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## Section 14: Communications

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### Communications

#### Character Code

The CNC 88 can send or receive either EIA or ASCII character codes. The EIA code output is intended for output to a tape punch only. The communications described in this section are intended for the ASCII mode.

#### Initial Connection

When the CNC 88 is in the command mode (ENTER NEXT COMMAND is on the screen), it constantly monitors the RS-232 port for incoming data. When data is detected, the CNC 88 switches to the terminal mode and subsequent input/output is through the RS-232 port. Also, the user can direct the CNC 88 to send its output to the RS-232 port by entering the proper CD command.

The initial communication to the machine requires the following communications parameters:

**7** Data Bits

**Even** Parity

**1** Stop Bit

Compatible Baud Rate (i.e. 2400 at both the computer and the machine).

#### Machine Grounding

The machine grounding may affect the communications capabilities. The machine **MUST** be properly grounded for best communication results. The FADAL VMC shall be grounded using any method listed in article 250 of the National Electrical Code. The minimum grounding method recommended by FADAL Engineering is detailed in the Installation chapter of the VMC Maintenance Manual. Inadequate grounding will result in a wide range of hard-to-diagnose problems in communications, positioning, spindle motion, etc.

#### Termination

If the MANUAL key is pressed while the control is in the terminal mode, communication will be terminated. This is also accomplished at the computer terminal by typing the word BYE.

#### Handshaking

Handshaking uses one of two available software protocols:

**XON/XOFF Protocol**     *DC1-READER ON (ASCII 17) DC2-PUNCH ON (ASCII 18)*  
*DC3-READER OFF (ASCII 19) DC4-PUNCH OFF (ASCII 20)*

While punching (or outputting) a program, the CNC receives either a DC3 or DC4, and the transmission pauses. When a DC1 or DC2 is received, transmission is resumed.

**XMODEM Protocol**     132-byte packet with 128 bytes of data and 4 control bytes, including a 1-byte checksum.

**How to Send a File Using XMODEM for DNCX**     The following listing provides an outline for implementing XMODEM protocol. Data is sent 128 bytes at a time. Program lines are concatenated with other lines until there are 128 bytes to send (including carriage returns). Four control bytes are added to the 128 bytes to complete a packet. The first three bytes are 1) CHR\$(1); 2) Block Number (from 0-255, starting at 1); 3) 255 - Block Number. The 128 data bytes are next, followed by a checksum byte.

The procedure for sending data is based on ACKs and NAKs. ACK means acknowledged, or success. NAK means not acknowledged, or failure. An EOT is sent if an unrecoverable error or end-of-file has occurred. The logic is better described in sample code than in words.

**EXAMPLE:**

```

SUB DNC ()
  ' SETUP VALUES
  ' TRANSMIT BLOCK - [3-128-1], 1ST IS CONTROL BYTE
  SENDBLOCK$ = CHR$(1) + STRING$(131, 32)
  ' BLOCKNUMBER WILL BE INCREMENTED TO 1 IN FIXBLOCK
  BLOCKNUMBER% = 0
  ' TIMES BLOCK WAS BEEN TRANSMITTED, 3 FOR ERROR
  XMITTEDCOUNTER% = 0
  RECDNAK% = 0
  RECDACK% = 0
  SENDFLAG% = 0
  EOTS$ = CHR$(4)
  NAK$ = CHR$(21)
  ACK$ = CHR$(6)
  STARTCHAR% = 4
  CALL CLEARPORT
NEXTBLOCK:
  CALL NEXTDNC(DATA$)
  IF DATA$ = "" THEN GO TO SPACEFILL
BACKTOSLOW:
  DATA$ = DATA$ + CHR$(13)
  DATALENGTH% = LEN(DATA$)
  SELECT CASE STARTCHAR% + DATALENGTH%
    CASE IS > 132
      CANFIT% = 132 - STARTCHAR%
      LEFTOVER% = DATALENGTH% - CANFIT%
      MID$(SENDBLOCK$, STARTCHAR%, CANFIT%) = LEFT$(DATA$, CANFIT%)
      GO SUB BEGINSENDING
      MID$(SENDBLOCK$, 4, LEFTOVER%) = RIGHT$(DATA$, LEFTOVER%)
      STARTCHAR% = 4 + LEFTOVER%
    CASE 132
      MID$(SENDBLOCK$, STARTCHAR%, DATALENGTH%) = DATA$
      GO SUB BEGINSENDING
      STARTCHAR% = 4
    CASE ELSE
      MID$(SENDBLOCK$, STARTCHAR%, DATALENGTH%) = DATA$
      STARTCHAR% = STARTCHAR% + DATALENGTH%
  END SELECT
  GO TO NEXTBLOCK
SPACEFILL:
  ' SPACE FILL REST OF BLOCK, TERMINATING CR
  MID$(SENDBLOCK$, STARTCHAR%, 131 - STARTCHAR% + 1) =
  STRING$(131 - STARTCHAR%, CHR$(32)) + CHR$(13)
  GO SUB BEGINSENDING
FINISHUP:
  CALL DWELSENDING
  CALL CLEARPORT
QUITTING:
  CLOSE
EXIT SUB

BEGINSENDING:
  CALL FIXBLOCK
BEGINSENDINGSKIP:
  CALL CHECKFORABORT
  ' WAS LAST BLOCK ACKED OR NAKED?
  IF RECDACK% OR RECDNAK% THEN RECDACK% = 0: GO TO ZXREADYTOSEND
ZXREADYTORECD:
  CALL WAITTILGOT(STOP$)
  SELECT CASE STOP$

