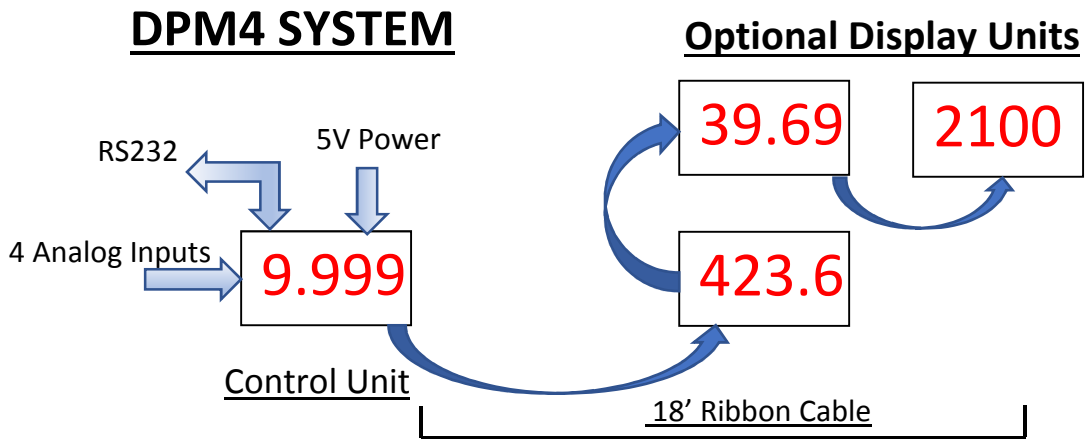
DPM4 Digital Panel Meter System

By Versalent Revised 11/16/21

1 to 4 meter digitally *programmable* 4-digit LED Panel Meters

Description:

The DPM4 is a low-cost panel meter system which offers from one to four 4-digit digital .36" LED panel meters for less than similar performance conventional digital panel meters (DPMs). Up to 4 units/displays are daisy-chained together with just a ribbon cable. The first unit (the Control Unit) contains 2/4 analog inputs and amplifiers , 4-channel analog-to-digital converter, 5V power input and an RS232 communications port. Display units 2-4 are the same size as the control unit (2.6" X 1.6" X 1") and are independently mounted display-only units since all A/D conversions occur on the control unit. Each 4-digit display is provided with its own panel mount bezel, optical filter and panel hardware so they can be mounted in any row/column/offset spacing configuration needed. The ribbon cable allows the optional displays to be mounted up to 18 feet apart [*1] in any direction and contains all power and control signals so no additional wiring is needed. [Ref ***Channel*** refers to an analog input, associated amplifier and A/D converter, while ***Display*** refers to just the LED display, and ***Meter*** refers to a combination of analog channel and display].



The control unit provides 2 (model DPM4/2) or 4 (Model DPM4) analog channels and one 4-digit display which can be configured to show any one of the user-scaled-and-offset channels, or one differential (user-scaled-and-offset) pair of channels. Any of the analog channels can be configured in a differential-pair. For a differential pair, the displayed value = CH 1 - CH 2, or CH 2 – CH1, etc.

Displays 2-4 are optional and like the control unit display, each may be configured to show a user-scaled analog channel, or a user-defined differential pair (its own scaled analog voltage minus any other channel voltage). So the DPM4 can simultaneously provide multiple non-differential and differential meters. Analog channels are not required to have their own displays, but can still be part of a differential pair.

Multiple displays can be 'mapped' to the same analog channel and so that both show the same value. This allows the same display value to be viewed from up to 4 different, even visually-isolated, viewing angles. Meter configuration is controlled via the RS232 port, and can be altered dynamically to change scaling and offsets and mapping of displays-to-channels. For instance it can change from displaying pounds to kilograms using a command string of about 20 characters. (see command set below).

User defined scaling allows the resulting meters to show ANY values between -9999 to +9999 for ANY input from 200mv to 50V, and the Versalent DPM4 Configurator application computes and downloads the scaling and offset factors needed. Meters show numerically scaled values in whatever units and offsets you require … gallons in a tank, microns of movement, pressure in a pipe etc. And because of the programmable offsets, the meter zero-input-display can be non-zero. The same input signal of 0V - 4V can be displayed as 55.5 (gallons) - 5750 (gallons) , or -305 (microns) to +8860 (microns).. using factors computed and downloaded with the Configurator. These are truly versatile meters. An online DPM4 Configurator and Meter Simulator which allows a 1-channel test-drive can be seen here.

DPM4 Details:

The DPM4 operates like a standard digital panel meter however it offers several advantages:

1. Conventional DPM's are typically scaled to 200mv, 2V, or 10V full scale, and they display voltage. The DPM4 offers 2/4 conversion channels and up to 4 displays (each a fully independent meter). ***Measurement scaling is programmable*** with the DPM4… so the meters are calibrated in your units, not just voltage. Full scale input (Hardware Range) is independent on each channel and can be 200mv to 50V, 4mA-20mA. Measurement resolution is 12-bits for all ranges.

2. DPM4 allows user-generated offsets as well as scaling. These two factors allow ANY input value (within the channel's factory set Hardware Range) to be displayed as ANY 4-digit value between -9999 to +9999 providing a very flexible measurement system . And the meters can output their measured values via RS232 to your computer systems for logging or process control. Over/under range values (beyond +/-9999) cause the

associated meter to flash OL ¯¯ or OL _ _ . All inputs are internally protected from excess input voltages.

3. A single power connection to the control unit operates all meters. The RS232 port receives initial configuration commands from the Configurator, accepts dynamic meter re-scaling during operation and can send live measurement data to your own computer systems.

