



# PROGRAMMING THE MC1468705G2 MICROCOMPUTER EPROM

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## INTRODUCTION

This application note provides information for programming early mask set versions of MC1468705G2 MCU EPROMs (mask sets MJ3, 1MJ3, and 2MJ3) as well as subsequent mask set versions. The schematic diagram at the end of this application note defines a circuit with simple jumpering which can be used when programming devices with any of the mask set versions. In addition to the schematic diagram, the programming steps for each different mask set version are included. The ( )MJ3 mask sets are covered in the next section. All subsequent and future mask set versions are covered in the third section.

## PROGRAMMING THE ( )MJ3 MASK SET VERSIONS

The MC1468705G2 CMOS EPROM MCU with a date code MJ3XXXX or 1MJ3XXXX incorporates the EPROM programmable mask option register (MOR). The following options are available:

1. Crystal oscillator (MOR bit 7=0); bit 7=1 for XTAL
2. Divide-by-4 oscillator (MOR bit 6=0); bit 6=1 for ÷2
3. Edge-sensitive interrupt trigger input (MOR bit 4=0); bit 4=1 for edge-sensitive and level-sensitive trigger input.

### NOTE

These options, while programmable, are affected by the POWER-ON substrate currents and, at times, can latch in an incorrect value. This anomaly is usually corrected by an additional RESET of the MCU.

The MC1468705G2 CMOS EPROM MCUs with date code 2MJ3XXXX are identical to the standard MC1468705G2, except that the mask option register (MOR = \$10) has been permanently altered as follows:

1. Crystal oscillator (MOR bit 7=0)
2. Divide-by-4 oscillator (MOR bit 6=0)
3. Edge-sensitive and level-sensitive interrupt trigger input (MOR bit 4=1)

Refer to the attached schematic diagram. In the actual programming circuit, connect jumpers K1, K2, K3, and K4 as follows:

1. Connect K1 jumper between pins 1 and 2 if an MCM2532 type EPROM is used as U2. If an MCM68764 EPROM or MCM68766 EPROM is used as U2, connect K1 jumper between pins 5 and 6. These connections ensure that the input to pin 21 is either +5 V to V<sub>pp</sub> if an MCM2532 is used, or a logical zero to A12 if an MCM68764/66 is used.
2. Connect K2 and K3 jumpers between pins 1 and 2 to ensure correct LED input from PD5 and PD6.
3. Connect jumper K4 between pin 1 and pin 2 to ensure that the address decoder (U3 and U4) output drives the E (enable) input to U2.

Since the actual EPROM memory used in the MC1468705G2 is 2106 bytes, the EPROM device (U2) used in programming only needs 4K bytes of memory location. Figure 1 shows the memory location in which the MC1468705G2 program should be stored in an MCM2532, an MCM68764, or an MCM68766 EPROM.

### NOTE

Program \$00 at memory locations \$8B0 through \$8F5 as well as in the MOR at location \$FF5 in the MCM2532, MCM68764, or MCM68766 EPROM (whichever is used).

Prior to programming the MC1468705G2 EPROM, it should be erased by exposure to high-intensity ultraviolet (UV) light with a wavelength of 2537 angstroms. The recommended integrated dose (UV intensity x exposure time) is 40 Ws/cm<sup>2</sup>. The UV lamps should be used without shortwave filters and the MC1468705G2 should be positioned about one inch from the UV tubes.

\$00 Erased State	\$000
MC1468705G2 Program	\$07F \$080
\$00	\$8AF \$8B0
\$00 Erased State	\$8F5 \$8F6
MC1468705G2 MOR (\$1FF5) \$00	\$FF4 \$FF5
MC1468705G2 Vectors \$1FF6-\$1FFF	\$FF6 \$FFF
\$FF Erased State (Don't Care)	\$1000 \$1FFF

FIGURE 1 — MC1468705G2 Program Memory Map for the MCM2532 or MCM68764/66

#### CAUTION

Because the MC1468705G2 is sensitive to any light entering the window during programming and operation, be sure that the EPROM window is shielded from light with an *OPAQUE* cover at all times except when erasing.

