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PLEASE CHECK FOR CHANGE INFORMATION AT THE REAR OF THIS MANUAL.

50M70 PROGRAMMABLE DEVELOPMENT CARD

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97077

070-3725-00
Product Group 75

Serial Number _____

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INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first number or letter designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B000000	Tektronix, Inc., Beaverton, Oregon, USA
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

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WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

LIST OF ILLUSTRATIONS

LIST OF TABLES

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OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

TERMS

In This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

As Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS

In This Manual

This symbol indicates where applicable cautionary or other information is to be found.

As Marked on Equipment

DANGER — High voltage.

Protective ground (earth) terminal.

ATTENTION — refer to manual.

Power Source

This product is intended to operate from a power module connected to a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the power module power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power module power cord is essential for safe operation.

Danger Arising From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Fuse

To avoid fire hazard, use only the fuse of correct type, voltage rating and current rating as specified in the parts list for your product.

Refer fuse replacement to qualified service personnel.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Operate Without Covers

To avoid personal injury, do not operate this product without covers or panels installed. Do not apply power to the plug-in via a plug-in extender.

SERVICE SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also the preceding Operators Safety Summary

Do Not Service Alone

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

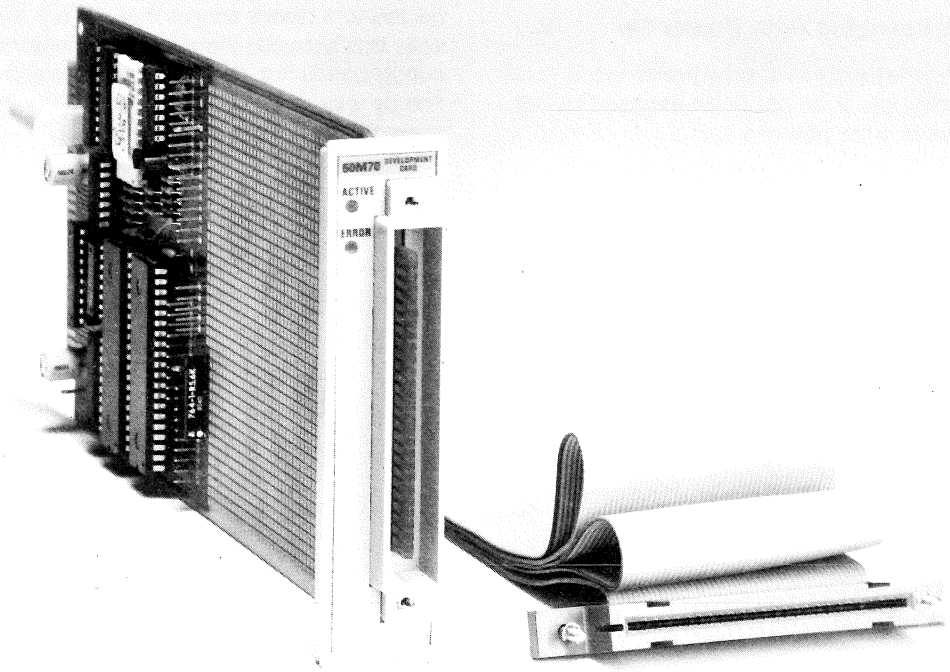
Use Care When Servicing With Power On

Dangerous voltages may exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Disconnect power before removing protective parts, soldering, or replacing components.

Power Source

This product is intended to operate in a power module connected to a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.



3725-01

50M70 Programmable Development Card

SPECIFICATION

Instrument Description

The TEKTRONIX 50M70 Programmable Development Card contains two interface logic registers (PIA's), address and data buffers, a breadboard area (4 in × 4 in) for user development, and its own firmware (ROM).

With the 50M70, the user may create a specialized function card to be used in the MI 5010/MX 5010 Multifunction Interface system. When completed, the 50M70 can be programmed in high level language over the IEEE 488 (GPIB) bus described in IEEE Standard 488-1978. Typical applications include:

- Specialized DAC/ADC functions.
- Timing Functions.
- Special communication interface functions.
- Keyboard/Display functions, etc.

Special features of the 50M70 include:

- Programmable data direction registers.
- Programmable trigger conditions.
- Programmable data transfer, register configuration, status, and interrupts.
- Front panel interface connector configured by the user.

Standard Accessories

1 Instruction Manual
1 Reference Guide
1 User Cable Assembly
4 Cable Assemblies, 10 conductor, 8 inches long
1 Cable Assembly, 5 conductor, 5 inches long

NOTE

Refer to the tabbed Accessories page in the rear of this manual for more information.

Related Documents

Instruction Manual, MI 5010/MX 5010 Programmable Multifunction Interface w/Interface Extender.

Performance Conditions

The limits stated in the Performance Requirements column of Table 1-1 are valid only if the 50M70 is operating in an ambient temperature between 0°C and +50°C unless otherwise noted.

Information given in the Supplemental Information column of the following tables is provided for user information only, and should not be interpreted as Performance Requirements.

The 50M70 must be in an environment whose limits are described under Environmental Characteristics (Table 1-2).

Allow at least 5 minutes warmup time for operation to specified accuracy, 60 minutes after storage in high humidity environment.

Table 1-1
ELECTRICAL CHARACTERISTICS

Characteristics	Performance Requirements	Supplemental Information
	INPUT/OUTPUT DATA LINES	
I/O 0 through I/O 7		Pins 1 through 8 on J1200, J1202, J1210, and J1214.
Output High Level		+2.4 V minimum, +5.5 V maximum.
Output Low Level		0 V minimum, +0.4 V maximum. Load current = 1.6 mA nominal when low true.
Maximum Load (Sink) Current (Any Output)		3.2 mA at 0.4 V dc.
Input Load Current		1.3 mA nominal, 2.4 mA maximum. V_{in} = 0.4 V dc.
User Ground Points		
Analog Ground (A GND)		TP1201
Digital Ground (D GND)		TP1211
	CONTROL LINES	
B02 (System Clock)		≈ 1 MHz, TTL compatible. Pin 5, J1211
Output Interrupt Lines, (ODV) (IDR) CB1-X and CB1-Y (ODV),CA1-Y (IDR)		Low true outputs on pin 10 of J1202, J1210, and J1214.
Sink Current		3.2 mA.
Output High Level		+2.4 V minimum, +5.5 V maximum. I_L = −200 μA.
Output Low Level		0 V minimum, 0.4 V maximum. I_L = 3.2 mA maximum.
Input Interrupt Lines (IDV) (ODR) CA2-Y (IDV), CB2-X and CB2-Y (ODR)		Programmable slopes. Inputs on pin 9 of J1202, J1210, and J1214. Input leakage current = 1.0 μA minimum, 2.5 μA maximum.
Minimum Hold Time		3 μsec.
ERROR Line		Low during self-test, goes high if no error. Pin 4 on J1211.
Output High Level		+4.5 V minimum, +5.5 V maximum. I_L = 10 μA.
Output Low Level		0 V minimum, +0.4 V maximum. I_L = 3.2 mA maximum.

Table 1-1 (cont)

Characteristics	Performance Requirements	Supplemental Information
CONTROL LINES (cont)		
RESET		Pin 1, J1211. Goes high after reset.
Output High Level		+4.5 V minimum, +5.5 V maximum. I_L = 10 mA.
Output Low Level		0 V minimum, +0.4 V maximum. I_L = 40 mA maximum.
BFR TRIG		Pin 2, J1211. High true.
Output High level		+4.5 V minimum, +5.5 V maximum. I_L = 10 mA.
Output Low Level		0 V minimum, +0.4 V maximum. I_L = 40 mA maximum.
DC VOLTAGE SOURCES		
+26 and −26 V dc		±9%. Maximum average current 100 mA. Peak-to-peak current change limited to 130 mA up to 12.5 kHz, decreasing at 1/f rate above 12.5 kHz.
+8 V dc		±5%. Maximum average current 600 mA. Peak-to-peak current change limited to 300 mA up to 12.5 kHz, decreasing at 1/f rate above 12.5 kHz.
+5 V dc		±5%. 1.25 A maximum.
Total Combined Power Limit		Not to exceed 7.5 W.

Table 1-2
ENVIRONMENTAL CHARACTERISTICS[a]

Characteristics	Description	
Temperature		Meets MIL-T-28800B, class 5.
Operating	0°C to +50°C	
Non-operating	−55°C to +75°C	
Humidity	95% RH, 0°C to 30°C 75% RH, to 40°C 45% RH, to 50°C	Meets MIL-T-28800B, class 5.
Altitude		Meets MIL-T-28800B, class 5.
Operating	4.6 km (15,000 ft)	
Non-operating	15 km (50,000 ft)	
Vibration	0.38 mm (0.015 in) peak to peak, 5 Hz to 55 Hz, 75 minutes	Meets MIL-T-28800B, class 5, when installed in qualified power module.[b]
Shock	30 g's (1/2 sine) 11 ms duration, 3 shocks in each direction along 3 major axes, 18 total shocks.	Meets MIL-T-28800B, class 5, when installed in qualified power modules.[b]
Bench Handling[c]	12 drops from 45°, 4 in or equilibrium, whichever occurs first.	Meets MIL-T-28800B, class 5.
Transportation	Qualified under National Safe Transit Association Preshipment Test Procedures 1A-B-1 and 1A-B-2.	
EMC[d] User circuits not installed. Without user cable	Within limits of VDE 0871, and MIL-461A tests RE01, RE02, CE01, CE03, RS01, RS03, CS01, and CS02.	
Electrical Discharge	20 kV maximum charge applied to instrument case. Excluding user cable and front panel connector J1210.	

[a]With power module.

[b]Refer to TM 5000 power module specifications.

[c]Without power module.

[d]System performance subject to exceptions of power module and other individual plug-ins.

Table 1-3
MECHANICAL CHARACTERISTICS

Characteristics	Description
Nominal Overall Dimensions	
Height	4.457 inches (113.2 mm).
Width	1.068 inches (27.13 mm).
Length	10.147 inches (257..7 mm).
Net Weight	0.432 lbs (.20 kg).
Finish (Front Panel)	Plastic/aluminum laminate.

PREPARATION FOR USE

Internal Data Ports (Channels)

To prepare the 50M70 for specialized operation, the user designs his own circuits and mounts the desired components in the open bread-board area and then connects the internal data ports (channels) to his circuit.

For convenience, the user may use a reproduced copy of schematic 2 to draw his specialized interface circuit between the internal data ports and the front panel connector. The internal data ports, with signal nomenclature, is illustrated in Fig. 2-1. The ODV (Output Data Valid) and ODR (Output Data Received) signals on CHA 2 and CHA 4 may be used to handshake output data to the user's interface circuit. The IDV (Input Data Valid) and IDR (Input Data Received) may be used to handshake the data input to the 50M70. CHA 1 may be used to expand the data to 32 bits. Data bit direction is set by the DIR (direction) command argument (see Programming Information).

Inverting buffer devices are recommended between the low-level ODV (pin 10 on J1202 and J1210) and IDR (pin 10 on J1214) signal ports and the front panel interface connector, J1400. The use of inverting buffers cause the polarity of these signals to be compatible with the positive-true handshake logic on other function cards. The polarity of ODR and IDV is not important; their slopes are programmable. The data lines may be of any desired polarity.

Four output signals at J1211 may be connected to the user's interface circuit:

B02 —Buffered 1 MHz system clock to all function cards.

ERROR —Performs the same function as the ERROR indicator light on the front panel.

BFR TRIG —Occurs when the <GET> interface message is received in the DT SET mode (see Programming Information).

RESET —System reset signal to microprocessor and all function cards.

CAUTION

It is recommended that the user's circuit layout and decoupling circuits localize circulating currents and limit the rate of change of current (di/dt) to 1 mA/msec or less in the A GND circuit board runs. Refer all data port connections and front panel interface cabling to qualified service personnel.

Front Panel Interface Cabling

Figure 2-2 shows a schematic drawing of the 50-wire, flat-ribbon cable assembly provided with the 50M70. This cable assembly is used for connecting external data, or sensor points to the front panel connector, J1400. The front panel connector is shown in Fig. 2-3. Internal signal connections and nomenclature to the front panel connector is assigned by the user.

For convenience, a front panel input/output reference log is provided at the back of this section of the manual. Enter the card slot number and pertinent data associated with your external system requirements. Reproduce the completed reference log, if desired, but retain the original in the manual for future reference.

When connecting the unterminated ends of the wires in the flat-ribbon cable, the red-striped wire indicates pin 1A on J1400, the next wire downward indicates pin 1B. The A and B paired-wire pattern is then followed on down to the last pair of wires, 25A (49) and 25B (50).

Front Panel Indicator Lights

If the ERROR indicator light remains illuminated after the power-up self-test routine has been completed, it indicates a hardware error has occurred on the 50M70.

The ACTIVE indicator light is pulsed on for a minimum of 20 ms each time the program software or the MI 5010 microprocessor selects the 50M70.

