Bitronics

D650 Universal/Remote Display

User Manual

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VERSION HISTORY (ABRIDGED)

V1.00	2016-03-08	D650 Initial Release
V2.00	2018-06-29	D650 Client Protocol
V2.12	2019-08-15	D650 Client Protocol Flex Scaling
V2.14	2020-04-20	Supports 32-bit integer, multiple counters, two-row displays
V2.20	2021-01-08	Enhanced configuration of Universal Display

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CERTIFICATION

Bitronics LLC certifies that the calibration of our products is based on measurements using equipment whose calibration is traceable to the United States National Institute of Standards Technology (NIST).

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In order to maintain UL recognition, the following Conditions of Acceptability shall apply:

a) After installation, all hazardous live parts shall be protected from contact by personnel or enclosed in a suitable enclosure.

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This product is warranted against defects in materials and workmanship for a period of one-hundred-and-twenty (120) months from the date of their original shipment from the factory. Products repaired at the factory are likewise warranted for eighteen (18) months from the date the repaired product is shipped, or for the remainder of the product's original warranty, whichever is greater. Obligation under this warranty is limited to repairing or replacing, at our designated facility, any part or parts that our examination shows to be defective. Warranties only apply to products subject to normal use and service. There are no warranties, obligations, liabilities for consequential damages, or other liabilities on the part of Bitronics LLC except this warranty covering the repair of defective materials. The warranties of merchantability and fitness for a particular purpose are expressly excluded.

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DNP DNP3

The following are trademarks or registered trademarks of Schneider Automation, Inc.:
MODSOFT Modicon Modbus Plus Modbus Compact 984 PLC

SAFETY SECTION

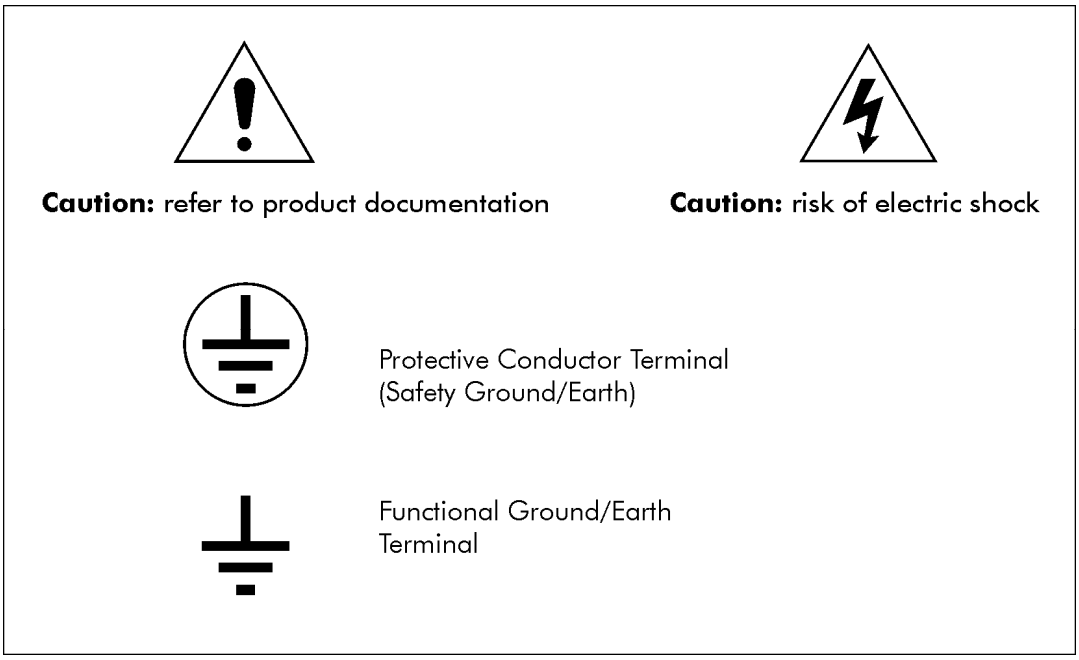
This Safety Section should be read before commencing any work on the equipment.

Health and safety

The information in the Safety Section of the product documentation is intended to ensure that products are properly installed and handled in order to maintain them in a safe condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of the Safety Section.

Explanation of symbols and labels

The meaning of symbols and labels that may be used on the equipment or in the product documentation is given below.



Installing, Commissioning and Servicing

Equipment connections

Personnel undertaking installation, commissioning or servicing work on this equipment should be aware of the correct working procedures to ensure safety. The product documentation should be consulted before installing, commissioning or servicing the equipment.

Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated.

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If there is unlocked access to the equipment, care should be taken by all personnel to avoid electric shock or energy hazards.

Voltage and current connections should be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety. To ensure that wires are correctly terminated, the correct crimp terminal and tool for the wire size should be used.

Before energizing the equipment, it must be grounded (earthed) using the protective ground (earth) terminal, or the appropriate termination of the supply plug in the case of plug connected equipment. Omitting or disconnecting the equipment ground (earth) may cause a safety hazard.

The recommended minimum ground (earth) wire size is 2.5 mm^2 (#12 AWG), unless otherwise stated in the technical data section of the product documentation.

Before energizing the equipment, the following should be checked:

1. Voltage rating and polarity
2. CT circuit rating and integrity of connections
3. Protective fuse rating
4. Integrity of ground (earth) connection (*where applicable*)
5. Equipment operating conditions

The equipment should be operated within the specified electrical and environmental limits.

Current transformer circuits

Do not open the secondary circuit of a live CT since the high voltage produced may be lethal to personnel and could damage insulation.

Insulation and dielectric strength testing

Insulation testing may leave capacitors charged up to a hazardous voltage. At the end of each part of the test, the voltage should be gradually reduced to zero, to discharge capacitors, before the test leads are disconnected.

Do not attempt to perform installation, maintenance, service or removal of this device without taking the necessary safety precautions to avoid shock hazards. De-energize all live circuit connections before work begins.

Fiber optic communication

Where fiber optic communication devices are fitted, these should not be viewed directly. Optical power meters should be used to determine the operation or signal level of the device.

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WARNING: EMISSIONS – CLASS A DEVICE (EN55011)

This is a Class A industrial device. Operation of this device in a residential area may cause harmful interference, which may require the user to take adequate measures.

DECOMMISSIONING AND DISPOSAL

1. Decommissioning

The auxiliary supply circuit in the equipment may include capacitors across the supply or to ground (earth). To avoid electric shock or energy hazards, after completely isolating the supplies to the meter (both poles of any dc supply), the capacitors should be safely discharged via the external terminals before decommissioning.

2. Disposal

It is recommended that incineration and disposal to watercourses is avoided. The product should be disposed of in a safe manner. Any products containing batteries should have them removed before disposal, taking precautions to avoid short circuits. Particular regulations within the country of operation may apply to the disposal of lithium batteries.

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1.0 DESCRIPTION & SPECIFICATIONS

1.1 Introduction

There are two versions of the D650 Display. The D650 Universal Display (D650MX) connects to other equipment via Modbus or DNP3 Serial or TCP/IP to display values from that equipment using over 50 predefined screens of common three-phase power system measurements, and up to 30 user configurable screens. The D650BX Detached Display is targeted to replace the Model M870D Detached Display. The Model D650BX connects to 70 Series IEDs or PPX II devices through one of their serial communications ports. The Model D650BX is designed to provide a convenient way to view measurements made by 70 Series or PowerPlex II IEDs. A maximum of 64 (when used with 70 Series) or 10 (when used with PowerPlex II) user-configurable measurement screens can be displayed. The instrument can be set to display a single screen continually or automatically scroll through all available screens. Additionally, the user may manually step through all available screens. All the screens can be scrolled.

Three individual D650 Displays may be mounted horizontally on a 19” panel, if desired.

1.2 Features

1. Modbus or DNP3 Serial or TCP/IP Client Protocol (D650MX)
2. Flex scaling and measurement assignment in D650MX Universal
3. Configurable RS-232/RS-485 serial port
4. Wide-range universal power supply
5. Rugged aluminum 4” round industry standard case.
6. 3-line at once, easy-to-read, long-life LED displays
7. Ultimate precision with five digits per line
8. Instant recognition of the displayed function from the alphanumeric display in engineering units
9. Easy setup and scrolling from front display with “Touch-Sense” buttons
10. Configurable Display ID addresses and baud rate settings
11. Web-based configuration via Ethernet service port for D650MX, limited setup for D650BX.
12. PC based Configuration utilizing 70 Series software tools when using with Mx7x devices.

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1.3 Specifications

1.3.1 Power Supply Input (Auxiliary) Voltage	
Input Terminals	L1(+) and L2(-); Safety ground stud
Installation Category (Auxiliary power supply)	CAT II. Refer to definitions below.
Nominal	48-250V dc, 69-240V ac (50/60Hz)
Operating Range	36-300V dc, 55-275V ac (45-65Hz)
Burden	8W max, 24VA max

1.3.2 Display	
Display	3 lines of 5 digits, Red LED, 0.56” High 1 line 8-character alphanumeric, Red LED, 0.20” High
Display Interface	4 buttons
Distance (max)	50 ft. (15m) RS232, 4000 ft. (1200m) RS485
Addressability (Display ID)	Configurable Display Addresses 1 .. 15 (D650BX)

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1.3.3 Communication Ports – Serial & Ethernet	
Serial port (Display; Modbus RTU, DNP3 – D650MX)	RS-232, RS-485 (4-wire), full duplex, Software configurable port.
	Baud rate: Configurable, 9600, 19200, 38400, 57600, 115200 bps, D650BX Display's baud rate settings must match the port baud rate settings on 70 Series (M87x, M57x) or PowerPlex II (PPX II)
	Parity: Configurable; factory default setting is None.
	Fixed Serial Communication Parameters: 8 bits & 1 stop bit.
Ethernet	Single port; copper 10/100 Base-TX (standard) RJ45.

1.3.4 Environmental	
Operating Temperature	-40C to 70C
Relative Humidity	0-95% non-condensing
Pollution Degree	Pollution Degree 2. Refer to definitions below.
Enclosure Protection (to IEC60529: 2001)	Front Panel: IP 20, Rear: IP 20 When equipment is mounted in an appropriately rated protective enclosure to NEMA or IP protection classifications, as required for the installation. Ratings are applicable for enclosure category 2 (see definitions)
Altitude	Up to and including 2000m above sea level
Intended Use	Indoor use; Indoor/Outdoor use when mounted in an appropriately rated protective enclosure to NEMA or IP protection classifications, as required for the installation. Class 1 equipment to IEC61140: 2001

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1.3.5 Physical		
Connections  (located on back panel)	Protective Conductor Terminal	10-32 Studs for connection with protective earth ground. Recommended Torque: 12 In-Lbs, 1.36 N-m Cable temperature rating: 85C minimum
	Voltage (AUX PWR only)	Terminal Block accepts #22-10 AWG (0.35 to 5mm^2) wire, or terminal lugs up to 0.375" (9.53mm) wide. Precautions must be taken to prevent shorting of lugs at the terminal block. A minimum distance of 1/8" (3mm) is recommended between uninsulated lugs to maintain insulation requirements. Recommended Torque: 9 In-Lbs, 1.02 N-m Cable temperature rating: 85C minimum. Note: On the Model D650 Display the terminals VA, VB, VC, VN on the terminal block are disconnected and do not function as inputs).
	Serial Port (Display)	6 position removable terminal block, accepts 26-14AWG solid or 26-12 AWG stranded wire. Recommended Torque 7 in-lbs, 0.79 N-m. Cable temperature rating: 85C minimum.
	Ethernet	RJ45, 8 position modular jack, Category 5 for copper connection; 100m (328 ft.) UTP (unshielded twisted pair) cable.
Weight (typical)	1.8 lbs (.8 kg)	
Size	Industry standard 4” round case, 7.0 inches long	

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Definitions:

Enclosure Category 2: Enclosures where no pressure difference relative to the surrounding air is present.

Installation Category II (Overvoltage Category II) or CAT II: Equipment is intended for connection to the fixed installation of a building. The power supply to the electronic equipment is separated from other circuits, usually by a dedicated transformer for the mains power supply.

Measurement/Installation Category III (Overvoltage Category III) or CAT III: Distribution Level, fixed installation, with smaller transient overvoltages than those at the primary supply level, overhead lines, cable systems, etc.

Pollution: Any degree of foreign matter, solid, liquid, or gaseous that can result in a reduction of electric strength or surface resistivity of the insulation.

Pollution Degree 2: Only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is to be expected.

1.4 Standards and Certifications

UL/CSA Recognized, File Number E164178
UL61010-1, Edition 3, Issue Date 2012/05/11
Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements
UL61010-2-30, Edition 1 – Issue Date 2012/05/11
Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2: Particular Requirements for Testing and Measuring Circuits

CSA C22.2 No. 61010-1-12-CAN/CSA, Edition 3, Issue Date 2012/05/01
CAN/CSA Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements
CSA C22.2 No. 61010-2-30-12-CAN/CSA, Edition 1 – Issue Date 2012/05/01
Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-030: Particular Requirements for Testing and Measuring Circuits

If applicable, the CE mark must be prominently marked on the case label.

CE European Community Directive on EMC (EMCD) 2014/30/EU, superseding 2004/108/EC and Directive 91/263/EC [TTE/SES].
European Community Directive on Low Voltage (LVD) 2014/35/EU, superseding 2006/95/EC

Product and Generic Standards
The following product and generic standards were used to establish conformity:
Low Voltage (Product Safety)
IEC 61010-1, Edition 3, Issue Date 2010
Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements
IEC 61010-2-30, Edition 1 – Issue Date 2010
Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-030: Particular Requirements for Testing and Measuring Circuits

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EMC: EN 61326-1: 2013 (Supersedes EN61326-1: 2006), EN 61000-6-2: 2005 + AC: 2005 (supersedes EN 61000-6-2:2005),
EN 61000-6-4: 2007 + A1:2011 (IEC date 2010)

Radiated Emissions Electric Field Strength
EN 55011: 2009 + A1: 2010
EN 55011: 2016
EN 61000-6-4: 2007 + A1:2011 (IEC date 2010
Group 1, Class A
Frequency: 30 - 1000 MHz

AC Powerline Conducted Emissions
EN 55011: 2009 + A1: 2010
EN 55011: 2016
EN 61000-6-4: 2007 + A1:2011 (IEC date 2010
Group 1, Class A
Frequency: 150 kHz – 30 MHz

Conducted Emissions, Telecommunication port (Ethernet port)
EN 55022: 2010 + AC: 2011
EN 55032: 2012 + AC: 2013
EN 55032: 2015 + AC: 2016-07
Group 1, Class A
Frequency: 150 kHz – 30 MHz

Electrostatic Discharge (ESD)
EN61000-4-2: 2009
Discharge voltage: ± 8 KV Air; ± 4 KV Contact & Additionally meets ± 6 KV Contact

Immunity to Radiated Electromagnetic Energy (Radio Frequency)
EN 61000-4-3: 2006 + A1: 2008 + A2:2010, Class III
Frequency: 80 – 1000 MHz, Amplitude: 10.0 V/m, Modulation: 80% AM @ 1 kHz
Frequency: 1400 – 2000 MHz, Amplitude: 3.0 V/m, Modulation: 80% AM @ 1 kHz
Frequency: 2000 – 2700 MHz, Amplitude: 1.0 V/m, Modulation: 80% AM @ 1 kHz
Digital Radio Telephones:
Frequency: 900 MHz & 1890 MHz, Amplitude: 10.0 V/m, 3.0 V/m,
Modulation: 80% AM @1kHz

Electrical Fast Transient / Burst Immunity
EN 61000-4-4: 2012 (supersedes EN 61000-4-4: 2004 + A1:2010)
Burst Frequency: 5 kHz
Amplitude, AC Power Port: ± 4 KV (Severity Level 4), exceeds ± 2 KV requirement
Amplitude, Signal Port: ± 1 KV, Additionally meets ± 2 KV (Severity Level 3)
Amplitude, Telecom ports (Ethernet): ± 1 KV

Current/Voltage Surge Immunity
EN 61000-4-5: 2014 (supersedes EN 61000-4-5: 2006)
Open Circuit Voltage: 1.2 / 50 μs
Short Circuit Current: 8 / 20 μs
Amplitude, AC Power Port: ± 2 KV common mode, ± 1 KV differential mode

Immunity to Conducted Disturbances Induced by Radio Frequency Fields
EN 61000-4-6: 2014 (supersedes EN 61000-4-6: 2009)
Level: 3
Frequency: 150 kHz – 80 MHz

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Amplitude: 10 V rms
Modulation: 80% AM @ 1 kHz

Power Frequency Magnetic Fields
EN 61000-4-8: 2010
Amplitude: 30A/m
Frequency: 50 and 60 Hz

AC Supply Voltage Dips and Short Interruptions
EN 61000-4-11: 2004

Surge Withstand Capability Test For Protective Relays and Relay Systems
ANSI/IEEE C37.90.1: 2002 (2.5 kV oscillatory wave and 4 kV EFT)

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2.0 PHYSICAL CONSTRUCTION & MOUNTING

The D650 meters are packaged in rugged aluminum cases specifically designed to meet the harsh conditions found in utility and industrial applications.

The Front panel view is shown in Figure 1. The mechanical dimensions are shown in Figure 2.

Figure 1 –D650 Front View

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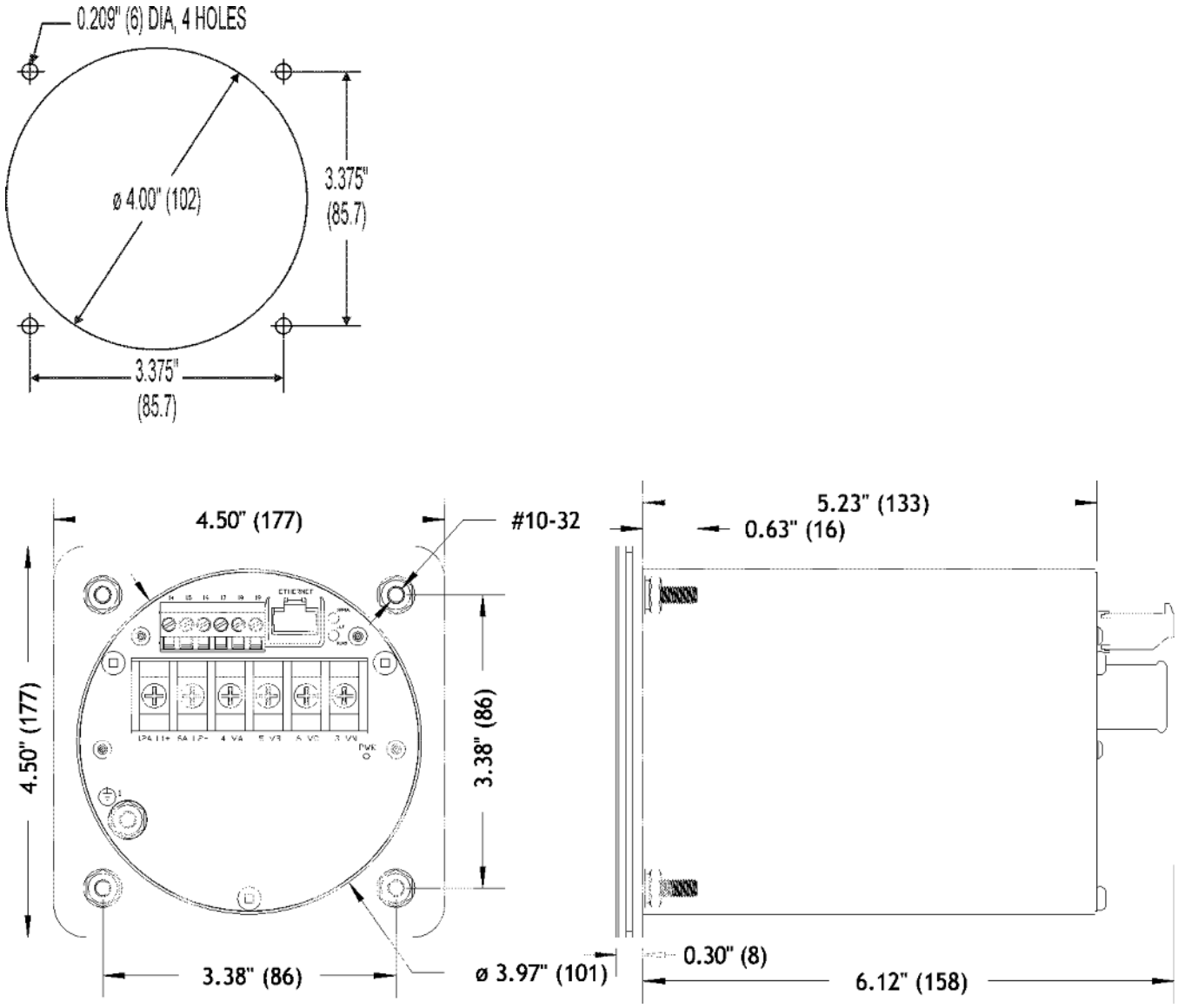

Figure 2 - Mounting and Overall Dimensions D650

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2.1 Installation

WARNING - INSTALLATION AND MAINTENANCE SHOULD ONLY BE PERFORMED BY PROPERLY TRAINED OR QUALIFIED PERSONNEL.

2.2 Initial Inspection

Bitronics instruments are carefully checked and "burned in" at the factory before shipment. Damage can occur however, so please check the instrument for shipping damage as it is unpacked. Notify Bitronics LLC immediately if any damage has occurred, and save any damaged shipping containers.

2.3 Protective Ground/Earth Connections

The device must be connected to Protected Earth Ground. The minimum Protective Ground wire size is 2.5 mm^2 (#12 AWG). Bitronics LLC recommends that all grounding be performed in accordance with ANSI/IEEE C57.13.3-1983.

2.4 Overcurrent Protection

To maintain the safety features of this product, a 3 Ampere time delay (T) fuse must be connected in series with the ungrounded/non-earthed (hot) side of the supply input prior to installation. The fuse must carry a voltage rating appropriate for the power system on which it is to be used. A 3 Ampere slow blow UL Listed fuse in an appropriate fuse holder should be used in order to maintain any UL product approval.

2.5 Supply/Mains Disconnect

Equipment shall be provided with a Supply/Mains Disconnect that can be actuated by the operator and simultaneously open both sides of the mains input line. The Disconnect should be UL Recognized in order to maintain any UL product approval. **The Disconnect should be acceptable for the application and adequately rated for the equipment.**

2.6 Instrument Mounting

The instrument may be mounted into a standard 4” round panel opening as shown in Figure 2. The unit will mount through the 4-inch round panel opening from the front. Align the four #10-32 studs attached to the flange with their appropriate mounting holes, as shown by the panel hole pattern. Use four #10-32 nuts with lock washers applied onto the studs from the back side of the panel. *Make sure that any paint or other coatings on the panel do not prevent electrical contact.*

WARNING – DO NOT over tighten the nuts on the mounting studs, **HAND** tighten with a standard nut driver, 12 inch-pounds (1.36 N-m) is recommended, **MAXIMUM** torque is 15 inch-pounds (1.69 N-m).

Several instruments may be mounted on a 19" Rack panel if desired. Three of the D650 displays will fit side by side on a standard 5.25" high panel. Figure 2 indicates the dimensions of the panel hole cutout. Leave adequate space surrounding the instrument when determining mounting arrangements.

2.7 Cleaning

Cleaning the exterior of the instrument shall be limited to the wiping of the instrument using a soft damp cloth applicator with cleaning agents that are not alcohol based, and are non-flammable and non-explosive.

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3.0 BACK PANEL & WIRING

The rear view of the D650 is shown in Figure 3 with the Serial (Display) port shown (removable terminal block at the top. Refer to Section 3.4 in this user manual when wiring the serial communication port for your display.

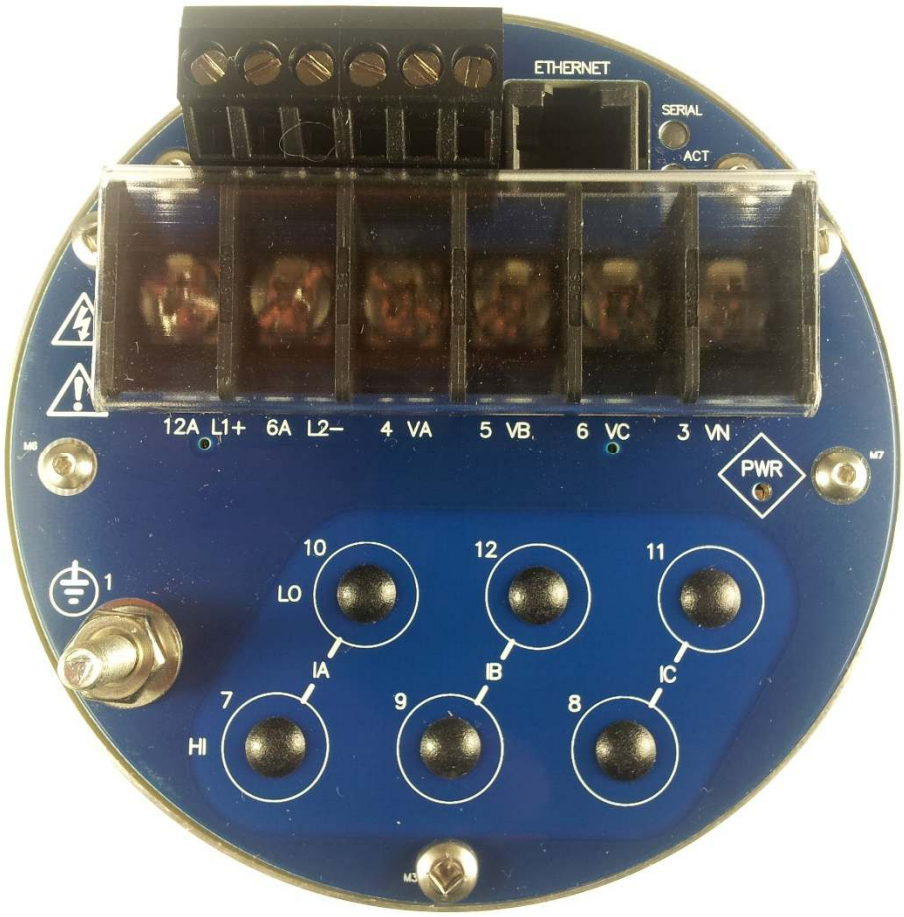

Figure 3 – Rear View D650

(Note: Back panel shown by Figure 3 contains hole plugs used on the earliest production parts, however a variation of the back panel is incorporated on later production parts where holes and their associated markings have been removed.)

3.1 Auxiliary Power

The D650 display is powered by connections to L1(+) and L2(-). A Blue LED Power (PWR) indicator is provided on the rear panel to indicate that the unit is powered ON. It is located on the right side of the rear panel. Refer to section 1.3.1 for specifications.

3.2 Ethernet

The D650 Ethernet port meets or exceeds all requirements of ANSI/IEEE Std 802.3 (IEC 8802-3:2000) and additionally meets the requirements of part 8-1 TCP/IP T-profile for physical layer 1 (Ethernet copper interface).

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The D650 display is offered with a standard Ethernet 10/100 Megabit (Mb) RJ45 (copper) interface (10BASE-T and 100BASE-TX) which automatically selects the most appropriate operating conditions via auto-negotiation. This interface is capable of operating either as half-duplex (compatible with all Ethernet infrastructure) or full-duplex interfaces (which allow a potential doubling of network traffic). Note that the meters come with the port setup as a service port. On the D650MX, the Ethernet port also supports Modbus and DNP3 TCP/IP Client Protocol.

3.2.1 Indicators – Ethernet (ACT) & Serial LEDs

There are 2 LEDs on the rear panel to indicate activity is occurring on the communication ports. These LEDs are useful in determining that there is activity occurring on the ports. The "ACT" LED will flash to indicate there is activity on the Ethernet port. It will also indicate that a link has been established. The Serial LED flashes to indicate there is activity occurring for the serial port.

A troubleshooting guide is found in Appendix A1, which may be useful in establishing Ethernet connections.

3.2.2 Network settings

The D650 Display comes preconfigured for interconnection to an HTML web server with default settings for IP address, SUBNET mask, and ROUTER (GATEWAY) address.

Network Default (Preconfigured) Settings		
IP Address	Subnet mask	Router (Gateway) Address
192.168.0.171	255.255.255.0	192.168.0.1

It is very important that the network have no duplicate IP addresses, so an IP address conflict is NOT created for your network. It is recommended to perform your initial setup for network addresses using the front buttons on the meter, unless it is known that the default (preconfigured) IP address is not already an assigned address on your network. Changing the stored Configuration of these network addresses may be accomplished by using one of the following methods

Enter Network addresses using the meter's front buttons:

Refer to the section in this manual on "Navigating the D650's setup menu from the Front panel" for further instruction regarding the button sequence you will use to scroll through the menu structure. This will provide a handy menu tree.

Activate the setup mode using the front buttons on the meter by pressing the Up + Toggle (Exit) buttons simultaneously. Scroll to menu selection "1.1 Network", in order to change the Network settings. Enter an IP address that you know is an unassigned address for your network. You can ping the IP address to make sure it is not already in use on your network. You may also want to check with your network administrator to make sure the IP address you plan on using is available to use on your network. After entering the Network addresses, exit out of the menu, and when prompted to save the new configuration settings, press the button directly under the SAVE prompt identified as "Y" (Yes). Reboot the meter for the configuration changes to take effect.

Enter the IP Address for the meter through a standard web browser:

Before entering an IP address with this method, make sure the current IP address and the new IP address to be assigned to the meter will not cause IP address conflicts on your local network. To connect to the web server, enter the meter's current IP Address in your web browser's address bar. When the web server screen appears, click on the "Settings" tab. Please refer to screen captures below for "Settings" and "Network" pages. Type the new Network settings (IP address, Subnet mask,

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Gateway) in the appropriate fields and click the "**Apply**" button to send the new network settings to the meter. Reboot the meter for the configuration change to take effect.

The D650 uses the following port numbers for each type of protocol:

Protocol	Port Number
HTML	80 (TCP)
Modbus Client	502 (TCP) configurable
DNP3 Client	20000 (TCP/UDP) configurable

Determining the IP Address if unknown:

Although the IP address can be obtained via the display, Bitronics has created a utility program to request the IP address for a specific MAC address on an Ethernet network. This program can be used with the D650 as well. Please contact customer service to obtain the program.

The program uses the Inverse Address Recognition Protocol to perform the lookup and thus is called inarp. The InARP protocol definition can be found at www.apps.ietf.org/rfc/**rfc2390**.html. The inarp utility can also scan an Ethernet network for a range of MAC addresses, printing the IP address for any devices which respond.

The general form of inarp is defined below, followed by some usage examples.

inarp usage:

```
 inarp [-i <if_ipaddr>] [-n <cnt>] [-p <ms>] [-v] <mac-spec>

   where
     <if_ipaddr> := interface ip address (default is 1st Ethernet interface)
          <cnt> := count of addresses to poll (default 1)
           <ms> := period between polls (100ms)
     <mac-spec> := <6ByteMac> | <[3-5]ByteMac> | <macRangeName>
     <6ByteMac> := xx:xx:xx:xx:xx:xx - <cnt> can specify a range to scan
     <5ByteMac> := xx:xx:xx:xx:xx - default <cnt> is 256
       ...
     <3ByteMac> := xx:xx:xx - default <cnt> is 16,777,216
   <macRangeName> := "50series"
                     50Series MAC base (00:d0:4F:03), default <cnt> is 65,536
              -v := request verbose information

   CTRL-C stops a scan.
```

The inarp utility requires the WinPcap and Packet libraries which are bundled in the WinPcap "Installer for Windows." This can be downloaded from www.winpcap.org.

Installation requires Administrator privileges.

Examples:

```
   to poll the 1st IPv4 interface,
            inarp -v 50series
            CTRL-C stops the scan

   to poll the IPv4 interface associated with 192.168.1.1, use
            inarp -v -i 192.168.1.1 50series
```

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or to poll a specific mac, use
inarp -v -i 192.168.1.1 00:D0:4F:03:00:15

The inarp utility is Copyright (c) 2011 by Bitronics, LLC. All rights reserved.
Portions of inarp are
Copyright (c) 1999 - 2005 NetGroup, Politecnico di Torino (Italy), and
Copyright (c) 2005 - 2010 CACE Technologies, Davis (California)

3.2.3 Firmware upgrades and saving and loading configuration files – Ethernet service port

New versions of firmware may be released by Bitronics from time to time, either to add new functionality or to correct errors in code that may have escaped detection prior to commercial release. Consult the factory for detailed information pertaining to the availability of firmware upgrades. In cases such as this, it is desirable to support a mechanism for new firmware to be installed remotely. The ability to upgrade Firmware is done over the Ethernet port. The M650/D650 family utilizes a page in the Web Server interface to upload and install new firmware. Note, this only updates the firmware for the D650 display, not the device it is connected to.

Before loading new firmware, you should restore the meter to the factory defaults. On the Load/Store settings page, select Restore All Defaults to bring the meter back to default settings.
To upload the new firmware, first obtain a copy of the firmware image. The firmware image is a binary file, less than 1 MB in length, that can be attached to email, distributed on a CD, or downloaded from an FTP site as circumstances dictate. Place a copy of the firmware image on your computer then access the upload page from the Firmware Upload link on the Configuration Settings page.
This will take you to the Firmware Upload page, which looks like the screen capture in Figure 4.

Figure 4 – Bitronics D650 Firmware Upload Page

Once the Firmware Upload page is visible, use the Browse button to locate the firmware image on your computer. Next, use the Submit button to initiate the file transfer and installation process. The instrument must be rebooted to make the new firmware active. At the completion of the file transfer and installation process, the instrument will prompt you to reset the instrument remotely by displaying the dialog box below after the firmware has been successfully installed.

It is strongly recommended that you clear your web browser's cache (delete the temporary internet files) after updating the firmware so that the new content will be loaded into your browser. Please refer to your browser's help file on how to clear the cache. A useful keyboard shortcut common to Internet Explorer, Firefox and Chrome is CONTROL + SHIFT + DELETE, which will take you directly to the relevant dialog panel. Carefully select the items to be cleared. Be sure to check the boxes that clear "temporary internet files", "cache" or "website data" and uncheck any boxes that preserve data.

3.3 Serial Port

The D650 display is equipped with a serial port. The Model D650BX utilizes the serial port to connect with the following Bitronics models in serial display protocol: M57x, M87x, or PowerPlex II. The port is software (user) configurable for RS-232 or RS-485. Baud rate is fixed at 19.2kbps for the PowerPlex II and supports rates up to 38.4k Display protocol when used with the Mx7x. The RS-232 drivers support full and half duplex modes. See Figures 5 & 6 for signal assignments applicable to RS232 and RS485. See section 1.3.3 for specifications. The Model D650MX can operate in serial display protocol if that option is selected on the web page in which case it will act like the D650BX. The D650MX can utilize the serial port if configured for Modbus/DNP3 to connect to other devices as a SCADA Master to display values from those devices. In SCADA mode, 9600, 19200, 38400, 57600, 115200 bps are supported

Set-up of the D650 Serial Port can be accomplished by using a web browser connected to the Ethernet port, or via the front display buttons (Setup menu - [1.2] **Serial Port**). The default configuration for the serial ports is:

Serial Port Default Setting					
Port	Protocol	Parity	Baud	IED Addres	Physical Media
Serial	Display	None	9600	1	RS-232

Serial cable requirements for RS485 connections:
Tie RS-485 cable shields (pin 15) to earth ground at one point in system.

The recommended torque ratings for the terminal block wire fasteners are listed in the Physical Specifications table (section 1.3.5).

Transient Voltage Suppressor (TVS) clamp devices are used on the serial port as the method of protection. The serial port is clamped to a voltage of 16.7-18.5V nominal, 24.46V max. The clamps are rated for a peak pulse current of 24.6 Amps max.

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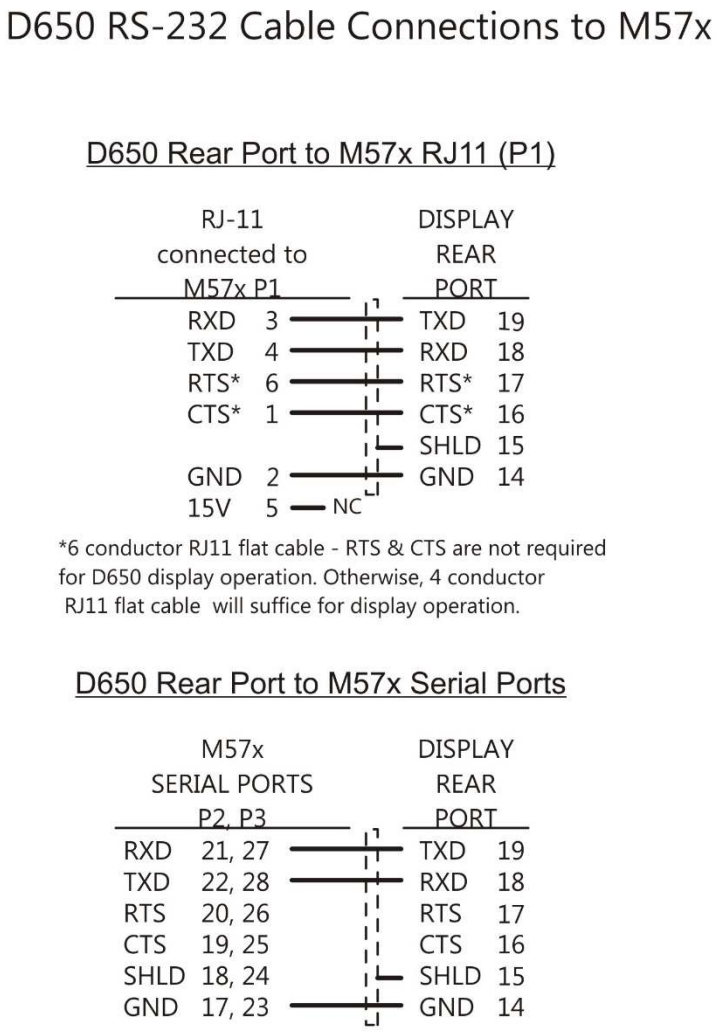
3.4 Interconnections to D650 Serial Port

3.4.1 Communication Connections - Serial Port RS232 Mode for M57x to D650



The rear port of the D650 Display and the port of the M57x must be set to RS-232, matching Baud rates and parity, and Display protocol.

The cable should be Belden 9842 or equivalent, unless otherwise specified.
The maximum cable length for RS-232 is 50 ft (15m).

RDSCables-232_D650_M57x_R1.cdr 1/7/16

Figure 5A – RS-232 Cable Wiring Diagram – M57x to D650

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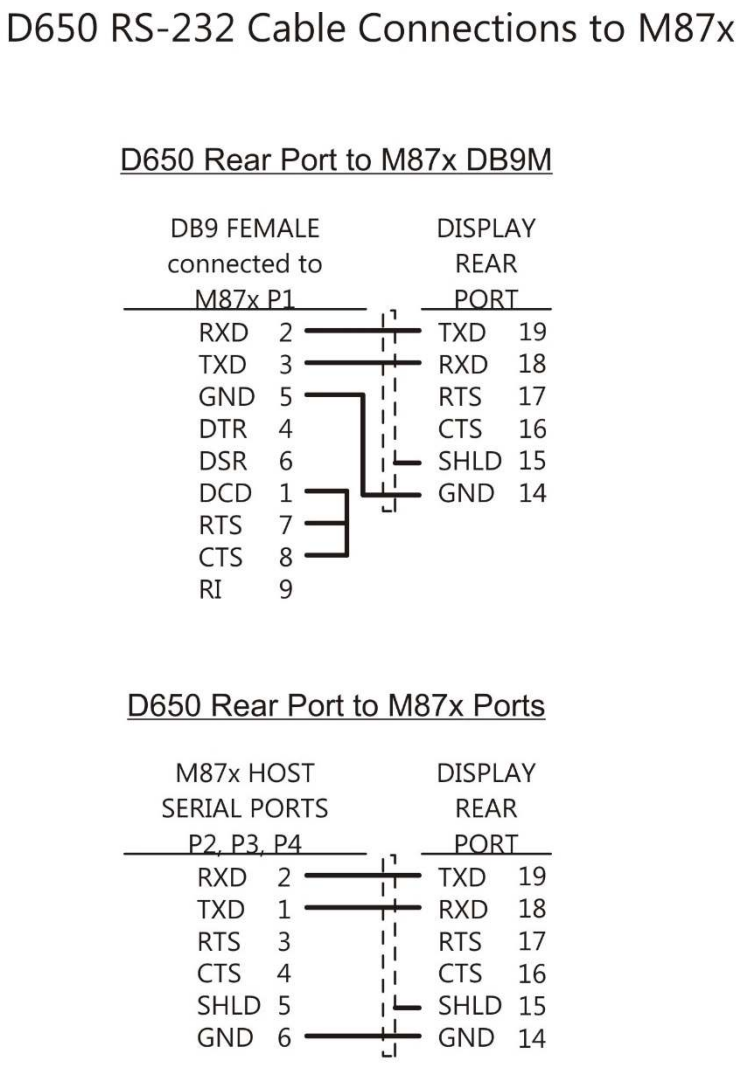
3.4.2 Communication Connections - Serial Port RS232 Mode for M87x to D650



The rear port of the D650 Display and the Host port of the M87x must be set to RS-232, matching Baud rates and parity, and Display protocol.

The cable should be Belden 9842 or equivalent.
The maximum cable length for RS-232 is 50 ft (15m).

RDSCables-232 D650 M87x R1.cdr, 1/7/16

Figure 5B – RS-232 Cable Wiring Diagram – M87x to D650

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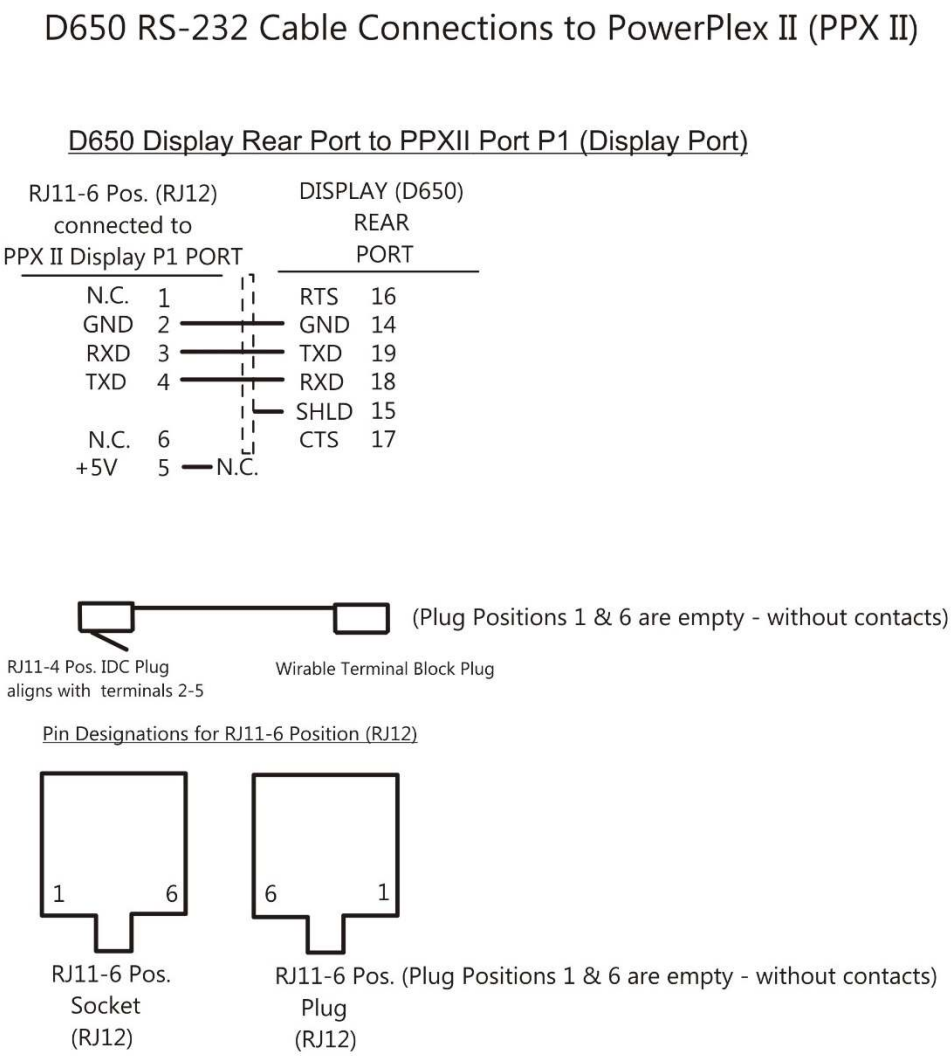
3.4.3 Communication Connections - Serial Port RS232 Mode for PPX II to D650



1. The rear port of the D650 Display and the Display P1 (Host) port of the PPXII must be set to RS-232, matching Baud rates, parity, and Display protocol.

