

THREE PHASE SCR CONTROL AND REGULATION BOARD

Datasheet and Applications Guide

**Features Include:**

- **Automatic frequency tracking of input mains from 30Hz to 90Hz = no phase delay errors! (higher frequencies available on request)**
- **Automatically corrects for phase rotation**
- **On-board diagnostic LED indicators**
- **Feedback for solid-state over temperature sensing of SCR heatsink**
- **Hard DC gate firing, suitable for firing large area devices**
- **The phase reference signals are filtered to reduce harmonic content above the fundamental**
- **On-board Feedback Control – eliminates the need for an external controller**
- **Improved logic implementation with state-of-the-art FPGA**
- **NEW - Microprocessor for increased flexibility and improved performance**
- **Optional on board Isolated voltage and current feedback inputs**
- **Industry standard size, form factor and connector interface**
- **NEW - Current Limit in Open Loop mode**
- **NEW – On board pot for phase angle control in Open Loop mode**



The BAP1950A is a new release of the BAP1950.

This is a versatile three-phase bridge SCR firing board with many advanced features and functions. The BAP1950A is the ideal firing circuit for large industrial power supplies, motor controllers and generator controllers. It can be used to phase control AC mains; soft-start high power systems; produce variable, unregulated DC; and with the closed loop feedback option, produce regulated DC output with voltage control and current limiting.

The BAP1950A is insensitive to phase sequence and mains voltage distortion. It features high gate isolation, soft and instant start/stop functions, phase loss inhibit and can be used at mains frequencies between 30 and 90Hz without adjustment. Its form factor and size are industry standard and requires no additional cards to implement all of its functions and options.

## Functional Description

### Signal Conditioning of Input Reference

Controlling SCRs requires varying the phase angle at which they turn on in order to control the portion of the input voltage that is conducted to the output. The BAP1950A phase locks to the input source in order to create the references required to control the conduction angle of SCRs in any topology. References can be derived from the cathodes of the three SCRs on J2, which are connected to the input source; or from an auxiliary connector, J5. In either case, the signals used to create the references are filtered in order to remove unwanted harmonics that will affect the precision with which the delay angle is controlled.

The phase rotation of the three-phase input is sensed and the SCR gating is automatically adjusted to account for either ABC or ACB rotation. Therefore, the three-phase input source cannot be connected with an incorrect phase rotation. **However, if the auxiliary input J5 is used, the three inputs for J5 must be consistent with the rotation of the phases at J1 and J2. This is explained in more detail in the connection section on page 8.**

### SCR Gating Phase Locked to the Utility Input

In order for the delay angles to control the conduction angle of the SCRs, the delay angle must be phase locked and then phase shifted from the utility input by an amount determined by the delay angle control. The BAP1950A uses a phase locked loop circuit to keep the SCR gating signals in phase with the three-phase input. An additional control loop has been added that will force the delay angle to remain constant as the input frequency varies from 30Hz to 90Hz.

### Delay Angle Control

The magnitude of the delay angle determines the point on the input waveform an SCR will be switched on. This controls the output voltage of a Converter (AC in, DC out) or an AC Controller (AC in, phase-controlled AC out). The BAP1950A will accept a voltage or a current that will allow the user to control the delay angle. The default scaling for the Delay Angle Control input is:

0V corresponds to maximum delay angle (minimum conduction angle) or zero output

And

5V corresponds to minimum delay angle (maximum conduction angle) or maximum output.

The control input can be modified to accept a current input or a different scaling of the input voltage.

In order to provide a controlled and orderly start up sequence, the delay angle commanded by the user is not instantly applied to the SCRs at turn-on. At start up, the delay angle is forced to the maximum value. When the SCR control signals are phase locked to the input references, with no errors present, the delay angle will ramp down from the maximum value to the programmed value in approximately 400mS. While in operation, the SCR gate firing can be turned off using either the soft stop function (shorting J3-12 to J3-11) or the fast turn off feature (open the contact closure between J3-4 and J3-6). When the soft stop is used, the delay angle will ramp up to its maximum value in approximately 100mS. If the board is forced into a fast turn off condition, all SCR gate signals will be turned off within 1mS.

### Logic Implementation

All of the logic required to perform the delay angle control is contained on a single FPGA (Field Programmable Gate Array). Since it is programmable, it can be modified to adapt to customer needs in certain applications.

### DC Gate Drive

The BAP1950A comes equipped with DC gate drives, rather than picket fence drives, which offers improved performance in circuits with discontinuous load currents. If an SCR loses its holding current when being driven with a picket fence, the SCR will turn off and may not turn on again until it is turned on with the higher current leading edge pulse of the next turn on transition. The DC drive keeps current flowing into the gate so that the SCR will continue to be commanded on for the entire time that the SCR can be in conduction.

The current waveform sourced to each SCR gate is an initial 2 Amp peak pulse (rising at a rate of approximately 1A/ $\mu$ S) approximately 10 $\mu$ S wide, followed by 500mA of DC current for the remainder of the turn-on signal. The open circuit voltage applied to the gate is 24 volts, which enables the BAP1950A to drive large area devices under high di/dt conditions.

### **Options for Powering the Board**

There are several options for applying power to the BAP1950A. Transformer T2 can be driven by 120 VAC or 240 VAC via connector J4. There are jumpers between T2 and J4 that configure the board to accept either of these inputs. The transformer can also be powered directly from the three-phase source that the SCRs are controlling. By removing J4 and installing jumpers JP8 and JP9, the voltage at the cathodes of the phase A and phase B load-to-line SCRs is connected to the primary of T2. In this condition the turns ratio of transformer T2 is determined by the magnitude of the input source.

### **Fault Detection and Shut Down Sequence**

In open loop mode, the delay angle is controlled directly by the delay angle control voltage supplied by the user at J3-10 or by adjusting a pot installed in the J10 location. In closed loop mode, the delay angle is controlled by the output of the voltage and current loops. It can be turned off fast by removing the contact closure between J3-4 and J3-6 or ramped down slowly by shorting J3-12 to J3-11. Either of these conditions will turn on the INHIBIT LED.

If one or all of the input phases are lost, the PHASE LOSS LED is illuminated and a fast turn off is initiated which inhibits all gate signals within 1mS. When the lost phase is restored, the unit will ramp up to the programmed delay angle in 400mS.

