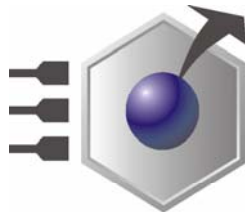


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THE COMPLETE EMBEDDED PC SOLUTION

***An0044***

**COM-1270; High speed serial ports**

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## ABOUT THIS MANUAL

This application note is intended to describe the COM-1270 high speed serial ports capability.



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## Conventions

The following table lists conventions that are used throughout this guide.

Icon	Notice Type	Description
	<b>Information note</b>	Important features or instructions
	<b>Warning</b>	Information to alert you to potential damage to a program, system or device or potential personal injury

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## Chapter 1 Introduction

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The COM-1270 is a PC/104 formfactor board designed for communications, it supports eight channels serial ports, two CAN ports and one ethernet.

The first four serial ports can operate in RS232/485 and RS422 mode or be disabled by pair, the other ports works only in RS232 mode; all the operating modes are software selectable.

The serial transmission functionalities of the board are related to the UART 16C554 chipset which is capable to support high speed baudrates. The board is configured from factory to operate in a standard baud rate range: 50, 300, 600, 1200, 2400, 4800, 9600, 19K2, 38K4, 57K6 and 115K2 software selectable.

This brief application note is intended to describe how to modify and configure the COM-1270 board to operate with higher baud rates describing which are the hardware settings you've to realize to make the board high speed capable.

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### Exar 16C554 Programmable Baud Rate Generator

The serial functionality of the board is based on two Exar 16C554D chipsets which can support up to 921.6Kbps data rate for eight serial ports at his output pins. Single baud rate generator is provided for the transmitter and receiver, allowing independent TX/RX channel control. The programmable Baud Rate Generator is capable of accepting an input clock up to 24 MHz, as required for supporting a 1.5Mbps data rate.

An external clock is connected to the XTAL1 pin to clock the internal baud rate generator for standard or custom rates. The generator divides the input 16X clock by any divisor from 1 to  $2^{16} - 1$ . The 16C554D divides the basic crystal or external clock by 16. Further division of this 16X clock provides two table rates to support low and high data rate applications using the same system design. Customized Baud Rates can be achieved by selecting the proper divisor values for the MSB and LSB sections of baud rate generator. Programming the Baud Rate Generator Registers DLM (MSB) and DLL (LSB) provides a user capability for selecting the desired final baud rate.

## Chapter 2 COM-1270 Serial Connectors interfaces

The following image show the layout of the serial ports connectors of the COM-1270 board:

