Trig-Tek™

203M
Charge Amplifier
User Manual

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Before undertaking any troubleshooting, maintenance or exploratory procedure, read carefully the **WARNINGS** and **CAUTION** notices.

This equipment contains voltage hazardous to human life and safety, and is capable of inflicting personal injury.

If this instrument is to be powered from the AC line (mains) through an autotransformer, ensure the common connector is connected to the neutral (earth pole) of the power supply.

Before operating the unit, ensure the conductor (green wire) is connected to the ground (earth) conductor of the power outlet. Do not use a two-conductor extension cord or a three-prong/two-prong adapter. This will defeat the protective feature of the third conductor in the power cord.

Maintenance and calibration procedures sometimes call for operation of the unit with power applied and protective covers removed. Read the procedures and heed warnings to avoid “live” circuit points.

Before operating this instrument:

1. Ensure the proper fuse is in place for the power source to operate.

2. Ensure all other devices connected to or in proximity to this instrument are properly grounded or connected to the protective third-wire earth ground.

If the instrument:

- fails to operate satisfactorily
- shows visible damage
- has been stored under unfavorable conditions
- has sustained stress

Do not operate until performance is checked by qualified personnel.

Table of Contents

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List of Figures

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DOCUMENT CHANGE HISTORY

Revision	Date	Description of Change
A	06/14/2011	Document Control release

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Chapter 1
Introduction

The 203M Charge Amplifier (**Figure 1-1)** is a versatile charge amplifier covering the frequency range from 5 Hz to 30,000 Hz. It will accommodate sensors with sensitivities varying from 1 to 110 pC/g or mV/g and provides an output of either 10 mV/g or 100 mV/g with selectable Peak or RMS indication.

A double integration process provides velocity and displacement outputs. A CAL-OPER switch connects the charge amplifier input to either the calibrate signal or to the normal input.

Three standard low pass filters with cutoff frequencies of 3, 10, or 30 kHz, other cutoffs can be supplied at the time of order.

The unit will operate with high temperature accelerometers where pyroelectric effects may be encountered and will function with 1 MegOhm or greater shunt input resistance. The unit has an alarm circuit to alert if preset levels are exceeded and a relay contact closure is provided.

The Charge Amplifiers are packaged in a plug-in module. Up to six modules will plug into a standard 19-inch cabinet space, seven inches high, or in a single module cabinet.

Features include:

- pC/g or mV/g
- Accel, Vel, Displ
- 1 to 110 pC or mVg
- DVM Indictor
- Alarm
- Level Hold
- Built-in Calibrator

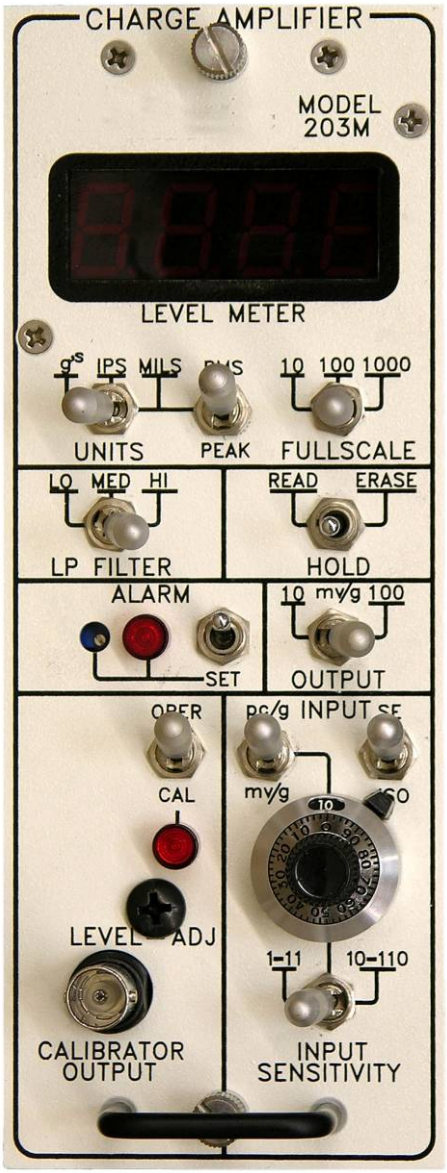

Figure 1-1, 203M Charge Amplifier

System Description

General

The 203M is a versatile charge amplifier covering the frequency range from 5 Hz to 30,000 Hz. It will accept inputs with sensitivities varying from 1 to 110 mV or pC/g and provides an output of either 10 mV/g or 100 mV/g with selectable peak or RMS indication. It also integrates the input signal to provide velocity and displacement outputs with sensitivities of 10 mV/unit.

