applied acoustics

underwater technology

CSP-SNv 1250 / 2400
Capacitor Charging Unit
Operation Manual

European Quality Assurance
UKAS MANAGEMENT SYSTEMS
047
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ISO9001:2015

Revision History

Issue	Change No.	Reason for change	Date
3	2542	CSP-SNv 2400 power settings updated.	29/07/21
2	2504	Appendix C Q.C. Log Format updated.	19/04/21
1	2488	Sections 1.5 Settings, 1.5 Download Log & Specifications updated. CSP-SNv 2400 added. Production Issue.	17/02/21
C	-	Appendix D added	11/11/20
B	2391	Appendix C added	15/07/20
A	-	First Issue	16/04/19

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modulus technology ltd carries out all technical support, servicing and repairs. If you have any technical issues with our products please contact the modulus technology team:

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Applied Acoustic Engineering Ltd has made every effort to ensure that the information contained in this manual is correct at time of print. However our policy of continual product improvement means that we cannot assume liability for any errors which may occur.

These written instructions must be followed fully for reliable and safe operation of the equipment that this manual refers to. Applied Acoustic Engineering Ltd cannot be held responsible for any issues arising from the improper use or maintenance of equipment referred to in this manual or failure of the operator to adhere to the instructions laid out in this manual. The user must be familiar with the contents of this manual before use or operation.

WARNING

THIS EQUIPMENT CONTAINS LETHAL VOLTAGES, AND MUST BE EARTHED AT ALL TIMES.

ENSURE ADEQUATE SAFETY PROCEDURES ARE EMPLOYED.

Section 1 - OPERATIONAL

1.1. Environmental Considerations

Seismic Sound Sources and Marine Life

Although not proven, there is concern in some quarters that marine mammals may be harmed or their behaviour changed by seismic activity. The sound pulses from sparkers and boomers is much lower in amplitude and higher in frequency (so it will travel less far) than air guns. However it makes sense that a precautionary approach to emitting sounds in the whales and dolphins' natural habitat should be observed.

The CSP energy sources described in this manual have the ability to "soft-start" and increase the energy emitted in the water slowly over time and this technique will give any marine mammals nearby the opportunity to escape before maximum signal amplitude is reached. It will also give them a chance to get used to the noise if they choose to stay (!) rather than being subjected to a sudden shock of a full power seismic signal.

The procedure is quite simple:-

By using a slow repetition rate – say at 1 pulse per 15 seconds and by using the "Auto" charge rate, the energy will slowly increase over the course of several minutes. Once full power has been achieved, the repetition rate can then be slowly increased until the rate desired for the survey has been achieved.

Another factor to consider is to ensure that the start of any survey line is not in such a location that any cetacean is trapped by the vessel and the noise, for example in a small harbour. In such an instance, the survey should start in such a place that any cetacean in the vicinity has a clear and rapid means of escape into open water and away from any unnatural noise source. Further details and advice can be obtained from the following web site:- http://www.jncc.gov.uk/pdf/Seismic_survey_guidelines_200404.pdf. This web site refers to UK waters and relates to air guns as the sound source (in many ways different to a sparker or boomer), but should serve as a useful guide nonetheless.

1.2. Introduction

The CSP-SNv is an evolution of the CSP-S range of seismic power supplies. The CSP-SNv has a high voltage charger rated at 4000 joules per second (peak), and can supply up to 1250 or 2400 joules of energy per shot into the seismic sound source, for example Dura-Spark. The CSP-SNv incorporates microprocessor control and configuration for greater configuration flexibility and reliability whilst retaining a fail-safe logic design.

The CSP-SNv is built on the proven high voltage technology of the industry leading CSP range of power supplies adding to the standard safety systems and operational functions found across the entire range of CSP energy sources.

The CSP-SNv is configured by an intuitive menu driven app, when operational the LCD provides real time system status for operational safety and monitoring.

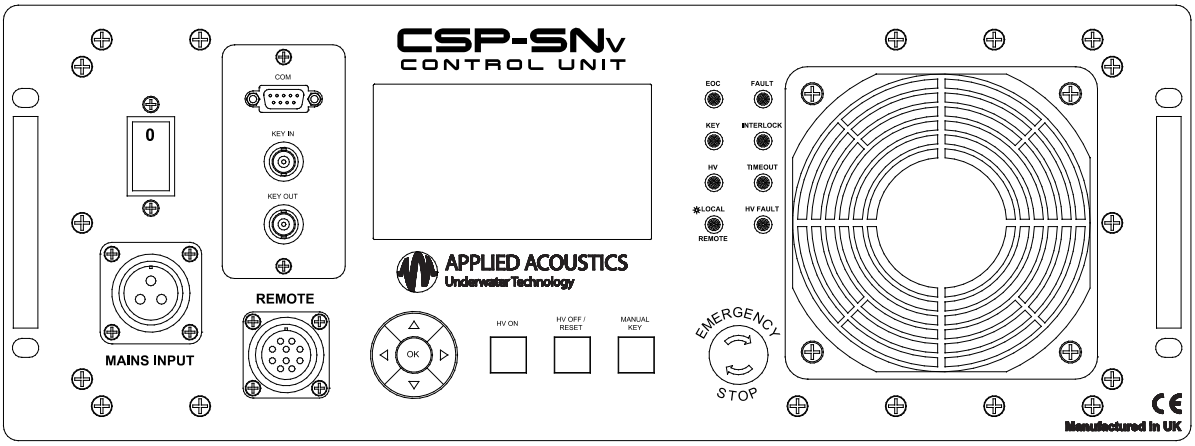
The CSP-SNv feature a selectable soft-start 'power save' setting; AVIP (Automatic Variable Input Power) which allows the units to be operated from reduced generator sizes when operating at low output powers. Traditional high voltage power supplies (bang boxes) will charge the energy storage capacitors at a fixed high rate for example at 4000J per second even when the average energy drawn from the capacitors is less; a typical example may be 100J at 3 pps (300J). This results in a rapid capacitor charge rate for <30mS followed by nothing, until the next discharge / charge cycle. This charge / no charge operation can often result in generator hunting as the load changes, and may mean that a larger generator is needed than would be the case if the power requirement was averaged over time. By reducing the peak charge rate, the generator hunting is all but eliminated, and a smaller capacity generator is required. The AVIP will automatically adjust charge rate from 20% to 95% of specification, thus lowering the peak charge rate to just 300J / second compared to bursts of 4000J / second.

The CSP-SNv allows the user to effectively 'tune' the sound source to operate at a lower frequency by lowering the operating voltage and increasing the capacitance to supply the correct energy to the sound source. This may be effective in certain instances where more penetration is required.

The CSP-SNv monitor the output of the system for open circuit fault conditions and over current fault conditions, limited to approx. 10,000A.

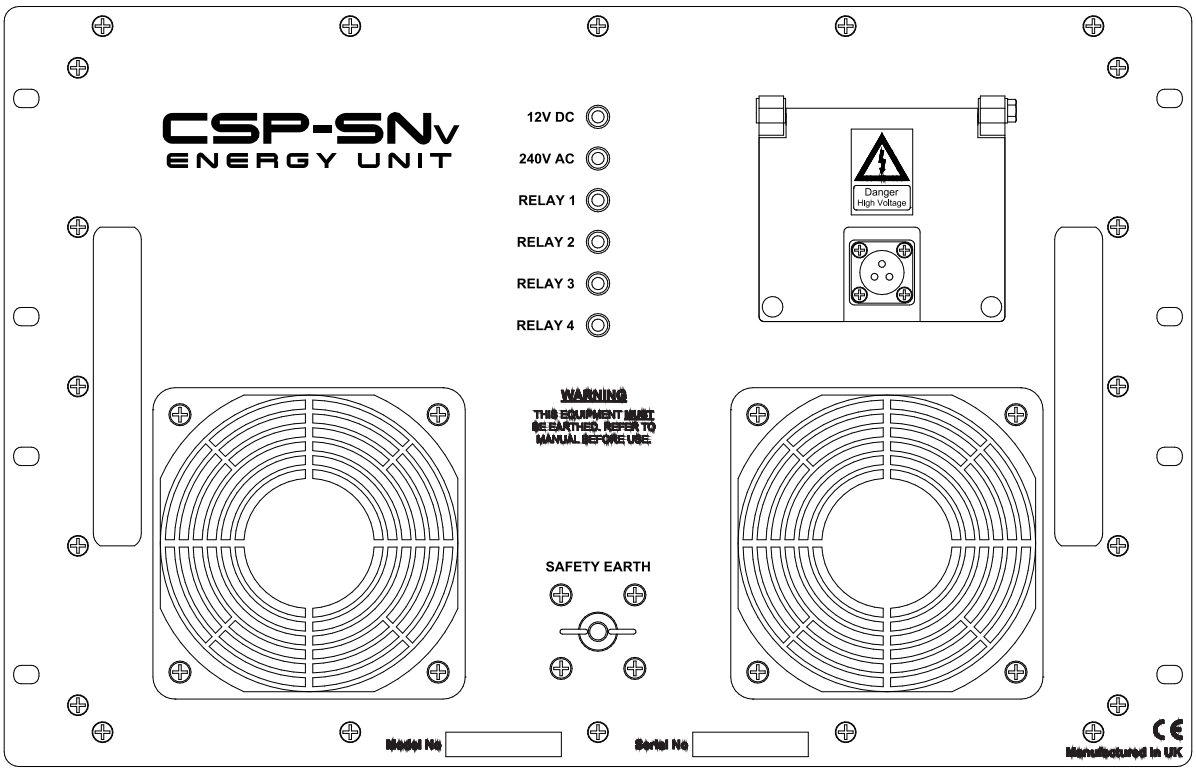
The CSP-SNv is a 2-module system comprised of:

Control Unit



- System interface, control & monitoring
- HV Charger
- System mains input

Energy Unit



- Relay-switchable HV capacitor bank
- HV energy switch
- Output connector

1.3. Installation

Siting the CSP-SNv

The CSP-SNv delivers high energy, high voltage pulses, yet still emits minimal electrical emissions, and so can carry the CE mark.

The CE marking ensure that the CSP-SNv can be sited next to sensitive electronic equipment which carry their own CE marking (for susceptibility to emissions) and will be unlikely to cause them interference. However it is often more convenient to locate the CSP-SNv nearer to the back deck and the deployment area so that the high voltage 'output' cable run is minimised.

As high voltages are present, the CSP-SNv must be located away from water spray and condensation, in an environment which is not allowed to become too hot. Care should be taken to allow safe and easy access, and that high voltage cables are out of harm's way. It should also be possible to switch off the unit quickly without having to reach over it!

Ventilation should also be present. All units draw air in from the rear and exhaust air from the front. For operation in high ambient temperatures, the rear cover of the transit case should be removed to allow a good air flow. If condensation is allowed to develop serious damage may occur. Good room ventilation should be ensured, with no sudden change in temperature (i.e. bringing the unit into a warm room from a cold area) and allow the fans to operate for 10 - 15 minutes before switching on the high voltage.

The CSP-SNv Unit will normally be supplied from the factory in a 'Hardigg' transit case. As is the case with all electronic equipment, care should be exercised in handling. For maximum airflow in high ambient temperatures it is recommended that the anti-vibration housing rear panel be removed. The CSP-SNv should be positioned on its base in a dry ventilated area. Airflow for cooling is from back-to-front of the unit; there must be at least 50-60mm clear room from the rear panel to any obstruction. If the unit is to be operated in very warm ambient temperature (25°C or above), for optimum performance an air conditioned environment is strongly advised. If the unit overheats, it will switch OFF for a few minutes until it is cool.

Although the unit produces minimal interference, and carries a CE mark, it is often good practice to put the CSP-SNv away from the navigation and survey equipment and somewhere where cabling to the sound source can be run conveniently and safely. It is this cabling which is the most common source of electrical interference.

EARTHING - FURTHER REMINDER

THIS UNIT MUST BE EARTHED / GROUNDED BEFORE ANY POWER IS APPLIED. FAILURE TO DO SO MAY REPRESENT A SEVERE HAZARD TO BOTH EQUIPMENT AND PERSONNEL.

The front of the CSP-SNv must be grounded to the ship's ground system. This is achieved by attaching a short length of thick wire or earth braid from the CSP-SNv front panel earth stud, to an appropriate earthing point on the vessel. If a suitable earth cannot be found, the CSP-SNv earth stud should be connected directly to the water using an adequate length of heavy wire, with the insulation removed from the submerged end in the water. A weight will also be necessary to keep the wire submerged when the vessel is underway.

The CSP-SNv range of Capacitor Discharge PSUs are compact and easy to operate. However, the units still generate lethal voltages, and the operators should make themselves aware of all necessary safety procedures. The equipment is designed so that there is no need for the operator to go inside for anything, except major repairs. We cannot be liable for any consequences should the units be opened. Health and Safety guidelines and our own Safety Policy strongly suggest that factory training is received before opening the top cover.