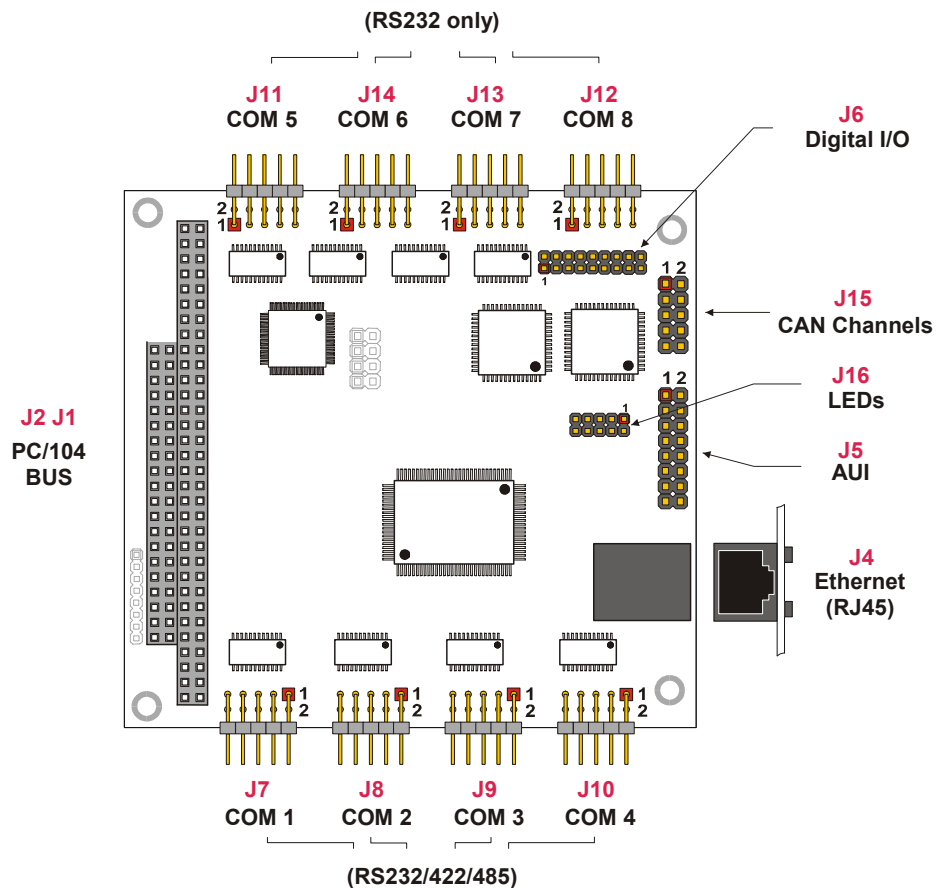


Figure 1. J7-J12 serial connector layout



Note: in the previous figure, a red square pad indicates pin 1 of each connector.

### *J7..J14 Serial Ports in RS232 mode*

The following table shows the pinout of the J7..J14 serial connectors in RS232 mode.

Table 1. J7..J14 connectors in RS232 mode.

Pin	Signal	Function	In/Out	DB25	DB9
1	DCD	Data Carrier Detect	In	8	1
2	DSR	Data Set Ready	In	6	6
3	RX	Receive Data	In	3	2
4	RTS	Request To Send	Out	4	7
5	TX	Transmit Data	Out	2	3
6	CTS	Clear To Send	In	5	8
7	DTR	Data Terminal Ready	Out	20	4
8	RI	Ring Indicator	In	22	9
9,10	GND	Signal Ground	--	7	5

### *J7..J10 Serial ports in RS422 mode*

The following table shows the pinout of the J7..J10 serial connectors with RS422 mode.

Table 2. J7..J10 connectors in RS422 mode.

Pin	Signal	Function	In/Out
1	-TX	Transmit Data	Out
2	--	Not connected	--
3	+TX	Transmit Data	Out
4	--	Not connected	--
5	-RX	Receive Data	In
6	--	Not connected	--
7	+RX	Receive Data	In
8	--	Not connected	--
9,10	GND	Signal ground	--

### *J7..J10 Serial ports in RS485 mode*

The following table shows the pinout of the J7..J10 serial connectors with RS485 mode.

Table 3. J7..J10 connectors in RS485 mode.

Pin	Signal	Function	In/Out
1	-TX/-RX	Transmit/Receive Data	Out/In
2	--	Not connected	--
3	+TX/+RX	Transmit/Receive Data	Out/In
4	--	Not connected	--
5	--	Not connected	--
6	--	Not connected	--
7	--	Not connected	--
8	--	Not connected	--
9,10	GND	Signal ground	--



### *J11..J14 Serial Ports in TTL mode*

The following table shows the pinout of the J11,12,13,J14 serial connectors in TTL mode.

Table 4. J11,12,13,J14 connectors in TTL mode.

Pin	Signal	Function	In/Out	DB25	DB9
1	DCD	Data Carrier Detect	In	8	1
2	DSR	Data Set Ready	In	6	6
3	RX	Receive Data	In	3	2
4	RTS	Request To Send	Out	4	7
5	TX	Transmit Data	Out	2	3
6	CTS	Clear To Send	In	5	8
7	DTR	Data Terminal Ready	Out	20	4
8	RI	Ring Indicator	In	22	9
9,10	GND	Signal Ground	--	7	5

For detailed information on how to configure the TTL mode for J11,12,13,J14 serial ports please read on.

### *Serial settings*

In order to configure the serial interfaces you have to run the Setup Program. For detailed informations please refer to Chapter 5 of the COM-1270 user's manual.

## Chapter 3 Serial port hardware architecture

To know why hardware modification are necessary to reach high speed serial transmission it is necessary to analyze the hardware architecture of the COM-1270 board. This section is intended to do this to explain the features of the board with a macro block analysis.

The following block diagram show the hardware architecture of the serial ports.

