

BARTH ELECTRONICS, INC.

Attenuators



**HIGH
VOLTAGE
PULSE
RESISTIVE
COMPONENTS**

Since 1964

Voltage Probes &
Terminators



Power Dividers



Pulse Generators

PULSE CATALOG 08



Click in any red box to be redirected to that page

TABLE OF CONTENTS:	PAGE
MODEL NUMBER NUMERICAL INDEX.....	2
COMPANY CAPABILITIES.....	3
TECHNICAL SPECIFICATIONS.....	4
APPLICATION NOTE, "VOLTAGE COEFFICIENT OF RESISTANCE"	5-6
TERMINATORS.....	7-11
ATTENUATORS.....	12-20
HIGH POWER ATTENUATORS.....	21-22
IMPEDANCE MATCHING COMPONENTS.....	23-24
RESISTIVE PULSE HIGH VOLTAGE PROBES.....	25-27
MATCHED RESISTIVE POWER DIVIDERS.....	28-37
MATCHED RESISTIVE POWER COMBINERS.....	38
PORT DIVIDERS.....	39-40
TRANSFORMER COMPONENTS.....	41-44
PULSE GENERATORS.....	45-46
TEM ANTENNA.....	47
CONNECTORS / ADAPTERS.....	48-52
CABLE ASSEMBLIES.....	53
ORDERING INFORMATION.....	54
WORLDWIDE SALES REPRESENTATIVES.....	55

MODEL NUMBER NUMERICAL INDEX

MODEL	PAGE	MODEL	PAGE	MODEL	PAGE
2-20.....	14	623-GLP.....	42	2934-MFNF.....	38
101-xxx.....	8	632.....	45	3004.....	47
102-GP-20.....	15	641A-GLP.....	24	6115-BMFP.....	41
102-GLP-20.....	15	650A-NFT.....	43	6419-NFP.....	39
142-xxx-3.....	17-18	651-NFP.....	43	9201GMF.....	40
142-xxx-4.....	17-18	652-NFP.....	43	EL-L.....	51
142-xxx-6B.....	17-18	732.....	46	HNL.....	51
142-xxx-8B.....	17-18	2033-HFP.....	10	HNT.....	51
142-xxx-10B.....	17-18	2051-GHFP.....	11	QHPB.....	51
142-xxx-14B.....	17-18	2051-GHMP.....	11	VP1E3-20-1E3.....	27
142-xxx-20B.....	17-18	2237-HFNFP.....	19	VP2E3-35-1R2H.....	27
142-xxx-26B.....	17-18	2238-HFNFP.....	20	VP2E3-35-1R2N.....	27
151-xxx.....	29	2239-HFNFP.....	19	VP5E2-28-8R2.....	27
201-BMP.....	9	2440.....	25-26	Connectors/Adapters:	
201A-xxx.....	8	2511-30F.....	21	0874-9700.....	52
202-xxx-N.....	16	2536-HFP-3.....	22	0874-9701.....	52
202-xxx-T.....	16	2536-HFP-6.....	22	0874-9710.....	52
202-xxx-X.....	16	2536-HFP-10.....	22	0874-9711.....	52
220-NFP.....	23	2536-HFP-20.....	22	0874-9800.....	52
220A-GLP.....	23	2642-MFP.....	32	0874-9801.....	52
223-BMFP.....	9	2642-MMFP.....	32	0874-9810.....	52
224A-GLP.....	24	2702-BFP.....	33	0874-9811.....	52
251-xxx.....	30	2703-BFP.....	33	0874-QMMJ.....	52
280-GLP.....	31	2704-BFP.....	33	0874-QMMP.....	52
401-371.....	48	2705-BFP.....	33	Cable Assemblies:	
401-HNB.....	48	2706-BFP.....	33	BTF4.....	53
402-HNB.....	48	2746-NFMF.....	34	RG214/U.....	53
404-HFF.....	49	2812-xxx.....	35-36	xxx = connector	
404-HMM.....	49	2813-xxx.....	35-36	configurations, please	
404-HFNF.....	49	2814-xxx.....	35-36	refer to page # listed for	
404-HMNM.....	49	2815-xxx.....	35-36	your specific needs.	
444-HMSP.....	50	2816-xxx.....	35-36		
472-HMNF.....	50	2825-NFP.....	37		
621-NFP.....	41	2828-NFP.....	37		
621A-GLP.....	41	2830-NFP.....	37		
621A-MFP.....	41	2832-NFP.....	37		
		2921-HFP.....	38		

BARTH ELECTRONICS CAPABILITIES

Barth Electronics, Inc. has been designing and manufacturing "state of the art" sub-nanosecond high energy, pulse power coaxial components since 1964. Our first high voltage pulse instrumentation hardware was designed for underground nuclear testing, and taught us much about reliable wideband HV attenuators. These "special" products have become "STANDARDS" and are used every day for reliable pulse measurements in physics and pulse power laboratories around the world. Our instrumentation advances developed as high voltage pulse technology evolved, (and has been consistently faster than pulses that could be generated). We stay at the leading edge of this technology by constantly creating innovations in component design that you require now, or will need tomorrow.

The resistor used in our attenuators, terminators, and voltage probes has many capabilities designed specifically for high voltage pulse use. It has a very low voltage coefficient of resistance, which is why our components provide the same accurate measurements at millivolt or kilovolt signal levels. Their low temperature coefficient of resistance also provides minimal attenuation change with temperature and our resistors are held to 50 ohms ± 0.5 ohms for accurate and repeatable attenuation measurements.

Our microwave and HV design capabilities have enabled us to put our resistors into coaxial housings that provide the best pulse response possible for their rated energy. The combination of these capabilities provides you with the fastest pulse rated components available.

Our attenuator design capability continues to evolve and has resulted in improved pulse response, voltage rating and in greatly increased average power rating. Our components remain the best high voltage coaxial devices available anywhere.

We strive to minimize your problems in interconnection of measuring instrumentation by providing many different coaxial connectors with close tolerances on our products. We offer type "SMA", "TNC", "BNC", "N", "SHV" and "HN" connector selections on many of our standard products. We are working on the design of new and higher voltage connectors for use with your constantly increasing pulse voltages.

Our high voltage probes are usually designed to meet specific requirements of resistance, voltage, pulse width, risetime, and physical dimensions for each application. They are presently being used in air, vacuum, and water systems, with risetimes as fast as 100 picoseconds, and voltages as high as 500kV.

Our line of pulse transformer components, have less loss and narrower bandwidth than resistive units for dividing, combining, or signal sampling. We make several extremely wide bandwidth reactive units that have high energy capability as well. We have developed a 50 picosecond risetime pressurized reed switch pulse generator that has an output voltage that is adjustable from 100 to 2500 volts.

Our waveform modification capabilities include impulse, linear ramp, staircase generators and risetime spoilers and positive exponential generators. Units have been produced that can operate up to 10kV and are as fast as sub-nanosecond or as slow as 100 ns risetimes.

We are continuously investigating new technologies that can be applied to EM measurements and are designing new products as needs arise. If we have not already designed what you need, we have other sources that may be helpful with your high voltage measurements. Call us to discuss your pulse measurement needs.

TECHNICAL SPECIFICATIONS

TESTING FOR GUARANTEED PERFORMANCE

Components are 100% tested with 1000 pulses at their rated voltage and pulse width. The resistance of all ports is measured before and after HV testing. Each unit passes this test only if its resistance, after HV pulsing, increases less than 0.02%. Any higher increase indicates a breakdown, and that unit is rebuilt and retested. In addition to the DC resistance measurements, each unit is also tested for pulse response and reflection coefficient to be certain they meet our specifications. The pulse amplitude and width capability of a unit listed as 5kV/400ns means that it is guaranteed to withstand 5kV rectangular pulses that are 400ns long. **We recommend that DC resistance tests be performed regularly on all of your resistive attenuators, of any make, as an easy detection of resistor failure.** All of our products are guaranteed to perform to their specifications indefinitely when used within its specifications.

MAXIMUM INPUT LIMITATION

The voltage specification of our products is sometimes limited by the breakdown characteristics of the connectors. The voltage limits we use for our specifications are 4kV for the "N" connector, 6kV for the GR 874 connector and 15kV for the "HN" connector. These limitations are for DC, and provide a safety factor for our pulse length ratings. The "N" connector, for instance, can pass 10kV at short (10ns) pulse widths.

The breakdown limitations of our film resistors are related to pulse energy. A unit that has been tested to withstand 5kV, 400ns FWHM rectangular pulses should be able to withstand 10kV, 75ns FWHM rectangular pulses. While this general "rule of thumb" has been found to be useful in practice, we cannot guarantee higher voltages or pulse widths unless we test the particular unit to your pulse specification.

Some units have been designed and rated to withstand exponentially decaying pulses and are listed with a $1/\epsilon$ notation. An exponentially decaying pulse with a $1/\epsilon$ time constant has half the energy of a rectangular pulse, with the same FWHM time. Therefore, our resistive units can withstand exponential pulses that have a time constant twice as long as a rectangular pulse.

Please call if your pulse measurement requirements cannot be met by the standard product specifications.

VOLTAGE COEFFICIENT OF RESISTANCE

The voltage coefficient error of our resistive components is less than 1 % at their rated voltage. It is usually significantly lower than this but we cannot specify it any better because of present measurement limitations. **See our Application Note for further information regarding the importance of Voltage Coefficient in pulse voltage measurement.**

PULSE RISETIME

The 10%-90% risetime through our attenuators is listed as τ (tau). It is calculated by taking the square root of the difference between the observed risetime squared and the input risetime squared. This would be the risetime out of our attenuator with a perfect (zero risetime) input. Our risetime and reflection coefficient measurements are made with a 54120A HP digital sampling system that can be normalized to as fast as 10ps.

VOLTAGE COEFFICIENT OF RESISTANCE APPLICATION NOTE

Application note # 1

The purpose of this application note is to describe some important considerations in high voltage pulse measurements with resistors as dividing elements. The term "**Voltage Coefficient of Resistance**" has been around for a long time¹; but is seldom used or well understood. As high voltage pulse measurements improve, and higher accuracy becomes available, voltage coefficient errors that could once be ignored now must be considered.

It is well known that the resistance increases with temperature rise of nearly all resistors, including the commonly encountered carbon composition resistor. The temperature **coefficient of resistance** (of a resistor) may be expressed as the ratio of the resistance change to the temperature rise. Such a temperature coefficient classification is useful if the resistance changes uniformly with temperature rise and fall.

Resistors undergo temperature variations not only due to changes in ambient temperature, but also due to dissipation of electrical energy when current is passed through them. It is desirable in measurements using resistors, that their temperature coefficient be small to minimize errors. One can see, for example, that when a measurement apparatus involving resistors is calibrated at low signal levels, the calibration may be invalid at higher signal levels if the resistance values change.

It has also been known for a long time¹ that the resistance of a resistor can change due to a change in the voltage applied to it, even though the temperature may be held constant. The **voltage coefficient of resistance** may be expressed as the ratio of the resistance change in ohms to the corresponding increase in applied voltage in volts when the temperature is held constant. Such voltage coefficient of resistance definition is useful to characterize the resistance change with an increase in applied voltage. Of course, for any useful resistor material, the resistance returns to its original value when the applied voltage is removed.

When a steady voltage is applied to a resistor, it normally undergoes resistance changes due to both applied voltage and temperature increase. The temperature increase is caused by the dissipation of electrical energy in the resistor due to current flow. At low voltages the temperature coefficient is usually larger than the voltage coefficient. This change in resistance is almost entirely due to a temperature change in the resistor.

When a short pulse is applied to a resistor, and very little average power is dissipated in the resistor, its temperature will not rise appreciably. Most of the resistance change of a low temperature coefficient resistor will be due mainly to the application of voltage, and limited to the time when the voltage is applied. When high voltage pulses are applied to low value resistors, the change in resistance can be appreciable, and can be very important in measurement applications.