2. The maximum cable length for RS-232 is 50 ft. (15m).

Figure 5C – RS-232 Cable Wiring Diagram – PowerPlex II to D650

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3.4.4 Communication Connections - Serial Port RS485 Mode for M57x to D650

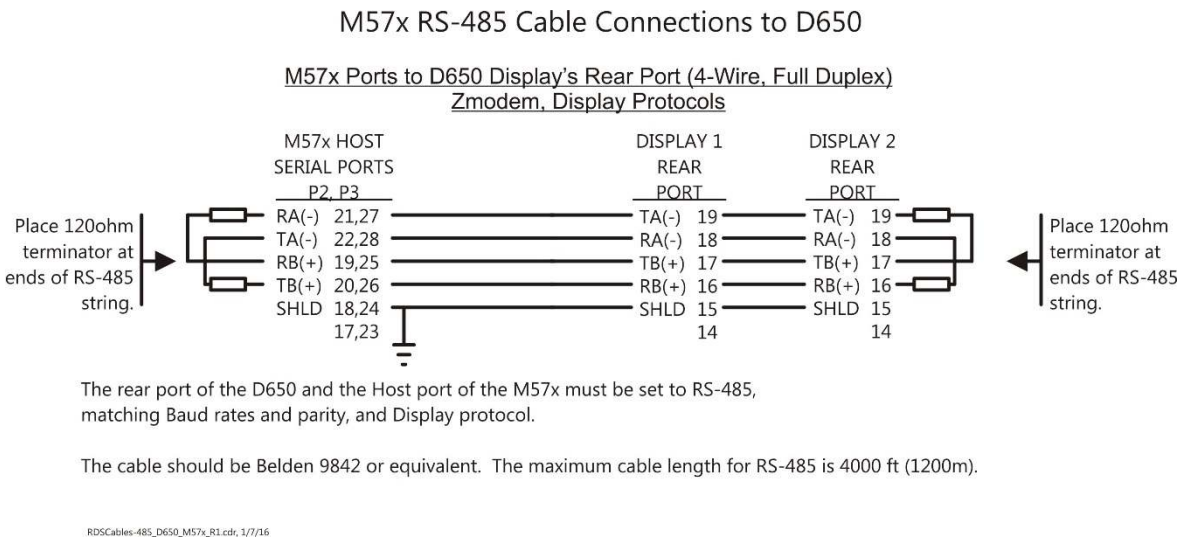

Figure 6A - Typical RS-485 Cable Wiring – M57x to D650

3.4.5 Communication Connections - Serial Port RS485 Mode for M87x to D650

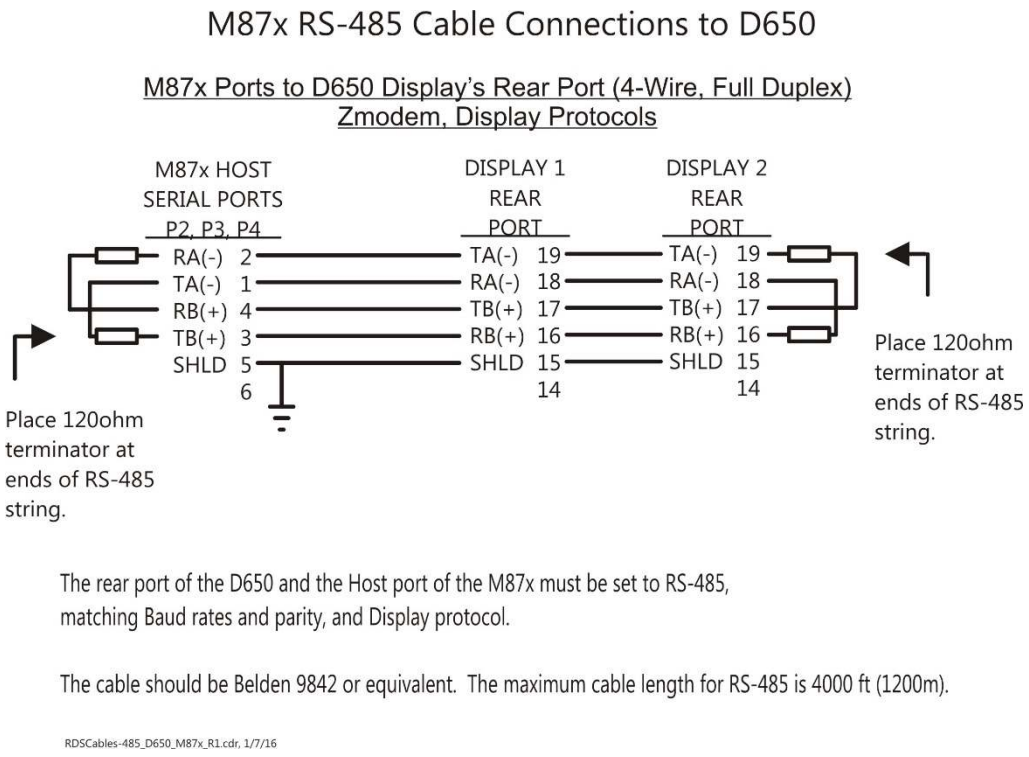

Figure 6B - Typical RS-485 Cable Wiring - M87x to D650

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3.4.6 Communication Connections - Serial Port RS485 Mode for PPX II to D650

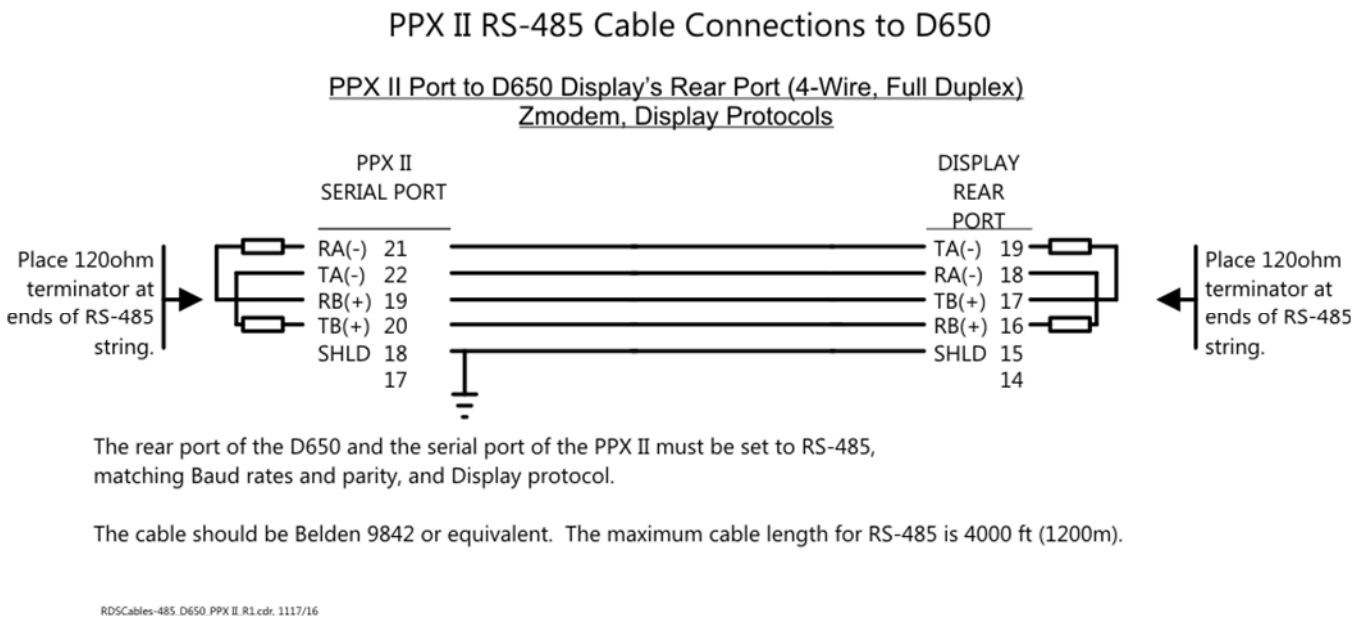

Figure 6C - Typical RS-485 Cable Wiring – PPX II to D650

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3.5 Setup Mode – D650 Display Settings

The D650 has four configurable parameters that must be set to match the device to which it is connected. The configurable parameters consist of the “ID of Display” (1-15) for serial display protocol only, Serial Mode/Physical Media (RS232 or RS485), Baud rate and Parity configuration settings. Please refer to the “Display” and “Serial Port” screen captures in Section 5.5 to see where to set these parameters via the web interface. To setup using the front display, press the up arrow key and the Toggle (Exit) key simultaneously to enter the display setup mode. The alphanumeric display will describe the selected parameter, while the digit display will show the value. Use the up and down arrow keys to scroll through the available values for that parameter. When the desired value is displayed, press Home (Enter) button to confirm the setting. The left arrow button is used to go to the next configurable parameter. When ‘Exit’ appears in the alphanumeric display, press the Toggle (Exit) button to return to normal operation. The instrument will automatically return to normal operation if no keys have been pressed in five minutes. This timeout prevents the instrument from inadvertently being left in setup mode.

Table 1 – Configurable Parameters

Parameter	Available Values (Programmed/Configured)
ID of Display	1 – 15 (Serial display protocol only)
Serial Mode Physical Media)	232, 485
Baud	9600,19200, 38400 Baud
Parity	None, Even, Odd, Always 1 (Mark), Always 0 (Space)
Version	Displays current version information. This value cannot be modified.
Exit	Allows exiting setup mode.

WARNING - THE METER ADDRESS, COMMUNICATION MODE, AND BAUD RATE PARAMETERS ARE STORED IN NON-VOLATILE MEMORY. THIS MEMORY STORAGE HAS A 1,000,000 CYCLE ENDURANCE RATING. (PARAMETERS CAN BE CHANGED 1,000,000 TIMES).

3.6 Interdependency – Meter Configuration controls D650 Display Screens with Serial Display Protocol

The screens that are displayed in the D650’s scrolling mode when set in serial display protocol are generated by the meter (M57x, M87x, or PPX II). The meter is responsible for sending its programmed screen data to the D650 Detached Display. The Detached Display screens can be programmed (ENABLED/DISABLED) by the user by configuring the meter. The programming and configuration settings for the displayed measurement screens reside with the meter. The configuration of the individual screens as well as screen content is dependent upon what model is connected to the D650’s serial port. See the following subsections for more details on programming and configuring the D650 based on whether the Detached Display is connected to a M57x/M87x or a PPX II.

3.6.1 Setup the Measurements for Display Screens - 70 Series Configurator (M57x or M87x)

Measurements that are shown on the D650 Display Front panel can be set up using the Windows® based 70 Series Configurator. There are two folders in the Communication section, which must be configured before the D650 can successfully establish communication with the meter. The folder as shown by Figure 7 is used to setup the Port Assignments. Set the protocol of the port to which the Remote Display is connected to “Zmodem/Display/Log”. Set the Serial Mode Physical Media, Parity,

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and Baud settings as required so that these settings are the same as the settings entered for the D650. The “RxD to TxD Display” parameter can be set to zero and the Run Display box must be checked. In this example, Port 4 is set to run the display.

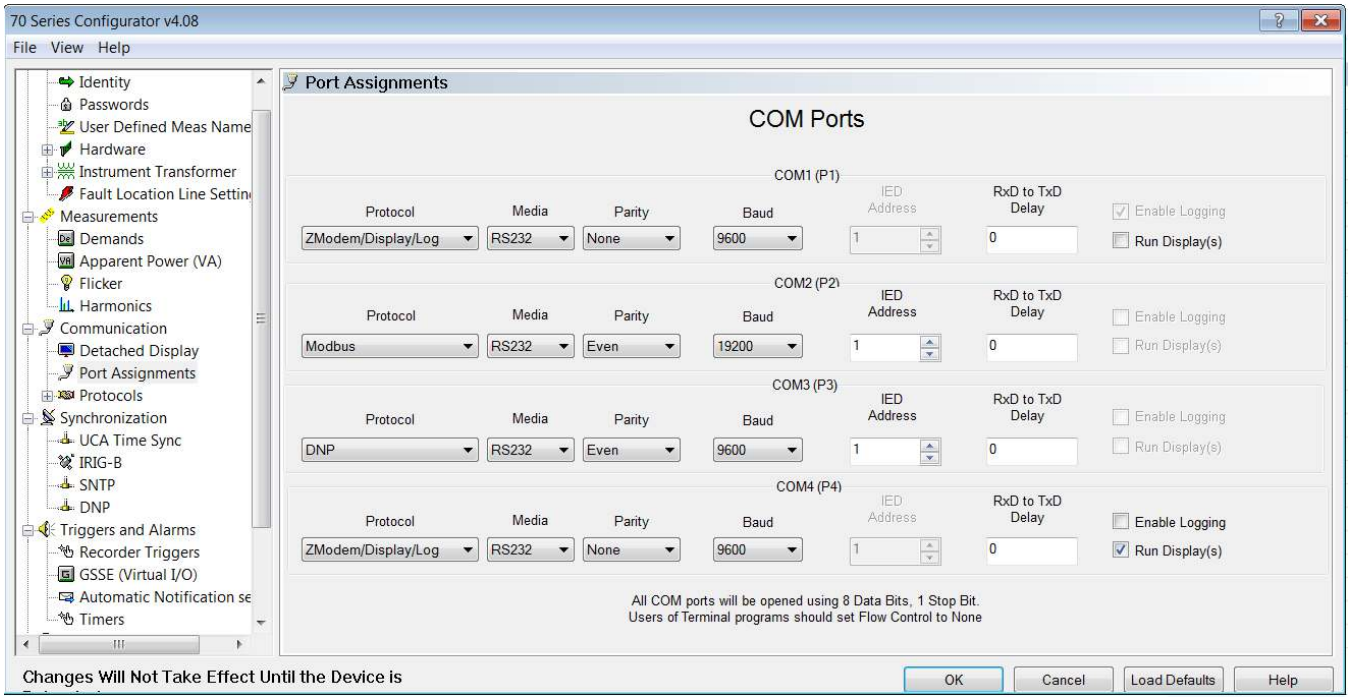

Figure 7 – Configurator Communication/Port Assignments Folder

The Detached Display Folder must now be set up to show the proper measurements. Figure 8 shows the layout of this folder.

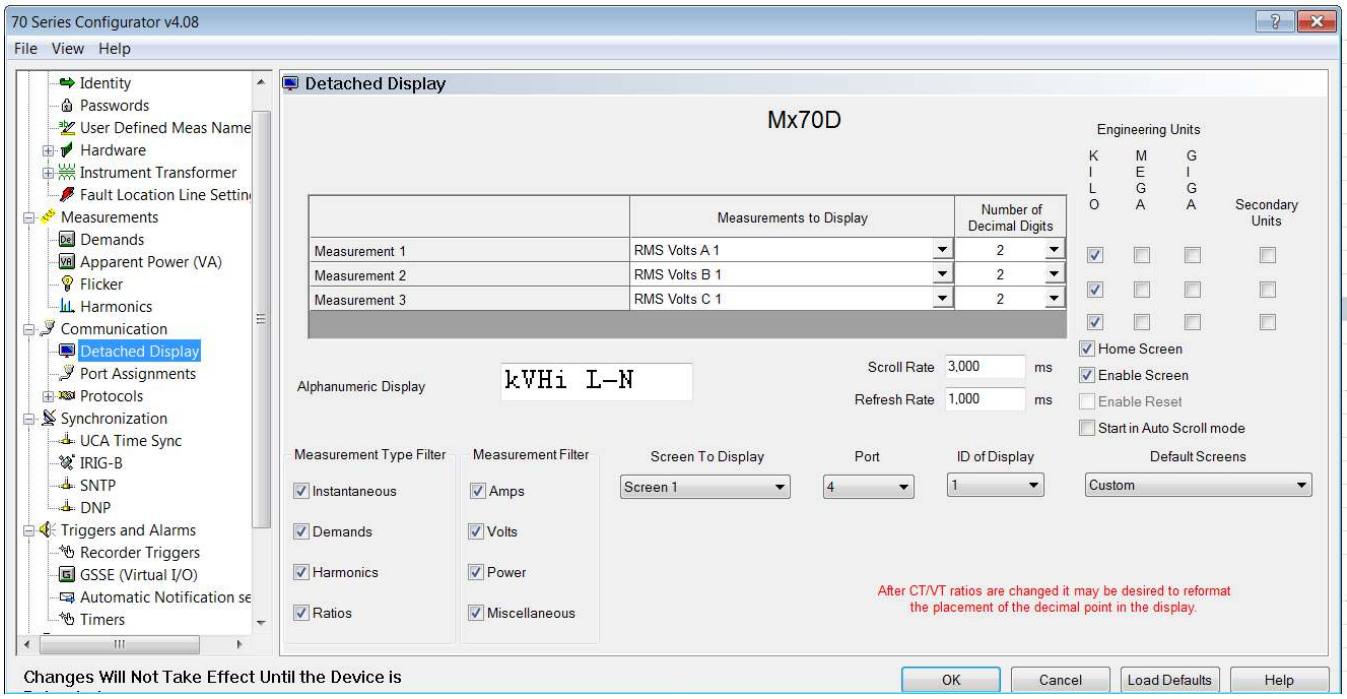

Figure 8 – Configurator Communication/Detached Display Folder

Note: The Detached Display folder will configure either Mx70D or D650 type displays

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Screens are defined by choosing measurements from a drop down list and then specifying the resolution (Number of Decimal Digits), scale factor (Kilo, Mega, Giga), whether scale factor is attributed with the secondary of the Voltage Transformer (VT) or Potential Transformer (PT), and text information for the screen (Measurements to Display). Up to 64 screens can be defined for each display. Multiple displays can be attached to a single 70 Series IED, but the total number of available screens is limited to 64. Each screen can be assigned to a particular 70 Series IED serial port (Port) and remote display address (ID of Display settings). The screen definitions are stored in the 70 Series IED and not in the Remote Display.

Demand and Energy values may be reset from the front panel if this option is selected in the 70 Series configuration software. If this option is chosen, the displayed values will be reset when the Combination of Home (Enter) and Toggle (Exit) buttons on the front panel are depressed simultaneously.

Please refer to the online help in the 70 Series Configurator for additional information.
Note: The Display ID of the D650 must match the "ID of Display" value entered in the folder shown by Figure 8. In RS485 Mode, multiple displays may be connected over a single port. Each display would be assigned a different “ID of Display” value associated with its own separate set of Enabled screens.

For M57x and M87x, programming of the Detached Display screens is accomplished by using Bitronics Configurator software. Any changes to display screens originating in 70 Series meters may only be performed by changing the configuration entered under the Detached Display menu tab.

The 70 Series Configurator software is used to program which screens are sent serially to the D650 Detached Display. There are 22 screens with pre-assigned Measurements as the default screens for the Detached Display. The measurements may be changed or additional screens configured in order to display any of the 70 Series Measurements available in the measurement database. When the Enable Screen check box is checked, that Measurement screen is sent to the display. The Home Screen check box, when checked, determines which screen appears as the D650’s Home screen. Click on the 70 Series Configurator software Help button to obtain
helpful information with respect to the Detached Display Configuration screen.

3.6.2 Setup the Measurements for Display Screens – Web Browser (PPX II)

For PPX II, programming of the Detached Display screens is accomplished through the PPX II web browser interface. When the D650 Detached Display serial port is connected to the PowerPlex II (PPX II) display port, it is necessary that the web browser interface associated with the PPX II be utilized to configure any display screens that will be sent to the Detached Display. The Screens that will be sent to the display must be configured on the PPX II web page. From the PPX II web page, click on the Enable Screen checkbox for any measurement screen you wish to send serially to the D650 Detached Display. The “Screen Enable” selection should appear automatically under the Settings tab on the web page, once the D650 serial port connection is established between the D650 and the PPX II. It may take several seconds for the web page to refresh when the D650 Detached Display is connected to Display Port P1 (RJ11) of the PPX II. From the web page, select the Settings tab then click on Screen Enable in the menu list. See the PowerPlex II User manual for information on the Screen Enable page and settings on Custom Display Screens.

Refer to Appendix A2 or the PowerPlex II User Manual, which covers PowerPlex Settings for Screen Enable and Custom Display Screens.

NOTE:
The following are NOT supported from the D650BX or D650MX when set for serial display protocol Detached Display front buttons: 1.) Configuration changes to M57x, M87x, 2) Changes to PowerPlex II settings, 3) Screen Enable/Disable .

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3.7 Setup Mode – D650MX Client Protocol

Setup for the D650MX Universal is done via the web pages of the device. This involves setup on the Input page, Serial Port or Network Page, Protocol Page, and Enable Screen Page. More information on the pages are available in section 5.5. There is the option for using the Scaling setup page to provide greater flexibility in interfacing directly to other IEDs such as relays. More information on this can also be found in section 5.5 and in the Appendix A5 showing examples of using flex scaling.

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4.0 OPERATION

4.1 Display (See Appendix Sections A3 & A4 – Standard Formats & Display Screens)

The D650 can display all the standard and configurable screens that are available on M57x, M87x or PPX II. To make all quantities available, the display scrolls from quantity to quantity approximately every 5 seconds. The quantities are refreshed once a second. If the D650 is used with a 70 Series IED the scroll and refresh rates are settable from the 70 Series Configurator using the Detached Display folder. The Alphanumeric display at the bottom of the instrument indicates to the user what quantity is being displayed. The Alphanumeric display also provides the user with primary engineering units (Watts, kWatts, MWatts, etc.). The associated IED's Configurable screen settings allow the user to enable or disable each of the display screens, in order to view only a selected subset of all the measurements the meter is capable of displaying.

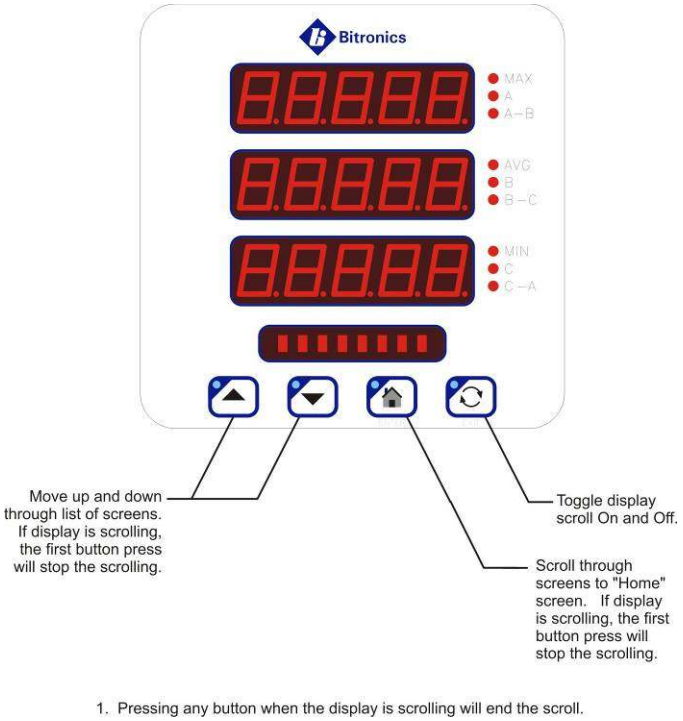
70 Series (M57x, M87x): See section 3.6.1 on setup using the 70 Series Configurator Software for programming and enabling screens for the D650 Detached Display.

PowerPlex II (PPX II): Refer to the PowerPlex II manual for setting screens in the web browser for PPX II that will be sent serially over the Display port to the D650 display.

4.1.1 D650 Display Resolution for Negative quantities

For all the Watt, VAR and/or PF displays the "SIGN" of the quantity is indicated by the center segment of the left most digit, which will be illuminated to produce a "-" for negative quantities. Positive quantities will have no polarity indication. This restricts the display to 4 digits of resolution in the Watt and/or VAR display, however this is a restriction for the display only.

4.1.2 Overview – Buttons Functions: Display Mode vs. Setup Mode



1. Pressing any button when the display is scrolling will end the scroll.

Figure 9 – Button functions for Display Mode

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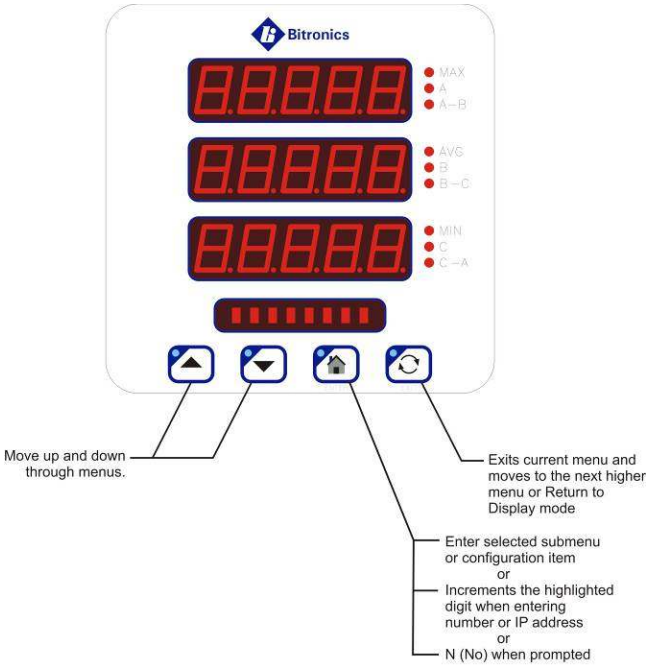

1. Setup mode is initiated upon pressing combination of Up Arrow and Exit

Figure 10 – Button functions in Set-up Mode

4.1.3 Keypad Functions for Display Mode

Measurement screens may be stepped through manually by pushing the up and down arrow keys. Pushing the Toggle (Exit) key turns the scroll function off and on. When the scroll function is activated, the measurement screens will automatically step through the user-defined screens. Auto scroll state (ON/OFF) is stored in non-volatile memory. Pressing the Home (Enter) key will bring up the home screen. The factory default home screen will be Amps A, B, C.

Home screen (D650 used as PowerPlex II Display): When D650 display is connected to a PowerPlex II the Home Screen may be designated or enabled in either of the following ways:

1. From the D650 front panel the user would press a Combination of “Home (Enter)” and “Toggle (Exit)” keys when on the screen desired as the Home Screen.
2. From the web browser interface by clicking on the appropriate “Enable Home Screen” setting box from the “Enable Screen” settings tab located on the PowerPlex II web page.

Home screen (D650 used as 70 Series Display): When the D650 display is connected to a M57x or M87x the Home Screen cannot be designated or enabled through the D650 front panel. The Home Screen must be configured through the 70 Series Configurator Software. Refer to section 3.6.1.

Home screen for D650MX: Selection of the Home Screen can be set on the Screen Enable page. The Default HOME screen is:

Amps A,B,C.

4.1.3.1 Demand Resets (Serial Display Protocol Only)

The demand values are reset in 4 groups: current, voltage, power and energy. This can be accomplished via the front display. Refer to Table 2 for the button combinations, which depends on the type of instrument to which the display is attached. Refer to the appropriate measurement instrument’s manual about resetting groups of measurements such as current, voltage, power and energy.

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Table 2 –Button Functions (Display Mode vs Setup Mode)

Button	Display Mode Function (D650 Display) With following meter dependency		Setup Mode Function (D650 Display)
	M57x, M87x	PPX II	
Up Arrow 	Next measurement/value	Next measurement/value	Next menu item
Down Arrow 	Previous measurement/value	Previous measurement/value	Previous menu item or Y (Yes) when prompted
Home (Enter) 	Scroll to designated home screen	Jump to designated home screen	Enter selected submenu (or configuration item), or Increments the highlighted digit when entering number, or IP address, or N (No) when prompted
Toggle (Exit)  EXIT	Toggle Auto Scroll On/Off	Toggle Auto Scroll On/Off	Exits current menu selection and moves up to next higher menu level. Returns to display mode on exit from main setup menu
Combination Up and Exit keys 	Enter Setup Mode (Configuration setting is done in the setup menu)	Enter Setup Mode (Configuration setting is done in the setup menu)	
Combination Up and Down Keys 		Resets Demand Values for the Group	
Combination Home (Enter) and Toggle (Exit) keys 	Resets Demand Values for the Group (if Enabled)	Designate the displayed screen as “Home Screen”	

4.1.4 Display Error/Informational Messages

Error messages from self-test are shown on the display. Table 3 summarizes the errors and the messages displayed:

Table 3 - SELF TEST RESULT SUMMARY FOR D650 DISPLAY

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(Refer to the appropriate user manual for the corresponding model connected to the D650 display)

Fault	Fault Indication	Refer to appropriate Model's User Manual	Effects of Fault	Corrective Action
Display Oveflow	Display flashes 9999	√	Measured quantity is too large to be displayed. Communication option output may still be accurate, if overload does not exceed meter input ratings.	Correct fault external to instrument.
Input gain calibration checksum error	G CAL	√	Calibration constants for the input gain are in error. The display and the communication option output are reduced in accuracy to approximately +/-3%.	Return meter to factory for repair
Input phase calibration checksum error	P CAL	√	Calibration constants for the phase are in error. The display and the communication option output are reduced in accuracy to approximately +/-3%.	Return meter to factory for repair
Analog outputs calibration checksum error	A CAL	√ (M57x/M87x)	Calibration constants for the analog outputs are in error. The analog output option is reduced in accuracy to approximately +/-3%.	Return meter to factory for repair
Input Over-Range	CLIP	√	Peak input quantity exceeds the range of the instrument. Both display and communication option output accuracy reduced by an amount depending upon the degree of over-range.	Verify input signals are within range. If within range, return to factory for repair.
Protocol Configuration Error (Available in Future)	P CFG	√	Instrument protocol configuration may be corrupted and inaccurate. This may cause communication errors.	Reset configuration.
Firmware Download in Progress	FLASH	PPX II	Will be displayed during PowerPlex II (PPX II) download and will disappear shortly after user reboots meter	Reboot PPX II meter when prompted.
	FLASH d650	D650	Will be displayed during D650 download and will disappear shortly after user reboots display	Reboot D650 Display when prompted.

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Message	Explanation	Action
No Comm	No valid messages are being received by the display.	Check cable connections and setup parameters on the Remote Display and corresponding IED model (M57x, M87x, PPX II).

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5.0 FUNCTIONAL DESCRIPTION

5.1 Configuration

D650: Setup of the D650BX Display is most easily performed using the web interface via the Ethernet service port. Basic configuration can also be handled from the front display panel by entering setup mode using the keypad. Refer to Table 2 in Section 4.1.3 that indicates the key combination (Combination Up and Exit keys) that is used to “Enter Setup Mode”. The D650MX configuration is done primarily through the web interface. All the Client Protocol selections (protocol, screen enable, custom screens, etc.) are done via the web pages. Note that the D650MX Universal can be configured to operate as a D650BX by selecting “Serial display protocol” from the drop down on the Input page.

70 Series: The screens displayed by the D650 are determined by the settings programmed into a M57x or M87x using the 70 Series Configurator software. The 70 Series configurator is used to program screen content and enable the screens that will be sent to the D650 Display.

PPX II: The screens displayed by the D650 are determined by the Screen Enable settings programmed into the PowerPlex II using the Web browser interface. The PPX II Screen Enable and Custom Display Screen web pages found under the Settings tab are used to program screen content and enable the screens that will be sent to the D650 Display.

5.2 HTML Web Server

The D650 incorporates an internal web-based configuration utility.

5.3 Passwords

Passwords can be set up through the web interface in the 50 Series for use in controlling access to configuration and other functions available through the Ethernet port or the front panel display. Passwords may be comprised of the 95 printable ASCII characters as defined by http://en.wikipedia.org/wiki/ASCII#ASCII_printable_characters which includes 0-9, a-z, A-Z, and special characters. Passwords may have maximum length of 20 characters and a minimum of 1 character. Passwords prompts are disabled by leaving the new password field blank and clicking the 'Change Password' button. The default from the factory is to have no password set.

The password is used to authenticate a session when prompted. The session authentication will last until the user clicks the 'Log Out' link on the upper right corner of the Web Interface or after five minutes elapses. Authentication will be required when attempting the following actions:

- Applying changes to any settings on the Web Interface Settings tab
- Uploading new firmware on the Firmware Upload page
- Changing the password on the Password Security page
- Rebooting the IED

The Password Security page includes the Front Panel Configuration Lock, which may be used to prevent access to the following actions:

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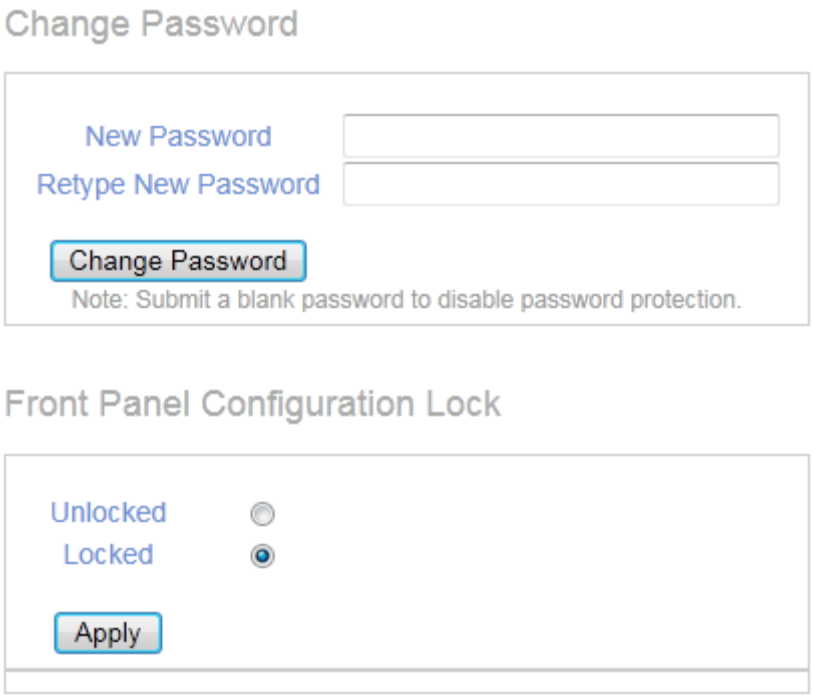
- Setup Mode on the Front Panel (see section 5.4)
- Demand Resets from the Front Panel (section 4.1.3.1).
- Home Screen selection from the Front Panel (section 4.1.3)

If these options are attempted while the lock is enabled, the message 'Locked' will be briefly displayed on the front panel alphanumeric display for D650.



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5.4 Navigating the D650's setup menu from the front panel

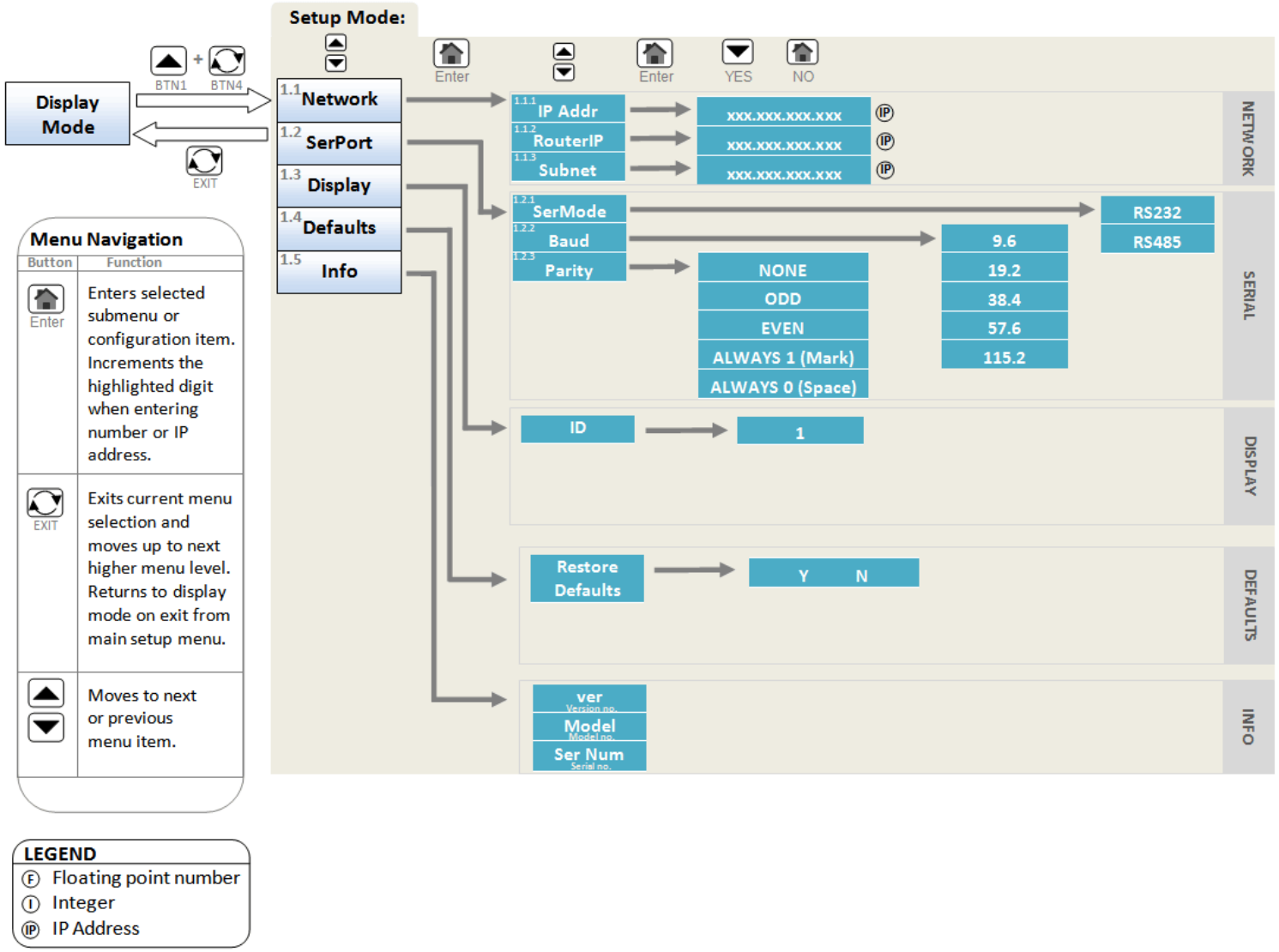

Figure 11 - D650 Front Panel Setup Menu

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How to Enter an Integer:

Increment highlighted digit by 1.

Highlight Previous/Next digit.

Exit to menu

How to Enter a Floating Point Number:

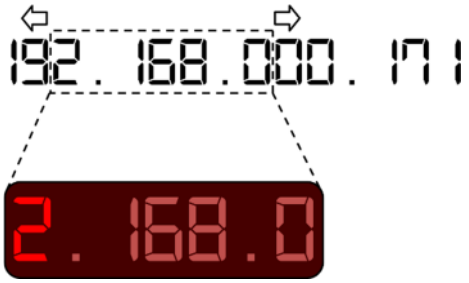
Increment highlighted digit by 1.

Shifts decimal point one place to right. Decimal moves to left-most digit when right-most digit is passed.

Highlight Next digit. Highlights left-most digit when right-most digit is passed.

Exit to menu

How to Enter an IP address:



Increment highlighted digit by 1.

Highlight Previous/Next digit. Numbers scroll left and right to follow highlighted digit.

Exit to Network menu

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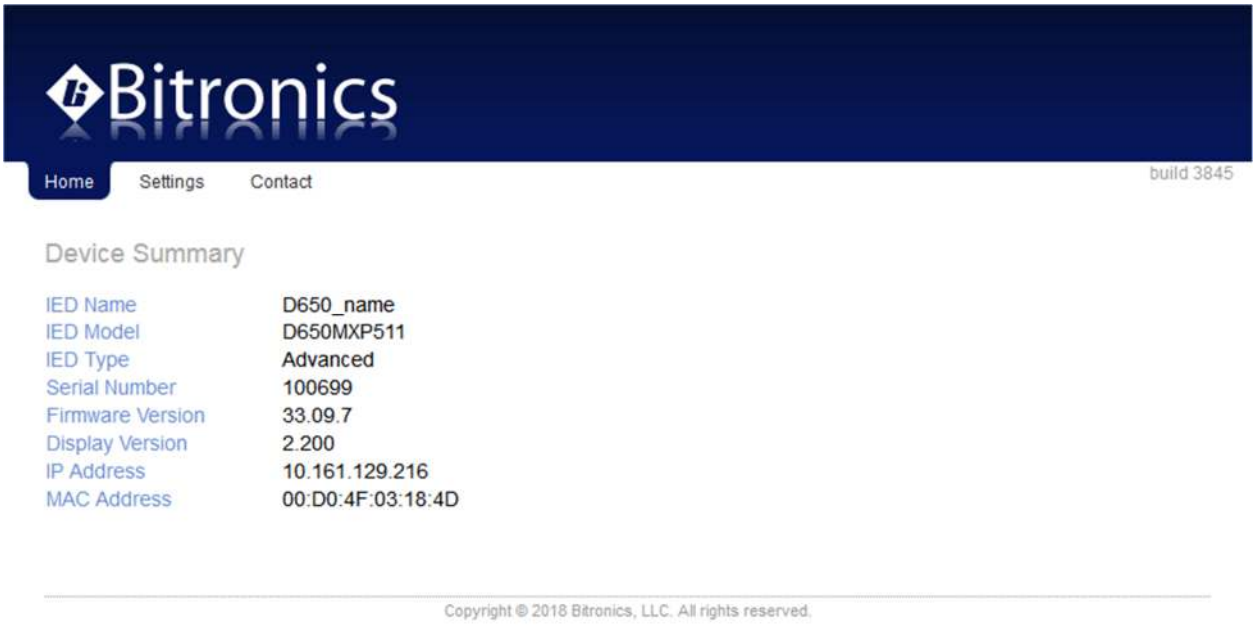
5.5 Performing set-up through the web page interface – D650 Detached Display

This section will assume you are able to use the factory default IP address of 192.168.0.171 to connect to the web page using an HTML web server. If this is not the case, you may need to refer to section 3.2.2 (Network settings) and the previous section (Section 5.4: Navigating the D650's setup menu from the Front panel) to change your network configuration settings.

