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- |             |   |
|-------------|---|
| No. ATADC2A | 3 PHASE PEAK DEMAND AMMETER   |
| No. AQADC2A | 4 PHASE PEAK DEMAND AMMETER   |
| No. ASADC2A | 1 PHASE PEAK DEMAND AMMETER   |
| No. VTAMC2A | 3 PHASE MINIMAX VOLTMETER   |
| No. VSAMC2A | 1 PHASE MINIMAX VOLTMETER   |
| No. GQWMC2A | 3 PH PEAK DEMAND AMMETER &<br>1 PH MINIMAX VOLTMETER<br>COMBINATION METER |

Includes Option Manuals for -VD3, -V06 and -VD6  
 (Formerly DOVD3, DOVD5, DOVOS)

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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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## REVISION HISTORY

PH2-40 8/1/2000  
Initial release of modified code that runs on Intel 805x family processor Previous versions ran on Intel 8749 processor. Requires PCB 697 for proper operation, micro cannot be used to upgrade modules based on PCB587 PCB697 modules are interchangeable with PCB587 modules. Instrument model numbers were all modified with the addition of an "A" suffix to indicate this change.

Added 7500 and 9000 CT ratios. Added 5min (300sec) integration time. Added 17 PT ratios.

## 1.0 DESCRIPTION

### 1.1 Introduction

Current and voltage demand remain as excellent tools to optimize the control and delivery of electric power. State of the art technology makes it possible to measure these functions very accurately, over a wide range of input signals. The Bitronics Triple II Digital Demand Meter is a rugged electronic instrument designed for utility and industrial applications requiring reliable, precise measurements of three-phase current, current-demand or MiniMax three-phase voltage and voltage demand. True RMS measurements are standard, with digital accuracy and repeatability across the entire range of input signal levels. The Triple II is an advanced instrument, based on Bitronics proven Triple I. The Triple II is a modular design with push-button rescaling to display primary values when using any standard Current or voltage transformer. Rescaling can be done in the field, in a matter of minutes, without the need for any calibration equipment. Demand integration time is also easily changed from the industry standard 15 minutes. Physical dimensions of the Triple II remain the same as the Triple I; a compact design less than seven inches on a side. Two companion designs, the four-channel Quad II, and one channel Single II contain all the features of the Triple II.

### 1.2 Features

- \* Simultaneously displays three-phase, true RMS signal and demand values for each phase
- \* Push-button rescaling in the field accommodates all ANSI CT and PT ratios. Displays primary or secondary values
- \* User-selectable demand periods, including the "utility standard" 15 minutes
- \* Field-changeable modular design for easy maintenance
- \* Single reset button also displays active CT/PT setting
- \* Non-volatile memory backup of settings and demand data. No batteries are needed
- \* Rugged metal housing fits same cutout as Triple I
- \* True RMS measurements are standard
- \* Six LCD four-digit displays simultaneously indicate three-phase current and current demand
- \* Watchdog timer maximizes system reliability
- \* Low cost optional outputs include:
  - C21, -C23, -C24 0-1mA current output for each phase
  - P21, -P23, -P24 Isolated pulse output (each phase)

### 1.3 Specifications

Ammeter Input Signal:	0 to 5* A ac nominal, three phase, with continuous overload to 10* A ac. 400A ac for 2 seconds. 1500V ac isolation, minimum.
Voltmeter Input Signal:	0 to 150V ac nominal, three phase. 1500V ac isolation, minimum. 0 to 300V ac optional.
Display:	0000 to 9999 with user selected decimal
Scaling:	User selectable using internal CT/PT tables.
Integration Time:	User selectable, 7 to 3600 sec (1 hr)
Accuracy:	Exceeds 0.5% Class (ANSI Std 460-1988) True RMS
Signal Frequency:	50Hz to 450Hz
Signal Burden (Ammeter):	4mV ac at 5A ac input (0.02VA)
Signal Burden (Voltmeter):	<1mA ac at 120V ac input (0.1VA)
Power Requirements:	115V ac +/- 20%, 6VA
-VA1 Option:	230V ac +/-20%
-VD3/5/6 Option:	40 to 175V dc, 50 to 140V ac
Operating Temperature:	-20C to 70C

## 2.0 PRINCIPLES OF OPERATION

### 2.1 General

The Bitronics Triple Demand Meter is a unique hardware and software-based instrument designed to provide an accurate representation of the current or voltage demand of each phase of a three phase electrical power system. The instrument is equipped with separate real time and demand displays for each independent phase channel. The left displays indicate the instantaneous true RMS current or voltage, and the light displays indicate the current or voltage demand experienced by each phase since the last time the meter was reset. The traditional thermal demand instrument displays a value which represents the logarithmic response of a heating element in the instrument driven by an applied signal. The largest value since the last instrument reset is known as the peak demand value. Since thermal demand is a heating and cooling phenomenon, the demand value

has a response time  $T$ , defined as the time for the demand function to change by 90% of the difference between the applied signal value and the initial demand value. For utility applications, the traditional value of  $T$  is 15 minutes for amp/kW demand, and 5-10 minutes for volt demand. The factory settings for the Triple II integration times are 15 minutes or 7.5 minutes, respectively, but these are easily changed in the field.

