MAINTENANCE MANUAL

FOR

JEM®1 SERIES

JOULE ELECTRONIC METERS

YF-09175-001-N
Revision D
March, 1999

WARRANTY

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U.S. Patent Numbers

3,976,942	3,971,979
3,975,682	3,794,917

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MAINTENANCE MANUAL
FOR
JEM® SERIES
JOULE ELECTRONIC METERS

SECTION 1 - Overview

Introduction

The JEM® Maintenance Manual provides the customer with basic testing and troubleshooting procedures needed to prevent and/or correct minor problems encountered with the JEM® Series.

Audience

The manual is written for use by meter, shop, and laboratory personnel involved with ordering, receiving, configuring, testing, and installing JEM1s. A good knowledge of safe metering practices is needed.

Related Manuals

Reference to the following JEM® manuals may be necessary:

JEM Series Joule Electronic Meters, Instruction Manual, YD-08787-001-N

JEM Coed, Coded Output for Electronic Display/Demand Register, Operating Instructions, YD-08788-001-N

For additional information, see the manual(s) for your specific product. An "Additional Related Manuals" list is included at the end of this section.

Additional Related Manuals

JEM Series Joule Electronic Meters, Instruction Manual, YD-08787-001-N.

Jem Coed, Coded Output for Electronic Display/Demand Register, Operating Instructions, YD-08788-001-N.

JEM Series Joule Electronic Meters With Quadrant Detector, Instruction Manual, YD-08837-001-N.

JEM Series Joule Electronic Meters With Slow Pulse Rate Meter Option for 2, 2-1/2, and 3 Elements, Instruction Manual, YD-08838-001-N.

JEM Series Joule Electronic Meters Totalizer Model 6368, Instruction Manual, YD-08911-001-N.

JEM Series Joule Electronic Meters, With Addendum for Bidirectional Watthour With Line Loss Compensation, Instruction Manual, YD-09409-001-N.

JEM Series, With Addendum For Bidirectional Watthour With Line Loss Compensation, Maintenance Manual, YD-09412-001-N.

EXJ Register User's Guide Supplement to JEM 1 User's Manual, YD-09480-001-N.

EXJ-II Register, Retrofit Guide, YD-09492-001-N.

EXJ Set Manual for EXJ-II Register-Preliminary, YD-09493-001-N.

EXJ-II™ Register User's Guide, Supplement to JEM®1, User's Manual, Revision C, YD-09494-001-N.

Replacement of battery in JEM Electronic Registers, Instructions, YT-09461-001-N

Replacement of JEM Electronic Register in the Field, Instructions, YT-09462-001-N

Field Changing PROM in the Electronic Demand Register of the JEM Meter, Instructions, YT-09463-001-N

SECTION 2

PRECAUTIONS

WARNING

ALWAYS REMOVE AUXILIARY POWER AND INPUT SIGNALS WHEN INSERTING OR REMOVING SUBASSEMBLIES FROM THE JEM® METERS.

Introduction — This section contains special handling procedures needed when testing or troubleshooting the JEM® meters.

Related Pages — CMOS Handling Procedures

CMOS HANDLING PROCEDURE

Introduction

CMOS (complementary symmetry metal oxide semiconductor) devices are used because of their attractive properties such as low power dissipation and high noise immunity. Because of their high impedance, they are subject to damage by exposure to static charge: therefore, special care is required in handling of CMOS devices or subassemblies containing CMOS devices.

Use

Even though input protection circuits have been added by every manufacturer, the following procedure must be used each time CMOS devices are handled to avoid accidental destruction of IC's.

Recognition

The following CMOS dual in-line integrated circuit series are used:

a) CD40XX BF

b) CDPXXXXCD

c) MWSXXXXDL

d) MC140XX-CL

Handling and Insertion

Step	Procedure
1.	The work bench surface is to be grounded and conductive.
2.	The assembler should refrain from wearing any nylon clothing.
3.	The assembler is to be grounded by a conductive wrist strap through a 1 megohm resistor (or equivalent).
4.	CMOS devices are to remain in their conductive carriers until they are ready to be inserted (pertains to new, replacement IC's received by customer).
5.	If the insertion process will require only a short period of time, the insertion can be performed on a sheet of metal. Grounds are unnecessary.

Hand Soldering

Step	Procedure
1.	Follow the handling and insertion pre-cautions carefully.
2.	Any soldering iron used must first be grounded.

SECTION 3

TROUBLESHOOTING AND TESTING

Introduction	This section gives detailed troubleshooting and testing procedures, both for the meter in general and for individual subassemblies.
Purpose	The purpose of this section is to determine if the JEM® meter is functioning properly; and if not, to verify if the meter can be repaired in the field or if the unit must be returned to the factory for repair.
Comment	Careful reading of the *JEM® Instruction Manual* is a prerequisite to troubleshooting and testing a JEM meter.
Equipment	Basic equipment needed is listed below:
	Digital Voltmeter
	Oscilloscope
	Extender card (Part # 04021-001K)
	JEM Series Joule Electronic Meters, Instruction Manual
	Extender Cable for Electronic Register
Related Pages	Meter Symptoms Table 1
	Power Supply Table 3

METER SYMPTOMS

Introduction	Common meter symptoms, possible causes, and actions required to correct these problems are listed in this section.
Comment	A careful visual inspection is often the most useful aid in troubleshooting. For example, loose screws, broken wires at terminal blocks, cards not fully inserted in edge connectors, broken components, or even loose cable assemblies may be found.

WARNING!

DO NOT DISCONNECT THE AUXILIARY POWER WITH THE POTENTIAL AND CURRENT APPLIED TO PT'S AND CT'S. DO NOT REMOVE OR INSTALL ANY INDIVIDUAL CARD WITH THE AUXILIARY POWER APPLIED.

TABLE 1 METER TROUBLESHOOTING GUIDE

SYMPTOMS	POSSIBLE CAUSE	ACTION REQUIRED
Unit totally inoperable.	Auxiliary power not within acceptable limits.	Check wiring. Check nameplate data.
	Defective P/C Board.	Refer to Power.
Register not functioning.	Loose cable connection.	Slide register out and verify 16 contact cable assembly is firmly inserted into socket and held in place with rubber retainer. Verify cable is firmly attached to backplane. Refer to Instruction Manual, "Specifications, Input Signals", and verify with scope and/or DVM that all signals are present. Refer to Figure 3.
KYZ outputs not functioning, register not accumulating counts, rate indicators not flashing.	Input to Integrator wrong polarity or absent.	Check analog output to verify positive output, or negative output for in-watt or leading vars on bidirectional units.
	Defective Integrator Card.	Refer to Integrator Troubleshooting.
	No oscillator.	Check Power Supply Card.
Analog output wrong polarity.	Improper input wiring.	Refer to Figs. 2.6, 2.7, 2.8 in Instruction Manual.
No analog output or incorrect output.	Defective multiplier card.	Refer to Multiplier troubleshooting.
	Defective transformer assembly.	Substitute known good multiplier card to verify. If problem is in transformer assembly, return unit to factory.
Digital calibration not correct.	Tap selector and/or calibration header incorrect.	Refer to Instruction Manual Section 4.3.
	Analog input incorrect.	Test Analog calibration.
	Defective Integrator.	Substitute known good integrator and/or troubleshoot integrator card.

SUBASSEMBLIES

If a problem exists which is not one of the general meter symptoms, and the problem cannot be isolated to one or more P/C board, it is recommended that the unit be returned to the factory for repair. A verification can be made to check if a problem can be isolated to an individual board. A known good board of the same type is inserted in place of the suspected defective board and the unit is then checked for proper operation.

WARNING!

PERFORMING THIS TYPE OF CIRCUIT BOARD SUBSTITUTION WILL AFFECT METER CALIBRATION.

The transformer assembly, with the exception of a visual check of wiring and/or cable connections, should be left alone. The following procedures can be followed to troubleshoot other subassemblies.

POWER SUPPLY

Reference Part Numbers: 14438-001 and 14438-002

INTRODUCTION

Circuit Description (see schematics in Section 5):
The JEM1 Power Supply is composed of three sections: a discrete linear regulator with current limiting, a precision 5.85 Vdc reference, and a 504 kHz crystal-based time reference.

Theory of Operation:
The discrete linear regulator employs TIP29C and TIP30C transistors as series pass elements. A LM747 operational amplifier uses Kelvin sense feedback to control the pass transistors, thus maintaining + / - 14 Vdc at the output. 2N3904 and 2N3906 transistors provide current limiting for the pass transistors.

A precision 5.85 Vdc reference voltage for the JEM1 meter is generated from a precision 6.2 V zener diode. The diode is biased for zero temperature coefficients. The reference is buffered by a frequency compensated LM301 operational amplifier, configured as a voltage follower. A potentiometer, accessible from the front of the meter, provides adjustment of the voltage reference and the amplitude of the + / - 14 Vdc outputs.

The 504 kHz crystal-based time reference is produced in one of two ways. On version 14438-001 of the board, a 504 kHz crystal and a CD4007AE are used in a Pierce

oscillator configuration. On version 14438-002, a 2.016 MHz crystal and a 4001B are used in a Pierce oscillator configuration to produce 2.016 MHz output. A 4013B divides this output by four to obtain the desired 504 kHz. Either version may be used in the JEM1.

Related Documents
Maintenance Manual for JEM®1 Series Joule Electronic Meter, Instruction Manual, Rev. C, May, 1990, YF-09175-001-N.

TROUBLESHOOTING:

WARNING!
Always remove auxiliary power and input signals
when inserting or removing subassemblies from the JEM1 meter.

WARNING!
Do not disconnect the auxiliary power with the potential and current applied to the PTs and CTs. Do not remove or install any individual card with the auxiliary power applied.

Suggested Equipment:
1. Digital Voltmeter
2. Oscilloscope
3. Extender Card (Scientific Columbus Part B4021)
4. JEM Series Joule Electronic Meters, Instruction Manual

Test Points:

There are five miniature test points on the power supply board which accommodate 0.080 inch diameter pin probes. Table 2 lists the test points, color and description.

Table 2 Test point identification

Test Point	Color	Description
1	Green	5.85 Vdc precision reference
2	Orange	-14.00 minimum to -14.30 Vdc maximum
3	Violet	circuit ground
4	Yellow	504 kHz crystal oscillator output
5	Red	+13.80 to +14.50 Vdc

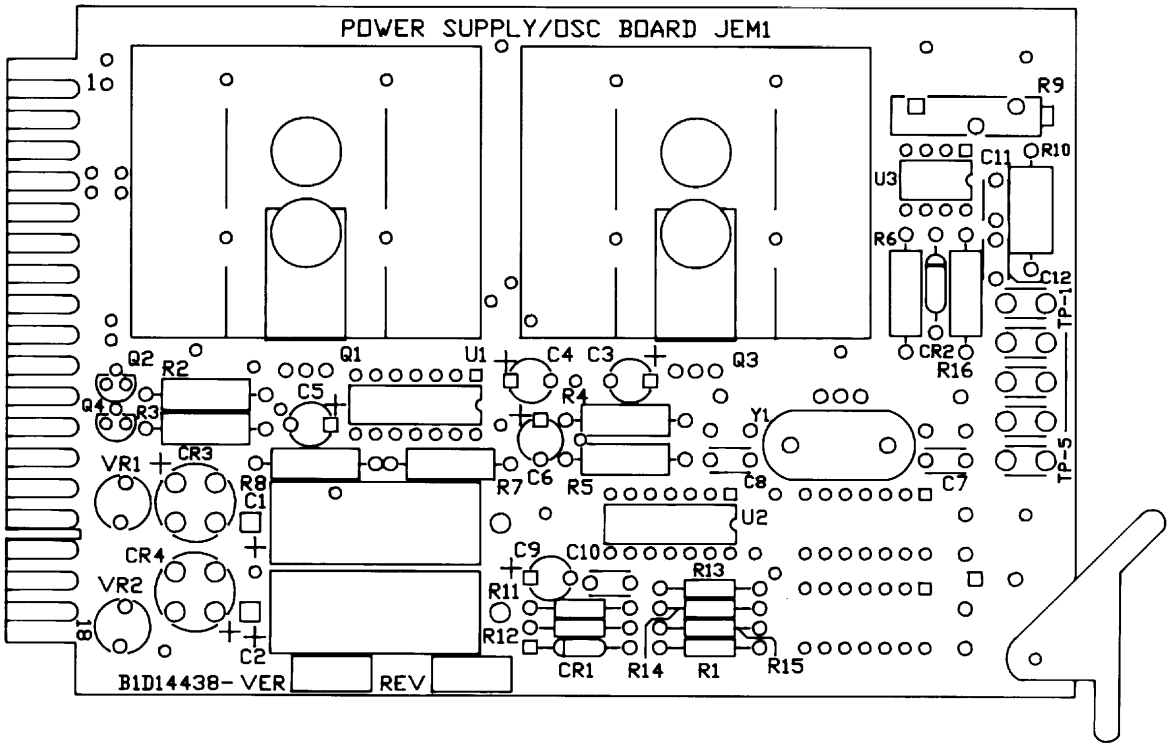
Note: The magnitude of the -14 Vdc supply should be within 200 mVdc of the +14 Vdc supply.

WARNING!
Always remove auxiliary power and input signals when inserting or removing subassemblies from the JEM1 meter.

WARNING!
Do not disconnect the auxiliary power with the potential and current applied to the PTs and CTs. Do not remove or install any individual card with the auxiliary power applied.

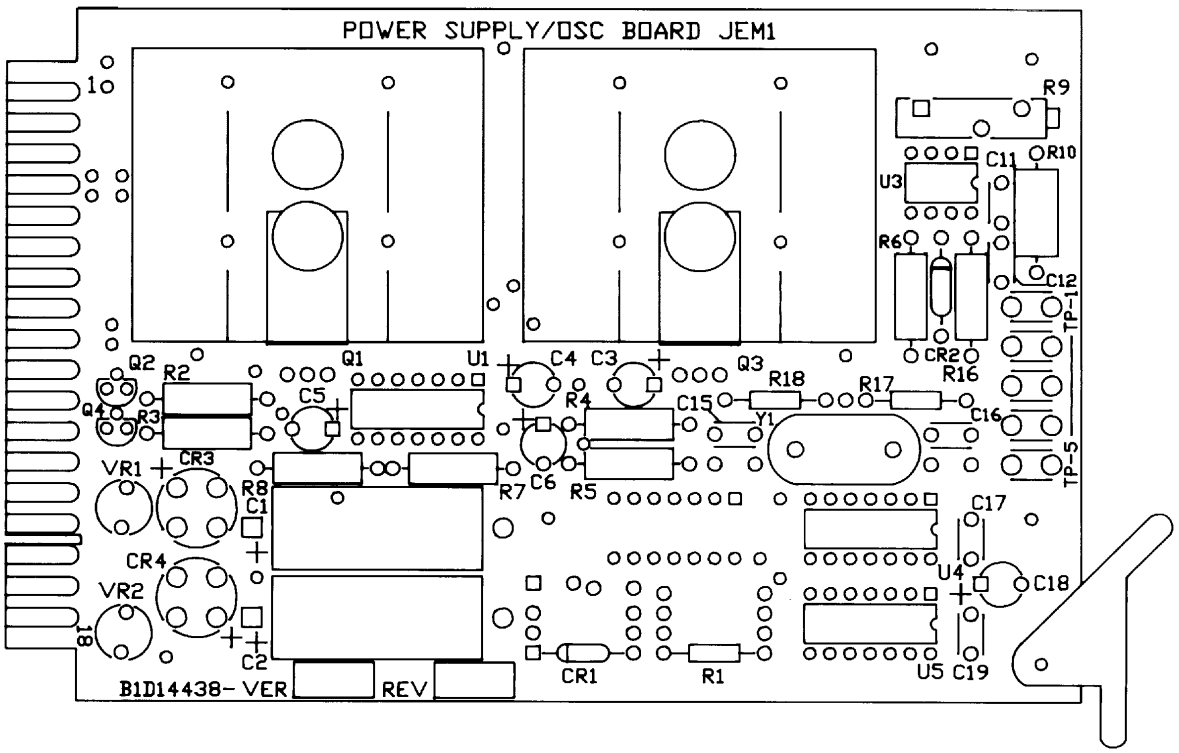
Table 3 Power Supply Troubleshooting Guide

SYMPTOM	POSSIBLE CAUSE	ACTION REQUIRED
Power Supply not regulating +14 Vdc < 13.75 Vdc	Excessive loading due to other subassemblies	Remove individual PC boards one at a time to determine if one or more subassemblies are loading the Power Supply. Note the position of each board and return to the same position.
No oscillator output	Version -001 Defective CD4007AE Version -002 Defective 4001B and/or 4013B	Return to factory for repair.
Power Supply output at zero volts	Transistors Q2 and/or Q4 defective	Q2, Q4 can be removed since they provide short circuit protection. If Power Supply returns to +14 Vdc, replace with same type transistor.
Cannot adjust 5.85 V reference to 5.8500 Vdc $\pm$.0001 Vdc	LM301A and/or 1N827A Zener Reference (CR2) defective	Return to factory for repair.