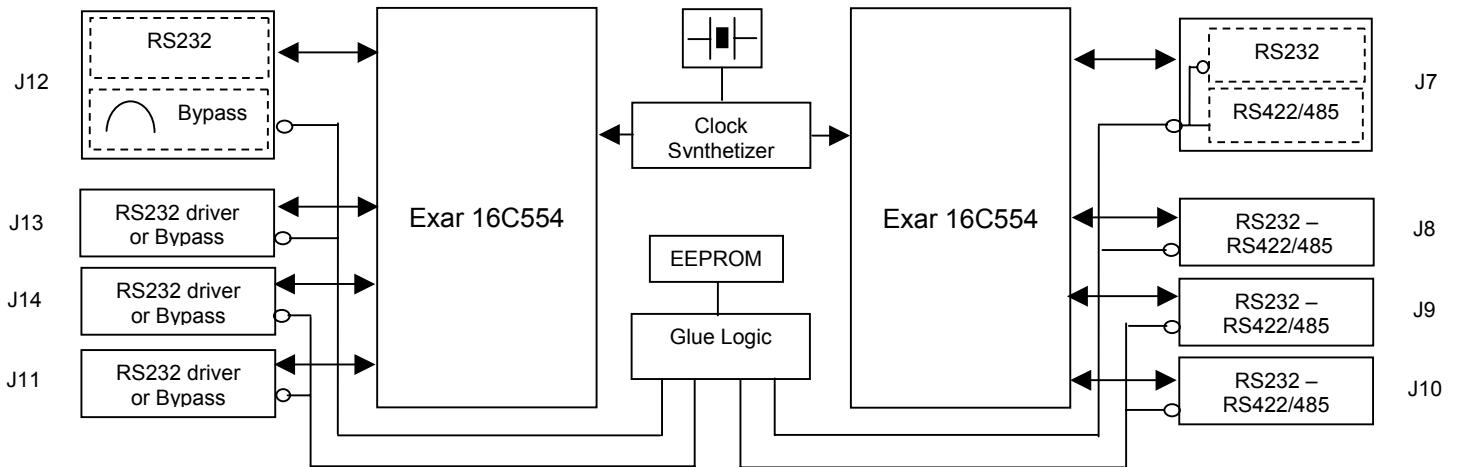


Figure 2. Block diagram

The serial hardware architecture may be divided into the following main subsections:

- Serial chipset section (two Exar ST16C554 chipsets)
- Clock syntetizer
- Glue Logic
- Serial port driver section

## Exar ST16C554 chipsets

The core of the serial functionality of the COM-1270 board is based on two Exar ST16C554 chipsets (quad UART with 16-byte fifo's); each chipset provide four serial ports. For detailed information about the Exar ST16C554 chipset please refer to the technical data sheet.

Baud rate of the serial transmission may be programmed by software accessing serial register; the baud rate depends on the Clock input frequency applied to the pin 26 of the chipset, the following relation describe the baudrate versus the input frequency:

$$\text{Baudrate} = \text{Input Frequency} / (16 * \text{Clock Divisor}_{\text{DEC}})$$

This component can reach speeds of receives trigger levels and data rates up to 1.5Mbps (with a clock reference of 24MHz).

As an example we reports the following table for the derived baudrates starting from two clock reference (1.8432 MHz Clock and 7.3728 MHz Clock):

Output Baud Rate (1.8432 MHz Clock)	Output Baud Rate (7.3728 MHz Clock)	User 16 x Clock Divisor (Decimal)	User 16 x Clock Divisor (HEX)	DLM Program Value (HEX)	DLL Program Value (HEX)
50	200	2304	900	09	00
300	1200	384	180	01	80
600	2400	192	C0	00	C0
1200	4800	96	60	00	60
2400	9600	48	30	00	30
4800	19.2K	24	18	00	18
9600	38.4k	12	0C	00	0C
19.2k	76.8k	6	06	00	06
38.4k	153.6k	3	03	00	03
57.6k	230.4k	2	02	00	02
115.2k	460.8k	1	01	00	01

Table 1. ST16C554 programming baud rates

## Serial port frequency baud generator

To operate properly the Exar 16C554 chipset needs an external clock source, internally differents baud rates may be programmed as described in the following of the document.

The primary clock source is generated by an external programmable CT2292 clock syntethizer (Ref. U3 chipset on Figure 3) which generates custom clock syntesys starting from a 14.7456MHz 50ppm reference crystal. Figure 3 show the schematic section of the clock syntetizer which generated two clocks: the CLK\_SER\_IN1 and CLK\_SER\_IN2 clock for Exar ST16554 chipsets and a clock reference for the CAN section.

