



## **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. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.

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

# **2445/2465 OPTION 01 DMM OPTION SERVICE**

## **INSTRUCTION MANUAL**

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


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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  
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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 and do 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.

## Terms as Marked on Equipment

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

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

## Symbols 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 source that does 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 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 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 Power Cord

Use only the power cord and connector specified for your product.

Use only a power cord that is in good condition.

## Use the Proper Fuse

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

## 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 Remove Covers or Panels

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.

## **SERVICING SAFETY SUMMARY**

### ***FOR QUALIFIED SERVICE PERSONNEL ONLY***

*Refer also to 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.

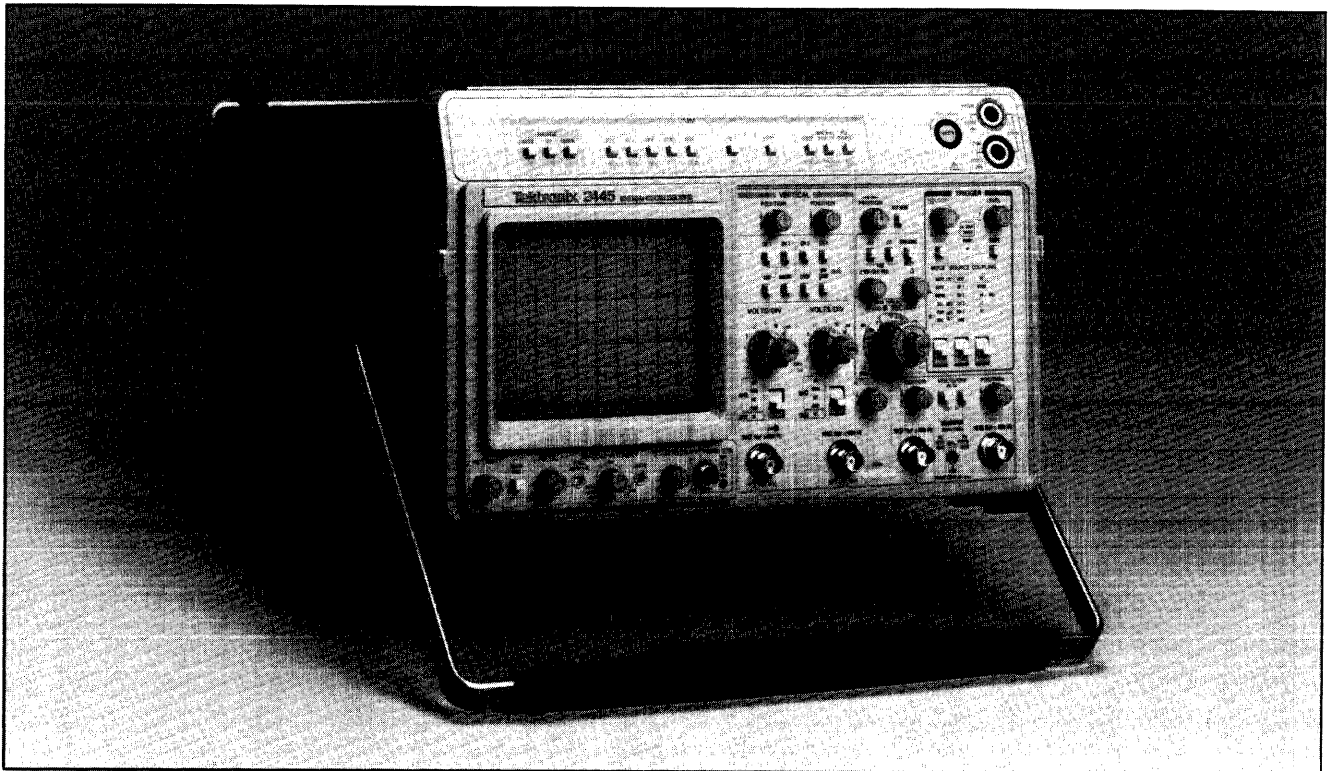
#### **Use Care When Servicing With Power On**

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

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

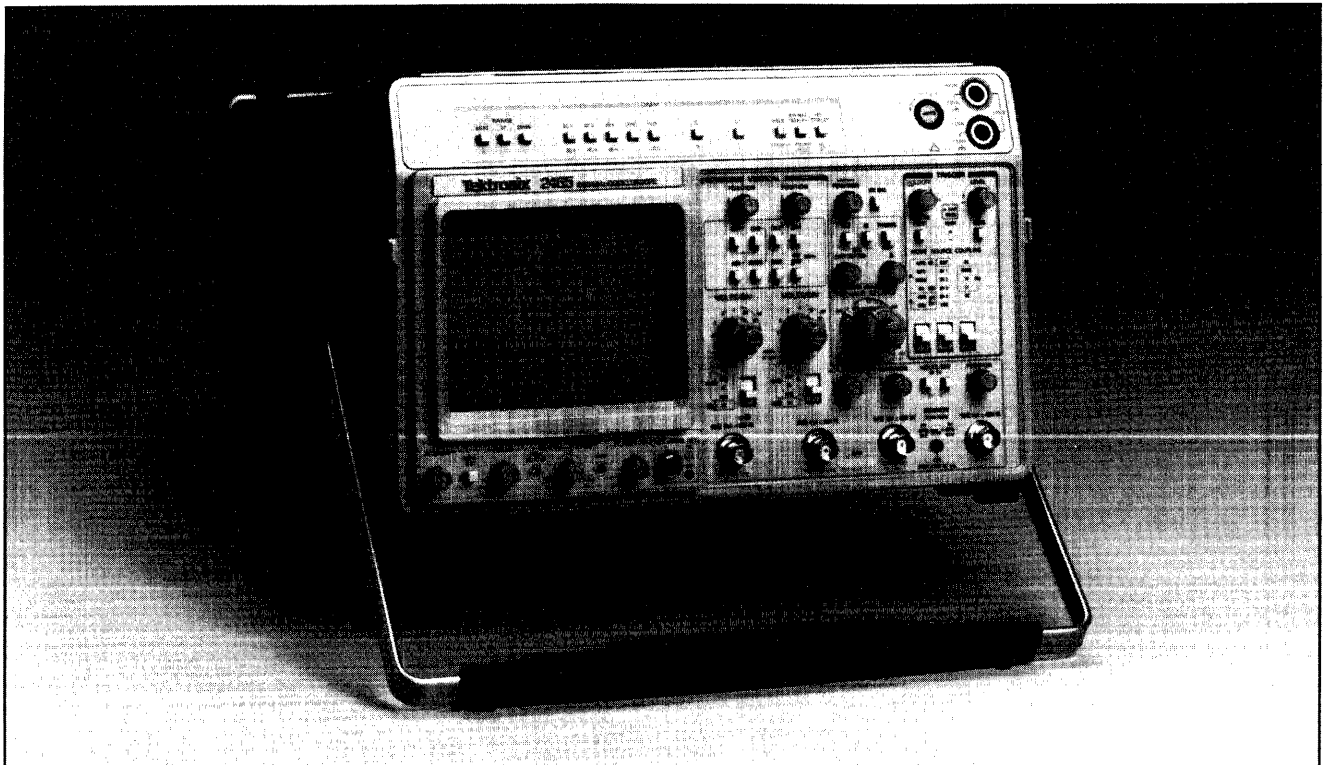
#### **Power Source**

This product is intended to operate from a power source that does 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.



4183-01

The 2445 Option 01 (DMM) Oscilloscope.



4183-02

The 2465 Option 01 (DMM) Oscilloscope.

# SPECIFICATION

## INTRODUCTION

Option 01 (DMM) to the TEKTRONIX 2445 and 2465 Oscilloscopes is a 4-1/2 digit, fully autoranging digital multimeter which measures dc and ac voltage and current, resistance, dBV, dBm, continuity, and temperature. Option 1B is the same as Option 01 except that the temperature probe is not included. The DMM is controlled by "soft" front-panel switches which are used by the operator to determine the function or operation to be performed. All the controls are contained in the extended front panel.

Measurement results and DMM messages are displayed on the top line of the oscilloscope crt readout. The processor can turn off the DMM when a display conflict arises either between the DMM and the standard oscilloscope or between the DMM and an option.

When the GPIB (General Purpose Information Bus) Option (Option 10) is also installed in the oscilloscope, the DMM functions can be controlled and the measurement results read via the bus. All controls available from the DMM front panel are also available through the GPIB interface. GPIB control, which differs from front-panel control, explicitly turns functions on and off. The normal front-panel control switches work as toggles (when pressed, the function switches to the opposite state).

In addition to the standard accessories listed in the basic oscilloscope manuals, the following DMM Option standard accessories are provided:

- 2445/2465 Option 01 DMM Operators Manual
- 2445/2465 Option 01 DMM Reference Guide
- Probe Set
- Accessories to Probe Set
- P6602 Temperature Probe

The following optional accessories are also available for these options:

- 2445/2465 Option 01 DMM Service Manual
- Rain Jacket

For part numbers, refer to "Replaceable Parts List" (Section 6) of this manual. Your local Tektronix Field Office or representative can also provide information and ordering assistance.

## PERFORMANCE CONDITIONS

Except as noted in Tables 1-1 and 1-2 of this manual, the electrical, mechanical, and environmental characteristics of Option 01 instruments are identical to those specified in the respective 2445 or 2465 Oscilloscope Service Manual.

**Table 1-1**  
**Option 01 Electrical Characteristics**

Characteristics	Performance Requirements
<b>DC VOLTS</b>	
<b>Range Accuracies</b>	
+18°C to +28°C 200 mV, 2 V, 20 V, and 200 V	±(0.03% of reading + 0.01% of full scale).
500 V	±(0.03% of reading + 0.04% of full scale).
-15°C to +18°C and +28°C to +55°C 200 mV, 2 V, 20 V, and 200 V	Add ±(0.003% of reading + 0.001% of full scale)/°C below 18°C or above 28°C. <sup>a</sup>
500 V	Add ±(0.003% of reading + 0.004% of full scale)/°C below 18°C or above 28°C. <sup>a</sup>

<sup>a</sup>Performance Requirement not checked in the manual.

**Table 1-1 (cont)**

<b>Characteristics</b>	<b>Performance Requirements</b>
Common Mode Rejection Ratio	>100 dB at dc: >80 dB at 50 and 60 Hz, with 1 k $\Omega$ imbalance.
Normal Mode Rejection Ratio	>60 dB at 50 and 60 Hz.
Resolution	4-1/2 digits. <sup>a</sup>
Step Response Time	
Manual	Less than 1 second. <sup>a</sup>
Auto	Less than 2 seconds. <sup>a</sup>
Input Resistance	
200 mV and 2 V Ranges	>1 G $\Omega$ or 10 M $\Omega$ . <sup>a</sup>
20 V to 500 V Ranges	10 M $\Omega$ $\pm$ 1%. <sup>a</sup>
Maximum Input Voltage between Inputs or Ground	500 V rms; 700 V peak. <sup>a</sup>
Input Bias Current at 23°C Ambient Temperature	Less than 10 pA. <sup>a</sup>
Reading Rate	Approximately 3 per second. <sup>a</sup>

**AC VOLTS**

Range Accuracies	
+18°C to +28°C	
200 mV, 2 V, 20 V, and 200 V	Input signal between 5% and 100% of full scale.
40 Hz to 10 kHz	$\pm$ (0.3% of reading + 0.1% of full scale).
20 Hz to 40 Hz and 10 kHz to 20 kHz	$\pm$ (0.7% of reading + 0.1% of full scale).
20 kHz to 100 kHz	$\pm$ (5% of reading + 0.1% of full scale).
500 V	Input signal greater than 100 V and less than 500 V.
40 Hz to 10 kHz	$\pm$ (0.3% of reading + 0.2% of full scale).
20 Hz to 40 Hz and 10 kHz to 20 kHz	$\pm$ (0.7% of reading + 0.2% of full scale).
20 kHz to 100 kHz	$\pm$ (5% of reading + 0.2% of full scale).
-15°C to +18°C and +28°C to +55°C	
200 mV, 2 V, 20 V, and 200 V	Input signal between 5% and 100% of full scale.
40 Hz to 10 kHz	$\pm$ (0.5% of reading + 0.1% of full scale). <sup>a</sup>
20 Hz to 40 Hz and 10 kHz to 20 kHz	$\pm$ (1.0% of reading + 0.1% of full scale). <sup>a</sup>
20 kHz to 100 kHz	$\pm$ (6% of reading + 0.1% of full scale). <sup>a</sup>
500 V	Input signal greater than 100 V and less than 500 V.
40 Hz to 10 kHz	$\pm$ (0.5% of reading + 0.3% of full scale).
20 Hz to 40 Hz and 10kHz to 20 kHz	$\pm$ (1.0% of reading + 0.3% of full scale). <sup>a</sup>
20 kHz to 100 kHz	$\pm$ (6% of reading + 0.3% of full scale). <sup>a</sup>

<sup>a</sup>Performance Requirement not checked in the manual.

Table 1-1 (cont)

Characteristics	Performance Requirements
Common Mode Rejection Ratio	> 60 dB from dc to 60 Hz, with 1 k $\Omega$ imbalance.
Crest Factor	4 at full scale. <sup>a</sup>
Resolution	4-1/2 digits. <sup>a</sup>
Response Time	
Manual	Less than 2 seconds. <sup>a</sup>
Auto	Less than 3 seconds. <sup>a</sup>
Input Impedance	1 M $\Omega$ in parallel with less than 100 pF. <sup>a</sup>
Maximum V*Hz Product	10 <sup>7</sup> V*Hz. <sup>a</sup>
Maximum Input Voltage between Inputs and Ground	500 V rms; 700 V peak. <sup>a</sup>
dB Volts	
Accuracy	Same as AC VOLTS specification. <sup>a</sup>
Resolution	0.01 dB. <sup>a</sup>

**HI OHMS**

Range Accuracies	
+18°C to +28°C	
2 k $\Omega$ , 20 k $\Omega$ , 200 k $\Omega$ , and 2 M $\Omega$	$\pm(0.1\%$ of reading $+0.01\%$ of full scale).
20 M $\Omega$	$\pm(0.5\%$ of reading $+0.01\%$ of full scale).
-15°C to +18°C and +28°C to +55°C	
2 k $\Omega$ , 20 k $\Omega$ , and 200 k $\Omega$	Add $\pm(0.01\%$ of reading $+0.001\%$ of full scale)/°C above 28°C or below 18°C. <sup>a</sup>
2 M $\Omega$	Add $\pm(0.01\%$ of reading $+0.001\%$ of full scale)/°C above 28°C or below 18°C $\pm 2\%$ of reading per 10% relative humidity above 70% relative humidity. <sup>a</sup>
20 M $\Omega$	Add $\pm(0.05\%$ of reading $+0.001\%$ of full scale)/°C above 28°C or below 18°C $\pm 2\%$ of reading per 10% relative humidity above 70% relative humidity. <sup>a</sup>
Maximum Input Voltage	500 V rms; 700 V peak. <sup>a</sup>
Voltage at Full Scale	Approximately 2 V. <sup>a</sup>
Maximum Open Circuit Voltage	Less than 6 V. <sup>a</sup>
Range Measuring Current	
2 k $\Omega$	Approximately 1 mA. <sup>a</sup>
20 k $\Omega$	Approximately 0.1 mA. <sup>a</sup>
200 k $\Omega$	Approximately 10 $\mu$ A. <sup>a</sup>
2 M $\Omega$	Approximately 1 $\mu$ A. <sup>a</sup>
20 M $\Omega$	Approximately 0.1 $\mu$ A. <sup>a</sup>

<sup>a</sup>Performance Requirement not checked in the manual.

**Table 1-1 (cont)**

Characteristics	Performance Requirements
Resolution	4-1/2 digits. <sup>a</sup>
Range Response Time	
2 k $\Omega$ , 20 k $\Omega$ , 200 k $\Omega$ , and 2 M $\Omega$	
Manual	Less than 1 second. <sup>a</sup>
Auto	Less than 2 seconds. <sup>a</sup>
20 M $\Omega$	Less than 5 seconds. <sup>a</sup>
Range Reading Rate	
2 k $\Omega$ , 20 k $\Omega$ , 200 k $\Omega$ , and 2 M $\Omega$	Approximately 3 per second. <sup>a</sup>
20 M $\Omega$	Approximately 1.5 per second. <sup>a</sup>
<b>LO OHMS</b>	
Range Accuracies	
+18°C to +28°C	
200 $\Omega$	$\pm(0.1\%$ of reading $+0.1\%$ of full scale).
2 k $\Omega$ , 20 k $\Omega$ , and 200 k $\Omega$	$\pm(0.1\%$ of reading $+0.01\%$ of full scale).
2 M $\Omega$	$\pm(0.25\%$ of reading $+0.01\%$ of full scale).
-15°C to +18°C and +28°C to +55°C	
200 $\Omega$ , 2 k $\Omega$ , and 20 k $\Omega$	Add $\pm(0.01\%$ of reading $+0.001\%$ of full scale)/°C above 28°C or below 18°C. <sup>a</sup>
200 k $\Omega$	Add $\pm(0.01\%$ of reading $+0.001\%$ of full scale)/°C above 28°C or below 18°C $\pm 2\%$ of reading per 10% relative humidity above 70% relative humidity. <sup>a</sup>
2 M $\Omega$	Add $\pm(0.025\%$ of reading $+0.001\%$ of full scale)/°C above 28°C or below 18°C $\pm 2\%$ of reading per 10% relative humidity above 70% relative humidity. <sup>a</sup>
Maximum Input Voltage	500 V rms; 700 V peak. <sup>a</sup>
Voltage at Full Scale	Approximately 0.2 V. <sup>a</sup>
Maximum Open Circuit Voltage	Less than 6 V. <sup>a</sup>
Range Measuring Current	
200 $\Omega$	Approximately 1 mA. <sup>a</sup>
2 k $\Omega$	Approximately 0.1 mA. <sup>a</sup>
20 k $\Omega$	Approximately 10 $\mu$ A. <sup>a</sup>
200 k $\Omega$	Approximately 1 $\mu$ A. <sup>a</sup>
2 M $\Omega$	Approximately 0.1 $\mu$ A. <sup>a</sup>
Resolution	4-1/2 digits. <sup>a</sup>

<sup>a</sup>Performance Requirement not checked in the manual.



Table 1-1 (cont)

Characteristics	Performance Requirements
Response Time	
Manual	Less than 1 second. <sup>a</sup>
Auto	Less than 2 seconds. <sup>a</sup>
Reading Rate	Approximately 3 per second. <sup>a</sup>
<b>DC AMPS</b>	
Range Accuracy	
+18°C to +28°C	±(0.1% of reading + 0.02% of full scale).
-15°C to +18°C and +28°C to +55°C	±(0.15% of reading + 0.06% of full scale). <sup>a</sup>
Response Time	
Manual	Less than 1 second. <sup>a</sup>
Auto	Less than 2 seconds. <sup>a</sup>
Range Input Resistance	
100 µA	Approximately 1 kΩ. <sup>a</sup>
1 mA	Approximately 100 Ω. <sup>a</sup>
10 mA	Approximately 10.5 Ω. <sup>a</sup>
100 mA	Approximately 1.5 Ω. <sup>a</sup>
1 A (1000 mA)	Approximately 0.5 Ω. <sup>a</sup>
Maximum Input Current	1 A. <sup>a</sup>
Maximum Open Circuit Input Voltage (HIGH to LOW)	500 V rms; 700 V peak. <sup>a</sup>
Maximum Floating Voltage (HIGH or LOW to Ground)	500 V rms; 700 V peak. <sup>a</sup>
Resolution	4 digits. <sup>a</sup>
<b>AC AMPS</b>	
Accuracy	20 Hz to 10 kHz sinusoidal waveform.
+18°C to +28°C	±0.6% of reading + 0.1% of full scale.
-15°C to +18°C and +28°C to +55°C	±0.7% of reading + 0.15% of full scale. <sup>a</sup>
Response Time	
Manual	Less than 2 seconds. <sup>a</sup>
Auto	Less than 3 seconds. <sup>a</sup>

<sup>a</sup>Performance Requirement not checked in the manual.

Table 1-1 (cont)

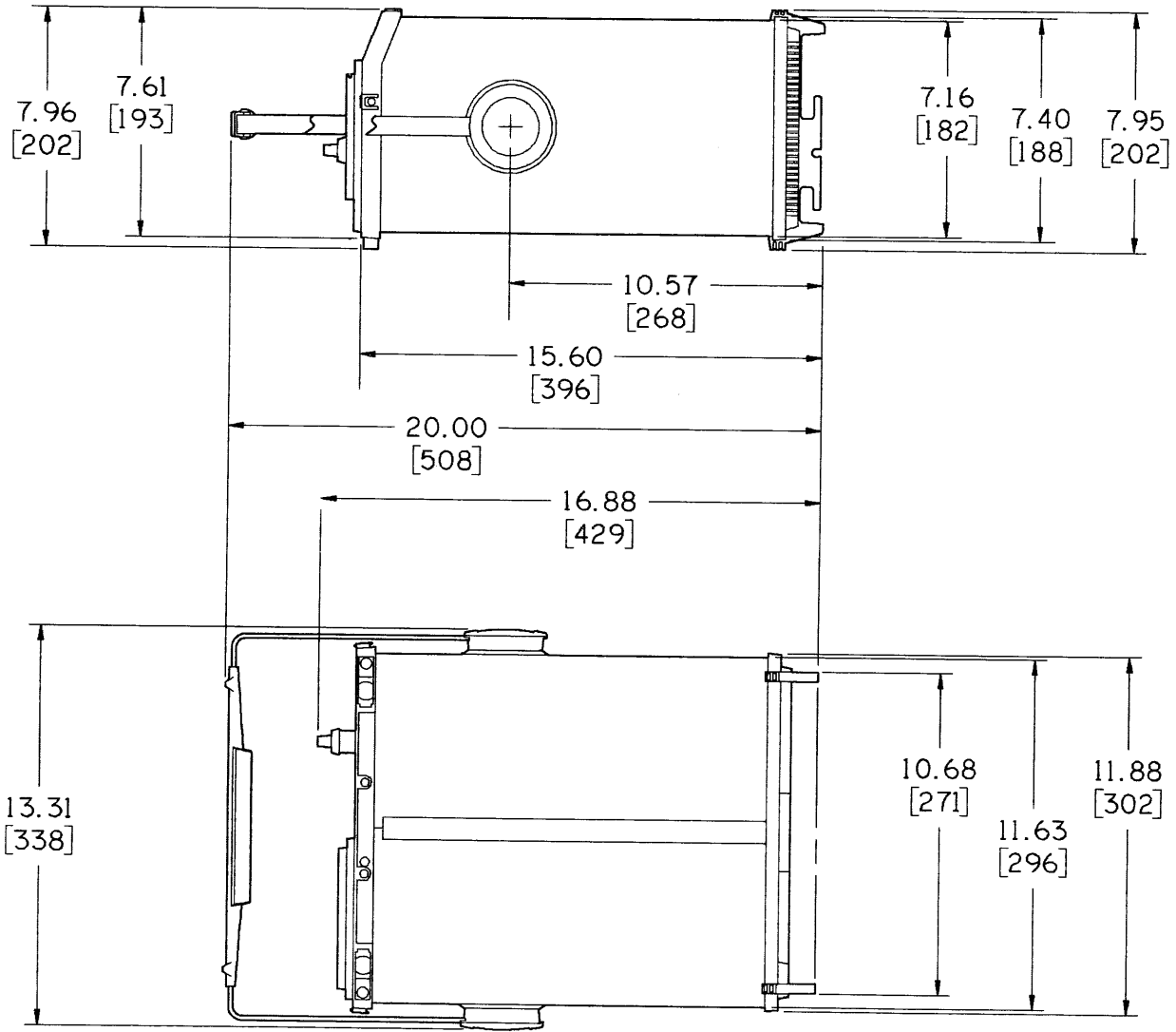
Characteristics	Performance Requirements
Range Input Resistance	
100 $\mu$ A	Approximately 1 k $\Omega$ . <sup>a</sup>
1 mA	Approximately 100 $\Omega$ . <sup>a</sup>
10 mA	Approximately 10.5 $\Omega$ . <sup>a</sup>
100 mA	Approximately 1.5 $\Omega$ . <sup>a</sup>
1 A (1000 mA)	Approximately 0.5 $\Omega$ . <sup>a</sup>
Maximum Input Current	1 A. <sup>a</sup>
Maximum Open Circuit Input Voltage (HIGH to LOW)	500 V rms; 700 V peak. <sup>a</sup>
Maximum Floating Voltage (HIGH or LOW to Ground)	500 V rms; 700 V peak. <sup>a</sup>
Resolution	4 digits. <sup>a</sup>
<b>CONTINUITY</b>	
Response Time	Approximately 0.1 second. <sup>a</sup>
Threshold Resistance	10 $\Omega$ $\pm$ 1 $\Omega$ . <sup>a</sup>
<b>TEMPERATURE</b>	
Range Accuracy	
+18°C to +28°C Ambient Temperature	$\pm$ (2% of reading + 1.5°C). <sup>a</sup>
–15°C to +18°C and +28°C to +55°C Ambient Temperature	$\pm$ (2% of reading + 2.0°C). <sup>a</sup>
Probe Tip Measurement Range	–62°C to +230°C in one range. <sup>a</sup>
Resolution	0.1°C or 0.1°F. <sup>a</sup>
<b>ADDITIONAL CHARACTERISTICS</b>	
Warmup Time to Meet Electrical Specification	45 minutes. <sup>a</sup>
DMM Isolation	500 V rms; 700 V peak. <sup>a</sup>
Maximum V*Hz Product	10 <sup>7</sup> V*Hz. <sup>a</sup>

<sup>a</sup>Performance Requirement not checked in the manual.

**Table 1-2  
Option 01 Mechanical Characteristics**

<b>Characteristics</b>	<b>Description</b>
Weight	
With Accessories and Accessories Pouch	13.1 kg (28.8 lb).
Without Accessories and Accessories Pouch	12.2 kg (26.9 lb).
Shipping Weight	
Domestic	19.2 kg (42.2 lb).
Height	See Figure 1-1 for a dimensional drawing.
With Feet and Accessories Pouch	231 mm (9.1 in).
Without Accessories Pouch	202 mm (7.9 in).
Width	
With Handle	338 mm (13.3 in).
Depth	
With Front Cover	429 mm (16.9 in).
With Handle Extended	508 mm (20.0 in).

Specification  
 2445/2465 Option 01 Service



Dimensions are in inches [mm]

4182-01

Figure 1-1. Dimensional drawing of the 2445/2465 Option 01 Oscilloscope.

# OPERATING INFORMATION

## PREPARATION FOR USE

This part of the manual explains the power-up of the main instrument containing the DMM Option. The power-up sequence of the oscilloscope is described, along with explanations of option-related error messages that may occur if the instrument is not functioning properly.

### POWER-UP SEQUENCE

Before turning on power to the instrument, read Section 2, "Preparation for Use," in the oscilloscope operators manual and follow the safety and precautionary information described there.

The power-up tests, automatically performed each time the oscilloscope is turned on, test both the standard oscilloscope circuitry and the DMM Option circuitry. Tests that apply to the DMM Option are integrated into the power-up tests for the host oscilloscope and include the DMM Kernel test.

#### Kernel Test

Operation of the DMM Option memory (ROM) is checked by the standard instrument Kernel test. Kernel test failures will result in an attempt to flash the front-panel A SWP TRIG'D indicator.

#### NOTE

*On some instruments having other options installed, the A/B TRIG button may be labeled A/B/MENU.*

Even with a Kernel failure, pressing in the A/B TRIG switch may still place the instrument in an operating mode. However, if the operating mode is successfully entered, instrument operation may be unpredictable. If the instrument then functions adequately for your particular measurement, it can be used; but refer it to a qualified service technician for repair as soon as possible.

#### Confidence Tests

Failure of a DMM Confidence test during power-up is indicated in the bottom line of the crt readout. The failure display has the following format:

**DM TEST 7X FAIL YY**

where 7X indicates the DMM Option and YY represents the code for the failed test segment.

A Confidence test failure may not render the DMM inoperable. Pressing the A/B TRIG button may still place the instrument into the normal operating mode; however, it may not meet all DMM specifications.

#### Successful Power-Up Sequencing

When the power-up routine is completed without a failure indication, the oscilloscope enters the normal operating state. The oscilloscope parameters are set to correspond with current front-panel switch positions and with switch functions that were established for at least 10 seconds before instrument power was last turned off. The instrument is now ready to make measurements.

If the DMM was on when the oscilloscope was turned off, the DMM will return to the same operating condition when power is restored to the main instrument, with the exception of dc amps, ac amps, continuity, and the hold operator. With any one of these functions, the DMM will initialize upon power-up to dc volts. For all DMM functions at power-up, the minimum and maximum values will be reset, but the reference in effect before the oscilloscope was turned off will be retained.

### POWER-DOWN SEQUENCE

When the POWER switch is set to OFF, the instrument powers down and the instrument front-panel settings that were unchanged for at least 10 seconds before power-off will be stored for use the next time power is applied to the instrument.

## DMM PARAMETER SELECTION

The following procedures are used to verify DMM push-button operation, to set the continuity function audible indicator frequency, and, if enabled, to set or determine the input impedance of the 0.2 V and 2 V DC DMM ranges.

Exercise procedure DM EXER 71, accessed via the oscilloscope Diagnostic Monitor, allows the operator to verify that the DMM front-panel push buttons are functioning properly.

Exercise procedure DM EXER 72, also accessed via the Monitor, lets the operator set the continuity function audible-indicator frequency. Also, if enabled during the calibration of the DMM Option, the input impedance of the 0.2 V and 2 V DC ranges may be selected.

Perform the following procedure to access the functional selections described above.

1. Hold in both the  $\Delta V$  and  $\Delta t$  buttons and push in the TRIGGER SLOPE button to enter the Diagnostic Monitor.

2. Repeatedly push up and release the TRIGGER MODE switch until the message **DM EXER 71** appears at the bottom-left corner of the crt.

3. Push up and release the TRIGGER COUPLING switch once, and the top of the display will contain all 1's grouped on the crt to match the DMM push-button layout.

4. When a DMM button is pressed, the corresponding 1 in the crt readout should change to a 0. This will verify that the button is functioning. After checking each button, push down once on the COUPLING switch.

5. Push up and release the TRIGGER MODE switch. The message **DM EXER 72** will be displayed at the bottom-left corner of the crt.

6. Push up and release the COUPLING switch once, and the message **MOVE SOURCE FOR CONTINUITY TONE** will appear in the crt readout.

7. Touch the test lead tips together and a tone will be heard. Push up on the SOURCE switch to increase the frequency of the tone or push down on the SOURCE switch to decrease the frequency of the tone.

8. Push up on the COUPLING switch to get the message relating to the input impedance of the DMM in the 0.2 V and 2 V DC ranges. The message will be either:

**INPUT Z ON 0.2VDC 2VDC = 10 M $\Omega$**  or

**INPUT Z ON 0.2VDC 2VDC > 100G $\Omega$**

9. If the desired input impedance is not displayed, push up once and release the COUPLING switch. The correct impedance should now be displayed.

10. Once the correct impedance is displayed, push down once on the COUPLING switch to store the impedance selection.

11. Push the A/B TRIG button to exit the Diagnostic Monitor and resume normal operation.

## DMM FUSES

The DMM has two fuses, in series with the HI input connector, to protect the DMM circuitry from current overload. One of the fuses is on the DMM front panel and the other is inside the instrument cabinet. Only the front-panel fuse is operator replaceable; if the internal fuse opens, refer the instrument for fuse replacement or repair to a qualified service technician.

If the DMM does not make measurements after a potential current overload condition has occurred, turn off the instrument, remove the probes, and check the front-panel fuse. If it has opened, replace it with a fuse of the same type and rating. Otherwise replace the fuse in its holder and turn on the instrument. If the internal fuse has opened, the message **DM TEST 76 FAIL 01** will appear on the crt readout during instrument power-up. In this case, refer the instrument to a qualified service technician for repair.

## CONTROLS, CONNECTORS, AND INDICATORS

This part of the manual describes the controls, connectors, and indicators used in the operation of the DMM Option. For details about the controls used to operate the basic oscilloscope, refer to the respective instrument operators manual.

### FRONT PANEL CONTROLS AND CONNECTORS

All DMM front-panel controls are momentary push buttons. See Figure 2-1 for the location of the controls and connectors described in this section.

**56 RANGE Switches**—These switches set the measurement mode and range to be used.

**AUTO**—Pressing this button sets the DMM to autorange. In this mode, the input attenuator settings are changed as necessary to maintain the proper measurement range. Autoranging is automatically selected each time a measurement function is changed. If the DMM is in the autorange mode, pressing this button stops autoranging, and the current range is held. When the button is pressed again, the DMM returns to the autoranging mode.

While the DMM is selecting the range which produces the greatest resolution, the display remains blanked. If the parameter value being measured is beyond the limits of the autoranging capability, an overrange indication, **OVER**, is displayed in the crt readout.

A measurement range is down-shifted only when a reading is more than 10% below the top of the next lower range. This amount of range overlapping prevents unnecessary range shifting near the range boundary limits. For example, if the reading is 1.799 k $\Omega$  and the present range is 20 k $\Omega$ , then the DMM will shift down to the 2 k $\Omega$  range. The range shifts down from 20 k $\Omega$  to 2 k $\Omega$  as the reading drops below 1.800 k $\Omega$ ; it shifts up from 2 k $\Omega$  to 20 k $\Omega$  when the reading exceeds 2.0000 k $\Omega$ .

**UP and DOWN**—Pressing these buttons manually changes the measurement range to the next higher (UP button) or next lower (DOWN button) range, if available. If the DMM is in autorange and either button is pushed, autoranging will be disabled and the DMM will switch to the next range above or below the present range, if available. When the DMM is in the highest range and the UP button is pressed, or the lowest range and DOWN is pressed, the range will not change. The

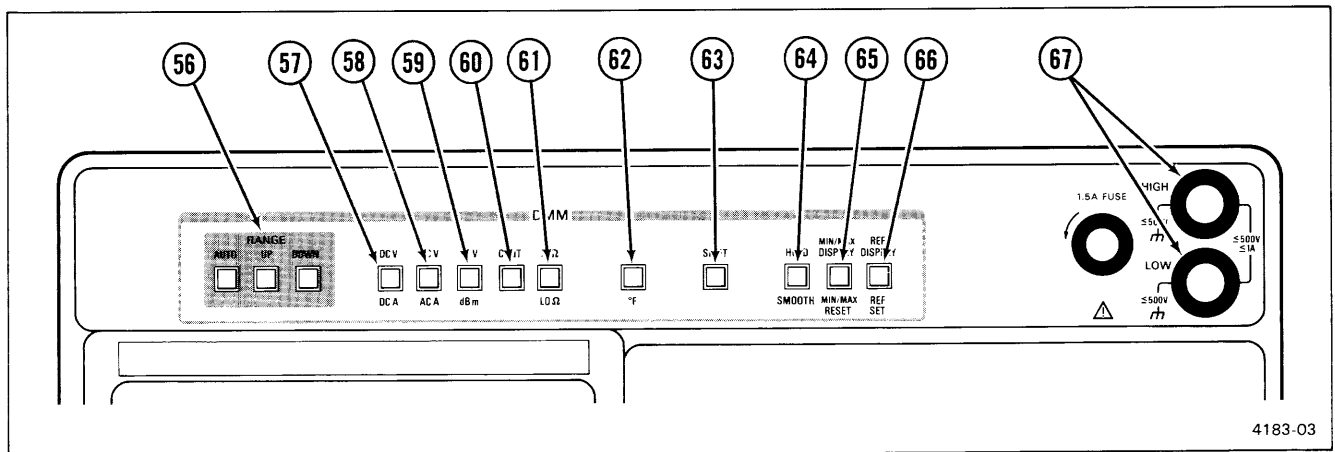


Figure 2-1. DMM Option front-panel controls and connectors.

**Operating Information**  
**2445/2465 Option 01 Service**

DMM will go from autoranging to manual or manual to autoranging, depending on the previous mode selection.

The display will show **MNL** when the DMM is manually ranging. Autoranging is the default mode.

In the manual range mode, the DMM allows 10% overranging in every range except the top range. Above the range limit, the word **OVER** is displayed in the numerical field of the crt readout to indicate that the value being measured is over the limit of the presently selected range. Over-ranging is not allowed above 500 V, ac or dc, as damage to the instrument may result.

**57 DC V-DC A Switch**—Selects either dc volts or dc amps for measurement.

**DC V**—Sets the DMM to measure dc volts. The following ranges are available: 200 mV, 2 V, 20 V, 200 V, and 500 V.

**DC A**—Sets the DMM to measure dc current. The following ranges are available: 100  $\mu$ A, 1 mA, 10 mA, 100 mA, and 1 A.

**58 AC V-AC A Switch**—Selects either ac volts or ac amps for measurement.

**AC V**—Sets the DMM to measure rms ac volts. The ranges available are the same as those for DC V.

**AC A**—Sets the DMM to measure ac current. The ranges available are the same as those for DC A.

**59 dB V-dB m Switch**—Selects either dB V or dB m for measurement.

**dB V**—Sets the DMM to measure the voltage ratio of an unknown input voltage referenced to 1 V. The displayed result is equal to  $20 \log (V_{\text{unk}}/V_{\text{ref}})$ , where  $V_{\text{unk}}$  is the unknown voltage and  $V_{\text{ref}}$  is 1 V. The dB V function can only be used for ac voltage measurements. If  $V_{\text{unk}}$  is equal to zero, the readout will display **OVER**.

**dB m**—Sets the DMM to measure the voltage ratio of an unknown reference voltage referenced to 1 mW into 600  $\Omega$ . The displayed result is equal to  $20 \log (V_{\text{unk}}/V_{\text{ref}})$  where  $V_{\text{unk}}$  is the unknown voltage and  $V_{\text{ref}}$  is 0.7746 V. The dB m function can only be used for ac voltage measurements. If  $V_{\text{unk}}$  is equal to zero, the readout will display **OVER**.

**60 CONT Switch**—Selects the continuity function. The DMM is set to LO  $\Omega$  resistance mode in the 200  $\Omega$  range, and autoranging is disabled. If the resistance being measured is less than 10  $\Omega$ , an audible tone is produced. The right side of the crt display will read either  $< 10 \Omega$  or  $> 10 \Omega$ , as appropriate, to indicate that continuity is being measured, and the center of the display will read either **SHORT** or **OPEN**. Continuity measurements are taken at a rate of 50 per second.

When the continuity function is selected, the following buttons have no effect on DMM operation: AUTO, UP, DOWN, HOLD, SMOOTH, MIN/MAX DISPLAY, MIN/MAX RESET, REF DISPLAY, and REF SET.

**61 HI  $\Omega$ -LO  $\Omega$  Switch**—Selects the resistance measurement function of the DMM.

**HI  $\Omega$** —Sets the DMM for resistance measurements. The following ranges apply: 2 k, 20 k, 200 k, 2 M, and 20 M. The maximum output voltage used to determine resistance is 2 V, which will bias on a semiconductor junction.

**LO  $\Omega$** —Sets the DMM for resistance measurements. The following ranges apply: 200, 2 k, 20 k, 200 k, and 2 M. The output test voltage used to determine resistance is 0.2 V, which will not bias on a semiconductor junction.

**62  $^{\circ}$ C- $^{\circ}$ F Switch**—Selects the temperature measurement function of the DMM when using the P6602 temperature probe. When this function is selected, the DMM automatically switches to the 200  $\Omega$  range. If a temperature probe is not connected to the input jacks when the function is selected, the crt display will read **ATTACH TEMP PROBE**. The temperature is displayed on the crt readout.

**$^{\circ}$ C**—Sets the DMM to measure temperature in  $^{\circ}$ C.

**$^{\circ}$ F**—Sets the DMM to measure temperature in  $^{\circ}$ F.

**63 SHIFT**—This button acts as a function-change button and works with the following buttons: DC V-DC A, AC V-AC A, dB V-dB m, HI  $\Omega$ -LO  $\Omega$ ,  $^{\circ}$ C- $^{\circ}$ F, HOLD-SMOOTH, MIN/MAX DISPLAY-MIN/MAX RESET, and REF DISPLAY-REF SET. Pressing this button causes a shift to the lower row function associated with the next button that is pressed. For example, pushing SHIFT, then DC V-DC A, causes dc amps to be the measurement mode selected. If SHIFT is not pushed before DC V-DC A, then dc voltage is the measurement mode selected. Pushing the SHIFT button again will cancel the shift function.



**64 HOLD-SMOOTH Switch**—Selects either the hold or smooth operators.

**HOLD**—Pressing the button stops the updating of the value being displayed, and the present value is held in the display. The crt readout will display **HLD** when the measurement is being held. The next push of the HOLD button will cause the DMM to resume the operation being performed before the HOLD command was invoked. The HOLD function will be turned off by activating any other DMM function or operator.

**SMOOTH**—Pressing this button provides a smoothing or filtering effect on subsequent measurement values. A mean value is calculated from blocks of eight accumulated measurement values and is displayed on the crt. After 64 measurements are accumulated, the running average is updated (in blocks of eight) to reflect the most recent 64 measurements. Another push of the SMOOTH button will turn this operator off.

Smoothing will be indicated in the display by a field on the right that shows the number of values used in the current average: **/XX/**, where XX is 8, 16, 24, 32, 40, 48, 56, or 64. When dB V or dB m is selected, the ac voltage values will be smoothed, and the smoothed values will be used to calculate the dB value. Smoothing is not allowed when the continuity function is selected.

To reset the averaging process, smoothing must first be turned off, then back on.

**65 MIN/MAX DISPLAY-MIN/MAX RESET Switch**—Selects the minimum/maximum accumulators for display or resets the accumulators.

**MIN/MAX DISPLAY**—Pressing this button causes a display of either the minimum or the maximum value that has occurred since the last minimum/maximum accumulator reset or function change. Each press of this button will step the display through the following sequence: MIN, MAX, then the display measurement. Minimum and maximum values are not shown on the crt at the same time.

The minimum and maximum registers are continually updated with each measurement, so the user will see the value for the selected limit (e.g., the minimum value will change as new minimums are taken).

**MIN/MAX RESET**—Resets the values in the minimum and maximum accumulators to the next valid value. A minimum/maximum reset occurs after each function change.

**66 REF DISPLAY-REF SET Switch**—Displays or sets the reference value used by the DMM.

**REF DISPLAY**—Displays the current value set as a reference. If the REFSET operator is off, the reference value display will be 0.

**REF SET**—Sets the reference value to the displayed value, which then becomes the new "zero". All subsequent values will have this reference value subtracted from them before they are displayed. If there is no value displayed, or if the present value is overrange, the REF SET button is ignored. To turn the reference off, either measure 0.0 and push the REF SET button or select a new function. When a reference value is being used, the display will have a delta ( $\Delta$ ) symbol on the left side. The REF SET operator can be used with every function except continuity. If REF SET is selected when the DMM is measuring dB V or dB m, the measured voltage will be used as  $V_{ref}$ .

**67 HIGH and LOW Connectors**—Two banana-like jacks provide positive (red) and negative (black) inputs for the DMM probes.

## DMM DISPLAYS

Large-sized digits are used in the crt readout to display DMM measurement values. All parameter units and other text except **OVER** are displayed as smaller sized letters and digits. The following examples show various output displays of the different functions:

DC Voltage	15.693 V DC
SMOOTH	1.4356 A DC /64/
Using a reference value	$\Delta$ 0.9861 A DC
Reference display	1.3461 V DC=REF
Minimum display	0.5201 V AC=MIN
Maximum display (with reference)	$\Delta$ 0.8293 V DC=MAX
Continuity display	OPEN >10 $\Omega$ SHORT <10 $\Omega$
Overrange display	OVER

## NONCALIBRATED DMM DISPLAYS

If during DMM calibration one or more steps were skipped or incorrectly done, the DMM will "remember" that those ranges and functions were not calibrated. When a measurement is requested in a range or function that

was not calibrated or has an out-of-limit calibration constant, the value will be displayed with dots (...), as in the following examples, instead of blank spaces.

```
..... 1569.3.V DC.....
..... 2.05.V DC=REF.....
```

## OPERATING PROCEDURES

Consult the oscilloscope operators manual to acquire a thorough understanding of the operation of the standard oscilloscope before trying to use the features of the DMM Option. With the DMM Option installed, all standard oscilloscope functions (as explained in the respective oscilloscope technical manuals) remain unchanged.

turned off because of a display conflict (and the oscilloscope power has not been turned off and back on again), only the reference value will remain as set before the DMM was turned off.

### DMM OPTION SELECTION

The DMM is enabled when any function (DC V, DC A, AC V, AC A, dB V, dB m, CONT, HI  $\Omega$ , LO  $\Omega$ , °C, or °F) on the front panel is selected while the oscilloscope is operating. If an operator button (HOLD, SMOOTH, REF SET, REF DISPLAY, AUTO, UP, DOWN, MIN/MAX DISPLAY, MIN/MAX RESET, or SHIFT) is pressed, the DMM will remain off. The DMM can be turned off by pressing the button of the function currently selected.

### OPERATING CONSIDERATIONS

Each operator interacts with the others as shown in Table 2-1. At every function change, all operators are turned off. A measurement value will have operators applied in the following order: MIN or MAX, SMOOTH, then REF, after which the result is displayed.

If the DMM is turned off because of a crt display conflict, the DMM will remain off even if the display space becomes available. A DMM function button must then be pressed to turn the DMM on again. If the function selected is the same one that was active when the DMM was

### GPIB CONTROLLABLE FUNCTIONS

If the GPIB Option is installed in the instrument, the DMM Option adds additional commands to control the DMM Option via the GPIB. The commands are listed in Table 2-2, and only the upper-case characters of a command are required for recognition. See the GPIB Operators Manual for additional information relating to the GPIB Option.

Table 2-1  
Operator Interaction

New Operator Requested	Currently Selected Operator				
	REF SET	HOLD	SMOOTH	REF DISPLAY	MIN/MAX DISPLAY
REF SET	N	O	X	O	O
HOLD	X	N	X	X	X
SMOOTH	X	O	N	O	O
REF DISPLAY	X	O	X	N	O
MIN/MAX DISPLAY	X	O	X	O	A

- O = Turn this operator off and return to normal or requested display.
- X = Doesn't change the state of this operator.
- N = Negate the state of this operator (if on, turn off; if off, turn on).
- A = See the descriptions of the MIN/MAX display.

Table 2-2  
GPIB Command Set for the DMM Option

Header	Argument	Argument	Comments
DMM	OFF SUSp		The DMM is turned on with a function command, the same as during front panel operation. However, to prevent the DMM from turning itself off by receiving a SET command, the GPIB is only able to turn off the DMM with the command "DMM OFF;". "DMM ON;" causes an error message (SRQ) to be sent back to the GPIB. "DMM SUS;" causes the DMM to be put into the state caused by being forced off by other options. The only difference between DMM SUS and DMM OFF is that the next time a function is selected, if it is the same at the function previously selected, the DMM will not reinitialize (the reference value and the states of SMOOTH, AUTO, etc. remain as set before the DMM was turned off). If the DMM is suspended when SET? or LLSET? is issued, the string will have DMM SUSP appended at the end. Otherwise, all settings would be lost when the user chose a function.
DMM?			Query response is: "DMM ON;"; "DMM SUS;"; or "DMM OFF;".
DMMSend DMMSend?			DMMSend and DMMSend? are treated identically. This command returns the displayed measurement in the <nr3> format. The value will be adjusted to basic units such as volts, ohms, or amps. If there is no valid value displayed, the DMM will wait until a value is available. If the value being displayed is overranged, the value 1.0E+99 will be returned.
DISplay	MINIum MAXimum REF NORmal		The MINIum and MAXimum arguments cause the display to show the minimum and maximum values that have been accumulating. The REF argument shows the present value of the reference. The NORmal argument restores the normal measurement to the display. With no argument, NORmal is assumed.
DISplay?			Query response is: "DIS MINI;"; "DIS MAX;"; "DIS NOR;"; or "DIS REF;". To receive the value currently stored as minimum over the GPIB, for example, send "DISplay MINIum;"; followed by "DMMSend;".
MINMaxres			This command caused the values in the minimum and maximum accumulators to be reset to the next valid value.
RANge	<nrx>		This command sets the range of the present function. The absolute value of <nrx> is rounded up to the top of the nearest range, making the measurement specified by <nrx> to the highest degree of resolution. If the argument is omitted or zero, the DMM will autorange. If the argument is negative, the DMM will autorange after setting the range as requested, except for the dB V, and dB m functions. For these two functions a valid negative argument will set manual ranging and issue a possible Settings Conflict warning (SRQ 101/550). If the argument value is larger than the highest range, an argument error (SRQ) will be issued, and the command will be ignored.
RANge?			Query response is: "RANGE <nr3>";. The range value will be in basic units such as volts, amps, or ohms. A positive argument indicates manual ranging, a negative argument autoranging, except for the dB V and dB m functions where the sign is required to identify the range and does not convey auto/manual information.

Table 2-2 (cont)

Header	Argument	Argument	Comments
REFset	<nrx>		This command caused the argument to be used as the reference value. If the argument is equal to zero, the reference will be turned off. If the argument is a negative value and the present function is one that doesn't allow negative values, the reference will also be turned off. The argument is rounded up to the closest value represented by the DMM (1 part in 40,000). If the argument is larger than the highest value that can be represented, an SRQ will be issued, and the reference will not be changed. This follows the convention set by the Tektronix Codes and Formats standard. If no argument follows REFset, the reference value will be set to the displayed value. This command is illegal in Continuity.
REFset?			Query response is: "REF <nr3>:". The reference value will be sent in basic units such as volts, ohms, or amps. This query is illegal in Continuity.
SET?			The answers to the queries of FUNCtion, DISPlay, REFset, SMOoth, and OVer are sent, in that order. If the DMM is suspended (SUS) when this query is sent, the most recent settings will be sent, followed by "DMM SUS". This string can be read back to the DMM to reset a previous instrument state.
HOLD	ON OFF		This command controls the display hold feature. If no argument is sent, ON will be assumed.
HOLD?			Query response is: "HOL ON;" or "HOL OFF;".
SMOoth	ON OFF		This command turns smoothing on or off. Each time the command "SMOoth ON;" is issued, the number of averages taken is reset to zero. If no argument is sent, ON will be assumed.
SMOoth?			Query response is: "SMO ON;" or "SMO OFF;".
AVGs?			Query response is: "AVG <nr3>:" <nr3> reflects the number of averages associated with the current displayed value. If smoothing is off, the query returns an SRQ.
DCV ACV DCA ACA HIOhms LOOHms DBV DBM DEGC DEGF CONt	<nrx> <nrx> <nrx> <nrx> <nrx> <nrx> <nrx> <nrx>		These commands select the desired measurement function. An optionally included argument will set the DMM function range, as described in the RANge comments.
FUNCtion?			This query returns "(function name) <nr3>:", where <nr3> is the highest value in the present range. Nr3 will be omitted when a range value is unnecessary (e.g., DEGC). If the DMM is autoranging, the range value preceded by a negative sign will be returned (for example DCV -2.0E+1), except for the dB V and dB m functions.

Table 2-2 (cont)

Header	Argument	Argument	Comments
OVER	ON OFF		The command "OVER ON" turns on the warning SRQ if an overrange condition is detected. "OVER OFF" disables transmission of the warning SRQ. With no argument, ON is assumed.
OVER?			Query response is: "OVE ON;" or "OVE OFF;".
STONE	<nrx>		This command selects the tone to be used by the Continuity function. The values for nrx are 1, 2, 3, or 4, and the default value is 1.
TONE?			Query response is: "TON <nr3>,". The value returned in <nr3> is the current tone value.
HIZ	ON OFF		This command selects the input impedance to be used by the DCV function in the 200 mV and 2 V ranges. No argument or the "ON" argument selects an input impedance > 100 GΩ, while the "OFF" argument selects an input impedance of 10 MΩ. During the CAL 7:7 procedure, 'Settable Input Impedance' must have been selected or a 'Settings Conflict' SRQ will be returned.
HIZ?			Query response is: "HIZ ON;" or "HIZ OFF;".
BEEp	<nrx>	:<nrx>	Causes a tone whose pitch is specified by the first argument with a duration as specified by the second argument, or multiple tones and durations by separating the groups of arguments by commas. The DMM Option must be either off or suspended or a mode SRQ is sent. The range of valid values for the first argument is 0 to 13 and 1 to 255 for the second argument. If arguments are not specified, default values of 6 and 3 respectively are used. The first argument must be present if a second argument is specified. A value of 0 for the first argument produces no sound, and each unit of the second argument is a duration of approximately 0.1 second.
ID?			See the GPIB Option manual system commands for details. The string returned for the DMM Option is DMM:FVz where z is the version number.

## BASIC APPLICATIONS

This part of the manual gives information and procedures to enhance the operator's understanding of the DMM Option. After becoming familiar with the controls, connectors, indicators, operating considerations, and capabilities of the instrument, perform the following procedures to become familiar with the instrument functions for making DMM measurements.

Before proceeding with these instructions, refer to "Preparation for Use" in this section.

Verify that the POWER switch is OFF (push button out); then plug the power cord into the power outlet and turn the instrument on (POWER switch in). Connect the DMM meter leads to the HIGH and LOW input connectors.

### 1. Low Impedance Measurements

This procedure demonstrates how to use the DMM to make low-impedance measurements using the reference operator to negate meter lead resistance.

- a. Select the LO  $\Omega$  function.
- b. Remove any adaptors from the DMM meter leads and short the two tips together.
- c. Push in the REF SET button to "zero" the DMM reading.
- d. A low-impedance measurement can now be accurately made, since the resistance of the meter leads is compensated for in the display readout.
- e. Remove the meter leads from the test circuit.

### 2. Circuit dB Loss or Gain Measurements

This procedure shows how to make circuit dB loss or gain measurements using the DMM dB V or dB m functions and the reference operator.

- a. Set the DMM for the desired measurement function (dB V or dB m).
- b. Connect the meter leads to the input of the circuit to be measured.
- c. Push in the REF SET button to "zero" the DMM reading. The display should be **0.00 DB R**.
- d. Connect the meter leads to the output of the circuit being measured.
- e. The readout now shows the circuit dB gain or loss relative to the circuit input.
- f. The original reference can be displayed by pushing the REF DISPLAY button.
- g. Remove the meter leads from the test circuitry.

### 3. Minimum/Maximum Circuit Monitor

This procedure demonstrates how to use the minimum and maximum accumulators to show the deviations over time of a dc power supply.

- a. Push in the DC V button.
- b. Connect the meter leads to the dc power supply to be monitored.
- c. Push in the MIN/MAX RESET button to reset the high and low accumulators. The DMM accumulators will now track the minimum and maximum voltages of the supply.

d. To display the accumulators, push the MIN/MAX DISPLAY button to see the minimum voltage. Push the MIN/MAX DISPLAY button again to see the maximum voltage, and then a third time to return to the normal display mode.

e. Remove the meter leads from the test circuitry.

#### **4. Manual Overrange Measurements**

This procedure can be used when the value of the function is between 100% and 110% of the top of the next lower measurement range being used (except for the highest range). The DMM is first in the autoranging mode and is then set to the manual mode.

a. Select the function for the measurement to be taken.

b. Connect the probes to the circuit to be measured.

c. If the reading is between 100% and 110% of the top of the next lower range being used by the DMM for the measurement (except for the highest range), greater resolution can be obtained by manually downranging the DMM (push the DOWN button).

d. The display now contains the reading with the highest resolution possible.

e. Remove the meter leads from the test circuitry.

# THEORY OF OPERATION

## INTRODUCTION

### SECTION ORGANIZATION

This section contains a functional circuit description of the Option 01 Digital Multimeter (DMM) circuitry for the 2445 and 2465 Oscilloscopes. The discussion begins with an overview of option functions and continues with detailed explanations of each major circuit. Reference is made to supporting schematic and block diagrams which aid in understanding the text. These diagrams show interconnections between parts of the circuitry, identify circuit components, list specific component values, and show interrelationships with the standard oscilloscope.

The detailed block and schematic diagrams are located in the tabbed "Diagrams" section at the rear of this manual. The particular schematic diagram associated with

each circuit description is identified in the text, and the diagram number is shown (enclosed within a diamond symbol) on the tab of the appropriate foldout page. For the best understanding of the circuit being described, refer to both the applicable schematic and block diagrams.

### DIGITAL LOGIC CONVENTIONS

Digital logic circuits perform many functions within the instrument. The operation of these circuits is represented by specific logic symbology and terminology. Logic-function descriptions contained in this manual use the positive-logic convention. The specific voltages which constitute a HI or a LO vary between individual devices. For specific device characteristics, refer to the manufacturer's data book.

## GENERAL CIRCUIT DESCRIPTION

Before individual circuits are discussed in detail, a general block-level discussion is provided to aid in understanding overall operation of the option circuitry. A simplified block diagram of the option, showing basic interconnections, is shown in Figure 3-1. The diamond-enclosed numbers in the blocks refer to the schematic diagrams at the rear of this manual in which the corresponding circuitry is located. Throughout this discussion, standard oscilloscope refers to the 2445 and 2465 Oscilloscopes without option circuitry.

The activities of the options are directed by the microprocessor contained in the standard oscilloscope. The microprocessor, under the control of firmware present in the options, monitors each option's functions and sets up the operating modes according to instructions received.

While executing the control program, the microprocessor retrieves previously stored calibration constants and front-panel settings and, as necessary, places program-generated data in temporary storage for later use. The electrically alterable read-only memory (EAROM) contained

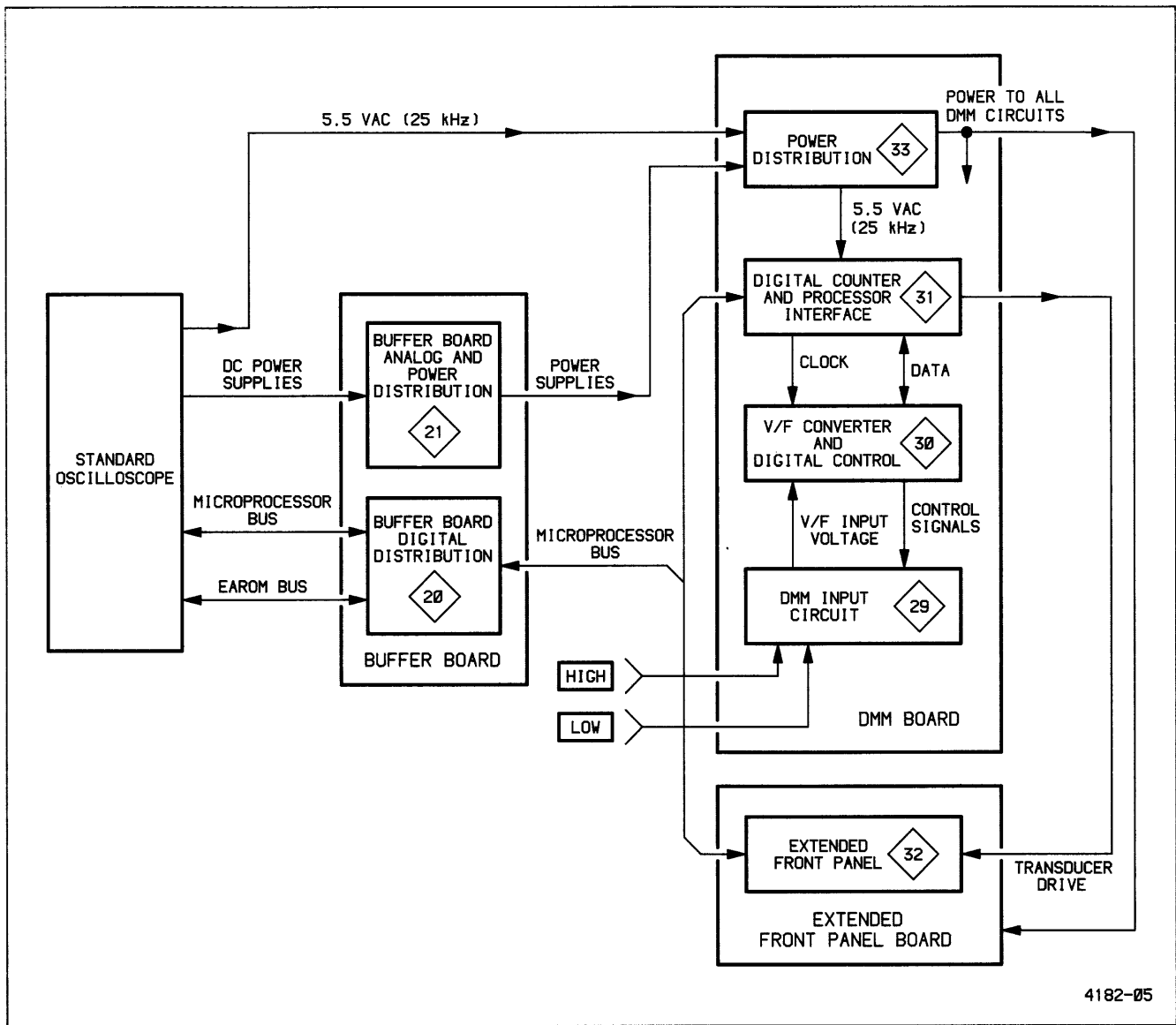
in the Buffer circuit board and the random access memory (RAM) contained in the standard instrument provide these storage locations.

### BUFFER BOARD

The DMM option connects to the standard oscilloscope through the Buffer circuit board. The Buffer board performs the following functions:

1. Buffers and modifies the timing of the microprocessor bus.
2. Distributes the microprocessor bus, power supplies, and analog signals from the standard oscilloscope to the options.
3. Provides additional ROM for interfacing options to the standard instrument.
4. Provides an EAROM for options use.
5. Provides a mechanical interface.





4182-05

Figure 3-1. Simplified block diagram.

The microprocessor control bus, address bus, and data bus are buffered by Buffer board circuitry. Microprocessor bus timing for the options is modified by buffers on the Buffer board to make bus timing compatible with the options. The EAROM bus allows the microprocessor to access the option EAROM located on the Buffer board. These signal paths are used for communication between the DMM option and the standard oscilloscope.

## **DMM BOARD**

The DMM option adds hardware and software, to the 2445 and 2465 Oscilloscopes, to allow measuring ac and dc voltage and current, resistance, dBV, dBm, and temperature. The standard oscilloscope and the option are interconnected by the Buffer board. The DMM board circuitry is divided into five sections:

1. DMM Input Circuit.
2. V/F Converter and Digital Control.
3. Digital Counter and Processor Interface.
4. Extended Front Panel.
5. Power Distribution.

