Murata Power Solutions

# DM-3102A, DM-3102B

Autoranging 3-1/2 Digit Digital Panel Meters

**OBSOLETE PRODUCT**

Contact Factory for Replacement Model

## FEATURES

- **Two Model Ranges**
  - **Model DM-3102A: 200 mV, 2V, 20V, and 200V full scale autoranges**
  - **Model DM-3102B: 2V, 20V, 200V, and 1000V full scale autoranges**
- **Accuracy +/–0.1%, +/–1 count over any full scale range**
- **3½ Digit LCD display, .5″ high (12,7mm)**
- **Low power consumption, +5V dc at 15 mA typical**
- **Multiplexed BCD data outputs to drive a slave display**
- **-5V dc power output at 15 mA for external low power circuitry**
- **Seven unit descriptors: K, Ω, m, DC, AC, V, A**
- **Balanced differential inputs with nominal 9 megohms input**




*THE DM-3102A AND DM-3102B DIGITAL PANEL METERS ARE LOW-COST, AUTORANGING METERS FOR APPLICATIONS REQUIRING HIGH SIGNAL RESOLUTION OVER VERY WIDE DYNAMIC RANGES.*

## GENERAL DESCRIPTION

The DM-3102 is a 3½ digit, four decade, autoranging digital panel meter (DPM) with true balanced differential analog inputs. The low profile DPM measures only 2.92″W × 1.32″H × 3.5″D and is available in two model configurations. Model DM-3102A has 4 full-scale ranges of 200 mV, 2V, 20V, and 200V dc while Model DM-3102B has 4 ranges of 2V, 20V, 200V and 1000V dc. Both models typically draw 15mA from a +5V dc power source. Output power of –5V dc at 15mA is available to the user for powering low-power external circuitry.

Multiplexed BCD data outputs allow interfacing the DPM to microprocessors or UART's. They may also drive additional slave display meters. A RUN/HOLD signal freezes the display and stops A/D conversions. Based on a single chip CMOS A/D converter, the DM-3102A/B autoranging meter has an accuracy of +/–1 count in 20,000 counts, or +/–0.1% of any full scale range.

Typical conversion cycle time of the A/D converter is 300 milliseconds. The worst-case autoranging time interval would be 900 milliseconds maximum. Analog input signals enter through a .1% matched resistor network and the nominal signal input impedance is 9 megohms.

Functionally, two major logic circuits control the DM-3102 DPM's operations; the analog-to-digital (A/D) converter logic and the autoranging logic (See Figure 1). The A/D converter logic changes the received analog signal into a digital equivalent. The autoranging logic essentially places the decimal point in the proper display location based upon changes in input voltages. Analog signals from the control board become converted to BCD outputs as well as data inputs to the display driver logic.

The sensing circuitry in the A/D converter always begins looking at the input signal within the lowest full scale range limits. If the input signal is above the range's highest full scale limit, an internal overrange (OR) condition exists. If the input signal is below the range's lowest full scale limit, an underrange (UR) condition exists. The lowest possible reading is 100 μV in the 200 mV range.

When either condition exists, autoranging logic selects the next higher (or lower) full scale range attenuation circuit. The input voltage is latched to the proper 0.1% attenuation resister via a relay. The relay stays energized as long as no OR or UR condition exists for the scale selected.

While an analog signal is matched to its proper attenuation resistor, the A/D logic generates a BCD version of the input. The BCD output is fed to a decoding display driver, where it is decoded into the proper digits which appear on the display. The BCD data is also available to peripheral devices on J2 of the converter board, pins A7, A8, A9, and A10.

### Printed Wiring Assembly (PWA) Locations

Internally, all logic circuitry exists on two printed wiring assemblies (PWA's) which slide into the enclosure from the rear (see Figure 2). The upper PWA is the control board, which contains the autoranging and analog input circuitry. The lower PWA is the converter/display PWA.

Figures 3a and 3b show the required PWA interwiring as well as power input signal connections.

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## FUNCTIONAL SPECIFICATIONS
**(Typical at @25°C, 2V range unless otherwise noted)**

### ANALOG INPUT

| | |
|---|---|
| **Configuration** | True balanced differential bipolar inputs. If single-ended inputs are preferred, close SG4 solder gap. |
| **Full Scale Input Range** | +/−1000V dc |
| **Input Bias Current** | 1pA typical, 10pA maximum |
| **Displayed Accuracy** | Adjustable to +/−0.1% of any full scale range, +/−1 count |
| **Warm-up Time** | 5 minutes |
| **Resolution** | 100 μV in last digit (200mV range only) |
| **Temperature Drift of Zero** | Autozeroed, +/−1 count over 0 to +50°C temperature range |
| **Temperature Drift of Gain** | +/−50ppm of reading/°C typical<br>+/−100ppm of reading/°C maximum |
| **Input Impedance** | 9 Megohms, nominal |
| **Input Overvoltage** | +/−300 volts dc, 175 VRMS *continuous maximum on the* 200V range, model DM-3102A.<br>+/−350 volts intermittent maximum, 1500 VRMS continuous maximum on the 1000V range, model DM-3102B. |
| **Reference** | Internal, referred to Analog Common, (between pins A13/B13). An External, user-supplied reference source referenced to pin B15 is optional for ratiometric operation. |
| ***External Ref. Range*** | *+90 mV to +200 mV dc referenced to Analog Common, pin B15.* |
| **Common-Mode Voltage Range** | Both inputs must remain within +/−3V dc of Power Common. The user must provide external circuitry to keep the inputs within the common-mode range. |

### DISPLAY SPECIFICATIONS

| | |
|---|---|
| **Number of Digits** | 3 decimal digits and most significant "1" digit (3½ digits) |
| **Display Type** | Black digits on white liquid crystal display (LCD). Requires external illumination under low ambient light conditions. |
| **Display Height** | 0.5 inches (12,7 mm) |
| **Over Range** | Inputs exceeding the full scale range cause the "OR" symbol in the upper left corner to flash (Model DM-3102A only). |
| **Autopolarity** | A plus or minus sign is automatically displayed for positive or negative voltage inputs. The polarity display may be disabled by opening solder gap SG1. |
| **Sampling Rate** | Approximately 3 conversions per second. |
| **Decimal Points** | Right-of-digit selectable decimal points are included for scale multipliers. |

### POWER REQUIREMENTS

**External**

+5V dc unregulated is required at 15mA typical, 30mA maximum. Logic spikes must not exceed 50mV. [Note: Any current consumed by external devices using the -5V output (pin A15) must be added to +5V power consumption to yield total meter power consumption.]

