Instruction Manual

High Power, High Speed, High Current
High Voltage Switch/Pulse Generator

Models: HVC-XXXX/QCW-USB

This manual contains Operating, Safety, and Maintenance information and subjects to change without notice.

LIC Engineering
122 Calistoga Rd. Suite 210
Santa Rosa, CA 95409 USA
Phone: (707) 327-2705
Email: info@LicEngine.com

2013 Rev.1.3

TABLE OF CONTENTS

Safety Precaution

Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

Before Applying Power
Verify that all safety precautions are taken. Make all connections to the unit before applying power.

Ground the Instrument
To minimize shock hazard, the instrument chassis and cover must be connected to an electrical ground. The instrument must be connected to the AC power mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Fuses and/or Circuit Breaker
Only fuses with required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuse holders. To do so could cause a shock or fire hazard. If circuit breaker is activated, take a careful inspection and don't repeat the breaker on/off.

Do Not Operate in an Explosive Atmosphere
Do not operate the instrument in the presence of flammable gases or fumes.

Do Not Remove the Instrument Cover
Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover.

Do Not Modify the Instrument
Do not install substitute parts or perform any unauthorized modification to the product. Return the product to LIC Engineering factory for service and repair to ensure that safety features are maintained.

1.1 GENERAL

High Power, High Speed, High Voltage Switch/Pulse Generator, HVC-XXXX/QCW-USB are designed to drive many application in CW, QCW (Quasi Continuous Wave), and Normal Pulse mode.
HVC-XXXX/QCW-USB has a *built-in high efficient H.V power supply* and communicates closely with the output voltage/current.
HVC-XXXX/QCW-USB has achieved QCW high power up to 30KV/500A, and fastest rise time of 5ns-200ns.

For customer's different load impedance, there is a special made stripline available to avoid the reflection caused from mismatched impedance. This stripline enables the distance from the unit to a customer's load 1m (standard), or 2m (optional) keeping the rise time of 5ns-200ns & the minimum pulse width of 5ns.

HVC-XXXX/QCW-USB QCW uses a double isolated USB interface so that user can control the LD driver through user's PC control screens.
The isolated USB interface is isolated from the user's computer as well as from the HVC-XXXX/QCW-USBunit. This ensures the highest noise immunity even in the harsh industrial environment.

HVC-XXXX/QCW-USB also uses a high speed current sensing device to watch the real load current as well as a drive signal at the same time so that user can monitor the real operating condition and compare with a drive signal.

1.2 DESCRIPTION

The high current/high power High Voltage Switch HVC-XXXX/QCW-USB uses a high frequency zero-current switching power supply to minimize a switching loss and achieve high conversion efficiency in a small body (up to 5KW CW Power with air cooled, and 25KW with water cooled). This zero-current switching technology has been used for Lic's CO2 laser power supply since 1986.

Complete protection circuits:
Unit contains the complete protection circuits to protect the unit against any potential risks. There are total 9 protection circuits installed in the system and these are explained in detail later in this manual.

1). Power Supply Faults.
2). LD-Driver Over Current.
3). LD-Driver Over Voltage.
4). LD-Driver & Power supply Over Temperature.
5). Pulse-Frequency Fault.
6). Pulse-Width Fault (minimum & Maximum).
7). Pulse Duty Fault
8). Product of V.I.T fault (Vd Fault)
9). Interlock.

Accurate, high speed, and high power current sense system:
The load current is sensed with an ultra small inductance and high power resistor that accuracy is +/- 1%. To minimize the inductance, we use the same technology that has been used for our LSP-series high speed LD-Drivers.

50 ohm BNC output is used to monitor the real time output current accurately. The attenuation ratio is 5mV/A-100mV/A depends on the specification selected.

Built in Power Supply:
HVC-XXXX/QCW-USB High Voltage Switch uses a built-in a *high efficient Power Supply.* In QCW mode, the output current is supplied through a huge capacitor bank where the necessary output energy is stored. This capacitor bank is charged and discharged at the speed of an output pulse frequency. The load impedance for the charging power supply is changed from almost short circuit to infinite impedance during this charging process. If the charging power supply is not designed for this type of the load, the power supply may have problems: such as over current trip, taking too long charging time, or broken at the worst case.
Refer to 1.8 CAPACITOR CHARGING POWER SUPPLY for detail.

1.3 SPECIFICATIONS OF HVC-XXXX/QCW

1.3.1 AC INPUT

Three phase/380V/480V/47-63Hz.

1.3.2 OUTPUT POWER

Maximum to 25KW

1.3.3 MAX. OUTPUT VOLTAGE

Up to 30KV (User selectable from 1KV to 30KV)

1.3.4. OUTPUT CURRENT

Up to 500A in QCW mode (User selectable).

1.3.5 OUTPUT POLARITY

Positive (Standard).

1.3.6 OUTPUT RISE TIME

5ns-200ns:	Depends on the unit purchased.

1.3.7 MAXIMUM & MINIMUM PULSE REPETATION RATE

Minimum:	Single Shot, or 0.001Hz
Maximum:	5MHz (depends on the unit purchased)
Steps:	10ns
Accuracy:	5ns + (0.0001xperiod)
Time base:	50MHz, 50PPM crystal oscillator

*Note: In QCW mode, the pulse rate is limited by the average power and the current droop specified.
Refer to 3.1.1 Average Power and Pulse Setting for detail.

1.3.8 MAXIMUM & MINIMUM PULSE WIDTH

Minimum:	10ns (depends on the unit purchased)
Maximum:	1000s (depends on the unit purchased)
Steps:	10ns
Accuracy:	10ns + (0.0001xpulse width)

*Note:
In QCW mode the maximum pulse width is limited by 1). average power specified and 2). current droop specified.
Refer to 3.1.0 Current Droop and 3.1.1 Average Power and Pulse Setting for detail.

1.3.9 PROTECTION CIRCUIT

There are total of 9 fault reasons that the unit ceases the operation. When the protection circuit detects those fault conditions, the unit shuts off instantaneously indicating with FAULT light.

Over Current Protection (1) for internal power supply:
Protects the internal power supply against (1) direct or indirect output short condition, (2) Any electrical disturbances induced by external or internal noises, (3) Overload caused from improper load, or pulse setting.

Over Current Protection (2) for output Switch:
The protection circuit for the output switch ***activates in 100ns***. This response time is required to protect the switch against huge output power (the maximum peak pulse power reaches to 1MW). The load current is however, several hundred ns to several us delay time after the protection circuit is activated.

Over temperature protection:
Detects a base temperature on which main switching devices and other power semiconductors are mounted. When the base temperature reaches to setting level, the protection circuit activates and the unit ceases the operation.

