Moonraker Marine Lightning Protection Systems

Moonraker LPS lightweight aluminium lightning rods may provide a zone of protection for vessels. The LPS keeps resistance to a minimum providing an attractive low impedance path to the ground/sea. The stainless steel tip is sharpened to increase the intercept capability of the lightning leader in the charged field below a thunderstorm. A stainless steel stud combined with the solid aluminium base provides direct electrical connection to the earth system or to the metal deck or superstructure of a ship. Rods are available in 3, 4 or 5 metre heights.

The ***Moonraker LPU horn gap over voltage system*** for HF antenna feeders gives an easy path to earth for high voltage static charges, such as those induced in the antenna system by lightning induction and other electromagnetic disturbances. The unit exhibits low capacitance to earth in order to cause minimal effect upon antenna tuning. Coupled with CSS protection, the range is extended to cover all frequencies from MF to 2 GHz.

Transient over voltages appearing between the inner conductor of the coaxial cable and its screen can directly damage receiver and line driver chips of communications equipment. ***Moonraker CSS marine coaxial surge suppressors*** contain fast response gas filled arrestors to provide low let through voltage for fast rise time transients. They provide over voltage protection for radio transmitters, receivers, tuning units, high frequency LANs and all high frequency cable systems from high voltage spikes caused by lightning strikes. Models suit various transmitter powers and receivers.

DC and AC external cables feeding navigation lights, wind speed and direction indicators, etc., can also carry transient over voltages to other instruments and electronic devices such as chart plotters, computers and the like, to cause damage. ***Moonraker DCL and ACL line protectors*** act to prevent this happening by clamping the voltage and conducting surges safely to ground.

In making earth connections, it is not actual size that counts, but rather total surface area. ***Moonraker E Plates*** although compact in size have a large surface area with no high resistance joints and provide an efficient low impedance connection to the sea in wooden or fibreglass vessels. They are available in copper or aluminium for installations where electrolysis could occur. Connecting conductor should be 25 x 3 (75 sq mm) copper or aluminium strap, welded together to provide the required length if continuous length is not available.

For a more in-depth view of our product range, please visit our website at: ***http://www.moonraker.com.au***

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MOONRAKER

MOONRAKER AUSTRALIA

Over 10% of deaths at sea oncrusing sailing boats alone are caused by lightning. Marine vessels standing out against the vast expanse of ocean water can often be a prime target for a lightning leader seeking the most attractive path to ground.

Moonraker lightning systems are designed and manufactured to give you the protection you need.

Don't be a target!

Marine Lightning Protection Systems
high performance solutions for demanding environments

Moonraker Marine Lightning Protection

Don’t be a target!

In a storm cloud, positive and negative charges separate. When the negative charges reach a high enough level, ionisation occurs and a stepped leader is sent out bringing the electrical charge with it. Forking occurs as it seeks an easy path to the positively charged ground below.

As the leader approaches the ground, the electrical field intensifies further, especially around objects that stand out from the surface of the earth. The greater the height of the object, the greater the intensification.

When the intensification reaches a sufficient level (3 million volts per metre) at ground level, ionisation occurs. Return streamers of positive charge reach up from the ground to meet the downward leaders, when they meet the electrical charge in the cloud is discharged using the ionised pathway or return stroke to ground.

