EM120 Ethernet-to-serial Module

The EM120 is an Ethernet Module for onboard installation. Module hardware includes one 10BaseT Ethernet port (standard Ethernet magnetics are **NOT integrated** into the Module), one serial port (CMOS-level) with a number of additional general-purpose I/O lines, and an internal processor, whose firmware acts as a bridge between the Ethernet and serial ports. Ethernet "side" of the Module connects directly to a standard Ethernet magnetics circuit (such as YCL-20F001N) or RJ45 connector with integrated magnetics. Serial "side" interfaces directly to the serial port pins of most microcontrollers, microprocessors, UARTs, etc.

From the hardware standpoint, the EM120 can be viewed as a universal platform suitable for running a variety of network and serial communications-related applications. It is the application firmware, not hardware that gives the EM120 most of its functionality.

The Application firmware EM120 is supplied with, currently in its 3rd generation ("Release3"), turns the EM120 into a Serial Device Server used to connect serial devices to the Ethernet (TCP/IP) networks.

The application firmware of the EM120 can be upgraded through the module's serial port or Ethernet port. Serial upgrades are facilitated by a so-called Monitor- a fixed "service" firmware inside the EM120. The Monitor cannot be upgraded. Network upgrades rely on the application firmware itself- there is a self upgrade algorithm

that will be detailed later.

Since most of the EM120's operation is defined by its firmware the major part of EM120's functional description can be found in the Device Server Application Firmware Manual. This *EM120 Ethernet Module Manual* focuses on the hardware portion of the EM120.

I/O pin assignment and pin functions
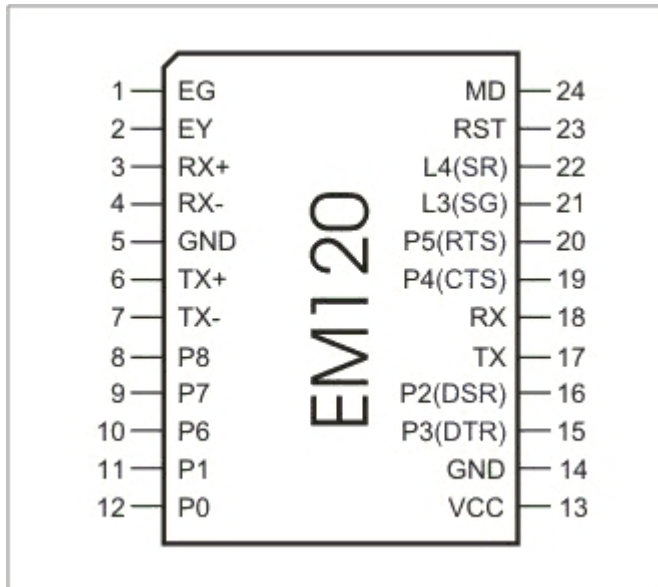
Click on the pin in the diagram above or one of the links provided below to learn more about EM120's I/O pins:

- Ethernet port lines

- Serial port and general-purpose I/O lines

- LED lines

- Power, reset, and mode selection lines

Ethernet port lines

#6	TX+	Output	Positive line of the differential output signal pair
#7	TX-	Output	Negative line of the differential output signal pair
#3	RX+	Input	Positive line of the differential input signal pair
#4	RX-	Input	Negative line of the differential input signal pair

Ethernet port of the EM120 is of 10BaseT type. Onboard electronics of the EM120 do not include Ethernet magnetics, so magnetic circuitry must be connected externally. You can use either a standalone magnetics part (such as YCL-20F001N) or RJ45 connector with integrated magnetics.

It is important to make the PCB wire connections between the Ethernet port pins of the EM120 and external 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 and CE regulations. Additionally, longer Ethernet lines on the PCB will make your board more susceptible to the damage from the ESD (electrostatic discharge).
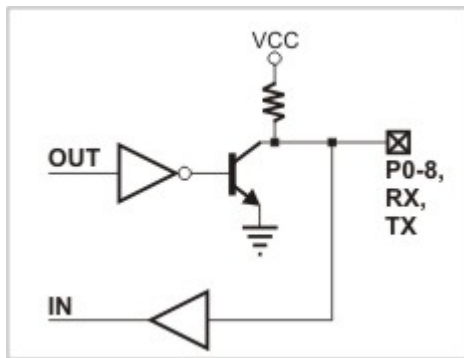
Serial port and general-purpose I/O lines

