

# ANALYSIS OF 20-HERTZ RINGING LOAD CURRENT USING J86294A RINGING DEMAND METER AND J86294B SUPPLEMENTARY RINGING DEMAND METER EQUIPMENT OPERATING METHODS

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## 1. GENERAL

1.01 This section covers the method of using the J86294A ringing demand meter (RDM) and the J86294B supplementary RDM equipment.

1.02 This section is reissued to revise calibration procedures for modified ringing plants and to include a method of determining if a ring plant is exceeding its rated capacity. Since this is a general revision, arrows ordinarily used to indicate changes have been omitted.

1.03 The J86294A RDM, as shown in Fig. 1, is a transistorized instrument used to provide a statistical analysis of 20-Hz ringing load current. The results are expressed as the proportion of time that the current equals or exceeds a preselected current value during the total time interval measured.

1.04 The meter consists of a 10-Hz blocking oscillator, a binary divider stage, three amplifiers connected in parallel across the binary divider output, three counters, three transistor

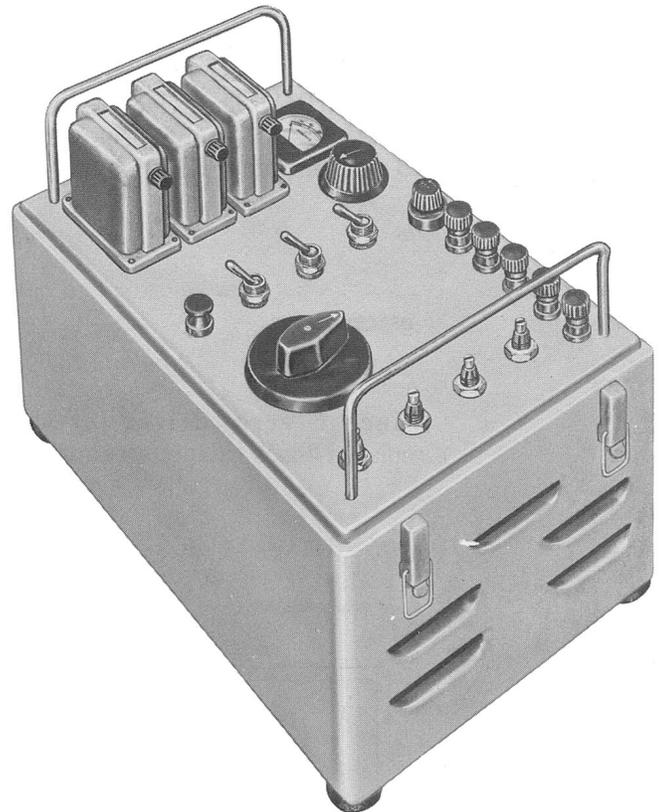


Fig. 1—J86294A Ringing Demand Meter

gates, a rectifier, and a current range selector connected in series with the 20-Hz load current.

1.05 Figure 2 shows the arrangement and designation of apparatus on the meter panel. For a detailed description of the meter, refer to the circuit description CD-81387-01. The instructions in this section are based on drawing SD-81387-01, Issue 7AR.

### NOTICE

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**SECTION 100-266-301**

**1.06** When calibrating the meter or using it to analyze ringing load current, make sure to avoid service interruptions.

**1.07** The J86294B supplementary RDM equipment, as shown in Fig. 3, extends the range of the J86294A RDM from 2 amperes to 4 and 6 amperes. The J86294B supplementary RDM equipment consists of two precision resistors and a switch mounted in a small metal carrying case.

**1.08** When the J86294B supplementary RDM equipment is used, the two leads of the equipment are connected to the normal and common terminals of the J86294A RDM. The selector switch on the J86294A RDM is set at 2 amperes when used with the J86294B supplementary RDM equipment.

