General

The CSI Model DB1000 Decoder is available in a PLCC-44 pin package. The list below describes the function of each pin. The basic connection schematic shows connections that are common to all configurations. Individual schematics show connections for RS-232, RS-485, laser gun and keyboard wedge configurations.

Pin Assignments

Pin 1 – Do Not Connect

Pins 2, 3 - Baud rate select - Selects the baud rate for the serial transmission.

Pin 4 - Scanner Type Select - Selects either a fixed beam and wand type scanner or a laser gun type scanner. (See Laser Option later in this document.)

Pin 5 - Request To Send line - True = low. Switches to true state when serial data is available for transmission then determines the state of the CTS input. If CTS is true, serial transmission is initiated and continues as long as CTS is true. RTS remains true until transmission of the last character is complete. In addition to performing the normal function of RTS in a serial interface, this line will also be used to control the state of an RS-422 or RS-485 driver in a multidrop interface.

Pin 6 - Clear to Send Input - True = low. When this input is in the true state serial transmission is enabled. If this line reverts to false at any time during the serial transmission, transmission of the current character will be completed, then transmission will be suspended.

Pins 7, 8 - Scanner Data Input. Both these inputs are tied together. This is the digital bar and space input to the decoder. Level is TTL. A bar is +5V in Normal Mode, zero in Laser Mode.

Pin 9 - Watch dog timer output - This pulse output is designed to interface to a Maxim MAX 824 Watch Dog Timer/Reset chip. The WDT time-out is 1.6 seconds.

Pin 10 – Reset the chip resets low going high. Use Maxim MAX824 reset / watchdog controller.

Pin 11 - Receive Data - This port and the Transmit data port are designed to interface with a MAX232 or similar circuit to form an RS-232 serial data port. (See Connection Diagram)

Pin 12 – Do Not Connect

Pin 13 - Transmit Data - See receive data above.

Pin 14 - Drive for Good Read LED - Signal duration of 200 milliseconds. Occurs every time a barcode is successfully decoded. The LED also blinks three times after successful power-up and initialization.

Pin 15 – Push Button Compare Input. This is a TTL level input. Grounding this pin enters the last code read into the compare buffer, if compare mode is enabled.

Pin 16 - Wedge clock line - Bi-directional clock line. See section on Wedge Interface later in this document.

Pin 17 - Wedge data line - Bi-directional data line. See section on wedge interface later in this document.

Pin 18 - EEprom Clock line - I2C serial interface to 24CXX series EEPROMS.

Pin 19 - EEprom Data line - I2C serial interface to 24CXX series EEPROMS.

Pin 20 – Xtal

Pin 21 – Xtal

Pin 22 – Vss

Pin 23 – Do Not Connect

Pin 24 - Serial/Wedge Select - This selects between serial data output and wedge output. The unit does not have both outputs simultaneously. (See Wedge Output later in this document)

Pin 25 – WCL Wedge Control. Controls data transmission in wedge circuit.

Pin 26 - Polling/Normal select - This line will select between normal "read and transmit" mode and polling mode. See Polling Protocol later in this document.

Pins 27, 28, 29 - Laser interface signals. See 'Laser Interface' later in this document. 27 = SSY 28 = TRG 29 = LSE

Pins 30, 31 - Parity select. These lines are used to select mark, space, even or odd parity for the serial data transmission. See Table

Pin 32 – Do Not Connect

Pin 33 – Do Not Connect

Pin 34 – Do Not Connect

Pin 35 – Do Not Connect

Pin 36 - Compare output. A TTL level output. See the description of the Compare Function later in this document. If unit is not in the Compare Mode, this output can be controlled with an Escape Sequence. See Esc-y<n>D.

Pin 37 - Send Code 39 Check - Include the check character as part of the Barcode Data in the serial transmission.

Pin 38 - Enable Interleaved 2 of 5 check character. Indicates Interleaved 2 of 5 will have a Modulo 10 check character as the last character in the code. In this case the character should be evaluated as a valid check character. If the character is invalid, a No Read Condition occurs. (See No Read Condition).

Pin 39 - Enable Code 39 Check character - Indicates Code 39 will have a Modulus 43 check character as the last character in the code. In this case the character should be evaluated as a valid check character. If the character is invalid, a No Read Condition occurs. (See No Read Condition).