#8	P8	Input/output	General-purpose input/output line
#9	P7	Input/output	General-purpose input/output line
#10	P6	Input/output	General-purpose input/output line
#11	P1	Input/output	General-purpose input/output line
#12	P0	Input/output	General-purpose input/output line
#15	P3 (DTR)	Input/output (output)	General-purpose input/output line Data terminal ready output
#16	P2 (DSR)	Input/output (input)	General-purpose input/output line Data set ready input
#17	TX		Serial transmit line
#18	RX		Serial receive line
#19	P4 (CTS/SEL)	Input/output (input)	General-purpose input/output line Clear to send input Full-/half-duplex selection input
#20	P5 (RTS/DIR)	Input/output (output)	General-purpose input/output line Request to send output (full-duplex mode) Data direction control output (half-duplex mode)

*Line functions defined by the application firmware are shown in **blue***

The EM120 features a serial port (RX, TX lines) and several general-purpose I/O lines (P0-P8). All of the above lines are of CMOS type. From the hardware point of view, all general-purpose I/O lines can serve as inputs or outputs. Maximum load current for all CMOS lines is 10mA.

Simplified structure of EM120'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.

The application firmware of the EM120 maps certain serial port functions onto the general-purpose I/O pins- these functions are shown in blue in the table at the top of this topic. For example, P5 is a universal input/output but the application firmware can be set to turn this line into the RTS output of the serial port. Therefore, depending on your application you can view P5 as a general-purpose I/O line or specific control line of the serial port (RTS).

Being of CMOS type, the serial port and I/O lines of the EM120 can be connected directly to the serial port pins and I/O lines of most microcontrollers, microprocessors, etc. An interface IC* must be added to the EM120 externally if you want to connect the module to a "true" serial port (for example, COM port of the PC).

Logical signals on the serial port lines of the EM120 are active LOW. TX and RX lines are high when idle, start bit is LOW, stop bit is HIGH; LOW on CTS and RTS lines means "transmission allowed" and HIGH means "transmission not allowed". This is standard for CMOS-level serial ports and is exactly opposite to the signalling on the RS232 cables. Logical signals on the EM120 are inverted because standard interface ICs* invert the signals internally too.

As explained earlier, actual functionality of the I/O lines is firmware-dependent. See serial port and serial communications for details.

* Such as MAX232 for RS232, MAX485 for RS485, etc.

LED lines

#1	**EG**	Output	Green Ethernet status LED
#2	**EY**	Output	Yellow Ethernet status LED
#21	**L3 (SG)**	Output	LED output 3, Green status LED
#22	**L4 (SR)**	Output	LED output 4, Red status LED

*Line functions defined by the application firmware are shown in **blue***

The EM120 has four LED control lines. 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.
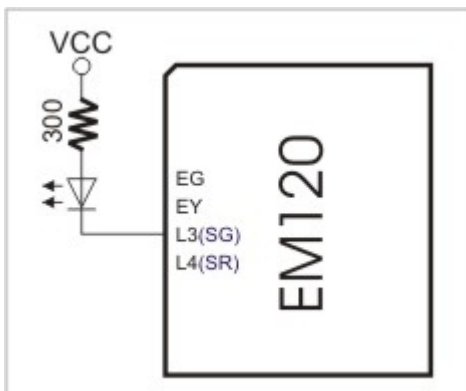
EG and EY lines reflect the status of the Ethernet port. The EG LED is normally ON, and is temporarily turned off whenever the EM120 receives a network packet. The EY is normally OFF, and is temporarily turned on whenever a data collision is detected on the Ethernet.

SG and SR lines are under firmware control and display various status information depending on what firmware is running at the moment. Follow the links below to learn more about the behaviour of these LEDs under different conditions:

- SR/SG behavior in the monitor firmware.
- SR/SG behavior in the application firmware.

Power, reset, and mode selection lines

#13	VCC		Positive power input, 5V nominal, +/- 5%, app. 50mA
#5	GND		Ground
#14	GND		Ground
#23	RST	Input	Reset, active high
#24	MD (MD)	Input	Mode selection pin

*Line functions defined by the application firmware are shown in **blue***

The EM120 should be powered from a stabilized DS power supply with output nominal voltage of 5V (+/- 5% tolerance). Current consumption of the EM120 is approximately 50mA.

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 EM120 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 EM120 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 the reset will be applied to the EM120 at the same time when the host microcontroller is reset. All the host microcontroller has to do is release the EM120 from reset at an appropriate time by switching the state of the I/O line to LOW.

