Richmond Sound Design Ltd.

MODEL MTS-232 MIDI/RS232 CODE TRANSLATOR

Reference Guide V1.2

Richmond Sound Design Ltd.

MTS-232 MIDI/RS232 CODE TRANSLATOR

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MTS-232 MIDI/RS232 CODE TRANSLATOR

1. INTRODUCTION

The MTS-232 includes MIDI In, MIDI Thru, and MIDI Out connectors plus a total of four 25-pin Male "D" style Serial port connectors conforming to the ANSI/EIA-232-D-1986 interface standard. The MTS-232 is a 1U high rack mount device with connectors on the rear panel and TX and RX indicators for each RS232 channel plus a power indicator on the front panel. Power supply is a separate low voltage AC adapter type.

MIDI data received at the MIDI In port is reformed and retransmitted in normal fashion by the MIDI Thru port. MIDI data received at the MIDI In port which conforms to the correct System Exclusive coding format can transmit any valid serial data via any or all of the RS232 ports and/or can set or reset RTS & DTR outputs. Each MTS-232 can be preset with any of 128 different addresses so that up to 512 RS232 serial ports can be accessed by a single MIDI network.

Serial data in the form of specific ASCII characters received by each RS232 port is interpreted and retransmitted as a similar hexadecimal MIDI message via the MIDI Out port. Each serial port can be independently set to any baud rate between 300 and 38400, with eight data bits, software selectable parity and one stop bit.

2. INSTALLATION

2.1 General

In normal operation, DIP switches are read on power-up only. Any changes to DIP switch settings will have no effect until the device is powered down and up again.

The exception is when "diagnostic mode" is selected. In this mode, baud rate and device address switches update the corresponding parameters on a continuous basis.

2.2 DIP Switch Assignments

GROUP	SWITCHES	PURPOSE
S1	1,2,3	RS232 channel 3 baud rate
	4,5	Factory preset OPEN
	6,7,8	EPROM size
S2	1,2,3	RS232 channel 4 baud rate
	4-8	Factory preset OPEN
S3	1,2,3	RS232 channel 1 baud rate
	4,5,6	RS232 channel 2 baud rate
	7,8	Factory preset OPEN
S4	1-7	Device address
	8	Diagnostic mode select

2.2.1 Baud Rate Settings

Eight baud rates are supported for each channel. Channels 1, 3 and 4 are set with switches 1, 2 and 3 of their respective switch groups. Channel 2 is set with switches 4, 5 and 6 of its switch group. See DIP Switch Assignments, above, for switch groups.

SWITCH: 3 (6)	2 (5)	1 (4)	BAUD
1	1	1	38400
1	1	0	19200
1	0	1	9600
1	0	0	4800
0	1	1	2400
0	1	0	1200
0	0	1	600
0	0	0	300

Notes: 1 = OPEN/OFF 0 = CLOSED/ON

2.2.2 EPROM Size Setting

Though there are eight possible combinations of the three switches assigned to EPROM size, only two settings are valid.

EPROM	S1: 8	7	6
8K (2764)	1	1	0
32K (27256)	0	0	1

Note: 1 = OPEN 0 = CLOSED

2.2.3 Device Address

Seven switches are assigned to device address, allowing 128

addresses. The switches are binary encoded, as follows:

S4 SWITCH SETTING							ADDRESS
7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	1
0	0	0	0	0	1	0	2
0	0	0	0	0	1	1	3
			etc.				
1	1	1	1	1	1	1	127

Note: 1 = OPEN 0 = CLOSED

2.2.4 Diagnostic Mode Select

The diagnostic mode can be used to verify that the hardware is operational and that baud rates, device number, and cabling are correct. The diagnostic mode transmits data on all RS232 channels and MIDI simultaneously.

Each RS232 channel sends both the device address (0 to 127) and the channel number (1 to 4) at the current baud rate setting. The MIDI output sends alternate Note On and Note Off messages (channel 1, note 64, velocity 64). Messages are transmitted at a rate of about one per second.

