

# FastPulse Technology, Inc.

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**MODEL 8025RS**

**HIGH VOLTAGE PULSE GENERATOR**



RoHS

**SERIAL NUMBER: 4092**

**WHEN CALLING OR CORRESPONDING ABOUT THIS INSTRUMENT  
ALWAYS MENTION THE SERIAL NUMBER.**

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## MODEL: 8025RS

This instrument complies with EU Directive 2002/96/EG (RoHS Compliant) and conforms to the protection requirements of EMC Directive 89/336/EEC, specifically, EN 55011 Radiated and Conductive Emissions, EN 50082-1 Immunity (IEC 801-2, -3, -4) and safety requirements of EN 60601-2-22 (IEC 601-2-22:1995-11).

It is essential that the instrument be correctly connected, that the AC mains ground have a low impedance and that following precautions are observed:

1. Replacement Cables: Interconnecting coaxial cables must be matched to the impedance of the connectors used on the instrument, its input signal source and where possible, the output circuit load . Thus, 50 Ohm BNC cable connectors must be attached to 50 Ohm cable (RG58A/U OR RG55/U) and 75 Ohm MHV cable connectors to 75 Ohm cable (RG59/U). Impedance mismatches will cause ringing and radiated emissions. To reduce residual emissions due to impedance mismatch, aluminum foil may be wrapped around the cables or the cables may be enclosed in flexible braided copper tubing which is made for this purpose. In either case, the shielding must be well grounded.
2. Pockels cells which may be supplied as accessories to this instrument are passive components which are intended to be operated in the end-user's shielded enclosure. Failure to properly enclose the cell may result in electrically radiated noise.
3. As supplied, the Pockels cell light modulator and HV Pulse Modules are enclosed in a EMI shielded enclosure. This metal enclosure must be connected electrically to house ground. Because the modulator enclosure must have apertures to permit passage of the laser beam, these openings may be a source of low level RFI/EMI. If sensitive detectors or instruments are located in the immediate vicinity of the enclosure apertures, it may be necessary to provide additional shielding around the apertures in the form of a second grounded metal enclosure or a small cardboard carton covered with aluminum foil. The foil is grounded and two apertures are cut into the foil and cardboard. If the distance between the apertures in the modulator enclosures or cardboard box is 1 to 2 inches (25 to 50 mm) the residual radiation, if any, will be significantly attenuated .
4. This instrument generates internal voltages which can be hazardous. It is important to read and understand the operations manual provided with the instrument prior to connecting and applying AC line power or DC voltages. All cables must be connected to their mating connectors before application of any electrical power and turn-on of the power switches.

# MODEL 8025RS HIGH VOLTAGE PULSE GENERATOR

## 1.0 GENERAL DESCRIPTION

The Model 8025RS High Voltage Pulse Generator is designed to drive the capacitive load impedance presented by Pockels cell electro-optic light modulators. It produces symmetrical, fast rise and fall time voltage pulses. The 8025RS utilizes high voltage MOSFET type transistors in the output voltage switching stages. The MOSFETs are very reliable and have proven to be the devices of choice for switching thousands of volts in a nanosecond time frame.

### **The 8025RS Provides Two Modes of Operation:**

Selection of the operating mode is made by a front panel switch labeled "SELECT" and "DIRECT". SELECT corresponds to the Pulse Generator mode and DIRECT results in setting up the Pulse Follower. In Pulse Follower mode the thumb wheel switches have no control or effect; they are bypassed.

### **1.1 Pulse Generator (Switch in SELECT Position)**

In this mode, a positive or negative input trigger pulse applied to the 50  $\Omega$  input BNC connector initiates operation. The timing and width of the output pulse applied to the Pockels cell is controlled by digital thumb wheel switches on the front panel. The output pulse can be delayed in time from the input trigger by means of digital thumb wheel switches adjacent to the pulse width controls. In the Pulse Generator mode, output pulse width and input to output delay are controlled solely by the thumb wheel switch settings.