Pin 40 - Enable Extended Code 39. If code 39 is selected, then this port selects regular or extended. It signals that the code scanned will be the extended version. Extended Code 39 encodes ASCII characters not represented in the standard character set, as character pairs. The code is scanned and decoded as if it were normal Code 39. The data characters are then examined for the specified character pairs. The data string is then modified, substituting the specified character for the character pair before data transmission. Note that this decoder does not support concatenation of Code 39 labels.

Pins 41, 42 - Trailer Select - Selects the trailer character(s) that signals the end of a data transmission. The data transmission format will be:

[scanner identifier character][header string][label data][trailer]

The trailer is either None, Carriage Return, Carriage Return/Line Feed or Tab.

Pin 43 - C39/I25 Select - Selects between Code 39 and Interleaved 2 of 5. This decoder does not auto-discriminate. It will be setup to read only one code type at one time

Pin 44 – Vcc

Table 1. Jumper Functions.

Pin #	Function	Comment 0 = GND, 1 = +5V
43	Code 39/I 2 of 5 Select	0 = I 2 of 5, 1 = Code 39
40	E39 Read Extended C39	0 = No 1 = Yes
39	C3C Code 39 Check Digit	0 = No 1 = Yes
38	I2C I 2 of 5 Check Digit	0 = No 1 = Yes
37	CST Send C39 Check	0 = No 1 = Yes
36	CO Compare Output	low = compare high = no
4	STS Scanner type select	0 = wand 1 = laser
5	RTS Request to Send	Output
6	CTS Clear to Send	Input
24	SWS Serial/Wedge Sel.	0 = serial 1 = wedge
26	POL Polling/Norm. Sel.	0 = Norm. 1 = polling

	None	CRLF	TAB	CR
TR0 (42)	0	0	1	1
TR1 (41)	0	1	0	1

	9600	19200	4800	2400
BR0 (2)	0	1	0	1
BR1 (3)	0	0	1	1

	Space	Even	Mark	Odd
PT0 (30)	0	0	1	1
PT1 (31)	0	1	0	1

Important Note: The jumper settings determine the default value of these parameters until over ridden by any values programmed using escape sequences. When programmed values are set and saved, they become the new default values. The decoder will revert to the jumper settings in the event of an EEPROM failure.

Escape Sequence Programming.
Decoder functions listed in Table 1 have their default values set by the state of the pin. These can either be set by jumpers, or hardwired to a particular state. Other parameters, not set by these pins, will have their values set in software. All of these parameters can have their values changed using Escape Sequence Programming. When a value is changed, and saved (See Esc-y5Z), it is saved in EEprom and becomes the new default for that parameter. If not saved, the new value is used until the decoder is reset.

Escape sequence programming is performed through the decoder's serial port. All sequences begin with the Escape, minus and lower case 'y' characters. The following is a summary of the Escape sequences that will be used.

Escape Programming Protocol
Escape sequence commands can be sent to the decoder at any time. There are no constraints in timing of the transmission of characters in a sequence. Once a character is received that does not conform to the escape sequence format, for example the value of n for that command is out of bounds, previous information is discarded. An escape character always indicates the start of a new command and any previous characters are discarded. All valid commands begin with the escape character.

Esc-y<n>A<1 character>
n = 0 = clear address
n = 1 = set address
Assigns a single character address to the decoder or clears an address previously set. The character is limited to the numbers 0 thru 9 and the upper and lower case alpha characters. Addresses are case sensitive. The default value is that no character is assigned. The purpose of assigning an address is to give each decoder a unique identity within a group of other decoders. This is necessary in RS-422 or RS-485 networks. If a decoder has an address, it has the ability to respond to addressed escape sequences. An addressed sequence adds a period followed by the address character after the 'y' in the sequence. For more information on addressed sequences, see the section on Polling Protocol.
Examples:

Esc-y0A - Clears the address assigned to decoder.
Esc-y1Ac - Assigns lower case 'c' as the decoders address character.

