PACIFIC SCIENTIFIC
OECO

F.W. BELL®

Current and Voltage Sensors/Hall Generators

PRODUCT CATALOG

PACIFIC SCIENTIFIC
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www.oeco.com

http://www.oeco.com

Looking for faster, smaller, feature rich Current and Voltage Sensors? Then look to F.W. Bell products from Pacific Scientific-OECO, where you can expect a superior level of performance, satisfaction and support that can only come from a world leader. We provide the industry's most extensive, trusted product line of standard and custom Current Sensor Solutions.

F.W. BELL®

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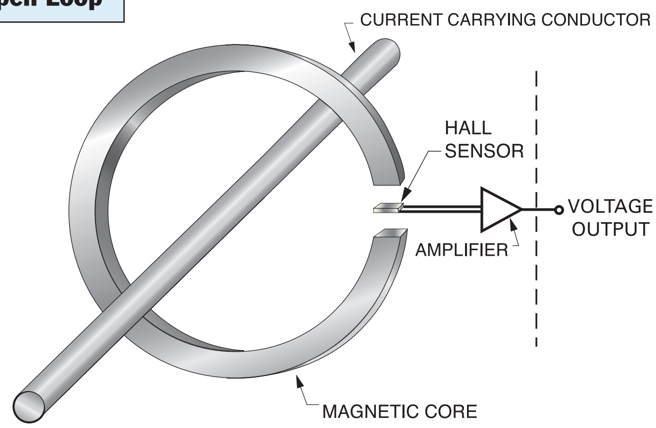
Open Loop



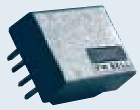
An open loop current sensor consists of a Hall Sensor mounted in an air gap of a magnetic core. The current carrying conductor placed through the aperture of the sensor produces a magnetic field that is proportional to the current. The field is concentrated by the core and measured by the Hall Sensor. Most open loop sensors contain circuitry to provide temperature compensation and calibrated high level voltage output. Most open loop current sensors measure DC and AC currents and provide electrical isolation between the circuit being measured and the output of the sensor. Typically, open loop sensors cost less than closed loop sensors. They are preferred in battery powered circuits due to their low operating power requirements.

Product	Drawing Number	Rated Current	Supply Voltage	Rated Output	Currents Measured	Frequency Range from DC	Overall Accuracy	Operating Temperature	Sensing Technology	Mounting
Units		± Amps	VDC	V		kHz	% of In @ 25˚C	˚C		
MS-15	1	15	+5 ±0.5	V_{DD} - 0.34	AC/DC	20	±5.0	-40 to +85	Open Loop Hall Effect	PCB
IHA-25	2	25	±12 to ±17	±1		50	±2.5	0 to +75		Bulkhead
MS-30	1	30	+5 ±0.5	V_{DD} - 0.34		20	± 5.0	-40 to +85		PCB
IHA-100	2	100	±12 to ±17	±5		50	±2.5	0 to +75		Bulkhead
IHA-150	8	150								
BBP-150F	6	150	±15	±6		60	±2.0	-25 to +85		Panel
BBP-150H	7	150								Bulkhead
BBP-300H	7	300				10				
BBP-300F	6	300								Panel
PI-350	9	350	40mA DC	±.175 to .385		1	±5.0	-40 to +100		PCB
PI-600	9	600		±.150 to.330						
BBP-600F	6	600	±15	±6		10	±2.0	-25 to +85		Panel
BBP-600H	7	600								Bulkhead
IA-Series	4	100-3000		±10	DC	DC only	±1.5	-30 to +75		
IF-Series	5	100-3000			AC/DC	1				Panel
RSS-A Series	3	100-1000	+12 to +18	+6 ±1.6		25	±0.75	-40 to +85		Bulkhead/ Panel
CCP-20A	10	±20	+5 to +10	+/-10mV		5	±2.0	0-70		Clamp On
CSM-010-B	47	15A	4.75 to 12.5	2.5Vdc ±0.5%	±15A	50KHz	n/a	20 to +80		PCB
NA-25	35	±25A	±9V	±22.5 to ±62.5	AC/DC	1kHz	±1%	-40 to +85		Bulkhead

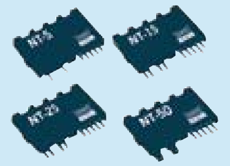
For complete specifications, please see our datasheets at: **www.oeco.com**

** Contact Engineering for information.*


MS-15


CDS

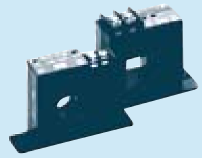

SCC/SCV-Series


NT Series


PI-600


IA Series


CLN-50SP1

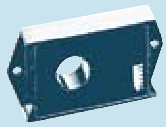

CS/CSS-150 Series

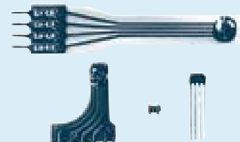

BH-700


IHA-150

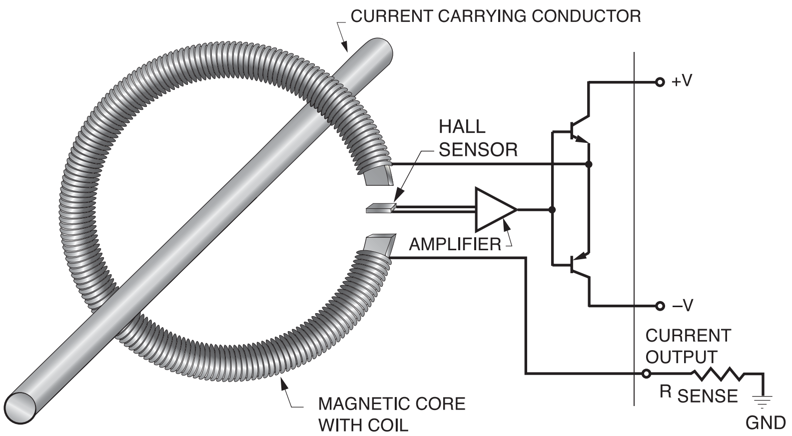

RSS-A Series


CLN-500SP1


BBP-600F


GH Series

Closed Loop



A closed loop current sensor consists of a Hall sensor mounted in an air gap of a magnetic core, a coil wound around the core and a current amplifier. The current carrying conductor placed through the aperture of the sensor produces a magnetic field that is proportionate to the current. This field is concentrated by the core and sensed by the Hall sensor. The Hall sensor is connected to the input of the current amplifier, which drives the coil. The current through the coil produces an opposing field to that provided by the current through the aperture, thus the flux in the core is constantly driven to zero. The coil connects to the output of the sensor. Therefore, the output is a current proportional to the aperture current, divided by the number of turns on the coil. A sensor with a 1000 turn coil provides an output of 1mA per ampere. The current output is converted to a voltage by connecting a resistor between the output of the sensor and ground. The output is scaled by selecting the resistor value. Closed loop sensors measure DC and AC currents and provide electrical isolation. They offer fast response, high linearity and low temperature drift. The current output of the closed loop sensor is relatively immune to electrical noise. They are the sensor of choice when high accuracy is essential.