1.4 Connections and Indicators

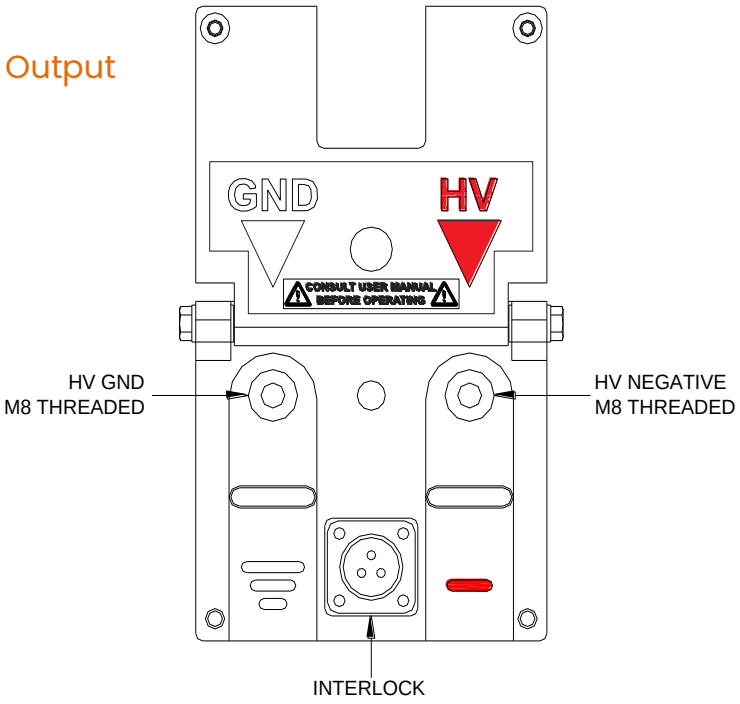
Safety Earth

The CSP-SNv MUST be earthed. The M8 earth bolt on the front panel should be connected to the vessel earth by a heavy gauge wire or cable. Typically 25mm² or greater. On larger ships, earth is usually a steel bulkhead, but for smaller fibre glass / wooden vessels a sea earth is necessary.

A sea earth can be constructed from a 25 mm^2 or larger copper cable with 1 – 2 metres of insulation stripped off with all the exposed copper conductor in the water. A weight will be required to ensure that the sea earth cable is in the water at all times during towing activity even during heavy roll.

It is recommended that earth arrangements are checked regularly as corrosion or abrasion (or metal cutting gear!) can cause damage which may result in the equipment becoming unsafe from having an ineffective earth.

Transducer: HV Output



The 2-pin proprietary high voltage and current terminal connector, is designed to be provide a safe electromechanical connection from the CSP Power supply to the HV Junction Box. The terminal connections are proof tested to 6000 volts and can operate with current pulses up to 10,000 amps. The second connector provides the safety interlock to the HV Junction Box.

The output connector is fitted with automatic guards to prevent operators from handling the high voltage terminals when the cover is secured. When the cover is lifted for access to the terminals a 2 stage electrical and mechanical interlock protects the user disabling the high voltage and placing a shorting link across the terminals.

Ensure CSP-SNv is switched off and VAC isolated before removing HV Output Connector Cover.

Ensure High Voltage terminals are clean and free of debris before connection.
Ensure High Voltage terminals are tight using a M13 socket / ring spanner.

Connect Red HV cable from junction box to the terminal marked HV and the black cable to GND.

Mains Input: Line Voltage Connection

Mains input is connected by the 3-Pin Amphenol on the left of the front panel. Nominal input voltage is 230VAC 45-65 Hz. The wiring to this connector is as follows:-

A	Ground / Earth
B	Neutral
C	Live

A mains supply cable will be supplied from the factory with the following colour coding:-

Green/Yellow	Earth
Blue	Neutral
Brown	Live

The operator must ensure that the AC supply is capable of supplying sufficient energy to power the CSP-SNv unit. Although the unit will operate from most generators of 5kVA, the quality and regulation vary considerably from make to make and how well they have been maintained.
A voltage stabiliser is not necessary as any reasonable variation of the AC supply will not affect the output voltage (hence power) unlike older designs.

NB Some older 'inverter' type generators do not work well with the CSP-SNv.

Typical Currents

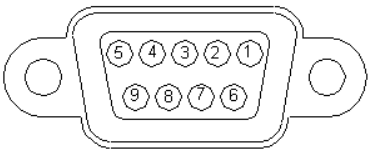
At 2800J at 1 pps (AVIP out of circuit); Non PFC charger, the following currents apply:-

Voltage	Peak Current	Average Current
240 VAC 50 Hz	40A	18A

(At 60 Hz, the peak currents are slightly smaller)
To see clearly the effect of the AVIP board the following measurements are typical:-
240 VAC at 50 Hz supply. 100J at 1 pps output power

	Peak Current	Average Current
AVIP IN	2.58A	1.06A
AVIP OUT	9.51A	1.11A

COM Serial Connector



2 Receive Data (RXD)
3 Transmit Data (TXD)
5 GND

Allows operator to update control firmware. Refer Appendix A.

REMOTE Socket

Allows operator to remotely control CSP-SNv.

KEY IN Input BNC

The Key In Input is connected via a BNC connector. The unit can be configured to key on a positive edge or negative key pulse trigger. The input range is 5 - 12 volts, the interface is opto-isolated to 10KV. A contact closure can be interfaced by selecting negative edge trigger mode.

KEY OUT Output BNC

The Key Out signal is available in internal and external key modes, key out is a synch pulse for the time break signal for the discharge of the CSP-SNv.

The unit can be configured to be internal or external key operation. When internal mode is selected the key out pulse is available from the Key Out BNC connector.

HV OFF / RESET Switch

This button operates as the HV OFF button and is an indicator of the HV Status. When illuminated the HV is OFF, when HV is ON press HV OFF to switch OFF.

The HV OFF / RESET also operates as a fault clearance / system reset, press to clear any reported fault modes upon power up or interlock shutdown. Note if fault persists the unit will continue to report fault status. Any faults must be cleared to allow HV operation.

HV ON Switch

Switches in capacitors and HV PSU, (note delays on switching), switch illuminates when the high voltage is switched on.

Press and Hold HV ON for 3 Seconds to enable High Voltage

MANUAL KEY Switch

Triggers the CSP unit when Manual Key mode is selected. MANUAL KEY switch indicator will flash briefly on key press.

Manual Key Mode must be selected to active manual fire mode.

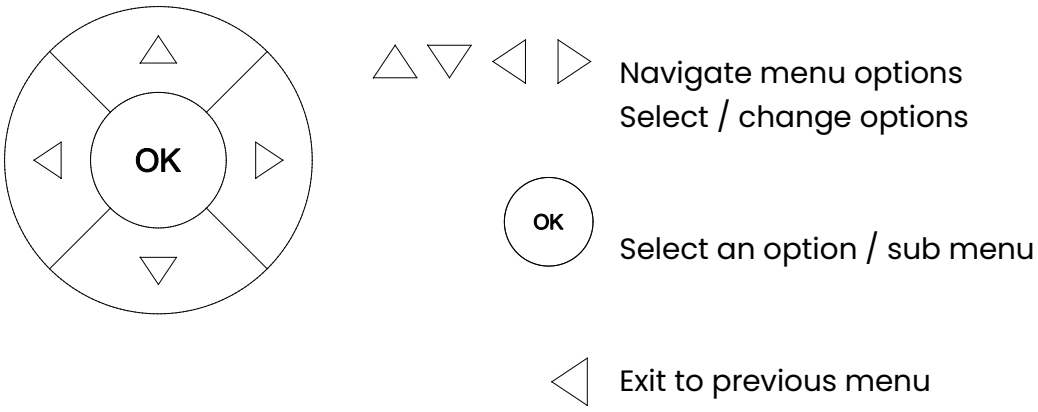
MAINS POWER Switch

Double-pole switch that also acts as an over-current circuit breaker. It is situated above the mains input connector. The switch has standard O I positions.

EMERGENCY STOP switch

In the event of an emergency the unit can be shut down. This switch shuts off the control logic of the charger thus disabling the system. Rotate to reset.

KEY PAD



EOC (End Of Charge) Indicator

The EOC LED is illuminated when the storage capacitors have reached their potential voltage (~2.5 to 4 kV). In this way the operator can see if the unit is being run faster than the charger can cope with. If the operator notices loss of data on the recording system, it may mean the CSP-SNv is firing too quickly, not allowing the capacitors to charge to their full potential. Slowing the repetition rate down until the EOC LED flashes will ensure the appropriate voltage is reached across the storage capacitors, also the correct energy is being discharged in the sound source. The LCD operation screen displays a histogram of the EOC level for monitoring.

KEY Indicator

Synchronised to Key Out.

HV Indicator

Indicates HV is enabled on system

Local / Remote Indicator

LOCAL Operation indicated by LED ON.
REMOTE Operation indicated by LED OFF.

FAULT Indicator

It will illuminate during internal fault modes, see LCD display for fault identification.
You will need to press RESET once the fault condition has been cured.

INTERLOCK Indicator

Illuminated if an interlock condition is detected, please see main display for details of interlock. You will need to press RESET once the interlock fault condition has been cleared.

TIME OUT Indicator

For safety, the HV is switched OFF after a user selectable period without a key pulse present. This also helps preserve the capacitors, as all pulse discharge capacitors are not designed to sit powered up indefinitely.

HV FAULT Indicator

Indicates an HV Output over-current, open-circuit condition or HV charger module fault.

Rear Panel Fuses

The rear panel contains 3 fuse holders, and these are the only things we recommend the operator checks if he has not received factory training. The fuses are rated as follows:-

F1	3A Antisurge 1¼"	(240V)
F2	250mA Antisurge 1¼"	(240V)
F3	3A Antisurge 1¼"	(240V)

F1 Protects 12v power supply
F2 Protects the interlock board
F3 Protects the line voltage powering the high voltage relays and the front panel fans.

Fan Filters

The rear panels of the units have 2 fan filters for the cooling air intake. These filters should be periodically cleaned to ensure maximum air flow. This can be done with a small stiff brush.

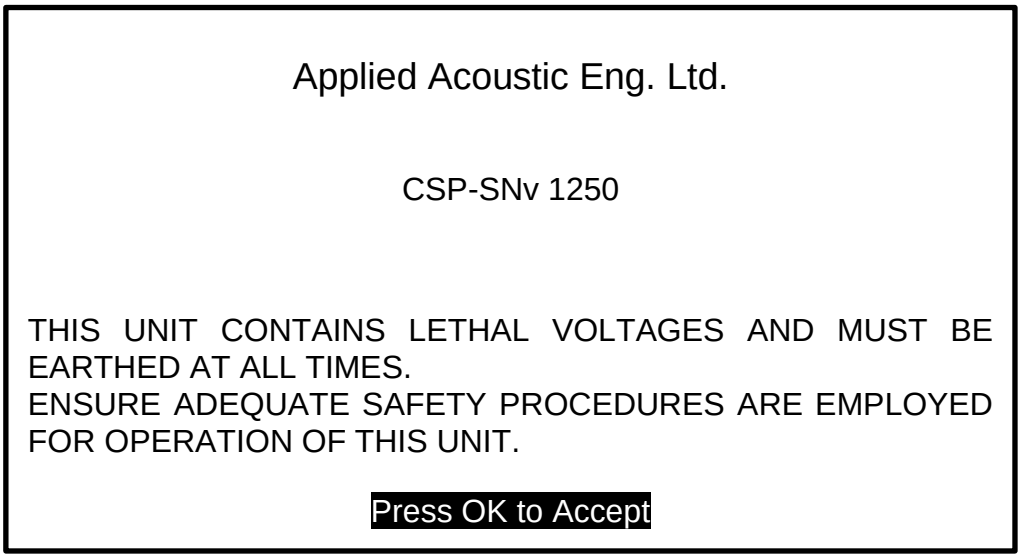
SAFETY NOTICE

All interlocks and safety features are doubled. For example, if the HV connector is removed, the HV is shut OFF by the logic which controls the charger module AND the high voltage is switched OFF by a separate relay. The interlock circuit operates from its own isolated 12V supply and operates 2 relays, as well as the control electronics. However, it cannot be stressed enough that the operator and all those who might come into contact with this equipment treat it with extreme caution and should not take any safety feature for granted.

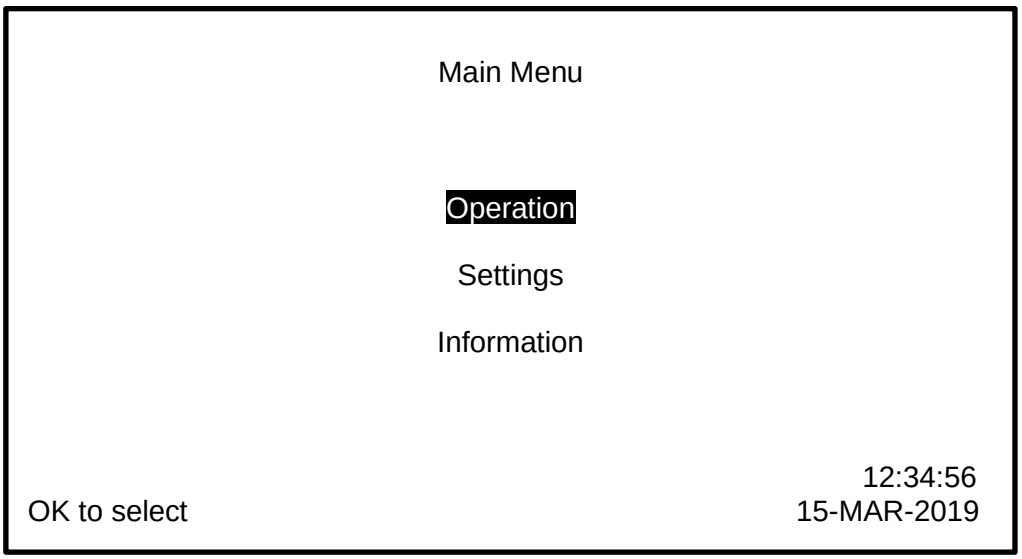
Ensure the CSP-SNv is electrically isolated from the sound source prior to any user adjustments to the cabling or source. Despite being heavily insulated, the HV cable should not be touched or held when the unit is operating. The load should always be in the water before operation.

1.5 Operation: System Configuration

On turn on, splash screen will detail CSP model and a safety warning:



Press OK to accept the safety warning.



Use △ ▽ to navigate menu options. Press OK to select.