Be sure that S1 is off and S2 is in RESET when inserting the MC1468705G2 and/or MCM2532 or MCM68764/66 EPROM(s) into their respective sockets (see Figure 4). This ensures that RESET is held low and power is not applied when inserting the device(s). To program, use the following steps:

1. Close switches S3, S4, and S5 to select the program and verify mode (PC0, PC1, and PC3 = logical zero).
2. Close S1 to apply  $V_{DD}$  (-18 V) and to provide a positive voltage to the TIMER pin and a negative voltage to the IRQ pin.

#### NOTE

The following steps are applicable when using either the MCM2532 or MCM68764/66 EPROMs.

3. Set switch S2 at RUN to remove RESET.

#### NOTE

Once the MCU comes out of RESET, the  $V_{pp}$  control line (PD7) goes low and the  $V_{pp}$  voltage is applied to pin 3. With  $V_{pp}$  applied, the MCU is programmed one byte at a time with the corresponding data in the EPROM. The MC1468705G2 bootstrap provides the address to the EPROM to permit complete self programming.

4. Check that the programming LED is turned on and remains on throughout the programming sequence.

#### NOTE

Transfer of the entire contents of the EPROM requires approximately 200 seconds (100 ms/byte). The internal counter is then cleared and the loop is repeated to verify that the MCU programmed data is precisely the same as the incoming data from the EPROM. This repeated loop requires approximately 8 seconds to complete.

5. Approximately 8 seconds after the programming LED turns off, the verified LED will turn on. This indicates that the MC1468705G2 has been correctly programmed.
6. Set S2 at RESET to reset the MC1468705G2, and switch S1 to off (to remove -18 V and  $V_{DD}$ ) prior to removing any device (MCU or EPROM) from its socket.
7. Remove the MC1468705G2 from its socket, if no further programming is required.

#### PROGRAMMING SUBSEQUENT AND FUTURE MASK SET VERSION

Refer to the attached schematic diagram. In the actual programming circuit, connect jumpers K1, K2, K3, and K4 as follows:

1. Connect K1 jumper between pins 3 and 4. These connections ensure that the input to pin 21 is address bit A12, thus allowing the full use of the 8K program space in an MCM68764 or MCM68766 EPROM. A MCM2532 EPROM *cannot* be used in this method of programming.
2. Connect K2 and K3 jumpers between pins 2 and 3 to invert the output from PD5 and PD6 before application to each LED.
3. Connect jumper K4 between pins 2 and 3 to bypass the address decoder (U3 and U4) and use the TSC output to drive the E (enable) input to U2.

Since the addressed memory used in the MC1468705G2 is 8K bytes, the EPROM device (U2) used in programming also requires 8K bytes of memory location (MCM68764 or MCM68766 EPROM). Figure 2 shows the MCM68764/66

\$00 Erased State	\$000
MC1468705G2 Program	\$007F \$0080
\$00 Erased State	\$08AF \$08B0
MOR (See Note)	\$1FF4 \$1FF5
MC1468705G2 Vectors	\$1FF6 \$1FFF

Note:  
Refer to the MC1468705G2 Advance Information Data Sheet for mask option register programming. The MOR should be programmed with hexadecimal \$00, \$10, \$40, \$50, \$80, \$90, \$C0, or \$D0 depending on oscillator type, clock divider, and interrupt trigger requirements.

FIGURE 2 — MC1468705G2 8K Byte Program Memory Map for MCM68764/66

memory location in which the MC1468705G2 2106-byte program should be stored.

Prior to programming the MC1468705G2, the EPROM should be erased by exposure to high-intensity ultraviolet (UV) light with a wavelength of 2537 angstroms. The recommended integrated dose (UV intensity  $\times$  exposure time) is 40 Ws/cm<sup>2</sup>. The UV lamps should be used without shortwave filters and the MC1468705G2 should be positioned about one inch from the UV tubes.

#### CAUTION

Because the MC1468705G2 is sensitive to any light entering the window during programming and operation, be sure the EPROM window is shielded from light with an *OPAQUE* cover at all times except when erasing.

Be sure that S1 is off and S2 is reset when inserting the MC1468705G2 and/or MCM68764/66 EPROM(s) into their respective sockets. This ensures that RESET is held low and power is not applied when inserting the device(s).

1. Set switches S3, S4, and S5 to select the program and verify mode (PC0, PC1, and PC3 = logical zero).
2. Close S1 (to apply V<sub>DD</sub> - 18 V, and to provide a positive voltage to the TIMER pin and a negative voltage to the IRQ pin).
3. Open S2 (to remove reset).