For complete specifications, please see our datasheets at: **www.oeco.com**

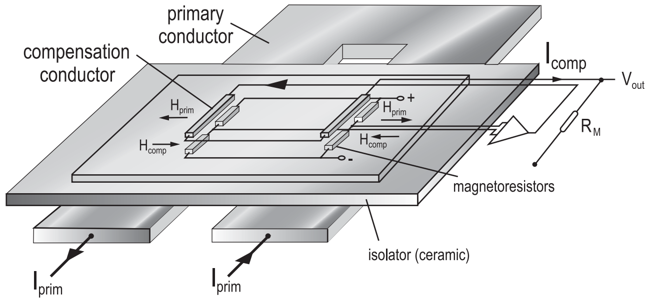
F.W. Bell Closed Loop Current Sensors

Product	Drawing Number	Rated Current (IN)	Supply Voltage	Rated Output	Currents Measured	Frequency Range from DC	Overall Accuracy	Operating Temperature	Sensing Technology	Mounting
Units		± Amps	V	mA		kHz	% of In @ 25˚C	˚C		
CLSM-05mA	11	5mA	±12 to ±18	±25	AC/DC	100Hz	±0.8	-40 to +85	Closed Loop Hall Effect	PCB
CLSM-10mA	11	10mA				100Hz	±0.5			
CLN-25	12	25	±12 to ±15			150				
CLSM-25	14	25	±12 to ±18			200				
CLS-25	13	25	±12 to ±15							
CLSM-25M	15	25	±12 to ±18							
CLN-50	16	50	±12 to ±15	±50		150				
CLN-50SP1	18	50								
CLSM-50	20	50	±12 to ±18			100		-25 to +85		
CLSM-50S	23	50				200				
CLSM-50MT	21	50	±15 to ±18			250				
CLSM-50LA	22	50				200		-40 to +85		Bulkhead
CLN-100	17	100	±12 to ±15	±100		150				PCB
CLN-100SP1	19	100								
CLSM-100	20	100	±15 to ±18	±50		250		-25 to +85		
CLSM-100S	25	100	±12 to ±18			200				
CLSM-100MT	21	100	±15 to ±18			250				
CLSM-100LA	24	100				200		-40 to +85		Bulkhead
CLSM-200LA	24	200	±15 to ±18	±100		150				
CLN-300	26	300	±12 to ±18	±150						
CLN-300SP1	28	300								
CLSM-300	27	300	±15 to ±18			150		-25 to +85		
CLN-500	30	500	±15 to ±24	±100		100		-40 to +85		
CLN-500SP1	29	500								
CLN-1000	31	1000	±12 to ±18	±200		150	±0.3			
CLSM-1000	32	1000	±15 to ±18			100	±0.5	-25 to +85		
CLSM-1000B	48	1000A	±15Vdc to ±24Vdc	250		100KHz		-40 to +70		
CLSM-2000	33	2000	±15 to ±24	±400		100		-25 to +85		

For complete specifications, please see our datasheets at: **www.oeco.com**

Magneto Resistive

In thin films of permalloy (Fe-Ni) material, the electrical resistance changes when an external magnetic field is applied in the plane of the film. This change is due to the rotation of the film magnetization. The variation of the resistance due to an external field is called the anisotropic magneto-resistive (AMR) effect, Due to a special design of the chip, the resistance change is proportional over a wide range of measured field.



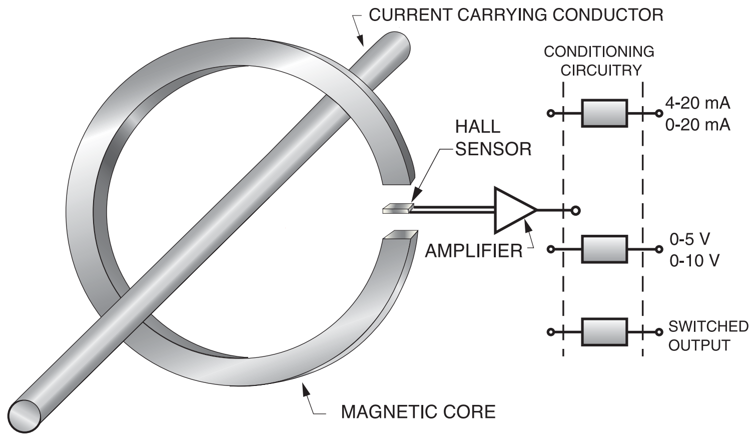
Product	Drawing Number	Rated Current	Supply Voltage	Rated Output	Currents Measured	Frequency Range from DC	Overall Accuracy	Operating Temperature	Sensing Technology	Mounting
Units		± Amps	VDC	V		kHz	% of In @ 25˚C	˚C		
NT-05	36	5	±12 to ±15	±2.5	AC/DC	100	±0.3	-25 to +85	Magneto Resistive	PCB
NT-15	37	15								
NT-25	38	25								
NT-50	39	50								
CMR-25	34	25	+5	±12.5 mA rms		200	±0.24	-40 to +85		
CDS 4006 ABC	40	6	+5	4.375*		200	0.8	-40 to +105		
CDS 4010 ABC	40	10								
CDS 4015 ABC	40	15								
CDS 4025 ABC	40	25								
CDS 4050 ABC/ACC	40	50								
CDS 4100 ACC	41	100								
CDS 4125 ACC	41	125								
CDS 4150 ACC	41	150								

** Output voltage is sealed by changing Rm, but not beyond this point.*

For complete specifications, please see our datasheets at: **www.oeco.com**

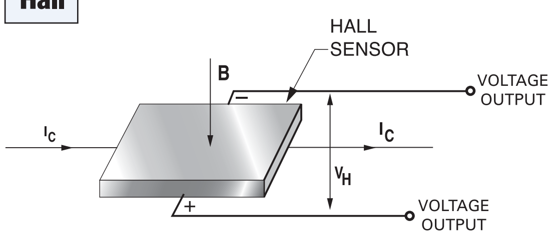
Industrial

The line of industrial current sensors offered by F.W. Bell covers a wide variety of features. Several of these sensors offer 4-20mA output levels, while some offer unidirectional voltage output. Many of these devices have clamping apertures, which means that they may be clamped around existing cables, without having to break their circuit. Some of these devices only measure AC currents, while others measure various levels of AC and/or DC current and provide a switch at the output. All of these devices are panel mounted, and most have jumper selectable full scale ranges.



Product	Drawing Number	Rated Current	Supply Voltage	Rated Output	Currents Measured	Frequency Range	Overall Accuracy	Operating Temperature	Sensing Technology	Mounting
Units		± Amps	V	V		Hz	% of In @ 25˚C	˚C		
PC-50	42	10/20/50	5-40 VDC	4-20mA	AC	20 to 100	±0.5	-20 to +50	Industrial	Bulkhead
PCS-50	43									
SCC-100C	44	50/75/100	20-50 VDC or 22-38 VAC rms	0-20mA	DC	DC only (unipolar)	±1.0			
SCC-100P	44			4-20mA						
SCV-100L	44			+5						
SCV-100H	44			+10						
PC-200	42	100/150/200	5-40 VDC	4-20mA	AC	20 to 100	±0.5			
PCS-200	43									
SCC-200C	44		20-50 VDC or 22-38 VAC rms	0-20mA	DC	DC only (unipolar)	±1.0			
SCC-200P	44			4-20mA						
SCV-200L	44			+5						
SCV-200H	44			+10						
SCC-300C	44	150/225/300		0-20mA						
SCC-300P	44			4-20mA						
SCV-300L	44			+5						
SCV-300H	44			+10						
CSS-150	46	150	self powered	Switch	AC	6 to 100	not applicable	-50 to +65		
CS-150	45			Switch						

Hall



A hall generator is a four-terminal, solid state device capable of producing an output voltage, VH, proportional to the product if the input current, I_C, the magnetic flux density, B, and the sine of the angle between B and the plane of the Hall sensor. A reversal in the direction of either the magnetic field or the control current will result in a polarity change of V_H. A reversal in the direction of both will keep the polarity the same. By holding the control current constant, the Hall voltage may be used to measure magnetic flux density. Multiplication may be accomplished by varying both the control current and the magnetic field.