**1.09 List of Tools**

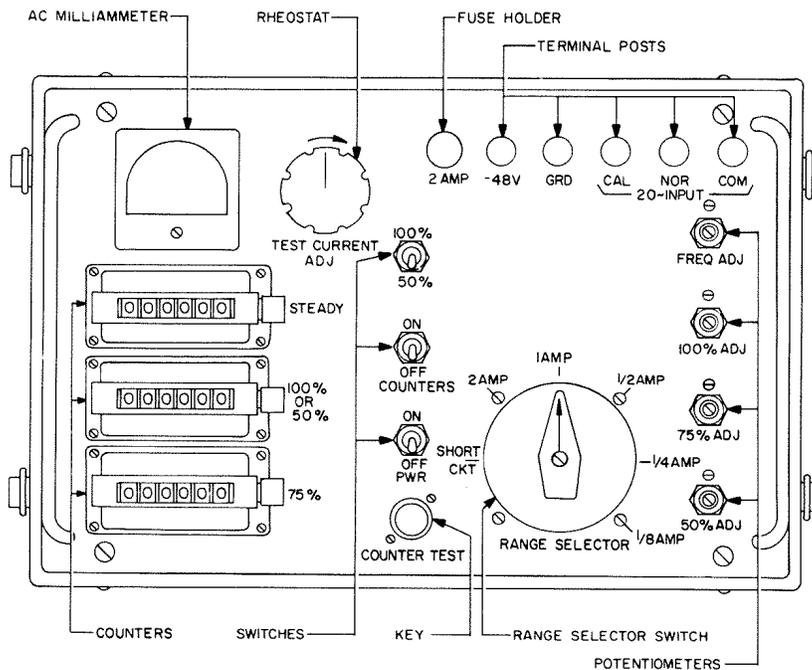
CODE OR SPEC NO.	DESCRIPTION
TOOLS	
—	3-inch C screwdriver (or the replaced 3-inch cabinet screwdriver)

**2. METHOD OF CALIBRATING THE RINGING DEMAND METER**

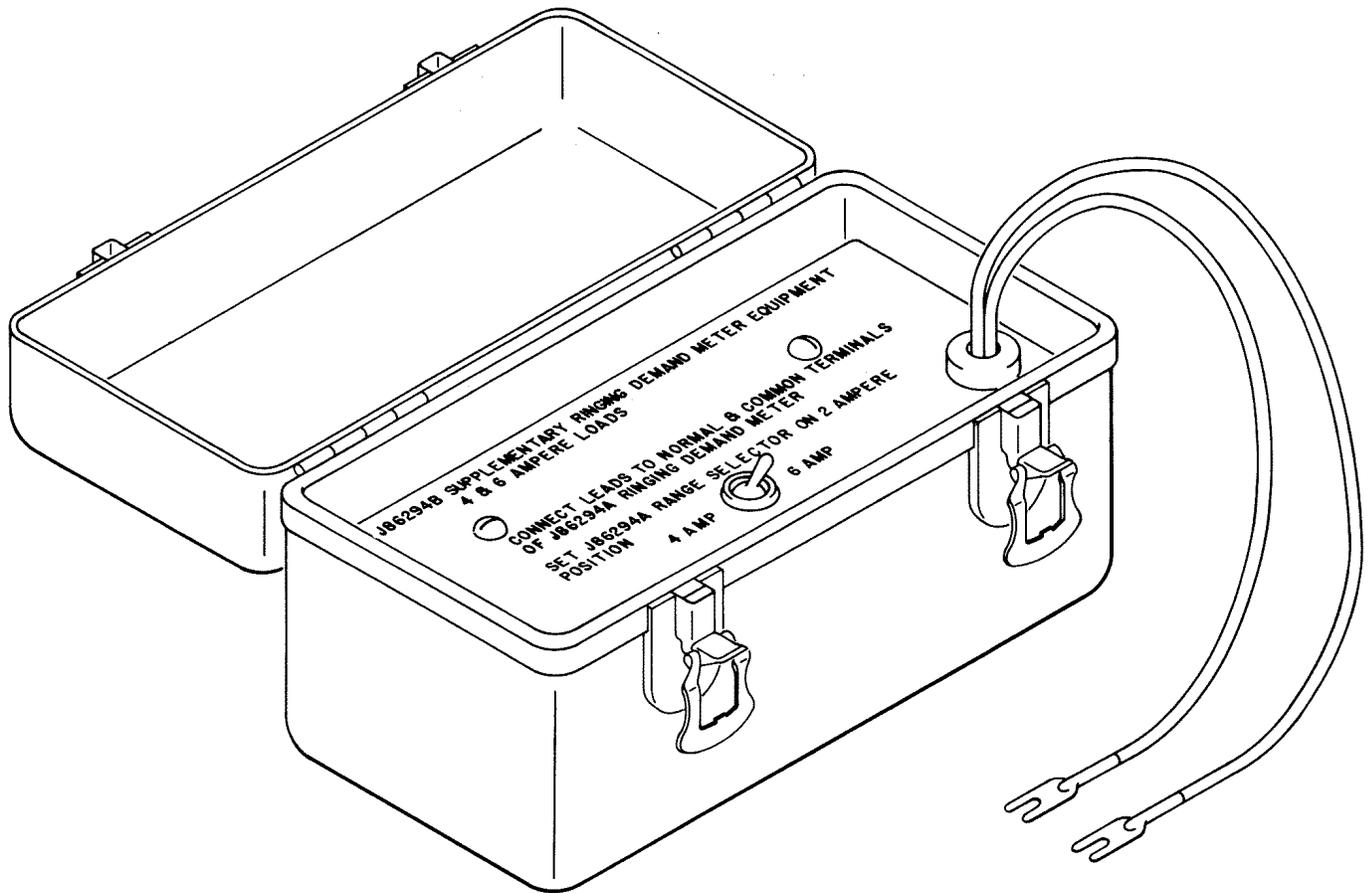
**2.01 General:** Determine the following before calibration begins.