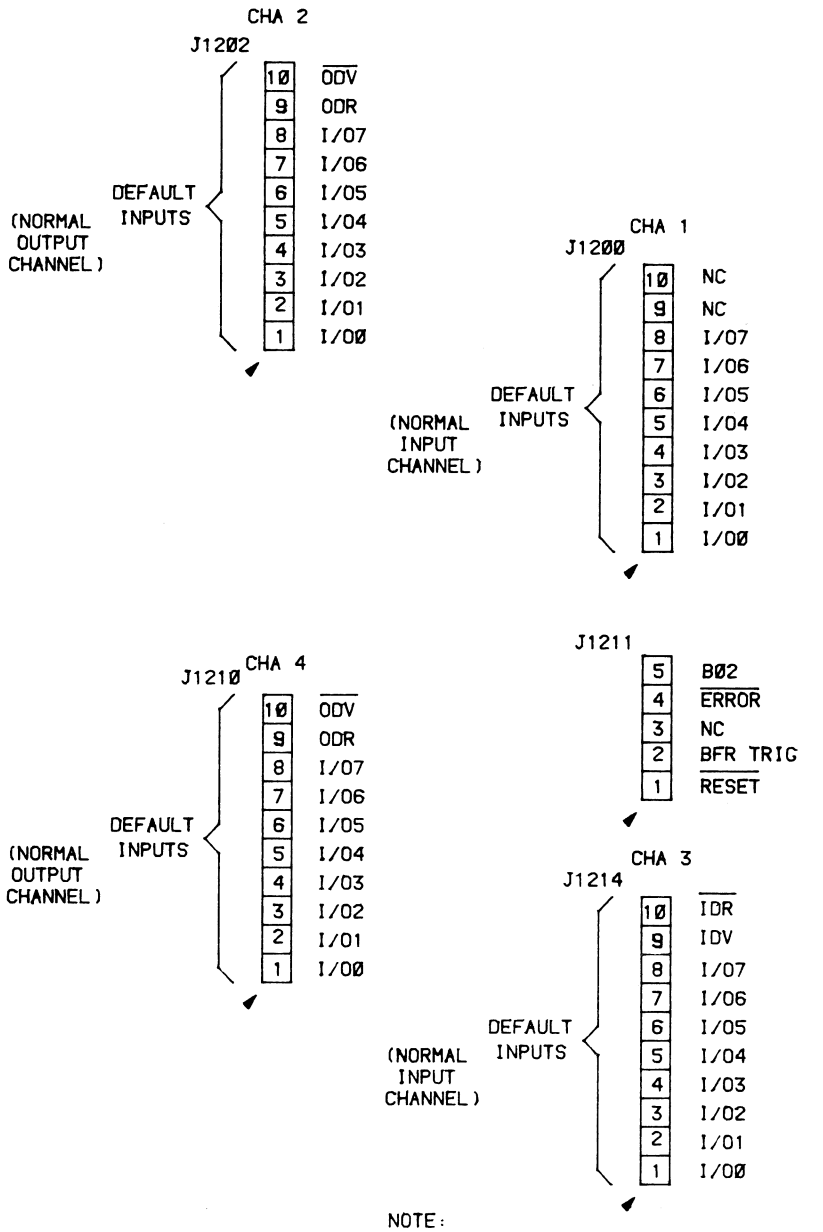


Fig. 2-1. Internal data channel signal assignments.

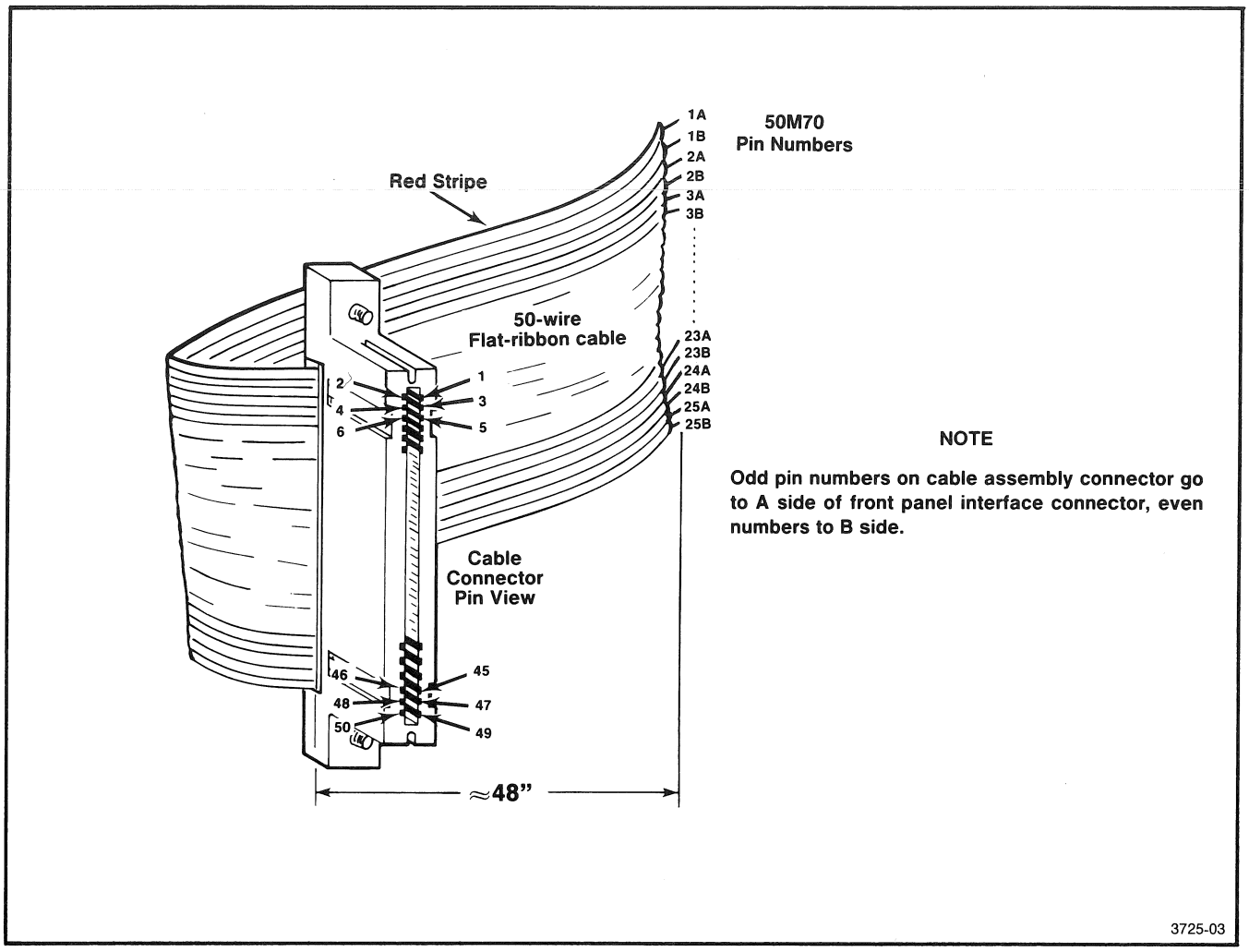


Fig. 2-2. Front panel (user) interface cable assembly.

Function Card Installation

CAUTION

To prevent damage to the 50M70, turn off the power module before installing or removing the function card from the MI 5010/MX 5010 units. Do not use excessive force when installing or removing any unit from the MI 5010/MX 5010 system.

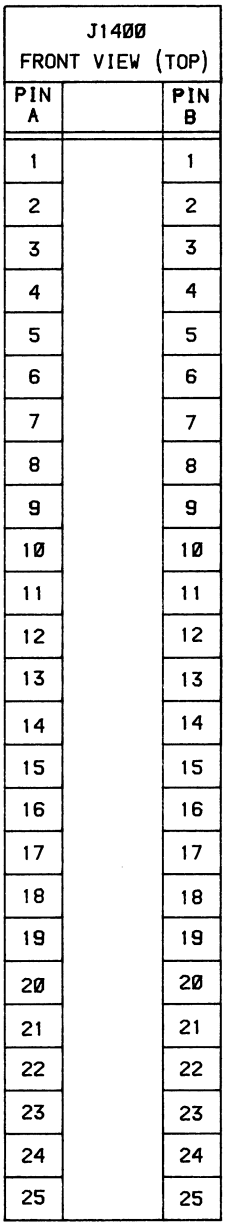
The 50M70 may be installed in any vacant slot in either the MI 5010 (slots 1, 2, or 3) or the MX 5010 (slots 4, 5, or 6).

Place the function card in the upper and lower guide rails associated with the chosen slot and push firmly straight in until the rear edge card connector mates with its connector on the Main Interconnect board at the rear of the MI 5010 or MX 5010.

Be certain that the function card is aligned with the associated slot thumb screw on the rear panel, then use the thumb screw to lock the function card in its designated slot.

Repackaging for Shipment

If the instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing: owner (with address) and the name of the individual at your firm that can be contacted. Include complete instrument description, serial number, and a description of the service required.



J14ØØ
FRONT VIEW (TOP)

PIN A		PIN B
1		1
2		2
3		3
4		4
5		5
6		6
7		7
8		8
9		9
1Ø		1Ø
11		11
12		12
13		13
14		14
15		15
16		16
17		17
18		18
19		19
2Ø		2Ø
21		21
22		22
23		23
24		24
25		25

NOTE

PIN ASSIGNMENTS AND CONNECTIONS ASSIGNED BY USER.

3725-04

Fig. 2-3. 50M70 front panel interface connector.

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If the original package is not fit for use or not available, repackage the instrument as follows:

Surround the instrument with polyethylene sheeting, or other suitable material, to protect the exterior finish. Obtain a carton of corrugated cardboard of adequate strength that has inside dimensions no less than six inches more than the instrument dimensions. Cushion the instrument by tightly packing dunnage or urethane foam between the carton and the instrument, on all sides. Seal the carton with shipping tape or an industrial stapler.

The carton test strength for your instrument is 200 pounds.

50M70
FRONT PANEL INPUT/OUTPUT REFERENCE LOG

SLOT NUMBER _____ :

"A" Side Pin No./Name	Sensor Point/Comments	"B" Side Pin No./Name	Sensor Point/Comments
1A/		1B/	
2A/		2B/	
3A/		3B/	
4A/		4B/	
5A/		5B/	
6A/		6B/	
7A/		7B/	
8A/		8B/	
9A/		9B/	
10A/		10B/	
11A/		11B/	
12A/		12B/	
13A/		13B/	
14A/		14B/	
15A/		15B/	
16A/		16B/	
17/		17B/	
18A/		18B/	
19A/		19B/	
20A/		20B/	
21A/		21B/	
22A/		22B/	
23A/		23B/	
24A/		24B/	
25A/		25B/	

PROGRAMMING INFORMATION

INTRODUCTION

General Information

Programming and remote control of the 50M70 Programmable Development Card is via the microprocessor in the MI 5010 Programmable Multifunction Interface unit. In turn, the MI 5010 is programmed and controlled via the digital interface specified and described in IEEE Standard 488-1978.

Programming the 50M70 requires a thorough understanding of the operation and commands listed in the MI 5010/MX 5010 Instruction manual. The Programming Information section of the MI 5010/MX 5010 Programmable Multifunction Interface w/Interface Extender Instruction manual contains information related to function card commands, system operating modes, message formats, message processing, IEEE 488 interface messages, basic programming examples, status bytes, error codes, and other useful information related to programming the complete Multifunction Interface system.

This section of the 50M70 Instruction manual contains only those commands resident in the 50M70 firmware and other information related to user development purposes.

The 50M70 cannot be operated under local control nor does it have a front panel control to return it to a local mode.

The ACTIVE indicator light is illuminated every time the program software of the microprocessor selects the 50M70 for any reason.

The ERROR indicator light will remain illuminated if the microprocessor detects a hardware error in the 50M70 during the power-up self-test routine. The error is reported to the controller in response to the error query (ERR?).

Power-up Default and INIT Command Settings

After the power-up self-test routine has been successfully completed, the 50M70 goes to the following default settings:

DT OFF;CHA 1;
CHA 1;DAT X;DIR 0;
CHA 2;DAT X;DIR 0;ARM OFF;SLO NEG;
CHA 3;DAT X;DIR 0;ARM OFF;SLO NEG;
CHA 4;DAT X;DIR 0;ARM OFF;SLO NEG;

NOTE

The power-up default settings and INIT command configure all channels as inputs (DIR 0). The DATA response (DAT X) to an FSET? or DATA? query command can be any number (X) from 0 to 255, usually DAT 255 if there are no external (user) connections. If external (user) connections exist, the DATA number (X) response depends on the external data logic levels. See the DIRECTION and DATA commands on how to program Channels 1, 2, 3, and 4.

When the INIT command is sent, the 50M70 returns to its power-up default settings, but does not assert SRQ.

NOTE

Refer to the MI 5010/MX 5010 Instruction manual for information related to obtaining system settings by the user of the SET?, SELECT, and FSET? commands.

The TEST command resets the 50M70 handshake lines, but does not affect the current settings.

COMMAND SUMMARY

NOTE

The following commands may be sent to the 50M70 in the immediate or buffered mode. These commands will not affect the 50M70 unless it has been first selected by the proper SELECT command argument.