### **1.2 Pulse Follower (Switch in DIRECT Position)**

In this mode of operation, the width of the output pulse applied to the Pockels cell closely approximates the pulse width of the input trigger pulse. As a pulse follower, the output pulse can be as short as  $\approx 50$  ns and infinitely long, depending on the length of the input pulse. Output pulse width is controlled by the leading and trailing edges (rise and fall times) of the input trigger pulse. Minimum pulse width is limited by the 50 ns intrinsic propagation time of the pulse processing circuits. Trigger inputs with pulse widths shorter than 50 ns will result in output pulse widths equal to the  $\approx 50$  ns + input width.

## 1.3 Trigger Inputs

Two trigger input connectors (BNC) are provided.

**1.3.1** The 50  $\Omega$  Trigger Input is intended to be driven from an appropriate trigger source that provides TTL type signal voltages - usually up to  $\pm 5$  Volts maximum amplitude (plus or minus). A switch is provided to select between positive and negative sources.

**1.3.2** A connector is available for positive going trigger pulses of up to 24 Volts amplitude for use with a variety of signal sources. Fast rise and fall times in the range of 10 nanoseconds maximum are recommended to insure accurate triggering and timing.

## 2.0 Application

When employed with an electro-optic light modulator/ Q-switch, the 8025RS produces rectangular optical pulses useful in such laser applications as Q-switching, pulse slicing or chopping, shaping and gating. The 8025RS is compatible with Lasermetrics' Series 1040, 1050, 1145, and 1147 Pockels cells as well as other low capacitance, two terminal light modulators. The generator is intended for driving capacitive loads only. Use of resistive or inductive loads may result in damaged components.

The 8025RS utilizes high voltage, high speed MOSFET differential switching amplifiers which are indicated as the "ON" and "OFF" switches in Figure 1. When the HV Supply is energized, equal retardation voltages, via the "ON" and "OFF" MHV connectors located on the front panel, are applied to both electrodes of the modulator. This condition produces a net zero voltage across the modulator crystal electrodes and thus no optical retardation occurs.

With the SELECT/DIRECT switch set to DIRECT, the generator is operating in the DIRECT or Pulse Follower mode and output pulse width is controlled by the width of the input trigger signal. When a trigger input pulse is applied, the leading edge of the pulse causes the "ON" amplifier to switch from its high voltage state to its low voltage state. The "OFF" amplifier is unaffected and remains in its high voltage state.

This condition produces a net differential voltage, closely approximating the voltage indicated by the meter, across the modulator crystal thereby inducing a phase retardation proportional to the voltage.

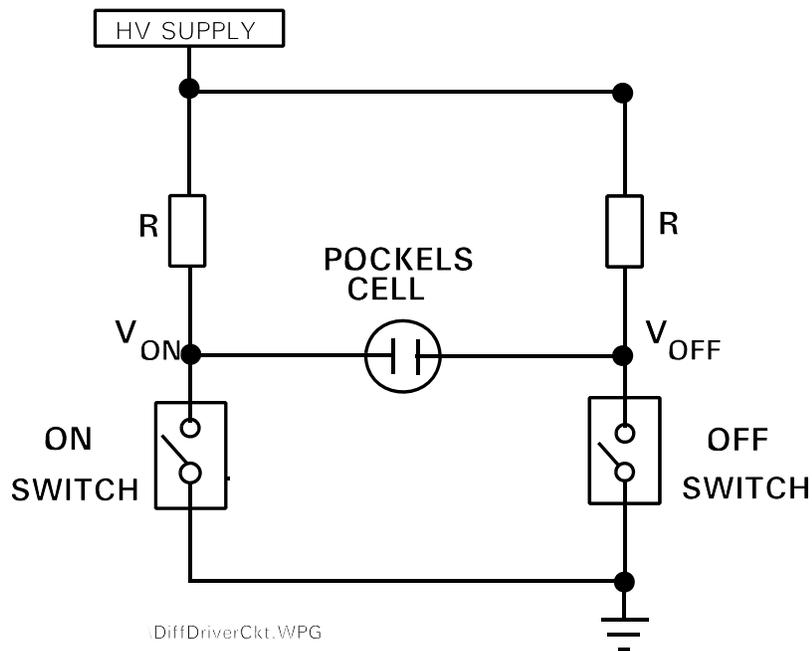


Figure 1: Equivalent circuit of 8025RS high voltage switching stages

When the input signal is terminated, the trailing edge of the input pulse causes the "OFF" amplifier to be switched from its high to a low state. Since the "ON" amplifier is still in the low voltage state, this results in a net zero voltage across the modulator which again corresponds to zero retardation. Both outputs then simultaneously return to their high voltage states thereby maintaining zero differential voltage until the next input pulse is applied. When the 8025RS is operated in the SELECT mode, output pulse width is dependent only on the setting of the Pulse Width control and the intrinsic pulse propagation times in the pulse processing circuits.

