MTX RS232

The basic Memotech micros do not have an RS232 interface, but with suitable circuitry this facility can easily be provided.

Richard Sargent

The Memotech computers, the MTX 500 and 512, have a good range of user-ports but the standard RS232 interface is lacking on the basic models.

It may therefore come as something of a surprise to find the command BAUD in MTX BASIC, which can set one or two RS232 channels to one of ten standard communications baud rates.

Where are the two channels? The answer is simple — like so many other computers, the Memotech acquires additional facilities through a series of upgrades.

The facility can therefore be purchased, but the MTX RS232 board is a 14-chip PCB which has buffering and decoding for FDX disc drives and has a 14-chip price-tag. The purpose of this project is to provide a bare-bones RS232 card at a specification which will allow its use by the MTX ROM routines.

DART Communications

The Memotech serial interface is a full-specification RS232C provided by the Z80 DART (Dual-channel Asynchronous Receiver/Transmitter) and gives two independent full-duplex channels with separate modem controls. Industry standard line drivers and receivers ensure correct levels of data transmission.

The D&ME RS232 card uses the same DART and similar line drivers to obtain maximum compatibility with the MTX board. It is a 4-chip design and therefore small enough to be made with discreet wiring on a V-Q Board and still fit inside the computer case.

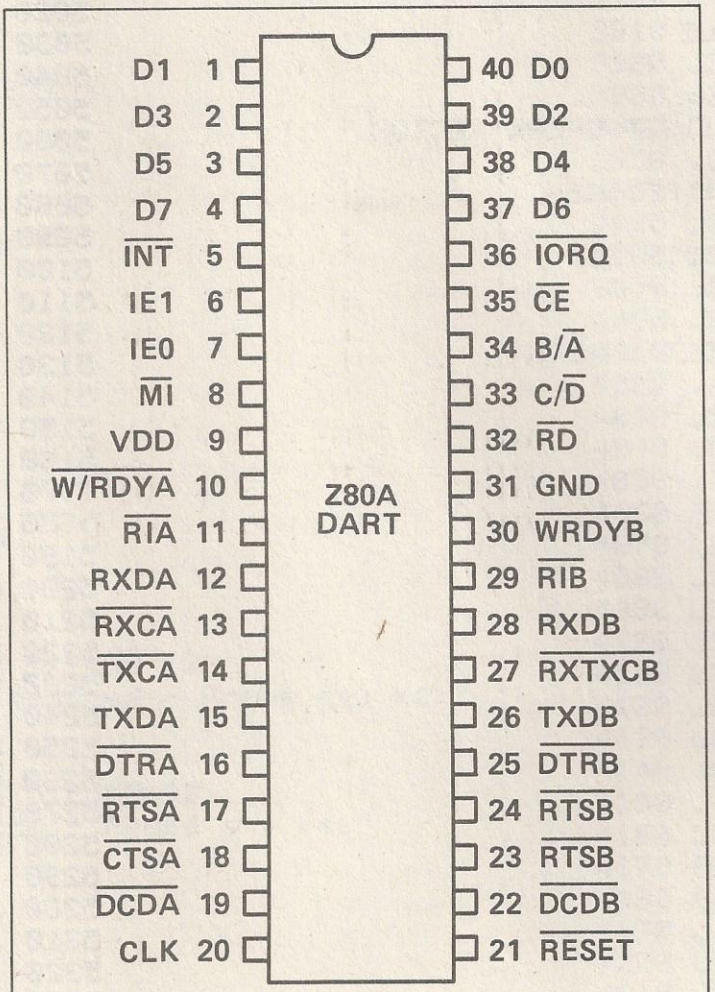

Figure 1. The DART pin designations.

As MTX owners know, any extension card must be designed to go on *either* the external edge-connector *or* the internal edge-connector. The same card cannot fit onto either edge-connector unless the card itself has two sockets.

The D&ME design has opted for an internal connection, on the grounds that 1) there should certainly be room inside the case and 2) the MTX ROM wordprocessor may well be occupying the external edge-connector.

MTX Mapping

The MTX user manual explains in great detail how the Input/Output ports are mapped. All 256 low-byte ports are perfectly decoded and the basic MTX computer uses ports &00-&0F (hex) inclusive. Ports &10-&1E are unused and &1F is reserved for cassette remote control. Addresses &20 upwards are used by the disc expansion units.

The communications DART occupies four contiguous read/write ports at &0C-&0F, as shown in **Table 1**.

Cross referencing with the DART pin designations (**Figure 1**), it is clear that address line A0 is driving the B/A select pin and address line A1 is driving the Control/Data select pin. Furthermore, address lines A7-A2, which together give 000011, are decoded to provide the DART enable pulse require by the chip select pin.

