INSTRUCTION MANUAL

NANOCOULOMBMETER

MODEL 253

MONROE ELECTRONICS, INC.
LYNDONVILLE, NEW YORK 14098
Printed in USA

P/N 0340039

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MODEL 253
NANOCOULOMBMETER

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Section 1

SPECIFICATIONS

RANGE OF MEASUREMENT -- ±20 or ±200nC fs

ACCURACY -- 2%

DRIFT -- LESS THAN 0.002 nC/SEC.

OFFSET SHIFT -- LESS THAN .002 nC/DEGREE C

ANALOG OUTPUT --

RANGE 0 TO 2V (1V = 100 nC)

ACCURACY - 2%

IMPEDANCE - 100 OHMS

Section 2

THEORY

The Monroe Electronics Model 253 Nanocoulomb Meter consists of three basic elements:

1. Faraday Cup
2. Electrometer Charge Amplifier
3. The Digital Display and Analog Output

1. The Faraday cup consists of two concentric cans with expanded polyethylene as an insulator between them. The outer can is at ground potential and the inner can is the sensing electrode for the electrometer. The electrometer is enclosed in the Faraday cup assembly which eliminates shielding and cable noise problems which can occur in other configurations.

2. The electrometer charge amplifier consists of an I.C. electrometer amplifier (A1)) with a 0.1 μF polystyrene capacitor connected in a negative feedback position. The Faraday cup acts as a capacitive input and is connected to the minus input of A1 through R1. (100K ohms.) The minus input is at zero volts or virtual ground so all charge that is induced or directly deposited on the sensitive can of the Faraday cup is transferred to C1. Since Q=CV, the output voltage of A1 is directly proportional to the charge injected in the input, that is 100 nanocoulombs input equals 1.0 volts output. The input being at virtual ground reduces leakages and polarization of insulators, thus minimizing these effects on the readings.

   A1 is followed by A2 which is a unity gain inverter which is used to correct the gain error caused by variations in capacitor C1 and the inversion of A1.

   The nanocoulomb meter is zeroed by a low leakage reed relay assembly (94052) which discharges C1. All offsets are corrected for by R4 which is the offset adjustment for A1.

3. The analog output is connected directly to A2. This is also the input for the display, which is a 200 mV full scale, 3½ digit LED display. It is either connected directly, as in the 20.0 nanocoulomb mode, or is divided by ten via R1, R2 and R3 on the 3383 PC board in the 200 nanocoulomb mode.

Section 3

OPERATION

The Monroe Electronics Model 253 Nanocoulomb Meter has been designed for extreme ease of operation.

1. Connect Faraday cup to meter module.
2. Plug meter module into 117VAC receptacle.
3. Allow 5 minutes warm-up and zero.
4. Zero the instrument.
5. Place charged object in Faraday cup and set meter range to appropriate setting.
6. Take reading.

The Faraday cup comes with a cover which can be used when zeroing or when taking readings in areas where one suspects that outside electric fields may be affecting readings.

One can measure both "mobile" and "immobile" charge in objects to be tested. To do this, follow the above procedure. After step 5 note the reading (this reading is the "total" charge reading). Then remove the object being tested by dumping it out of the cup or by lifting it out with a set of wooden tongs. The reading that is now being displayed in the meter is the "free" charge on the object being tested.

Since "total" charge = "mobile" charge + "immobile" charge, we can calculate the "immobile" charge by subtracting the "mobile" charge from the "total" charge.

Section 4

CALIBRATION CHECK

The purpose of this section is to provide the operator of the Monroe Electronics Model 253 Nanocoulomb Meter with a means of verifying that overall calibration of the instrument is within the specified limits (±2%).

A calibration capacitor is shipped with each unit. This capacitor is factory tested and marked with its precise value.

With the capacitor charged to exactly 1.00 volt and then discharged into the Faraday cup, a meter reading equal to the capacitor value (±2%) should appear on the DPM (set to the 20 nCoulomb range).

Charging the calibration capacitor to 10.00 volts and then discharging it into the cup should produce a DPM reading of ten times the capacitor value (±2%) on the 200 nCoulomb range.

Hold the capacitor by <u>one lead only</u> and touch this lead to the bare metal surface of the outer can <u>first</u>, then manipulate this lead so that the other lead contacts the inner can. Do <u>not</u> hold the capacitor by it's body or discharge it by touching both leads with the fingers.

Incorrect Digital Panel Meter (DPM) readings indicate a need for calibration (see Section 5).

Section 5

CALIBRATION

Set up as described in the Operation Section, again allow five minutes warm-up.

FARADAY PAIL CALIBRATION:

1. Connect a digital voltmeter to the BNC output connector. Hold power switch in reset position and adjust R4 through access hole on bottom of Faraday cup for zero volts (less than 0.05 mV) on the external DVM.

