2500 Series®
Programmable Automation Control System

Serial Communications with CTI 2500 Series and Simatic/TI 505 Series PLC systems

Firstly, this application presents background information on RS232 communications.

Next are the details of RS232 port pinouts and communication cable requirements for CTI 2500 Series and Simatic/TI 505 Series PLC Systems.

Lastly, this document also includes an appendix with reference documents for the PLC hardware discussed.

RS-232 communications background

 RS-232 is an Electronics Industries Association (EIA) standard designed to aid in connecting equipment together for serial communications. The standard specifies connector types, pin assignments, voltage levels, etc. Even though the specification exsists, it was not specific enough, and allowed manufactures options for its implementation. This means that if two devices are connected together, they still may not communicate. The main problem exists in the wiring of cable between the two devices, but in order to see what type of cable is needed, we need to first see what type of devices are being connected together, and what handshaking signals are needed for each device.

DEVICE TYPES

There are two types of RS-232 devices: Data Terminal Equipment (DTE), and Data Communication Equipment (DCE). One main difference between the two types of equipment is how the connectors are wired. Personal computers with a serial port are almost always configured as a DTE type of device. A modem is always configured as a DCE type of device. The H-350, the H-500, and the H-370-L are configured as DTE types of devices. Even though the H-350 and the H-500 are configured for DTE operation, they use a female connector.

The connector for the DTE device has output pins that match up with input pins on the DCE device. This means that a straight through cable will normally work when connecting a DTE device to a DCE device. Notice in the two tables that follow, that the output pins of one type of device match the inputs of the other type of device. On the other hand, if two devices of the same type are to be connected together, then a special cable is needed. Contact WaterLOG support for any cabling questions or needs.

DTE Pinouts

The normal connector used for an RS-232 DTE device is a 9-pin male D connector. Older devices used a 25-pin male D connector. Yet other implementations may have used some completely different type of connector. Standard 9-pin to 25-pin adapters are available to convert from the old type connector to the new or vise versa. The following type shows the pin out for the 9-pin DTE connector.

PIN	DIRECTION	DESCRIPTION
DTE PIN OUT FOR A 9-PIN D CONNECTOR
1	Input	Carrier Detect (CD)
2	Input	Receive Data (RXD)
3	Output	Transmit Data (TXD)
4	Output	Data Terminal Ready (DTR)
5	N/A	Ground (GND)
6	Input	Data Set Ready (DSR)
7	Output	Request To Send (RTS)
8	Input	Clear To Send (CTS)
9	Input	Ring Indicator (RI)

The normal connector used for an RS-232 DCE device is a 9-pin female D connector. The following table shows the pin out for the 9-pin connector

DCE PIN OUT FOR A 9-PIN D CONNECTOR		
PIN	DIRECTION	DESCRIPTION
1	Output	Carrier Detect (CD)
2	Output	Receive Data (RXD)
3	Input	Transmit Data (TXD)
4	Input	Data Terminal Ready (DTR)
5	N/A	Ground (GND)
6	Output	Data Set Ready (DSR)
7	Input	Request To Send (RTS)
8	Output	Clear To Send (CTS)
9	Output	Ring Indicator (RI)

Note that pin 1 on the DTE device will drive pin 1 on the DCE device, likewise for pin 2. This correlation continues on for all the pins. This makes connecting a DTE device to a DCE device simple using a straight through cable. If connecting two DTE devices or DCE devices to each other, then the cable must be wired in order to prevent two outputs from driving each other, and two inputs connected together without any driving signal.

Signal Descriptions

There are three signal types: data signals, handshaking signals and a ground. The data signals and ground are always needed, but the handshaking signals may or may not be required.