When six bits are a mixture of 0s and 1s, the cheapest IC available to decode them is the 74LS138 "3-to-8 line" decoder. A2 (high) goes to positive-enable. A7 and A6 (lows) go to the two negative-enables. A3, A4 and A5 are high-low-low and go to the count inputs C, B and A to give 100, the count of four.

Consequently output Q4, which is active-low, is used as the DART enabling signal.

DART – CPU Connections

The DART Chip (**Figure 2**) uses the eight data lines from the main data bus and, as usual, the Z80 peripheral-driving signals are also required. There are IORQ, M1, READ, CLOCK and RESET.

However, the DART is a complicated device and requires some extra connections to another Z80-family IC, the CTC (Counter — Timer Chip), which is on the main MTX PCB.

The CTC passes three signals to the DART, namely CTCIEO (CTC Interrupt-Enable Output), SER1 (serial clock 1) and SER2 (serial clock 2).

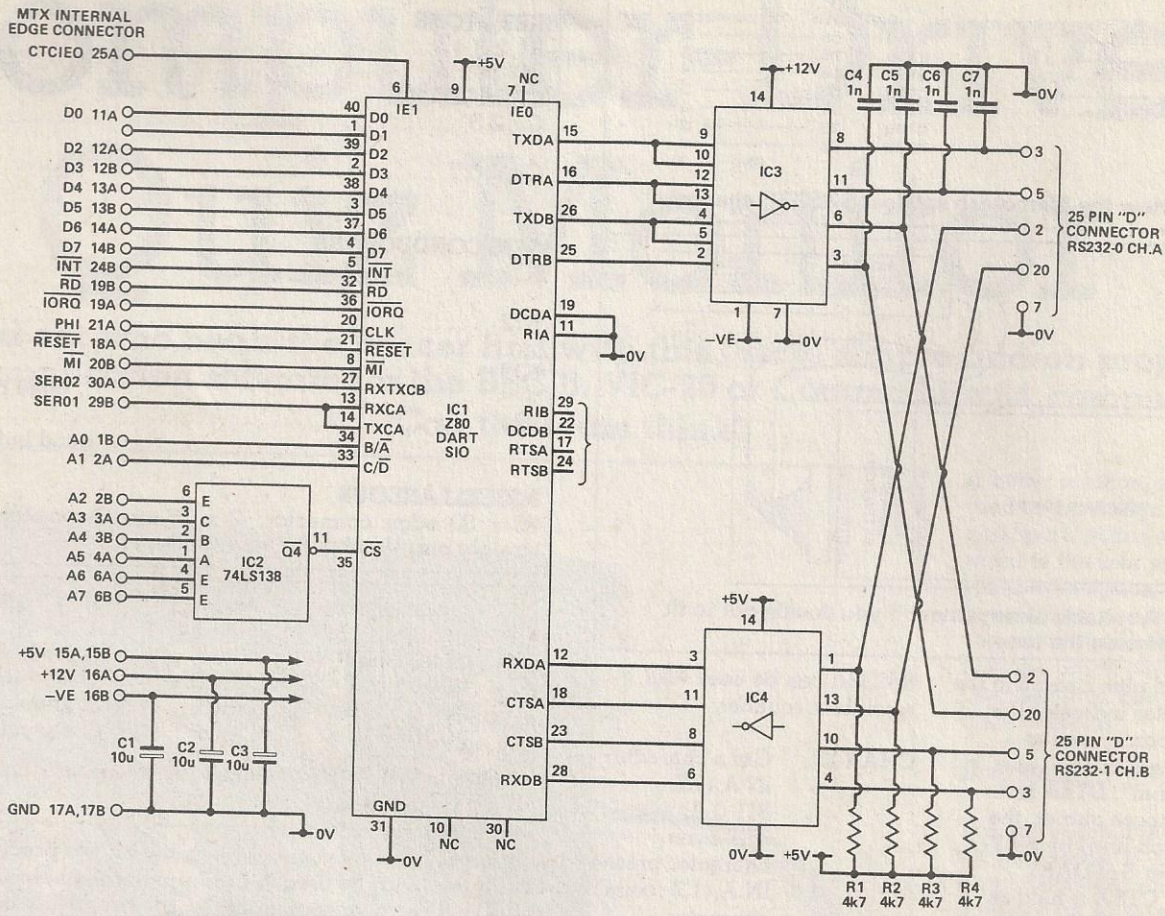

Figure 2. The full circuit for the MTX interface.

SER1 and SER2 are programmable pulse generators which provide the Receive/Transmit clocks for channels A and B respectively. Passing instructions to the CTC effectiveley controls the BAUD rate of the twin RS232 interface. The routines to do this are already in the ROM, and are invoked by the command BAUD x,n where x is the channel number 0 or 1 and n is the baud rate 75-19200.

