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Sonic Buoy general handbook

K G Birch, C H Clayson & R W Pascal

1994

Natural Environment Research Council

INSTITUTE OF OCEANOGRAPHIC SCIENCES
DEACON LABORATORY

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ABSTRACT

The Sonic Buoy was designed as a surface-following meteorological buoy, with the primary aim of measuring wind turbulence using a Gill Solent sonic anemometer.

This report outlines the general function of the Sonic Buoy and its various sub systems and includes a detailed description of the layout and wiring of the sub system interconnections. The buoy has recently been used as part of the 1993 SWALES Experiment to gather data to support a Wave Tide Surge Model. The buoy has been described in the configuration used during this experiment.

KEYWORDS

DSP GCAT
MULTIMET
SOLENT SONIC ANEMOMETER
SONIC BUOY

ISSUING ORGANISATION

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1. INTRODUCTION

The report will outline the function of the Sonic Buoy and its subsystems and further describe the layout of the buoy and the various system inter connections.

1.1. Functional Description

The buoy consists of a 3 meter discus hull, containing a central instrumentation canister, and a 2.3 meter high quadruped tower with an annular ring. The buoy and tower design is optimised for providing good exposure for all the sensors and navigation aids, but in particular the Solent Sonic anemometer. To assist the correct exposure of the sensors the buoy is oriented into the wind by the use of dual vanes mounted from on of the tower legs.

The sensors, satellite aerials, and navigational aids are mounted on the 1.5m diameter ring on the top of the quadruped tower. Each of the devices is fitted with a quick release clamp to facilitate easy replacement, whilst the buoy is deployed, in event of failure or damage. External cabling on the tower is minimised by use of a single multi-core cable for all sensor signals. This cable connects between the central instrument housing and a mast head junction box.

The instrumentation canister, which is mounted within the central 'cotton reel', contains the Formatter / Sonic system, MultiMet, Buoy Motion Package, Raw Data systems, satellite transmitters, compass, DC-DC Converters and 5 lithium battery pack tubes. Each individual unit is housed in a waterproof housing, connected by inter-unit cables with sealed environmental connectors, giving a high degree of protection against water ingress.

1.2. System Modules

1.2.1. Formatter and Sonic System

The formatter and sonic system consists of two independent sub systems, contained within one housing.

1.2.1.1. The Formatter system

The Formatter is a complete PC-based processing system (Ref 4 Clayson. C. H. & Pascal. R. W. 1994), using DSP GCAT^{TM} 3000 and 2000 boards and two AMPRO MINIMODULE^{TM} /SSP boards; these boards are mounted on a motherboard BMPPROC2 of IOSDL design. The system is mounted within a tube which also contains the Sonic Processor system. The Formatter is designed to link the timing and data of the Sonic and MultiMet Processors and to provide back-up storage and satellite telemetry of an abbreviated data set; the latter function is intended for diagnostic checks and as a last resort data back-up.

1.2.1.2. Sonic Processor System

The Sonic Processor is a complete PC-based processing system (Ref 3 Clayson, C.H. and Pascal, R.W. 1994), using DSP ECAT^{TM} and ECATX^{TM} boards, mounted on a motherboard plugging into an IOSDL 1802 microboard backplane. Also plugged into this backplane are an interface board, SEROPT, and an IOSDL EPROM logger, comprising a processor board and four memory boards. The system is mounted within a tube which also contains the Formatter system. The Sonic Processor is designed to communicate with a Gill Solent Sonic anemometer, to spectrally process 12,288 samples of anemometer data at quarter-hour intervals, and to output a parameters message to the Formatter. The processor also outputs the spectrum and parameters to the EPROM logger at quarter-hour intervals.

1.2.2. MultiMet

The MultiMet logger (Ref 1 Birch & Pascal 1987) is a system designed to obtain one minute samples of the normal meteorological variables (air and sea temperatures, wind, etc.). The system includes an IOSDL Eprom Logger for data storage, all of which is mounted within a tube as one of the buoy systems.

From MultiMet there are two types of data output streams, 8 bit parallel and RS232 serial. The parallel data is sent to the IOSDL Eprom Logger for internal data storage,; this has a capacity of 8 Mbytes (~80 days). The RS232 data stream is output from the MultiMet tube to the Formatter where it is used for monitoring and secondary data storage.

In the buoy, MultiMet logs various sensors which include two air temperatures, two sea surface temperatures, wind speed, wind direction and buoy heading. The system is also used to monitor battery voltages from the main +24 V supply and the flashing light.

1.2.3. Transmitter System

The Transmitter system is designed around an Argos PTT and a Meteosat DCP system. Each system has secondary batteries to provide the required power during transmission. Both systems are mounted together, with a battery charging unit for the secondary cells, in one case.

The primary function of the Argos PTT is to provide positional information for the sonic Buoy, thus enabling the user to determine whether the buoy is on station or adrift. The Argos PTT also transmits a 32 byte message, allowing buoy parameters to be received. These are sent over RS232 by the Sonic Buoy Formatter to the Argos PTT. The reception of data relies on the availability of satellites, which is in the order of 1 every three hours.