Measurement of short high voltage pulses are made in investigations of the effects of lightning strikes, EMP testing on electrical equipment, instrumenting underground nuclear tests, and the pulse power industry.

Most resistors have a negative voltage coefficient, which means that at higher voltages, the resistance decreases during the pulse. If the resistance increases with voltage, the resistor has a

positive voltage coefficient. This voltage dependent change of resistance happens instantaneously and can be observed to occur in less than 1 nanosecond. If the period of voltage application is too long, the temperature may rise and cause large resistance changes that can mask voltage coefficient effects.

Short pulses applied to many resistors will show voltage coefficient effects during the time the voltage is applied. Although a resistor may not burn out during extensive pulsing, or have a permanent resistance change, it can have significant voltage coefficient changes during the time of the pulse.

The voltage coefficient varies with different resistive materials, and seems to be greatest for materials that are composed of a granular conglomeration of resistive material held together with an insulating binder. Carbon composition and cermet film resistors use these types of resistive materials.

Nonlinear resistivity can easily be displayed by placing a small amount of finely powdered conducting or semiconducting material between two skewed small diameter wires. Graphite, shaved from a pencil or from a carbon composition resistor displays this effect nicely. The effect can be observed using as little as 1 volt between the two wires. The nonlinear voltage versus current ratio can easily be seen on a simple transistor/ diode curve tracer as a nonlinear slope. This nonlinear resistance occurs for both positive and negative voltages and is symmetrical if there is no rectifying contact. Of course, resistors of a few thousandths of an inch in length are not used in high voltage applications; but if you put 1,000 of these small resistors mentioned above, that are three thousandths of an inch long, in series, you would have a resistor three inches long. This resistor, assembled from many low voltage nonlinear junctions, would have a nonlinear resistance when used at 1,000 volts.

The voltage coefficient of resistance of the resistor depends not only upon the length of the resistor, but also upon the conductive interfaces between the resistive particles that make up the resistor. These interfaces result in emission current (tunneling) across microscopic gaps between conductive particles such as graphite. It is complicated by many factors such as size of particles, their size distribution, and electron emission coefficients. If resistance can be obtained without resorting to high resistance contacts between granular low resistivity materials, then low voltage coefficients can be achieved.

Bulk metal resistors have almost unmeasurable voltage coefficients. However, due to the low resistivity of metals, wire wound resistors must be used to achieve reasonable resistance values. The combined inductance and capacitance effects of wire wound resistors prevent their use either at high frequencies or with fast pulses.

Thin metal film can also be used to achieve reasonable resistance values, but these resistors have a high voltage coefficient. This may result from the extremely thin metal film deposited on a very rough ceramic substrate, that allows tunneling or current flow across the ceramic valleys.

Carbon composition resistors are made with powdered or granular graphite material, which has a relatively low bulk resistivity.

VOLTAGE COEFFICIENT OF RESISTANCE APPLICATION NOTE

Application note # 1 continued

Many different resistivity compositions are made to cover the 10 ohm to 10 megohm resistor range. The graphite/insulator compositions are held in place with a phenolic binder that also anchors the wire terminals into the carbon resistance element. This is the original construction method for carbon composition resistors and creates a robust and inexpensive resistor.

Ordinary carbon composition resistors normally are made in 1/4, 1/2, 1, and 2 watt sizes. Our measurements found the 2 watt size to have a much higher voltage coefficient than the 1 watt size, and the 1/2 watt size to have the lowest voltage coefficient over all. It was also found that the voltage coefficient of any particular wattage rating is not much different between manufacturers. This would lead us to believe that something in the basic manufacturing process of this type of resistor may be responsible for its very high voltage coefficient.

In order to increase the surface area of a carbon composition resistor and allow it to dissipate more energy, the size of the resistor is increased. Increasing the size of the resistor will usually decrease its resistance unless one increases the resistivity of the bulk material to compensate for the increase in cross sectional area. For example a typical 1/2 watt resistor,² has a length of 0.375 inch and a diameter of 0.140 inch. The typical 2 watt resistor has a length of 0.688 inch and a diameter of 0.318 inch. The length has been increased by a factor of 1.8, and the diameter by a factor of 2.27, so that the cross sectional area has increased by a factor of 5.2. The resistance of a cylindrical resistor would be $R = r I/A$, where r is the resistivity of the bulk material, I is the length, and A is the cross sectional area. The resistance would be increased by a factor of 1.8 due to the longer length, and decreased by a factor of 5.2 due to the larger cross sectional area. This example assumes parallel end terminals, although commercial carbon composition resistors have very non-uniform end terminals.

In order to maintain the same resistance, in going from 1/2 watt size to the 2 watt size, the resistivity of the bulk material must be increased by a factor of 2.9. The resistivity depends upon the ratio of graphite particles (and their size distribution) to the insulating binder material. A higher resistivity is achieved by decreasing this ratio, using more binder or less graphite in the mixture. Therefore, the resistance material of a 2 watt resistor has a smaller percentage of graphite, than a 1/2 watt resistor with the same value. Fewer contacts between granular resistor particles results in more tunneling, causing a higher voltage coefficient.

The mechanism that causes resistors to change value with the application of voltage is difficult to define with certainty. However, the evidence for such a change is real, and substantial changes in resistance can be observed. In one of our tests, the resistance of a 2 watt carbon composition resistor was observed to decrease from 390 ohms to 200 ohms during pulse testing. The high voltage resistance was approximately 51% of the resistance at low voltage during application of a 2kv, 100ns wide pulse. In pulse tests at 3kV with the same value resistors, a 1 watt resistor decreased approximately 15%, and a 1/2 watt resistor decreased approximately 6%.*

An additional factor that probably contributes to a decrease in resistance upon the application of high voltage is the effect of the swaged tinned metal contacts of these resistors. They protrude into the bulk resistive material in such a way as to cause non-uniform current distribution at both ends of the resistor.

In high voltage pulse testing, inaccurate results are obtained when high voltage coefficient resistors are used for voltage division or attenuation measurements. The measurement of voltage coefficient of resistance can be accomplished at audio and radio frequencies by measuring the production of harmonic signals due to resistor nonlinear behavior³. We have developed additional measurement methods using voltage pulses, and will continue resistor and attenuator testing.

We hope this information helps provide a better understanding of voltage coefficient and the causes of resistance changes at high voltage. Reduced accuracy is the result of using common resistors in high voltage pulse measurements. The effect of voltage coefficient and the importance of using resistors with a low voltage coefficient in high voltage measurements is gradually becoming more widely appreciated.

Because future designs are based on voltage measurements made today, it becomes obvious that the use of low voltage coefficient resistive instrumentation is essential for tomorrow's designs.

*This agrees within the limit of 0.02 percent per volt quoted by G.W.A. Dummer⁴. The results quoted for 1 megohm resistors of 1/4 to 2 watt ratings by F. LangfordSmiths⁵ cannot be compared to those obtained at Barth Electronics, Inc., because there is no information on the dimensions of the resistors, and because Barth Electronics test resistors had lower resistance values.

REFERENCES

- ¹ "Measurements of Nonlinearity in Cracked Carbon Resistors", G.H. Millard, Proc. I.E.E. (London) Vol.106B, Jan. 1959, pp.31-34.
- ² "Electronic Designers Handbook", L.J. Giacoletto, Editor, Second Edition, McGraw-Hill Book Co. 1977, pp.3-B.
- ³ "Harmonic Testing Pinpoints Passive Component Flaws", V. Peterson and P. Harris, Electronics, July 11,1966, pp. 93-100.
- ⁴ "Materials for Conductive and Resistive Functions", G.W.A. Dummer, Hayden Book Co., 1970, p.279.
- ⁵ "Radiotron Designer's Handbook", F. Langford Smith, Editor, Fourth Edition, Electron Tube Div. RCA, 1953, p.188.
Barth Electronics, Inc. © 'VCADV' 5/3/88

HIGH VOLTAGE PULSE TERMINATOR

ADVANTAGES OVER STANDARD RF TERMINATORS

- Low reflection coefficient
- Withstands high voltage pulses
- Pulse power rated
- Low voltage coefficient
- High reliability
- Impedance held very close to nominal



DESCRIPTION

Barth High Voltage Pulse Terminators are designed to terminate 50 ohm systems with a very low reflection coefficient. High voltage pulses are terminated with characteristics as good as, or better than, most instrument loads. These units are ideal for use in nuclear and high energy experiments. Extensive testing during manufacturing insures very high reliability for single-shot experiments. A voltage coefficient of the resistive film of less than .0001 %/V allows low voltage calibration of most systems.

TERMINATOR MODEL COMPARISON

Model	Peak Voltage	Maximum Input** @ Pulse width ns	Input reflection coefficient at 100ps τ	Connectors
101-xxx	2,500	400	< 1%	*
201 A-xxx	5,000	400	< 1%	*
201-BMP	3,000	250	< 1%	BNC male
2033-HFP	10,000	250	< 4%	HNB female
2051-GHMP	10,000	100	< 3%/100ps τ	GHV male
2051-GHFP	10,000	100	< 3%/100ps τ	GHV female
223-BMFP	4,000	100	< 5%	BNC male/female

NOTE: Our type HN (HNB) connectors are specially designed to obtain the minimum reflection coefficient for fast risetimes. For best pulse response, our Model 401-HNB male or Model 402-HNB female cable connector for RG214/U coax should be used for interconnection.

* Any male or female (GR, N, HNB) can be supplied. Units with N connectors are limited to a 4kV rating. The Model 101 is not supplied with HNB connectors to avoid voltage capability confusion. These are our most popular terminators, and are stocked for immediate delivery.

** See Technical Specifications (Maximum Input Limitations) on page 4 for explanation of voltage and pulse width ratings.

HIGH VOLTAGE PULSE TERMINATOR

MODEL 101-xxx, 201A-xxx

DESCRIPTION

50 Ω High Voltage Pulse Terminator



Model 101-GLP



Model 201A-NMP

SPECIFICATIONS

Maximum Input:	101-xxx:	2.5kV, 400ns FWHM Pulse
	201A-xxx:	5kV, 400ns FWHM Pulse **
Peak Input Power:		125kW at rated pulse width
Average Input Power:		4W maximum
Impedance:		50 $\Omega \pm 0.5\%$
Reflection-TDR:		< 1% to a 100ps risetime step function
Voltage Coefficient:		< 1% at rated voltage
SWR:		DC-4GHZ < 1.005 +.013f GHZ DC-6GHZ < 1.005 +.013f GHZ
Connectors:	101/201A-GP	GR 874 Non locking
	101/201A-GLP	GR 874 Locking
	101/201A-NMP	N male **
	101/201A-NFP	N female **
	201A-HMP	HNB male ** (201A only)
	201A-HFP	HNB female ** (201A only)
Dimensions:		2.5" long, 1.25" dia. max.
Weight:		.2 lbs.

NOTE: Our type HN (HNB) connectors are only available in 201A series and are specially designed to obtain the minimum reflection coefficient for fast risetimes. For best pulse response, our Model 401-HNB male or Model 402-HNB female cable connector for RG214/U coax should be used for interconnection.

- xxx: Connector identifier, see list under connector heading for our standard (stocked) configurations. Call for connector configurations not shown.

** Units with N connectors are limited to a 4kV rating.

HIGH VOLTAGE PULSE TERMINATOR

MODEL 201-BMP, 223-BMFP



Model 201-BMP

DESCRIPTION

50 Ω High Voltage Pulse Terminator

SPECIFICATIONS

Maximum Input:	3kV, 250ns FWHM Pulse
Peak Input Power:	200kW at rated pulse width
Average Input Power:	1W maximum
Impedance:	50 $\Omega \pm 0.5\%$
Reflection-TDR:	< 1% to a 100ps risetime step function
Voltage Coefficient:	< 1% at rated voltage
Connector:	BNC male
Dimensions:	1.5" long x 19/32" dia. max.
Weight:	<1 oz.