**Power Output**

-5V dc unregulated is available to the user by closing solder gap SG2 (normally open). The solder gap is located on the bottom of the converter/display board.

### PHYSICAL-ENVIRONMENTAL

| | |
|---|---|
| **Outline Dimensions** | 2.53″W × 3.34″D × 0.94″H (64,3 × 85 × 23,8mm) |
| **Cutout Dimensions** | 2.562″W × 0.97″H minimum (65,1 × 24,6mm) |
| **Mounting Method** | Through a front panel cutout secured by brackets and two removable side case screws. Accommodates panel thicknesses up to 0.62″ (15,9mm). |
| **Weight** | Approximately 5 ounces (142 grams). |
| **Connector** | Dual 15-pin, 0.100″ centers, Datel Part # 58-2073083 (not included). |
| **Mounting Position** | Limited by readability of LCD's (typical viewing angle of 70 degrees). |
| ***Operating Temperature Range*** | *0 to +50°C (avoid long* exposure to temperatures above +55° Celcius). |
| **Altitude** | 0 to 15,000 feet (4900 meters) |
| **Storage Temperature Range** | 0 to +55°C |
| **Humidity** | 20% to 80% non-condensing |

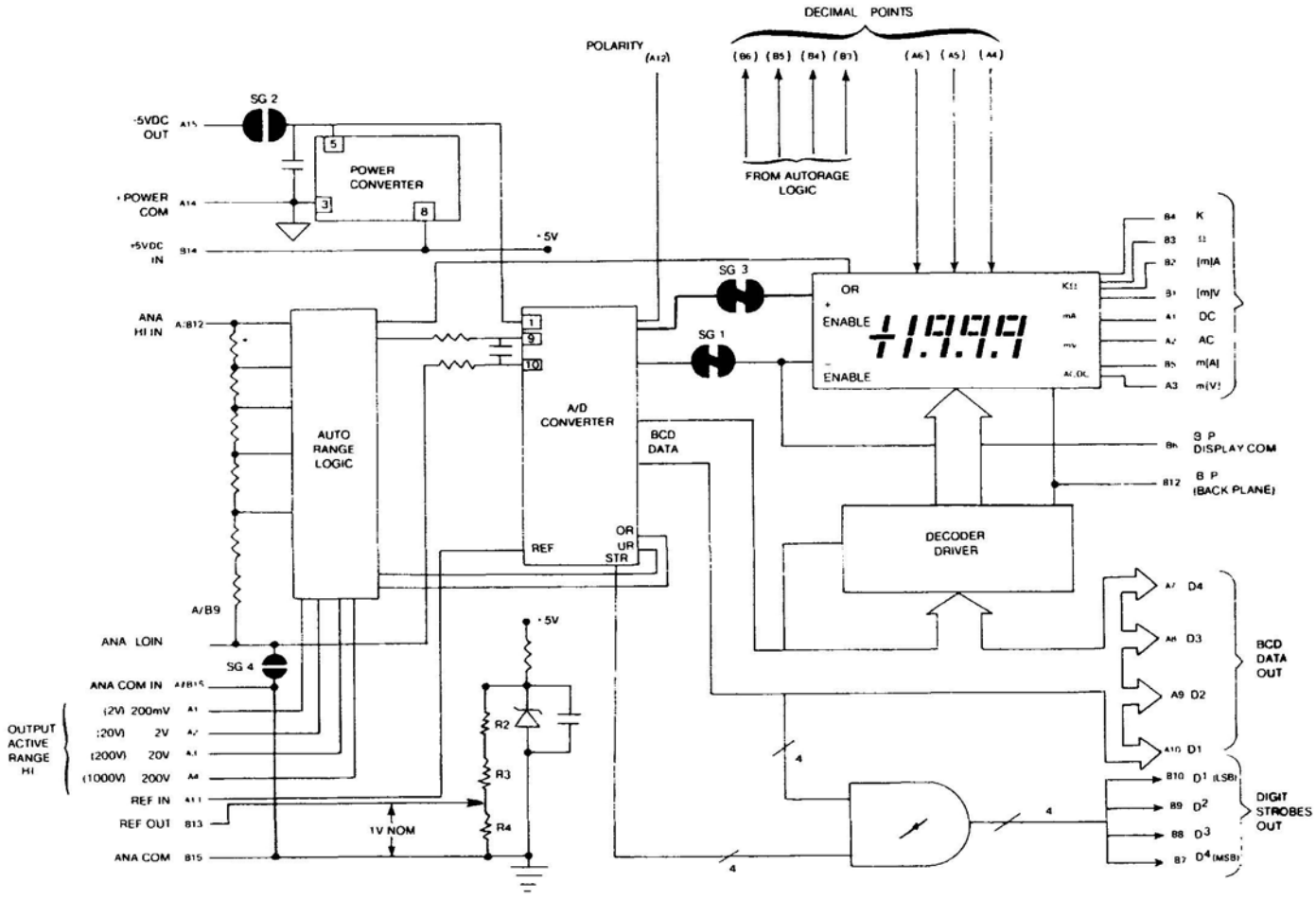



**Figure 1. DM-3102A, DM-3102B Simplified Block Diagram**

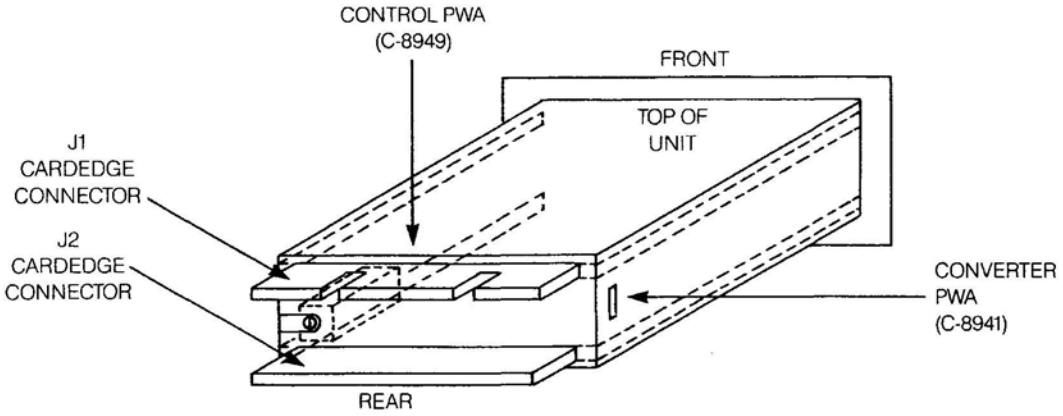



**Figure 2. Location of Printed Wiring Assemblies**

## INPUT/OUTPUT CONNECTIONS

| | |
|---|---|
| ANALOG HI INPUT (PINS A/B12) | Differential input signals are applied to pins A/B12 and A/B9. A single-ended input configuration is available by closing solder gap SG4. This effectively ties the ANALOG LO to input (pins A/B9) to ANALOG COMMON (pins A/B 15). |
| ANALOG LO IN (PINS A/B9) | |
| REF IN/OUT (PINS A13/B13) | The instrument is calibrated when a +0.1V dc drop exists between pins B13 (+) and B15 (-). An internal reference voltage circuit, adjustable by potentiometer R3, provides this reference voltage. To use this internal reference, the user joins pins A13 and B13 at the connector. The reference voltage may also be read at any time at pin B13. If the user wishes to generate an external reference voltage, pin A13 is used as the input, biased against pin B15. External reference range: +0.1V dc to +2.0V dc. Refer to the ratiometric diagram for a typical application showing an external reference input. |
