Nx SERIES

PULSE FORMING NETWORKS
PAPER, TEFLON OR POLYETHYLENE

TYPE 'E' PULSE FORMING NETWORKS: Commonly used for radar and missile applications in circuits which convert direct current or sinusoidal alternating current to unidirectional square pulses at high energy levels for short durations having equal capacitance per mesh and mutual inductance between adjacent coils (Figure A).

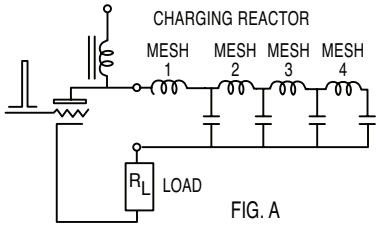


FIG. A

Activating the switch discharges the capacitor energy through the inductors of the pulse forming network, resulting in a flat topped wave across R. The squareness of the wave is a function of the number of meshes, provided the external circuit is nonreactive. In addition, the energy stored in the network will be dissipate into the load R1 when it matches the characteristic impedance of the pulse forming network. Furthermore, the voltage appearing across the load is one-half the voltage at which the network is charged.

The number of MESHES or SECTIONS is determined by the rise time requirements and the duration of the pulse width. The rise time of the network is determined by the rise time of one mesh of the network. Shortening the pulse width of the mesh decreases the rise time. This results in the need for more meshes for a given pulse width. Total capacitance requirements of a Type 'E' pulse forming network.

$$C = \frac{T}{2Z}$$

where: C = µF, T = µsecs, Z = Characteristic Impedance

Capacitance per mesh is the total capacitance divided by the number of meshes. Similarly, the total inductance is:

$$L = \frac{TZ}{2} \qquad \textit{where } L = \textit{inductance in } \mu H$$

Inductance per mesh is the total inductance divided by the number of meshes. The first and last inductor are generally larger and the others are smaller. This, in conjunction with proper adjustment of the mutuals between adjacent inductors, results in a flat topped discharge wave.

RISE TIME: Requirement is determined from the magnetron characteristics in conjunction with the pulse transformer and other components in the circuit. A long rise time will result in poor spectrum characteristics and a rise time which is too short might result in magnetron sparking, over-shoots and other undesired characteristics of operation. For ease of specifying, rise time is generally indicated along the linear portion of the wave front and measured from 10% to 90% of the average peak amplitude (Figure B).

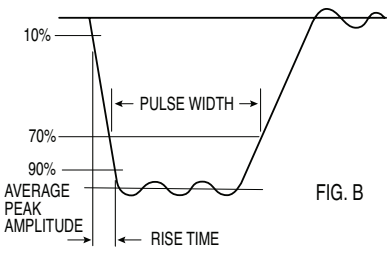
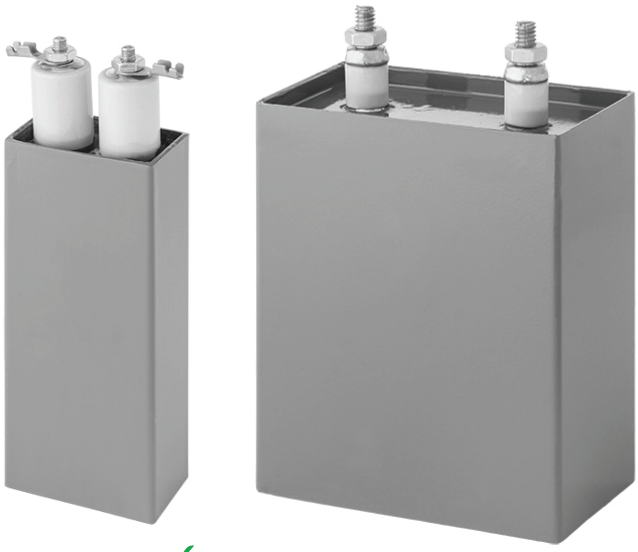


FIG. B



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PULSE WIDTH: A requirement which is determined from various factors, such as range of the radar system. Pulse width is ordinarily specified at 70% of the average peak amplitude (the half power point). Pulse width can be fixed accurately in the pulse forming network and remain stable for many years. Multiple pulse widths can be achieved by the use of individual pulse forming networks in same or separate container (Fig. C).

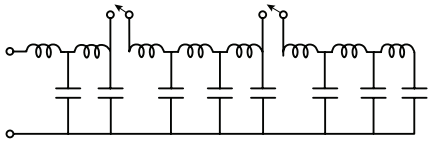

FIG. C

Figure C illustrates a typical additive pulse forming network with the capability of supplying three pulse widths, each working into a nominal design impedance with the same rise time.