|	
TXD	The TXD (Transmit Data) signal is the data signal from the DTE device to the DCE device, a PC to a modem for example.
RXD	The RXD (Receive Data) signal is the data input signal to the DTE device, a PC receives data from a modem on this signal.
DTR	Data Terminal Ready is activated by the DTE device when it is ready for communications. A PC normally activates this line when some type of terminal program, like Procomm, is run. When the program is terminated, the DTR signal goes inactive. This signal is the compliment of the DSR signal.
DSR	Data Set Ready is driven by the modem and goes active when the modem is powered and ready to receive data. This line is the compliment of the DTR signal.
RTS	Request To Send is activated by the DTE device when it is ready to receive data. This line is the compliment of the CTS signal.
CTS	Clear To Send is activated by the DCE device when it is ready to receive data. This line is the compliment of the RTS signal. A PC and modem using hardware flow control will handshake with these two lines to prevent internal data buffers from overrunning.
RI	Ring Indicator will go active as a modem is receiving a phone call. The modem sends this signal to the DTE device, which may or may not use it. A PC running a terminal emulation program may detect this signal and print a "RING" message to the screen.
CD	Carrier Detect will go active when one modem is receiving a signal from another modem over the phone line. When 2 modems establish a communication link, a carrier signal is transmitted between the 2 modems. As long as this carrier signal is present, the CD signal will be active.
GND	A ground connection is always required. It is used as the reference for both the data lines and the handshaking lines.

Basic Cable Configurations

The following sections show and describe some of the most common cable wiring diagrams. Normally one of these cables will work for most all applications. Some of these cables are also available at local computer stores or Radio Shack stores. Note that the pin numbers are for the 9-pin D connector.

Standard DTE to DCE Cable

This is a straight through cable and is readily available from most computer stores. This cable allows for all data and handshaking for a DTE device connected to a DCE device. This is the most common cable when using a PC (DTE) and a modem (DCE).
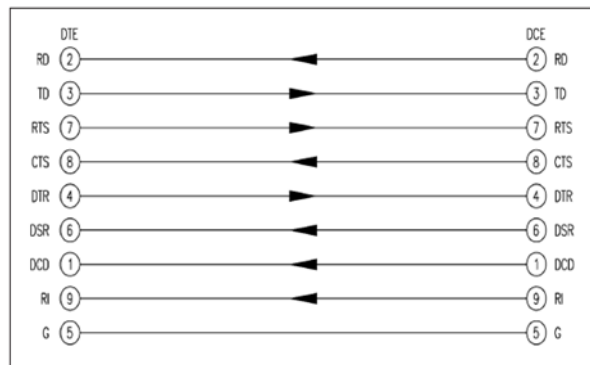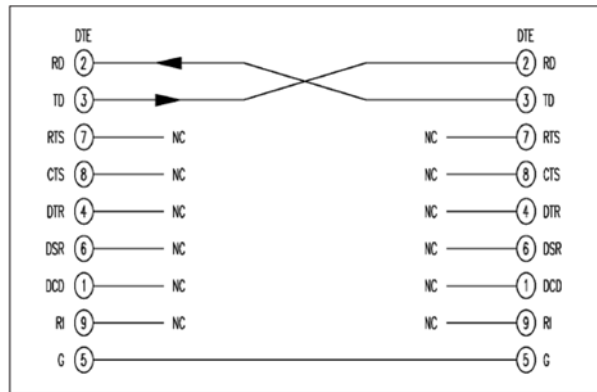

DTE to DCE Cable with Looped Handshaking

This cable provides for data to be transferred from one device to the other but the handshaking lines are looped back in such a way that the device will act as if the handshaking is operating normally. For example, as the DTE device enables DTR normally to signal the modem it is ready, it actually signals itself that the modem is ready. The modem may not be ready or may not even be connected, but the DTE device thinks it is ready. The same process works for the other signals also.
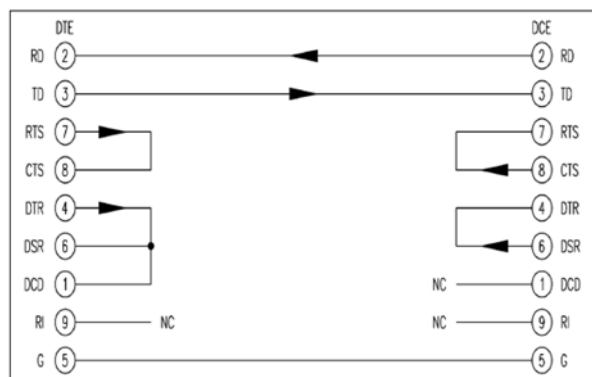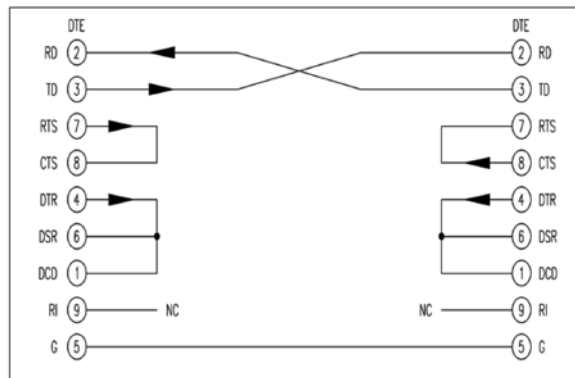
DTE to DCE Basic Three Wire Cable

Notice here that the transmit and receive lines have been swapped. This is what allows two DTE devices to be connected together. This cable does not take care of any of the handshaking signals. In some cases this is fine as the device in use may not be using them.

