KEITHLEY

Model 7061 Universal Adapter Card
Instruction Guide

A GREATER MEASURE OF CONFIDENCE

SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Model 7061 is a breadboard card that can be custom wired for unique applications. The card has a hole pattern on 100 mil centers that will accept conventional integrated circuits packages as well as transistors, relays, resistors and other passive components. For ease in wiring, the card has a power (+6V) bus and a common (ground) bus. The power (+6V) bus runs along the bottom of the card and the common (ground) bus runs along the top of the card. The Model 7061 is intended for use in the Model 705 and Model 706 scanner mainframes. The card can be used for many applications such as: an extender card, unique relay card, an experimental circuit card etc. The card edge connector contains the terminals by which the control signals from the mainframe are transmitted to the card.

The Model 7061 contains a card edge connector assembly that allows the card to be used as an extender card. Refer to Section 3 for complete details on the Model 7061 use as an extender card. Section 2 contains information on assembly methods of breadboarding circuits on the Model 7061. Section 3 contains several examples of applications for the Model 7061. Section 4 contains the Model 7061 parts list and layout diagram.

Tables 1-1 and 1-2 contain card number/channel number assignment for the Model 705 and 706 scanner mainframes. Tables 1-3 and 1-4 list and describe the Model 706's mainframe connections to the card. Tables 1-5 and 1-6 list and describe the Model 705's mainframe connections to the card.

Included with the Model 7061 are upper and lower plastic clamps and the cable assembly. The upper and lower plastic clamps should be installed upon receipt of the card so that it can be used with a scanner mainframe immediately. Refer to Figure 3-1 for clamp assembly.

NOTE
Fastening hardware is included with the Model
7061. Do not discard.

Table 1-1. Model 705 Card Number/Channel Number Assignment

Card Number	Channels Included		
	1-Pole Mode	2-Pole Mode	4-Pole Mode
1 (Top Card)	1-20	1-10	*
2 (Bottom Card)	21-40	11-20	*

Table 1-2. Model 706 Card Number/Channel Number Assignment

Card Number	Channels Included		
	1-Pole Mode	2-Pole Mode	4-Pole Mode
1	1-20	1-10	*
2	21-40	11-20	*
3	41-60	21-30	*
4	61-80	31-40	*
5	81-100	41-50	*
6	101-120	51-60	*
7	121-140	61-70	*
8	141-160	71-80	*
9	161-180	81-90	*
10	181-200	91-100	*

*Using the 4-pole mode normally requires two scanner cards. A 4-pole channel is obtained by closing two relays. One relay on each of two adjacent relay cards. For example: To close 2 in the 4-pole mode, relay #2 in card slot #1 and relay #2 are both closed.

1-1

Table 1-3. Model 706 Mainframe Connections to the Model 7061

Pin Number	1-Pole Mode	2-Pole Mode	4-Pole Mode
1	No Connection	No Connection	No Connection
2	No Connection	No Connection	No Connection
3*	Control line for the 1st and 2nd channel of the corresponding card slot.	Control line for the 1st channel of the corresponding card slot.	**
4	No Connection	No Connection	No Connection
5	Common	Common	Common
6	Common	Common	Common
7*	Control line for the 5th and 6th channel of the corresponding card slot.	Control line for the 3rd channel of the corresponding card slot.	**
8	No Connection	No Connection	No Connection
9*	Control line for the 3rd and 4th channel of the corresponding card slot.	Control line for the 2nd channel of the corresponding card slot.	**
10	No Connection	No Connection	No Connection
11*	Control line for the 9th and 10th channel of the corresponding card slot.	Control line for the 5th channel of the corresponding card slot.	**
12	Data (Serial data for matrix operation, refer to Table 1-4.) Drive capability is -1.25mA, sink capability is 3.2mA.	Data (Serial data for matrix operation, refer to Table 1-4). Drive capability is -1.25mA, sink capability is 3.2mA.	Data (Serial data for matrix operation refer to Table 1-4). Drive capability is -1.25mA, sink capability is 3.2mA.
13*	Control line for the 7th and 8th channel of the corresponding card slot.	Control line for the 4th channel of the corresponding card slot.	**
14	Clock (Serial data clock works in conjunction with pin 12 (DATA) for matrix operation).	Clock (Serial data clock works in conjunction with pin 12 (DATA) for matrix operation).	Clock (Serial data clock works in conjunction with pin 12 (DATA) for matrix operation).
15	No Connection	No Connection	No Connection
16	No Connection	No Connection	No Connection
17	Positive +6V supply. Four amps minimum to drive relays with 10 cards installed. Table 2-15 in the Model 706 Instruction Manual lists the maximum number of simultaneous relay closures.	Positive +6V supply. Four amps minimum to drive relays with 10 cards installed. Table 2-15 in the Model 706 Instruction Manual lists the maximum number of simultaneous relay closures.	Positive +6V supply Four amps minimum to drive relays with 10 cards installed. Table 2-15 in the Model 706 Instruiction Manual lists the maximum number of simultaneous relay closures
18	Positive +6V supply. Four amps minimum to drive relays with 10 cards installed. Table 2-15 in the Model 706 Instruction Manual lists the maximum number of simultaneous relay closures.	Positive +6V supply. Four amps minimum to drive relays with 10 cards installed. Table 2-15 in the Model 706 Instruction Manual lists the maximum number of simultaneous relay closures.	Positive +6V supply. Four amps minimum to drive relays with 0 cards in- Table 2-15 in the Model 706 Instruction Manual lists the maximum number of simultaneous relay closures.
19*	Control line for the 11th and 12th channel of the corresponding card slot.	Control line of the 6th channel of the corresponding card slot.	**
20	Strobe Line Drive capability is -12mA, sink capability is 24mA.	Strobe Line Drive capability is -12mA, Sink capability is 24mA.	Strobe Line Drive capability is -12mA, Sink capability is 24mA.
21*	Control line for the 13th and 14th channel of the corresponding card slot.	Control line of the 7th channel of the corresponding card slot.	**

Table 1-3. Model 706 Mainframe Connections to the Model 7061 (Cont.)

Pin Number	1-Pole Mode	2-Pole Mode	4-Pole Mode
22	Strobe Line (Not Used)	Strobe Line (Not Used)	Strobe Line (Not Used)
23*	Control line for the 15th and 16th channel of the corresponding card slot.	Control line for the 8th channel of the corresponding card slot.	**
24*	Control line for the odd channels output.	Not Used	Not Used
25*	Control line for the 17th and 18th channel of the corresponding card slot.	Control line for the 9th channel of the corresponding card slot.	**
26*	Control line for the even channel output.	Not Used	Not Used
27*	Control line for the 19th and 20th channel of the corresponding card slot.	Control line for the 10th channel of the corresponding card slot.	**
28	No Connection	No Connection	No Connection
29	No Connection	No Connection	No Connection
30	No Connection	No Connection	No Connection

*The control lines have a maximum current sink of 350mA. The actual current sink is defined as the drive voltage (+6V) minus the saturation drop (1.2V typical, 1.6V max) of the current driver chips (ULN2003) divided by the coil resistance of the relay. If the control line is not used to drive relays, the actual current is defined as the drive voltage minus the saturation drop of the current driver chips divided by the load resistance. Refer to Figure 4-5 for an illustration of the driver chips.

**Using the 4-pole mode normally requires two scanner cards. A 4-pole channel is obtained by closing two relays. One relay on each of two adjacent relay cards. For example: to close channel 2 in the 4-pole mode, relay 2 in card slot 1 and relay 2 in card slot 2 are both closed.