RIPPLE: Normal ripple tolerance of 5% for single networks or 7.5% for additive networks excursion from the overage peak amplitude is relatively easy to obtain. This ripple percentage is suitable for many applications. However, it is possible to obtain ripple percentages of plus/minus 2% for single networks and plus/minus 4% for additive networks by closer adjustment of the network component parts.

The listing of two terminal pulse forming networks which follows is intended to give the engineer insight into the effect of variable size and operation. It is especially interesting to note the effect of repetition rate with various types of capacitor dielectrics.

TEMPERATURE RANGE: Ambient convection cooled operating range varies by dielectric type. The ambient temperature plus internal heat rise (PPS per 10°C Rise) should never exceed the maximum of the dielectric range range.

Paper Dielectric:	-40°C to +55°C
Polyethylene Dielectric:	-60°C to +75°C
Teflon Dielectric:	-40°C to +125°C

Example: Part #NH50-500 is rated for 500 PPS per 10°C rise and a max ambient temperature of 75°C. At half power, 250 PPS, the max ambient could be raised to 80°C, or if doubled to 1000 PPS, would create a 20°C internal heat rise recuing the max ambient to 65°C. The addition of heatsink fins and air flow can increase the power dissipation of the container.

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DECAY OR FALL TIME: Is approximately three times the value of the rise time for a Type 'E' pulse forming network.

SALT SPRAY: All listed pulse forming networks are designed to withstand a 50 hour salt spray test per MIL-QQ-151A. One-hundred (100) hour withstand is also available.

HUMIDITY: Per paragraph 3.12 humidity cycle of MIL-C-25A or 30 day cycle per MIL-E-5272.

CHARACTERISTIC IMPEDANCE: 50 OHMS

VIBRATION: Per MIL-C-25A. 10 to 55 cps for .060" total excursion traversed once per minute. One hour in each plane and using the mounting clamps as used in end equipment.

TEMPERATURE and IMMERSION CYCLING: Per MIL-C-25A paragraph 4.6.9

LIFE TEST: The pulse forming networks are designed to withstand the following life test: Life test shall be conducted at the high listed ambient temperature with a KVA equivalent to 1.5 rated KVA by either increasing the repetition rate by 50% or by increasing the charging voltage by 22.5% for a period of 250 hours without failure.

IMPEDANCE: The listed pulse forming networks are established for a matching impedance of 50 ohms plus/minus 5 ohms into a resistive load. All other characteristic measurements are also made with a 50 ohm resistive load. Other impedance values are available. Since the impedance largely determines the size of the network for a given duration, a generality might be made whereby the following is substantially true.

The cubical volume of a pulse forming network is inversely proportional to the matching impedance. This statement is made for the engineer who requires another matching impedance for the purpose of evaluating the approximate size.

ADDITIVE NETWORKS: The engineers of Plastic Capacitors, Inc., are prepared to design additive networks to your specification. High voltage networks with external coils for high power installations, while not commonplace, are being made regularly to specification. Current peaks of 4000 amperes and charging voltage of 80KV are readily achieved and are not the limit of practicability.

HOW TO SPECIFY:

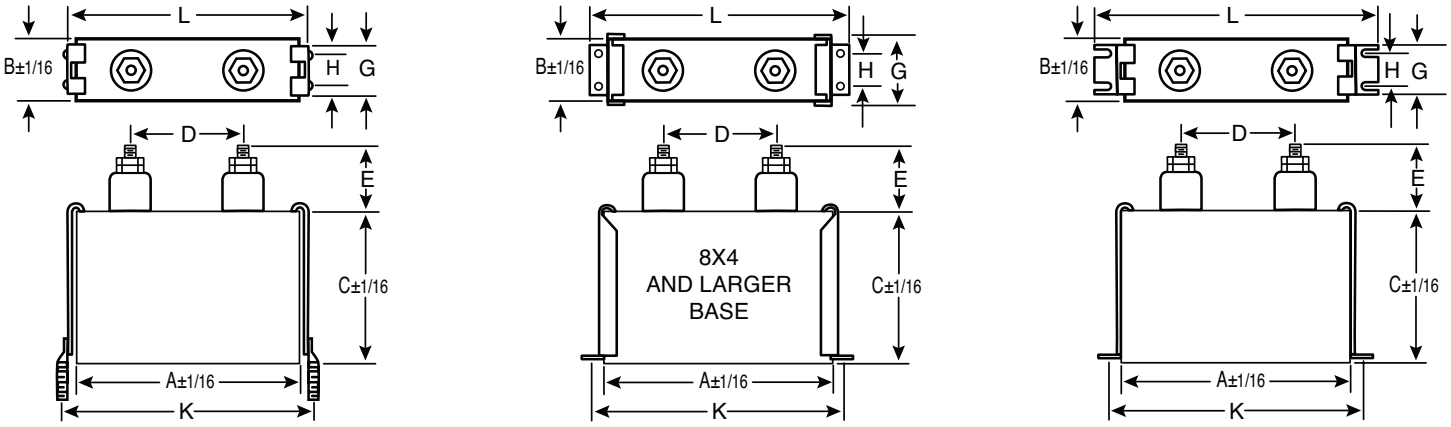
The following information is required for the design of pulse forming networks.