JEM1 POWER SUPPLY/504 KHZ OSC BOARD
SILK SCREEN
REVISION A

Figure 1



JEM1 POWER SUPPLY/2.0160 MHZ OSC BOARD
SILK SCREEN
REVISION A

Figure 2

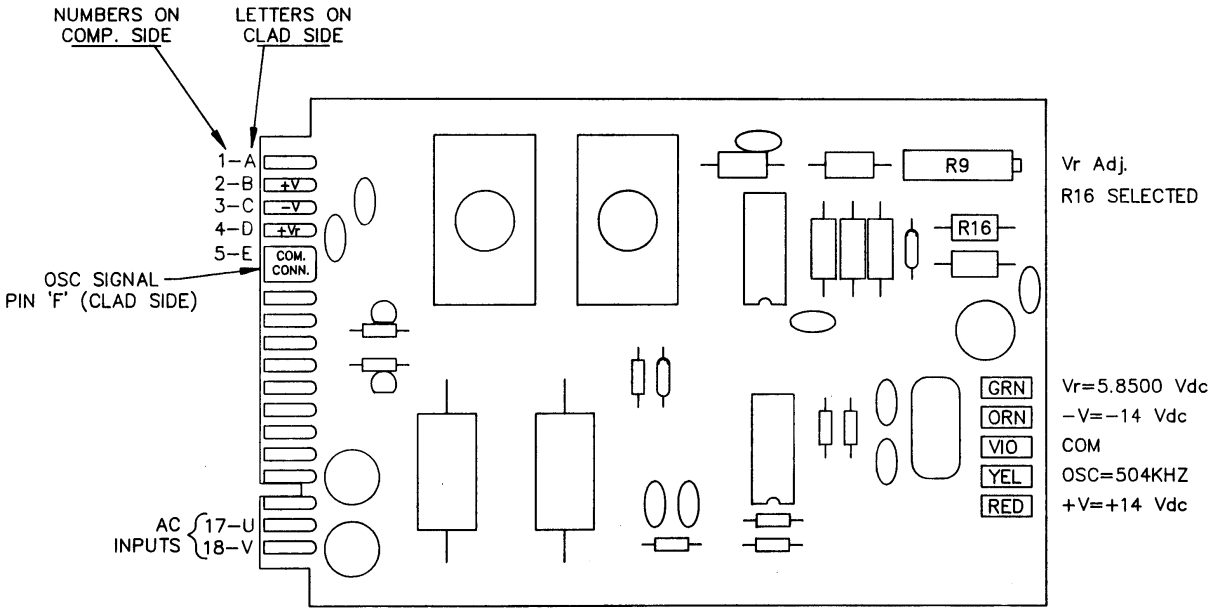


Figure 3 Power Supply Test Points

WATT/Q MULTIPLIER

Figure 4	Shows the Watt/Q multiplier test point locations.
Figure 5	Shows the chopper waveform obtained from the yellow test points. The green test point will give a triangle wave as shown in Figure 5.
Figure 6	Triangle Wave - Green Test Point, Watt/Q/Var Multiplier
Figure 7	Illustrate the chopper drive signal that is obtained from pin 3 of one of the CD4007's.
Figure 8	Shows the multiplier waveforms superimposed.
Figure 9	Illustrate a test circuit for the analog test jack.
Table 4	Common Watt/Q Multiplier symptoms.

VAR MULTIPLIER

Test points for the Var multiplier card are the same as a Watt/Q Multiplier card. Operation of the Var multiplier is identical to the Watt/Q multiplier except for phase shifters which are used to obtain a 90 phase shift of voltage signals before multiplication with the current signals. For a list of Var multiplier symptoms, see Table 4 since the Watt//Q multiplier symptoms are identical.

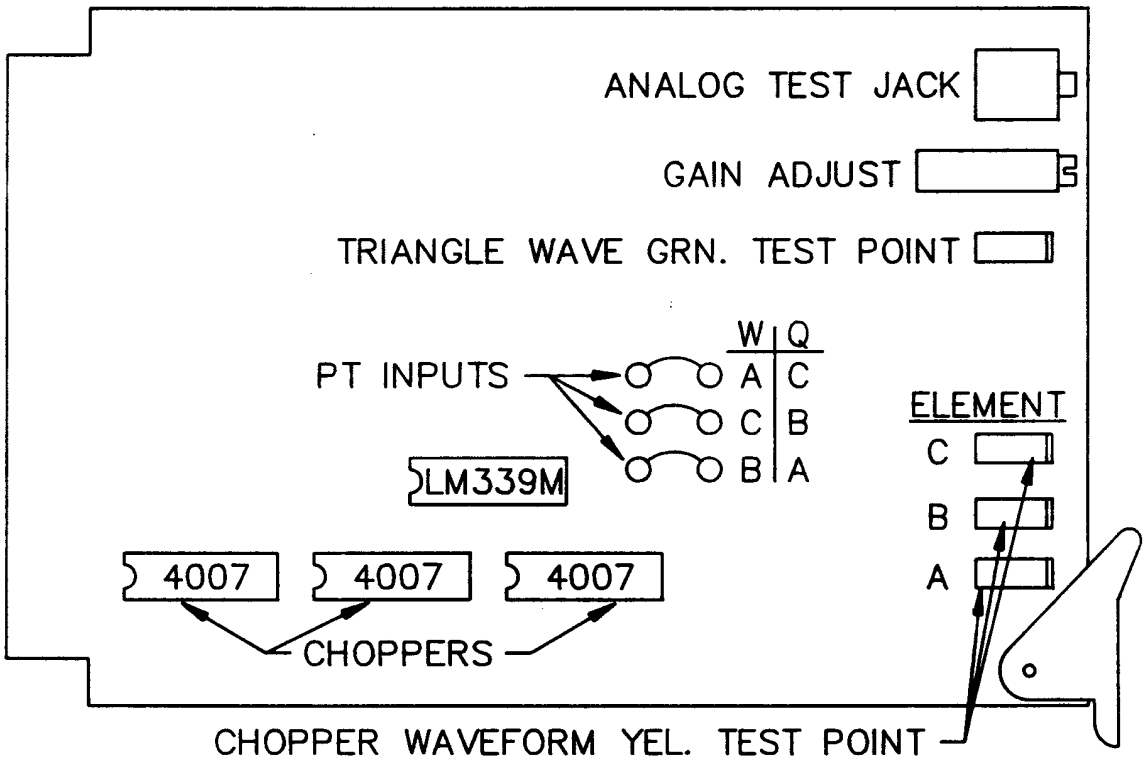


Figure 4
Test Points - Watt/Q Multiplier

Observe each signal at test points TP2, TP3, TP4 (Yellow). Compare symmetry, amplitude distortion, etc., for evidence of proper operation.

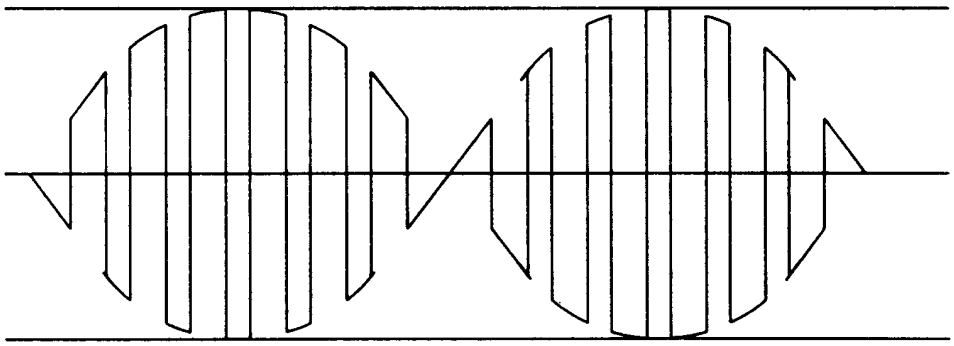


Figure 5
Chopper Waveform for Watt Multipliers

Figure 6
Triangle Wave - Green Test Point

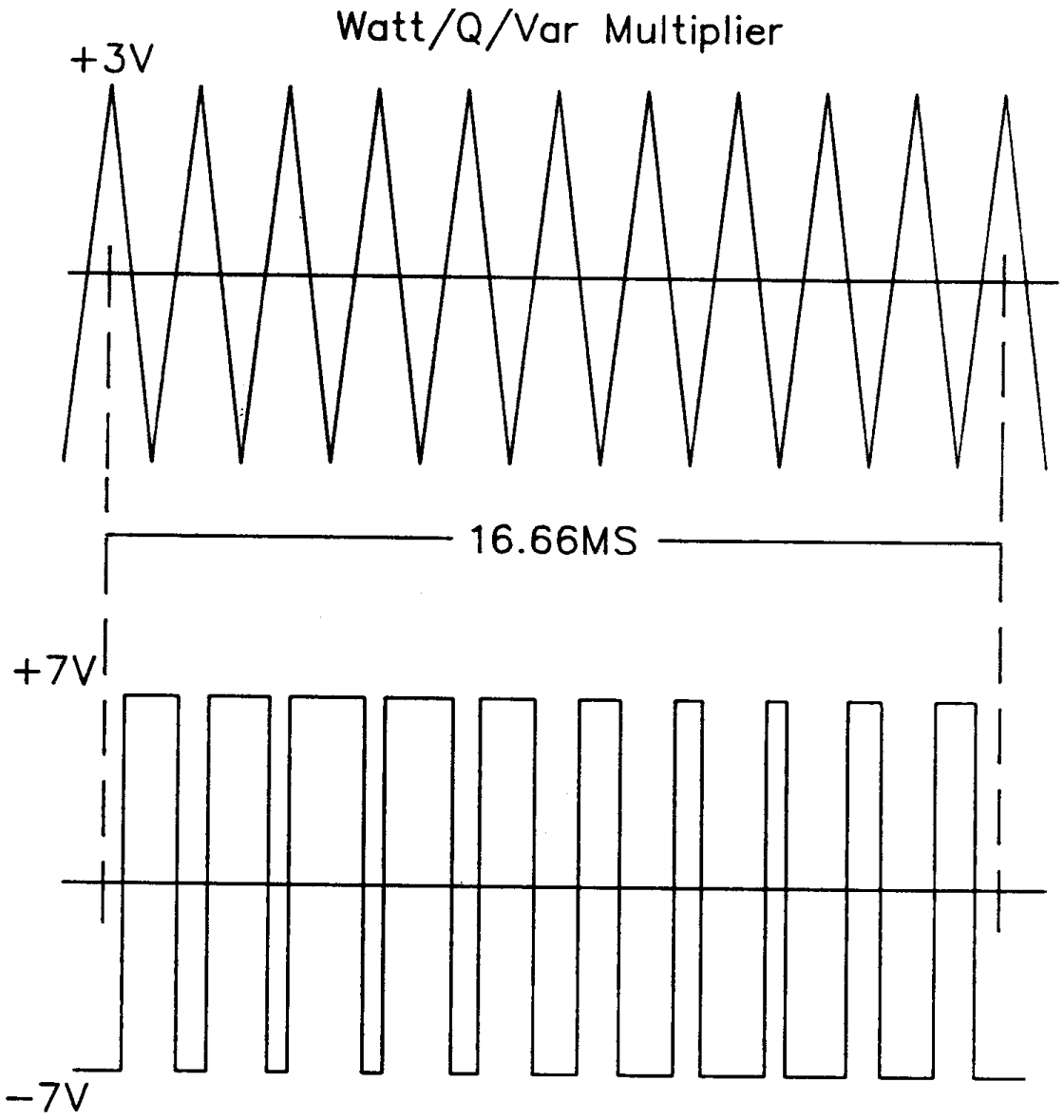


Figure 7
Chopper Drive Signal - Pin 3 - CD4007
Watt/Q Multiplier

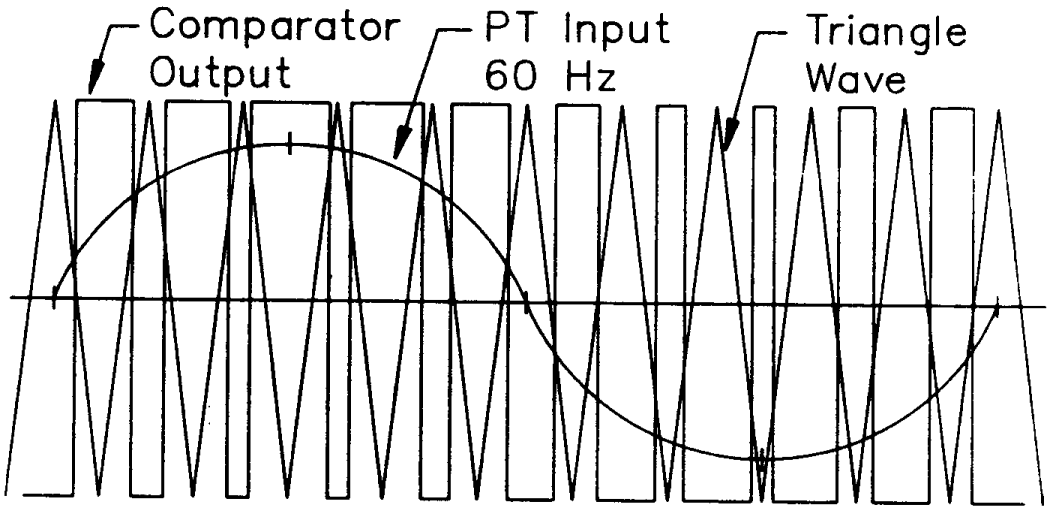
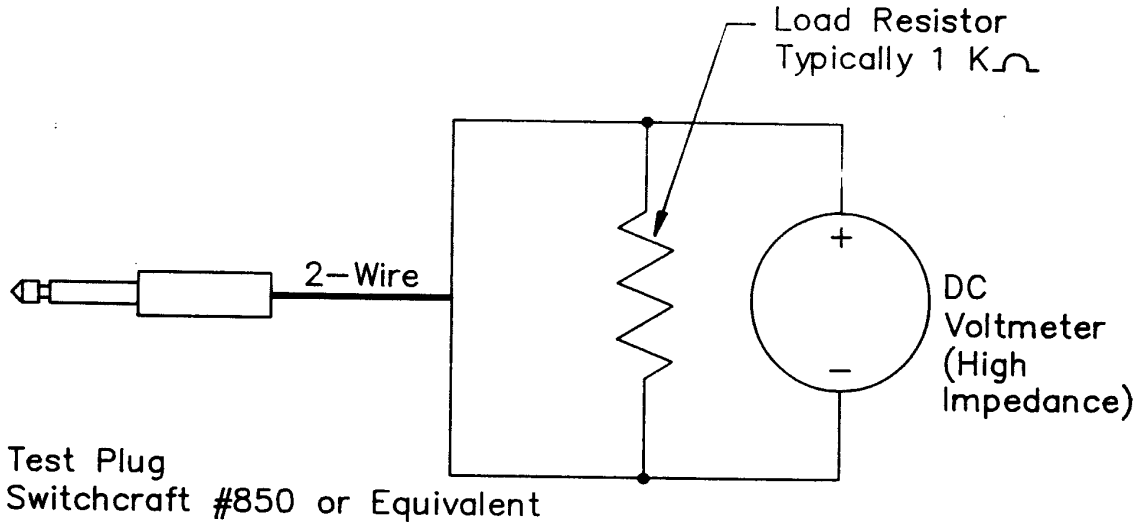


Figure 8
Superimposed Multiplier Waveforms



Note: Analog Output Terminal at backplane or F Option output connector must be shorted to use Analog Test Jack.

Figure 9 Analog Test Jack

TABLE 4 WATT/Q MULTIPLIER TROUBLESHOOTING GUIDE

Symptoms	**Possible Cause**	**Action Required**
No output.	Incorrect wiring.	Refer to Instruction Manual Re-check input wiring. If using test jack, analog output on the backplane must be shorted.
	Triangle wave.	Check test point.
4 / 3 expected output on single phase test.	2 - 1 / 2 Element Wattmeter.	None. 2 - 1 / 2 Element Wattmeter produces 4/3 expected output in single phase test.
Partial output.	One or more elements not functioning.	Check CT waveform. See waveform & test point.
	Blown choppers.	Check CT waveform and replace IC if necessary.

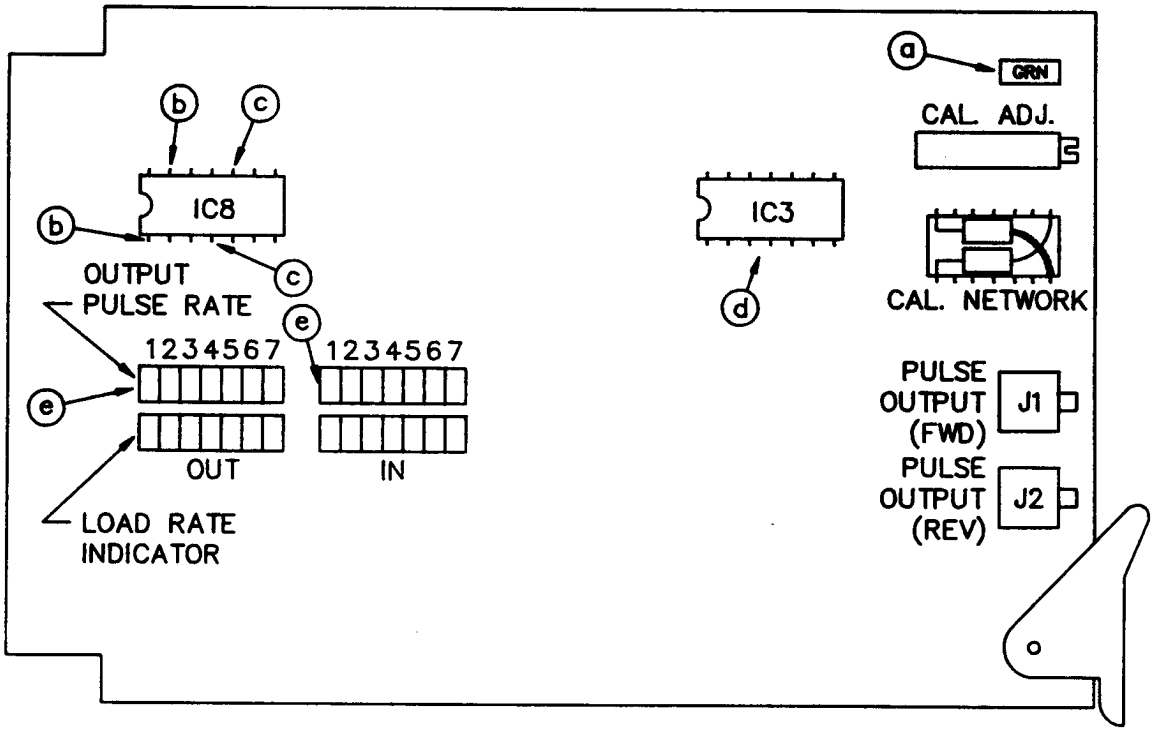
INTEGRATOR

This section contains:

Figure 10 Calibration Component and Test Point Location

Figure 11 Waveforms

Table 5 Troubleshooting Guide



○ Waveform Reference

* Applies to bidirectional integrators only

Calibration Component and Test Point Location

Only components shown are for location of test points. See assembly drawing for complete details.