#### NOTE

Once the MCU comes out of RESET, the V<sub>pp</sub> control line (PD7) goes low and the V<sub>pp</sub> voltage is applied to pin 3 each time a byte is to be programmed. In this manner, the MCU is programmed one byte at a time with the corresponding data in the EPROM. The MC1468705G2 bootstrap provides the address (A0-A12) and enable (TSC) signals to permit complete self programming.

4. Check that the programming LED is turned on and remains on throughout the programming sequence.

#### NOTE

Transfer of the entire contents of the EPROM requires approximately 200 seconds. The internal counter is then cleared and the loop is repeated to verify that the MCU programmed data is precisely the same as the incoming data from the EPROM. This repeated loop requires approximately 8 seconds to complete.

5. Approximately 8 seconds after the programming LED turns off, the verified LED will turn on. This signals that the MC1468705G2 has been correctly programmed.
6. Set S2 at RESET (resets the MC1468705G2), and switch S1 to off (removes - 18 V and V<sub>DD</sub>) prior to removing any device (MCU or EPROM) from its socket.
7. Remove the MC1468705G2 from its socket if no further programming is required.

#### PROGRAMMING SCHEMATIC DIAGRAM DIFFERENCES BETWEEN ( )MJ3 AND SUBSEQUENT MASK SETS

The MC1468705G2 programming schematic diagram at

the end of this application note contains circuits required for the ( )MJ3 mask set versions which are not required for subsequent mask set versions. These circuits include: (1) the eight 10 kilohm pullup resistors on the D0-D7 data lines; (2) decoding logic provided by U3 and U4; and (3) jumper connections K1, K2, K3, and K4.

If some of the MC1468705G2 EPROM MCUs that require programming were manufactured using the ( )MJ3 mask set version, then all of the parts shown on the schematic diagram are required. If none of the MC1468705G2 EPROM MCUs being programmed were manufactured using the ( )MJ3 mask set version, then the eight 10K pullup resistors, U3, and U4 can be eliminated. In addition, transistors Q5 and Q6 may be eliminated by reconnecting DS3 and DS4 as shown in Figure 3.

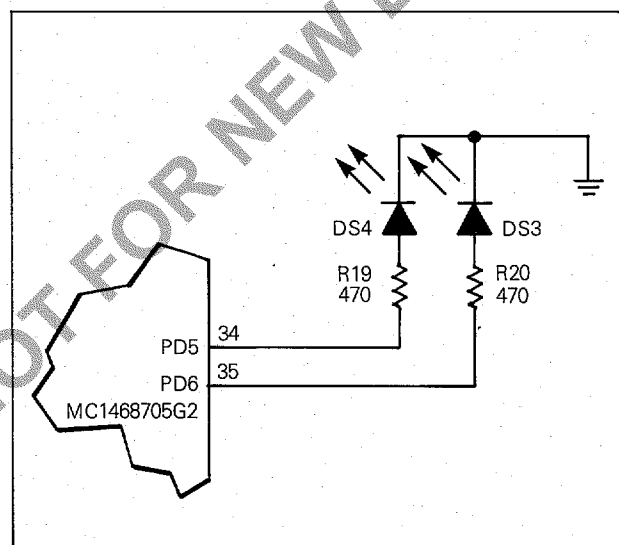


FIGURE 3 — DS3 And DS4 Connections for Programming MC1468705G2 with Mask Set Version other than ( )MJ3

#### PRINTED CIRCUIT BOARD AND PARTS LIST

Since the routine required to program the MC1468705G2 is actually located within the device, only a small number of parts are required to build the circuit for programming the EPROM MCU. Figure 4 shows a parts layout of the printed circuit board which may be used to configure the programming circuit. Table 1 is the recommended parts list for the programming circuits.

The printed circuit board is a single-sided board with 17 fixed-wire connections which allow for the single-sided board. Figure 5B contains the circuit art detail which is actual size and can be used for developing the single-sided board. Note that the 17 fixed-wire connections are shown on Figure 5A (the component or front side) and they should be insulated wires rather than bare wires.

Also note on Figure 5B (the conductor or back side) that each jumper terminates into two square pads on the PCB (i.e., V<sub>SS</sub> connects to V<sub>SS</sub>, A7 connects to A7, V<sub>pp</sub> connects to V<sub>pp</sub>, etc.). These jumpers in Figure 5A are shown in actual size and can be used for developing double-sided PCBs, thus eliminating the need for the 17 fixed-wire jumpers.

