher, and may also be prohibitively expensive. Not to worry -- your system can be assembled in a Tibbo Project Box.

There is a Box for every TPP size. You can also choose a TPB with an LCD display and sensor keys.

Tibbo Project Boxes can be ordered unassembled (as part kits) or fully assembled. We also offer an *optional* [retail packaging](#) for TPBs, as well as vibration protection and DIN rail mounting kits.

TPP + Tibbits [+ TPB] = Tibbo Project System (TPS)

Combine a Tibbo Project PCB (TPP) with at least one Tibbit, and you get a Tibbo Project System (TPS). A TPS may or may not be housed in a Tibbo Project Box (TPB).

Configure your TPS online

<http://tibbo.com/tps-configurator/>

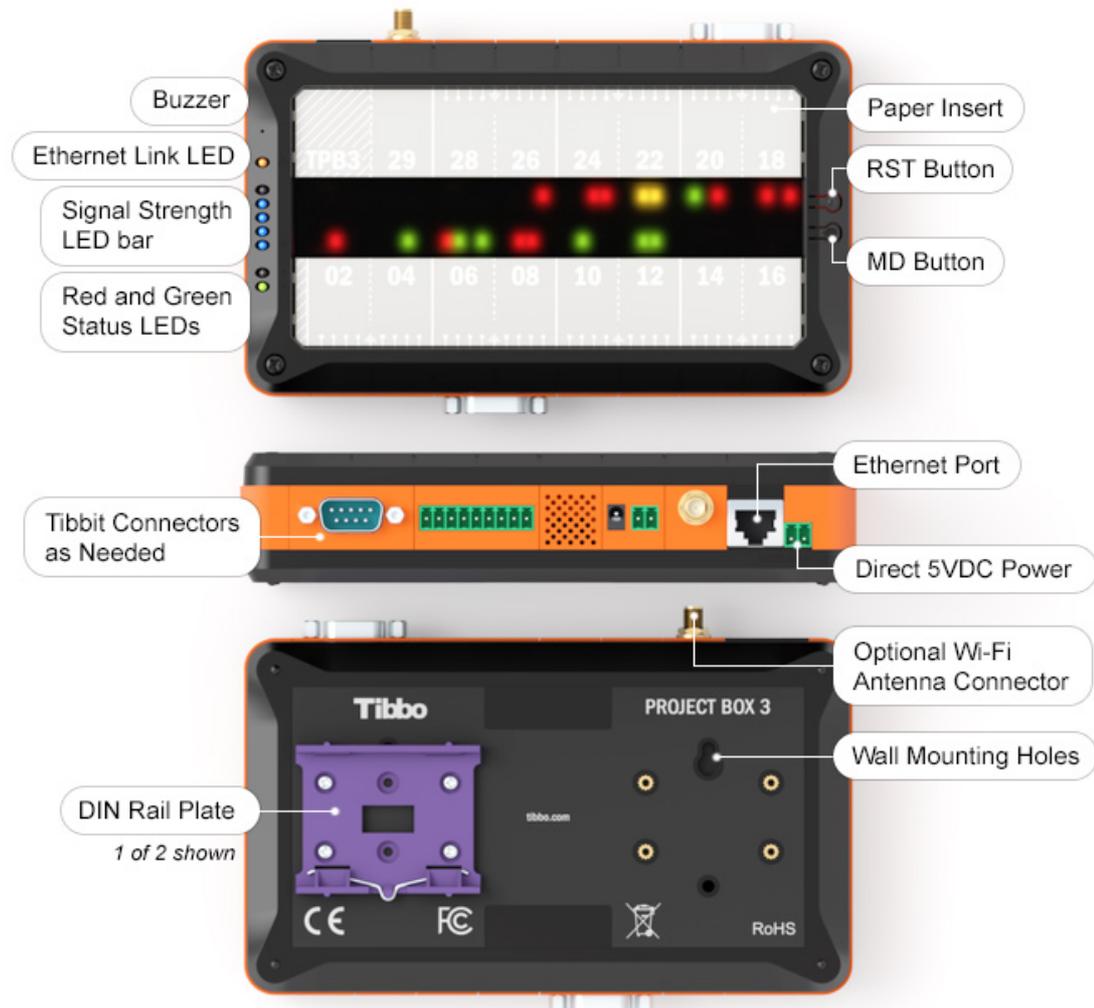
For your convenience we've created an online configurator that allows you to choose the TPP board, "plug in" Tibbits, and save your custom configuration under a unique name. The configurator will make sure your design is valid, i.e. Tibbit combinations are used correctly, the total power consumption is within the available

power budget, etc.

The configurator will also let you select options: whether the system should be shipped unassembled or assembled and in commercial packaging or not. You will be able to specify if you need the vibration protection kit, DIN rail mounting kit(s), and/or Wi-Fi.

You can immediately view and order validated configurations at our online store: <http://tibbo.com/buy/tps/tpc>.

The TPS: General View

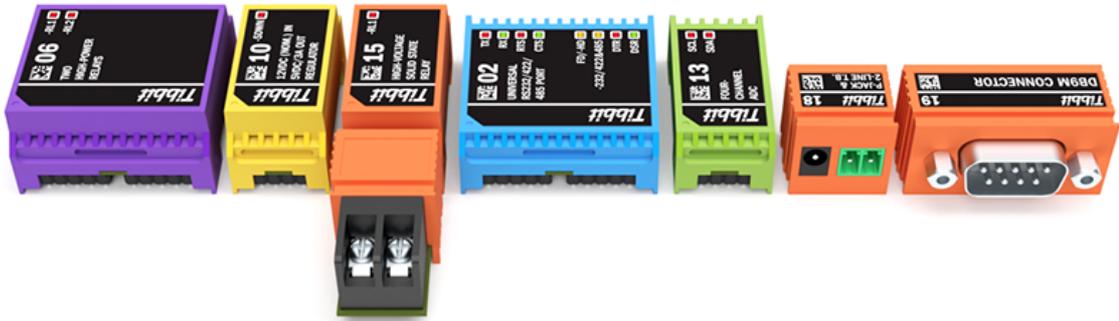


Shown above is a typical Tibbo Project System in a housing (Tibbo Project Box).

To be exact, the above image depicts a *size 3* system. We also offer *size 2* systems that are approximately half as wide.

The internal structure of the Tibbo Project System can be found in the [TPB Structure](#) topic.

Tibbits



Tibbits (as in "Tibbo Bits") are blocks of prepackaged I/O functionality, designed to simplify your testing, prototyping, product development, and integration.

Tibbits implement a wide variety of I/O functions. Want an ADC? There is a Tibbit for this. 5V power supply? Got that! RS232/422/485 port? We have this, and many other Tibbits, too.

Tibbits are housed in color-coded rectangular shells. Their pins have a classic 2.54 (0.1") pitch, so they can be installed on prototyping boards. You can use Tibbits with virtually all popular microcontrollers (PIC, Atmel, ARM,...).

Tibbits are divided into Tibbit modules ("M" devices) and Tibbit connectors ("C" devices). There are also hybrid ("H") Tibbits that combine the two. Tibbit connectors have convenient hooks that additionally secure them on the board's edge.

Tibbits are an integral part of the Tibbo Project System. They plug into [Tibbo Project PCBs](#) and fit in our [Tibbo Project Box](#) enclosures. Connector Tibbits actually form two walls of a Tibbo Project Box, as you can clearly see on the [general view](#) image.

Tibbit Form Factors & Colors

Tibbits are divided into Tibbit modules ("M" devices) and Tibbit connectors ("C" devices). There are also hybrid ("H") Tibbits that combine the two.

"M" and "C" devices can have single ("1") or double ("2") width. They can also be short ("S") or tall ("T").

Tibbit connectors have convenient hooks that additionally secure them on the board's edge.

[M1 "Narrow" Tibbits](#)

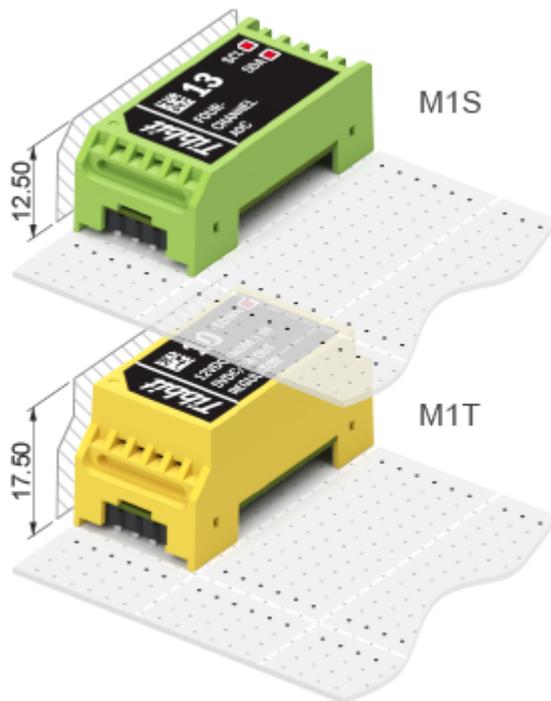
[M2 "Wide" Tibbits](#)

[C1 "Narrow" Tibbits](#)

[C2 "Wide" Tibbits](#)

[H1 "Hybrid" Tibbits](#)

M1 "Narrow" Tibbits

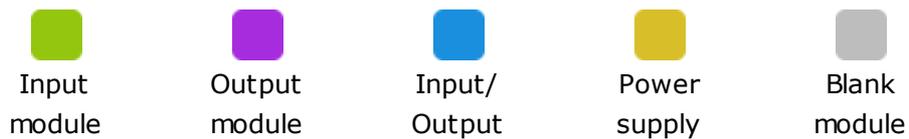


M1 Tibbits are single-width modules occupying one ["M" socket on the standard tile](#). Their footprint is roughly 7 x 14 "squares" (one "square" is 2.54 x 2.54 mm).

M1 devices have four I/O lines for interfacing with the outside world. We found four to be the magic number. It is just right for a wide variety of I/O functions.

M1s can be short (M1S) or tall (M1T). Most M1 devices fit into "short" 12.5mm shells, selected few are 17.5mm "tall".

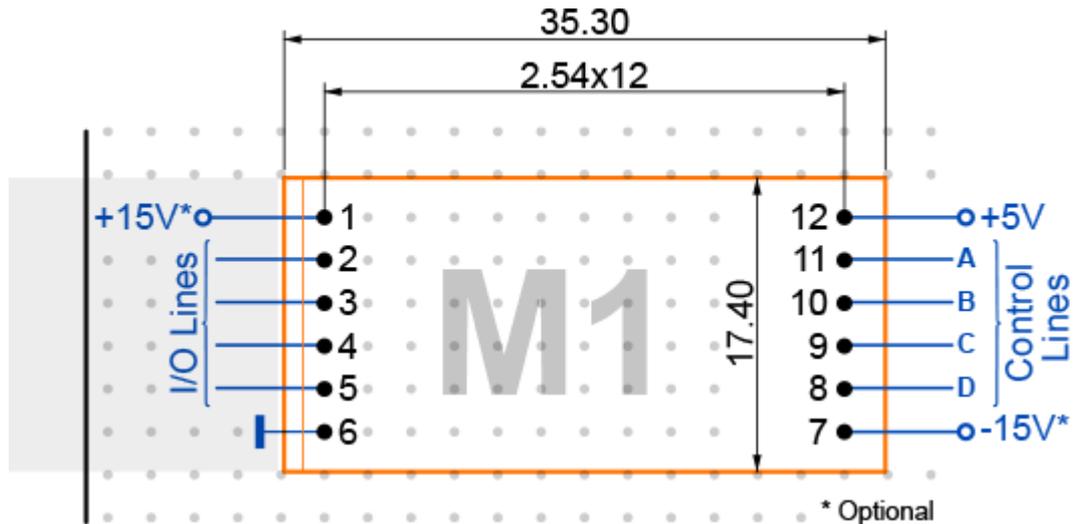
Each M1 module's color will tell you if it is an...



M1 Tibbits can incorporate up to [four status LEDs](#).

I/O pins

M1 modules have 2 rows of 6 pins:



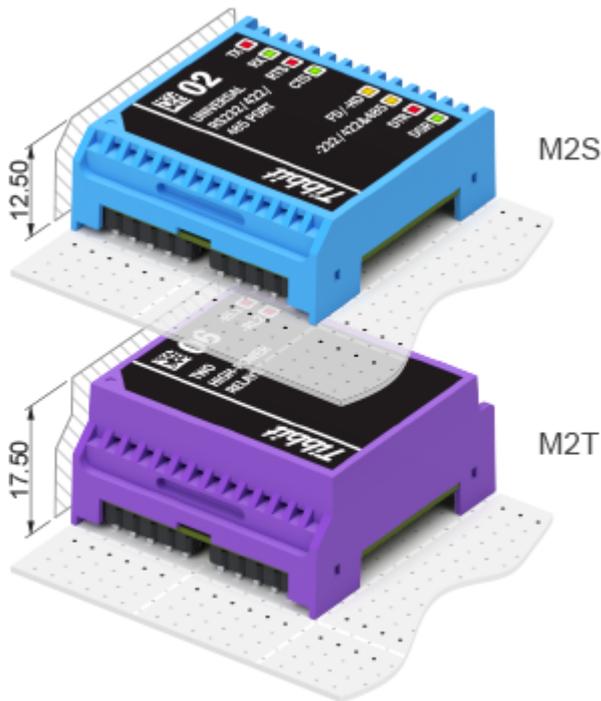
Pins 8-11 are control lines A-D. They are for interfacing to our [embedded modules](#) or other microcontrollers. On [Tibbo Project PCBs](#) these pins are connected to the main CPU.

Pins 2-5 are I/O lines facing the outside world. On Tibbo Project PCBs they go to Tibbit [connector sockets](#) (i.e. connect to [C1](#) and [C2](#) devices).

Pins 6 and 12 are the GROUND and +5V power pins. Most Tibbit Modules consume (take) 5V power. There are also power supply Tibbits that generate 5V power from a variety of sources. Those *output* 5V through pin 12. As an example of power Tibbits see Tibbits [#10](#) and [#23](#).

Pins 1 and 7 are for the additional +15V and -15V voltages. These are optional and only needed by few Tibbits. A special power supply Tibbit [#12](#) generates +/-15V from the main 5V power.

M2 "Wide" Tibbits



M2 Tibbits are double-width modules occupying [two "M" sockets on the standard tile](#). They are roughly 14 x 14 "squares" (one "square" is 2.54 x 2.54 mm).

With double the size comes the doubled internal space and I/O capacity. M2s have eight I/O lines. They are used for "grander things" that just wouldn't fit into the [M1 form factor](#).

Like M1s, M2 devices can be short (M2S) or tall (M2T).

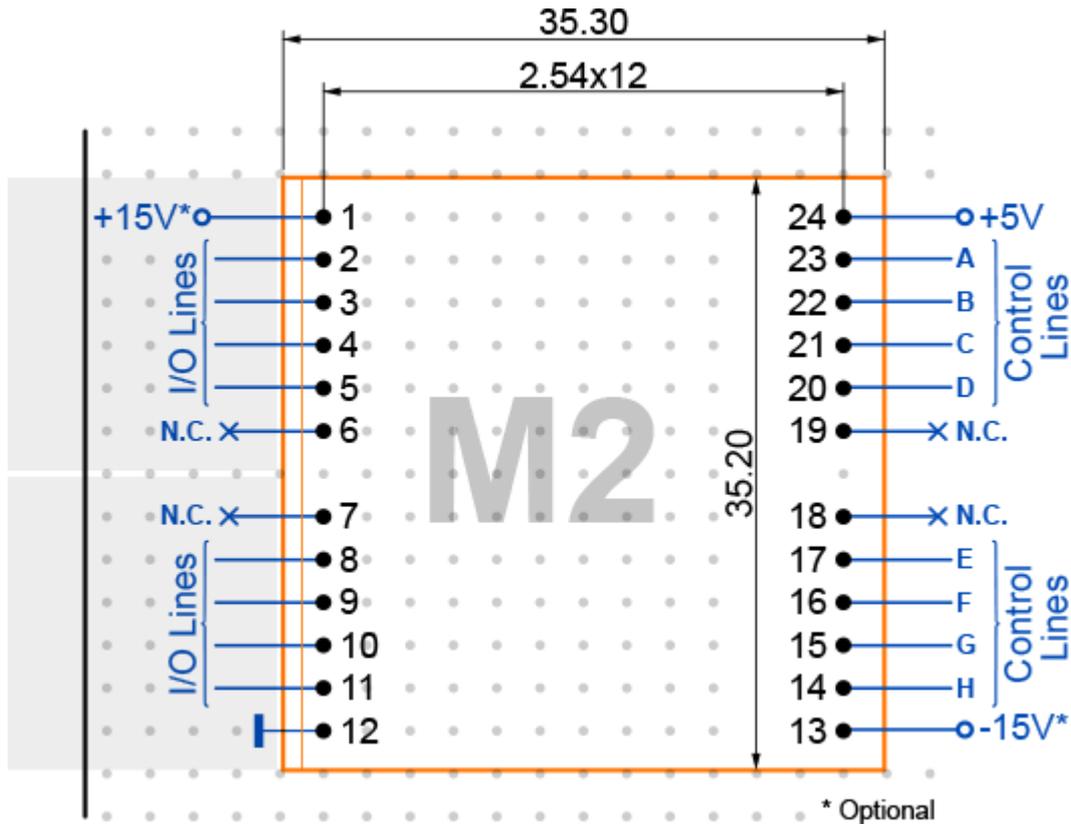
The color coding scheme is identical to that of M1 Tibbits:



M2 Tibbits can incorporate up to [eight status LEDs](#).

I/O pins

M2 modules have 4 groups of 6 pins arranged into 2 rows:



Pins 14-17 and 20-23 are control lines A-H. They are for interfacing to our [embedded modules](#) or other microcontrollers. On [Tibbo Project PCBs](#) these pins are connected to the main CPU.

Pins 2-5 and 8-11 are I/O lines facing the outside world. On Tibbo Project PCBs they go to Tibbit connector sockets (i.e. connect to [C1](#) and [C2](#) devices).

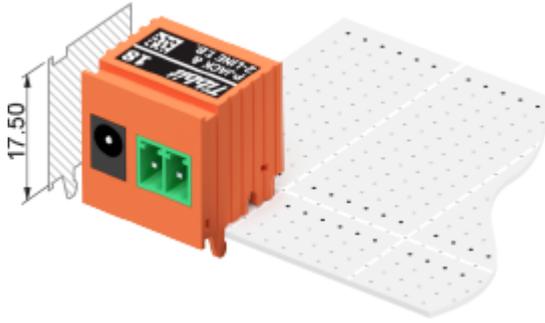
Pins 12 and 24 are the GROUND and +5V power pins. Most Tibbit Modules consume (take) 5V power. There are also power supply Tibbits that generate 5V power from a variety of sources. Those *output* 5V through pin 12. As an example of power Tibbits see Tibbits [#10](#) and [#23](#).

Pins 1 and 13 are for the additional +15V and -15V voltages. These are optional and only needed by few Tibbits. A special power supply Tibbit [#12](#) generates +/-15V from the main 5V power.

Pins 6, 7, 18 and 19 are unused and should be left unconnected.

Notice that each pin row has a "missing pin" in this middle. This separates a row into two groups of 6 pins.

C1 "Narrow" Tibbits



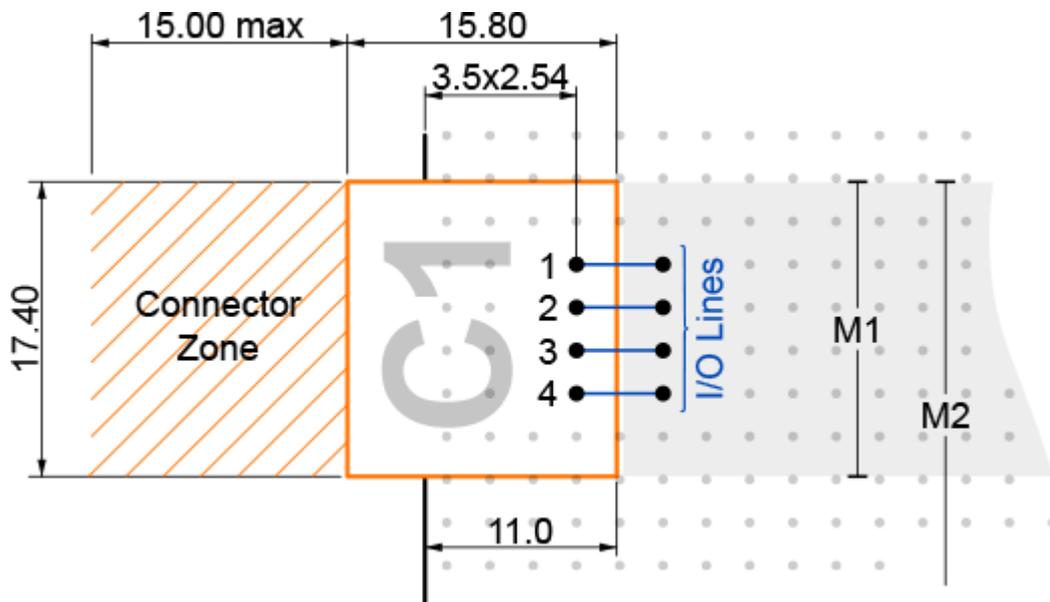
C1 devices are single-width "connectors". They occupy [one "C" socket on the standard tile](#) and install alongside "M" Tibbits. C1s have the equal width and height with [M1T devices](#). Tibbit "connectors" have hooks that hold on to the host board's edge thus adding mechanical stability.

Some C1s are really just connectors of the [power jack](#), [terminal block](#), etc. variety. Others "sense" the outside world: [temperature](#), [humidity](#), [vibration](#), and so on.

C1 Tibbits are always orange. C1s never have status LEDs.

I/O pins

C1 Tibbits have a single row of 4 pins:



All four pins are I/O lines that connect directly to four I/O lines of the [adjacent "M" socket](#).

There are no dedicated ground or power pins. Many C1s don't need ground and power anyway -- they house connectors and nothing else.

If an attached external device needs ground and/or power then these must come from the adjacent "M" Tibbit. Ground and power are also necessary for "sensor" C1s.

For example, Tibbit [#28](#) is the ambient light sensor. It houses active circuitry which requires 5V power. Two of this device's pins are I2C clock and data, the third pin is +5V power, and the remaining pin is ground. This C1 device must be used in conjunction with Tibbit [#00-3](#), which passes through 2 lines of the I2C interface, and also provides power and ground.

C2 "Wide" Tibbits

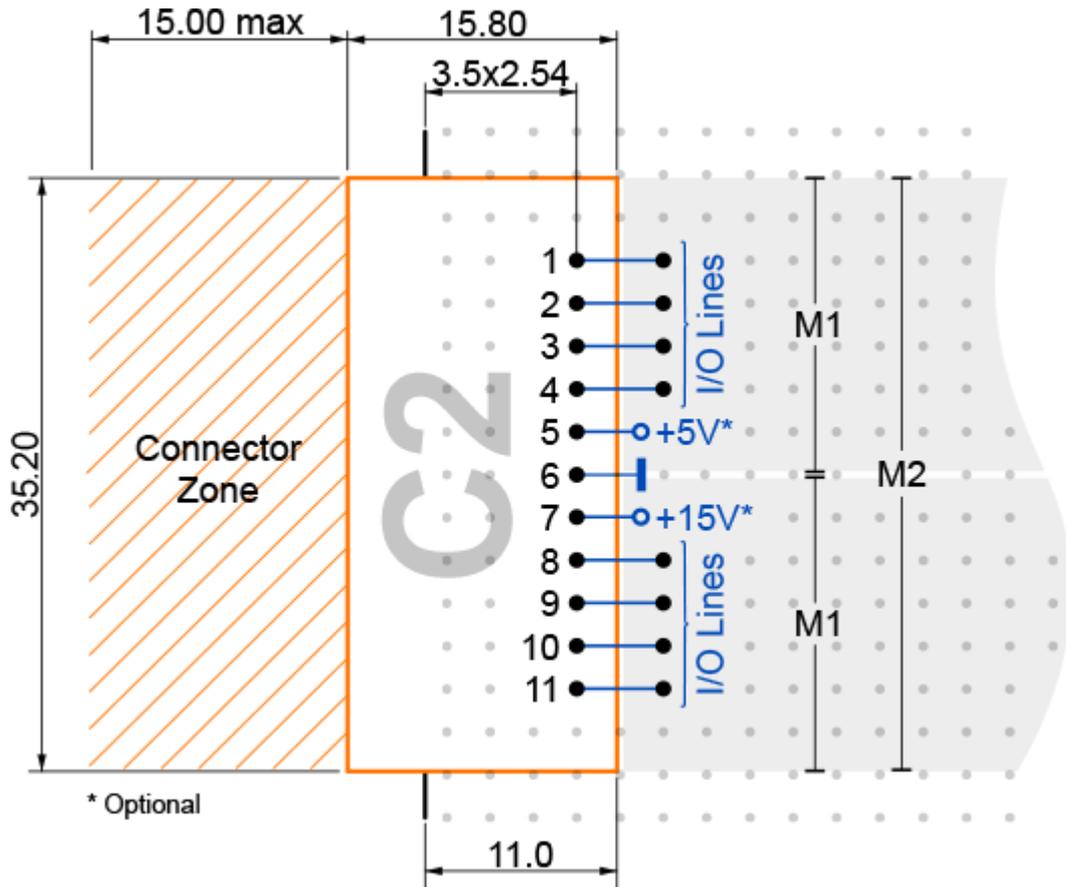


With double the width of [C1s](#), C2 Tibbits are wide enough to house DB9 connectors and 9-row terminal block banks. They occupy [two "C" sockets on the standard tile](#). C2s have the equal width and height with [M2T devices](#). Tibbit "connectors" have hooks that hold on to the host board's edge thus adding mechanical stability.

C2 Tibbits are always orange. C2s never have status LEDs.

I/O pins

C2 Tibbits have a single row of 11 pins:



Pins 1-4 and 8-11 are I/O lines that connect directly to the I/O lines of [two adjacent "M" sockets](#). A single C2 may connect to one [M2](#) Tibbit or two [M1](#) Tibbits.

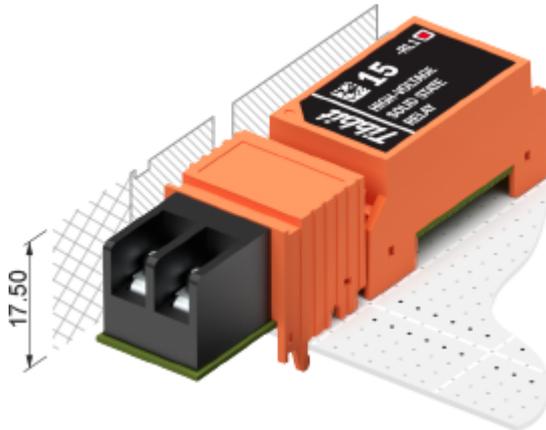
Pin 5 is the +5V power pin. Most C2 devices only house connectors and do not require any power. Still, we are sure there will be uses for this power pin in the future.

Pin 6 is the ground pin.

Pin 7 is the +15V power pin. Again, this is reserved for the future use.

Since C2 devices have dedicated ground and power lines they are not dependent on "M" Tibbits for power and ground, as [C1s](#) are. There is no provision for connecting -15V power though. If any C2 device needs -15V then this must be supplied by the adjacent "M" device.

H1 "Hybrid" Tibbits



H1 Tibbits are merged [M1T](#) and [C1](#) devices. They occupy the combined space of one M1 and one C1 Tibbit.

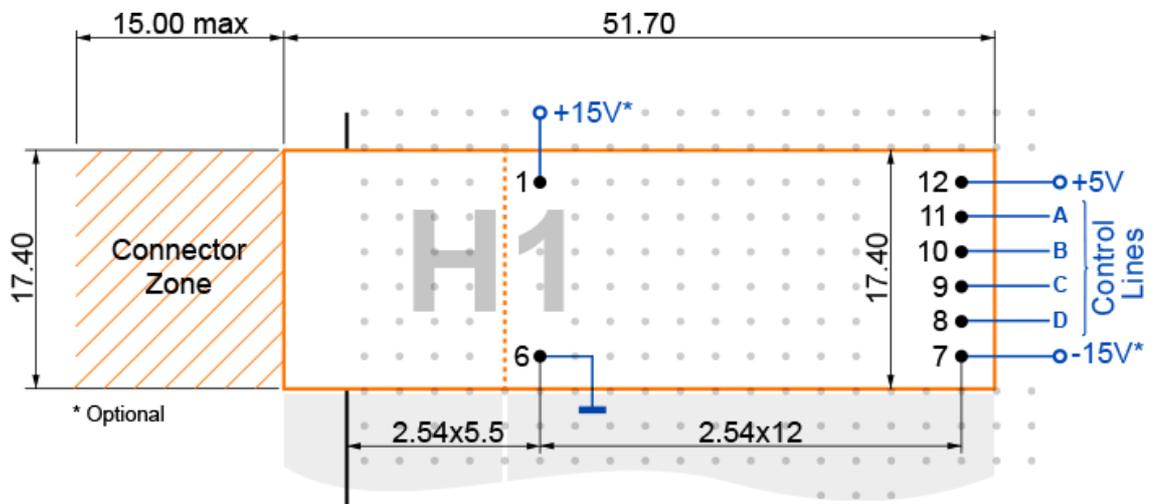
The H1 form factor is used when it is unsafe or undesirable to interconnect M1 and C1 Tibbits via a [Tibbo Project PCB](#) (or any other host board).

Examples of such cases are high-voltage and high-frequency (radio) circuits.

H1 Tibbits are always orange. These devices can have up to [four status LEDs](#) on the M1 side.

I/O pins

H1 devices have no pins on their C1 "section":

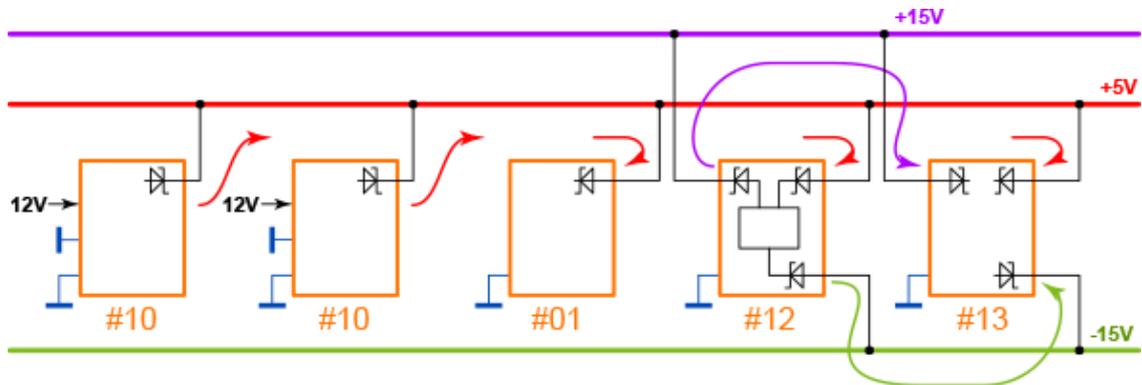


Pins on the M1 section have the standard positioning, except pins 2-5 (I/O lines on the standard M1) are not present.

This is because the [M1](#) and [C1](#) sections of hybrid devices are interconnected directly.

Tibbit Power Lines

By now you know that the main supply voltage for Tibbits is +5V, and that some Tibbits also need +15V and -15V power. You also know that [C1](#) Tibbits have no standard ground and +5V pins, while [C2s](#) do not have a provision for -15V power. Finally, you know that some Tibbits *do not require* any power. This section continues with the explanation of Tibbit power lines.



The diagram above shows five Tibbits. Two of them are [#10](#) (+5V power supply), one is [#01](#) (four-line RS232 port), another one is [#12](#) (+15V/-15V power supply), and the last one is [#13](#) (the ADC converter).

Notice how all five Tibbits have diodes in their power lines. On power consuming Tibbits ([#01](#), [#13](#)) these diodes prevent damage to Tibbits if power is accidentally applied in reverse. On power generating Tibbits ([#10](#), [#12](#)) the diodes allow you to bank power sources. By having two power supply Tibbits ([#10](#)) you can either combine their current output or increase reliability (by having several redundant power sources).

Power, of course, can also be applied to the power rails externally (i.e. from a lab power supply). Our own [TPP2](#) and [TPP3](#) boards have power terminals for direct 5V power input. The boards do not have direct inputs for +15V and -15V. So, although [TPP2](#) and [TPP3](#) have +15V and -15V power rails, the only way to have power on them is to insert the [Tibbit #12](#). You only have to do it if there are any Tibbits in your system that require these optional voltages. On the above diagram, Tibbit [#13](#) does require +/-15V.

One additional point. Power supply Tibbits that provide +5V power generate it from external power sources. For example, Tibbit [#10](#) takes DC input in the 9-18V range, while Tibbit [#23](#) implements PoE (power-over-Ethernet) power supply. Both take external power and convert it into +5V. Tibbit [#12](#), however, generates +15V/-15V voltages from the 5V power rail.

Tibbit Sockets and Tiles

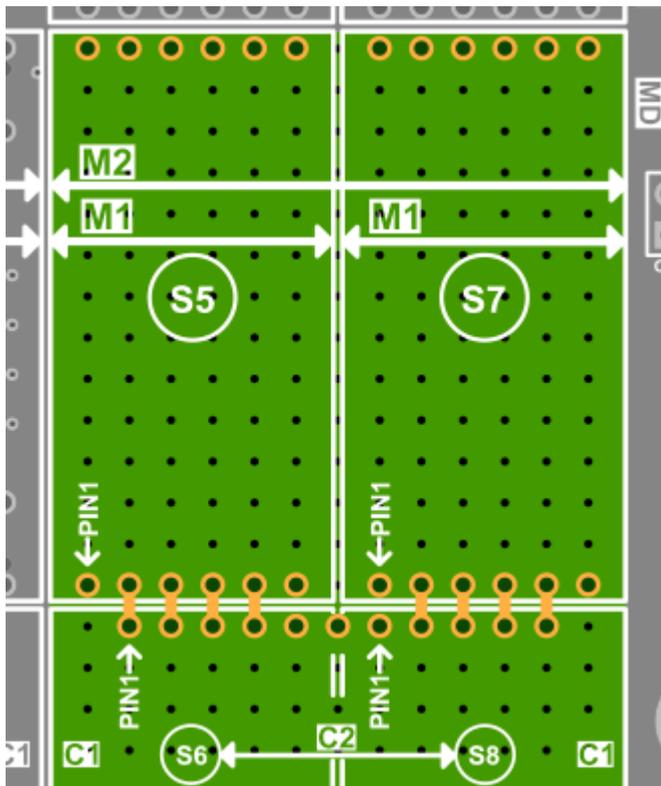
As long as you follow electrical specifications for Tibbits you can use and interconnect them in any way you like. This manual teaches a structured approach based on *Tibbit sockets* and *tiles*. This is the approach used by the Tibbo Project

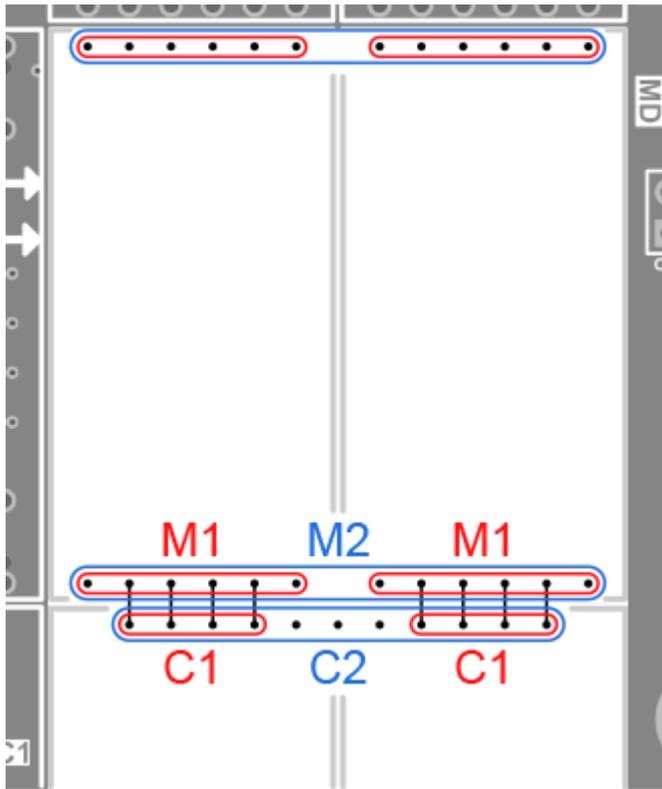
System.

We will use the term *Tibbit socket* (or simply *socket*) to denote a landing space for a Tibbit. "Socket" here does not mean a *physical socket* into which a Tibbit can be plugged. Rather, it describes a space on the board that can accommodate a Tibbit device. This is not to say that actual physical sockets aren't there. In fact, Tibbits are installed on physical sockets most of the time. Our [TPP2](#) and [TPP3](#) boards offer a pair of *physical sockets* for each *Tibbit socket*.

More strictly, we will use the term *Tibbit socket* to describe landing spaces for single-width [C1](#) or [M1](#) devices. Of course, Tibbits sockets for M1 and C1 are different.

The following diagram depicts a fragment of the [TPP3 board](#). The diagram shows a single tile with Tibbit sockets (S5), (S6), (S7), and (S8).





Tibbit socket for "M" Tibbits occupies 7 x 14 board "squares" (one "square" is 2.54 x 2.54 mm) and has two 6-pin physical sockets. M2 devices require two Tibbit sockets next to each other. On the picture above (S5) and (S7) are "M" sockets. Note how there is an arrow with the M2 mark. This arrow indicates that an M2 device will occupy both S5 and S7 spaces.

Tibbit socket for "C" Tibbits occupies 7 x 4.5 board "squares". C2 devices take two Tibbit sockets. On the picture above (S6) and (S8) are "C" sockets. Notice how this socket pair shares a single 11-pin physical socket. This is because C2 devices have 11 pins.

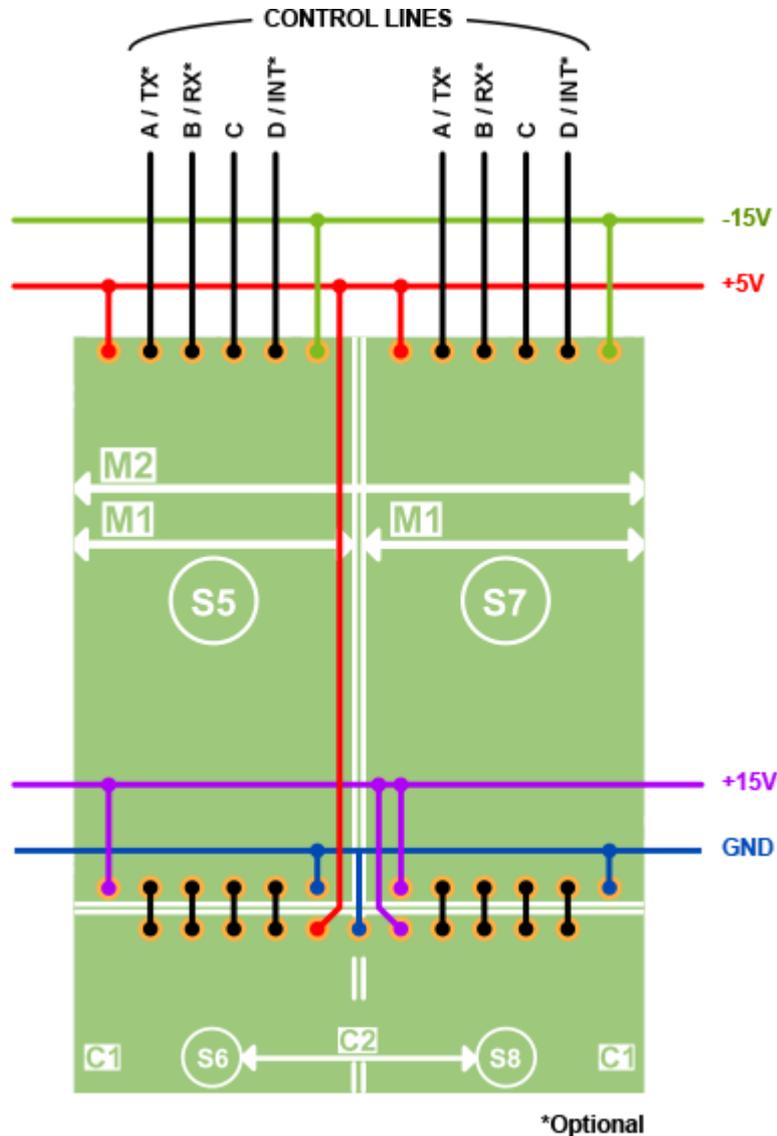
A pair of "M" sockets and a pair of "C" sockets together form a *tile*, as shown on the picture above. The diagram above on the right illustrates how the pins of M1, M2, C1, and C2 modules plug into the tile sockets.

A single tile can accommodate Tibbits of difference sizes and in various combinations:

- Up to two C1 + up to two M1 devices
- Up to two C1 and one M2 device
- One C2 device and up to two M1 devices
- Up to two H1 hybrid Tibbits

Electrical Connections on a Tile

The diagram below shows electrical connections on a [tile](#). Again, if you are making your own board or using a prototype board you can connect Tibbits in any way you like (as long as it doesn't cause them to smoke and burn). The diagram illustrates our own structured approach to building things with Tibbits.



GND, +5V, +15V, and -15V rails were already explained in [Tibbit Power Lines](#).

Eight control lines of the tile -- four per "M" socket -- go to the [TPP's](#) CPU.

"C" sockets and "M" sockets are interconnected directly (see eight short black lines).

A word on the naming of control lines. "M" sockets (these are (S5) and (S7) on the diagram above) have control lines A, B, C, and D. [M1 Tibbits](#) have a matching set of control lines A-D. [M2 Tibbits](#) have eight control lines A-H. When you plug an M2 device into the tile, its control lines correspond to the control lines of the tile as follows:

M2 Tibbit	Corresponding control line on a tile
A	First "M" socket*, A
B	First "M" socket*, B
C	First "M" socket*, C
D	First "M" socket*, D
E	Second "M" socket**, A
F	Second "M" socket**, B
G	Second "M" socket**, C
H	Second "M" socket**, D

* (S5) on the diagram

** (S7) on the diagram

Tibbits with "Special Needs"

Most Tibbits happily work with simple control (GPIO) lines of the CPU. Some, however, require dedicated I/O functionality from the CPU lines:

[\[SER\] Tibbits that require TX and RX UART lines](#)

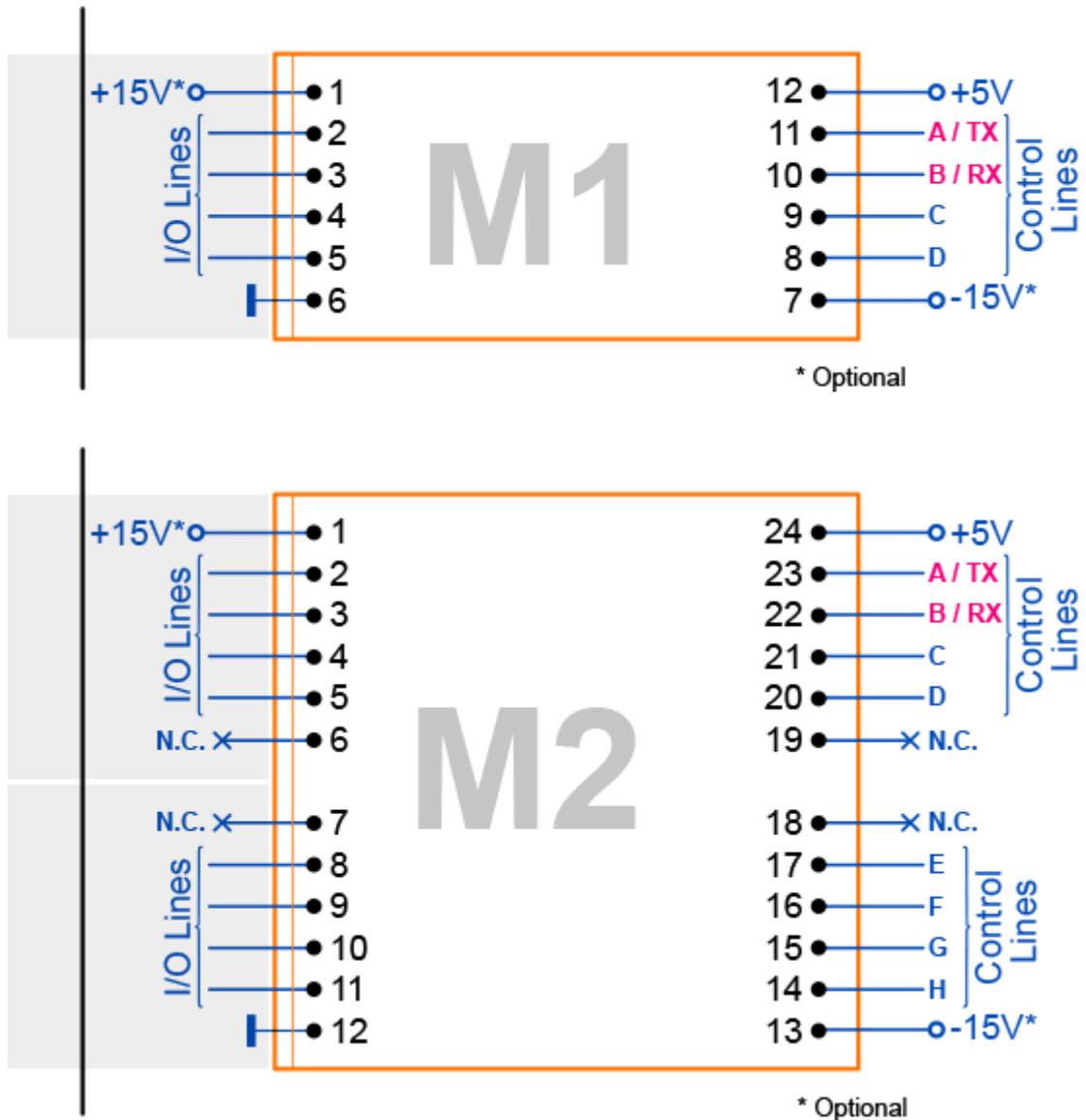
[\[INT\] Tibbits that require an interrupt line](#)

[\[POE\] Tibbits that require PoE power lines](#)

[SER] Tibbits That Require UART Functionality

Some Tibbits, such as [#01](#) (four-line RS232 port) and [#02](#) (universal RS232/422/485 port) are designed to work with UART lines of the CPU. Of course, nothing "bad" will happen if you just connect them to regular GPIO lines. After all, UART communications at low baud rates can even be emulated with regular CPU pins. The intended use of these Tibbits, however, is with TX and RX UART lines of the CPU.

TX and RX control lines, when present on a Tibbit, are always mapped onto the control lines A and B, respectively:

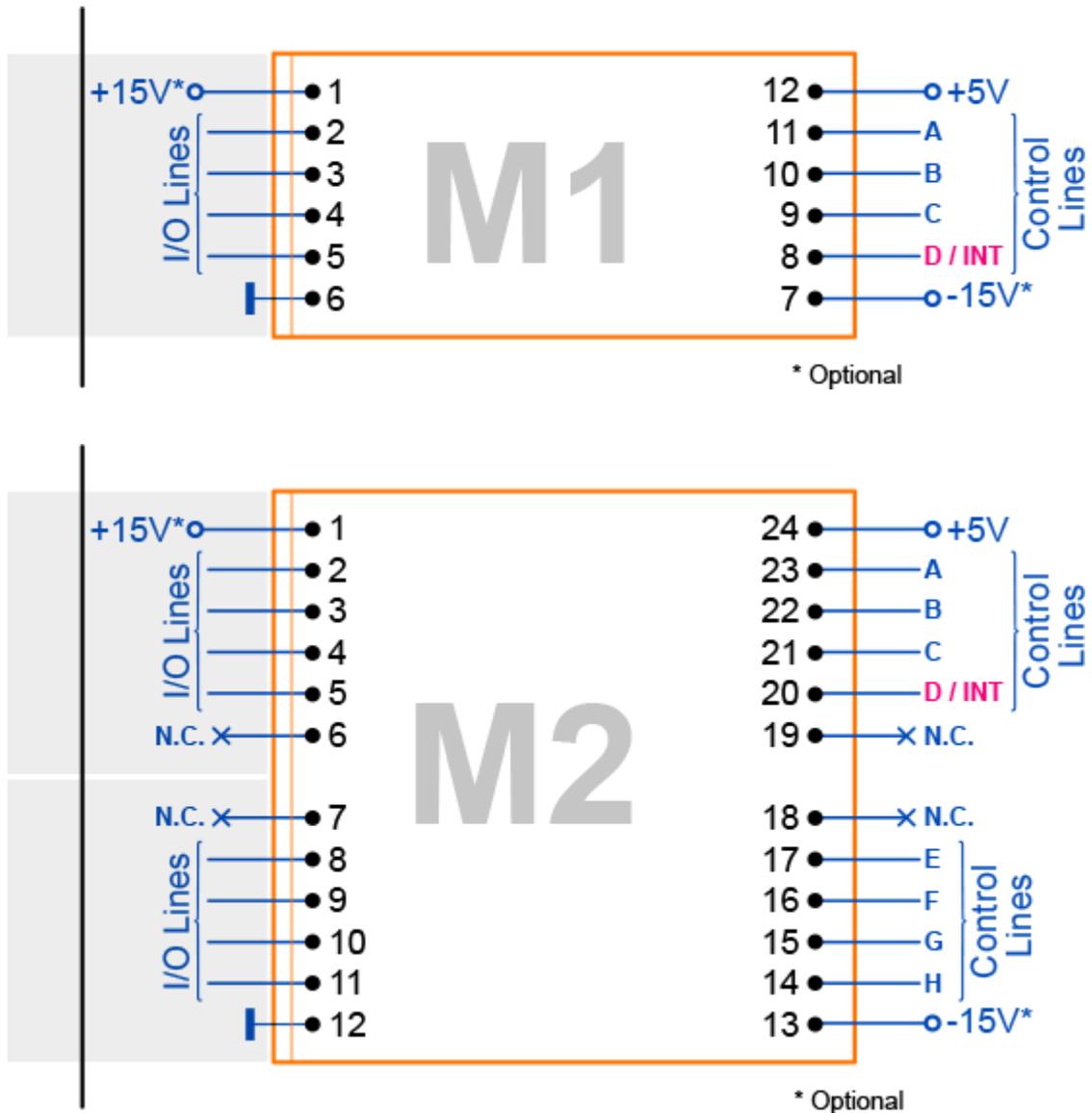


[TPP2](#) and [TPP3](#) boards offer four "M" sockets with UART lines.

[INT] Tibbits That Require an Interrupt Line

Some Tibbits require an interrupt line. For example, on Tibbits [#01](#) (simple RS232 port), [#02](#) (universal RS232/422/485 port) the interrupt is used to detect state changes on the CTS line. This is necessary for the RTS/CTS flow control. Obviously, an RS232 port doesn't always need the flow control, so the interrupt line may not be necessary. Other Tibbits, such as [#08](#) (Wiegand and clock/data reader port) *must* be wired to the interrupt line, or they won't be able to do their job.

The INT line, when present on a Tibbit, is always mapped into the control line D:



The [TPP2](#) features six "M" sockets with interrupt lines, while the [TPP3](#) has eight such sockets.

[POE] Tibbits That Require PoE Power Lines

Tibbits [#22](#) and [#23](#) implement PoE (power-over-Ethernet) power supplies. By definition, PoE power comes from the Ethernet cable. Therefore, PoE Tibbits must be wired in such a way as to receive PoE power input from the RJ45 jack.

[TPP2](#) and [TPP3](#) both have a single socket which can receive PoE power.

Combining "C" and "M" Tibbits

"M" and "C" Tibbits were designed to work together and complement each other. A single [tile](#) can accommodate Tibbits of all possible form factors.

Narrow "M" Tibbits can be mixed with wide "C" devices and vice versa, but there are rules for this. All such combinations can only take place within the space of a single tile. Under no circumstances should Tibbits be arranged in ways that share them between tiles. In other words, Tibbits can't cross tile borders.

The four possible combinations are:

[C1 + M1](#)

[C2 + M2](#)

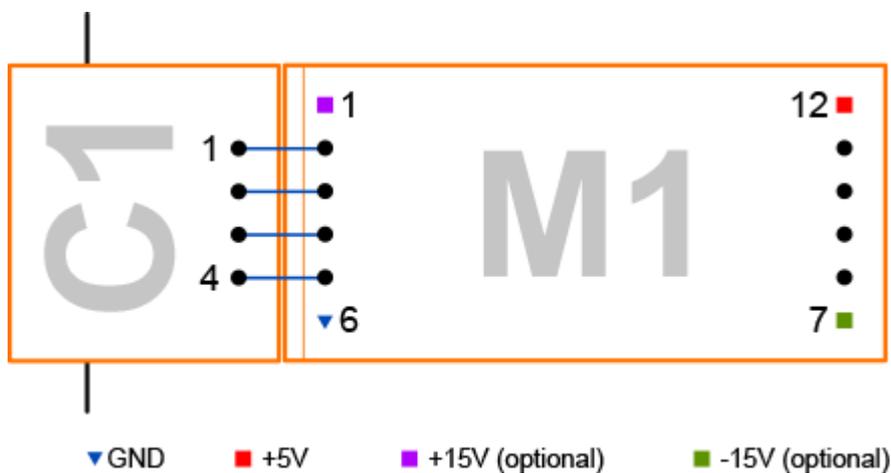
[C2 + Two M1s](#)

[Two C1s + M2](#)

There is also a generous degree of interchangeability. For example, Tibbit [#02](#) (universal RS232/422/485 port) can be wired to Tibbit [#19](#) (DB9 connector). The #02 can also be used with [#20](#) ("nine terminal blocks" device). Who knows -- maybe this, and not the DB9, is what's need in your project! This is the main reason why Tibbits were split into "modules" and "connectors".

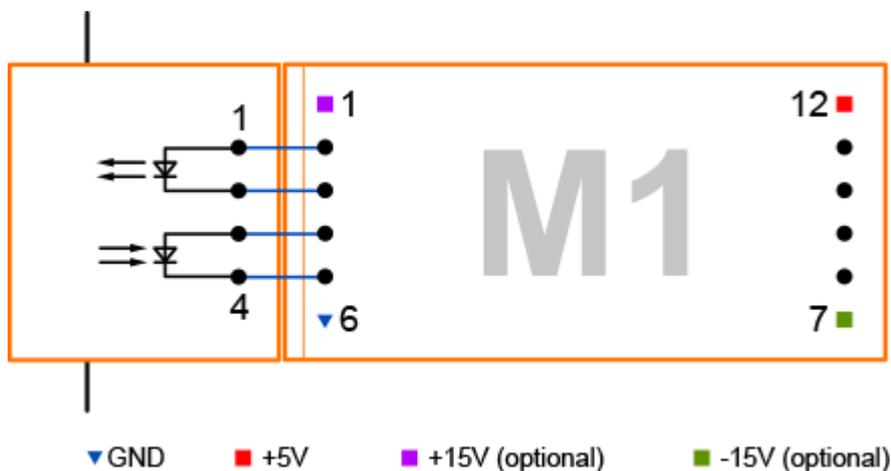
C1 + M1.2.6.1

[C1](#) and [M1](#) devices are interconnected by four interface lines:

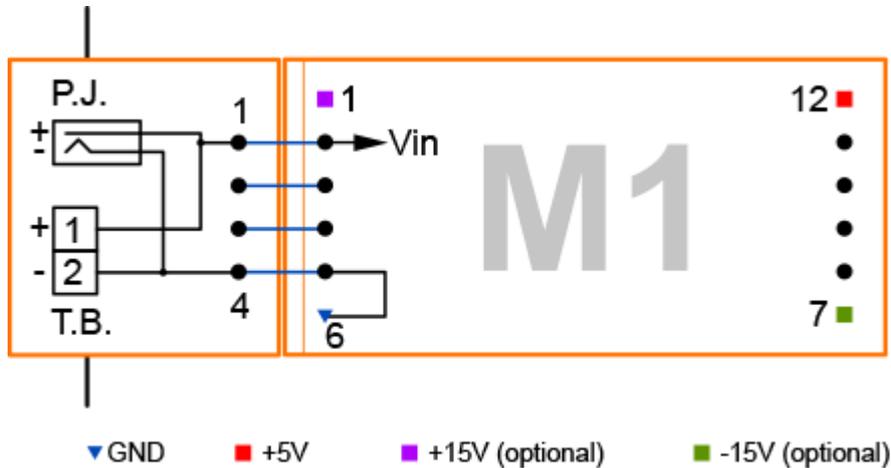


[As was explained](#), C1 devices do not have dedicated ground and power lines.

