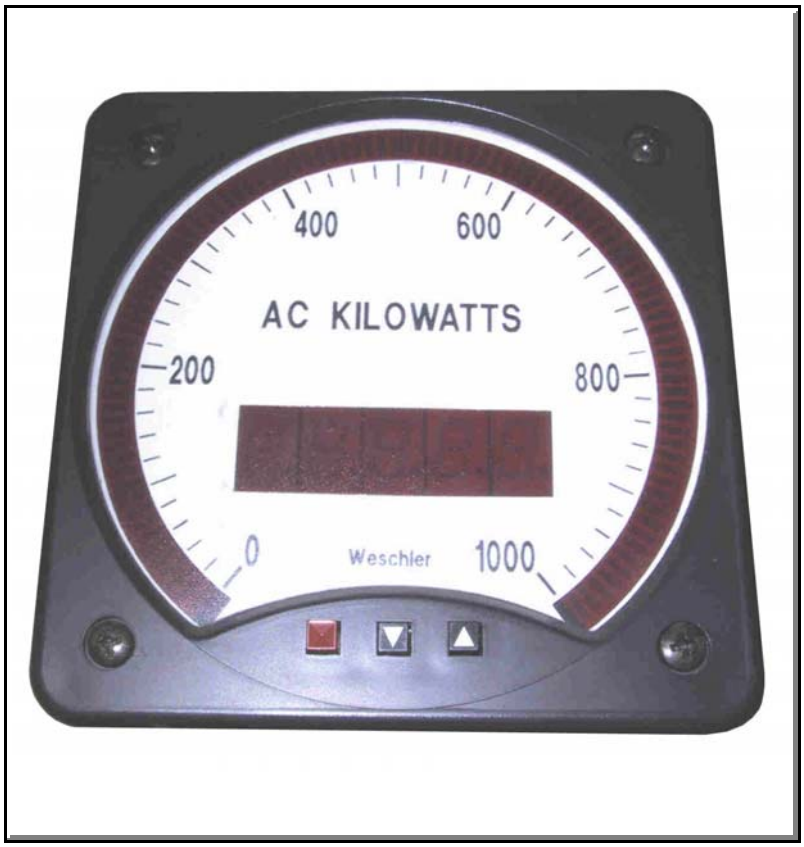
WESCHLER INSTRUMENTS
DIVISION OF HUGHES CORP.

ACP4 BarGraph Watt & Var Meters

Owners Manual



Manual Part Number OMBGP100

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1.0 Introduction

Description

The ACP4 BarGraph watt and var meters are part of the ACP4 series of AC power instruments, comprising voltmeter, ammeter, watt meter, var meter and power factor functions. The instruments in the series are driven by the latest state of the art technology, utilizing a digital signal processing (DSP) IC for power measurement and conversion and a microprocessor for function coordination, configuration, communications and display presentation.

Intended Usage

The ACP4 series instruments are intended for use wherever there exists a need for measurements of AC power quantities of high accuracy and reliability in an industrial quality switchboard instrument. Some models are available in military ruggedized and spray-tight versions; consult the factory for availability of these models.

In existing applications, the Weschler ACP4 series watt and varmeters are intended to replace analog instruments such as the Weschler or Westinghouse KP-241 and KP-261, KV-241 and KV-261 and the GE / Yokogawa AB40. In new applications the ACP4 series is ideally suited where an increased level of functionality is desired.

Models and Features

The watt and var models are identified by the three character prefix BGP (watt meter), BGG (var meter for use with a phase shifting transformer) or BGV (var meter for use without a phase shifting transformer). The ACP4 series is available in standard switchboard sizes identified by the three digit suffix 241 (4 ½ inch square), 251 (7 ½ inch round) 261(8 ¾ inch square) and 281 (10 inch round). All sizes are available in the standard and enhanced display configurations. TriColor versions are available in 241, 261 and 281 sizes. Standard, Enhanced and TriColor models are primarily differentiated by their display presentation, although the feature set becomes more flexible from standard to TriColor models.

The standard BarGraph is available with a red, green or amber numeric display with a measurement range of -19999 to +19999 counts. The standard bar color is red. Fixed position color zones are possible in the bar display, but brightness of the green and amber colors may be a problem in areas where high ambient light intensity exists. It is recommended that if color zones are required in the bar, that the enhanced or TriColor models be considered.

The Enhanced model is available with red, green or amber color numeric displays with a measurement range of -9999 to +50000 counts. The standard red bar color is a very bright, sunlight readable intensity. The bar display can be a solid red, green or amber, or mixed, fixed-position color zones. The amber and green colors are suitable for high ambient lighting intensity, but may not be suitable for sunlight readability. The enhanced models also has a dual-level display brightness setting that is programmable from the front panel buttons.

The TriColor model is available with a red, green or amber numeric display with a measurement range of ± 50000 counts. The bar display can be programmed for zoned or banded patterns, with contrasting set points that delineate the boundary of the bands or zones. By programming the four set point values, the bar may be set to change colors at different measured signal magnitudes, insuring that operators are instantly aware of operation within or outside of normal boundaries, without reading the actual value.

Table 1. Feature Comparison Summary

Feature	BGP Wattmeters, BGG and BGV Varmeters		
	Standard	Enhanced	TriColor
Measurement Range	± 19999	-9999 to 50000 (Neg Autoscale)	± 50000
Basic Accuracy	± 0.5% FS, ± 1 Count	± 0.5% FS, ± 1 Count	± 0.5% FS, ± 1 Count
Potential Range	120, 240 vrms	120, 240 vrms	120, 240 vrms
Self-Contained Current Maximum	10.00 arms	10.00 arms	10.00 arms
Numeric Display Characters	4 ½ Digit	4 ¾ Digit	4 ¾ Digit
Numeric Display Colors	Red, Green, Amber	Red, Green, Amber	Red, Green, Amber
Bar Colors	Red, Green, Amber (note 1)	Red, Green, Amber	Red, Green, Amber
Bar Color Arrangement	Fixed Zones	Fixed Zone	Programmable Zone or Band
Display Brightness	Fixed	Two Level Programmable	16 Level Programmable
Alarm Hysteresis	0.5, 1 & 2 % FS for All Alarms	0.0-10.0% FS for All Alarms	0.00-10.00 % FS for All Alarms
Relays	2 OR 4 Form C	2 OR 4 Form C	2 OR 4 Form C
Relay Latching	N/A	Yes	Yes
HI - LO Alarms	2 HI, 2 LO	Individually Programmable	Individually Programmable
Analog Retransmit	256 Step Resolution	65000 Step Resolution	65000 Step Resolution
Communications	RS-232 or 485	RS-232 or 485	RS-232 or 485

