KEITHLEY

Model 7708

40-Channel Differential Multiplexer with Automatic CJC

Packing List

PA-744 Rev. B / 12-00

KEITHLEY

Model 7708
40-Channel Differential Multiplexer with Automatic CJC

Packing List

Introduction

The Model 7708 is a 40-channel differential multiplexer card with the following features:

- DC and AC voltage measurement
- 2-wire or 4-wire Ω measurement (automatically pairs switches for four wire measurements — *n* + 20)
- Temperature applications (RTD, thermistor, thermocouple)
- Built-in cold junction reference
- Screw terminal connections
- Designed specifically for use with Keithley's Model 2700 Multimeter/Data Acquisition System.

Description **Page**

Specifications

The specifications for the Model 7708 switching card are located at the end of this packing list.

Operating instructions

Switching card operation is covered in the Model 2700 User's Manual. The Model 7708 operates the same as the Model 7700 switching card with the following differences:

- The Model 7708 has 40 channels; the Model 7700 has 20 channels.
- The Model 7708 does not have any amps channels; the Model 7700 has two amps channels.

Card configuration

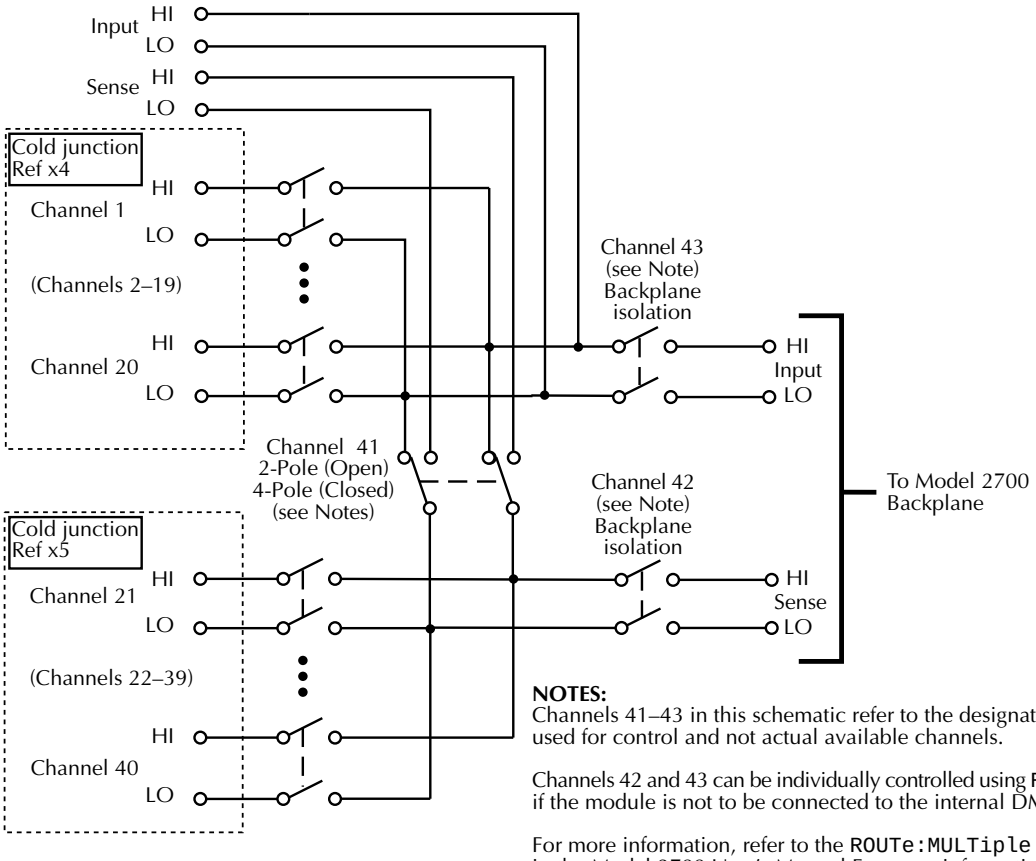
Description

Figure 1 shows a simplified schematic diagram of the Model 7708 module. As shown, the Model 7708 has channels that are grouped into two banks of twenty channels (forty channels total). Backplane isolation is provided for each bank. Each bank also includes separate cold junction reference points. The first bank contains channels 1 through 20 while the second bank contains channels 21 through 40. Each channel of the 40-channel multiplexer card is wired with separate inputs for HI/LO providing fully isolated inputs.

Although the Model 7708 relays are the latching type (relays hold their state even after power has been removed), all relay states are set to open a few seconds after either a power cycle or a *RST command is issued.

Connections to DMM functions are provided through the card backplane connector.

Figure 1
Simplified schematic of Model 7708



NOTES:
Channels 41–43 in this schematic refer to the designations used for control and not actual available channels.

Channels 42 and 43 can be individually controlled using `ROUTe:MULTiple` if the module is not to be connected to the internal DMM.

For more information, refer to the `ROUTe:MULTiple` command section in the Model 2700 User's Manual.For more information, refer to the `ROUTe:MULTiple` command section in the Model 2700 User's Manual.

Channel 41 (2W/4W Configuration), Channel 42 (Sense Isolation), and Channel 43 (Input Isolation) are normally automatically configured by the Model 2700. However, by using the `:ROUT:MULT:` commands (refer to Section 2 of the Model 2700 User's Manual), they can be manually configured.

NOTE *Connect 4-wire sense leads using channels 21–40.*

To disconnect channels 21–40 from channels 1–20, send:
`:ROUT:MULT:CLOS (@141)` (*note opposite logic).*

When automatically configured for 4-wire Ω, RTD temperature, Ratio, and Channel average) the channels are paired as follows:

- CH1 and CH21
- CH2 and CH22
- CH3 and CH23
- CH4 and CH24
- CH5 and CH25
- CH6 and CH26
- CH7 and CH27
- CH8 and CH28
- CH9 and CH29
- CH10 and CH30
- CH11 and CH31
- CH12 and CH32
- CH13 and CH33
- CH14 and CH34
- CH15 and CH35
- CH16 and CH36
- CH17 and CH37
- CH18 and CH38
- CH19 and CH39
- CH20 and CH40

Card connections

WARNING **The information in this section is intended for qualified service personnel. Do not attempt to perform this procedure unless qualified to do so.**

Figure 2 shows how to access the screw terminals on the Model 7708. Channel designations for the screw terminals are contained in Figure 3.

WARNING **Do not exceed the maximum specifications for the Model 7708 module. Refer to the end of this packing list for specifications.**

Figure 2
Screw terminal access

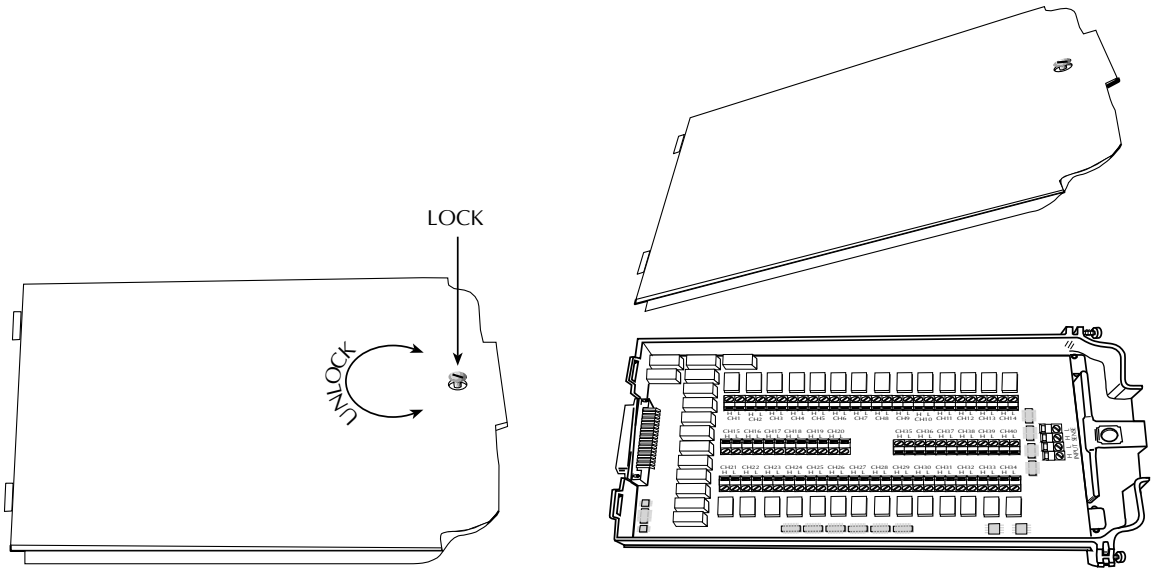
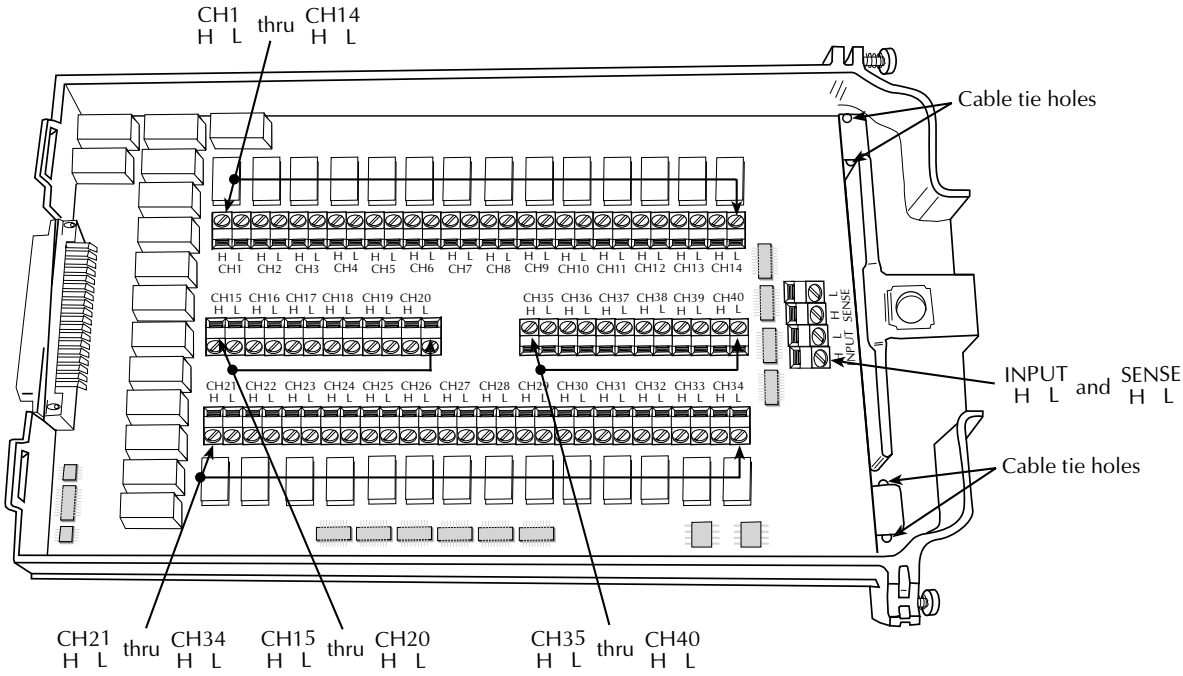