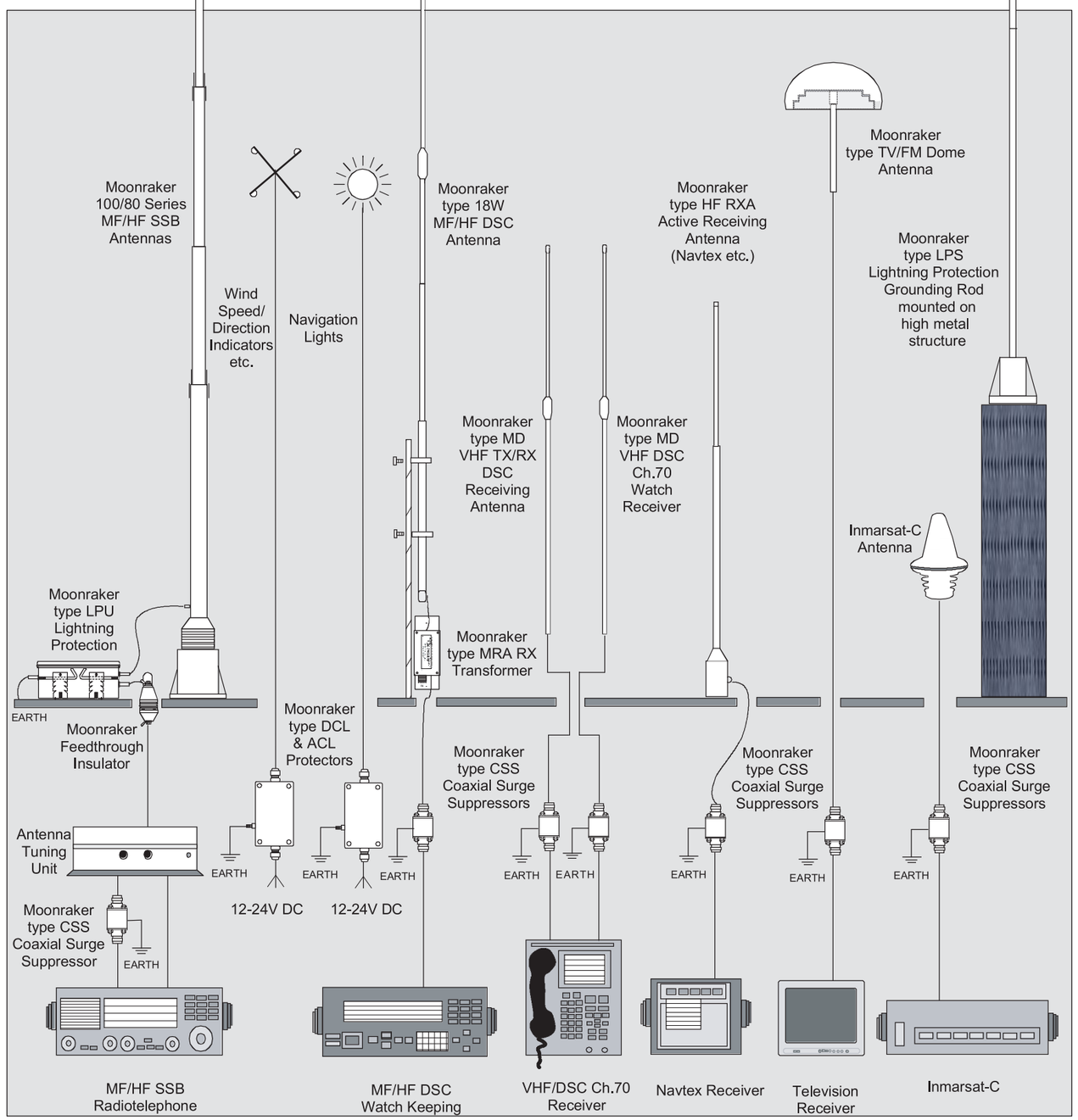
This is the process that creates lightning strike, that ends in tragic deaths and billions of dollars of damage every year. Frighteningly, a large thunderstorm has more total energy that an atomic bomb and can generate temperatures as great as 50,000°F (28,000°C), which is five times hotter than the surface of the sun!

Lightning discharge is a common occurrence. More than a thousand thunderstorms around the Earth cause some 6,000 flashes of lightning every minute. Most lightning strikes occur in less than half a second with each charge containing 30 million volts at 100,000 amperes. And, despite popular belief, lightning can and does strike in the same place twice!

Even if you are kilometres away, so great is the energy involved that voltage or transient currents from lightning can be induced into antennas and cables, causing extensive damage to equipment.

A vessel with antennas and masts, standing out from the relatively flat surface of the sea, will look very attractive to a lightning leader seeking an easy path to ground. Installing a lightning protection system is your best insurance against becoming a statistic.

The main aim of a lightning protection system is to attempt to capture the lightning strike, conduct it safely to ground, dissipate the energy into the earth/sea through a low impedance ground system and provide a form of overvoltage protection for electronic systems both from direct lightning strike and from induced transient currents.



Playing it safe

By installing a lightning protection system, you will be making your vessel more lightning-protected rather than lightning-proof. Lightning protection systems do not prevent lightning strikes - but neither do they increase the chance of you being struck.

Essentially, there are two main situations to be dealt with. The first is that of a direct strike. The second is that of a nearby strike creating an overvoltage situation. This means that you need to have a system that encompasses the whole ship and the equipment on board. The aim is to keep overvoltages outside the vessel and therefore out of contact with all electronic equipment, such as engines, computers, etc.

Usually, but not always, direct strikes will be taken by the highest fitting on the ship. Often the most attractive path to ground is provided by the mast where there is one. Protection involves ensuring that the mast can conduct the lightning safely to ground and that it is more attractive than other parts of the vessel.

To achieve this, the mast and all other major metal masses need to be bonded together with heavy conductors to create a type of Faraday Cage. All equipment needs to be connected with low resistance cables or strap and well grounded to the sea following as direct a route as possible.

It is important to ensure that your crew falls within the protection of the cage and that communications equipment is grounded separately.

Even vessels without masts can protrude considerably above the surface of the water and thus be at risk. Having a mast or other conductive metal protrusion known as an air terminal extending well above the vessel gives you the advantage of creating a cone or zone of protection. This zone extends radially at a 45° angle from its tip in the shape of a cone, and if the mast or air terminal is sufficiently high enough, the entire vessel should fall within the protected zone.

Lightning protection rods can be used singly or, when placed around the upper perimeter of a defined area, like decks on ships, can protect the area within.

MF/HF antennas are high voltage and, being tall, can be a prime lightning target. So, special protection must be provided to protect communications equipment from serious damage if they are struck.