The Meteosat DCP transmitter sends data via the WMO Geostationary satellite on an hourly basis and is received in near real time at IOSDL, after re transmission from Darmstat. With a data capacity of 620 bytes per transmission, more detailed information can be sent, providing data backup and house keeping checks for the buoy. This data is also provided by the Sonic Buoy Formatter via RS232.

Formatter is designed to link the timing and data of the Sonic and MultiMet Processors and to provide back-up storage and satellite telemetry of an abbreviated data set; the latter function is intended for diagnostic checks and as a last resort data back-up.

1.2.4. Buoy Motion Package

The buoy motion system is an integrated package of motion sensors sampled by a microprocessor and with internal data storage. The system is controlled by a low power PC compatible processor, using DSP GCAT^{TM} 3000 and 2000 boards, with 4 M Bytes Flash EEprom data storage on a PCMCIA Card.

The analogue sensors are anti-alias filtered and sampled by a 12 bit A/D at a frequency of 4 Hz, with the processor software sampling all channels for a predetermined period. The software calculates mean , maxima and minima values for each sensor channel with raw data stored to the flash Eprom. Additionally the unit can function as a "Black Box" recording data once predetermined limits have been exceeded.

The microprocessor software acquires motion sensor data under conditional sampling set by wind speed parameters which are set to various wind range bins. This provides a series of data sets, in pre-determined bands i.e. 0-5 m/s, 5-10 m/s etc, with a maximum number of records for each wind speed band. The wind speed is derived from the second Young AQ wind sensor.

1.2.5. GCAT Raw Data system

The GCAT Raw data system is a complete PC-based processing system, using DSP GCAT^{TM} 3000 which is mounted on a motherboard BMPPROC2 of IOSDL design. The system is mounted within an IP65 die-cast case, which also contains the DC to DC converter for the VHF Raw data system. The system is designed to transparently read both the RS232 output from the Sonic anemometer and the control signals sent to it. Then once every two days take a 10 minute record, which is written to Flash EEprom on a 4 Mbyte Card. The RS232 data is passed through the enclosure to the VHF Raw data system for transmission over the VHF link.

1.2.6. VHF Raw Data system

The VHF Raw data system is a self contained unit, housed in an IP65 die-cast case, produced by Thorcom Ltd for IOSDL. The system consists of a 0.5 Watt VHF transmitter operating at 153.3 MHz and a radio modem programmed to accept messages from the Sonic anemometer. Data is transmitted one way only to a shore station where the data are written to file which coincide with the Sonic processor acquisition and processing periods on the buoy. The system requirements are a 12 volt supply, RS232 data input and connection to an VHF aerial.

1.2.7. DC to DC Converter Box

The function of the DC to DC converter box is to merge all the main battery packs into one 24 volt bus, and then generate the various supplies needed in the buoy. The only exception to this is the flashing light which has its own dedicated battery pack. With the use of DC to DC converters a wide range of supplies are generated enabling each system to receive all the supplies needed for it to function through its own multi cored cable link. Although some systems such as the Buoy motion Package and the GCAT Raw System only require the 24 volt bus as they have DC to DC converters within their own modules.

1.2.8. Compass

The compass is a DigiCOURSE model 225 which has a gimballed housing and interface which provides a digital and an analogue output. The digital output is read by the MultiMet system, whereas the analogue output is sent to an analogue input of the Sonic Anemometer for inclusion in the sonic processing.

1.2.9. Main Battery Packs

The main power supply for the buoy is derived from 10 x 24 volt Lithium Thionyl Chloride battery packs, which are paralleled together at the DC to DC converter box to produce a 24 volt power bus. Two packs are housed in a one tube , and both supplies go to the lid connector, the lid also has a safety venting valve. A pack is made up of 3 layers of 21 'D' cell batteries giving 9 paralleled sets of 7 batteries. Each 3.5 volt battery has a capacity of 16.5 AH, producing a nominal pack capacity of 148.5 AH at 24.5 volts.

1.2.10. Flashing Light Battery Pack

A flashing light is the minimum navigational and legal requirement for the buoy, therefore it has been given its own separate supply to improve reliability and duration. The pack is made up from Manganese alkaline "D" cell batteries, 12 on a layer, with 6 parallel layers in the pack. This gives a nominal voltage of 18 volts and a capacity of a 100 AH. The flashing light requires a supply between 11 - 23 volts and has a current drain of about 0.5 amp during a flash, but may peak at 1.5 amps. The flash rate is 5 flashes every 20 seconds with a 0.5 second flash duration, the beacon also has a photo electric cell to switch off the light during day light hours. Taking a 1:10 proportion light character operating for 14 hours per night, then a pack will last for over 100 days.