DESCRIPTION

50 Ω High Voltage Pulse Feed through Terminator

Model 223-BMFP

SPECIFICATIONS

Maximum Input:	4kV, 100ns FWHM Pulse
Peak Input Power:	300kW at rated pulse width
Average Input Power:	1W maximum
Impedance:	50 $\Omega \pm 0.5\%$
Reflection-TDR:	< 5% to a 100ps risetime step function
Voltage Coefficient:	< 1% at rated voltage
Connectors:	BNC male/female
Dimensions:	1.7" long x 1.1" wide x .6" high Weight: <2 oz.

HIGH VOLTAGE PULSE TERMINATOR

MODEL 2033-HFP



Model 2033-HFP

DESCRIPTION

50 Ω High Voltage Pulse Terminator

SPECIFICATIONS

Maximum Input:	10kV, 250ns FWHM Pulse
Peak Input Power:	2MW at rated pulse width
Average Input Power:	4W Maximum
Impedance:	50 $\Omega \pm 0.5\%$
Reflection-TDR:	< 4% to a 100ps risetime step function
Voltage Coefficient:	< 1% at rated voltage
Connector:	HNB female *
Dimensions:	4.8" long x 1.3" wide x 1.3" high
Weight:	1 lb.

NOTE: *Our type HN (HNB) connectors are specially designed to obtain minimum reflection coefficient for fast risetimes. For best pulse response, our model 401-HNB male or 402-HNB female cable connector for RG214/U coax, should be used for interconnection.

HIGH VOLTAGE PULSE TERMINATOR

MODEL 2051-GHMP



Model 2051 - GHMP

DESCRIPTION

50 Ω High Voltage Pulse Terminator

SPECIFICATIONS

Maximum Input:	10kV, 100ns FWHM Pulse
Peak Input Power:	2MW at rated pulse width
Average Input Power:	2W maximum
Impedance:	50 $\Omega \pm 0.5\%$
Reflection-TDR:	< 3% to a 100ps risetime step function
Voltage Coefficient:	< 1% at rated voltage
Connector:	GHV male
Dimensions:	3.2" long x 1" dia. max.
Weight:	< 1/3 lb.

HIGH VOLTAGE PULSE ATTENUATOR

DESCRIPTION

Barth High Voltage Pulse Attenuators are matched impedance coaxial attenuators for use primarily in pulsed 50 ohm systems, or where occasional transients would damage ordinary units. The attenuator design closely matches the impedance around each resistor, to that resistor. These attenuators feature an input impedance very close to 50 ohms, with characteristics as good or better than most microwave attenuators. These units are ideal for use in nuclear and high energy experiments. Extensive testing during manufacturing insures very high reliability for single-shot experiments. A voltage coefficient of the resistive film of less than .0001 %/V allows low voltage calibration of most systems.

ADVANTAGES OVER STANDARD RF ATTENUATORS

- Low reflection coefficient
- Withstands high voltage pulses
- Pulse power rated
- Low voltage coefficient
- High reliability
- Input/Output impedance held very close to nominal

MAXIMUM INPUT CONSIDERATIONS

The breakdown limitations of our film resistors are related to pulse energy. A unit that has been rated and tested to withstand 5kV, 400ns FWHM rectangular pulses should be able to withstand 10kV, 75ns FWHM rectangular pulses. While this general "rule of thumb" has been found useful in practice, we cannot guarantee higher voltages or pulse widths unless we test the particular unit to your pulse specification.

NOTE: We will only guarantee other voltages and pulse widths or shapes if we life test a unit for that particular pulse specification.

Our standard units are all 50 ohm impedance. We do, however, manufacture and stock many 100 ohm impedance units. If we are unable to meet your requirements with a stock unit, call, as other types and impedance's can be designed to your specifications.

SPECIAL USE CONSIDERATIONS

Attenuators purchased at list price can be used at higher voltages and shorter pulse width ratings but are not guaranteed.

Guaranteed pulse energy performance is available with a nominal additional cost for special testing at specified voltage & pulse width.

HIGH VOLTAGE PULSE ATTENUATOR MODEL COMPARISON

Model	Average input power	Voltage ratio dB	Maximum peak voltage	Input @ pulse width ns	Reflection coefficient at 100ps	Risetime through unit ps	Effective bandwidth DC to	Connectors
102-GP-20	5W	20	2,500	400	< 2%	< 5	7 GHz	GR 874 non-locking
102-GLP-20	5W	20	2,500	400	< 2%	< 50	7 GHz	GR 874 locking
142-xxx-3	2W	3	2,500	400	< 3%	< 10	30 GHz	**
142-xxx-4	2W	4	2,500	400	< 3%	< 10	30 GHz	**
142-xxx-6B	2W	6	2,500	400	< 3%	< 10	30 GHz	**
142-xxx-8B	2W	8	2,500	400	< 3%	< 10	30 GHz	**
142-xxx-10B	2W	10	2,500	400	< 3%	< 10	30 GHz	**
142-xxx-14B	2W	14	2,500	400	< 3%	< 10	30 GHz	**
142-xxx-20B	2W	20	2,500	400	< 3%	< 10	30 GHz	**
142-xxx-26B	2W	26	2,500	400	< 3%	< 10	30 GHz	**
202B-GLP-N	2W	8	5,000	400	< 5%	< 20	17 GHz	GR 874 locking
202A-GLP-T	2W	14	5,000	400	< 5%	< 20	17 GHz	GR 874 locking
202A-GLP-X	2W	20	5,000	400	< 5%	< 20	17 GHz	GR 874 locking
202B-NMFP-N	2W	8	4,000	400	< 5%	< 20	17 GHz	N female/male
202-NMFP-T	2W	14	4,000	400	< 5%	< 20	17 GHz	N female/male
202-NMFP-X	2W	20	4,000	400	< 5%	< 20	17 GHz	N female/male
2237-HFNFP	2.5W	26	10,000	400	< 4%	< 50	7 GHz	HNB female input
2238-HFNFP	2.5W	26	16,000	400	- - -	< 1ns	0.35 GHz	N female output
2239-HFNFP	2.5W	26	16,000	400	< 4%	<100	3.5GHz	N female output
2511-30F	25W	30	8,000	150	< 5% @ 1ns	< 1ns	0.35 GHz	Fischer input BNC output
2536-HFP-3	200W	3	7,000 15,000	400 75	< 5%	< 30	10 GHz	HNB female*
2536-HFP-6	200W	6	7,000 15,000	400 75	< 5%	< 30	10 GHz	HNB female*
2536-HFP-10	200W	10	7,000 15,000	400 75	< 5%	< 30	10 GHz	HNB female*
2536-HFP-20	200W	20	7,000 15,000	400 75	< 5%	< 30	10 GHz	HNB female*

NOTE: Our type HN (HNB) connectors are specially designed to obtain minimum reflection coefficient for fast risetimes. For best pulse response, our model 401-HNB male or 402-HNB female cable connector for RG214/U coax should be used for interconnection.

* Unit is supplied with a Barth Model 404-HMM low reflection HNB male to male adapter, so that either the input or output can be adapted to a male connection.

** Any male or female (GR, N, HNB, GHV) can be supplied.

LOW VOLTAGE ATTENUATOR

MODEL 2-20



Model 2-20

ADVANTAGES

- Inexpensive
- Small Dimensions
- Closely matched impedance for accurate pulse measurements

DESCRIPTION

Take advantage of excellent attenuators at a low price. These low voltage units have excellent microwave characteristics and are ideal as an inexpensive low voltage unit for use with our 142 series high voltage precision attenuators while still providing a very respectable and clean 20 ps output risetime.

After a high voltage pulse has been reduced in amplitude with a high voltage attenuator, such as the 102, 142, 202, 2237, or 2239, low voltage attenuator can often be used to further reduce the pulse voltage.

Modern digital oscilloscopes often have a maximum voltage input of five (5) volts and the Model 2-20 can reduce a 50 Volt pulse to 5 Volts, two Model 2-20 attenuators can reduce a 200 volt pulse to 2 volts to keep the pulse amplitude to an oscilloscope within its maximum ratings.

SPECIFICATIONS

Voltage ratio: 10.0/1 Vr (20dB)

Impedance: 50 Ohms +/- 1%

Accuracy:

<u>Attenuation</u>	<u>DC</u>	<u>0-12 GHz</u>	<u>12-18 GHz</u>
20dB	+/- 0.3	+/- 0.6	+/- 1.0

Connectors: N Male and N Female

Average Input Power: 1 Watt Maximum

<u>Frequency Range</u>			<u>VSWR</u>
DC	to	4 GHz	1.15
4	to	8 GHz	1.20
8	to	12 GHz	1.25
12	to	18 GHz	1.35

Dimensions: 2.25" long x 1.0" dia.

HIGH VOLTAGE PULSE ATTENUATOR

MODEL 102-GP-20, 102-GLP-20



Model 102-GLP-20

ADVANTAGES

- High voltage pulse rated
- Least expensive high voltage coaxial attenuator available
- Small dimensions
- Higher average power than 142 series

DESCRIPTION

This unit utilizes a patented design, which provides for maintaining good HV capabilities and good power dissipation. While this unit has a simpler housing design than our precision attenuators, for better heat dissipation, it still provides a very respectable and clean 50 ps output risetime.

SPECIFICATIONS

Voltage Ratio:	10.0/1 Vr (20dB)
Maximum Input:	5.0kV, 80ns FWHM Pulse, 500kW Peak Power 2.5kV, 400ns FWHM Pulse, 125kW Peak Power 1.25kV, 1600ns FWHM Pulse, 31kW Peak Power
Average Input Power:	5W maximum 10W with optional fins (Model CF) for external cooling
Impedance:	50 $\Omega \pm 1\%$
Risetime through Unit:	< 50ps
Bandwidth (-3dB):	DC to 7GHz
Reflection-TDR:	< 2% to a 100ps risetime step function
SWR:	< 1.05 to 1GHz < 1.30 to 4GHz
Voltage Coefficient:	< 1% at rated voltage
Connectors:	102-GLP-20 GR 874 locking 102-GP-20 GR 874 non-locking
Dimensions:	4.5' long x 0.625" dia.
Weight:	3/8 lb.

HIGH VOLTAGE PULSE ATTENUATOR

MODEL 202 – XXX

ADVANTAGES

- High voltage pulse rated
- High voltage precision coaxial attenuator
- Small dimensions



Model 202B-NMFP-N

DESCRIPTION

The Model 202 utilizes our original patented design, which still provides the best high voltage attenuator available. This unit withstands 5kV, 400ns FWHM pulses into either end and has a 20ps risetime.

SPECIFICATIONS

Voltage Ratio:	202-xxx-N	2.5/1 Vr (8dB)
	202-xxx-T	5.0/1 Vr (14dB)
	202-xxx-X	10.0/1 Vr (20dB)
Maximum Input:	5.0kV, 400ns FWHM Pulse **	
Peak Input Power:	500kW at rated pulse width	
Average Input Power:	2W maximum	
Impedance:	50 Ω \pm 1%	
Risetime through Unit:	< 20ps	
Bandwidth (-3dB):	DC to 17GHz	
Reflection-TDR:	< 5% to a 100ps risetime step function	
SWR:	< 1.05 to 1GHz < 1.30 to 4GHz	
Voltage Coefficient:	< 1% at rated voltage	
Connectors:	202-NMFP-y	N male/female
	202-GLP-y	GR 874 Locking
	202-HMFP-y	HNB male/female
Dimensions:	4.1" to 3.3" long x 1.2" wide x 1" high depending on value	
Weight:	< 1/2 lb.	

