



Barth Electronics, Inc.

Pulse Power Catalog













Since 1961





www.BarthElectronics.com Phone: (702) 293-1576

TABLE OF CONTENTS	PAGE
PULSE MODEL NUMBER INDEX	2
COMPANY CAPABILITIES	3-4
TECHNICAL SPECIFICATIONS (Maximum Input Limitations)	5
APPLICATION NOTE, "VOLTAGE COEFFICIENT OF RESISTANCE"	6-7
INFORMATION ON HN AND BARTH HNB CONNECTORS	8
INFORMATION ON BARTH BE 40kV CONNECTORS	9
COAXIAL COMPONENTS	10
TERMINATORS	11-15
ATTENUATORS	16-23
454-BE, XXX-BE CONNECTORS	24-25
HIGH POWER ATTENUATORS	26-28
WIDE BAND IMPEDANCE MATCHING COMPONENTS	29-31
RESISTIVE PULSE HIGH VOLTAGE PROBES	32-34
MATCHED RESISTIVE POWER DIVIDERS	35-45
MATCHED RESISTIVE POWER COMBINERS	46-48
TRANSFORMER COMPONENTS	49-52
BIAS-T	53
PULSE GENERATORS	54-55
ULTRA LINEAR RAMP GENERATOR	56
COMMON MODE TRANSIENT (CMT) GENERATOR	57-58a
TRANSIENT PULSE GENERATOR	59
1GHZ RISETIME FILTER	60
TEM ANTENNA	61
CONNECTORS/ADAPTERS	62-66
CABLE ASSEMBLIES	67
HV TRIGGER TAPOFFS	68-71
WIDE BAND HV TRANSFORMERS/MONITORS	72-77

PULSE MODEL NUMBER NUMERICAL INDEX

MODEL	Page	MODEL	Page	MODEL	Page
	<u> </u>	•	<u> </u>		1
0874 Series	66	621-NFP	51	2812-xxx	41-42
101-xxx	12	621A-GLP	51	2813-xxx	41-42
102-GLP-20	18	621A-MFP	51	2814-xxx	41-42
102-NMFP-20	18	650A-NFT	52	2815-xxx	41-42
142-xxx-3	20-21	651-NFP	52	2816-xxx	41-42
142-xxx-4	20-21	652-NFP	52	2825-NFP	43
142-xxx-6B	20-21	691-MFBM	46	2828-NFP	43
142-xxx-8B	20-21	731	54	2830-NFP	43
142-xxx-10B	20-21	733	55	2832-NFP	43
142-xxx-14B	20-21	790	59	2921-HFP	47
142-xxx-20B	20-21	1400-1	10	2934-MFNF	48
142-xxx-26B	20-21	1090-350NF	60	3004A	61
151-xxx	36	2033-HFP	14	45350	53
201-BMP	13	2035-HFP	14	45355	53
201A-xxx	12	2051-GHFP	15	CMT 781	57-58a
202-xxx-N	19	2051-GHMP	15	5101-MMFP	30
202-xxx-T	19	2237A-HFNFP	22	6115-BMFP	50
202-xxx-X	19	2239A-HFNFP	22	6419-MFP	44
220-NFP,220 MMFP	29	2240-BENFP	23	9201-GMF	45
224A-GLP	31	2248-HFNFP	27	EL-L	65
241-xxx - 245-xxx	69	2440	32-33	HNL	65
242-xxx	70	2511-30F	26	HNT	65
243-xxx	71	2536-HFP-3	28	NMBF	64
251-xxx	37	2536-HFP-6	28	QHPB	65
401-371	62	2536-HFP-10	28	RG214/U Cable	67
401-HNB	62	2536-HFP-20	28	VP1E3-20-1E3	34
402-HNB	62	2642-MFP	38	VP2E3-35-1R2H	34
404-HFF, HMM	63	2642-MMFP	38	VP2E3-35-1R2N	34
404-HFNF, HMNM	63	2702-BFP	39	VP5E2-28-8R2	34
421-NMM	64	2703-BFP	39	CT5-GLP	73
422-NFF	64	2704-BFP	39	CT5-GLBFIP	73
423-NFMMM	64	2705-BFP	39	CT6-xxx	74
444-HMSP	64	2706-BFP	39	CT20-xxx	75
454-BE	24-25	2710-BFP	39	CV1A	76-77
472-HMNF	64	2746-NFMF	40		



Company Background - Pulse Power Division

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 has 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, stairstep generators and risetime spoilers and positive exponential generators. Units have been produced that can operate up to 10kV and are a fast as subnanosecond 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 0.04%. 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 13kV 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.

ATTENUATORS ENERGY RATINGS

Attenuator Model	Pulse Energy Rating	
BEI 142	50 mJ	Higher voltage and >12 GHz bandwidth
BEI 102	50 mJ	Higher voltage and 7 GHz bandwidth
BEI 202	200 mJ	Maximum N connector voltage 17 GHz bandwidth
BEI 2237A	800 mJ	HN connector 7 GHz bandwidth
BEI 2239A	2050 mJ	HN connector 3.5 GHz bandwidth
BEI 2536	400 mJ	HN connector, 200 watt average power

VOLTAGE COEFFICIENT OF RESISTANCE

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 timeP^{1P}; 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 #1

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, P² Phas 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 behaviorP^{3P}. 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. DummerP^{4P}. The results quoted for 1 megohm resistors of 1/4 to 2 watt ratings by F. LangfordSmithsP^{5P} 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. 1.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.
- "Materials for Conductive and Resistive Functions",
 G.W.A. Dummer, Hayden Book Co., 1970, p.279.
 "Radiotron Designer's Handbook", F. Langford Smith, Editor,
 Fourth Edition, Electron Tube Div. RCA, 1953, p.188.

Barth Electronics, Inc. © 'VCADV" 5/3/88

Information on HN and Barth HNB Connectors:

The Barth HNB connector was specifically designed to provide both high voltage pulse capability and fast rise time performance in an HN compatible connector. These two characteristics are not available, both together in any other commercially available HN connector.

While the HN connector interface is not quite as good as the precision N connector, it is still a very respectable connector and has the advantage of withstanding much higher voltages. The HN connector to connector interface will handle 15kV DC at sea level and somewhat higher pulse voltages.

However all HN connector to cable interfaces are not created equal, some are capable of handling high voltages and others are not! The high voltage limitations of a cable connector, or any connector for that matter, are often limited by the transitions on the end of the connector opposite the connector to connector interface. This is especially true of cable connectors, where the center conductor to outer conductor air gap spacing at the cable to connector transition is often not designed for high voltage, that is, it is shorter than the connector interface air gap spacing. A real danger in this is that breakdown can be occurring inside a connector and it will most likely not be apparent at the connector interface.

The Amphenol UG-59B/U male HN cable connectors as well as the Barth 401-HNB male HN cable connectors have a cable to connector interface (center conductor to outer conductor) air path which is 50% longer than the HN to HN interface air path, and thus gives these connectors good high voltage capability. The easiest, and typical design,(as used in the Amphenol UG-59B), to make an HN cable connector handle high voltage is to cut the cable insulation off square and then have the connector insulator overlap the cable insulation by a length which is longer (commonly 50%) than the connector to connector interface air gap path. While this does a good job of providing high voltage capability, it causes a severe discontinuity which limits the bandwidth of this connection.

The Barth 401-HNB male HN cable connector is designed to handle high voltage and provide the best possible bandwidth. The way we provide both high voltage capability and wide bandwidth is to cut down the diameter of the insulation, in the cable to connector interface area, with a special hand tool. The connector insulator will then overlap this area to provide the high voltage capability, and it is made the correct diameter to also provide the correct impedance, which eliminates the discontinuity and therefore the bandwidth limitations inherent of the typical dielectric overlap used in the typical high voltage HN connectors.

Other HN Connectors such as the Kings KH-59-19 male HN cable have an improved RF specification. This improved bandwidth typically is the result of shortening of the dielectric overlap area, and thus creates a reduction in the length of mismatched impedance. This improvement for bandwidth comes at the expense of lower voltage handling capability in the cable to connector interface. In the case of the Kings KH-59-19 male HN cable connector, the cable to connector interface (center conductor to outer conductor) air path is 50% shorter than the HN to HN interface air path, and thus makes this connector unsuitable for high voltage applications. The shorter air gap in the coax to connector interface will almost always break down before break down occurs in the connector interface (where it would be more easily detected).

The Barth HNB interface is completely compatible with the standard HNB interface and when 2 HNB connectors are mated you have the best available match for HN type connectors. If your fast pulse rise times are slower than 0.5ns, you probably wouldn't benefit from the advantages of the Barth HNB connectors, but if your pulse rise times are on the order of 200-300ps then you would see some benefit, and if your rise times are faster than 100ps the HNB connectors are a must.

If your application does not need the wide bandwidth of the HNB connectors, just insure that the HN connectors you are using have a cable to connector interface that will handle your highest pulse voltage pulses.

We hope this information will help you to achieve good test results using HN connectors.

Information on Barth BE 40kV Connectors:

The Barth BE connector is a unisex connector with a mating bullet that was specifically designed to addresses the Pulse Power need for a connector that will take higher voltage than an HN connector, and can still pass fast sub-ns pulse rise times. While the HN connector to connector interface will handle 15kV DC at sea level and somewhat higher pulse voltages. The BE connector interface will handle 40kVDC, at sea level and somewhat higher pulse voltages. The BE connector provides both fast rise time performance, and high voltage pulse capability, for applications up to 40kV. These two characteristics are not both together available in any other commercially available connector at this voltage rating.

