

# RRampMeter Application Notes

by Don Fiehmann



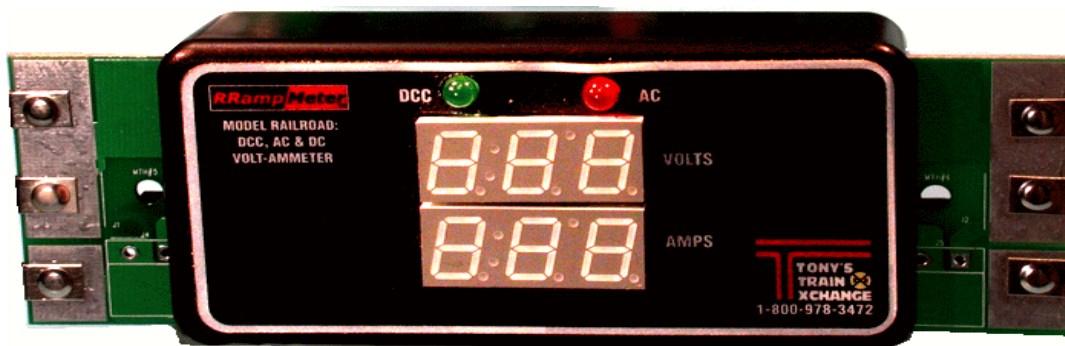
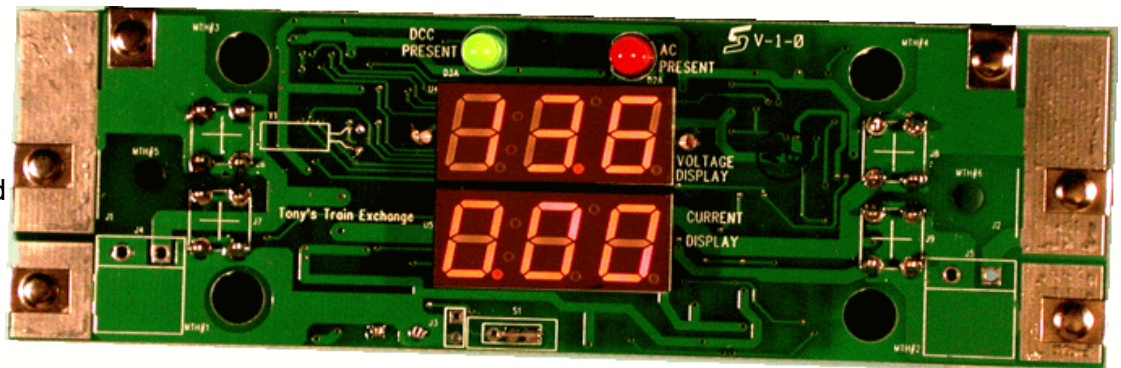
Meter shows the voltage at 13.4 volts and no current flow. LEDs at top show the type of power. Green LED indicates DCC Power.

The RRampMeter is designed as a flexible tool to monitor and analyze the electrical operation of a layout. It is designed to work not only DCC power but also with ac and dc. Three models are available in two different current ranges. The standard meter is rated at up to 10 amps and up to 23 volts DCC or d.c. and 6 amp at up to 16 volts on a.c. There is a model unit for large scales has a capacity of up to about 20 amps.

The three models are (a) a bare module design for panel mounting, (b) mounted in a plastic case and (c) mounted in a plastic case with the option of battery power. All of the meters are powered by the input voltage as long as it is greater than 7 volts. The last unit can use a 9 volt battery to operate with input voltages of less than 7 volts.

The meter can be used either as a portable meter or mounted permanently. Screw terminals are supplied with the meter that can be soldered to the back side of the meter's circuit board.

This is the bare meter without a case. The meter can be mounted in a control panel or used as is.