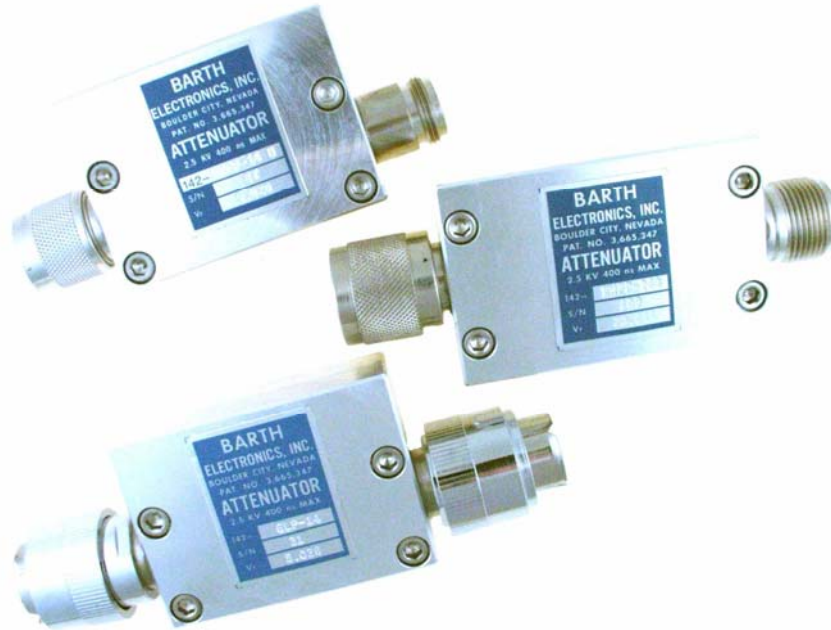
-xxx Connector identifier, see list under connectors heading for our standard (stocked) configurations. Call for connector configurations not shown.

-y Attenuation value identifier

** Units with N connectors are limited to a 4kV rating.

HIGH VOLTAGE PULSE ATTENUATOR

MODEL 142 SERIES



Model 142 Series

ADVANTAGES

- High voltage pulse rated
- Wide range of standard attenuation values, custom values available
- Units with standard connector combinations are available from stock
- Custom connector combinations can be manufactured from standard parts.

DESCRIPTION

The 142 series attenuators are available in 8 standard attenuator values and are rated for 2.5Kv/400ns wide rectangular pulse. Any non standard value, between 1.2 and 20dB, can be manufactured. Most combinations of input - output connectors can be built. Attenuators with connector arrangements other than male/female of the same type are generally not stock items.

SPECIFICATIONS

Voltage Ratio - Attenuation dB:

142-xxx-3:	1.4/1 Vr (3dB)
142-xxx-4:	1.5/1 Vr (4dB)
142-xxx-6B:	2.0/1 Vr (6dB)
142-xxx-8B:	2.5/1 Vr (8dB)
142-xxx-10B:	3.2/1 Vr (10dB)
142-xxx-14B:	5.0/1 Vr (14dB)
142-xxx-20B:	10.0/1 Vr (20dB)
142-xxx-26B:	20.0/1 Vr (26dB)

Continued on Next Page

HIGH VOLTAGE PULSE ATTENUATOR

MODEL 142 SERIES

SPECIFICATIONS continued

Maximum Input:	2.5kV, 400ns FWHM Pulse	
Peak Input Power:	125kW at rated pulse width	
Average Input Power:	2W maximum	
Impedance:	50 \pm 1%	
Risetime through Unit:	< 10ps	
Bandwidth (-3dB):	DC to 30GHz	
Reflection-TDR:	< 3% to a 100ps risetime step function	
Voltage Coefficient:	< 1% at rated voltage	
Connectors:	142-NMFP-yy 142-GLP-yy 142-HMFP-yy 142-GHMFP-yy 142-SPJ	N male/female * GR 874 Locking HNB male/female ** GHV male/female *** SHV male/female ***
Dimensions:	Outline drawings available	
Weight:	3/4 lb max.	
Ordering Information:	142-xxx-yy	

-xxx Connector identifier, see list under connectors heading for our standard (stocked) configurations. Call for connector configurations not shown.

-yy Attenuation value in dB, see list of standard values under Voltage Ratio heading, or call for nonstandard values.

NOTE: Actual measured voltage ratio is recorded on each nameplate.

* Most popular general purpose lab items, in stock for immediate delivery.

** Our type HN (HNB) connectors are specially designed to obtain minimum reflection coefficient for fast risetimes. For best pulse response, our model 401-HNB male or 402-HNB female cable connector for RG214/U coax should be used for interconnection.

*** Connector has risetime limitations; please specify test pulse risetime.

HIGH VOLTAGE PULSE ATTENUATOR

MODEL 2237-HFNFP, 2239-HFNFP

Model 2237-HFNFP



Model 2239-HFNFP



DESCRIPTION

26dB attenuators with HN female input connectors.

SPECIFICATIONS

Voltage Ratio:		20/1 Vr (26dB)
Maximum Input:	2237	10kV, 400ns FWHM Pulse
	2239	16kV/400ns, 20kV/200ns, FWHM Pulse
Peak Input Power:	2237	2MW at rated pulse width
	2239	18MW at rated pulse width
Average Input Power:		2.5W maximum
Impedance:		50 $\Omega \pm 1\%$
Risetime through Unit:	2237	< 50ps
	2239	<100ps
Bandwidth (-3dB):	2237	DC to 7.0GHz
	2239	DC to 3.5GHz
Reflection-TDR:	Input	< 4% to a 100ps risetime step function
	Output	< 3% to a 100ps risetime step function
Voltage Coefficient:		< 1% at rated voltage
Connectors:		HN female input * N female output
Dimensions:	2237	4.8" long x 1.250" wide x 2" high
	2239	10.5" long x 1.250" wide x 2" high
Weight:	2237	1 ¼ lb.
	2239	1 ¾ lb.

NOTE: * Our type HN (HNB) connectors are specially designed to obtain minimum reflection coefficient for fast risetimes. For best pulse response, our model 401-HNB male or 402-HNB female cable connector for RG214/U coax should be used for interconnection. A RG214/U coax "pigtail" input is also available and can be supplied with a HNB male connector on the coax. We have found that the best HN Connector pair cannot withstand 25kV at 10ns pulse width for more than 1000 shots. We have to limit any attenuator with HN connectors to 20kV at 200ns. They can withstand 25 or 30kV at much shorter pulses. But we cannot specify what that pulse width limit may be.

HIGH VOLTAGE PULSE ATTENUATOR

MODEL 2238-HFNFP



DESCRIPTION

The 2238-HFNFP was designed for measurement of signal risetimes as fast as 1ns, to address the requests of some of our customers for a less expensive alternative to our ultra wide band high voltage attenuators. The Model 2238-HFNFP while not as wide bandwidth as most of our products, was designed for lower manufacturing costs while still offering the quality and reliability which we have been known for since 1964.

SPECIFICATIONS

Voltage Ratio:	20/1 +/- 5% Vr (26dB)
Maximum Input Voltage:	16kV, 400ns FWHM Pulse
Peak Input Power:	18MW at rated pulse width
Average Input Power:	2.5W Maximum
Impedance:	50 Ohm +/- 1%
Risetime through Unit:	< 1ns
Reflection - TDR:	Input < 4% to a 100ps risetime step function Output < 3% to a 100ps risetime step function
Voltage Coefficient:	<1% at rated voltage
Connectors:	HN female input N female input
Dimensions:	10.5" long x 1.25" wide x 2" high
Weight:	1 ¾ lbs.

HIGH VOLTAGE PULSE POWER ATTENUATOR

MODEL 2511-30F

ADVANTAGES

- Used for high voltage, high repetition rate testing of sources.
- Electrical Fast Transients pulse sources.

DESCRIPTION

The Model 2511-30F has a medium power rating that allows for high repetition rate testing of EFT generators, at their high voltage rating.



SPECIFICATIONS

Voltage Ratio:	30dB	31.6/1 Vr
Maximum Input:	8 kV @ 50 ns FWHM Pulse, 100 ns 1/e Exponential decay	
Average Input Power:	25 W	
Impedance:	50 Ω	
Risetime through Unit:	1 ns	
Bandwidth (-3dB):	350 MHz	
Reflection-TDR:	< 5% @1 ns	
Voltage Coefficient:	< 1% at 10 kV	
Connectors:	Fischer 103 receptacle input; BNC receptacle output	
Dimensions:	5.5" long x 4.2" wide x 3.5" high	
Weight:	2.8 lbs.	

HIGH VOLTAGE PULSE POWER ATTENUATOR

MODEL 2536

ADVANTAGES

- High voltage pulse rated
- 200 Watt average power
- For use with high rep rate pulses

DESCRIPTION

A high voltage pulse/high power microwave (HPM) attenuator that contains a liquid dielectric coolant. It has an integral coolant pump, heat exchanger, and fan, which enables this unit to dissipate high average power.



SPECIFICATIONS

Voltage Ratio:	2536-HFP-3	1.4/1 Vr (3dB)
	2536-HFP-6	2.0/1 Vr (6dB)
	2536-HFP-10	3.2/1 Vr (10dB)
	2536-HFP-20	10.0/1 Vr (20dB)

Additional attenuation values can be designed, call for availability.

Maximum Input:	7kV/400ns, 15kV/75ns, 30kV/15ns, 60kV/2ns FWHM Pulse
Peak Input Power:	72MW at rated pulse width
Average Input Power:	200W maximum
Impedance:	50 Ω \pm 1% (output terminated with 50 Ω)
Risetime through Unit:	< 30ps
Bandwidth (-3dB):	DC to > 10Ghz
Reflection-TDR:	< 5% to a 100ps risetime step function
Voltage Coefficient:	< 1% at 25kV
Connector:**	HNB female *
Dimensions:	Approx. 5(12.7 cm) Wide x 6" (15.3 cm) High x 12"(30.5 cm) Deep
Weight:	Approx. 17 lbs. (7.8 kg)
Power Requirements:	115V/60Hz, 4 Amp to power cooling pump, fan and highly visible "power on" light (240 V/50-60Hz model available for export)

NOTE:

* Our type HN (HNB) connectors are specially designed to obtain minimum reflection coefficient for fast risetimes. For best pulse response, our model 401-HNB male or 402-HNB female cable connector for RG214/U coax should be used for interconnection.

** Unit is supplied with a Barth Model 404-HMM low reflection male to male adapter, so that either the input or output can be a male connector.

WIDE BAND IMPEDANCE MATCHING COMPONENTS

MODEL 220-NFP, 220A-GLP

Model 220-NFP



50 Ω Series Resistor

Model 220A-GLP



50 Ω - 100 Ω Series Resistor

DESCRIPTION

50 Ω series high voltage pulse resistor, for a one way match of 100 Ω components to 50 Ω components.

SPECIFICATIONS

Input-Output Impedance:		100 Ω to 50 Ω (50 Ω series resistor)
Input-Output Voltage Ratio:		2/1 (6.02dB)
Maximum Input:		2.5kV, 250ns FWHM Pulse
Peak Input Power:		62.5kW at rated pulse width
Average Input Power:		2W maximum
Risetime:	220-NFP	< 400ps
	220A-GLP	< 50ps
Bandwidth (-3 dB):	220-NFP	DC-1GHz
	220A-GLP	DC-8GHz
Voltage Coefficient:		< 1% at rated voltage
Connectors:	220-NFP	50 Ω N female
	220A-GLP	GR 874 locking 50 Ω - GR 874 locking 100 Ω

WIDE BAND IMPEDANCE MATCHING COMPONENTS

MODEL 224A-GLP, 641A-GLP

DESCRIPTION

Model 224A-GLP, 50 Ω to 100 Ω resistive matched attenuator

SPECIFICATIONS

Input-Output Impedance:	50 Ω to 100 Ω
Voltage Ratio:	3.035 V_r (9.64dB) 50 Ω to 100 Ω direction 7.07 V_r (16.99dB) 100 Ω to 50 Ω direction
Maximum Input:	2.5kV, 250ns FWHM Pulse
Peak input Power:	62.5kW at rated pulse width
Average Input Power:	2W maximum
Risetime:	< 20 ps
Bandwidth (-3 dB):	DC - 18GHZ
Voltage Coefficient:	< 1 % at rated voltage
Connectors:	GR 874 locking 50 Ω - GR 874 locking 100 Ω



Model 224A-GLP

DESCRIPTION

Model 641A-GLP, 50 Ω to 100 Ω impedance transformer, tapered transmission line

SPECIFICATIONS

Input-Output Impedance:	100 Ω - 50 Ω
Input-Output Risetime:	< 40 ps
Maximum Input:	5kV, 500ns FWHM Pulse
Voltage Coefficient:	< 1% at rated voltage
Connectors:	GR 874 locking 50 Ω - GR 874 locking 100 Ω



Model 641A-GLP

HAND HELD HIGH VOLTAGE HIGH FREQUENCY VOLTAGE PROBE

MODEL 2440 - 6 GHz

DESCRIPTION

The Model 2440 Hand Held, High voltage, High Frequency voltage probe, is intended for passive probing of high speed, high voltage pulse circuits. The probe kit contains one 450 ohm resistive probe for a 10:1 voltage ratio (20dB), one 950 ohm resistive probe for a 20:1 voltage ratio (26dB), and one each 450 and 950 ohm replacement resistors.

