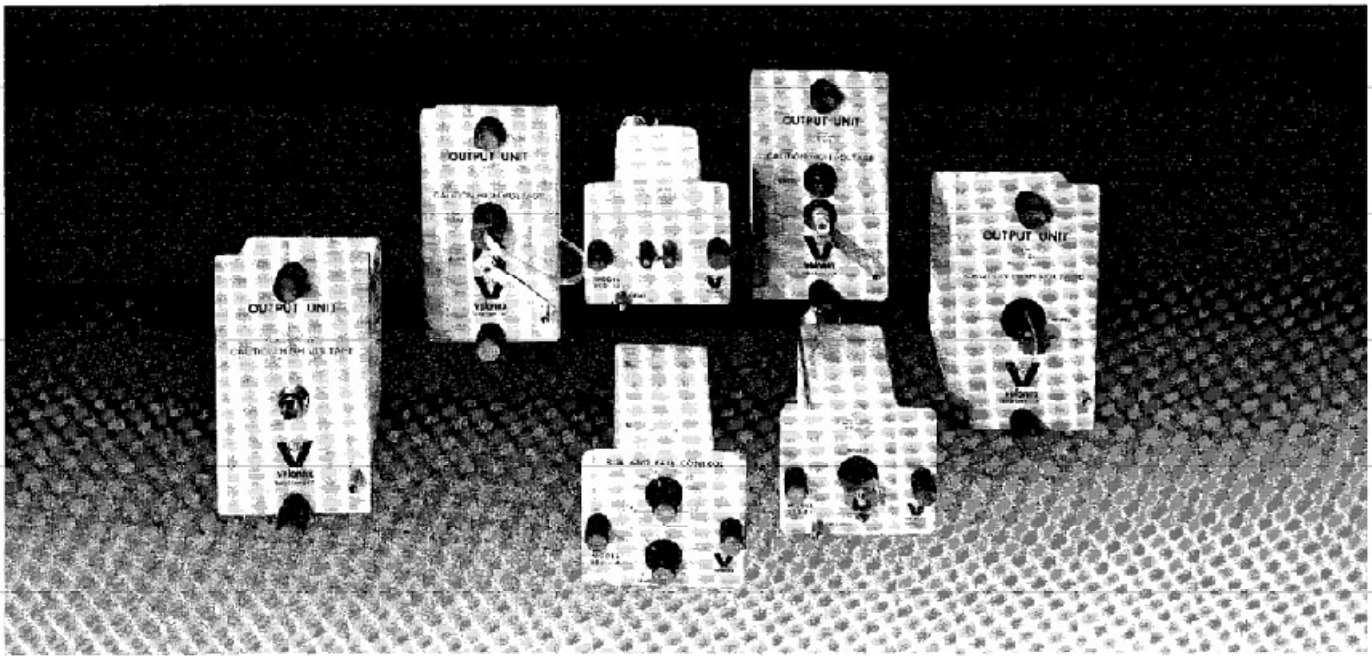
PLUG-IN OUTPUT UNITS for High-Power Pulse Generators



PLUG-IN VERSATILITY

Velonex High-Power Pulse Generators offer exceptional versatility with a wide range of standard fully recessed plug-in output units. These units are easily inserted and removed to provide a large selection of output currents and voltages (impedance matching); DC isolation; inversion of output pulse polarity; and varying rise and fall times. Interlocks automatically remove high voltage if plug-ins are removed while power is on. Operator safety and waveform are enhanced by making all plug-ins fully recessed-flush with the front panel — *a Velonex exclusive.*

Each standard Velonex generator is delivered with a direct feed-through output plug-in. Tables I and II present detailed specifications of all standard plug-ins when used with standard generators. The plug-ins of Table I can, in most cases, be used in all generators except for the Model 380 Generator. Plug-ins for the Model 380 are in Table II.

GENERAL INFORMATION

Most Plug-In Output Units for Velonex High-Power Pulse Generators employ pulse transformers of unique design. To optimize the rise and fall times and the pulse-top droop, the majority of these units are designed to cover a pulse-width range of ten to one. A slight power loss occurs when using plug-in units, which is usually somewhat greater for the longer pulse-width units.