| OUTPUTS: +2.4V ≤ "1" = HI ≤ +5.0V 0V ≤ "0" = LO ≤ +0.4V | Digital Connections employ MOS technology and will drive TTL, TTLS, or CMOS devices. Outputs wil ldrive 1 TTL load (1.6 mA sink minimum). Inputs should be driven from open collector TTL outputs (10 Kohm pullup or less) or CMOS buffers (4049, 4050, etc.) or hard-wired connections to logic ground or +5V dc. Totem pole drivers should use pullups. |

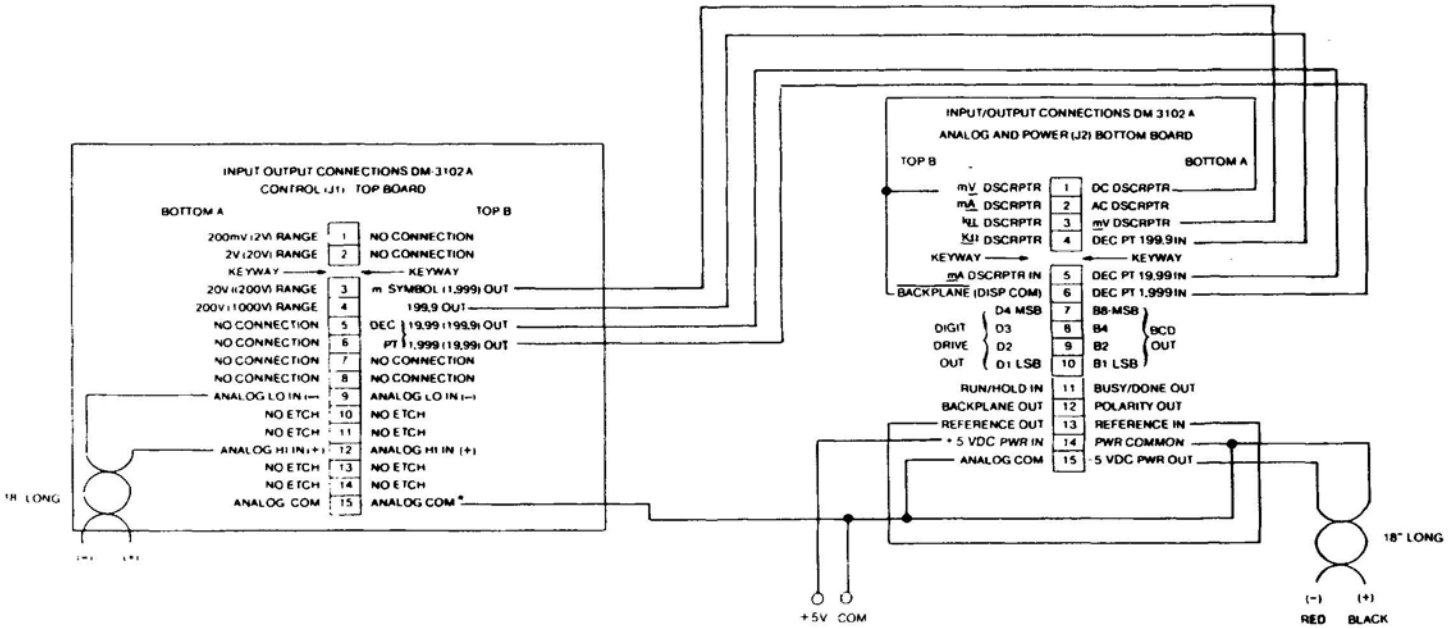
**CAUTION**

MOS inputs may be damaged by static discharge voltage spikes. Use ground protection techniques when wiring or handling.

| | |
|---|---|
| $\overline{\text{BUSY}}$/DONE OUT (Pin A11) | This output is High during A/D conversions. The falling edge indicates that a new valid digit Strobe output will appear in 1.3 milliseconds. The high Busy level may be used by automatic equipment to prevent changing the input voltage during conversion. |
| DIGIT STROBE OUT (Pins B7, B8, B9, B10) | Strobe consists of 4 positive pulses per conversion of approximately 4 microseconds width and approximately 1.6 milliseconds apart issued after an A/D conversion. They indicate that valid multiplexed data is available on the BCD data output lines, starting with the Most Significant Digit (MSD). The Polarity of the BCD data is not multiplexed out with the BCD data. A fifth line (Polarity Out, Pin A12) must be polled to determine the sign. |
| $\overline{\text{RUN}}$/HOLD IN (Pin B11) | For normal operation, leave this pin open. Grounding pin B11 halts A/D conversions and displays the last valid sample until the pin returns to a high state. |
| POLARITY OUT (Pin A12) | A high on this line indicates a positive input; a low indicates a negative input. Polarity must be sampled after the falling edge of BUSY since it is not multiplexed out with the BCD data. This output is valid even for a zero reading. In other words, a display of +0000 means that the signal is positive but less than the LSB. |
| −5V dc POWER OUT (Pin A15) | Up to 15 mA of −5V dc power may be taken to power external user-supplied circuits such as signal conditioners. |

**CAUTION**

Pin A15 is not short circuit protected.