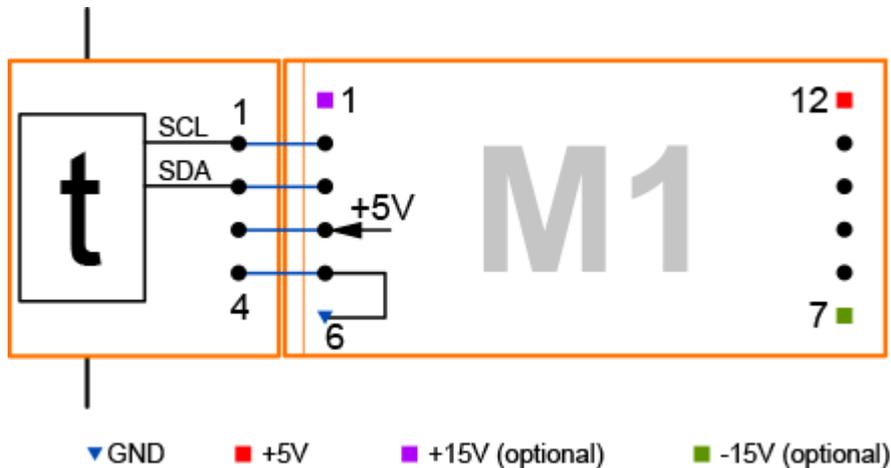
Sometimes, such lines are just not necessary. For example, Tibbit [#27](#) (IR receiver/transmitter) works fine without the ground and power:



Some C1 devices, such as [#18](#) (power input) do need to be connected to the system ground. Tibbit [#18](#) was designed to be used with power supply Tibbits [#09](#) and [#10](#). These "M" devices provide ground on their pin 5, and this solves the problem. Incoming supply voltage (V_{in}) is routed through pin 1:



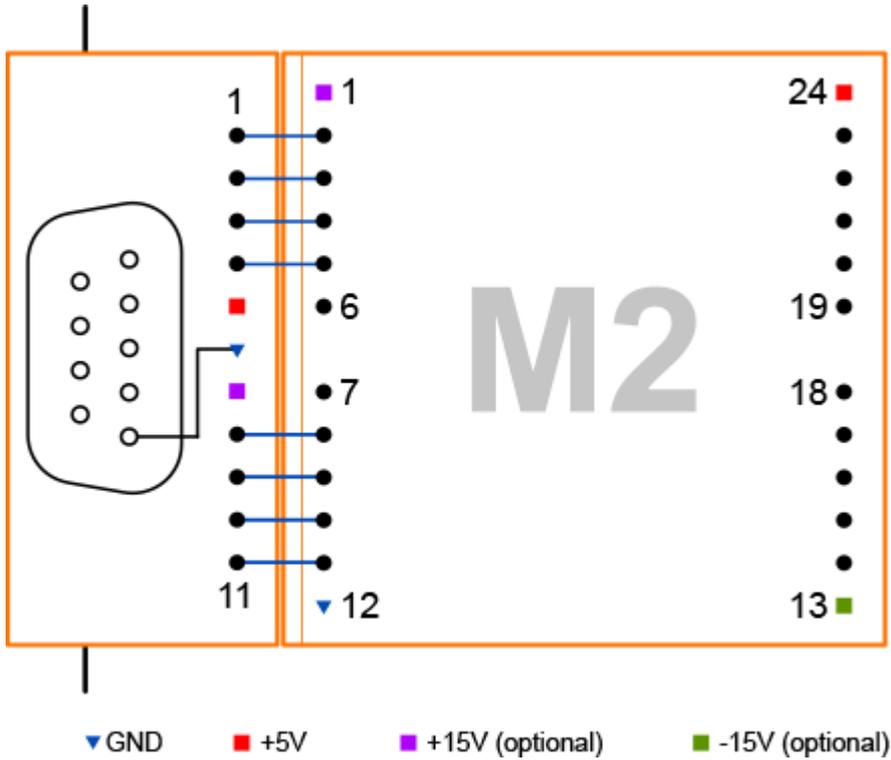
Several C1 Tibbits implement various sensors: [temperature](#), [humidity](#), [pressure](#), etc. These need both the ground and +5V power lines, which are provided by the "M" Tibbit [#00-3](#). This Tibbit propagates ground through pin 5 and outputs +5V power through pin 4:



C2 + M2.2.6.2

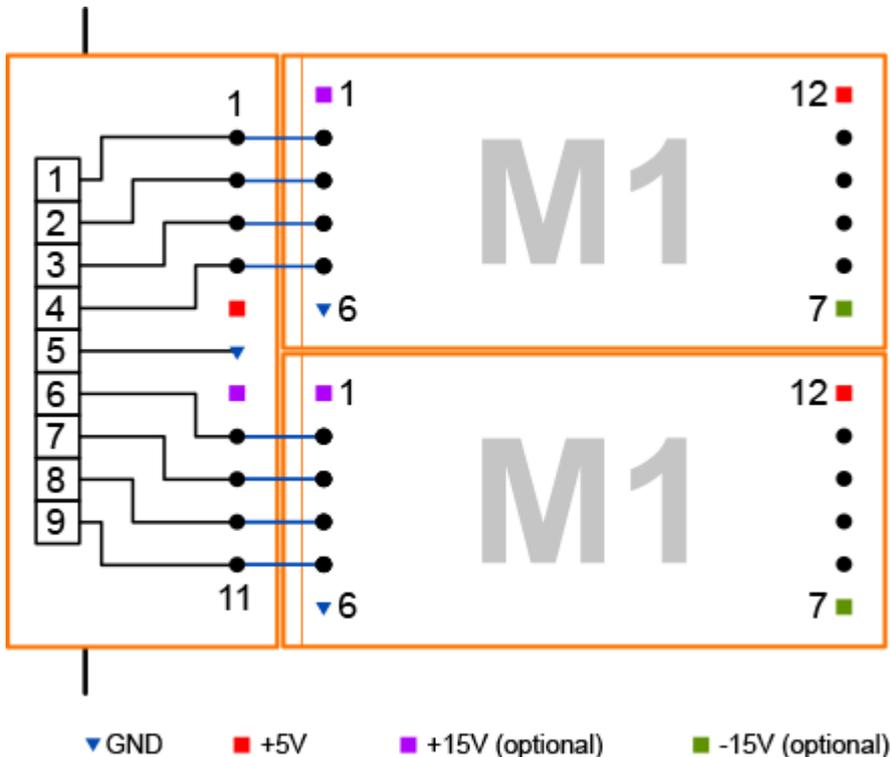
[C2](#) and [M2](#) devices are interconnected by eight interface lines.

C2 Tibbits have dedicated ground, +5V, and +15V pins. Here is the illustration of how the ground line gets used. Tibbit [#19](#) incorporates the DB9 connector, which requires the ground line. Since C2 devices have ground pins, there is no need to waste one of the available eight interface lines, so all lines can be put to good use and this comes handy for Tibbit [#02](#) (RS232/422/485 port) that utilizes all eight lines.



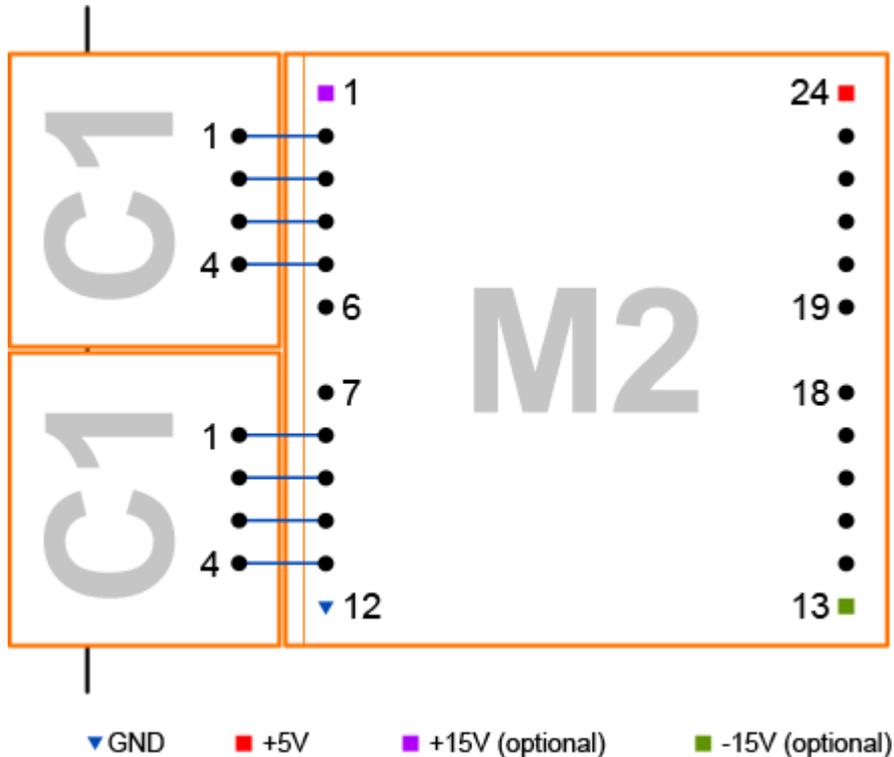
C2 + Two M1s

Some [C2](#) devices can be connected to two [M1](#) Tibbits simultaneously. The most obvious example is "C" Tibbit [#20](#) (nine terminal blocks). This is a very generic Tibbit that mixes well with various "M" devices. For example, "M" Tibbits [#03-1](#) (two relays) can surely be connected to the outside world through the terminal block connector:



Two C1s + M2

This possibility exists but there is little practical use for it...



Tibbit LEDs and Their Colors

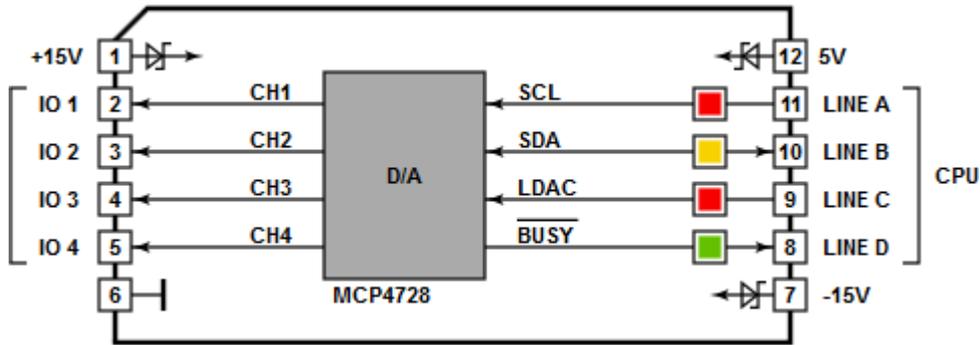
"M" Tibbits have LED indicators. [M1](#) devices have up to four LEDs. [M2s](#) can have as many as eight "lights".

LEDs on *most* Tibbits indicate the state of their control lines. This is why the number of LEDs matches the number of control lines on narrow and wide Tibbits. This is not a rule -- LEDs exist to provide sensible and useful indication of Tibbit states, so they do not "belong" to control lines per se. For example, there are "power good" LEDs on power supply Tibbits ([#09](#), [#10](#), [#22](#), etc.). They indicate the presence of the required voltage on the power line.

We use different LED colors to indicate the direction of the corresponding signal:

- Red LEDs are used for output lines (and power "flowing" out).
- Green LEDs are used for input lines (and power "flowing" in).
- Yellow LEDs are used for lines that work both as inputs and outputs.

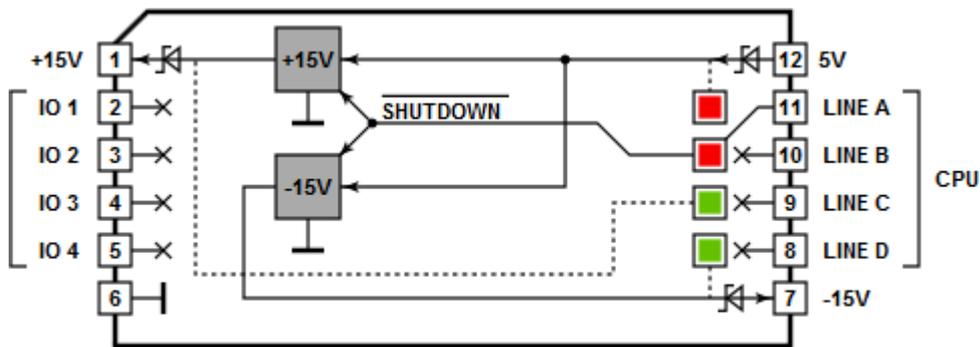
Terms *output* and *input* should be interpreted with respect to the main CPU of the host board. Therefore, "in" means "from the outside world and into the board". "Out" means "from the board towards the outside world".



As an example, consider Tibbit [#14](#) (DAC, shown above). This Tibbit is based on the MCP4728 IC from Microchip. It communicates with the main CPU via the I2C interface lines SCL and SDA. There are also two additional interface lines LDAC and BUSY. LED colors are:

- SCL: this is the clock line of the I2C interface. Red LED is used because this line is an output.
- SDA: this is the data line of the I2C interface. Yellow LED is used because the data line is bi-directional.
- LDAC: this is the control line manipulated by the CPU. Hence, the LED color is red.
- BUSY: this is the status line from the DAC IC. Hence, the LED color is green.

The same logic applies to "power good" LEDs. If the LED is on the power line that provides power to the main CPU/board (power flowing in) then the color of this LED will be green. If this is the power line that takes power from the main CPU/board (power flowing out) then the color of this LED will be red.



Example: Tibbit [#12](#) (+/- 15V power supply). This Tibbit takes power from the +5V supply rail and generates voltages for +15V and -15V power rails. Four LED indicators on the module are:

- 5V power good -- the LED is red because this power is provided by (is flowing out of) the system.
- SDWN -- the LED is red because this is a shutdown line that is controlled by the main CPU.
- +15V and -15V -- these LEDs are green because the Tibbit provides the corresponding voltages to the board (+15V and -15V power is flowing into the board).

LEDs connected to the control lines are *usually* wired to light up when the control line state is LOW. On the contrary, "power good" LEDs indicate the presence of voltage on power lines (a "HIGH" state of sorts).

LEDs of Tibbit devices are usually buffered. That is, they do not impose any significant load on the lines they are connected to.

There are no LEDs on "C" Tibbits.

Labeling

Each Tibbit device has a label which states this Tibbit's number and function.

A small 2D barcode (micro QR type) encodes the Tibbit number as well. This number is a 4-digit code. First three digits in the code represent Tibbit number, and the fourth digit indicates the device version (some Tibbits have more than one version available).

For example, if the code is 0032 then this is [Tibbit #03, version 2](#):

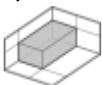


Available Tibbits

- #00-1, [M1S: Four Direct I/O lines](#)
- #00-2, [M1S: Three direct I/O lines and ground](#)
- #00-3, [M1S: Two direct I/O lines, +5V power, ground](#)
- #01, [M1S: Four-line RS232 port](#) [SER, INT]
- #02, [M2S: RS232/422/485 port](#) [SER, INT]
- #03-1, [M1S: Two low-power relays \(configuration 1\)](#)
- #03-2, [M1S: Two low-power relays \(configuration 2\)](#)
- #04-1, [M1S: Two isolated inputs](#)
- #04-2, [M1S: Three isolated inputs, common \(-\)](#)
- #04-3, [M1S: Three isolated inputs, common \(+\)](#)
- #04-4, [M1S: Four opto-inputs, common ground](#)
- #05, [M1S: RS485 port](#)
- #06, [M2T: Two high-power relays](#)
- #07, [M1S: Two solid state relays](#)
- #08, [M1S: Wiegand and clock/data reader port](#) [INT]

- #09, [M1S: Low-power 5V supply, 12V input](#)
- #10, [M1T: Medium-power 5V supply, 12V input](#)
- #11, [M1S: Four open collector outputs](#)
- #12, [M1S: Low-power +15/-15V power supply](#)
- #13, [M1S: Four-channel ADC](#)
- #14, [M1S: Four-channel DAC](#)
- #15, [H1S: High-voltage AC solid state relay](#)
- #16, [M1S: Three PWMs with OC outputs](#)
- #17, [M1S: Three PWMs with power outputs](#)
- #18, [C1: Power input](#)
- #19, [C2: DB9 connector](#)
- #20, [C2: Nine terminal blocks](#)
- #21, [C1: Four terminal blocks](#)
- #22, [M2T: Non-isolated PoE \[POE\]](#)
- #23, [M2T: Isolated PoE \[POE\]](#)
- #24, [M1S: Thermocouple temperature meter](#)
- #25, [M2S: High-power 5V supply, 24V input](#)
- #26, [M1S: IR code processor](#)
- #27, [C1: IR receiver/transmitter](#)
- #28, [C1: Ambient light sensor](#)
- #29, [C1: Ambient temperature meter](#)
- #30, [C1: Ambient humidity/temperature meter](#)
- #31, [M1S: PIC coprocessor](#)
- #35, [C1: Barometric pressure sensor](#)
- #36, [C1: 3-axis accelerometer](#)
- #37, [C1: RF connector](#)
- #38, [C1: Pushbutton](#)
- #39-1~4, [C1: Large LED](#)
- #40-1~4, [M1S: Digital potentiometer](#) (four nominals)
- #41, [C1: 8-bit port](#)
- #42, [M1S: RTC and NVRAM with backup](#)
- #43, [C1: 3.5mm phone jack](#)
- #45-1, [M1S: Current/power meter, 0-1A range](#)

#00-1, M1S: Four direct I/O lines



Function: Four directly exposed I/O lines of the microcontroller

Form factor: [M1S](#)

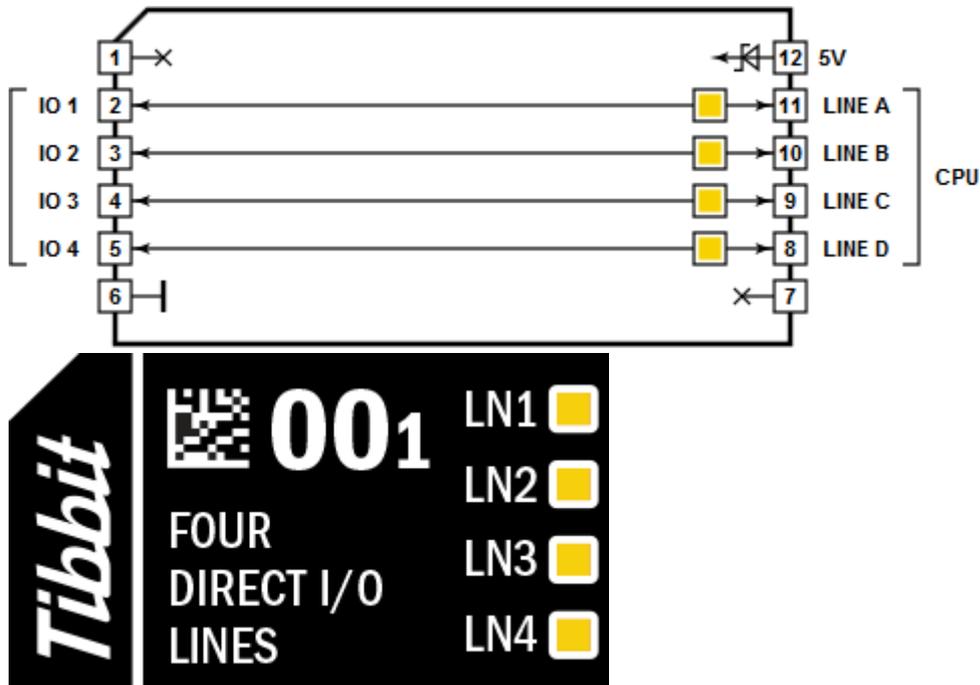
Category: Blank module

Special needs: ---

Power requirements: 5V/20mA

Mates with: [#19](#), [#20](#), [#21](#) (limited use)

See also: [#00-2](#), [#00-3](#)



Details

Sometimes you just want to work with CPU I/O lines directly -- no logic or circuitry in between. This Tibbit is (basically) four wires that connect its control lines to I/O lines. Complement it with terminal block Tibbit [#20](#) (nine terminal blocks) or [#21](#) (four terminal blocks) and you have four CPU lines "exposed" and ready to be used.

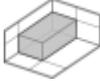
Note that a CPU I/O line has the voltage swing from 0-3.3V when the line is enabled (io.enabled= 1- YES). The voltage may be close to 5V when the line is disabled (io.enabled= 0- NO). This is because the CPU has weak pull-up resistors connected to 5V.

Combining this Tibbit with [#21](#) is potentially limited in use because [#00-1](#) doesn't have dedicated ground or power lines, and Tibbit [#21](#) doesn't have them, either. Need ground (and power)? Consider replacing [#21](#) with [#20](#) (it has ground and power), or turn to using Tibbit [#00-2](#) (it provides ground) or [#00-3](#) (it provides ground and power).

LEDs

Four yellow LEDs are connected to four control lines of the CPU (through buffering gates). LEDs light up for the LOW state of control lines.

#00-2, M1S: Three direct I/O lines and ground



Function: Three directly exposed I/O lines of the microcontroller plus the ground line

Form factor: [M1S](#)

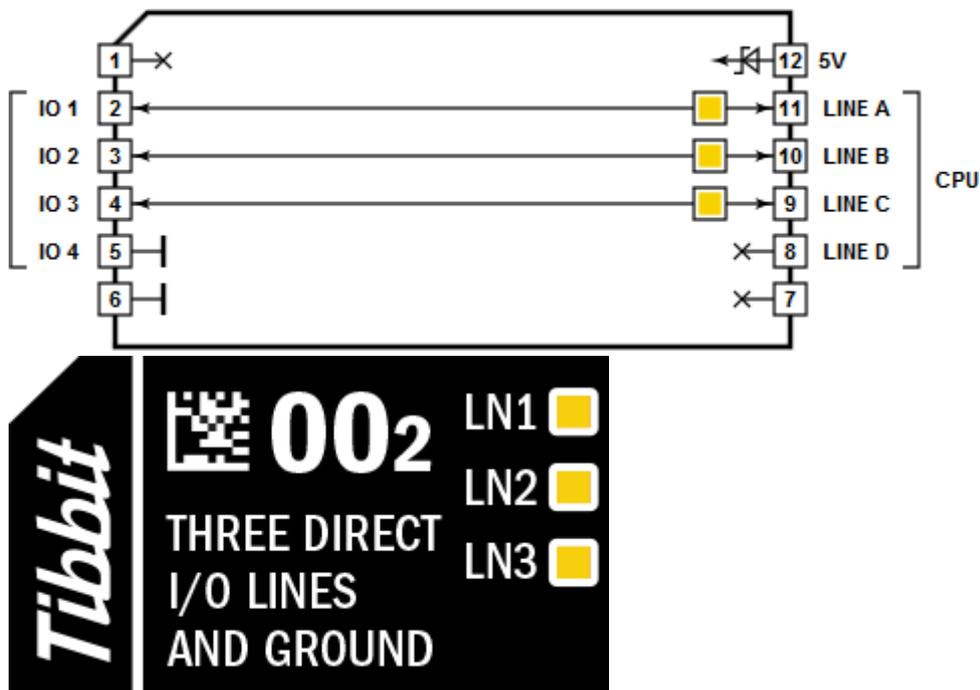
Category: Blank module

Special needs: ---

Power requirements: 5V/20mA

Mates with: [#19](#), [#20](#), [#21](#)

See also: [#00-1](#), [#00-3](#)



Details

As with Tibbit [#00-1](#), this device allows you to work with CPU lines directly. The only difference is that one of the lines is replaced by the ground (GND) line.

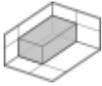
The GND line may be necessary when using this Tibbit with "C" device [#21](#) (four terminal blocks). #21 doesn't have its own dedicated ground, so if the ground is necessary (and it usually is) then it must come from the neighboring "M" device, such as this Tibbit.

Note that a CPU I/O line has the voltage swing from 0-3.3V when the line is enabled (io.enabled= 1- YES). The voltage may be close to 5V when the line is disabled (io.enabled= 0- NO). This is because the CPU has weak pull-up resistors connected to 5V.

LEDs

Three yellow LEDs are connected to three control lines of the CPU (through buffering gates). LEDs light up for the LOW state of control lines.

#00-3, M1S: Two direct I/O lines, +5V power, ground



Function: Two directly exposed I/O lines of the microcontroller plus the +5V output and ground lines

Form factor: [M1S](#)

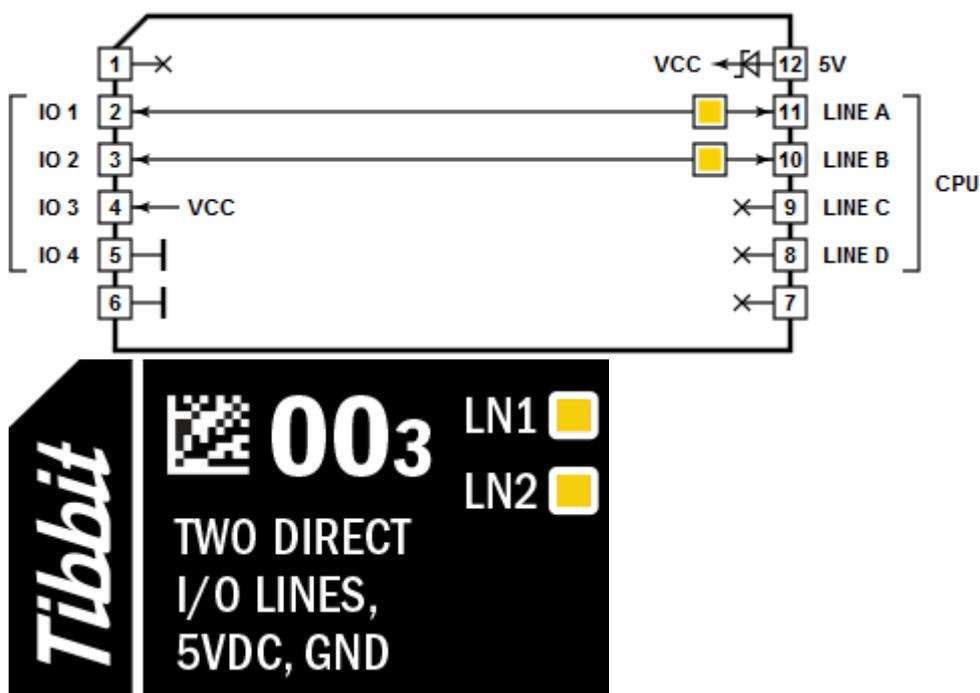
Category: Blank module

Special needs: ---

Power requirements: 5V/20mA

Mates with: [#19](#), [#20](#), [#21](#), [#28](#), [#29](#), [#30](#), [#35](#), [#36](#)

See also: [#00-1](#), [#00-2](#)



Details

As with Tibbits [#00-1](#) and [#00-2](#), this one "gets the CPU lines out". The only difference is that one of the lines is replaced by +5V power, and another line is ground. This leaves you with only two CPU lines, but very often this is sufficient.

The GND and +5V lines may be necessary when using this Tibbit with "C" Tibbit [#21](#) (four terminal blocks). #21s doesn't have its own ground or power, so those must

come from the neighboring "M" device, such as this Tibbit.

Another use for this Tibbit is with "C" devices that implement various sensors:

- [#28](#): Ambient light sensor
- [#29](#): Ambient temperature meter
- [#30](#): Ambient humidity meter
- [#35](#): Barometric pressure sensor
- [#36](#): 3-axis accelerometer

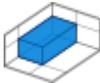
All of the above sensors use I2C interface to talk to the main CPU. I2C only requires two CPU lines. The remaining two lines are ground and +5V power.

Note that a CPU I/O line has the voltage swing from 0-3.3V when the line is enabled (io.enabled= 1- YES). The voltage may be close to 5V when the line is disabled (io.enabled= 0- NO). This is because the CPU has weak pull-up resistors connected to 5V.

LEDs

Two yellow LEDs are connected to two control lines of the CPU (through buffering gates). LEDs light up for the LOW state of control lines.

#01, M1S: Four-line RS232 port



Function: Simple RS232 port with only TX, RX, RTS, and CTS lines

Form factor: [M1S](#)

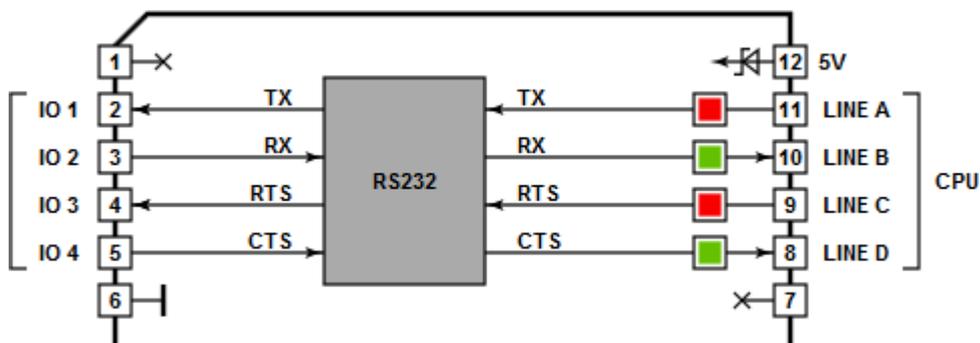
Category: Input/output module

Special needs: [\[SER\]](#), [\[INT\]](#)

Power requirements: 5V/20mA

Mates with: [#19](#), [#20](#), [#21](#) (limited use)

See also: [#02](#), [#05](#)





Details

This is a standard "simple" RS232 port. This Tibbit is based on a generic RS232 transceiver (we use Zywyn ZT232F).

For "normal" RS232 applications, this Tibbit has to be connected to the TX and RX lines of the CPU's UART (see [\[SER\]](#)). Planning to use RTS/CTS flow control as well? An interrupt line must be available, too (see [\[INT\]](#)).

Combining this Tibbit with the "C" device [#19](#) (DB9M connector) will create a serial port with standard pin assignment on the DB9M:

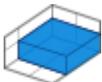
#1	<No connection>
#2	RX (input)
#3	TX (output)
#4	<No connection>
#5	Ground
#6	<No connection>
#7	RTS (output)
#8	CTS (input)
#9	<No connection>

You can also combine the RS232 Tibbit with [#20](#) (9 terminal blocks). Using [#21](#) (four terminal blocks) is also possible if you can steal the ground elsewhere ([#21](#) doesn't have its own ground line).

LEDs

There are four LEDs: two red and two green. Red LEDs are connected to TX and RTS lines. Green ones are for RX and CTS. All LEDs are buffered (with logic gates) and light up for the LOW state of control lines.

#02, M2S: RS232/422/485 port



Function: Universal RS232/422/485 port with electronic mode selection

Form factor: [M2S](#)

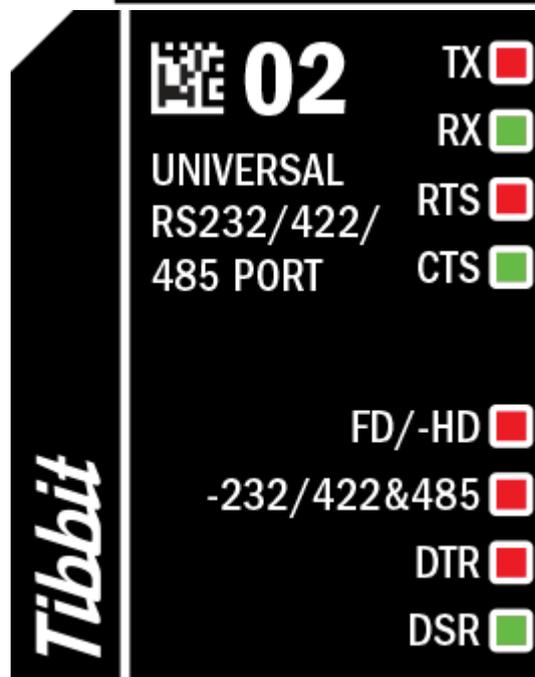
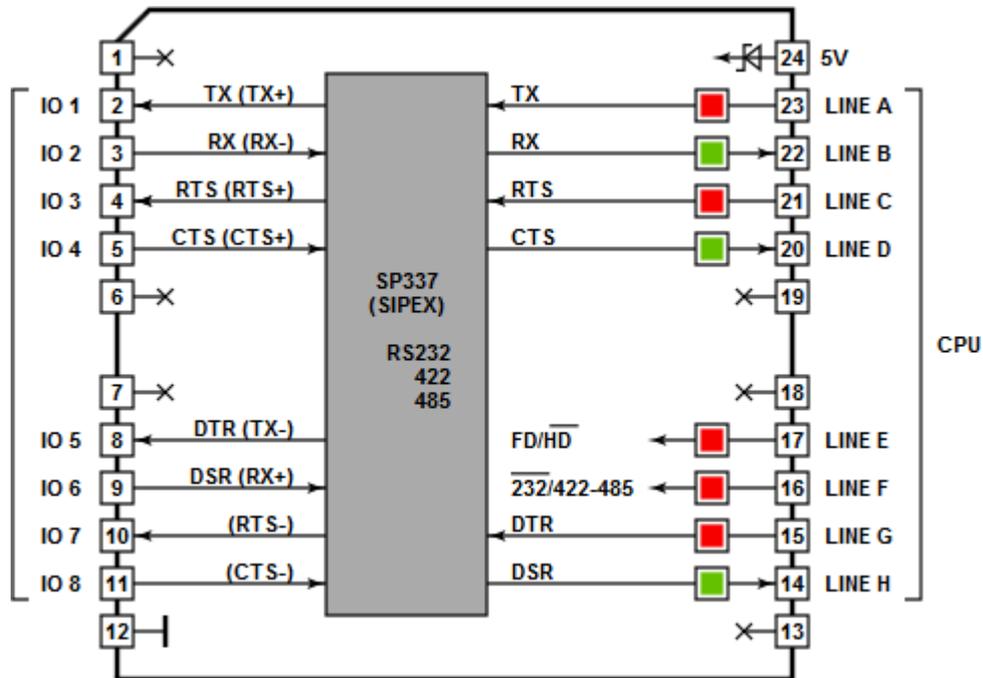
Category: Input/output module

Special needs: [\[SER\]](#), [\[INT\]](#).

Power requirements: 5V/40mA

Mates with: [#19](#), [#20](#)

See also: [#01](#), [#05](#)



Details

This is a "full" serial port that can be electronically programmed to work in RS232, RS422, or RS485 mode. The Tibbit is based on the Sipex SP337 universal transceiver.

Mode selection is through FD/HD and 232/422-485 control lines:

Mode	FD/-HD	-232/422-485
RS232	HIGH	LOW
RS422	HIGH	HIGH
RS485	LOW	HIGH

When unconnected, FD/-HD defaults to HIGH, while -232/422-485 defaults to LOW. This means that the RS232 mode will be selected.

In the RS232 mode the port has RX, TX, RTS, CTS, DTR, and DSR signals. This is the full-duplex mode.

In the RS422 mode the port has +/-RX, +/-TX, +/-RTS, and +/-CTS signal pairs. This is the full-duplex mode.

In the RS485 mode the port has only +/-RX and +/-TX signal pairs. This is the half-duplex mode, so you can connect +RX to +TX, and -RX to -TX. This will allow your system to communicate over a single twisted pair. Direction control is through the RTS line -- the line shall be LOW for data input and HIGH for output.

For "normal" RS232/422/485 applications, this Tibbit has to be connected to the TX and RX lines of the CPU's UART (see [\[SER\]](#)). Planning to use RTS/CTS flow control as well? An interrupt line must be available, too (see [\[INT\]](#)).

Combining this Tibbit with the "C" device [#19](#) (DB9M connector) will create a serial port with the following pin assignment on the DB9M:

	RS232	RS422	RS485
#1	<No connection>	TX2- (output, commonly RTS-)	<No connection>
#2	RX (input)	RX- (input)	RX- (input)
#3	TX (output)	TX+ (output)	TX+ (output)
#4	TX3 (output, commonly DTR)	TX- (output)	TX- (output)
#5	Ground	Ground	Ground
#6	RX3 (input, commonly DSR)	RX+ (input)	RX+ (input)
#7	TX2 (output, commonly RTS)	TX2+ (output, commonly RTS+)	<No connection>
#8	RX2 (input, commonly CTS)	RX2+ (input, commonly CTS+)	<No connection>
#9	<No connection>	RX2- (input, commonly CTS-)	<No connection>

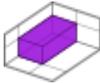
The above pin assignment is the same we use on all our devices with the universal port (for example, see the [serial port of the DS1102](#)).

You can also combine the RS232 Tibbit with [#20](#) (9 terminal blocks).

LEDs

There are eight LEDs: five red and three green. Red LEDs are connected to TX, RTS, DTR, FD/-HD, and -232/422-485 lines. Green ones are for RX, CTS, and DSR. All LEDs are buffered (with logic gates) and light up for the LOW state of control lines.

#03-1, M1S: Two low-power relays (configuration 1)



Function: Two mechanical low-power relays with independent normally opened terminals

Form factor: [M1S](#)

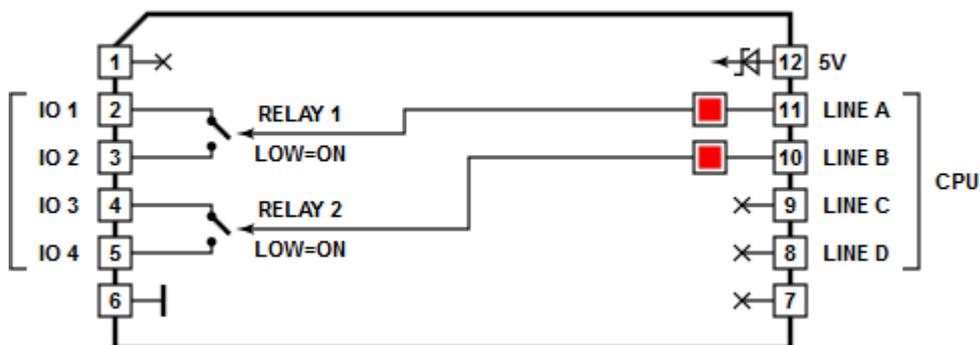
Category: Output module

Special needs: ---

Power requirements: 5V/60mA (with both relays activated)

Mates with: [#19](#), [#20](#), [#21](#)

See also: [#03-2](#), [#06](#), [#07](#), [#15](#)



Details

These relays are rated for 1A/30V.

To activate a relay, set the corresponding control line LOW. When left unconnected, control lines default to HIGH (and, hence, relays are off).

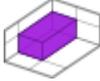
Combine this Tibbit with terminal block devices -- [#20](#) (nine terminal blocks) or [#21](#)

(four terminal blocks).

LEDs

There are two red LEDs which are connected to two relay control lines. LEDs light up for the LOW state of control lines (i.e. when relays are activated).

#03-2, M1S: Two low-power relays (configuration 2)



Function: Two mechanical low-power relays with joined middle (common) terminals. Relay 1 has normally closed and normally opened terminals. Relay 2 only has the normally opened terminal exposed.

Form factor: [M1S](#)

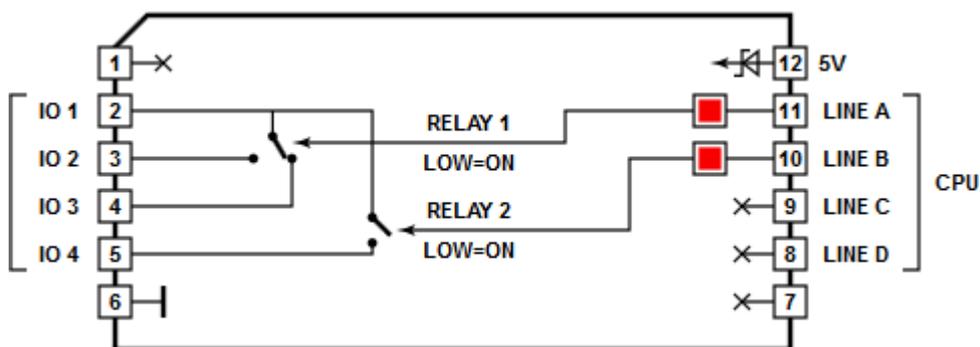
Category: Output module

Special needs: ---

Power requirements: 5V/60mA (with both relays activated)

Mates with: [#19](#), [#20](#), [#21](#)

See also: [#03-1](#), [#06](#), [#07](#), [#15](#)



Details

These relays are rated for **TBD/TBD**.

To activate a relay, set the corresponding control line LOW. When left unconnected, control lines default to HIGH (and, hence, relays are off).

Combine this Tibbit with terminal block devices -- [#20](#) (nine terminal blocks) or [#21](#) (four terminal blocks).

LEDs

There are two red LEDs which are connected to two relay control lines. LEDs light up for the LOW state of control lines (i.e. when relays are activated).

#04-1, M1S: Two isolated inputs



Function: Two optically isolated inputs with independent terminals. Inputs are fully isolated from system ground.

Form factor: [M1S](#)

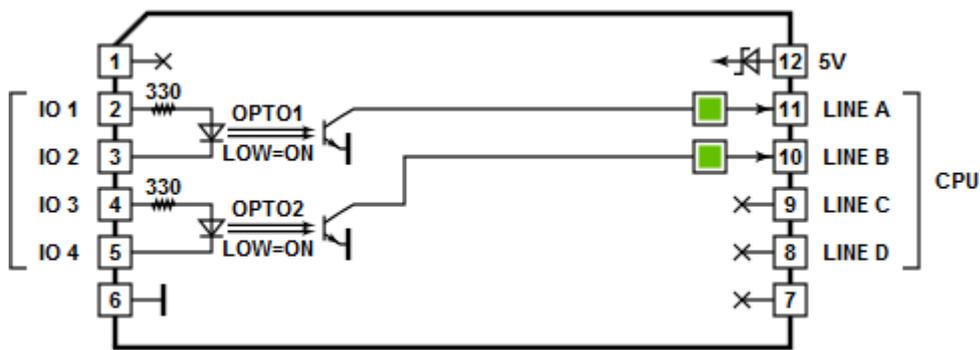
Category: Input module

Special needs: ---

Power requirements: 5V/30mA

Mates with: [#19](#), [#20](#), [#21](#)

See also: [#04-2](#), [#04-3](#), [#04-4](#)



Details

If no external resistor is added these inputs activate at about 2V. Forward current should not exceed 10mA, and this caps the maximum input voltage at around 5V. Add external resistors if you need to apply higher input voltage.

Combine this Tibbit with terminal block devices -- [#20](#) (nine terminal blocks) or [#21](#) (four terminal blocks).

LEDs

There are two green LEDs which are connected to two control lines. LEDs light up for the LOW state of control lines (i.e. when current passes through the diodes of

the opto-couples).

#04-2, M1S: Three isolated inputs, common (-)



Function: Three optically isolated inputs with common (-). Inputs are fully isolated from system ground.

Form factor: [M1S](#)

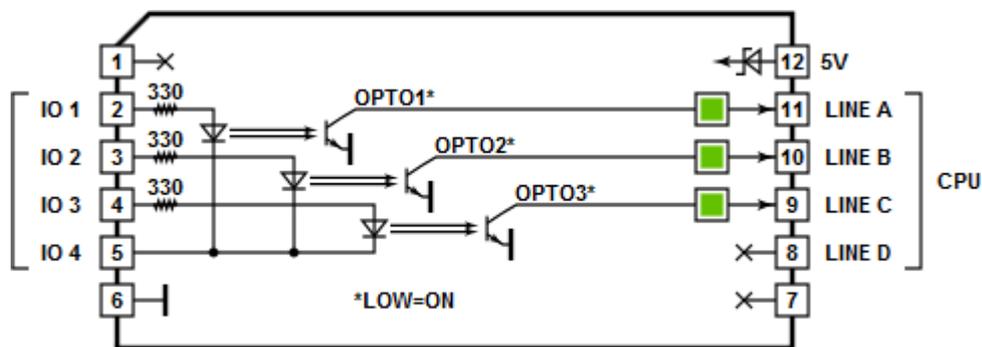
Category: Input module

Special needs: ---

Power requirements: 5V/35mA

Mates with: [#19](#), [#20](#), [#21](#)

See also: [#04-1](#), [#04-3](#), [#04-4](#)



Details

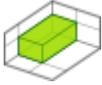
If no external resistor is added these inputs activate at about 2V. Forward current should not exceed 10mA, and this caps the maximum input voltage at around 5V. Add external resistors if you need to apply higher input voltage.

Combine this Tibbit with terminal block devices -- [#20](#) (nine terminal blocks) or [#21](#) (four terminal blocks).

LEDs

There are three green LEDs which are connected to three control lines. LEDs light up for the LOW state of control lines (i.e. when current passes through the diodes of the opto-couples).

#04-3, M1S: Three isolated inputs, common (+)



Function: Three optically isolated inputs with common (+). Inputs are fully isolated from system ground.

Form factor: [M1S](#)

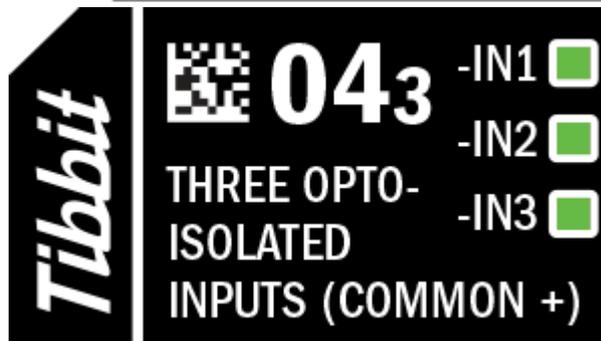
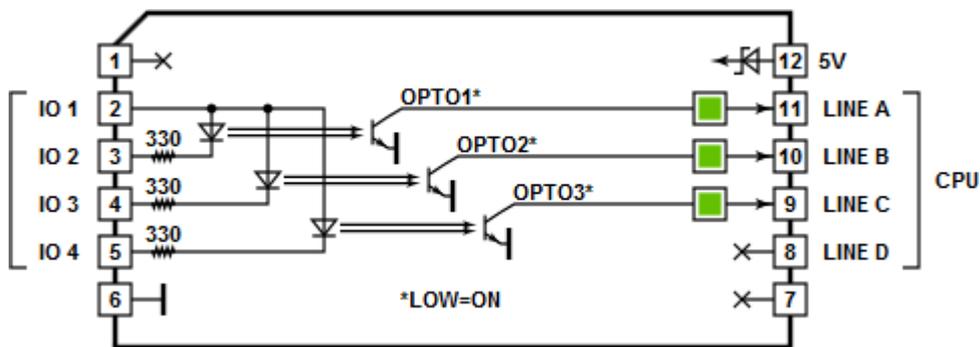
Category: Input module

Special needs: ---

Power requirements: 5V/35mA

Mates with: [#19](#), [#20](#), [#21](#)

See also: [#04-1](#), [#04-2](#), [#04-4](#)



Details

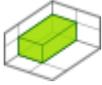
If no external resistor is added these inputs activate at about 2V. Forward current should not exceed 10mA, and this caps the maximum input voltage at around 5V. Add external resistors if you need to apply higher input voltage.

Combine this Tibbit with terminal block devices -- [#20](#) (nine terminal blocks) or [#21](#) (four terminal blocks).

LEDs

There are three green LEDs which are connected to three control lines. LEDs light up for the LOW state of control lines (i.e. when current passes through the diodes of the opto-couplers).

#04-4, M1S: Four opto-inputs, common ground



Function: Four opto-couple inputs with the '-' terminal connected to the system ground, independent '+' terminals

Form factor: [M1S](#)

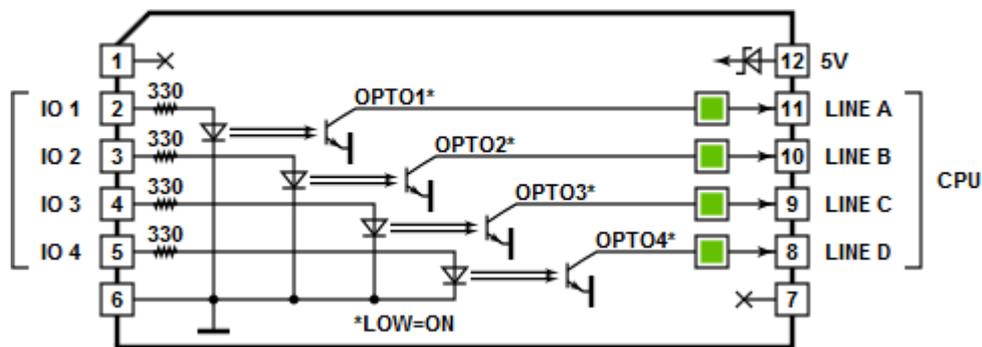
Category: Input module

Special needs: ---

Power requirements: 5V/40mA

Mates with: [#19](#), [#20](#), [#21](#) (limited use)

See also: [#04-1](#), [#04-2](#), [#04-3](#)



Details

If no external resistor is added these inputs activate at about 2V. Forward current should not exceed 10mA, and this caps the maximum input voltage at around 5V. Add external resistors if you need to apply higher input voltage.

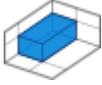
Note that these are not "isolated inputs" -- they share the ground line with the rest of your system. Still, the optical stage isolates your system from noise, ESD, spikes, and other external influences.

Combine this Tibbit with terminal block devices -- [#20](#) (nine terminal blocks) or [#21](#) (four terminal blocks).

LEDs

There are four green LEDs which are connected to four control lines. LEDs light up for the LOW state of control lines (i.e. when current passes through the diodes of the opto-couples).

#05, M1S: RS485 port



Function: RS485 port with full-duplex or half-duplex operation

Form factor: [M1S](#)

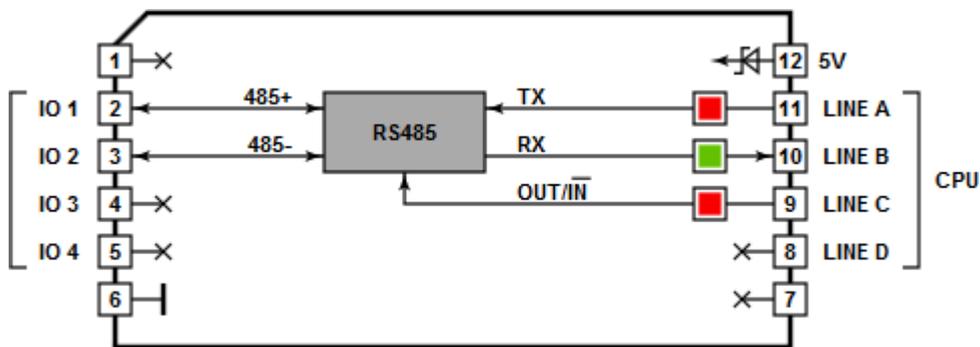
Category: Input/output module

Special needs: [\[SER\]](#)

Power requirements: 5V/15mA

Mates with: [#19](#), [#20](#), [#21](#)

See also: [#01](#), [#02](#)



Details

This port has only +/-RX and +/-TX signal pairs. If you are working in the half-duplex mode, connect +RX to +TX, and -RX to -TX. This will allow your system to communicate over a single twisted pair. Direction control is through the RTS line -- the line shall be LOW for data input and HIGH for output. Keep the RX and TX pairs separate for the full-duplex mode and set the RTS line HIGH to keep the TX enabled at all times.

For "normal" RS485 applications, this Tibbit has to be connected to the TX and RX lines of the CPU's UART (see [\[SER\]](#)).

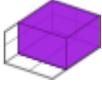
Combine this Tibbit with terminal block devices -- [#20](#) (nine terminal blocks) or [#21](#) (four terminal blocks).

LEDs

There are three LEDs: two red and one green. Red LEDs are connected to TX and

OUT/-IN lines. The green LED is for the RX input. All LEDs are buffered (with logic gates) and light up for the LOW state of control lines.

#06, M2T: Two high-power relays



Function: Two mechanical high-power relays with normally opened and normally closed terminals

Form factor: [M2T](#)

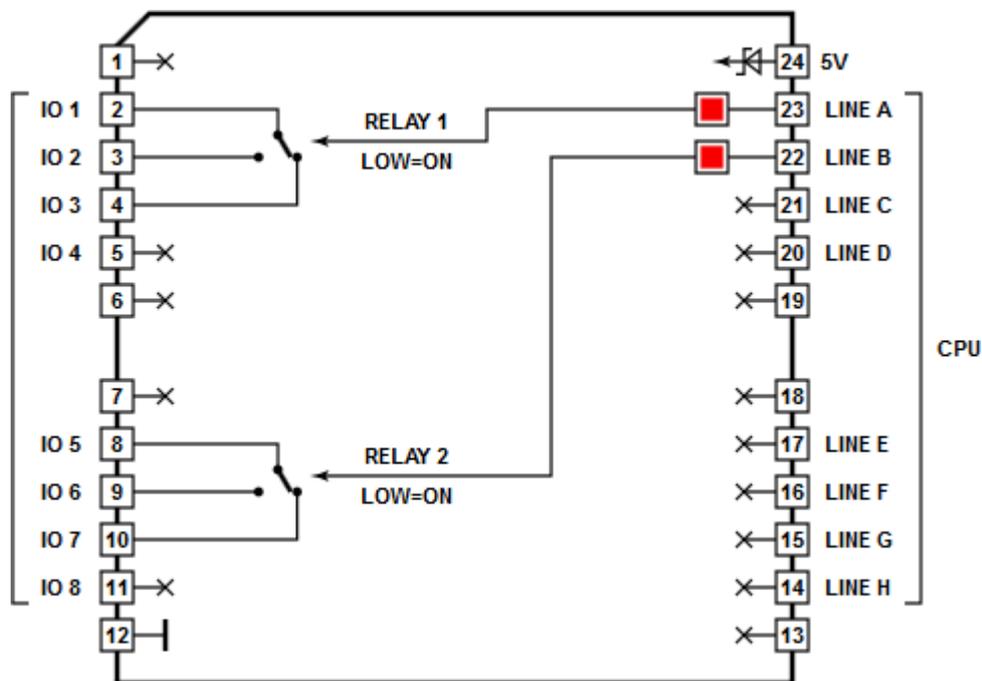
Category: Output module

Special needs: ---

Power requirements: 5V/140mA (with both relays activated)

Mates with: [#19](#), [#20](#), [#21](#)

See also: [#03-1](#), [#03-2](#), [#07](#), [#15](#)





Details

These relays have the contact capacity rated at 16A/48V (resistive load).

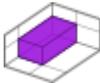
To activate a relay, set the corresponding control line LOW. When left unconnected, control lines default to HIGH (and, hence, relays are off).

Combine this Tibbit with Tibbit [#20](#) (nine terminal blocks).

LEDs

There are two red LEDs which are connected to two relay control lines. LEDs light up for the LOW state of control lines (i.e. when relays are activated).

#07, M1S: Two solid state relays



Function: Two solid state normally opened relays

Form factor: [M1S](#)

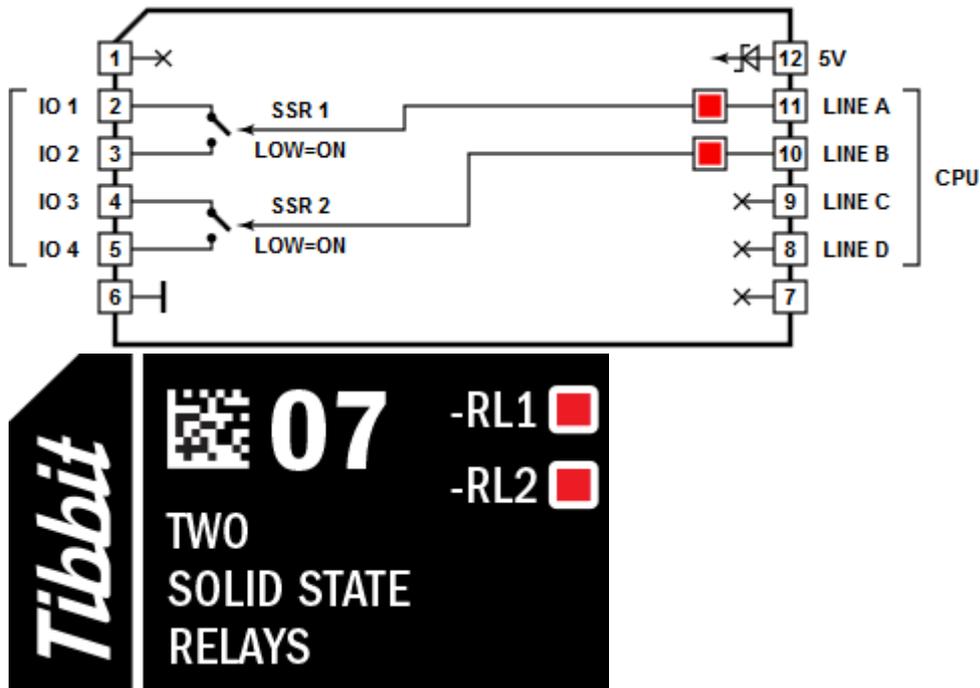
Category: Output module

Special needs: ---

Power requirements: 5V/25mA (with both relays activated)

Mates with: [#19](#), [#20](#), [#21](#)

See also: [#03-1](#), [#03-2](#), [#06](#), [#15](#)



Details

These relays are rated for the maximum load of 1A per relay.

