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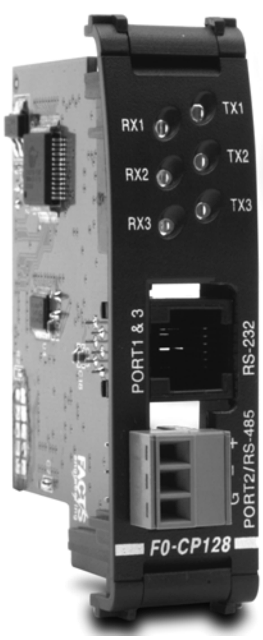
Direct Logic 05 and 06

Triple Port BASIC CoProcessor

F0-CP128

User's Manual



Manual Order Number: F0-CP-M

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MANUAL HISTORY

Refer to this history in all correspondence and/or discussion of this manual.

Title: Direct Logic 05 and 06 Triple Port BASIC CoProcessors User's Manual
Part Number F0-CP-M

Issue / Date	Effective Pages	Description of Changes
Prelim 2/2005		First Draft
Prelim 8/2005	Front Cover, 10,12,13,15,16,17,19, 21,22,23,34	Added B&W Picture Various Corrections and Removed references to COMMAND@2
Prelim 9/2005	11,14,15,18,19	Misc Corrections
First 9/2005	17,19	First Edition – Corrections
August 2010	9,11,14,17	Removed references to ONPLC

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CHAPTER 1 : INTRODUCTION

This manual describes details specific to the 05 and 06 BASIC CoProcessor. This document should be used to supplement the FACTS Extended BASIC User's Reference (FA-BASIC-M) when programming the FACTS Engineering 05 and 06 CoProcessor modules.

05 and 06 CoProcessor modules are installed in the expansion slot of a D0-05 brick or in any of the four expansion slots in a D0-06 brick.

The CoProcessor module communicates to the DL05 or DL06 PLC CPU using the S06_, BMOVE, and DPORT instructions. A high speed dual port RAM interface, across the parallel bus of the DL05 or DL06 backplane, is used for CoProcessor to PLC and PLC to CoProcessor communications. Up to 256 bytes can be transferred by the CoProcessor in one PLC scan using the BMOVE instruction. No PLC ladder logic is required for CoProcessor to PLC or PLC to CoProcessor communications. The CoProcessor does not take any X's or Y's from the PLC CPU's memory map.

The CoProcessor module communicates to external devices using the built in serial port(s).

CPU SYNCHRONIZATION

Upon application of power the CoProcessor resets and establishes communication with the DL05 or DL06 PLC CPU. Next the operating mode saved by the last AUTOSTART command is executed. Please see AUTOSTART in the FACTS Extended BASIC User's Reference for additional information.

The CoProcessor does not reset when the PLC CPU is out of RUN mode. If desired, the current state of the PLC CPU may be determined by examining Special Purpose relays SP11-20. See Chapter 2 (CoProcessor Statements) for a description of the S06_ statement. See the DL05 or DL06 User's Manual for a description of PLC CPU special relays.

Example

```
10   IF S06_SP(11) THEN PRINT "Forced running state"
20   IF S06_SP(12) THEN PRINT "TERM RUN state"
30   IF S06_SP(13) THEN PRINT "TEST RUN state"
40   IF S06_SP(15) THEN PRINT "TEST PGM state"
50   IF S06_SP(16) THEN PRINT "TERM PGM state"
60   IF S06_SP(17) THEN PRINT "Forced STOP state"
70   IF S06_SP(20) THEN PRINT "PGM Mode"
```

Often a CPU control relay or stage status is used as a permissive in the BASIC program. Control relays and stage status bits are used to communicate program status information to the CoProcessor. For example, a control relay may be used to signal the start of a shift report or to simply indicate that the PLC CPU is running.

Example

```
10   IF S06_C(0) THEN PRINT "CR 0 Energized"
20   IF S06_SG(10) THEN PRINT "Stage 10 is active"
```

COMMAND@

Function Selects the programming port

Syntax COMMAND@ *port*

Usage *port* is either 1 or 3 and specifies the programming/command port. BASIC sends all messages to and accepts only COMMANDs from the specified port.

The factory default programming/command port is Port 1 at 9600 baud.

Use the SETPORT statement to change the power-up baud rate of any of the serial ports.

Use COMMAND@ to debug communications with an external device connected to another port. COMMAND@ can be used to get complete utilization of both ports while minimizing the need for cable swapping or the use of switch boxes.

Example Assume the program for a diagnostic/shift report printer connected to Port 3 has been completed. Now it is desired to operate a stepper motor controller using Port 1. To begin programming the stepper:

```
>SETPORT 3, 9600    Sets the baud rate for Port 3
>COMMAND@3          Programming port is now Port 3
```

Move the programming device cable from Port 1 to Port 3. A cable splitter is include for this purpose.

To go back to programming at Port 1, enter COMMAND@1

CHAPTER 2 : COPROCESSOR STATEMENTS

BMOVE

Function Directly access a block of DL05 or DL06 CPU memory

Syntax BMOVE *direction*, *starting operand*(*number*), *ending operand*(*number*)
BMOVE *direction*, *starting operand*(*number*), K (*number of bytes*)

See Also DPORT and S06_

Usage Up to 256 bytes of DL05 or DL06 memory may be read or written in one scan using BMOVE. Memory in the PLC CPU is referenced using any one of 11 different operands specified with an octal address *number*.

Block move begins in the CoProcessor at dual port memory location DPORT(0) and in the PLC CPU at *starting operand*(number). The block move continues through consecutive memory addresses up to and including *ending operand*(number). Alternately, the number of bytes to transfer may be specified as an expression in parenthesis following "K". If *number* of bytes is 0 then 256 bytes will be copied.

Use either a "R" or "W" for *direction* to specify a PLC CPU memory Read or Write. "R" will read PLC CPU memory and copy to DPORT memory. "W" will read DPORT memory and copy to PLC CPU V-memory.

If *starting operand* or *ending operand* is a BIT data type, the entire V-Memory address containing the operand is used.

IEEE Floating Point

Numeric Variables in the CoProcessor module are stored internally as a floating point value in the range of ±1E-127 to ±.99999999E+127. The PLC CPU can store numbers as a BCD, BINary, or as an IEEE floating point value in the range of ±3.402822E±38. If you are using IEEE floating point values in the PLC and you want to operate on those values in the CoProcessor module use BMOVE and DPORT with the R *portion* or S06_VR.

Octal numbering and data types for BMOVE operands

DL05 BMOVE Operands

Description	*Operand*	Qty	Octal numbering	Data Type	V-Memory Octal Word
Timer Current Count Current	T CT	128 128	0-177 0-177	BCD BCD	0-177 1000-1177
V-Memory Volatile Non-volatile System Parameters	VH	 3968 128 128	 1200-7377 7400-7577 7600-7777	HEX or BCD or Float	 1200-7377 7400-7577 7600-7777
Inputs Outputs Internal Relays Stage Status Timer Status Counter Status Special Relays (Read Only)	X Y C SG TS CS SP	256 256 512 256 128 128 512	0-377 0-377 0-777 0-377 0-177 0-177 0-777	Bit Bit Bit Bit Bit Bit Bit	40400-40417 40500-40517 40600-40637 41000-41017 41100-41107 41140-41147 41200-41237