If connecting a D650 Display service port to an Ethernet network, a different IP address must be assigned to each of the separate network devices to avoid generating an IP address conflict on the network.

Enter the D650's IP address into your internet browser to connect with the D650 web page interface. Internet browsers supported are Firefox, Internet Explorer, Safari and Google Chrome. The Home page screen should appear as shown below.

Home page (D650MX shown):



From the home screen you can select from the following tabs:
Settings – This page allows the user to change the configuration settings. Making D650 configuration changes requires the unit to be rebooted. Configuration settings for the D650 are stored in flash memory.
Contact – This page indicates how to contact Bitronics

NOTE: Some screen shots shown below may not exactly match the appearance of those from your actual meter.

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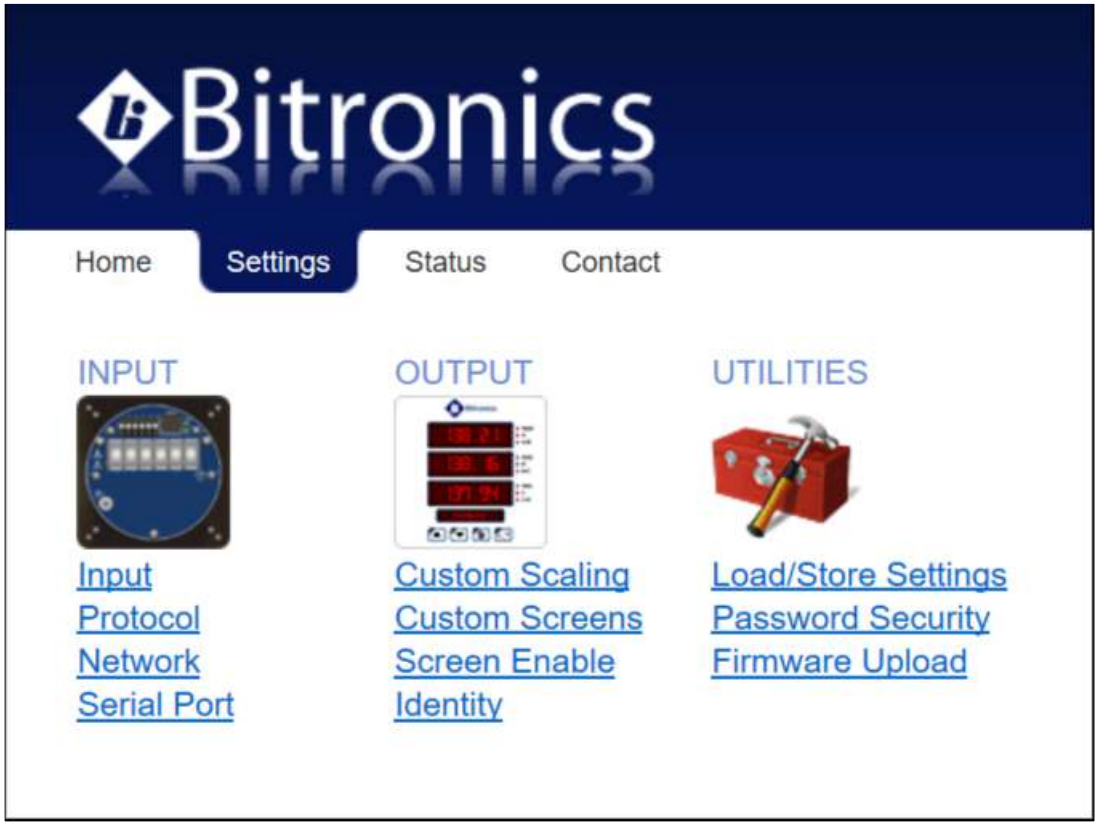
Settings page:

The setting page divides functions into Input, Output, and Utilities. Click on one of the settings categories under each to be taken to the next page. Note that for the D650BX many of the settings pages are not applicable and won't appear.



Settings Page Selections:
From the Settings page screen you can select one of the following selections:

Input – This page allows the user to select between Modbus/DNP3 Client, or Serial display protocol. It also allows for manual setting of CT and PT ratios if not set previously in the outstation device.

Protocol – This is to select the Client Protocol to be used in the D650M3 and to select the registers or points.

Network – This page allows the user to change the network configuration settings for IP address, gateway and router address.

Serial Port – This page allows user configuration for the serial port settings.

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Custom Scaling – This page is used to set flexible scaling and assign measurement types

Custom Screens – This page applies to the D650MX only and allows the user to create custom screens.

Screen Enable – This page applies to the D650MX only and allows the user to select those screens that will be displayed from the device it is connected to.

Identity– This page allows the user to enter information that is necessary to identify the meter. It gives an identity to a particular D650. Each D650 should have different information entered for its identity.

Load/Store Settings – This page allows you to save and retrieve settings for the D650 Display.

Password Security – This page allows the user to set a password and to enable or disable access to front display configuration (D650)

Firmware Upload – This page allows the user an interface to browse for or type in the location on their PC of new firmware for purposes of uploading to the unit.

Screen shots showing the selections to be made for each of the above selections follow on the next few pages. Default values are shown where applicable.

D650 configuration changes require the unit to be rebooted. Configuration settings for the D650 are stored in flash memory.

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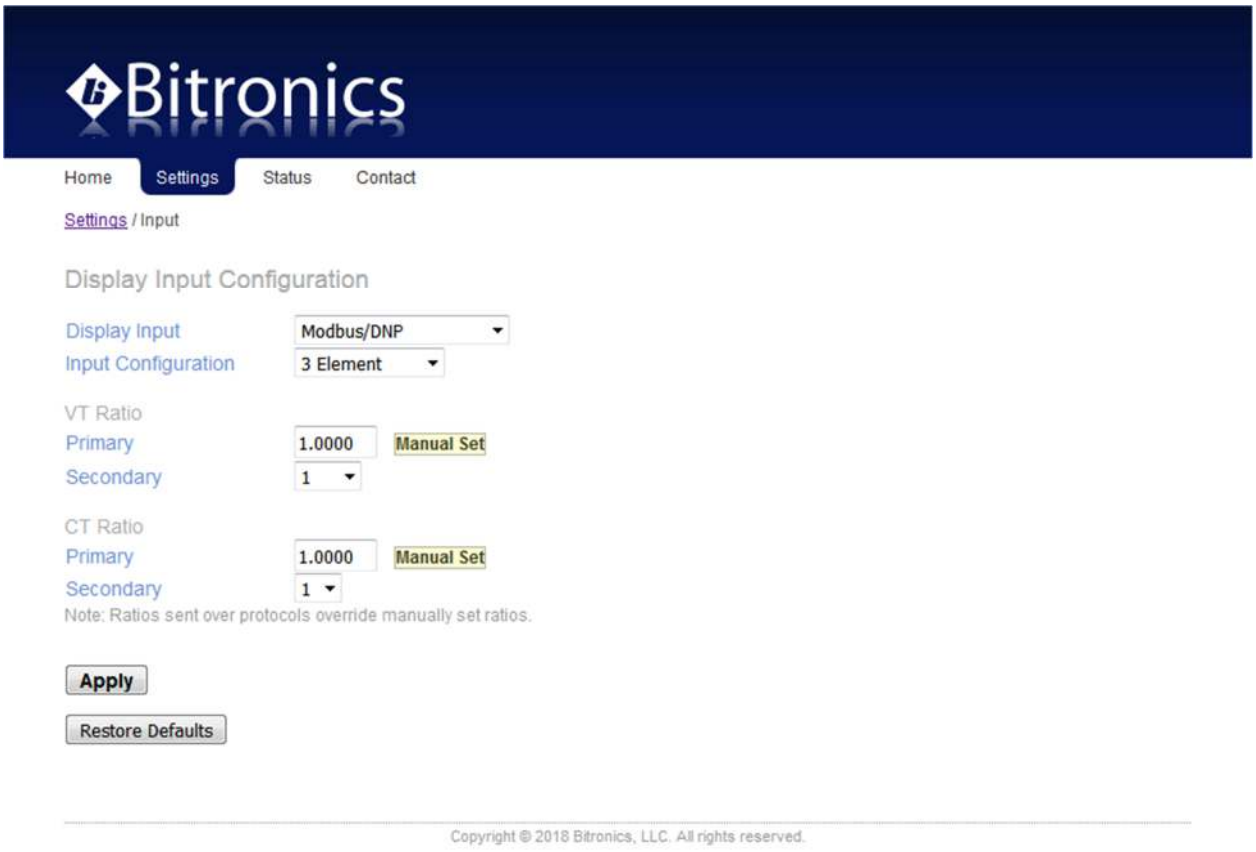
Input:


Bitronics
Home
Settings
Status
Contact
Settings / Input
Display Input Configuration
Display Input
Modbus/DNP
Input Configuration
3 Element
VT Ratio
Primary
1.0000
Manual Set
Secondary
1
CT Ratio
Primary
1.0000
Manual Set
Secondary
1
Note: Ratios sent over protocols override manually set ratios.
Apply
Restore Defaults
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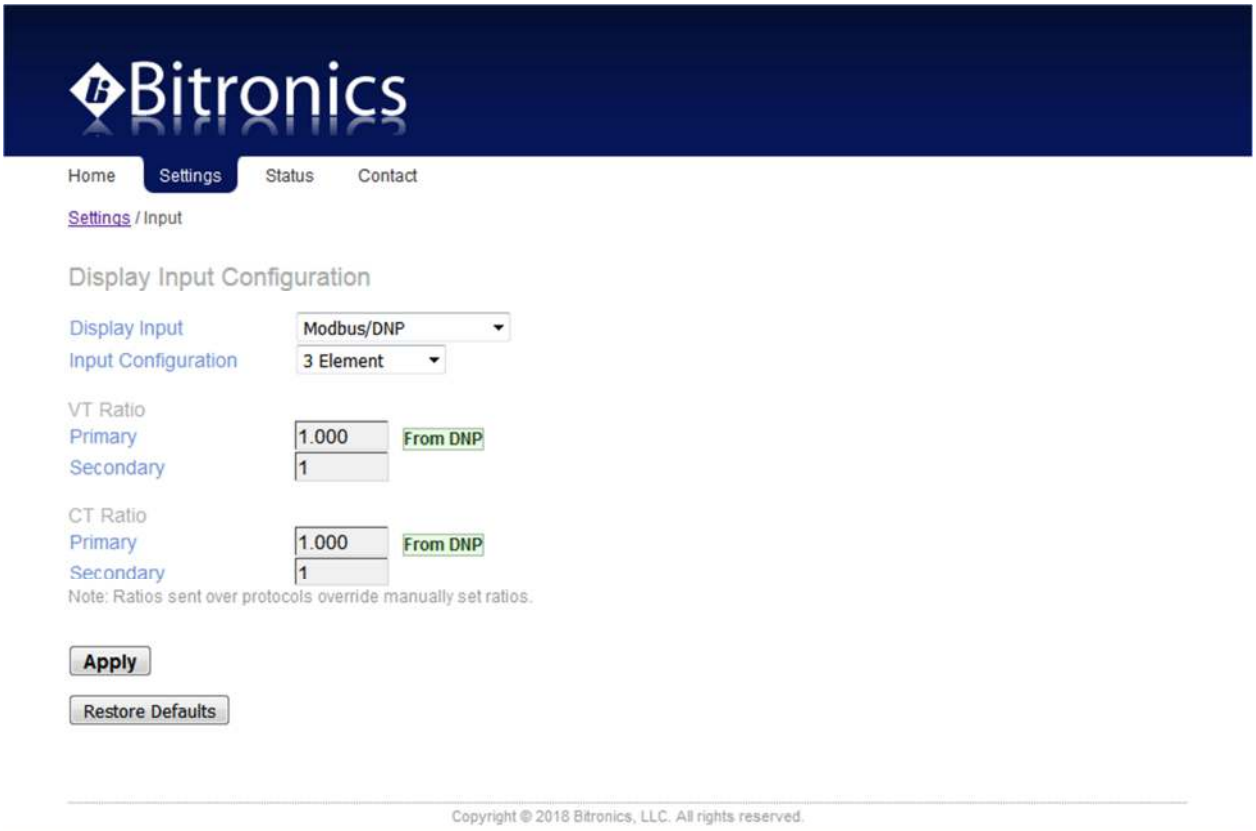

Note that the D650MX will use the CT and PT ratios set up in the device, it will ignore those on the Input page unless no ratios are set in the device it is interfacing with (Manual setting). Selecting “Serial display protocol” instead of Modbus/DNP3 disables the Client protocol functions and makes the D650MX operate like the D650BX.

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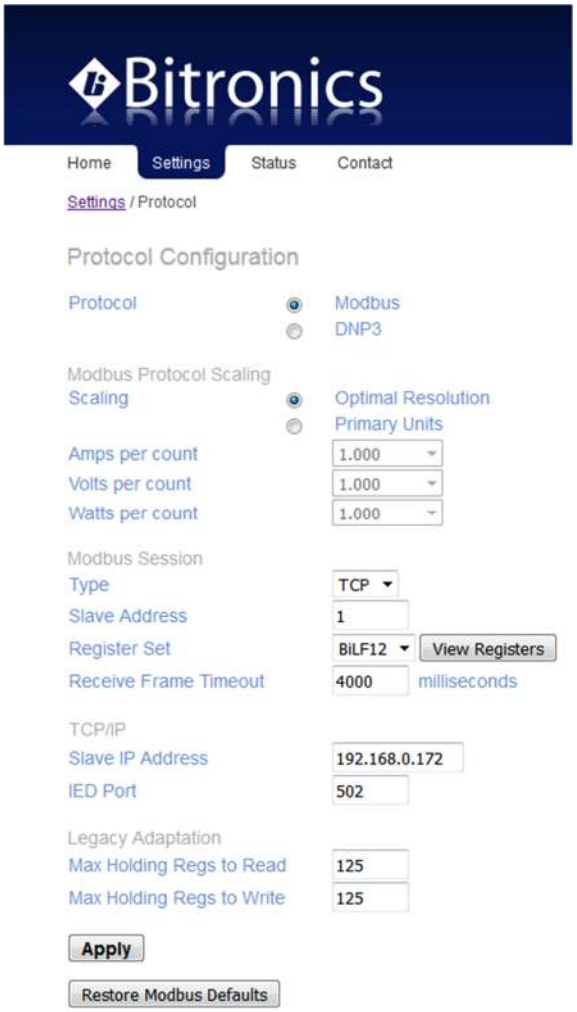
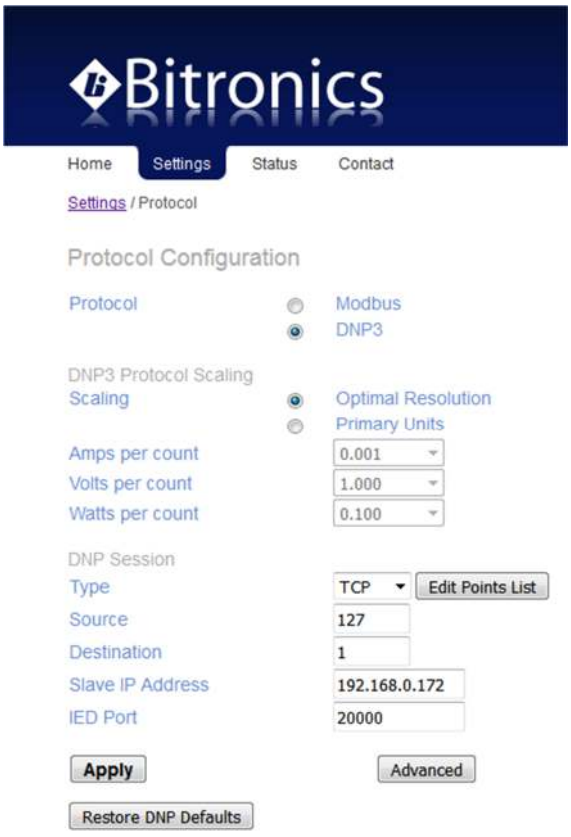
Protocol (D650MX):





Modbus DNP3

First select between Modbus or DNP3. You will then select Optimal Resolution (default) or Primary Units. In the Session section, under Type, there will be 2 different selections for Modbus and 2 for DNP3. Under Modbus the options are TCP or RTU. For DNP3 the selections are Serial or TCP. There is only one session per each D650. Under DNP3, clicking on the Advanced button reveals more advanced functions that may or may not need to be changed. Clicking on the Basic button hides the advanced functions. A detailed description of the setup parameters for Modbus and DNP3 can be found in the Appendix of the respective protocol manuals.

There are both fixed and configurable register/point lists. Please refer to the appropriate protocol manual for more information regarding how to view or edit the register/point list. For Modbus, the drop down for the Register Set is Bitronics Legacy Fixed (BiLF) 12-bit or 16-bit, or Total User Configurable (TUC).

There is a Filter feature available for choosing from the Available and Selected columns when editing the Modbus Register Configuration or DNP3 Points Configuration as shown below.

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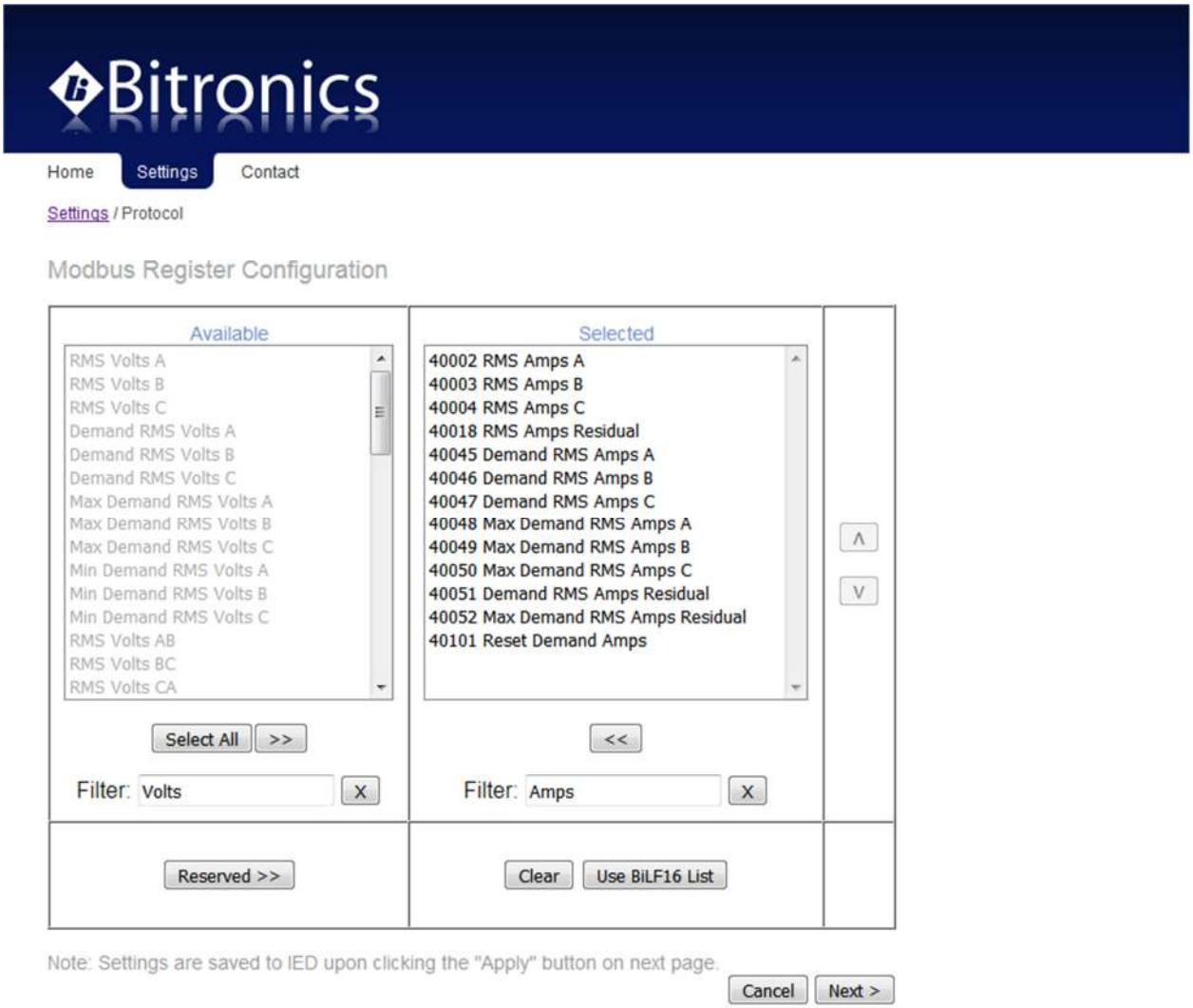

Network:

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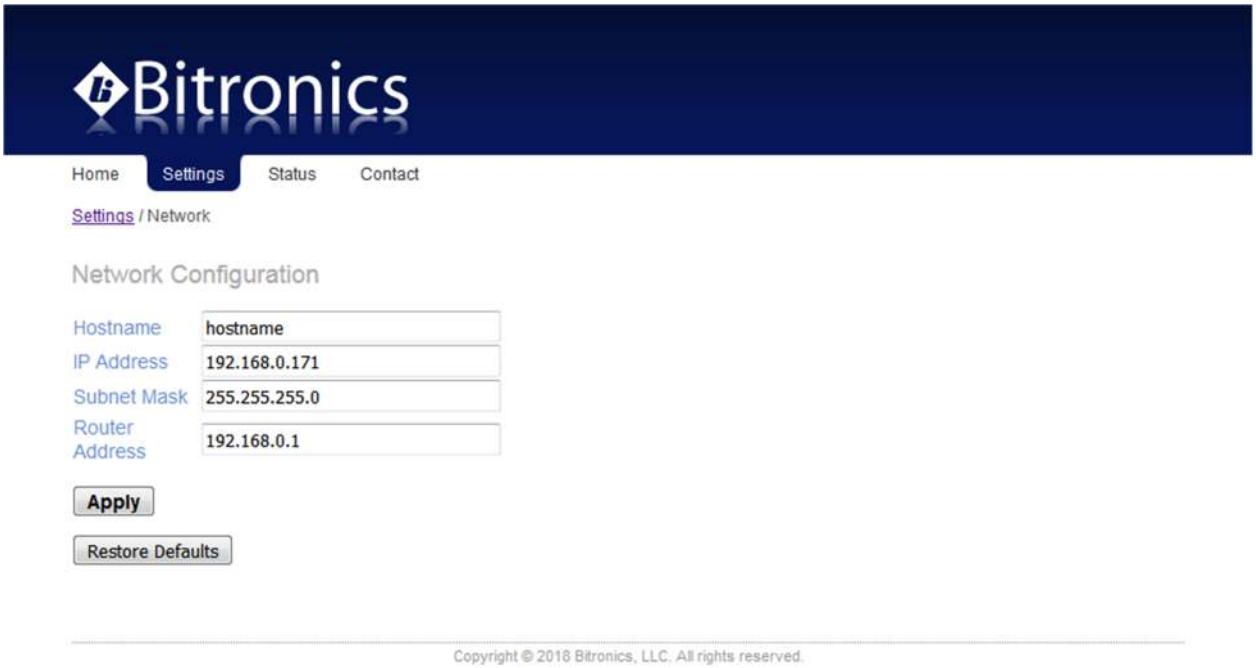
Bitronics
Home
Settings
Status
Contact
Settings / Network
Network Configuration
Hostname
hostname
IP Address
192.168.0.171
Subnet Mask
255.255.255.0
Router Address
192.168.0.1
Apply
Restore Defaults
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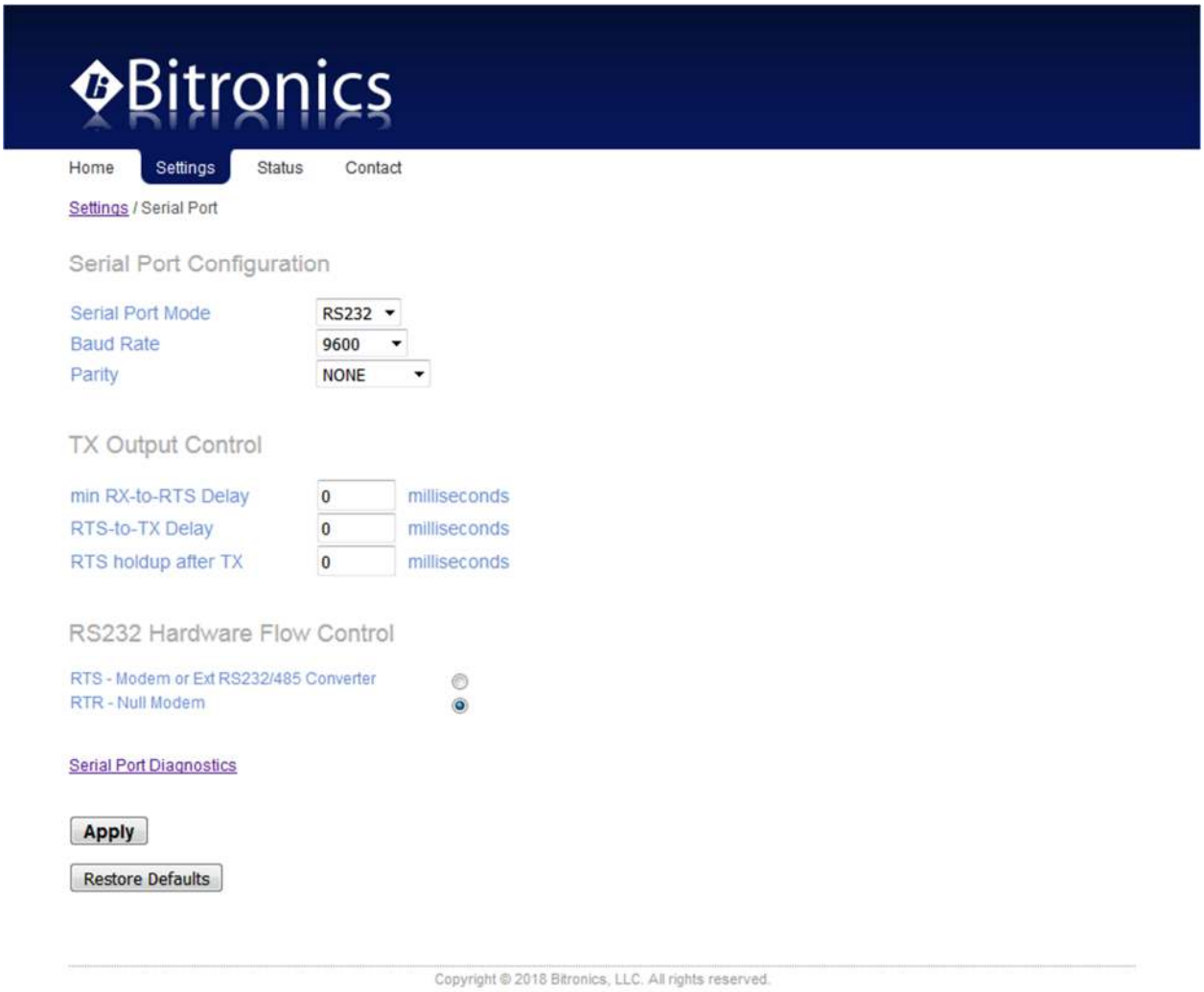
Serial Port:


Bitronics
Home
Settings
Status
Contact
Settings / Serial Port
Serial Port Configuration
Serial Port Mode
RS232
Baud Rate
9600
Parity
NONE
TX Output Control
min RX-to-RTS Delay
0
milliseconds
RTS-to-TX Delay
0
milliseconds
RTS holdup after TX
0
milliseconds
RS232 Hardware Flow Control
RTS - Modem or Ext RS232/485 Converter
RTR - Null Modem
Serial Port Diagnostics
Apply
Restore Defaults
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Scaling:

A custom, linear two-point scaling method can be used to associate the display with any device. The user associates the value of two polled points “on the wire” with two values desired to be displayed (e.g 3200 and 21200 polled “on the wire” are associated with 0.0 and 100.0 displayed). The selected points do not have to be minimum and maximum.

Custom scaling files can be edited offline using JSON (JavaScript Object Notation) or a text editor. Custom scaling files can be saved and moved to other D650 Universal Displays.

Once the custom scaling values are defined, they are assigned to Measurements using the names for the polled values. Phase and Modifier are referenced to the point LEDs on the right of the three display lines and the display will be controlled by these selections.

Once these Measurements are assigned, the user can go to Protocol settings and edit the list to have the Measurements polled. Provision exists to be able to insert blank lines to position polled values in points/register list.

Please refer to the Appendix A5 for a more detailed overview on how to setup the Custom/Flex Scaling.

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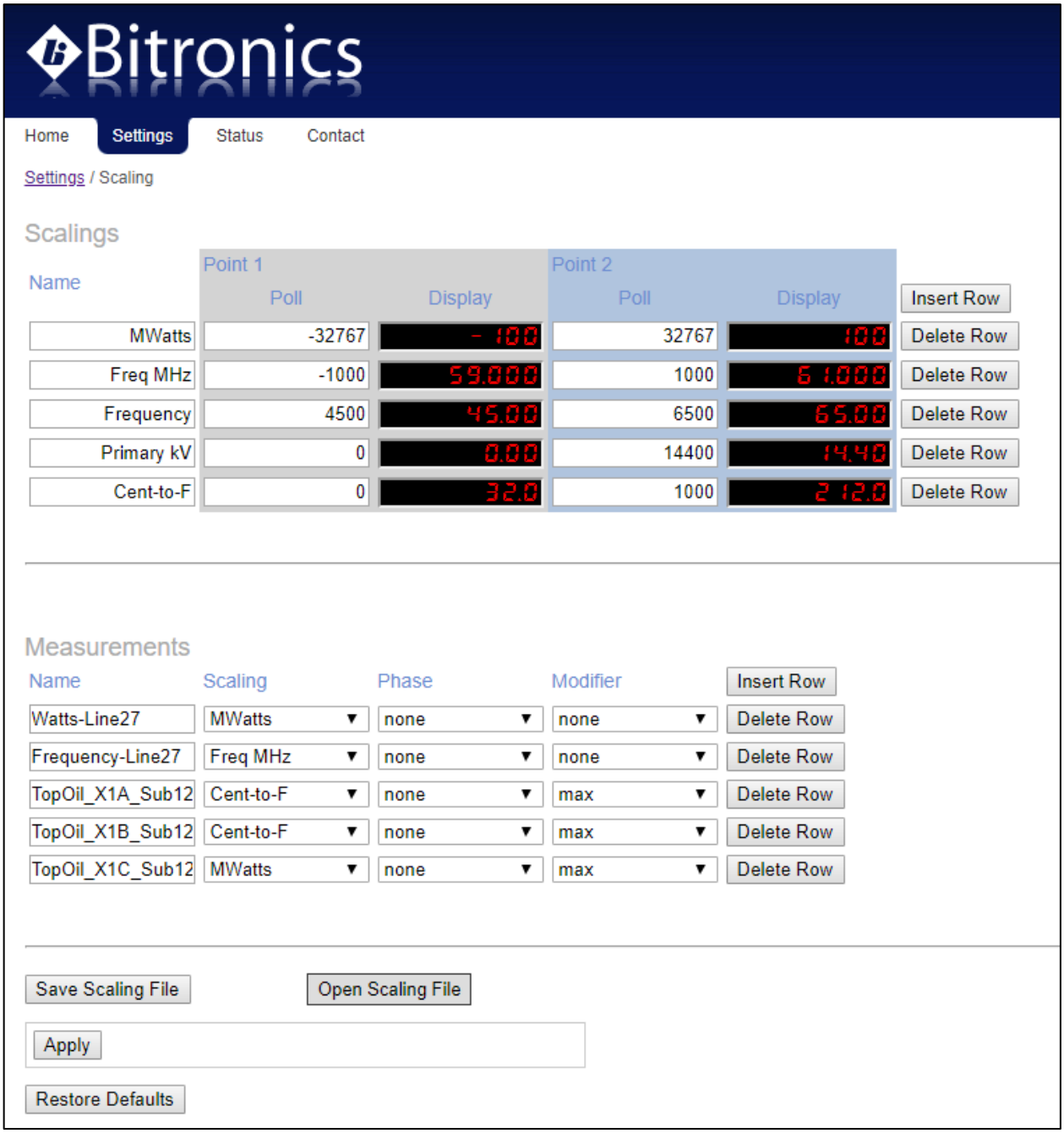

Screen Enable:

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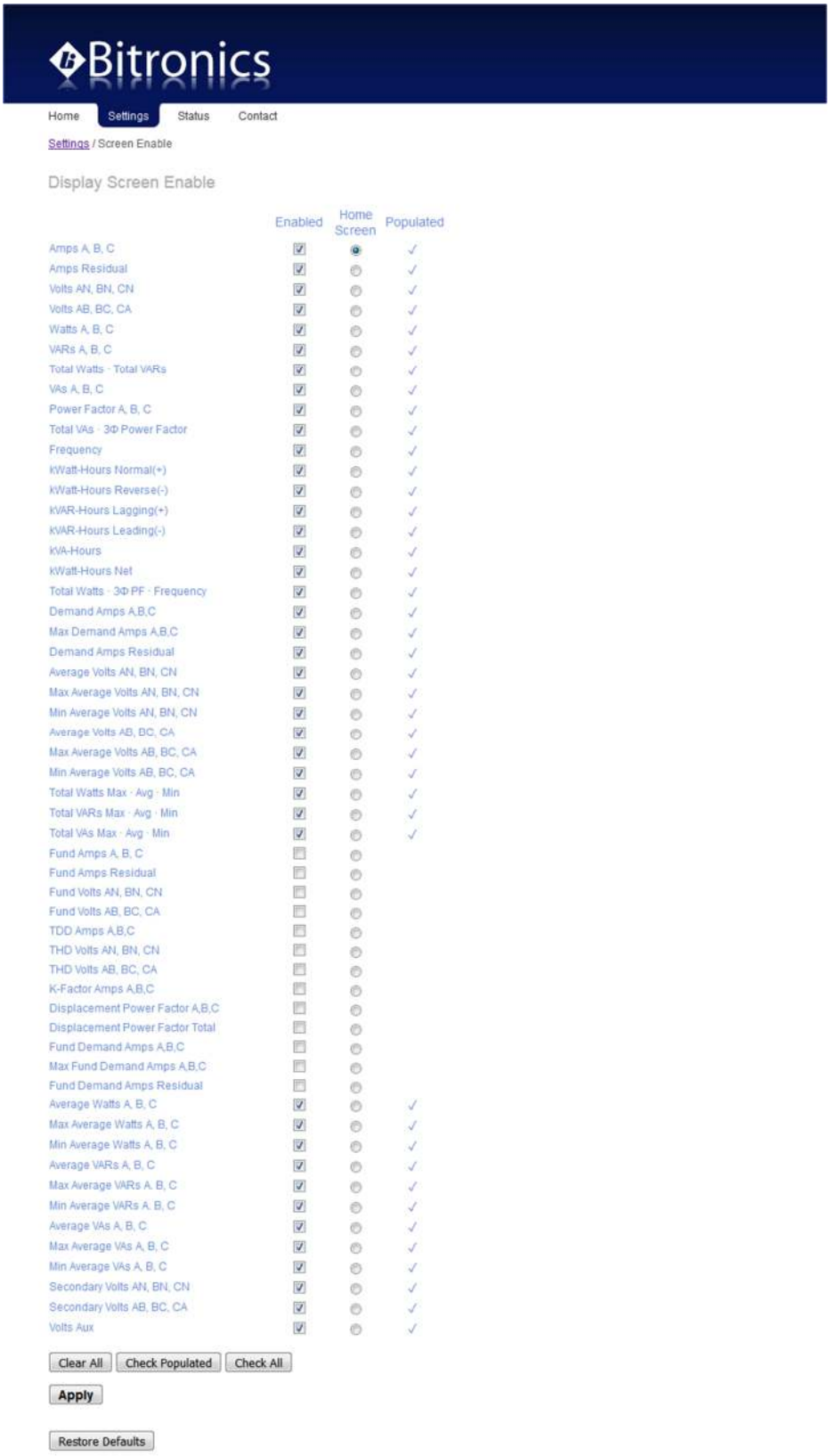

The Screen Enable web page shown above only applies to the D650MX Universal Display. As explained in Section 3.6 above, the D650BX screens are setup via the 70 Series

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Configurator or PPX II web page (see Appendix 2). Note in the view above, that a checkmark appears for those items that are available from the device that the D650MX is interfacing with. Clicking on the Check Populated will enable the screens for all the items available on the outstation device.

Custom Display Screen Settings: Two Sections – Build/Edit and Summary

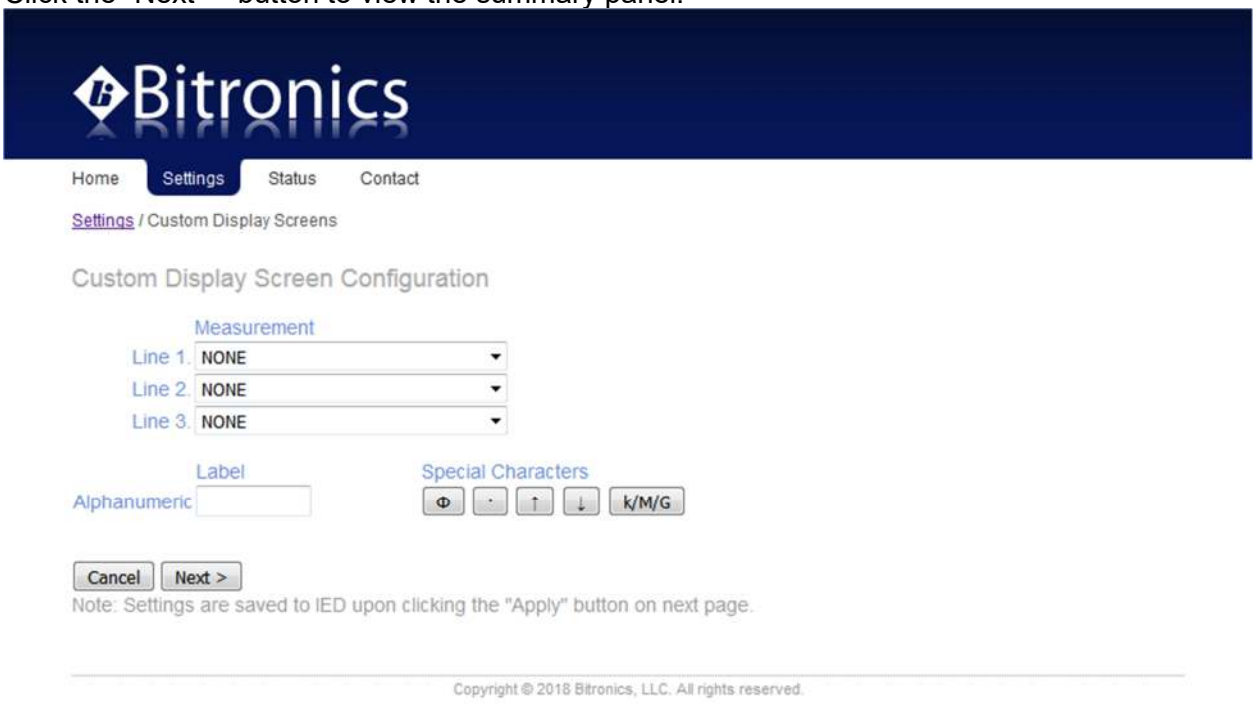
The Custom Display Screen Configuration page only applies to the D650MX Universal Display. It contains two sections: the Build/Edit panel and the Summary panel. One custom display screen is built at a time in the Build/Edit panel and is then added to the Summary panel, which presents a list of all the custom screens that have been built. The Build/Edit panel is presented if there are no custom screens stored on the IED when the page is loaded; otherwise, the Summary panel is presented. Only one panel is visible at a time.

Build/Edit panel
Select a measurement to be displayed on each display line from the dropdown lists and enter an alphanumeric label that describes the display screen.

Special character buttons insert the characters shown on the buttons into the “Label” field. The “k/M/G” (kilo/Mega/Giga) button inserts an underscore character into the “Label” field, which is automatically replaced with the appropriate unit prefix when displayed on the IED’s front panel. The dot character is used to separate parts of a single label into multiple labels that apply to the different display lines. It is necessary to place dots between underscore that apply to different display lines.

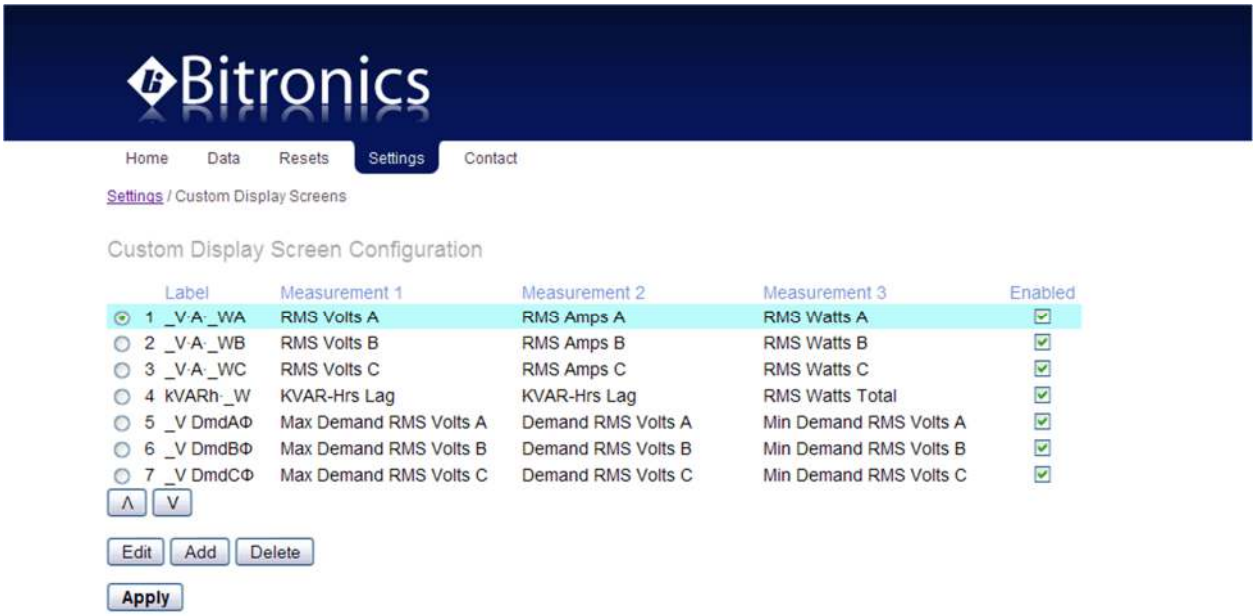
The MIN, MAX, AVG, line and phase LEDs are automatically lit by the IED, based on the selected measurements.

Click the “Next >” button to view the summary panel.

