Jameco ELECTRONICS

JE664 EPROM PROGRAMMER
8K TO 64K EPROMS

OPERATION MANUAL

CONTENTS

JE664 Programmer Operation Manual

INTRODUCTION

The JAMECO JE664 is a machine for programming and emulating various 8-bit-word EPROMs of up to 64K-bit capacity.

Compatible EPROMs *(see List of EPROMs, page 2)* — previously unprogrammed or properly erased with ultraviolet light — are programmed from data residing in the JE664's internal 8K x 8-bit RAM. These data may be entered in 3 ways: From the JE664's hexadecimal keyboard, from an already-programmed compatible EPROM or other ROM, or from an external machine via an RS-232 bus (a JE664 option — JE665).

The JE664's 64K RAM may be accessed for emulation purposes using a short (user-supplied) jumper cable. In programming and emulation, the JE664 allows for examination, change and validation of program content.

PREPARATION FOR USE

Follow the operating instructions in this manual to program, verify or emulate compatible EPROMs.

For any usage of the JE664, be sure that (a) the JE664 is powered from a 115VAC 60Hz source, (b) a Jumper Module is used that is correct for the EPROM at hand and (c) that both Plug and EPROM are inserted with pin 1 upward and with a 24-pin EPROM in the lower 24 pins of the 28-pin socket. Insert or remove the EPROM with EPROM POWER off and the MODE switch at KEYBOARD.
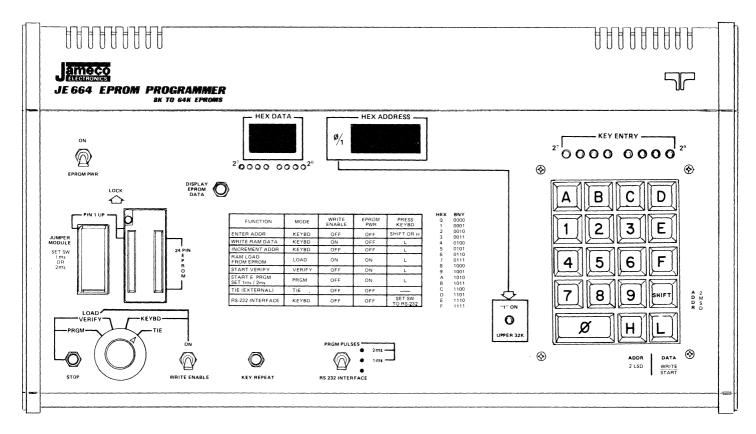
For emulation, you will need a suitable adapter cable — recommended to be no longer than about 1 foot — to plug into the EPROM socket, and also the appropriate Jumper Module.

LIST OF EPROMS

EPROM MFR.	EPROM	JE664 JUMPER MODULE	PRGM PULSES	PRGM TIME (See Note 2)
AMD Intel Motorola National T.I.	2708	JM08A	1ms	90sec
Fujitsu Intel Motorola National NEC T.I.	MBM2716 2716 MCM2716 (25V) MM2716 MPD2716 TMS2516	JM16A	2ms	16sec
Motorola T.I.	TMS2716 (25V)	JM16B	1ms	90sec
Motorola T.I.	MCM2532 (25V) TMS2532	JM32A	2ms	32sec
AMD Fujitsu Hitachi Intel NEC	2732 (25V)	JM32B	2ms	32sec
Fujitsu Intel	2732A (21V)	JM32C	2ms	32sec
Motorola	MCM68764 (25V) MCM687L64	JM64A	2ms	64sec
Intel	2764 (21V)	JM64B	2ms	64sec
T.I.	TMS2564 (25V)	JM64C	2ms	64sec

NOTE:
1. Above listing not complete. Additions of new Jumper Modules will be separately listed when available.

2. EPROM programming time shown is to be used as a guide only. Always refer to the manufacturer for proper programming time and programming voltage requirements.