Header	Argument(s)	Description
ARM	**ON**	Causes handshake lines to generate both a logical condition and an SRQ when an ODR or IDV signal occurs on the selected channel (Channel 1 has no handshake lines).
	COND	Only a logical condition is generated for an ODR or IDV signal. The logical condition is defined as the satisfaction of the WAIT COND command.
	SRQ	Only an SRQ is generated for an ODR or IDV signal.
	OFF	No action is generated by the ODR or IDV signal.
ARM?		Arming status query.
CHA	<**num**>	Selects user defined channel, <num> = 1, 2, 3, or 4.
CHA?		Currently selected channel query.
DAT	<**num**>	Puts binary equivalent of a decimal number into the data output register of the currently selected channel.
	B<**num**>	Puts 8-bit binary number into data output register of currently selected channel.
	H<**num**>	Puts the binary equivalent of a hexadecimal number into the data output register of the currently selected channel.
DAT?		Decimal data format query.
BDAT?		Binary data format query.
HDAT?		Hexadecimal data format query.
DIR	<**num**>	A decimal number is used to set up the Data Direction register of the currently selected channel.
	B<**num**>	An 8-bit binary number is used to set up the Data Direction register of the currently selected channel (0 = input port, 1 = output port).
	H<**num**>	A hexadecimal number is used to set up the Data Direction register of the currently selected channel.
DT	**SET**	Causes 50M70 to wait for <GET> before altering its settings.
	TRIG	Causes the 50M70 to wait for the TRIGGER (TRIG) command before altering its settings.
	OFF	No action is taken on receipt of <GET> or TRIG command.
DT?		Device trigger setting query.
FLAG?		ODR or IDV interrupt flag query.
FSET?		50M70 current settings query.
NAM?		Card name query.
SLO	**POS**	Causes 50M70 to respond to the positive edge of an ODR or IDV signal.
	NEG	Causes 50M70 to respond to the negative edge of an ODR or IDV signal.
SLO?		ODR or IDV signal slope setting query.

DETAILED COMMAND LIST

ARM

Type:
Setting and Query

Mode:
Immediate or buffered

Setting Syntax (one of the following):
ARM ON
ARM SRQ
ARM COND
ARM OFF

Query Syntax:
ARM?

Query Response (one of the following):
ARM ON;
ARM SRQ;
ARM COND;
ARM OFF;

Discussion:

The ARM command defines the action taken by the 50M70 upon receipt of an Output Data Received (ODR) or an Input Data Valid (IDV) signal from an external system:

ARM SRQ —causes the SRQ line on the IEEE 488 digital interface to be asserted.

ARM COND —causes a logical condition that satisfies the WAIT COND command.

ARM ON —causes both of the above actions to occur.

ARM OFF —causes no action to be taken.

NOTE

This command and query will cause error 204 if sent when CHA 1 is accessed.

CHANNEL (CHA)

Type:
Operational and Query

Mode:
Immediate or buffered

Setting Syntax:
CHANNEL <num>

Example (one of the following):
CHA 1
CHA 2
CHA 3
CHA 4

Query Syntax:
CHA?

Query Response (one of the following):
CHA 1;
CHA 2;
CHA 3;
CHA 4;

Discussion:

The CHANNEL command accesses (selects) the desired input/output data channel. The argument value for <num> is:

1, 2, 3, or 4

NOTE

See DIRECTION (DIR) command.

The CHA? query returns the currently selected channel.

DATA (DAT)

Type:
Setting and Query

Mode:
Immediate or buffered

Setting Syntax (one of the following):
DATA <num>
DATA B<num>
DATA H<num>

Examples:
DAT 227
DAT B10110101
DAT HB5

Query Syntax (one of the following):
DAT?
BDAT?
HDAT?

Query Response (one of the following):
DAT <decimal number>;
DAT B<binary number>;
DAT H<hexadecimal number>;

Discussion:

The DATA commands load the data output register of the currently accessed channel with the binary equivalent of the argument value. The decimal range for <num> is from 0 to 255; hexadecimal range is from 00 to FF. Preceding <num> with the letter B causes the number to be recognized as a binary number; preceding <num> with the letter H causes it to be recognized as a hexadecimal number.

DIRECTION (DIR)

Type:
Setting and Query

Mode:
Immediate or buffered

Setting Syntax (one of the following):
DIR <num>
DIR B<num>
DIR H<num>

Examples:
DIR 144
DIR B10010000
DIR H90

Query Syntax (one of the following):
DAT?
BDIR?
HDIR?

Query Response (one of the following):
DIR <decimal number>;
DIR B<8-bit binary number>;
DIR H<two-character hexadecimal number>;

Discussion:

The DIRECTION command sets up the PIA Direction register of the currently accessed channel with the binary equivalent of a decimal, binary, or hexadecimal number; where 1's designate output ports and 0's designate input ports on whatever channel is selected. For example, DIR B10010000 sets up the LSB as an input, MSB and MSB-3 as outputs. DIR 0 sets up all data ports on an accessed channel as inputs; DIR 255 sets up all data ports on an accessed channel as outputs.

DT

Type:
Operational and Query

Mode:
Immediate or buffered

Setting Syntax (one of the following):
DT SET
DT OFF

Query Syntax:
DT?

Query Response (one of the following):
DT SET;
DT OFF;

Discussion:

The DT (Device Trigger) command directs the use of the <GET> interface message or the TRIG command:

DT SET —causes the 50M70 to wait until receipt of the <GET> message or the TRIG command before altering its settings.

DT OFF —<GET> or TRIG command has no effect on operation of the 50M70.

FLAG?

Type:
Query

Mode:
Immediate or buffered

Query Syntax:
FLAG?

Query Response (one of the following):
FLAG 0;
FLAG 1;

Discussion:

The FLAG? query asks status information about the Output Data Received (ODR) signal or the Input Data valid (IDV) signal.

Response is:

FLAG 0; —if ODR or IDV did not occur.
FLAG 1; —if ODR or IDV occurred.

Execution of the FLAG? query causes the response to be FLAG 0 until an ODR or IDV signal occurs.

NOTE

This query will cause error 204 if sent when CHA 1 is accessed.

FSETTINGS? (FSET?)

Type:
Query

Mode:
Immediate or buffered

Query Syntax:
FSETTINGS? or FSET?

Query Response:
<current settings>;

Example:

```
DT OFF; CHA 1;DAT 255; DIR 0;
CHA 2;DAT 0;DIR 255;ARM OFF;SLO NEG;
CHA 3;DAT 255;DIR 0;ARM OFF;SLO NEG;
CHA 4;DAT 0;DIR 255;ARM OFF;SLO NEG;
```

NAME? (NAM?)

Type:
Query

Mode:
Immediate or buffered

Query Syntax:
NAME? or NAM?

Query Response:
NAME DEVM70,V79.1,Fxx;

Discussion:

The NAME? query asks for the name of the 50M70 function card. In the response, DEV is the three letter code for the 50M70, V79.1 is the Tektronix Codes and Formats version number, and Fxx is the fimware version number.

SLOPE (SLO)

Type:
Setting and Query

Mode:
Immediate or buffered

Setting Syntax (one of the following):
SLOPE POSITIVE
SLOPE NEGATIVE

Example:
SLO POS
SLO NEG

Query Syntax:
SLO?

Query Response (one of the following):
SLO POS;
SLO NEG;

Discussion:

The SLOPE command programs the currently accessed channel (2, 3, or 4) to respond to the positive edge (POS) or negative edge (NEG) of an ODR or IDV handshake signal.

NOTE

This command and query will cause error 204 if sent when CHA 1 is accessed (selected).

PROGRAMMING NOTES

STATUS BYTES AND ERROR CODES

NOTE

Refer to the MI 5010/MX 5010 Instruction manual for status bytes (STB) and error code definitions.

Serial Poll Response (STB)	Error Query Response	Description
99	**36x**	50M70 ROM error.
225	**74x**	Cannot clear 50M70 PIA Data Direction registers.
225	**75x**	Cannot operate 50M70 PIA Control registers.
192+x	**79x**	ODR or IDV signal occurred with ARM SRQ or ARM ON status set.

NOTE

The value of "x" in the status byte or error code response depends on which slot the 50M70 is located. The range of "x" is 1 through 6. If the MI 5010 is busy when serial polled, the status byte code will be 16 higher than that listed.

PROGRAMMING EXAMPLE

NOTE

The following example was developed using a Tektronix 4050-series controller. If another controller is used, the programming example must be modified for that particular controller.

Event Sense Routine

The routine in Example 1 was developed for detecting the occurrence (clocked or unclocked) of a digital word on the input lines of a set of comparators. The comparator circuits and logic gates were built on the user development area of the 50M70. See Fig. 1.

The initial task is to put the 50M70 in the appropriate state (lines 100-280). This is done by selecting the 50M70 in slot 2 and resetting Channels 1 and 3 as outputs — they powered up as input channels.

The routine then determines whether to clock the data (lines 310-340), under what conditions to generate an SRQ (lines 350-400), and generates the appropriate word from this information for Channel 3 (line 410). Channel 3 controls operation.

Lastly, the comparison point is acquired (lines 420-430), inverted (line 440), and separated into two bytes; Channel 1 (LSB) and Channel 2 (MSB), lines 450-460. The SRQ function is armed (line 530) and the remainder of the program is checking for SRQ and waiting for occurrence of the digital word.

```
100 REM   EXAMPLE #1
110 REM DEV EVENT SENSE
120 REM
130 M1=23
140 D2=3
150 ON SRQ THEN 1000
160 REM
170 REM  CHA 1=LSB
180 REM  CHA 2=MSB
190 REM  CHA 3=CONTROL
200 REM  CHA 2 IRQ = SENSE
210 REM
220 REM INITIALIZE
230 REM
240 PRINT @M1:"SEL ";D2
250 PRINT @M1:"CHA 1;DIR HFF"
260 PRINT @M1:"CHA 3;DIR HFF"
270 REM
280 REM INITIALIZATION COMPLETE
290 REM CONSTRUCT DATA WORDS
300 REM
310 PRINT "DETECT OPTIONS"
320 PRINT "0=NO DETECT,1=CLOCK"
330 PRINT "2=CLOCK NOT,3=ALWAYS"
340 INPUT I
350 PRINT "SENSE OPTIONS"
360 PRINT "0=OFF,1="">"""
370 PRINT "2=""<"",3="""<>"""
380 PRINT "4="""="",5="">="""
390 PRINT "6="""<="",7=OFF"
400 INPUT J
410 I=I+4+J*8
420 PRINT "INPUT DATA WORD"
430 INPUT J
440 J=45535-J
450 K=INT(J/256)
460 J=J-K*256
470 PRINT @M1:"CHA 3;DAT ";I
480 PRINT @M1:"CHA 1;DAT ";J
490 PRINT @M1:"CHA 2;DAT ";K
500 REM
510 REM SRQ GENERATED ON SENSE
520 REM
530 PRINT @M1:"ARM SRQ"
540 GO TO 540
1000 POLL X,Y;M1
1010 IF Y=192+D2 OR Y=208+D2 THEN 1040
1020 PRINT "STATUS BYTE = ";Y
1030 RETURN
1040 PRINT "SENSED"
1050 RETURN
```

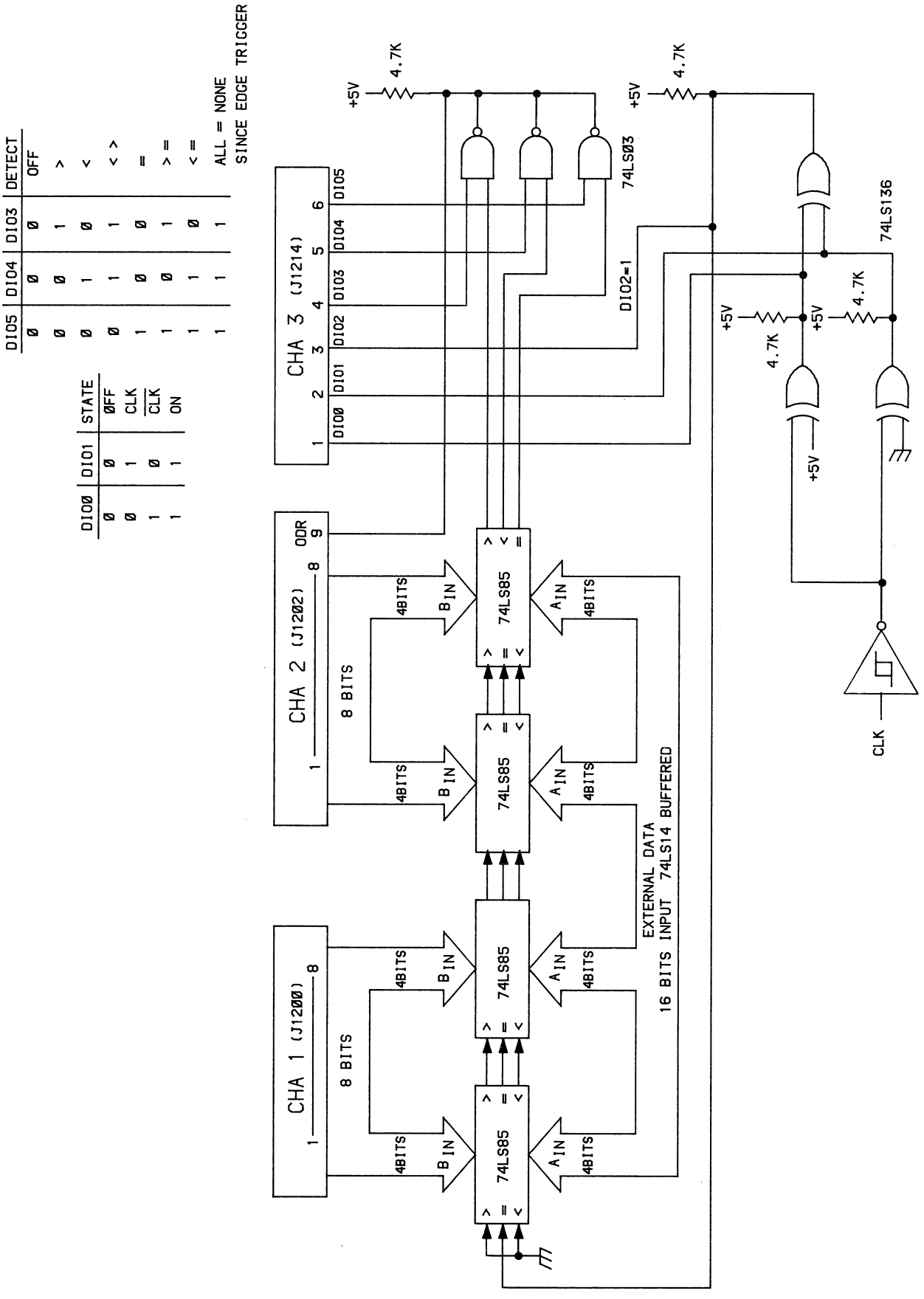


FIG. 1. SCHEMATIC DIAGRAM FOR 50M70 PROGRAMMING EXAMPLE 1.

