LIMITED WARRANTY

Auburn Technology Corporation, Warrants this product against defects in materials and workmanship for a period of one year from date of purchase by the original consumer purchaser.

The product shall not have been altered, repaired, or serviced by anyone other than a service facility authorized by Auburn Technology Corporation or have been subject to accident, misuse, abuse, or operated contrary to the instructions.

Auburn Technology Corporation, shall not be liable for direct, incidental, consequential, or other types of damages resulting from the use of this product. This warranty is in lieu of all other warranties, express or implied; including, but not limited to, the implied warranties of merchantability or fitness for a particular purpose. Some states do not permit limitation or exclusion of implied warranties; therefore, the above limitations and exclusions may not apply to you.

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P-20 RF PROBE
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DESCRIPTION

The P-20 is a PASSIVE 10:1 RF VOLTAGE PROBE with a 50 Volt DC BLOCK built in. It has been designed to allow users of RF test equipment to use standard signal tracing techniques.

The P-20 makes it possible to conveniently and accurately monitor or inject signals up to 3 GHz into RF circuits without significantly loading or detuning them. The P-20 comes with Interchangeable Ground Clips that adapt to a wide range of applications.

THEORY OF OPERATION

A frequency compensated 450 ohm resistive element is utilized in the probe's design to reduce circuit loading and to give the P-20 a 10:1 VOLTAGE RATIO when connected to a 50 ohm instrument and probing a 50 ohm source. Special construction techniques of the P-20 produce less than 1 pf of stray capacitance at 1 MHz to minimize the capacitive loading effects on RF circuits.

RF instruments require low inductance grounding to make consistent and accurate measurements. The P-20's Interchangeable Ground Clips provide low inductance grounding and the ability to make contact with the circuit's active RF ground.

To prevent false readings or damage to test equipment, an internal DC blocking capacitor (50 volts MAX.) is provided to decouple in-circuit supply voltages.

P-20 USER NOTES

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RF GROUNDING

To obtain consistent and accurate RF amplitude measurements Proper RF Grounding is *REQUIRED*.

Measurements from 100 KHz to 1 GHz can be accurately measured by directly grounding the P-20's grounding barrel or by using the short pin or flexible ground clip. Frequencies from 1 to 2 GHz will require direct grounding of the P-20's grounding barrel or the use of the short pin ground clip. Frequencies from 2 to 3 GHz will require direct grounding of the P-20's grounding barrel. See page 3 for more information.

Ground clips can be changed by grasping the ring portion of the clip and twisting it, while pulling to remove or pushing to assemble. Moderate force may be required.

If a good RF ground is out of reach, a 6 inch metal ruler or similar item can often be used to extend the ground to the probe. To minimize inductance, it's better to make direct contact with the grounding barrel of the probe.

Verification of a low inductance RF ground can be accomplished by slightly changing the P-20's ground contact position while observing that there are no significant changes in readings.

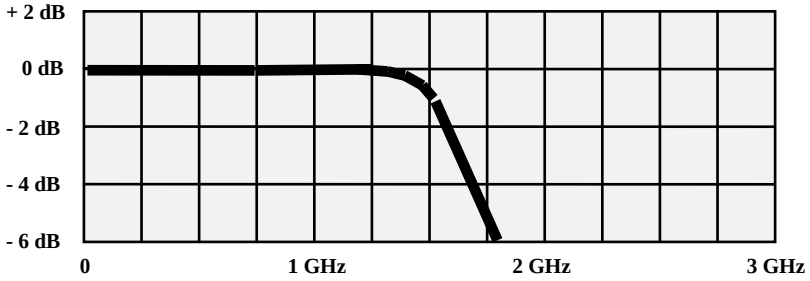
CAUTION !

The P-20's grounding barrel is a low impedance ground.

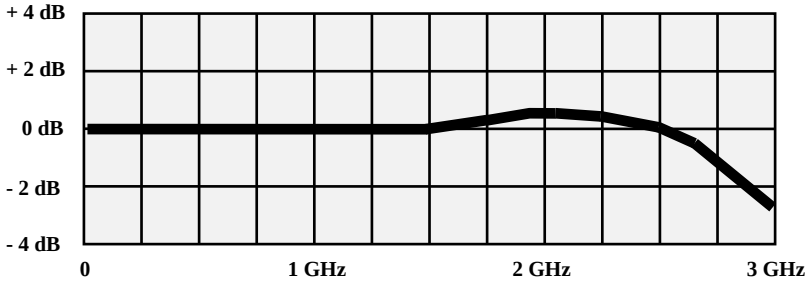
Avoid Contact with Supply Voltages and Personal Contact if High Voltages are present !