The Triple II generates a demand value using modern microcomputer technology in place of heating and cooling circuits. It is thus far more accurate and repeatable over a wide range of input values, and can frequently eliminate switches and other hardware needed with older thermal designs. In operation, the Triple II continuously samples the true RMS instantaneous signal for each phase, and digitally integrates the samples with a time constant  $T$  to obtain the demand value. The calculated demand value is continuously checked against the previous peak demand value, and is displayed on the demand display if it is a new peak demand. This process continues indefinitely, or until the reset button is pressed to set the peak demand value to zero.

To better understand the functioning of the Triple II demand meter, consider the block diagram shown in Figure 1. There are four main circuit boards in the instrument: (1) one interconnect and power supply board, and (2) three signal processing and display modules. Option boards, if present, plug into the modules and interconnect board.

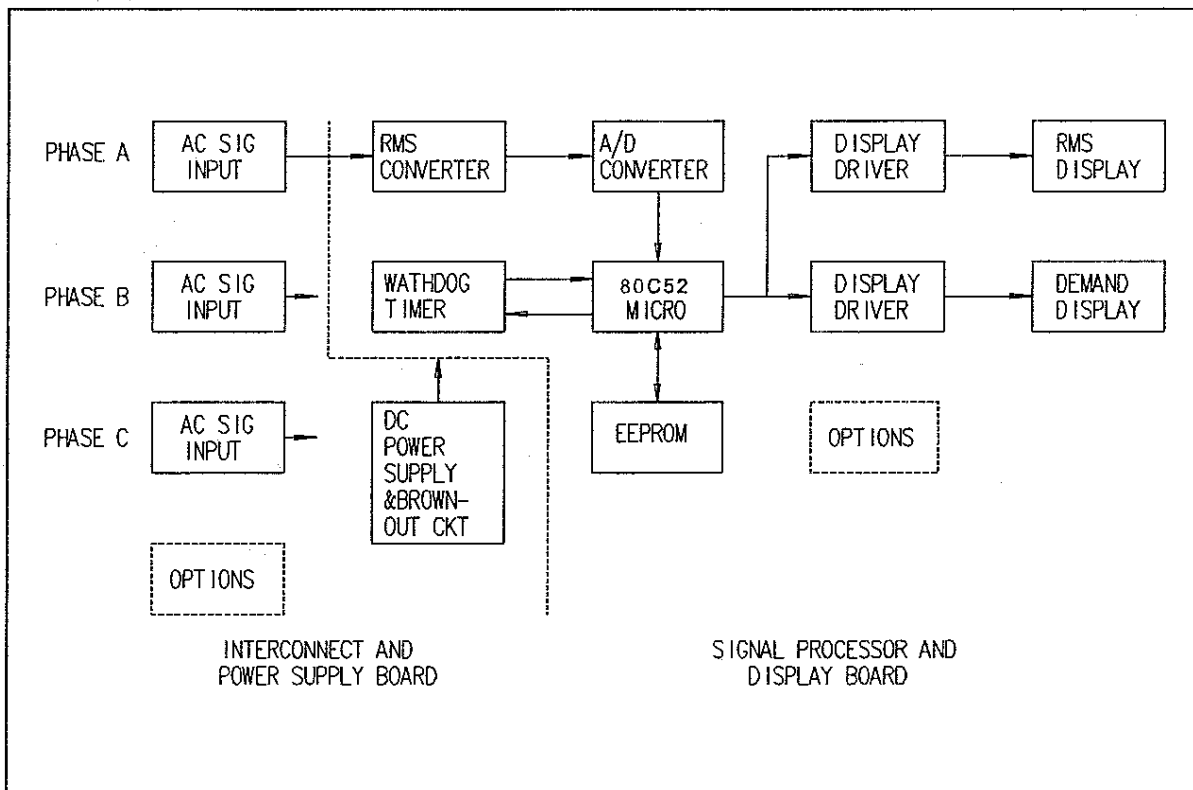


Figure 1 – Triple II Functional Block Diagram



## 2.2 Input Signal Connections

The Triple II family has independent signal inputs; one for each phase being measured. Current or voltage signals are connected directly to #10.32 studs on the rear panel of the instrument. The instrument can be connected directly to current transformer (CT) or potential transformer (PT) circuits. The impedance at the Triple II terminals is nearly a short circuit for ammeters and high impedance ( $> 100$  K-ohms) for voltmeters. These ideal impedances provide low burden loads for the CT or PT circuits supplying the signals. The polarity of the applied signals is unimportant to the function of the instrument, through the signal terminals are labeled La or HI to aid in wiring the units into substation or control panels. **WARNING - DO NOT** overtighten the nuts on the input connections, **HAND** tighten with a standard nutdriver, 12 inch-pounds is recommended, **MAXIMUM** torque is 15 inch-pounds. Grounding of the PT & CT signals per ANSI/IEEE C57 13.3-1983 is recommended.

