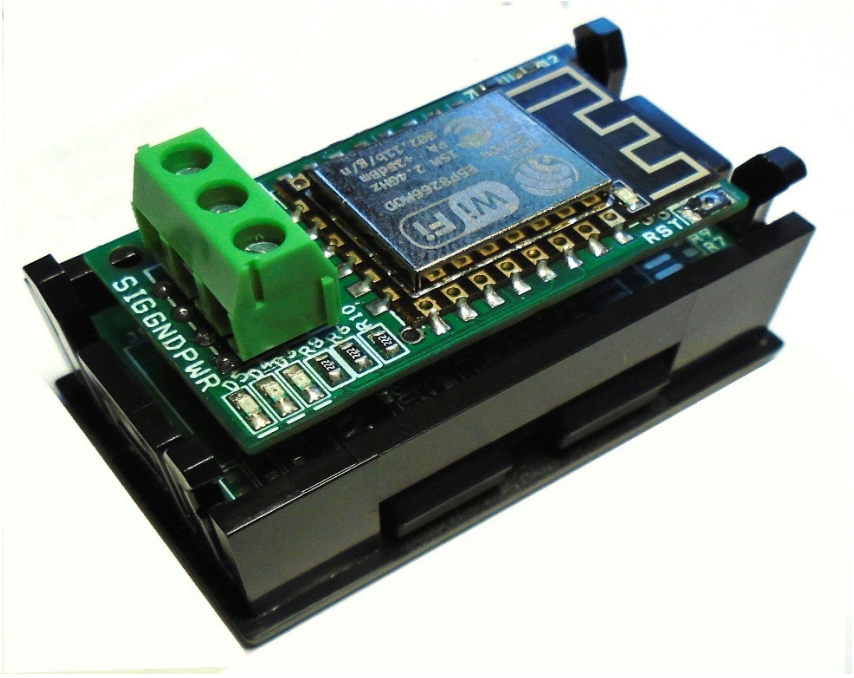
CDPMW (Wifi) Manual

By Versalent **4-digit LED Scaleable/Offsetable Wifi Panel Meter**

Revised 12/12/24



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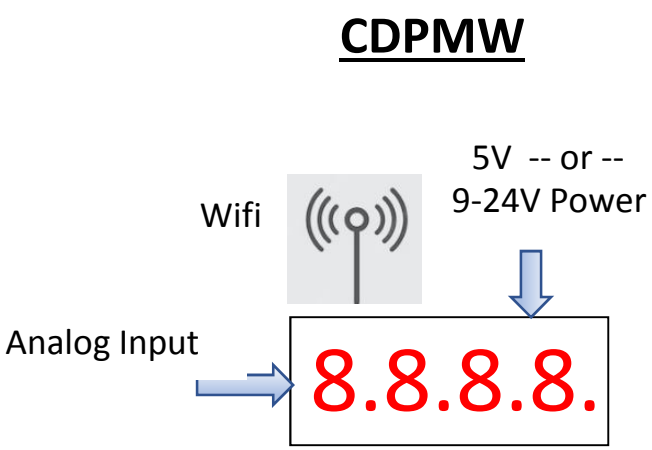
General Description:

The CDPMW is a precision, low-cost, Wifi-enabled panel meter with a 4-digit .36" LED display. It offers user-generated *display offset and scale factors* which separate the measurement scale from the display scale. The result is a meter than can accurately measure an analog input (0-50mv/0-10V etc), and display it as 0.00 to 10.00, or 250.0 to 9560 for instance. The scale factors can even be negative which reverses the display to show 9560 down to 250.0 .

CDPMW accepts configuration commands, and optional run-time commands using the Versalent Command Protocol . The Wifi interface presents a standard http web server which can be accessed using any web browser or other http client. The Versalent Command Protocol (described below) is a very simple protocol/command set that uses ASCII characters – so simple that commands can even be manually entered. Depending on network configuration, the webserver can be accessed from the local network or from around the world.

CDPMW commands allow for user-configuration of the 8-decimal-digit scaling/offset factors.. separate scalings means that the meter's analog input voltage range can be displayed as ANY digital display range. Display values can be calibrated to units other than volts -- so it could accurately show the number of gallons in a tank – even if zero volts does not correspond to zero gallons. (The factory default configuration is scaled to display volts like other meters.)