Esc-y<n>B<characters>
This is used to enter a compare value into the compare buffer when compare mode is selected. Otherwise this instruction will be ignored. The value of n is the number of characters to be entered. (Default = empty)

Esc-y<n>C
This command is used to enable or disable the LED for situations where barcode throughput could be increased by doing so.

n = 0 = LED enabled (default)
n = 8 = LED disabled

Esc-y<n>D
This command can be used to control the state of the CO line (Pin 36) if the Compare Function is not enabled. Sending Esc-y0D will turn this port off (zero volts). Sending Esc-y1D will turn it on (5 volts).

Esc E
This is the only command that departs from the general form. This command resets the decoder. It is the equivalent of interrupting the power to the decoder.

Esc-y<n>E
This command signals the decoder to look for a wand or a laser input device. See Laser Interface later in this document.
n = 0 = wand (default)
n = 1 = laser
n = 4 = HP Wand (more tolerant of first bar error)

Esc-y<n>F
This command sets the barcode type to be read.

n = 1 = Code 39
n = 2 = Interleaved 2 of 5
n = 4 = Code 128 (future)

Esc-y<n>G
This command sets or clears check character verification for I 2 of 5 and Code 39.

n = 0 = no check character verification
n = 1 = Verify Code 39 check character
n = 2 = Verify Interleaved 2 of 5 check character.
n = 4 = Verify Code 39 Check and Xmit the Character
n = 8 = Verify Interleaved 2 of 5 Check and Xmit the digit

Esc-y<n>H
This command sets or clears the use of extended Code 39.
n = 0 = Use standard Code 39
n = 1 = Use extended Code 39

Esc-y<n>J
This command is used to set the operating mode of the decoder.
n = 0 = Normal mode
n = 2 = Polling mode (Can be combined with Compare or Data Change)
n = 4 = Compare Mode (push button)
n = 8 = Compare Mode (serial)
n = 16 = Data Change Mode
n = 32 = Keyboard Wedge Mode (Can be combined with Compare or Data Change).
When Combining modes, add the n values. Example: Polling mode with Data change: n = 2 + 16 = 18.

Esc-y<n>N<n characters>
This command is used to specify a header string. The characters in the header string are transmitted immediately preceding the barcode label data in the serial data transmission. Up to 10 characters can be specified. Headers must be composed of printable ASCII characters. (Default = empty)
n = number of characters in the header.
Example: To set header to 'scanner1' send: **Esc-y8Nscanner1**

Esc-y<n>O
This command sets the serial transmission terminator character(s).
n = 0 = CR
n = 1 = CR/LF
n = 2 = Tab
n = 3 = none

Esc-y<n>P
This command configures the Serial Communications Port. It sets the baud rate, stop bits and parity in one command. To find the value of n, add the n value for baud rate, stop bits and parity. Examples are shown below.

Baud Rate
n = 4 = 2400 baud
n = 5 = 4800 baud
n = 6 = 9600 baud
n = 7 = 19200 baud

Stop Bits

n = 0 = 1 stop bit
n = 8 = 2 stop bits

Parity

n = 0 = space
n = 16 = mark
n = 32 = even
n = 48 = odd

Example: to set the port to 9600 baud, 1 stop bit and odd parity, send:

Esc-y54P. (54 = 6 + 0 + 48)

Note: You can't use this command to change only one port parameter. You must specify all parameters even though others may not change. For example you can't just change the number of stop bits to two by sending Esc-y8P. The change happens instantly, so the programming terminal may have to be adjusted.

Esc-y<n>Q

This command is used to enable or disable serial transmissions when a No Read condition occurs. For further discussion of the No Read condition, refer to the No Read section of this document. When a No Read occurs, the characters 'NR' are substituted for the barcode data in the serial transmission.

n = 0 = disabled (default)
n = 2 = enabled

Esc-y<n>R

Applies only in Wedge Mode. <n> = 0 = default = ignore unprintable (00H to 1FH) ASCII characters. <n> = 1 = translate these characters to keycodes per the attached table.

Esc-y<n>S

Controls transmission of Address Character. n = 0 = No. n = 1 = Yes.

Esc-y0T

This command is used to flash the good read LED. Its primary purpose is to have a simple way of checking that communications has been established. When received the Decoder should send an ACK (06) character.