DTE to DTE with looped handshaking

This diagram shows the basic three wire cable with the addition of looping the handshake lines. This is a very common cable used in many applications, and is often called a "NULL Modem" cable. This type of cable makes a DTE device look like a DCE device.

DTE to DTE with handshaking

This diagram shows the basic three wire cable with the addition of the handshake lines also crossed so they can still be used. This cable is also common and is another variation of the "NULL Modem" cable.
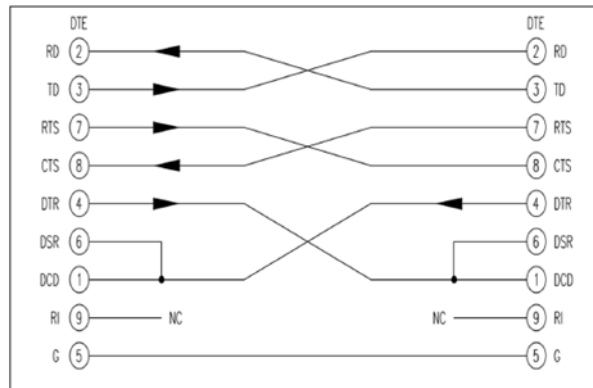
9-Pin to 25-Pin Conversion

9-Pin D Connector to 25-Pin D Connector Conversion		
9-PIN	25-Pin	DESCRIPTION
1	8	Carrier Detect (CD)
2	3	Receive Data (RXD)
3	2	Transmit Data (TXD)
4	20	Data Terminal Ready (DTR)
5	7	Ground (GND)
6	6	Data Set Ready (DSR)
7	4	Request To Send (RTS)
8	5	Clear To Send (CTS)
9	22	Ring Indicator (RI)

RS232 port pinouts and communication cable requirements

There are two types of cables normally used for serial communications with the CTI 2500 Series and the Simatc/TI 505 Series of PLC's:

TiSoft cable
Null Modem cable

NOTE:

This serial port connectivity could be used for connection of a programming tool such as 505WorkShop or TiSoft, as well as any multitude of HMI or other devices that support serial communication with the CTI 2500 Series or the Simatic/TI 505 Series of PLC's.

TiSoft cable

The early DOS programming environment for the TI505 Series - TiSoft - specified a unique cable pinout for their PLC platform that is a hybrid combination of the 'DTE to DTE with handshaking' cable and the 'DTE to DTE with looped handshaking' cable. This hybrid pinout for the most part is the 'DTE to DTE with handshaking' cable with the modification to the wiring for pins 7 & 8 which matches that of the 'DTE to DTE with looped handshaking' cable functions for pins 7 & 8.

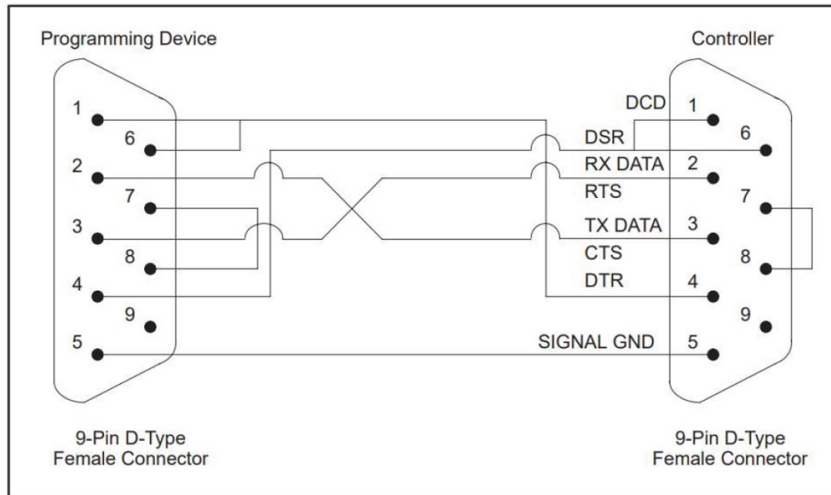Here is the cable pinout from the TiSoft manual:

Figure 1-3   RS-232-C 9-Pin to 9-Pin Cable

This programming cable is the only cable that will work on Simatic/TI 505 Series PLC's, and Remote I/O Remote Base Controller serial ports.
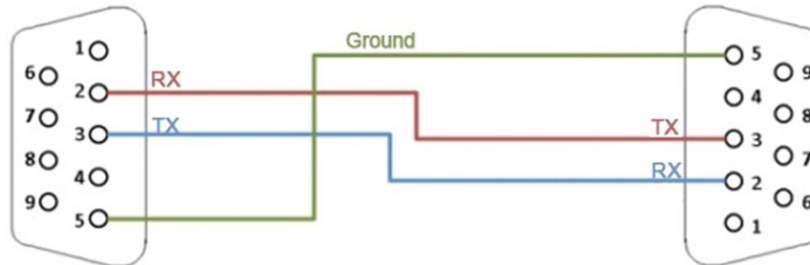
It will also work on Simatic/TI 505 Series Profibus Remote Base Controller serial ports.

Additionally, it will also work on all CTI 2500 Series PLC's and Remote I/O Remote Base Controller serial ports.

Null Modem cable

The standard Null Modem cable is the communication media that all CTI 2500 Series PLC's and Remote I/O Remote Base Controllers have been designed for use with.

Here is the pinout of that cable:

This programming cable will not work on the Simatic/TI 505 Series PLC's, and Remote I/O Remote Base Controller serial ports.

It will however, work on Simatic/TI 505 Series Profibus Remote Base Controller serial ports.

And it will work on all CTI 2500 Series PLC's and Remote I/O Remote Base Controller serial ports.

Summary

Below is a matrix of these two cable types and the serial ports that they each respectively will work on:
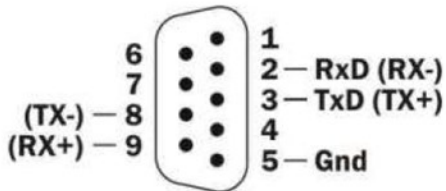
	TiSoft cable	Null modem cable
Simatic / TI		
545/555 PLC	yes	no
Remote I/O RBC	yes	no
Profibus I/O RBC	yes	yes
CTI		
Classic PLC	yes	yes
Remote I/O RBC	yes	yes
Profibus I/O RBC	n/a	n/a
Compact PLC	yes	yes
Remote I/O RBC	yes	yes
Profibus I/O RBC	n/a	n/a

Appendix

CTI 2500 Classic and Compact Series PLC (Programmable Logic Controller) serial port and pinout

Serial Port Pinout

The serial port supports both the RS-232 and RS-422 electrical interface. The electrical interface in use is selected by a dipswitch setting (see Section 2.3). The cable used with the interface must connect to the correct pins used by the electrical interface. See the following pinout diagram for the serial port DB-9 connector.

```
        6              1
        7              2 — RxD (RX-)
(TX-) — 8              3 — TxD (TX+)
(RX+) — 9              4
                       5 — Gnd
```

For RS -232 the following pins are used:

Pin	Signal	Description
2	RxD	Received Data
3	TxD	Transmitted Data
5	GND	Signal Ground

1.8 2500 Series Classic Controller Front Panel

1. **Operational Status LEDs**
   CPU GOOD
   RUN
   BATTERY GOOD

2. **Multi-Segment Display` (MSD)**

3. **Battery Holder**

4. **SD Card Slot**

5. **USB Port**

6. **Network LEDs**
   LS — Link Status
   NS- Network Status

7. **Ethernet Port**
   XMT LED — Flashes when transmitting
   RCV LED — Flashes when receiving

8. **Serial Communications Port**
   RS-232/RS-422)

9. **Profibus DP Port**

10. **Remote I/O Port**

1.9 2500 Series Compact Controller Front Panel

1. **Status LEDs**
   CPU GOOD
   RUN
   BATTERY GOOD

2. **Multi-Segment Display` (MSD)**

3. **USB Port**

4. **SD Card Slot**

5. **Network LEDs**
   LS – Link Status
   NS- Network Status

6. **Battery Holder**

7. **Ethernet Port**
   XMT LED – Flashes when transmitting
   RCV LED – Flashes when receiving