The charge sensitivity control is continuously variable from 1 to 11 with an additional X10 Switch to allow operating with pickups having sensitivities from 1 to 110 mV or pC/g.

A toggle switch permits selection of either 10 mV/g or 100 mV/g output sensitivity. A CAL-OPER switch connects the charge amplifier input to either internal calibrator signal or to the normal input.

A front panel filter switch selects three low pass filter cutoff frequencies of 3, 10, or 30 kHz marked LOW, MEDIUM, or HIGH.

The unit will operate with high temperature accelerometers where pyroelectric effects may be encountered. It will function with 1 MegOhm or great shunt input resistance.

The unit has an alarm circuit to alert if preset levels are exceeded. The Charge Amplifiers are packaged in a plug-in module. Up to six modules will plug into a standard 19-inch rack space, seven inches high.

System Specifications

Input

Connector	BNC.
Charge Sensitivity	1 to 110 mV or pC/g (provided with two selectable ranges), 1-11 and 10-110 mV or pC/g with continuous adjustment for each.
Frequency Response	±3% from 5 Hz to 30,000 Hz referred to 100 Hz.
Overload Recovery	10.000 pC or less, 1 ms half sine input pulse will cause no effect at the output, except clipping.
Amplitude (Stability vs. Input capacity)	Less than 0.1% change per 1000 pF.
Amplitude (Stability Temperature)	Less than 3% change from 30˚ to 130˚F.
Shunt Resistance	Will operate with any input impedance above 100k Ohms.
Filtering	12dB per octave roll off with 3dB cutoffs selectable for 3 kHz, 10 kHz, and 30kHz. (Other cutoff frequency supplied on request)

Acceleration Outputs (NOR and AUX)

Voltage (Max)	10 Volts RMS.
Sensitivity	10 mV/g or 100 mV/g.
Impedance	Less than 50 Ohms. (NOR 10 mA max; AUX 10 mA max.
Amplitude Linearity	±1% of best straight line approximation of output vs. input amplitude.
Amplitude Accuracy	±2% of reading ±1% of FS in series with selected Low Pass Filter.
Noise	0.05 pC maximum with 1.0 pC/g sensitivity. Noise increases 0.007g/1000 pF of additional capacity at the input.
Harmonic Distortion	Less than 1%.
DC Offsst	Less than 5 millivolts.

Velocity Output

Voltage Max	10 Volt RMS.
Sensitivity	10 mV/in/sec.
Impedance	Less than 50 Ohms (10 mA max).
Frequency Response	±3% 5 Hz to 30000 Hz of a –6dB/oct slope, in series with selected input Low Pass Filter.
Dynamic Range	46 dB below full scale.
DC Offset	Less than 5 millivolts.

Displacement Output

Level	0-10 Volts RMS.
Impedance	Less than 50 Ohms (20 mA max)
Sensitivity	10 mV/mil DA.
Amplitude Accuracy	±5% of reading ±0.5% FS.
Frequency Response	±3% 10 Hz to 10000 Hz of a –12dB slope. ±5% for 5 Hz to 3000 Hz of a –12dB slope in series with the selected Low Pass Filter.
Dynamic Range	36dB below full scale.
DC Offset	Less than 5 millivolts (noise signal must be averaged).

DC Output

Level	10 Volts DC full scale (meter range).
Impedance	Less than 50 Ohms (10 mA max)
Sensitivity	10 Volts for selected full scale.
Linearity	1% full scale.
Amplitude Accuracy	2% of reading ±1% FS.
Dynamic Range (Accel)	60 dB below full scale.