Figure 10
Calibration Component and Test Point Location

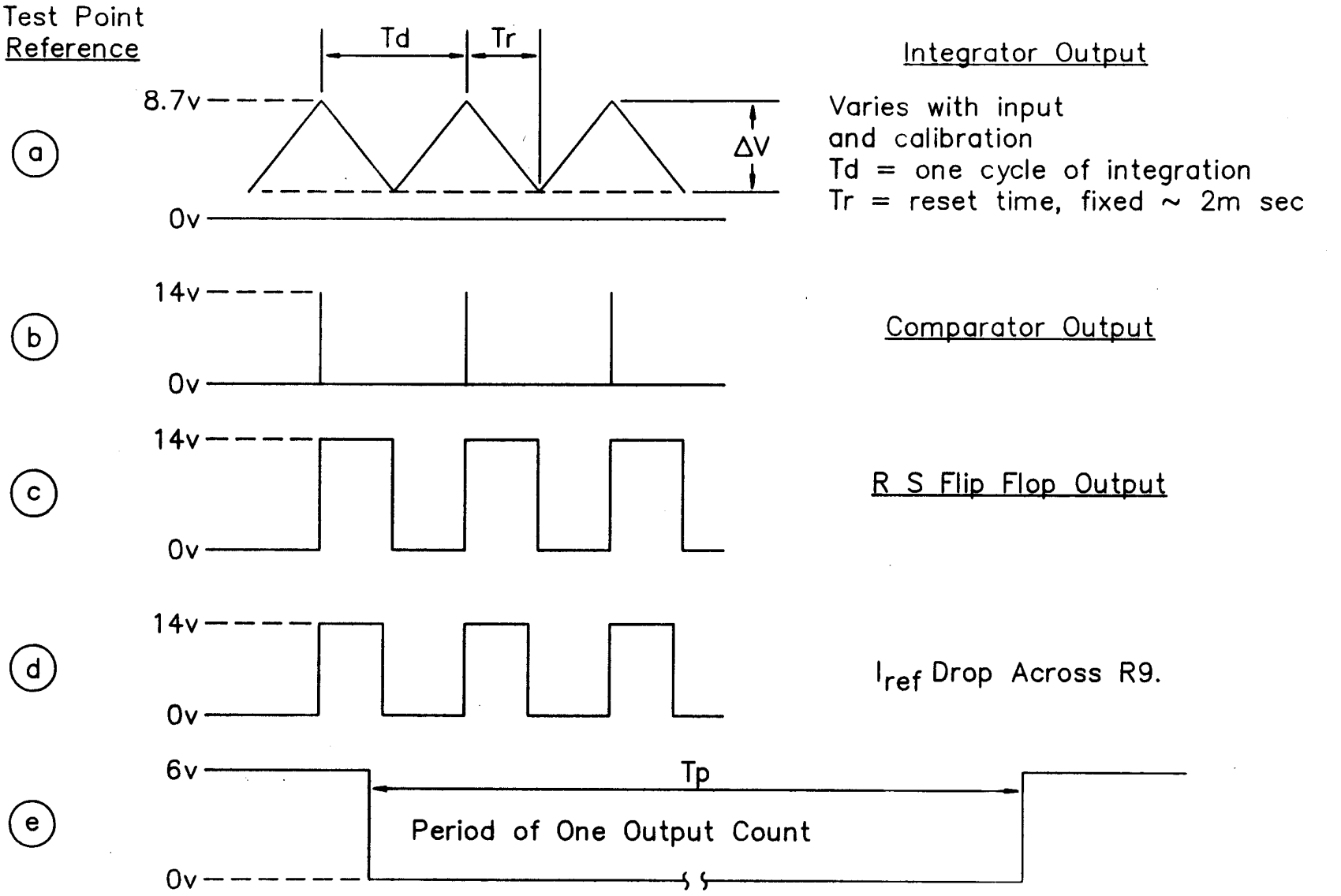


Figure 11 Integrator Waveforms for Analog-to-Pulse Converter

TABLE 5 INTEGRATOR TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSE	ACTION REQUIRED
No KYZ output. (Also, no register counts or load rate indication.)	Analog signal wrong polarity.	Check polarity of analog output. Possible connection error.
	Crystal oscillator failed (on Power Supply Board).	Check oscillator waveform at Power Supply yellow test point.
	Other component failure.	Isolate problem by using waveform test points on Figures 10 & 11.
No KYZ output . Register and load rate indicators working.	Output driver IC-13. Opto couplers IC-14, 15, 16, 17.	Replace defective component or exchange P/C assembly.
"Creep"; output counts with no load.	Excessive offset in Multiplier card.	Remove Multiplier card, recheck. Integration waveform can be monitored at green test point [a] Maximum slew rate at 0 Load 10 mV/Sec.
	Excessive bias current in input (IC-4).	
KYZ output out of calibration or won't calibrate.	Wrong calibration components or divider tap selector installed.	Check per calibration tables. Section 4 of Instruction Manual.

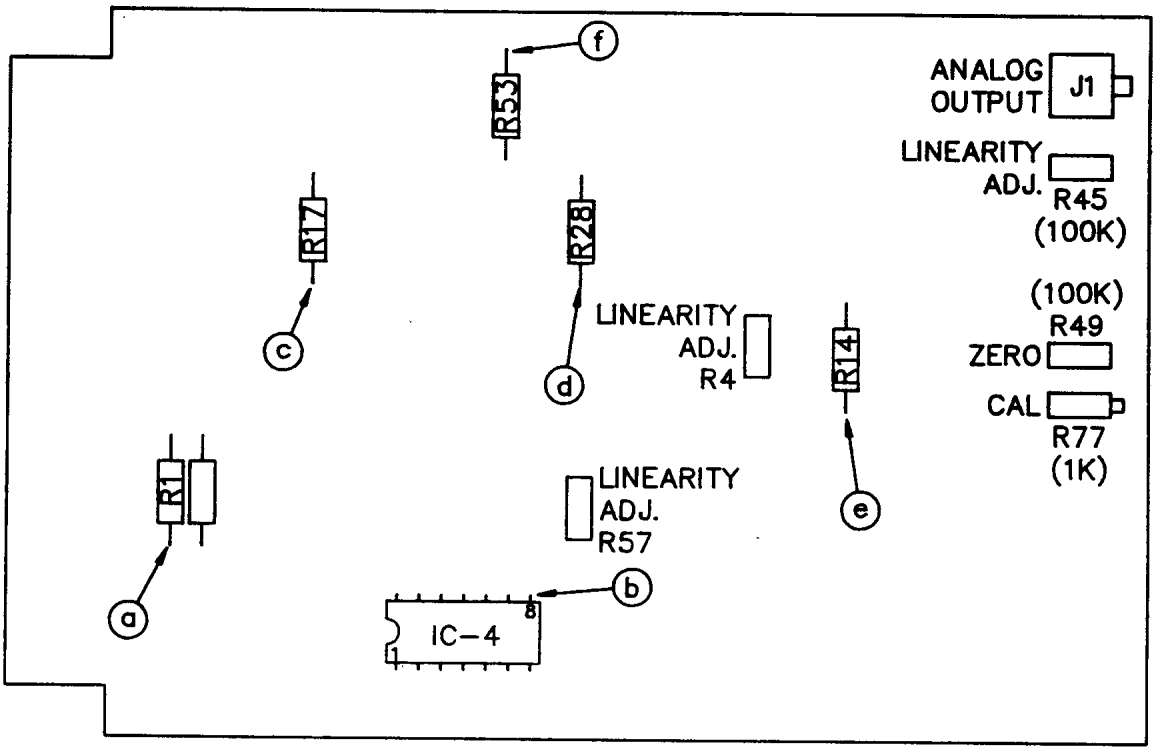
VA MULTIPLIER

This section contains the following:

Figure 12 Calibration Component and Test Point Location

Figure 13 VA Waveforms

Table 6 VA Multiplier Troubleshooting Guide



Calibration Component and Test Point Location

Only components shown are for location of test points.
See assembly drawing B05701–001 for complete details.

Figure 12 Calibration Component and Test Point Location

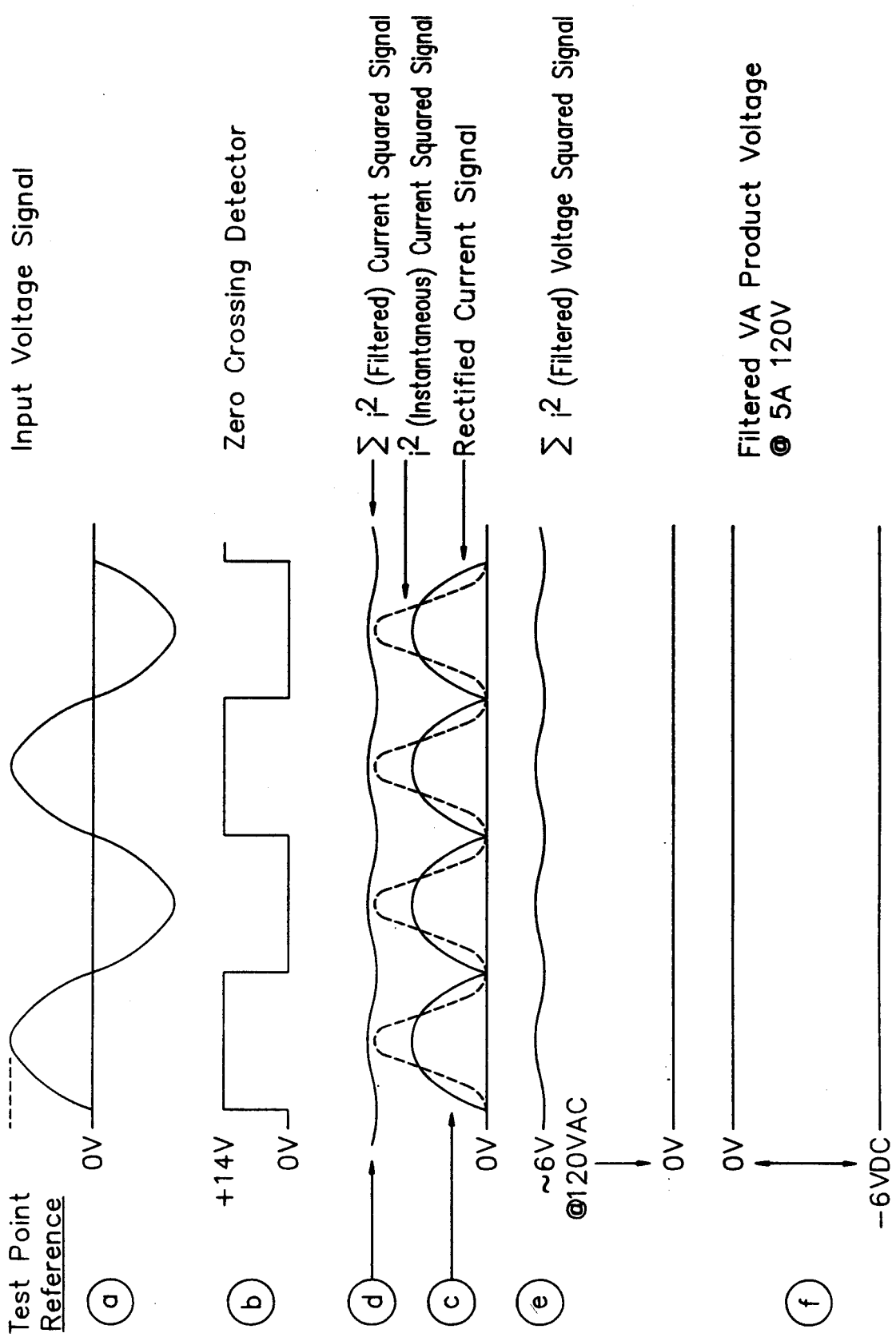


Figure 13 VA Waveforms

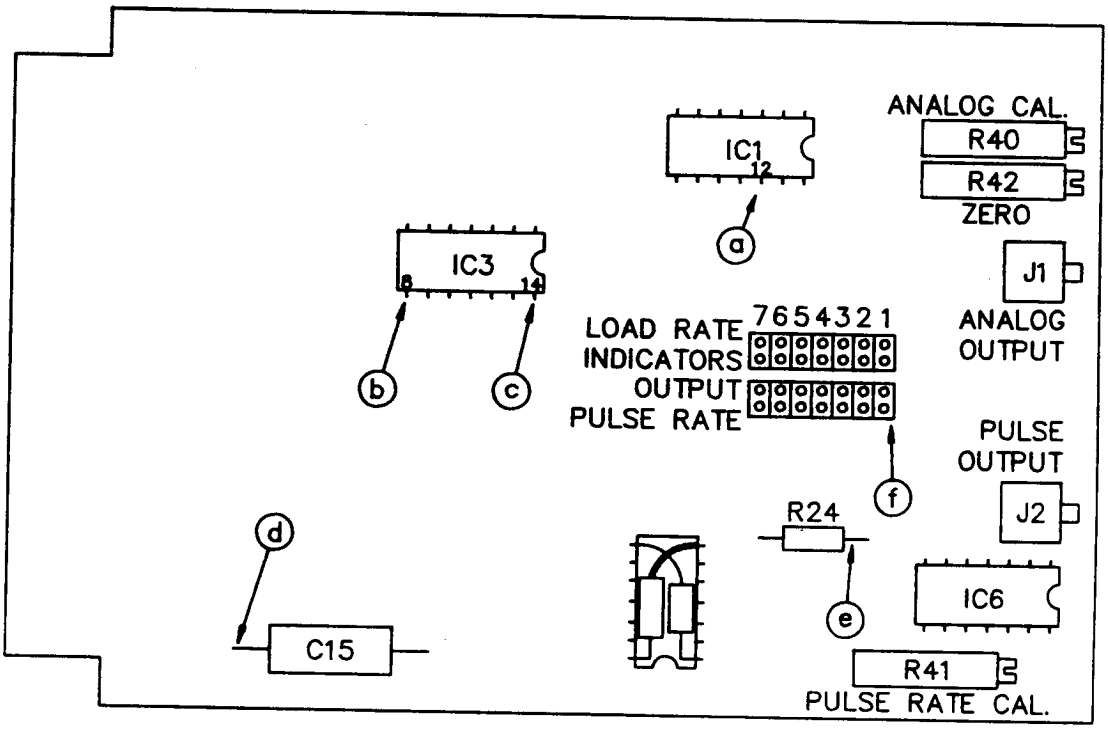
TABLE 6 VA MULTIPLIER TROUBLESHOOTING GUIDE

SYMPTOMS	POSSIBLE CAUSE	ACTION REQUIRED
No output or output does not vary with load.	Defective circuit component.	Check waveforms at test points to isolate problem.
Waveform [a] okay. [b] incorrect.	Zero crossing detector.	Replace IC-4.
Waveforms [a] and [b] okay [c] incorrect.	Input multiplexer.	Replace IC-2.
Waveforms [a], [b], [c] okay. [d] incorrect.	Current squaring circuit.	Replace IC-14, IC-9.
Waveform [e] incorrect.	Voltage squaring circuit.	Replace IC-7, IC-13, IC-8.
Waveforms [a], [b], [c], [d], [e] okay. [f] incorrect.	Square root or output circuit.	Replace IC-11, IC-10, IC-7, IC-12.

VOLT, VOLT^2, AND EXPANDED SCALE VOLT CARD

This section contains:

Figure 14 Calibration Component and Test Point Location
Figure 15 Volt Analog/Vh Integrator Waveforms
Table 7 Troubleshooting Guide



Volt, Volt^2 and Expanded Scale Volt Calibration Component and Test Point Locations

Only components shown are for location of test points. See assembly drawing for complete details.