```

**EXAMPLE:**

```

CASE IS = EOT$
    GOTO QUITING
CASE IS = NAK$
    RECDACK% = 0
    RECDNAK% = 1
    IF SENDFLAG% THEN
        ' BLOCK WAS SENT BUT NOT RECEIVED, RE-TRANSMIT UP TO 3 TIMES
        SELECT CASE XMITEDCOUNTER%
            CASE IS = 0, 1
                XMITEDCOUNTER% = XMITEDCOUNTER% + 1
            CASE ELSE
                CALL MHSENDDATA(PORT%, EOT$, ECODE%)
                IF ECODE% THEN ERRORERRRTRANSMIT%
                GOTO FINISHUP
        END SELECT
    END IF
    GOTO ZXREADYTO SEND
CASE IS = ACK$
    IF SENDFLAG% THEN
        ' BLOCK WAS SENT AND RECEIVED
        SENDFLAG% = 0
        XMITEDCOUNTER% = 0
        RECDNAK% = 0
        RECDACK% = 1
        RETURN
    END IF
END SELECT
ZXREADYTO SEND:
    CALL DWELSENDING
    CALL MHSENDDATA(PORT%, SENDBLOCK$, ECODE%)
    IF ECODE% THEN ERRORERRRTRANSMIT%
    SENDFLAG% = 1
    ' WAIT FOR ACK
    GOTO ZXREADYTO RECD
END SUB

SUB FIXBLOCK
    ' SET BYTES 2 AND 3 FOR HEADER, 132 HOLDS CHECKSUM
    BLOCKNUMBER% = BLOCKNUMBER% + 1
    IF BLOCKNUMBER% > 255 THEN BLOCKNUMBER% = 0
    MID$(SENDBLOCK$, 2) = CHR$(BLOCKNUMBER%)
    MID$(SENDBLOCK$, 3) = CHR$(255 - BLOCKNUMBER%)
    CSUM% = 0
    FOR I = 1 TO LEN(SENDBLOCK$) - 1
        CSUM% = CSUM% + ASC(MID$(SENDBLOCK$, I))
    NEXT I
    MID$(SENDBLOCK$, 132) = CHR$(CSUM% MOD 256)
END SUB

NEXTDNC:
    ' RETURNS NEXT ASCII LINE TO SEND
    DATA$ = "" IF END OF FILE
DWELSENDING:
    ' WAIT UNTIL TRANSMISSION BUFFER IS EMPTY

```

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**Commands****CNC 88 Commands**

All of the CNC 88 commands may be issued from the computer terminal. The MANUAL key is simulated by a control/E (05 hex or ENQ character). The line delete function is accomplished by the @ key and the backspace function is accomplished by the underline key. The TA and PU commands have special requirements and features discussed below.

**Tape Input**

The following is a description of the two possibilities to initiate data input.

- a. From the keyboard, enter the commands: CD, (Baud Rate #) and TA,1
- b. While in the command mode if a DC2 is received from the RS-232 port, a TA,1 is assumed by the CNC.

The following events are required to successfully complete the transfer of an NC program.

- 1) The CNC 88 starts by issuing a DC1 control character. Terminals such as the teletype with the AUTO mode respond to DC1 by turning on the tape reader. If the sending device has a tape reader that does not respond to DC1, the operator must start the reader after the TA,1 command has been issued. The TA,1 command will send a DC3 to activate the tape reader.
- 2) The next data sent must be a “%” character followed by a CR control character, to signal the start of NC program data.
- 3) The terminal must now send the body of the NC program. Lines of the program must be separated by a CR control character. An LF character is optional. After all lines are sent, one or more TO commands followed by one or more FO commands may be sent to build the tool and fixture data tables.
- 4) The terminal must conclude the NC program data by sending a “%” character followed by a CR control character.
- 5) An optional checksum may follow. The checksum is sent as a string of characters consisting of one to four numeric digits(0-9) and terminated by a carriage return. The checksum may be generated by a high level language like BASIC. An example follows:

```
10 REM update checksum after sending character C$
```

```
20 CK + CK = ASC (C$)
```

```
30 If CK9999 Then CK=CK-9999
```

**Note:**

- a. CK is set to zero before the “%” Character is sent in step 20 above.
  - b. CK includes all characters sent up to, but excluding, the first character of the checksum.
  - c. The only control character included in the checksum is the CR (i.e. the LF character is not counted).
  - d. If a null line (only a CR) is sent, the CR must not be included in the checksum.
- 6) At the completion of a successful TAPE input, when no CHECKSUM is received, the CNC displays the message “TAPE INPUT TERMINATED”. When a CHECKSUM is correct, the message “TAPE IS GOOD” is displayed.

**PU Command** The following is a description of two ways to initiate data output:

- a. From the keyboard, type CD, (baud rate #) and press ENTER then type PU and press ENTER.
- b. While in the command mode if a DC1 is received from the RS-232 port, a PU is assumed by the CNC.

The PU command has two modes of transmission. The first assumes that the remote device is a “dumb” terminal such as a punch or a teletype. This mode is initiated by the PU command (with no parameters). The CNC 88 transmits the NC program as follows:

- 1) A DC2 control character is sent. Some terminals respond to this by turning on the tape punch.
- 2) Approximately 300 NULL characters (leader) are sent next (when punch tape format is selected). Leader is transmitted only at baud rates 600, 300, 150, and 110.
- 3) The data portion is then opened with a “%” character followed by LF and CR characters.
- 4) The body of the NC program is transmitted next with LF and CR characters terminating each line.
- 5) After the NC program, TO and FO commands are output (if selected) to download the tool and fixture data tables.
- 6) The data is finally closed with a “%” character followed by LF and CR characters.
- 7) The last line sent is the checksum as described in the TA command.

The second mode assumes that the remote device is programmable and is prepared to receive the NC data in the order described below. This mode is invoked by the PU,,,1 command. The order is as follows:

- 1) The CNC 88 sends one null character and waits for a DC1 or DC2 from the remote device.
- 2) The remote device then sends a DC1 or DC2 when it is ready to receive data.
- 3) The CNC 88 responds with ten lines of data.
- 4) The remote device must process the data received in step 3.
- 5) Steps 2 through 4 must be repeated until the end of file is detected. The end of file is indicated by a line consisting of a single “%” character. All lines are terminated by LF only.
- 6) After the end of file, the CNC 88 sends the checksum as described above.