Switch setting is as follows:

S4-8 SETTING	MODE
OPEN	Diagnostic mode
CLOSED	Normal operation

To exit diagnostic mode, the MTS-232 must be powered down and up again.

2.3 Connectors

All MIDI connectors follow the current MIDI standard, with pins 4 and 5 carrying the current loop signal, 1 and 3 not used, and pin 2 grounded on MIDI Thru and MIDI Out but unconnected on MIDI In.

All serial connectors follow the current ANSI/EIA-232-D-1986 interface standard, configured as Data Terminal Equipment. Male 25-pin "D" type connectors with 4-40 screw thread standoffs are supplied on the rear panel.

Pinouts are as follows:

PIN	FUNCTION
2	TX Data
3	RX Data
4	RTS (transmitted)
5	CTS (received)

6	DSR (received)
7	Signal Ground
20	DTR (transmitted)
Others	No connection

Note: Pins 4 & 20 are connected internally with a jumper
Pins 5 & 6 are connected internally with a jumper

Low voltage AC/DC power input is provided via a bayonet connector with 2.1mm centre pin diameter. External power supply is nominally 9V @ 500mA.

3. PROGRAMMING

3.1 General

The MTS-232 Code Translator converts packets of data between RS232 and MIDI interface standards. Data can be translated both from MIDI to RS232 and from RS232 to MIDI.

The MIDI data packets are in the form of MIDI System Exclusive (SysEx) messages. The same format is used for both received and transmitted packets.

The RS232 data packets received are in the form of hexadecimal ASCII strings, terminated with a carriage return or line feed character. The RS232 data packets transmitted can take any form desired, dependent on the MIDI SysEx data received.

In all cases the MTS-232 collects up entire data packets and checks for valid message format before retransmitting.

The RS232 outgoing RTS & DTR control lines can be set and the RS232 incoming CTS & DSR control lines can be monitored with MIDI via SysEx messages.

3.1.1 MIDI Setup Messages

The MIDI Setup Message presets most characteristics of the RS-232 transmitting and receiving protocols employed by each of the four RS232 ports. The MIDI Setup Message format is summarized as follows:

FIELD #		CODE	MEANING
1	1	F0h	MIDI "Start of SysEx" code
2	3	00h 00h 40h	Richmond Sound Design mfr. ID #
3	1	00h	MTS232 device ID #
4	1	00h-7Fh	Device address #
5	1	10h-1Fh	RS232 channel & data bits (lower nibble)
		30h-3Fh	setup flag & stop bits (upper nibble)
		50h-5Fh	
6	0-n	70h-7Fh	optional additional data
7	1	F7h	MIDI "End of SysEx" code

Where "n" represents the number of data bytes in the message, and

the "#" column indicates the number of bytes in each field.

As with all MIDI system exclusive messages, the message begins with an F0h (field 1), followed by the vendor ID number (field 2), and ends with an F7h (field 7).

The 5th byte in the message (field 3) is a device ID which allows for expansion of the MIDI network to include other Richmond Sound Design MIDI-controlled devices. This byte must be 00h for an MTS-232 to respond to the SysEx message

The 6th byte in the message (field 4) is the MTS-232 device address, which allows up to 128 MTS-232 units to be addressed on a single MIDI network.

Only MTS-232 units with a DIP switch setting matching this number will respond to the SysEx message. (These DIP switch settings are detailed in 2.2.3, above)

The 7th byte (field 5) specifies the RS232 channel address, number of data bits and number of stop bits desired.

The lower nibble of the 7th byte specifies the channel address and number of data bits, with values of 0 to 3 selecting RS232 channels 1 to 4 respectively, setting the number of data bits used by the selected channel to the default value of 8. Values of 4 to 7 select channels 1 to 4 and set the number of data bits in the chosen channel to 7. Values of 8 to B select channels 1 to 4 and set the number of data bits in the chosen channel to 6. Values of C to F select channels 1 to 4 and set the number of data bits in the chosen channel to 5.

