BIAS NOTES

All Pearson Current Monitors use ferromagnetic cores which can become saturated by the dc component (average value) of the current (Idc), or by the current-time product (I•t) of the pulses. Since the output of the monitor is sustained by the changing flux level in the core, magnetic saturation will degrade performance. As a function of increasing Idc, the effective permeability of the core decreases, causing the droop rate and low-frequency cut-off point to increase. Also, the available flux swing is decreased, reducing the maximum viewable I•t. When viewing a pulse, the output voltage will drop to zero when the integrated value of current with respect to time causes the flux level to reach saturation. The monitor will recover after the applied current returns to zero and the flux returns to its remanent value.

Biasing can enable operation with a larger dc component of current, and/or improve the maximum viewable current-time product. The objective of biasing is to reset the flux in the core to a value near the negative saturation level so that the maximum flux swing is available.

The I•t value given in the specification sheets is based on a flux swing from zero to saturation for all models. However, models indicated in the specification sheet with ** have high-permeability core material which has a residual induction of 0.6 to 0.8 of the saturation value. These models will need bias to obtain more than 0.2 to 0.4 of the rated I•t. With bias all models can achieve nearly twice the specified I•t, since the flux can be reset close to negative saturation.

For pulses with small I•t, the droop rate will increase as Idc approaches "Idc max" in the table. Idc max is the approximate level at which the droop rate will be doubled. In this situation, bias is used to cancel Idc and allow normal operation.

Bias may be applied by either of two methods. The necessary Ampere-turns may be obtained by injecting current into the secondary winding via a coaxial "T" adapter, or by winding one or more turns of wire through the current monitor hole. The choice of methods depends on the model and on the available power supply.

BIAS THROUGH HOLE

The circuit configuration for biasing through the hole is shown in Figure 1. The polarity of the bias current should be opposite to that of the expected signal. The correct value for the bias current is the larger of Idc or "I_{BIAS}" from Table 1. The bias current source must have enough resistance to avoid the effect of a shorted turn through the core.

The amount of current needed from the bias supply may be reduced by using multiple turns on the bias winding through the current monitor hole. To calculate the minimum bias

supply source resistance, R_{BIAS}, such that its loading will not affect the current monitor sensitivity by more than 1%, multiply the square of the number of turns, N, on the bias winding by the factor in the table appropriate to the current monitor model.

For example, if the Model 110 is wrapped with 10 turns, the bias supply source resistance should be at least 10^2 x 0.02 = 2 ohm. Using I^{BIAS} from Table 1, the needed voltage is 2 ohm x 0.59 Ampere-turns / 10 turns = 0.118 Volts.

To minimize direct magnetic coupling between the bias winding and the conductor under test, the bias winding should be wrapped onto the current monitor as illustrated in Figure 2, and the conductor under test should be centered approximately in the hole.

BIAS WITH "T" ADAPTER

Bias current may also be injected into the secondary winding via a "T" adapter connected to the output connector. Figure 3 shows the proper circuit configuration. The polarity of the bias current should be opposite to that of the output voltage pulses. The load at the instrument end of the cable should be high enough so that no significant bias current is diverted from the monitor. The source resistance of the bias current source must not load the output of the current monitor. For models with 50 Ω output resistance, a bias source resistance of 5000 Ω will result in a 1% shift in sensitivity. The amount of current to be applied with this method is that which was calculated above divided by "Ratio" from Table 1.

In a pure ac signal, Idc is zero and the I•t of the positive and negative parts of the cycle are equal. The "I/f" value from the specification sheet gives the maximum amplitude for a sine wave of frequency f. Biasing cannot improve performance for ac signals.
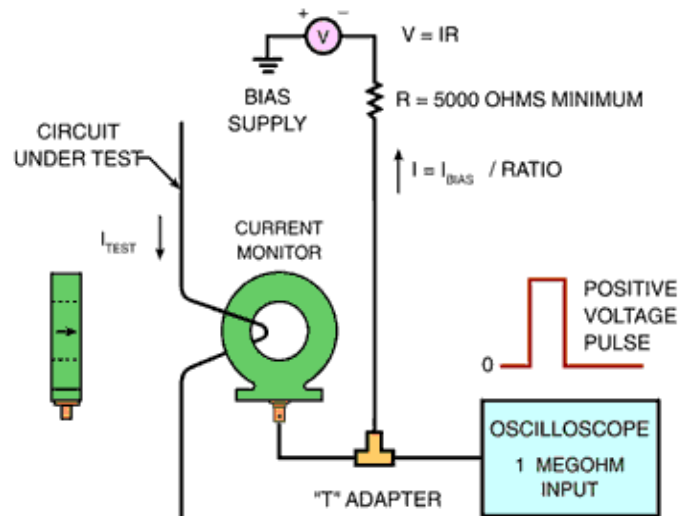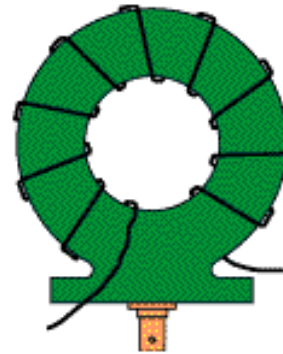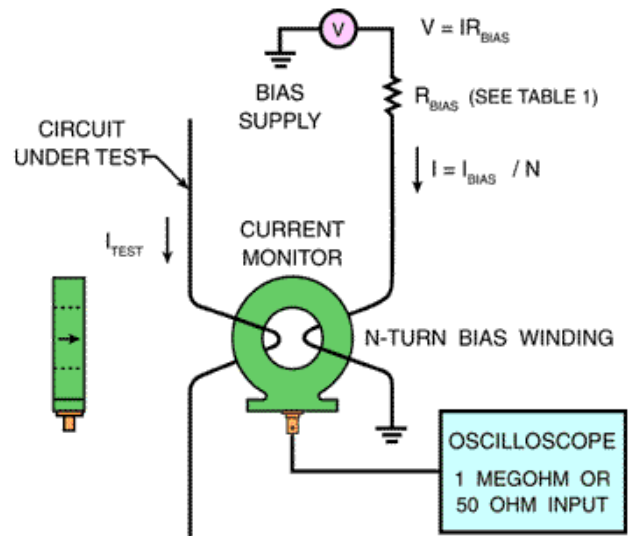
Model	$I_{DC\ MAX}$ (A)	I_{BIAS} (A-turn)	Ratio	R_{BIAS} (x N^2 Ω)
2877	0.17	0.13	50	2.0
4100	0.32	0.25	50	2.0
2100	0.78	0.59	50	2.0
3100	1.9	1.4	50	2.0
150	0.78	0.59	99	0.50
325	25		142	0.17
2878	0.17	0.13	45	0.20
410	10		424	0.020
411	0.32	0.25	424	0.020
110	0.78	0.59	414	0.020
110A	0.78	0.59	414	0.020
310	25		352	0.028
1010	160	120	490	0.020
1025	8		361	0.0031
3025	25		513	0.0028
2879	0.17	0.13	46	0.010
101	0.78	0.59	325	0.0010
301X	60		312	0.0011
1080	60		173	0.00050
1330	60		345	0.00025
1423	60		80	0.00005
2093	150		473	0.00010

Table 1