DL06 BMOVE Operands

Description	*Operand*	Qty	Octal numbering	Data Type	V-Memory Octal Word
Timer Current Count Current	T CT	256 128	0-377 0-177	BCD BCD	0-377 1000-1177
V-Memory Volatile Non-volatile System Parameters	VH	 192 3200 4096 128 64 128 1024	 400-677 1200-7377 10000-17777 7400-7577 700-777 7600-7777 36000-37777	HEX or BCD or Float	 400-677 1200-7377 10000-17777 7400-7577 700-777 7600-7777 36000-37777
Inputs Outputs Internal Relays Stage Status Timer Status Counter Status Remote I/O Special Relays (Read Only)	X Y C SG TS CS GX GY SP	512 512 1024 1024 256 128 2048 2048 512	0-777 0-777 0-1777 0-1777 0-377 0-177 0-3777 0-3777 0-777	Bit Bit Bit Bit Bit Bit Bit Bit Bit	40400-40437 40500-40537 40600-40677 41000-41077 41100-41117 41140-41147 40000-40177 40200-40377 41200-41237

Example — Load a table of 6 constants into user V-Memory starting at V2000

```
10   REM   Load the table into dual port memory
20   DPORT(0)=10H
30   DPORT(2)=20H
40   DPORT(4)=25H
50   DPORT(6)=30H
60   DPORT(8)=100H
70   DPORT(10)=9798H
80   REM   Copy the table to PLC CPU V-Memory
90   BMOVE W, VH(2000), K(12)
```

Example — Multiply a range of user V-Memory by a constant value

```
10   BMOVE R, VH(2000), K(32) : REM  Get the values
20   REM   Multiply by 2.5
30   FOR ADDR = 0 TO 31 STEP 2
40   DPORT(ADDR)=DPORT(ADDR)*2.5
50   NEXT ADDR
60   BMOVE W, VH(2000), K(32) : REM Put the values back
```

Example — Get the DL240 X (Input) image table

```
10   BMOVE R, X(0), X(477)
```

Advanced — If no operand is specified then address number is the hexadecimal representation of the Octal V-Memory address (7FH = Octal V-Memory 177). BMOVE R, VH(2000), K(10) is the same as BMOVE R, (400H), K(10).

This feature simplifies FOR-NEXT loops and other types of "calculated" PLC memory accesses.

Example — Find all user V-Memory locations which match a constant

```
10 K = 1234 : REM   Match value
15 REM   Search V-Memory V2000-V7777
20 FOR INDEX=400H TO 1000H STEP 127 : REM 2 BYTES/V-MEM
30 BMOVE R, (INDEX), K(127)
40 FOR ADDR = 0 TO 125 STEP 2
50 IF DPORT(ADDR)<>K THEN 70
60 PRINT1 "Matched at V-Memory hex address = ",
62 PRINT1 HEX$(INDEX+ADDR)
70 NEXT ADDR
80 NEXT INDEX
```

DPORT

Function Read or write memory shared with the DL05 or DL06 PLCs

Syntax DPORT (*address*, *portion*) = expression
variable = DPORT (*address*, *portion*)

Usage DPORT (dual port memory) is used in conjunction with the BMOVE (block move) statement to access the PLC CPU.

The DPORT operator retrieves the value at the dual port memory address and assigns it to the variable.

The DPORT statement stores the value of expression at the dual port memory address.

address is an expression from 0 to 516, which selects two bytes of dual port memory. DPORT retrieves or assigns an integer value (0 to 65535) at address.

portion is optional and is used to specify a bit position, a nibble (group of 4 bits), a byte (group of 8 bits), a BCD word (2 bytes), or an IEEE Floating Point value (4 bytes).

Use "B(n)" to specify one of 16 bit positions, where n = 0-15.
Use "N(n)" to specify one of four nibbles, where n = 0-3.
Use "H" to specify the high byte or use "L" to specify the low byte.
Use "B" to specify a word hexadecimal to BCD conversion.
Use “R” to specify a BASIC Floating Point to IEEE Floating Point conversion.

The first 256 bytes of dual port memory, DPORT(0) to DPORT(255), are used by the BMOVE statement when reading from or writing data to the PLC.

IEEE Floating Point

Numeric Variables in the CoProcessor module are stored internally as a floating point value in the range of ±1E-127 to ±.99999999E+127. The PLC CPU can store numbers as a BCD, BINary, or as an IEEE floating point value in the range of ±3.402822E±38. If you are using IEEE floating point values in the PLC and you want to operate on those values in the CoProcessor module use BMOVE and DPORT with the R *portion* or S06_VR.

Example Retrieve a 4 digit BCD (0-9999) value from dual port memory

```
10   REM   Put a BCD number at V-Memory 2000
20   S06_VB(2000)=1234
30   REM   Get it back with a block move
40   BMOVE R, VH(2000), K(2)
50   PRINT1 "BCD value at V-Memory 2000 =",
52   PRINT1 HEX$(DPORT(0))
```

NOTE: Use DirectSoft DataView and BCD/HEX display format to view BCD data in the PLC.

Example Store 8 digit BCD (0-99999999) values in V-Memory 2000 and 2001 using BMOVE

```
10   DPORT(0) = 1234H : REM  Constant for V-Memory 2000
20   A = 5678 : REM A Must be a BCD value from 0 - 9999
30   DPORT(2) = VAL("0"+STR$(A)+"H") : REM Same as DPORT(2,B)=A
40   BMOVE W, VH(2000), VH(2001)
```

NOTE: Use DirectSoft DataView and BCD/HEX display format to view BCD data in the PLC.

Example Retrieve a Hex/Integer (0-FFFFH/0-65535d) value from dual port memory

```
10   REM   Put a Hex/Decimal number at V-Memory 2000
20   S06_VH(2000)=1234
30   REM   Get it back with a block move
40   BMOVE R, VH(2000), K(2)
50   PRINT1 "Integer value at V-Memory 2000 =",
52   PRINT1 HEX$(DPORT(0))
```

NOTE: Use DirectSoft DataView and Decimal display format to view Integer data in the PLC.

Example Store a PLC Floating Point value then retrieve a value

```
10 REM Write a Float Value to V1400/1401 and Read a Float from V1410/1411
20 DPORT(0,R)= +3.402822E+38
30 BMOVE W,VH(1400),K(4) : REM Floats use 2 words/4 bytes
40 BMOVE R,VH(1410),K(4) : REM Floats use 2 words/4 bytes
50 X=DPORT(0,R)
```

NOTE: Use DirectSoft DataView and Real or Exponential display format to view IEEE Floating Point data in the PLC.

Example

Using DPORT with PICK statement type modifiers

```
1000   V=1120H
1010   DPORT(0)=V :  PRINT1 "Retrieving values from DPORT"
1020   PH1. "DPORT(0) = ",V," in hexadecimal"
1030   PRINT1 "1st nibble = ",DPORT(0,N(0)), SPC (5),
1040   PRINT1 "3rd nibble = ",DPORT(0,N(2))
1050   PRINT1 "DPORT(0) in binary = "; :  FOR BT=15 TO 0 STEP -1
1060   IF DPORT(0,B(BT)) THEN  PRINT1 "1"; ELSE  PRINT1 "0";
1070   NEXT BT :  PRINT1
1080   PH1. DPORT(0),
1090   PRINT1 " or ",V," treated as BCD = ",DPORT(0,B)," decimal"
1100   HB=DPORT(0,H) :  REM   Swap the bytes
1110   DPORT(0,H)=DPORT(0,L) : DPORT(0,L)=HB
1120   PH1. "Value with bytes swapped = ",DPORT(0)
1130   PRINT1  :  PRINT1 "Assigning bits and nibbles in DPORT"
1140   DPORT(0)=0
1150   FOR BT=0 TO 15
1160   DPORT(0,B(BT))=1
1170   IF BT=8 THEN  PRINT1
1180   PH1. DPORT(0), SPC (3),
1190   NEXT  :  PRINT1
1200   DPORT(0)=0
1210   FOR N=0 TO 3
1220   DPORT(0,N(N))=0FH
1230   PH1. DPORT(0), SPC (3),
1240   NEXT  :  PRINT1
1250   PRINT1 "BCD ASSIGNMENT"
1260   DPORT(0,B)=1120
1270   PH1. DPORT(0)," = 1120"
READY
>run
Retrieving values from DPORT
DPORT(0) = 1120H in hexadecimal
1st nibble = 0     3rd nibble = 1
DPORT(0) in binary = 0001000100100000
1120H or 4384 treated as BCD = 1120 decimal
Value with bytes swapped = 2011H

Assigning bits and nibbles in DPORT
0001H   0003H   0007H   000FH   001FH   003FH   007FH   00FFH
01FFH   03FFH   07FFH   0FFFH   1FFFH   3FFFH   7FFFH   FFFFH
000FH   00FFH   0FFFH   FFFFH

BCD ASSIGNMENT
1120H = 1120
```

S06_

Function Directly access PLC CPU memory

Syntax S06_*operand*(*number*) = expression
variable = S06_*operand*(*number*)

Shorthand S. *operand*(*number*)

See Also BMOVE and DPORT

Usage PLC CPU memory may be accessed directly each scan using any one of 12 different operands specified with an octal address *number*.