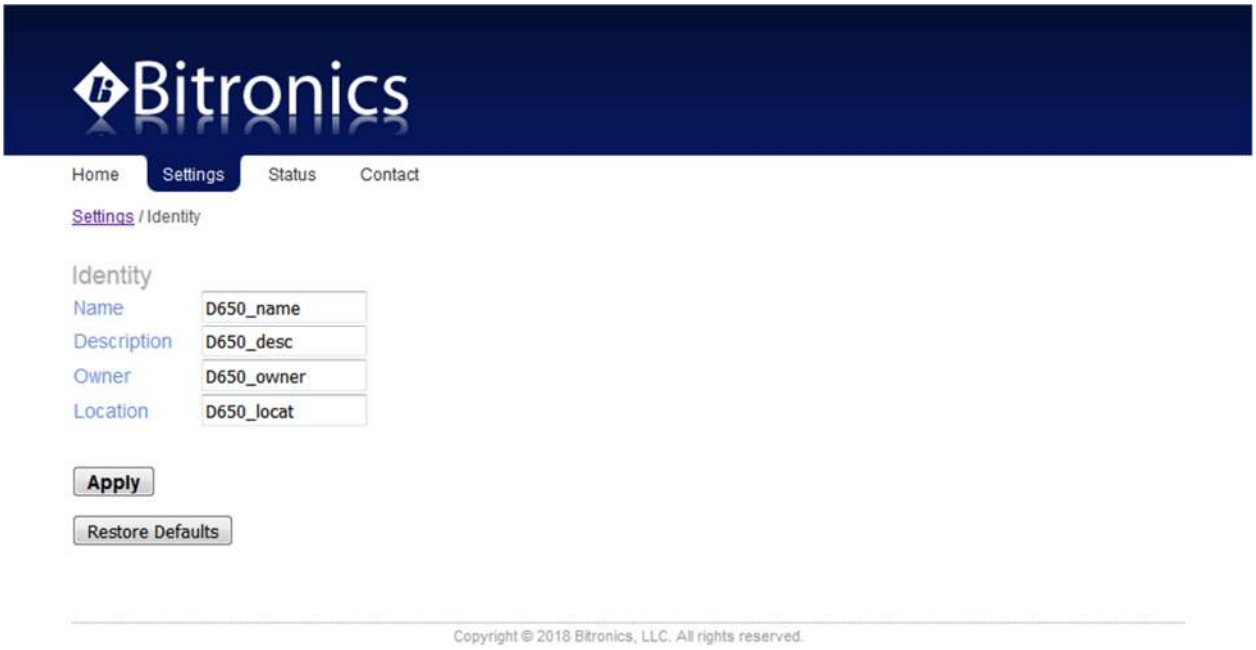


Summary panel
Screens are saved to IED once the “Apply” button has been clicked. A row (screen) from the summary table can be selected for viewing, editing or deleting by clicking its radio button.

The order of the screens can be changed by selecting a screen from the list and clicking on the up or down arrows.



Identity:



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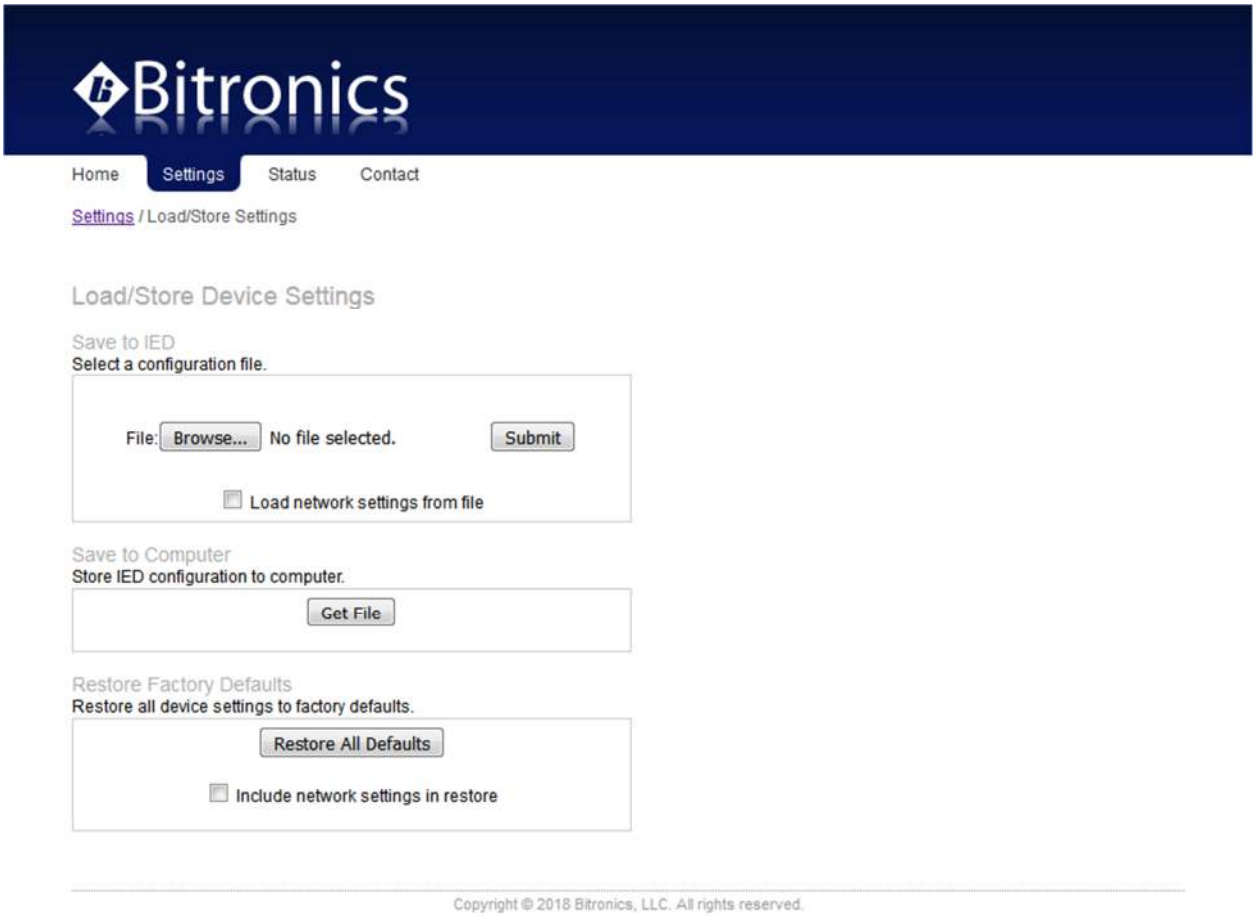
Load/Store Device Settings:



Password Security Settings:

The Password can be entered using the web browser interface for the D650 Display. Applying a Password provides a layer of security by enabling a Configuration Lock on the D650 Display front panel during Setup Mode. The Front Panel Configuration Lock disables the ability to change configuration settings and reset Demand values from the front panel buttons of the display. However, Display Mode operation to obtain informational readouts and scroll through screens is not affected. Note that the Configuration Lock must be unlocked in both the D650 and the PowerPlex II configurations in order to use the key combinations for reset demand values and set home screen.

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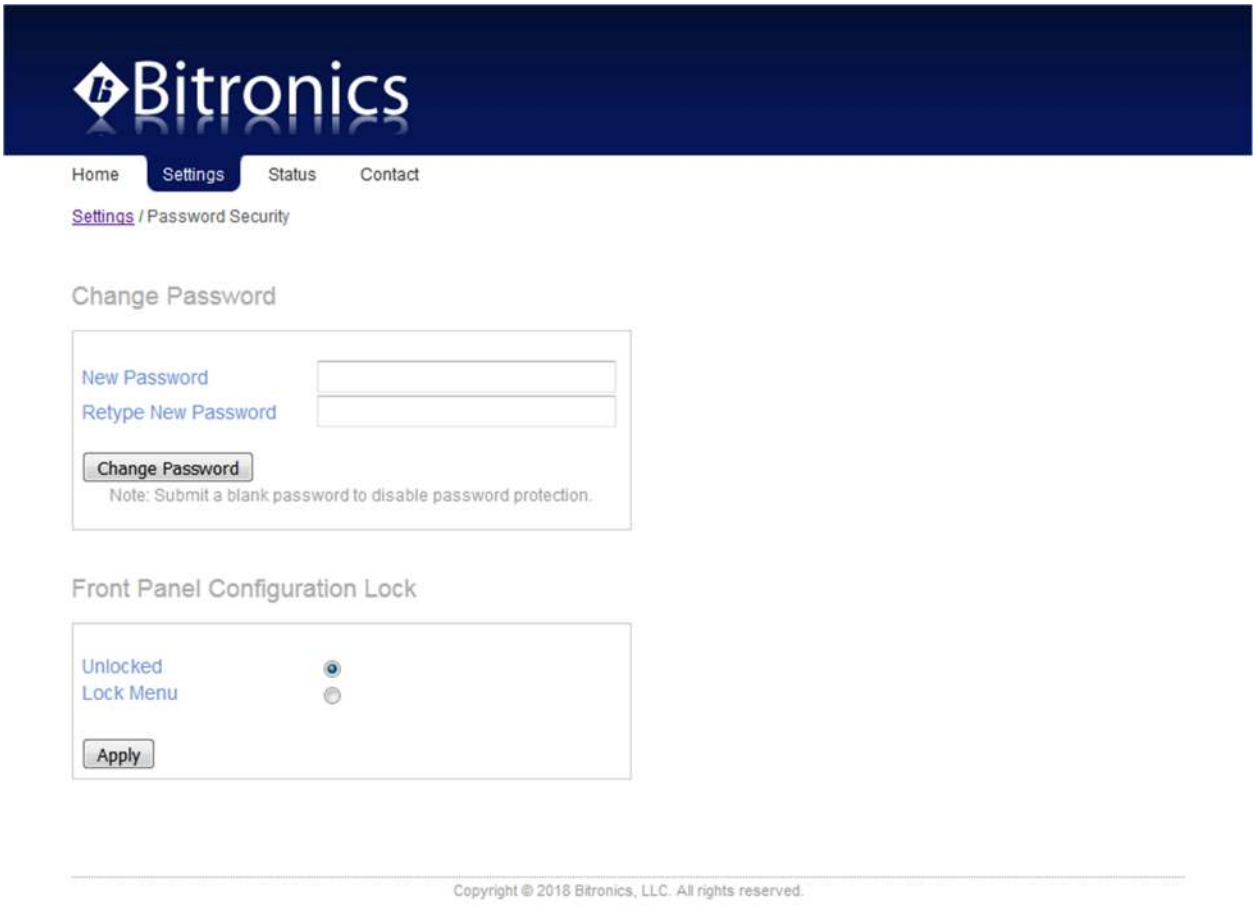

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Firmware Upload:

Status Page:

Contact Page:

6.0 DISPLAYABLE MEASUREMENTS

6.1 List of Display Capable Measurements from M57x

Please note that not all measurements are available in every M57x model (second set of current measurements and corresponding power, energy, etc. only in M572)

Available Measurements	
Accrued Digital IO Module #0-6, Input 1-16	K-factor Amps A (1 and 2)
Accrued Digital IO Module #0-6, Output 1-4	K-factor Amps B (1 and 2)
Accrued DR1/DR2 Active, Completed, Started	K-factor Amps C (1 and 2)
Accrued Pulse KWH, KVARH Positive (Bus 1 and 2)	K-factor Amps Residual (1 and 2)
Accrued Pulse KWH, KVARH Negative (Bus 1 and 2)	Log Interval
Accrued Virtual IO, Inputs 1-32, Outputs 1-32	Meter Type
Accrued WR1/WR2 Active, Completed, Started	Misc. Packed Bits
Amps A, B, C, Residual (Feeder 1 and 2)	Network Time Sync
Any Recorder Active	Peak Fault Current Amps A, B, C, Residual, Bus (1 and 2)
Any Recorder Memory Full	Phase Angle Amps A Harmonic (1…63 for 1 and 2)
Any Recorder Stored	Phase Angle Amps B Harmonic (1…63 for 1 and 2)
Any Recorder Triggered	Phase Angle Amps C Harmonic (1…63 for 1 and 2)
Avg. 3-phase Amps (1 and 2)	Phase Angle Volts A Bus1-Bus2
Avg. 3-phase Volts (1 and 2)	Phase Angle Volts A Harmonic (1…63)
Best Clock	Phase Angle Volts AB Harmonic (1…63)
Class 0 Response Setup	Phase Angle Volts B Bus1-Bus2
CT Scale Factor	Phase Angle Volts B Harmonic (1…63)
CT Scale Factor Divisor	Phase Angle Volts BC Harmonic (1…63)
Demand (Max.) Amps A, B, C, Residual (1 and 2)	Phase Angle Volts C Bus1-Bus2
Demand (Max.) Fund. Amps A, B, C, Residual (1 and 2)	Phase Angle Volts C Harmonic (1…63)
Demand (Max.) TDD Amps A, B, C, Residual (1 and 2)	Phase Angle Volts CA Harmonic (1…63)
Demand (Max.) THD Volts Bus1 AN, BN, CN, AB, BC, CA	Phase Angle Volts to Amps A (1 and 2)
Demand (Max.) THD Volts Bus2 AN, BN, CN, AB, BC, CA	Phase Angle Volts to Amps B (1 and 2)
Demand (Max.) VARs A, B, C, Total (1 and 2)	Phase Angle Volts to Amps C (1 and 2)
Demand (Max.) VAs A, B, C, Total (1 and 2)	Power Factor A, B, C, Total (Bus 1 and 2)
Demand (Max.) Volts Bus1 AN, BN, CN, NG, AB, BC, CA	Power Factor Total Arithmetic (Bus 1 and 2)
Demand (Max.) Volts Bus2 AN, BN, CN, NG, AB, BC, CA	Power Factor Total Equivalent L-L (Bus 1 and 2)

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Available Measurements	
Demand (Max.) Watts A, B, C, Total (1and 2)	Power Factor Total Equivalent L-N (Bus 1 and 2)
Demand (Min.) THD Volts Bus1 AN, BN, CN, AB, BC, CA	Power Factor Total Geometric (Bus 1 and 2)
Demand (Min.) THD Volts Bus2 AN, BN, CN, AB, BC, CA	Protocol Version
Demand (Min.) VARs A, B, C, Total (1 and 2)	PT Scale Factor
Demand (Min.) VAs A, B, C, Total (1 and 2)	PT Scale Factor Divisor
Demand (Min.) Volts Bus1, AN, BN, CN, NG, AB, BC, CA	Pulse Status- Negative VArHrs (1 and 2)
Demand (Min.) Volts Bus2, AN, BN, CN, NG, AB, BC, CA	Pulse Status- Negative WHrs (1 and 2)
Demand (Min.) Watts A, B, C, Total (1 and 2)	Pulse Status- Positive VarHrs (1 and 2)
Demand Amps A, B, C, Residual	Pulse Status-Positive WHrs (1 and 2)
Demand Fundamental Amps A, B, C, Residual	Pulse VAR-Hrs Normal (1 and 2)
Demand TDD Amps A, B, C, Residual	Pulse VAR-Hrs Reverse (1 and 2)
Demand THD Volts Bus1 AN, BN, CN, AB, BC, CA	Pulse Watt-Hrs Normal (1 and 2)
Demand THD Volts Bus2 AN, BN, CN, AB, BC, CA	Pulse Watt-Hrs Reverse (1 and 2)
Demand VARs A, B, C, Total	Reactance A, B, C (1 and 2)
Demand VAs A, B, C, Total	Resistance A, B, C, (1 and 2)
Demand Volts Bus1 AN, BN, CN, NG, AB, BC, CA	Slip Freq. Volts A Bus1-Bus2
Demand Volts Bus2 AN, BN, CN, AB, BC, CA	Slip Freq. Volts B Bus1-Bus2
Demand Watts A, B, C, Total	Slip Freq. Volts C Bus1-Bus2
Digital IO#0 Debounce Time	SNTP Time Sync
Digital IO#0 Input Point 1-4	Symmetrical comp. of Bus 1 voltage (mag. and angle)
Digital IO#0 Output Point 1-4	Symmetrical comp. of Bus 2 voltage (mag. and angle)
Digital IO Module #0-6 Status Output Point 1-4	Symmetrical comp. of current (mag. and angle, 1 & 2)
Displacement Power Factor A, B, C (1 and 2)	System Frequency
Displacement Power Factor Total (1 and 2)	Tag Register
Displacement Power Factor Total Arithmetic (1 and 2)	TDD Amps A, B, C, Residual (1 and 2)
Displacement Power Factor Total Equivalent L-L (1 & 2)	TDD Denominator A, B, C, (1 and 2)
Displacement Power Factor Total Equivalent L-N (1 & 2)	TDD, Even, Amps A, B, C, Residual (1 and 2)
Displacement Power Factor Total Geometric (1 & 2)	TDD, Odd, Amps A, B, C, Residual (1 and 2)
DNP Time Sync	Temperature
DR 1 Active	THD Volts Bus1 AN, BN, CN, AB, BC, CA
DR1 Memory Full	THD Volts Bus2 AN, BN, CN, AB, BC, CA
DR1 Record Count	THD, Even, Volts Bus1 AN, BN, CN, AB, BC, CA
DR1 Stored	THD, Even, Volts Bus2 AN, BN, CN, AB, BC, CA

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Available Measurements	
DR1 Triggered	THD, Odd, Volts Bus1 AN, BN, CN, AB, BC, CA
DR2 Active	THD, Odd, Volts Bus2 AN, BN, CN, AB, BC, CA
DR2 Memory Full	Time Sync Error (usec, msec, sec)
DR2 Record Count	Trigger Derivative 1-120
DR2 Stored	Unbalance Volts (1 and 2)
DR2 Triggered	Unbalance Amps (1 and 2)
DSP Version	User Gain Amps A, B, C, Residual (1 and 2)
Factory Version Hardware	User Gain Volts Bus1 A, B, C, N
Factory Version Software	User Gain Volts Bus2 A, B, C, N
Fault Completed (Bus 1, Bus 2)	User Gain Volts Bus2 Aux1-Gnd, Aux2-Gnd, Aux1-Aux2
Fault Count (Bus 1, Bus 2)	User Phase Correction Amps A, B, C, Residual (1 and 2)
Fault Distance AN, BN, CN, AB, BC, CA (Bus 1, Bus 2)	User Phase Correction Volts Bus1 AN, BN, CN, NG, AB, BC, CA
Fault Target (A, B, C, Bus 1 and Bus 2)	User Phase Correction Volts Bus2 AN, BN, CN, NG, AB, BC, CA
Fault Type (Bus 1, Bus 2)	User Phase Correction Volts Bus2 Aux1-Gnd, Aux2-Gnd, Aux1-Aux2
Flicker Short (PST VAN, VBN, VCN Bus 1 and 2)	VA/PF Calc. Type (1 and 2)
Flicker Long (PLT VAN, VBN, VCN Bus 1 and 2)	VA-Hrs (1 and 2)
Frequency Amps A, B, C, Residual (1 and 2)	VAR-Hrs Lag (1 and 2)
Frequency Volts Bus1 A, B, C	VAR-Hrs Lead (1 and 2)
Frequency Volts Bus2 A, B, C	VARs A, B, C, Total (1 and 2)
Fund. Amps A, B, C, Residual (1 and 2)	VAs A, B, C, Total (1 and 2)
Fund. VAs Tot. Arith (1 and 2).	VAs Tot. Arith. (1 and 2)
Fund. VAs Tot. Equiv. L-L (1 and 2)	VAs Tot. Equiv. L-L (1 and 2)
Fund. VAs Tot. Equiv. L-N (1 and 2)	VAs Tot. Equiv. L-N (1 and 2)
Fund. VAs Tot. Geom. (1 and 2)	VAs Tot. Geom. (1 and 2)
Fund. VAs Total (1 and 2)	Virtual Input Point 1-32
Fund. Volts Bus1 AN, BN, CN, AB, BC, CA	Virtual Output Point 1-32
Fund. Volts Bus2 AN, BN, CN, AB, BC, CA	Volts Aux1-Gnd, Aux2-Gnd, Aux1-Aux2
Harmonic, Individual, Amps A, B, C, (1…63 for 1 & 2)	Volts Bus1 AN, BN, CN, NG, AB, BC, CA
Harmonic, Individual, Bus1, Volts A (1...63)	Volts Bus2 AN, BN, CN, NG, AB, BC, CA
Harmonic, Individual, Bus1, Volts AB (1...63)	Watt-Hrs Normal (1 and 2)
Harmonic, Individual, Bus1, Volts B (1...63)	Watt-Hrs Reverse (1 and 2)
Harmonic, Individual, Bus1, Volts BC (1...63)	Watts A, B, C, Total (1 and 2)
Harmonic, Individual, Bus1, Volts C (1...63)	Waveform Status
Harmonic, Individual, Bus1, Volts CA (1...63)	WV1/WV2 Active
Harmonic, Individual, Bus2, Volts A (1...63)	WV1/WV2 Memory Full
Harmonic, Individual, Bus2, Volts AB (1...63)	WV1/WV2 Record Count
Harmonic, Individual, Bus2, Volts B (1...63)	WV1/WV2 Stored
Harmonic, Individual, Bus2, Volts BC (1...63)	WV1/WV2 Triggered
Harmonic, Individual, Bus2, Volts C (1...63)	Xfmr Ratio Amps A, B, C, Residual (1 and 2)

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Available Measurements	
Harmonic, Individual, Bus2, Volts CA (1...63)	Xfmr Ratio Future Use
Health	Xfmr Ratio Volts Bus1 A, B, C, N
Heartbeat	Xfmr Ratio Volts Bus2 A, B, C, N
Impedance A, B, C (1 and 2)	Xfmr Ratio Volts Bus2 Aux1-Gnd, Aux2-Gnd, Aux1-Aux2
IrigB Time Sync	

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6.2 List of Display Capable Measurements from M87x

Please note that not all measurements are available in every M87x model (i.e. neutral current in M871 only, second set of current measurements and corresponding power, energy, etc. only in M872)

Available Measurements	
Accrued Digital IO Module #0-6, Input 1-16	K-factor Amps B (1 and 2)
Accrued Digital IO Module #0-6, Output 1-4	K-factor Amps C (1 and 2)
Accrued DR1/DR2 Active, Completed, Started	K-factor Amps N
Accrued Pulse KWH, KVARH Positive (Bus 1 and 2)	K-factor Amps Residual (1 and 2)
Accrued Pulse KWH, KVARH Negative (Bus 1 and 2)	Log Interval
Accrued Virtual IO, Inputs 1-32, Outputs 1-32	Meter Type
Accrued WR1/WR2 Active, Completed, Started	Misc. Packed Bits
Amps A, B, C, N, Residual (Feeder 1 and 2)	Network Time Sync
Any Recorder Active	Peak Fault Current Amps A, B, C, Residual, Bus (1 and 2)
Any Recorder Memory Full	Phase Angle Amps A Harmonic (1…63 for 1 and 2)
Any Recorder Stored	Phase Angle Amps B Harmonic (1…63 for 1 and 2)
Any Recorder Triggered	Phase Angle Amps C Harmonic (1…63 for 1 and 2)
Avg. 3-phase Amps (1 and 2)	Phase Angle Amps N Harmonic (1…63)
Avg. 3-phase Volts (1 and 2)	Phase Angle Volts A Bus1-Bus2
Best Clock	Phase Angle Volts A Harmonic (1…63)
Class 0 Response Setup	Phase Angle Volts AB Harmonic (1…63)
CT Scale Factor	Phase Angle Volts B Bus1-Bus2
CT Scale Factor Divisor	Phase Angle Volts B Harmonic (1…63)
Demand (Max.) Amps A, B, C, N, Residual (1 and 2)	Phase Angle Volts BC Harmonic (1…63)
Demand (Max.) Fund. Amps A, B, C, N, Resid. (1 and 2)	Phase Angle Volts C Bus1-Bus2
Demand (Max.) TDD Amps A, B, C, N, Resid. (1 and 2)	Phase Angle Volts C Harmonic (1…63)
Demand (Max.) THD Volts Bus1 AN, BN, CN, AB, BC, CA	Phase Angle Volts CA Harmonic (1…63)
Demand (Max.) THD Volts Bus2 AN, BN, CN, AB, BC, CA	Phase Angle Volts to Amps A (1 and 2)
Demand (Max.) VARs A, B, C, Total (1 and 2)	Phase Angle Volts to Amps B (1 and 2)
Demand (Max.) VAs A, B, C, Total (1 and 2)	Phase Angle Volts to Amps C (1 and 2)
Demand (Max.) Volts Bus1 AN, BN, CN, NG, AB, BC, CA	Power Factor A, B, C, Total (Bus 1 and 2)
Demand (Max.) Volts Bus2 AN, BN, CN, NG, AB, BC, CA	Power Factor Total Arithmetic (Bus 1 and 2)
Demand (Max.) Watts A, B, C, Total (1and 2)	Power Factor Total Equivalent L-L (Bus 1 and 2)

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Available Measurements	
Demand (Min.) THD Volts Bus1 AN, BN, CN, AB, BC, CA	Power Factor Total Equivalent L-N (Bus 1 and 2)
Demand (Min.) THD Volts Bus2 AN, BN, CN, AB, BC, CA	Power Factor Total Geometric (Bus 1 and 2)
Demand (Min.) VARs A, B, C, Total (1 and 2)	Protocol Version
Demand (Min.) VAs A, B, C, Total (1 and 2)	PT Scale Factor
Demand (Min.) Volts Bus1, AN, BN, CN, NG, AB, BC, CA	PT Scale Factor Divisor
Demand (Min.) Volts Bus2, AN, BN, CN, NG, AB, BC, CA	Pulse Status- Negative VArHrs (1 and 2)
Demand (Min.) Watts A, B, C, Total (1 and 2)	Pulse Status- Negative WHrs (1 and 2)
Demand Amps A, B, C, N, Residual	Pulse Status- Positive VarHrs (1 and 2)
Demand Fundamental Amps A, B, C, N, Residual	Pulse Status-Positive WHrs (1 and 2)
Demand TDD Amps A, B, C, N, Residual	Pulse VAR-Hrs Normal (1 and 2)
Demand THD Volts Bus1 AN, BN, CN, AB, BC, CA	Pulse VAR-Hrs Reverse (1 and 2)
Demand THD Volts Bus2 AN, BN, CN, AB, BC, CA	Pulse Watt-Hrs Normal (1 and 2)
Demand VARs A, B, C, Total	Pulse Watt-Hrs Reverse (1 and 2)
Demand VAs A, B, C, Total	Reactance A, B, C (1 and 2)
Demand Volts Bus1 AN, BN, CN, NG, AB, BC, CA	Resistance A, B, C, (1 and 2)
Demand Volts Bus2 AN, BN, CN, AB, BC, CA	Slip Freq. Volts A Bus1-Bus2
Demand Watts A, B, C, Total	Slip Freq. Volts B Bus1-Bus2
Digital IO Module #0-6 Debounce Time	Slip Freq. Volts C Bus1-Bus2
Digital IO Module #0-6 Input Point 1-16	SNTP Time Sync
Digital IO Module #0-6 Output Point 1-4	Symmetrical comp. of Bus 1 voltage (mag. and angle)
Digital IO Module #0-6 Status Output Point 1-4	Symmetrical comp. of Bus 2 voltage (mag. and angle)
Displacement Power Factor A, B, C (1 and 2)	Symmetrical comp. of current (mag. and angle, 1 & 2)
Displacement Power Factor Total (1 and 2)	System Frequency
Displacement Power Factor Total Arithmetic (1 and 2)	Tag Register
Displacement Power Factor Total Equivalent L-L (1 & 2)	TDD Amps A, B, C, N, Residual (1 and 2)
Displacement Power Factor Total Equivalent L-N (1 & 2)	TDD Denominator A, B, C, N (1 and 2)
Displacement Power Factor Total Geometric (1 & 2)	TDD, Even, Amps A, B, C, Residual (1 and 2)
DNP Time Sync	TDD, Odd, Amps A, B, C, Residual (1 and 2)
DR 1 Active	Temperature
DR1 Memory Full	THD Volts Bus1 AN, BN, CN, AB, BC, CA
DR1 Record Count	THD Volts Bus2 AN, BN, CN, AB, BC, CA
DR1 Stored	THD, Even, Volts Bus1 AN, BN, CN, AB, BC, CA
DR1 Triggered	THD, Even, Volts Bus2 AN, BN, CN, AB, BC, CA

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Available Measurements	
DR2 Active	THD, Odd, Volts Bus1 AN, BN, CN, AB, BC, CA
DR2 Memory Full	THD, Odd, Volts Bus2 AN, BN, CN, AB, BC, CA
DR2 Record Count	Time Sync Error (µsec, msec, sec)
DR2 Stored	Transducer Input Module # 1-7, Input Point 1-8
DR2 Triggered	Trigger Derivative 1-120
DSP Version	Unbalance Volts (1 and 2)
Factory Version Hardware	Unbalance Amps (1 and 2)
Factory Version Software	User Gain Amps A, B, C, N, Residual (1 and 2)
Fault Completed (Bus 1, Bus 2)	User Gain Volts Bus1 A, B, C, N
Fault Count (Bus 1, Bus 2)	User Gain Volts Bus2 A, B, C, N
Fault Distance AN, BN, CN, AB, BC, CA (Bus 1, Bus 2)	User Gain Volts Bus2 Aux1-Gnd, Aux2-Gnd, Aux1-Aux2
Fault Target (A, B, C, Bus 1 and Bus 2)	User Phase Correction Amps A, B, C, N, Residual (1 and 2)
Fault Type (Bus 1, Bus 2)	User Phase Correction Volts Bus1 AN, BN, CN, NG, AB, BC, CA
Flicker Short (PST VAN, VBN, VCN Bus 1 and 2)	User Phase Correction Volts Bus2 AN, BN, CN, NG, AB, BC, CA
Flicker Long (PLT VAN, VBN, VCN Bus 1 and 2)	User Phase Correction Volts Bus2 Aux1-Gnd, Aux2-Gnd, Aux1-Aux2
Frequency Amps A, B, C, Residual (1 and 2)	VA/PF Calc. Type (1 and 2)
Frequency Volts Bus1 A, B, C	VA-Hrs (1 and 2)
Frequency Volts Bus2 A, B, C	VAR-Hrs Lag (1 and 2)
Fund. Amps A, B, C, N, Residual (1 and 2)	VAR-Hrs Lead (1 and 2)
Fund. VAs Tot. Arith (1 and 2).	VARs A, B, C, Total (1 and 2)
Fund. VAs Tot. Equiv. L-L (1 and 2)	VAs A, B, C, Total (1 and 2)
Fund. VAs Tot. Equiv. L-N (1 and 2)	VAs Tot. Arith. (1 and 2)
Fund. VAs Tot. Geom. (1 and 2)	VAs Tot. Equiv. L-L (1 and 2)
Fund. VAs Total (1 and 2)	VAs Tot. Equiv. L-N (1 and 2)
Fund. Volts Bus1 AN, BN, CN, AB, BC, CA	VAs Tot. Geom. (1 and 2)
Fund. Volts Bus2 AN, BN, CN, AB, BC, CA	Virtual Input Point 1-32
Harmonic, Individual, Amps A, B, C, N (1…63 for 1 & 2)	Virtual Output Point 1-32
Harmonic, Individual, Bus1, Volts A (1...63)	Volts Aux1-Gnd, Aux2-Gnd, Aux1-Aux2
Harmonic, Individual, Bus1, Volts AB (1...63)	Volts Bus1 AN, BN, CN, NG, AB, BC, CA
Harmonic, Individual, Bus1, Volts B (1...63)	Volts Bus2 AN, BN, CN, NG, AB, BC, CA
Harmonic, Individual, Bus1, Volts BC (1...63)	Watt-Hrs Normal (1 and 2)
Harmonic, Individual, Bus1, Volts C (1...63)	Watt-Hrs Reverse (1 and 2)
Harmonic, Individual, Bus1, Volts CA (1...63)	Watts A, B, C, Total (1 and 2)
Harmonic, Individual, Bus2, Volts A (1...63)	Waveform Status
Harmonic, Individual, Bus2, Volts AB (1...63)	WV1/WV2 Active
Harmonic, Individual, Bus2, Volts B (1...63)	WV1/WV2 Memory Full
Harmonic, Individual, Bus2, Volts BC (1...63)	WV1/WV2 Record Count

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Available Measurements	
Harmonic, Individual, Bus2, Volts C (1...63)	WV1/WV2 Stored
Harmonic, Individual, Bus2, Volts CA (1...63)	WV1/WV2 Triggered
Health	Xfmr Ratio Amps A, B, C, N, Residual (1 and 2)
Heartbeat	Xfmr Ratio Future Use
Impedance A, B, C (1 and 2)	Xfmr Ratio Volts Bus1 A, B, C, N
IrigB Time Sync	Xfmr Ratio Volts Bus2 A, B, C, N
K-factor Amps A (1 and 2)	Xfmr Ratio Volts Bus2 Aux1-Gnd, Aux2-Gnd, Aux1-Aux2

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6.3 List of Display Capable Measurements from PowerPlex II

Available Measurements	
Amps A, B, C, Residual	K-factor Amps C
Average Volts AN, BN, CN, AB, BC, CA (Bus 1)	K-factor Amps Residual
Average (Max.) Volts AN, BN, CN, AB, BC, CA (Bus 1)	Phase Angle Amps A, B, C
Average (Min.) Volts AN, BN, CN, AB, BC, CA (Bus 1)	Phase Angle Volts A, B, C
Average Watts A, B, C, Total	Phase Angle Volts AB, BC, CA
Average (Max.) Watts A, B, C, Total	Phase Angle Volts A 1-2, B 1-2, C 1-2
Average (Min.) Watts A, B, C, Total	Power Factor A, B, C, Total
Average VARs A, B, C, Total	Slip Frequency Volts A 1-2, B 1-2, C 1-2
Average (Max.) VARs A, B, C, Total	TDD Amps A, B, C, Residual
Average (Min.) VARs A, B, C, Total	TDD Denominator A, B, C
Average VAs A, B, C, Total	THD Volts AN, BN, CN, AB, BC, CA
Average (Max.) VAs A, B, C, Total	Uncompensated VARs, Total
Average (Min.) VAs A, B, C, Total	Uncompensated Watts, Total
Demand (Max.) Amps A, B, C, Residual	VA-Hrs
Demand (Max.) Fund. Amps A, B, C, Residual	VAR-Hrs Lag
Demand Amps A, B, C, Residual	VAR-Hrs Lead
Demand Fundamental Amps A, B, C, Residual	VARs A, B, C, Total
Displacement Power Factor A, B, C	VAs A, B, C, Total
Displacement Power Factor Total	Volts AN, BN, CN, AB, BC, CA (1 and 2)
Frequency (System)	Volts Aux
Frequency Volts A, B, C (1 & 2)	Watt-Hrs Net
Fund. Amps A, B, C, Residual	Watt-Hrs Normal
Fund. Volts AN, BN, CN, AB, BC, CA (1 & 2)	Watt-Hrs Reverse
K-factor Amps A	Watts A, B, C, Total
K-factor Amps B	

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6.4 List of Standard Display Measurements with D650 (M650 Measurements)

Available Measurements	
Amps A, B, C, Residual	Heartbeat
Average 3-phase Amps[1]	K-factor Amps A[1]
Average 3-Phase Volts (L-L, L-N)[1]	K-factor Amps B[1]
Average Volts AN, BN, CN, AB, BC, CA[1]	K-factor Amps C[1]
Average (Max.) Volts AN, BN, CN, AB, BC, CA[1]	K-factor Amps Residual[1]
Average (Min.) Volts AN, BN, CN, AB, BC, CA[1]	Meter Type
Average Watts A, B, C, Total[1]	Phase Angle Amps A, B, C[1]
Average (Max.) Watts A, B, C, Total[1]	Phase Angle Volts A, B, C[1]
Average (Min.) Watts A, B, C, Total[1]	Phase Angle Volts AB, BC, CA[1]
Average VARs A, B, C, Total[1]	Power Factor A, B, C, Total
Average (Max.) VARs A, B, C, Total[1]	Protocol Version
Average (Min.) VARs A, B, C, Total[1]	PT Scale Factor
Average VAs A, B, C, Total[1]	PT Scale Factor Divisor
Average (Max.) VAs A, B, C, Total[1]	TDD Amps A, B, C, Residual[1]
Average (Min.) VAs A, B, C, Total[1]	TDD Denominator A, B, C, [1]
Class 0 Response Setup[1]	THD Volts AN, BN, CN, AB, BC, CA[1]
CT Scale Factor	Uncompensated VARs, Total
CT Scale Factor Divisor	Uncompensated Watts, Total
Demand (Max.) Amps A, B, C, Residual	VA-Hrs
Demand (Max.) Fund. Amps A, B, C, Residual[1]	VAR-Hrs Lag
Demand Amps A, B, C, Residual	VAR-Hrs Lead
Demand Fundamental Amps A, B, C, Residual[1]	VARs A, B, C, Total
Displacement Power Factor A, B, C[1]	VAs A, B, C, Total
Displacement Power Factor Total[1]	Volts AN, BN, CN, AB, BC, CA
Factory Version Hardware	Volts Aux
Factory Version Software	Watt-Hrs Net
Frequency	Watt-Hrs Normal
Fund. Amps A, B, C, Residual[1]	Watt-Hrs Reverse
Fund. Volts AN, BN, CN, AB, BC, CA[1]	Watts A, B, C, Total
Health	

6.5 Calibration

Routine re-calibration is not recommended or required. A field calibration check every few years is a good assurance of proper operation

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APPENDIX

A1 Ethernet Troubleshooting

If the Link LED fails to illuminate, this is an indication that there is trouble with the connection and communication will not proceed without solving the problem. If a copper connection is used between the D650 and the hub/switch, check the following items:

1. Verify that the connectors are fully engaged on each end.
2. Verify that the cable used is a "straight-through" cable connected to a "normal" port.
3. Verify that both the D650 and hub/switch are powered.
4. Try another cable.
5. If a long CAT-5 cable is used, verify that it has never been kinked. Kinking can cause internal discontinuities in the cable.
6. If a copper connection is used to an external fiber converter:
7. Verify that the LINK LED on the converter is lit on at least one side. Both sides need to be lit for a valid connection to be established.
8. At least one brand of converters will not output an optical idle unless it receives a forced 10 Mb copper link pulse (for some reason, auto-negotiation pulses confuse it). Some hubs/switches will not output an optical idle unless they receive an optical idle. This then inhibits the converter from outputting a copper link pulse enabling the D650 to link. In this condition, no device completes the link.
9. Verify that the fiber converter(s) and/or fiber hub/switch are matched for the same type of fiber connections. A 100BASE-FX port will NEVER inter-operate with the 10BASE-FL port (fiber auto-negotiation does not exist).
10. On the fiber connection, try swapping the transmit and receive connector *on one end*.
11. Verify that the fiber converter(s) and/or fiber hub/switch use the proper optical wavelength (100BASE-FX should be 1300nm).

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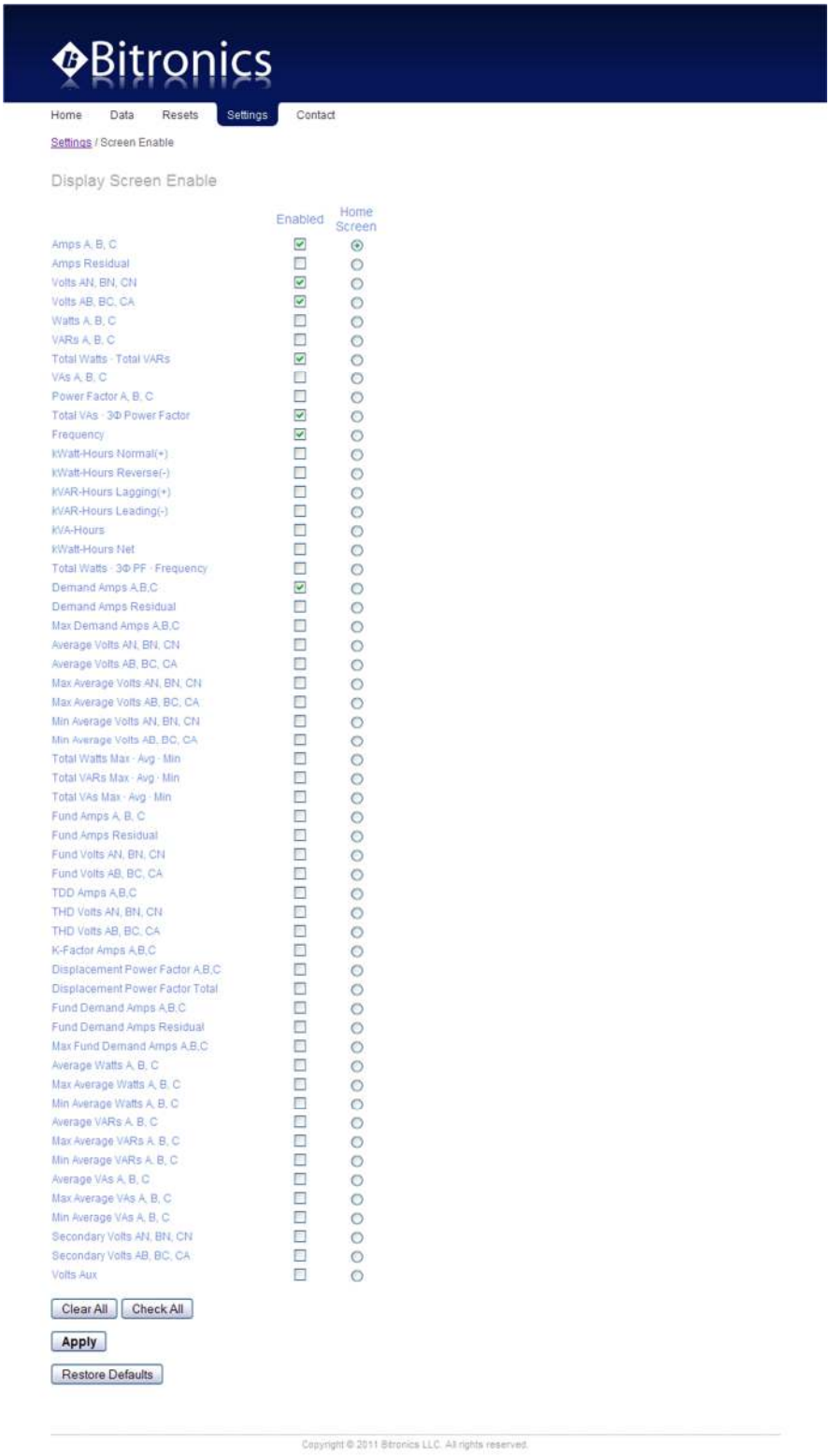
A2 Setting Screen configurations on PowerPlex II for D650 Detached Display – Screen Enable & Custom Display Screens

Screen Enable:



Custom Display Screen Settings: Two Sections – Build/Edit and Summary

The Custom Display Screen Configuration page contains two sections: the Build/Edit panel and the Summary panel. One custom display screen is built at a time in the Build/Edit panel and is then added to the Summary panel, which presents a list of all the custom screens that have been built. The Build/Edit panel is presented if there are no custom screens stored on the IED when the page is loaded; otherwise, the Summary panel is presented. Only one panel is visible at a time.

Build/Edit panel
Select a measurement to be displayed on each display line from the dropdown lists and enter an alphanumeric label that describes the display screen.