Most high voltage connectors are not designed to be wide bandwidth; likewise most RF connectors are not designed to handle high voltage. There are a few RF connectors on the market that will handle 20 to 25kV pulses, and some are matched better than others for rise time performance. Most are limited to a particular cable type, and others are only found on pulse generators and are supplied with the mating connector on a piece of coax.

The high voltage limitations of a coaxial cable connector are often determined by the cable to connector transition, the end of the connector opposite the connector to connector interface. Coaxial cable connectors are typically designed for RF performance, and not with high voltage in mind. Most often the center conductor to outer conductor air gap spacing at the cable to connector transition is not designed for high voltage, that is, it is shorter than the connector interface air gap spacing. A real danger in this is that breakdown can be occurring inside a connector and it will most likely not be apparent at the connector interface.

The coaxial connector, cable to connector interface air path (center conductor to outer conductor), for a well-designed high voltage connector, is made to be longer than the connector to connector interface air path, and thus gives the connectors reliable high voltage capability. The easiest, and typical design to make a cable connector handle high voltage is to cut the cable insulation off square and then have the connector insulator overlap the cable insulation by a length which is longer (commonly 50%) than the connector to connector interface air gap path. While this does a good job of providing high voltage capability, it causes a severe discontinuity which limits the bandwidth of these connectors.

The Barth BE connector is designed to provide the best possible bandwidth and to also reliably handle high voltage. The way we provide both is to cut down the diameter of the cable insulation in the cable to connector interface area with a special hand tool. The connector insulator will then overlap this area to provide the high voltage capability. This allow us to also maintain the correct dielectric diameter to provide the correct impedance, which eliminates the discontinuity and therefore the bandwidth limitations inherent of the typical dielectric overlap design used in most high voltage connectors.

The Barth BE interface is now standard on many of our higher voltage products, and we offer a cable version for RG-214 cable. Other versions for RG-217 will be available, other high performance low-loss cables, as will be adapters to HN, N, bulkhead feedthroughs and bulkhead flange to transmission line versions. A hermetic feedthrough for vacuum applications is also being planned.

When 2 BE connectors are mated you have the best available match for your high voltage pulse system. If your fast pulse rise times are slower than 1ns, you may not benefit much from the advantages of the Barth BE connectors, but if your pulse rise times are faster than 500ps then you would see some benefit, and if your rise times are faster than 100ps, the BE connectors are a must.

If your application does not need the wide bandwidth of the BE connectors, just insure that the high voltage connectors you are using have a cable to connector interface that will handle your highest pulse voltage pulses. We hope this information will help you to achieve good test results using BE connectors.

COAXIAL COMPONENTS

MODEL 1400-1 Test Kit

ADVANTAGES

- Pulse tested and characterized for time domain applications
- Wide bandwidth, triple shielded, flexible, high performance cable
- Rugged stainless steel connector construction for long life

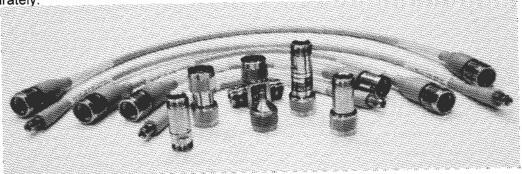
DESCRIPTION

Barth Model 1400-1 test kit contains cable assemblies, adapters, attenuators and dividers.

The cable assemblies feature minimal fast pulse distortion to provide the fastest possible risetime response for 1GHz or 3.5GHz bandwidth oscilloscopes. The cables are constructed with precision "SMA" or "N" type connectors for minimum reflection losses.

The coaxial adapters, attenuators and divider are used for coaxial interconnections of sub-nanosecond risetime pulse information during high performance CDM and ESD testing.

Each component is TDR tested for low reflection, and pulse tested for risetime response to ensure minimal degradation of sub-nanosecond pulses. The kit contains the cable assemblies, connector adapters, attenuators, and power dividers listed below and all components are also available separately.



Quantity in kit	Description	Model
2	10" SMA plug-SMA plug picosecond cable assembly	460-MMP-10
2	15" SMA plug-SMA plug picosecond cable assembly	460-MMP-15
2	20" SMA plug-SMA plug picosecond cable assembly	460-MMP-20
2	10" N plug-N plug picosecond cable assembly	460-NMP-10
2	15" N plug-N plug picosecond cable assembly	460-NMP-15
2	20" N plug-N plug picosecond cable assembly	460-NMP-20
1	36" N plug-SMA plug picosecond cable assembly	460-NMMMP-36
2	N plug to N jack precision adapter	420-NMF
2	N plug to N plug precision adapter	421-NMM
2	N jack to N jack precision adapter	422-NFF
6	N plug to SMA jack adapter	423-NMMF
2	10/1 VR 20ps time domain attenuators - low voltage	2-20
2	2 way resistive divider - low voltage	1506A

High Voltage Pulse Terminator

ADVANTAGES OVER STANDARD RF TERMINATORS

- 3 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

		Maximum Input*		
Model	Peak Voltage	@ 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
2035-BEP	20,000	200	< 4%	Barth BE Series
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.

- * Please refer to the Technical Specifications (Maximum Input Limitations) page for a full explanation of voltage and pulse width ratings.
- ** 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



High Voltage Pulse Terminator Barth Model 101-xxx, 201A-xxx

Model 101-GLP

Model 201A-NMP

DESCRIPTION

50 Ω High Voltage Pulse Terminator

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)

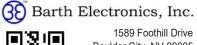
Dimensions: 2.5" long, 1.25" dia. max.

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 Barth Model 201-BMP



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.



High Voltage Pulse Terminator Barth Model 2033-HFP, 2035-HFP





DESCRIPTION

50 Ω High Voltage PulseTerminator

SPECIFICATIONS

Maximum Input: 2033 10kV, 250ns FWHM Pulse

2035 20kV, 200ns FWHM Pulse

Peak Input Power: 2033 2MW at rated pulse width

2035 2MW at rated pulse width

Average Input Power: 2033 4W Maximum

2035 8W 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

Barth BE Series

Dimensions: 2033 4.8" long x 1.3" wide x 1.3" high

2035 10.4" long x 1.3" wide x 1.3" high

Weight: 2033 1 lb.

2035 2 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.



www.BarthElectronics.com

High Voltage Pulse Terminator Barth Model 2051-GHMP, 2051-GHFP



Model 2051 – GHMP (Male Version Shown)

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, or GHV female

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
- 9 Pulse power rated
- Low voltage coefficient
- 4 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.

ZAPLESS ®





High Voltage Pulse Attenuator **Barth Model Comparison**

Maximum Input*								
Model	Average input power	Voltage ratio dB	Maximum peak voltage	Input @ pulse width ns	Pulse Energy Joules	Risetime through unit ps	Effective bandwidth DC to	Connectors
102-GP-20	5W	20	2,500	400		< 50	7 GHz	GR 874
					0.05			non-locking
102-GLP-20	5W	20	2,500	400	0.05	< 50	7 GHz	GR 874 locking
102-NMFP-20	5W	20	2,500	400	0.05	< 50	7 GHz	N Male/Female**
102 with CF Option	10W	20	2,500	400	0.05	< 50	7 GHz	See available configurations above
142-xxx-3	2W	3	2,500	400	0.05	< 10	30 GHz	***
142-xxx-4	2W	4	2,500	400	0.05	< 10	30 GHz	***
142-xxx-6B	2W	6	2,500	400	0.05	< 10	30 GHz	**
142-xxx-8B	2W	8	2,500	400	0.05	< 10	30 GHz	***
142-xxx-10B	2W	10	2,500	400	0.05	< 10	30 GHz	***
142-xxx-14B	2W	14	2,500	400	0.05	< 10	30 GHz	***
142-xxx-20B	2W	20	2,500	400	0.05	< 10	30 GHz	***
142-xxx-26B	2W	26	2,500	400	0.05	< 10	30 GHz	***
202B-GLP-N	2W	8	5,000	400	0.20	< 20	17 GHz	GR 874 locking
202A-GLP-T	2W	14	5,000	400	0.20	< 20	17 GHz	GR 874 locking
202A-GLP-X	2W	20	5,000	400	0.20	< 20	17 GHz	GR 874 locking
202B-NMFP-N	2W	8	4,000	400	0.128	< 20	17 GHz	N female/male
202-NMFP-T	2W	14	4,000	400	0.128	< 20	17 GHz	N female/male
202-NMFP-X	2W	20	4,000	400	0.128	< 20	17 GHz	N female/male
2237A-HFNFP	2.5W	26	10,000	400	0.80	< 50	7 GHz	HNB female input
2239A-HFNFP	2.5W	26	16,000	400	2.05	<100	3.5GHz	N female output
2240A-BENFP	2.5W	26	20,000	200	1.60	<100	7 GHz	Barth 454 Input N Female Output
2248-HFNFP	10W	26	5,000	4µs	2.00	<100	DC to 3.5 GHz	HN Female Input N Female Output
2511-30F	25W	30	8,000	150	0.192	< 1ns	0.35 GHz	Fischer input BNC output
2536-HFP-3	200W	3	7,000 15,000	400 75	0.392 0.337	35	10 GHz	HNB female****
2536-HFP-6	200W	6	7,000 15,000	400 75	0.392 0.337	35	10 GHz	HNB female****
2536-HFP-10	200W	10	7,000 15,000	400 75	0.392 0.337	35	10 GHz	HNB female****
2536-HFP-20	200W	20	7,000 15,000	400 75	0.392 0.337	35	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.

- Please refer to the Technical Specifications (Maximum Input Limitations) page for a full explanation of voltage and pulse width ratings.
- Units with N connectors are limited to a 4kV rating.
- Any male or female (GR, N, HNB, GHV) can be supplied.
- 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.