Without any user configuration the CDPMW operates autonomously displaying Volts. But with any http client, like the Versalent CDPMW Manual Command Tool , it offers more advanced features not available in other low cost meters:

1. **Data Return:**
   Any http client can retrieve the meter readings for logging or perhaps to adjust an industrial process, or issue an alarm.
2. **Dynamic Re-configuration:**

An http client can send a few simple commands to change the scaling and offset to change the display from pounds to kilograms for instance.

3. **Display Functions:**
   An http client can dim the display to one of 8 levels, flash the display, or even show any cryptic text message like 'Err9' that can be assembled from a list of special characters that 7-segment LED digit-displays can emulate.

The real power of the CDPMW is the digital scaling and offsets which provide ***any display for any input***. Calculation of the needed scale factors requires a bit of math that the online Versalent CDPM Simulator does for you. By entering just a few simple values, the scale/offset factors are computed, and can be send with the CDPMW Command Tool or other http client. These values are retained until a new meter configuration is received. You can test-drive the CDPMW with the online configuration and meter simulator tool.

In Summary:

User defined scaling/offset allows the CDPMW to show ANY values between -9999 to +9999 for ANY input range from 50mv to 100V. The meter shows a digitally scaled value in your units … psi in a pipe, gallons in a tank, microns of movement, etc. And because of the programmable offsets, analog zero-input can show a non-zero display. The CDPMW allows the units to be user-defined… ('gallons', 'microns' etc) and although these units are not shown on the LED panel, they are returned with the web response.

CDPMW Advantages:

The CDPM operates like a standard digital panel meter however it offers features not found in other meters:

1. Conventional DPM's offer measurements scaled to 200mv, 2V, 10V etc. and the display shows volts only with no zero-offset capability. The CDPMW also offers this, but *because the display is separately scaled and offset*, it can be calibrated in your units. The full scale input range can be ordered in 21 different ranges (see below) and the measurement resolution is 12-bits.

2. CDPMW outputs its measured value via Wifi to your browser, or computer systems for logging or process control. Over/under range values (beyond +/-9999) cause the associated meter to flash OL ¯ ¯ or OL _ _ (overrange or underrange) . The input is internally protected from excessive voltages.

3. CDPMW operates on a 5VDC, or 9-24VDC power input depending on model.

Input Voltage Ranges Available:

CDPMW offers a wide range of pre-calibrated input voltage ranges so there is never a need to adjust potentiometers. For best measurement resolution, order an input range that most closely encompasses the expected range of input signals, and use the scale factor to get the display readings desired. The input voltage range is defined by assembly configuration and is not user-alterable.

CDPMW Input Voltage Ranges Available

Model Code	Unipolar Input Range (Span)		Model Code	Bipolar Input Range * (Span)
0	0.0V to 50mV		1	-50mV to +50mV
2	0.0V to 100mV		3	-100mV to +100mV
4	0.0V to 200mV		5	-200mV to +200mV
6	0.0V to 1.0V		7	-1.0V to +1.0V
8	0.0V to 2.0V		9	-2.0V to +2.0V
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	0.0 to 100.0V		19	-100.0 to +100.0V
20	4.0mA to 20mA		-	-

TABLE 1

- For bipolar ranges the meter displays a portion of its bipolar voltage reference when the input is left floating

Negative Display Values:

The CDPMW shows up to 3 negative digits (continuously) using the left-most digit as a negative sign. It shows 4 negative digits by alternately flashing the minus sign by itself, then the 4 negative digits so it can display from -9999 to 9999 on a 4-digit display.

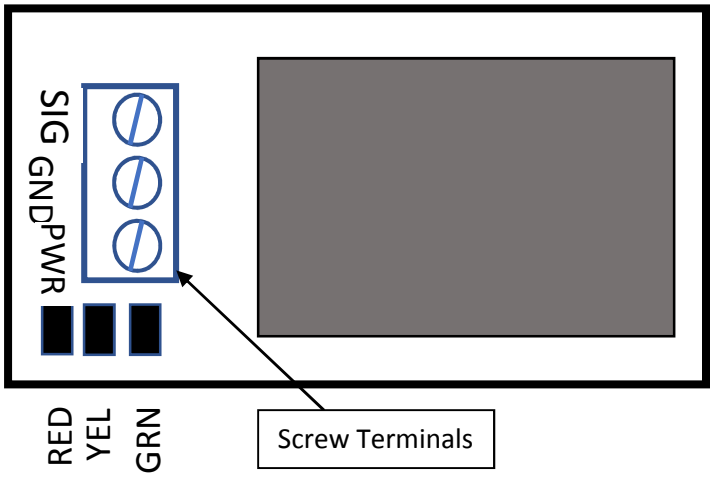
Overload Displays:

Because of the wide-ranging scaleability, and display-offset capabilities, it is possible to generate a display value beyond the -9999 to 9999 range even without exceeding the analog input range.

- If the applied input voltage exceeds the model's range by more than about 1.5% , an overload is generated and the display shows OL‾ ‾ (overscores flash).
- For Bipolar ranges, if the applied input voltage is lower than the model's range by about 1.5% an under-range is generated and the display shows OL _ _ (underscores flash).
- If the input voltage is within the model's range, but the scaling and offset factor cause the display to exceed +9999, the display shows OL‾ ‾ (overscores flash).
- If the input voltage is within the model's range, but the scaling and offset cause the display to be less than -9999, the display shows OL _ _ (underscores flash).
- 4-20mA meters show OL_ _ if the input current is less than 3.8 mA (broken wire).

Signal Connections:

1) 3-Pin Terminal Strip. SIG is the analog input signal to be measured, GND is the power supply and signal ground, and PWR is the 5V or 9-24VDC power input. Recommended wire gauge is #24 stranded with end 'tinned' with solder to insure that all the strands are captured in the terminals.



Rear View of CDPMW

Signal source impedance should be kept as low as possible. Since the CDPMW input impedance is > 1M ohm on all voltage-input ranges, a source impedance of:

- 100 ohms causes a measurement error of no more than 0.01%
- 1000 ohms causes a measurement error of no more than 0.10%
- 10k ohms causes a measurement error of no more than 1.0%

Low Voltage Ranges/Single Point Ground:

The CDPMW provides very low voltage measurement ranges (50mv/100mv/200mv full scale, so lower digits show microvolts). It is very important at these low ranges, that the sensor's ground be connected to the meter's ground very close to the Signal Ground terminal. This 'single-point ground' scheme prevents the meter's LED currents from causing an offset in the meter reading which significantly reduces accuracy.

LED Indicators:

The dual function RED LED stays lit if the CDPMW fails to connect to the configured (SSID/PASSWORD) Wifi network. Once connected, this LED turns off, then flashes briefly if an invalid CDPMW Wifi command is received.

The GREEN LED is on when the CDPMW successfully connects to the local Wifi network.

The YELLOW LED flashes briefly when a valid Wifi command is received.

CDPMW Specifications:

- 1 Analog input with 21 analog input ranges from 50mv to 100V
- 5V @150mA models and 9-24V models (typical 125mA @ 9V, 45mA @ 24V)
- 0.36" high 4-digit LED display (red standard, other colors available)
- 0.25% accuracy all ranges >= 200mv @ 25^{o}C, +/- .01%/^{o}C
- 0.35% accuracy ranges < 200mv @ 25^{o}C, +/- .01%/^{o}C
- Zero-offset factory calibrated to +/- 1 LS digit all ranges
- Input Resistance:
  - UNIPOLAR voltage ranges > 1.0M to signal ground.
  - 4ma-20mA input resistance 100 ohms to signal ground.
  - BIPOLAR voltage ranges > 1M ohm to internal 2.5V reference.

- Dimensions: 1.9” X 1.1” X 1.3””
- Mounts in panel thickness of .030” to .15”
- CDPMW executes Versalent Protocol commands
- Programmable scaling and offset factors from -9999 to +9999 .
- Display Brightness programmable in 8 levels
- Connections via 4MM screw terminals
- Non-volatile parameter configuration endurance: 100k cycles typical
- Receive Sensitivity -88dBm

Connecting to Your Network

The CDPMW provides a web server which executes commands as included in an http Get request. A browser creates these when it accesses the CDPMW’s address/command such as http://192.168.1.21/Command_Parameters^ . Any other http client can be used as well. The CDPMW must connect to a local Wifi network to communicate. The setup process is needed only once each time the CDPMW is moved to a new network. Steps 1-5 are REQUIRED, steps 6-10 are OPTIONAL.