For complete specifications, please see our datasheets at: **www.oeco.com**

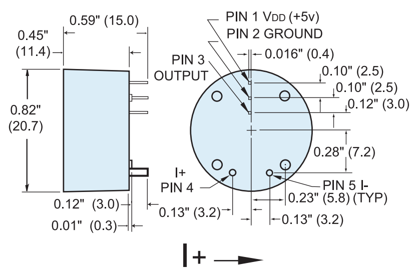
F.W. Bell Hall Sensors

Product	Magnetic Sensitivity	Max. Resistive Residual Voltage V_M @ B=0 Gauss $I_c = I_{cn}$	Input Resistance Rin	Output Resistance Rout	Nominal Control Current	Max Linearity Error	Operating Temperature
Units	mV/kG	± µV	ohms	ohms	mA	% of RDG	˚C
BH-900	.55 to 1.1	75	1.5 max.	1.5 max.	100	1.5	-40 to +100
BH-910						0.25	
BH-921						2	-269 to +100
BH-706	6 to 9	200	3 max.	3 max.		1	-40 to +100
BH-209	6.75 ±25%	100	2.5 max.		75	1.5	
BH-703	7 to 10	100	3.5 max.	3.5 max.	100	1	
BH-701	7.5 ±20%	75	2 max.	2 max.		0.25	
BH-704			2.5 max.	2.5 max.			
HS-100	8 min.	6mV	30 to 160	60 to 360	10	2	-55 to +185
BH-202	10 ±25%	100	3 max.	3 max.	100	1	-40 to +100
BH-203							
BH-205					125		
BH-705		300	2.2 max.	2 max.	100		-65 to +100
FH-301-020	10 min.	2mV	20 to 40	28 to 120	25	Call for specs	-55 to +100
FH-520							
BH-204	11 ±25%	200	3 max.	3 max.	100	1.5	-40 to +100
FH-301-040	12 min.	4mV	40 to 80	56 to 240	15	Call for specs	-55 to +100
FH-540							
FH-560		6mV	80 to 160	150 to 480	10		
BH-201	12 ±25%	250	3 max.	3 max.	100	1.5	0 to +100
BH-200	15 ±25%	100			150	1	-40 to +100
BH-207		200	2.7 max.	2.7 max.		1.5	
BH-850	18 min. (mV/G)	190	3.5 max.	3.5 max.	200	Call for specs	-55 to +85
BH-700	50 min.	1500	5.5 max.	5.5 max.		3	-40 to +100
GH-600	50 to 140	14mV	450 to 900	580 to 1,700	5	2	-55 to +125
GH-601							
GH-700				approx. 1,000			
BH-206	60 ± 25%	500	7 max.	5 max.	200		-40 to +100
SH-420	100 to 330	16mV	240 to 550	240 to 550	5	Call for specs	-40 to +110
SH-410	290 to 1,760	20mV					
SH-430							
BH-702	Call for specs	250	3.5 max.	3.5 max.	200		-55 to +100

For complete specifications, please see our datasheets at: **www.oeco.com**

All dimensions are in inches (millimeters)

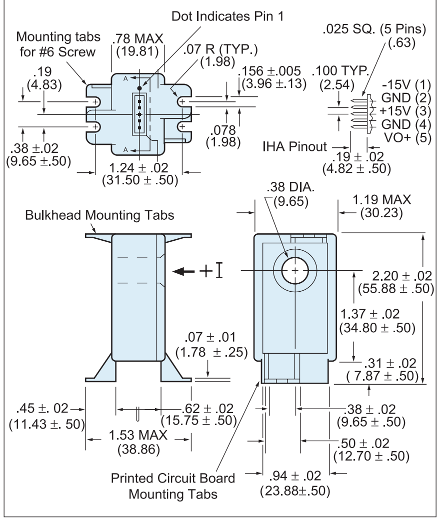
1 MS-15 / MS-30



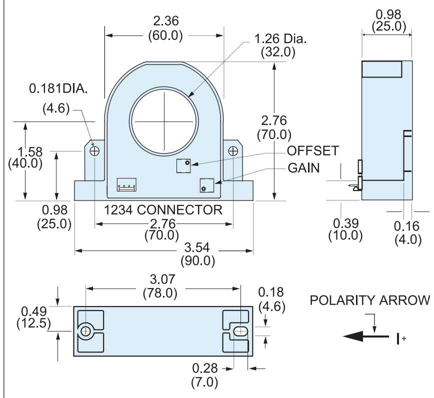
Pins 4,5: MS-15 (18 AWG) MS-30 (13 AWG)

Tolerance: ±0.01" (±0.254mm)