The S06_ statement moves the value of expression into the PLC CPU memory address specified by operand(*number*). If the memory address is written to by the PLC CPU ladder program, the S06_ statement will be overridden.

The S06_ operator copies the value from the PLC CPU memory address specified by operand(*number*) into a numeric variable.

S06_ values will be BCD (VB), HEXadecimal (VH), BIT (X,Y,C etc.) or IEEE Floating Point (VR) data types depending on the operand used. Discrete operands such as I/O points and control relays operate on bits and return logical values. Timer and counter accumulated values are in BCD.

The table below specifies the octal numbering and data types for each of the S06_ operands (typical VB and VH operand usage is shown).

IEEE Floating Point

Numeric Variables in the CoProcessor module are stored internally as a floating point value in the range of ±1E-127 to ±.99999999E+127. The PLC CPU can store numbers as a BCD, BINary, or as an IEEE floating point value in the range of ±3.402822E±38. If you are using IEEE floating point values in the PLC CPU and you want to operate on those values in the CoProcessor module use BMOVE and DPORT with the R *portion* or S06_VR.

Octal numbering and data types for S06_ operands

DL05 CPU S06_ Operands

Description	*Operand*	Qty	Octal numbering	Data Type	V-Memory Octal Word
Timer Current Count Current	T CT	128 128	0-177 0-177	BCD BCD	0-177 1000-1177
V-Memory Volatile Non-volatile System Parameters	VH VB VR	 3968 128 128	 1200-7377 7400-7577 7600-7777	HEX or BCD or Float	 1200-7377 7400-7577 7600-7777
Inputs Outputs Internal Relays Stage Status Timer Status Counter Status Special Relays (Read Only)	X Y C SG TS CS SP	256 256 512 256 128 128 512	0-377 0-377 0-777 0-377 0-177 0-177 0-777	Bit Bit Bit Bit Bit Bit Bit	40400-40417 40500-40517 40600-40637 41000-41017 41100-41107 41140-41147 41200-41237

DL06 CPU S06_ Operands

Description	*Operand*	Qty	Octal numbering	Data Type	V-Memory Octal Word
Timer Current Count Current	T CT	256 128	0-377 0-177	BCD BCD	0-377 1000-1177
V-Memory Volatile Non-volatile System Parameters	VH VB VR	 192 3200 4096 128 64 128 1024	 400-677 1200-7377 10000-17777 7400-7577 700-777 7600-7777 36000-37777	HEX or BCD or Float	 400-677 1200-7377 10000-17777 7400-7577 700-777 7600-7777 36000-37777
Inputs Outputs Internal Relays Stage Status Timer Status Counter Status Remote I/O Special Relays (Read Only)	X Y C SG TS CS GX GY SP	512 512 1024 1024 256 128 2048 2048 512	0-777 0-777 0-1777 0-1777 0-377 0-177 0-3777 0-3777 0-777	Bit Bit Bit Bit Bit Bit Bit Bit Bit	40400-40437 40500-40537 40600-40677 41000-41077 41100-41117 41140-41147 40000-40177 40200-40377 41200-41237

Example Using bit data type operands:

```
10 REM   Display status on Input X4
20 IF S06_X(4) THEN PRINT1 "ON" ELSE PRINT1 "OFF"

10 REM Turn ON PLC CPU internal Control Relay C400
20 S06_C(400) = 1

10 REM Output Y23=OFF if CT2 is ON and X17 is OFF
20 IF S06_CS(2).AND.NOT(S06_X(17)) THEN S06_Y(23) =0
```

Example Using BCD data type operands:

```
10 REM  Display current count for CNT C10 and TMRF T0
20 PRINT1 "Counter 10 = ",S06_CT(10)
30 PRINT1 "Timer 0 = ",S06_T(0)/100

10 REM   Divide the current count of CNT C7 by 2
20 S06_CT(7) = S06_CT(7)/2

10 REM Value from Analog Input is in V-Memory 2000
20 REM V-Memory 2001 gets the value for an Analog Out
30 REM Keep the Analog Out proportional to Analog In
35 SCALE=.5 : OFFSET=100
40 AOUT = S06_VB(2000) * SCALE - OFFSET
50 REM Limit range of Analog Out value (0-4095)
60 IF AOUT < 0 THEN AOUT = 0
70 IF AOUT > 4095 THEN AOUT = 4095
80 S06_VB(2001) = AOUT
```

Example Using hexadecimal data types:

```
10   REM   Display the current scan time
20   PRINT1 "Current scan time = ",S06_VH(7775)
```

Advanced The V-Memory numbering for each operand is shown in the previous table. The VH and VB operands may be used to access any portion of V-Memory.

Display current count for CNT C0

```
>P. S.VB(1000)
```

Display status of first 16 Input points, X0 - X17

```
>P. S.VH(40400)
```

S06_ with no operand permits hexadecimal V-Memory addressing. The V-Memory hexadecimal address is equal to the octal address. S06_VH(2000) is the same as S06_(400H). This feature is useful for FOR-NEXT loops and other types of "calculated" PLC memory accesses.

CHAPTER 3 : F0-CP128 Triple Port OverDrive CoProcessor

F0-CP128 GENERAL SPECIFICATIONS

Mounting Requirement	- Any option card expansion slot
Power Consumption	- 150 mA @ 5 Vdc maximum (supplied by 05 or 06 base)
Operating Environment	- 0 to 60 degrees C (32 to 140 degrees F) - 5 to 95% humidity (non-condensing)
Processor	- Cygnal C8051F123
Clock Speed	- 100 Mhz, up to 100 MIPS
User Memory	- 128K Total (64K Data, 64K Program) Non-volatile
Physical Connectors	- 1 Six Conductor RJ12 Plug (Port 1 and Port 3 RS-232) - 1 Three Position Removable Terminal Block (Port 2 RS-485)
Indicator LEDs	- TXD1, RXD1, TXD2, RXD2, RTS1/TXD3, CTS1/RXD3
Port 1	- RS-232 - 512000 Baud Maximum
Port 2	- RS-485 - 512000 Baud Maximum
Port 3	- RS-232 - 115200 Baud Maximum
Additional Features	- Battery Backed Calendar/Clock - Programmable from Port 1 or Port 3

F0-CP128 DESCRIPTION

This DL05/06 family compatible CoProcessor Module features 128K of non-volatile memory, three serial ports, real-time battery backed calendar clock, floating point math, and the FACTS Extended BASIC interpreter.

The Pipelined Instruction Architecture executes 70% of the processors instructions in 1 or 2 system clock cycles. A phase locked loop generates a 100 MHz internal system clock for up to 100 MIPS execution. The BASIC execution speed is about 10 times faster then previous generation products. Easy to maintain and develop Interpreted BASIC programs can now operate at speeds comparable to previous compiled BASIC, assembly language or C programs.