If the electro-optic light modulator is placed between crossed polarizers in the path of a laser beam, minimum transmission will occur when the differential voltage is zero. Transmission will occur when the amplifier outputs are not equal and the intensity of the transmitted beam will depend on the power supply DC voltage setting and the differential voltage amplitude applied to the modulator.

When the 8025RS is operating as a Pulse Follower amplifier, i.e., front panel SELECT/DIRECT switch is in the DIRECT position, output pulse width closely approximates the width of the input trigger pulse. The output of the 8025RS is a differential voltage appearing between the "ON" and "OFF" output connectors on the rear panel of the cabinet. These voltages switch between the high voltage setting indicated by the front panel meter and  $\approx$ zero volts.

Under static conditions, when there is no trigger input signal, there is zero differential voltage between the "ON" and "OFF" leads and thus zero volts across the Pockels cell terminals.

When a trigger voltage is applied, the voltage at the "ON" lead switches to zero and the differential voltage is approximately the value of the setting on the front panel meter. When the trigger signal is terminated, the "OFF" side voltage goes to zero and the differential voltage goes to zero. This differential zero condition is maintained during the recovery cycle between output pulses.

Thus, in the "Pulse Follower" mode, output voltage pulse width corresponds to the width of the input trigger pulse (plus pulse propagation time of about 50 ns in the signal processing circuits,). The output pulse can be delayed from a given event by use of an external laboratory type, low voltage pulse generator or by a computer control which generates time delayed trigger pulses of the appropriate width and trigger voltage level. In the Pulse Follower mode, pulse width can be changed on a pulse to pulse basis. Recall however, the front panel controls for with Pulse Width and Pulse Delay are disabled when the switch is in the DIRECT position.

**Note: Make all cable connections with the AC Power turned off.**

**When the AC Line Voltage is turned on, High voltages may be present and can lead to personnel injuries and damaged components.**

For additional details on the operation of electro-optic light modulators, see "User's Guide for KD\*P, RTP & Lithium Niobate Q-switches and Modulators ....." which is attached to this manual as an addendum.

# WARNING

## HIGH VOLTAGE

The 8025RS High Voltage Pulse Amplifier contains voltages which could be dangerous if contacted. All reasonable safety precautions have been taken in the design and manufacture of this instrument. **DO NOT** attempt to defeat the interlock protection provided.

AC Power must be removed by unplugging the AC line cord. HV capacitors should be discharged prior to any maintenance work. Connect and disconnect cables and connections only when AC line power is turned off or unplugged or the power switch is in the OFF position and/or the AC line cord is disconnected. When changing AC line operating voltage by means of the switch on the chassis rear, first disconnect the line cord from the AC line

Only recommended replacement parts should be used. We suggest that you contact the factory before attempting to make repairs, replacements or internal adjustments. In many instances our engineers can provide information to help diagnose the problem and suggest an appropriate repair procedure.

The equipment should be maintained only by qualified personnel who are familiar with high voltage components, circuits and measurement techniques. If qualified personnel are not available, the equipment should be returned to FastPulse Technology, Inc. for maintenance and repair.

### NOTE

**Make all cable connections to the Pockels cell and the panel connectors with the AC line power turned off. Making these connections with power on may damage components and cause injury to the user.**

### **3.0 SYSTEM CONNECTIONS & OPERATION**

The Model 8025RS High Voltage Pulse Generator is designed to produce rectangular electrical pulses with amplitudes between 1 kV and 5 kV at repetition rates of up to 500 pps.

The 8025RS is designed to operate with a capacitive impedance load such as that presented by a Pockels cell electro-optic light modulator. The 8025RS should not be used to drive resistive or inductive loads or Pockels cells that are configured as 50 ohm impedances.