Table 1-4. Model 706 Mainframe Connections to the Model 7061 in the Matrix Mode

Pin Number	Crosspoints Included
1	No Connection
2	No Connection
3*	Control line for the crosspoint 001 1 in card slot number 1. Control line for the crosspoint 006 1 in card slot number 2. Control line for the crosspoint 011 1 in card slot number 3. Control line for the crosspoint 016 1 in card slot number 4. Control line for the crosspoint 021 1 in card slot number 5. Control line for the crosspoint 026 1 in card slot number 6. Control line for the crosspoint 031 1 in card slot number 7. Control line for the crosspoint 036 1 in card slot number 8. Control line for the crosspoint 041 1 in card slot numbr 9. Control line for the crosspoint 046 1 in card slot number 10.
4	No Connection
5	Common
6	Common
7*	Control line for the crosspoint 003 1 in card slot number 1. Control line for the crosspoint 008 1 in card slot number 2. Control line for the crosspoint 013 1 in card slot number 3. Control line for the crosspoint 018 1 in card slot number 4. Control line for the crosspoint 023 1 in card slot number 5. Control line for the crosspoint 028 1 in card slot number 6. Control line for the crosspoint 033 1 in card slot number 7. Control line for the crosspoint 038 1 in card slot number 8. Control line for the crosspoint 043 1 in card slot number 9. Control line for the crosspoint 048 1 in card slot number 10.
8	No Connection
9*	Control line for the crosspoint 002 1 in card slot number 1. Control line for the crosspoint 007 1 in card slot number 2. Control line for the crosspoint 012 1 in card slot number 3. Control line for the crosspoint 017 1 in card slot number 4. Control line for the crosspoint 022 1 in card slot number 5. Control line for the crosspoint 027 1 in card slot number 6. Control line for the crosspoint 032 1 in card slot number 7. Control line for the crosspoint 037 1 in card slot number 8. Control line for the crosspoint 042 1 in card slot number 9. Control line for the crosspoint 047 1 in card slot number 10.
10	No Connection
11*	Control line for the crosspoint 005 1 in card slot number 1. Control line for the crosspoint 010 1 in card slot number 2. Control line for the crosspoint 015 1 in card slot number 3. Control line for the crosspoint 020 1 in card slot number 4. Control line for the crosspoint 025 1 in card slot number 5. Control line for the crosspoint 030 1 in card slot number 6. Control line for the crosspoint 035 1 in card slot number 7. Control line for the crosspoint 040 1 in card slot number 8. Control line for the crosspoint 045 1 in card slot number 9. Control line for the crosspoint 050 1 in card slot number 10.
12*	Data line that controls the following crosspoints in the following card slots. The drive capability is -1.2mA. The sink capability is 3.2mA.

Table 1-4. Model 706 Mainframe Connections to the Model 7061 in the Matrix Mode (Cont.)

CARD NUMBER

1	2	3	4	5	6	7	8	9	10
003 3	008 3	013 3	018 3	023 3	028 3	033 3	038 3	043 3	048 3
004 3	009 3	014 3	019 3	024 3	029 3	034 3	039 3	044 3	049 3
005 3	010 3	015 3	020 3	025 3	030 3	035 3	040 3	045 3	050 3
001 4	006 4	011 4	016 4	021 4	026 4	031 4	036 4	041 4	046 4
002 4	007 4	012 4	017 4	022 4	027 4	032 4	037 4	042 4	047 4
003 4	008 4	013 4	018 4	023 4	028 4	033 4	038 4	043 4	048 4
004 4	009 4	014 4	019 4	024 4	029 4	034 4	039 4	044 4	049 4
005 4	010 4	015 4	020 4	025 4	030 4	035 4	040 4	045 4	050 4

Pin Number	Crosspoints Included
13*	Control line for the crosspoint 004 1 in card slot number 1. Control line for the crosspoint 009 1 in card slot number 2. Control line for the crosspoint 014 1 in card slot number 3. Control line for the crosspoint 019 1 in card slot number 4. Control line for the crosspoint 024 1 in card slot number 5. Control line for the crosspoint 029 1 in card slot number 6. Control line for the crosspoint 034 1 in card slot number 7. Control line for the crosspoint 039 1 in card slot number 8. Control line for the crosspoint 044 1 in card slot number 9. Control line for the crosspoint 049 1 in card slot number 10.
14	Clock that works in conjunction with pin 12. The serial data on pin 12 is not transmitted until the clock is enabled. The drive capability is -1.25mA. The sink capability is 3.25mA.
15	No Connection
16	No Connection
17	Positive +6V supply. Four amp minimum to drive relays. Table 2-15 of the Model 706 Instruction Manual lists the maximum number of simultaneous relay closures.
18	Positive +6V supply. Four amp minimum to drive relays. Table 2-15 of the Model 706 Instruction Manual lists the maximum number of simultaneous relay closures.
19*	Control line for the crosspoint 001 2 in card slot number 1. Control line for the crosspoint 006 2 in card slot number 2. Control line for the crosspoint 011 2 in card slot number 3. Control line for the crosspoint 016 2 in card slot number 4. Control line for the crosspoint 021 2 in card slot number 5. Control line for the crosspoint 026 2 in card slot number 6. Control line for the crosspoint 031 2 in card slot number 7. Control line for the crosspoint 036 2 in card slot number 8. Control line for the crosspoint 041 2 in card slot number 9. Control line for the crosspoint 046 2 in card slot number 10.
20	Strobe Line. Drive capability is -12mA, Sink capability is 24mA.
21*	Control line for the crosspoint 002 2 in card slot number 1. Control line for the crosspoint 007 2 in card slot number 2. Control line for the crosspoint 012 2 in card slot number 3. Control line for the crosspoint 017 2 in card slot number 4. Control line for the crosspoint 022 2 in card slot number 5. Control line for the crosspoint 027 2 in card slot number 6. Control line for the crosspoint 032 2 in card slot number 7. Control line for the crosspoint 037 2 in card slot number 8. Control line for the crosspoint 042 2 in card slot number 9. Control line for the crosspoint 047 2 in card slot number 10.
22	Strobe Line (Not Used). Drive capability is -12mA, Sink capability is 24mA.

Table 1-4. Model 706 Mainframe Connections to the Model 7061 in the Matrix Mode (Cont.)