If the optional temperature sensing circuit is used, the OVERTEMP LED will be illuminated and the gate signals are inhibited 1mS after the over temperature threshold is exceeded. The default value for the over temperature threshold is 90°C. The gate signals will ramp up to the programmed value after the heatsink temperature drops to 85°C. This value of thermal hysteresis can be modified to suit the customer's requirements.

## **DIP Switch Settings**

### **Open Loop Mode**

In Open Loop mode, the delay angle controlling when the SCRs are fired is directly controlled by either a voltage input to J3-10 or by a pot mounted in the J10 location. When the voltage applied to J3-10 is 5 volts (also when the pot in J10 is rotated fully CW), the delay angle is a minimum producing maximum output voltage. When the voltage applied to J3-10 is 0 volts (also when the pot in J10 is rotated fully CCW), the delay angle is maximum, producing a minimum output voltage.<sup>1</sup>

To configure the BAP1950A as an open loop controller, slide the leftmost switch on the dip switch to the lower position. Depending on whether the SCRs are configured as a converter (AC in, DC out) or AC controller (AC in, phase controller AC out) will determine the position of the second switch. If the BAP1950A is not working with another BAP1950A as a Master or Slave, then the last three switches should be as shown in **Figure 1**, up down down.

<sup>1</sup> In a converter topology that produces only positive DC output voltage and current, the SCRs will not begin to conduct until the voltage is  $\geq 1.75$  volts at J3-10 (there will be a deadband in the pot as it is turned CW from fully CCW). In an AC controller topology, the SCRs will begin to conduct when the voltage applied to J3-10 is just above 0 (or when the pot is initially rotated CW from fully CCW).

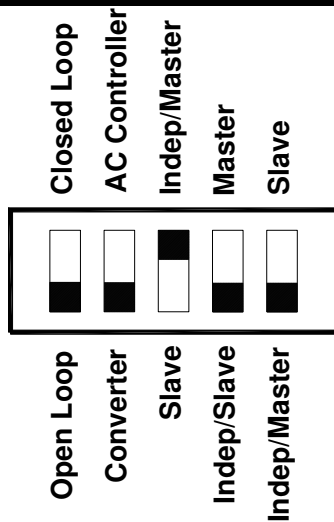


Figure 1: Open Loop mode DIP switch settings.

**Closed Loop Mode**

In Closed Loop mode, the delay angle is determined by the outputs of the control loops on the BAP1950A. A slow outer voltage loop drives a fast inner current loop that then determines the magnitude of the delay angle control voltage. The DC power supplies illustrated in Figures 8 and 9 utilize the closed loop function of the BAP1950A and require voltage and current feedback. The DIP switch settings for the Figure 8 application should be as indicated in Figure 2 below.

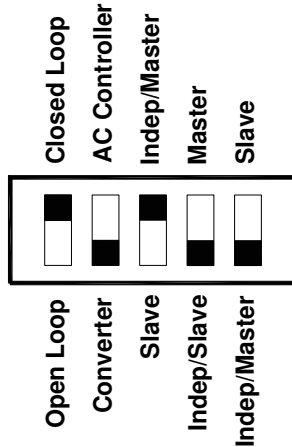


Figure 2: Closed Loop mode converter topology

If the AC controller topology in Figure 9 is used, simply slide the second switch from the left down to the lower position.

**Master/Slave Configuration**

If two or more boards are connected in a Master/Slave configuration, then the DIP switches on each board must be set up accordingly. The voltage loop of the Master will control its own current loop as well as the current loop of the Slave unit. Therefore, the DIP switches of the **Master board** in Figure 10 will be set as in Figure 3 below.

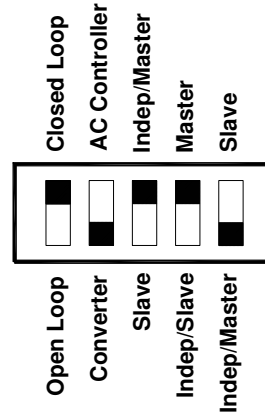


Figure 3: Master board DIP switch settings

For the **Slave board** in Figure 10, configure the DIP switch settings as in Figure 4 below.

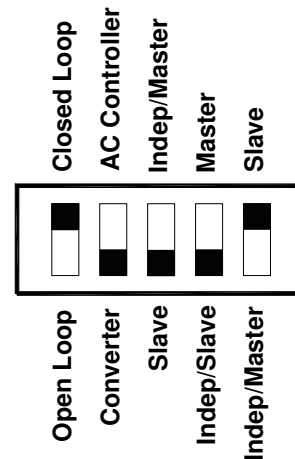
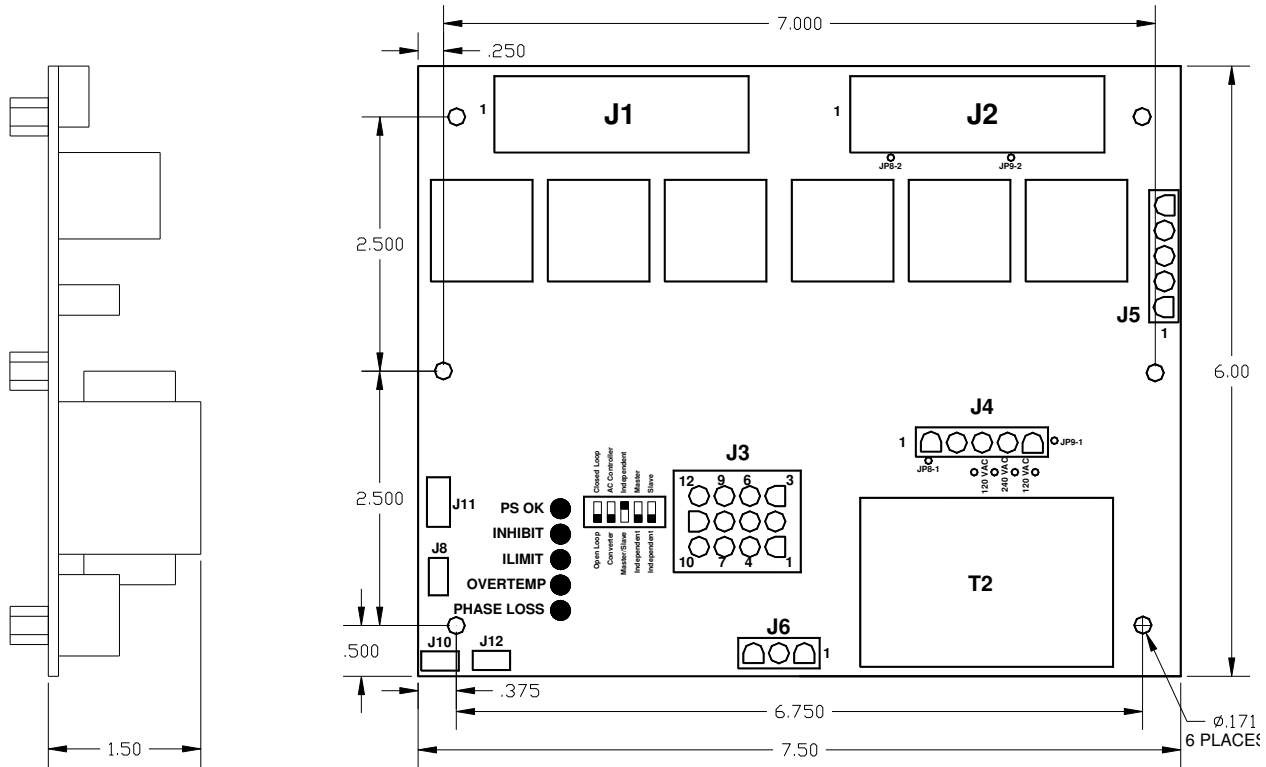