FUNCTION	MODE	WRITE ENABLE	EPROM PWR	PRESS KEYBD
ENTER ADDR	KEYBD	OFF	OFF	SHIFT OR H
WRITE RAM DATA	KEYBD	ON	OFF	L
INCREMENT ADDR	KEYBD	OFF	OFF	L
RAM LOAD FROM EPROM	LOAD	ON	ON	L
START VERIFY	VERIFY	OFF	ON	L
START E PRGM SET 1ms / 2ms	PRGM	OFF	ON	L
TIE (EXTERNAL)	TIE	OFF	OFF	——
RS-232 INTERFACE	KEYBD	OFF	OFF	SET SW TO RS-232

HEX	BNY
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111

JE664 FRONT PANEL ARRANGEMENT

EXTERNAL FEATURES

*POWER switch:	Controls AC power to the JE664
*FUSE:	Fuses the AC line "hot" side. Size — "3AG," ½A
*Power cord:	Connects to a source of 115VAC 60Hz, with grounding pin. Power drain less than 10W.
JUMPER MODULE socket:	Receives a Jumper Module that configures the EPROM socket for the EPROM at hand.
EPROM socket:	A zero-insertion-force receptacle for the EPROM or for an emulation cable.
Mode switch:	The rotary switch selecting how the JE664 is to be used.
PRGM:	For "burning" data into an EPROM from the JE664's RAM.
LOAD/VERIFY:	For loading data into the JE664's RAM from an EPROM. For verifying that RAM data correspond to EPROM data.
KEYBOARD:	Activates the keyboard for processing RAM data.
TIE:	Configures the JE664 so that its RAM may be connected to an external machine for emulation purposes.
REPEAT button:	When held down, causes consecutive entry of keyboard data (for loading with all 1's, all 0's, etc.)
STOP button:	Stops the LOAD, VERIFY or PROGRAM scan-sequence.
DISPLAY EPROM DATA button:	Changes data readout from RAM word to EPROM word.
WRITE ENABLE: switch:	Enables writing into RAM in the KEYBOARD and LOAD/VERIFY modes. Allows for manual incrementing of address and for verification-scan when off.
EPROM PWR switch:	Applies power to the EPROM socket for loading (EPROM to RAM), verifying or programming.
2MS/1MS/RS-232 switch:	Selects programming-pulse width to suit the EPROM at hand. Activates the RS-232 interface when this option is present.
The Hex Keyboard:	Provides for manual hexadecimal address and data entry to RAM. SHIFT key enters 2 address MSDs, H key enters 2 address LSDs and L key loads data or starts load-scan, verify-scan or program-scan. Has associated binary entry-readout.
HEX ADDRESS readout:	Displays current RAM address in hexadecimal code. The MSD reads out at a single LED adjacent to the keyboard.
HEX DATA readout:	Displays RAM or EPROM data, at indicated address, in hexadecimal code. Has associated binary display.

*ON REAR OF ENCLOSURE

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Operation

Basic Operations Available ———————————————————————————

1. Loading data into RAM via the keyboard.

2. Changing elements of a loaded-in program.

3. Programming an EPROM.

4. Verifying an EPROM's program.

5. Loading a program into RAM from an already-programmed EPROM.

6. Emulating a PROM or EPROM.

7. Loading a program into RAM via the optional RS-232 interface.

Initial Switch Settings, All Operations (after turning on rear-panel POWER) ————

1. EPROM PWR, WRITE ENABLE off.

2. Mode switch to KEYBOARD.

3. EPROM socket lever UP.

Data Loading and Changing from the Keyboard ————————————————————

1. Set Mode switch to KEYBOARD, WRITE EN on and POWER on.

   1st IMPORTANT NOTE: If a program is not to occupy all addresses of an EPROM, it is a good idea to first enter all 1's in RAM and then enter your program. Then, since EPROM's are programmed **from** *the all-1's state, unused addresses may be programmed later without the necessity for UV-erasing.*

   To enter all 1's, enter FF at the keyboard, switch WRITE ENABLE on, hold down REPEAT and press L. Allow the left-most hex ADDRESS starting digit to repeat + 1 or more before releasing REPEAT to ensure that all addresses have been scanned. See 2nd and 3rd IMPORTANT NOTES below.

2. Enter the address from which you want to start data entry as follows:
   a. Enter the two MSDs (most-significant digits), with the most significant first, and press SHIFT.
   b. Enter the two LSDs (least-significant digits), again with the most significant first, and press H.

   As SHIFT and H are pressed, the respective two digits will appear in the address readout. Each pair of digits may be selected at will.

   An Example: To enter address 1234, press 1, then 2, then SHIFT. The MSD LED illuminates and "2" appears as the address's 2nd MSD. The press 3, then 4, then H. "3" and "4" now appear to complete the desired address.

3. Enter the two data digits, MSD first and press L. The data are now entered into RAM at the address previously selected, and the address is automatically incremented by one.

   Note that since this machine provides automatic address incrementing, the data just entered are not displayed. If you want confirmation of any data value, or if you want to change it, it is only necessary to re-select the two LSDs of the address (entered using H) and the data will appear in the hex (and binary) readout. It is best to switch WRITE ENABLE off while doing this to avoid inadvertent data-changing.

