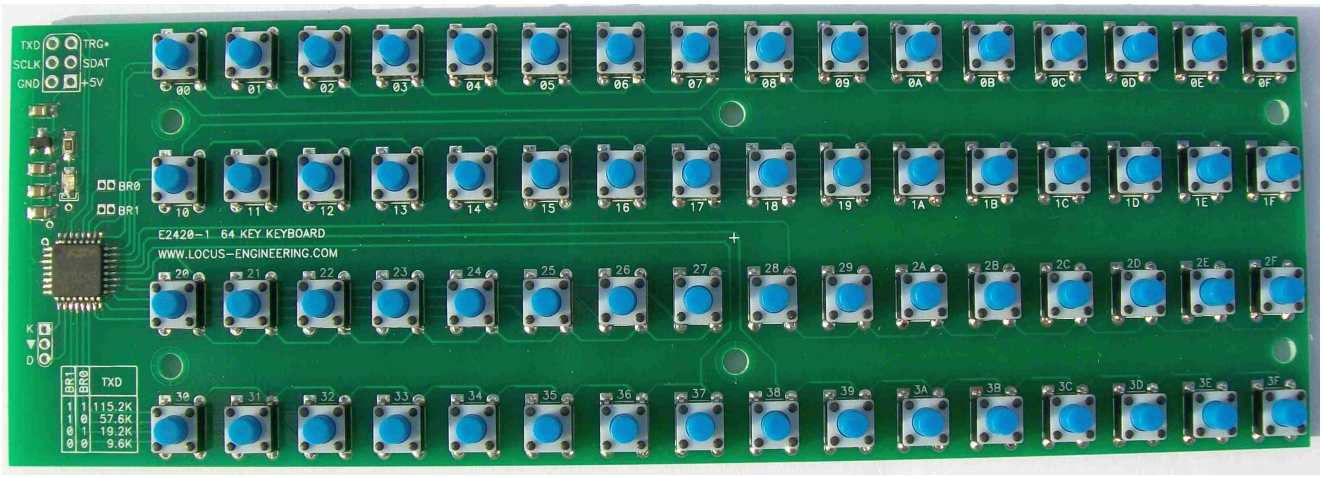
Locus Engineering Inc. E2420

Decoded 64 Key Keyboard



FEATURES

- 4x16 keyswitch array
- exclusive 8 bit code (00h to 3Fh) for each of 64 keys
- 20 ms debounced keys
- output on make of key closure
- 2 key rollover
- typematic function, 5 cps after 600ms key closure
- selectable 9.6K, 19.2K, 57.6K, 115.2K baud serial output
- separate ~100KHz clocked serial output
- trigger pulse output
- TTL compatible outputs
- +3.3V to +5.5V operation
- 6 mA supply current
- 2.25” x 6.75” size
- 0.375”W x 0.625”H keyswitch grid
- #4 mounting holes on 1.25” x 5.75”

DESCRIPTION

The E2420 64 Key Keyboard is an easy to use data entry device encoding 64 keys into a glitch free 8 bit code on the make of each key closure. A robust key lockout algorithm prevents multiple keys from sending erroneous codes. All 64 keys are scanned within 3 ms while providing a 20 ms debounce time for each key. The baud rate is selectable using solderable jumpers. A clocked serial data output similar to a PS/2 interface running at 100 KHz is also provided. An 8msec trigger output is active 50 µsec prior to the data being sent. The keys are labeled with their keycodes on the PCB and the keyboard is easily mounted with #4 hardware. Power input is +3.3V to +5.5V and the outputs are TTL compatible.

Note: the keys are NOT soldered in place to allow custom switch placements or the use of other switches with different button heights. As supplied, the button height is 3.3mm/0.130” high. Keyswitches are standard 4.5mm x 6.5mm lead spacing.