#### DNC Mode

DNC mode is generally used when a program is too big for the memory of the CNC control. CAD/CAM software usually posts a program too big to fit into the CNC memory, either the program is sectioned and stored, or it is sent DNC.

DNC mode does not store a program in the control. The control receives program code via the RS-232 port in blocks. Enough program code is sent to fill a buffer for the machine tool to perform. Once the machine has performed the code, it looks to the buffer for more information. When the buffer starts to empty, the control talks to the units sending the code to refill or keep filling the buffer so that the machine can have a continuous run. Since the DNC program does not remain in the control, certain differences to the code are as follows:

- a. **NO** O word program identification numbers are allowed.
- b. **NO** comments are allowed.
- c. **NO** user defined subroutines (L01-L89) are allowed.
- d. Fixed subroutines **are** allowed during DNC.
- e. Sequence numbers **are** optional.
- f. The program should be ended with either an M0 or with **NO** code at all.
- g. Macro statements (see Section 18) **ARE** allowed.

Using FADAL communications software such as Assist, ProSend, or CNC Memory Manager in the DNC mode, a server program can be accessed by encoding a drive, path and filename within the program. During DNC the program lines indicating the path and filenames may **NOT** have line sequence numbers.

**EXAMPLE:** *N1 G0 G90 S3000 M3 E1 X0 Y0  
N2 H1 Z.1 M7  
C:\ASSIST\CNCDATA\MOLD.CNC  
N3 G0 G90 H0 Z0  
N4 M0*

**Note:** A % sign is not required in sub program

**DNC Protocols** The control may use either one of two types of handshaking protocols.

- 1) **DNC**, the standard protocol is XON/XOFF.
  - a. This protocol uses DC1 through DC4 to control data flow.
  - b. When the machine cannot continue to receive data, or the buffer is full, the XOFF stop signal is sent. When transmission can resume, the XON start signal is sent.
  - c. This protocol is used for normal DNC operations.
- 2) **DNCX**, Xmodem protocol is used at a baud rate setting of 9600 baud or **above**.
  - a. X modem protocol sends data in blocks of 128 bytes.
  - b. After sending each block a CHECKSUM is performed. These blocks are used to report errors that may occur during transmission.
  - c. X modem protocol requires the use of the DNCX command during DNC operations.
  - d. DNCX must be used with computer software or a device that can send a file at X modem protocol.
  - e. DNCX command is available with the 1400-3 processor only.

### **RS-232-C Interface Connection**

Data and command input to the CNC is normally via the keyboard on the VMC pendant. However, the CNC can be instructed to receive its input from the RS-232-C interface. Likewise, data normally sent to the CRT can also be directed to the interface. This interface is set up in the data terminal equipment (DTE) mode per the Electronic Industries Association (EIA) Standard numbered RS-232-C published by:

Electronic Industries Association  
Engineering Department  
2001 Eye St. N.W.  
Washington, D.C. 20006



Table 1 shows the circuits that are implemented in the CNC's RS-232-C interface. In this table, DCE, stands for Data Communication Equipment. The DCE is normally a telephone modem. If the user wishes to connect a computer or a data terminal directly to the CNC, it must be determined whether the device is set up as DTE or DCE.

If the device is DCE, a commercially available 9 wire cable will be satisfactory. The CNC requires the socket housing (female) connector at its end of the cable. If the device is DTE, the user must make or buy a modem bypass cable (also called a null modem).

Two versions of a null modem are shown in tables 2 and 3. Table 2 is for simple 3 wire cabling. Table 3 is for equipment that uses the DTR circuit to indicate conditions, such as buffer full. This condition requires a brief pause in transmission from the CNC (see handshaking). If the CNC finds its DSR line low for more than 1 second it ceases transmission until it is reconnected.

The CNC RS-232-C interface has a programmable baud rate. It can be changed by use of the CD command (see Section 8, Commands, for more details). When the CNC is powered on, the initial baud rate is set by the SETP command. The CNC is set up for Asynchronous Communication only.

The CNC control expects and transmits seven (7) data bits and one (1) stop bit. For ASCII data, even parity (E) is required, and for EIA-RS-244-B data, odd parity (O) is required.

FADAL's Parts Department has RS232C cables and NULL modem cables available, properly configured for communication with the VMC.

## Cable Configuration

**Table 1: Cable Configuration**

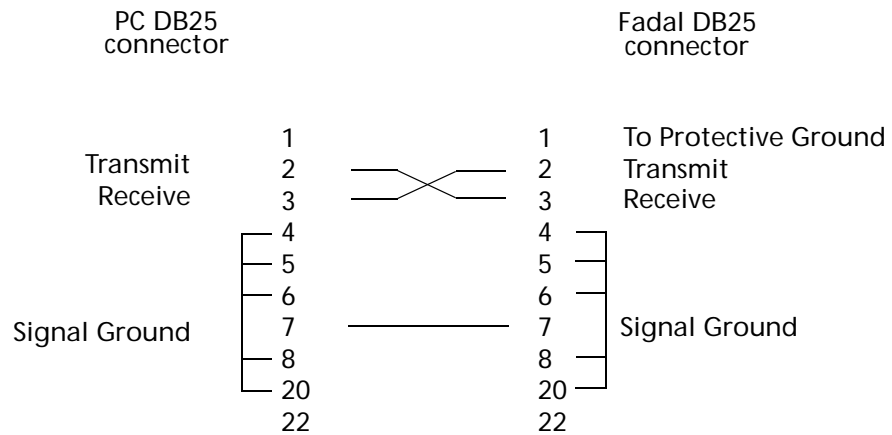
PIN NUMBER	DESCRIPTION	SIGNAL SOURCE	
		DTE (VMC)	DCE (MODEM)
25 PIN DIN CONNECTOR			
1	Protective Ground (PG)		
2	Transmitted Data (TD)	X	
3	Received Data (RD)		X
4	Request To Send (RTS)	X	
5	Clear To Send (CTS)		X
6	Date Set Ready (DSR)		X