4. DPM4 allows its 4 measurement channels to be configured as differential meters (channels can be digitally subtracted from others). So DPM4 can operate as 4 non-differential meters, or up to 4 differential meters or any combination of meters all uniquely scaled to your needs. Each display can show from -9999 to 9999 with over/under range values causing the associated meter to flash OL ¯¯ or OL _ _ . All inputs are protected from excess input voltages.

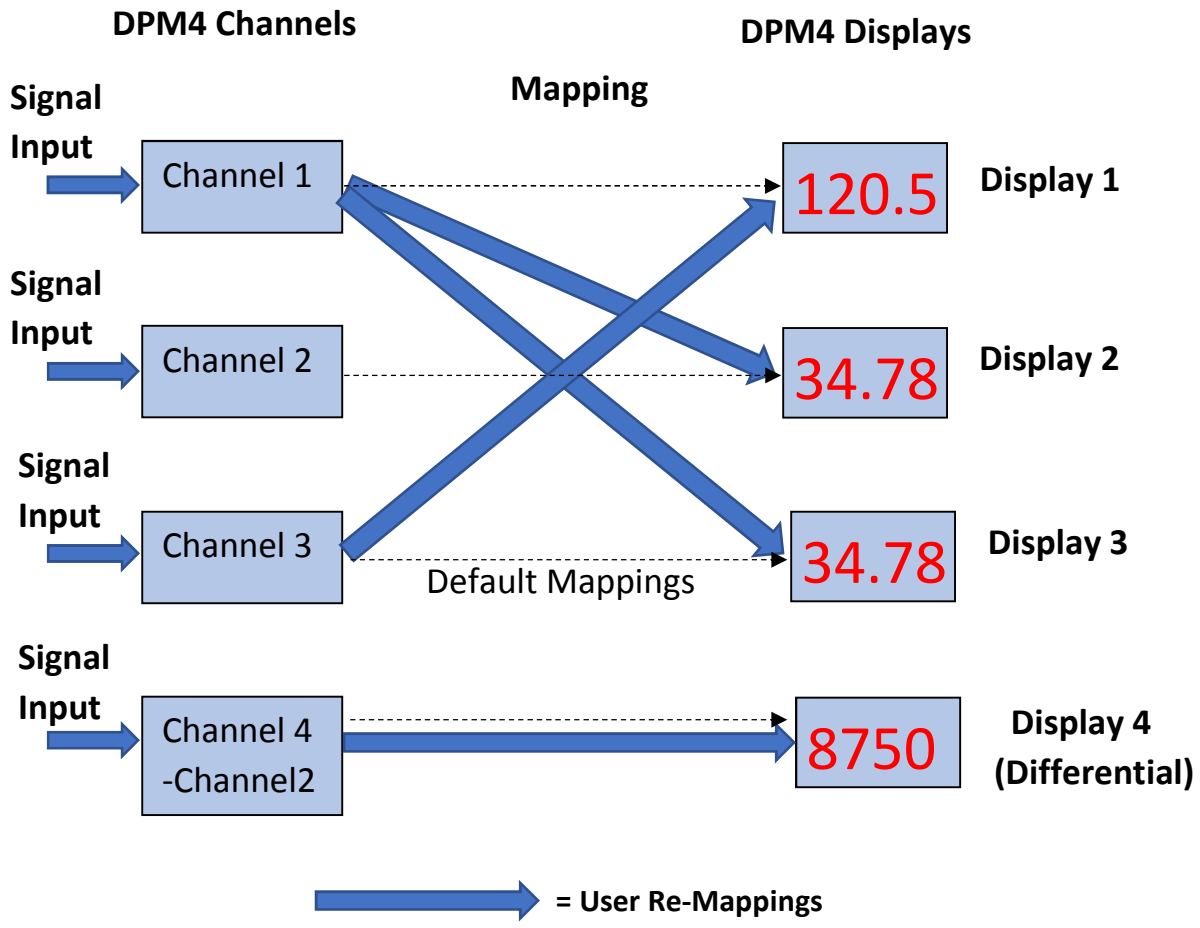
5. DPM4 provides separate power and signal grounds to help maintain accurate measurements in all settings. **Signal ground and power ground must be tied together** at some point. See Single point grounding description later in this manual.

Connector and Jumper Positions

Display Mapping:

The DPM4 allows 'display mapping' which means that each display 1-4 can be mapped to any channel 1-4. This association of displays to channels allows for multiple displays to be mapped to the same channel and thus display the same data. And with the 18 foot daisy-chain display separation the DPM4 allows, you can place displays at different locations/angles which need to view the same data. All 4 displays could be mapped to a single analog channel in a 360 degree Kiosk for instance. The Configurator provides simple checkboxes to select the mapping. So swapping meter positions after physical mounting is quick/easy/dynamic.

Typical Display Mapping Diagram:



A/D Conversion Technique:

Comparisons to Standard Dual-Slope Integrating Meter:

Conventional meters are often dual-slope A/D types which are inherently compensated for variations in their reference voltage(*) . The DPM4 uses successive approximation conversion which does not have this inherent reference insensitivity, however it achieves measurement stability by using a high stability reference.

Noise Cancellation:

Another reason the dual-slope A/D conversion method was widely adopted is its inherent noise immunity. Noise frequencies higher than 2X the sampling rate are reduced or cancelled by the integration process. The DPM4 uses a similar 'digital integration' technique. The DPM4's programmable sample rate can be as low as 10 seconds rejecting noise down to 1/5 Hz.