Moderate waveform alteration can occur depending upon the particular plug-in, the generator control settings, and the impedance of the load.

Operation beyond the specified pulse width limits is frequently possible without damage to the unit (provided that the duty factor limit of the generator is maintained) but this may cause waveform alteration.

The relationship between rated peak output voltage and maximum pulse width is such that the product of the two equals a constant, i.e., $(E_{MAX})(PW_{MAX}) = K$, for any given output transformer. ("K" is a function of transformer core saturation.) Therefore, if the output voltage is reduced to less than full output, the maximum pulse width may be increased proportionately. For example, when using a V-1729 Plug-In (maximum rated pulse width of 100μs at an output of 10kV), if the output voltage is set at 4kV, the pulse width may be increased up to 250μs.

For operation of some microwave tubes, a bifilar secondary is desired to allow for filament excitation. Certain plug-in units can be provided with this feature, if required.

When operating a Model 570 or 580 Generator in burst mode, the maximum gate width for 10% droop at 50% duty factor within the gate is at least twice the nominal pulse width in the non-burst mode.

A direct output plug-in unit, V-1102, allows the insertion of a DC voltage from +1.5kV to −2.5kV in series with the external load and the output of a Model 345, 350 or 570 Generator. It may be used for DC blocking applications.

When using a test load to check plug-in performance, be certain to keep series inductance and parallel capacitance very low. Use resistors rated to withstand the peak voltage and capable of dissipating the average power applied. Forced-air cooling may be required.

CALIBRATION

For calibration of the Models 345, 350 and 570, the V-1121 output plug-in is available. This consists of a 200Ω internal load and a 1000:1 attenuator. Two output terminals are provided; one of these connects to the full output pulse, while the second provides a 1000 times (±2%) attenuated signal of the same pulse shape as the output pulse. This allows low level monitoring of the generator output without the need for high voltage probes.

A Model V-1786, 200Ω internal load is available for Models 360, 580 and 660. This unit allows checking and calibrating the High-Power Pulse Generator output into its rated load.

The Models V-1121 and V-1786 are also useful when driving load impedances above 5000Ω to improve the fall time. The installed, V-1786 protrudes approximately 7" in front of the generator panel and contains a load cooling fan.

Velonex High-Power Pulse Generator Models 360, 580 and 660 each incorporate an integral monitor output (attenuated output). When using plug-in units, the monitor output indicates the voltage at the primary of the pulse transformer, hence, this does not completely represent the actual output pulse. The monitor output can still be used for observing changes once a "reference" has been established.

APPLICATIONS ASSISTANCE

Applications bulletins or assistance may be obtained directly from Velonex or your local representative. Bulletins describing DC Isolation Voltage ratings (applications bulletin Number 115) and special output units are available.

VELONEX

SPECIFICATIONS

Figure 1a.

Figure 1b.

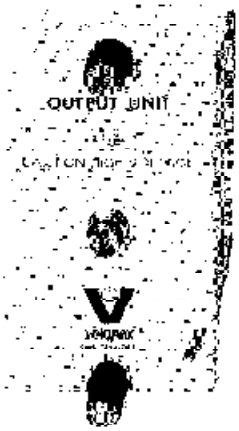


Figure 1c.

Figure 1d.