- (a) Complete calibration covered in 2.02 should be made:
  - (1) Before meter is used initially.
  - (2) When meter is to be used in a different circuit from that in which it was last used. If there is doubt as to its last use, the complete calibration should be made.
  - (3) When meter is to be used after it has been idle for a period of more than 30 days.

(b) Only gate circuit calibrations covered in 2.02(b) should be made when meter is to



**Fig. 2—J86294A Ringing Demand Meter—Panel Designations**



**Fig. 3—J86294B Supplementary Ringing Demand Meter Equipment**

be used in the same circuit in which it was last used within a period of 30 days.

## **2.02 Calibration Procedures**

### **(a) Calibration of Counters**

- (1) Connect -48 volt battery and ground to the -48V and GRD terminal posts.
- (2) Operate the PWR and COUNTERS switches to the ON position, and check that the COUNTER TEST key is depressed. All three counters should be counting steadily at the same rate.
- (3) Pull up the COUNTER TEST key. The 100% (or 50%) and 75% counters should stop operating. The STEADY counter should continue to count.
- (4) Operate the COUNTERS switch to the OFF position, and reset all three counters to zero manually.
- (5) Using the 3-inch C screwdriver, set the FREQ ADJ potentiometer to the center of its range and depress the COUNTER TEST key.
- (6) Operate the COUNTERS switch to the ON position, and allow the counters to operate for exactly 1 minute. If the counting rate is higher than  $300 \pm 3$  counts per minute, turn the FREQ ADJ potentiometer counterclockwise and recheck for correct count of  $300 \pm 3$  counts per minute. If the count is less than  $300 \pm 3$  counts per minute, turn the FREQ ADJ potentiometer clockwise and recheck for correct count. Take at least three 1-minute counts for each setting of the FREQ

ADJ potentiometer. Check the counting rate with the second hand of a watch.

- (7) Pull out the COUNTER TEST key, throw the COUNTERS switch to the OFF position, and reset all three counters to zero.

(b) **Calibration of Gate Circuits**

- (1) Set the RANGE SELECTOR switch to the 1/4-ampere position.
- (2) Turn the TEST CURRENT ADJ rheostat and the 100% ADJ, the 75% ADJ, and the 50% ADJ potentiometers fully counterclockwise.

**Caution:** *Make sure that the TEST CURRENT ADJ potentiometer is turned fully counterclockwise (so that maximum resistance is in the circuit) before applying the 20-Hz voltage.*

- (3) The RDM must be calibrated on any 20-Hz ringing voltage in the range of 28 to 105 volts. While the regular ringing generator is being used to calibrate the RDM, the ringing plant load must be connected to the standby 20-Hz generator. Therefore, before plugging the RDM plug into the DM- jack, refer to Table A to determine the proper calibration procedures and connections for the ring plant under test.

**Note:** In ringing plants where the DM- jack circuit has not been provided, consult the associated SD prints to determine whether it is available on a standard basis. If available it should be provided before an analysis is attempted. If not available on a standard basis, then a request for a job basis modification is in order.

**Calibrating 100 Percent Circuit**

- (4) Throw the 100% or 50% switch to the 100% position.
- (5) Adjust the TEST CURRENT ADJ rheostat to obtain a reading of 250 mA on the milliammeter.
- (6) Throw the COUNTERS switch to the ON position.

- (7) Turn the 100% ADJ potentiometer slowly clockwise until the 100% counter counts at the same rate as the STEADY counter. It will be necessary to reset the counters to zero several times during this procedure.

- (8) Slowly turn the 100% ADJ potentiometer counterclockwise until the 100% counter begins to miss counts. Readjust the 100% ADJ potentiometer to the point at which the 100% counter again counts at the same rate as the STEADY counter.