Flexibility of Scaling and Offsets:

Conventional DPM's measure voltage (or current with a shunt resistor) and using a pot they can be scaled down. They cannot scale up (to show a number larger than their voltage reading). The DPM4's digital scaling allows ANY input within its voltage range to be converted to ANY display range from -9999 to +9999.

And conventional meters have no offset adjustments. If the zero-volts display should be 200 of your units they offer no way to achieve that. Again the DPM4 provides the solution. Each meter can be offset positive or negative as required.

(*) The internal reference voltage is used to compare an applied input voltage and arrive at a measured value. The technique of integrating a reference voltage, then de-integrating the input voltage renders the measurement insensitive to the actual value of the reference voltage.

Channel Sampling:

The DPM4 samples (and averages) each channel 32 times within a selectable period of time as it simulates the continuous averaging that dual-slope integrators provide. The longer sample times provide lower frequency filtering with the attendant slower display update rate. For faster meter response, the shorter sampling periods provide higher-frequency filtering with faster display-tracking. Refer to the 'R' command.

Hardware Input Ranges:

DPM4 offers a wide range of pre-calibrated input voltage ranges so there is never a need to adjust potentiometers. Order an input range that most closely encompasses the range of input signals, and use the Configurator to scale up or down digitally to get the display readings desired. These 'Hardware' input voltage ranges are so named because they are defined by assembly configurations and are not user-alterable.

DPM4 Hardware Input Voltage Ranges (per channel)

DPM4 Code	Unipolar Hardware Range	DPM4 Code	Bipolar Hardware Range
0	0.0V to 200mv	1	-200mv to +200mv
2	0.0V to 1.0V	3	-1.0V to +1.0V
4	0.0V to 2.0V	5	-2.0V to +2.0V
6	0.0V to 2.50V	7	-2.50V to +2.50V
8	0.0V to 4.0V	9	-4.0V to +4.0V
10	0.0V to 5.0V	11	-5.0V to +5.0V
12	0.0V to 10.0V	13	-10.0V to +10.0V
14	0.0V to 20.0V	15	-20.0V to +20.0V
16	0.0V to 50.0V	17	-50.0V to +50.0V
18	4.0mA to 20mA	-	-

TABLE 1

Measurement Resolution:

All measurements are 12-bit (0 – 4095) however the upper 95 counts are reserved for offset and calibration uses, so all measurements use the range of 0 – 4000. Therefore resolution is +/- 1/4001 = +/-0.025% . Total channel measurement accuracy is +/- 0.50% from 0C to +50C .

Differential Measurements:

By subtracting one channel from another, the DPM4 can provide differential measurements (i.e. CH1 – CH2) . The only condition is that the two selected channels must have the same Hardware Range (0-18 above). Since the subtraction occurs BEFORE user scaling and offset are applied, the two channels are NOT required to have the same user scale/offset values. The difference voltage will be scaled with the first channel's scale and offset factors. The second channel may be scaled and displayed separately from its participation in the differential pair. Channels can participate in more than one differential pair.

DPM4 Configuration (using the Configurator):

The Configurator application organizes and simplifies the use of these very flexible meters. Scaling and offsets are auto-computed after a few simple entries, and display mappings or differential assignments are created with simple mouse clicks. It can also generate dynamic configurations that the user host can send during operation to change scaling or other meter functions instantly.

DPM4 Specifications:

- 1 to 4 DC digital panel meters with 19 analog input ranges from 200mv to 50V
- 5V power :
  - Control Unit (display off) 27mA typical
  - Each display (full brightness) 50mA typical
- 0.36" high 4-digit LED displays (red standard, other colors available)
- 0.5% accuracy all ranges
- Input Resistance:
  - UNIPOLAR voltage ranges > 1.0M to signal ground.
  - 4ma-20mA input resistance 50 ohms to signal ground.
  - BIPOLAR voltage ranges > 1M ohm to internal 2.5V reference.
- Dimensions: 2.6" X 1.6" X 1.2" deep including mounting bezel. Not including mounting panel thickness. Bezel 1.83" X 1.28" X 0.20 " black, included with each unit.
- Mounts in panel thickness of .030" to 1/4"
- RS232 command port, 1200 to 38.4k baud, jumper configured
- Programmable scaling and offset factors from -9999 to +9999 .
- Configurator Application for generating and setting 8-decimal digit scaling and offset factors (per channel).
- Display Brightness programmable in 8 levels, independent per channel
- Display unit separation from control unit 18 feet max with standard flat cable.
- Connections via 3.5mm terminal blocks accepting 22 to 26 gauge wire.
- Non-volatile parameter configuration endurance: 100k cycles.

DPM4 Negative Display Values:

Displaying negative values typically requires that the first of the 4 digits be used for a negative sign, therefore limiting negative displays to 3 digits. The DPM4 shows all 4 digits by alternately flashing the minus sign by itself, then the 4 digits with no sign so can display from -9999 to 9999 on a 4-digit display.