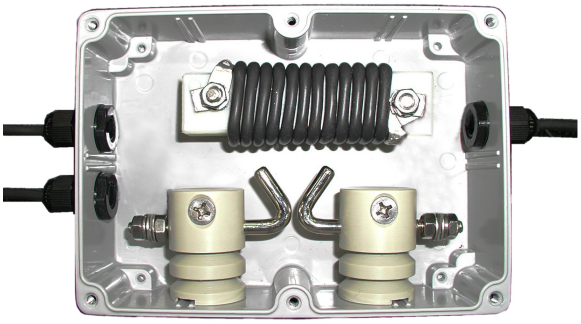
Obviously fitting surge suppression devices on all primary conductors attached to communications equipment and antennas is a simple precaution that can prevent serious damage from induced transients. Similarly line protectors can prevent damage to equipment connected to the DC or AC power supply.

for all vessels of all sizes

M O O N R A K E R

Type LPU

MF to HF Lightning Protection Unit
for marine and land based antenna systems



The Moonraker LPU is a horn gap overvoltage lightning protection system designed to be placed in MF/HF open wire antenna feeders. It gives an easy path to earth for high voltage static charges, such as those induced in the antenna system by lightning induction and other electromagnetic disturbances. When used with the CSS Coaxial Surge Suppressor, the range is extended to cover all frequencies from MF to 2 GHz.

The solid copper, nickel plated horns are mounted upon special ribbed high voltage insulators which facilitate easy horn gap adjustment. The device is completely enclosed in an IP56 rated (weatherproof) cast aluminium housing, finished with a high durability epoxy based coating, highly resistant to chemical attack, abrasion and the effects of ozone and ultra violet radiation. It is designed to be back mounted externally, close to the antenna feed point. The LPU metal housing ensures it is intrinsically safe from fire and explosion.

The unit exhibits low capacitance to earth in order to cause minimal effect upon antenna tuning. As most antenna tuning units (ATUs) provide little resistance to high reverse voltages, we also recommend that a Coaxial Surge Suppressor be fitted in the 50Ω coaxial cable between the ATU and the transmitter for HF installations.

Specifications

LPU	Tested in accordance with ANSI C6241 Category B, ie 45kV 1.2/50 micro second (rise/fall times) voltage pulse, 5kA 8/20 microsecond current pulse; observed breakdown with continuous RF at 3.3 MHz 1.5mm gap, 3.5kV rms (refer to installation instructions)
Housing Dimensions	55H x 120W x 170Lmm L (215mm including cable glands)
Maximum RF Power	1.2kW PEP
Adjustment	Screwdriver clamps on horns using feeler (thickness) gauges (refer to installation instructions)
Connection	1metre Moonraker HV silicone insulated antenna cable supplied at each end for connection to antenna feed stud, ATU and to earth
Weight	910g (2 lbs)
Packed Weight	1.5 kg (3.3 lbs)

Specifications subject to change 7/07

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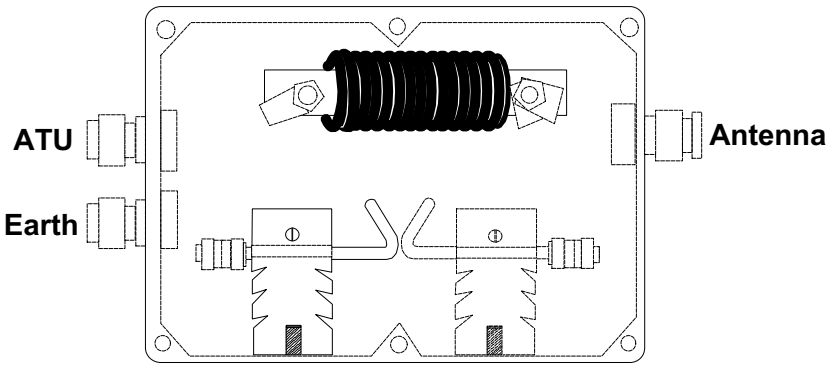
M O O N R A K E R

INSTALLATION INSTRUCTIONS TYPE LPU



The unit is designed to be placed in the open wire feeder between the antenna and antenna tuning unit (ATU). A close by, low resistance earth point is essential for optimum protection.

MOUNTING

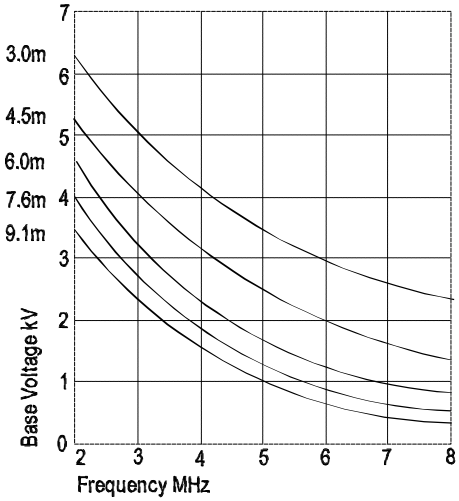
The LPU may be mounted on either a horizontal or vertical surface utilising the mounting holes in the bottom panel.