8. **Serial Communications Port**
   RS-232/RS-422)

9. **Profibus DP Port**

10. **Remote I/O Port**
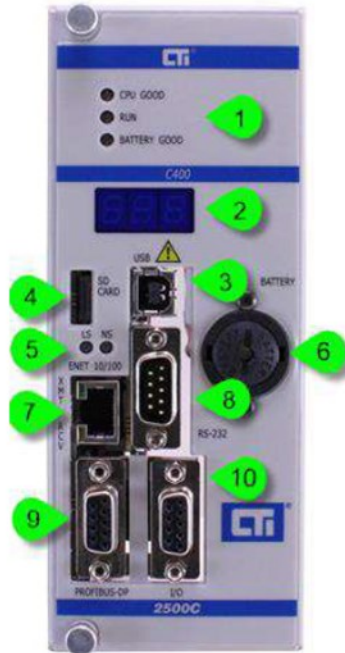
2.6. Connecting to the RS232 Port

The RS232 port is provided to interface to PLC programming and configuration tools such as TISOFT™. The use of this port is optional. A standard 9-pin PC RS232 serial cable can be used to connect to the programming device or modem. The port details are shown in *Figure 3*. Note that the serial port on the standby unit in a redundant RBC pair is inoperative. This is normal – the CPU makes no attempt to communicate with the serial port of the standby RBC. The standby unit is the one displaying a "C" on the front panel LED display.

9-Pin D-Shell Male Connector
Compatible with standard PC Serial Port

DSR (6)
RTS (7)
CTS (8)

DCD (1)
RxD (2)
TxD (3)
DTR (4)
SGND (5)

Figure 3. RS232 Serial Port

Figure 1. 2500-RIO-B Front Panel

2.7 Connecting to the RS232 Port

The RS232 port is provided to interface to PLC programming and configuration tools such as TISOFT™. The use of this port is optional. A standard 9-pin PC RS232 serial cable can be used to connect to the programming device or modem. The port details are shown in *Figure 3*.
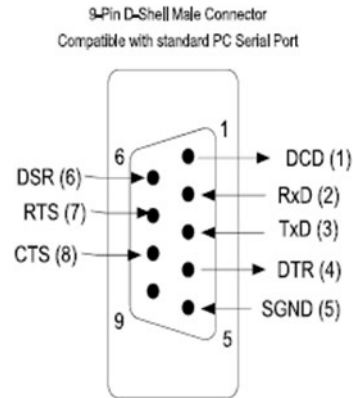
9-Pin D-Shell Male Connector
Compatible with standard PC Serial Port

DSR (6)
RTS (7)
CTS (8)

6
9

1
5

DCD (1)
RxD (2)
TxD (3)
DTR (4)
SGND (5)

Figure 3. RS232 Serial Port

2.4   2500C-RBC-RS485 Front Panel Layout

Status Indicator

RBC Address Selection Thumbwheel Switch

Serial RS-232 9pin Port

Remote RS-485 9pin Port

STATUS

RBC-RS485

BASE

STATUS CODES
0-RBC GOOD
1-SELF DIAG FAILURE
2-MODULE MISMATCH
3-I/O COMM TIME OUT
4-RAM PARITY ERROR
5-STANDBY, NO CONF
6-ADDR MISMATCH
7-COMM OK, NO CONF
8-WATCHDOG TIME OUT
C-STANDBY, CONF
A,B,E-INTERNAL ERROR
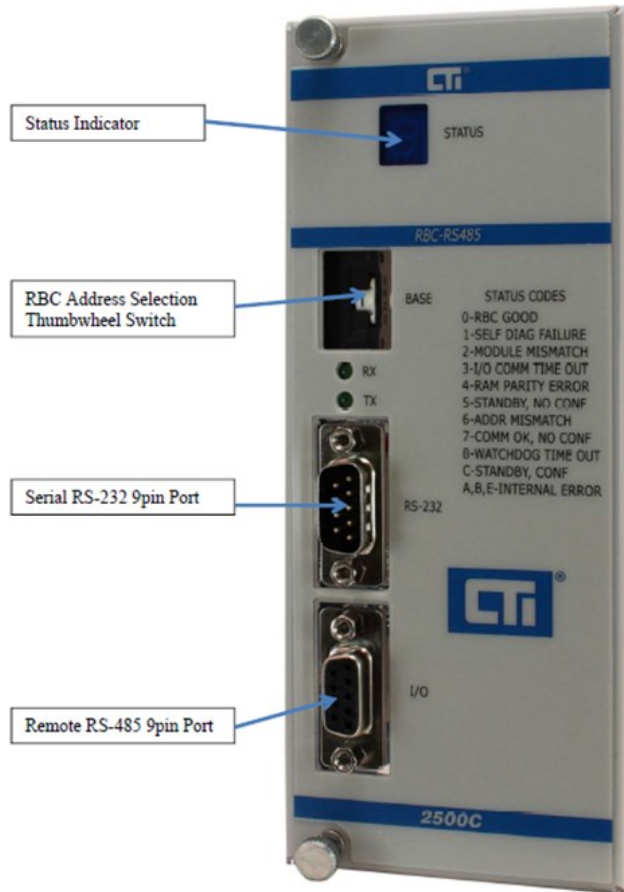
RX
TX