2. HARDWARE

2.1. Mechanical Design

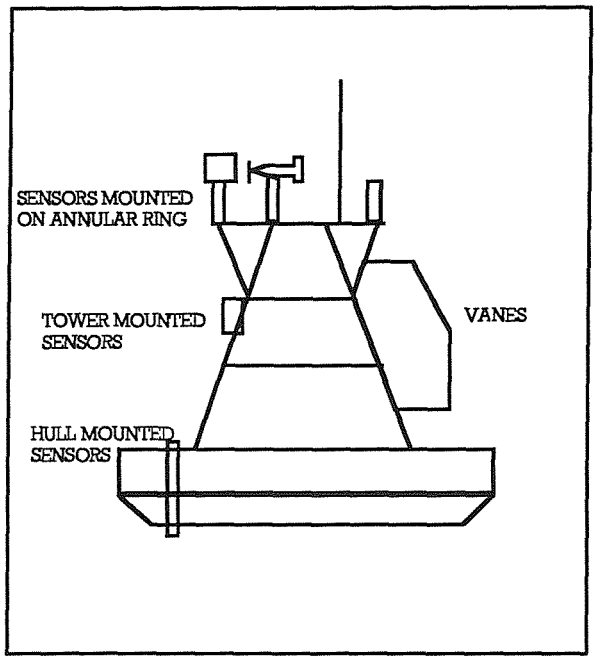
(Ref 2 Hart, B.H., Timins, N.T., Grohmann, D., Birch, K.G., Clayson, C.H. and Pascal, R.W. 1993)

2.2. Buoy External Layout

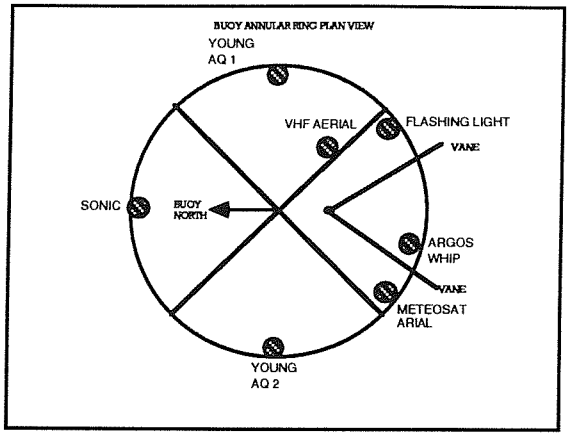
The buoy has been designed to minimise water ingress into the central instrument canister, although the sub system modules are also housed in watertight units. The lid of the main canister has a double 'O' ring seal and connectors that penetrate the lid are of a waterproof design (LEMO's). All connectors on the lid, and for the SST sensors, have secondary waterproofing using a tophat cover, which has a gland for the cable and an 'O' ring seal on the lid.

Sensors are mounted on the Tower and Annular ring by means of quick release clamps. This allows sensors to be easily removed for recovery or replacement while the buoy is still deployed.