Esc-y<n>,<i>,<j>U
This command is used to set maximum and minimum barcode data character lengths. The value of n sets the barcode type. The value of i sets the minimum number of characters while the value of j sets the maximum. If i=j then only one length will be read. Note: with interleaved 2 of 5, i will always be at least 4 even if less is specified. If an odd value is specified for either i or j it will be increased by one.

n = 1 = Code 39
n = 2 = Interleaved 2 of 5
n = 4 = Code 128 (future)
(Default: I 2 of 5 = 4 to max Code 39 = 1 to max)

Esc-y<n>Z
N = 1 = Hard Reset. Same as Esc E.
N = 2 = Revert to jumper (default) settings. Invalidate EEPROM.
N = 3 = Goes back to stored settings in the EEPROM, if it is valid.
N = 5 = This command is used to save configuration changes made with escape sequences to Eeprom. Any changes made with escape sequences will be in effect only until the decoder is reset, unless they are saved.

Status Request
A status screen can be displayed on a standard 80 column terminal. Send the escape sequence **Esc-y4S** to display this screen.

The status of any parameter that can be programmed with escape sequences can be requested individually with a similar sequence used to program it. The status request sequence will contain a + after the Escape character rather than a minus. In cases where the original escape sequence to program the parameter followed the form:
Esc-y<n>X, the status of the parameter can be determined by sending Esc+yX. The decoder will respond by sending the value of n followed by a CR character. For example: to find out what code the decoder is programmed to read send: Esc+yF. The decoder will respond by transmitting 1 if Code 39 is programmed, or 2 if interleaved 2 of 5 is programmed. Sequences that do not conform to this general form are:

Esc+yA is sent to determine the address character of a decoder. The decoder will respond by sending the character. If no character is programmed () will be sent. Either will be followed by a CR character.

Esc+yB is sent to determine the contents of the compare buffer. The decoder will respond by sending the characters currently in the buffer followed by a CR character. If there are no characters in the buffer, the decoder will send '() CR'.

Esc+yN is used to determine the header string that is programmed. The decoder will send the header string characters or () if no string is programmed, followed by a CR character.

Esc+yU is used to determine the Min and Max length set for a particular code. The decoder will respond by sending " **min**,**max**U", where **min** in the minimum length (1 or 2 digits), **max** is the maximum length (1 or 2 digits).

Polling Protocol

The decoder may be used in a multi-drop environment. The serial data to the decoder would be handled by an appropriate communications interface circuit such as the MAX483 for RS-485 or an LT491 or MAX 491 for RS-422. As mentioned earlier, the tristate condition of the RS-485 or RS-422 driver is controlled by the decoder's RTS line.

In a polling application each decoder will be programmed with a single character identifier. The polling protocol centers on two escape sequences not covered in the previous list. These are normally used as addressed sequences. In a polling network, only a decoder with a matching address will respond to an addressed sequence. Normal sequences, such as those previously described are global. In a polling network all units will respond to global sequences. The escape sequences used in polling are:

Esc-y.X3S is used to query a particular decoder to see if it has barcode data to send. The 'X' in the above example represents the single character address of the decoder. If the decoder has read a barcode it will respond by sending an ACK (06H) character. If it has no data to send it will respond with a NAK (15H) character.

Esc-y.X<n>K is used to signal the decoder to transmit the barcode data and be ready to read another code.

When n = 1 Enables the decoder to make the next read. Any previously stored read is lost.

When n = 2 the decoder is instructed to transmit the barcode information it has read.

When n = 3 the two commands above are combined into a single command, that is the decoder will transmit data that it has and then be enabled to make the next read.

The **Esc-y2J** command is used to set the decoder to the polling mode. Once polling mode the decoder will only decode a single barcode and then wait to be polled. It will not decode further codes until it has transmitted its data and is ready to read again.

No Read Condition

A No read condition occurs when:

1. A barcode is read, but the check character calculation fails.
2. A code is read that is outside the minimum or maximum code length programmed for that code type.
3. In the case of Code 39, a valid start character is decoded, but the complete code cannot be.

If transmission on No Read is enabled (see Esc-y<n>Q) the characters 'NR' will be substituted for the barcode data and a normal serial transmission will be made. In polling mode this transmission will only be made if no good reads occurred in the interval between polls. In other words, if a no read occurs and then a good read occurs, both within the polling interval, the good read will invalidate the No Read and the barcode data will be sent.

Keyboard Wedge Interface.