Pin Number	Crosspoints Included
23*	Control line for the crosspoint 003 2 in card slot number 1. Control line for the crosspoint 008 2 i card slot number 2. Control line for the crosspoint 013 2 in card slot number 3. Control line for the crosspoint 018 2 in card slot number 4. Control line for the crosspoint 023 2 in card slot number 5. Control line for the crosspoint 028 2 in card slot number 6. Control line for the crosspoint 033 2 in card slot number 7. Control line for the crosspoint 038 2 in card slot number 8. Control line for the crosspoint 043 2 in card slot number 9. Control line for the crosspoint 048 2 in card slot number 10.
24	Not used in the matrix mode.
25*	Control line for the crosspoint 004 2 in cardslot number 1. Control line for the crosspoint 009 2 in card slot number 2. Control line for the crosspoint 014 2 in card slot number 3. Control line for the crosspoint 019 2 in card slot number 4. Control line for the crosspoint 024 2 in card slot number 5. Control line for the crosspoint 029 2 in card slot number 6. Control line for the crosspoint 034 2 in card slot number 7. Control line for the crosspoint 039 2 in card slot number 8. Control line for the crosspoint 044 2 in card slot number 9. Control line for the crosspoint 049 2 in card slot number 10.
26	Not used in the matrix mode.
27*	Control line for the crosspoint 005 2 in card slot number 1. Control line for the crosspoint 010 2 in card slot number 2. Control line for the crosspoint 015 2 in card slot number 3. Control line for the crosspoint 020 2 in card slot number 4. Control line for the crosspoint 025 2 in card slot number 5. Control line for the crosspoint 030 2 in card slot number 6. Control line for the crosspoint 035 2 in card slot number 7. Control line for the crosspoint 040 2 in card slot number 8. Control line for the crosspoint 045 2 in card slot number 9. Control line for the crosspoint 050 2 in card slot number 10.
28	No Connection
29	No Connection
30	No Connection

*The control lines have a maximum current sink of 350mA. The actual current sink is defined as the drive voltage (+ 6V) minus the saturation drop (1.2V typical, 1.6V max) of the current driver chips (ULN2003) divided by the coil resistance of the relay. If the control line is not used to drive relays, the actual sink current is defined as the drive voltage minus the saturation drop of the current driver chips divided by the load resistance. Refer to Figure 3-5 for an illustration of the drivers.

Table 1-5. Model 705 Mainframe Connections to the Model 7061

Pin Number	1-Pole Mode	2-Pole Mode	4-Pole Mode
1	No Connection	No Connection	No Connection
2	No Connection	No Connection	No Connection
3*	Control line of the 1st and 2nd channel of the corresponding card slot.	Control line for the 1st channel of the corresponding card slot.	**
4	Future expansion capability line. Not used.	Future expansion capability line. Not used.	Future expansion capability line. Not used.
5	Common	Common	Common
6	No Connection	No Connection	No Connection
7*	Control line for the 5th and 6th channel of the corresponding card slot.	Control line for the 3rd channel of the corresponding card slot.	**
8	Future expansion capability line. Not used.	Future expansion capability line. Not used.	**
9*	Control line for the 3rd and 4th chan- of the corresponding card slot.	Control line for the 2nd channel of the corresponding card slot.	
10	No Connection	No Connection	No Connection
11*	Control line for the 9th and 10th channel of the corresponding card slot.	Control line for the 5th channel of the corresponding card slot.	
12	Data (Serial data for matrix operation. Refer to Table 1-7). Drive capability is -100μA. Sink capability is 1.6mA.	Data (Serial data for matrix operation. Refer to Table 1-7). Drive capability is -100μA. Sink capability is 1.6mA.	Data (Serial data for matrix operation. Refer to Table 1-7). Drive capability is -100μA. Sink capability is 1.6mA.
13*	Control line for the 7th and 8th channel of the corresponding card slot.	Control line for the 4th channel of the corresponding card slot.	**
14	Clock (Serial data clock works in conjunction with pin 12). Drive capability is -100μA. Sink capability is 1.6mA.	Clock (Serial data clock works in conjunction with pin 12). Drive capability is -100μA. Sink capability is 1.6mA.	Clock (Serial data clock works in conjunction with pin 12). Drive capability is -100μA. Sink capability is 1.6mA.
15	No Connection	No Connection	No Connection
16	No Connection	No Connection	No Connection
17	Positive +6V supply. (350mA minimum to drive relays.)	Positive +6V supply. (350mA minimum to drive relays.)	Positive +6V supply. (350mA minimum to drive relays).
18	No Connection	No Connection	No Connection
19*	Control line for the 11th and 12th channel of the corresponding card slot.	Control line for the 6th channel of the corresponding card slot.	**
20	Strobe Line. Used in matrix operation. Refer to Table 1-6. Drive capability is typically -400μA. Sink capability is typically 1mA.	Strobe Line. Used in matrix operation. Refer to Table 1-6. Drive capability is typically -400μA. Sink capability is typically 1mA.	Strobe Line. Used in matrix operation. Refer to Table 1-6. Drive capability is typically -400μA. Sink capability is typically 1mA.
21*	Control line for the 13th and 14th channel of the corresponding card slot.	Control line for the 7th channel of the corresponding card slot.	**
22	Strobe Line. Used for matrix operation. Refer to Table 1-6. Drive capability is typically -400μA. Sink capability is typically 1mA.	Strobe Line. Used for matrix operation. Refer to Table 1-6. Drive capability is typically -400μA. Sink capability is typically 1mA.	Strobe Line. Used in matrix operation. Refer to Table 1-6. Drive capability is typically -400μA. Sink capability is typically 1mA.
23*	Control line for the 15th and 16th channel of the corresponding card slot.	Control line for the 8th channel of the corresponding card slot.	**
24*	Control line for the odd channels output.	Not Used	Not Used

Table 1-5. Model 705 Mainframe Connections to the Model 7061

Pin Number	1-Pole Mode	2-Pole Mode	4-Pole Mode
25*	Control line for the 17th and 18th channels of the corresponding card slot.	Control line for the 9th channel of the corresponding card slot.	**
26*	Control line for the even channels of the corresponding card slot.	Not Used	Not Used
27*	Control line for the 19th and 20th channels of the corresponding card slot.	Control line for the 10th channel of the corresponding card slot.	**
28	No Connection	No Connection	No Connection
29	No Connections	No Connection	No Connection
30	No Connection	No Connection	No Connection

*The control lines have maximum current sink of 350mA. The actual current sink is defined as the driver voltage (+6V) minus the saturation drop (1.2V typical, 1.6V max) of the current driver chips (ULN2003) divided by the coil resistance of the relays. If the control line is not used to drive relays, the actual current sink is defined as the drive voltage minus the saturation drop of the current driver chips divided by the load resistance. Refer to Figure 3-5 for an illustration of the driver chips.

**Refer to ** on Table 1-3.

Table 1-6. Model 705 Mainframe Connections to the Model 7061 in the Matrix Mode

Pin Number	Crosspoints Included
1	No Connection
2	No Connection
3*	Control line for the crosspoint 01 1 in the top card slot. Control line for the crosspoint 06 1 in the bottom card slot.
4	Future expansion capability line. Not used.
5	Common
6	No Connection
7*	Control line for the crosspoint 03 1 in the top card slot. Control line for the crosspoint 08 1 in the bottom card slot.
8	Future expansion capability. Not used.
9	Control line for the crosspoint 02 1 in the top card slot. Control line for the crosspoint 07 1 in the bottom card slot.
10	No Connection
11*	Control line for the crosspoint 05 1 in the top card slot. Control line for the crosspoint 10 1 in the bottom card slot.

12	Data (Serial Data for Matrix Operation(Controls the following crosspoints in the following card slots.
	Drive capability is $-100\mu A$. Sink capability is 1.6mA.
	