ZAPLESS ®



Fax 702.293.7024 www.BarthElectronics.com

High Voltage Pulse Attenuator Barth Model 102 Series

ADVANTAGES

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



Model 102-NMFP-20

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: < 4% to a 100ps risetime step function

SWR: < 1.05 to 1GHz

< 1.30 to 4GHz

Voltage Coefficient: < 1% at rated voltage

Connectors: 102-NMFP-20 N Male/Female**

102-GLP-20 GR 874 locking 102-GP-20 GR 874 non-locking

Dimensions: 102-NMFP-20 5" long x .8" dia.

102-GP-20 4.5" long x 0.625" dia. 102-GLP-20 4.5" long x 1.01" dia.

Weight: 3/8 lb.

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

ZAPLESS ®



Barth Electronics, Inc.

High Voltage Pulse Attenuator Barth Model 202-XXX

ADVANTAGES

DESCRIPTION

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



Model 202B-NMFP-N

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/I Vr (20dB)

Maximum Input: 5.0kV, 400ns FWHM Pulse **

Peak Input Power: 500kW at rated pulse width

Average Input Power: 2W maximum

Impedance: $50 \Omega \pm 1\%$

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

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 identifie

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

ZAPLESS ®





High Voltage Pulse Attenuator Barth 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.



Voltage Ratio - Attenuation dB:



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

ZAPLESS ®

Specifications are continued on the next page





High Voltage Pulse Attenuator Barth Model 142 Series

SPECIFICATIONS continued

Bandwidth (-3dB): DC to 30GHz

Reflection-TDR: < 3% to a 100ps risetime step function

Voltage Coefficient: < 1% at rated voltage

Connectors: 142-NMFP-yy N male/female *

142-GLP-yy GR 874 Locking 142-HMFP-yy HNB male/female 142-GHMFP-yy GHV male/female *** 142-SPJP-yy 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: 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.

Actual measured voltage ratio is recorded on each nameplate.

- * Most popular general purpose lab items, in stock for immediate delivery.
- *** Connector has risetime limitations; please specify test pulse risetime.

ZAPLESS ®



High Voltage Pulse Attenuator Barth Model 2237A-HFNFP, 2239A-HFNFP

Model 2237A-HFNFP



Model 2239A-HFNFP

DESCRIPTION

26dB attenuators with HN female input connectors.

SPECIFICATIONS

Voltage Ratio:

20/1 Vr (26dB)

Maximum Input:

2237A 10kV/400ns FWHM Pulse

2239A 16kV/400ns

Peak Input Power:

2237A 2MW at rated pulse width

2239A 5.12MW at rated pulse width

Average Input Power:

2.5W maximum

Impedance:

 $50 \Omega \pm 1\%$

Risetime through Unit:

2237A < 50ps

2239A <100ps

Bandwidth (-3dB):

2237A DC to 7.0GHz

2239A 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:

2237A 4.8" long x 1.250" wide x 2" high

2239A 10.5" long x 1.250" wide x 2" high

Weight:

2237A 1 1/4 lbs.

2239A 1 3/4 lbs.

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 the maximum pulse voltage of any attenuator with HN connectors. They can withstand 25 or 30kV at much shorter pulses. But we cannot specify what that pulse width limit may be.

ZAPLESS ®



High Voltage Power Pulse Attenuator Barth Model 2240A-BENFP



DESCRIPTION:

The 2240A-BENFP is an ultra wide band high voltage attenuator designed for measurement of signal rise times as fast as 100ps

SPECIFICATIONS:

Voltage Ratio: 20/1 +/- 5% (26dB)

Maximum Input Voltage: 20kV, 200ns FWHM

25kV, 125ns FWHM

Peak Input Energy: 1.6 Joules (Watt Seconds)

Average Input Power: 2.5W Maximum

Impedance: 50 Ohm +/- 1%

Risetime through Unit: <100ps

DC to 3.5GHz Bandwidth

Reflection - TDR: Input <4% to a 100ps rise time step Output <3% to a 100ps rise time step

Voltage Coefficient: <1% at any voltage

Connectors: Barth BE Series Input

N Female Output

Supplied Mating Cable: 454-BE-1M* 454-BE Series on 1 meter*

RG-214 open

(*Other lengths are available)

Dimensions: 10.5" long x 1.25" wide x 2" high

Weight: 1.5 lbs.

Also available is an HNB male connector assembled onto the open end of the 454-BE cable. The HNB connector will limit the useable voltage to 15kV maximum.



Barth Electronics, Inc.

Barth Model 454-BE Connector

DESCRIPTION:

The Barth 454-BE Connector is for use with RG-214 Coax



SPECIFICATIONS:

30 kV DC **Maximum Input Voltage:**

100 kV, 20ns FWHM

Average Input Power: 1kw@ 1 Ghz.

50 Ohm +/- 1% Impedance:

Risetime through Unit: <100ps

Bandwidth: DC to 7.0GHz

Reflection - TDR: <4% to a 100ps risetime step

Connector: Barth BE

RG-214 pigtail unterminated

Connector Dimensions: Approx. 1.6" Dia. x 4" long

Weight: Approx. 1 lb. (Connector +

1M RG-214 coax)





Barth Model XXX-BE Connector



*NOTE: **Additional Connectors** Coming.

DESCRIPTION:

The Barth XXX-BE Connector is for use with TBD Coax

SPECIFICATIONS:

40 kV DC **Maximum Input Voltage:**

100 kV, 20ns FWHM

Average Input Power: 1kw@ 1 Ghz.

50 Ohm +/- 1% Impedance:

Risetime through Unit: <100ps

Bandwidth: DC to 7.0GHz

Reflection - TDR: <4% to a 100ps risetime step

Connector: Barth BE

RG-214 pigtail unterminated

Connector Dimensions: Approx. 1.6" Dia. x 4" long

Weight: Approx. 1 lb. (Connector +

1M RG-214 coax)



www.BarthElectronics.com

High Voltage Pulse Power Attenuator Barth 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

Peak Input Energy: 64 mJ @ 50 ns Pulse Width

Average Input Power: 25 W

50 Ω Impedance:

Risetime through Unit: 1 ns

Bandwidth (-3dB): 350 MHz

Reflection-TDR: < 5% @1ns

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.

ZAPLESS ®



www.BarthElectronics.com

High Voltage Pulse Power Attenuator Barth Model 2248

DESCRIPTION:

The 2248-HFNFP is an ultra wide band high voltage attenuator designed for measurement of signal rise times as fast as 100ps



SPECIFICATIONS:

Voltage Ratio: 20/1 +/- 5% (26dB)

Maximum Input Voltage: 5kV, 4µs FWHM

Peak Input Energy: 2.0 Joules (Watt Seconds)

Average Input Power: 12W Maximum

Impedance: 50 Ohm +/- 1%

Risetime through Unit: <100ps

Bandwidth DC to 3.5GHz

Reflection - TDR:Input
<4% to a 100ps rise time step</p>
Output
<3% to a 100ps rise time step</p>

Voltage Coefficient: <1% at any voltage

Connectors: HN Female Input (Receptacle)

N Female Output (Receptacle)

Dimensions: 8.25" long x 5.5" wide x 4.25" high

Weight: 5.8 lbs.





High Voltage Pulse Power Attenuator Barth Model 2536

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.



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

The Model 2536-HFP-X is warranted to perform to its specifications for a period of 1 year. This warranty does not apply to units subjected to input power higher than a 200W average or being used without the cooling pump being in operation for the minimum time as specified on the operations tag. A unit determined to have failed under normal operating conditions without excess power or voltage, will be repaired under warranty.

SPECIFICATIONS:

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

Maximum Input: 7kV/400ns, 15kV/75ns, 30kV/15ns, 60kV/2ns FWHM Pulse

72MW at rated pulse width **Peak Input Power:**

Average Input Power: 200W Maximum

Impedance: $50 \Omega + 1\%$ (output terminated with 50Ω)

Risetime through Unit: 35ps

Bandwidth (-3dB): DC to >10GHz

Reflection - TDR: <5% to a 100ps risetime step function

<1% at 25kV **Voltage Coefficient:**

Connectors:** **HNB** Female

Dimensions: \approx 5"(12.7 cm) wide x 10"(25.4 cm) high x 12"(30.5 cm)

deep

Weight: ≈17 lbs. (7.8 kg)

Power Requirements: 115V/60Hz, 4 Amp to power cooling pump, fan and

highly visible "power on" light (240V/50-60Hz model

available for export)





Wide Band Impedance Matching Components Barth Model 220-NFP, 220 MMFP

DESCRIPTION

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



Model 220-NFP

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: < 400ps

Bandwidth (-3 dB): DC-1GHz

Voltage Coefficient: < 1% at rated voltage

Connectors: 50 Ω N female



50 Ohm Series Resistor

Similar Products:

- 220-NFP 50 ohm Series Resistor
- 3 220a-GLP 50 ohm Series Resistor



The Barth Model 5101-MMFP-1 is a 50 Ohm Series High Voltage Pulse Resistor designed for a one way match of 100 ohm components to 50 ohm components.

Specifications:

Input Output Resistance: 100 ohm to 50 ohm (50 ohm Series Resistor)

Maximum Peak Input Voltage: 1.5kV/100ns FWHM rectangular pulse

Input-Output (VR): 2/1 (-6.02 dB)

Input-Output 10-90% Risetime: < 400ps

Bandwidth (- 3dB): DC - 1GHz

Maximum Peak Power (kW): 22.5kW at rated pulse width

Maximum Average Input Power: 1 Watt Maximum

Voltage Coefficient: < 1% at rated voltage

Connector Configuration: SMA male / SMA female - bidirectional



Wide Band Impedance Matching Components Barth Model 224A-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 Vr (9.64dB) 50 Ω to 100 Ω direction

7.07 Vr (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



Hand Held High Voltage High Frequency Voltage Probe Barth Model 2440-6GHz

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 low loss 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 low loss cable for connection

of probe to measurement system.