4. Always enter data and address two digits at a time, as described, with the most-significant digit of each pair entered first.

5. To scan a sequential set of addresses for examination of their data content, select the starting address as described above. With WRITE ENABLE *off* press L each time you want the next address.

   2nd IMPORTANT NOTE: Data are **volatile** *in the JE664's RAM; that is, if line power is turned off or otherwise interrupted, data stored in RAM will not be retained.*

3rd IMPORTANT NOTE: *While writing data from the keyboard, address incrementing is automatic only for the three LSDs. Incrementing from 0FFF to 1000 or from 1FFF to 0000 is done manually (by entering the proper two MSDs followed by SHIFT).*

The process of programming an EPROM entails sequentially presenting to it all data in RAM and, while each pair of data words is present, applying appropriate programming pulses to the EPROM. The JE664's Jumper Module pre-sets the JE664 for the proper programming pulses and configures the EPROM socket connections for the particular EPROM.

Programming an EPROM

1. Set Mode to KEYBOARD, EPROM POWER off and the EPROM socket's lever up before inserting or removing an EPROM. Always lock the lever down when using the EPROM.

2. Select the Jumper Module corresponding to your EPROM and install it and the previously-erased EPROM in their sockets, pins 1 up. Then turn on EPROM POWER.

3. Assuming your desired program has been entered into RAM (either by keyboard entry, via the RS-232 option if present, or from another EPROM), set Mode to PRGM. Have a clock handy with which you can time the programming period. This should be about 1 second per K bits, e.g. 16 seconds for a 16K EPROM (it is not critical except that it must not be too short; 1 second/K bits allows a comfortable margin).

4. Press key L to start the programming process. After the requisite time has elapsed, press STOP. The rapidly-changing indications at the ADDRESS readout will be a signal that programming is in process.

   IMPORTANT NOTE: Programming of a 64K EPROM is done 32K at a time. The starting address of 0XXX (where X = don't care) should be selected for the first 32K and 1XXX for the second 32K.

5. At completion of programming or verifying (see below), set Mode to KEYBOARD, turn EPROM POWER off, raise the socket lever and remove the EPROM. You are advised to suitably mark the EPROM to show that it is programmed and what its program is. Also its window should be covered with black tape to precluse inadvertant erasure by exposure to too much light.

6. A newly-programmed EPROM should always be verified, as described following.

Verifying an EPROM's Program

Verifying entails scanning all EPROM and RAM addresses together while comparing EPROM data words against RAM data words. The scan is stopped should a difference in supposedly-identical words appear.

1. Set Mode to KEYBOARD, EPROM POWER off and the EPROM socket's lever up before inserting or removing an EPROM. Always lock the lever down when using the EPROM.

2. Select the Jumper Module corresponding to your EPROM and install it and the EPROM in their sockets, pins 1 up. Turn on EPROM POWER.

3. Assuming the desired program is in RAM, set Mode to VERIFY: be sure WRITE ENABLE is off.

4. Note the 2nd MSD ADDRESS digit and then press L to initiate the verification scan. Rapidly-changing ADDRESS indications will show the scan is in process. Should a data error appear, the scan will stop at that address. If there is no error, allow the 2nd MSD ADDRESS starting digit to repeat + 1 (or more) before pressing STOP, to ensure that all addresses have been checked.

   IMPORTANT NOTE: Verifying of a 64K EPROM is done 32K at a time. The starting address of 0XXX (where X = don't care) should be selected for the first 32K and 1XXX for the second 32K.

5. If the scan stops at an error, you may see what the EPROM data word is, at that address, by pressing the DISPLAY EPROM DATA button. To continue the scan, switch to KEYBOARD, press L, then switch back to VERIFY and press L again.

6. The Verify scan will likely stop at addresses past the last programmed EPROM address unless the unused RAM data were programmed to all 1's as suggested under Data Loading.

7. If incorrect EPROM data are found another PROGRAM scan may be made, but if data are still in error the EPROM must be UV-erased and reprogrammed. Occasionally EPROM and RAM data may appear the same at a verify-stopped address. This will be because the read-out logic sense "1" at about +1V while the data-comparison logic senses "1" at about +2½V. In this case, the EPROM usually has been sufficiently erased prior to programming.

8. After Verifying, set Mode to KEYBOARD, turn EPROM POWER off, raise the socket lever and remove the EPROM.

Program Loading from an EPROM or other pin-compatible ROM

1. Before loading a program into RAM you may wish to load all 1's per the first NOTE under Data Loading from Keyboard (page 5).

