



***Mx1000 BTR  
Installation & User's Manual***

*For Fanuc Tape Readers*



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Mx1000 BTR With Serial Cable (left DB25), 50 Conductor Fanuc Tape Reader Cable (top right) and Facit 4070 Punch cable (middle). Note power for unit comes from Fanuc Tape Reader cable – truly plug and play.

## ***Introduction***

Thank you for your purchase of the Mx1000 BTR unit. Memex puts a great deal of effort in the design, manufacture and testing of each unit we sell. We are confident you will find the Mx1000 a useful addition to your shop floor communications system.

### ***About this Manual***

This manual contains the specific steps necessary for the installation of your Mx1000, as well as operating procedures and helpful hints for operating the BTR. It is divided into two chapters and includes a table of contents, a glossary and two appendices.

Chapter 1 *Installation Instructions* explains how to install your Mx1000 BTR interface board.

Chapter 2 Reference contains a troubleshooting section, and gives you customer service and technical support information.

Appendix A Contains information for software configuration, jumper settings and a Memex serial cable pin out chart.

Appendix B Contains an ASCII chart for your reference.

### ***Behind The Tape Reader***

A BTR or Behind the Tape Reader, as it is commonly called, is an electronic signal processor designed to emulate the signals of a paper Tape Reader; thus providing an alternate method of data entry to an NC or CNC control. That method, namely RS232 serial communication, is an international standard form of electronic communication and data input that is certainly faster and much more reliable than the conventional method of punching tape or Manual Data Input (MDI).

Originally, the only one way that a G-Code operating program could be entered into a machine tool was through MDI mode, which allowed the program to be inputted using a keypad at the control. The MDI process was fine for small programs, but it was time consuming and error prone for longer programs. It took time to setup and to proof the MDI code before operation could commence. Machine flexibility was low, since each new program required time to input. With all the wasted time and lack of flexibility, it was not very long before someone invented an alternate form of control input, the paper Tape Reader.

The paper Tape Reader provided a faster, more reliable form of data input to the industrial control. However, these Tape Readers were mechanical in nature, and required regular maintenance and care to perform properly. Tape Readers allowed data and programs that were punched out on a paper tape to be read in by the control at a rate of approximately 300 to 400 characters per second. A few problems inherent in the Tape Reader were: its limited ability to accept commands, its mechanical problems, its limited ability to inform the operator of problems and status, its need to be kept clean and its need for lubrication and other maintenance. It was commonly suggested that a busy shop keep a spare reader in inventory in preparation for the time when one broke down. In spite of the costs associated with Tape Readers, the advantages of speedy input and reusable tapes were welcome.

Unfortunately, the process of punching data tapes (whether they be paper, Mylar or metal) was expensive, lengthy and necessitated storage concerns. Because of the absolute nature of a punched tape, the process had to be redone for every program revision. As well, proper communication had to be kept up between the programmer and operator for the tape to be accurate and kept up to date. Old tapes had to be filed or destroyed while the latest version had to be marked as such and stored. Finally, the tape itself had to be handled with care since it was prone to damage.

Later machine controls had a new mode of operation that allowed their Tape Reader's "endless" spool of tape to surmount memory constraints. Originating on Numerical Controls (NC) that had no memory, Direct Numeric Control (DNC) allowed execution of a program as it was read by the reader. This "drip-feed" method meant that your program was limited in size only by the length of tape that you used. This type of operation was very much appreciated later on with the advent of Computerized Numeric Controls (CNC).

With true onboard memory the CNC had much greater capabilities and inevitably programs got longer and the need for more memory grew. With control memory being expensive and limited, DNC has remained the only way some modern manufacturers can operate. With all this said, Tape Readers are still commonplace on modern controls today; however, with serial DNC capabilities, many shops use Tape Readers for backup purposes only.

The modern equivalent to a Tape Reader is the BTR serial interface board, which emulates paper Tape Readers. The Mx1000 is a microcontroller based serial interface board, that allows serial communications with a machine control for the purposes of loading programs into memory or running DNC. BTR's generally connect with a computer and permit a programmer to send a completed, formatted program to the machine control. The machine would then load the program from "Tape" to memory or to execute the statements, block by block (in the case of DNC). Because the Mx1000 BTR emulates the Tape Reader, the control really has no way of knowing that the source of the program is from a serial port, instead of a paper tape.