Controls

Filter Switch	Selects LOW, MED, and HIGH nominal –3 dB frequency cutoffs for the Low Pass Filter. **Cutoff Frequency KHz** LOW 3 MED 10 HIGH 30
CAL-OPER Switch	Connects the amplifier input to either the internal calibrator signal or to the Accel Input jack.
MV/g Output Switch	Selects 10 or 100 mV/g output.
PC/g-mV/g Switch	mV/g accommodates accelerometers with built-in electronics; while pC/g accommodates standard accelerometers.
Sensitivity Switch	Selects 1-11, or 10-110 mV/g or pC/g.
Sensitivity Dial	Adjusts the charge sensitivity from 1-11 for each range.
UNITS Switch	Selects either g's IPS or MILS as the meter units.
FULL SCALE Switch	Selects 10, 100, or 1000 units as full scale for the meter.
RMS-PEAK Switch	Scales the front panel DVM for either PEAK or RMS units at the input.
ALARM SET Switch	Provides the means of monitoring the alarm set point; also RESETS the alarm.
SE-DIFF Switch	Selects either single-ended or differential configuration at the input.
READ-HOLD Switch	The READ position connects the level stored in the Peak-Hold circuit to the meter, and the ERASE position resets the Peak-Hold circuit to zero.

Indicators

CAL Light	Illuminates when the CAL mode is selected.
ALARM Light	Illuminates when the alarm set point is exceeded.

Power

	115 or 230, 10% Volts, 50-400 Hz, 3 watts nominal.

Size

	7 inches high x 2.7 inches wide x 13 inches deep; up to six units mounted side by side in a standard 19-inch wide rack.

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Chapter 2
Operation

The 203M Charge Amplifier is in a modular package with a self-contained power supply. Insert the amplifier into one of the six rack spaces of a six-module rack or the single-module cabinet. Connect the AC line into either 115 Volts or 220 Volts RMS, 60 Hz power. A switch (S1) mounted on the circuit board of each module selects either 110 or 220 Volts operation. Operation with this switch set for 110 Volts when using 220 Volt power will damage the unit. The power to the six modules is controlled by the POWER switch on the left-hand side of the rack; place this switch to POWER.

CAUTION

The 115-230 VAC switch (S1) must be at the proper setting.
If 230 V Power is applied when this switch is set for
115 V RMS, circuitry will be damaged.

Input Switch

The Charge amplifier is designed to accept inputs from either standard charge type pickups or from the type with the electronics built it. Place the INPUT switch to pC/g for standard charge type pickups and to mV/g for the other. When this switch is in the mV/g position, a current output is supplied to operate the pickup electronics. This will be set for 3-5 milliamps when shipped. Connect the pickup to the ACCEL INPUT jack (BNC connector), at the rear of the rack.

Digital Panel Meter

The DPM is a 3-1/2 digit meter that monitors the input level. It has three ranges: 10, 100, or 1000 units, and a switch to select either Acceleration g's, Velocity IPS, or Displacement MILS.

Units Switch

The UNITS switch selects g's, IPS, or MILS as the UNITS to be displayed on the front panel meter and at the DC OUTPUT jack.

METER RANGE Switch

The METER RANGE Switch has three positions to select: 10, 100, or 1000 units full scale. The DC OUTPUT is 10 Volts full scale for each range

Sensitivity (RANGE) 1-11 or 10-110 Switch

The two-position SENSITIVITY Switch is a range selector for the variable sensitivity control. The proper range selection and sensitivity control setting allows using pickups from 1 to 110 pC/g or mV/g sensitivities. Place this switch to the range the pickup sensitivity falls in. For instance, if the pickup is 20 pC/g, the 10 to 110 range is selected.

SENSITIVITY Control

The sensitivity control is a calibrated ten-turn potentiometer to provide a continuously variable sensitivity for each range selected by the SENSITIVITY RANGE switch. For the above example, the control will be set for 2.0

SE-DIFF Switch

This switch permits selection of a single-ended input (SE) or Differential Input (DIFF). When the DIFF position is selected, the common mode rejection can be adjusted by the DIFF ADJ control, a screwdriver adjustment immediately below the DIFF position of the switch. If operating with a pickup that is insulated (no ground) the single-ended (SE) position should be used. When the pickup common is grounded, the Differential (DIFF) input opens the ground path between the pickups and the amplifier and provides rejection of the common mode voltage.

OPER-CAL Switch

The OPER-CAL switch selects either the ACCEL input when in OPER, or the internal calibrator input when in the CAL position. The internal calibrator level can be monitored at the CALIBRATION INPUT BNC connector just below the OPER-CAL switch. When the OPER-CAL switch is in the OPER position, the calibrate mode can be selected from a remote CAL CONTROL line. When the CAL mode is selected, either by the front panel switch or the remote CAL CONT line, the CAL LIGHT just to the right of the switch illuminates, and the meter should read 100 ±3 g's or 100 ±5 MILS.