Over load protection:
LNS-XXXX/HP, LNS-XXXX/QCW adjusts its average power automatically when pulse setting changes, and stays always within the pre-determined average power. When, however, the pulse setting exceeds the predetermined average power (by external pulse setting, for example), the over load protection activates to protect the internal power supply against an over load condition.
This over load is calculated as a product of pulse width and pulse frequency.

Pulse Width Protection:
When the setting pulse width, or an external pulse width exceeds a predetermined value, this protection circuit activates.

Pulse Frequency Protection:
When the setting pulse frequency, or an external pulse frequency exceeds a predetermined value, this protection circuit activates.

Vd Value:
When setting Vd value exceeds a calculated value based on presetting pulse conditions, this protection circuit activates. The calculation is based on the product of Vd value & LD current, and Pulse on time. If this fault happens, adjust one of the following values.

1). Reduce Vd value
2). Reduce setting current
3). Reduce pulse width

Interlock Input:
This is an additional safety feature. Unless this input is closed, the unit keeps fault condition.
This input can be used as a remote switch as well and the cable length can be several meters from the unit. This input is isolated with an optical isolator.

Note:

To restart the unit from the fault condition, use RESET signal. Refer to RESET signal at SECTION 1.4.4 for detail.

1.3.10 OPERATING TEMPERATURE

Ambient temperature: +10 to 40C

1.3.11 OUTPUT CONNECTORS/TERMINALS

Main Output: 1) 50ohm BNC located on rear panel, or
2) Direct stripline from rear panel

1.3.12 EXTERNAL PULSE INPUT

BNC 1K Ohm impedance

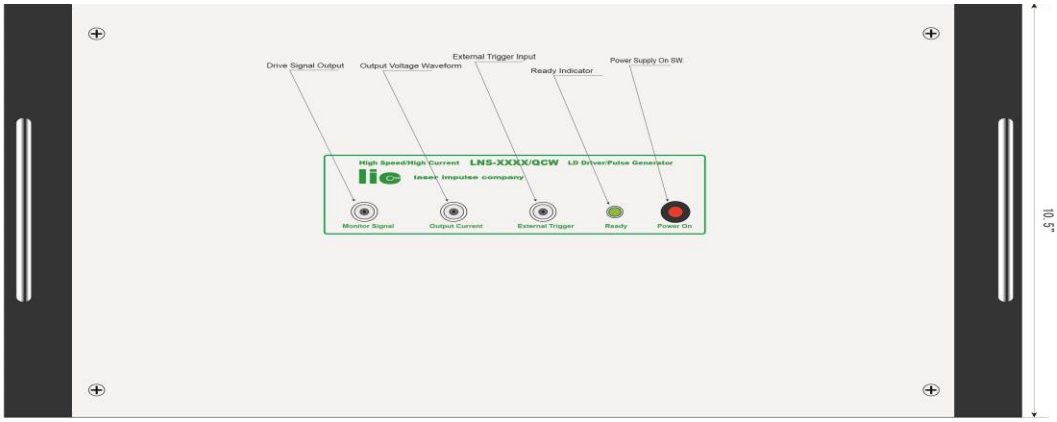
1.3.13 DIMENSIONS (WxDxH inch)

Up to 25KW (water cooled): 17”(W) x 17.5”(D) x 10.5”(H) excluding handle

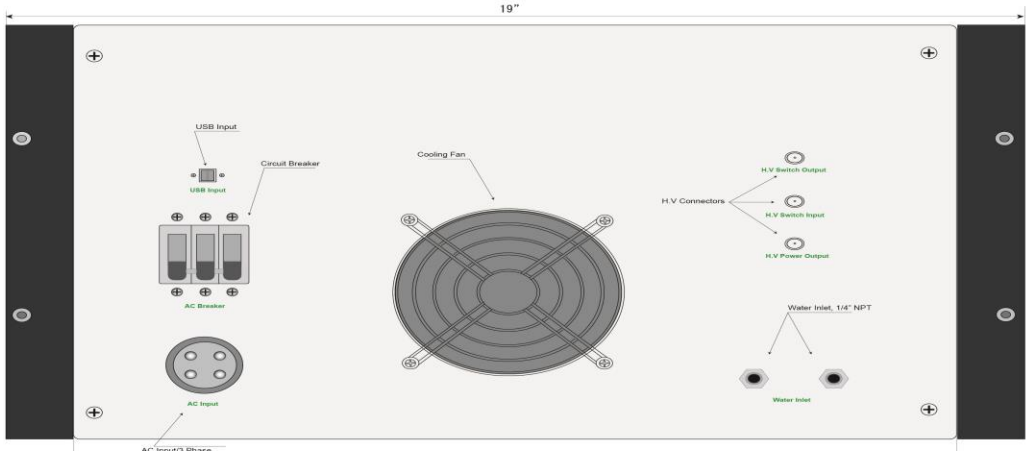
1.3.14 WEIGHT (Lb.)

Up to 25KW CW: 57 lb (Water Cooled)

1.4 FRONT & REAR PANELS



(Front Panel)



(Rear Panel)

(Top View)

1.5 EXPLANATION OF FRONT & REAR PANELS

1.5.1 Ready indicator (Yellow)

Indicates the unit is ready for operation.

1.5.2 Power Supply SW.

When an AC breaker located on a rear panel is turned on, the unit still stays off. Only when Power Supply SW. is pushed, the internal power supply for HVC-XXXX is energized that is indicated by a Ready indicator is lighted.
For safety purpose, the output is disabled even if a mechanical Output On/Off SW. stays on position after when the unit is accidentally powered off, and then turned on. To resume the operation, just push this SW again.

1.5.3 Output Monitor

50 ohm BNC output is used to monitor the real time output current. The attenuation ratio is 5mV/A-10mV/A depends on the specification selected. The load current is sensed with an ultra small inductance and high power resistor of which accuracy is *+/- 1%* and its inductance is far below *0.1nH*. To minimize the inductance, we use the same technology that has been used for our LSP-series high current sensing technology for long time.

Note *): The oscilloscope input have to be terminated with a 50 ohm to receive a correct waveform of the current.

1.5.4 Drive (Monitor) Signal Output

This is the output signal to activate/deactivate the output switch. With this Signal, user can synchronize the load current gate time to user's external device.

1.5.5 External Trigger Input

External pulse condition should not exceed the pulse set that is specified when the unit is ordered. If the pulse set exceeds the predetermined values, the unit ceases the operation indicating Fault condition. This is activated by Pulse Frequency Protection, Pulse Width Protection, and Over Load Protection.
Interface condition is TTL/CMOS, 5V/1Khom.

1.6 Rear Panel

1.6.1 USB Input

USB input is ground-isolated both from a user's PC system and HVC-XXXX/QCW-USB HVC-XXXX control circuit. This ensures for high noise immunity even in harsh industrial environment. The USB speed is USB 2.0 standard.