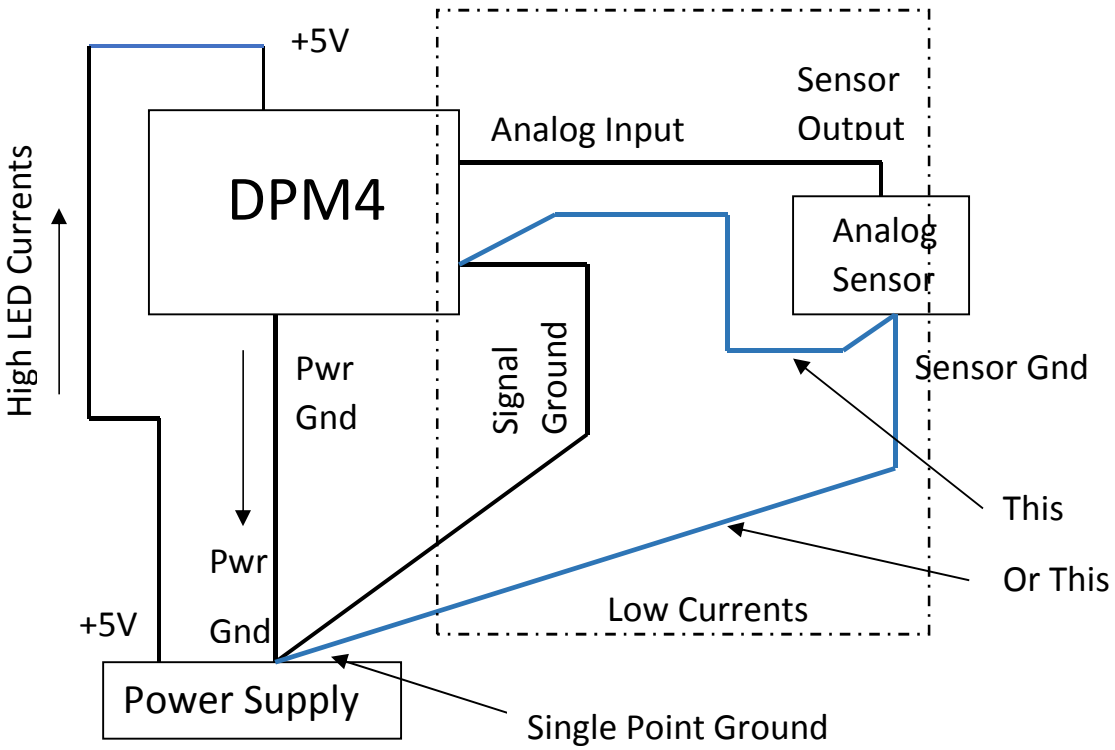
Because of the wide-ranging scaleability, and display-offset capabilities, it is possible to send the display value beyond the -9999 to 9999 range (even without exceeding the analog channel input range). To show positive overload the DPM4 shows OL ¯¯ ¯¯ (over-scores flashing) and negative overload as OL _ _ (under-scores flashing).

Signal Connections and Single Point Grounding:

NOTE: Signal Ground (on 6-terminal block) and **Power Ground** (on 4-terminal block) ***MUST be connected together*** somewhere in your system.

When the power supply, and DPM4 and sensors are physically close together, the interconnect wires are short (low resistance) and their small current-induced voltage drops are insignificant. However as the length of the connections increases so do those voltage drops. When the separation distances are more than 1-2 feet, a single-point connection scheme can reduce or eliminate the errors caused by interconnect wiring.

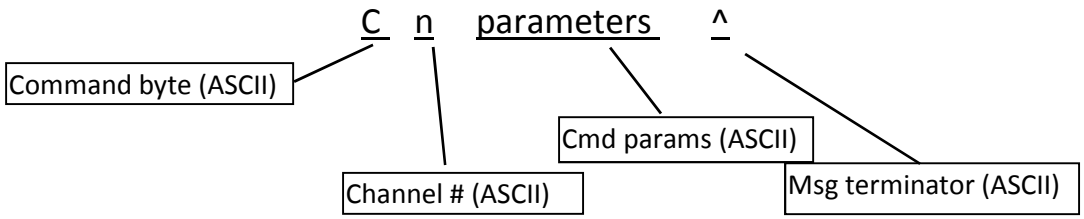
DPM4 provides both a **Signal Ground** (on 6-terminal block) and **Power Ground** (on 4-terminal block) ***which MUST be connected together***, but where you connect them directly affects the accuracy of your measurements. For best accuracy, a single-point ground scheme is recommended. By keeping the large LED current out of the signal paths, measurement accuracy is improved considerably.



DPM4 Command Set

The DPM4 provides an RS232 port through which it can accept the following command set. These commands are used for initial setup by the Configurator and can dynamically change scaling/offset parameters during operation. (For instance you can make channel 1 toggle between lbs and kilograms, or add a weighing scale's 'tare' weight as an offset).

All commands are comprised of ASCII characters, and start with a single ASCII command character that is followed by parameters, and terminated with a '^' character. The command format is:



(The space between characters above is shown for clarity only). Commands that are not channel-specific have no channel # included as described below. After a command is processed a response is returned to the host. All responses start with a single character indicating 'A'cknowledge or 'R' ejected. The 'A'ck character may be followed by a channel number if appropriate, and data depending on the command, and a 'R'ejected command always includes an error code (see error codes following command table) . Error message format:

Re^ Error response for a bad/missing parameter etc

e is a single ASCII character identifying the error.

Channel numbers in commands or responses are single-digit ASCII characters '1' – '4' and all commands and responses end with a '^' message terminator character. Each command parameters is preceded with an underscore '_' character. See below for complete command descriptions.

Commands should be issued one at a time with the host waiting for a response before issuing another command -- to avoid possible buffer overruns.