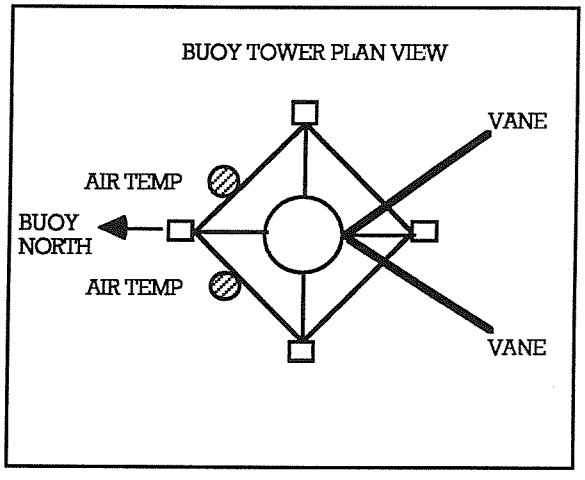
2.2.1. Sensor Over View



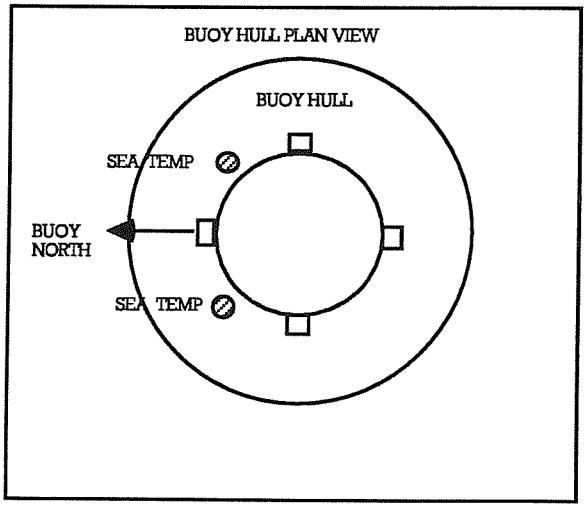
2.2.2. Annular Ring Mounted Sensors



2.2.3. Tower Mounted Sensors



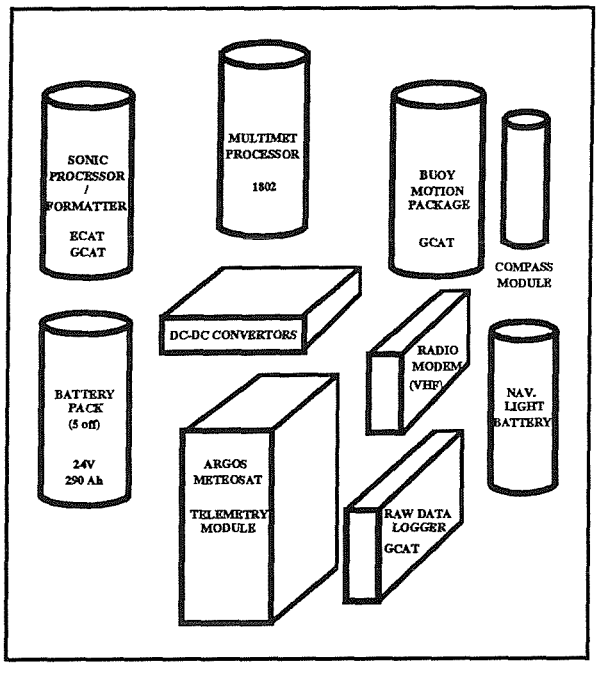
2.2.4. Hull Mounted Sensors



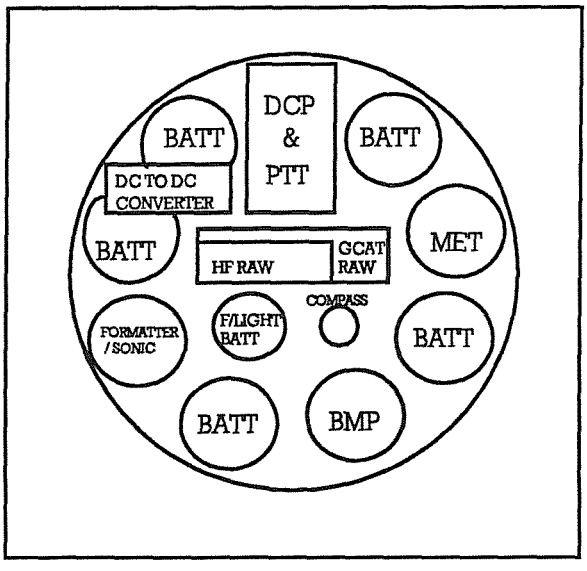
2.3. Buoy Internal Layout

The central instrument canister houses the sub system modules. Each system is contained within a tubular watertight housing, which have waterproof connectors (LEMO's) for sub system interconnection. These modules are held in place with the use of a rigid closed cell foam. Modules which need specific orientation use a keyway slot in the foam to give correct alignment.

2.3.1. Sonic Buoy Modules

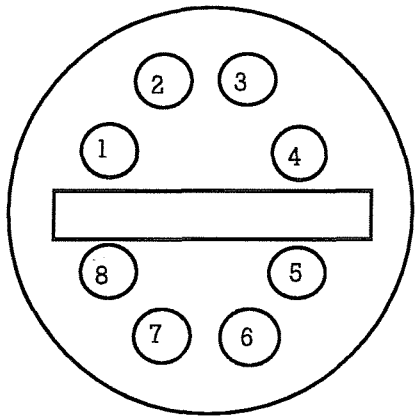


2.3.2. Module layout in Buoy



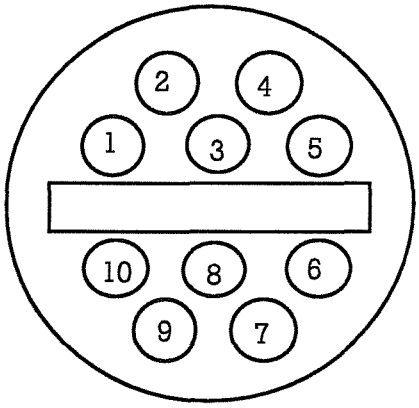
2.4. Systems Lid connectors

2.4.1. Formatter / Sonic System Lid



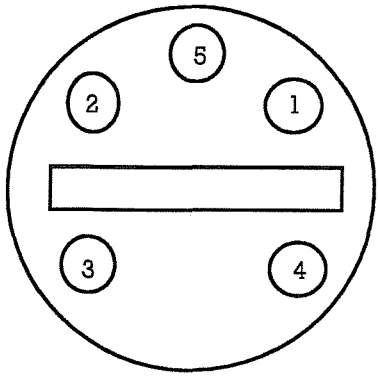
FS 1	METEOSAT	SERIES 3 5 PIN
FS 2	SONIC SENSOR	SERIES 3 6 PIN
FS 3	MONITOR	SERIES 3 5 PIN
FS 4	RAW DATA O/P	SERIES 3 8 PIN
FS 5	MET SERIAL I/P	SERIES 3 2 PIN
FS 6	SPARE	SERIES 3 5 PIN
FS 7	POWER	SERIES 3 10 PIN
FS 8	ARGOS	SERIES 3 7 PIN

2.4.2. MultiMet System Lid



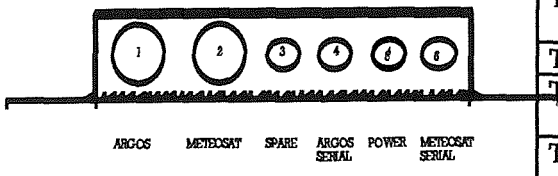
MET 1	COMPASS	SERIES 3 10 PIN
MET 2	SENSOR POWER	SERIES 3 10 PIN
MET 3	SST 2	SERIES 3 3 PIN
MET 4	AIR 2	SERIES 3 4 PIN
MET 5	YOUNG AQ 2	SERIES 3 5 PIN
MET 6	YOUNG AQ 1	SERIES 3 5 PIN
MET 7	AIR 1	SERIES 3 4 PIN
MET 8	SST 1	SERIES 3 3 PIN
MET 9	CPU POWER	SERIES 3 14 PIN
MET 10	MET SERIAL O/P	SERIES 3 2 PIN