Table I

Model Number Output Polarity +	Model Number Output Polarity −	Rise Time µs Max	Fall Time µs Max	R_L Nominal Resistive Ω	MODELS 360, 580(3), 680 (at 1.5% Duty Factor) (5) E_O Peak Volts Max	I_O Peak Amps Max	Pulse Width Range µs
V-1720	V-1721	11.0	12.0	30K	30K	1.0	20–100
V-1723	V-1724	2.0	2.3	13.3K	20K	1.5	3–10
V-1725	V-1726	4.5	5.5		20K	1.5	10–100
V-1911	V-1912	0.3	0.3	3.3K	10K	3.0	0.3–1.0
V-1727	V-1728	0.5	0.6		10K	3.0	1–10
V-1729	V-1730	2.0	2.0		10K	3.0	10–100
V-1731	V-1732	4.5	4.6		9K	3.0	100–300
V-1733	V-1734	0.09	0.08	680	5.0K	6.0	0.2–1.0
V-1735	V-1736	0.2	0.2		5.0K	6.0	1–10
V-1737	V-1738	1.2	0.8		5.0K	6.0	10–100
V-1739	V-1740	4.5	2.0		4.7K	6.0	100–300
V-1741	V-2475	0.07	0.07	200	2.4K	12	0.1–1.0
V-1742	V-2476	0.15	0.13		2.4K	12	1–10
V-1743	V-2477	0.8	0.8		2.4K	12	10–100
V-1744	V-2478	2.0	1.0		2.4K	12	100–300
V-1745(1)	V-1746(1)	0.06	0.06	50	1.2K	25	0.1–1.0
V-1747(1)	V-1748(1)	0.15	0.12		1.2K	25	1–10
V-1749(1)	V-1750(1)	0.9	0.7		1.2K	25	10–100
V-1751(1)	V-1752(1)	2.0	2.0		1.2K	25	100–300
V-1753	V-1754	0.07	0.07	12	600	50	0.1–1.0
V-1755	V-1756	0.2	0.2		600	50	1–10
V-1757	V-1758	0.8	0.6		600	50	10–100
V-1759(2)		2.0	2.0		570	50	100–300
V-1761(2)		0.08	0.08	3.0	300	100	0.1–1.0
V-1762(2)		0.2	0.15		300	100	1–10
V-1763(2)		1.0	1.0		300	100	10–100
V-1764(2)		2.0	2.0		280	100	100–300
V-1765(2)		0.07	0.08	0.5	120	250	0.1–1.0
V-1766(2)		0.3	0.2		120	250	1–10
V-1767(2)		1.2	1.2		120	250	10–100
V-1768(2)		2.5	1.5		115	250	100–300
V-1913(2)		0.16	0.11	0.12	60	500	0.3–1.0
V-1769(2)		0.4	0.3		60	500	1–10
V-1770(2)		2.0	1.5		60	500	10–100
V-1771(2)		3.0	2.0		56	500	100–300
V-1772(2)		0.5	0.3	0.055	40	750	1–10
V-1773(2)		2.5	2.0		40	750	10–100
V-1777(2)		3.0	2.0		38	750	100–300
N/A	V-1102	DC Blocking Network		200	N/A		
N/A	V-1121	Same as Generator Load for Calibration		200 (internal)	N/A		
N/A	V-1786	Same as Generator Load for Calibration		200 (internal)	2.5K	N/A	0.05–3000
All above units		Total Droop (including Generator)			5% max.(6)		
		Backswing			30% max.		
		Overshoot			6% max. except V-1732, V-1734, V-2475.		

(1) Add "U" suffix for isolated (floating) output, per Fig. 1b; see Applications Bulletin No. 115.
(2) Where one No. spans both + and − columns, unit may be used for either polarity by grounding one terminal.
(3) In non-burst mode.