Figure 4: Slave DIP switch settings

**Connectors**



**Figure 5:** BAP1950A board layout and connector locations

**Gate Drive Connectors J1 and J2**

Two Mate-N-Lok™ type connectors allow for a convenient interface with the SCR gates. The mates for these connectors are supplied with the board along with keying plugs to eliminate the possibility of inadvertently swapping J1 and J2. Only one mating connector is included if the board is to be used in a semi converter application.

Each connector has three pairs of wires to drive three SCRs. J1 is configured to drive the three upper SCRs in a converter topology or the three SCRs with the anodes connected to the utility in an AC controller topology.

J2 is configured to drive the three lower SCRs in a converter topology or the three SCRs with the cathodes connected to the utility in an AC controller topology. For this reason, the phase reference signals are obtained from the J2 connector. Therefore, if an AC controller or a semi converter is being controlled by the BAP1950A without using J2, J5 must be used to obtain the reference signals.

**J1 Connector**

Pin	Signal Name	Description
1	A+ Gate	Gate signal for phase A, upper SCR in converter
2	A+ Cathode	Reference for A+ Gate signal
3	Keying Plug	
4	B+ Gate	Gate signal for phase B, upper SCR in converter
5	B+ Cathode	Reference for B+ Gate signal
6	Blank	
7	C+ Gate	Gate signal for phase C, upper SCR in converter
8	C+ Cathode	Reference for C+ Gate signal

**J2 Connector**

Pin	Signal Name	Description
1	A- Gate	Gate signal for phase A, lower SCR in converter
2	A- Cathode	Reference for A- Gate signal; used to derive phase A reference
3	Blank	
4	B- Gate	Gate signal for phase B, lower SCR in converter
5	B- Cathode	Reference for B- Gate signal; used to derive phase B reference
6	Keying Plug	
7	C- Gate	Gate signal for phase C, lower SCR in converter
8	C- Cathode	Reference for C- Gate signal; used to derive phase C reference

**Control Signal Connector J3**

The control signal connector is the BAP1950A interface to the system controller. The table below describes the pin functions of J3

When the BAP1950A is being used in open loop mode with an external controller, the delay angle is proportional to the voltage applied to J3-10. The voltage applied to J3-10 can be from an external power supply referenced to J3-8 or J3-11. It can be obtained from a pot with one end tied to J3-7 the other tied to J3-8 or 11 and the wiper tied to J3-10. It can also be obtained by installing a pot in the J10 location on the board. Regardless of how the voltage is applied, 5 volts at J3-10 will result in a minimum delay angle (maximum voltage) and 0 volts will correspond to a maximum delay angle (minimum voltage).

When the BAP1950A is configured as a DC power supply, J3-10 no longer controls the delay angle. By sliding the leftmost DIP switch up to the closed loop position, the delay angle is now controlled by the output of the voltage and current control loops on the BAP1950A. The rest of the pins on J3 perform the same function in open loop or closed loop mode. An explanation of the feedback connectors required for

closed loop mode and how they should be wired is included in the DC power supply option section later in this document.

To enable the board, J3-4 must be pulled up to at least 5 volts. This can be accomplished by jumpering J3-4 to J3-6 (or J3-7) or the user can make this connection via a relay contact to instantly inhibit the SCR firing by opening up the contact.

The Soft Start / Soft Stop function is controlled by J3-12. A connection between J3-12 and J3-8 (or J3-11) will result in a soft stop condition, which is the SCR firing pulses ramping down to a maximum delay angle in 100mS. When this connection is opened, a soft start cycle will begin, which is the SCR firing pulses ramping up to a minimum delay angle in 400mS.

The BAP1950A annunciates to the user anytime the SCR firing pulses are inhibited by allowing J3-9 to be pulled up to a voltage determined by the user. Under normal running conditions, J3-9 is terminated through a 1KΩ resistor.

This Inhibit annunciate pin can be pulled high in a phase loss condition, if J3-4 is not pulled high, an over temperature condition has occurred or when the BAP1950A is not phase locked to the utility input

Pins J3-,2,3,6,and 7 are power supplies available to the user with limited drive capability. If the maximum currents indicated in the table are exceeded, damage will result on the board

### J3 Connector

Pin	Signal Name	Description
1	24 VAC	From secondary winding of T2. 100mA available for customer use.
2	24 VAC	From secondary winding of T2. 100mA available for customer use.
3	24 VDC	100mA available for customer use.
4	Fast Turn off	Shorting this to pin 6 or 7 enables the board. Letting it float will disable gating signals within 1mS
5	Master/Slave	This pin is used when 2 or more boards are configured as Master/Slaves.
6	15 VDC	25mA available for customer use.
7	5 VDC	25mA available for customer use.
8	GND	Reference for BAP1950A control circuitry including delay angle control, therefore it must be tied to reference for delay angle control
9	Inhibit Annunciate	Normally low through a 1k resistor. Transitions high in a Fast turn off or in an out of phase lock condition.
10	Delay Angle Control	0 to 5 V analog input to control delay angle. 0V → Max Delay Angle; 5V→ Min Delay Angle
11	GND	Reference for BAP1950A control circuitry including delay angle control, therefore it must be tied to reference for delay angle control
12	Soft Start/Stop	When it transitions from a contact closure to pin 11 to an open circuit the delay angle ramps down from maximum to programmed value. If the board is running, when it transitions from an open circuit to a contact closure to pin 11, the delay angle ramps up from the programmed value to the max value.

