Using Current Probes

Some Practical Hints On Effective Current Measurement

LeCroy offers a series of AC/DC sensitive current probes with maximum continuous current ranges to 150 A and bandwidths to 50 MHz. Figure 1 shows the CP015 and CP150 current probes, the latest additions to the LeCroy current probe line. These probes join a family of current probes summarized in the table below.

Figure 1 LeCroy's CP 150 (on the left) and CP015 Current Probes

Note that all the current probes are fully integrated into the scope via the LeCroy ProBus interface. They receive power from the scope and produce waveforms in units of Amperes. They are also fully controlled, including degaussing and autozero operations, from the input coupling menus.

The CP015 and CP150 offer the smallest size for the current capacity available among competitive probes. This makes these probes more usable in tight spaces, which is often the case in modern electronics. At the same time, the CP015 offers one of the largest conductor capacities in the industry. While the CP150 provides 50 % greater maximum current capacity along with the smaller overall size than competitive probes.

While all these current probes have a wide sensitivity range it is sometime desirable to be able to increase the sensitivity of the probe. of the measurement. For measuring very small currents, the sensitivity of a current probe can be increased by wrapping multiple turns through the primaryas shown in figure 2. Since current probes follow the transformer rules, the sensitivity will increase by a factor of the number of turns passing through the primary. Note that the insertion impedance will increase by the square of

Model	CP015	AP015	CP150
Maximum Continuous Current (A)	15	30	150
Bandwidth (MHz)	50	50	10
Sensitivity (per Division)	20 mA- 10A	10 mA - 20A	200 mA-150 A
Maximum Peak Pulse	50 A (≤ 10µs)	50 A (10 s)	500A (≤ 30µs)
Maximum Conductor Diameter (mm/in)	5/0.2	5/0.2	20/0.79
Interface	ProBus	ProBus	ProBus

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number of turns. For example, wrapping 10 turns through the jaw opening of a current probe will increase the sensitivity by a factor of 10, and the insertion impedance by a factor of 100. Usually this is not problem, since current levels this low will not generate very large voltage potentials across the insertion impedance. When using this technique, be sure to factor the transformer ratio into any on screen scale factors, and math functions.

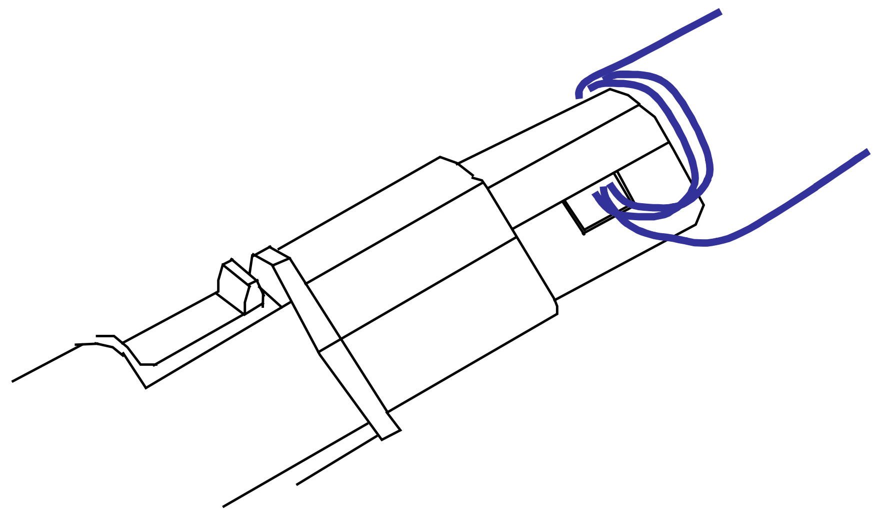

Figure 2 Increasing the sensitivity of the current probe

By passing multiple conductors through the primary, as shown in figure 3, the current probe will only measure the net current sum flowing through all of the conductors. Currents of equal magnitude and opposite polarity will cancel. This technique can also be used extend the DC or low-frequency AC current range without exceeding specified limits by subtracting an offset current with a second conductor that has a pure DC component of a known value. You can also cancel low frequency, common components in this manner. The second conductor's current can be increased by winding multiple turns.