RS-232

I/O

2500C

Figure 3. 2500C-RBC-RS485 Front Panel

NOTE:

Serial port operations for end-user use are not currently implemented in this product.
The Serial Port is for CTI internal use and connection only

Figure 1. 2500-RBC Front Panel

NOTE:

USB port operations for end-user use are not currently implemented in this product.
The USB Port is for CTI internal use and connection only

Figure 1. 2500C-RBC-PRF Front Panel

Port 1
RS-232 Port Pinouts
Controller
Male 9-Pin D Type

Pin	Signal
1	RSD
2	RCV
3	XMT
4	DTR
5	GND
6	DSR
7	RTS
8	CTS

Port 2[1]
RS-232 Port Pinouts
Controller
Male 9-Pin D Type

Pin	Signal
2	RCV
3	XMT
5	GND
6	SEL232*

(3)

Port 2[1]
RS-422 Port Pinouts
Controller
Male 9-Pin D Type

Pin	Signal
3	DO+
9	DI+
5	GND
8	DO–
2	DI–
6	SEL232*

Port 2[2]
RS-485 Port Pinouts
Controller
Male 9-Pin D Type

Pin	Signal
3	TX/RX+
8	TX/RX–
5	GND
6	SEL232*

(1) Dipswitch 1 is On.
(2) Dipswitch 1 is Off.
(3) User connection to select RS-232 operation.

120 Ω termination resistors can be used for higher noise immunity and more reliable long-distance communication.
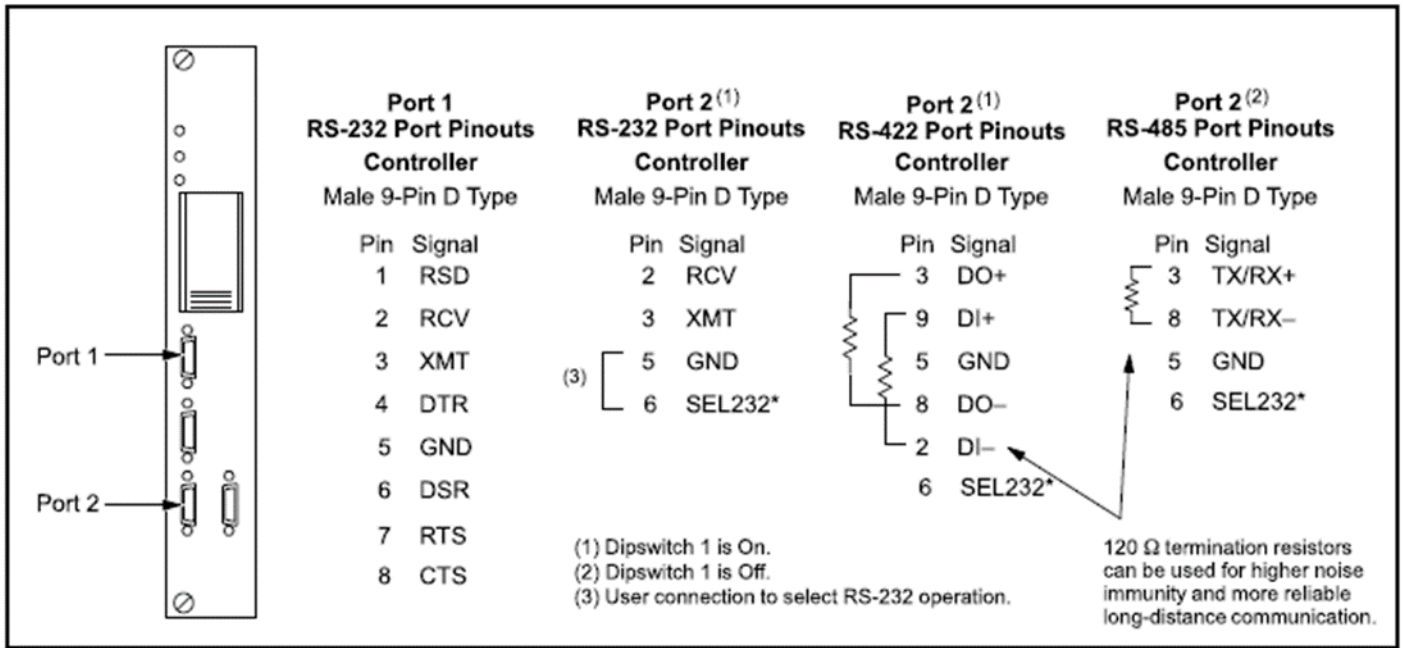
Figure 3-13   545/555 CPU Port Locations