1.6.2 Cooling fan

Fan speed is controlled by internal device temperature. As the device temperature increases, the fan speed increases.

1.6.3 AC Circuit Breaker

This is used as a power switch as well as an emergency cut off switch. To use the unit, first turn this breaker on. If by some reason the internal safety features do not work, this circuit breaker shut off the AC power from a user's power line.

1.6.3 Output Terminal/Direct Stripline

1) Direct Stripline:

If the output is not 50ohm, there a special made transmission line is used to connect a load to the unit. The stripline is designed for the customer's specific load impedance to carry a high current without destroying the current pulse shape (avoiding the reflective wave caused by the impedance miss-matching). One side of the strip line is just open to the load to connect by soldering/screws.
See 2.3 section for detail.

2) H.V Switch Output

This is the H.V output for a 50ohm BNC. Customer can connect this output to the customer's 50ohm load.

3) H.V Switch Input

This is the H.V switch input for a 50ohm BNC. Customer can use this input to switch customer's H.V output. Usually this input is connected to H.V Power Supply Output with a 50ohm H.V coaxial cable supplied.

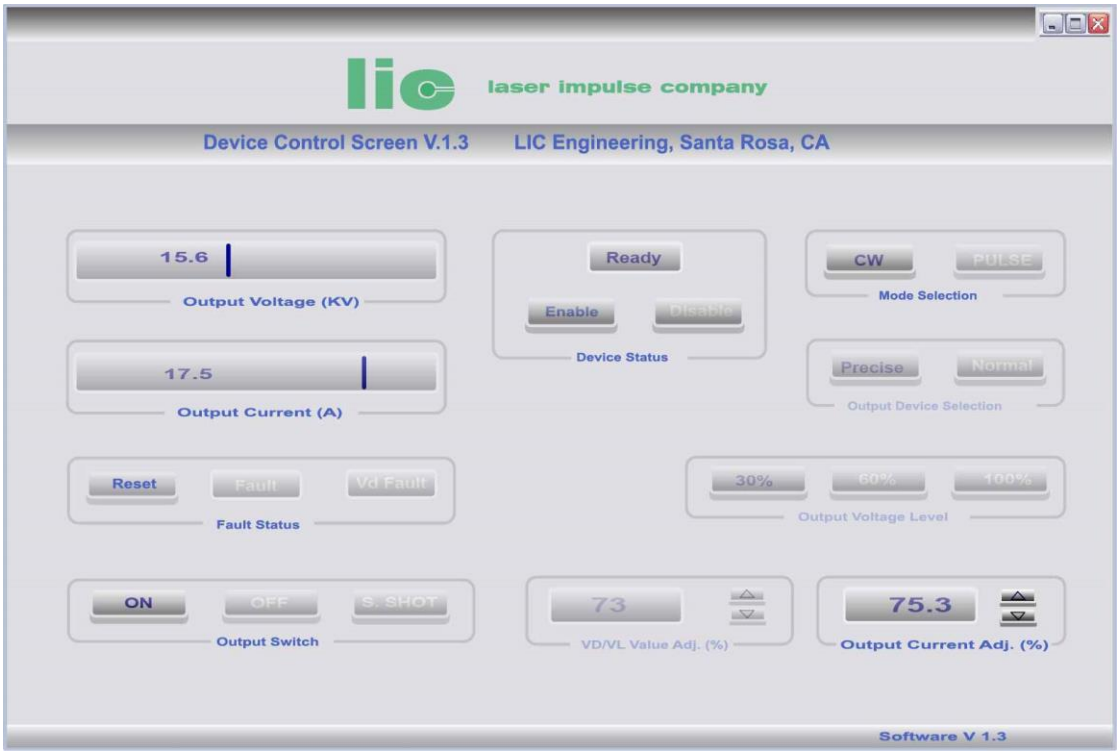
4) H.V Power Supply Output

This is the H.V output from the H.V power supply built in the unit. Usually this output is connected to H.V Switch Input with a 50ohm H.V coaxial cable supplied.

1.6.4 Water Inlet for 25KW model

Water inlet is ¼" NPT connector. Required water flow is 5 liter/minute minimum and the water pressure is 3kg/cm^2 minimum required.

1.7 Control Screen



Control Screen

1.7.1 READY

It indicates when the HVC-XXXX is ready for operation. When the unit is ready, the READY indicator is lighted.
It doesn't come to a ready status only turning AC beaker located on the rear panel. After pressing Power On button, the unit will be ready status in 10-30 seconds.

1.7.2 Enable/Disable

Pressing Enable/Disable button enables/disables the device (energizing /disarms the device).
When the unit is powered on, it automatically turns to Enable mode after Ready comes. To change the following operating mode however, Disable button must be pressed before the change. Otherwise, it can't be changed: A pop up note is displayed saying: "Press Disable button before changing this selection".

Disable required before change:
1). Output Level Selection

1.7.3 Output Device Selection - Precise/Normal Mode

This is a disabled function for HVC-XXXX/USB series models.

1.7.4 Output Level Selection

This is a disabled function for HVC-XXXX/USB series models.

1.7.5 VD/VL Value Selection

This is a disabled function for HVC-XXXX/USB series models.

1.7.6 CW/PULSE

This changes the operating mode either in CW, or Pulse. It can be toggled only when Output Switch is OFF state. If either button is pressed while Output Switch signal is ON, a pop up note is displayed saying: "Turn off Output Switch before changing this button".

When PULSE button is pressed, the control screen goes to a **pulse setting screen** (See section 1.8. Pulse Setting Screen) and a user can set any pulse combinations. If a user set a pulse combination that is not designed for the unit purchased, a FAULT indicator is highlighted.
Refer to FAULT for detail.
When the system starts, the mode is in CW mode and CW indicator is highlighted.

1.7.7 Output Current Adj.

This adjusts the actual output current and a user can set a desired output current by pressing and drag a mouse, or just enter numeral numbers by a keyboard.
This adjustment is a percentage to the maximum output current and reflects directly to the Output Current/Voltage indicators described below.

1.7.8 Output Current Display

The bar graph and numeral numbers in the box show the actual output current flowing to the load. It samples at every micro-seconds in real time to display the actual load current. The current is sensed with a precise & high speed current sensing device.

1.7.9 Output Voltage Display

This shows an actual output voltage of the unit. Whenever a user changes the load current, the output voltage indicator shows the output voltage corresponding to the setting output current. The bar graph and numeral numbers in the box show the actual output voltage**.*1)**

1.7.10 FAULT

It indicates the LD driver is in fault condition. There are many safety features built in the unit to protect the unit against damage and these protection circuits generate FAULT when the fault condition is detected. The fault conditions are as follows:

1). Power Supply Faults.
2). LD-Driver Over Current.
3). LD-Driver Over Voltage.
4). LD-Driver & Power supply Over Temperature.
5). Pulse-Frequency Fault.
6). Pulse-Width Fault (minimum & Maximum).