The option is under control of the microprocessor in the standard oscilloscope. The Processor Interface provides the interface to the microprocessor. After reading the switches in the Extended Front Panel, the microprocessor sets up the Digital Control circuitry for the desired operating mode. Range changing in the input circuitry is also controlled by the microprocessor through the Digital Control circuitry.

The DMM Input Circuit converts the input signal to a dc voltage for use by the V/F Converter. The voltage produced is proportional to the input signal. The V/F Converter generates a signal whose frequency is inversely proportional to the input voltage. The Digital Counter counts the frequency during the measurement interval. At the end of the measurement interval the microprocessor reads the Digital Counter, calculates and displays the input's value.

The Power Distribution circuitry contains the floating power supplies used by the DMM circuitry.

# **DETAILED CIRCUIT DESCRIPTION**

## **INTRODUCTION**

The following discussion provides detailed information concerning the electrical operation and circuit relationships of the 2445 and 2465 Buffer board and Digital Multimeter circuitry. Unique circuitry is described in detail, while circuits common in the electronics industry are not. The descriptions are supported by the associated detailed block diagram (Figure 7-4) and schematic diagrams located at the rear of this manual in the tabbed foldout pages.

## **BUFFER BOARD DIGITAL DISTRIBUTION**

The Buffer Board Digital Distribution circuitry (see Diagram 20) interconnects the standard oscilloscope and the DMM board. Most of the microprocessor signals are buffered and have their timing modified. In addition, some of the memory used for option functions is included on the Buffer board.

## **Electrically Alterable ROM**

Nonvolatile storage for the calibration constants and power-down settings is provided by EAROM U4207. By using different clock sources, the microprocessor is able to select either EAROM U2008 in the standard oscilloscope or Buffer board EAROM U4207. The clock source for the Buffer board EAROM comes from U2308 pin 5 (see Diagram 2 in the standard oscilloscope manual). Mode control inputs C1 and C3 are interchanged between the two EAROMs to prevent data contention. A TTL-to-MNOS level shift of the clock signal is provided by Q4201. For additional information on EAROM operation, consult the "Theory of Operation" section of the standard oscilloscope service manual.

## **Address Decoding**

Gates U4240A and U4240C partially decode the address bus. Enable BVMA U4240C pin 8 is HI for addresses from 1000-7FFF (this and all other address references are in hexadecimal), the address space used by the options and the Buffer board.

## Theory of Operation

### 2445/2465 Option 01 Service

Enable  $\overline{\text{BUFEN}}$  U4250C pin 8 is LO for the address space of 1000-1FFF. Address strobe  $\overline{\text{LOWAD}}$  is active LO for the address space of XFFC-XFFF (where X is a don't care). These decoded address signals are used in selecting ROM U4260 on the Buffer board, disabling data bus buffer U4255, and selecting circuitry in the Extended Front Panel (1FFC-1FFF).

### Buffer Board ROM

Buffer board ROM U4260 is used to interface the option to the standard oscilloscope. Its output enable (at pin 20) is  $\overline{\text{ROMEN}}$ . The signals  $\overline{\text{ROMEN}}$  and  $\overline{\text{BUFEN}}$  are the same if P4256 is present. With  $\overline{\text{ROMEN}}$  and  $\overline{\text{BUFEN}}$  the same, the Buffer board ROM address space is 1000-1FFF. Whenever the Buffer board ROM is addressed, shift register U4275 (that controls the data bus buffer) is reset by  $\overline{\text{ROMEN}}$ . This prevents the Buffer board data bus buffer and the Buffer board ROM from driving the microprocessor side of the data bus at the same time.

With the DMM option installed, P4256 is not installed. In this case  $\overline{\text{BUFEN}}$  is further decoded in the Extended Front Panel circuitry. The  $\overline{\text{ROMEN}}$  signal produced makes the Buffer board ROM active over the address space of 1000-1FFB. The other decoded addresses are used by the DMM Extended Front Panel circuitry, as explained later.

### Bus Buffers

The 10MHz clock signal of the standard oscilloscope is buffered by U4265D. The buffered clock (B10MHZ) clocks shift register U4275 and is also sent to the options.

The  $\overline{\text{E}}$  clock,  $\overline{\text{RESET}}$ ,  $\overline{\text{VMA}}$ , and  $\overline{\text{R/W}}$  are buffered by latch U4225. The pull-up on U4225 pin 12 allows  $\overline{\text{RESET}}$  and  $\overline{\text{E}}$  to pass through the latch unmodified. The buffered E clock is delayed  $> 30$  ns by R4265, C4265, and U4265C. This delayed BE clock latches  $\overline{\text{VMA}}$ ,  $\overline{\text{R/W}}$  (U4225) and the address bus (U4235 and U4245), which provides extra hold time on these signals for the options.

### Data Bus Buffer

Data bus buffer U4255 is a bidirectional bus driver that is controlled by the signals on pin 1 and pin 19. Pin 1 controls the direction of data flow through the buffer, and pin 19 turns the drivers on and off. When pin 1 is HI, the buffer is configured to drive data from the microprocessor to the options. Conversely, when pin 1 is LO, the buffer is configured to drive data from an option to the microprocessor. Pin 1 is HI except when the microprocessor is reading data from an option.

Signals on pin 1 and pin 19 coordinate the states of U4255 so that data bus contention never occurs. Buffer U4255 drives two buses: the bus between U4255 and the Control board of the standard oscilloscope, and the bus between U4255 and the options. Both of these must be kept free of contentions (i.e., it is not allowed for more than one device to drive the bus at the same time). These two buses will be examined individually.

The bus between the Control board and U4255 is driven by the Control board during a write bus cycle, driven by the Control board during a read cycle from non-option space (0000-0FFF and 8000-FFFF), driven by U4255 during a read cycle from option space (2000-7FFF), and driven by U4260 during a read from Buffer board ROM (1000-1FFF). The Control board changes its drivers from output to input on the rising edge of E (this is the high-true E, not the low-true  $\overline{\text{E}}$  used by the option) when going from a write to a read cycle. It changes from input to output on the falling edge of R/W when going from a read to a write cycle. Data buffer U4255 drives the Control board data bus only when  $\overline{\text{BVMA}}$  and  $\overline{\text{BR/W}}$  are both true, i.e., a read cycle from the option is being performed. This is done by driving U4255 pin 1 from  $\overline{\text{BVMA}}$  NANDed with  $\overline{\text{BR/W}}$  (after passing through a delay consisting of two cycles of the 10 MHz clock). Pin 19 of U4255 is driven by  $\overline{\text{E}}$  delayed for two cycles of the 10 MHz clock. This two-cycle delay ensures that U4255 will be driving the Control board data bus only in a read cycle from option address space, during a time interval starting after the rising edge of E and ending after the falling edge of E. A delay of two cycles of the 10 MHz clock is necessary to guarantee that the Control board data bus drivers have turned off before U4255 starts driving the bus. This is a period of time when the Control board never drives the data bus during a read cycle. Shift register stages in U4275 are cleared by  $\overline{\text{ROMEN}}$ , forcing U4255 pin 19 HI while Buffer board ROM is being read.

The bus between U4255 and the options must be driven by U4255 during a write cycle to the options (2000-7FFF) and may be driven by an option only during a read cycle from the option (2000-7FFF). Bus driver U4255 actually drives the bus to the option during all cycles except read cycles from 1000-7FFF. The bus is driven by an option only while E is true during an option read cycle. Address bus driver U4255 drives the bus during an option write cycle while U4255 pin 19 is LO, but in this case pin 19 is delayed from  $\overline{\text{E}}$  only by one cycle of the 10 MHz clock, driving the data to the options as soon as it is available from the microprocessor.

## DIGITAL MULTIMETER OPTION CIRCUIT BOARD

The DMM option adds hardware and software to allow measuring ac and dc voltage and current, resistance, dBV, dBm, and temperature. The DMM board is divided into five sections:

1. DMM Input Circuit.
2. V/F Converter and Digital Control.
3. Digital Counter and Processor Interface.
4. Extended Front Panel.
5. Power Distribution.

In general, the measurement procedure is the same for all measurements: The microprocessor sets up the Digital Control circuitry. The Digital Control circuitry sets up the input circuit for the desired operating mode. The input signal is attenuated by the Input Attenuators. Then the signal is buffered by one of the Volts Buffers. The V/F Input Multiplexer selects the buffer's output, sending it to the V/F Converter. The V/F Converter converts the input to a frequency. The signal is then counted, the reading calculated, and then displayed.

Interleaved between each measurement of the unknown input is the measurement of an offset or a reference. The measurement sequence is: unknown, offset, unknown, reference, unknown, offset,...

### DMM Input Circuit

The DMM Input Circuit (see Diagram 29) converts all inputs to a standard range of voltages. The circuitry contains Input Attenuators, an Ohms Current Source, a DC Volts Buffer, an AC Volts Buffer, and the V/F Input Multiplexer.

The gain path in DC Volts is maintained to keep the voltage to the V/F Converter at a full scale range of  $\pm 2$  V, except in the 500 V range where the full scale range is  $\pm 0.5$  V. The gain path selections used are shown in Table 3-1.

In the Current ranges, the Input Attenuators convert the input current to a voltage (0.1 V at the top of the range) which is then sent to the 0.2 V input of one of the Volts buffers. The Volts buffer multiplies by 10, producing 1 V at the top of the range to the V/F Converter. The rest of the process is the same as for voltage readings.

Table 3-1  
DC Volts Selections

DC Volts Range	Input Atten	Reference	Buffer Gain	V/F Input Selected
0.2 V	$\div 1$	-0.2 V	X10	X1
2 V	$\div 1$	-2 V	X1	X1
20 V	$\div 10$	-2 V	X1	X1
200 V	$\div 100$	-2 V	X1	X1
500 V	$\div 100$	-2 V	X1	$\div 10$

In the Ohms ranges, the Ohms Current Source generates a current. This current is sent through the unknown resistance, producing a voltage proportional to the unknown resistance. The voltage produced is sent to the volts buffer, where the rest of the process is the same as for voltage readings.

In Continuity mode, the circuitry is set up as in the Ohms ranges. Before measurements start, a  $10 \Omega$  resistance in the Input Attenuators is measured and used as a reference. Measurements of  $10 \Omega$  or less sound the continuity tone; measurements greater than  $10 \Omega$  do not sound a tone.

For Temperature measurements, the circuitry is set up as for the 200  $\Omega$  range. The resistance of the Temperature Probe (a  $100 \Omega$  at  $0^\circ\text{C}$  thermistor) is measured. The resistance measured (which is proportional to temperature) is converted to temperature and displayed.

**INPUT ATTENUATORS.** The Input Attenuators contain the voltage dividers that attenuate the inputs to levels usable by the voltage buffers. Both the AC and the DC Volts Buffers have their own input attenuators. In addition, part of the attenuator for the DC Volts Buffer is used in the Amps ranges to convert the input current to a voltage. The setup for a given range is controlled by the Digital Control circuitry.

**DC Volts Attenuator.** Resistors R5081, R5080, R5082, R4960, and R4975 make up the voltage divider for the DC Volts Attenuator. Relays K4981 and K5091 determine which voltage tap will be used. Relay K5191 selects between  $> 100 \text{ G}\Omega$  and the  $10 \text{ M}\Omega$  input impedances. If the attenuator is to divide by 10 or 100, the  $10 \text{ M}\Omega$  input impedance is selected.

**AC Volts Attenuator.** Resistors R5181 and R5177 make up the voltage divider for the AC Volts Attenuator. Relay K5180 determines which voltage tap will be used. Relay K5191 switches the input to the AC circuitry.

## Theory of Operation

### 2445/2465 Option 01 Service

The attenuator is ac compensated by C5170. The effective capacitance of C5170 is changed by multiplier U5170 and the D-A Converter made up of R4970, R4971, R4972, R4973, R4974, and R5073. The effective capacitance required is determined during calibration and is the same for all ac voltage ranges.

**Amps Attenuator.** The Amps Attenuator converts the input current to a voltage. The resistances used are in R4960 and R4975. The resistance used in a given Amps range is selected by FETs Q4970, Q4971, Q4972, Q4973, and Q4980. Relay K4990 switches the input to the Amps circuitry. The attenuator is set to maintain  $\pm 0.10$  V dc or ac rms full scale into the Volts Buffers. To give a  $\pm 1$  V full scale signal to the V/F Converter, the buffers multiply by 10.

**DC VOLTS BUFFER.** The DC Volts Buffer buffers dc input voltages, sending the resultant signal to the V/F Input Multiplexer.

Input voltages first pass by U5060B, an active low pass filter. It removes both input noise and FET switching noise from the input signal. FET Switch Q5070A and Q5070B, selects either the unknown input voltage or the voltage reference (OFFSET or INPUT REF). Operational amplifier U5060A maintains proper bias on the FET switch, with varying input voltages. The B5 and B5 Digital Control signals control the FET switch.

Operational amplifier U4970 amplifies the selected input signal. FET switches U4950C and U4950D control the feedback resistance and therefore the gain of the operational amplifier. The B6 Digital Control signal controls the FET switches. A LO on the control input (pin 16 or pin 9) of one of the FET switches closes the switch.

**AC VOLTS BUFFER.** The AC Volts Buffer buffers ac input voltages, converts the ac voltage to dc, and then sends the resultant signal to the V/F Input Multiplexer.

Operational amplifier U5151B buffers the ac input voltage. VR5160, VR5162, R5167, R5168, CR5163, and CR5164 protect the amplifier's input. The output of the operational amplifier is sent to operational amplifier U5151A. FET switches U5150C and U5150D control the operational amplifier's feedback resistance and therefore its gain. The C7 Digital Control signal controls the FET switches. A LO on the control input (pin 16 or pin 9) of one of the FET switches closes the switch. The output of the operational amplifier is converted to dc by rms-to-dc converter U5140.

**V/F INPUT MULTIPLEXER.** The V/F Input Multiplexer selects one signal from the DMM Input Circuit. The selected signal is sent to the V/F Converter. Signal selection is controlled by Digital Control signals B2, B3, and B4. The signal selected is either the output of the AC Volts Buffer (AC X1 or AC  $\div 10$ ), the output of the DC Volts Buffer (DC X1 or DC  $\div 10$ ), the  $-2$  V REF, the Ground REF, or the AMPS ST signal.

**OHMS CURRENT SOURCE.** The Ohms Current Source generates the constant currents used to make resistance measurements. Also contained in the circuitry are the voltage references used by the current source and those used in all measurement sequences.

The voltage references are produced by U5050, R5049, R5054, R5055, and R5056. The Ohms Current Source uses the  $-6.95$  V reference. The  $-2.0$  V or  $-0.20$  V reference is measured during reference measurement cycles. FET switch U4942B selects one of the references. The A6 Digital Control signal controls the FET switch. FET switch U4942A selects either the selected reference or the ground offset. The offset is measured during an offset measurement cycle. The A5 Digital Control signal controls the FET switch. For ac measurements, the  $-2.0$  V reference is always used, and the V/F Input Multiplexer selects the  $-2.0$  V reference and the offset directly.

The voltage drop across R4951 determines the current through Q4952. The voltage reference of  $-6.95$  V is at one end of the resistor. FET switch U4942C, controlled by the A7 Digital Control signal, selects either  $-6.26$  V or  $0.0$  V for the other end of the resistor. Voltage follower U5040 buffers the selected voltage.

The resulting current through Q4952 (either 1 mA or 0.1 mA) is divided by either 1 or 10 by R4957 and FET switches U4950A and U4950B, the negative feedback loop for operational amplifier U4960. The positive feedback loop for U4960 drops the same voltage as its negative feedback loop. The B0 Digital Control signal controls the negative feedback; the B1 Digital Control signal controls the positive feedback. The selections for each Ohms range are shown in Table 3-2.

The Voltage Clamp, CR4980 and CR4981, keeps the output voltage between  $-0.7$  V and  $5.7$  V and protects the current source from over-voltage inputs.

Table 3-2  
Ohms Selection

Range	Low-Voltage Ranges			High-Voltage Ranges		
	Output Current	Current at Q4952	Output Voltage Full Scale	Output Current	Current at Q4952	Output Voltage Full Scale
200 $\Omega$	1 mA	1 mA	0.2 V			
2 k $\Omega$	100 $\mu$ A	0.1 mA	0.2 V	1 mA	1 mA	2 V
20 k $\Omega$	10 $\mu$ A	0.1 mA	0.2 V	100 $\mu$ A	0.1 mA	2 V
200 k $\Omega$	1 $\mu$ A	0.1 mA	0.2 V	10 $\mu$ A	0.1 mA	2 V
2 M $\Omega$	100 nA	0.1 mA	0.2 V	1 $\mu$ A	0.1 mA	2 V
20 M $\Omega$				100 nA	0.1 mA	2 V

### V/F Converter and Digital Control

The V/F Converter and Digital Control circuitry (see Diagram 30) generates a frequency that is inversely proportional to the voltage received from the input circuit. It also contains the registers which control the DMM Input Circuit hardware.

**VOLTAGE-TO-CURRENT CONVERTER.** The V/F Input Multiplexer (U5020 Diagram 29) selects the input to the Voltage-to-Current Converter. The selected input is converted to a current and inverted by operational amplifiers U5030A and U5030B. The current, which is inversely proportional to the input voltage, passes through Q4934 and charges integrating capacitor C4914 negatively.

**INTEGRATING CAPACITOR.** Integrating Capacitor C4914 is charged negatively by the Voltage-to-Current Converter. If the Current Source is turned on by the comparator, the Current Source charges the capacitor positively. The Comparator senses the charge on the capacitor; if the charge on the capacitor drops below zero volts, the comparator turns on the Current Source. Each time the Current Source is turned on it charges the capacitor for the same length of time. The voltage on the capacitor ramps down at a rate determined by the input signal. Once the capacitor's voltage goes below zero volts, the voltage on the capacitor ramps up at a rate determined by the input signal and the Current Source.

**COMPARATOR.** The Comparator senses the charge on the Integrating Capacitor, controls the Current Source, and sends a frequency, which is inversely proportional to the option's input, to the Digital Counter.

If the charge on the capacitor drops below zero volts, the collector of Q4932 goes HI. The HI enables the Current Source (U4932B pin 12), and is inverted LO by U4920D. The LO is buffered by Q5130 and sent to the

Digital Counter. This signal starts and stops all measurements and is counted to determine the measurement.

Whenever the microprocessor is loading the Digital Control circuitry with the hardware control information, ENL (U5130B pin 3) stops the Comparator from sending the frequency signal to the Digital Counter. Whenever control information is being sent, ENL is LO. The LO is inverted HI by U5130B. The HI prevents the Comparator from sending frequency information to the Digital Control circuitry by holding the output of U4920D LO. The Digital Counter ignores its input during this time (see Delay Generator).

**CURRENT SOURCE.** The Current Source charges the Integrating Capacitor in the positive direction whenever the Current Source is enabled by the Comparator.

Crystal Y4910 and U4920C make up a 3.58 MHz crystal oscillator. This clock is buffered and inverted by both U4920A and U4920B.

When the Comparator senses that the charge on the Integrating Capacitor is below zero volts, its output (collector of Q4932), going to U4932B pin 12, goes HI. The next time the clock goes HI (U4932B pin 11), U4932B sets, making pin 8 LO. The LO at pin 8 causes counter U4930 to be loaded with zeros, making MAX/MIN (U4930 pin 12) LO. Flip-flop U4932A resets when the next rising edge of the clock arrives at U4932A pin 3. Resetting U4932A switches the current source for Q4920 from ground to the Integrating Capacitor and resets U4932B, removing the load signal from counter U4930.

The amount of current removed from the Integrating Capacitor is determined by Q5020. Counter U4930 controls the length of time the current is removed. The

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counter counts the oscillator clocks at pin 14. When the maximum count (15) is reached, MAX/MIN pin 12 goes HI. The next rising clock at U4932A pin 3 sets U4932A, switching the current source for Q4920 back to ground.

The current from the Current Source charges the Integrating Capacitor up past zero volts. The amount of charge and the time of charge is always the same: the constant current through Q5020 and Q4920 for 16 cycles of the crystal oscillator (see Figure 3-2). The frequency of these charge cycles (about 20 kHz at 2 V, 40 kHz at 0.0 V, and 70 kHz at -2 V) varies inversely with the DMM's input.

**DIGITAL CONTROL.** The Digital Control circuitry stores the hardware (relays and FET switches that determine the measurement path) control words. As explained later, the Register Control circuitry serially shifts the hardware control words to the Digital Control circuitry. Due to transformer coupling in the Register Control circuitry, U5124 only sees the rising and falling edges of the CLK (pin 10) and DATA (pin 7) signals. The signals are reconstructed by line receiver U5124. The reconstructed data is clocked into the 24-bit register by the reconstructed clock signal (see Figure 3-3). Three serial-input parallel-output latches (U5122, U5120, and U4940) make up the 24-bit register. The control signals are buffered and inverted by U5132, U5130, U5010, and Q4950.

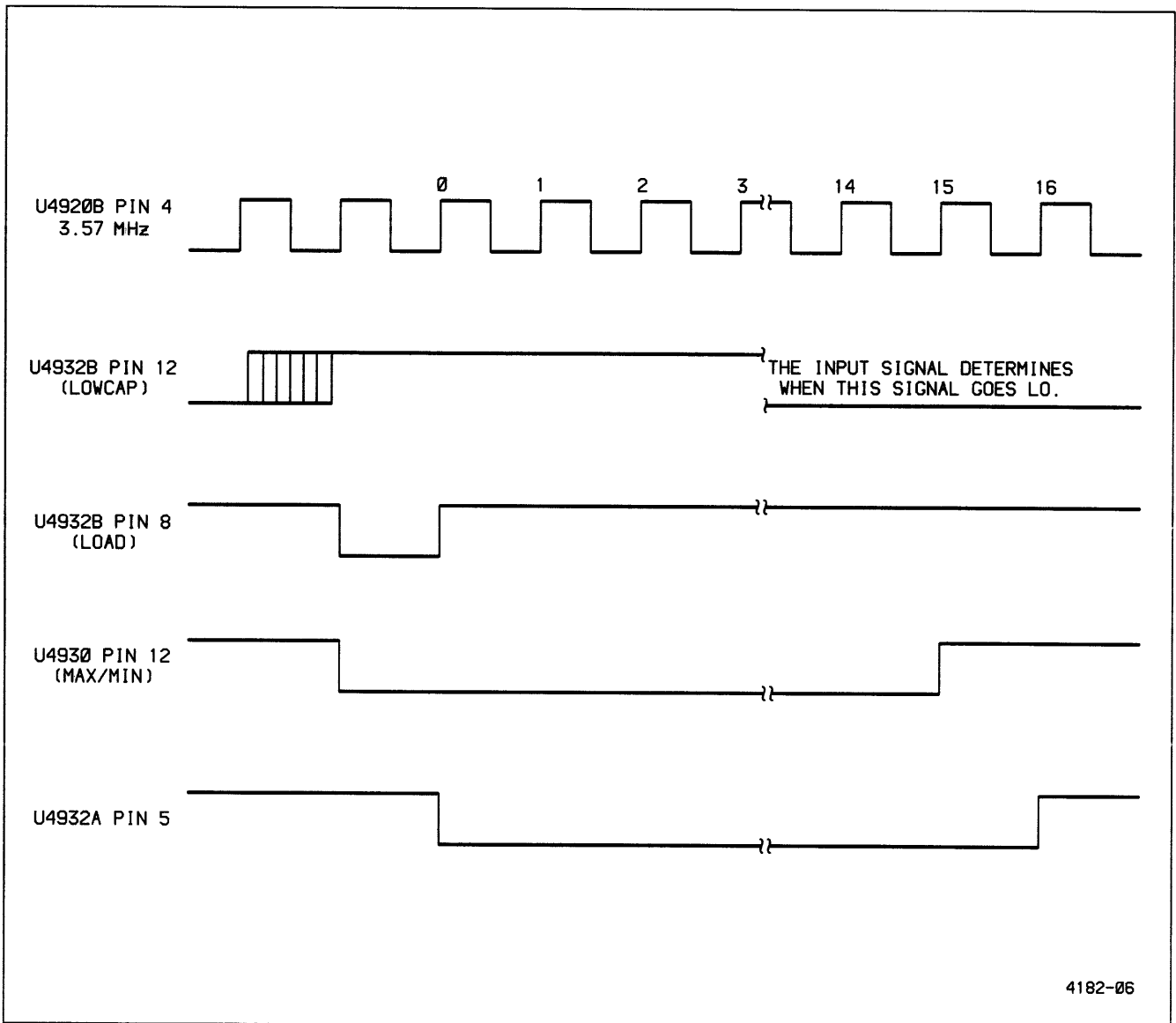


Figure 3-2. Current Source timing diagram.

When digital control words are not being written, the V/F Converter (Comparator) uses the DATA line. Before the digital control words can be written, the V/F Converter's information must be stopped. Sending an initial series of CLK pulses stops the information. The pulses discharge C5130. The LO on C5130 is inverted HI by U5130B. The HI on U4920D pin 11 keeps its output LO, stopping the V/F Converter's information.

When the CONT button is pushed, the continuity function is calibrated by measuring the 10 Ω current shunt (the 10 Ω reference). The instrument then enters the 200 Ω unknown position and takes measurements. The state of the control signals, in hexadecimal, for each DMM operating mode is shown in Tables 3-3 through 3-11.

### Digital Counter and Processor Interface

The Digital Counter and Processor Interface (see Diagram 31) contains the option's microprocessor interface, Counters, Delay Generator, and Register Control circuitry. Included in the microprocessor interface is the option's memory, buffers, registers, and latches that interface the option to the microprocessor. The counters time clocks used in calculating measurements. The Delay Generator delays each measurement's start until the hardware (relays and FET switches) settles. The Register Control circuitry loads the Digital Control registers and isolates instrument circuitry from the voltages possible at the DMM inputs.

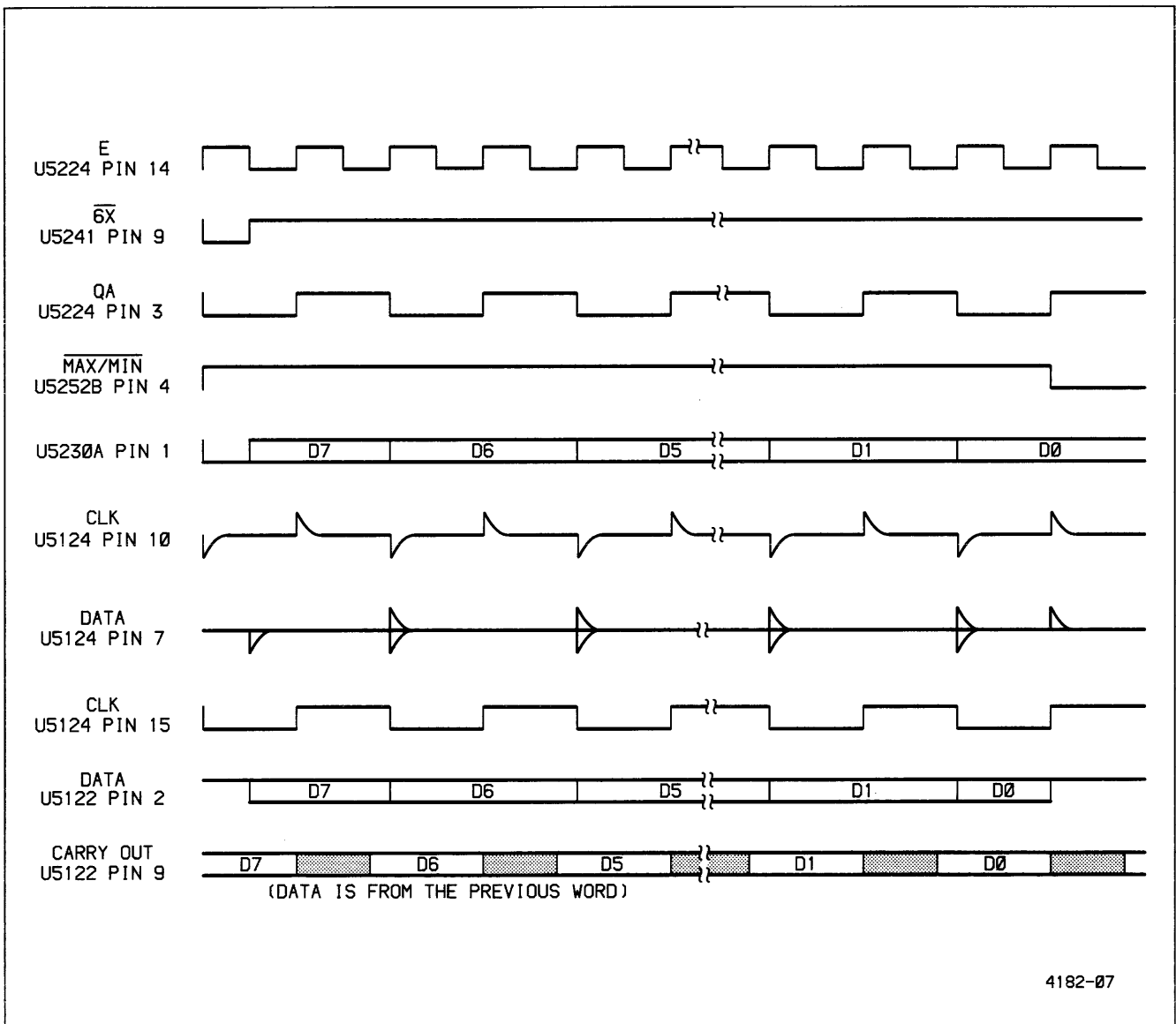


Figure 3-3. Digital Control timing diagram.



Table 3-3  
Continuity

	A	B	C
Calibration	E5	36	00
Measurement	E0	B6	22

Table 3-4  
LO Ω Control Signals

Range	Unknown			Reference			Offset		
	A	B	C	A	B	C	A	B	C
200 Ω	E0	B6	22	C0	96	22	E0	96	22
2 kΩ	60	B6	22	40	96	22	60	96	22
20 kΩ	60	B7	22	40	97	22	60	97	22
200 kΩ	60	B4	22	40	94	22	60	94	22
2 MΩ	60	B5	22	40	95	22	60	95	22

Table 3-5  
HI Ω Control Signals

Range	Unknown			Reference			Offset		
	A	B	C	A	B	C	A	B	C
2 kΩ	E0	F6	22	80	D6	22	E0	D6	22
20 kΩ	60	F6	22	00	D6	22	60	D6	22
200 kΩ	60	F7	22	00	D7	22	60	D7	22
2 MΩ	60	F4	22	00	D4	22	60	D4	22
20 MΩ	60	F5	23	00	D5	22	60	D5	22

Table 3-6  
DC Volts Control Signals

Range	Unknown			Reference			Offset		
	A	B	C	A	B	C	A	B	C
0.2 V	60	B4	2X	40	94	2X	60	94	2X
2 V	60	F4	2X	00	D4	2X	60	D4	2X
20 V	60	74	04	00	54	04	60	54	04
200 V	60	74	24	00	54	24	60	54	24
500 V	60	64	24	00	44	24	60	44	24

X is 0 if input Z is >1 GΩ, and X is 4 if input Z = 10 MΩ.

Table 3-7  
AC Volts Control Signals

Range	Unknown			Reference			Offset		
	A	B	C	A	B	C	A	B	C
0.2 V	6X	0C	88	6X	10	88	6X	00	88
2 V	6X	0C	08	6X	10	08	6X	00	08
20 V	6X	0C	98	6X	10	98	6X	00	98
200 V	6X	0C	18	6X	10	18	6X	00	18
500 V	6X	1C	18	6X	10	18	6X	00	18

The value of X is set during calibration; the value depends on the amount of frequency compensation required. Also, since X is a 5 bit word, the 6X could be a 7X.

Table 3-8  
DC Amps Control Signals

Range	Unknown			Reference			Offset		
	A	B	C	A	B	C	A	B	C
100 μA	71	34	40	51	14	40	71	14	40
1 mA	69	34	40	49	14	40	69	14	40
10 mA	65	34	40	45	14	40	65	14	40
100 mA	63	34	40	43	14	40	63	14	40
1 A	60	34	40	40	14	40	60	14	40

Table 3-9  
AC Amps Control Signals

Range	Unknown			Reference			Offset		
	A	B	C	A	B	C	A	B	C
100 μA	71	4C	C0	71	50	C0	71	40	C0
1 mA	69	4C	C0	69	50	C0	69	40	C0
10 mA	65	4C	C0	65	50	C0	65	40	C0
100 mA	63	4C	C0	63	50	C0	63	40	C0
1 A	60	4C	C0	60	50	C0	60	40	C0

Table 3-10  
Control Signals to Measure  
AC Volts Offset at Calibration

Range	Unknown			Reference			Offset		
	A	B	C	A	B	C	A	B	C
0.2 V	70	4C	81	70	50	81	70	40	81
2 V	70	4C	01	70	50	01	70	40	01
20 V	70	0C	11	70	10	11	70	00	11
200 V	70	4C	11	70	50	11	70	40	11
500 V	70	5C	11	70	50	11	70	40	11

**Table 3-11**  
**Control Signals to Measure**  
**AC Amps Offset at Calibration**

Range	Unknown			Reference			Offset		
	A	B	C	A	B	C	A	B	C
ALL	F1	4E	83	F1	52	83	F1	42	83

**MEMORY AND I/O DECODERS.** This circuitry generates enabling signals and strobes that allow the microprocessor to control the various circuit functions and devices as in the standard oscilloscope (see "Address Decode" description in the service manual of the standard oscilloscope). The DMM option memory map is shown in Table 3-12.

**Table 3-12**  
**DMM Option Memory Map**

Address	Device Description
1000-1FFB	Buffer board EPROM
1FFC-1FFF	Extended front panel switches
4000-7FFF	Data bus buffer
4000-7F7F	EPROM
7F80	Tone control register (set)
7F81	Tone control register (reset)
7F82	Flip-flop U5273B (set)
7F83	Flip-flop U5273B (reset)
7F84	Delay generator (set)
7F85	Status register
7F86	Register control (shift/load)
7F87	EPROM select register
7F88-7F8F	Timer U5272 registers
7F90-7F97	Address decoder image
7F98-7F9F	Timer image
7FA0-7FA7	Address decoder image
7FA8-7FAF	Timer image
7FB0-7FB7	Address decoder image
7FB8-7FBF	Timer image
7FC0-7FFE	Option select register images
7FFF	Option select register

**OPTION SELECT REGISTER.** The Option Select Register, U5251B, enables and disables access to DMM circuitry.

When there is a write to address 7FFF, data bus line BBD6 is latched by the register. If BBD6 is HI when latched, DMM circuitry is selected for memory and I/O

accesses within the paged address space (4000-7FFF). If BBD6 is LO when latched, the DMM is deselected. While the DMM is deselected, the Option Select Register is the only DMM circuitry that can be accessed by the microprocessor.

**DATA BUS BUFFER.** Bidirectional buffer U5282 buffers the data bus.

The buffer is enabled by BVMA, BA14, E, and the Option Select Register through U5232A and U5242A. BR/ $\bar{W}$  through U5270A controls the direction of data flow through the buffer.

**EPROM.** The EPROM stores the option's control program.

The Option Select Register, through U5271A and U5271B, enables both EPROM U5280 and U5281. EPROM data is sent over the data bus when an EPROM address is decoded by U5242A and U5250 through U5270D, U5271D, and U5232A.

If both EPROMs are used, the EPROM Select Register (U5251A) allows only one EPROM to be enabled at a time. When the register's address is decoded by U5241, the register latches D0. If D0 was HI, U5281 is enabled; if D0 was LO, U5280 is enabled.

If only EPROM U5281 is used, jumper W5260 will connect U5271 pin 1 and pin 10. This enables the EPROM whenever the option is selected.

**REGISTER CONTROL.** The Register Control circuitry loads the hardware control word into the Digital Control register.

The DMM Input Circuit hardware (relays and FET switches that determine the measurement path) is controlled by writing three 8-bit words in succession (A, B, and C) to shift register U5240. The microprocessor writes the three words every 150 ms, once to set up each unknown, offset, and reference measurement. Each write loads shift register U5240 and resets counter U5242. The counter then outputs eight clock pulses at one-half the microprocessor clock (E) rate. The eight pulses shift the word through U5240.

The word (DATA) is sent to the Digital Control circuitry through U5242B, U5230A, and T5230. The DATA is only sent when the shift register is not being loaded and the

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counter is not at its maximum count. The same CLK used to shift the word out of the shift register is sent to the Digital Control circuitry through U5230B and T5220.

Before sending each group of three words, part of another word is sent. The sending of this word disables the V/F output clock which also uses the data path through T5230.

Transformers T5230A and T5230B isolate the Digital Counter, Processor Interface, and Extended Front Panel circuitry from the floating ground and high input potentials associated with the rest of the circuitry.

**DELAY GENERATOR.** The Delay Generator delays the start of a measurement. The delay starts after the Register Control circuitry has loaded the Digital Control registers. This delay allows the measurement path (relays and FET switches) to settle before a measurement is taken.

Whenever counter U5224 is not at its maximum count, reset, or counting, counter U5231 and flip-flop U5222A are reset. While the flip-flop is reset, counters U5272 and U5274 do not count. When the Digital Control register (see Diagram 30) has been loaded, U5224 will be at its maximum count. The MAX/MIN output (U5224 pin 2) goes HI, removing the reset hold it had on both U5231 and U5222A. This is the start of the delay. Counter U5231 then counts the 25 kHz clock (5.5 Vac) at U5231 pin 10.

About 50 milliseconds after the start of the delay, U5231 pin 15 goes HI. If DATA (C0) was HI, U5222A sets, ending the delay. If, however, the option is in its 20 M $\Omega$  range, DATA will be LO, keeping U5222A reset. In this case, the delay lasts about 400 ms. The delay ends when U5231 pin 3 goes HI, stopping counter U5231 through CR5211, and setting U5222A through U5252A, U5232C, and U5252C. In both cases, counter U5272 starts counting V/F pulses once U5222A is set.

If the DMM mode is changed by pushing a front-panel switch, the microprocessor does not wait for the delay to end. When the mode is changed, the microprocessor writes to 7F84, making U5241 pin 11 LO. This sets U5222A through U5252C and U5232C, ending the delay.

**COUNTERS.** Timer U5272 takes all measurements. The timer contains three programmable counters. Except for Continuity and some Diagnostics modes, the timer is programmed as follows:

Counter 1 counts V/F clock pulses. Counting starts when the counter's gate goes LO. When the gate goes HI, counting stops and the measurement-complete bit is set.

Counter 2 counts the most-significant bits of the 10 MHz clock over the same interval as Counter 1.

Counter 3 counts the internal E clock. The counter produces the 0.1 s measurement interval, outputting a positive 0.1 s pulse when its gate goes LO.

Counting does not start until after the Delay Generator's delay has ended. When the delay ends, Counter 3 starts and its output goes HI. The first V/F clock after the output of Counter 3 goes HI starts Counters 1 and 2. The first V/F clock after Counter 3 goes LO (0.1 s measurement interval ends) stops Counters 1 and 2. When Counter 1 stops (its gate goes HI), Counters 1 and 2 are read and the measurement calculated (see Figure 3-4). Three of these measurements are required to display a reading; the unknown measurement measures the input signal, the offset measurement measures zero volts, and the reference measurement measures the  $-0.2$  V or the  $-2$  V reference. After all three measurements are made, the measurement to be displayed is calculated and then displayed.

At the start of the delay period, U5274A pin 2, U5272 pin 2, and U5272 pin 5 all go HI. This resets the least-significant bits, from the previous measurement, of the 10 MHz counter (U5274A) and prevents Counters 2 and 3 from counting. When Counter 3 is not counting, its output, U5272 pin 6, is LO.

When the delay ends (U5222A pin 6 goes LO), DELAY goes LO enabling Counter 3. When Counter 3 is enabled, it starts counting and its output (U5272 pin 6) goes HI. This HI, at U5273B pin 12, allows U5273B to set when the next V/F clock arrives (at U5273B pin 11). When U5273B is set, Counter 1 and U5273A are both enabled. Counter 1 starts counting the V/F clocks, and the 10 MHz counter (U5273A, U5274A, and Counter 2) starts counting the B10MHZ clocks.

This counting continues until the measurement interval ends. At the end of the interval, the output of Counter 3 goes LO (U5272 pin 6). This LO allows U5273B to be reset when the next V/F clock arrives. The reset U5273B stops Counter 1 and sets U5273A, stopping the 10 MHz counter.

The V/F clock is stretched and inverted by Q5230, U5271B, U5274B, and U5252D. When the V/F clock goes LO, Q5230 turns on. This makes U5274B pin 12 HI, resetting U5274B. This makes U5252 pin 9 LO. This signal stays LO until four E clocks, through U5271B, are counted by U5274B. This stretched V/F clock is inverted by U5252D.

**TONE CONTROL.** The Tone Control circuitry generates a tone when the resistance measured in Continuity mode is less than  $10\ \Omega$ . This circuitry is only used in Continuity mode.

At the start of Continuity mode, a  $10\ \Omega$  resistance is measured. The count obtained in Counter 1 during the measurement is used for each initialization of Counter 1 for the duration of Continuity mode. Counter 2 is set up to produce the tone selected for continuity measurements. Counter 3 is set up to produce the measurement interval, which for Continuity mode is about 20 ms.

Counter 2 is always producing a tone signal in Continuity mode. Flip-flop U5222B determines whether or not the tone reaches the speaker. If the flip-flop is set, CR5212 is reverse biased, allowing the tone to reach Q5210. If the flip-flop is set, Q5210 inverts the tone signal and drives the speaker located in the Extended Front Panel circuitry. If the flip-flop is reset, CR5210 is forward biased, stopping the tone before it reaches Q5210.

Since Counter 1 is initialized to the count obtained for a  $10\ \Omega$  resistance, if the resistance being measured is less than or equal to  $10\ \Omega$ , the counter counts down to zero

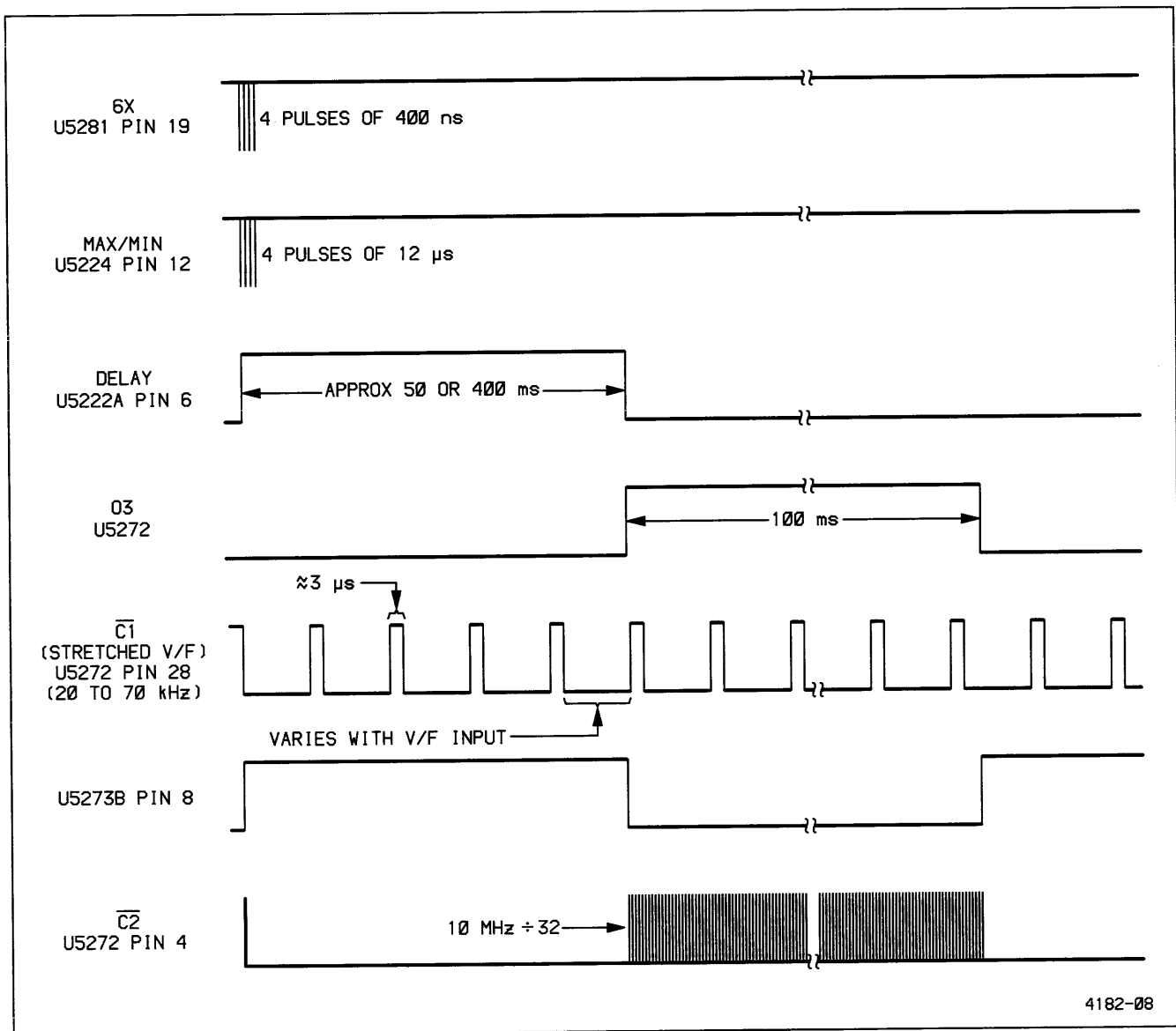


Figure 3-4. Digital Counter timing diagram.

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within the measurement interval. When the counter reaches zero, its output goes HI. If the resistance being measured is greater than  $10\ \Omega$ , the counter will not reach zero, and its output will remain LO.

At the end of each measurement interval, the output of Counter 3 goes HI. This HI clocks the output of Counter 1 into flip-flop U5222B. If the output of Counter 1 is HI (resistance is  $10\ \Omega$  or less), the flip-flop sets and the tone sounds. If the output of the counter is LO (resistance is greater than  $10\ \Omega$ ), the flip-flop resets and the tone does not sound.

**STATUS REGISTER.** The microprocessor reads the Status Register whenever the register's address is decoded by U5241 during a read operation. The register contains the least-significant bits of the 10 MHz counter (U5274A), the output of the Register Control's shift register (U5240), and the state of the Tone Control flip-flop.

### Extended Front Panel

The Extended Front Panel circuitry (see Diagram 32) contains the Continuity Indicator, I/O Decoders, Extended Front Panel Switches, and the Switch Column Buffer.

**CONTINUITY INDICATOR.** The Continuity Indicator is a speaker driven by the Tone Control circuitry during Continuity measurements.

**I/O DECODERS.** The I/O Decoders decode addresses from the microprocessor, generating strobes for the Buffer Board ROM ( $\overline{ROMEN}$  at U4310B pin 11) and the Extended Front Panel Switches (U4310A and U4310B pin 12). Decoder outputs are buffered by U4300.

**EXTENDED FRONT PANEL SWITCHES.** The Extended Front Panel Switches are pushed to select the desired DMM operating mode.

The switches are arranged in three rows and five columns. When the microprocessor wants to see if a switch has been pushed, it consecutively reads each row of switches. The row of switches being read is pulled LO by U4310A when the row's address is decoded. If the row being read has a switch pushed in, the column the switch is in is LO. Each read of a switch row returns the state of all five switch columns.

**SWITCH COLUMN BUFFER.** The Switch Column Buffer buffers the five switch columns, driving the data bus with switch column data whenever the switches are read.

### Power Distribution

The Power Distribution circuitry (see Diagram 33) contains the floating power supplies used by the DMM circuitry and distributes both the floating supplies and the standard instrument's 5 V supply to the DMM circuitry.

# PERFORMANCE CHECK AND CALIBRATION PROCEDURES

## INTRODUCTION

This section contains the Option 01 (DMM) portion of the instrument performance check and calibration procedures. The "Performance Check Procedure" is used to verify that the instrument's performance meets the requirements listed in the "Specification" (Section 1). The "Calibration Procedure" is used to restore optimum performance or return the option to conformance with its "Performance Requirements" as listed in the "Specification".

Instrument performance should be checked after every 2000 hours of operation or once each year if used infrequently. A more frequent interval may be necessary if your instrument is subjected to harsh environments or severe usage. The results of these periodic checks will determine the need for recalibration.

Before performing either procedure, ensure that the LINE VOLTAGE SELECTOR switch is set for the ac power source being used (see "Preparation for Use" in Section 2 of the standard instrument service manual). Connect the instrument to be checked and the test equipment to an appropriate power source.

Turn the instrument on and ensure that no error message is displayed on the crt. If the instrument displays **DIAGNOSTIC. PUSH A/B TRIG TO EXIT** at power on, one of the power-up tests has failed. If the error message on the bottom line of the crt is **TEST 04 FAIL XX** where XX is X1, 1X, or 11, the stored calibration data is in error and

the instrument should be recalibrated by a qualified service technician before performing the "Performance Check Procedure". If any other error messages occur, the failure is probably not related to calibration and the instrument should be repaired by a qualified service technician before performing either procedure.

## TEST EQUIPMENT

The test equipment listed in Table 4-1 is a complete list of the equipment required to accomplish both the "Performance Check Procedure" and the "Calibration Procedure". To assure accurate measurements, it is important that test equipment used for making these checks meet or exceed the specifications described in Table 4-1. When considering use of equipment other than that recommended, use the "Minimum Specification" column to determine whether available test equipment will suffice.

The procedures in this section are written using the equipment listed in Table 4-1. When substitute equipment is used, control settings stated in the test setup and in the procedures may need to be altered.

Detailed operating instructions for test equipment are not given in this procedure. If more operating information is needed, refer to the appropriate test-equipment instruction manual.

Table 4-1  
Test Equipment Required

Item and Description	Minimum Specification	Examples of Suitable Test Equipment
1. Calibrator	Dc voltage: 180 mV to 450 V. Voltage accuracy: 0.0075%. Resistance: 100 $\Omega$ to 10 M $\Omega$ . Resistance accuracy: 0.025%. Dc current: 10 $\mu$ A to 900 mA. Current accuracy: 0.03%. Ac current: 10 $\mu$ A to 900 mA. Current accuracy: 0.01%.	Fluke 5101B with Option 03.
2. Ac Calibration System	Ac voltage: 20 mV to 450 V. Voltage accuracy: 0.2%. Frequency: 50 Hz to 50 kHz.	Fluke 5101B and 5205A.
3. Cable	Impedance: 50 $\Omega$ .	Tektronix Part Number 012-0057-01.
4. Adapter (2 required)	BNC-Female-to-Dual Banana.	Tektronix Part Number 103-0090-00.
5. Adapter	Connectors: BNC-Male-to-Dual Binding Post.	Tektronix Part Number 103-0035-00.
6. Adapter	BNC-Female-to-BNC Female.	Tektronix Part Number 103-0028-00.
7. Patch Cord	Banana-Plug-to-Banana Plug.	Tektronix Part Number 012-0039-00.
8. Resistor	1 k $\Omega$ , 1/4 W.	

## PERFORMANCE CHECK PROCEDURE

This procedure is used to verify proper operation of the option and may be used to determine the need for calibration. This check may also be used as an acceptance test and as a preliminary troubleshooting aid. Perform all steps, both in the sequence presented and in their entirety, to ensure that control settings are correct for the following step.

### LIMITS AND TOLERANCES

The tolerances given in this procedure are valid for an instrument that has been previously calibrated in an ambient temperature between +20°C and +30°C. The instrument must also have had at least a 45-minute

warm-up period. To assure instrument performance, perform all steps in the following procedures at the same ambient temperature.

### PREPARATION

Removing the wrap-around cover is not necessary to perform this procedure. All checks are made using operator-accessible controls and connectors.

All the test equipment items listed in Table 4-1 are required to perform this procedure. Since detailed operating instructions for the test equipment are not provided in this procedure, refer to the appropriate test-equipment instruction manual if additional information is needed.

## DMM OPTION CHECKS

### 1. Check Dc Volts Accuracy

a. Connect the calibrator via a BNC-female-to-dual banana adapter, a 50- $\Omega$  cable, and a BNC-female-to-dual banana adapter to the HIGH and LOW DMM input connectors.

b. Select the DC V function.

c. CHECK—Reading is within the limits shown in Table 4-2 for each dc calibrator output voltage.

Table 4-2  
Dc Voltage Readout Checks

Calibrator Dc Voltage (V)	Display Readout Limits (V)
180 m	179.93 m to 180.07 m
-180 m	-179.93 m to -180.07 m
1.8	1.7993 to 1.8007
-1.8	-1.7993 to -1.8007
18	17.993 to 18.007
-18	-17.993 to -18.007
180	179.93 to 180.07
-180	-179.93 to -180.07
450	449.7 to 450.3
-450	-449.7 to -450.3

### 2. Check Ac Volts Accuracy

a. Select the AC V function.

b. CHECK—Reading is within the limits shown in Table 4-3 for each ac calibrator output voltage.

c. Disconnect the test equipment from the instrument.

Table 4-3  
Ac Voltage Readout Checks

Calibrator Ac Voltage (V)	Frequency (Hz)	Display Readout Limits (V)
20 m	50	19.68 m to 20.32 m
180 m	50	178.72 m to 181.28 m
	10 k	178.72 m to 181.28 m
0.2	50	0.1968 to 0.2032
1.8	50	1.7872 to 1.8128
	10 k	1.7872 to 1.8128
2	50	1.968 to 2.003
18	50	17.872 to 18.128
	10 k	17.872 to 18.128
	20 k	17.800 to 18.200
	50 k	17.080 to 18.920
20	50	19.68 to 20.32
180	50	178.72 to 181.28
450	50	446.3 to 453.7

### WARNING

*Use extreme caution when performing the following ac voltage checks. Make sure that the signal connectors are correctly oriented so that ac voltage is not present on any exposed metal pieces.*

d. Connect the ac power amplifier via a BNC-male-to-dual binding post adapter, a BNC-female-to-BNC female adapter, a 50- $\Omega$  cable, and a BNC-female-to-dual banana adapter to the HIGH and LOW DMM input connectors.

e. CHECK—Reading is within the limits shown in Table 4-4 for each ac calibrator output voltage.

f. Disconnect the test equipment from the instrument.

### 3. Check Resistance Accuracy

a. Connect the calibrator via a BNC-female-to-dual banana adapter, a 50- $\Omega$  cable, and a BNC-female-to-dual banana adapter to the HIGH and LOW DMM input connectors.



**Performance Check and Calibration Procedures  
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b. Select the LO  $\Omega$  function.

c. CHECK—Reading is within the limits shown in Table 4-5 for each calibrator output resistance.

b. Select the HI  $\Omega$  function.

c. CHECK—Reading is within the limits shown in Table 4-6 for each calibrator output resistance.

**Table 4-4  
Ac Voltage Readout Checks**

Calibrator Ac Voltage (V)	Frequency (Hz)	Display Readout Limits (V)
180	10 k	178.72 to 181.28
	20 k	178.00 to 182.00
	50 k	170.80 to 189.20
450	10 k	446.3 to 453.7
	20 k	444.5 to 455.5
	50 k	426.5 to 473.5

**Table 4-5  
LO  $\Omega$  Readout Checks**

Calibrator Resistance ( $\Omega$ )	Display Readout Limits ( $\Omega$ )
100	99.70 to 100.30
1 k	0.9988 k to 1.0012 k
10 k	9.988 k to 10.012 k
100 k	99.88 k to 100.12 k
1 M	0.9973 M to 1.0027 M

**Table 4-6  
HI  $\Omega$  Readout Checks**

Calibrator Resistance ( $\Omega$ )	Display Readout Limits ( $\Omega$ )
2 k	1.9978 k to 2.002 k
10 k	9.988 k to 10.012 k
100 k	99.88 k to 100.12 k
1 M	.9973 M to 1.0027 M
10 M	9.948 M to 10.052 M

**4. Check Continuity Function**

a. Set the calibrator to produce a 1- $\Omega$  output resistance.

b. Select the CONT function.

c. CHECK—The instrument produces an audible tone.

**5. Check Dc Current Accuracy**

a. Select the DC A function.

b. CHECK—Reading is within the limits shown in Table 4-7 for each dc calibrator output current.

**6. Check Ac Current Accuracy**

a. Select the AC A function.

b. CHECK—Reading is within the limits shown in Table 4-8 for each ac calibrator output current.

c. Disconnect the test equipment from the instrument.

**Table 4-7  
Dc Current Readout Checks**

Calibrator Dc Current (A)	Display Readout Limits (A)
10 $\mu$	9.97 $\mu$ to 10.03 $\mu$
-10 $\mu$	-9.97 $\mu$ to -10.03 $\mu$
90 $\mu$	89.89 $\mu$ to 90.11 $\mu$
-90 $\mu$	-89.89 $\mu$ to -90.11 $\mu$
0.9 m	0.8989 m to 0.9011 m
-0.9 m	-0.8989 m to -0.9011 m
9 m	8.989 m to 9.011 m
-9 m	-8.989 m to -9.011 m
90 m	89.89 m to 90.11 m
-90 m	-89.89 m to -90.11 m
0.9	0.8989 m to 0.9011 m
-0.9	-0.8989 m to -0.9011 m

Table 4-8  
Ac Current Readout Checks

Calibrator Ac Current (A)	Frequency (Hz)	Display Readout Limits (A)
10 $\mu$	50	9.84 $\mu$ to 10.16 $\mu$
	1 k	9.84 $\mu$ to 10.16 $\mu$
	5 k	9.84 $\mu$ to 10.16 $\mu$
90 $\mu$	50	89.36 $\mu$ to 90.64 $\mu$
0.9 m	50	0.8936 m to 0.9064 m
9 m	50	8.936 m to 9.064 m
90 m	50	89.36 m to 90.64 m
900 m	50	893.6 m to 906.4 m

a. Connect the calibrator via a BNC-female-to-dual banana adapter, a 50- $\Omega$  cable and a BNC-female-to-dual banana adapter to the HIGH and LOW DMM input connectors.

b. Select the DC V function.

c. Set the calibrator to produce a 60-Hz, 1.0-V output.

d. CHECK—Reading is between  $-1.0000$  mV and  $+1.0000$  mV.

e. Disconnect the test equipment from the instrument.

f. Connect the test setup as shown in Figure 4-1.

g. Set the calibrator to produce a 10-V dc output.

h. CHECK—Reading is between  $-0.1000$  mV and  $+0.1000$  mV.

i. Set the calibrator to produce a 60-Hz, 10 V output.

j. CHECK—Reading is between  $-10.000$  mV and  $+10.000$  mV.

k. Select the AC V function.

l. Set the calibrator to produce a 60-Hz, 10.0-V output.

m. CHECK—Reading is less than 10.000 mV.

n. Disconnect the test equipment from the instrument.

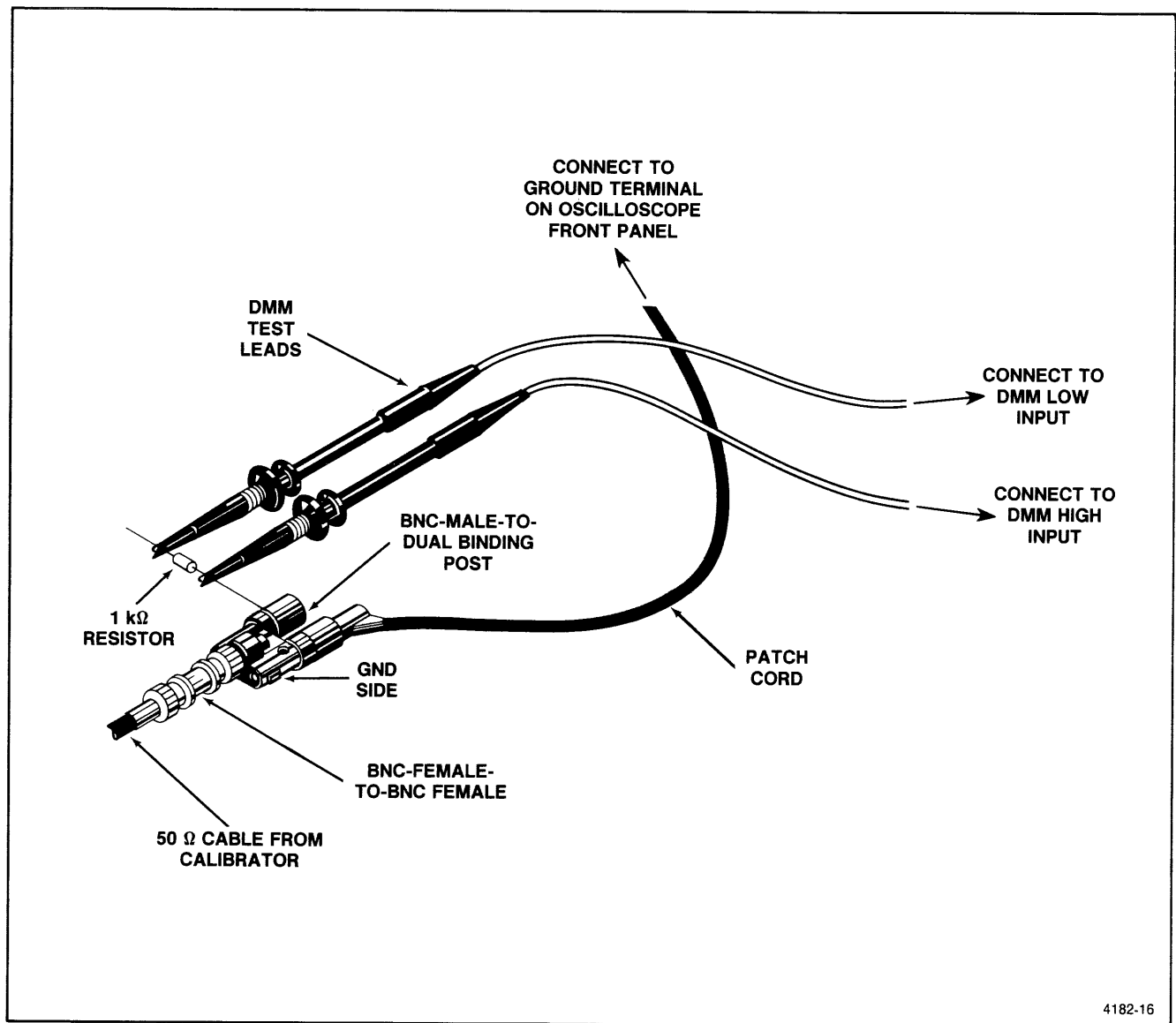


Figure 4-1. Test setup for DMM common mode check.