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

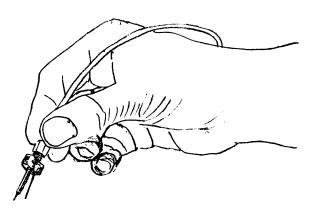
Phone 702.293-1576

Fax 702.293.7024 www.BarthElectronics.com

Hand Held High Voltage High Frequency Voltage Probe Barth Model 2440-6GHz

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.



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 low loss 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. 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 low loss 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.



Fax 702.293.7024 www BarthFlectronics com

Custom High Voltage Probes For Dedicated Pulse Location Instruments

Output risetime depends on housing construction around these resistors.

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

The resistors listed here are examples made specifically for fast HV pulse measurement application. They were designed and tested inside a specific metal housing that accurately simulates their final application use. They are located in special gas insulation, HV dielectric material, or were potted in place to provide the required pulse amplitude and risetime response characteristics. They were constructed to produce repeatable sub-nanosecond response which requires that the resistor remains attached to the pulse voltage terminal being measured. We welcome requests for specific pulse voltage measurement applications.

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	Terminals
VP1E3-20-1E3	20,000	1000 Ω	1 μs	**	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

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 Model 402-HNB female cable connector for RG214/U coax should be used for interconnection.

DISCLAIMER: These resistors were designed for special uses in special housings; **these resistors are not hand** held voltage probes.

Fax 702.293.7024 www.BarthFlectronics.com

^{**}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.

High Voltage Pulse Match Resisted 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, Low Voltage Coefficient, as well as a Low Reflection Coefficient
- Input/Output impedance held very close to nominal
- High Reliability, and Pulse Power Rated

MATCHED RESISTIVE POWER DIVIDER MODEL COMPARISON

					WIODEL		
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	**
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	< 5%	< 65	BNC female
2703-BFP	3	9.5	2,500	250	< 5%	< 65	BNC female
2704-BFP	4	12.0	2,500	250	< 5%	< 65	BNC female
2705-BFP	5	14.0	2,500	250	< 5%	< 65	BNC female
2706-BFP	6	15.6	2,500	250	< 5%	< 65	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-BENFP	***	***	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

-xxx Connector identifier, see connector list heading above for our standard (stocked) configurations; call for connector configurations not shown





^{**} 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 Power Matched Resistive Power Divider Barth 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: $50 \Omega \pm .25 \Omega$

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 Barth 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: 50Ω

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.



Fax 702.293.7024 www.BarthElectronics.com

High Voltage Pulse Match Resistive Power Divider Barth 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: 50Ω

Reflection-TDR: Input < 1% to a I00ps 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. 2.3 oz.



High Voltage Pulse Matched Resistive Power Divider Barth Model 2700 Series



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.

Model 2706-BFP

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) 2710-BFP 10.0/1 Vr (20.0 dB)

Maximum Input: 2.5kV, 250ns FWHM Pulse

Peak Input Power: 125kW at rated pulse width

Average Input Power: 8W maximum

Impedance: 50Ω

Input Reflection-TDR: < 5% to a 100ps risetime step function

Risetime through Unit: < 65ps

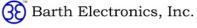
Bandwidth: DC to 6GHz

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 Barth Model 2746-NFMFP



DESCRIPTION

High Voltage 6 Way Matched Resistive Power Divider

Model 2746-NFMFP

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: 50Ω

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 Barth Model 2810 Series



DESCRIPTION

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

SPECIFICATIONS

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





High Voltage Pulse Matched Resistive Power Divider Barth Model 2810 Series

SPECIFICATIONS continued

Maximum input: 281x-NFP/NMFP 2.5kV, 250ns FWHM Pulse

281x-HFNFP 5.0kV, 100ns FWHM Pulse 281x-BENFP 10.0kV, 25ns FWHM Pulse

Peak Input Power: 281x-NFP/NMFP 125kW at rated pulse width

281x-HFNFP 500kW at rated pulse width 281x-BENFP 1.0MW at rated pulse width

Average Input Power: 8W maximum

Impedance: $50 \Omega \pm 1\%$

Reflection-TDR: 281x-NFP Input < 2% to a 100ps risetime step function

Output < 6% to a 100ps risetime step function

281x-BENFP 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: ±10ps maximum time difference between any/all output ports

Attenuation Matching: ± 1.0% between ports from DC to 300MHz minimum

Voltage Coefficient: < 1% at rated voltage

Connectors: 281x-NFP N female (standard stocked configuration)

281x-NMFP N male input, N female output 281x-HFNFP HN female input, N female output 281x-BENFP Ultra fast BE100 input, N female output

Note: Inputs are labeled, outputs are numbered.

Dimensions: Outline drawings available

Weight: 2812-NFP approx. ½ lb.

2813-NFP approx. ¾ lb. 2814-NFP approx. 7/8 lb. 2815-NFP approx. 1 lb. 2816-NFP approx. 1 ¼ lb.

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



www.BarthElectronics.com

High Voltage Pulse Matched Resistive Power Divider Barth 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: 50Ω

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 9 Port Power Divider Barth Model 6419-MFP

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.



High Voltage Pulse 100 Port Power Divider Barth 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 a meet a customers requirements.



DESCRIPTION

100 Output High Voltage Pulse Divider specifically designed for use with a fast rise high voltage pulse generator such as Barth Model 731, (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.





Balanced Probe Combiner Barth Model 691-MFBM



ADVANTAGES:

- High sensitivity, for accurate differential measurements, in the presence of high common mode noise levels.
- Very wide bandwidth for fast risetime measurements of power supplies to the fastest digital systems.

DESCRIPTION:

Barth Model 691 balanced probe combiner is designed for making fast risetime pulse differential measurements. This combiner provides wide bandwidth with high Common Mode Rejection (CMR). Features include 50 Ohm "+" and "-" SMA Jack inputs with a BNC Plug output for direct attachment to an oscilloscope.

SPECIFICATIONS:

Input/Output Voltage Ratio: 2.0:1, -6.0 dB

(When used as a differential combiner)

Impedance: 50 +/- 1/2 ohm

Risetime: 350ps

Droop: 7% at 1μ s

Frequency Range: 15kHZ to 1GHz

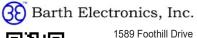
CMR: > 40 dB 100kHz to >1GHz

> 30 dB 20kHz to >1GHz

Input Connectors: SMA Jacks

Output Connector: BNC Plug

Dimensions: 4.75"l x 1.25"dia. **Weight:** 8 oz., 225 g.





High Voltage Pulse Matched Resistive Power Combiner Barth Model 2921-HFP

DESCRIPTION

2 Input 4 Output Combiner

SPECIFICATIONS

Voltage Ratio: 2.0/1 Vr

Maximum Input: 2kV, 500ns FWHM Pulse

Connectors: HNB female

Dimensions: 4 3/8 " long x 4 5/8 " wide x 1 1/4 " high

Weight: 1.5 lbs.





High Voltage Pulse Matched Resistive Power Combiner Barth 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: 50Ω

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.





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 Vxμs	< 4%	< 400 *	n/a	BNC male/female
621A-GLP	2,000	250 Vxμs	< 5%	< 70	n/a	GR 874 locking
621A-MFP	2,000	250 Vxμs	< 5%	< 70	n/a	SMA female
621-NFP	2,000	250 Vxμs	< 5%	< 70	n/a	N female
BALUNS						
650A-NFT	300	30 Vxμs	< 1%	n/a	< 60	N female input- N female output
651-NFP	1,000	500 Vxμs	< 1%	n/a	< 90	N female input- N female output
652-NFP	1,000	100 Vxμs	< 1%	n/a	< 50	N female input- N female output

* Input Reflection Coefficient rated at 500psτ.



Fax 702.293.7024 www.BarthElectronics.com

High Voltage Wide Band Pulse Inverter Barth Model 6115-BMFP

DESCRIPTION

50 Ω High Voltage Pulse Inverter



SPECIFICATIONS

Model 6115-BMFP

Voltage Ratio: 1/(-1)

Maximum Input: 1kV, 45Vxμs Pulse

Impedance: 50Ω

Risetime: < 400ps, inverted pulse > 98% at 1μ s

Bandwidth (-3dB): 700MHz

Droop: <10% at 1μ 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 Barth Model 621A-GLP, 621A-MFP, 621-NFP

DESCRIPTION

SPECIFICATIONS

50 Ω High Voltage Pulse Inverter



Model 621A-GLP

Voltage Ratio: 1/(-1)

Maximum Input: 2kV, 250Vxμs Pulse

Impedance: 50Ω

Risetime: < 70ps, inverted pulse >94% at .5ns

Bandwidth (-3dB): 5GHz

Droop: 2% at100ns

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 Balun Barth 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 ± 1 kV, 500ns (500Vx μ s) 652-NFP ± 1 kV, 100ns (100Vx μ s)

Impedance: 50Ω

Risetime: 650A-NFT < 60ps

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.

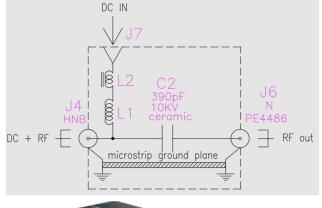
Weight: 1.8 lbs.



Bias-T (10 kV), 45355 (5 kV) Barth Model 45350

Bias-T Design

While Bias tees rated for 100 V are common, HV Bias Tees rated up to 10kV have not been available until now. The Barth Bias-T is designed to handle up to 10 kV of DC bias while simultaneously passing up to 20 W of RF power in the frequency range of 50-500 MHz. (A simplified circuit is shown to the right.)