The Mx1000 BTR eliminates punching of tape, has no moving parts, can handle transfer speeds that are 10 times that of a Tape Reader, uses the programmed (source) file, is less expensive and does not require maintenance. It's no wonder that the BTR, in combination with DNC, has become the most cost effective alternative to having on-board memory.

While the Memex BTR gives the modern machine control the ability to receive programs from a PC, it has nothing to do with what is being sent to the control. For this, one requires a terminal program or other serial transfer utility (i.e.; multi-DNC). Your control is concerned with the data it receives and the form in which it is sent. The BTR acts only as a gateway or port to your control. Your terminal program has to be configured to send the data as if it were a tape. This special program format is usually described in your controls Operations Manual. Please consult this manual on how to configure your programs for your control. The BTR is only interfacing with the Tape Reader input on your control. Should you have any additional questions concerning BTR's in general, you are welcome to call us any time.



Standard Connection:  
Multi-DNC on a PC + Mx1000 BTR + 50 Pin Fanuc Tape Reader Cable to  
CAT Connector on left of Masterboard + Facit 4070 Punch Cable on Door  
(Honda 20 pin Connector)



## **Chapter 1**

# ***Installation Instructions***

## ***For the Fanuc Tape Reader***

Estimated time to complete: *Under 45 minutes*

## ***Unpacking the Mx1000***

### ***Component Checklist***

- 1 x Memex Mx1000 BTR..... Supplied
- 1 x Fanuc Interface Cable..... Supplied
- 1 x Screwdriver..... Supplied
- 1 x Manual..... Supplied

### ***Optional Components***

- Serial Interface Cable (PC – BTR)..... Optional
- SKU-5100 Fanuc punch interface cable.... Optional
- Serial Transfer Software (Multi-DNC)..... Optional

### ***Before you Proceed***

Please read all instructions before proceeding. We recommended that you first make a temporary installation, so that you familiarize yourself with the components and orientation of the assembly before making the installation permanent (i.e.; routing all cables through their appropriate channels).

# ***Installing the Mx1000 BTR***

## ***General***

The Memex BTR installation is a straight forward, relatively easy to complete procedure. All the hardware and accessories are provided for you. All you need are some basic skills and hand tools. The installation requires you to mount the Memex BTR on the inside of the Tape Reader door, unplug the Tape Reader and connect the BTR. A ribbon cable that is supplied allows the Reader to be reconnected via the BTR.

## ***To install your Mx1000***

### **1. Prepare the site.**

Ensure that the Tape Reader and control are working properly before committing to this installation. When you are ready, turn OFF all power to the control, machine and your computer system.

### **2. Open the control door.**

Locate the door on you machine control that has the Tape Reader mounted in it. Open this door to gain access to the back of the Reader.

### **3. Locate the 50 pin connector.**

Located and identify the Tape Reader printed circuit board. The board is located directly behind the reader and has two 50-pin IDC connectors, labeled CNT1 and CNT2. The second (CNT2) has wires going to the Tape Reader head. The Tape Reader cable (CNT1) has a connector with a 50-conductor ribbon cable on it. The cable on this connector goes to your CNC.

### **4. Disconnect the Control.**

Locate the 50-conductor cable that runs from the Tape Reader to the Fanuc's main control board. Disconnect this cable from the back of the Tape Reader PCB (CNT1).

### **5. Connect to the Control.**

Holding the Memex BTR unit in front of you, orient it so that the 50-pin connectors are on the upper half of the board, the DB-25 serial line connector is at the bottom and the component side of the unit is facing you. Now connect the cable which was plugged into CNT1 on the Tape Reader into the left connector (Control A) of the BTR without twisting the cable.

**6. Mount the Mx1000 BTR.**

Locate and magnetically mount your Memex BTR serial interface board in a convenient spot on the back of the door.