# CALIBRATION PROCEDURE

## INTRODUCTION

The "Calibration Procedure" is used to restore optimum performance or return the option to conformance with its "Performance Requirements" as listed in the "Specification" (Section 1).

Calibration constants are generated for each of the functional ranges by the system microprocessor and are stored in nonvolatile memory. Although this procedure is designed to calibrate all DMM functions, an individual calibration routine may be performed separately if only one function is suspected of being out of calibration. For example, DM CAL 74 may be run alone if the LO  $\Omega$  function is suspected of being out of calibration. See Table 4-9 for a listing of the calibration routines and the associated function that is calibrated.

## PREPARATION

Remove the wrap-around cabinet from the instrument as described in step 1 of the "Option Assembly Removal" procedure in the "Maintenance" section of this manual.

Table 4-9  
Calibration Routines

Calibration Routine	Function Calibrated
DM CAL 71	DC V
DM CAL 72	AC V
DM CAL 73	HI $\Omega$
DM CAL 74	LO $\Omega$
DM CAL 75	DC A
DM CAL 76	AC A
DM CAL 77	DC V input impedance selection

Then set the CAL/NO CAL jumper (P501) in the standard instrument to the CAL position (between pins 1 and 2).

Calibration of the instrument must be done at an ambient temperature between +20°C and +30°C, and the instrument must have had a warm-up period of at least 45 minutes. Performing this procedure while the temperature is drifting may cause wrong calibration settings.

**Equipment Required (see Table 4-1):**

Calibrator (Item 1)

Adapters (Item 4)

Cable (Item 3)

## DMM CALIBRATION

### NOTE

a. Connect the calibrator via a BNC-female-to-dual banana adapter, a 50- $\Omega$  cable, and a BNC-female-to-dual banana adapter to the HIGH and LOW DMM input connectors.

b. Push the TRIGGER SLOPE switch while holding in both the  $\Delta V$  and  $\Delta t$  switches to access the Diagnostic Menu.

### NOTE

*If the calibration feature is disabled (the CAL/NO CAL jumper is in the NO CAL position), CAL messages will not appear in the Diagnostic Menu of the crt readout.*

c. Repeatedly push up and release the TRIGGER MODE switch until the **DM CAL 71** message appears in the Diagnostic Menu of the crt readout.

d. Start the calibration routine by pushing up on the TRIGGER COUPLING switch.

e. Set the calibrator to produce the signal called for in the Diagnostic Menu of the crt readout.

f. Start the calibration constant calculation by pushing up on the TRIGGER COUPLING switch. The top line of the crt readout will display **BUSY**.

g. Wait for the microprocessor to finish calculating the calibration constant. When finished, the **BUSY** display is removed and the display is updated in preparation for the calculation of the next calibration constant.

*If the calculation of the calibration constant fails, **OUT OF LIMIT** is displayed in the top line of the crt readout and the display is updated in preparation for the calculation of the next calibration constant. This will happen if the applied signal is not within tolerance or if it is not applied soon enough. If desired, the calibration constant calculation may be re-attempted by pushing down and then up on the TRIGGER COUPLING switch.*

h. Repeat parts e through g until **COMPLETE** is displayed in the bottom line of the crt readout.

i. Push up on the TRIGGER COUPLING switch to exit the current calibration routine.

j. Push up on the TRIGGER MODE switch to select the next calibration routine.

k. Repeat steps d through j until **DM CAL 77** is displayed in the bottom line of the Diagnostic Menu.

l. Push up on the TRIGGER COUPLING switch. One of the following messages will be displayed on the crt readout:

**INPUT Z ON 0.2VDC 2VDC = 10M $\Omega$**

**INPUT Z ON 0.2VDC 2VDC > 100G $\Omega$**

m. If the desired input impedance message is not displayed, push up and release the TRIGGER COUPLING switch once. The desired input impedance message should now be displayed.

n. Push down once on the TRIGGER COUPLING switch to store the selected impedance. The crt readout will then display one of the following messages:

**INPUT Z IS NOT SELECTABLE**

**INPUT Z IS SELECTABLE**

*NOTE*

*The ability to select the input impedance of the 0.2 V dc and 2 V dc ranges using DM EXER 72 is determined by this calibration setting.*

o. If the desired input impedance selection message is not displayed, push up and release the the TRIGGER COUPLING switch once. The desired input impedance selection message should now be displayed.

p. Push down once on the TRIGGER COUPLING switch to store the desired impedance selection.

q. Push the A/B TRIG or A/B/MENU button as appropriate to exit the Diagnostic Monitor.

r. Disconnect the test equipment from the instrument.

s. Turn the instrument off and disconnect it from its ac power source.

t. Return the CAL/NO CAL jumper to its NO CAL position.

u. Reinstall the instrument cabinet using the reverse of the procedure outlined in step 1 of the "Option Assembly Removal" procedure in the "Maintenance" section of this manual.

# MAINTENANCE

This section contains information for troubleshooting the 2445 and 2465 Option 01, DMM Option. Maintenance information contained in the standard instrument Service Manual also applies to maintenance of this option. To function properly, the option requires a working standard oscilloscope and Buffer board.

## TROUBLESHOOTING

Preventive maintenance performed on a regular basis should reveal most potential problems before an instrument malfunctions. However, should troubleshooting be required, the following information is provided to facilitate location of a fault. In addition, the material presented in the "Theory of Operation" and "Diagrams" sections of this manual and the "Troubleshooting" section of the standard instrument's service manual may be helpful while troubleshooting.

### GENERAL TROUBLESHOOTING PROCEDURE

The information presented here is intended to complement the information contained in the "Troubleshooting Procedures" part of the "Diagrams" section of the manual. Become familiar with the rest of the information in this section before proceeding with instrument troubleshooting. If the instrument will run the diagnostic routines as described in the "Diagnostic Routines" part of this section, perform the routines to help localize the instrument problems.

First make sure that the standard instrument functions properly. This can be assumed, for DMM troubleshooting purposes, if it has a sweep and its readout functions properly. Then make sure that the Buffer board functions properly. To do this, disconnect P4330 and P4241, install zero-ohm jumper P4256, and run the Buffer board diagnostics. Then verify that the option works properly. If additional options are installed in the instrument, consult their service manuals for information that may impact the information in this section.

### DIAGNOSTIC ROUTINES

Control of Diagnostic routines and their display format is the same as for the standard instrument.

### Kernel Tests

The standard instrument's Kernel tests include checks to determine if the Buffer board and any options are present. A ROM checksum test is performed on each Buffer board and option ROM contained in the instrument.

A failure of a Kernel test is considered "fatal" to the operation of the microprocessor system. Kernel test failures will result in an attempt to flash the front-panel A SWP TRIG'D indicator and illuminate certain other front-panel indicators with an error code. The code points to the failure area as indicated in Table 5-1. Tables 5-2 and 5-3 are used to determine the option and device numbers used in Table 5-1.

**Table 5-1  
Kernel Test Failure Codes**

Failure Codes		Failing Device
Option	Device	
0	0	Control Board RAM U2496
0	1	Control Board ROM U2162
0	2	Control Board ROM U2362
0	3	Control Board ROM U2378
0	4	Control Board ROM U2178
1	1	GPIB Option ROM U4715
1	2	GPIB Option ROM U4710
1	4	GPIB Option RAM U4811
6	1	TV Option ROM U5565
7	1	DMM Option ROM U5280 <sup>a</sup>
7	2	DMM Option ROM U5281 <sup>a</sup>
F	1	Buffer Board ROM U4260

<sup>a</sup> When only one ROM is used, either device code indicates ROM U5281 is the failing device.

Table 5-2  
Front-Panel LED Option Codes

Option Code				Option Number (in hex)	Option Name
CH 1 LED (bit 3)	CH 2 LED (bit 2)	CH 3 LED (bit 1)	CH 4 LED (bit 0)		
OFF	OFF	OFF	OFF	0	Standard Instrument
OFF	OFF	OFF	ON	1	Option 10 (GPIB)
OFF	OFF	ON	OFF	6	Option 05 (TV)
OFF	ON	ON	ON	7	Option 01 (DMM)
ON	OFF	OFF	OFF	8	Option 06 (C/T/T)
ON	OFF	OFF	OFF	8	Option 09 (WR)
ON	ON	ON	ON	F	Buffer Board

Table 5-3  
Front-Panel LED Device Codes

Device Codes			Device Number
Ready LED (bit 2)	+ LED (bit 1)	- LED (bit 0)	
OFF	OFF	OFF	0
OFF	OFF	ON	1
OFF	ON	OFF	2
OFF	ON	ON	3
ON	OFF	OFF	4
ON	OFF	ON	5
ON	ON	OFF	6
ON	ON	ON	7

Even if a failure is reported, the A/B TRIG (sometimes labeled A/B/MENU, dependent upon which option is installed) switch may be pushed (or the GPIB command NORM may be used) to try to resume normal instrument operation. However, because of the failure, operation of specific instrument functions is unpredictable.

### Confidence Tests

Option 01 related Confidence tests, Exerciser routines, and their associated error codes are listed in Table 5-4. DMM Confidence Test 76 is performed automatically at power-up if the Kernel tests are completed successfully; the input leads must be disconnected for other DMM Option Confidence tests to pass. These routines may be initiated by the operator from the Diagnostics Monitor by:

1. Pushing the TRIGGER SLOPE switch while holding in both the  $\Delta V$  and  $\Delta t$  switches to access the Diagnostic Menu.

2. Select the desired test number by repeatedly pushing the TRIGGER MODE switch up, until the test number appears in the Diagnostic Menu of the crt readout.

3. Start the test procedure by pushing up on the TRIGGER COUPLING switch.

4. If a failure is reported in the Diagnostic Menu, refer the instrument to a qualified service technician.

5. When the procedure ends, exit the Diagnostic Menu by pushing the A/B TRIG select switch.

**EAROM TEST (BU TEST F1).** Checks EAROM to verify its contents and the interface circuitry.

**Read/Write Test**—The contents of one location are read, modified, and then reread to verify functioning of the device interface.

**Test checks:** EAROM input and output lines, EAROM mode control, EAROM reading and writing, and EAROM clock.

**Checksum Test**—The contents of locations containing calibration constants and power-down settings are checksummed using a spiral-add technique. The result is compared to the contents of location 0.

**Test checks:** EAROM addressing and EAROM contents.



**Table 5-4  
Diagnostic and Exerciser Routines**

Routine Type	Test Number	Routine Name	Error <sup>a</sup> Code	Error Code Meaning
Buffer Board Test	F1	EAROM Test	X8	Bad read after write.
			1X	Bad checksum.
DMM Board Tests	71	Digital	01	Malfunction of timer U5272 or associated micro-processor signals.
			02	Malfunction of timer U5272, flip-flop U5222, decoder U5241, or Status Register U5260.
			03	Malfunction of timer U5272 or flip-flop U5222.
			04	Malfunction of timer U5272, dividers U5273 and U5274, or the B10MHZ signal.
			05	Malfunction of timer U5272, transistor Q5230, gate U5271, counter U5274, or inverter U5252.
			06	Malfunction of shift register U5240, counter U5224, gate U5252E, or Status Register U5260.
			07	Malfunction of timer U5272.
			08	Malfunction of the Delay Generator, decoder U5241, or timer U5272.
	72	V/F Converter	01	Malfunction of floating power supplies, fuse F5220, or V/F Converter, with 0 V input.
			02	Malfunction of V/F Input Multiplexer, Voltage-to-Current Converter, or Current Source, with -2 V input.
			03	Malfunction of V/F Input Multiplexer, Voltage-to-Current Converter, or Current source, with +5 V input.
			04	Frequency change between 0 V and +5 V is low, but is ok between 0 V and -2 V. Malfunction of multiplexer U5020 or shift register U5120.
			05	Frequency change between -2 V, 0 V, and +5 V is very low. Malfunction of multiplexer U5020 or shift registers U5122, U5120, or U4940.
			06	Malfunction of precision reference U5050 or the Voltage-to-Current Converter.
			07	Frequency of V/F Converter is offset. Check frequency at U4920B pin 4 and zeners VR5020 and VR5031.

<sup>a</sup>An X in the Error Code column indicates a don't care condition.

Table 5-4 (cont)

Routine Type	Test Number	Routine Name	Error <sup>a</sup> Code	Error Code Meaning
	73	DC Volts	01	Malfunction of the DC Volts Buffer.
			02	The 0 V reference through the DC Volts Buffer at X1 gain is incorrect, but $\div 10$ gain is ok.
			03	Previous reference measurements failed, but measurements from the input passed. Check the reference at FET Q5070A.
			04	Previous measurements failed. Output of the DC Volts Buffer is offset. Check amplifier U4970, FET switch U4950D, FET switch U4950C, amplifier U5060A, FET Q5070A, and FET Q5070B.
			05	The $\div 10$ output of the DC Volts Buffer is offset.
			06	The 0 V reference through the DC Volts Buffer X10 is offset.
			07	Voltage on input of DC Volts Buffer causing an offset. Check voltage to ground at R5080, and check resistance to ground at R5080.
			09	Malfunction of FET Q5070A, FET switch U4942B, or FET switch U4942A.
			0A	The $-0.2$ V reference through the DC Volts Buffer at X10 gain is incorrect, but the $-2$ V X1 gain is ok. Check resistor R5064 and FET switches U4942A, U4942B, U4950C, and U4950C.
			0B	The $-0.2$ V reference through the DC Volts Buffer at X1 gain is incorrect, but $-0.2$ V X10 gain is ok. Check resistor R5064 and FET switches U4942A, U4942B, U4950C, and U4950C.
	74	AMPS/OHMS	01	Measurement time-out. Unable to obtain a reading.
			05	Measured too low using test setup A. Malfunction of Ohms Current Source, relay K5090, relay K5091, or the front panel fuse or the connections to it.
			02	Measured too high using test setup A. Malfunction of Ohms Current Source, $10\text{ M}\Omega$ resistor chain, relay K4980, FET switches U4942 and U4950, or operational amplifiers U5040 and U4960.
			03	Measurements using test setups A and B were not equal. Malfunction of FET switch U4950 or shift register U5120.

<sup>a</sup>An X in the Error Code column indicates a don't care condition.

**Table 5-4 (cont)**

Routine Type	Test Number	Routine Name	Error <sup>a</sup> Code	Error Code Meaning
			04	Measurement using test setup C failed. Malfunction of relay K5191, resistor R5181, or resistor R5177. This will also cause DM TEST 75 to fail with error code 02.
			06	Measurements using test setup D failed. Malfunction of fuse F4990, relay K4980, or FETs Q4972, Q4973, or Q4980.
			07	Measurement using test setup D with 0.1 mA failed. Malfunction of shift register U4940, or FETs Q4970 or Q4971.
			08	Measurement using test setup D with 1 mA failed. Malfunction of FET Q4971 or FET switch U4942C.
	75	AC Volts	01	Measurement time-out.
			02	Malfunction of the AC Volts Buffer or the V/F Input Multiplexer.
	76	Power-up	02	Malfunction of decoder U4310, buffer U4300, or cable W4330 to Buffer board.
			03	Malfunction of resistor R4320, buffer U4320, or cable W4330 to Buffer board.
			04	Malfunction of front panel switch S4302, S4306, S4309, or S4318.
			05	Malfunction of front panel switch S4304, S4308, S4312, or S4314, or S4316.
			06	Malfunction of front panel switch S4303, S4307, S4310, or S4317.
			01	Malfunction of DMM, or if this is the only failure, V/F Input Multiplexer U5020 input pin 2.
Buffer Board Exerciser	F1	Option Identification	None	
Buffer Board Exerciser	F2	Page Selection	None	
Exerciser	02	EAROM Examine	None	
DMM Exerciser	71	Extended Front Panel Switches	None	
DMM Exerciser	72	Tone and Input Impedance	None	

<sup>a</sup>An X in the Error Code column indicates a don't care condition.

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**DIGITAL (DM TEST 71).** The circuitry in the digital half of the DMM board is checked. Failure of analog tests that follow do not affect this test. A failure of this test will probably cause all other tests to fail.

**V/F CONVERTER (DM TEST 72).** This test checks the voltage-to-frequency conversion circuitry. A failure of this test will cause all tests that follow to fail.

**DC VOLTS (DM TEST 73).** DMM Test 73 checks the offsets and gain of the DC Volts Buffer.

Zero volts is first applied to the input of the buffer from the reference and then from the input (see Figure 5-1). Each time, the buffer's gain is changed from X1 to  $\div 10$  to X10 and the results compared to 0.0 V into multiplexer U5020. Then the  $-2$  V reference is applied to the input of the buffer with X1 gain and compared to  $-2$  V through the multiplexer. Finally, the  $-0.2$  V reference is applied to the input of the buffer with X10 gain and compared to  $-2$  V through the multiplexer.

**AMPS/OHMS (DM TEST 74).** This test checks the input relays, the Ohms Current Source, and the Amps range selection circuitry. The input leads must be disconnected for the test to pass.

The test setups used during this test are shown in Figure 5-2. Every setup results in 1 V on the output of the DC Volts Buffer; a voltage other than 0.0 V or 1 V is a failure.

**AC VOLTS (DM TEST 75).** This Confidence test checks the ac signal path between FET switch U5150A and multiplexer U5020. The input leads must be disconnected for the test to pass.

Software generates a 1 Vac signal to pin 2 of FET switch U5150 by switching 0.1 mA from the Ohms Current Source on and off (see Figure 5-3). The 0.1 mA is sent through FET Q4970 into the 1 k $\Omega$  of R4960 and R4975. This produces a 0.1 V square wave that the AC Volts Buffer multiplies by 10 to a 1 V square wave. The RMS Converter converts this to 0.5 Vdc (1 V square wave = 0.5 Vrms). Then, a measurement is made before RMS Converter U5140 has a chance to decay. This measurement is compared with a measurement identical to the measurement made during the AMPS/OHMS Test divided by two.

**POWER-UP (DM TEST 76).** This test makes a quick check of the circuitry on the DMM board and the Extended Front Panel. The input leads may be connected for this test.

**Exerciser Routines**

Operation of Exerciser routines is the same as for the standard instrument. The Exerciser routines allow the operator to set and examine various bytes of control data used in determining option function.

**OPTION IDENTIFICATION (BU EXER F1).** This routine displays the option designator for all installed options across the top line of the crt readout. Option designators are listed in Table 5-5.

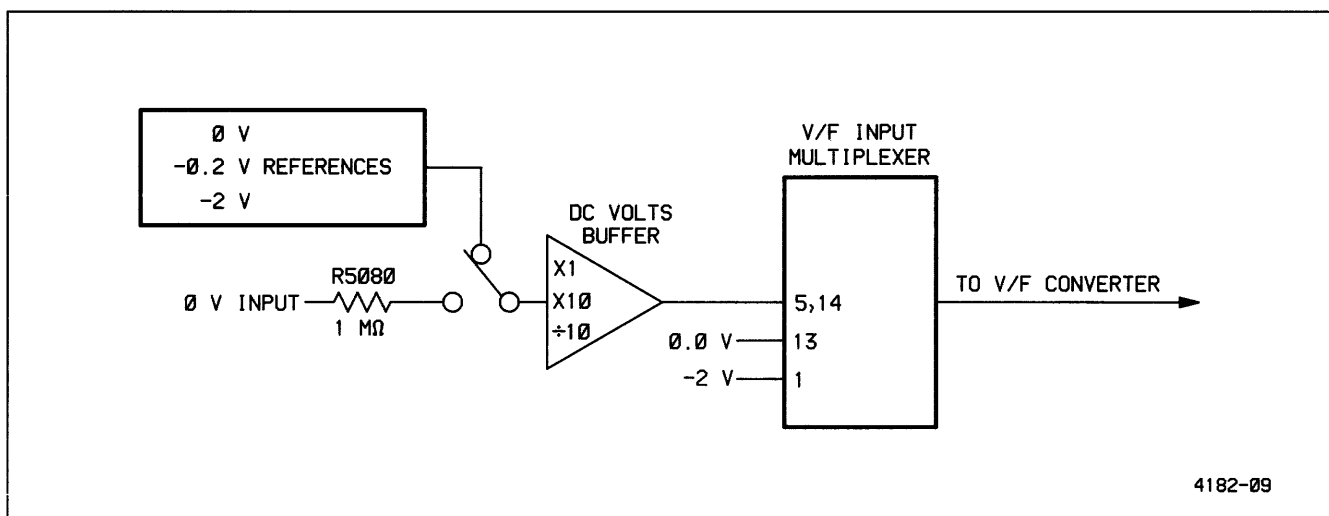
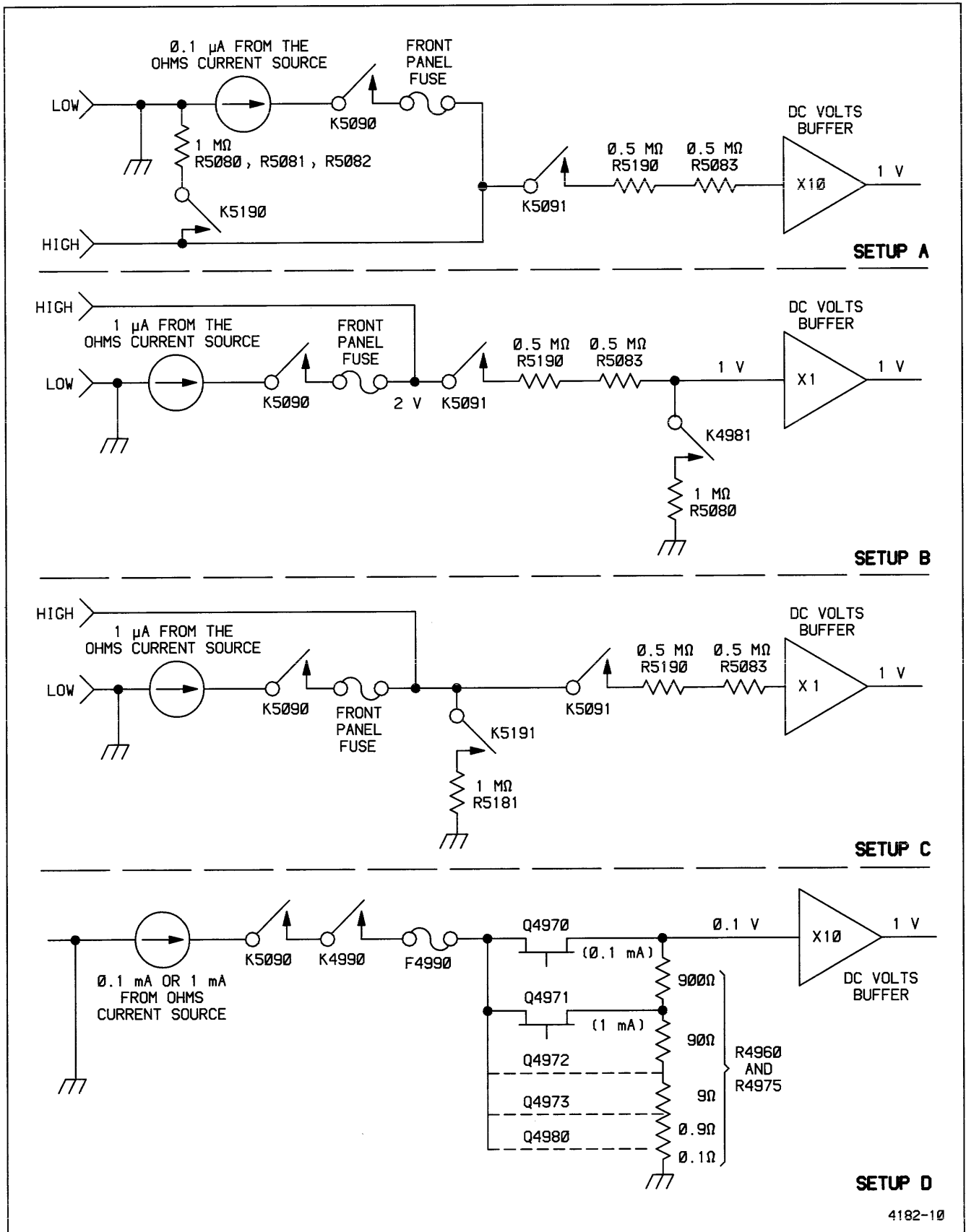


Figure 5-1. DC Volts test setup.



4182-10

Figure 5-2. AMPS/OHMS test setups.

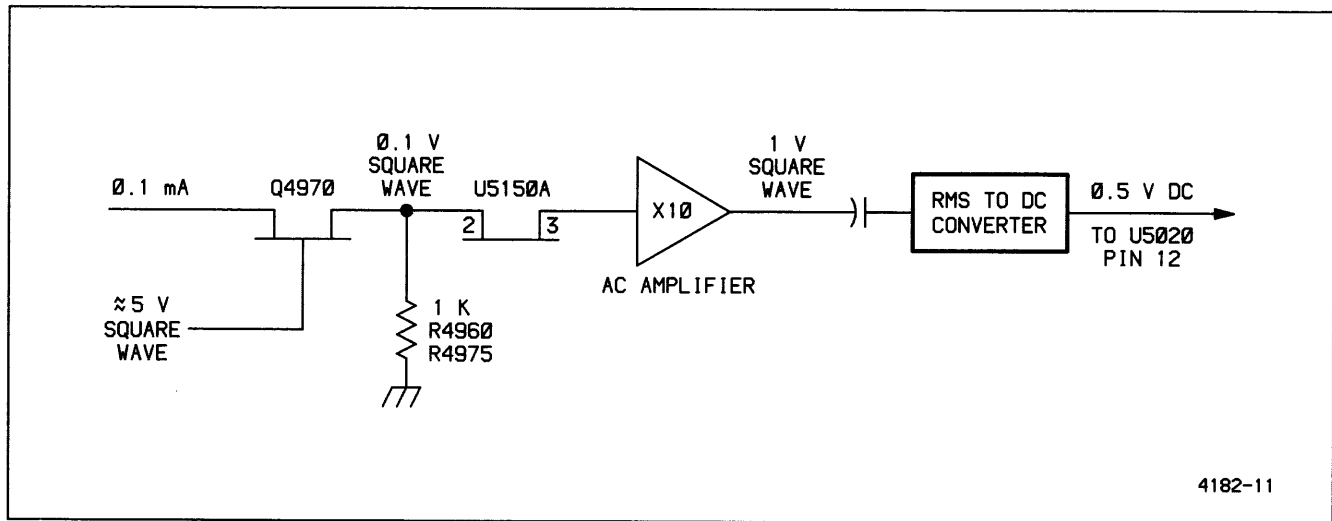


Figure 5-3. AC Volts test setup.

Table 5-5  
Option Designators

Option	Option Designator
Buffer Board	BU
GPIB	GP
TV	TV
DMM	DM
Counter/Timer/Trigger	CT
Word Recognizer	CT

**PAGE SELECTION (BU EXER F2).** This routine continuously selects and deselects each of the option select registers.

**EAROM EXAMINE (EXER 02).** This is the standard instrument EAROM Examine routine. Locations 64 (hex) to C7 (hex) access the Buffer Board EAROM.

**EXTENDED FRONT PANEL SWITCHES (DM EXER 71).** This routine displays, across the top line of the crt readout, a one for each switch in the Extended Front Panel. When a DMM switch is pushed, the one representing the depressed switch is replaced by a zero and all other switches are represented by a one. Use of this routine is described in Section 2 of this manual. The following is the display when the ACV/ACA switch is pushed in or shorted:

111 10111 11 111

**TONE AND INPUT IMPEDANCE (DM EXER 72).** This routine changes the tone of the continuity indicator and changes the input impedance of the 0.2 Vdc and 2 Vdc ranges. Its use is explained in Section 2 of this manual.

### EXTENDER CABLE USE

An extender cable kit, which can be ordered from Tektronix, Inc., is needed when troubleshooting an instrument containing options. The kit is used when troubleshooting the standard instrument by itself or when connecting a removed option assembly to the standard instrument for troubleshooting purposes.

Table 5-6 lists all cables contained in the kit (Tektronix Part Number 020-1075-00). In addition to the cables, the kit contains 12 zero-ohm jumpers (Tektronix Part Number 131-0993-00). The procedures that follow reference the cables by numbers as shown in column one. Refer to Figure 5-4 as an aid in cable identification.

### Instrument Troubleshooting Without Options

When troubleshooting the standard instrument with the option assembly removed, perform the following steps to complete the signal paths required for operation of the standard instrument circuitry. Note that all the steps will not necessarily be performed, depending on which options were included in the instrument.

Table 5-6  
Extender Cables

Cable Number	Tektronix Part No.	Option Usage
1	175-7183-00	All
2	175-7184-00	All
3	175-9178-00	All
4	175-9181-00	All
5	175-7215-00	GPIB
6	175-9179-00	GPIB
7	175-9182-00	GPIB
8	175-9175-00	TV
9	175-9180-00	TV
10	175-9183-00	TV
11	175-9174-00	TV, C/T/T
12	175-7932-00	WR
13	175-9176-00	C/T/T
14	175-9177-00	C/T/T

**NOTE**

*In the following steps, P100, P101, and P102 are all located on the Main board in the standard instrument.*

1. If the instrument contained the GPIB Option, use cable 7 to connect front-panel cable connector P4256 and Control-board connector P651.

2. If the instrument contained the TV Option, connect pins 1 and 2 of P100 and pins 9 and 10 of P100, using the extender cable kit jumpers.

3. If the instrument contained the TV or C/T/T Options, connect pins 3 and 4 of P102 and pins 7 and 8 of P102, using the extender cable kit jumpers.

4. If the instrument contained the C/T/T Option, connect pins 1 and 3 of P101 and pins 6 and 8 of P101, using the extender cable kit jumpers.

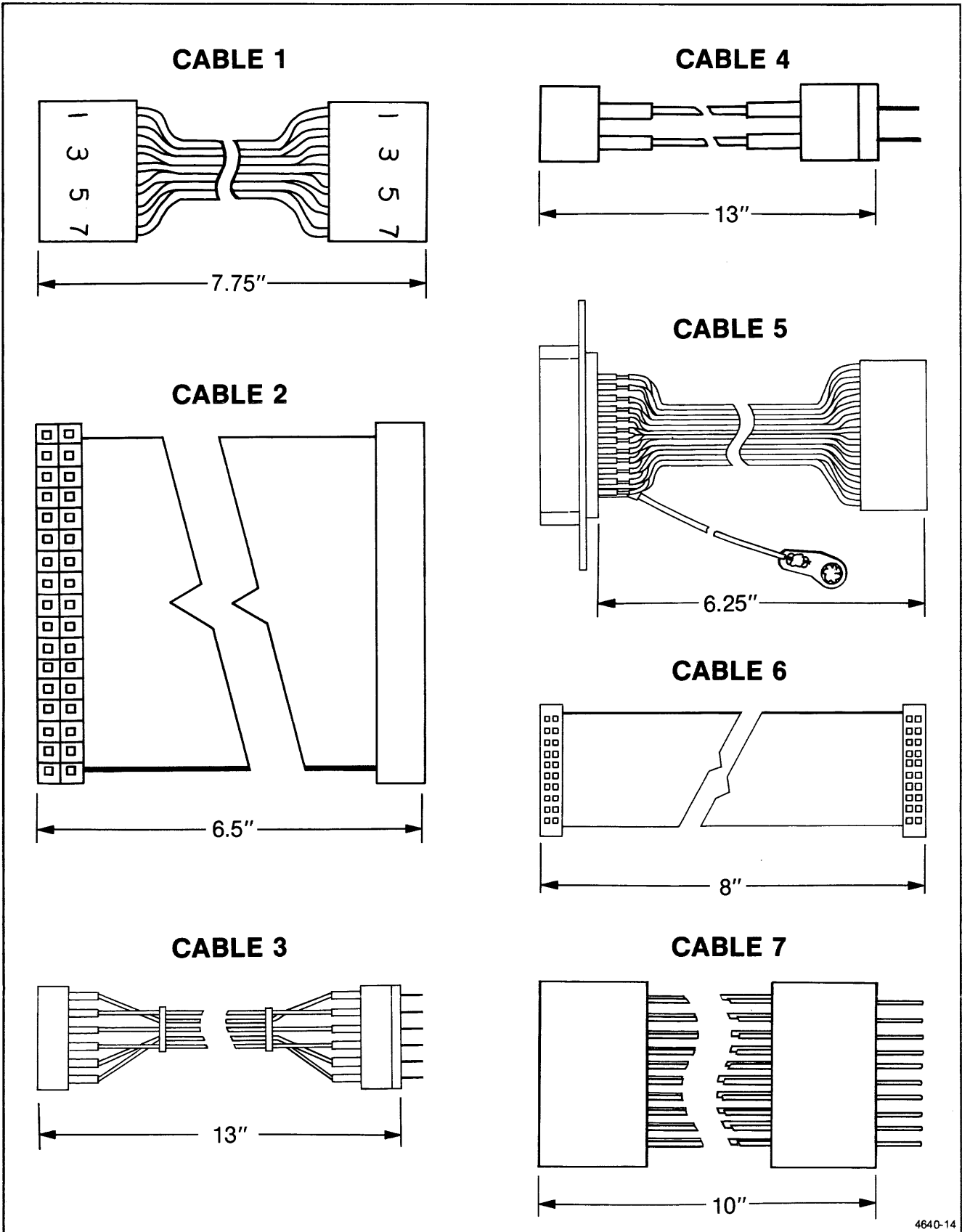
**Instrument Troubleshooting With Options**

To operate the instrument and its options with the option assembly removed for troubleshooting, the option assembly is placed upside down and to the right of the standard instrument (see Figure 5-5). The arrows represent the extender cables that are connecting the option assembly and the standard instrument. For the DMM Option, this procedure is only necessary when troubleshooting the Buffer board portion of the option. Troubleshooting of the DMM board can be done with the board rotated out on its hinge.

**NOTE**

*Jumper P4256 must be installed when cable P4330 is disconnected. The jumper permits the Buffer board and all options except the DMM to work. The jumper also permits DMM diagnostics to run (however, DM TEST 76 will fail with an 02 error code). While the DMM diagnostics will run, the switches in the Extended Front Panel will not work and the DMM will not operate under the control of the switches in the Extended Front Panel. If the instrument also contains the GPIB Option, the DMM will operate under the control of GPIB commands.*

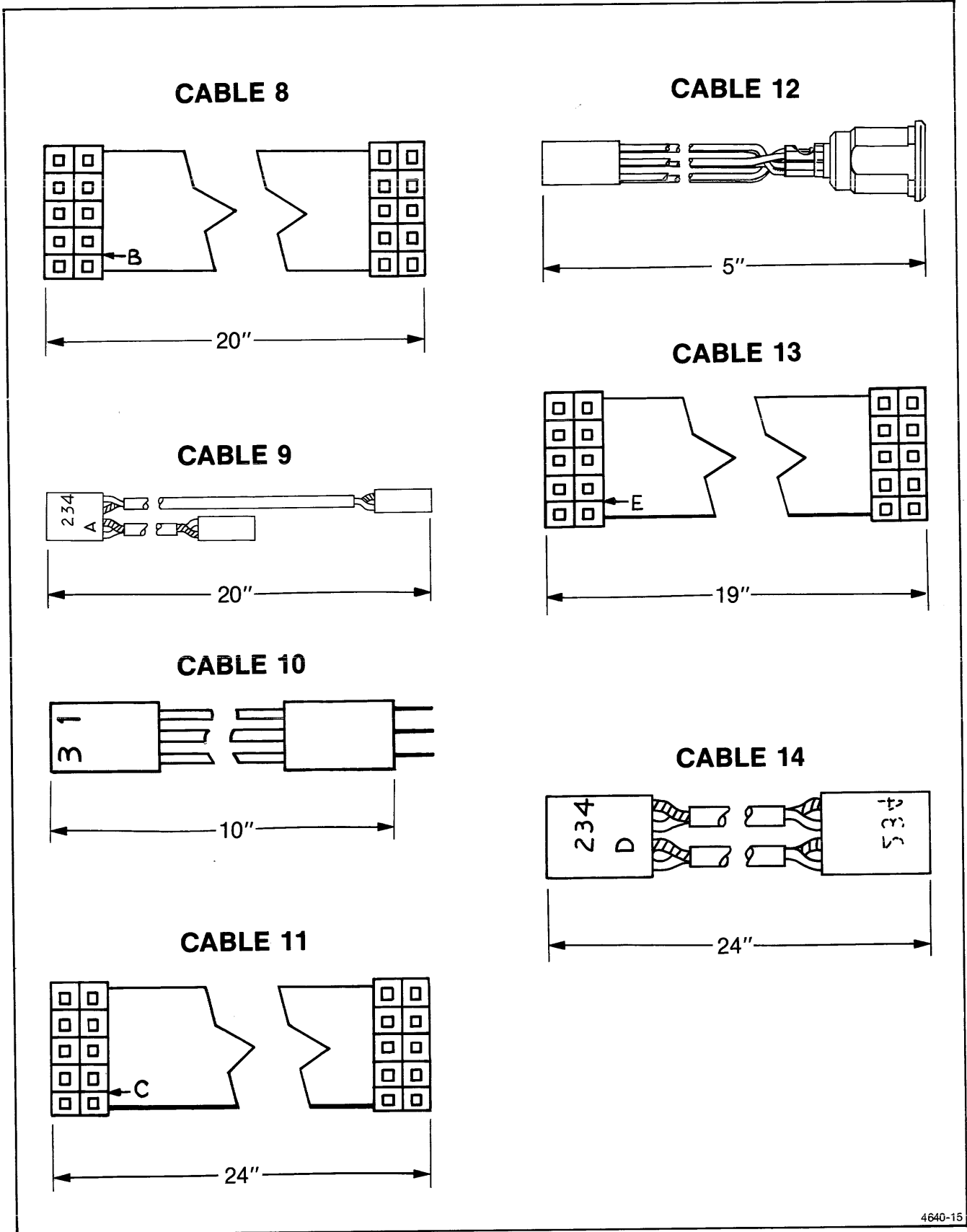
When operating the instrument with the option assembly removed for troubleshooting, all extender cables are not required for each option. Table 5-6 lists which extender cables are used to connect and operate a particular option whose operation is in question. Cable number and Buffer board-standard instrument interconnection information for the DMM option is shown in Figure 5-6. The "Troubleshooting Procedures" in the "Diagrams" section of this manual contain information about cable usage during the troubleshooting session.



4640-14

Figure 5-4. Option extender cables.





4640-15

Figure 5-4. (cont). Option extender cables.

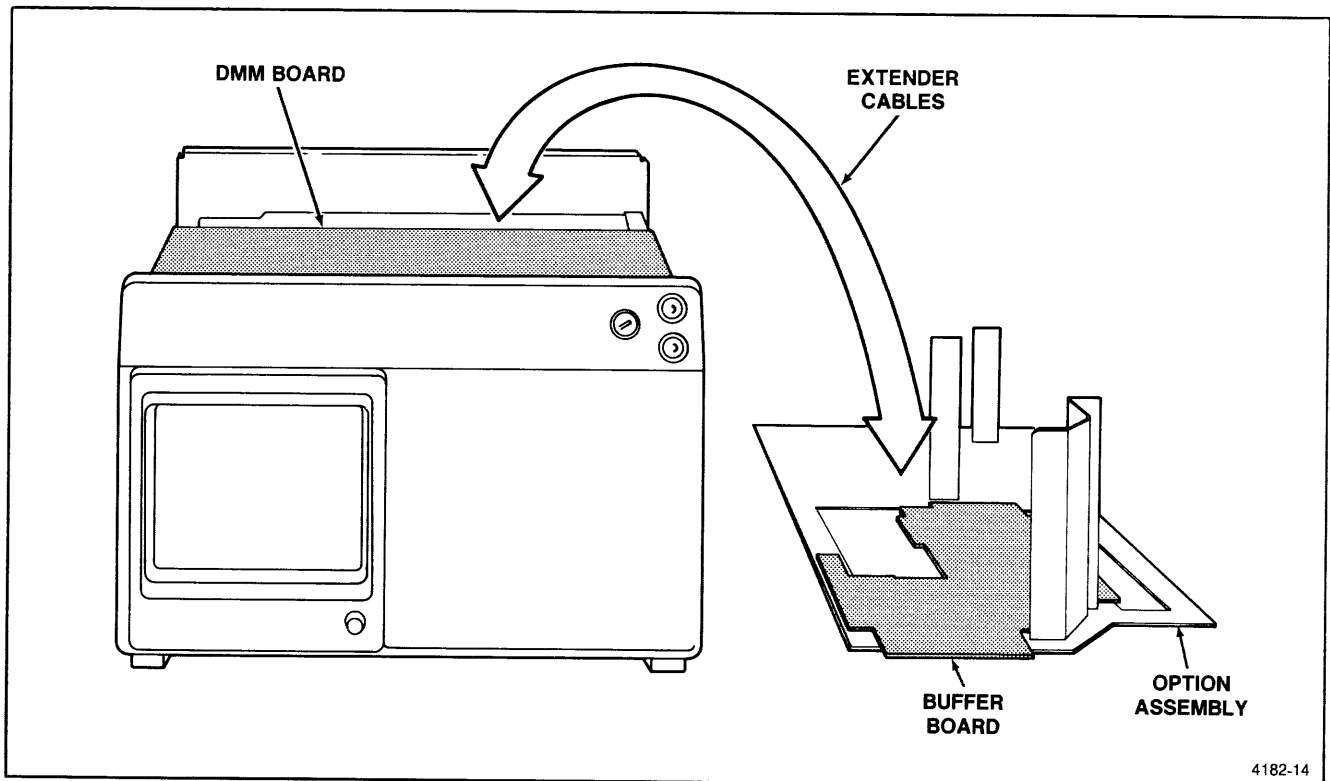
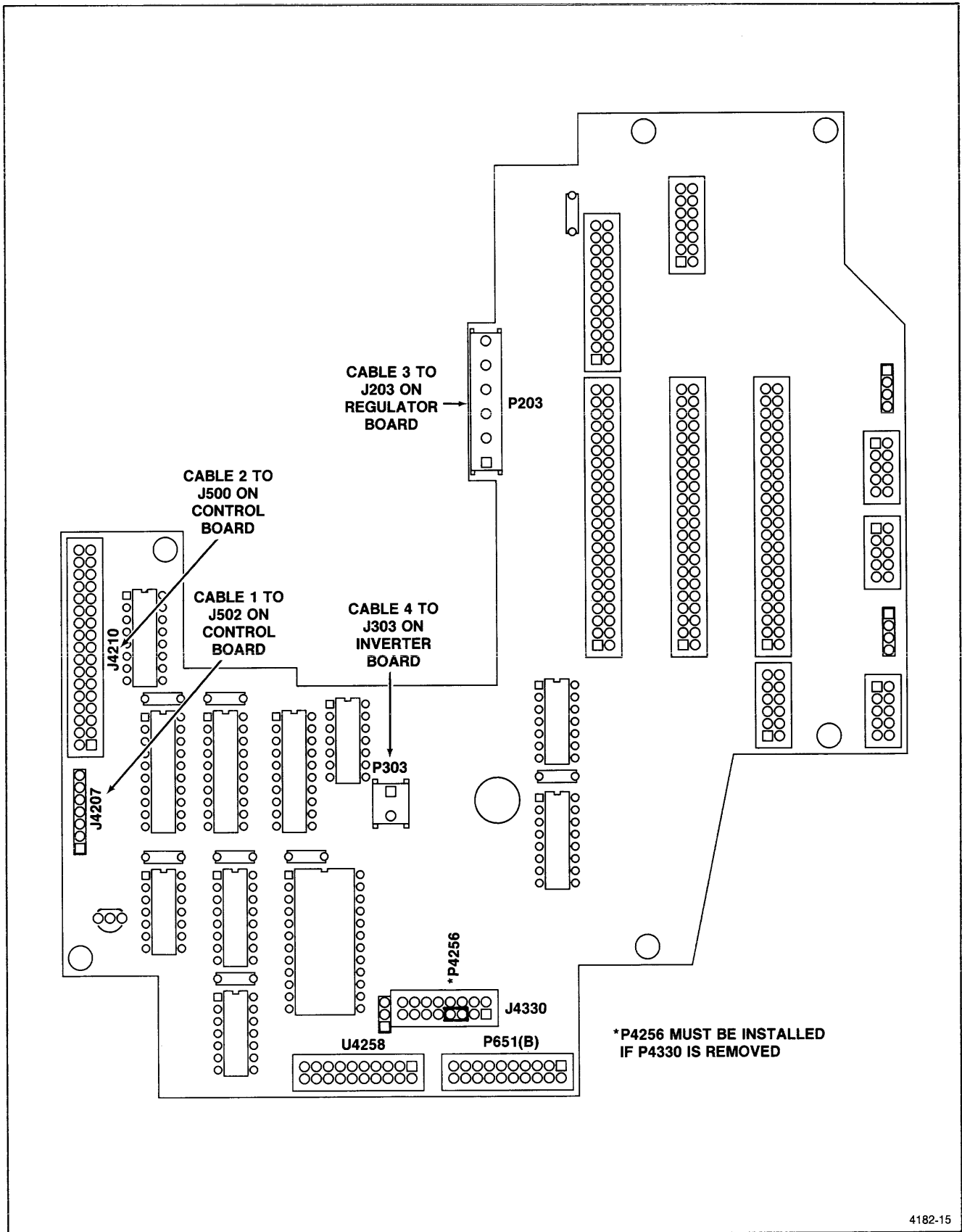


Figure 5-5. Orientation of assemblies when using extender cables.



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Figure 5-6. Extender cable connection points for troubleshooting.

## CORRECTIVE MAINTENANCE

Corrective maintenance for the DMM Option is the same as for the standard instrument unless stated otherwise in this section.



*To avoid increased leakage, avoid touching the circuit board and the components located under the shields.*

### REMOVAL AND REPLACEMENT INSTRUCTIONS

The DMM board, the Extended Front Panel board, the Probe Connector and Fuse assembly, and the Buffer board may be removed for repair or replacement using the following procedures. Before beginning any procedure, read the information at the beginning of "Removal and Replacement Instructions" in the Maintenance Section of the standard instrument manual. If additional options are installed in the instrument, consult that particular option's service manual for removal and replacement information that may impact the following procedures.



*The input potential to the DMM is present on the five screws mounting the DMM board shields. To avoid electric shock, remove inputs to the DMM HIGH and LOW input connectors.*

#### Option Assembly Removal

To remove the Option assembly:

1. Perform the "Cabinet Removal" procedure as outlined in the "Removal and Replacement Instructions" in the standard instrument service manual, making the following changes to the procedure:

In step 5, remove the six screws in the rear-panel feet.

In step 6, the top-center screw is about 2.5 inches from the top of the rear panel.

#### WARNING

*To avoid electric shock, remove inputs to the DMM HIGH and LOW input connectors.*

2. Disconnect cable (P5210) at left-rear edge of the DMM board.

3. Remove the two board-securing screws located at the left edge of the DMM board.

4. Lift and rotate the DMM board about its right edge until its top is about level; support the extended edge of the board.

5. Disconnect cable (P4241) at center of top-cover plate.

6. Disconnect cable (P4330) at the front edge of the Buffer board.

7. Perform the first six steps of the "Top-Cover Plate Removal" procedure as outlined in the "Removal and Replacement Instructions" in the standard instrument manual.

8. Remove the two top-securing screws located at the right-center portion of the top-cover plate.

9. Lift the top-cover plate above the instrument approximately 2 inches.

10. Disconnect two cables at the right-front edge of the Buffer board (P4207 and P4210).

11. Lift the option assembly out of the instrument.

**CAUTION**

*When securing the option assembly back into the main instrument, be sure that the connector cables are indexed correctly. Also check that the cables are not crimped and that P203 and P303 are seated correctly in their connectors. The two circuit board retainers located along the right edge of the top-cover plate should securely engage the Readout board.*

To reinstall the option assembly into the standard instrument, perform the reverse of the preceding steps.

### Buffer Board Removal

To remove the Buffer board for repair or replacement:

1. Perform the preceding "Option Assembly Removal" procedure.
2. Remove the five securing screws that attach the Buffer board to the Vertical Board support.
3. Remove the Buffer board from the top-plate cover and option assembly.

To reinstall the Buffer board and option assembly into the standard instrument, perform the reverse of the preceding steps.

### Extended Front Panel Board Removal

To remove the Extended Front Panel board for repair or replacement:

1. Perform the first four steps of the "Option Assembly Removal" procedure.
2. Disconnect cable at the front edge of the Buffer board (P4330).
3. Loosen the set screw in the standoffs at the right and left sides and at the center of the Extended Front Panel board.
4. Remove the Extended Front Panel board from the Extended Front Panel.

To reinstall the Extended Front Panel board into the Extended Front Panel, perform the reverse of the preceding steps.

### Probe Connector and Fuse Assembly Removal

To remove the Probe Connector and Fuse Assembly for repair or replacement:

**WARNING**

*To avoid electric shock, remove inputs to the DMM HIGH and LOW input connectors.*

1. Perform the first four steps of the "Option Assembly Removal" procedure.
2. Remove screw at right-front corner of the DMM board.
3. Disconnect two wires at right-front edge of DMM board (P4991 and P5090).
4. Perform the first seven steps of the "A6 and A7—Front-Panel and Variable Board Assembly Removal" procedure as outlined in the standard instrument service manual.
5. Remove two screws from the right front of the Extended Front Panel.
6. Remove the Probe Connector and Fuse Assembly.

To reinstall the Probe Connector and Fuse Assembly into the Extended Front Panel, perform the reverse of the preceding steps.

### DMM Board Removal

To remove the DMM board for repair or replacement:

**WARNING**

*To avoid electric shock, remove inputs to the DMM HIGH and LOW input connectors.*

1. Perform the first five steps of the "Option Assembly Removal" procedure.

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2. Remove screw at right-front corner of the DMM board.
3. Disconnect two wires at right-front edge of DMM board (P4991 and P5090).
4. Disconnect cable from left rear of DMM board (P5220) and remove cable from board bracket.
5. Rotate the DMM board back to its normal position.
6. Remove the two board-mounting screws at the right edge of the DMM board.
7. Remove the DMM board.



*To avoid increased leakage, avoid touching the circuit board and the components located under the shields.*



*The input potential to the DMM is present on the five screws mounting the DMM board shields. To avoid electric shock, remove inputs to the DMM HIGH and LOW input connectors.*

8. Remove five screws from DMM board shields.
9. Remove shields.

To reinstall the DMM board, perform the reverse of the preceding steps.

# 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

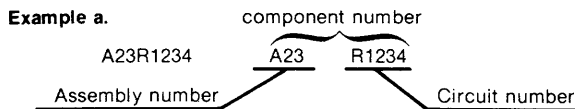
The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

### ABBREVIATIONS

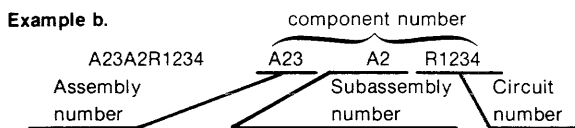
Abbreviations conform to American National Standard Y1.1.

### 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:



**Read: Resistor 1234 of Assembly 23**



**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 Code
00779	AMP INC	P O BOX 3608	HARRISBURG PA 17105
01121	ALLEN-BRADLEY CO	1201 SOUTH 2ND ST	MILWAUKEE WI 53204
01295	TEXAS INSTRUMENTS INC SEMICONDUCTOR GROUP	13500 N CENTRAL EXPRESSWAY P O BOX 225012 M/S 49	DALLAS TX 75265
02735	RCA CORP SOLID STATE DIVISION	ROUTE 202	SOMERVILLE NJ 08876
03508	GENERAL ELECTRIC CO SEMI-CONDUCTOR PRODUCTS DEPT	M GENESEE ST	AUBURN NY 13021
03888	KOI PYROFILM CORP	60 S JEFFERSON RD	MHIPPANY NJ 07981
04222	AVX CERAMICS DIV OF AVX CORP	19TH AVE SOUTH P O BOX 867	MYRTLE BEACH SC 29577
04713	MOTOROLA INC SEMICONDUCTOR GROUP	5005 E MCDOWELL RD	PHOENIX AZ 85008
05292	ITT COMPONENTS DIV		CLIFTON NJ
05397	UNION CARBIDE CORP MATERIALS SYSTEMS DIV	11901 MADISON AVE	CLEVELAND OH 44101
07263	FAIRCHILD CAMERA AND INSTRUMENT CORP SEMICONDUCTOR DIV	464 ELLIS ST	MOUNTAIN VIEW CA 94042
07716	TRM INC TRM ELECTRONICS COMPONENTS TRM IRC FIXED RESISTORS/BURLINGTON	2850 MT PLEASANT AVE	BURLINGTON IA 52601
11236	CTS OF BERNE INC	406 PARR ROAD	BERNE IN 46711
13409	SENSITRON SEMICONDUCTOR DIV OF RSM ELECTRON POWER INC	221 N INDUSTRY COURT	DEER PARK NY 11729
14433	ITT SEMICONDUCTORS DIV		WEST PALM BEACH FL
14552	MICRO/SEMICONDUCTOR CORP	2830 S FAIRVIEW ST	SANTA ANA CA 92704
14752	ELECTRO CUBE INC	1710 S OEL MAR AVE	SAN GABRIEL CA 91776
14936	GENERAL INSTRUMENT CORP DISCRETE SEMI CONDUCTOR DIV	600 M JOHN ST	HICKSVILLE NY 11802
15513	DATA DISPLAY PRODUCTS	303 N OAK ST	LOS ANGELES CA 90302
15636	ELEC-TROL INC	26477 N GOLDEN VALLEY RD	SAUGUS CA 91350
17856	SILICONIX INC	2201 LAURELWOOD RD	SANTA CLARA CA 95054
18324	SIGMETICS CORP	811 E ARQUES	SUNNYVALE CA 94086
19647	CADDOCK ELECTRONICS INC	3127 CHICAGO AVE	RIVERSIDE CA 92507
19701	MEPCO/ELECTRA INC A NORTH AMERICAN PHILIPS CO	P O BOX 760	MINERAL WELLS TX 76067
22526	DU PONT E I DE MEMOURS AND CO INC DU PONT CONNECTOR SYSTEMS	30 HUNTER LANE	CAMP HILL PA 17011
24355	ANALOG DEVICES INC	RT 1 INDUSTRIAL PK P O BOX 280	NORMOOD MA 02062
24546	CORNING GLASS WORKS	550 HIGH ST	BRADFORD PA 16701
27014	NATIONAL SEMICONDUCTOR CORP	2900 SEMICONDUCTOR DR	SANTA CLARA CA 95051
27264	MOLEX INC CORPORATE HQ	2222 WELLINGTON COURT	LISLE IL 60532
32293	INTERSIL INC	10900 N TANTAU AVE	CUPERTINO CA 95014
32997	BOURNS INC TRIMPOT DIV	1200 COLUMBIA AVE	RIVERSIDE CA 92507
33096	COLORADO CRYSTAL CORP	2303 W 8TH ST	LOVELAND CO 80537
50157	MIDWEST COMPONENTS INC	1981 PORT CITY BLVD P O BOX 787	MUSKEGON MI 49443
54473	MATSUSHITA ELECTRIC CORP OF AMERICA	ONE PANASONIC WAY	SECAUCUS NJ 07094
54583	TDK ELECTRONICS CORP	755 EASTGATE BLVD	GARDEN CITY NY 11530
57668	ROHM CORP	16931 MILLIKEN AVE	IRVINE CA 92713
58361	GENERAL INSTRUMENT CORP OPTOELECTRONICS DIV	3400 HILLVIEW AVE	PALO ALTO CA 94304
59660	TUSONIX INC	2155 N FORBES BLVD	TUCSON, ARIZONA 85705
59821	CENTRALAB INC SUB NORTH AMERICAN PHILIPS CORP	7158 MERCHANT AVE	EL PASO TX 79915
61529	AROMAT CORP	250 SHEFFIELD ST	MOUNTAINSIDE NJ 07092
71400	MCGRAW-EDISON CO BUSSMANN MFG DIV	502 EARTH CITY PLAZA P O BOX 14460	ST LOUIS MO 63178
75042	TRM INC TRM ELECTRONIC COMPONENTS IRC FIXED RESISTORS PHILADELPHIA DIV	401 N BROAD ST	PHILADELPHIA PA 19108
75915	LITTELFUSE INC	800 E NORTHWEST HWY	DES PLAINES IL 60016
80009	TEKTRONIX INC	4900 S M GRIFFITH DR P O BOX 500	BEAVERTON OR 97077



CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
81483	INTERNATIONAL RECTIFIER	9220 SUNSET BLVD P O BOX 2321 TERMINAL ANNEX	LOS ANGELES CA 90069
91637	DALE ELECTRONICS INC	P O BOX 609	COLUMBUS NE 68601
TK1015	MUSASHI WORKS OF HITACHI LTD	1450 JOSUIMON-CHO KODAIRA-SHI	TOKYO JAPAN
TK1601	PULSE ENGINEERING INC	1680 THE ALAMEDA	SAN JOSE CA 95126

Replaceable Electrical Parts  
2445/2465 Option 01 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A2	672-0076-04	8020000	8028404	CIRCUIT 80 ASSY:LV PMR SPLY MODULE	80009	672-0076-04
A2	672-0076-05	8028405		CIRCUIT 80 ASSY:LV PMR SPLY MODULE (2445 ONLY)	80009	672-0076-05
A2	672-0076-04	8020000	8040452	CIRCUIT 80 ASSY:LV PMR SPLY MODULE	80009	672-0076-04
A2	672-0076-05	8040451		CIRCUIT 80 ASSY:LV PMR SPLY MODULE (2465 ONLY)	80009	672-0076-05
A6	-----			CKT 80 ASSY:FRONT PANEL (SEE STD MANUAL)		
A7	670-7284-00			CIRCUIT 80 ASSY:FRONT PANEL VARIABLE (SEE STANDARD INSTRUMENT MANUAL)	80009	670-7284-00
A14	670-8000-00			CIRCUIT 80 ASSY:DYNAMIC CENTERING (SEE STANDARD INSTRUMENT MANUAL)	80009	670-8000-00
A20	670-7830-00	8020000	8021699	CIRCUIT 80 ASSY:BUFFER (2445 ONLY)	80009	670-7830-00
A20	670-7830-00	8020000	8021999	CIRCUIT 80 ASSY:BUFFER (2465 ONLY)	80009	670-7830-00
A20	670-7830-01			CIRCUIT 80 ASSY:BUFFER (2445/2465 ONLY, OPT 01,06,09 ONLY)	80009	670-7830-01
A20	670-7830-02	8021700		CIRCUIT 80 ASSY:BUFFER (2445 ONLY)	80009	670-7830-02
A20	670-7830-02	8022000		CIRCUIT 80 ASSY:BUFFER (2465 ONLY)	80009	670-7830-02
A20	670-7830-03			CIRCUIT 80 ASSY:BUFFER (2445/2465, OPT 05 ONLY)	80009	670-7830-03
A20	670-7830-04			CIRCUIT 80 ASSY:BUFFER (2445/2465, OPT 01 & 05,OR, OPT 05 & 06 AND 09)	80009	670-7830-04
A20	670-7830-05	8025500	8027484	CIRCUIT 80 ASSY:BUFFER (2445 ONLY, OPT 01,M/ANY COMBO OF OPTS 06,09,10)	80009	670-7830-05
A20	670-7830-09	8027485		CIRCUIT 80 ASSY:BUFFER (2445 ONLY,OPTS 01,M/ANY COMBINATION OF OPTIONS 06,09,10. NO LONGER INCLUDES U4260)	80009	670-7830-09
A20	670-7830-05	8028060	8031229	CIRCUIT 80 ASSY:BUFFER (2465 ONLY, OPT 01,M/ANY COMBO OF OPTS 06,09,10)	80009	670-7830-05
A20	670-7830-09	8031230		CIRCUIT 80 ASSY:BUFFER (2465 ONLY,OPT 01,M/ANY COMBINATION OF OPTIONS 06,09,10. NO LONGER INCLUDES U4260)	80009	670-7830-09
A20	670-7830-06	8025500	8027484	CIRCUIT 80 ASSY:BUFFER (2445 ONLY, OPT 10 ONLY)	80009	670-7830-06
A20	670-7830-10	8027485		CIRCUIT 80 ASSY:BUFFER (2445 OPT 10 ONLY.NO LONGER INCLUDES U4260)	80009	670-7830-10
A20	670-7830-06	8028060	8031229	CIRCUIT 80 ASSY:BUFFER (2465 ONLY, OPT 10 ONLY)	80009	670-7830-06
A20	670-7830-10	8031230		CIRCUIT 80 ASSY:BUFFER (2465 OPT 10 ONLY.NO LONGER INCLUOER U4260)	80009	670-7830-10
A20	670-7830-07	8025500	8027484	CIRCUIT 80 ASSY:BUFFER (2445 ONLY,OPT 05,OR OPT 05/OPT 10 COMBO)	80009	670-7830-07
A20	670-7830-11	8027485		CIRCUIT 80 ASSY:BUFFER (2445 ONLY,OPT 05,OR OPT 05/OPT 10 COMBO) (NO LONGER INCLUDES U4260)	80009	670-7830-11
A20	670-7830-07	8028060	8031229	CIRCUIT 80 ASSY:BUFFER (2465 ONLY,OPT 05,OR OPT. 05/OPT 10 COMBO)	80009	670-7830-07
A20	670-7830-11	8031230		CIRCUIT 80 ASSY:BUFFER (2465 ONLY,OPT 05,OR OPT 05/OPT 10 COMBO.	80009	670-7830-11
A20	670-7830-08	8025500	8027484	CIRCUIT 80 ASSY:BUFFER (2445 ONLY,OPTS. 01 & 05,M/ANY COMBO OF OPTS. 06,09,10)	80009	670-7830-08
A20	670-7830-11	8027485		CIRCUIT 80 ASSY:BUFFER (2445 ONLY,OPTS 01 & 05,M/ANY COMBO OF OPTS 06,09,10.NO LONGER INCLUDES U4260)	80009	670-7830-11
A20	670-7830-08	8028060	8031229	CIRCUIT 80 ASSY:BUFFER (2465 ONLY,OPTS. 01 & 05,M/ANY COMBO OF OPTS. 06,09,10)	80009	670-7830-08
A20	670-7830-11	8031230		CIRCUIT 80 ASSY:BUFFER (2465 ONLY,OPTS 01 & 05,M/ANY COMBO OF OPTS 06,09,10.NO LONGER INCLUDES U4260)	80009	670-7830-11