128K bytes of nonvolatile memory allows multiple program storage and execution, DL05 or DL06 nonvolatile V-Memory expansion, and retentive data storage and retrieval. Memory is battery backed for 10 years in the absence of power.

Port 1 is a high performance 512,000 baud maximum fully configurable RS-232 serial interface. Port 2 is a high performance 512,000 baud maximum fully configurable RS-485 serial interface. Port 3 is a 115,200 baud maximum fully configurable RS-232 serial interface. All three ports have 255 character type-a-head input buffers for simultaneous communication with three or more external devices.

The real-time battery-backed calendar clock maintains time and date when power outages occur. Time based BASIC interrupts can be programmed to .005 of a second.

Floating point math solves complex formulas to 8 significant digits.

The FACTS Extended BASIC interpreter has many features and statements that simplify control oriented programming.

Program from Port 1 or Port 3 (COMMAND@)

Flexible bit manipulation instruction (BITS and PICK)

Serial port and timer interrupts (ONPORT and ONTIME)

Extensive serial port control (SETPORT, SETINPUT, PRINT, INPUT, INPLEN, INLEN)

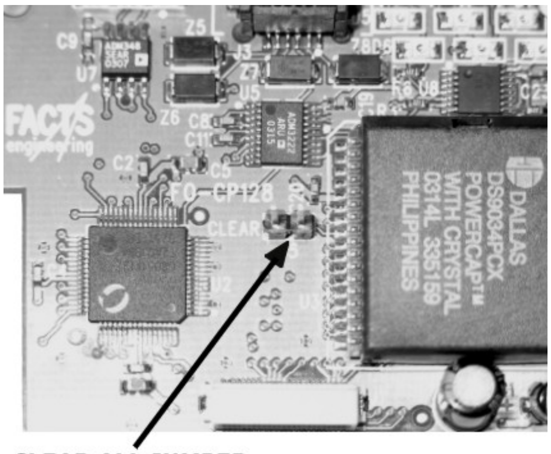
Extensive string manipulation instructions (MID$, LEFT$, RIGHT$, REVERSE$, ASC, CHR$, LCASE$, UCASE$, STR$, VAL, HEX$, OCTHEX$, DATE$, TIME$)

Debugging tools (TRACE, STOP, CONT)

Program chaining (GOPRM)

Statements and control structures common to most BASICs

F0-CP128 JUMPER DESCRIPTION AND LOCATION



CLEAR ALL JUMPER

CLR ALL

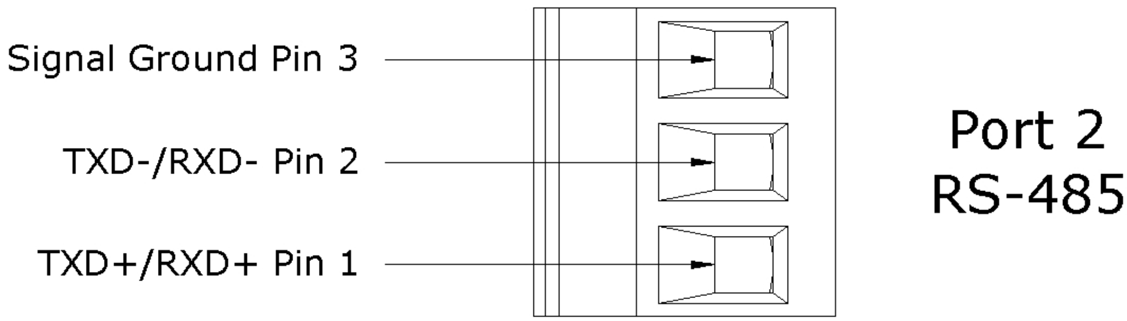
The CLR ALL jumper enables or disables an AUTOSTART mode reset.

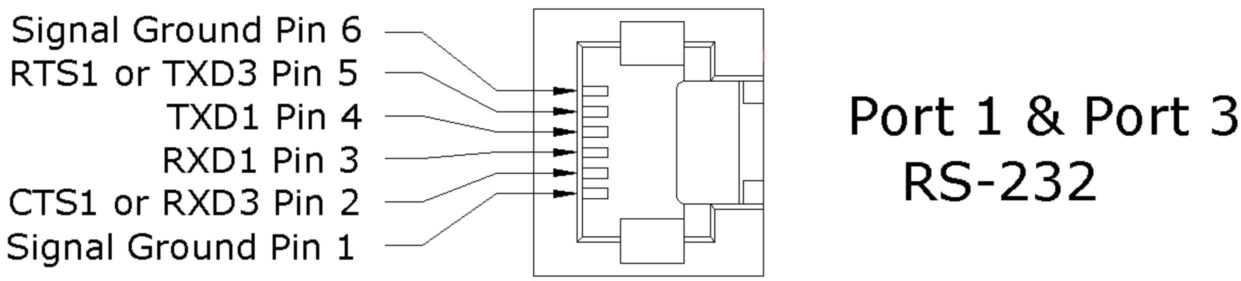
Placing the jumper on one post enables AUTOSTART mode. After power-up, the module will use the last stored AUTOSTART parameters. This is the default factory setting and the normal operating mode position.

Placing the jumper on both posts disables AUTOSTART and forces a clear all. Normally this is only done if all other measures to communicate with the CoProcessor have failed. This is also the only way to remove a LOCKOUT security statement. When the CoProcessor is powered-up with the CLR ALL jumper installed on both posts, COMMAND is at Port 1 and the Port 1 baud rate is 9600.

CAUTION: Installing the CLR ALL jumper will erase program 0, all stored variables, cancel a COMMAND@2, remove LOCKOUT, and clear stored AUTOSTART information.