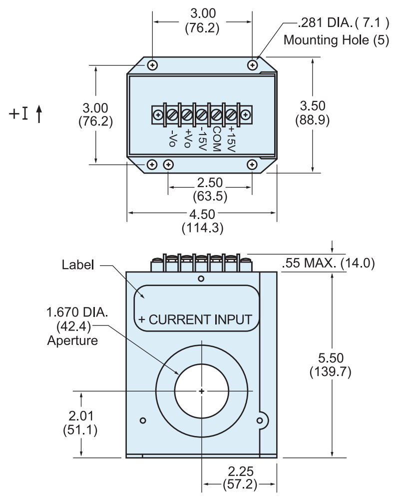
2 IHA-25 / IHA-100



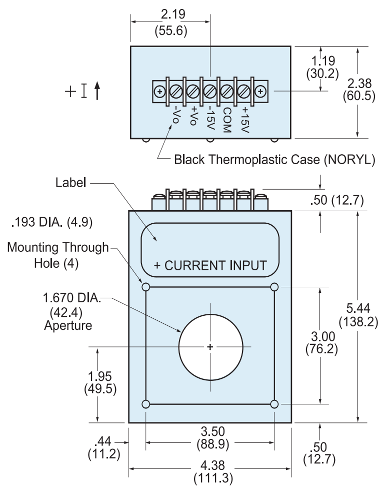
3 RSS-A



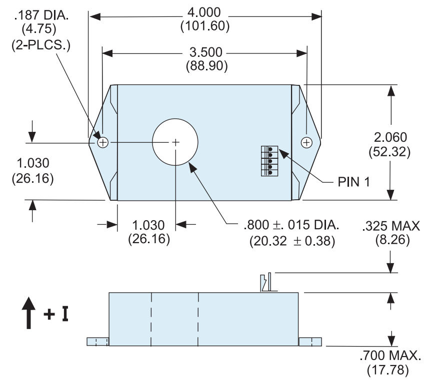
4 IA Series



5 IF Series



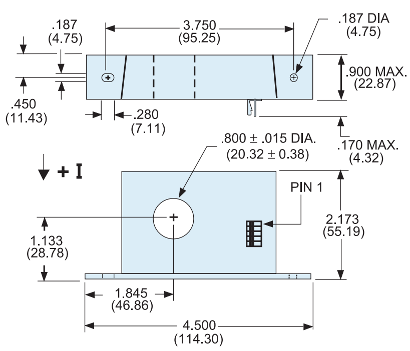
6 BBP-150F, 300F & 600F



ELECTRICAL CONNECTIONS

PIN	SIGNAL
1	Vo
2	Vo GND
3	GND
4	-Vcc
5	+Vcc

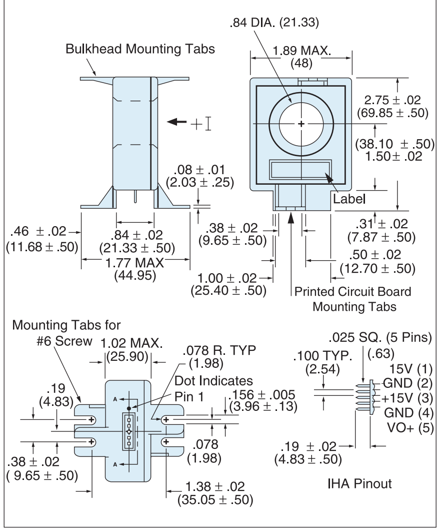
7 BBP-150H, 300H & 600H



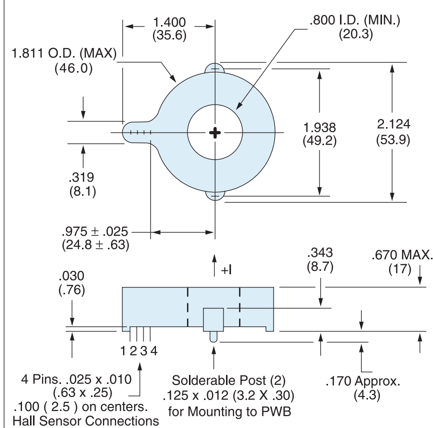
ELECTRICAL CONNECTIONS

PIN	SIGNAL
1	Vo
2	Vo GND
3	GND
4	-Vcc
5	+Vcc

8 IHA-150



9 PI-350 / PI-600



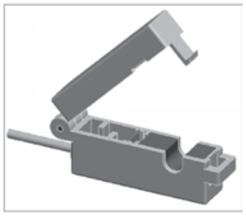
Pin Identification

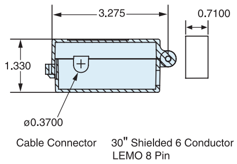
1	$-I_C$	Negative Control Current
2	$+V_H$	Positive Output Voltage
3	$-V_H$	Negative Output Voltage
4	$+I_C$	Positive Control Current

Note: due to continuous process improvement, all specifications are subject to change without notice.

All dimensions are in inches (millimeters)