Simatic/TI 505 Series Remote I/O RBC (Remote Base Controller) serial ports and pinouts

Series 505 RBCs, including the 505 PROFIBUS-DP RBC, have two communication ports.

RS-232 Port

The RS-232 port is an interface to programming devices that use software like TISOFT or other configuration tools. To connect your RBC to a programming device/modem, use a standard 9-pin RS-232 serial cable that conforms at a minimum to the pinouts shown in Figure 5-3. A standard cable that conforms to the minimum requirements is available through Siemens; specify part number 2601094–8001.
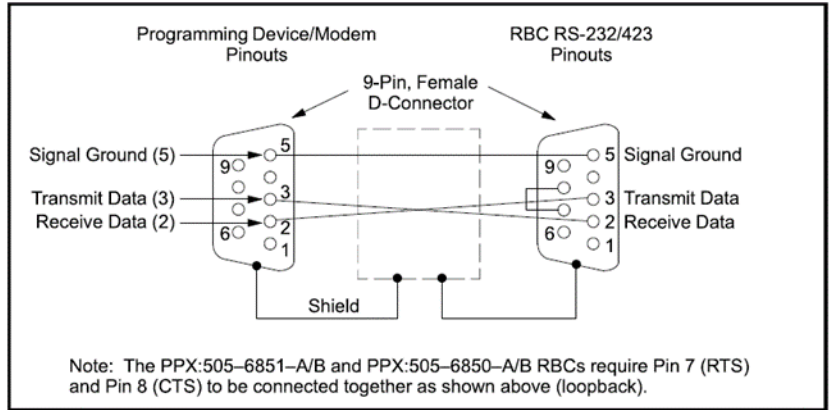

Figure 5-3 RS-232 Serial Port, Minimum Cable Pinouts
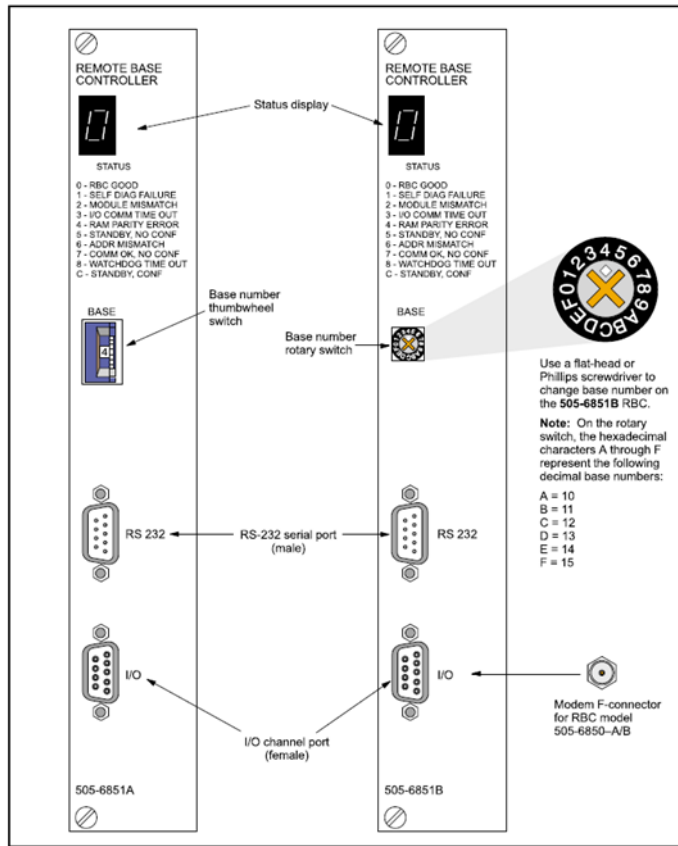
PPX:505–6851–A/B and PPX:505–6850–A/B RBCs (continued)