**7. Option: Connect the Tape Reader.**

Take the new 50-conductor ribbon cable and plug it into the connector on the other side of the BTR labeled "TAPE READER A". The red wire and pin 1 should be aligned. Plug the other end of the cable into the CNT1 connector on the Fanuc Tape Reader board. Again the red wire on the ribbon cable should be aligned with pin 1 on the connector.

**8. Option: Fanuc punch cable.**

Locate the punch port on your control. It is usually a blue, rectangular, 20 pin connector. Plug the Fanuc punch port interface adapter into this port. Plug the other end (26-pin IDC) into the BTR connector labeled "PUNCH IN". Ensure that you have the proper alignment of pin 1. Be sure to remove the jumper in the upper right corner of the BTR labeled "PUNCH DISABLE".

**9. Mark the Cables.**

Mark the connectors and cables so that you are sure that they will be reassembled properly during the final assembly process. Disassemble the cables in order to route them neatly with the BTR unit attached at a convenient location inside the control cabinet.

**10. Connect to Computer.**

Now connect a serial cable from the DB25F on the BTR unit to the computer's serial port. Route the extra cable in a neat and tidy fashion and secure with tie-wraps. *Refer to page 16 for cable diagrams.*

**11. Clean Up.**

Complete the installation by tidying up the cables and making them neat. Plug in the power cords for the computer. Check your work, and turn on the power. Everything should come to life.

***Caution***

It is *very important* that the cables be installed properly and with the correct orientation. If an end of one of the Reader cables is plugged in upside down, sever damage *will* occur to the Option Card, Tape Reader and the Control's Master Board.

### ***Summary of Mx1000 Safety Features:***

You Mx1000 (and its new version the Mx1100) have several unique safety features built-in. They include:

- Low Power Reset Chip (if the power is less than 4.6 Volts DC, the main micro-processor is held in reset state to protect against data loss);
- The use of keys on the cables to protect against improper insertion;
- The use of self resetting fuses to guard against shorts and undue maintenance costs in case of accidents;
- The use of a back biases diode to protect against improper powering of the unit from the screw-down terminals;
- The ability for the unit to be remotely reset using a Control + C command (hex 03 character) to prevent against residual data left from a previous aborted download;
- The inclusion of on-board power regulation allows for voltage variance from 7-30 volts DC when needed.

## ***Operating your Mx1000 BTR***

To use your new serial port, connect your cables and prepare your software. Reset the BTR to ensure that no residual data is present in its buffer. This can be done by simply pressing RESET on the Fanuc control or by switching the Tape Reader (if connected) between AUTO and RELEASE modes.

Start an upload to your control with your software, then go and load a program at the control as you normally would from Tape.

### ***Note:***

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Follow the procedures in your Operators Manual with one exception: Keep the switch on your Tape Reader in the RELEASE position when you wish to load programs through the BTR. The Mx1000 BTR senses the position of the "AUTO / RELEASE" switch on the Tape Reader. Your control will load the G-Code file as if it were a tape, although it will indeed load from your computer through the BTR.

### ***Helpful hints***

Add a couple of Carriage Returns to the end of your file, thus ensuring that the entire file is transmitted.



## **Chapter 2**

### **Reference**

This chapter contains troubleshooting hints and information about Memex Technical Support and Service.

#### **General Troubleshooting**

The Mx1000 is designed to install easily and quickly. However, if you do experience difficulty in the procedures, please check the following to isolate the problem and resolve it quickly.

**1. Check that the PWR LED is on and bright on the BTR. It is located\* on the lower edge of the BTR just left of center.**

If there is no power to the BTR, ensure that the cables from the Control and from the Tape Reader are oriented properly and are well secured. Also, check that the +5TR jumper is ON or that the +24TR jumper and the REG ENBL jumper are ON. All three of those jumpers should NOT be on at the same time. The proper setup of the jumpers will enable the power to be supplied from the Tape Reader or the control. If the PWR LED still does not come on, carefully find a source of power on the control between 9 and 24VDC and wire it in to the “screw down” terminal block in the lower left corner of the BTR. When you bring power in through the terminal block, you will have to put jumpers on the +24TR and REG ENBL. Make sure the +5TR jumper is removed in this case.