	Top Card Bottom Card
	   03 3 08 3
	   04 3 09 3
	   05 3 10 3
	   01 4 06 4
	   02 4 07 4
	   03 4 08 4
	   04 4 09 4
	   05 4 10 4

13*	Control line for the crosspoint 04 1 in the top card slot. Control line for the crosspoint 09 1 in the bottom card slot.
14	Clock (Serial data clock works in conjunction with pin 12.) The serial data is not transmitted until the serial clock is enabled. Drive capability is $-100\mu A$. Sink capability is 1.6mA.
15	No Connection
16	No Connection
17	Positive +6V supply (350mA minimum to drive relays)
18	No Connection
19*	Control line for the crosspoint 01 2 in the top card slot. Control line for the crosspoint 06 2 in the bottom card slot.
20	Strobe Line. Used in conjunction with pins 12 and 14. Serial data is not transmitted until strobe line is enabled. Drive capability is typically $-400\mu A$. Sink capability is typically 1mA.
21*	Control line for the crosspoint 02 2 in the top card slot. Control line for the crosspoint 07 2 in the bottom card slot.
22	Strobe Line. Used in conjunction with pins 12 and 14. Serial data is not transmitted until strobe is enabled. Drive capability is typically $-400\mu A$. Sink capability is typically 1mA.
23*	Control line for the crosspoint 03 2 in the top card slot. Control line for the crosspoint 08 2 in the bottom card slot.
24	Not used in the matrix mode.
25*	Control line for the crosspoint 04 2 in the top card slot. Control line for the crosspoint 09 2 in the bottom card slot.

Table 1-6. Model 705 Mainframe Connections to the Model 7061 in the Matrix Mode (Cont.)

Pin Number	Crosspoints Included
26	Not used in the matrix mode.
27*	Control line for the crosspoint 05 2 in the top card slot. Control line for the crosspoint 10 2 in the bottom card slot.
28	No Connection
29	No Connection
30	No Connection

*The control lines have a maximum current sink of 350mA. The actual current sink is defined as the drive voltage (+ 6V) minus the saturation drop (1.2V typical, 1.6V max) of the current driver chips divided by the coil resistance of the relay. If the control line is not used to drive relays, the actual sink current is defined as the drive voltage minus the saturation drop of the current driver chips divided by the load resistance. Refer to Figure 3-5 for an illustration of the drivers.

SECTION 2
TYPICAL BREADBOARD ASSEMBLY METHODS

2.1 INTRODUCTION

Section 2 contains several points on typical assembly methods for breadboarding circuits on the Model 7061.

2.2 BREADBOARD ASSEMBLY

1. The component side of the card (refer to Figure 4-1) has plated through holes that are on 100 mil centers and are 0.040 inches in diameter. These holes accept conventional integrated circuit packages as well as transistors, relays, resistors and other passive components.
2. The solder side of the card (refer to Figure 4-2) has plated through holes that are on 100 mil centers and, are also connected together in pairs. This is a convenient feature that allows the user to make a connection to a component without crowding multiple connections into a single hole. These connected holes can be easily cut with a sharp knife or razor blade if the need arises.
3. The plated through holes also accept vector pins and micro klip pins for ease in connecting the circuit. The holes are 0.04 inches in diameter.
4. The leads of the components or the vector pins should not extend more than 0.1 inches from the card.

WARNING
Prevent the leads of the circuit from protruding more than 0.1 inches from the card. Otherwise, the pins or leads could short to the card shield resulting in a shock hazard or damage to the instrument. The maximum applied voltage with this spacing is 250V peak.

5. Make absolutely certain that the power (+6V) bus is not inadvertently connected to common (ground) before inserting the card into the mainframe or before power is turned on.
6. The Model 7061 is designed to have both +6V and common available on the card. If other voltages are required they will have to be supplied externally or obtained from some voltage converter.
7. Design and construct the circuit so that it is shielded from high voltage and RFI/EMI interference.
8. Decoupling-The power bus (+6V) can be decoupled by cutting the bus with a sharp knife at the point desired. Place a low value resistor (under 1k) in series with the +6V supply and add a capacitor (less than 1μF) as shown in Figure 2-1. For noisier applications a low inductance (approximately 100μH) coil could be substituted for the resistor.
9. Use bypass capacitors when the user's circuit dictates. The component side of the Model 7061 has a designated place for the capacitors. One capacitor is ceramic and approximately 0.01μF for high frequency bypass. Another capacitor is electrolytic and approximately 10μF for low frequency bypass.
10. The maximum voltage potential between adjacent pads on the Model 7061 is 100V peak.
11. On the solder side of the card and at the rear (by the plastic clamps), every other column of the last six rows is connected together. This allows terminal strips or connectors to be easily mounted on the card.
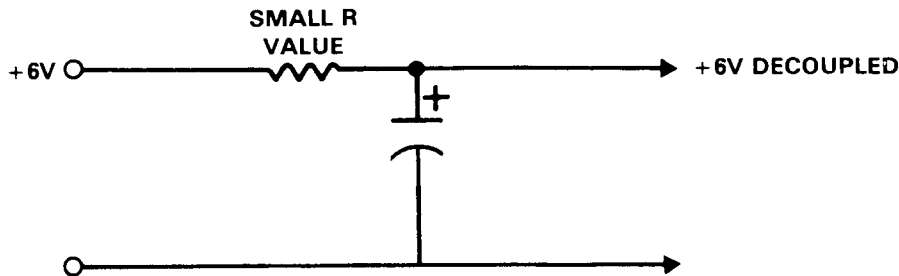

Figure 2-1. Decoupling

SECTION 3
APPLICATIONS

3.1 INTRODUCTION

The Model 7061 can be used in a variety of different applications. Some typical applications are listed below:
1. Different relay coil voltages other than 5V relays used with the +6V scanner mainframe are required.
2. Zero Crossing AC Switch
3. Remote Switching
4. Isolation Requirements

These are a few examples of uses of the Model 7061.

3.2 EXTENDER CARD

The Model 7061 includes a card edge connector cable assembly (7061-301) that allows the Model 7061 to be used as an extender card. As an extender card, the Model 7061 can be used for many applications some of which are:
1. Troubleshooting the relay card and/or the scanner mainframe.
2. The relay card that has been set outside of the scanner mainframe can be placed in an environmental chamber, humidity chamber, etc.
3. The Model 7061 can be equipped with relays that might not fit into the scanner mainframe. Some of the relays might be; RF relays, high current relays, high voltage relays etc. This would require two Model 7061 cards.
4. The card edge connector can be connected to a test system that has relays installed in a special fixture.
5. A sensitive circuit could dictate that the relays be set as close as possible to the circuit.

To configure the Model 7061 as an extender card, the plastic clamps must be assembled on the Model 7061 as shown in Figure 3-1. Refer to Figure 3-2 for cable assembly installation. Note in Figure 3-2 where the cable is connected to the card. The cable assembly is mounted on the component side of the card; then, it is routed through the cable clamps and secured by the foam pads on the clamps.
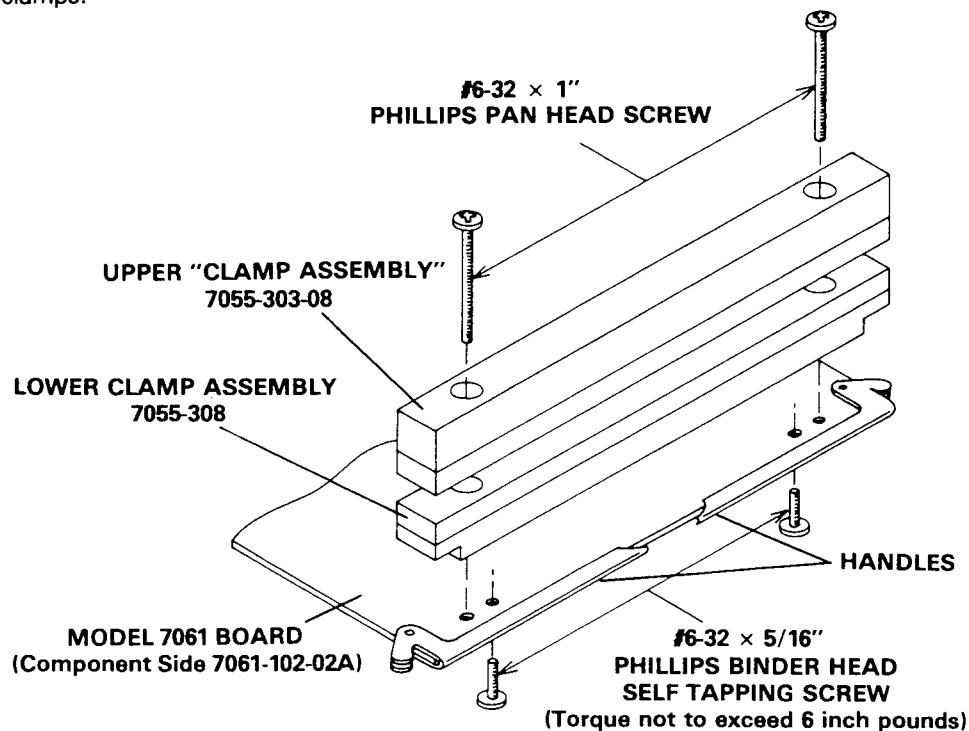
Figure 3-1. Upper and Lower Clamp Installation