Replaceable Electrical Parts  
2445/2465 Option 01 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A22	670-8159-00			CIRCUIT BD ASSY:LED	80009	670-8159-00
A23	670-7558-02			CIRCUIT BD ASSY:GPIB OPT	80009	670-7558-02
A29	670-7835-01	B020000	B025924	CIRCUIT BD ASSY:DMM (2445 ONLY)	80009	670-7835-01
A29	670-7835-02	B025925	B026449	CIRCUIT BD ASSY:DMM (NO LONGER INCLUDES U5280,U5281) (2445 ONLY)	80009	670-7835-02
A29	670-7835-03	B026450	B026656	CIRCUIT BD ASSY:DMM (2445 ONLY)	80009	670-7835-03
A29	670-7835-04	B026657		CIRCUIT BD ASSY:DMM (2445 ONLY)	80009	670-7835-04
A29	670-7835-01	B020000	B028679	CIRCUIT BD ASSY:DMM (2465 ONLY)	80009	670-7835-01
A29	670-7835-02	B028680	B029524	CIRCUIT BD ASSY:DMM (NO LONGER INCLUDES U5280,U5281) (2465 ONLY)	80009	670-7835-02
A29	670-7835-03	B029523	B029862	CIRCUIT BD ASSY:DMM (2465 ONLY)	80009	670-7835-03
A29	670-7835-04	B029863		CIRCUIT BD ASSY:DMM (2465 ONLY)	80009	670-7835-04
A30	670-7894-00			CIRCUIT BD ASSY:FRONT PANEL	80009	670-7894-00
A2	672-0076-04	B020000	B028404	CIRCUIT BD ASSY:LV PMR SPLY MODULE	80009	672-0076-04
A2	672-0076-05	B028405		CIRCUIT BD ASSY:LV PMR SPLY MODULE (2445 ONLY)	80009	672-0076-05
A2	672-0076-04	B020000	B040452	CIRCUIT BD ASSY:LV PMR SPLY MODULE	80009	672-0076-04
A2	672-0076-05	B040451		CIRCUIT BD ASSY:LV PMR SPLY MODULE (2465 ONLY)	80009	672-0076-05
A6	-----			CKT BD ASSY:FRONT PANEL (SEE STD MANUAL)		
A7	670-7284-00			CIRCUIT BD ASSY:FRONT PANEL VARIABLE (SEE STANDARD INSTRUMENT MANUAL)	80009	670-7284-00
A14	670-8000-00			CIRCUIT BD ASSY:DYNAMIC CENTERING (SEE STANDARD INSTRUMENT MANUAL)	80009	670-8000-00
A20	670-7830-00	B020000	B021699	CIRCUIT BD ASSY:BUFFER (2445 ONLY)	80009	670-7830-00
A20	670-7830-00	B020000	B021999	CIRCUIT BD ASSY:BUFFER (2465 ONLY)	80009	670-7830-00
A20	670-7830-01			CIRCUIT BD ASSY:BUFFER (2445/2465 ONLY, OPT 01,06,09 ONLY)	80009	670-7830-01
A20	670-7830-02	B021700		CIRCUIT BD ASSY:BUFFER (2445 ONLY)	80009	670-7830-02
A20	670-7830-02	B022000		CIRCUIT BD ASSY:BUFFER (2465 ONLY)	80009	670-7830-02
A20	670-7830-03			CIRCUIT BD ASSY:BUFFER (2445/2465, OPT 05 ONLY)	80009	670-7830-03
A20	670-7830-04			CIRCUIT BD ASSY:BUFFER (2445/2465, OPT 01 & 05, OR, OPT 05 & 06 AND 09)	80009	670-7830-04
A20	670-7830-05	B025500	B027484	CIRCUIT BD ASSY:BUFFER (2445 ONLY, OPT 01,M/ANY COMBO OF OPTS 06,09,10)	80009	670-7830-05
A20	670-7830-09	B027485		CIRCUIT BD ASSY:BUFFER (2445 ONLY,OPTS 01,M/ANY COMBINATION OF OPTIONS 06,09,10. NO LONGER INCLUDES U4260)	80009	670-7830-09
A20	670-7830-05	B028060	B031229	CIRCUIT BD ASSY:BUFFER (2465 ONLY, OPT 01,M/ANY COMBO OF OPTS 06,09,10)	80009	670-7830-05
A20	670-7830-09	B031230		CIRCUIT BD ASSY:BUFFER (2465 ONLY,OPT 01,M/ANY COMBINATION OF OPTIONS 06,09,10. NO LONGER INCLUDES U4260)	80009	670-7830-09
A20	670-7830-06	B025500	B027484	CIRCUIT BD ASSY:BUFFER (2445 ONLY, OPT 10 ONLY)	80009	670-7830-06
A20	670-7830-10	B027485		CIRCUIT BD ASSY:BUFFER (2445 OPT 10 ONLY.NO LONGER INCLUDES U4260)	80009	670-7830-10

Replaceable Electrical Parts  
2445/2465 Option 01 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A20	670-7830-06	8028060	8031229	CIRCUIT 80 ASSY:BUFFER (2465 ONLY, OPT 10 ONLY)	80009	670-7830-06
A20	670-7830-10	8031230		CIRCUIT 80 ASSY:BUFFER (2465 OPT 10 ONLY.NO LONGER INCLUDER U4260)	80009	670-7830-10
A20	670-7830-07	8025500	8027484	CIRCUIT 80 ASSY:BUFFER (2445 ONLY,OPT 05,OR OPT 05/OPT 10 COMBO)	80009	670-7830-07
A20	670-7830-11	8027485		CIRCUIT 80 ASSY:BUFFER (2445 ONLY,OPT 05,OR OPT 05/OPT 10 COMBO) (NO LONGER INCLUDES U4260)	80009	670-7830-11
A20	670-7830-07	8028060	8031229	CIRCUIT 80 ASSY:BUFFER (2465 ONLY,OPT 05,OR OPT. 05/OPT 10 COMBO)	80009	670-7830-07
A20	670-7830-11	8031230		CIRCUIT 80 ASSY:BUFFER (2465 ONLY,OPT 05,OR OPT 05/OPT 10 COMBO.	80009	670-7830-11
A20	670-7830-08	8025500	8027484	CIRCUIT 80 ASSY:BUFFER (2445 ONLY,OPTS. 01 & 05,M/ANY COMBO OF OPTS. 06,09,10)	80009	670-7830-08
A20	670-7830-11	8027485		CIRCUIT 80 ASSY:BUFFER (2445 ONLY,OPTS 01 & 05,M/ANY COMBO OF OPTS 06,09,10.NO LONGER INCLUDES U4260)	80009	670-7830-11
A20	670-7830-08	8028060	8031229	CIRCUIT 80 ASSY:BUFFER (2465 ONLY,OPTS. 01 & 05,M/ANY COMBO OF OPTS. 06,09,10)	80009	670-7830-08
A20	670-7830-11	8031230		CIRCUIT 80 ASSY:BUFFER (2465 ONLY,OPTS 01 & 05,M/ANY COMBO OF OPTS 06,09,10.NO LONGER INCLUDES U4260)	80009	670-7830-11
A20C4215	283-0421-00	8010100	8027484	CAP,FXD,CER 01:0.1UF,+80-20%,50V (2445 OPTION 01 ONLY)	04222	M0015C104MAA
A20C4215	281-0909-00	8027485		CAP,FXD,CER 01:0.022UF,20%,50V (2445 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4215	283-0421-00	8010100	8031229	CAP,FXD,CER 01:0.1UF,+80-20%,50V (2465 OPTION 01 ONLY)	04222	M0015C104MAA
A20C4215	281-0909-00	8031230		CAP,FXD,CER 01:0.022UF,20%,50V (2465 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4215	281-0909-00			CAP,FXD,CER 01:0.022UF,20%,50V (OPT.05,OPT.01 COMBO)	54583	MA12X7R1H223M-T
A20C4224	283-0421-00	8010100	8027484	CAP,FXD,CER 01:0.1UF,+80-20%,50V (2445 OPTION 01 ONLY)	04222	M0015C104MAA
A20C4224	281-0909-00	8027485		CAP,FXD,CER 01:0.022UF,20%,50V (2445 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4224	283-0421-00	8010100	8031229	CAP,FXD,CER 01:0.1UF,+80-20%,50V (2465 OPTION 01 ONLY)	04222	M0015C104MAA
A20C4224	281-0909-00	8031230		CAP,FXD,CER 01:0.022UF,20%,50V (2465 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4224	281-0909-00			CAP,FXD,CER 01:0.022UF,20%,50V (OPT 05/OPT 01 COMBO)	54583	MA12X7R1H223M-T
A20C4240	283-0421-00	8010100	8027484	CAP,FXD,CER 01:0.1UF,+80-20%,50V (2445 OPTION 01 ONLY)	04222	M0015C104MAA
A20C4240	281-0909-00	8027485		CAP,FXD,CER 01:0.022UF,20%,50V (2445 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4240	283-0421-00	8010100	8031229	CAP,FXD,CER 01:0.1UF,+80-20%,50V (2465 OPTION 01 ONLY)	04222	M0015C104MAA
A20C4240	281-0909-00	8031230		CAP,FXD,CER 01:0.022UF,20%,50V (2465 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4240	281-0909-00			CAP,FXD,CER 01:0.022UF,20%,50V (OPTION 05/01 COMBO)	54583	MA12X7R1H223M-T
A20C4241	283-0421-00	8010100	8027484	CAP,FXD,CER 01:0.1UF,+80-20%,50V (2445 OPTION 01 ONLY)	04222	M0015C104MAA
A20C4241	281-0909-00	8027485		CAP,FXD,CER 01:0.022UF,20%,50V (2445 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4241	283-0421-00	8010100	8031229	CAP,FXD,CER 01:0.1UF,+80-20%,50V (2465 OPTION 01 ONLY)	04222	M0015C104MAA
A20C4241	281-0909-00	8031230		CAP,FXD,CER 01:0.022UF,20%,50V (2465 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4241	281-0909-00			CAP,FXD,CER 01:0.022UF,20%,50V (OPTION 05/01 COMBO)	54583	MA12X7R1H223M-T

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A20C4255	283-0421-00	B010100	B027484	CAP,FXD,CER D1:0.1UF,+80-20%,50V (2445 OPTION 01 ONLY)	04222	MD015C104MAA
A20C4255	281-0909-00		B027485	CAP,FXD,CER D1:0.022UF,20%,50V (2445 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4255	283-0421-00	B010100	B031229	CAP,FXD,CER D1:0.1UF,+80-20%,50V (2465 OPTION 01 ONLY)	04222	MD015C104MAA
A20C4255	281-0909-00		B031230	CAP,FXD,CER D1:0.022UF,20%,50V (2465 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4255	281-0909-00			CAP,FXD,CER D1:0.022UF,20%,50V (OPTION 05/01 COMBO)	54583	MA12X7R1H223M-T
A20C4260	283-0421-00	B010100	B027484	CAP,FXD,CER D1:0.1UF,+80-20%,50V (2445 OPTION 01 ONLY)	04222	MD015C104MAA
A20C4260	281-0909-00		B027485	CAP,FXD,CER D1:0.022UF,20%,50V (2445 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4260	283-0421-00	B010100	B031229	CAP,FXD,CER D1:0.1UF,+80-20%,50V (2465 OPTION 01 ONLY)	04222	MD015C104MAA
A20C4260	281-0909-00		B031230	CAP,FXD,CER D1:0.022UF,20%,50V (2465 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4260	281-0909-00			CAP,FXD,CER D1:0.022UF,20%,50V (OPTION 05/01 COMBO)	54583	MA12X7R1H223M-T
A20C4265	281-0764-00			CAP,FXD,CER D1:82PF,5%,100V	04222	MA101A820JAA
A20C4270	283-0421-00	B010100	B027484	CAP,FXD,CER D1:0.1UF,+80-20%,50V (2445 OPTION 01 ONLY)	04222	MD015C104MAA
A20C4270	281-0909-00		B027485	CAP,FXD,CER D1:0.022UF,20%,50V (2445 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4270	283-0421-00	B010100	B031229	CAP,FXD,CER D1:0.1UF,+80-20%,50V (2465 OPTION 01 ONLY)	04222	MD015C104MAA
A20C4270	281-0909-00		B031230	CAP,FXD,CER D1:0.022UF,20%,50V (2465 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4270	281-0909-00			CAP,FXD,CER D1:0.022UF,20%,50V (OPTION 05/01 COMBO)	54583	MA12X7R1H223M-T
A20C4280	283-0421-00	B010100	B027484	CAP,FXD,CER D1:0.1UF,+80-20%,50V (2445 OPTION 01 ONLY)	04222	MD015C104MAA
A20C4280	281-0909-00		B027485	CAP,FXD,CER D1:0.022UF,20%,50V (2445 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4280	283-0421-00	B010100	B031229	CAP,FXD,CER D1:0.1UF,+80-20%,50V (2465 OPTION 01 ONLY)	04222	MD015C104MAA
A20C4280	281-0909-00		B031230	CAP,FXD,CER D1:0.022UF,20%,50V (2465 OPTION 01 ONLY)	54583	MA12X7R1H223M-T
A20C4280	281-0909-00			CAP,FXD,CER D1:0.022UF,20%,50V (OPTION 05/01 COMBO)	54583	MA12X7R1H223M-T
A20J651	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL (QUANTITY OF 20)	22526	48283-036
A20J4203	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL (QUANTITY OF 3)	22526	48283-036
A20J4207	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL (QUANTITY OF 7)	22526	48283-036
A20J4210	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL (QUANTITY OF 34)	22526	48283-036
A20J4220	131-0589-00			TERM,PIN:0.46L X 0.025 SQ BRZ GLD PL (QUANTITY OF 14)	22526	48283-029
A20J4221	131-0589-00			TERM,PIN:0.46L X 0.025 SQ BRZ GLD PL (QUANTITY OF 24)	22526	48283-029
A20J4228	131-2919-00			CONN,RCPT,ELEC:HEADER,1 X 4,0.1 SPACING	80009	131-2919-00
A20J4230	131-2920-00			CONN,RCPT,ELEC:HEADER,2 X 5,0.1 SPACING	00779	86479-3
A20J4232	131-2920-00			CONN,RCPT,ELEC:HEADER,2 X 5,0.1 SPACING	00779	86479-3
A20J4234	131-2919-00			CONN,RCPT,ELEC:HEADER,1 X 4,0.1 SPACING	80009	131-2919-00
A20J4236	131-2920-00			CONN,RCPT,ELEC:HEADER,2 X 5,0.1 SPACING	00779	86479-3
A20J4238	131-0589-00			TERM,PIN:0.46L X 0.025 SQ BRZ GLD PL (QUANTITY OF 12)	22526	48283-029
A20J4240	131-0589-00	B010100	B027484	TERM,PIN:0.46L X 0.025 SQ BRZ GLD PL (QUANTITY OF 40, LOCATION A) (2445 OPTIONS)	22526	48283-029

Replaceable Electrical Parts  
2445/2465 Option 01 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A20J4240	131-1742-00	8027485		TERM,PIN:0.662 L X 0.025 SQ PH BRS GOLD PL (QUANTITY OF 40, LOCATION A) (2445 OPTIONS)	22526	48283-086
A20J4240	131-0589-00	8010100	8031229	TERM,PIN:0.46L X 0.025 SQ BRZ GLD PL (QUANTITY OF 40, LOCATION A) (2465 OPTIONS)	22526	48283-029
A20J4240	131-1742-00	8031230		TERM,PIN:0.662 L X 0.025 SQ PH BRS GOLD PL (QUANTITY OF 40, LOCATION A) (2465 OPTIONS)	22526	48283-086
A20J4240	131-0589-00			TERM,PIN:0.46L X 0.025 SQ BRZ GLD PL (QUANTITY OF 4, LOCATION B)	22526	48283-029
A20J4242	131-0589-00			TERM,PIN:0.46L X 0.025 SQ BRZ GLD PL (QUANTITY OF 44)	22526	48283-029
A20J4243	131-0589-00			TERM,PIN:0.46L X 0.025 SQ BRZ GLD PL (QUANTITY OF 44)	22526	48283-029
A20J4256	131-0589-00	8010100	8027484	TERM,PIN:0.46L X 0.025 SQ BRZ GLD PL (QUANTITY OF 2, 2445 OPTIONS)	22526	48283-029
A20J4256	131-1742-00	8027485		TERM,PIN:0.662 L X 0.025 SQ PH BRS GOLD PL (QUANTITY OF 2, 2445 OPTIONS)	22526	48283-086
A20J4256	131-0608-00	8027485		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL (QUANTITY OF 14, 2445 OPTIONS)	22526	48283-036
A20J4256	131-0589-00	8010100	8031229	TERM,PIN:0.46L X 0.025 SQ BRZ GLD PL (QUANTITY OF 2, 2465 OPTIONS)	22526	48283-029
A20J4256	131-1742-00	8031230		TERM,PIN:0.662 L X 0.025 SQ PH BRS GOLD PL (QUANTITY OF 2, 2465 OPTIONS)	22526	48283-086
A20J4256	131-0608-00	8031230		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL (QUANTITY OF 14, 2465 OPTIONS)	22526	48283-036
A20J4258	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL (QUANTITY OF 20)	22526	48283-036
A20J4330	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL (QUANTITY OF 16)	22526	48283-036
A20P203	131-2924-00			CONN,RCPT,ELEC:HEADER,1 X 6,0.2 SPACING	27264	10-51-1061
A20P303	131-2923-00			CONN,RCPT,ELEC:HEADER,1 X 2,0.2 SPACING	27264	10-51-1021
A20Q4201	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A20R4200	321-0085-00			RES,FXD,FILM:75 OHM,1%,0.125M,TC=TO	57668	CR814FXE 75 OHM
A20R4201	321-0085-00			RES,FXD,FILM:75 OHM,1%,0.125M,TC=TO	57668	CR814FXE 75 OHM
A20R4202	321-0122-00	8020000	8025499	RES,FXD,FILM:182 OHM,1%,0.125M,TC=TO (2445 ONLY)	19701	5033ED182R0F
A20R4202	321-0132-00	8025500		RES,FXD,FILM:232 OHM,1%,0.125M,TC=TO (2445 ONLY)	91637	MFF1816G232R0F
A20R4202	321-0122-00	8020000	8028059	RES,FXD,FILM:182 OHM,1%,0.125M,TC=TO (2465 ONLY)	19701	5033ED182R0F
A20R4202	321-0132-00	8028060		RES,FXD,FILM:232 OHM,1%,0.125M,TC=TO (2465 ONLY)	91637	MFF1816G232R0F
A20R4203	321-0105-00	8020000	8025499	RES,FXD,FILM:121 OHM 1%,0.125M,TC=\0 (2445 ONLY)	07716	CEA0121R0F
A20R4203	321-0101-00	8025500		RES,FXD,FILM:110 OHM,1%,0.125M,TC=TO (2445 ONLY)	07716	CEA0110R0F
A20R4203	321-0105-00	8020000	8028059	RES,FXD,FILM:121 OHM 1%,0.125M,TC=\0 (2465 ONLY)	07716	CEA0121R0F
A20R4203	321-0101-00	8028060		RES,FXD,FILM:110 OHM,1%,0.125M,TC=TO (2465 ONLY)	07716	CEA0110R0F
A20R4204	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25M	57668	NTR25J-E05K1
A20R4205	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A20R4206	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25M	57668	NTR25J-E05K1
A20R4207	321-0105-00	8020000	8025499	RES,FXD,FILM:121 OHM 1%,0.125M,TC=\0 (2445 ONLY)	07716	CEA0121R0F
A20R4207	321-0101-00	8025500		RES,FXD,FILM:110 OHM,1%,0.125M,TC=TO (2445 ONLY)	07716	CEA0110R0F
A20R4207	321-0105-00	8020000	8028059	RES,FXD,FILM:121 OHM 1%,0.125M,TC=\0 (2465 ONLY)	07716	CEA0121R0F
A20R4207	321-0101-00	8028060		RES,FXD,FILM:110 OHM,1%,0.125M,TC=TO (2465 ONLY)	07716	CEA0110R0F

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A20R4208	321-0122-00	B020000	B025499	RES,FXD,FILM:182 OHM,1%,0.125W,TC=TO (2445 ONLY)	19701	5033ED182R0F
A20R4208	321-0132-00	B025500		RES,FXD,FILM:232 OHM,1%,0.125W,TC=TO (2445 ONLY)	91637	WFF1816G232R0F
A20R4208	321-0122-00	B020000	B028059	RES,FXD,FILM:182 OHM,1%,0.125W,TC=TO (2465 ONLY)	19701	5033ED182R0F
A20R4208	321-0132-00	B028060		RES,FXD,FILM:232 OHM,1%,0.125W,TC=TO (2465 ONLY)	91637	WFF1816G232R0F
A20R4210	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W (OPT.05,OPT.01 COMBO ONLY)	57668	NTR25J-E470E
A20R4224	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JED1K0
A20R4265	315-0681-00			RES,FXD,FILM:680 OHM,5%,0.25W	57668	NTR25J-E680E
A20U4207	156-1566-00			MICROCKT,DGTL:PMOS,100 X 14,EEPROM14	14936	ER1400
A20U4225	156-1318-00			MICROCKT,DGTL:LSTTL,4-BIT BISTABLE LATCH	01295	SN74LS375NP3
A20U4235	156-1065-01			MICROCKT,DGTL:OCTAL D TYPE TRANS LATCHES	04713	SN74LS373 ND/JD
A20U4240	156-0718-03			MICROCKT,DGTL:TRIPLE 3-INP NOR GATE,SCRN	01295	SN74LS27NP3
A20U4245	156-1065-01			MICROCKT,DGTL:OCTAL D TYPE TRANS LATCHES	04713	SN74LS373 ND/JD
A20U4250	156-0386-02			MICROCKT,DGTL:TRIPLE 3-INP NAND GATE,SCRN	07263	74LS10PCQR
A20U4255	156-1111-02			MICROCKT,DGTL:OCT BUS XCVRS W/3 ST OUT	01295	SN74LS245N3
A20U4260	160-1833-05	B010100	B027484	MICROCKT,DGTL:4096 X 8 EPROM,PRGM (2445 OPTIONS)	80009	160-1833-05
A20U4260	160-1833-06	B027485		MICROCKT,DGTL:4096 X 8 EPROM,PRGM (2445 OPTIONS)	80009	160-1833-06
A20U4260	160-1833-05	B010100	B031229	(NOT PART OF A20 BOARD, ORDER SEPARATELY) MICROCKT,DGTL:4096 X 8 EPROM,PRGM (2465 OPTIONS)	80009	160-1833-05
A20U4260	160-1833-06	B031230		MICROCKT,DGTL:4096 X 8 EPROM,PRGM (2465 OPTIONS) (NOT PART OF A20 BOARD, ORDER SEPARATELY)	80009	160-1833-06
A20U4265	156-0383-02			MICROCKT,DGTL:QUAD 2-INP NOR GATE,SCRN	18324	N74LS02NB
A20U4275	156-0392-03			MICROCKT,DGTL:QUAD LATCH W/CLEAR,SCRN,	07263	74LS175PCQR
A20U4280	156-0866-02			MICROCKT,DGTL:13 INP NAND GATES,SCRN	04713	SN74LS133 (NDS)
A22	670-8159-00			CIRCUIT BD ASSY:LED	80009	670-8159-00
A22054540	150-1064-00			LT EMITTING DIO:YELLOW,585NM,40 MA MAX	15513	SP840113
A22054542	150-1064-00			LT EMITTING DIO:YELLOW,585NM,40 MA MAX	15513	SP840113
A22054545	150-1064-00			LT EMITTING DIO:YELLOW,585NM,40 MA MAX	15513	SP840113
A23	670-7558-02			CIRCUIT BD ASSY:GPIB OPT	80009	670-7558-02
A23C4521	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4530	283-0047-00			CAP,FXD,CER D1:270PF,5%,500V	59660	0831604Z5FD271J
A23C4621	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4625	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4626	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4631	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4635	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4636	285-1187-00			CAP,FXD,MTLZD:0.47 UF,10%,100 V	05292	PMT 3R .47K 100
A23C4637	285-1187-00			CAP,FXD,MTLZD:0.47 UF,10%,100 V	05292	PMT 3R .47K 100
A23C4638	285-1187-00			CAP,FXD,MTLZD:0.47 UF,10%,100 V	05292	PMT 3R .47K 100
A23C4640	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4644	285-1187-00			CAP,FXD,MTLZD:0.47 UF,10%,100 V	05292	PMT 3R .47K 100
A23C4645	285-1187-00			CAP,FXD,MTLZD:0.47 UF,10%,100 V	05292	PMT 3R .47K 100
A23C4705	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4706	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4708	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4730	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4735	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4738	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4745	283-0203-00			CAP,FXD,CER D1:0.47UF,20%,50V	04222	SR3055C474MAA
A23C4747	290-0847-00			CAP,FXD,ELCTL:47UF,+50-10%,10V	54473	ECE-B1AV470S
A23C4801	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA
A23C4805	283-0421-00			CAP,FXD,CER D1:0.1UF,+80-20%,50V	04222	MD015C104MAA

Replaceable Electrical Parts  
2445/2465 Option 01 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscnt	Name & Description	Mfr. Code	Mfr. Part No.
A23C4808	283-0421-00		CAP,FXD,CER 01:0.1UF,+80-20%,50V	04222	M0015C104MAA
A23C4831	283-0421-00		CAP,FXD,CER 01:0.1UF,+80-20%,50V	04222	M0015C104MAA
A23C4838	283-0421-00		CAP,FXD,CER 01:0.1UF,+80-20%,50V	04222	M0015C104MAA
A23CR4525	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4526	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4527	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4530	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4531	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4532	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4533	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4534	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4540	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4541	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4542	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4641	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4642	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4643	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23CR4652	152-0141-02		SEMICONO DVC,01:SM,SI,30V,150MA,30V,00-35	03508	0A2527 (1N4152)
A23J4540	131-0589-00		TERM,PIN:0.46L X 0.025 SQ BRZ GLD PL (QUANTITY OF 4)	22526	48283-029
A23J4800	131-0608-00		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL (QUANTITY OF 24)	22526	48283-036
A23P4238	131-2888-00		CONN,RCPT,ELEC:CKT 80,HORIZ,2 X 6,0.1 SP	00779	86063-2
A23P4243	131-2887-00		CONN,RCPT,ELEC:CKT 80,HORIZ,2 X 22,0.1,SP	00779	1-86063-8
A23Q4526	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A23Q4530	151-0188-00		TRANSISTOR:PMP,SI,TO-92	80009	151-0188-00
A23Q4533	151-0188-00		TRANSISTOR:PMP,SI,TO-92	80009	151-0188-00
A23Q4541	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A23Q4543	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A23Q4743	151-0622-00		TRANSISTOR:PMP,SI,TO-92	04713	SPS8956 (MPSM51A)
A23Q4745	151-0736-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0736-00
A23R4501	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A23R4502	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A23R4503	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A23R4510	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A23R4511	315-0272-00		RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A23R4512	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A23R4513	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A23R4515	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A23R4516	315-0272-00		RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A23R4520	315-0272-00		RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A23R4521	321-0344-00		RES,FXD,FILM:37.4K OHM,1%,0.125W,TC=TO	19701	5033ED 37K40F
A23R4523	321-0300-00		RES,FXD,FILM:13.0K OHM,1%,0.125W,TC=TO	07716	CEA013001F
A23R4525	321-0300-00		RES,FXD,FILM:13.0K OHM,1%,0.125W,TC=TO	07716	CEA013001F
A23R4526	321-0300-00		RES,FXD,FILM:13.0K OHM,1%,0.125W,TC=TO	07716	CEA013001F
A23R4531	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A23R4532	315-0272-00		RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A23R4533	315-0220-00		RES,FXD,FILM:22 OHM,5%,0.25W	19701	5043CX22R00J
A23R4534	315-0130-00		RES,FXD,FILM:13 OHM,5%,0.25W	01121	C81305
A23R4535	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A23R4543	315-0201-00		RES,FXD,FILM:200 OHM,5%,0.25W	57668	NTR25J-E200E
A23R4544	315-0201-00		RES,FXD,FILM:200 OHM,5%,0.25W	57668	NTR25J-E200E
A23R4545	315-0201-00		RES,FXD,FILM:200 OHM,5%,0.25W	57668	NTR25J-E200E
A23R4546	315-0620-00		RES,FXD,FILM:62 OHM,5%,0.25W	19701	5043CX63R00J
A23R4547	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A23R4548	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A23R4549	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A23R4550	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A23R4615	307-0445-00		RES NTWK,FXD,FI:4.7K OHM,20%,(9)RES	32997	4310R-101-472



Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A23R4630	307-0730-00			RES NTMK,FXD,FI:7,47K OHM,2%,0.18W EA	11236	750-81-R47K
A23R4731	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A23R4732	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A23R4733	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A23R4734	315-0131-00			RES,FXD,FILM:130 OHM,5%,0.25W	19701	5043CX130R0J
A23R4735	315-0271-00			RES,FXD,FILM:270 OHM,5%,0.25W	57668	NTR25J-E270E
A23R4740	315-0152-00			RES,FXD,FILM:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A23R4743	315-0152-00			RES,FXD,FILM:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
A23TP4523	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A23TP4524	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A23TP4748	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A23TP4749	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A23TP4809	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A23TP4841	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A23TP4843	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A23TP4845	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A23TP4848	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A23TP4849	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A23U4501	156-0956-02			MICROCKT,DGTL:OCTAL BFR W/3 STATE OUT	01295	SN74LS244NP3
A23U4505	156-0956-02			MICROCKT,DGTL:OCTAL BFR W/3 STATE OUT	01295	SN74LS244NP3
A23U4525	156-0513-03			MICROCKT,LINEAR:CMOS,8 CHAN ANALOG MUX	04713	MC140518CL
A23U4601	156-0866-02			MICROCKT,DGTL:13 INP NAND GATES,SCRN	04713	SN74LS133(NDS)
A23U4605	156-0866-02			MICROCKT,DGTL:13 INP NAND GATES,SCRN	04713	SN74LS133(NDS)
A23U4606	156-0385-02			MICROCKT,DGTL:HEX INVERTER,SCRN	07263	74LS04PCQR
A23U4608	156-1111-02			MICROCKT,DGTL:OCT BUS XCVRs W/3 ST OUT	01295	SN74LS245N3
A23U4621	156-0513-03			MICROCKT,LINEAR:CMOS,8 CHAN ANALOG MUX	04713	MC140518CL
A23U4625	156-1221-00			MICROCKT,DGTL:LSTTL,HEX D-TYPE FF,SCRN	01295	SN74LS378N3
A23U4626	156-1221-00			MICROCKT,DGTL:LSTTL,HEX D-TYPE FF,SCRN	01295	SN74LS378N3
A23U4631	156-1126-00			MICROCKT,LINEAR:VOLTAGE COMPARATOR	01295	LM311P
A23U4635	156-1200-00			MICROCKT,LINEAR:OPERATIONAL AMP,QUAD BI-FET	01295	TL074CN
A23U4641	156-1191-00			MICROCKT,LINEAR:DUAL BI-FET OPNL AMPL	01295	TL072ACP
A23U4701	156-1277-00			MICROCKT,DGTL:LSTTL,3-STATE OCTAL BFR,SCRN	27014	DM81LS95ANA+
A23U4705	156-0480-02			MICROCKT,DGTL:QUAD 2-INP & GATE,SCRN,	01295	SN74LS08NP3
A23U4706	156-0382-02			MICROCKT,DGTL:QUAD 2 INP NAND GATE BURN	18324	N74LS00NB
A23U4708	156-0469-02			MICROCKT,DGTL:3/8 LINE DCDR,SCRN	01295	SN74LS138NP3
A23U4710	160-1681-00			MICROCKT,DGTL:8192 X 8 EPROM,PRGM	80009	160-1681-00
A23U4715	160-1692-00			MICROCKT,DGTL:16K X 8 EPROM,PRGM	80009	160-1692-00
A23U4730	156-0467-02			MICROCKT,DGTL:QUAD 2-INP NAND BFR W/OC OUT	01295	SN74LS38NP3
A23U4735	156-0382-02			MICROCKT,DGTL:QUAD 2 INP NAND GATE BURN	18324	N74LS00NB
A23U4738	156-0386-02			MICROCKT,DGTL:TRIPLE 3-INP NAND GATE,SCRN	07263	74LS10PCQR
A23U4801	156-0865-02			MICROCKT,DGTL:OCTAL D FF W/CLEAR,SCRN	01295	SN74LS273NP3
A23U4805	156-1415-00			MICROCKT,DGTL:TTL,OCTAL GPIB XCVR MGT BUS	01295	SN75161A N
A23U4808	156-1414-00			MICROCKT,DGTL:TTL,OCTAL GPIB XCVR DATA BUS	01295	SN75160 (N OR J)
A23U4811	156-1594-00			MICROCKT,DGTL:NMOS,2048 X 8 SRAM	TK1015	HM6116P-3(DP-24)
A23U4831	156-0479-02			MICROCKT,DGTL:QUAD 2-INP OR GATE,SCRN	01295	SN74LS32NP3
A23U4838	156-0388-03			MICROCKT,DGTL:DUAL D FLIP-FLOP,SCRN	01295	SN74LS74ANP3
A29	670-7835-01	8020000	8025924	CIRCUIT BD ASSY:DMM (2445 ONLY)	80009	670-7835-01
A29	670-7835-02	8025925	8026449	CIRCUIT BD ASSY:DMM (NO LONGER INCLUDES U5280,U5281) (2445 ONLY)	80009	670-7835-02
A29	670-7835-03	8026450	8026656	CIRCUIT BD ASSY:DMM (2445 ONLY)	80009	670-7835-03
A29	670-7835-04	8026657		CIRCUIT BD ASSY:DMM (2445 ONLY)	80009	670-7835-04
A29	670-7835-01	8020000	8028679	CIRCUIT BD ASSY:DMM (2465 ONLY)	80009	670-7835-01
A29	670-7835-02	8028680	8029524	CIRCUIT BD ASSY:DMM (NO LONGER INCLUDES U5280,U5281) (2465 ONLY)	80009	670-7835-02

Replaceable Electrical Parts  
2445/2465 Option 01 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A29	670-7835-03	8029523	8029862	CIRCUIT 80 ASSY:OMM (2465 ONLY)	80009	670-7835-03
A29	670-7835-04	8029863		CIRCUIT 80 ASSY:OMM (2465 ONLY)	80009	670-7835-04
A29C4910	281-0775-00			CAP,FXD,CER 0I:0.1UF,20%,50V	04222	MA205E104MAA
A29C4911	281-0809-00			CAP,FXD,CER 0I:200 PF,5%,100V	04222	MA101A201JAA
A29C4912	281-0809-00			CAP,FXD,CER 0I:200 PF,5%,100V	04222	MA101A201JAA
A29C4913	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C4914	285-0558-00			CAP,FXD,PLASTIC:0.05 UF 2%,50V	80009	285-0558-00
A29C4915	281-0775-00	8027108		CAP,FXD,CER 0I:0.1UF,20%,50V (2445 ONLY)	04222	MA205E104MAA
A29C4915	281-0775-00	8030556		CAP,FXD,CER 0I:0.1UF,20%,50V (2465 ONLY)	04222	MA205E104MAA
A29C4932	281-0775-00	8027108		CAP,FXD,CER 0I:0.1UF,20%,50V (2445 ONLY)	04222	MA205E104MAA
A29C4932	281-0775-00	8030556		CAP,FXD,CER 0I:0.1UF,20%,50V (2465 ONLY)	04222	MA205E104MAA
A29C4960	281-0773-00			CAP,FXD,CER 0I:0.01UF,10%,100V	04222	MA201C103KAA
A29C4961	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C4962	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C4963	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C5015	281-0773-00			CAP,FXD,CER 0I:0.01UF,10%,100V	04222	MA201C103KAA
A29C5020	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C5031	281-0775-00			CAP,FXD,CER 0I:0.1UF,20%,50V	04222	MA205E104MAA
A29C5050	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C5051	281-0762-00			CAP,FXD,CER 0I:27PF,20%,100V	04222	MA101A270MAA
A29C5052	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C5070	285-0753-00			CAP,FXD,PLASTIC:0.01UF,3.5%,100V	80009	285-0753-00
A29C5071	285-0753-00			CAP,FXD,PLASTIC:0.01UF,3.5%,100V	80009	285-0753-00
A29C5110	290-0532-00			CAP,FXD,ELCTLT:150UF,20%,6V	05397	T354J157M006AS 2
A29C5111	290-0876-00			CAP,FXD,ELCTLT:15UF,20%,25 MVOC	05397	T330C156M025AS
A29C5112	290-0876-00			CAP,FXD,ELCTLT:15UF,20%,25 MVOC	05397	T330C156M025AS
A29C5122	283-0177-00			CAP,FXD,CER 0I:1UF,+80-20%,25V	04222	SR302E105ZAA
A29C5124	283-0177-00			CAP,FXD,CER 0I:1UF,+80-20%,25V	04222	SR302E105ZAA
A29C5130	281-0772-00			CAP,FXD,CER 0I:4700PF,10%,100V	04222	MA201C472KAA
A29C5140	290-0523-00			CAP,FXD,ELCTLT:2.2UF,20%,20V	05397	T368A225M020AS
A29C5142	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C5150	290-0876-00			CAP,FXD,ELCTLT:15UF,20%,25 MVOC	05397	T330C156M025AS
A29C5151	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C5152	290-0534-00			CAP,FXD,ELCTLT:1UF,20%,35V	05397	T368A105M035AZ
A29C5153	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C5155	290-0523-00			CAP,FXD,ELCTLT:2.2UF,20%,20V	05397	T368A225M020AS
A29C5170	281-0809-00			CAP,FXD,CER 0I:200 PF,5%,100V	04222	MA101A201JAA
A29C5171	285-1106-00			CAP,FXD,PLASTIC:0.022UF,20%,600V	14752	23081F223
A29C5220	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C5222	290-0536-00			CAP,FXD,ELCTLT:10UF,20%,25V TANTALUM	05397	T368B106M025AS
A29C5224	281-0785-00	8025925		CAP,FXD,CER 0I:68PF,10%,100V (2445 ONLY)	04222	MA101A680KAA
A29C5224	281-0785-00	8028680		CAP,FXD,CER 0I:68PF,10%,100V (2465 ONLY)	04222	MA101A680KAA
A29C5230	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C5231	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C5232	281-0791-00	8026657		CAP,FXD,CER 0I:270PF,10%,100V (2445 ONLY)	04222	MA101C271KAA
A29C5232	281-0791-00	8029863		CAP,FXD,CER 0I:270PF,10%,100V (2465 ONLY)	04222	MA101C271KAA
A29C5250	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C5251	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C5280	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T
A29C5281	281-0909-00			CAP,FXD,CER 0I:0.022UF,20%,50V	54583	MA12X7R1H223M-T

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A29C5290	281-0909-00		CAP,FXD,CER DI:0.022UF,20%,50V	54583	WA12X7R1H223M-T
A29CR4952	152-0141-02		SEMICON DVC,DI:SM,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A29CR4970	152-0674-00		SEMICON DVC,DI:RECT,SI,800V,1.0A,DO-41	13409	1N4947
A29CR4971	152-0674-00		SEMICON DVC,DI:RECT,SI,800V,1.0A,DO-41	13409	1N4947
A29CR4980	152-0246-00		SEMICON DVC,DI:SM,SI,40V,200MA,DO-7	14433	MG1537TK
A29CR4981	152-0246-00		SEMICON DVC,DI:SM,SI,40V,200MA,DO-7	14433	MG1537TK
A29CR4982	152-0141-02		SEMICON DVC,DI:SM,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A29CR5030	152-0141-02		SEMICON DVC,DI:SM,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A29CR5031	152-0141-02		SEMICON DVC,DI:SM,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A29CR5110	152-0333-00		SEMICON DVC,DI:SM,SI,55V,200MA,DO-35	07263	FDH-6012
A29CR5111	152-0333-00		SEMICON DVC,DI:SM,SI,55V,200MA,DO-35	07263	FDH-6012
A29CR5112	152-0333-00		SEMICON DVC,DI:SM,SI,55V,200MA,DO-35	07263	FDH-6012
A29CR5113	152-0333-00		SEMICON DVC,DI:SM,SI,55V,200MA,DO-35	07263	FDH-6012
A29CR5114	152-0333-00		SEMICON DVC,DI:SM,SI,55V,200MA,DO-35	07263	FDH-6012
A29CR5115	152-0333-00		SEMICON DVC,DI:SM,SI,55V,200MA,DO-35	07263	FDH-6012
A29CR5130	152-0141-02		SEMICON DVC,DI:SM,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A29CR5163	152-0246-00		SEMICON DVC,DI:SM,SI,40V,200MA,DO-7	14433	MG1537TK
A29CR5164	152-0246-00		SEMICON DVC,DI:SM,SI,40V,200MA,DO-7	14433	MG1537TK
A29CR5170	152-0307-00		SEMICON DVC,DI:SM,SI,100V,0.13A,DO-92	04713	SSD1150
A29CR5210	152-0141-02		SEMICON DVC,DI:SM,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A29CR5211	152-0141-02		SEMICON DVC,DI:SM,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A29CR5212	152-0141-02		SEMICON DVC,DI:SM,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A29CR5221	152-0141-02		SEMICON DVC,DI:SM,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A29D55201	150-1014-00		LT EMITTING DIO:RED,695NM,100MA MAX	58361	Q6444/MV5054-1
A29F4990	159-0224-01		FUSE,CARTRIDGE:5AG,3A,600V,FAST	71400	BBS-3
A29F5220	159-0159-00		FUSE,WIRE LEAD:1.5A,125V,5 SEC	75915	25501.5
A29J5210	131-0608-00		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL (QUANTITY OF 2)	22526	48283-036
A29J5220	131-0608-00		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL (QUANTITY OF 3)	22526	48283-036
A29J5290	131-0608-00		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL (QUANTITY OF 40)	22526	48283-036
A29J5291	131-0608-00		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL (QUANTITY OF 40)	22526	48283-036
A29K4980	148-0146-00		RELAY,REED:1FORMA,500VDC,COIL 5VDC,400 OHM	15636	ORDER BY DESCR
A29K4981	148-0149-00		RELAY,ARMATURE:1 FORM A,1 FORM B,8A,250VAC, COIL 12VDC,600 OHMS	61529	ST1E-DC12V
A29K4990	148-0149-00		RELAY,ARMATURE:1 FORM A,1 FORM B,8A,250VAC, COIL 12VDC,600 OHMS	61529	ST1E-DC12V
A29K5080	148-0149-00		RELAY,ARMATURE:1 FORM A,1 FORM B,8A,250VAC, COIL 12VDC,600 OHMS	61529	ST1E-DC12V
A29K5090	148-0149-00		RELAY,ARMATURE:1 FORM A,1 FORM B,8A,250VAC, COIL 12VDC,600 OHMS	61529	ST1E-DC12V
A29K5091	148-0149-00		RELAY,ARMATURE:1 FORM A,1 FORM B,8A,250VAC, COIL 12VDC,600 OHMS	61529	ST1E-DC12V
A29K5190	148-0141-00		RLY,REED:1FORMA,100VDC,COIL 15VDC,2.2K OHM	15636	R7620-2
A29K5191	148-0141-00		RLY,REED:1FORMA,100VDC,COIL 15VDC,2.2K OHM	15636	R7620-2
A29Q4920	151-0354-00		TRANSISTOR:PNP,SI,TO-78	32293	ITS-1200-A
A29Q4922	151-1054-00		TRANSISTOR:FET,N-CHAN,SI,TO-71	80009	151-1054-00
A29Q4930	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A29Q4932	151-0221-00		TRANSISTOR:PNP,SI,TO-92	04713	SP5246
A29Q4934	151-1103-00		TRANSISTOR:FE,N CHANNEL,SI,TO-72	17856	DM1001
A29Q4936	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A29Q4950	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A29Q4952	151-1078-00		TRANSISTOR:FET,N-CHAN,SI,TO-92	04713	SPF3040
A29Q4960	151-0254-00		TRANSISTOR:DARLINGTON,NPN,SI	03508	X38L3118
A29Q4970	151-1103-00		TRANSISTOR:FE,N CHANNEL,SI,TO-72	17856	DM1001
A29Q4971	151-1103-00		TRANSISTOR:FE,N CHANNEL,SI,TO-72	17856	DM1001
A29Q4972	151-1063-00		TRANSISTOR:MOS FET,N-CHANNEL,SI	81483	IRFD113

Replaceable Electrical Parts  
2445/2465 Option 01 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscnt	Name & Description	Mfr. Code	Mfr. Part No.
A2904973	151-1063-00		TRANSISTOR:MOS FET,N-CHANNEL,SI	81483	IRFD113
A2904980	151-1136-00		TRANSISTOR:MOSFE,N-CHANNEL,SI,TO-220AB	04713	IRF530
A2905020	151-0342-00		TRANSISTOR:PMP,SI,TO-92	07263	5035928
A2905070	151-1077-01		TRANSISTOR:FET,N-CHAN,SI	80009	151-1077-01
A2905124	151-1059-00		TRANSISTOR:FET,N-CHAN,TO-106	04713	ORDER BY DESCR
A2905130	151-0221-00		TRANSISTOR:PMP,SI,TO-92	04713	SPS246
A2905210	151-0254-00		TRANSISTOR:DARLINGTON,NPN,SI	03508	X38L3118
A2905230	151-0221-00		TRANSISTOR:PMP,SI,TO-92	04713	SPS246
A2904910	315-0331-00		RES,FXD,FILM:330 OHM,5%,0.25M	57668	NTR25J-E330E
A2904910	315-0823-00		RES,FXD,FILM:82K OHM,5%,0.25M	57668	NTR25J-E82K
A2904911	315-0681-00		RES,FXD,FILM:680 OHM,5%,0.25M	57668	NTR25J-E680E
A2904913	315-0273-00		RES,FXD,FILM:27K OHM,5%,0.25M	57668	NTR25J-E27K0
A2904914	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JED1K0
A2904915	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JED1K0
A2904916	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JED1K0
A2904917	315-0221-00		RES,FXD,FILM:220 OHM,5%,0.25M	57668	NTR25J-E220E
A2904920	315-0221-00		RES,FXD,FILM:220 OHM,5%,0.25M	57668	NTR25J-E220E
A2904921	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JED1K0
A2904922	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25M	57668	NTR25J-E 2K
A2904923	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25M	57668	NTR25J-E100K
A2904924	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A2904925	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A2904926	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A2904927	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25M	57668	NTR25J-E 2K
A2904930	315-0471-00		RES,FXD,FILM:470 OHM,5%,0.25M	57668	NTR25J-E470E
A2904932	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JED1K0
A2904934	315-0302-00		RES,FXD,FILM:3K OHM,5%,0.25M	57668	NTR25J-E03K0
A2904950	315-0471-00		RES,FXD,FILM:470 OHM,5%,0.25M	57668	NTR25J-E470E
A2904951	325-0252-00		RES,FXD,FILM:6.95K OHM,0.1%,0.1M	03888	
A2904952	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25M	57668	NTR25J-E100K
A2904953	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A2904954	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A2904955	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A2904957	307-0765-00		RES NTWK,FXD,FI:1K OHM & 9K OHM,5% EA,0.1M	07716	4168
A2904958	307-0765-00		RES NTWK,FXD,FI:1K OHM & 9K OHM,5% EA,0.1M	07716	4168
A2904960	307-0934-00		RES NTWK,FXD,FI:SINGLE INLINE,0.25%	19647	1787-31
A2904971	315-0334-00		RES,FXD,FILM:330K OHM,5%,0.25M	57668	NTR25J-E 330K
A2904972	315-0164-00		RES,FXD,FILM:160K OHM,5%,0.25M	57668	NTR25J-E160K
A2904973	321-0924-02		RES,FXD,FILM:40K OHM,0.5%,0.125M,TC=T2	19701	5033RE40K000
A2904974	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125M,TC=T0	19701	5033ED20K00F
A2904975	307-0346-02		RES,FXD,FILM:1 OHM,0.1%	80009	307-0346-02
A2904976	321-0289-09		RES,FXD,FILM:10.0K OHM,1%,0.125M,TC=T9	19701	5033RE10K00F
A2904977	322-0481-07		RES,FXD,FILM:1M OHM,0.1%,0.25M,TC=T9	19701	5043RE1M0008
A2904978	323-0385-00		RES,FXD,FILM:100K OHM,1%,0.5M,TC=T0	75042	CECT0-1003F
A2904979	317-0101-00		RES,FXD,CMPN:100 OHM,5%,0.125M	01121	881015
A2904980	307-0662-00		RES,THERMAL:1K OHM,40%	50157	180010216
A2904980	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JED1K0
A2905010	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A2905011	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A2905012	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A2905013	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A2905014	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A2905015	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A2905016	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25M	57668	NTR25J-ED5K1
A2905017	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25M	57668	NTR25J-ED5K1
A2905020	321-0225-00		RES,FXD,FILM:2.15K OHM,1%,0.125M,TC=T0	19701	5033ED2K15F
A2905021	315-0152-00		RES,FXD,FILM:1.5K OHM,5%,0.25M	57668	NTR25J-E01K5
A2905030	315-0681-00		RES,FXD,FILM:680 OHM,5%,0.25M	57668	NTR25J-E680E
A2905032	315-0152-00		RES,FXD,FILM:1.5K OHM,5%,0.25M	57668	NTR25J-E01K5

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A29R5033	321-0318-00	B020000	B025924	RES,FXD,FILM:20.0K OHM,1%,0.125M,TC=T0 (2445 ONLY)	19701	5033E020K00F
A29R5033	321-0325-00	B025925		RES,FXD,FILM:23.7K OHM,1%,0.125M,TC=T0 (2445 ONLY)	07716	CEAD23701F
A29R5033	321-0318-00	B020000	B028679	RES,FXD,FILM:20.0K OHM,1%,0.125M,TC=T0 (2465 ONLY)	19701	5033E020K00F
A29R5033	321-0325-00	B028680		RES,FXD,FILM:23.7K OHM,1%,0.125M,TC=T0 (2465 ONLY)	07716	CEAD23701F
A29R5034	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125M,TC=T0	19701	5033E020K00F
A29R5035	315-0122-00			RES,FXD,FILM:1.2K OHM,5%,0.25M	57668	NTR25J-E01K2
A29R5036	321-0239-00			RES,FXD,FILM:3.01K OHM,1%,0.125M,TC=T0	19701	5043ED3K010F
A29R5039	321-0296-00			RES,FXD,FILM:11.8K OHM,1%,0.125M,TC=T0	07716	CEAD11801F
A29R5041	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25M	57668	NTR25J-E03K0
A29R5042	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25M	57668	NTR25J-E03K0
A29R5043	315-0152-00			RES,FXD,FILM:1.5K OHM,5%,0.25M	57668	NTR25J-E01K5
A29R5044	321-0753-06			RES,FXD,FILM:9K OHM,0.25%,0.125M,TC=T2	07716	CEAE90000C
A29R5045	321-0193-07			RES,FXD,FILM:1K OHM,0.1%,0.125M,TC=T9	19701	5033RE1K000B
A29R5047	321-0277-00			RES,FXD,FILM:7.50K OHM,1%,0.125M,TC=T0	24546	NA5507501F
A29R5048	315-0243-00			RES,FXD,FILM:24K OHM,5%,0.25M	57668	NTR25J-E24K0
A29R5049	315-0152-00			RES,FXD,FILM:1.5K OHM,5%,0.25M	57668	NTR25J-E01K5
A29R5054	325-0394-00			RES,FXD,FILM:4.95K OHM,1%,0.1M,T-13	19701	5023ZB 4K950F
A29R5055	325-0079-00			RES,FXD,FILM:1.8K OHM,1%,0.1M,TC-13	19701	5023ZB1K800F
A29R5056	325-0393-00			RES,FXD,FILM:200 OHM,1%,0.1M,T-13	19701	5023 ZB 200R0F
A29R5057	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A29R5058	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A29R5063	321-0753-06			RES,FXD,FILM:9K OHM,0.25%,0.125M,TC=T2	07716	CEAE90000C
A29R5064	321-0193-00			RES,FXD,FILM:1K OHM,1%,0.125M,TC=T0	19701	5033ED1K00F
A29R5066	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25M	57668	NTR25J-E05K1
A29R5070	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JED1K0
A29R5071	315-0155-00			RES,FXD,FILM:1.5M OHM,5%,0.25M	19701	5043CX1M500J
A29R5072	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25M	57668	NTR25J-E05K1
A29R5073	315-0563-00			RES,FXD,FILM:56K OHM,5%,0.25M	19701	5043CX56K00J
A29R5075	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A29R5080	325-0034-00			RES SET,MATCHED:1 EA,9M,900K,99K OHM,1% (FURN AS A SET M/R5081,R5082)	03888	ORDER BY DESC
A29R5081	-----			(FURN AS SET M/R5080,R5082)		
A29R5082	-----			(FURN AS SET M/R5080,R5081)		
A29R5083	322-0673-03			RES,FXD,FILM:500K OHM,0.25%,0.25M,TC=T2	75042	CCAT2-5003C
A29R5090	315-0510-00			RES,FXD,FILM:51 OHM,5%,0.25M	19701	5043CX51R00J
A29R5122	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25M	57668	NTR25J-E100K
A29R5124	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25M	57668	NTR25J-E100K
A29R5130	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A29R5131	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A29R5132	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JED1K0
A29R5133	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A29R5134	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JED1K0
A29R5150	321-0753-06			RES,FXD,FILM:9K OHM,0.25%,0.125M,TC=T2	07716	CEAE90000C
A29R5151	321-0193-07			RES,FXD,FILM:1K OHM,0.1%,0.125M,TC=T9	19701	5033RE1K000B
A29R5167	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A29R5168	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A29R5170	315-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.25M	57668	NTR25J-E1K8
A29R5171	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25M	57668	NTR25J-E05K1
A29R5172	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25M	57668	NTR25J-E05K1
A29R5173	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25M	57668	NTR25J-E03K9
A29R5174	315-0106-00			RES,FXD,FILM:10M OHM,5%,0.25M	80009	315-0106-00
A29R5176	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25M	57668	NTR25J-E06K8
A29R5177	321-0289-09			RES,FXD,FILM:10.0K OHM,1%,0.125M,TC=T9	19701	5033RE10K00F
A29R5180	307-0662-00			RES,THERMAL:1K OHM,40%	50157	180Q10216
A29R5181	324-0620-09			RES,FXD,FILM:990K OHM,1%,1M,TC=T9	80009	324-0620-09

Replaceable Electrical Parts  
2445/2465 Option 01 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A29R5182	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JE01K0
A29R5190	322-0673-03		RES,FXD,FILM:500K OHM,0.25%,0.25M,TC=T2	75042	CCAT2-5003C
A29R5191	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25M	19701	5043CX51R00J
A29R5210	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A29R5211	315-0331-00		RES,FXD,FILM:330 OHM,5%,0.25M	57668	NTR25J-E330E
A29R5212	307-0103-00		RES,FXD,CMPSN:2.7 OHM,5%,0.25M	01121	C82765
A29R5220	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A29R5222	315-0273-00		RES,FXD,FILM:27K OHM,5%,0.25M	57668	NTR25J-E27K0
A29R5223	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25M	57668	NTR25JE01K0
A29R5224	315-0151-00	8025925	RES,FXD,FILM:150 OHM,5%,0.25M (2445 ONLY)	57668	NTR25J-E150E
A29R5224	315-0151-00	8029680	RES,FXD,FILM:150 OHM,5%,0.25M (2465 ONLY)	57668	NTR25J-E150E
A29R5230	315-0510-00	8020000	8026449 RES,FXD,FILM:51 OHM,5%,0.25M (2445 ONLY)	19701	5043CX51R00J
A29R5230	315-0101-00	8026450	RES,FXD,FILM:100 OHM,5%,0.25M (2445 ONLY)	57668	NTR25J-E 100E
A29R5230	315-0510-00	8020000	8029524 RES,FXD,FILM:51 OHM,5%,0.25M (2465 ONLY)	19701	5043CX51R00J
A29R5230	315-0101-00	8029525	RES,FXD,FILM:100 OHM,5%,0.25M (2465 ONLY)	57668	NTR25J-E 100E
A29R5231	315-0511-00		RES,FXD,FILM:510 OHM,5%,0.25M	19701	5043CX510R0J
A29R5232	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25M	19701	5043CX51R00J
A29R5233	315-0102-00	8026657	RES,FXD,FILM:1K OHM,5%,0.25M (2445 ONLY)	57668	NTR25JE01K0
A29R5233	315-0102-00	8029863	RES,FXD,FILM:1K OHM,5%,0.25M (2465 ONLY)	57668	NTR25JE01K0
A29R5251	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A29R5252	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A29R5270	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25M	19701	5043CX10K00J
A29R5271	315-0511-00		RES,FXD,FILM:510 OHM,5%,0.25M	19701	5043CX510R0J
A29T5210	120-1494-00		TRANSFORMER,PMR:ISOLATION HF,POT CORE	80009	120-1494-00
A29T5230	120-1533-00		XFMR,ISOLATION:2KV,1:1 RATIO,DUAL SIGNAL	TK1601	63920
A29TP4910	131-0608-00		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A29TP4960	131-0608-00		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A29TP4980	131-0608-00		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A29TP5140	131-0608-00		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A29TP5210	131-0608-00		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A29TP5270	131-0608-00		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A29TP5271	131-0608-00		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A29TP5290	131-0608-00		TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
A29U4920	156-0383-02		MICROCKT,DGTL:QUAD 2-IMP NOR GATE,SCRN	18324	N74LS02NB
A29U4930	156-0422-02		MICROCKT,DGTL:UP/DOWN SYN BINARY CNTR,SCRN	18324	N74LS191NB
A29U4932	156-1611-00		MICROCKT,DGTL:DUAL 0 TYPE EDGE-TRIGGERED FF	07263	74F74(PC OR DC)
A29U4940	156-0796-00		MICROCKT,DGTL:8 STG SHF & STORE BUS RGTR	02735	C040948F
A29U4942	156-0515-02		MICROCKT,DGTL:TRIPLE 3-CHAN MUX,SEL	80009	156-0515-02
A29U4944	156-0048-00		MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046
A29U4950	156-1850-00		MICROCKT,LINEAR:CMOS,QUAD SPST ANALOG SM	17856	50621107
A29U4960	156-1978-01		MICROCKT,LINEAR:OP AMP,LOW BIAS CURRENT	80009	156-1978-01
A29U4970	156-1838-01		MICROCKT,LINEAR:OPERATIONAL AMPLIFIER	80009	156-1838-01
A29U5010	156-1225-00		MICROCKT,LINEAR:DUAL COMPARATOR	01295	LM393P
A29U5020	156-0513-00		MICROCKT,LINEAR:CMOS,8-CHANNEL MUX	04713	MC140518CL
A29U5030	156-1191-01		MICROCKT,LINEAR:DUAL BI-FET OP-AMP,8 DIP	80009	156-1191-01
A29U5040	156-0854-00		MICROCKT,LINEAR:OPNL AMPL	27014	LM308AN
A29U5050	156-0783-00		MICROCKT,LINEAR:PRECISION VOLTAGE REFERENCE	27014	LM399
A29U5060	156-1191-01		MICROCKT,LINEAR:DUAL BI-FET OP-AMP,8 DIP	80009	156-1191-01
A29U5110	156-1207-00		MICROCKT,LINEAR:VOLTAGE REGULATOR,-12 V	04713	MC79L12ACG
A29U5112	156-1160-00		MICROCKT,LINEAR:VOLTAGE REGULATOR	04713	MC78L12ACG
A29U5120	156-0796-00		MICROCKT,DGTL:8 STG SHF & STORE BUS RGTR	02735	C040948F
A29U5122	156-0796-00		MICROCKT,DGTL:8 STG SHF & STORE BUS RGTR	02735	C040948F