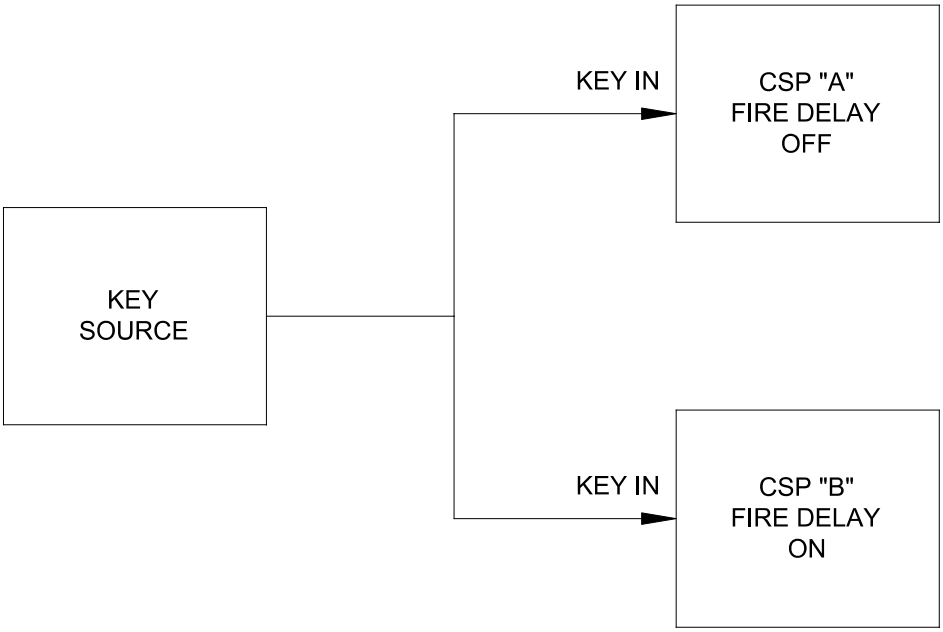
Settings

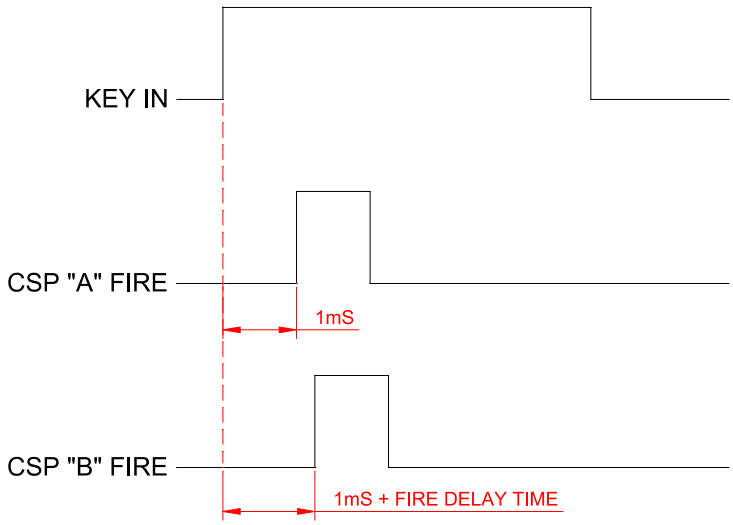
SETTINGS		
	Power:	Refer section Energy Settings
	Level:	High Low
	Key:	Int (Internal) Ext (External) Manual (Key Press)
	Key In Polarity:	Pos (Positive) Neg (Negative)
	Fire Delay:	On Off
	Fire Delay Time:	5uS to 500uS
	Key Out Polarity:	Pos (Positive) Neg (Negative)
	Internal Rate:	200mS to 9975mS
	Key In Timeout:	10 Seconds to 120 seconds
	AVIP:	On Off
	Flip-Flop:	On Off
	QC Log Output:	On Off
	Local / Remote:	Local Remote
	LCD Contrast:	0% to 100%

System settings are saved and restored on power up.

Fire Delay & Fire Delay Time Settings

There is a fixed 1mS delay between a key and the CSP firing (discharge of the CSP). With Fire Delay setting selected 'On', this delay is extended by the Fire Delay Time setting. Applies to external key source only.

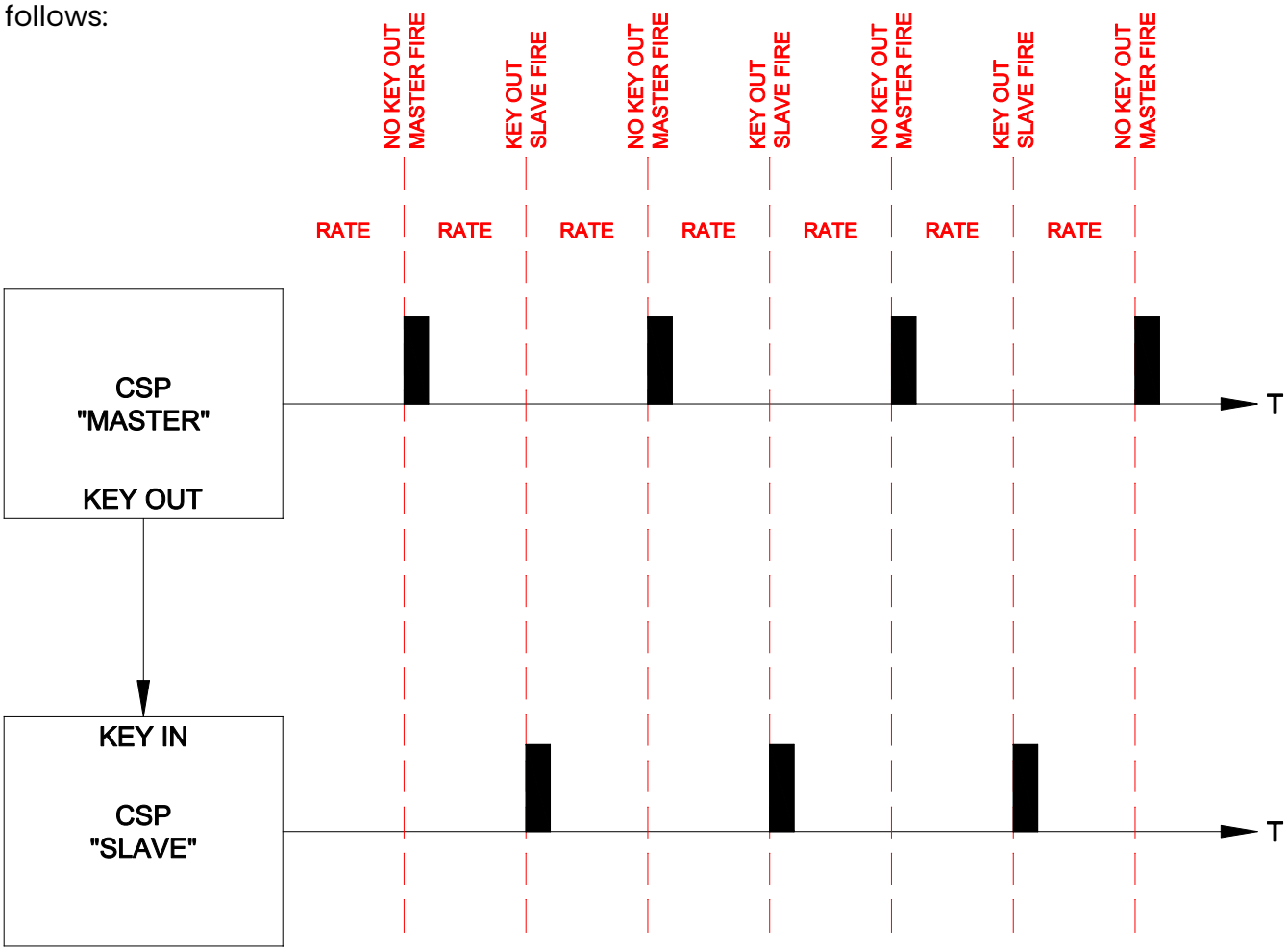




The pulse on KEY OUT BNC is a synch pulse for the time break signal for the CSP firing.

Flip-Flop Setting

With flip-flop setting selected 'On', the CSP is the master in master-slave operation as follows:



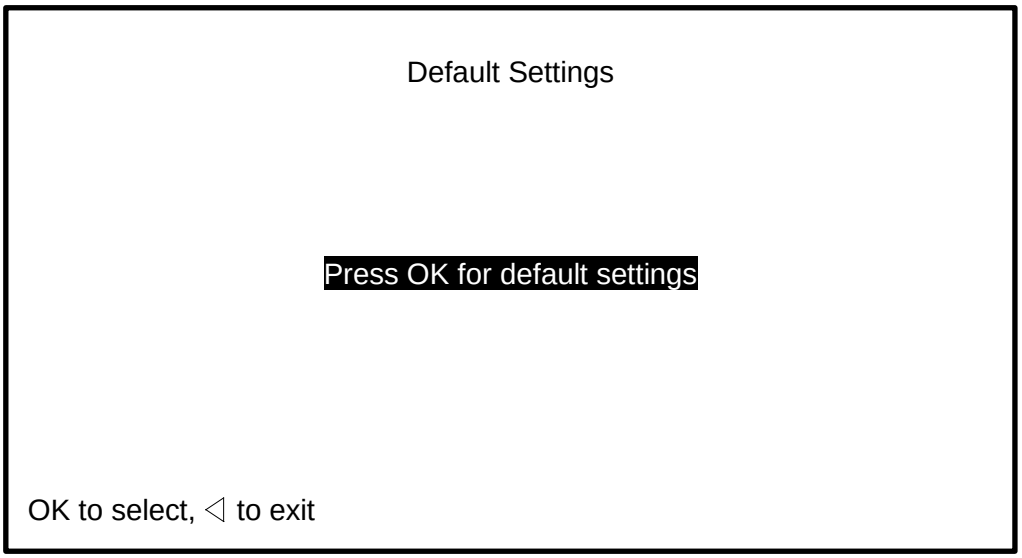
At selected rate (internal, external or manual) the master will alternately fire or output a key pulse on KEY OUT BNC to key the slave.

QC Log Output Setting

With QC log output setting selected 'On', the CSP sends a log of the operational status of the CSP for each key to the COM serial connector. This log explicitly states end of charge (EOC) status yes or no (Y or N).

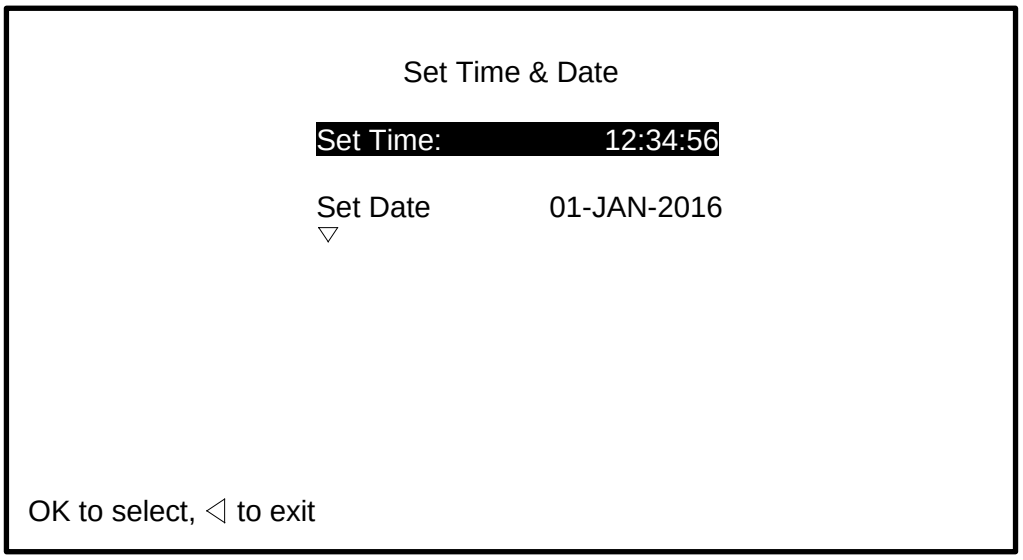
Baud:	115200
Data Bits:	8
Stop Bits:	1
Parity:	None

Default Settings



Press ◁ to exit. Press OK for default system settings.

Set Time & Date



Press ◁ to exit. Press △ ▽ to navigate menu options. Press OK to select.

Press △ ▽ ◁ ▷ to change time / date and press OK to select.

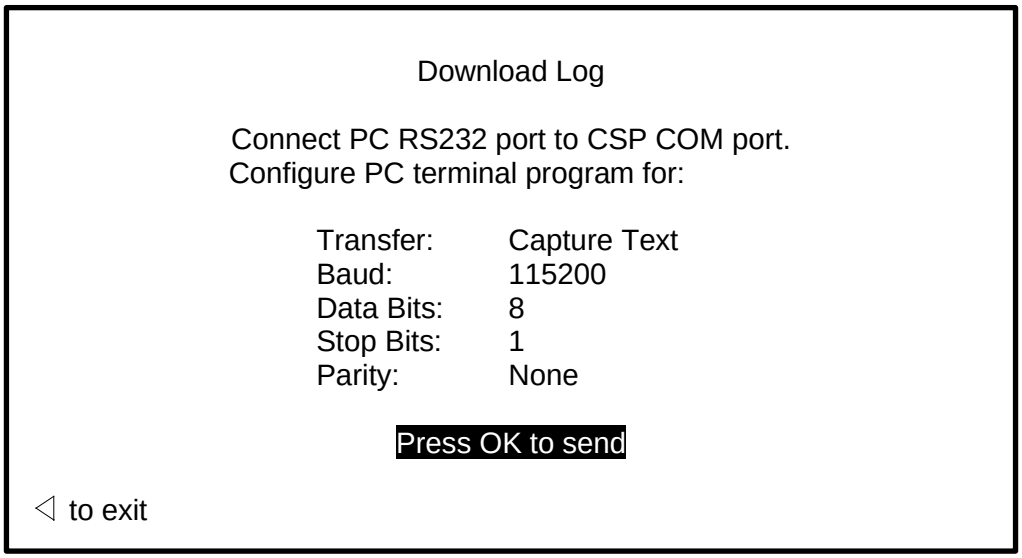
Time format is 24 hours HH:MM:SS
Date format is DAY-MONTH-YEAR

Download Log

In operation mode, enabling HV ON begins an operational logging procedure. The log contains all CSP settings and operational status of up to the last 2042 keys received until HV OFF due to user intervention, fault or power supply interruption.