The probe is designed to have the output terminated into a 50 ohm system. It is intended for output into an attenuator or 50 ohm scope input. The probe's specified response is for the probe connected with the included coaxial cable.

SPECIFICATIONS

Maximum Input:	10:1 probe	3kv, 500ns 1/e Exponential decay pulse
	20:1 probe	5kv, 500ns 1/e Exponential decay pulse
Risetime:		< 60ps Typical
Bandwidth:		DC to 6GHz Typical Risetime and bandwidth can be limited by the physical structure surrounding the measurement point.
Input Resistance:	10:1 probe	500 ohm - when probe is terminated
	20:1 probe	1k ohm - into nominal 50 ohm load
Voltage Coefficient:		< 1 % at rated voltage
Connectors:		SMA female on probe bodies SMA male on both ends of 36" long cable for connection of probe to measurement system.

The probe ratings are for use with the supplied 36" long cable. Use of longer or higher loss cable will degrade the risetime of the measured pulse.

WARNING / SAFETY

The Model 2440 Voltage Probe is designed for the measurement of short high voltage pulses on open transmission structures in a laboratory environment. General laboratory safety procedures for working on active High Voltage systems should be followed. Only personnel experienced in the safe operation of high voltage research and development laboratory type equipment should use this probe.

HAND HELD HIGH VOLTAGE HIGH FREQUENCY VOLTAGE PROBE

MODEL 2440 - 6 GHz

OPERATION NOTE

Appropriate precautions must be taken to discharge the probe and connecting cable when the probe is being connected to sensitive sampling scope inputs, because they are very susceptible to electrostatic damage. Any Teflon dielectric coaxial cable can easily become statically charged and can hold a charge for a long period of time. Failure to discharge a piece of coax before connecting it to the sensitive scope inputs can easily damage the expensive front end electronics of these sensitive instruments.

The coax cable included with the probe can easily be discharged from either end by connecting a short or providing a resistive connection from the center conductor to the ground conductor.

Touching your finger between the center conductor and outer (ground) conductor on the SMA cable connector is a simple effective method to remove any charge on the probe cable.

The output of the probe must be connected with the included coaxial cable to a 50 ohm system, for instance to an attenuator or directly to a 50 ohm scope input. The correct method for holding the probe when making measurements, is to hold the probe body by the SMA connector in your hand between your thumb and fingers in the same manner that you would hold a pencil (see Figure 1.). Placing your hand or fingers closer to the probe tip will add capacitance to the probe and will degrade the risetime of the probe output. The probe risetime specification includes the use of the supplied 36" long cable. Use of longer or higher loss cable will degrade the probe's response.

AVERAGE POWER RATING WARNING

The peak, or average power rating, only applies to a well terminated load. Any reflection greater than 10% will significantly add to the power the DC-20Ghz bandwidth resistor will have to absorb.

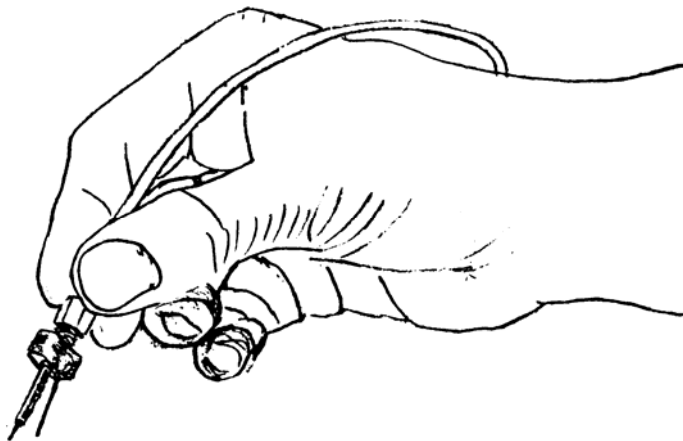


Figure 1.

HIGH VOLTAGE RESISTORS FOR DEDICATED LOCATION PULSE MEASUREMENTS

Output risetime depends on housing construction around these resistors.

When used in the proper/optimum housing, the assembly has <100ps risetime (τ).

These high voltage resistors were built for specific applications such as coaxial lines, strip lines, and balanced lines in different dielectric media such as water, vacuum, nitrogen, SF6, and fluorine gas. We design housings for use with these resistors to meet customer specifications.

If you have a need for a high voltage probe we can design a specific resistor and housing to fit your requirements.

Examples:

Model	Maximum peak voltage	Resistance	@ pulse width ns	Risetime of resistive output ps	Output connectors
VP1E3-20-1E3	20,000	1000 Ω	1 μ s	**	8-32 female thread ***
VP5E2-28-8R2	28,000	500 Ω	800	**	HNB female *
VP2E3-35-1R2N	35,000	2000 Ω	100	**	N female
VP2E3-35-1R2H	35,000	2000 Ω	100	**	HNB female *

* Our type HN (HNB) connectors are specially designed to obtain minimum reflection coefficient for fast risetimes. For best pulse response, our Model 401-HNB male or Model 402-HNB female cable connector for RG214/U coax, available on page 48, should be used for interconnection. Cable assemblies are available on page 53.

** The output risetime will be dependent on the housing.

*** Consult factory for optimum installation assistance for your application. Custom connector mounted probes can usually be designed for specific measurement requirements.

DISCLAIMER:

These resistors listed were designed for special uses in special housings and are **not** hand held voltage probes.

HIGH VOLTAGE PULSE MATCHED RESISTIVE POWER DIVIDER

Barth High Voltage Resistive Power Dividers are matched impedance coaxial devices for use primarily in pulsed 50 ohm systems, or where occasional transients would damage ordinary units. These units are ideal for use in nuclear and high energy experiments. These dividers feature input and output impedance very close to 50 ohms. Extensive testing during manufacturing insures very high reliability for single-shot experiments. A voltage coefficient of the resistive film of less than .0001%/V allows low voltage calibration of most systems.

ADVANTAGES OVER STANDARD RF POWER DIVIDERS

- Withstands High Voltage Pulses
- Input/Output impedance held very close to nominal
- High Reliability
- Low Voltage Coefficient
- Low Reflection Coefficient
- Pulse Power Rated

MATCHED RESISTIVE POWER DIVIDER MODEL COMPARISON

Model	# of output ports	Voltage ratio dB	Maximum peak voltage	@ pulse width ns	Input reflection coefficient at 100ps τ	Risetime through unit ps	Connectors
151-xxx	2	6.0	2,500	400	< 4%	< 40	*
251-xxx	2	6.0	5,000	400	< 4%	< 40	*
280-GLP	3	9.5	5,000	400	< 2%	< 50	GR 874 locking
2642-MMFP	2	6.0	1,000	400	< 1%	< 35	SMA female/SMA male
2642-MFP	2	6.0	1,000	400	< 1%	< 35	SMA female
2702-BFP	2	6.0	2,500	250	< 4%	< 60	BNC female
2703-BFP	3	9.5	2,500	250	< 4%	< 60	BNC female
2704-BFP	4	12.0	2,500	250	< 4%	< 60	BNC female
2705-BFP	5	14.0	2,500	250	< 4%	< 60	BNC female
2706-BFP	6	15.6	2,500	250	< 4%	< 60	BNC female
2746-NFMF	6	15.6	4,000	100	< 4%	< 45	N female/SMA female
2812-NFP	2	6.0	2,500	250	< 2%	< 50	N female
2813-NFP	3	9.5	2,500	250	< 2%	< 50	N female
2814-NFP	4	12.0	2,500	250	< 2%	< 50	N female
2815-NFP	5	14.0	2,500	250	< 2%	< 50	N female
2816-NFP	6	15.6	2,500	250	< 2%	< 50	N female
281x-NMFP	**	**	2,500	250	< 2%	< 50	N male/N female
281x-HFNFP	**	**	5,000	100	< 2%	< 50	HN female/N female
281x-UNFP	**	**	10,000	25	< 3%	< 50	UHLC/N female
2825-NFP	5	14.0	4,000	100	< 2%	< 75	N female
2828-NFP	8	18.1	4,000	100	< 2%	< 65	N female
2830-NFP	10	20.0	4,000	100	< 2%	< 70	N female
2832-NFP	12	21.6	4,000	100	< 2%	< 75	N female

* Any male or female (GR, N, HNB) can be supplied. Units with N connectors are limited to 4kV.

** Refer to similar - NFP model above for # of Output Ports, and Voltage Ratio.

HIGH VOLTAGE PULSE MATCHED RESISTIVE POWER DIVIDER

MODEL 151-XXX



Model 151-NFP

DESCRIPTION

High Voltage 2 Way Matched Power Divider (3 resistors)

SPECIFICATIONS

Voltage Ratio:	2.0/1Vr (6dB)
Maximum Input:	2.5kV, 400ns FWHM Pulse
Peak Input Power:	125kW at rated pulse width
Average Input Power:	2W maximum
Impedance:	50 Ω \pm .25 Ω
Reflection-TDR:	< 4% to a 100ps risetime step function
Risetime through Unit:	< 40ps
Bandwidth:	DC to 9GHz
Voltage Coefficient:	< 1% at rated voltage
Connectors:	151-GP GR 874 Non locking 151-GLP GR 874 Locking 151-NMP N male 151-NFP N female
Dimensions:	4" long x 2.5" wide x 1" high
Weight:	Approx. 1/2 lb.

- XXX Connector identifier, see connector list heading above for our standard (stocked) configurations.
Call for connector configurations not shown.

HIGH VOLTAGE PULSE MATCHED RESISTIVE POWER DIVIDER

MODEL 251-XXX



Model 251-NFP

DESCRIPTION

High Voltage 2 Way Matched Power Divider (3 resistors)

SPECIFICATIONS

Voltage Ratio:	2.0/1 Vr (6dB)
Maximum Input:	5kV, 400ns FWHM Pulse
Peak Input Power:	500kW at rated pulse width
Average Input Power:	2W maximum
Impedance:	50 Ω
Reflection-TDR:	< 4% to a loop risetime step function
Risetime through Unit:	< 40ps
Bandwidth:	DC to 9GHz
Voltage Coefficient:	< 1% at rated voltage
Connectors:	251- GP GR 874 non-locking 251- GLP GR 874 locking 251- NMP N male ** 251- NFP N female ** 251- HMP HNB male * 251- HFP HNB female *
Dimensions:	4" long x 2.5" wide x 1" high
Weight:	Approx. 1/2 lb.

-XXX Connector identifier, see connector list heading above for our standard (stocked) configurations.
Call for connector configurations not shown.

NOTE: * Our type HN (HNB) connectors are specially designed to obtain minimum reflection coefficient for fast risetimes. For best pulse response, our model 401-HNB male or 402-HNB female cable connector for RG214/U coax should be used for interconnection.