TABLE 1 — MC1468705G2 Programming Schematic Parts List

Reference Designation	Description
C1	1.0 $\mu$ F (Ceramic)
C2, C3	27 pF
C4 through C12	0.1 $\mu$ F (Ceramic)
D1	1N4148 (or Equivalent)
DS1	Red LED (– 18 Vdc Indicator)
DS2	Red LED (+5 Vdc Indicator)
DS3	Green LED (Programming Indicator)
DS4	Green LED (Verified Indicator)
K1, K2, K4	Berg Jumper (3-Pin)
K3	Berg Dual Jumper (3-Pin/Dual)
P1	Connector (Jones Type, 6 Terminal)
Q1, Q3, Q4, Q7	2N3906 or Equivalent (PNP)
Q2, Q5, Q6	2N2222 or Equivalent (NPN)
R1	100 k
R2	1.0 M
R3	470 Ohms
R4	1.8 k
R5	1 k
R6	1 k
R7	75 Ohms
R8	2.7 k
R9	15 k
R10	5.6 k
R11	1 k
R12	3 k
R13	5.6 k
R14	470 Ohms
R15	470 Ohms
R16	5.6 k
R17	3.0 k
R18	5.6 k
R19	3.0 k
R20, R21, R22	10 k
R23, R24	33 k
R25	10 k ( $\times 8$ ) SIP
S1	Switch, DPST (C&K 7201)
S2	Switch, SPST/DPST (C&K 7201)
S3, S4, S5, S6	Switch, SPST (Quad) DIP
U1	MC1468705G2
U2	MCM68764, MCM68766, or MCM2532
U3	MC74HC02 or Equivalent
U4	MC74HC11 or Equivalent
X1	40-Pin ZIF Socket (TEXTTOOL-240-3346) or Equivalent
X2	24-Pin ZIF Socket (TEXTTOOL—224-3346) or Equivalent
X3, X4	14-Pin Socket
VR1	1N4742A; 12 Vdc ( $\pm 5\%$ ) or Equivalent
VR2	1N5534C; 14 Vdc ( $\pm 2\%$ ) or Equivalent
Y1	1.0 MHz Quartz Crystal
Chassis (Optional)	Vector Chassis Box #W30-66-46B
PCB*	Single-Sided (with Jumpers or Double-Sided with Plated Through Holes)