APPLICATION

Electron Lenses in RHIC are designed with a series of biased drift tubes through which the electron beam propagates in the opposite direction of the RHIC ion beams. The image currents inducted on the drift tubes are detrimental to the electron & ion beams. The Barth Bias-T is a custom HV RF system that was developed to measure beam loss signals.

Production Design

To produce a final design to pass greater than 90% of RF energy from 50 to 1000 MHz through a Bias T requires a special inductor and capacitor design. Moreover, each of the elements of the Barth Bias-T is designed to withstand 10kV or 5kV bias voltage, depending upon model.

Specifications:

Impedance: 50 Ohm Risetime: <100PS

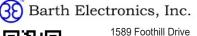
Droop: 45355: $1/\epsilon \, \text{decay} = 88 \, \text{ns}$

Connectors: DC+ RF/Pulse: HN female RF/Pulse: N female

RF/Pulse: N female DC Bias: AMP-LGH*

Barth Electronics has been the worldwide leader in High Voltage pulse instrumentation since 1964. All of our products are unconditionally guaranteed to perform exactly to our listed specifications. Call or email us for additional information or to discuss your application.

Contact us for additional information or to discuss your application.





^{*} Unit supplied with mating HV connector, HV flying lead of customer specified length can also be provided.

High Voltage Pulse Generator Barth Model 731



DESCRIPTION

The Model 731 high voltage pulse generator provides pulses of < 200ps risetime, 500 volts through 3kV amplitude, to drive into any load impedance through 50 ohm coax.

The generator is capable of a minimum pulse width of 1.5ns and a maximum of 400ns. The rectangular output pulse width is determined by charge line length. HPM, impulse driven antennas, dry run simulation, and HV pulse testing are just a few of the uses for this HV pulse generator. Unit comes standard with 10ns charge line, and (1) additional charge line up to 100ns of customer's choice.

PRELIMINARY SPECIFICATIONS

Output Pulse: < 200ps risetime at all output voltages

Output Amplitude: Continuously adjustable from < 500 volts output to > 3kV output

Output Pulse Width: 1.5ns to 400ns

Output Pulse Rep Rate: Single pulse / internal repetitions / external trigger modes

Internal mode adjustable from >20 sec between pulses to 10Hz repetition

Trigger Input: 5V at 1mA through a grounding switch, or a 1V, 1µs input trigger pulse

Mechanical Switch Life: > 3,000,000 pulses at 2kV/400ns pulse width

(switch life is energy dependent)

Connectors: HN female output and charge line connectors

Input Power: Standard 120 volt/60Hz line power at 10 amps

(50Hz model available for export)

Dimensions: 19" wide (rack mount) x 5 1/4" high x 15" deep

Weight: 24 lbs.

Accessories:

<u>Model:</u>	Description:
464-HMP-5ns	5ns charge line
464-HMP-10ns	10ns charge line
464-HMP-20ns	20ns charge line
464-HMP-50ns	50ns charge line
464-HMP-100ns	100ns charge line
464-HMP-200ns	200ns charge line
464-HMP-400ns	400ns charge line

Any Value from 1.5ns to 400ns available

Contact us for additional information or to discuss your application.





High Voltage Pulse Generator Barth Model 733



DESCRIPTION

The Model 733 high voltage pulse generator provides pulses of < 200ps risetime, 500 volts through 5kV amplitude, to drive into any load impedance through 50 ohm coax.

The generator is capable of a minimum pulse width of 1.5ns and a maximum of 400ns. The rectangular output pulse width is determined by charge line length. HPM, impulse driven antennas, dry run simulation, and HV pulse testing are just a few of the uses for this HV pulse generator. Unit comes standard with 10ns charge line, and (1) additional charge line up to 100ns of customer's choice.

PRELIMINARY SPECIFICATIONS

Output Pulse: < 200ps risetime at all output voltages

Output Amplitude: Continuously adjustable from < 500 volts output to > 5kV output

Output Pulse Width: 1.5ns to 400ns

Output Pulse Rep Rate: Single pulse / internal repetitions / external trigger modes

Internal mode adjustable from >20 sec between pulses to 10Hz

repetition rate

Trigger Input: 5V at 1mA through a grounding switch, or a 1V, 1μs input trigger pulse

Mechanical Switch Life: > 3,000,000 pulses at 2kV/400ns pulse width

(switch life is energy dependent)

Connectors: HN female output and charge line connectors

Input Power: Standard 120 volt/60Hz line power at 10 amps

(50Hz model available for export)

Dimensions: 19" wide (rack mount)

Weight: 24 lbs.

Accessories:

<u>Model:</u>	<u>Description:</u>
464-HMP-5ns	5ns charge line
464-HMP-10ns	10ns charge line
464-HMP-20ns	20ns charge line
464-HMP-50ns	50ns charge line
464-HMP-100ns	100ns charge line
464-HMP-200ns	200ns charge line
464-HMP-400ns	400ns charge line

Contact us for additional information or to discuss your application.

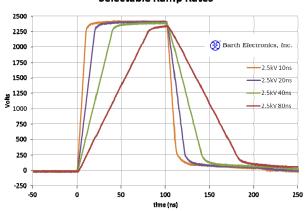
Any Value from 1.5ns to 400ns available



Ultra Linear Ramps

Extremely Linear kV Ramps Any Ramp Time, Any Voltage (mV to kV) 1 Volt to kV

Selectable Ramp Rates



Barth Electronics latest invention turns step functions into ramp functions

These ramps are generated by special circuits we have developed that convert a rectangular pulse into a ramp. This is accomplished with 50 ohm impedance circuits which allow ordinary cables and connectors to deliver the ramp with minimal distortion.

SELECTABLE RAMP RATES

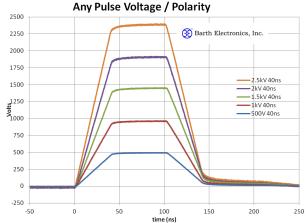
Rates are selectable in 2:1 steps. Steps can be made very small or very large to fit the application.

ANY VOLTAGE / POLARITY

The maximum voltage we have used in our ramp circuits has typically been 5 kV. Higher voltage ramps to 100kV or above can be built. HN connectors will allow peak voltages to about 15 kV; while our BE 100 connector will allow peak voltages reaching 100 kV.

Ramp times from picoseconds to microseconds can be built for step function input.

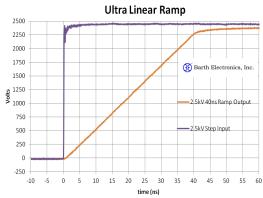
Note that the ramp time is independent of the pulse voltage, so various dV/dt rates can easily be generated by varying the pulse voltage.



EXTREMELY LINEAR

Linearity is only limited near the top by whatever rounding of the step function is present. The 10 ns flat top of the pulses shown have the same rounding as the pulse source. Better than 1% linearity is possible with this invention.

Contact us for additional information or to discuss your application.



This ramp generator design is very scalable allowing fast to slow ramp rates in 2:1 steps, and outputs from very low voltages, to very High voltages, positive and negative polarity, limited only by the connector and cable capabilities.

The waveforms shown were produced using our prototype ramp generator system which was driven by our Model 731 pulse generator. Measurements were made on a Tektronix TDS-6604 6GHz scope.





1589 Foothill Drive Boulder City, NV 89005 Phone 702.293-1576 Fax 702.293.7024 www.BarthElectronics.com

Common Mode Transient (CMT) Generator Barth Model 781

3.12 To 1600 kV/ μ s Into 50 Ω Loads

Features:

- Interactive control allows the user to gradually increase, or decrease the dV/dt rate applied to a DUT
- Stepped mode features user adjustable constant voltage and 14 stepped dV/dt selections
- Variable dV/dt mode features a more continuously variable dV/dt selectable by the user.
- 3.12 to 1600kV/µs can be delivered into 50 ohm loads
- 6.25 to 3200kV/µs can be realized into high impedance loads.
- Touch screen interface allows quick interactive and intuitive control.
- Internal rate and external triggering capability
- Designed for Common-Mode Transient Immunity (CMTI) testing
- Optional Exponential decay Pulse shape module with 50 ohm termination
- Provision for external switch Interlock
- One year warranty on the entire system



Description:

The Barth Common Mode Transient (CMT) Generator was developed for CMTI (CMT Immunity) characterization testing. The generator test system combines our 3kV Pulse Generator and Barth Multi Ramp Generator to produce high voltage, selectable fixed rate linear rise ramp pulses.

How It Works

The Barth Model 781 CMT

Generator produces a fast rise time
high voltage rectangular pulse. This
pulse is then passed through an
internal Barth Multi Ramp generator
module to create a linear ramp.

225

126

127

128

129

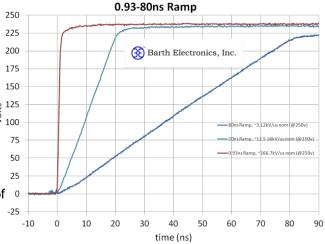
129

120

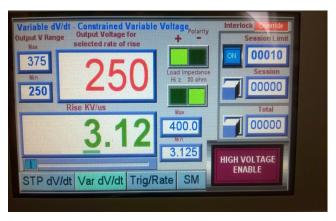
Operation

Quick interactive and intuitive control of the generator operational parameters is provided via a touch screen interface. The test system provides interactive control of the two variables that define the dV/dt rate, the pulse voltage and ramp rate, to achieve specific kV/us rate pulses. The control also allows the user to interactively increase, or decrease the dV/dt rate which is applied to the DUT.

The 2 basic operational modes are: The "STP" stepped mode which features user adjustable voltage and 14 stepped dV/dt selections based on the 14 fixed ramp rates, and the "VAR" variable dV/dt mode which features a more continuously variable dV/dt selectable by the user. This mode is accomplished by varying the output voltage within an output voltage range and jumping to the next ramp selection as required automatically.