** Units with N connectors are limited to 4kV rating.

HIGH VOLTAGE PULSE MATCHED RESISTIVE POWER DIVIDER

MODEL 280-GLP



Model 280-GLP

DESCRIPTION

3 Way High Voltage Power Divider

SPECIFICATIONS

Voltage Ratio:	3.0/1 Vr (9.54dB)
Maximum input:	5kV, 400ns FWHM Pulse
Peak Input Power:	500kW at rated pulse width
Average Input Power:	3W maximum
Impedance:	50 Ω
Reflection-TDR:	< 2% to a 100ps risetime step function
Risetime through Unit:	< 50ps
Bandwidth:	DC to 7GHz
Voltage Coefficient:	< 1% at rated voltage
Connectors:	GR 874 locking
Dimensions:	4.3" long x 4.3" wide x 1.5" high
Weight:	3/4 lb.

HIGH VOLTAGE PULSE MATCHED RESISTIVE POWER DIVIDER

MODEL 2642-MMFP, 2642-MFP

DESCRIPTION

High Voltage 2 Way Matched Resistive Power Divider with SMA Connectors.



Model 2642-MMFP

SPECIFICATIONS

Voltage Ratio:	2.0/1 Vr (6dB)
Maximum Input:	1kV, 400ns FWHM Pulse
Peak Input Power:	20kW at rated pulse width
Average Input Power:	1W maximum
Impedance:	50 Ω
Reflection-TDR:	Input < 1% to a 100ps risetime step function Output < 2% to a 100ps risetime step function
Risetime through Unit:	< 35ps
Bandwidth:	DC to 10GHz
Voltage Coefficient:	< 1% at rated voltage
Connectors:	2642-MMFP SMA male in, 2 SMA female out 2642-MFP SMA female
Dimensions:	1.560" long x 1.370" wide x .640" high
Weight:	Approx. 6.5 oz.

HIGH VOLTAGE PULSE MATCHED RESISTIVE POWER DIVIDER MODEL 2700 SERIES



Model 2706-BFP

DESCRIPTION

The 2700 series High Voltage Power Dividers offer 2, 3, 4, 5, or 6 output ports and are designed for use primarily in pulsed 50 ohm systems, or where occasional transients would damage ordinary units. These dividers feature input and output impedance very close to 50 ohms.

SPECIFICATIONS

Voltage Ratio:	2702-BFP	2.0/1 Vr (6.02dB)
	2703-BFP	3.0/1 Vr (9.54dB)
	2704-BFP	4.0/1 Vr (12.04dB)
	2705-BFP	5.0/1 Vr (13.98dB)
	2706-BFP	6.0/1 Vr (15.56dB)
Maximum Input:	2.5kV, 250ns FWHM Pulse	
Peak Input Power:	125kW at rated pulse width	
Average Input Power:	8W maximum	
Impedance:	50 Ω	
Reflection-TDR:	< 4% to a 100ps risetime step function	
Risetime through Unit:	< 60ps	
Bandwidth:	DC to 6GHz	
Voltage Coefficient:	< 1% at rated voltage	
Connectors:	BNC female	
Dimensions:	2.9' x 3" dia. + (2) 8-32 mounting studs	
Weight:	1 lb.	

HIGH VOLTAGE PULSE MATCHED RESISTIVE POWER DIVIDER

MODEL 2746-NFMF



Model 2746-NMFP

DESCRIPTION

High Voltage 6 Way Matched Resistive Power Divider.

SPECIFICATIONS

Voltage Ratio:	6.0/1 Vr (15.56dB)
Maximum Input:	4kV, 100ns FWHM Pulse
Peak Input Power:	125kW at rated pulse width
Average Input Power:	4W Maximum
Impedance:	50 Ω
Reflection-TDR:	< 4% to a 100ps risetime step function
Risetime through Unit:	< 45ps
Bandwidth:	DC to 8GHz
Voltage Coefficient:	< 1% at rated voltage
Connectors:	N female input, SMA female output
Dimensions:	2.9" x 3" dia. + (2) 8-32 mounting studs on 2" Centers
Weight:	1 lb.

HIGH VOLTAGE PULSE MATCHED RESISTIVE POWER DIVIDER MODEL 2810 SERIES



DESCRIPTION

The 2810 series 50 ohm matched resistive power divider equally divides and distributes signals in high voltage pulse applications.

SPECIFICATIONS

Voltage Ratio:	2812-NFP/NMFP	}	2 WAY DIVIDER
	2812-HFNFP		2.0/1 $V_r \pm 2\%$ (6.02dB)
	2812-UNFP		
	2813-NFP/NMFP	}	3 WAY DIVIDER
	2813-HFNFP		3.0/1 $V_r \pm 2\%$ (9.54dB)
	2813-UNFP		
	2814-NFP/NMFP	}	4 WAY DIVIDER
	2814-HFNFP		4.0/1 $V_r \pm 2\%$ (12.04dB)
	2814-UNFP		
	2815-NFP/NMFP	}	5 WAY DIVIDER
	2815-HFNFP		5.0/1 $V_r \pm 2\%$ (13.98dB)
	2815-UNFP		
	2816-NFP/NMFP	}	6 WAY DIVIDER
	2816-HFNFP		6.0/1 $V_r \pm 2\%$ (15.56dB)
	2816-UNFP		

HIGH VOLTAGE PULSE MATCHED RESISTIVE POWER DIVIDER

MODEL 2810 SERIES

SPECIFICATIONS continued

Maximum input:	281x-NFP/NMFP 281x-HFNFP 281x-UNFP	2.5kV, 250ns FWHM Pulse 5.0kV, 100ns FWHM Pulse 10.0kV, 25ns FWHM Pulse
Peak Input Power:	281x-NFP/NMFP 281x-HFNFP 281x-UNFP	125kW at rated pulse width 500kW at rated pulse width 1.0MW at rated pulse width
Average Input Power:	8W maximum	
Impedance:	50 $\Omega \pm 1\%$	
Reflection-TDR:	281x-NFP 281x-UNFP	Input < 2% to a 100ps risetime step function Output < 6% to a 100ps risetime step function Input < 3%
Risetime through Unit:	< 50ps	
Bandwidth:	DC to 7GHz	
Maximum Precursor:	< $\pm 0.1\%$ for a 100ps risetime pulse	
Time Domain Overshoot:	< 2% overshoot for a 100ps risetime input pulse with no ringing	
Time Match between Ports:	± 10 ps maximum time difference between any/all output ports	
Attenuation Matching:	$\pm 1.0\%$ between ports from DC to 300MHz minimum	
Voltage Coefficient:	< 1% at rated voltage	
Connectors:	281x-NFP 281x-NMFP 281x-HFNFP 281x-UNFP	N female (standard stocked configuration) N male input, N female output HN female input, N female output UHV-50* input, N female output Input labeled, Outputs numbered.
Dimensions:	Outline drawings available	
Weight:	2812-NFP 2813-NFP 2814-NFP 2815-NFP 2816-NFP	approx. 1/2 lb. approx. 3/4 lb. approx. 7/8 lb. approx. 1 lb. approx. 1 1/4 lb.

x = number of outputs (2, 3, 4, 5, or 6)

* UHV-50 is the highest voltage high speed coaxial connector available.

HIGH VOLTAGE PULSE MATCHED RESISTIVE POWER DIVIDER

MODEL 2825-NFP, 2828-NFP, 2830-NFP, 2832-NFP

DESCRIPTION

The 2820/2830 Series Power Dividers are designed to equally divide and distribute signals in high voltage pulse applications.

SPECIFICATIONS

Voltage Ratio:	2825-NFP	5.0/1Vr (13.98dB)
	2828-NFP	8.0/1Vr (18.06dB)
	2830-NFP	10.0/1Vr (20.00dB)
	2832-NFP	12.0/1Vr (21.58dB)

Maximum Input: 4kV, 100ns FWHM Pulse

Peak Input Power: 320kW at rated pulse width

Average Input Power: 10W maximum

Impedance: 50 Ω

Reflection-TDR: < 2% to a 100ps risetime step function

Risetime through Unit:	2825-NFP	< 75ps
	2828-NFP	< 65ps
	2830-NFP	< 70ps
	2832-NFP	< 75ps

Bandwidth:	2825-NFP	DC to 4.5GHz
	2828-NFP	DC to 5.4GHz
	2830-NFP	DC to 5.0GHz
	2832-NFP	DC to 4.5GHz

Voltage Coefficient: < 1% at rated voltage

Connectors: N female

Dimensions: Outline drawing available

Weight:	2825-NFP	1 1/8 lbs.
	2828-NFP	2 1/4 lbs.
	2830-NFP	3 lbs.
	2832-NFP	3 3/4 lbs.



Model 2820/2830 Series

HIGH VOLTAGE PULSE MATCHED RESISTIVE POWER COMBINER

MODEL 2921-HFP

DESCRIPTION / 2921-HFP

2 Input 4 Output Combiner

SPECIFICATIONS

Voltage Ratio:	2.0/1 Vr
Maximum Input:	2kV, 500ns FWHM Pulse
Connectors:	HNB female



Model 2921-HFP

HIGH VOLTAGE PULSE MATCHED RESISTIVE POWER COMBINER

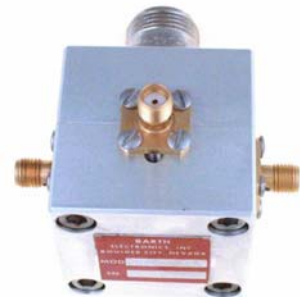
MODEL 2934-MFNF

DESCRIPTION

4 Way Broadband High Peak Resistive Combiner

SPECIFICATIONS

Voltage Ratio:	1.0/1 Vr
Maximum Input:	2kV, 10ns FWHM Pulse
Average Input Power:	1W Maximum
Impedance:	50 Ω
Risetime through Unit:	< 30ps
Connectors:	SMA female inputs - N female output
Dimensions:	2.2" long x 2.2" wide x 2.2" high
Weight:	1/2 lb.



Model 2934-MFNF

9 PORT DIVIDER

MODEL 6419-NFP

ADVANTAGES

- Specifically designed for maximum amplitude output with fixed duration flat top, while maintaining a fast clean risetime.
- Outputs are very consistent from port to port, with respect to risetime, amplitude, and delay.
- Similar dividers with different number of outputs, other input voltages, pulse widths, or risetime specifications can be designed to meet a customers requirements.



DESCRIPTION

9 Output High Voltage Pulse divider specifically designed for use with 10 kV, 250 ps risetime high voltage pulses.

SPECIFICATIONS

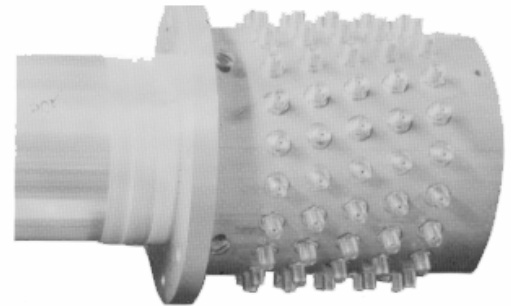
Number of Outputs:	9 Outputs
Input-Output Voltage Ratio:	2.94:1 / 3.21:1 (9.75dB +/- 0.38 dB)
Output Pulse Risetime:	280 ps for a 250ps Input Risetime
Maximum Input Pulse Amplitude:	10 kV/10 ns, Rectangular Pulse
Input Reflection Coefficient :	+ 1.6%, - 3.0%, to a 250 ps Risetime Step Function
Maximum Pulse Droop:	6% @ 16 ns
Connectors:	Type "N" Receptacle (female) on Input and Outputs
Dimensions:	Approx. 7.3" x 7.3" x 3" Height
Weight:	4.5 lbs.

100 PORT DIVIDER

MODEL 9201-GMF

ADVANTAGES

- Specifically designed for maximum amplitude output with fixed duration flat top, while maintaining a fast clean risetime.
- Outputs are very consistent from port to port, with respect to waveshape, risetime, amplitude, and delay.
- Similar dividers with different number of outputs, pulse width, voltage, or risetime specifications can be designed to meet a customer's requirements.