F0-CP128 PORT PINOUTS



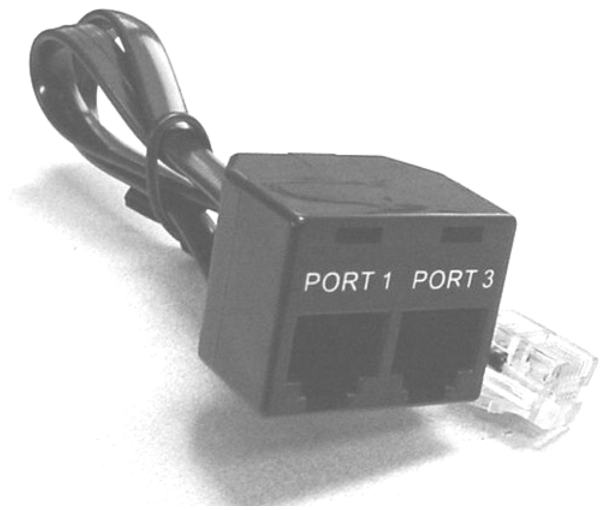


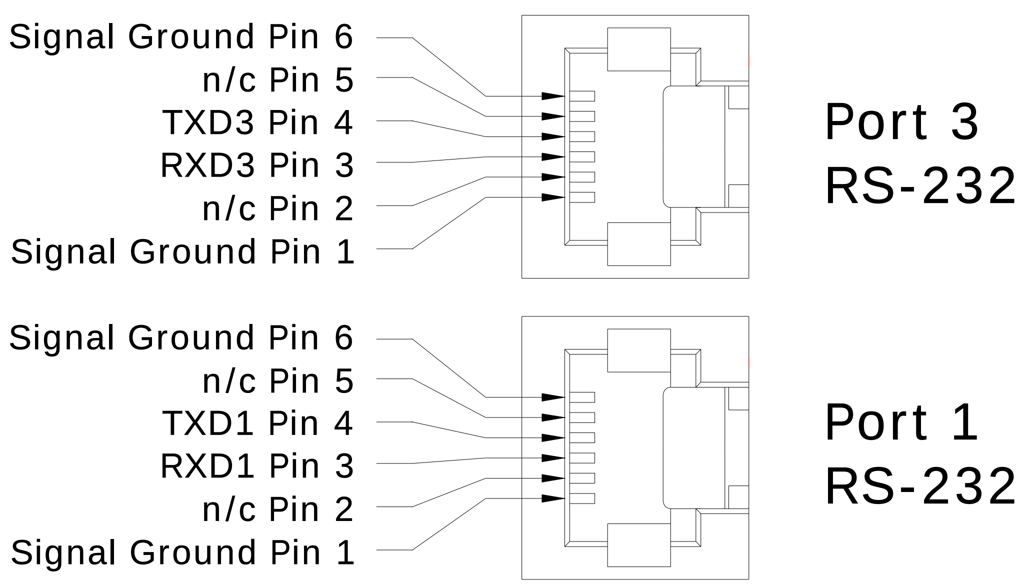
A RS-232 modular plug cable and a 9-pin PC to modular jack adapter is provided with the module for easy connection to a PC. If you have a PC such as a laptop that doesn't have an RS-232 port, please order the USB to RS-232 cable (USB-RS232).

The module's RS-232 jack with the included cable is compatible with all PLC modular jacks. It also directly plugs into FA-15HD (15-pin HD DSUB adapter for PLCs), FA-CABKIT (general purpose RS-232 adapters including modems and DB-25 connectors) and the FA-ISOCON (RS-232 to isolated RS-485 converter).

PORT SPLITTER PINOUTS

If RTS1 and CTS1 are not being used then connect the Port 1 and Port 3 splitter shown below to the module's RS-232 port. This will provide easy connection of RS-232 cables to both Port 1 and Port 3.





APPENDIX A : QUICK START

INITIAL MODULE OPERATION USING ABM COMMANDER PLUS

1. Run ABM Commander for Windows.

2. Review the ABM Commander for Windows Help/Instructions.

3. Connect the cable from the computer to the CoProcessor module.. See APPENDIX C for wiring diagrams.

4. Turn ON the power to the PLC.

5. Select the pull down menu "Communication" then select "Parameters(Port)".

6. Select the PC serial port you are using. Click the "Defaults" button. The communication settings are now 9600, 8, none, 1, none. Click the "Apply" button.

5. Select "COMMAND MODE Connect to BASIC Module" from the main window. Select "SYstem_Stats" from the COMMAND MODE menu.

6. The module will now respond with a ready prompt.

   READY
   > (">" character indicates BASIC is in COMMAND mode)

   If you do not receive the sign on message, please follow the trouble shooting procedure in APPENDIX B.

7. The BASIC CoProcessor is now ready for online programming, monitoring or program upload and download.

EDITING A PROGRAM

User Action	Display Window
Select 'Auto' from the menu bar. Select Mode 0, Program 0, and Click 'OK'.	AUTOSTART 0,0 Mode = 0, Edit Program = 0 Port 1 Baud = 9600 Programming (Port 2 = 9600) (Port 3 = 9600) >
Enter the following on the 'Command Line' field 10 p. <ENTER> 65535 p. <ENTER>	>10 p. >65535 p. >
Select 'ReseT' from the menu bar. Cycling the power to the PLC will also reset the BASIC CoProcessor.	RESET F A C T S E x t e n d e d B A S I C P l u s DL05/06 PLCs Warp Drive CoProcessor Version 1.00/HS (c)Copyright FACTS Engineering, Inc. 1988 - 2004 AUTOSTART Mode, Program, Baud Mode = 0, Edit Program = 0 Port 1 Baud = 9600 Programming (Port 2 = 9600) (Port 3 = 9600) 0 stored programs, 65528 program storage bytes free PRM 0 READY >
Select 'List' from the menu bar. Note that mode zero uses the stored baud rate. The program in the edit buffer, PROGRAM 0, is retained during loss of power in mode zero.	list 10 PRINT1 65535 PRINT1 PRM 0 READY >

SAVING A PROGRAM

User Action	Display Window
Select 'NeW' from the menu bar.	NEW >
Enter the following on the 'Command Line' field: 10 P."MY FIRST PROGRAM" <ENTER>	>10 p. "MY FIRST PROGRAM" >
Select 'SaVe' NOTE: The F0-CP128 is shipped with a diagnostic program in PRM1 so the first SAVEd program will go into PRM2.	SAVE Saving program 2 2 stored programs, 64310 program storage bytes free PRM 0 READY >
Enter the following on the 'Command Line' field: 10 P."MY SECOND PROGRAM" <ENTER>	>10 p. "MY SECOND PROGRAM" >
Select 'SaVe'	SAVE Saving program 3 3 stored programs, 64284 program storage bytes free PRM 0 READY >

AUTO RUN MODE

User Action	Display Window
Select 'Auto' from the menu bar. Select Mode 1, Program 2, and Click 'OK'. This specifies that the BASIC CoProcessor will run program 2 after a reset.	AUTOSTART 1,2 Mode = 1, RUN (CLEAR) Program = 2 Port 1 Baud = 9600 Programming (Port 2 = 9600) (Port 3 = 9600) >
Select 'ReseT' from the menu bar. Cycling the power to the PLC will also reset the BASIC CoProcessor.	RESET MY FIRST PROGRAM PRM 2 READY >
Select 'Sel' from the menu bar. Click the 'Program 0' radio button then 'OK'.	>
Select 'List' from the menu bar. Confirm that the program in the edit buffer (PRM0) is still present.	list 10 PRINT1 "MY SECOND PROGRAM" PRM 0 READY >

DELETING A PROGRAM

User Action	Display Window
Select 'Del' from the menu bar. Enter '2' then click 'OK'. Click 'Yes' on the confirmation dialog.	DELPRM2 2 stored programs, 64309 program storage bytes free >
Select 'ReseT' from the menu bar. Cycling the power to the PLC will also reset the BASIC CoProcessor.	RESET MY SECOND PROGRAM PRM 2 READY >

CANCEL AUTO RUN MODE

User Action	Display Window
Select 'Auto' from the menu bar. Select Mode 0, Program 0, and Click 'OK'. This specifies that the BASIC CoProcessor will start up in edit mode after a reset.	AUTOSTART 0,0 Mode = 0, Edit Program = 0 Port 1 Baud = 9600 Programming (Port 2 = 9600) (Port 3 = 9600) >

CHANGING THE PROGRAMMING PORT

When communicating with two or three external devices, you can change the programming port from Port 1 to Port 2 or even Port 3. An RS-232 to RS-485 converter will be needed to allow a personal computer RS-232 connection to Port 2. Changing the command port is done as shown below.

User Action	Display Window
In the 'Port Select' field (Bottom Left of the Command Window) select the 'Port 3' radio button.	No Change
In the 'Port Select' field click on the 'Command Port (ABM)' button. Click 'Yes' on the confirmation dialog.	No Change
Move cable from Port 1 to Port 3 then click 'OK' on the dialog prompting the cable change.	No Change
Select 'SYstem_Stats' from the menu bar.	>

APPENDIX B : TROUBLE SHOOTING

UNABLE TO ESTABLISH COMMUNICATION WITH BASIC COPROCESSOR

1. If the Port 1 RXD LED flashes when data is entered on the terminal then go to step 2. If the LED does not flash then use a RS-232 break-out box to determine if the problem is in the cable or the computer.

2. Power off the base, remove the module, and place the "CLR ALL" jumper on both posts (see page 22)

   CAUTION: Installing the CLR ALL jumper will erase program 0, all stored data, cancel a COMMAND@2, remove LOCKOUT, and clear stored AUTOSTART information.