Figure 3
Model 7708 screw terminal channel designations



Wiring procedure

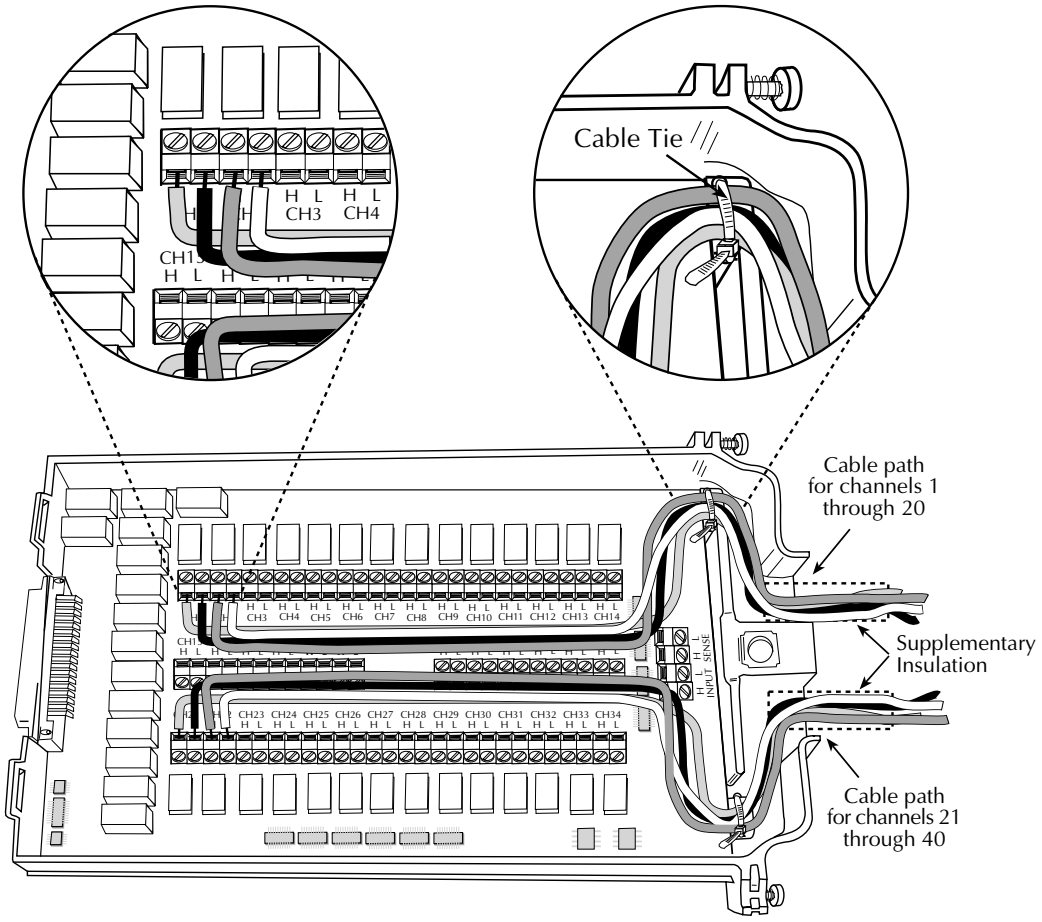
WARNING **The information in this section is intended for qualified service personnel. Do not attempt to perform this procedure unless qualified to do so.**

Use the following procedure to wire the Model 7708 module. Make all connections using the correct wire size (up to 20 AWG). Also, make sure to add supplementary insulation around the harness for voltages above 42V peak (see Figure 4).

WARNING **All wiring and supplementary insulation must be rated for the maximum voltage in the system. For example, if 1000V is applied to the front terminals of the Model 2700, the plug-in module wiring must be rated for 1000V.**

1. Make sure all power is discharged from the Model 7708 module.
2. Access the screw terminals (see Figure 2).
3. Using a small flat-blade screwdriver, loosen terminal screws and install wires as desired. (Figure 4 shows connections to channels 1 and 2.)
4. Route wire along wire-path and secure with cable ties as shown.
5. Fill in a copy of the connection log (Table 1) and affix it to the module cover.
6. Close and lock cover.

Figure 4
Wire dressing



Typical connections

The following examples show typical wiring connections for the following types of measurements:

- Thermocouple connections, see Figure 5
- Ω2-wire and thermistor connections, see Figure 6
- Ω4-wire and RTD connections, see Figure 7
- Voltage (AC or DC), see Figure 8

Figure 5
Thermocouple connections

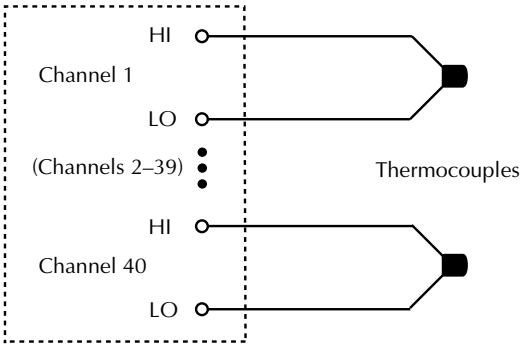


Figure 6
Ω2-wire and thermistor connections

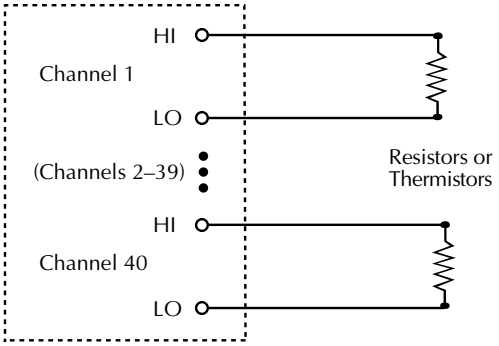


Figure 7
Ω4-wire and RTD connections

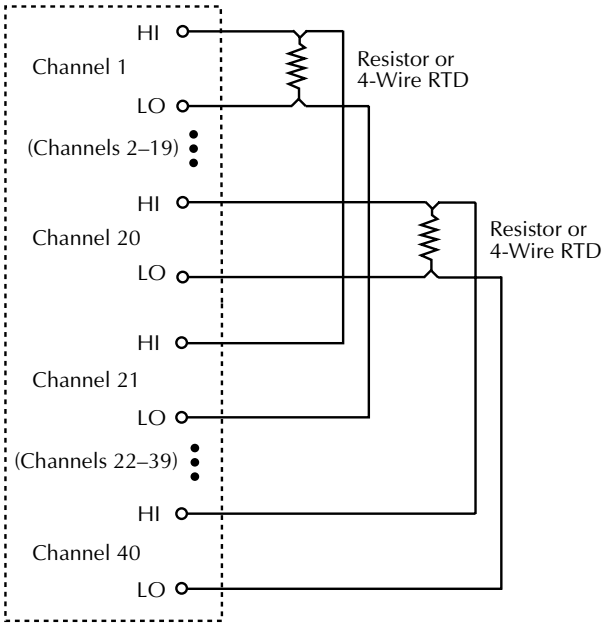
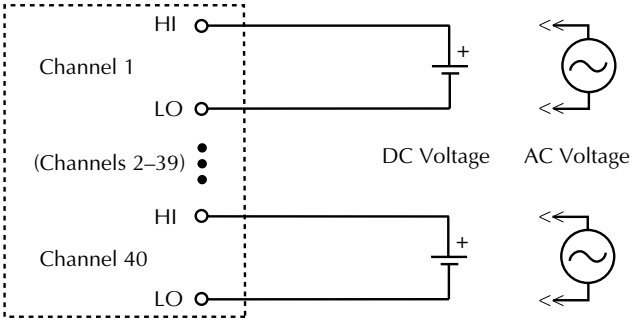


Figure 8
Voltage connections (DC or AC)



Connection log

Make a copy of Table 1 and affix it to the cover of the Model 7708. Use this to record connection information and channel descriptions as needed.