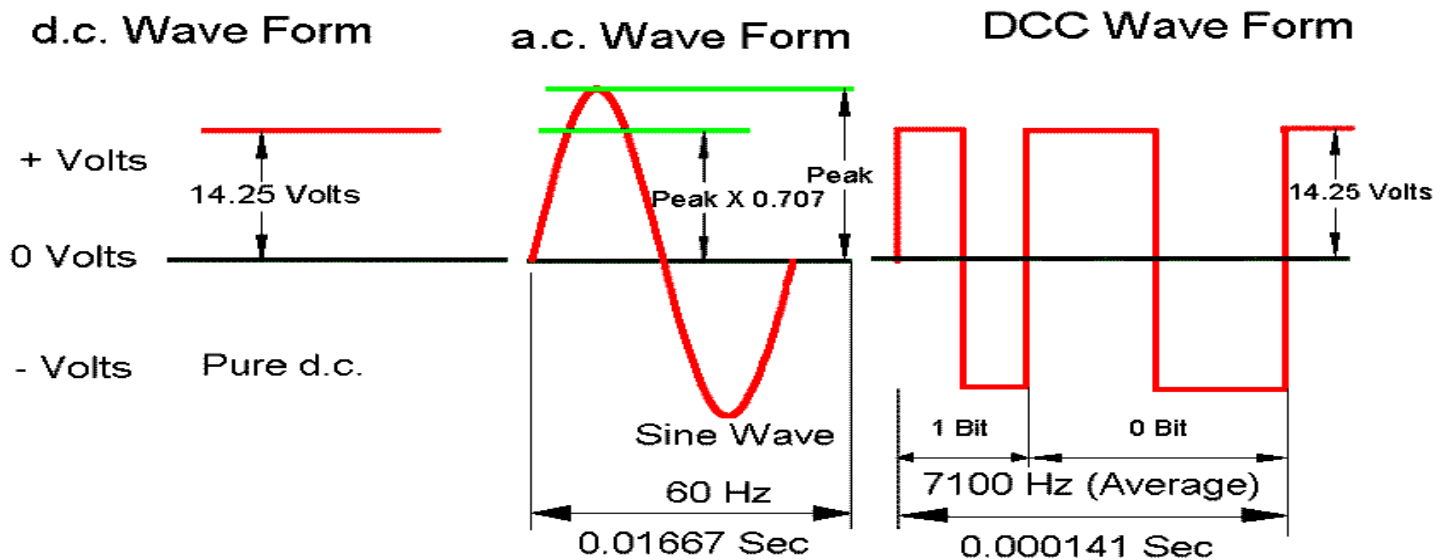
RRampMeter in a case. Battery power meter looks the same, but has a on/off switch below the display.

## True "RMS"

Most common meters can read both ac and dc, but can not accurately read DCC power. In order to accurately read DCC power a "true RMS" meter, like the RRampMeter is needed. This is due to the shape and frequency of the DCC signal. The RRampMeter automatically detects and switches to the type of power it is measuring. Two LEDs indicate DCC or ac, no LED on indicates dc.

RMS is an abbreviation for Root Means Squared. It is a mathematical way of analyzing a distorted wave form.

The d.c. wave form is easy to read as it is a steady signal. The a.c. wave form is a relatively



The RRampMeter automatically sense and switches the type of power. Only a "true RMS" meter can accurately measure DCC voltage and current.

slow signal with a higher peak voltage compared to the d.c. signal. Most meters assume a sine wave at 60 Hz and simply take the peak voltage of the wave form and readout a value of 0.707 of the peak. DCC is a different type of signal. The signal is a much higher frequency can vary. In order for the meter to accurately read the DCC value it must compute the value of the voltage to get a true reading.

#### TRACK VOLTAGE

Voltage is read by connecting to the two terminals on the left side of the meter. The end of the circuit board has an area that allows you to put the meter directly on the rails to measure the voltage. In order to measure amps, the current must flow thru the meter by connecting to the two terminals on the right side of the meter.