3. Run ABM Commander for Windows.

4. Review the ABM Commander for Windows Help/Instructions.

5. Connect the cable from the computer to the CoProcessor module. See APPENDIX C for wiring diagrams.

6. Turn ON the power to the PLC.

7. Select the pull down menu "Communication" then select "Parameters(Port)".

8. Select the PC serial port you are using. Click the "Defaults" button. The communication settings are now 9600, 8, none, 1, none. Click the "Apply" button.

9. Select "COMMAND MODE Connect to BASIC Module" from the main window. Select "SYstem_Stats" from the COMMAND MODE menu.

10. The module will now respond with a ready prompt.

11. Type the following command and press return.

    >AUTOSTART 0,0

12. Power off the base and remove the module. Place the "CLR ALL" jumper on a single post.

11. Install the module and power up the base. The module will now respond with the sign on message.

```
FACTS Extended BASIC Plus
...

READY
>    (">" prompt character indicates BASIC is in COMMAND mode)
```

APPENDIX C : RS-232 AND RS-485 WIRING DIAGRAMS

RS-232 STANDARD

RS-232-C (RS-232) is an interface standard from the Electronic Industries Association (EIA). The standard names and defines 20 communication signals, assigned to separate pins in a 25-pin connector. The five unassigned pins may carry nonstandard signals required by any individual system.

Each signal is transmitted as a positive or negative electric current between 3 and 15 volts (usually 12 volts). The signal assigned to each pin flows in one direction only. Signals output, for example, from a computer must input to a terminal, and vice versa.

RS-232 signals travel over a serial interface cable that may have up to 25 wires. Since most signals are not required for simple communication, cables have as few as 2 or 3 wires. As shown in the following cabling diagrams, jumpers often are installed at one or both of the connectors to ensure that flow control signals are satisfied.

The signals flow between two types of interface ports, data communication equipment (DCE) and data terminal equipment (DTE). The pin names are the same for both DCE and DTE equipment, however, the direction of signal flow is reversed.

RS-232 DTE and DCE Pin Names and Signal Flow

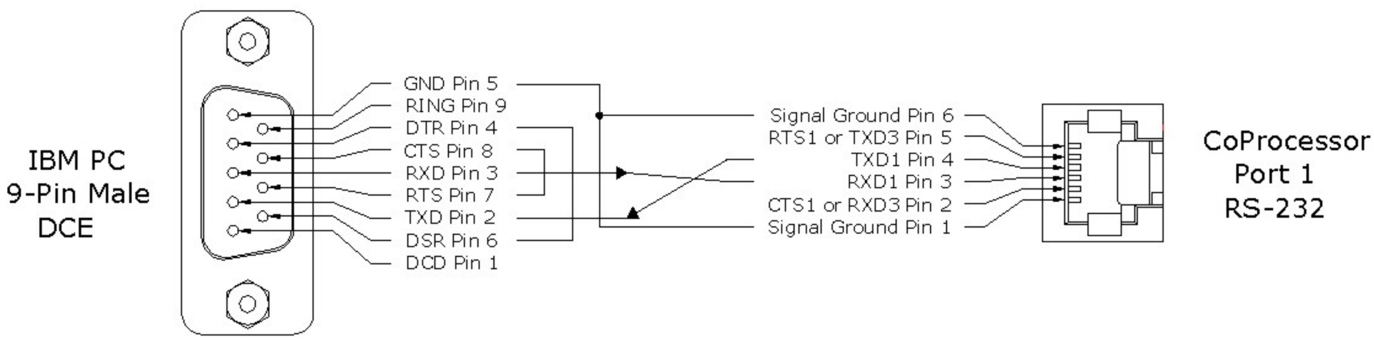
Pin	Abrev.	Name	Signal Direction		Description
			DCE	DTE	
1	FG	Frame Ground	None	None	
2	TXD	Transmit Data	Input	Output	DTE Output Data Path
3	RXD	Receive Data	Output	Input	DCE Output Data Path
4	RTS	Request to Send	Input	Output	DTE has data to XMIT
5	CTS	Clear to Send	Output	Input	DTE may XMIT data
6	DSR	Data Set Ready	Output	Input	DCE has data to XMIT
7	SG	Signal Ground	Input	Output	
8	DCD	Data Carrier Detect	Output	Input	Modem has carrier
20	DTR	Data Terminal Ready	Input	Output	DCE may XMIT data
22	RI	Ring Indicator	Output	Input	

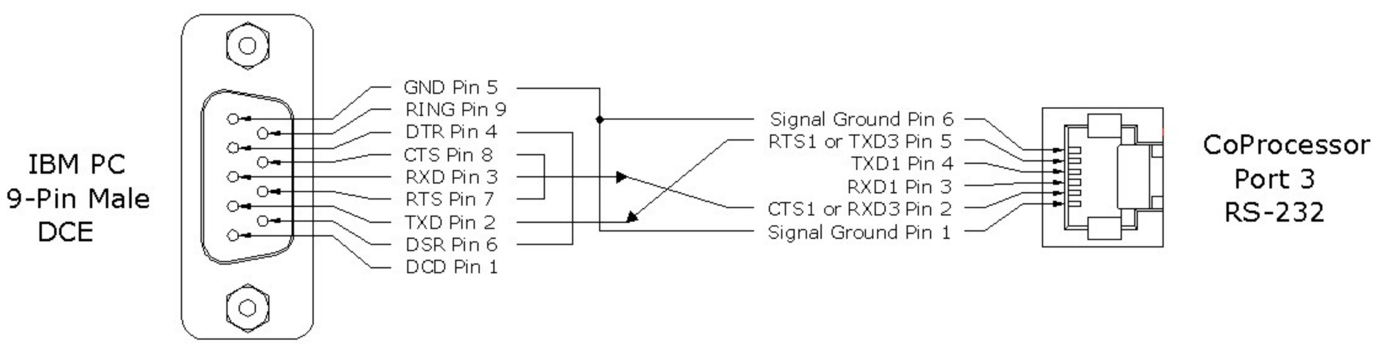
IBM COMPUTER (PC) CABLES

The F0-CP128 includes a RS-232 cable and 9-pin DSUB adapter to interface to PCs. A Port 1 and Port 3 splitter is also included to allow the PC to be connected to either Port 1 or Port 3 of the CoProcessor.

The AutomationDirect FA-CABKIT provides a RS-232 cable and adapters to interface to most RS-232 devices including an additional PC. This is a quick and easy way to make an RS-232 connection between the CoProcessor and an external device. If you want a shielded cable or need a different cable length, use the following wiring diagrams to make an interface cable.

Most newer laptop computers do not have an RS-232 port. To interface these laptops to the CoProcessor, you will need a USB to RS-232 9-pin connector adapter cable (AutomationDirect part number USB-RS232). The RS-232 cable and adapter included with the F0-CP128 plugs into the PC USB adapter cable, USB-RS232.