MODELS 350, 570(3) (at 1.0% Duty Factor)(4)			MODELS 345 (at 1.0% Duty Factor)				MODELS 570, 580 (DF max = 50% in Burst)		
E_O Peak Volts Max	I_O Peak Amps Max	Pulse Width Range µs	E_O Peak Volts Max	I_O Peak Amps Max	PW Range µs	Over-shoot %	Max PRF in Burst Mode Hz +	Max PRF in Burst Mode Hz −	Output Connections
24K	0.8	20-120	11.4K	0.4	20-250	5	33K	33K	See Note (7)
16K	1.2	3-12	7.6K	0.6	3-25	5	165K	165K	
16K		10-125	7.6K		10-250	10	65K	65K	
8.0K	2.4	0.3-1.2	3.8K	1.2	0.3-2.5	10	1.0M	500K	Two 5-Way Binding Posts See Figure 1b
8.0K		1-12	3.8K		1-25	5	330K	280K	
8.0K		10-125	3.8K		10-250	10	165K	165K	
7.7K		100-300	3.7K		100-750	10	500K	65K	
4.0K	4.8	0.2-1.2	1.9K	2.3	0.2-2.5	10	2.0M	2.0M	
4.0K		1-12	1.9K		1-25	10	2.0M	2.0M	
4.0K		10-125	1.9K		10-250	10	1.0M	1.0M	
3.8K		100-300	1.8K		100-750	10	500K	500K	
2.0K	10	0.1-1.2	950	4.8	0.1-2.5	10	2.0M	2.0M	
2.0K		1-12	950		1-25	10	2.0M	2.0M	
2.0K		10-125	950		10-250	10	2.0M	2.0M	
1.9K		100-300	920		100-750	10	500K	500K	
1000	20	0.1-1.2	480	9.6	0.1-2.5	15	2.0M	2.0M	Gen Rad Type 874 See Figure 1c
1000		1-12	480		1-25	10	2.0M	2.0M	
1000		10-125	480		10-250	12	1.0M	500K	
960		100-300	460		100-750	8	500K	250K	
490	40	0.1-1.2	240	20	0.1-2.5	20	2.0M	2.0M	Two 5-Way Binding Posts See Figure 1b
490		1-12	240		1-25	17	2.0M	1.0M	
490		10-125	240		10-250	20	500K	500K	
480		100-300	230		100-750	15	500K	500K	
250	83	0.1-1.2	120	40	0.1-2.5	12	2.0M	2.0M	Strip-Line L = 1.70" with two 1/4" lugs See Figure 1d
250		1-12	120		1-25	11	2.0M	2.0M	
250		10-125	120		10-250	15	500K	500K	
240		100-300	115		100-750	10	250K	250K	
100	200	0.1-1.2	48	96	0.1-2.5	12	2.0M	2.0M	
100		1-12	48		1-25	5	2.0M	2.0M	
100		10-125	48		10-250	15	300K	300K	
95		100-300	46		100-750	15	300K	300K	
50	415	0.3-1.2	24	200	0.3-2.5	10	1.0M	1.0M	
50		1-12	24		1-25	5	1.0M	1.0M	
50		10-125	24		10-250	5	330K	330K	
48		100-300	23		100-750	10	200K	200K	
33	600	1-12	16	290	1-25	5	670K	670K	
33		10-125	16		10-250	5	330K	330K	
32		100-300	15		100-750	5	200K	200K	
2.1K	10.5	0.1-200	1.0K	5.0	0.1-300	3	2.0M	2.0M	One 5-Way Post; One GND Terminal
2.1K & 2.1	N/A	0.1-300	1.0K & 1.0	N/A	0.1-1000		2.0M	2.0M	One 5-Way Post; BNC, GND Terminal
N/A			N/A				2.0M	2.0M	Same as Generator
15% max. (6) 30% max.			20% max. (6) 35% max.						
V-2476, and V-2477 which are 15% max.			See Listing Above						

(4) Useable to 1.5% on Model 350-E.
(5) These generators contain built in 1000:1 voltage dividers.
(6) At full rated pulse width. Droop is significantly less at shorter pulse widths.
(7) HV Receptacle (AMP LGH-3) with mating 18" HV lead; 5-Way Binding Post. See Figure 1a.

PLUG-IN OUTPUT UNITS for High-Power Pulse Generators

Figure 2a.

Figure 2b.

TABLE II MODEL 380 OUTPUT PLUG-IN UNITS (at 1.0% Duty Factor)

Model No. Output Polarity +	Model No. Output Polarity −	Rise Time ns Max.	Fall Time ns Max.	R_L Nominal Resistive Ω	E_O Peak Volts Max.	I_O Peak Amps Max.	Pulse Width Range μs	Output Connections
V-1267	V-1266	20	20	200	1000	5	0.05–0.5	Two 5-way Binding Posts
V-1269	V-1268	230	260				0.5–20	
V-1264	—	15	15	50	500	10	0.05–1.0	Gen Rad Type 874
V-1265	—	100	100				0.2–20	
V-1261	V-1260	15	20	0.5	50	100	0.05–0.5	Strip Line L = 1.50" 2 lugs, 1/4"
V-1263	V-1262	100	200				0.5–5	
Droop		<6%						
Backswing		<25%						
Overshoot		V-1262 & 1263 <10%, 1260 & 1261 <25%, all others <5%						