**Table 1: Cable Configuration**

PIN NUMBER	DESCRIPTION	SIGNAL SOURCE	
7	Signal Ground (SG)		
8	Received Line Signal Detector (RLSD)	X	
20	Data Terminal Ready (DTR)	X	

**IBM-Compatible PC-  
Simple DB25 Null  
Modem**

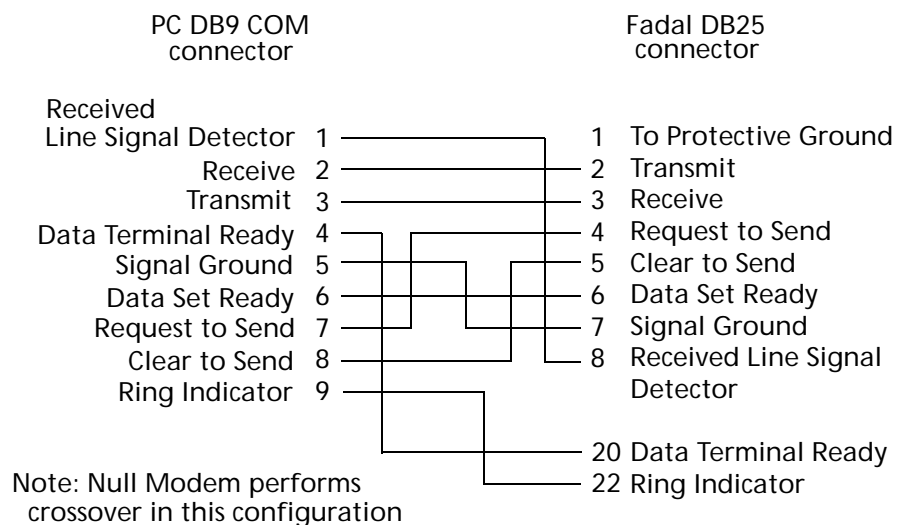
***RS232 Pinouts for the IBM-compatible PC  
Simple DB25 Null Modem***



**Note:** Connect pin one to the shield **only** at the machine end.

**IBM-Compatible PC-  
DB9 to DB25 for DTE  
Equipment-Null  
Modem Not Included**

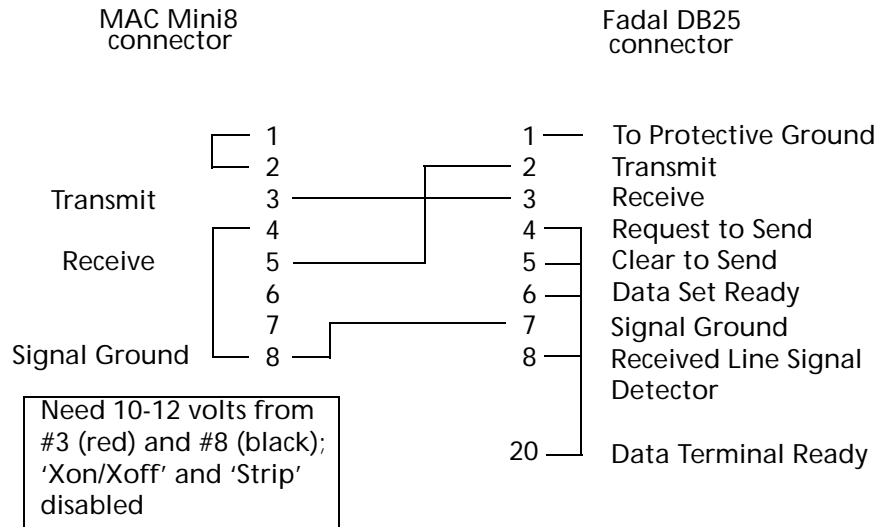
***RS232 Pinouts for the IBM-compatible PC  
DB9 (@PC) to DB25 (@VMC) for DTE Equipment***