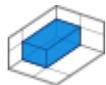
To activate a relay, set the corresponding control line LOW. When left unconnected, control lines default to HIGH (and, hence, relays are off).

Combine this Tibbit with terminal block devices -- [#20](#) (nine terminal blocks) or [#21](#) (four terminal blocks).

LEDs

There are two red LEDs which are connected to two SSR control lines. LEDs light up for the LOW state of control lines (i.e. when relays are activated).

#08, M1S: Wiegand and clock/data reader port



Function: Wiegand and clock/data reader port plus one open collector output

Form factor: [M1S](#)

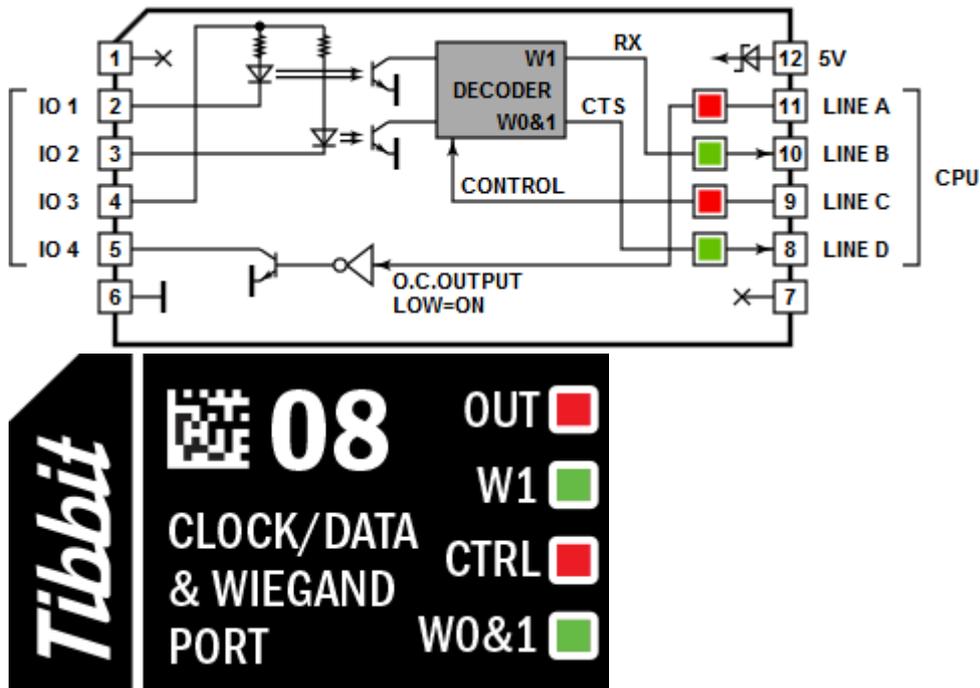
Category: Input/output module

Special needs: [\[SER\]](#)

Power requirements: 5V/[TBD](#)mA

Mates with: [#19](#), [#20](#), [#21](#) (limited use)

See also: [#11](#)



Details

Our programmable devices (such as [TPP2](#) and [TPP3](#)) have the unique ability to process input from card readers with clock/data or Wiegand interface. This is achieved through the ser. object running in the clock/data or Wiegand mode. Tibbit #08 implements necessary hardware.

In order to be able to process card reader output, this Tibbit has to be connected to the RX and CTS lines of the CPU's UART (see [\[SER\]](#)).

When connecting a clock/data reader, wire the clock line to IO1, and the data line to IO2. Set the CONTROL line to LOW -- this selects the clock/data mode for the Tibbit's hardware.

When connecting a Wiegand reader, wire the W0 line to IO1, W1 line -- to IO2. Set the CONTROL line to HIGH to select the Wiegand mode.

In both cases, the IO3 line must be connected to the external power source. Most card readers with clock/data and Wiegand interfaces have open collector outputs. Such outputs require pull-up resistors on the receiving end. On this Tibbit, the role of pull-up resistors is played by opto-LEDs and resistors connected in series.

The exact voltage of the power source depends on the reader. Very often it is the supply voltage for the reader itself (typically, +12V). In this case just split the reader power line and connect the same power to IO3. Some readers require 12V power and pull-up resistors to 5V. This means IO3 will need to receive +5V.

This Tibbit also has a standalone open collector output controlled through LINE D. Set LINE D LOW to open the transistor. When left unconnected, the line defaults to HIGH (hence, the transistor is closed).

Combine this Tibbit with terminal block devices -- [#20](#) (nine terminal blocks) or [#21](#) (four terminal blocks). Note that #21 doesn't provide the ground line, and using this Tibbit requires the ground line between the reader and your system. Hence, if you use Tibbit #21 you will need to "steal" the ground somewhere else.

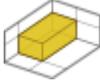
Check out the Tibbit [#11](#) (four open collector outputs) if you are looking to *emulate*

clock/data or Wiegand reader output (that is, of you want to turn your device into a reader that outputs data).

LEDs

There are four LEDs: two red and two green. Red LEDs are connected to the CONTROL and OC line. Green LEDs are connected to W0&1 and W1 lines. All LEDs are buffered (with logic gates) and light up for the LOW state of control lines.

#09, M1S: Low-power 5V supply, 12V input



Function: Low-power non-isolated power supply with 5V output, 9-18V input range, shutdown control

Form factor: [M1S](#)

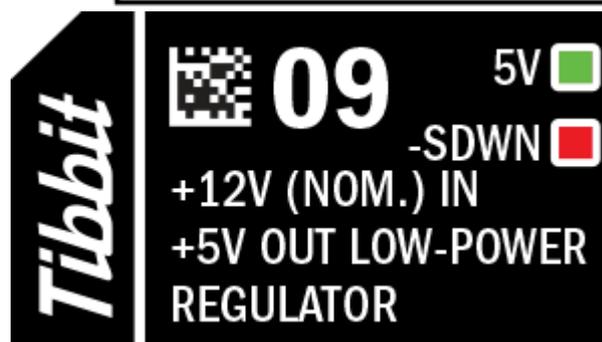
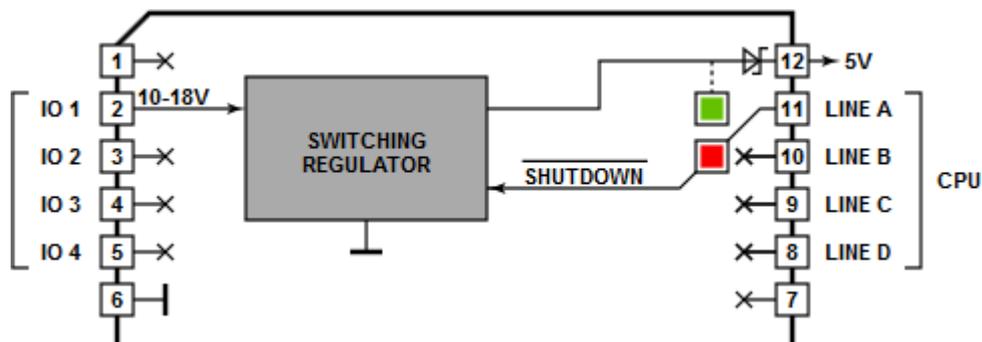
Category: Power supply module

Special needs: ---

Power requirements: external 9-18V power

Mates with: [#18](#), [#19](#), [#20](#), [#21](#)

See also: [#10](#), [#12](#), [#22](#), [#23](#)



Details

This Tibbit is capable of generating up to 700mA of 5V power from the external input in the 9-18V range. Multiple power supply Tibbits can be used to increase available current or for power redundancy.

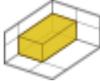
The module has a dedicated shutdown (-SDWN) line. Pull the line LOW to disable this Tibbit.

Combine this Tibbit with [#18](#) (it has a power jack and two terminal blocks), [#20](#) (nine terminal blocks), or [#21](#) (four terminal blocks).

LEDs

There is one green and one red LED. The green LED is connected to the +5V output and lights up when the voltage is present on this line. Red LED is connected to the -SHUTDOWN line and lights up when the line is LOW (i.e. when the power supply is in shutdown). The red LED is buffered (with a logic gate).

#10, M1T: Medium-power 5V supply, 12 V input



Function: Medium-power non-isolated power supply with 5V output, 9-18V input range, and shutdown control

Form factor: [M1T](#)

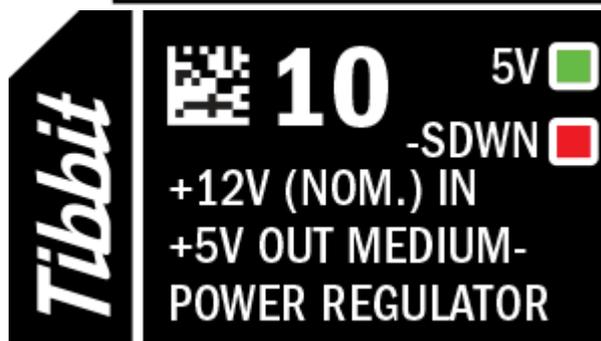
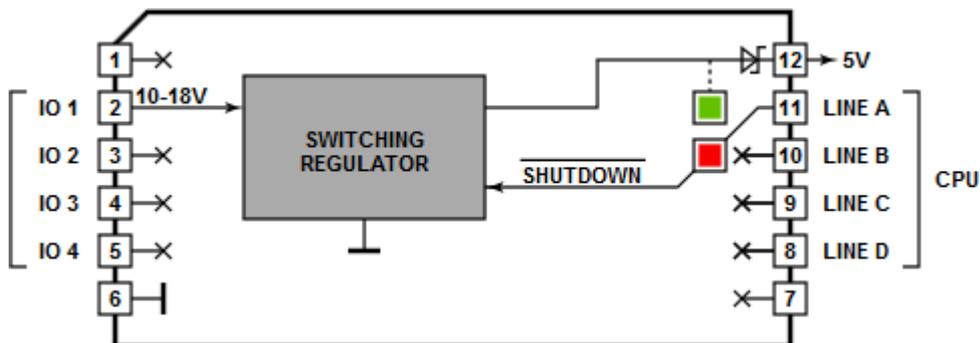
Category: Power supply module

Special needs: ---

Power requirements: external 9-18V power

Mates with: [#18](#), [#19](#), [#20](#), [#21](#)

See also: [#09](#), [#12](#), [#22](#), [#23](#)



Details

This Tibbit is capable of generating up to 1100mA of 5V power from the external input in the 9-18V range. Multiple power supply Tibbits can be used to increase available current or for power redundancy.

The module has a dedicated shutdown (-SDWN) line. Pull the line LOW to disable

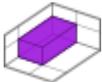
this Tibbit.

Combine this Tibbit with [#18](#) (it has a power jack and two terminal blocks), [#20](#) (nine terminal blocks), or [#21](#) (four terminal blocks).

LEDs

There is one green and one red LED. The green LED is connected to the +5V output and lights up when the voltage is present on this line. Red LED is connected to the -SHUTDOWN line and lights up when the line is LOW (i.e. when the power supply is in shutdown). The red LED is buffered (with a logic gate).

#11, M1S: Four open collector outputs



Function: Four open collector outputs

Form factor: [M1S](#)

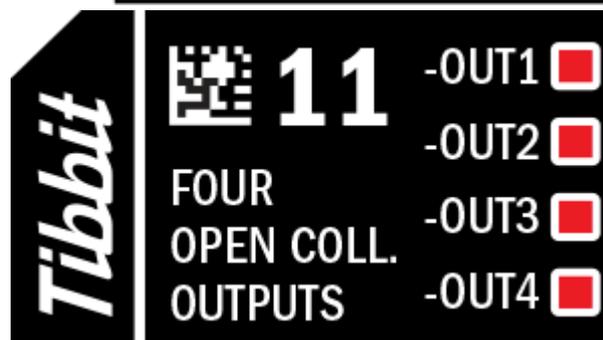
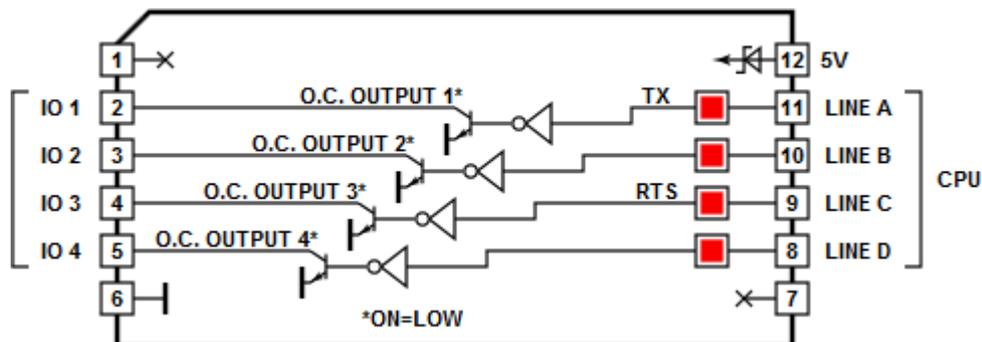
Category: Output module

Special needs: [\[SER\]](#) (if reader emulation is desired)

Power requirements: 5V/50mA

Mates with: [#19](#), [#20](#), [#21](#) (limited use)

See also: [#16](#)



Details

Transistors are rated for the maximum voltage of 24V and the maximum per-channel current of 0.5A. Note that the maximum current should not be exceeded even at lower voltages. Do not apply negative voltage!

To open a transistor, set the corresponding control line LOW. When left unconnected, control lines default to HIGH (and, hence, transistors will be closed).

Combine this Tibbit with terminal block devices -- [#20](#) (nine terminal blocks) or [#21](#) (four terminal blocks). Note that [#21](#) doesn't provide the ground line, and using this Tibbit requires the ground line between the outside world and your system. Hence, if you use Tibbit [#21](#) you will need to "steal" the ground somewhere else.

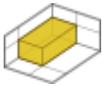
One additional possible use of this Tibbit is for the emulation of clock/data or Wiegand card readers. Our programmable devices (such as [TPP2](#) and [TPP3](#)) have the unique ability to output data in the clock/data or Wiegand format. This is achieved through the ser. object running in the clock/data or Wiegand mode. Card readers usually have open collector outputs so this Tibbit is ideally suited as the hardware front-end for the job. For this to work, the Tibbit has to be connected to the TX and RTS lines of the CPU's UART (see [\[SER\]](#)).

As with many "real" readers, the equipment on the receiving end will need pull-up resistors.

LEDs

There are four red LEDs which are connected to four control lines. All LEDs are buffered (using logic gates) and light up for the LOW state of control lines (i.e. when transistors are in the opened state).

#12, M1S: Low-power +15/-15V power supply, 5V input



Function: Low-power non-isolated power supply with +15/-15V output, 5V input, shutdown control

Form factor: [M1S](#)

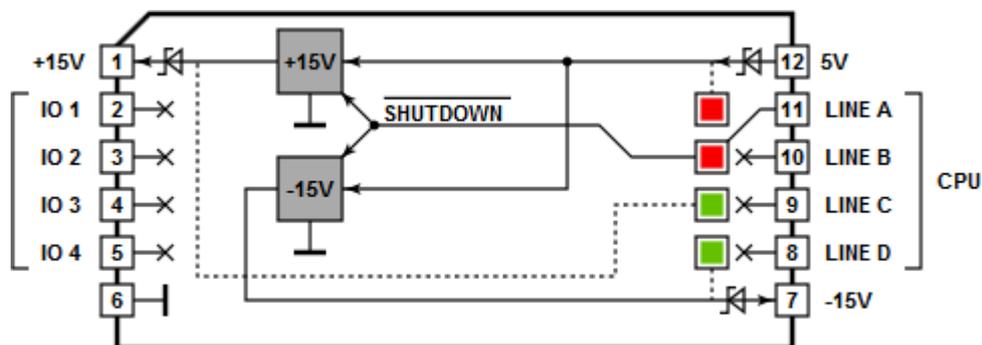
Category: Power supply module

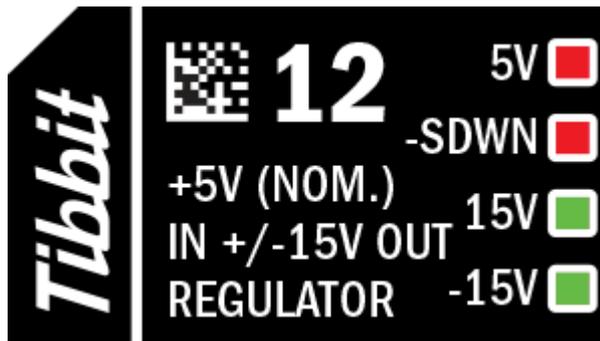
Special needs: ---

Power requirements: 5V/230mA + curr * 4.5 ("curr" is the combined current consumed on 15V and -15V outputs)

Mates with*: [#19](#), [#20](#), [#37](#)

See also: [#13](#), [#14](#)





Details

This Tibbit is capable of generating up to 15mA of +15V power and 15mA of -15V power from the main 5V supply rail. This Tibbit, therefore, does not rely on the outside power but instead generates +/-15V from the internal main power of the TPS. The diagram in [Tibbit Power Lines](#) actually shows Tibbit #12 and its "power relationship" with other Tibbits. Multiple Tibbits #12 can be used to increase available +/-15V current budget.

The module is required for the correct operation of Tibbits [#13](#) (ADC) and [#14](#) (DAC).

This Tibbit has a base (idle) power consumption of 230mA. Each additional mA of current consumed on the +15V and -15V outputs results in 4.5mA of extra power drain on the 5V input. This 4.5 ratio is explained by the threefold difference in the input (5V) and output (15V) voltages, as well as associated power conversion losses.

The module has a dedicated shutdown (-SDWN) line. Pull the line LOW to disable this Tibbit.

LEDs

There are two red and two green LEDs. The first red LED is connected to the +5V input. The second red LED is connected to the -SHUTDOWN line and lights up when the line is LOW (i.e. when the module is in shutdown). Green LEDs are +15V and -15V power indicators.

** "Mates" in this case means "doesn't mind them close" as this device requires no connector Tibbits for its own operation.*

#13, M1S: Four-channel ADC



Function: Four-channel ADC

Form factor: [M1S](#)

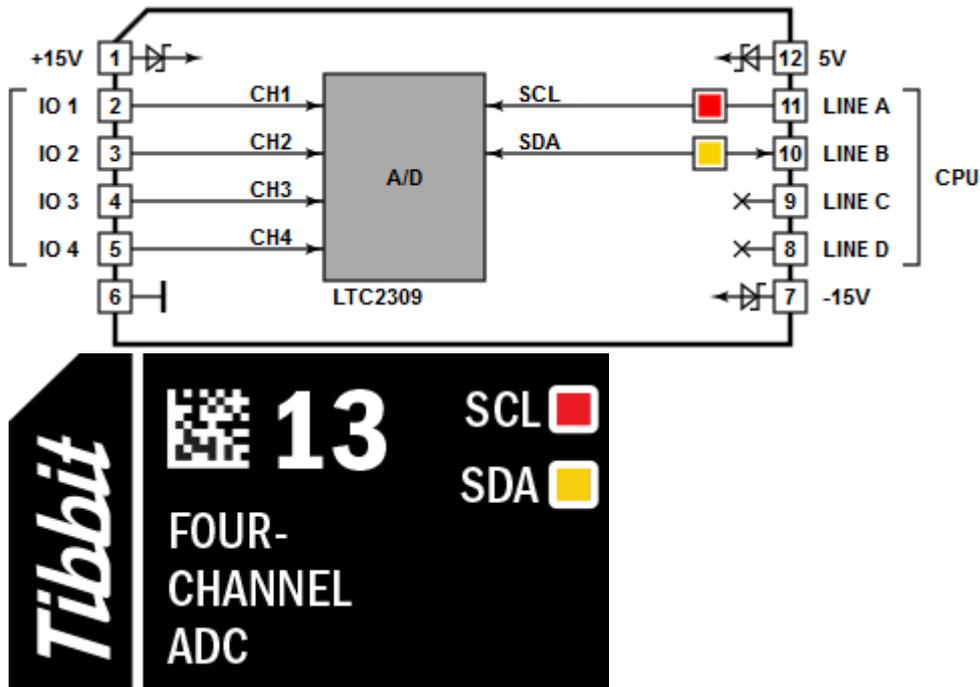
Category: Input module

Special needs: +15V and -15V power (use Tibbit [#12](#) to generate these voltages)

Power requirements: 5V/10mA, 15V/9mA, -15V/3.5mA (the aggregated consumption through Tibbit #12 is 66mA)

Mates with: [#19](#), [#20](#), [#21](#) (limited use)

See also: [#12](#), [#14](#)



Details

This ADC Tibbit is based on the LTC2309 12-bit ADC with I2C interface. Only four channels of this ADC are used by the Tibbit. The analog front end of the module allows you to measure signals in the -10V to +10V range. All measurements are with respect to the system ground.

Keep in mind that every time you are reading the data out of the LCD2309 IC you are actually getting the previous conversion result. This may not be an issue when running a conversion loop for a single ADC channel. You will have to ignore the first result in these cases:

- Discard the first ADC result after the channel change. Only the second measurement will bring you the conversion data for the newly selected channel.
- Do the conversion twice and discard the first result when performing sporadic measurements. This way you will obtain the "current" data.

The LTC2309 ADC IC has a 12-bit resolution. The Tibbit #13 has the effective resolution of around 9~10 bits. This reduction is caused by the system noise and other factors that affect the measurement quality.

Combine this Tibbit with [#20](#) (nine terminal blocks) or [#19](#) (DB9M connector). It's not common but possible to use the latter for wiring into the ADC inputs. The Tibbit [#21](#) (four terminal blocks) can also be used but you will have to steal the ground elsewhere, as #21 doesn't have its own ground line and the ADC measures input voltages with respect to the system ground.

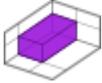
LEDs

There is one red and one yellow LED. The red LED is connected to the SCL line of the I2C interface, the yellow LED -- to the SDA line.

Sample project

The use of this and other "I2C" Tibbits is illustrated by a group of Tibbo BASIC test projects. You can find them at http://tibbo.com/basic/resources/i2c_tibbits.html.

#14, M1S: Four-channel DAC



Function: Four-channel DAC

Form factor: [M1S](#)

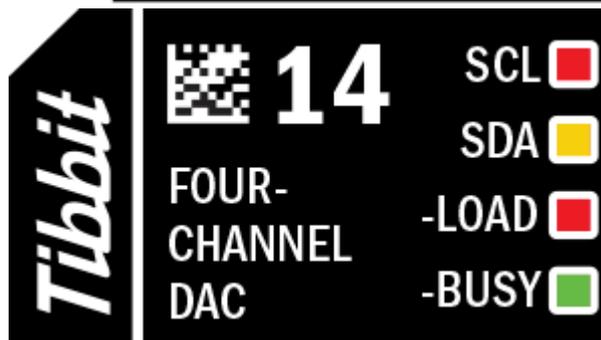
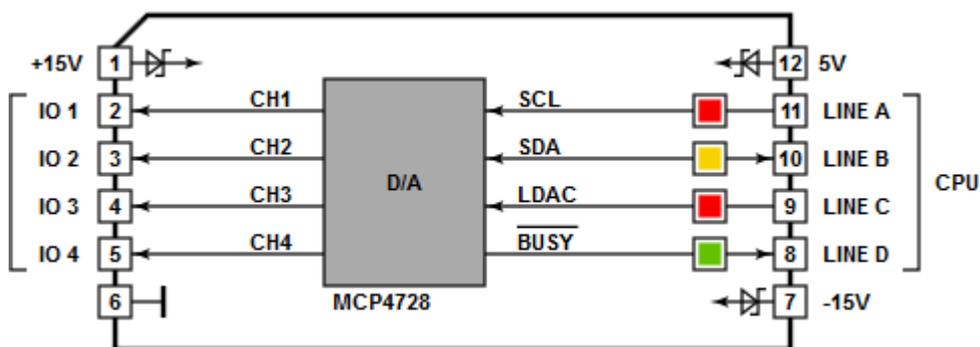
Category: Output module

Special needs: ---

Power requirements: 5V/20mA, 15V/4mA, -15V/4mA (the aggregated consumption through Tibbit #12 is 56mA, measurements were made with no loads on the DAC outputs)

Mates with: [#19](#), [#20](#), [#21](#) (limited use)

See also: [#13](#)



Details

This DAC Tibbit is based on the MCP4728 12-bit DAC with I2C interface. All four channels of this DAC are used by the Tibbit. The analog front end of the module allows you to output signals in the -10V to +10V range (relative to the system ground).

The MCP4728 DAC IC has a 12-bit resolution. The Tibbit #14 has the effective resolution of around 9~10 bits. This reduction is caused by the system noise and

other factors that affect the measurement quality.

Combine this Tibbit with [#20](#) (nine terminal blocks) or [#19](#) (DB9M connector). It's not common but possible to use the latter for wiring into the DAC outputs. The Tibbit [#21](#) (four terminal blocks) can also be used but you will have to steal the ground elsewhere, as #21 doesn't have its own ground line and the DAC outputs voltages with respect to the system ground.

LEDs

There are two red, one yellow, and one green LED. The red LEDs are connected to the SCL and LDAC lines, the yellow LED -- to the SDA line, and the green LED -- to the -BUSY line.

Sample project

The use of this and other "I2C" Tibbits is illustrated by a group of Tibbo BASIC test projects. You can find them at http://tibbo.com/basic/resources/i2c_tibbits.html.

#15, H1: High-voltage AC solid state relay



Function: High-voltage AC solid state normally opened relay

Form factor: [H1](#)

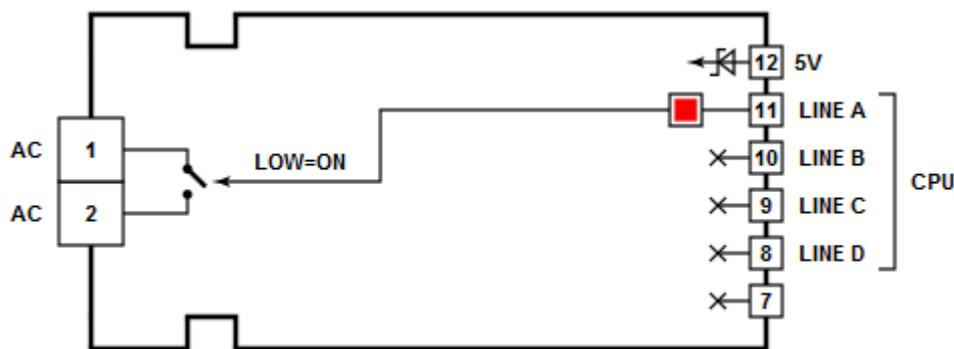
Category: Output module

Special needs: ---

Power requirements: 5V/[TBD](#)mA

Mates with: ---

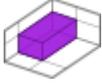
See also: [#03-1](#), [#03-2](#), [#06](#), [#07](#)



Details

This Tibbit is not yet documented.

#16, M1S: Three PWMs with OC outputs



Function: Three PWMs with open collector outputs

Form factor: [M1S](#)

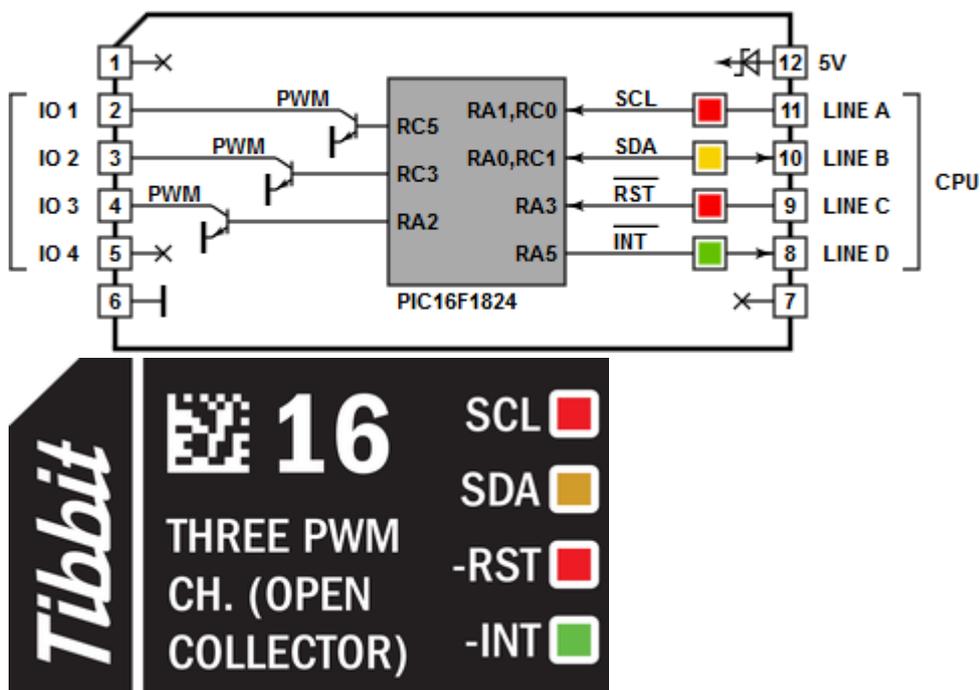
Category: Output module

Special needs: ---

Power requirements: 5V/20mA

Mates with: [#19](#), [#20](#), [#21](#) (limited use)

See also: [#17](#), [#31](#)



Details

This Tibbit is based on the PIC16F1824 microcontroller and takes advantage of the PWM channels available on this PIC device. The PIC micro has four PWM channels but one of the channels cannot be used because it shares I/O lines with the I2C interface. The I2C interface is utilized for communications with the main CPU of the [TPP board](#) and also for PIC firmware upgrades.

The frequency and the pulse width (duty cycle) are set independently for each PWM channel. The frequency is controlled through a divider and a period value. The divider allows you to select the base frequency applied to the divider. Available choices are 32MHz, 8MHz, 2MHz, and 500KHz. The output signal of the PWM can then be programmed to have the period equal to 4~1024 base frequency periods in 4-period steps (i.e. 4, 8, 12,...1020, 1024). This gives you the output range from 8MHz down to 488Hz. The PWM pulse width can be programmed to have the period

equal to 1~1024 base frequency periods in 1-period steps (1, 2, 3,... 1023, 1024). Each PWM channel uses one Zetex FFMT491 NPN transistor which is rated for 1A continuous collector current.

Combine this Tibbit with [#20](#) (nine terminal blocks) or [#19](#) (DB9M connector). It's not common but possible to use the latter for wiring into the PWM outputs. The Tibbit [#21](#) (four terminal blocks) can also be used but you will have to steal the ground elsewhere, as #21 doesn't have its own ground line and the PWM Tibbit outputs voltages with respect to the system ground.

LEDs

There are two red, one yellow, and one green LED. The first red LED is connected to the SCL line of the I2C interface, the second one -- to the -RST line of the PIC micro. The yellow LED is connected to the SDA line of the I2C interface. The green LED is on the -INT line.

PIC micro and GRA firmware

Tibbit #16 ships with the GRA (*general register access*) firmware, which allows you to access internal PIC registers and memory through the I2C interface. The firmware implements a very simple communications protocol which essentially consists of two important commands -- *address read* and *address write*. These two commands are used to write to and read from PIC's internal RAM and registers. This facilitates a simple and versatile access to all microcontroller resources. The available Tibbo BASIC library sits on top of the GRA firmware and uses the communications protocol to access and set the PWM channels.

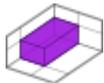
Since the GRA firmware does not do anything intelligent and all the setup work is essentially scripted in Tibbo BASIC, it is possible to modify PWM setup (and PIC behavior) without making any changes to the PIC firmware.

The GRA firmware can be updated or replaced using the *pic_firmware_upgrade* Tibbo BASIC project (see below). You can, therefore, create and run PIC applications that go far beyond providing simple register and memory access.

Sample project

The use of this and other "I2C" Tibbits is illustrated by a group of Tibbo BASIC test projects. You can find them at http://tibbo.com/basic/resources/i2c_tibbits.html. There are two project related to this Tibbit. The first one is titled *test_tibbit_16_17_31_(PIC_copro)*. Run the project in the *TEST_PWM_1* or *TEST_PWM_2* "mode". If this last statement sounds cryptic read the release notes published at http://tibbo.com/basic/resources/i2c_tibbits.html. The second project is *update_pic_firmware*. Use it to update the firmware running on the PIC micro.

#17, M1S: Three PWMs with power outputs



Function: Three PWMs with power outputs (the power must be supplied externally)

Form factor: [M1S](#)

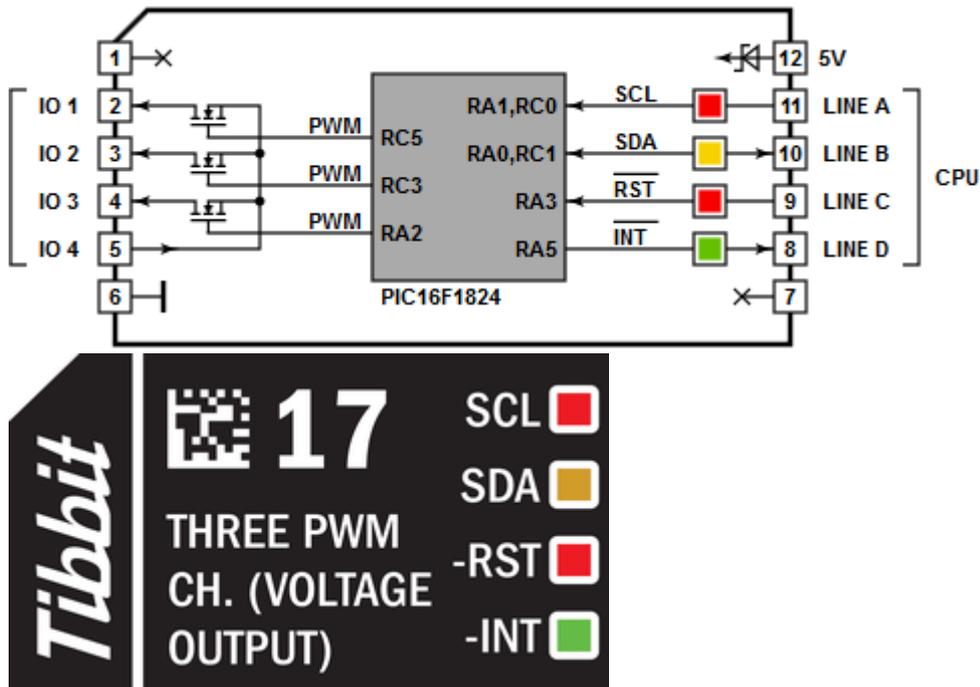
Category: Output module

Special needs: ---

Power requirements: 5V/20mA

Mates with: [#19](#), [#20](#), [#21](#) (limited use)

See also: [#16](#), [#31](#)



Details

This Tibbit is based on the PIC16F1824 microcontroller and takes advantage of the PWM channels available on this PIC device. The PIC micro has four PWM channels but one of the channels cannot be used because it shares I/O lines with the I2C interface. The I2C interface is utilized for communications with the main CPU of the [TPP board](#) and also for PIC firmware upgrades.

The frequency and the pulse width (duty cycle) are set independently for each PWM channel. The frequency is controlled through a divider and a period value. The divider allows you to select the base frequency applied to the divider. Available choices are 32MHz, 8MHz, 2MHz, and 500KHz. The output signal of the PWM can then be programmed to have the period equal to 4~1024 base frequency periods in 4-period steps (i.e. 4, 8, 12,...1020, 1024). This gives you the output range from 8MHz down to 488Hz. The PWM pulse width can be programmed to have the period equal to 1~1024 base frequency periods in 1-period steps (1, 2, 3,... 1023, 1024).

Each PWM channel uses one Singreat Electronics GT430PSB P-channel FET transistor which is rated for 4A continuous current at room temperature.

Combine this Tibbit with [#20](#) (nine terminal blocks) or [#19](#) (DB9M connector). It's not common but possible to use the latter for wiring into the PWM outputs. The Tibbit [#21](#) (four terminal blocks) can also be used but you will have to steal the ground elsewhere, as #21 doesn't have its own ground line and the PWM Tibbit outputs voltages with respect to the system ground.

LEDs

There are two red, one yellow, and one green LED. The first red LED is connected to the SCL line of the I2C interface, the second one -- to the -RST line of the PIC micro. The yellow LED is connected to the SDA line of the I2C interface. The green LED is on the -INT line.

PIC micro and GRA firmware

Tibbit #16 ships with the GRA (*general register access*) firmware, which allows you to access internal PIC registers and memory through the I2C interface. The firmware implements a very simple communications protocol which essentially consists of two important commands -- *address read* and *address write*. These two commands are used to write to and read from PIC's internal RAM and registers. This facilitates a simple and versatile access to all microcontroller resources. The available Tibbo BASIC library sits on top of the GRA firmware and uses the communications protocol to access and set the PWM channels.

Since the GRA firmware does not do anything intelligent and all the setup work is essentially scripted in Tibbo BASIC, it is possible to modify PWM setup (and PIC behavior) without making any changes to the PIC firmware.

The GRA firmware can be updated or replaced using the *pic_firmware_upgrade* Tibbo BASIC project (see below). You can, therefore, create and run PIC applications that go far beyond providing simple register and memory access.

Sample project

The use of this and other "I2C" Tibbits is illustrated by a group of Tibbo BASIC test projects. You can find them at http://tibbo.com/basic/resources/i2c_tibbits.html. There are two project related to this Tibbit. The first one is titled *test_tibbit_16_17_31_(PIC_copro)*. Run the project in the *TEST_PWM_1* or *TEST_PWM_2* "mode". If this last statement sounds cryptic read the release notes published at http://tibbo.com/basic/resources/i2c_tibbits.html. The second project is *update_pic_firmware*. Use it to update the firmware running on the PIC micro.

#18, C1: Power input



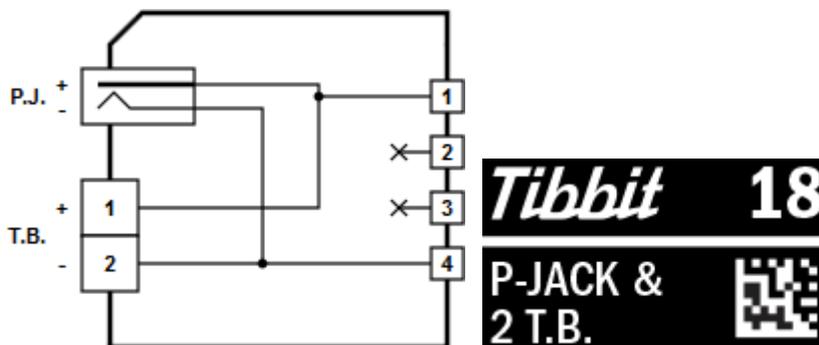
Function: Power jack and two terminal blocks

Form factor: [C1](#)

Special needs: ---

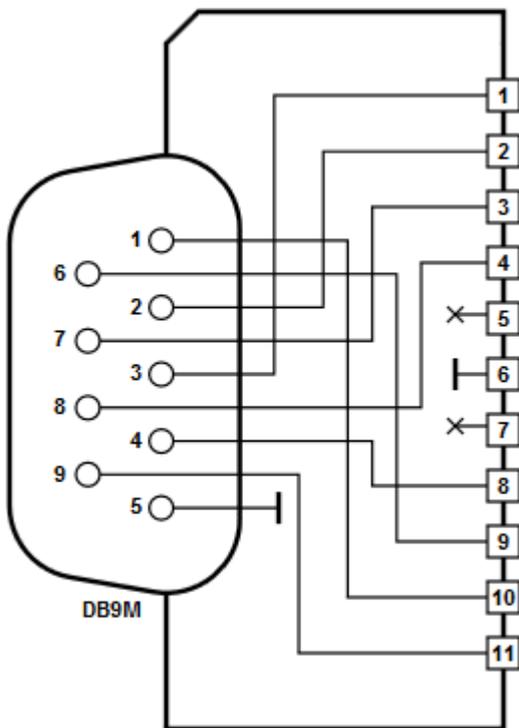
Power requirements: ---

See also: [#19](#), [#20](#), [#21](#)



Details

LEDs

#19, C2: DB9M connector**Function:** DB9M connector**Form factor:** [C2](#)**Special needs:** ---**Power requirements:** ---**See also:** [#18](#), [#20](#), [#21](#)**Details**

#20, C2: Nine terminal blocks



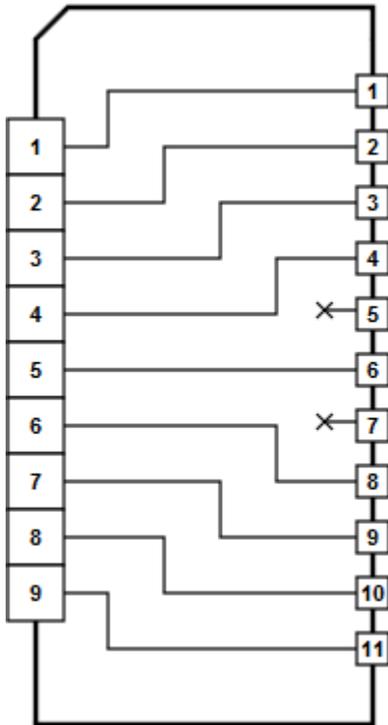
Function: Nine terminal blocks

Form factor: [C2](#)

Special needs: ---

Power requirements: ---

See also: [#18](#), [#19](#), [#21](#)



Details

#21, C1: Four terminal blocks



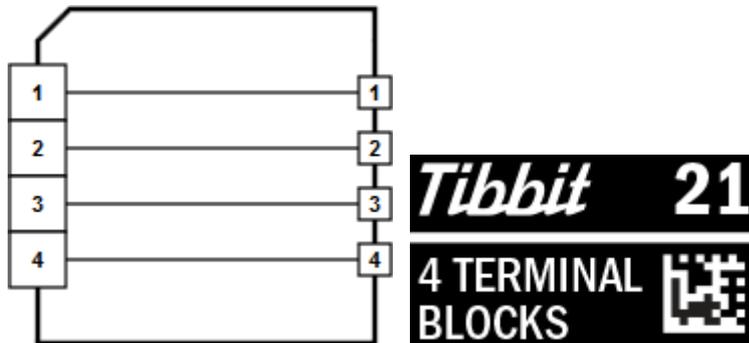
Function: Four terminal blocks

Form factor: [C1](#)

Special needs: ---

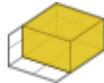
Power requirements: ---

See also: [#18](#), [#19](#), [#20](#)



Details

#22, M2T: Non-isolated PoE



Function: Non-isolated PoE power supply with 5V output, shutdown control

Form factor: [M2T](#)

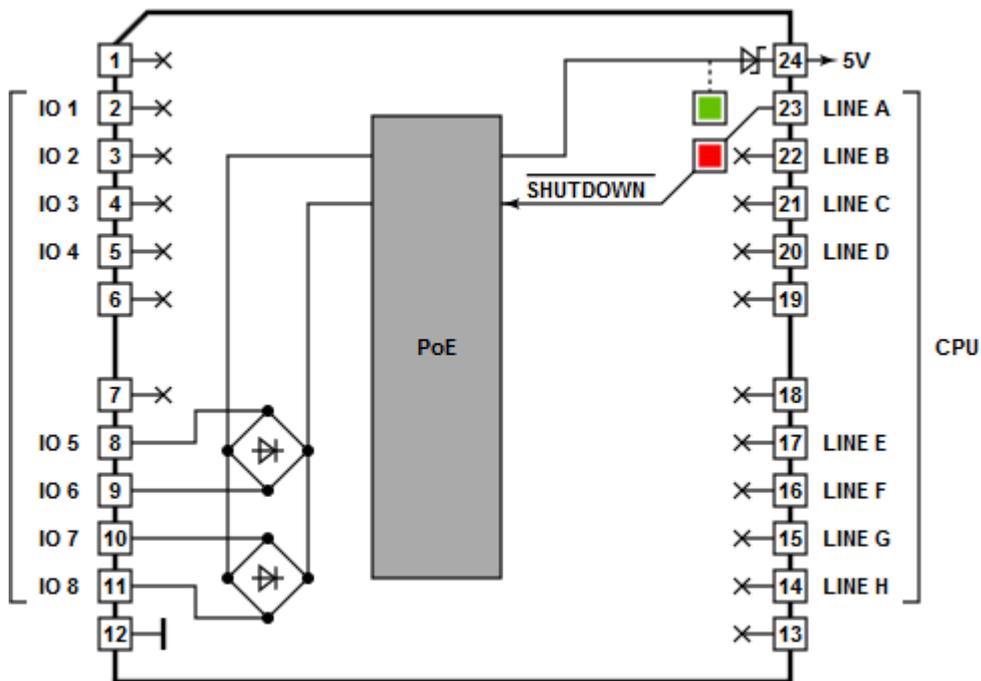
Category: Power supply module

Special needs: [\[POE\]](#)

Power requirements: PoE-compliant power source

Mates with: [#19](#), [#20](#), [#37](#)

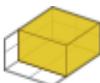
See also: [#09](#), [#10](#), [#12](#), [#23](#)



Details

This Tibbit is not yet documented.

#23, M2T: Isolated PoE



Function: Isolated PoE power supply with 5V output, shutdown control

Form factor: [M2T](#)

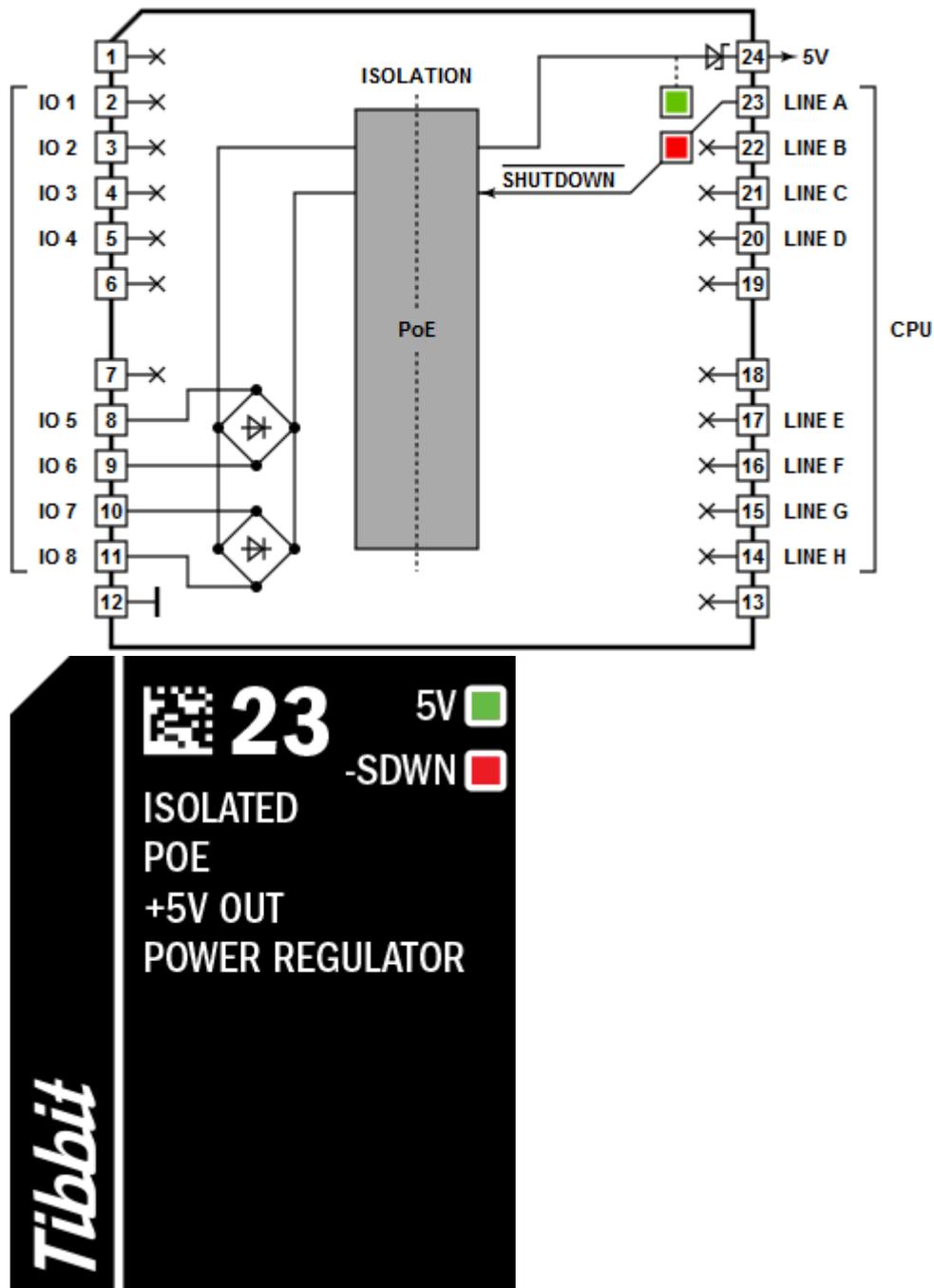
Category: Power supply module

Special needs: [\[POE\]](#)

Power requirements: PoE-compliant power source

Mates with: [#19](#), [#20](#), [#37](#)

See also: [#09](#), [#10](#), [#12](#), [#22](#)



Details

This Tibbit is not yet documented.

#24, M1S: Thermocouple temperature meter



Function: Thermocouple temperature meter for type K probes

Form factor: [M1S](#)

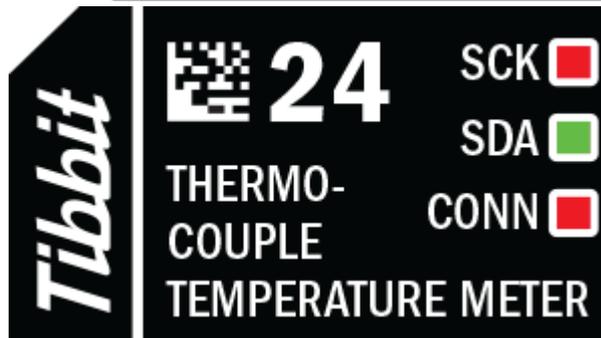
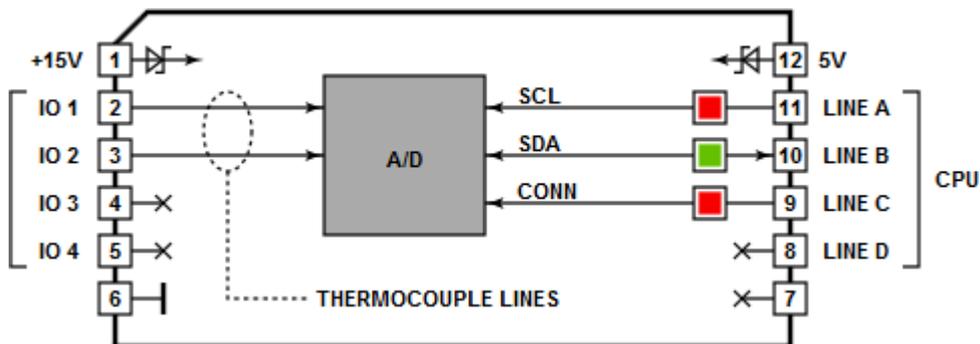
Category: Input module

Special needs: ---

Power requirements: 5V/[TBD](#)mA

Mates with: [#19](#), [#20](#), [#21](#)

See also: [#29](#)



Details

This Tibbit is not yet documented.

#25: M2S: High-power 5V supply, 24V input

This Tibbit is not yet documented.

#26, M1S: IR code processor



Function: Records and plays back infrared codes of conventional IR remote controls

Form factor: [M1S](#)

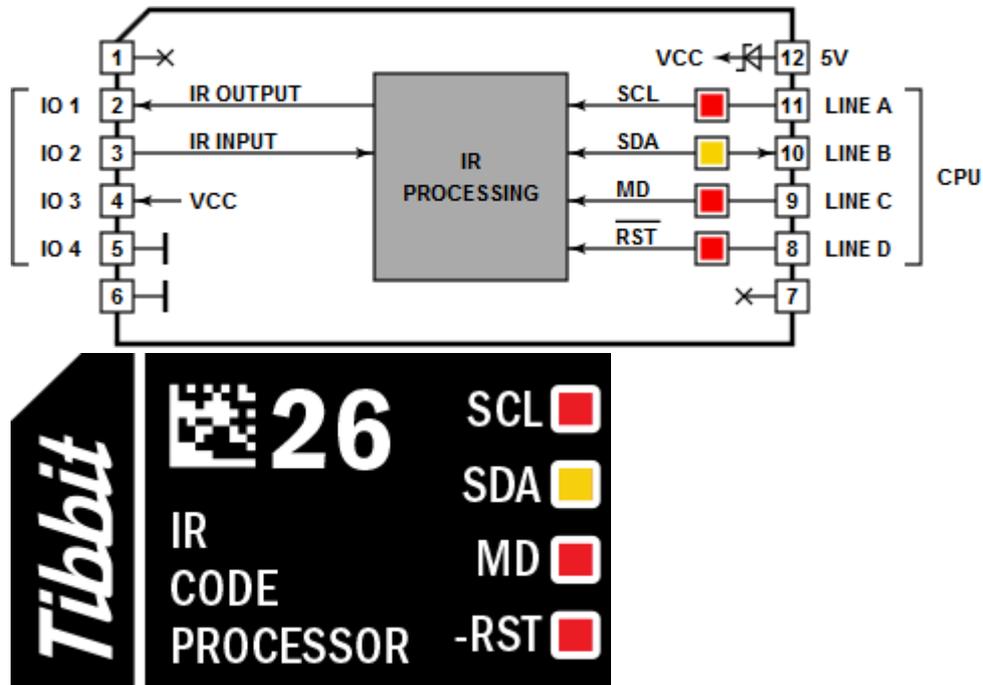
Category: Input/output module

Special needs: ---

Power requirements: 5V/**TBD**mA

Mates with: [#19](#), [#20](#), [#21](#), [#27](#)

See also: [#27](#)



Details

This Tibbit is not yet documented.

#27, C1: IR receiver/transmitter



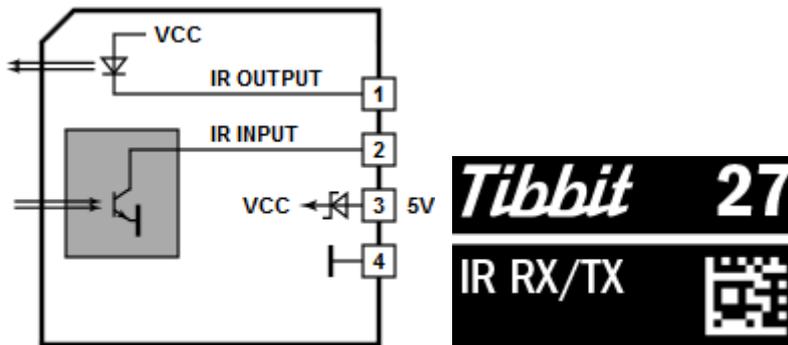
Function: Infrared receiver circuitry and transmitter diode

Form factor: [C1](#)

Special needs: ---

Power requirements: 5V/**TBD**mA

See also: [#26](#)



Details

This Tibbit is not yet documented.

#28, C1: Ambient light sensor



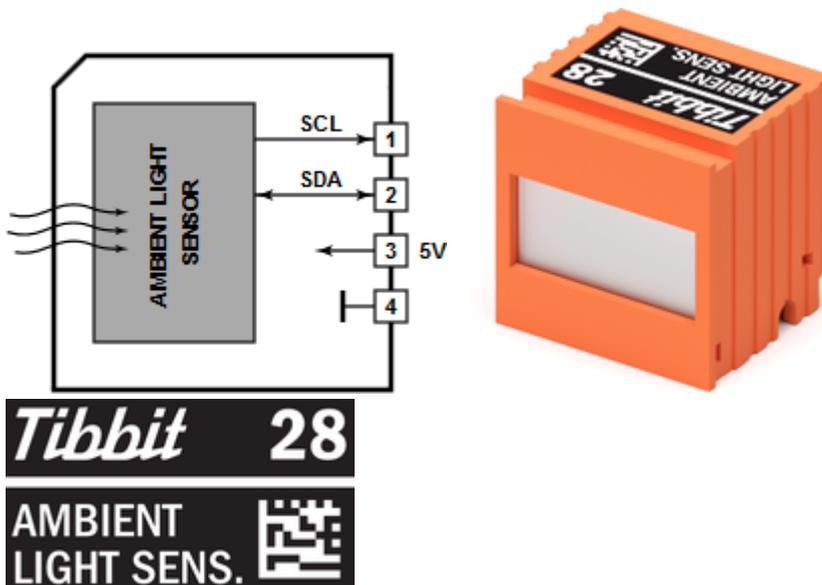
Function: Visible spectrum ambient light sensor

Form factor: [C1](#)

Special needs: ---

Power requirements: 5V/2mA

See also: [#29](#), [#30](#), [#35](#), [#36](#)



Details

This Tibbit is based on the BH1721FVC ambient light sensor with I2C interface. The sensor is implemented as the [C1 device](#) with a clear (transparent) window. The module measures the light intensity of the surrounding environment and its spectral response is close to that of a human eye.