\*Hole sizes for components

1. Connector and two switches: 0.0625" dia. (18 ea.)
2. All others: 0.035" dia. (301 ea.)



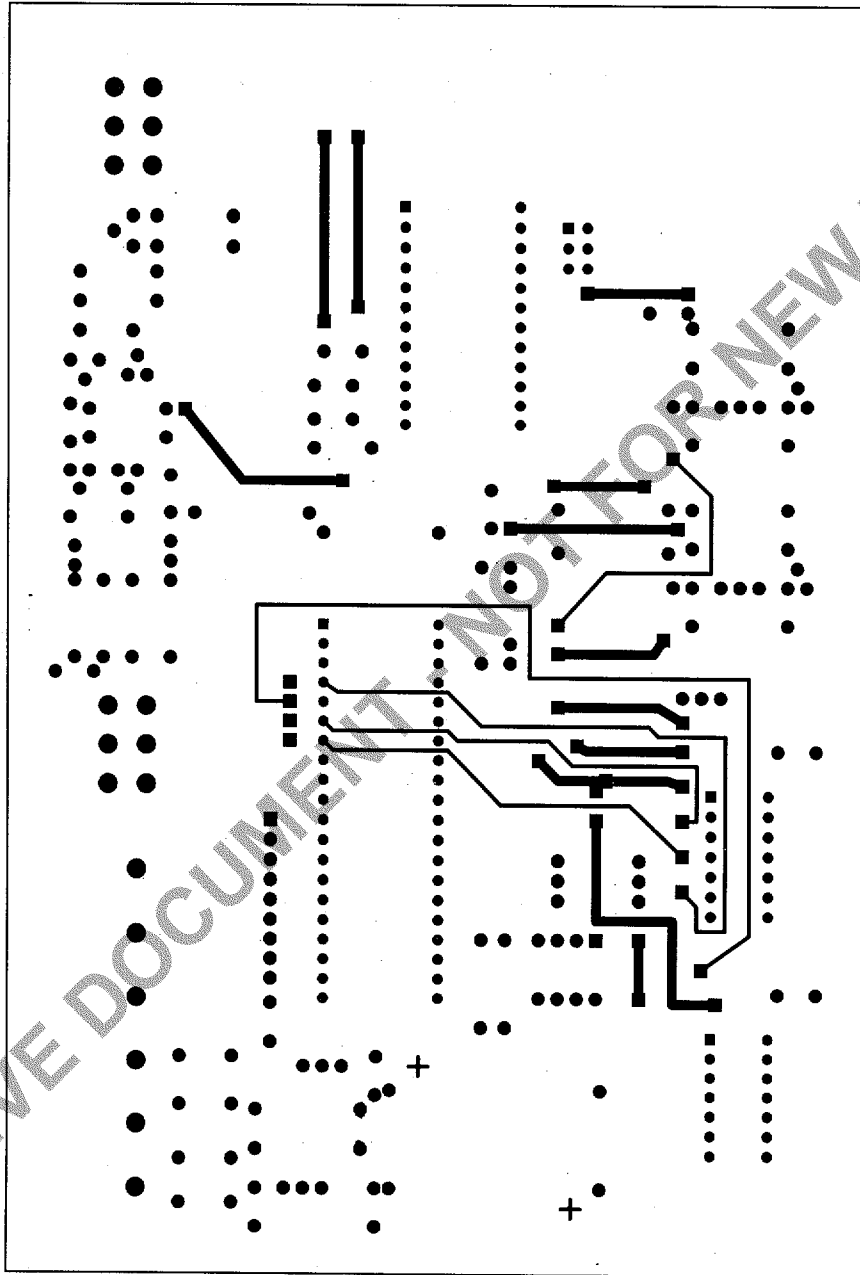
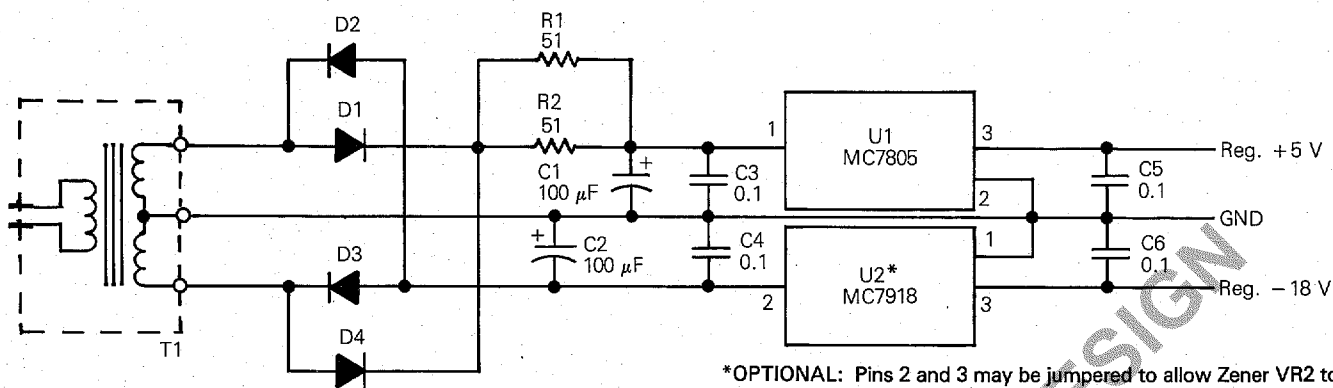


FIGURE 5A — MC1468705G2 Programming Module  
Circuit Board Art (Front)



\*OPTIONAL: Pins 2 and 3 may be jumpered to allow Zener VR2 to regulate the voltage.

OPTIONAL WALL-POWERED POWER SUPPLY SUBASSEMBLY

#### OPTIONAL POWER SUPPLY PARTS LIST

Reference Designation	Description
C1, C2	100 $\mu$ F, 25 Vdc (Polarized)
C3, C4, C5, C6	0.1 $\mu$ F
D1, D2, D3, D4	1N4001
R1, R2	51 Ohms, 1/2W
U1	MC7805CT; +5 Vdc Regulator
U2	MC7918CT; -18 Vdc Regulator
T1	Transformer; Ault #308-1124T (24VAC, 10VACT)

NOTES: 1. Unless otherwise indicated: capacitor values are in microfarads; resistor values are in ohms.