Samples of 0.93ns, 20ns, and 80ns ramp output showing Leading edge of pulse into matched 50 ohm load



"VAR" variable dV/dt mode shown features a continuously variable dV/dt selectable by the user.

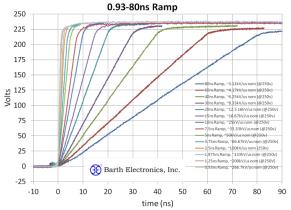




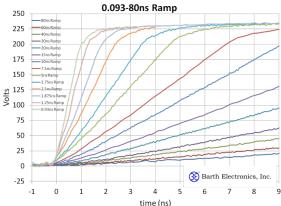
Common Mode Transient (CMT) Generator Barth Model 781

System Components:

- Barth 781 High Voltage Fast Rise Time Pulse Generator
- Internal 100ns Pulse Charge line
- Output cable Signal tap-off interconnect cables
- Optional Exponential decay Pulse shape module with 50 ohm termination



Sample pulse outputs showing Leading edge of pulse into matched 50 ohm load for all 14 ramp selections.



Same Sample Pulse Outputs with expanded time scale.

Specifications:

- 3.12 to 1600kV/µs can be delivered into 50 ohm loads
- 6.25 to 3200kV/µs can be realized into high impedance loads.
- 'N' Female output Connector.
- 90V-230V, Input Power.

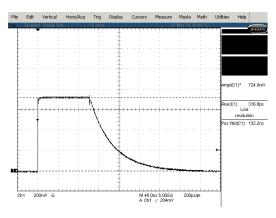
Size/Weight:

- Approximately 19" w x 11" h x 21"d.
- Total weight is approximately 50 lbs.
- Output compliant with IEC....specifications.

Operation (cont.)

Specific kV/µs rate pulses between 3.12 and 1600kV/µs can be achieved into 50 ohm loads. Rates between 6.25 and 3200kV/µs can be realized into high impedance loads.

The fall time mirrors the rise time, and with optional pulse shape module a long exponential decay fall time is also available as shown below.



Fast Ramp with Pulse Shape module (adds Exponential decay on falling edge) into matched 50 ohm load.

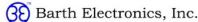
This Product Features
Barth Designed ZAPLESS ®
High Speed Measurement
Components

Pulse Rate and Triggering:

The pulse rate and triggering is similar to the 731/733 pulse generator, including internal triggering for single shot or repetitive pulsing. Repetition rates to 10Hz are selectable. External triggering capability is also included.

Interlock:

The interlock provision provides a means to prevent pulsing when a test fixture with a lid or other movable safety is employed. This requires a switch on the fixture that will close to indicate the closed lid position.





Common Mode Transient (CMT) Generator Barth Model 781

Model	Description

781 CMT Includes:

100ns Charge Line (Internal to CMT Box)

5150A Pulse Shaper Module with Integrated 50 ohm HV Pulse Terminator

n/a Output Pulse Cable, N Male – N Male 1M Low Loss Cable n/a Trigger Output Cable, BNC Male - BNC Male 30" RG-223

326-ILC-3 Interlock Cable 3 pin DIN plugs

TB3M DIN Interlock Receptacle -for Customer Interlock Circuit
BITSB Barth Interlock Test - Switch Box- for interlock function test

n/a Power Cord n/a 781 User's Manual

781 CMT Options:

n/a DUT to Attenuator cable N Male-BNC Male 15" RG-223
422-NFF N Female to N Female Adapter (Midwest AD2590-FF-NNN-02)
142-NMFP-20B (Qty.2) 20dB (10:1VR) High Voltage Pulse Attenuators

NMBF N Male to BNC F Adapter Amphenol 31-216 (UG-201A/U)

FMAT7437-20 Fairview BNC 20 dB Attenuator

n/a Attenuator to scope cable BNC Male -BNC Male 15" RG-223

IE Interlock Enclosure Options:

781-IES Interlock Enclosure Box (holds up to 6" x 9" test boards)
n/a IE Input to DUT board cable BNC male-BNC Male 10" RG-223

781-IEL Interlock Enclosure Box (holds up to 10" x 13" test boards)
n/a IE Input to DUT board cable BNC male-BNC Male 10" RG-223

781-RC Remote Control Capability

n/a USB Interface Remote Control Software

n/a USB A-B Cable

781-2:1 2:1 Option – Provides 125 V to 750V Operation Capability

142-NMFP-6B 6dB (2:1VR) High Voltage Pulse Attenuator –

781-10:1 10:1 Option - Provides 25 V to 150V Operation Capability

142-NMFP-20B 20dB (10:1VR) High Voltage Pulse Attenuator



Boulder City, NV 89005

0 to +/- 200 Volt Transient Pulse Generator Barth Model 790



DESCRIPTION

The Model 790 Transient Pulse Generator is a combined Latch Up sensitivity tester and a power supply load response tester. The generator uses a mechanical reed switch and a custom network to create the single clean fast risetime transient pulses. The power supply test alternates a resistive load on a power supply between 510 ohms and 10 ohms to allow observation of supply recovery parameters.





1 GHz Risetime Filter Barth Model 1090-350NF

ADVANTAGES

- Get 7104 comparable data from your SCD 5000.
- Easily connects to the SCD 5000 input, in series with the input signal.
- Get instant waveform data without mathematical or software waveform conversions.



DESCRIPTION

Barth Model 1090-350NF Risetime Filter is designed to be connected in series with the input of a TEK SCD 5000 digitizer to spoil the waveform to what would be observed on a TEK 7104 Oscilloscope. This filter enables the SCD 5000 user to obtain directly comparable waveforms on the SCD 5000 without need of a 7104, thus enabling supplier and user to obtain comparable results for various testing scenarios. Special Barth construction techniques utilized in this risetime filter have been developed over the past 31 years designing products for government laboratories in time domain applications.

SPECIFICATIONS

Input Impedance: 50.0 Ohms +/- 5%

Output Impedance: 50.0 Ohms +/- 5%

Input/Output Risetime: 90ps Input / 350ps Output

Input Connection: Type "N" Female (jack) connector

Output Connector: Type "N" Female (jack) connector*

Dimensions: Length: 3.625"

Width: 1.5" body

3-3/8" across connectors w/ Male to Male adapters)

Height: 1.25"

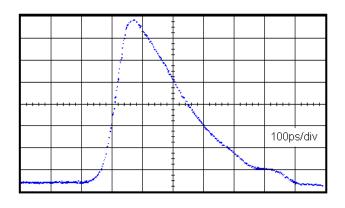
Weight: < 0.50 lb., 226 g.

*Supplied with "N" Male (Plug) to "N" Male (Plug) adapter for direct connection to the SCD 5000 input connector.



TEM Time Domain Antenna Barth Model 3004A





The Model 3004A 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 731 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 3004A receiving antenna was fed directly into to a HP 54120A digital sampling oscilloscope through 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 can also design 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.



Phone 702.293-1576

Fax 702.293.7024 www.BarthElectronics.com

Connectors/Adapters High Voltage Pulse Barth Model 401-HNB. 402-HNB. 401-371



DESCRIPTION

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

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

SPECIFICATIONS

Maximum Input: 15kV, 1μs FWHM Pulse

Impedance: 50Ω

Reflection-TDR: < 4% at 100ps risetime

Risetime: < 20ps

For optimum reflection, the use of Model 401-371 connector installation tool is suggested.

Note: Model 401-HNB or 402-HNB cable connectors are also available assembled onto a user specified length of RG214/U coax (standard length is one meter).



DESCRIPTION

The Model 401-371 HNB trim tool is 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.

Phone 702.293-1576

Fax 702.293.7024 www.BarthElectronics.com

Connectors Adapters High Voltage Pulse Barth 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, 1μs FWHM Pulse

Impedance: 50Ω

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, 1μ FWHM Pulse

Impedance: 50Ω

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

Barth HNB connector

Risetime: < 20ps

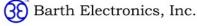
Connectors: 404-HFNF HNB Female, N Female

404-HMNM HNB male. N male











Connectors/Adapters High Voltage Pulse: Barth Model 421-NMM, 422-NFF, 423-NFMMM, NFBM, NMBF 444-HMSP, 472-HMNF

MODEL 444-HMSP, HN male to SHV plug adapter

Maximum Input: 10kV

Impedance: 50Ω

Reflection-TDR: \pm 5% at 100ps

Connectors: HN male and SHV plug



Maximum Input: 4kV, 1μs FWHM Pulse

Impedance: 50Ω

Connectors: HN male, N female



MODELS



421-NMM N male to N male adapter; 3kV dc



422-NFFN female to N female adapter; 3kV dc



423-NFMMN female to SMA male adapter; 1.5kV dc



423-NMMMN male to SMA male adapter; 1.5kV dc



423-NFMFN male to SMA female adapter; 1.5kV dc



423-NMMFN male to SMA female adapter; 1.5kV dc



NFBMN female to BNC male adapter; 3kV dc



NMBF N male to BNC female adapter; 3kV dc



Barth Electronics, Inc.