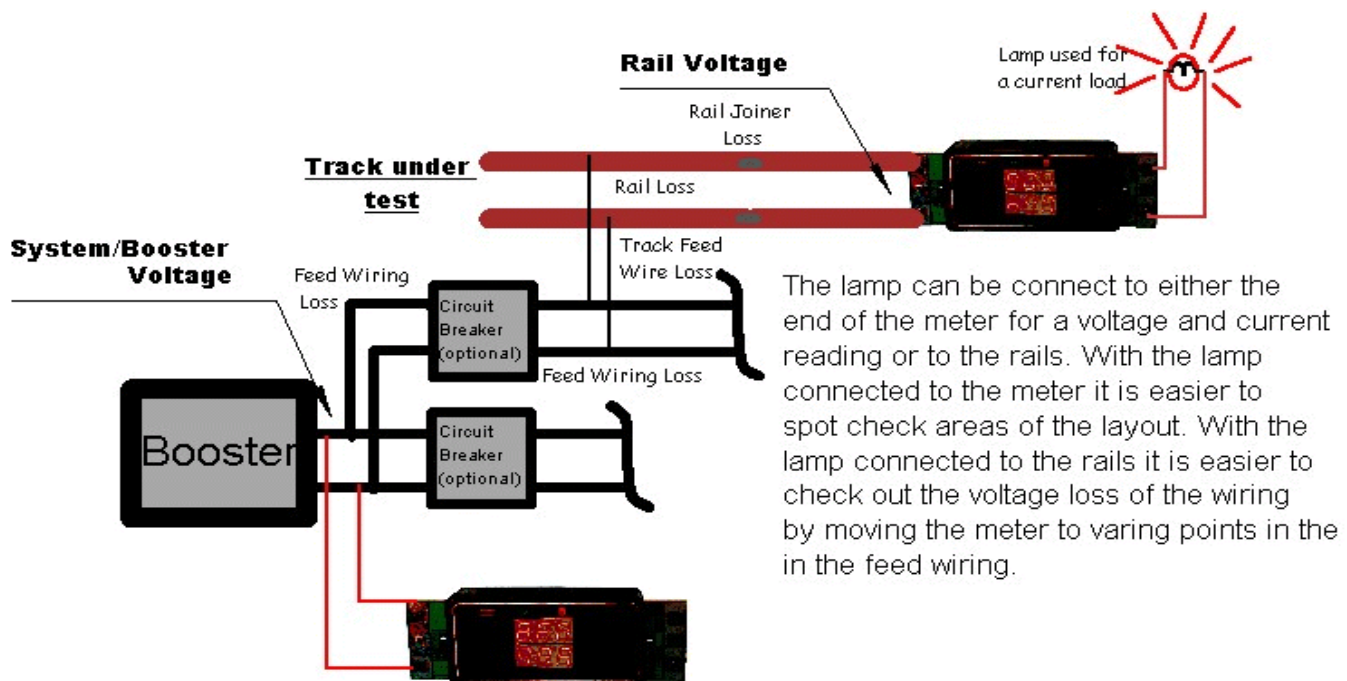
#### PANEL METER

A meter mounted near the system or booster will let you monitoring the power supplied to the layout. This will let you can determine how well your system or booster is regulating voltage under load. You can also measure just how close you are to the maximum power limit of the booster or system. This will indicate the operation of the system/booster, but not the voltage drop of the wiring and rails of the layout.

#### LAYOUT VOLTAGE LOSS

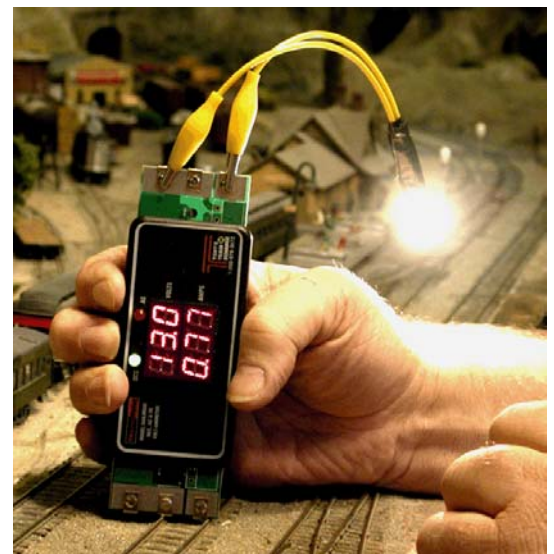
When the rail voltage to a decoder drops the train speed can also drop along with lights dimming. There are many places in the path from the booster to the decoder where voltage can be lost. The voltage from at the booster or system may have a small drop as more current is drawn. The wiring from the booster to the rail will also lose some voltage. Devices like circuit breakers and block detector can add to the voltage loss. Nickle Silver rail is not as good a conductor electricity as copper wire and can be a significant part of the voltage loss. Rail joiners can also cause a loss in voltage.