2.4.3. Buoy Motion Package Lid



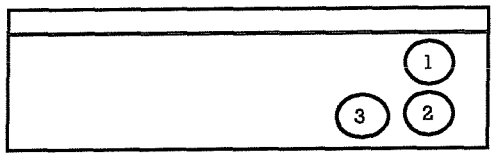
BMP 1	POWER I/P +24 V	SERIES 3 3 PIN
BMP 2	YOUNG AQ	SERIES 3 5 PIN
BMP 3	METEOSAT SERIAL O/P	SERIES 3 5 PIN
BMP 4	ARGOS SERIAL O/P	SERIES 3 7 PIN
BMP 5	PRESSURE RELIEF VALVE	NONE

2.4.4. Transmitter System Lid



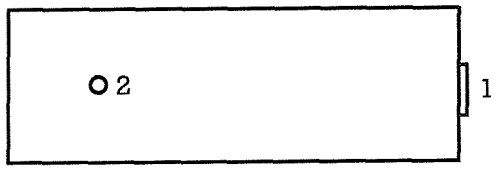
T 1	ARGOS AERIAL	SERIES 4 TRIAXIAL
T 2	METEOSAT AERIAL	SERIES 4 TRIAXIAL
T 3	N/C	SERIES 2 5 PIN
T 4	ARGOS DATA I/P RS232	SERIES 2 7 PIN
T 5	TRANSMITTER POWER	SERIES 2 3 PIN
T 6	METEOSAT DATA I/P RS232	SERIES 2 6 PIN

2.4.5. GCAT Raw Data System



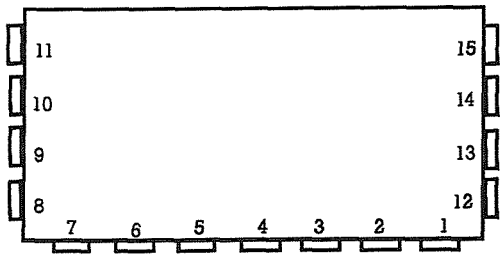
GR 1	GCAT RAW POWER	SERIES 3 3 PIN
GR 2	RAW DATA I/P	SERIES 3 8 PIN
GR 3	RAW DATA O/P	SERIES 3 8 PIN

2.4.6. VHF Raw Data System



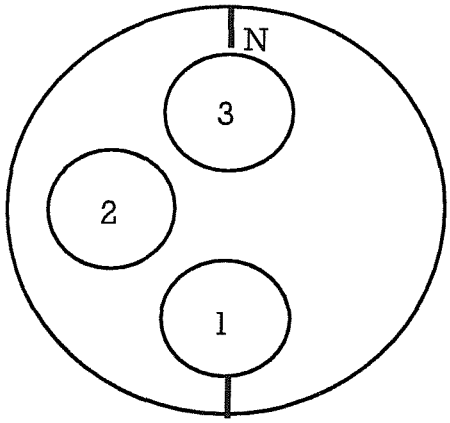
HF 1	DATA / POWER I/P	CANNON 19 WAY
HF 2	VHF AERIAL	BNC

2.4.7. DC to DC Converter Box



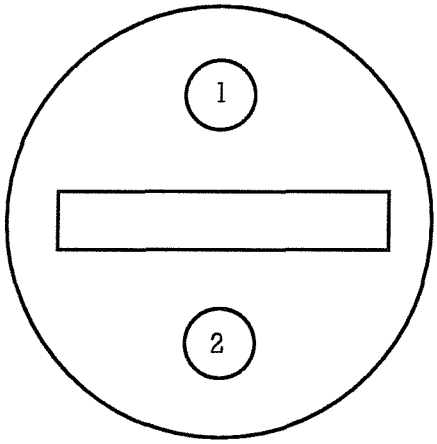
PR 1	BATTERY 1	SERIES 3 5 PIN
PR 2	BATTERY 2	SERIES 3 5 PIN
PR 3	BATTERY 3	SERIES 3 5 PIN
PR 4	BATTERY 4	SERIES 3 5 PIN
PR 5	BATTERY 5	SERIES 3 5 PIN
PR 6	BATTERY 6	SERIES 3 5 PIN
PR 7	COMPASS	SERIES 3 2 PIN
PR 8	MULTIMET	SERIES 3 14 PIN
PR 9	SENSOR	SERIES 3 10 PIN
PR 10	TRANSMITTER	SERIES 3 3 PIN
PR 11	F/LIGHT	SERIES 3 4 PIN
PR 12	SONIC / FORMATTER	SERIES 3 10 PIN
PR 13	GCAT RAW DATA	SERIES 3 2 PIN
PR 14	BMP	SERIES 3 2 PIN
PR 15	SPARE	SERIES 3 2 PIN