The following setup procedure assumes that a suitable oscilloscope, optical detector, laser, pulse generator and light modulator are available for use with the 8025RS

**3.1** Connect the "ON" and "OFF" outputs of the HV amplifier to the optical modulator. Use the cables provided. Longer cable lengths will reduce the maximum pulse repetition rate attainable.

**3.2** Connect one of the 8025RS Trigger Input jacks to a pulse source capable of driving the input load as specified.

**3.3** Energize the 8025RS. Allow a minute or so for warm-up to stabilize internal components

**3.4** Pre-set the retardation voltage to approximately the level specified for the given optical modulator. In most E-O modulator data sheets, the  $\frac{1}{2}$  wave or  $\frac{1}{4}$  wave retardation voltage given is based on the "un-clamped" or DC voltage electro-optic coefficient. This value is usually about 15% to 20% lower than the "clamped" or high frequency e-o coefficient which is the value to be used for high frequency and fast pulse driving voltages. Therefore, the high voltage to be applied to the modulator as indicated by the setting on the 8025RS HV meter may have to be increased accordingly. The front panel meter provides an indication of the DC High Voltage level.

**3.5** To attain maximum amplitude of the detected laser pulse, optimize the high voltage pulse amplitude being applied to the modulator while applying an input pulse to the HV pulse amplifier and adjusting the HV level.

**3.6** The 8025RS is provided with a "ONE SHOT" button on the front panel for manually generating an output pulse for test or measurement purposes. A short push on the button will generate a single pulse. To use this feature, connect the "INPUT" monitor jack to an oscilloscope. The positive output sync pulse is used to trigger the scope when the "ONE SHOT" switch is activated. Pulse timing can be obtained from the pulse width MONITOR jack and viewed on an oscilloscope to set the "IN/OUT" delay. Synchronize the oscilloscope to the positive edge of PW monitor output to set the output pulse width.