Power is applied to two #10-32 studs, also located on the rear cover of the instrument. **WARNING - DO NOT** overtighten the nuts on the power connections, **HAND** tighten with a standard nutdriver, 12 inch-pounds is recommended, **MAXIMUM** torque is 15 inch-pounds. Because of the solid state design and LCD displays, the total load required to operate the unit is only six watts. It is therefore possible to power the Triple II with AC station power or an auxiliary PT, provided the voltage remains above 90V ac (30 to 140V ac with optional universal power supply). If the unit is to be powered from a PT, it is recommended that one side of the PT be grounded at the instrument following ANSI/IEEE C57.13 3-1983.

A standard design feature includes metal-oxide varistors (MOV's) connected to the external power input studs. These provide an added measure of protection against heavy switching transients occasionally experienced in the field. The MOV's are designed to clamp applied power voltages above 170V ac RMS (270 V ac RMS for 230V instruments). To avoid damaging the MOV protectors, maintain continuously applied power voltages within the ratings of the instrument.

## 2.3 Interconnect and Power Supply Board (I & PS Board)

The main function of the interconnect and power supply (I&PS) board is to provide regulated  $\pm 5$ V dc power to the instrument modules and option cards. The board also houses isolation transformers used in each of the signal input channels and in the instrument power circuits. Transient protectors are also installed at appropriate locations on this board. The standard power supply circuit is a conservative, conventional design. Rectifier and solid state regulator components were selected on the basis of years of successful field service. Filter capacitors are operated at a fraction of their voltage and temperature ratings, and should provide years of trouble-free service under extreme environmental conditions. The  $+5$ V regulator also provides a separate logic output signal, normally  $+5$ V, which drops to zero under low voltage conditions. This logic signal is used by the instrument to save important data in non-volatile memory if brownout or blackout conditions occur. A detailed description of the DOVD Universal Power Supplies is located in Section 7.0.

Triple II instruments have a unique design which provides for complete interchangeability among signal processing and display modules. Ammeter and voltmeter modules cannot be interchanged. Compensation for normal variations in input isolation transformer gain is achieved simply by

providing a signal adjustment potentiometer across the secondary of each input isolation transformer. The potentiometers are factory-adjusted to provide identical signal gain (attenuation) in each of the three isolated signal input paths. Under normal circumstances, the potentiometers will not require readjustment from the factory settings. High quality, multipin connectors for each channel are mounted on the I&PS board, and connect low level inputs, outputs, and power signals to the signal processing and display modules.

## **2.4 Signal Processing and Display Modules (SP&D Modules)**

The function of each identical SP&D module is to process the low level AC signal provided by the interconnect board, calculate true RMS and demand values, and to present the results on the two LCD displays. Each of the modules is identical.

Signal processing begins with the low level AC signal conducted from the PS&I board to each module. Each module performs signal processing on one input signal. The low level signal is conveyed to a stable, low noise buffer amplifier, where the ac signal is amplified to about one volt ac RMS for a full scale input signal. The amplified signal is then conducted to a high quality "true RMS" converter chip which converts the applied signal to a signal proportional to its "true RMS" value. Pure sine wave inputs or complex, distorted, periodic waveforms are handled equally well - a major advantage when computing the demand value for unknown current or voltage waveforms. This design frees the user from concern about errors which will otherwise occur during the measurement of distorted waveforms with non-true RMS instruments.

Once amplified, the RMS signal is processed by a precision 4½ digit single chip Analog to Digital Converter (ADC). The ADC produces a multiplexed, Binary Coded Decimal (BCD) representation of the RMS analog signal. As part of the digital conversion, a single calibration potentiometer at the input to the ADC compensates for minor gain variations to make the SP&D modules truly interchangeable. Once digitized, the BCD signal is transmitted to an 8051 family micro-controller where the signal is processed to calculate the demand function, scaled using the user-settable CT IPT ratios, and sent to the instantaneous and demand displays. Most of these functions are carried out using the firmware program permanently stored in the micro's on-board EPROM memory, but the micro calls upon information stored in an external EEPROM memory for user settable scaling factors, integration times, and data recorded during blackouts/ brownouts. The micro also performs chores required when the demand is reset, CT/PT ratios are changed, integration times are changed, and the data is stored in non-volatile memory. Peak amp demand is calculated in the ammeter Triples, and both Max/Min voltage demand are simultaneously calculated in the voltmeter Triples.

The display board is an integral part of the SP&D module and contains an integrated circuit driver for each of the two LCD displays. Removal of the front cover permits access to the instrument for rescaling and changing integration times without the need to remove the meter from a switchboard panel. Of course, individual SP&D modules can also be removed as required for maintenance.