APPLICATIONS

- custom keyboards
- industrial controls
- robotics

Table 1. Absolute Maximum Ratings

Parameter	Rating
Input Voltage to GND	-0.3 to +5.5V
Operating temperature range	-40 to +85°C
Storage temperature range	-65 to +150°C
Maximum output current through port pin	100mA
Maximum total current through Vdd or GND	300mA

Table 2. Electrical Characteristics

Test Conditions: Supply Voltage V_{dd} = +5.0V, $T_{ambient}$ = 25° C, unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{dd}	Supply voltage	3.3	5.0	5.5	V
I_{dd}	Supply current		5.4		mA
V_{OH}	Digital high output voltage	2.5V @Iout -10mA	2.6V @Iout -3mA	3.2V @Iout -10µA	V
V_{OL}	Digital low output voltage	0.1V @Iout 10µA	0.6V @Iout 10mA	1.0V @Iout 25mA	V
$T_{debounce}$	Debounce time		20		msec
T_{tstart}	Trigger start to data valid		50		µsec
T_{tpw}	Trigger pulse width		8		msec
$T_{typematic}$	Typematic delay		600		msec
F_{repeat}	Typematic repeat		5		cps
F_{baud}	Output baud rate, selectable	9.6		115.2	KBaud

General Precautions

Charged devices and circuit boards can discharge without warning. Proper ESD precautions should be followed to avoid failure.

This device is not authorized for use in any product where the failure or malfunction of the product can reasonably be expected to cause failure in a life support system or to significantly affect its operation.

Locus Engineering Inc. reserves the right to make changes at any time without notice to improve product features or reliability.

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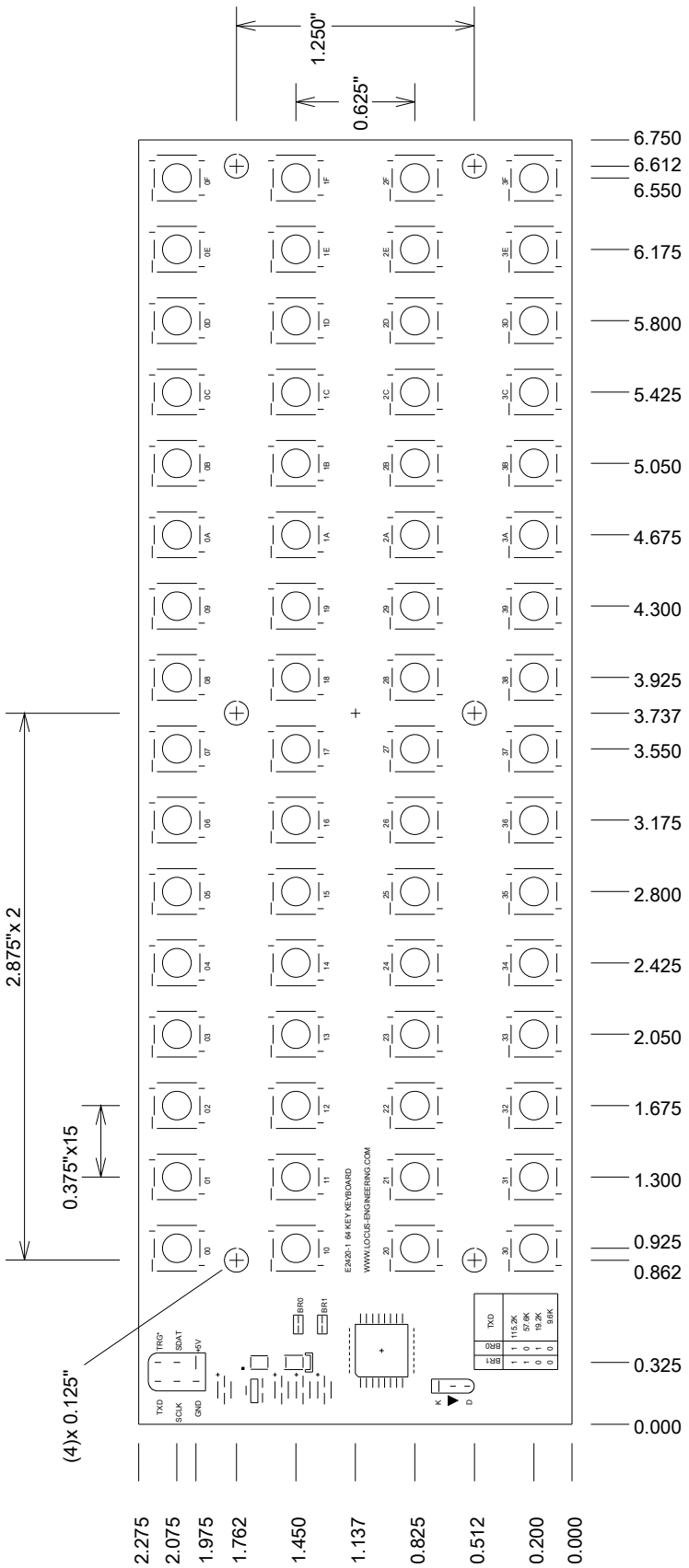