MV/g Output Switch

This switch sets the normalized sensitivity at the ACCEL OUTPUT. Either 10 mV/g or 100 mV/g can be selected. This switch setting does not affect the sensitivity at the displacement output.

LP FILTER Switch

The Low Pass Filter (LP FILTER) switch has three positions marked LOW, MED, and HIGH. Nominal frequency cutoffs of 3, 10, or 30 kHz are selected. The cutoffs can be altered if different cutoffs are more appropriate.

HOLD Circuit

The HOLD circuit has a center OFF switch with a momentary READ and ERASE position. The HOLD circuit stores the highest TRMS value encountered during a test, and this value can be displayed on the meter by depressing the momentary READ position of the switch. The HOLD circuit can be restored to zero by depressing the switch to momentary ERASE.

ALARM Circuit

The ALARM circuit has a SET switch, a light, and a SET ADJ control associated with it. When the SET switch (momentary) is depressed, the SET ADJUST is connected to the meter to indicate what level the alarm is set for. While the switch is depressed, the alarm levels can be changed by varying the screwdriver adjustment and noting the new value on the front panel meter. When released, the alarm is reset, the light is out, and it will remain thus until a level is encountered which is higher than the ALARM SET level. When this level is encountered, the ALARM light will illuminate and the alarm relay will be energized. The contacts of the alarm relay are on a terminal strip on the rear panel. It should be noted that the alarm level is interconnected through the METER RANGE switch. For instance, if 8 g's is set on the 10 g's range, it will become 80 g's if the 100 g range is selected.

RMS-PEAK Switch

The RMS-PEAK switch provides a means of scaling the meter circuit to read in either PEAK or RMS units. When the input to the unit is sinusoidal, it may be desirable to use peak g's. When the input is random noise, the RMS position scale the meter to read RMS units, and because the detector is a true RMS converter, it will read either sinusoidal or random inputs correct in RMS units.

Chapter 3
Performance Test

This procedure outlines a method of testing the Charge Amplifier for compliance to the manufacturer's specifications. The unit uses integrated circuits and very stable parts and should not require calibration more often than every six months. The amplifier may be in a single-unit cabinet or one that holds six units. The following procedure is for a single unit, and must be repeated for each module. In the event that a reading is out of tolerance the unit will require calibration. (See Chapter 4.)

Test Equipment

Note: Equivalent equipment can be substituted.

Multimeter	Fluke 8000A
Generators (2)	Trig-Tek 346B Synthesized Calibrator.

Performance Test Procedure

CAUTION

The 115-230 VAC switch (S1, mounted on the unit's circuit board) must be at the proper setting. If 230 V Power is applied when this switch is set for 115 V RMS, circuitry will be damaged.

Check the unit to be tested for any loose or broken wires or signs of damage caused by rough handling or dropping. While the unit is out of the chassis, check S1, the 110-220 switch, is set for 110 if 105 to 120 Volts is to be used, and for 220 if 210 to 230 Volts is to be used. The unit will be damaged if plugged into 220 VAC power when set up for 110 VAC operations.

Plug the unit into the chassis and turn the POWER Switch ON; this is a single switch at the left side of the chassis. The meter displays, and the POWER LED will illuminate.

Control Settings

Place the CAL-OPER switch to OPER, the SENSITIVITY switch to 1-11, the SENSITIVITY DIAL to 10.0, the PEAK-RMS switch to RMS, the UNITS switch to g's, the FULL SCALE switch to 100, the INPUT switch to pC/g, the SE-DIFF switch to SE, the OUTPUT mV/g switch to 10, and the LP FILTER SWITCH to MED.