**Note:** Connect pin one to the shield **only** at the machine end.

**Macintosh II Mini-8 Connector**

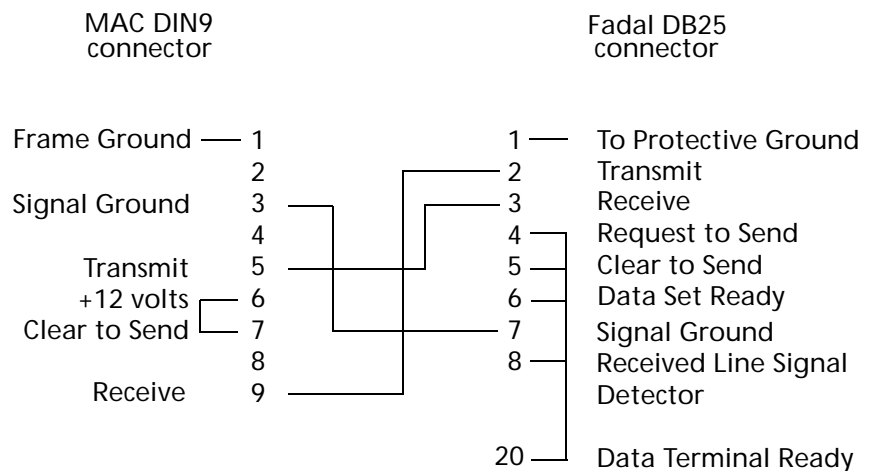
**RS232 Pinouts for the Macintosh II**



**Note:** Connect pin one to the shield **only** at the machine end.

**Macintosh Plus DIN-9 Connector**

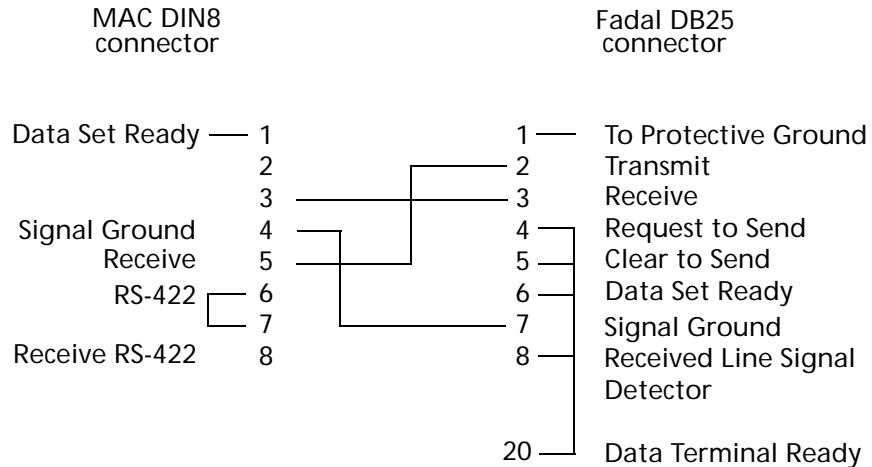
**RS232 Pinouts for the Macintosh Plus**



**Note:** Connect pin one to the shield **only** at the machine end.

Macintosh Plus DIN-8 Connector

*RS232 Pinouts for the Macintosh Plus*



**Note:** Connect pin one to the shield **only** at the machine end.

**VMC Communications Procedures**

**VMC Control Parameters**

The first step to any communications is to prepare the VMC control. At the ENTER NEXT COMMAND prompt, enter the command CD,# and press ENTER. This sets the machine baud rate and readies the RS-232 port. Use the appropriate command for the desired baud rate.

- CD,1 = 110 baud*
- CD,2 = 150 baud*
- CD,3 = 300 baud*
- CD,4 = 600 baud*
- CD,5 = 1200 baud*
- CD,6 = 2400 baud*
- CD,7 = 4800 baud*
- CD,8 = 9600 baud*
- CD,9 = 19200 baud*
- CD,10 = 38400 baud*
- CD,11 = 57600 baud*
- CD,12 = 115200 baud*

### Receiving Data / Programs at the VMC

**EXAMPLE: To Receive Data:**

*CD,6 ENTER This sets the baud rate at 2400 baud*

The line feed and echo parameters may also be used with the CD command. See Section Eight, Commands for detailed information on these parameters.

When a file is to be received at the VMC the TA,1 command is used. This command is entered after the CD command.

**EXAMPLE:** The program sent to the control should start and conclude with the “%” sign.

*CD,6 ENTER*

*TA,1 ENTER The VMC is now ready to receive a program*

After entering the TA command the control is ready to receive a file. The program can now be sent to the control from the source device.

### Sending Data / Programs from the VMC

When a program is to be transmitted from the VMC to a receiving device, the PU command is used. Prior to using the PU command the receiving device MUST be ready to receive. Check the device requirements for receiving a file. When the device is ready to receive, enter the CD and PU commands at the VMC.

**EXAMPLE: To Send Data:**

*CD,6 ENTER*

*PU,2 ENTER This transmits the program data only to the receiving device*

The use of the PU command parameters may be required for different devices.

*Data Options*

*0 = Currently active program and offsets*

*1 = Offsets only*

*2 = Currently active program only*

*3 = All programs in memory*

*Code Option*

*0 = ASCII (Standard)*

*1 = EIA*

*TTY Option**0 = Computer (Standard)**1 = Leader, Program, Trailer (This option is used for tape punches)*

After entering the PU command the program is transmitted to the receiving device.

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**Device  
Communications  
Procedures****Computer**

The procedures described in this section are for generic computer communications.

The computer **MUST** be equipped with a serial port (RS-232 port). If a mouse or pointing device is installed, insure that there is a serial port available for communications. Identify whether the port is COM1 or COM2. This information is required for the software being used.

The RS-232 cable **MUST** be configured for communications. The standard 25-pin configuration in Table 2 above should be used. This pin configuration may be achieved by using the FADAL Null Modem cable. Connect the cable(s) from the VMC to the computer serial port.

The communications parameters must now be set at the computer software. The software documentation will describe the procedure for setting these parameters. To communicate with the FADAL VMC use the following parameter settings:

- 1) Set the baud rate compatible with the machine (Normally 2400).
- 2) Even Parity
- 3) 7 Data Bits
- 4) 1 Stop Bit
- 5) XON/XOFF Handshaking In Effect (On)

Some software may have additional parameters. Use the following settings:

- 6) Strip Line Feeds (No)
- 7) Code Format (ASCII or EIA)
- 8) Strip Carriage Returns (No)

- 9) Echo Keyboard To Screen (Yes)
- 10) Delay After End Of Line (0.0 seconds)

The VMC and computer are now ready for communications.

Receiving at the VMC:

- 1) Enter the appropriate CD command at the VMC control.
- 2) Enter the TA command desired to receive a program at the VMC.
- 3) Perform the software procedures to transmit the file to the VMC.
- 4) After receiving the file, press the MANUAL button to return to the command mode.

Transmitting from the VMC:

- 1) Enter the appropriate CD command at the VMC control.
- 2) Prepare the computer to receive a file. See the software documentation for these procedures.
- 3) Enter the desired PU command at the VMC control.
- 4) After receiving the file, press the Manual button to return to the command mode.

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### **Tape Punch / Teletype**

The procedures outlined in this section are designed for the DSI tape punch model LRP300. Procedures for other tape punches or teletypes may vary with model. Contact your device manufacturer for exact procedures.