## Measuring Layout Voltage Drop and Loss



The lamp can be connect to either the end of the meter for a voltage and current reading or to the rails. With the lamp connected to the meter it is easier to spot check areas of the layout. With the lamp connected to the rails it is easier to check out the voltage loss of the wiring by moving the meter to varing points in the in the feed wiring.

To determine the layout voltage loss the voltage must be measured at the rails when current is flowing. Without a current flow there is little to no voltage loss. It is almost impossible to get a good stable voltage reading using a train running as a current load. The best way to measure the loss is with some type of steady load. An automotive lamp turns out to be a good device to use as a steady load. They are cheap and easily available. A couple of pieces of wire with clips can be soldered the lamp. (See photo) Depending on your scale and booster rating one of the following should work. The #912 draws about 1 amp the #1141 about 1.5 amps and the #1156 about 2.25 amps. (Due to the low cold resistance of a lamp, the 1156 lamp can cause low powered systems like the Zephyr to shut down [overload]. The 912 should be OK for this test.) Choose a lamp that is near the maximum current used in a block, not the current used by the layout.



Lamp used as load

The first test should be to determine the voltage loss of the system or booster. (A) Measure the output voltage of the booster at a point close to the booster with no trains running. If you have an RRampMeter connected as a panel meter close to the booster this reading should work. (B) Next connect the load to the rails load (lamp) to the rails with the meter still next to the booster. The difference between the two readings will give you the voltage loss of the booster at this current. (C) Read the voltage at the rails with out a load. (D) Read the voltage at the rails with the load. The lamp can be connected the terminals of the RRampMeter so a number of reading can be made in the same block. You may be surprised at the voltage loss at different points of the same block. This can be due to the poor conductivity of Nickle Silver rail. Poor connections of rail joiners is another thing to look for. Wire that is under size is also a cause of voltage loss. When making measurements of loss across things like rail joiners and connections the voltage is so low

that the RRampMeter with the battery option make be needed.

## Wire Size

It is best to keep the voltage loss due to wiring and rails under 1 volt. More than a couple of volts can cause slowing of locomotives and in extreme cases even cause the decoder to drop out.

Here is a wire chart that shows the length of wire for a ½ volt drop due to wire resistance. The chart shows the voltage drop for 1, 2, 5 and 10 Amps. This is a chart for *one way* resistance. If you wire out to the rails and back (double the length ) this chart becomes a 1 volt chart.

Voltage loss for ½ volt for different currents and wire size.

Wire Size	1 Amp	2 Amps	5 Amps	10 Amps
8	796	398	159	80
10	501	250	100	50
12	314	157	63	31
14	198	99	40	20
16	124	62	25	12
18	78	39	16	8
20	50	25	10	5

## Which Size?

The 20 to 18 gauge wire should be used only for Z and N scales. This size can be used for short track feeders in larger scales. The 16 gauge works for most small layouts with short runs. The 14 to 12 gauge for larger layouts in most scales. The 8 to 10 should be reserved for older O scale and G scale layouts. This size wire becomes a bit cumbersome to work with.

Stranded wire can be used anywhere, but solid with should only be used where it will not be flexed or moved.

## Monitoring Current

If your layout uses common rail wiring and you have more than one booster you can monitor the current from both boosters. Run the common of both booster thru the meter and this will get you an indication of total layout current. NOTE this will only work with common rail wiring.

## Two Booster and One Meter with Common Rail