Special character buttons insert the characters shown on the buttons into the “Label” field. The “k/M/G” (kilo/Mega/Giga) button inserts an underscore character into the “Label” field, which is automatically replaced with the appropriate unit prefix when displayed on the IED’s front panel. The dot character is used to separate parts of a single label into multiple labels that apply to the different display lines. It is necessary to place dots between underscore that apply to different display lines.

The MIN, MAX, AVG, line and phase LEDs are automatically lit by the IED, based on the selected measurements.

Click the “Next >” button to view the summary panel.

Summary panel
Screens are saved to IED once the “Apply” button has been clicked. A row (screen) from the summary table can be selected for viewing, editing or deleting by clicking its radio button.

The order of the screens can be changed by selecting a screen from the list and clicking on the up or down arrows.

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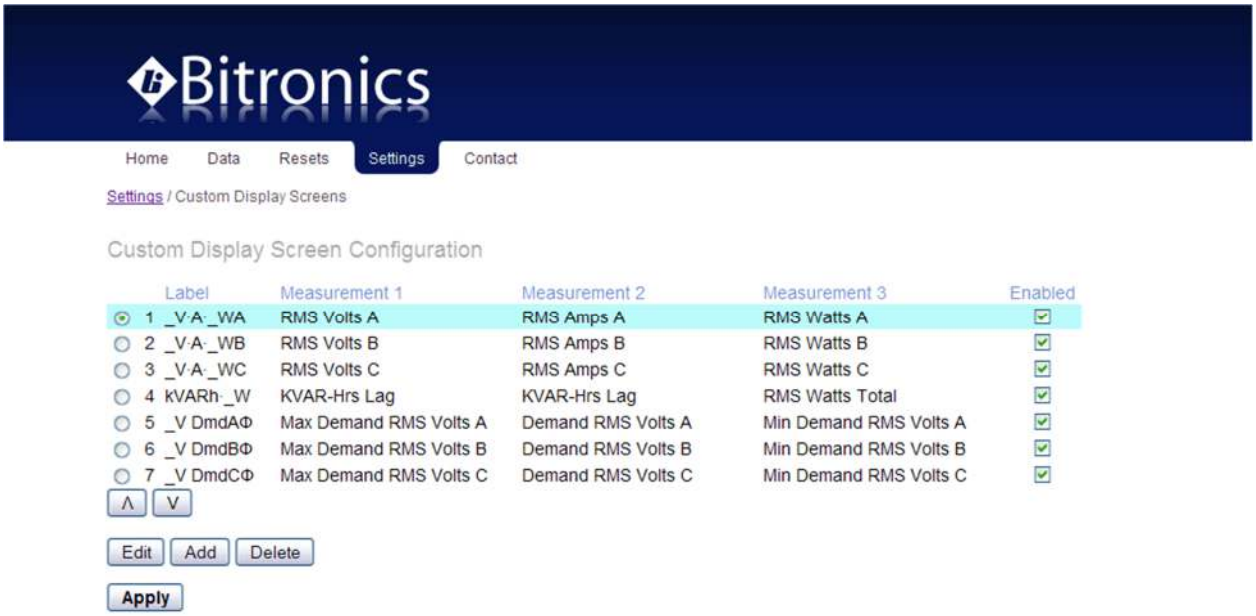

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A3 PowerPlex II Display Screens – Standard Formats

INSTANTANEOUS DISPLAY SCREENS

	Format	Quantity
1.	00000	Phase A Amperes
	00000	Phase B Amperes
	00000	Phase C Amperes
	AmpsΦ	
2.	00000	Residual Amperes [1]
	□□□□□	Unused
	□□□□□	Unused
	AmpsR	
3.	00000	Phase A Volts [1]
	00000	Phase B Volts
	00000	Phase C Volts
	xVolts	
4	00000	Phase A-B Volts
	00000	Phase B-C Volts
	00000	Phase C-A Volts
	xVolts	
5.	00000	Phase A Watts [1]
	00000	Phase B Watts
	00000	Phase C Watts
	xWatts Φ	
6.	00000	Phase A VARs [1]
	00000	Phase B VARs
	00000	Phase C VARs
	xVAR Φ	
7.	00000	Total Watts
	00000	Total VARs
	□□□□□	Unused
	xW·xVAR	
8.	00000	Phase A VAs [1]
	00000	Phase B VAs
	00000	Phase C VAs

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xVA Φ

9. 00000 Phase A PF [1]
   00000 Phase B PF
   00000 Phase C PF
   PF Φ

10. 00000 Total VAs
    00000 3Φ PF
    □□□□□ Unused
    xVAs·PF

11. 00.000 Frequency
    □□□□□ Unused
    □□□□□ Unused
    Hz

12. 12345 ⎫ Positive
    6789A. ⎭ kWh
    □□□□□ Unused
    +kWh

13. 12345 ⎫ Negative
    6789A. ⎭ kWh
    □□□□□ Unused
    -kWh

14. 12345 ⎫ Positive
    6789A. ⎭ kVARh
    □□□□□ Unused
    +kVARh

15. 12345 ⎫ Negative
    6789A. ⎭ kVARh
    □□□□□ Unused
    -kVARh

16. 000.00 VA hours (Most significant half)
    000.00 VA hours (Least significant half)
    □□□□□ Unused
    kVAh

17. 00000 Watt hours Net (Most significant half)

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	00000	Watt hours Net (Least significant half)
	□□□□□	Unused
	kWh NET	

18.	00000	Total Watts
	00000	3Φ PF
	0000	Frequency
	xW·PF·Hz	

[1] - Screen available on WYE meters only
x - indicates blank, (k)ilo, (M)ega, or (G)iga

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DEMAND DISPLAY SCREENS

	Format	Quantity
19.	000.00	Phase A Amps Demand
	000.00	Phase B Amps Demand
	000.00	Phase C Amps Demand
	Amps Dmd	
20.	00000	Phase A Maximum Amperes Demand
	00000	Phase B Maximum Amperes Demand
	00000	Phase C Maximum Amperes Demand
	Amps MAX	
21.	000.00	Residual Amps Demand Maximum
	000.00	Residual Amps Demand
	□□□□□	Unused
	AmpsDmdR	
22.	000.00	Phase A Average Voltage
	000.00	Phase B Average Voltage
	000.00	Phase C Average Voltage
	xV Avg	
23.	00000	Phase A Maximum Volts Demand [1]
	00000	Phase B Maximum Volts Demand
	00000	Phase C Maximum Volts Demand
	xV MAX	
24.	00000	Phase A Minimum Volts Demand [1]
	00000	Phase B Minimum Volts Demand
	00000	Phase C Minimum Volts Demand
	xV MIN	
25.	000.00	Phase A-B Average Voltage
	000.00	Phase B-C Average Voltage
	000.00	Phase C-A Average Voltage
	xV Avg	
26.	00000	Phase A-B Maximum Volts Demand
	00000	Phase B-C Maximum Volts Demand
	00000	Phase C-A Maximum Volts Demand
	xV MAX	
27.	00000	Phase A-B Minimum Volts Demand
	00000	Phase B-C Minimum Volts Demand
	00000	Phase C-A Minimum Volts Demand
	xV MIN	
28.	00000	Total Maximum Watt Demand
	00000	Total Watts (Also on Screen 7)

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00000 Total Minimum Watt Demand
xW · ↑ · ↓

29. 00000 Total Maximum VAR Demand
00000 Total VARs (Also on Screen 7)
00000 Total Minimum VAR Demand
xVAR · ↑ · ↓

30. 00000 Total Maximum VAs
00000 Total VAs (Also on Screen 10)
00000 Total Minimum VAs
xVA · ↑ · ↓

[1] - Screen available on WYE meters only
x - indicates blank, (k)ilo, (M)ega, or (G)iga

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HARMONIC SUMMARY DISPLAY SCREENS

	Format	Quantity
31.	00000	Phase A Fundamental Amperes
	00000	Phase B Fundamental Amperes
	00000	Phase C Fundamental Amperes
	Fnd Amps	
32.	00000	Fundamental Residual Amperes [1]
	□□□□□	Unused
	□□□□□	Unused
	FndN · Amps	
33.	00000	Phase A Fundamental Volts
	00000	Phase B Fundamental Volts
	00000	Phase C Fundamental Volts
	Fnd xV	
34.	000.00	Phase A-B Fundamental Voltage
	000.00	Phase B-C Fundamental Voltage
	000.0	Phase C-A Fundamental Voltage
	Fnd xV	
35.	000.00	Phase A Current %Total Demand Distortion (%TDD)
	000.00	Phase B Current %Total Demand Distortion (%TDD)
	000.00	Phase C Current %Total Demand Distortion (%TDD)
	%TDD I	
36.	000.00	Phase A Voltage %Total Harmonic Distortion (%THD)[1]
	000.00	Phase B Voltage %Total Harmonic Distortion (%THD)
	000.00	Phase C Voltage %Total Harmonic Distortion (%THD)
	%THD V	
37.	000.00	Phase A-B Voltage %Total Harmonic Distortion (%THD)
	000.00	Phase B-C Voltage %Total Harmonic Distortion (%THD)
	000.00	Phase C-A Voltage %Total Harmonic Distortion (%THD)
	%THD V	
38.	00.000	K-Factor Phase A (Current)
	00.000	K-Factor Phase B (Current)
	00.000	K-Factor Phase C (Current)
	K-Factor	

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[1] - WYE meters only
x - indicates blank, (k)ilo, (M)ega, or (G)iga

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HARMONIC SUMMARY DISPLAY SCREENS (Cont'd)

	Format	Quantity
39.	0.0000	Phase A Displacement PF [1]
	0.0000	Phase B Displacement PF
	0.0000	Phase C Displacement PF
	DispPF Φ	
40.	00000	3Φ Displacement PF
	□□□□□	Unused
	□□□□□	Unused
	DispPF T	
41.	000.00	Phase A Fundamental Demand Amps
	000.00	Phase B Fundamental Demand Amps
	000.00	Phase C Fundamental Demand Amps
	FndDmdIΦ	
42.	000.00	Phase A Maximum Fundamental Demand Amps
	000.00	Phase B Maximum Fundamental Demand Amps
	000.00	Phase C Maximum Fundamental Demand Amps
	FndDmdIΦ	
43.	000.00	Maximum Fundamental Demand Amps Residual
	000.00	Fundamental Demand Amps Residual
	□□□□□	Unused
	FundDmdIR	
44.	000.00	Phase A Average Watts
	000.00	Phase B Average Watts
	000.00	Phase C Average Watts
	xW Avg	
45.	000.00	Phase A Maximum Average Watts
	000.00	Phase B Maximum Average Watts
	000.00	Phase C Maximum Average Watts
	xW Max	
46.	000.00	Phase A Minimum Average Watts
	000.00	Phase B Minimum Average Watts
	000.00	Phase C Minimum Average Watts
	xW Min	

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47.	000.00	Phase A Average VARs
	000.00	Phase B Average VARs
	000.00	Phase C Average VARs
	xVAR Avg	
48.	000.00	Phase A Maximum Average VARs
	000.00	Phase B Maximum Average VARs
	000.00	Phase C Maximum Average VARs
	xVAr Max	
49.	000.00	Phase A Minimum Average VARs
	000.00	Phase B Minimum Average VARs
	000.00	Phase C Minimum Average VARs
	xVAR Min	
50.	000.00	Phase A Average VAs
	000.00	Phase B Average VAs
	000.00	Phase C Average VAs
	xVA Avg	
51.	000.00	Phase A Maximum Average VAs
	000.00	Phase B Maximum Average VAs
	000.00	Phase C Maximum Average VAs
	xVA Max	
52.	000.00	Phase A Minimum Average VAs
	000.00	Phase B Minimum Average VAs
	000.00	Phase C Minimum Average VAs
	xVA Min	
53.	00000	Phase A Secondary Volts[1]
	00000	Phase B Secondary Volts
	00000	Phase C Secondary Volts
	SecVolts	
54.	00000	Phase A-B Secondary Volts
	00000	Phase B-C Secondary Volts
	00000	Phase C-A Secondary Volts
	SecVolts	
55.	000.00	Auxiliary Voltage
	□□□□□	Unused

 Copyright 2021 Bitronics, LLC

□□□□□ Unused
V aux

[1] - Screen available on WYE meters only
x - indicates blank, (k)ilo, (M)ega, or (G)iga

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A4 PowerPlex II Standard Display Screens – Visual Representations D650

Screen

1

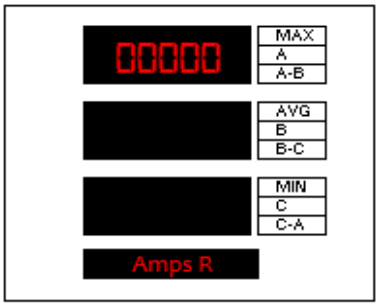
Amps A, B, C

Phase A Amps

Phase B Amps

Phase C Amps

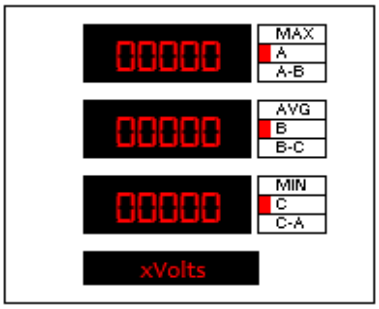
2



Amp Residual

Amps Residual

3



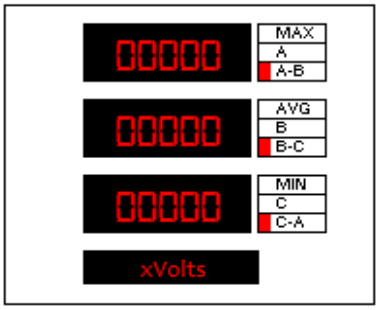
Volts AN, BN, CN

Volts A

Volts B

Volts C

4



Volts AB, BC, CA

Volts AB

Volts BC

Volts CA

5

Watts A, B, C

Watts A

Watts B

Watts C

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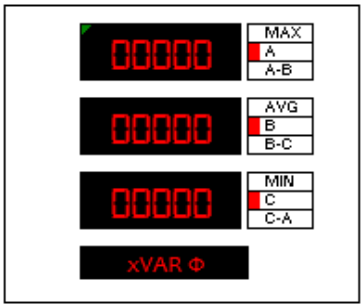
VARs A, B, C

6



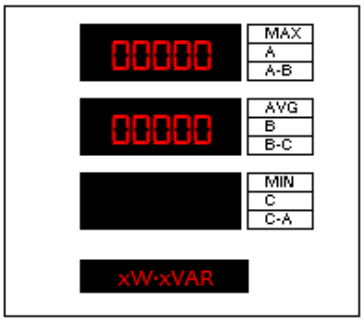
VARs A

VARs B

VARs C

Total Watts · Total VARs

7

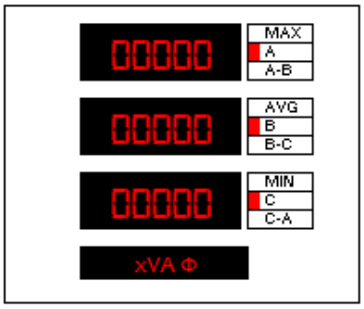


Total Watts

Total Vars

VAs A, B, C

8



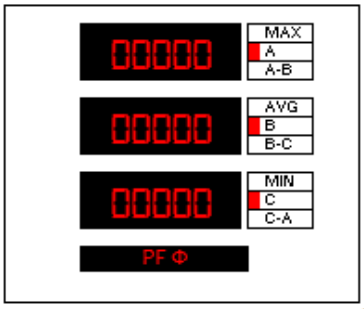
VAs A

VAs B

VAs C

Power Factor A, B, C

9



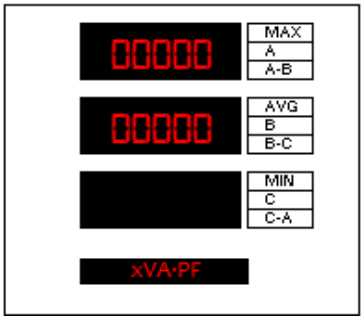
PF A

PF B

PF C

Total VAs · 3Φ PF

10



VAs Total

3Φ PF

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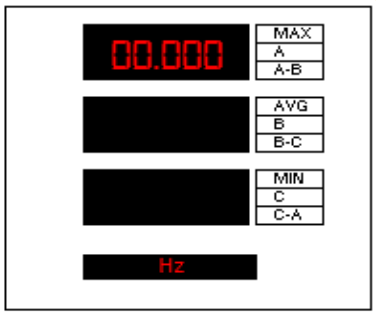
Frequency

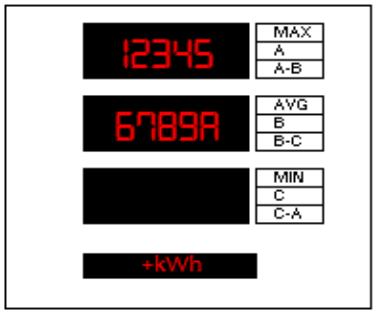
11



Frequency

Watt Hrs Normal (+)

12

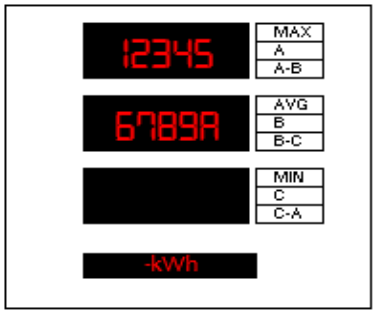


Most significant half

Least significant half

Watt Hrs Reverse (-)

13

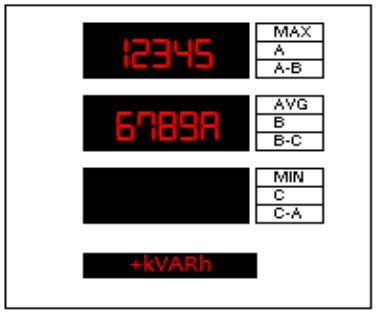


Most significant half

Least significant half

VAR Hrs Lagging (+)

14

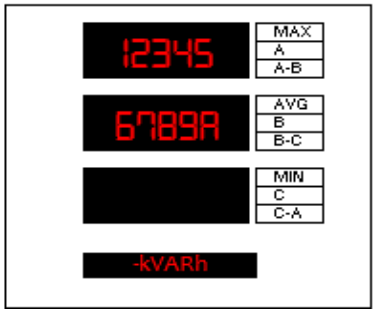


Most significant half

Least significant half

VAR Hrs Leading (-)

15



Most significant half

Least significant half

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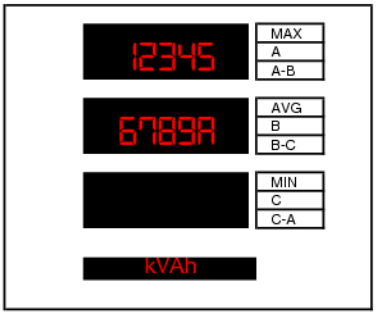
kVA Hrs

16

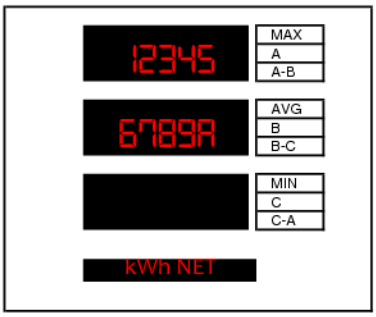


Most significant half

Least significant half

kWatt Hrs Net

17

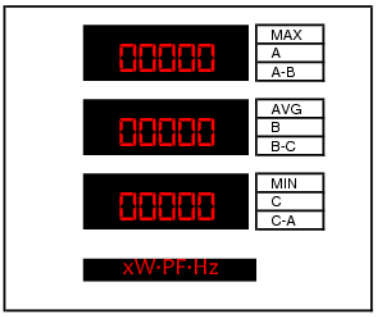


Most significant half

Least significant half

Total Watts · 3Φ PF · Frequency

18



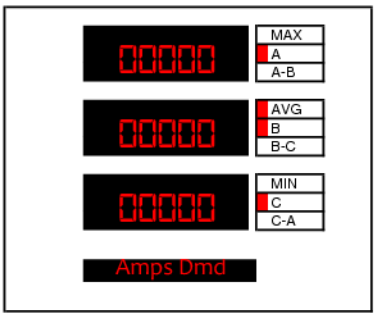
Total Watts

3Φ PF

Frequency

Demand Amps A, B, C

19



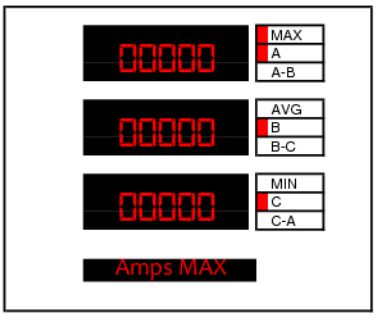
Demand Amps A

Demand Amps B

Demand Amps C

Max Dmd Amps A,B,C

20



Dmd Amps A Max

Dmd Amps B Max

Dmd Amps C Max

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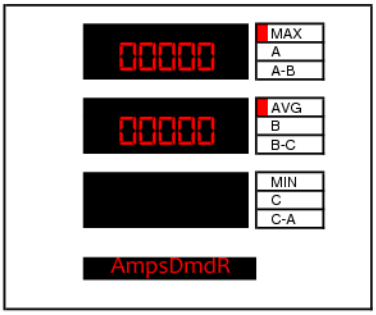
Demand Amps Residual

21

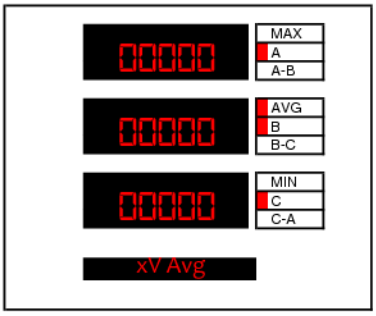


Demand Amps R MX

Dmd Amps R

Average Volts AN, BN, CN

22



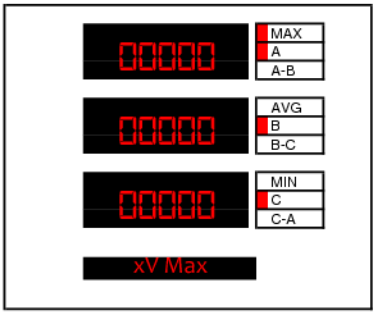
Volts A

Volts B

Volts C

Max Average Volts AN, BN, CN

23



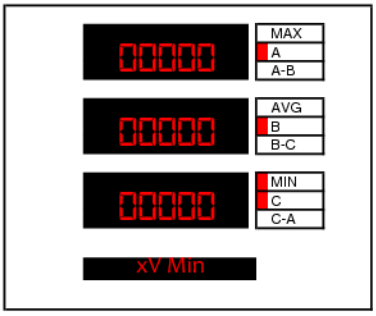
Volts A

Volts B

Volts C

Min Average Volts AN, BN, CN

24



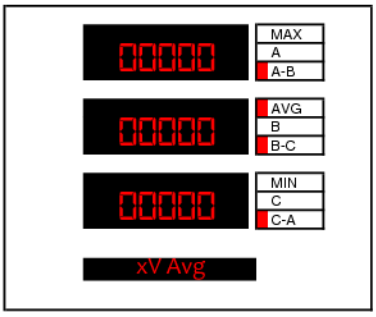
Volts A

Volts B

Volts C

Average Volts AB, BC, CA

25



Volts AB

Volts BC

Volts CA

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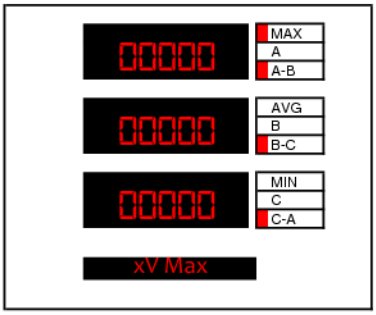
Max Average Volts AB, BC, CA

26



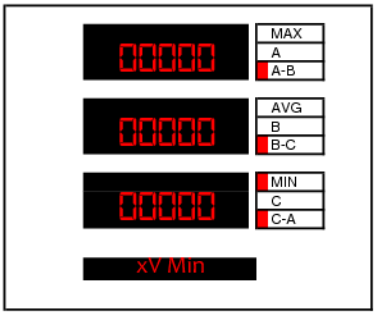
Volts AB

Volts BC

Volts CA

Min Average Volts AB, BC, CA

27



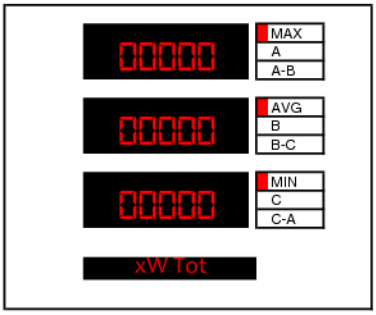
Volts AB

Volts BC

Volts CA

Total Watts Max · Avg · Min

28



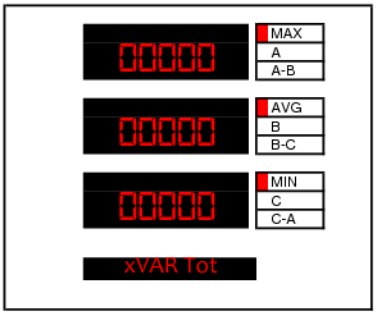
Average Watts Max

Average Watts Avg

Average Watts Min

Total VARs Maxl · Avg · Min

29



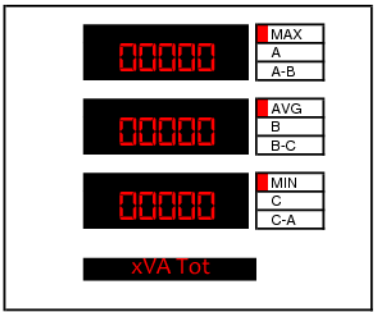
Average VARs Max

Average VARs Avg

Average VARs Min

Total VAs Max· Avg · Min

30



Average VAs Max

Average VAs Avg

Average VA Min

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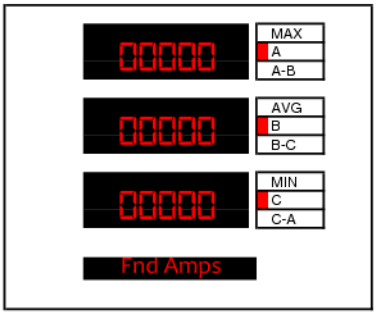
Fundamental Amps A, B. C

31



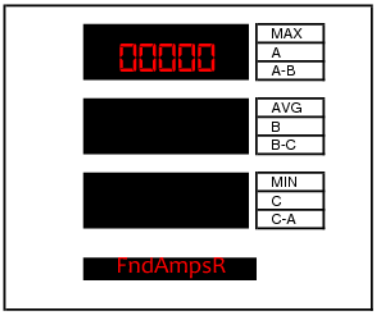
Fnd Amps A

Fnd Amps B

Fnd Amps C

Fundamental Amps Residual

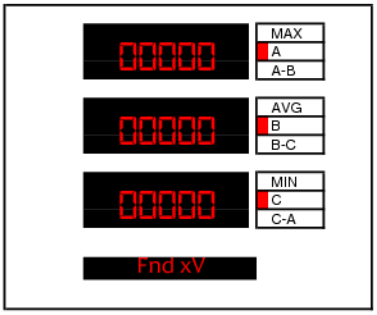
32



Fnd Amps Residual

Fund. Volts AN, BN, CN

33



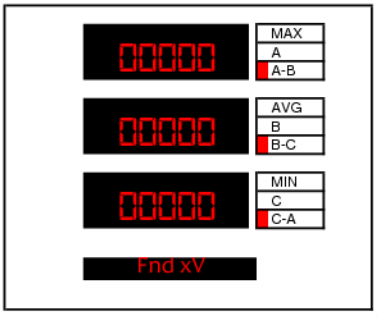
Fnd Volts A

Fnd Volts B

Fnd Volts C

Fund. Volts AB, BC, CA

34



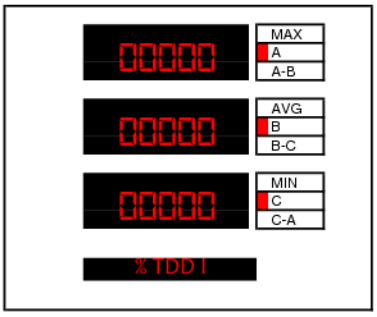
Fnd Volts AB

Fnd Volts BC

Fnd Volts CA

TDD Amps A, B, C

35



TDD Amps A

TDD Amps B

TDD Amps C

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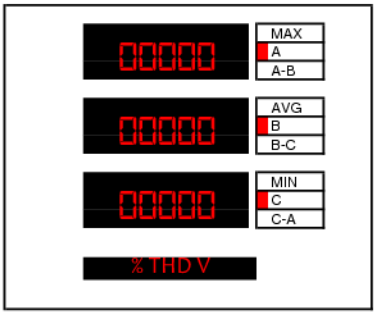
THD Volts AN, BN, CN

36



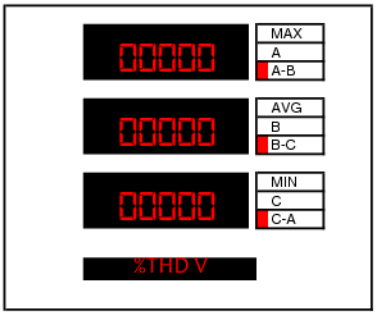
THD Volts AN

THD Volts BN

THD Volts CN

THD Volts AB, BC, CA

37



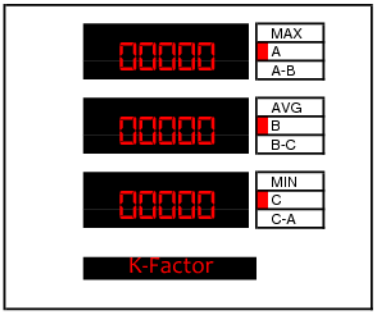
THD Volts AB

THD Volts BC

THD Volts CA

K-Factor Amps A, B, C

38



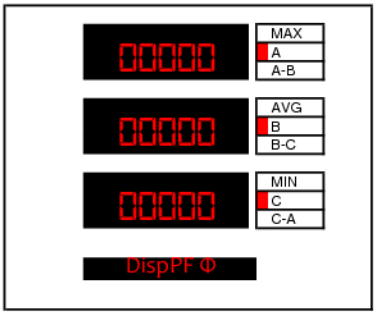
K-Factor A

K-Factor B

K-Factor C

Displacement Power Factor A, B, C

39



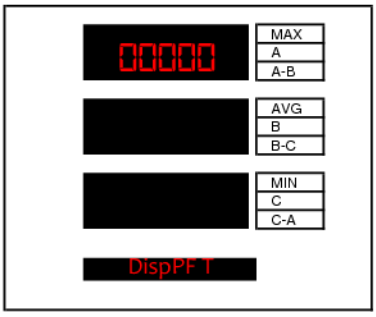
Displacement PF A

Displacement PF B

Displacement PF C

Displacement Power Factor Total

40



Displacement PF T

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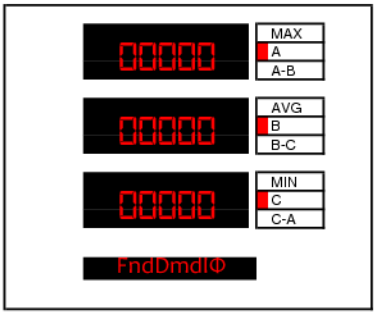
Fund. Demand Amps A, B, C

41



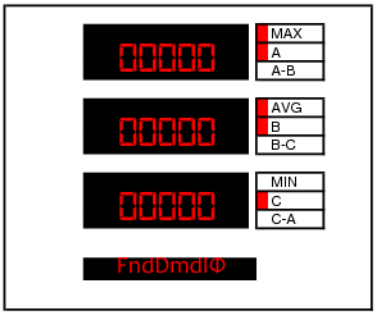
Fnd Dmd Amps A

Fnd Dmd Amps B

Fnd Dmd Amps C

Max Fund. Demand Amps A, B. C

42



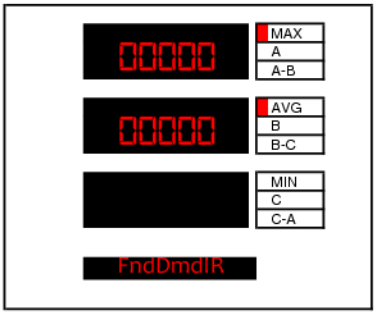
Fnd Dmd Amps A

Fnd Dmd Amps B

Fnd Dmd Amps C

Max Fund. Demand Amps Residual

43

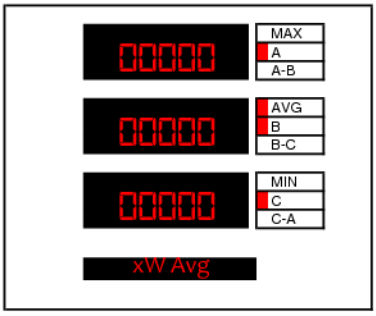


Fnd Dmd Amps R

Fnd Dmd Amps R

Average Watts A, B, C

44



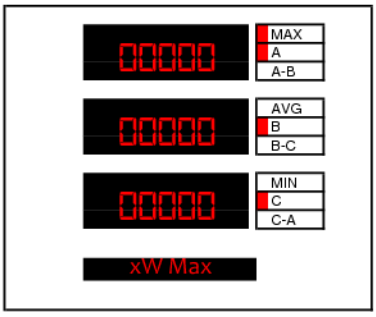
Watts A

Watts B

Watts C

Max Average Watts A, B, C

45



Watts A

Watts B

Watts C

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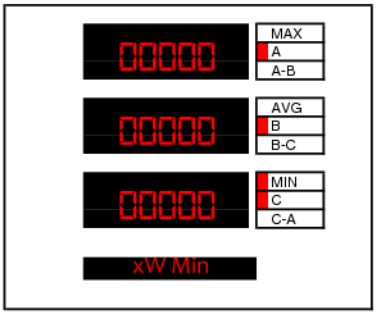
Min Average Watts A, B, C

46



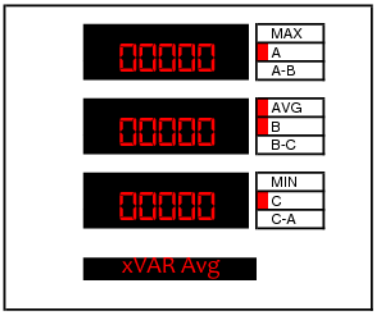
Watts A

Watts B

Watts C

Average VARs A. B, C

47



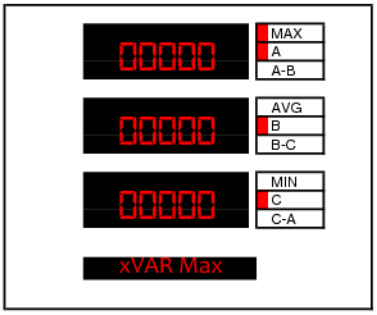
VARs A

VARs B

VARs C

Max Average VARs A. B, C

48



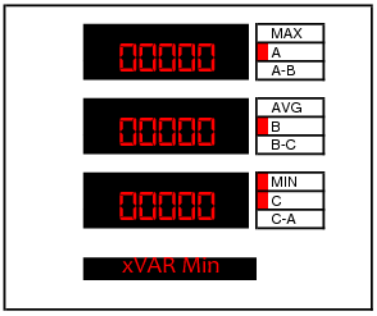
VARs A

VARs B

VARs C

Min Average VARs A. B, C

49



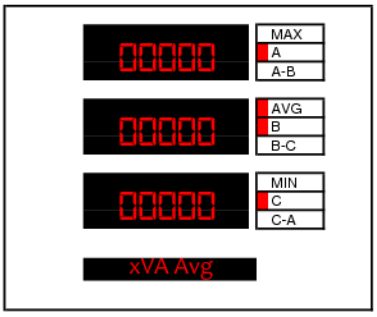
VARs A

VARs B

VARs C

Average VAs A, B, C

50



VAs A

VAs B

VAs C

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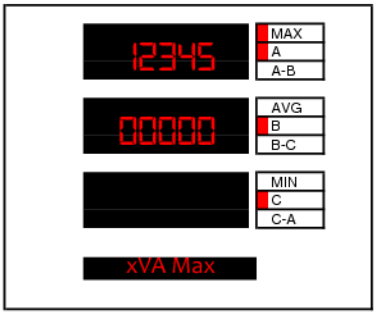
Max Average VAs A, B, C

51



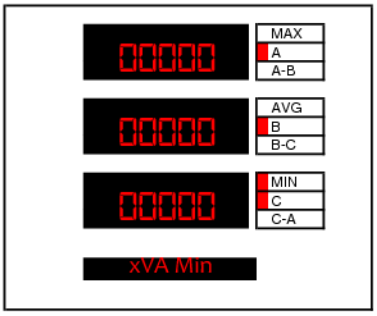
VAs A

VAs B

VAs C

Min Average VAs A, B, C

52



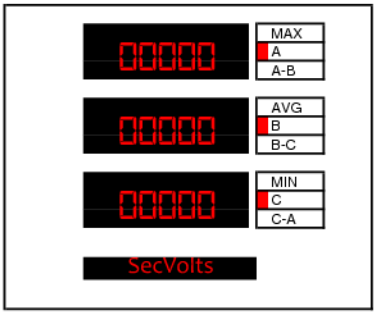
VAs A

VAs B

VAs C

Secondary Volts AN, BN, CN

53



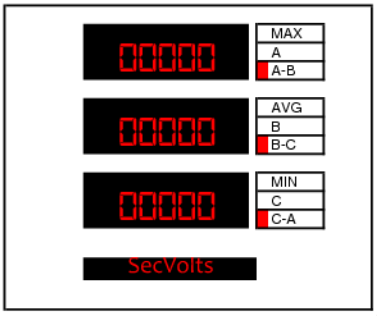
SecVolts A

SecVolts B

SecVolts C

Secondary Volts AB, BC, CA

54



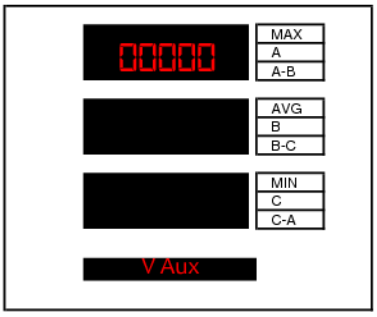
SecVolts AB

SecVolts BC

SecVolts CA

Volts Aux

55



V Aux

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A5 Configuring the D650MX Universal Display

New User Settings have been added to simplify the setup of the D650MX to devices other than Bitronics products. There is a new check box to show or not show Bitronics meter settings.
Default for the MX is to not show Bitronics meter settings. Checking the box on the top right will add additional settings that are native to the Bitronics 50 and 60 Series meters and are useful in setting up displays connected to M87x or PPX II devices. Some settings tabs are not affected by checking this. Checking or unchecking this box applies to all screens.
Connect to the display with the standard IP address of 192.168.0.171. You can change this either directly from the front buttons or on the 'Network' page which is part of the 'Settings' tab. Before leaving any page, you should hit 'Apply' to save changes made to that page. There are options to restore to default on individual pages as well as an overall option to restore all pages on the 'Load/Store Settings' page.
When you connect, it will be to the 'Home' Page. Clicking the 'Show Bitronics meter settings' button has no effect on this page.

Click on the 'Settings' tab at the top to configure the display. Again for this page there will be no change by clicking on the 'Show Bitronics meter settings' button.