#### 4.0 MODEL 8025RS HIGH VOLTAGE PULSE GENERATOR: Serial No. 4092

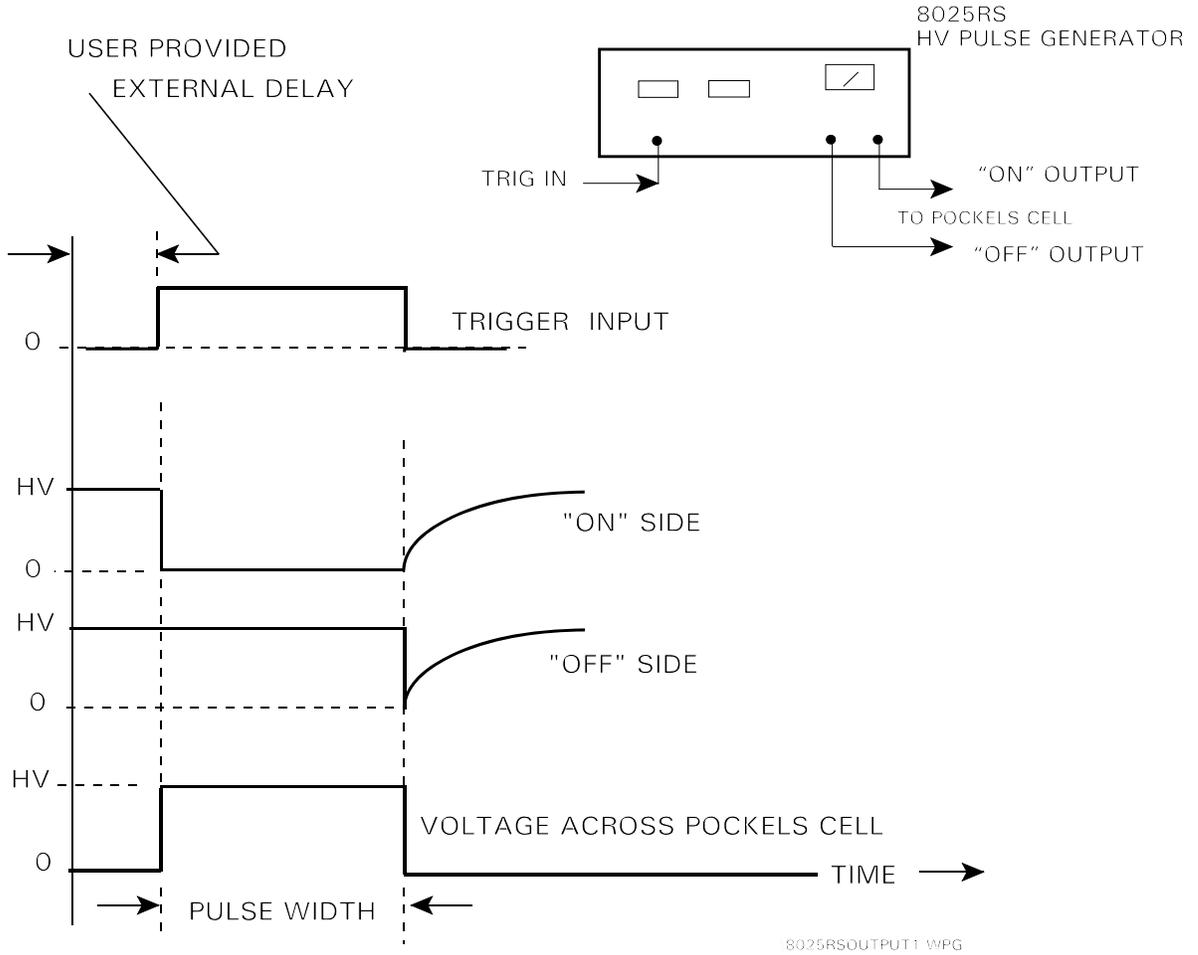
##### NOMINAL SPECIFICATIONS

Max. Voltage Range, Output	0 to 5.0 kV
Recommended Operating Output Voltage Range	1.0 to 5.0 kV
Pulse Repetition Frequency	DC to 500 Hz
Output Pulse Rise & Fall Times, 20% to 80%	≤10 ns
Input to Output Delay (Intrinsic Propagation Time)	DIRECT: ≤85 ns SELECT: 100 ns
Input to Output Delay Adjust Range (SELECT)	0 to 999.9 μs
Pulse Width Range, Pulse Follower Mode (DIRECT)	≤85 ns to Infinity
Pulse Width Range, Pulse Generator Mode (SELECT)	0 to 999.9 μs
Pulse Width Monitor Output Level (into 50 Ω)	2.3 Volts
Jitter: DIRECT Input to Output SELECT Input to Output (@200 nsec Delay & 2 ns to 200 ns Pulse Width)	< 1 ns
Trigger Input Pulse, 50 Ω Input (@50 ns PW, 100 Hz PRF)	4.5 ± 0.5 Volts, Peak
Trigger Input Pulse, 300 Ω Input (@50 ns PW, 100 Hz PRF)	22 ± 1 Volts, Peak, Max.
Cabinet Dimensions, inches	11 W X 8 ½ H X 11 D
AC Line Operating Voltages	115 Volts, 50/60 Hz
AC Line Power	50 Watts
Fuse	MDL-2A (Slo-Blo)

##### **NOTE:**

**The output switching stages of the 8025RS are intended to drive capacitive loads.  
Use of resistive or inductive loads may result in damaged components.**