1. Peak charging voltage.
2. Pulse duration - where measured and tolerance.
3. Pulse rise time - where measured and tolerance, if any.
4. Characteristic impedance and tolerance.
5. Repetition rate.
6. Maximum ripple allowable.
7. Temperature range - operational and storage.
8. Operational life required. Describe fully.
9. Decay or fall time, if pertinent.
10. Vibration and shock requirements.
11. Altitude of operation. If pressurized, so state.
12. Forced or natural air circulation.
13. Number of terminals required.
14. Limiting dimensions.
15. Mounting brackets required.
16. Other environmental requirements.
17. Other mechanical requirements such as weight, unusual configuration, etc.

CASE BASE DIMENSIONS A	B	FOOTED K BRACKET	SPADE BRACKET	L MAX	G MAX	H	J
1 3/4	1	2 1/2	2 1/16	3 1/16	25/32	*	.213
2 1/2	1 3/16	3 1/4	2 3/4	3 13/16	29/32	*	.213
3 3/4	1 1/4	4 7/16	4	5	29/32	*	.213
3 3/4	1 3/4	4 7/16	4	5	1 1/2	5/8	.213
3 3/4	2 1/4	4 11/16	4	5 1/4	2	1 1/4	.213
3 3/4	3 3/16	4 11/16	4	5 1/4	2 7/8	2	.213
4 9/16	3 3/4	4 11/16	4	5 1/4	4 5/16	3 3/8	.213
6	4 11/16	5 11/16	Not	6 1/4	4 13/16	4 1/4	.213
7 3/8	5 5/8	6 1/2	Avail.	7 1/8	6 1/16	5 1/2	.213
8	4	10 1/8		11 1/4	4 9/32	2 1/8	.437
13 1/2	4 1/8	15 5/8		16 3/4	4 13/32	2 1/8	.437
13 1/2	5 1/8	15 5/8		16 3/4	5 13/32	3 1/8	.437

***Single slot or lug centered-J Hole or slot diameter on footed brackets.**
Brackets for base sizes $4^{9/16"}x3^{3/4"}$, $6x4^{11/16"}$, and $7^{3/8"}x5^{5/8"}$ are mounted on the side parallel to the centerline drawn through the terminals.

OUTLINE DRAWING:



REV 190311A

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Nx SERIES

PULSE FORMING NETWORKS
PAPER, TEFLON OR POLYETHYLENE

PAPER DIELECTRIC MODELS

TEMPERATURE RANGE -40°C TO +55°C

Peak Charge Volts	Model	µsec Pulse	PPS per 10°C Rise	A	B	C
1,000	NP10-50	0.50	-	1.750	1.000	2.125
	NP10-100	1.00	5000	1.750	1.000	2.500
	NP10-200	2.00	4200	2.500	1.188	2.125
	NP10-400	4.00	2100	2.500	1.188	2.125
	NP10-500	5.00	2200	2.500	1.188	3.000
2,000	NP20-50	0.50	2200	1.750	1.000	2.125
	NP20-100	1.00	2100	2.500	1.188	2.125
	NP20-200	2.00	1900	2.500	1.188	2.500
	NP20-400	4.00	700	2.500	1.188	3.000
	NP20-500	5.00	700	2.500	1.188	4.000
3,000	NP30-25	0.25	4200	2.500	1.188	2.500
	NP30-50	0.50	2100	2.500	1.188	2.500
	NP30-100	1.00	1200	2.500	1.188	3.000
	NP30-200	2.00	780	2.500	1.188	4.000
	NP30-400	4.00	380	3.750	1.250	2.500
	NP30-500	5.00	340	3.750	1.250	3.000
4,000	NP40-25	0.25	2400	2.500	1.188	2.500
	NP40-50	0.50	1200	2.500	1.188	2.500
	NP40-100	1.00	700	2.500	1.188	3.000
	NP40-200	2.00	440	2.500	1.188	4.000
	NP40-400	4.00	240	3.750	1.250	3.000
	NP40-500	5.00	220	3.750	1.250	3.500
5,000	NP50-25	0.25	2100	2.500	1.188	3.000
	NP50-50	0.50	1000	2.500	1.188	3.000
	NP50-75	0.75	700	2.500	1.188	3.500
	NP50-100	1.00	500	2.500	1.188	3.500
	NP50-200	2.00	335	2.500	1.188	5.000
	NP50-400	4.00	200	3.750	1.250	3.500
	NP50-500	5.00	200	3.750	1.750	4.500
7,500	NP75-10	0.10	2300	2.500	1.188	3.500
	NP75-25	0.25	920	2.500	1.188	3.500
	NP75-50	0.50	500	2.500	1.188	4.000
	NP75-75	0.75	410	3.750	1.250	3.500
	NP75-100	1.00	350	3.750	1.250	4.000
	NP75-200	2.00	230	3.750	1.750	4.500
	NP75-400	4.00	150	3.750	2.250	5.500
	NP75-500	5.00	140	3.750	3.188	5.500
10,000	NP100-10	0.10	1900	3.750	1.750	3.250
	NP100-25	0.25	760	3.750	1.750	3.250
	NP100-50	0.50	430	3.750	1.750	3.750
	NP100-75	0.75	300	3.750	1.750	4.000
	NP100-100	1.00	240	3.750	1.750	4.500
	NP100-200	2.00	175	3.750	2.250	6.000
	NP100-400	4.00	130	4.563	3.750	6.000
	NP100-500	5.00	140	4.563	3.750	9.000
15,000	NP150-10	0.10	900	3.750	1.750	4.500
	NP150-25	0.25	430	3.750	1.750	5.000
	NP150-50	0.50	320	3.750	2.250	6.000
	NP150-75	0.75	250	3.750	2.250	9.000
	NP150-100	1.00	210	3.750	3.188	7.000
	NP150-200	2.00	170	4.563	3.750	10.000
	NP150-400	4.00	100	8.000	4.000	7.000
	NP150-500	5.00	100	8.000	4.000	9.250

POLYETHYLENE DIELECTRIC MODELS

TEMPERATURE RANGE -60°C TO +75°C

Peak Charge Volts	Model	µsec Pulse	PPS per 10°C Rise	A	B	C
2,500	NH25-10	0.10	...	2.500	1.188	2.125
	NH25-25	0.25	...	2.500	1.188	2.125
	NH25-50	0.50	...	2.500	1.188	2.500
	NH25-100	1.00	3600	2.500	1.188	2.500
	NH25-200	2.00	2800	3.750	1.250	2.500
	NH25-400	4.00	1400	3.750	1.250	2.500
	NH25-500	5.00	1240	3.750	1.250	2.750
5,000	NH50-10	0.10	...	2.500	1.188	2.750
	NH50-25	0.25	...	2.500	1.188	2.750
	NH50-50	0.50	3000	3.750	1.250	2.750
	NH50-100	1.00	1620	3.750	1.250	3.000
	NH50-200	2.00	1160	3.750	1.750	3.000
	NH50-400	4.00	930	3.750	1.750	4.000
	NH50-500	5.00	500	3.750	1.750	4.250
7,500	NH75-10	0.10	...	3.750	1.250	2.750
	NH75-25	0.25	2500	3.750	1.250	2.750
	NH75-50	0.50	1300	3.750	1.250	2.750
	NH75-75	0.75	1000	3.750	1.250	3.250
	NH75-100	1.00	940	3.750	1.250	4.250
	NH75-200	2.00	550	3.750	1.750	4.250
	NH75-400	4.00	460	3.750	2.250	7.500
	NH75-500	5.00	450	3.750	3.188	7.500
10,000	NH100-10	0.10	4000	3.750	1.750	3.250
	NH100-25	0.25	2000	3.750	1.750	3.250
	NH100-50	0.50	1150	3.750	1.750	4.000
	NH100-75	0.75	910	3.750	1.750	4.750
	NH100-100	1.00	760	3.750	1.750	5.500
	NH100-200	2.00	525	3.750	2.250	7.000
	NH100-400	4.00	380	3.750	3.188	9.000
	NH100-500	5.00	400	8.000	4.000	5.250
12,500	NH125-10	0.10	4300	3.750	1.750	4.000
	NH125-25	0.25	1700	3.750	1.750	4.000
	NH125-50	0.50	860	3.750	2.250	4.000
	NH125-75	0.75	620	3.750	2.250	4.500
	NH125-100	1.00	600	3.750	2.250	6.000
	NH125-200	2.00	450	3.750	3.188	8.000
	NH125-400	4.00	390	8.000	4.000	7.000
	NH125-500	5.00	310	8.000	4.000	7.000
15,000	NH150-10	0.10	3000	3.750	1.750	4.500
	NH150-25	0.25	1200	3.750	2.250	4.000
	NH150-50	0.50	730	3.750	2.250	5.000
	NH150-75	0.75	200	3.750	2.250	6.500
	NH150-100	1.00	580	3.750	3.188	7.500
	NH150-200	2.00	440	8.000	4.000	5.250
	NH150-400	4.00	300	8.000	4.000	9.250
	NH150-500	5.00	260	8.000	4.000	9.250
20,000	NH200-10	0.10	2800	4.563	3.750	4.500
	NH200-25	0.25	1200	4.563	3.750	5.000
	NH200-50	0.50	630	4.563	3.750	5.500
	NH200-75	0.75	520	4.563	3.750	7.000
	NH200-100	1.00	500	8.000	4.000	5.250
25,000	NH250-10	0.10	1900	4.563	3.750	5.000
	NH250-25	0.25	800	4.563	3.750	5.500
	NH250-50	0.50	600	4.563	3.750	9.000
	NH250-75	0.75	520	8.000	4.000	7.000