## 2.5 Additional Special Functions

An important feature of this instrument is its ability to retain data and all scaling parameters under blackout or brownout conditions. The power supply of the Triple II is designed to function with supply line variations of at least 20%, so planned brownout conditions are unlikely to have any influence on the instrument. In addition, the instrument monitors its own power supply regulation. If power is lost, or if the supply voltage drops too low for regulation, the instrument automatically saves its information in EEPROM. When supply power is restored, the data is automatically uploaded from the nonvolatile memory into the micro, and processing resumes where it left off. No backup batteries are needed in the instrument. A watchdog timer is provided to prevent the microcontroller from "locking up" in the event of a transient or other type of interference.

The BiCOMM™ Remote Communications Option for the Triple II family of Demand instruments is a modular add-on option for providing remote communications, data retrieval and programming. Either RS-232 or 20mA current loop outputs are available, with the 20mA current loop providing optical isolation from the rest of the instrument.

Another popular low-cost option includes a 0-1mA output for each phase, proportional to instantaneous true RMS applied signal. This is an economic alternative to separate external transducers which does not require additional panel wiring.

### **3.0 INSTALLATION**

Current dimensions and terminal connections can be found in the Appendix.

#### **3.1 Initial Inspection**

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

#### **3.2 Power Requirements**

The Triple II is normally configured for 115V ac, 60Hz power 230V ac, 50/60Hz and Universal (AC/DC) are available when requested at the time of order Power is connected to the two labeled terminals at the rear of the case as shown in the Appendix. Both terminals are electrically isolated from the meter case and from the electronic circuitry. Variations of the ac supply voltage of +/- 20 % will not affect the performance of the instrument. The power supply and regulators provide constant dc power to the modules independent of variations in supply voltage over this range. If the supply voltage drops below the point at which the regulators can function properly, data is automatically saved as described previously.

#### **3.3 Instrument Mounting**

The instrument may be mounted into a panel cutout using the dimensions shown in the appendix. **WARNING - DO NOT** overtighten the nuts on the mounting studs, **HAND** tighten with a standard nutdriver, 12 inch-pounds is recommended, **MAXIMUM** torque is 15 inch-pounds.

#### **3.4 Surge Protection**

It is recommended that metal oxide varistors (MOVs) be placed across the power supply inputs to protect the meter in the event of high voltage surges or lightning strikes. Triple II family meters are shipped with these already attached as a standard design MOV s provide an added measure of protection against heavy switching transients occasionally experienced in the field. The MOV's are designed to clamp applied power voltages above 170V ac RMS (270 V ac RMS for 230V instruments). Three MOVs are provided, and protect the meter Line to Line, and each Line to ground (AC only). To avoid damaging the MOV protectors, maintain continuously applied power voltages within the ratings of the instrument. The GREEN lead of the MOV assembly should be connected to a good earth ground (AC only). In most instances, this is usually accomplished by connecting the GREEN lead to the panel via one of the front mounting studs. Mounting of the MOVs external to the instrument allows easy access so that the MOVs may be readily inspected for damage If the unit is to be powered from a PT, it is recommended that one side of the PT be grounded at the instrument following ANSI/IEEE C57 13 3-1983. The MOV board voltage rating is indicated on the MOV board, and must match the supply rating of the instrument.

## 4.0 FIELD ADJUSTMENTS

### 4.1 Rescaling

The Bitronics Triple peak average demand meter has been factory set to display 0000 +/- one digit for zero signal input and the customer specified CT ratio current for 5 amperes input. For example, a meter set to a 1200/5 CT ratio will display 1200 with 5.00 A ac applied to the rear terminals. It is even possible to set each phase to a different CT ratio. Voltmeters are set to display the customer-specified PT ratio voltage with 120 V ac applied to the rear terminals. For example, a voltmeter set to a 100/1 PT ratio will display 12.00kV ac when a 120 volt is applied. Decimal points are easily set or changed by moving the jumper installed on each SP&D module.

One of the most powerful features of the Triple II family is the extreme ease of rescaling the instrument on the bench or in the field. No calibrator is needed. Even though the units are factory scaled to customer CT/PT ratios, these ratios may be changed in the field as transformers are "tapped down." Rescaling is simple and is carried out in the panel as follows:

- 1 Remove front cover with the Triple under power.
- 2 Flip the small toggle on each module to the CT/PT position.  
The right hand displays will show the present CT/PT setting.  
Ignore any powers of ten. They will be set by moving the decimal jumper.
- 3 Index through the available CT/PT ratios by repeatedly pushing the reset button. Ignore any powers of ten. Stop when you see the correct one.
- 4 Return the toggle to the center position. You will see a digit check (all eights displayed) and the new CT ratio will be "locked" into the meter.
- 5 If necessary, remove the modules to reset the decimal point to get the correct "power of ten." Replace them in the unit. The decimal point is set with the blue jumper (S4) behind the right-front of each module.
- 6 Replace cover and push the reset button Done!!

Note that the meter momentarily displays the CT/PT ratio setting as a check each time the reset button is pushed.