DESCRIPTION

100 Output High Voltage Pulse Divider specifically designed for use with a fast rise high voltage pulse generator such as Barth Model 732, (2kV output with < 50ps rise time).

SPECIFICATIONS

Number of Outputs:	100 Outputs
Input-Output Voltage Ratio:	> 14:1
Output Voltage Example:	> 138V x 2ns flat top for a 2kV x 2ns, 50ps risetime input
Input-Output Risetime:	< 60 ps
Output Risetime Example:	< 74ps for 2ns wide, 50ps risetime input
Maximum Input Voltage:	2.5kV, 0.75ns to 2ns pulse width
Output Time Variation between ports:	< 5ps, typically < 2ps
Output Amplitude Variation between ports:	< 15%
Connectors:	Input - General Radio Type 874/Output - SMA Female
Dimensions:	Approx. 7.64' (2.33m) long x 6" (15.3 cm) Outer Diameter 12" Tapered Input Section - 8" long 100 way Output Section
Weight:	45 lbs./20.4 Kilos

Note: Other High Voltage Pulse Dividers are available, call us with your needs.

WIDE BAND HIGH VOLTAGE TRANSFORMER

TRANSFORMER COMPONENT MODEL COMPARISON

Transformer Type Model #	Maximum peak voltage	Maximum energy without saturation	Input reflection coefficient @ 100ps τ	Risetime through unit mainline ps	Risetime of coupled output ps	Connectors
PULSE INVERTERS						
6115-BMFP	1,000	45 V $\times\mu$ s	< 4%	< 400 **	n/a	BNC male/female
621A-GLP	2,000	250 V $\times\mu$ s	< 5%	< 70	n/a	GR 874 locking
621A-MFP	2,000	250 V $\times\mu$ s	< 5%	< 70	n/a	SMA female
621-NFP	2,000	250 V $\times\mu$ s	< 5%	< 70	n/a	N female
623-GLP	1,000	30 V $\times\mu$ s	< 5%	< 70	n/a	GR 874 locking
BALUNS						
650A-NFT	300	30 V $\times\mu$ s	< 1%	n/a	< 40	N female input- N female output
651-NFP	1,000	500 V $\times\mu$ s	< 1%	n/a	< 90	N female input- N female output
652-NFP	1,000	100 V $\times\mu$ s	< 1%	n/a	< 50	N female input- N female output

* Our type HN (HNB) connectors are specially designed to obtain minimum reflection coefficient for fast risetimes. For best pulse response, our model 401-HNB connector or 402-HNB female cable for RG214/U coax, available on page 48, should be used for interconnection. Cable assemblies are available on page 53.

** Input Reflection Coefficient rated at 500ps τ .

WIDE BAND HIGH VOLTAGE PULSE INVERTER

MODEL 6115-BMFP

DESCRIPTION

50 Ω High Voltage Pulse Inverter



Model 6115-BMFP

SPECIFICATIONS

Voltage Ratio:	1/(-1)
Maximum Input:	1kV, 45Vx μ s Pulse
Impedance:	50 Ω
Risetime:	< 400ps, inverted pulse >98% at 1 μ s
Bandwidth (-3dB):	700MHz
Droop:	<10% at 1 μ s
Reflection-TDR:	< 4% to a 500ps risetime step function
Connectors:	BNC male/female
Dimensions:	2.8" long x 0.725" diameter
Weight:	2 oz.

WIDE BAND HIGH VOLTAGE PULSE INVERTER

MODEL 621A-GLP, 621A-MFP, 621-NFP

DESCRIPTION

50 Ω High Voltage Pulse Inverter



Model 621A-GLP

SPECIFICATIONS

Voltage Ratio:	1/(-1)
Maximum Input:	2kV, 250Vx μ s Pulse
Impedance:	50 Ω
Risetime:	< 70ps, inverted pulse >94% at .5ns
Bandwidth (-3dB):	5GHz
Droop:	2% at 100ns
Reflection-TDR:	< 5% to a 100ps risetime step function
Connectors:	621A-GLP GR 874 locking 621A-MFP SMA locking 621-NFP N female
Dimensions:	621A-GLP 7.12" x 1.5" dia. 621A-MFP 7.12" x 1.5" dia. 621-NFP 6" x 1.5" dia.
Weight:	1 lb.

WIDE BAND HIGH VOLTAGE PULSE INVERTER

MODEL 623-GLP



Model 623-GLP

DESCRIPTION

50 Ω High Voltage Pulse Inverter

SPECIFICATIONS

Voltage Ratio:	1/(-1)
Maximum Input:	1kV, 30Vx μ s Pulse
Impedence:	50 Ω
Risetime:	< 70ps, inverted pulse >96% at .5ns
Droop:	6% at 100ns, 0.6% at 10ns
Bandwidth (-3dB):	5GHz
Reflection – TDR:	< 5% to a 100ps risetime step function
Connectors:	GR 874 locking
Dimensions:	6.5" long x 2.5" wide x 1.25" high
Weight:	1 lb.

WIDE BAND HIGH VOLTAGE BALUN

MODEL 650A-NFT, 651-NFP, 652-NFP



Model 652-NFP

DESCRIPTION

50 Ω Balun with (+) and (-) N female inputs

SPECIFICATIONS

Voltage Ratio:	1.0 when used as a differential combiner	
Maximum Input:	650A-NFT	$\pm 300V$, 100ns (30Vx μ s)
	651-NFP	$\pm 1kV$, 500ns (500Vx μ s)
	652-NFP	$\pm 1kV$, 100ns (100Vx μ s)
Impedance:	50 Ω	
Risetime:	650A-NFT	< 40ps
	651-NFP	< 90ps
	652-NFP	< 50ps
Bandwidth (-3dB):	650A-NFT	8.75GHz
	651-NFP	3.8GHz
	652-NFP	3.5GHz
Droop:	650A-NFT	5.0% at 100ns
	651-NFP	0.5% at 100ns
	652-NFP	1.5% at 100ns
Voltage Coefficient:	< 1% at rated voltage	
Connector:	N female	
Dimensions:	7.12" x 2.25" dia.	
Weight:	1 lb.	

PICOSECOND PULSE GENERATOR

MODEL 632



DESCRIPTION

The Barth Model 632, 2.5Kv Pulse Generator, provides high voltage pulses of less than 50ps risetime that can drive into any load impedance without damage to the output switch. It is useful for calibrating sensors because of its clean pulse and very fast risetime. The output pulse width is determined by external charge line length for flat top output pulses or discharge capacitors for exponentially decaying pulses. The generator is capable of a minimum pulse width of 750ps and is supplied with a 5 nanosecond charge line. The output is adjustable over a range of 500 volts through 2500 volts pulse amplitude of either polarity. Barth high voltage pulse attenuators are recommended for fast rise time, low voltage pulse applications, and for impedance matching to reduce multiple reflections when the generator is operated with unmatched loads.

SPECIFICATIONS

Output Pulse:	50 ps, 10-90%, risetime at all output voltages
Output Amplitude:	Continuously adjustable from +/-500 volts output to +/-2.5kv output
Output Pulse Width:	750ps minimum to 5ns, pulse width determined by external charge line. Unit supplied with 5ns charge line, shorter charge lines available as options
Output Pulse Rep Rate:	Single shot with push-button/external triggering or adjustable from .1 Hz to 10Hz
Trigger Input:	5V at 20mA input pulse at up to 10 Hz rep rate
Mechanical Switch Life:	> 5,000,000 pulses at 2.5 kv and 5ns pulse width output (switch life is output pulse energy dependent)
Connectors:	GR 874 locking, with a "N" female adapter supplied on the output connector
Input Power:	90-132 VAC @ 2.5 amps or 175-264 VAC @ 1.6 amps (47-63 Hz single phase)
Dimensions:	6.0" wide x 10.5" high x 12.5" deep
Weight:	21 lbs.

HIGH VOLTAGE PULSE GENERATOR

MODEL 732



DESCRIPTION

The model 732 pulse generator provides pulses of < 50ps risetime, 100 volts through 2kV amplitude, to drive into any load impedance through 50 ohm coax. The generator is capable of a minimum pulse width of 750ps and a maximum of 1 microsecond. The rectangular output pulse width is determined by charge line length or by capacitors for $1/\epsilon$ decay pulses. HPM, impulse driven antennas, dry run simulation, and HV pulse testing are just a few of the uses for this HV pulse generator.

SPECIFICATIONS

- Output Pulse:** < 50ps risetime at all output voltages, with < 5% overshoot
- Output Amplitude:** Continuously adjustable from < 100 volts output to > 2kV output with < 1% output amplitude jitter at maximum output voltage
- Output Pulse Rep Rate:** Adjustable in steps from >20 sec/pulse to 120Hz
- Trigger Input:** 5V at 1mA through a grounding switch, or a 1V, 1 μ s input trigger pulse
- Mechanical Switch Life:** > 3,000,000 pulses at 2kV/400ns pulse width (switch life is energy dependent)
- Connectors:** GR 874 locking (2.5kV max output) or type N female (2.0kV max output at sea level) charge line and output connectors
- Input Power:** Standard 120 volt/60Hz line power at 10 amps (50Hz model available for export)
- Dimensions:** 19" wide (rack mount) x 7" high x 16" deep
- Weight:** 50 lbs.

Accessories:

Model

Description

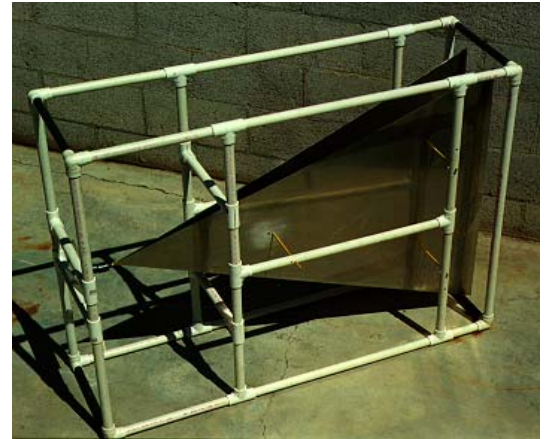
7401-.075GL	0.75ns Charge Line;	3/4ns charge line jumper w/integral charge resistor
7401-1-GL	1ns Charge Line;	1ns charge line jumper w/integral charge resistor
7401-2-GL	2ns Charge Line;	2ns charge line jumper w/integral charge resistor
7801	Adjustable Suicide Cross;	Converts step functions to delta functions

NOTE: Other accessories are under development.

TEM TIME DOMAIN ANTENNA

MODEL 3004

The Model 3004 is a 50 ohm impedance time domain antenna used to make measurements directly in the time domain. Use of this antenna for transmitting and receiving allows simple calculations of impulse amplitudes and risetimes. This "direct" method of measurement avoids the transformation between the frequency and time domains and minimizes the errors that can arise when basic assumptions are made about a radiating source. We have found time domain measurements to be much more reliable when made with this "time domain antenna", to eliminate frequency domain conversions.

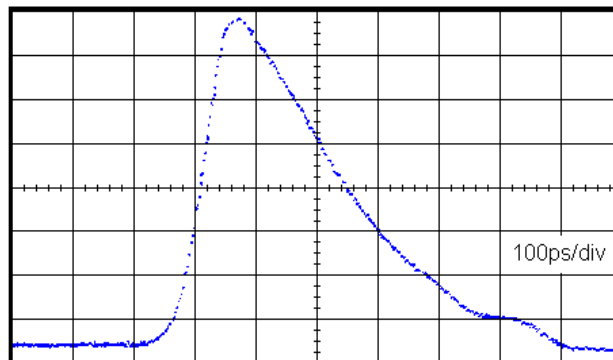


The antenna has a balanced 50 ohms construction to allow maximum bandwidth and minimum reflection, fed with an integral 50 ohm wide band balun to allow the direct connection between the balanced antenna structure and ordinary coaxial line.