Table 1
Connection log Model 7708

Channel		Color	Description	Description	Color	Channel	
INPUT	H						
	L						
SENSE	H						
	L						
CH1	H					H	CH21
	L					L	
CH2	H					H	CH22
	L					L	
CH3	H					H	CH23
	L					L	
CH4	H					H	CH24
	L					L	
CH5	H					H	CH25
	L					L	
CH6	H					H	CH26
	L					L	
CH7	H					H	CH27
	L					L	
CH8	H					H	CH28
	L					L	
CH9	H					H	CH29
	L					L	
CH10	H					H	CH30
	L					L	
CH11	H					H	CH31
	L					L	
CH12	H					H	CH32
	L					L	
CH13	H					H	CH33
	L					L	
CH14	H					H	CH34
	L					L	
CH15	H					H	CH35
	L					L	
CH16	H					H	CH36
	L					L	
CH17	H					H	CH37
	L					L	
CH18	H					H	CH38
	L					L	
CH19	H					H	CH39
	L					L	
CH20	H					H	CH40
	L					L	

Performance verification

The performance of the Model 7708 card is tested by verifying measurement accuracy through the card. If verification limits are met through the front panel terminals of the Model 2700, they should also be met through the card.

WARNING **The information in this section is intended only for qualified service personnel. Do not attempt these procedures unless you are qualified to do so.**

NOTES *Measurement accuracy through the Model 7708 card should only be verified after instrument accuracy has already been verified through the front panel terminals of the Model 2700. The procedures to verify accuracy from the front panel inputs are provided in the Model 2700 Service Manual.*

If the Model 7708 card is still under warranty and is the cause of measurement inaccuracy, contact your Keithley representative or the factory to determine the correct course of action.

Model 7708 verification test procedures include:

- DC volts
- AC volts
- Resistance
- Temperature
- Frequency
- Ratio and average

Verification test requirements

Be sure that you perform the verification tests:

- Under the proper environmental conditions.
- After the specified warm-up period.
- Using the correct line voltage.
- After restoring factory defaults.
- With the INPUTS switch in the REAR (in) position.

Also, make sure to use the proper calibration equipment (Table 2) and the reading limits provided with the verification procedures.

Environmental conditions

Conduct your performance verification procedures in a test environment that has:

- An ambient temperature of 18° to 28°C (65° to 82°F).
- A relative humidity of less than 80% unless otherwise noted.

Warm-up period

Allow the Model 2700 to warm up for at least two hours before conducting the verification procedures.

If the instrument has been subjected to temperature extremes (those outside the ranges stated above), allow additional time for the instrument's internal temperature to stabilize. Typically, allow one extra hour to stabilize a unit that is 10°C (18°F) outside the specified temperature range.

Also, allow the test equipment to warm up for the minimum time specified by the manufacturer.

Line power

The Model 2700 requires a line voltage of 100V/120V/220V/240V, ±10% and a line frequency of 47.5Hz to 63Hz. Note that the line frequency is automatically sensed at power-up, but the line voltage must be manually set to either 100V/120V or 220V/240V as described in Section 3 of the Model 2700 Service Manual.

Factory defaults

Before performing the verification procedures, restore the instrument to its factory defaults as follows:

1. Press SHIFT and then SETUP. The instrument will display the following prompt:
   RESTORE: FACT.
2. Using either range key, select FACT, then restore the factory default conditions by pressing ENTER.

INPUTs switch

In order to connect the Model 7708 card to the meter of the Model 2700, the INPUTs switch must be in the REAR (in) position. The INPUTS switch is located on the front panel of the Model 2700 multimeter near the input terminals.

Test considerations

When performing the verification procedures:

- Be sure to restore factory defaults as outlined above.
- Make sure that the equipment is properly warmed up and connected to the correct input terminals. Also make sure that the INPUTS switch is in the REAR (in) position.
- Do not use autoranging for any verification tests because autorange hysteresis may cause the Model 2700 to be on an incorrect range. For each test signal, you must manually set the correct range for the Model 2700 using the range keys.
- Make sure the calibrator is in operate before you verify each measurement.
- Always let the source signal settle before taking a reading.

WARNING **Observe the following safety precautions when performing these tests:**

- **Some of the procedures in this section may expose you to dangerous voltages. Use standard safety precautions when such dangerous voltages are encountered to avoid personal injury or death caused by electric shock.**
- **The maximum common-mode voltage (voltage between any plug-in module terminal and chassis ground) is 300V DC or 300V RMS. Exceeding this value may cause a breakdown in insulation, creating a shock hazard.**

Verification limits

The verification limits stated in this section have been calculated using only the Model 2700 one-year accuracy specifications, and they do not include test equipment uncertainty. If a particular measurement falls slightly outside the allowable range, recalculate new limits based on both Model 2700 specifications and pertinent calibration equipment specifications.

Example reading limit calculation

The following is an example of how reading limits have been calculated. Assume you are testing the 10V DC range using a 10V input value. Using the Model 2700 one-year accuracy specification for 10V DC of ± (30ppm of reading + 5ppm of range), the calculated limits are:

Reading limits = 10V ± [(10V × 30ppm) + (10V × 5ppm)]
Reading limits = 10V ± (0.0003 + 0.00005)
Reading limits = 10V ± 0.00035V
Reading limits = 9.99965V to 10.00035V

Calculating resistance reading limits

Resistance reading limits must be recalculated based on the actual calibration resistance values supplied by the equipment manufacturer. Calculations are performed in the same manner as shown in the preceding example, except, of course, that you should use the actual calibration resistance values instead of the nominal values when performing your calculations.

For example, assume that you are testing the 10kΩ range using an actual 10.03kΩ calibration resistance value. Using Model 2700 one-year 10kΩ range accuracy of ± (100ppm of reading + 6ppm of range), the calculated reading limits are:

Reading limits = 10.03kΩ ± [(10.03kΩ × 100ppm) + (10kΩ × 6ppm)]
Reading limits = 10.02894kΩ to 10.03106kΩ

Recommended test equipment

Table 2 summarizes recommended verification equipment. You can use alternate equipment as long as that equipment has specifications at least as good as those listed in Table 2. Keep in mind, however, that calibrator uncertainty will add to the uncertainty of each measurement.

Table 2
Recommended verification equipment

Fluke 5700A Calibrator:		
DC voltage	**AC voltage (1kHz, 50kHz)**	**Resistance**
100mV:±14ppm 1.0V:±7ppm 10V:±5ppm 100V:±7ppm 1000V:±9ppm	100mV:±200ppm 1.0V:±82ppm 10V:±82ppm 100V:±90ppm 700V:±85ppm	100Ω:±17ppm 1kΩ:±12ppm 10kΩ:±11ppm 100kΩ:±13ppm 1MΩ:±18ppm 10MΩ:±37ppm 100MΩ:±120ppm
Fluke 5725A Amplifier: AC Voltage, 50kHz: 700V, ±375ppm		
Keithley 3930A or 3940 Frequency Synthesizer: 1V RMS, 10V RMS, 1kHz, ±5ppm, steady state and burst modulation		
General Radio 1433-T Precision Decade Resistance Box: 10Ω to 400Ω, ±0.02%		
Miscellaneous Equipment: Double banana plug to double banana plug shielded cables (2) BNC to double banana plug shielded cable		

NOTE: The Fluke 5725A amplifier is necessary only if you wish to verify the 750V AC range at 50kHz. Verification at 220V and 50kHz using only the 5700A calibrator is adequate for most applications.

Performance verification procedures

NOTE *The following procedures check one channel (CH1) or one channel pair (CH1 and CH21) of the Model 7708 card. To check other channels (or channel pairs), modify the procedures by connecting the verification equipment to the appropriate channel (or channel pair) and then closing that channel.*

Verifying DC voltage

Check DC voltage accuracy by applying accurate voltages from the DC voltage calibrator to the Model 7708 input terminals and verifying that the displayed readings fall within specified limits.

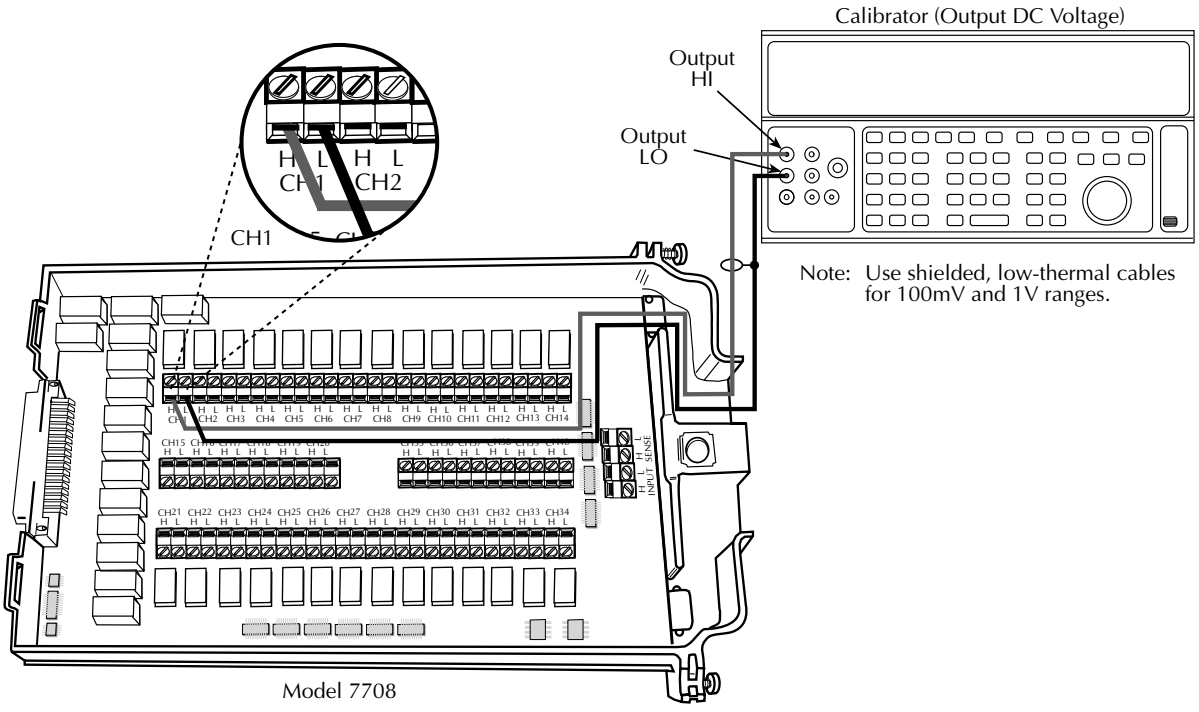
CAUTION **Do not exceed 300V DC between plug-in module INPUT H and L terminals or between any adjacent channels.**