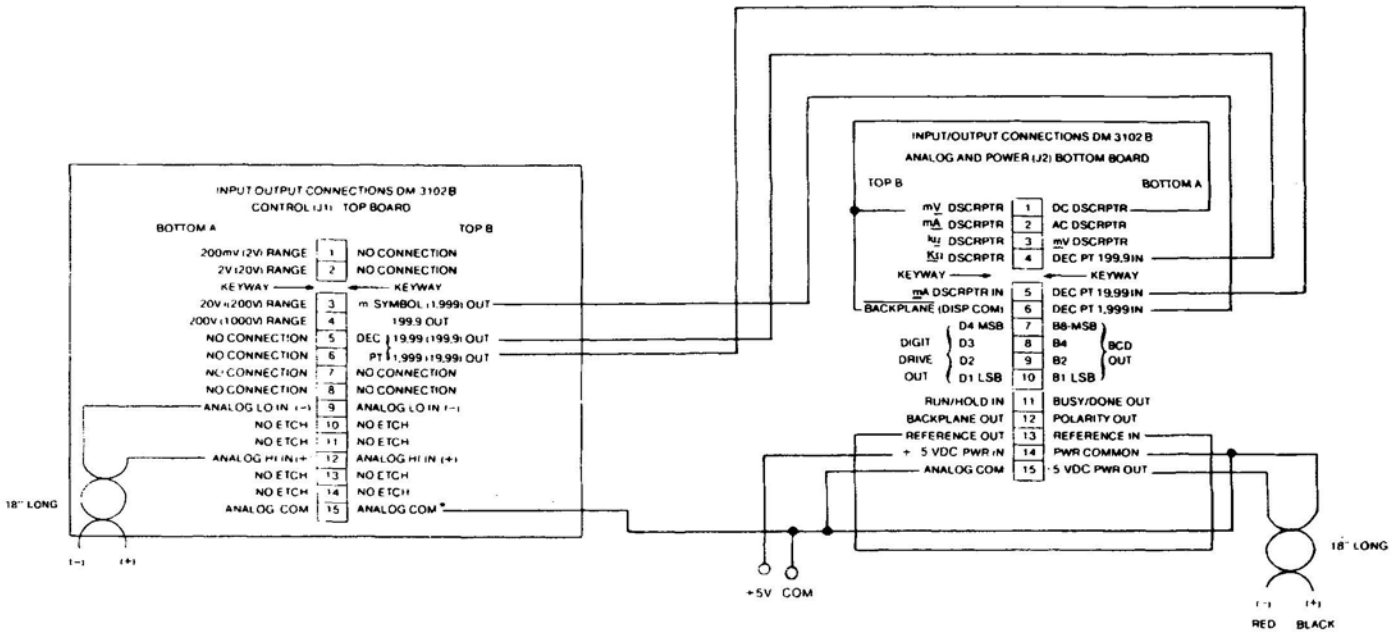




**Figure 3a &3b. DM-3102A and DM-3102B PWA Interwiring**

## CIRCUIT BOARD ACCESS

If access to the internal circuit board is required, bow the rear cover plate outward by prying up in the center with a small screwdriver or knifeblade, releasing the two catches in the sides of the case. When reinstalling the circuit board, first be sure that the front filter is flush against the inside of the housing. The circuit board engages a pair of guide tracks which are molded inside the case.

When re-installing the rear cover plate, be sure that the trim pot access hole is over the trimpot itself. Compress the cover plate slightly so that it snaps into the two retaining slot catches at the rear sides.

## SOLDER GAPS

Figure 4 shows the relative locations of the solder gaps on both PWA's. Functions are enabled or disabled by closing or opening these solder gaps. Solder gaps SG1 and SG3 are on the Converter/Display PWA. SG1 and SG3 are normally closed. When opened by the user, the polarity sign is disabled to indicate AC voltages.

SG2 is normally open and also located on the Converter/Display PWA. When −5V dc at 15mA is needed, the user must close solder gap SG2. When SG2 is closed, −5V dc is available on Pin A15.

The control PWA has a solder gap, SG4, which is normally open. When closed by the user, the differential input configuration of the DM-3102A or B is changed to single-ended. SG4, when closed, connects ANA LO IN pins A/B9 with ANA COM IN pins A/B15. See Table 1 for a summary of the solder gap functions and locations.

**Table 1. Solder Gap Functions**

| Solder Gap Function | Solder Gap Number | Location |
|---|---|---|
| Polarity Enable, "+" sign | SG3 (NC) | Converter/Display PWA |
| Polarity Enable, "−" sign | SG1 (NC) | Converter/Display PWA |
| −5V dc Output | SG2 (NO) | Converter/Display PWA |
| Analog LO IN to Analog Com IN | SG4 (NO) | Control PWA |

**NOTES:**

1. Displaying a "+" sign requires closing both SG1 and SG3 (both normally closed).
2. SG2 is normally open, providing −5V dc at 15 mA maximum.
3. SG4 is normally open, close for single-ended input configurations.
4. NC = NORMALLY CLOSED
   NO = NORMALLY OPEN