This tape reader uses the RS-232 cable for data transfer. The cable **MUST** be straight wired. This means that the wire connected to each pin must connect to the corresponding pin at the opposite end of the cable. The Null Modem is **NOT** used for the tape reader or teletype. The RS-232 cable should be attached to the DSI tape punch at the bottom 25 pin port.

The DSI tape punch switch settings for communication are defined as follows:

<i>OC/L RS-232</i>	<i>RS-232</i>
<i>HIGH/LOW</i>	<i>HIGH</i>
<i>FULL/HALF</i>	<i>FULL</i>
<i>LINE/LOCAL</i>	<i>LOCAL</i>
<i>OFF/REM CTL</i>	<i>OFF</i>

*OFF/PRINT*      *PRINT*  
*ON/PUNCH*      *PUNCH*

*RUN*              *Press to start*

Prepare the machine for communications by entering the CD command. Use the command CD,3 to set the baud rate at 300 baud. This is the baud rate that the tape punch uses. The machine and the tape punch are now ready for communications.

Receiving at the VMC:

- 1) Enter the CD,3 command at the VMC control.
- 2) Enter the TA command desired to receive a program at the VMC.
- 3) Load the paper tape into the tape reader or teletype.
- 4) Press the RUN button to begin the transmission.
- 5) After receiving the file, press the Manual button to return to the command mode.

Transmitting from the VMC:

- 1) Enter the CD,3 command at the VMC control.
- 2) Press the RUN button on the tape reader to prepare the reader to receive the file.
- 3) Enter the desired PU command at the VMC control.
- 4) After receiving the file, press the MANUAL button to return to the command mode.

### **Communications Troubleshooting**

For communication problems several factors must be examined. Review the environment, then check the file, the VMC, the cables, the computer, and finally the computer's communications software. Any one of these subsystems can propagate a communication problem.

If, after following these procedures, communications cannot be successfully carried out, please call FADAL's its representative's) Programming Support department for assistance.

### **Environment**

In areas where lightning strikes are common, communications can be interrupted when or after lightning has struck a power line. The lightning may affect the memory of the CNC control, which would then have to be zeroed from



the DI mode. It is suggested to call a service person or see the maintenance manual for this zeroing procedure.

**Note:** An RS-232 surge suppressor adds protection in this kind of environment.

- File**
- 1) Has the file ever successfully been transmitted to the VMC before? If the file has been transmitted before, has it recently been edited and has something been introduced into the file? Use an editor or word processor to show hidden characters. If hidden characters are present in the file, remove them.
  - 2) If the file has not been successfully transmitted, use an editor or word processor to show hidden characters. If hidden characters are present in the file, remove them.
    - a. The only accepted characters allowed before the initial percent sign are DNC, DNCX, or TA,1. In addition, no O words are allowed in DNC mode.

**EXAMPLE:** *DNC*  
*%*

- b. A two-second dwell is required between the DNC command and the first percent symbol (%). If the software being used to transmit the program cannot support this dwell time, remove the DNC, DNCX, or TA,1 command from the file and type the command at the VMC before starting file transmission.
- 3) When a file is posted for a paper tape, or when a paper tape is read and placed on a disk, it may have leader characters before the initial percent sign — they need to be removed.
- 4) If some of the file can be transmitted, but some of it cannot, check for syntax errors.
  - a. Examine the area in the file for syntax errors and repair them. For example, double motion words or missing words are syntax errors.

**EXAMPLE:** *X1.23 X4.5 Double motion words*  
*-Y2.3 Incorrect placement of - (minus)*  
*.534 No word at all*

**Note:** Use the TA,1,1 command for program transmission so that the control will halt transmission and display the line where the syntax error occurs.

- 5) If a word processor or editor is used to write the program, it must be saved in a text only format. Some processors will add formatting characters to the file which will disallow communications.

**VMC**

- 1) Check to see if the grounding wires are properly attached.
  - a. The only proper and acceptable primary ground is a single continuous copper wire attached from the ground bus in the junction box of the VMC to the main power box of the building. A green sticker in the junction box further expounds the grounding requirement. Any other methods of grounding, such as grounding to the conduit, or to a ground rod, are not acceptable and will lead to communication problems. See the Maintenance Manual for grounding procedures.
  - b. Check to see if the screws attaching the ground wire to the VMC are tight at both ends.
  - c. The ground wire of the RS-232 DB25 plug on the inside of the CNC control cabinet must be attached from the RS-232 port to the inside of the CNC control cabinet. This wire is attached to pin #1 of the DB25 plug, and is used to shield the cable at the VMC end ONLY (see Table 2 for proper pin configuration).

**Note:** If the paint has not been removed from this area, scrape the paint away and re-attach the wire.

- 2) Check the cable from the RS-232 port on the inside of the CNC control cabinet to the 1030 board.
  - a. Sometimes this cable will work itself out of the plug. Press the plug into the board to confirm a good connection.
  - b. Examine the cable for cuts or kinks and replace it if there is evidence of damage.
- 3) For VMCs with a phone modem, make sure that the DB25 plug on the inside of the CNC control cabinet is NOT plugged into the back of the modem — if it is, it will interrupt normal communications through the RS-232 port.
- 4) Use the test plug to test the 1030 board. The test plug is stored in the bottom of the CNC control cabinet when the VMC is shipped. It is a DB25 plug with no wires coming from it. On the inside of the plug, pins 2 and 3

are crossed to complete the communications path. Plug the test plug into the RS-232 port on the outside of the back of the CNC control cabinet.

Use the diagnostics mode to complete the test.