CONNECTION

Utilising the nuts, lugs and washers on the threaded ends of the horn gap rods, connect one horn to the antenna feed (preferably at or near the base of the antenna) and the other horn directly to a low resistance earth (ground). 1 metre of Moonraker HV Silicone Cable is supplied at each end for these connections. The antenna connection must be made to the horn connected internally to the coil. The earth lead should be as short and as direct (no sharp bends) to earth (ground) as possible. The ATU should be connected to the other end of the coil. Seal up all cable entries and unused mounting holes with silicone sealant to prevent moisture and insect ingress to housing.

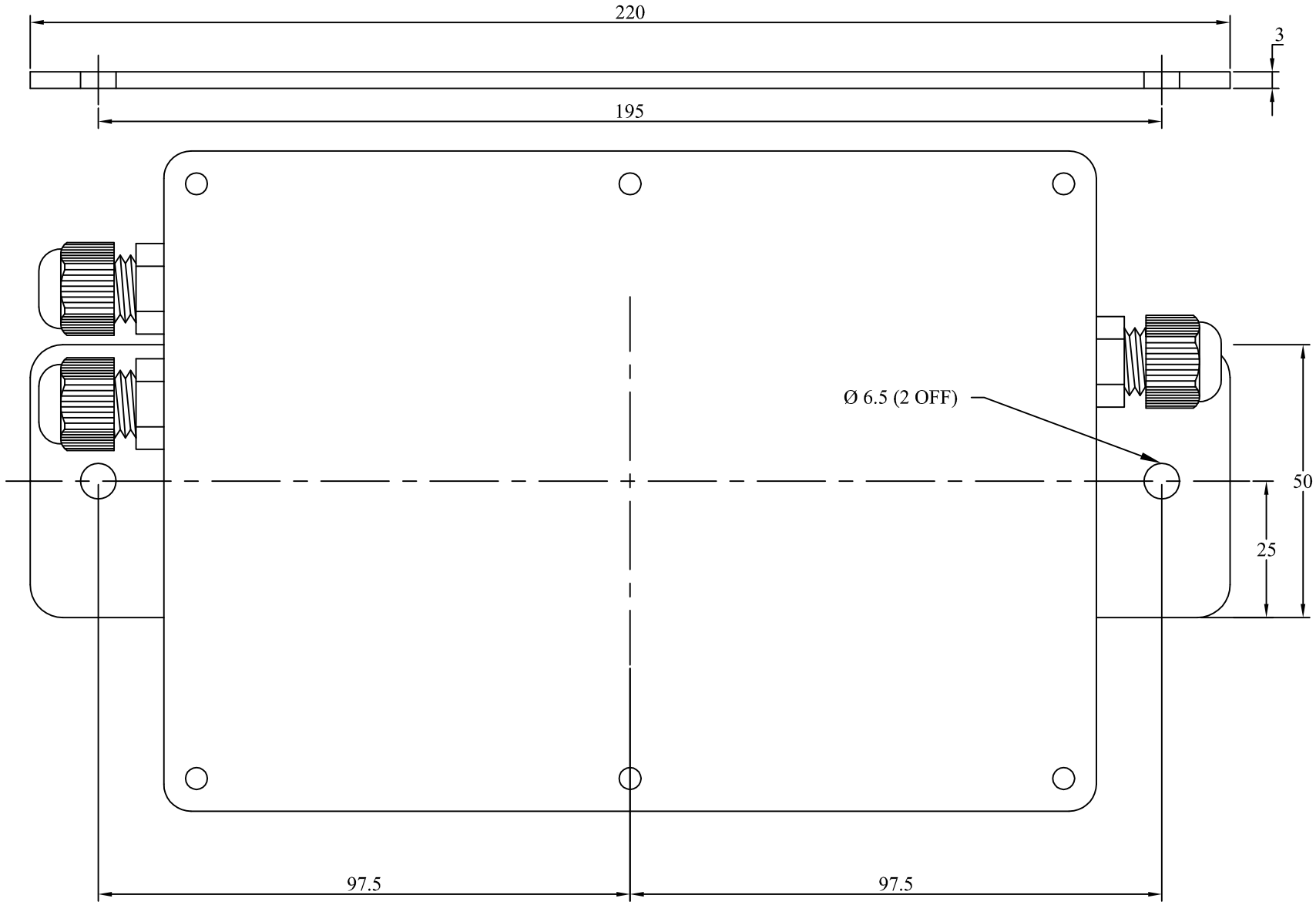
ADJUSTMENT

The horn gap must now be adjusted to suit the particular installation.