**ASADC2A, ATADC2A,  
AQADC2A, GQWMC2A  
CT RATIOS**

**VSAMC2A, VTAMC2A  
GQWMC2A  
PT RATIOS**

1	0500/5	1.00/1
2	0600/5	1.10/1
3	0750/5	1.15/1
4	0800/5	1.20/1
5	0900/5	1.37/1
6	1000/5	1.40/1
7	1100/5	1.50/1
8	1200/5	1.73/1
9	1500/5	1.75/1
10	1600/5	1.80/1
11	2000/5	2.00/1
12	2200/5	2.31/1
13	2400/5	2.40/1
14	2500/5	2.50/1
15	3000/5	2.51/1
16	3500/5	3.00/1
17	4000/5	3.46/1
18	4500/5	3.50/1
19	5000/5	3.75/1
20	6000/5	4.00/1
21	7500/5	4.35/1
22	8000/5	4.50/1
23	9000/5	5.00/1
24		5.77/1
25		6.00/1
26		6.25/1
27		6.35/1
28		6.64/1
29		6.93/1
30		7.00/1
31		8.00/1
32		8.08/1

Decimal position is set independently.  
8/1/00 PH2-40

## 4.2 Integration Time Setting

Most electric utility operations traditionally use the 15 minute (900 second) demand interval. This is the default factory setting and will rarely be changed. There are special utility and industrial applications, however, which require a different integration time. The Triple II family makes it easy to do this as follows:

1. Remove the front cover with the Triple II under power.
2. Flip the toggle on each module to the IT position.
3. The demand displays (right side) will show the present integration time setting in seconds.  
900 sec = 15 min
4. Index through the available integration times (7 sec to 1 hour) by pressing the reset button. The time doubles with each press, consistent with the logarithmic nature of the demand function.  
**NOTE** – The decimal point does not affect integration time, and should be ignored during this process.
5. Return the toggles to the mid (neutral) position to “lock in” the new integration times.
6. Replace front cover and push reset button. Done!!

### ASADC2A, ATADC2A, AQADC2A, VSAMC2A, VTAMC2A, GQWMC2A INTEGRATION TIMES

1	7 seconds	
2	15 seconds	
3	30 seconds	
4	60 seconds	(1 minute)
5	120 seconds	(2 minutes)
6	225 seconds	
7	300 seconds	(5 minutes)
8	450 seconds	(7.5 minutes)
9	900 seconds	(15 minutes)
10	1800 seconds	(30 minutes)
11	3600 seconds	(1 hour)

## 5.0 CALIBRATION

Although the Triple II can change ratio scaling without changing the meter calibration, a means for adjusting the gain and zero are provided. With the front cover removed, two trim pots are visible on the front of each module, to the right of the CT/PT setting switch. Under normal operation these should not need adjustment, but if service has been performed on the instrument they must be set. Additionally, there is a trim pot on the Interconnect & Power Supply board (VR 1, VR2, VR3, & VR7) to attenuate the signal from the isolation transformer of each phase. It is *very* important that these be properly set before any other adjustments are made, as they allow interchangeability between modules. **Adjustment of these signals is NOT RECOMMENDED! If gain adjustments must be made, use the gain trim pot on the module, as detailed in section 5.3.** The correct signal levels (measured between pins 12 and 24 on P1, P2, and P3) are as follows:

Triple II Ammeter		Triple II Voltmeter
Signal in: 5.000A ac RMS (Rear connections)		100.00V ac RMS
Signal out: 450.00mV ac RMS (I&PS board)		950.0mV ac RMS

### 5.1 Required Equipment

Calibration can be performed using the instrument housing itself, or the module can be calibrated using a separate calibration fixture (please consult factory for availability). If the original housing is used, an extender card (DOX1) will be required to obtain access to the test points on the module. Alternatively, the meter case can be removed, and the module plugged into the exposed back plane board. A DVM capable of reading in microvolts, and a 0-10A ac source for ammeters or a 0-150V ac source for voltmeters.

### 5.2 Adjusting the Zero

Locate the analog header P7 on the module (board #697), and the pin marked GND just above it. Connect the negative lead of a DVM to the GND pin, and the positive lead to PIN 12 of P7 (marked RMS). The module should be powered up and running for at least 20 min, with no input signal. Turn the trimpot marked "ZERO" (VR5) until a reading of less than +/-20uV is obtained.

### 5.3 Adjusting the Gain

Set the scaling ratio to 5000/5 (100/1 for voltmeters), ignoring the decimal point. Apply a 5000A ac signal (120.0V ac for voltmeters) to the input terminals. Adjust the trimpot marked "GAIN" (VR6) to obtain a display of 5000 (1200 for voltmeters). Check the linearity at various input levels. Set the CT or PT ratio to the desired *value*, and the decimal point to the required position by moving the jumper as described in Section 4.1.