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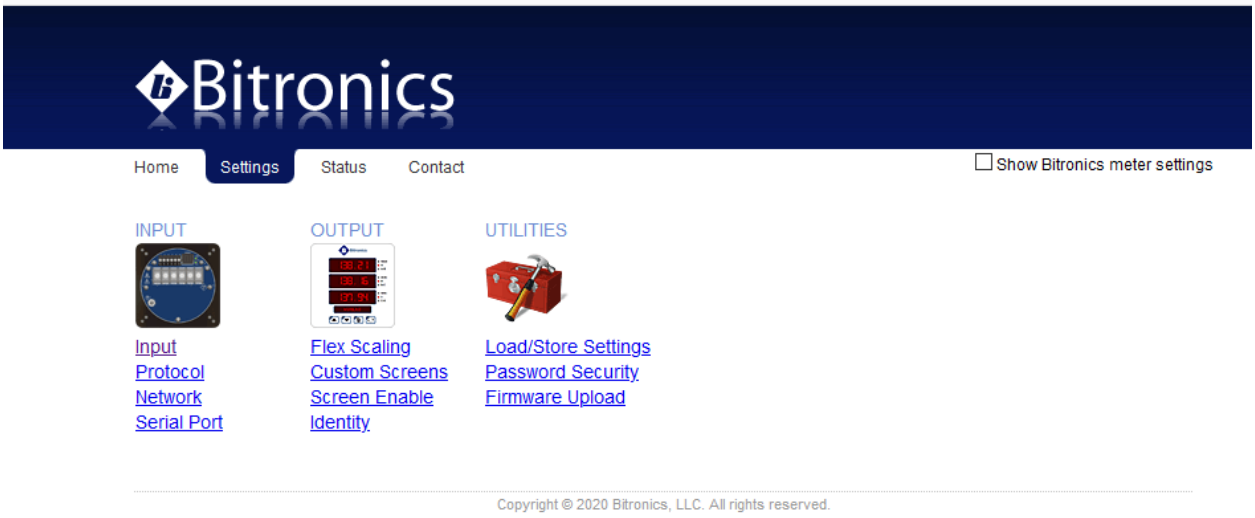
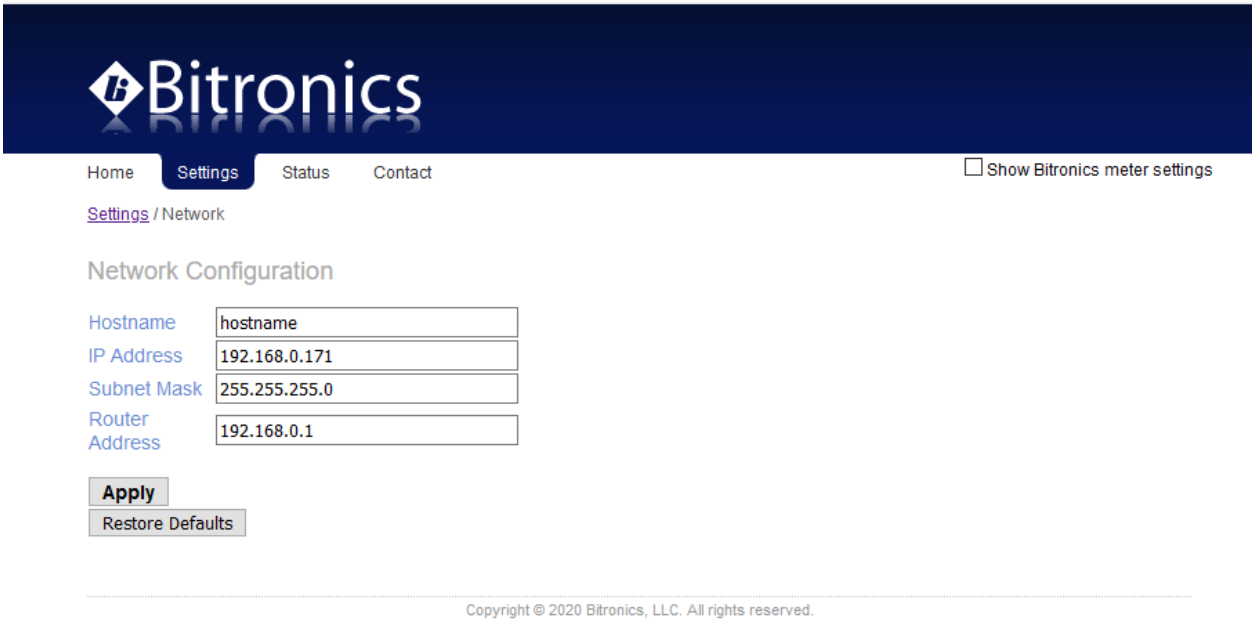
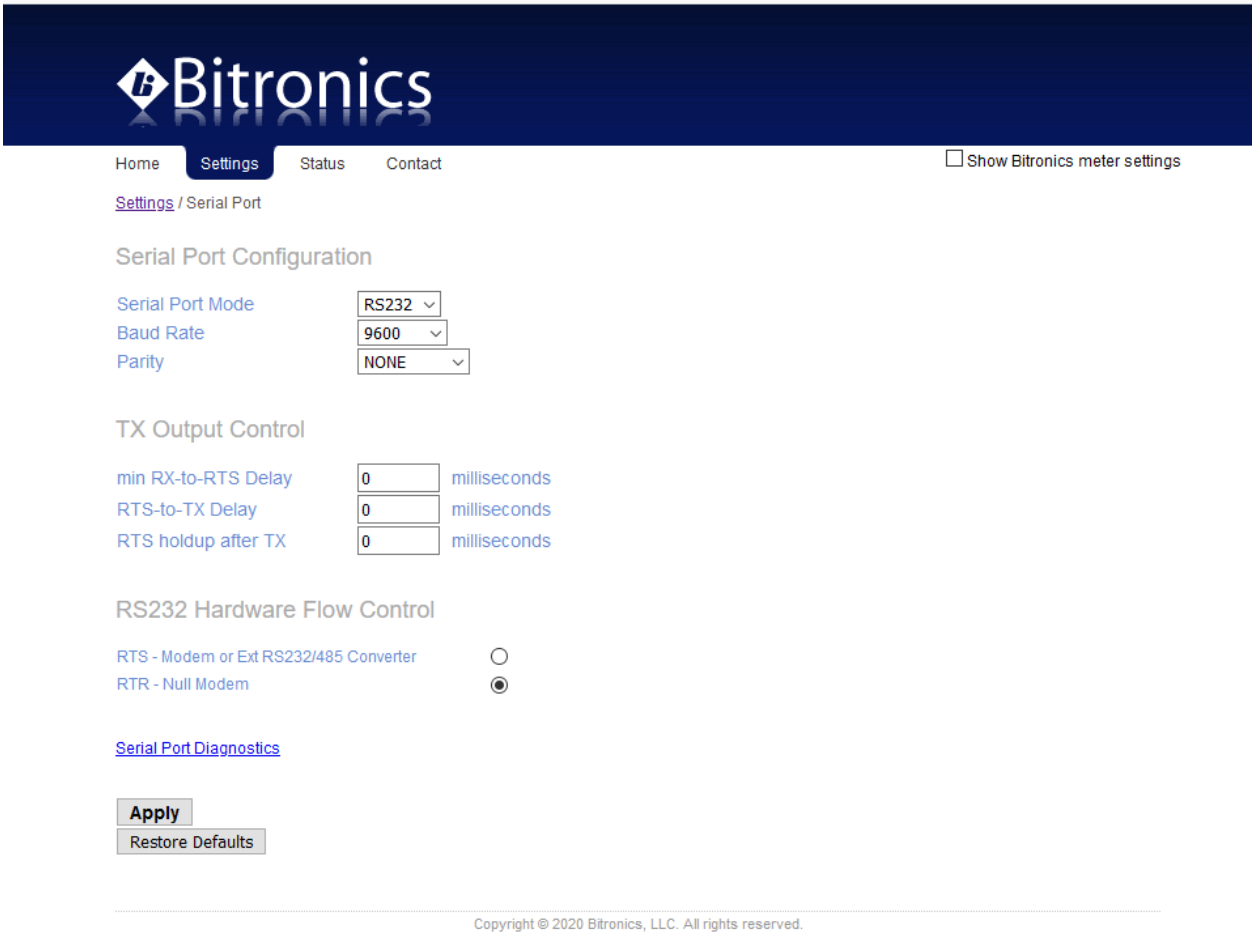


The items under 'UTILITIES' are not needed for configuration but are useful for saving and uploading configurations, adding password security including disabling the ability to make changes to configuration via the front display, and uploading new firmware that may become available from time to time.
The 'Input' page is not needed for set up of the D650MX Universal Display. The 'Serial Port' or 'Network' pages may be needed if you are connecting to the Display in one of these ways and need to make a change. The 'Identity' page is useful for assigning specific names and descriptions to the D650 display. A name change will appear in the 'Home' page.



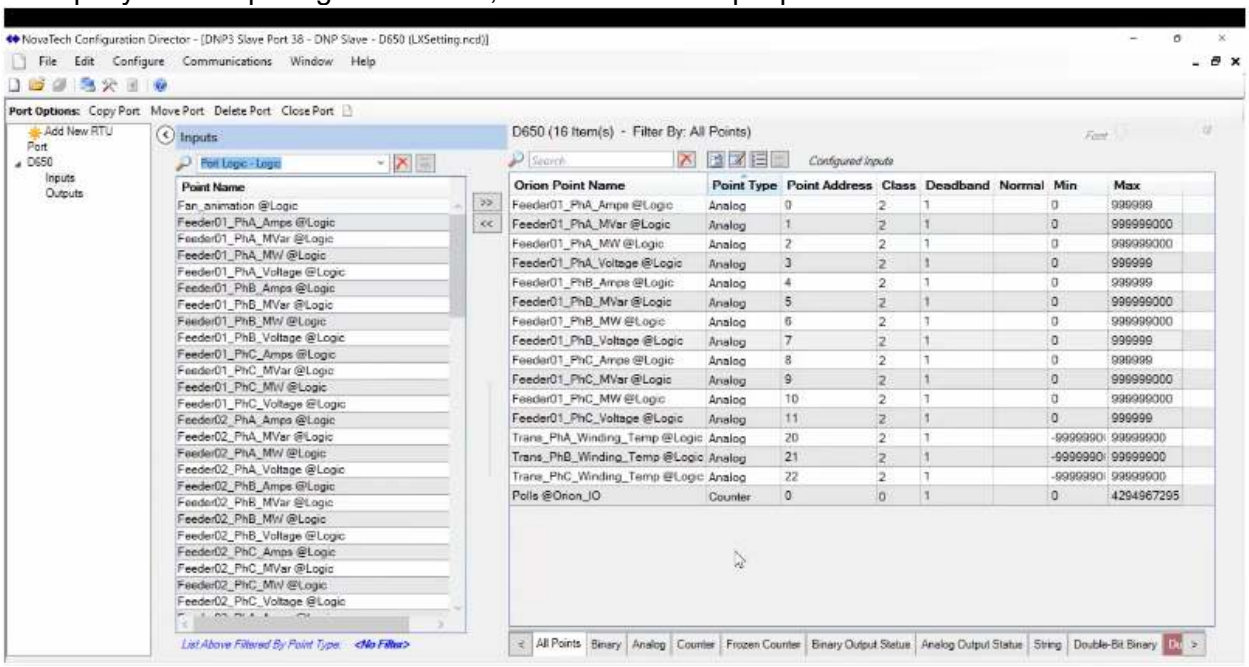


To configure the D650MX Universal Display there are four key steps done in this order:

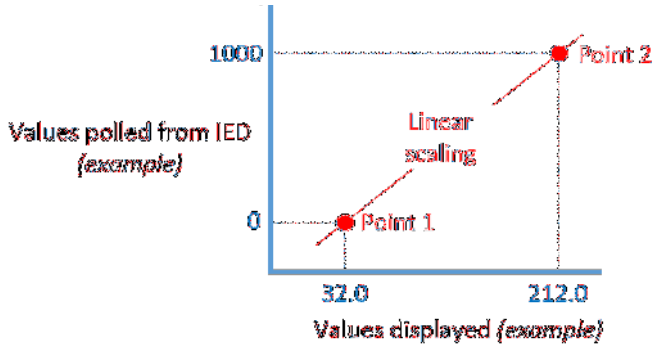
- Create ‘Flex Scaling’ and assign Measurements

- Assign points or registers under ‘Protocol’
- Configure ‘Custom Displays’
- Assign which displays you want to appear under ‘Screen Enable’

Again, remember to hit ‘Apply’ or ‘Next’ on each page you change. You do not need to ‘Reset’ until all changes are made but can do so if you have many changes and you want to make sure you don’t lose your changes.
Before starting, it is useful to view the points list of the device you will be polling. If for example you were polling an OrionLX, below is an example points list viewed in NCD:



Start with the ‘Flex Scaling’ page, this only applies to D650MX Universal Display not the D650BX display.
Scaling is based on two separate point values on a linear scale (they can be, but don’t need to be, min and max) as shown in the example in the graph below showing conversion for Celsius to Fahrenheit:



Some standard scaling calc types and example measurements have been created as part of the default page as shown below:

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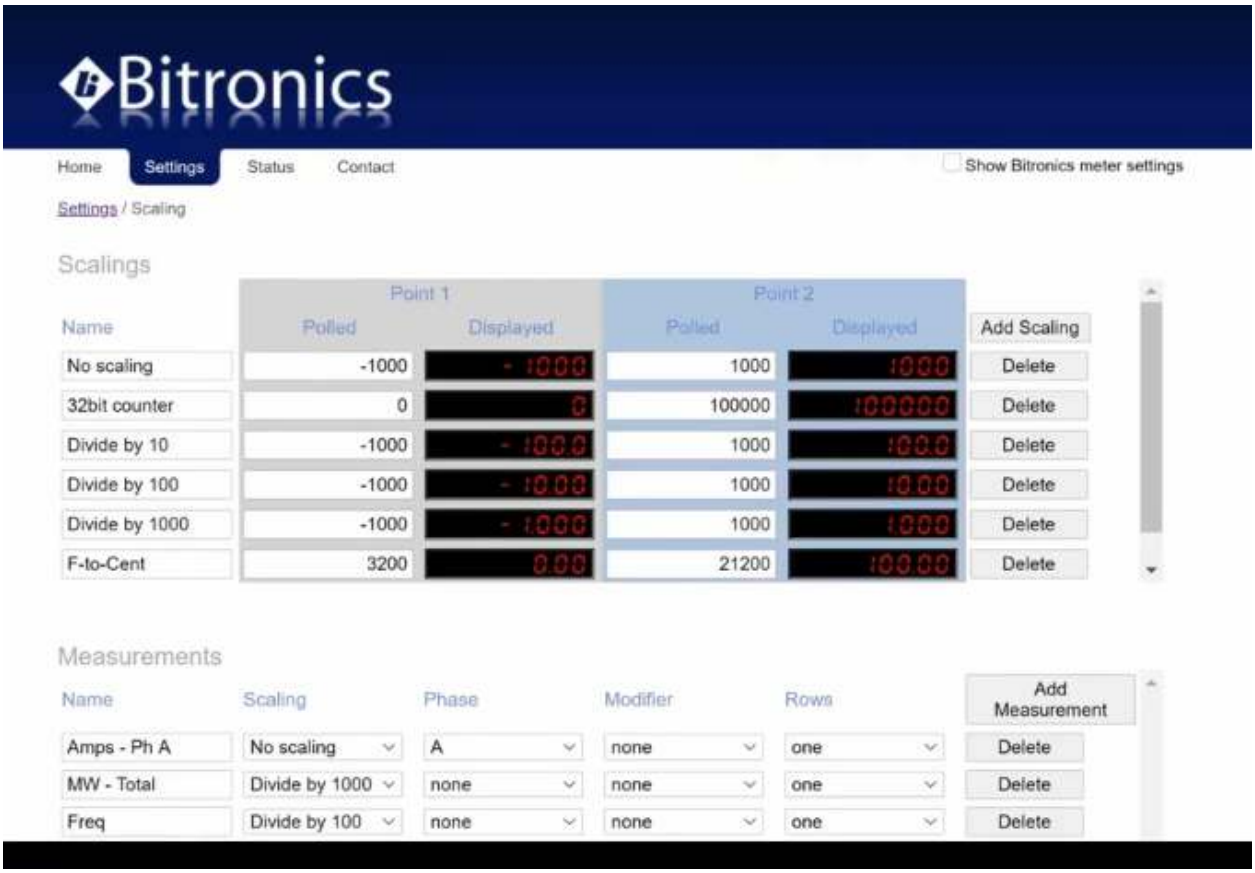

These can be used or deleted and replaced with user generated values.
The subsequent screens will show how new Scalings and Measurements are added.
First setup Scalings creating names and ranges for each calc type. We will create a kV phase-phase and kV phase-neutral as new scalings:

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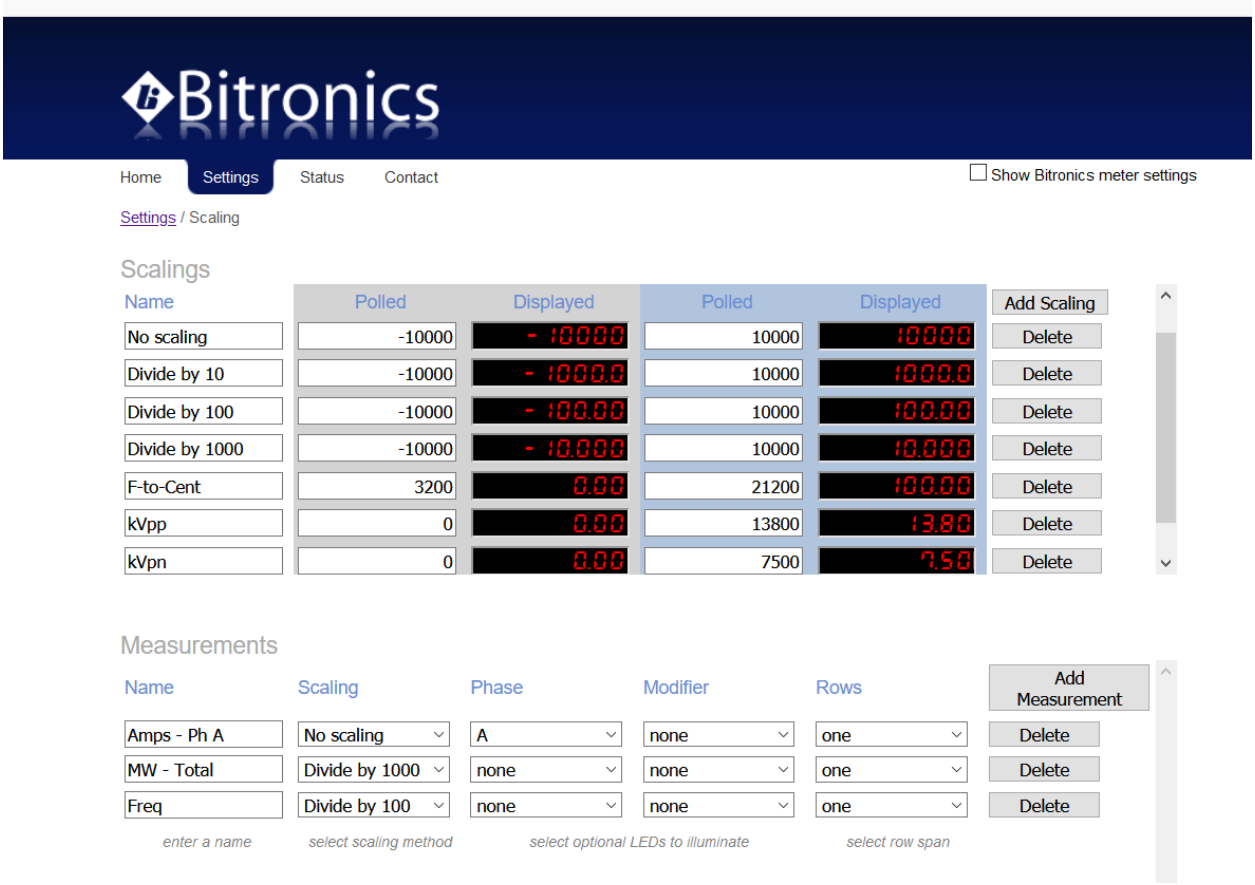

In another example, we can add scaling for amps and MW:

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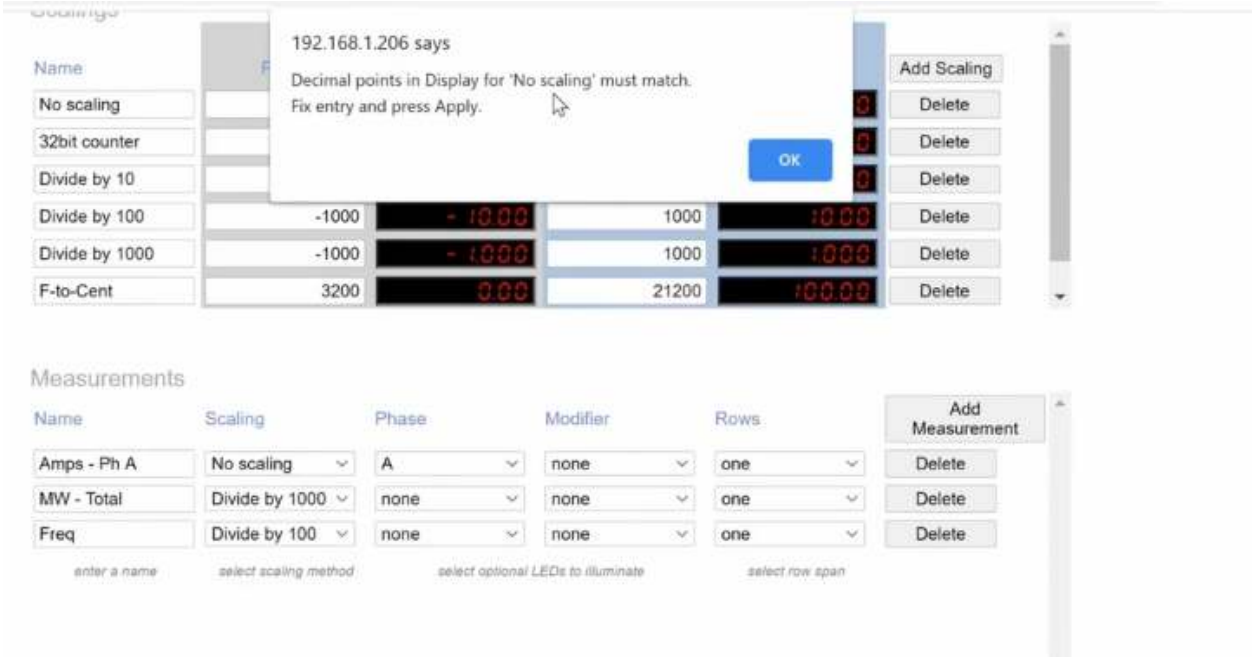
Note that decimal points must match on both points or an error message will appear, and you will need to correct before proceeding:



Once the Scalings are established, they will appear in the drop down when selecting Measurements. Just enter a name and select one of the Scaling drop down values. Phase can be selected as well as Modifier. These options correspond to the small LEDs on the right

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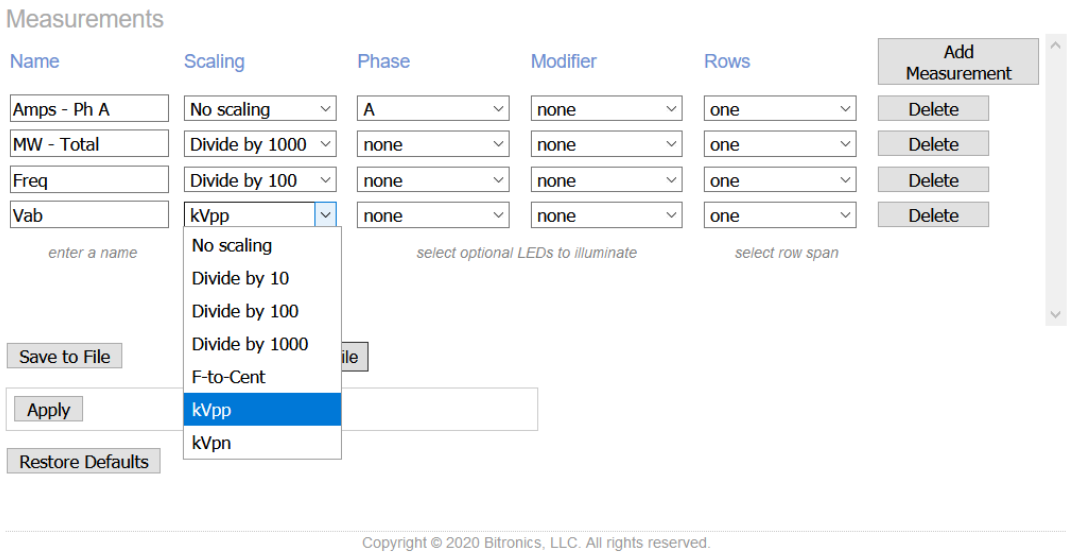
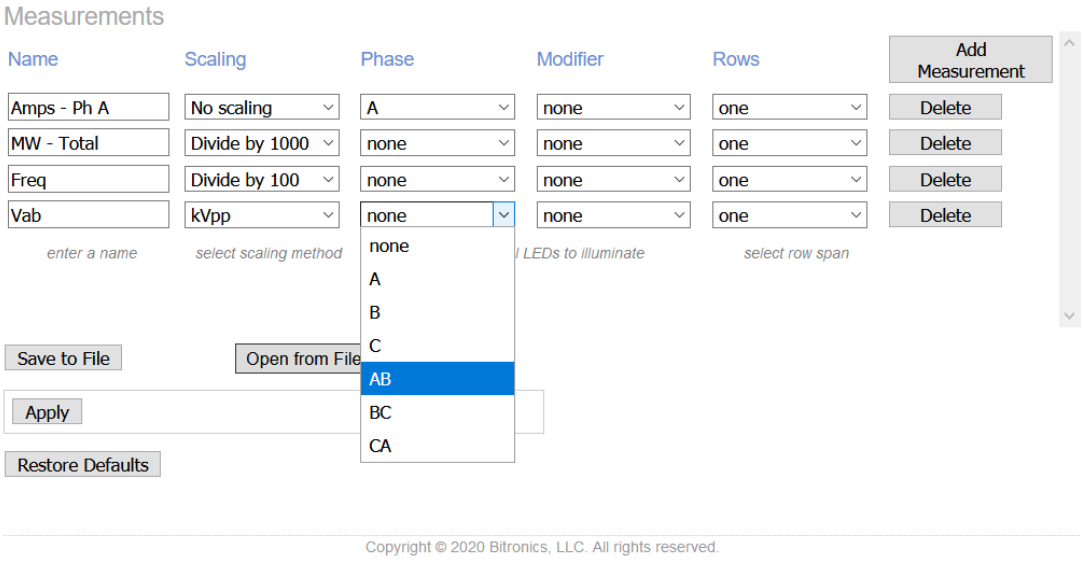
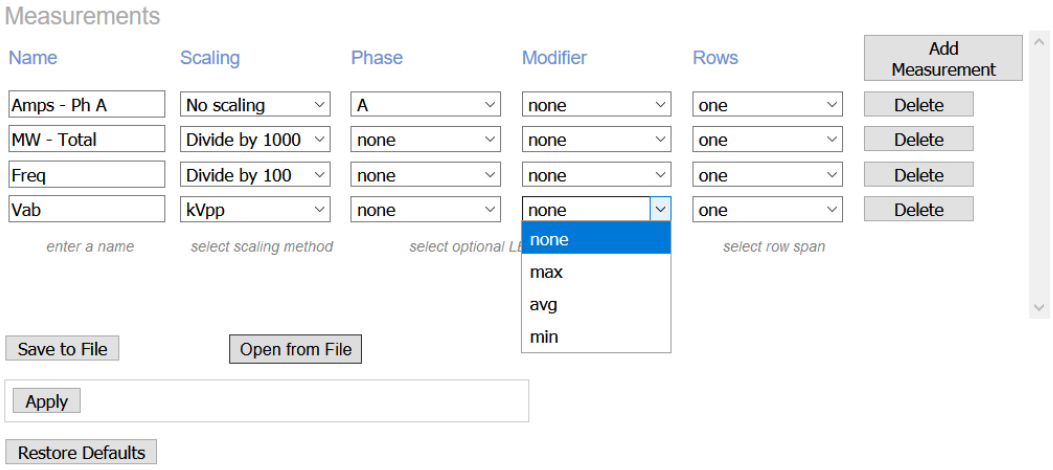
side of the display next to each of the three 5-segment lines where values are displayed. One or two rows can be selected (two rows are typically used for energy values which may wrap beyond one line and are required for a 32-bit counter).






Measurements
Name
Scaling
Phase
Modifier
Rows
Add Measurement
Amps - Ph A
No scaling
A
none
one
Delete
MW - Total
Divide by 1000
none
none
one
Delete
Freq
Divide by 100
none
none
one
Delete
Vab
kVpp
none
none
one
Delete
enter a name
select scaling method
select optional LE
select row span
none
max
avg
min
Save to File
Open from File
Apply
Restore Defaults
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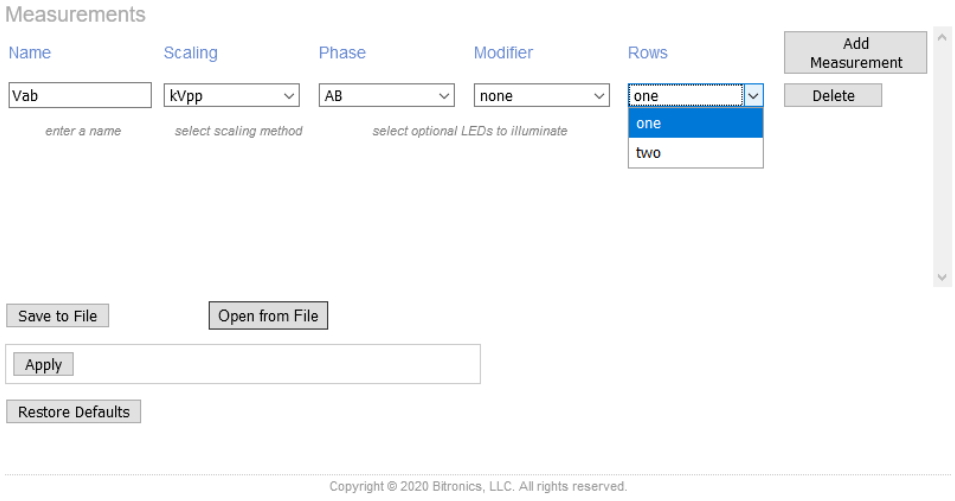
Measurements
Name
Scaling
Phase
Modifier
Rows
Add Measurement
Vab
kVpp
AB
none
one
Delete
enter a name
select scaling method
select optional LEDs to illuminate
one
two
Save to File
Open from File
Apply
Restore Defaults
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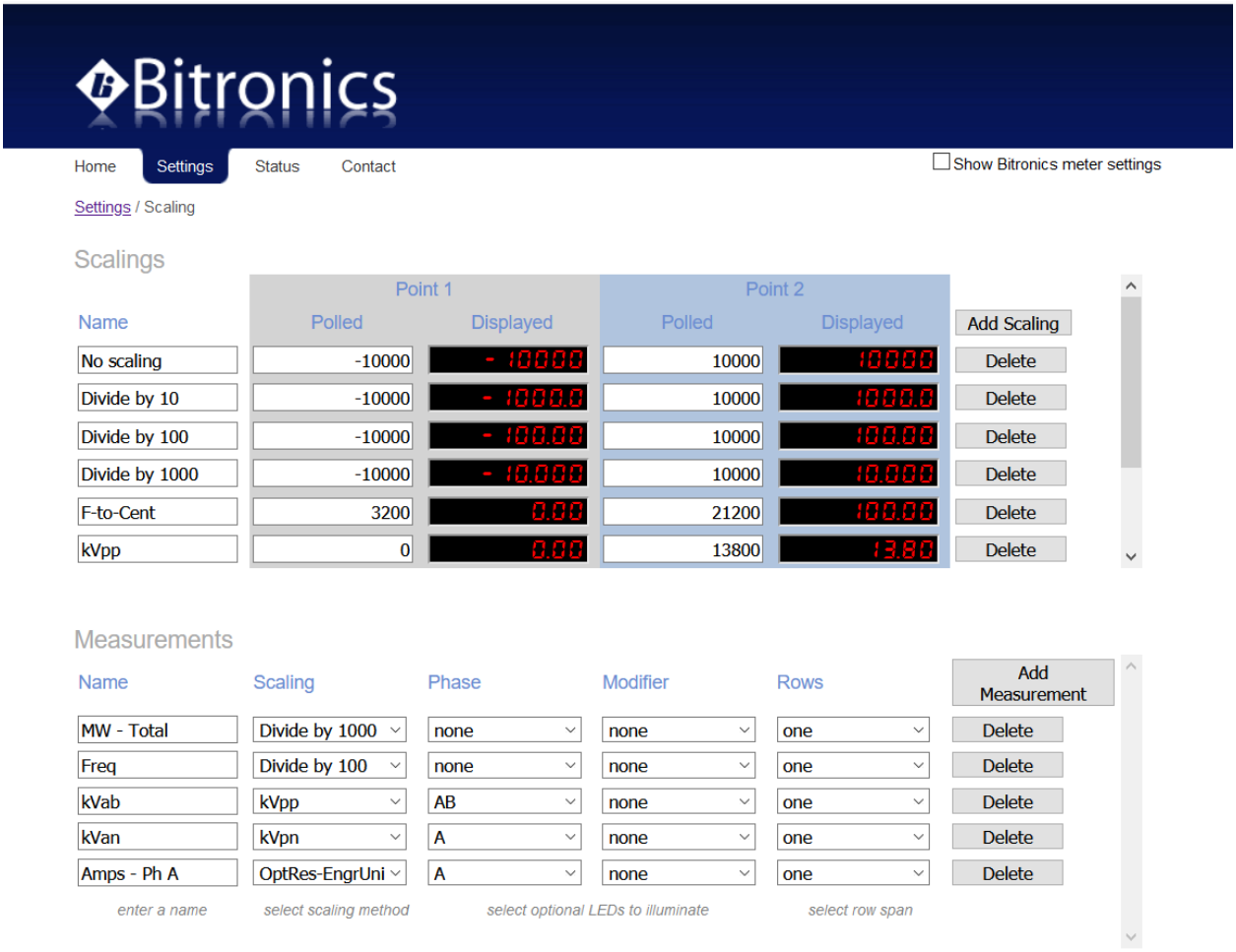
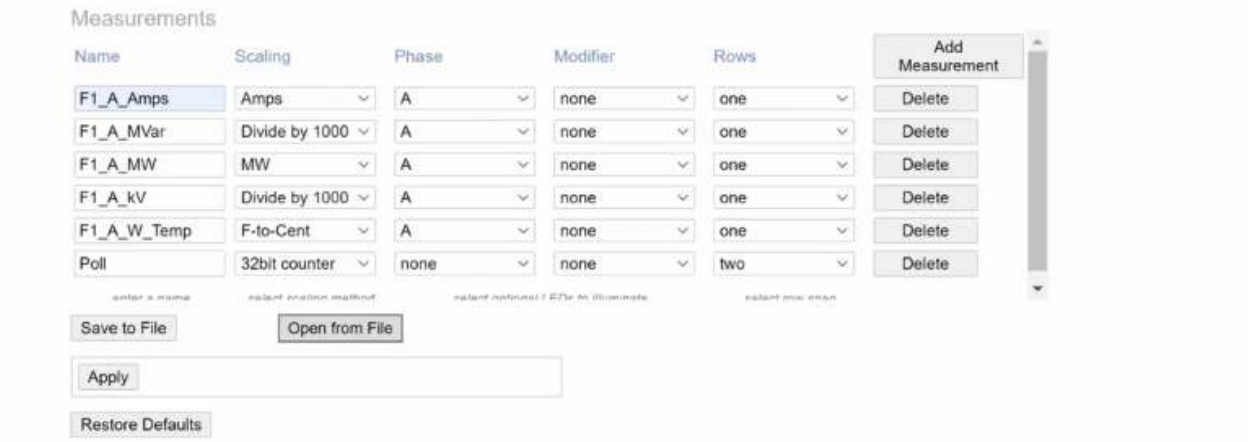


You can set up many Scalings and Measurements as illustrated below:



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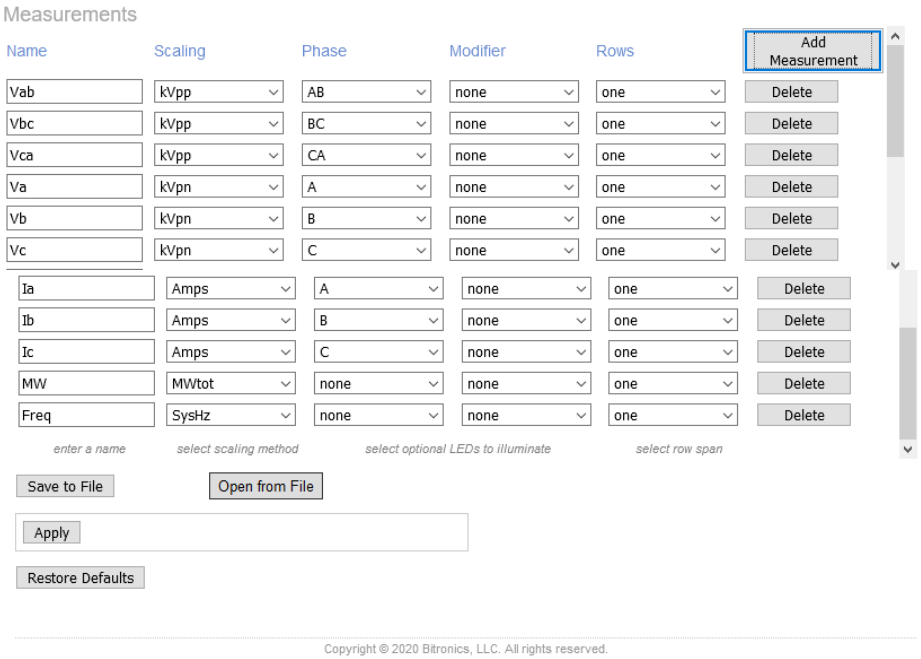
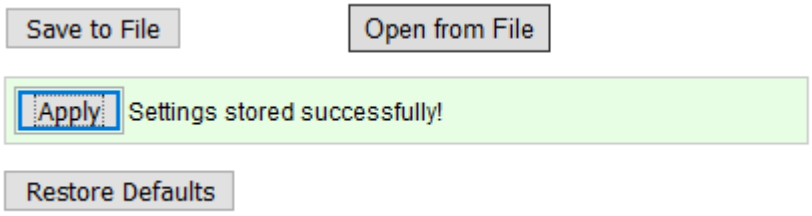
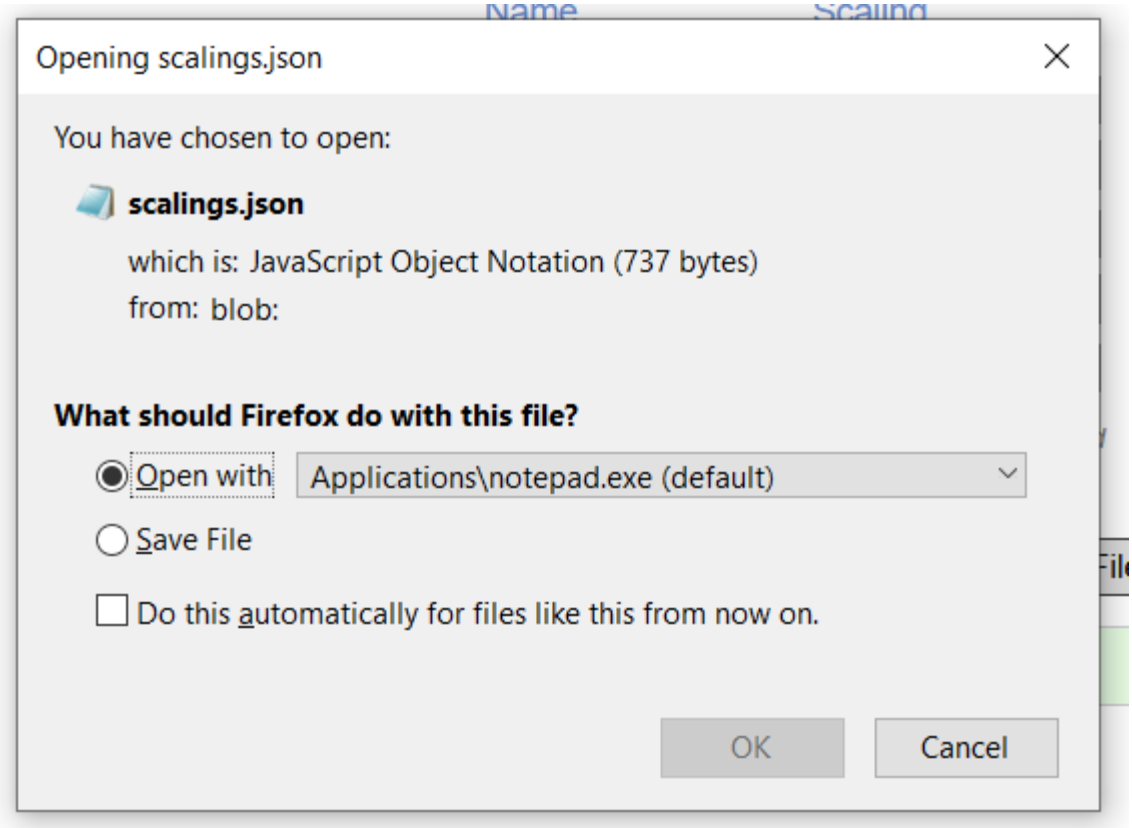


Make sure to hit Apply before leaving this page to save your settings!



You can save the ‘Flex Scaling’ file and either open it up and edit directly in a text editor or you can save and later select Open File to retrieve the file.



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scalings - Notepad

File Edit Format View Help

```
{
 "scalings": {
  "No scaling": [
   [-10000, "-10000"],
   [10000, "10000"]
  ],
  "Divide by 10": [
   [-10000, "-1000.0"],
   [10000, "1000.0"]
  ],
  "Divide by 100": [
   [-10000, "-100.00"],
   [10000, "100.00"]
  ],
  "Divide by 1000": [
   [-10000, "-10.000"],
   [10000, "10.000"]
  ],
  "F-to-Cent": [
   [3200, "0.00"],
   [21200, "100.00"]
  ],
  "kVpp": [
   [0, "0.00"],
   [13800, "13.80"]
  ],
  "kVpn": [
   [0, "0.00"],
   [7500, "7.50"]
  ]
 },
 "measurements": {
  "Amps - Ph A": ["No scaling", "A", "none", "one"],
  "MW - Total": ["Divide by 1000", "none", "none", "one"],
  "Freq": ["Divide by 100", "none", "none", "one"],
  "kVab": ["kVpp", "none", "none", "one"],
  "kVan": ["kVpn", "none", "none", "one"]
```

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You can make changes directly in Notepad or in a JSON editor. This is a very useful tool in creating long Scaling and Measurement lists. Instead of adding each Scaling and Measurment line by line in the 'Flex Scale' web page, you can copy and paste in the text editor (for example copy a list of A phase measurments to make corresponding B and C phase measurements via minor edits), then save and upload the JSON file back into the display.