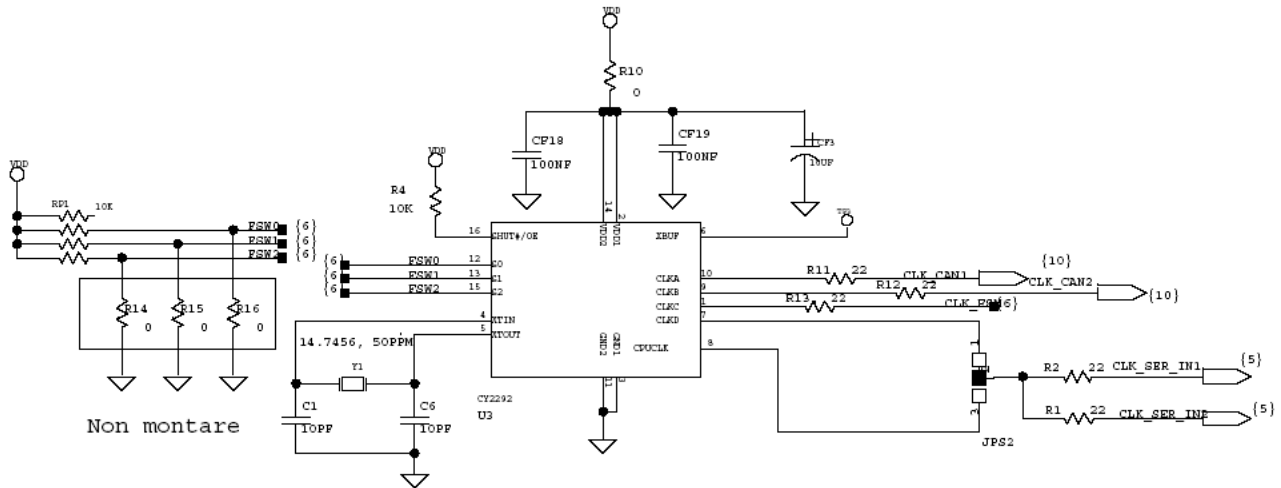


Figure 3. COM-1270 - CY2292 Clock synthesizer section

The COM-1270 has the capability to be customized to make frequency selection for the CY2292 installing or not the components listed below:

- to set FSW2 to a logic zero mount R14.
- to set FSW1 to a logic zero mount R15.
- to set FSW0 to a logic zero mount R16.

The following table report the CY2292 possible output frequency concerning the FSW2, FSW1 and FSW0 settings based on the 14.7456MHz:

FSW2	FSW1	FSW0	Frequency [MHz] CPUCLK
0	0	0	23.96160
0	0	1	22.11840
0	1	0	18.43200
0	1	1	16.58800
1	0	0	14.74560
1	0	1	11.05920
1	1	0	9.21600
1	1	1	7.37280

Table 2. CY2292 operating frequency selection

The UART frequency is derived by default from CLKB source present on U3 pin 7 output (1.8432 MHz) because the JPS2 factory default position is 1-2; the CPUCLK U3 pin 8 signal can be provided making JPS2 on 2-3 position. The R14, R15 and R16 factory default are not mounted, in this way you reach the FSW2,FSW1 and FSW0 0 logic for an output frequency of 7.37280MHz.

Sometimes, may occur that some custom baud rate couldn't be reached only with modifying the position of the FSW2..0 components and reprogramming the baud rate register; in this case you've to refer directly to the Eurotech S.p.A. for a custom modification changing the Y1 crystal (COM-1270 PCB has the capability to install two different formats of crystal to allow user selecting a wide range of crystal frequencies. The formats are HC49 or U4H SMD) with a new reference value and reprogramming the CY2292 Clock synthesizer firmware.

## Glue Logic

The glue logic is based on a Lattice isPLSI1032E which manage various digital logic parts of the COM-1270 board, in particular for the serial section manage the activation of the serial drivers reading the EEPROM parameters stored with the SETUP program. Note that the driver selection works in pair: you can disable, enable J7 & J8, J9 & J10, J11 & J14, J13 & J12 by pair.