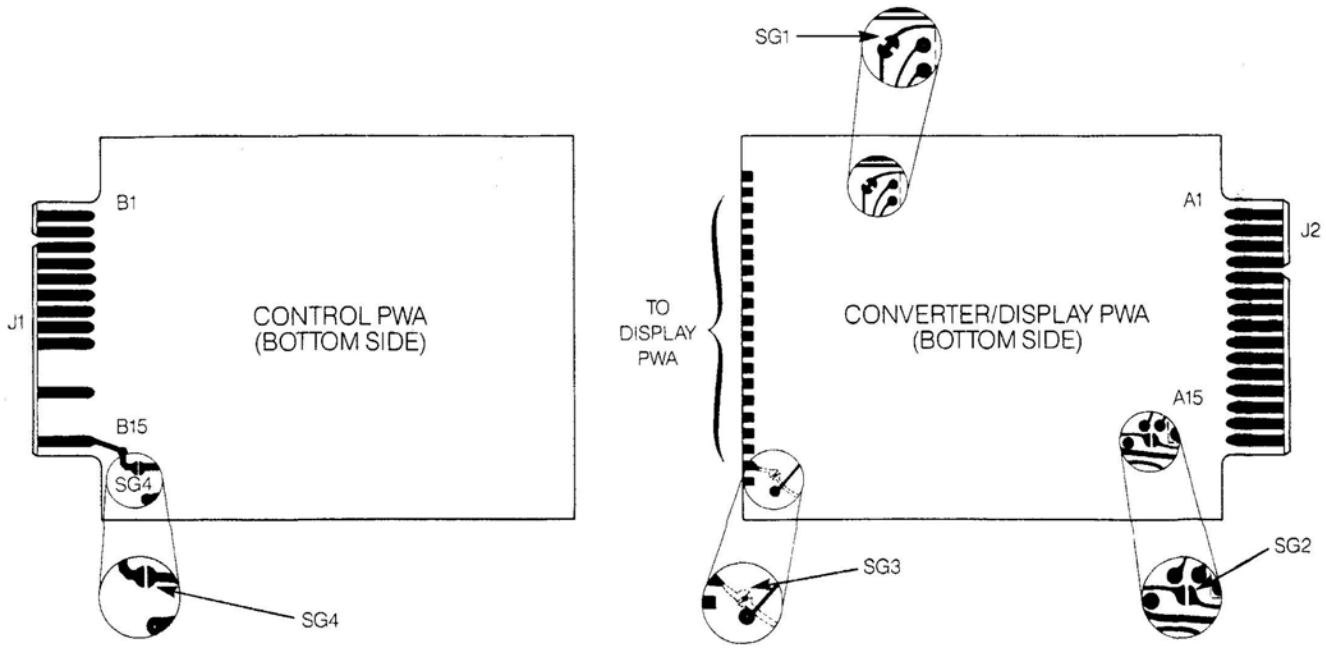



**Figure 4. Solder Gap Locations**

## DATA OUTPUT TIMING

The DM-3102A/B internally AND's digit drive pulses and strobes, providing the user with digit strobe pulses. Internal clock circuitry maintains an A/D conversion rate of three conversions per second.

As shown in Figure 5, a full measurement cycle consists of three phases:

1. An autozero phase lasting 10,000 counts.
2. Signal Integration lasting 10,000 counts.
3. Reference and zero integration lasting 20,000 counts.

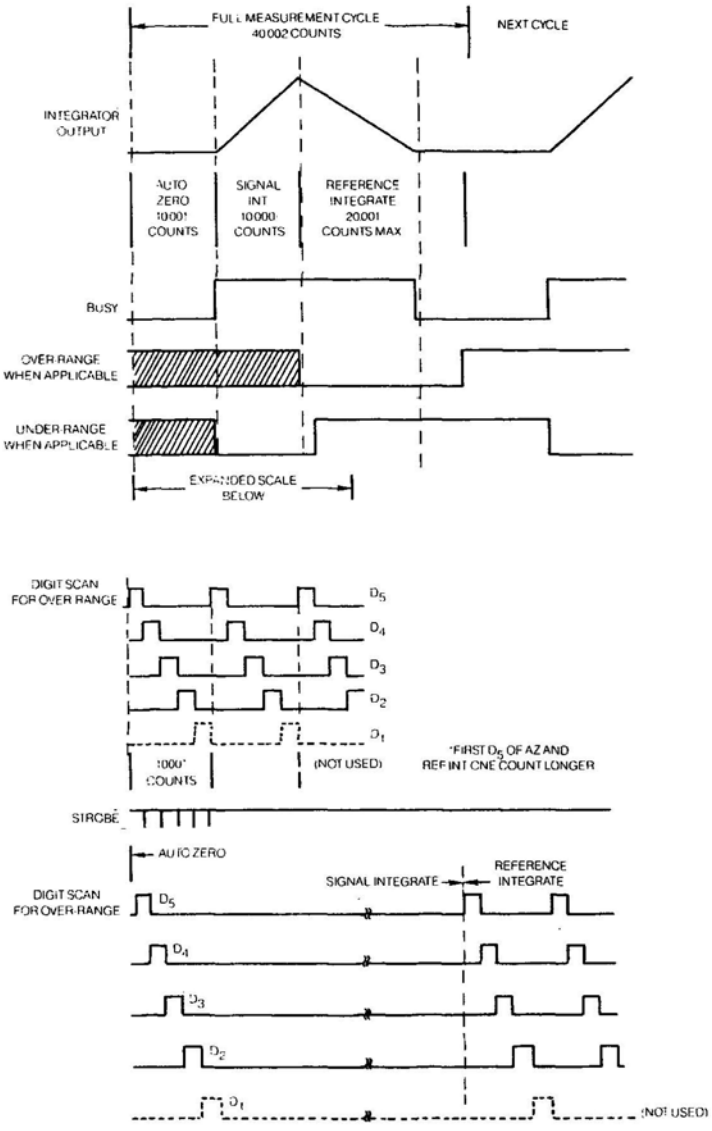



**Figure 5. DM-3102A and DM-3102B Conversion Cycle Timing**

First, the autozero phase ensures that a zero reference exists prior to looking at the actual voltage input. During the signal integration phase, the converter logic integrates the differential voltage between ANA HI IN (pins A/B12) and ANA LO IN (pins A/B9) for a fixed time. This differential voltage can be within a common-mode range of +/−3V dc with reference to Power Common, pin A14. For single-ended operation, close SG4 on the Converter/Display PWA, tying ANA LO IN to ANA COM IN (pins A/B15) and effectively referencing the input signal to ground.

The reference integration phase brings the integrator output back to zero before starting the next autozero phase. The reference can be either from an external source via pin A13 or can be the reference voltage generated by on-board circuitry. The conversion process continues after completing one full conversion, unless externally disabled by a RUN/$\overline{\text{HOLD}}$ control input. Several signals let the DM-3102 meter operate with more sophisticated systems. These include STROBE, RUN/$\overline{\text{HOLD}}$, and BUSY/$\overline{\text{DONE}}$ lines, making it possible to interface the device to a microprocessor or UART.

