ANALYTICAL PRODUCTS

H89 – H19

Automatic
Key Repeat

20663 Ave 352
Woodlake, CA 93286

THEORY OF OPERATION

The H89/H19 uses a National Semiconductor MM5740 keyboard encoder which works with a matrix keyboard. This IC outputs scan pulses to 9 columns and senses key closures on 10 rows. For an automatic repeat function, key closure needs to be sensed. The described circuit detects closure of keys by using a diode OR gate for all the rows. Any key closure will start a counter. If the key remains closed for about a half second, the repeat mode is engaged.

A word of caution. Since the circuit responds to the closure of any key, it is possible to inadvertently activate the repeat mode. This can happen by holding down a key for near a half second and then rolling over to another key. In practice, however, this does not happen often since the next key would have to be depressed within 140 uS.

INSTALLATION

Remove the six screws below the keyboard which hold it in place and slide the keyboard towards you. Disconnect the keyboard ribbon cable by gently pulling back on it. Install the automatic repeat board by plugging the female header onto the male pins of the keyboard. Note proper orientation as shown on the enclosed assembly drawing. Now plug the ribbon cable onto the pins on the back of the repeat board. Be sure to properly orient pin 1 of the connector. Inspect for proper installation and slide the keyboard back into place.

CAUTION - Some samples of the connector have firm contacts and may require extra force to plug it onto the pins of the keyboard header. A slight rocking action may help in such cases.

Test for proper operation. All keys should repeat when held down for over approximately half a second. Reinstall the six screws to secure the keyboard. If you have a shielded ribbon cable and experience problems, see the H89A note below.

The REP3 circuit includes a provision for disabling the automatic repeat function on the function row of keys. If this is desired, you may install a 1000 pf capacitor at the location marked Cx on the assembly drawing. The capacitor is not included.

An external defeat switch may be wired to the holes marked "S" on the circuit board. This will allow the auto repeat function to be disabled when the switch is on. The switch may be mounted on the back panel or by drilling a hole in the keyboard cover. The switch is not included.

KIT ASSEMBLY

Install and solder the components in place as shown on the board assembly drawing. Observe proper orientation for the diode cathode band and the positive end of the capacitor. Install the connector from the circuit side and position it to conform to the dimension shown on the drawing.

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+-----------------------------------+
: BE SURE THAT THE DIMENSION IS CORRECT !
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It is very difficult to unsolder the connector if you make a mistake. Solder the connector pins from the circuit side to avoid getting solder onto the pin contact area. Be careful not to burn the plastic body of the connector.

Inspect assembly for conformance to the drawing and proceed to installation instructions.

H89A / H19A

There may be a problem in using the REP circuit in the H89A or H19A, especially with a shielded keyboard ribbon cable. The presence of filter capacitors on several lines reduces the level of scan pulses appearing on pins 2, 4 and 9 of the ribbon connector. The signal may be too low to activate the CMOS ICs of the REP3. The symptoms are that the number row, the "QWERTY" row of keys and the zero and decimal keys on the numeric keypad will not repeat automatically.

This problem can usually be fixed easily by adding a 10K 1/4 watt resistor at the location marked "Z" on the layout for the REP3 board. The additional resistor is in parallel with C1 and pulls the IC supply voltage down to about 3.5 volts from the nominal 4.5 volts. Since the input threshold for CMOS is proportional to the supply voltage, the result is a more sensitive input circuit which will trigger on the reduced signals present in the H89A. If the addition of 10K resistor does not solve your problem, remove diode D1 to further reduce the supply voltage.