Follow these steps to verify DC voltage accuracy:

1. Connect the Model 7708 CH1 H and L INPUT terminals to the DC voltage calibrator as shown in Figure 9.

NOTE *Use shielded, low-thermal connections when testing the 100mV and 1V ranges to avoid errors caused by noise or thermal effects. Connect the shield to the calibrator's output LO terminal.*

Figure 9
Connections for DC volts verification



2. Install the Model 7708 in Slot 1 of the Model 2700, turn on the power, and allow the unit to warm up for two hours before proceeding. Be sure the front panel INPUTS switch is set to the REAR position.
3. Select the DC volts function by pressing the DCV key, and set the Model 2700 to the 100mV range. Close Channel 1 by pressing the CLOSE key and then keying in 101.
4. Set the calibrator output to 0.00000mV DC, and allow the reading to settle.
5. Enable the Model 2700 REL mode. Leave REL enabled for the remainder of the DC volts verification tests.
6. Source positive and negative and full-scale voltages for each of the ranges listed in Table 3. For each voltage setting, be sure that the reading is within stated limits.
7. Press the OPEN key to open Channel 1.

Table 3
DCV reading limits

Range	**Applied DC voltage***	**Reading limits (1 year, 18° to 28°C)**
100mV	100.0000mV	99.9925 to 100.0075mV
1V	1.000000V	0.999962 to 1.000038V
10V	10.00000V	9.99965 to 10.00035V
100V	100.0000V	99.9946 to 100.0054V
1000V	300.000V	299.976 to 300.024V

*Source positive and negative values for each range.

Verifying AC voltage

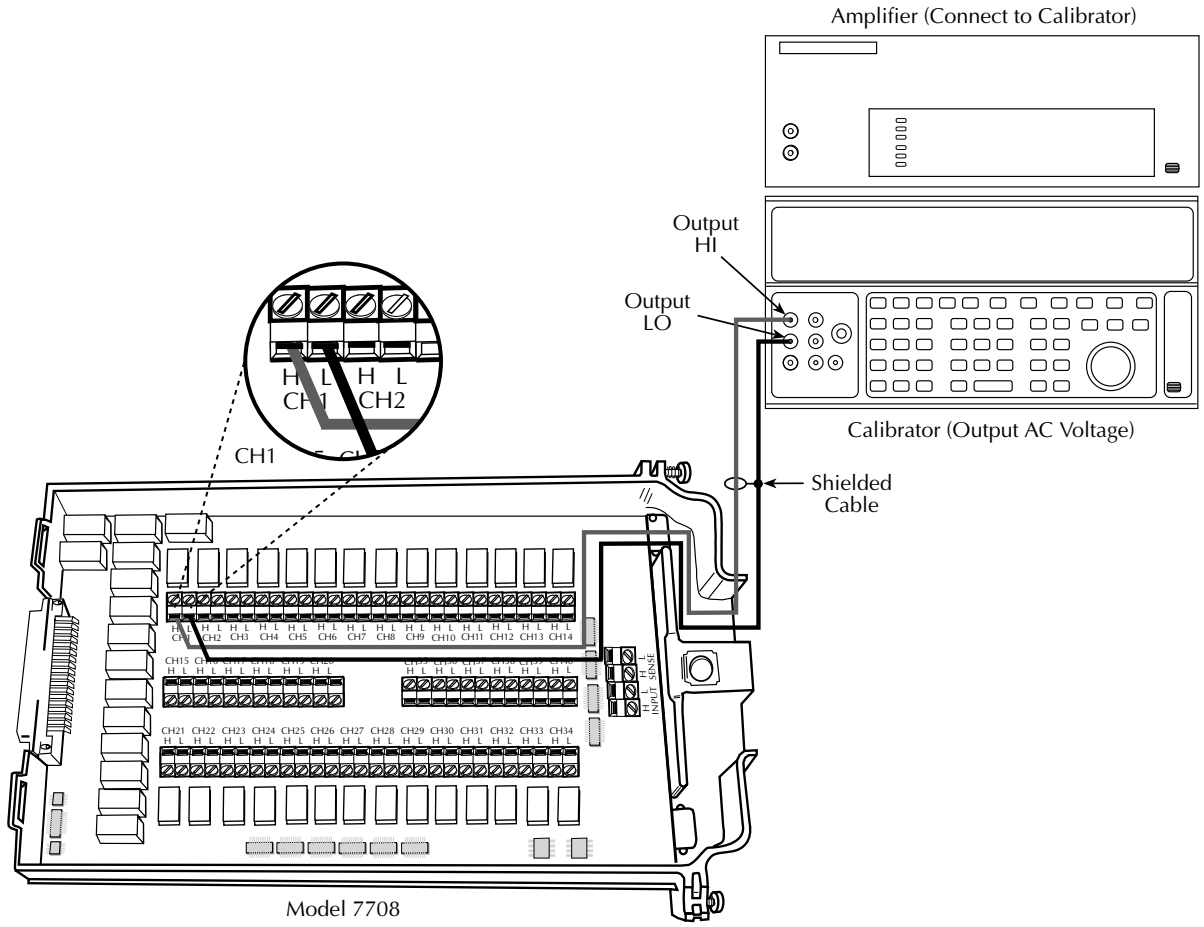
Check AC voltage accuracy by applying accurate AC voltages at specific frequencies from the AC voltage calibrator to the Model 7708 inputs and verifying that the displayed readings fall within specified ranges.

> ***CAUTION*** **Do not exceed 300V RMS between plug-in module INPUT H and L terminals or between adjacent channels, or 8×10^7 V•Hz input, because instrument damage may occur.**

Follow these steps to verify AC voltage accuracy:

1. Connect the Model 7708 CH1 H and L INPUT terminals to the AC voltage calibrator as shown in Figure 10.
2. Install the Model 7708 in Slot 1 of the Model 2700, turn on the power, and allow the unit to warm up for two hours before proceeding. Be sure the front panel INPUTS switch is set to the REAR position.
3. Select the AC volts function by pressing the ACV key. Close Channel 1 by pressing the CLOSE key and then keying in 101.

Figure 10
Connections for AC volts verification



4. Set the Model 2700 for the 100mV range; make sure that REL is disabled.
5. Source 1kHz and 50kHz AC voltages for each of the ranges summarized in Table 4, and make sure that the respective Model 2700 readings fall within stated limits.
6. Press the OPEN key to open Channel 1.

Table 4
ACV reading limits

ACV range	**Applied AC voltage**	**1kHz reading limits (1 year, 18°C to 28°C)**	**50kHz reading limits (1 year, 18°C to 28°C)**
100mV	100.0000mV	99.910 to 100.090mV	99.830 to 100.170mV
1V	1.000000V	0.99910 to 1.00090V	0.99830 to 1.00170V
10V	10.00000V	9.9910 to 10.0090V	9.98300 to 10.0170V
100V	100.0000V	99.910 to 100.090V	99.830 to 100.170V
750V	300.000V*	299.60 to 300.40V	299.27 to 300.73V

* If the 5725A amplifier is not available, change the 300V @ 50kHz step to 220V @ 50kHz. Reading limits for 220V @ 50kHz = 219.36 to 220.64V.

Verifying resistance

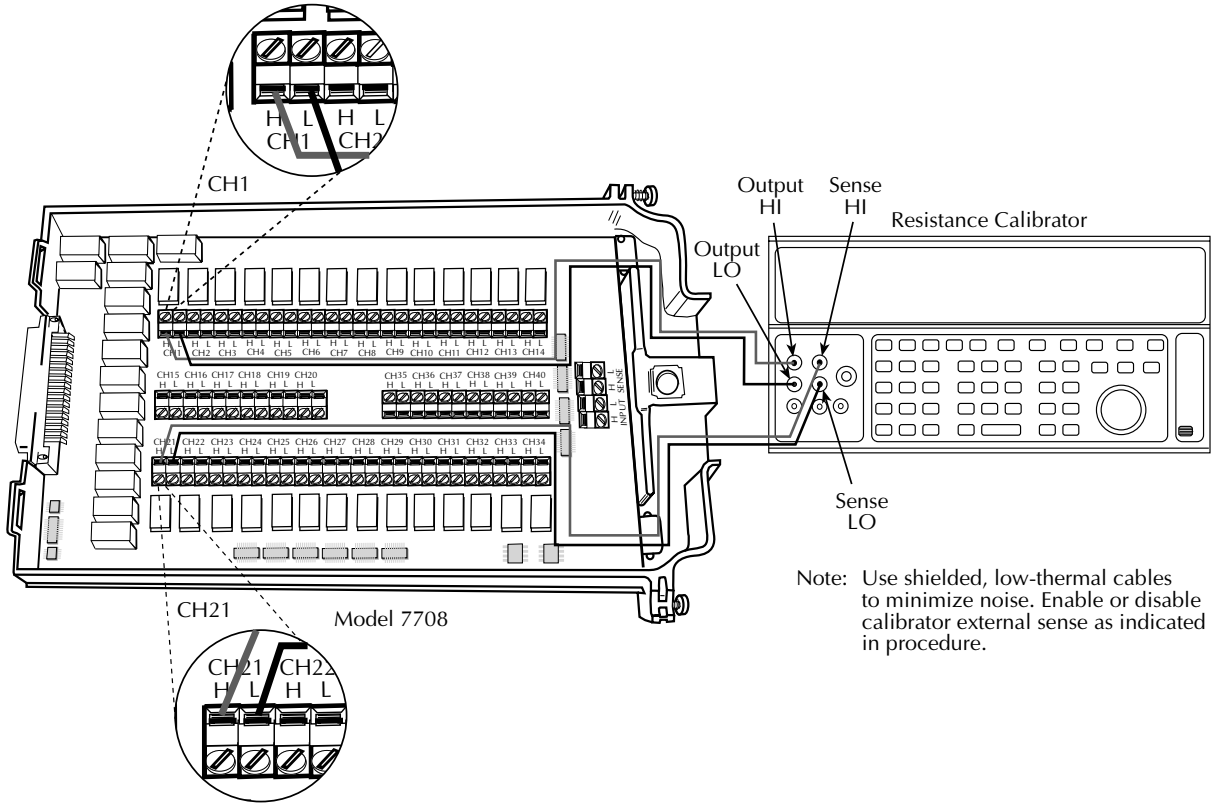
Check resistance by connecting accurate resistance values to the Model 7708 and verifying that its resistance readings are within the specified limits.