********** Required Steps **********

1) As received from the factory the CDPMW contains the factory’s SSID and PASSWORD so will fail to connect to your network. Arrange to power it up in the vicinity of the Wifi network where it will be used.
2) A Wifi-enabled computer is needed close to the CDPMW to be used to set the new SSID and PASSWORD. -- Power up the CDPMW – when its invalid network credentials make it fail to connect, it enters an AutoConnect mode creating its own temporary SSID named ‘AutoConnectAP’ (no password required).
3) Connect the computer to the AutoConnectAP network... Windows provides a small icon on the screen lower right that shows all available Wifi connections – open this window, note the current connected network. If AutoConnectAP does not appear in the connections-list, refresh the list. Select the ‘AutoConnectAP’ network and click ‘Connect’.
4) Open a browser and enter 192.168.4.1 in the address field. Press the Enter key or the browser’s Reload button -- the SSID/PASSWORD form will appear. Enter the values for <u>your</u> Wifi network and press SAVE. It now has the needed credentials to connect to your network – and has stored them for future use. In a few seconds the Green LED will light noting the connection.
5) If it does not connect, re-power the CDPMW and wait several seconds. Green = connected, Red = NOT connected. Upon connection the meter’s LED display will

sequence through the connected IP octets (assigned by DHCP[1]) and the signal strength - example: 'IP' '192.' '168.' '1.' '6.', 'SS H' . Each item appears for about a second. This is the CDPMW access address followed by the (SS) signal strength indicator which followed by a single letter 'E' (Excellent), 'H' (High) or 'L' (Low).

The above address is used to execute commands -- they appear on the display every time meter is powered up. This address can be used as-assigned, however an IP address provided by DHCP is subject to change. Routers usually try to make the same assignments which persists for perhaps days or weeks -- beyond that the DHCP-assigned IP address could change (lowest octet[2] on a Class-C network, lowest 2 octets on a class-B).

********** **Optional Steps** **********

6) It is more convenient to keep the meter at the same address regardless of the DHCP assignment. The CDPMW provides the ability to do this by setting a different address in a typically unused area of your network range, that will override the DHCP setting and remain fixed – hopefully beyond the range of DHCP assignments.

7) Using the CDPMW's SI command (Save IP) lets you define such an address. For a Class-C network, assign a high value to the lowest octet (like 253 perhaps. Example:192.168.1.253. A class-B network uses the two lower octets[2] .. 192.168.253.253 . DHCP makes its assignments from low to high, so unless your network uses all its available addresses, DHCP will never reach this high up in your network range and the CDPMW address will remain fixed and not conflict. To ***defeat this feature*** and allow the CDPMW to use its DHCP-assigned IP address, save an address that has its lowest octet set to 255 . .. example 192.168.1.255 . The CDPMW will not apply an override address that has its lowest octet set to this value. (Or set any address that is invalid on your network like 192.199.0.0 -- 2nd octet of .199 does not match the .168 network so CDMW will NOT apply the invalid override address).

[1] DHCP (Dynamic Host Configuration Protocol) assigns each network device an IP address
[2] Octets are the groups of digits between the periods in an IP address. Max value is 255.

*As described above, the CDPMW is **always recoverable** even if invalid or network-conflicting settings are entered. An invalid address that prevents connection causes entry into AutoConnect mode.*

Moving to a New Network:

Once a network connection has been established, the CDPMW continues to connect to this 'last successful network' each time it is reset. Moving the CDPMW to a distant network is simple because on power-up, it will fail to connect to that previous SSID, so simply repeat the 5-step process above**.**

However to connect to an alternate network that is ***within Wifi-range of the network that the CDPMW is already connected to*** -- requires an additional step. This step is: **With the CDPMW powered and connected (Green LED ON) .. press and hold the tiny NET switch for at least 3 seconds.** This will erase the currently active SSID and PASSWORD so that the power-up connection fails, allowing the 5-step process above to be executed. The NET switch is the very small pushbutton at one end of the 3-pin screw-terminals. A magnifying glass is helpful, and a small, non-metallic tool is needed to press the tactile-feel button.

(Note that a shorter press of this same switch clears a previously set security key, so if the switch is inadvertently released too quickly the security key may be erased requiring re-entry. See *Command Security* below.)