7). Pulse Duty Fault
8). Product of V.I.T fault (Vd Fault)
9). Interlock.

After removing the fault conditions, press RESET button. If there is no fault condition exists, the unit resumes the operation.

1.7.11 Vd Fault

This is a disabled function for HVC-XXXX/USB series models.

1.7.12 RESET

To reset the unit from the fault condition, this button is pressed. If there is fault condition exists, pressing RESET doesn't recover the unit. First remove the fault condition, and then press RESET.

1.7.13 ON/OFF/S.SHOT Output Switch

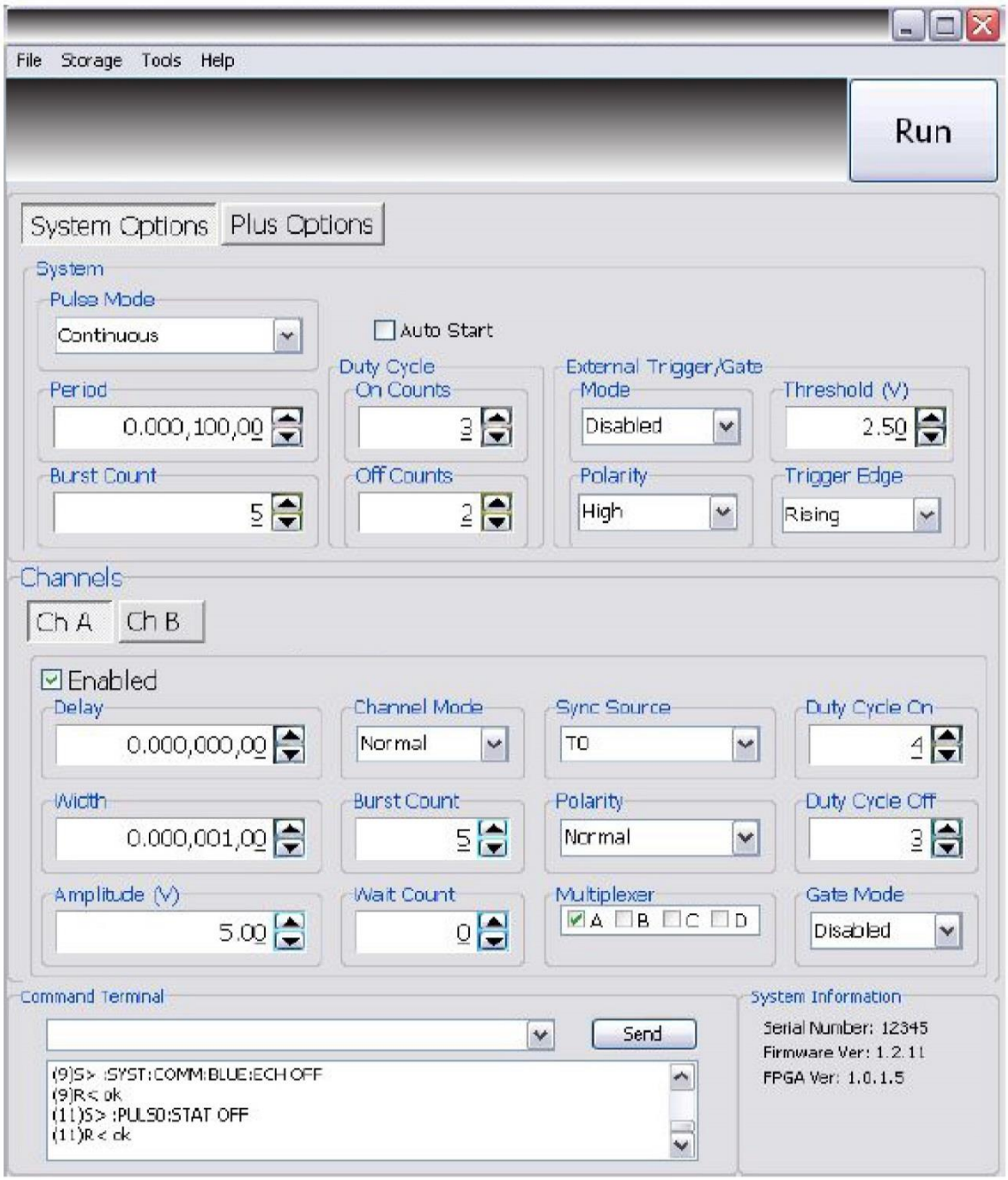
Output Switch OFF required before change:
1). CW/Pulse Selection
2). Output Device Selection
3). Output Voltage Level Selection

This button controls LD driver output both in CW and Pulse mode. Pressing ON enables the LD driver to send the output current. Once ON button is pressed, it stays on until OFF button is pressed.
In Pulse mode, the on time is not synchronized with the setting pulse. To synchronize to the pulse, go to PULSE mode and use Run/Stop button on pulse setting screen, and/or an external trigger. The detail is explained in a separate pulse setting manual.

S.SHOT (Single Shot) enables the output current while a mouse left button is pressed and disables when the mouse button is released. This works both in CW and Pulse mode, but again it is not synchronized with the setting pulse in Pulse mode. To synchronize a single shot to the setting pulse, go to pulse setting screen, and use a single shot available in the screen.

1.8.1 Pulse Setting Screen

The detail of this screen and how to set the pulse combination are explained in a separate manual. Refer to Pulse Setting Manual attached with our products.



Pulse Setting Screen

1.8.2 Pulse Setting Specification

Pulse Board Specifications	**MIN**	**TYP**	**MAX**	**UNIT**
I/O Configuration				
Input	1 Selectable Trigger/Gate Input			
Internal generator				
Rate (T_0 Period)	0.001	-	5,000,000	Hz
Resolution	-	10	-	ns
Accuracy	5ns + (0.0001 x Period)			
T_0 Period Jitter	-	-	500	ps(RMS)
Time Base	100MHz, Low Jitter PLL			
Oscillator	50MHz, 50ppm Crystal Oscillator			
System Modes	Single, Continuous, Burst, Duty Cycle			
Burst Mode	1	-	1,000,000	Pulses
Duty Cycle Mode	1	-	1,000,000	Pulses
Pulse Control Modes	Internal Rate Generator, External Trigger/Gate			