> *CAUTION* **Do not apply more than 300V between plug-in module INPUT or SENSE H and L terminal, or between any adjacent channels, or instrument damage could occur.**

Follow these steps to verify resistance accuracy:

1. Using shielded Teflon or equivalent cables in a 4-wire configuration, connect the Model 7708 CH1 H and L INPUT terminals, and CH21 H and L SENSE terminals to the calibrator as shown in Figure 11.
2. Install the Model 7708 in Slot 1 of the Model 2700, turn on the power, and allow the unit to warm up for two hours before proceeding. Be sure the front panel INPUTS switch is set to the REAR position.
3. Set the calibrator for 4-wire resistance with external sense on.
4. Select the Model 2700 4-wire resistance function by pressing the Ω4 key. Close Channel 1 by pressing the CLOSE key and keying in 101.

Figure 11
Connections for resistance verification (100Ω to 10MΩ) ranges)



5. Set the Model 2700 for the 100Ω range, and make sure the FILTER is on. Enable OCOMP (offset-compensated ohms) for the 100Ω range test. (Press SHIFT then OCOMP.)
6. Recalculate reading limits based on actual calibrator resistance values.
7. Source the nominal full-scale resistance values for the 100Ω-10MΩ ranges summarized in Table 5, and verify that the readings are within calculated limits.

Table 5
Limits for resistance verification

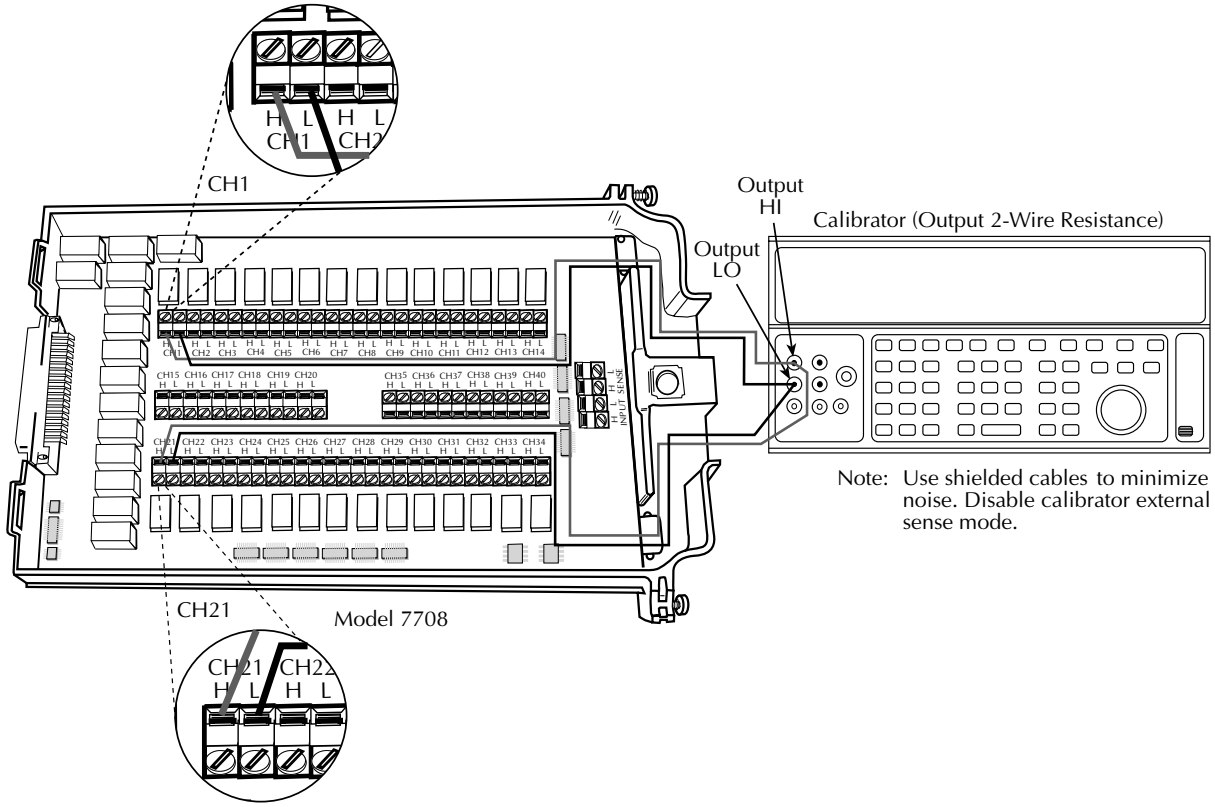
Ω Range	**Nominal resistance**	**Nominal reading limits (1 year, 18°C to 28°C)**	**Recalculated limits****
100Ω*	100Ω	99.9880 to 100.0120Ω	_____ to _____ Ω
1kΩ	1kΩ	0.999894 to 1.000106kΩ	_____ to _____ kΩ
10kΩ	10kΩ	9.99894 to 10.00106kΩ	_____ to _____ kΩ
100kΩ	100kΩ	99.9890 to 100.0110kΩ	_____ to _____ kΩ
1MΩ	1MΩ	0.999890 to 1.000110MΩ	_____ to _____ MΩ
10MΩ	10MΩ	9.99590 to 10.00410MΩ	_____ to _____ MΩ
100MΩ	100MΩ	99.5770 to 100.4230MΩ	_____ to _____ MΩ

* Enable OCOMP for 100Ω range.

** Calculate limits based on actual calibration resistance values and Model 2700 one-year resistance accuracy specifications. See *Verification limits*.

8. Connect the Model 7708 CH1 and CH21 terminals to the calibrator as shown in Figure 12.
9. Disable external sense on the calibrator.
10. Set the Model 2700 for the 100MΩ range.
11. Source a nominal 100MΩ resistance value, and verify that the reading is within calculated limits for the 100MΩ range.
12. Press the OPEN key to open Channel 1.

Figure 12
Connections for resistance verification (100MΩ range)



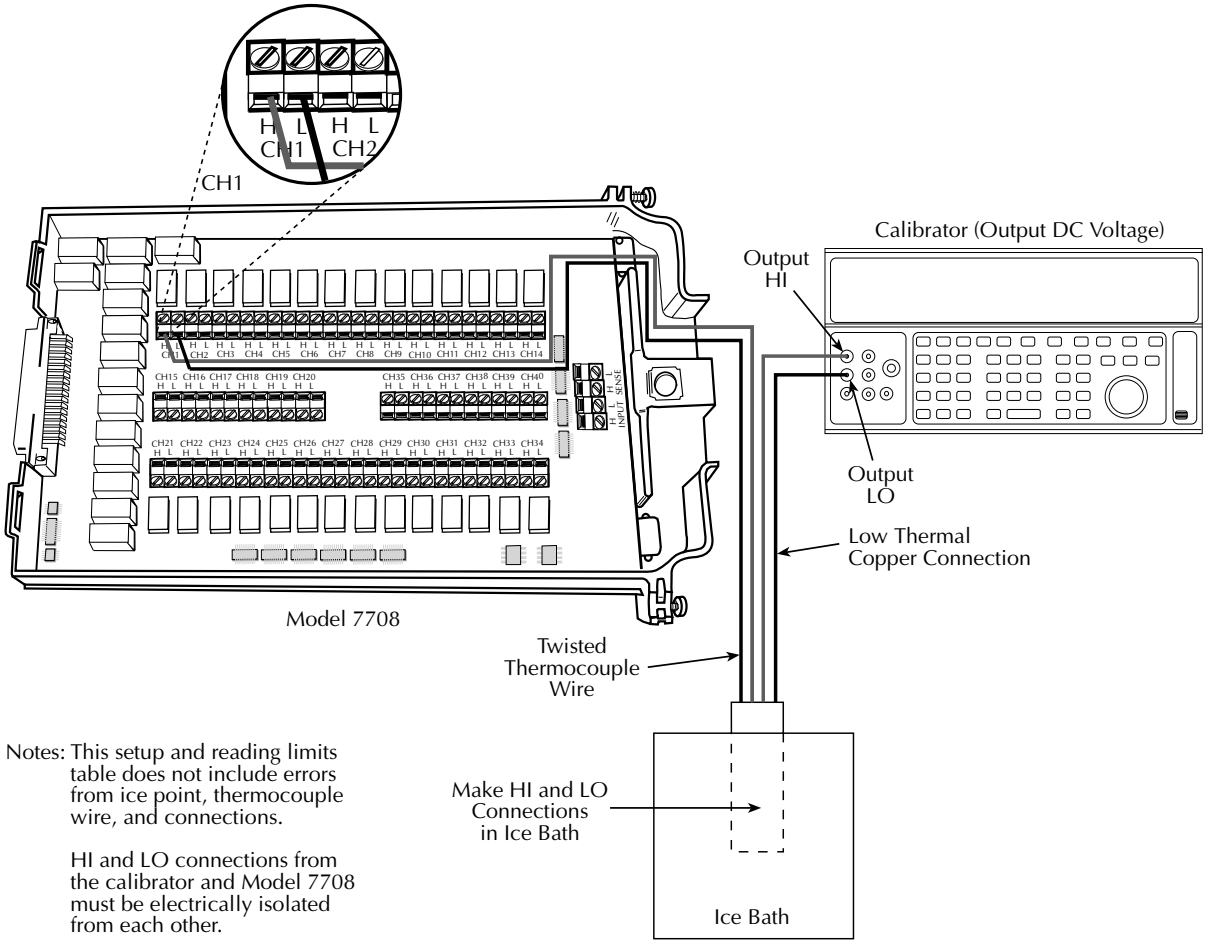
Verifying temperature

Thermocouple, thermistor, and RTD temperature readings are derived from DC volts and resistance measurements, respectively. For that reason, it is not necessary to independently verify the accuracy of temperature measurements. As long as the DC volts and resistance functions meet or exceed specifications, temperature function accuracy is automatically verified. However, temperature verification procedures are provided below for those who wish to separately verify temperature accuracy.

