APPLIED ACOUSTICS
Underwater Technology

CAPACITOR CHARGING UNIT

CSP-CSPD-8000/2

MODELS COVERED IN THIS MANUAL:

CSP-D 2400
CSP-D 1200
CSP-D 700

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OPERATION MANUAL

Section 1

CONTENTS **PAGE**

WARNING

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

ENSURE ADEQUATE SAFETY PROCEDURES ARE EMPLOYED.

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 cetacian 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 cetacian 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.

INTRODUCTION

This manual covers the following CSP-D models available from AAE:

1) **CSP-D 1200.** Based on the highly proven CSP1500, the CSP-D 1200 has a high voltage charger rated at 1500 joules per second, and can supply up to 1200 joules of energy per shot into boomer and sparker loads. The CSP-D allows the user to select HI and LO power levels this can effectively tune the source to a lower frequency response. The CSP-D 1200 can be supplied with just 700J of energy storage capacitors which allows for future upgrading.

2) **CSP-D 2400.** A higher capacity version of the CSP-D 1200, the CSP-D 2400 can operate with low energies for boomer operations or large energies which are tailored for use with the Squid 2000 sparker.

3) **CSP-D 700.** This is a lower capacity version of the above units and can be upgraded to the full 1200 or 2400 joule specification at the factory.

The CSP-D's incorporate many common parts and apart from the differing amounts of energy storage, can be considered essentially as the same. All units feature a switchable soft start 'power save' circuit; 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 1500J per second even when the average energy drawn from the capacitors is less; a typical example may be 100 J at 3 pps (300J). This results in a rapid capacitor charge rate for 67 mS 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 circuitry will automatically adjust charge rate from 20% to 100% of specification, thus lowering the peak charge rate to just 300 J / second compared to bursts of 1500J/second. The circuitry also features a soft start function, which may take around 20 seconds before the charge rate is ramped up to the correct amount for the task in hand.

The CSP-D's allow 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 maybe effective in certain instances where more penetration is required.

The CSP-Ds monitor the output of the system for open circuit fault conditions and over current fault conditions, limited to approx 5000A.

INSTALLATION

SITING THE CSP-D

The CSP-D units can deliver high energy, high voltage pulses, yet still emit minimal electrical emissions, and so can carry the CE mark.

The CE marking ensure that the CSP-D's 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-D's 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-D's 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 harms 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 (ie 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.

EARTHING

All CSP-D's 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. 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 time during towing activity even during heavy roll.

It is recommended that earthing 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.

The CSP-D 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.

This manual is supplied in three parts:

Section 1	Basic operation information details.
Section 2	For manufacturer trained technicians only and provides troubleshooting advice, schematics and circuit descriptions.
Section 3	Provides block and circuit diagrams.

OPERATION

INSTALLATION

The CSP-D 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-D 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-D 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-D 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-D front panel earth stud, to an appropriate earthing point on the vessel. If a suitable earth cannot be found, the CSP-D 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.

OUTPUT CABLE CONNECTION

ENSURE POWER TO UNIT IS TURNED OFF BEFORE ANY CONNECTIONS ARE MADE. Connect the high voltage cable to the CSP-D front panel using the high voltage connector. The HV connector has 2 small sensing pins which will deactivate the high voltage if mains power is applied without the connector in place. Ensure the HV connector is fully mated to the unit. The two larger sockets should never be at a high potential but it makes sense never to attempt to touch these.

If you have our HV junction box, the two conductors of the acoustic source - boomer plate or sparker should be connected to this before connecting to the CSP-D. The terminal wing nuts should be tightened onto clean copper or tinned copper terminals. A good connection is necessary as high currents pass through these terminals. Ensure that the +ve or red terminal is connected to the + mark inside the HV Junction box. The black or –ve terminal should be connected to the – mark inside the HV junction Box. Ensure that the microswitch 'clicks' when the top cover is secured. The HV Junction Box can be bulkhead mounted before the cover is secured. In the situation of the power cable / sound source being caught on an object, the HV cable is pulled from the HV Junction Box, rather than the CSP-D unit being pulled onto the floor.

The junction box is usually supplied with a 1.5 metre lead, terminated in our HV connector. **FOR OPTIMUM SAFETY THE JUNCTION BOX MUST BE GROUNDED TO THE CSP-D FRONT PANEL.** The junction box is fitted with a microswitch which is connected to sense pins in the HV plug, ie deactivating the high voltage charger if the lid is removed and the 'INTERLOCK' light will illuminate.