1. Connect a 139.9 ±0.5 Hz signal set for 707 ±4 millivolts RMS from the PICOCOULOMB Output to the ACCEL INPUT jack at the rear of the chassis.
2. Connect the AC Voltmeter to the NOR ACCEL OUTPUT jack on the rear panel.
3. The indications on the Voltmeter should be 707 ±20 millivolts, and the front panel meter will indicate 70.7 ±2 g's.
4. Place the PEAK-RMS switch to PEAK.
5. The front panel meter will indicate 100 ±3 g's.
6. Place the OUTPUT mV/g switch to 100.
7. The indication on the AC Voltmeter will be 10x the previous reading or 7.07 ±0.2 Volt.
8. Place the OUTPUT mV/g switch to 10. Set the SENSITIVITY DIAL for 1.0 and the FULL SCALE switch to 1000.
9. The indication on the front panel will be 1000 ±30 g's.
10. Place the SENSITIVITY switch to 10-110, and the FULL SCALE switch to 100.
11. The indication on the front panel meter will be 100 ±3 g's.
12. Place the SENSITIVITY switch to 1-11, and the DIAL to 10.0.
13. Connect the DC Voltmeter to the DC OUTPUT jack.
14. The indication on the DC Voltmeter will be 10.00 ±0.3 Volt.
15. Connect the AC Voltmeter to the VELOCITY OUTPUT jack and place the UNITS to IPS. Set the generator frequency for 61.4 ±0.2 Hz.
16. The indication on the AC Voltmeter will be 0.707 ±0.02 VRMS, and the front panel will indicate 100 ±3 IPS
17. Connect the AC Voltmeter to the DISPLACEMENT OUTPUT jack, and place the UNITS switch to MILS. Set the generator frequency for 139.9 ±0.5 Hz.
18. The indication on the AC Voltmeter will be 0.707 ±0.02 VRMS, and the front panel will indicate 100 ±3 MILS.
19. Place the UNITS switch to g's, depress the ALARM SET switch, and set the ALARM adjust for an indication of 93 g's.

20. When the ALARM SET switch is released, the ALARM LIGHT will illuminate and the ALARM RELAY will energize. (Rear panel terminal strip).
21. Depress the ALARM SET switch and set the alarm level for 105 g's.
22. Release the ALARM SET switch; and ALARM will not come on.
23. The Low Pass filter cutoffs nominally have 3, 10, and 30 kHz 20% of frequency, -3dB bandwidths for the LOW, MED and HIGH LP Filter switch positions. Other cutoff frequencies are available, so determine the actual cutoffs before testing.
24. Place the LP FILTER switch to LOW.
25. Increase the generator frequency until the meter indicates 70.7 ±9 g's. The frequency of the signal generator is the –3dB cutoff for the LP FILTER.
26. Place the LP FILTER switch to MED.
27. Increase the generator frequency until the meter again indicates 70.7 ±9 g's, the –3dB cutoff of the MED low pass filter.
28. Place the LP FILTER switch to HIGH.
29. Increase the generator frequency until the meter again indicates 70.7 ±9 g's, the –3dB cutoff of the HIGH low pass filter.
30. Connect the counter and AC voltmeter to the CAL INPUT jack on the front panel.
31. Place the CAL-OPER switch to CAL.
32. The counter indication will be 139.9 ±0.8 Hz and the AC voltmeter will indicate 1.00 ±0.01 Volt RMS.
33. The front panel meter will indicate 100 ±3 g's.
34. Vary the SENSITIVITY DIAL from 1-11; observe that the front panel meter indication changes less than 1 g for any setting.
35. Place the SENSITIVITY switch to 10-110. The meter indication will remain 100 ±3 g's.
36. Place the UNITS switch to MILS. The meter will indicate 100 ±3 MILS.

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Chapter 4
Calibration Procedure

The 203M Charge Amplifier is a plug-in module with the circuitry on a single, printed board. To calibrate, remove the module and use the Module Power Cord Assembly TT-1535 to apply power and Board Test Assembly TT-1536 to provide an interface or monitoring. For adjustment locations refer to **Figure 4-1** and **Figure 4-2**.

Test Equipment

Note: Equivalent equipment can be substituted.

Multimeter	Fluke 8000A
Counter	Fluke 1900A
Function Generator	Trig-Tek 346B Synthesized Calibrator
Power Cord Assembly	Trig-Tek TT-1535.
Board Test Assembly	Trig-Tek TT-1536.

Switch Settings

1. Place the CALIB-OPER switch to OPER, the SENSITIVITY switch to 10-110, the mV/g-pC/g switch to pC/g, the SE-DIFF to SE, the UNITS switch to g's, the FULL SCALE switch to 1000, the PEAK-RMS switch to PEAK, the LP FILTER switch to HIGH, and the output mV/g switch to 10.
2. Turn the DIAL to 10.
3. Place the module to be tested on the bench, and plug the Charge Amplifier Assembly TT-1536 into the printed circuit board connector at the rear of the module and the Power Cord Assy. 1535 to the power receptacle.
4. Connect to 50 to 400 Hz, 110 or 220 Volt power.
5. Set the 110-220 switch, S1, as required to accommodate the power used.