## 6.0 QUESTIONS AND ANSWERS

1. What happens if the applied CT signal exceeds 5A?

The Triple II is accurate to twice the normal full scale limit (to 10A) on both the instantaneous and demand scales. The unit will operate at 100% overload without damage. Above 10A, the meter will display " - - - -", independent of the scaling factor, to let you know you have a seriously overloaded circuit. If continuous operation above 10A is needed, contact the factory.

2. Can Modules be removed under power?

Yes. Neither input signals nor power need to be removed to remove or rescale modules.

3. Is routine calibration necessary?

No, nor is it recommended. More problems are caused by improper calibration than by faulty meters. A calibration check every few years in the field is good assurance, however. If there is a question about the meter, exchanging a module may help verify performance.

4. HI and LO are marked on the inputs. Does polarity matter?

Not for the Triple II, but the markings help in designing substation wiring diagrams and in wiring panels.

5. I don't need an option now. Can I add it later?

Most options are low cost, so there is generally a savings if options are factory installed. In keeping with the modular design concept, however, you will be able to purchase and install option "kits" if you want to add them later.

6. Can I get a Triple II with 0-1mA, pulse output, and BiCOMM remote communications options?

Sorry, but two out of three ain't bad. Not enough space and connector pins to handle all three at once.

7. Can I put the Triple II in an outdoor cabinet?

Yes. Many Triple IIs are installed that way. The temperature range of -20C to 70C covers most applications. The case is gasketed, but not waterproof, so it should be enclosed.

8. How long will the Triple II save demand data without power?

The data is saved in a nonvolatile memory (EEPROM) which does not require battery backup. Retention is estimated by the manufacturer to exceed 10 years without refreshing. In any event, long enough to exceed most blackouts.

## 7.0 OPTIONAL UNIVERSAL POWER SUPPLY

### 7.1 Introduction

The -VD3 universal power supply option for the ATADC2A and VTAMC2A ( -VD6 for the AQADC2A and GQWMC2A, and -VD5 for the ASADC2A and VSAMC2A ) is designed to allow operation of these instruments from standard backup power systems. No external equipment is needed, and the supply has been designed for use in the utility environment.

### 7.2 Features

- \* For use on 48V dc, 125V dc, and 115V ac systems
- \* Electrically isolated power inputs
- \* Under/over-voltage, over-current, and over-temperature shut off
- \* External MOV's and internal transient protection
- \* All electrolytic capacitors rated to 105 Deg C

### 7.3 Specifications

Input Voltage: 40 to 175V dc, 55 to 140V ac @ 60Hz

Surge Suppression: Meets ANSI C37 9 Standards

Operating Temp: -20 to 70 Deg C

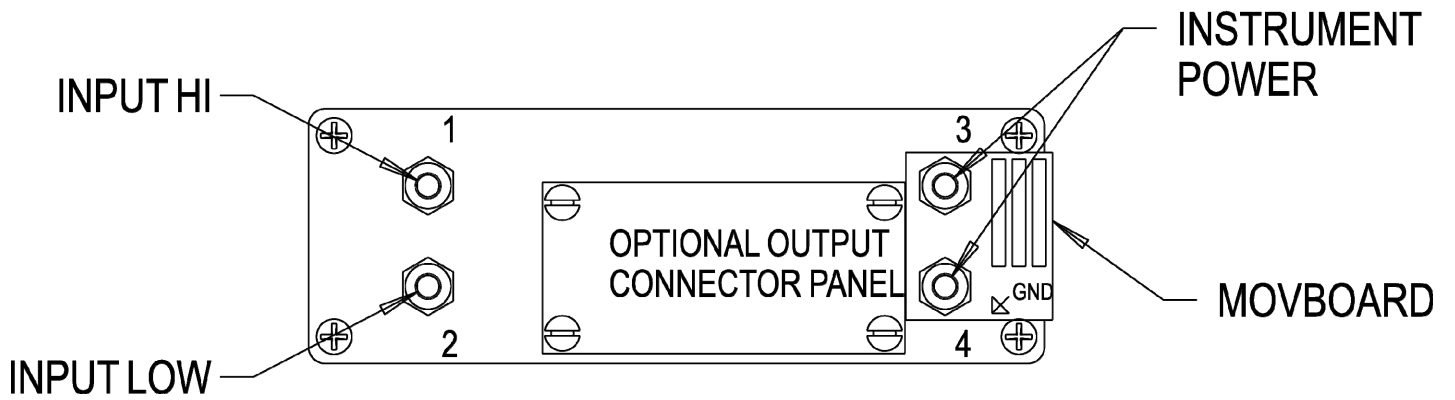
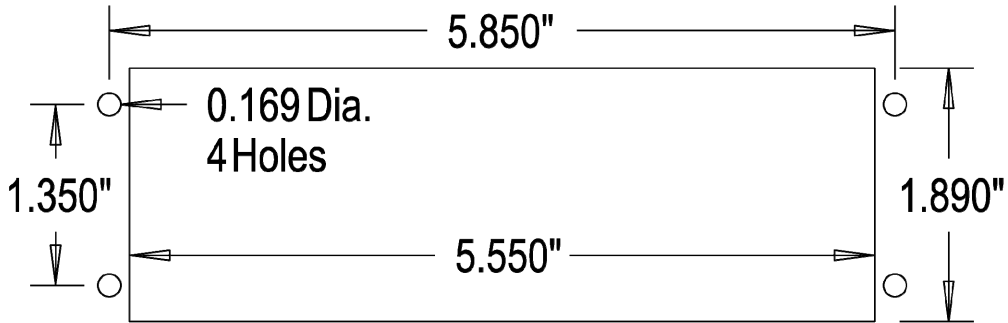
Input Frequency: dc or 40 to 400Hz ac