## Serial port driver section

To fulfil the RS232-RS422- RS485 standard the Exar ST16C554 serial lines have to be converted to the proper physical signal levels with specific drivers first to be applied to the external connector.

The RS232 mode is implemented inserting an ADM211 chipset; for the RS485 and RS422 a MAX483 is used. For detailed technical information regarding those chipsets please refer to the technical data sheet.

Looking at the ADM211 and MAX483 data sheet you will be noticed for the following maximum serial transmission speed listed on the next table:

Driver	Max Data Rate
ADM211	230Kbps
MAX483	250 Kbps

Table 3. Maximum data rate

Those are important informations to set the the CY2292 operating frequency selection and Exar ST16C554 baud rate selector, because if you select an higher baud rate then the driver may operate as a filter, limiting the maximum transmission speed occurring errors on the serial transmission.

The following table reports the configurability of the eight serial ports of the COM-1270, and listing the high speed capability for each connector:

Serial Port	Enable/Disable	Mode Selection	
		RS232	RS422/RS485
J7	Yes <sup>1</sup>	High Speed limitation	High Speed limitation
J8		High Speed limitation	High Speed limitation
J9	Yes	High Speed limitation	High Speed limitation
J10		High Speed limitation	High Speed limitation
J11	Yes	High Speed compliant in TTL mode without serial driver	--
J12		High Speed compliant in TTL mode without serial driver	--
J13	Yes	High Speed compliant in TTL mode without serial driver	--
J14		High Speed compliant in TTL mode without serial driver	--

Table 4. COM-1270 configuration modes

Note that high speed serial communications are compliant only for J11, J12, J13 and J14 ports operating in TTL. This may be reached making the proper modifications to the hardware board.

<sup>1</sup> The Enable/Disable functionality and the operative mode of the serial ports may be selected by pair.

## Chapter 4 Serial port hardware modification

This chapter is intended to give you necessary information to modify the COM-1270 default hardware settings to allow you reaching the high speed capability.

If you want to exceed the RS232 serial speed of 250Kbps you have to remove the driver speed limitation, this may be done only for J12, J13, J14 and J11 connectors which have the capability to be bypassed inserting zero ohm resistors packs operating the serial ports in TTL mode; to do this hardware modification are needed as described in the following table:

Serial	RS232 (factory default)	TTL
J11	U16 installed	Remove U16, install 0Ohm CAT16 Resistor Pack RP9, RP10
J12	U17 installed	Remove U17, install 0Ohm CAT16 Resistor Pack RP15, RP16
J13	U19 installed	Remove U19, install 0Ohm CAT16 Resistor Pack RP13, RP14
J14	U18 installed	Remove U18, install 0Ohm CAT16 Resistor Pack RP11, RP12

Table 5. TTL Hardware modifications

To modify the reference clock of the Exar ST16C554 you've to configure the R14, R15 and R16 R0805 resistors as described in the following table:

R14	R15	R16	Frequency
Mounted	Mounted	Mounted	23.96160
Mounted	Mounted	Removed	22.11840
Mounted	Removed	Mounted	18.43200
Mounted	Removed	Removed	16.58800
Removed	Mounted	Mounted	14.74560
Removed	Mounted	Removed	11.05920
Removed	Removed	Mounted	9.21600
Removed	Removed	Removed	7.37280 (factory default)

Table 6. R14, R15, R16 settings



If you need to move the JPS2 solder jumper position, please note that between pin 1 and 2 there's a wire on the PCB that must be cutted to prevent conflicts. The 2-3 JPS2 position is necessary if you want to send a custom clock to the Exar ST16C554 chipset.



To prevent damages to the board all the modifications described in this chapter have to be made by technical prepared personnel.



## Chapter 5 Exar ST16C554 Register List

This chapter is dedicated to list all the Exar ST16C554 registers as a short reference for the programmer. For a detailed description of each register please refer to the component data sheet.