TYPICAL P-20 PROBE RESPONSE
With and Without
GROUNDING ACCESSORIES

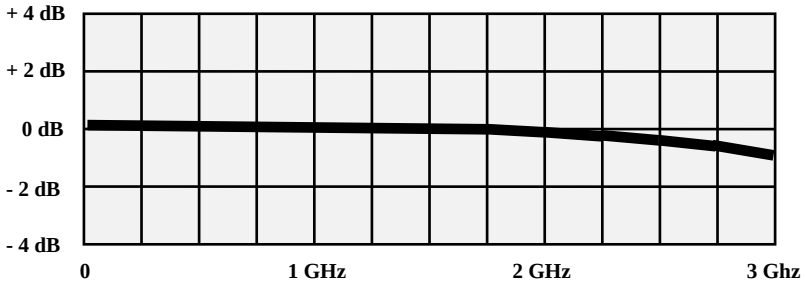
FLEXIBLE GND CLIP RESPONSE



SHORT PIN GND CLIP RESPONSE



DIRECT BARREL GROUNDING RESPONSE



SPECIFICATIONS

FREQUENCY RESPONSE:	**100 kHz to 3 Ghz** **+/- 3 dB**
VOLTAGE ATTENUATION:	**10:1 (Nominal)** **For 50 Ohm sources**
RF ATTENUATION:	**20 dB (Nominal)** **For 50 Ohm sources**
RF LOADING EFFECTS:	**500 Ohms +/- 10%** **< 1 pF at 1 MHz**
RF VOLTAGE RANGE:	**7 Vrms (Continuous)** **35 Vrms (MAX. 1 Sec.)**
DC VOLTAGE BLOCK:	**50 Volts Maximum**
PROBE CABLE:	**1 Meter in Length** **BNC Connector**

The continuous improvement of its products is the intent of Auburn Technology Corporation who reserves the right to make design or specification changes without notice.

dBm	VOLTS	POWER
- 30	7.07 mV	1.00 uW
- 31	6.30 mV	.794 uW
- 32	5.62 mV	.631 uW
- 33	5.01 mV	.501 uW
- 34	4.46 mV	.398 uW
- 35	3.98 mV	.316 uW
- 36	3.54 mV	.251 uW
- 37	3.16 mV	.200 uW
- 38	2.82 mV	.158 uW
- 39	2.51 mV	.126 uW
- 40	2.24 mV	.100 uW
- 41	1.99 mV	79.4 nW
- 42	1.78 mV	63.1 nW
- 43	1.58 mV	50.1 nW
- 44	1.41 mV	39.8 nW
- 45	1.26 mV	31.6 nW
- 46	1.12 mV	25.1 nW
- 47	999 uV	20.0 nW
- 48	890 uV	15.8 nW
- 49	793 uV	12.6 nW
- 50	707 uV	10.0 nW
- 51	630 uV	7.94 nW
- 52	562 uV	6.31 nW
- 53	501 uV	5.01 nW
- 54	446 uV	3.98 nW
- 55	398 uV	3.16 nW
- 56	354 uV	2.51 nW
- 57	316 uV	2.00 nW
- 58	282 uV	1.58 nW
- 59	251 uV	1.26 nW
- 60	224 uV	1.00 nW

RF VOLTAGE MEASUREMENTS

RF Voltage Measurements from 100 kHz to 3 GHz can be made at 7 Volts RMS continuous or up to 35 Volts RMS for one second.

The P-20 produces a 10:1 VOLTAGE RATIO when used with instruments, such as RF Volt Meters and RF Detectors while probing a 50 ohm source. RF circuits nominally have a 50 ohm impedance, thus measurement errors will typically be insignificant for standard signal tracing techniques.

Accurate RF Voltage Measurements can be obtained by MULTIPLYING the instrument's reading by 10.05 . (The .05 is the correction factor for the P-20's loading characteristics for a 50 ohm source.)

When a source with an impedance other than 50 ohms needs to be accurately measured, use the following equation to obtain the correction factor.

TRUE VOLTAGE = (MEASURED V * 10) * L RATIO
L RATIO = 1 + (CIRCUIT IMPEDANCE / 1000)

OSCILLOSCOPE MEASUREMENTS

Oscilloscopes will see the P-20 probe as a 1:1 VOLTAGE RATIO . Because of its low inductance grounding and low stray capacitance, High Frequency readings will be more accurately reproduced, than that of an ordinary scope probe .

RF POWER MEASUREMENTS

RF Power Measurements from 100 KHz to 3 GHz can be made up to +30 dBm (1.0 watt) continuously or +44 dBm (25 watts) for one second.

The P-20 when used with a Spectrum Analyzer or RF Power Meter can effectively make in-circuit RF Power Measurements without the need for complex calculations. ADD +20 dB to the instrument's reading if in dBm or MULTIPLY by 100 if using Watts to get the Power Measurement for a 50 ohm source. RF circuits commonly have or nearly have a 50 ohm impedance and because of this, measurement errors will typically be insignificant for standard signal tracing techniques.

Pulse Power Measurements up to +56 dBm (400 Watts) can be made, provided the average power level is less than +30 dBm and the Pulse Duration is less than 100 µS. *WARNING!* An external attenuator should be used between the probe and the instrument to prevent the possibility of instrument damage due to excessive peak power. An external DC BLOCK with an adequate voltage rating is required between the probe and attenuator to prevent possible damage to measurement equipment if voltages greater than 50 volts are present in the circuit.