Command	Command Description
Cn_x_y_z_b^	***Set Channel Configuration Parameters*** This command sets a channel's meter scaling, pre-scaling offset , post-scaling offset, and display brightness. With these parameters the meter can be scaled to display a wide variety of full scale values, as well as a controllable zero/offset value. C is the command character, n is the channel number ('1'-'4'), _x_y_z represent three underscore-separated 8-digit-max ASCII decimal values for scaling, pre-scale offset, and post-scale offset and b is a single ASCII digit setting the display brightness (see above). Each of the 3 decimal parameters contain from 1 to 8 ASCII decimal digits plus an optional decimal point, and an optional sign character as below in the example: **C3_-1.03426_3.5537634_-100.05_2^** The contained under-score-separated parameters are validated, then saved in non-volatile memory and put into use immediately. The response is an acknowledge or error code: Responses: **A3^** for a valid command. A= Acknowledge, 3 = channel number, ^ is the response terminator. Valid scaling values: -50.000000 to 50.000000 Valid Prescale Offset values: -9999.9999 to 9999.9999 Valid PostScale Offset values: -9999.9999 to 9999.9999
cn^	***Return Channel Configuration Parameters***. This command asks the DPM4 to return the meter scaling, pre-scaling offset , post-scaling offset, and display brightness. 'c' is the command character, n is one ASCII character specifying the channel number ('1'-'4'). The response is the 'A' acknowledge character, followed by one ASCII channel number character, three max-8-ASCII-digit decimal numbers (scale factor, pre-scaling-offset, and post-scaling-offset), then a single ASCII- character ('0'-'7') representing display brightness and a command terminator '^'. Each decimal parameter value is separated by the underscore character. example: **A3_-1.03426_3.5537634_-100.05_2^**

y^ ***Return the model number/serial*** number string from the unit. The response is an 'A'ck character, then the full model number including channel-range designations, followed by a 7-digit serial number. Example:

ADPM4-12-14-17-9_1185432

Model No. Serial No.

mn^ ***Return Meter Display***. This command returns the meter number and the value that is generated for the display (even if no display installed for the channel) with a -- sign for negative numbers. Meters are numbered '1-4' and n is an ASCII character specifying that number. The response is an 'A'ck character followed by the channel number, a parameter separator, and a decimal string matching the meter's display value. Example:

m3^

Responses: **A3_-60. 24^** for a valid command

RE^ for a bad/missing parameter etc

Even if the display is alternately flashing the negative sign, and 4-digit value as described above in **Negative Display Values**, the returned value remains steady and as described.

Mnwxyz^ **Create Message** (to replace meter value). This command allows you to send cryptic text messages which temporarily replace a numeric meter display. The 7-segment displays can show the following list of characters only: ACEFGHILOPUbcdilnoru -0123456789?. and Space (empty character position) . So you can display EA 1, or Err5, etc. In the command, wxyz each represent one of the listed ASCII characters which you can build into a string and send to any DPM4 channel . The message must contain exactly 4 digits/characters and may include decimal points after the 1st character which do NOT count as a character. (They are actually part of the character they follow). Some valid messages are: Err5 , Er.r5 , E.r.r.5. , P?.09 which all contain 4 of the listed characters, plus some decimal points scattered. The response is just an 'A'ck character, a display number ('1'-'4') and a terminator. A3^ . Note that this sets the alternate display message but does not display it. See the 'S' command which selects a display style and time for it to display.

Snt^ Show previously created message for display n, either solid or flashing, and either for a timed period or indefinitely until specifically turned off, causing a return to the meter display.

t	Message Display Details
'1' – '6'	Flash the message on/off for 10 thru 60 seconds (10 sec increments), then return to displaying the meter value
'7'	Flash the message on/off for 5 minutes then restore meter
'8'	Flash the message on/off for 10 minutes then restore meter
'9'	Flash the message on/off for 30 minutes then restore meter
':'	Flash the message on/off for 1 hour then restore meter
';'	Flash message on/off indefinitely
'A' – 'F'	Show the message solidly on for 10 to 60 seconds, then return to displaying meter value.
'G'	Show message solidly for 5 minutes, then restore meter
'H'	Show message solidly for 10 minutes, then restore meter
'I'	Show message solidly for 30 minutes, then restore meter
'J'	Show message solidly for 1 hour, then restore meter
'K'	Show the message solidly, indefinitely
'O'	Turn OFF any previous unlimited message and return to displaying meter value. This command also immediately aborts a flashing, or 'timed' message

The response to this command is 'A'cknowledge or 'R'eject (with an error code character) as below.

Ddn^ ***Map a display to a channel***. D is the command character, d is the one-character display number to be mapped, n is the analog channel number the display is to be mapped to. **Example: D21^** . Display 2 is mapped to show data generated for channel 1. The response is 'A'ck or 'R'ejected with an

error code and terminator. A1^ or RE^ Note that multiple displays can be mapped to the same channel for redundant displays.

Tnd^ ***Define channel n type*** as non-differential (d=0) or differential (d='1'-'4') with d indicating which channel is to be subtracted from channel n. Note that a channel subtracted from itself is always zero so n != d . **Example: I13^** . Channel 1 type is to be differential and its output is channel – channel 3. Also note that the two participating channels MUST have the same hardware range so that both channels remain linear through the same range of input.

tn^ ***Return the channel type*** for channel n. The response indicates whether the channel is differential or non-differential, and if differential, which is the participating channel. **Example: t1^ .**

a) If channel 1 is non-differential the response is **A10^** .. 'A'cknowledge, response is for channel 1, and '0' indicates that as defined above in 'T' command, it is non-differential .. no other channel is subtracted from it.
b) If channel 1 is differential the response is **A1x^ ..** 'A'cknowledge**,** response is for channel 1, and 'x' is '2'-'4' indicating which other channel is participating in the differential pair. NOTE that channel 'x' may itself be a differential channel with another channel subtracted from it. That would not alter the Channel 1 display. The Channel 'x' value subtracted from Channel 1 occurs prior to its participation in its own, or any other differential pair. And further, Channel 'x' can still be mapped to a display and scaled/offset way you like because its participation in any differential pairs occurs PRIOR to the application of its scale/offset values. Complicated? .. Yes, Versatile? .. YES!