Figure 1. Standard ACP4 BarGraph Dial and Front Panel Features

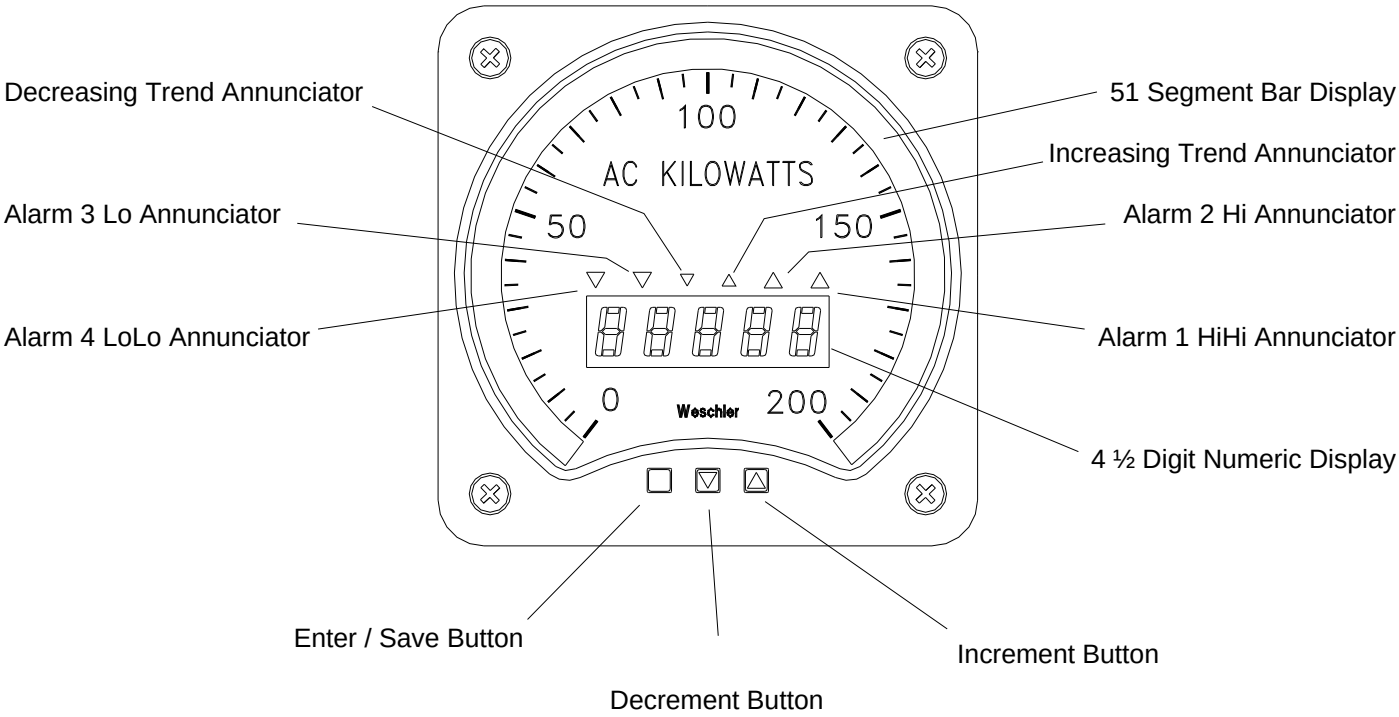


Figure 2. Enhanced and TriColor ACP4 BarGraph Dial and Front Panel Features

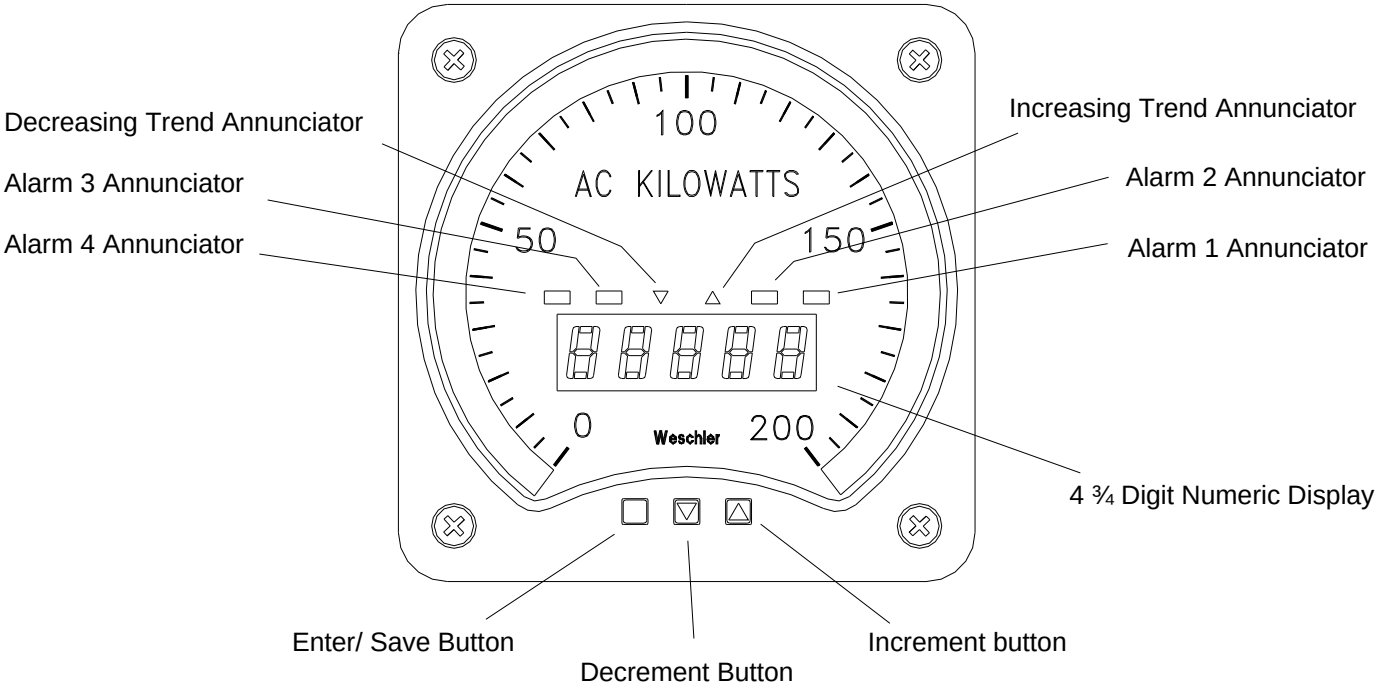
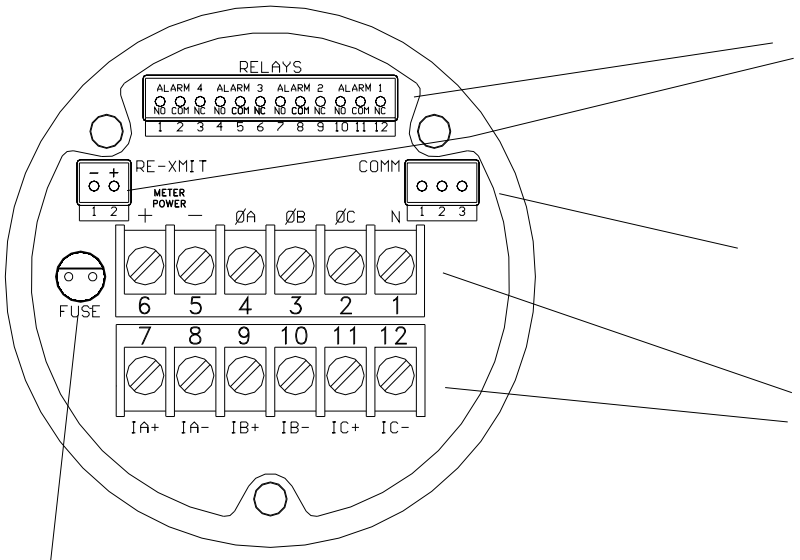


Figure 3. Base Terminal and Fuse Location (standard base)



Relay, Retransmit and Communications Connectors are Phoenix-Type. Plugs are Furnished if These Options are Ordered.

Communications Wiring

Terminal	RS-232	RS-485
1	TX	-
2	COM	GND
3	RX	+

#6-32 Screw Terminals

Wickman type 374/TR5 Time Lag Fuse. Note relationship of pins to the line marked on the fuse body.

2.0 Receipt Inspection

Packaging Inspection

The packaging in which your BarGraph is shipped is designed to protect its contents against normal shipping shock and vibration. If the external carton is damaged in any way, report any damage to the carrier as soon as possible and immediately unpack the carton for internal inspection.

Unpacking

The BarGraph is packaged with this manual, a software manual if equipped with digital communications, a mounting hardware kit, Phoenix-type plugs for mating with installed option connectors and a spare fuse. Other accessories such as calibration tools, or other items which may have been ordered at the same time will be included only if the packaging integrity is not compromised. Please remove all packing materials and check them for included accessories before discarding them.

Physically inspect the BarGraph and its accessories for signs of hidden shipping damage. Evidence of excessive roughness in shipping include a dented case and cracked display windows. Shake the instrument and listen for any rattling which would indicate parts adrift inside the case.

3.0 Installation

All signal and power connections are made to the terminal strips (standard base) or terminal studs (molded base). The molded base is primarily supplied for compatibility with Weschler and Westinghouse analog instruments. The number of terminal studs available in the molded base are limited by space constraints, and terminal assignments are therefore made depending upon the options ordered. See figure 6A - 6Z for option connections when the molded base is supplied.

On the Standard base, alarm relay, analog re-transmit and communications connections are made through Phoenix style receptacles and plugs rated for 300v, 8 amp service. The plugs are provided in the installation kit for the receptacle corresponding to an ordered option. Additional or replacement plugs are available from Weschler or electronic component supply companies according to the following table:

Receptacle	Weschler Part Number	Manufacturer	Mfg Part Number
Retransmit	2100003602	Phoenix	1803426
Relay	2100003612	“	1803439
Communications	2100003603	“	1803523

Analog Retransmit Connections

The analog retransmit output is available in two forms; PWM and DAC. The PWM style, supplied only on the standard ACP4 BarGraph, is a constant voltage type with 256 step resolution. It is available in isolated and non-isolated versions. Because the voltage is proportional to the signal, the loop resistance, including the load and lead resistance, must be carefully calculated in order to maintain the accuracy of the output current. If the loop resistance varies from the specified value, the output current will have a proportional error. Normally when using this type of output, the loop resistance is below the value specified and it is padded up to the required value with an external resistor.

The DAC retransmit is supplied on the Enhanced and TriColor ACP4 BarGraphs. It is a constant current type with 65000 step resolution. It is available in isolated output only. The constant current output means that the output will be unaffected by loop resistance within the loop resistance limits of 0 to 1000 ohms. This type of retransmit is configurable through front panel programming buttons for any current between 0 and 24 ma corresponding to any on-scale signal span. The output is not bipolar, however; if can only produce positive current values.

On both output types, 20 to 24 AWG, 300 volt, 105 °C hook up wire is recommended.

Alarm Relay Connections

The alarm relay contacts are rated for 5 amps maximum, and the hook-up wire should be selected accordingly. The potential rating of the relay contacts is related to the current rating as shown in table 2.

Table 2. Relay Contact Ratings

Contact	Current Rating . . . . . @	Potential Rating	Load
NO	5A	30 vdc	Resistive
	5A	120 / 240 vac	"
	1/14 HP	120/240 vac	Inductive
NC	5A	30 vdc	Resistive
	5A	120 / 240 vac	"
	1/10 HP	120 / 240 vac	Inductive

It is recommended that insulation be selected with a minimum 600 v, 105 °C rating.

Signal and Power Connections

The terminal strips used in ACP4 BarGraph are rated for 20 amps, 250 volts rms. The terminal screws should be tightened to 8 - 11 inch pounds. The maximum torque on the screws, without thread damage, is 13 inch pounds. Lead terminating lugs must be suitable for #6-32 terminal screws with a maximum lug width of 5/16 (0.312) inches. Actual connection diagrams are presented in figure 5 below.

Current Circuits

CAUTION! CAUTION!

Special attention must be taken when wiring to the current sense circuit if it is connected directly to a current transformer (CT), since the **open secondary of a CT can generate high voltages which are lethal to personnel.** Precautions must be taken to either de-energize the current circuit (preferred) or short circuit the CT secondary before making any wiring changes. Consult with your safety personnel for appropriate practice prior to making any current circuit connections.

The BarGraph's current circuits have ratings up to 10 amps maximum continuous, though the actual rating of your BarGraph may be less. The BarGraph current circuits are designed to withstand the 1000% momentary current overload and 120% sustained current overload specified in ANSI C39.1-1981, and the terminal lugs and hook-up leads must be capable of carrying this current as well, if the C39.1 overload is required. It is recommended that the wire have a 600 volt, 105 °C insulation rating. Consult national and local wiring standards for actual wiring requirements.

Potential Circuits

The BarGraph potential circuits are ultra low burden circuits which draw less than 1 ma of compliance current. Although this current is very low, it is recommended that the external wiring be 20 AWG or greater diameter with a 600 volt, 105 °C insulation rating. Consult national and local wiring standards for actual wiring requirements.

Power Circuit

The BarGraph can be powered from the power sources listed in table 2. The maximum compliance current (825 ma) of all BarGraph ACP4 instruments is drawn by the TriColor instrument at the 12 vdc source voltage level with maximum brightness, full amber bar and all relays picked up. All other instruments in the BarGraph ACP4 series draw less current. It is recommended that the external wiring be 20 AWG or greater diameter with a 600 volt, 105 °C insulation rating. Consult national and local wiring standards for actual wiring requirements.

Digital Communications Connections

The ACP4 series BarGraphs support full duplex RS-232 and half-duplex (2-wire), multidrop RS-485 communications.

For RS-232 applications, BarGraph comm connector terminal 1 (transmit) is connected to the host's receive terminal and BarGraph comm connector terminal 3 (receive) is connected to the host's transmit terminal. The BarGraph comm connector terminal 2 (common) is connected to the host's common terminal. The common terminal is not an earth ground connection. It is intended as a signal reference between the BarGraph and the host only.