PERFORMANCE CHECK PROCEDURE

Introduction

This Performance Check procedure consists of two software routines that perform the following checks for the 50M70 Programmable Development Card:

1. Checks all four data ports (channels) in both directions.
2. Checks handshake lines and condition flag.

Front Panel Connections

Before running the two software routines, the data ports (J1202, J1200, J1210, and J1215) must be wired according to the schematic drawing shown in Fig. 4-1.

Performance Check Interval

Other than a first-time performance check, it is not necessary to check the performance of the 50M70 at regular intervals. The performance check should be performed under the following conditions:

- Incoming inspection.
- If used infrequently.
- After repair.
- Operating conditions indicate degradation of performance.

The 50M70 has no internal adjustments for calibration purposes. If the instrument fails this performance check procedure, circuit troubleshooting is then indicated.

Services Available

Tektronix, Inc. provides complete instrument repair facilities at local field service centers and at the factory service center. Contact your local Tektronix field office or representative for more information.

Test Equipment Required

The test equipment (or equivalent) listed in Table 4-1 is suggested to perform this Performance Check procedure.

Table 4-1
LIST OF TEST EQUIPMENT REQUIREMENTS

Description	Performance Requirements	Example
Controller	GPIB compatibility	TEKTRONIX 4051 or TEKTRONIX 5052
GPIB Cable	GPIB standard interconnect, length 2 meters	Tektronix Part No. 012-0630-01
Power Module	GPIB compatibility	TEKTRONIX TM 5003 or TEKTRONIX TM 5006
Programmable Multifunction Interface		TEKTRONIX MI 5010/MX 5010

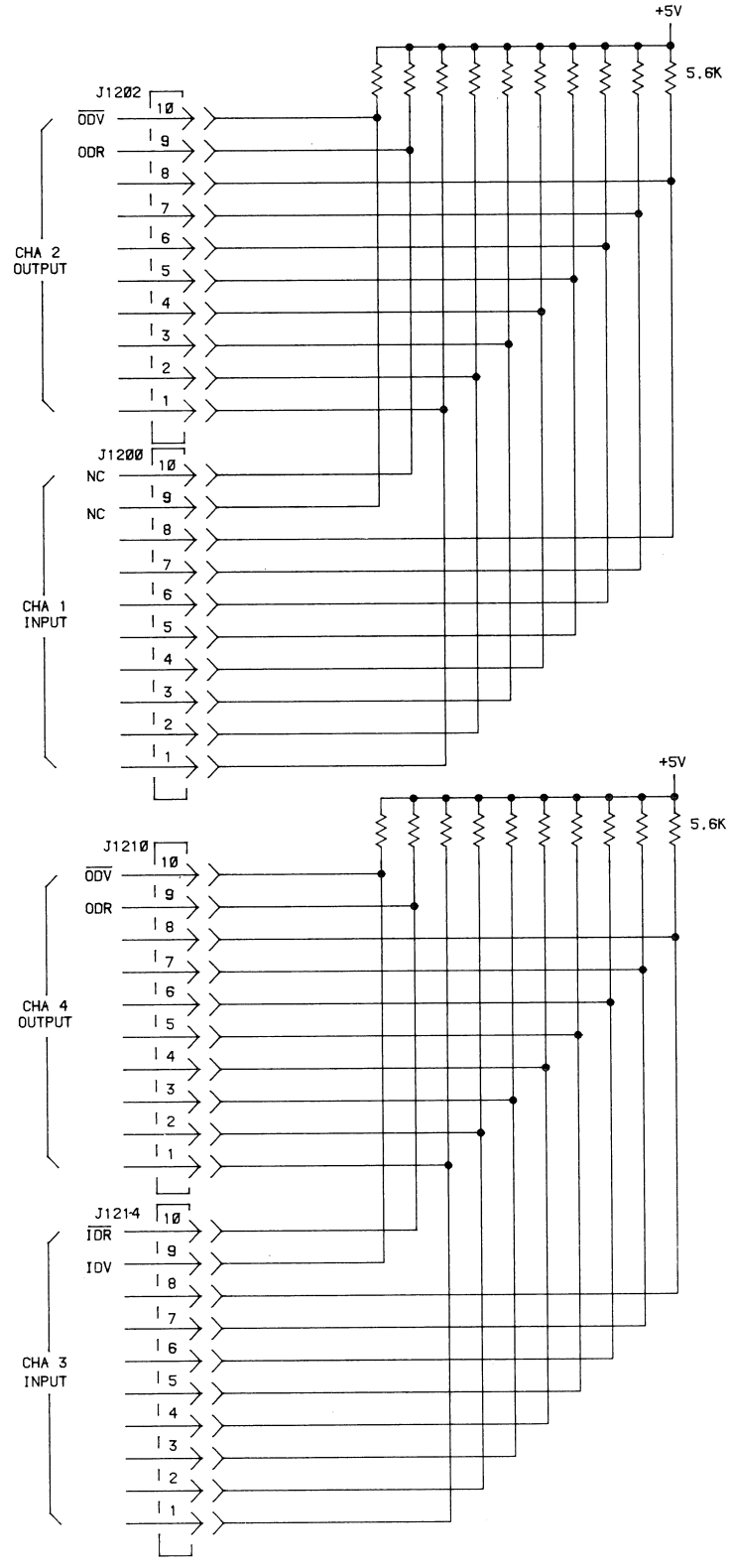


Fig. 4-1. 50M70 performance check test circuit.

1. Preliminary Procedure

a. Be certain that the data ports (J1202, J1200, J1210, and J1214) are wired according to the schematic diagram shown in Fig. 4-1.

CAUTION

To prevent damage to the 50M70 do not make direct solder connections to any pin number on any jumper plug. Use the 10-lead ribbon cables or other appropriate connectors to make connections to the resistors and +5 V supply.

b. Set up the IEEE 488 (GPIB) controller, GPIB cable, TM 5000-series power module and the MI 5010/MX 5010 for programming operations over the IEEE 488 digital interface. Verify that the MI 5010 address is set to decimal 23 and the message terminator switch set to EOI ONLY.

c. Insert the 50M70 (with performance check test circuit connected) in slot number 2 of the MI 5010. Turn on the power and allow 2-5 minutes for warm-up.

d. During warm-up time enter or load the following program into the controller's memory.

NOTE

If you plan to save this program for the Performance Check procedure on tape, the remark (REM) statements should be included for future use; if not they may be omitted. This program was written for TEKTRONIX 4050-series controllers. If a different type of controller is used, the program may need modification and message terminator switch set to the appropriate position for the controller in use. The MI 5010/MX 5010 should be the only instrument on the digital interface at this time.

FILE # 19

```
100 REM  *** 50M70 TEST 1 *** PERFORMANCE CHECK PROCEDURE ***
110 REM     SET T TO BE THE GPIB ADDRESS OF THE TEK MI5010
120 INIT
130 T=23
140 ON SRQ THEN 810
150 PAGE
160 FOR U=1 TO 6
170    PRINT @T;"INIT;SEL 2"
180    D=0
190    R=0
200    E=19
210    REM     VERIFY DATA TRANSFER (I/O) ON EACH CHANNEL
220    FOR I=1 TO 4
230       DATA 0,255,0,255,255,0,255,0
240       FOR G=1 TO 2
250          FOR C=1 TO 4
260             READ B
270             PRINT @T;"CHA ";C;";DIR ";B;";DAT ";E
280             NEXT C
290          FOR F=G TO 4 STEP 2
300             PRINT @T;"CHA ";F;";DAT?"
310             INPUT @T;D
330             IF D=E THEN 360
340             PRINT " *** RUN ERROR - CHA ";F;" SENT- ";E;" READ- ";D
350             STOP
360             NEXT F
370          NEXT G
380       RESTORE 230
390       E=E*2
400       NEXT I
405    E=E/16
410    PRINT " ALL I/O CHECK O.K."
430    REM     VERIFY HANDSHAKE (EXTERNALY) CHANNEL TO CHANNEL
440    J=4
450    PRINT @T;"CHA ";J;";DIR 255;ARM COND;FLAG?;CHA 3;DIR 0;"
460    PRINT @T;"CHA 3;ARM COND;CHA 1;DIR 0;CHA ";J;";DAT ";E
470    PRINT @T;"CHA ";J;";FLAG?;CHA 3;FLAG?;DAT?;FLAG?;"
480    INPUT @T;K,L,M,N
490    PRINT @T;"CHA ";J;";FLAG?;"
500    INPUT @T;O
510    PRINT "CHA ";J;" FLAG=";K;"   CHA 3 FLAG=";L;",DAT=";M;
520    PRINT ",FLAG=";N;"   CHA ";J;" FLAG=";O
530    IF K<>0 OR L<>1 OR N<>0 OR O<>1 THEN 600
540    IF M<>E THEN 590
550    PRINT " HANDSHAKE CHECKS O.K. "
560    NEXT U
570 PRINT "*** PROGRAM COMPLETE ***"
580 END
590 PRINT "*** BAD DATA RECEIVED, POSSIBLE "
600 PRINT "    HANDSHAKE ERROR - CHECK FLAGS CHANNEL ";J
610 PRINT "    DATA SENT: ";E;"   DATA RECEIVED: ";M
620 STOP
800 REM     HANDLE ANY SRQS
810 POLL X,Y;T
820 IF Y>83 AND Y<>128 THEN 840
830 RETURN
840 PRINT "*** SRQ ASSERTED STATUS BYTE WAS: ";Y
850 STOP
```

2. Running the Performance Check Procedure Program

a. Operate the controller to run (type RUN <CR>) the program.

b. If the programmed input and output channels and the handshake process between CHA 4 and CHA 3 are functioning properly (with no bus or system error messages to report) the following message appears:

ALL I/O CHECK OK
HANDSHAKE CHECKS OK

The above message repeats for six (6) times and is followed by:

PROGRAM COMPLETE

NOTE

The program, as written, checks the handshake process between CHA 4 and CHA 3 and all input/output ports on all channels. CHA 1 does not have handshake lines. In order to check the handshake process between CHA 2 and CHA 3, proceed to Step 2c.

c. Turn off the power and interchange the connectors on J1202 (CHA 1) and J1214 (CHA 3).

d. In the program, change the variable J=4 (line 440) to read J=2.

e. Re-insert the 50M70 in slot number 2, turn on the power, and rerun the complete program. If no errors are reported, the same messages stated in Step 2b will appear.

f. If there is a fault (error) on the 50M70 you will receive an error message containing information related to the possible fault. If any error code numbers or status byte code numbers are reported, refer to the Status Byte and Error Codes in the 50M70 and MI 5010/MX 5010 instruction manuals.

g. If the fault (error message or error code number) is determined to be located on the 50M70, refer to the Service/Test Procedure (50M70 TEST 2) located in the Maintenance section of this manual.

NOTE

IMPORTANT: After completion of Step 2e (checking the handshake process between CHA 2 and CHA 3) be certain that you change the variable J=2 (line 440) in the program back to its original form, J=4, and move J1214 and J1200 connection back to original position before running step 2b again.

h. This completes the Performance Check procedure for the 50M70.

THEORY OF OPERATION

CIRCUIT DESCRIPTION

Memory and Decoders ◇1

The 50M70 Programmable Development Card connects to the MI 5010 or MX 5010 Main Interconnect assembly via P1000. The microprocessor in the MI 5010 selects this card for data transfers (EBD0-EBD7) by setting pins 4 and 5 of U1110B high. The low level on pin 6 of U1110B enables the address decoder (U1101) on pin 5 and enables the bidirectional data buffer (U1011) on pin 19. Pins 4 and 5 of U1101 must be low and pin 6 must be high to enable the address decoder when a valid memory address (EBVMA) for the 50M70 appears on the external address bus (EBA0-EBA15).

The five control lines to the 50M70 are buffered by seven non-inverting buffers contained in U1002. Three of these control lines (RESET, B02, and BFR TRIG) are routed to J1211 located on schematic 2.

The CARD SELECT and EBVMA lines are set high each time the microprocessor selects the 50M70 for a read or write operation on an addressed memory device. The read/write control signal on pin 5 of U1002C goes high for a read operation and goes low for a write operation. A write operation is never performed on the read-only-memory device (ROM, U1100).