Figure 1. Keyboard Dimensions

Table 3. Pin Descriptions

Pin#	Name	Function
1	+5V	+3.3V to +5.5V
2	0V	Ground
3	SDAT	Clocked Data Port Data Output, inverted, ~100KHz
4	SCLK	Clocked Data Port Clock Output, ~100KHz
5	TRG*	Trigger output used as interrupt, 8msec active low
6	TXD	Serial Port Output, selectable 9.6K to 115.2K baud

Power Supply

The E2420 keyboard will operate from voltages between +3.3V to +5.5V, and uses approximately 6mA of current. An onboard low dropout (~200mV) regulator supplies ~+3.3V to the microcontroller.

Digital I/O

The digital input and output pins are TTL compatible. Outputs such as serial output TXD, trigger output TRG*, serial clock SCLK, and serial clocked data SDAT are push-pull with 0 to +3.3V voltage swings and are compatible with TTL or LVC inputs.

Reset

The power-on reset circuitry is self-contained within the module. Ensure the power supply ramp is faster than 1msec.

Keyswitches

The keyboard is optionally supplied with 64 keys however they are NOT soldered in place. This is to allow custom switch arrangements or to use switches with different button heights. Not all keys need to be in place for the keyboard to work. Keyswitches should have bounce times of <10msec; most tactile switches have bounce times <2msec.

Switches are TE 1-1825910-0 or equivalent; these have standard 4.5mm x 6.5mm pin spacings. The switches supplied have a button height of 3.3mm or 0.130" however other switches in the same series have longer button heights to accommodate different packaging requirements.

For soldering the switches, ensure that the keyswitches in one row are fully seated, solder one pin of each switch, then verify they are all still fully seated before soldering the diagonal pin of the switches. This ensures the keyswitches will all line up with the panel. Repeat for the other rows.

Keyboard Operation

On power up or external reset, the E2420 scans and debounces the 64 keys. The first key debounced on the make of the key closure locks out the rest and a single output is sent to both the serial port and to the clocked serial data port along with an active low interrupt pulse. The keyboard scan involves the rows being sequentially driven low by open drain drivers while the columns are sequentially sensed for a low due to a switch closure. Keys are debounced when they are solidly low for ~20msec. Some encoders encode a key on the first falling edge however EMI could also trigger a similar event which would be erroneous and other real pressed keys would be locked out and not properly validated.

The E2420 debounces each of the 64 switches to provide immunity from EMI and also a fast response to a valid switch closure. During a key closure, the contacts bounce between logic states for several milliseconds. A switch is considered debounced and stable once the switch contacts stop bouncing past a threshold of ~20msec. At this point it is encoded to a value 0x00 to 0x3F and sent as serial data at the selected baud rate followed by the clocked data. The trigger output is asserted low 50μsec prior to the data being sent to provide the host microcontroller time to service the interrupt and get ready for the serial clock and clocked data to be read. The trigger output is held low another 8msec to flash the LED. The remaining keys are inhibited in turn to prevent erroneous outputs in the case of multiple key closures.

If several keys are pressed, the first key decoded in the scanned array is sent out. As long as the first decoded key is pressed, all other keys are locked out, i.e. there are no further outputs until the first key is released. If there are several keys still pressed, the next decoded output will belong to the next scanned key in the array. The last switch pressed will produce a code.