It is advisable to allow adequate time for message transmission after sending any prior message data before sending a MIDI Setup Message since the selected channel is reset at that time. The settings specified will remain as long as the device remains powered. Upon power up, all channels are set to default values however, so if different bit values are important at all times it is recommended that MIDI Setup Messages be sent whenever the MTS-232 is likely to experience variable power conditions.

Combining the setting for data bit values with the Channel Select bits, there are 16 values of interest for the lower nibble of the 7th byte:

Channel	1	2	3	4
Setting				
8 (Default)	0H	1H	2H	3H
7	4H	5H	6H	7H
6	8H	9H	AH	BH
5	CH	DH	EH	FH

The upper nibble of the 7th byte sets the number of stop bits, and can have one of three valid values:

VALUE	ACTION
1H	Sets stop bit value to 1 (Default)

3H Sets stop bit value to 1½
5H Sets stop bit value to 2

Example:

Set channel 3 data bits to 7 and stop bits to 2, device address = 15H:

F0 00 00 40 00 15 56 F7

Detailed bit usage of the 7th byte is as follows:

Bit 7 6 5 4 3 2 1 0
0 S1 S0 1 D1 D0 C1 C0

where:
S1-S0 = Stop bit setting
D1-D0 = Data bit setting
C1-C0 = Channel select

Stop bit settings can be one of three combinations:

S1 S0 Meaning

0 0 1 Stop bit in specified channel (Default)
0 1 1½ Stop bits in specified channel
1 0 2 Stop bits in specified channel

Data bit settings can be one of four combinations:

D1 D0 Meaning

0 0 8 Data bits in specified channel (Default)
0 1 7 Data bits in specified channel
1 0 6 Data bits in specified channel
1 1 5 Data bits in specified channel

Channel bits can be set to one of four combinations:

C1 C0 Meaning

0 0 Channel 1
0 1 Channel 2
1 0 Channel 3
1 1 Channel 4

Starting at the 8th byte of the MIDI Setup Message, optional data is sent.

This field is normally left "blank" by making the 8th byte transmitted the MIDI "End of SysEx" code (F7h). Future revisions of the MTS-232 firmware will use this optional data for additional features as they become necessary.

3.2 MIDI to RS232

Data is passed from the MIDI input to one of four RS232 outputs via a MIDI SysEx message. The MIDI message format is summarized

as follows:

FIELD	#	CODE	MEANING
1	1	F0h	MIDI "Start of SysEx" code
2	3	00h 00h 40h	Richmond Sound Design mfr. ID #
3	1	00h	MTS232 device ID #
4	1	00h-7Fh	Device address #
5	1	00h-0Fh	RS232 channel & parity (lower nibble)
		40h-4Fh	RTS & DTR setting (upper nibble)
		60h-6Fh	
6	0-n	70h-7Fh	RS232 data packet (maximum 64 bytes)
7	1	F7h	MIDI "End of SysEx" code

Where "n" represents the number of data bytes in the message (64 maximum), and the "#" column indicates the number of bytes in each field.

As with all MIDI system exclusive messages, the message begins with an F0h (field 1), followed by the vendor ID number (field 2), and ends with an F7h (field 7).

The 5th byte in the message (field 3) is a device ID which allows for expansion of the MIDI network to include other Richmond Sound Design MIDI-controlled devices. This byte must be 00h for an MTS-232 to respond to the SysEx message

The 6th byte in the message (field 4) is the MTS-232 device address, which allows up to 128 MTS-232 units to be addressed on a single MIDI network.

Only MTS-232 units with a DIP switch setting matching this number will respond to the SysEx message. (These DIP switch settings are detailed in 2.2.3, above)

The 7th byte (field 5) specifies the RS232 channel address, parity format and the RTS & DTR setting desired.

The lower nibble of the 7th byte is the channel address and parity, with values of 0 to 3 selecting RS232 channels 1 to 4 respectively, causing no change of parity setting for both transmitting and receiving in that channel.
Values of 4 to 7 select channels 1 to 4 and effect a 'no parity' setting in the chosen channel. Values of 8 to B select channels 1 to 4 and effect an 'odd parity' setting in the chosen channel. Values of C to F select channels 1 to 4 and effect an 'even parity' setting in the chosen channel.