**Note:**

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\* All references made to objects located on the BTR will be made with respect to the BTR being oriented horizontally so that you can read the Memex Electronics name in the top left.

**2. Check that the BTR is working properly.**

When you turn on power to the control, the STATUS LED on the BTR should blink. One blink indicates that the Mx1000 is in BTR Mode.

This means that it is ready to receive information through the serial port and to send it to the control. Two blinks indicate that the BTR is in TAPE Mode. This means that it is ready to pass information through the BTR from the Tape Reader to the Control.

On some Readers, turning the Tape Reader on/off or switching the Reader between Load and Release will switch the BTR between these different modes.

**3. If the BTR “Locks Up”?**

Look in the upper left corner of the BTR for the four pins labeled RESET and LOAD. Of those four pins, the top two are the reset pins. Touching the two RESET pins together while the power is on should reset the BTR and make the STATUS light flash when you release them. This action is the equivalent to pressing the reset button on a PC. It is like a “cold boot”. You should not have to do this on a regular basis but you may need to do so occasionally.

**4. Check the status message.**

When the BTR is connected properly to a computer, a small message should appear on the screen when the BTR has just been turned on or reset. This message indicates the mode that the BTR is currently in.

**5. The Status light flashes but there is no status message reported back to the computer.**

First you have to be watching for the status message with a terminal program or utility. Once you have loaded a program that receives RS232 information on your computer, verify that you are using the correct communication parameters and check that you are using the correct COM port on the computer. Check that the BAUD RATE is properly set and matches the baud rate on the BTR (check option jumpers A1 and A2; *see pg. 15*) and that the STOP BITS are set for 1. Make sure that the cable you are using is a straight through MODEM cable and that it is properly connected (*see page 16*). Also verify that your PC's COM port is functioning properly.



- 6. The file you are sending to your control doesn't wait for you to press "Cycle Start".** You probably do not have the correct "handshaking" set. Check that you are using either Hardware or Software handshaking on your terminal software and that the appropriate option is set on the BTR (jumper A3). If you are trying to use Software handshaking, some terminal programs look at the XOFF character (13 hex) with even parity (93 hex). Try setting option jumper A4 to make the XOFF character a 93h. If you are trying to use Hardware handshaking, make sure that you are using the proper cable. You must have pins 4 and 5 connected properly between your terminal and the BTR. If you are using a three conductor cable to communicate, Hardware handshaking is not possible.
- 7. Your control gives you an error just after pressing "Cycle Start".** Try to remove either the CR (carriage return) characters or the LF (line feed) characters from your program. Machine controls usually read ISO or EIA code through a taper reader. As a result they may only accept "pure" ISO or EIA code through the Tape Reader or BTR. These codes typically do not contain any CR characters so your control may give an error if it reads one.
- 8. Your control gives you a Tape Vertical (TV) alarm.** Tape Vertical checking was a way that controls verified the accuracy of the program code they read in through the Tape Reader. It is usually an option and does not apply when you are using a BTR. Turn this option off.
- 9. Your control gives you a Tape Horizontal (TH) alarm.** Tape Horizontal is equivalent to Even parity. Use even parity when you are sending your programs from the terminal or PC (see also note 7).
- 10. If the Power LED comes on the BTR but the STATUS LED does not.** Check the supply voltage to the BTR. If you are using a 5VDC supply and it is less than 4.7VDC, the BTR may actually be protecting itself from under voltage. Find a better 5V supply or use the screw down terminal in bottom, left corner and use a supply of 9-24V. Be sure to set up the power jumpers correctly, in any case (see note 1).
- 11. Other machine errors:**  
Ensure that you have added in the proper tape codes at the beginning or end of your program. Some machines require that you have a % sign as the first and/or last character in your program. Check your control manual for any termination characters that may be required.

## ***Memex Technical Support & Service***

Memex Automation provides toll-free technical support for the Mx1000 BTR. If you have a problem, be sure to review the troubleshooting section of this manual prior to calling for technical support. If you cannot resolve a problem after reading through the troubleshooting section, please contact Memex Automation technical support at **1-905-529-1533**.