2. Set Mode to KEYBOARD, EPROM POWER off and the EPROM socket's lever up before insering or removing an EPROM. Always lock the lever down when using the EPROM.

3. Select the Jumper Module corresponding to your (already programmed) EPROM and install it and the EPROM in their sockets, pins 1 up.

4. Apply EPROM POWER, set Mode to LOAD, EPROM POWER on and WRITE ENABLE on.

5. Note the 2nd MSD ADDRESS digit and then press L to initiate the RAM-loading scan. Rapidly-changing ADDRESS indications will show that the scan is in process. Allowing the 2nd MSD ADDRESS digit to repeat +1 before pressing STOP will ensure that all data have been entered.
   IMPORTANT NOTE: Loading from a 64K EPROM is done 32K at a time. the starting address of 0XXX (where X = don't care) should be selected for the first 32K and 1XXX for the second 32K.

6. After loading, set Mode to KEYBOARD. Turn EPROM POWER off, raise the socket lever and remove the EPROM.

7. When loading data from a ROM, PROM, EPROM etc. for which there is not identified a specific JE664 Jumper Module, function assignment for the variable-function pins must be determined. A special jumper module may be made up if no standard one will suffice. Some ROMs are edge-triggered at Select-True to update data output. These are not accommodated by the JE664.

Emulating a ROM

In emulating, the JE664's RAM is directly connected to an external machine to substitute temporarily for a ROM (PROM, EPROM, etc.). Such connection is made with a user-supplied jumper cable from the JE664's EPROM socket.

1. Ensure that the machine to which you wish to connect the JE664 is compatible in drive capability and loading requirements. Within the JE664:
   Address loading: One LS load
   Select-line loading: One LS load
   Data-line drive capability: One LS load
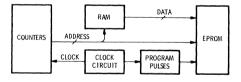   Voltage withstanding, address and select: -.5 to +5.25V

2. Be sure to leave EPROM POWER off to prevent paralleling of JE664 and external power. Set Mode to TIE.

3. Insert a Jumper Module into the JE664 appropriate to the ROM you wish to emulate (to complete the proper connections for address MSDs and select/enable lines).

4. Provide a short jumper-cable assembly (24- or 28-pin as appropriate and preferably 1-1½ feet or less in length) to connect from the JE664's EPROM socket to the external machine. Be sure the jumper plugs are both properly oriented (Pin 1 up at the JE664).

5. With line POWER on and assuming your program exists in the JE664's RAM, the JE664 will now emulate the ROM for which it has been configured.

6. You may modify a program while connected for emulation to an external machine by switching Mode to KEYBOARD and modifying RAM data per the Data Loading and Changing instructions above. Turn WRITE ENABLE off to continue the emulation.

7. Since the JE664 has independent control of the "upper" and "lower" 32K of RAM, two ROMs may be emulated simultaneously provided that:
   a. Neither ROM is larger than 4K words and
   b. All address and data lines are shared by the two ROMs. Address A12 at Jumper Module connector pin 25 may be used to select between upper and lower 32K and this may be controlled, by suitable user-supplied temporary logic, by the respective $\overline{CS}$ signals. In a simple example, the two $\overline{CS}$ signals may be diode-ORed (preferably using germanium diodes for their lower forward drop) to operate the JE664's $\overline{CS}$ line at Jumper pin 10 while only one of them provides the $\overline{A12}$ signal. When ROMs with multiple $\overline{CS}$ lines are encountered, more complex external logic will be required.
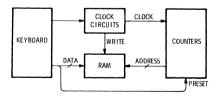
The RS-232C Interface Option

Details of this optional feature are given in the Operation Manual for the option. This option allows external-machine reading from and writing into the JE664's RAM via an RS-232 connection. To activate this feature (when equipped) set the JE664's PULSE switch to RS-232 and Mode to KEYBOARD.
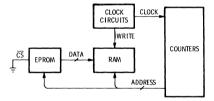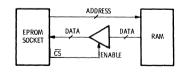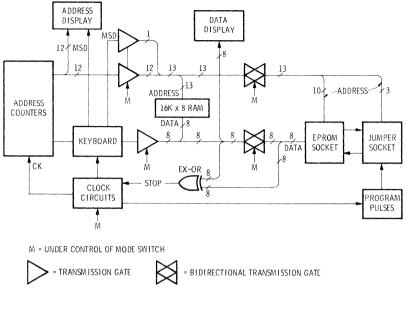
PROGRAM MODE