The CTC also generates interrupts of a high priority. To ensure that a CTC interrupt is serviced before a DART interrupt, the Interrupt Enable Output line is taken from the CTC and fed into the Interrupt Enable Input pin of the DART.

This link is the so-called "daisy chain" arrangement, whereby devices can be allocated priority to issue interrupts to the CPU.

The DART is a low-priority device and can only issue an interrupt (a low on the DART's INT pin) when the CTC signals that it is permissable to do so (by sending a high to the DART's IEI pin).

The Line Buffers

These are industry-standard MC1488 and MC1489 devices, also supplied as SN75188 and SN75189 types. The '88 is a quad driver and the '89 is a quad receiver.

Technically they are level-changing inverting buffers — in practice they are devices which safely handle 0 to +5 voltages on one side of the gate and +12 to 0 to −12 on the other. Very useful.

The RS232 Signals

Figure 3 shows the RS232 signals which are available on the DART IC, channel A. A second set of the identical signals are available on channel B.

The MTX ROM routines relate to channel A, "RS232-0", which can be used as an alternative printer port. There are no facilities for using channel B, "RS232-1", in the ROM BASIC, but it can of course be accessed using machine code.

The way that Memotech set the MTX RS232 channels is shown in **Figure 4**. The difference in

```
TXD TRANSMITTED DATA
DTR DATA TERMINAL READY
RTS REQUEST TO SEND
RXD RECEIVED DATA
CTS CLEAR TO SEND
DCD DATA CARRIER DETECT
RI  RING INDICATOR
```

Figure 3. The RS232 signals which are available from the DART IC.

RS232-0 Channel A

DART pin		"D"connector pin
RXDA	12	2
TXDA	15	3
DTRA	16	5
CTSA	18	20
	GND	7

RS232-1 Channel B

DART pin		"D"connector pin
TXDB	26	2
RXDB	28	3
DTRA	16	4
CTSB	23	5
RIB	29	6
DTRB	25	20
DCDB	22	8
	GND	7

Figure 4. How the Memotech sets each RS232 channel.

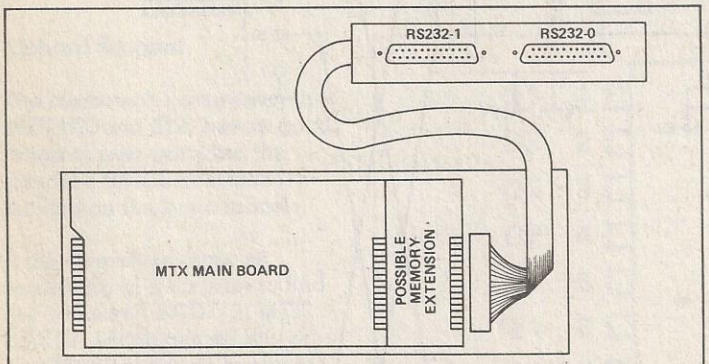

Figure 5. A suitable arrangement if you decide not to fit the board inside the case.

the wiring of pins 2 and 3 in the "D" connector indicates that RS232-0 is configured as a "data set" and RS232-1 as a "data terminal". DTRA is a general purpose output, the level of which is set by bit 7 in write register 5 of DART channel A. CTSA is held as "enable" by the pull-up resistor and so the channel can operate under open loop conditions with no handshake lines connected.

The D&ME RS232 card provides an RS232-0 port which is identical to the Memotech configuration, and an RS232-1 port which is a "data terminal" version of RS232-0.

RS232-0 is used as a printer port by changing the value of system variables "PRORPL" to 1 and "IOPL" to 2. Thus:

POKE 64885,1:POKE 64143,2

RS232-1 can be used with assembler routines:

CHAR-IN: Get a character
```
IN A,(15)
BIT 0,A
RET Z ;no character present
IN A,(13) ;collect character
RET
```

CHAR-OUT: Output value in E
```
IN A,(15)
BIT 2,A
;transmit buffer empty?
JR Z CHAR-OUT
LD A,E
OUT (13),A
;write character
RET
```

Construction

If the D&ME RS232 card is fitted inside the MTX case, some special constructional techniques must be used to fit the 30 x 30 way connector onto the Veroboard.

There is no clearance between the lower edge of this connector and the MTX case, so if you are not a particularly neat solderer you should opt for an external board — the connector remains inside the MTX, but ribbon cable takes the signals out through the back of the case to a Verobox (see **Figure 5**).