For RS-485 applications, BarGraph comm terminal 1 (-) is connected to the host's (-) terminal and BarGraph comm terminal 3 (+) is connected to the host's (+) terminal. The BarGraph comm connector terminal 2 (common) may or may not be necessary for system operation. It is normally used to suppress common mode voltage on the two active lines. When it is required to be connected, it is recommended to add a 100 ohm resistor in series with the host in order to limit surge currents. The RS-485 standard allows 32 devices to be connected to the same pair of lines. In multidrop installations it may be necessary to connect a 125 ohm resistor across the terminals of the last device in the string in order to suppress signal reflection. It is recommended that the system be operated without the resistor and ad it only if the system operates unsatisfactorily.

A common communications circuit which is used to interface a PC to BarGraph and other RS-485 devices, employs an RS-232 to RS-485 converter, as illustrated in Figure 4. In this diagram, the user is communicating with three BarGraphs, each with its own unique comm identification number.

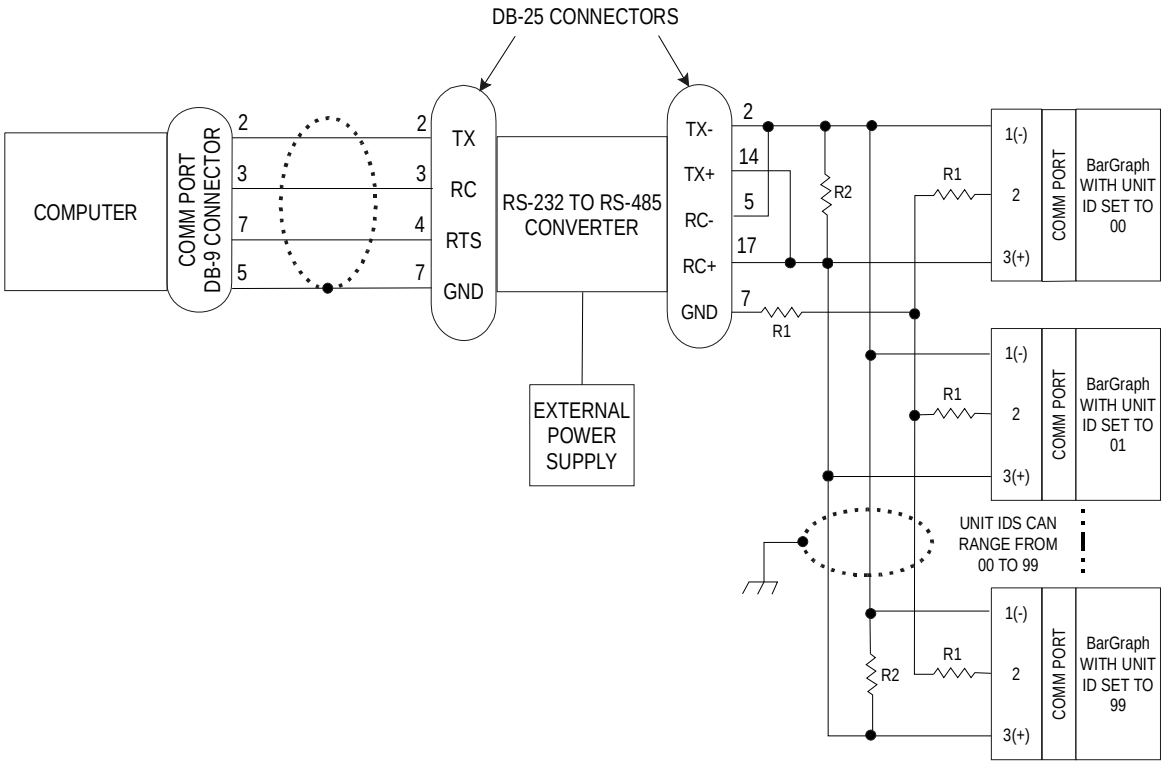


Figure 4. Interfacing a PC for Digital Communications with Multiple BarGraphs

Notes for Figure 4

1. The computer, converter, cabling and resistors shown are user supplied.
2. Add 100 ohm resistors (R1) between the signal ground of the converter and terminal 2 of each BarGraph.
3. Add 120 ohm resistors (R2) at the output of the converter and across the terminals of the last BarGraph on the branch.
4. Up to 32 BarGraphs may be connected to a common RS-485 branch circuit. Each BarGraph must have its own unique unit ID, selected from a range of 00 to 99 hex (153 decimal). Note that the BarGraph display shows unit ID's as decimal numbers, but the actual protocol uses hex numbers. The decimal number shown on the display must therefore be converted to hex in order for the host to correctly address the BarGraph.

Connection Diagrams

The diagrams below present all common power measurement schemes. The alarm relay, communications and retransmit connections are omitted, since these are well known circuits or have been described above.

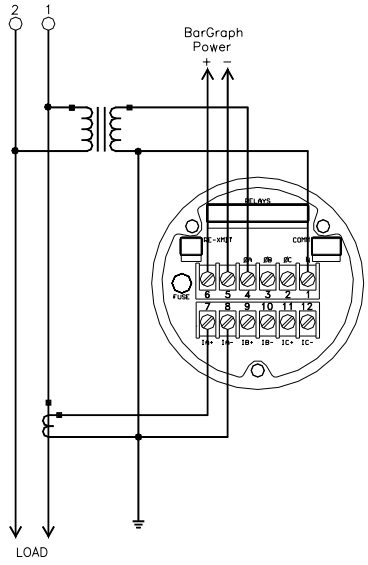


Figure 5A. 1 Phase 2 Wire Type BGP Wattmeter & BGV Varmeter

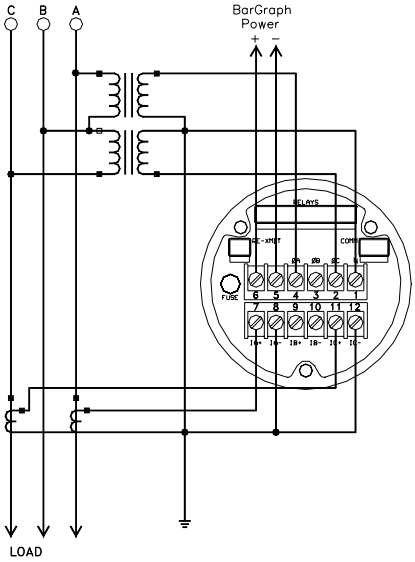


Figure 5B. 3 Phase 3 Wire Type BGP Wattmeter & BGV Varmeter

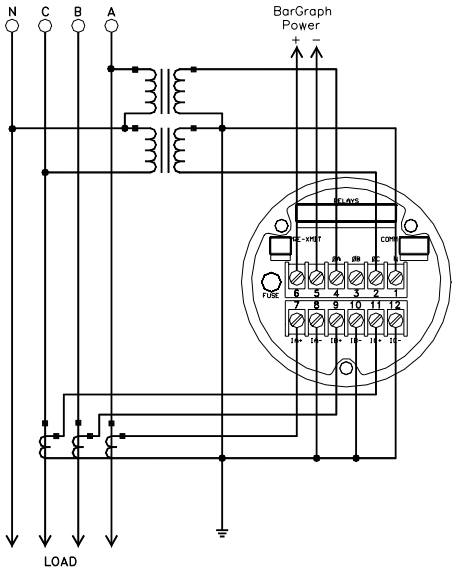


Figure 5C. 3 Phase 4 Wire Type BGP Wattmeter & BGV Varmeter

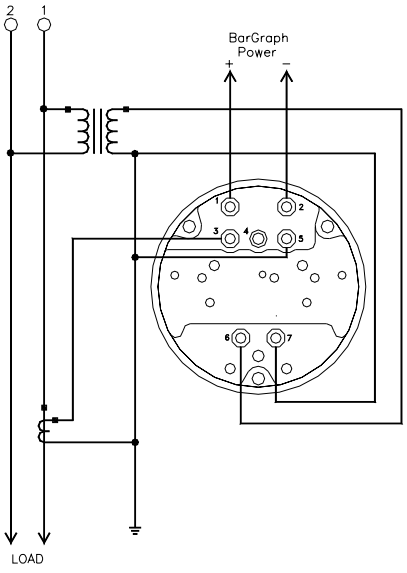


Figure 5D. 1 Phase 2 Wire Type BGP Wattmeter and BGV Varmeter with Molded Base

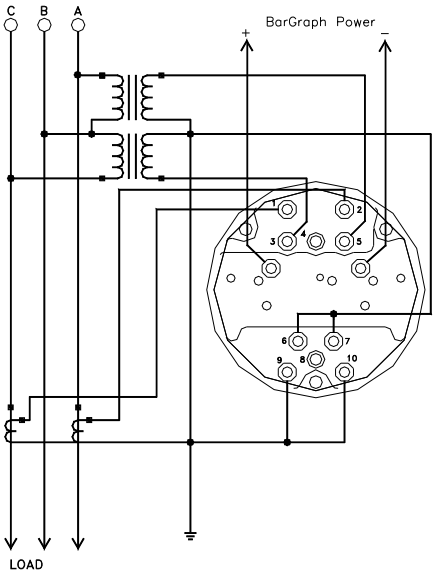


Figure 5E. 3 Phase 3 Wire Type BGP Wattmeter and BGV Varmeter with Molded Base

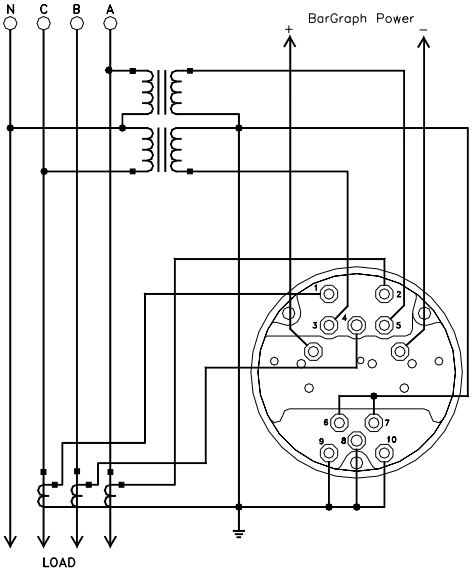


Figure 5F. 3 Phase 4 Wire Type BGP Wattmeter and BGV Varmeter with Molded Base

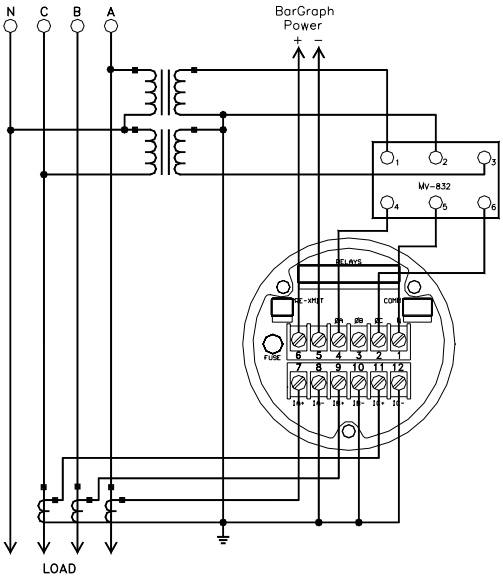


Figure 5G. 3 Phase 4 Wire Type BGG Varmeter for Use with Phase Shifting Transformer