2. This schematic diagram illustrates a programming circuit for both early (MJ3) and subsequent or future mask sets of the MC1468705G2. Differences are reflected by jumper options K1, K2, K3, and K4. See JUMPER OPTION TABLES.

3. Switches S3, S4, and S5 control the mode as shown below:

#### JUMPER OPTION TABLES (Note 2)

K1 - Jumpers		
Connect	U1 Device	Mask Set
1 - 2	MCM2532	( )MJ3
5 - 6	MCM687464/66	( )MJ3
3 - 4	Full 8K	Future


K2, K3, K4 Jumpers	
Connect	Mask Set
1 - 2	( )MJ3
2 - 3	Future

PC3 (S5)	PC1 (S4)	PC0 (S3)	Mode	Mask Set
0	0	0	Program & Verify	( )MJ3
0	0	1	Verify Only	
0	1	0	Unused	Future
0	1	1	Unused	

0 = Switch Closed

1 = Switch Open

4. Switches S1 and S2 are shown in the open position; switches S3, S4, and S5 are also shown in the open position.

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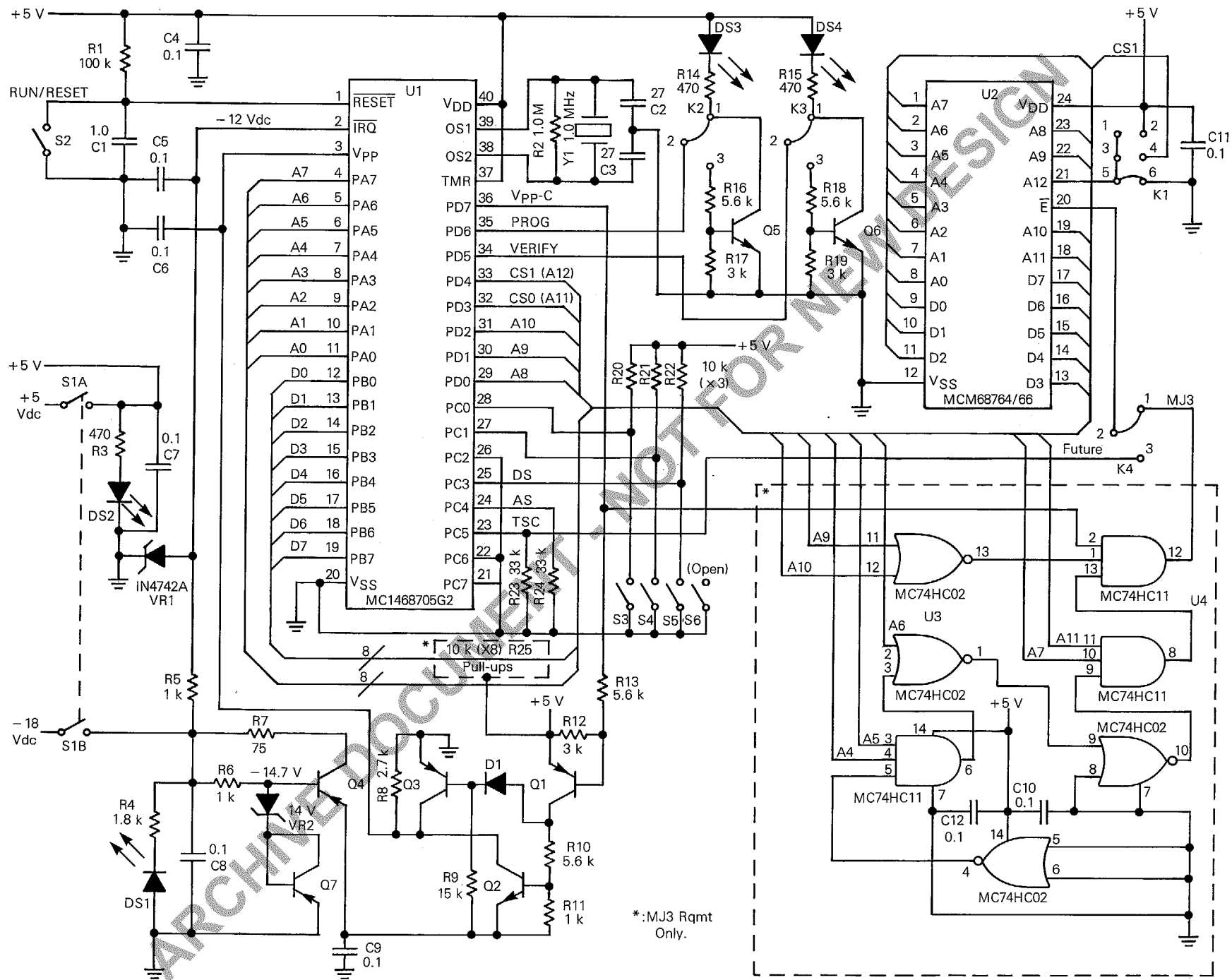