The good balun prevents off-axis radiation errors from unbalanced currents when used either for transmitting or receiving. The pulse response between two identical antennas is included below and shows a 75.6 PS. risetime followed by a slow decay. One antenna was fed with a 50 PS risetime step function of 5 ns. pulse length generated by our Model 732 reed switch pulse generator fed through low loss BFT4 coax for minimal pulse distortion. The very flat top from this pulse generator minimizes additional distortion of the antenna pulse decay after the initial rise.

The Model 3004 receiving antenna was fed directly into to a HP 54120A digital sampling oscilloscope through our BFT4 low loss coax. A pulse response through two antennas was 75.6 ps, or for each antenna an individual risetime of about 53.5 PS. The pulse decay through the pair of antennas to 50% amplitude was about 242 Ps. The antennas were spaced 20 feet apart for this measurement and the pulse response would be slightly better at wider separations.

The antenna framework is 48 inches long by 39 inches wide by 15 inches high. The complete antenna weighs 22 pounds. We are designing some smaller time domain antennas for smaller aperture use, at closer spacings. We are also designing some larger time domain antennas with higher directivity/gain for use with air propagation or ground penetrating radar. If you require time domain pulse radiation measurements, our commercial time domain antenna hardware, high voltage pulse generators, and high voltage pulse experience is available for you.



CONNECTORS/ADAPTERS HIGH VOLTAGE PULSE

MODEL 401-HNB, 402-HNB, 401-371



DESCRIPTION

401-HNB, HNB Male cable connector for RG214/U coax; modified for low reflection coefficient.

402-HNB, HNB Female cable connector for RG214/U coax; modified for low reflection coefficient.

SPECIFICATIONS

Maximum Input: 15kV, 1 μ s FWHM Pulse

Impedance: 50 Ω

Reflection-TDR: < 4% at 100ps risetime

Risetime: < 20ps

The 401-HNB or 402-HNB cable connector requires the Model 401-371 connector installation tool.

Note: 401-HNB or 402-HNB cable connectors are also available assembled onto a user specified length of RG214/U coax, on page 53.



DESCRIPTION

HNB Trim tool used for preparing RG214/U coax for installation of a 401-HNB / 402-HNB cable connector.

SPECIFICATIONS

Our type HN (HNB) connectors are specially designed to obtain minimum reflection coefficient for fast risetimes. For best pulse response, our Model 401-HNB male or 402-HNB female cable connector for RG214/U coax should be used for interconnection.

CONNECTORS/ADAPTERS HIGH VOLTAGE PULSE

MODEL 404-HFF, 404-HMM, 404-HFNF, 404-HMNM

DESCRIPTION

404-HFF HNB female to female adapter specifically designed to maintain high voltage hold off and provide a low reflection coefficient.

404-HMM HNB male to male adapter specifically designed to maintain high voltage hold off and provide a low reflection coefficient.



SPECIFICATIONS

Maximum Input: 15kV, 1 μ s FWHM Pulse

Impedance: 50 Ω

Reflection-TDR: < 2% at 100ps risetime when mated with Barth HNB connector

Risetime: < 20ps

Connectors: 404-HFF HNB Female, HNB Female
404-HMM HNB Male, HNB Male



DESCRIPTION

404-HFNF HNB female to N female adapter specifically designed to maintain high voltage hold off and provide a low reflection coefficient

404-HMNM HNB male to N male adapter specifically designed to maintain high voltage hold off and provide a low reflection coefficient

SPECIFICATIONS

Maximum Input: 4kV, 1 μ FWHM Pulse

Impedance: 50 Ω

Reflection-TDR: < 2% at 100ps risetime when mated with Barth HNB connector

Risetime: < 20ps

Connectors: 404-HFNF HNB Female, N Female, 404-HMNM HNB male, N male



CONNECTORS/ADAPTERS HIGH VOLTAGE PULSE

MODEL 444-HMSP, 472-HMNF

DESCRIPTION

444-HMSP HN male to SHV plug adapter



SPECIFICATIONS

Maximum Input: 10kV
Impedance: 50Ω
Reflection-TDR: ± 5% at 100ps
Connectors: HN male and SHV plug

DESCRIPTION

472-HMNF HN male to N female adapter



SPECIFICATIONS

Maximum Input: 4kV, 1μs FWHM Pulse
Impedance: 50 Ω
Connectors: HN male, N female

CONNECTORS/ADAPTERS HIGH VOLTAGE PULSE

MODEL HNL, HNT, EL-L, QHPB

DESCRIPTION

HNL HNB right angle adapter

SPECIFICATIONS

Maximum Input: 15kV, 1 μ s FWHM Pulse
Impedance: 50 Ω
Connectors: HNB male/female



DESCRIPTION

HNT HNB unmatched "T"

SPECIFICATIONS

Maximum Input: 15kV, 1 μ s FWHM Pulse
Impedance: 50 Ω
Connectors: HNB female

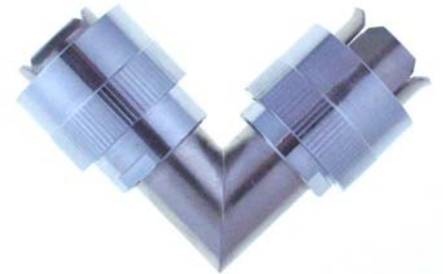


DESCRIPTION

EL-L 50 Ω 90 deg. Elbow (Gilbert/GR part #0874-9527)

SPECIFICATIONS

Maximum Input: 5kV, 1 μ s FWHM Pulse
Impedance: 50 Ω
Reflection-TDR: < 1% at 100ps risetime
Risetime: < 30ps
Connectors: GR 874 locking



DESCRIPTION

QHPB HNB male to GR 874 locking adapter (Gilbert/GR part #0874-9804 w/added locking nut)

SPECIFICATIONS

Maximum Input: 5kV, 1 μ s FWHM Pulse
Impedance: 50 Ω
Reflection-TDR: < 4% at 100ps risetime
Risetime: < 20ps



CONNECTORS/ADAPTERS HIGH VOLTAGE PULSE

MODEL 0874 SERIES

GR to N ADAPTERS

<u>Model</u>	<u>Connectors</u>
0874-9710	GR 874 non-locking/N female
0874-9711	GR 874 locking/N female
0874-9810	GR 874 non-locking/N male
0874-9811	GR 874 locking/N male



GR to BNC ADAPTERS

<u>Model</u>	<u>Connectors</u>
0874-9700	GR 874 non-locking/BNC female
0874-9701	GR 874 locking/BNC female
0874-9800	GR 874 non-locking/BNC male
0874-9801	GR 874 locking/BNC male



GR to SMA ADAPTERS

<u>Model</u>	<u>Connectors</u>
0874-QMMP	GR 874 to SMA male
0874-QMMJ	GR 874 to SMA female



CABLE ASSEMBLIES - BTF4

MODEL 462-NMMP-X, 462-HMMP-X

BTF4: Low loss foam Teflon® dielectric coax cable with quadruple shields. Minimum higher order mode generation for fastest risetime propagation.



Impedance: 50 Ω

Connector: Available configurations shown below.

462-NMMP-X Two (2) “N” Male connectors assembled on X inches of BTF4 coax.
For example: 462-NMMP-9 would be a 9” BTF4 coax cable assembly with two (2) “N” male connectors.

462-HMMP-X Two (2) “HN” Male connectors assembled on X inches of BTF4 coax.
For example: 462-HMMP-35 would be a 35” BTF4 coax cable assembly with two (2) “HN” male connectors.

NOTE: Base price assemblies include up to three (3) feet in length of BTF4 coax.
Assemblies are available in lengths of more than 3 feet, call factory for pricing.

CABLE ASSEMBLIES - RG214/U

MODEL 463-GLP, 463-HMFP, 463-HMP, 463-HFP



RG214/U: Coax with connector, available configurations shown below.

463-GLP One (1) GR Type 874 Locking connector assembled on RG214/U coax.

463-HMFP One (1) 401-HNB Male connector and One (1) 402-HNB Female connector assembled on RG214/U coax.

463-HMP One (1) 401-HNB Male connector assembled on RG214/U coax.

463-HFP One (1) 402-HNB Female connector assembled on RG214/U coax.

NOTE: Base price assemblies include up to three (3) feet in length of RG214/U coax.
Assemblies are available in lengths of more than 3 feet, call factory for pricing.

ORDERING INFORMATION

BUSINESS HOURS:

We are located in Boulder City, NV, USA in the Pacific Time zone. Our business hours are 8:00 a.m. to 5:00 p.m. Monday through Friday.

TERMS:

Prices and discounts are subject to change without notice. Specifications for any product may be improved at any time without notice. Major improvements in a specification usually add a letter to the original part number.

Domestic Terms are Net 20 days. International Terms are Net 30 days. Accounts over 20 days are past due and will receive a finance charge of 0.05% per day (18 % per Annum). All prices are F.O.B. Boulder City, Nevada. We provide commercial packaging for shipment.

CONDITIONS OF SALE:

Determination of price, terms, conditions of sale, and final acceptance of orders are made at the factory in Boulder City, Nevada.

DOMESTIC SHIPPING / RUSH ORDERS:

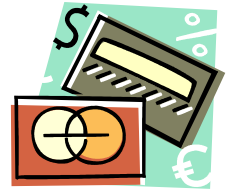
Products in stock are available for immediate delivery. Every effort is made to stock the most popular items. Delivery for a product not in-stock is dependent upon our production schedule.

EXPORT TERMS / SHIPPING:

The "end-use" and "customer name" for exported products must be included with all confirming purchase orders. Export orders may require a letter of credit before shipment is made. If an export license is required, it will take approximately three weeks to ship the order.

CREDIT CARDS:

Barth Electronics, Inc. accepts VISA, Discover and Master Card. Maximum credit card charge is \$20,000.00 USD, per transaction.



DISCOUNTS:

Discounts for quantities are available. Call factory for quantity discount pricing.

QUALITY:

We at Barth Electronics stand behind every high quality product we manufacture. Our commitment to quality and workmanship are among the highest in the world. Quality does cost and all high voltage pulse power items produced by Barth Electronics Inc. are buy it once use it forever, when used within catalog specifications.

SALES INQUIRIES:

To contact our sales team email beisales@barthelectronics.com , or call 1-702-293-1576

TECHNICAL QUESTIONS:

For technical support email beitechsupport@barthelectronics.com , or call 1-702-293-1576



Worldwide Sales Representatives

DOMESTIC

UNITED STATES

www.barthelectronics.com

Barth Electronics, Inc.

1589 Foothill Drive

Boulder City, NV 89005

Phone: 1-702-293-1576

Fax: 1-702-293-7024

beisales@barthelectronics.com

INTERNATIONAL

FRANCE

www.pulsemc2.fr/

Pulse MC2

Z.I. de la Petite Montagne Sud

3, Rue de L'Aubrac - CE 1714

91017 EVRY Cedex, France

Michel Chaillou

Phone: 011 311 60 86 21 26

Fax: 011 331 64 97 54 98

michel.chaillou@pulseMC2.fr

JAPAN & KOREA

www.tet.co.jp

Toshi Isofuku

TET (Tokyo Electronics Trading Co.)

5-16-30, Shibasaki-cho

Tachikawa-Shi

Tokyo 190-0023 Japan

Phone: 011 81 42 548 8011

Fax: 011 81 42 548 8013

isofuku@tet.co.jp

UNITED KINGDOM

www.pppower.co.uk

PPM (Pulse Power & Measurement LTD)

65 Shrivenham Hundred Bus. Park

Watchfield, Swindon, Wiltshire

SN6 8TY UK

Dave Willford

Tel: +44 (0) 1793 784389

Fax: +44 (0) 1793 784391

dwillford@ppm.co.uk

Philip Surman

Mobile: +44 (0) 7798 894124

Direct: +44 (0) 1793 786917

phil.surman@ppm.co.uk

Update: 05/28/08



Barth Electronics, Inc.

1589 Foothill Drive

Boulder City, NV 89005

Phone: 702-293-1576

Fax: 702-293-7024

beisales@BarthElectronics.com

www.BarthElectronics.com