The module outputs ambient light measurements as 16-bit values that do not correspond to any standard measurement units.

This C1 device requires the Tibbit [#00-3](#) to be installed in the neighboring ["M" Tibbit socket](#). #00-3 provides two direct lines for I2C comms, as well as the ground and +5V power for the BH1721FVC IC.

Sample project

The use of this and other "I2C" Tibbits is illustrated by a group of Tibbo BASIC test projects. You can find them at http://tibbo.com/basic/resources/i2c_tibbits.html.

#29, C1: Ambient temperature meter



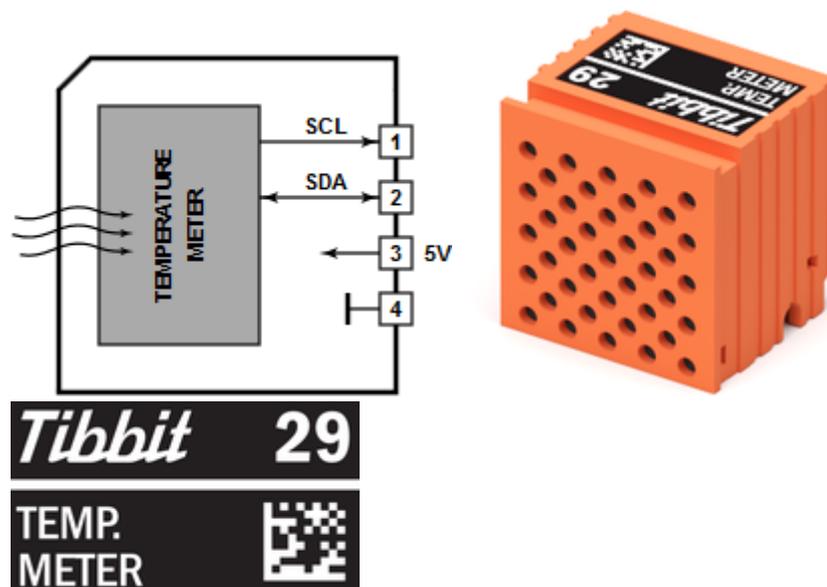
Function: Ambient temperature meter

Form factor: [C1](#)

Special needs: ---

Power requirements: 5V/2mA

See also: [#28](#), [#30](#), [#35](#), [#36](#)



Details

This Tibbit is based on the MCP9808 ambient temperature sensor IC with I2C interface. The sensor is implemented as the [C1 device](#) with perforated front face and a rubber wall separating the temperature sensor from the internal space of the TPS system. This is done to minimize the influence of the heat produced by the TPS motherboard and adjacent Tibbits.

The MCP9808 has programmable resolution and can measure the ambient temperature in steps as small as 1/16 degree Celsius. The conversion process is rather slow at this resolution and takes ~250ms. Our sample project (see below) operates with 1/4 degree precision, which also requires a relatively short conversion

time of ~65ms.

This device operates with a typical accuracy of +/-0.25 deg.C.

This C1 device requires the Tibbit [#00-3](#) to be installed in the neighboring ["M" Tibbit socket](#). #00-3 provides two direct lines for I2C comms, as well as the ground and +5V power for the MCP9808.

Sample project

The use of this and other "I2C" Tibbits is illustrated by a group of Tibbo BASIC test projects. You can find them at http://tibbo.com/basic/resources/i2c_tibbits.html.

#30, C1: Ambient humidity/temperature meter



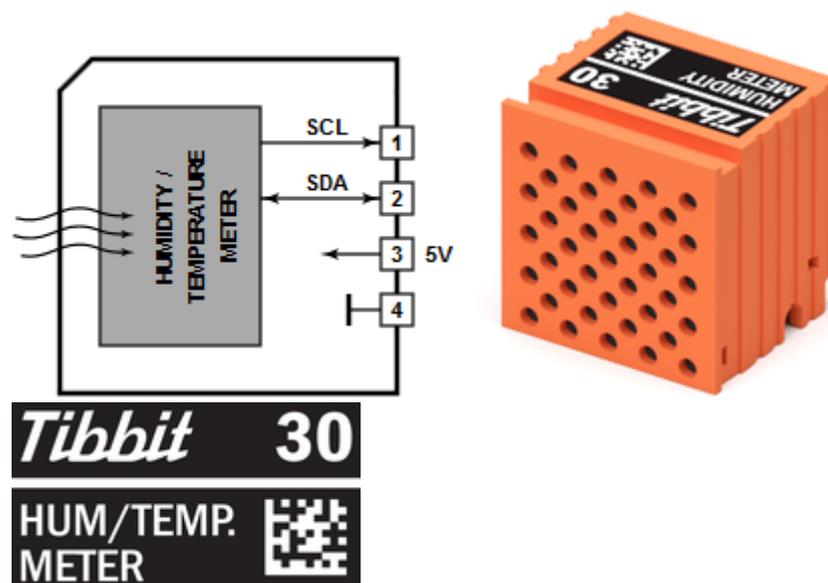
Function: Ambient humidity and temperature meter

Form factor: [C1](#)

Special needs: ---

Power requirements: 5V/2mA

See also: [#28](#), [#29](#), [#35](#), [#36](#)



Details

This Tibbit is based on the HIH6130 ambient humidity and temperature sensor IC with I2C interface. The sensor is implemented as the [C1 device](#) with perforated front face and a rubber wall separating the sensor from the internal space of the TPS system. This is done to minimize the influence of the heat produced by the TPS motherboard and adjacent Tibbits.

The module measures the ambient relative humidity with 0.04% resolution and +/-4%RH accuracy. The temperature is measured with 0.025 deg.C resolution and +/-1 deg.C accuracy.

This C1 device requires the Tibbit [#00-3](#) to be installed in the neighboring ["M" Tibbit socket](#). #00-3 provides two direct lines for I2C comms, as well as the ground and

+5V power for the HIH6130 IC.

Sample project

The use of this and other "I2C" Tibbits is illustrated by a group of Tibbo BASIC test projects. You can find them at http://tibbo.com/basic/resources/i2c_tibbits.html.

#31, C1: PIC coprocessor



Function: PIC coprocessor (PWM, ADC, UART, IO)

Form factor: [M1S](#)

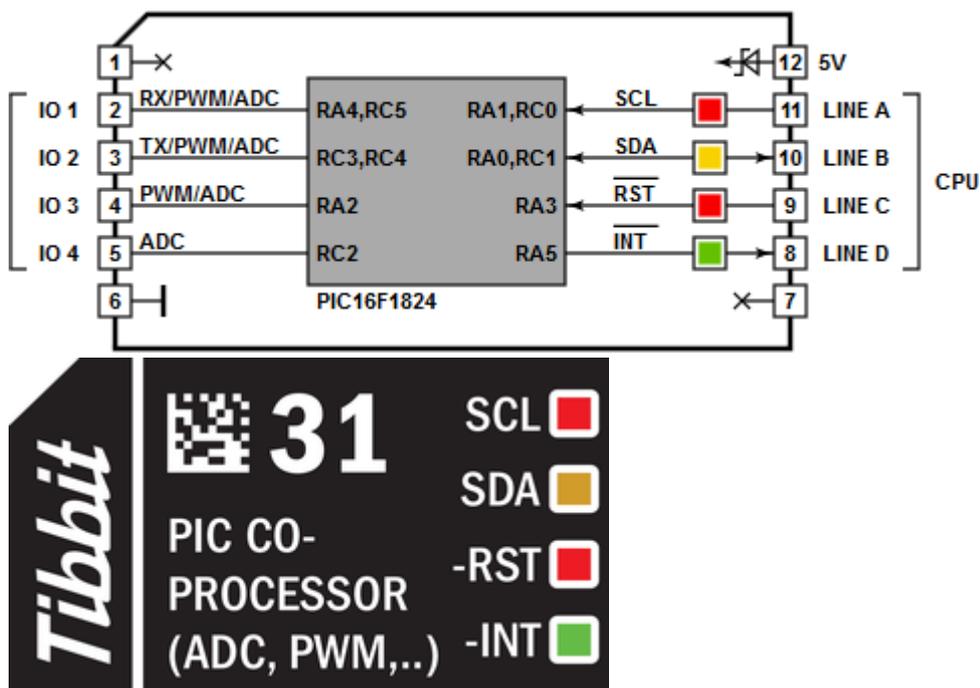
Category: Input/output module

Special needs: ---

Power requirements: 5V/20mA

Mates with: [#19](#), [#20](#), [#21](#) (limited use)

See also: [#16](#), [#17](#)



Details

Tibbit #31 is based on the PIC16F1824 microcontroller and takes advantage of the rich peripheral set available on this PIC device. The I2C interface is used for communications with the main CPU of the [TPP board](#) and also for PIC firmware upgrades. Four of the micro's I/O lines act as IO1~4 lines of the Tibbit module:

- Three lines have PWM capability;
- All four lines can work as ADC inputs;
- Two lines can act as TX and RX of the PIC's UART;

- Each line can also function as a regular input/output.

Three PWM channels are exposed through lines IO1~3. Each channel allows you to independently set its frequency and the pulse width (duty cycle). The frequency is controlled through a divider and a period value. The divider selects the base frequency for the PWM channel. Available choices are 32MHz, 8MHz, 2MHz, and 500KHz. The output signal of the PWM can then be programmed to have the period equal to 4~1024 base frequency periods in 4-period steps (i.e. 4, 8, 12,...1020, 1024). This gives you the output range from 8MHz down to 488Hz. The PWM pulse width can be programmed to have the period equal to 1~1024 base frequency periods in 1-period steps (1, 2, 3,... 1023, 1024).

The analog-to-digital converter has the resolution of 10 bits and the input range of 0~5V.

The UART has standard capabilities that include programmable baudrate, parity bit, and the choice of the 8-bit or 9-bit operation.

Combine this Tibbit with [#20](#) (nine terminal blocks) or [#19](#) (DB9M connector). It's not common but possible to use the latter for wiring into this Tibbit. The Tibbit [#21](#) (four terminal blocks) can also be used but you will have to steal the ground elsewhere, as #21 doesn't have its own ground line and the PWM Tibbit outputs voltages with respect to the system ground.

LEDs

There are two red, one yellow, and one green LED. The first red LED is connected to the SCL line of the I2C interface, the second one -- to the -RST line of the PIC micro. The yellow LED is connected to the SDA line of the I2C interface. The green LED is on the -INT line.

PIC micro and GRA firmware

Tibbit #31 ships with the GRA (*general register access*) firmware, which allows you to access internal PIC registers and memory through the I2C interface. The firmware implements a very simple communications protocol which essentially consists of two important commands -- *address read* and *address write*. These two commands are used to write to and read from the PIC's internal RAM and registers. This facilitates a simple and versatile access to all microcontroller resources. The available Tibbo BASIC library sits on top of the GRA firmware and uses the communications protocol to control the micro.

Since the GRA firmware does not do anything intelligent and all the setup work is essentially scripted in Tibbo BASIC, it is possible to modify the PIC behavior without making any changes to its firmware.

The GRA firmware can be updated or replaced using the *update_pic_firmware* Tibbo BASIC project (see below). You can, therefore, create and run PIC applications that go far beyond providing simple register and memory access.

Sample project

The use of this and other "I2C" Tibbits is illustrated by a group of Tibbo BASIC test projects. You can find them at http://tibbo.com/basic/resources/i2c_tibbits.html. There are two project related to this Tibbit. The first one is titled *test_tibbit_16_17_31_(PIC_copro)*. Run the project in the *TEST_PWM_1* or *TEST_PWM_2* "mode". If this last statement sounds cryptic read the release notes published at http://tibbo.com/basic/resources/i2c_tibbits.html. The second project is *update_pic_firmware*. Use it to update the firmware running on the PIC micro.

#35, C1: Barometric pressure sensor



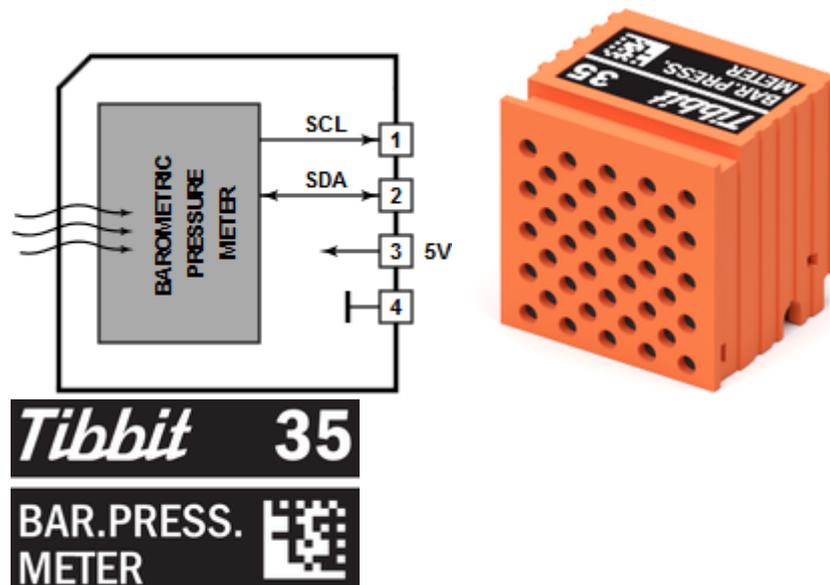
Function: Barometric pressure sensor

Form factor: [C1](#)

Special needs: ---

Power requirements: 5V/2mA

See also: [#28](#), [#29](#), [#30](#), [#36](#)



Details

This Tibbit is based on the MPL115A2 barometric pressure measurement IC with I2C interface. The sensor is implemented as the [C1 device](#) with perforated front face.

The module measures the atmospheric pressure with 0.15 kPa resolution and +/- 1 kPa accuracy.

This C1 device requires the Tibbit [#00-3](#) to be installed in the neighboring ["M" Tibbit socket](#). #00-3 provides two direct lines for I2C comms, as well as the ground and +5V power for the MPL115A2 IC.

Sample project

The use of this and other "I2C" Tibbits is illustrated by a group of Tibbo BASIC test projects. You can find them at http://tibbo.com/basic/resources/i2c_tibbits.html.

#36, C1: 3-axis accelerometer



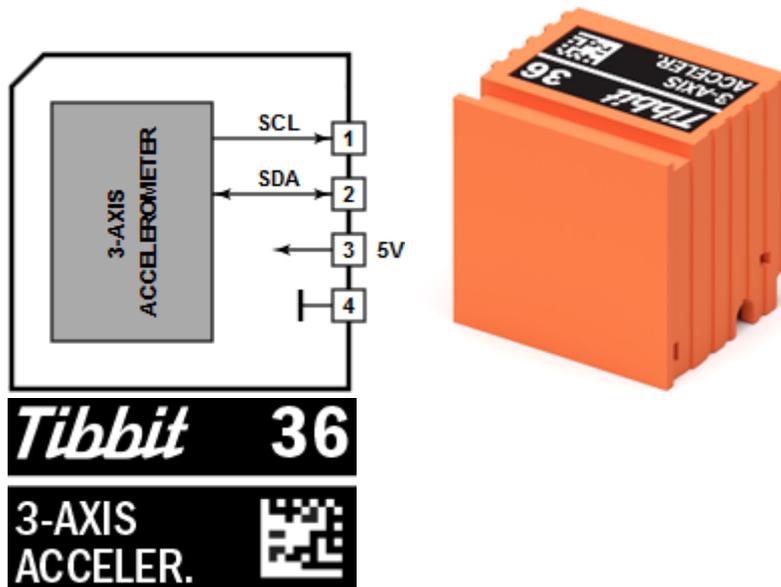
Function: 3-axis accelerometer (shock sensor)

Form factor: [C1](#)

Special needs: ---

Power requirements: 5V/2mA

See also: [#28](#), [#29](#), [#30](#), [#35](#)



Details

This Tibbit is based on the ADXL312 accelerometer IC with I2C interface. The sensor is implemented as the [C1 device](#).

The module measures acceleration in the +/-12G range, simultaneously in three axes, and with 2.9mG resolution.

This C1 device requires the Tibbit [#00-3](#) to be installed in the neighboring ["M" Tibbit socket](#). #00-3 provides two direct lines for I2C comms, as well as the ground and +5V power for the ADXL312 IC.

Sample project

The use of this and other "I2C" Tibbits is illustrated by a group of Tibbo BASIC test projects. You can find them at http://tibbo.com/basic/resources/i2c_tibbits.html.

#37, C1: RF connector



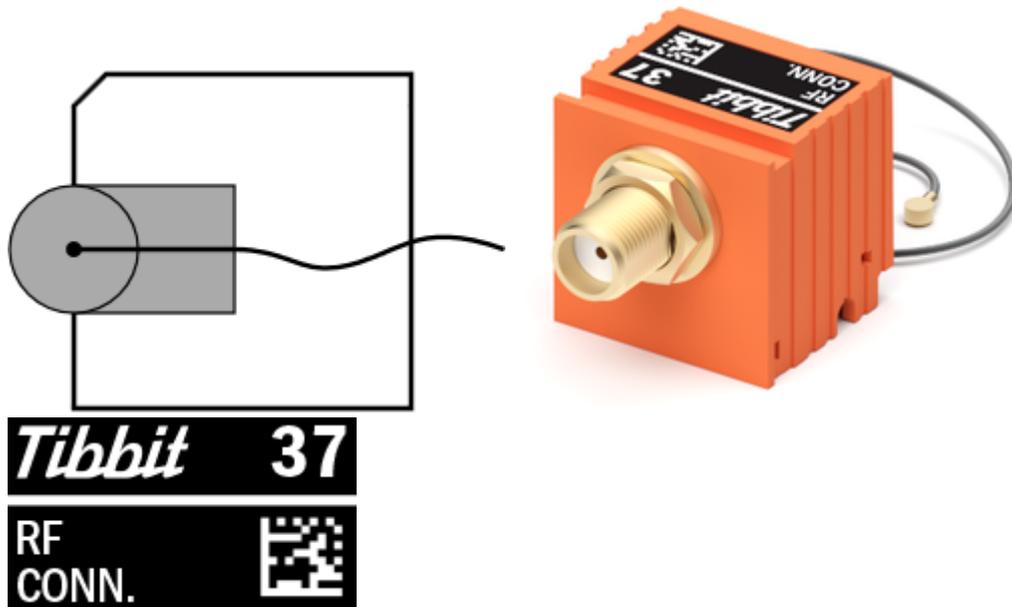
Function: RF connector

Form factor: [C1](#)

Special needs: ---

Power requirements: ---

See also: ---



Details

#38: C1: Pushbutton



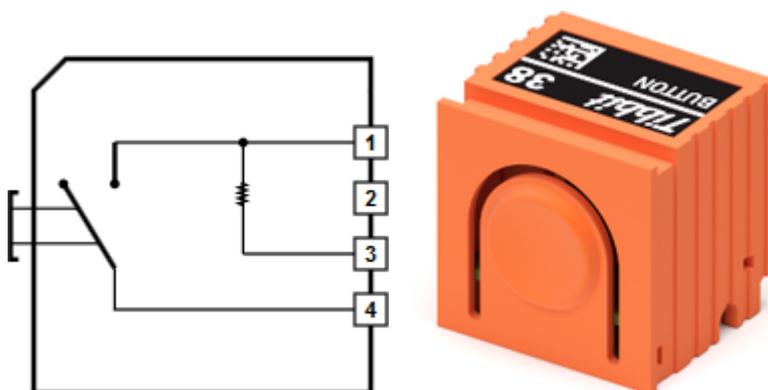
Function: One pushbutton

Form factor: [C1](#)

Special needs: ---

Power requirements: 5V/[TBD](#)mA

See also: [#39](#)





Details

This Tibbit is not yet documented.

#39-1~4, C1: Large LED (four colors available)



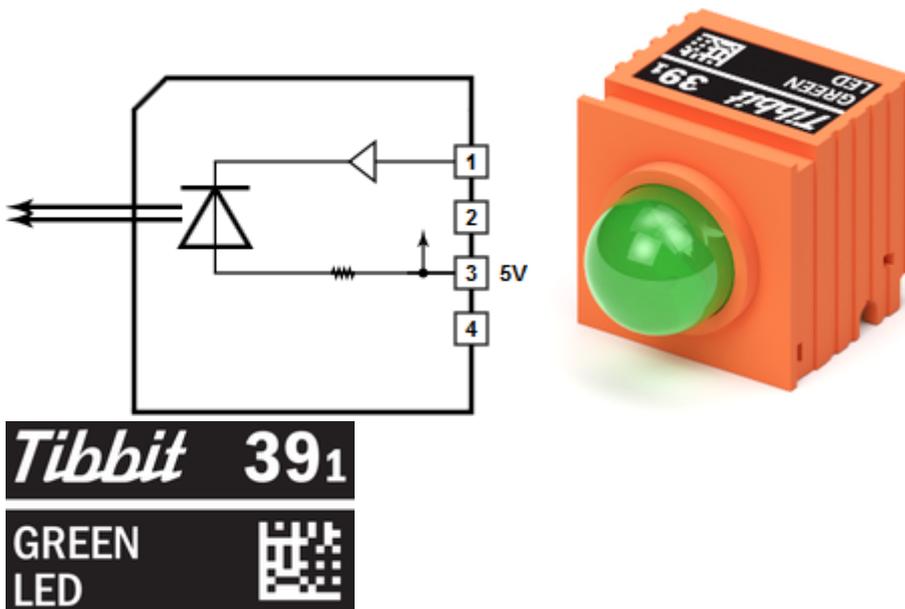
Function: Large LED (four colors available)

Form factor: [C1](#)

Special needs: ---

Power requirements: 5V/[TBD](#)mA

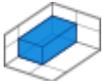
See also: [#38](#)



Details

These Tibbits are not yet documented.

#40-1~4, M1S: Digital potentiometer (four nominals)



Function: Digital potentiometer (four nominals)

Form factor: [M1S](#)

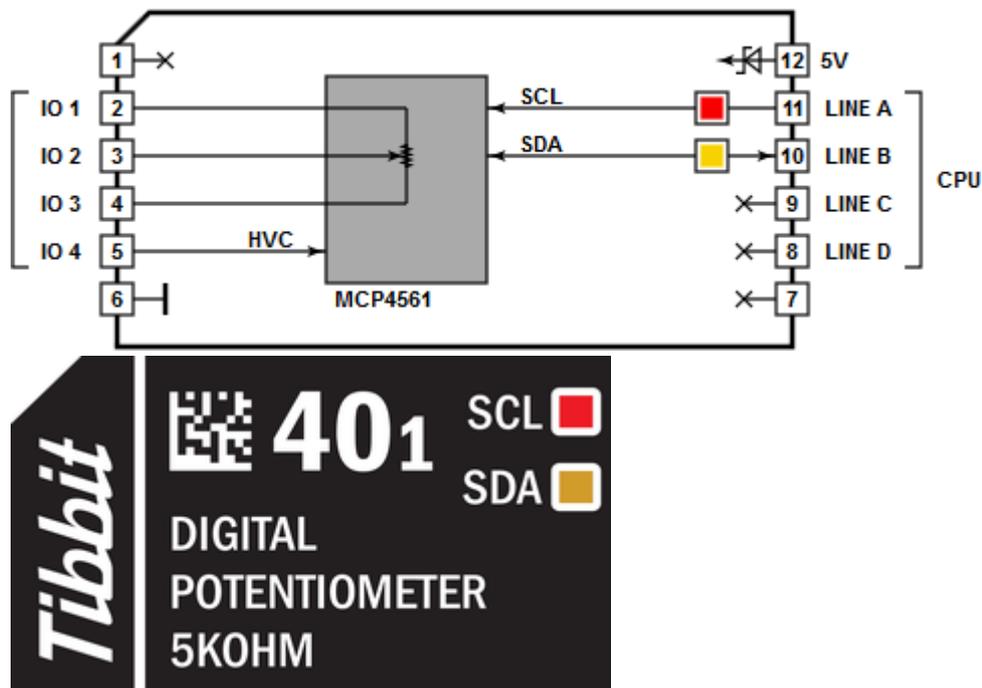
Category: Input/output module

Special needs: ---

Power requirements: 5V/[TBD](#)mA

Mates with: [#19](#), [#20](#), [#21](#) (limited use)

See also: ---



Details

These Tibbits are not yet documented.

#41, C1: 8-bit port



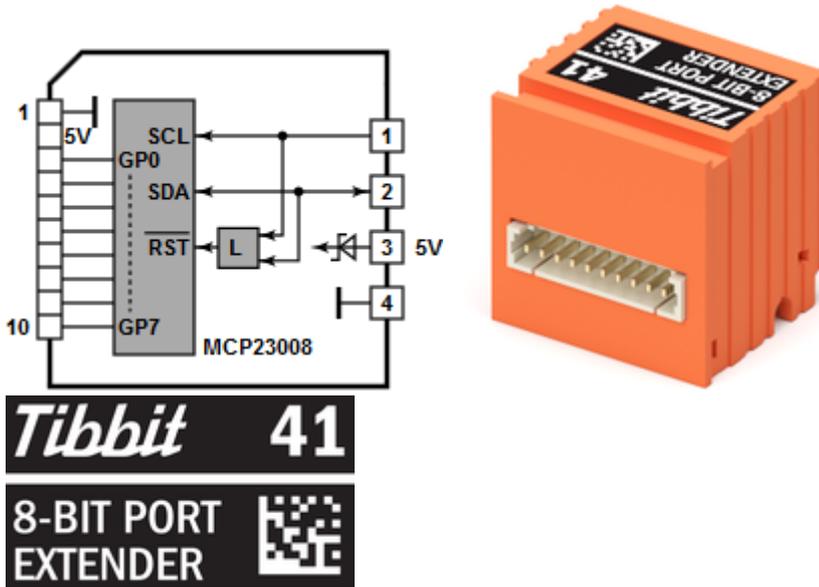
Function: 8-bit port

Form factor: [C1](#)

Special needs: ---

Power requirements: 5V/[TBD](#)mA

See also: ---

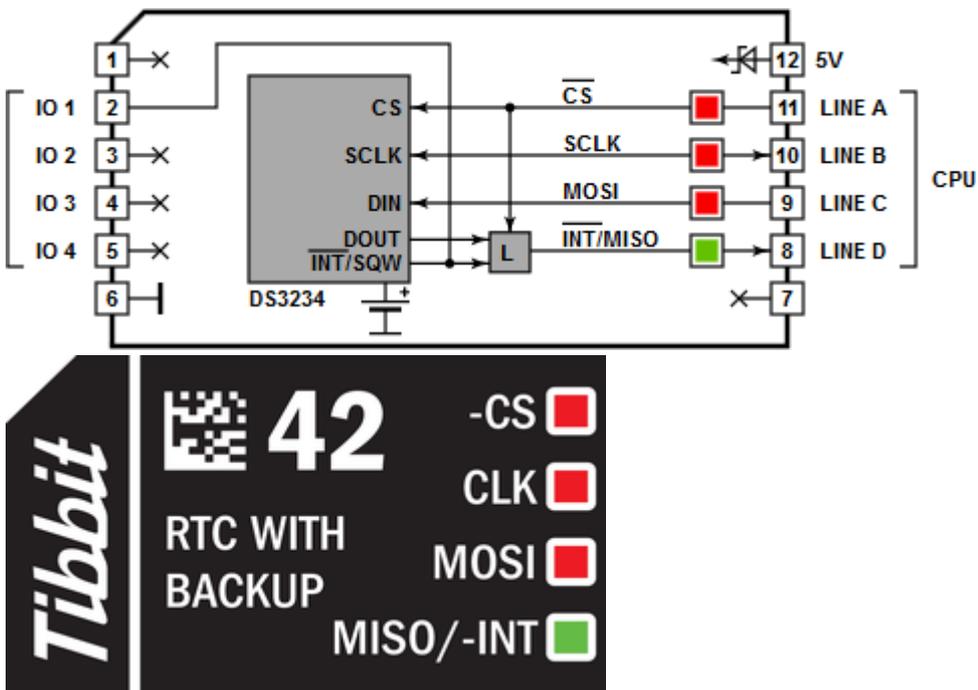


Tibbit 41
8-BIT PORT EXTENDER

Details

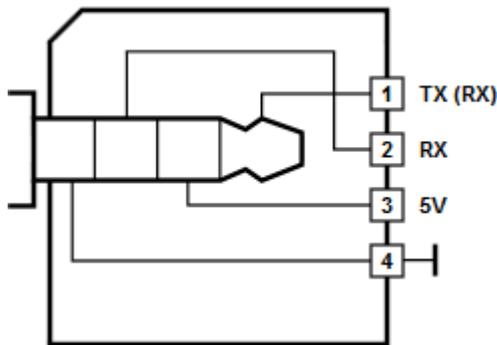
This Tibbit is not yet documented.

#42, M1S: RTC and NVRAM with backup



Tibbit 42
RTC WITH BACKUP
-CS (red)
CLK (red)
MOSI (red)
MISO/-INT (green)

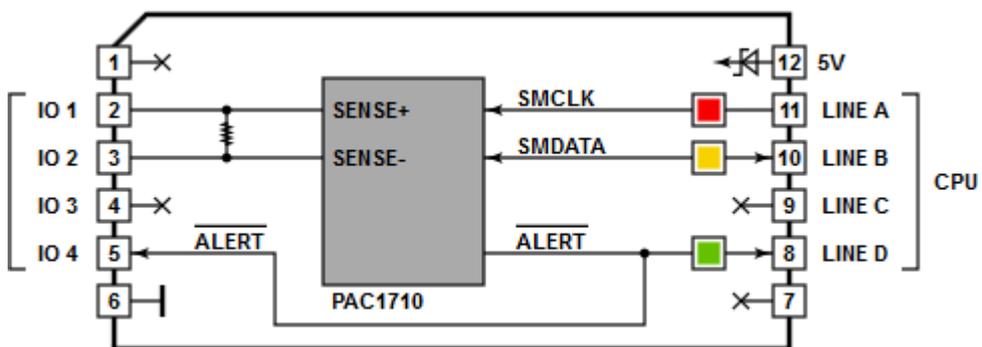
#43, C1: 3.5mm phone jack



Tibbit 43

PHONE JACK

#45-1, M1S: Current/power meter, 0-1A range



Tibbit 451

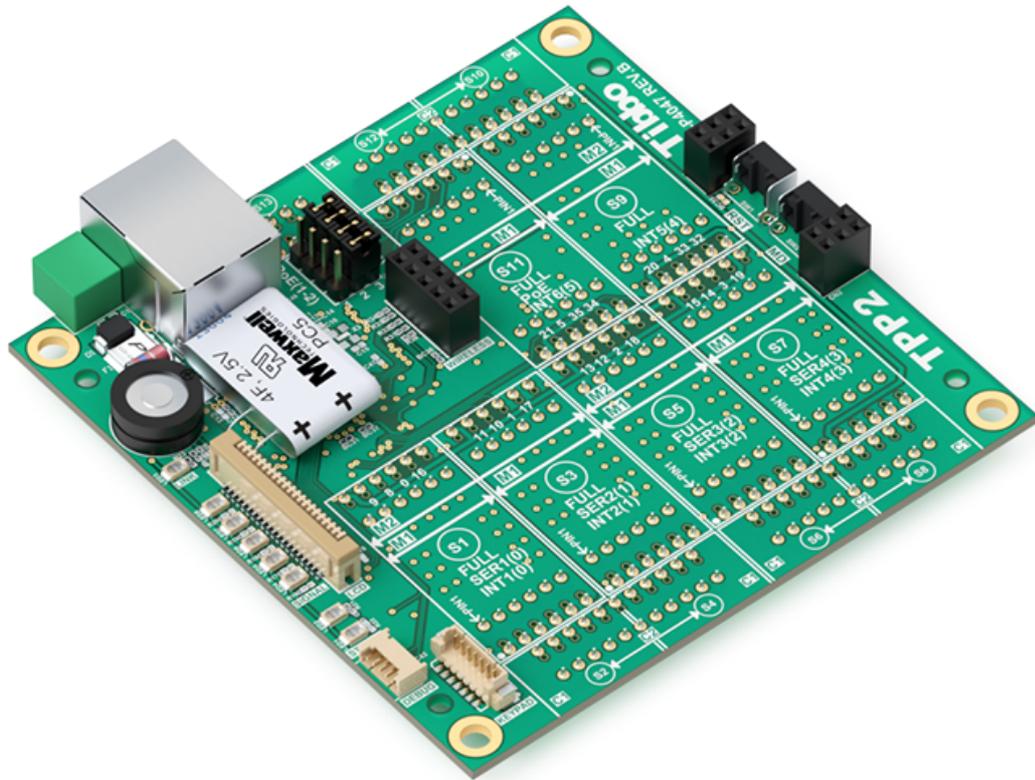
CURRENT SENSOR 0~1A

CLK

DATA

-ALERT

Tibbo Project PCBs (TPPs)



Tibbo Project PCBs are motherboards that accommodate Tibbits. Like our [EM1000](#) module, Tibbo Project PCBs are programmable in Tibbo BASIC and carry the T1000 CPU, Ethernet port, flash memory, and the EEPROM. Unlike the EM1000, a TPP doesn't need a host board to plug into. The TPP is the host board.

Each TPP offers a number of [standard tiles](#) with installation sockets for [Tibbits](#). Plug in desired Tibbits, put the assembly into an optional [Tibbo Project Box](#), and you've got yourself a cost-effective, highly customized automation device that carries no unwanted excess.

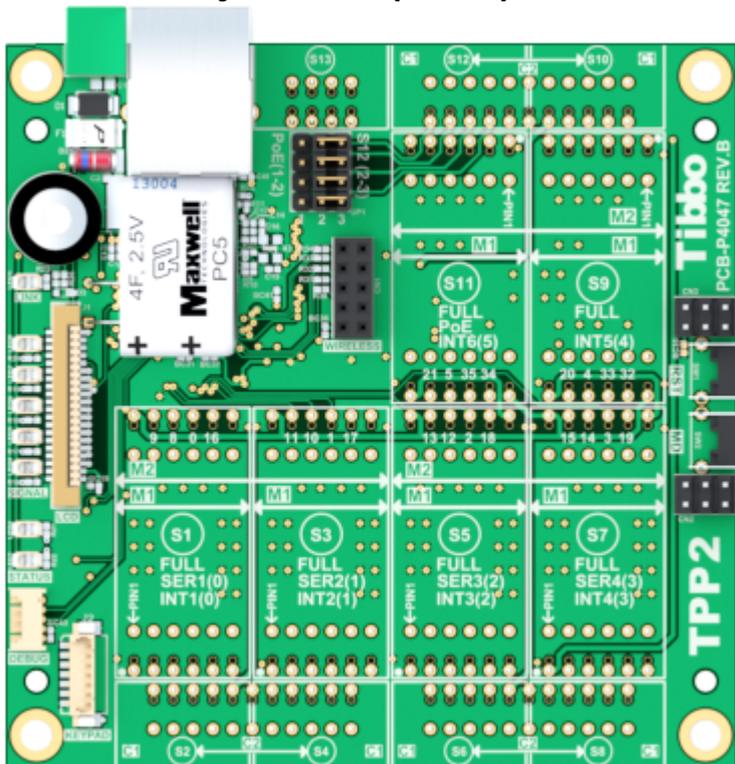
To achieve economical basic unit price, TPPs keep the onboard circuitry to the necessary minimum. For example, there is no built-in power supply -- the boards directly accept only regulated +5V power. Real-world power processing (from [12V](#), [PoE](#), etc.) is achieved by adding power supply Tibbits. This "no excess" approach is the cornerstone of the Tibbo Project System.

Available TPP Models

[Size 2 Tibbo Project PCB \(TPP2\)](#) -- 3 [tiles](#)

[Size 3 Tibbo Project PCB \(TPP3\)](#) -- 7 [tiles](#)

Size 2 Tibbo Project PCB (TPP2)



Introduction

Size 2 Tibbo Project PCB is perfect for systems with a medium number of I/O lines. The board can optionally control a TFT display and a keypad, so it is suitable for applications requiring a human-machine interface (HMI).

This product can be used as a bare board or assembled into a [size 2 Tibbo Project Box](#). For HMI applications, the board can also be assembled into the [TPB2L](#) box, which features a 320x240 TFT LCD and a 4-button sensor keypad.

Featuring [3 tiles for a total of 6 "M" and 6 "C" sockets](#), the TPP2 can implement configurations with up to four simple serial ports, up to 12 relays, or up to 24 opto-inputs, PWM, or open-collector outputs.

The TPP2 is perfect for data collection and AutoID projects, as well as factory, shop, data center, hotel, and home automation applications. The board contains enough "C" sockets to simultaneously accommodate [temperature](#), [humidity](#), [pressure](#), [ambient light](#), and [shock](#) sensors. With the use of appropriate Tibbits the board can even [control legacy IR devices](#) by emulating traditional IR remote controls.

Hardware features

- Based on a high-performance purpose-built 88-MHz T1000 ASIC.
- 10/100BaseT auto-MDIX Ethernet port (automatic detection of "straight" and "cross" cables).
- 3 [tiles](#) (6 x "M" + 6 x "C" sockets, 24 control lines):
 - Four "M" sockets with [UART capability](#):
 - > Baudrates of up to 921,600bps;
 - > None/even/odd/mark/space parity modes;
 - > 7/8 bits/character modes;

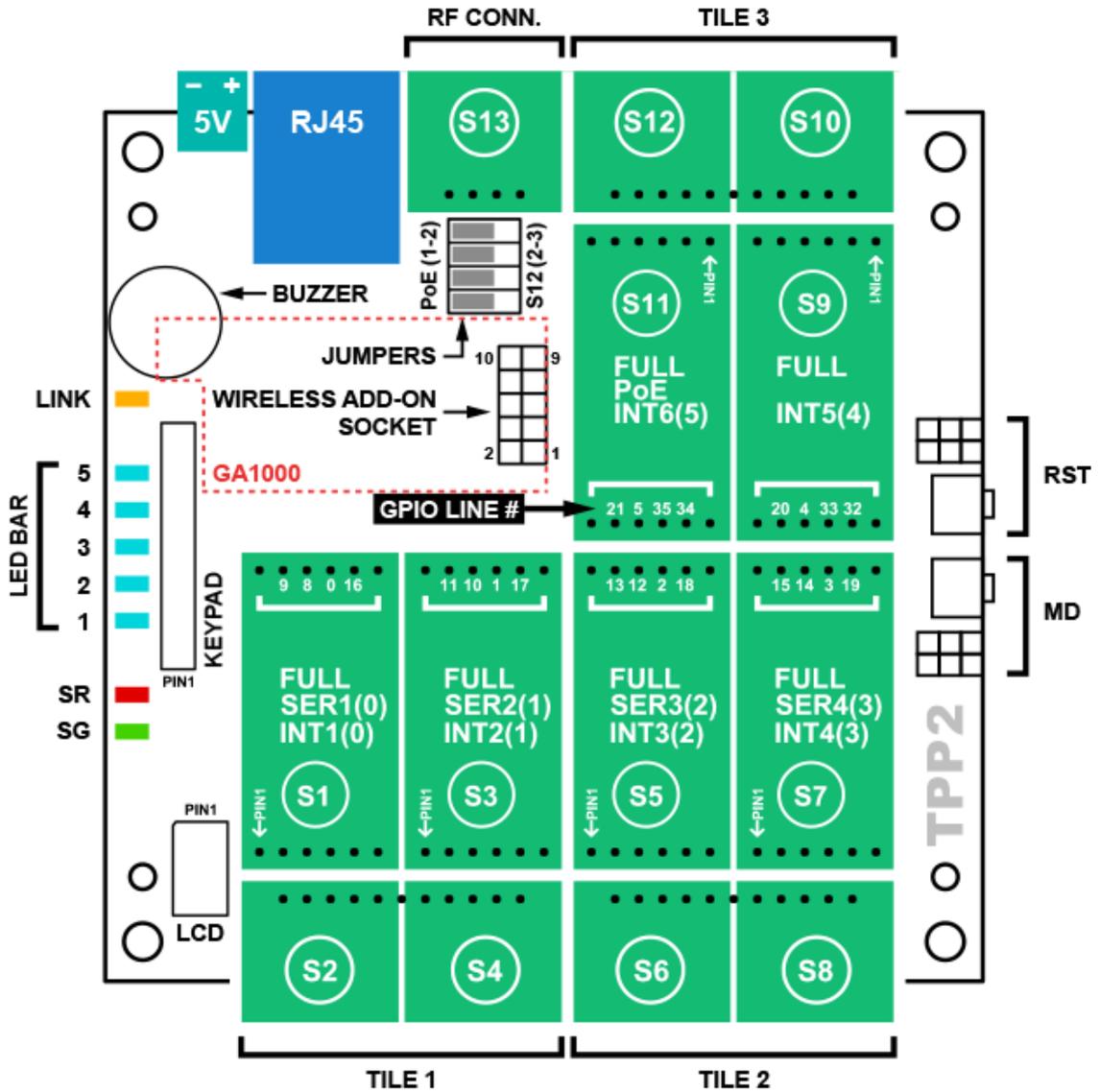
- > Full-duplex mode with optional flow control;
- > Half-duplex mode with direction control;
- > Encoding and decoding of Wiegand and clock/data streams.
- Six "M" sockets with [interrupt capability](#);
- One "M" socket with [PoE capability](#).
- Optional Wi-Fi interface (requires the [GA1000](#) add-on module).
- Connectors for optional TFT LCD and 4-button sensor keypad.
- 1024KB flash memory for firmware, application, and data storage.
- 2KB EEPROM for data storage.
- RTC with dedicated backup supercapacitor.
- Eight LEDs:
 - Green and Red main status LEDs;
 - Yellow Ethernet link LED;
 - Five blue LEDs (can be used for Wi-Fi signal strength indication or any other purpose).
- Onboard buzzer.
- Software- and hardware-controlled onboard PLL to select the clock frequency of the device: 11.0592MHz with PLL off, 88.4736MHz with PLL on.
- Reliable power-on/ brown-out reset circuit.
- Power: 300mA @ 5V (100BaseT mode, PLL on, all LEDs off).
- Dimensions: 94x94mm.
- Firmware and Tibbo BASIC application are upgradeable through the serial port or network.
- Tibbo BASIC application can be debugged through the network and no additional debugging hardware, such as in-circuit emulator, is required.

Programming features

- Variable Types: Byte, char, integer (word), short, dword, long, real, string, plus user-defined arrays and structures.
- Function Groups: string functions (27 in total!), date/time conversion functions (8), encryption/hash calculation functions (AES128, RC4, MD5, SHA-1), and more.
- Platform objects:
 - Lcd — controls the TFT LCD display (optional, connected externally);
 - Kp — handles four-button keypad (optional, connected externally);
 - Sock — socket communications (up to 16 UDP, TCP, and HTTP sessions);
 - Net — controls the Ethernet port;
 - Wln — handles the Wi-Fi interface (requires [GA1000](#) add-on module);
 - Ssi — implements up to four serial synchronous interface (SSI) channels, supports SPI, I2C, clock/data, etc.;
 - Ser — in charge of four serial ports (UART, Wiegand, and clock/data modes);
 - Io — handles I/O lines, ports, and six interrupts;
 - Rtc — keeps track of date and time;
 - Fd — manages flash memory file system and direct sector access;
 - Stor — provides access to the EEPROM;

- Romfile — facilitates access to resource files (fixed data);
- Pppoe — provides access to the Internet over an ADSL modem;
- Ppp — provides access to the Internet over a serial modem (GPRS, POTS, etc.);
- Pat — "plays" patterns on green and red status LEDs;
- Beep — generates buzzer patterns;
- Button — monitors the MD (setup) button;
- Sys — in charge of general device functionality.

Tiles, Sockets, Connectors, Controls



The TPP2 board features 6 x "M" and (6+1) x "C" sockets.

Sockets (S1) ~ (S12) form 3 standard [tiles](#).

There are 24 control lines connecting "M" sockets to the CPU -- four per each socket.

Additionally:

- "M" sockets (S1), (S3), (S5), and (S7) have the [UART capability](#).

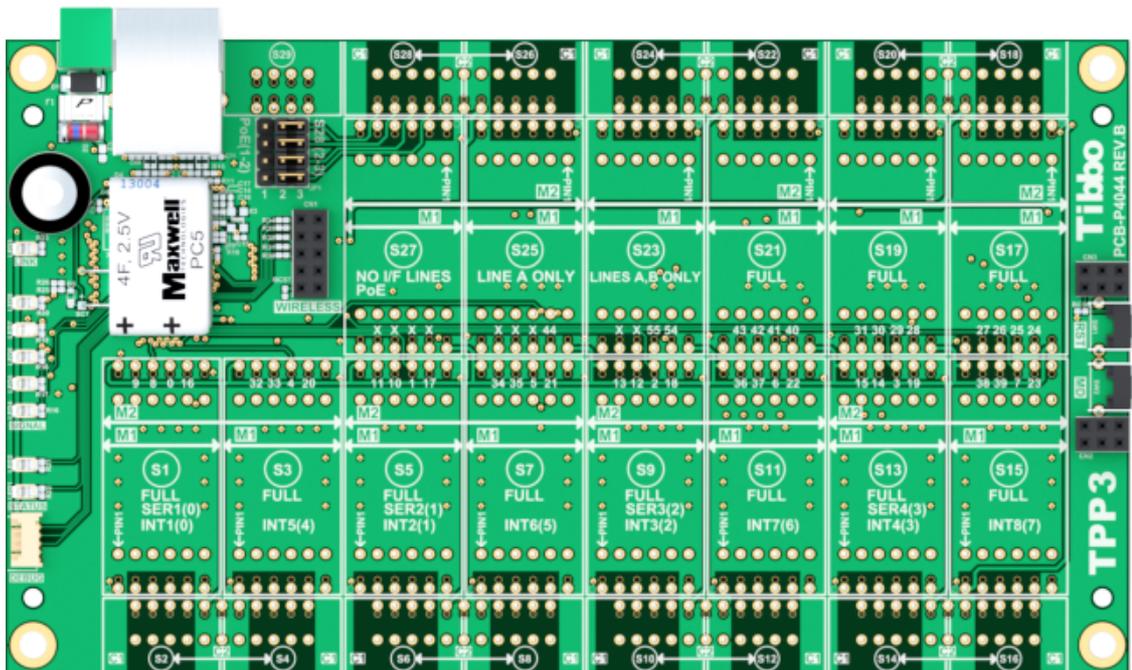
- "M" sockets (S1), (S3), (S5), (S7), (S9), and (S10) have the [interrupt capability](#).
- "M" socket (S11) has the [PoE capability](#), provided that four TPP2 jumpers are set to 1-2 position (see below).
- "C" socket (S13) exists exclusively for the installation of the RF connector Tibbit [#37](#). This socket has no other functions.

The jumpers

Four jumpers next to the RJ45 jack define the connection between the "M" socket (S11), "C" socket (S12), and the RJ45 jack:

- When the jumpers are in the 1-2 position, four power lines from the RJ45 jack are connected to four I/O lines of (S11). Under this arrangement you can install an M1 PoE device into the (S11), or M2 PoE device into the (S9)-(S11).
- When the jumpers are in the 2-3 position, the RJ45 jack is disconnected from the socket (S11). The socket (S11) is instead connected to (S12) in a "standard tile way".

Size 3 Tibbo Project PCB (TPP3)



Introduction

Size 3 Tibbo Project PCB is ideal for applications that require no human-machine interface (HMI) while calling for a significant number of I/O lines and/or functions.

The TPP3 board can be used to replace dumb PLC controllers or work as a safety, security, or access control device. The TPP3 is also ideal for factory, lab, shop, building, hotel, and home automation projects.

Offering [7 tiles for a total of 14 "M" and 14 "C" sockets](#), the TPP3 can be used to construct devices with up to four full serial ports, up to 25 relays, or up to 47 opto-inputs, PWM, or open-collector outputs.

Further, the generous number of available Tibbit sockets means you can increase

your system's versatility by offering multiple power supply options, such as +5V, [+12V](#), [PoE](#), etc. You can also install multiple power supply Tibbits to increase total available power or provide power redundancy.

This product can be used as a bare board, or assembled into a [size 3 Tibbo Project Box](#).

Hardware features

- Based on a high-performance purpose-built 88-MHz T1000 ASIC.
- 10/100BaseT auto-MDIX Ethernet port (automatic detection of "straight" and "cross" cables).
- 7 [tiles](#) (6 x "M" + 6 x "C" sockets, 47 control lines):
 - Four "M" sockets with [UART capability](#):
 - > Four "M" sockets with UART capability:
 - > Baudrates of up to 921,600bps;
 - > None/even/odd/mark/space parity modes;
 - > 7/8 bits/character modes;
 - > Full-duplex mode with optional flow control;
 - > Half-duplex mode with direction control;
 - > Encoding and decoding of Wiegand and clock/data streams.
 - Eight "M" sockets with [interrupt capability](#);
 - One "M" socket with [PoE capability](#).
- Optional Wi-Fi interface (requires [GA1000](#) add-on module).
- 1024KB flash memory for firmware, application, and data storage.
- 2KB EEPROM for data storage.
- RTC with dedicated backup supercapacitor.
- Eight LEDs:
 - Green and Red main status LEDs;
 - Yellow Ethernet link LED;
 - Five blue LEDs (can be used for Wi-Fi signal strength indication or any other purpose).
- Onboard buzzer.
- Software- and hardware-controlled onboard PLL to select the clock frequency of the device: 11.0592MHz with PLL off, 88.4736MHz with PLL on.
- Reliable power-on/ brown-out reset circuit.
- Power: 300mA @ 5V (100BaseT mode, PLL on, all LEDs off).
- Dimensions: 165x94mm.
- Firmware and Tibbo BASIC application are upgradeable through the serial port or network.
- Tibbo BASIC application can be debugged through the network and no additional debugging hardware, such as in-circuit emulator, is required.

Programming features

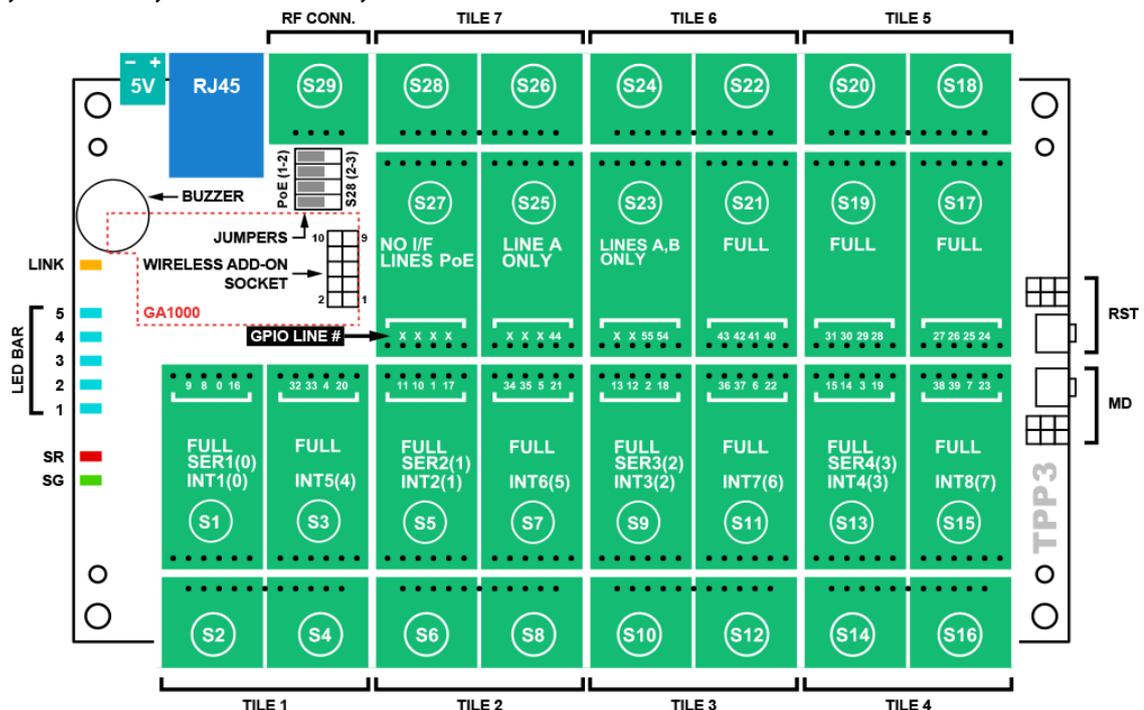
- Variable Types: Byte, char, integer (word), short, dword, long, real, string, plus user-defined arrays and structures.
- Function Groups: string functions (27 in total!), date/time conversion functions

(8), encryption/hash calculation functions (AES128, RC4, MD5, SHA-1), and more.

- Platform objects:

- Sock — socket communications (up to 16 UDP, TCP, and HTTP sessions);
- Net — controls the Ethernet port;
- Wln — handles the Wi-Fi interface (requires [GA1000](#) add-on module);
- Ssi — implements up to four serial synchronous interface (SSI) channels, supports SPI, I2C, clock/data, etc.;
- Ser — in charge of four serial ports (UART, Wiegand, and clock/data modes);
- Io — handles I/O lines, ports, and eight interrupts;
- Rtc — keeps track of date and time;
- Fd — manages flash memory file system and direct sector access;
- Stor — provides access to the EEPROM;
- Romfile — facilitates access to resource files (fixed data);
- Pppoe — provides access to the Internet over an ADSL modem;
- Ppp — provides access to the Internet over a serial modem (GPRS, POTS, etc.);
- Pat — "plays" patterns on green and red status LEDs;
- Beep — generates buzzer patterns;
- Button — monitors the MD (setup) button;
- Sys — in charge of general device functionality.

Tiles, Sockets, Connectors, Controls



The TPP3 board features 14 x "M" and (14+1) x "C" sockets.

Sockets (S1) ~ (S28) form 7 standard [tiles](#).

There are 47 control lines connecting "M" sockets to the CPU. The number of control lines is smaller than the number of "M" sockets multiplied by four. This is because some sockets have a reduced number of control lines, or have no lines connected at

all:

- Socket (S23) only has control lines A and B. Control lines C and D are not implemented.
- Socket (S25) only has the control line A. Control lines B, C, and D are not implemented.
- Socket (S27) has no control lines connected to it.
- Remaining "M" sockets have all four control lines implemented.

Additionally:

- "M" sockets (S1), (S5), (S9), and (S13) have the [UART capability](#).
- "M" sockets (S1), (S3), (S5), (S7), (S9), (S11), (S13), and (S15) have the [interrupt capability](#).
- "M" socket (S27) has the [PoE capability](#), provided that four TPP2 jumpers are set to 2-3 position (see below).
- "C" socket (S29) exists exclusively for the installation of the RF connector Tibbit [#37](#). This socket has no other functions.

The jumpers

Four jumpers next to the RJ45 jack define the connection between the "M" socket (S27), "C" socket (S28), and the RJ45 jack:

- When the jumpers are in the 1-2 position, four power lines from the RJ45 jack are connected to four I/O lines of (S27). Under this arrangement you can install an M1 PoE device into the (S27), or M2 PoE device into the (S25)-(S27).
- When the jumpers are in the 2-3 position, the RJ45 jack is disconnected from the socket (S27). The socket (S27) is instead connected to (S28) in a "standard tile way".

Common Information

- [Power arrangement](#)
- [Ethernet port](#)
- [MD and RST Buttons](#)
- [LEDs](#)
- [Buzzer](#)
- [LCD Display Connector \(TPP2 only\)](#)
- [Keypad Connector \(TPP2 only\)](#)
- [Optional Wi-Fi](#)

Power Arrangement

The TPP2 can be powered directly through two terminal blocks located next to the RJ45 jack. The board expects regulated +5V power. We recommend the power supply with at least 1-1.5A output current capability. 300mA of this power budget will be used for the TPP2 alone. The [GA1000](#) Wi-Fi add-on, if present, will consume an additional 300mA of current. Installed [Tibbits](#) will also add to the overall power consumption.

Alternatively, the TPP2 can be powered using power supply Tibbits (such as [#9](#), [#10](#), [#22](#), etc.), in which case there will be no need to connect +5V power to the

board.

Some Tibbits (such as [#13](#) or [#14](#)) require additional +15V and -15V power to function. These voltages are not generated by the TPP2 and can't be applied externally. The only way to produce them is to install a special power Tibbit [#12](#).

The [Tibbit Power Lines](#) topic contains additional information on the subject.

Ethernet Port



The Ethernet port of the TPP2 is of 10/100BaseT type.