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A29U5124	156-0934-00			MICROCKT,DGTL:DUAL LINE RCVR	01295	SN75152
A29U5130	156-0745-01			MICROCKT,DGTL:HEX INVERTER,BURN-IN	02735	CD4069UBFX
A29U5132	156-1245-00			MICROCKT,LINER:7 XSTR,HV/HIGH CUR,SCREENED	01295	ULN2003AN-P3
A29U5140	156-1457-01			MICROCKT,LINER:TRUE RMS TO DC CONVERTER,	24355	AD41134
A29U5150	156-1850-00			MICROCKT,LINER:CMOS,QUAD SPST ANALOG SW	17856	SDG21107
A29U5151	156-1191-01			MICROCKT,LINER:DUAL BI-FET OP-AMP,8 DIP	80009	156-1191-01
A29U5170	156-0130-00			MICROCKT,LINER:MODULATOR/DEMULATOR	80009	156-0130-00
A29U5222	156-0388-03			MICROCKT,DGTL:DUAL D FLIP-FLOP,SCRN	01295	SN74LS74ANP3
A29U5224	156-0844-02			MICROCKT,DGTL:SYN 4 BIT CNTR,SCRN	01295	SN74LS161A(NP3)
A29U5230	156-0302-02			MICROCKT,DGTL:DUAL 2-INP NAND DRVR,SCRN	01295	SN75452PP3
A29U5231	156-0895-01			MICROCKT,DGTL:14 BIT BINARY COUNTER,BURN-IN	02735	CD4020BFX
A29U5232	156-0386-02			MICROCKT,DGTL:TRIPLE 3-INP NAND GATE,SCRN	07263	74LS10PCQR
A29U5240	156-0789-02			MICROCKT,DGTL:8 BIT SR,PRL LOAD,SCREENED	01295	SN74LS165JP3
A29U5241	156-0469-02			MICROCKT,DGTL:3/8 LINE DCDR,SCRN	01295	SN74LS138NP3
A29U5242	156-0480-02			MICROCKT,DGTL:QUAD 2-INP & GATE,SCRN,	01295	SN74LS08NP3
A29U5250	156-0465-02			MICROCKT,DGTL:8-INP NAND GATE,SCRN	01295	SN74LS30NP3
A29U5251	156-0388-03			MICROCKT,DGTL:DUAL D FLIP-FLOP,SCRN	01295	SN74LS74ANP3
A29U5252	156-0385-02			MICROCKT,DGTL:HEX INVERTER,SCRN	07263	74LS04PCQR
A29U5260	156-0852-02			MICROCKT,DGTL:LSTTL,HEX DRVR M/3 STATE OUT	01295	SN74LS367NP3
A29U5270	156-0385-02			MICROCKT,DGTL:HEX INVERTER,SCRN	07263	74LS04PCQR
A29U5271	156-0479-02			MICROCKT,DGTL:QUAD 2-INP OR GATE,SCRN	01295	SN74LS32NP3
A29U5272	156-1426-00			MICROCKT,DGTL:NMOS,PROGRAMMABLE TIMER MDL	04713	MC68840 (L OR P)
A29U5273	156-0388-03			MICROCKT,DGTL:DUAL D FLIP-FLOP,SCRN	01295	SN74LS74ANP3
A29U5274	156-1172-01			MICROCKT,DGTL:DUAL 4 BIT BIN CNTR,SCRN	01295	SN74LS393NP3
A29U5280	160-2161-00	B020000	B025924	MICROCKT,DGTL:16384 X 8 EPROM M/3 STATE OUT (2445 ONLY)	80009	160-2161-00
A29U5280	160-2161-01	B025925	B026449	MICROCKT,DGTL:16384 X 8 EPROM M/3 STATE (NO LONGER PART OF A29 ASSEMBLY) (2445 ONLY)	80009	160-2161-01
A29U5280	160-2161-00	B020000	B028679	MICROCKT,DGTL:16384 X 8 EPROM M/3 STATE OUT (2465 ONLY)	80009	160-2161-00
A29U5280	160-2161-01	B028680	B029524	MICROCKT,DGTL:16384 X 8 EPROM M/3 STATE (NO LONGER PART OF A29 ASSEMBLY) (2465 ONLY)	80009	160-2161-01
A29U5281	160-1902-00	B020000	B025924	MICROCKT,DGTL:16384 X 8 EPROM,PRGM (2445 ONLY)	80009	160-1902-00
A29U5281	160-1902-01	B025925	B026449	MICROCKT,DGTL:16384 X 8 EPROM,PRGM (NO LONGER PART OF A29 ASSEMBLY) (2445 ONLY)	80009	160-1902-01
A29U5281	160-3299-02	B026450		MICROCKT,DGTL:32768 X 8 EPROM,PRGM (2445 ONLY)	80009	160-3299-02
A29U5281	160-1902-00	B020000	B028679	MICROCKT,DGTL:16384 X 8 EPROM,PRGM (2465 ONLY)	80009	160-1902-00
A29U5281	160-1902-01	B028680	B029524	MICROCKT,DGTL:16384 X 8 EPROM,PRGM (NO LONGER PART OF A29 ASSEMBLY) (2465 ONLY)	80009	160-1902-01
A29U5281	160-3299-02	B029525		MICROCKT,DGTL:32768 X 8 EPROM,PRGM (2465 ONLY)	80009	160-3299-02
A29U5282	156-1111-02			MICROCKT,DGTL:OCT BUS XCVRS M/3 ST OUT	01295	SN74LS245N3
A29VR5010	152-0127-00	B020000	B027939	SEMICONDCVC,DI:ZEN,S1,7.5V,5%,0.4M,DO-7	14433	Z5347 (1N9588)
A29VR5010	152-0175-00	B027940		SEMICONDCVC,DI:ZEN,S1,5.6V,5%,0.4M,DO-7 (2445 ONLY)	14552	T03810976
A29VR5010	152-0127-00	B020000	B031920	SEMICONDCVC,DI:ZEN,S1,7.5V,5%,0.4M,DO-7	14433	Z5347 (1N9588)
A29VR5010	152-0175-00	B031921		SEMICONDCVC,DI:ZEN,S1,5.6V,5%,0.4M,DO-7 (2465 ONLY)	14552	T03810976
A29VR5020	152-0227-00	B020000	B025924	SEMICONDCVC,DI:ZEN,S1,6.2V,5%,0.4M,DO-7 (2445 ONLY)	04713	S213903
A29VR5020	152-0760-00	B025925		SEMICONDCVC,DI:ZEN,S1,6.2V,2%,400MM.DO-35 (2445 ONLY)	04713	S2G30205
A29VR5020	152-0227-00	B020000	B028679	SEMICONDCVC,DI:ZEN,S1,6.2V,5%,0.4M,DO-7 (2465 ONLY)	04713	S213903
A29VR5020	152-0760-00	B028680		SEMICONDCVC,DI:ZEN,S1,6.2V,2%,400MM.DO-35 (2465 ONLY)	04713	S2G30205

Replaceable Electrical Parts  
2445/2465 Option 01 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A29VR5031	152-0662-00		SEMICOND DVC,DI:ZEN,SI,5V,1%,400MM,00-7	04713	SZG195RL
A29VR5160	152-0217-00		SEMICOND DVC,DI:ZEN,SI,8.2V,5%,0.4M,00-7	04713	SZG20
A29VR5162	152-0217-00		SEMICOND DVC,DI:ZEN,SI,8.2V,5%,0.4M,00-7	04713	SZG20
A29VR5210	152-0246-00		SEMICOND DVC,DI:SM,SI,40V,200MA,00-7	14433	MG1537TK
A29M4980	195-0964-00		LEAD,ELECTRICAL:26 AWG,2.0 L,9-1	80009	195-0964-00
A29M5070	131-0566-00		BUS,COND:DUMMY RES,0.094 00 X 0.225 L	24546	OMA 07
A29M5075	195-1259-00		LEAD,ELECTRICAL:26 AWG,1.5 L,9-4	80009	195-1259-00
A29M5080	195-1259-00		LEAD,ELECTRICAL:26 AWG,1.5 L,9-4	80009	195-1259-00
A29M5085	195-1259-00		LEAD,ELECTRICAL:26 AWG,1.5 L,9-4	80009	195-1259-00
A29M5260	131-0566-00		BUS,COND:DUMMY RES,0.094 00 X 0.225 L	24546	OMA 07
A29Y4910	158-0261-00		XTAL UNIT,QTZ:3.579MHZ,01%	33096	CCAT101773HC18
A30	670-7894-00		CIRCUIT BO ASSY:FRONT PANEL	80009	670-7894-00
A30C4310	283-0421-00		CAP,FXD,CER DI:0.1UF,+80-20%,50V	04222	M0015C104MAA
A30LS4330	119-1427-00		XDCR,AUDIO:6V,30MA,1-4.2KHZ	TK1066	QMB-06 (SEALED)
A30P4300	131-0589-00		TERM,PIN:0.46L X 0.025 SQ BRZ GLD PL (QUANTITY OF 2)	22526	48283-029
A30R4320	307-0542-00		RES NTMK,FXD,FI:(5)10K OHM,5%,0.125M	01121	106A1030R706A103
A30S4302	260-2171-00		SWITCH,PUSH:3 BUTTON,1 POLE,RANGE	59821	ORDER BY DESCR
A30S4303	260-2170-00		SWITCH,PUSH:5 BUTTON,1 POLE,INPUT SEL	59821	ORDER BY DESCR
A30S4304	260-2088-00		SWITCH,PUSH:1 BTN,1 POLE,TRIGGER	59821	ORDER BY DESCR
A30S4305	260-2088-00		SWITCH,PUSH:1 BTN,1 POLE,TRIGGER	59821	ORDER BY DESCR
A30S4306	260-2171-00		SWITCH,PUSH:3 BUTTON,1 POLE,RANGE	59821	ORDER BY DESCR
A30M4300	156-1080-01		MICROCKT,DGTL:HEX BUFFERS W/OC HV OUT,SCRN	01295	SN7407NP3
A30M4310	156-0541-02		MICROCKT,DGTL:DUAL 2-TO 4-LINE DCOR/DEMUX	04713	SN74LS139MOS
A30M4320	156-1220-01		MICROCKT,DGTL:HEX BUS DRIVER,SCREENED	01295	SN74LS365NP3



# 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.

## 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.

## 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.**

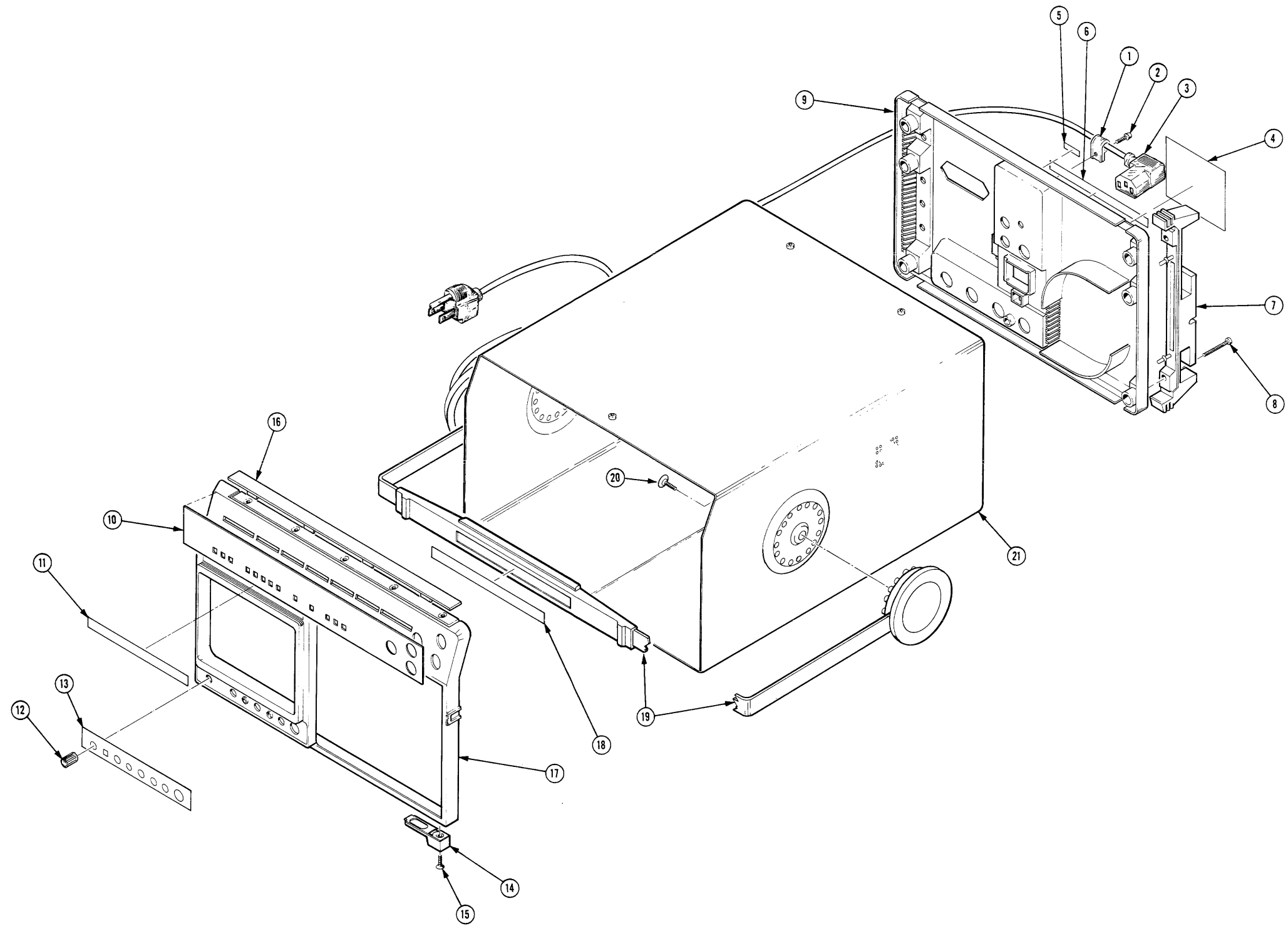
## ABBREVIATIONS

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

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
01536	TEXTRON INC CAMCAR DIV SEMS PRODUCTS UNIT	1818 CHRISTINA ST	ROCKFORD IL 61108
06915	RICHCO PLASTIC CO	5825 N TRIPP AVE	CHICAGO IL 60646
09922	BURNBY CORP	RICHARDS AVE	NORMAL CT 06852
16428	BELDEN CORP ELECTRONIC DIV	2200 US HWY 27 SOUTH P O BOX 1980	RICHMOND IN 47374
24931	SPECIALTY CONNECTOR CO INC	2620 ENDRESS PLACE P O BOX 0	GREENWOOD IN 46142
54583	TKX ELECTRONICS CORP	755 EASTGATE BLVD	GARDEN CITY NY 11530
71400	MCGRAM-EDISON CO BUSSMANN MFG DIV	502 EARTH CITY PLAZA P O BOX 14460	ST LOUIS MO 63178
73743	FISCHER SPECIAL MFG CO	446 MORGAN ST	CINCINNATI OH 45206
77900	SHAKEPROOF DIV OF ILLINOIS TOOL WORKS	SAINT CHARLES RD	ELGIN IL 60120
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIVISION	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	4900 S W GRIFFITH DR P O BOX 500	BEAVERTON OR 97077
83385	MICRODOT MANUFACTURING INC GREER-CENTRAL DIV	3221 N BIG BEAVER RD	TROY MI 48098
83486	ELCO INDUSTRIES INC	1101 SAMUELSON RD	ROCKFORD IL 61101
85480	BRADY M H CO	727 W GLENDALE AVE	MILWAUKEE WI 53209
86928	SEASTROM MFG CO INC	701 SONORA AVE	GLENDALE CA 91201
88245	LITTON SYSTEMS INC USECO DIV	13536 SATICOY ST	VAN NUYS CA 91409
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61101
93629	SCHURTER AG H C/O PANEL COMPONENTS CORP	2015 SECOND STREET	BERKELEY CA 94170
TK0433	PORTLAND SCREM CO	6520 N BASIN	PORTLAND OR 97217
TK0435	LEMIS SCREM CO	4114 S PEORIA	CHICAGO IL 60609
TK0861	H SCHURTER AG DIST PANEL COMPONENTS	2015 SECOND STREET	BERKELEY CA 94170
TK1154	COMPLEX TOOLING INC	4635 NAUTILUS COURT SOUTH	BOULDER CO 80301

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No.		Qty	12345	Name & Description	Mfr.	
		Effective	Dscont				Code	Mfr. Part No.
1-	200-2275-00			1		COVER, REAR:	80009	200-2275-00
-1	343-0003-00			1		CLAMP, LOOP:0.25 ID, PLASTIC ATTACHING PARTS	06915	E4 CLEAR ROUND
-2	211-0691-00			1		SCREW, MACHINE:6-32 X 0.625, PMH, STL END ATTACHING PARTS	83486	ORDER BY DESCR
-3	161-0104-00			1		CABLE ASSY, PMR,:3 WIRE, 98.0 L, W/RTANG CONN (OPTIONAL VERSIONS LISTED ON ACCESS PAGE)	16428	CH8352, FH-8352
-4	334-4377-04			1		MARKER, IDENT:MKD CAUTION	80009	334-4377-04
-5	334-4379-00			1		MARKER, IDENT:MKD PROBE POWER	80009	334-4379-00
-6	334-4381-00			1		MARKER, IDENT:MKD CONNECTOR IDENT	80009	334-4381-00
-7	348-0780-00			2		FOOT, CAB:M/CORD MRAP, REAR, BLK POLYURETHANE ATTACHING PARTS	80009	348-0780-00
-8	212-0154-00			4		SCREW, MACHINE:8-32 X 1.125, PMH, STL END ATTACHING PARTS	83385	ORDER BY DESCR
-9	200-2685-00			1		COVER, REAR: (BMC HOLE PUNCHED OUT WHEN OPT.10 PRESENT) ATTACHING PARTS	80009	200-2685-00
	211-0691-00			2		SCREW, MACHINE:6-32 X 0.625, PMH, STL END ATTACHING PARTS	83486	ORDER BY DESCR
-10	333-2995-00			1		PANEL, FRONT:	80009	333-2995-00
-11	334-4658-00			1		MARKER, IDENT:MKD TEKTRONIX	80009	334-4658-00
-12	366-2041-01			4		KNOB:GY, BAR, 0.172 ID X 0.41 OD X 0.496 H	80009	366-2041-01
	366-2036-00			1		PUSH BUTTON:GY, 0.206 SQ, 1.445 H	80009	366-2036-00
-13	333-2877-00			1		PANEL, FRONT:CRT	80009	333-2877-00
-14	348-0740-00			2		FOOT, CABINET:BOTTOM FRONT, PLASTIC ATTACHING PARTS	80009	348-0740-00
-15	211-0711-00			2		SCR, ASSEM MSHR:6-32 X 0.25, PMH, STL, T15 END ATTACHING PARTS	01536	ORDER BY DESCR
-16	200-2779-00			1		COVER, TOP:TRIM	80009	200-2779-00
-16.1	361-1340-00	8026328		1		SHIM:0.025 THK X 11.250 L X 0.5000, AL (2445 ONLY)	80009	361-1340-00
	361-1340-00	8028990		1		SHIM:0.025 THK X 11.250 L X 0.5000, AL (2465 ONLY)	80009	361-1340-00
-17	101-0095-00			1		TRIM, DECORATIVE:FRONT ATTACHING PARTS	80009	101-0095-00
	211-0718-00			10		SCREW, MACHINE:6-32 X 0.312, FLH, 100 DEG, STL END ATTACHING PARTS	83486	ORDER BY DESCR
-18	334-4659-00			1		MARKER, IDENT:MKD TEKTRONIX 2445	80009	334-4659-00
-19	367-0303-04			1		HANDLE, CARRYING:12.86 L, GRIP & INDEX ATTACHING PARTS	80009	367-0303-04
-20	212-0144-00			2		SCREW, TPG, TF:8-16 X 0.562 L, PLASTITE, SPCL END ATTACHING PARTS	93907	225-38131-012
-21	437-0309-00			1		CABINET, SCOPE:	80009	437-0309-00
	348-0764-02	8020000	8026099	1		SHLD GSKT, ELEK:0.235 X 0.094, MIRE MESH, 2 (2445 ONLY)	80009	348-0764-02
	348-0764-04	8026100		1		SHLD GSKT, ELEK:0.125 X 0.188, MIRE MESH (2445 ONLY)	80009	348-0764-04
	348-0764-02	8020000	8028799	1		SHLD GSKT, ELEK:0.235 X 0.094, MIRE MESH, 2 (2465 ONLY)	80009	348-0764-02
	348-0764-04	8028800		1		SHLD GSKT, ELEK:0.125 X 0.188, MIRE MESH (2465 ONLY)	80009	348-0764-04



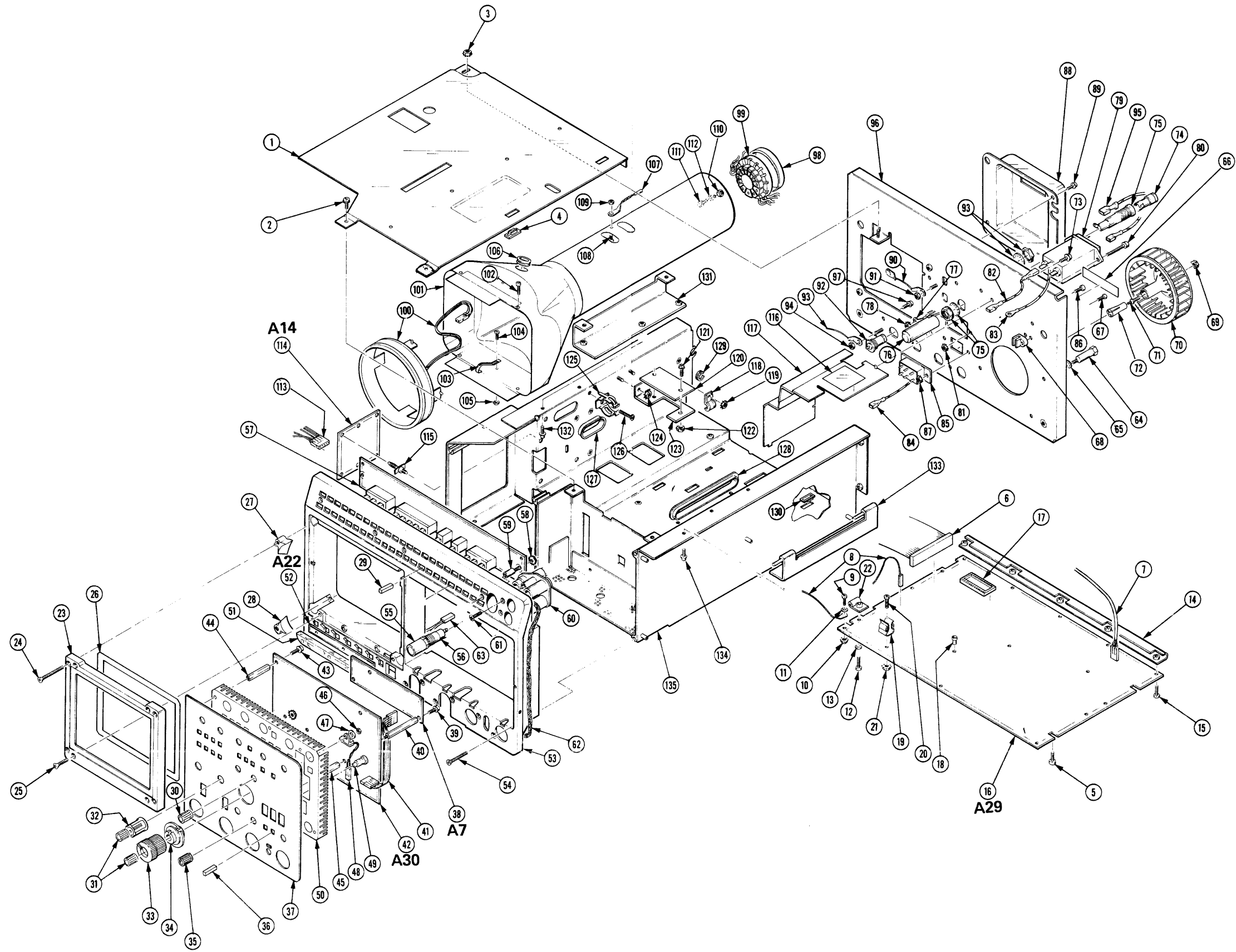




Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-1	407-1473-00			1	BRACKET,SUPPORT:CKT BD,ALUMINUM ATTACHING PARTS	80009	407-1473-00
-2	211-0711-00			4	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,T15	01536	ORDER BY DESC
-3	210-0457-00			4	NUT,PL,ASSEM MA:6-32 X 0.312,STL CD PL END ATTACHING PARTS	78189	511-061800-00
-4	343-1012-00			1	RETAINER,CKT BD:POLYCARBONATE	80009	343-1012-00
-5	211-0304-00			2	SCR,ASSEM WSHR:4-40X0.312,PNH,STL,T9 TORX	01536	ORDER BY DESC
-6	175-8324-00			1	CA ASSY,SP,ELEC:40,36 AWG,4.0 L,RIBBON	80009	175-8324-00
-7	175-8323-00			1	CA ASSY,SP,ELEC:3,26 AWG,13.0 L,9-N	80009	175-8323-00
-8	196-2924-00			1	LEAD ASSY,ELEC:2,24 AWG,5.5 L,9-1/9-2 (OWN BD TO HVPS TO FRONT PANEL FUSE HOLDER) ATTACHING PARTS	80009	196-2924-00
-9	211-0304-00			1	SCR,ASSEM WSHR:4-40X0.312,PNH,STL,T9 TORX	01536	ORDER BY DESC
-10	210-0586-00			1	NUT,PL,ASSEM MA:4-40 X 0.25,STL CD PL	78189	211-041800-00
-11	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,STL END ATTACHING PARTS	77900	1214-05-00-0541C
-12	211-0711-00			2	SCR,ASSEM WSHR:6-32 X 0.25,PNH,STL,T15	01536	ORDER BY DESC
-13	-----			2	(CALLED OUT IN ERROR-PART OF 211-0711-00)		
-14	407-3092-00			1	BRKT,CMPNT MTG:OWN ATTACHING PARTS	80009	407-3092-00
-15	211-0304-00			5	SCR,ASSEM WSHR:4-40X0.312,PNH,STL,T9 TORX END ATTACHING PARTS	01536	ORDER BY DESC
-16	-----			1	CKT BD ASSY:OGTL MULTIMETER(SEE A29 REPL)		
-17	136-0755-00	8020000	8026449	2	.SKT,PL-IN ELEK:MICROCIRCUIT,28 DIP (2445 ONLY)	09922	01L828P-108
	136-0755-00	8026450		1	.SKT,PL-IN ELEK:MICROCIRCUIT,28 DIP (2445 ONLY)	09922	01L828P-108
	136-0755-00	8020000	8029524	2	.SKT,PL-IN ELEK:MICROCIRCUIT,28 DIP (2465 ONLY)	09922	01L828P-108
	136-0755-00	8029525		1	.SKT,PL-IN ELEK:MICROCIRCUIT,28 DIP (2465 ONLY)	09922	01L828P-108
-18	358-0136-00			18	.INSULATOR,BSHG:0.075 ID X 0.203 OD X 0.075	88245	429971
-19	344-0356-00			2	.CLIP,ELECTRICAL:FUSE,BRONZE,ALBALDY PL ATTACHING PARTS	71400	5960-63
-20	211-0722-00			2	.SCREW,MACHINE:6-32 X 0.25,PNH,STL	01536	ORDER BY DESC
-21	210-0457-00			2	.NUT,PL,ASSEM MA:6-32 X 0.312,STL CD PL END ATTACHING PARTS	78189	511-061800-00
	361-1270-00			5	.SPACER,RELAY:PLASTIC	80009	361-1270-00
-22	214-3492-00			2	HINGE HALF:OWN,ALUMINUM	80009	214-3492-00
-23	426-1864-00			1	FRAME,CRT: ATTACHING PARTS	80009	426-1864-00
-24	211-0713-00			4	SCREW,MACHINE:6-32 X 1.25,FLH,100 DEG,STL	83385	ORDER BY DESC
-25	213-0194-00			4	THUMBSCREW:0.25-36 X 0.203,0.312 OD HD,BRS	80009	213-0194-00
-26	348-0731-00			1	GASKET:CRT,POLYCARBONATE	80009	348-0731-00
	337-2926-00			1	SHLD,IMPLOSION:4.33 X 3.56 X 0.06,CLEAR	80009	337-2926-00
-27	343-0993-00			2	RETAINER,CRT:LEFT,PLASTIC (UPPER LEFT/LOWER RT/BLACK)	80009	343-0993-00
-28	343-0992-00			2	RETAINER,CRT:RIGHT,PLASTIC (UPPER RT/LOWER LEFT/NATURAL)	80009	343-0992-00
-29	366-2013-02			13	PUSH BUTTON:IVORY GRAY,0.186 SQ X 0.48 H	80009	366-2013-02
-30	366-1833-00			3	KNOB:GRAY,0.25 ID X 0.392 OD X 0.466 H	80009	366-1833-00
-31	366-2145-01			3	KNOB:DOVE GRAY,TIME/OIV,0.08X0.392X0.466	80009	366-2145-01
-32	366-2038-00			2	KNOB:GY,0.25 ID X 0.706 OD X 0.6H	80009	366-2038-00
-33	366-2039-01			1	KNOB:GY,8 SNEEP	80009	366-2039-01
-34	366-2040-00			1	KNOB:CLEAR,A SNEEP,0.252 ID X 1.12 OD	80009	366-2040-00
-35	366-2041-03			7	KNOB:DOVE GRAY,BAR,0.172X0.41X0.496	80009	366-2041-03
-36	366-2017-00			16	PUSH BUTTON:0.18 SQ X 0.644 H,IVORY GY	TK1154	ORDER BY DESC
-37	333-2915-01			1	PANEL,FRONT: ATTACHING PARTS	80009	333-2915-01
-38	-----			1	CKT BD ASSY:FRONT PANEL VAR(SEE A7 REPL) (STANDARD MANUAL) ATTACHING PARTS		
-39	211-0304-00			3	SCR,ASSEM WSHR:4-40X0.312,PNH,STL,T9 TORX END ATTACHING PARTS	01536	ORDER BY DESC
-40	129-0941-00			2	SPCR,POST:1.86 L,4-40 INT/EXT,STL,0.188 HEX	80009	129-0941-00
-41	175-4597-00			1	CA ASSY,SP,ELEC:5,26 AWG,4.0 L,RIBBON	80009	175-4597-00
-42	-----			1	CKT BD ASSY:FRONT PANEL(SEE A6 REPL) (STANDARD MANUAL)		

Replaceable Mechanical Parts  
2445/2465 Option 01 Service

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont		Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
2-						ATTACHING PARTS		
-43	211-0304-00			5		SCR,ASSEM MSHR:4-40X0.312,PNH,STL,T9 TORX END ATTACHING PARTS	01536	ORDER BY DESCR
-44	129-0938-00			5		SPCR,POST:1.102 L,4-40 EA END,AL,0.188 HEX	80009	129-0938-00
-45	129-0978-00			2		SPACER,POST:0.375-32,AL,0.5 HEX	80009	129-0978-00
-46	220-0495-00			2		NUT,PLAIN,HEX:0.375-32 X 0.438,BRS,CD PL	73743	ORDER BY DESCR
-47	210-0012-00			3		WASHER,LOCK:0.384 ID,INTL,0.022 THK,STL	77900	1220-02-00-0541C
-48	-----			1		SWITCH,PUSH:SPST,0.1A,125VAC (SEE CHASSIS S3185 REPL)(STANDARD INST)		
-49	377-0550-00			10		INSERT,KNOB:0.178 ID X 0.640 THK,	80009	377-0550-00
-50	354-0632-01			1		RING,MOUNTING:5.41 X 4.18,BRASS	80009	354-0632-01
-51	378-0204-00			1		REFLECTOR,LIGHT:INT SCALE ILLUMINATION	80009	378-0204-00
	361-1317-00			3		SPACER,SLEEVE:0.375 L X 0.085 ID,PVC BLK (USED ONLY WHEN OPT.01 & OPT.10 ARE COMBINE)	80009	361-1317-00
-52	-----			1		CKT BD ASSY:LED (SEE A22 REPL)		
	361-1317-00	8026200		3		.SPACER,SLEEVE:0.375 L X 0.085 ID,PVC BLK (2445 ONLY)	80009	361-1317-00
	361-1317-00	8028460		3		.SPACER,SLEEVE:0.375 L X 0.085 ID,PVC BLK (2465 ONLY)	80009	361-1317-00
-53	386-5133-00			1		SUBPANEL,FRONT:	80009	386-5133-00
						ATTACHING PARTS		
-54	213-0914-00			2		SCREW,TPG,TR:6-32 X 0.75,FLH,100 DEG,STL END ATTACHING PARTS	83385	ORDER BY DESCR
-55	200-2264-00	8010100	8029322	1		CAP,FUSEHOLDER:3AG FUSES (2445 ONLY)	53629	FEK 031 1666
	200-2264-00	8010100	8041832	1		CAP,FUSEHOLDER:3AG FUSES (2465 ONLY)	53629	FEK 031 1666
-56	204-0833-00	8010100	8029322	1		BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES	TK0861	031 1653 (FEU)
	352-0765-01	8029323		1		FUSEHOLDER:3AG,PNL MT (2445 ONLY)	80009	352-0765-01
	204-0833-00	8010100	8041832	1		BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES	TK0861	031 1653 (FEU)
	352-0765-01	8041833		1		FUSEHOLDER:3AG,PNL MT (2465 ONLY)	80009	352-0765-01
-57	-----			1		CKT BD ASSY:FRONT PANEL(EXTENDED) (SEE A30 REPL)		
						ATTACHING PARTS		
-58	210-0457-00			3		NUT,PL,ASSEM MA:6-32 X 0.312,STL CD PL END ATTACHING PARTS	78189	511-061800-00
-59	361-1273-00			3		SPACER,CKT BD:M/POST SPACER	80009	361-1273-00
-60	352-0691-01			1		HOLDER,CONN:POLYCARBONATE	80009	352-0691-01
-61	213-0914-00			2		SCREW,TPG,TR:6-32 X 0.75,FLH,100 DEG,STL END ATTACHING PARTS	83385	ORDER BY DESCR
	136-0765-00			2		JACK,TIP:BANANA	80009	136-0765-00
	210-0202-00			2		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TIN PL ATTACHING PARTS	86928	A-373-158-2
	211-0304-00			2		SCR,ASSEM MSHR:4-40X0.312,PNH,STL,T9 TORX END ATTACHING PARTS	01536	ORDER BY DESCR
	196-1577-01			1		LEAD,ELECTRICAL:24 AWG,3.0 L,9-1 (FROM OHM BD)	80009	196-1577-01
-62	348-0792-02			1		GASKET:ELECTRICAL SHIELD,37.0 L	80009	348-0792-02
-63	175-8730-00			1		CA ASSY,SP,ELEC:2,26 AWG,7.5 L	80009	175-8730-00
-64	361-1188-00			1		SPACER,POST:1.15 L,4-40 THD ONE END,STL	80009	361-1188-00
-65	210-0994-00			1		WASHER,FLAT:0.125 ID X 0.022 X 0.25 OD	86928	A371-283-20
-66	334-4865-00			1		MARKER,IDENT:MKD FAN,CAUTION	80009	334-4865-00
-67	211-0304-00			2		SCR,ASSEM MSHR:4-40X0.312,PNH,STL,T9 TORX	01536	ORDER BY DESCR
-68	386-4863-00			1		SUPPORT,CKT BD:	80009	386-4863-00
-69	220-0555-00			1		NUT,PLAIN,HEX:8-32 X 0.25 HEX,STL CD PL	TK0433	ORDER BY DESCR
-70	369-0043-01			1		IMPLR,FAN ASSY:2.8 DIA,0.25 DIA SHAFT,POLY	80009	369-0043-01
-71	355-0192-00			1		STUD,SHLDR&STEP:4-40/8-32 THD EA END,0.5 L, SST	80009	355-0192-00
-72	343-1040-01			1		COLLAR,FAN MT:POLYWIDE	80009	343-1040-01
-73	211-0711-00			1		SCR,ASSEM MSHR:6-32 X 0.25,PNH,STL,T15	01536	ORDER BY DESCR
-74	200-2264-00			1		CAP,FUSEHOLDER:3AG FUSES	53629	FEK 031 1666
-75	204-0833-00	8020000	8020099	1		BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES	TK0861	031 1653 (FEU)
	352-0765-00	8020100	8026475	1		FUSEHOLDER:3AG,PANEL MOUNT (2445 ONLY)	71400	HFH-1



Fig. & Index No.	Tektronix Part No.	Serial/Assembly No.		Qty	12345	Name & Description	Mfr.	
		Effective	Dscont				Code	Mfr. Part No.
2-	204-0833-00	8026476		1		BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES (2445 ONLY)	TK0861	031 1653 (FEU)
	352-0765-00	8020100	8029599	1		FUSEHOLDER:3AG,PANEL MOUNT (2465 ONLY)	71400	HFH-1
	204-0833-00	8029600		1		BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES (2465 ONLY)	TK0861	031 1653 (FEU)
-76	200-2265-00			1		CAP,FUSEHOLDER:5 X 20MM FUSES	TK0861	FEK 031.1663
-77	195-3984-00			1		LEAD,ELECTRICAL:22 AWG,4.0 L,8-01 ATTACHING PARTS	80009	195-3984-00
-78	210-0457-00			1		NUT,PL,ASSEM MA:6-32 X 0.312,STL CD PL END ATTACHING PARTS	78189	511-061800-00
-79	119-1536-00			1		FILTER,RFI:3A,250VAC,50/60HZ ATTACHING PARTS	54583	ZU82203-00
-80	211-0332-00			2		SCR,ASSEM MSHR:4-40 X 0.5,PNH,STL,TORX T9	01536	ORDER BY DESCR
-81	210-0586-00			2		NUT,PL,ASSEM MA:4-40 X 0.25,STL CD PL END ATTACHING PARTS	78189	211-041800-00
-82	195-3989-00			1		LEAD,ELECTRICAL:18 AWG,4.0 L,8-9	80009	195-3989-00
-83	195-3990-00			1		LEAD,ELECTRICAL:18 AWG,4.5 L,5-4	80009	195-3990-00
-84	195-3987-00			1		LEAD,ELECTRICAL:22 AWG,4.0 L,8-19	80009	195-3987-00
-85	-----			1		LEAD,ELECTRICAL:22 AWG,4.0 L,8-29	80009	195-3988-00
				1		SWITCH,SLIDE:OPDT: (SEE CHASSIS S90 REPL)(STANDARD MANUAL) ATTACHING PARTS		
-86	211-0304-00			2		SCR,ASSEM MSHR:4-40X0.312,PNH,STL,T9 TORX	01536	ORDER BY DESCR
-87	210-0586-00			2		NUT,PL,ASSEM MA:4-40 X 0.25,STL CD PL END ATTACHING PARTS	78189	211-041800-00
	334-0260-00			1		MARKER,IDENT:MKD CAUTION	80009	334-0260-00
-88	200-2686-00			1		COVER,REAR:CRT ATTACHING PARTS	80009	200-2686-00
-89	211-0718-00			4		SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL END ATTACHING PARTS	83486	ORDER BY DESCR
-90	195-8410-00			1		LEAD,ELECTRICAL:22 AWG,1.65 L (GROUND FROM REAR PLATE TO CRT SHIELD) ATTACHING PARTS	80009	195-8410-00
-91	210-0551-00			1		NUT,PLAIN,HEX:4-40 X 0.25,ST CD PL END ATTACHING PARTS	TK0435	ORDER BY DESCR
-92	131-1910-01			4		CONN,RCPT,ELEC:BNC,FEMALE	24931	28JR284-1
-93	195-9513-00			1		LEAD,ELECTRICAL:22 AWG,1.4 L, ATTACHING PARTS	80009	195-9513-00
-94	210-0551-00			1		NUT,PLAIN,HEX:4-40 X 0.25,ST CD PL END ATTACHING PARTS	TK0435	ORDER BY DESCR
-95	195-3584-00			1		LEAD,ELECTRICAL:22 AWG,12.0 L,9-7	80009	195-3584-00
-96	386-5048-00			1		PLATE,REAR:PMR SUPPLY ATTACHING PARTS	80009	386-5048-00
-97	211-0711-00			5		SCR,ASSEM MSHR:6-32 X 0.25,PNH,STL,T15 END ATTACHING PARTS	01536	ORDER BY DESCR
-98	200-0917-01			1		COVER,CRT SKT:2.052 OD X 0.291 H,PLASTIC	80009	200-0917-01
-99	198-4603-00			1		WIRE SET,ELEC:	80009	198-4603-00
-100	119-1478-00			1		COIL,TUBE DEFL:FXD,TRACE ROTATION	80009	119-1478-00
-101	337-2931-00			1		SHIELD,CRT: ATTACHING PARTS	80009	337-2931-00
-102	211-0337-00			4		SCREW,MACHINE:4-40 X 0.25,PNH,SST END ATTACHING PARTS	01536	ORDER BY DESCR
-103	214-0291-00			1		CONTACT,ELEC:CRT CONNECTOR,CU BE SIL PL ATTACHING PARTS	80009	214-0291-00
-104	211-0324-00			1		SCR,ASSEM MSHR:4-40 X 0.188,PNH,T9 TORX DR	01536	829-06780-024
-105	210-0586-00			1		NUT,PL,ASSEM MA:4-40 X 0.25,STL CD PL END ATTACHING PARTS	78189	211-041800-00
-106	348-0762-00			1		GROMMET,PLASTIC:BLACK,ROUND,0.54 ID	80009	348-0762-00
-107	195-6851-00			1		LEAD,ELECTRICAL:BRAIDED,1.65 L ATTACHING PARTS	80009	195-6851-00
-108	211-0324-00			1		SCR,ASSEM MSHR:4-40 X 0.188,PNH,T9 TORX DR	01536	829-06780-024
-109	210-0551-00			1		NUT,PLAIN,HEX:4-40 X 0.25,ST CD PL END ATTACHING PARTS	TK0435	ORDER BY DESCR
-110	210-0457-00			1		NUT,PL,ASSEM MA:6-32 X 0.312,STL CD PL	78189	511-061800-00
-111	211-0324-00			1		SCR,ASSEM MSHR:4-40 X 0.188,PNH,T9 TORX DR	01536	829-06780-024
-112	210-0994-00			1		WASHER,FLAT:0.125 ID X 0.022 X 0.25 OD	86928	A371-283-20

Replaceable Mechanical Parts  
2445/2465 Option 01 Service

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-113	175-8010-00			1	CA ASSY,SP,ELEC:5,22 AWG,10.5 L,RIBBON	80009	175-8010-00
-114	-----			1	CKT BD ASSY:DYNAMIC CENTERING (SEE A14 REPL)(STANDARD MANUAL) ATTACHING PARTS		
-115	361-0067-00			3	SPACER,CKT BD:0.187,NYLON END ATTACHING PARTS	06915	LC853M
-116	334-4759-00			1	MARKER,IDENT:MKD SHIELDS INVERTER	80009	334-4759-00
-117	337-3120-00			1	SHIELD,ELEC:DMM,TOP	80009	337-3120-00
-118	343-0081-00			1	STRAP,RETAINING:0.125 DIA,NYLON ATTACHING PARTS	85480	CPNY-172BK
-119	210-0457-00			1	NUT,PL,ASSEM MA:6-32 X 0.312,STL CO PL END ATTACHING PARTS	78189	511-061800-00
-120	307-1154-00			1	PASSIVE NETWORK:CRT TERMINATOR ATTACHING PARTS	80009	307-1154-00
-121	211-0711-00			2	SCR,ASSEM MSHR:6-32 X 0.25,PNH,STL,T15	01536	ORDER BY DESCR
-122	210-0457-00			2	NUT,PL,ASSEM MA:6-32 X 0.312,STL CO PL END ATTACHING PARTS	78189	511-061800-00
-123	407-2809-00			1	BRACKET,ANGLE:RESISTOR,AL ATTACHING PARTS	80009	407-2809-00
-124	210-0457-00			2	NUT,PL,ASSEM MA:6-32 X 0.312,STL CO PL END ATTACHING PARTS	78189	511-061800-00
-125	343-1099-00			1	RTNR,POWER SPLY:LOW VOLTAGE,FRONT,PC ATTACHING PARTS	80009	343-1099-00
-126	211-0711-00			1	SCR,ASSEM MSHR:6-32 X 0.25,PNH,STL,T15 END ATTACHING PARTS	01536	ORDER BY DESCR
-127	348-0763-00			1	GROMMET,PLASTIC:NATURAL,OVAL,1.235 ID	80009	348-0763-00
-128	348-0751-00			1	GROMMET,PLASTIC:BLACK,3.11 X 0.645 OBLONG	80009	348-0751-00
-129	348-0757-00			1	GROMMET,PLASTIC:BLACK,U SHAPE,0.25 ID	80009	348-0757-00
-130	343-1012-00			1	RETAINER,CKT BD:POLYCARBONATE	80009	343-1012-00
-131	407-3092-00			1	BRKT,COMPNT MTG:DMM ATTACHING PARTS	80009	407-3092-00
-132	211-0711-00	8020000	8026475	2	SCR,ASSEM MSHR:6-32 X 0.25,PNH,STL,T15	01536	ORDER BY DESCR
	211-0711-00	8026476		3	SCR,ASSEM MSHR:6-32 X 0.25,PNH,STL,T15 (2445 ONLY)	01536	ORDER BY DESCR
	211-0711-00	8020000	8029599	2	SCR,ASSEM MSHR:6-32 X 0.25,PNH,STL,T15	01536	ORDER BY DESCR
	211-0711-00	8029600		3	SCR,ASSEM MSHR:6-32 X 0.25,PNH,STL,T15 (2465 ONLY) END ATTACHING PARTS	01536	ORDER BY DESCR
-133	407-3124-00			1	BRKT ASSY,HINGE:ALUMINUM ATTACHING PARTS	80009	407-3124-00
-134	211-0711-00			2	SCR,ASSEM MSHR:6-32 X 0.25,PNH,STL,T15 END ATTACHING PARTS	01536	ORDER BY DESCR
-135	441-1618-01			1	CHASSIS,SCOPE:MAIN	80009	441-1618-01
					STANDARD ACCESSORIES		
	010-6602-00			1	PROBE,TEMP:P6602,64.0 L,230 DEG C	80009	010-6602-00
	020-0087-00			1	ACCESSORY PKG:	80009	020-0087-00
	012-0941-00			1	. LEAD SET,METER:(2)LEAD,ELEC,(2)PROBE HEAD	80009	012-0941-00
	070-4183-00			1	MANUAL,TECH:OPERATOR,2465/2445	80009	070-4183-00
	070-5365-00	8024900		1	CARD,INFO:REF,DMM OPTION (2445 ONLY)	80009	070-5365-00
	070-5365-00	8026720		1	CARD,INFO:REF,DMM OPTION (2465 ONLY)	80009	070-5365-00
					OPTIONAL ACCESSORIES		
	070-4182-00			1	MANUAL,TECH:SERV,2465 OPT 01 DIG MULTIMETER	80009	070-4182-00
	016-0720-00			1	COVER,PROT:NYLON	80009	016-0720-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-						STANDARD ACCESSORIES		
	010-6602-00			1		PROBE,TEMP:P6602,64.0 L,230 DEG C	80009	010-6602-00
	020-0087-00			1		ACCESSORY PKG:	80009	020-0087-00
	012-0941-00			1		.LEAD SET,METER:(2)LEAD,ELEC,(2) PROBE HEA	80009	012-0941-00
	070-4183-00			1		MANUAL,TECH:OPERATOR,2445/2465 OPT.01	80009	070-4183-00
	070-5365-00	B024900		1		CAR,INFO:REF,DMM OPTION	80009	070-5365-00
	-----			-		(2445 ONLY)		
	070-5365-00	B026720		1		CAR,INFO:REF,DMM OPTION	80009	070-5365-00
	-----			-		(2465 ONLY)		
						OPTIONAL ACCESSORIES		
	070-4182-00			-		MANUAL,TECH:SERVICE,2445/2465 OPT.01	80009	070-4182-00
	016-0720-00			-		COVER,PROT:NYLON	80009	016-0720-00

# 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).

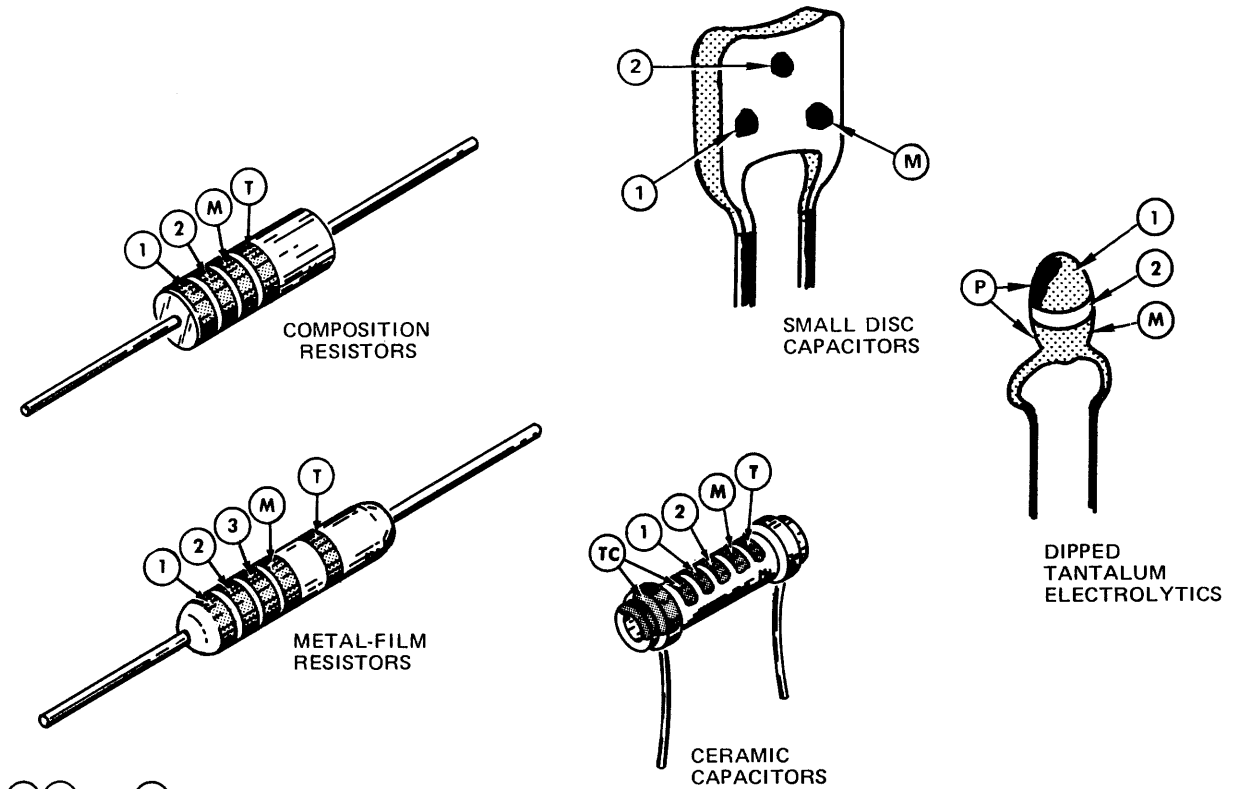
— The information and special symbols below may appear in this manual. —

## Assembly Numbers and Grid Coordinates

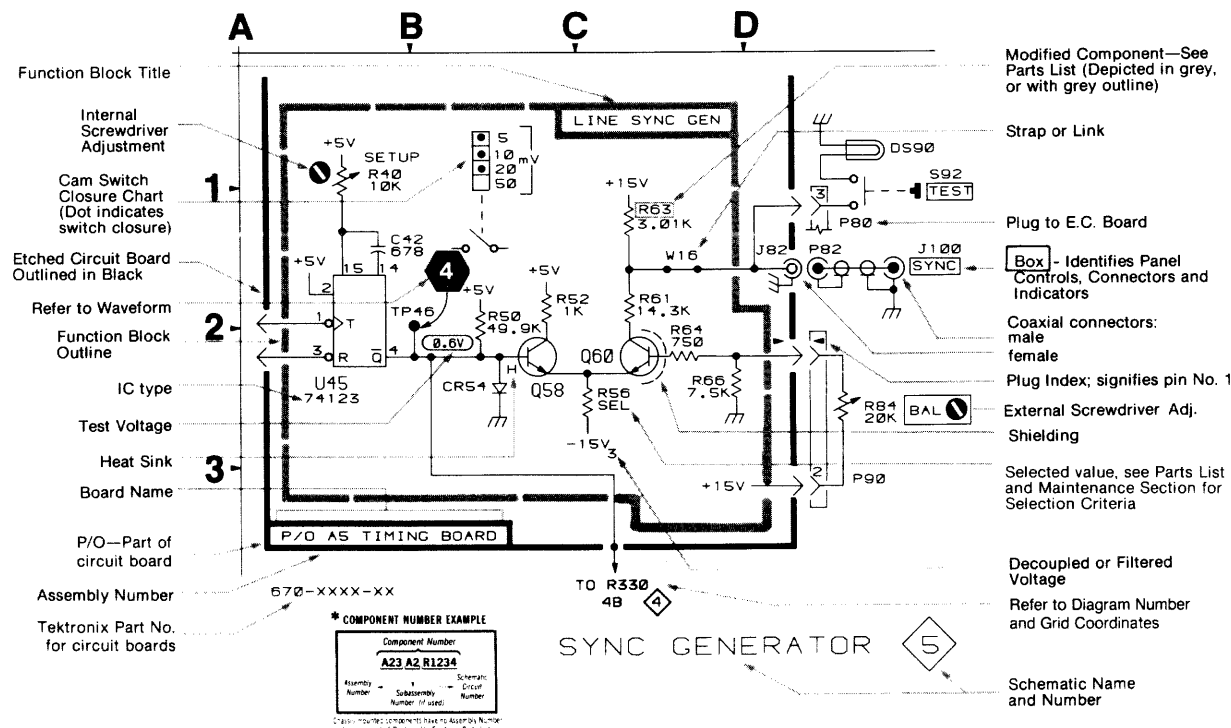
Each assembly in the instrument is assigned an assembly number (e.g., A20). The assembly number appears on the circuit board outline on the diagram, in the title for the circuit board component location illustration, and in the lookup table for the schematic diagram and corresponding component locator 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.

## COLOR CODE



- ① ② and ③ — 1st, 2nd, and 3rd significant figures
- Ⓜ — multiplier Ⓣ — tolerance
- ⓉⓈ — temperature coefficient
- Ⓟ — polarity and voltage rating
- Ⓣ and/or Ⓢ color code may not be present on some capacitors



COLOR	SIGNIFICANT FIGURES	RESISTORS		CAPACITORS		DIPPED TANTALUM VOLTAGE RATING
		MULTIPLIER	TOLERANCE	MULTIPLIER	TOLERANCE	
BLACK	0	1	---	1	±20%	4 VDC
BROWN	1	10	±1%	10	±1%	6 VDC
RED	2	10 <sup>2</sup> or 100	±2%	10 <sup>2</sup> or 100	±2%	10 VDC
ORANGE	3	10 <sup>3</sup> or 1 K	±3%	10 <sup>3</sup> or 1000	±3%	15 VDC
YELLOW	4	10 <sup>4</sup> or 10 K	±4%	10 <sup>4</sup> or 10,000	+100% -9%	20 VDC
GREEN	5	10 <sup>5</sup> or 100 K	±½%	10 <sup>5</sup> or 100,000	±5%	25 VDC
BLUE	6	10 <sup>6</sup> or 1 M	±¼%	10 <sup>6</sup> or 1,000,000	---	35 VDC
VIOLET	7	---	±1/10%	---	---	50 VDC
GRAY	8	---	---	10 <sup>-2</sup> or 0.01	+80% -20%	±0.25 pF
WHITE	9	---	---	10 <sup>-1</sup> or 0.1	±10%	±1 pF
GOLD	-	10 <sup>-1</sup> or 0.1	±5%	---	---	---
SILVER	-	10 <sup>-2</sup> or 0.01	±10%	---	---	---
NONE	-	---	±20%	---	±10%	±1 pF

Figure 7-1. Color code for resistors and capacitors.

# RATIONS

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for Quantities Used in  
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on the diagrams are in  
l otherwise:

ter are in picofarads (pF).  
one are in microfarads

is manual.

circuit board component  
. A lookup table with the  
for ease of locating the  
ts illustrated on the facing  
p table. When more than  
o illustrate the circuitry on  
ard illustration may only  
ram on which it was il-  
ist the diagram number of  
itry of the circuit board

Modified Component—See  
Parts List (Depicted in grey,  
or with grey outline)

Strap or Link

Plug to E.C. Board

Box - Identifies Panel  
Controls, Connectors and  
Indicators

Coaxial connectors:  
male  
female

Plug Index; signifies pin No. 1

External Screwdriver Adj.

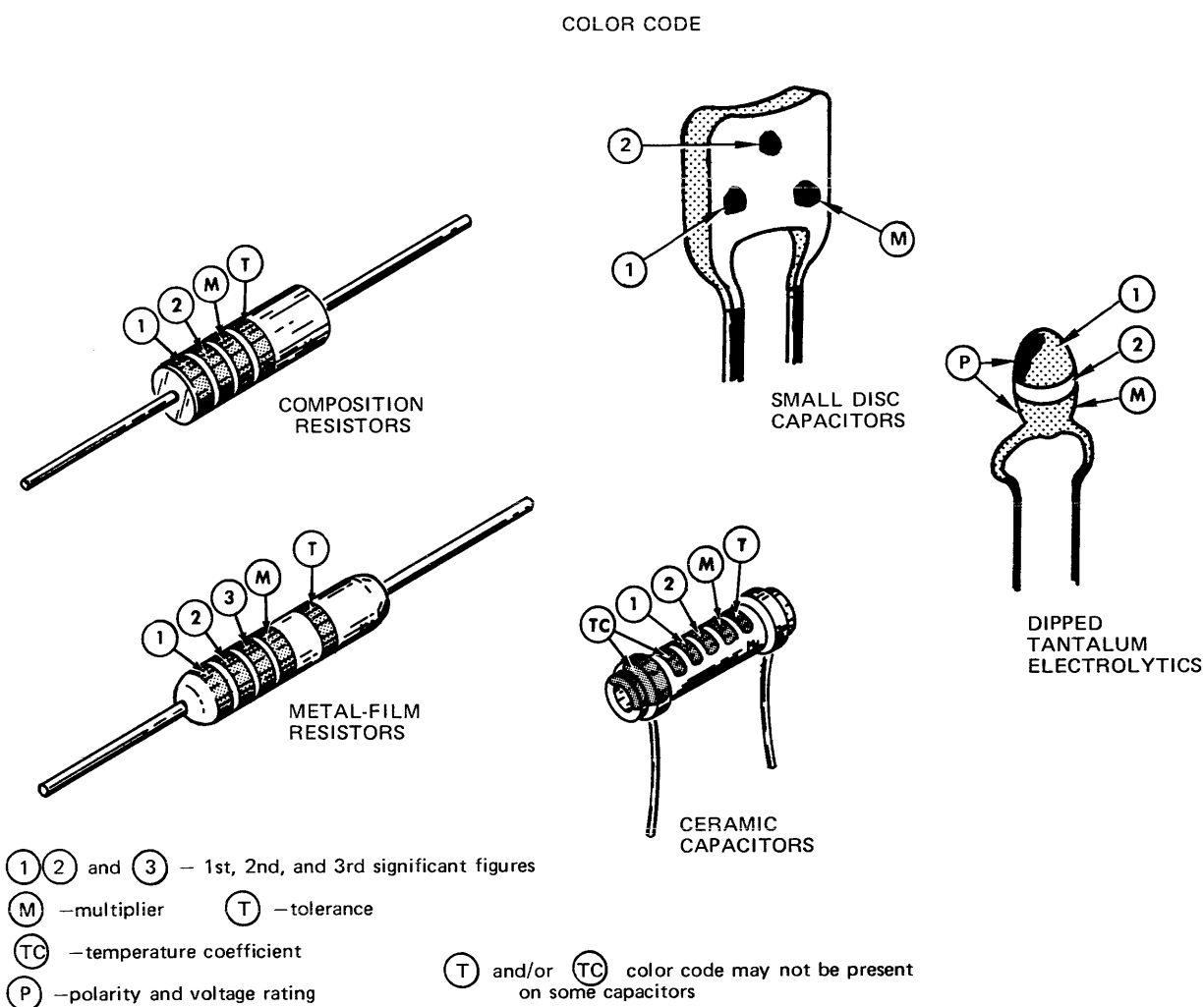
Shielding

Selected value, see Parts List  
and Maintenance Section for  
Selection Criteria

Decoupled or Filtered  
Voltage

Refer to Diagram Number  
and Grid Coordinates

Schematic Name  
and Number



COLOR	SIGNIFICANT FIGURES	RESISTORS		CAPACITORS		DIPPED TANTALUM VOLTAGE RATING	
		MULTIPLIER	TOLERANCE	MULTIPLIER	TOLERANCE		
BLACK	0	1	---	1	±20%	±2 pF	4 VDC
BROWN	1	10	±1%	10	±1%	±0.1 pF	6 VDC
RED	2	10 <sup>2</sup> or 100	±2%	10 <sup>2</sup> or 100	±2%	---	10 VDC
ORANGE	3	10 <sup>3</sup> or 1 K	±3%	10 <sup>3</sup> or 1000	±3%	---	15 VDC
YELLOW	4	10 <sup>4</sup> or 10 K	±4%	10 <sup>4</sup> or 10,000	+100% -9%	---	20 VDC
GREEN	5	10 <sup>5</sup> or 100 K	±½%	10 <sup>5</sup> or 100,000	±5%	±0.5 pF	25 VDC
BLUE	6	10 <sup>6</sup> or 1 M	±¼%	10 <sup>6</sup> or 1,000,000	---	---	35 VDC
VIOLET	7	---	±1/10%	---	---	---	50 VDC
GRAY	8	---	---	10 <sup>-2</sup> or 0.01	+80% -20%	±0.25 pF	---
WHITE	9	---	---	10 <sup>-1</sup> or 0.1	±10%	±1 pF	3 VDC
GOLD	—	10 <sup>-1</sup> or 0.1	±5%	---	---	---	---
SILVER	—	10 <sup>-2</sup> or 0.01	±10%	---	---	---	---
NONE	—	---	±20%	---	±10%	±1 pF	---

Figure 7-1. Color code for resistors and capacitors.

(1861-20A) 2662-48

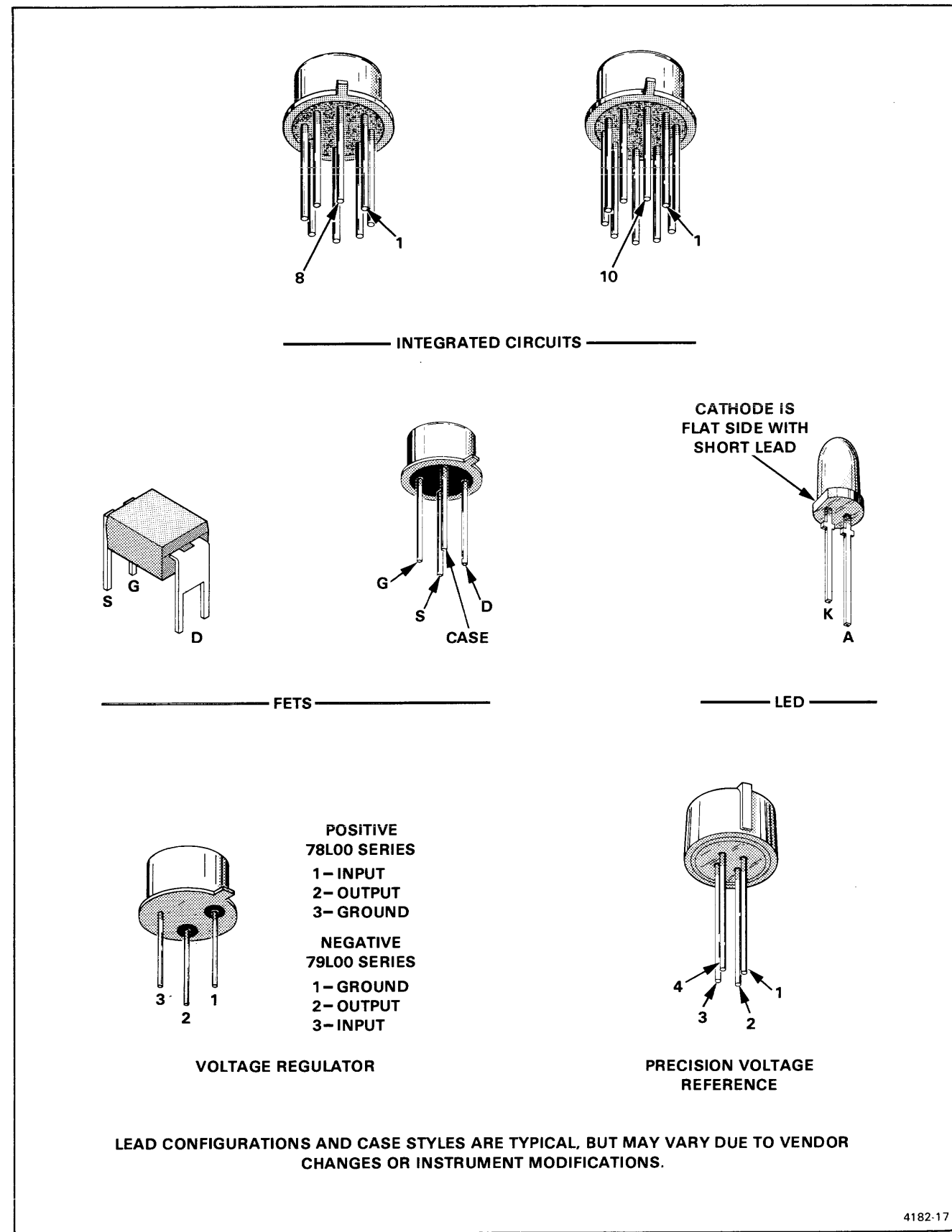


Figure 7-2. Semiconductor lead configurations.