- a. Move to the cold start position.
- b. From the command mode type DI then press ENTER.
- c. Type GO 3000 and press ENTER to enter the test menu.
- d. Press 4 to select the RS-232 (1030) test.
- e. Select a baud rate (usually the baud rate used in normal communications).
- f. Observe the screen.
  - Numbers next to the word TESTING should be changing constantly. This is good, and the 1030 board has passed the test.
  - The numbers at the end of the other sentences should all be zero. Any numbers appearing at the end of these sentences indicates that the 1030 board is faulty (assuming the cable was checked in step (2) above).

**Note:** It has been our experience that the 1030 is rarely faulty.

- If the diagnostics test passes, then it is safe to conclude that the VMC is not at fault for a communication problem.

- g. Press the MANUAL button to end the communication test.
- h. Power off the VMC, wait 10 seconds, then power on again.

5) Has the proper baud rate been selected at the VMC?

- a. The CD,# command is used to select a baud rate. The MU command has a list of each baud rate in the menu, or see *Section Eight, Commands* for the same list.
- b. The SETP command, for the VMC parameters, can be used to select a baud rate as default. The CD,# command will temporarily override the selection in the SETP parameter page.

- Cables**
- 1) Verify that all connections between the communications cable and both the VMC and the computer are firmly seated, including surge suppressors, gender changers, and couplers. Pick up the cables and physically confirm that each connection is properly together.

- Loose cable connections are one of the most common causes of communication problems.
- 2) If a switch box is used, determine if the switch is in the proper position.
    - a. Examine the cable connections to see if they are in the correct ports.
    - b. Turn the switch handle back and forth a few times. Sometimes the contacts are corroded and turning the handle will temporarily correct the problem.
  - If turning the handle corrects the problem, it is suggested to clean the contacts or replace the switch box with a new one.
  - 3) If the cable is coiled because the cable is too long, it is suggested to get a shorter cable. The coiling may cause intermittent problems. Also, the shorter the cable, the less chance a parity error will occur.
  - 4) Check to see if the cable is draped over fluorescent lights or wrapped around or connected on the high-voltage line for the power to the VMC or other machines. This can cause RF noise and inductive voltages on the cable, and communications will be interrupted from time to time.
    - a. Welding machines and EDM machines close to the VMC or the cable will also cause communication problems. These machines also cause RF noise which interrupts communications.
  - 5) Open the DB25 plugs to see if the solder on the pins has been applied properly. Cold solder joints for these wires will need to be soldered again.
  - 6) Check to see if the wires are connected to the proper pins. See earlier in this section for the proper pinout.
    - Confirm that, with shielded cable, pin one is connected to the shield at the VMC side only. Pin one cannot be connected at the computer side.
  - 7) If straight cable is used a null modem is required. A null modem cable can be purchased from the FADAL Parts Department (part # WIR-0150), or from any computer store. A null modem is a short portion of cable or ribbon cable that has pins 2 and 3 crossed. The crossover and the proper jumpers on each end can be found earlier in this section. If a null modem is used

that was supplied from FADAL, the switch must be in the outward position away from the cable.

- 8) Use the mirror plug test as described in step 4 of the VMC section above to test each section of cable from the VMC to the computer, replacing any section that fails.
- 9) What is the length of the cable?
  - a. The longer the cable the slower the baud rate must be.
  - b. The faster baud rates may work for the longer cables, but the chance of losing information increases the faster the baud rate.
  - c. Try using a slower baud rate, and if this works better, this may be the best solution. However, this may also indicate an IO port at the computer with low voltage. See the **Computer and Computer IO Port** section on the next page.

### **Computer and Computer IO Port**

- 1) Is the cable plugged into the proper port in the back of the computer?
  - a. Some ports are marked COM or SER — these are the proper ports.
  - b. If the ports are unmarked, a COM or serial port will be the male gender port (the port with the exposed pins — the female gender port will have sockets).

**Note:** A gender changer plug may be needed if the gender on the cable will not plug into the proper COM or serial port.

- 2) Is the port active?
  - a. Is the cable on the inside of the computer cover attached to the port?
  - b. Check the voltage across pins 2 and 7 while transmitting a file (use a file large enough to allow time to check the voltage while the transmission is in progress). With the positive lead on pin 2 and the negative on pin 7, the voltage should range between 10 and 12 volts. Any voltage below 10 volts could result in interrupted communications.

**Note:** A FLUKE meter (or equivalent) used to measure voltage must be set to AC to obtain a reading.

- 3) When the computer was set up, did any interrupts interfere with the communications port?

**Note:** A qualified computer setup person will be able to confirm that the port is free of other interrupts.

- 4) If an IBM-compatible computer has a serial mouse, is the mouse plugged into the proper port?
  - a. Usually the serial mouse is used in COM1 or serial port one.
    - Move the mouse to COM1 and the VMC cable into COM2 and try to communicate again.
    - If the mouse is not to be used during the DNC process, remove the mouse software commands from the CONFIG.SYS and/or AUTOEXEC.BAT file(s), and then reboot the computer. (CAUTION: Only a person familiar with altering these files should perform this operation, as these files are necessary for startup of an IBM-compatible computer. Refer to the DOS manual for any questions regarding these files and how to properly modify them.)
- 5) Some screen saver software can interrupt communication, change the baud rate, or transmit an odd hidden character, when the screen saver starts to display. Remove or disable the screen saver software and try to communicate again.
- 6) The quality of the IO board must be considered. Multipurpose IO boards are usually not recommended. High quality boards dedicated to only IO functions are recommended. DigiBoard and Quad Tech are examples of companies which produce high quality IO boards. These boards are specific to the operating system used by the computer — one board is used for DOS, another for Windows, and another for micro channel (IBM PS/2). These boards usually test 12 volts across pins 2 and 7 at the computer, for the best quality transmission.

**Note:** A FLUKE meter (or equivalent) used to measure voltage must be set to AC to obtain a reading.

- 7) If a network board is installed in the computer, the computer technician who installed the board must check for conflicting interrupts and IO addresses.
- 8) The FADAL Assist software has in its utility menu an RS-232 tester. Use the mirror plug in the port and follow the instructions on the screen for test number one.