LOAD FROM EPROM

LOAD FROM KEYBOARD

TIE MODE

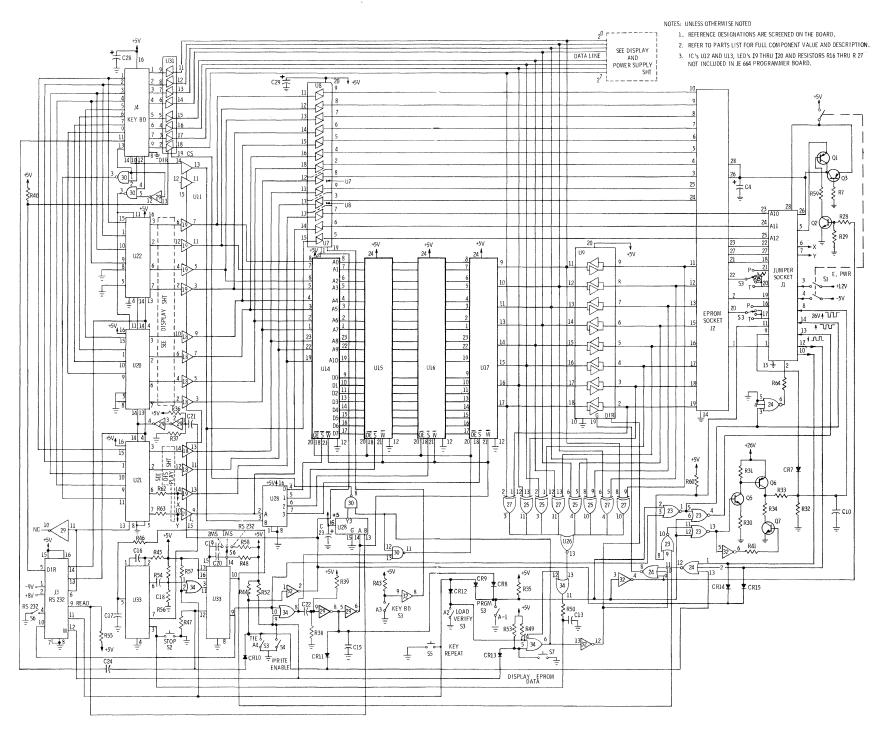### INFORMATION FLOW VS. OPERATIONAL PROCEDURE

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JE664 BLOCK DIAGRAM — FIG 1

Basic Components *(Refer to Figure 1)*

- **The Keyboard and its Register,** for writing into address counters or RAM data inputs.

- **The Address Counters,** preset from the keyboard register, clocked by the clock generator and outputing, via transmission gates to the EPROM socket and/or the RAM, and directly to the address display.

- **The Clock Generator,** whose output advances the address counter, clocks the programming pulses. It is triggered from the Keyboard and stopped (when free-running) by the STOP button or by the EX-OR (exclusive-OR) output when validating.

- **The Displays,** providing hexadecimal readout of address-counter and RAM or EPROM data-content.

- **The Transmission Gates,** interconnecting address counters, EPROM socket and RAM for address- and data-flow.

- **The 16K x 8 RAM,** with address- and data-paths connected via the transmission gates to the address-counters and EPROM socket, and directly to the data display.

- **The EX-OR (exclusive-OR) Gate,** with inputs, during validation, from the EPROM connector's and RAM's data lines.

- **The EPROM connector and Jumper Module Socket,** addressed from the address counter or addressing RAM, via the transmission gates, and inputing data from RAM or outputing data to it via the EX-OR switch.

- **The Programming Circuits,** for generating the various programming and logic-pulses to be applied to EPROMs.

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JE664 EPROM PROGRAMMER SCHEMATIC DIAGRAM

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NOTES: UNLESS OTHERWISE NOTED

1. REFERENCE DESIGNATIONS ARE SCREENED ON THE BOARD.
2. REFER TO PARTS LIST FOR FULL COMPONENT VALUE AND DESCRIPTION.
3. IC's U12 AND U13, LED's I9 THRU I20 AND RESISTORS R16 THRU R 27 NOT INCLUDED IN JE 664 PROGRAMMER BOARD.

Circuit Description _____

(Refer to EPROM Programmer, Display, and Power Supply Schematics)

Address

In the Programmer Schematic, U22, U20 and U21, at the left side, are the address counters. They are preset from the keyboard, directly above, and deliver 11 lines of output (address A0 through A10) via transmission gates U18 and U19 to the RAM, U14 through U17. Also driving this address bus are 11 lines from the EPROM socket J2, of which A10 is connected via the jumper socket J1. These 11 lines connect through transmission gates U7 and U8.