The log is stored in non-volatile memory for retrieval using the COM serial connector by the user. Only one log can be stored.

Configure PC terminal software for log capture as detailed below:



Press ◁ to exit. Press OK to send log.

During log download, press ◁ to cancel download. Press OK to resend log.

Energy Settings

CSP-SNv 1250	
OUTPUT POWER	
HIGH	LOW
125	100
250	200
375	300
500	400
625	500
750	600
875	700
1000	800
1125	900
1250	1000

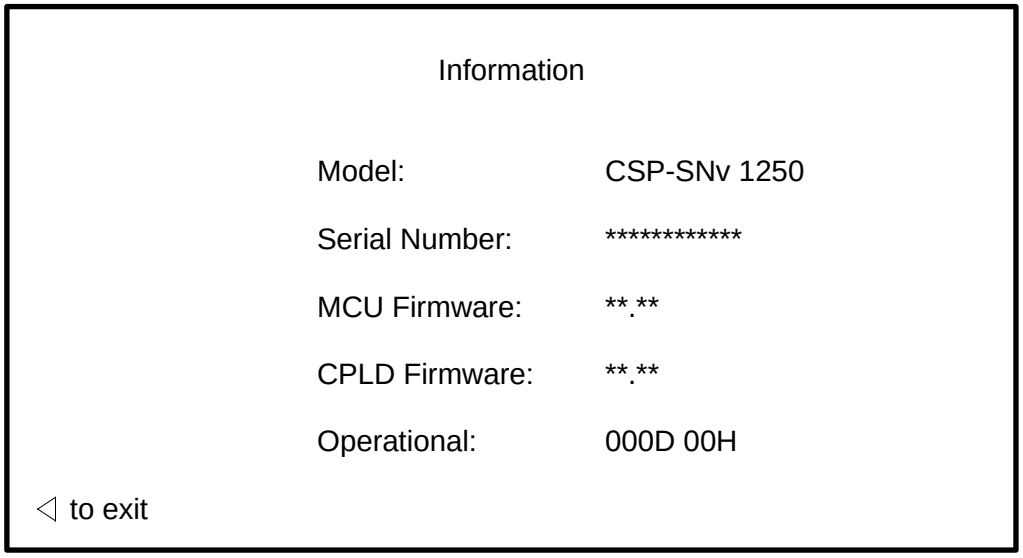
CSP-SNv 2400	
OUTPUT POWER	
HIGH	LOW
125	100
250	200
375	300
500	400
625	500
750	600
875	700
1000	800
1125	900
1250	1000
1500	1100
1750	1200
2000	
2250	
2400	

- CSP-SNv 1250 All power levels are suitable for the 3-Boom Catamaran.

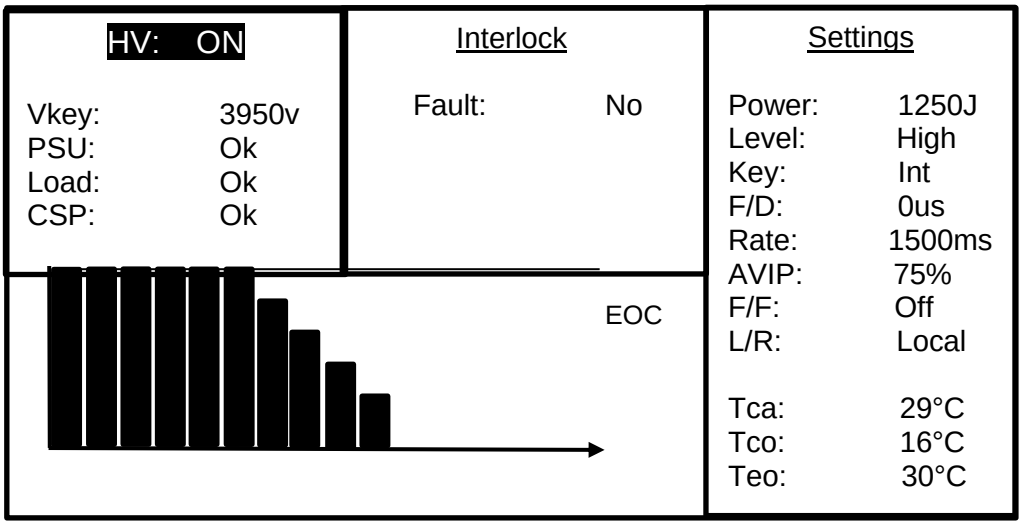
Do not exceed the rated power levels of the connected sound source. The CSP-SNv is capable of delivering 4000J per second to a sound source - over driving a sound source will result in damage to equipment and present hazards to personnel.

Information

System information details model and serial number, plus current firmware revisions and operational time in days and hours.



Operation



The operation mode displays system settings together with operational feedback of system status.

When HV is OFF the system continues to monitor system status.

The HV ON switch is only active in OPERATION MODE. To enable HV operation, the HV ON button must held on for 3 seconds.

The top left panel provides the status of the High Voltage (HV), HV status is also displayed by the HV ON LED and HV ON // HV OFF Switch LEDs.

"Vkey" is the output high voltage level prior to key trigger.

"PSU" indicates status of the internal HV charger module. If a PSU fault occurs the HV FAULT indicator is ON.

PSU Status	Description
Ok	Ok
O/P Load Summ	HV Level Fault detected. Load Fault, internal fault HV Capacitor. Summary Fault, internal fault Low VAC, temperature, output over voltage detected.

"Load" indicates status of the load (sound source). The system monitors the output current and voltage shot by shot to check for over-current condition (short-circuit) or open-circuit condition. The Load fault type is displayed if detected. If a "Load" fault occurs the HV FAULT indicator is ON.

"CSP" indicates status of the CSP power supply.

CSP Status	Description
Ok	Ok
Fault	Internal fault, e.g. Keyboard, Control Logic.
Temp	Temperature limit 0 to 45°C
Time	Key In Time Out, external or manual key not detected
Mains	Low VAC Mains Supply detected, limit 180VAC$_{RMS}$
Rem	Remote Unit not detected.

Interlock

The interlock status is displayed, the overall status is indicated that there are no interlocks present, if an interlock is present the status will change to yes and the interlock reported.

Interlock Message	Description
HV Socket	Indicates active interlock at either the HV Socket or HV Junction Box
Top Cover	Indicates active interlock on the top cover of the CSP chassis.
Thermal Switch	Indicates active over temp interlock on output thyristor
Emergency Stop	Indicates active emergency stop

A summary of the configured settings are displayed:

Power:	1250J	Discharge power level in joules
Level:	High	High / Low option
Key:	Int	Key source
F/D:	0us	Fire Delay (0uS in this example as internal key source)
Rate:	1500ms	Key rate
AVIP:	75%	AVIP PWM percentage if On, or Off
F/F:	Off	Flip-Flop On or Off
L/R:	Local	Local / Remote operation

Temperature

	Description
Tca	Control Unit ambient temperature
Tco	Control Unit outlet temperature
Tout	Energy Unit outlet temperature

EOC Histogram

The histogram displays the status of the end of charge voltage history of the last 20 shots, this allows the operator to monitor the system operation at a glance with instant feedback of the overall system performance.

The histogram is only reset upon HV ON, the display is retained upon shut down to provide feedback.

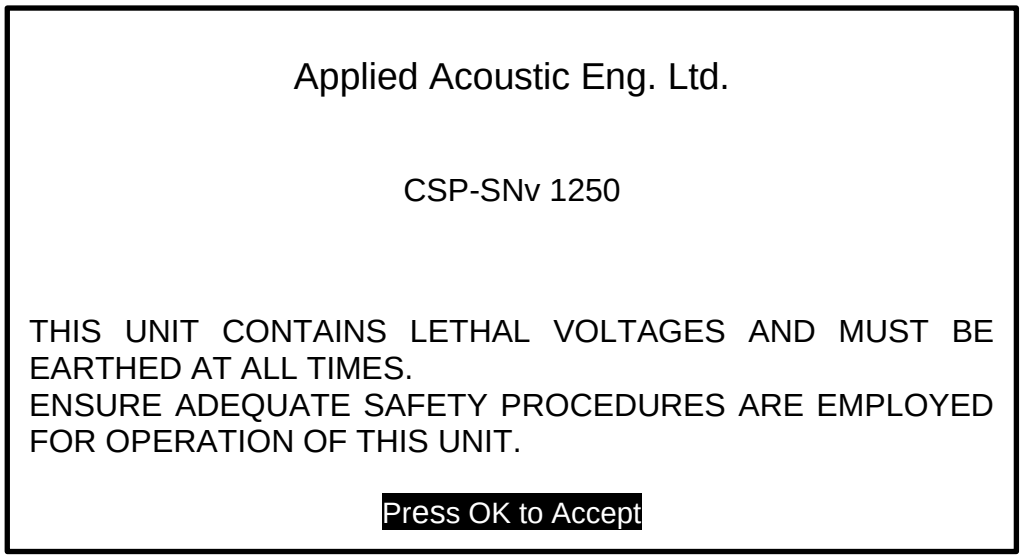
1.6. Operation: Enabling High Voltage Starting Operations

Installation check-list:-

a) A good earth has been connected to the 'Safety Earth' on the front panel. Recommended configuration:
Earth connection from VAC Supply to CSP Safety Earth to Sea Earth or Vessel Hull
b) The sound source (boomer plate or sparker) has been connected and it is in the water.
c) A key mode is selected – either internal or external. Key connections are connected.
d) AC mains is connected to the 'Mains Input' connector.
e) A safety check has been carried out to ensure that there is no-one in the water and that crew members know that the unit is about to be operated.

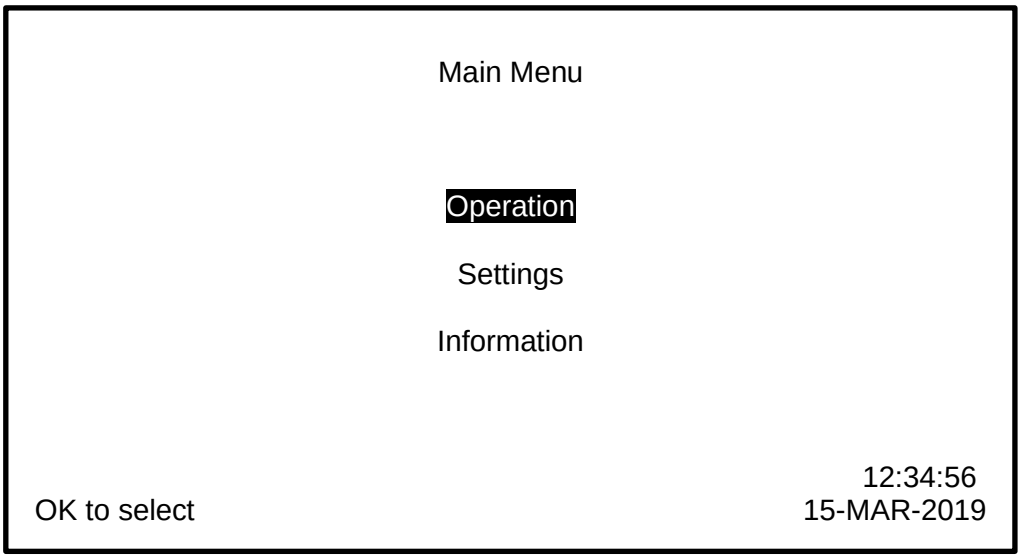
Power Up

When suitably connected to ground, the transducer and AC mains, and the sound source is deployed. The power can be applied using the ON / OFF switch and circuit breaker. The front panel fans will run, and the HV OFF / RESET button will illuminate.

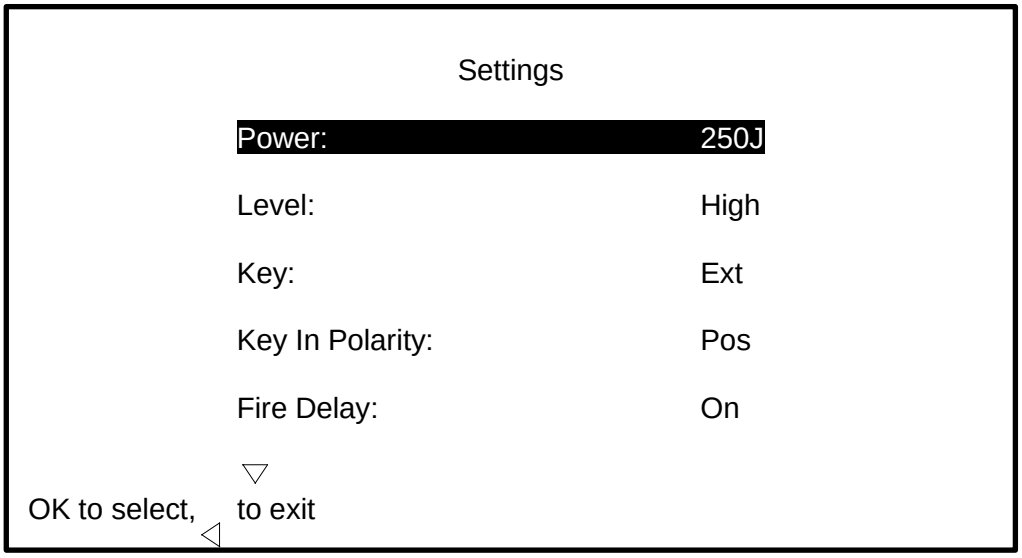


Press OK to accept safety warning and continue to Main Menu

Settings



From main menu, use △ ▽ to navigate to Settings menu option. Press OK to select.