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

If a ready-wired plug is supplied, it 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-D unit. Although the unit will operate from most generators of 3 kVA, the quality and regulation vary considerably from make to make and how well they have been maintained. We have used 3.5 kVA generators without problems. 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 ‘inverter’ type generators do not work well with CSP-D units.

The AVIP technology inside the unit can be utilised to reduce the generator requirements. The CHARGE RATE switch has two positions (Located on rear panel)

IN : High Charge rate.

The charger delivers the full charge rate (1650 J/sec peak) on demand to charge the storage capacitors.

OUT : Auto Charge rate.

The AVIP (Automatic Variable Input Power) circuitry is operational. This adjusts the charge rate automatically to suit the capacitor selection and the repetition rate used, and ensures that a constant current is drawn from the AC mains supply. It is a soft start circuit and adjusts the charge rate by 5% per sample; a sample occurs each trigger pulse. AVIP will adjust the charge rate from 20% to 98%, thus allowing 100J 3pps operation from a 500 VA generator. Note that it can take up to 16 samples for the charge rate to be set to the correct amount.

AC POWER REQUIREMENTS

Voltage ratings are quoted elsewhere in this manual.

TYPICAL CURRENTS
At 1500J at 1 pps (AVIP out of circuit); Non PFC charger, the following currents apply:-

Voltage	Peak Current	Average Current
110 VAC 50 Hz	28A	19.7A
240 VAC 50 Hz	19.5A	7.9A

(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

LINE VOLTAGE DERATING

The capability of the HV charger to deliver energy to the load (storage capacitors) reduces with reduced line voltage as the following tables apply.

240 V Models.

Line Voltage	**Charge Rate**
180 VAC	1250 J/second
200 VAC	1400 J/second
210 VAC	>1500 J/second

115 V models

Line Voltage	**Charge Rate**
100 - 115 VAC	1300 J/second
116 – 130 VAC	>1500 J/second

You may notice that the low line voltages above are below those specified in the rear of this manual under ‘specifications’ The above tables denote the ability of the charger to perform under certain line voltage conditions, and not the complete system. We do not recommend operating the CSP-D units below the minimum voltages listed in the specification section of this manual.

FURTHER REMINDER

If the unit has recently been moved from a cold environment to a warm one, condensation may have developed, which may cause arcing in high voltage equipment. The operator is advised to switch the unit on and run the fans for 10-15 minutes before allowing the high voltage to be switched on. This will allow the unit to warm up to the room temperature, and any condensation will disperse.

Power Up

When suitably connected to ground, the transducer and AC mains, and the transducer is in the water, the power can be applied using the ON / OFF switch and circuit breaker. The fans will run, and the HV OFF / RESET button will illuminate. Select the appropriate power output required and press the RESET button to reset the internal circuitry. Turn and hold the HV ENABLE KEY & simultaneously press the HV ON button: there will be a small delay before the HV relays engage, and then the high voltage will come on as indicated by the illuminated HV ON switch. Any changes in system parameters (such as power change) will cause the HV to switch OFF, and the unit will need to be RESET before the HV can be switched on again. If the INTERLOCK indicator illuminates, check the HV plug / HV junction box.

Trigger Input

Trigger input is by BNC connector. The unit accepts +ve trigger (triggers on rising edge) 5 - 20 volts. opto-isolated, or by contact closure, as controlled by the KEY switch. (OUT for +ve key, IN for contact closure.) The manual key button can be used too and this also shows, by illumination, when a key pulse has been accepted. (A lockout circuit limits the unit to around 6PPS maximum.)

Local / Remote

The LOCAL / REMOTE switch allows connection of remote box for operation from the laboratory or instrument room. Using the remote box is achieved by turning the LOCAL / REMOTE switch to remote. The high voltage can only be turned on from the instrument room and *not* from the CSP-D Unit. The high voltage OFF button is operational from the CSP-D Unit *and* remote box. The CSP Unit can also be keyed from the remote box via a BNC socket. The remote also monitors the status of the key detect circuitry, and the key LED will only illuminate on reception of a valid key pulse within the CSP-D itself, thus the operator can also see if the interconnection cable is OK. The remote also has a FAULT LED, as well as high voltage ON and high voltage OFF indicators.

LOCAL Operation indicated by LED on – Switch OUT.
REMOTE Opersation indicated by LED out – switch IN

OPERATION

Operation of the CSP-D is similar to previous versions of the CSP.

Installation check-list:-

a) The sound source (boomer plate or sparker) has been connected and that it is in the water.
b) A key pulse is connected – either through the front panel BNC connector or through the remote input.
c) A good earth has been connected from the 'Safety Earth' bolt on the front panel preferably to both the ship and a sea earth.
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.