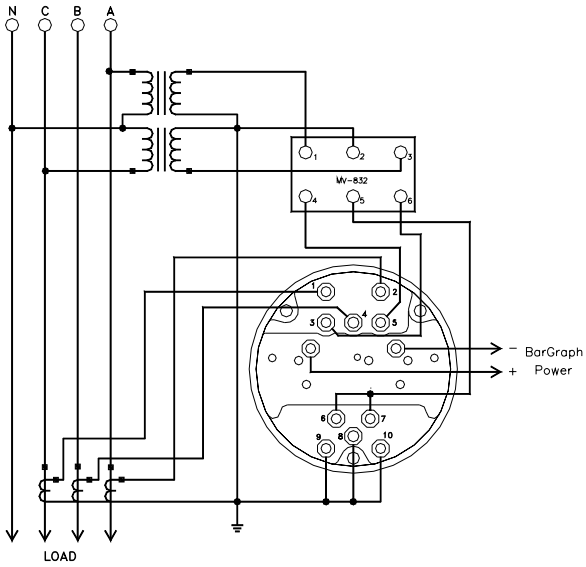


Figure 5H. 3 Phase 4 Wire Type BGG Varmeter with Molded Base for Use with Phase Shifting Transformer

The following connections are less common, but are supported by APP-4 BarGraphs:

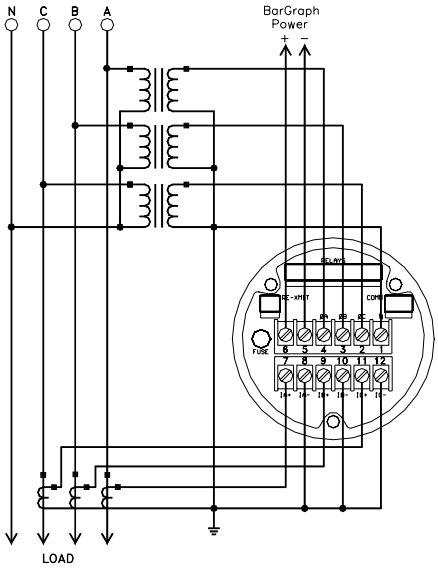


Figure 5I. 3 Phase 4 Wire, 3 PT Type BGV Varmeter

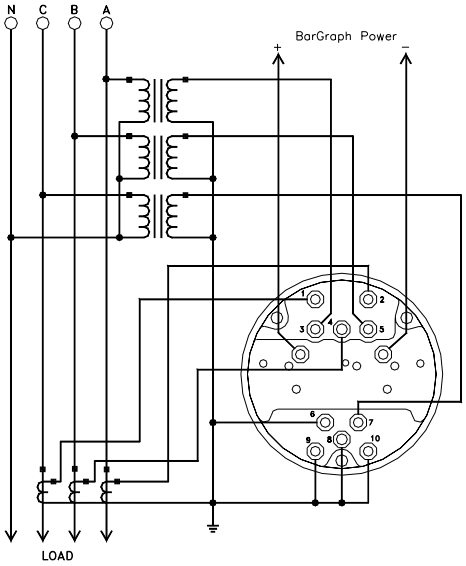
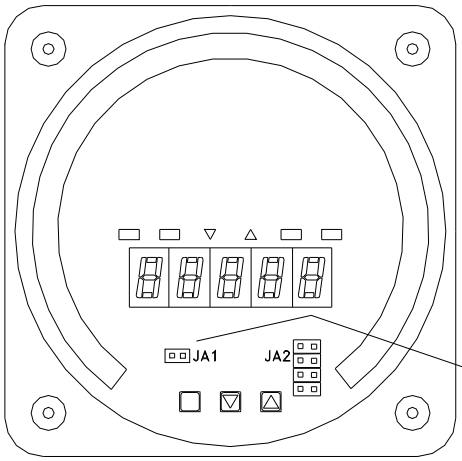


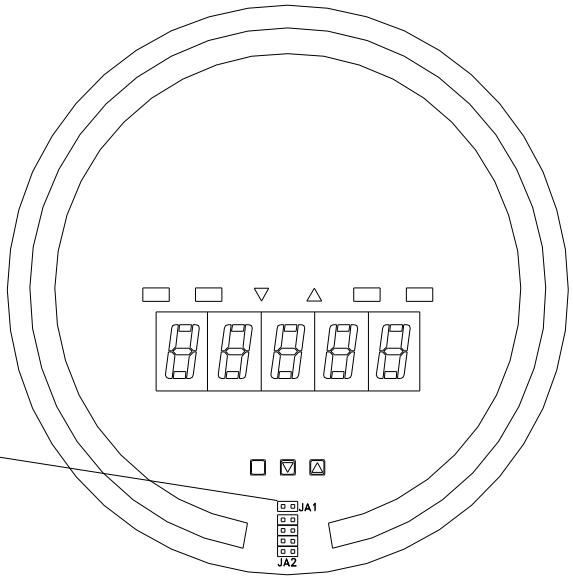
Figure 5J. 3 Phase 4 Wire, 3 PT Types BGP & BGV Wattmeter & Varmeter with Molded Base

Figure 6. Jumper Locations

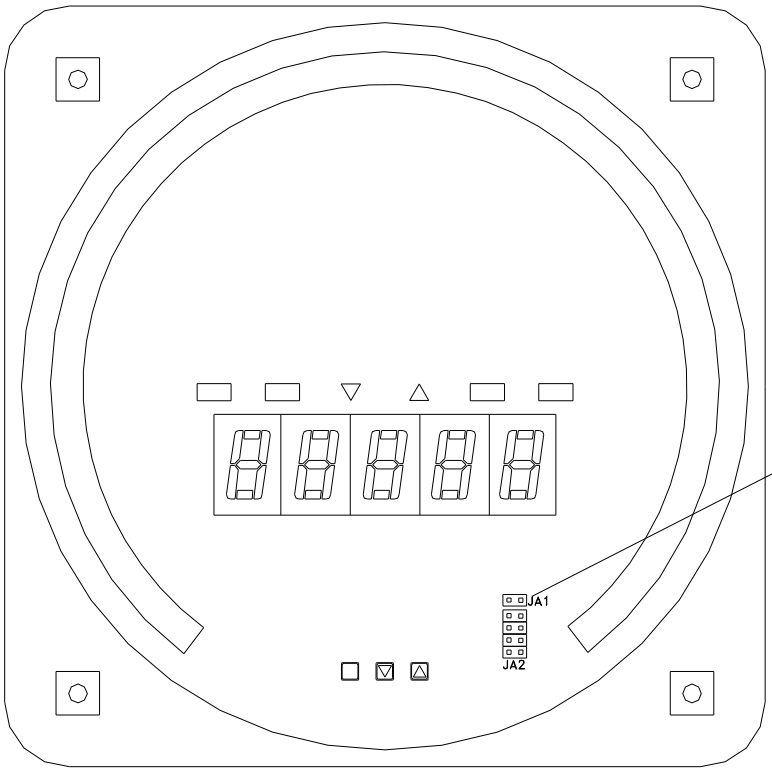
BGG/BGP/BGV-241



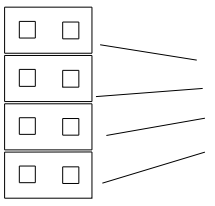
BGG/BGP/BGV 251 & 281



BGG/BGP/BGV 261



Jumper Block JA2



4.0 Configuration

Supervisor Mode

The supervisor mode is provided to allow users to configure all user programmable settings. These settings should be changed only by knowledgeable individuals, since the calibration and / or operation of the BarGraph can be seriously affected by the values entered in this mode.

In order to enter the supervisor mode, the cover and dial of the instrument must be removed and a jumper must be placed across the pins of jumper header JA1. Refer to figure 6 for locations of the jumpers on your BarGraph. When supervisor setup is first entered, the prompt “CnF” will appear in the numeric display.

The keystrokes of figures 7A and 7B Are used to configure a standard ACP4 BarGraph.

Keystroke by Keystroke Guide to Configuration

This guide explains what the keystrokes in the supervisory set up loop are for and how they impact ACP4 BarGraph function. The **bold** paragraph heading indicates a main loop prompt. Normal font paragraph headings indicate sub-loops where the actual parametric values are entered.

In order to enter the main loop, the cover and dial must be removed from the instrument and a jumper placed across the JA1 header. See figure 6 for the location of the jumper header in your BarGraph model. The jumper is a standard type for use with pin headers of 0.1 inch spacing and 0.025 inch square pins.

CnF

This prompt indicates the entry and end points for the supervisor mode **C**o**nF**iguration loop. It has no other significance other than to let the user know that the entire loop has been traversed. It is not necessary to scroll to this prompt in order to exit the loop. The loop will be exited as soon as the jumper is removed from JA1.

PEA

The **PEA**k is a toggle which function allows the user to turn the peak / valley function on or off. The peak and valley feature continuously monitors the measured quantity (watts or vars) and records the highest and lowest value. The valley value may be displayed by pressing the decrement button at any time during normal operation. The peak value may be displayed by pressing the increment button at any time during normal operation. To reset the peak value, press the enter and increment buttons simultaneously. To reset the valley value, press the enter and decrement buttons simultaneously. The peak and valley values are stored in volatile memory, meaning that if instrument power is lost, the peak and valley values will be lost.

After choosing an option value, be sure to press the enter button to save the choice.

HYS

The hysteresis value specifies the magnitude of the dead band between the alarm set point and the alarm drop out point, for all alarms. The value is expressed as a percent of scale.

When referred to set point operation, hysteresis is the magnitude, or amount, that a process value must retreat from an alarm condition, to cause the alarm to reset. After choosing an option value, be sure to press the enter button to save the choice.

ZErO

This function is a calibration operation, which sets the signal value that is to be applied and the number to be shown on the numeric display at **ZErO** scale. See the calibration section for details on how to use this function. If you are not totally prepared to calibrate the instrument, do not enter this function. If this loop is incorrectly executed, the calibration of the instrument can be grossly affected.