The decoder can be operated in keyboard wedge mode. The keyboard wedge interface mimics a PC/AT keyboard. The keyboard wedge circuit uses a CD4066B, quad analog switch or equivalent. Two switches are connected in parallel to reduce the series resistance. There are two circuits, clock and data. In normal operation the keyboard clock and data signals are connected to the PC through the analog switch. When the decoder has data to transmit, it uses the analog switches to momentarily disconnect the keyboard. The decoder takes the place of the keyboard, and sends the barcode data in keyboard format. It then reconnects the keyboard. *The wedge interface will send only barcode label data followed by a data terminator (see Esc-y<n>O). There is no header or identifier character as far as this interface is concerned*. It only operates in normal mode, not polling.

The keyboard wedge takes the ASCII characters encoded in the barcode, translates them to PC/AT key-code sequences which are sent using the wedge clock and data lines. Since there is not a one to one correspondence between ASCII characters and the keys on a PC/AT keyboard, a translation can be made for the non-printing ASCII characters (See Esc-y<n>R). These are the characters with values between 01h and 1Fh. The following is a list shows the translation that will be made, if translation is selected. Note that this only pertains to applications using extended Code 39. Extended Code 39 can encode all 128 ASCII characters. Normal Code 39 cannot.

ASCII Character	Keyboard Key	ASCII Character	Keyboard Key
NUL (00H)	Nothing	DC2 (12H)	Up Arrow
SOH (01H)	ALT Key Down	DC3 (13H)	F1
STX (02H)	ALT Key up	DC4 (14H)	F2
ETX (03H)	CTRL-C	NAK (15H)	F3
EOT (04H)	CTRL-D	SYN (16H)	F4
ENQ (05H)	CTRL Key Down	ETB (17H)	F5
ACK (06H)	CTRL Key Up	CAN (18H)	F6
BEL (07H)	CTRL-G	EM (19H)	F7
BS (08H)	Backspace	SUB (1AH)	F8
HT (09H)	TAB	ESC (1BH)	ESC
LF (0AH)	END	FS (1CH)	F9
VT (0BH)	Page Up	GS (1DH)	F10
FF (0CH)	Page Down	RS (1EH)	F11
CR (0DH)	Enter	US (1FH)	F12
SO (0EH)	Home		
SI (0FH)	Left Arrow		
DLE (10H)	Right Arrow		
DC1 (11H)	Down Arrow		

The ALT Key Down and ALT Key Up can only be used in combination with other non-printable ASCII characters. For example: it is possible to put an ALT-F2 key sequence in barcode. You would encode the SOH, DC4 and STX ASCII characters in extended Code 39 to send this sequence to the keyboard port.

The serial receive line is still active in wedge mode, so the decoder is still capable of receiving escape sequences.

Laser Interface

The decoder has an interface for laser gun type devices. These devices scan in the 35 to 45 scan per second range. There are three interface signals that are used to interface to the laser. They are as follows.

TRG is an input from the laser that indicates that the trigger has been pulled. This signal is high going low. After receiving this signal the decoder waits for 75 microseconds and issues a LSE output (see below).

LSE is a high going low output to the laser enabling it to read. Once a good read is obtained the LSE line is driven high again. If a good read is not obtained in about 90 scans (2 seconds) this line is also driven high.

SSY is a TTL Logic input to the decoder. It changes state at the end of each scan. Since these scanners normally contain oscillating mirrors, this means that the mirror has reached the end of a scan. There is no significance to the value of this signal, only to when it changes.

The digital data from the scanner is connected to the same input as with fixed beam scanners. The Laser Interface is selected using the STS jumper (Pin 4) or the Esc-y<n>E escape sequence.

Compare Mode

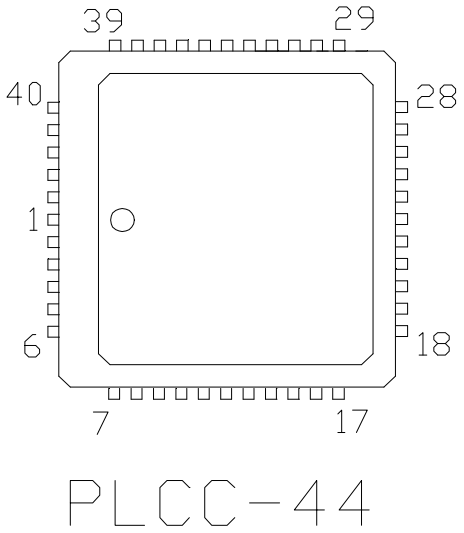
Compare mode compares the barcode read to a code contained in a compare buffer. If the code compares, the compare output (Pin 36) remains low and a normal serial data transmission takes place. If the code read does not compare, the compare output is driven high and the characters 'NC' are substituted for the barcode data in the serial transmission. The compare output remains high until a good compare occurs.