The key code assignments are shown in Figure 1 Mechanical Dimensions drawing. As an example, the key code for a closed switch at row 3 and column 4 would be 0x23 hexadecimal.

The typematic function waits for a key to be continually closed for ~600msec; after this the encoded switch value is sent to the serial port and the clocked data port, and the interrupt output is pulsed every ~200msec or ~5 characters per second rate (5cps) until the key is released.

Serial Data Port

The serial port baud rate is selectable between 9.6K, 19.2K, 57.6K, and 115.2K baud, 8 bits, no parity, and 1 stop bit. Of the 8 bits, only the lower 6 bits are used and the most significant 2 bits are zeroes. The data output ranges from 0x00 to 0x3F and is sent least significant bit first. The TXD pin is a push-pull output with 0 to +3.3V signal swing. It is a single line connection to the host microcontroller's RXD pin. The serial data can be converted to RS-232 levels using a MAX232 or equivalent.

Table 4. Baud Rate Table

BR1	BR0	Baud Rate
1	1	115.2K baud
1	0	57.6K baud
0	1	19.2K baud
0	0	9.6K baud

To set a baud rate, short the BR1 or BR0 for a “0”, or leave open for a “1”. For a baud rate of 57.6K baud, only the BR0 pads would be shorted with a solder bridge.

Clocked Data Port

The clocked data port operates at approximately 100KHz and consists of a serial clock (SCLK), serial data (SDAT), and trigger (TRG*) outputs. The serial clock is pulsed low then high within the data bit so either edge can be used to sample the data. The TRG* signal is active low and precedes the first clock by 50µsec and completes 8msec after the last bit is sent. The TRG* can be used as an interrupt to indicate to the host microcontroller that a data transmission will commence. The TRG* output also drives the onboard LED. See Figure 2 Signal Output Timing. The serial data output is inverted and can easily be viewed using a 74LV164 or equivalent shift register connection as shown in Figure 3. To provide an audible key closure feedback, connect the TRG* output to a non-inverting open drain buffer such as a 74LVC1G07; connect a low power internally driver piezo sounder between the +5V and the buffer output.

Additional References

Locus Engineering application note AN102 describes how keyboard data can be parsed into commands and data.