Nn_w_x_y_z^ ***Store user entry values*** just as the user entered them in the Configurator. This is necessary in order to restore the Configurator's channel frames if the user connects a pre-configured DPM4 and wants to see the parameters as entered. W-x-y-z are each numeric strings from the Input Value Low, Input Value High , Display Value Low , Display Value High fields respectively. When the Configurator finds a DPM4 it retrieves these value for the display. n is the channel number '1' to '4'. The response is An^.

nx^ ***Retrieve Configurator entry values*** (as above). 'n' is the command character and x is the channel number. The response is A_w_x_y_z^ where w,x,y and z

are the numeric strings that were entered into the Configurator and stored previously. (See N command above).

Rp^ ***Set A/D sampling period***. R is the command byte and p is the ASCII parameter directing the A/D to spread its 32 averaged samples (for each channel) equally over the following periods:

p	Sampling Period
'0'	0.25 sec
'1'	0.50 sec
'2'	0.75 sec
'3'*	1.0 sec
'4'	1.5 sec
'5'	2 sec
'6'	5 sec
'7'	10 sec

*Default factory value

V^ ***Retrieve DPM4 firmware version number***. Tis command is used by the Versalent Configurator to validate that a DPM4 is indeed connected to the I2C adapter, and that it is communicating. The response is typically 13 characters : A=DPM4 v1.05^

Command Error Code Reference:

Error Code	Description of Error
1	Unrecognized command
2	Bad Byte Count
3	Invalid Parameter
4	Wrong Number of Parameters
5	Bad Command Length
6	Bad Channel Parameter #1
7	Bad Channel Parameter #2
8	Bad Channel Parameter #3
9	Bad Channel Parameter #4
10	Non-Numeric Parameter
11	Command Buffer Overflow
12	Command Timeout
13	Invalid Channel Number
14	Bad Factory Parameter #1
15	Bad Factory Parameter #2
16	Bad Factory Parameter #3

Command Timing:

Once a command has been started, that is, the first character of a command has been received, the rest of the command must be received within 500ms. If it is not, the partial command received is flushed, an error is issued, and DPM4 is ready for a new command.

Many commands cause the DPM4 to update its non-volatile memory which is a relatively slow process (5ms per byte). So the command response may be delayed by 50-70ms for commands with multiple 8-digit parameters (like 'F' and 'C' commands). The host should wait for a response from each command before issuing any new commands. Typically a host will wait for either a '^' message terminator in the response, or a maximum of 75ms.

Since the non-volatile memory has a limited endurance (100k writes) the host should only issue *configuration* commands when it needs to change DPM4 operation – and not within any frequently repeating software loops. (Configuration commands are those that set an operational parameter and does not include those that merely request data).

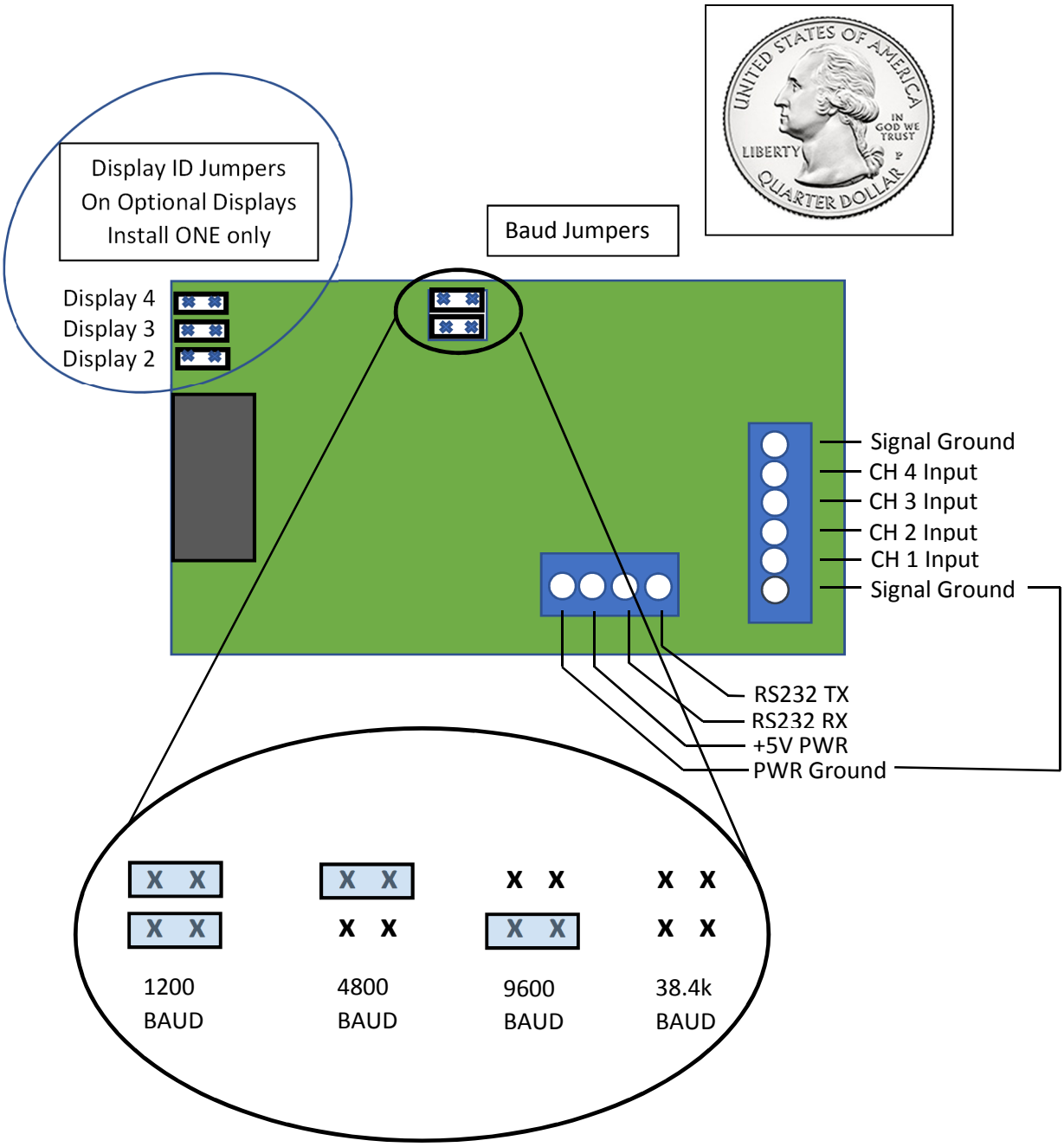
DPM4 Configuration Defaults:

Unless ordered differently, the factory defaults for all channels is as follows:

- Hardware ranges configured per ordered model #. DPM4-W-X-Y-Z. Each letter corresponds to a number from 0 to 18 designating the associated channel's allowable maximum input voltage range.
- Channel Scale = 1.000, PreScale Offset = 0.00, PostScale Offset = 0.00 .
- Channel Types: All Channels non-differential
- Display Mapping: Channel #n -> Display #n n=1-4
- Text Message for Display #n = "CHn[space]" n = 1-4
- Display Refresh Rate = ½ second
- Baud rate 9600 n-8-1

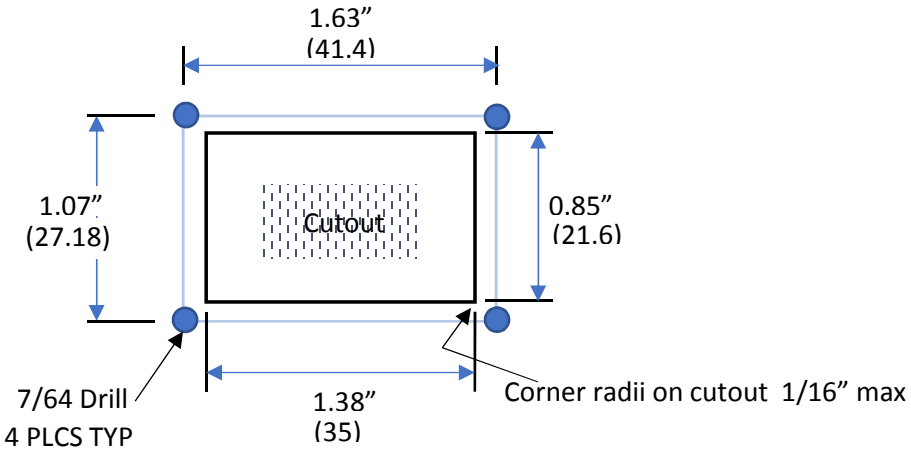
Setting the Baud Rate:

The baud rate is configurable using two small shunt jumpers as shown below. The baud rate is configurable down to 1200 baud to allow for up to hundreds of feet to the RS232 host.



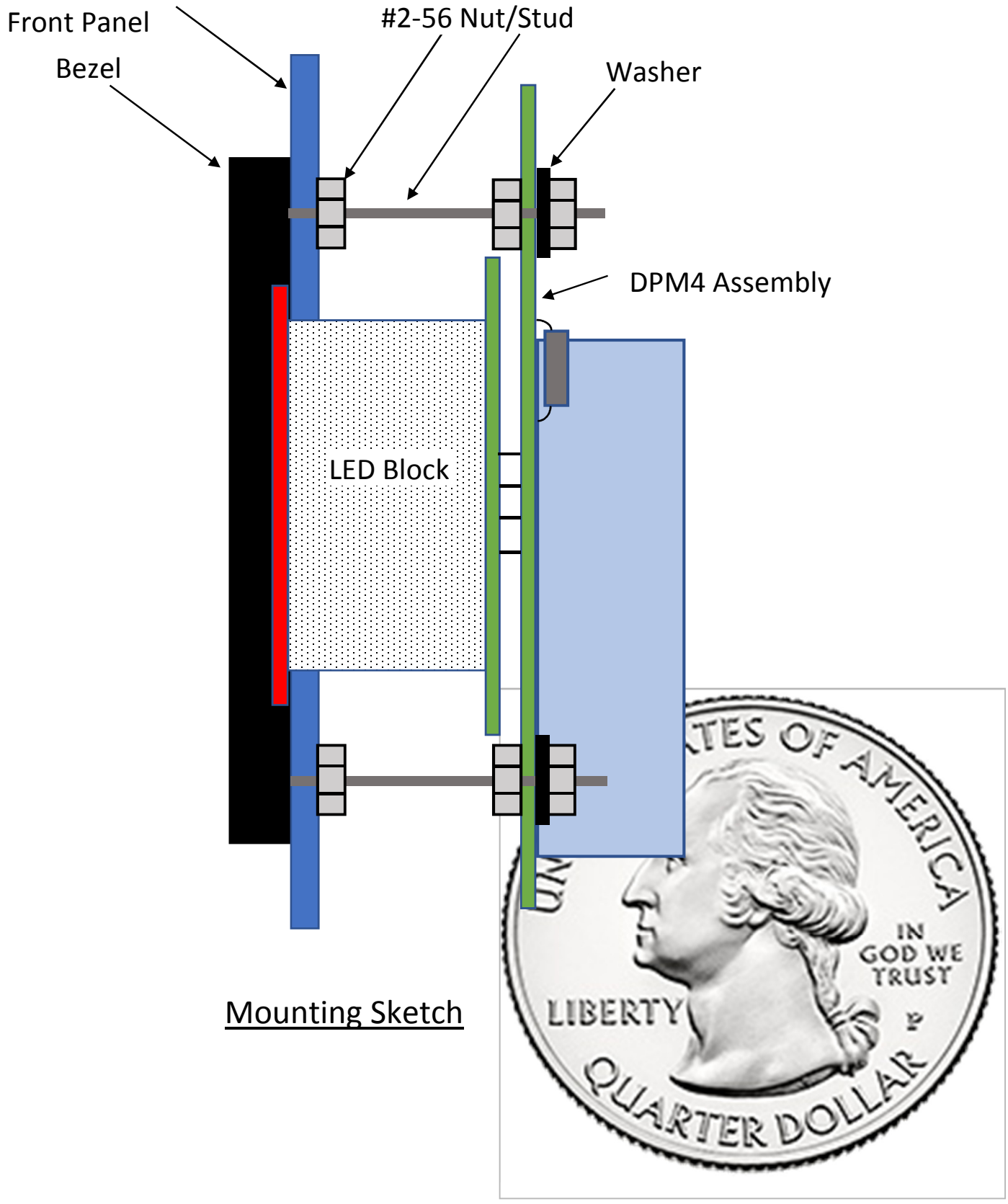
Physical Mounting:

The DPM4 main unit, and each tethered display unit are provided with their own black plastic mounting bezel and mounting hardware. The hole pattern and the panel cut-out diagram are shown below. Can accommodate panel thicknesses of 1/32" to 1/4" (or thicker with recess in rear of panel). The #2-56 mounting hardware is small and assembly requires good dexterity and the ability to work with small parts.



Installation Instructions:

1) Drill the 4 mounting holes and cut the rectangular viewing hole in your panel.
2) Thread the 4 provided 2-56 X 1" studs into the 4 corners of the plastic bezel with finger-tight torque.
3) Install the bezel to the display panel by pushing the threaded studs through the drilled holes, and attaching to the panel with (4) 2-56 nuts. The bezel will be tightly held in place up against your panel.
4) Thread 4 more nuts onto the studs which now protrude through the panel. Thread them down close to the nuts which hold the bezel in place but leave them loose.
5) Place the DPM4 assembly over the studs (with the LED decimal points down) and press gently until the face of the LED contacts the red filter portion of the bezel.
6) While holding the DPM4 LED against the filter, reverse each of the loose nuts on the studs until they contact the DPM4 circuit board. Continue reversing the nut for another ½ turn.
7) Place a nylon washer and nut on each stud that now protrudes through the DPM4 circuit board and tighten lightly. The bezel and DPM4 are now firmly attached to the panel.



Mounting Sketch

FAQ/Trouble-Shooting:

Problem 1:	Display remains at 0 with non-zero voltage applied
Cause #1	Display mapped to wrong channel. Send 'Ddn^' d=display #, n=channel # to map channel input to desired display. n and c are '1'-'4'
Cause #2	Channel scale factor set to 0. Use 'Cn_1_5_0_2^' so set scale factor to 1, display offset to 5. Zero-input should read 5, display increases with input
Cause #3	Channel in differential pair with itself so display = CHx – CHx = 0. Send command 'Tn0^' to set channel n to non-differential mode.
Problem 2:	Display flashes negative when non-negative is expected.
Cause #1	Applying a voltage outside of the Input Range specified during Configurator setup. Adjust input voltage or modify Configurator settings.
Cause #2	Channel is designated in differential pair, and the subtracting channel has a higher value than the applied input. –OR—Channel is in a differential pair with a channel that has different scaling. Differential channels MUST have the same scaling and factory-configured hardware ranges to work correctly. Send command 'tn^ ' . DPM4 will return channel type. 0= non-differential, 1,2,3,4 means this secondary channel is being subtracted from channel n. Check hardware ranges and scaling of participating differential channels.
Problem 3:	Display unexpected shows OL _ _ or OL ¯¯ ‐‐ .
Cause #1	Channel can be in overload (display value > 9999 or < -9999) due to input voltage beyond the range of the factory-configured hardware range, input voltage beyond the Input Low/High values specified during Configurator setup, or channel is in a differential pair and the combined (subtracted) values generate a value beyond the allowable range. Confirm hardware range, scaling, differential mode configuration.
Problem 4:	Display appears on wrong display or displays values are swapped.
Cause #1	Display->Channel mapping incorrect. Send 'dn^' to confirm which channels and displays are mapped to each other.
Cause #2	Hardware Jumpers on the display units are set incorrectly. Display #1 is on the Control Unit, and Displays 2-4 are on daisy-chained display units. The jumpers allow you to designate which one is Display #2, #4 and #4
Problem 5:	Display unit displays corrupted/not stable, flash unexpectedly

Cause #1	Display unit jumpers conflicting. Only one display unit can be jumper-selected to be Display #2, one can be Display #3 , one can be Display #4. Multiple unit set to the same value will cause conflicts.
Problem 6:	Meters not showing values accurately.
Cause #1	**Signal Ground** (on 6-terminal block) and **Power Ground** (on 4-terminal block) ***MUST be connected together***. Refer to above section on single point grounding.

Manual Revision History

Date	Description
11/16/21	Initial release