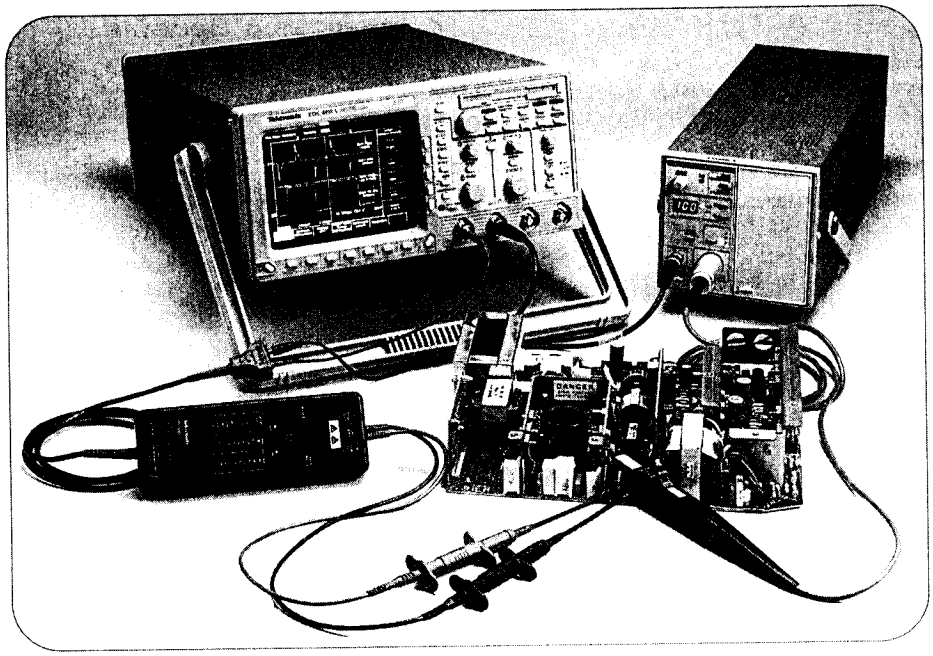
Current Measurements



▶ *AM503S current probe system with P5200 high voltage differential probe with TDS460A.*

▶ Features & Benefits

AC/DC Current
DC to 2 GHz
1 mA to 20,000 A
Split Core and Solid Core

▶ Applications

Motor Drives
Switching Power Supplies
Disk Drive
Electronic Ballasts
Inverters
Avionics
Data Storage Read Channel Design
Silicon Characterization
High-frequency Analog Design
ESD Testing
Signal Injection
Differential Current Measurements
Single Shot Low Rep-rate Pulse Measurements
Propagation Delay Measurement

Current Measurements

Tektronix offers the widest selection of high performance current probes available. Tektronix current measurement systems provide programmable and manual simultaneous AC/DC measurements, bandwidth coverage from DC to 1 GHz and amplitude measurements from mAs to 20,000 A.

Current probes measure the flux field generated by the movement of electrons through a conductor. Within the range specifications of the current probe, the flux field surrounding a conductor is converted to a linear voltage output that can be displayed and analyzed on an oscilloscope or other measurement instrument.

Tektronix provides current probes for AC only and AC/DC current measurements. The AC only probes are available in solid and split core configurations.

AC and DC Current Measurements

AC currents induce voltage in a transformer resulting from the buildup and collapse of flux fields as the current changes direction. AC current probes are passive in that they do not require external power. A steady state DC current, however, will not induce a current in a transformer. By taking advantage of the Hall Effect, a current biased semiconductor device will produce a voltage output in response to a DC generated flux field. Consequently, a DC current probe is an active device in that it requires external power.

Each type of current sensing device will roll off or produce a non-linear output at a certain point. A given AC probe will roll off at a certain maximum current amplitude and frequency, as well as at a minimum amplitude and low-end frequency. DC current probes will be linear from DC to a maximum frequency and will have a minimum and maximum sensitivity level as well. Since we often encounter signals which contain both AC and DC components, it is important to be able to measure both simultaneously with a single probe. In addition, signals which may look like AC, such as a square wave switching on and off, but never fall below zero amps, actually have a significant DC component and cannot be accurately captured with a transformer-only AC probe. The unique Tektronix solution is to combine both a Hall Effect device and a transformer to provide broadband current measurement capabilities within one system.

Split Versus Solid Core

To accurately measure the flux field, we need to completely surround the conductor with the probe core. Tektronix offers two mechanical probe configurations: split core and solid core. Split core probes offer convenience. Precisely engineered and manufactured, the split core probes can be clipped onto a conductor without having to break the connection.

Solid core current transformers (CT) offer small size and very high frequency response for measur-

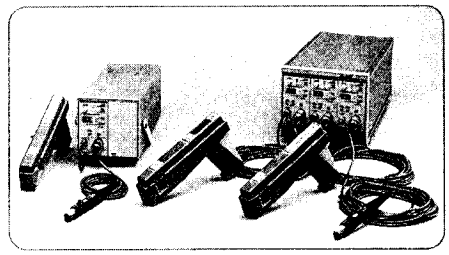
ing very fast, low amplitude current pulses and AC signals. They are designed to be permanently or semi-permanently installed and have cables which are easily connected and disconnected to the CT.

In this Current Probe section we will describe the features and characteristics of each of the Tektronix Current Probes, as well as mention some of the primary applications of each.