Operating Without a Wifi Connection:

CDPMW can operate with or without a Wifi connection .. Even if the Wifi is never configured the meter still operates and displays its measured value on the display LEDs. The rear red LED Error indicator will stay on indicating the failed state of the Wifi connection, and no commands can be executed. CDPMW meter scaling will remain at its last-set scaling (from the factory it is scaled to show volts or millivolts as purchased). So the CDPMW can be optionally configured with a Wifi connection, then deployed where there will be no connection – as long as there is no need for dynamic configuration, or for any of the advanced features of the meter.

CDPMW Configuration (CDPMW Manual Command Tool):

The Manual Command Tool (MCT) provides a simple interface for users to set the IP address of the CDPMW as well as set display scaling and execute any of the CDPMW commands described below. This simple tool is operated by opening cdpmwebtool.htm with any standard web browser. Restriction: internet security requires that this .htm file, along with its associated group of files, MUST reside on a computer/laptop that is connected to the same local network as the CDPMW.

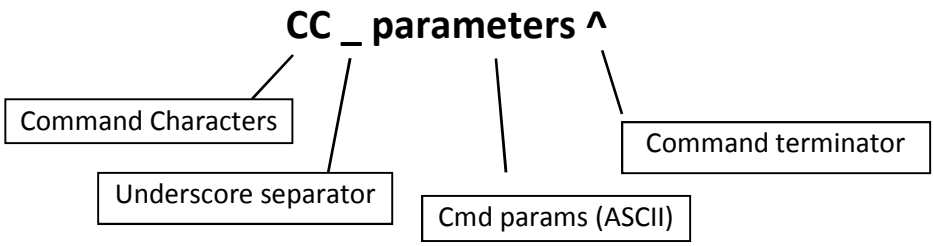
This tool (.zip file) can be downloaded from www.versalent.biz/downloads/cdpmwebtool.zip
Unzip to any directory then open cdpmwebtool.htm .

Protocol/ Command Set

The CDPMW presents an HTTP web server that responds upon command from a WIfI client. It only responds when a command is sent to the its uniquely-assigned IP address (port 80 = standard http). Multiple CDPMWs cannot talk to each other, and they do not initiate any conversations with clients. Just like all standard internet webservers they await a client's request for service.

Versalent Command Protocol

Versalent Protocol Commands contain all ASCII characters -- see below. The two-character ASCII command characters are followed by optional parameters, and terminated with a '^' character. This command string must be part of an http GET request issued from a browser or other html client: Example 192.168.1.21/Command-text All correctly addressed commands (with valid or invalid command formats) **receive an html response** containing a <DATA>result</DATA> section for easy extraction by automated clients. Because it is html it is viewable with a browser. The result could contain valid data, or an 'E-3^' error-code. The command format:



The underscore character '_' is the field-separator, and one must appear before each command parameter. The result also separates returned parameters with a '_'. After a command is processed an html response containing a string result is returned to the client. All result strings start with a single character indicating 'A'cknowledge or 'E'rror. An 'E'rror result always includes an error code (see error codes following command table) . Normal result format:

A_p1_p2^ An acknowledge result can include optional underscore-separated parameters and ends with a '^' result terminator character.

E_e^ Error Text Error result for a bad/missing parameter, command timeout etc

e is a 1 or 2 ASCII digit code identifying the error -- separator character precedes the error code . ^ is the result terminator Following this is a short text description of the error.

When a command returns no data/parameters the result is the acknowledge 'A' character followed by a result terminator A^ (no separator).

Commands should be issued one at a time with the sender waiting for a response before issuing another command. Non-browser clients should implement a response-timeout to recover from a 'missing' response – like browsers do.