Charge Converter and Displacement Adjust

1. Set the Dial to 10.0
2. Place the SENSITIVITY Switch to 10-110 and the CALIB-OPER switch to OPER.
3. Connect the AC Voltmeter to Pin 8 of P1 (ACCEL OUTPUT of the Test Board).
4. Connect a 61.4 ±0.1 Hz signal to the ACCEL INPUT jack on the Test Board and set it for 7.07 ±0.04 Volts RMS.
5. Set the ACCEL ADJ R8 for a 707 ±4 millivolts RMS indication on the AC Voltmeter.
6. Set the Dial for 1.0.
7. Set the DIAL ADJ R1 for a 7.07 ±0.04 Volts RMS indication on the AC voltmeter.
8. Connect the AC voltmeter to Pin 10 of P1 (VEL OUTPUT of the Connector Board Assembly).
9. Set the VEL FS ADJ R7 for a 7.07 ±0.07 Volt RMS indication on the AC Voltmeter.
10. Connect the AC Voltmeter to the DISPL OUTPUT, Pin 11 of P1 of the Test Board, and set the input frequency for 139.9 ±0.3 Hz.
11. Set the DISPL FS ADJ R4 for a 7.07 ±0.07 Volt RMS indication on the AC Voltmeter.

DVM Adjustments

1. Place the SENSITIVITY Switch to 1-11, the Dial to 10.0, the CALIB-OER switch to OPER.
2. Connect the DC Voltmeter to Pin 13 of P1, DC OUTPUT of the Test Board.
3. Connect a 7.07 ±0.04 Volt signal of 139.9 ±0.5 Hz to Pin 17 of P1, the ACCEL INPUT of the Test Board.
4. Observe a 10.00 ±0.05 Volt indication on the DC Voltmeter.
5. Set the DVM FS AJ R1 (**Figure 4-2**) on the front panel meter assembly for a 1000 ±8 counts on the front panel meter. (Adjust the resistor through the hole on front panel board.)

Calibrator Adjustments

1. Place the CALIB-OPER switch to CALIB. (The CALIB light should illuminate.)
2. Connect the counter and Voltmeter to the CALIBRATOR OUTPUT BNC on the front panel.
3. Observe a 139.9 ±0.4 Hz indication on the counter.
4. Set the 1 Volt front panel LEVEL ADJ for a 1.000 ±0.005 Volt RMS indication on the Voltmeter. (The front panel LEVEL ADJ screw will need to be removed if adjustment is necessary).
5. Place the sensitivity switch to 1-11, the Dial to 10.0, the FULL SCALE switch to 100, and the PEAK-RMS switch to PEAK.
6. Set the CAL ADJUST R9 for 100.0 ±0.8 g's counts indication on the front panel meter.
7. Set the Dial for 1.00.
8. Set the DIAL CAL ADJ R2 for a 100.0 ±0.8 g's counts indication on the front panel meter.