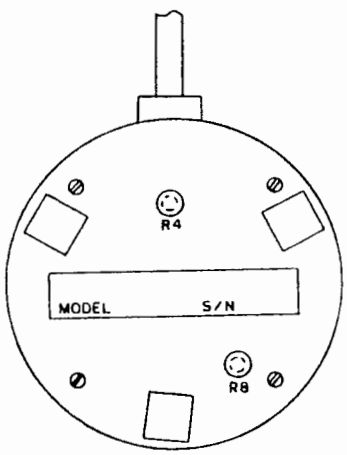
2. a. Charge a precision 0.01 μF (10 nF) polystyrene capacitor to 10.0V from a precision voltage source (or 0.10 μF to 1.00V). For accurate calibration keep charging voltage over 1.0 volts.

   b. Discharge the capacitor between outer can and inner can of the Faraday cup.

   c. Adjust R8 through access hole on the bottom of Faraday cup for 1.000 volts out.

3. Repeat steps 2a and 2b to verify calibration.

NOTE: Since Q=CV, one can adjust the voltage to make up for capacitor errors if the capacitor is off value or one can calculate the correct Q for the capacitor and voltage available and adjust the output accordingly.



DISPLAY MULTIPLIER CALIBRATION:

1. Remove Faraday cup cable from meter/power supply module.

2. Connect a precision voltage source to BNC output jack.

   Set voltage source to 0.1900 volts and range switch to 20.0 nCoulombs.

   DPM should display a reading of 19.00 ±1 digit. See NOTE below.

3. Set range switch to 200 nCoulombs. Set voltage source to 1.900 volts and adjust R1 on 3383 PC Board for an output reading of 190.0.

NOTE: Calibration of the DPM is usually not necessary. If it is required, the meter will have to be removed from the panel (from the inside). UNPLUG THE INSTRUMENT FROM THE POWERLINE!

The DPM calibration potentiometer is accessible from the top of the meter in a position which is normally hidden behind the panel.

Section 6

MATERIAL LIST

MONROE ELECTRONICS MODEL 253 NANO COULOMB METER

REF.	DESCRIPTION	MFG.
S101	Switch ON-ON-(ON) DPDT	C & K 7213-J61 RED ROCKER & BLACK FRAME
S102	Switch ON-NONE-ON DPDT	C & K 7201-J61
	Connector	AMP 206433-1
	Pin	AMP 1-66504-0
	Line Cord	BELDEN 17236
	GND Post	SUPERIOR BP30NC
	BNC	AMPHENOL 31-10
	Display	MARTEL (LASCAR) DPM-40
	Calibration Capacitor	MONROE 92006

MATERIAL LIST

MODEL 253 CABLE

REF.	DESCRIPTION	MFG.
	Cable	BELDEN 8456
	Connector	AMP 206434-1
	Pin	AMP 1-66506-0
	Cable Clamp	AMP 206062-1