2.0 PULSE FOLLOWER MODE: FRONT PANEL SWITCH SET TO: "DIRECT"  
 OUTPUT PULSE WIDTH SAME AS INPUT PULSE WIDTH



8025RSOUTPUT1.WPG



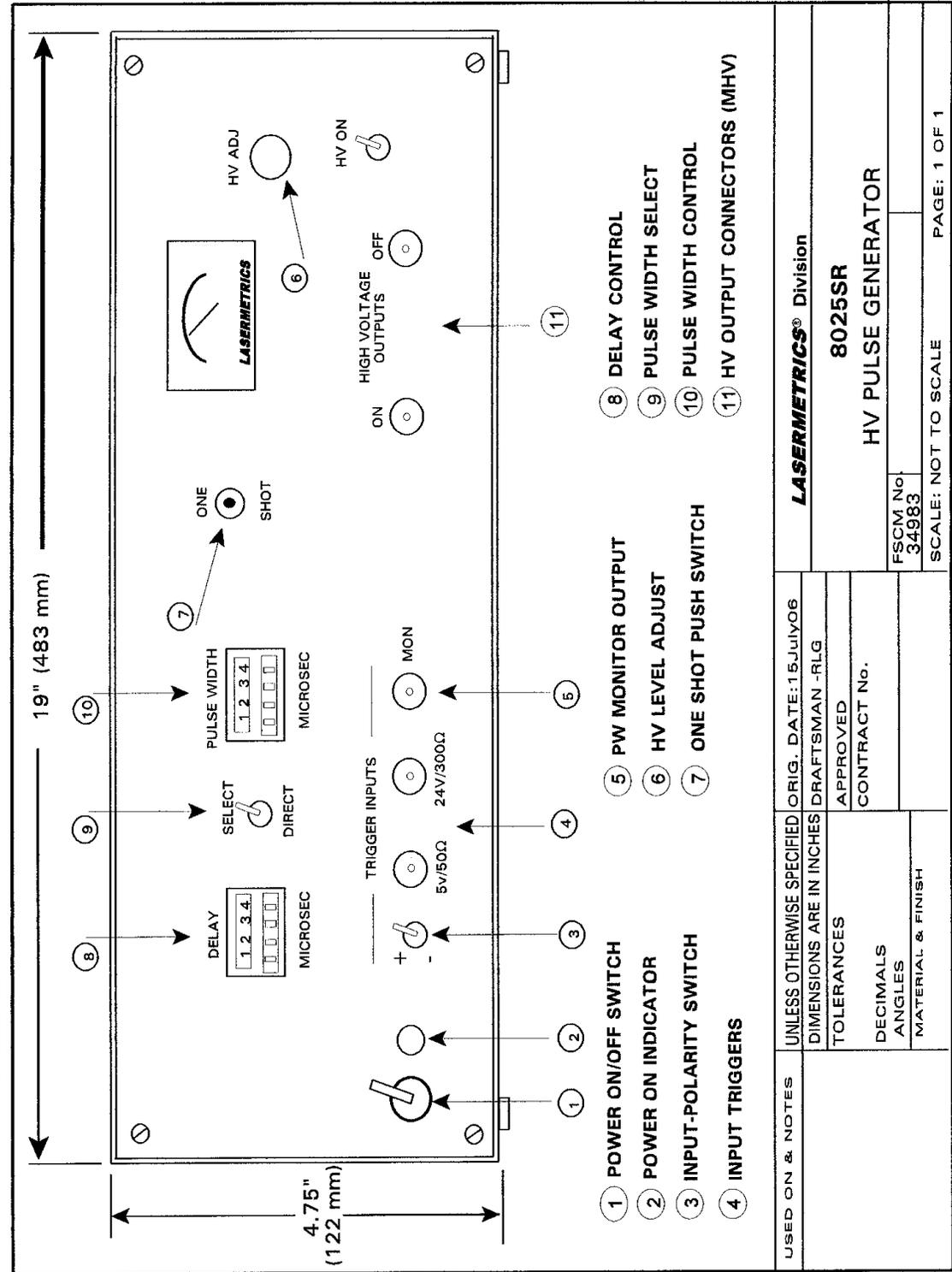
## 7.0 OPERATIONAL & CONTROL FUNCTIONS

### FRONT PANEL

AC "ON" Switch	Controls AC line voltage
AC "ON" Lamp	Indicates AC line is applied
Input Polarity Switch	Allows use of positive or negative trigger voltages
Trigger Input Jack (BNC)	Provides interconnection to 5 Volt trigger sources capable of driving 50 Ohm load
Trigger Input Jack (BNC)	Provides 300 $\Omega$ interconnection for 24 volt trigger sources
Monitor Jack, MON (BNC)	Provides a low level representation of the output pulse width useful as a sync pulse prior to generating the output pulse
One Shot Switch	Allows manual triggering to provide a single output pulse
Delay Thumbwheel Switch Control	Provides means to adjust the time delay between the input trigger and output HV pulses.
Pulse Width Thumbwheel Control	Permits adjusting the width of the output pulse
High Voltage Level Control	Sets the level of the High Voltage power supply
High Voltage Meter	Indicates the high voltage level above ground level
Output Connector Jacks "ON" & "OFF"	MHV type connectors - Used to couple 8025RS outputs to modulators with appropriate connectors/terminals. Both Outputs must be used for normal differential operation.