While all other functions of the sysex message remain operational when parity is being set, it is advisable to change parity only after a suitable delay after any prior message data has been sent since the channel is reset upon receipt of a parity change and data in the process of being transmitted may be lost. The setting specified will remain as long as the device remains powered. Upon power up, all channels are set to 'no parity' however, so if correct parity is important at all times it is recommended that parity be set in each message.

Combining the Parity setting bits with the Channel Select bits, there are 16 values of interest for the lower nibble of the 7th byte:

Channel	1	2	3	4
Setting				
No Change	0H	1H	2H	3H
No Parity	4H	5H	6H	7H
Odd Parity	8H	9H	AH	BH
Even Parity	CH	DH	EH	FH

The upper nibble of the 7th byte controls RTS & DTR, and can have one of three valid values:

VALUE	ACTION
0H	No change to RTS & DTR
4H	Set RTS & DTR ON
6H	Set RTS & DTR OFF

Example:

Set channel 2 parity to odd and set RTS/DTR on, device address = 10H:

F0 00 00 40 00 10 49 F7

Detailed bit usage of the 7th byte is as follows:

Bit	7	6	5	4	3	2	1	0
	0	R1	R0	0	P1	P0	C1	C0

where:
R1-R0 = RTS/DTR setting
P1-P0 = Parity setting
C1-C0 = Channel select

RTS/DTR bits can be set to one of three combinations:

R1	R0	Meaning
0	0	No change to current setting
1	0	Set RTS/DTR on in specified channel
1	1	Set RTS/DTR off in specified channel

Parity bits can be set to one of four combinations:

P1	P0	Meaning
0	0	No change to current parity setting
0	1	Set specified channel to no parity
1	0	Set specified channel to odd parity
1	1	Set specified channel to even parity

Channel bits can be set to one of four combinations:

C1	C0	Meaning
0	0	Channel 1

0 1 Channel 2
1 0 Channel 3
1 1 Channel 4

Starting at the 8th byte of the MIDI message, the RS232 data packet is sent (field 6). This field can be left "blank," by making the 8th byte transmitted the MIDI "End of SysEx" code. The maximum number of data bytes allowed is 64.

Each RS232 data byte in the packet is transferred in two consecutive MIDI bytes. Each of the two MIDI bytes contains one nibble of the RS232 byte.

The first of each pair of MIDI bytes contains the upper RS232 nibble, while the second of the pair contains the lower RS232 nibble. The lower MIDI nibble contains an RS232 nibble, while the upper MIDI nibble is always 7.
Legal codes are therefore in the range of 70h to 7Fh. The pair of MIDI bytes 73h 71h will be translated into the RS232 byte 31h.

Example: MIDI to RS232

The MIDI message: F0 00 00 40 00 01 03 73 71 73 72 73 73 F7 results in the ASCII string of "123" being transmitted on RS232 channel 4 of MTS-232 unit with address 1. In this example, parity and RTS/DTR setting is not changed from what it was prior to this message being sent.

3.3 RS232 to MIDI

Data packets from all four RS232 inputs are merged onto the single MIDI output.

The RS232 message format consists of a hexadecimal ASCII string with a maximum of 64 characters terminated with a carriage return or line feed character. The hexadecimal ASCII format requires that two ASCII characters must be received on the RS232 input for each byte transmitted on the MIDI output.

Valid RS232 code values are as follows:

CODE	ASCII
30h to 39h	'0' to '9'
41h to 46h	'A' to 'F'
61h to 66h	'a' to 'f'
0Ah	LF (Line Feed)
0Dh	CR (Carriage Return)

The content of the message is not evaluated by the MTS-232, so the system programmer must ensure that RS232 messages sent to the MTS-232 will result in valid MIDI transmissions.

Example: RS232 to MIDI

The RS232 string "904040\n" ('\n' here specifies CR or LF)

translates into the hexadecimal bytes: 90 40 40 being transmitted out the MIDI Out port.