PIN 1

CABLE ASSEMBLY
(Cable length is 2 ft.)

BOTTOM SIDE
ODD NUMBER PINS

TOP SIDE
EVEN NUMBER PINS

CARD EDGE
CONNECTOR

THIS CONNECTS TO THE RELAY CARD
THAT IS TO BE SET OUTSIDE OF THE
SCANNER MAINFRAME.
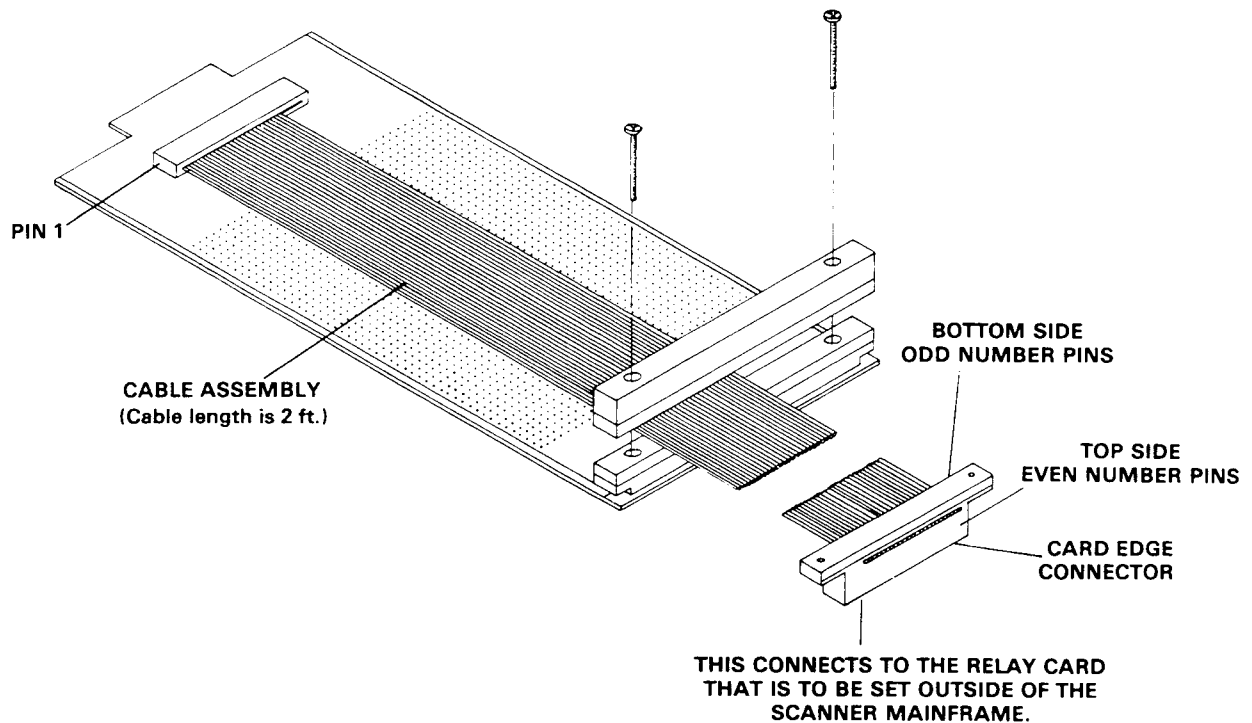
Figure 3-2. Cable Assembly Installation

Installation of the Model 7061 is the same as installing a scanner card. The Model 7061 is inserted into the scanner mainframes and the connector cable is connected to the scanner card. The cable is of sufficient length (2 ft) to allow the connector card to be set outside of the scanner mainframe.

WARNING
**Place the relay card that has been set out-
side of the scanner mainframe on a non-
conductive surface. Do not place the card
on a conductive surface such as a metal
rack, etc. User supplied and mainframe
voltages could short causing a shock
hazard or possible damage to the instru-
ment.**

Once the card is out of the mainframe it is no longer protected from RFI/EMI interference or static discharge into CMOS components by the mainframe shields. If the card is to be set in an environment with this type of interference, shield the card accordingly.

3.3 DRIVE CARD FOR EXTERNAL RELAY

The Model 7061 can be configured with a user's circuit to drive relays that are external to that of the scanner mainframe. The external relays might not fit onto the Model 7061 or they could be mounted in a sensitive circuit that will not fit onto the Model 7061. There are numerous reasons why some relays can not be placed in the scanner mainframe. They include:

1. Special relays do not fit into the scanner mainframe.
2. User requires a greater degree of high voltage isolation. The maximum voltage that can be used on the Model 7061 is 100V peak due to pad spacing.
3. The relays are required to be in a more controlled environment than the scanner mainframe. The controlled environment could be a temperature environment, humidity environment, RFI shielded, light shielded etc.
4. The relays are required to be placed in a test fixture outside of the scanner mainframe.

Typical uses of an external relay:

1. RF Relays
2. Remote Switching Applications
3. Inductive Load Relays
4. Relays that are too large to fit in the scanner mainframe.

As an example of using different relays, refer to Figure 3-3. Figure 3-3 shows the Model 7061 configured with solid state relays. The relays used are Teledyne 675-6 (Keithley Part No. RL-78). These relays operate on a voltage of 3VDC to 32VDC. Since the scanner mainframe supplied relay voltage is +6V, these relays will operate with the available voltage. The minimum turn on current for relays is 100mA. The load was chosen to limit current to less than 250mA. This configuration is switching 24V AC to operate electric motors of the same voltage.