Please note that Memex stands behind its product with a 3 year limited normal use warrantee. This warrantee does not protect against lightening or power surge damage, but experience has shown that even in these cases only a small repair charge is ever necessary. Our goal is your 100% satisfaction and years of reliable service.

If you have any other questions or concerns, need answers to technical questions, or need information about Memex products and/or services please contact your local product dealer, or contact Memex Automation sales at the address below:

**Memex Automation Inc.**  
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## ***Glossary***

**ANSI (American National Standards Institute)** The official US agency and voting representative for ISO. This institute develops information exchange standards above 50 Mbps.

**ASCII (American Standard Code for Informational Interchange)** A seven bit alphanumeric code used extensively in data communications. A parity bit is often added to the seven-bit code for error detection.

**ASR 33** An asynchronous serial interface standard that specifies the electrical, functional, and mechanical interface specification between communicating devices. Also known as “Current Loop”.

**ASYNCHRONOUS TRANSMISSION** The transmission of characters separated by time intervals that vary in length, usually in accordance with the key entries of a terminal operator. Start and stop bits are used to identify (frame) the beginning and end of the asynchronously transmitted character.

**BAUD RATE** The rate at which a signal is changed or modulated. Baud rate is directly related to the number of bits transmitted per second.

**BTR (Behind the Tape Reader)** An electronic input device used to emulate a Tape Readers signals on a machine control. They usually convert some form of serial communication to the parallel Tape Reader signals.

**CNC (Computerized Numerical Control)** An industrial computer that is used to control the axis and movement of a machine. A CNC usually uses programs coded with G-codes and M-codes.

**CONTROL** Refers to a Computerized Numerical Control (CNC).

**CTS (Clear To Send)** One of the control lines used in RS232 communication. Found on pin 4 or 5 on a DB25 and pin 4 or 8 on a DB9 depending on the type of device (DTE or DCE).

**CURRENT LOOP** A serial interface standard that has evolved from the old electromechanical teletype which used current to activate its relays. Typically 20ma or 60ma is turned on and off in accordance with the binary serial data.

**DCE (Data Communication Equipment)** Typically a modem or data set used to interface a terminal or computer to the telephone lines.

**DNC (Direct/Distributed Numeric Control)** A means of communicating or “Drip Feeding” a program to a CNC through a Tape Reader or serial interface. The program code is acted upon immediately block by block as it is read by the control.

**DTE (Data Terminal Equipment)** In data communications, it is an end user or termination circuit, typically a terminal or computer.

**ECHO** A reflected signal. Information is sent back to the transmitter from the receiver, often for verification purposes.

**EIA (Electronic Industries Alliance)** A United States organization of manufacturers that establishes and recommends industrial standards. They developed the EIA standard code used in early NC and CNC communications. The standard allows for ODD parity and is countered with ISO which is EVEN parity on the data bits.

**FRAMING** The procedure used to identify the beginning and end of a group of data bits.

**FRAMING ERROR** This type of error occurs when a receiver loses synchronism to the incoming data.

**HANDSHAKING** A process that regulates and controls the flow of data between two devices.

**HARDWARE HANDSHAKING** Handshaking by use of the RTS and CTS control lines on a RS232 serial interface.

**ISO (International Standards Organization)** One of the largest and most widely recognized standards organizations in the world. Also, a form of data format (encryption) similar to ASCII. It is a form of 7 bit ASCII with even parity used largely on CNC's.

**LOCAL ECHO** When a terminal is configured to internally route its transmitted character around to its receiver section for display, a local echo is said to be generated.

**MARK** A logic 1.

**MODEM** A contraction of the words modulator/demodulator. The modem converts a computer's digital bit stream into an analog signal suitable for the telephone lines and vice versa.

**PAPER TAPE** A media of program code storage. Holes were punched in the paper tape to represent different program codes. These tapes were then read through a Tape Reader to be loaded into CNC memory.