2.4.8. Compass



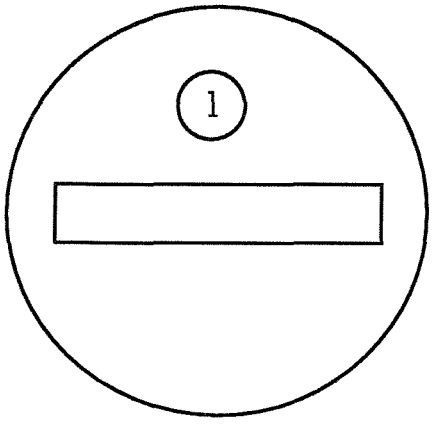
COMP 1	ANALOGUE O/P	SERIES 3 2 PIN
COMP 2	COMPASS POWER	SERIES 3 3 PIN
COMP 3	COMPASS DATA	SERIES 3 10 PIN

2.4.9. Main Battery Pack



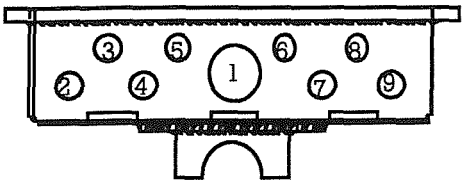
BAT 1	+24 V O/ P	SERIES 3 5 PIN
BAT 2	PRESSURE RELIEF VALVE	NONE

2.4.10. Flashing Light Battery Pack



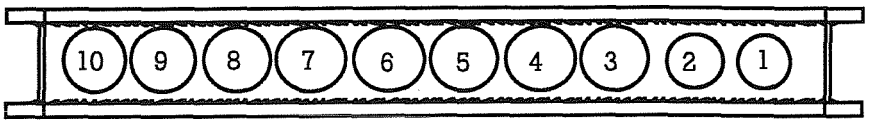
FL 1	+18 V O/ P	SERIES 3 2 PIN

2.4.11. Mast Junction Box



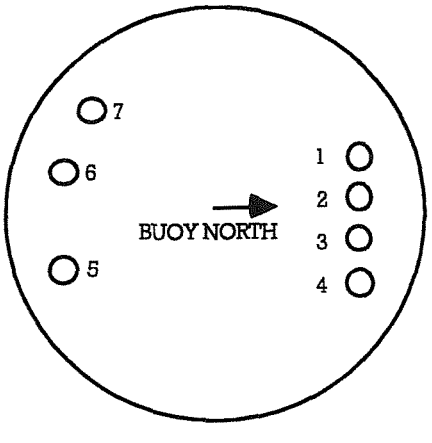
MJB 1	MAIN CABLE	SERIES 5 44 PIN
MJB 2	AIR 1	SERIES 3 4 PIN
MJB 3	YOUNG AQ 1	SERIES 3 5 PIN
MJB 4	SONIC SERIAL	SERIES 3 6 PIN
MJB 5	SONIC ANALOGUE	SERIES 3 2 PIN
MJB 6	F/LIGHT	SERIES 3 3 PIN
MJB 7	SPARE	SERIES 3 2 PIN
MJB 8	YOUNG AQ 2	SERIES 3 5 PIN
MJB 9	AIR 2	SERIES 3 4 PIN

2.4.12. Lid Junction Box



LJB 1	SONIC ANALOGUE	SERIES 2 2 PIN
LJB 2	SONIC SERIAL	SERIES 2 6 PIN
LJB 3	SST 1	SERIES 3 3 PIN
LJB 4	AIR 1	SERIES 3 4 PIN
LJB 5	YOUNG AQ 1	SERIES 3 5 PIN
LJB 6	F/LIGHT	SERIES 3 4 PIN
LJB 7	SERIAL MONITOR	SERIES 3 5 PIN
LJB 8	SST 2	SERIES 3 3 PIN
LJB 9	AIR 2	SERIES 3 4 PIN
LJB 10	YOUNG AQ 2	SERIES 3 5 PIN