When designing with solid state relays observe the zero cross turn on and off characteristics of the relays. The relays must be isolated from the drive to the load. The relays used in this configuration are isolated.
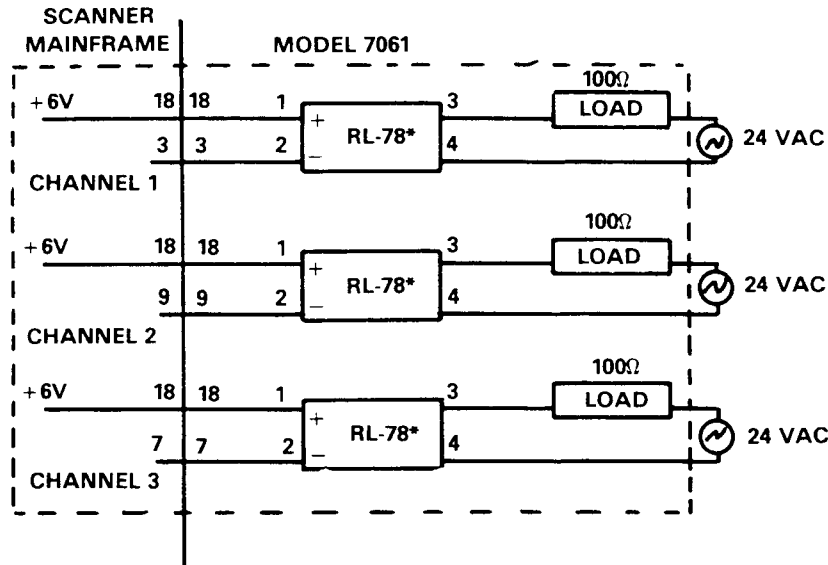
*The solid state relays used in this configuration are Teledyne 675-6 (Keithley Part No. RL-78)

Figure 3-3. Model 7061 Configured With Solid State Relays

3.4 DIFFERENT COIL VOLTAGE APPLICATIONS

There are many uses and applications where the user needs a different relay coil voltage than that which is supplied in the scanner mainframe. The coil voltage supplied in the scanner mainframe is +6V. To drive relays that require a different coil voltage, an additional drive circuit similar to that shown in Figure 3-4 might be needed. The mainframe control line is connected to the CMOS inverter with the pull up resistor to +6V. The base resistor biases the transistor which provides drive current to the relay coil. The diode is a clamp diode that prevents coil kickback. Any relay voltage can be used as long as the transistor being used is rated for the voltage. The drive circuit is in addition to the drivers inside the scanner mainframe. The drivers in the mainframe are ULN2003A as shown in Figure 3-5.

The relay voltage supplied in the mainframe is +6V. This coil voltage runs +5V relays on all the accessory relay cards (e.g. 7052, 7053, 7054, etc.) The saturation ($V_{ce \; on}$) drop of the relay drivers in the mainframe (0.9V) drops the +6V to a level suitable for the +5V relays.

Some design points to consider for the additional drive circuits are as follows:

1. Verify the drivers have the capability to drive the relays.
2. The maximum voltage between the adjacent pads on the card is 100V peak.
3. Do not exceed the power rating of the relays driver package.
4. Verify the relay drivers used can operate on the relay voltage.
5. The ULN2003A outputs are not TTL compatible and have open collector outputs.

The drive circuit shown in Figure 3-4 could be used to drive telephone type relays (DPDT or 2 Form C) at a different relay coil voltage. Figure 3-6 shows the simplest method of driving 6V or 5V relays.
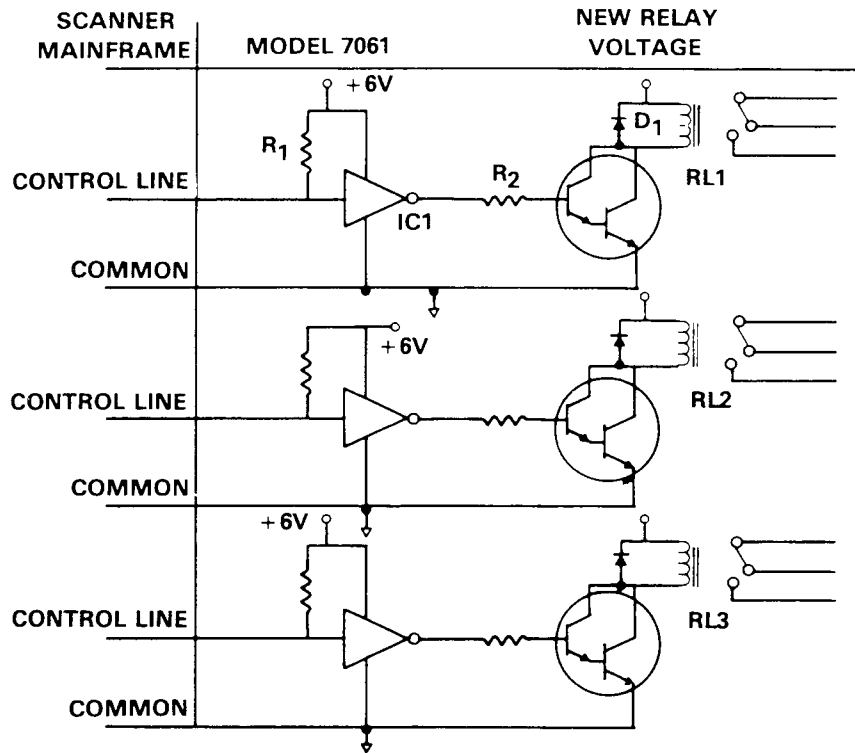
NOTES
1. R1 is a 3.3k pull up resistor. The drivers in the mainframe are open collector and therefore, require a pull up resistor.
2. IC1 is a CMOS inverter. When the channel is closed the control line is pulled low. IC1 inverts the signal and turns on the transistor.
3. R2 is of such a value that allows the CMOS inverter to operate and still let the transistor turn on. In this example, it is approximately 4.7k.
4. D1 is a clamp diode for coil kickback.
5. Q1 is the drive transistor. It is a darlington transistor for high current gain.
6. The relays used in this example operate on a coil voltage of 24V.
7. Each control line for every relay requires a drive circuit.

Figure 3-4. Drive Circuit For Different Relay Voltage
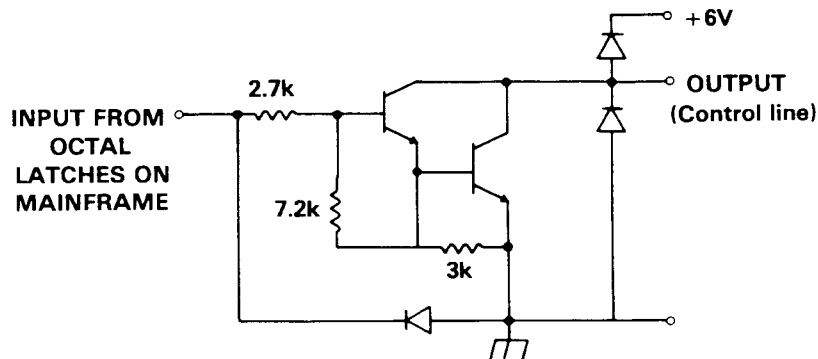
$V_{ce\ sat}$ = 1.3V at 200mA sink

$V_{ce\ sat}$ = .9V max at 100mA sink

It is recommended that with more than four relays closed do not exceed the 100mA/relay sink specification so as not to exceed the power specification of the package. It is recommended with less than four relays closed the 200mA/relay sink specification can be used. The output of the ULN2003A is not TTL compatible.