When an RF source needs to be measured accurately refer to the "Correction Factor for Loading Effects" chart and the "Power Level Conversion" chart if the source has an impedance other than 50 ohms.

dBm	VOLTS	POWER
0	224 mV	1.00 mW
- 1	199 mV	.794 mW
- 2	178 mV	.631 mW
- 3	158 mV	.501 mW
- 4	141 mV	.398 mW
- 5	126 mV	.316 mW
- 6	112 mV	.251 mW
- 7	99.9 mV	.200 mW
- 8	89.0 mV	.158 mW
- 9	79.3 mV	.126 mW
- 10	70.7 mV	.100 mW
- 11	63.0 mV	79.4 uW
- 12	56.2 mV	63.1 uW
- 13	50.1 mV	50.1 uW
- 14	44.6 mV	39.8 uW
- 15	39.8 mV	31.6 uW
- 16	35.4 mV	25.1 uW
- 17	31.6 mV	20.0 uW
- 18	28.2 mV	15.8 uW
- 19	25.1 mV	12.6 uW
- 20	22.4 mV	10.0 uW
- 21	19.9 mV	7.94 uW
- 22	17.8 mV	6.31 uW
- 23	15.8 mV	5.01 uW
- 24	14.1 mV	3.98 uW
- 25	12.6 mV	3.16 uW
- 26	11.2 mV	2.51 uW
- 27	9.99 mV	2.00 uW
- 28	8.90 mV	1.58 uW
- 29	7.93 mV	1.26 uW

CROSS REFERENCE LEVEL CHART

dBm	VOLTS	POWER
+ 30	7.07 V	1.00 W
+ 29	6.30 V	794 mW
+ 28	5.62 V	631 mW
+ 27	5.01 V	501 mW
+ 26	4.46 V	398 mW
+ 25	3.98 V	316 mW
+ 24	3.54 V	251 mW
+ 23	3.16 V	200 mW
+ 22	2.82 V	158 mW
+ 21	2.51 V	126 mW
+ 20	2.24 V	100 mW
+ 19	1.99 V	79.4 mW
+ 18	1.78 V	63.1 mW
+ 17	1.58 V	50.1 mW
+ 16	1.41 V	39.8 mW
+ 15	1.26 V	31.6 mW
+ 14	1.12 V	25.1 mW
+ 13	999 mV	20.0 mW
+ 12	890 mV	15.8 mW
+ 11	793 mV	12.6 mW
+ 10	707 mV	10.0 mW
+ 9	630 mV	7.94 mW
+ 8	562 mV	6.31 mW
+ 7	501 mV	5.01 mW
+ 6	446 mV	3.98 mW
+ 5	398 mV	3.16 mW
+ 4	354 mV	2.51 mW
+ 3	316 mV	2.00 mW
+ 2	282 mV	1.58 mW
+ 1	251 mV	1.26 mW

CORRECTION FACTOR FOR LOADING EFFECTS

Circuit Impedance in OHMS	Readings in WATTS MULTIPLY BY:	Readings in dBm ADD:
25	1.05	.21
50	1.10	.42
75	1.16	.63
100	1.21	.83
200	1.44	1.58
500	2.24	3.52
1000	4.00	6.00

To calculate loading effects at other impedance:

VOLTAGE RATIO = 1 + (IMPEDANCE / 1000)
POWER RATIO = VOLTAGE RATIO SQUARED

POWER LEVEL CONVERSION

Circuit Impedance in OHMS	Readings in WATTS MULTIPLY BY:	Readings in dBm ADD:
2	25.0	14.0
5	10.0	10.0
10	5.0	7.0
20	2.5	4.0
25	2.0	3.0
50	1.0	0.0
75	.67	-1.8
100	.50	-3.0
200	.25	-6.0

RF SIGNAL INJECTION

The P-20 probe is a PASSIVE device. This means that RF signals can flow through the probe in either direction. Because of this characteristic and the P-20's 500 ohm impedance, RF signals can be injected without excessively loading the circuit being tested or the signal source.

The INSERTION LOSS of the P-20 probe is approximately 20 dB when connected to a 50 ohm source and injecting the signal into a 50 ohm circuit.

NOTE! **The Insertion Loss will change depending on the impedance of the circuit being injected.**

PERFORMANCE VERIFICATION

The performance of the P-20 can be verified by removing the ground clip and properly probing the output of a known RF source such as a RF Signal Generator.

PLEASE NOTE! **RF Signal Generators are designed and calibrated to drive a 50 ohm load. If the generator's output is not terminated there will be a 6 dB increase in the generator's output VOLTAGE.**

Measurements of a 50 ohm RF output terminated only with the P-20 will appear to have a +5.2 dB increase in POWER. This is due to the light loading characteristics of the P-20 probe, resulting in a measured INSERTION LOSS of 14.8 dB instead of the normal 20 dB.

Normalization of frequency response errors when using the P-20 probe with a spectrum analyzer and tracking generator can be done the same way as the above verification. Be aware that frequency response ripple is a function of the probe and analyzer input impedance, and will be constant as long as the analyzer input attenuator is not changed. Be sure to allow for the +5.2 dB error if the signal source is *NOT* terminated into 50 ohms. If the signal source *IS* terminated into 50 ohms the measurement error due to the P-20 loading is -.2 dB.