FIGURE 14

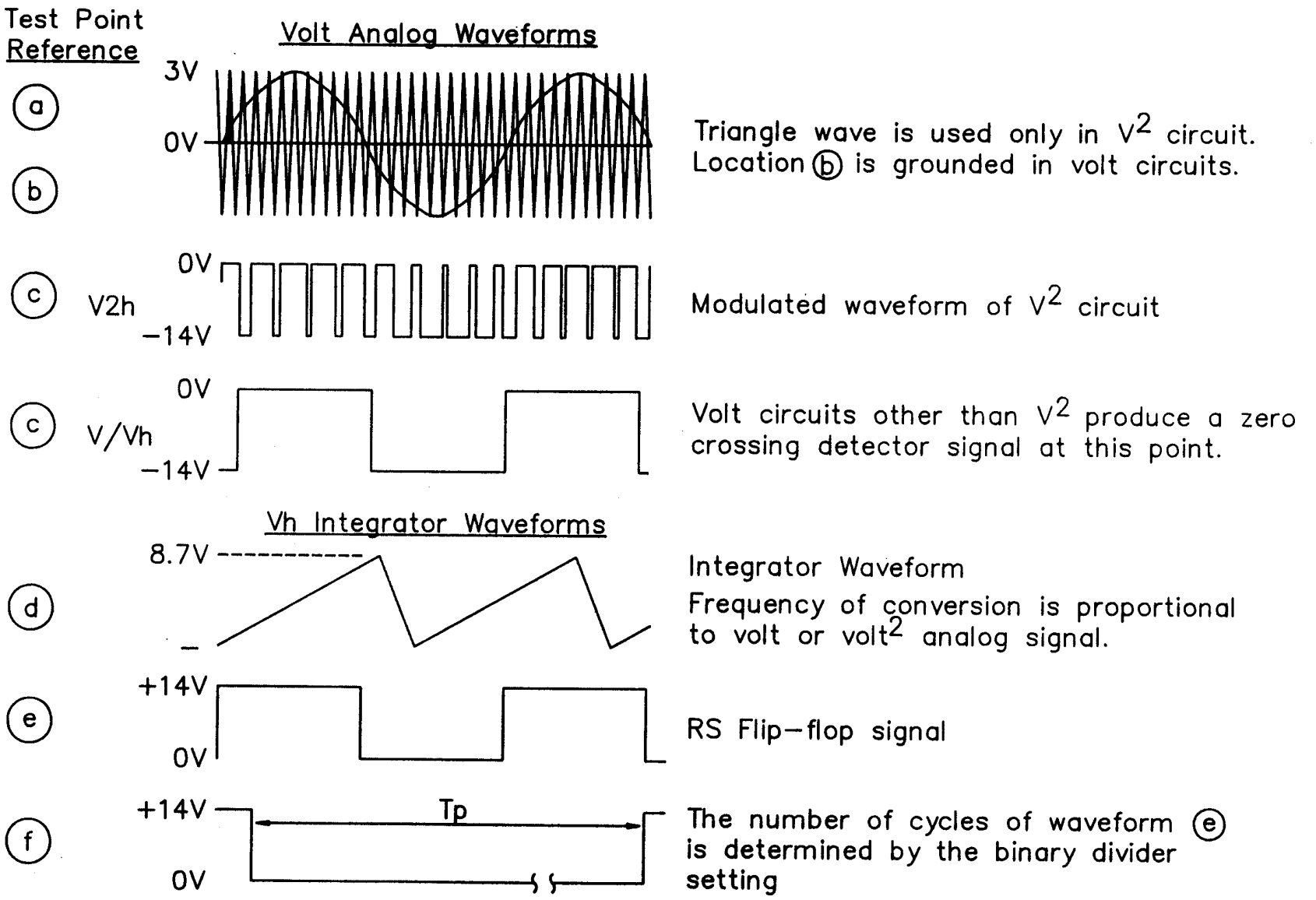


Figure 15 Waveforms

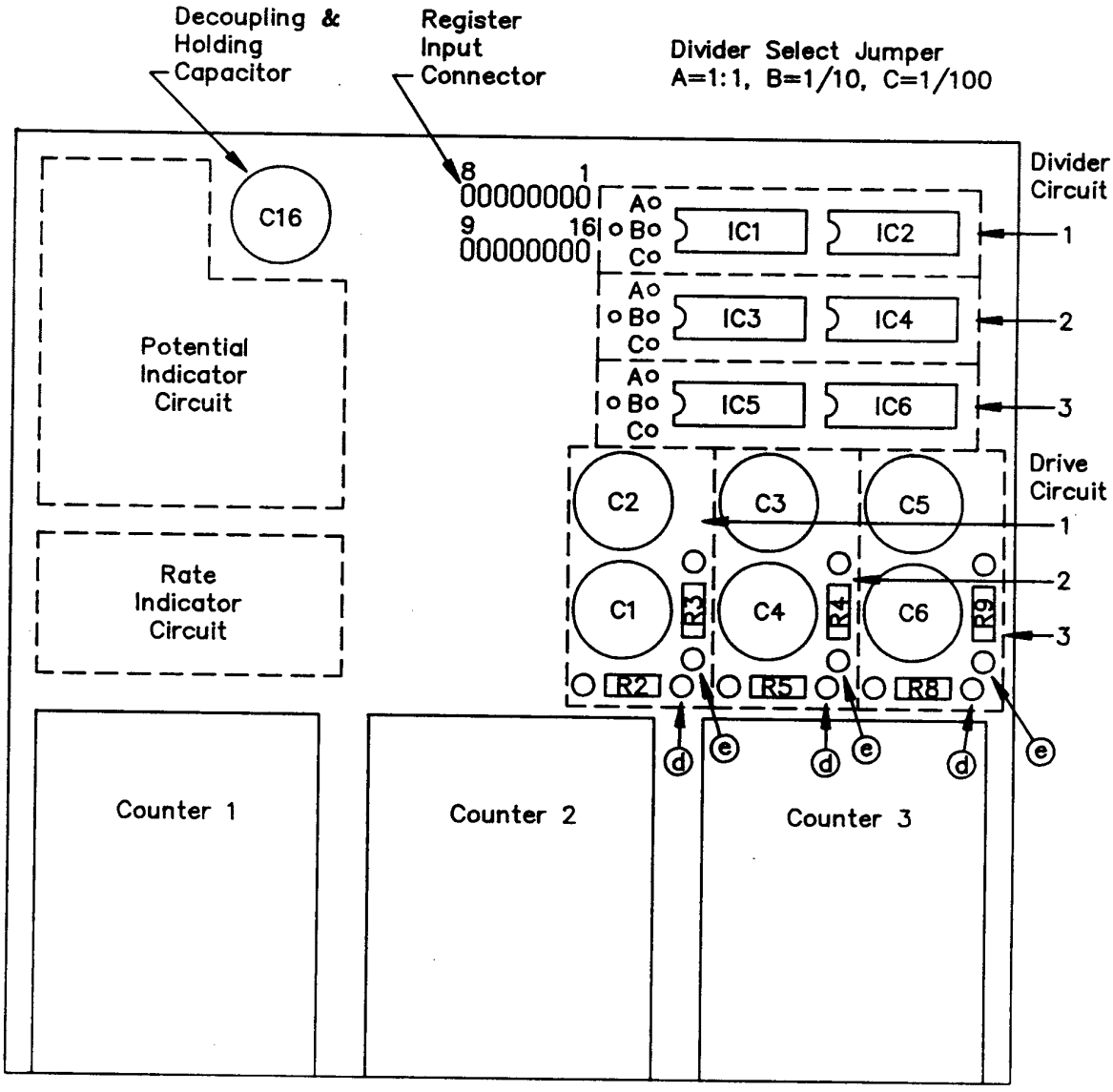
TABLE 7 VOLT, VOLT^2, EXPANDED SCALE VOLT CARD TROUBLESHOOTING GUIDE

SYMPTOMS	POSSIBLE CAUSE	ACTION REQUIRED
No analog output or output does not respond properly to input.	No input to circuit.	Verify waveform at test point [a]. Possible connection problem.
	If input is present and board is determined to be defective, the problem can be isolated to a probable component problem by observing waveforms Figure 14, 15.	
	Waveform [b] incorrect. (Applies to V function .)	Replace IC-1, IC-3, IC-4.
	Waveforms [a] and [b] okay. Waveform [c] incorrect.	Replace IC-3.
	Waveforms [a], [b] and [c] okay.	Replace IC-1, IC-2.
No pulse output (KYZ), analog okay.	Check integrator section waveforms to isolate faulty components.	
	Waveform [d] not correct.	Replace IC-6, IC-7, IC-8.
	Waveforms [d] and [e] correct. [f] not correct.	Replace IC-5, or IC-11, IC-12.

ELECTRO-MECHANICAL REGISTER

This section contains the following:

Figure 16	Electro-mechanical Register Calibration Component and Test Point Location
Figure 17	Electro-mechanical Register Waveforms
Table 8	Troubleshooting Guide



Electro–mechanical Register Calibration Component and Test Point Locations

Only components shown are for location of test point. See assembly drawing for complete details.

Figure 16

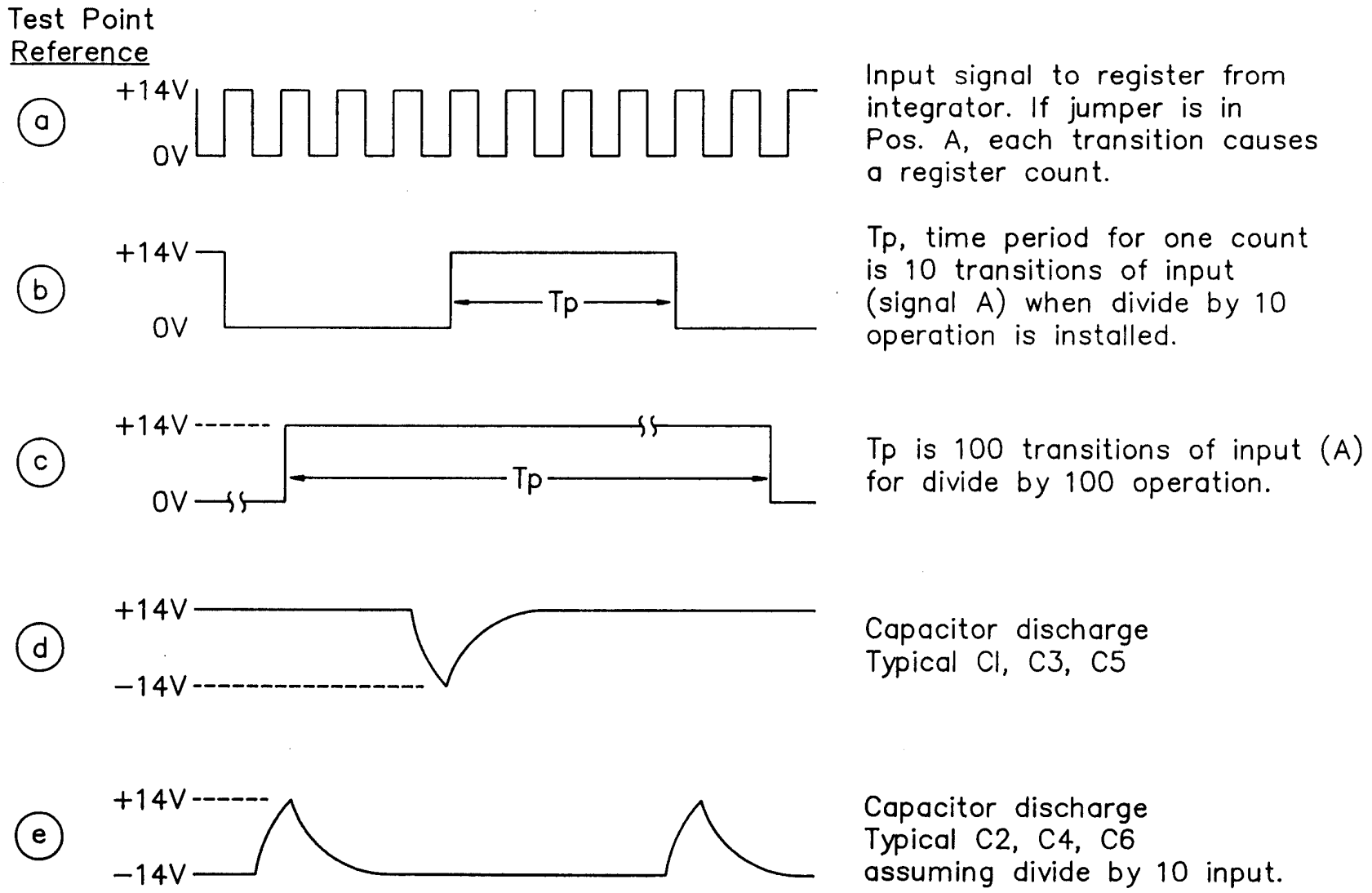


Figure 17 Electro-mechanical Register Waveforms

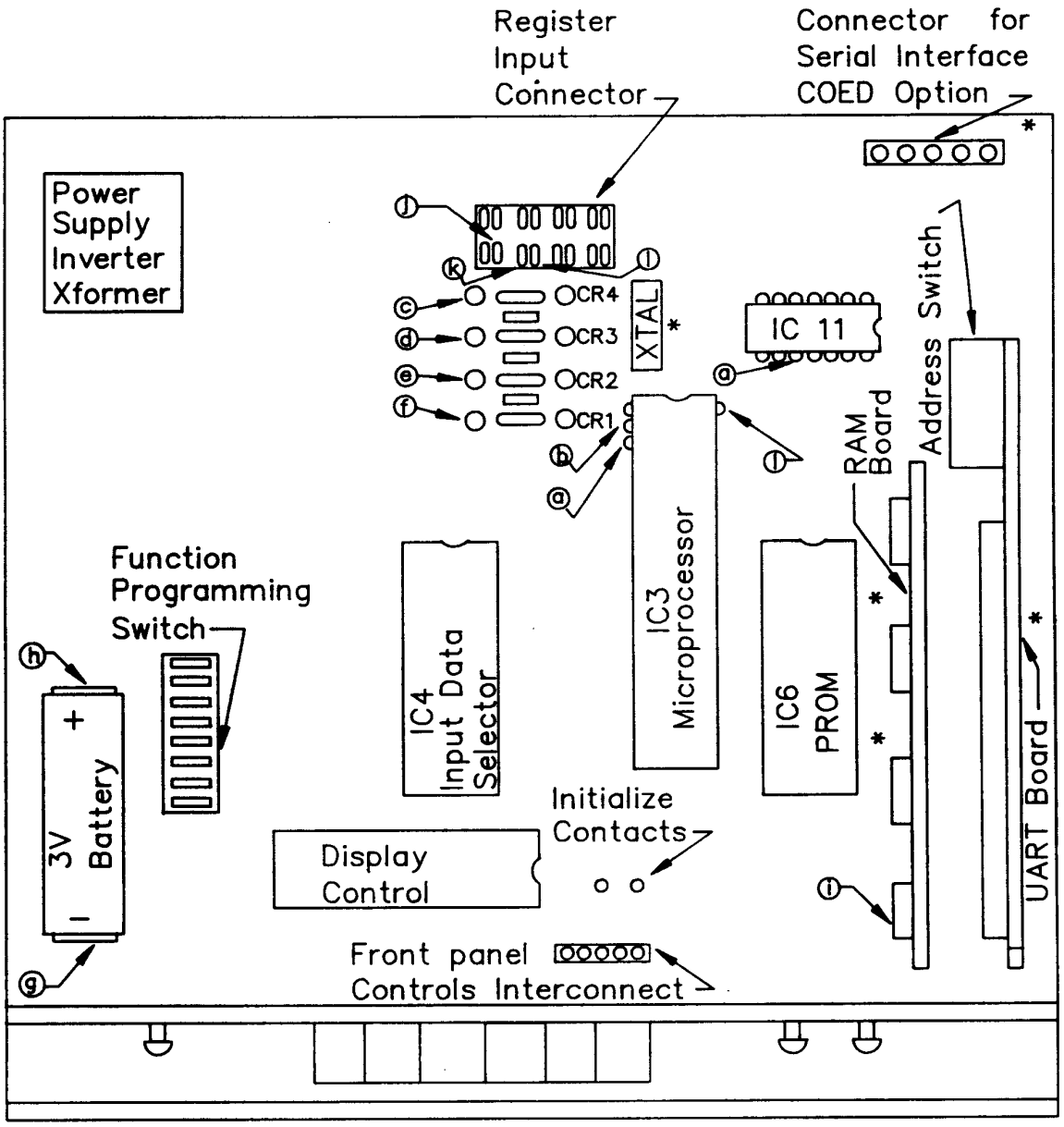
TABLE 8 ELECTRO-MECHANICAL REGISTER TROUBLESHOOTING GUIDE

SYMPTOMS	POSSIBLE CAUSE	ACTION REQUIRED
Register does not count.	Loose cable connector.	Verify cable is properly inserted and that retainer is in place.
	Divider circuit not functioning, if installed.	Verify divider operation by observing input and output of divider stages at test points [a], [b], and [c]. Replace divider IC-6 (as required).
	If signal is present at the divider, select jumper [a], [b] or [c]; then the problem is either in the counter drive circuit or the counter mechanism.	Figure 16, 17 will aid in determining defective part.
		Check counter mechanism for possible misalignment of digits.

ELECTRONIC REGISTER

This section contains the following:

Figure 18	Electronic Register Calibration Component and Test Point Location
Figure 19	Waveforms and Test Point Descriptions
Table 9	Troubleshooting Guide



Electronic Register Calibration Component and Test Point Location

Figure 18

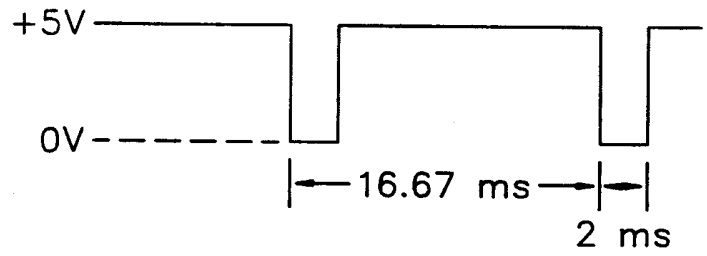
ELECTRONIC REGISTER

Waveforms and Test Point Descriptions

Test Point
Reference

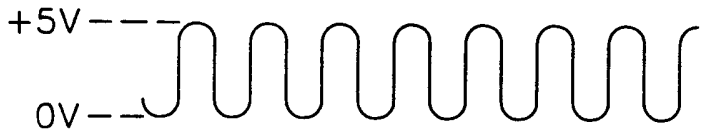
ⓐ Line Sync Signal

Generated at IC 11 Pin 10, applied to clear input of 1802 μP, Pin 3.



ⓑ MicroProcessor Clock

Applied to IC 3 Pin 3, approximately 2 mHz on non-COED units. COED (ASCII) units have crystal controlled 2.4576 mHz clock which is divided to 9600 Hz for signal for UART operation.



ⓒ ⓓ ⓔ ⓕ

Input Signals from Integrator Cards are determined by soldered-in jumpers on the JEM back plane. Interconnect boards are listed in Table 4.2.

Each transition results in a register "count".

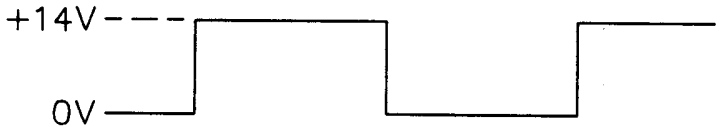


Figure 19

Four input signals are possible along with a corresponding rate indicator signal for each. Data is accumulated for each input signal and displayed with a function indicator as listed below and shown on Figure 18.

TEST POINT REFERENCE	CTR. INPUT PIN	FUNCTION INDICATOR	RATE INDICATOR	INDICATOR PIN OF RATE INDICATOR
[c]	9	F4	F9	6
[d]	3	F2	F6	4
[e]	2	F1	F8	5
[f]	13	F5	F7	14

TEST POINT REFERENCE	CIRCUIT COMMON
[g]	Battery clip may be used as reference point for measuring waveform or voltages.
[h]	Battery positive terminal nominal 3 Vdc (2.7 V minimum).
[i]	Data Retention Power, decoupled from battery is supplied to the microprocessor (pin 40) and RAM IC's (pin 22). 2.2 to 2.6 Vdc (with auxiliary power off).
[j]	Pin 10 of input connector PS common.
[k]	Pin 11 of input connector -14 Vdc.
[l]	Pin 12 of input connector +14 Vdc.

TABLE 9 ELECTRONIC REGISTER TROUBLESHOOTING GUIDE

SYMPTOMS	POSSIBLE CAUSE	ACTION REQUIRED
No display.	Power not supplied to Register.	Check main power supply, regulator, input connector.
Displays fixed data, won't roll or count.	Faulty cable connection.	Check input connector cable and insure that retainer is in place.
Displays counts but won't roll.	Connect to front panel controls.	Check inter-connection to front panel switches.
Displays undesired quantities, time interval wrong, counts off by ratio of 10 or 100.	Programming switch set incorrectly.	Field programmable variations are defined in Section 3 of Instruction Manual.
Incorrect or not functioning after auxiliary power removed and re-applied.	Battery defective or not properly installed.	Check battery voltage. Replace if below 2.7 Vdc.
	Data lost due to removal of battery without power amplifier or due to handling of register module.	If register information is lost by lack of battery power or other cause, it may be necessary to "initialize' the register by shorting the contacts provided.
	NOTE: <u>All readings are cleared by the "initializing" action.</u>	

EXJ REGISTER

INTRODUCTION

The Scientific Columbus EXJ™ Register is a multifunction programmable register/communications controller that may be installed in any of the JEM®1 family of electronic meters. As opposed to the traditional mechanical registers previously used in the JEM1, the EXJ Register can be configured by the user to operate with **any** JEM1 meter. In addition, the EXJ Register contains a nonvolatile, real-time clock, a nonvolatile data storage (with mass memory option), and serial communications compatible with 20 mA digital current loop, optical and RS-232C/V.24 interfaces, and optional internal modem..

The EXJ Register is a direct replacement for all JEM®1 register types, both mechanical and electronic, and may be installed with essentially no modification to the JEM®1. Usually, the only parts required are the EXJ Register itself and a new faceplate for the JEM®1 enclosure.

In September of 1990, minor physical changes were made to the EXJ Register design to allow standard subassemblies to fit both switchboard and non-switchboard models of the JEM1.

Optional features include an internal modem and a load-profile data storage system.