### **Power Supply Connection Options J4**

The necessary power supplies to run the logic on the board and drive the SCR gates are generated through T2. There are several options for applying input power to T2:

1. Apply 120VAC across J4-1 and J4-5 install both 120 VAC jumpers between J4 and T2 (see Figure 5).
2. Apply 240VAC across J4-1 and J4-5 install center 240 VAC jumper between J4 and T2
3. Remove J4, connect JP8-1 to JP8-2 and connect JP9-1 to JP9-2. The user must indicate the voltage applied to T2, i.e. the voltage being controlled by the SCRs, so that the correct transformer can be installed in the board.
4. 480 VAC input transformer available upon request.

#### J4 Connector

Pin	Signal Name	Description
1	VAC input	AC Input to transformer T2; 120 VAC or 240 VAC
2	Blank	
3	Blank	
4	Blank	
5	VAC input	AC Input to transformer T2; 120 VAC or 240 VAC

#### **Phase Reference Options J5**

The default method of deriving references is to sense the cathodes of the three SCRs on J2 that are connected to the input voltage. This is a convenient point to obtain the utility inputs, which are then attenuated and filtered so they can be phase locked to the delayed gate commands. The magnitude of the utility input must be known when the board is ordered so that the correct components are inserted into the interface circuitry on the board.

Phase references may also be obtained by using auxiliary connector, J5. J5 is a Mate-N-Lok™ series connector that may be used if the circuit topology does not allow the input voltage to be sensed via the SCR cathodes normally available on J2. It is important to connect J5-1 to the input phase that is controlled by J2 pins 1 & 2, J5-3 to the input phase that is controlled by J2 pins 4 & 5, and J5-5 to the input phase controlled by J2 pins 7 & 8 (see **Figure 3**).

#### J5 Connector

Pin	Signal Name	Description
1	Phase A Reference	Reference input for phase controlled by gate drives on J1/J2 pins 1 & 2
3	Phase B Reference	Reference input for phase controlled by gate drives on J1/J2 pins 4 & 5
5	Phase C Reference	Reference input for phase controlled by gate drives on J1/J2 pins 7 & 8

#### **High Voltage Feedback J6**

If the closed loop option is ordered, the DC output of the power supply is brought back to the board via J6. An isolation amplifier on the BAP1950A board attenuates the high voltage and isolates it from the

output so that the feedback can be referenced to the signal ground.

#### J6 Connector

Pin	Signal Name	Description
1	Output Voltage	DC output voltage up to 1000V; tied to the cathodes of upper SCRs, or after filter in a converter topology
2	Blank	
3	Output Reference	DC output reference; tied to the anodes of the lower SCRs in a converter topology

### **Current Limit Control J8**

The value of current at which the power supply will fold back can be adjusted with a remote pot connected to J8 or on-board pot installed in the J8 location. A 10 kΩ pot should be used in this application.

The BAP1950A allows the user to incorporate this feature in open loop or closed loop modes. Current feedback provided at J11 by an open loop Hall Effect sensor and a current limit controlling pot installed locally or remotely at J8 is all that is required.

Rotating J8 to the fully CW position will result in maximum output current, determined by the size of the Hall Effect Sensor and resistor scaling on the BAP1950A. Rotating the pot in the CCW will reduce the amount of current output from the SCRs. This feature allows the BAP1950A to operate as a current source in open or closed loop mode.

### **J8 Connector**

Pin	Signal Name	Description
1	High Side	Connected to the high side of the pot
2	Pot Wiper	Connected to the wiper of an external 10K pot
3	GND	Connected to the low side of the pot

### **Remote Voltage Control J10**

The output voltage of the power supply can be controlled remotely with an external pot (the minimum pot used in this application should be a 1K) or a 0 to 5V signal. This connector can be replaced with a board mounted 10K pot to control

the power supply output voltage, or the phase angle in open loop mode. The 5V reference at J10-1 has a limited source capability of 10 mA. Therefore, it should not be used for any circuitry other than the pot.

### **J10 Connector**

Pin	Signal Name	Description
1	5V Reference	Precision 5V reference created on board used to control output voltage; limited to 10 mA. Connected to the high side of the pot.
2	Pot Wiper	Connected to the wiper of an external pot. This pin can also be driven by a remote voltage source referenced to pin 3, where 0V is 0V on the output and 5V is the full-scale output.
3	GND	GND; Connected to the low side of the pot

### **Current Feedback J11**

The BAP1950A provides a connectorized interface to an open loop current transducer for current feedback to be used for an inner current loop and/or current limiting. The inner current loop enhances system performance by improving stability and allowing the user to set or vary a current limit. The 4 pin header on the board interfaces directly with the HAS and HAX open loop hall effect sensors from LEM, providing an inexpensive means for obtaining accurate current feedback.

The LEM current transducer can be placed on either side of the load. All diagrams show the current transducer on the positive load side, with the appropriate the current flow (arrow). If the current transducer is required on the negative side of the load, to eliminate floating the current transducer in high voltage supplies, for example, the current flow is reversed (arrow points away from the load).

### J11 Connector

Pin	Signal Name	Description
1	15 VDC	15 VDC
2	-15 VDC	-15 VDC
3	Current Feedback	Voltage proportional to the current sensed
4	GND	GND

### **Temperature Sense J12**

A temperature sensor can be used to interface with the board via J12. The temperature sensor can be mounted on a heatsink to prevent the SCRs from operating at a temperature beyond their ratings. A threshold can be set on the board, so that when

the temperature is exceeded, the BAP1950A will inhibit SCR gating and illuminate the OVERTEMP LED. The temperature sensor used is an LM-35A mounted near the hottest point of the heatsink. Selecting this option includes an LM-35 assembly that is to be mounted on the heatsink.

