

## Half-Digits, Resolution, and Other Digital Panel Meter Display FAQs

Some of the more frequently asked (FAQ) display-related questions we receive from first-time users of digital panel meters go something like: “exactly what is a half-digit, anyway?” or, “what’s the resolution of a 3½ digit panel meter?” These questions are one of the motivating reasons for this application note. The “FAQ” style used below will allow readers to quickly find answers to their questions without having to read the entire application note.

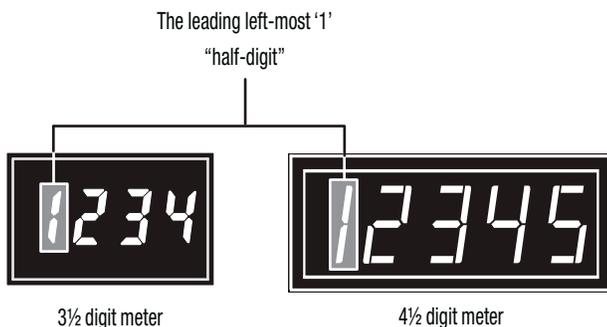
“1234” =



In the following FAQs, actual display readings are denoted by the use of quotation marks. For example, “1234” represents exactly what will be seen on a 2Vdc range, 3½ digit meter’s display when its input voltage is 1.234Vdc. This quotation marks convention is used in all Murata Power Solutions DMS Series data sheets and application notes. Note that in this example, no decimal points are illuminated on the meter’s display even though the input is 1.234V; this an important concept which will be explained below.

### Question: What exactly is a “half-digit”?

When digital panel meters first appeared on the market the convention of using a full-scale display range of “000” to “1999” for 3½ digit meters and “0000” to “19999” for 4½ digit meters became an industry standard. And, for reasons still unknown to this writer, the leading left-most ‘1’ (also referred to as the most significant digit, or MSD) became known as the infamous “half-digit.” This half-digit represents the one-thousands digit on a 3½ digit meter and the ten-thousands digit on a 4½ digit meter.



### Question: How is the half-digit displayed?

The half-digit, or left-most ‘1’, is always OFF (not visible) with display readings between “000” and “999” on 3½ digit meters and between “0000” and “9999” on 4½ digit meters. The half-digit is turned ON with display readings greater than or equal to “1000” on 3½ digit meters and with display readings greater than or equal to “10000” on 4½ digit meters. An enabled half-digit in combination with all other digits OFF is used to indicate an input overrange condition which occurs when the applied input exceeds the meter’s measurement capability.

### Question: What is a “count,” and how is it related to resolution?

First, let’s define the terms ‘display resolution’ and ‘counts’. A 3½ digit meter can resolve an input signal into 1,999 parts, while a 4½ digit meter can resolve an input signal into 19,999 parts. A change of 1 count is defined as the right-hand most digit going up or down by one ( $\pm 1$ ). For example, a display which is continuously alternating between “1899”, “1900”, and “1901” is said to be indicating “1900”  $\pm 1$  count (or  $\pm 1$  digit).



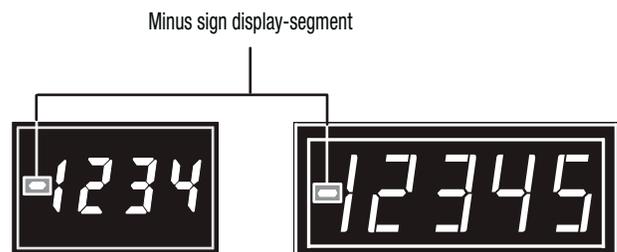
A 3½ digit meter with a full-scale input range of  $\pm 2$ Vdc resolves a 1.999V input into 1999 counts, or 1999mV, with one count representing 1mV (0.001V resolution). If the first decimal point (DP1) is enabled, 1999mV can be displayed as “1.999”. If the third decimal point is enabled (DP3), the same 1.999V input can also represent “199.9”. The 0.001V resolution of the meter hasn’t changed, but the decimal point has made the 1999mV look like “199.9”.