To increase flexibility in field data reading, the EXJ Register includes a liquid-crystal display of two lines with eight characters each with built-in backlighting. The display provides both numeric and user defined textual data for any combination of JEM®1 functions. Display formats, pulse divisors, demand times, and serial data parameters are all user programmable.

EXJ Section Organization

This section begins with an introduction followed by a discussion of the compatibility of pre-1990 and post-1990 EXJ registers with the switchboard and non-switchboard JEM1 models. Then, each board in the EXJ Register is discussed with information about the board description, theory of operation, and the user serviceable components. The silk screen and schematic drawings for each board are grouped together in a separate section. A board to drawing cross reference chart precedes the drawings.

EXJ Contents

Your EXJ contains the following assembly modules:

- Controller Board Assembly

  Daughter Board Assembly (only on EXJ Controller Board Revision A)

- Display Assembly - (Consists of two parts)
  - Display Board
  - Liquid Crystal Display module

- Display interconnect cable assembly, as required

- One of the following boards will be included depending on model (switchboard or non-switchboard) and options of your JEM1:

  - Communication Interface Board, PCB part number 13269-002K, for
    A-base and S-base models.

  - Multiaccess Communication Interface Board, 13397-001K, for A-base and S-base models

  - Communications Interface Board, PCB part number 13535-001K, for switchboard models

- Ground Plane Board (One of the following)

  - Part number 12711-001 for non-switchboard models
  - Part number 13658-002 for switchboard models

Related Manuals:

Reference to the following JEM® manuals may be necessary:

JEM® Series Joule Electronic Meters, Instruction Manual, YD-08787-001-N.

JEM Coed, Coded Output for Electronic Display/Demand Register, Operating Instructions, YD-08788-001-N.

For additional information, see the manual(s) for your specific product.

REGISTER COMPATIBILITY

EXJ Registers built prior to the introduction of the JEM1 switchboard meter late in 1990 had an interconnection between the Controller board assembly and the Display assembly comprised of a direct pluggable, right angle header and socket. (See Figure 20.)

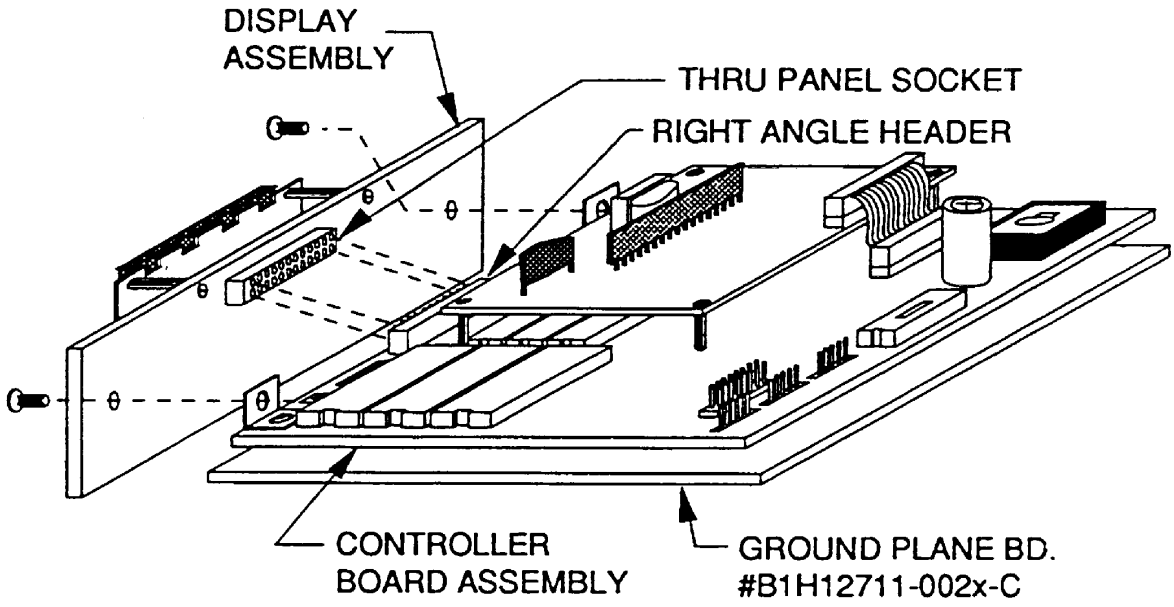


Figure 20
Pre-Switchboard Configuration; Non-Switchboard Only
Part No. 12711-002

The direct pluggable feature was deleted in favor of the more versatile ribbon cable interconnect, thus allowing standardized controller board assembly and display board assembly modules to be used on both switchboard and non-switchboard models of the JEM1 meter. (See Figures 21 and 22.)

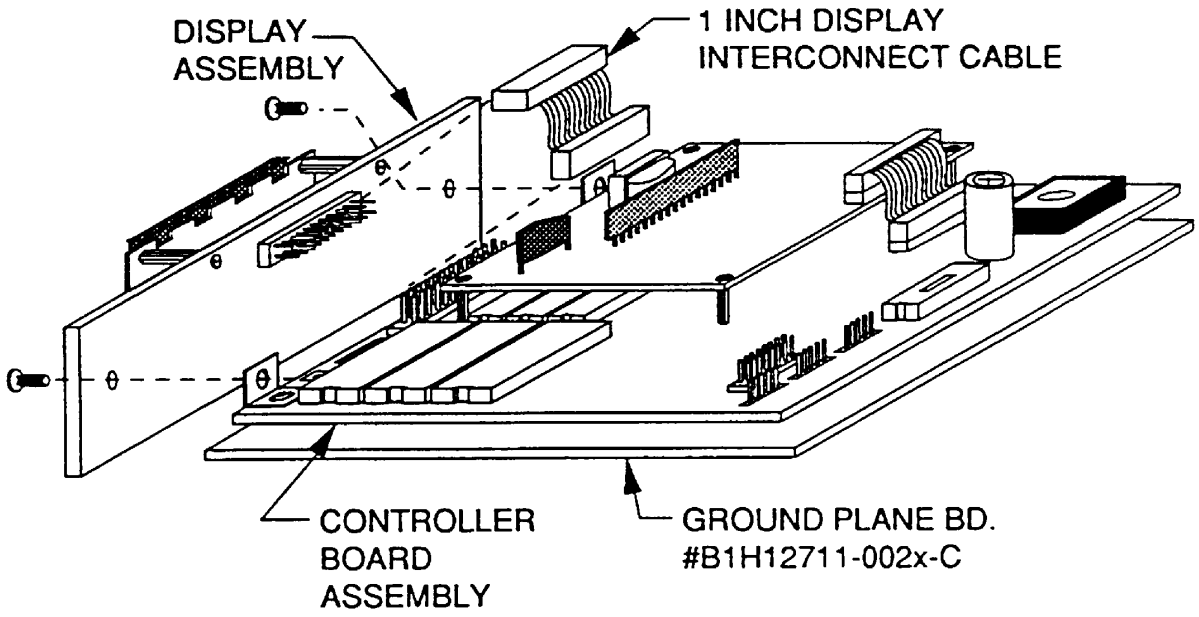


Figure 21 Post-Switchboard Configuration; Non-Switchboard Models
Part No.: 12711-002

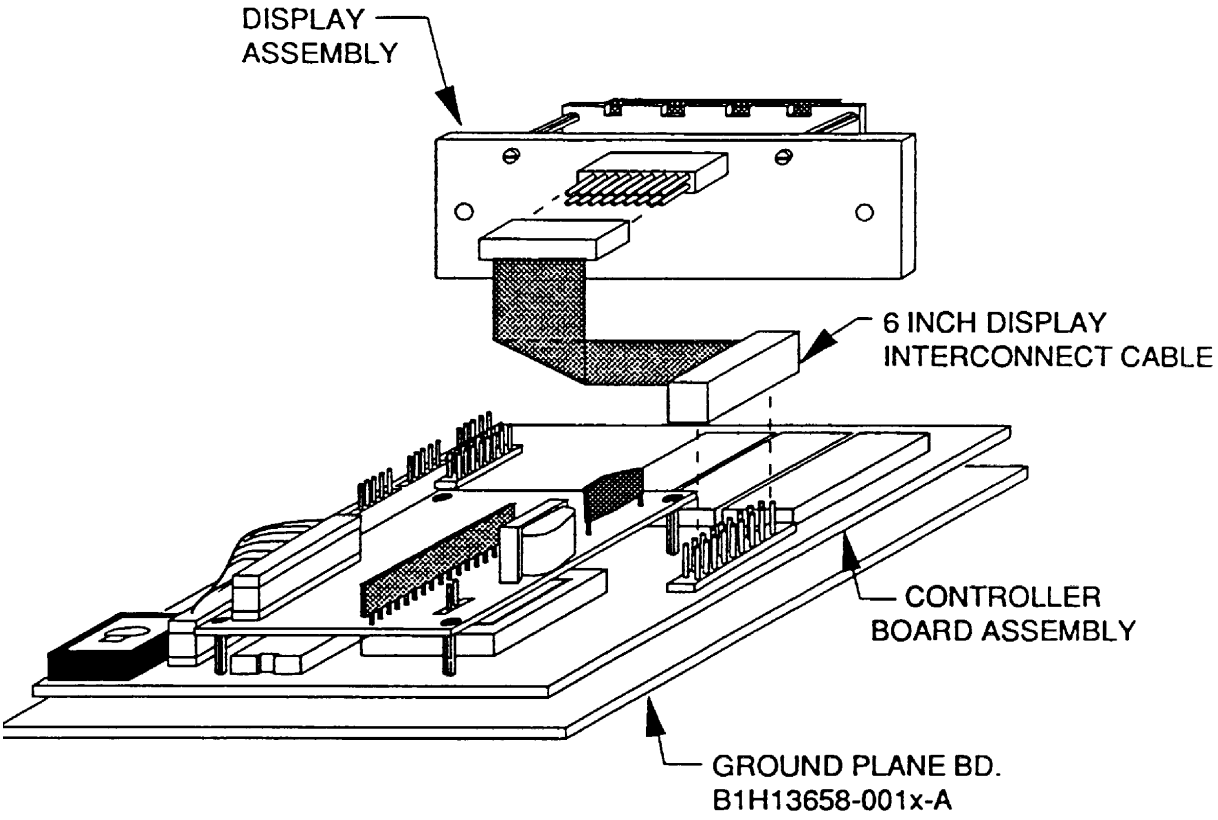


Figure 22 Post-Switchboard Configuration; Switchboard Meters
Part No.: 13658-001

Pre-switchboard EXJ Registers cannot be used on switchboard models.

Post-switchboard (cable connected) EXJ Registers, with the use of the appropriate display interconnect cable and ground plane board, can be used on any model of the JEM1 meter.

EXJ Controller Board

Board Deription:

The EXJ Controller Board assembly is the heart of the EXJ Register. It contains all of the functional elements of the register except the Liquid Crystal Display and display driver circuits and the communications interface circuits. The Controller board is also the platform for optional mass memory and the optional internal modem. **Note**: Optional modem and mass memory are not available on the Revision A, Controller Board.

Theory of Operation:

All information is processed on the main controller board with the 80C451 microcontroller found in U1. Socket U5 houses the MK48T02 nonvolatile clock/calendar integrated circuit where all configuration and register information is stored.

For revision B or later, sockets U4 and U6 accommodate the static random access memory. (U4 had volatile static RAM on Revision A.) The memory is nonvolatile if the mass memory option is present or volatile otherwise. Load profile data are stored in these locations.

Note: Schematic drawings Revision D and E are identical. Revision E occurred because the assembly revision level changed with the inclusion of switchboard models. See Figures 23, 24, and 25.

User Serviceable Components:

WARNING!
The first step is to de-energize the meter and <u>completely</u> isolate it from all service lines. <u>Never</u> dismantle an energized meter.

All nonvolatile integrated circuits listed above contain embedded energy cells. The chips should be replaced every ten years to assure data integrity.

The EXJ Controller must be reconfigured after integrated circuit replacement.

EXJ Daughter Board

Board Description:

The EXJ Daughter Board is a separate board that plugs into socket U9.

Theory of Operation:

The EXJ Daughter Board contains a large electrolytic capacitor which stores enough energy to allow the microcontroller to perform a graceful shutdown. (This board is used on Revision A only.) The EXJ Daughter Board also adds hysteresis to the power line frequency monitoring circuitry to eliminate electrical noise.

User Serviceable Components:

WARNING!
The first step is to de-energize the meter and <u>completely</u> isolate it from all service lines. <u>Never</u> dismantle an energized meter.

Problems may be traced to a disturbed connection between the EXJ Daughter Board and the EXJ Controller Board Revision A. If a problem does arise, please check this connection.

After removing power from the JEM1, firmly seat the EXJ Daughter Board into socket U9.

EXJ Display Board

Board Description:

The EXJ Display Board provides an interface between the EXJ Controller Board and the Liquid Crystal Display Module. The board contains optical interface circuitry, temperature compensation for the Liquid Crystal Display Module and a multiturn potentiometer for display angle adjustment.

Theory of Operation:

The EXJ Display Board employs two functionally independent circuits for control of the Liquid Crystal Display Module. The display viewing angle is temperature dependent. Therefore, thermistor based temperature compensation is used to maintain the user-set viewing angle. The viewing angle can be adjusted over approximately a 45 degree angle in the vertical plane with the multiturn potentiometer (R101).

User Serviceable Components:

The 15-turn potentiometer provides contrast and viewing angle adjustment for the Liquid Crystal Display Module. Clockwise rotation increases the contrast and raises the viewing angle. Counterclockwise rotation decreases the contrast and lowers the viewing angle.

EXJ Communication Interface Board

(For non-switchboard JEM1 models)

Board Description:

The EXJ Communication Interface Board (PCB # 13269-002K) provides transient surge protection for RS-232C, current loop, R/T option, and modem interfaces. The board is functionally composed of two parts. The components located between the subminiature "D" connector (P1) and the 16-pin header (J1) provide surge protection for RS-232C, current loop, and R/T option. Modem surge protection is provided by the components located between the RJ-11 receptacle (J2) and the two-pin header (J3).

Theory of Operation:

The RS-232C, 20 mA digital current loop, and R/T option surge protection is provided by unidirectional and bidirectional transient surge suppressors which react to clamp incoming voltage transients to acceptable limits.

Two stages of metallic oxide varistors are utilized to protect the modem from common and transverse mode voltage transients. Fuses, which are in series with both line and tip, protect the metallic oxide varistors from transients with too great of energy content.

User Serviceable Components:

WARNING!
The first step is to de-energize the meter and completely isolate it from all service lines. Never dismantle an energized meter.

WARNING!
Disconnect the telephone line from J2 before replacing F1 and/or F2. The telephone line can have high voltages present.

Fuses F1 and F2 should be replaced with Scientific Columbus Part Number 6006-305.

Multiaccess EXJ Communication Interface Board

(For non-switchboard JEM1 models)

Board Description

The Multiaccess EXJ Communication Interface Board (13397-001K) provides transient surge protection for RS-232, 20 mA digital current loop, and R/T option interfaces. The subminiature "D" connector (P1) and terminal blocks (TB1, TB2, and TB3) are connected in parallel to interface the JEM1 with the field. Header J1 is paralleled with J2, J3, J4. These terminals provide the interface between the Multiaccess Board and the EXJ.

Theory of Operation:

The Multiaccess Communication Interface Board utilizes unidirectional and bidirectional transient surge suppressors which react to clamp incoming voltage transients to within acceptable limits.

User Serviceable Components:

No user serviceable components exist on the Multiaccess Board.

EXJ COMMUNICATION INTERFACE BOARD

(For switchboard JEM1 models)

Board Description:

The EXJ Communication Interface Board (PCB # 13535-001K) provides transient surge protection for RS-232, current loop, R/T option, and modem interfaces. The board is functionally composed of two parts. The components located between the subminiature 'D' connector (P1) and the three 5 pin headers (J4, J5 and J6) provide surge protection for RS-232C, current loop and R/T option. Modem surge protection is provided by the components located between the RJ-11 receptacle and the 2 pin header (J3).

Theory of Operation:

The RS-232C, 20 mA digital current loop, and R/T option surge protection is provided by unidirectional and bidirectional transient surge suppressors which react to clamp incoming voltage transients to acceptable limits.

Two stages of metallic oxide varistors are utilized to protect the modem from common and transverse mode voltage transients. Fuses, which are in series with both line and tip, protect the metallic oxide varistors from transients with too great of energy content.

User Serviceable Components:

WARNING!
The first step is to de-energize the meter and <u>completely</u> isolate it from all service lines. <u>Never</u> dismantle an energized meter.

WARNING!
Disconnect the telephone line from J2 before replacing F1 and/or F2. The telephone line can have high voltages present.

Fuses F1 and F2 should be replaced with Scientific Columbus Part Number 6006-305.