### 7.4 Input Power Connections & Circuit Operation

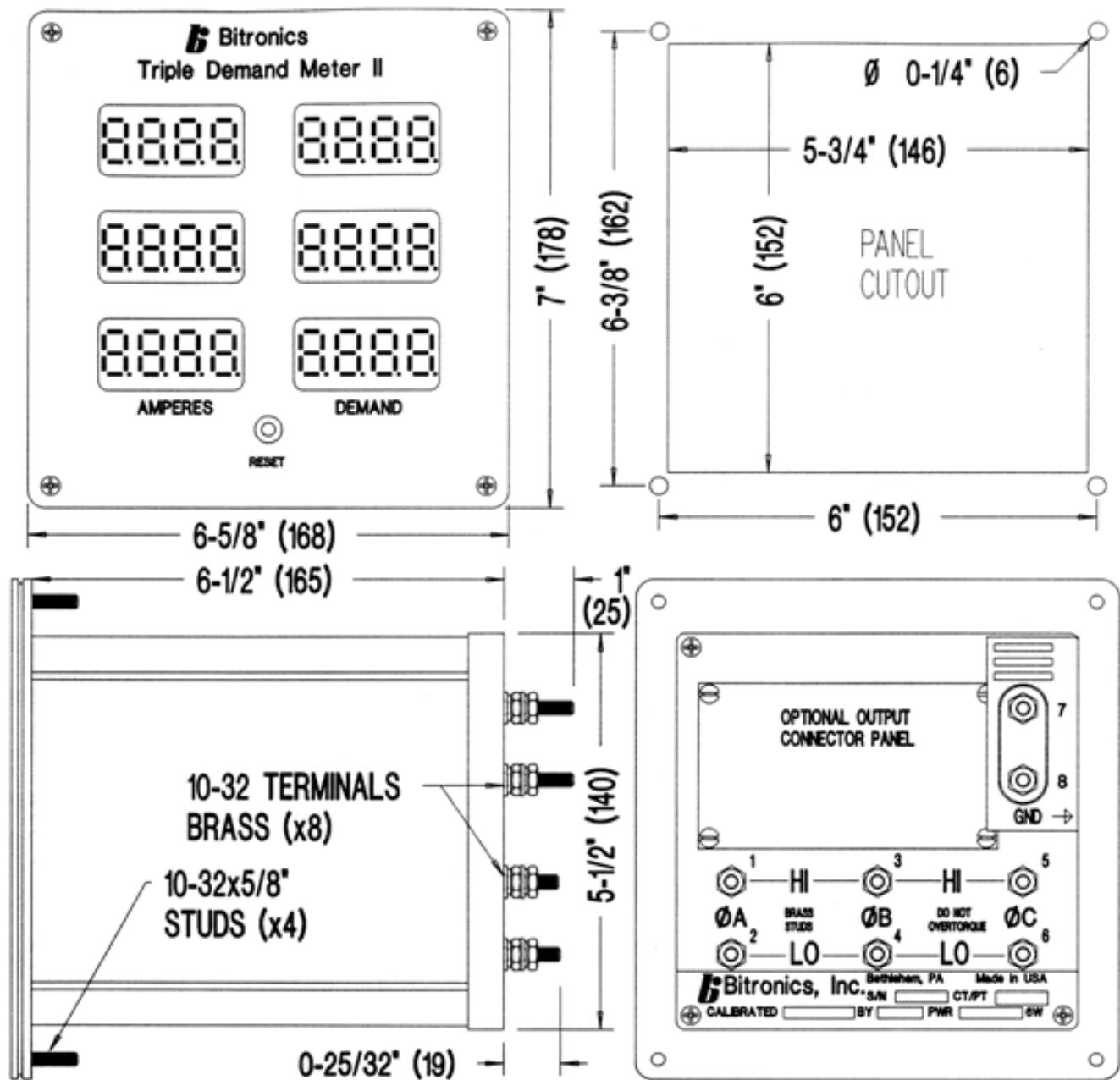
The universal power supply is a high-efficiency, high-frequency switching power supply with integrated under & over-voltage, over-temperature, and over-current protection. Power connections to the instrument are made directly to #10-32 brass studs on the rear panel of the instrument. Please refer to Section 2.2 of this manual concerning input connections and torque specifications, also refer to Section 3 4 concerning the external MOV board.