Channel Timing generator				
Pulse Width Range	10n	-	1,000	s
Width Accuracy	10ns + [0.0001 x (width + delay)]			
Width Resolution	-	10	-	ns
Pulse Delay Range	-1,000	-	1,000	s
Delay Accuracy	10ns + (0.0001 x delay)			
Delay Resolution	-	10	-	ns
Jitter (Channel to	-	-	250	ps(RMS)
Multiplexer	Any/all channels may be OR'd to any/all outputs			
Time Base	Same as internal rate generator			
Channel Modes	Single Shot, Normal, Burst, Duty Cycle			
Burst Mode	1	-	1,000,000	Pulses
Duty Cycle Mode	1	-	1,000,000	Pulses
Wait Function	0	-	1,000,000	Pulses
Control Modes	Internally triggered or externally gated. Each channel may be independently set to either mode.			
System External Trigger/Gate Input				
Trigger Input Function	System will generate a *single* T_0 pulse for every external trigger pulse. See "External Input Overview" for more information.			
Trigger Edge	Rising / Falling			
Gate Input Function	External gate input controls the output of the unit			

Gate Input Modes	System Gate (Pulse Inhibit) Channel Gate (Output Inhibit) See External Trigger/Gate section for more information			
Gate Polarity	Active High / Active Low			
Trigger/Gate Input Module				
Threshold	0.2	-	15	V
Max Input Voltage	-	-	30	V
Resolution	-	10	-	mV
Trigger Accuracy	±3% of Threshold Voltage			
Impedance	5.3K ohm + 40pF			
Trigger Rate	DC	-	5	MHz
Trigger Input Jitter	-	-	20	ns(RMS)
Trigger Input Insertion Delay	-	-	150	ns
Trigger Input Minimum Pulse Width	20	-	-	ns
Pulse Inhibit Delay	-	-	150	ns
Output Inhibit Delay	-	-	100	ns

1.8 Built-in POWER SUPPLY

High voltage H.V switch HVC-XXXX/QCW-USB contains a high efficient and powerful capacitor charging power supply. This type of power supply is designed to charge a capacitor load efficiently. It works at full power condition regardless the load is shorted (at the beginning of charging), heavy or light. If a normal DC power supply is used for this purpose, it may create several problems such as:

1). DC power supply may be tripped by an over current fault.
2). There maybe no feedback loop formed between the charging power supply and the capacitor bank, so the accurate and real time setting/adjustment is difficult.
3). It takes a long time to charge up because the charging process is very inefficient.
4). It may need an extra series resistor to avoid an over load condition and this causes a fair amount of heating loss.
5). It may be difficult to decrease the output voltage in short time since the capacitor bank is so huge.

In HVC-XXXX/QCW unit, there is a feedback loop formed between the huge output capacitor bank and the capacitor charging power supply to regulate the output current accurately.
HVC-XXXX/QCW uses the double switching technology that charging and discharging the output voltage efficiently in short time. Combined with the precise current tacking system, user can set the current (increasing and decreasing) precisely regardless the output is in heavy or no load at all.

2.0 INSTALLATION

2.1 GENERAL

After unpacking, general inspection and preliminary checkout procedures should be performed to ensure that the unit is in proper working order. If it is determined that the unit has been damaged, the carrier should be notified immediately. Contact Lic directly:

LIC Engineering
122 Calistoga Rd. Suite 210
Santa Rosa, CA 95409 USA
Tel: (707) 327-2705
email: info@LicEngine.com

2.2 INSPECTION

Check for damage incurred during shipment as follows:
1) Inspect unit case for cracking, bending, and other obvious signs of damage.

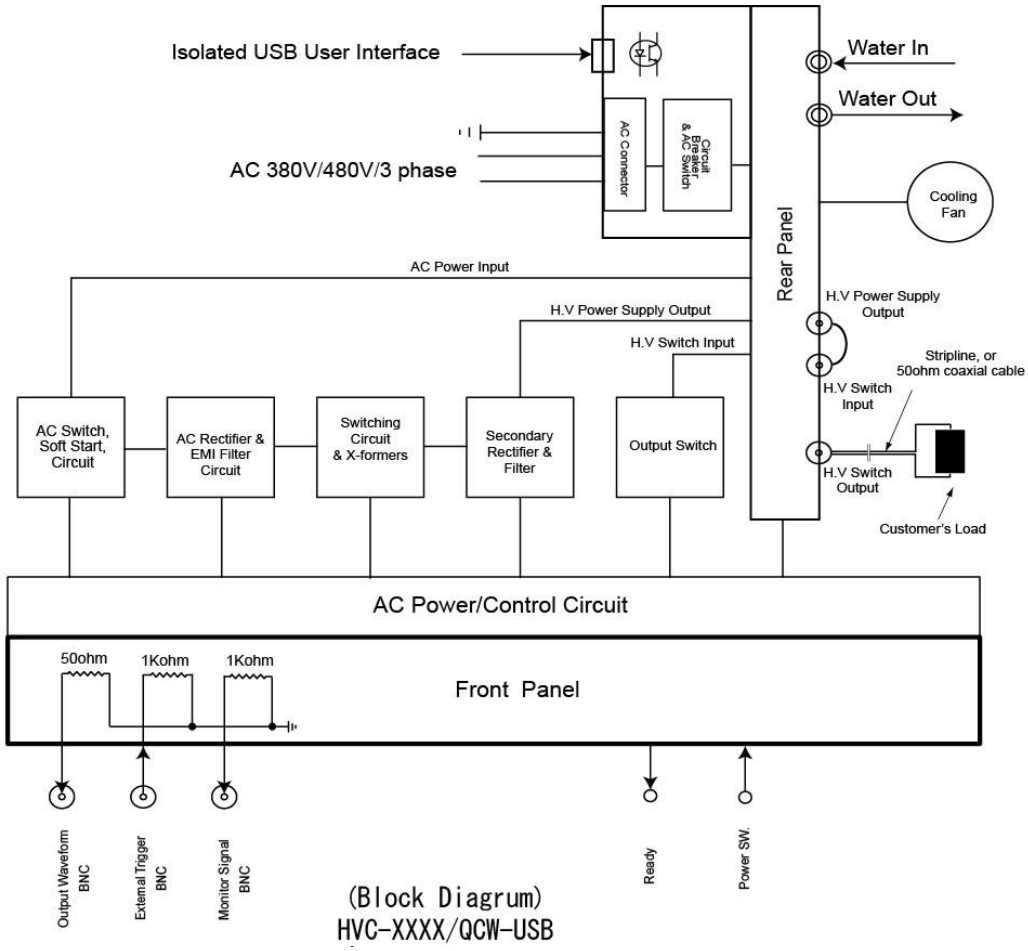
2.3 OUTPUT CONNECTIONS

Connect the stripline/coaxial cable to the load using a soldering iron, or screws.

The physical distance between the load and tip of the stripline/coaxial cable must be as short as possible.
Do not use any extra wires to connect between the stripline/coaxial cable and a load.