The memory devices for the 50M70 consist of a 2k × 8 bit ROM (U1100) and two peripheral interface adapters (U1103 and U1111).

The 16 address bits (EBA0-EBA15) are buffered by unidirectional, non-inverting buffers U1000 and U1001; buffered address bits BA11 and BA12 are not implemented in the 50M70 with a 2k ROM. The hexadecimal addresses for the 50M70 operating system are in the 4000-DFFF range.

Integrated circuit U1101 decodes buffered address bits BA13, BA14, and BA15 to select the ROM or both PIA's for addressing. The ROM (U1100) is selected when the microprocessor places hexadecimal address 4000 on the external address bus, setting pin 18 of U1100 to a low state. An instruction word is placed on the BD0-BD7 data bus when the read/write and clock signals on pins 1and 2 of U1110A both go high.

Both peripheral interface adapters, U1103 and U1111, are selected for addressing when hexadecimal address 8000 sets pin 23 on each device to a low state. Buffered address bit BA3 is inverted by U1202C. The inversion of BA3 allows the microprocessor to select either U1103 or U1111 for data transfer. Communication with the internal registers of U1103 or U1111 is via adress bits BA0 and BA1. For either PIA pin 23 must be low and pin 24 must be high to select the proper data channel. Buffered data is clocked into (a write operation) or out of (a read operation) an internal register on the rising edge of the clock signal on pin 25 of either PIA.

NOTE

For more detailed information related to internal register selection for U1103 or U1111 refer to the manufacturer's data sheet.

At power-up the RESET control line (U1102A, pin 3) goes low. This resets all of the internal registers of the PIAs to zero. The microprocessor then configures all of the CA1, CA2, CB1, CB2 ports of the PIAs as inputs. The CA2-X port (U1103, pin 39) is held high by R1202B. This causes the ERROR light, DS1402, to be illuminated with a low level on pin 4 of U1200B until the completion of the self-test routine. Upon successful completion of the self-test routine, the CA2-X port is programmed to a low state, turning off the ERROR light. If a 50M70 related error occurs, the CA2-X port is programmed to a high state, keeping DS1402 illuminated. The ERROR signal (a low level) is also routed to J1211, pin 4, on schematic 2.

The low level CARD SELECT input to the base of Q1212 may be of very short duration. The pulse stretching circuit consisting of U1200D, Q1212, Q1211, and associated components ensure that the ACTIVE indicator light, DS1401, will remain on long enough to be seen (20 ms minimum), even though the 50M70 is selected for only one instruction cycle.

Interrupt signals to the microprocessor in the MI 5010 are via the IRQ-X and IRQ-Y lines (pins 37 and 38 on the PIAs). An interrupt from either PIA causes pin 24B of P1000 to go low and remain low until the microprocessor clears the interrupt condition.

The BFR TRIG (Buffered Trigger) signal on pin 9 of U1002G is generated via the GPIB Control chip in the MI 5010 in response to the <GET> (Group Execute Trigger) interface message sent over the IEEE 488 digital interface. The CA1-X port for U1103 (pin 40) operates as a feedback interrupt flag path that allows the microprocessor to know that the 50M70 function card has received the BFR TRIG signal.

Front Panel Interface ◇2◇

For convenience, the layout of schematic diagram 2 has been drawn to appear as close as possible to the actual physical layout for the user's development area on the 50M70 function card. Space has been provided for the user to draw his own circuit(s) between J1200, J1202, J1211, J1214 and the pins on the front panel connector, J1400.

The power-up routine configures the direction of the peripheral data registers in U1103 and U1111 as follows: channels 1 and 3 as inputs, channels 2 and 4 as inputs. After power-up any single PA or PB port on any channel can be programmed over the IEEE 488 digital interface to operate as an input or output (see DIR command in the Programming section of this manual). All of the peripheral data registers are cleared to zeros at power-up (logical 0's on all PA and PB lines).

Six lines to U1103 and U1111 are reserved for handshake signals between the user's eternal device and the microprocessor; 1 to 32-bit data can be transferred by the use of the handshake signals. The general definitions for the handshake signals are as follows:

- ODV — Output Data Valid. An output signal generated by the microprocessor that tells the user's external device that the output data byte on the selected channel (2 or 4, or both) is valid.
- ODR — Output Data Received. An input interrupt signal from the user's external device that tells the microprocessor that the output data on the selected channel (2 or 4, or both) has been received.
- IDV — Input Data Valid. An input interrupt signal from the user's external device indicating that the input data byte on the selected channel (1 or 3, or both) is valid.
- IDR — Input Data Received. An output signal generated by the microprocessor that tells the user's external device that the input data byte on the selected channel (1 or 3, or both) has been received and stored in an assigned space in the MI 5010 random-access-memory (RAM).

NOTE

At power-up the ODV and IDR lines are programmed as low-true outputs, the ODR and IDV lines are programmed as high-true inputs. After power-up the ODR and IDV lines can be programmed to respond to a positive-slope or negative-slope input signal from the user's external device.

MAINTENANCE

STATIC-SENSITIVE COMPONENTS

CAUTION

Static discharge can damage any semiconductor component in this instrument.

This instrument contains electrical components that are susceptible to damage from static discharge. See Table 6-1 for relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Observe the following precautions to avoid damage:

1. Minimize handling of static-sensitive components.

2. Transport and store static-sensitive components or assemblies in their original containers, on a metal rail, or on conductive foam. Label any package that contains static-sensitive assemblies or components.

3. Discharge the static voltage from your body by wearing a wrist strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.

4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.

5. Keep the component leads shorted together whenever possible.

6. Pick up components by the body, never by the leads.

7. Do not slide the components over any surface.

8. Avoid handling components in areas that have a floor or work surface covering capable of generating a static charge.

9. Use a soldering iron that is connected to earth ground.

10. Use only special antistatic suction type or wick type desoldering tools.

Table 6-1
RELATIVE SUSCEPTIBILITY TO STATIC DISCHARGE DAMAGE

Semiconductor Classes	Relative Susceptibility Levels[a]
MOS or CMOS microcircuits or discretes, or linear microcircuits with MOS inputs. (Most Sensitive)	1
ECL	2
Schottky signal diodes	3
Schottky TTL	4
High-frequency bipolar transistors	5
JFETs	6
Linear microcircuits	7
Low-power Schottky TTL	8
TTL (Least Sensitive)	9

[a] **Voltage equivalent for levels:**

1 = 100 to 500 V 4 = 500 V 7 = 400 to 1000 V(est.)
2 = 200 to 500 V 5 = 400 to 600 V 8 = 900 V
3 = 250 V 6 = 600 to 800 V 9 = 1200 V

(Voltage discharged from a 100 pF capacitor through a resistance of 100 Ω.)

GENERAL MAINTENANCE

Except for the Service Display LED in the MI 5010, general maintenance procedures for the 50M70 are similar to the general maintenance procedures for the MI 5010. Refer to the MI 5010/MX 5010 Instruction manual.

TROUBLESHOOTING

Refer to the Theory of Operation section of this manual and the schematic diagrams to gain an understanding of circuit operation.

To help determine the cause of the difficulty, run the test programs given in the Performance Check section of this manual.

Most problems can be solved using conventional digital troubleshooting techniques. To eliminate external circuits as possible sources of trouble, disconnect the user's interface circuitry at the data port connectors and from the power supply being used; (P1205, +5 V), (P1301, +26 V), (P1305, −26 1V), or (P1405, +8 V). Refer to circuit board illustration in the foldout pages.

SERVICE/TEST PROCEDURE

1. Preliminary Procedure

a. Perform Steps 1a through 1d (and read the NOTE following Step 1d) located in the Performance Check procedure, except that the following program allows you to insert the 50M70 in any desired slot and use any legal GPIB address for the MI 5010

2. Running the Service/Test Program (50M70 TEST 2)

a. Enter or load the following program into the controller's memory. When you are ready to run the program type RUN <CR> or press user-defined key #1. To get a list of the other user-defined keys and their purpose, press user-defined key #5 (UD #5). The program will prompt you for the address of the MI 5010, the card slot number, the data you want to send to the card, the number of times that you want the program to run, and whether or not you want to check the handshake process.

b. If there is no fault or error on the 50M70 you will receive the following message, repeated every time you run the program:

ALL I/O CHECK OK
HANDSHAKE CHECKS OK

NOTE

If error code numbers appear, refer to Status Byte and Error Code information in the 50M70 and MI 5010/MX 5010 instruction manuals.

c. In the event of a fault or error on the 50M70 information will be displayed that should help you to determine which portion of this test or what data to run next. For example, using UDK #2 input data equivalent to decimal 19 and run it one time. Then double the data value to decimal 38 and run UDK #2 again. Double the data value four times and run it four times. At this time, if no errors occur, you have verified that all CHA 4 and CHA 3 input/output pins are free from opens, or shorts to another pin or signal level. Checking binary values for data received against binary values for data sent allows you to locate the faulty data point.

d. User-defined key #4 (UDK #4) is used as a repeat key. Once you have entered the information requested for any portion of the test, pressing UDK #4 will cause the last test done to be repeated without having to re-enter the necessary information to run the program.

e. When you have completed checking and testing CHA 4 to CHA 3 interchange, the connectors on J1200 (CHA 1) and J1214 (CHA 3) and use UDK #3 to check and test CHA 2 as an output with CHA 3 as an input. Again, UDK #4 can be used to repeat the last test done without re-entering information.

f. When you have completed checking and testing CHA 2 and CHA 3 you have tested the flag and data conditions on all three handshake channels.

FILE # 18

```
2 REM *** 50M70 TEST 2 *** SERVICE/TEST PROCEDURE ***
3 REM     RUN PROGRAM FROM THE BEGINNING-     KEY #1
4 GO TO 110
7 REM     RE-RUN, OMIT ADDRESS AND CHANNEL SETUP-     KEY#2
8 GO TO 280
11 REM     EXECUTE CHANNEL 2 TO CHANNEL 3 HANDSHAKE-     KEY #3
12 GO TO 680
15 REM     RE-RUN LAST TEST DONE WITHOUT ANY CHANGES-     KEY #4
16 GO TO 300
19 REM     DISPLAY USER DEFINED KEY OPTIONS-     KEY #5
20 PAGE
21 LIST 1,19
22 END
100 REM     START OF PROGRAM, NORMAL ENTRY POINT FOR UD KEY #1
110 INIT
120 T=0
130 ON SRQ THEN 1510
140 PAGE
150 PRINT @32,26:0
160 GOSUB 1210
170 PRINT "ENTER THE SLOT # (1-6) OF THE CARD UNDER TEST: ";
180 INPUT S
190 IF S<1 OR S>6 THEN 170
200 PRINT "DO YOU WISH TO CHECK THE HANDSHAKE ? (Y OR N): ";
210 H=0
220 INPUT H$
230 H$=SEG(H$,1,1)
240 IF H$<>"Y" THEN 260
250 H=1
260 J=4
270 REM     ENTRY POINT FOR UD KEY #2
280 GOSUB 1010
290 REM     ENTRY POINT FOR UD KEY #4
300 FOR U=1 TO V
310    PRINT @T:"INIT;SEL ";S
320    E=0
330    R=0
340    FOR C=1 TO 4
350       PRINT @T:"CHA ";C;";DIR?"
360       INPUT @T:D
370       IF D=0 THEN 400
380       R=1
390       PRINT "*** INIT ERROR - CHA ";C;" EXPECT 0, READ ";D
400       NEXT C
410    IF R=0 THEN 430
420    STOP
430    DATA 0,255,0,255,255,0,255,0
440    E=I
450    FOR G=1 TO 2
460       FOR C=1 TO 4
470          READ B
480          PRINT @T:"CHA ";C;";DIR ";B;";DAT ";E
490          NEXT C
500       FOR F=G TO 4 STEP 2
510          PRINT @T:"CHA ";F;";DAT?"
520          INPUT @T:D
530          IF D=E THEN 560
540          PRINT "*** RUN ERROR - CHA ";F;" SENT: ";E;" READ: ";D
```

```
550          STOP
560          NEXT F
570       E=255-E
580       NEXT G
590    RESTORE 430
600    PRINT @32,26;2
610    PRINT " ALL I/O CHECK O.K."
620    IF H=0 THEN 640
630    GOSUB 820
640    NEXT U
650 PRINT "PROGRAM COMPLETE,  EXECUTED ";V;" TIMES."
660 END
670 REM     ENTRY POINT FOR UD KEY #3
680 J=2
700 GOSUB 1210
710 ON SRQ THEN 1510
720 PAGE
730 GOSUB 1010
740 E=I
750 PRINT "SWAP CONNECTORS ON J1200 & J1214. HIT RETURN TO CONT."
760 INPUT H$
770 FOR U=1 TO V
780    GOSUB 820
790    NEXT U
800 GO TO 650
810 REM     SUBROUTINE FOR CHAN (2 OR 4) TO CHAN 3 HANDSHAKE
820 E=255-E
830 PRINT @T:"CHA ";J;";DIR 255;ARM COND;FLAG?;CHA 3;DIR 0;ARM COND;"
840 PRINT @T:"CHA 1;DIR 0;CHA ";J;";DAT ";E
850 PRINT @T:"CHA ";J;";FLAG?;CHA 3;FLAG?;DAT?;FLAG?;CHA ";J;";FLAG?;"
860 INPUT @T:K,L,M,N,O
870 PRINT "CHA ";J;" FLAG=";K;" CHA 3 FLAG=";L;",DAT=";M;",FLAG=";N;
880 PRINT "   CHA ";J;" FLAG=";O
890 IF K=0 AND O=0 AND M<>E THEN 940
900 IF K<>0 OR L<>1 OR N<>0 OR O<>1 THEN 970
910 IF M<>E THEN 960
920 PRINT " HANDSHAKE CHECKS O.K. "
930 RETURN
940 PRINT "*** DID YOU FORGET TO SWAP J1200 AND J1214?"
950 STOP
960 PRINT "*** BAD DATA RECEIVED, POSSIBLE"
970 PRINT "    HANDSHAKE ERROR-CHECK FLAGS"
980 PRINT "    CHANNEL ";J;" SENT: ";E;"   RECV: ";M
990 STOP
1000 REM     SET OUTPUT DATA AND LOOP COUNT
1010 RESTORE 430
1020 PRINT "ENTER INITIAL OUTPUT DATA (0-255) : ";
1030 INPUT I
1040 PRINT "HOW MANY TIMES SHOULD THE PROGRAM RUN ?: ";
1050 INPUT V
1060 RETURN
1200 REM     INPUT GPIB ADDRESS
1210 IF T<>0 THEN 1250
1220 PRINT "ENTER THE GPIB ADDRESS (1-30) OF THE MI5010: ";
1230 INPUT T
1240 IF T<1 OR T>30 THEN 1220
1250 RETURN
1500 REM     SRQ HANDLER
1510 GOSUB 1200
1520 POLL X,Y;T
1530 IF Y>83 AND Y<>128 THEN 1550
1540 RETURN
1550 PRINT "*** SRQ ASSERTED, STATUS BYTE WAS: ";Y
1560 PRINT @T:"ERR?"
1570 INPUT @T:Z
1580 PRINT "*** ERROR QUERY RESPONSE WAS: ";Y
1590 STOP
```