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```
   [7977, "7.98"]
  ],
  "OptRes-EngrUnits": [
   [0, "0"],
   [52176, "1000"]
  ]
 },
 "measurements": {
  "MW - Total": ["Divide by 1000", "none", "none", "one"],
  "Freq": ["Divide by 100", "none", "none", "one"],
  "kVab": ["kVpp", "AB", "none", "one"],
  "kVan": ["kVpn", "A", "none", "one"],
  "Amps - Ph A": ["OptRes-EngrUnits", "A", "none", "one"]
'kVbc": ["kVpp", "BC", "none", "one"],
  "kVbn": ["kVpn", "B", "none", "one"],
  "Amps - Ph B": ["OptRes-EngrUnits", "B", "none", "one"]
'kVca": ["kVpp", "CA", "none", "one"],
  "kVcn": ["kVpn", "C", "none", "one"],
  "Amps - Ph C": ["OptRes-EngrUnits", "C", "none", "one"]
 }
}
```

Another example:

```
 },
 "measurements": {
  "F1_A_Amps": ["Amps", "A", "none", "one"],
  "F1_A_MVar": ["Divide by 1000", "A", "none", "one"],
  "F1_A_MW": ["MW", "A", "none", "one"],
  "F1_A_kV": ["Divide by 1000", "A", "none", "one"],
  "F1_A_W_Temp": ["F-to-Cent", "A", "none", "one"],
"F1_B_Amps": ["Amps", "B", "none", "one"],
  "F1_B_MVar": ["Divide by 1000", "B", "none", "one"],
  "F1_B_MW": ["MW", "B", "none", "one"],
  "F1_B_kV": ["Divide by 1000", "B", "none", "one"],
  "F1_B_W_Temp": ["F-to-Cent", "B", "none", "one"],
"F1_C_Amps": ["Amps", "C", "none", "one"],
  "F1_C_MVar": ["Divide by 1000", "C", "none", "one"],
  "F1_C_MW": ["MW", "C", "none", "one"],
  "F1_C_kV": ["Divide by 1000", "C", "none", "one"],
  "F1_C_W_Temp": ["F-to-Cent", "C", "none", "one"],
  "Poll": ["32bit counter", "none", "none", "two"]
 }
```

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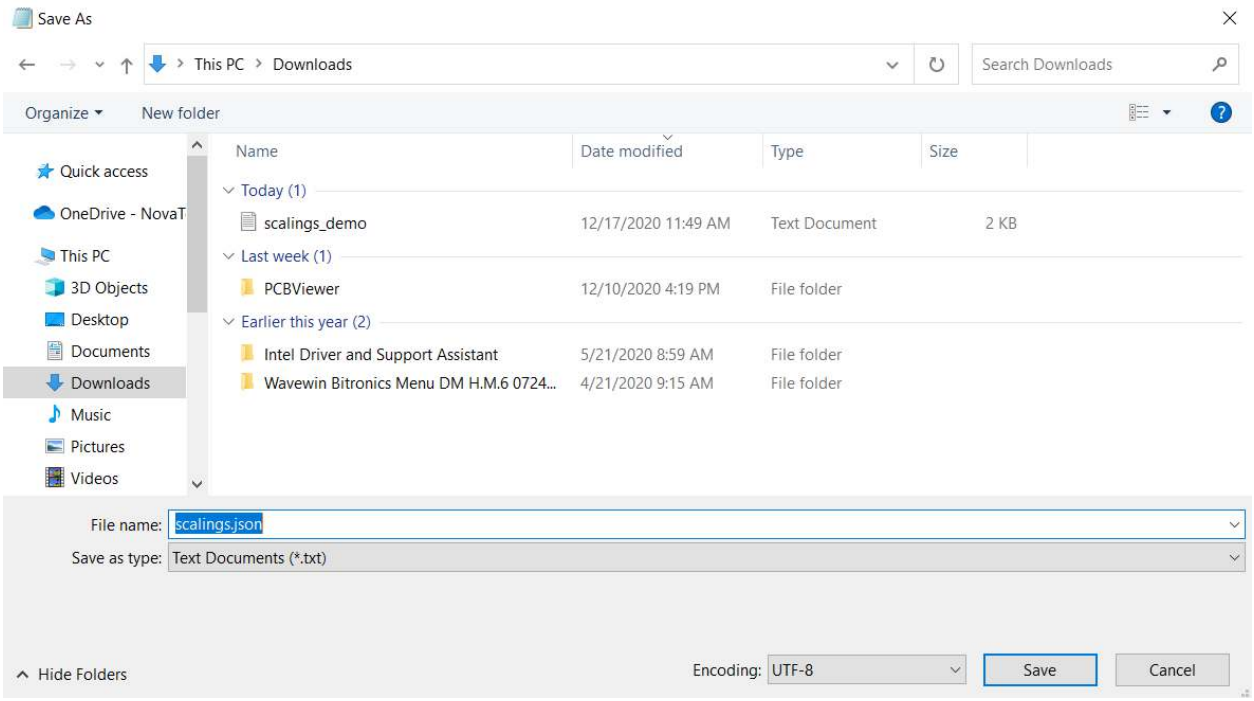
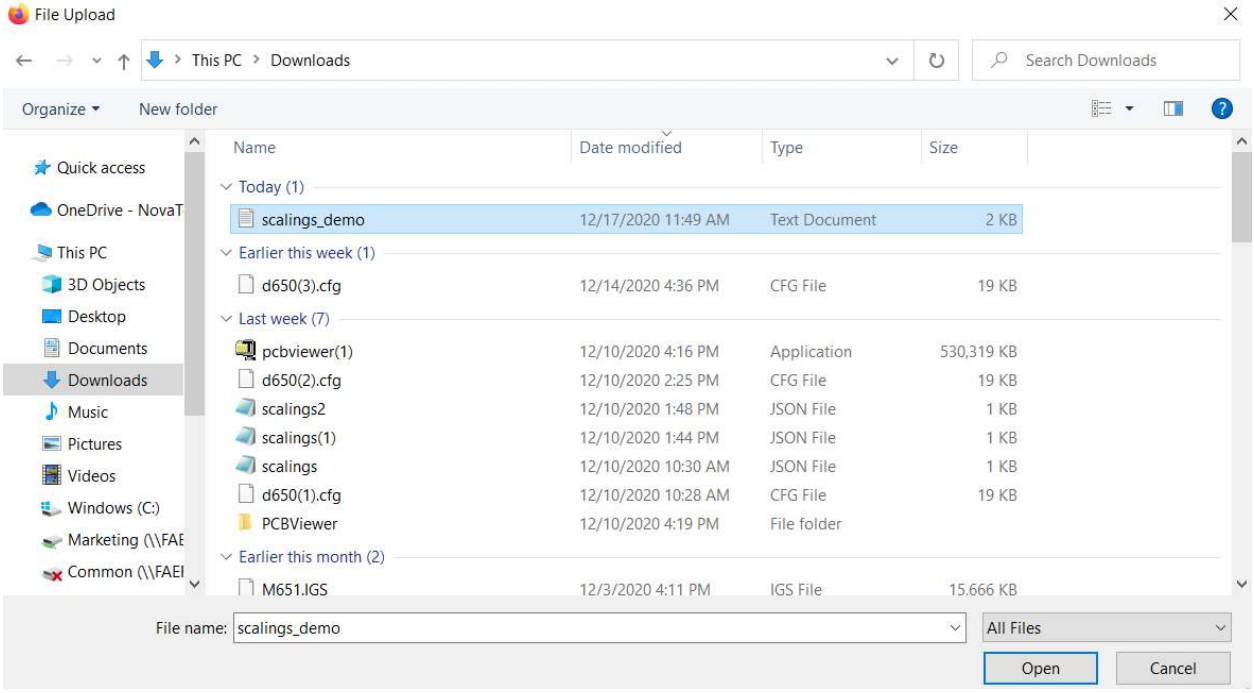


After saving the edited JSON file, go back to the web browser for the D650 to the 'Flex Scaling' page and select 'Open from File' near the bottom of the page and upload the file to the D650:



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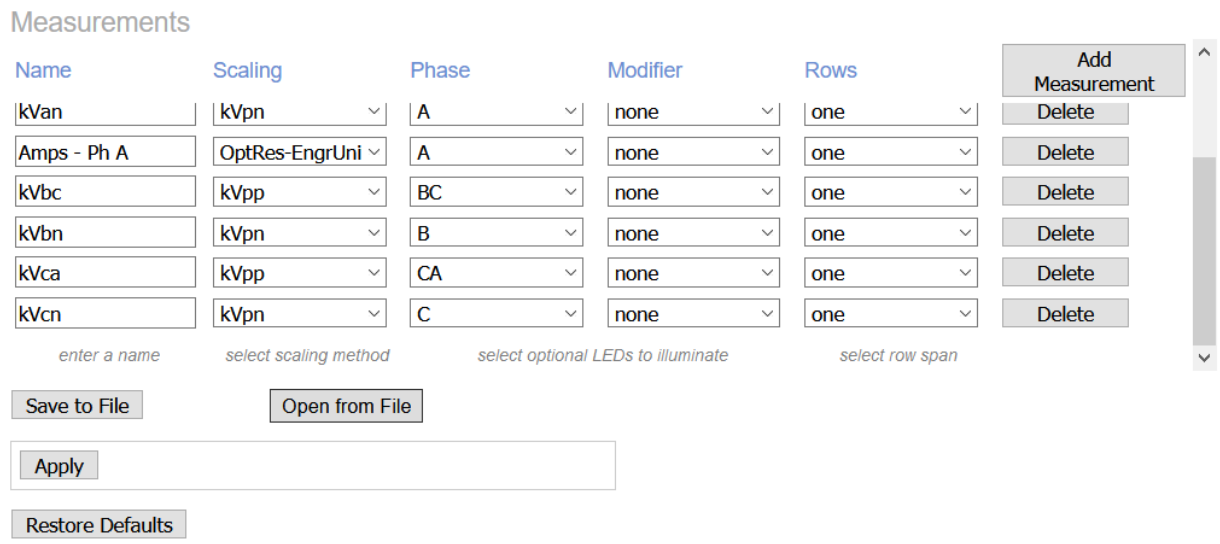
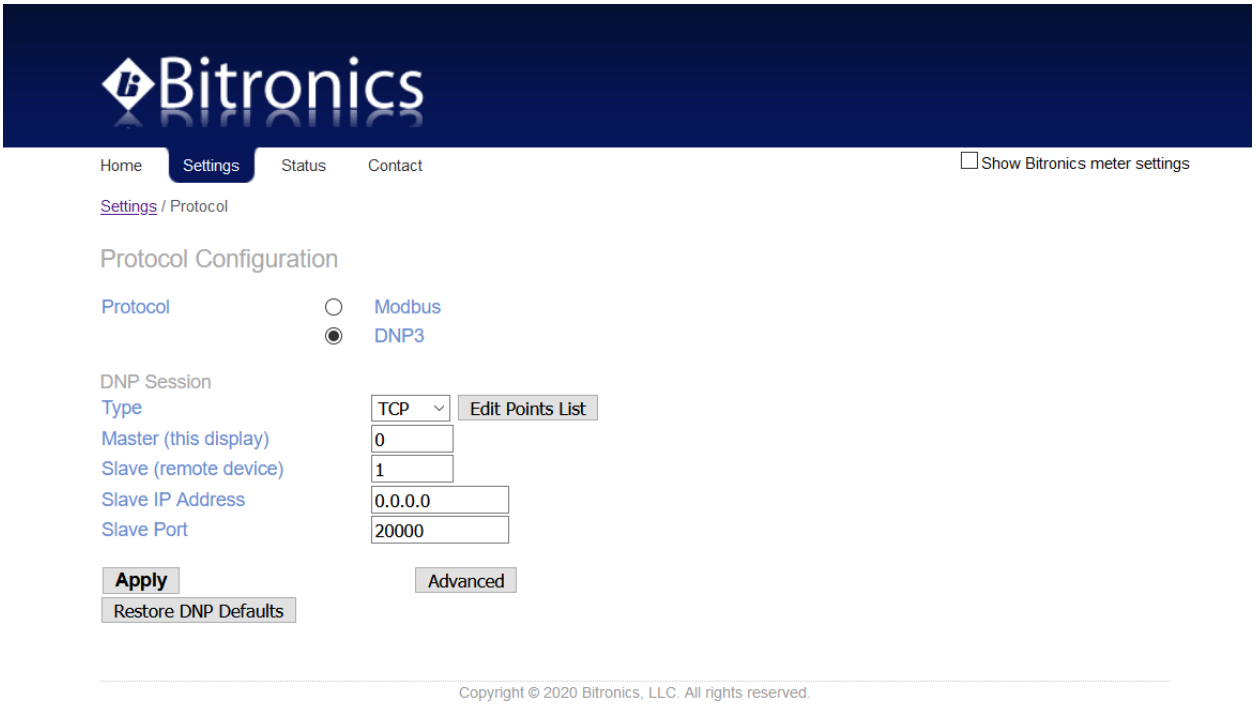


The additional BC, CA, B, and C kV lines have been added.
Next we will go to the 'Protocol' page. We will show an example for DNP3. Select DNP3, then Edit Points List



When you hit the 'Edit Points List' this page will not show points until you hit the 'Edit List' and the Measurements you created will be available (two examples shown below):

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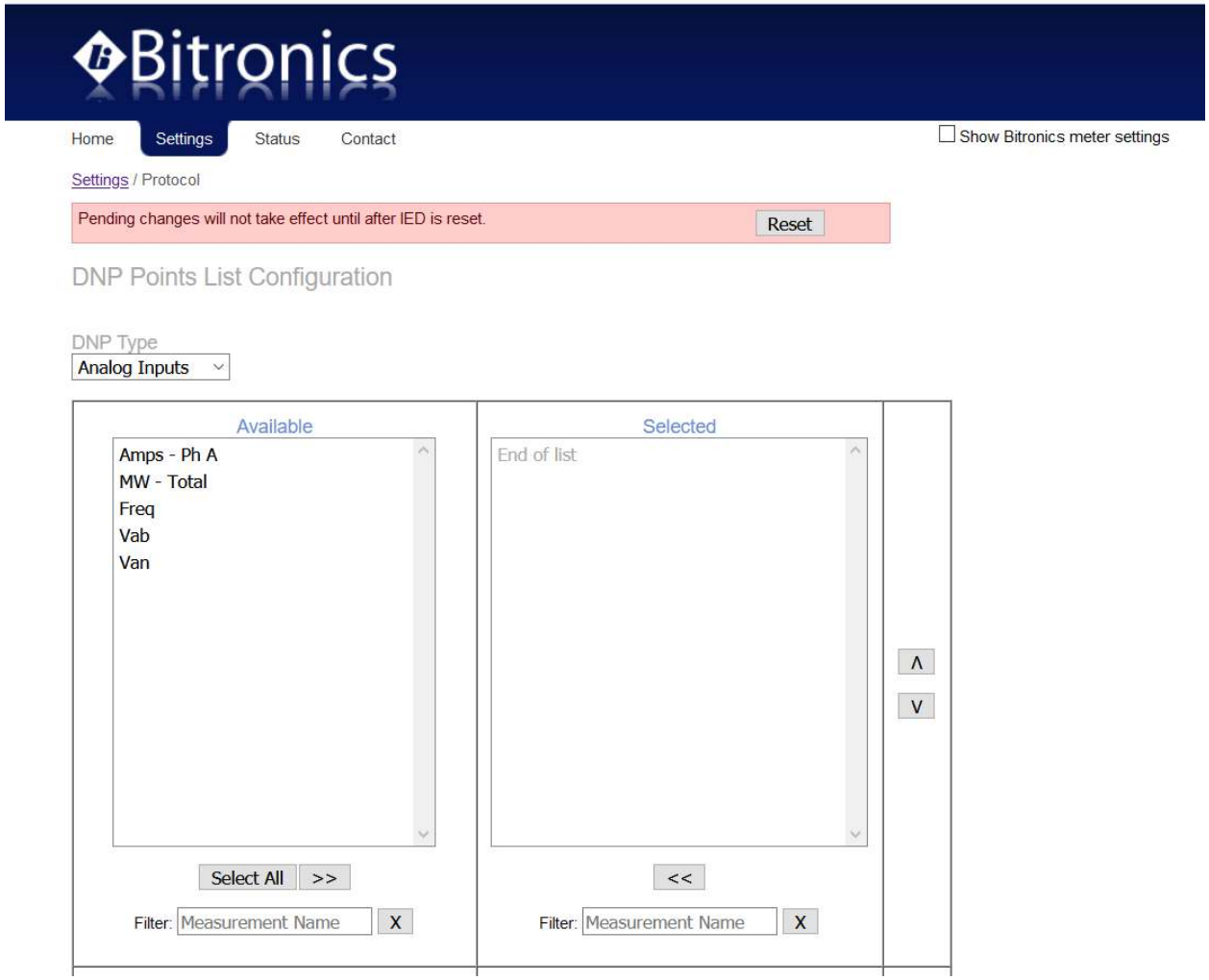
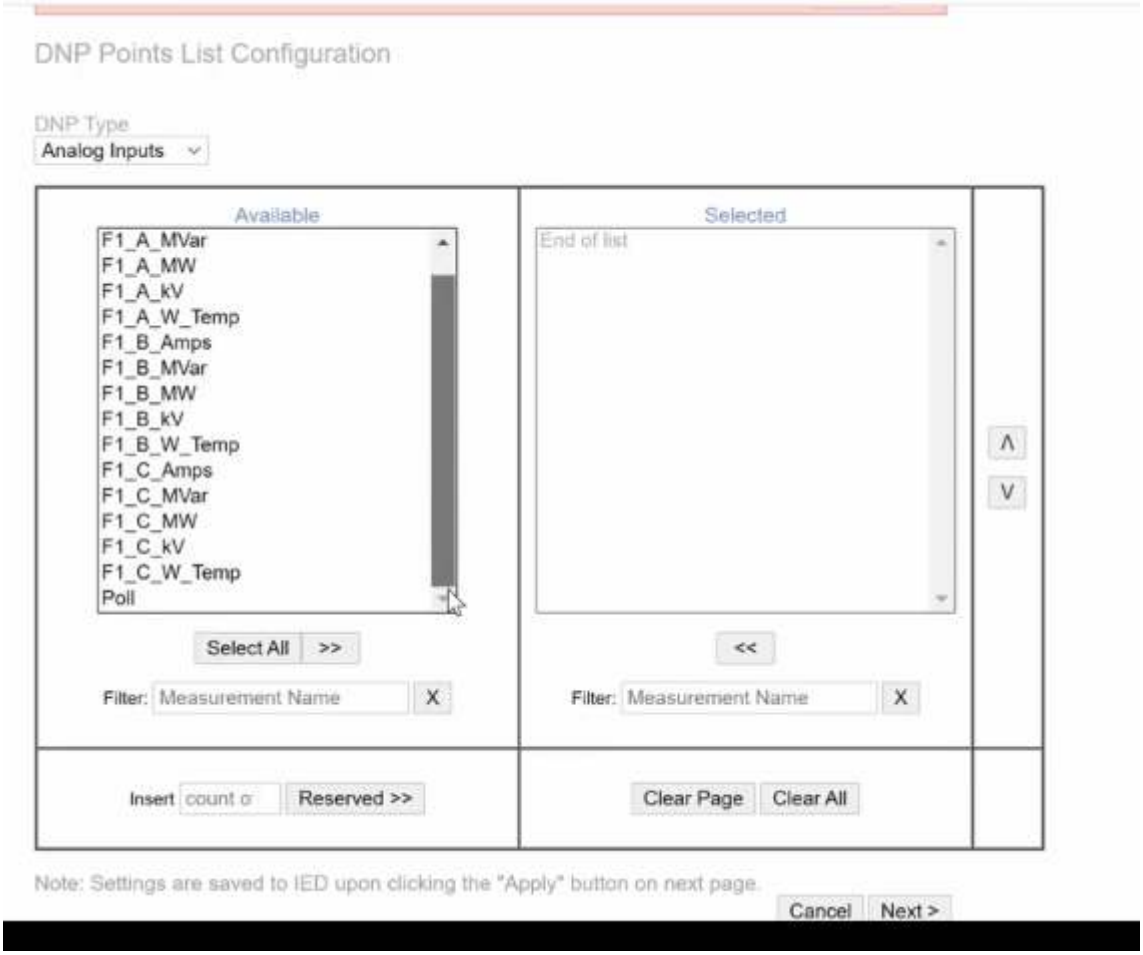


 Copyright 2021 Bitronics, LLC



You can then select any or all the available measurements. Select all and then hit the >> button to move them over.
You can use the 'Reserved' button to add in points to account for gaps in the list from where your points are in the IED you are communicating with.
Here is an example with non-continuous points. First select the points that are in order and transfer them over. Then add the reserve points.

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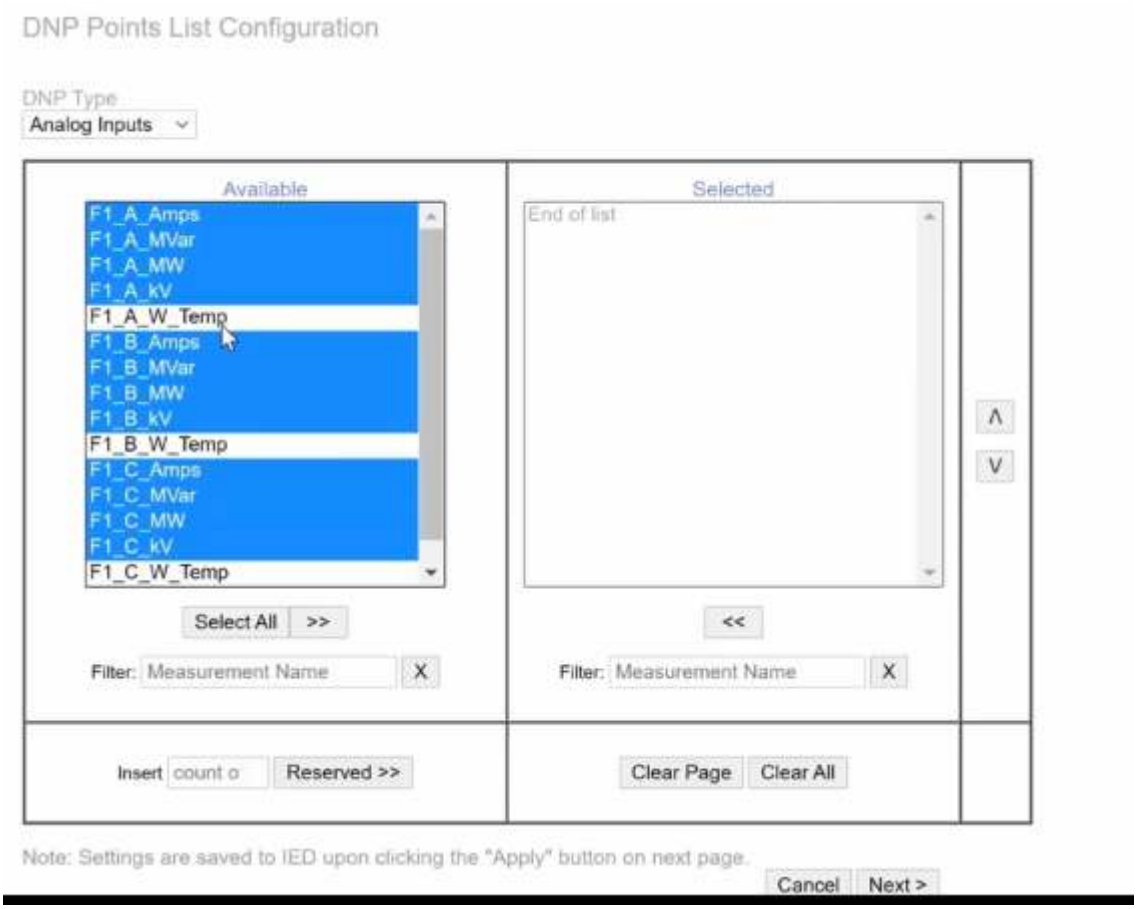

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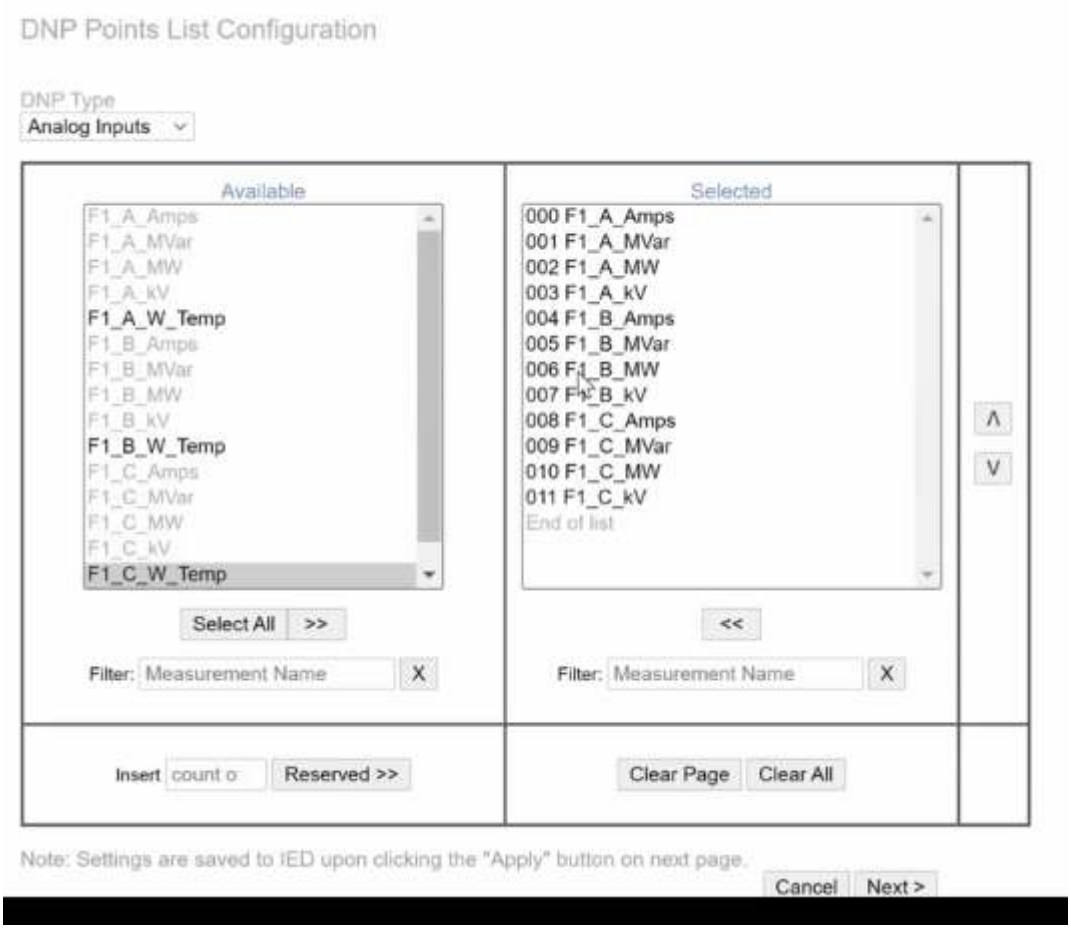
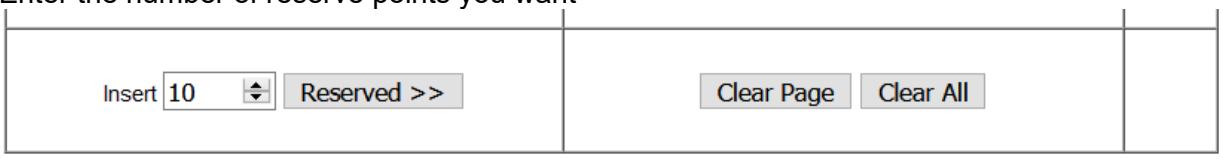
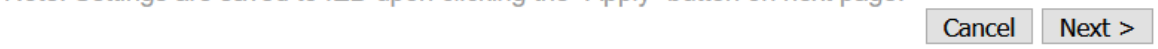


Enter the number of reserve points you want





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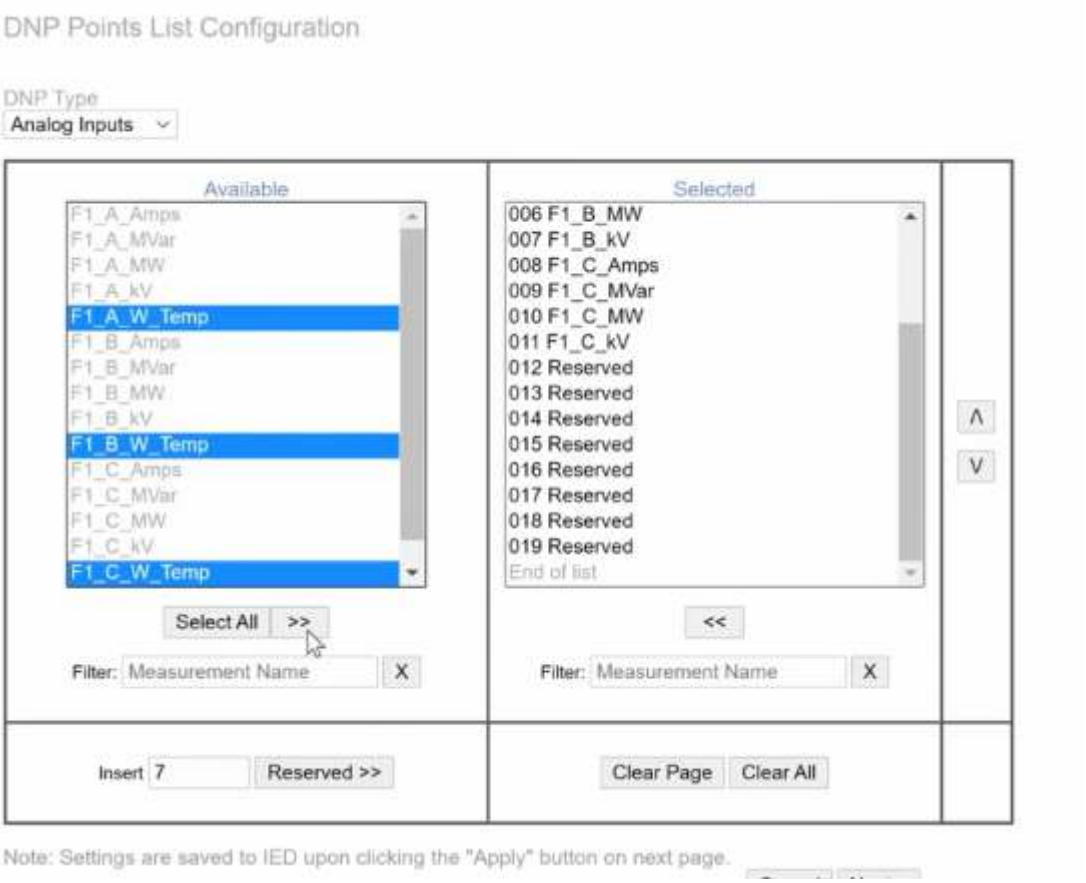

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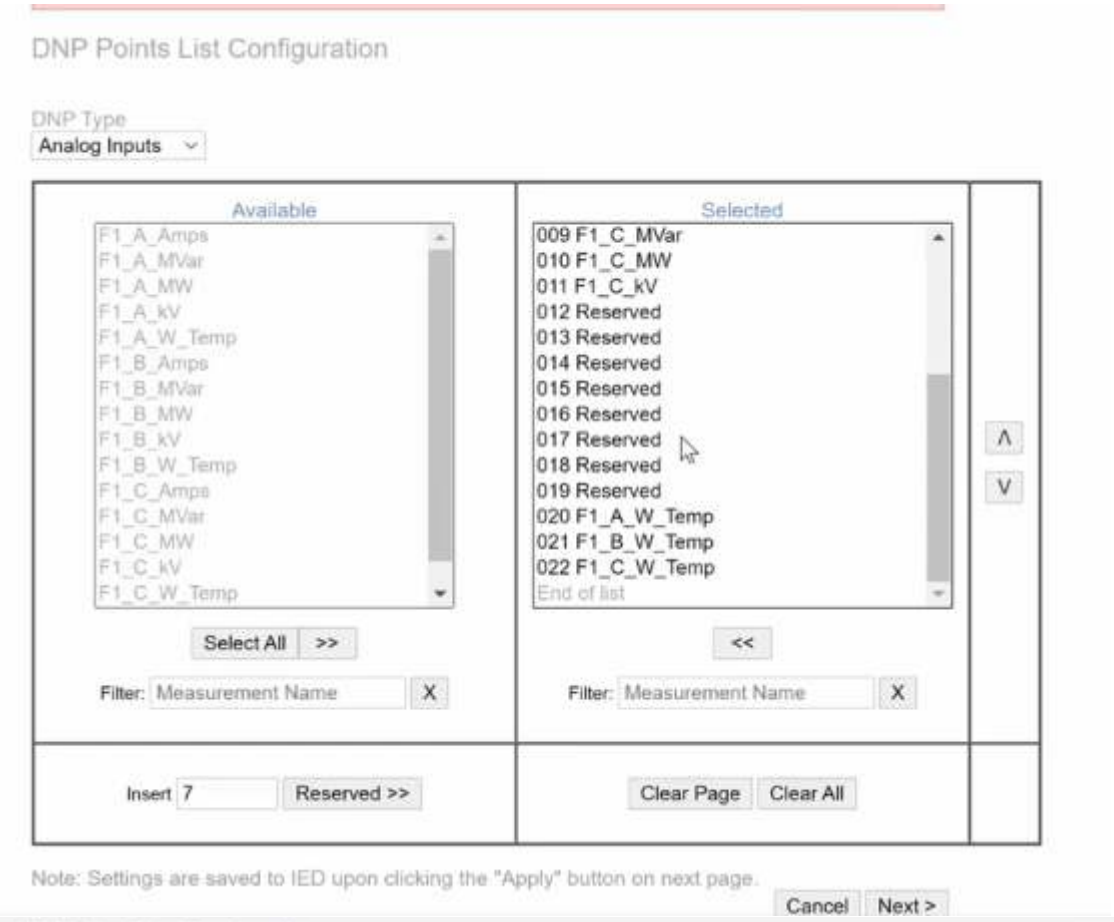

You can then move from the Analog points to Counters if you have any and add them in in the same way.

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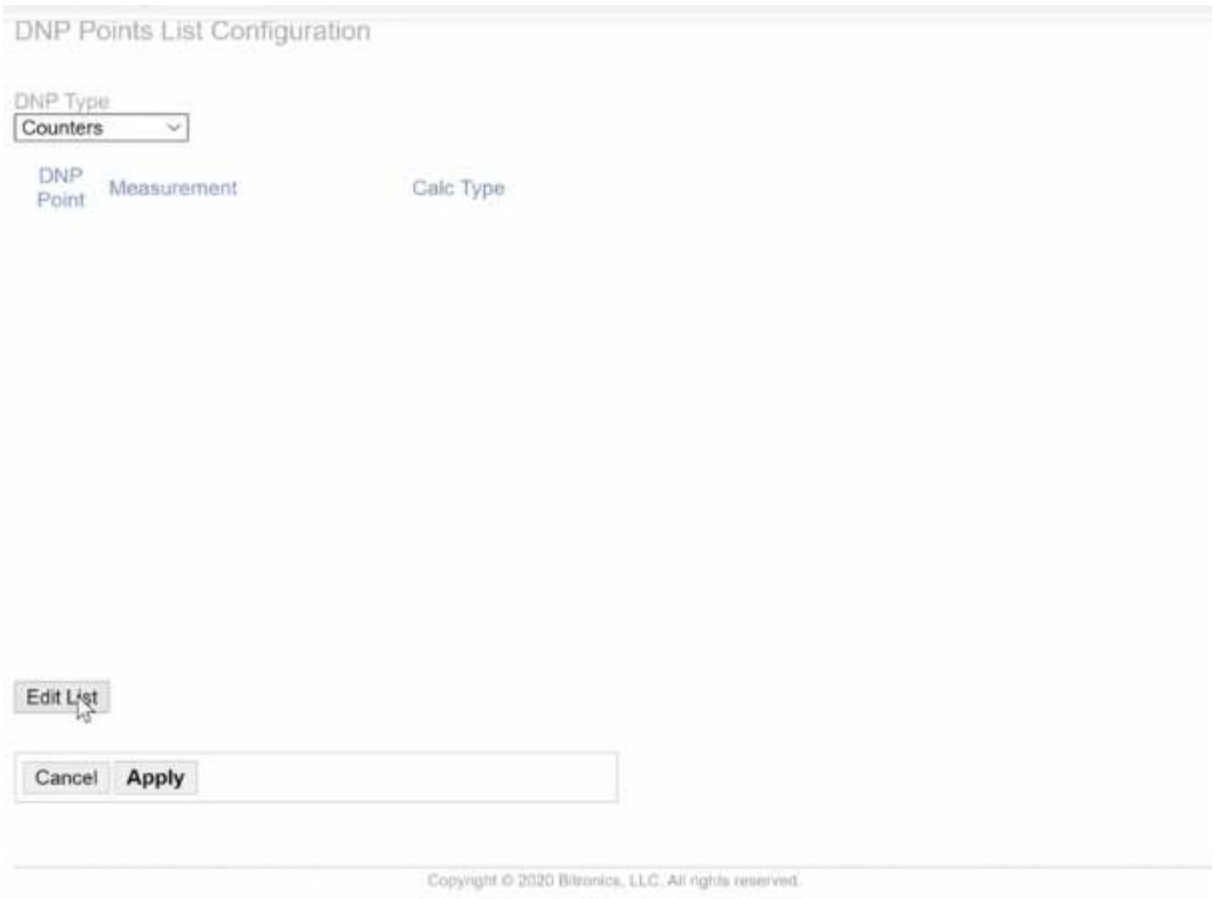
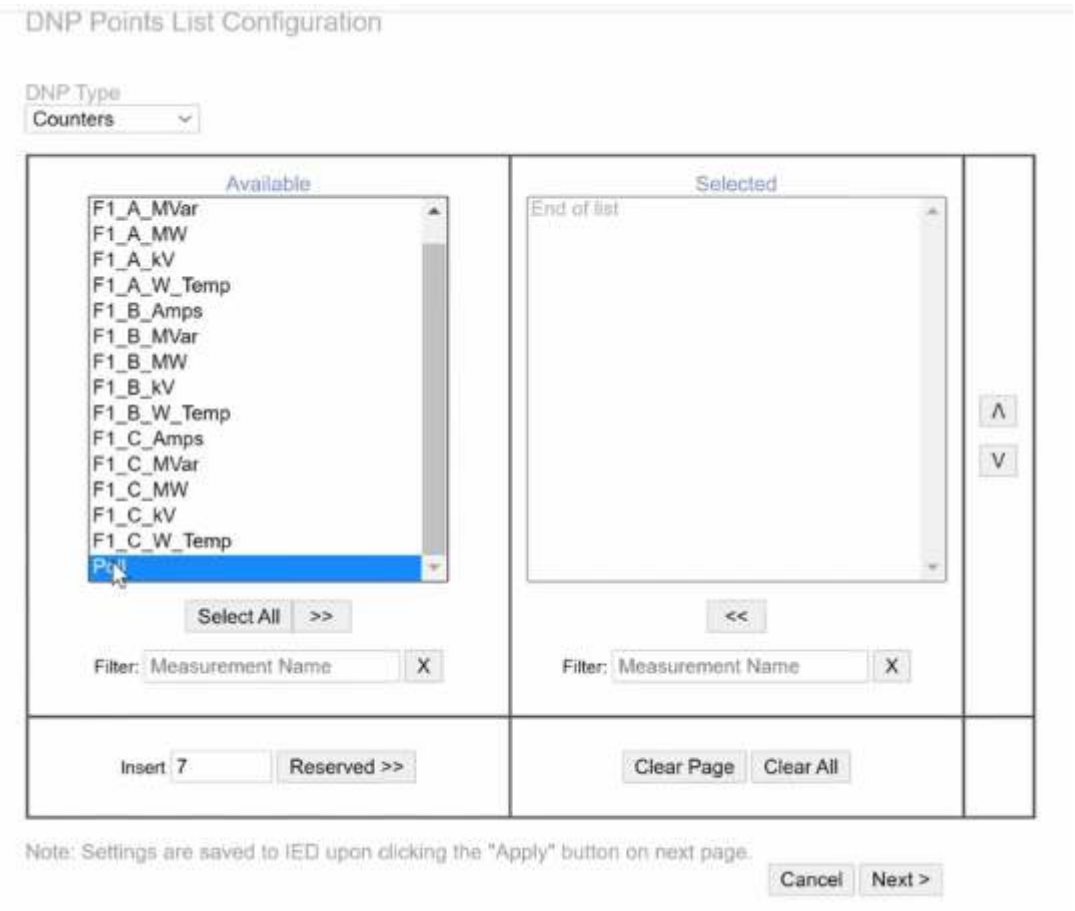
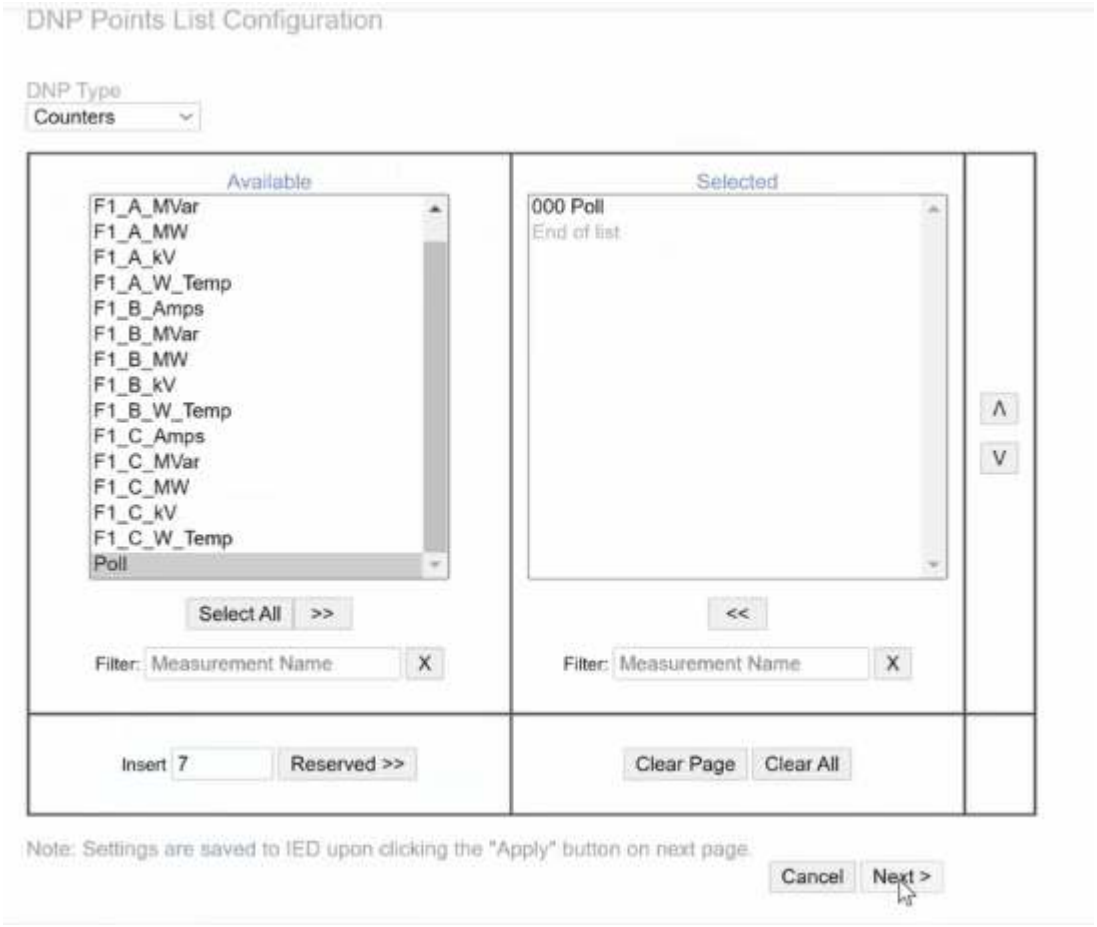

DNP Points List Configuration
DNP Type
Counters
DNP Point
Measurement
Calc Type
Edit List
Cancel
Apply
Copyright © 2020 Bitronics, LLC. All rights reserved.


DNP Points List Configuration
DNP Type
Counters
Available
F1_A_MVar
F1_A_MW
F1_A_kV
F1_A_W_Temp
F1_B_Amps
F1_B_MVar
F1_B_MW
F1_B_kV
F1_B_W_Temp
F1_C_Amps
F1_C_MVar
F1_C_MW
F1_C_kV
F1_C_W_Temp
Select All
>>
Filter:
Measurement Name
X
Selected
End of list
<<
Filter:
Measurement Name
X
Insert
7
Reserved >>
Clear Page
Clear All
Note: Settings are saved to IED upon clicking the "Apply" button on next page.
Cancel
Next >



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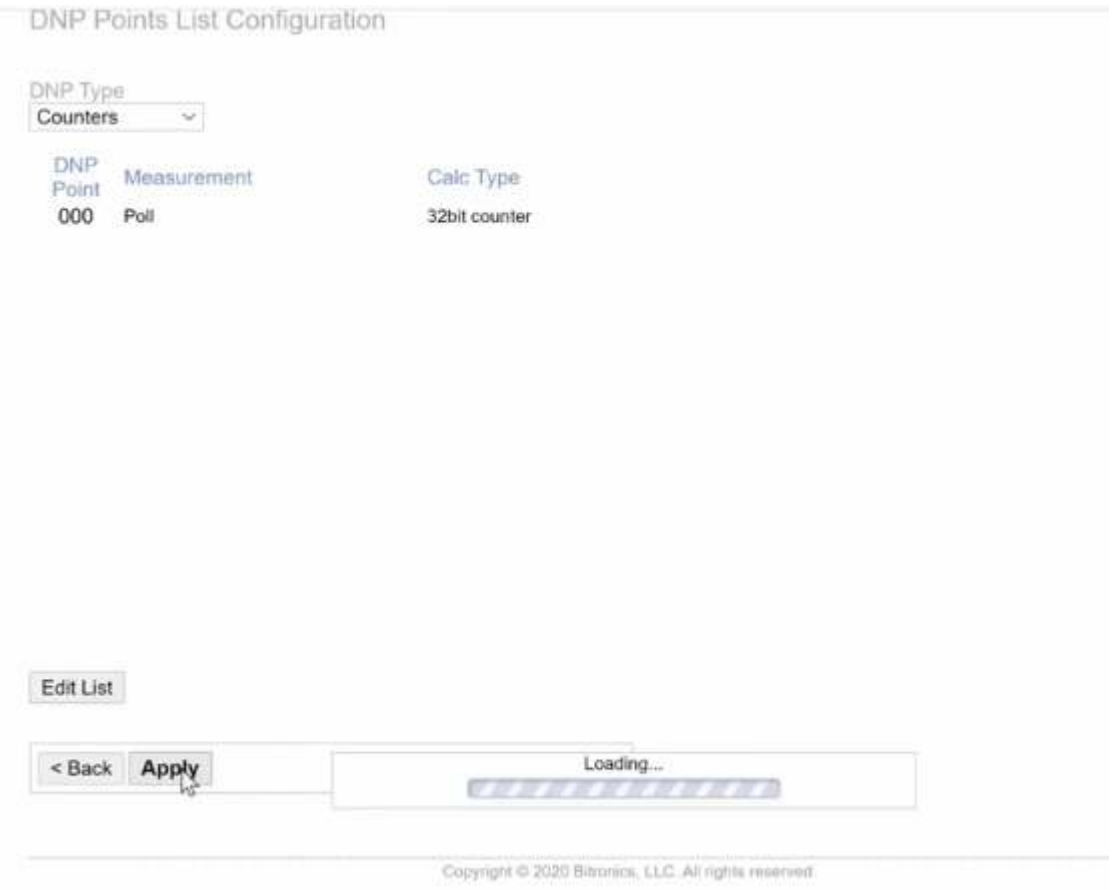
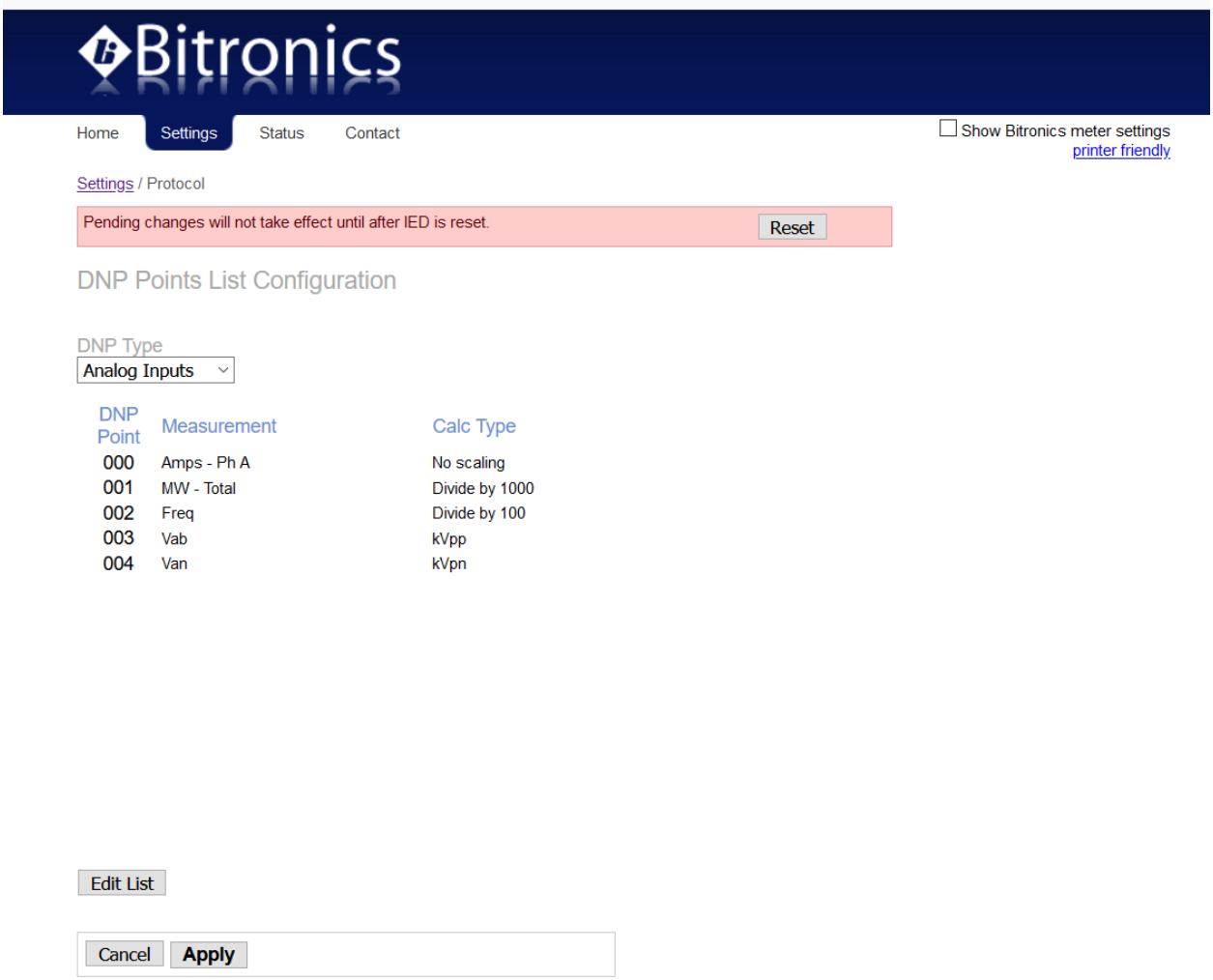
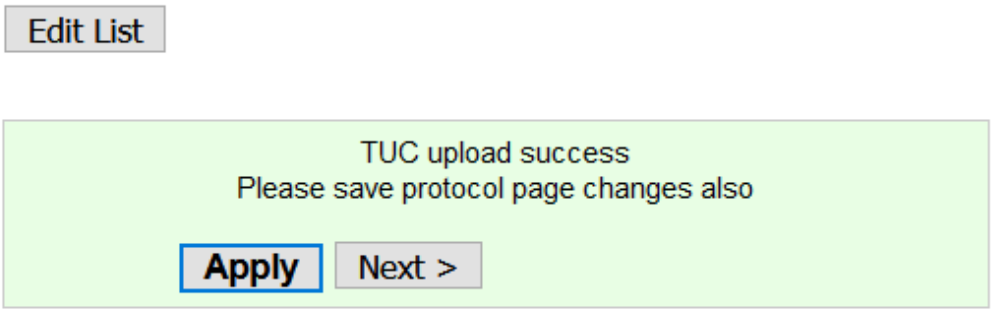


Select Next and you will see the measurements showing their respective calc types:



Hit Apply and the custom points list is saved:



Hit Next> and then Apply
Next go to the Custom Display Page. You will need to create the screens you want to display. Below is an example:

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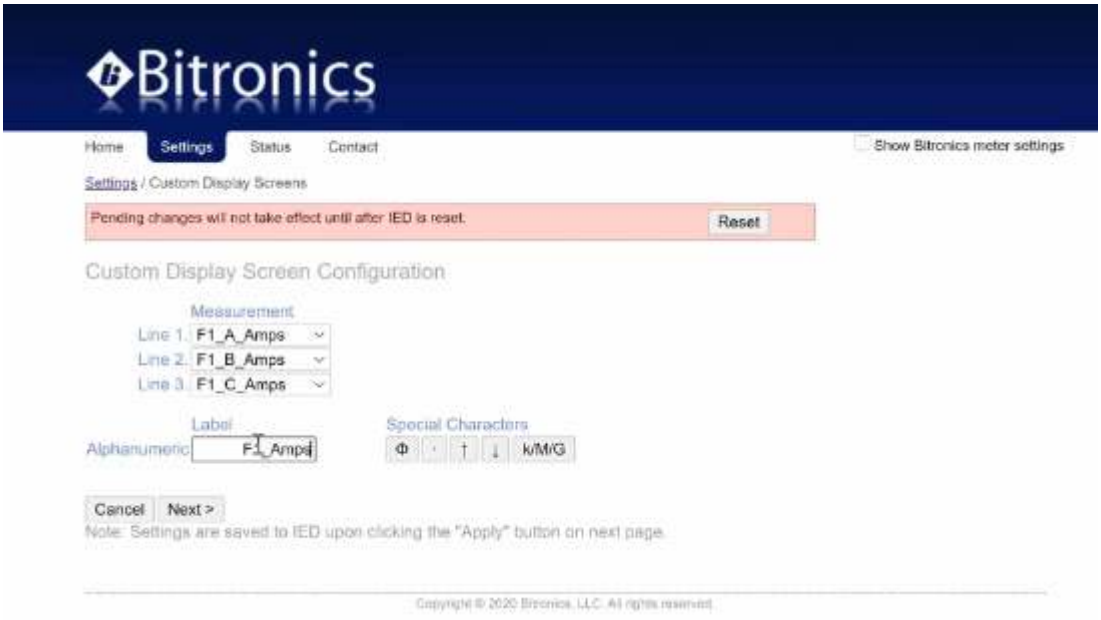
Bitronics
Home
Settings
Status
Contact
Show Bitronics meter settings
Settings / Custom Display Screens
Pending changes will not take effect until after IED is reset.
Reset
Custom Display Screen Configuration
Measurement
Line 1. F1_A_Amps
Line 2. F1_B_Amps
Line 3. F1_C_Amps
Label
Alphanumeric
F1_Amps
Special Characters
Φ · ↑ ↓ k/M/G
Cancel
Next >
Note: Settings are saved to IED upon clicking the "Apply" button on next page.
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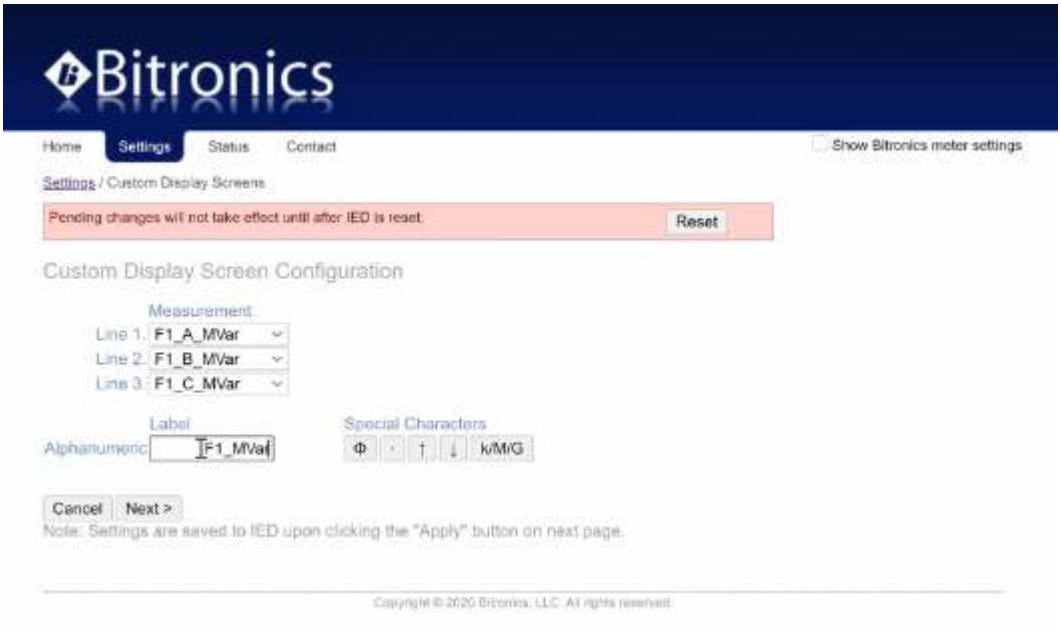
Bitronics
Home
Settings
Status
Contact
Show Bitronics meter settings
Settings / Custom Display Screens
Pending changes will not take effect until after IED is reset.
Reset
Custom Display Screen Configuration
Measurement
Line 1. F1_A_MVar
Line 2. F1_B_MVar
Line 3. F1_C_MVar
Label
Alphanumeric
F1_MVar
Special Characters
Φ · ↑ ↓ k/M/G
Cancel
Next >
Note: Settings are saved to IED upon clicking the "Apply" button on next page.
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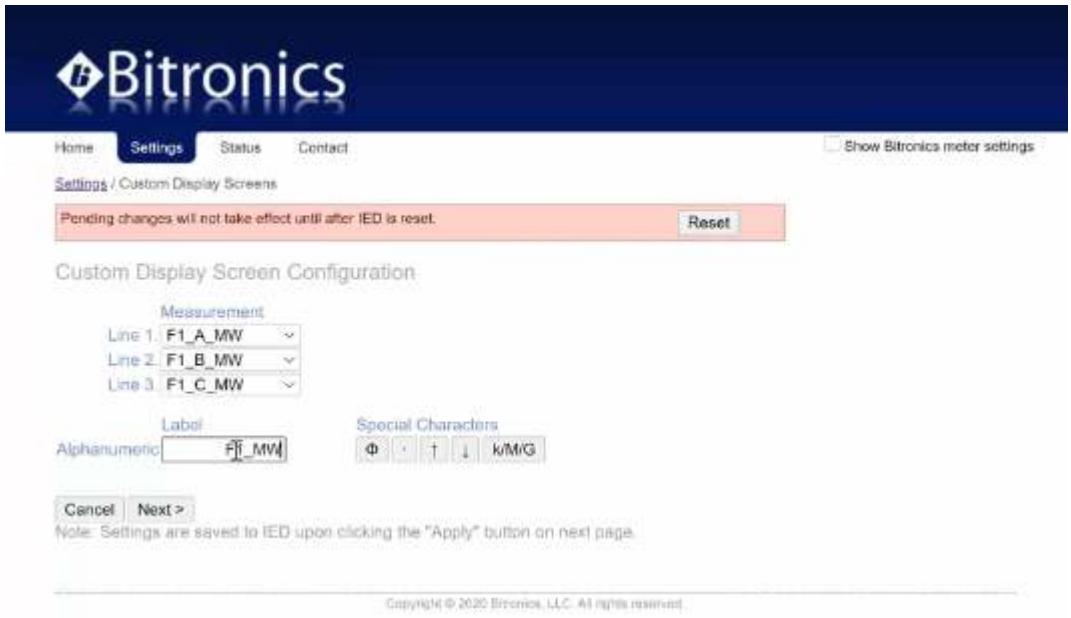
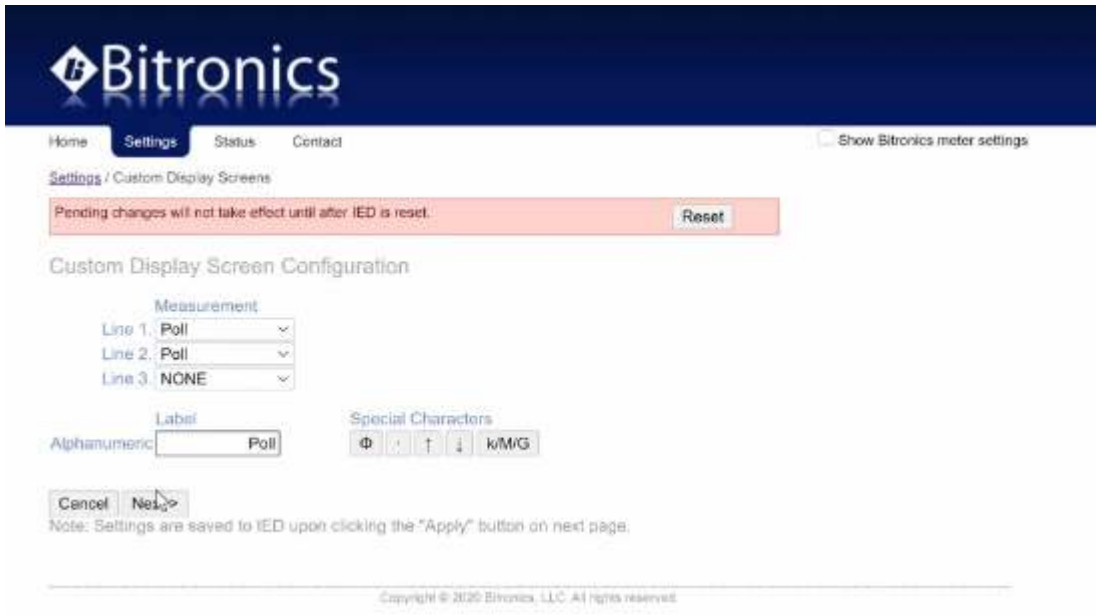
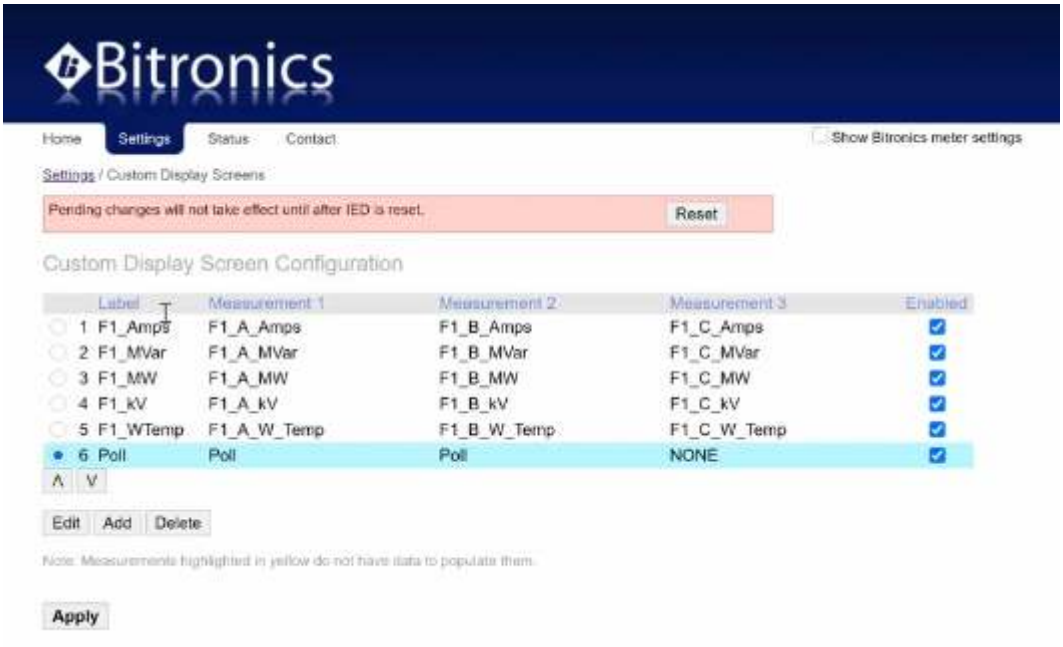
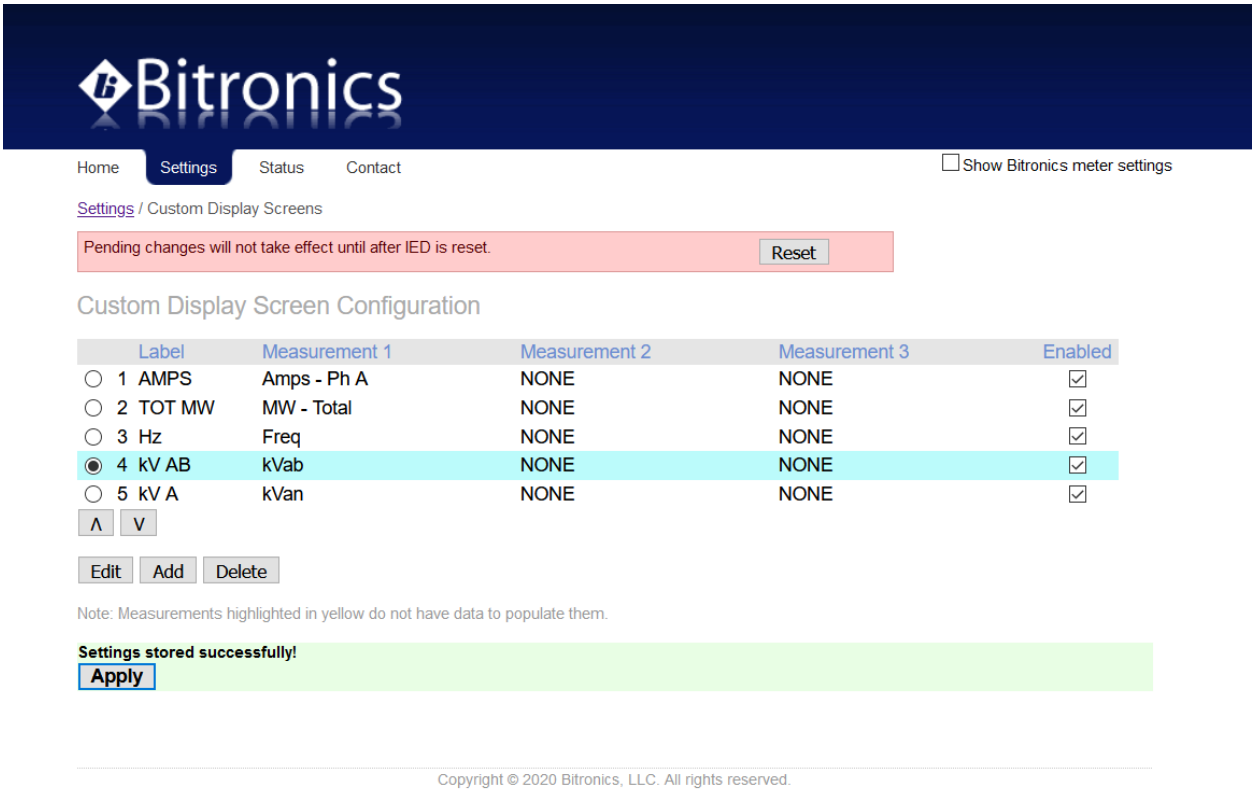


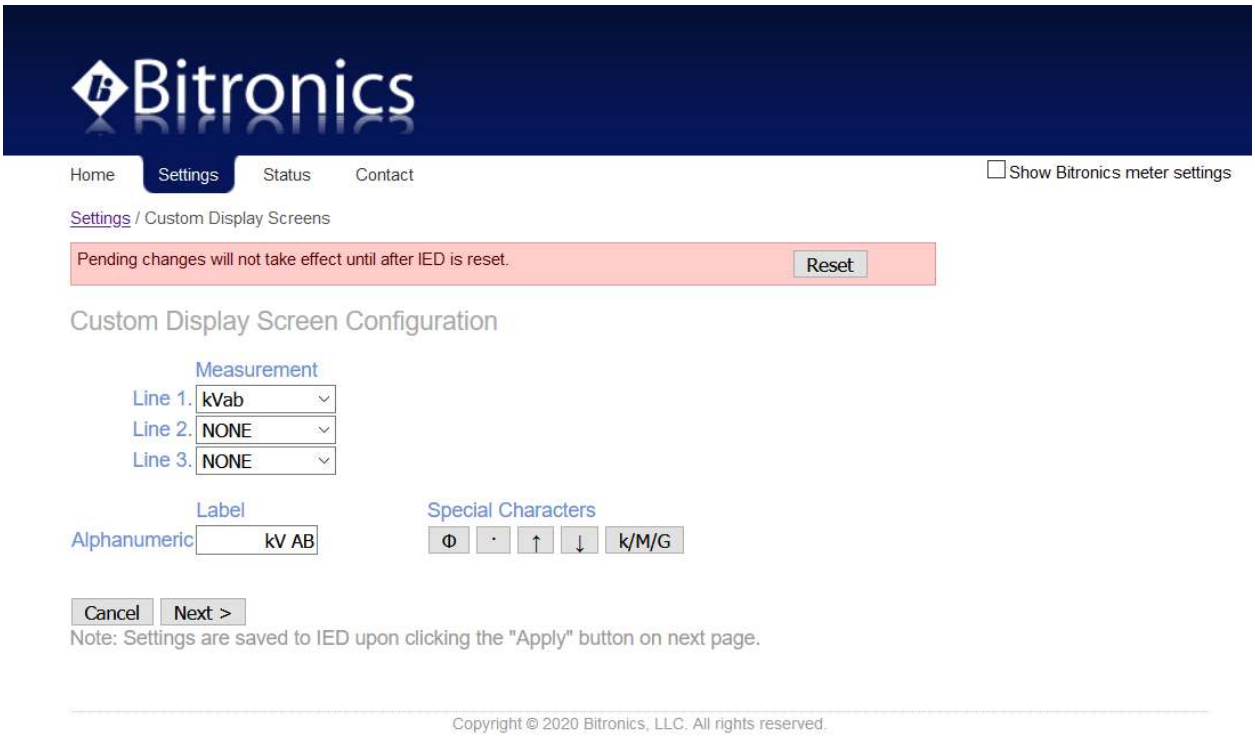
Note when you add the Poll (Counters) it takes up two lines and automatically reflects this in the Custom Display Screen Configuration:



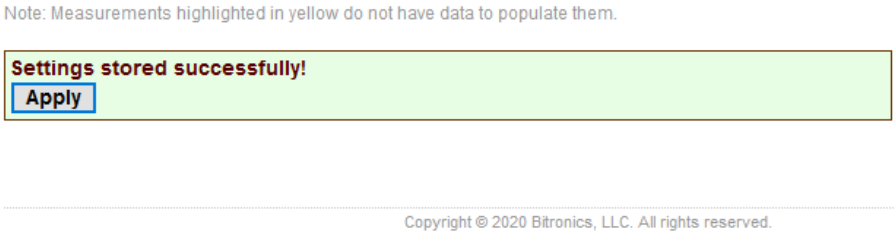




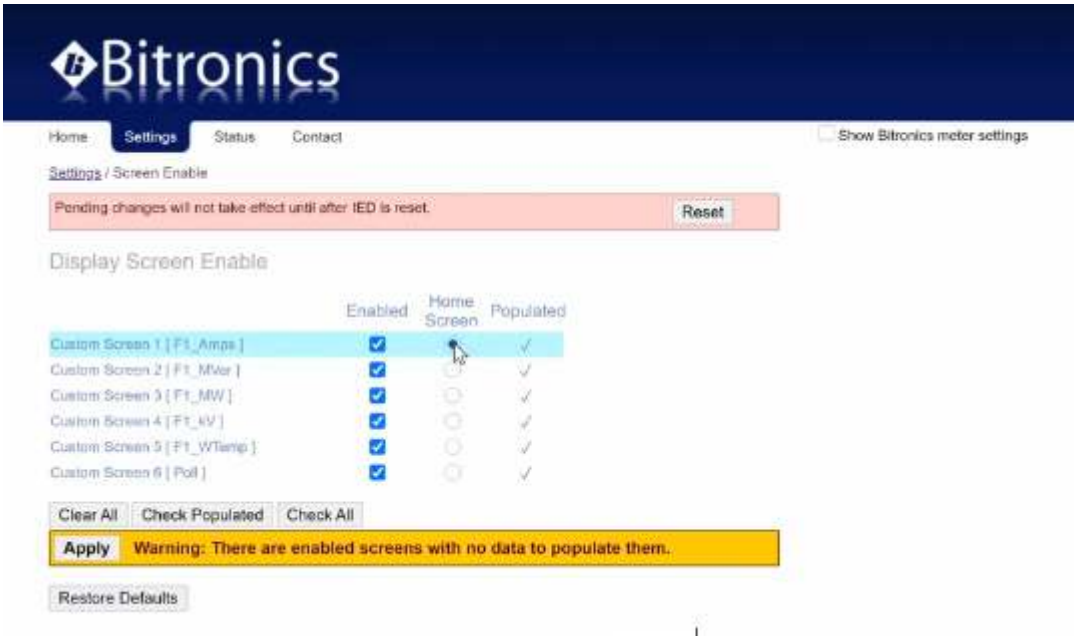
You can add or edit as needed. Below is an example of clicking Measurement 4 and then Edit

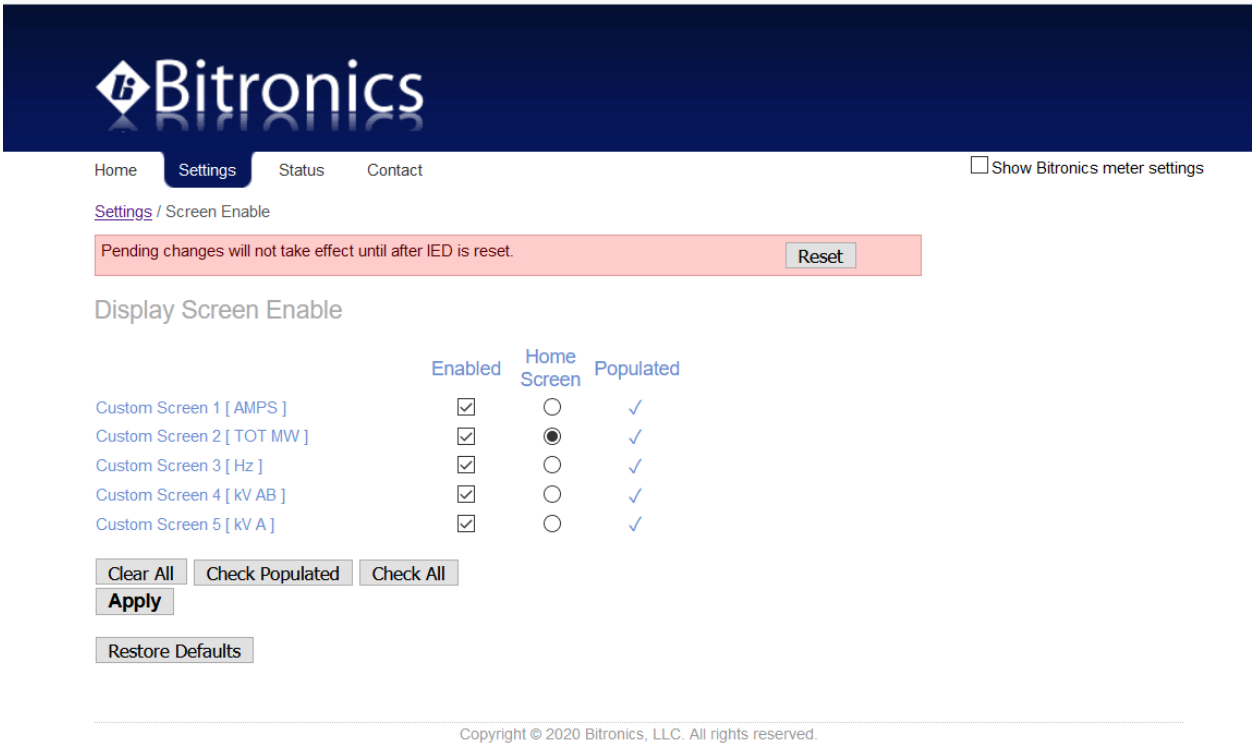


Make sure to hit Apply to save your settings!



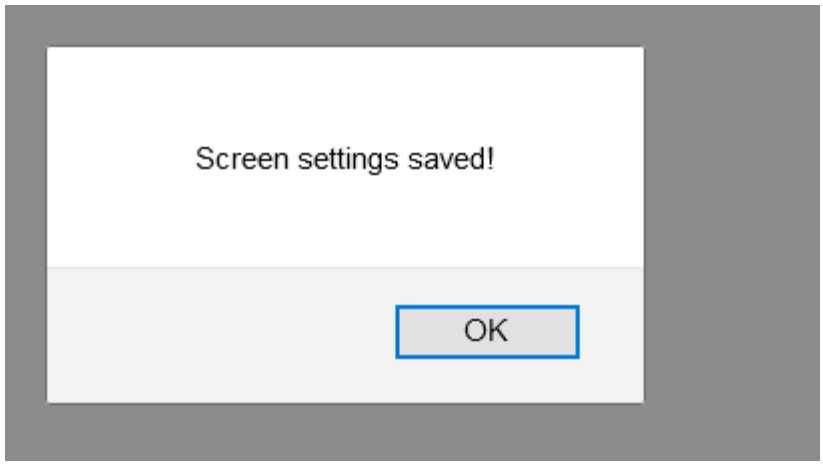
Next you need to go to the Enable Screen Page :





You can choose what screen you want for the Home screen and decide if you want to display all or just some of the values you created.

Hit Apply and you will save your settings:



Hit OK and then Reset to save all your changes. Done!

You can always check the status of the Device with a simple Green/Red display for Connection Status on the Status page:

The remainder of the Settings pages are unaffected by checking the Show Bitronics meter settings (Identify, Load/Store Settings, Password Security, and Firmware Upload).
Make sure to Reset if you have not already done so to save changes.

Now your display will be showing the screens you want:

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Below is a link to the NovaTech Power Hour Webinar Recording for D650 Universal Display, Overview and Configuration:

https://power.novatechautomation.com/s/article/Power-Hour-2020-12-16

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A NovaTech Company

EC Declaration of Conformity

This declaration of conformity is issued under the sole responsibility of the manufacturer.

We, the undersigned:

Manufacturer:	**Bitronics LLC** 261 Brodhead Road Bethlehem, PA 18017-8698 USA **T** +610.997.5100 **F** +610.997.5450 **E** bitronics@novatechweb.com	**Authorized Representative in the European Union:**	**NovaTech Europe BVBA** Kontichsesteenweg 71 2630 Aartselaar Belgium **T** +32.3.458.0807 **F** +32.3.458.1817 **E** info.europe@novatechweb.com

hereby declare that the following product(s) :

Product type :	50 Series & 60 Series
Description :	Multifunction 3-Phase Scada Meters, Multifunction 3-Phase Scada Transducers, 3-Phase Scada Ammeters and Voltmeters, Detached Display