There are two methods of entering data into the compare buffer. The first is by using the **Esc-y<n>B<characters>** escape sequence. The second is by using the push button compare input. This input is normally pulled high. Pulling this line low, when the compare function has been enabled, enters the last code read into the compare buffer. If the compare function is not enabled this line is ignored and receipt of the above escape sequence will also be ignored.

Data Change Mode

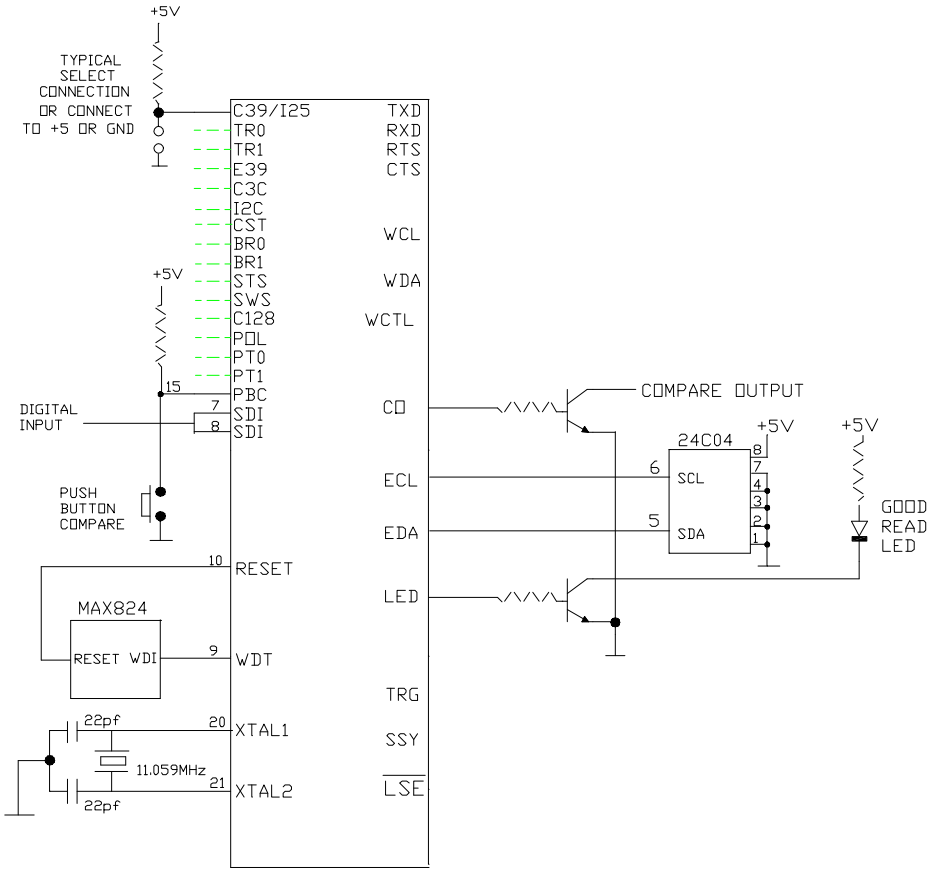
Data Change mode is the same as normal mode, except a serial data transmission will not be made unless the current barcode read is different that the code immediately preceded it. In many fixed beam applications redundant barcode labels may be used to insure a higher read rate, but it is desirable that only one transmission be made.

PLCC-44 Package
The PLCC-44 package pin assignments are as shown below.