MATERIAL LIST

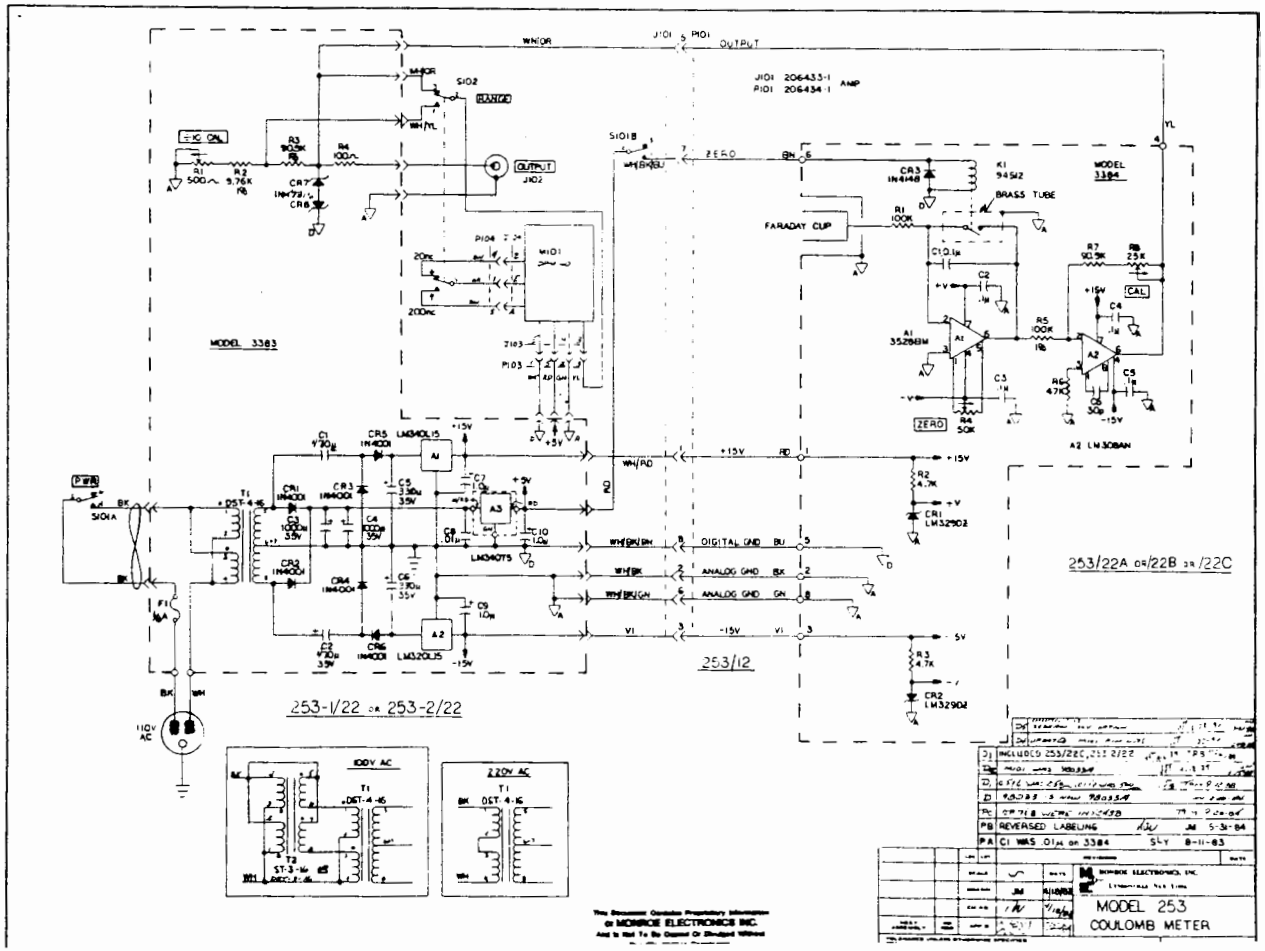
MODEL 3383 POWER SUPPLY

REF.	DESCRIPTION	MFG.
R1	Pot 500 Ohm	BECKMAN 72PR500
R2	Resistor 9.76K, 1%	MF 1/4-1/2
R3	Resistor 90.9K, 1%	MF 1/4-1/2
R4	Resistor 100 Ohm, 1/8W, 5%	AB BB
C1 & 2	Cap. 470 µF, 35V	ARCO RME470-35
C3 & 4	Cap. 1000 µF, 35V	ARCO RME1000-35
C5 & 6	Cap. 330 µF, 35V	RME-330-35
C7,9,& 10	Cap. 1.0 µF, 35V, Tan.	SPRAGUE 199D105X9 035AB2
C8	Cap .01 µF, 100V, Cer.	TG-S10
CR1-6	Diode	MOTOROLA IN4001
CR7 & 8	Diode	MOTOROLA IN4731
A1	Reg.	NATIONAL LM340LAZ-15
A2	Reg.	NATIONAL LM320LZ-15
A3	Reg.	NATIONAL LM340T-5.0
T1	Transformer	SIGNAL DST-4-16
T2	Transformer	SIGNAL ST-3-16 or DST-3-16
F1	Fuse, 1/8A	LITTELFUSE 312.125

MATERIAL LIST

MODEL 3384 ELECTROMETER

REF.	DESCRIPTION	MFG.
R1	Resistor 100K (Glass)	CORNING RLR07
R2 & 3	Resistor 4.7K, 1/4W, 5%	AB CB
R4	Pot. 50K	BECKMAN 66WR50K (no sub)
R5	Resistor 100K, 1%	MF 1/4-1/2
R6	Resistor 47K, 1/4W, 5%	AB CB
R7	Resistor 90.9K, 1%	MF 1/4-1/2
R8	Pot. 25K	BECKMAN 66WR25K (no sub)
C1	Cap. 0.10 µF, Polystyrene	MALLORY SXK010
C2-5	Cap. 0.1 µF, 25V	SPRAGUE HY-550
C6	Cap. 30p	ELEMENCO DM15-300J
CR1 & 2	Diode, Ref.	NATIONAL LM329DZ
CR3	Diode	GE IN4148
A1	I.C.	BURR-BROWN OPA128KM
A2	I.C.	NATIONAL LM308AN
K1	Coil & Reed Assembly	ME 94512


MODEL 253
COULOMB METER
MODEL 3383
MODEL 3384
FARADAY CUP
BRASS TUBE
253/22A OR/22B OR /22C
253/12
253-1/22 OR 253-2/22
J101 206433-1 AMP
P101 206434-1
OUTPUT
RANGE
ZERO
CAL
110V AC
220V AC
DIGITAL GND
ANALOG GND
A1 3528BM
A2 LM308AN
REVERSED LABELING
INCLUDED 253/22C, 253 2/22
C1 WAS .01μF on 3384