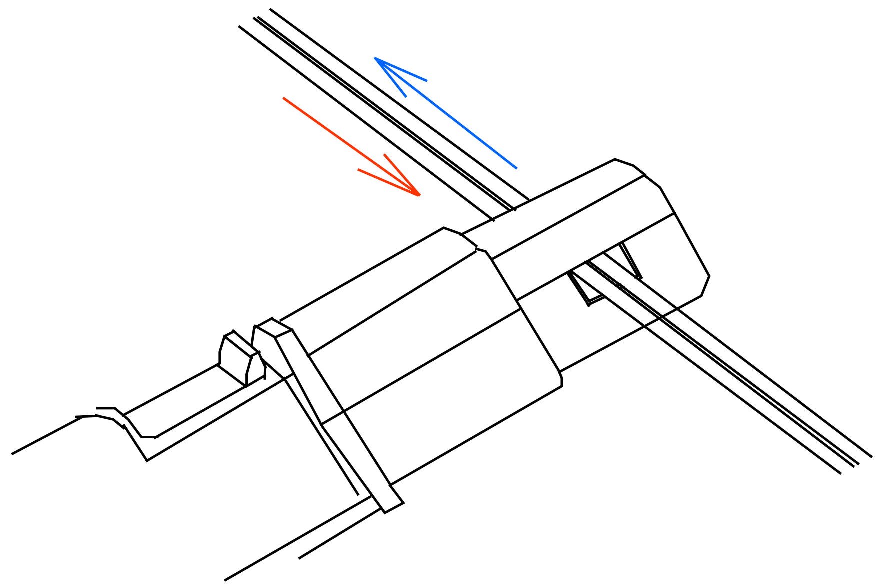

Figure 3 Setup for measuring the net current in a pair of conductors

When using current probes you should be aware of some common characteristics shared by all such devices. All current probes have some type of shielding to minimize the pickup of electrostatic fields radiating from the test conductor. Optimizing the design of the shield for maximum rejection has some compromises in other probe parameters. Thus, different vendors' probes have differing ability to reject fast dv/dt signals in the test conductor. While the LeCroy current probes have among the lowest voltage sensitivity in the industry you should still be aware of it. This means that wherever possible you should probe the circuit under test on the low voltage side of the circuit. When that is not possible A simple test can be used to quantify the e-field pick up in the actual circuit. Connect a short piece of wire to the test conductor. Do not terminate the opposite end. Place the jaw opening around the conductor and view the waveform.

Because no current is flowing through the unterminated wire, any signal displayed in the waveform is due to the dv/dt coupling into the probe. Ideally, none of the voltage signal would be visible in the displayed waveform.

Inductance and some resistance is added to circuit from the loop added for probe attachment. The smaller jaw configurations of the LeCroy probes reduce this impedance because they permit measurement using smaller test loops. A simple trick to reduce the loop inductance further is to twist the loop tightly near the probe reduces the inductance as shown in figure 5.

Whatever your current measurement needs LeCroy offers a range of probes from DC to 50 MHz and from milliAmps to 150 Amp measurement capability fully compatible with your LeCroy oscilloscope.

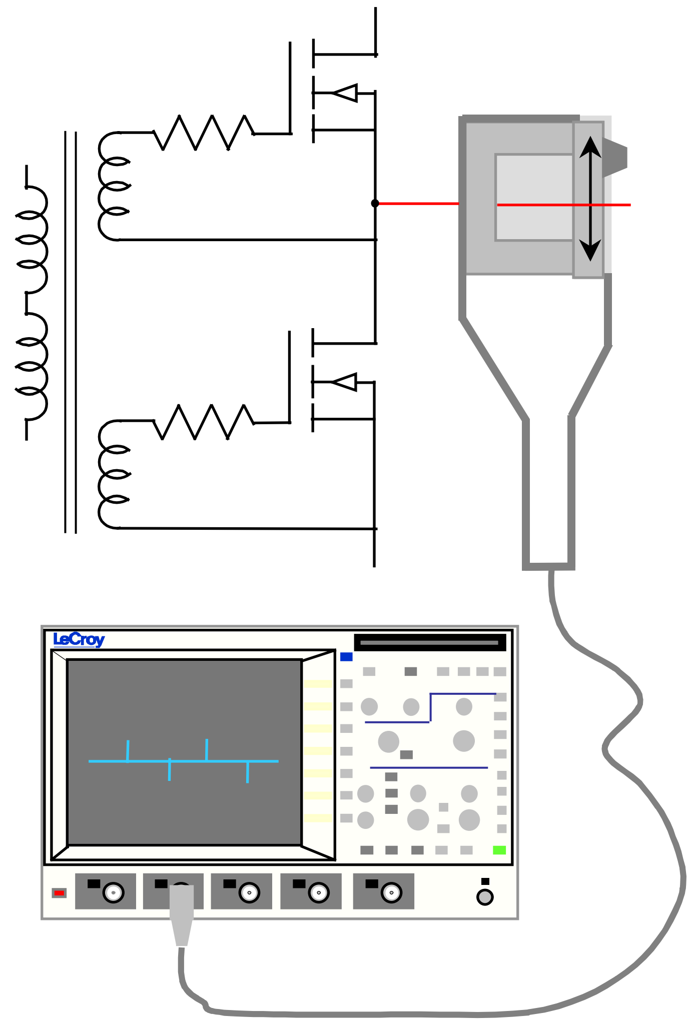

Figure 4 A test for dV/dt sensitivity

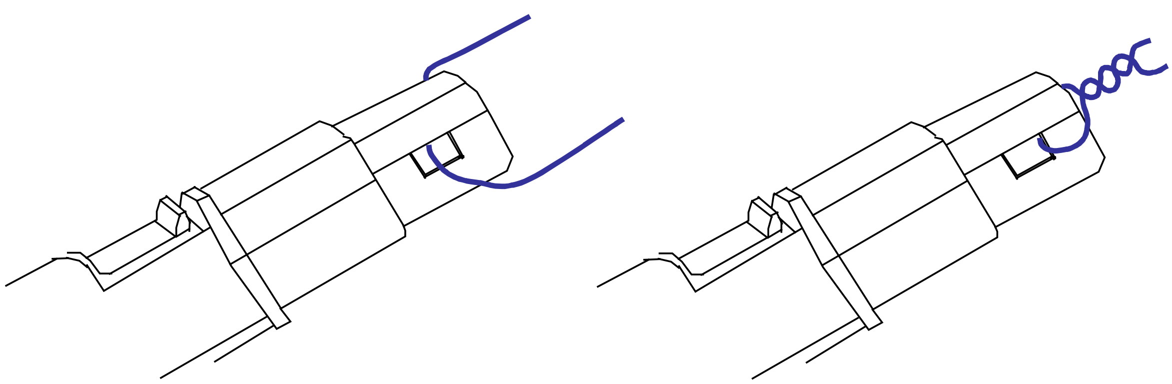

Figure 5 Reducing test loop inductance by twisting the test loop