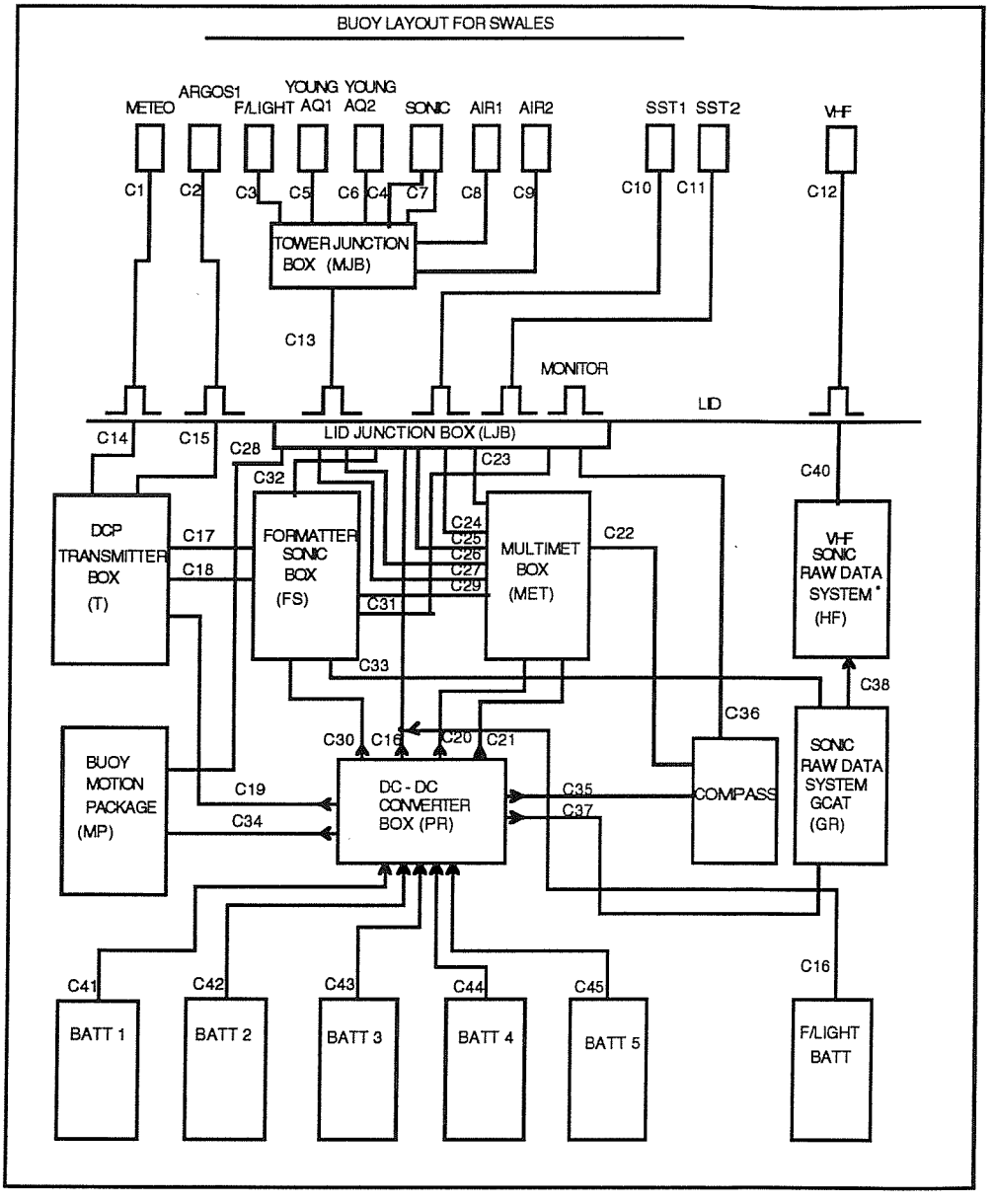
2.4.13. Main Canister Lid



LID 1	MAIN CABLE	SERIES 5 44 PIN
LID 2	SST 1	SERIES 3 3 PIN
LID 3	SST 2	SERIES 3 3 PIN
LID 4	SERIAL MONITOR	SERIES 3 5 PIN
LID 5	ARGOS AERIAL	SERIES 4 TRIAXIAL
LID 6	METEOSAT AERIAL	SERIES 4 TRIAXIAL
LID 7	VHF AERIAL	SERIES 4 TRIAXIAL

3. WIRING

3.1. Buoy layout



3.2. External Cables

Cable	Function	Source	Connector Type	Dest.	Connector Type	Cable Type
C1	Meteosat Aerial Cable	Meteosat Aerial	N Type Connector	LID 6	Lemo Triaxial Series 4	RG213
C2	Argos Aerial Cable	Argos Aerial	None	LID 5	Lemo Triaxial Series 4	RG58
C3	Flashing Light Cable	Flashing Light	None	MJB 6	Lemo 3 Pin Series 3	Metvin 2 Core
C4	Sonic Analogue Cable	Sonic	Lemo 2 Pin Series 2	MJB 5	Lemo 2 Pin Series 3	Metvin 2 Core
C5	Young AQ 1 Cable	Young AQ 1	Lemo 5 Pin Series 3	MJB 3	Lemo 3 Pin Series 3	Metvin 6 Core
C6	Young AQ 2 Cable	Young AQ 2	Lemo 5 Pin Series 3	MJB 8	Lemo 5 Pin Series 3	Metvin 6 Core
C7	Sonic Serial Cable	Sonic	Lemo 6 Pin Series 2	MJB 4	Lemo 6 Pin Series 3	Metvin 6 Core
C8	AIR 1 Cable	AIR 1	Lemo 4 Pin Series 3	MJB 2	Lemo 4 Pin Series 3	Metvin 4 Core
C9	AIR 2 Cable	AIR 2	Lemo 4 Pin Series 3	MJB 9	Lemo 4 Pin Series 3	Metvin 4 Core
C10	SST 1 Cable	SST 1	Lemo 3 Pin Series 3	LID 3	Lemo 3 Pin Series 3	Metvin 4 Core
C11	SST 2 Cable	SST 2	Lemo 3 Pin Series 3	LID 4	Lemo 3 Pin Series 3	Metvin 4 Core
C12	HF Aerial Cable	VHF Aerial	N Type	LID 7	Lemo Triaxial Series 4	RG213
C13	Tower Junction Box Cable	MJB 1	Lemo 36 Pin Series 5	LID 1	Lemo 44 Pin Series 5	RS 36 Core