STROBE is a negative going output pulse that aids in transferring the BCD data to a latch. There are five negative going STROBE pulses that occur in the center of each of the digit drive pulses. These STROBE pulses occur once, and only once, for each measurement cycle. The digit drive continues to scan (unless the previous signal was overrange) but no additional STROBE pulses will be sent until a new measurement is available. STROBE may be used to generate an interrupt which an intelligent device would respond to by reading the BCD data before operating on it.

When the RUN/$\overline{\text{HOLD}}$ signal is high (or open), the A/D converter will free run. If taken low, the converter continues the full measurement cycle that it is doing, and then holds this reading as long as RUN/$\overline{\text{HOLD}}$ is low. The BUSY/$\overline{\text{DONE}}$ signal goes high at the beginning of conversion signal staying high until the first clock pulse after zerocrossing (or after end of measurement in the case of an overrange).

## INTERFACING

To reduce the amount of wiring required to implement a slave display, four-wire BCD data is multiplexed using four digit drive outputs. Each digit drive sequentially turns on its respective signal when the drive signal is high. The digit is blanked when the drive line is low. The DM-3102A/B minimizes the wiring to a remote display, UART, or microprocessor since only 14 wires are needed to transfer the data which include 4 BCD data lines, 4 digit strobes, 4 range indications, polarity and BUSY/$\overline{\text{DONE}}$.

## DISPLAY DESCRIPTOR SELECTION

The DM-3102A/B display allows enabling optional unit descriptors by jumpering pins on the converter PWA. Polarity and overrange indicators, as well as the unit descriptors, are driven by logic on the converter PWA.

| PIN | A3 | B5 | A2 | A1 | B1 | B2 | B3 | B4 |
|---|---|---|---|---|---|---|---|---|
| DESCRIPTORS | m [V] | m [A] | AC | DC | [m] V | [m] A | Ω | K |

To activate the desired unit descriptor, the corresponding pin must be connected to pin B6, BP DISPLAY COMMON. Connect any unused unit descriptor selection pins to Pin B12, BACKPLANE.

## INPUT CONFIGURATIONS

The DM-3102A/B standard input configuration is differential, and the user can convert to single-ended by closing solder gap SG4 on the control PWA, connecting ANA LO IN (pins A/B9) with ANA COMMON IN (pins A/B15). Figure 6 illustrates standard wiring to implement either of these input configurations.

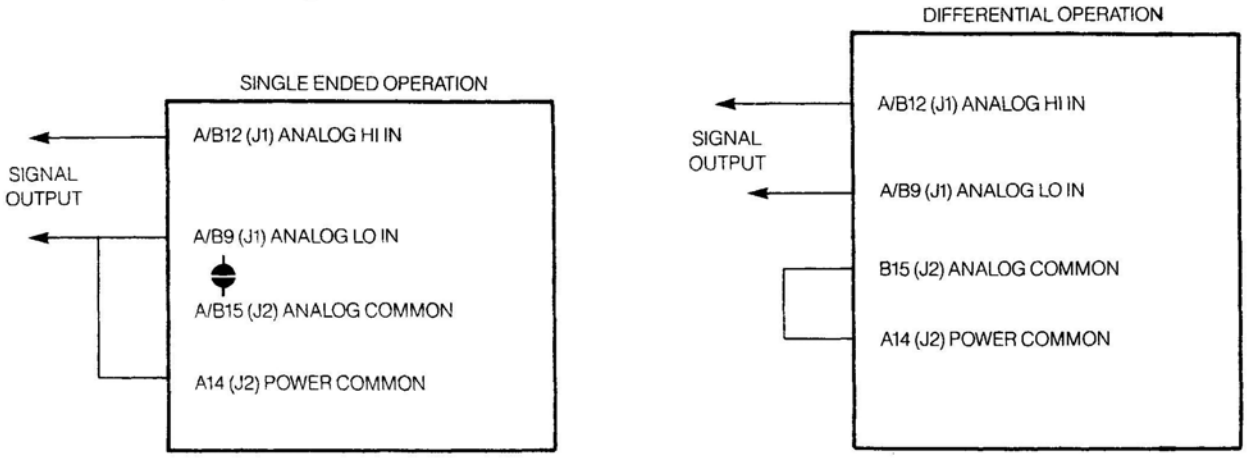



**Figure 6. DM-3102A, DM-3102B Input Configurations**

## APPLICATION EXAMPLE

*DM-3102A or DM-3102B Configured for Ratiometric Operation*

Ratiometric operation is used with bridge-type differential inputs to reduce system errors when two or more reference voltages are used. By using a single reference to operate the entire reference circuit, accuracy depends only upon the tracking ratio of the resistors rather than the magnitude of the reference voltage.

In the circuit shown in Figure 7, the DPM's input is the output of a sensor bridge (e.g., a strain guage or load cell). The bridge requires a source of exitation voltage which varies with the type of application. The DPM also requires a reference voltage. Both the bridge exitation source and the DPM reference input source must be stable to avoid errors.

Bridge output is directly proportional to the bridge exitation. However, the DPM display is inversely proportional to the reference input. That is, with a smaller reference input, larger values are displayed. By using a common reference source to excite the bridge and the DPM reference, the DPM will automatically compensate for small bridge output variations. Since the bridge exitation is usually larger than the +1V dc used to reference the DPM, a precision pot on the voltage source supplies the DPM's reference as a proportion of the voltage source. Over a limited range (+0.1 to +2V dc), this pot may be used as the DPM's full scale adjustment. Since the DPM's internal reference may be used for the entire circuit in place of the external voltage source. However, an external user-supplied amplifier may be required to get adequate bridge exitation.