**Calibrating 75 Percent Circuit**

- (9) Adjust the TEST CURRENT ADJ rheostat to obtain reading of 187 mA on the milliammeter.
- (10) Adjust the 75% ADJ potentiometer as described for the 100% ADJ potentiometer in (5), (6), (7), and (8).

**Calibrating 50 Percent Circuit**

- (11) Adjust the TEST CURRENT ADJ rheostat to obtain reading of 125 mA on the milliammeter.
- (12) Throw the 100% or 50% switch to the 50% position.
- (13) Adjust the 50% ADJ potentiometer as described for the 100% ADJ potentiometer in (5), (6), (7), and (8).
- (14) Repeat the 100 percent calibration by repeating (4), (5), (6), and (7).
- (15) Similarly repeat the 75 percent and 50 percent calibrations with the TEST CURRENT ADJ rheostat set for 187 mA and 125 mA, respectively.
- (16) Operate the COUNTERS switch to the OFF position, depress the COUNTER TEST key, and remove the leads from the COM and CAL terminals.

TABLE A

RINGING PLANT	TRANSFER PLANT LOAD TO	CALIBRATE TERMINALS	
		COM	CAL
803C	RING G2	± G1 FUSE	CC, DD GRD-SUP OFFICE
			-48V AC-DC OFFICE
804C	RING G2	± G1 FUSE	B GRD-SUP OFF. WITH DRY CELLS
			-48V SUP OFF. WITH DC CONV
			-48V AC-DC OFFICE
804D	RING GEN	VM FUSE	B GRD-SUP OFFICE
			-48V AC-DC OFFICE
805B	RING G2	RING G1 FUSE	-48V
805C	RING G2	± G1 FUSE	H GRD-SUP OFFICE
			-48V AC-DC OFFICE
806D	RING G2	TR TRANS TERM. 4 or 5	TR TRANS TERM. 3
806E/F	RING G2	RING G1 GEN TERM. 86	RING G1 GEN TERM. 0
806G	RM 2	RM1 GEN TERM. 23	RM1 GEN TERM. 4
806H (Note 1)	RING G1	* DM0 JACK	+48V
		* DM1 JACK	-48V
808A (Note 2)	GEN 1	* DM0 JACK	A GRD
		* DM1 JACK	-48V
812A	GEN 1		
841A	GEN 1		
852A	GEN 2	* DM1 JACK	-48V
853A 861A		* DM2 JACK	+48V
862A 863A		* DM3 JACK	GRD
856A 857A 871A 872A	GEN 2	* DM JACK	GRD

*Note 1:* Apply Issue 8B to SD-81605-01 of 806H in order to utilize calibrate procedure in this table.

*Note 2:* Apply Issue 10B to SD-81709-01 of 808A in order to utilize calibrate procedure in this table.

\* Plug and cord provided for load test is used for calibrate procedure. When calibration has been completed at the end of 2.02(b)(16), the lead connected to the CAL terminal of the RDM must be disconnected.

### 3. METHOD OF USING THE RINGING DEMAND METER

#### Connecting Meter

**3.01** In general, analysis of the ringing load should be made using the regular ringing plant, but connections should be made while the load is transferred to the reserve plant.

**3.02** Set the RANGE SELECTOR switch to the SHORT CKT position.

**3.03** Connect -48 volt battery and ground to the -48V and GRD terminals.

**3.04** Insert the RDM plug into the DM- jack. Operate the POWER switch to the ON position, the 100% or 50% switch to the 100% position, and pull out the COUNTER TEST key.

#### Analyzing Ringing Load Current

**3.05** In order to analyze the load current, the RANGE SELECTOR switch is set to the current rating of the ringing plant and the counter switch to the ON position. The STEADY counter will then count continuously at 300 counts per minute, while the 100% and 75% counters will count only when the ringing current equals or exceeds 100 percent and 75 percent, respectively, of the setting of the RANGE SELECTOR switch. The results are expressed as the ratios of the count of the 100% and 75% counters to the count of the STEADY counter. From these ratios is obtained the percentage time that the ringing load current equals or exceeds 100 percent or 75 percent of the selected current value.

**3.06** If the ratios obtained in 3.05 for both counters are low, the 100% or 50% switch is thrown to the 50% position and a new trial run is made. If the ratios from this run are still low, the RANGE SELECTOR switch is set to a lower range until the 50 percent ratio is high. In this manner the load current can be analyzed quite accurately. Each trial run should continue for approximately 5 minutes with all counters set to zero at the beginning of each run by throwing the COUNTERS switch to the OFF position and manually resetting each counter to zero.