A2	A1	A0	Register [Note *5]	BIT-7	BIT-6	BIT-5	BIT-4	BIT-3	BIT-2	BIT-1	BIT-0
<b>General Register Set</b>											
0	0	0	RHR[XX]	bit-7	bit-6	bit-5	bit-4	bit-3	bit-2	bit-1	bit-0
0	0	0	THR[XX]	bit-7	bit-6	bit-5	bit-4	bit-3	bit-2	bit-1	bit-0
0	0	1	IER[00]	0	0	0	0	modern status interrupt	receive line status interrupt	transmit holding register	receive holding register
0	1	0	FCR	RCVR trigger (MSB)	RCVR trigger (LSB)	0	0	DMA mode select	XMIT FIFO reset	RCVR FIFO reset	FIFO enable
0	1	0	ISR[01]	FIFO's enabled	FIFO's enabled	0	0	INT priority bit-2	INT priority bit-1	INT priority bit-0	INT status
0	1	1	LCR[00]	divisor latch enable	set break	set parity	even parity	parity enable	stop bits	word length bit-1	word length bit-0
1	0	0	MCR[00]	0	0	0	loop back	-OP2/ INTx enable	-OP1	-RTS	-DTR
1	0	1	LSR[60]	FIFO data error	trans. empty	trans. holding empty	break interrupt	framing error	parity error	overrun error	receive data ready
1	1	0	MSR[X0]	CD	RI	DSR	CTS	delta -CD	delta -RI	delta -DSR	delta -CTS
1	1	1	SPR[FF]	bit-7	bit-6	bit-5	bit-4	bit-3	bit-2	bit-1	bit-0
<b>Special Register set: Note *2</b>											
0	0	0	DLL[XX]	bit-7	bit-6	bit-5	bit-4	bit-3	bit-2	bit-1	bit-0
0	0	1	DLM[XX]	bit-15	bit-14	bit-13	bit-12	bit-11	bit-10	bit-9	bit-8

Note \*2: The Special register set is accessible only when LCR bit-7 is set to "1".

Table 7. ST16C554 Register

## Chapter 6 Pratical example

Suppose you want to connect an high speed RS232 device operating at 500Kb to the COM-1270.

First of all you have to know that only J11, J14, J13 and J12 may be used to connect this device because it hasn't speed limitation operating in TTL mode.

Running at 500Kb need some hardware modification removing the U16, U17, U18, U19 RS232 serial drivers and install a 0 Ohm resistor packs (CAT16 package) for RP9, RP10, RP11, RP12, RP13, RP14, RP15 and RP16, this allow you to output TTL serial level.

You've then to make the proper baud rate selection, looking at the following relation you can find the proper Clock Divisor knowing that the Input Frequency is

$$\text{Baudrate} = \text{Input Frequency} / ( 16 * \text{Clock Divisor}_{\text{DEC}})$$

The Clock Divisor<sub>DEC</sub> became:

$$\text{Clock Divisor}_{\text{DEC}} = \text{Input Frequency} / ( 16 * \text{Baudrate})$$

With the clock frequencies listed on Table 2 you will obtain the following Clock Divisor rates:

Frequency [MHz] CPUCLK	Clock Divisor <sub>DEC</sub> Calculated	Clock Divisor <sub>DEC</sub> Approximed	Baud Rate Approximed	Baud Rate Error
23.96160	2,9952	3	499200	800
22.11840	2,7648	3	460800	39200
18.43200	2,304	2	576000	-76000
16.58800	2,0735	2	518375	-18375
14.74560	1,8432	2	460800	39200
11.05920	1,3824	1	691200	-191200
9.21600	1,152	1	576000	-76000
7.37280	0,9216	1	460800	39200

Note that with an input frequency of 23.96160MHz obtained configuring the R14, R15 and R16 as listed in the following table you reach the minimum difference between the obtained and the wanted baud rate (difference of 800baud).

R14	R15	R16
Mounted	Mounted	Mounted

To select the desired input frequency you've to modify the R14,R15 and R16 resistor position as listed below referring to Table 2.

Frequency is output from U3 pin 8 (JPS2 must be on 2-3 position – use a cutter to break the standard 1-2 default position).

Some time a little difference between the wanted and obtained baudrate is tolerated from the circuitry, so first to go on with other modifications try the configuration.

If you've stricked limitation on the baud rate frequency you can also change the crystal reference frequency to obtain the exactly baud rate value.

If you need an exactly baud rate frequency please refer to the Eurotech S.p.A.Techsupp to obtain a custom configuration.

After this your serial port is ready to operate at the desired baud rate.

## Related Documents

COM-1270 user's manual  
EXAR ST16C554 QUAD UART WITH 16-BYTE FIFO.S  
Cypress CT2292  
National Devices ADM211  
Maxim MAX483

<http://www.eurotech.it>

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