Connectors/Adaptors High Voltage Pulse Barth Model HNL, HNT, EL-L, QHPB

DESCRIPTION

HNL: HNB right angle adapter

SPECIFICATIONS

Maximum Input: 15kV, 1μs FWHM Pulse

Impedance: 50Ω

Connectors: HNB male/female



DESCRIPTION

HNT: HNB unmatched "T"

SPECIFICATIONS

Maximum Input: 15kV, 1μs FWHM Pulse

Impedance: 50Ω

Connectors: HNB female



DESCRIPTION

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

SPECIFICATIONS

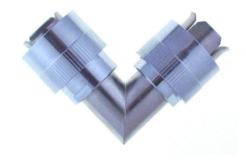
Maximum Input: 5kV, 1μs FWHM Pulse

Impedance: 50Ω

Reflection-TDR: < 1% at I00ps 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, 1μs FWHM Pulse

Impedance: 50Ω

Reflection-TDR: < 4% at 100ps risetime

Risetime: < 20ps





Connectors/Adaptors High Voltage Pulse Barth Model 0874 Series

GR to N ADAPTERS

<u>Model</u>	Connectors
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>	Connectors
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

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







Cable Assemblies - RG214U Barth Model 463 Series

RG214/U: Low loss coaxial cable with double shield. 50 Ω Impedance. Available configurations shown below. NOTE: Base price assemblies include up to one meter in length of RG214/U coax. Longer length assemblies are available.

463-GLP One (1) GR Type 874 Locking connector assembled on RG214/U coax; max voltage specification is 5kV DC.



463-HFP One (1) 402-HNB Female connector assembled on RG214/U coax; max voltage specification is 15kV DC.



463-HMP One (1) 401-HNB Male connector assembled on RG214/U coax; max voltage specification is 15kV DC.



463-HMFP One (1) 401-HNB Male connector <u>and</u> one (1) 402-HNB Female connector assembled on RG214/U coax; max voltage specification is 15kV DC.



463-HMMP One (1) HN Male connector assembled on each end of RG214/U coax; max voltage specification is 15kV DC.

(x2)



463-NMMP One (1) N Male connector assembled on <u>each</u> end of RG214/U coax; Maximum voltage specification is 3kV DC.

(x2)





High Voltage Resistive Signal/Trigger Tap off

DESCRIPTION

Barth High Voltage Resistive Signal Tap Offs are useful for signal monitoring or device triggering. They are constructed using our voltage probes incorporated into a unit with connectors to allow easy insertion into a coaxial system. This arrangement is very useful in a laboratory setup, and for system monitoring.

HIGH VOLTAGE RESISTIVE SIGNAL/TRIGGER TAP OFF COMPARSION

Maximum Input*						
Model	Maximum Peak Voltage	@ Pulse width ns	Risetime through mainline ps	Voltage Ratio Tap Off	Risetime of Resistive Output	Connectors
241-NMFFP-11	2,500	400	< 30	11:1	<60ps	N male/female mainline
245-NMFFP-100	2,500	400	< 30	100:1	<60ps	N female tap off
242-GLBFP-100	5,000	400	< 30	100:1	<900ps	GR874 locking mainline/BNC female tap off
242-GLBFP-50	5,000	400	< 30	50:1	<400ps	GR874 locking mainline/BNC female tap off
242-GLBFP-25	5,000	400	< 30	25:1	<215ps	GR874 locking mainline/BNC female tap off
243-HMFNFP-100	15,000	2µS	< 30	100:1	<1.5ns	HNB male/female

NOTE: Our type HN (HNB) connectors are specially designed to obtain minimum reflection coefficient for fast rise times. 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.

* Please refer to the Technical Specifications (Maximum Input Limitations) page for a full explanation of voltage and pulse width ratings.

Phone 702.293-1576

Fax 702.293.7024

High Voltage Resistive Signal/Trigger Tap Off Barth Model 241-NMFFP-11, Model 245-NMFFP-100

ADVANTAGES

- High Voltage Pulse rated
- N mainline and tap off connectors
- Wide bandwidth

DESCRIPTION

A High Voltage resistive signal tap off useful for signal monitoring or device triggering.



Voltage Ratio: 241-xxx-11 1:1 mainline into a 50 Ω load

11:1 tap off into a 50 Ω load

TAPOF

245-xxx-100 1:1 mainline into a 50 Ω load

100:1 tap off into a 50 Ω load

2.5kV @ 400ns rectangular pulse on mainline* **Maximum Input:**

Peak Input Power: 125kW at rated pulse width

Average Input Power: 1W maximum

Mainline Risetime: < 30ps

Tap Off Risetime: 241-xxx-11 < 60ps

245-xxx-100 < 60ps

Tap off 5GHz, mainline 10GHz Bandwidth (-3dB): 241-xxx-11

> 245-xxx-100 Tap off 5GHz, mainline 10GHz

Impedance: 241-xxx-11 50Ω with 450 Ω tap off

245-xxx-100 50Ω with 4950 Ω tap off

Voltage Coefficient: < 1% at rated voltage

Connectors: 245-NMFFP-xxx Mainline N male/female

> 241-NMFFP-xxx Tap off output N female

Mainline GR 874 Locking Tap off Output N female 241-GLNFP-xxx

Dimensions: Approx. 3 9/16" wide (9.1 cm) x 2 3/8" high (6.0 cm) x

3/4" deep (1.9 cm)

1/2 lb. Weight:

NOTE: Other configurations-voltage ratio/tap off can be obtained. User must specify desired tap off voltage ratio or resistance value, voltage, and risetime requirements. BNC female is optionally available for tap off connector. The risetime and voltage specifications are dependent on, and in some cases limited by, the resistance value selected.



1589 Foothill Drive Boulder City, NV 89005 Phone 702.293-1576 Fax 702.293.7024

Barth Electronics, Inc.

^{*} Maximum rating requires mainline be terminated into 50 Ω.

High Voltage Resistive Trigger Tap Off Barth Model 242-SPJBFP-25, 50, 100, Model 242-GLBFP-25, 50, 100







Model 242-GLBFP-100

DESCRIPTION

A High Voltage resistive signal tap off useful for signal monitoring or device triggering on a coaxial cable system.

SPECIFICATIONS

Voltage Ratio:		1:1 mainline, into a 50 Ω load 242-XXXXX-25 25/1 (27.96dB) into a 50 Ω load
	2/2 YYYYY 50	50/1/33 08dB\into a 50 O load

242-XXXXX-50 50/1 (33.98dB) into a 50 Ω load 242-XXXXX-100 100/1 (40dB) into a 50 Ω load

Maximum input: 5kV, 400ns FWHM Pulse*

Peak/Average Input Power: 500kWat rated pulse width, 1W maximum*

Impedance:	242-XXXXX-25	50Ω with 1200 Ω tap off
	242-XXXXX-50	50Ω with 2450 Ω tap off
	242-XXXXX-100	50Ω with 4950 Ω tap off

Mainline Risetime: < 30ps

Tap Off Risetime/	242-XXXXX-25	< 215ps	1.6GHz
Bandwidth (-3db):	242-XXXXX-50	< 400ps	870 MHz
	242-XXXXX-100	< 900ps	450MHz

Voltage Coefficient: < 1% at rated voltage

Reflection-TDR: < 3% to a 100ps rise time step function

Connectors: 242-GLBFP-XX Mainline GR 874 locking, N male/female,

HN male/female - BNC Tap Off

242-SPJBFP-XX Mainline SHV Plug/SHV Jack,

GHV male/female - BNC Tap Off

Dimensions: 242-GLBFP-XX Approx. 3.6 long x 2.2" wide x 1" high

242-SPJBFP-XX Approx. 5.6" long x 2.25" wide x .78" high

Weight: 242-GLBFP-XX Approx. 5 oz. 242-

SPJBFP-XX Approx. 8 oz.



^{*} Maximum rating requires mainline be terminated into 50 Ω_{\bullet}

High Voltage Resistive Signal/Trigger Tap Off Barth Model 243-HMFNFP-100

ADVANTAGES

High Voltage Pulse Rated

49 HN Mainline Connectors

DESCRIPTION

A High Voltage resistive signal tap off useful for signal monitoring or device triggering.

SPECIFICATIONS

Voltage Ratio: 1:1 mainline, into a 50 Ω load

100:1 (40dB) tap off, into a 50 Ω load

Maximum Input: 15kV, 2us FWHM Pulse *

Peak Input Power: 4.5MW at rated pulse width *

Average Input Power: 1W maximum *

Mainline Risetime: < 30ps

Tap Off risetime: < 1.5ns

Bandwidth (-3dB): Tap off 250 MHz, Mainline 10 GHz

Impedance: 50 Ω with 5k Ω tap off

(This provides 1/100 of the amplitude of the main line voltage on the sampled signal output connector)

Voltage Coefficient: < 1% at rated voltage

Connectors: Mainline HN male/female, Tap off output N female*

Dimensions: Approx. 3 3/4" (9.5 cm) wide x 3" (7.6 cm) high x 3/4" (1.9 cm) deep

Weight: Approx. 5/8 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 Model 402-HNB female cable connector for RG214/U coax should be used for interconnection; available in our Pulse Catalog.

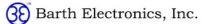
Other configurations-voltage ratio/tap off can be obtained. User must specify desired tap off voltage ratio or resistance value, voltage and risetime requirements, and desired sampled signal output connector. N female and BNC female are currently available. The risetime and voltage specifications are dependent on, and in some cases limited by, the resistance value

selected.

* Maximum rating requires mainline be terminated into 50 Ω .



Model 243-HMFNFP-100





Wide Band High Voltage Transformer Transformer Component Model Comparison

SIGNAL PICKOFFS

		Maximum In	put*			
Model	Maximum Peak Voltage	Energy without saturation	Reflection coefficient at 100psτ	Risetime through unit mainline ps	Risetime of coupled Output ps	Connectors
CT5-GLP	5,000	800Vxµs	< 5%	< 70	350	GR 874 locking
CT5-GLBFIP	5,000	800Vxµs	< 5%	< 70	350	GR 874 locking Mainline/BNC female isolated
CT6-NFP-8	4,000	135Vxµs	< 5%	< 70	< 300	N female
CT20B-HFNFP-20	15,000	1,300Vxµs	< 5%	< 70	<170	HN female mainline/N female output
CT20B-HFNFP-8	15,000	135Vxµs	< 5%	< 70	300	HN female mainline/N female output**

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 connector or Model 402-HNB female cable for RG214/U coax should be used for interconnection; available in our Pulse Catalog.