FULL

This function is a calibration operation, which sets the signal value that is to be applied and the number to be shown on the numeric display at **FULL** scale. See the calibration section for details on how to use this function. If you are not totally prepared to calibrate the instrument, do not enter this function. If this loop is incorrectly executed, the calibration of the instrument can be grossly affected.

bAr

The bar function sets the origin of the bar display. The origin is the point from which the bar display “grows”. The bar function is NOT a calibration function and it only affects the bar display. There are five absolute values and three relative positions. After choosing an option value, be sure to press the enter button to save the choice.

Absolute values

The absolute value options represent a percentage of full scale span from the left end scale. The “0” value (0%) sets the origin to the first LED at the left end scale. The “25", “33", “50" or “100" values set the origin at 25%, 33%, 50% or 100% of full scale. When an absolute value of 25, 33, or 50 is chosen for the bAr variable, and a negative signal polarity is applied, the bar display will grow from the origin to the left end scale. When an absolute value of 25, 33 or 50 is chosen for the bAr variable, and a positive signal polarity is applied, the bar display will grow from the origin to the right end scale. If “100" is chosen the bar will grow from the right end scale towards the left end scale with application of a positive signal polarity. The bar will not respond to a negative signal polarity.

bIP

The **bIP**olar option moves the origin point from left to right end scale automatically, depending upon the polarity of the signal. The origin is placed at 0% of full scale and the bar grows towards the right end scale as the signal magnitude increases in the positive polarity. The origin is placed at 100% of full scale and the bar grows towards the left end scale as the signal magnitude increases in the negative signal polarity.

vAr

The **vAr**iable option allows the user to explicitly specify values for the origin and right bar end scale, based on absolute signal (numeric display) values. The origin is always placed at the first LED at the left end scale. This function is used with the bZr (set bar zero scale) and bFL (set bar full scale)to set the origin and right end scale values respectively.

This feature is used to expand the bar display within a signal range of particular interest, to indicate at a distance that a process is within limits.

dEv

The **dEv**iation option allows the user to explicitly specify values for the left and right bar end scales, based on absolute signal (numeric display) values. The origin is always placed at the center LED of the bar. The signal value associated with the origin is calculated by the BarGraph to be the median point between the left and right end scale value. The bar will grow from the origin toward left end scale for any signal value less than the median point value. The bar will grow from the origin toward right end scale for any signal value greater than the median point value. This function is used with the bZr (set bar zero scale) and bFL (set bar full scale) functions. The bZr function is used to specify the left end scale in absolute signal value and the bFL function is used to specify the right end scale in absolute signal value.

OPr

The **OPe**r**r**ator is a toggle function which either enables or disables the operator mode feature. The option has two choices; “On” (enable) or “OFF” (disable). See the Operator Mode section above for capabilities provided with this feature. After choosing an option value, be sure to press the enter button to save the choice.

dEC

The dECimal function allows the user to scale the numeric display to any decade value by moving the radix to any of five positions. Pressing the increment or decrement buttons moves the radix left or right to the actual position it will occupy during normal operation. Reference the dEC keystrokes of figure 7B.

bZr

This prompt will only appear if the dEv (deviation) or vAr (variable) option is chosen in the **bAr** loop. The values set by this function are different when used in conjunction with either the deviation or variable option. Please refer to the dEv or vAr function, above for more details.

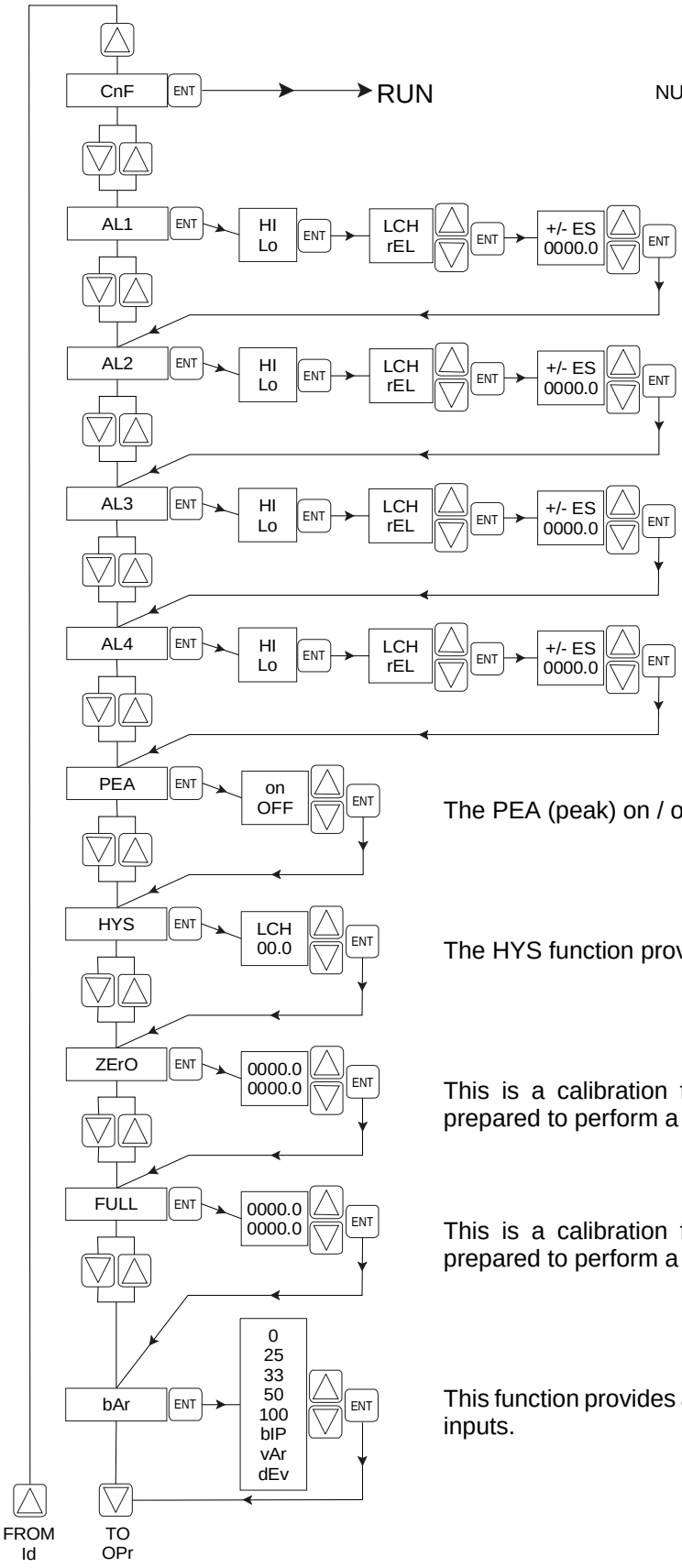
bFL

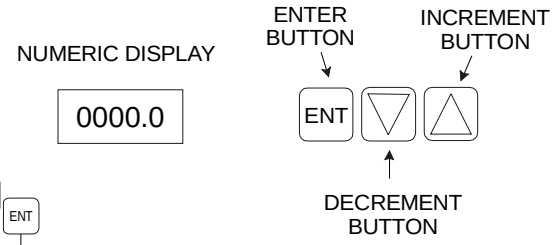
This prompt will only appear if the dEv (deviation) or vAr (variable) option is chosen in the **bAr** loop. The values set by this function are different when used in conjunction with either the deviation or variable option. Please refer to the dEv or vAr function, above for more details.

Id

The communications **Id**entification number function is used to set the digital communications address which is used by a host computer to uniquely identify a single intelligent electronic device (IED) on a communications cable with multiple connected IED’s. The ID number can be of any value between 0 (default) and 255.

Figure 7A. Supervisor Set Up Loop





All alarms are configured identically. If the hardware which supports the alarm is not installed, the submenu for that alarm will not appear.

The PEA (peak) on / off toggle turns this function on or off.

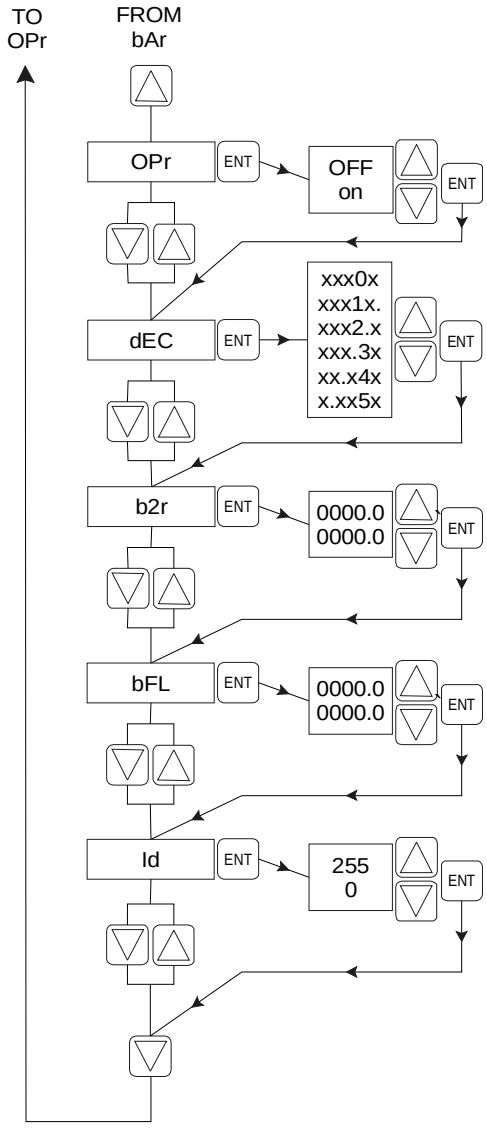
The HYS function provides for setting a hysteresis value for all alarms.

This is a calibration function. Do not disturb settings unless you are fully prepared to perform a full calibration. See the calibration section 6 for details.

This is a calibration function. Do not disturb settings unless you are fully prepared to perform a full calibration. See the calibration section 6 for details.

This function provides a means of setting up the bar display's response to signal inputs.

Figure 7B Supervisor Set Up Loop (conclusion)



This function enables (on) or disables (OFF) the operator mode.

This function allows for positioning of the radix (decimal point).

This non-calibration function works in conjunction with the bAr function to allow specification of bar display end scale points in terms of absolute signal values.

This non-calibration function works in conjunction with the bAr function to allow specification of bar display end scale points in terms of absolute signal values.

This function specifies the communications address of the instrument.

5.0 Operation

The ACP4 series watt and varmeters are designed to provide many years of low maintenance, trouble free service. The recommended calibration check interval is five years and in the unlikely event that re-calibration is required, it is a simple process requiring only a watt standard, a few keystrokes and whatever time the standard requires for warmup.