GROUND PLANE BOARD

Functions

The Ground Plane board serves two functions:

1. Provides an additional margin of EMI/RFI shielding for the EXJ Register.

2. Serves as a physical mounting platform for the register.

Versions

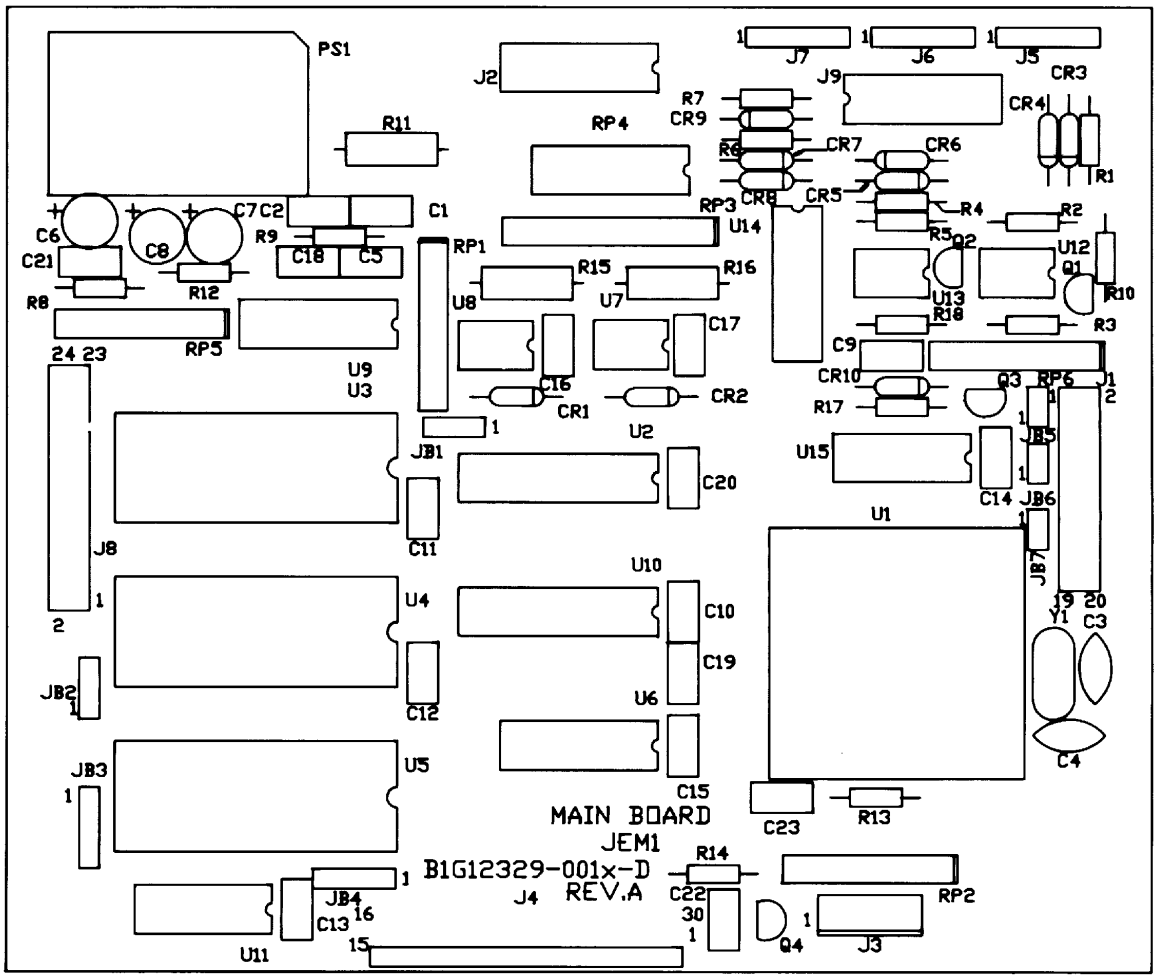
Two versions of the Ground Plane board are used depending on the packaging style of the individual meter:

1. For all non-switchboard JEM1 meters, the EXJ Register requires the Ground Plane Board, PCB part number 12711-001.

2. For all switchboard JEM1 meters, the EXJ Register requires the Ground Plane board, PCB part number 13658-001.

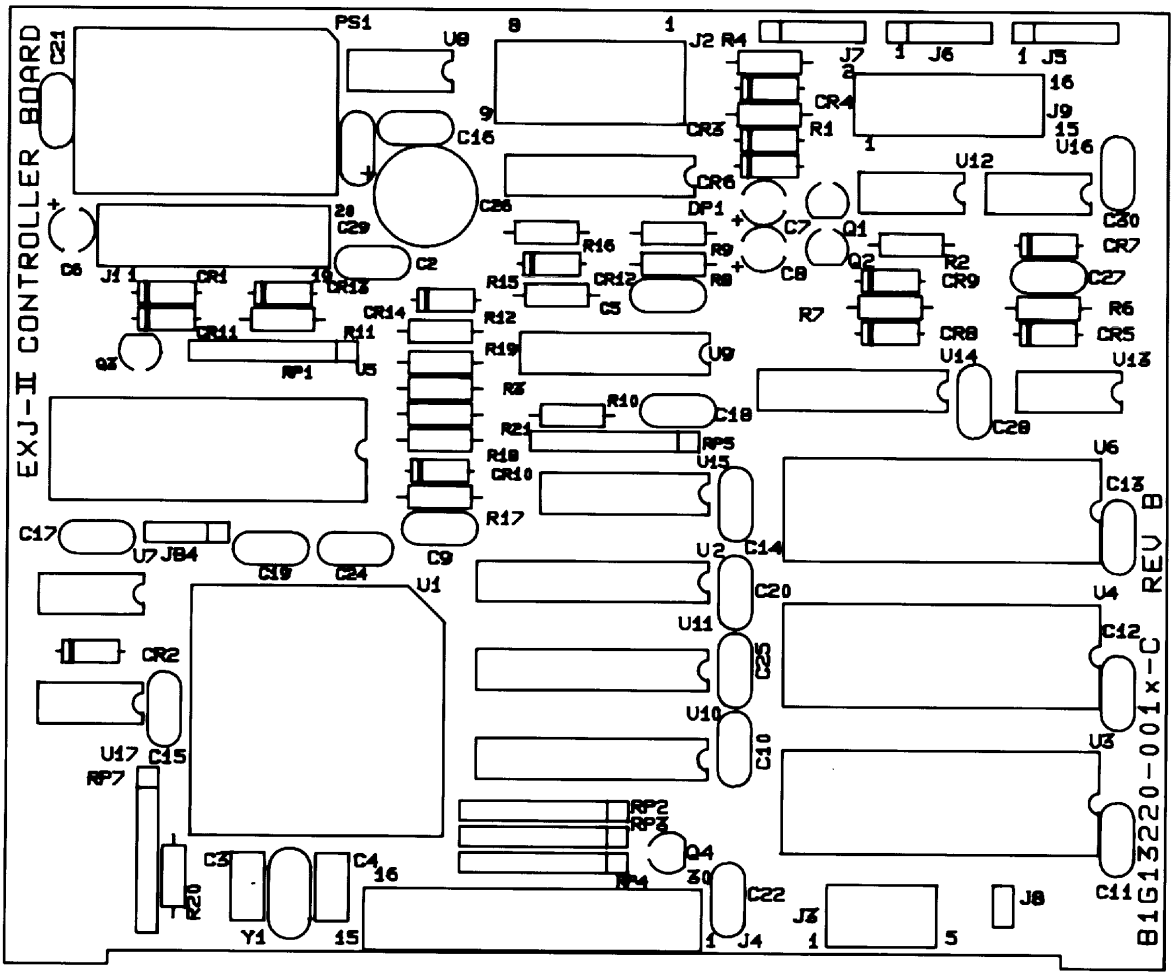
CROSS REFERENCE CHART
SILK SCREEN AND SCHEMATIC DRAWINGS

BOARD	PAGE NUMBER	SILK SCREEN	SCHEMATIC
EXJ Controller	51, 52	B1G12329-001x-D	B1E12330-001x-C
	53, 54	B1G13220-001x-C	B1E13221-001x-C
	55, 56	B1G13220-001x-C	B1E13221-001x-C
Daughter	57, 58	B1G12799-001x-C	B1E12798-001x-A
Display	59, 60	B1G12327-001x-C	B1E12328-001x-B
	61, 62	B1G12327-001x-C	B1E12328-001x-B
	63, 64	B1G13542-001x-A	B1E13543-003x-B
Communication Interface, non-switchboard models	65, 66	B1G13268-001x-C	B1E13269-001x-B
	67, 68	B1G13268-001x-C	B1E13269-001x-B
Multiaccess Communication Interface	69, 70	B1G13396-001x-C Final Assembly number: 13397-001	B1E13397-001x-B
Communication Interface, Switchboard Models	71, 72	B1G13534-001x-B	B1E13535-001x-B



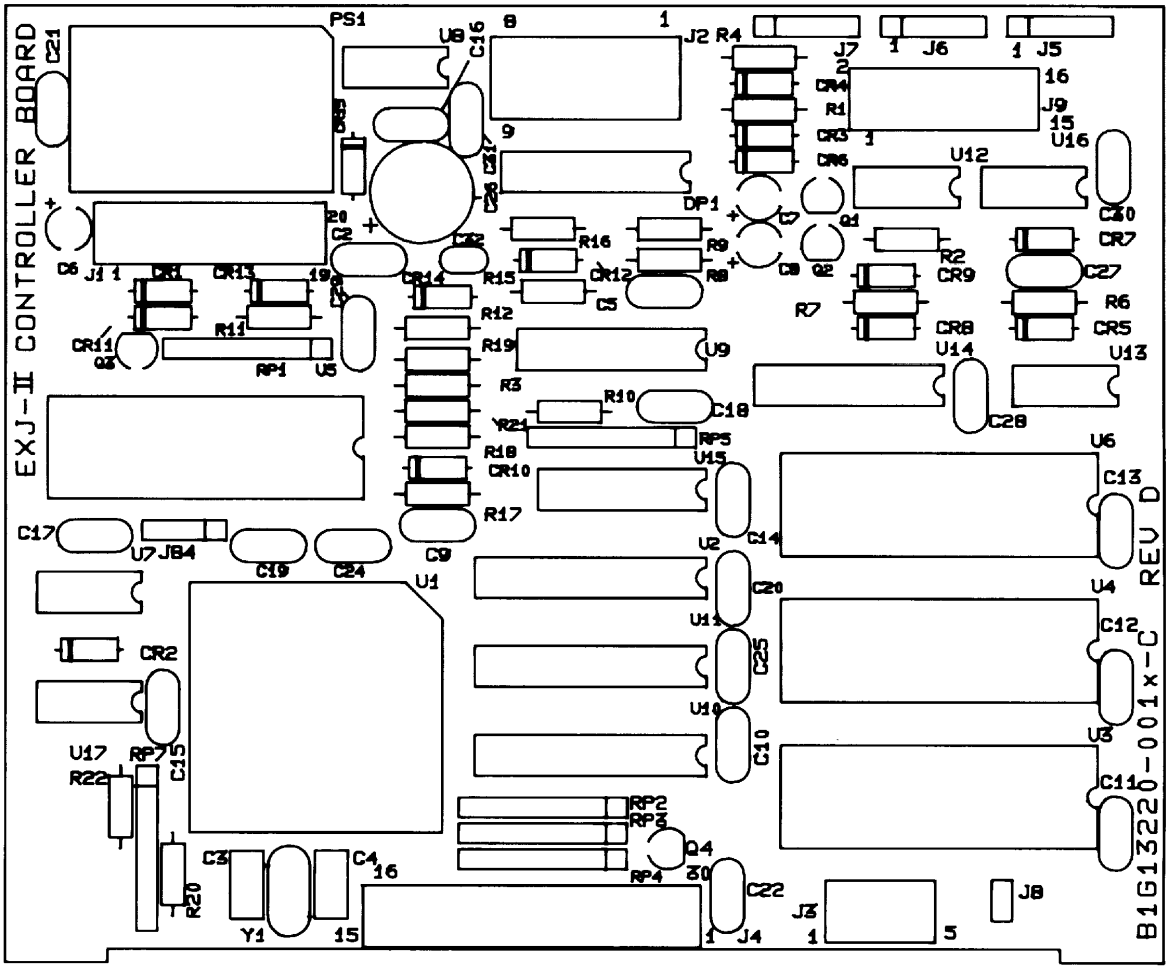
EXJ CONTROLLER BOARD
SILK SCREEN
REVISION A

Figure 23



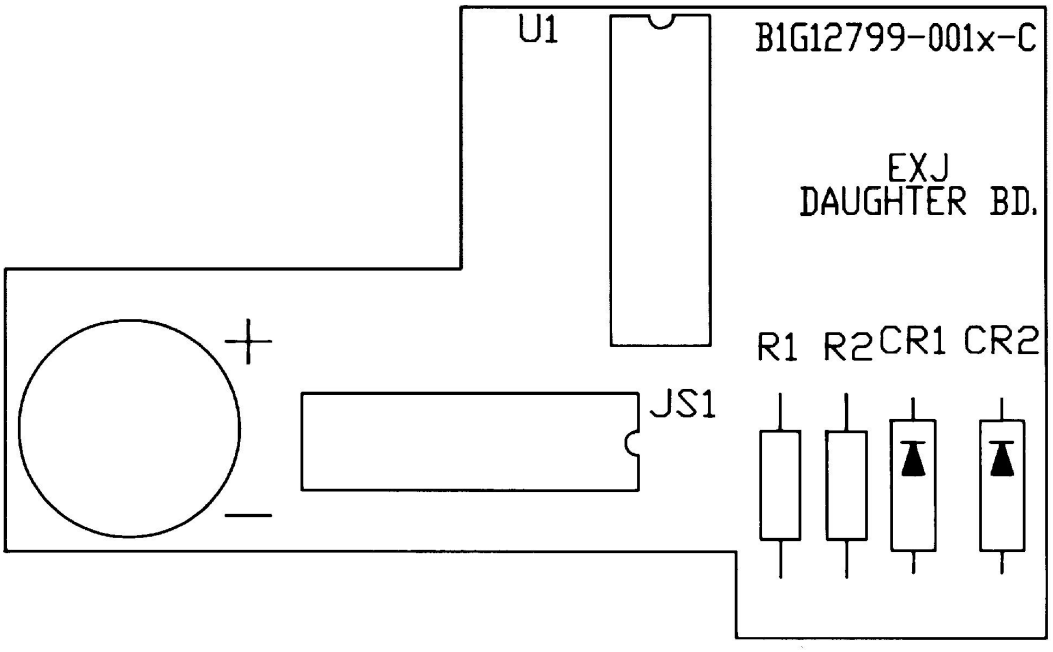
EXJ CONTROLLER BOARD
SILK SCREEN
REVISION B

Figure 24

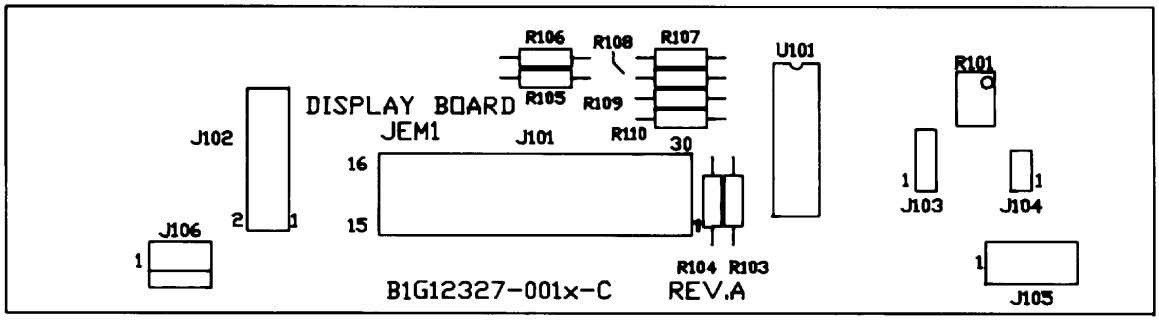


EXJ CONTROLLER BOARD
SILK SCREEN
REVISION D

Figure 25

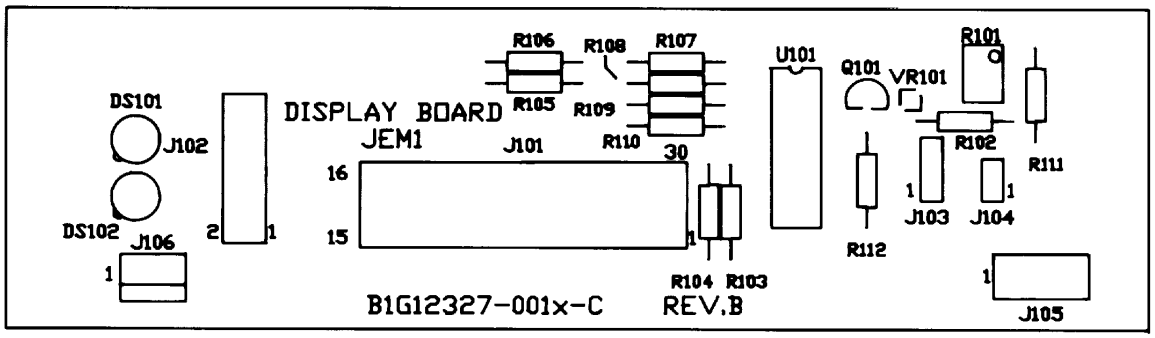


EXJ DAUGHTER BOARD
SILK SCREEN



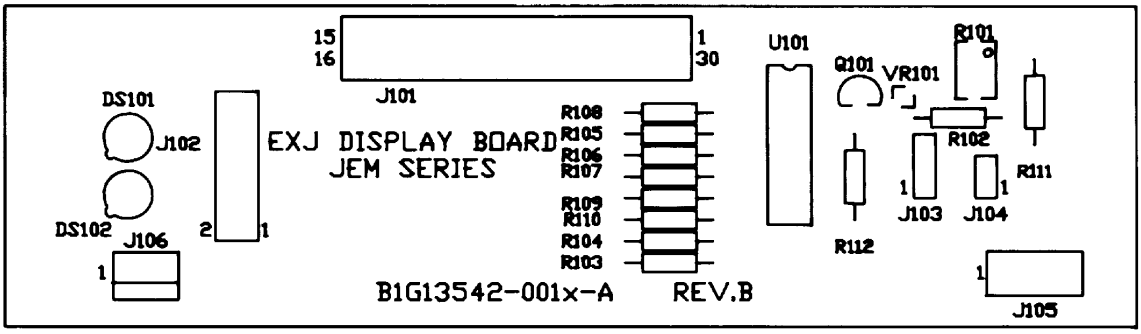
EXJ DISPLAY BOARD
SILK SCREEN
REVISION A