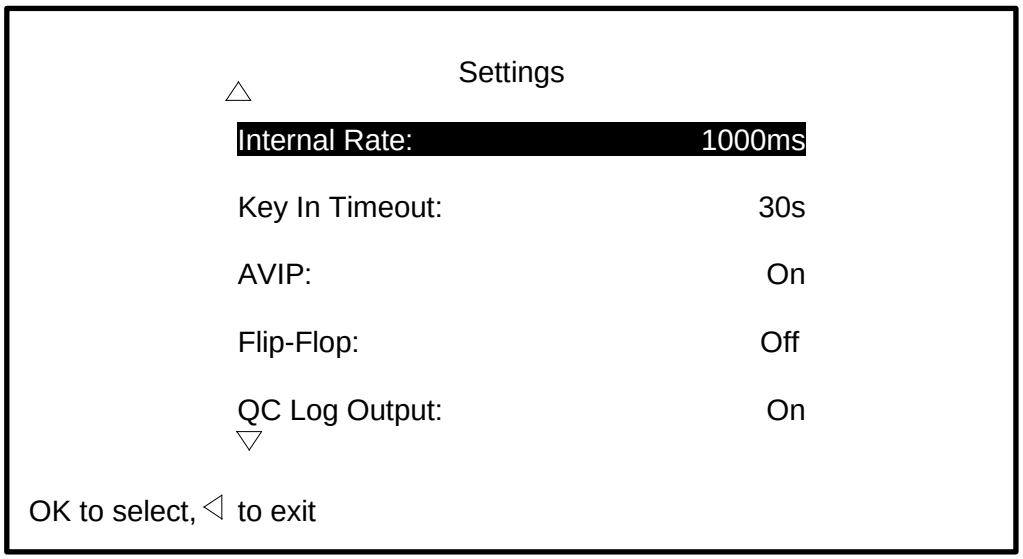


Set Power, Level and Key settings to select the appropriate power required.

Use △ ▽ to navigate settings. Press OK to select a setting.

Use △ ▽ to adjust a setting. Press OK to select new setting.

The maximum repetition rate is governed by the charge rate (4000 Joules per second peak) and the amount of capacitance selected. Plus VAC supply rating, if a lower VAC supply is connected charge rate is lower. For example, at 500J / shot the CSP-SNv will run at a max of approx. 8 PPS. Note do not exceed the power rating of the sound source connected.



Select Internal Rate and AVIP settings.

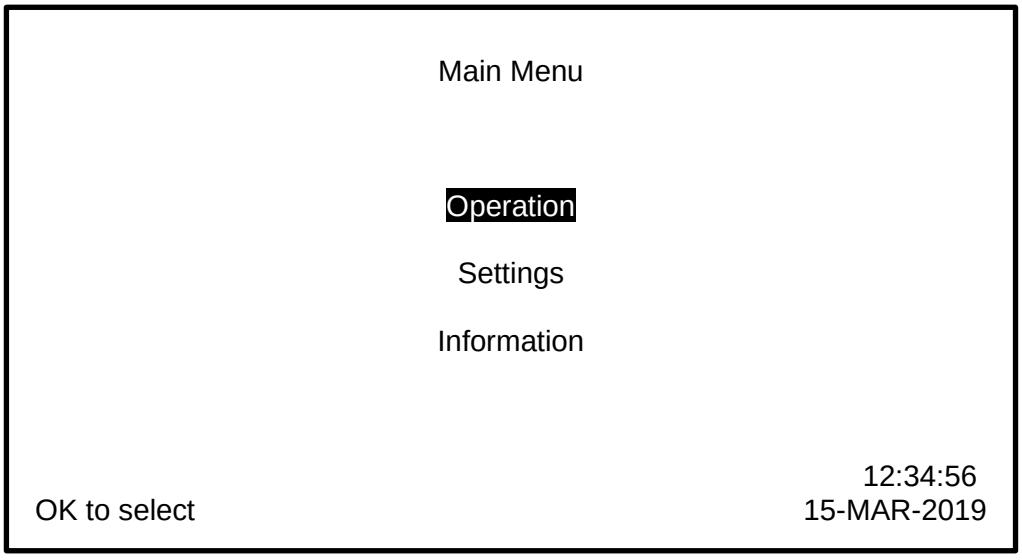
Key In Timeout can be set in the range of 10 to 120 seconds.

Use △ ▽ to navigate settings. Press OK to select a setting.

Use △ ▽ to adjust a setting. Press OK to select new setting.

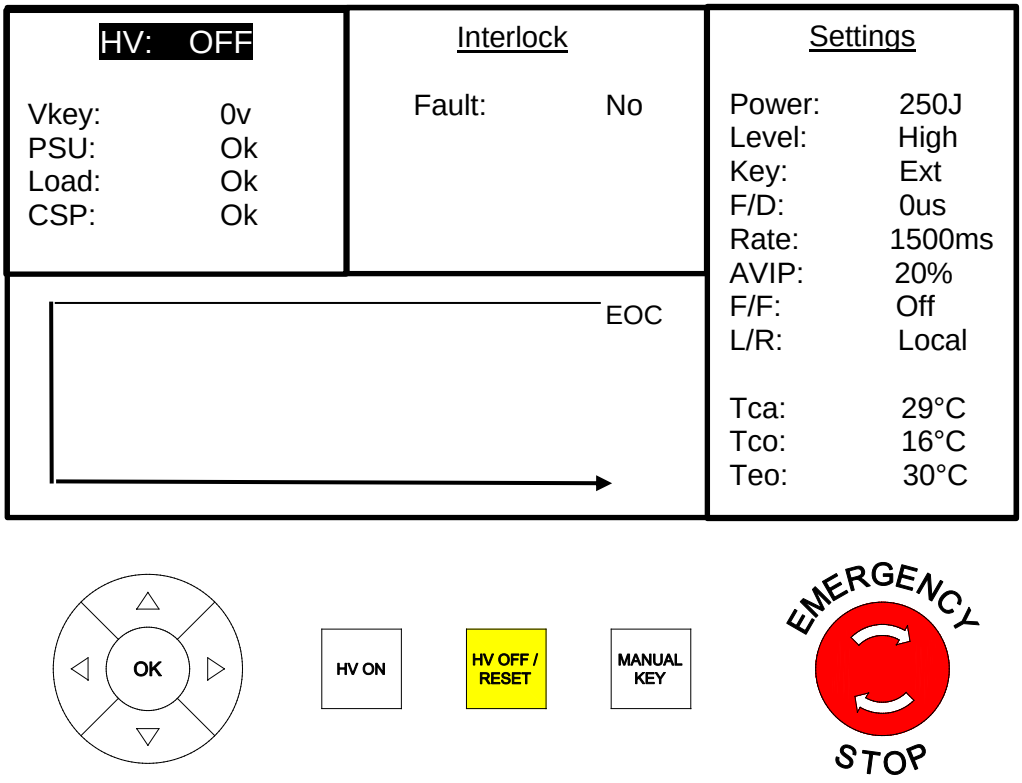
Press ◁ to exit to main menu.

System settings are saved and restored on power up



From main menu, use △ ▽ to navigate to Operation menu option. Press OK to select.

Operation



HV OFF / RESET switch indicator will be ON, indicating High Voltage is OFF. All other indicators should be OFF

Any Interlocks or fault modes will be displayed and indicated. If Interlock is present press HV OFF / RESET to clear or investigate if does not clear.

Prior to enabling HV, review Settings.

EARTHING - FURTHER REMINDER

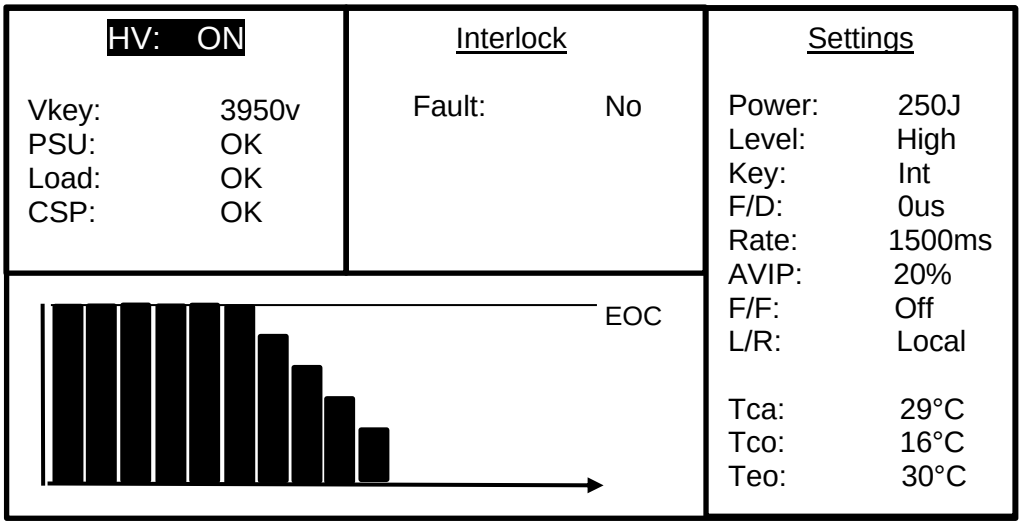
THIS UNIT MUST BE EARTHED / GROUNDED BEFORE ANY POWER IS APPLIED. FAILURE TO DO SO MAY REPRESENT A SEVERE HAZARD TO BOTH EQUIPMENT AND PERSONNEL.

Operation: Enable High Voltage

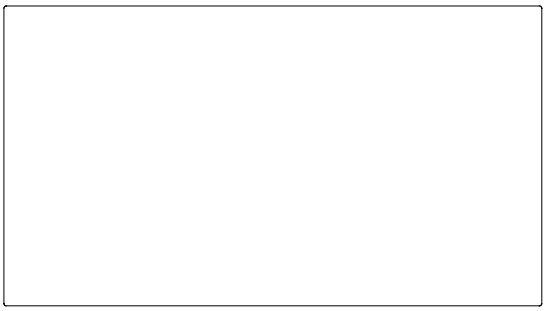
To enable High Voltage press and hold the HV ON button for 3 seconds.

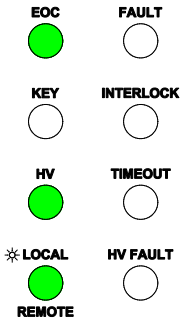
Depending on settings, 1,2,3,4 or 5 relays will engage over a fixed 6 second period.

High voltage will then enable, and the system will begin to cycle.



EOC and Vkey level gradually increases at start up due to AVIP function.



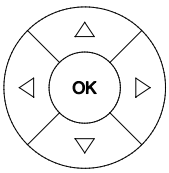


EOC is ON when EOC achieved

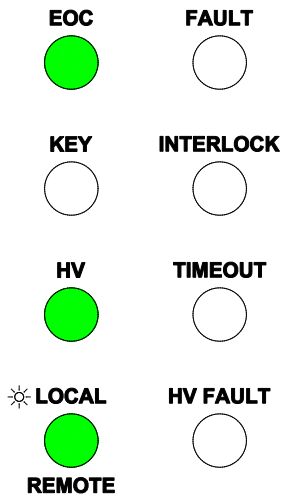
Key flash to indicate fire

HV is ON when enabled

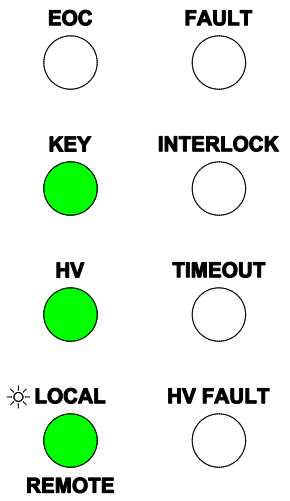
LOCAL is ON for local operation



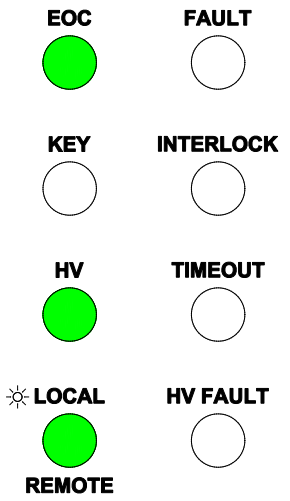
System Cycle of Operation



HV Capacitor(s) charged EOC ON
System ready to discharge upon arrival of Key



Key received.
Capacitors discharged, EOC OFF.
No fault lights ON, system re-charges capacitor(s).



HV Capacitor(s) charged EOC ON
System ready to discharge upon arrival of Key

Operation: Disable High Voltage

Press HV OFF / RESET to switch OFF High Voltage

In an emergency, press EMERGENCY STOP or SWITCH POWER OFF.
High Voltage is automatically discharged.

Local / Remote

Required:
CSP-CSPDV-7060 Remote Unit
CSP-CSPDV-4060 Remote Cable

The Local / Remote setting allows the use of a Remote Unit for operation from a laboratory or instrument room.

The Remote Unit mirrors the CSP HV ON and HV OFF switch indicators, plus EOC, KEY and general FAULT indicators, regardless of Local / Remote setting. HV ON and HV OFF switches are recessed to prevent accidental operation.

HV can only be activated with the CSP in OPERATION MODE.

The HV OFF button is operational on the CSP AND the Remote Unit regardless of Local / Remote setting.

The LOCAL / REMOTE setting determines operation of the Remote Unit when connected:

Local / Remote set to Remote

- **HV can only be enabled from the Remote Unit, NOT from the CSP.**

Local / Remote set to Local

- **HV can only be enabled from the CSP, NOT from the Remote Unit.**

With Local / Remote set to Remote, a fault mode will persist if the Remote Unit is not detected, e.g. unplugging Remote Unit during operation.