AMP*Second Product

As mentioned in the current probe introduction, transformer core materials saturate and become nonlinear when they are subjected to too much current. "Too much current" is a function of both the amplitude of the current and the time it is applied. The product of the average amplitude times the pulse width is called the amp*second product. Each probe has an amp*second product specification (see the Current Probe Selection Guide). If the signal does not exceed this specification, the voltage output will be linear and the measurement accurate.

A special feature of the AM503S Current Probe Systems utilizes the phenomenon that opposing currents are subtractive. The AM503S senses the current level in the conductor under test and feeds an equal but opposite current through the probe. This "bucking current" nulls out the current in the transformer and eliminates any core saturation. The bucking current limit is 20 A in the A6312 and A6302XL, 100 A in the A6303XL and 500 A in the A6304XL. Up to these amplitudes you need not be concerned about the amp*second product.



▶ *AM50xx Series Current Measurement Family (Left to Right) A6303, AM503S, A6302, A6303XL, A6304XL, A6302XL, AM5030S with two additional AM5030 plug-ins.*

▶ Current Probe Selection Guide

Type AM503B or AM5030 Amplifiers with:	Bandwidth Hz to MHz	Peak Pulse	Max AC p-p	Derate Below	Derate Above	Max DC	Amp*S Product	Current/Div Display Range	Rise Time	Insertion Impedance @ 1 MHz	Max Barewire Voltage	Max Conductor Diameter	Cable Length
A6312	DC to 100	50 A	40 A	N/A	20 kHz	20 A	$100x10^{-6}$	1 mA to 5 A*1	≤3.5 ns	0.1 Ω	300 V	0.15 in.	2 m
A6312 w/CT4	0.5 to 20	20 kA*2	2 kA*3	50 Hz	1.2 kHz	20 A	0.1	20 mA to 5 kA*1	≤17.5 ns	30 mΩ	3 kV	1.5 in.	2 m
A6302	DC to 50	50 A	40 A	N/A	20 kHz	20 A	$100x10^{-6}$	1 mA to 5 A*1	≤7.0 ns	0.1 Ω	300 V	0.15 in.	2 m
A6302 w/CT4	0.5 to 20	20 kA*2	2 kA*3	50 Hz	1.2 kHz	20 A	0.1	20 mA to 5 kA*1	≤17.5 ns	30 mΩ	3 kV	1.5 in.	2 m
A6302XL	DC to 17	50 A	40 A	N/A	20 kHz	20 A	$100x10^{-6}$	1 mA to 5 A*1	≤20 ns	0.1 Ω	300 V	0.15 in.	8 m
A6302XL w/CT4	0.5 to 13	20 kA*2	2 kA*3	50 Hz	1.2 kHz	20 A	0.1	20 mA to 5 kA*1	≤20 ns	30 mΩ	3 kV	1.5 in.	8 m
A6303	DC to 15	500 A	200 A	N/A	20 kHz	100 A	$10,000x10^{-6}$	5 mA to 50 A*1	≤23 ns	0.02 Ω	700 V	0.83 in.	2 m
A6303XL	DC to 10	500 A	200 A	N/A	1.8 kHz	100 A	$10,000x10^{-6}$	5 mA to 50 A*1	≤35 ns	0.02 Ω	700 V	0.83 in.	8 m
A6304XL	DC to 2	700 A	700 A	N/A	1.8 kHz	500 A	0.4	500 mA to 200 A*1	≤175 ns	0.2 Ω	700 V	0.83 in.	8 m
P6021	120 to 60	250 A	15 A	300 Hz	0.5 MHz	0.5 A	$500x10^{-6}$	20 mA or 100 mA*1	≤5.8 ns	0.03 Ω	600 V	0.15 in.	1.5 m/ 2.75 m*5
P6021 w/CT4	120 to 20	20 kA*2	2 kA*3	300 Hz	1.2 MHz	20 A	0.5	400 mA or 100 A*1	≤17.5 ns	0.03 Ω	3 kV	1.5 in.	1.5 m/ 2.75 m*5
P6022	935 to 120	100 A	6 A	3 kHz	10 MHz	0.2 A	$9x10^{-6}$	10 mA or 100 mA*1	≤2.2 ns	0.03 Ω	600 V	0.10 in.	2.75 m
CT1	25 K to 1000	12 A	1.4 A			0.3 A	$1x10^{-6}$	2 mA*1 (5 mV/mA)	≤0.35 ns	1 Ω	175 V_{RMS}	0.070 in.	1.07 m
CT2	1.2 K to 200	36 A	7 A			0.3 A	$50x10^{-6}$	10 mA*1 (1mV/mA)	≤0.5 ns	0.1 Ω	175 V_{RMS}	0.052 in.	1.07 m
CT6	250 K to 2000	6 A	.7 A			200 mA	$-0.25x10^{-6}$	2 mA (5mV/mA)	<200 ps	1.1 Ω	30 V_{RMS}	0.032 in.	1 m
TEKPROBE™ (TDS400/500/600/700, TDS3000, TDS7000 and 11000 Series)													
TCP202	DC to 50	50 A	40 A	N/A	20 kHz	15 A	$500x10^{-6}$	*4	≤7.0 ns	0.07 Ω	300 V	0.15 in.	2.2 m
TCP202 w/CT4	0.5 to 20	20 kA*2	2 kA*3	50 Hz	1.2 kHz	15 A	0.1	*4	≤17.5 ns	30 mΩ	3 kV	1.5 in.	2.2 m

*1 Scope set at 10 mV/Div.

*2 Based on voltage breakdown.

*3 Based on thermal heating limits in CT4.

*4 Depends on instrument used.

*5 Opt. 03 is 2.75 meters long.