The connector is of RJ45 type, pin assignment is as follows:

#1	TX+
#2	TX-
#3	RX+
#4	PoE+
#5	PoE+
#6	RX-
#7	PoE-
#8	PoE-

MD and RST Buttons

The function of the MD button is described in [Appendix 2: Setup \(MD\) Button \(line\)](#).

Pressing the reset button causes a hardware reset.

Both buttons face *right* on Tibbo Project PCBs. For assembly inside a Tibbo Project Box (TPB), a TPP must be outfitted with a so-called MD/RST button PCB. This is a small PCB with two buttons facing upward. When plugged into the TPP board, these buttons work in parallel with the buttons of the TPP board.

The MD/RTS PCB is necessary only when you assemble the TPP board into the Tibbo Project Box. Hence, the MD/RST PCB is supplied as a part of the TPB kit, not the Tibbo Project PCB.

LEDs

Each TPP board carries 8 LEDs.

Two status LEDs

These are our standard green and red status LEDs. See [Appendix 1: Status LEDs](#) on how this LED works.

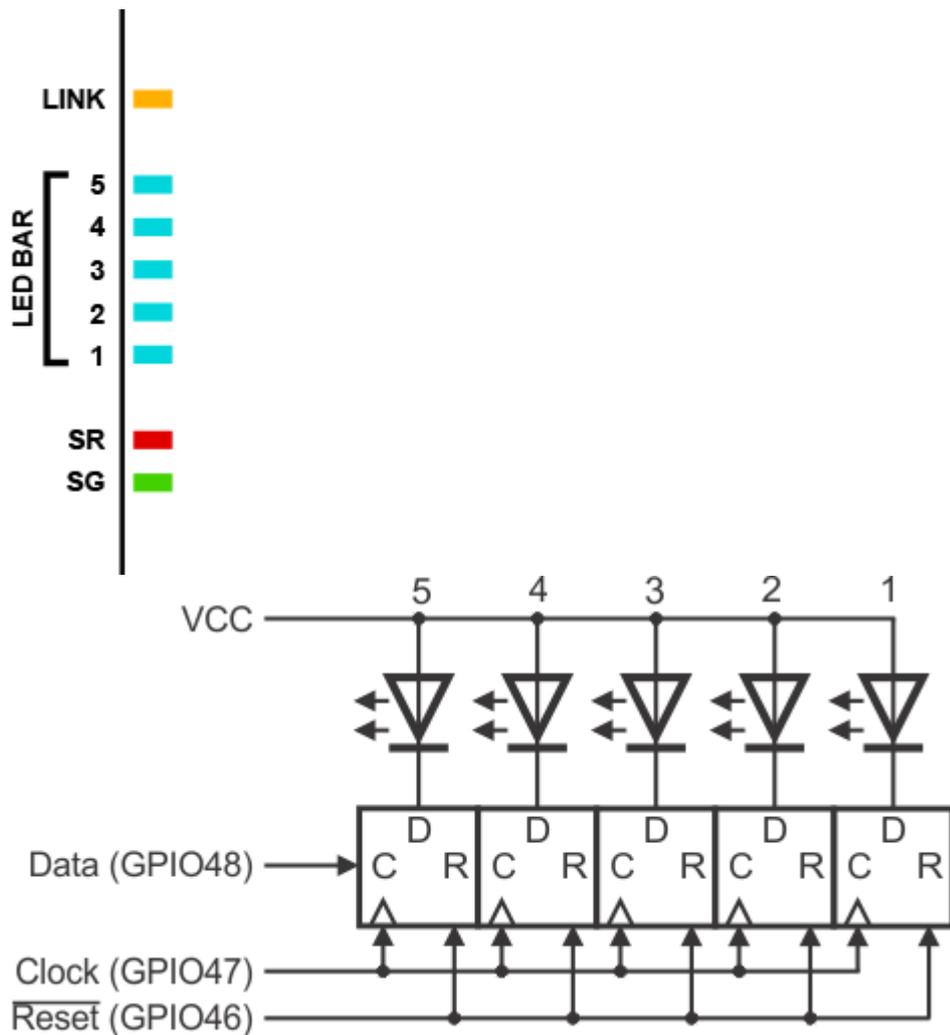
One Ethernet status LED

The TPP2 has a single Ethernet status LEDs -- the yellow "link" LED. See [Appendix 1: Status LEDs](#). on how this LED works.

Five signal strength LEDs

Five blue LEDs form an LED bar. They are intended primarily for the indication of the RF signal strength (i.e. of the Wi-Fi signal). These LEDs are controlled through three GPIO lines 46, 47, and 48.

GPIO46 is the reset line of the LED bar. Clearing this line sets all five outputs LOW and this turns all LEDs ON. GPIO47 is a clock line- a positive (LOW-to-HIGH) transition on this line "shifts in" the data on the data line. The LED control circuit is shown below.



If you want to switch an LED ON then set the corresponding data line LOW. In the following example we set the LEDs like this:

LED #5	LED #4	LED #3	LED #2	LED #1
OFF	ON	OFF	ON	ON

Assuming all the LEDs were off previously (shown in gray), these are our steps. Each step represents one cycle of the clock line (HIGH-LOW-HIGH):

Clock	Data	LED #5	LED #4	LED #3	LED #2	LED #1
1	LOW	ON	OFF	OFF	OFF	OFF
2	LOW	ON	ON	OFF	OFF	OFF
3	HIGH	OFF	ON	ON	OFF	OFF
4	LOW	ON	OFF	ON	ON	OFF
5	HIGH	OFF	ON	OFF	ON	ON

The reset line is not really necessary. You can be certain what pattern is displayed by the LEDs for as long as you generate five clock cycles every time you send new data into this circuit.

Buzzer

The buzzer of the TPP2 is connected to the GPIO45/CO line.

Your application can control the buzzer through the "beeper" (beep.) object (see "TIDE and Tibbo BASIC Manual"). Recommended value for the beep.divider property is 21600.

LCD Display Connector (TPP2 only)

The TPP2 can control an LCD display of the [TPB2L kit](#). The TPB2L product has a 320x240 TFT LCD display with onboard controller. The following GPIO lines are used to control the LCD:

GPIO line/ port	Function
Port 0	8-bit bi-directional data bus
GPIO40	CS
GPIO41	RD
GPIO42	WR
GPIO43	DC
GPIO55	RST
GPIO54	Backlight (ON when LOW)

LCD control is the responsibility of the lcd. object. See "TIDE and Tibbo BASIC Manual" for details.

Keypad Connector (TPP2 only)

The TPP2 can control a 4-key sensor keypad of the [TPB2L kit](#). The following GPIO lines are used to work with the keypad:

GPIO line/ port	Function
GPIO44	Reset (active LOW)
GPIO36	Return line 1 (left button)
GPIO37	Return line 2
GPIO38	Return line 3
GPIO39	Return line 4 (right button)

Keypad handling is the responsibility of the `kp.` object. See "TIDE and Tibbo BASIC Manual" for details.

Optional Wi-Fi Interface

The TPP2 can optionally accommodate the [GA1000](#) Wi-Fi add-on module.

The following GPIO lines are used to control the GA1000:

GPIO line	Function	GA1000 pin
49	CS	3
50	DO ⁽¹⁾	5
51	RST	7
52	DI ⁽²⁾	9
53	CLK	10

Notes:

1. "Data out" line of the TPP2, connects to the "data in" on the GA1000.
2. "Data in" line of the TPP2, connects to the "data out" on the GA1000.

Wi-Fi data communications is the responsibility of the `sock.` object (see "TIDE and Tibbo BASIC Manual"). Before such data communications can take place, the Wi-Fi interface must be properly configured. This is jointly achieved by the `wln.` object and WLN library (again, see "TIDE and Tibbo BASIC Manual").

Tibbo Project Box (TPB) Kits

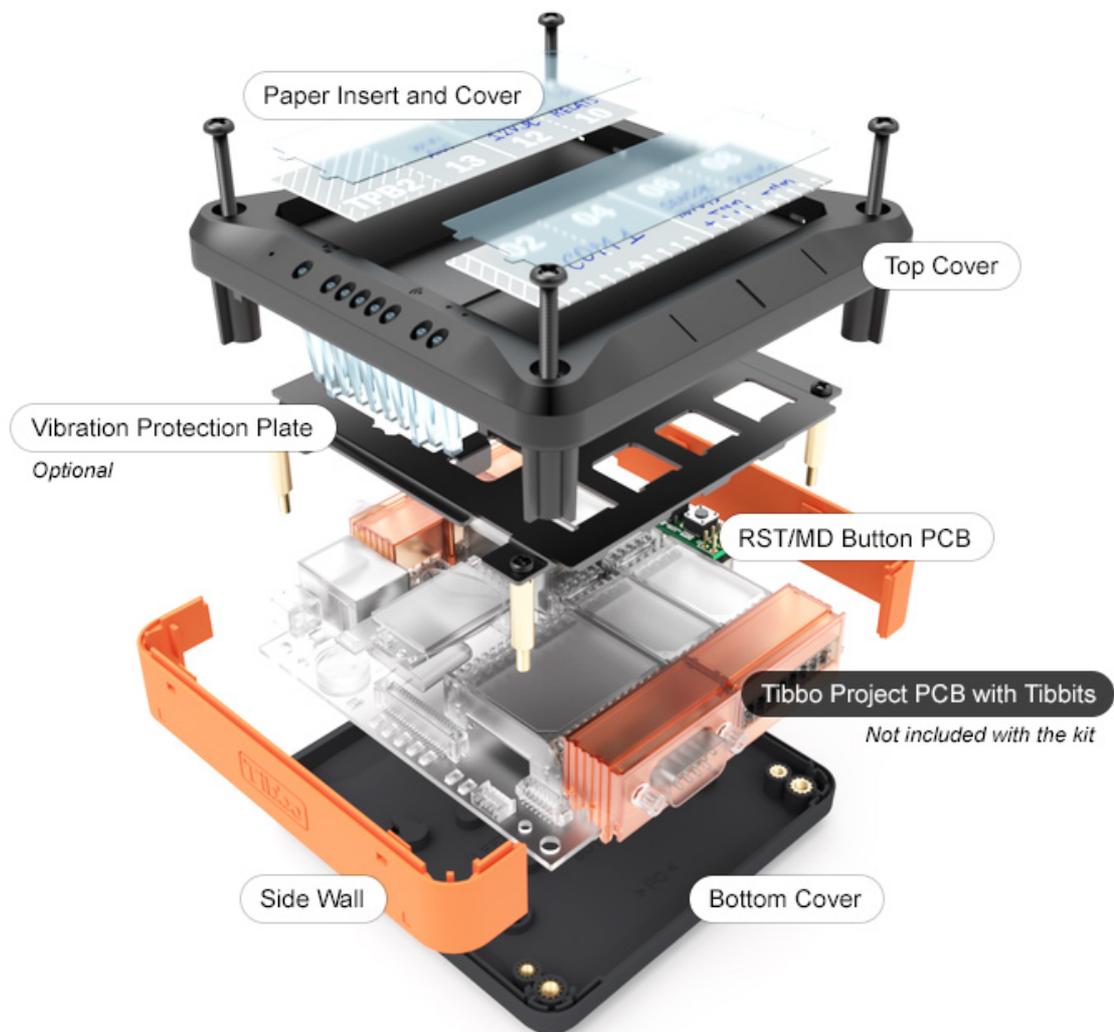


Most projects require an enclosure. Designing one is a tough job. Making it beautiful is even tougher, and may also be prohibitively expensive. Not to worry -- your Tibbo Project System can optionally be ordered with a Tibbo Project Box (TPB) kit.

There is a Box for every [Tibbo Project PCB](#) size. You can also choose a TPB with an LCD display and sensor keys.

Tibbo Project Boxes can be ordered unassembled (as part kits) or fully assembled. We also offer an *optional* [retail packaging](#), as well as vibration protection and DIN rail mounting kits.

TPB Structure



This exploded view illustrates the internal construction of a Tibbo Project System (TPS) assembled in the Tibbo Project Box (TPB). Specifically, this is the size 2 system (TPS2) in the [size two Box \(TPB2\)](#).

A Tibbo Project Box comprises the bottom cover, left and right side walls, the top cover, and the LED light guide. Unless this is the TB2L system with LCD and keys, the top cover has two recesses for paper inserts and protective cover overlays. Paper inserts are for marking wires and connectors in the same way you mark direct dial buttons on your office phone.

The Box assembly is extremely easy and fast. Snap the LED light guide into the top cover, then attach the left and right walls onto the top cover as well. All three parts snap into place with a "click". To avoid confusion, the inner surface of the bottom cover has arrows indicating left, right, top, and bottom. The left wall has the "L" mark on it, while the right wall is marked "R". Notice that the left wall has a cutout for the terminal blocks and the RJ45 jack of the [Tibbo Project PCB](#) (TPP).

There are 2 sets of screws supplied with each Box. Smaller screws secure the TPP, large screws are for the Box itself. Pay attention to the TPP placement. In the normal bottom cover orientation (judging by arrows printed on the inner surface of the cover), the RJ45 jack should face *away* from you. You will notice that the bottom cover has a small protrusion on which the RJ45 rests if the TPP is correctly installed.

Each Tibbo Project Box kit additionally includes the [MD/RST button PCB](#). This PCB plugs into the TPP. The PCB is necessary if the TPP is to be assembled into the Tibbo Project Box.

The vibration protection plate shown above is optional and must be purchased (specified) separately as a part of the vibration protection kit (VPK).

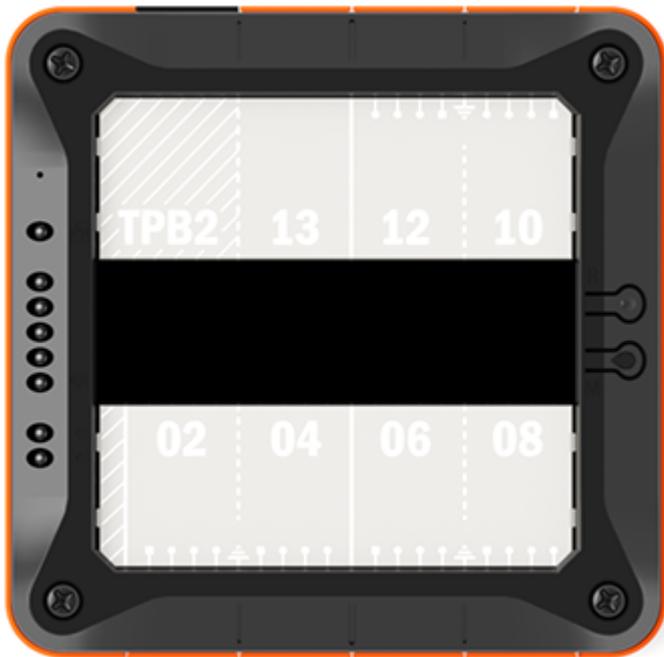
Available Tibbo Project Box Kits

[Size 2 Tibbo Project Box \(TPB2\)](#) -- fits [TPP2](#)

[Size 2 Tibbo Project Box with LCD/Keys \(TPB2L\)](#) -- fits [TPP2](#)

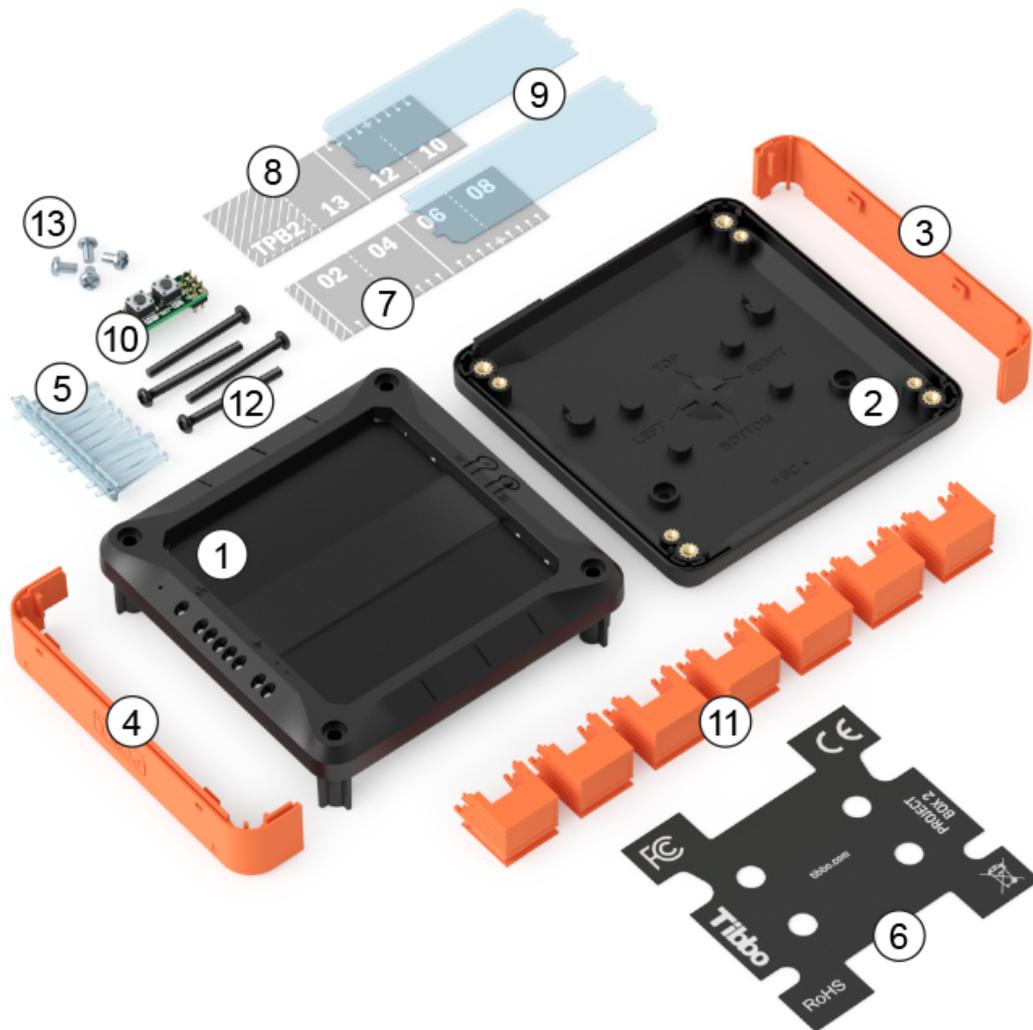
[Size 3 Tibbo Project Box \(TPB3\)](#) -- fits [TPP3](#)

Size 2 Tibbo Project Box (TPB2)



This Tibbo Project Box accommodates [size 2 Tibbo Project PCB](#) (TPP2).

TPB2 Parts and Accessories

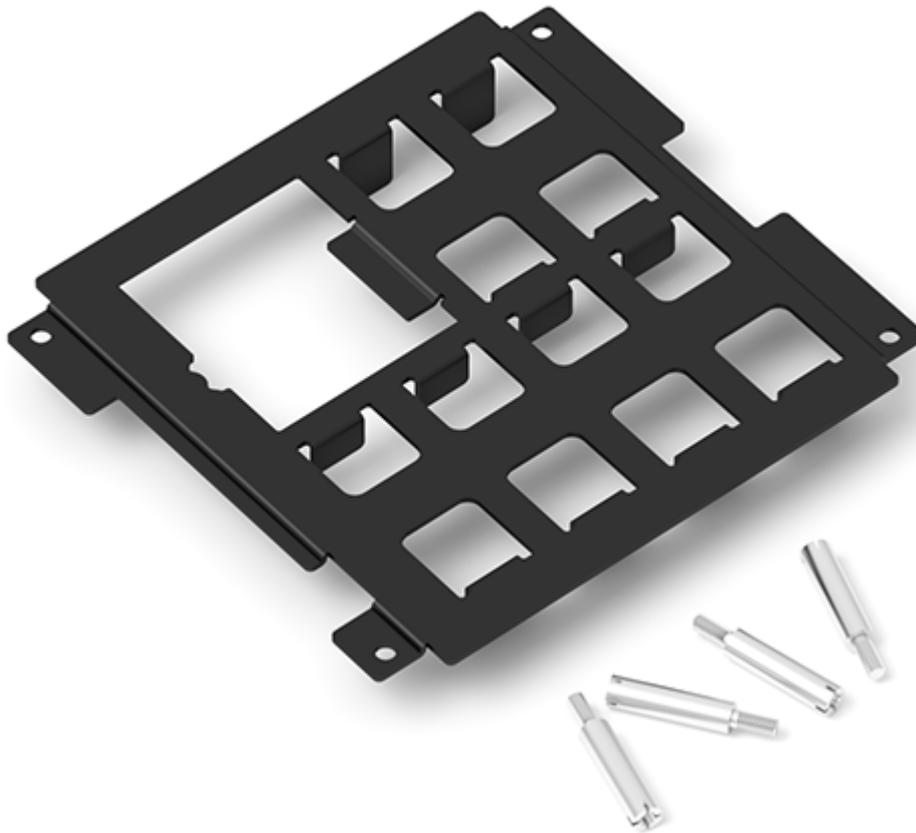


List of parts included with the TPB2 kit

	Part	Description	Qty
1.	PM01P1054:	Top cover (TPB2)	1
2.	PM01P1055:	Bottom cover (TPB2, TPB2L)	1
3.	PM01P1049:	Right side wall (all TPB models)	1
4.	PM01P1050:	Left side wall (all TPB models)	1
5.	PM06P1004:	LED light guide (all TPB models)	1
6.	PM03P1017:	Back label (TPB2, TPB2L)	1
7.	PM921009:	Paper insert, bottom row (TPB2)	1
8.	PM921010:	Paper insert, top row (TPB2)	1
9.	PM03P1020:	Paper Insert Cover (TPB2)	2
10.	PCB-P2164:	MD/RST button PCB (all TPB models)	1
11.	PM12P1001-03:	Blank Tibbit shell, C1 form factor, orange	7
12.	SM3R5+32SPBC:	Main Screw (all TPB models)	4
13.	SM2R6+05SPNC:	PCB screw (all TPB models)	4

The TPB2 can be purchased with an optional [vibration protection kit \(VPK\)](#), as well as the DIN rail mounting kit.

Size 2 Vibration Protection Kit (VPK)

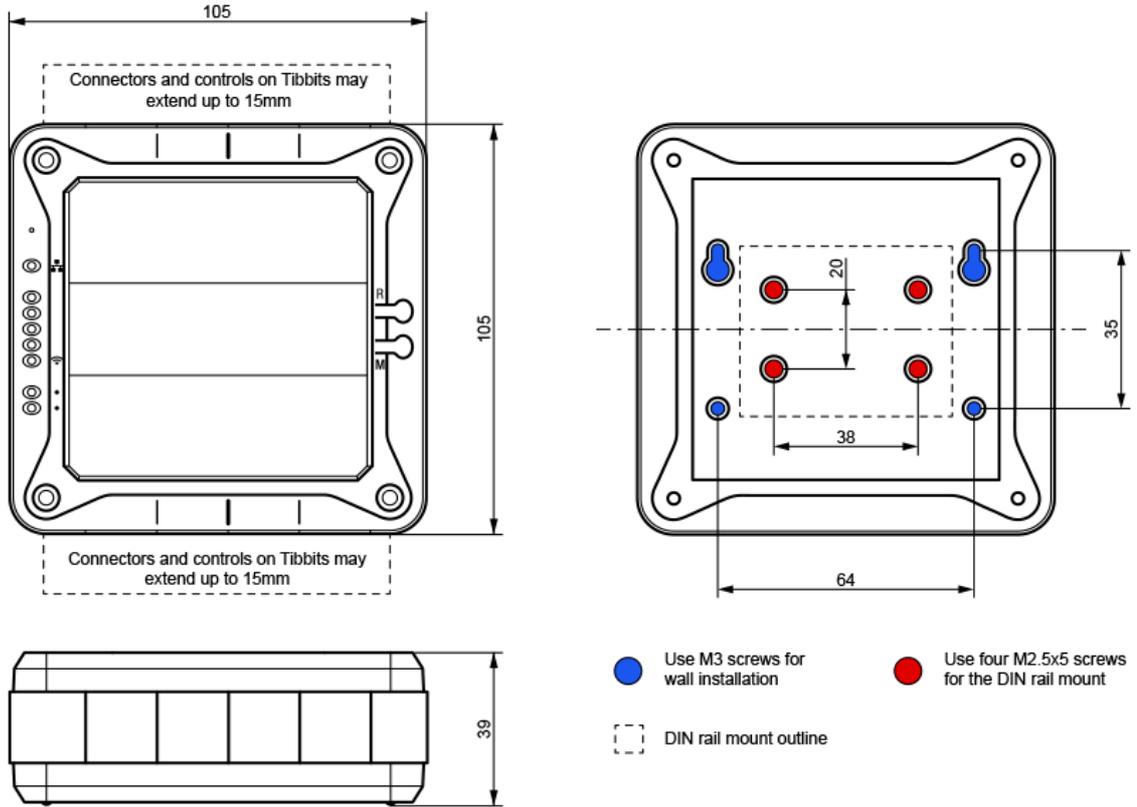


The vibration protection kit (VPK) consists of the vibration protection plate, four special screws, and two small rubber parts that cushion the [GA1000](#) Wi-Fi add-on, when installed (they come attached to the plate and are not visible on the above picture).

The plate is installed as shown on the [exploded view](#) of the TPS:

- Four M2.5 screws securing the [TPP](#) are removed and four special screws (shown above) are instead used to attach the TPP onto the bottom cover;
- The vibration protection plate goes over [Tibbits](#) (installed on the TPP) and rests on these special screws;
- Four M2.5 screws that originally held the TPP in place are used to secure the vibration protection plate onto the special screws.

Mechanical Dimensions



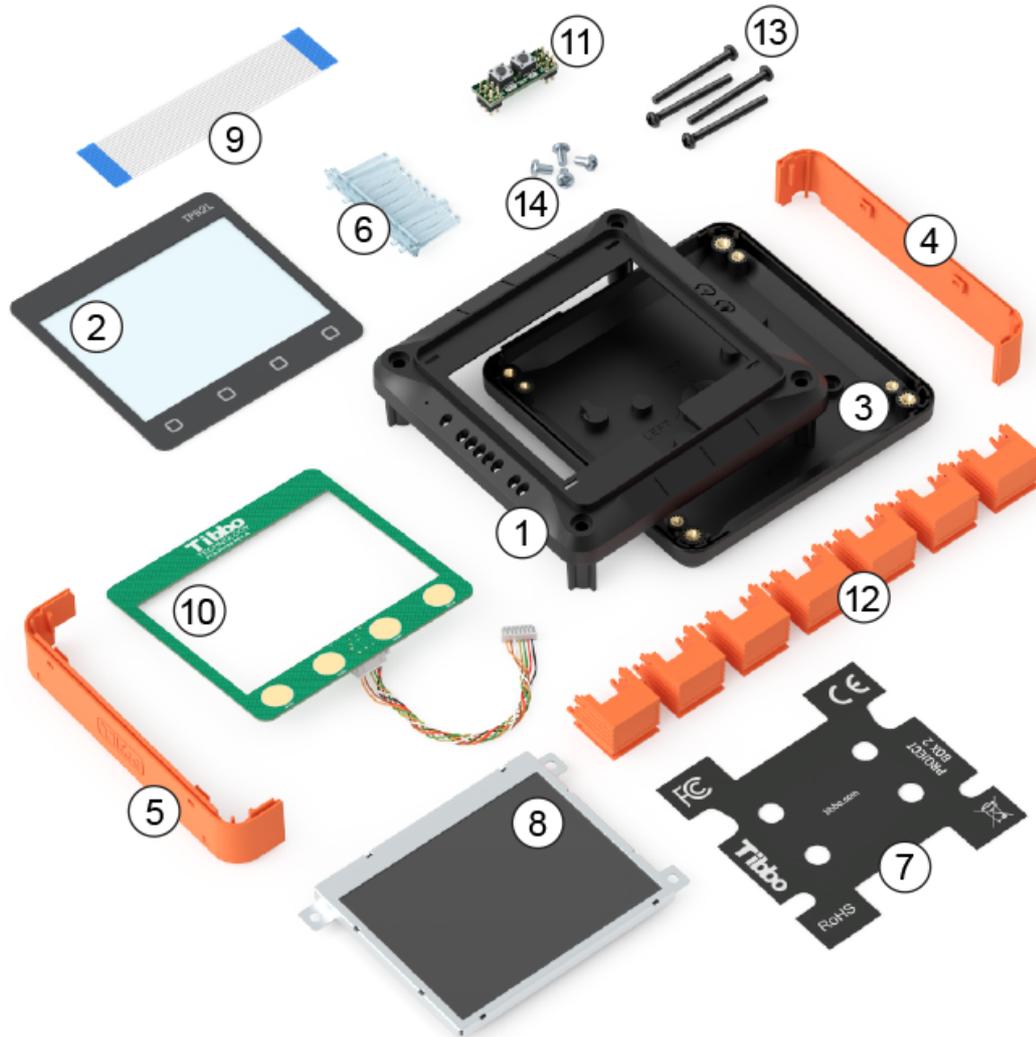
Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

Size 2 Project Box With LCD/Keys (TPB2L)



This Tibbo Project Box accommodates [size 2 Tibbo Project PCB](#) (TPP2).

TPB2L Parts and Accessories



List of parts included with the TPB2L kit

	Part	Description	Qty
1.	PM01P1053:	Top cover (TPB2L)	1
2.	PM03P1018:	Faceplate (TPB2L)	1
3.	PM01P1055:	Bottom cover (TPB2, TPB2L)	1
4.	PM01P1049:	Right side wall (all TPB models)	1
5.	PM01P1050:	Left side wall (all TPB models)	1
6.	PM06P1004:	LED light guide (all TPB models)	1
7.	PM03P1017:	Back label (TPB2, TPB2L)	1
8.	LCD-P0005:	3.5" 320x240 TFT LCD panel with controller	1
9.	WAS-P0036:	LCD-to-TPP2 cable	1

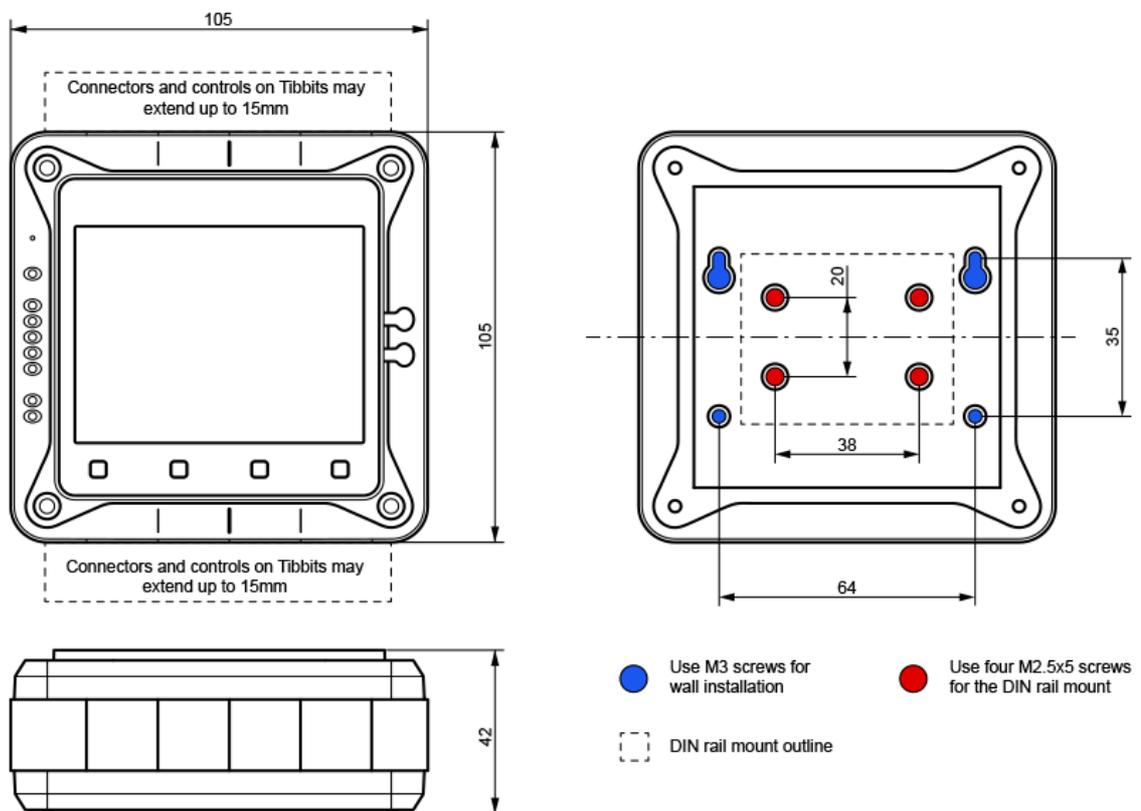
10.	PA-PCB-P2165-00:	Keypad PCB for TPB2L, with cable	1
11.	PCB-P2164:	MD/RST button PCB (all TPB models)	1
12.	PM12P1001-03:	Blank Tibbit shell, C1 form factor, orange	7
13.	SM3R5+32SPBC:	Main Screw (all TPB models)	4
14.	SM2R6+05SPNC:	PCB screw (all TPB models)	4

The TPB2L can be purchased with an optional [vibration protection kit \(VPK\)](#), as well as the DIN rail mounting kit.

Size 2 Vibration Protection Kit (VPK)

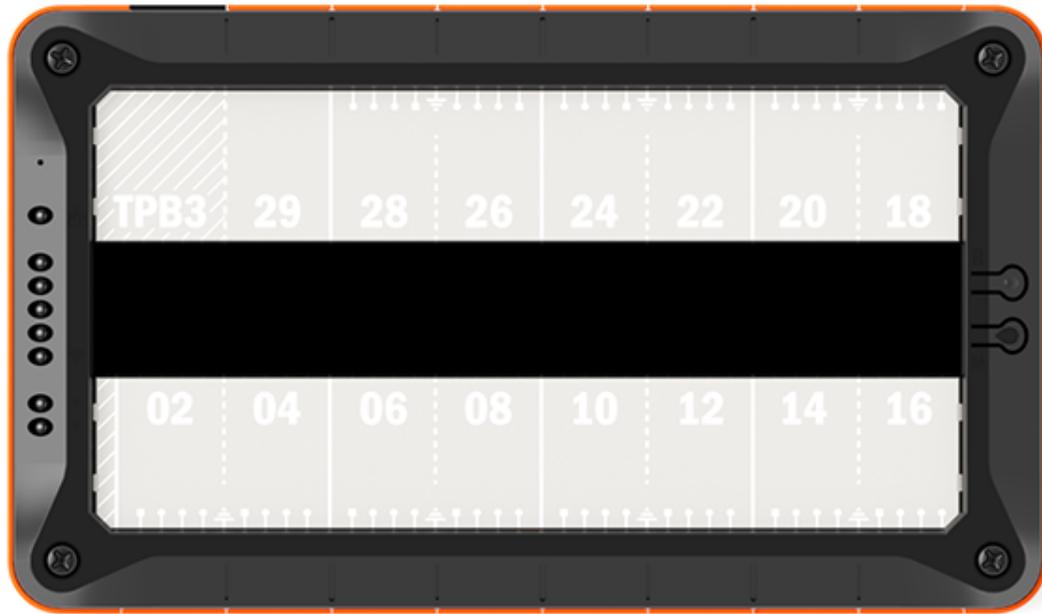
The TPB2L uses the same [size 2 vibration protection kit \(VPK\)](#) as the TPB2.

Mechanical Dimensions



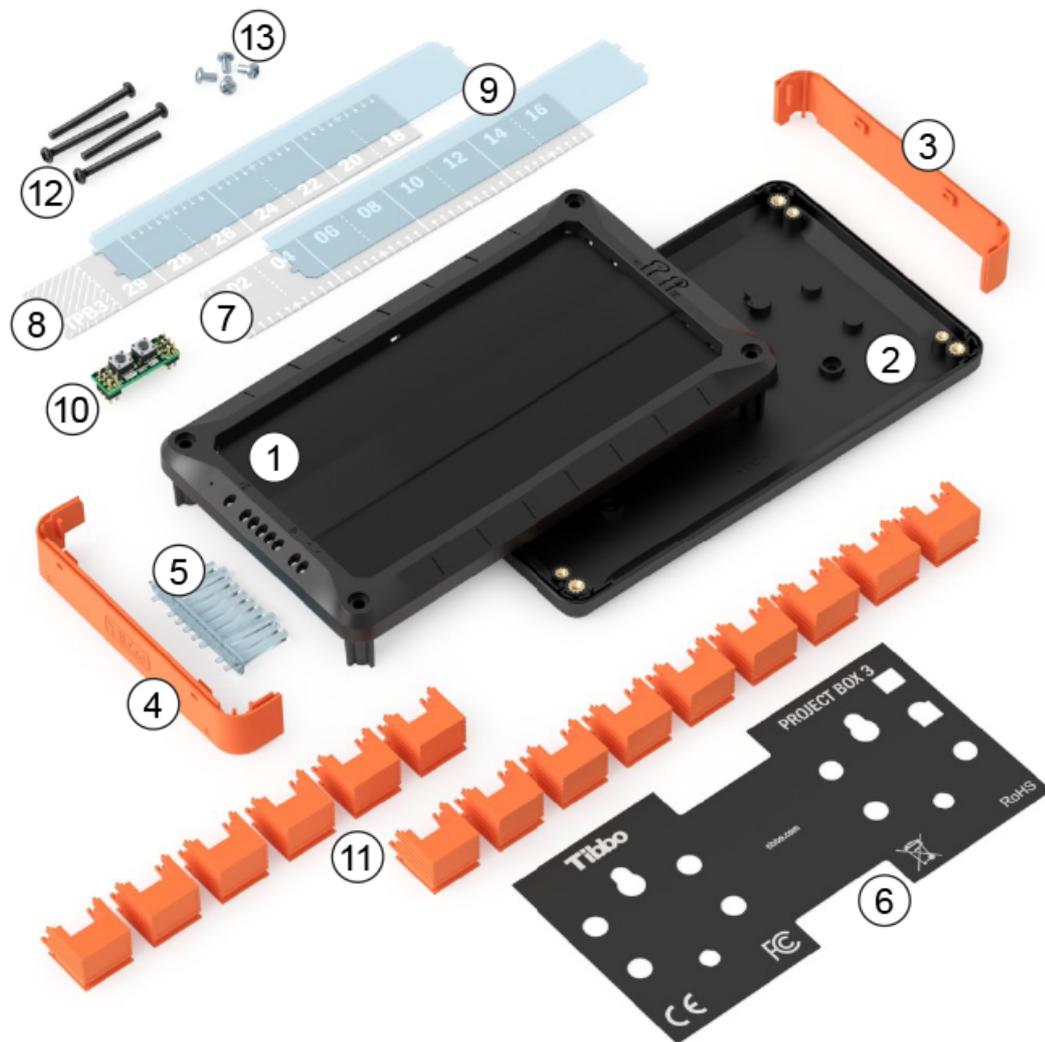
Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

Size 3 Tibbo Project Box (TPB3)



This Tibbo Project Box accommodates size [3 Tibbo Project PCB](#) (TPP3).

TPB3 Parts and Accessories



List of parts included with the TPB3 kit

	Part	Description	Qty
1.	PM01P1047:	Top cover (TPB3)	1
2.	PM01P1048:	Bottom Cover (TPB3)	1
3.	PM01P1049:	Right side wall (all TPB models)	1
4.	PM01P1050:	Left side wall (all TPB models)	1
5.	PM06P1004:	LED light guide (all TPB models)	1
6.	PM03P1016:	Back label (TPB3)	1
7.	PM921007:	Paper insert, bottom row (TPB3)	1
8.	PM921008:	Paper insert, top row (TPB3)	1
9.	PM03P1019:	Paper Insert Cover (TPB3)	2
10.	PCB-P2164:	MD/RST button PCB (all TPB models)	1
11.	PM12P1001-03:	Blank Tibbit shell, C1 form factor, orange	15
12.	SM3R5+32SPBC:	Main Screw (all TPB models)	4
13.	SM2R6+05SPNC:	PCB screw (all TPB models)	4

The TPB3 can be purchased with an optional [vibration protection kit \(VPK\)](#), as well as DIN rail mounting kits (two kits are required for DIN rail installation).

Size 3 Vibration Protection Kit (VPK)

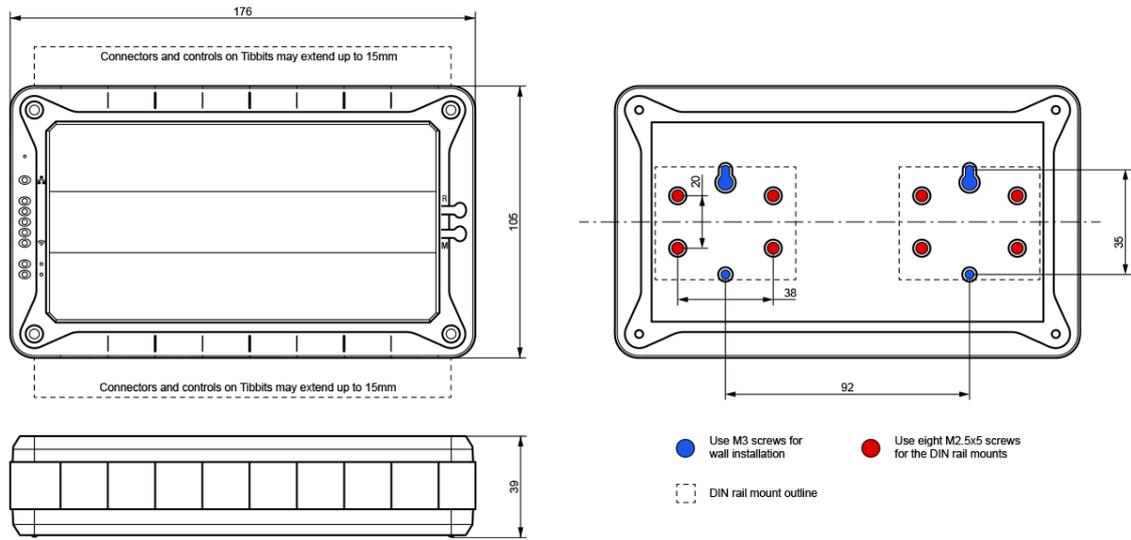


The vibration protection kit (VPK) consists of the vibration protection plate, four special screws, and two small rubber parts that cushion the [GA1000](#) Wi-Fi add-on, when installed (they come attached to the plate and are not visible on the above picture).

The plate is installed as shown on the [exploded view](#) of the TPS:

- Four M2.5 screws securing the [TPP](#) are removed and four special screws (shown above) are instead used to attach the TPP onto the bottom cover;
- The vibration protection plate goes over [Tibbits](#) (installed on the TPP) and rests on these special screws;
- Four M2.5 screws that originally held the TPP in place are used to secure the vibration protection plate onto the special screws.

Mechanical Dimensions



Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

Retail Packaging



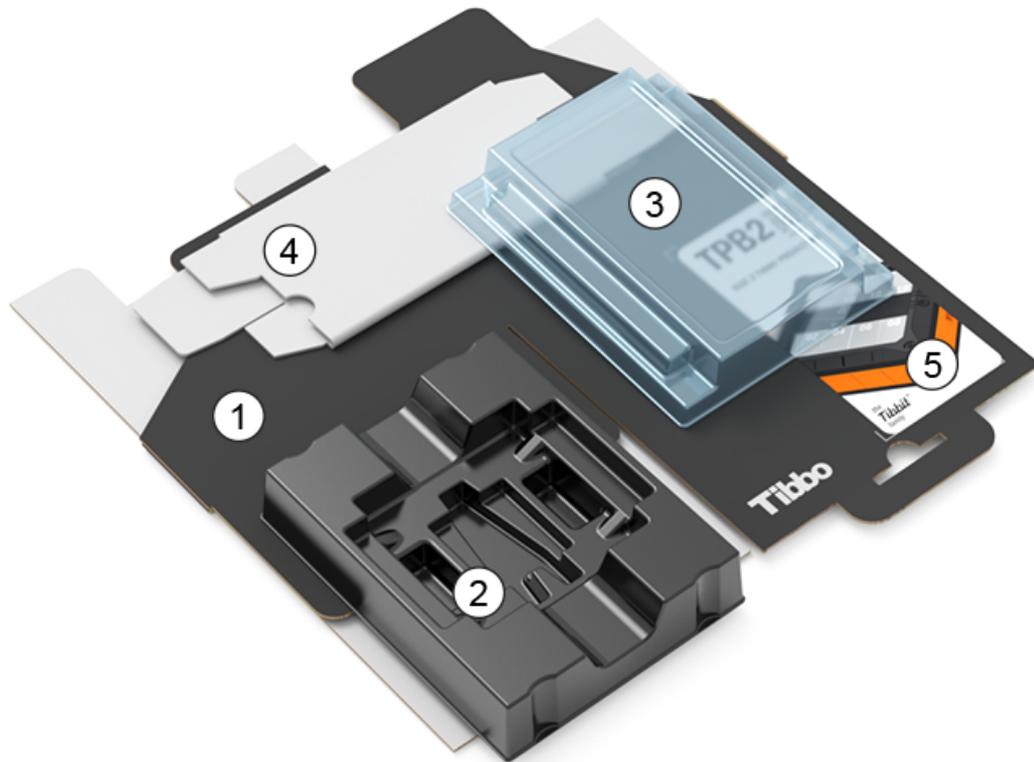
In the automation world, presentation may not be everything but it is certainly still very important. Any product benefits from an attractive retail box, and our [Tibbo Project Box \(TPB\)](#) kits and Tibbo Project Systems (TPS) are no exception.

TPB/TPS retail packaging kits were designed with the ease of assembly and economical cost in mind. You have the choice of ordering unassembled (flattened) cartons and stacked plastic inserts to save space and transportation costs, or you can order your TPB/TPS fully assembled, in which case it will arrive in the retail package fully assembled as well.

Important note: if you order fully assembled TPB/TPS, the retail packaging for each Box (System) will be automatically included as well. This is because assembled Boxes (Systems) require proper packaging for transportation. Ordering unassembled goods allows you to choose whether to include the retail packaging kits or not.

Another note: the Tibbit remover tool (shown above) is not included with the retail packaging kit. It is provided for free for every Tibbo Project System ordered. The remover can also be purchased separately (part #PM05P1014-01).

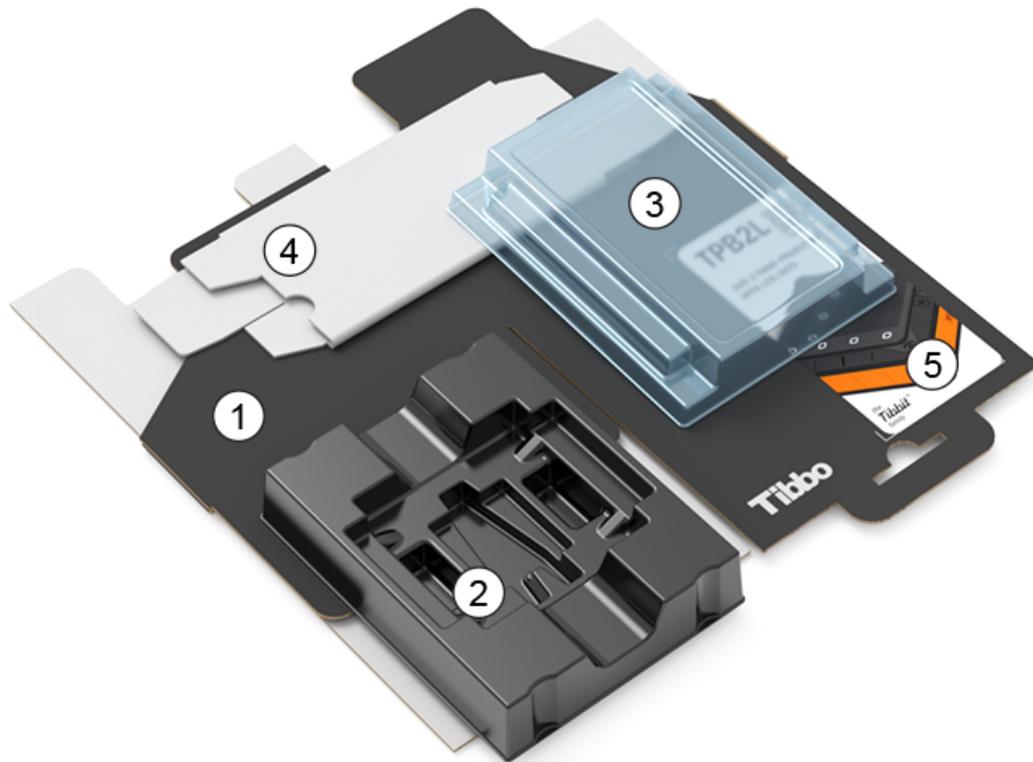
TPB2/TPS2 Retail Packaging Kit



List of parts included with the TPS2/TPB2 retail packaging kit

	Part	Description	Qty
1.	PM911018	Retail box (all TPS/TPB models)	1
2.	PM07P1012	Package tray for TPS2/TPB2, TPS2L/TPB2LTPB2L	1
3.	PM07P1010	Transparent tray cover (all TPS/TPB models)	1
4.	PM911019	Accessories box (all TPS/TPB models)	1
5.	PM921012	Retail package label (TPS2/TPB2)	1

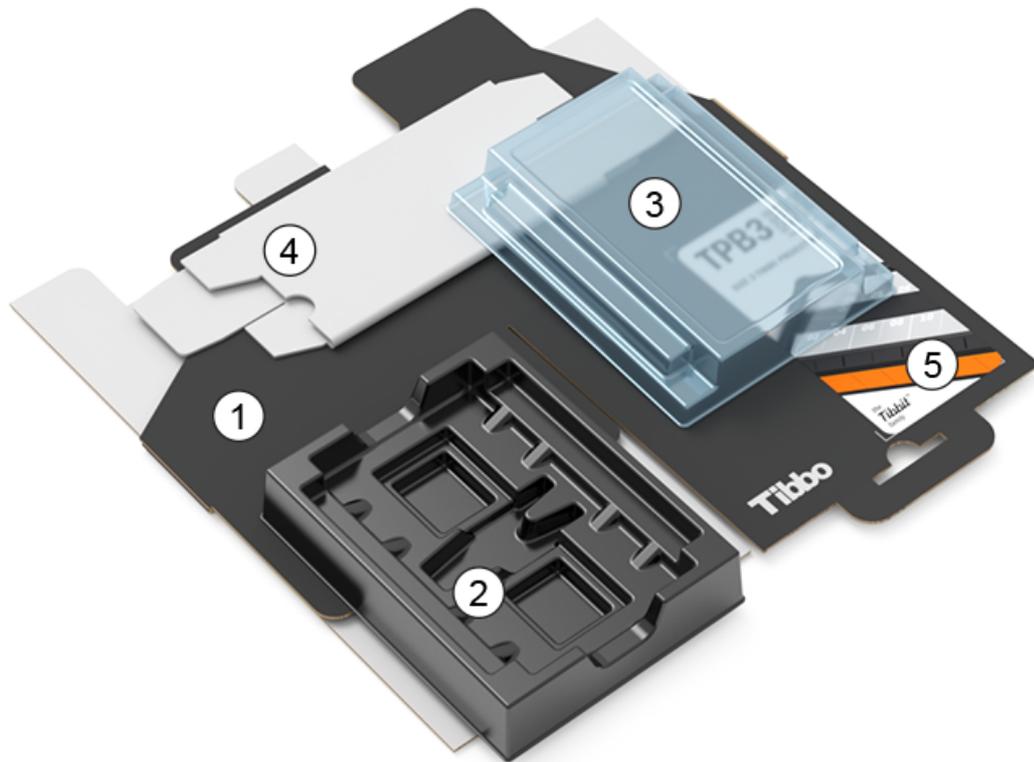
TPB2L/TPS2L Retail Packaging Kit



List of parts included with the TPS2L/TPB2L retail packaging kit

	Part	Description	Qty
1.	PM911018	Retail box (all TPS/TPB models)	1
2.	PM07P1012	Package tray for TPS2/TPB2, TPS2L/TPB2LTPB2L	1
3.	PM07P1010	Transparent tray cover (all TPS/TPB models)	1
4.	PM911019	Accessories box (all TPS/TPB models)	1
5.	PM921011	Retail package label (TPS2L/TPB2L)	1

TPB3/TPS3 Retail Packaging Kit



List of parts included with the TPS3/TPB3 retail packaging kit

	Part	Description	Qty
1.	PM911018	Retail box (all TPS/TPB models)	1
2.	PM07P1011	Package tray (TPS3/TPB3)	1
3.	PM07P1010	Transparent tray cover (all TPS/TPB models)	1
4.	PM911019	Accessories box (all TPS/TPB models)	1
5.	PM921014	Retail package label (TPS3/TPB3)	1

Assembled Retail Package



This is how the assembled retail package looks. The accessories box (2) goes into the retail package box (1). The accessories box is meant for transporting Wi-Fi antennas, wires, cables, etc.

Ordering Info

External Controllers

The following external controllers and controller families are currently being offered by Tibbo:

- [DS110x Family](#)
- [DS1206](#)
- [DS1202](#)
- [DS10xx Family](#)

DS110x

Introduction

The DS110x is a family of compact BASIC-programmable controllers designed for serial-over-IP and serial control applications.

The DS110x family currently includes:

- The DS1100 serial controller with a single-channel RS232 port, this model targets cost-sensitive applications;
- The DS1101 serial controller with the 3.5-channel RS232 port;
- The DS1102 serial controller with the universal RS232 (3-channel)/422/485 port.

The family is fully supported by TIDE software.

DS110x devices ship preloaded with a fully functional serial-over-IP application. Written in Tibbo BASIC, the application is compatible with Tibbo Device Server Toolkit software, comes with full source codes, and can be modified by the user.

Differentiating features

	DS1100	DS1101	DS1102
Device color			
Serial port	RS232 port on DB9M connector	RS232 port on DB9M connector	RS232/422/485 port on DB9M conn.
No of serial port channels	1 channel	3.5 channels	3 channels (RS232), 1 ch.(RS422/485)
Serial port lines	TX, RX, RTS, CTS, DTR, DSR	TX, RX, RTS, CTS, DTR, DSR, DCD	TX, RX, RTS, CTS, DTR, DSR (RS232) TX, RX, RTS, CTS (RS422) TX, RX half-duplex (RS485)
Maximum baudrate	Up to 115200bps	Up to 921600bps	
Flow and direction control	Optional RTS/CTS flow control		Opt. RTS/CTS flow control (232/422) Direction control (RS485)
Parity modes	None/even/odd/mark/space parity		
Bits/character	7/8 bits/character		
Power input/output on DB9	"12V" power input on pin 9 of DB9	"12V" power input and output on pin 9 of DB9 (software-controllable)	not provided

Flash memory	512KB for firmware and application storage. No flash disk functionality.	1024KB for firmware, application and data (flash disk)	
EEPROM	200 bytes	2048 bytes	
LEDs	Red and green status LEDs Yellow Ethernet link LED	Red and green status LEDs Yellow Ethernet link LED Five blue LEDs (can be used for Wi-Fi signal strength indication)	
Wi-Fi	no	optional 802.11b/g interface (GA1000)*	
Display	no	optional 96x32 monochrome OLED	
PoE	optional	optional*	
Buzzer	no	yes	
Processor	T2000	T1000	
Operating frequency and PLL	80Mhz, no PLL	88MHz, software-controlled PLL	
Superior upgrade to...	DS203	DS1206	DS1206 , DS100B
Firmware upgrades	Through the serial port or network (including cold upgrades through the network).	Through the serial port or network (no cold upgrades through the network).	

* *Wi-Fi and PoE options are mutually exclusive and cannot be installed together*

Common hardware features of the DS110x family

- 10/100BaseT auto-MDIX Ethernet port.
- Power: 12VDC nominal (min. 9V, max. 18V).
- Dimensions: 90x48x25mm.
- Operating temperature range: -5 ~ 70 C.
- CE- and FCC-certified.