Key In & Key Out is functionally identical on the CSP and the Remote Unit. Note if using external Key In, connect only at CSP or Remote Unit, not both simultaneously.

Operation: Enable High Voltage with Remote Unit

- CSP Local / Remote setting must be set to Remote.
- CSP must be in OPERATION MODE.
- HV must be off.
- Fault modes must be reset.

Activation Sequence

1. Hold Remote Unit HV OFF switch until HV ON switch flashes. This indicates the operator has 5 seconds to enable HV.

2. Release HV OFF switch.

3. Hold HV ON switch for minimum of 3 seconds until HV ON activates.

Operation: Disable High Voltage with Remote Unit

Press HV OFF to switch OFF High Voltage

The chassis and control electronics of the Remote Unitl are isolated from the CSP-SNv and can be connected to the local earth for safety.

1.7.1 Operation with a Boomer Sound Source

A boomer plate as a sound source produces a single pulse and the amplitude and duration of this pulse is controlled by the energy going into it. The energy is derived from the voltage and the quantity of energy stored in the CSP unit. Traditionally, boomers have operated from around 3500 to 3800 volts. However a feature of the AA200 and AA300 boomer plates is that they will produce a longer pulse (and hence more penetration) with a lower voltage and higher capacitance from the energy source (CSP). The Low setting achieves this so, for example, using an AA300 boomer plate at 200J at 3 pulses per second may be a common way of using the transducer with the traditional 3.5 kV supply voltage.

Load Specifications

The CSP-SNv units are designed to deliver high currents into boomer or sparker type loads. The loads are quite different in make-up.

Boomer Load

A boomer plate consists of a coil imbedded in an epoxy or plastic material and thus by its nature is an inductive load. The inductive 'kickback' is controlled by circuitry inside the CSP. Typical currents into a boomer plate are listed below:-

Energy (HI)	AA251 Plate	EG+G Uniboom
100J	800A	900A
200J	1050A	1200A
300J	1250A	1350A

The currents will vary according to the length and type of cable used between the load and the energy source. Note that the CSP-SNv units are specified for AAE and EG+G boomer plates and have not – to date- been tested with any other type.

Ensure that the energy and repetition rate do not overdrive the sound source! (Boomer plate - check the boomer plate manual).

1.7.2 Operation with a Sparker Sound Source

The CSP-SNv is designed for use with the Dura-Spark Sparker. The CSP-SNv is not compatible with the Squid Sparker range of sparker sound sources due to the polarity of the power supply.

The polarity of the CSP-SNv reduces tip wear to a minimum ensuring a stable repeatable sound source.

A sparker consists of a number of electrodes in the (salt) water which creates a sound pulse as the plasma bubble expands. The current into a sparker varies with cable length and type as well as by the number of tips and the salinity of the water. Typical values are shown below for AAE sparkers in seawater with a salinity of 35 ppm.

Energy	Dura Spark 80 Tips	Dura Spark 160 Tips	Dura Spark 240 Tips	Dura Spark 400 Tips
300J	1800A	2000A	2500A	
500J	2400A	3000A	3500A	4500A
1250J		4500A	6000A	6500A
2000J				8500A

Operation of the CSP-SNv with a Non AAE Sound Source

When used with sparker sound sources from other manufacturers the operator must ensure that the operational characteristics of the sparker are within the parameters of the CSP-SNv. It is recommended that the operator measures the discharge current level and rise time consulting with AAE before commencing survey operations to ensure reliability / compatibility.

Dummy Load

AAE manufacture a dummy load with precisely designed characteristics which can be used for testing of CSP-SNv units in the workshop to avoid 'water based dummy loads'.

Please check with other sparker manufacturers if their sparkers are compatible with the specifications laid out in this manual.

1.8. Product Recycling / Disposal

Within the UK, all electronic components and batteries must be taken for separate collection at the end of their working life under the Waste Electrical and Electronic Equipment (WEEE) Regulations 2013 and Waste Batteries and Accumulators Regulations 2009 respectively. The AAE Technologies Ltd group (AAE Tg) of companies as UK manufacturers will responsibly dispose of any returned end of life AAE Tg components/batteries through registered/approved recycling schemes. In order to prevent uncontrolled waste disposal and promote recycling, please contact Technical Support for a RMA number and return any end of life items (if safe to do so) carriage paid by the sender to our UK head office

1.9 System Interconnection

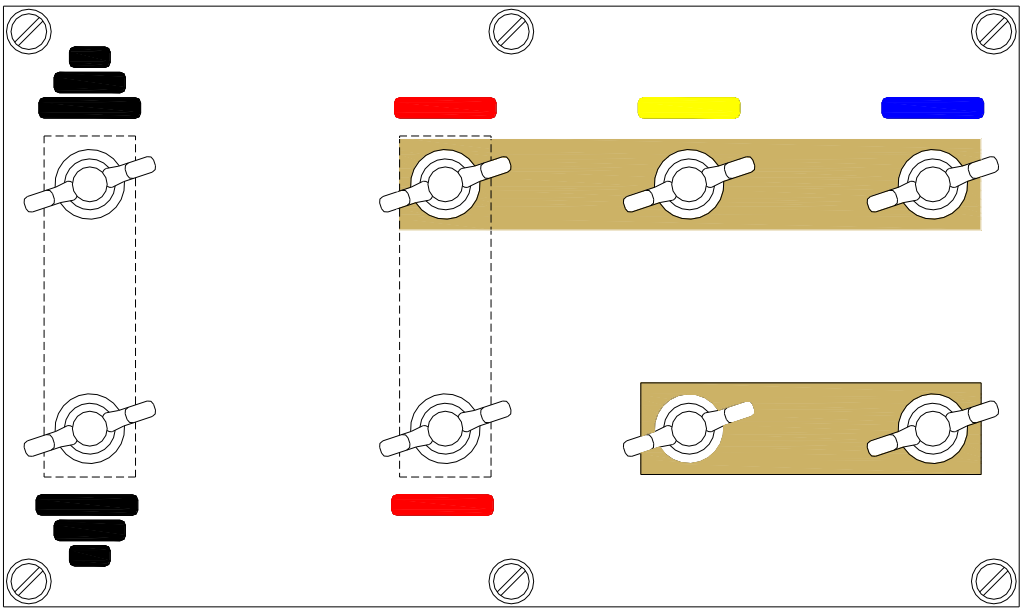
HVJ3004 HV Junction Box

The CSP-SNv is supplied with the HV Junction Box HVJ3004, for use with the following sound sources and HV Cables.

Seismic Power Supply	HV Cable	Sound Source
CSP-SNv	HVC 3000	S-Boom
CSP-SNv	HVC-3500	Dura Spark
CSP-SNv	HVC-2000	AA251, AA301 Boomer