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

LIST OF ASSEMBLIES

A list of assemblies can be found at the beginning of the Electrical Parts List. The assemblies are listed in numerical order. When the complete component number of a part is known, this list will identify the assembly in which the part is located.

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

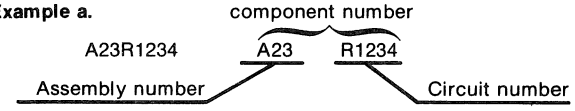
ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

COMPONENT NUMBER (column one of the Electrical Parts List)

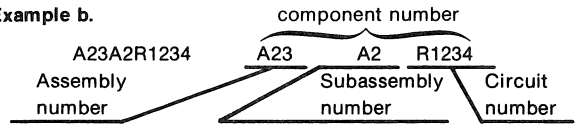
A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:

Example a.



Read: Resistor 1234 of Assembly 23

Example b.



Read: Resistor 1234 of Subassembly 2 of Assembly 23

Only the circuit number will appear on the diagrams and circuit board illustrations. Each diagram and circuit board illustration is clearly marked with the assembly number. Assembly numbers are also marked on the mechanical exploded views located in the Mechanical Parts List. The component number is obtained by adding the assembly number prefix to the circuit number.

The Electrical Parts List is divided and arranged by assemblies in numerical sequence (e.g., assembly A1 with its subassemblies and parts, precedes assembly A2 with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix and are located at the end of the Electrical Parts List.

TEKTRONIX PART NO. (column two of the Electrical Parts List)

Indicates part number to be used when ordering replacement part from Tektronix.

SERIAL/MODEL NO. (columns three and four of the Electrical Parts List)

Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.

NAME & DESCRIPTION (column five of the Electrical Parts List)

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

MFR. CODE (column six of the Electrical Parts List)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

MFR. PART NUMBER (column seven of the Electrical Parts List)

Indicates actual manufacturers part number.

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000JJ	INDUSTRIAL DEVICES	700 HUDSON AVE	EDGEWATER, NJ 07020
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A71	670-7204-00			CKT BOARD ASSY:DEVELOPMENT	80009	670-7204-00
A71C1000	290-0755-00			CAP.,FXD,ELCTLT:100UF,+50-10%,10V	56289	502D223
A71C1001	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A71C1010	290-0755-00			CAP.,FXD,ELCTLT:100UF,+50-10%,10V	56289	502D223
A71C1011	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A71C1100	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A71C1101	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A71C1200	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A71C1210	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A71C1211	281-0813-00			CAP.,FXD CER DI:0.047UF,20%,50V	04222	GC705-E-473M
A71DS1401	150-1107-00			LT EMITTING DIO:RED,650NM,20MA	000JJ	5321A11
A71DS1402	150-1107-00			LT EMITTING DIO:RED,650NM,20MA	000JJ	5321A11
A71Q1211	151-0281-00			TRANSISTOR:SILICON,NPN	03508	X16P4039
A71Q1212	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A71R1111	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
A71R1112	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
A71R1113	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
A71R1114	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
A71R1115	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
A71R1202	315-0205-00			RES.,FXD,CMPSN:2M OHM,5%,0.25W	01121	CB2055
A71R1211	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
A71R1213	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
A71R1214	315-0824-00			RES.,FXD,CMPSN:820K OHM,5%,0.25W	01121	CB8245
A71R1215	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
A71R1216	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	01121	CB2745
A71R1218	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
A71R1220	307-0595-00			RES NTWK,FXD FI:7,5.6K OHM,2%,1.0W	32997	4308R-101-562
A71TP1010	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A71TP1201	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A71TP1211	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A71U1000	156-0956-02			MICROCIRCUIT,DI:OCTAL BFR W/3STATE OUT	01295	SN74LS244NP3
A71U1002	156-0956-02			MICROCIRCUIT,DI:OCTAL BFR W/3STATE OUT	01295	SN74LS244NP3
A71U1002	156-0956-02			MICROCIRCUIT,DI:OCTAL BFR W/3STATE OUT	01295	SN74LS244NP3
A71U1011	156-1111-02			MICROCIRCUIT,DI:OCTAL BUS TRANSCEIVERS	01295	SN74LS245JP3
A71U1100	160-1481-01			MICROCIRCUIT,DI:2048 X 8,EPROM,PRGM	80009	160-1481-01
A71U1101	156-0469-02			MICROCIRCUIT,DI:3/8 LINE DCDR	01295	SN74LS138NP3
A71U1103	156-1205-00			MICROCIRCUIT,DI:PERIPHERAL INTFC ADAPTER	80009	156-1205-00
A71U1110	156-0384-02			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE	01295	SN74LS03
A71U1111	156-1205-00			MICROCIRCUIT,DI:PERIPHERAL INTFC ADAPTER	80009	156-1205-00
A71U1200	156-0058-02			MICROCIRCUIT,DI:HEX INVRTR,SCREENED	01295	SN7404

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The overline on a signal name indicates that the signal performs its intended function when it is in the low state.

Abbreviations are based on ANSI Y1.1-1972.

Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

Y14.15, 1966	Drafting Practices.
Y14.2, 1973	Line Conventions and Lettering.
Y10.5, 1968	Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

American National Standard Institute
1430 Broadway
New York, New York 10018

Component Values

Electrical components shown on the diagrams are in the following units unless noted otherwise:

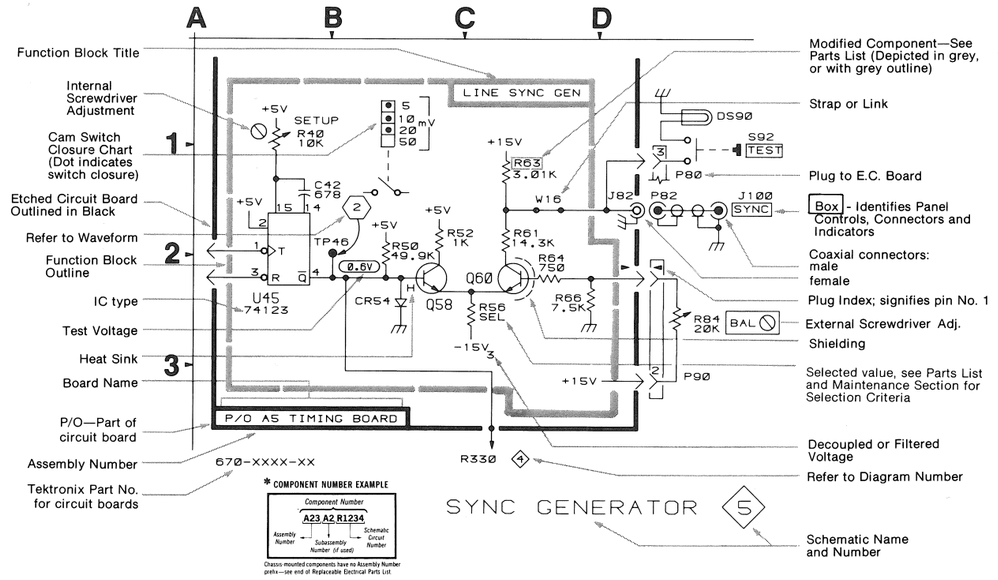
Capacitors = Values one or greater are in picofarads (pF). Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

The information and special symbols below may appear in this manual.

Assembly Numbers and Grid Coordinates

Each assembly in the instrument is assigned an assembly number (e.g., A20). The assembly number appears on the circuit board outline on the diagram, in the title for the circuit board component location illustration, and in the lookup table for the schematic diagram and corresponding component locator illustration. The Replaceable Electrical Parts list is arranged by assemblies in numerical sequence; the components are listed by component number *(see following illustration for constructing a component number).

The schematic diagram and circuit board component location illustration have grids. A lookup table with the grid coordinates is provided for ease of locating the component. Only the components illustrated on the facing diagram are listed in the lookup table. When more than one schematic diagram is used to illustrate the circuitry on a circuit board, the circuit board illustration may only appear opposite the first diagram on which it was illustrated; the lookup table will list the diagram number of other diagrams that the circuitry of the circuit board appears on.