The decimal points do not change the meter’s basic resolution or sensitivity, they are simply place holders used to suit the user’s engineering scaling requirement. The “199.9” reading in the preceding paragraph could represent 199.9 pounds (or, for the rest of the world, 199.9 Kilograms), 199.9 °C, etc.



### Question: How is input polarity displayed?

DMS Series meters indicate negative input signals by turning ON a minus sign display-segment (“-”) located to immediate left of the half-digit. Positive inputs are indicated by turning OFF the minus sign segment. For example, “-1234” is displayed for negative inputs, and “1234” for positive inputs. The minus sign is ON when IN HI (pin 11) is slightly more negative than IN LO (pin 12). Operation of the minus sign is automatic and cannot be externally disabled by the user.



**Question: How do the decimal points function?**

This is the second most frequently asked display-related question. The meter's decimal points are totally user selectable, that is, the meter's analog-to-digital converter (ADC) has no control over which decimal point is ON or which decimal point is OFF. This feature is due to the fact that most fixed-input range digital panel meters are not intended to directly readout in volts, but instead are intended to display some other physical parameter such as pounds, degrees, amperes, etc.

One of the few exceptions to the above are Murata Power Solutions' self-powered 2-wire meters. These meters are designed to measure only one electrical parameter (ac volts, dc volts, etc.) and, depending on the display resolution, a decimal point is pre-wired ON and cannot be disabled by the user.

Both the individual product data sheets and DMS Application Note 13 contain detailed information on how to enable the meter's decimal points.

**Question: I don't want any decimal points enabled; what do I do?**

The answer is simple: absolutely nothing! – leave all the decimal-point control pins open (i.e., not connected to anything). If not specifically enabled by the user, all decimal points on DMS Series panel meters are OFF. Decimal points are ON only when the desired decimal-point input pin is externally connected by the user to the meter's power return (pin 3). However, unless otherwise indicated on the meter's individual data sheet, unused decimal point inputs can be connected to the meter's positive power supply input (pin 1). See the applicable product data sheet and DMS Application Note 13 ("Decimal Point Drivers") for more information.

**Question: Are low-power red LED meters dimmer than standard-intensity meters?**

The answer is an emphatic no! Murata Power Solutions' low-power red LED meters, identified with an '-RL' part number suffix, are actually brighter than their standard-intensity, '-RS' suffix counterparts! Red low-power LED meters typically consume 10–15 times less power than '-RS' meters. However, this dramatically lower power consumption is achieved with no sacrifice in display intensity or electrical performance.

Murata Power Solutions' low-power red LED meters cost approximately 10% more than standard-intensity meters. However, in many applications

this extra cost is easily offset by using lower-cost power supplies. Low power LED meters can be used in many applications where LCD display meters were once the only option – including battery powered instrumentation. DMS Application Note 1, titled "The LED versus LCD Decision," provides more information on the pros and cons of LED and LCD display technologies.



DMS-20PC-1-RL

Vs.



DMS-20PC-1-RS

**Question: Do I need a 3½ or a 4½ digit meter?**

In the course of answering literally thousands of application calls, we encounter many customers who specify 4½ digit meters for applications in which a lower-cost 3½ digit meter would be adequate. For example, monitoring the output of a 30Vdc supply with a 200V full-scale input range 4½ digit meter will result in a display reading of "30.00" with a resolution of 0.01V (1/100 of a volt). A 200V full-scale input range 3½ digit meter will display the same 30V input as "30.1" (1/ 10 of Volt resolution).

Most voltage and/or current monitoring applications do not benefit greatly from the extra resolution 4½ digit meters offer, in fact, in many applications, the extra digit may result in unwanted, difficult-to-view, display bouncing of the last digit. In general, use a 4½ digit meter only when values over 1999 must be displayed in their entirety for clarity or calibration purposes. If you are not sure which meter to use in your application, don't hesitate to contact Murata Power Solutions – we are more than happy to discuss your requirements in greater detail!



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