**PARITY** An error detection method whereby a single bit is added to a group of bits to make the total number of 1 bits either even or odd (depending on the type of parity; even or odd).

**PARITY ERROR** Indicates that the total number of 1 bits in a received character does not agree with the type of parity expected.

**RI (Ring Indicator)** One of the control lines used by modems in RS232 communication. Found on pin 18 on a DB25 and pin 9 on a DB9 connector.

**RS232-C** An asynchronous serial interface standard that specifies the electrical, functional, and mechanical interface specification between data communication devices.

**RTS (Request To Send)** One of the control lines used in RS232 communication. Found on pin 4 or 5 on a DB25 and pin 4 or 8 on a DB9 connector (depends on whether port is for DCE or DTE).

**RTS/CTS** Hardware handshaking using the RTS and CTS control lines.

**Rx** Receive Data

**SG** Signal Ground.

**START BIT** The first bit used to frame an asynchronously transmitted character. Its logic level is a 0 (space).

**STOP BIT** The last bit used to frame an asynchronously transmitted character. Its logic level is a 1 (mark).

**SYNCHRONOUS TRANSMISSION** High speed communication whereby data characters are sent in direct succession to each other without the use of Start and Stop bits.

**TAPE READER** Input device used on CNC Machines and other industrial equipment. Used to “read” coded data on a punched paper tape. Older Tape Readers were a mechanical device; today Tape Readers use optical devices that sense light passing through the holes in the tape.

**TERMINAL** An input/output device used by an operator to communicate with a host computer. It consists of a keyboard and a display to monitor alphanumeric characters entered at the keyboard or received from a remote device.

**TIME-OUT ERROR** This type of error occurs when a device fails to respond to a message within a given period of time.

**TTY Teletype** Used in the Telex exchange. An electromechanical terminal consisting of a keyboard, printer, paper Tape Reader and punch. Teletype is a trade mark of the former Teletype Corp.

**Tx** Transmit Data.

**XOFF (Transmit Off)** A device control character (DC3 or \$13 hex) used to control the flow of data between two devices. XOFF is used as a handshake with XON.

**XON (Transmit On)** A device control character (DC1 or \$11 hex) used to control the flow of data between two devices. XON is used as a handshake with XOFF.





















**XON/XOFF** Software handshaking using the XON and XOFF control characters.

# Appendix A Configuration & Settings

## Software Configurations

Baud.....9600  
 Parity.....Even  
 Data Bits..... 7  
 Stop Bits..... 1  
 ASCII Xfer Options.....With Strip the High Bit – ON  
 Duplex.....FULL  
 Handshake.....OFF

## Option Jumpers on BTR

A1		= 1200 Baud		= 2400 Baud		= 4800 Baud		= 9600 * Baud
A2								
A3		CTS/RTS flow control		Xon/Xoff flow control *				
A4		Xoff = \$13 hex *		Xoff = \$93 hex				
A5		Single Xoff *		Continuous Xoff				
A6		Echo *		No Echo				
A7		No conversion *		ISO – EIA conversion				
A8		Switch enabled		BTR mode only *				

### \* Factory Defaults

<b>+24TR</b>	Enable 24V power from Tape Reader
<b>+5TR</b>	Enable 5V power from Tape Reader
<b>+5V on 6,20</b>	5V output on pins 6 and 60 of DB25F
<b>REG ENBL</b>	Enable 5V Power Regulator
<b>Punch Disable</b>	Use if Punch Port not connected

### NOTE:

 = NO Jumper       = Jumper ON

## RS232-C Serial Port Data

Pin 1.....	Frame ground (shielding)
Pin 2.....	Receive Data
Pin 3.....	Transmit Data
Pin 4.....	CTS
Pin 5.....	RTS
Pin 6.....	Loop Back to 20
Pin 7.....	Signal Ground
Pin 8.....	GND
Pin 20.....	Loop back to 6
Pin 22.....	5 V
Pin 23.....	5 V
Pin 24.....	GND
Pin 25.....	GND

*Note:* Memex has enabled Pin 18 as a power out line. A Raychem Polyswitch or jumper must be present in position "F2" on the board. Power is limited to 300 mA by the RayChem Polyswitch. Voltages vary depending on power input on screwdown terminals.