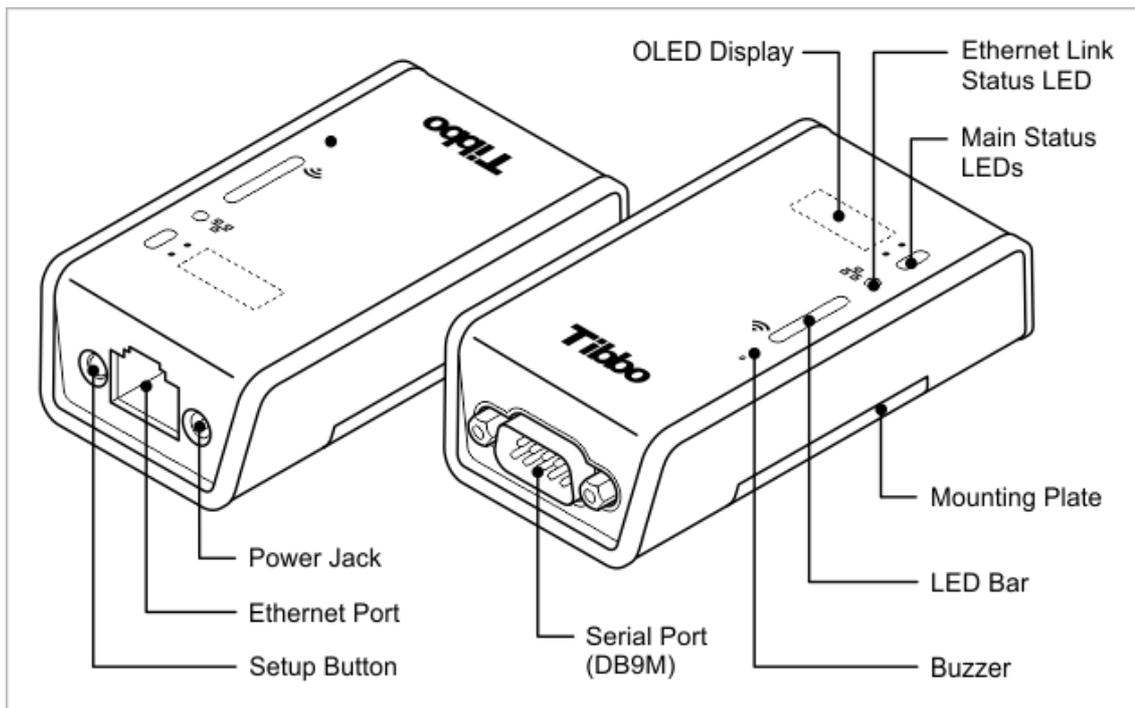
Programming features

- Variable Types: Byte, char, integer (word), short, dword, long, real, string, plus user-defined arrays and structures.
- Function Groups: string functions (27 in total!), date/time conversion functions (8), encryption/hash calculation functions (AES128*, RC4, MD5, SHA-1), and more.
- Platform objects:
 - Sock — socket communications (up to 16 UDP, TCP, and HTTP sessions);
 - Net — controls the Ethernet port;

- Wln — handles the Wi-Fi interface (when the GA1000 is installed, DS1101 and DS1102 only);
- Lcd — controls the OLED display (when the display is installed, DS1101 and DS1102 only).
- Ser — in charge of serial channels;
- Io — handles I/O lines, ports, and interrupts;
- Fd — manages flash memory file system and direct sector access;
- Stor — provides access to the EEPROM;
- Romfile — facilitates access to resource files (fixed data);
- Pppoe — provides access to the Internet over an ADSL modem;
- Ppp — provides access to the Internet over a serial modem (GPRS, POTS, etc.);
- Pat — "plays" patterns on green and red status LEDs;
- Beep — generates buzzer patterns (DS1101 and DS1102 only);
- Button — monitors the setup button;
- Sys — in charge of general device functionality.

* The DS1100 does not support AES functions (*aes128enc* and *aes128dec*).

DS110x Connectors and Controls



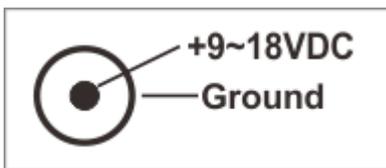
- [Power arrangement](#)
- [Ethernet port](#)
- [Serial port](#)
- [Flash and EEPROM Memory](#)
- [Buzzer](#) (DS1101 and DS1102 only)

- [Optional Wi-Fi](#) (DS1101 and DS1102 only)
- [Optional OLED display](#) (DS1101 and DS1102 only)
- [LED bar](#) (DS1101 and DS1102 only)
- [DIN rail and wall mounting plates](#)
- [Status LEDs](#) (main status LEDs and Ethernet link status LED)
- [Setup button](#)

Power Arrangement

All DS110x devices are "normally" powered through the power jack.

The power jack accepts "small" power connectors with 3.5mm diameter. Use [APR-P0011](#), [APR-P0012](#), or [APR-P0013](#) power adaptor supplied by Tibbo or similar adaptor with 12VDC nominal output voltage. Adaptor current rating should be at least 500mA. On the power jack, the ground is "on the outside", as shown on the figure below.



There are also "alternative" ways of powering the devices. Click the links below to explore:

[DS1100](#)

[DS1101](#)

[DS1102](#)

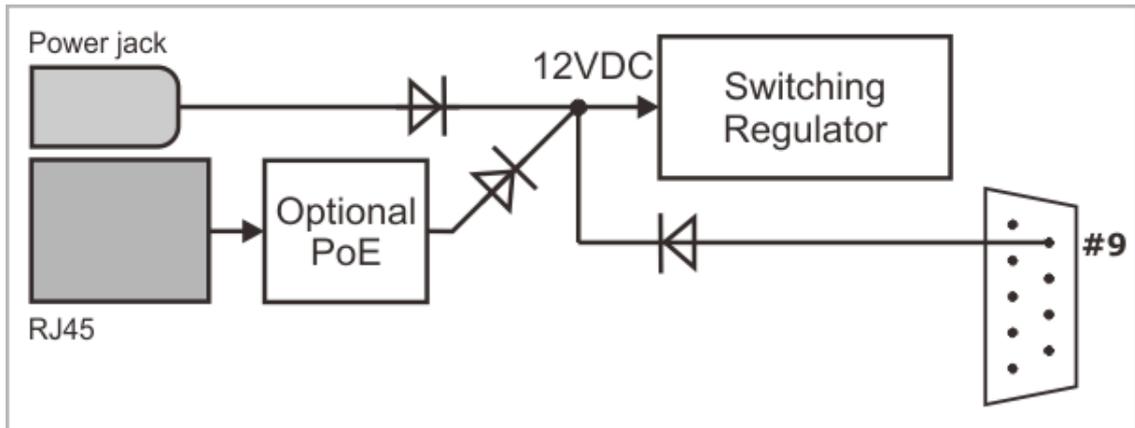
DS1100

The DS1100 can be powered through its power jack, pin 9 of the DB9 (RS232) connector, or the optional PoE module (letter "P" in the [model numbering scheme](#)).

Pin 9 input has the same [input voltage requirements](#) as for the power jack.

Optional PoE module is supposed to be powered by 48V (nominal), which is standard for PoE equipment. Your PoE-enabled hub will take care of this. The PoE module outputs 12VDC.

Internally, all three power sources are connected to the DS1100's power regulator through three diodes, as shown on the diagram below.



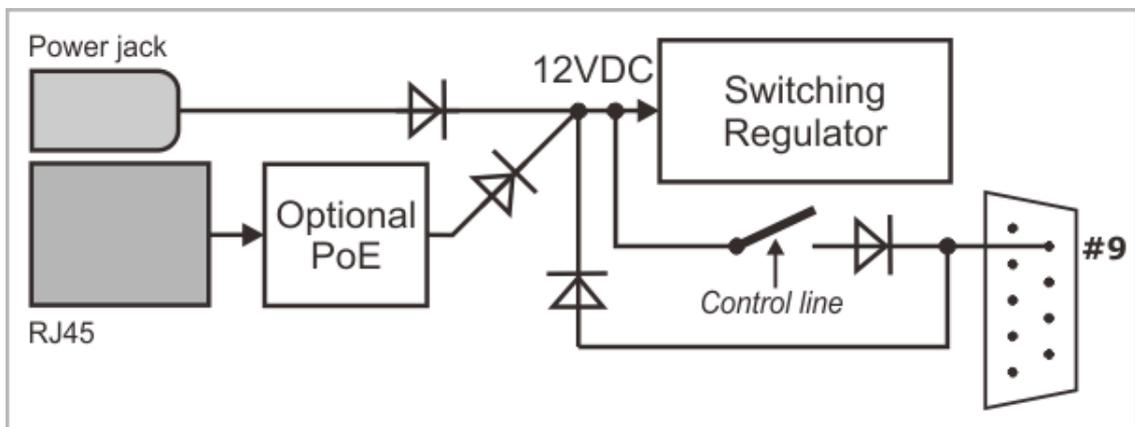
DS1101

The DS1101 can be powered through its power jack, pin 9 of the DB9 (RS232) connector, or the optional PoE module (letter "P" in the [model numbering scheme](#)).

Pin 9 input has the same [input voltage requirements](#) as for the power jack.

Optional PoE module is supposed to be powered by 48V (nominal), which is standard for PoE equipment. Your PoE-enabled hub will take care of this. The PoE module outputs 12VDC.

Internally, all three power sources are connected to the DS1101's power regulator through three diodes, as shown on the diagram below.



Pin 9 of the DB9M connector can also be used to provide "12VDC" power to an attached serial device. Many small serial devices, such as barcode scanners, accept power on pin 9 of their DB9 connectors.

We intentionally printed "12VDC" in quotation marks. This is because there is no guarantee that the output voltage will be exactly 12V. It will actually be the "input voltage minus the voltage drop across the diode". In plain words, it will be slightly below the input voltage. If you connect 12V to the power jack you will get around 11.7V out of pin 9.

To turn the power switch on from within your Tibbo BASIC application, enable (configure as output) the PL_IO_NUM8_PWR0UT GPIO line and then set this line to LOW. Additional programming information can be found in "TIDE and Tibbo BASIC Manual" (see i.o object and the DS1101 platform documentation).

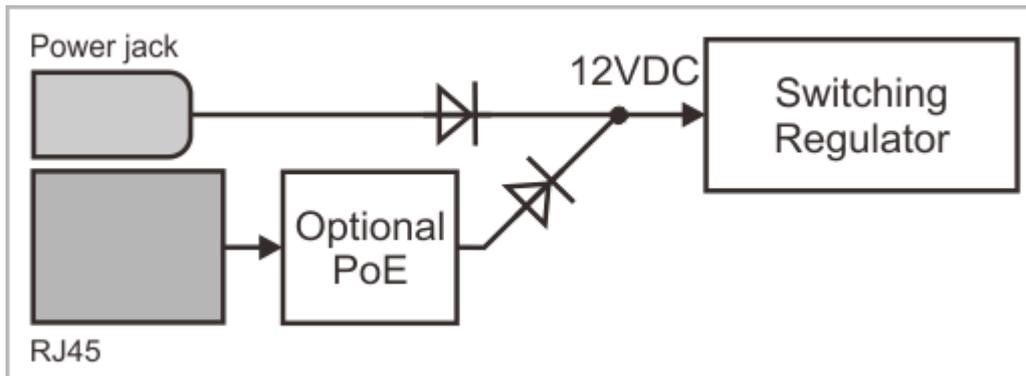
Note that the DS110x devices cannot accommodate the PoE and [Wi-Fi](#) options at the same time.

DS1102

The DS1102 can be powered through its power jack or the optional PoE module (letter "P" in the [model numbering scheme](#)).

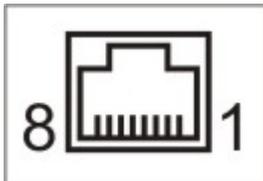
The PoE module is supposed to be powered by 48V (nominal), which is standard for PoE equipment. Your PoE-enabled hub will take care of this. The PoE module outputs 12VDC.

Internally, both power sources are connected to the DS1102's power regulator through two diodes, as shown on the diagram below.



Note that the DS110x devices cannot accommodate the PoE and [Wi-Fi](#) options at the same time.

Ethernet Port



The Ethernet port of the DS110x is of 10/100BaseT type.

The connector is of RJ45 type, pin assignment is as follows:

#1	TX+
#2	TX-
#3	RX+
#4	PoE+
#5	PoE+
#6	RX-
#7	PoE-
#8	PoE-

Serial Port 1.3

Serial port capabilities are different for each device in the DS110x family:

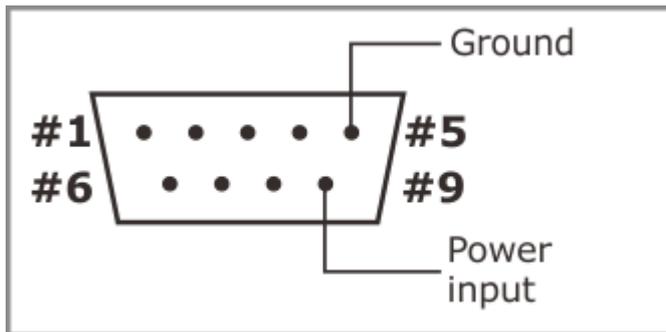
[DS1100](#)

[DS1101](#)

[DS1102](#)

DS1100

The DS1100 carries a single-channel RS232 DB9M port.



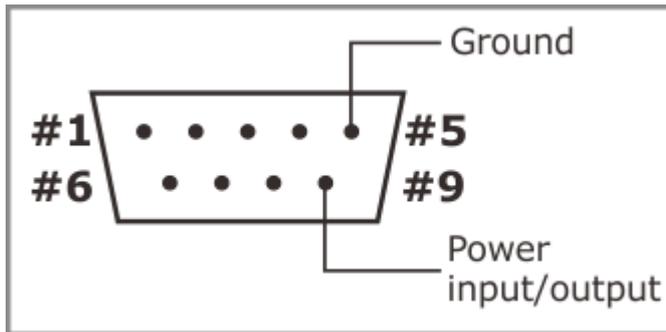
#1	<No connection>
#2	RX (input)
#3	TX (output)
#4	DTR (output)
#5	Ground
#6	DSR (input)
#7	RTS (output)
#8	CTS (input)
#9	Power input ("12VDC")

DS1101

The DS1101 features a multi-channel RS232 port. Physically, the port is implemented as a single DB9M connector with three output lines, four input lines, [power input/output](#), and the ground.

Internally, the DS1101 has four independent serial ports. These are controlled through the ser. object (see "TIDE and Tibbo BASIC Manual").

Each of the four ports has its own TX and RX lines. These lines are implemented in hardware and can't be "remapped". The following table shows how the RX and TX lines are connected to the DB9M:



#1	RX3 (input, commonly DCD)
#2	RX (input)
#3	TX (output)
#4	TX3 (output, commonly DTR)
#5	Ground
#6	RX3 (input, commonly DSR)
#7	TX2 (output, commonly RTS)
#8	RX2 (input, commonly CTS)
#9	Power input/output ("12VDC")

Each logical serial port of the ser. object also support RTS/CTS flow control, which is implemented in firmware (TiOS). Ser.rtsmap and ser.ctsmap properties allow you to assign any GPIO line of the DS1101 to serve as the RTS or CTS line of any logical serial port. So, TX2 and RX2 lines (pins 7 and 8) can be assigned to work as RTS and CTS lines, as is traditionally the case for RS232 ports. At the same time, these lines can be set to function as an independent serial channel.

The same goes for the DTR and DSR lines, except they don't even "exist" from the ser. object's perspective. These lines are implemented on the application level. For example, our own "serial-over-IP" application supports these lines. Again, instead of using TX3 and RX3 (pins 4 and 6) as the lines of an independent serial channel, it is possible to use them as DTR and DSR lines, as is common.

To simplify the discussion, let's look at the RS232 port from the serial-over-IP application's point of view. This application defines 15 mapping options:

Mapping option	Available signals	Pins on the DB9M connector							Missing line
		#2	#3	#8	#7	#6	#4	#1	
Option 0	RX/TX/CTS/RTS/DSR/DTR	RX	TX	CTS	RTS	DSR	DT	---	---
Option 1	RX/TX/CTS/RTS/DSR/DTR + RX/tx	RX	TX	CTS	RTS	DSR	DT	RX4	tx4
Option 2	RX/TX/CTS/RTS + RX/TX + RX/tx	RX	TX	CTS	RTS	RX3	TX3	RX4	tx4
Option 3	RX/TX/CTS/RTS + RX/TX/CTS/rts	RX	TX	CTS	RTS	RX3	TX3	CTS3	rts3
Option 4	RX/TX/CTS/RTS + RX/TX/DSR/dtr	RX	TX	CTS	RTS	RX3	TX3	DSR3	dtr3

Option 5	RX/TX/DSR/DTR + RX/TX + RX/tx	RX	TX	RX2	TX 2	DS R	DT R	RX4	tx4
Option 6	RX/TX/DSR/DTR + RX/TX/CTS/rts	RX	TX	RX2	TX 2	DS R	DT R	CT S2	rts2
Option 7	RX/TX/DSR/DTR + RX/TX/DSR/dtr	RX	TX	RX2	TX 2	DS R	DT R	DS R2	dtr2
Option 8	RX/TX + RX/TX + RX/TX + RX/tx	RX	TX	RX2	TX 2	RX3	TX 3	RX4	tx4
Option 9	RX/TX/CTS/rts + RX/TX + RX/TX	RX	TX	RX2	TX 2	RX3	TX 3	CT S	rts
Option 10	RX/TX/DSR/dtr + RX/TX + RX/TX	RX	TX	RX2	TX 2	RX3	TX 3	DS R	dtr
Option 11	RX/TX/CTS/RTS + RX/tx/CTS/RTS	RX	TX	CT S	RT S	CT S4	RT S4	RX4	tx4
Option 12	RX/TX/CTS/RTS + RX/tx/DSR/DTR	RX	TX	CT S	RT S	DS R4	DT R4	RX4	tx4
Option 13	RX/TX/DSR/DTR + RX/tx/CTS/RTS	RX	TX	CT S4	RT S4	DS R	DT R	RX4	tx4
Option 14	RX/TX/DSR/DTR + RX/tx/DSR/DTR	RX	TX	DS R4	DT R4	DS R	DT R	RX4	tx4

"Available signals" column shows a particular combination of I/O lines for each option. For example, option 0 defines the standard serial port arrangement with RX, TX, CTS, RTS, DSR, and DTR lines. Option 2 gives you one channel with RX, TX, CTS, and RTS lines, one more channel with just RX and TX lines, and yet another channel with a single RX line. The TX line is "missing" because, once again, there are only three outputs available. This is why this line is shown in gray (tx).

DS1102

The DS1102 features a multi-mode, multi-channel RS232/422/485 port. Physically, the port is implemented as a single DB9M connector.

The definition of RS422 and 485 modes

To avoid any misunderstanding of what the RS422 and RS485 modes are, let's clarify that the term "RS422 mode" refers to full-duplex differential signaling interface with at least RX and TX signals, and possibly with CTS and RTS signals. Each signal is carried by a pair of "+" and "-" lines. The term "RS485 mode" refers to half-duplex differential signaling interface with RX and TX lines, where each signal is also carried by a pair of "+" and "-" lines. The RTS line of the serial port is used (within the DS1102) to control the direction, so TX and RX lines can be combined (externally) to form a two-wire bus that carries data in both directions. On a physical signal level (voltages, etc.), there is no difference between the RS422 and RS485 -- they are implemented in the same way.

RS422 and RS485 modes typically require termination circuits. No such circuits are provided within the DS1102. A simple 120Ohm resistor (added externally) is sufficient for the proper termination of one "+"/"-" pair.

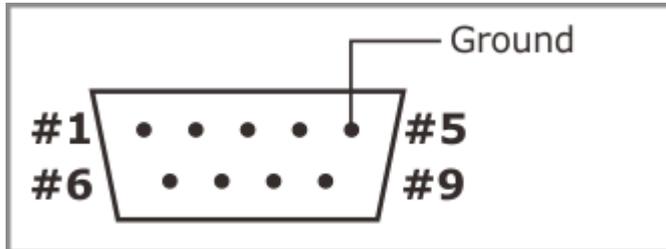
Pin assignment

In the RS232 mode, the serial port of the DS1102 has 3 output and 3 input lines. In the RS422 mode, you get 2 output and 2 input line pairs. The RS485 mode offer one

output line pair and one input line pair and these are not independent -- they operate in the half-duplex mode).

Internally, the DS1102 has three independent serial ports. These are controlled through the ser. object (see "TIDE and Tibbo BASIC Manual").

Each of those ports has its own TX and RX lines. These lines are implemented in hardware and can't be "remapped". The following table shows how these RX and TX lines are connected to the DB9M:



	RS232	RS422	RS485
#1	<No connection>	TX2- (output, commonly RTS-)	<No connection>
#2	RX (input)	RX- (input)	RX- (input)
#3	TX (output)	TX+ (output)	TX+ (output)
#4	TX3 (output, commonly DTR)	TX- (output)	TX- (output)
#5	Ground	Ground	Ground
#6	RX3 (input, commonly DSR)	RX+ (input)	RX+ (input)
#7	TX2 (output, commonly RTS)	TX2+ (output, commonly RTS+)	<No connection>
#8	RX2 (input, commonly CTS)	RX2+ (input, commonly CTS+)	<No connection>
#9	<No connection>	RX2- (input, commonly CTS-)	<No connection>

Each logical serial port of the ser. object also support RTS/CTS flow control, which is implemented in firmware (TiOS). Ser.rtsmap and ser.ctsmap properties allow you to assign any GPIO line of the DS1102 to serve as the RTS or CTS line of any logical serial port. So, TX2 and RX2 lines (pins 7 and 8) can be assigned to work as RTS and CTS lines, as is traditionally the case for RS232 ports. At the same time, these lines can be turned to function as an independent serial channel.

The same goes for the DTR and DSR lines, except they don't even "exist" from the ser. object's perspective. These lines are implemented on the application level. For example, our own "serial-over-IP" application supports these lines. Again, instead of using TX3 and RX3 (pins 4 and 6) as the lines of an independent serial channel, it is possible to use them as DTR and DSR lines, as is common.

To simplify the discussion, let's look at the serial port from the serial-over-IP application's point of view. This application defines 15 mapping options. Even in the RS232 mode, some options are redundant on the DS1102 (but not on the [DS1101](#)). Many more options are redundant in the RS422 mode. See the links below to explore further:

[Mapping options for the RS232 mode](#)

[Mapping options for the RS422 mode](#)

And where are mapping options for the RS485 mode? There are none -- but you knew this already.

Mapping Options for the RS232 Mode

Unlike on the [DS1101](#) device, the DS1102 does not have an input on line 1. Hence, some of the [15 mapping options](#) become indistinguishable from other options. Only "unique" options are shown in the table below.

Mapping option	Available signals	Pins on the DB9M connector						Missing lines
		#2	#3	#8	#7	#6	#4	
Option 0	RX/TX/CTS/RTS/DSR/DTR	RX	TX	CTS	RTS	DSR	DTR	---
Option 2	RX/TX/CTS/RTS + RX/TX	RX	TX	CTS	RTS	RX3	TX3	rx4, tx4
Option 5	RX/TX/DSR/DTR + RX/TX	RX	TX	RX2	TX2	DSR	DTR	rx4, tx4
Option 8	RX/TX + RX/TX + RX/TX	RX	TX	RX2	TX2	RX3	TX3	rx4, tx4
Option 11	RX/TX/CTS/RTS + CTS/RTS	RX	TX	CTS	RTS	CTS4	RTS4	rx4, tx4
Option 12	RX/TX/CTS/RTS + DSR/DTR	RX	TX	CTS	RTS	DSR4	DTR4	rx4, tx4
Option 13	RX/TX/DSR/DTR + CTS/RTS	RX	TX	CTS4	RTS4	DSR	DTR	rx4, tx4
Option 14	RX/TX/DSR/DTR + DSR/DTR	RX	TX	DSR4	DTR4	DSR	DTR	rx4, tx4

Mapping Options for the RS422 Mode

There are even fewer options in the RS422 mode:

Mapping option	Available signals	Pin pairs on the DB9M connector				Missing lines
		#6,2	#3,4	#8,9	#7,1	
Option 0	RX/TX/CTS/RTS/DSR/DTR	RX	TX	CTS	RTS	dtr, dsr
Option 5	RX/TX/DSR/DTR + RX/TX + RX/tx	RX	TX	RX2	TX2	dtr, dsr, rx4, tx4
Option 14	RX/TX/DSR/DTR + RX/tx/DSR/DTR	RX	TX	DSR4	DTR4	dtr, dsr, rx4, tx4

Mapping Options for the RS485 Mode

There are no mapping options in the RS485 mode. You have one TX line pair, and one RX line pair. That's all.

Flash and EEPROM Memory

DS1100

The DS1100 has 512KBytes of internal flash memory and 208 bytes of EEPROM memory.

A portion of the internal flash memory is used to store the TiOS firmware. When you are performing a firmware upgrade it is this memory you are saving the firmware binary into.

The rest of this flash memory is available to your Tibbo BASIC application. The internal flash memory **cannot** be used as a flash disk.

The EEPROM is almost fully available to your application, save for a small 8-byte area called "special configuration area". The EEPROM is accessed through the stor. object (see "TIDE and Tibbo BASIC Manual").

DS1101 and DS1102

The DS1101 and DS1102 devices have 1024KBytes of flash memory and 2KBytes of EEPROM memory.

The first 64KBytes of flash memory are used to store the TiOS firmware. When you are performing a firmware upgrade it is this memory you are saving the firmware binary into.

The rest of this flash memory is available to your Tibbo BASIC application and its data. Whatever memory space is left after the compiled application is loaded can be used as a flash disk (see fd. object documentation in the "TIDE and Tibbo BASIC Manual").

The EEPROM is almost fully available to your application, save for a small 8-byte area called "special configuration area". The EEPROM is accessed through the stor. object (see "TIDE and Tibbo BASIC Manual").

Buzzer (DS1101 and DS1102)

The buzzer is only available on the DS1101 and DS1102 devices. It is connected to the **PL_IO_NUM_37_CO** GPIO line.

Your application can control the buzzer through the "beeper" (beep.) object (see "TIDE and Tibbo BASIC Manual"). Buzzer center frequency is 2730Hz, so the recommended value for the beep.divider property is 16203.

Optional Wi-Fi (DS1101 and DS1102)

The DS1101 and DS1102 devices can optionally accommodate the [GA1000](#) Wi-Fi add-on module (letter "G" in the [model numbering scheme](#)).

The following GPIO lines are used to control the GA1000:

GPIO line	Function	GA1000 pin
PL_IO_NUM_15	CS	3

PL_IO_NUM_13	DO ⁽¹⁾	5
PL_IO_NUM_11	RST	7
PL_IO_NUM_12	DI ⁽²⁾	9
PL_IO_NUM_14	CLK	10

Notes:

1. "Data out" line of the DS1101/2, connects to the "data in" on the GA1000.
2. "Data in" line of the DS1101/2, connects to the "data out" on the GA1000.

Wi-Fi data communications is the responsibility of the sock. object (see "TIDE and Tibbo BASIC Manual"). Before such data communications can take place, the Wi-Fi interface must be properly configured. This is jointly achieved by the wln. object and WLN library (again, see "TIDE and Tibbo BASIC Manual").

Note that the DS110x devices cannot accommodate the Wi-Fi and PoE options at the same time.

Optional OLED Display (DS1101 and DS1102)

The DS1101 and DS1102 devices can optionally be outfitted with a 96x32 monochrome OLED display (letter "D" in the [model numbering scheme](#)).



As all displays of this type, the DS1101/2's OLED display has a limited life span. There will be a decrease in the display brightness after ~10000 hours of operation. To prolong display life, use the lcd.lock method of the .lcd object to turn the display off whenever possible. Display image is preserved when the display is "locked".

The following GPIO lines are used to control the display:

GPIO line	Function
PL_IO_NUM_36_OLED_RST	RST
PL_IO_NUM_35_OLED_DC	DC
PL_IO_NUM_34_OLED_WR	WR
PL_IO_NUM_33_OLED_RD	RD
PL_IO_NUM_32_OLED_CS	CS
PL_IO_PORT_NUM_0	data bus

The display is controlled by the .lcd object see ("TIDE and Tibbo BASIC Manual"). Proper I/O line mapping is required for the display to work, and it takes a single line of code to set this right:

```
lcd.iomapping="36,35,34,33,32,0"
```

Additionally, the following lines must be enabled (io.enabled= 1- YES):

- **PL_IO_NUM_36_OLED_RST**
- **PL_IO_NUM_35_OLED_DC**
- **PL_IO_NUM_34_OLED_WR**
- **PL_IO_NUM_33_OLED_RD**
- **PL_IO_NUM_32_OLED_CS**

The **PL_IO_PORT_NUM_0** port doesn't need to be enabled. It is bidirectional and the `.lcd` object will control it internally.



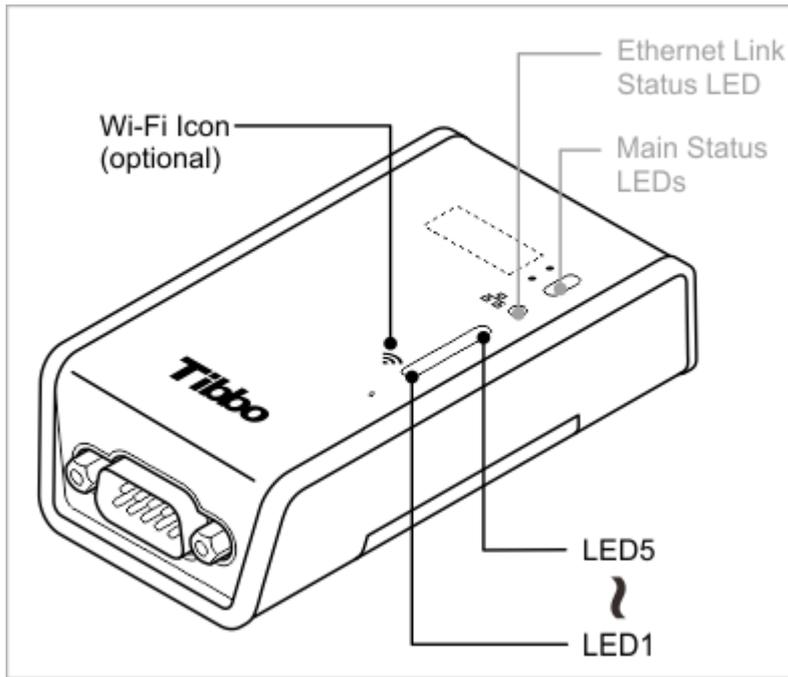
LED Bar (DS1101 and DS1102)

The DS1101 and DS1102 devices feature an LED bar comprising five blue LEDs. The bar can be used for signal strength indication. To turn an LED on, enable the corresponding I/O line (`io.enabled= 1- YES`) and set this line LOW (`io.state= 0- LOW`). Hint: these are properties of the I/O object (see "TIDE and Tibbo BASIC Manual").

DS1101/2 devices that ship with the [Wi-Fi option](#) installed will have a Wi-Fi icon next to the LED bar. Devices without the Wi-Fi interface, as well as devices where the [GA1000](#) add-on module wasn't installed by Tibbo will not have this icon.

Remaining three LEDs on the face of DS1101/2 devices are green and red status LEDs, and a yellow Ethernet link LED. These are standard [status LEDs](#).

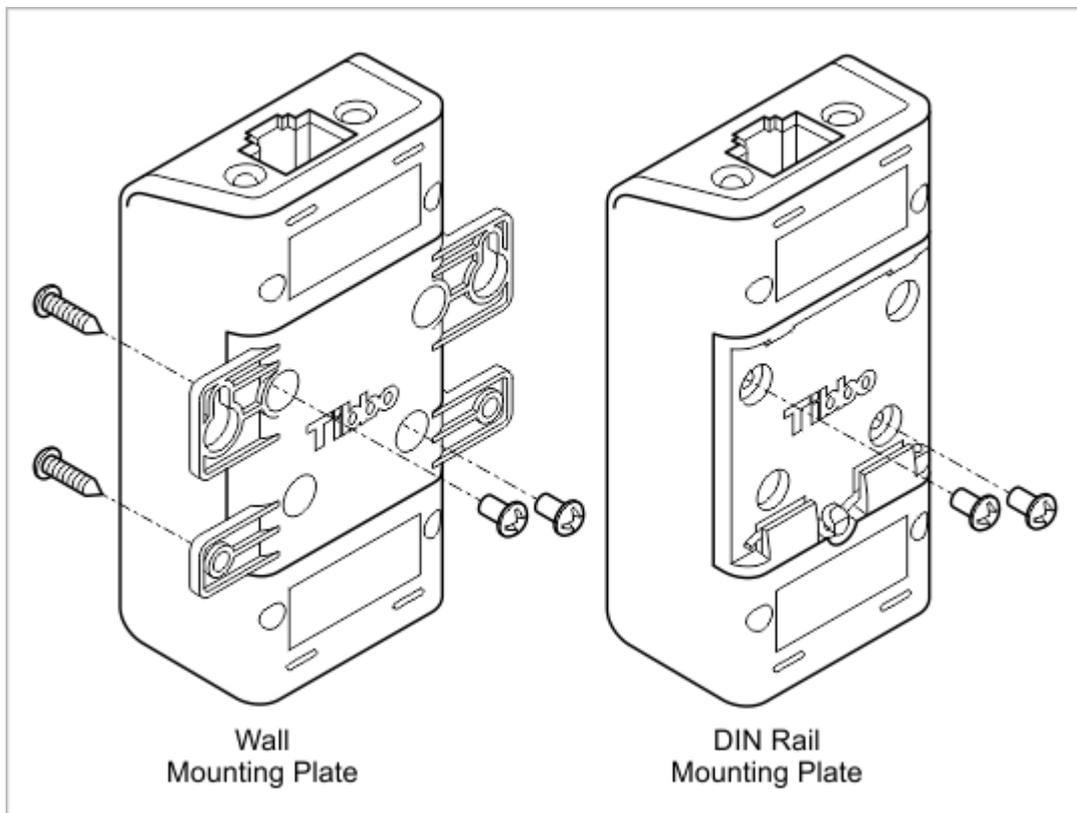
GPIO line	LED
PL_IO_NUM_23_SB5	LED5 (top, the strongest signal)
PL_IO_NUM_22_SB4	LED4
PL_IO_NUM_21_SB3	LED3
PL_IO_NUM_20_SB2	LED2
PL_IO_NUM_19_SB1	LED1 (bottom, "the lowest signal")



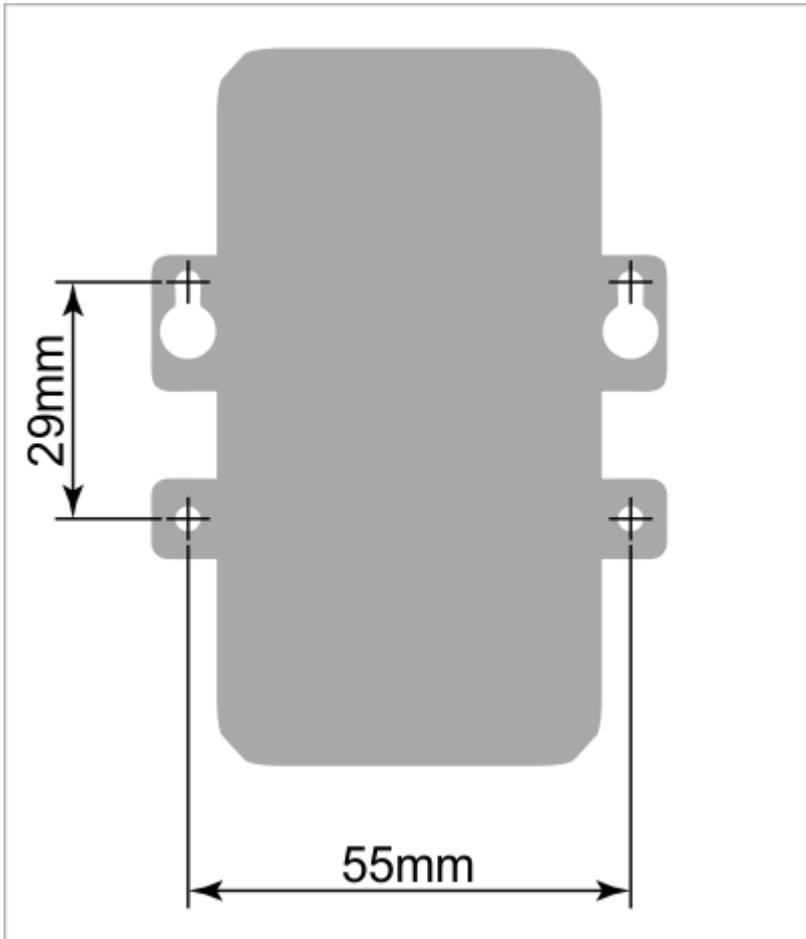
DIN Rail and Wall Mounting Plates

Every DS110x device is shipped with two mounting plates -- one for the installation on a DIN rail, and one for mounting on the wall.

Both plates are secured onto the device using two supplied screws.

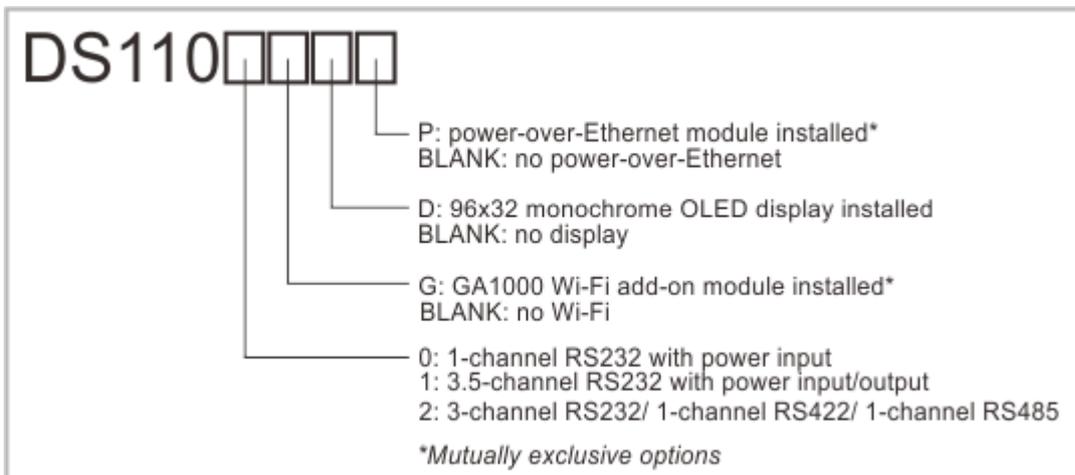


Wall mounting plate can be used to affix the DS110x to a wall in a semi-permanent or permanent manner. The diagram below shows important dimensions.



Ordering Info and Specifications

Device numbering scheme is as follows:



Visit our online store for the up-to-date list of accessories offered with DS110x devices.

Examples of valid model numbers

Model number	Description
DS1101GD	DS1101 device with the Wi-Fi add-on and OLED display
DS1102P	DS1102 device with the power-over-Ethernet module

Hardware specifications

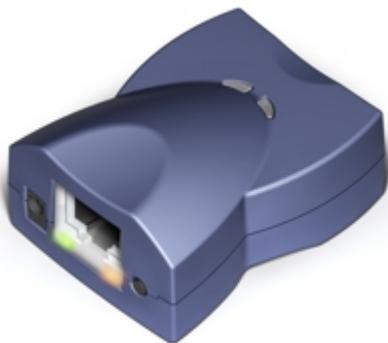
	DS1100	DS1101	DS1102
Device color			
Ethernet interface	10/100BaseT Ethernet, Auto-MDIX, magnetics not built-in		
Serial port	RS232 port on DB9M connector	RS232 port on DB9M connector	RS232/422/485 port on DB9M conn.
No of serial port channels	1 channel	3.5 channels	3 channels (RS232), 1 ch.(RS422/485)
Serial port lines	TX, RX, RTS, CTS, DTR, DSR	TX, RX, RTS, CTS, DTR, DSR, DCD	TX, RX, RTS, CTS, DTR, DSR (RS232) TX, RX, RTS, CTS (RS422) TX, RX half-duplex (RS485)
Maximum baudrate	Up to 115200bps	Up to 921600bps	
Flow and direction control	Optional RTS/CTS flow control		Opt. RTS/CTS flow control (232/422) Direction control (RS485)
Parity modes	None/even/odd/mark/space parity		
Bits/character	7/8 bits/character		
Power input/output on DB9	"12V" power input on pin 9 of DB9	"12V" power input and output on pin 9 of DB9 (software-controllable)	not provided
Flash memory	512KB for firmware and application storage. No flash disk functionality.	1024KB for firmware, application and data (flash disk)	

EEPROM	200 bytes	2048 bytes
LEDs	Red and green status LEDs Yellow Ethernet link LED	Red and green status LEDs Yellow Ethernet link LED Five blue LEDs (can be used for Wi-Fi signal strength indication)
Wi-Fi	no	optional 802.11b/g interface (GA1000)*
Display	no	optional 96x32 monochrome OLED
PoE	optional	optional*
Buzzer	no	yes
Processor	T2000	T1000
Operating frequency and PLL	80Mhz, no PLL	88MHz, software-controlled PLL
Firmware upgrades	Through the serial port or network (including cold upgrade firmware uploads through the network).	Through the serial port or network (no cold upgrades through the network).
Supply voltage	12VDC nominal (min. 9V, max. 18V)	
Operating temperature range	-5 ~ 70 degrees C	
Operating relative humidity	10 ~ 90%	
Mechanical dimensions	90x48x25mm	
Carton dimensions	137x99x70mm	

* *Wi-Fi and PoE options are mutually exclusive and cannot be installed together*

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DS1206



Introduction

The DS1206 is a miniature BASIC-programmable controller designed primarily for serial-over-IP and serial control applications.

The DS1206 features a multi-channel serial port. The device has a single DB9M connector and is priced as a single-port product, yet it packs four independent serial channels. Have no use for those DSR and DTR lines? Turn them into RX and TX of an additional serial channel. Don't want CTS and RTS either? That's one more channel! In total, there are 15 different configurations to choose from.

Another feature of the DS1206 is software-controlled power output on pin 9 of the RS232 port, so you can power an attached serial device directly through the DS1206. Alternatively, the DS1206 itself can be powered through this pin.

The DS1206 is fully supported by TIDE software and a dedicated DS1206 platform that covers all hardware facilities of the device (see "TIDE and Tibbo BASIC Manual"). This product ships preloaded with a fully functional serial-over-IP application. Written in Tibbo BASIC, the application is compatible with Tibbo Device Server Toolkit software, comes with full source codes, and can be modified by the user.

Hardware features

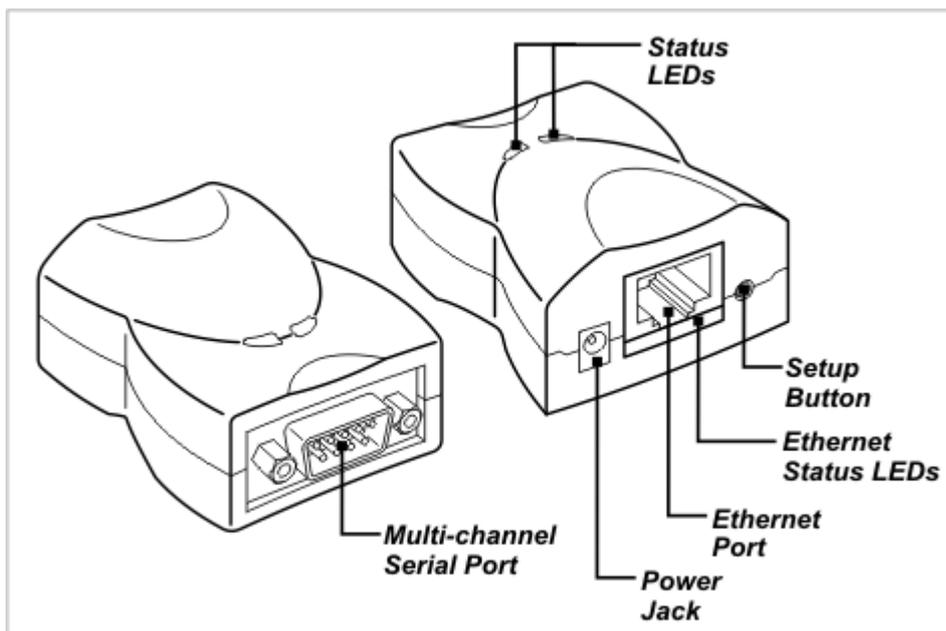
- Superior upgrade to the DS203 and [DS1202](#) devices.
- Based on high-performance purpose-built 88-MHz T1000 ASIC.
- 100BaseT auto-MDIX Ethernet port (automatic detection of "straight" and "cross" cables).
- Up to 3.5 serial channels on a single RS232 connector:
 - Baudrates of up to 921,600bps;
 - None/even/odd/mark/space parity modes;
 - 7/8 bits/character modes;
 - Optional flow control;
 - Flexible mapping with 15 different options, such as:
 - A single channel: RX, TX, CTS, RTS, DSR, and DTR lines;
 - 3.5 channels: RX, TX, RX2, TX2, RX3, TX3, and RX4 lines.
 - Optional "12V" power output on pin 9 of the DB9M connector (software-controllable);
 - Optional "12V" power input from pin 9 of the DB9M connector (instead of supplying power through the power jack).
- 512KB or 1024KB flash memory for firmware, application, and data storage.
- 2KB EEPROM for data storage.
- Four LEDs:
 - Green and red status LEDs on top of the device;
 - Link and speed Ethernet status LEDs on the RJ45 jack.
- Software-controlled onboard PLL to select the clock frequency of the device: 11.0592MHz with PLL off, 88.4736MHz with PLL on.
- Supply voltage range: 10-24V (12V nominal).
- Dimensions: 60x47x30mm.
- Firmware and Tibbo BASIC application are upgradeable through the serial port or network.

- Tibbo BASIC application can be debugged through the network and no additional debugging hardware, such as in-circuit emulator, is required.
- Also available as [DS1206N](#) (board without housing).

Programming features

- Variable Types: Byte, char, integer (word), short, dword, long, real, string, plus user-defined arrays and structures.
- Function Groups: string functions (27 in total!), date/time conversion functions (8), encryption/hash calculation functions (AES128, RC4, MD5, SHA-1), and more.
- Platform objects:
 - Sock — socket communications (up to 16 UDP, TCP, and HTTP sessions);
 - Net — controls the Ethernet port;
 - Ser — in charge of serial channels;
 - Ssi — implements up to four serial synchronous interface (SSI) channels, supports SPI, I2C, clock/data, etc.;
 - Io — handles I/O lines, ports, and interrupts;
 - Fd — manages flash memory file system and direct sector access;
 - Stor — provides access to the EEPROM;
 - Romfile — facilitates access to resource files (fixed data);
 - Pppoe — provides access to the Internet over an ADSL modem;
 - Ppp — provides access to the Internet over a serial modem (GPRS, POTS, etc.);
 - Pat — "plays" patterns on green and red status LEDs;
 - Button — monitors the setup button;
 - Sys — in charge of general device functionality.

DS1206 Connectors and Controls



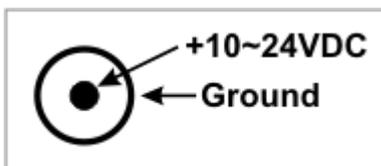
Click on one of the links provided below to learn more about the DS1206:

- [Power arrangement](#)
- [Ethernet port](#)
- [Multi-channel RS232 port](#)
- [Flash and EEPROM Memory](#)
- [Status LEDs](#)
- [Setup button](#)

Power Arrangement

Normally, the DS1206 is powered through its power jack.

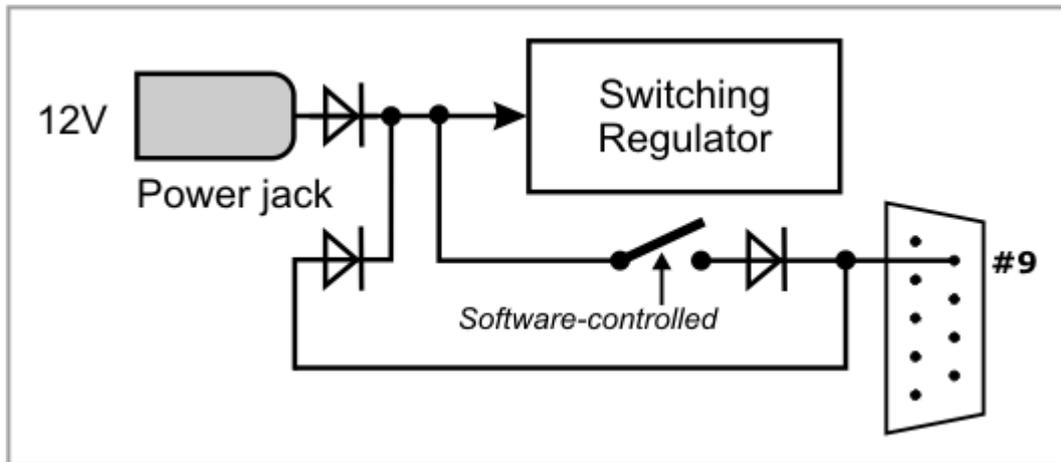
The power jack of the DS1206 accepts "small" power connectors with 3.5mm diameter. Use [APR-P0011](#), [APR-P0012](#), or [APR-P0013](#) power adaptor supplied by Tibbo or similar adaptor with 12V nominal output voltage. Adaptor current rating should be at least 500mA. On the power jack, the ground is "on the outside", as shown on the figure below.



Alternatively, the DS1206 can be powered through a pin 9 of the DB9M (RS232) connector. Two internal diodes combine power jack and pin 9 inputs into a single line, which goes to the internal regulator of the DS1206.

The pin 9 of the RS232 port can also be used to provide "12V" power to an attached serial device. Many small serial devices, such as barcode scanners, accept power on pin 9 of their DB9 connectors.

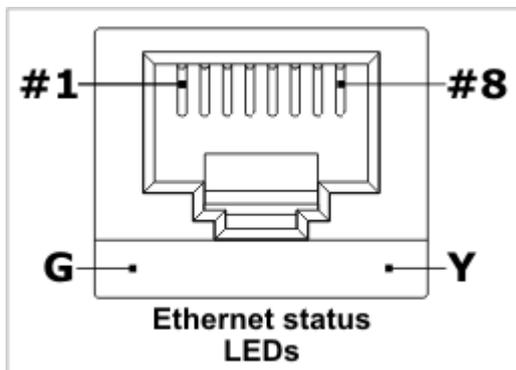
"12V" actually means "input power on the power jack", which is not necessarily stabilized. The power line of the jack passes through a software-controlled switch and is then connected to pin 9 of the RS232 port through a Schottky diode (shown on the diagram below). Therefore, the voltage on pin 9 is close to the input voltage on the power jack. Also, the maximum current an attached serial device can source depends on the maximum output power of the power adaptor (power supply) plugged into the power jack (minus the power consumed by the DS1206 itself).



Tibbo serial-over-IP application supplied with the DS1206 has a dedicated "PS" ("Power on pin 9") setting to control the power switch. To turn the power switch on from within your Tibbo BASIC application, enable (configure as output) line `PL_IO_NUM8_PWROUT` and then set this line to HIGH. Additional programming information can be found in "TIDE and Tibbo BASIC Manual" (see i.o object and DS1206 platform documentation).

If you want to use pin 9 of the DB9M connector to power an attached serial device, then you must power the DS1206 itself through the power jack. We know you understand this, but we still had to mention it.

Ethernet Port



Ethernet port of the DS1206 is of 10/100BaseT type.

The connector is of RJ45 type, pin assignment is as follows:

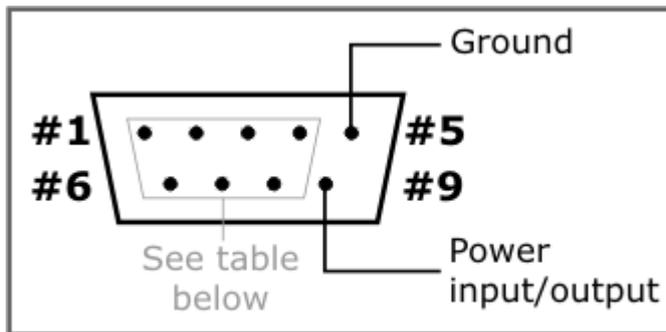
#1	TX+
#2	TX-
#3	RX+
#4	<No connection>
#5	<No connection>
#6	RX-
#7	<No connection>
#8	<No connection>

The Ethernet port of the DS1206 incorporates two [Ethernet status LEDs](#).

Multi-channel RS232 Port

The DS1206 features a multi-channel RS232 port. Internally, the DS1206 has four independent serial ports, and each of those ports can potentially have its own RX, TX, CTS, RTS, DSR, and DTR lines. Physically, the RS232 port of the DS1206 has three output lines and four input lines. Flexible mapping allows you to choose how these inputs and outputs will be used.

The serial-over-IP application supplied with the DS1206 defines 15 mapping options. These are presented in the table below:



Mapping option	Available signals	Pins on the DB9M connector							Missing line	
		#2	#3	#8	#7	#6	#4	#1		
Option 0	RX/TX/CTS/RTS/DSR/DTR	RX	TX	CTS	RTS	DSR	DT	RT	---	---
Option 1	RX/TX/CTS/RTS/DSR/DTR + RX/tx	RX	TX	CTS	RTS	DSR	DT	RT	RX4	tx4
Option 2	RX/TX/CTS/RTS + RX/TX + RX/tx	RX	TX	CTS	RTS	RX3	TX3	TX	RX4	tx4
Option 3	RX/TX/CTS/RTS + RX/TX/CTS/rts	RX	TX	CTS	RTS	RX3	TX3	CTS3	CTS	rts3
Option 4	RX/TX/CTS/RTS + RX/TX/DSR/dtr	RX	TX	CTS	RTS	RX3	TX3	DSR3	DSR	dtr3
Option 5	RX/TX/DSR/DTR + RX/TX + RX/tx	RX	TX	RX2	TX2	DSR	DT	RT	RX4	tx4
Option 6	RX/TX/DSR/DTR + RX/TX/CTS/rts	RX	TX	RX2	TX2	DSR	DT	CTS2	CTS	rts2
Option 7	RX/TX/DSR/DTR + RX/TX/DSR/dtr	RX	TX	RX2	TX2	DSR	DT	DSR2	DSR	dtr2
Option 8	RX/TX + RX/TX + RX/TX + RX/tx	RX	TX	RX2	TX2	RX3	TX3	TX	RX4	tx4
Option 9	RX/TX/CTS/rts + RX/TX + RX/TX	RX	TX	RX2	TX2	RX3	TX3	CTS	CTS	rts
Option 10	RX/TX/DSR/dtr + RX/TX + RX/TX	RX	TX	RX2	TX2	RX3	TX3	DSR	DSR	dtr
Option 11	RX/TX/CTS/RTS + RX/tx/CTS/RTS	RX	TX	CTS	RTS	CTS4	RTS4	RX4	RX4	tx4
Option 12	RX/TX/CTS/RTS + RX/tx/DSR/DTR	RX	TX	CTS	RTS	DSR4	DT	RX4	RX4	tx4

Option 13	RX/TX/DSR/DTR + RX/tx/CTS/RTS	RX	TX	CTS4	RTS4	DSR	DTR	RX4	tx4
Option 14	RX/TX/DSR/DTR + RX/tx/DSR/DTR	RX	TX	DSR4	DTR4	DSR	DTR	RX4	tx4

"Available signals" column shows a particular combination of I/O lines for each option. For example, option 0 defines the standard serial port arrangement with RX, TX, CTS, RTS, DSR, and DTR lines. Option 2 gives you one channel with RX, TX, CTS, and RTS lines, one more channel with just RX and TX lines, and yet another channel with a single RX line. The TX line is "missing" because, once again, there are only three outputs available. This is why this line is shown in grey lowercase (tx).

Notice that on the DS1206, pin 9 of the RS232 port can be used to power the DS1206 or provide power to an attached serial device. See [Power Arrangement](#) for details.

Additional programming information regarding serial ports can be found in "TIDE and Tibbo BASIC Manual".

Flash and EEPROM Memory

The DS1206 has 512KBytes or 1024KBytes of flash memory and 2KBytes of EEPROM memory.

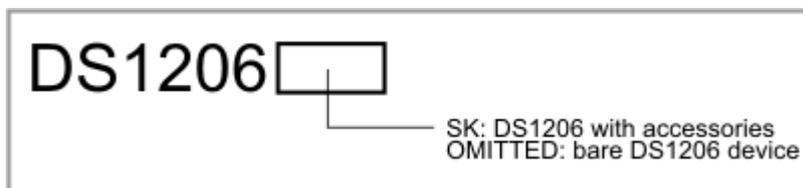
The first 64KBytes of flash memory are used to store the TiOS firmware. When you are performing a firmware upgrade it is this memory you are saving the firmware binary into.

The rest of this flash memory is available to your Tibbo BASIC application and its data. Whatever memory space is left after the compiled application is loaded can be used as a flash disk (see fd. object documentation in the "TIDE and Tibbo BASIC Manual").

The EEPROM is almost fully available to your application, save for a small 8-byte area called "special configuration area". The EEPROM is accessed through the stor. object (see "TIDE and Tibbo BASIC Manual").

Ordering Info and Specifications

Device numbering scheme is as follows:



Visit our online store for the up-to-date list of accessories offered with the DS1206.