There are no components to adjust or select. All adjustments are made from the front panel. Calibration can be accomplished in the panel or on the bench. Please refer to section 6 for calibration procedure.

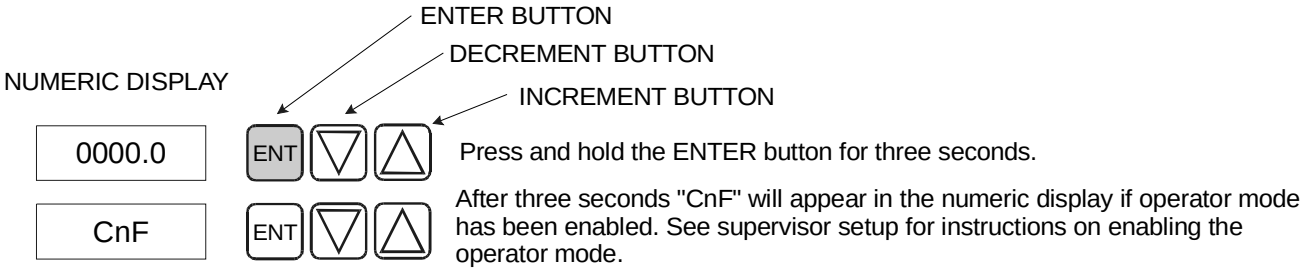
The only other maintenance that may be required is cleaning of the dial window. This should be done with a soft cloth moistened with a mild liquid dishwashing detergent such as Dawn, mixed one table spoon of detergent to one quart of water. Wipe the window area with another cloth dampened with clear water to rinse off any remaining detergent. Avoid getting water into the button holes of the BarGraph.

Operator Mode

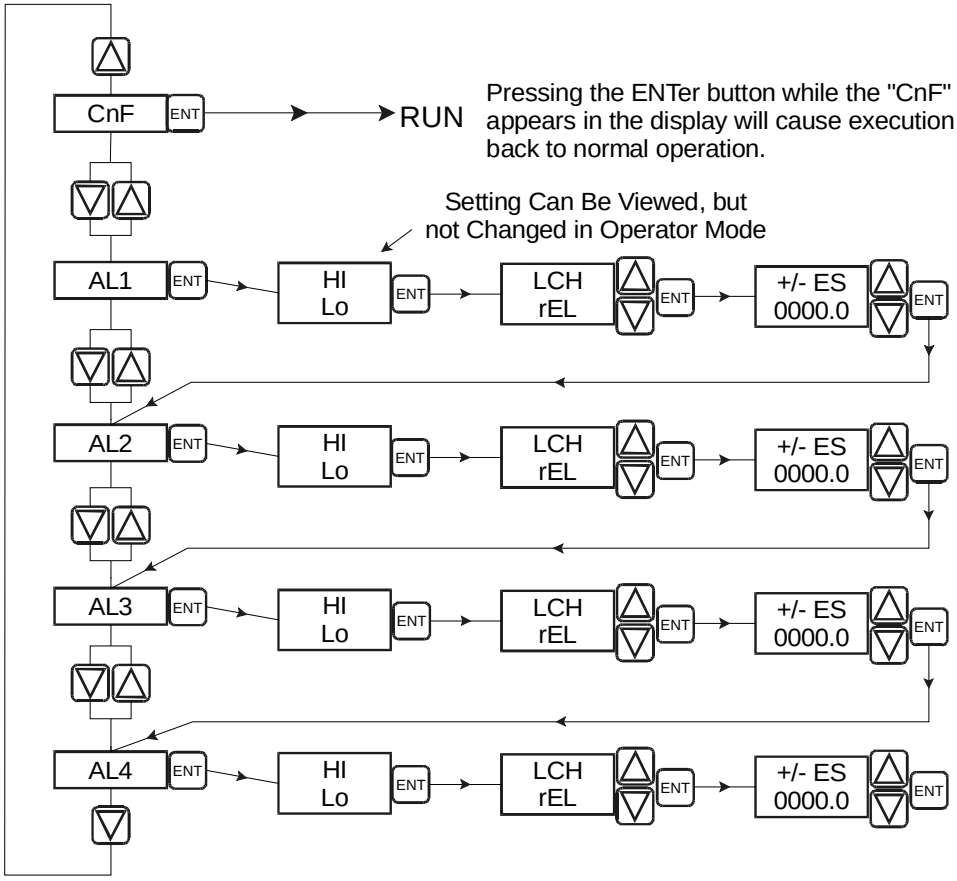
The operator mode provides for limited access to BarGraph alarm function. The Hi (ascending trip) or Lo (descending trip) settings may be viewed and the set point value may be changed. In addition, if the alarm has been set to latching type, the relay's state-of-alarm (latched or released) can be viewed and if latched, may be released.

The operator mode can only be entered if it has been enabled in the supervisor set up loop. See the next topic, "Supervisor Mode" for keystrokes necessary to enable the operator mode

Figure 8. Operator Mode Keystroke Diagram



Once the operator mode has been entered, the alarms can be configured using the keystrokes below. The menu structure can be navigated without changing any values as long as the increment or decrement buttons are not pressed. If it is desired to save a value, the enter button must be pressed after scrolling to the new value with the increment and / or decrement buttons.The alarm sub menues will only appear if the hardware that supports it is installed. If no alarm hardware is installed and the operator mode is entered, only the"CnF" pompt will appear.



If no button activity has been logged for 45 seconds, the BarGraph willl revert to normal operation. While in operator mode, all background processes, including alarm operation, communications and analog retransmit continue to function normally. Changes to alarm values will take effect after resuming normal operation.

6. Calibration

ACP4 calibration is performed by comparison of the BarGraph indication the indication of standards of higher accuracy. To set up for calibration you will need the following equipment:

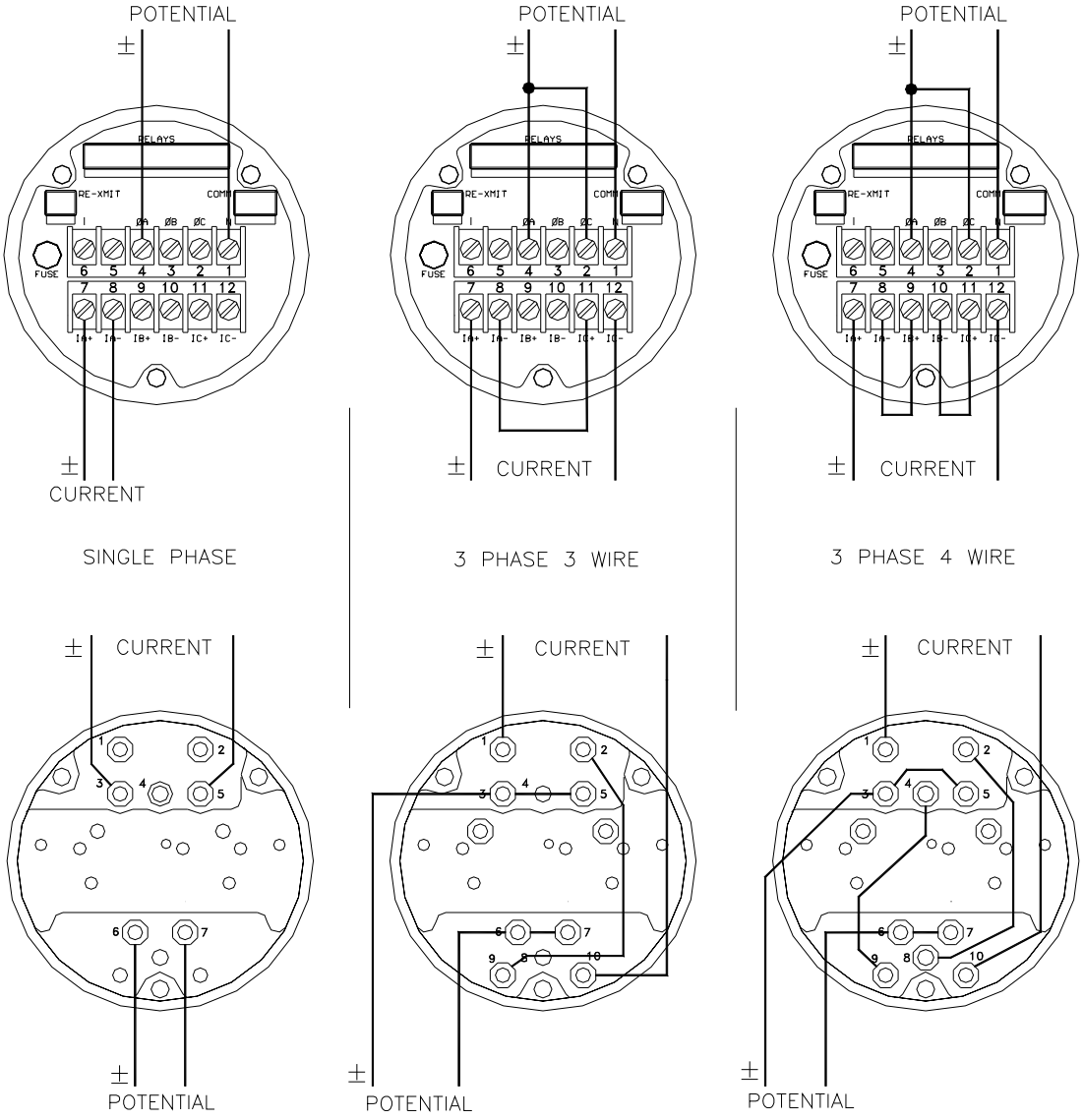
1 A watt / var calibrator capable of sourcing appropriate current and potential levels and shifting the phase angle of the current with respect to the potential by ± 90°.

2. If a watt / var calibrator is not available, an individual current and potential source that is capable of sourcing current and potential corresponding to the values that are applied in the application, plus a watt / var standard (Voltech PM3000ACE or equivalent), plus a phase shifter capable of shifting the phase angle of the current with respect to the potential by ± 90°.

Calibration Procedure

1. Connect the BarGraph potential circuits in parallel and the current circuits in series as shown in figure 9. Polarity is indicated by the " ± " character.