## Basic BTR Cable Configurations

### A – Software Handshaking Only

<b>Computer</b>	<b>Mx1000 BTR</b>
<b>DB-25F</b>	<b>DB-25M</b>
Tx – 2	2 – Rx
Rx – 3	3 – Tx
SG – 7	7 – SG
<b>DB-9F</b>	<b>DB-25M</b>
Tx – 3	2 – Rx
Rx – 2	3 – Tx
SG – 5	7 – SG

### B - Hardware Handshaking

<b>Computer</b>	<b>Mx1000 BTR</b>
<b>DB-25F</b>	<b>DB-25M</b>
Tx – 2	2 – Rx
Rx – 3	3 – Tx
RTS – 4	4 – CTS
CTS – 5	5 – RTS
SG – 7	7 – SG
<b>DB-9F</b>	<b>DB-25M</b>
Tx – 3	2 – Rx
Rx – 2	3 – Tx
RTS – 7	4 – CTS
CTS – 8	5 – RTS
SG – 5	7 – SG



**Appendix B**  
**ASCII Table**

<b>DEC</b>	<b>HEX</b>	<b>SYM</b>	<b>KEY</b>	<b>DEC</b>	<b>HEX</b>	<b>SYM</b>	<b>DEC</b>	<b>HEX</b>	<b>SYM</b>
0	0	NUL	ctrl @	43	2B	+	86	56	V
1	1	SOH	ctrl A	44	2C	,	87	57	W
2	2	STX	ctrl B	45	2D	-	88	58	X
3	3	ETX	ctrl C	46	2E	.	89	59	Y
4	4	EOT	ctrl D	47	2F	/	90	5A	Z
5	5	ENQ	ctrl E	48	30	0	91	5B	[
6	6	ACK	ctrl F	49	31	1	92	5C	\
7	7	BEL	ctrl G	50	32	2	93	5D	]
8	8	BS	ctrl H	51	33	3	94	5E	^
9	9	HT	ctrl I	52	34	4	95	5F	~
10	A	LF	ctrl J	53	35	5	96	60	
11	B	VT	ctrl K	54	36	6	97	61	a
12	C	FF	ctrl L	55	37	7	98	62	b
13	D	CR	ctrl M	56	38	8	99	63	c
14	E	SO	ctrl N	57	39	9	100	64	d
15	F	SI	ctrl O	58	3A	:	101	65	e
16	10	DLE	ctrl P	59	3B	;	102	66	f
17	11	DC1	ctrl Q	60	3C	<	103	67	g
18	12	DC2	ctrl R	61	3D	=	104	68	h
19	13	DC3	ctrl S	62	3E	>	105	69	i
20	14	DC4	ctrl T	63	3F	?	106	6A	j
21	15	NAK	ctrl U	64	40	@	107	6B	k
22	16	SYN	ctrl V	65	41	A	108	6C	l
23	17	ETB	ctrl W	66	42	B	109	6D	m
24	18	CAN	ctrl X	67	43	C	110	6E	n
25	19	EM	ctrl Y	68	44	D	111	6F	o
26	1A	SUB	ctrl Z	69	45	E	112	70	p
27	1B	ESC	ctrl [	70	46	F	113	71	q
28	1C	FS	ctrl \	71	47	G	114	72	r
29	1D	GS	ctrl ]	72	48	H	115	73	s
30	1E	RS	ctrl ^	73	49	I	116	74	t
31	1F	US	ctrl _	74	4A	J	117	75	u
32	20	SP		75	4B	K	118	76	v
33	21	!		76	4C	L	119	77	w
34	22	"		77	4D	M	120	78	x
35	23	#		78	4E	N	121	79	y
36	24	\$		79	4F	O	122	7A	z
37	25	%		80	50	P	123	7B	{
38	26	&		81	51	Q	124	7C	
39	27	'		82	52	R	125	7D	}
40	28	(		83	53	S	126	7E	~
41	29	)		84	54	T	127	7F	DEL
42	2A	*		85	55	U			



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