10 CCP-20A

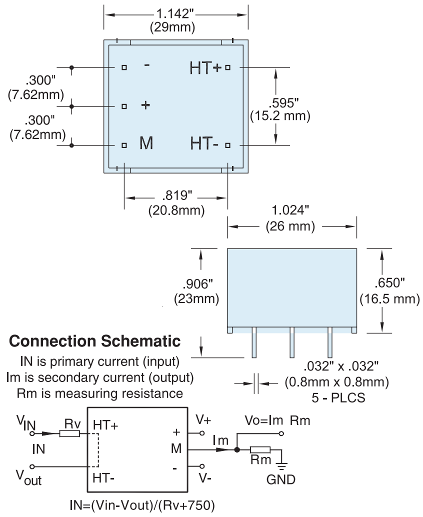




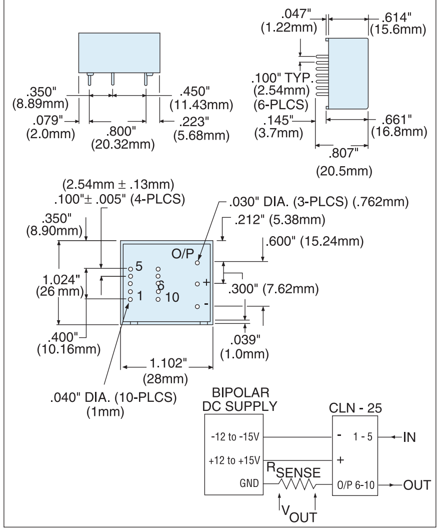
Connector Pinout

Pin #	Discription
1	+5V DC
2	VH–
3	VH+
4	–5V DC
5	Shield
6	+EID
7	–EID
8	N/C

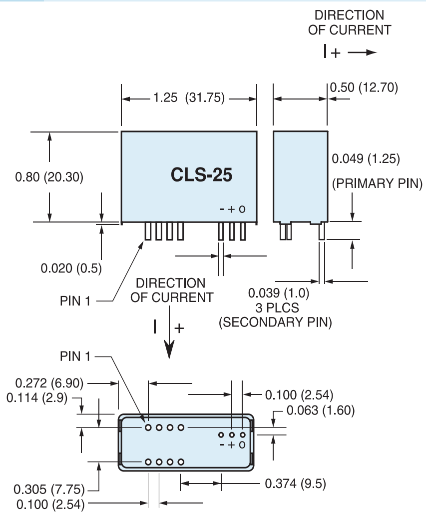
11 CLSM-05 / 10mA



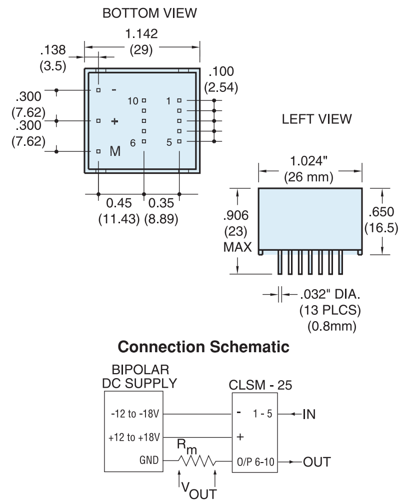
12 CLN-25



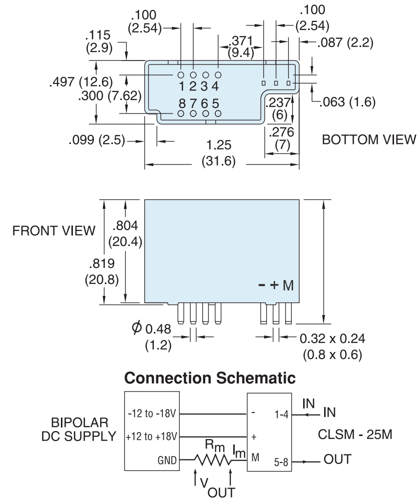
13 CLS-25



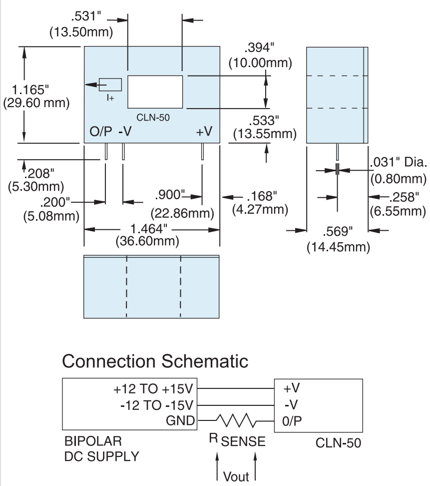
14 CLSM-25



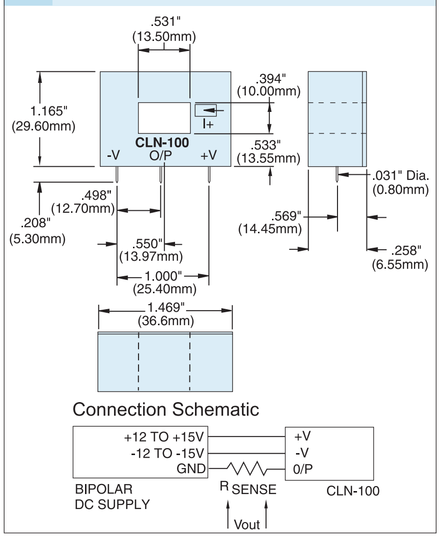
15 CLSM-25M



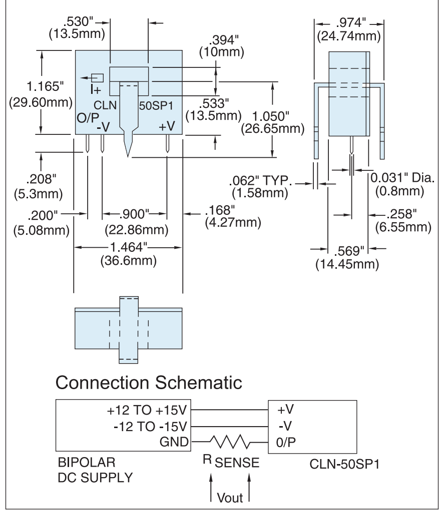
16 CLN-50



17 CLN-100



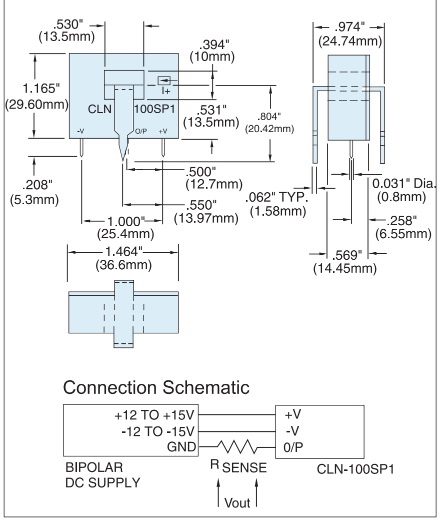
18 CLN-50SP1



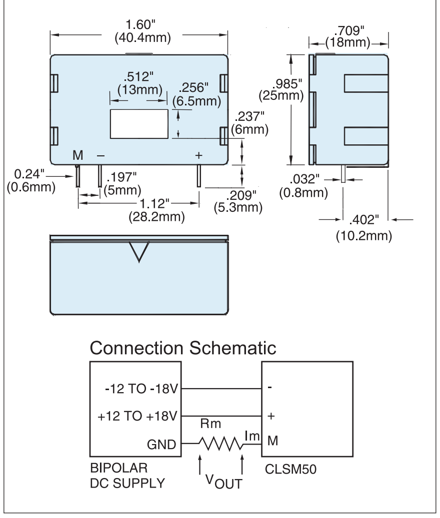
Note: due to continuous process improvement, all specifications are subject to change without notice.

All dimensions are in inches (millimeters)