Examples of valid model numbers

Model number	Description
--------------	-------------

DS1206-512K-00	DS1206 device with 512KBytes of flash memory
DS1206-1024K-00	DS1206 device with 1MB of flash memory

Hardware specifications

Ethernet interface	10/100BaseT Ethernet, Auto-MDIX
Serial ports	One RS232 port (DB9M) with 3.5 serial channels (four inputs and three outputs)
UART capabilities	Baudrates up to 921'600bps; none/even/odd/mark/space parity and 7/8 bits/character.
Clock frequency	11.0592MHz with PLL off 88.4736MHz with PLL on
Flash memory	512KBytes or 1024KBytes, entire memory minus 64KB is available to store Tibbo BASIC application and data
EEPROM memory	2048 bytes, 2040 bytes available to store application data
Supply voltage range	DC 10-24V (12V nominal)
Operating temperature	-5 to +70 degrees C
Operating relative humidity	10-90%
Mechanical dimensions	60x47x30mm
Carton dimensions	125x95x52mm
Gross weight	110g

All specifications are subject to change without notice and are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

DS1202



Introduction

The DS1202 is a miniature BASIC-programmable controller designed primarily for serial-over-IP and serial control applications.

The DS1202 features a multi-channel serial port. The device has a single DB9M connector and is priced as a single-port product, yet it packs four independent serial channels. Have no use for those DSR and DTR lines? Turn them into RX and TX of an additional serial channel. Don't want CTS and RTS either? That's one more channel! In total, there are 15 different configurations to choose from.

The DS1202 is fully supported by TIDE software and a dedicated DS1202 platform that covers all hardware facilities of the device (see "TIDE and Tibbo BASIC Manual"). This product ships preloaded with a fully functional serial-over-IP application. Written in Tibbo BASIC, the application is compatible with Tibbo Device Server Toolkit software, comes with full source codes, and can be modified by the user.

Hardware features

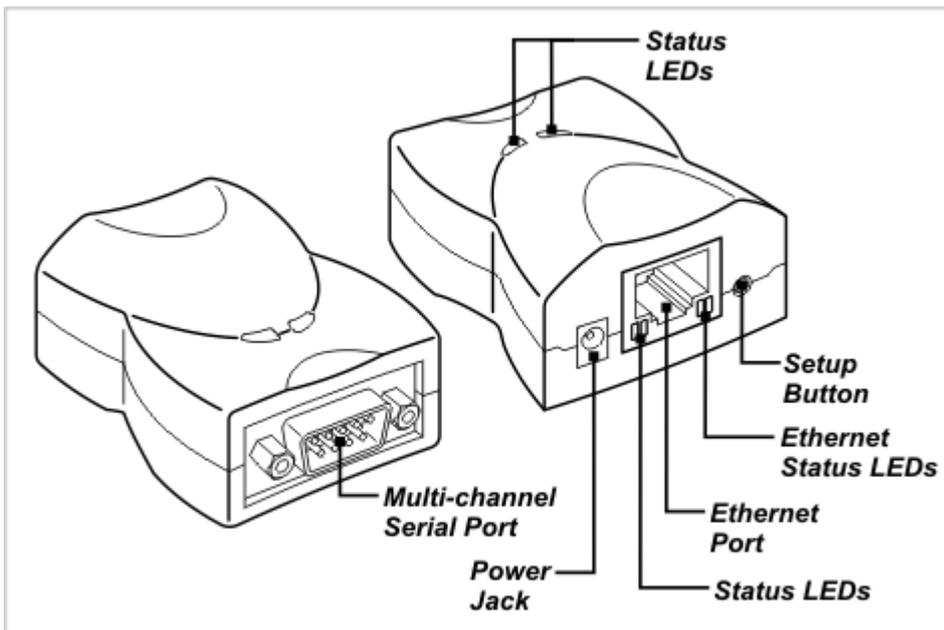
- Superior upgrade to the DS203 devices.
- Based on the [EM1202](#) BASIC-programmable embedded module.
- 100BaseT auto-MDIX Ethernet port (automatic detection of "straight" and "cross" cables).
- Up to 3.5 serial channels on a single RS232 connector:
 - Baudrates of up to 921,600bps;
 - None/even/odd/mark/space parity modes;
 - 7/8 bits/character modes;
 - Optional flow control;
 - Flexible mapping with 15 different options, such as:
 - A single channel: RX, TX, CTS, RTS, DSR, and DTR lines;
 - 3.5 channels: RX, TX, RX2, TX2, RX3, TX3, and RX4 lines.
- 1024KB flash memory for firmware, application, and data storage.
- 2KB EEPROM for data storage.
- Six LEDs:
 - Green and red status LEDs on top of the device;
 - Green and red status LEDs on the RJ45 jack;
 - Link and speed Ethernet status LEDs on the RJ45 jack.
- Software-controlled onboard PLL to select the clock frequency of the device: 11.0592MHz with PLL off, 88.4736MHz with PLL on.
- Supply voltage range: 10-24V (12V nominal).
- Dimensions: 60x47x30mm.
- Firmware and Tibbo BASIC application are upgradeable through the serial port or network.
- Tibbo BASIC application can be debugged through the network and no additional debugging hardware, such as in-circuit emulator, is required.
- Also available as a [EM1202EV](#) (board without housing).

Programming features

- Variable Types: Byte, char, integer (word), short, dword, long, real, string, plus user-defined arrays and structures.
- Function Groups: string functions (27 in total!), date/time conversion functions (8), encryption/hash calculation functions (AES128, RC4, MD5, SHA-1), and more.

- Platform objects:
 - Sock — socket communications (up to 16 UDP, TCP, and HTTP sessions);
 - Net — controls the Ethernet port;
 - Ser — in charge of serial channels;
 - Ssi — implements up to four serial synchronous interface (SSI) channels, supports SPI, I2C, clock/data, etc.;
 - Io — handles I/O lines, ports, and interrupts;
 - Fd — manages flash memory file system and direct sector access;
 - Stor — provides access to the EEPROM;
 - Romfile — facilitates access to resource files (fixed data);
 - Pppoe — provides access to the Internet over an ADSL modem;
 - Ppp — provides access to the Internet over a serial modem (GPRS, POTS, etc.);
 - Pat — "plays" patterns on green and red status LEDs;
 - Button — monitors the setup button;
 - Sys — in charge of general device functionality.

DS1202 Connectors and Controls

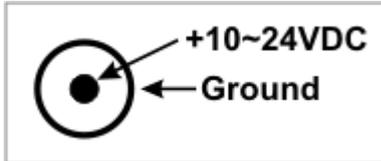


Click on one of the links provided below to learn more about the DS1202:

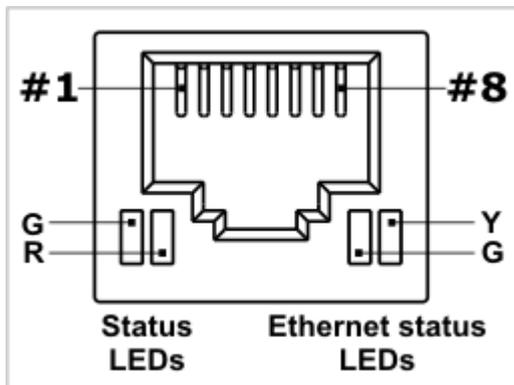
- [Power arrangement](#)
- [Ethernet port](#)
- [Multi-channel RS232 port](#)
- [Flash and EEPROM memory](#)
- [Status LEDs](#)
- [Setup button](#)

Power Arrangement

The DS1202 is powered through its power jack. The power jack of the DS1202 accepts "small" power connectors with 3.5mm diameter. Use [APR-P0011](#), [APR-P0012](#), or [APR-P0013](#) power adaptor supplied by Tibbo or similar adaptor with 12V nominal output voltage. Adaptor current rating should be at least 500mA. On the power jack, the ground is "on the outside", as shown on the figure below.



Ethernet Port



Ethernet port of the DS1202 is of 10/100BaseT type.

Connector is of RJ45 type, pin assignment is as follows:

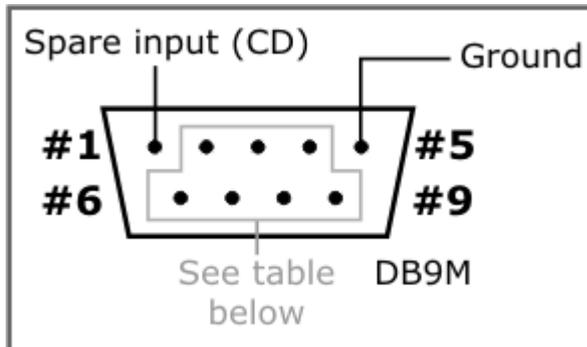
#1	TX+
#2	TX-
#3	RX+
#4	<No connection>
#5	<No connection>
#6	RX-
#7	<No connection>
#8	<No connection>

The Ethernet port of the DS1202 incorporates [four LEDs](#) (two status LEDs and two Ethernet status LEDs). The DS1202 has another pair of status LEDs located on top of the board. Two status LED pairs work in parallel.

Multi-Channel RS232 Port

The DS1202 has four serial ports internally. The RS232 port of the DS1202 implements three outputs, four inputs, and one "spare" input (CD). Each of the three outputs can be used as a TX line of a serial channel, or as a control output such as RTS or DTR. Input lines can be used as an RX line of a serial channel, or as a control input such as CTS or DSR. The spare input cannot work as an RX line. This input is not used by the serial-over-IP application supplied by Tibbo and will be largely omitted from further discussion. Your Tibbo BASIC application can always use this extra input if you require it.

With three outputs and four inputs, the DS1202 can be said to offer 3.5 serial "channels". We say "3.5 channels" and not "four channels" because one channel will only have RX line and no TX line (remember, there are four inputs but only three outputs).



Mapping option	Available signals	Pins on the DB9M connector of the DS1202-RS							Missing line	
		#2	#3	#8	#7	#6	#4	#9		
Option 0	RX/TX/CTS/RTS/DSR/DTR	RX	TX	CTS	RTS	DSR	DT	RT	---	---
Option 1	RX/TX/CTS/RTS/DSR/DTR + RX/tx	RX	TX	CTS	RTS	DSR	DT	RT	RX4	tx4
Option 2	RX/TX/CTS/RTS + RX/TX + RX/tx	RX	TX	CTS	RTS	RX3	TX3	TX4	RX4	tx4
Option 3	RX/TX/CTS/RTS + RX/TX/CTS/rts	RX	TX	CTS	RTS	RX3	TX3	CTS3	CTS3	rts3
Option 4	RX/TX/CTS/RTS + RX/TX/DSR/dtr	RX	TX	CTS	RTS	RX3	TX3	DSR3	DSR3	dtr3
Option 5	RX/TX/DSR/DTR + RX/TX + RX/tx	RX	TX	RX2	TX2	DSR	DT	RT	RX4	tx4
Option 6	RX/TX/DSR/DTR + RX/TX/CTS/rts	RX	TX	RX2	TX2	DSR	DT	CTS2	CTS2	rts2
Option 7	RX/TX/DSR/DTR + RX/TX/DSR/dtr	RX	TX	RX2	TX2	DSR	DT	DSR2	DSR2	dtr2
Option 8	RX/TX + RX/TX + RX/TX + RX/tx	RX	TX	RX2	TX2	RX3	TX3	RX4	RX4	tx4
Option 9	RX/TX/CTS/rts + RX/TX + RX/TX	RX	TX	RX2	TX2	RX3	TX3	CTS	CTS	rts
Option 10	RX/TX/DSR/dtr + RX/TX + RX/TX	RX	TX	RX2	TX2	RX3	TX3	DSR	DSR	dtr
Option 11	RX/TX/CTS/RTS + RX/tx/CTS/RTS	RX	TX	CTS	RTS	CTS4	RTS4	RX4	RX4	tx4
Option 12	RX/TX/CTS/RTS + RX/tx/DSR/DTR	RX	TX	CTS	RTS	DSR4	DT	RT	RX4	tx4
Option 13	RX/TX/DSR/DTR + RX/tx/CTS/RTS	RX	TX	CTS4	RTS4	DSR	DT	RT	RX4	tx4
Option 14	RX/TX/DSR/DTR + RX/tx/DSR/DTR	RX	TX	DSR4	DT	DSR	DT	RT	RX4	tx4

"Available signals" column shows a particular combination of I/O lines for each option. For example, option 0 defines the standard serial port arrangement with RX, TX, CTS, RTS, DSR, and DTR lines. Option 2 gives you one channel with RX, TX, CTS, and RTS lines, one more channel with just RX and TX lines, and yet another channel with a single RX line. The TX line is "missing" because, once again, there are only three outputs available. This is why this line is shown in grey lowercase (tx).

Flash and EEPROM Memory

The DS1202 has 1024KBytes of flash memory and 2KBytes of EEPROM memory.

The first 64KBytes of flash memory are used to store the TiOS firmware. When you are performing a firmware upgrade it is this memory you are saving the firmware binary into.

The rest of this flash memory is available to your Tibbo BASIC application and its data. Whatever memory space is left after the compiled application is loaded can be used as a flash disk (see fd. object documentation in the "TIDE and Tibbo BASIC Manual").

The EEPROM is almost fully available to your application, save for a small 8-byte area called "special configuration area". The EEPROM is accessed through the stor. object (see "TIDE and Tibbo BASIC Manual"). Details on the special configuration area are provided in the Platform-dependent Programming Information section inside the DS1202 and EM1202 platform documentation (same manual).

Ordering Info and Specifications

The DS1202 device is only available in a single configuration and can be order as "DS1202".

Hardware specifications

Ethernet interface	10/100BaseT Ethernet, Auto-MDIX
Serial ports	One RS232 port (DB9M) with 3.5 serial channels (four inputs and three outputs)
UART capabilities	Baudrates up to 921'600bps; none/even/odd/mark/space parity and 7/8 bits/character.
Clock frequency	11.0592MHz with PLL off 88.4736MHz with PLL on
Flash memory	1024KBytes, entire memory minus 64KB is available to store Tibbo BASIC application and data
EEPROM memory	2048 bytes, 2040 bytes available to store application data
Supply voltage range	DC 10-24V (12V nominal)
Operating temperature	-5 to +70 degrees C
Operating relative humidity	10-90%
Mechanical dimensions	60x47x30mm
Carton dimensions	125x95x52mm
Gross weight	110g

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DS10xx



The DS10xx is a family of BASIC-programmable industrial controllers.

The DS10xx is a universal platform that is well suited for a variety of control applications. The functionality of the device depends on a Tibbo BASIC application created (loaded) by the user.

All devices of the DS10xx family share a [number of common features](#).

Internally, each device contains two main boards: an [NB10x0](#) network board ("NB"), and an [IB100x](#) interface boards ("IB") that implements the I/O functionality of devices. These boards are interconnected by an [IC1000](#) cable. Some interface boards also carry a second "supplementary" board ("SB"). Additionally, there are two LED boards -- [LB1000](#) and [LB1001](#). The LB1000 is attached to the NB10x0, the LB1001 -- to the IB100x.

At the moment, the DS10xx family includes the following devices:

- [DS10x0](#) (4 RS232 ports);
- [DS10x2](#) (4 RS232/422/485 ports);
- [DS10x3](#) (4 isolated RS232/422/485 ports);
- [DS10x4](#) (8 analog inputs, 4 analog outputs, RS232/485 port, 2 relays);
- [DS10x5](#) (8 opto-isolated inputs, 6 relays, RS232/485 port);

If none of standard DS10xx devices suit your needs, you are welcome to create your very own controller with exactly the set of I/Os required for your project. You can also subcontract the design and manufacturing of your custom "IB" board to Tibbo.

When used with the included [waterproof cover](#), all devices of the DS10xx family are dust and water-proof to IP68.

Programming features

- Variable Types: Byte, char, integer (word), short, dword, long, real, string, plus user-defined arrays and structures.
- Function Groups: string functions (27 in total!), date/time conversion functions (8), encryption/hash calculation functions (AES128, RC4, MD5, SHA-1), and more.
- Platform objects:
 - Sock — socket communications (up to 16 UDP, TCP, and HTTP sessions);
 - Net — controls the Ethernet port;
 - Wln — handles the Wi-Fi interface (requires [GA1000](#) add-on module);
 - Ser — in charge of serial channels;
 - Ssi — implements up to four serial synchronous interface (SSI) channels, supports SPI, I2C, clock/data, etc.;
 - Io — handles I/O lines, ports, and interrupts;
 - Rtc — keeps track of date and time;
 - Fd — manages flash memory file system and direct sector access;
 - Stor — provides access to the EEPROM;
 - Romfile — facilitates access to resource files (fixed data);
 - Pppoe — provides access to the Internet over an ADSL modem;
 - Ppp — provides access to the Internet over a serial modem (GPRS, POTS, etc.);
 - Pat — "plays" patterns on green and red status LEDs;
 - Beep — generates buzzer patterns;
 - Button — monitors the setup button;
 - Sys — in charge of general device functionality.

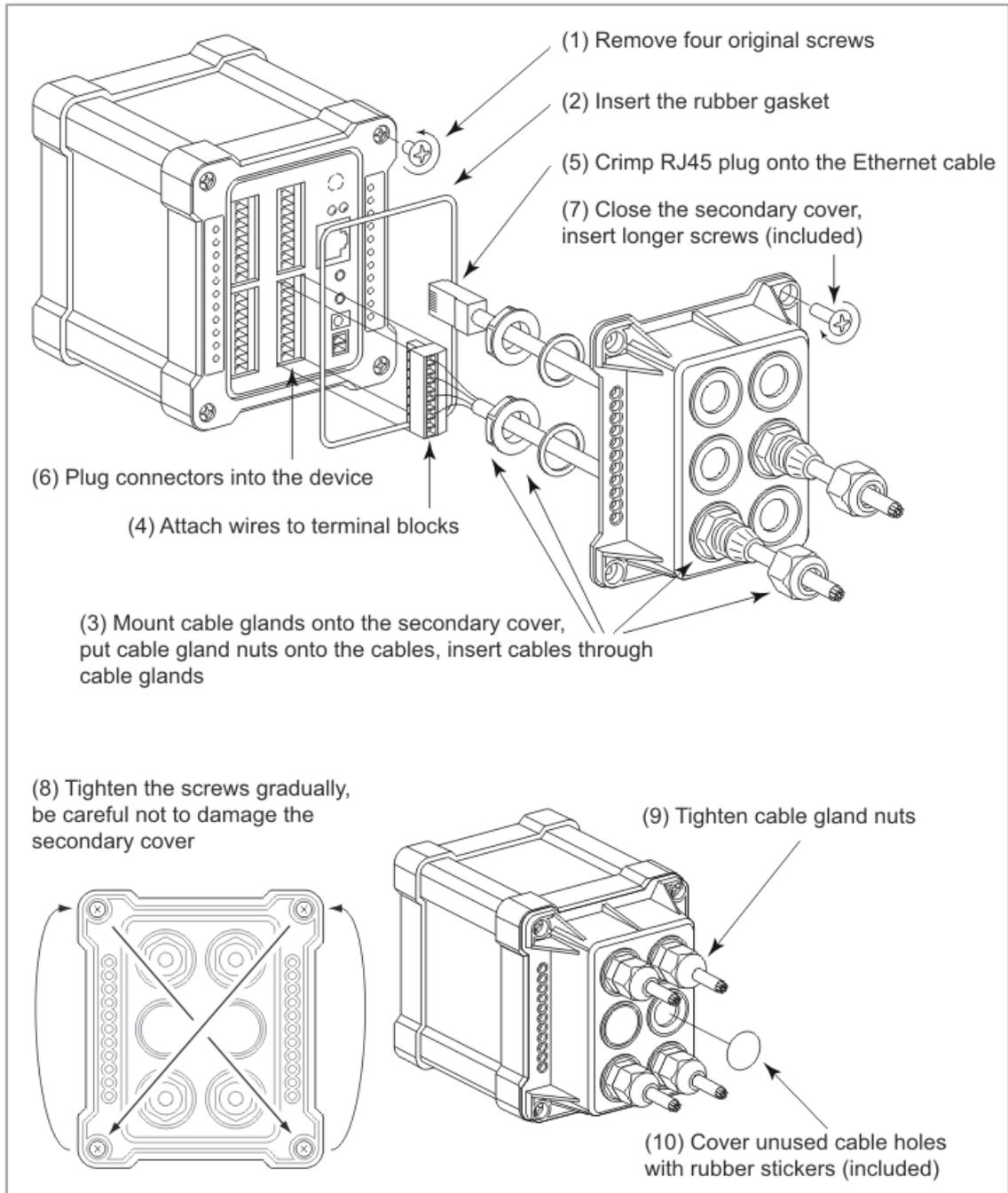
Common Features of the DS10xx Family

This section describes all common features of the DS10xx family:

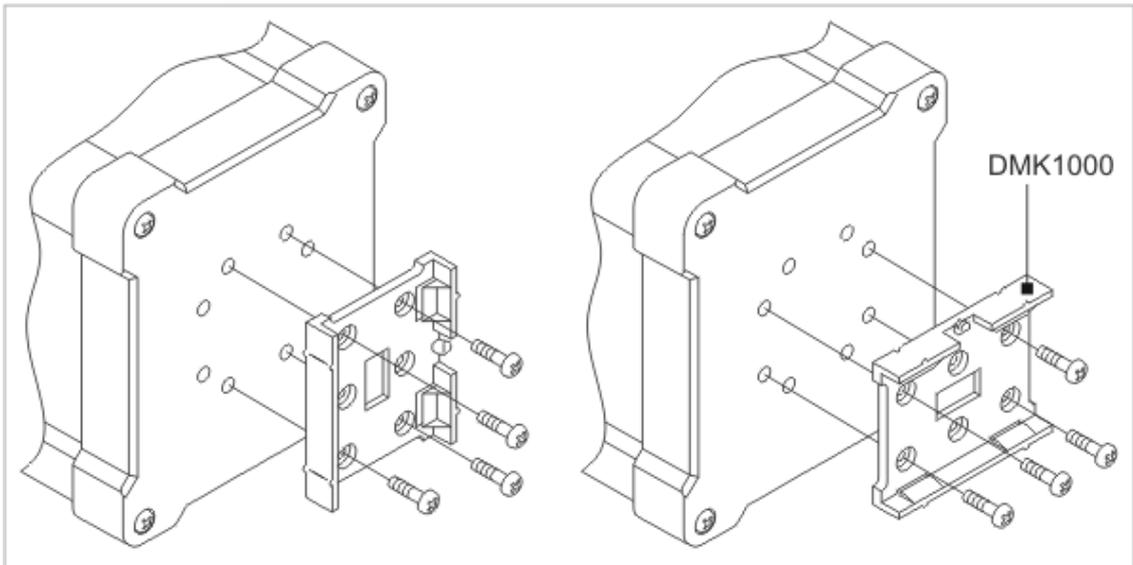
- [Secondary cover](#)
- [DIN rail mounting](#)

Secondary Cover

All DS10xx devices are dust- and water-proof to IP68 when used with the properly installed secondary cover. Diagram below shows the procedure of waterproofing any DS10xx device. Shown on the diagram are devices with terminal blocks ([DS1004](#), [DS1005](#)). Other devices in the DS10xx series have DB9 connectors (see [DS1000](#), [DS1002](#), [DS1003](#)). Tibbo offers a [TB1000](#) terminal block adaptor that "converts" DB9 connector into terminal blocks. The TB1000 is compatible with the secondary cover.

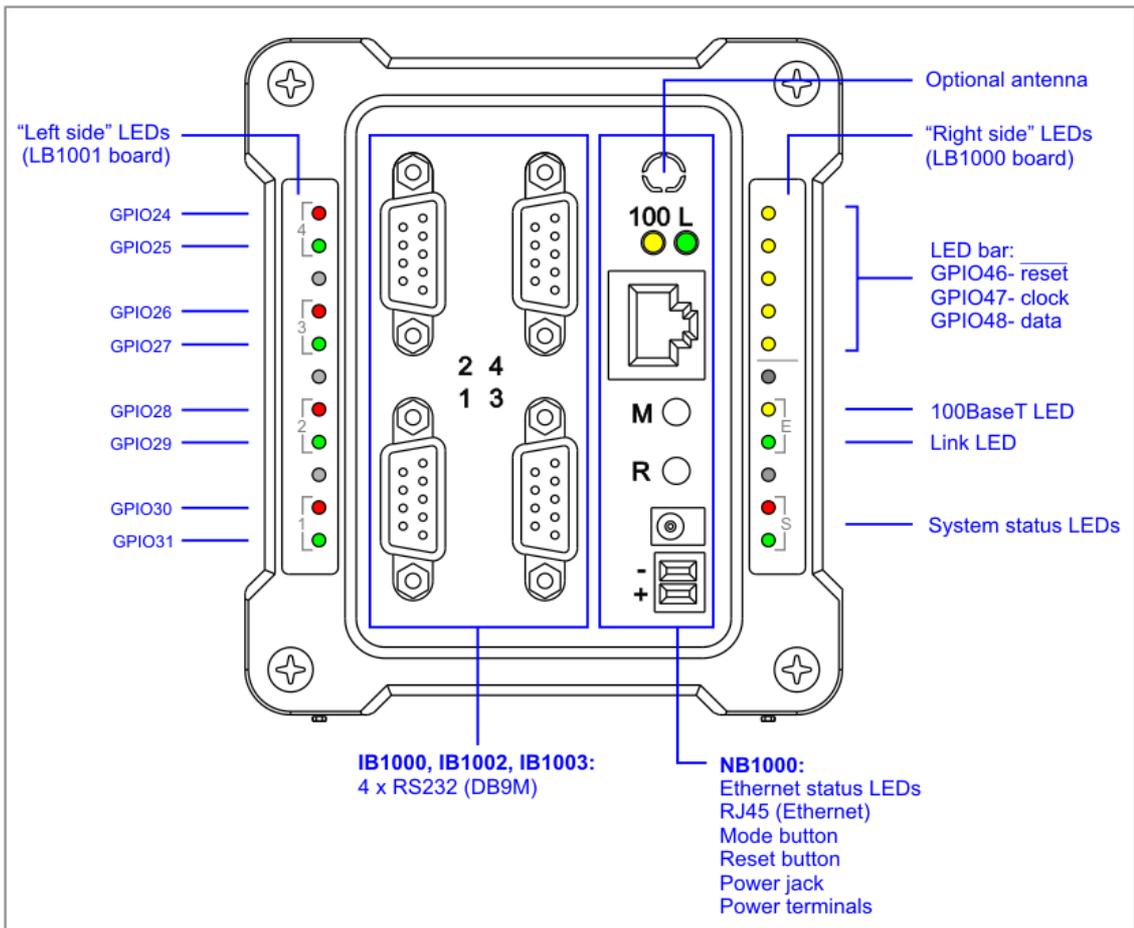


DIN Rail Mounting



All DS10xx devices are supplied with the DMK1000 DIN rail mounting kit. Mounting holes on the back of the device allow you to attach the DIN rail mounting bracket horizontally or vertically.

DS10x0, DS10x2, DS10x3 (4 Serial Ports)



The DS10x0, DS10x2, and DS10x3 BASIC-programmable controllers offer four serial

ports. DS1000, DS1002, and DS1003 are based on the [NB1000](#) network board (Ethernet interface only). DS1010, DS1012, and DS1013 are based on the [NB1010](#) network board (Ethernet + optional Wi-Fi + optional GPRS).



Read carefully the [explanation](#) about the type of antenna installed when the DS1010, DS1012, and DS1013 are ordered with Wi-Fi, GPRS, or Wi-Fi and GPRS options.

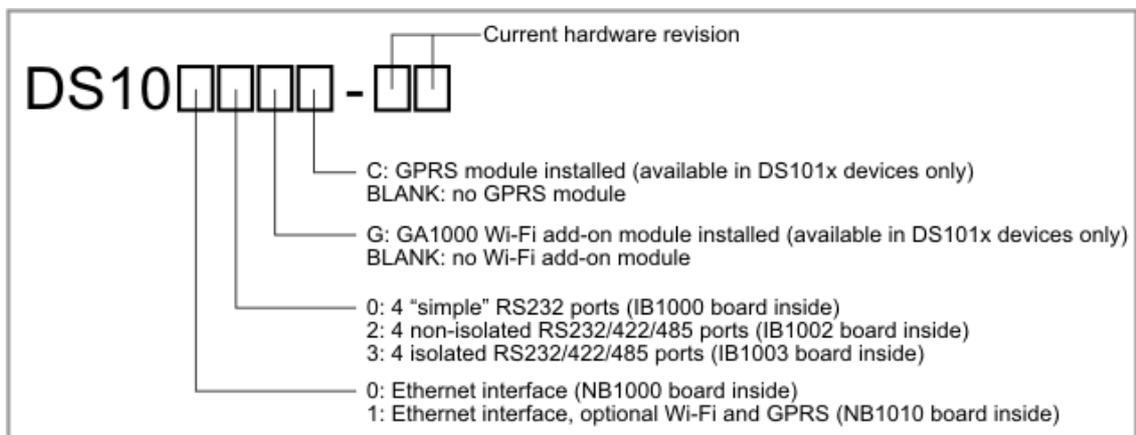
- The DS1000 and DS1010 have 4 "simple" RS232 serial ports (the [IB1000](#) interface board is used);
- The DS1002 and DS1012 have 4 non-isolated universal RS232/422/485 serial ports (the [IB1002](#) interface board is used);
- The DS1003 and DS1013 have 4 electrically isolated RS232/422/485 serial ports (the [IB1003](#) interface board is used);

Follow these quick links to often needed information:

- Right (network) side of the device:
 - [Power jack, terminals, and power regulator](#);
 - [Ethernet jack](#);
 - [Ethernet LEDs, M \(mode\) and R \(reset\) buttons](#);
 - ["Right side" LEDs](#);
 - [Buzzer control](#);
 - [Optional Wi-Fi interface](#) (DS101x devices only);
 - [Optional GPRS interface](#) (DS101x devices only).
- Left (interface) side of the device:
 - [Pin assignment](#) and [control](#) of serial ports;
 - ["Left side" LEDs](#).

Ordering Info and Specifications

Device numbering scheme is as follows:



DS101x devices without "G", "C", or "GC" options are not being offered by Tibbo. If you want to purchase Ethernet-only device (without any wireless options), then

order DS100x instead.

External Antenna

DS1010, DS1012, and DS1013 devices can be ordered with Wi-Fi, GPRS, or Wi-Fi and GPRS options. The Wi-Fi interface works better when equipped with an antenna. In the absence of Wi-Fi antenna, the Wi-Fi interface still works (relying on a small "chip" antenna on the [GA1000](#)), but the operating range is reduced. The GPRS interface can't work without the antenna at all. Therefore:

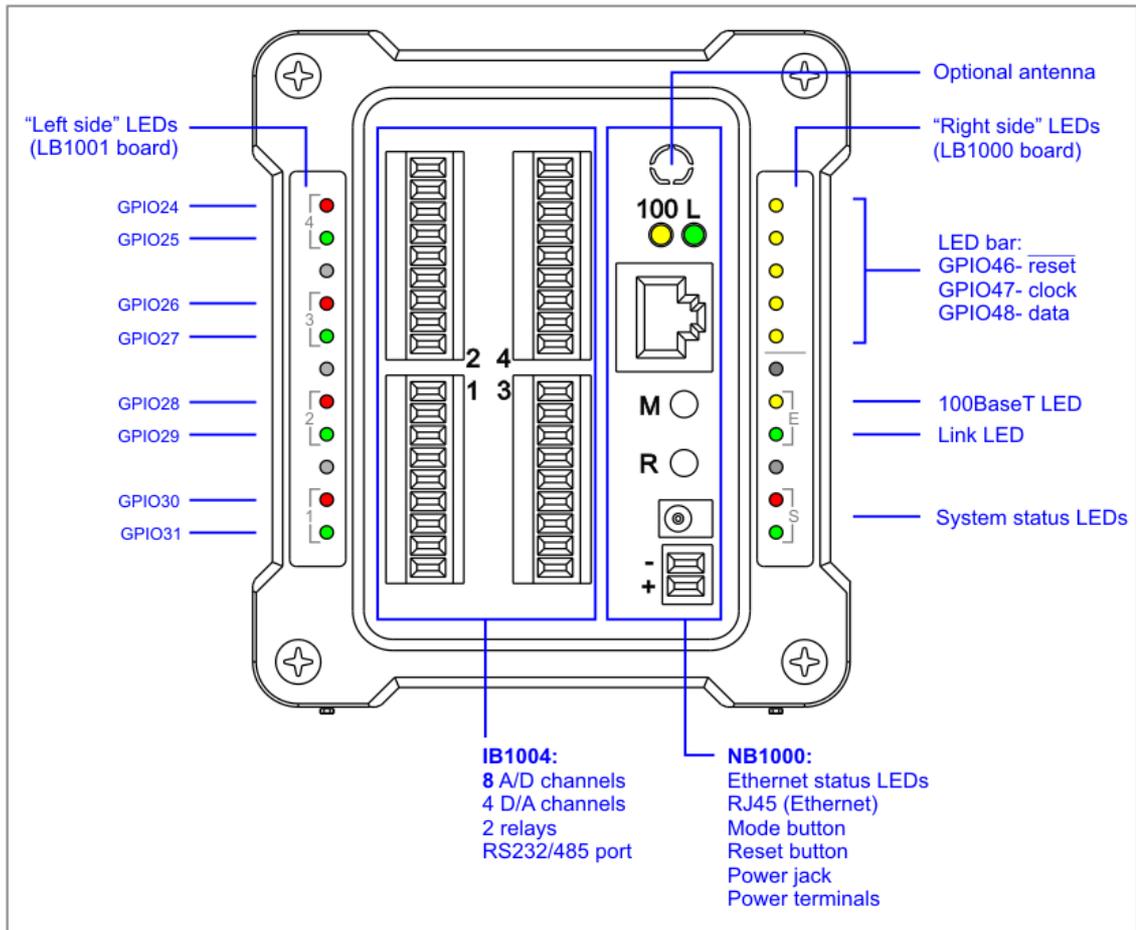
- DS1010G, DS1012G, and DS1013G devices (with Wi-Fi option) will be shipped with Wi-Fi antenna.
- DS1010C, DS1012C, and DS1013C devices (with GPRS option) will be shipped with GPRS antenna.
- DS1010GC, DS1012GC, and DS1013GC devices (with Wi-Fi and GPRS options) will be shipped with GPRS antenna. The Wi-Fi interface will rely on the internal "chip" antenna and, therefore, will have reduced range compared to DS1010G, DS1013G, and DS1013G devices.

Hardware specifications

Network side	DS1000, DS1002, and DS1003: NB1000 + LB1000 DS1010, DS1012, and DS1013: NB1000 + LB1000
Interface side	DS1000 and DS1010: IB1000 + LB1001 DS1002 and DS1012: IB1002 + LB1001 DS1003 and DS1013: IB1003 + LB1001
Supply voltage range	DC 10-18VDC (12VDC nominal)
Operating temperature	-30 to +80 degrees C
Operating relative humidity	10-90%
Mechanical dimensions	91x104x99mm
Carton dimensions	203x160x110mm

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DS10x4 (Analog I/O)



The DS10x4 BASIC-programmable controllers feature eight A/D inputs, four D/A outputs with both voltage and current outputs, two low-power relays, and one RS232/485 port. The DS1004 is based on the [NB1000](#) network board (Ethernet interface only), and the DS1014 is based on the [NB1010](#) network board (Ethernet + optional Wi-Fi + optional GPRS).



Read carefully the [explanation](#) about the type of antenna installed when the DS1014 is ordered with Wi-Fi, GPRS, or Wi-Fi and GPRS options.

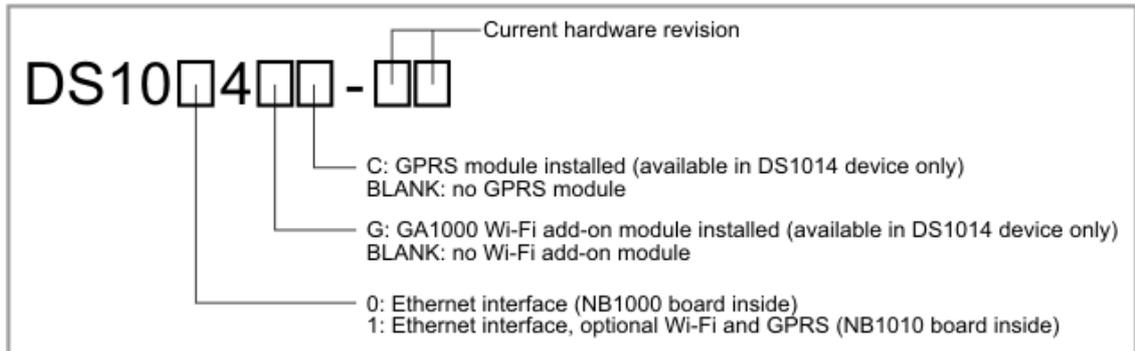
Follow these quick links to often needed information:

- Right (network) side of the device:
 - [Power jack, terminals, and power regulator](#);
 - [Ethernet jack](#);
 - [Ethernet LEDs, M \(mode\) and R \(reset\) buttons](#);
 - ["Right side" LEDs](#);
 - [Buzzer control](#);
 - [Optional Wi-Fi interface](#) (DS1014 devices only);
 - [Optional GPRS interface](#) (DS1014 devices only).
- Left (interface) side of the device:
 - [Terminal blocks](#) and [control lines](#);

- [A/D converter](#);
- [D/A converter](#);
- [Relays](#);
- [RS232/485 port](#);
- ["Left side" LEDs](#).

Ordering Info and Specifications

Device numbering scheme is as follows:



DS1014 devices without "G", "C", or "GC" options are not being offered by Tibbo. If you want to purchase Ethernet-only device (without any wireless options), then order DS1004 instead.

External Antenna

The DS1014 can be ordered with Wi-Fi, GPRS, or Wi-Fi and GPRS options. The Wi-Fi interface works better when equipped with an antenna. In the absence of Wi-Fi antenna, the Wi-Fi interface still works (relying on a small "chip" antenna on the [GA1000](#)), but the operating range is reduced. The GPRS interface can't work without the antenna at all. Therefore:

- The DS1014G device (with Wi-Fi option) will be shipped with Wi-Fi antenna.
- The DS1014C device (with GPRS option) will be shipped with GPRS antenna.
- The DS1014GC device (with Wi-Fi and GPRS options) will be shipped with GPRS antenna. The Wi-Fi interface will rely on the internal "chip" antenna and, therefore, will have reduced range compared to the DS1014G.

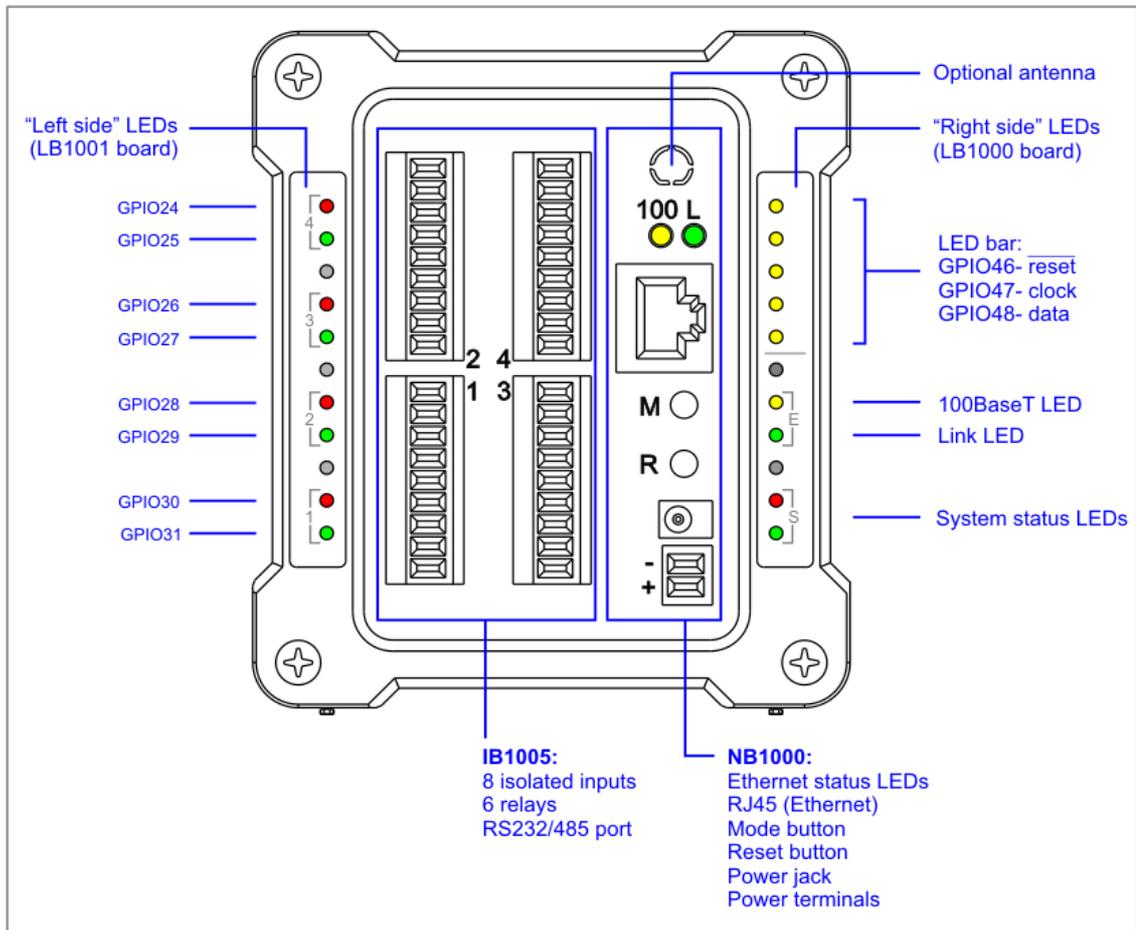
Hardware specifications

Network side	DS1004: NB1000 + LB1000 DS1014: NB1000 + LB1000
Interface side	IB1004 + SB1004 + LB1001
Supply voltage range	DC 10-18VDC (12VDC nominal)
Operating temperature	-30 to +80 degrees C
Operating relative humidity	10-90%
Mechanical dimensions	91x104x99mm
Carton dimensions	203x160x110mm

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DS10x5 (Digital I/O)



The DS10x5 BASIC-programmable controllers feature eight opto-isolated digital inputs, six high-power relays, and one RS232/485 port. The DS1005 is based on the [NB1000](#) network board (Ethernet interface only), and the DS1015 is based on the [NB1010](#) network board (Ethernet + optional Wi-Fi + optional GPRS).



Read carefully the [explanation](#) about the type of antenna installed when the DS1015 is ordered with Wi-Fi, GPRS, or Wi-Fi and GPRS options.

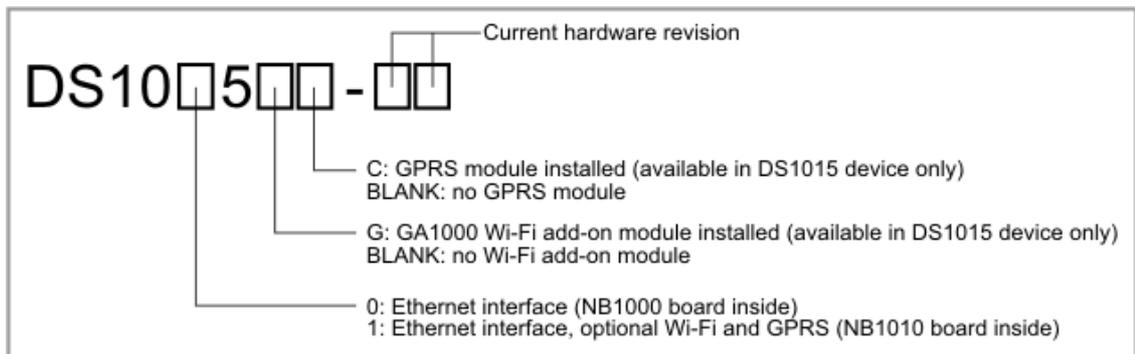
Follow these quick links to often needed information:

- Right (network) side of the device:
 - [Power jack, terminals, and power regulator](#);
 - [Ethernet jack](#);
 - [Ethernet LEDs, M \(mode\) and R \(reset\) buttons](#);
 - ["Right side" LEDs](#);
 - [Buzzer control](#);
 - [Optional Wi-Fi interface](#) (DS1015 devices only);

- [Optional GPRS interface](#) (DS1015 devices only).
- Left (interface) side of the device:
 - [Terminal blocks](#) and [control lines](#);
 - [Opto-isolated inputs](#);
 - [Relays](#);
 - [RS232/485 port](#);
 - ["Left side" LEDs](#).

Ordering Info and Specifications

Device numbering scheme is as follows:



DS1015 devices without "G", "C", or "GC" options are not being offered by Tibbo. If you want to purchase Ethernet-only device (without any wireless options), then order DS1005 instead.

External Antenna

The DS1015 can be ordered with Wi-Fi, GPRS, or Wi-Fi and GPRS options. The Wi-Fi interface works better when equipped with an antenna. In the absence of Wi-Fi antenna, the Wi-Fi interface still works (relying on a small "chip" antenna on the [GA1000](#)), but the operating range is reduced. The GPRS interface can't work without the antenna at all. Therefore:

- The DS1015G device (with Wi-Fi option) will be shipped with Wi-Fi antenna.
- The DS1015C device (with GPRS option) will be shipped with GPRS antenna.
- The DS1015GC device (with Wi-Fi and GPRS options) will be shipped with GPRS antenna. The Wi-Fi interface will rely on the internal "chip" antenna and, therefore, will have reduced range compared to the DS1015G.

Hardware specifications

Network side	DS1005: NB1000 + LB1000 DS1015: NB1000 + LB1000
Interface side	IB1005 + SB1005 + LB1001
Supply voltage range	DC 10-18VDC (12VDC nominal)
Operating temperature	-30 to +80 degrees C
Operating relative humidity	10-90%
Mechanical dimensions	91x104x99mm

Carton dimensions	203x160x110mm
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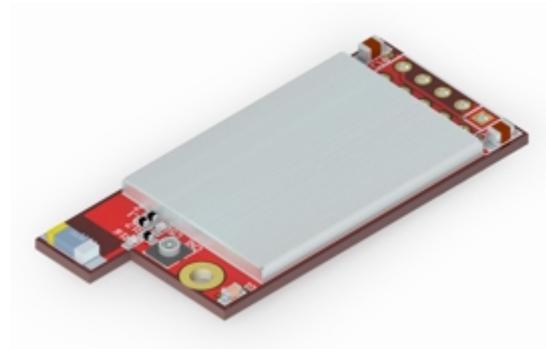
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Companion Products

The following companion products are currently being offered by Tibbo:

- [GA1000](#) (Wi-Fi add-on module)
- [RJ203](#) (jack/magnetics module)

GA1000



Introduction

The GA1000 Wi-Fi add-on module further expands the scope of potential applications for Tibbo BASIC-programmable modules by adding 802.11b/g communications capability to the already powerful hardware mix. The GA1000 can be used with these Tibbo devices: [EM1000](#), [EM1202](#), [EM1206](#), [EM500](#).

The module utilizes an [SPI interface](#) and only requires [five GPIOs](#) to control. This can be reduced to four if two NAND gates are used to generate reset signal. On the EM500, the number is even down to three lines! For more information, see [Connecting GA1000 to Tibbo Devices](#).

The GA1000 is fully supported by TIDE software (see "TIDE and Tibbo BASIC Manual", wln. object). For convenient testing and evaluation Tibbo offers [EM1206EV](#), [EM1000TEV](#) and [EM1000EV](#) development systems.

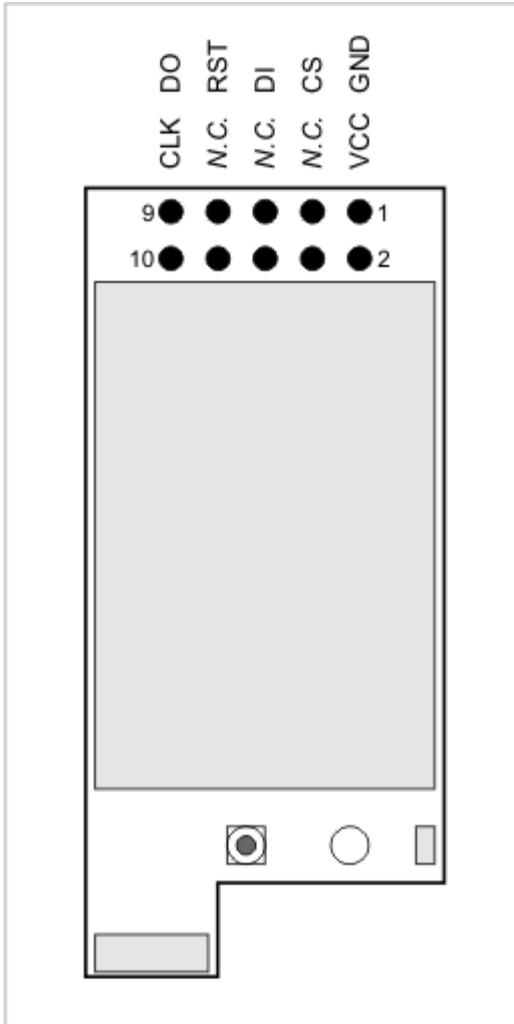
Please note that the GA1000 is a slave device and cannot be used on its own. This add-on will only work together a BASIC-programmable Tibbo module.

Hardware features

- Superior upgrade to the now obsolete WA1000 module.
- Implements 802.11b/g Wi-Fi standard.
- Compatible with [EM1000](#), [EM1202](#), [EM1206](#), and [EM500](#) modules.
- Requires [3-5 GPIO lines](#) to control.
- Chip antenna onboard, coaxial connector for external antenna.
- [Red status LED](#) for scan/link indication.
- Max. power: 280 mA (max) @ 3.3V.

- Dimensions: 42.0x19.0x6.7mm.

I/O Pin Assignment and Pin Functions



I/O pin assignment

Pin #	Function	Description
1	GND	System ground.
2	VCC	Positive power input, 3.3V nominal, +/- 5%.
3	CS	Chip select, active LOW (input*).
4	N.C.	<i>No connection.</i>
5	DI	SPI port, data in (input*, must be connected to DO of Tibbo module).
6	N.C.	<i>No connection.</i>
7	RST	Reset, active LOW (input*).
8	N.C.	<i>No connection.</i>
9	DO	SPI port, data out (output*, must be connected to DI of

		Tibbo module).
10	CLK	SPI port, clock (input*).

* Of the GA1000.

Connecting GA1000 to Tibbo Devices

GA1000 interface

The GA1000 communicates with Tibbo devices through an [SPI interface](#). Your device will control the GA1000 through five GPIO lines:

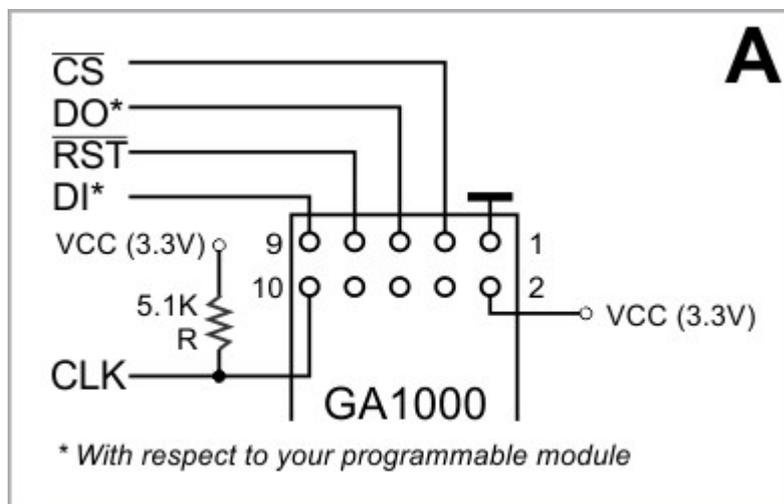
- **CS** -- SPI bus, chip select (active low);
- **CLK** -- SPI bus, clock;
- **DI** -- SPI bus, data in (must be connected to the GA1000's DO);
- **DO** -- SPI bus, data out (must be connected to the GA1000's DI);
- **RST** -- reset (active low). This line can be eliminated -- see below for details.

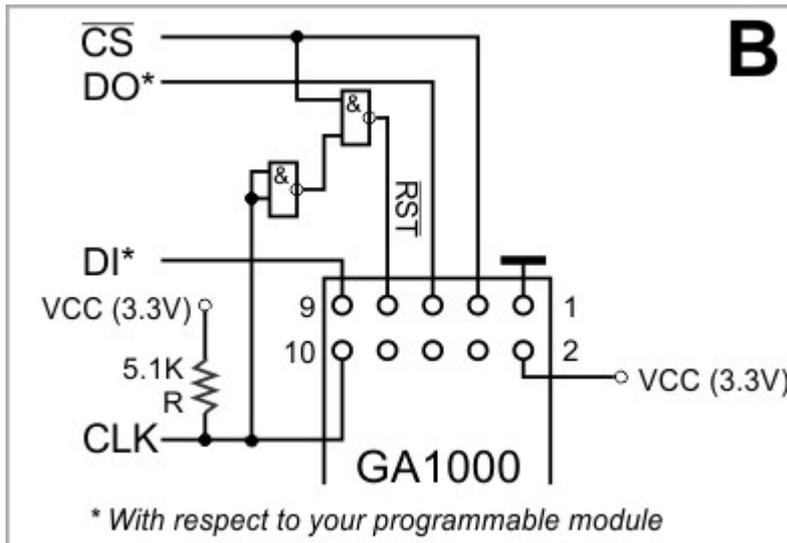
- On the [EM1000](#), [EM1202](#), and [EM1206](#), do not forget to configure CS, CLK, DO, and RST as outputs. DI must be configured as input. The wln. object won't do this automatically. GPIO configuration is not necessary on the [EM500](#), whose lines are bidirectional.

Providing hardware reset

The wln. object directly controls CS, CLK, DI, and DO lines. Your application, however, must take care of the proper hardware reset for the GA1000. There are two methods for doing this:

- Use a dedicated GPIO line to act as the RST line of the GA1000 interface (shown on diagram A below).
- Use 2 NAND gates to combine CS and CLK signals and produce the reset signal for the GA1000 (shown on diagram B). This approach takes advantage of the fact that during SPI communications, CLK line will never be LOW while the CS line is HIGH. Schematic diagram on figure B generates reset when CS=HIGH and CLK=LOW. This way you save one GPIO line of your programmable module.

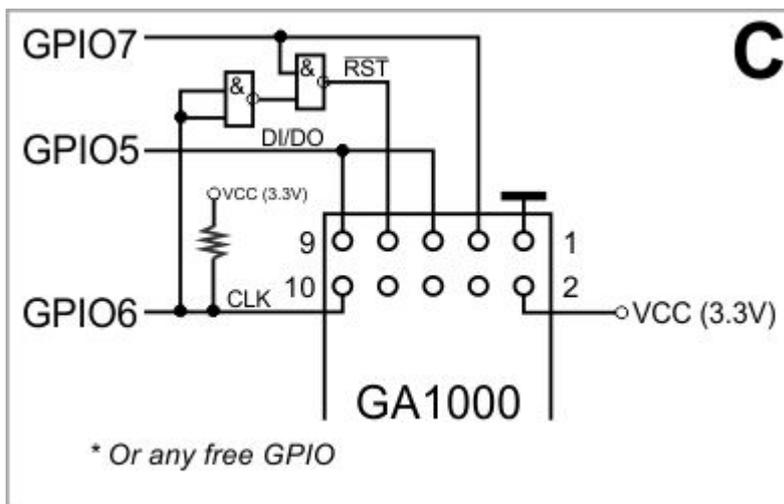




Tibbo devices differ in whether the CS, CLK, DI, and DO lines are remappable. On the [EM1000](#), [EM1202](#), and [EM1206](#), you can choose any set of GPIOs to control the GA1000. On the [EM500](#) where remapping isn't provided, you just have to use "prescribed" GPIO lines.

Special case -- the EM500

Diagram C shows the recommended way of connecting the GA1000 to the [EM500](#) module. GPIO lines are a precious commodity on the EM500 -- there are only eight of them available. As seen on the diagram C, you can get away with using only three lines to control the GA1000 (against the standard five lines). One line is saved by producing the reset out of CS and CLK lines. The second line is saved because EM500's bidirectional GPIOs allow interconnecting DI and DO. The EM500 does not allow remapping of GA1000 lines, so GPIO line assignment shown below cannot be changed.