If problems persist, you may need to remove capacitors C475, C476, C477 and C478 on the TERMINAL LOGIC board. Since surgery is undesirable, you may wish to contact us for more hints before removing the capacitors.
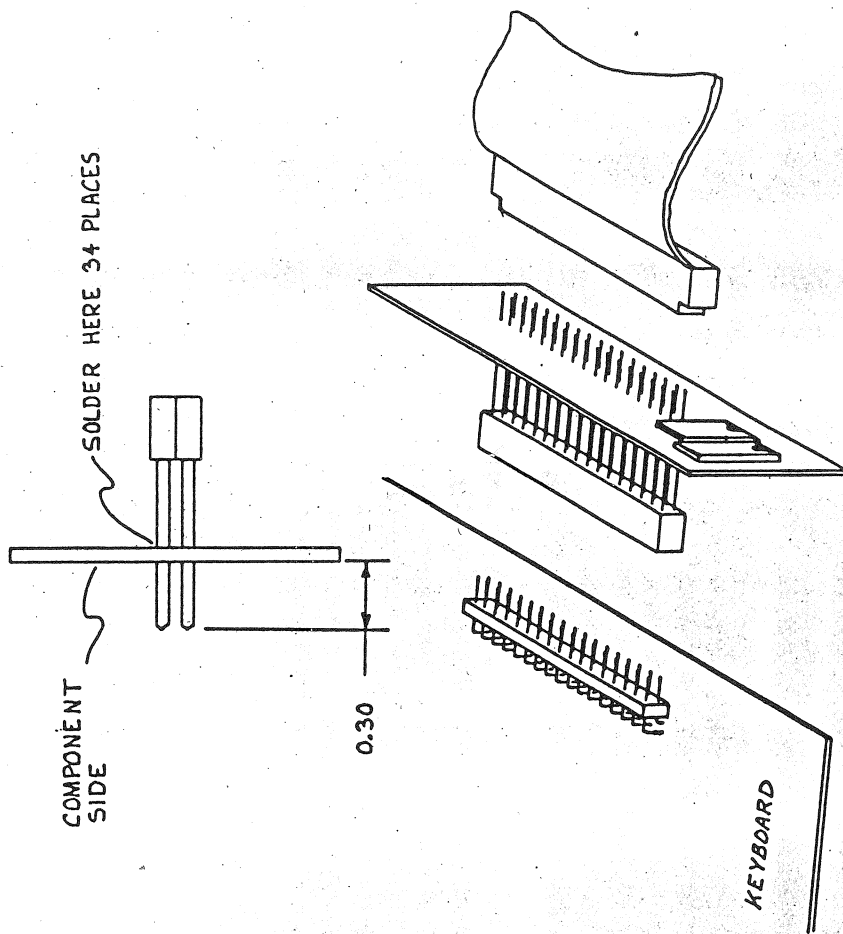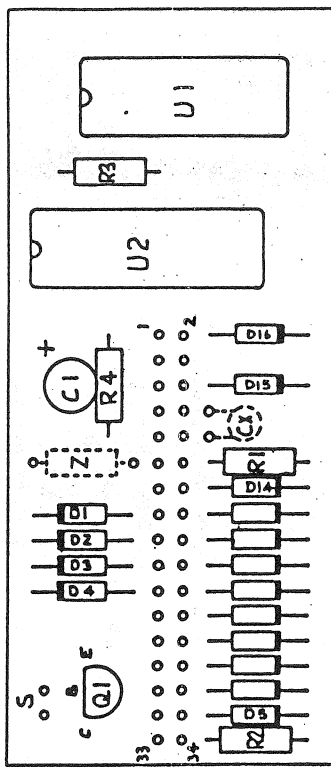
TIMING DIAGRAM

Circuit timing is presented for information only. The automatic repeat board requires no calibration or adjustment for proper operation.
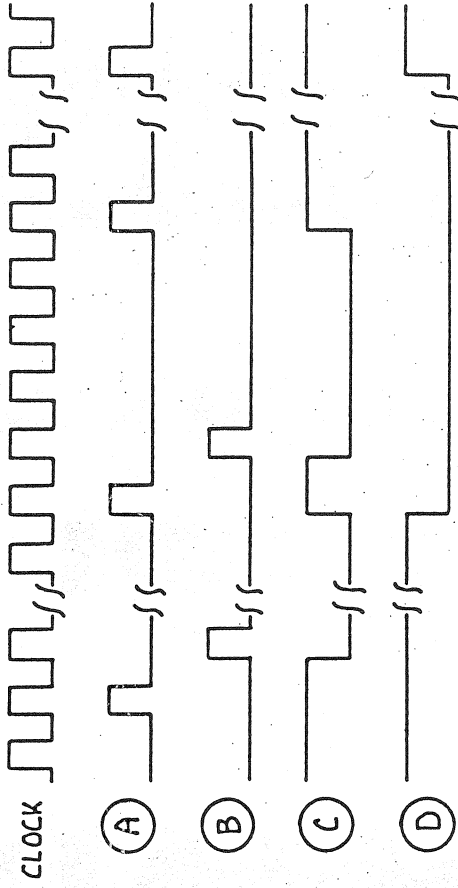
The clock signal is not present on the circuit board but is for reference to the operation of the circuit.

(A) This is a reference timing pulse. It is one of the nine strobe pulses available. Actually, any one of the nine could have been used for this.

(B) This is the key row closure sensing. Whenever any key is pressed, a pulse appears at this input. If a key stays depressed, a pulse will appear every 70 microseconds.

(C) The NOT output of the first D Flip Flop is set high by the clock signal (A). If the (B) signal does not set it to low within the strobe cycle, the high will be transferred to the second Flip Flop U1-B.

(D) If no key sensing pulse is present on (B) within two cycles of the reference signal (A), then the RESET output (D) will go high to reset counter U2.