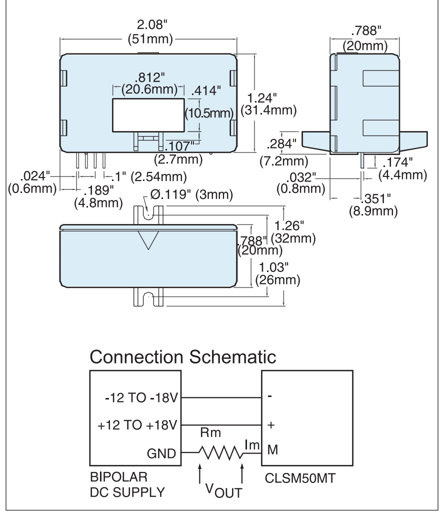
19 CLN-100SP1



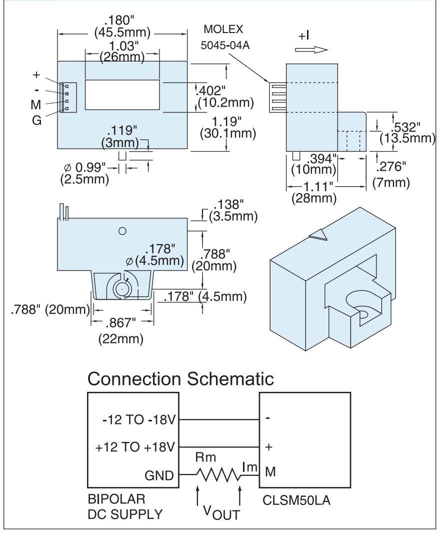
20 CLSM-50 / 100



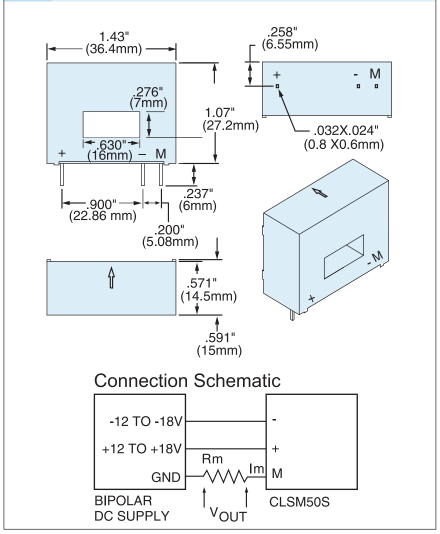
21 CLSM-50 / 100MT



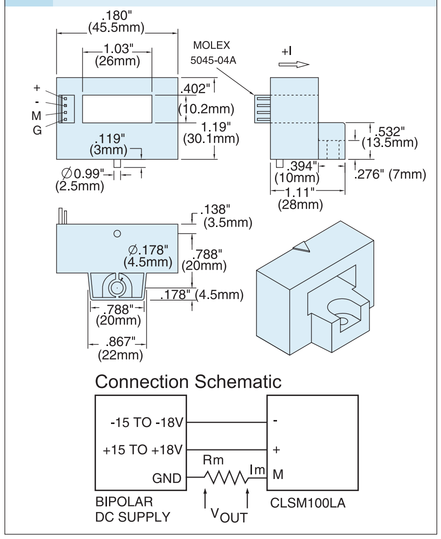
22 CLSM-50LA



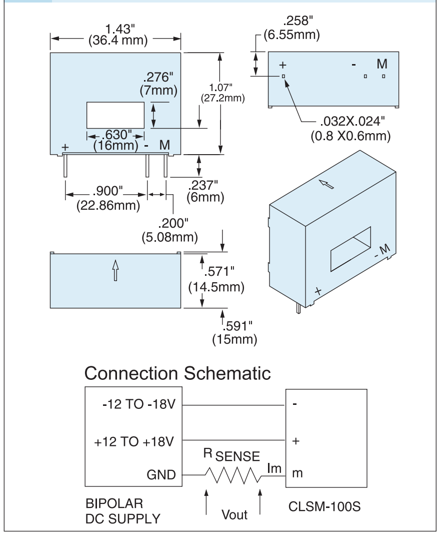
23 CLSM-50S



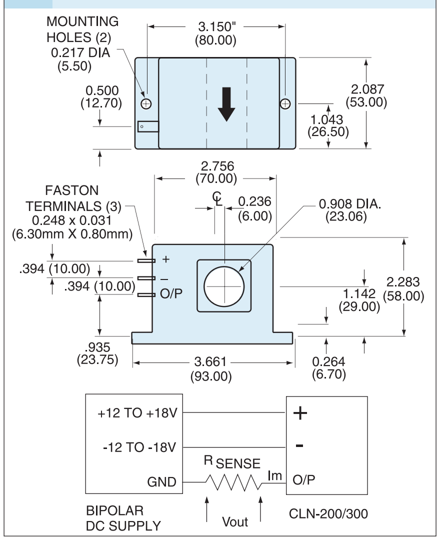
24 CLSM-100 / 200LA



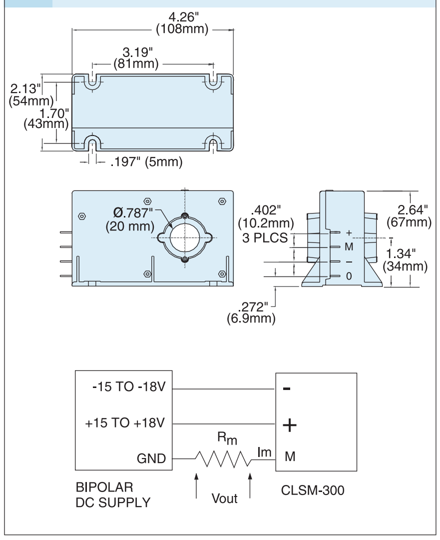
25 CLSM-100S



26 CLN-300



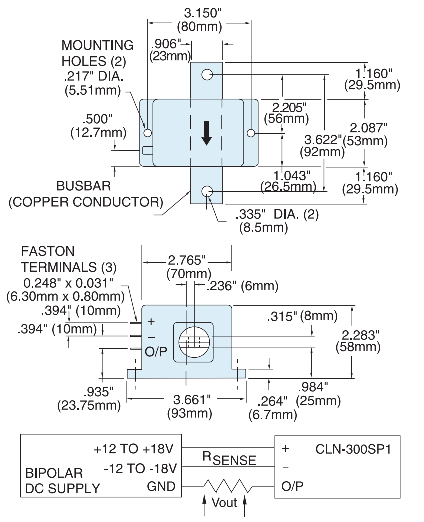
27 CLSM-300



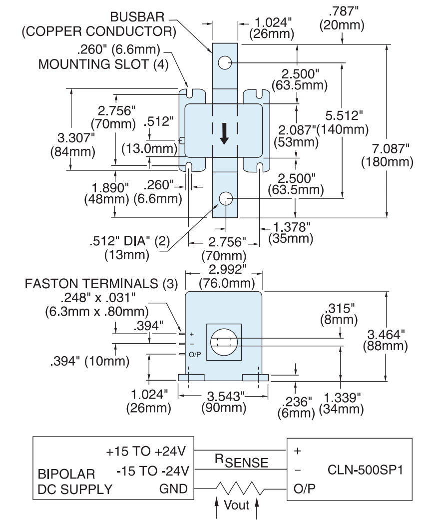
Note: due to continuous process improvement, all specifications are subject to change without notice.

All dimensions are in inches (millimeters)

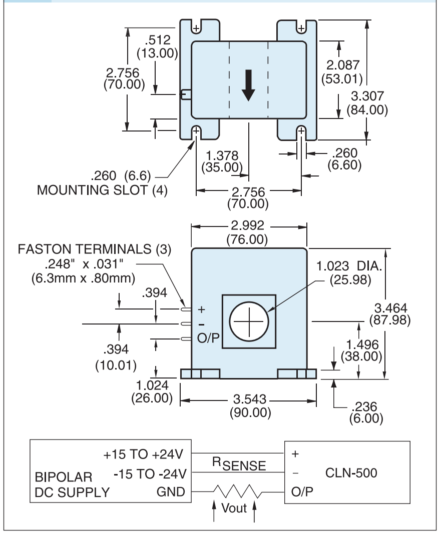
28 CLN-300SP1



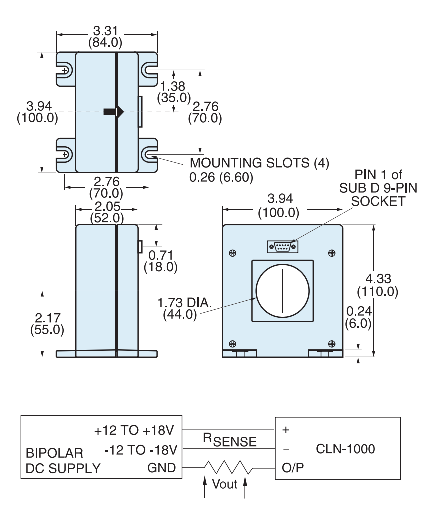
29 CLN-500SP1



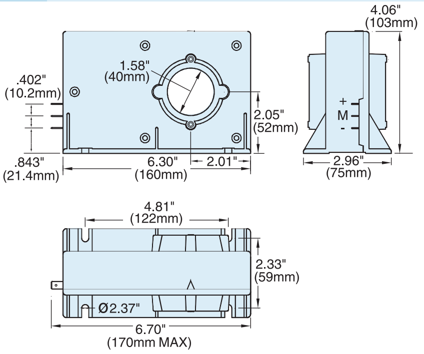
30 CLN-500



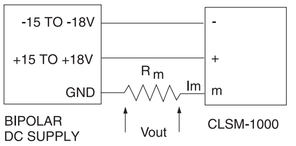
31 CLN-1000



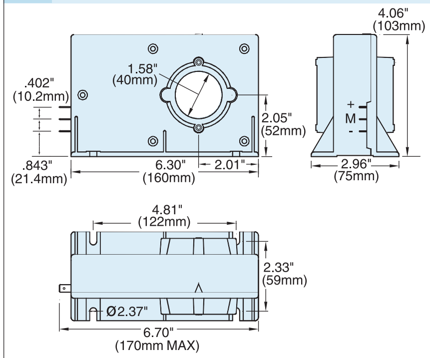
32 CLSM-1000



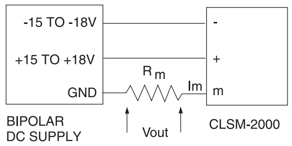
Connection Schematic



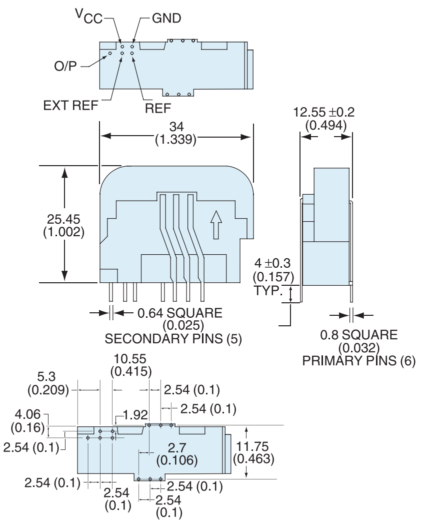
33 CLSM-2000



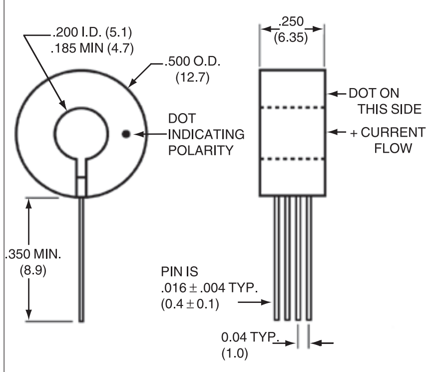
Connection Schematic



34 CMR-25

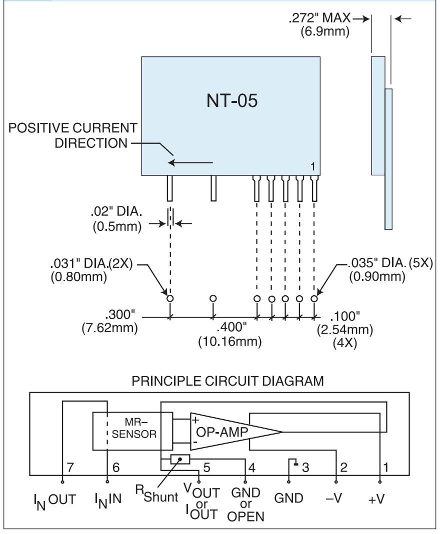


35 NA-25



PIN	SIGNAL	DESCRIPTION
1	$+I_C$	+ CONTROL CURRENT
2	$+V_H$	+ OUTPUT VOLTAGE
3	$-I_C$	– CONTROL CURRENT
4	$-V_H$	– OUTPUT VOLTAGE

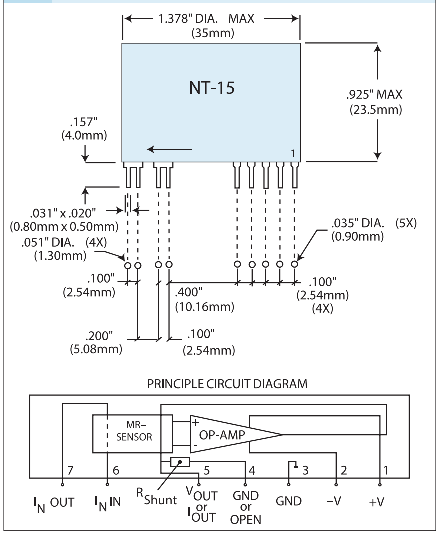
36 NT-05



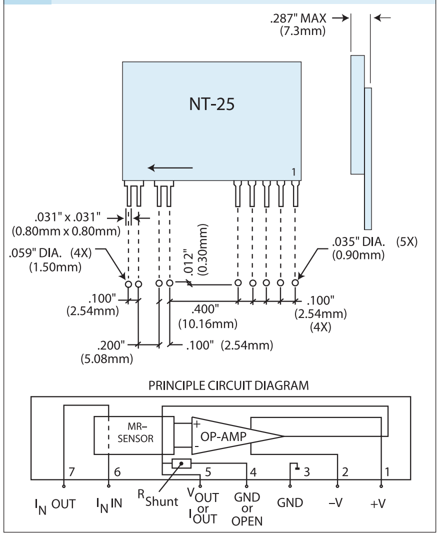
Note: due to continuous process improvement, all specifications are subject to change without notice.