Status LED

The GA1000 has a single red status LED:

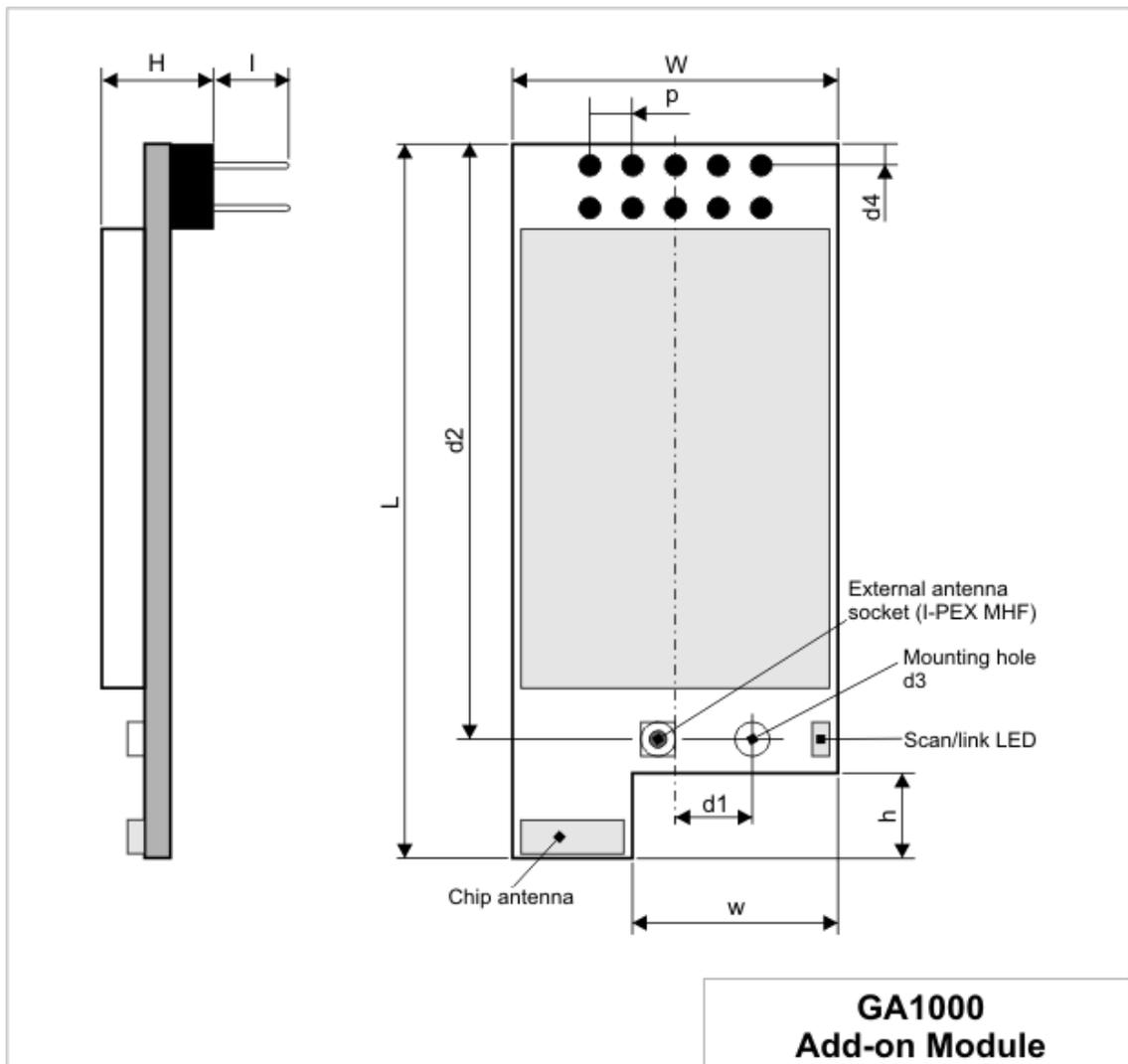
- During scanning (see `wln.scan*`), the LED blinks.
- When the GA1000 is associated with an access point (see `wln.associate*`), the

LED is ON.

- When the GA1000 is in ad-hoc mode and has another peer connected to it, the LED is ON as well.
- In all other cases, the LED is off.

*See "TIDE and Tibbo BASIC Manual", .wln object documentation.

Mechanical Dimensions



L	Max.	42.1	Module length.
W	Max.	19.1	Module width.
H	Max.	6.7	Module height.
I	Min.	4.0	Pin length.
w	Min	11.7	Horizontal cutout dimension.
h	Min.	4.5	Vertical cutout dimension.
d1	Aver	4.5	Horizontal distance from the centerline of the module to the center of the mounting hole.
d	Aver	35.0	Vertical distance from the edge of the board to the center

2	.		of the mounting hole.
d 3	Min.	2.1	Mounting hole diameter
d 4	Aver .	2.5	Vertical distance from the edge of the board to the center of the first row of pins of the connector
p	Aver .	2.54	Pin pitch

Dimensions are for reference only. Tibbo assumes no responsibility for any errors which may appear in this Manual, and does not make any commitment to update the information contained herein.

Ordering Info and Specifications

The GA1000 device is only available in a single configuration and can be order as "GA1000".

A set consisting of the [EM1000](#) and GA1000 modules can also be ordered using the "EM1000G" ordering code (see [Specifications and Ordering Info](#) for the EM1000). The GA1000 also works with [EM1202](#), [EM1206](#), and [EM500](#) devices.

Specifications

Wireless interface	802.11b/g
Interface type	SPI
Nominal power supply voltage (VCC pin)	DC 3.3V, +/- 5%
Operating current (VCC pin)	Post-reset, before boot: ~65mA; Fully functional, no data transmission: ~200mA; During data transmission: ~280mA.
Operating temperature	-20 to +70 degrees C
Operating relative humidity	10-90%
Mechanical dimensions (excl. leads)	42x19x6.7mm
Packaging	Tray, 30 modules/tray.

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RJ203 Jack/Magnetics Module

Patent pending



The RJ203 is an "Ethernet front-end" module that contains 10/100BaseT Ethernet magnetics and a standard RJ45 jack. Module's magnetics are designed to work with Davicom's DM9000B Ethernet controller.

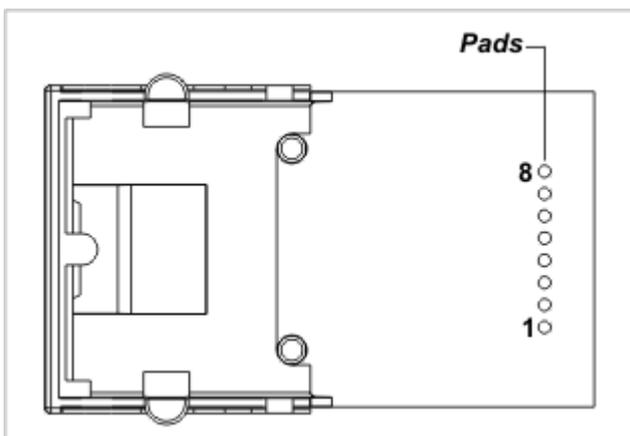
Unique patent-pending design of the module minimizes module's footprint and allows you to put other components required on your host board under the RJ203, thus saving valuable host board space. Moreover, translucent housing of the RJ203's face enables you to place status LEDs directly on the host board and have these LEDs visible through the front face of the RJ203.

There are two ways in which you can utilize the RJ203 in your design:

- You can [interface](#) the RJ203 to the DM9000B IC located, together with the CPU and other necessary components, directly on your host PCB.
- Alternatively, you can use the RJ203 [in combination](#) with the EM203 Ethernet-to-serial module (documented in the "Serial-over-IP Solutions Manual") or [EM1206](#) BASIC-programmable Ethernet module. These modules fit right "under" the RJ203, thus taking (virtually) no additional space on the host PCB.

Interface Pads

The RJ203 has a single row of interface pins.



#1	RX+	Output	Ethernet port, positive line of the differential input signal pair
#2	RX-	Output	Ethernet port, negative line of the differential input signal pair
#3	AVCC	Input	"Clean" 1.8V power output for magnetics circuitry
#4	---	---	---
#5	---	---	---

#6	GND		Ground
#7	TX+	Input	Ethernet port, positive line of the differential output signal pair
#8	TX-	Input	Ethernet port, negative line of the differential output signal pair

Interfacing the RJ203 to the DM9000B

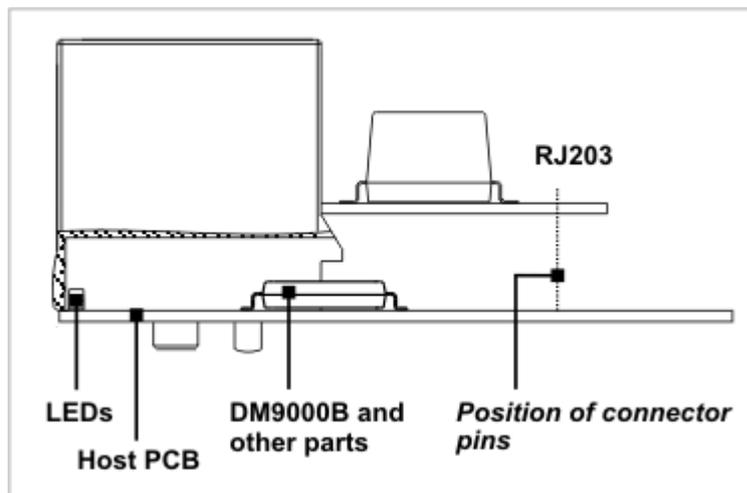
The RJ203 module interfaces directly to the DAVICOM's DM9000B Ethernet controller. The following table details the interconnection between the DM9000A and the [interface pads](#) of the RJ203:

DM9000B	RJ203
RX+ (#3)	RX+ (#1)
RX- (#4)	RX- (#2)
TX+ (#7)	TX+ (#7)
TX- (#8)	TX- (#8)
RXVDD (#2), TXVDD (#9)	AVCC (#3)

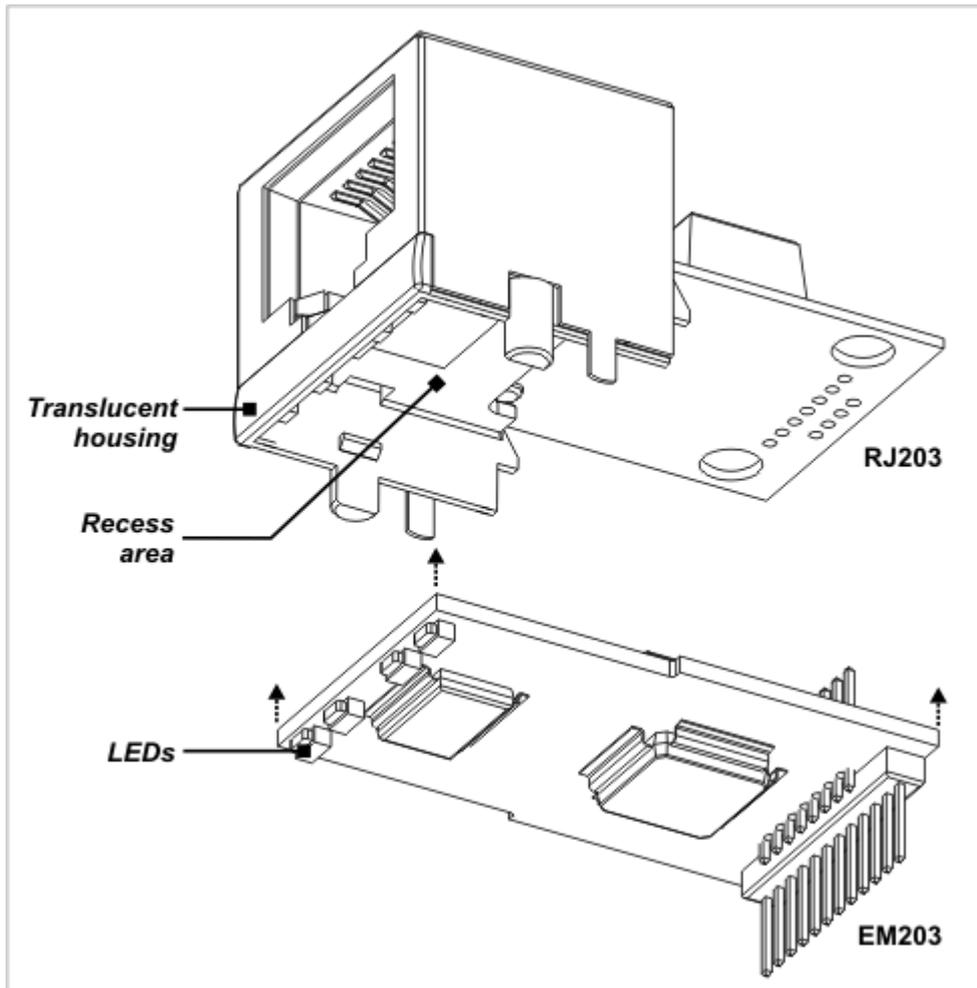
Don't forget to connect grounds too!

Additional passive components, such as resistors and capacitors must also be placed near the DM9000B and connected to RX and TX lines. For detailed information see the DM9000B datasheet.

To take full advantage of the unique space-saving design of the RJ203, place the DM9000B (and/or any other components as you see fit) under the module. The housing of the module has a substantial recess area under the RJ45 jack. This area can be utilized to accommodate various board components. Moreover, the housing of the RJ203 is made of a translucent material, so you can also place necessary status LEDs within the recess area and in the proximity to the front wall of the RJ203. This way, your status LEDs will be visible through the translucent front face of the RJ203. Four to six LEDs can easily fit along that front wall.



Using the RJ203 With the EM203 and Other Modules

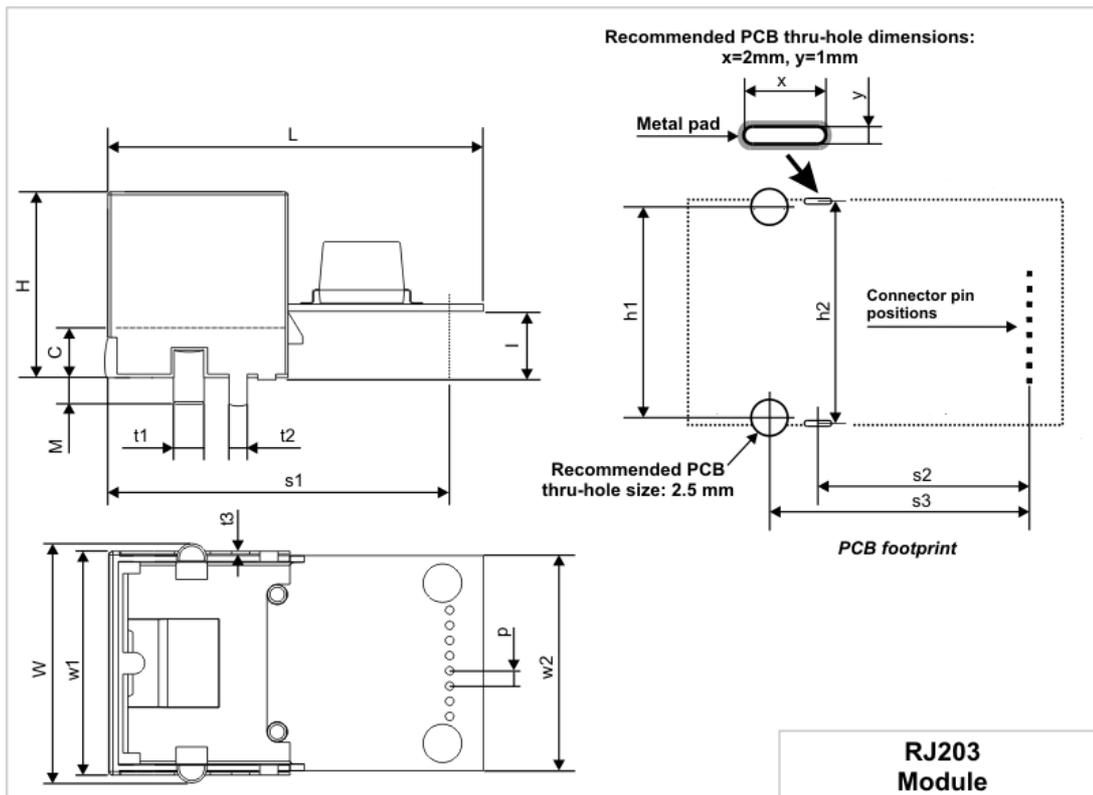


The RJ203 can also be used in combination with the EM203 Ethernet-to-serial module (documented in the "Serial-over-IP Solutions Manual") or [EM1206](#) BASIC-programmable Ethernet module.

Connector pins of the EM203 and EM1206 are designed to mate with [interface pads](#) of the RJ203. The EM203 (EM1206) fits "under" the RJ203 and partially within the recess area provided by the RJ203. This recess area is formed by a translucent housing of the RJ203. When the EM203 (EM1206) is combined with the RJ203, the [status LEDs](#) of the EM203 (EM1206) become positioned close to the translucent front wall of the RJ203 and remain visible through the front face of the RJ203.

Detailed mechanical information can be found in the [Mechanical Dimensions: RJ203 +EM203](#) and [Mechanical Dimensions: RJ230+EM1206](#) topic.

Mechanical Dimensions: RJ203

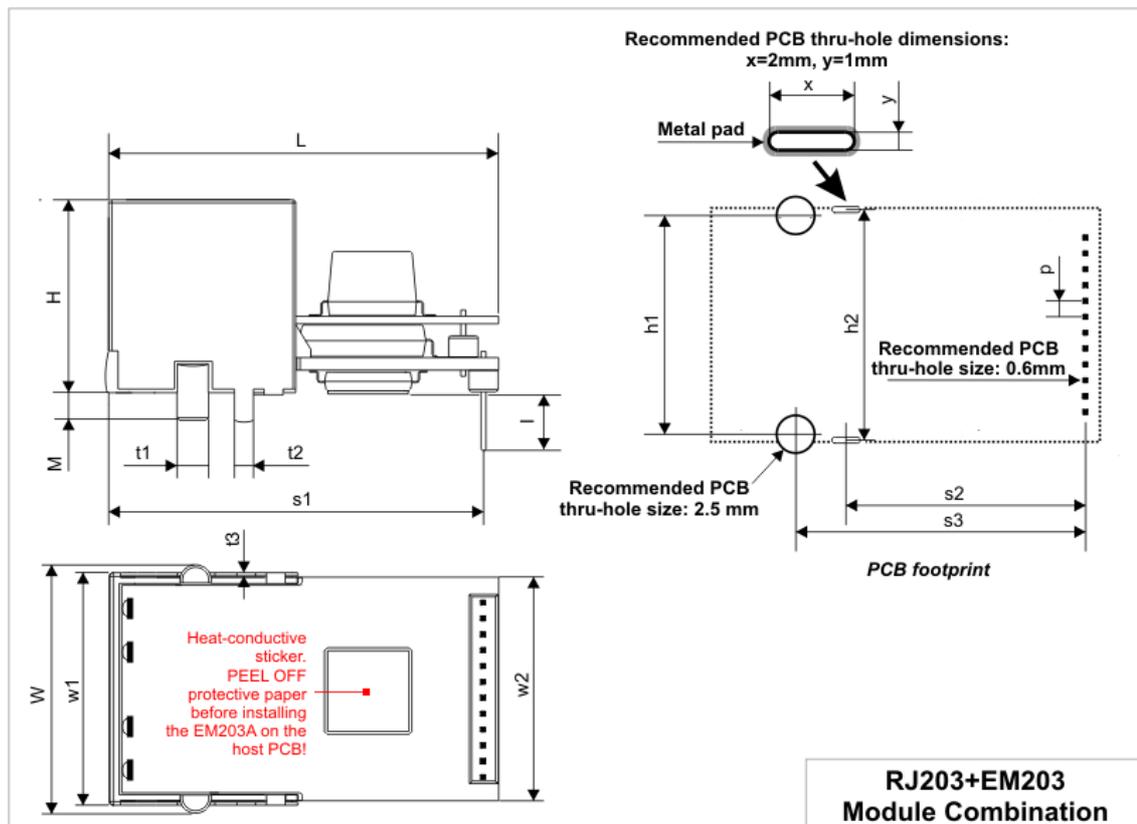


L	Max	31.0	Length
W	Max	20.0	Width
H	Max	15.5	Height
I	Aver	5.5	Clearance between the installation surface and the bottom of the RJ203's board
w1	Max	19.0	Width at the face excluding mounting stands
w2	Max	18.1	Board width
M	Min.	1.9	Mounting stand and tail height
t1	Aver	2.5	Mounting stand diameter
t2	Aver	1.5	Solder tail width
t3	Aver	0.25	Solder tail thickness
p	Aver	1.27	Connector pad pitch
s1	Aver	28.1	Distance from device face to the pad row
s2	Aver	17.4	Distance from the second pad row to the vertical centerline of solder tails
s3	Aver	21.4	Distance from the second pad row to the vertical centerline of mounting stands
h1	Aver	17.5	Distance between the horizontal centerlines of mounting stands

h2	Aver	18.5	Distance between the horizontal centerlines of solder tails
C	Min.	4.4	Clearance from the installation surface to the top wall of the recess area of the housing

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Mechanical Dimensions: RJ203+EM203

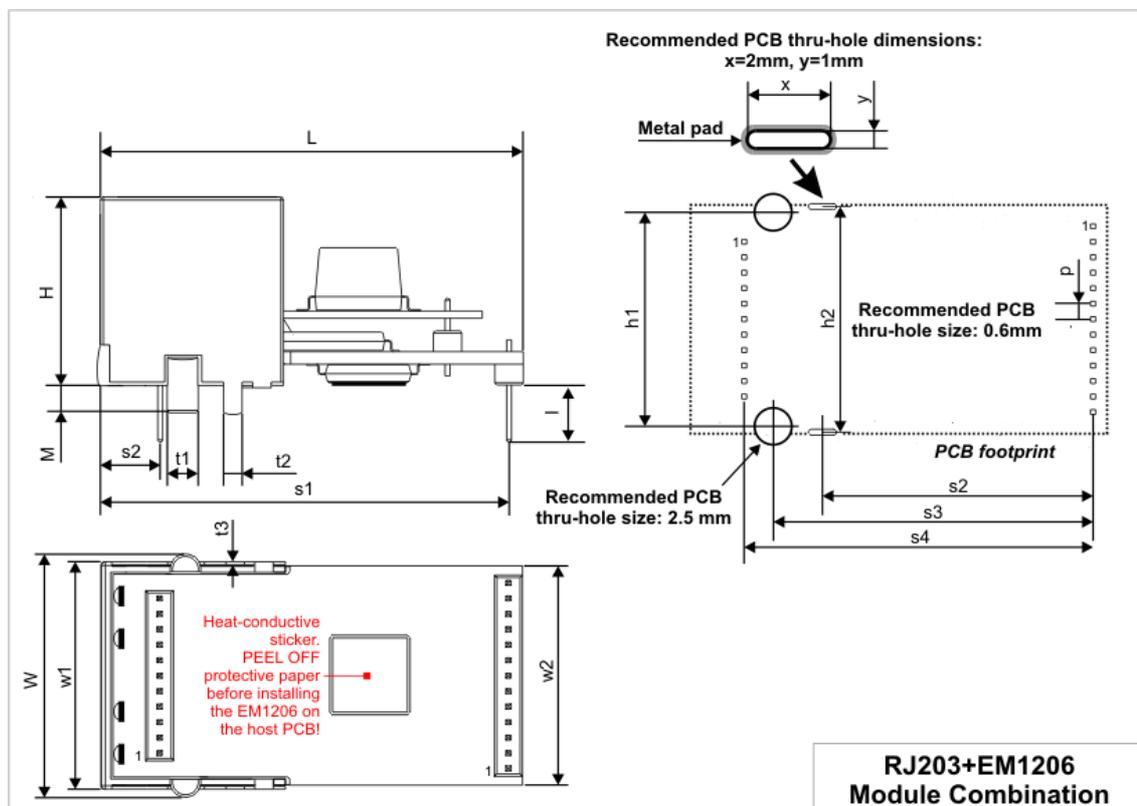


L	Max.	31.0	Length
W	Max.	20.0	Width
H	Max.	15.5	Height
I	Min.	4.0	Connector pin length
w1	Max.	19.0	Width at the face excluding mounting stands
w2	Max.	18.1	Board width
M	Min.	1.9	Mounting stand and tail height
t1	Aver	2.5	Mounting stand diameter
t2	Aver	1.5	Solder tail width
t3	Aver	0.25	Solder tail thickness
p	Aver	1.27	Connector pin pitch
s1	Aver	29.7	Distance from the face to the connector pins

s2	Aver	19.0	Distance from connector pins to the vertical centerline of solder tails
s3	Aver	23.0	Distance from connector pins to the vertical centerline of mounting stands
h1	Aver	17.5	Distance between the horizontal centerlines of mounting stands
h2	Aver	18.5	Distance between the horizontal centerlines of solder tails

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Mechanical Dimensions: RJ203+EM1206



L	Max	34.4	Length
W	Max	20.0	Width
H	Max	15.5	Height
I	Min.	4.0	Connector pin length
w1	Max	19.0	Width at the face excluding mounting stands
w2	Max	18.1	Board width
M	Min.	1.9	Mounting stand and tail height
t1	Aver	2.5	Mounting stand diameter

t2	Aver	1.5	Solder tail width
t3	Aver	0.25	Solder tail thickness
p	Aver	1.27	Connector pin pitch
s1	Aver	33.1	Distance from the face to the connector pins of the main connector
s2	Aver	22.2	Distance from the connector pins of the main connector to the vertical centerline of solder tails
s3	Aver	26.2	Distance from the connector pins of the main connector to the vertical centerline of mounting stands
s4	Aver	28.3	Distance from the connector pins of the main connector to the connector pins of the additional connector
h1	Aver	17.5	Distance between the horizontal centerlines of mounting stands
h2	Aver	18.5	Distance between the horizontal centerlines of solder tails

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Ordering Info and Specifications

The RJ203 device is only available in a single configuration and can be order as "RJ203".

The RJ203 can also be ordered in combination with the EM203 (documented in the "Serial-over-IP Solutions Manual") or [EM1206](#) module. To receive the RJ203 and EM203 pre-assembled together, please specify "RJ203+EM203" on your order. To receive the RJ203 and EM1206 pre-assembled together, please specify "RJ203+EM1206" on your order.

Specifications

Jack type	Standard RJ45 Ethernet jack
Magnetics type	10/100BaseT, designed to work with DAVICOM DM9000B Ethernet controller
Operating temperature	-20 to +70 degrees C
Operating relative humidity	10-90%
Mechanical dimensions (excl. leads)	31.0x20.0x15.5 mm
Packaging	RJ203 devices and RJ203+EM1206 module combination: tray, 30 modules/tray RJ203+EM203 module combination: tube, 10 modules/tube

All specifications are subject to change without notice and are for reference only.

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Accessories

The following accessories are currently being offered by Tibbo:

- [WAS-P0004\(B\) DS-to-device serial cable](#)
- [WAS-P0005\(B\) DS-to-PC serial cable](#)
- [WAS-1499 "straight" Ethernet cable](#) (DS-to-hub cable)
- [WAS-1498 "crossover" Ethernet cable](#) (DS-to-device cable)
- [12VDC Power Adaptors](#)
- [TB100 Terminal Block Adaptor](#)
- [TB1000 Terminal Block Adaptor](#)
- [TB1004 Test Board](#)
- [TB1005 Test Board](#)

WAS-P0004(B) DS-to-Device Serial Cable

WAS-P0004(B) is a female-male serial cable that can be used to connect Tibbo Device Server or Board to the serial port of your device.

DB9M (Male)	DB9F (Female)
#2	#2
#3	#3
#4	#4
#5	#5
#6	#6
#7	#7
#8	#8

The cable is of **blue color**, approximately 1.5m long.

WAS-P0005(B) DS-to-PC Serial Cable

WAS-P0005(B) is a female-female serial cable that can be used to connect Tibbo Device Server or Evaluation Board to the COM port of your PC.

DB9F (Female)	DB9F (Female)
#2	#3
#3	#2
#4	#6
#5	#5
#6	#4
#7	#8
#8	#7

The cable is of **green color**, approximately 1.5m long.

WAS-1499 'Straight' Ethernet Cable

WAS-1499 can be used to connect Tibbo Device Server or Evaluation Board to an Ethernet hub.

Side A	Side B
#1 (pair 1)	#1
#2 (pair 1)	#2
#3 (pair 2)	#3
#6 (pair 2)	#6

The cable is of blue color, approximately 1.5m long.

WAS-1498 'Crossover' Ethernet Cable

WAS-1498 can be used to connect Tibbo Device Server or Evaluation Board directly to some other Ethernet device (i.e. Ethernet port of the PC). This is a so called "crossover" cable that can interconnect two Ethernet devices without a hub.

Side A	Side B
#1 (pair 1)	#3
#2 (pair 1)	#6
#3 (pair 2)	#1
#6 (pair 2)	#2

The cable is of green color, approximately 1.5m long.

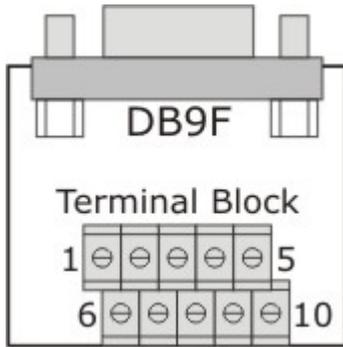
12VDC Power Adaptors

The following adaptor models are now offered:

Products	Specifications	US	Europe	UK
EM120/200-EV	12VDC/0.5A, non-switching, "large" connector (5.5mm)	APR-1014	APR-1015A	APR-1018A
EM1000-EV EM1000-TEV DS1000 family	12VDC/1A, switching, "small" connector (3.5mm)	APR-P0008	APR-P0009	APR-P0010
DS1202 , DS1206 , DS1026N , EM1202EV	12VDC/0.5A, switching, "small" connector (3.5mm)	APR-P0011	APR-P0012	APR-P0013

TB100 Terminal Block Adaptor

The TB100 Terminal Block Adaptor attaches to the DB9M connector. The TB100 provides a convenient way of wiring RS422 and RS485 lines to the serial port of a Tibbo device. The wires are inserted into the terminal contacts and the terminals are then tightened using a screwdriver.



The following table details terminal block contact functions in RS232, RS422, and RS485 modes of operation. The table assumes that the TB100 is connected to a Tibbo device with universal serial port that has DB9M connector.

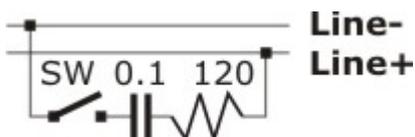
	RS232	RS422	RS485
#2	<No connection>	RTS- (output)	<No connection>
#7	RX (input)	RX- (input)	RX- (input)
#8	TX (output)	TX+ (output)	TX+ (output)
#9	DTR (output)	TX- (output)	TX- (output)
#10	Ground	Ground	Ground
#6	DSR (input)	RX+ (input)	RX+ (input)
#1	RTS (output)	RTS+ (output)	<No connection>
#3	CTS (input)	CTS+ (input)	<No connection>
#4	<No connection>	CTS- (input)	<No connection>

Although Tibbo devices support half-duplex RS485 communications, TX and RX lines remain independent on these devices even in the RS485 mode. In order to arrange a two-wire half-duplex RS485 bus you need to externally connect RX+ to TX+ and RX- to TX-. On the TB100 this is conveniently done by closing (putting to ON position) two switches- SW1 and SW2. These are located on the back of the TB100.

Additionally, the TB100 provides termination circuits typically needed at the end of long RS422 or RS485 lines. There are four identical terminators that can be switched on and off individually using four switches located on the back of the TB100. The following table details which line pairs the terminators can be connected to:

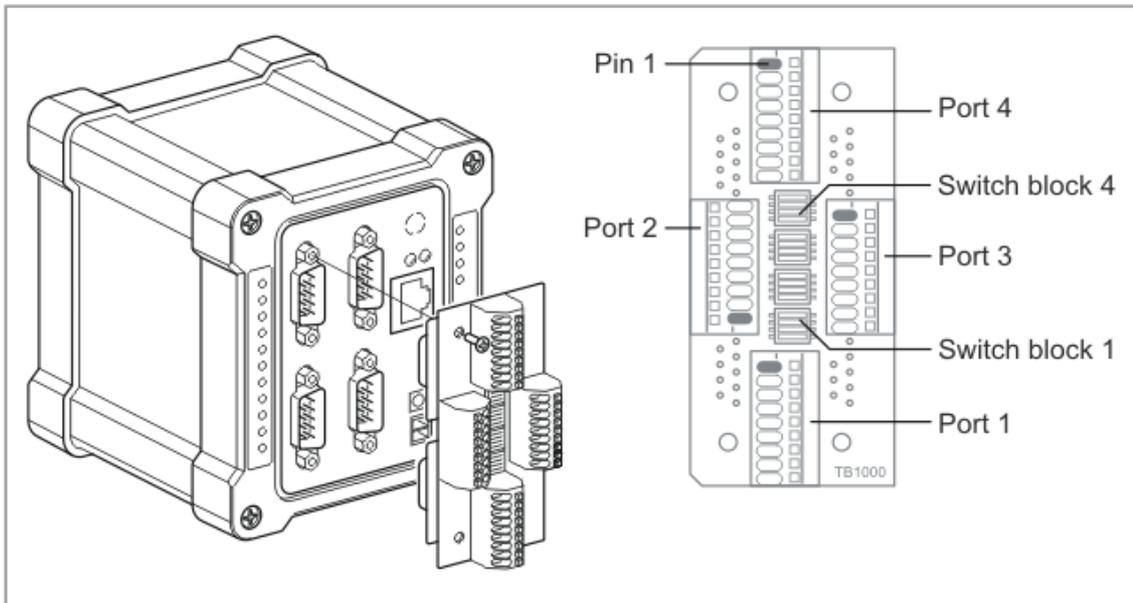
SW3	CTS+/CTS-
SW4	RTS+/RTS-
SW5	RX+/RX-
SW6	TX+/TX-

Schematic diagram for one of the terminators is shown on figure below.



If you are using RS485 mode (SW1 and SW2 are closed) and you want to terminate the RS485 bus, then you only need to close either SW5 or SW6. Having both switches closed will effectively add two termination circuits to the same bus!

TB1000 Terminal Block Adaptor



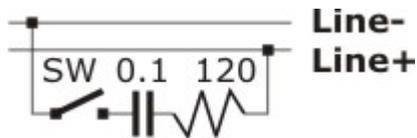
The TB1000 terminal block adaptor is designed to be used with [DS1000](#), [DS1002](#), and [DS1003](#) devices (or [IB1000](#), [IB1002](#), and [IB1003](#) boards). This adaptor "converts" DB9 connectors of the DS1000, DS1002, and DS1003 into 9-terminal blocks of "spring clamp" type. These are convenient for attaching wires, which is very useful for industrial installations.

Each terminal of the terminal block connects directly to a pin on the DB9 connector. Pin numbers on DB9 connectors and terminal blocks match exactly. Therefore, terminal assignment on each terminal block is as follows:

Terminal #	RS232 mode	RS422 mode	RS485 mode
1	---	RTS- (output)	---
2	RX (input)	RX- (input)	RX- (input)
3	TX (output)	TX+ (output)	TX+ (output)
4	DTR (output)	TX- (output)	TX- (output)
5	SYSTEM GROUND	SYSTEM GROUND	SYSTEM GROUND
6	DSR (input)	RX+ (input)	RX+ (input)
7	RTS (output)	RTS+ (output)	---
8	CTS (input)	CTS+ (input)	---
9	---	CTS- (input)	---

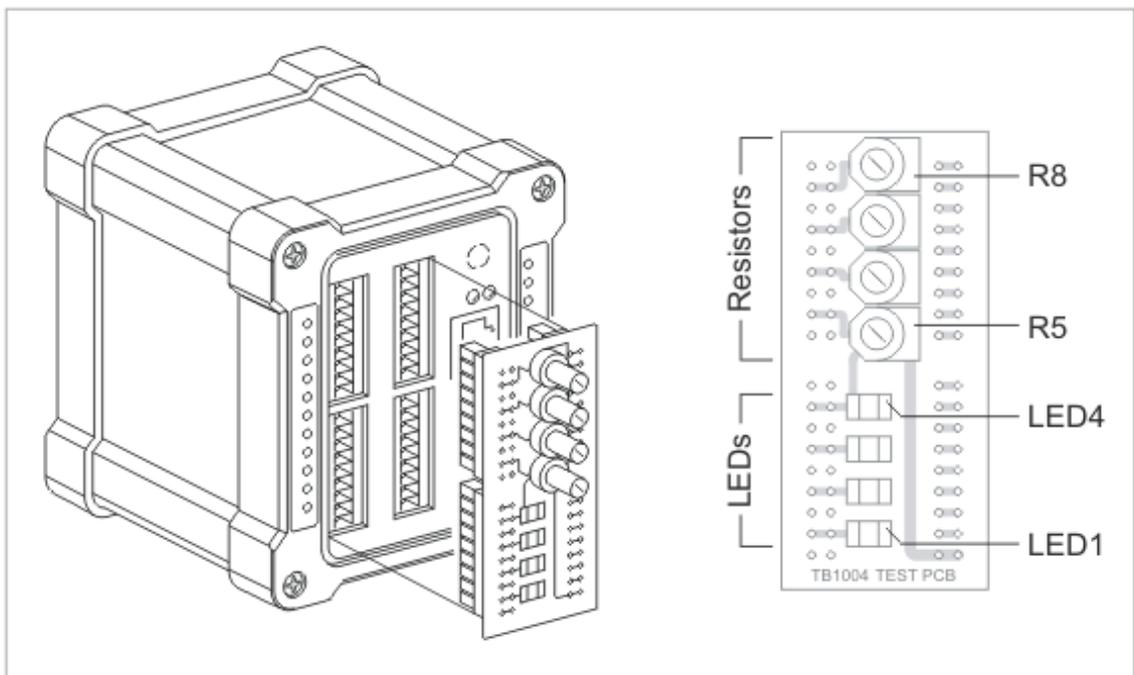
DS1002 and DS1003 devices have universal serial ports that can additionally work in RS422 and RS485 modes. Proper signal termination may be required when longer cables are used in these modes. The TB1000 have four switch blocks, one for each port. Each switch block includes four switches. When closed, each switch connects a termination circuit between the "+" and "-" signals in a signal pair:

Switch # within the block	Signal pair
1	CTS+/CTS-
2	RTS+/RTS-
3	RX+/RX-
4	TX+/TX-

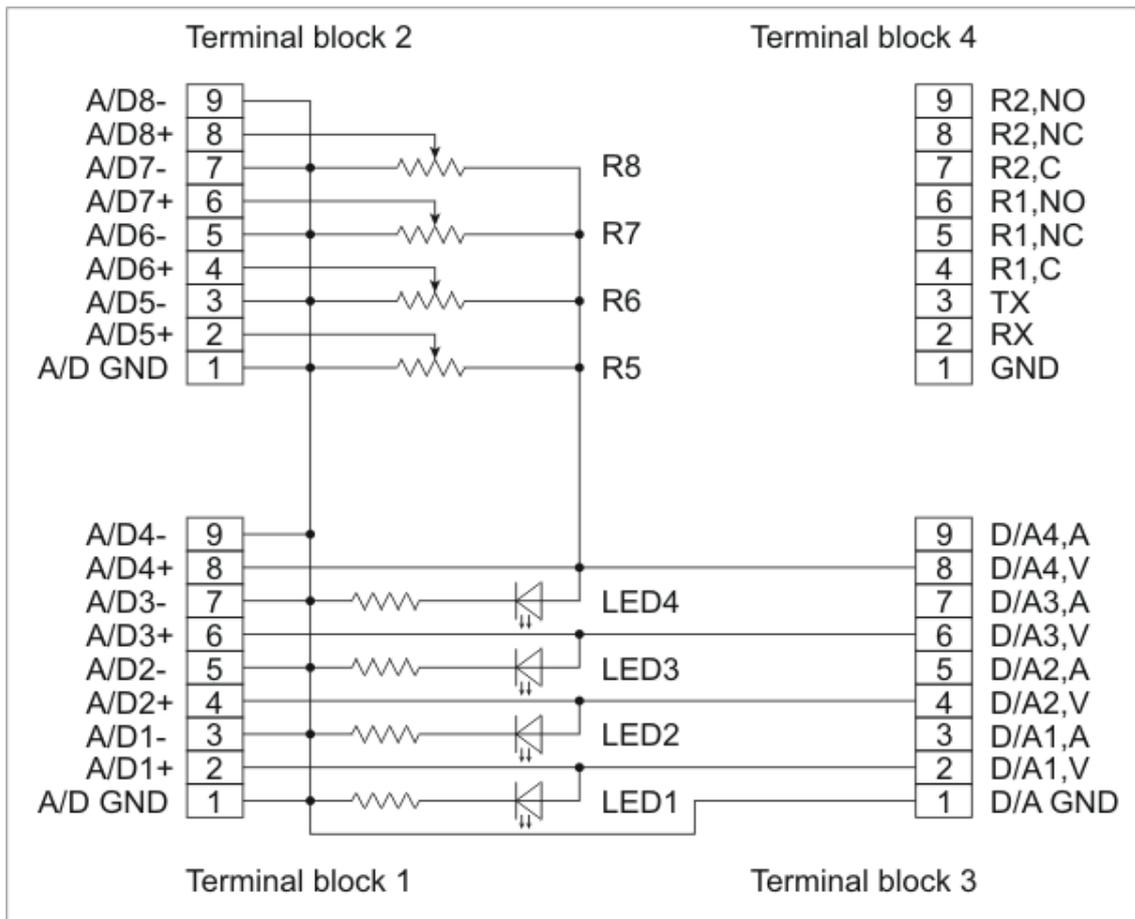


The TB1000 can be additionally secured on the DS10xx device using four screws (included). This terminal block adaptor is also compatible with the ["secondary cover"](#), also known as "waterproof cover".

TB1004 Test Board



The TB1004 test board is provided for the convenience of evaluating the [DS1004](#) controller ([IB1004 + SB1004](#) boards). The board is basically a loopback, feeding D/A outputs into A/D inputs of the DS1004. Schematic diagram of the test board's connections is shown below:

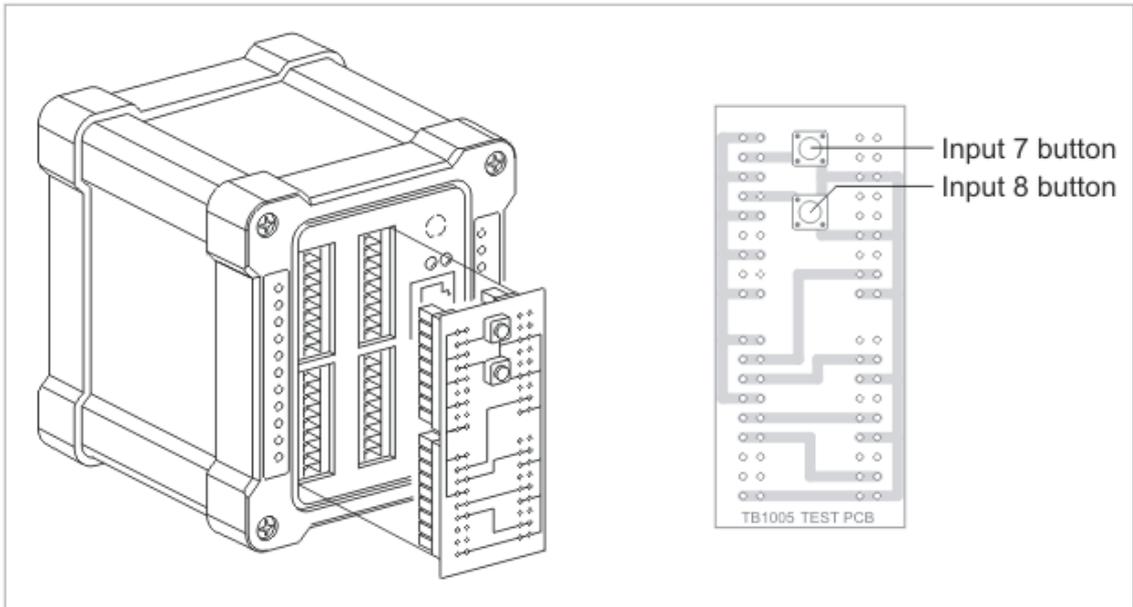


Voltage outputs of D/A channels 1-4 are connected directly to A/D inputs 1-4, and also to four red LEDs 1-4. The brightness of these LEDs is proportional to the voltage on D/A outputs. Obviously, LEDs will only work for positive output voltages and will stay off for negative voltages. Thus, LEDs provide indication only for 1/2 of the D/As' output range.

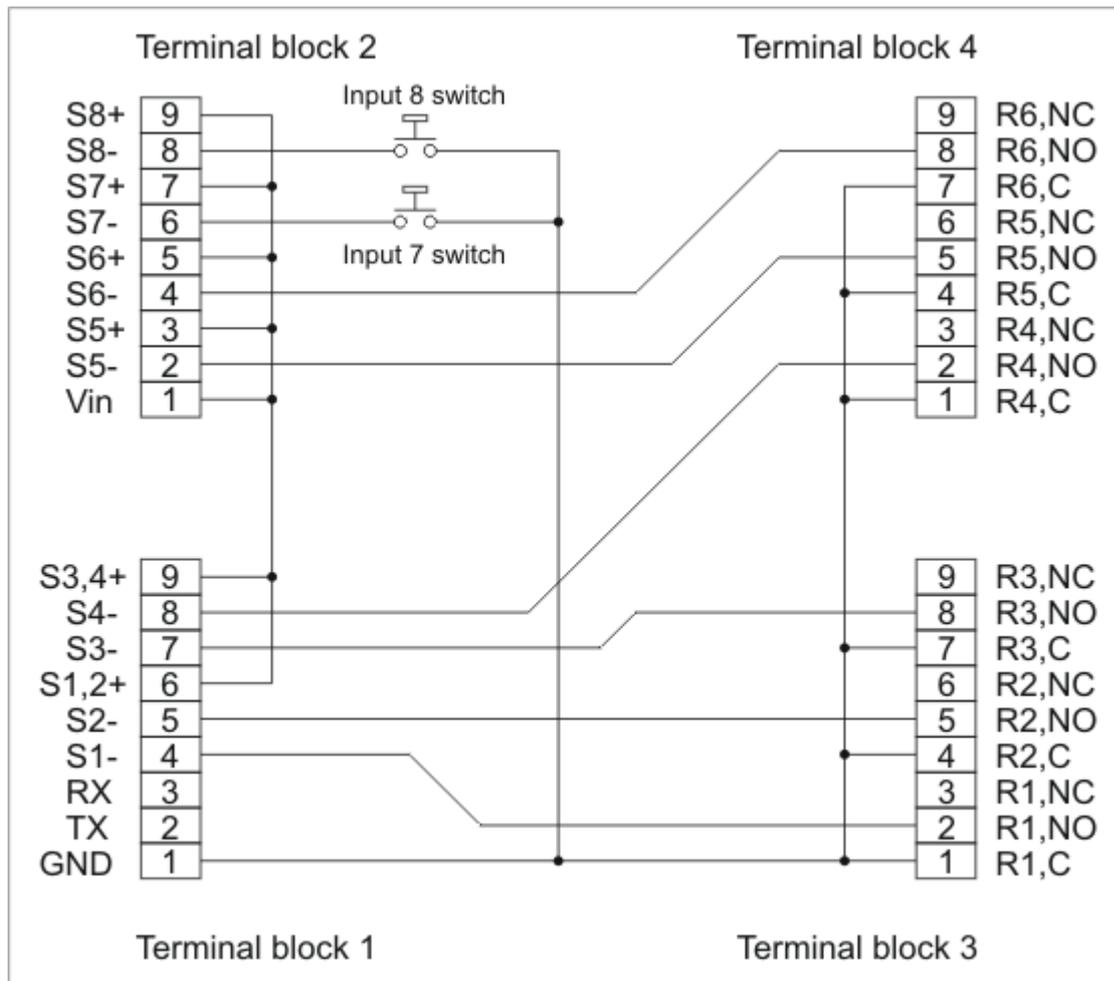
Current outputs of D/A channels are not used at all and can't be tested with the TB1004 board.

A/D inputs 4-8 are wired into the circuit through four adjustable resistors R1-4. Voltage for these resistors comes from the D/A output 4. Therefore, the voltages on central taps of R1-4 are a fraction of the current output of D/A 4.

TB1005 Test Board



The TB1005 test board is provided for the convenience of evaluating the [DS1005](#) controller ([IB1005 + SB1005](#) boards). The board is basically a loopback, feeding relay outputs into sensor inputs of the DS1004. Schematic diagram of the test board's connections is shown below:



Relays 1-6 are wired into sensor inputs 1-6. They commutate "Vin", which is the voltage from the power source for the DS1005. When a relay is activated, this voltage is applied to a corresponding sensor input.

There are eight sensor inputs but only six relays. Remaining sensor inputs 7 and 8 are controlled by two buttons which play the same role as the relays. Push a button and a corresponding sensor input is triggered.

Appendix 1: Status LEDs

Status LEDs

BASIC-programmable devices supplied by Tibbo have a pair of **green** and **red** status LEDs and/or control lines for connecting such LEDs externally. Particular status LED arrangement is product-specific, but these LEDs and/or their control lines are always implemented in one way or another.

Status LEDs have multiple functions:

- When the device is in the serial upgrade mode, these LEDs indicate the status of firmware upload process.
- When the device is under TiOS firmware control and Tibbo BASIC application is not running, these LEDs show current Tibbo BASIC application status.

- When the Tibbo BASIC application is running, status LEDs are under the control of the .pat object (see "TIDE and Tibbo BASIC Manual").

The following table summarizes predefined status LED blinking (flashing) patterns:

Serial upgrade mode		
	Green LED blinks slowly	File upload completed successfully.
	One long and one short "blink" of red LED	Communications error encountered during the serial file transfer.
	One long and two short "blinks" of red LED	FLASH memory failure.
Normal operation, Tibbo BASIC application not running		
	Fast-blinking GRGRGR... pattern	TiOS firmware not loaded or corrupted.
	Fast-blinking BBBB... pattern (B= red and green together)	Tibbo BASIC application loaded but cannot run due to insufficient variable (RAM) memory
	Fast-blinking G-G-G... pattern	Tibbo BASIC application loaded but not running.
	Fast-blinking R-R-R... pattern	Tibbo BASIC application not loaded or corrupted.

Ethernet status LEDs (when there are two of them)

Many Tibbo devices also have a pair of **green** and **yellow** Ethernet status LEDs and/or control lines for connecting such LEDs externally.

Ethernet status LEDs indicate the following:

- Link/Data LED (green) is turned on when "live" Ethernet cable is plugged into the device. The LED blinks whenever an Ethernet packet is received.
- 100BaseT LED (yellow) is turned on when the device links with the hub at 100Mb. The LED is off when the link is established at 10Mb.

The [EM500](#) and [EM500EV](#) devices do not have Ethernet status LEDs and the function of Ethernet state indication is performed by the status LEDs (status LED control lines) of these devices. These so-called dual-function status LEDs indicate the device state through familiar blinking (flashing) patterns, while LED brightness indicates the physical link state.

When "live" Ethernet cable is not plugged into the device, flashing patterns displayed by the status LEDs are "dimmed". That is, LEDs turn on at around 20% of their nominal brightness. When a "live" Ethernet cable is plugged into the device, flashing patterns are displayed at full brightness.

With this method of Ethernet status indication, there is no way to determine whether the link is established at 10 or 100Mb. This aspect, however, is of little importance these days because the majority of network hubs on the market are of the 100BaseT type.

Single Ethernet status LED

Some Tibbo devices only have a single Ethernet LED of yellow color. This LED is turned on when "live" Ethernet cable is plugged into the device. On *some* devices, the LED blinks whenever an Ethernet packet is received.

Appendix 2: Setup (MD) Button (Line)

Tibbo [boards](#)* and [external controllers](#) have a button called "setup" or "MD" button ("MD" abbreviation stands for "mode"). Tibbo [modules](#) have an MD pin for connecting an external button.

The setup button (line) has three functions:

- When a Tibbo BASIC application is running, it can use the button for its own purposes (see "TIDE and Tibbo BASIC Manual", button. object).
- When the device is password-protected, keeping the button pressed while accessing the device from TIDE allows to bypass the password. This is the way to reset the password on the device.
- When the device is powered up (exits from the hardware reset) with the button pressed (line pulled low), it enters a firmware upgrade mode in which new TiOS firmware, possibly with compiled Tibbo BASIC application attached, can be uploaded into the device. If the device is powered up with the setup button not pressed (line not pulled low), the device starts the execution of the TiOS firmware (if loaded).

** This only applies to boards that carry a Tibbo [module](#) or directly incorporate BASIC-programmable hardware (such as the T1000 ASIC).*

Update history

08MAY2014

- Documented Tibbits [#16](#), [#17](#), and [#31](#)

12MAR2014

- Updated documentation for the following Tibbits: [#12](#), [#13](#), [#14](#), [#28](#), [#29](#), [#30](#), [#35](#), [#36](#).
- Revealed these upcoming Tibbits: [#25](#), [#31](#), [#38](#), [#39](#), [#40](#), [#41](#), [#42](#), [#43](#), [#45](#).

08NOV2013

- Corrections made to the [Tibbo Project System \(TPS\)](#) documentation (notably, there are several new diagrams).

01NOV2013

- Documented [Tibbo Project System \(TPS\)](#)

01SEP2012 release

- Documented [DS110x](#) devices

06FEB2012 release

- Documented the [NB1010](#) board.
- Expanded [DS10xx](#) documentation to include devices based on the NB1010.
- Documented [TB1000](#), [TB1004](#), and [TB1005](#) adaptors.
- Updated [EM500EV](#) documentation in connection with the release of the new IB1 (Wi-Fi/flash) board.
- Corrected [Ethernet Port Lines](#) topic in EM1206 documentation to note correct voltage (1.8V instead of 2.5V).
- Updated the ordering info for most products.

30MAY2011 release

- Expanded and corrected [GA1000](#) documentation:
 - Many small corrections throughout;
 - Correction in [I/O Pin Assignment and Pin Functions](#) (of the GA1000): DI and DO pins were shown incorrectly (swapped);
 - One new [Connecting GA1000 to Tibbo Devices](#) topic.
- Expanded and corrected EM500 documentation:
 - Many small corrections throughout;
 - [Flash and EEPROM Memory](#) topic now provides information on connecting external flash IC for fd. object.
 - [I/O Pin Assignment and Pin Functions](#) contains information about attaching external flash IC and GA1000.

25MAY2011 release

- Corrected a part number in EM1206 [Ordering Info and Specifications](#).

16MAY2011 release

- Edited [EM500](#) manual: provided details on how an external flash IC can be connected to the EM500.

21MAR2011 release

- Removed all references to WA1000. This legacy module is no longer supported.

8MAR2011 release

- Replaced references to obsolete WA1000 with GA1000, updated part numbers and links.

16FEB2011 release

- Updated list of [power adaptors](#).

14FEB2011 release

- Corrected typographical error in PSU part numbers (APR instead of ARP)

04JAN2011 release

- Updated image on [EM1000TEV](#) topic to reflect use of GA1000 component.

03DEC2010 release

- Added pin diameter for EM500, EM1206, EM1202, EM200, EM1000

20JUL2010 release

- Documented [EM500EV](#).
- Reworked [Appendix1: Status LEDs](#) topic.
- Reworked [Appendix2: Setup Button \(MD line\)](#) topic, also renamed it to "Setup (MD) Button (Line)".

22JUN2010 release

- Corrected various documentation errors, including incorrect model numbers in [DS1000, DS1002, DS1003 \(4 Serial Ports\)](#) topic.

17JUN2010 release

- Clarified and expanded [External LED Control](#) topic for NB1000.

15JUN2010 release

- Fixed incorrect reference to Winstar LCD model number (replaced WG12864F with WG12864A)
- Fixed [GA1000](#) max. power consumption.
- Fixed lines 6 and 7 in EM1206 [I/O Pin Assignment and Pin Functions](#)

01JUN2010 release

- Updated [Module Comparison Table](#).
- Documented [EM500](#).

01FEB2010 release

- Updated [NB10x0 and IB100x Boards](#) section (new [IB1004 + SB1004](#), [IB1005 + SB1005](#) devices). Almost every pre-existing topic has also been edited.
- Updated [DS10xx Family](#) section -- again, almost every topic has been edited.
- Documented [TB1000](#), [TB1004](#), and [TB1005](#) accessories.

29JUL2009 release

- Documented the following products: [EM1206](#), [EM1206EV](#), [GA1000](#), [DS1206](#), [DS1206N](#), [DS1202](#), and [EM1202EV](#).

- Edited cover pages for [EM1000](#) and [EM1202](#) products.
- Edited Ordering Info and Specifications for [EM1000](#) and [EM1202](#) devices.
- Created [Appendix 1: Status LEDs](#) and [Appendix 2: Setup Button \(MD line\)](#) topics, added links to these new topics from each product's manual.
- Edited I/O Pin Assignment and Pin Functions topics of [EM1000](#) and [EM1202](#) modules.

Initial release

- Revamped [DS1000](#) description. It now includes DS1001 and DS1002 devices. Content is totally new -- the manual simply refers to the [NB1000](#) and [IB1000-2](#) docs.
- Documented [IB1004](#) and [DS1004](#) devices.
- Documented [IB1005](#) and [DS1005](#) devices.

The Programmable Hardware Manual is a spin-off of the Tibbo Document System Manual. Original split was performed on 09JUN2008.

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