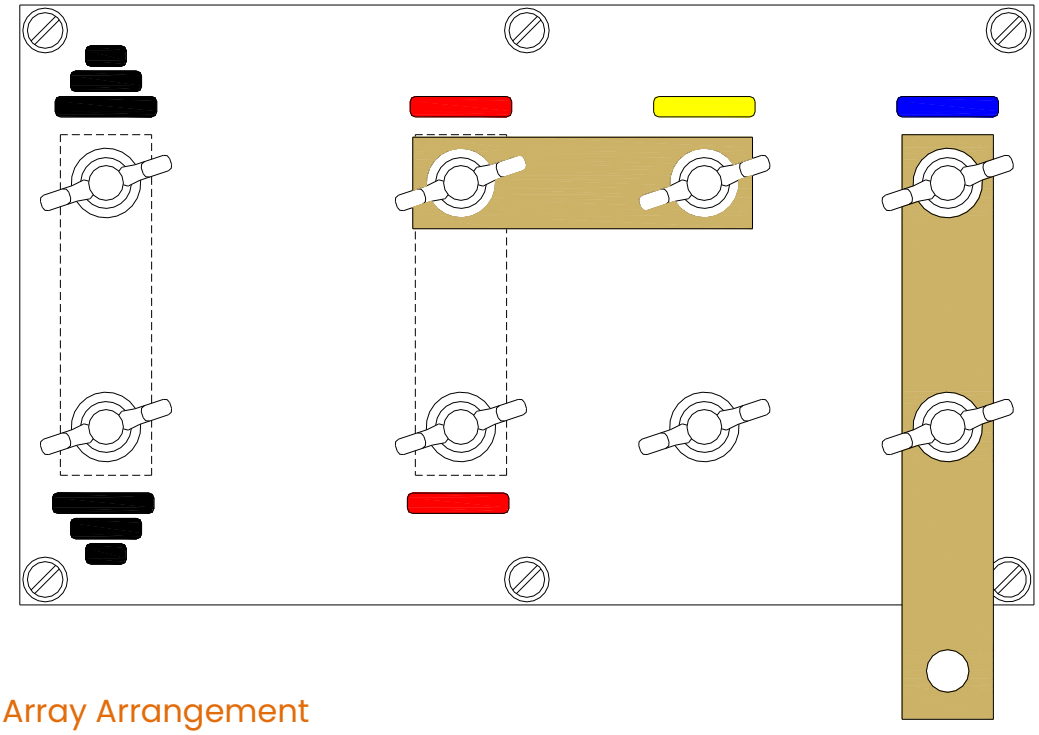
Triple Array Arrangement

400 Tips DuraSpark 400 // 240 Tips DuraSpark 240 // 3 Boomer Plate S-Boom



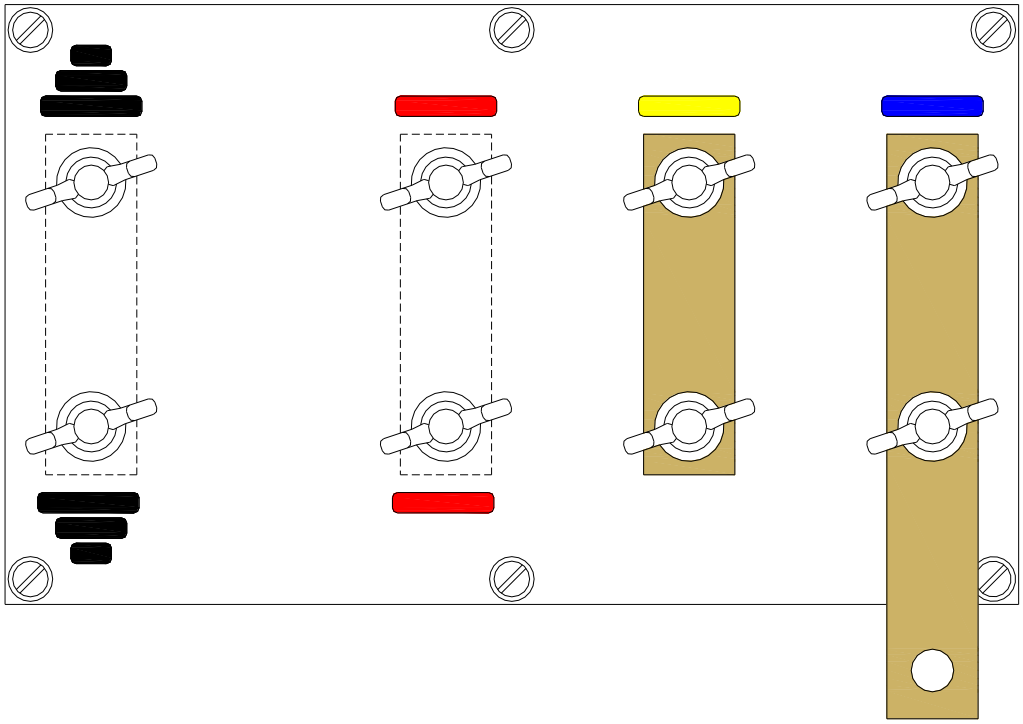
Double Array Arrangement

240 Tips DuraSpark 400 // 160 Tips DuraSpark 240 // 2 Boomer Plate S-Boom

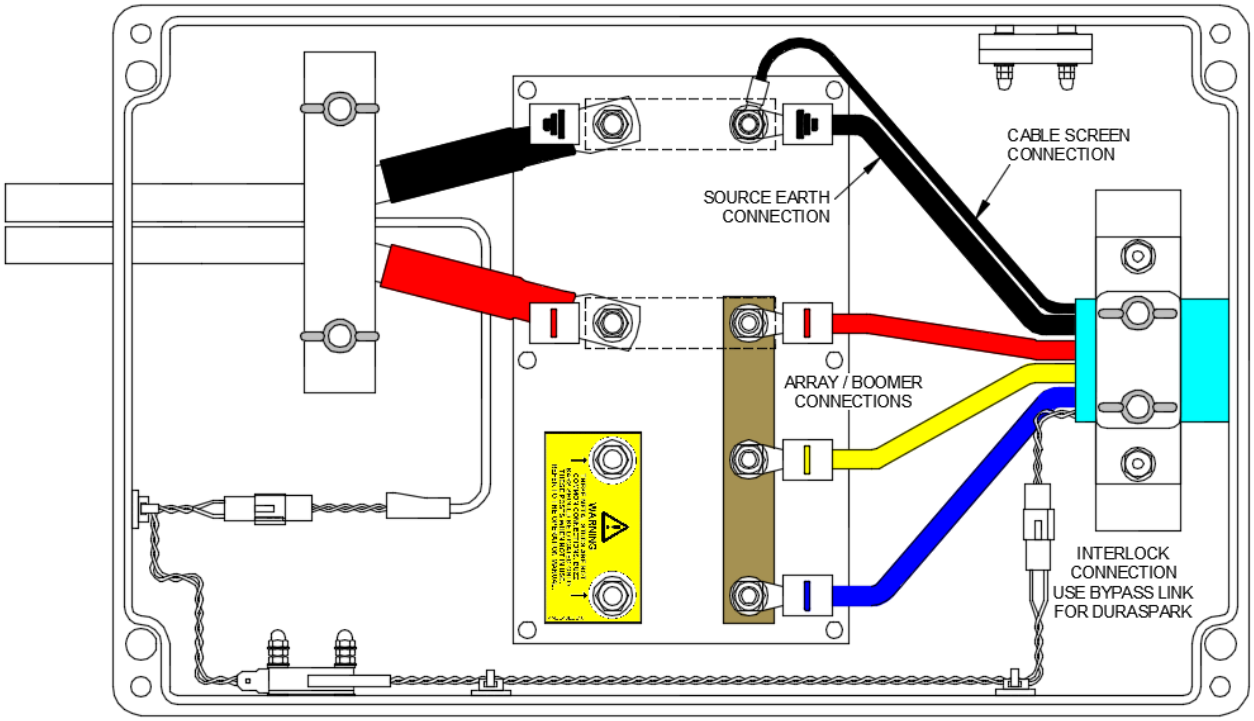


Single Array Arrangement

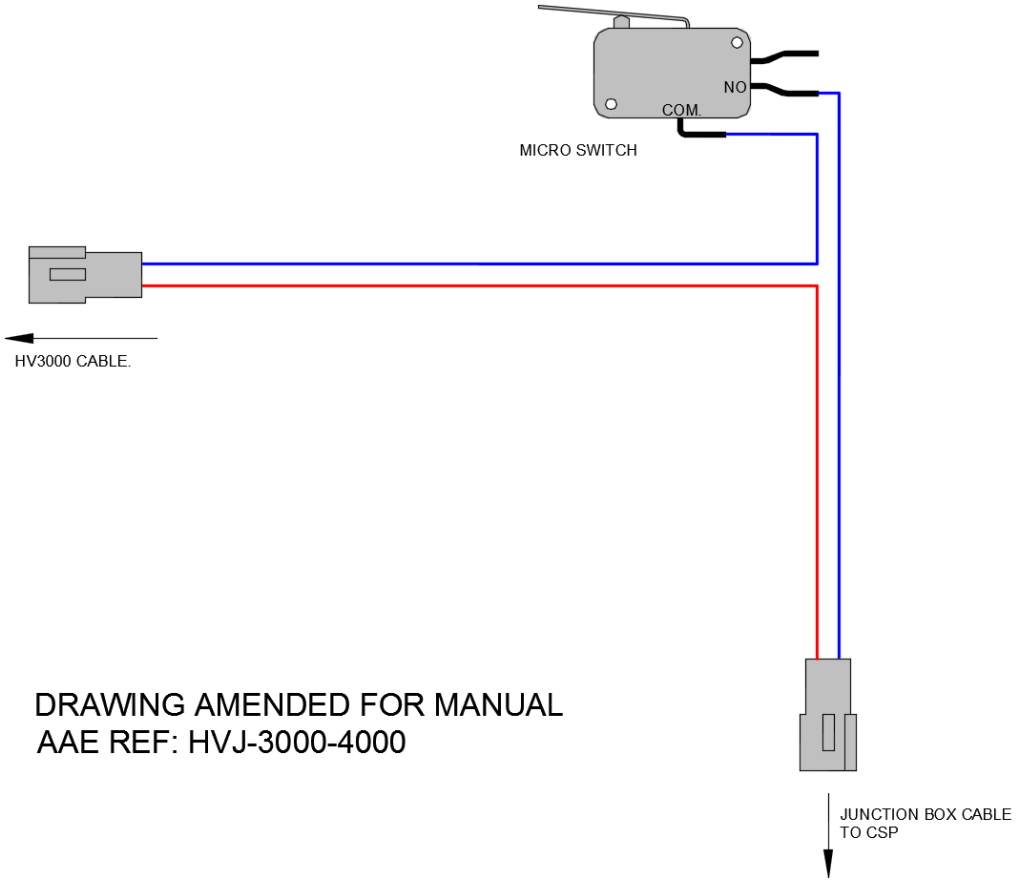
80 Tips DuraSpark 400 and 240 // Single Boomer Plate S-Boom

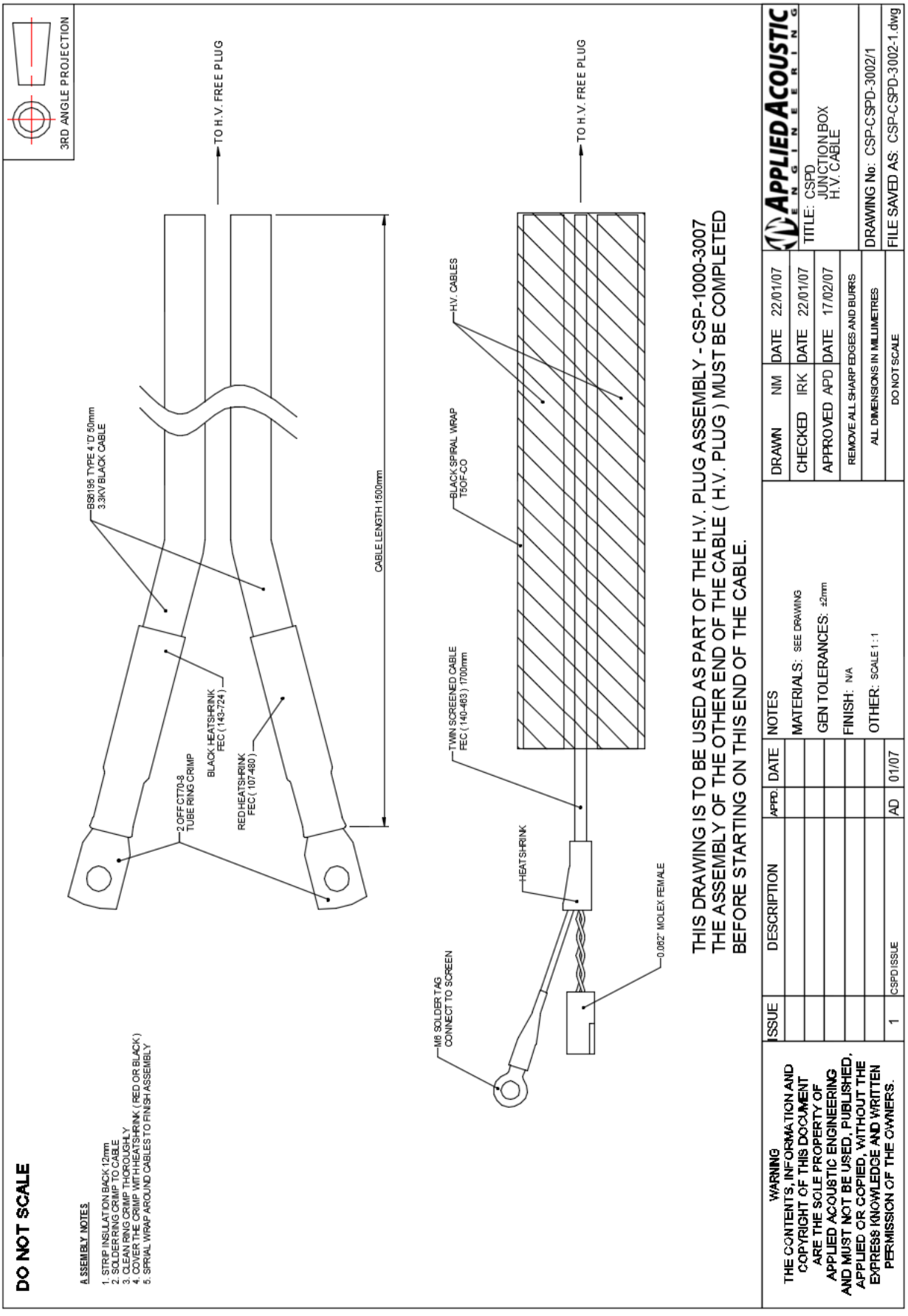


HVJ3004 Interconnections



HVJ3001 Junction Box Interlock Wiring




DO NOT SCALE
3RD ANGLE PROJECTION
ASSEMBLY NOTES
1. STRIP INSULATION BACK 12mm
2. SOLDER RING CRIMP TO CABLE
3. CLEAN RING CRIMP THOROUGHLY
4. COVER THE CRIMP WITH HEATSHRINK (RED OR BLACK)
5. SPIRAL WRAP AROUND CABLES TO FINISH ASSEMBLY
TO H.V. FREE PLUG
BS8196 TYPE 4 'D' 50mm
3.3KV BLACK CABLE
2 OFF CT70-8
TUBE RING CRIMP
BLACK HEATSHRINK
FEC (143-724)
RED HEATSHRINK
FEC (107-480)
CABLE LENGTH 1500mm
TO H.V. FREE PLUG
H.V. CABLES
BLACK SPIRAL WRAP
TSOF-CO
TWIN SCREENED CABLE
FEC (140-463) 1700mm
HEATSHRINK
M6 SOLDER TAG
CONNECT TO SCREEN
0.082" MOLEX FEMALE
THIS DRAWING IS TO BE USED AS PART OF THE H.V. PLUG ASSEMBLY - CSP-1000-3007
THE ASSEMBLY OF THE OTHER END OF THE CABLE (H.V. PLUG) MUST BE COMPLETED
BEFORE STARTING ON THIS END OF THE CABLE.
WARNING
THE CONTENTS, INFORMATION AND COPYRIGHT OF THIS DOCUMENT ARE THE SOLE PROPERTY OF APPLIED ACOUSTIC ENGINEERING AND MUST NOT BE USED, PUBLISHED, APPLIED OR COPIED, WITHOUT THE EXPRESS (KNOWLEDGE AND WRITTEN PERMISSION OF THE OWNERS.
ISSUE
DESCRIPTION
APPD
DATE
1
CSPD ISSUE
AD
01/07
NOTES
MATERIALS: SEE DRAWING
GEN TOLERANCES: ±2mm
FINISH: N/A
OTHER: SCALE 1 : 1
DRAWN NM DATE 22/01/07
CHECKED IRK DATE 22/01/07
APPROVED APD DATE 17/02/07
REMOVE ALL SHARP EDGES AND BURRS
ALL DIMENSIONS IN MILLIMETRES
DO NOT SCALE
APPLIED ACOUSTIC ENGINEERING
TITLE: CSPD JUNCTION BOX H.V. CABLE
DRAWING No: CSP-CSPD-3002/1
FILE SAVED AS: CSP-CSPD-3002-1.dwg

Specifications

Physical Specification

Size	Transit Case 19" rack 11U high
Weight	CSP-SNv 1250, case and cover: 90kg CSP-SNv 2400, case and cover: 93kg

Electrical Specification

Mains Input	240Vac 45-65Hz @ 6.0kVA single phase. 3 pin connector Variable Input Power Circuitry (AVIP) 'soft start' control
Voltage Output	CSP-SNv 1250 3536 to 3953VDC CSP-SNv 2400 2500 to 3974VDC 4 pin interlocked connector Solid state semi-conductor discharge method
Output Energy	CSP-SNv 1250 100,200,300,400,500,600,700,800,900,1000 Joules 125,250,375,500,625,750,875,1000,1125,1250 Joules CSP-SNv 2400 100,200,300,400,500,600,700,800,900,1000,1100,1200 Joules 125,250,375,500,625,750,875,1000,1125,1250,1500,1750,2000, 2250,2400 Joules
Charging Rate	4000J/second peak operation at 0-45°C. 220VAC Supply.
Capacitance	CSP-SNv 1250 176uF @ 10^8 shot life CSP-SNv 2400 304uF @ 10^8 shot life
Trigger	User configured: External: +ve key (5-12VDC), -ve key or isolated closure (CSP & Remote Unit) Internal: Manual: Key press Opto Isolated BNC connector on front panel and remote box (optional)
Repetition rate	User configured: External: 10pps maximum Internal: 200ms to 9975ms Limited by charge rate, energy level and sound source rating
Earth	M8 stainless steel stud on front panel

Safety Features

- Main microprocessor control circuits with fail-safe layer of logic circuitry
- LCD display with system status information, configuration
- Specially designed HV connector with interlock
- High speed dump resistors for high voltage components
- Capacitor bleed resistors
- HV output open circuit shutdown
- Trigger monitoring with time out and over clock shutdown
- HV output current monitor and shutdown
- Supply Voltage monitoring and shutdown
- High Voltage monitoring
- Over temperature shut-down
- Cover and connector interlocks
- Diagnostic log download for improved support
- Remote Unit available to trigger and operator remotely

Options

Remote Unit	:	Allows operator to control CSP at a distance. Includes Key In and Key Out.
Junction Box	:	For connection of standard transducer cables to HV connector.
Shock Mount Housing	:	For transportation and operation. (Recommended.)
Transit Case	:	For storage and transportation. Foam lined.
Field Spares Kit	:	For trained technicians only. For servicing units in the field.

Although correct at time of printing, these specifications are subject to change without notice.

Appendix A – CSP Firmware Upgrade

Requirements

- PC with RS232 serial port & Hyperterminal
- RS232 cable (not crossover type)

Procedure

1. Ensure CSP is turned off.

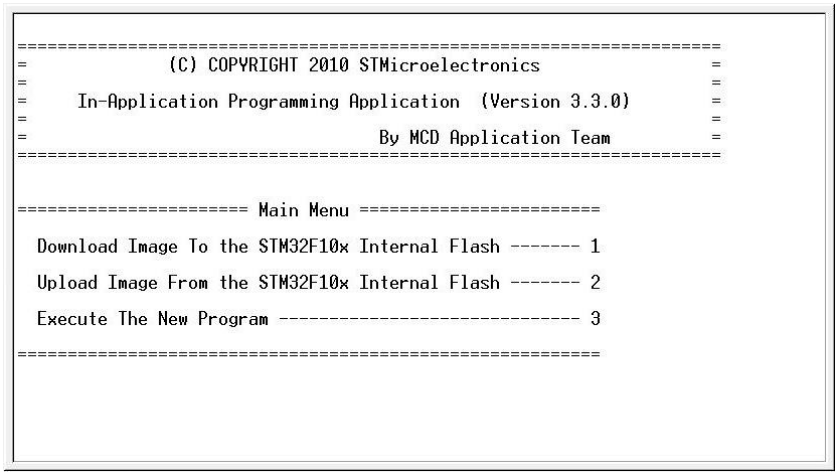
2. Connect RS232 cable between PC serial port & CSP front panel COM port.