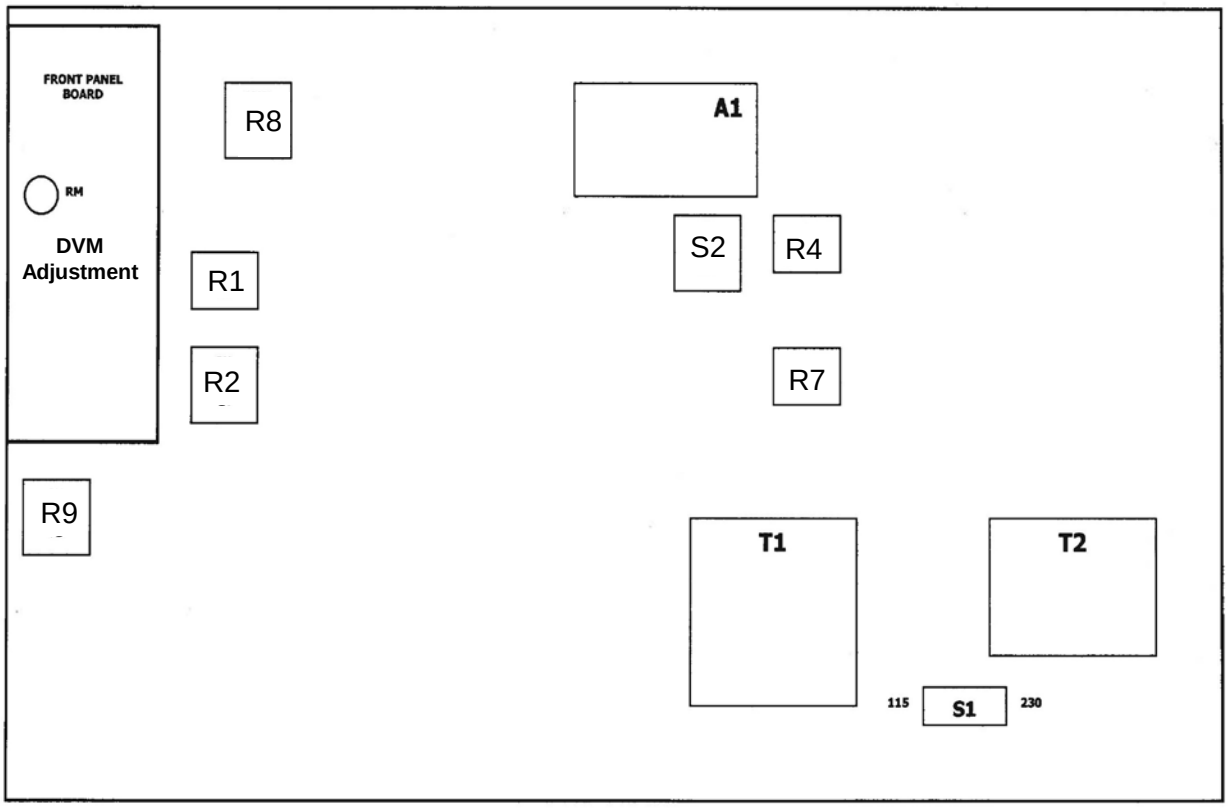

Figure 4-1, 203M Adjustment Locations

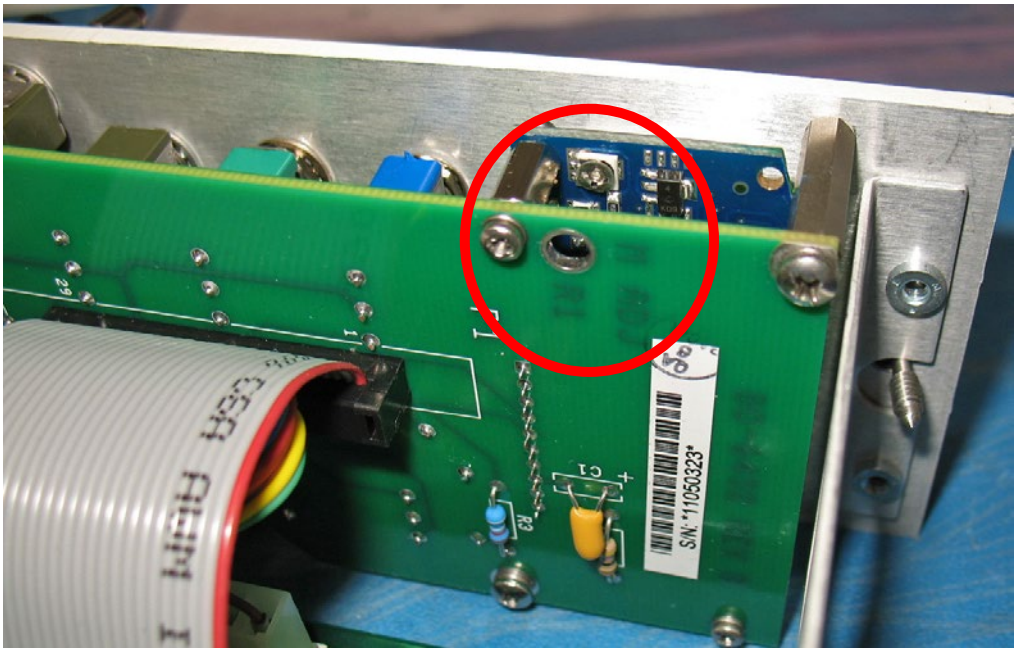

Figure 4-2, DVM Adjustment Resistor R1

(Adjust R1 though hole in board)