Addresses A11 and A12 from J2 also connect via J1 and U7 but are wire-ORed with counter U21's MSD and with the keyboard register's MSD, respectively. *These* two lines then drive code-converter U28 to provide signals to the four 2K x 8 RAM ICs (U14, U15, U16 and U17).

Data

Data-flow into or out of RAM is controlled by transmission gates in U9 connecting to EPROM socket J2 and by similar gates in U31 (upper left) connecting from the keyboard.

Display

In the Display and Power Supply Schematic, the 3 LSDs of the address are displayed in hexadecimal and derive their inputs directly from address counters U22, U20 and U21. The address MSD is a single LED (LED 9 in Display and Power Supply Schematic). The MSD is selected using the keyboard's SHIFT and H keys.

The 2 data hexadecimal digits derive their inputs from the RAM's 8-bit data bus via U10 and U11. Also provided are LED binary displays.

All Hexadecimal digits are display ICs containing decoding logic so as to accept 4-bit binary inputs. Their brightness is controlled by the oscillator circuit of U32.

The EX-OR circuit

Exclusive-OR gates U27 and U25 (lower right) compare the 8 bits of RAM data with those from the EPROM when the transmission gates in U9 are open. Their outputs OR in U26 which delivers a scan-stop signal via U34.

Clocking circuits

The two halves of U33 (lower left) form a clock oscillator whose outputs are at pins 9 and 10. The oscillator's pulse train is started by a pulse at pin 12 from the "L" output of the keyboard. It is stopped by a LOW signal at pin 3 wire-ORed from EX-OR output U34 and the STOP pushbutton.

The clock oscillator's outputs are processed by associated logic to provide for $\overline{OE}$ and $\overline{W}$ signals to the RAM ICs, EPROM programming-pulse synchronization, address-counter clocking, and transmission-gate control.
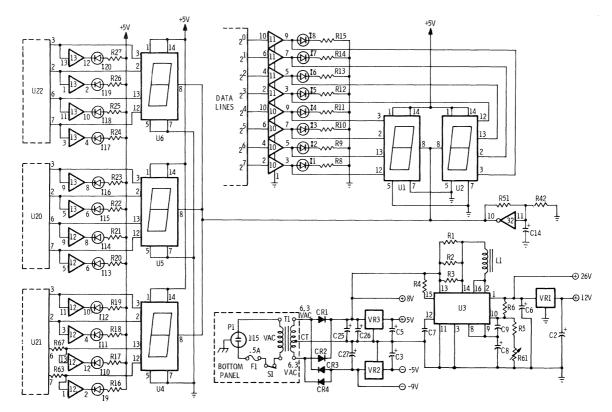
Programming pulse and voltage control

Gates U23, U24 and U32 together with transistors Q5, Q6 and Q7 generate and control EPROM programming pulses.

Transistors Q1, Q2 and Q3 provide for +5 to +12V level-shifting when programming a TMS2716 EPROM.