Versalent Command Descriptions:

Command	Description
SI_x_s^	**Set CDPMW IP Address**. 'x' represents a valid IP string to override the DHCP address setting. 's' is the single character 'C' or 'B' to designate a class-C or B network respectively. This command must be sent using the currently connected address, and it does not take effect until the next power-up cycle. The address MUST reside on the current network. So for a Class-C network, if DHCP assigned 192.168.1.6, you can assign an otherwise UNUSED override address such as 192.168.1.200_C (check with network admin). **Stored in non-volatile memory.** The result is an 'A'cknowledge character followed by the IP and terminator A_192.168.1.200^ Note that the connected IP address is shown on the LED display during startup. This is a protected command… see Command Security)
GI^	**Get CDPMW IP Address**. Return the saved IP address and port. A typical result is A_192.168.1.6:82^ . Note: the CDPMW will *try* to use these values at startup. That is, after power-up and getting an initial IP address from DHCP, the CDPW will then override this address with the user-saved address ***if the saved address resides on the same network*** it is currently connected to.
BR_x^	***Set/Get Meter Brightness*** The meter can be set to one of 8 brightness levels. X is a single ASCII character - '0' to '7' (preceded by a '_' parameter separator) which sets the level with '7' being the brightest. Factory default is '3'. The result is an ""A^" acknowledge. Value is **stored in non-volatile memory.** If the command is issued without a parameter ("BR^") the current brightness is returned as part of the acknowledge: "A_x^"
SS_ x_y_z_n^	***Set Scaling and Offsets*** The x,y,z parameters (scaling, prescale offset, postscale offset) are the parameters that control the CDPMW's display scaling. Each is an up-to-8 decimal digit factor generated by the online CDPM Simulator, and each parameter is preceded with a '_' parameter separator. For dynamic scaling, a client can send a different set of previously generated (3 or 4) parameters. The last parameter is optional and can have only two values – none, or the character 'n' : when 'n' is present it causes **storage in**

nonvolatile memory so the meter retains this scaling through power cycling. Without this parameter the meter operates in a 'temporary' (non-persistent) configuration and will revert to its last nonvolatile configuration on reset. The result is an "A^" acknowledge. This is a protected command… see Command Security)

RS^ ***Return Meter Scaling and Offsets*** This command returns the current configuration factors (scaling, prescale offset, postscale offset each preceded by a parameter separator) see x,y,z parameters immediately above. It retrieves them from operating storage (not nonvolatile) so if the meter is operating with a 'temporary' configuration, those are the parameters in effect, and those are returned. Typical result:

A_0.994669_450.0_120.0^

RN^ ***Return the model number*** string from the unit. The result is an 'A'cknowledge character, a parameter separator '_' ,then the full model number including input-range designation, then result terminator. Example:

A_CDPMW-14^

RL^ ***Return serial number*** string from the unit. The result is an 'A'cknowledge character followed by a parameters separator '_' , the 7-decimal digit serial number, and the result terminator. Example:

A_1234567^

RM^ ***Return Meter Display***. This command returns the (string) value that the meter most recently measured/displayed. During a text message display, this command continues to return meter measurements – not the text message on the display. If an overload HIGH "OL~ ~' or LOW "OL_ _" condition occurs, that text will be returned since there is no valid measurement available. Otherwise the numeric display value is returned . The result is a string containing the 'A'cknowledge character , a parameter separator, and the displayed digits/decimal. Example result:

A_-60. 24^ (optional UNits .. see below)

Note: if the display is alternately flashing the negative sign, and 4-digit value as described previously in **Negative Display Values**, the returned value will include the negative sign and remain steady .. it does not 'flash' like the LED display.

UN_x_ko^ ***Set Measured Units .***. when the meter display (RM^ command) is returned, measurement units can be displayed -- a text description that follows the value in the html response. It can be 'Volts', 'gallons', 'nanometers' etc – whatever the meter has been scaled to measure. 'x' is the string to be displayed after the meter value. K is the security key which protects the command, and 'o' has two possible values .. '_strip', or (empty) . If set to '_strip', the leading 'A_' and trailing command terminator '^' characters are removed from the response. The Units string and strip control are **stored in nonvolatile memory.** This is a protected command… see Command Security)

Unstripped response: **A_12.45^ Microns** … stripped: **12.45 Microns**

Example command: UN_volts_MYKEY_strip^

AN_x^ ***Set Annunciator LED .***. CDPMW can momentarily flash the LED display's right-most decimal point to indicate 'Command Received'. This provides the same function as the (rear) Yellow LED, but allows an operator to confirm activity from the front side of the meter. The feature is turned ON when x = '1' and OFF when x = '0' . Factory default is ON. The result is an "A^" acknowledge . **Stored in non-volatile memory.**