Figure 27



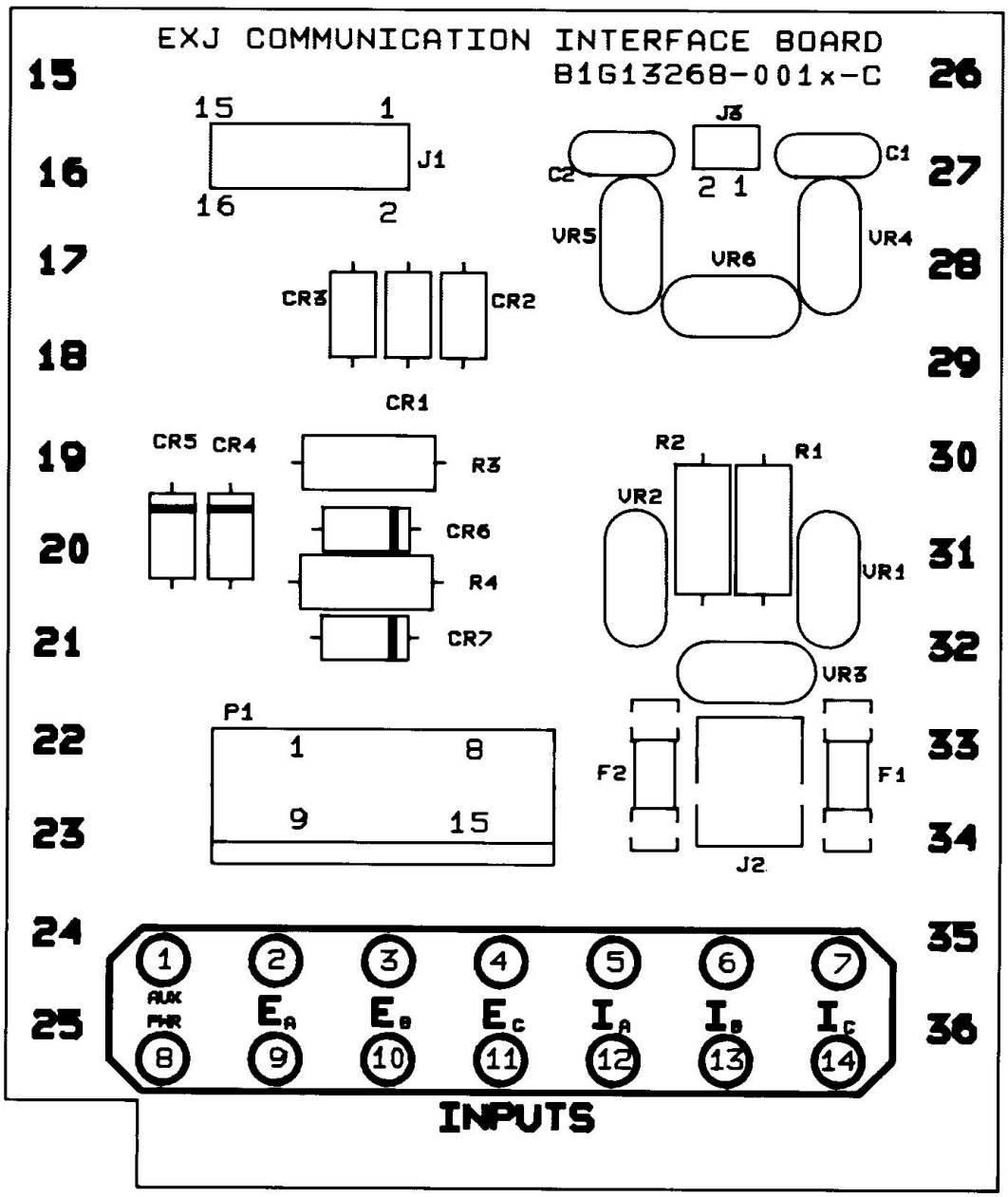
EXJ DISPLAY BOARD
SILK SCREEN
REVISION B

Figure 28

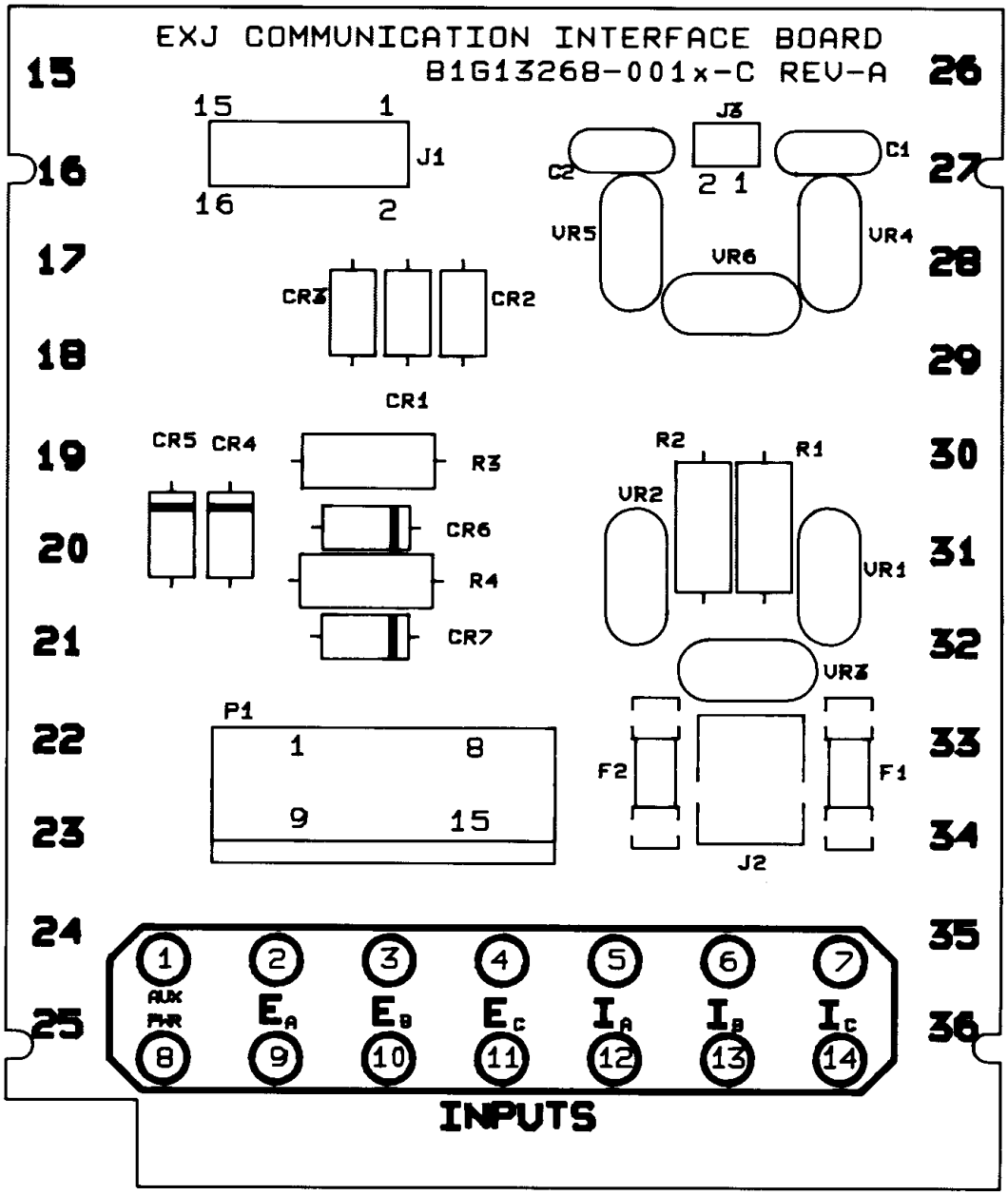


EXJ DISPLAY BOARD
SILK SCREEN
REVISION B

Figure 29

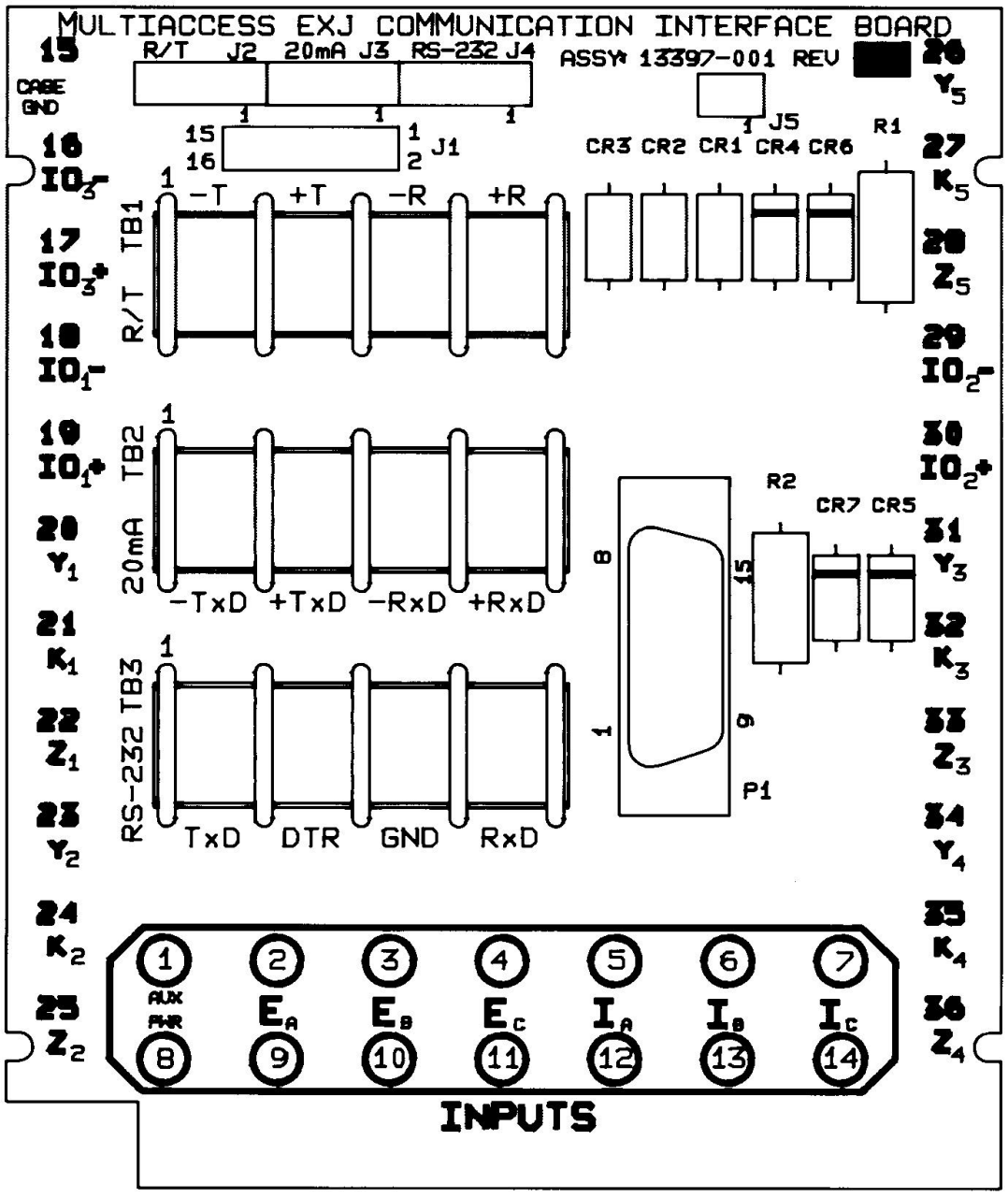


EXJ COMMUNICATION INTERFACE BOARD
SILK SCREEN
REVISION NONE

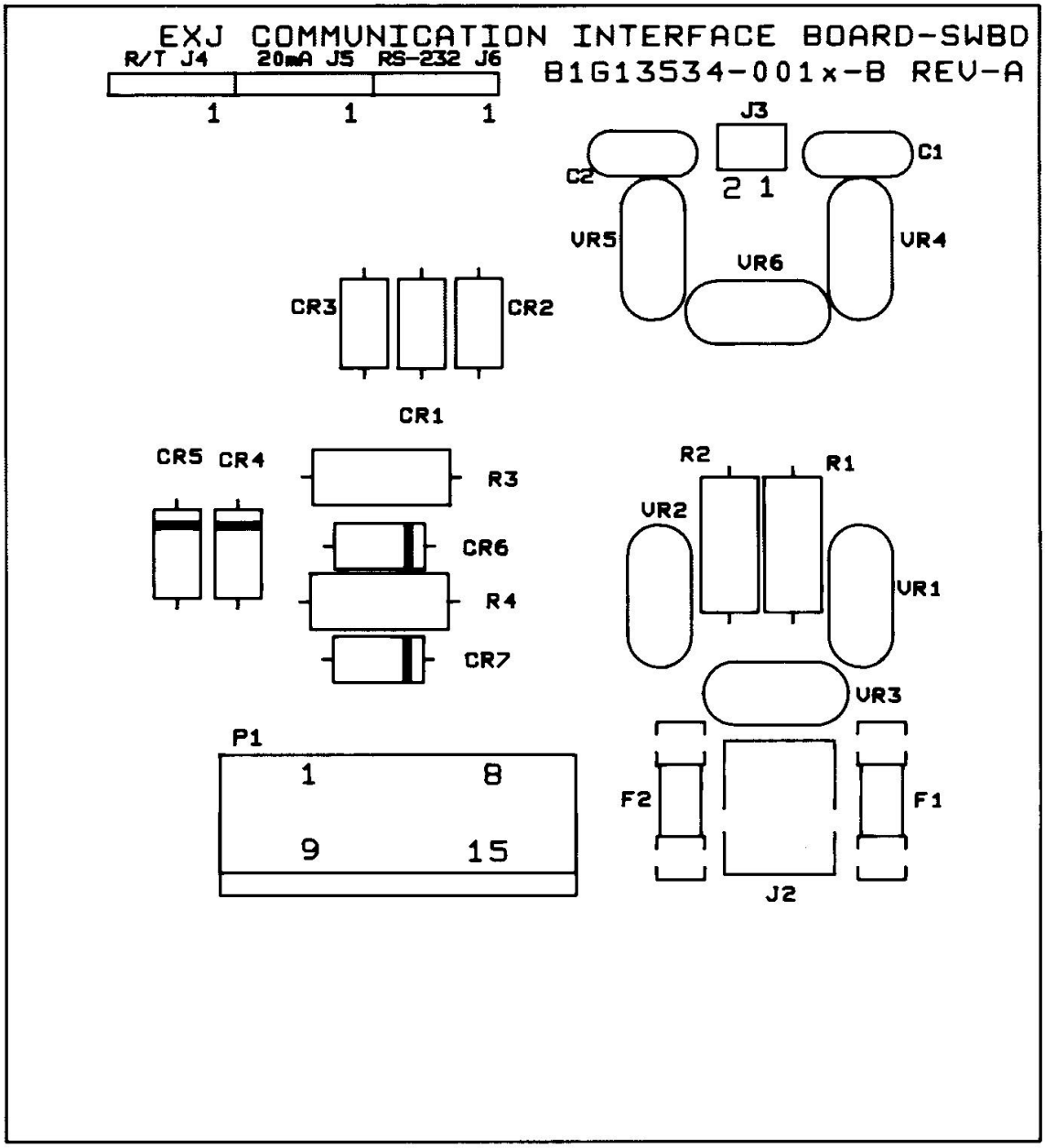


EXJ COMMUNICATION INTERFACE BOARD
SILK SCREEN
REVISION A

Figure 31



MULTIACCESS EXJ
COMMUNICATION INTERFACE BOARD
REVISION NONE



EXJ COMMUNICATION INTERFACE BOARD
SWITCHBOARD MODELS
SILK SCREEN
REVISION A

JEM®1 RECOMMENDED SPARE PARTS LIST

REPAIR PARTS

	Description / Type	SCI Part #
*	Output Isolator IC OMA121	08304-001
*	Output Isolator (early version) IC H11DX	06754-003
	Chopper Chip IC CD4007	05441-002
	Counter Chip IC CD4040	05430-003
*	EXJ RAM Chip w/External Battery; IC Timekeeper	12275-002
*	E Series Register Battery; Electrochem/Panasonic	06271-002
*	E Series Register Battery; Mallory	11750-001K
	Roll/Reset Switch Harness; Front Panel	05918-001
	Input Varistors; 150V MOV	06297-007
	Transistor, MPS A14	06362-001
	Replacement Card Guides	06772-001
*	Surge Arrestor Kit; 120V	11282-002K
*	Surge Arrestor Kit, 480V	11282-005K
	Extender Test Board	04021-001K
	Register Ribbon Cable (main)	06280-001
	Register Communications Ribbon Cable (Front Panel)	12461-002

* Order the type your unit uses.

CALIBRATION PARTS

Description / Type	SCI Part #
CAL Network A	10316-001K
CAL Network B	10316-002K
CAL Network C	10316-003K
CAL Network D	10316-004K
CAL Network E	10316-005K
Slow Count Module (K_eX100)	04677-001K
EXJ SET Software	12623-001

JEM®1 P.C. BOARD LIST

NOTE: Different Model #'s use different boards. Always specify Model #'s when ordering boards. "Using the proper parts is important!"

	Function Boards	SCI Part #
	Power Supply	03793-001L
	Watt/Q	03792-001L
	Var	03792-002L
*	UNI Integrator	04812-002L
*	BI± Integrator	04812-001L
	Volt (Analog only)	07620-001K
*	Volt Hour	05014-002L
	$Volt^2$ (Analog only)	07620-002K
*	$Volt^2$ Hour	05014-001L
*	Volt Hour (Expanded Scale)	05014-003L
	Ampere (3 element)	11385-006L
	$Ampere^2$ (3 element)	11385-003L
	Volt-Ampere (1 element)	05701-004L
	Volt-Ampere (2 element)	05701-001L
	Volt-Ampere (3 element)	05701-003L
	Volt-Ampere (2 1/2 element)	05701-002L

	Specialized Boards	SCI Part #
*	UNI Integrator Dual KYZ	04812-101L
*	UNI Integrator Dual K_e	04812-003Z
	± Watthour Dual KYZ (ZZ)	08680-001L
	Polarity Detector/Reversal Shut Down	07945-001K
	6590 Input Board	11334-001L
	6368 Volt Summing	04776-001K
*	Specify Calibration	

	Register Boards	SCI Part #
*	"EXJ"	12330-002K
*	"E" Series	04559-004L
*	"E" Series Coed	04559-006L
	Single Mechanical	04816-001L
	Dual Mechanical	04816-002L
	Triple Mechanical	04816-003L
	Quad Mechanical	04609-001L
	PT Indicator Board	04816-004Z
	"E" Series Display	04555-001K
	"EXJ" Up View Display	12328-001K
	"EXJ" Down View Display	12298-001/
	"EXJ" Down View Display	11695-002
		10158-002-Qty-2

* Specify Configuration and Model #.

SECTION 4

SIGNAL JUMPER REQUIREMENTS AND TYPICAL BLOCK DIAGRAMS

1. Jumper Requirements

Figure 34 illustrates a rear view of the JEM1 Backplane Circuit Board. Solid lines represent backside circuitry and dotted lines represent opposite side circuitry.