### REAR PANEL

AC Line Socket	Connector for AC line cord
AC Line Fuse	Safety fuse, Type MDL-2A, Slo-Blo, 2 Amps
AC Interlock Switch	Interrupts the AC line when unit is opened (Mounted on inside right rear corner of chassis) Can be overridden by pulling & locking the plunger outward
AC Line Voltage Switch	Sets internal transformer connections for operation at either 115 Volts (110 to 120 Volts) or 230 Volts (220 to 240 Volts), 50 /60 Hz.



- ① POWER ON/OFF SWITCH
- ② POWER ON INDICATOR
- ③ INPUT-POLARITY SWITCH
- ④ INPUT TRIGGERS
- ⑤ PW MONITOR OUTPUT
- ⑥ HV LEVEL ADJUST
- ⑦ ONE SHOT PUSH SWITCH
- ⑧ DELAY CONTROL
- ⑨ PULSE WIDTH SELECT
- ⑩ PULSE WIDTH CONTROL
- ⑪ HV OUTPUT CONNECTORS (MHV)

USED ON & NOTES	UNLESS OTHERWISE SPECIFIED	ORIG. DATE: 15 July 06
	DIMENSIONS ARE IN INCHES DRAFTSMAN -RLG	
TOLERANCES	APPROVED	
	CONTRACT No.	
	FSCM No. 34983	
DECIMALS ANGLES MATERIAL & FINISH	LASERMETRICS® Division	
	8025SR	
HV PULSE GENERATOR		
SCALE: NOT TO SCALE		
PAGE: 1 OF 1		

FIG. 4 8025RS FRONT PANEL AND DIMENSIONS

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## WARRANTY

Each standard component and instrument manufactured by FastPulse Technology (the Company) is guaranteed to be free from defects in material and workmanship for a period of one (1) year from the original date of shipment to the original purchaser. This warranty is voided if such equipment is operated beyond its safe operation limits, without proper routine maintenance, or under unclean conditions so as to cause optical or other damage; or if it is otherwise abused, exposed to power line or other electrical surges, connected incorrectly electrically, or if used in applications for which it was not intended or if modified in any way.

Our liability under this warranty is restricted to, at the Company's option, replacing, servicing or adjusting any instrument returned to the factory for that purpose, and to replacing any defective parts. Indicator lamps; vacuum, gas and vapor tubes; fuses, batteries, optical coatings, components in lasers and laser systems such as: focusing lenses and other optical components external to the laser cavity, expendable items such as flash lamps and water filters and the like are specifically excluded from any liability. FastPulse Technology does not assume liability for installation, patent violation claims, labor, injuries, or consequential damages.

Major parts and subsystems manufactured by other companies which are integrated in FastPulse Technology equipment are covered by the original manufacturers' warranty.

Equipment must be returned to the factory with transportation charges prepaid and with advance notice to the Company. Repaired equipment will be returned to the purchaser with shipping charges prepaid. If it is deemed impractical to return the equipment to the factory, the purchaser may request the dispatch of a FastPulse Technology service engineer whose services, travel and living expenses will be provided at the then current rates.

This warranty does not imply and is expressly in lieu of all other liabilities, obligations, or warranties. FastPulse Technology neither assumes nor authorizes any other person or organization to assume on behalf of the Company any other liability in connection with these products. FastPulse Technology disclaims the implied warranties of merchantability and fitness of such products for a particular purpose.

In many instances, equipment problems can, with the user's assistance, be resolved through brief communications with a factory engineer either by telephone or FAX. Should, in FastPulse Technology's opinion, the problem be caused by a component or subassembly failure, the Company shall at its discretion ship a replacement to the user, and/or request that the failed component or subassembly be returned to the factory for analysis or repair.

### CLAIM FOR DAMAGE IN SHIPMENT

The equipment should be tested as soon as possible after receipt. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent and this report should be forwarded to the Company. We will then advise the disposition to be made of the equipment and arrange for repair or replacement.

Include model number and serial number when referring to this equipment for any reason.

REV. 23 Feb 2004, C:\WP\FIT\WARRANTY