Figure 3-5. Drive Circuit of Mainframe (ULN2003A)
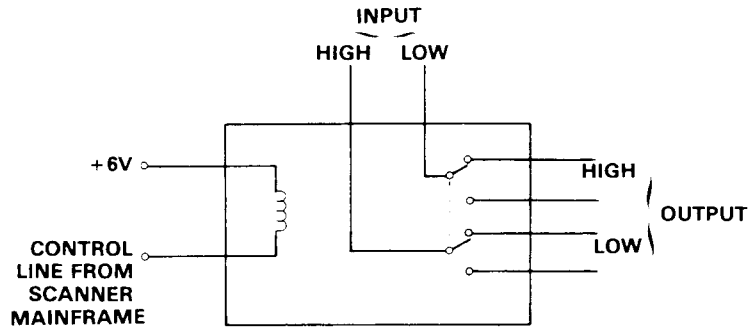
Figure 3-6. 2 Form C Relay Operation

3.5 CURRENT SHUNTS FOR CURRENT MEASUREMENTS

In a current measurement circuit an ammeter is placed in series with the current that is to be measured. This usually means a disruption of the current path to insert the ammeter. The Model 7061 can be used to avoid this problem. Figure 3-7 shows a circuit that measures the current with a voltmeter instead of the ammeter. The circuit shows that there are sense resistors placed in series between the source and the load. The voltmeter is connected in such a way as to measure the voltage developed across the sense resistors. Knowing the value of the sense resistor and voltage across the sense resistor the current can be calculated by Ohm's law.

The relays chosen for this application could be DPST or 2 Form B. Refer to Figure 3-7. The relays and the sense resistors can be mounted right on the Model 7061. Therefore, the switching circuit could be located on the card and the connections to the source and load could be made by wires routed through the rear of the Model 7061.

The scanner mainframe could be used to switch from one set up to another by using front panel controls or over the IEEE bus. Refer to the mainframe's instruction manual for complete front panel and IEEE bus operation.
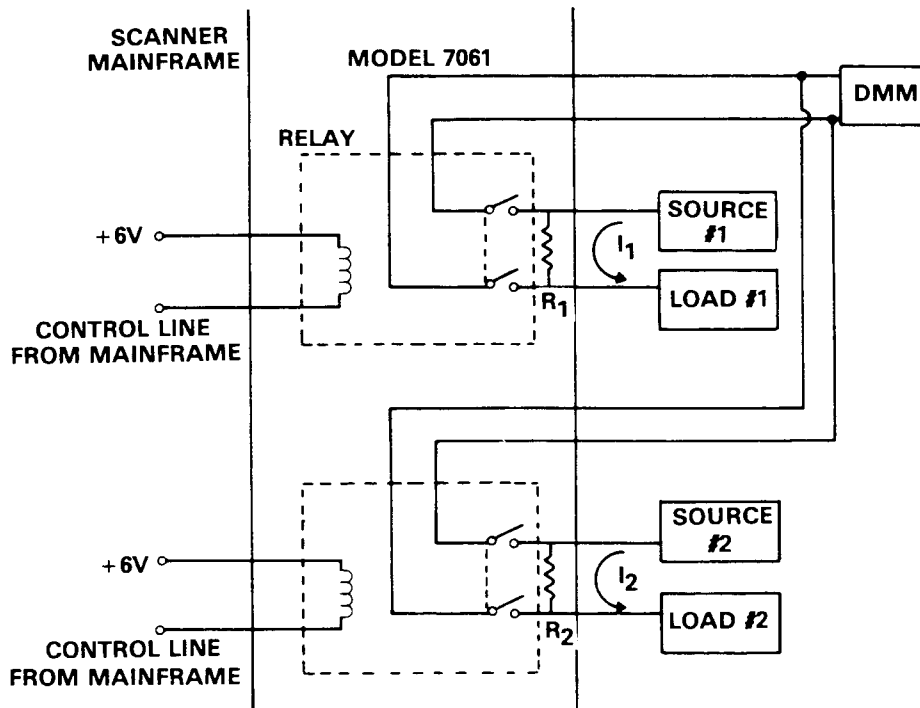
Figure 3-7. Current Shunts for Current Measurements

3.6   20 CHANNELS

Figure 3-8 shows a method to drive 20 channels from one card slot. In the figure there are 12 separate control lines that control 12 separate channels. These channels are driven by the circuit in Figure 3-5. The remaining eight channels are derived and controlled by the DATA, CLOCK, STROBE and OUTPUT ENABLE lines. These lines are driven by standard 4000 series CMOS circuits in the mainframe. The serial data is clocked into the latches of the 4094 chip by the data line. When the STROBE pulse is received the serial data is converted to parallel   data in the latches. When the output ENABLE pulse is received the data is placed on the outputs of the 4094. Then the drivers that have the data to turn on, pull the lines low turning on the LEDs. For control of external signals the LEDs can be replaced with relays. If relays are substituted for the LEDs, use a diode clamp on the line with the darlington transistor. The other lines are diode clamped by the driver circuits in the mainframe and the driver chip on the card (ULN2003A).
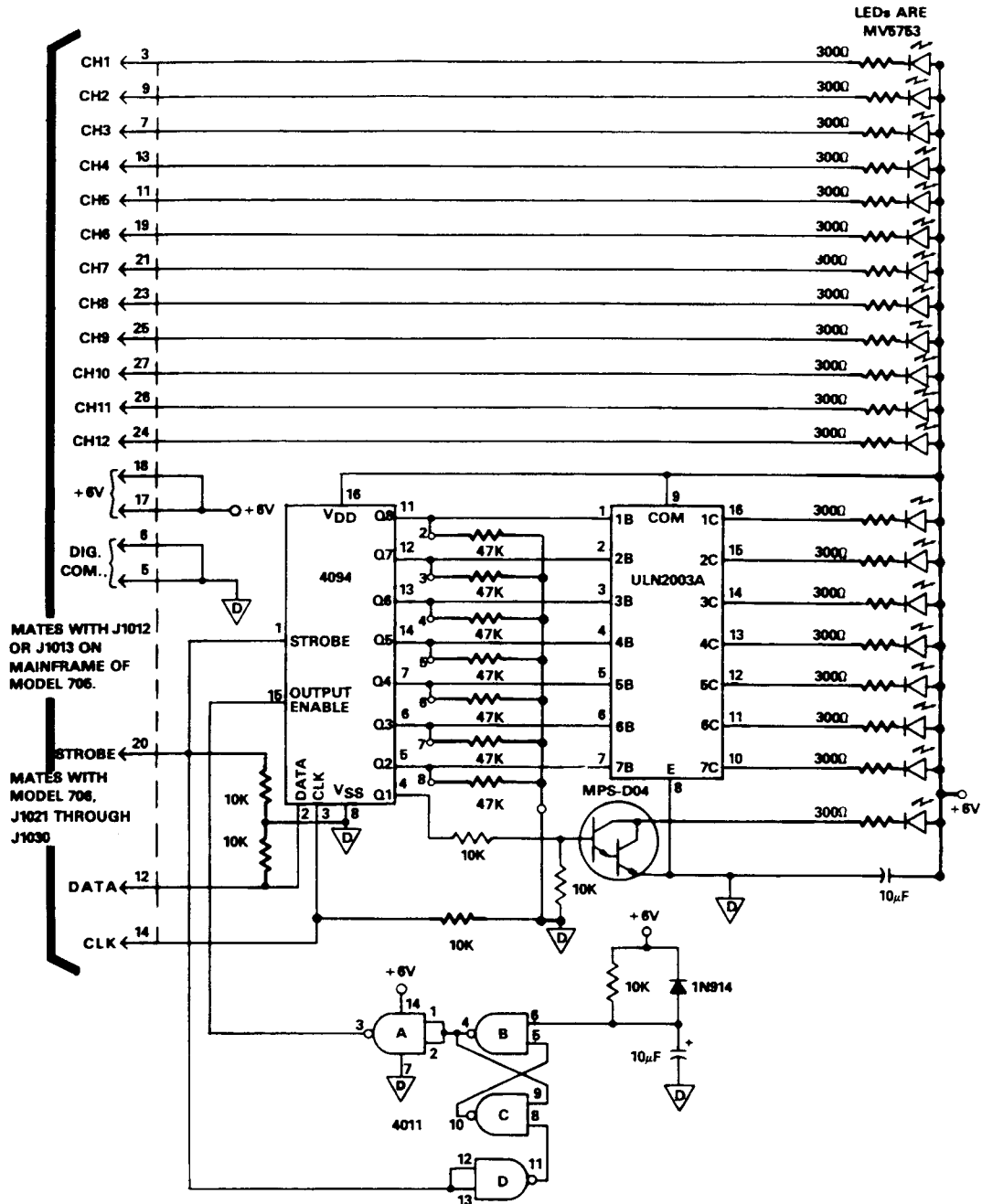
Figure 3-8. Channel LEDs