### J12 Connector

Pin	Signal Name	Description
1	15 VDC	15 VDC
2	Temp	Analog voltage proportional to temperature
3	GND	GND

## APPLICATIONS

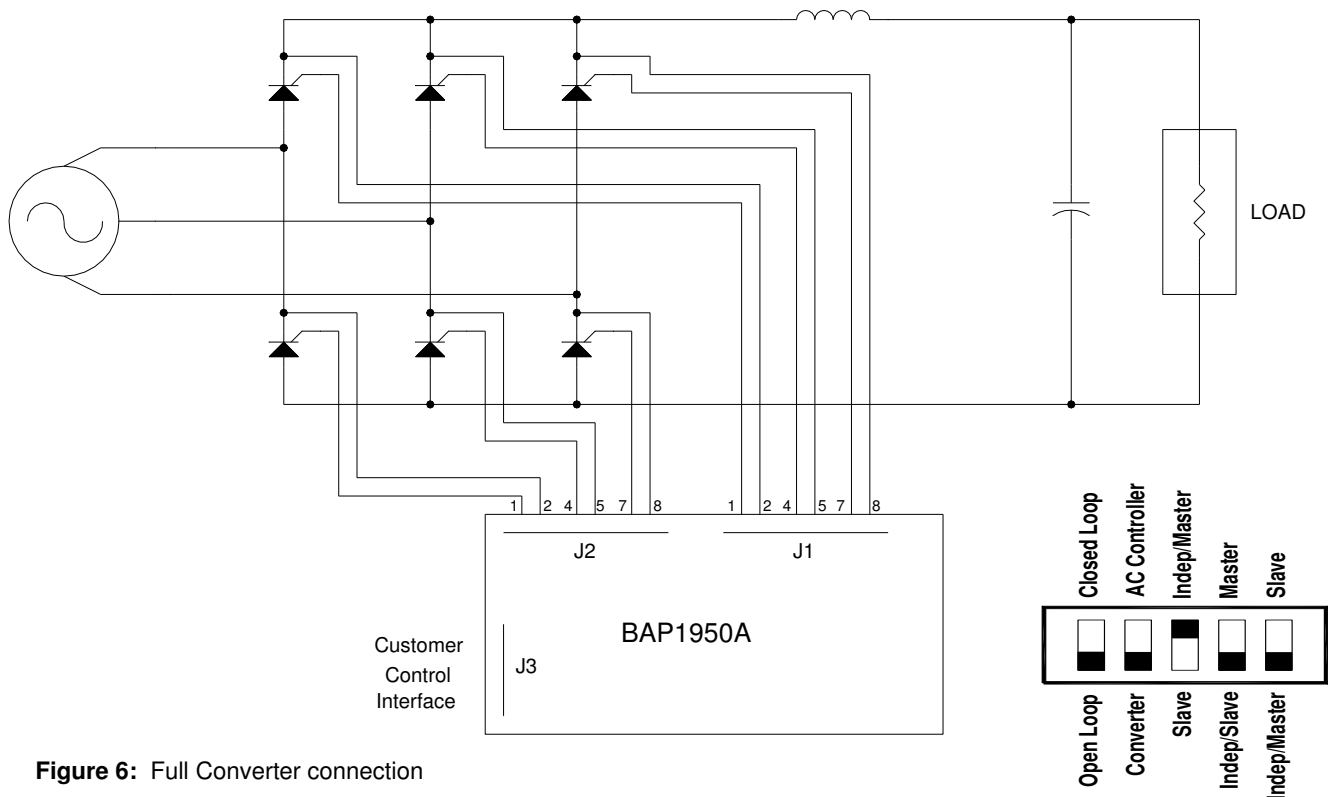
The following will provide the user with an explanation of how the BAP1950A controls SCRs in several common applications, basic DC converter, regulated DC converter and AC Controller. These are the most common circuit topologies found in industry. Included is a functional description of the circuitry and instructions for connecting the BAP1950A in a system.

### **DC Power Supply – Full Control Converter**

The basic design of an SCR three-phase bridge power supply is shown in **Figure 6**, below. This is called a full converter, converting 3-phase AC into DC. Connections to the BAP1950A board are shown. The SCRs are connected to the BAP1950A with connectors J1 and J2. The customer control signals used to control the phase angle delay for

firing the SCRs is accessed via J3. See the J3 connector description on pages **6** and **7**.

When the BAP1950A is configured as an open loop AC to DC converter, see **Figure 6**, the phase angle delay is determined by the voltage (0V to 5V) applied to J3-10. The DIP switch is set to the positions indicated in **Figure 1**. The other connections on J3 are used as needed.



**Figure 6:** Full Converter connection

### **DC Power Supply - Half Control Converter**

The default means of deriving references, in a full control converter topology, is to sense the cathodes of the three SCRs on J2 that are connected to the input voltage. However, in a half-control configuration as shown in **Figure 7**, rectifiers replace the SCRs and no reference is available.

Phase references may be obtained by using auxiliary connector, J5. J5 is a Mate-N-Lok™ series connector that may be used if the circuit topology does not allow the input voltage to be sensed via the SCR cathodes normally available on J2. It is important to connect J5-1 to the input phase that is controlled by J1 pins 1 & 2, J5-3 to the input phase that is controlled by J1 pins 4 & 5, and J5-5 to the input phase controlled by J1 pins 7 & 8 (see **Figure 7** on the following page).

### **Regulated DC Power Supply**

Designing a regulated DC power supply requires setting the DIP switch settings to those indicated in **Figure 2** and installing the isolation amplifier circuitry on the board. This allows the design of a DC voltage regulation loop with an adjustable current limit as well as an inner current loop for stability. Information must be provided to APS when ordering, regarding the system's output filter and required step response so that error amplifier compensation components can be selected. Computer simulations of the system's