Typical antenna base voltage at 100w using an ATU for various lengths of antenna/feedwire

- **Slacken the horn clamp screws at the top of the standoff insulators. The horns can now be oriented so that they are both in the same plane (exactly).**
- **Tighten the clamping screw on one of the horns. The other horn can now be slid in its clamp to facilitate gap adjustment relative to the other horn.**
- **Using the graph as a guide and from the approximate length of your antenna (including the length of feeder from the ATU) and the lowest frequency used, determine the likely maximum base voltage.**
- **Preset the horn gap to approximately 0.5mm (0.020in) per kV of calculated base voltage. The use of feeler gauges will assist here.**
- **Tune the system (transmitter and ATU) to the lowest frequency used. This ensures maximum transmit voltage is being applied across the horn gap. Use low power if possible. Increase transmitter power to maximum whilst observing the horn gap and the VSWR.**
- **If arcing effects are visible or tuning (ATU) needs to be varied, turn off the transmitter and increase the gap. Repeat until no arcing effects are observed at maximum power. (Arcing effects will show as a sudden change in VSWR as the horn gap is ionised and breakdown occurs.)**
- **Replace the cover after ensuring that the sealing gasket is seated correctly.**



MATERIAL : 3 ALUMINIUM PLATE

Moonraker Australia Pty. Ltd.
HOBART AUSTRALIA

	/ /		SCALE	1 : 1
	/ /		DES'ND	/ /
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LPU BOX MOUNTING PLATE

DRAWING NUMBER LPU - 004 -

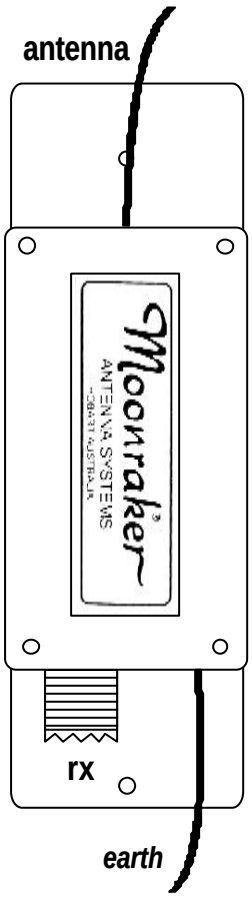
REV

M O O N R A K E R

Type MRA RX-Transformer

Matching transformer for receiving antennas

The MRA RX-Transformer is a wideband (0.3-30 MHz) impedance transformer, designed for matching either whip or long wire antennas to the coaxial cable and receiver. It is ideally suited for 7 metre (23ft) whips (types 23B/3, 23B/3C and 23H/S) and long wire antennas.



The transformer converts the widely varying antenna impedance to a constant 50ohms, permitting long or variable lengths of coaxial cable to be used between the antenna and the receiver. Low loss cable is recommended for lengths exceeding 40 metres (130 feet).

It is designed primarily for shipboard use, but is equally suitable for land based systems, to allow location of receiving antennas to be situated as far as practically possible from transmitting antennas or other high noise areas, such as power lines.

The antenna is DC grounded via the transformer to prevent static build-up and the connecting cable is DC isolated to prevent electrolysis. In addition a gas discharge device is also provided to allow for nearby lightning strikes.

Electrical connection to the antenna is by way of insulated cable to the antenna feedpoint and an earth cable connected to ground. Mechanical mounting is by way of two screws or small bolts through the holes in the PVC mounting plate. The unit should be fixed near to the feedpoint of the antenna. The transformer components are housed in an insulated fully marinised PVC box designed to withstand the harsh marine conditions. As a further guard against water ingress, the components are completely encapsulated in a silicone material.

Units are also available to meet military specifications, being housed in an additional zincanneal box, NATA tested to IP66 standard, and finished in pebble grey. Single outlet (type RXT1N) and dual outlet (type RXT2N) models with cable glands to internal coaxial connectors.

Specifications

Dimensions	Transformer Housing: 112 x 62 x 31 mm (4.4 x 2.5 x 1.2 in) military types: 300 x 150 x 120 mm (11.8 x 5.9 x 4.7 in); Mounting Plate 182 x 57 mm (7.2 x 2.2 in)
Frequency Range	0.28-30 MHz
Bandwidth	Full
Impedance	50Ω nominal
Antenna Types	7 metre(23ft) whips or long wire antennas
Mountings	Via a PVC plate and screws (not provided); distance between mounting holes 143mm (5.6 in), hole diameter 5mm (3/16 in)
Connection	UHF SO239 (in base of unit), allowing direct 50 ohm coaxial feed to receiver; military types: N type connector
Packed Weight	0.26 kg (0.57 lbs)

Specifications subject to change 10/99

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TYPE MRA RX TRANSFORMER

Installation Instructions

For best results the MRA RXshould be mounted close to the feed point of the antenna.

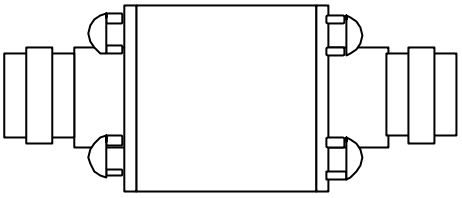
For ease of mounting the unit is fitted with a mounting plate at each end.