- * Please refer to the Technical Specifications (Maximum Input Limitations) page for a full explanation of voltage and pulse width ratings.
- ** Input Reflection Coefficient rated at 500 pst

Phone 702.293-1576

Fax 702.293.7024 www.BarthElectronics.com



Wide Band High Voltage Transformer Barth Model CT5-GLP, CT5-GLBFIP

DESCRIPTION

High Voltage 50 Ohm Transformer Coupled Signal Pickoff

SPECIFICATIONS

Voltage Ratio: 10.0/1

Maximum input: 5kV, 800Vxμs Pulse

Impedance: 50Ω

Mainline Risetime: < 70ps

Tap Off Risetime: < 350ps

Droop: < 5% at lµs

Bandwidth (-3dB): Mainline 5GHz, tap off 1GHz

Reflection-TDR: < 5% to a 100ps risetime step function

Connectors: CT5-GLP GR 874 locking

CT5-GLBFIP GR 874 locking mainline, BNC female isolated output

Dimensions: 4" long x 3.150" wide x 1" high

Weight: 5/8 lb.



Model CT5-GLBFIP

Wide Band High Voltage Current Transformer Barth Model CT6-NFP-8

DESCRIPTION

Transformer Coupled Signal Pickoff without direct connection to main transmission line



SPECIFICATIONS

Voltage Ratio: 8.0 + 10%, 2ns after 50% amplitude

Maximum Input: 4kV, 135Vxμs Pulse

Impedance: 50Ω

Mainline Risetime: < 70ps

Tap Oft Risetime: < 300ps

Bandwidth (-3dB): Mainline 5GHz, tap off 1.2GHz

Reflection-TDR: < 5% to a 100ps risetime step function

Connectors: N female

Dimensions: 2.8" long x 2.5" wide x 1" high

Weight: 1/2 lb.



Wide Band High Voltage Current Transformer Barth Model CT20B-HFNFP-20. Model CT20B-HFNFP-8

DESCRIPTION

High Voltage Transformer Coupled Signal Pickoff without direct connection to main transmission line.



Model CT20B-HFMNFP-20

SPECIFICATIONS

Voltage Ratio: CT20B-HFNFP-20 20.0/1 Vr

CT20B-HFNFP-8 8.0/1 Vr

Maximum Input: CT20B-HFNFP-20 15kV, 1300Vxμs Pulse

CT20B-HFNFP-8 15kV, 135Vxus Pulse

Impedance: 50Ω

Mainline Risetime: < 70ps

Tap Off Risetime: CT20B-HFNFP-20 < I70ps

CT20B-HFNFP-8 < 300ps

Bandwidth (-3dB): CT20B-HFNFP-20 Mainline 5GHZ, tap off 2GHz

CT20B-HFNFP-8 Mainline 5GHz, tap off 1.2GHz

Reflection-TDR: < 5% to a 100ps risetime step function

Connectors: HN female mainline, N female tap oft output **

Dimensions: 3" long x 3.3" wide x 1.5" high

Weight: 1 lb.

NOTE: The response is fairly flat from 40kHz to 950 MHz with the -3dB point at 16 kHz.

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 should be used for interconnection, available in our Pulse Catalog. Unit is supplied with a Barth Model 404-HMM low reflection male to male adapter, so that either the input or output can be adapted to a male connection.

** BNC female tap off output is optionally available.





Wide Band High Voltage Resistive Voltage Tap Off And Resistive Current Monitor – Barth Model CV1A



Model CV1A Current and Voltage Probe

ADVANTAGES

- Highest speed coaxial current sensor for time domain measurements
- Flat pulse response extending to microseconds
- Clean Response

DESCRIPTION

<u>Precision Coaxial Current Sensor</u>, a completely new patented design providing precise current measurements from sub-nanosecond to microseconds. This complementary voltage and current probe can provide precise measurements of incident and reflected energy for time domain pulses as fast as 30 picoseconds. The CV1A is a combination voltage, tap off, and current monitor. This product presently covers the tremendously wide measurement range of 3X10⁵, which can be extended.

SPECIFICATIONS

Voltage Sensor Ratio: $100:1 \text{ tap off, into } 50\Omega \text{ load}$

Maximum Input: 2.5kV @ 400ns rectangular pulse on mainline*

Peak Input Power: 125kW at rated pulse width

Average Input Power: 100W maximum*

* Maximum rating requires mainline be terminated into 50 Ω .



Phone 702.293-1576

Fax 702.293.7024 www.BarthElectronics.com

Wide Band High Voltage Resistive Voltage Tap Off And Resistive Current Monitor – Barth Model CV1A

SPECIFICATIONS Continued

Mainline Risetime: < 20ps

Voltage Tap Off Risetime: 30ps

Voltage Coefficient: < 1% at rated voltage and current

Current Sensitivity Volts/Amp: 0.5V/A

Current Sensitivity Droop: 1% in 1µs

Maximum Current: 300A

Average power: 1 watt maximum

Mainline N male/female Tap off N female

Dimensions: Approx. 6.8" w (17.3cm) x 2.9" h (7 .3cm) x 1.5" d (3.8cm)

Weight: 1.6lb. (.72kg)

NOTE: Other configurations-voltage ratio/tap off can be supplied. User must specify voltage ratio, Current ratio, voltage, and risetime requirements. The risetime and voltage specifications are Dependent on, and in some cases limited by, the resistance sensitivities selected.

* Maximum rating requires mainline be terminated into 50 Ω .

World Wide Customers Relying on Barth High Voltage Wide Bandwidth Pulse Power Instrumentation since 1964:

BAE- British Aerospace Systems

BNL- Brookhaven National Laboratory

CEA- The French Alternative Energies and Atomic Energy Commission

DRI - Desert Research Institute

Fermi – Fermi National Accelerator Laboratory

FID Technology Germany

Fraunhofer Institute Germany

General Atomics

Her Majesty's Government United Kingdom

Ioffe Physiotechnical Institute Russia

LANL- Los Alamos National Laboratory

LLNL -Lawrence Livermore National Laboratory

NAWCWD- Naval Air Warfare Center Weapons Division

Nevada Test Site

NSTEC- National Security Technologies, LLC

SNL - Sandia National Laboratories

SLAC -Stanford Linear Accelerator Center

University of Rochester Laboratory for Laser Energetics

UNR- University of Nevada Reno

USAFRL - U.S. Air Force Research Laboratory

USARL- U.S. Army Research Laboratory



Worldwide Sales Representatives

UNITED STATES

www.barthelectronics.com

Barth Electronics, Inc. 1589 Foothill Drive Boulder City, NV 89005 Sue Smith, Sales Manager

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 Nord 7 allee du Brevent 91019 EVRY Cedex France

Michel Chaillou

Phone: 011 33 1 60 86 21 26 Fax: 011 33 1 64 97 54 98 michel.chaillou@pulsemc2.fr

UNITED KINGDOM

www.ppmpower.co.uk

PPM (Pulse Power & Measurement LTD)

65 Shrivenham Hundred Bus. Park Watchfield, Swindon, Wiltshire SN6 8TY UK

Sam Whitaker

Direct: +44 (0) 1793 784389

sales@ppm.co.uk

INTERNATIONAL

CHINA

www.quatek.com.cn

Quatek Company Limited

Room 2112, 21 Floor, Yong Sheng Tower 2025, West Zhong Shan Road Shanghai, P.R.C. 200235

Kidd Shen Tel (86) 21-64813366 ext 819

Fax: (86) 21-64813369 kshen@quatek.com.cn

TAIWAN

www.quatek.com.tw

Quatek International Limited 4th Fl., 308, Sec. 1 Nei-Hu Road Nei Hu, 114 Taipei, TAIWAN R.O.C. 11493

Allen Chou Tel (02) 2797-3357 ext 275 Fax: (02) 2797-3957

achou@quatek.com.tw

JAPAN and KOREA

www.tet.co.jp

Hideki Sadohara

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

sadohara@tetjp.onmicrosoft.com

www.general-bussan.co.jp

(Pulse Only)

Keita Kanno

General Bussan Co., Ltd.

2-18-2 Nakano Nakano-ku

Tokyo 164-0001 Japan Phone: +81-3-3383-1711 Fax: +81-3-3383-1719

info@general-bussan.co.ip

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 4:00 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.

Terms are Net 30 days. Accounts over 30 days are considered 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" <u>and</u> "customer name" for exported products must be included with all confirming purchase orders. Export orders may require a letter of credit or pre-payment, before order is shipped. If an export license is required; order processing and shipping may be delayed.

CREDIT CARDS

Barth Electronics, Inc. accepts VISA, Discover and MasterCard. Maximum credit card charge is \$10,000.00 USD, per transaction. There will be a 4% processing fee added to all credit card orders.



DISCOUNTS

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

WARRANTY INFORMATION

We 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. **Note:** Tampering of any Barth pulse product in any way will void the warranty.

DOMESTIC & INTERNATIONAL SALES

Contact the Barth sales team <u>beisales@barthelectronics.com</u> 1-702-293-1576, or visit our website for the most complete and up to date sales representative information at <u>www.BarthElectronics.com</u>

TECHNICAL QUESTIONS

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

This page intentionally left blank.

Barth Electronics, Inc.

1589 Foothill Drive Boulder City, NV 89005 Phone: 702-293-1576 Fax: 702-293-7024 beisales@barthelectronics.com www. BarthElectronics.com