**2445/2465 Option 01 Service**

To identify any component mounted on a circuit board and to locate that component in the appropriate schematic diagram

**1. Locate the Circuit Board Illustration**

- In the instrument identify the Assembly Number of the circuit board in question. The Assembly Number is usually printed on the upper left corner of the circuit board on the component side.
- In the manual locate and pull out tabbed page whose title corresponds with the Assembly Number of the circuit board. Circuit board assembly numbers and board nomenclature are printed on the back side of the tabs (facing the rear of the manual).

**2. Determine the Circuit Number**

- Compare the circuit board with its illustration and locate the desired component by area and shape on the illustration.
- Scan the table adjacent to the Circuit Board Illustration and find the Circuit Number of the desired component.
- Determine the Schematic Diagram Number in which the component is located.

**3. Locate the Component**

- Locate and pull out correspond with the determined in the tabs and numbers are (facing the front of
- Scan the Component schematic diagram desired component.

PULL OUT PAGE TABS FOR CIRCUIT BOARD ILLUSTRATION

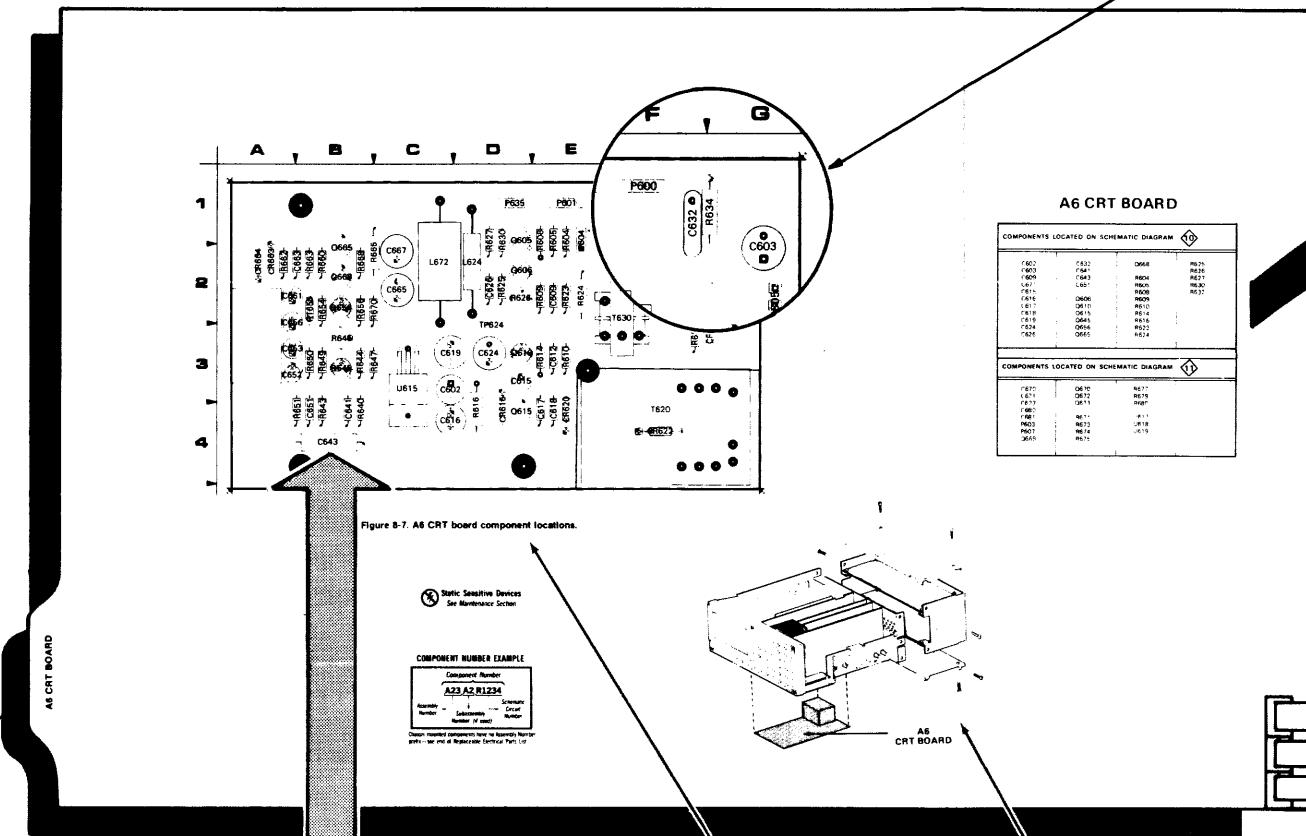
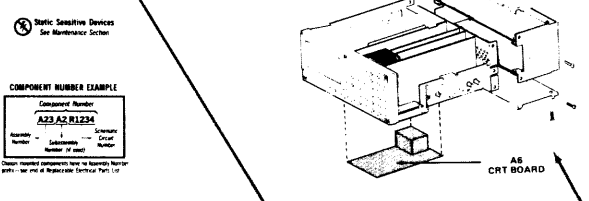


Figure 8-7. A6 CRT board component locations.



ASSEMBLY NUMBER AND CIRCUIT BOARD NAME  
ILLUSTRATION FOR INSTRUMENT CIRCUIT BOARD LOCATION

MANUAL BINDER

**A6 CRT BOARD**

COMPONENTS LOCATED ON SCHEMATIC DIAGRAM 10			
C602	C632	Q668	R625
C603	C641	R626	R627
C609	C643	R605	R630
C671	C651	R608	R632
C615	Q606	R609	
C616	Q610	R610	
C617	Q615	R614	
C618	Q645	R616	
C619	Q656	R623	
C624	Q665	R624	
C626	Q665		

COMPONENTS LOCATED ON SCHEMATIC DIAGRAM 11			
C670	Q670	R677	
C671	Q672	R679	
C673	Q673	R680	
C680			
C681			
C682			
C683			
C684			
C685			
C686			
C687			
C688			
C689			
C690			
C691			
C692			
C693			
C694			
C695			
C696			
C697			
C698			
C699			
C700			

COMPONENT LOCATION TABLE

**ASSEMBLY**

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C602	2C	3C	Q656	2F	2B
C603	1C	1G	Q665	1G	1B
C609	4E	2C	Q668	2G	2B
C612	7C	3E			
C615	7C	3D	R604	4C	1E
C616	2C	3C	R605	5D	1E
C617	7D	3D	R608	4E	1D
C618	7E	3E	R609	4E	2D
C619	6E	3C	R610	7B	3E
C624	4F	3D	R614	7C	3D
C626	7G	2D	R616	1C	3D
C632	8G	1F	R623	4D	2E
C643	3D	4B	R625	7F	2D
C651	3E	3B	R626	7F	2D
			R627	7G	1D
			R630	4E	1D

**CHASSIS MOUNTED PARTS**

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
L635	51	CHASSIS	V635	6J	CHASSIS

CRT CIRCUIT DIAGRAM 10

**A6 ASSEMBLY**

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C602	2C	3C	Q656	2F	2B
C603	1C	1G	Q665	1G	1B
C609	4E	2C	Q668	2G	2B
C612	7C	3E			
C615	7C	3D	R604	4C	1E
C616	2C	3C	R605	5D	1E
C617	7D	3D	R608	4E	1D
C618	7E	3E	R609	4E	2D
C619	6E	3C	R610	7B	3E
C624	4F	3D	R614	7C	3D
C626	7G	2D	R616	1C	3D
C632	8G	1F	R623	4D	2E
C643	3D	4B	R625	7F	2D
C651	3E	3B	R626	7F	2D
			R627	7G	1D
			R630	4E	1D

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
Q606	4E	2D	TP624	3B	2D
Q610	7C	3D	U615	1D	3C
Q615	7D	3D			
Q645	3E	3B			

MANUAL BINDER

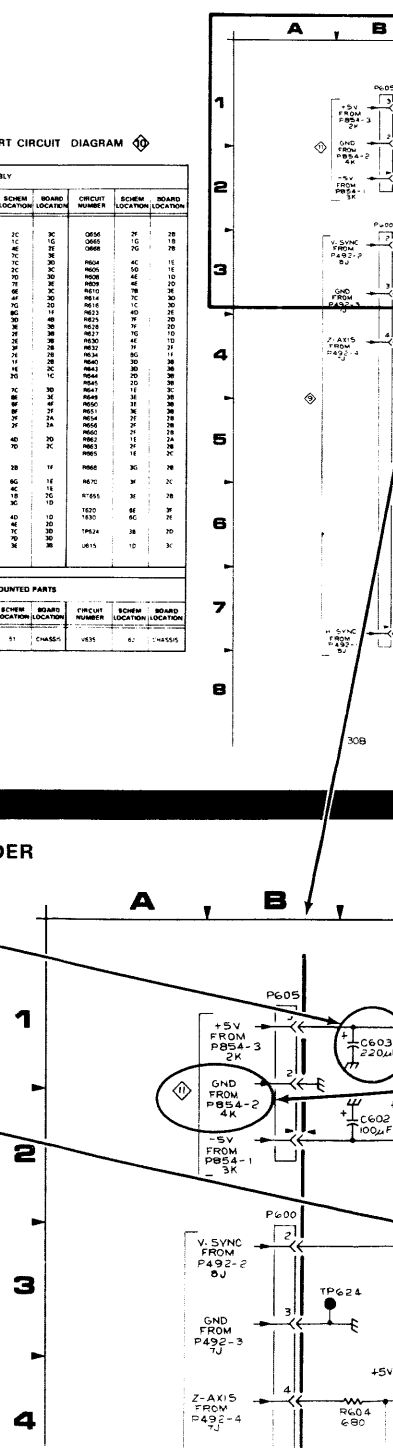
**5. Locate the Component on the Circuit Board**

- In the manual, locate and pull out the tabbed page whose title and Assembly Number correspond with the desired circuit board. This information is on the back side of the tabs.
- Using the Circuit Number and grid coordinates, locate the component on the Circuit Board Illustration.
- In the circuit board location illustration, determine the location of the circuit board in the instrument.
- Find the circuit board in the instrument and compare it with its illustration in the manual to locate the desired component on the board.

**4. Determine the Circuit Board Illustration and Component Location**

- From the schematic diagram, determine the Assembly Number of the circuit board on which the component is mounted. This information is boxed and located in a corner of the heavy line that distinguishes the board outline.
- Scan the Component Location Table for the Assembly Number just determined and find the Circuit Number of the desired component.
- Under the BOARD LOCATION column, read the grid coordinates for the desired component.

Figure 7-3. Locating components on schematic diagrams and circuit board illustrations.



- 2. Determine the Circuit Number**
- Compare the circuit board with its illustration and locate the desired component by area and shape on the illustration.
  - Scan the table adjacent to the Circuit Board Illustration and find the Circuit Number of the desired component.
  - Determine the Schematic Diagram Number in which the component is located.

- 3. Locate the Component on the Schematic Diagram**
- Locate and pull out tabbed page whose number and title correspond with the Schematic Diagram Number just determined in the table. Schematic diagram nomenclature and numbers are printed on the front side of the tabs (facing the front of the manual).
  - Scan the Component Location Table adjacent to the schematic diagram and find the Circuit Number of the desired component.
  - Under the SCHEM LOCATION column, read the grid coordinates for the desired component.
  - Using the Circuit Number and grid coordinates, locate the component on the schematic diagram.

**A6 CRT BOARD**

COMPONENTS LOCATED ON SCHEMATIC DIAGRAM 10

C602	C632	Q668	R625
C603	C641	R604	R626
C609	C643	R605	R627
C671	C651	R608	R630
C615		R609	R632
C616	Q606	R610	
C617	Q610	R614	
C618	Q615	R616	
C619	Q645	R623	
C624	Q656	R624	
C626	Q665		

COMPONENTS LOCATED ON SCHEMATIC DIAGRAM 11

C670	Q670	R677
C671	Q672	R679
C673	Q673	R680
C680		
C681	R671	U617
P603	R673	U618
P607	R674	U619
Q669	R675	

**COMPONENT LOCATION TABLE**

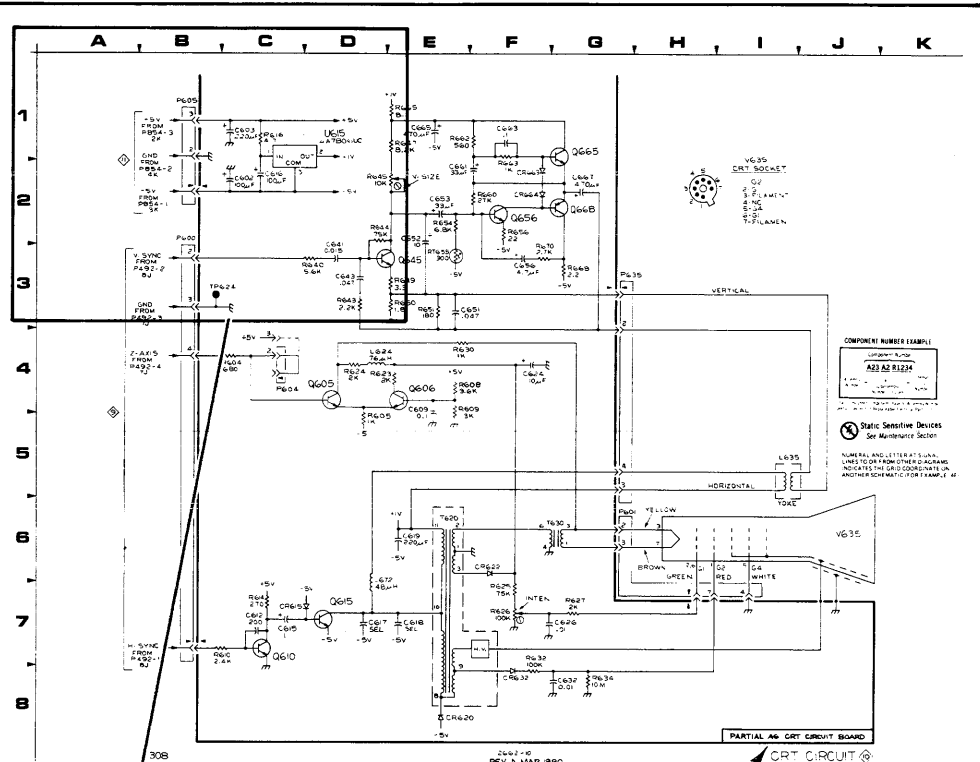
A6 ASSEMBLY

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C602	2C	3C	Q668	2F	2B
C603	1C	1G	Q665	1G	1B
C609	4E	2E	Q668	2G	2B
C612	7C	3E			
C615	7C	3D	R604	4C	1E
C616	2C	3C	R605	5D	1E
C617	7D	3D	R608	4E	1D
C618	7E	3E	R609	4E	2D
C619	6E	3C	R610	7B	3E
C624	4F	3D	R614	7C	3D
C626	7G	2D	R616	1C	3D
C632	8G	1F	R623	4D	2E
C643	3D	4B	R625	7F	2D
C651	3E	3B	R626	7F	2D
			R627	7G	1D
			R630	4E	1D

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
L635	51	CHASSIS	V635	6J	CHASSIS

**CRT CIRCUIT DIAGRAM 10**



**A6 ASSEMBLY**

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C602	2C	3C	Q656	2F	2B
C603	1C	1G	Q665	1G	1B
C609	4E	2E	Q668	2G	2B
C612	7C	3E			
C615	7C	3D	R604	4C	1E
C616	2C	3C	R605	5D	1E
C617	7D	3D	R608	4E	1D
C618	7E	3E	R609	4E	2D
C619	6E	3C	R610	7B	3E
C624	4F	3D	R614	7C	3D
C626	7G	2D	R616	1C	3D
C632	8G	1F	R623	4D	2E
C643	3D	4B	R625	7F	2D
C651	3E	3B	R626	7F	2D
			R627	7G	1D
			R630	4E	1D

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
Q605					
Q606	4E	2D	TP624	3B	2D
Q610	7C	3D			
Q615	7D	3D			
Q645	3E	3B	U615	1D	3C

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
L635	51	CHASSIS	V635	6J	CHASSIS

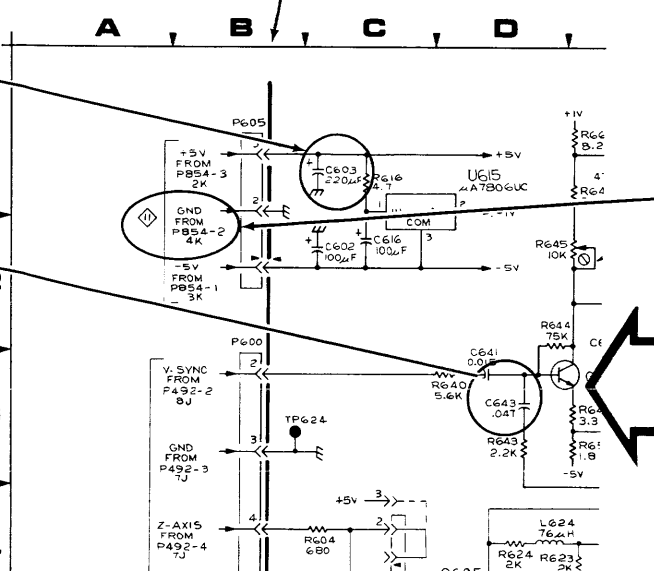


ILLUSTRATION FOR INSTRUMENT CIRCUIT BOARD LOCATION

Board Illustration and Component

tic diagram, determine the Assembly circuit board on which the component information is boxed and located in a corner hat distinguishes the board outline.

ent Location Table for the Assembly determined and find the Circuit Number of the t.

D LOCATION column, read the grid coordinates of the desired component.

omponents on schematic diagrams and circuit board illustrations.

PULL OUT PAGE TABS FOR SCHEMATIC DIAGRAMS

CRT CIRCUIT 10

PARTIAL A6 CRT CIRCUIT BOARD

CRT CIRCUIT 10

SCHEMATIC DIAGRAM NAME AND NUMBER

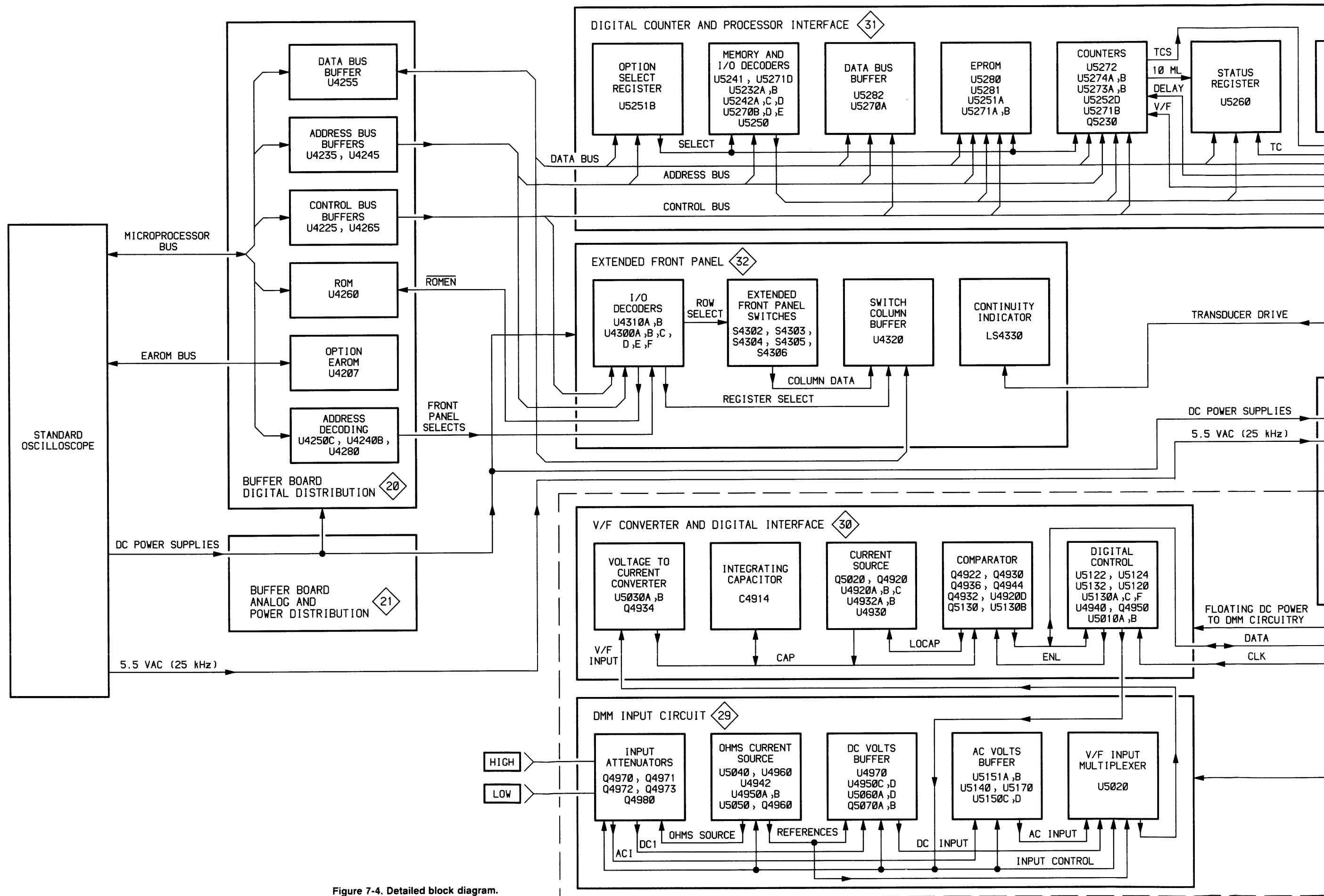
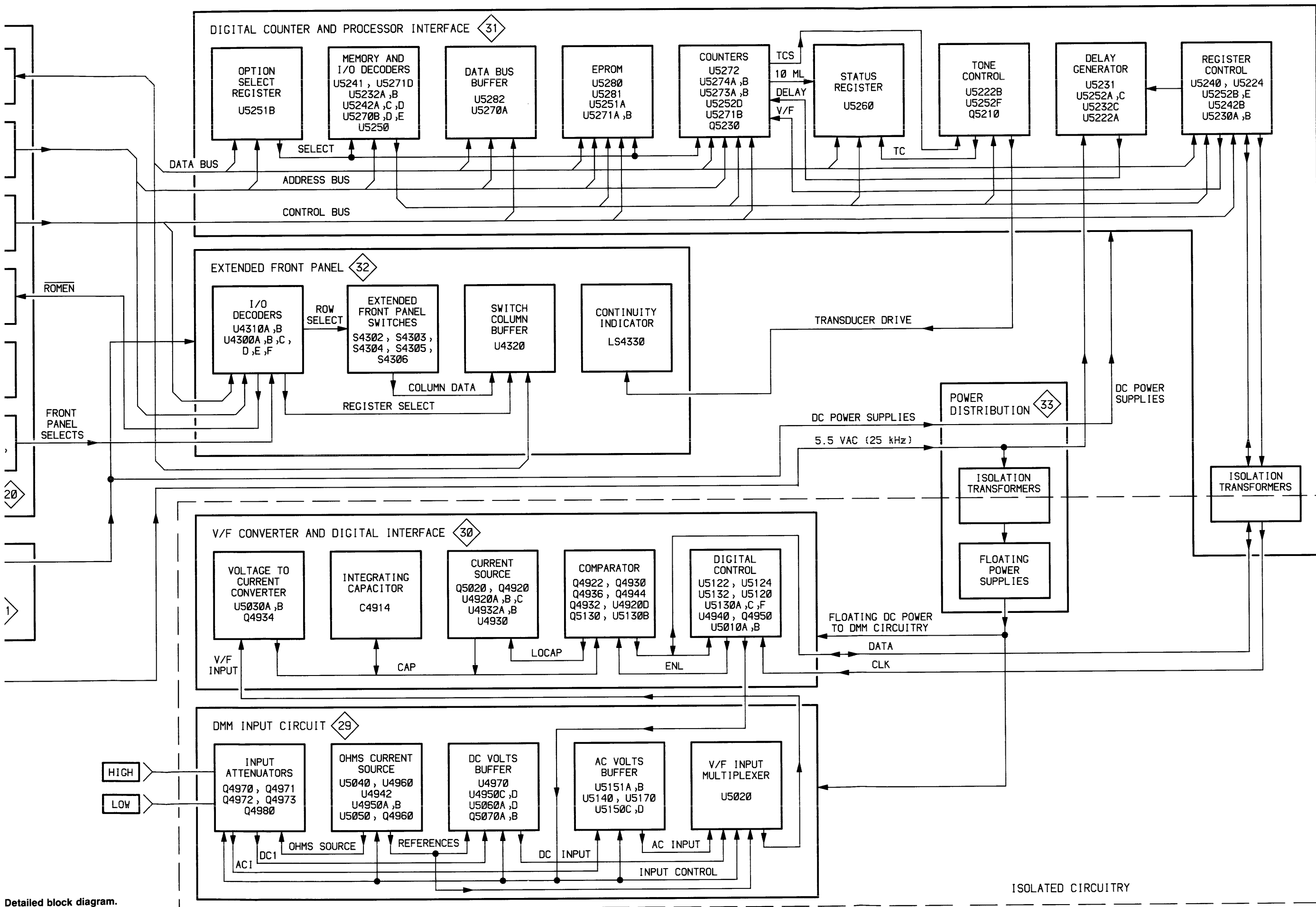
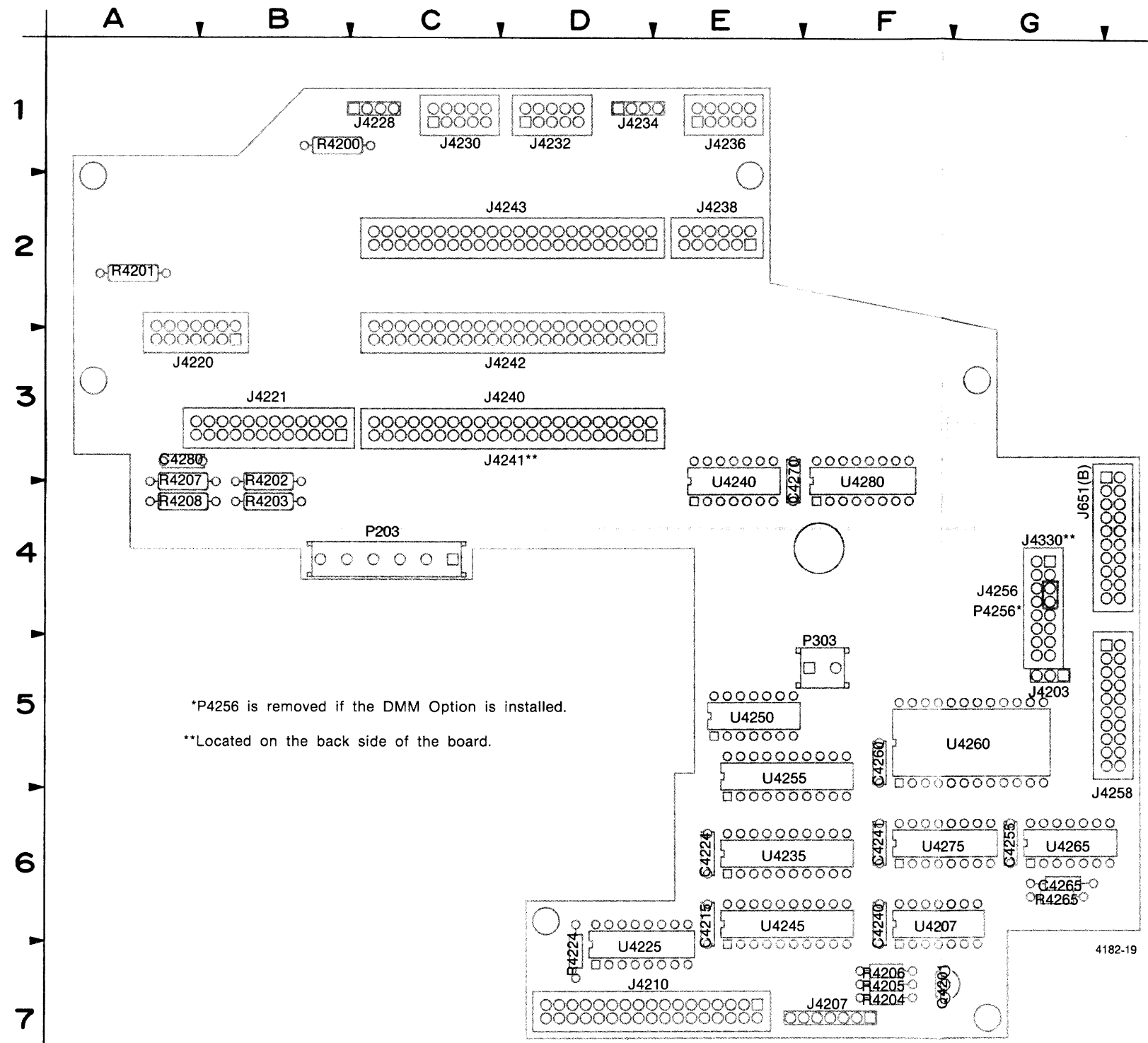


Figure 7-4. Detailed block diagram.





Detailed block diagram.



\*P4256 is removed if the DMM Option is installed.

\*\*Located on the back side of the board.

CIRCUIT NUMBER	SCH NUM
C4215	2'
C4224	2'
C4240	2'
C4241	2'
C4255	2'
C4260	2'
C4265	2'
C4270	2'
C4280	2'
J4203	2'
J4207	2'
J4210	2'
J4220	2'

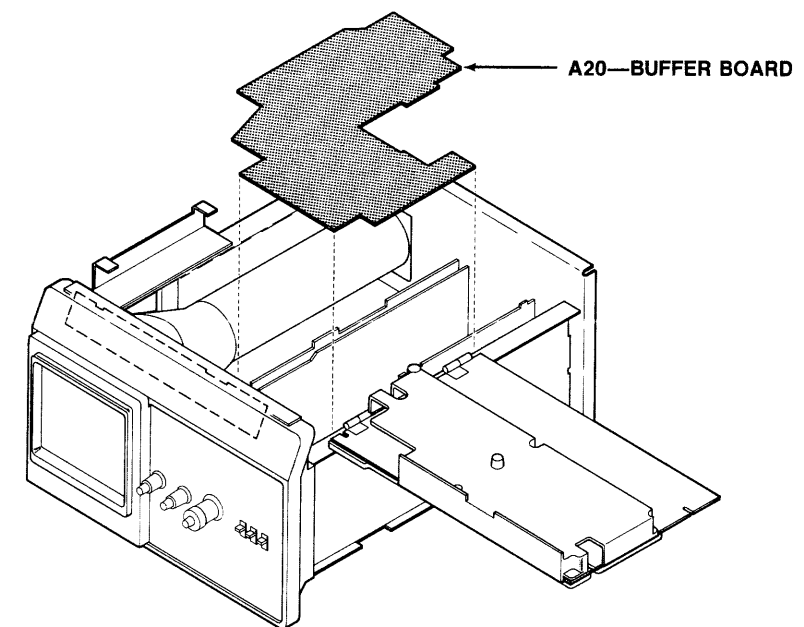
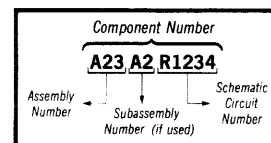


Figure 7-5. A20—Buffer board.

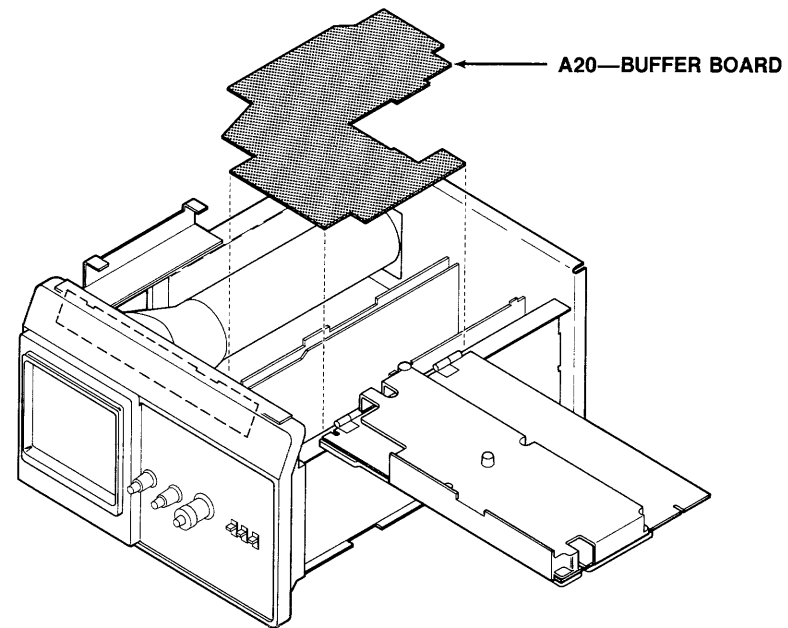
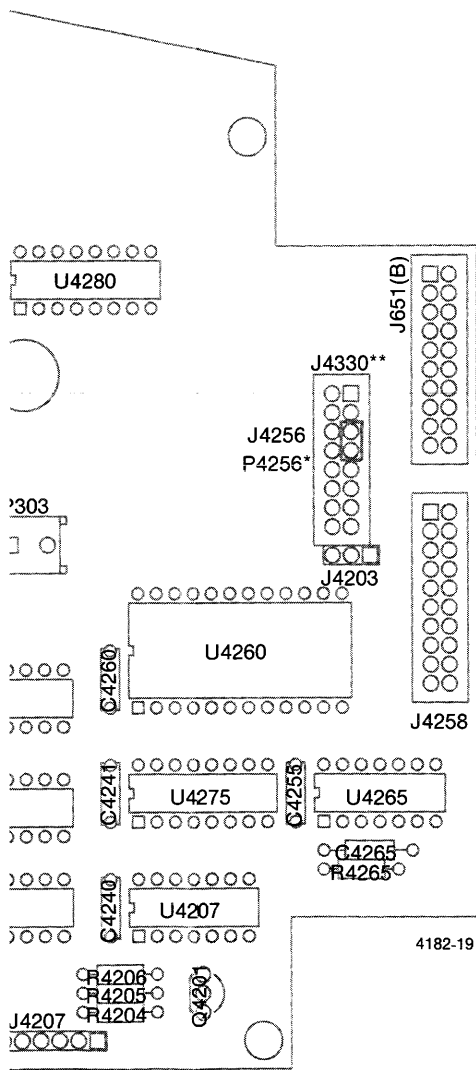
Static Sensitive Devices  
See Maintenance Section

**COMPONENT NUMBER EXAMPLE**



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

F G



### A20—BUFFER BOARD

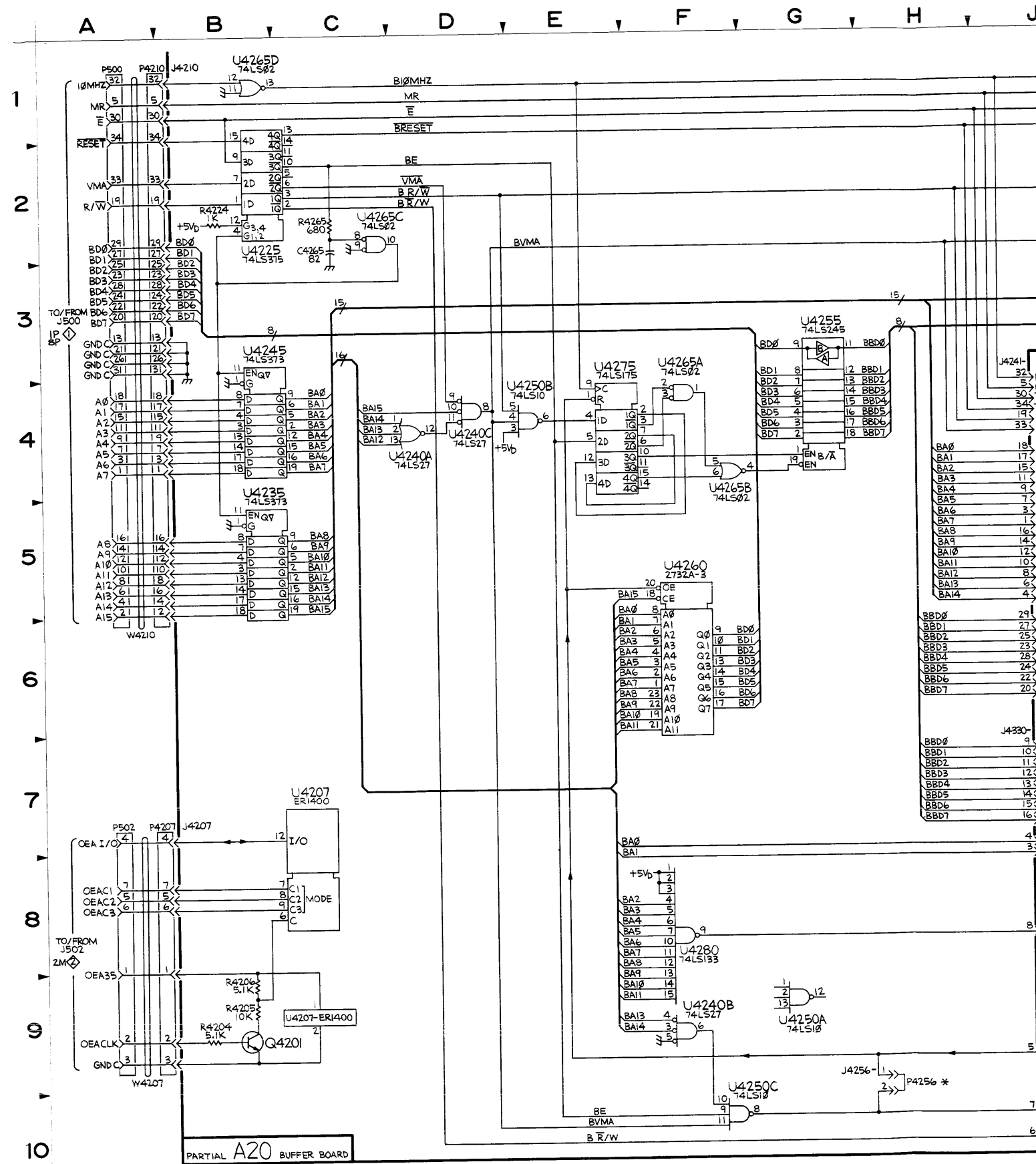
CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
C4215	21	J4221	21	J4243	20	R4202	21	U4235	20	U4255	21
C4224	21	J4228	21	J4243	21	R4203	21	U4235	21	U4260	20
C4240	21	J4230	21	J4256	20	R4204	20	U4240	20	U4260	21
C4241	21	J4232	21	J4258	21	R4205	20	U4240	20	U4265	20
C4255	21	J4234	21	J4330	20	R4206	20	U4240	20	U4265	20
C4260	21	J4236	21	J4330	21	R4207	21	U4240	21	U4265	20
C4265	20	J4238	21	J651(B)	21	R4208	21	U4245	20	U4265	20
C4270	21	J4240	20	P203	21	R4224	20	U4245	21	U4265	21
C4280	21	J4240	21	P303	21	R4265	20	U4250	20	U4275	20
J4203	21	J4241	20	P4256	20	U4207	20	U4250	20	U4275	21
J4207	20	J4241	21	Q4201	20	U4207	20	U4250	20	U4280	20
J4210	20	J4242	20	R4200	21	U4225	20	U4250	21	U4280	20
J4220	21	J4242	21	R4201	21	U4225	21	U4255	20	U4280	21

**BUFFER BOARD DIGITAL DISTRIBUTION DIAGRAM** 20

ASSEMBLY A20											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C4265	2C	6G	P4256	10H	4G	U4207	7C	6F	U4250C	10F	5E
J4207	7B	7F	Q4201	9B	7F	U4207	9C	6F	U4255	3G	5E
J4210	1B	7D				U4225	2B	7D	U4260	5F	5G
J4240	3L	3D	R4204	9B	7F	U4235	4B	6E	U4265A	3F	6G
J4241	3J	3D	R4205	9B	7F	U4240A	4D	3E	U4265B	4F	6G
J4242	3N	3D	R4206	9B	7F	U4240B	9F	3E	U4265C	2C	6G
J4243	1S	2D	R4224	2B	7D	U4240C	4D	3E	U4265D	1B	6G
J4256	9G	4G	R4265	2C	6G	U4245	3B	6E	U4275	3E	6F
J4330	7J	4G				U4250A	9G	5E	U4280	8F	3F
						U4250B	4E	5E			

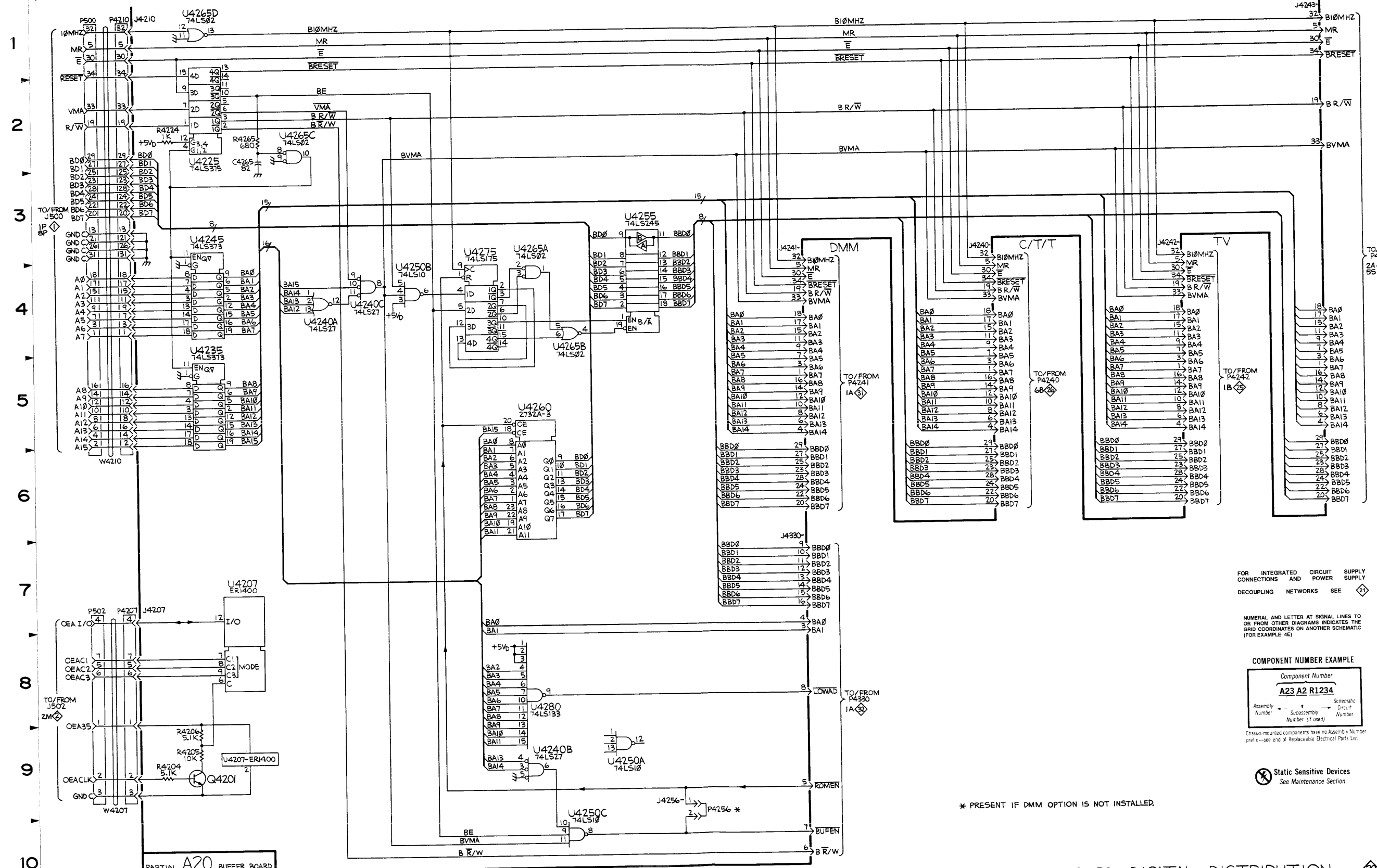
Partial A20 also shown on diagram 21.

CHASSIS MOUNTED PARTS											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P500	1A	CHASSIS	P4207	7A	CHASSIS	W4207	9A	CHASSIS			
P502	7A	CHASSIS	P4210	1A	CHASSIS	W4210	6A	CHASSIS			



**2445/2465 OPTION 01(DMM)**

A B C D E F G H J K L M N P S



SCHEM LOCATION	BOARD LOCATION
10F	5E
3G	5E
5F	5G
3F	6G
4F	6G
2C	6G
1B	6G
3E	6F
8F	3F

SCHEM LOCATION	BOARD LOCATION

FOR INTEGRATED CIRCUIT SUPPLY CONNECTIONS AND POWER SUPPLY DECOUPLING NETWORKS SEE 21

NUMERAL AND LETTER AT SIGNAL LINES TO OR FROM OTHER DIAGRAMS INDICATES THE GRID COORDINATES ON ANOTHER SCHEMATIC (FOR EXAMPLE: 4E)

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

Static Sensitive Devices See Maintenance Section

\* PRESENT IF DMM OPTION IS NOT INSTALLED.

PARTIAL A20 BUFFER BOARD  
2445/2465 OPTION 01 (DMM)

BUFFER BOARD DIGITAL DISTRIBUTION

**CHASSIS MOUNTED PARTS**

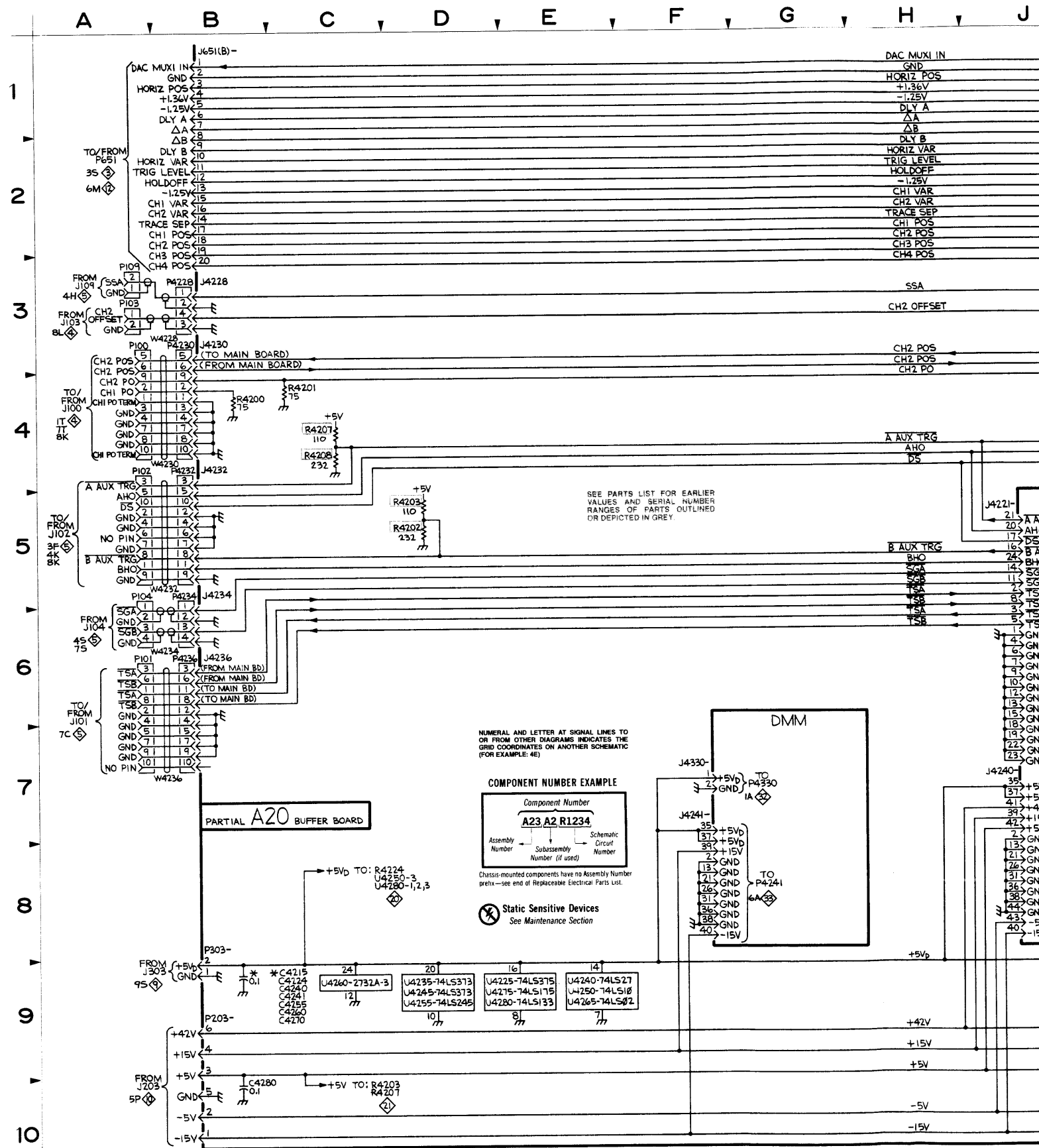
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P100	21	3A	P4207	20	7A	P5090	29	5B	W4234	21	6B
P101	21	6A	P4210	20	1A	P5210	31	8S	W4236	21	7B
P102	21	4A	P4228	21	3B	P5220	33	3B	W4241	31	10A
P103	21	3A	P4230	21	3B	P5290	31	1A	W4241	33	8B
P104	21	5A	P4232	21	4B	P5290	33	6B	W4258	21	3S
P109	21	3A	P4234	21	5B				W4990	29	9B
P302	33	3A	P4236	21	6B	W4203	21	9S	W4991	29	7B
P500	20	1A	P4241	31	1A	W4207	20	9A	W5090	29	5B
P502	20	7A	P4241	33	6A	W4210	20	6A	W5210	31	8S
P602	21	8S	P4258	21	1P	W4228	21	3B			
P651(B)	21	1S	P4300	31	8S	W4230	21	4B			
P4203	21	8P	P4991	29	6B	W4232	21	5B			

**BUFFER BOARD ANALOG AND POWER DISTRIBUTIONS DIAGRAM** 21

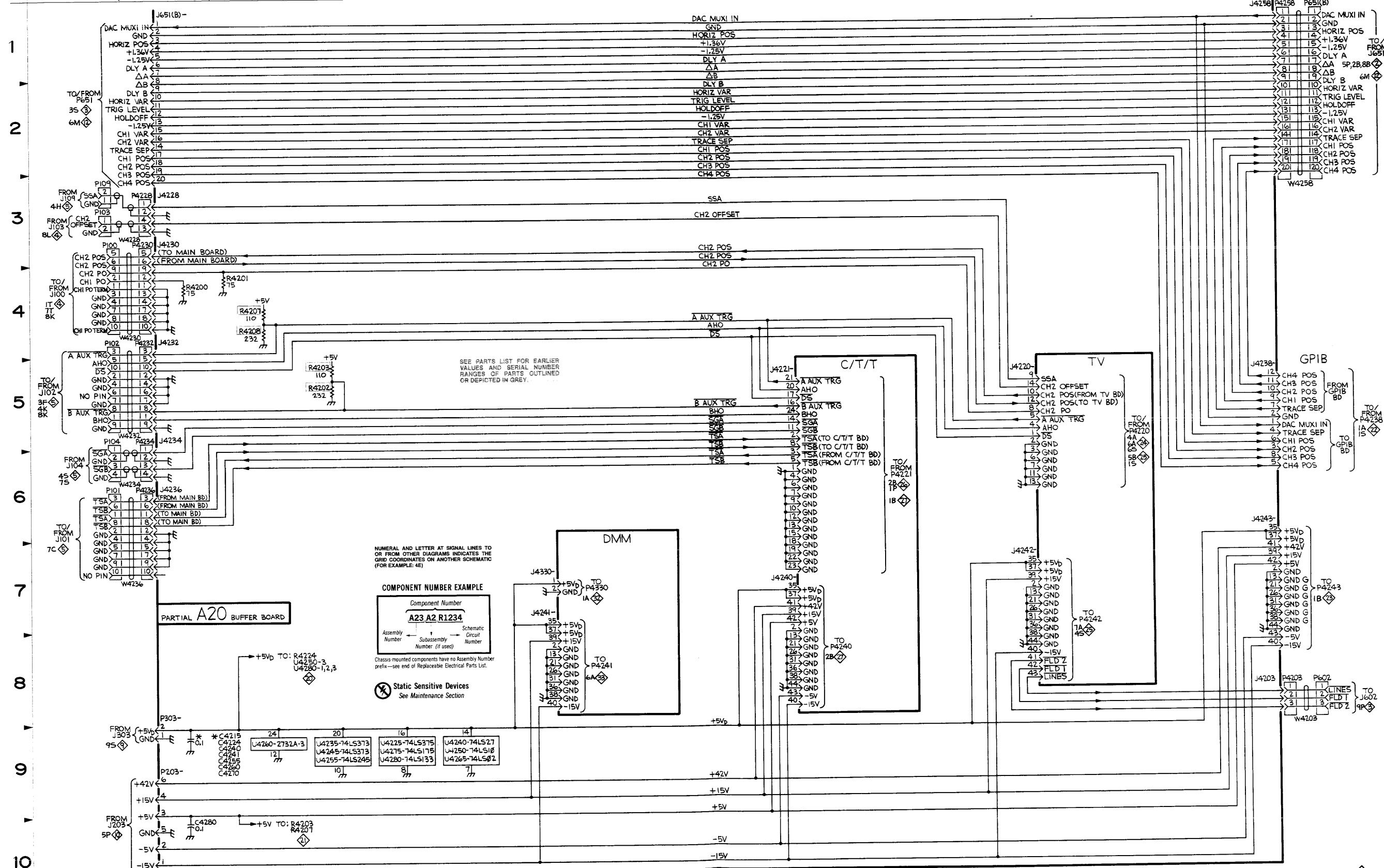
ASSEMBLY A20											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C4215	9C	6E	J4228	3B	1C	J651(B)	1B	4G	U4225	9D	7D
C4224	9C	6E	J4230	3B	1C				U4235	9D	6E
C4240	9C	6F	J4232	4B	1D	P203	9B	4C	U4240	9E	3E
C4241	9C	6F	J4234	5B	1D	P303	8B	5F	U4245	9D	6E
C4255	9C	6G	J4236	6B	1E				U4250	9E	5E
C4260	9C	5F	J4238	5P	2E	R4200	4B	1B	U4255	9D	5E
C4270	9C	3E	J4240	7J	3D	R4201	4C	2A	U4260	9C	5G
C4280	10B	3A	J4241	7F	3D	R4202	5D	3B	U4265	9E	6G
J4203	8P	5G	J4242	7L	3D	R4203	5D	4B	U4275	9D	6F
J4220	5L	3A	J4243	6P	2D	R4207	4C	3A	U4280	9D	3F
J4221	5J	3B	J4258	1P	5G	R4208	4C	4A			
J4221	5J	3B	J4330	7F	4G						

*Partial A20 also shown on diagram 20.*

CHASSIS MOUNTED PARTS											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P100	3A	CHASSIS	P602	8S	CHASSIS	P4236	6B	CHASSIS	W4230	4B	CHASSIS
P101	6A	CHASSIS	P4203	8P	CHASSIS	P4258	1P	CHASSIS	W4232	5B	CHASSIS
P102	4A	CHASSIS	P4228	3B	CHASSIS	P651(B)	1S	CHASSIS	W4234	6B	CHASSIS
P103	3A	CHASSIS	P4230	3B	CHASSIS				W4236	7B	CHASSIS
P104	5A	CHASSIS	P4232	4B	CHASSIS	W4203	9S	CHASSIS	W4258	3S	CHASSIS
P109	3A	CHASSIS	P4234	5B	CHASSIS	W4228	3B	CHASSIS			



A B C D E F G H J K L M N P S

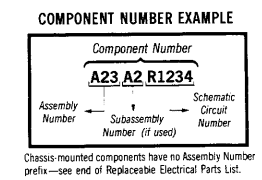


21

SCHEM LOCATION	BOARD LOCATION
9D	7D
9D	6E
9E	3E
9D	6E
9E	5E
9D	5E
9C	5G
9E	6G
9D	6F
9D	3F

SCHEM LOCATION	BOARD LOCATION
4B	CHASSIS
5B	CHASSIS
6B	CHASSIS
7B	CHASSIS
3S	CHASSIS

NUMERAL AND LETTER AT SIGNAL LINES TO OR FROM OTHER DIAGRAMS INDICATES THE GRID COORDINATES ON ANOTHER SCHEMATIC (FOR EXAMPLE: 4E)



Static Sensitive Devices See Maintenance Section

22



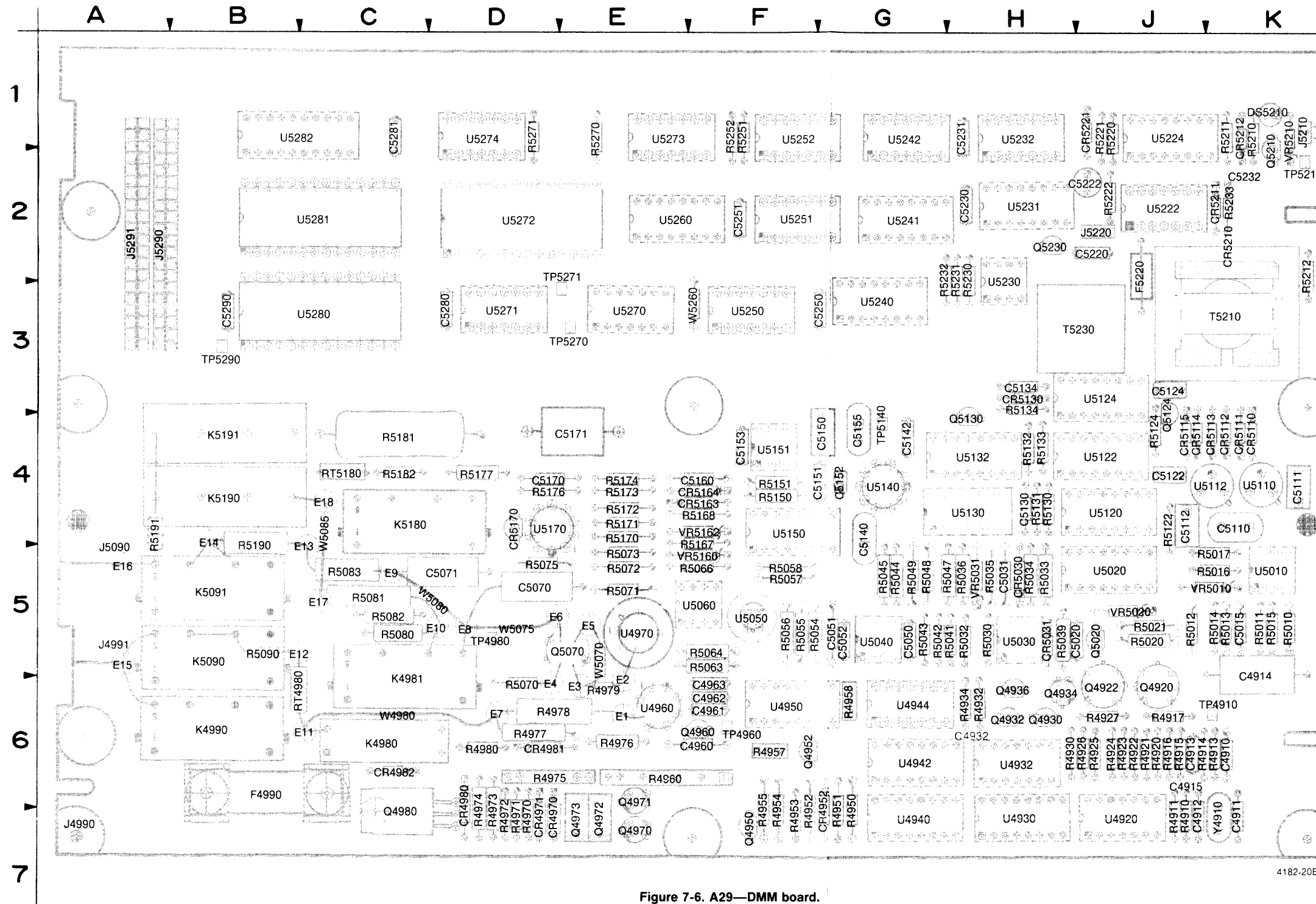
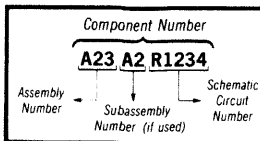


Figure 7-6. A29—DMM board.