1. Select a suitable mounting position on a rail or other structure close to the antenna feedpoint.
2. Using the unit and mounting plate as a template, mark the position of the two bolt/screw holes.
3. Drill the two holes to suit your bolts or screws.
4. Fasten the unit securely with the bolts or screws.
5. Connect the earth cable which is near the coaxial connector at the bottom of the unit, directly to earth or a nearby steel rail. Ensure this is a good electrical connection. It may be possible to utilise one of the unit's mounting bolts or screws for this.
6. Using good quality low loss coaxial cable and connector, connect the unit to the radio receiver directly via the coaxial socket. Waterproof the joint using a sealing compound or tape.
7. Ensure the coaxial cable is secured to prevent strain on the connector.
8. Connect the wire antenna cable at the top of the unit directly to the antenna feed point. Waterproof this connection using a sealing compound and tape.
9. The unit is completely sealed internally to prevent water and insect ingress.

M O O N R A K E R

Type CSS

RF Coaxial Surge Suppressor



Radio transmitters, receivers, high frequency LANs and all high frequency cable systems require protection from transient over voltage due to lightning strikes causing direct induction or potential differences due to earth potential rise caused by spikes to buildings and towers.

Transient over voltage appearing between the inner conductor of the coaxial cable and its screen can directly damage receiver and line driver chips of communications equipment connected via coaxial cables.

The coaxial cable surge protectors contain fast response gas filled arrestors to provide low let through voltage for fast rise time transients. The use of low capacitance gas filled arrestors ensures operation at high frequencies with low insertion loss. The coaxial cable protector consists of a fast acting gas filled arrestor enclosed in an in line mounting with coaxial connectors on either end. The device is configured to minimise circuit capacitance and present a 50Ω characteristic impedance so that performance up to 2GHz is assured. Standard models provide protection for receivers and transmitters up to a 1kW power level. Models for higher power levels are readily available. A range of connectors is available

Installation is easily effected by connecting the protector in the coaxial line as close to the equipment to be protected as is practical. The essential aim of these protectors is to provide electrical clamping between the inner and outer conductors of coaxial cables. Normal precautions such as earthing coaxial cable sheaths at building points of entry is still vitally important. The N bulkhead models are specifically designed to be mounted at cable entry points. The bulkhead mount allows a secure earth connection to the cable entry plate and provides a convenient cable termination point. This is the preferred method of installation.

Specifications

Description	Gas arrestor overvoltage surge protector for coaxial cable systems
Clamping Voltage	1000V line to screen (DC)
Impulse Clamping	<1400v (1kV/us)
RF Power Level	1kW PEP (higher power versions available)
Protection Stages	Gas filled surge arrester
Insulation Resistance	$>10^{10}\ \Omega$
Capacitance	<1.5pF
Surge Withstand	20KA (8/20us)
Insertion Loss	<0.2dB at 2 GHz
VSWR	1.07:1 to 1GHz; 1.1:1 to 2GHz
Cable Impedance	Suitable for 50Ω systems; F connector types 75Ω
Dimensions	70mm (max) x 25mm x 25mm
Connectors	50 & 75Ω types available. Please specify.

Specifications subject to change 10/00

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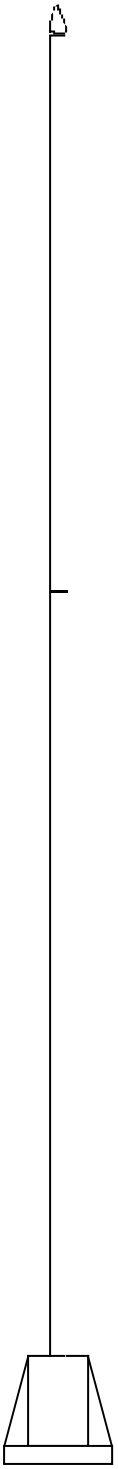
M O O N R A K E R

Type LPS

Lightning Protection Grounding Rod

Moonraker LPS Rods provide a low impedance path for lightning strikes to ground. They are equally suitable for protecting a large rooftop area of a building or for shipboard use when strategically placed around the upper perimeter of the area to be protected.



Lightning tends to take the path of least impedance (resistance and inductance). The LPS keeps this impedance to a minimum by the use of tempered marine grade aluminium tube which provides a large low loss surface area minimising the skin effect. Combined with this lowering of inductance from skin effect is the inherent low resistance of aluminium to provide an overall low impedance path. This type of construction keeps the overall weight low, important in modern ship design. The LPS also features a stainless steel tip sharpened to increase the intercept capability of the lightning leader in the charged field below a thunderstorm.

Mounting is via a cast aluminium alloy base flange and support tube integrally connected to the LPS Rod. A stainless steel stud provides direct electrical connection to the earth system or to the metal deck or superstructure of a ship. The base and the rod are fully protected by a high durability epoxy based coating resistant to chemical attack, abrasion and the effects of ozone and ultra-violet radiation.

For ease of transport, the LPS is supplied in two slip together sections, complete with special jointing shroud and conducting grease sealing kit. Standard colour is low reflecting silver grey.