Figure 6 shows the "wafer arrangement" which holds the connector firmly onto the board. There is ample clearance *above* the veroboard, but precious little underneath, so trim the soldered wire-ends close to the copper side of the board.

No attempt was made to fit the prototype board into the grooves in the MTX case, which is the system used to hold the main MTX PCB. The 30 x 30 connector grips like a vice anyway and there is no danger of it working loose!

The "D" connectors are fitted to the back of the MTX case, in the blank positions which are already there. Finally, take great care with the wiring

Remember that the position of the MTX signals on the PCB fingers are *always* numbered in relation to the polarisation slot (position 5) and that the "A" fingers are on the upper surface of the MTX PCB, the component side.

The internal expansion port is a "mirror image" of the external expansion port, which is why cards designed to fit internally cannot simply be plugged into the external expansion port.

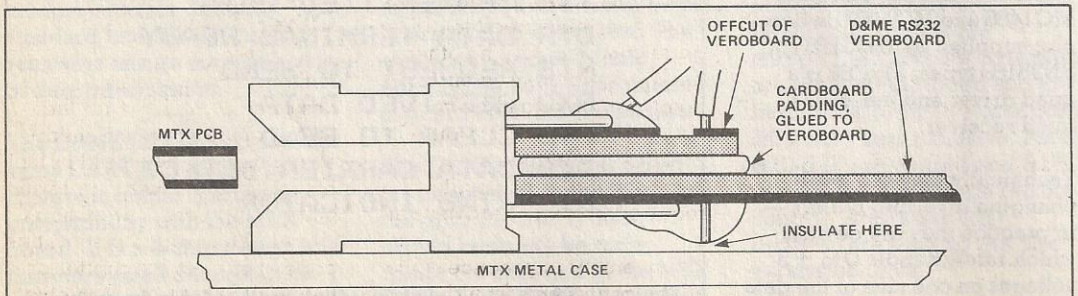

Figure 6. The "Wafer" arrangement which holds the connector firmly onto the board.

Parts List

RESISTORS
R1,2,3,4 ..... 4k7 0.25W

CAPACITORS
C1,2,3 ..... 10u 25V electro
C4,5,6,7 ..... 1n ceramic

SEMICONDUCTORS
IC1 ..... Z80 DART
IC2 ..... 74LS138 3-to-8 line decoder
IC3 ..... MC1488 quad buffer/driver
IC4 ..... MC1489 quad buffer/receiver

MISCELLANEOUS
30 x 30 edge connector; 2 x 25-pin D-connectors, female, straight pin; Veroboard, wire, solder etc.

Address Bits	Address (Hex)	Function
00001100	&0C	Channel A data
00001101	&0D	Channel B data
00001110	&0E	Channel A control
00001111	&0F	Channel B control

Table 1. The DART occupies four read/write ports as shown here.

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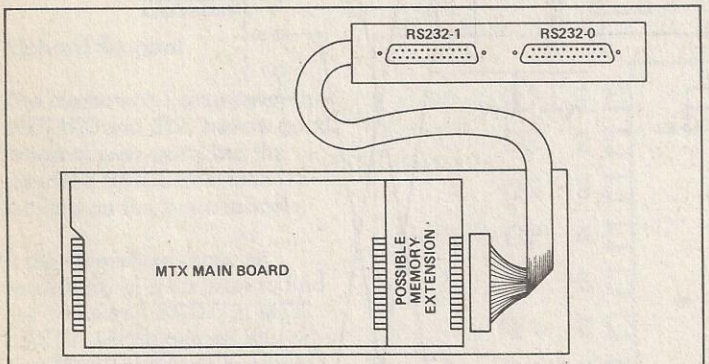

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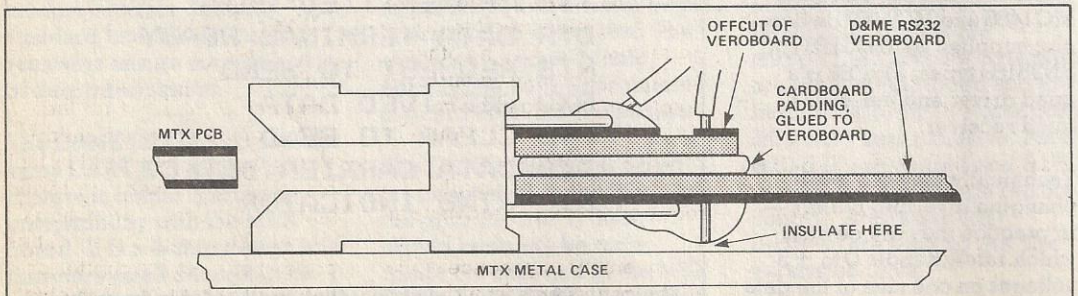

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