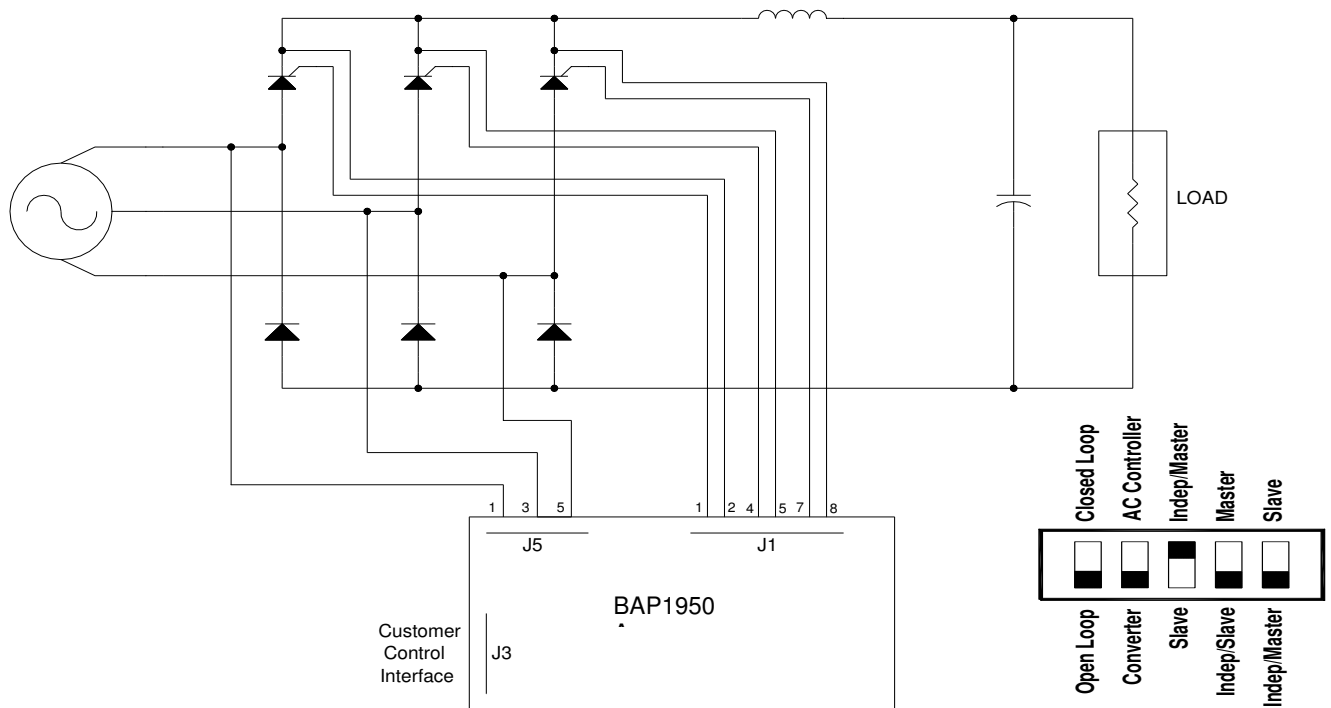
dynamic performance can be performed at APS to determine the compensation components that will optimize system response and ensure stability. With this information, one can use the BAP1950A board in the circuit configurations shown in **Figures 8 and 9**.

**Figure 8** is the most common circuit used for regulated power supplies. The BAP1950A board has the optional isolation amplifier and compensating components installed. In addition, a Hall Effect

current transducer is employed for current feedback to the BAP1950A. In order to optimize the performance of the system, the user must inform APS of the filter (capacitor and inductor) values. This will allow us to install the proper values of compensating components to insure proper operation, stability and response.

**Figure 9** is another common circuit employed for regulated DC power supplies. This topology is used when the output voltage is higher than 600V to 1kV

rms. The advantage of this topology is that the mains voltage is usually below 600V rms and SCRs with blocking voltages below 2kV can be used. It is usually easier to put rectifiers in series strings than it is to put SCRs in series. In addition, the current rating of the input mains SCRs is usually lower than they would be in the transformer secondary circuit. Depending on the specifics, the SCR and rectifier total costs may be lower with the circuit topology in **Figure 9** than the circuit topology in **Figure 8**.