Once switched on, the 'HV OFF / RESET' button must be pressed to reset any fault latches and the light behind the 'Manual Key' button is flashing in sequence with the key input signal. The output power can now be selected by using the two rotary switches as shown in the accompanying photographs. The two switches select a combination of capacitor settings (labelled 1 – 12) and voltage settings (labelled LO and HI) so the operator can choose the power setting required for the job in hand. Please see next section. Once the appropriate setting has been made, the 'HV ON' button can be pressed whilst simultaneously turning the 'HV Enable' keyswitch clockwise.

A series of up to 5 clicks will be heard depending on the energy selected as the relays switch in circuit. Once these relays have engaged, the high voltage is enabled.

If either of the power level switches is moved or if the HV off/reset button is pressed, the unit will shut down safely. In an emergency, the red 'STOP' button can be pressed.

The maximum repetition rate is governed by the charge rate (1500 Joules per second) and the amount of capacitance selected. For example, at 300J / shot the CSP-D models will run at 5 PPS. At 1200J (or 1250J), the CSP-D 1200 and 2400 will operate at 1 pulse per second, with a little in reserve.

Energy Settings.

CSP-D 700	OUTPUT POWER	
SWITCH POSITION	HI	LO
1	100	50
2	200	100
3	300	150
4	400	200
5	500	250
6	600	300
7	700	350

CSP-D 1200	OUTPUT POWER	
SWITCH POSITION	HI	LO
1	100	50
2	200	100
3	300	150
4	400	200
5	500	250
6	600	300
7	700	350
8	800	400
9	900	450
10	1000	500
11	1100	550
12	1200	600

CSP-D 2400	OUTPUT POWER	
SWITCH POSITION	HI	LO
1	100	50
2	200	100
3	300	150
4	500	200
5	750	300
6	1000	400
7	1250	500
8	1500	600
9	1750	700
10	2000	800
11	2250	900
12	2400	1000

- Items marked in red are not suitable for a single boomer.
- The blue column is unlikely to be suitable for sparker applications.

Operation of the CSP-D 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-D). The LO voltage 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 using switch positions 2 and HI. However if position 4-LO is used, the same energy is being applied to the transdcuer although at a lower voltage, so the pulse length is increased.

Load Specifications:

The CSP-D 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)	AA200 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-D 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 over drive the sound source ! (boomer plate - check the boomer plate manual).

Operation of the CSP-D with a sparker sound source.

It it not expected that the LO switch position will generate enough voltage for a sparker to operate successfully, with the exception of the unusual cases, so it is currently not recommended that the LO position is used for powering sparkers, although no damage will be done to either the sparker or the CSP-D.

Sparker power settings with CSP-D units.

AAE Sparker model number	Typical Input energy (Joules)
Squid 500	300 – 700
Squid 2000	600 – 2400
High Power Sparker	1200 – 6000

Sparker Load

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 standard seawater with a salinity of 35 ppm.

Energy	Squid 500 (60 tips)	Squid 2000 (120 tips)
100J	1000A	1900A
600J	1300A	2800A
1500J	1300A	3000A
2000J	-	3300A

Dummy Load

AAE manufacture a dummy load with precisely designed characteristics which can be used for testing of CSP-D units in the workshop to avoid ‘water based dummy loads’ such as dustbins full of salt water etc!

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

OPERATOR CONTROLS AND INDICATORS

MAINS POWER switch

Double pole switch that also acts as an overcurrent circuit breaker. It is situated by 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.

HV OFF/RESET switch

Needs to be pressed if fault occurs, or if someone has tampered with the controls. This button also operates as the HV OFF button. Press to switch OFF.

HV ON switch

Switches in capacitors and HV PSU, (note delays on switching), switch illuminates when the high voltage is switched on operated in conjunction with the HV ENABLE key switch, thus to switch HV ON, HV ENABLE needs to be enabled simultaneously.

MANUAL KEY switch

Triggers CSP unit when pressed. Also illuminates when an external key pulse is detected

KEY POLARITY switch

Used to select either:
+ve key pulse (3.5 – 20 volts, opto isolated triggers 0.5 mS from rising edge), or
contact closure (triggers 0.5 mS from falling edge or closure - not isolated).

LOCAL / REMOTE switch

Controls whether an external remote box can be used, as marked on the front panel.
Note that the unit can be switched off from the front panel and the remote at any time.

CHARGE RATE switch (Located on rear panel)

As previously described, this switch selects the AVIP circuitry or full charge.
Recommended position : Out (AVIP Engaged)

INDICATORS

EOC (End Of Charge) indicator

LED 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-D is being fired 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.