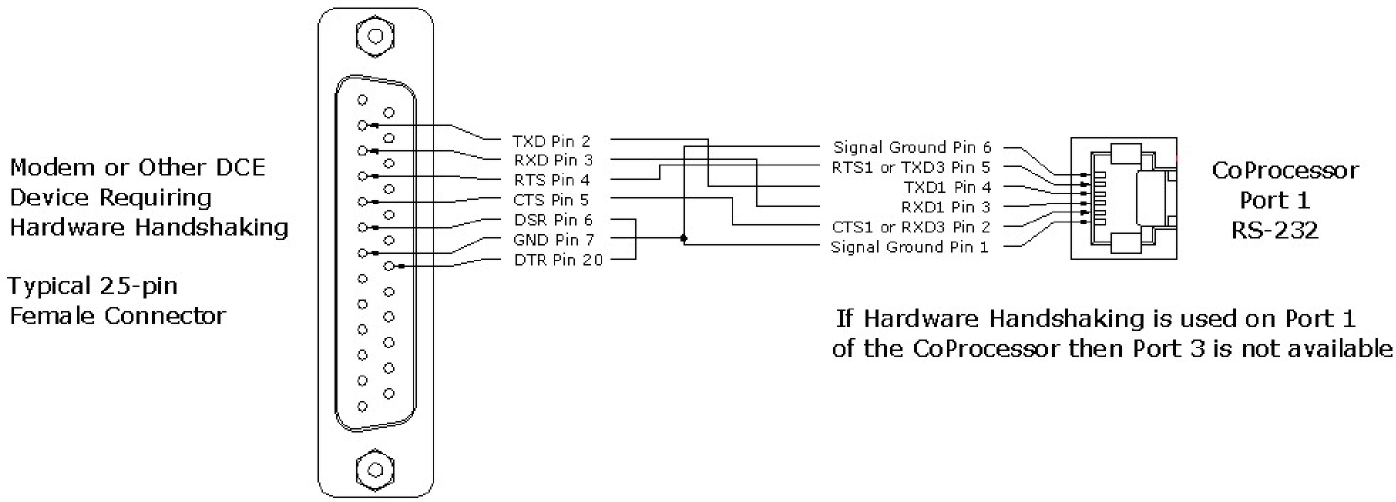


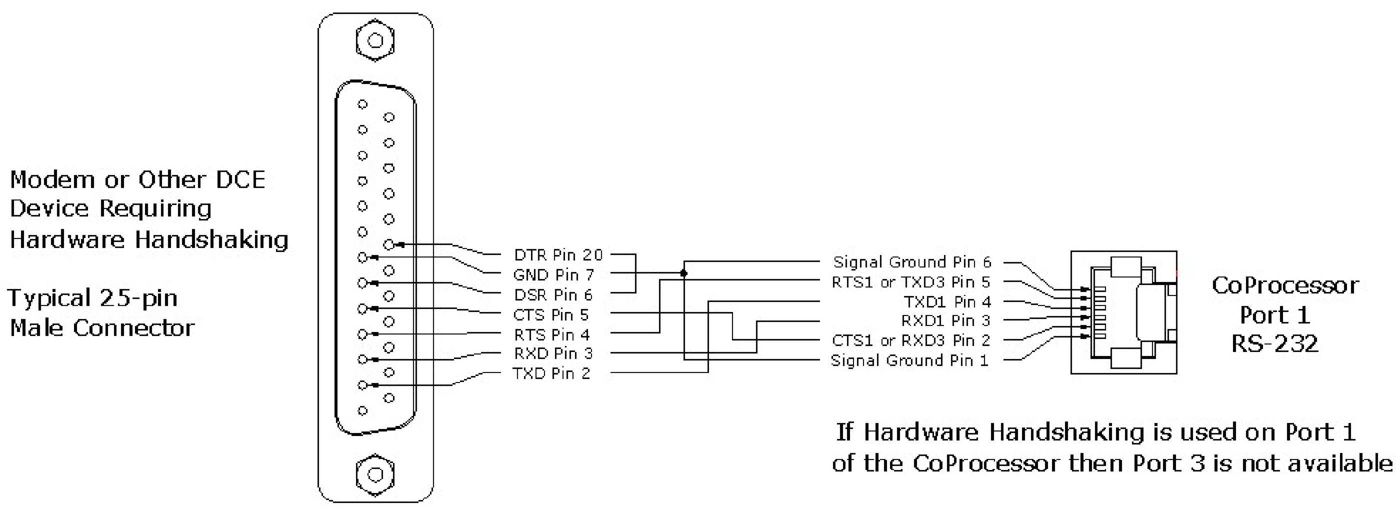


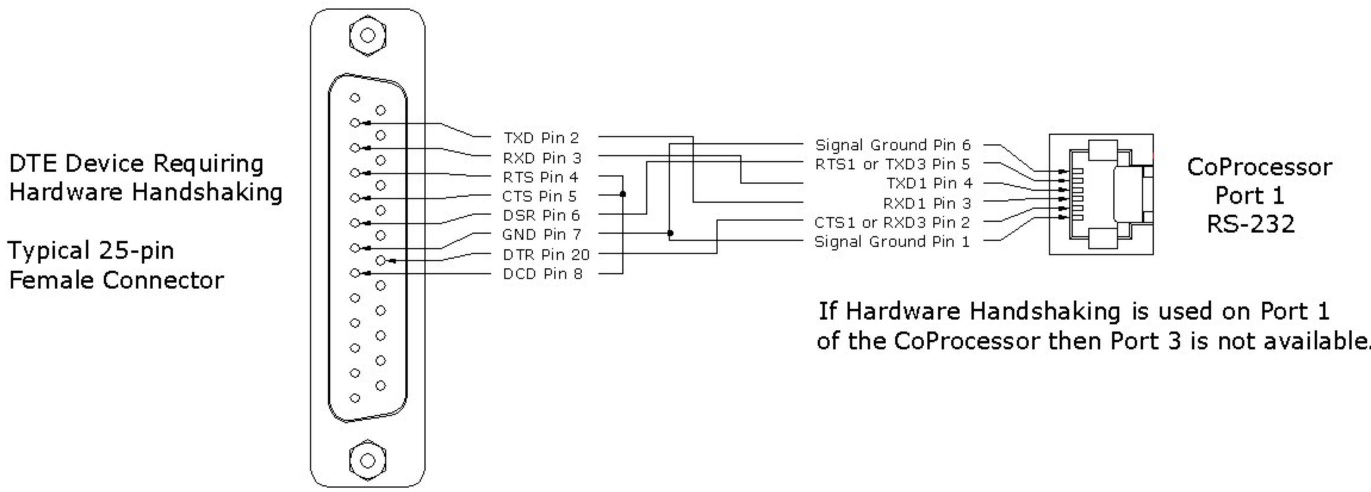
IDENTIFYING A COMMUNICATION PORT AS DCE OR DTE

With an unknown RS-232 port powered, measure the dc voltage between pin-2 and ground (pin-7) and pin-3 and ground. If the most negative pin is pin-2 then the port is DTE. If the most negative pin is pin-3 then the port is DCE. Improper connection of pins 2 and 3 will not damage the interface.

RS-232 WITH HARDWARE HANDSHAKE






DTE Device Requiring
Hardware Handshaking
Typical 25-pin
Female Connector
TXD Pin 2
RXD Pin 3
RTS Pin 4
CTS Pin 5
DSR Pin 6
GND Pin 7
DTR Pin 20
DCD Pin 8
Signal Ground Pin 6
RTS1 or TXD3 Pin 5
TXD1 Pin 4
RXD1 Pin 3
CTS1 or RXD3 Pin 2
Signal Ground Pin 1
CoProcessor
Port 1
RS-232
If Hardware Handshaking is used on Port 1
of the CoProcessor then Port 3 is not available.

RS-485 STANDARD

The RS-485 transceivers on CoProcessor's are compatible with RS-485 signals.

RS-485 is an upgraded version of EIA RS-422-A and offers higher current tri-state drivers which are internally protected from bus contentions caused by multiple drivers on the same line. RS-485 drivers will also withstand higher voltages on their outputs when disabled (high impedance state). RS-485 is specified for multiple transmitter and multiple receiver systems as well as single and multi-drop applications. The RS-485 standard allows up to 32 drivers and receivers on the same transmission line.

RS-485 COMMUNICATION

The CoProcessor has one RS-485 communication interface on Port 2. RS-485 echo cancellation is automatic. An RS-232 device may be connected to this port with an RS-232 to RS-485 converter (AutomationDirect order number FA-ISOCON).