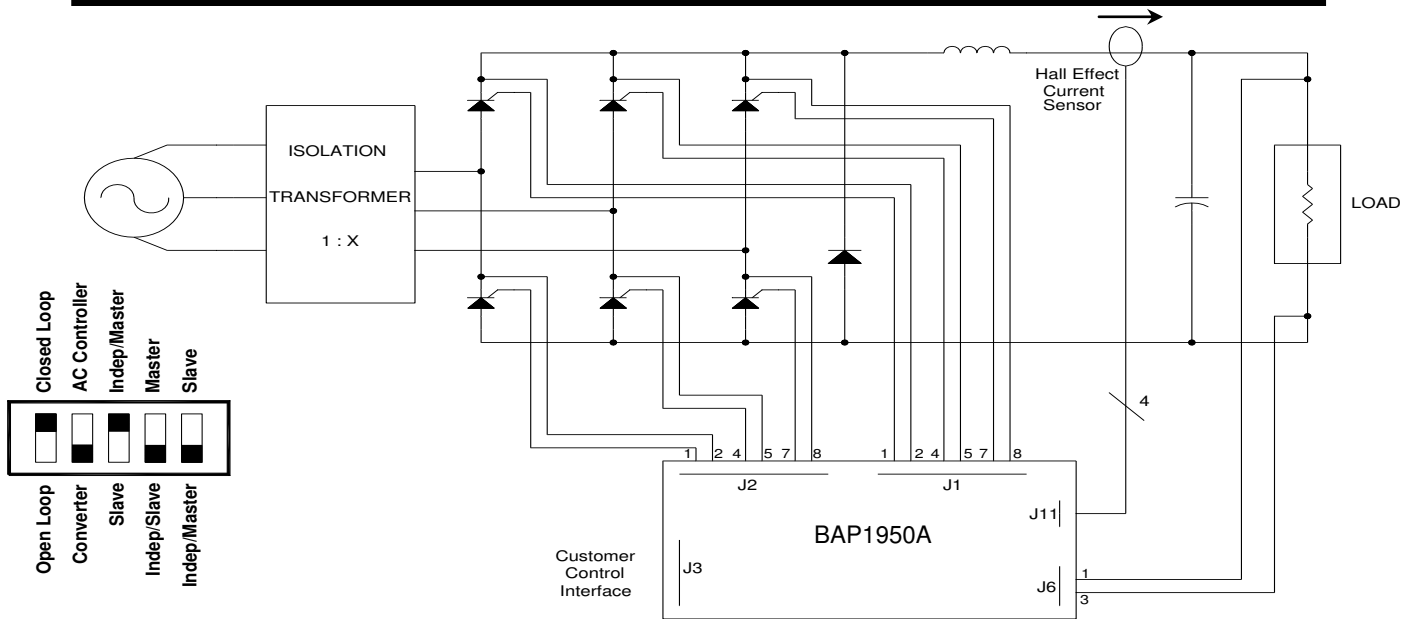


**Figure 7:** Sensing input voltage with auxiliary connector J5 to obtain phase reference, with half-control topology.

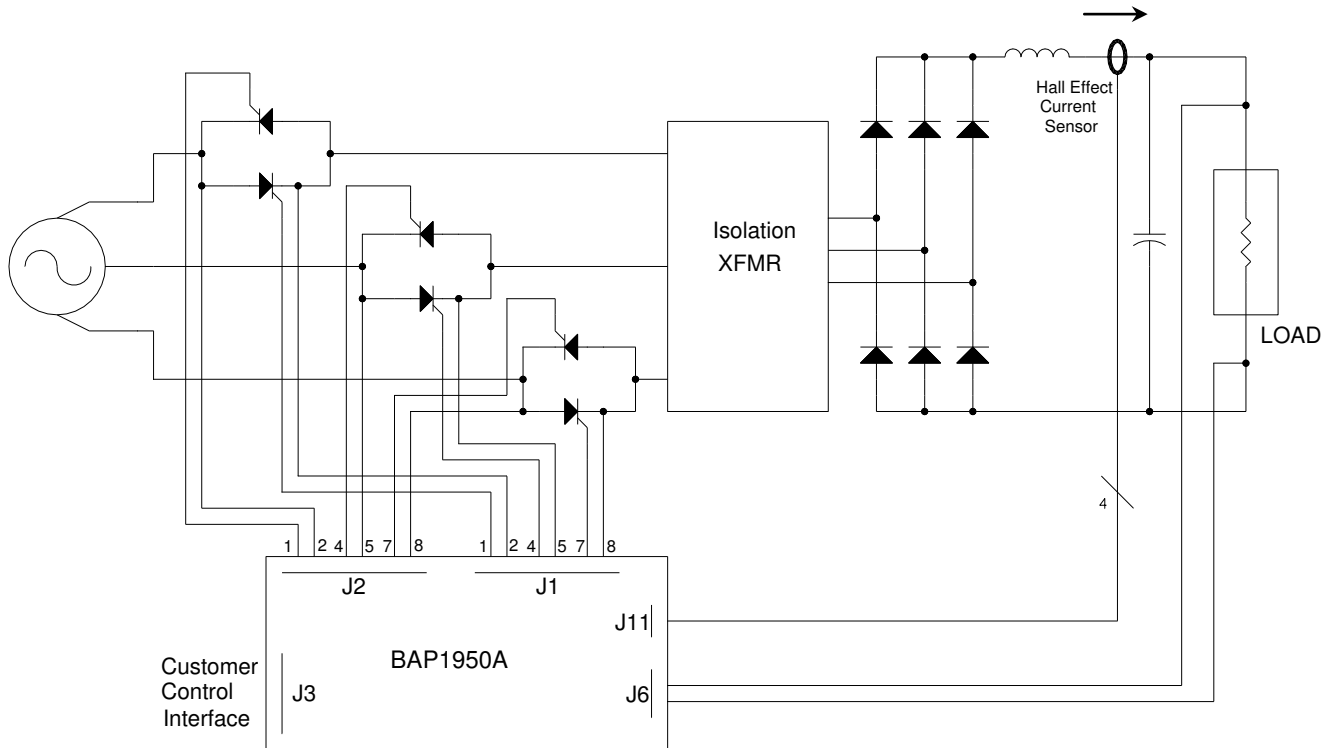
### Higher than Six Pulse Operation

If 12 pulse open loop regulation is required, one BAP3012 Controller may be used. If 18 pulse or higher is required, then several BAP1950A boards may be set up in a Master Slave configuration. The Master board will have the DIP switch settings as indicated in **Figure 3** and the slave boards will have the DIP switch settings as shown in **Figure 4**. The output of the voltage error amplifier of the master board will be exported out to J3-5 and it will

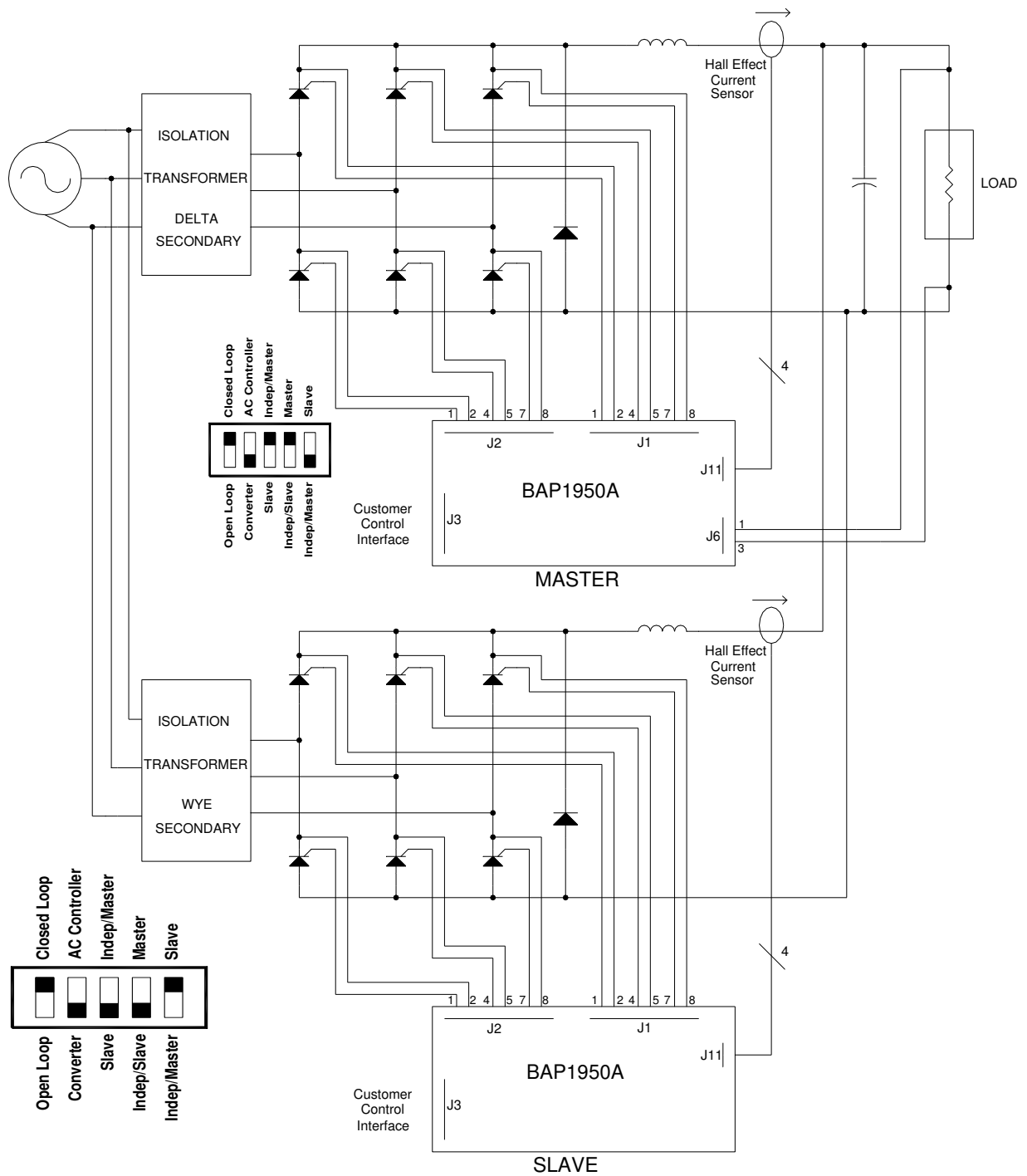
be imported on J3-5 of the slave boards. This voltage error signal will be the input to the current loop for the master as well as the slaves. The output of the current loops will determine the conduction angle of the SCRs. A DC power supply with a 12-pulse rectifier using two BAP1950As in a master/slave configuration is illustrated in **Figure 10**.