FAULT indicator

This indicator will normally illuminate when the unit is powered up, and will extinguish when the RESET button is pressed. It will otherwise illuminate during most faults. Please note that the fault light will not illuminate if the thermal cut-out operates in the charger module.

INTERLOCK indicator

Illuminated if front panel connector is left out when the unit is switched ON or if the lid of the HV junction box has not been closed correctly. The interlock LED will also illuminate if the top cover is removed. You will need to press RESET once the interlock condition has been cured.

TIME OUT indicator

For safety, the HV is switched OFF after a period of approximately 25 - 30 seconds without key. This also helps preserve the capacitors, as all pulse discharge capacitors are not designed to sit powered up indefinitely.

HV FAULT indicator

Indicates an output overvoltage, (possibly due to an open circuit capacitor), temperature fault or low input voltage condition.

LOAD FAULT Indicator

Indicates an HV Output over current or open circuit condition. The indicator will be illuminated together with the HV OFF LED for 10secs before reseting.

CONNECTORS

MAINS INPUT

200 – 250 VAC mains input. Connection details are supplied elsewhere in this manual.

REMOTE

Allows operator to remotely control CSP-D.

HV OUTPUT

4 pin proprietary connector. Using our HV2 plug, the large connector pins are proof tested to 6000 volts and can operate with current pulses up to 6000 amps. The two small pins are used as interlock pins. If these are left open circuit, the CSP-D will not be able to enable the high voltage (INTERLOCK fault).

TRIGGER INPUT

The trigger input is connected via a BNC socket.

REAR PANEL

FUSES

The rear panel contains 2 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)	7A Antisurge 1¼"	(110V)
F2	3A Antisurge 1¼"	(240V)	7A Antisurge 1¼"	(110V)

CHARGE RATE SWITCH (see text).

Reccomended position is OUT to make use of the AVIP circuitry.

FAN FILTERS

The rear panel of the units has 2 fold-down handles to ease installation, and also has 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

All interlocks and safety features are doubled. For example, if the HV connector is removed, the HV is shut OFF by the logic board 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.

The unit should be disabled by removal of the key switch or removal of the mains lead or the HV Plug before any attempt is made to make any wiring changes or inspection of the load. 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. Crewmembers should be made aware of these facts during mobilisations.

SPECIFICATIONS

CSP-D SERIES CAPACITOR DISCHARGE POWER SUPPLIES

Models Available

	CSP-D 700	:	1500J/s at up to 700J/shot.
	CSP-D 1200	:	1500J/s at up to 1200J/shot.
	CSP-D 2400	:	1500J/s at up to 2400J/shot.
Physical Specifications	Size	:	19" Rack Mount 7U high excluding shock mount housing.
CSP-D	Weight	:	51 kg CSP-D 700
		:	52 kg CSP-D 1200
		:	54 kg CSP-D 2400

Electrical Specifications

Mains Input	:	207 - 260 V 1 phase.
	:	45 - 65 Hz @ 2.5 kVA.*
	:	3-Pin connector.
Voltage Output	:	2700 to 4000 volts DC.
Output Power	:	100 to 2400J depending on model. By 4-Pin connector (Power and interlock).
Selection	:	Rotary switches.
Trigger	:	+ve key (+5 to 25V rising edge) opto isolated or contact closure. Set by front panel switch.
Discharge Method	:	Semiconductor module.
Maximum Current	:	A current sensor ensures that the unit shuts down beyond approximately 6000 Amps although the thyristor module can exceed this.
Remote	:	10 way amphenol.
Earth	:	M8 stainless stud on front panel.

* SEE TEXT ABOUT GENERATOR SELECTION. 110 VOLT VERSIONS ARE AVAILABLE.

Safety Features

Should any fault develop, the high voltage PSU (Charger) and all capacitors (which have bleed resistors) are individually dumped to ground, until the system is reset. A double layer of safety cut-outs ensure that partial failure results in system shutdown.

Interlocks	:	Dumps high voltage when fault develops.
Time Out	:	Shut down after period (~30 seconds) without key pulse.
Local/Remote	:	Disables remote (if fitted).
Load	:	Shuts down HV upon open circuit load or load over current.
Reset	:	Resets unit after fault or if interlock activated.
Keyswitch	:	Must be rotated to enable high voltage. Switch can be removed to disable unit for example when working on deck.
Open circuit detect	:	Disables firing when an open circuit load is present.
Output current detect	:	Shuts unit down if current exceeds a pre-determined level.
Thermal shut-down	:	HV charger shuts down if it overheats.

Options

Remote	:	Allows operator to control unit at a distance. Includes key pulse line.
Junction Box connector.	:	For connection of standard transducer cables to HV
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.