CM_x^ **Create Message** .. This command allows you to create a cryptic text message which is NOT displayed until a subsequent 'SM' (show message) command is issued. The four 7-segment displays can each show the following list of characters only:

A C E F H I L O P U b c d l l n o r u – 0 1 2 3 4 5 6 7 8 9 _ ? and ASCII Space for an empty character position . The x parameter represents a sequence of exactly 4 of these characters (no string terminator). Some valid text messages are: "Err5" , " P?09" . In addition, periods can be displayed AFTER any of the 4 characters by altering the preceding character setting its bit 8 to 1. So "P?En" is a valid 4 character message, and by altering the 'P' character from its normal 0x50 to 0xD0 (setting bit8=1) the display would be "P.?En " … Each of the 4 characters may display a trailing period. The result is an "A^" acknowledge. Stored in volatile memory.

SM_f_t^ **Show Text Message ..** displays either solid or flashing, and either for a timed period or indefinitely until specifically turned off causing a return to the meter display.

F = 'S' (message ON solidly, no flashing)
f = 'F' (message flashes)
f = 'O' (turn current message OFF)

t = 1 to 4 ASCII numeric digits ('0' – '3600') specifying the number of seconds the message should persist with '0' (zero) means the message remains ON indefinitely. (When f='O' , t can be any valid value). The result is an "A^" acknowledge .

RV^ ***Return CDPMW firmware version ..*** The result is an acknowledge followed by a version string parameter : A_CDPMW v1.05101^

ST^ ***Show Signal Strength..*** the Wifi signal strength is returned as 'EXLNT', 'HIGH', or 'LOW'. , followed by the numeric value measured in dbm:

A_EXLNT (-68dbm)^

SK_new_cur^ ***Set Security Key..*** 'new' is the new key to be assigned and 'cur' is the current key. Both are 0-12 character strings of ASCII characters which may not include the special characters '^' , '%' , '_' , ' " ' . This command allows the owner to prevent other network users from altering the basic setup and function of the meter. This is a protected command… see Command Security)

Access Tools Available:

Versalent provides two tools to access the CDPMW and execute commands: a Desktop tool and a Mobile tool. Neither requires an installation since they are web-page applications that use a standard browser, but each requires a simple configuration that allows it to handle both secure and unsecured connections (http: and https:). The 'help' links within these tools describes the necessary steps.

Command Security:

Even if the CDPMW/server has only private-network access, the owner may wish to protect the meter's configuration while allowing others access to other meter features. Setting the security key allows only the owner to change the IP address, meter scaling, and security key. Initially the key is empty – no key required and all network users can change access/scaling parameters. Once a key is set, the 4 commands referenced can only be executed by including the key in those commands.

Example: -- The unprotected command to change the IP address is:

SI_192.168.1.21_C^

While the protected version of the command with the key appended is:

SI_192.168.1.21_C_key^

If the key is lost or forgotten, pressing the NET switch for less than 1 second clears the key to empty.

Non-Volatile Memory:

Many commands cause the CDPMW to update its non-volatile memory. Since this memory has a limited endurance (100k writes) the host should not send non-volatile *configuration* commands within any frequently repeating software loops. The non-volatile commands are identified in the Command Set above.

Versalent 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 Parameter #1
'7'	Bad Parameter #2
'8'	Bad Parameter #3
'9'	Bad Parameter #4
'10'	Non-Numeric Parameter
'11'	Command Buffer Overflow
'12'	Command Timeout
'13'	Bad Command
'14'	Invalid command key
'15'	Command failed
'16'	Invalid Security Key

CDPMW Factory Defaults:

Unless ordered differently, the factory defaults for a CDPMW are as follows:

- Input ranges configured per ordered model #. CDPMW-R. R corresponds to a number from 0 to 20 designating the CDPMW's input voltage Range.
- Channel Scale/Offset = dependent on meter range. Scale/PreOffset/PostOffset factory set to display the input as volts (or millivolts) depending on model.
- Annunciator LED = ON
- Meter Brightness Level = 3 (of 7)
- IP Address = 192.168.1.21 on factory's network (SSID) .

CDPMW Technical Info:

Comparison to Standard Dual-Slope Integrating Meters:

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

Noise Cancellation:

Another reason the dual-slope A/D conversion method was widely adopted for meters is its inherent noise immunity. Noise frequencies higher than 2X the sampling rate are reduced by the integration process. The CDPMW uses a similar 'digital integration' technique which emulates analog integration to reject noise.