3.3.1 CTS & DSR to MIDI

When CTS & DSR changes occur on any of the RS232 inputs, the MTS232 responds by transmitting a MIDI SysEx message on the MIDI output. The SysEx message is in the same format as described above.

The device address (field 4) and RS232 channel (field 5) indicate which unit and channel changed. The CTS & DSR bit state is reflected in the upper nibble of field 5.

VALUE	MEANING
4	CTS & DSR has changed to ON
6	CTS & DSR has changed to OFF

The data field (field 6) is left blank.

Note that the MIDI SysEx message is only transmitted when the CTS & DSR line changes state.

After a hardware reset, the MTS-232 assumes the state is OFF. If it is not, it will transmit the SysEx message to indicate that the CTS & DSR line is ON. No message will be transmitted after reset if the CTS & DSR line is OFF as expected.

Example: CTS & DSR to MIDI

The CTS & DSR line of channel 2 of MTS-232 with address 5 has just changed from OFF to ON. The message: F0 00 00 40 00 05 42 F7 is transmitted on the MIDI Output.

Subject to change without notice.

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ASCII-Decimal-Hex Table
(partial)

CHR	DEC	HEX	CHR	DEC	HEX	CHR	DEC	HEX	CHR	DEC	HEX
NU	0	00		32	20	@	64	40	`	96	60
SH	1	01	!	33	21	A	65	41	a	97	61
SX	2	02	"	34	22	B	66	42	b	98	62
EX	3	03	#	35	23	C	67	43	c	99	63
ET	4	04	$	36	24	D	68	44	d	100	64
EO	5	05	%	37	25	E	69	45	e	101	65
AK	6	06	&	38	26	F	70	46	f	102	66
BL	7	07	'	39	27	G	71	47	g	103	67
BS	8	08	(	40	28	H	72	48	h	104	68
HT	9	09	)	41	29	I	73	49	i	105	69
LF	10	0A	*	42	2A	J	74	4A	j	106	6A
VT	11	0B	+	43	2B	K	75	4B	k	107	6B

FF	12	0C	,	44	2C	L	76	4C	l	108	6C
CR	13	0D	-	45	2D	M	77	4D	m	109	6D
SO	14	0E	.	46	2E	N	78	4E	n	110	6E
SI	15	0F	/	47	2F	O	79	4F	o	111	6F
DL	16	10	0	48	30	P	80	50	p	112	70
D1	17	11	1	49	31	Q	81	51	q	113	71
D2	18	12	2	50	32	R	82	52	r	114	72
D3	19	13	3	51	33	S	83	53	s	115	73
D4	20	14	4	52	34	T	84	54	t	116	74
NK	21	15	5	53	35	U	85	55	u	117	75
SY	22	16	6	54	36	V	86	56	v	118	76
E8	23	17	7	55	37	W	87	57	w	119	77
CN	24	18	8	56	38	X	88	58	x	120	78
EM	25	19	9	57	39	Y	89	59	y	121	79
US	26	1A	;	58	3A	Z	90	5A	z	122	7A
EC	27	1B	:	59	3B	[	91	5B	{	123	7B
FS	28	1C	<	60	3C	\	92	5C	|	124	7C
GS	29	1D	=	61	3D	]	93	5D	}	125	7D
RS	30	1E	>	62	3E	^	94	5E	~	126	7E
US	31	1F	?	63	3F	_	95	5F		127	7F

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RSD MODEL MTS-232 - 25 PIN "D" CONNECTOR PINOUT

Pin	Function
2	TX Data
3	RX Data
4	RTS (transmitted)
5	CTS (received)
6	DSR (received)
7	Signal Ground
20	DTR (transmitted)
Others	No Connection

Notes: Only Pins 2, 3 and 7 must be connected. Use pins 4, 5, 6 and 20 only if external equipment requires these signals.

Pins 4 & 20 are connected internally with a jumper

Pins 5 & 6 are connected internally with a jumper

Subject to change without notice.