SCHEMATIC — DISPLAY AND POWER SUPPLY

PART OF JE664 SCHEMATIC DIAGRAM SHEET

JE664 EPROM PROGRAMMER BOARD- COMPONENT MATERIAL LIST

SCHEM REF	DESCRIPTION	QTY
U1,2	IC-TIL311, DISPLAY, HEX DEC	5
U3	IC-78S40, 26V SW REG	1
U7-9	IC-74LS245, OCT TRNSCVR	3
U10,11,18,19	IC-74LS367, HEX BUFF	4
U14-17	IC-6116, DYN RAM	4
U20-22	IC-74LS191, UP/DWN BIN COUNTER	3
U23	IC-74LS02, QUAD OR-GATE	1
U24	IC-74LS27, TRI NOR-GATE	1
U25	IC-CD4030, QUAD OR-GATE	2
U26	IC-CD4078, 8 NOR-GATE	1
U28	IC-74LS139, DUAL DECODER	1
U29	IC-74LS04, HEX INV	1
U30	IC-74C00, QUAD NAND-GATE	1
U31	IC-74LS245, OCTAL BUS	1
U32	IC-74LS14, HEX SCHMITT TRIG	1
U34	IC-74LS32, QUAD GATE	1
VR1	IC-7812T, 12V REG	1
VR2	IC-7905T, -5V REG	1
VR3	IC-LM309K, 5V REG	1
Q1,3,6	TRANSISTOR, 2N2907A	3
Q2,5,7	TRANSISTOR, 2N2222A	3
CR1-4	DIODE, 1N4001	4
CR7-15	DIODE, 1N4148	9
C2,3,4,5,11,12, 14,23,28,29	CAPACITOR, TANT, 2.2MF, 35V	10
C6	CAPACITOR, TANT, 47MF, 25V	1
C7	CAPACITOR, DISC, .01MF, 50V	1
C8	CAPACITOR, TANT, .22MF, 35V	1
C9	CAPACITOR, DISC, .001MF, 50V	1
C10,13	CAPACITOR, MYLAR, .0022MF, 100V	2
C15-18,21,24	CAPACITOR, DISC, 100PF, 50V	6
C19,20	CAPACITOR, MYLAR, .01MF, 100V	2
C22	CAPACITOR, DISC, 220PF, 50V	1
C25,26	CAPACITOR, ELEC, 2200MF, 16V	2
C27	CAPACITOR, ELEC, 1000MF, 16V	1
I1-8	LED, XC209R	8
J1	JUMPER SOCKET, CA-28PIN SG,WW (MODIFIED)	1
J2	ZIP SOCKET, 228-3345 "TEXTOOL" (MODIFIED) ZIP RECPT, 228-3598	1 SET
L1	INDUCTOR CORE, MAGNETICS INC, 55118	1
R1-3	RESISTOR, ¼W, 5%, 1 OHM	3
R4	RESISTOR, ¼W, 5%, 430 OHMS	1
R5,31	RESISTOR, ¼W, 5%, 4.7K	2
R6,32	RESISTOR, ¼W, 5%, 100K	2
R7	RESISTOR, ¼W, 5%, 2K	1
R8-15,34	RESISTOR, ¼W, 5%, 180 OHMS	9
R28,29,35-40,43,44, 46,47,49,50,52-60	RESISTOR, ¼W, 5%, 27K	23
R30,51	RESISTOR, ¼W, 5%, 1K	2
R33	RESISTOR, ¼W, 5%, 100 OHMS	1
R41	RESISTOR, ¼W, 5%, 10K	1
R42	RESISTOR, ¼W, 5%, 1.2K	1
R45	RESISTOR, ¼W, 5%, 82K	1
R48	RESISTOR, ¼W, 5%, 180K	1
R61	RESISTOR, TRIM POT, 1K (840P-1K)	1
R62-64	RESISTOR, ¼W, 5%, 470 OHMS	3

JE664 EPROM PROGRAMMER BOARD- COMPONENT MATERIAL LIST (CONT'D.)

SCHEM REF	DESCRIPTION	QTY
S1	SWITCH, TOGGLE, 3DPT, C&K7301-P3-Y-ZQ or EQ) 1	
S2,5,7	SWITCH, MOM-ON, MS102 3	
S3	SWITCH, ROTARY, 3-POLE 4-POS C&KA304-N-C (OR EQ)....1	
S4	SWITCH, TOGGLE, SPDT, C&K7101-P3-Y-ZQ (OR EQ) 1	
S6	SWITCH, TOGGLE, 4PDT, C&K7403-P3-Y-CQ (OR EQ) 1	

JE664 BOTTOM PANEL COMPONENT MATERIAL LIST

SCHEM REF	DESCRIPTION	QTY
F1	FUSE, AGC 3AG, ½ AMP................................1	
XF1	FUSEHOLDER, HKP 1	
P1	POWERCORD, 3 COND, 17236...........................1	
S1	SWITCH, TOGGLE, SPDT, C&K7101-P3-ZQ (OR EQ) 1	
T1	TRANSFORMER, PWR, F25X (P8130 OR EQ)...............1	

JE664 HEXADECIMAL KEYBOARD

SCHEMATIC DIAGRAM COPYRIGHT 1979

PRINTED WIRING BOARD ASSEMBLY

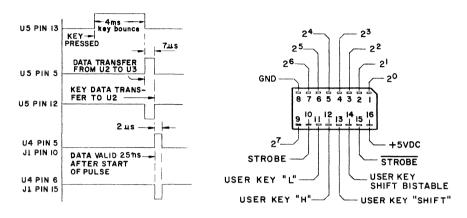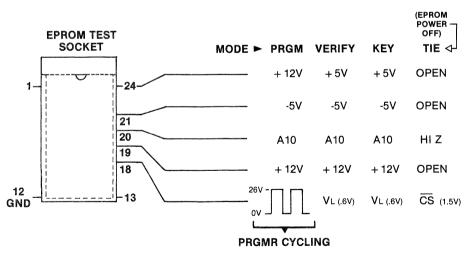# JE664 HEXADECIMAL KEYBOARD
TIMING DIAGRAM AND CONNECTOR PIN-OUT