Thermocouple temperature

1. Connect the DC voltage calibrator output terminals and ice point reference to the Model 7708 CH1 H and L INPUT terminals using low-thermal shielded connections, as shown in Figure 13.
2. Install the Model 7708 in Slot 1 of the Model 2700, turn on the power, and allow the unit to warm up for two hours before proceeding. Be sure the front panel INPUTS switch is set to the REAR position.
3. Select the temperature function by pressing the TEMP key. Close Channel 1 by pressing the CLOSE key and keying in 101.

Figure 13
Connections for thermocouple temperature verification



4. Configure the Model 2700 for °C units, type K temperature sensor, and internal reference junction as follows:
   a. Press SHIFT then SENSOR, and note the unit displays the temperature units: UNITS: C. (If necessary, use the cursor and range keys to select °C units.)
   b. Press ENTER. The unit then displays the sensor type: SENS: TCOUPLE.
   c. Make sure that TCOUPLE is displayed, then press ENTER. The unit displays the thermocouple type: TYPE: J.
   d. Select a type K temperature sensor, then press ENTER. The unit then displays the reference junction type: JUNC: SIM.
   e. Select INT reference junction, then press ENTER.
5. Source each of the voltages summarized in Table 6 and verify that the temperature readings are within limits. Be sure to select the appropriate thermocouple type for each group of readings. (See step 3 above.) Open Channel 1 after the test is completed.

Table 6
Thermocouple temperature verification reading limits

Thermocouple type	Applied DC voltage*	Reading limits (1 year, 18°C to 28°C)
J	-7.659mV	-192.33 to -187.67°C
	0mV	-1.0 to +1.0°C
	42.280mV	749.0 to 751.0°C
K	-5.730mV	-192.33 to -187.67°C
	0mV	-1.0 to +1.0°C
	54.138mV	1349.0 to 1351.0°C

*Voltages shown are based on ITS-90 standard.

RTD temperature

1. Connect the precision decade resistance box (listed in Table 2) to the Model 7708 CH1 and CH21 H and L terminals using four-wire connections. (See Figure 11 for similar connecting scheme.)
2. Install the Model 7708 in Slot 1 of the Model 2700, turn on the power, and allow the unit to warm up for two hours before proceeding. Be sure the front panel INPUTS switch is set to the REAR position.
3. Select the temperature function by pressing the TEMP key. Close Channel 1 by pressing the CLOSE key and keying in 101.
4. Configure the Model 2700 temperature function for °C units and RTD temperature sensor (α=0.00385) as follows:
   a. Press SHIFT then SENSOR, and note the unit displays the temperature units: UNITS: C.
   b. Press ENTER, and note the unit displays the sensor type: SENS: TCOUPLE.
   c. Using the cursor and range keys, set the display as follows: SENS: 4W-RTD.
   d. Press ENTER, and note the unit displays: TYPE: PT100.
   e. Using the cursor and range keys, set the unit for the following display: TYPE: PT385.
   f. Press ENTER to complete the temperature configuration process.
5. Set the decade resistance box to each of the values shown in Table 7, and verify that the temperature readings are within the required limits. Open Channel 1when finished.

Table 7
Plug-in module four-wire RTD temperature verification reading limits

Applied resistance*	Reading limits (1 year, 18°C to 28°C)
22.80Ω	-190.06 to -189.94°C
100.00Ω	-0.06 to +0.06°C
313.59Ω	599.94 to 600.06°C

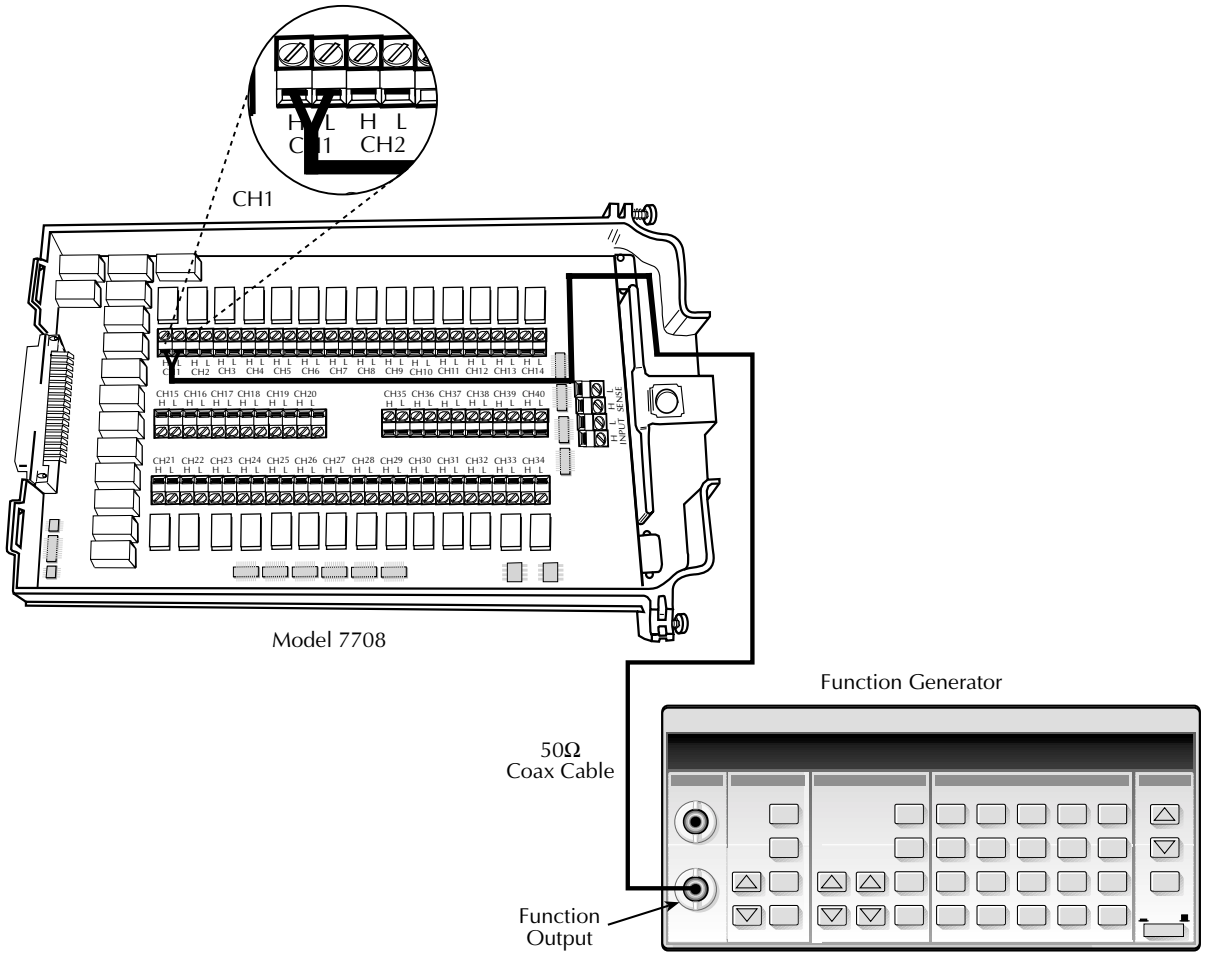
*Based on α = 0.00385. See text.

Verifying frequency

Follow the steps below to verify the Model 2700 frequency function:

1. Connect the function generator to the Model 7708 CH1 H and L INPUT terminals. (See Figure 14.)
2. Install the Model 7708 in Slot 1 of the Model 2700, then turn on the power, and allow the unit to warm up for one hour before proceeding. Be sure the front panel INPUTS switch is set to the REAR position.
3. Set the function generator to output a 1kHz, 1V RMS sine wave.
4. Select the Model 2700 frequency function by pressing the FREQ key. Close Channel 1 by pressing the CLOSE key and keying in 101.
5. Verify that the Model 2700 frequency reading is between 0.9999kHz and 1.0001kHz.