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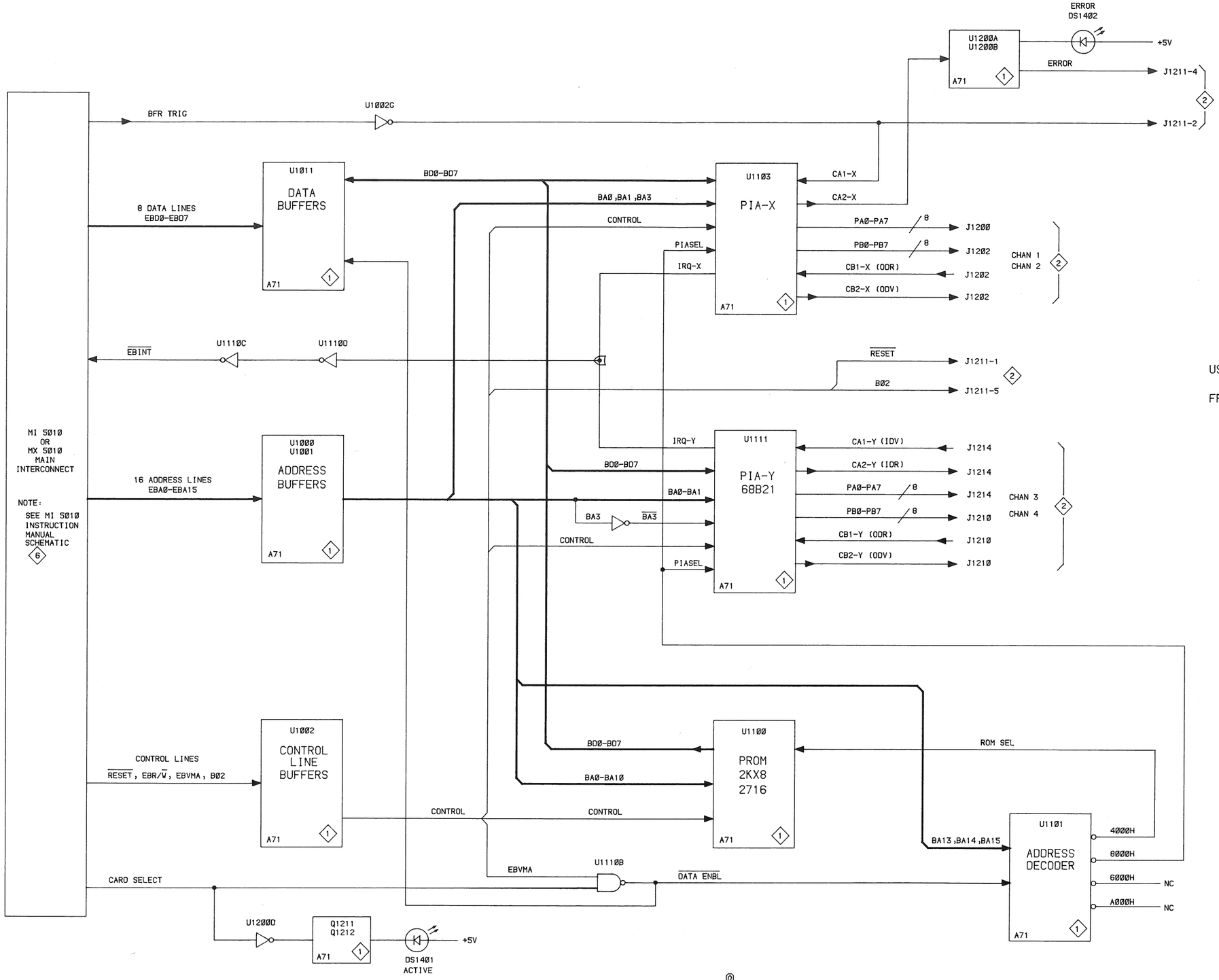
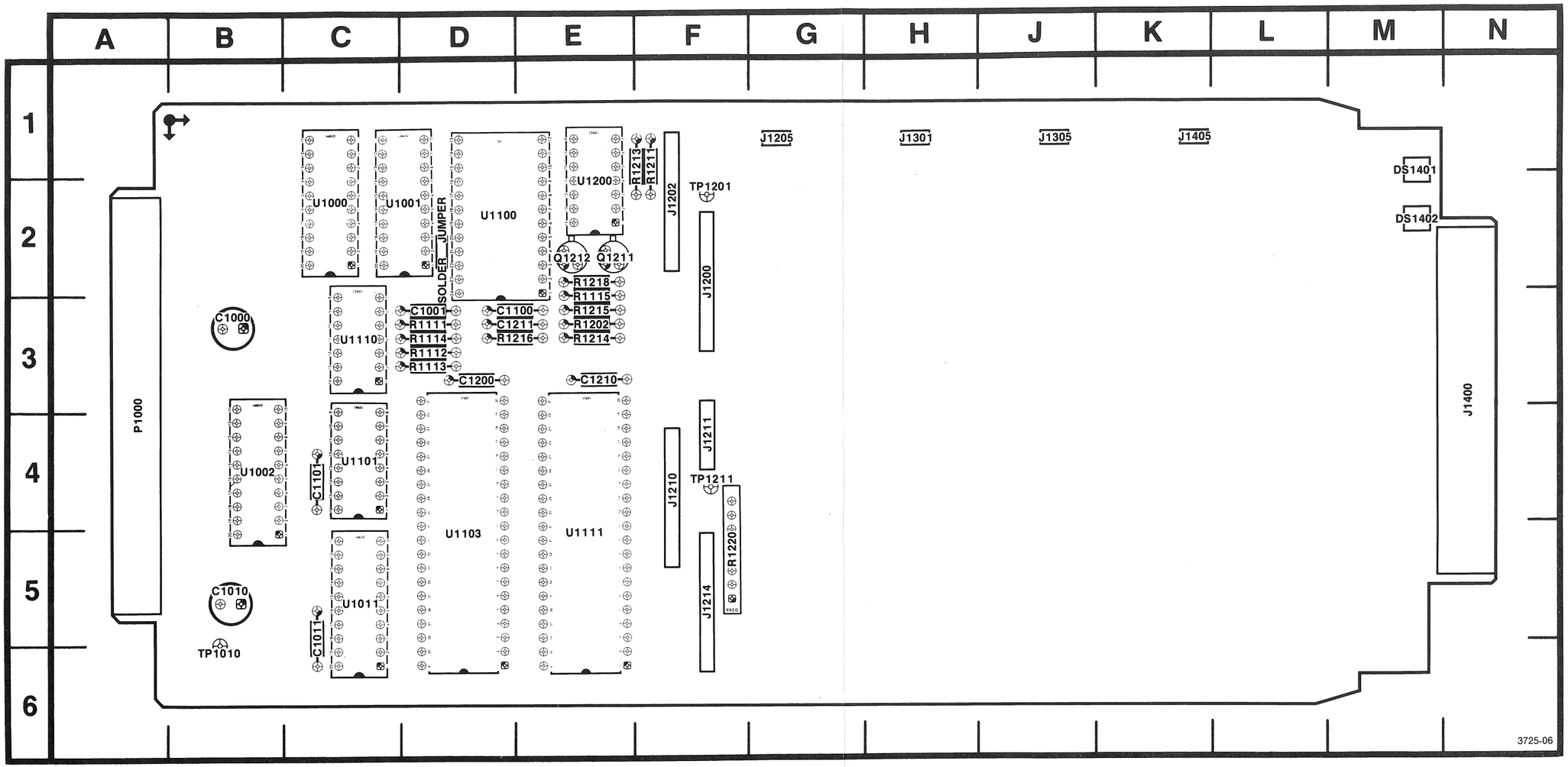

ERROR
DS1402
U1200A
U1200B
A71
+5V
ERROR
J1211-4
J1211-2
BFR TRIG
U1002G
U1011
DATA
BUFFERS
A71
8 DATA LINES
EBD0-EBD7
BD0-BD7
BA0 ,BA1 ,BA3
CONTROL
PIASEL
IRQ-X
U1103
PIA-X
A71
CA1-X
CA2-X
PA0-PA7
PB0-PB7
CB1-X (ODR)
CB2-X (ODV)
J1200
J1202
J1202
J1202
CHAN 1
CHAN 2
EBINT
U1110C
U1110D
RESET
B02
J1211-1
J1211-5
USER DEVELOPMENT AREA
AND
FRONT PANEL INTERFACE
MI 5010
OR
MX 5010
MAIN
INTERCONNECT
NOTE:
SEE MI 5010
INSTRUCTION
MANUAL
SCHEMATIC
6
U1000
U1001
ADDRESS
BUFFERS
A71
16 ADDRESS LINES
EBA0-EBA15
IRQ-Y
BD0-BD7
BA0-BA1
BA3
BA3
CONTROL
PIASEL
U1111
PIA-Y
68B21
A71
CA1-Y (IDV)
CA2-Y (IDR)
PA0-PA7
PB0-PB7
CB1-Y (ODR)
CB2-Y (ODV)
J1214
J1214
J1214
J1210
J1210
J1210
CHAN 3
CHAN 4
U1002
CONTROL
LINE
BUFFERS
A71
CONTROL LINES
RESET, EBR/W, EBVMA, B02
CONTROL
CONTROL
BD0-BD7
BA0-BA10
U1100
PROM
2KX8
2716
A71
ROM SEL
BA13 ,BA14 ,BA15
U1101
ADDRESS
DECODER
A71
4000H
8000H
6000H
A000H
NC
NC
EBVMA
U1110B
DATA ENBL
CARD SELECT
U1200D
Q1211
Q1212
A71
DS1401
ACTIVE
+5V

PARTS LOCATION GRID

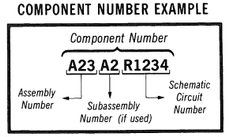
FIG. 8-1
COMPONENT LOCATION (A71 ASSY)



ASSY A71

Fig. 8-1. Development board (A71 Assembly)

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Static Sensitive Devices
See Maintenance Section

@

FIG. 8-1
COMPONENT LOCATION (A71 ASSY)

Table 8-1
COMPONENT REFERENCE CHART

P/O A71 ASSY — DEVELOPMENT BOARD ◇1

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
C1000	C3	B3
C1001	D6	D3
C1010	C3	B5
C1011	E1	C5
C1100	H6	D3
C1101	H9	C4
C1200	G1	D3
C1210	L2	E3
C1211	K11	D3
DS1401	L10	M1
DS1402	J3	M2
P1000	B2	A3
Q1211	L11	E2
Q1212	K11	E2
R111	F10	D3
R1112	G6	D3
R1113	K7	D3
R1114	L7	D3
R1115	J10	E3
R1202	L11	E3
R1211	K3	F1
R1213	L10	F1
R1214	K11	E3
R1215	K10	E3
R1216	K11	D3
R1218	J11	E2
R1220	M2	F5
TP1010	C6	B6
U1000	D7	C2
U1001	D9	C2
U1002	C4	B4
U1011	E3	C5
U1100	H7	D2
U1101	H9	C4
U1103	G1	D4
U1110	G6	C3
U111	L2	E4
U1200	J3	E2

P/O A71 ASSY also shown on ◇2

U1103 68B21 (PIA-X)
U1111 68B21 (PIA-Y)
U1011 74LS245
U1000 74LS244
U1001 74LS244
U1002A 74LS244
U1002B 74LS244
U1002C 74LS244
U1002D 74LS244
U1002E 74LS244
U1002F 74LS244
U1002G 74LS244
U1100 2716
U1101 74LS138
U1110A LS03
U1110B LS03
U1110C LS03
U1110D LS03
U1200A 7404
U1200B 7404
U1200C 7404
U1200D 7404

CHAN 1 (INPUT)
CHAN 2 (OUTPUT)
CHAN 3 (INPUT)
CHAN 4 (OUTPUT)

TYPE	+5V	GND
2716	12	24
68B21	20	1
7404		
74LS138	16	8
74LS244	20	10
74LS245	20	10
LS03	14	7

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

P/O A71 DEVELOPMENT BOARD

50M70 — 3725-50 — MEMORY & DECODERS — 1 JCS

COMPONENT LOCATION (A71 ASSY)

Table 8-2
COMPONENT REFERENCE CHART
(see Fig. 8-1)

P/O A71 ASSY — DEVELOPMENT BOARD ◇2

CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEMATIC LOCATION	BOARD LOCATION
J1200	E4	F2	P1000	B4	A3
J1202	D2	F2	P1205	E1	G1
J1205	E1	G1	P1301	F2	H1
J1210	D7	F4	P1305	H1	J1
J1211	E6	F4	P1405	I2	K1
J1214	E9	F5			
J1301	F2	H1	TP1201	C4	F2
J1305	H1	J1	TP1211	D8	F4
J1400	K2	N3			
J1405	I2	K1			