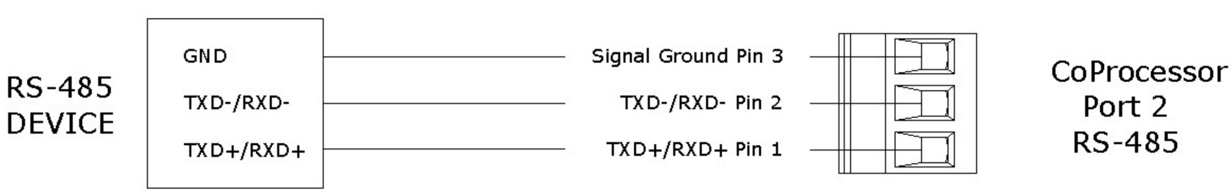
To enable the RS-485 transmitters only when PRINTing, use SETPORT to select multi-drop mode "M". Use the multi-drop option when the CoProcessor is a slave in a master/slave configuration or when a peer to peer configuration is required.

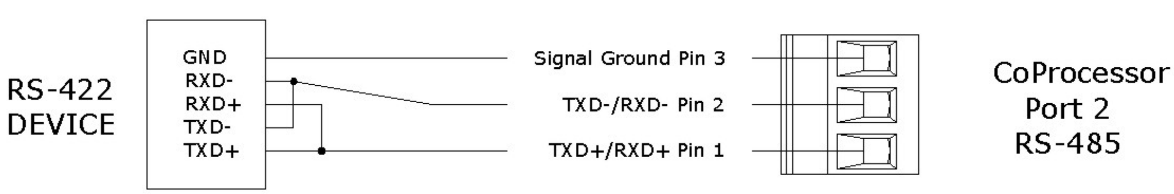
To leave the RS-485 transmitters ON even when not PRINTing, use SETPORT to select point to point mode "P". Use the point to point option when the CoProcessor is a single master in a master/slave or point to point configuration. This configuration provides the greatest noise immunity because the RS-485 drivers remain enabled and prevent noise from being received by the slave devices on the network.

Example: Configure Port 1 for 9600 baud, no parity, 8 bit word, 1 stop bit, software XON/XOFF handshaking, and multi-drop RS-485 mode.

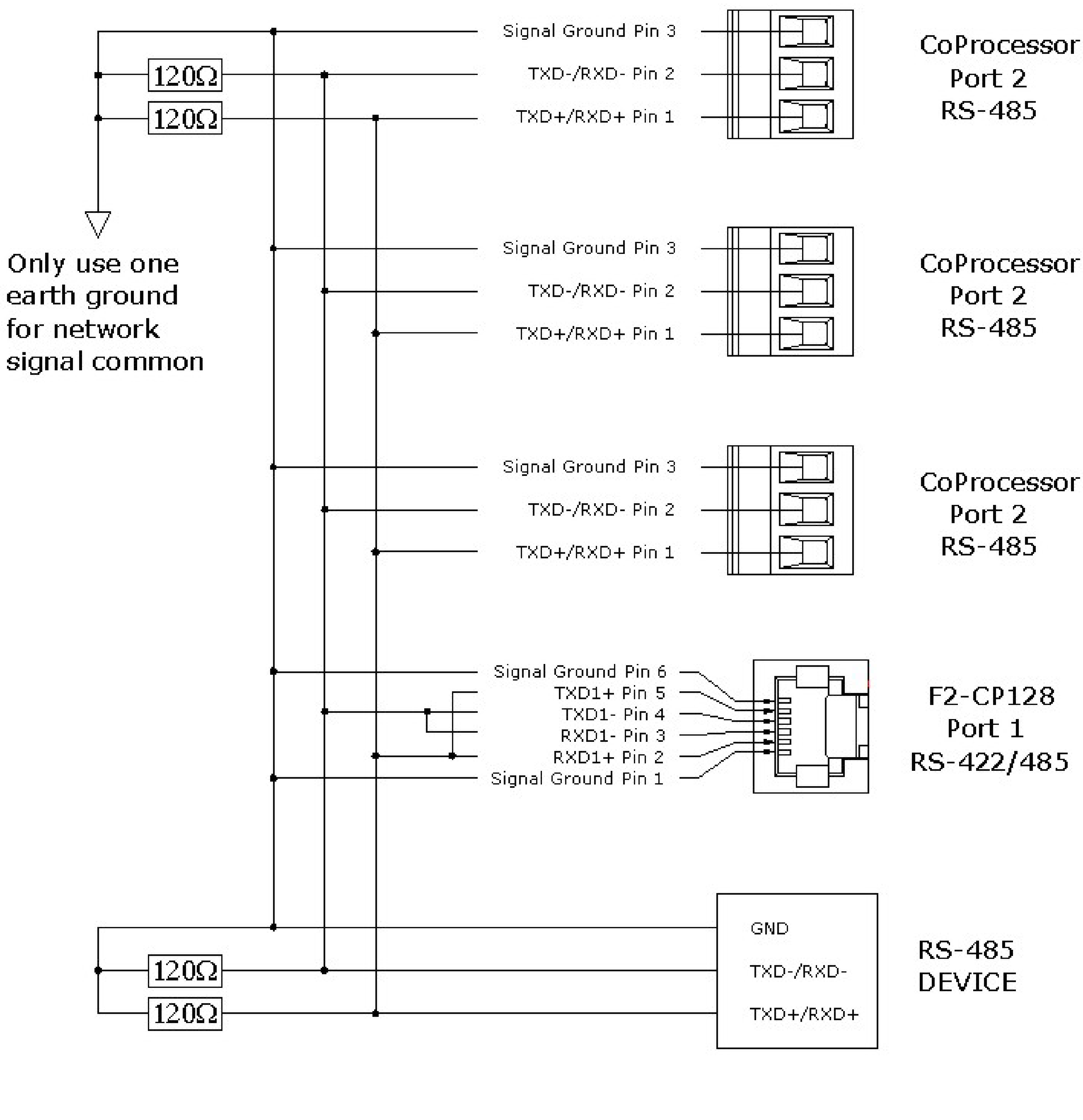
SETPORT 1, 9600, N, 8, 1, S, M

RS-485 POINT-TO-POINT CABLING





RS-485 TWO WIRE MULTI-DROP



Cable Shielding

Shielding improves noise immunity (magnetic field protection). It is important to ground the shield at the receiver end only. Grounding the receiver end only provides the least high frequency signal attenuation and the best rejection of unwanted signals. Grounding both ends of the shield will cause magnetic field induced noised currents to flow through ground. Noise may then appear on the data lines due to transformer like coupling with the shield. If the cable shield is used as the system ground conductor then placing a 100 Ω resistor in series with the shield and the ground connection will reduce noise producing ground currents.

Connecting Cables and Line Termination

A twisted pair plus ground connection is recommended for 2-wire RS-485 networks. Proper termination of the balanced transmission line is required to prevent data errors. A typical AWG 22 solid wire with .060 inch plastic cover, twisted 4.5 times per foot has a characteristic impedance of about 120 Ω. Thus the selection of the four 120 Ω line-to-ground terminating resistors (two 120 Ω in parallel on each line is 60 Ω). Line-to-ground termination is preferred to the often shown line-to-line 120 Ω termination. In noisy or long line applications the much better line-to-ground common-mode rejection capability is particularly important. In multidrop networks, the line must be terminated at the extreme ends only as shown in the two previous diagrams. Addition of intermediate terminations will adversely load the line.

Some RS-485 devices do not have a ground connection. These devices have an RS-485 plus connection, a RS-485 minus connection but no ground connection. In this case, a network isolator such as the AutomationDirect FA-ISOCON must be used to eliminate the ground connection on the CoProcessor. The FA-ISOCON provides isolation between the CoProcessor RS-232 port and the RS-485 network. The RS-485 port on the CoProcessor is not used with the FA-ISOCON.