Specifications

Current Capability	Multiple lightning strikes of 250,000 Amperes
Inductance (total)	3.2 micro henries
Resistance (total)	0.7 milli ohms
Overall Height	4m (13.1ft) and 5m (16.4ft) versions
Diameter	Base element: 32mm (1.3 in)
Construction	Aluminium alloy A6063 Temper T81 with stainless steel 316 rod tip
Wind Survival	250km/h (156 mph)
Bending Force	139MPat rod base including 1.5 safety factor (minimum yield tensile strength for A6063 T81: 205MPa)
Shock	Capable of operation after three successive shocks applied in each direction of three mutually perpendicular axes at : 981m/s for 6mS duration upwards, downwards and horizontally
Vibration	Designed for 10 hours in any of three perpendicular directions: 1.25mm 5-14Hz; 0.45mm 14-23Hz; 0.125mm 23-33Hz
Connection	Stainless steel stud and lock nuts at side
Mounting	Base flange, 152mm (6 in) diameter with 4 x 9mm (0.4 in) diameter holes located equidistant on a 127mm (5 in) circle
Weight	5m version: 7.8kg (17.2 lbs)

Specifications subject to change 11/07

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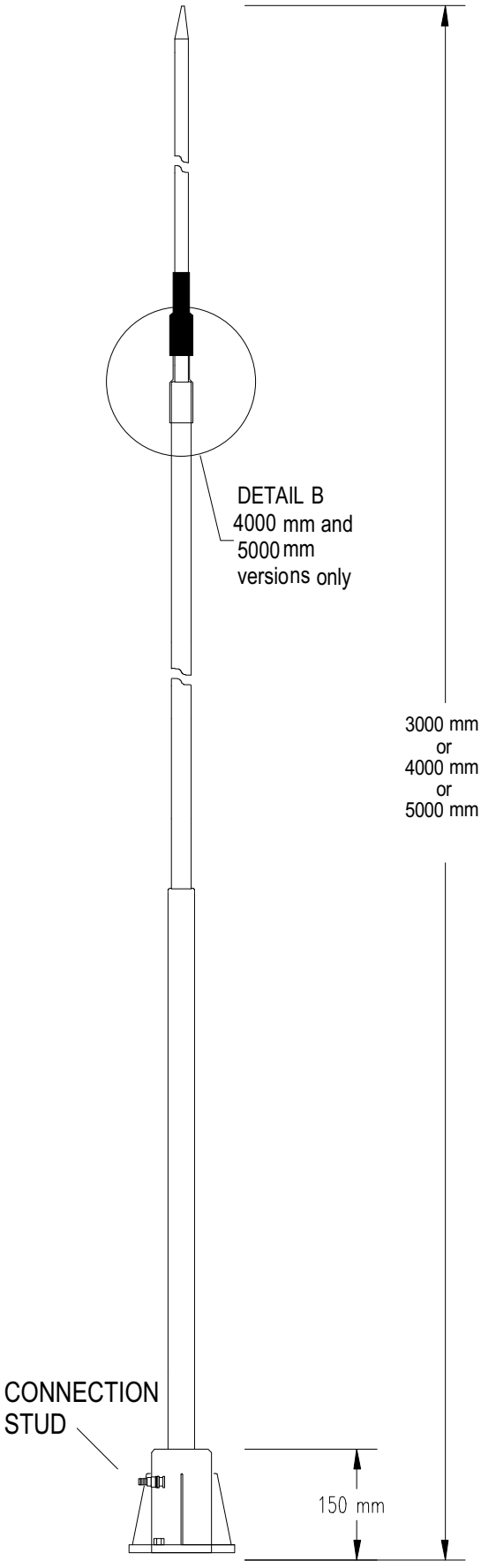
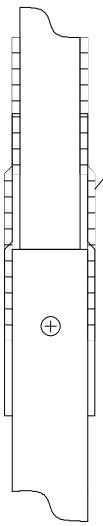


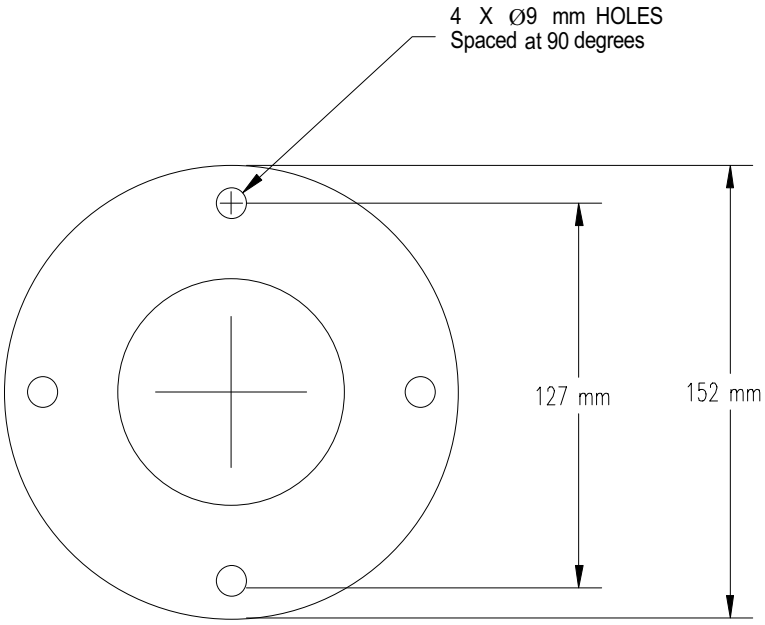


DETAIL B

SPECIFICATION

Overall Length	3, 4 and 5 Metre Versions
Wind Survival	250 km/h
Construction	Aluminium Alloy