P/O A71 ASSY also shown on ◇1

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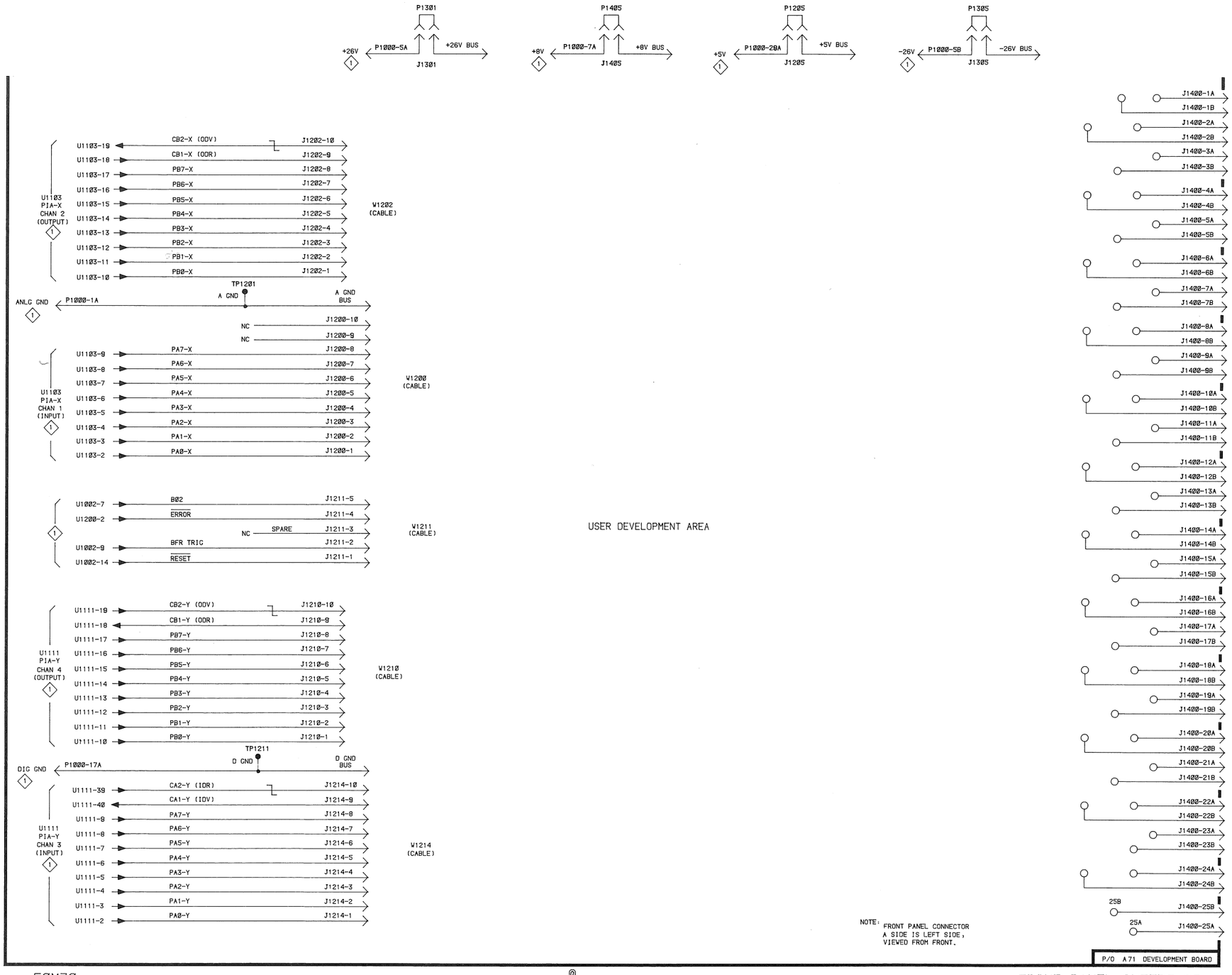
P1301
+26V
P1000-5A
+26V BUS
J1301
P1405
+8V
P1000-7A
+8V BUS
J1405
P1205
+5V
P1000-28A
+5V BUS
J1205
P1305
-26V
P1000-5B
-26V BUS
J1305
U1103 P1A-X CHAN 2 (OUTPUT)
U1103-19 CB2-X (ODV) J1202-10
U1103-18 CB1-X (ODR) J1202-9
U1103-17 PB7-X J1202-8
U1103-16 PB6-X J1202-7
U1103-15 PB5-X J1202-6
U1103-14 PB4-X J1202-5
U1103-13 PB3-X J1202-4
U1103-12 PB2-X J1202-3
U1103-11 PB1-X J1202-2
U1103-10 PB0-X J1202-1
W1202 (CABLE)
ANLG GND
P1000-1A
TP1201
A GND
A GND BUS
J1200-10
NC
J1200-9
NC
U1103 P1A-X CHAN 1 (INPUT)
U1103-9 PA7-X J1200-8
U1103-8 PA6-X J1200-7
U1103-7 PA5-X J1200-6
U1103-6 PA4-X J1200-5
U1103-5 PA3-X J1200-4
U1103-4 PA2-X J1200-3
U1103-3 PA1-X J1200-2
U1103-2 PA0-X J1200-1
W1200 (CABLE)
U1002-7 B02 J1211-5
U1200-2 ERROR J1211-4
NC SPARE J1211-3
U1002-9 BFR TRIG J1211-2
U1002-14 RESET J1211-1
W1211 (CABLE)
USER DEVELOPMENT AREA
U1111 P1A-Y CHAN 4 (OUTPUT)
U1111-19 CB2-Y (ODV) J1210-10
U1111-18 CB1-Y (ODR) J1210-9
U1111-17 PB7-Y J1210-8
U1111-16 PB6-Y J1210-7
U1111-15 PB5-Y J1210-6
U1111-14 PB4-Y J1210-5
U1111-13 PB3-Y J1210-4
U1111-12 PB2-Y J1210-3
U1111-11 PB1-Y J1210-2
U1111-10 PB0-Y J1210-1
W1210 (CABLE)
DIG GND
P1000-17A
TP1211
D GND
D GND BUS
U1111 P1A-Y CHAN 3 (INPUT)
U1111-39 CA2-Y (IOR) J1214-10
U1111-40 CA1-Y (IOV) J1214-9
U1111-9 PA7-Y J1214-8
U1111-8 PA6-Y J1214-7
U1111-7 PA5-Y J1214-6
U1111-6 PA4-Y J1214-5
U1111-5 PA3-Y J1214-4
U1111-4 PA2-Y J1214-3
U1111-3 PA1-Y J1214-2
U1111-2 PA0-Y J1214-1
W1214 (CABLE)
J1400-1A
J1400-1B
J1400-2A
J1400-2B
J1400-3A
J1400-3B
J1400-4A
J1400-4B
J1400-5A
J1400-5B
J1400-6A
J1400-6B
J1400-7A
J1400-7B
J1400-8A
J1400-8B
J1400-9A
J1400-9B
J1400-10A
J1400-10B
J1400-11A
J1400-11B
J1400-12A
J1400-12B
J1400-13A
J1400-13B
J1400-14A
J1400-14B
J1400-15A
J1400-15B
J1400-16A
J1400-16B
J1400-17A
J1400-17B
J1400-18A
J1400-18B
J1400-19A
J1400-19B
J1400-20A
J1400-20B
J1400-21A
J1400-21B
J1400-22A
J1400-22B
J1400-23A
J1400-23B
J1400-24A
J1400-24B
25B
J1400-25B
25A
J1400-25A
P/O A71 DEVELOPMENT BOARD
NOTE: FRONT PANEL CONNECTOR A SIDE IS LEFT SIDE, VIEWED FROM FRONT.
Static Sensitive Devices
See Maintenance Section
COMPONENT NUMBER EXAMPLE
Component Number
A23 A2 R1234
Assembly Number
Subassembly Number (if used)
Schematic Circuit Number
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 *Name & Description*

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153

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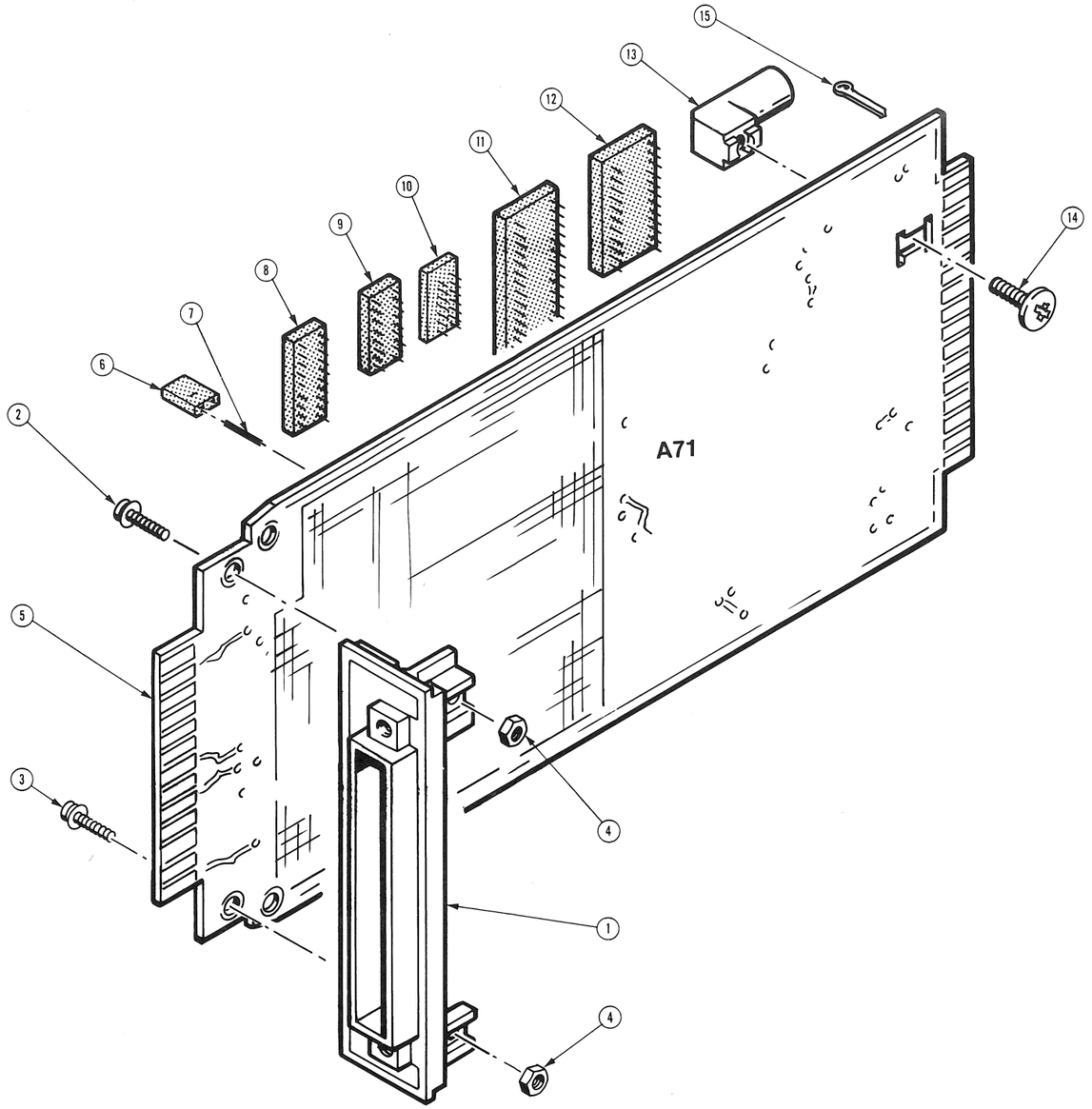
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	333-2859-00			1		PANEL,FRONT:W/SUBPANEL	80009	333-2859-00
						(ATTACHING PARTS)		
-2	211-0121-00			1		SCR,ASSEM WSHR:4-40 X 0.438 INCH,PNH BRS	83385	OBD
-3	211-0116-00			1		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
-4	210-0551-00			2		NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	000BK	OBD
						- - - * - - -		
-5	----- -----			1		CKT BOARD ASSY:DEVELOPMENT(SEE A71 REPL)		
-6	131-0993-00			4		. BUS,CONDUCTOR:2 WIRE BLACK	00779	530153-2
-7	131-0608-00			53		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-8	136-0634-00	B010100	B010164	4		. SOCKET,PLUG-IN:20 LEAD DIP,CKT BD MTG	73803	CS9002-20
	136-0752-00	B010165		1		. SKT,PL-IN ELEK:MICROCIRCUIT,20 DIP	09922	DILB20P-108
-9	136-0260-02	B010100	B010164	1		. SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CLE	71785	133-51-92-008
	136-0728-00	B010165		1		. SKT,PL-IN ELEK:MICROCKT,14 CONTACT	09922	DILB14P-108
-10	136-0269-02	B010100	B010164X	2		. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE	73803	CS9002-14
-11	136-0623-00	B010100	B010164	2		. SOCKET,PLUG-IN:40 DIP,LOW PROFILE	73803	CS9002-40
	136-0757-00	B010165		2		. SKT,PL-IN ELEK:MICROCKT,40 PIN	09922	DILB40P-108
-12	136-0578-00	B010100	B010164	1		. SKT,PL-IN ELEK:MICROCKT,24 PIN,LOW PROFILE	73803	C S9002-24
	136-0751-00	B010165		1		. SKT,PL-IN ELEK:MICROCKT,24 PIN	09922	DILB24P108
-13	214-3230-00			1		. FASTENER,MDL:POLYCARBONATE	80009	214-3230-00
						(ATTACHING PARTS)		
-14	213-0041-00			1		. SCR,TPG,THD CTG:6-32 X 0.375 INCH,TRH STL	83385	OBD
						- - - * - - -		
-15	----- -----			3		. TERM TEST POINT:(SEE A71TP1010,TP1201,		
	----- -----			-		. TP1211 REPL)		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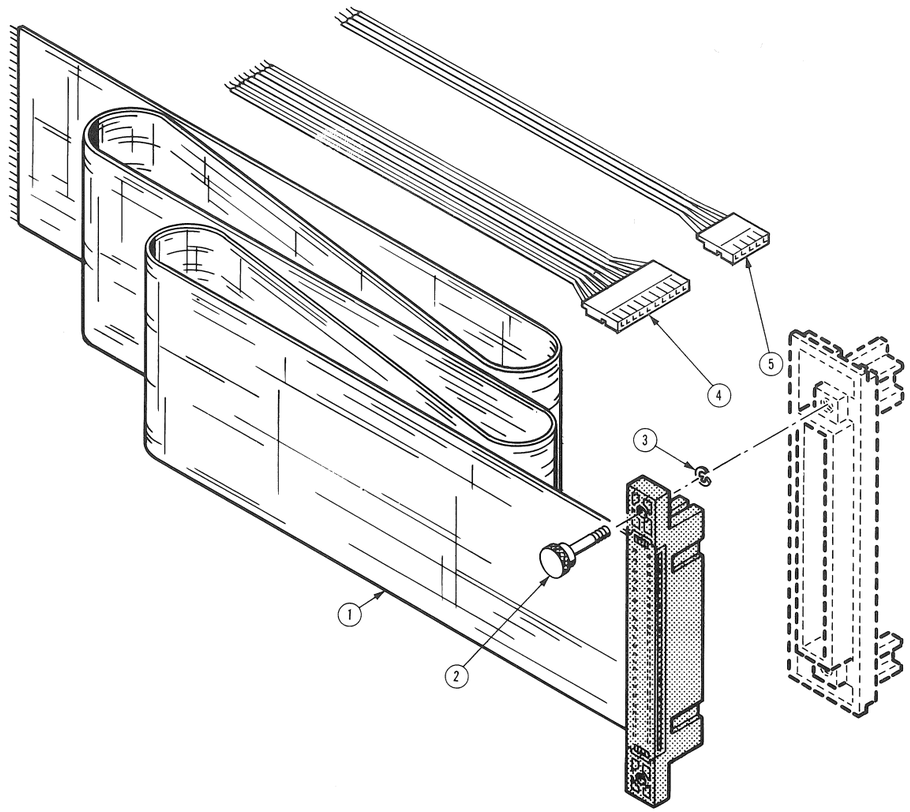

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
						STANDARD ACCESSORIES		
-1	015-0430-00			1		CABLE ASSY:EXTENDER	80009	015-0430-00
-2	213-0889-00			2		. THUMBSCREW:4-40 X 0.45 L,0.25 OD,SST	80009	213-0889-00
-3	354-0350-00			3		. RING,RETAINING:0.073"FREE ID X 0.015",STL	79136	5133-9MD
-4	175-4427-00			4		CA ASSY,SP,ELEC:10,26 AWG,8.0L,RIBBON	80009	175-4427-00
-5	175-3612-00			1		CA ASSY,SP,ELEC:5,26 AWG,8.0 L,RIBBON	80009	175-3612-00
	070-3725-00			1		MANUAL,TECH:INSTRUCTION	80009	070-3725-00
	070-3886-00			1		CARD,INFO:REFERENCE	80009	070-3886-00