Models (50 Series):	**M65xM3yzef, or M65xB3yzef, (where x=0,1,3) covering M650, M651, or M653, based on the following constructions:** with Auxiliary voltage input monitoring (y = P, for models M3 only, but not B3), or without Auxiliary voltage input monitoring (y = U); including Measurement signal inputs for 3-Phase Voltages, and Current (CT) inputs rated for one of the following: Nominal input current of 1A ac or 5A ac (internal isolation for current input options, z = 1 or 5), or External Split Core CT rated 5A ac nominal (current input option z = C); including a 6-position option port selected as one of the following: without option port (e = 0), with serial port (e=1), with 4-20mA Analog Transducer Output port (e = 2) , with 0-1mA Analog Transducer Output port (e = 3), including standard copper RJ45 Ethernet port (f = 0 with service port only, or f = 1 with port enabled for protocols), or an optional fiber Ethernet port (f = 2), **M350A3Uzef covering M350A3, based on the following constructions:** Ammeters with Measurement signal inputs for 3-Phase Current Transformer (CT) inputs rated nominal input current of 1A ac or 5 A ac (internal isolation for current input options, z = 1 or 5); including a 6-position option port selected as one of the following: without option port (e = 0), with serial port (e = 1), with 4-20mA Analog Transducer Output port (e = 2), with 0-1mA Analog Transducer Output port (e = 3); including standard copper RJ45 Ethernet port (f = 0 with service port only, or f = 1 with port enabled for protocols), or an optional fiber Ethernet port (f = 2). **M350V3Uzef covering M350V3, based on the following constructions:** Voltmeters with Measurement signal inputs for 3-Phase Voltage inputs (z = 0); including a 6-position option port selected as one of the following: without option port (e = 0), with serial port (e = 1), with 4-20mA Analog Transducer Output port (e = 2), with 0-1mA Analog Transducer Output port (e = 3); including standard copper RJ45 Ethernet port (f = 0 with service port only, or f = 1 with port enabled for protocols) or an optional fiber Ethernet port (f = 2). **D650BXy0ef covering D650 based on the following construction:** Detached Display without Auxiliary voltage input monitoring (y = U) ; with serial port (e = 1); including standard copper RJ45 Ethernet port (f = 0 with service port only).

Reference Number : DOC B005 **Issue :** F

Date of issue : 5-December-2016

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Models (60 Series): IEC 61850 protocol	**M66xM3yzef, (where x=0,1,3) covering M660, M661, or M663, based on the following constructions:** with Auxiliary voltage input monitoring (y = P), or without Auxiliary voltage input monitoring (y = U); including Measurement signal inputs for 3-Phase Voltages, and Current (CT) inputs rated for one of the following: Nominal input current of 1A ac or 5A ac (internal isolation for current input options, z = 1 or 5), or External Split Core CT rated 5A ac nominal (current input option z = C); including an Ethernet fiber option port selected as one of the following: without Ethernet fiber port (e = 0) or with Ethernet fiber port (e=5), including standard copper RJ45 Ethernet port (f = 1 with port enabled for protocols).

Conform(s) with the protection requirements of the following directive(s) :

1. European Community Directive on EMC (EMCD) 2014/30/EU, superceding 2004/108/EC, and Directive 91/263/EC [TTE/SES]. Fulfilment of the essential requirements set out in Annex I has been demonstrated.
2. European Community Directive on Low Voltage (LVD) 2014/35/EU, superceding 2006/95/EC. Fulfilment of the safety objectives referred to in Article 3 and set out in Annex I has been demonstrated.

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation: Directives 2004/108/EC & 2006/95/EC (until April 19th, 2016) and Directives 2014/30/EU &, 2014/35/EU (from April 20th, 2016).

The requirements for the following directive(s) were deternined to be not applicable

Directive #	Subject of Directive	Reason Directiive is Not Applicable
2011/65/EU	Restriction of the Use of Certain Substances in electrical equipment (RoHS)	Not applicable - large scale fixed installation is exempt per Article 2, clause 4e (utility substation equipment which is designed in)
2012/19/EU	Waste Electrical and Electronic (WEEE)	Not applicable - large scale fixed installation is exempt per Article 2, clause 4c (utility substation equipment which is designed in)

Reference Number : DOC B005 **Issue :** F

Date of issue : 5-December-2016

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The following route(s) were used to establish conformity :

1. **2014/30/EU: (EMCD) In accordance w**ith Article 14, Annex II (internal production control) supported by a Technical File, superceding 2004/108/EC, in accordance with Article 7, Annex II.

Technical File No. :	TF B005
Date Issued or Revised :	5-Dec-2016 or later - New Legislative Framework & EMC Directive, (Original issue: 13-Jul-2012, Reissued: 28-Oct-2013, 21-Mar-2016)
Conformity Assessment Body : (C.A.B.)	Underwriters Laboratories, LLC, WiSE, Melville Division 1285 Walt Whitman Road, Melville, NY 11747-3081 USA
Compliance Certificate / Test Report:	1001403534, 11ME06423, MC16183, 50 Series, EMC Assessment; 10059253, M66x, EMC Assessment; D650 reliance on preceding reports is based on similar construction with a subset of inputs/parts removed.

2. **2014/35/EU: (LVD)** Self Certification supported by a Technical File, in accordance with Article 12, Annex III (internal production control), superceding 2006/95/EC.

Technical File No. :	TF B005
Date Issued or Revised :	5-Dec-2016 or later - New Legislative Framework & LVD Directive, (Original issue: 13-Jul-2012, Reissued :28-Oct-2013 - transition to IEC 61010-1, Ed. 3, & 21-Mar-2016)
Conformity Assessment Body : (C.A.B.)	UL International (UK) Limited, Wonersh House, The Guildway, Old Portsmouth Road, Guilford, Surrey, GU3 1LR, United Kingdom
Compliance Certificate / Test Report: (Superceded)	CB Certificate No. DK-27045-UL issued by National Certification Body: UL (Demko), Borupvang 5A DK-2750 Ballerup, Denmark / CB Test Report E164178-A1-CB-1, 50 Series/60 Series, Product Safety Assessment
Conformity Assessment Body : (C.A.B.)	Underwriters Laboratories, LLC, Melville Division 1285 Walt Whitman Road, Melville, NY 11747-3081 USA
Compliance Certificate / Test Report:	CB Certificate No. US-22466-UL-A1 supercedes US-22466-UL & US-19849-UL issued by National Certification Body: UL (US), 333Pfingsten Rd., Northbrook, IL 60062, USA / CB Test Reports, E164178-A4-CB-1, including Amendment 1, Correction 2 & 1, supercedes E164178-A1-CB-2 & -1, 50 Series/60Series, Product Safety Assessments

Reference Number : DOC B005 **Issue :** F

Date of issue : 5-December-2016

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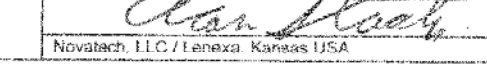
The following standards were used for reference and to establish conformity :

IEC/EN 61010-1, Edition 3, 2010 UL 61010-1, Edition 3, 2012/05/11 CAN/CSA No. 22.2, No. 61010-1-12, Ed. 3, 2012/05/01	Safety requirements for electrical equipment for measurement, control, and laboratory use. Part 1: General requirements
IEC/EN 61010-2-030, Edition 1, 2010 UL 61010-2-030, Edition 1, 2012/05/11 CAN/CSA No. 22.2, No. 61010-2-030-12, Ed. 1, 2012/05/01	Safety requirements for electrical equipment for measurement, control and laboratory use. Part 2-030: Particular requirements for testing and measuring circuits
EN 61326-1: 2013	Electrical Equipment for measurement, control and laboratory use – EMC requirements
EN 61000-6-4: 2007 + A1: 2011	Electromagnetic compatibility Part 6-4: Generic emission standard – Industrial environment.
EN 61000-6-2: 2005 + AC: 2005	Electromagnetic compatibility (EMC) Part 6-2: Generic standards - Immunity for industrial environments.
EN 55011: 2009 + A1: 2010, EN 55011: 2016, Group 1 Class A	Radiated Emissions Electric Field Strength, AC Powerline Conducted Emissions
EN 55022: 2010 + AC: 2011, EN 55032: 2012 + AC: 2013, EN 55032: 2015 + AC: 2016-07, Group 1 Class A (Conducted on Ethernet port)	Electromagnetic compatibility of multimedia equipment - Emission Requirements
EN 61000-4-2: 2009	Electrostatic Discharge (ESD)
EN 61000-4-3: 2006 + A1: 2008 + A2: 2010 Class III	Immunity to Radiated Electromagnetic Energy (Radio Frequency)
EN 61000-4-4: 2012, Severity Level 4 (AC Power)	Electrical Fast Transient / Burst Immunity
EN 61000-4-5: 2014, Installation Class 3	Surge Immunity
EN 61000-4-6: 2014, Level 3	Immunity to Conducted Disturbances Induced by Radio Frequency Fields
EN 61000-4-8: 2010	Immunity to Power Frequency Magnetic Fields
EN 61000-4-11: 2004	AC Supply Voltage Dips and Short Interruptions
ANSI / IEEE C37.90.1: 2002	Surge Withstand Capability Test for Protective Relays and Relay Systems

Signed for and on behalf of the Company :	Alan Staatz, Vice President, Engineering  Novatech, LLC / Lenexa, Kansas USA

CE Marking Year 2012, 2013, 2016

Reference Number : DOC 8005 **Issue :** F

Date of issue : 5-December-2016

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Revision	Date	Changes	By
A	1/29/2016	Draft - Original Issue Figure 2 shows prior board with plugs and Figure 3 dimensional drawing shows CTs but not part of D650. DOC for 50 Series needs to be updated to include D650.	R.Fisher
A	2/12/2016	Final draft with corrections/updates throughout – still need some updated figures to complete.	E. DeMicco, P. Dunmire
A	5/17/16	Final version with new Figure 2	E. DeMicco
B	11/17/16	Added PPX II to D650 RS485 Information section 3.4.6, added new DOC	E. DeMicco
C	5/22/17	Updated standards references in section 1.4	E. DeMicco R. Fisher
D	8/17/17	Updated information on inarp on page 23	E. DeMicco
E	6/22/18	Added information for D650MX Universal Display	E. DeMicco
F	9/5/19	Added information for flex scaling in D650 Universal Display	E. DeMicco
G	2/22/21	Changed reference to ‘Client’ and ‘Universal’ Display; added new Appendix A5 for configuration of Universal Display	E. DeMicco

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