ENCODER TIMING DIAGRAM

J1 CONNECTOR PIN ASSIGNMENT

U5 PIN 13	KEY PRESSED	4ms key bounce	7μs
U5 PIN 5	DATA TRANSFER FROM U2 TO U3		
U5 PIN 12	KEY DATA TRANSFER TO U2		
	2 μs		
U4 PIN 5 J1 PIN 10	DATA VALID 25ns AFTER START OF PULSE		
U4 PIN 6 J1 PIN 15			

2^4 2^3
2^5 2^2
2^6 2^1
GND 2^0

| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

2^7 +5VDC
STROBE $\overline{\text{STROBE}}$
USER KEY "L"   USER KEY SHIFT BISTABLE
USER KEY "H"   USER KEY "SHIFT"

SWITCH MODE CHART

EPROM TEST SOCKET

	MODE ►	PRGM	VERIFY	KEY	TIE ◁ (EPROM POWER OFF)
1 — 24		+12V	+5V	+5V	OPEN
21		-5V	-5V	-5V	OPEN
20 19		A10	A10	A10	HI Z
18		+12V	+12V	+12V	OPEN
12 GND — 13		26V 0V PRGMR CYCLING	V_L (.6V)	V_L (.6V)	$\overline{CS}$ (1.5V)

VOLTAGES SHOWN FOR WHEN USING THE JM16B JUMPER MODULE
(FOR THE TMS2716 EPROM)

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Troubleshooting

A good understanding of how the JE664 functions and a familiarity with where components are located is essential for effective troubleshooting. Always try to understand the full set of symptoms of a fault and in what modes of operation they appear. Then, very often, the necessary location of the problem will be evident from your understanding of the logic.

The basic troubleshooting considerations are:

1. Note all symptoms and under what conditions they occur.

2. Try to locate fault area by logical analysis. Try to determine the fault category, i.e., is it related to faulty bits, faulty words or to timing or counting.

3. Check the four supply voltages. The +5, -5 and +12 volt potentials should be within $\pm \frac{1}{2}$V of nominal and +26V, also within $\pm \frac{1}{2}$V. Measure for +8VDC across capacitors C25 and C26. Check for proper voltages at the EPROM socket with the proper Jumper Module in place. Refer to the EPROM's data sheet for terminal identification.

4. If a signal is found to be wrong, following it back toward its source in an orderly, logical manner should lead to the fault location.

5. Operating in the KEYBOARD mode will allow exercising of most of the circuit components from the keyboard. An oscilloscope and/or logic probe can then be used while keying in trial data.

6. Refer to standard catalog data on the various IC types, as necessary, for any logic-level or signal criteria that are not detailed in this manual.

7. When using an ohmmeter, generally avoid using the X1 range (to avoid excess currents through the elements) and also avoid higher ranges that may present open-circuit voltage greater than 9V or so.

8. Use extreme care in removing and re-installing soldered-in ICs. Unless a gang-desoldering tool is used, it is much the better procedure to clip a suspected IC away from its leads — one at a time — and then remove one lead at a time from the board. Use a "solder-sucker" or a wicking braid and avoid excess heat.

TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE
1. No keyboard entry correct.	(Keyboard) U1, U2 or U3*
2. Unable to enter part of address or data at keyboard.	(Keyboard) U6, U4. U30, U31 (data), U22 (address LSD), U20 (address 2nd LSD) U21 (address 2nd MSD)*
3. Address and data displays OK but data wrong in RAM and/or EPROM.	Transmission gates U18, U19.
4. Will not increment address.	U29, U32, U33, U34.
5. Will not verify.	Trans. gates U8 or U9, EX-OR U25/U27/U26, U34.
	U23, U24, U32, Q5, Q6, or Q7 in program-pulse circuit.
6. Data readout incorrect.	LED or hex display IC if binary and hex data do not agree; U10 or U11 if they do agree.
7. Address readout OK but wrong data in RAM.	RAM-enable IC U28.
8. EPROM data not displayed when DISPLAY EPROM DATA button pressed.	Decoder U28, U30. Transmission gates U31 or U9.

*When the RS-232 option is incorporated, keyboard connections pass through logic on the RS-232 board. Check the RS-232 transmission gates U10, U12 and U13.

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