Figure 9. Single Phase Test Connections



Calibration Procedure (continued)

2. Remove the cover and dial from the BarGraph. Place a jumper on pin header JA1.
3. Turn on and warm up the BarGraph and the test equipment. BarGraph warm-up time is negligible.
4. Record the single phase test watts from the data plate attached to the side of the BarGraph. If the data plate is illegible or missing, calculate the value from one of the following equations:

$$\text{Single Phase:} \quad SPTW = \frac{\text{Scale}}{PT \times CT}$$

$$\text{3 PH 3W:} \quad SPTW = \frac{\text{Scale}}{PT \times CT \times 2}$$

$$\text{3PH 4W} \quad SPTW = \frac{\text{Scale}}{PT \times CT \times 4}$$

   These equations are correct for most common connections; however, there are instances where unique connection schemes have been developed to accommodate unique systems. In the event that you are connecting the BarGraph to a system with a connection scheme that does not appear in this manual, contact the factory for instructions.

If the BarGraph being calibrated is a self-contained var meter, type BGV, skip down to step 10.

5. Energize the test circuit and adjust the potential to the BarGraph's rated voltage. Adjust the current output to zero and shunt the current input to the test circuit. The standard should be indicating zero watts.
6. Navigate to the ZErO prompt of the configuration loop by pressing the decrement button repeatedly. When the ZErO prompt appears, press the enter button.
7. Adjust the value shown on the numeric display to the desired value, usually 0. Press the enter button to accept the value. CAUTION! If you fail to press the enter button the new calibration value will not be saved.
8. If necessary, navigate to the FULL prompt and press the enter button. Adjust the current to achieve end scale single phase test watt indication on the standard watt meter.
9. Scroll the BarGraph's indicated end scale value to the desired end scale value, using the increment or decrement buttons. Press the enter button to accept the new value. CAUTION! If you fail to press the enter button the new calibration value will not be saved.

If the BarGraph being calibrated is NOT a self contained var meter (type BGV), calibration is complete. Skip down to step 15.

10. Set the calibrator to indicate vars. Energize the test circuit and adjust the potential to the BarGraph's rated voltage. Adjust the current output to zero and shunt the current input to the test circuit. The standard should be indicating zero vars.
11. If the type BGV BarGraph is set up for left zero (only left most LED is lighted with zero vars applied) navigate to the ZErO prompt of the configuration loop by pressing the decrement button repeatedly. When the ZErO prompt appears, press the enter button. Scroll to 0 on the BarGraph numeric display, then press the enter button again. CAUTION! If you fail to press the enter button the new calibration value will not be saved. Skip down to step 13.
12. If the type BGV BarGraph is set up for center or offset zero, remove the shunt from the current source. Adjust the phase shifter until the phase angle meter indicates -90°, then adjust the current until the var standard indicates the left end scale single phase test watts. Navigate to the ZErO prompt of the configuration loop by pressing the decrement button repeatedly. When the ZErO prompt appears, press the enter button. Scroll the BarGraph numeric display to the desired indicated value, then press the enter button. CAUTION! If you fail to press the enter button the new calibration value will not be saved.
13. Adjust the phase shifter until the phase angle indicates +90°. Adjust the current until the standard var meter indicates full scale (or right end scale) single phase test watts. Navigate to the FULL prompt of the configuration loop. When the FULL prompt appears, press the enter button. Scroll the BarGraph numeric display to the desired indicated value, then press the enter button. CAUTION! If you fail to press the enter button the new calibration value will not be saved.
14. Re-check left and right end scale indications using the above steps, without pressing any programming buttons.

15. De-energize the calibration circuit and turn off the test equipment and the BarGraph. Replace the BarGraph cover and return it to service.

7.0 Troubleshooting

The ACP4 series BarGraphs are designed for trouble free service, but it is acknowledged that power systems are complex circuits and problems which result in erroneous indications can be very frustrating to troubleshoot. This section is intended to help eliminate the BarGraph as a source of any problems.

Operational problems can be segregated into three general conditions; failure to operate, inaccurate indication and erroneous display.

Failure to Operate

Failure to operate is characterized by a lack of display illumination. This is typically caused by lack of adequate power or a blown fuse. Check the power source requirement on the BarGraph's data plate and ***measure*** the power that is applied to be sure that it is adequate. Compare the measured power level to the power requirement listed in the specifications section of this manual, for your BarGraph. If the power source is adequate, check the fuse. If it is inadequate, correct the problem before continuing.

The fuse is mounted on the I/O module inside the rear of the instrument. On instruments with the standard base, the fuse protrudes through the base plate and is readily accessible from the rear. Refer to figure 3 for its location. On instruments with the molded base, the fuse is not readily accessible. The unit must be removed from the panel, then removed from the case in order to access the fuse. The fuse is socketed, and may be removed by simply pulling straight out. The orientation of the pin sockets are as indicated in figure 3. The pins of the fuse are likewise oriented in parallel with a line marked on the face of the fuse.

The fuse ratings and part numbers are given in tables 3A, 3B and 3C. When referring to the tables, be sure you have the correct type (Standard, Enhanced or TriColor).

Table 3A Fuse Ratings and Part Numbers for Standard BarGraphs

Power Supply Voltage	Fuse Rating (A)	Weschler Part Number	Manufacturer	Manufacturer's Part Number
12 vdc	1.6	4300000316	Wickman	374-1160-041
24 vdc	1.0	4300000314	"	374-1100-041
28 vdc	1.0	4300000314	"	374-1100-041
48 vdc	0.8	4300000313	"	374-0800-041
125 vdc	0.5	4300000311	"	374-0500-041
250 vdc	0.25	4300000308	"	374-0250-041
120 vac	0.5	4300000311	"	374-0500-041
240 vac	0.25	4300000308	"	374-0250-041
Universal 120 vac / 125vdc	0.5	4300000311	"	374-0500-041

Table 3B Fuse Ratings and Part Numbers for Enhanced BarGraphs

Power Supply Voltage	Fuse Rating	Weschler Part Number	Manufacturer	Manufacturer's Part Number
12 vdc	1.6	4300000316	Wickman	374-1160-041
24 vdc	1.0	4300000314	"	374-1100-041
28 vdc	1.0	4300000314	"	374-1100-041
48 vdc	0.8	4300000313	"	374-0800-041
125 vdc	0.5	4300000311	"	374-0500-041
250 vdc	0.25	4300000308	"	374-0250-041
120 vac	0.5	4300000311	"	374-0500-041
240 vac	0.25	4300000308	"	374-0250-041
Universal 120 vac / 125vdc	0.5	4300000311	"	374-0500-041

Table 3C Fuse Ratings and Part Numbers for TriColor BarGraphs

Power Supply Voltage	Fuse Rating	Weschler Part Number	Manufacturer	Manufacturer's Part Number
12 vdc	1.6	4300000316	Wickman	374-1160-041
24 vdc	1.0	4300000314	"	374-1100-041
28 vdc	1.0	4300000314	"	374-1100-041
48 vdc	0.8	4300000313	"	374-0800-041
125 vdc	0.5	4300000311	"	374-0500-041
250 vdc	0.25	4300000308	"	374-0250-041
120 vac	0.5	4300000311	"	374-0500-041
240 vac	0.25	4300000308	"	374-0250-041
Universal 120 vac / 125vdc	0.5	4300000311	"	374-0500-041

Inaccurate Indication

Inaccurate indication means that magnitude of the displayed value is incorrect, or that the polarity shown on the numeric display is incorrect. If the direction of bar growth is incorrect, see the next heading, "Erroneous Display".

Inaccurate indication is typically due to a connection error or a calibration error. The difficulty with analyzing indication errors is that there are many variables to consider. There are many more wrong ways to make connections than there are correct ways. Dynamic phase relationships make that task all the more difficult. It is strongly suggested that if an indication error exists that the calibration of the BarGraph be checked per the instructions of section 6, Calibration. If the calibration is correct, the BarGraph can be used to help find the problem in the connections. If the calibration is incorrect, it can be corrected with the checking circuit.

Assuming that the calibration has been verified, tables 4A and 4B may help identify connection problems. Single phase watt and var meter errors will not be covered due to the simplicity of troubleshooting. It is assumed that errors in these devices can easily be traced to calibration or PT and/or CT ratio errors. Polyphase var meters will not be addressed here because fo the difficulty in predicting what may occur for all possible system states.

Table 4A. 3 Phase 3 wire Watt Meter Connection Error Symptoms

Symptom	Causes	Correction
Indication is zero with any signal level.	One phase current is connected in reverse polarity (180° out of phase). Potential Line connections are switched at terminals 2 and 4.	Reverse one phase current at a time until indiction is correct. Switch potential line connections at terminals 2 and 4.
Polarity of numeric display is opposite expected.	Both phase currents are connected in reverse polarity. Phase currents are switched to wrong terminals.	Reverse both phase current connections. Correct current terminal connections
Indication is ½ expected value.	One of the potential or current circuits is connected to the BarGraph's phase B terminals.	Check and correct connections.

Table 4B. 3 Phase 4 Wire Watt Meter Connection Error Symptoms

Symptom	Causes	Correction
Indication is zero with any signal level.	Potential Line connections are switched. Phase currents are switched to wrong terminals.	Switch potential line connections at terminals 2 and 4. Correct current terminal connections
Indication is ⅓ expected magnitude.	One phase current is reversed.	Reverse one phase current at a time until indiction is correct.
Indication is ⅓ expected magnitude and polarity is opposite expected.	Two phase currents are reversed.	Reverse one phase current. If magnitude becomes correct but polarity is still incorrect, reverse connection again and mark it as OK. If polarity becomes correct, mark the connection OK. Reverse the next phase connection. If magnitude and polarity become correct, mark all connections OK. If polarity becomes correct but magnitude is still incorrect, mark this connection as OK. Reverse the next phase connection. Polarity and magnitude should now be correct.