The MD line of the EM120 is used to select the operating mode of the EM120 and/or its application firmware. The reason why the pin name is shown as MD(MD) is because the functionality of this pin is in part hardwired and in part depends on the application firmware:

- **Hardwired functionality.** When the EM120 powers up it verifies the state of the MD input. If the MD input is at HIGH the EM120 proceeds to verifying and running the application firmware loaded into its internal FLASH memory. If the MD input is at LOW the EM120 enters the serial upgrade mode. For more information see Monitor.

- **Application firmware-dependent functionality.** When the application firmware is already running the MD line is typically used to make the EM120 enter the serial programming mode. For more information see serial programming.

When the EM120 is used as a co-processor in a host system the MD line can be also controlled by the host microcontroller. Ability to control both the RST and DS lines allows the host microcontroller to switch between the operating modes of the EM120.

Mechanical dimensions
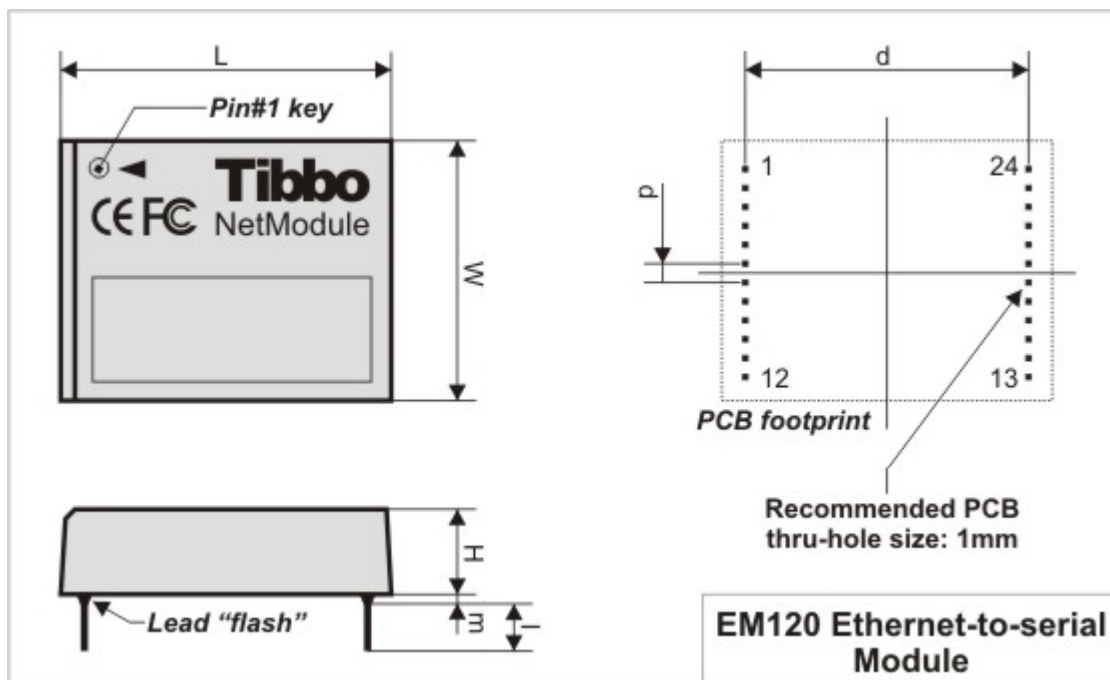
L	Max.	35.0	Module length
W	Max.	27.5	Module width
H	Max.	9.1	Module height
I	Min.	5.0	Lead length
m	Max.	0.5	Lead "flash"
d	Aver.	30.0	Distance between lead rows
p	Aver.	2.0	Pin pitch

All dimensions are in millimeters

Specifications and EM120 modifications

The EM120 has one submodel in circulation- EM120-00.

Device specifications are presented in the table below.

Parameter	EM120-00
Ethernet interface	10BaseT Ethernet, magnetics **not** built-in
Serial interface and I/O lines	CMOS-level; TX, RX, and 9 additional I/O lines with RTS, CTS, DTR, DSR implemented in application firmware
Routing buffers size	12Kbytes x 2*
Maximum load current of I/O lines	10mA
Power requirements	DC 5V, +/- 5%, app. 50mA
Operating temperature	-10 to +70 degrees C
Operating relative humidity	10-90%
Mechanical dimensions (excl. leads)	App. 35x27.5x9.1mm
Packing	Plastic tray, 50 modules/tray

Maximum possible buffer size. Actual size may be smaller depending on how much RAM is "consumed" by the firmware