FIGURE 6 — MC1468705G2 Programming Schematic Diagram



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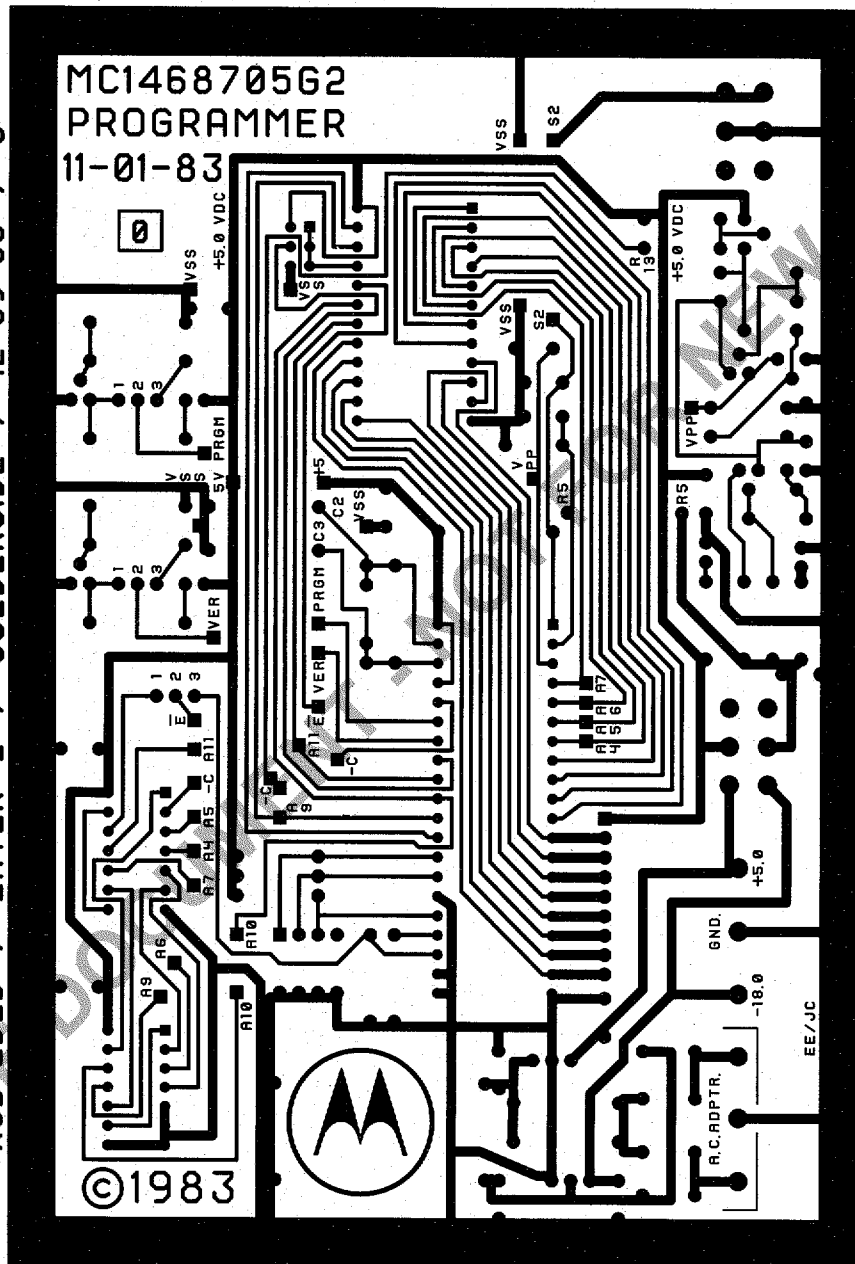


FIGURE 5B — MC1468705G2 Programming Module  
Circuit Board Art (Back)

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