KEYBOARD CONNECTOR - BOTTOM VIEW
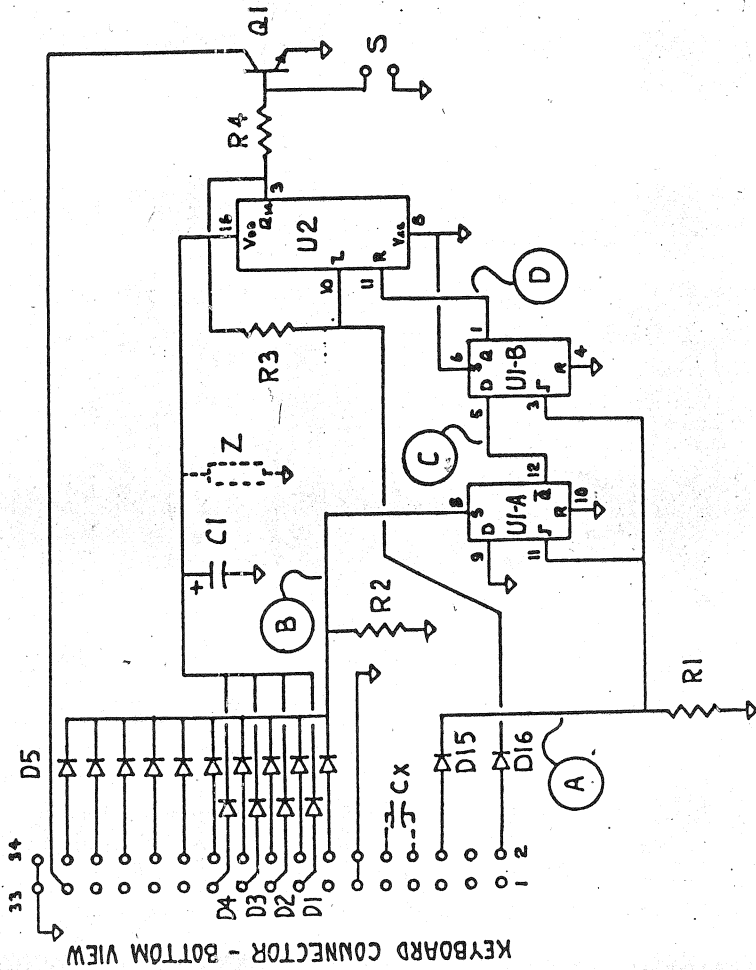
COMPONENTS

U1	4013 CMOS dual D flip flop
U2	4020 CMOS fourteen stage binary counter
Q1	2N3904 or similar NPN small signal transistor
C1	22 uF 10V teardrop tantalum capacitor
R1-R4	27K 10% 1/4W
D1-D16	1N4148 or similar general purpose signal diode

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Terry Hall
516 East Wakeman
Wheaton, IL 60187

You will be happy to know that the circuit board has been laid
out with a hacker like you in mind!   I purposely ran a trace so
that it could be cut and rerouted easily.   That is the good news.
I still strongly recommend against any changes - that's why no
pads were added to make the change even easier.

When a key is closed, the keyboard scan pulses start adding up in
the 14 stage binary counter U2.   When enough counts come in to
turn on Q14 output (8192 counts) the R3 feedback locks up any
additional counts and the repeat circuit turns on.   The repeat
mode then stays on till U2 is reset by removal of the key closed
signal.

Since the counter is only 14 stages long and the last stage is
already used, the delay time can only be shortened without adding
any additional components.   If you cut the short trace connecting
R4 to pin 3 of U2 and then connect R4 to pin 2 of U2, you will
cut the delay time in half (pin 2 is the Q13 output).   Although
shorter delays may seem like a good idea, I have found that there
are too many accidental repeats.   To have longer delays did not
seem worthwhile and would have required additional components.

If you do want to make the delay time longer, you can try adding
an RC delay at the output of U2.   A circuit sketch for this is
shown below.   You could pick pin 2 of U2 as the output and than
have infinitely variable delay from this shorter time to some
longer value by changing the value of the RC network.   Good luck.

Peter Shkabara
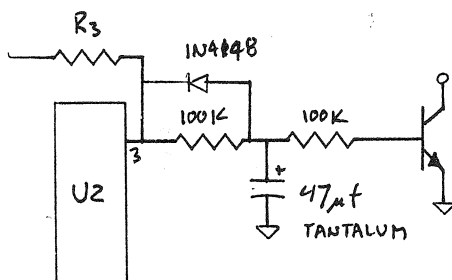
THIS CIRCUIT HAS NOT BEEN TESTED