Figure 14
Connections for frequency verification



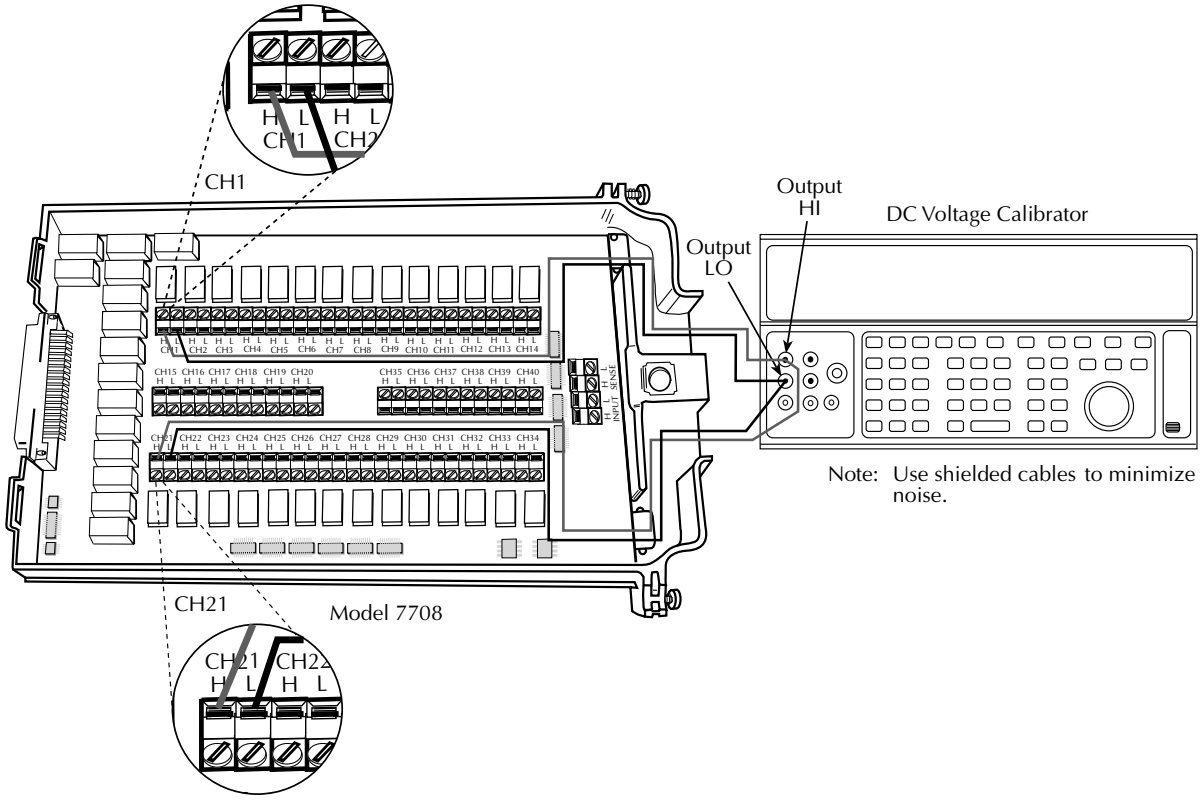
Verifying ratio and average

Follow the procedure below to verify ratio and average.

> *CAUTION* **Exceeding 300V between plug-in module INPUT or SENSE H and L terminals may cause instrument damage.**

1. Connect the Model 7708 CH1 and CH21 H and L terminals to the DC calibrator, as shown in Figure 15.
2. Install the Model 7708 in Slot 1 of the Model 2700, turn on the power, and allow the unit to warm up for two hours before proceeding. Be sure the front panel INPUTS switch is set to the REAR position.
3. Select the Model 2700 DCV function and the 1V range. Close Channel 1 by pressing the CLOSE key and keying in 101.
4. Select the Model 2700 RATIO function (press SHIFT then RATIO).
5. Set the calibrator output to 1.00000V DC, and allow the reading to settle.
6. Verify that the ratio reading is between 0.9999926 and 1.000074.
7. Press OPEN to open Channel 1.

Figure 15
Connections for ratio and average verification



Calibration

The following procedures calibrate the temperature sensors on the Model 7708 plug-in modules.

WARNING **The information in this section is intended only for qualified service personnel. Do not attempt these procedures unless you are qualified to do so.**

Recommended test equipment

In order to calibrate the Model 7708, you will need equipment summarized in Table 8.

Table 8
Recommended equipment for Model 7708 calibration

Digital Thermometer: 18 to 23°C, ±0.1°C
Keithley 7797 Calibration/Extender Board

Extender board connections

The Model 7708 being calibrated should be connected to the 7797 Calibration/Extender Board, and the extender board should then be installed in scanner Slot #1. Note that the module being calibrated will be external to the Model 2700 to avoid card heating during calibration.

Model 7708 calibration

NOTE *Before calibrating the Model 7708, make sure that power has been removed from the card for at least two hours to allow card circuitry to cool down. After turning on the power during the calibration procedure, complete the procedure as quickly as possible to minimize card heating that could affect calibration accuracy. Allow the Model 2700 to warm up for at least two hours.*

Front panel Model 7708 calibration

1. Connect the Model 7708 to the Model 7797 Calibration/Extender Board (see “Extender board connections” above).
2. With the power off, install the Model 7708/7797 combination in Slot 1 and select the rear inputs with the INPUTS switch. Allow three minutes for thermal equilibrium.
3. Accurately measure and record the cold temperature of the Model 7708 card surface at the center of the card with a digital thermometer.
4. Press in and hold the Model 2700 OPEN key while turning on the power.
5. Press SHIFT then TEST, then display TEST:CALIB with the up or down range key. Press ENTER, select RUN, then enter the appropriate calibration code (default: 002700).
6. With NEW CODE? displayed, use the up or down range key to display N, then press ENTER.
7. Using the up or down range key, select CARD at the CAL:RUN prompt, then press ENTER.
8. Set the display value to the cold calibration temperature (°C) you measured in Step 3, then press ENTER to complete Model 7708 calibration.

Remote Model 7708 calibration

1. Connect the Model 7708 to the 7797 Calibration/Extender Board (see “Extender board connections” above).
2. With the power off, install the Model 7708/7797 combination in Slot 1, and select the rear inputs with the INPUTS switch. Allow three minutes for thermal equilibrium.
3. Accurately measure and record the cold temperature of the Model 7708 card surface at the center of the card.
4. Press in and hold the Model 2700 OPEN key while turning on the power.
5. Enable calibration by sending the :CODE command. For example, the default command is:
   :CAL:PROT:CODE 'KI002700'
6. Initiate calibration by sending the following command:
   :CAL:PROT:CARD1:INIT
7. Calibrate the Model 7708 with the following command:
   :CAL:PROT:CARD1:STEP0 <temp>
   Here <temp> is the cold calibration temperature (°C) measured in Step 3.
8. Send the following commands to save calibration and lock out calibration:
   :CAL:PROT:CARD1:SAVE
   :CAL:PROT:CARD1:LOCK

Replaceable parts

This section contains replacement parts information and the component layout drawing for the Model 7708.

Parts list

Replaceable parts for the Model 7708 are listed in Table 9.

Table 9
Model 7708 parts list

Circuit Designation	Description	Keithley Part No.
C1, C3, C4, C7, C9-C11, C14, C200, C201, C203-C213	CAP, 0.1µF, 20%, 50V, CERAMIC	C-418-.1
C2, C6, C17-C20, C23-C25, C202	CAP, 47pF, 5%, 100V, CERAMIC	C-465-47P
C5	CAP, 4.7µF, 10%, 35V, TANTALUM	C-476-4.7
C16	CAP, 220µF, 20%, 10V, TANTALUM	C-558-220
CR1-CR14, CR15-CR42, CR45, CR48-CR56	DIODE, DUAL SWITCHING, BAV99L	RF-82
CR43, CR44, CR46, CR47	DIODE, SWITCHING, MMBD914	RF-83
CR101-CR104	DIODE, DUAL HIGH SPEED	RF-147
J1015	CONN, RT ANGLE DUAL ROM RECEPT	CS-1065-1
K1-K41	LATCHING RELAY, SINGLE COIL	RL-225
K42, K43	NON-LATCHING RELAY	RL-242
Q4, Q6	DIGITAL TRANS, DUAL PNP	TG-386
Q5	N-CHANNEL/P-CHANNEL POWER MOSFET	TG-360
Q7	DIGITAL TRANS, DUAL PNP	TG-385
Q25, Q27, Q29, Q31, Q33, Q35, Q37, Q39, Q41, Q43, Q45, Q47, Q49, Q51	TRANS, PNP SILICON	TG-388
Q26, Q28, Q30, Q32, Q34, Q36, Q38, Q40, Q42, Q44, Q46, Q48, Q50, Q52	TRANS, NPN SILICON	TG-389
R1	RES, 69.8kΩ, 1%, 1W, THICK FILM	R-418-69.8K
R2, R3, R5, R6, R108-R110, R12	RES, 1kΩ, 1%, 100mW, THICK FILM	R-418-1K
R4	RES, 10kΩ, 1%, 100mW, THICK FILM	R-418-10K
R7-R13	RES ARRAY, 4 x 4.3kΩ, 5%, 100mW	TF-276-4.3K
R14, R55	RES, 137Ω, 1%, 125mW, METAL FILM	R-391-137
R200-R202	RES, 470Ω, 5%, 125mW, METAL FILM	R-375-470
R203-R205	RES, 4.7kΩ, 5%, 125mW, METAL FILM	R-375-4.7K
R206, R207	RES, 1kΩ, 5%, 125mW, METAL FILM	R-375-1K
TE1, TE3, TE106, TE112, TE113	CONN, 4-PIN, JOLO BB-125-04	TE-115-4
TE2, TE4, TE101-T3103, TE107-TE109	CONN, 8-PIN	TE-115-8
U1-U3, U6, U8	IC, 8-STAGE SHIFT/STORE, MC14094BD	IC-772
U7, U25	IC, POS NAND GATES/INV, 74HCT14	IC-656
U9, U10	IC, DUAL OPTO	IC-1358
U11, U12	IC, 8-CHAN ANA MULTIPLEXER, DG408DY	IC-844
U13, U31-U38	IC, CENTIGRADE TEMP SENSOR, LM35DM	IC-906
U14	IC, RETRIG., MULTIVIB, 74HC123AM	IC-788
U16	IC, 2.5V, CASCADABLE SERIAL EEPROM	LSI-212
U24	IC, QUAD 2 IN AND, 74HCT08	IC-837
	TOP COVER HEAT STAKE ASSEMBLY	7700-302A
	BOTTOM CARD COVER	7702-301C
	COMPRESSION SPRING	SP-7-3

Ordering information

To place an order, or to obtain information concerning replacement parts, contact your Keithley representative or the factory (see inside front cover for addresses). When ordering parts, be sure to include the following information:

- Card model number (Model 7708)
- Card serial number
- Part description
- Component designation (if applicable)
- Keithley part number

Factory service

If the instrument is to be returned to Keithley Instruments for repair, perform the following:

- Call the Repair Department at 1-888-KEITHLEY for a Return Material Authorization (RMA) number.
- Complete the service form at the back of this manual, and include it with the instrument.
- Carefully pack the instrument in the original packing carton.
- Write ATTENTION REPAIR DEPARTMENT and the RMA number on the shipping label.