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TEFLON DIELECTRIC MODELS

TEMPERATURE RANGE -40°C TO +125°C

Peak Charge Volts	Model	µsec Pulse	PPS per 10°C Rise	A	B	C
3,000	NT30-10	0.10	...	1.750	1.000	2.125
	NT30-25	0.25	5000	1.750	1.000	2.125
	NT30-50	0.50	2500	2.500	1.190	2.500
	NT30-75	0.75	2000	2.500	1.190	2.500
	NT30-100	1.00	1500	2.500	1.190	2.500
	NT30-200	2.00	2000	3.750	1.250	2.500
	NT30-400	4.00	1200	3.750	1.250	3.000
	NT30-500	5.00	970	3.750	1.250	3.000
6,000	NT60-10	0.10	...	2.500	1.190	2.750
	NT60-25	0.25	3000	2.500	1.190	2.750
	NT60-50	0.50	2100	3.750	1.190	2.750
	NT60-75	0.75	1400	3.750	1.250	2.750
	NT60-100	1.00	1050	3.750	1.250	3.000
	NT60-200	2.00	680	3.750	1.750	3.000
	NT60-400	4.00	400	3.750	1.750	4.000
	NT60-500	5.00	360	3.750	1.750	4.500
9,000	NT90-10	0.10	5000	3.750	1.750	3.000
	NT90-25	0.25	2000	3.750	1.750	3.000
	NT90-50	0.50	1250	3.750	1.750	3.750
	NT90-75	0.75	890	3.750	1.750	4.500
	NT90-100	1.00	700	3.750	1.750	3.750
	NT90-200	2.00	530	3.750	2.250	5.500
	NT90-400	4.00	380	3.750	2.250	7.500
	NT90-500	5.00	325	3.750	2.250	7.500
12,000	NT120-10	0.10	4000	3.750	2.250	4.500
	NT120-25	0.25	2200	3.750	2.250	5.000
	NT120-50	0.50	1350	3.750	2.250	6.500
	NT120-75	0.75	1040	3.750	2.250	7.500
	NT120-100	1.00	780	3.750	2.250	8.500
	NT120-200	2.00	480	3.750	3.188	8.000
	NT120-400	4.00	320	4.563	3.750	9.000
	NT120-500	5.00	280	4.563	3.750	10.000
15,000	NT150-10	0.10	3500	3.750	2.250	5.000
	NT150-25	0.25	1500	3.750	2.250	6.000
	NT150-50	0.50	1000	3.750	3.188	6.000
	NT150-75	0.75	750	3.750	3.188	7.000
	NT150-100	1.00	680	4.563	3.750	7.000
	NT150-200	2.00	400	4.563	3.750	9.000

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