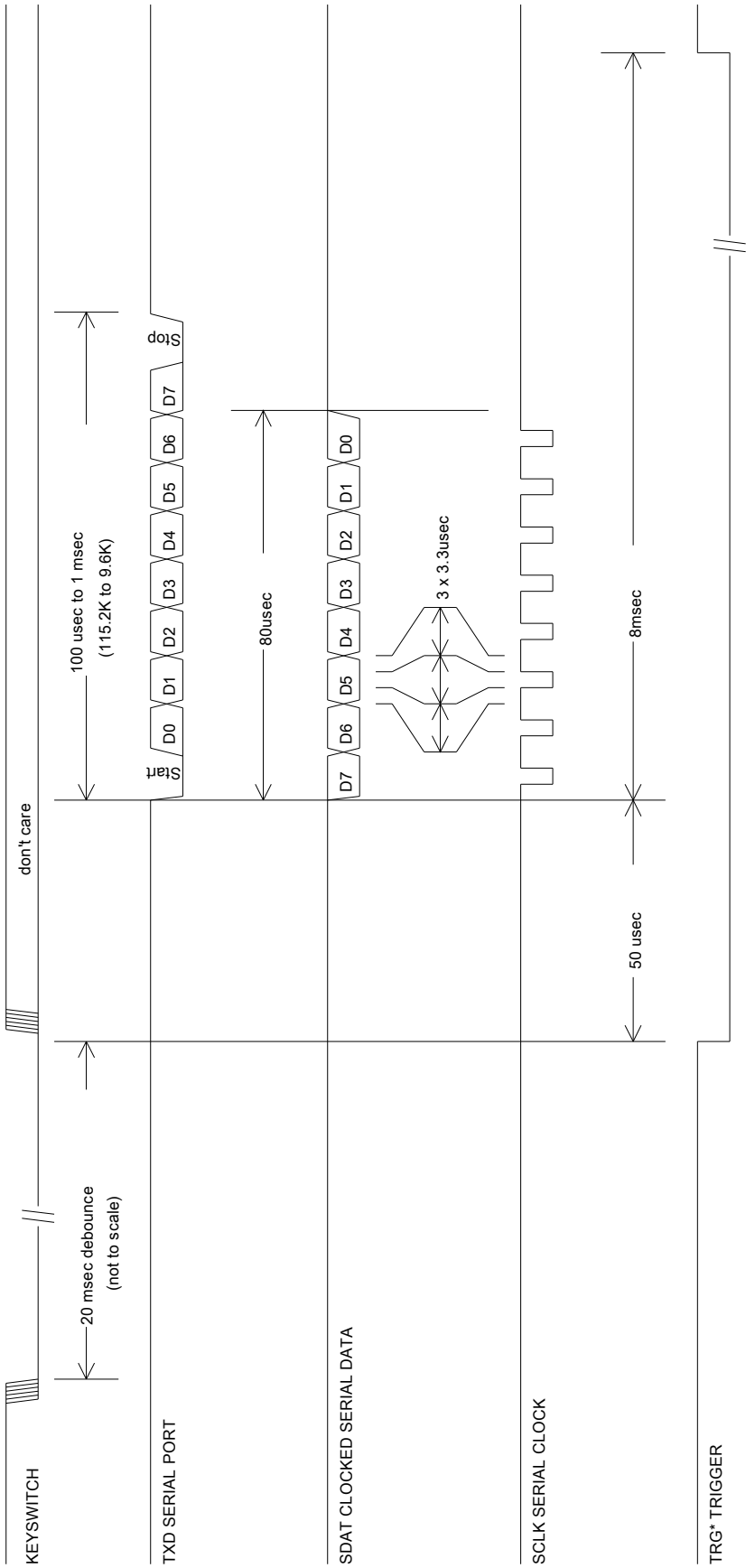

Figure 2. Signal Timing

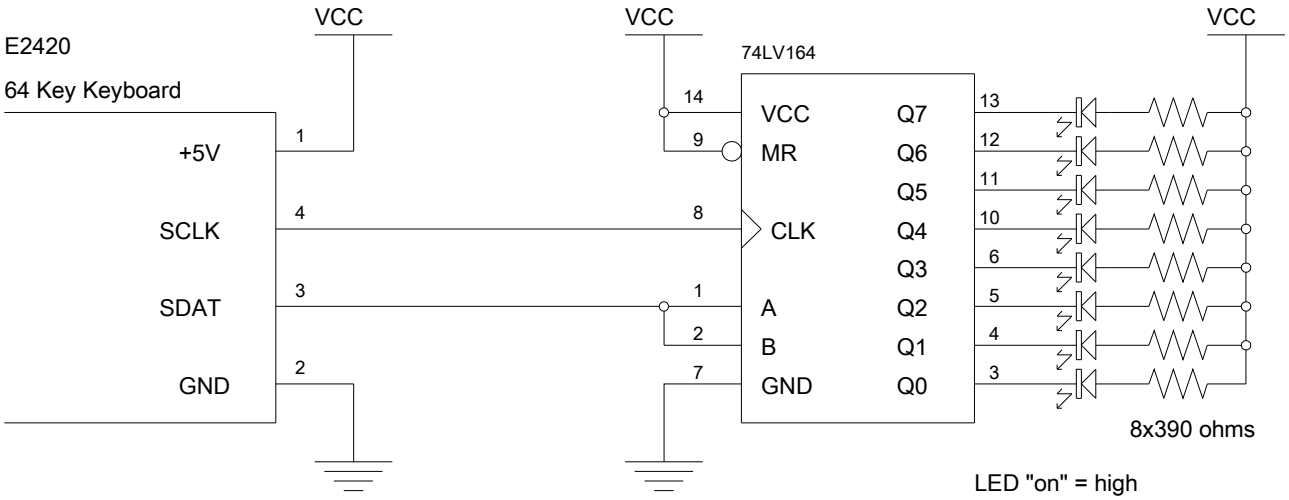

Figure 3. Clocked Data Test Circuit