4182-20B

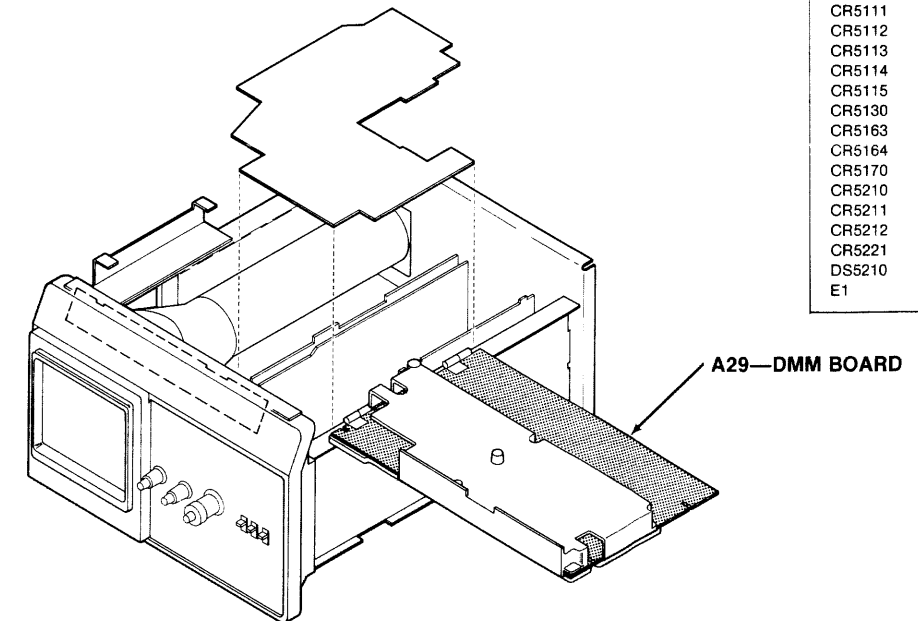
⚡ Static Sensitive Devices  
See Maintenance Section

COMPONENT NUMBER EXAMPLE

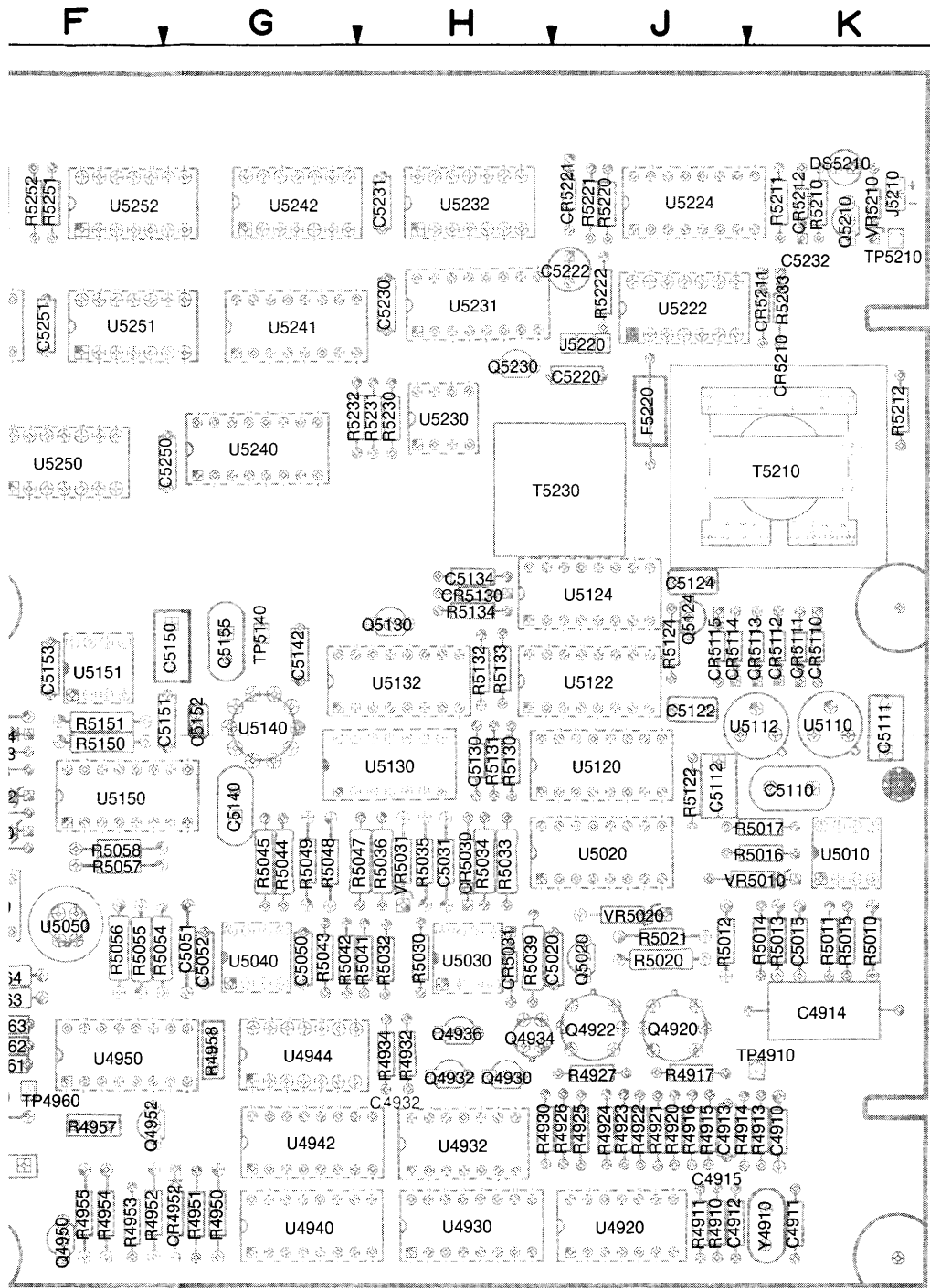


Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

CIRCUIT NUMBER	SCH E NUME
C4910	33
C4911	30
C4912	30
C4913	30
C4914	30
C4915	33
C4932	33
C4960	29
C4961	33
C4962	33
C4963	33
C5015	30
C5020	30
C5031	30
C5050	33
C5051	29
C5052	33
C5070	29
C5071	29
C5110	33
C5111	33
C5112	33
C5122	30
C5124	30
C5130	30
C5134	30
C5140	29
C5142	33
C5150	29
C5151	33
C5152	29
C5153	33
C5155	29
C5160	29
C5170	29
C5171	29
C5220	33
C5222	31
C5230	33
C5321	33
C5232	31
C5250	33
C5251	33
C5280	33
C5281	33
CR4952	29
CR4970	29
CR4971	29
CR4980	29
CR4981	29
CR4982	29
CR5030	30
CR5031	30
CR5110	33
CR5111	33
CR5112	33
CR5113	33
CR5114	33
CR5115	33
CR5130	30
CR5164	29
CR5170	29
CR5210	31
CR5211	31
CR5212	31
CR5221	31
DS5210	31
E1	29

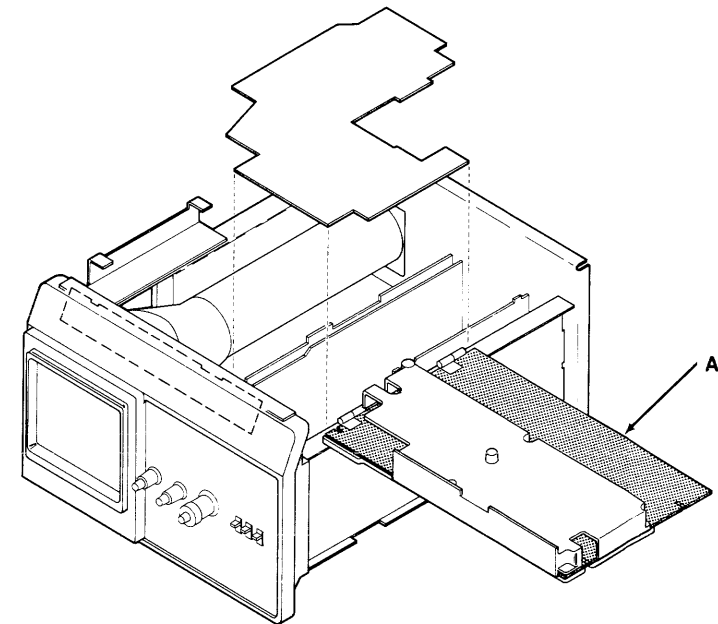


A29—DMM BOARD



4182-20B

A29—DMM board.



CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
C4910	33	E2	29	R4925	30	R5083	29	U4944	30	U5232	33
C4911	30	E3	29	R4926	30	R5090	29	U4944	30	U5240	31
C4912	30	E4	29	R4927	30	R5122	30	U4944	30	U5240	33
C4913	30	E5	29	R4930	30	R5124	30	U4944	30	U5241	31
C4914	30	E6	29	R4932	30	R5130	30	U4950	29	U5241	33
C4915	33	E7	29	R4934	30	R5131	29	U4950	29	U5242	31
C4932	33	E8	29	R4950	30	R5132	30	U4950	29	U5242	31
C4960	29	E9	29	R4951	29	R5133	30	U4950	29	U5242	31
C4961	33	E10	29	R4952	29	R5134	30	U4950	33	U5242	31
C4962	33	E11	29	R4953	30	R5150	29	U4960	29	U5242	33
C4963	33	E12	29	R4954	30	R5151	29	U4960	33	U5250	31
C5015	30	E13	29	R4955	30	R5167	29	U4970	29	U5250	33
C5020	30	E14	29	R4957	29	R5168	29	U4970	33	U5251	31
C5031	30	E15	29	R4958	29	R5170	29	U5010	30	U5251	31
C5050	33	E16	29	R4960	29	R5171	29	U5010	30	U5251	33
C5051	29	E17	29	R4970	29	R5172	29	U5010	33	U5252	31
C5052	33	E18	29	R4971	29	R5173	29	U5020	29	U5252	31
C5070	29	F4990	29	R4972	29	R5174	29	U5020	33	U5252	31
C5071	29	F5220	33	R4973	29	R5176	29	U5030	30	U5252	31
C5110	33	J4990	29	R4974	29	R5177	29	U5030	30	U5252	31
C5111	33	J4991	29	R4975	29	R5181	29	U5030	33	U5252	31
C5112	33	J5090	29	R4976	29	R5182	29	U5040	29	U5252	33
C5122	30	J5210	31	R4977	29	R5190	29	U5040	33	U5260	31
C5124	30	J5220	33	R4978	29	R5191	29	U5050	29	U5260	33
C5130	30	J5290	31	R4979	29	R5210	31	U5060	29	U5270	31
C5134	30	J5290	33	R4980	29	R5211	31	U5060	29	U5270	31
C5140	29	J5291	31	R5010	30	R5212	33	U5060	33	U5270	31
C5142	33	J5291	33	R5011	30	R5220	31	U5110	33	U5270	31
C5150	29	K4980	29	R5012	33	R5221	31	U5112	33	U5270	31
C5151	33	K4981	29	R5013	29	R5222	31	U5120	30	U5270	31
C5152	29	K4990	29	R5014	29	R5230	31	U5120	33	U5270	33
C5153	33	K5090	29	R5015	30	R5231	31	U5122	30	U5271	31
C5155	29	K5091	29	R5016	30	R5232	31	U5122	33	U5271	31
C5160	29	K5180	29	R5017	30	R5233	31	U5124	30	U5271	31
C5170	29	K5190	29	R5020	30	R5251	31	U5124	33	U5271	31
C5171	29	K5191	29	R5021	30	R5252	31	U5130	30	U5271	33
C5220	33	Q4920	30	R5030	30	R5270	31	U5130	30	U5272	31
C5222	31	Q4922	30	R5032	30	R5271	31	U5130	30	U5272	33
C5230	33	Q4930	30	R5033	30	RT4980	29	U5130	30	U5273	31
C5321	33	Q4932	30	R5034	30	RT5180	29	U5130	30	U5273	31
C5322	31	Q4934	30	R5035	30	T5210	33	U5130	30	U5273	33
C5250	33	Q4936	30	R5036	30	T5230	31	U5130	33	U5274	31
C5251	33	Q4950	30	R5039	30	T5230	31	U5132	30	U5274	31
C5280	33	Q4952	29	R5041	30	TP4910	30	U5140	29	U5274	33
C5281	33	Q4960	29	R5042	30	TP4960	29	U5140	33	U5280	31
C5290	33	Q4970	29	R5043	30	TP4980	29	U5150	29	U5280	33
CR4952	29	Q4971	29	R5044	29	TP5140	29	U5150	29	U5281	31
CR4970	29	Q4972	29	R5045	29	TP5210	33	U5150	29	U5281	33
CR4971	29	Q4973	29	R5047	30	TP5270	31	U5150	29	U5282	31
CR4980	29	Q4980	29	R5048	29	TP5271	33	U5150	33	U5282	33
CR4981	29	Q5020	30	R5049	29	TP5290	31	U5151	29	VR5010	33
CR4982	29	Q5070	29	R5054	29	U4920	30	U5151	29	VR5020	30
CR5030	30	Q5070	29	R5055	29	U4920	30	U5151	33	VR5031	30
CR5031	30	Q5124	30	R5056	29	U4920	30	U5170	29	VR5160	29
CR5110	33	Q5130	30	R5057	29	U4920	30	U5222	31	VR5162	29
CR5111	33	Q5210	31	R5058	29	U4920	33	U5222	31	VR5210	31
CR5112	33	Q5230	31	R5063	29	U4930	30	U5222	33	W4980	29
CR5113	33	R4910	30	R5064	29	U4930	33	U5224	31	W5070	29
CR5114	33	R4911	30	R5066	29	U4932	30	U5224	33	W5075	29
CR5115	33	R4913	30	R5070	29	U4932	30	U5230	31	W5080	29
CR5130	30	R4914	30	R5071	29	U4932	33	U5230	31	W5085	29
CR5163	29	R4915	30	R5072	29	U4940	30	U5230	33	W5260	31
CR5164	29	R4916	30	R5073	29	U4940	33	U5231	31	Y4910	30
CR5170	29	R4917	30	R5075	29	U4942	29	U5231	33		
CR5210	31	R4920	30	R5080	29	U4942	29	U5232	31		
CR5211	31	R4921	30	R5081	29	U4942	29	U5232	31		
CR5212	31	R4922	30	R5082	29	U4942	33	U5232	31		
CR5221	31	R4923	30			U4944	30				
DS5210	31	R4924	30								
E1	29										

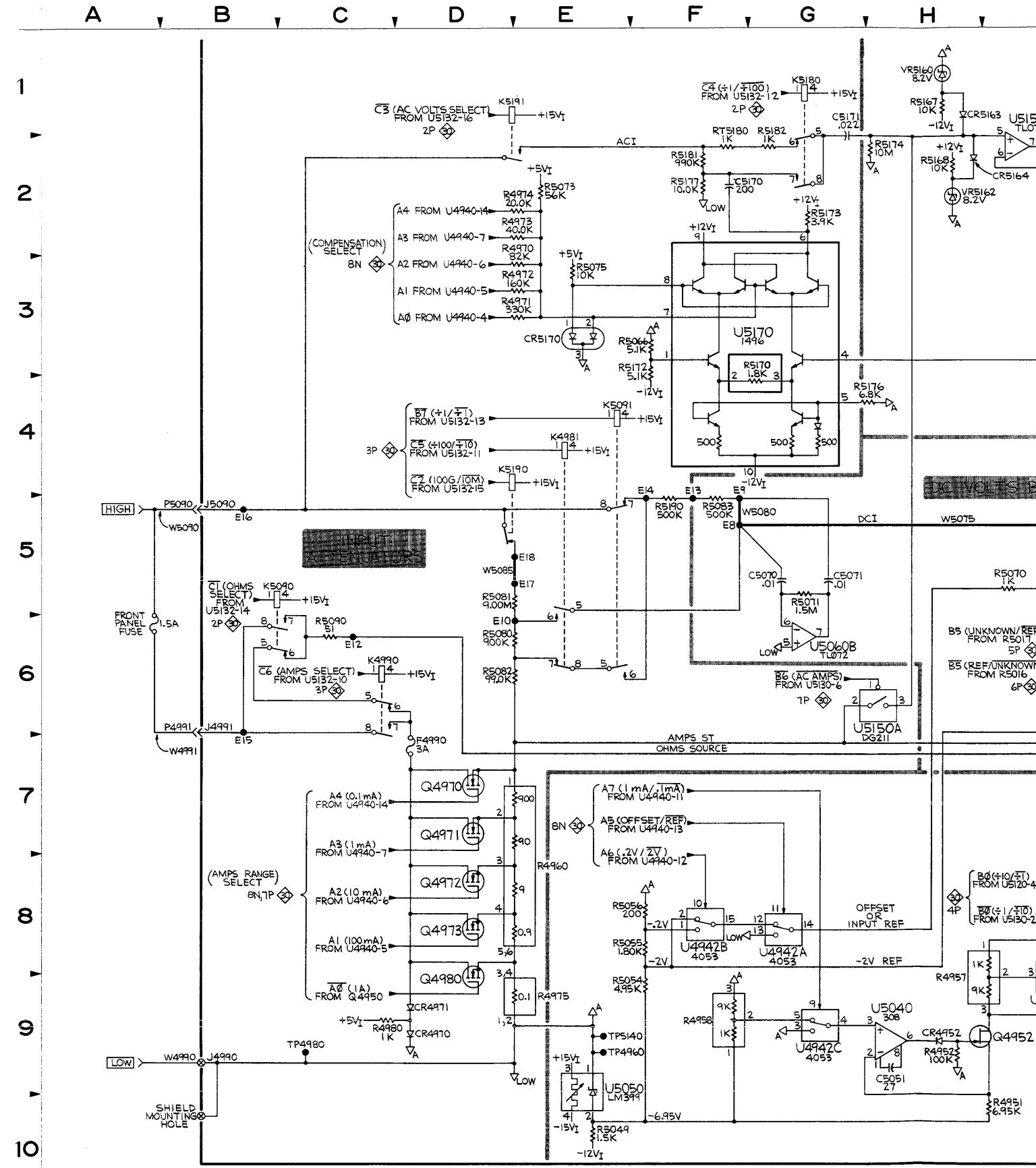
# DMM INPUT CIRCUIT DIAGRAM 29

ASSEMBLY A29											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C4960	8K	6F	F4990	7D	6B	R5013	1N	5K	RT4980	9L	6B
C5051	9H	5G				R5014	5M	5K	RT5180	1F	4C
C5070	5G	5D	J4990	9B	7A	R5044	1N	5G			
C5071	5G	5D	J4991	8B	5A	R5045	2N	5G	TP4960	9E	6F
C5140	1N	4G	J5090	5B	5A	R5048	1L	5G	TP4980	9C	5D
C5150	2L	4G				R5049	10E	5G	TP5140	9E	4G
C5152	1L	4G	K4980	9M	6C	R5054	9E	5F			
C5155	2L	4G	K4981	4E	6C	R5055	8E	5F	U4942A	8G	6G
C5160	3L	4F	K4980	6C	6B	R5056	8E	5F	U4942B	8F	6G
C5170	2F	4D	K5090	5B	5B	R5057	6K	5F	U4942C	9G	6G
C5171	1G	4E	K5091	4E	5B	R5058	6J	5F	U4950A	9J	6F
			K5180	1G	4C	R5063	6M	5F	U4950B	9K	6F
			K5190	4D	4B	R5064	9M	5F	U4950C	6L	6F
CR4952	9H	7G	K5191	1D	4B	R5066	3F	5F	U4950D	6L	6F
CR4970	9D	7D				R5070	5J	6D	U4960	9K	6E
CR4971	9D	7D	Q4952	9J	6F	R5071	5G	5E	U4970	5L	5E
CR4980	9L	7D	Q4960	10M	6F	R5072	3J	5E	U5020	4P	5J
CR4981	9L	6D	Q4970	7D	7E	R5073	2E	5E	U5040	9H	5G
CR4982	9M	6C	Q4971	7D	6E	R5075	3E	5D	U5050	9E	5F
CR5163	1J	4F	Q4972	8D	7E	R5080	6D	5C	U5060A	6K	5F
CR5164	2J	4F	Q4973	8D	7E	R5081	5D	5C	U5060B	6G	5F
CR5170	3E	4D	Q4980	9D	7C	R5082	6D	5C	U5140	2M	4G
E1	9K	6E	Q5070A	5K	5E	R5083	5F	5C	U5150A	6H	4F
E2	5K	6E	Q5070B	5J	5E	R5090	6C	5B	U5150B	4K	4F
E3	5K	6E				R5131	10M	4H	U5150C	3K	4F
E4	5J	6D	R4951	10J	7G	R5150	3L	4F	U5150D	2K	4F
E5	5K	5E	R4952	9H	7F	R5151	3L	4F	U5151A	1K	4F
E6	5J	5D	R4957	9H	6F	R5167	1H	4F	U5151B	1J	4F
E7	9L	6D	R4958	9F	6G	R5168	2H	4F	U5170	3G	4D
E8	5F	5D	R4960	8E	6E	R5170	3G	4E			
E9	4F	5C	R4970	2E	7D	R5171	3J	4E	VR5160	1H	5F
E10	6D	5D	R4971	3E	7D	R5172	3F	4E	VR5162	2H	4F
E11	9L	6C	R4972	3E	7D	R5173	2G	4E			
E12	6C	5B	R4973	2E	7D	R5174	2H	4E	W4980	9L	6C
E13	4F	4C	R4974	2E	7D	R5176	4G	4D	W5070	5K	5E
E14	4F	4B	R4975	9E	6D	R5177	2F	4C	W5075	5H	5D
E15	7B	5A	R4976	9K	6E	R5181	2F	4C	W5080	5G	5D
E16	5B	5A	R4977	9L	6D	R5182	1G	4C	W5085	5D	4C
E17	5E	5C	R4978	9L	6D	R5190	5F	4B			
E18	5E	4C	R4979	5K	6E	R5191	5C	4A			

Partial A29 also shown on diagrams 30, 31 and 33.

## CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4991	6B	CHASSIS	W4990	9B	CHASSIS	W5090	5B	CHASSIS			
P5090	5B	CHASSIS	W4991	7B	CHASSIS						

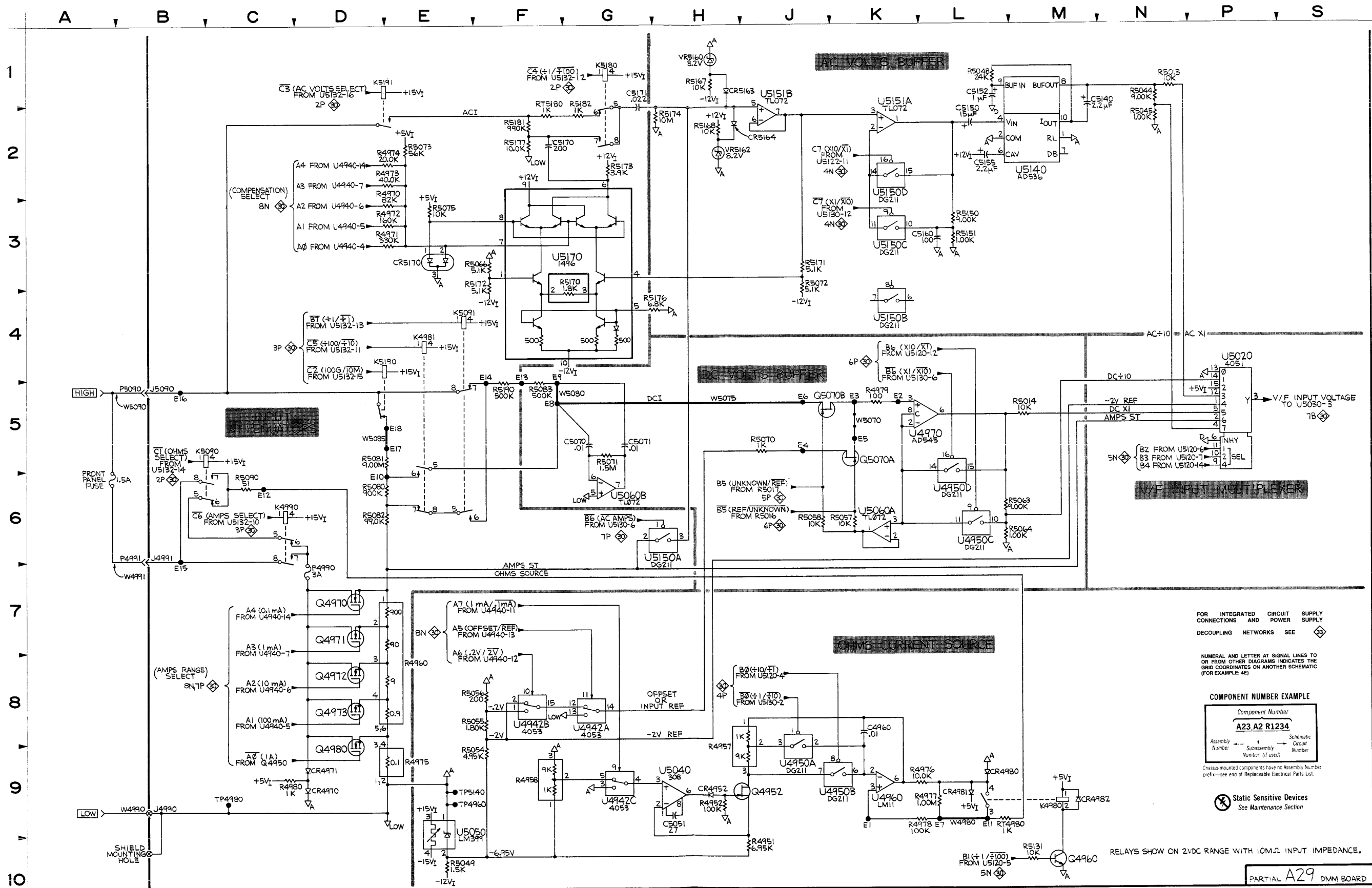


2445/2465 OPTION 01 (DMM)

SCHEM	BOARD
LOCATION	LOCATION
9L	6B
1F	4C
9E	6F
9C	5D
9E	4G
8G	6G
8F	6G
9G	6G
9J	6F
9K	6F
6L	6F
9K	6E
5L	5E
4P	5J
9H	5G
9E	5F
6E	5F
6G	5F
2M	4G
6H	4F
4K	4F
3K	4F
2K	4F
1K	4F
1J	4F
3G	4D
1H	5F
2H	4F
9L	6C
5K	5E
5H	5D
5G	5D
5D	4C

SCHEM	BOARD
LOCATION	LOCATION



2445/2465 OPTION 01 (DMM)

4182-27

DMM INPUT CIRCUIT

FOR INTEGRATED CIRCUIT SUPPLY CONNECTIONS AND POWER SUPPLY DECOUPLING NETWORKS SEE  $\square$

NUMERAL AND LETTER AT SIGNAL LINES TO OR FROM OTHER DIAGRAMS INDICATES THE GRID COORDINATES ON ANOTHER SCHEMATIC (FOR EXAMPLE, 4E)

COMPONENT NUMBER EXAMPLE  
 Component Number  
**A23 A2 R1234**  
 Assembly Number --- Subassembly Number (if used) --- Circuit Number

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

Static Sensitive Devices  
 See Maintenance Section

RELAYS SHOW ON 2VDC RANGE WITH 10MΩ INPUT IMPEDANCE.

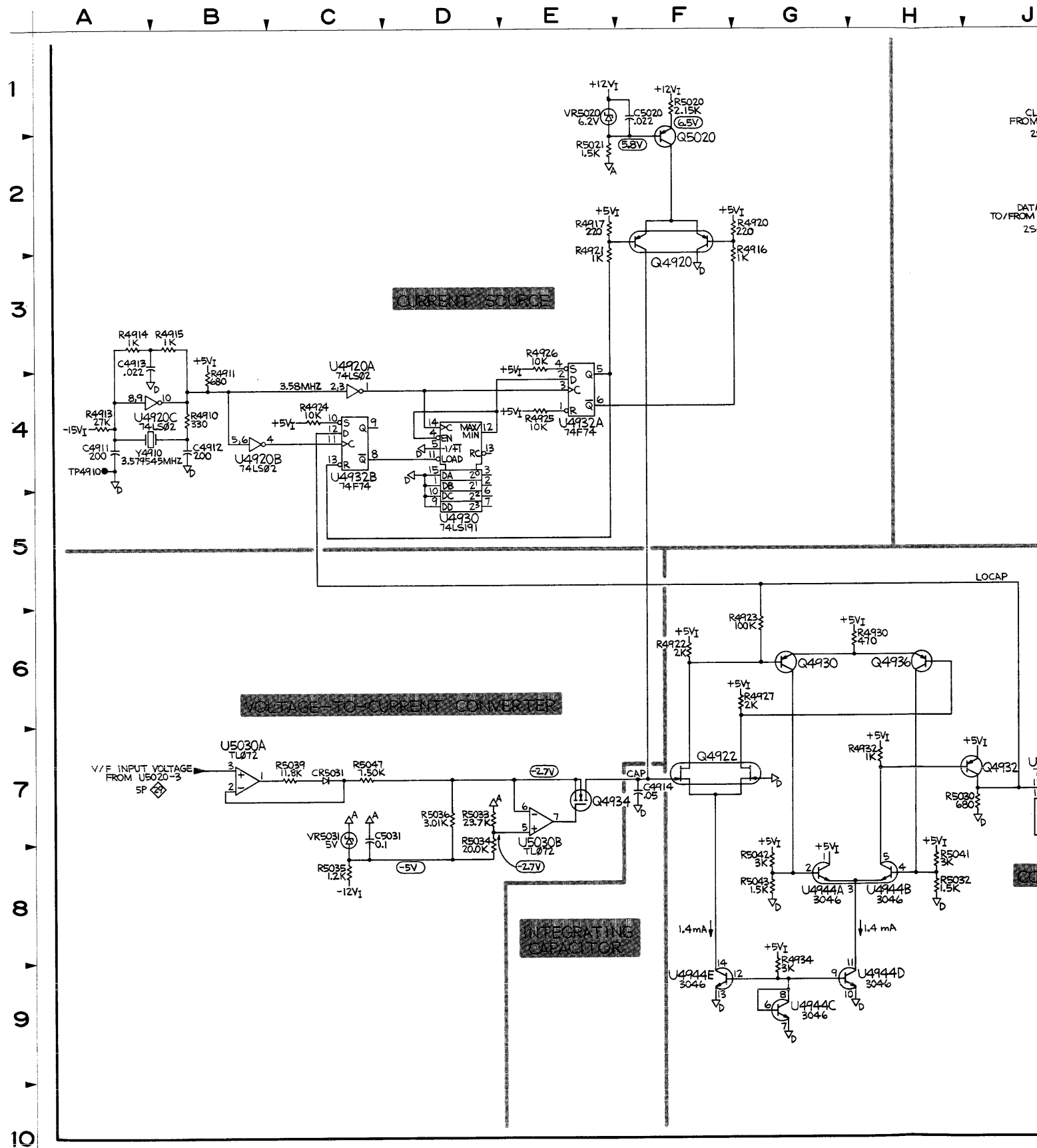
PARTIAL A29 DMM BOARD

V/F CONVERTER AND DIGITAL CONTROL DIAGRAM

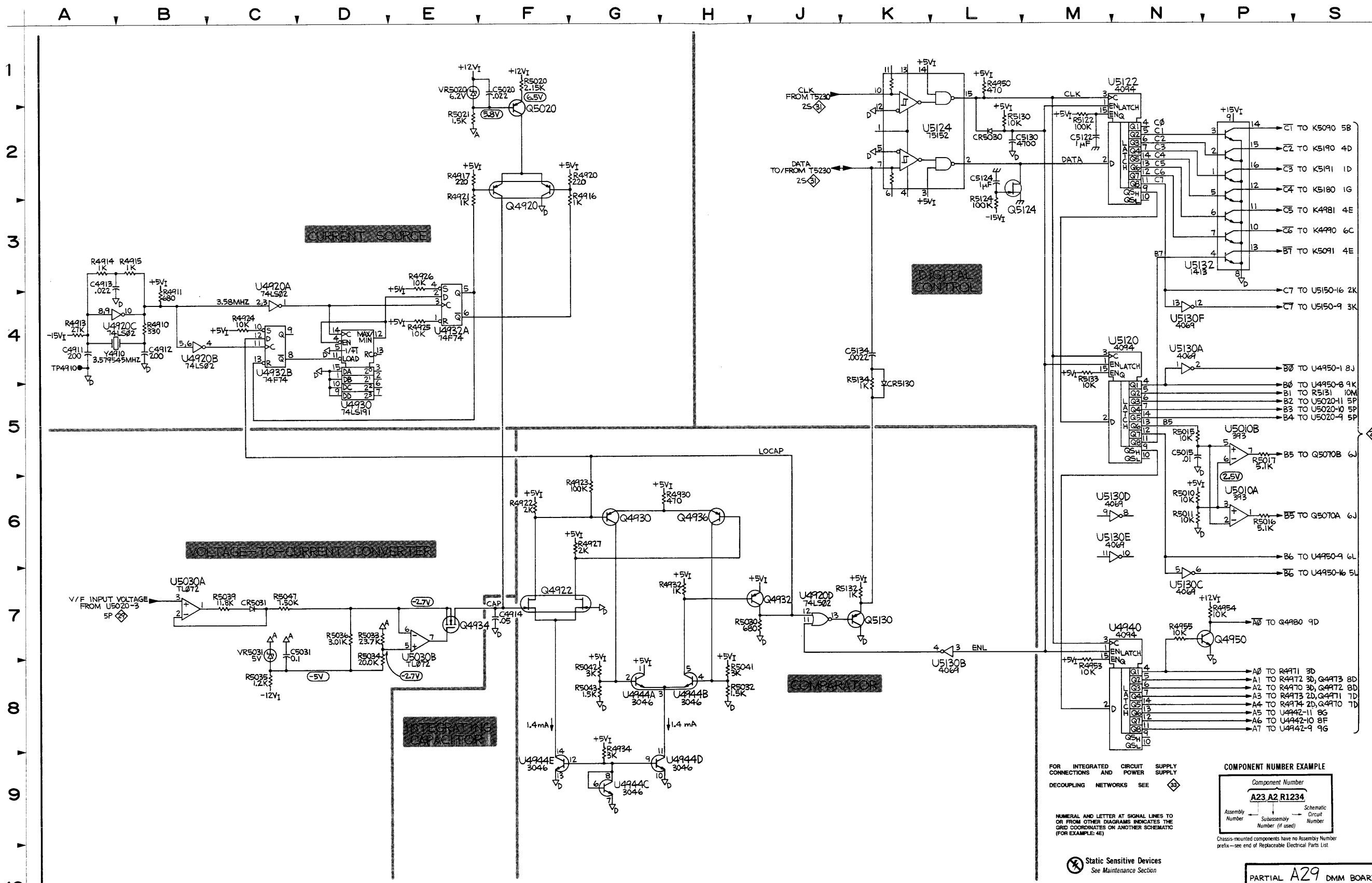
30

ASSEMBLY A29											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C4911	4A	7K	R4910	4B	7J	R5020	1F	5J	U4932A	4E	6H
C4912	4B	7J	R4911	3B	7J	R5021	2E	5J	U4932B	4C	6H
C4913	3A	6J	R4913	4A	6K	R5030	7H	5H	U4940	7N	7G
C4914	7F	5K	R4914	3A	6J	R5032	8H	5H	U4944A	8G	6G
C5015	5N	5K	R4915	3B	6J	R5033	7D	5H	U4944B	8H	6G
C5020	1F	5H	R4916	2G	6J	R5034	7D	5H	U4944C	9G	6G
C5031	7D	5H	R4917	2E	6J	R5035	8C	5H	U4944D	9H	6G
C5122	2M	4J	R4920	2G	6J	R5036	7D	5H	U4944E	9F	6G
C5124	2L	3J	R4921	2E	6J	R5039	7C	5H	U5010A	6P	5K
C5130	2M	4H	R4922	6F	6J	R5041	8H	5G	U5010B	5P	5K
C5134	4K	3H	R4923	6G	6J	R5042	8G	5G	U5030A	7B	5H
			R4924	4C	6J	R5043	8G	5G	U5030B	7E	5H
CR5030	2L	5H	R4925	4E	6J	R5047	7C	5G	U5120	4N	4J
CR5031	7C	5H	R4926	3E	6J	R5122	2M	4J	U5122	1N	4J
CR5130	5K	3H	R4927	6G	6J	R5124	3L	4J	U5124	2L	3J
			R4930	6H	6H	R5130	2L	4H	U5130A	4N	4H
			R4932	7H	6H	R5132	7K	4H	U5130B	8L	4H
Q4920	3F	6J	R4934	8G	6H	R5133	4M	4H	U5130C	7N	4H
Q4922	7F	6J	R4950	1L	7G	R5134	4K	3H	U5130D	6N	4H
Q4930	6G	6H	R4953	8M	7F				U5130E	6N	4H
Q4932	7J	6H	R4954	7P	7F	TP4910	4A	6K	U5130F	4N	4H
Q4934	7E	6H	R4955	7N	7F				U5132	3N	4H
Q4936	6H	6H									
Q4950	7P	7F	R5010	6N	5K	U4920A	3C	7J			
Q5020	2F	5J	R5011	6N	5K	U4920B	4B	7J	VR5020	1E	5J
Q5124	3L	4J	R5015	5N	5K	U4920C	4B	7J	VR5031	7C	5H
Q5130	7K	4H	R5016	6P	5K	U4920D	7J	7J			
			R5017	5P	5K	U4930	5D	7H	Y4910	4B	7K

Partial A29 also shown on diagrams 29, 31 and 33.



SCHEMATIC LOCATION	BOARD LOCATION
4E	6H
4C	6H
7N	7G
8G	6G
8H	6G
9G	6G
9H	6G
9F	6G
6P	5K
5P	5K
7B	5H
7E	5H
4N	4J
1N	4J
2L	3J
4N	4H
8L	4H
7N	4H
6N	4H
4N	4H
3N	4H
1E	5J
7C	5H
4B	7K



FOR INTEGRATED CIRCUITS AND DECOUPLING NETWORKS SEE SUPPLY POWER SUPPLY

NUMERAL AND LETTER AT SIGNAL LINES TO OR FROM OTHER DIAGRAMS INDICATES THE GRID COORDINATES ON ANOTHER SCHEMATIC (FOR EXAMPLE: 4E)

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

PARTIAL A29 DMM BOARD

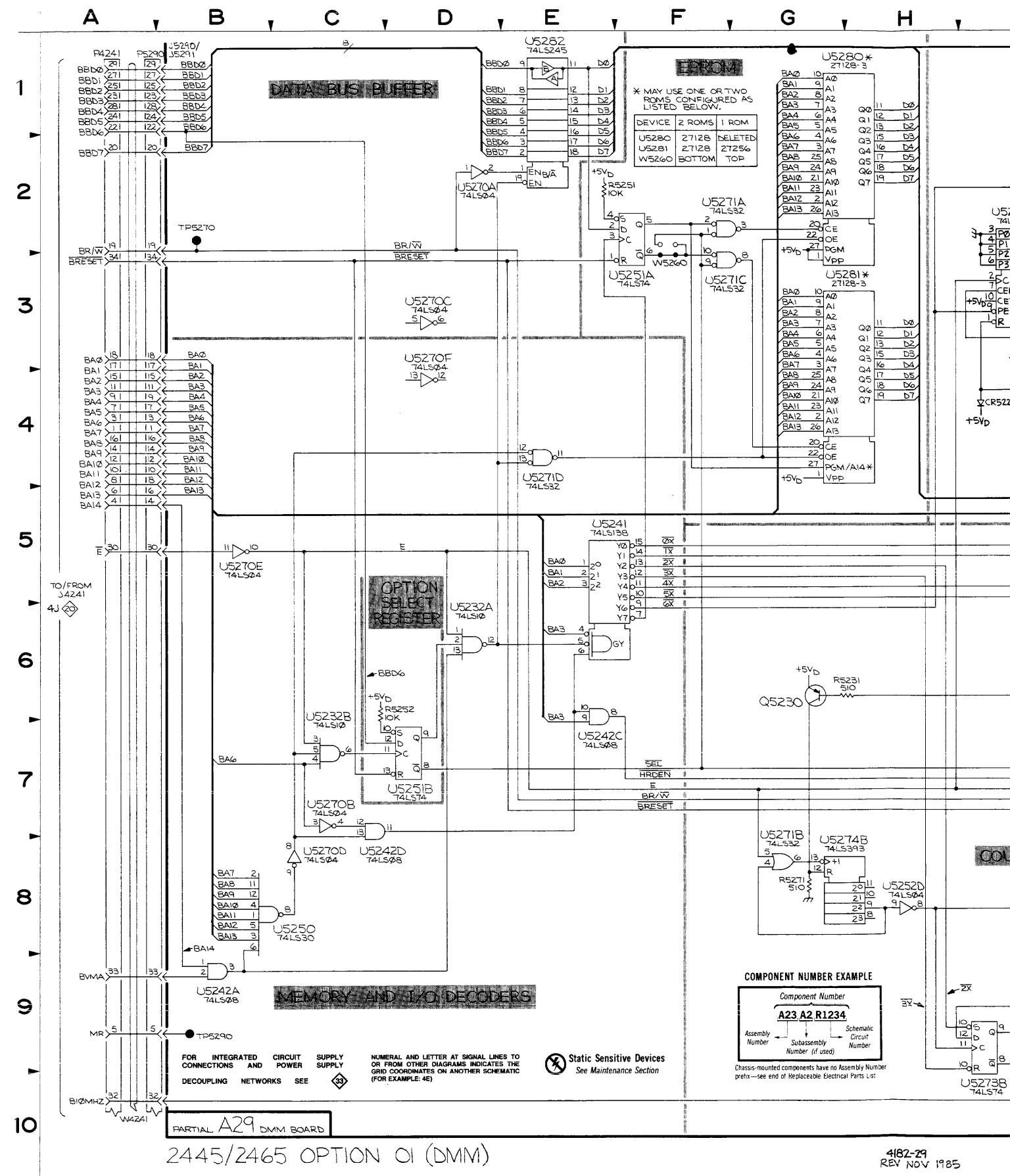
# DIGITAL COUNTER AND PROCESSOR INTERFACE DIAGRAM

31

ASSEMBLY A29											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C5222	4J	2J	R5231	6G	2H	U5232C	4N	1H	U5270E	5B	3E
C5232*	3L	2K	R5232	2P	2G	U5240	1K	3G	U5270F	3D	3E
CR5210	3L	2K	R5233*	3L	2K	U5241	5E	2G	U5271A	2F	3D
CR5211	3L	2K	R5251	2F	1F	U5242A	9B	1G	U5271B	8G	3D
CR5212	8N	1K	R5252	6D	1F	U5242B	1N	1G	U5271C	3F	3D
CR5221	4J	1J	R5270	10J	1E	U5242C	7E	1G	U5271D	4E	3D
			R5271	8G	1D	U5242D	8C	1G	U5272	7M	2D
DS5210	3P	1K	U5250	8C	3F	U5250	8C	3F	U5273A	10K	1E
J5210	8P	1K	T5230A	2S	3H	U5251A	3F	2F	U5273B	10J	1E
J5290	1B	1A	T5230B	2S	3H	U5251B	7D	2F	U5274A	9K	1D
J5291	1B	1A	TP5270	2B	3E	U5252A	4M	1F	U5274B	8G	1D
Q5210	8P	1K	TP5290	9B	3B	U5252B	3K	1F	U5280	1G	3C
Q5230	6G	2H				U5252C	4P	1F	U5281	3G	2C
			U5222A	4P	2J	U5252D	8H	1F	U5282	1E	1B
R5210	8N	1K	U5222B	9N	2J	U5252E	2K	1F	VR5210	8P	1K
R5211	4P	1K	U5224	2J	1J	U5252F	8M	1F	W5260	3F	3F
R5220	3L	1J	U5230A	2P	2H	U5260	9P	2E			
R5221	3K	1J	U5230B	3P	2H	U5270A	2D	3E			
R5222	4J	2J	U5230C	3M	2H	U5270B	7C	3E			
R5223	4J	2J	U5231	3M	2H	U5270C	3D	3E			
R5230	2P	2H	U5232A	6D	1H	U5270D	8C	3E			
			U5232B	6C	1H						

Partial A29 also shown on diagrams 29, 30 and 33.

CHASSIS MOUNTED PARTS											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P4241	1A	CHASSIS	P5210	8S	CHASSIS	W4241	10A	CHASSIS			
P4300	8S	CHASSIS	P5290	1A	CHASSIS	W5210	8S	CHASSIS			



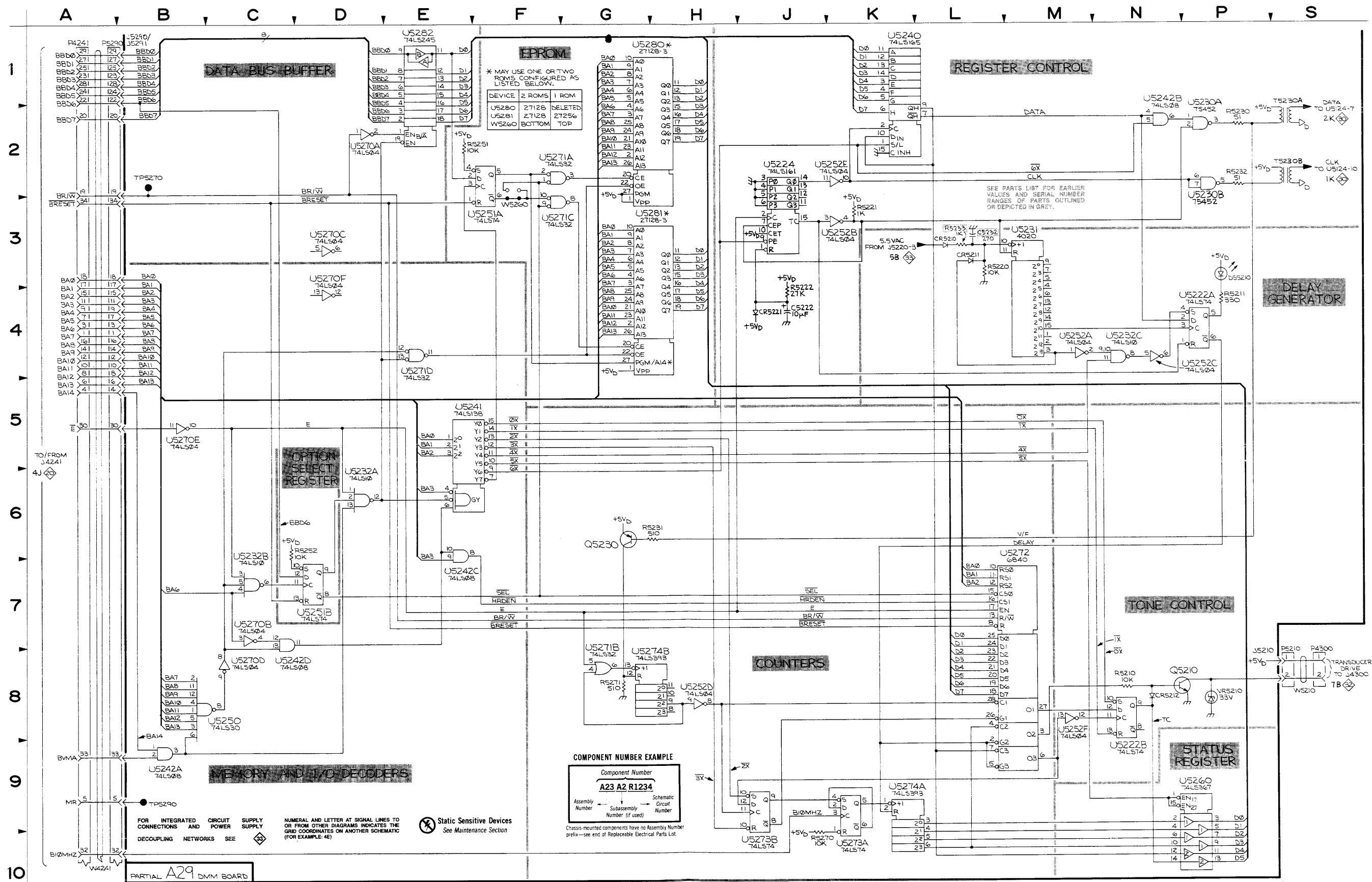
PARTIAL A29 DMM BOARD  
2445/2465 OPTION 01 (DMM)



31

SCHEM LOCATION	BOARD LOCATION
5B	3E
3D	3E
2F	3D
8G	3D
3F	3D
4E	3D
7M	2D
10K	1E
9K	1E
10J	1D
8G	1D
1G	3C
3G	2C
1E	1B

SCHEM LOCATION	BOARD LOCATION
8P	1K
3F	3F



PARTIAL A29 DMM BOARD  
2445/2465 OPTION 01 (DMM)

4182-29  
REV NOV 1985

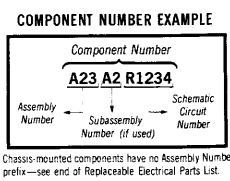
DIGITAL COUNTER AND PROCESSOR INTERFACE

31

FOR INTEGRATED CIRCUIT CONNECTIONS AND POWER SUPPLY DECOUPLING NETWORKS SEE **Static Sensitive Devices** See Maintenance Section

NUMERAL AND LETTER AT SIGNAL LINES TO OR FROM OTHER DIAGRAMS INDICATES THE GRID COORDINATES ON ANOTHER SCHEMATIC (FOR EXAMPLE: 4E)

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





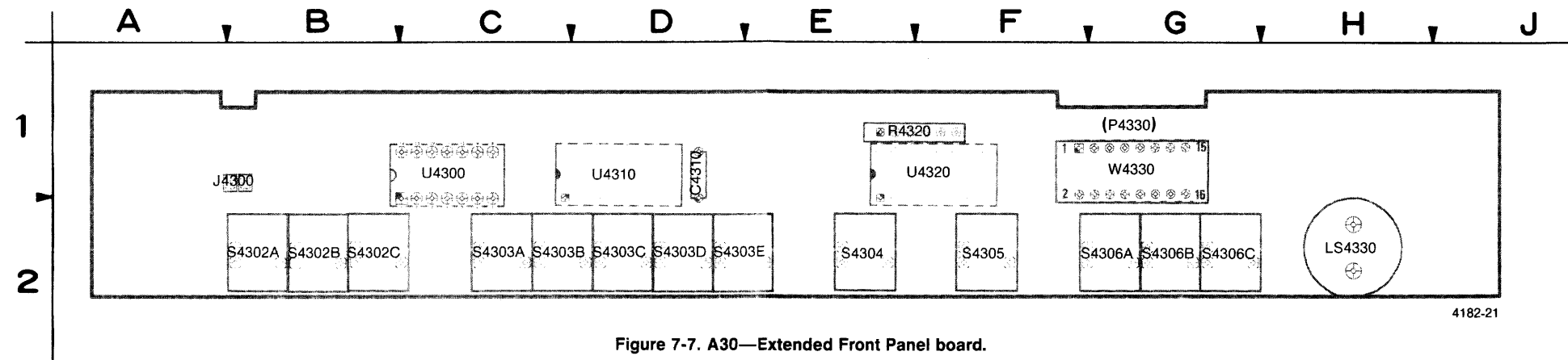
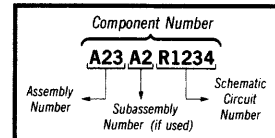


Figure 7-7. A30—Extended Front Panel board.

CIRCUIT NUMBER	SCH NUM
C4310	31
J4300	31
LS4330	31
P4330	31
R4320	31
S4302	31

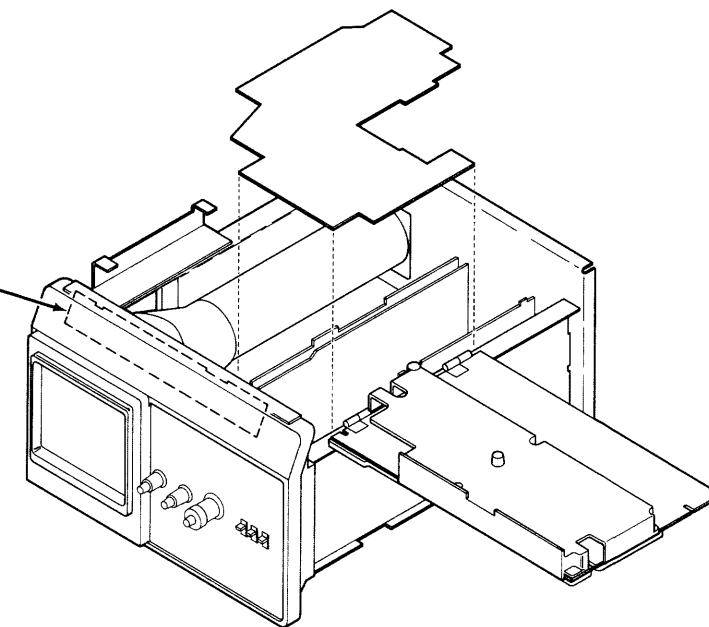
 Static Sensitive Devices  
See Maintenance Section

**COMPONENT NUMBER EXAMPLE**



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

A30—EXTENDED FRONT PANEL BOARD



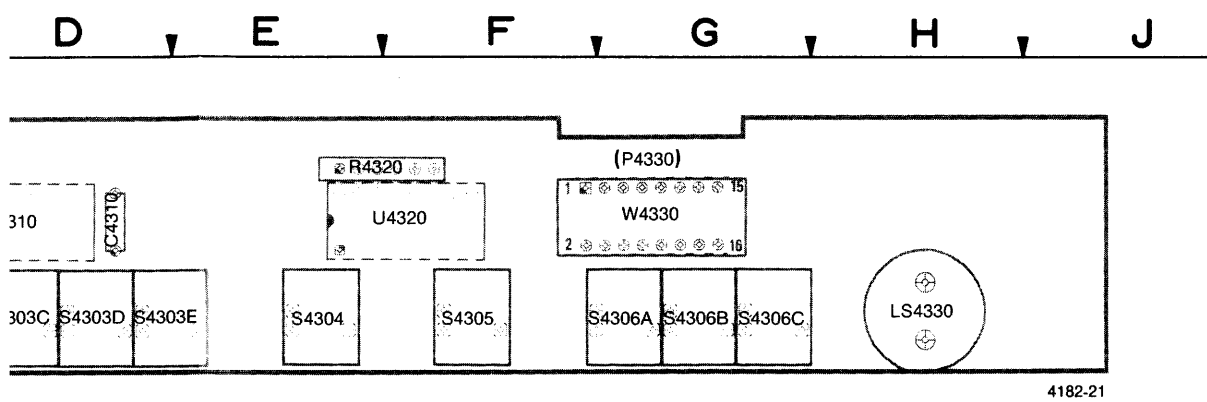
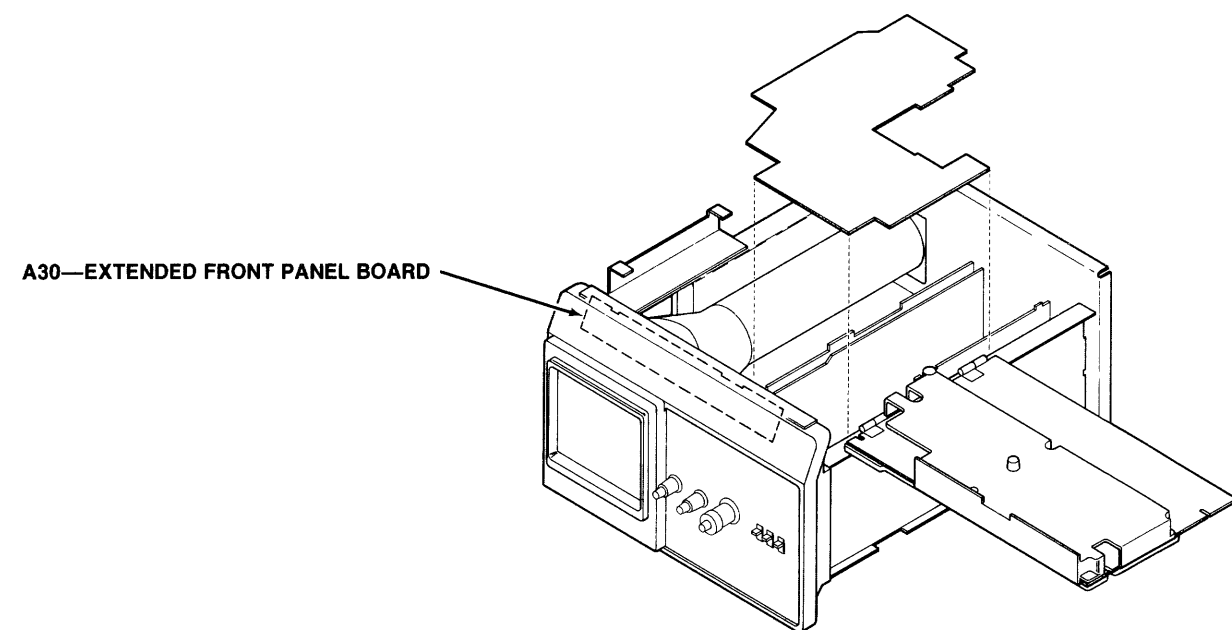


Figure 7-7. A30—Extended Front Panel board.

**A30—EXTENDED FRONT PANEL BOARD**

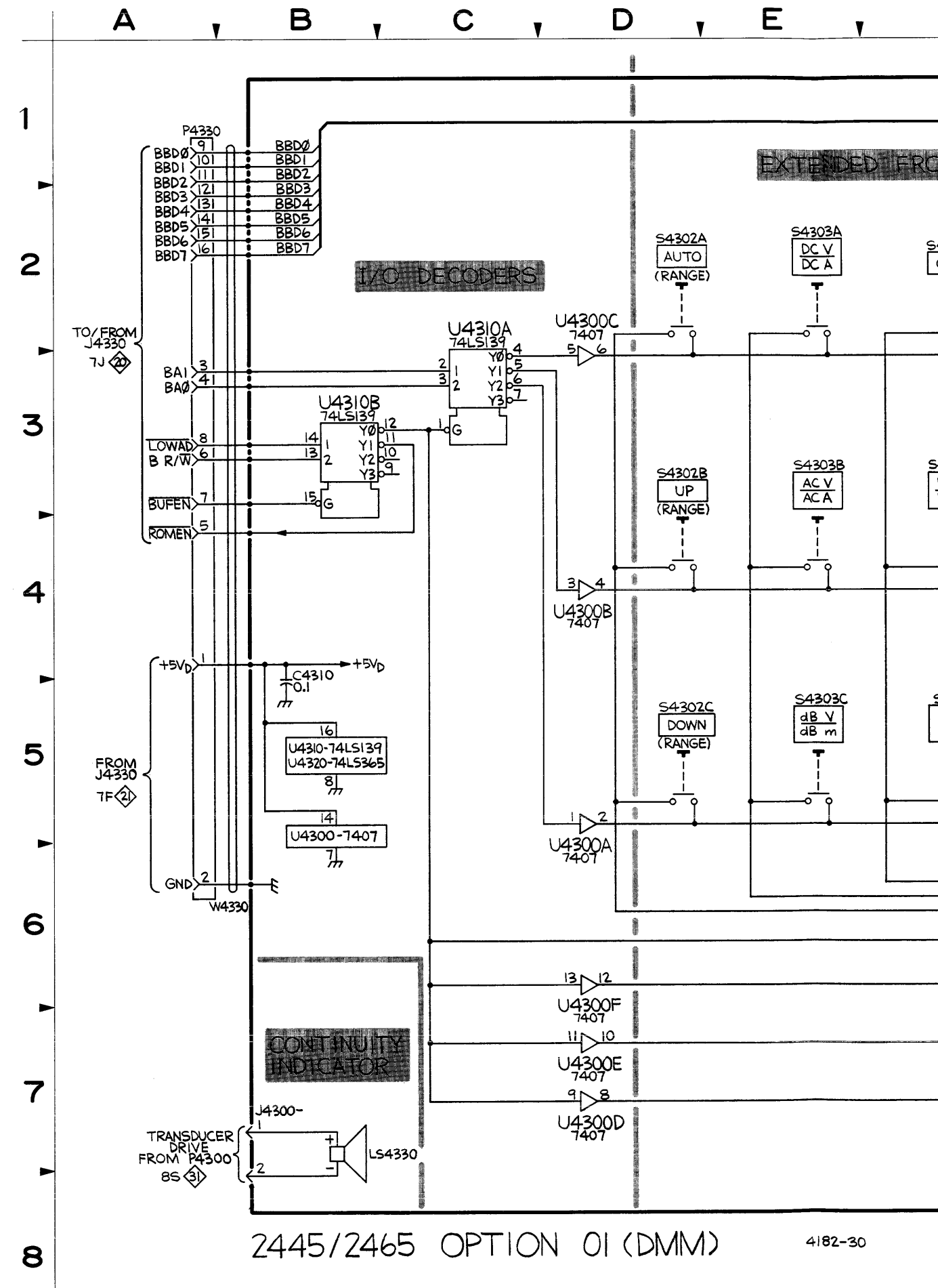
CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
C4310	32	S4302	32	S4303	32	U4300	32	U4300	32	W4330	32
J4300	32	S4302	32	S4304	32	U4300	32	U4310	32		
LS4330	32	S4303	32	S4305	32	U4300	32	U4310	32		
P4330	32	S4303	32	S4306	32	U4300	32	U4310	32		
R4320	32	S4303	32	S4306	32	U4300	32	U4320	32		
S4302	32	S4303	32	S4306	32	U4300	32	U4320	32		



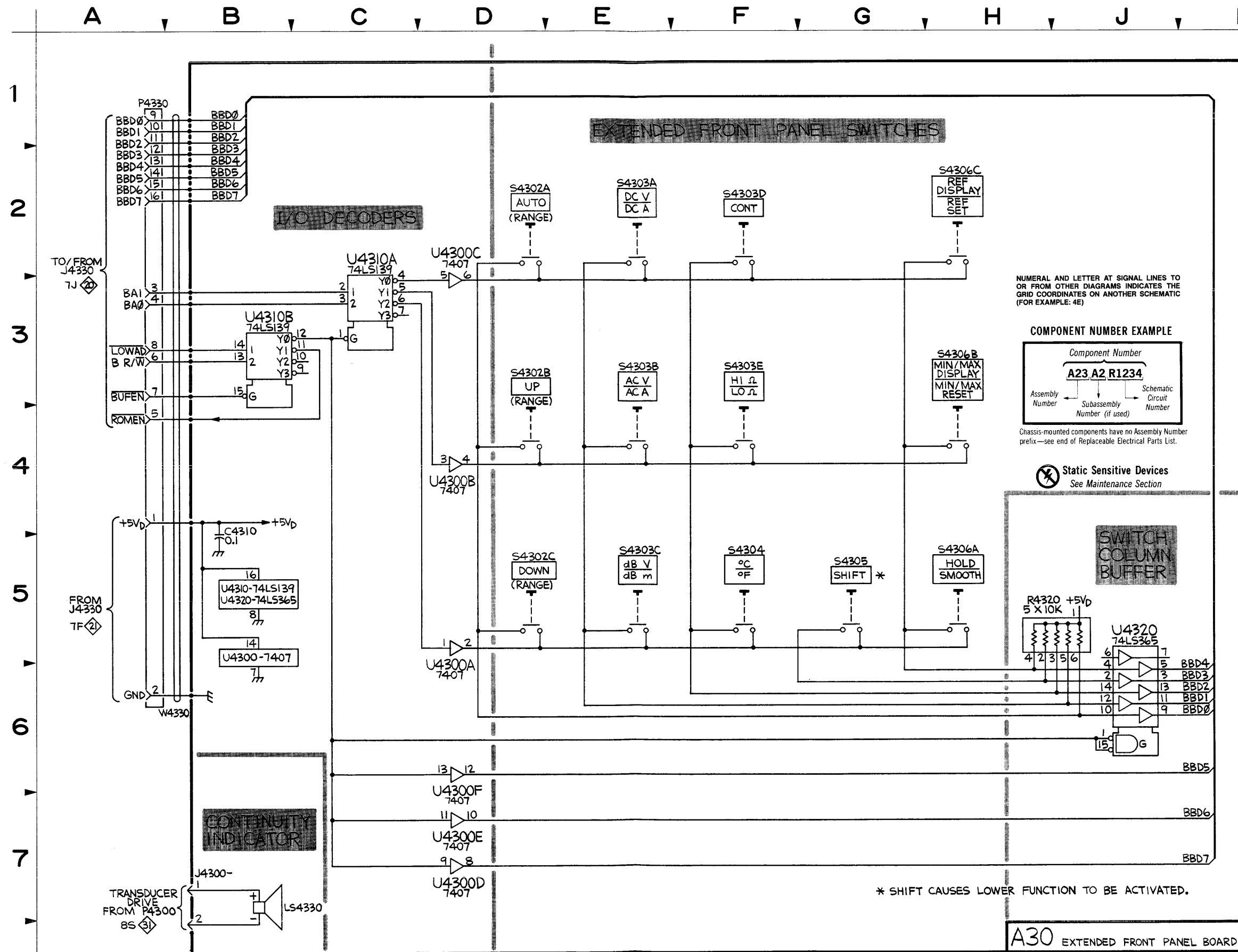
EXTENDED FRONT PANEL DIAGRAM

32

ASSEMBLY A30											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C4310	4B	1D	S4302A	2D	2B	S4306A	5H	2G	U4300	5B	1C
J4300	7B	1B	S4302B	3D	2B	S4306B	3H	2G	U4310A	2C	1D
LS4330	7C	2H	S4302C	5D	2B	S4306C	2H	2G	U4310B	3B	1D
P4330	1A	1G	S4303A	2E	2C	U4300A	5D	1C	U4310	5B	1D
R4320	5H	1E	S4303B	3E	2C	U4300B	4D	1C	U4320	5B	1F
			S4303C	5E	2D	U4300C	2D	1C	U4320	5J	1F
			S4303D	2F	2D	U4300D	7D	1C	W4330	6B	1G
			S4303E	3F	2D	U4300E	7D	1C			
			S4304	5F	2E	U4300F	6D	1C			
			S4305	5G	2F						



SCHEM LOCATION	BOARD LOCATION
5B	1C
2C	1D
3B	1D
5B	1D
5B	1F
5J	1F
6B	1G



NUMERAL AND LETTER AT SIGNAL LINES TO OR FROM OTHER DIAGRAMS INDICATES THE GRID COORDINATES ON ANOTHER SCHEMATIC (FOR EXAMPLE: 4E)

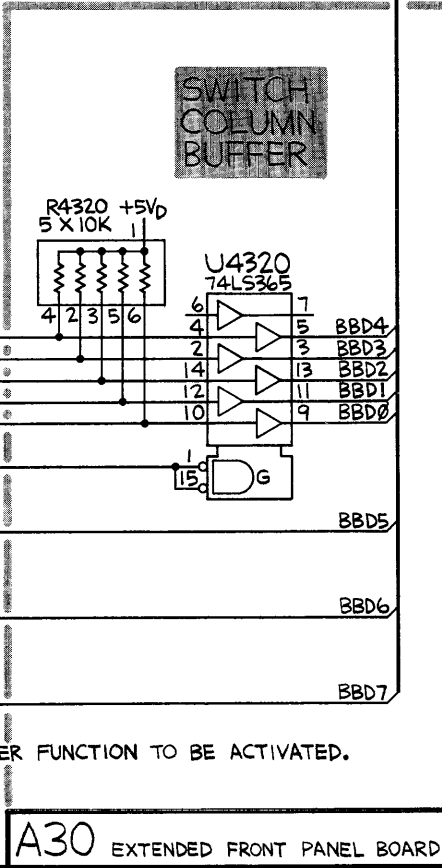
**COMPONENT NUMBER EXAMPLE**

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.