**3.07** High ratios obtained from both the 100% and 75% counters indicate the RANGE

SELECTOR switch should be set to the next higher range.

**3.08** In analyzing the ringing load current, one or more trial runs are made to determine the approximate load current level. Then, with the meter set on the basis of these results, an analysis of the ringing load current is made over a period of 1 hour.

#### Analyzing Total Ringing Load Current in 86- or 105-Volt Circuits

**3.09** The following procedures (3.10 through 3.16) describe the method of analyzing total ringing load current in a plant rated at 1/2 ampere. Similar procedures are followed for plants of other capacities, the RANGE SELECTOR switch in each case being set to the current rating of the plant for the initial trial runs.

**3.10** With the RDM connected to the load as covered in 3.01 through 3.04, set the RANGE SELECTOR switch to 1/2 ampere. Throw the POWER switch to the ON position, the 100% or 50% switch to the 100% position, and pull out the COUNTER TEST key.

**3.11** Turn the COUNTERS switch to the ON position, allow the counters to operate for 5 minutes, and turn the COUNTERS switch to OFF.

**3.12** Read the counters. Assume the STEADY counter reading to be 1500, based on 300 counts per minute. Assume that the 100 percent count is 25 and that the 75 percent count is 150. This shows that the ringing load current equaled or exceeded 1/2 ampere for 25/1500, or 1.7 percent of the time, and equaled or exceeded 3/8 ampere (75 percent of 1/2 ampere) for 150/1500, or 10 percent of the time. In both cases the ratios are low, indicating that another trial run should be made with the 100% or 50% switch set to the 50% position.

**3.13** With the 100% or 50% switch set to the 50% position, repeat 3.09. Assume for this run that the 75 percent count is 160, and that the 50 percent count is 750. Since the ringing load is continually changing, repeated runs made on the same range of the meter will not usually give the same count.

**3.14** The results from the second trial run show that the ring load current equaled or exceeded 3/8 ampere for 160/1500, or 10.7 percent of the time, and equaled or exceeded 1/4 ampere (50 percent of 1/2 ampere) for 750/1500, or 50 percent of the time. The ratios obtained indicate that the load current was running closer to 1/4 ampere than 1/2 ampere for most of the time during the trial runs. Therefore, the 1/4 ampere setting of the RANGE SELECTOR switch should be used for the regular run.

**3.15** A regular run may now be made for a full-hour period as follows.

- (a) Set the RANGE SELECTOR switch to the 1/4-ampere position and the 100% or 50% switch to the 100% position.
- (b) Allow the counters to operate for 1 hour. The STEADY counter will then read approximately 18,000. The 18,000 reading is assumed in the following computations.
- (c) Assume that the 100 percent count is 9500, and that the 75 percent count is 17,000. This shows that the load current during the hour period equaled or exceeded 1/4 ampere for 9500/18,000 or 52.8 percent of the time, and equaled or exceeded 3/16 ampere (75 percent of 1/4 ampere) for 17,000/18,000, or 94.5 percent of the time.

**3.16** A ringing machine should not have more than 20 percent overload 1 percent of the time. (See Part 4.)

#### **4. METHOD OF DETERMINING IF A RING PLANT IS EXCEEDING ITS RATED CAPACITY**

**4.01 Calibration Procedure:** The following steps are the calibration procedures required to initially calibrate the RDM to determine if the generator has exceeded its rated capacity.

- (1) Connect -48 volt battery and ground to the -48V and GRD terminal posts.
- (2) Operate the PWR and COUNTERS switches to the ON position, and check that the COUNTER TEST key is depressed. All three counters should be counting steadily at the same rate.

- (3) Pull up the COUNTER TEST key. The 100% (or 50%) and 75% counters should stop operating. The STEADY counter should continue to count.
- (4) Operate the COUNTERS switch to the OFF position, and reset all three counters to zero manually.
- (5) Using the 3-inch C screwdriver, set the FREQ ADJ potentiometer to the center of its range and depress the COUNTER TEST key.
- (6) Operate the COUNTERS switch to the ON position, and allow the counters to operate for 1 minute. If the counting rate is higher than  $300 \pm 3$  counts per minute, turn the FREQ ADJ potentiometer counterclockwise and recheck for correct count of  $300 \pm 3$  counts per minute. If the count is less than  $300 \pm 3$  counts per minute, turn the FREQ ADJ potentiometer clockwise and recheck for correct count. Take at least three 1-minute counts for each setting of the FREQ ADJ potentiometer. Check the counting rate with the second hand of a watch.
- (7) Pull out the COUNTER TEST key, operate the COUNTERS switch to the OFF position, and reset all three counters to zero.
- (8) Set the RANGE SELECTOR switch to the 1/2-amp position.
- (9) Turn the TEST CURRENT ADJ rheostat and the 100% ADJ, the 75% ADJ, and the 50% ADJ potentiometers fully counterclockwise.