8.0 Specifications

Table 5 Specifications

Unless otherwise stated, specifications apply to watt and varmeters

Uncertainty:
Display & Set Points:

Standard	± 0.1% FS, ± 1 Count
Enhanced and TriColor	± 0.1% FS, ± 1 Count

Temperature Coefficient of Uncertainty

Standard	± 1.3 PPM / °C
Enhanced & TriColor	± 0.5 PPM / °C

Numeric Displays:
Digits

Standard	4 ½ (-19999 to 19999)
Enhanced	4 ¾ (-19999 to 50000)
TriColor	4 ¾ (-19999 to 50000)

Resolution:

Standard	± 0.005%
Enhanced and TriColor	± 0.002%

Bar Displays
Number of Segment

Standard & Enhanced	101
TriColor	50

Resolution

Standard & Enhanced	1%
TriColor	2%

Scale Length

241	285°
251	270° or 345°
261 / 281	270°

Set Point Relays

Quantity	2 or 4 (all models)
Contact Arrangement	Form C (all models)
Set Point Types	
Standard & Enhanced	2 HI(ascending trip) and 2 LO (descending trip)
TriColor	All Programmable HI or LO
Ratings	See Table 2
Contact Protection	MOV Clamp
Hysteresis	Selectable for all set points collectively
Standard	0.5, 1 and 5% of Full Scale
Enhanced	0.0 to 10.0% of Full Scale
TriColor	0.00 to 10.00% of Full Scale

Environment:
Thermal

Standard	-20 to 60 °C
Enhanced & TriColor	-20 to 50 °C

Humidity

All Models	0 - 95% Non-Condensing (note 1)

Communications:
RS-232

Baud	9600
Start Bits	1
Stop Bits	1
Parity	None
Flow Control	None

RS-485

Duplex	Half
Baud	9600
Start Bits	1
Stop Bits	1
Parity	None
Flow Control	None

Protocol

Standard & Enhanced	Party Line
TriColor	Motorola “S”

Outputs:
Analog Retransmit

Standard	256 Step Resolution, Voltage source 0-1, 4-20, 10-50 ma. 0-5, 1-5 V
Enhanced & TriColor	65000 Step Resolution, Current Source 0-24 ma, 0-10 V Programmable

Inputs:
Potential

Nominal All Models	120, 240 vac
Maximum Continuous	150, 300 vac
Momentary Overload	175, 325 vac

Current

All Models	10 Amps
Maximum Continuous	12.5 Amps
Momentary Overload	100 Amps for 500ms

Frequency
All Models
50/60 or 400Hz

Power Requirement:	Tolerance	Compliance Current (Maximum)		Frequency
		Standard	**Enh & TriColor**	
12vdc	10-15vdc	225 ma	825 ma	NA
24vdc	18-36vdc	125 ma	420 ma	“
28vdc	“	100 ma	350 ma	“
48vdc	36-72 vdc	65 ma	210 ma	“
125vdc	± 10%	25 ma	75 ma	“
250vdc	± 10%	12 ma	25ma	“
120vac	± 10%	2.5 VA	12.5 VA	50-60 Hz
240vac	± 10%	1.3 VA	12.3 VA	“
Univ. 110vac/dc-250vac/dc	85-264vac/100-300vdc	3 VA / 35ma	11.5VA / 65ma	50-60 Hz / NA

Notes:

1. Condensing conditions are allowed provided the conformal coating option is ordered.

Figure 10A. BGG-BGP-BGV 241 Cutout and Drilling Diagram

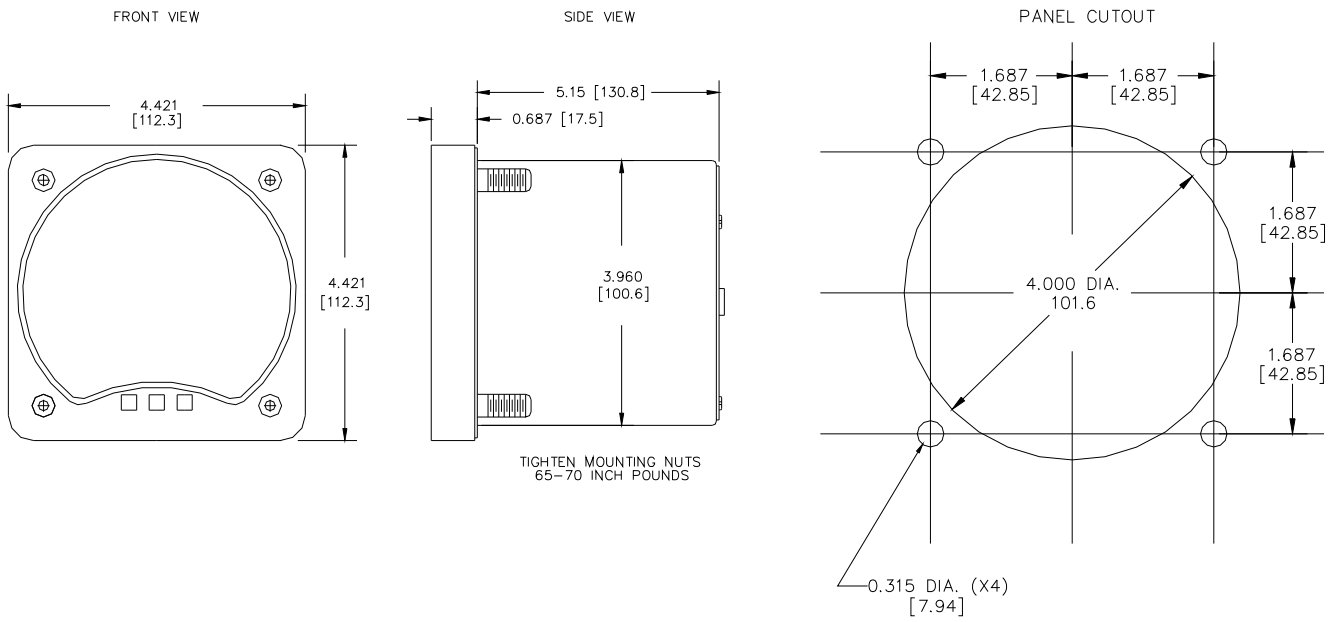


Figure 10B. BGG-BGP-BGV 261Cutout and Drilling Diagram

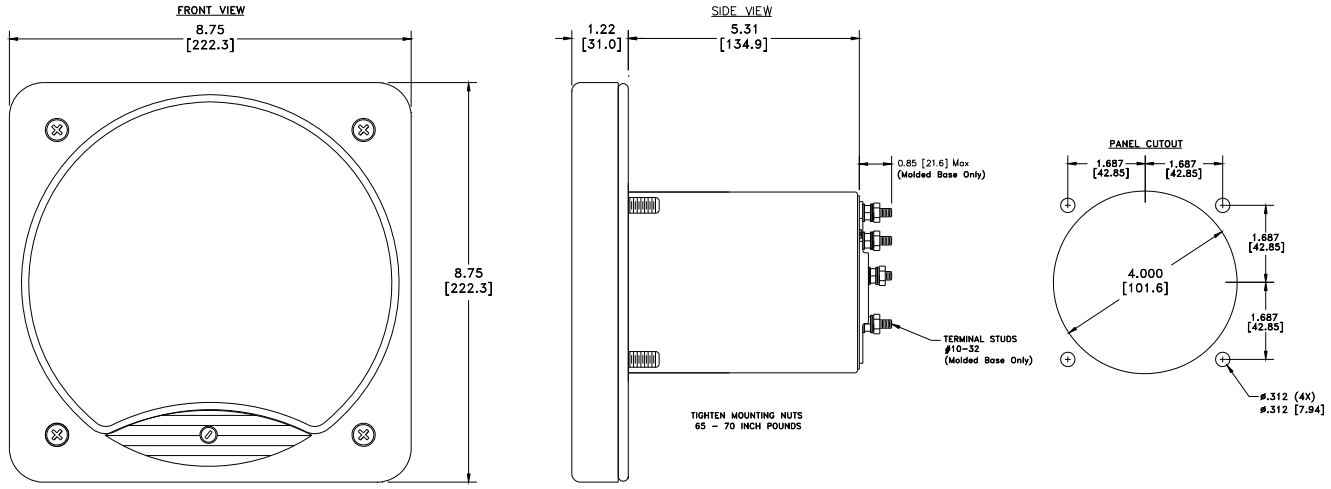
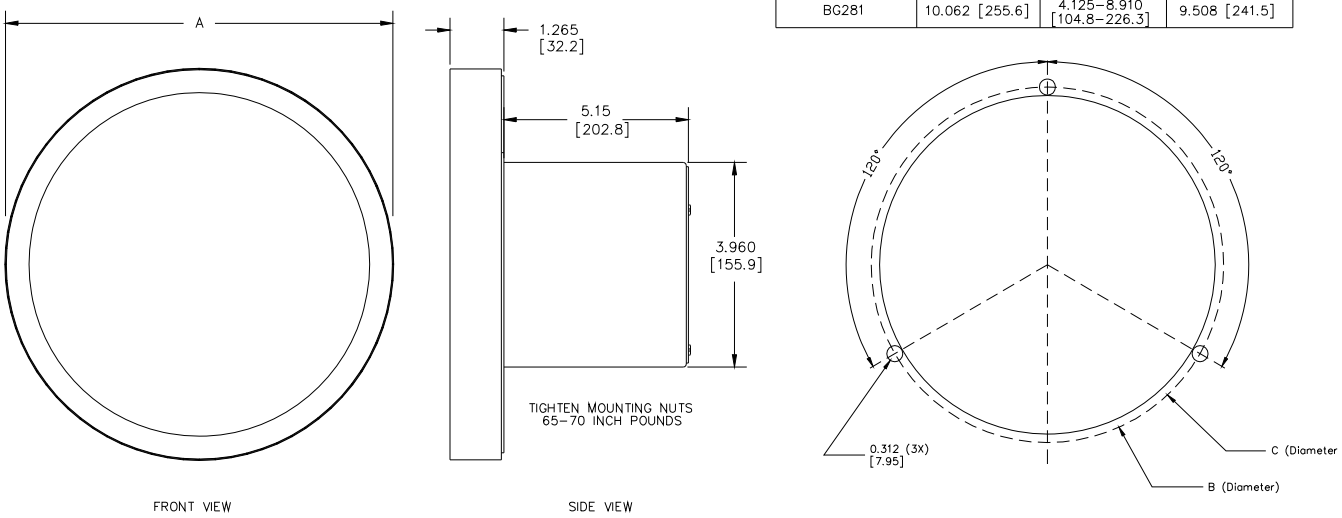


Figure 10C. BGG-BGP-BGV 251 & 281Cutout and Drilling Diagram

TYPE OF INSTRUMENT	A	B (Diameter)	C (Diameter)
BG251	7.500 [190.5]	4.125–6.550 [104.8–166.3]	6.88 [174.75]
BG281	10.062 [255.6]	4.125–8.910 [104.8–226.3]	9.508 [241.5]



9.0 Warranty Statement

All Weschler Instrument's ACP4 BarGraphs are warranted against defects in material and workmanship for a period of **two years** from date of delivery. Weschler Instruments, at its option, will repair or replace any defective product returned to it during the warranty period without charge, provided there is no evidence that the equipment was mishandled or abused. Any repairs or modifications not performed by an authorized factory representative are not warranted by Weschler Instruments. Field service is only available on a contract basis.

Customers must contact Weschler Instruments for an RMA number and shipping instructions BEFORE returning any product.

All products returned to Weschler Instruments must be insured by sender and carefully packed to prevent breakage from shock and rough handling.