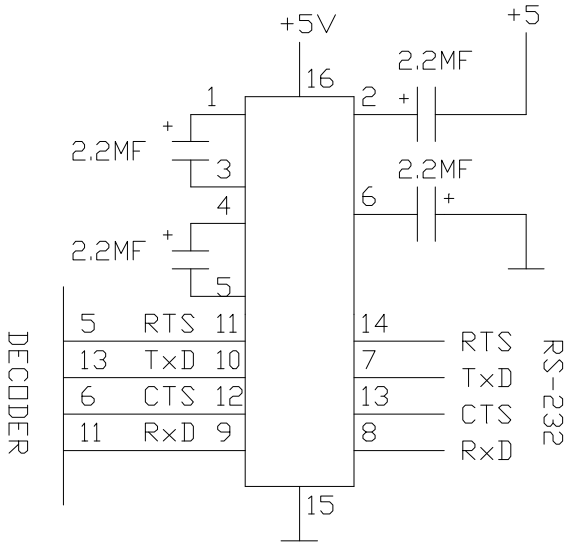
Basic Schematic

The following page contains a basic schematic of the decoder circuit. These are the components that are common to all configurations. The components for compare mode, the push button and output transistor, are shown. The transistor can be used to generate a logic level, with the addition of a pull-up resistor or energize a small relay. If compare will no be used, these components can be left out.



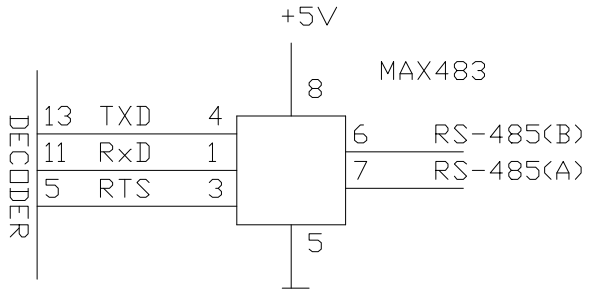
RS-232 Circuit

The following schematic shows a typical RS-232 circuit. This connection uses the TxD, RxD, RTS and CTS connections on the decoder. A MAX232 chip made by Maxim is shown, but there are a number of similar circuits available.



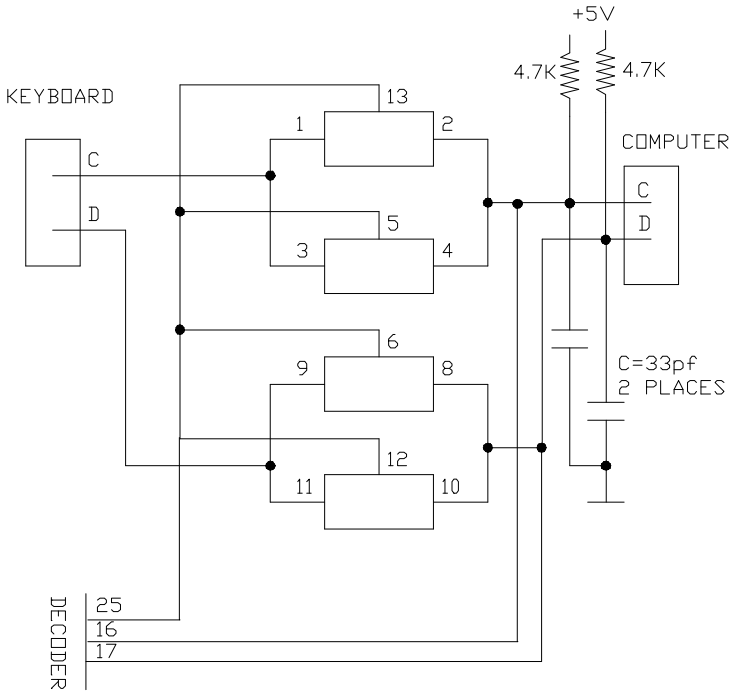
RS-485 Circuit

The following circuit can be used for RS-485 multidrop connections. This circuit features a Maxim MAX483 RS-485 transceiver, but there are many other similar circuits on the market.



Keyboard Wedge Circuit

The following circuit can be used with the decoder chip to provide an IBM PC/AT compatible keyboard wedge. A CD4066B quad analog switch circuit is used. The analog switch is used to disconnect the keyboard when the decoder has data to transmit.



Laser Gun Interface

The decoder can be used to interface to a standard laser gun type scanner. These scanners have scan speeds of 35 to 45 scans per second, and have a standard interface. The three interface signals, TRG, SSY and LSE are described earlier in this manual.