3. Configure Hyperterminal for:
   115200 baud
   8 data bits
   1 stop bit
   No parity
   No flow control

4. Whilst holding front panel ◁ button, turn on CSP.

5. Check FAULT indicator is on. Check LCD is blank & LCD backlight is off. Check HV OFF/RESET switch indicator is on. These checks indicate system is in bootloader mode. Hyperterminal should display the following:

Fig



6. Press 1 on PC keyboard. Message “Waiting for file to be sent …” will be displayed.

7. Select “Transfer”->”Send File” on Hyperterminal. Box “Send File” will open.

8. Select Protocol “Ymodem”. Select “Browse” then navigate to and select .bin file to open.

9. Select “Send”. Box will open detailing send process. After programming, Hyperterminal will display “Programming completed successfully!”

10. Press 3 on PC keyboard or turn CSP off & on to start program execution.
11. Disconnect RS232 cable from front panel COM port.

Appendix B – Remote Unit Firmware Upgrade

Requirements

- PC with RS232 serial port & Hyperterminal
- RS232 cable (not crossover type)
- CSP-CSPDV-4060 Remote Cable.

Procedure

1. **Ensure CSP is turned off. For safety, also engage CSP EMERGENCY STOP.**

2. If connected, disconnect Remote Unit from Remote Cable.

3. Remove 4 screws retaining Remote Unit front panel to gain access to internal PCB.

4. Identify 2-way DIP switch SW1 on edge of PCB and set SW1-1 to ON position.

5. Connect RS232 cable between PC serial port & Remote Unit 9-way 'D' socket.

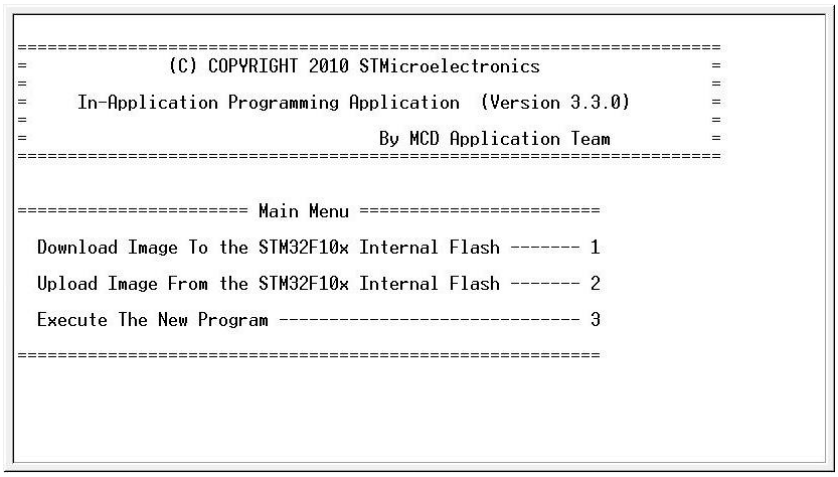
6. Connect Remote Cable between CSP & Remote Unit.

7. Configure Hyperterminal for:
   115200 baud
   8 data bits
   1 stop bit
   No parity
   No flow control

8. Turn on CSP.

9. Hyperterminal should display the following:

Fig



10. Press 1 on PC keyboard. Message “Waiting for file to be sent …” will be displayed.

11. Select “Transfer”->”Send File” on Hyperterminal. Box “Send File” will open.

12. Select Protocol “Ymodem”. Select “Browse” then navigate to and select .bin file to open.

13. Select “Send”. Box will open detailing send process. After programming, Hyperterminal will display “Programming completed successfully!”

14. Press 3 on PC keyboard or turn CSP off & on to start program execution.

15. Disconnect RS232 cable from Remote Unit 9-way ‘D’ socket.

16. Turn off CSP.

17. Disconnect Remote Unit disconnected from Remote Cable.

18. Identify 2-way DIP switch SW1 on edge of PCB and set SW1-1 to OFF position.

19. Fix Remote Unit front panel with 4 screws removed instruction 3.

Appendix C – CSP-Dv / CSP-Nv / CSP-SNv Log - MCU F/W 1.13

Log download after last CSP operation

Settings Format:
$SETTINGS,<MODEL>,<SERIAL NO>,<MCU F/W>,<CPLD F/W>,<POWER>,<LEVEL>,
<KEY SOURCE>,<KEY IN POLARITY>,<KEY IN DELAY>,<KEY IN DELAY TIME>,
<KEY OUT POLARITY>,<INTERNAL RATE>,<KEY IN TIMEOUT>,<AVIP>,<FLIP-FLOP>,
<QC LOG OUTPUT>,<LOCAL/REMOTE>,<LCD CONTRAST>,<EOC LIMIT>,<CURRENT LIMIT>,
<32-BIT HEX PEAK CURRENT SCALER>,<KEY IN OFFSET>,<CHARGE PROFILE>:

Example Settings:
$SETTINGS,CSP-Nv 1200,2345678,1.14,1.07,0050J,LO,EXT,POS,ON,0085us,POS,
1000ms,30s,ON,OFF,ON,LOC,050%,090%,7700A,000625D5,0024us,1:

Log Format:
$LOG,<TIME>,<DATE>,<32-BIT HEX KEY NUMBER>,<KEY RATE>,
<PRE-FIRE VOLTAGE>,<POST FIRE VOLTAGE>,<PEAK CURRENT>,
<TAMBIENT>,<TINLET>,<TOUTLET>,
<32-BIT HEX EVENT FLAGS>,<32-BIT HEX FAULT FLAGS>:

Example Logs:
$LOG,14:44:59,24-MAY-2018,00001786,0200ms,2504v,0022v,6446A,25c,26c, 24c,
00020080,00000000:
$LOG,14:44:59,24-MAY-2018,00001786,0000ms,0000v,0000v,0000A,25c,26c, 24c,
00000000,00000001:

Termination Log Format indicates CSP operation termination source:
$TERMINATION,<SOURCE(S)>:

Example Termination Logs:
$TERMINATION,HV_OFF_LATCH,HV_OFF SWITCH:
This log indicates CSP operation was terminated normally by HV OFF button press.

$TERMINATION,HV_OFF_LATCH,FAULT_LATCH,TA FAULT:
This log indicates CSP operation was terminated abnormally due to high ambient temperature of operating environment.

$TERMINATION,POWER SUPPLY INTERRUPTED FAULT:
This log indicates CSP operation was interrupted abnormally by mains input or internal power supply failure.

QC Log Format output per shot

QC Log is appended with EOC status:
$LOG,<EOC STATUS>,<POWER>,<LEVEL>,<TIME>,<DATE>,<32-BIT HEX KEY NUMBER>,
<KEY RATE>,<PRE-FIRE VOLTAGE>,<POST FIRE VOLTAGE>,<PEAK CURRENT>,
<TAMBIENT>,<TINLET>,<TOUTLET>,
<32-BIT HEX EVENT FLAGS>,<32-BIT HEX FAULT FLAGS>:

Example QC Logs:
$LOG,EOC=Y,01000J,LO,14:44:59,24-MAY-2018,00001786,0200ms,2504v,0022v,6446A,
25c,26c, 24c,00020080,00000000:
$LOG,EOC=N,01000J,LO,14:44:59,24-MAY-2018,00001786,0000ms,0000v,0000v,0000A,
25c,26c, 24c,00000000,00000001:

Note no termination log for QC Log Output.

Event Flags

Format is 32-bit hex long word.
Only flags logged are EOC flag (bit 7) and OPERATING flag (bit 17).
i.e for event flags 0x00020080, 2 is OPERATING flag & 8 is EOC flag.

Fault Flags

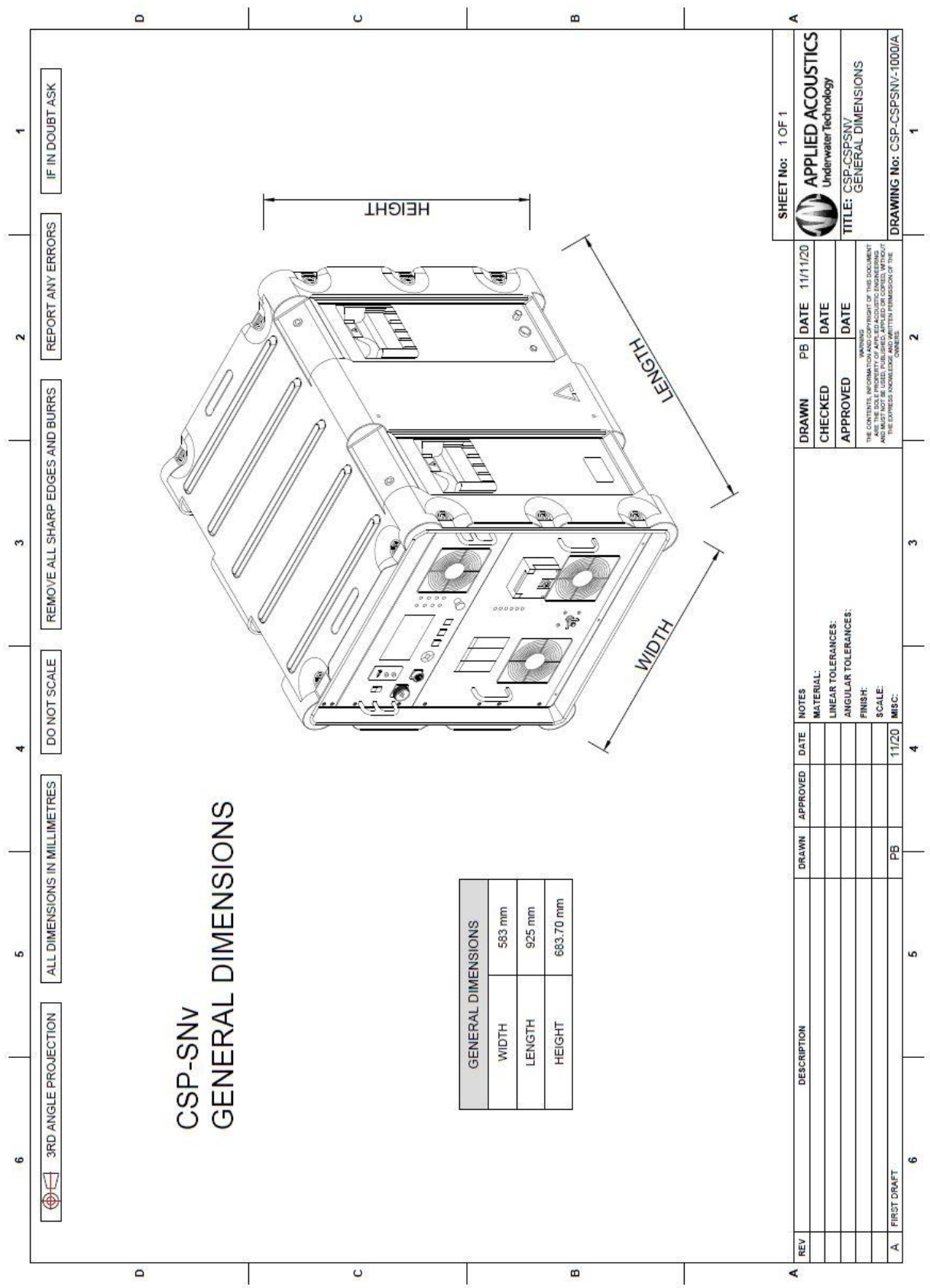
Format is 32-bit hex long word.
All fault flags are logged. Bit descriptions below:

BIT	DESCRIPTION
0	HV OFF LATCH
1	INTERLOCK LATCH
2	FAULT LATCH
3	HV FAULT LATCH
4	KEY IN TIMEOUT FAULT
5	HV SHORT CIRCUIT FAULT
6	HV OPEN CIRCUIT FAULT
7	HV CHARGER SUMMARY FAULT
8	HV CHARGER LOAD FAULT
9	HV CHARGER OUTPUT FAULT
10	HV SPARE FAULT
11	TA FAULT
12	TIN FAULT
13	TOUT FAULT
14	HV CONNECTOR INTERLOCK FAULT
15	TOP COVER INTERLOCK FAULT
16	THYRISTOR TEMPERATURE INTERLOCK FAULT
17	SPARE INTERLOCK FAULT
18	EMERGENCY STOP INTERLOCK FAULT
19	EMERGENCY STOP SWITCH FAULT
20	INTERLOCK BOARD FAULT
21	MCU FAULT
22	CPLD FAULT
23	LCD FAULT
24	EEPROM FAULT
25	LOW MAINS FAULT
26	REMOTE UNIT FAULT

e.g. for fault flags 0x00000001, 1 is HV OFF LATCH with no other faults (user ended operation with HV OFF key).

POWER SUPPLY INTERRUPTED FAULT is assumed if all fault flags are zero.

Appendix D – General Dimensions



Applied Acoustic Engineering Limited is a leading company in the design and manufacture of a wide range of subsea navigation and positioning products, and marine seismic survey equipment.

The extensive product range includes the innovative USBL tracking system, Easytrak, a variety of positioning and release beacons and seismic sub-bottom profiling equipment for offshore geotechnical and seabed analysis.

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