Note :- 3 metre version is one piece



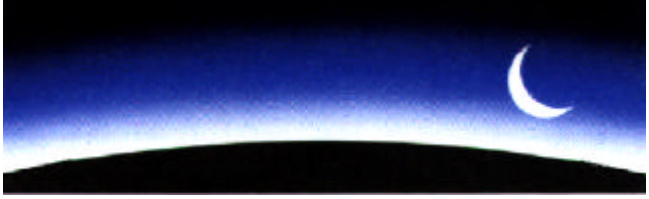
BASE MOUNT FLANGE DETAILS

NOTE:
Base and ground strap must have direct low resistance electrical connection via ship's metal hull or metal superstructure to the sea.
Connection should be via 25 x 3mm aluminium strip.
Avoid sharp bends!

It is important that the connection between the stud and the aluminium strip and the connection between the strip and the ship are sealed gainst water ingress. A neutral cure silicone selant or Sixoflex type material is suitable.

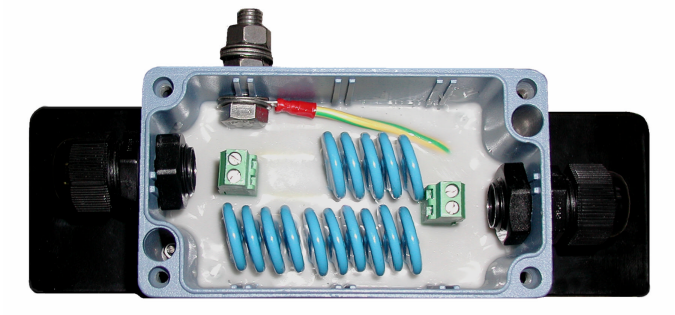
MOONRAKER AUSTRALIA PTY. LTD.
HOBART AUSTRALIA

GLE	20 / 03 / 08	Stud connection	SCALE	NTS		TYPE LPS LIGHTING PROTECTION GROUNDING ROD
			DES,ND	CWE	97	
			DRAWN	RL	98	DRAWING NUMBER / REV
REV BY	DATE	REVISION DESCRIPTION	APPR'D	PC	98	



M O O N R A K E R
Type DCL/ACL

DC and AC Line Lightning Protection for vessels at sea



Lightning generated transients or overvoltages appearing across DC or AC cables and between them and earth are likely to be damaging to connected equipment. DC and AC external cables feeding navigation lights, wind speed and direction indicators, etc., can also carry these transient over voltages via the ships DC or AC wiring to other instruments and electronic devices such as chart plotters, computers, radios and the like, to cause damage.

Moonraker DCL/ACL line protectors provide high quality protection from these potentially damaging transients by clamping the voltage and conducting surges safely to ground. The use of solid-state transient clamping devices connected between each cable and earth, ensures virtually instantaneous protection is achieved. With a rating of 10 amps continuous current, a single DCL or ACL protector will, for instance, support the navigation lights in. For higher current drain two units should be used.

The protectors should be fitted at the point of entry of the cables to the interior of the vessel. Connection in the type DC or type AC cable is via sealed cable glands and internal screw terminals. The lid of the housing is fitted with an O ring seal. The housing is mounted via two bolts (not supplied) through the mounting plate.

The protectors are housed in safe all metal enclosures so that they are intrinsically safe. In the event of a prolonged overvoltage they will not catch fire or explode. The housing is constructed from cast aluminium, being finished with a high durability epoxy based coating, highly resistant to chemical attack, abrasion and the effects of ozone and ultra-violet radiation, and sealed to IP65 rating for waterproofing.

Specifications

Operating Voltage	type DCL suitable for 12, 24 and 32 volts DC; type ACL suitable for 110 and 240 volts AC, 50 or 60 Hz
Operating Current	10 Amps maximum (split the system and use extra units for higher currents)
Earth Leakage Current	less than 500µA (micro amp)
Operating Temperature	-40°C to +80°C
Housing Dimensions	66W x 58H x 114mm long (163 including cable glands)
Earth Terminal	M8 stainless steel stud on side of housing
Maximum Surge Current	type DCL 10kA; type ACL 50kA
Response Time	<5NS
Connection	via cable glands to screw terminals (16mm OD maximum cable)
Mounting	via 2 bolts (not supplied) through base plate 6.5mm (0.26 in)holes
Weight	550g (1.2 lbs)
Packed Weight	1 kg (2.2 lbs)

Specifications subject to change10/09

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