**Figure 8:** Basic regulated DC power supply using the closed loop option of the BAP1950A board.



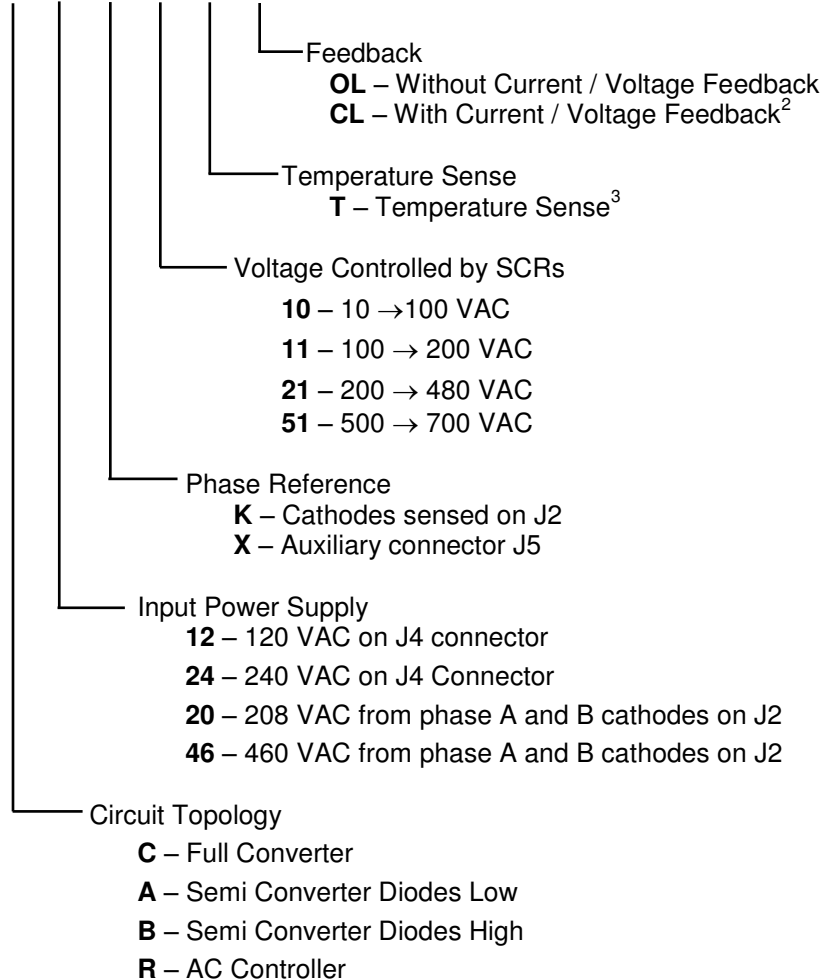
**Figure 9:** DC regulated power supply using AC Controller topology



**Figure 10:** DC regulated power supply with paralleled converters using Master/Slave configuration  
**(Note:** If closed loop control is not required, one BAP3012 controller may be used in place of the two BAP1950A controllers)

**Ordering Information:**

***BAP1950A-X-XX-X-XX-X-XX***



**A complete part number, as well as the information requested on the last page must be submitted when requesting a quote or placing an order.**

<sup>2</sup> **Closed loop option requires the following information:**

1. Full scale output voltage (1kVdc max.)
2. Maximum output current
3. Current sensor being used (mfg. and part number)
4. How will output voltage and current limits be controlled?
  - a. If using potentiometers, are they to be on-board or off-board?
  - b. If providing voltages, what is full-scale voltage?

<sup>3</sup> Consult factory for Over Temperature threshold settings – heatsink Over Temperature set-point can be set between 40°C and 100°C.

**Additional information required for BAP1950A Ordering**

**Full Part Number of the board you are ordering:**

**BAP1950A-**\_\_\_\_\_

What is full scale output voltage?	
What is the full scale output current?	
If ordering a Closed Loop version (-CL), what Hall Effect current sensor is being used? <b>NOTE:</b> the BAP1950 only supports open loop Hall Effect current sensors such as the LEM HAS series.	
Do you prefer on-board potentiometers, off-board pots (board will be supplied w/ 3 pin headers) or a signal voltage to control $V_{prog}$ and $I_{limit}$ ?	
If not using pots to control $V_{prog}$ and $I_{limit}$ , then what will the input signal be to control these functions? $V_{prog}$ : 0 – 10V, 0 – 5V, or 4-20mA? $I_{limit}$ : -5V – 0	
What is the AC voltage frequency? 50, 60, 400Hz; other	
What is the type of load? (ie: resistive, inductive, other)	

Please supply this information with your order or RFQ as well as any other details specific to the application.