All dimensions are in inches (millimeters)

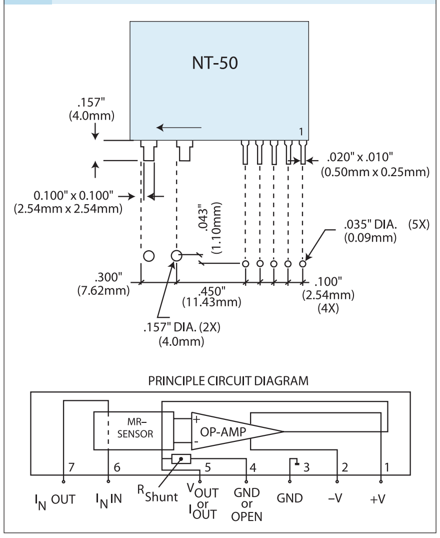
37 NT-15



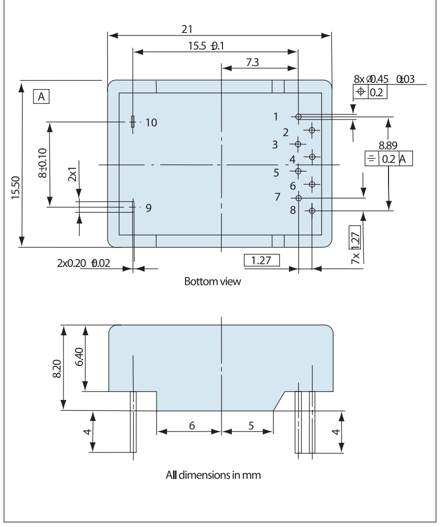
38 NT-25



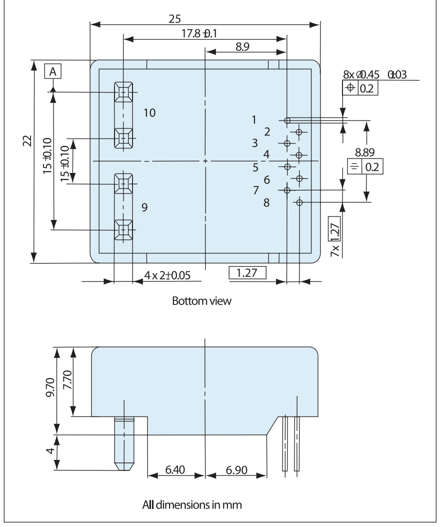
39 NT-50



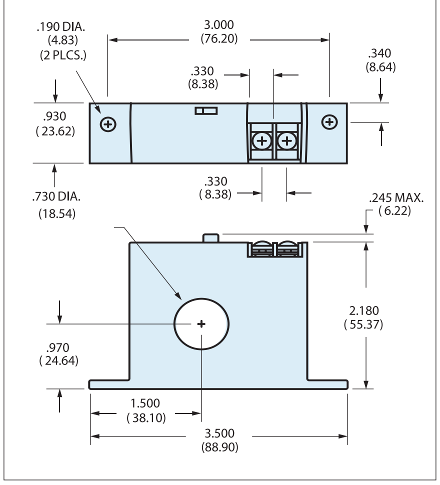
40 CDS-4006 / 4050



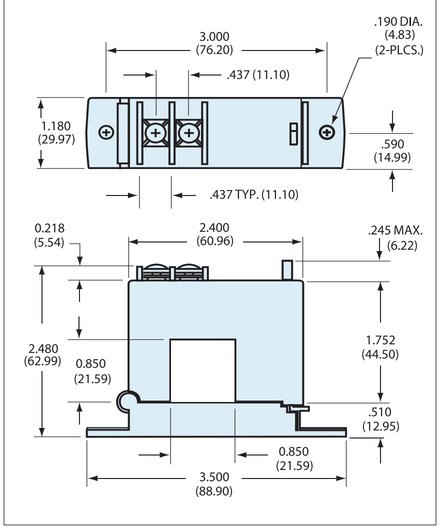
41 CDS-4050 / 4100 / 4150



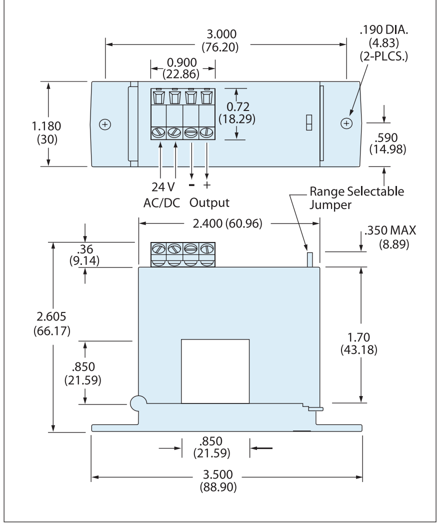
42 PC-50 / 200



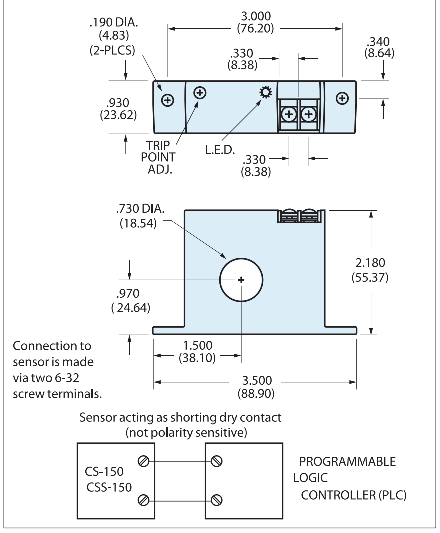
43 PCS-50 / 200



44 SCC / SCV-100, 200 & 300



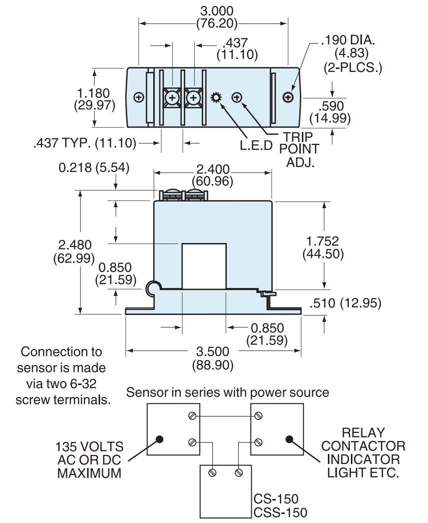
45 CS-150



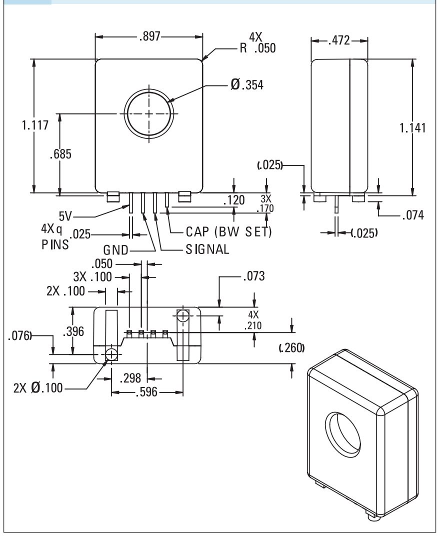
Note: due to continuous process improvement, all specifications are subject to change without notice.