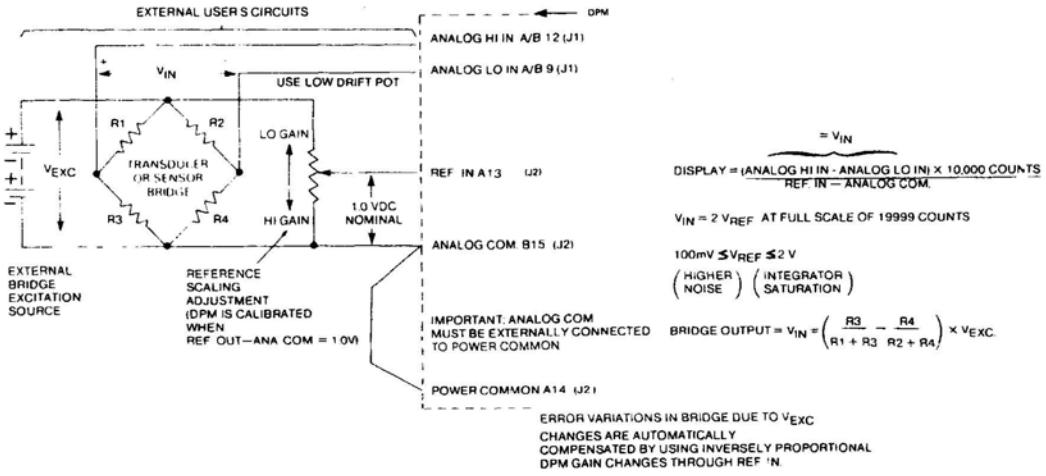


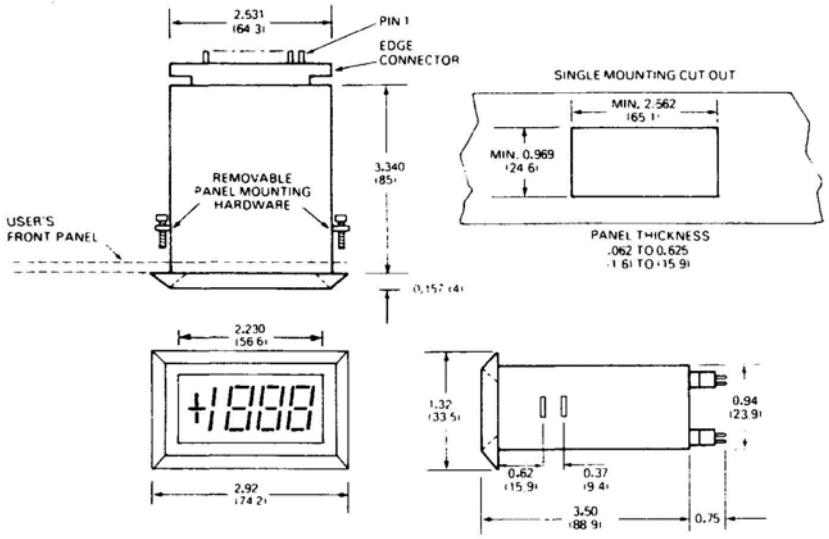

**Figure 7. DM-3102A/B Configured for Ratiometric Operation**

## PANEL INSTALLATION INSTRUCTIONS

The low-profile case is retained in a front panel cutout by sliding the DPM housing in through the cutout opening and securing the housing from the rear using two 'L' brackets and screws. Referring to Figures 8 and 9, proceed as follows:

1. After determining the correct position, form a cutout in the mounting panel. Refer to the cutout drawing for the proper dimensions.
2. Install the panel meter from the front (display) side of the mounting panel as shown.
3. There are two pairs of slots in the side of the case to accept the 'L' brackets and retaining screws. Most applications will use the front pair of slots. For panels thicker than about .25 inches (6mm) thick, use the rear slot pair.
4. A thin plastic moulding may cover the selected slots. This can be broken through with the 'L' bracket itself in the next step or can be removed using a screwdriver or knife before panel installation.
5. Assemble the supplied 4-40 screws into the brackets as shown, turning the screws several times until several threads are engaged.
6. Using the screw as a lever, push the short side of the bracket into the slot as shown and rotate the screw backwards 1/4 turn until the screw is parallel to the case side and the 'L' bracket is fully captured in the case.
7. Lightly tighten the screws against the front panel.

**Inches (mm)**




**NOTE:** FIGURE 10 AT THE END OF THIS DOCUMENT IS A FULL SIZE CUTOUT TEMPLATE.

**Figure 8. Mechanical and Panel Cutout Dimensions for a DM-3102A or DM-3102B**

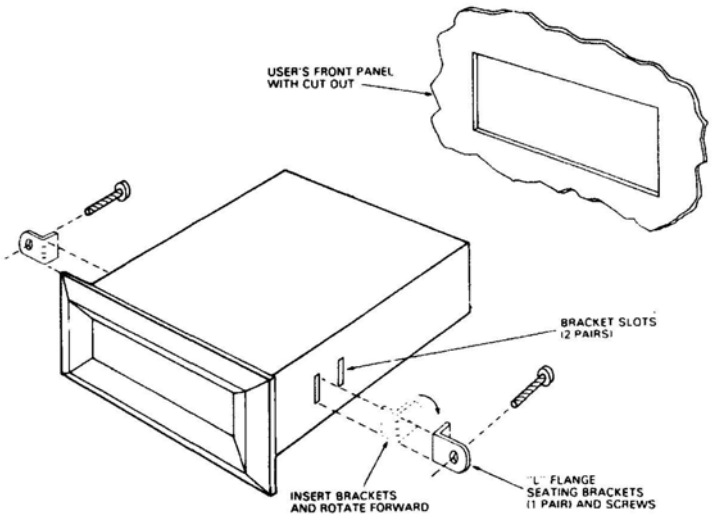



**Figure 9. Panel Installation**

## ORDERING GUIDE

| Model | Description |
|---|---|
| DM-3102A | Digital panel meter autoranging 200mV, 2V, 20V, 200V full scale ranges |
| DM-3102B | Digital panel meter autoranging 2V, 20V, 200V, 1000V full scale ranges |
| 58-2073083 | Dual 15-pin, 0.100″ centers PC edge board connector (not included—order two with each DPM). |
| UPA-5/500 | AC to +5V dc power adapter. |
| DM-4106 | Low-profile Slave Display (no descriptors). |
| DVC-350 | Voltage calibrator (see below). |