**Software**

- 1) Check the communication parameters in the software.
  - a. TA, DNC, and PU (using Xon/Xoff)

- Baud rate - This is variable and it must match the baud rate set at the VMC with the SETP command or with the CD,# command.
  - Parity - E (Even)
  - Data Bits - 7 (Seven)
  - Stop Bits - 1 (One)
  - EOB (End Of Block) - CR,LF (ASCII 13,10)
  - Starting and ending character - % (ASCII 37)
  - Xon/Xoff (Software handshaking) disabled for TA
  - Enabled for DNC and PU
  - Hardware handshaking - disabled
- b. DNCX (using XMODEM)
- Baud rate - This is variable and it must match the baud rate set at the VMC with the SETP command or with the CD,# command.
  - Parity - N (None)
  - Data Bits - 8 (Eight)
  - Stop Bits - 1 (One)
  - EOB (End Of Block) - CR,LF (ASCII 13,10)
  - Starting and ending character - % (ASCII 37)
  - Packet Data Bytes - 128
  - Hardware handshaking - disabled
  - For more information, see 'How to Send a File Using XMODEM for DNCX'.
- 2) Use DOS to send a file, bypassing the communications software in the computer. If this works, the software is in doubt.
- a. From the DOS prompt type the following two DOS commands:

```
Type MODE COM2:2400,E,7,1  MODE port:parity,data bits,stop bits
MODE      =      DOS command (followed by a space)
port      =      COM2
:         =      : (the : is required DOS syntax)
baud      =      2400
,         =      , (the , is required DOS syntax)
parity    =      EVEN
,         =      , (the , is required DOS syntax)
data bits =      7
,         =      , (the , is required DOS syntax)
stop bits =      1
```

```
Type TYPE C:\CNCDATA\PN1234.NC>COM2TYPE pathnamefilename>port
```

*TYPE* = *DOS command (followed by a space)*  
*pathname* = *C:\CNCDATA\ substitute the drive-and-directory(ies) where  
the file being sent to the  
VMC is stored*  
*filename* = *N1234.NC substitute the name of the file sent to  
the VMC*  
*>* = *> (the > is required DOS syntax to redirect the file to COM2*  
*port* = *COM2*

- Note: Before typing these two lines, the VMC should be in the TA,1 mode ready to receive the program at 2400 baud.
  - Refer to the DOS manual for answers to additional questions about the DOS commands used here.
- 3) Running DOS-based software from Windows may not work for communications.
- 4) Introducing another computer into a situation where communications are not happening may be useful only if the computer has been proven to work in other situations. Otherwise the second computer may also have a problem.



**Table 2: Fadal Software Error Codes**

04	OUT OF DATA	52	BAD FILE NUMBER
05	ILLEGAL FUNCTION CALL	53	FILE NOT FOUND
06	OVERFLOW	54	BAD FILE MODE
07	OUT OF MEMORY	55	FILE ALREADY OPEN
11	DIVISION BY ZERO	57	DEVICE I/O ERROR
12	ILLEGAL DIRECT	58	FILE ALREADY EXISTS
13	TYPE MISMATCH	61	DISK FULL
14	OUT OF STRING SPACE	62	INPUT PAST END
15	STRING TOO LONG	63	BAD RECORD NUMBER
16	STRING FORMULA TOO COMPLEX	64	BAD FILE NAME
17	CAN'T CONTINUE	67	TOO MANY FILES
18	UNDEFINED USER FUNCTION	68	DEVICE UNAVAILABLE
19	NO RESUME	69	COMMUNICATION BUFFER OVERFLOW
21	UNPRINTABLE ERROR	70	DISK WRITE PROTECTED
22	MISSING OPERAND	71	DISK NOT READY
23	LINE BUFFER OVERFLOW	72	DISK MEDIA ERROR
24	DEVICE TIMEOUT	74	RENAME ACROSS DISKS
25	DEVICE FAULT	75	PATH/FILE ACCESS ERROR
27	OUT OF PAPER	76	PATH NOT FOUND

**Table 3: CNC Main Errors**

150	"THE CNC NEEDS TO BE UPGRADED TO USE THIS PROGRAM"
151	"THIS VERSION OF CNCMAIN IS INCOMPATIBLE WITH YOUR CNC"
152	"CANNOT ESTABLISH LINK WITH CNC"
153	"INTERNAL ERROR: "
154	"CNC WILL NOT RESPOND"
155	"CANNOT RESPOND TO CNC"
156	"NO RESPONSE FROM CNC"
157	"INTERNAL ERROR: R"
158	"CNC DOES NOT RESPOND"
159	"OPERATION ABORTED"
160	"CNC REQUIRES A COLD START"
161	"NO SUCH STARTING BLOCK"
162	"SERIAL PORT NOT RESPONDING"
167	"STARTING BLOCK NOT FOUND"
170	"TOO MANY RETRIES ON A SINGLE PACKET"
180	"CANNOT FIND FILE"
181	"NOT AVAILABLE IN DESKTOP VERSION"

**Table 4: Syntax Errors**

190	"ALPHA CHARACTER MUST SEPARATED BY NUMBERS"
191	"DATA INPUT ERROR"
192	"ILLEGAL CHARACTER"
193	"ILLEGAL ENDING CHARACTER"
194	"ILLEGAL STARTING CHARACTER"
195	"CANNOT FIND NESTED FILE"
196	"FILES NESTED MORE THAN 3 DEEP"
251	"THIS PROGRAM REQUIRES A MOUSE"
253	"THIS PROGRAM REQUIRES A VGA COLOR MONITOR"
254	".SYS FILE IS MISSING"
255	"INCORRECT VERSION OF .SYS FILE"

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