USING SUCH EXTRA WIRES WILL INCREASE A RISE AND FALL TIME DRAMATICALLY.

2.3 Block Diagram of the unit



(Block Diagrum)
HVC-XXXX/QCW-USB

2.4 AC LINE CONNECTION

Confirm AC GND (Earth GND) is connected to the power supply GND. Confirm that AC line voltage is proper for the unit ordered, and AC power to the unit is still off. The standard center voltages are:
380V/three phase, +/- 10%

3.0 OPERATION

3.1 PREPARERATION & PRECAUTION

3.1.1 CURRENT DROOP

In QCW mode, the output current decays by the time for the given pulse width. The percentage of this current deduction is decided by A). The value of the capacitor bank, B). Pulse width, and C). The load impedance.

The formula is d=Pwx100/CxZd (%),
where d=current droop (%), Pw=Pulse width(seconds), and Zd=load impedance

3.1.2 AVERAGE POWER AND PULSE SETTING.

In QCW mode, both Pulse Width and Pulse Rate are limited by an average power of the unit.
Assume the ordered unit is 5KW average power, the maximum pulse width is 5ms, load voltage is 1KV, and the maximum load current is 100A, then the maximum pulse rate of this unit is 10Hz.

$P\_average=5KW=10^{3}(A)x100(V)x5x10^{-3}(s)xF(Hz)$, so
$F=5x10^{3}/10^{3}(A)x100(V)x5x10^{-3}(s)=10Hz$.

Even if user attempt to increase the pulse rate, the unit automatically decrease the pulse rate to limit the average power within the power ordered to protect the capacitor charging power supply of the unit.
Or, If user attempt to increase the pre-determined pulse width, the unit becomes Fault condition.

3.1.4 PRECAUTION

1). Do not shut off AC line voltage while the power supply is running. This is not a good manner from the safety point of view.
2). Confirm that Cur./Vol. Adj. is set to adequate level before turning Output SW. ON
3) Don't change Internal/External SW. while the unit is running.
4) Don't change Rise Time selection while the unit is running.

3.2 STARTING IN CW/PULSE MODE

3.2.1 CW OPERATION

STEP 1. TURN AC CIRCUIT BREAKER ON AT BACK PANEL

STEP 2. PRESS POWER ON BUTTON IN FRONT PANEL
Confirm READY will come on in 10-30 seconds.

STEP 3. ADJUST LOAD CURRENT
Adjust Output Current on the control screen at the desired value. It shows percentage to a full current value.

STEP 4. TURN OUTPUT ON/OFF SW. ON
For QCW unit, the setting voltage is slightly changed after the load current is flowed. Adjust the current, if necessary.
The output voltage indicator shows the actual voltage.

3.2.2 PUSE OPERATION USING INTERNAL PULSE GENERATOR

STEP 1. TURN AC CIRCUIT BREAKER ON AT BACK PANEL

STEP 2. PRESS POWER ON BUTTON ON FRONT PANEL
Confirm READY will come on in 10-30 seconds.

STEP 3. PRESS PULSE BUTTON ON THE CONTROL SCREEN
The control screen moves to a Pulse Setting Screen.

STEP 4. SET DESIRED PULSE COMBINATION ON THE SCREEN
The detail of this screen and how to set the pulse combination are explained in a separate manual. Refer to Pulse Setting Manual attached with the product.

STEP 5. ADJUST LOAD CURRENT
Adjust Output Current on the control screen at the desired value. It shows percentage to a full current value.

STEP 6. TURN OUTPUT ON/OFF SW. ON
For QCW unit, the setting voltage is slightly changed after the load current is flowed. Adjust the current, if necessary.
The output voltage indicator shows the actual voltage.

3.2.3 PUSE OPERATION USING EXTERNAL TRIGGER

STEP 1. TURN AC CIRCUIT BREAKER ON AT BACK PANEL

STEP 2. PRESS POWER ON BUTTON ON FRONT PANEL
Confirm READY will come on in 10-30 seconds.

STEP 3. PRESS PULSE BUTTON ON THE CONTROL SCREEN
The control screen moves to a Pulse Setting Screen.

STEP 4. SET DESIRED PULSE COMBINATION ON THE SCREEN
The detail of this screen and how to set the pulse combination are explained in a separate manual. Refer to Pulse Setting Manual attached with the product.

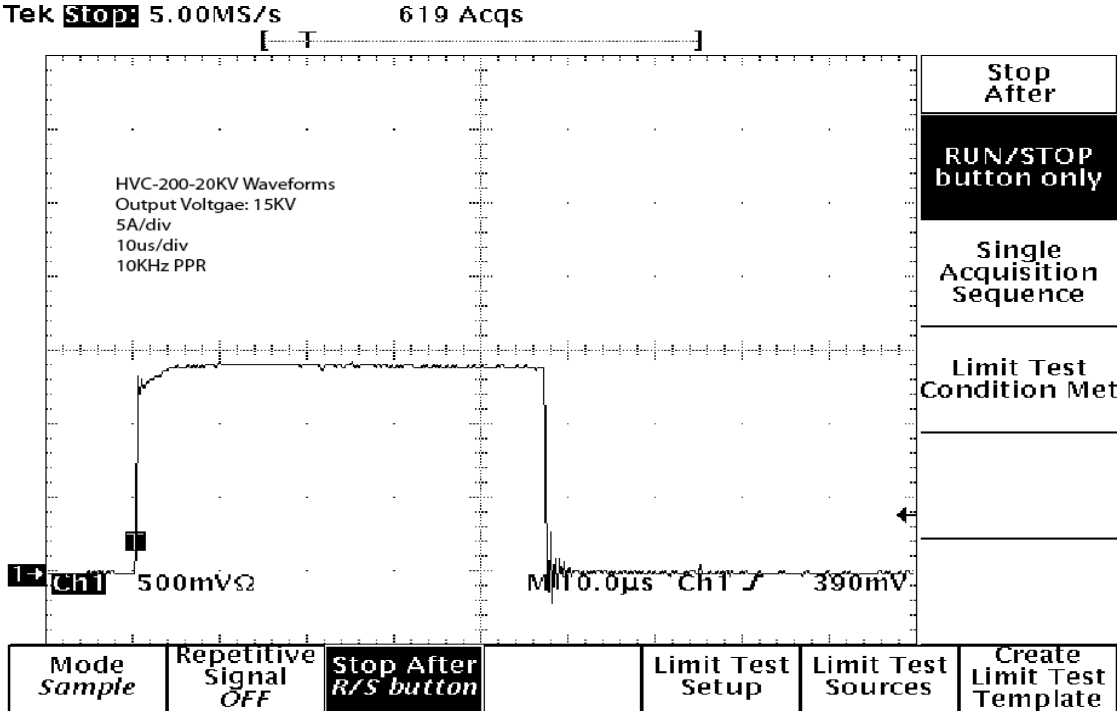
STEP 5. CONNECT EXTERNAL SIGNAL TO BNC ON FRONT PANEL
The detail of this screen and how to use the external signal is explained in a separate manual. Refer to Pulse Setting Manual attached with the product.

