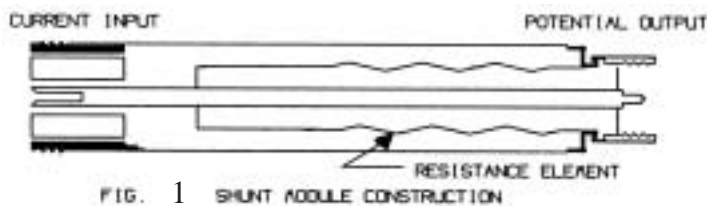


TECHNICAL NOTES
PRIMARY AC SHUNTS
MODEL HCS-1

8 April 2004

Holt Instrument model HCS-1 shunts were designed in 1962 by C.P. DeWitt, the founder of Holt Instrument. They follow the pattern of shunts that were developed by Parks at the National Standards Laboratory in Boulder Colorado for the investigation of current in lightning strikes. Parks principal was that if a shunt terminating a coaxial line were constructed with a tubular center conductor returning the current to the source and with the potential lead routed through the center of that tube the potential lead would be in a magnetic field free space. There would therefore be no stray voltage induced in the potential lead due to the field of the current being measured. This construction is shown in figure 1.



The spacing between the tubular resistance element and the outer coaxial tube is very small so that the inductance of the shunt resistor and the current return path is small. As a result the frequency response of the shunt resistor as measured from the current input connector to the potential output connector is flat from DC to well above 100 KHz. The AC-DC difference at frequencies below 50 KHz is less than 200 parts in 10⁶. At frequencies below 1 KHz and down to DC the AC-DC difference is only a few parts per million. These characteristics are a function of the geometry of the shunt. No adjustments are made during the testing of any these units. Every shunt that Holt has built since 1962 has had an identical AC-DC difference within the uncertainties of the measurements. The table below show the typical AC-DC difference versus frequency for each range.

Part Number	Current Range	Applied Current	Typical AC-DC Difference in parts in 10 ⁶						
			20 Hz	50 Hz	1 KHz	10 KHz	20 KHz	50 KHz	100 KHz
HCS-1A	10 mA	10 mA	+6		+1	-6	+6	+17	+31
HCS-1A	25 mA	25 mA	-1		-3	-9	+2	+16	+25
HCS-1A	50 mA	50 mA	-2		-5	-11	0	+6	+12
HCS-1A	100 mA	100 mA	+4		-8	-11	0	+7	+21
HCS-1A	250 mA	250 mA	-3		-2	-6	-16	-13	-41
HCS-1B	0.5 A	0.5 A	+10		-2	-9	-35	-122	-320
HCS-1C	1 A	1 A	-6		-4	-10	-10	-63	-177
HCS-1D	2.5 A	2.5 A	+1		-9	-9	-30	-166	-466
HCS-1E	5 A	5 A	+5		-5	+5	+45	+3	-156
HCS-1F	10A	10A	-8		-8	+14	+62	-49	
HCS-1G	20 A	20 A			-13	+57	+85	+11	