Component layout

The component layout for the Model 7708 is shown at the end of this packing list.

7708 40-Channel Differential Multiplexer Module

GENERAL

40 CHANNELS: 40 channels of 2-pole relay input. All channels configurable to 4-pole.

RELAY TYPE: Latching electromechanical.

ACTUATION TIME: <3ms.

CAPABILITIES

CHANNELS 1–40: Multiplex one of 40 2-pole or one of 20 4-pole signals into DMM.

INPUTS

MAXIMUM SIGNAL LEVEL:

Channels (1–40): 300V DC or rms, 1A switched, 60W, 125VA maximum.

CONTACT LIFE (typ): $>10^5$ operations at max. signal level.
$>10^8$ operations cold switching.

CONTACT RESISTANCE: <1Ω at end of contact life.

CONTACT POTENTIAL: <±500nV typical per contact, 1µV max.
<±500nV typical per contact pair, 1µV max.

OFFSET CURRENT: <100pA.

CONNECTOR TYPE: Screw terminal, #20 AWG wire size.

ISOLATION BETWEEN ANY TWO TERMINALS: $>10^{10}\Omega$, <100pF.

ISOLATION BETWEEN ANY TERMINAL AND EARTH: $>10^9\Omega$, <200pF.

CROSS TALK (10MHz, 50Ω Load): <–40dB.

INSERTION LOSS (50Ω Source, 50Ω Load): <0.1dB below 1MHz.
<3dB below 2MHz.

COMMON MODE VOLTAGE: 300V between any terminal and chassis.

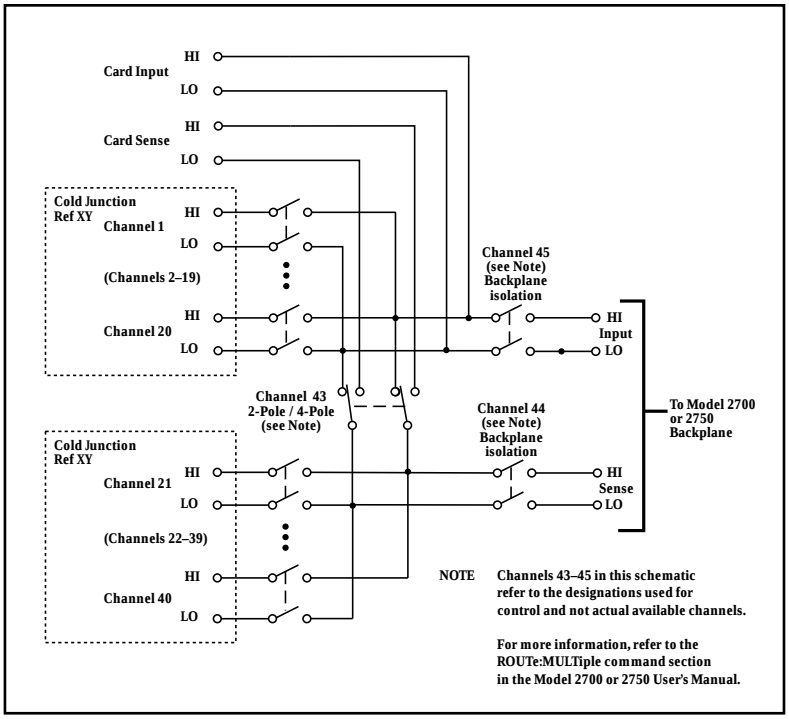
ENVIRONMENTAL:

T/C COLD JUNCTION: 1.0°C (18°–28°C).
1.5°C (0°–18°C and 28°–50°C).

OPERATING ENVIRONMENT: Specified for 0°C to 50°C.
Specified to 80% R.H. at 35°C.

STORAGE ENVIRONMENT: –25°C to 65°C.

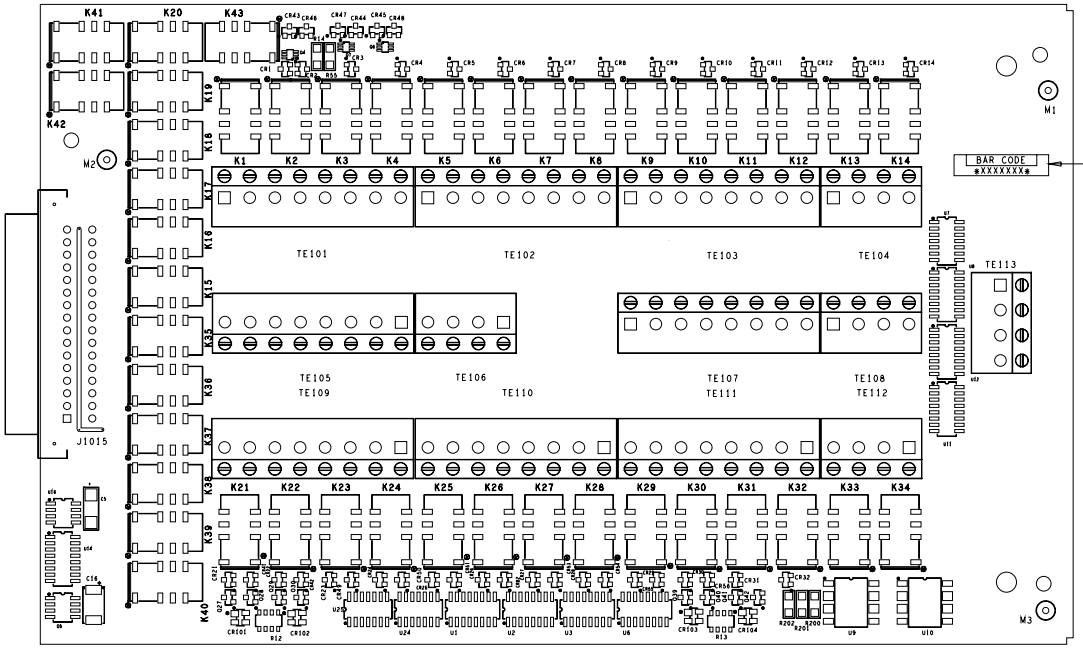
WEIGHT: 0.52kg (1.16 lb).



NO. 7708-100

LTR.	ECA NO.	REVISION	ENG.	DATE
A		PRELIMINARY	LM/ELS	5/25/00

PRIMARY SIDE COMPONENTS (SIDE-06)



FOR COMPONENT INFORMATION, SEE PRODUCT STRUCTURE.

MODEL	NEXT ASSEMBLY	QTY.
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NO. 7708-100

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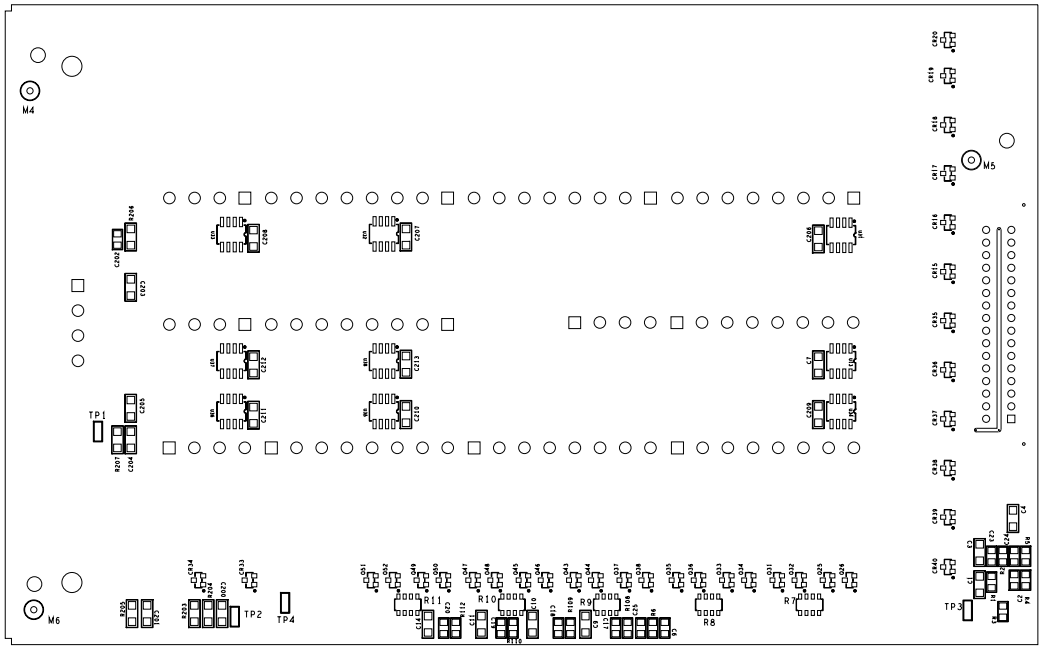
SECONDARY SIDE COMPONENTS (SIDE-01)



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