Measurement Resolution:

CDPMW measurements are 12-bit (0 – 4095 A/D counts) however the upper 95 counts are reserved for offset and calibration uses, so measurements use the range of 0 – 4000. Therefore measurement resolution is +/- 1/4001 = +/-0.025% . Total measurement accuracy is +/- 0.25% from 10C to +40C .

Display Resolution:

The 4-digit display can show 0-9999 counts, so has a maximum resolution of +/- 1/10000 = +/- .01% (more than 2X higher than the measurement resolution). When digital scaling is set to show a maximum display of 4000, the measurement and display resolutions are the same, and each increment of measurement results in 1 count on the display.

If the display is scaled-up to show 8000 as its maximum, then as the measurement changes by one increment, the display will change by two units. For displays scaled to greater than 4000 units, display resolution = maximum display units/4000.

Calibration:

CDPMW achieves it accuracy using two sets of digital calibrations factors:

1) Factory Calibration Factors .. these compensate for component tolerances, offsets etc – anything that contributes to the meter's zero or full scale inaccuracies. After factory calibration these values never change and are not alterable by the user.
2) Scale/Offset Factors .. these are the user-factors generated by the Simulator or Configurator applications and provide the meter with its ability to scale the display to any units. User can change scaling at any time as needed.

Both sets of digital calibrations are up to 8-decimal digits which assures that calculation accuracies are much better than 1 least-significant meter digit.

(*) The internal reference voltage is used to compare against 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.

Digital Stabilization:

Noise in the measured signal can make a digital meter's least significant digits 'bounce' between digits especially if the signal is near the threshold between one digit and the next. CDPMW uses 'close-in filtering' to prevent this digit-bounce and stabilize the display. Small changes to the least significant display digit must persist for several A/D conversions before a change is made to the displayed value.

FAQ/Trouble-Shooting:

Problem 1:	Red LED ON, Green Off
Cause 1	This indicates no Wifi connection. The SSID and PASSWORD for the local network have not been set/are incorrect. See Connecting To Your Network above.
Cause 2	No Wifi coverage at CDPMW location. If mounted in a metal panel it may be shielding the CDPMW antenna – may need to move the access point or provide a stronger Wifi signal.
Problem 2:	Green LED lit but no response to commands.
Cause 1	Command address or port does not match CDPW or they are inaccessible. Check if ANY LEDs flash when a command is sent – if not, the IP Address or port may be blocked by a router or firewall. If Red LED flashes, the command is arriving but has an invalid format. An error

	response should be received. If Yellow LED flashes, the command is valid and a response was sent. Selected port must be opened to both send and receive.
Problem 3:	Meter display stays at zero as analog voltage changes.
Cause 1	Scale factor is set to 0.
Cause 2	Signal wire broken/not attached to CDPMW terminal strip.
Problem 4:	Display flashes negative when non-negative is expected.
Cause 1	Signal ground not connected to CDPMW ground.
Cause 2	Incorrect scale or offset factors set. Check values by reading from meter.
Problem 5:	Display unexpected shows OL _ _ or OL -- --- .
Cause 1	Meter in overload (display value > 9999 or < -9999) due to input voltage beyond the range of the factory-configured input range or input voltage beyond the Input Low/High values specified in Simulator.
Cause 2	Scale factor too large (positive or negative) causing the multiplication of signal measurement to exceed 9999 positive or negative.
Problem 6:	(Bipolar Ranges) Floating input does not read 0.0 volts
Cause 1	Bipolar ranges use an internal voltage reference used as an 'input offset'. ***It is normal*** that an unconnected input will display the offset (or part of it), and not 0.0 volts. Connect the input to a signal voltage within the input range.
Problem 7:	Meters not showing measurements accurately.
Cause 1	**Signal Ground** should be connected to ground at/near the CDPMW connector -- (Single Point Ground). If the signal ground is connected to CDPMW ground some distance from the CDPMW, then power supply currents flowing in the ground wire can add/subtract from the signal voltage creating measurement offsets and inaccuracies.

Manual Revision History

Date	Description
11/22/24	Initial release
12/7/24	Update text in several areas
12/12/24	Add section 'Access Tools Available'