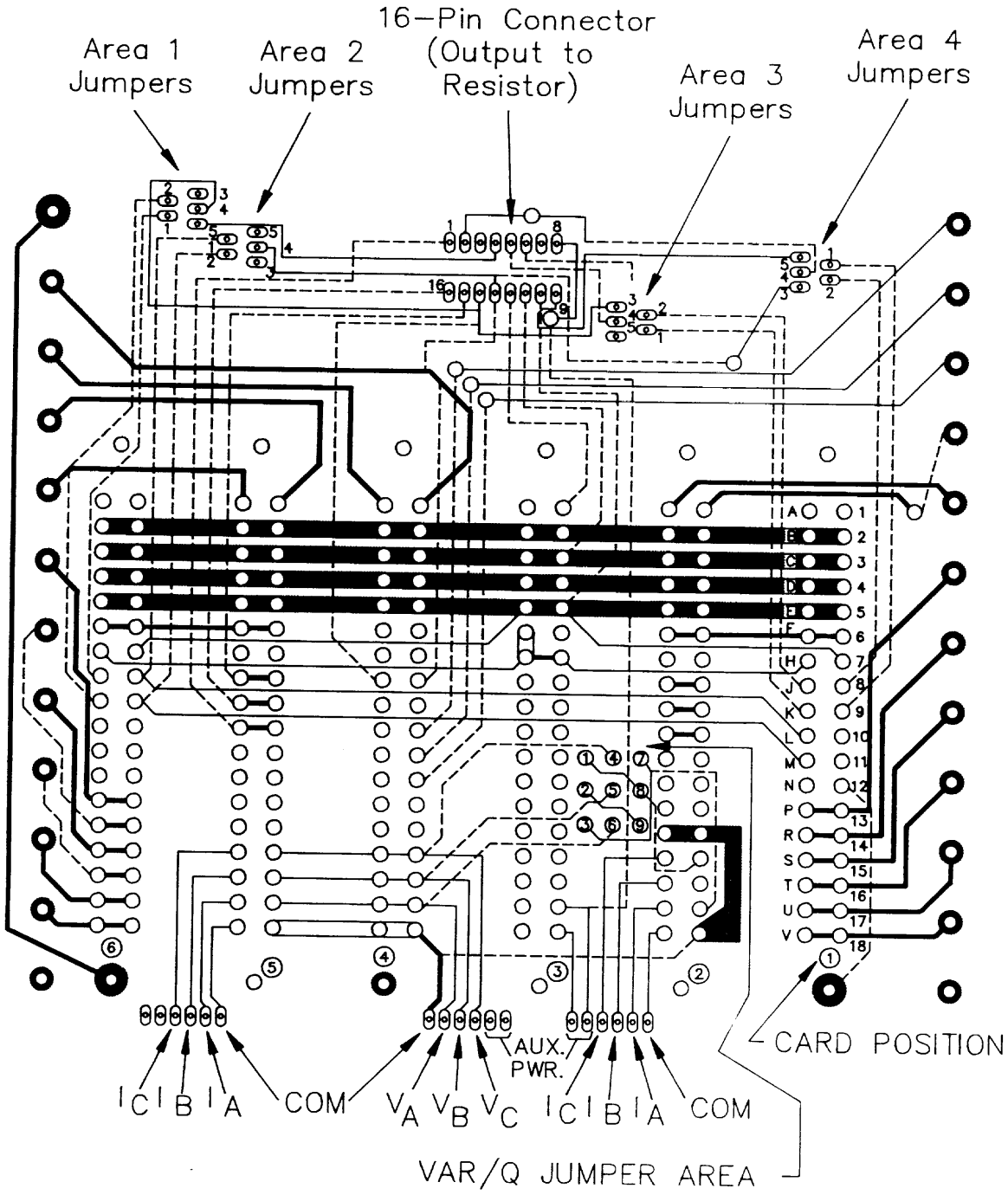
This figure details the location of five (5) jumper areas. Table 10 identifies which connection points, in each area, must be jumpered for each individual model number. These jumpers are factory installed. The only time jumper relocation may be required is if circuit card function are changed or added to a unit.

Jumper Area Function:

Area 1 Jumpers	Connect watthour output function from card position 6 to register load rate indicator LED.
Area 2 Jumpers	Connect watthour output function from card position 6 to register counter.
Area 3 Jumpers	Connect varhour output function from card position 1 to register load rate indicator LED.
Area 4 Jumpers	Connect varhour output function from card position 1 to register counter.
Var/Q Area	Connect potential inputs to card position 2 in correct phase for proper operation of Var or Q function multiplier.

2. Typical Block Diagrams included on the following pages to illustrate how circuit cards are interconnected to form various model number options.

Model	Function
303	kWh / kQh
533	kWh / Vh / kVAh
603	+kWh / +kVARh
643	+kWh / kQh / V^2h



Rear View of Back Plane Board
with Cover Removed
(Dashed Lines Indicate Circuitry on Back Side of Board)

Figure 34

TABLE 10 JEM® JUMPER SELECTION CHART

(Reference Figure 34)

MODEL NO.	FUNCTION	AREA 1 JUMPERS	AREA 2 JUMPERS	AREA 3 JUMPERS	AREA 4 JUMPERS	VAR/Q JUMPERS
102 (3) (4)	kWh	1-4	1-4	-	-	-
112 (3) (4)	kVARh	1-4	1-4	-	-	-
121	Vh	-	-	-	-	-
121-09	Vh Exp. Scale	-	-	-	-	-
131 (2) (4)	Ih	1-4	1-4	-	-	-
141 (2) (3) (4)	I (Analog only)	-	-	-	-	-
152 (3) (4)	kVAh	1-4	1-4	-	-	-
161 (2) (3) (4)	I^2h	1-4	1-4	-	-	-
202 (3)	+kWh (out)	1-5	1-5	-	-	-
(4)	-kWh (in)	2-3	2-3	-	-	-
212 (3)	+kVARh (lag)	1-5	1-5	-	-	-
(4)	-kVARh (lead)	2-3	2-3	-	-	-
302 (3)	kWh	1-5	1-5	2-4	2-4	4-7
	kQh	-	-	-	-	5-8
		-	-	-	-	6-9
304	kWh	1-5	1-5	2-4	2-4	5-7
	kQh					
		-	-	-	-	6-9
312 (3)	kWh	1-5	1-5	2-4	2-4	1-4
(4)	kVARh (lag)	-	-	-	-	2-5
		-	-	-	-	3-6
322 (3)	+kWh (out)	1-5	1-5	-	-	1-4
(4)	-kWh (In)	2-3	2-3	-	-	2-5
	kVAR	-	-	-	-	2-6
332 (3)	kW	-	-	-	-	1-4
(4)	kVAR	-	-	-	-	2-5
		-	-	-	-	3-6
342 (3)	kWh	1-4	1-4	-	-	1-4
(4)	kVAR	-	-	-	-	2-5
		-	-	-	-	3-6

TABLE 10 JEM® JUMPER SELECTION CHART

(Reference Figure 34)

MODEL NO.	FUNCTION	AREA 1 JUMPERS	AREA 2 JUMPERS	AREA 3 JUMPERS	AREA 4 JUMPERS	VAR/Q JUMPERS
351 (2) (3) (4)	KWh KVAh	1-5 - -	1-5 - -	2-4 - -	2-4 - -	1-4 2-5 3-6
362 (3) (4)	KWh -kVARh (lead)	1-5 - -	1-5 - -	1-4 - -	1-4 - -	1-4 2-5 3-6
372 (3)	KVAh KQh -	1-5 -	1-5 -	2-4 -	2-4 -	4-7 5-8 6-9
374	KVAh KQh -	1-5 -	1-5 -	2-4 -	2-4 -	5-7 6-9
382 (3) (4)	+kWh (out) -kWh (in) V^2h	1-5 2-3 -	1-5 2-3 -	- - -	- - -	- - -
392 (3) (4)	kWh Ih	1-5 -	1-5 -	2-4 -	2-4 -	- -
402 (3)	kWh/Volt	1-4	1-4	-	-	-
412 (3)	Volt +kWh (out) -kWh (in)	1-5 2-3 -	1-5 2-3 -	- - -	- - -	- - -
422 (3)	kWh/I (Amp)	1-4	1-4	-	-	-
432 (3)	+kWh (out) -kWh (in) I (Amp)	1-4 2-3 -	1-4 2-3 -	- - -	- - -	- - -
442 (3)	KWh Var Volt	1-4 -	1-4 -	- -	- -	1-4 2-5 3-6

TABLE 10 JEM® JUMPER SELECTION CHART

(Reference Figure 34)

MODEL NO.	FUNCTION	AREA 1 JUMPERS	AREA 2 JUMPERS	AREA 3 JUMPERS	AREA 4 JUMPERS	VAR/Q JUMPERS
452 (3)	+kWh (out)	1-5	1-5	-	-	1-4
	-kWh (in)	2-3	2-3	-	-	2-5
	Var/Volt	-	-	-	-	3-6
462 (3)	kWh	1-4	1-4	-	-	-
	Volt	-	-	-	-	-
	I (Amp)	-	-	-	-	-
472 (3)	+kWh (out)	1-5	1-5	-	-	-
	-kWh (in)	2-3	2-3	-	-	-
	Volt	-	-	-	-	-
	I (Amp)					
492 (3) (4)	kWh	1-5	1-5	2-4	2-4	1-4
	kVARh	-	-	-	-	2-5
	Volt	-	-	-	-	3-6
502 (3)	kWh	1-5	1-5	2-4	2-4	4-7
	Vh	-	-	-	-	-
	kQh	-	-	-	-	5-8
		-	-	-	-	6-9
504	kWh	1-5	1-5	2-4	2-4	5-7
	Vh	-	-	-	-	-
	kQh	-	-	-	-	6-9
512 (3)	kWh	1-5	1-5	2-4	2-4	4-7
	V^2h	-	-	-	-	-
	kQh	-	-	-	-	5-8
		-	-	-	-	6-9
514	kWh	1-5	1-5	2-4	2-4	5-7
	V^2h	-	-	-	-	-
	kQh	-	-	-	-	6-9
522 (3)	kWh	1-5	1-5	2-4	2-4	1-4
	V^2h	-	-	-	-	2-5
	kVARh					3-6

TABLE 10 JEM® JUMPER SELECTION CHART

(Reference Figure 34)

MODEL NO.	FUNCTION	AREA 1 JUMPERS	AREA 2 JUMPERS	AREA 3 JUMPERS	AREA 4 JUMPERS	VAR/Q JUMPERS
532 (3)	KWh	1-5	1-5	2-4	2-4	1-4
	Vh	-	-	-	-	-
(4)	KVAh	-	-	-	-	2-5
		-	-	-	-	3-6
542 (3) (4)	KWh	1-5	1-5	2-4	2-4	1-4
	KVARh	-	-	-	-	2-5
	Volth	-	-	-	-	3-6
552 (3) (4)	kWh	1-5	1-5	2-4	2-4	1-4
	kVARh	-	-	-	-	2-5
	Volt	-	-	-	-	3-6
562 (3) (4)	+kWh (out)	1-5	1-5	-	-	-
	-kWh (in)	2-3	2-3	-	-	-
	Volt ^{2}	-	-	-	-	-
	I^2					
572 (3) (4)	+kVARh (lag)	1-5	1-5	-	-	1-4
	-kVARh (lead)	2-3	2-3	-	-	2-5
	$Volt^2$	-	-	-	-	3-6
	I^2					
582 (3) (4)	kWh	1-5	1-5	2-4	2-4	-
	$Volt^2h$	-	-	-	-	-
	I^2h	-	-	-	-	-
592 (3) (4)	+kWh (out)	1-5	1-5	Customer	Customer	1-4
	-kWh (in)	2-4	2-4	Selected	Selected	2-5
	kVARh (4 Quad)	-	-			3-6
602 (3)	+kWh (out)	1-5	1-5	1-5	1-5	1-4
(4)	-kWh (in)	2-4	2-4	2-4	2-4	2-5
	+kVARh (lag)	-	-	-	-	3-6
	-kVARh (lead)	-	-	-	-	-

TABLE 10 JEM® JUMPER SELECTION CHART

(Reference Figure 34)

MODEL NO.	FUNCTION	AREA 1 JUMPERS	AREA 2 JUMPERS	AREA 3 JUMPERS	AREA 4 JUMPERS	VAR/Q JUMPERS
612 (3)	+kWh (out)	1-5	1-5	2-4	2-4	4-7
	-kWh (in)	2-4	2-4	-	-	5-8
	kQh	-	-	-	-	6-9
614	+kWh (out)	1-5	1-5	2-4	2-4	5-7
	-kWh (in)	2-4	2-4	-	-	6-9
	kQh	-	-	-	-	-
622 (3)	kWh	1-5	1-5	1-4	1-4	1-4
(4)	+kVARh (lag)	-	-	2-3	2-3	2-5
	-kVARh (lead)	-	-	-	-	3-6
632	+kWh (out)	1-5	1-5	2-4	2-4	1-4
	-kWh (in)	2-4	2-4	-	-	2-5
	kVAh	-	-	-	-	3-6
642 (3)	+kWh (out)	1-5	1-5	2-5	2-5	4-7
(4)	-kWh (in)	2-3	2-3	-	-	5-8
	kQh/V^2h	-	-	-	-	6-9
644	+kWh (out)	1-5	1-5	2-5	2-5	5-7
	-kWh (in)	2-3	2-3	-	-	6-9
	kQh	-	-	-	-	-
	V^2h	-	-	-	-	-
652 (3) (4)	kWh	1-5	1-5	1-5	1-5	1-4
	Vh	-	-	2-4	2-4	2-5
	+kVARh (lag)	-	-	-	-	3-6
	-kVARh (lead)	-	-	-	-	-
662 (3) (4)	kWh	1-5	1-5	1-5	1-5	1-4
	+kVARh (lag)	-	-	2-4	2-4	2-5
	-kVARh (lead)	-	-	-	-	3-6
	$Volt^2h$	-	-	-	-	-

TABLE 10 JEM® JUMPER SELECTION CHART

(Reference Figure 34)

MODEL NO.	FUNCTION	AREA 1 JUMPERS	AREA 2 JUMPERS	AREA 3 JUMPERS	AREA 4 JUMPERS	VAR/Q JUMPERS
682 (3) (4)	+kWh (out)	1-5	1-5	2-5	2-5	1-4
	-kWh (in)	2-3	2-3	-	-	2-5
	kVARh	-	-	-	-	3-6
	Volt^{2}h	-	-	-	-	-
692 (3) (4)	+kWh (out)	1-5	1-5	2-4	2-4	1-4
	-kWh (in)	2-4	2-4	-	-	2-5
	kVARh	-	-	-	-	3-6
702 (3) (4)	+kWh (out)	1-5	1-5	1-5	1-5	1-4
	-kWh (in)	2-4	2-4	2-4	2-4	2-5
	+kVARh (lag)	-	-	-	-	3-6
	-kVARh (lead)	-	-	-	-	-
	Volt ^{2}h	-	-	-	-	-
712 (3) (4)	KWh	1-5	1-5	2-4	2-4	1-4
	KVAh	-	-	-	-	2-5
	Volt^{2}h	-	-	-	-	3-6
720	I^{2}h	1-5	1-5	2-4	2-4	-
	I^{2}h	-	-	-	-	-
	I^{2}h	-	-	-	-	-
3595	Volt^{2}h	1-5	1-5	2-4	2-4	-
	Volt^{2}h	-	-	-	-	-
	Volt^{2}h	-	-	-	-	-
4094	I^{2}h	1-5	1-5	2-4	2-4	-
	I^{2}h	-	-	-	-	-
	I^{2}h	-	-	-	-	-
6368	Ch1	1-5	1-5	-	-	-
	Ch2	2-3	2-3	-	-	-
		*Can Vary	*Can Vary	-	-	-

TABLE 10 JEM® JUMPER SELECTION CHART

(Reference Figure 34)

MODEL NO.	FUNCTION	AREA 1 JUMPERS	AREA 2 JUMPERS	AREA 3 JUMPERS	AREA 4 JUMPERS	VAR/Q JUMPERS
6590	Ch1	1-5	1-5	1-5	1-5	-
	Ch2	2-4	2-4	2-4	2-4	-
	Ch3	-	-	-	-	-
	Ch4	-	-	-	-	-

JEM Meter Interconnection Wiring Diagrams

Description	**Drawing Number**
Model 303 KWh/KQh	B06050-002
Model 533 KWh/Vh/KVAh	B06050-003
Model 603 "KWh/"KVARh	B06050-001
Model 643 "KWh/KQh/V^2h	B06050-004

SECTION 5

SCHEMATIC AND ASSEMBLY DRAWINGS

This section contains all the schematic and assembly drawings for JEM subassemblies such as the Watt/Var Multiplier, Unidirectional Integrator, Electronic Register with COED, etc. Each drawing is the current version. Your board could vary slightly depending on age. If you have any questions, please call the Scientific Columbus Technical Support number at the rear of this manual.

SCHEMATIC AND ASSEMBLY DRAWING
CROSS-REFERENCE CHART

ITEM	PAGE NO.	SCHEMATIC DRAWING	ASSEMBLY DRAWING	P/C BOARD B/M
Watt/Var Multiplier	5-3/5-4 5-5	D03891-001	B03792-001	03792-001L
			B03792-002	03792-002L
kVA	5-6/5-7	C05702-001	B05701-001	05701-001L thru 05701-004L
V^2h	5-8/5-10 Mosfet Output	C05180-001	B05014-001	05014-001L
	5-9/5-17/5-18 Bridge Output	C05180-001		
Vh	5-11/5-12 Bridge Output	C05180-002	B05014-002	05014-002L
	5-13/5-17/5-18 Mosfet Output	C05180-002		
Expanded Scale Volt	5-15/5-16 Bridge Output	C05180-003	B05014-003	05014-003L
	5-14/5-17/5-18 Mosfet Output	C05180-003		
Unidirectional Integrator	5-19/5-20 Bridge Output	C04813-002	B04812-002	04812-002L
	5-21/5-25/5-26 Mosfet Output	C04813-002		
Bi-directional Integrator	5-22/5-23 Bridge Output	C04813-001	B04812-001	04812-001L
	5-24/5-25/5-26 Mosfet Output	C04813-001		
Power Supply/ Oscillator	5-27/5-28	B1E14438-001x-C	B1D14438-001x-C	
Electro-Mechanical Register				
Single	5-29/5-30	C04817-001	C04816-001	04816-001L
Dual	5-29/5-31	C04817-001	C04816-002	04816-002L
Triple	5-29/5-32	C04817-001	C04816-003	04816-003L
Quad Function Register (Top)	5-33/5-34	C04013-001	B04011-001	04011-001K
Quad Function Register (Bot.)	5-35/5-36	C04013-002	B04011-002	04011-002K
Elect. Reg. Without COED	5-37/5-38	D04561-001	C04559-003	04559-004L
Elect. Reg. With COED	5-39/5-40/5-41	D04561-002	C04559-002	04559-006L
Elect. Reg. With R Options	5-42/5-43	D04561-003	C04559-004	04559-03
Elect. Reg. With T Options	5-42/5-44	D04561-003	C04559-005	04559-04

Insert the following drawings in the order shown.

D03891-001
B03792-001
B03792-002
C05702-001
B05701-001
C05180-001
B05014-001
05014-000-C
C05180-002
B05014-002
05014-000-C
C05180-003
B05014-003
05014-000-C
C04813-002
B04812-002
04812-000-C
C04813-001
B04812-001
04812-000-C
B1E14438-001x-C
B1D14438-001x-C
C04817-001
C04816-001
C04816-002
C04816-003
C04013-001
B04011-001
C04013-002
B04011-002
D04561-001
C04559-003
D04561-002
C04559-002
D04561-003
C04559-004
D04561-003
C04559-005