Figure 5-7 RBC Status Display and Base Number Switch

The 505 and 500 PROFIBUS-DP RBCs have two communication ports, an RS-232 port and a PROFIBUS-DP I/O channel port.

RS-232 Port

When used with a Series 505 CPU, the RS-232 port is an interface to programming devices that use software like TISOFT or other configuration tools. To connect your RBC to a programming device/modem, use a standard 9-pin RS-232 serial cable that conforms at a minimum to the pinouts shown in Figure 4. A standard cable that conforms to the minimum requirements is available through Siemens; specify part number 2601094–8001.
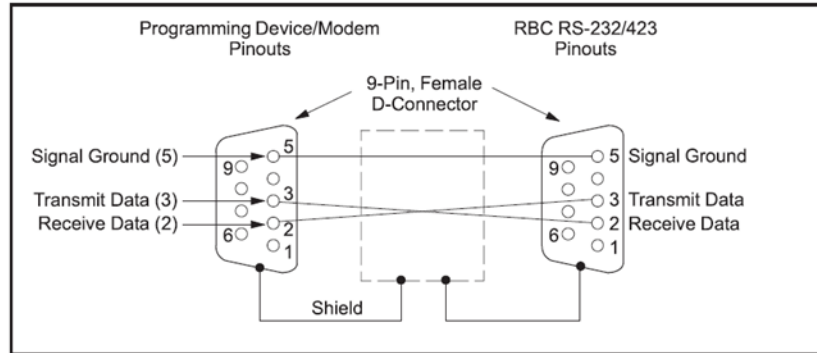

Figure 4   RS-232 Serial Port, Minimum Cable Pinouts

PPX:505–6870 RBC (continued)

Dipswitch Options

You can select the RS-232/423 baud rate, RBC station address, and display mode of the RBC status display by setting a dipswitch that is accessible from the bezel of the RBC. Figure 5-10 shows the location of the dipswitch.
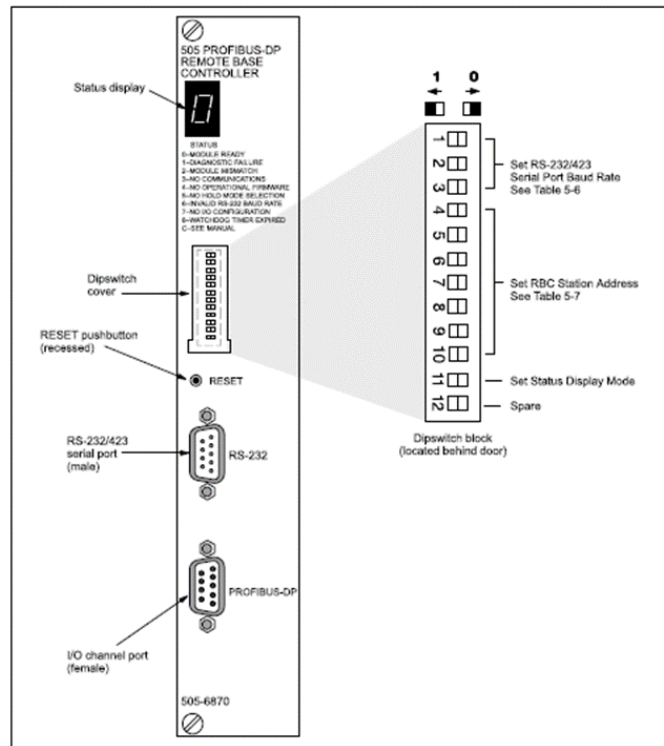

Figure 5-10   505 PROFIBUS-DP Remote Base Controller

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