## *And For Your Calibrator Needs*

***The DVC-350 Voltage Calibrator... at home in the field or in the lab.***

- *Data acquisition system computers*
- *Engineering prototypes, breadboards and setups*
- *A/D converters*
- *V/F converters*
- *DPMs*
- *Indicators*
- *DVMs*
- *Transducers (load cells, strain gauges, LVDTs, etc.)*
- *Oscilloscopes*
- *Recorders*
- *Controllers*
- *Wherever accuracy and portability is required*

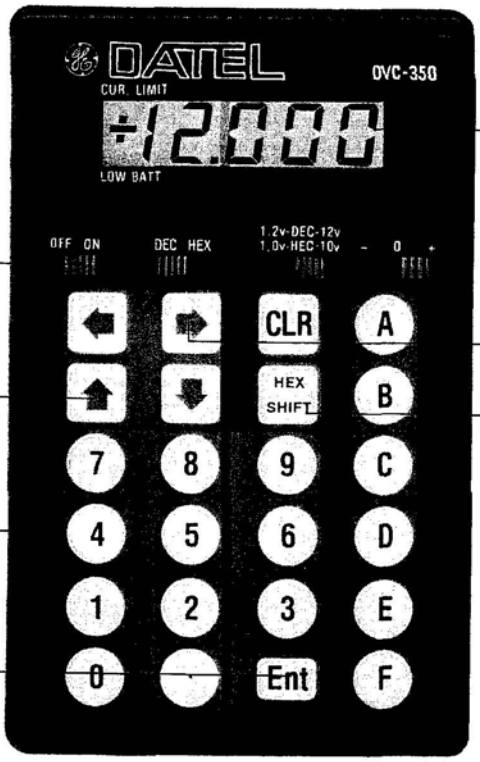
***The DVC-350 Voltage Calibrator.***

*Four convenient, switch-selectable controls for Power (on/off), Mode of Operation (decimal or hexadecimal), Output Voltage Full Scale Ranges (decimal ±12VDC, ±12VDC and hexadecimal ±1VDC and ±10VDC), and Polarity (+V, oV, or −V).*

*Voltage increment and decrement control.*

*Rugged ABS plastic case (5.75" x 3.6" x 1.29").*

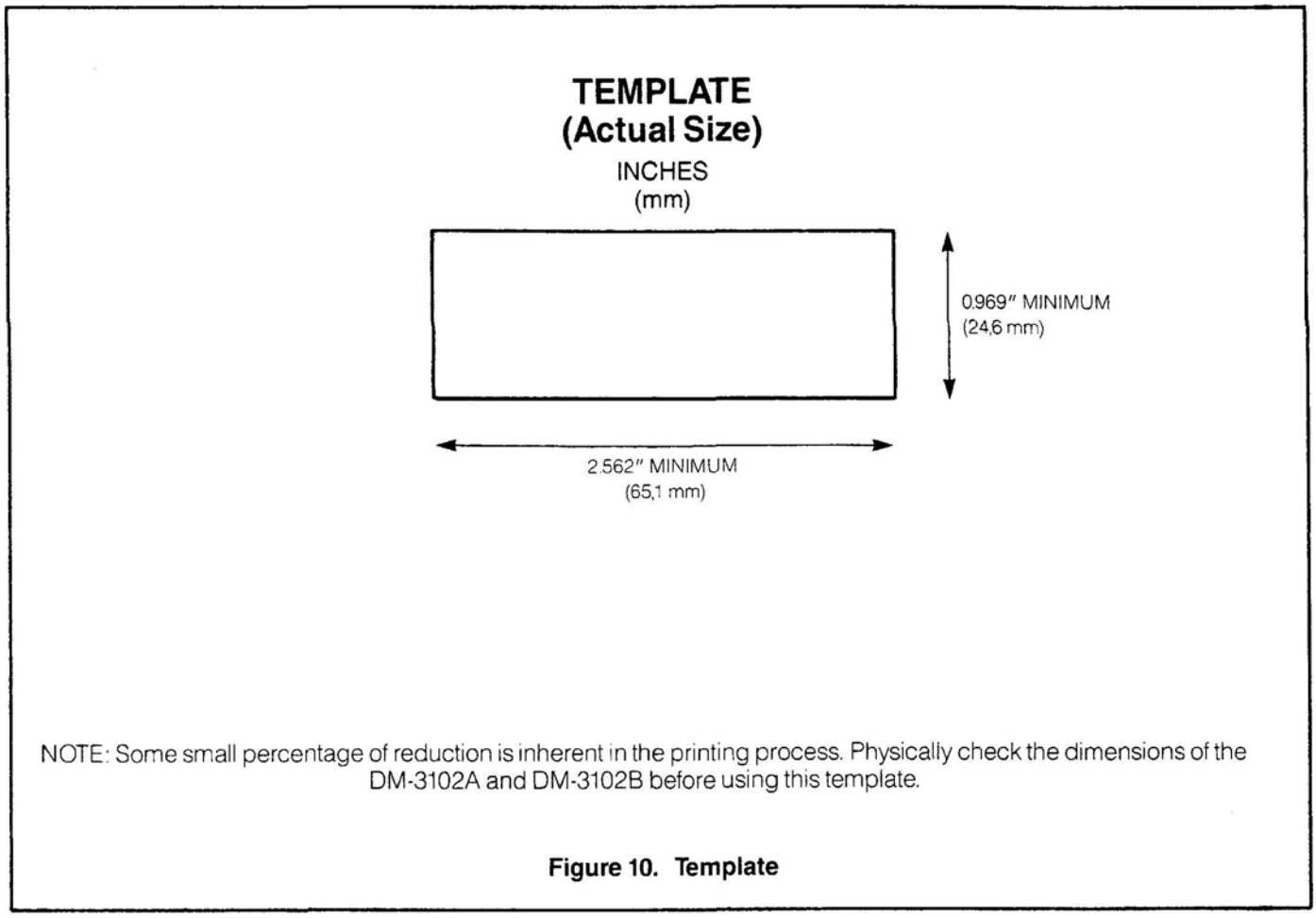
*Touch sensitive membrane keyboard with audio feedback.*




*4½ digit LDC display with current limit and low battery indicators*

*Decade cursor control.*

*Hex shift control.*




NOTE: Some small percentage of reduction is inherent in the printing process. Physically check the dimensions of the DM-3102A and DM-3102B before using this template.

**Figure 10. Template**

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01/02/09

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