**Static Sensitive Devices**  
 See Maintenance Section



\* SHIFT CAUSES LOWER FUNCTION TO BE ACTIVATED.

A30 EXTENDED FRONT PANEL BOARD

POWER DISTRIBUTION DIAGRAM

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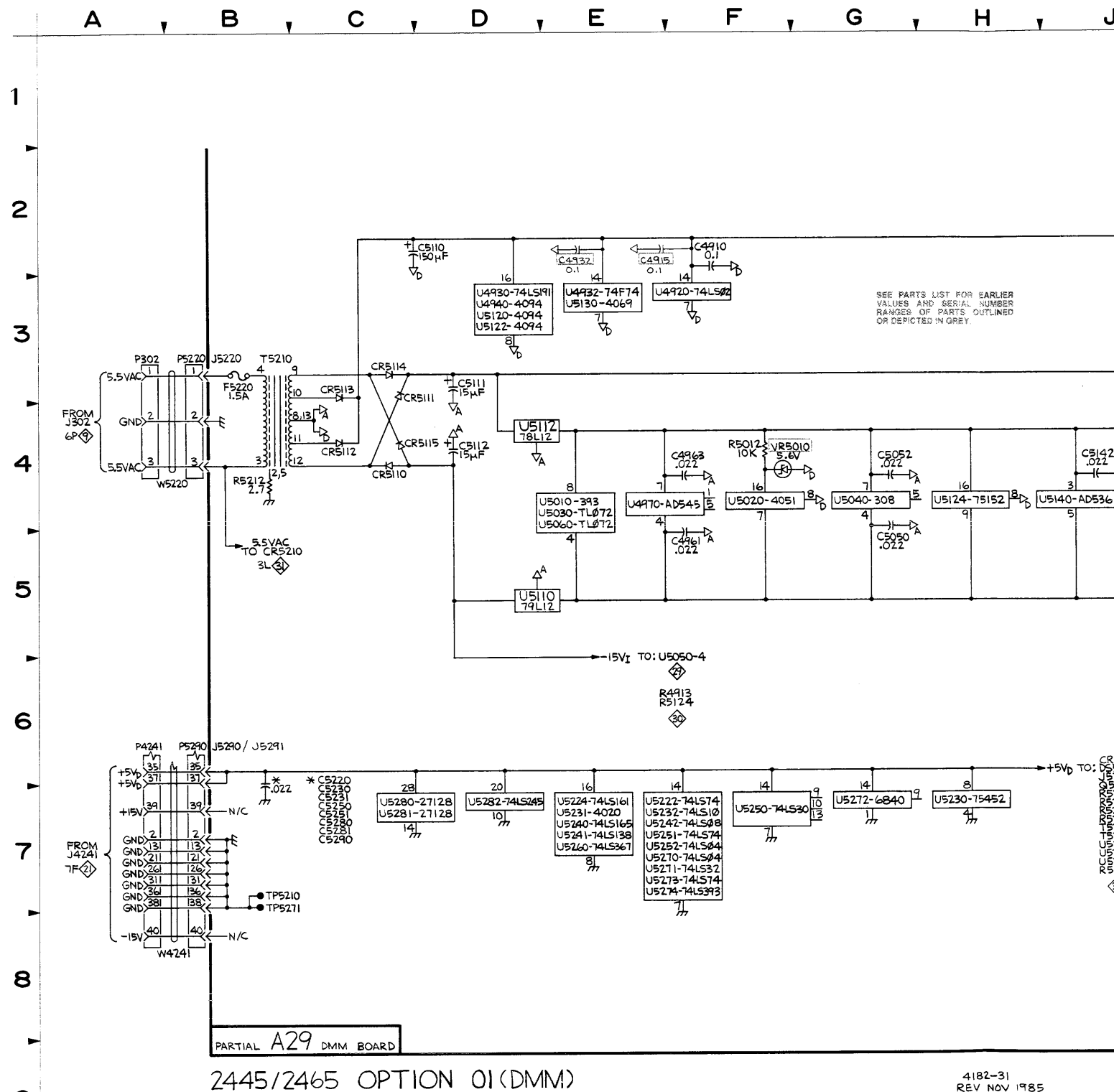
ASSEMBLY A29											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C4910	2F	6K	CR5111	3D	4K	U4940	3D	7G	U5231	7E	2H
C4915*	3F	6H	CR5112	4C	4K	U4942	4P	6G	U5232	7E	1H
C4932*	3E	6J	CR5113	3C	4K	U4950	4M	6F	U5240	7E	3G
C4961	5F	6F	CR5114	3C	4J	U4960	4N	6E	U5241	7E	2G
C4962	4N	6F	CR5115	4D	4J	U4970	4E	5E	U5242	7E	1G
C4963	4F	6F				U5010	4E	5K	U5250	7F	3F
C5050	5G	5G	F5220	3B	2J	U5020	4F	5J	U5251	7E	2F
C5052	4G	5G				U5030	4E	5H	U5252	7E	1F
C5110	2D	4K	J5220	3B	2J	U5040	4G	5G	U5260	7E	2E
C5111	3D	4K	J5290	6B	1A	U5060	4E	5F	U5270	7E	3E
C5112	4D	4J	J5291	6B	1A	U5110	5D	4K	U5271	7E	3D
C5142	4J	4G				U5112	4D	4K	U5272	7G	2D
C5151	5L	4G	R5012	4F	5J	U5120	3D	4J	U5273	7E	1E
C5153	4L	4F	R5212	4B	2K	U5122	3D	4J	U5274	7E	1D
C5220	6C	2J				U5124	4H	3J	U5280	7C	3C
C5230	7C	2H	T5210	3B	3K	U5130	3E	4H	U5281	7C	2C
C5231	7C	1H				U5140	4J	4G	U5282	7D	1B
C5250	7C	3G	TP5210	7B	2K	U5150	4J	4F			
C5251	7C	2F	TP5271	7B	2D	U5151	4K	4F	VR5010	4G	5K
C5280	7C	3D				U5222	7E	2J			
C5281	7C	1C	U4920	3F	7J	U5224	7E	1J			
C5290	7C	3B	U4930	3D	7H	U5230	7H	2H			
CR5110	4C	4K	U4932	3E	6H						

Partial A29 also shown on diagrams 29, 30 and 31.

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
P302	3A	CHASSIS	P5220	3B	CHASSIS	W4241	8B	CHASSIS			
P4241	6A	CHASSIS	P5290	6B	CHASSIS	W5220	4B	CHASSIS			

\*See Parts List for serial number ranges.



PARTIAL A29 DMM BOARD  
2445/2465 OPTION 01 (DMM)



J100 A1 TO A20		
Pin	Line Name	Schem
1	CH1 PO TERM	4
2	CH1 PO	4
3	GND	4
4	GND	4
5	CH2 POS	4
6	CH2 POS	4
7	GND	4
8	GND	4
9	CH2 PO	4
10	CH2 PO TERM	4

P100 A1 TO A20		
Pin	Line Name	Schem
1	GND	21
2	CH2 PO	21

J/P101 A1 TO A20		
Pin	Line Name	Schem
1	TSA	5,21
2	GND	5,21
3	TSA	5,21
4	GND	5,21
5	GND	5,21
6	TSB	5,21
7	GND	5,21
8	TSB	5,21
9	GND	5,21
10	NO PIN	5,21

J/P102 A1 TO A20		
Pin	Line Name	Schem
1	BHO	5,21
2	GND	5,21
3	A AUX TRG	5,21
4	GND	5,21
5	AHO	5,21
6	NO PIN	5,21
7	GND	5,21
8	B AUX TRG	5,21
9	GND	5,21
10	DS	5,21

J/P500 A5 TO A20		
Pin	Line Name	Schem
1	A7	1,20
2	A15	1,20
3	A6	1,20
4	A14	1,20
5	MR	1,20
6	A13	1,20
7	A5	1,20
8	A12	1,20
9	A4	1,20
10	A11	1,20
11	A3	1,20
12	A10	1,20
13	GND C	1,20
14	A9	1,20
15	A2	1,20
16	A8	1,20
17	A1	1,20
18	A0	1,20
19	R/W	1,20
20	BD7	1,20
21	GND C	1,20
22	BD6	1,20
23	BD3	1,20
24	BD5	1,20
25	BD2	1,20
26	GND C	1,20
27	BD1	1,20
28	BD4	1,20
29	BD0	1,20
30	E	1,20
31	GND C	1,20
32	10MHz	1,20
33	VMA	1,20
34	RESET	1,20

J/P502 A5 TO A20		
Pin	Line Name	Schem
1	OEA35	2,20
2	OEACLK	2,20
3	GND C	2,20
4	OEAI/O	2,20
5	OEAC2	2,20
6	OEAC3	2,20
7	OEAC1	2,20

J651(B)/P651/W651 A6 TO A20		
Pin	Line Name	Schem
1	DAC MUX1 IN	3,21
2	GND	12,21
3	HORIZ POS	3,21
4	+1.36V	3,21
5	-1.25V	3,21
6	DLY A	3,21
7	ΔA	3,21
8	ΔB	3,21
9	DLY B	3,21
10	HORIZ VAR	3,21
11	TRIG LEVEL	3,21
12	HOLDOFF	3,21
13	-1.25V	3,21
14	TRACE SEP	3,21
15	CH1 VAR	3,21
16	CH2 VAR	3,21
17	CH1 POS	3,21
18	CH2 POS	3,21
19	CH3 POS	3,21
20	CH4 POS	3,21

J651/P651(B) A20 TO A5		
Pin	Line Name	Schem
1	DAC MUX1 IN	2,21
2	GND	12,21
3	HORIZ POS	2,21
4	+1.36V	2,21
5	-1.25V	2,21
6	DLY A	2,21
7	ΔA	2,21
8	ΔB	2,21
9	DLY B	2,21
10	HORIZ VAR	2,21
11	TRIG LEVEL	2,21
12	HOLDOFF	2,21
13	-1.25V	2,21
14	TRACE SEP	2,21
15	CH1 VAR	2,21
16	CH2 VAR	2,21
17	CH1 POS	2,21
18	CH2 POS	2,21
19	CH3 POS	2,21
20	CH4 POS	2,21

J/P/W4207 A5 TO A20		
Pin	Line Name	Schem
1	OEA35	20
2	OEACLK	20
3	GND C	20
4	OEAI/O	20
5	OEAC2	20
6	OEAC3	20
7	OEAC1	20

J/P/W4210 A5 TO A20		
Pin	Line Name	Schem
1	A7	20
2	A15	20
3	A6	20
4	A14	20
5	MR	20
6	A13	20
7	A5	20
8	A12	20
9	A4	20
10	A11	20
11	A3	20
12	A10	20
13	GND C	20
14	A9	20
15	A2	20
16	A8	20
17	A1	20
18	A0	20
19	R/W	20
20	BD7	20
21	GND C	20
22	BD6	20
23	BD3	20
24	BD5	20
25	BD2	20
26	GND C	20
27	BD1	20
28	BD4	20
29	BD0	20
30	E	20
31	GND C	20
32	10MHz	20
33	VMA	20
34	RESET	20

J/P4220 A20 TO A25		
Pin	Line Name	Schem
1	DS	21,25
2	GND	21,25
3	GND	21,25
4	AHO	21,25
5	A AUX TRG	21,25
6	GND	21,25
7	GND	21,25
8	CH2 PO	21,24
9	SSA	21,24
10	GND	21,25
11	GND	21,25
12	GND	21,25
13	GND	21,25
14	CH2 OFFSET	21,24

J/P4221 A20 TO A27		
Pin	Line Name	Schem
1	GND	21,27
2	TSA	21,26
3	TSA	21,26
4	GND	21,27
5	TSB	21,26
6	GND	21,27
7	GND	21,27
8	TSB	21,26
9	GND	21,27
10	GND	21,27
11	SGB	21,26
12	GND	21,27
13	GND	21,27
14	SGA	21,26
15	GND	21,27
16	B AUX TRG	21,26
17	DS	21,26
18	GND	21,27
19	GND	21,27
20	AHO	21,26
21	A AUX TRG	21,26
22	GND	21,27
23	GND	21,27
24	BHO	21,26

J4230 A1 TO A20		
Pin	Line Name	Schem
1	CH1 PO TERM (GND)	21
2	CH1 PO	21
3	GND	21
4	GND	21
5	CH2 POS	21
6	CH2 POS	21
7	GND	21
8	GND	21
9	CH2 PO	21
10	CH2 PO TERM (GND)	21

P4230 A1 TO A20		
Pin	Line Name	Schem
1	GND	21
2	CH2 PO	21

J/P/W4232 A20 TO A1		
Pin	Line Name	Schem
1	BHO	21
2	GND	21
3	A AUX TRG	21
4	GND	21
5	AHO	21
6	GND	21
7	GND	21
8	B AUX TRG	21
9	GND	21
10	DS	21

J/P/W4236	
Pin	Line Name
1	TSA
2	GND
3	TSA
4	GND
5	GND
6	TSB
7	GND
8	TSB
9	GND
10	NO PIN

J/P4238	
Pin	Line Name
1	DAC MUX1 II
2	GND
3	CH2 POS
4	TRACE SEP
5	CH4 POS
6	CH1 POS
7	TRACE SEP
8	CH3 POS
9	CH1 POS
10	CH2 POS
11	CH3 POS
12	CH4 POS

TO A20

Schem

3,21  
12,21  
3,21  
3,21  
3,21  
3,21  
3,21  
3,21  
3,21  
3,21  
3,21  
3,21  
3,21  
3,21  
3,21  
3,21  
3,21  
3,21  
3,21  
3,21

0 TO A5

Schem

2,21  
12,21  
2,21  
2,21  
2,21  
2,21  
2,21  
2,21  
2,21  
2,21  
2,21  
2,21  
2,21  
2,21  
2,21  
2,21  
2,21  
2,21  
2,21  
2,21

J/P/W4207		A5 TO A20	
Pin	Line Name	Schem	
1	OEA35	20	
2	OEACLK	20	
3	GND C	20	
4	OEAI/O	20	
5	OEAC2	20	
6	OEAC3	20	
7	OEAC1	20	

J/P4220		A20 TO A25	
Pin	Line Name	Schem	
1	$\overline{DS}$	21,25	
2	GND	21,25	
3	GND	21,25	
4	AHO	21,25	
5	$\overline{A}$ AUX TRG	21,25	
6	GND	21,25	
7	GND	21,25	
8	CH2 PO	21,24	
9	SSA	21,24	
10	GND	21,25	
11	GND	21,25	
12	GND	21,25	
13	GND	21,25	
14	CH2 OFFSET	21,24	

J4230		A1 TO A20	
Pin	Line Name	Schem	
1	CH1 PO TERM (GND)	21	
2	CH1 PO	21	
3	GND	21	
4	GND	21	
5	CH2 POS	21	
6	CH2 POS	21	
7	GND	21	
8	GND	21	
9	CH2 PO	21	
10	CH2 PO TERM (GND)	21	

J/P/W4236		A1 TO A20	
Pin	Line Name	Schem	
1	$\overline{TSA}$	21	
2	GND	21	
3	$\overline{TSA}$	21	
4	GND	21	
5	GND	21	
6	$\overline{TSB}$	21	
7	GND	21	
8	$\overline{TSB}$	21	
9	GND	21	
10	NO PIN	21	

J/P4240		A20 TO A27	
Pin	Line Name	Schem	
1	BA7	20,26	
2	GND	21,27	
3	BA6	20,26	
4	BA14	20,26	
5	MR	20,26	
6	BA13	20,26	
7	BA5	20,26	
8	BA12	20,26	
9	BA4	20,26	
10	BA11	20,26	
11	BA3	20,26	
12	BA10	20,26	
13	GND	21,27	
14	BA9	20,26	
15	BA2	20,26	
16	BA8	20,26	
17	BA1	20,26	
18	BA0	20,26	
19	BR/W	20,26	
20	BBD7	20,26	
21	GND	21,27	
22	BBD6	20,26	
23	BBD3	20,26	
24	BBD5	20,26	
25	BBD2	20,26	
26	GND	21,27	
27	BBD1	20,26	
28	BBD4	20,26	
29	BBD0	20,26	
30	$\overline{E}$	20,26	
31	GND	21,27	
32	B10MHz	20,26	
33	BVMA	20,26	
34	$\overline{BRESET}$	20,26	
35	+5V <sub>D</sub>	21,27	
36	GND	21,27	
37	+5V <sub>D</sub>	21,27	
38	GND	21,27	
39	+15V	21,27	
40	-15V	21,27	
41	+42V	21,27	
42	+5V	21,27	
43	-5V	21,27	
44	GND	21,27	

J/P/W4241		A20 TO A29	
Pin	Line Name	Schem	
1	BA7	20,31	
2	GND	21,33	
3	BA6	20,31	
4	BA14	20,31	
5	MR	20,31	
6	BA13	20,31	
7	BA5	20,31	
8	BA12	20,31	
9	BA4	20,31	
10	BA11	20,31	
11	BA3	20,31	
12	BA10	20,31	
13	GND	21,33	
14	BA9	20,31	
15	BA2	20,31	
16	BA8	20,31	
17	BA1	20,31	
18	BA0	20,31	
19	BR/W	20,31	
20	BBD7	20,31	
21	GND	21,33	
22	BBD6	20,31	
23	BBD3	20,31	
24	BBD5	20,31	
25	BBD2	20,31	
26	GND	21,33	
27	BBD1	20,31	
28	BBD4	20,31	
29	BBD0	20,31	
30	$\overline{E}$	20,31	
31	GND	21,33	
32	B10MHz	20,31	
33	BVMA	20,31	
34	$\overline{BRESET}$	20,31	
35	+5V <sub>D</sub>	21,33	
36	GND	21,33	
37	+5V <sub>D</sub>	21,33	
38	GND	21,33	
39	+15V	21,33	
40	-15V	21,33	

J/P/W4210		A5 TO A20	
Pin	Line Name	Schem	
1	A7	20	
2	A15	20	
3	A6	20	
4	A14	20	
5	MR	20	
6	A13	20	
7	A5	20	
8	A12	20	
9	A4	20	
10	A11	20	
11	A3	20	
12	A10	20	
13	GND C	20	
14	A9	20	
15	A2	20	
16	A8	20	
17	A1	20	
18	A0	20	
19	R/W	20	
20	BD7	20	
21	GND C	20	
22	BD6	20	
23	BD3	20	
24	BD5	20	
25	BD2	20	
26	GND C	20	
27	BD1	20	
28	BD4	20	
29	BD0	20	
30	$\overline{E}$	20	
31	GND C	20	
32	10MHz	20	
33	VMA	20	
34	$\overline{RESET}$	20	

J/P4221		A20 TO A27	
Pin	Line Name	Schem	
1	GND	21,27	
2	$\overline{TSA}$	21,26	
3	$\overline{TSA}$	21,26	
4	GND	21,27	
5	$\overline{TSB}$	21,26	
6	GND	21,27	
7	GND	21,27	
8	$\overline{TSB}$	21,26	
9	GND	21,27	
10	GND	21,27	
11	$\overline{SGB}$	21,26	
12	GND	21,27	
13	GND	21,27	
14	$\overline{SGA}$	21,26	
15	GND	21,27	
16	$\overline{B}$ AUX TRG	21,26	
17	$\overline{DS}$	21,26	
18	GND	21,27	
19	GND	21,27	
20	AHO	21,26	
21	$\overline{A}$ AUX TRG	21,26	
22	GND	21,27	
23	GND	21,27	
24	BHO	21,26	

P4230		A1 TO A20	
Pin	Line Name	Schem	
1	GND	21	
2	CH2 PO	21	

J/P/W4232		A20 TO A1	
Pin	Line Name	Schem	
1	BHO	21	
2	GND	21	
3	$\overline{A}$ AUX TRG	21	
4	GND	21	
5	AHO	21	
6	GND	21	
7	GND	21	
8	$\overline{B}$ AUX TRG	21	
9	GND	21	
10	$\overline{DS}$	21	

J/P4238		A20 TO A23	
Pin	Line Name	Schem	
1	DAC MUX1 IN	21,22	
2	GND	21,22	
3	CH2 POS	21,22	
4	TRACE SEP	21,22	
5	CH4 POS	21,22	
6	CH1 POS	21,22	
7	TRACE SEP	21,22	
8	CH3 POS	21,22	
9	CH1 POS	21,22	
10	CH2 POS	21,22	
11	CH3 POS	21,22	
12	CH4 POS	21,22	



J/P4242 A20 TO A25		
Pin	Line Name	Schem
1	BA7	20,25
2	GND	21,25
3	BA6	20,25
4	BA14	20,25
5	MR	20,25
6	BA13	20,25
7	BA5	20,25
8	BA12	20,25
9	BA4	20,25
10	BA11	20,25
11	BA3	20,25
12	BA10	20,25
13	GND	21,25
14	BA9	20,25
15	BA2	20,25
16	BA8	20,25
17	BA1	20,25
18	BA0	20,25
19	BR/W	20,25
20	BBD7	20,25
21	GND	21,25
22	BBD6	20,25
23	BBD3	20,25
24	BBD5	20,25
25	BBD2	20,25
26	GND	21,25
27	BBD1	20,25
28	BBD4	20,25
29	BBD0	20,25
30	E	20,25
31	GND	21,25
32	B10MHz	20,25
33	BVMA	20,25
34	BRESET	20,25
35	+5V <sub>b</sub>	21,25
36	GND	21,25
37	+5V <sub>b</sub>	21,25
38	GND	21,25
39	+15V	21,25
40	-15V	21,25
41	FLD2	21,25
42	FLD1	21,25
43	LINES	21,25
44	GND	21,25

J/P4243 A20 TO A23		
Pin	Line Name	Schem
1	BA7	20,22
2	GND	21,23
3	BA6	20,22
4	BA14	20,22
5	MR	20,22
6	BA13	20,22
7	BA5	20,22
8	BA12	20,22
9	BA4	20,22
10	BA11	20,22
11	BA3	20,22
12	BA10	20,22
13	GND G	21,23
14	BA9	20,22
15	BA2	20,22
16	BA8	20,22
17	BA1	20,22
18	BA0	20,22
19	BR/W	20,22
20	BBD7	20,22
21	GND G	21,23
22	BBD6	20,22
23	BBD3	20,22
24	BBD5	20,22
25	BBD2	20,22
26	GND G	21,23
27	BBD1	20,22
28	BBD4	20,22
29	BBD0	20,22
30	E	20,22
31	GND G	21,23
32	B10MHz	20,22
33	BVMA	20,22
34	BRESET	20,22
35	+5V <sub>b</sub>	21,23
36	GND G	21,23
37	+5V <sub>b</sub>	21,23
38	GND G	21,23
39	+15V	21,23
40	-15V	21,23
41	+42V	21,23
42	+5V	21,23
43	-5V	21,23
44	GND	21,23

J/P/W4258 A20 TO A5		
Pin	Line Name	Schem
1	DAC MUX1 IN	21
2	GND	21
3	HORIZ POS	21
4	+1.36V	21
5	-1.25V	21
6	DLY A	21
7	ΔA	21
8	ΔB	21
9	DLY B	21
10	HORIZ VAR	21
11	TRIG LEVEL	21
12	HOLDOFF	21
13	-1.25V	21
14	TRACE SEP	21
15	CH1 VAR	21
16	CH2 VAR	21
17	CH1 POS	21
18	CH2 POS	21
19	CH3 POS	21
20	CH4 POS	21

J/P4330 A20 TO A30		
Pin	Line Name	Schem
1	+5V <sub>b</sub>	21,32
2	GND	21,32
3	BA1	20,32
4	BA0	20,32
5	ROMEN	20,32
6	B $\bar{R}$ /W	20,32
7	BUFEN	20,32
8	LOWAD	20,32
9	BBD0	20,32
10	BBD1	20,32
11	BBD2	20,32
12	BBD3	20,32
13	BBD4	20,32
14	BBD5	20,32
15	BBD6	20,32
16	BBD7	20,32

J/P4800 A23 TO GPIB CONNECTOR		
Pin	Line Name	Schem
1	DIO1	22
2	DIO5	22
3	DIO2	22
4	DIO6	22
5	DIO3	22
6	DIO7	22
7	DIO4	22
8	DIO8	22
9	EOI	22
10	REN	22
11	DAV	22
12	GND G	22
13	NRFD	22
14	GND G	22
15	NDAC	22
16	GND G	22
17	IFC	22
18	GND G	22
19	SRQ	22
20	GND G	22
21	ATN	22
22	GND G	22
23	GND	22
24	GND G	22

J/P5290 A20 TO A29		
Pin	Line Name	Schem
1	BA7	31
2	GND	33
3	BA6	31
4	BA14	31
5	MR	31
6	BA13	31
7	BA5	31
8	BA12	31
9	BA4	31
10	BA11	31
11	BA3	31
12	BA10	31
13	GND	33
14	BA9	31
15	BA2	31
16	BA8	31
17	BA1	31
18	BA0	31
19	BR/W	31
20	BBD7	31
21	GND	33
22	BBD6	31
23	BBD3	31
24	BBD5	31
25	BBD2	31
26	GND	33
27	BBD1	31
28	BBD4	31
29	BBD0	31
30	E	31
31	GND	33
32	B10MHz	31
33	BVMA	31
34	BRESET	31
35	+5V <sub>b</sub>	33
36	GND	33
37	+5V <sub>b</sub>	33
38	GND	33
39	+15V	33
40	-15V	33

J/P/W5990 A27 TO WORD RECOGNIZER CONNECTOR		
Pin	Line Name	Schem
1	WORD	26,28
2	WDATA	26,28
3	WCLOCK	26,28
4	GND	26,28
5	+5V <sub>w</sub>	26,28
6	DATA RETURN	26,28

J/P/W6370 WORD RECOGNIZER CONNECTOR TO A32		
Pin	Line Name	Schem
1	WORD	28
2	WDATA	28
3	WCLOCK	28
4	GND	28
5	+5V <sub>w</sub>	28
6	DATA RETURN	28
7	GND	28

J/P6380 A32 TO A33		
Pin	Line Name	Schem
1	+5V <sub>w</sub>	28
2	WCLOCK	28
3	SYNCH	28
4	GATED CLOCK	28
5	GND	28

J/P6385 A32 TO A33		
Pin	Line Name	Schem
1	GND	28
2	LOW BYTE EQUAL	28
3	SERIAL DATA	28
4	GATED Q	28
5	Q DONT CARE	28
6	DATA RETURN	28

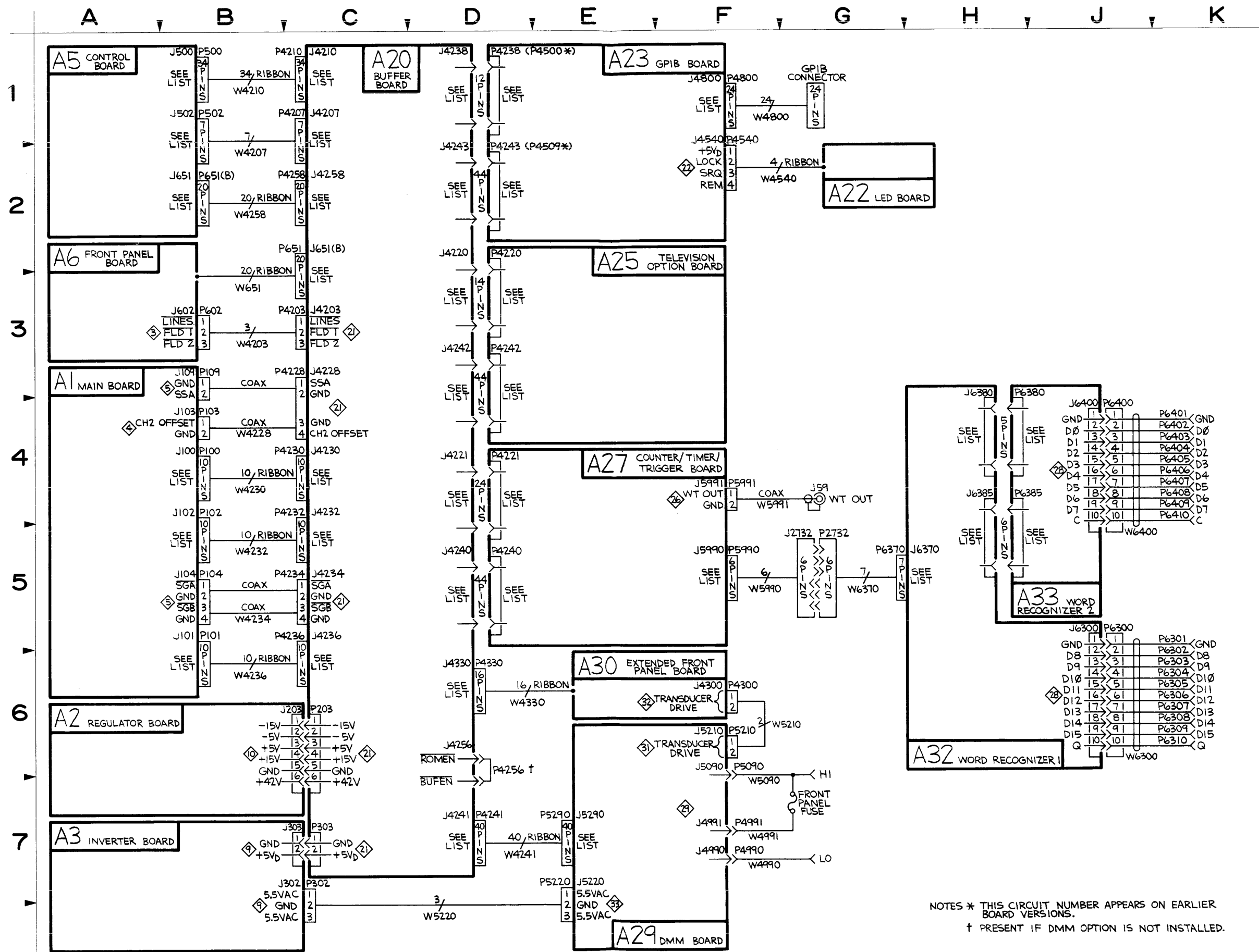
J/P4242 A20 TO A25		
Pin	Line Name	Schem
1	BA7	20,25
2	GND	21,25
3	BA6	20,25
4	BA14	20,25
5	MR	20,25
6	BA13	20,25
7	BA5	20,25
8	BA12	20,25
9	BA4	20,25
10	BA11	20,25
11	BA3	20,25
12	BA10	20,25
13	GND	21,25
14	BA9	20,25
15	BA2	20,25
16	BA8	20,25
17	BA1	20,25
18	BA0	20,25
19	BR/W	20,25
20	BBD7	20,25
21	GND	21,25
22	BBD6	20,25
23	BBD3	20,25
24	BBD5	20,25
25	BBD2	20,25
26	GND	21,25
27	BBD1	20,25
28	BBD4	20,25
29	BBD0	20,25
30	E	20,25
31	GND	21,25
32	B10MHz	20,25
33	BVMA	20,25
34	BRESET	20,25
35	+5V <sub>0</sub>	21,25
36	GND	21,25
37	+5V <sub>0</sub>	21,25
38	GND	21,25
39	+15V	21,25
40	-15V	21,25
41	FLD2	21,25
42	FLD1	21,25
43	LINES	21,25
44	GND	21,25

J/P4243 A20 TO A23		
Pin	Line Name	Schem
1	BA7	20,22
2	GND	21,23
3	BA6	20,22
4	BA14	20,22
5	MR	20,22
6	BA13	20,22
7	BA5	20,22
8	BA12	20,22
9	BA4	20,22
10	BA11	20,22
11	BA3	20,22
12	BA10	20,22
13	GND G	21,23
14	BA9	20,22
15	BA2	20,22
16	BA8	20,22
17	BA1	20,22
18	BA0	20,22
19	BR/W	20,22
20	BBD7	20,22
21	GND G	21,23
22	BBD6	20,22
23	BBD3	20,22
24	BBD5	20,22
25	BBD2	20,22
26	GND G	21,23
27	BBD1	20,22
28	BBD4	20,22
29	BBD0	20,22
30	E	20,22
31	GND G	21,23
32	B10MHz	20,22
33	BVMA	20,22
34	BRESET	20,22
35	+5V <sub>0</sub>	21,23
36	GND G	21,23
37	+5V <sub>0</sub>	21,23
38	GND G	21,23
39	+15V	21,23
40	-15V	21,23
41	+42V	21,23
42	+5V	21,23
43	-5V	21,23
44	GND	21,23

J/P/W4258 A20 TO A5		
Pin	Line Name	Schem
1	DAC MUX1 IN	21
2	GND	21
3	HORIZ POS	21
4	+1.36V	21
5	-1.25V	21
6	DLY A	21
7	ΔA	21
8	ΔB	21
9	DLY B	21
10	HORIZ VAR	21
11	TRIG LEVEL	21
12	HOLDOFF	21
13	-1.25V	21
14	TRACE SEP	21
15	CH1 VAR	21
16	CH2 VAR	21
17	CH1 POS	21
18	CH2 POS	21
19	CH3 POS	21
20	CH4 POS	21

J/P4330 A20 TO A30		
Pin	Line Name	Schem
1	+5V <sub>0</sub>	21,32
2	GND	21,32
3	BA1	20,32
4	BA0	20,32
5	ROMEN	20,32
6	BR/W	20,32
7	BUFEN	20,32
8	LOWAD	20,32
9	BBD0	20,32
10	BBD1	20,32
11	BBD2	20,32
12	BBD3	20,32
13	BBD4	20,32
14	BBD5	20,32
15	BBD6	20,32
16	BBD7	20,32

J/P4800 A23	
Pin	L
1	DIC
2	DIC
3	DIC
4	DIC
5	DIC
6	DIC
7	DIC
8	DIC
9	EOI
10	REI
11	DA'
12	GN
13	NR
14	GN
15	ND
16	GN
17	IFC
18	GN
19	SR
20	GN
21	ATI
22	GN
23	GN
24	GN

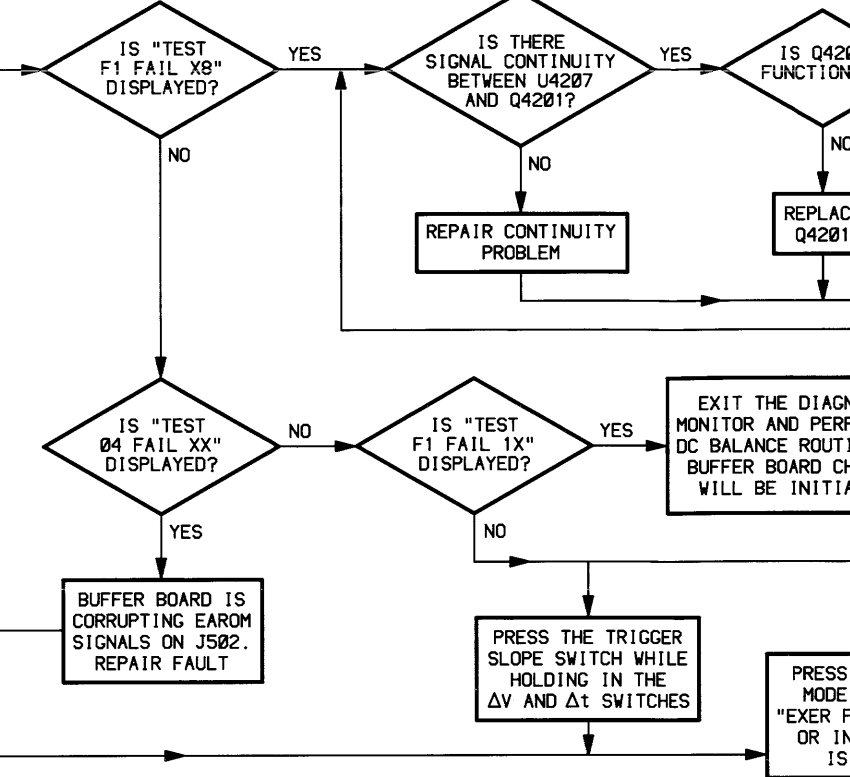
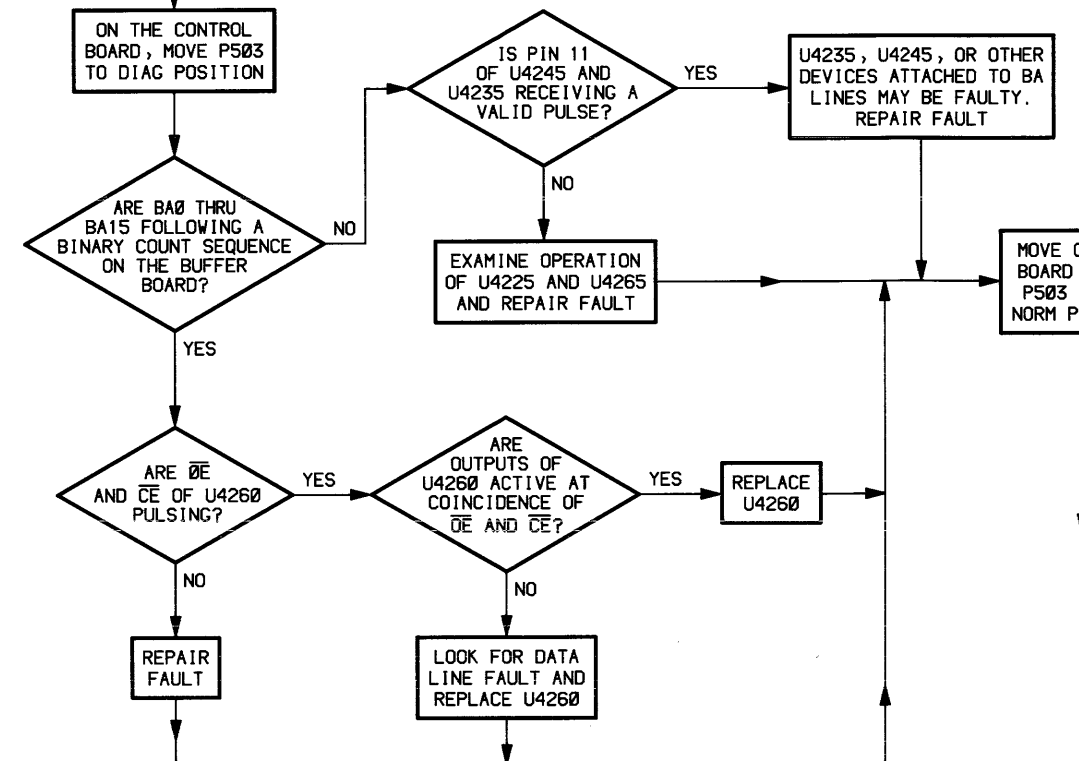
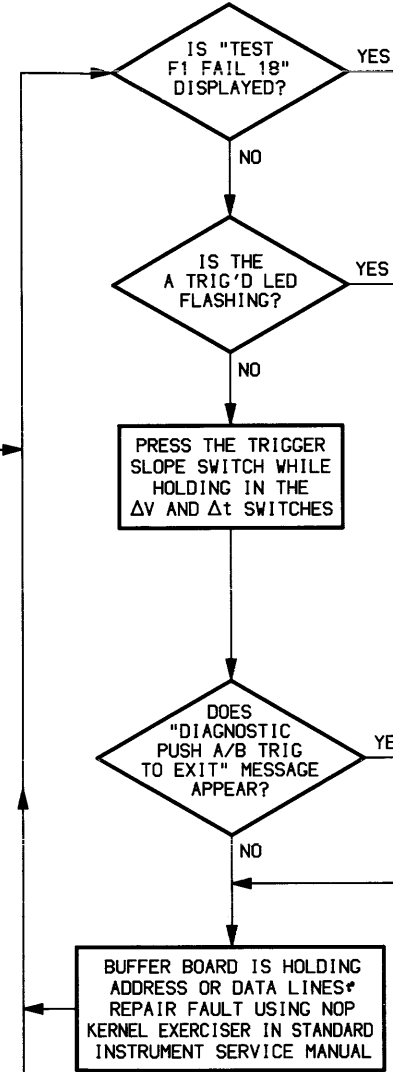
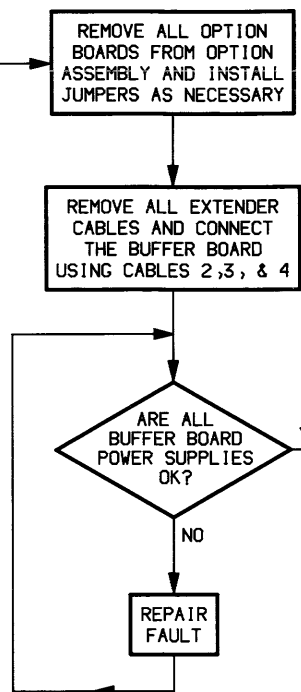
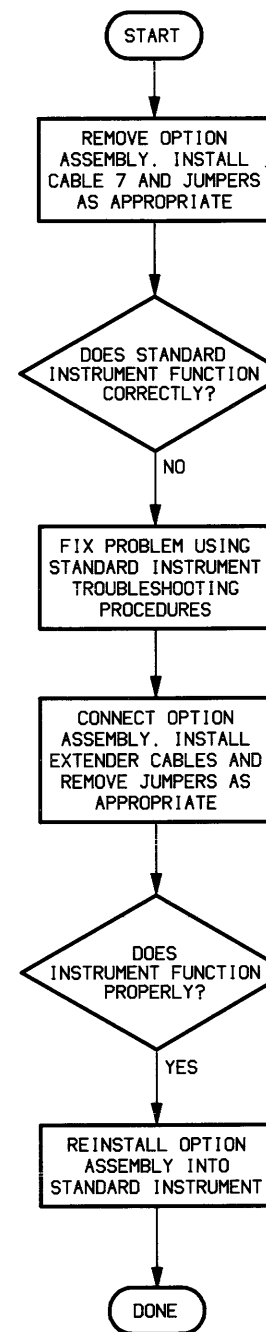


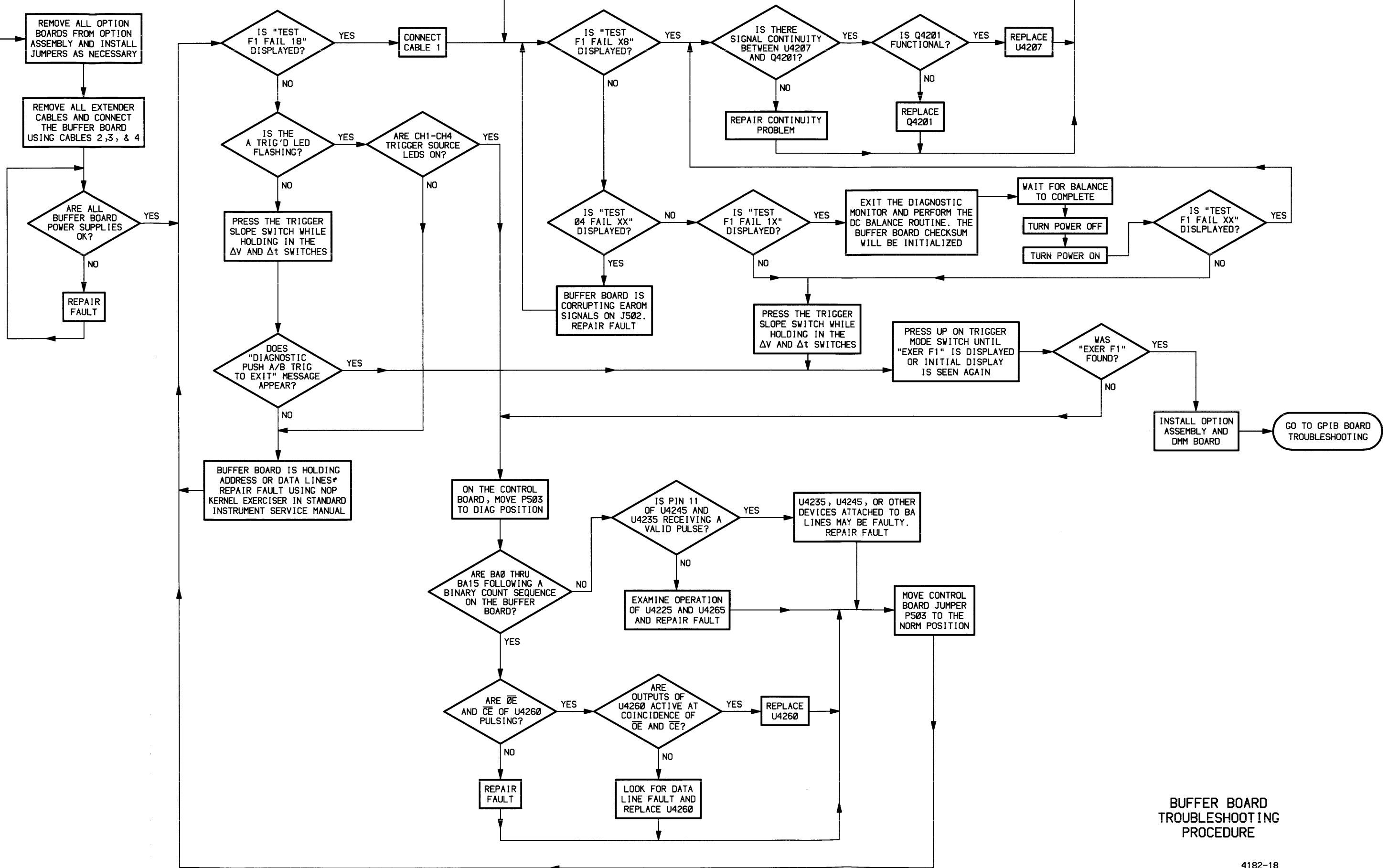
8 2445/2465 OPTIONS

4182-32

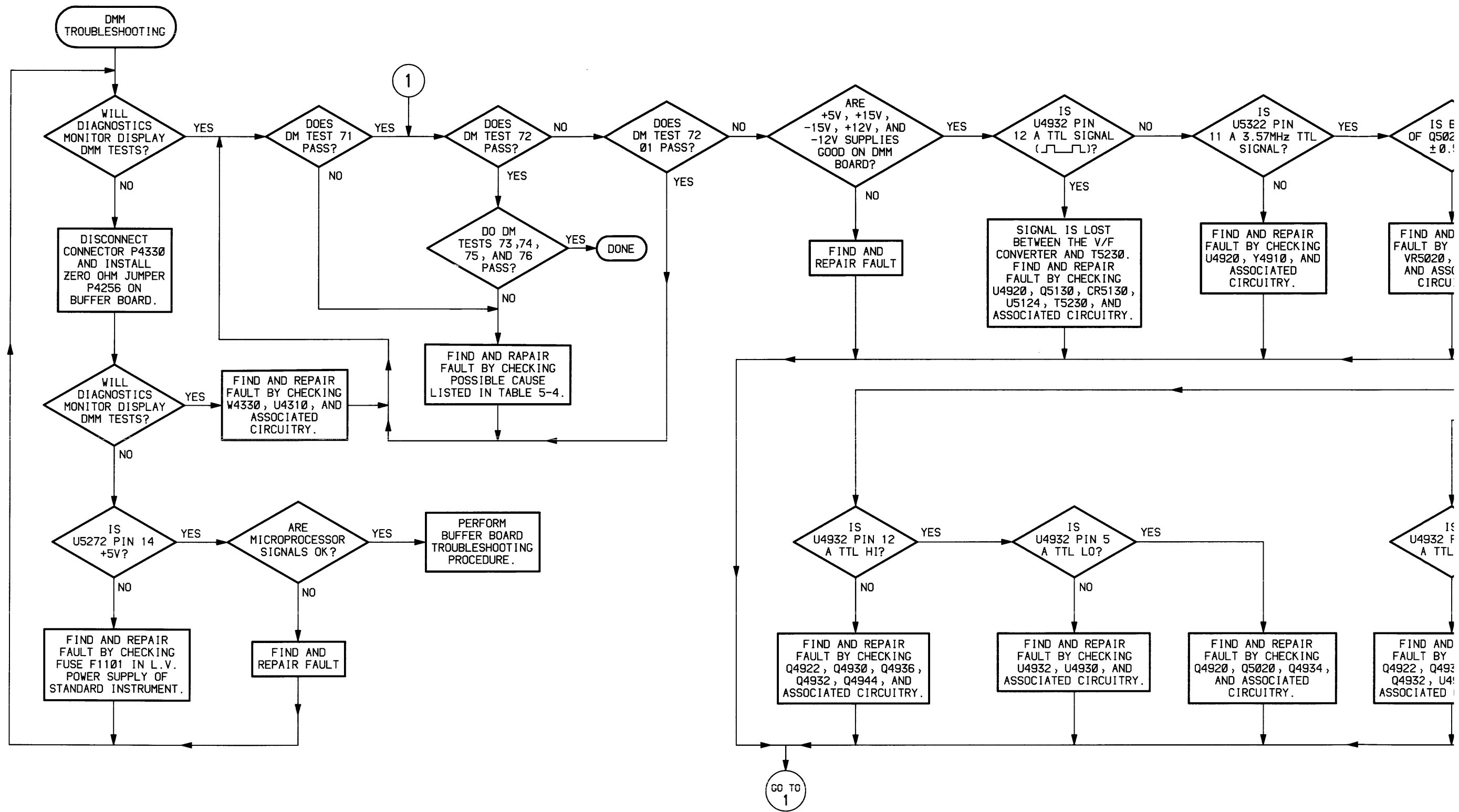
INTERCONNECTION DIAGRAM 34

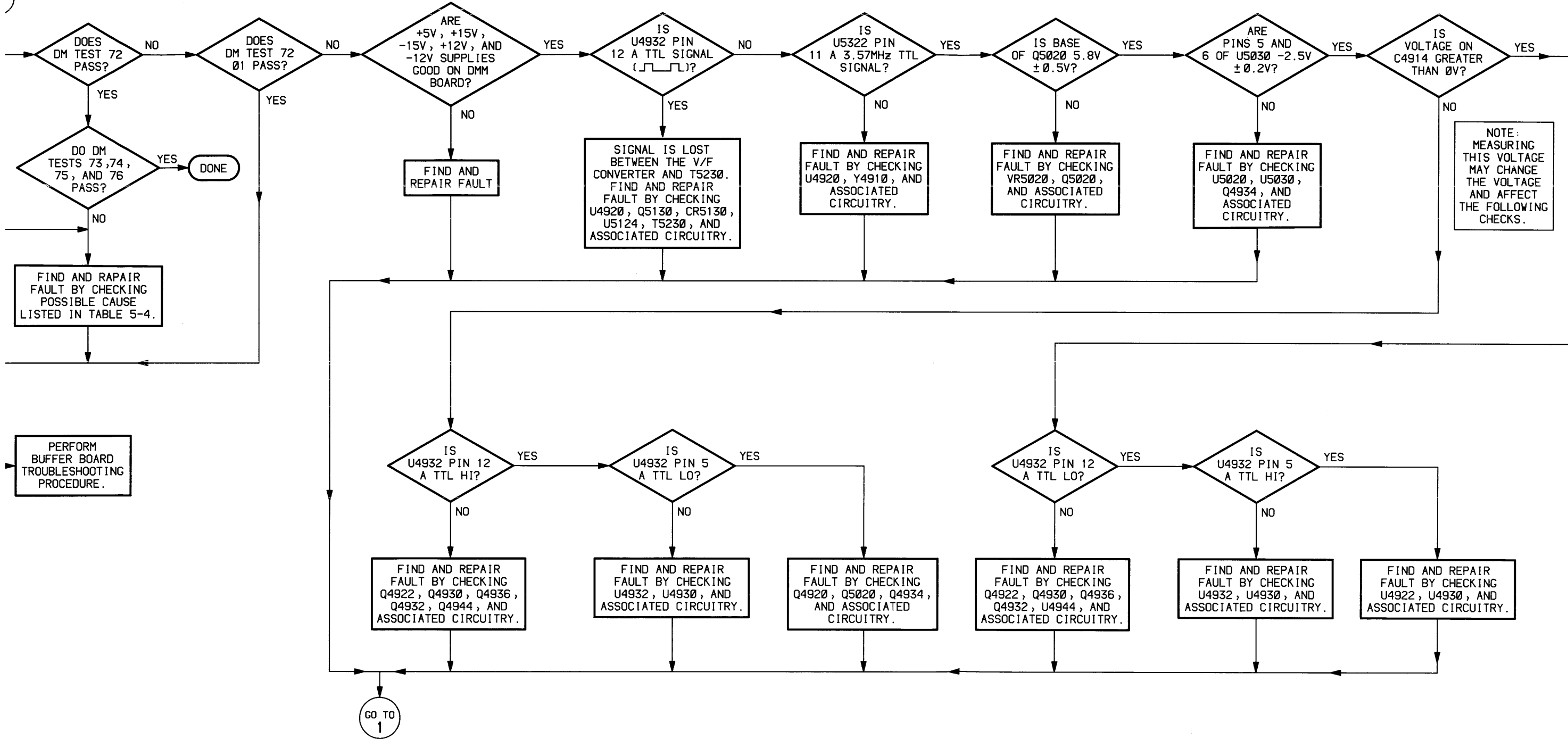
NOTES \* THIS CIRCUIT NUMBER APPEARS ON EARLIER BOARD VERSIONS.  
 † PRESENT IF DMM OPTION IS NOT INSTALLED.





BUFFER BOARD TROUBLESHOOTING PROCEDURE





DMM  
TROUBLESHOOTING  
PROCEDURE

## **MANUAL CHANGE INFORMATION**

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.



Date: 6-11-85

Change Reference: M56402

Product: 2445/2465 OPTION 01 SERVICE

Manual Part No.: 070-4182-00

**DESCRIPTION**

PG 38

**EFFECTIVE SERIAL NUMBER:** B027495 (2445)  
B031245 (2465)

**REPLACEABLE MECHANICAL PARTS LIST CHANGES**

Add the following as an attachable part to the Front Panel Board, Figure 2-42.

342-0754-00    1    INSULATOR,PLATE: FRONT PNL BD,FIBER SHEET

SEE BELOW FOR EFFECTIVE SERIAL NUMBERS

**REPLACEABLE MECHANICAL PARTS LIST CHANGES**

**2445 OSCILLOSCOPE**

**CHANGE TO:**

Fig.

1-17	101-0095-00	B010100	B027989	1	TRIM,DECORATIVE: FRONT
	101-0095-01	B027990	B028113	1	TRIM,DECORATIVE: FRONT
	101-0095-00	B028114	B029264	1	TRIM,DECORATIVE: FRONT
	101-0095-01	B029265		1	TRIM,DECORATIVE: FRONT

ATTACHING PARTS

361-1340-00	B010100	B027989	1	SHIM: 0.025 THK X 11.250 L X 0.50 OD,AL
361-1340-00	B028114	B029264	1	SHIM: 0.025 THK X 11.250 L X 0.50 OD,AL
211-0718-00			10	SCREW,MACHINE: 6-32 X 0.312,FLH,DEG TORX

**2465 OSCILLOSCOPE**

**CHANGE TO:**

Fig.

1-17	101-0095-00	B010100	B032007	1	TRIM,DECORATIVE: FRONT
	101-0095-01	B032008	B032191	1	TRIM,DECORATIVE: FRONT
	101-0095-00	B032192	B041833	1	TRIM,DECORATIVE: FRONT
	101-0095-01	B041834		1	TRIM,DECORATIVE: FRONT

ATTACHING PARTS

361-1340-00	B010100	B032007	1	SHIM: 0.025 THK X 11.250 L X 0.50 OD,AL
361-1340-00	B032192	B041833	1	SHIM: 0.025 THK X 11.250 L X 0.50 OD,AL
211-0718-00			10	SCREW,MACHINE: 6-32 X 0.312,FLH,DEG TORX



# MANUAL CHANGE INFORMATION

Date: 1-27-86

Change Reference: M58269

Product: 2445/2465 OPTION 01 SERVICE

Manual Part No.: 070-4182-00

DESCRIPTION

PG 38

**EFFECTIVE SERIAL NUMBERS: B030772 (2445)  
B051521 (2465)**

## REPLACEABLE ELECTRICAL PARTS LIST CHANGES

### CHANGE TO:

A30                      670-7894-01              CKT BOARD ASSY: FRONT PANEL

## REPLACEABLE MECHANICAL PARTS LIST CHANGES

### REMOVE:

2-58    210-0457-00    3    NUT,PL,ASSEM WA: 6-32 X 0.312,STL CD LL

### CHANGE:

#### FROM:

2-59    361-1273-00    3    SPACER,CKT BD: W/POST SPACER

#### TO:

2-59    361-1273-01    3    SPACER,CKT BD: W/POST SPACER  
         355-0235-00    3    STUD,PRESSMOUNT: 4-40 X 0.312 L, PH BRZ TIN PL

Date: 3-24-86

Change Reference: M59775

Product: 2445/2465 OPTION 01 SERVICE

Manual Part No.: 070-4182-00

**DESCRIPTION**

Product Group 38

**EFFECTIVE SERIAL NUMBER: 2445 B030846  
2465 B051592**

**REPLACEABLE MECHANICAL PARTS LIST CHANGES**

**CHANGE TO:**

Fig. 2-132	210-0858-00	1	WASHER,FLAT: 0.172 ID X 0.5 OD X 0.062,BRS
	211-0730-00	1	SCR,ASSEM WSHR: 6-32 X .375L,PNH,TORX