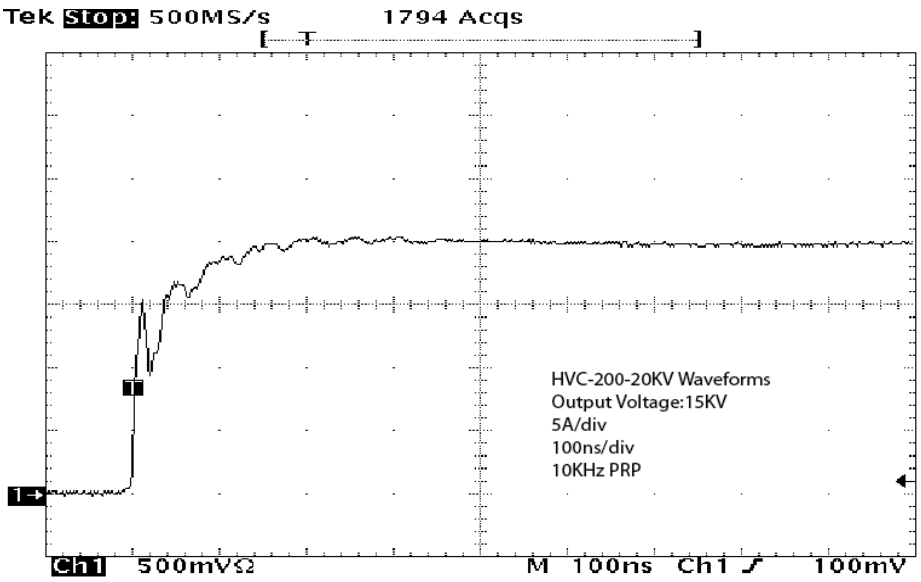
STEP 6. ADJUST LOAD CURRENT
Adjust Output Current on the control screen at the desired value. It shows percentage to a full current value.

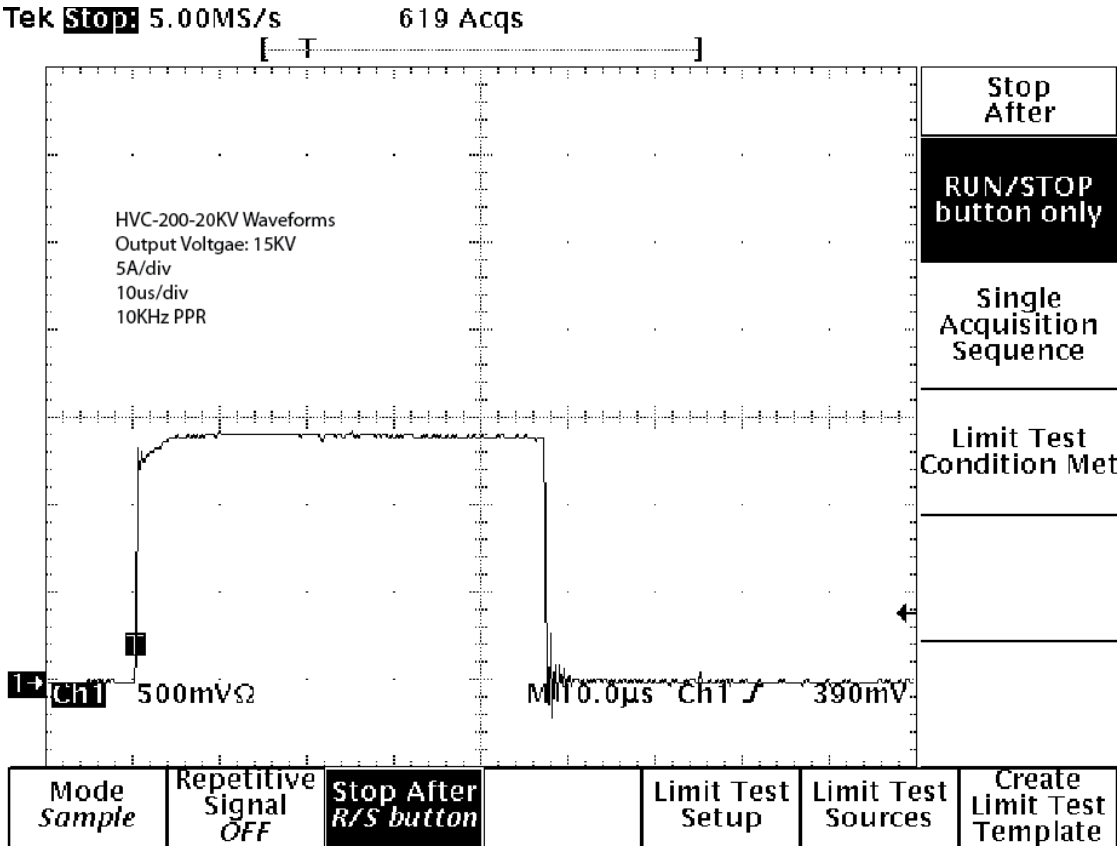
STEP 7. TURN OUTPUT ON/OFF SW. ON
For QCW unit, the setting voltage is slightly changed after the load current is flowed. Adjust the current, if necessary.
The output voltage indicator shows the actual voltage.