STRIP-LINE CONSIDERATIONS

Connections made to a strip-line should duplicate the strip-line in width and separation. Figure 3 shows the strip-line dimensions. This necessitates a separation between the two conductors of approximately 0.01 inch. Either mylar or teflon insulation is recommended.

The nominal impedance of the strip-line is $Z=377d/w$, where "d" is the separation between conductors and "w" is the conductor width. The short strip-line on the plug-in unit has an impedance of approximately 4Ω. If an interconnection length of more than 3 inches is needed, a strip-line of the proper load impedance should be employed.

Care should be taken to eliminate series inductance when using high current plug-in units as this generates ringing on the pulse top and the base line. It is necessary to ground one side of the load to the ground terminal of the plug-in unit. The ground conductor should be at least a #10 stranded wire or flat 1/2 inch wide strap.

All leads to high current plug-in units should be of minimum length to preserve best waveshape.

STRIP-LINE DIMENSIONS

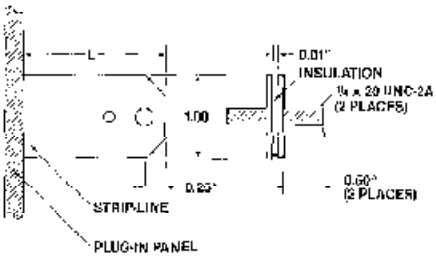


Figure 3.

VARIABLE RISE AND FALL TIME UNITS

Velonex offers three standard Rise and Fall Control Units for use with its High-Power Pulse Generators. Each unit is continuously variable over the specified range in five nanosecond steps. Two controls are employed on each unit; rise times are indicated by the sum of the two knob settings. Fall times vary with the rise times and are equal to the rise time within ±30%. Linearity between the 15% and 85% points on the pulse rising and falling edges is ±5%.

These units are passive devices, incorporating multisection low-pass filters whose cutoff frequencies are set by the control knobs. All units may be used either by feeding their outputs directly into their rated loads, or they may be used simultaneously with any standard plug-in unit. This allows the Rise/Fall Control to be employed over wide pulse voltage and current ranges, and to provide either output pulse polarity and DC isolation.

Table III indicates the proper Rise/Fall Control for use with each generator.

TABLE III

Generator Model No.	Rise/Fall Control Model No.	Rise Time Range ns	Output Resistive Termination Ω	Note
345	V-1276	50–345	200	2
350	V-1276	50–345	200	2
360	V-1883	50–345	200	3
380	V-1270	25–295	50	1
570	V-1276	50–345	200	2
580	V-1883	50–345	200	3
660	V-1883	50–345	200	3

Note 1: **Model V-1270** plugs directly into the *upper* cavity of a Model 380 High-Power Pulse Generator. When so installed, either the direct feed-thru unit, supplied with the generator, or any auxiliary plug-in unit employed should be inserted into the *lower* cavity.

Note 2: **Model V-1276** inserts into the front panel cavity of the generator. When installed, it protrudes approx. 7" in front of the generator. If an accessory plug-in unit is to be used, it is inserted directly into the V-1276; otherwise the direct feedthru unit, supplied with the generator, is plugged into the V-1276. When used with a rack-mounted Model 340 or 345, clearance below the unit is required.

Note 3: **Model V-1883** is housed in a separate, 19¾" × 18" × 11", cabinet which contains a plug-in cavity to accomodate any standard plug-in unit. When using the V-1883, a V-1918 auxiliary unit and an interconnecting cable assembly (separately available) are recommended. The V-1918 plugs into the High-Power Pulse Generator front panel cavity and is interconnected to the V-1883 by the cable assembly.

Your Local Velonex Rep. is:

Specifications subject to change without notice.

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