All dimensions are in inches (millimeters)

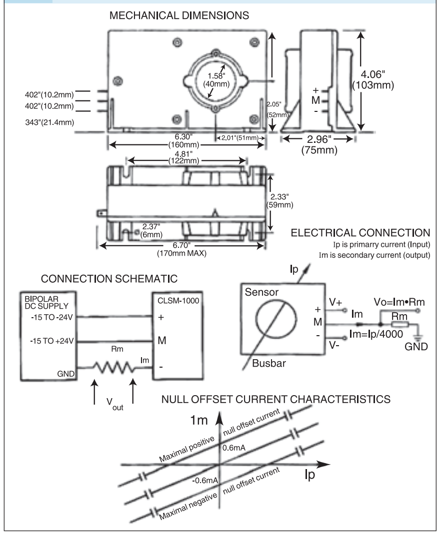
46 CSS-150



47 CSM-010-B



48 CLSM-1000B



Note: due to continuous process improvement, all specifications are subject to change without notice.

New Products

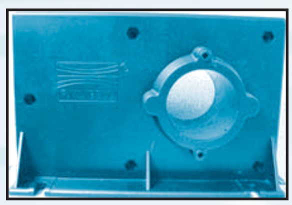
Pacific Scientific-OECO is pleased to announce two new products within the renewable energy markets, our CSM-010-B (solar) and CLSM-1000B (wind) sensors.

CSM-010-B

In a compact, 5V logic compatible design, the CSM-010-B bipolar current sensor measures from less than -15A to over +15A with a bandwidth up to 50KHz. Its quiescent output of 2.5V nicely scales mid-range with today's 5V logic and microcomputer ADC inputs. The bandwidth may be easily lowered to match your sampling rates with an addition of a single, external capacitor. The vertical design minimizes PWB footprint area and the large current wire opening permits easy dressing of large diameter wire or multiple turns of smaller wire for even higher sensitivity.

CLSM-1000B

The CLSM-1000B is a closed loop Hall effect current sensor that accurately measures DC and AC currents and provides electrical isolation between the current carrying conductor and the output of the sensor.



These new current sensors are based on principle of Hall effect and null balance method with galvanic isolation between input and output. The output (secondary) from the current sensor is the balancing current which is the perfect image of the primary (input) current. This current can be expressed as a voltage by passing it through a resistor. The sensors provide wide application combinations and can be used as a feedback element to control or regulate the electronic devices.

Frequently Asked Questions

Which is better suited for my application, open or closed loop current sensors?

Open loop sensors are preferred in battery powered applications, such as electric cars. They take considerably less power to operate and above 100A, they are considerably lighter. They also have a higher ability to withstand sustained overloads than closed loop sensors. If cost is a major consideration, the open loop sensors should be the first choice. Closed loop sensors offer fast response and excellent linearity. The closed loop sensor's current output is less susceptible to electrical noise. They are often preferred in high frequency circuits, such as switching power supplies, when quick response and noise immunity to high di/dt's is critical.

How does the position of the conductor inside the aperture effect the reading?

For best accuracy, keep the conductor in the center of the aperture. The effect of positioning is more noticeable when the size of the conductor is significantly smaller than the sensor aperture.

Can I use the Hall effect sensor to measure true power (P = V x I x COS)?

Models PI, NA-25 and NAP-25 can provide a DC output which is accurately proportional to Real Power. This is possible because of the multiplying ability of the Hall sensor used in the current sensor. The load current is sensed by passing the load current carrying conductor through the aperture of the sensor, eliminating the need for a current transformer (CT). The Hall sensor excitation current is derived from a step down potential transformer and resistor. The output of the sensor is an instantaneous multiple of the excitation current and aperture current. The output wave form is an AC ripple on top of a DC component. This DC component is proportionate to Real Power.

Why is there a specification for a minimum and maximum sense resistor on a closed loop sensor?

Closed loop current sensors require a resistor to be connected between the output of the sensor and ground to complete the circuit. This resistor is in series with a compensation coil and one of the drive transistors (depending on the polarity of the aperture current), which is connected to one leg of the bipolar power supply. Each component exhibits a voltage drop, which is both current and temperature dependent. As the current being measured increases, more current is required to drive the coil which nulls the field. This results in a larger voltage drop across the coil and sense resistor. The total of these voltage drops can not exceed the supply voltage minus the voltage drop across the collector/emitter leads of the transistor. Therefore it is the maximum sensed current that determines the maximum value of the sense resistor. For DC analysis, the voltage drop across the sense resistor, compensation coil and drive transistor must total the supply voltage. If less voltage is dropped across the sense resistor, more voltage must be dropped across the drive transistor, since the coil can be treated as a fixed value resistor. The maximum power dissipation of the drive transistor determines the minimum value of the sense resistor.

What determines the frequency range of an open loop current sensor?

In most applications, it is the eddy current heating of the core that sets the upper limit of the frequency. This limit is specified as ampere-kilohertz, which is the product of the frequency and current.

Can I operate multiple sensors from a common power supply?

All F.W. Bell current sensors that operate from a bipolar power supply can have several sensors connected in parallel to the supply. Connections to the power supply ground and output ground should be make separately. Also, the sensor output grounds should be tied to a common ground connection in order to prevent ground loops and possible noise problems.

What happens when an in-rush current far exceeding the sensor's rating is applied? An open loop sensor will not be damaged.

There may be a slightly larger offset due to the magnetization of the core. This additional offset is temporary and will be removed if a current is applied in the opposite direction. A closed loop sensor may be damaged depending on the duration, duty cycle and amplitude of the over current. Consult F.W. Bell with exact requirements.

Why do most sensors require a bipolar plus and minus 15 Vdc? Will they operate on ±12 Vdc?

F.W.Bell current sensors measure current in both the positive and negative direction. A positive current flow as defined in the specification sheet will result in a positive output and a negative current will result in a negative output. With the exception of zero offset, the sensor will have zero output at zero current. This allows the sensor to provide the most accurate representation of dc, AC and AC superimposed on top of DC current wave forms. Most F. W. Bell sensors will operate on ±12Vdc.In some cases there may be some additional zero current offset. The measuring range and sense resistor values may be effected on the closed loop sensors.

I want to measure currents below 2 amperes. How can I do this when the lowest rated sensor you manufacturer is 25 amperes?

By winding turns through the aperture of the sensor, the current is magnetically multiplied by the number of turns. For example, a sensor with 10 turns through the aperture will see 10 A when 1 A is flowing through the conductor. Besides greater sensitivity, ampere turns also decrease the effect of zero offset and offset temperature drift proportionately to the number of turns. For example, at 1 A the Model BB-25 has an output of 40 mV with a typical offset of 5 mV and a typical offset temperature drift of 0.30 mV/°C. Assuming the worst case, over a 10°C change the output could vary form 32 mV to 48 mV, a 20% error. With 10 turns, the sensor sees 10A and has an output of 400 mV. Assuming the same conditions as above, the output could vary from 392mv to 408 mV, a 2% error. The 10 turns results in a reduction in error of 10 times!

Full technical specifications for the products listed in this catalog are available at:

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