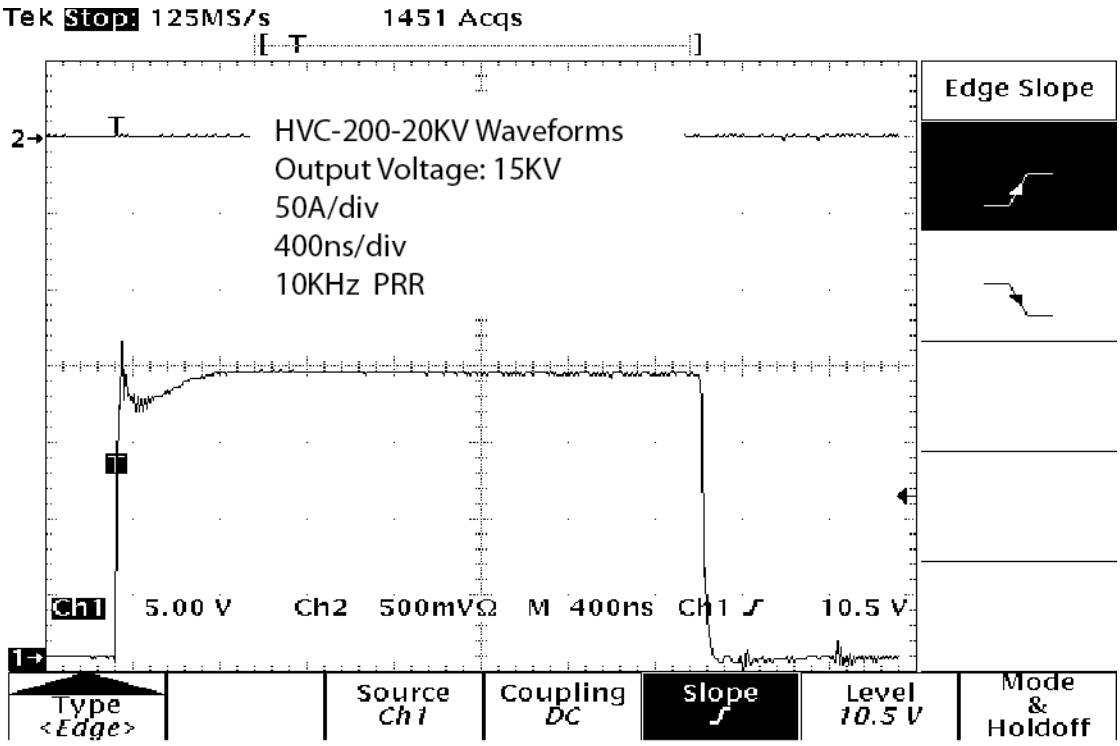
3.3 SAMPLE WAVEFORMS

Note: If user want to see other waveforms, please contact to factory. We have many waveforms stocked for each product.




Tek Stop: 500MS/s 1794 Acqs
HVC-200-20KV Waveforms
Output Voltage:15KV
5A/div
100ns/div
10KHz PRP
Ch1 500mVΩ
M 100ns Ch1 ƒ 100mV


Tek Stop: 5.00MS/s 619 Acqs
HVC-200-20KV Waveforms
Output Voltgae: 15KV
5A/div
10us/div
10KHz PPR
Ch1 500mVΩ
M 10.0µs Ch1 ƒ 390mV
Stop After
RUN/STOP button only
Single Acquisition Sequence
Limit Test Condition Met
Mode Sample
Repetitive Signal OFF
Stop After R/S button
Limit Test Setup
Limit Test Sources
Create Limit Test Template


Tek Stop: 125MS/s 1451 Acqs
HVC-200-20KV Waveforms
Output Voltage: 15KV
50A/div
400ns/div
10KHz PRR
Edge Slope
Ch1 5.00 V Ch2 500mVΩ M 400ns Ch1 ∫ 10.5 V
Type <Edge>
Source Ch1
Coupling DC
Slope ∫
Level 10.5 V
Mode & Holdoff

4.0 MAINTENANCE

4.1 GENERAL

Lic's laser power supply contains potentiometers that are set at Lic's factory. Do not try to adjust these potentiometers. ***There are no user-serviceable parts in Lic's products.***
IF USER ATTEMPTS TO OPEN, ADJUST, MODIFY, OR REPAIR THE PRODUCTS, THEN LIC ENGINEERING CAN NO LONGER BE RESPONSIBLE FOR THE SAFE OPERATION OF THE UNIT, AND THE WARRANTY SHALL BE IMMEDIATELY VOID.

4.2 CAUTION

1). DO NOT ALLOW THE UNIT TO BE IN OPEN CIRCUIT.
2). DO NOT ALLOW THE UNIT TO BE SHORT CIRCUIT.
3). DO NOT ATTEMPT TO OPEN, MODIFY OR ADJUST ANY PARTS OF THE POWER SUPPLY.
4). DO NOT MECHANICALLY SHOCK.
5). KEEP WATER OR MOISTURE FROM THE UNIT EXCEPT IN-/-OUTLET OF THE UNIT.
6). DO NOT MISUSE, OVERUSE, OR ABUSE THE UNIT.

4.3 TROUBLE SHOOTING

4.3.1 NOT READY SIGNAL COMES ON

CAUTION:
IF READY DOES NOT ON APPEAR WITHIN 60 SECONDS AFTER TURNING ON AC POWER OF THE UNIT, SWITCH AC POWER OFF IMMEDIATELY TO AVOID DESTROYING INTERNAL COMPONENTS.

1). Confirm that LASER and POWER signals stay at ground level.
2). Check all signal conditions including DC power line.

4.3.2 FAULT COMES ON

1). Check if Cur. Adj. is not set at the maximum. In certain case the first edge of the peak current is detected by an over current protection circuit.

4.3.3 OUTPUT DOES NOT APPEAR

1). Confirm READY is active, On/Off SW. is on, and Cur. Adj. signal has certain voltage levels.

2). Check Remote Interlock terminal (back side of the unit) is shorted.

4.3.4 ODORS OR UNUSUAL SOUNDS

If odors or unusual sounds are detected, turn AC Power off immediately. Contact Lic.

5.0 WARRANTY

LIC Engineering warrants its products against all defects in materials and workmanship to the original using purchaser for a period of one year from the date of delivery to the original purchaser.
During this period, LIC Engineering will repair or replace its products if defective free of charge. This warranty applies only when the products are properly installed, maintained and used for the intended purpose, and only to the original purchase/user of the products, and only so long as the products are used in the country to which it was originally shipped by LIC Engineering, or by an authorized distributor.
Any shipping charge incurred shall be paid by the purchaser/user of the products.

This warranty is null and void if the user attempts to service the products (other than performing the maintenance described in the Instruction Manual), or if service is performed by people who are not trained and authorized to do so by LIC Engineering.

THE EXPRESS WARRANTY ABOVE IS THE SOLE WARRANTY OBLIGATION OF LIC ENGINEERING AND THE REMEDY PROVIDED ABOVE IS IN LIEU OF GUARANTEES, OR WARRANTIES--ORAL OR WRITTEN, EXPRESS OR IMPLIED-- INCLUDING WITHOUT LIMITATION WARRANTY OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.
LIC ENGINEERING HAS NO LIABILITY WHATSOEVER FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGE ARISING OUT OF ANY DEFECT, IMPROPER USE, OR UNAUTHORIZED SERVICE OR REPAIR.

5.2 RETURN OF THE UNITS

Prior to return of a unit, or any portion thereof, LIC Engineering must be consulted to avoid unnecessary shipping.
If return of the units is deemed necessary, a Return Authorization Number "RAN" will be assigned. This number must be recorded on the outside of the shipping container.

Contact:

LIC Engineering
122 Calistoga Rd. Suite 210
Santa Rosa, CA, USA
Tel: (707) 327-2705
email: info@LicEngine.com