**Caution:** Be certain that the TEST CURRENT ADJ potentiometer is turned completely counterclockwise, so that maximum resistance is in the circuit, before applying the 20-Hz voltage.

- (10) The RDM must first be calibrated on any 20-Hz ringing voltage in the range of 28 to 105 volts. The ringing plant load must not be connected to the 20-Hz generator under test during the calibration procedure. Therefore, before plugging the RDM plug into the DM-jack, refer to Table A to determine the proper calibrate procedures and connections for the ring plant under test.

- (11) Operate the 100%-50% switch to the 100% position.
- (12) Adjust the TEST CURRENT ADJ rheostat for 150 mA reading of the milliammeter.
- (13) Operate the COUNTERS switch to the ON position.
- (14) The gate adjustment is made as follows.
  - (a) Turn the 100% ADJ potentiometer slowly clockwise until the 100% counter counts at the same rate as the STEADY counter. It will be necessary to reset the counters to zero several times during this procedure.
  - (b) Then slowly turn the 100% ADJ potentiometer counterclockwise until the 100% counter begins to miss count. Readjust the 100% ADJ potentiometer to the point at which the 100% counter again counts at the same rate as the STEADY counter.
- (15) Repeat Steps (12), (13), and (14). For this test, the 75% counter is ignored.
- (16) Operate the COUNTERS switch to the OFF position, depress the COUNTER TEST key, and remove the leads from the COM and CAL terminals.
- (17) The RDM is now calibrated for testing when the ringing generator is running at 20% overload.

**Note:** This test should be conducted during the peak of the office busy hour (BH).

**4.02 RDM Use:** The following steps should be followed when using the RDM to determine if the ringing plant's rated capacity is being exceeded.

- (1) Set the RANGE SELECTOR switch to the SHORT CKT position.
- (2) Connect -48 volt battery and ground to the -48V and GRD terminals.
- (3) Insert the RDM plug into the DM- jack.

- (4) Operate the POWER switch to the ON position, the 100%-50% switch to the 100% position, and pull out the COUNTER TEST key.

- (5) Set the RANGE SELECTOR switch to the current rating of the ringing plant, and operate the COUNTERS switch to the ON position. The STEADY counter will count continuously at 300 counts per minute, while the 100% counter will count only when the ringing generator current equals or exceeds 120% of the setting of the RANGE SELECTOR switch. The results may be expressed as the ratio of the count of the 100% counter (now adjusted to a 120% count) to the count of the STEADY counter. Therefore, this test will give the percentage time that the ringing load current equals or exceeds 120% of the selected current value.

**4.03 RDM Use Example:** As an example using a 1/2 ampere plant, assume that this circuit is to be used to measure how much of the time the 20-Hz ringing load current is exceeding its allowable 20% overload. This circuit has been calibrated according to 4.01(1) through (15) and has been connected into the 20-Hz load circuit as directed in 3.04(a). The RANGE SELECTOR is set at 1/2 ampere, and the 100%-50% switch is set at the 100% position. The counters are turned on and allowed to operate for a trial run of 5 minutes. At the end of the run, the counters are turned off and their count is recorded. The STEADY count will be 1500. Assume that the count recorded on the 100% counter is 20. In this case the rated plant capacity has equaled or exceeded  $1.3\%$  ( $20/1500 \times 100 = 1.3\%$ ).

For a thorough investigation, several 3 or 4 minute runs during the busy hour should be made.

At the end of 1 hour, the STEADY counter will read 18,000 counts. Assume that the count recorded on the 100% counter is 198. This indicates that for 1.1% ( $198/18,000 \times 100 = 1.1\%$ ) of the busy hour the 20-Hz ringing load is equal to or greater than the rated 1/2 ampere capacity of the plant and is a candidate for replacement by a larger plant.

**4.04 Closeout:** Return the RDM circuit to its normal calibration by repeating 4.01.