Power from the input terminals is conducted to a full-wave bridge rectifier and capacitor to convert ac power inputs to filtered-dc. DC power inputs are unaffected by the bridge rectifier. Input polarities are marked for reference only. The dc voltage across the filter capacitor is alternately connected and disconnected to the isolation/power transformer at a rate of about 300kHz, by a pulse-width controller. A separate feedback winding on the power transformer provides a signal which is used by the controller to vary the time that the transformer is connected to the power source. This allows the supply to provide a constant output voltage over a wide range of input voltages and output loads.

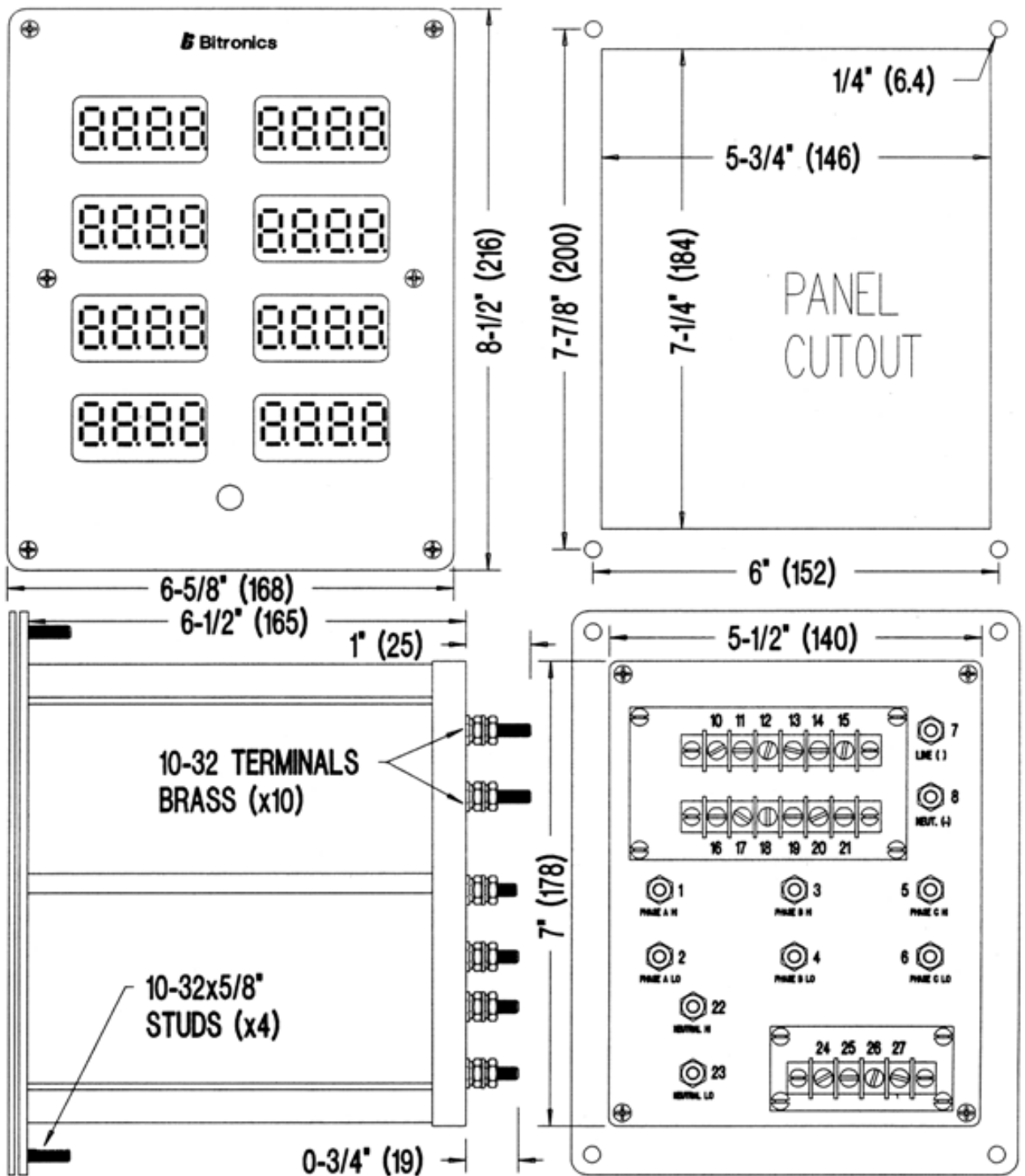
**APPENDIX**  
**Connection Diagrams**



**ASADC2A & VSAMC2A Rear Connections and Cutout Drawing**



ATADC2 & VTAMC2 Dimensions



AQADC2A & GQWMC2A Rear Connections and Cutout Drawing

Revision	Date	Changes	By
A	01/30/2009	Update Bitronics Name, Logo	E. Demicco
B	10/19/2009	Updated logos and cover page	MarCom
C			



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