SECTION 4
LAYOUT DIAGRAMS AND PARTS LIST

4.1 LAYOUT DIAGRAM

Figure 4-1 contains the component side of the Model 7061. Figure 4-2 contains a view of the solder side of the Model 7061.

NOTE

The solder mask area for the two 16-pin DIPs is not populated at the factory. It is not intended to support the circuit of Figure 3-8.
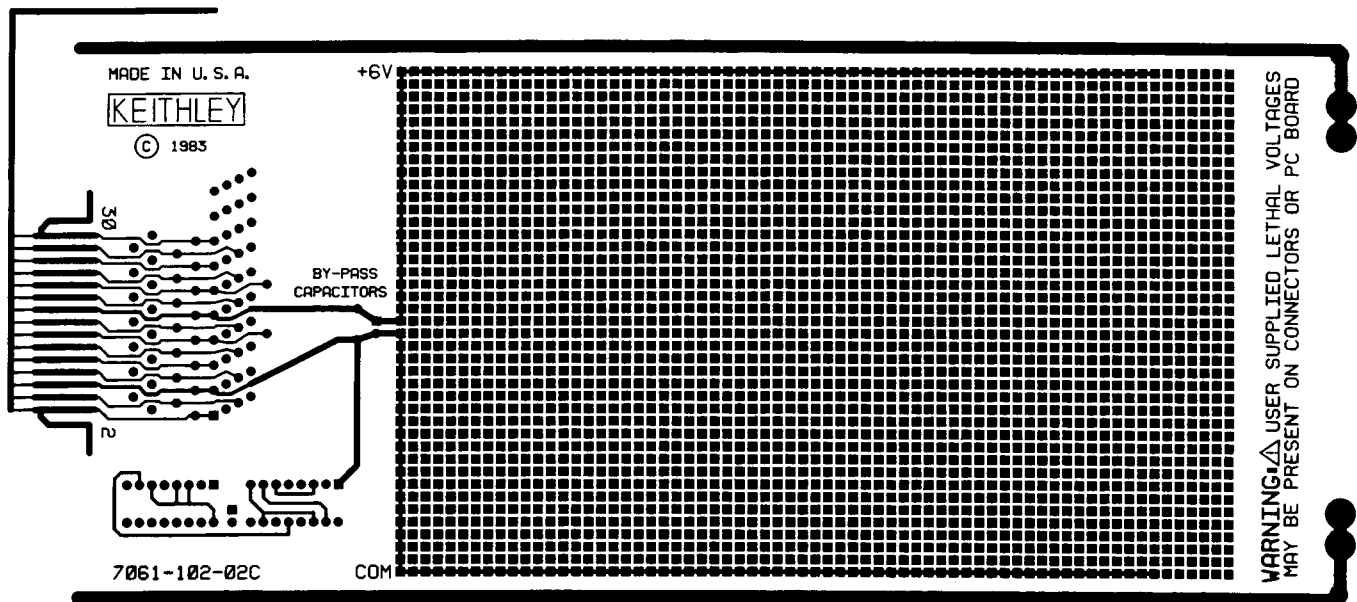
Figure 4-1. Model 7061 Layout Diagram, Component Side
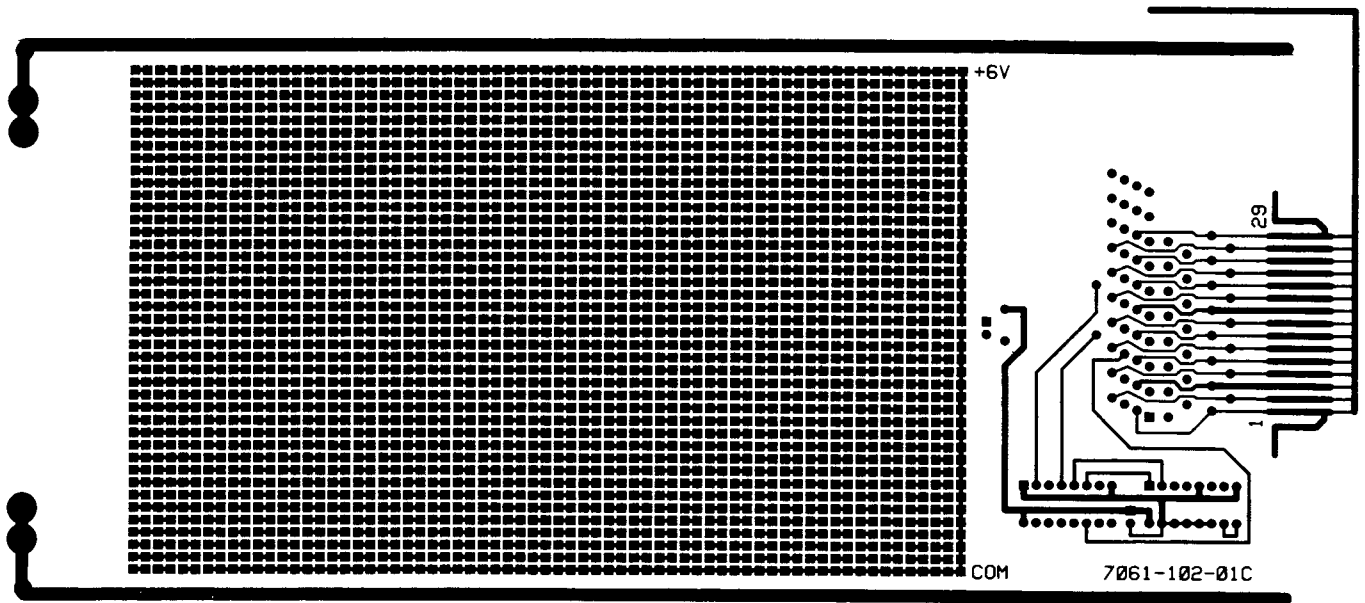
Figure 4-2. Model 7061 Layout Diagram, Solder Side

Table 4-1. Model 7061 Parts List

Description	Keithley Part No.	Qty.
Universal Interface Card	—	1
Clamp, Assembly, Upper	7055-303-08	1
Clamp, Assembly, Lower	7055-308	1
Cable Assembly	7061-301	1
Phillips Pan Head Screw	6-32 × 1"	2
Phillips Binder Head Self Tapping Screw (Torque not to exceed 6 inch pounds)	6-32 × 5/16"	2

NOTE

Fastening hardware is included in kit. Do not discard.

Specifications are subject to change without notice.

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