3.3. Internal Cables

Cable	Function	Source	Connector Type	Dest.	Connector Type	Cable Type
C14	Meteosat Aerial Cable	LID 6	Soldered	T 2	Lemo Triaxial Series 4	RG213
C15	Argos Aerial Cable	LID 5	Soldered	T 1	Lemo Triaxial Series 4	RG58
C16	Flashing Light	LJB 6	Lemo 4 Pin Series 3	PR 11 FL 1	Lemo 4 Pin Series 3 Lemo 2 Pin Series 3	Metvin 4 Core
C17	Argos Serial In	FS 8	Lemo 7 Pin Series 3	T4	Lemo 7 Pin Series 3	Metvin 6 Core
C18	Meteosat Serial In	FS 1	Lemo 5 Pin Series 3	T6	Lemo 6 Pin Series 3	Metvin 4 Core
C19	DCP Power Supply +24v	PR 10	Lemo 2 Pin Series 3	T 5	Lemo 2 Pin Series 3	Metvin 2 Core
C20	CPU Power Supplies	PR 9	Lemo 10 Pin Series 3	MET 9	Lemo 10 Pin Series 3	RS 12 Core
C21	Sensor Power Supplies	PR 8	Lemo 10 Pin Series 3	MET 2	Lemo 10 Pin Series 3	RS 12 Core

Internal Cables Cont.

Cable	Function	Source	Connector Type	Dest.	Connector Type	Cable Type
C22	Compass Data	COMP 3	Lemo 10 Pin Series 3	MET 1	Lemo 10 Pin Series 3	RS 12 Core
C23	SST 1	LJB 3	Lemo 3 Pin Series 3	MET 8	Lemo 3 Pin Series 3	Metvin 4 Core
C24	AIR 1	LJB 4	Lemo 4 Pin Series 3	MET 7	Lemo 4 Pin Series 3	Metvin 4 Core
C25	Young AQ 1	LJB 5	Lemo 5 Pin Series 3	MET 6	Lemo 5 Pin Series 3	Metvin 6 Core
C26	SST 2	LJB 8	Lemo 3 Pin Series 3	MET 3	Lemo 3 Pin Series 3	Metvin 4 Core
C27	AIR 2	LJB 9	Lemo 4 Pin Series 3	MET 4	Lemo 4 Pin Series 3	Metvin 4 Core
C28	Young AQ 2	LJB 10	Lemo 5 Pin Series 3	BMP 2	Lemo 5 Pin Series 3	Metvin 6 Core
C29	MultiMet RS232 Data	MET 10	Lemo 2 Pin Series 3	FS 5	Lemo 2 Pin Series 3	Metvin 2 Core
C30	Formatter Power	PR 12	Lemo 10 Pin Series 3	FS 7	Lemo 10 Pin Series 3	RS 12 Core
C31	Sonic RS485	LJB 2	Lemo 6 Pin Series 2	FS 2	Lemo 6 Pin Series 3	Metvin 6 Core
C32	Monitor	LJB 7	Lemo 5 Pin Series 3	FS 3	Lemo 5 Pin Series 3	Metvin 6 Core
C33	Sonic Raw Data Plus Opto Pwr	FS 4	Lemo 8 Pin Series 3	GR 2	Lemo 8 Pin Series 3	RS 12 Core
C34	Motion Package Power Supply 24v	PR 13	Lemo 2 Pin Series 3	BMP 1	Lemo 3 Pin Series 3	Metvin 2 Core
C35	Compass Power	PR 7	Lemo 2 Pin Series 3	COMP 2	Lemo 3 Pin Series 3	Metvin 2 Core
C36	Analogue Compass Data	LJB 1	Lemo 2 Pin Series 2	COMP 1	Lemo 2 Pin Series 3	Metvin 2 Core
C37	GCAT Raw Power	PR 15	Lemo 2 Pin Series 3	GR 1	Lemo 2 Pin Series 3	Metvin 2 Core
C38	Sonic Raw Data Plus Power	GR 3	Lemo 8 Pin Series 3	HF 1	Cannon 19 Way	RS 12 Core
C40	VHF Aerial Cable	LID 7	Soldered	HF 2	BNC	RG58
C41	Buoy Power Supply 1	BAT 1 a	Lemo 5 Pin Series 3	PR 1	Lemo 5 Pin Series 3	Metvin 4 Core
C42	Buoy Power Supply 2	BAT 1 b	Lemo 5 Pin Series 3	PR 2	Lemo 5 Pin Series 3	Metvin 4 Core
C43	Buoy Power Supply 3	BAT 1 c	Lemo 5 Pin Series 3	PR 3	Lemo 5 Pin Series 3	Metvin 4 Core
C44	Buoy Power Supply 4	BAT 1 d	Lemo 5 Pin Series 3	PR 4	Lemo 5 Pin Series 3	Metvin 4 Core
C45	Buoy Power Supply 5	BAT 1 e	Lemo 5 Pin Series 3	PR 5	Lemo 5 Pin Series 3	Metvin 4 Core

3.4. Connector Cable Wiring

All cables which have the identical connectors at each end are connected according to following convention. Conformity to this convention, i.e. all pins connected, will ensure that cables can be used in any inter-connection

Connector	Cable
Lemo 2 Pin	2 Core Metvin
1	Blue
2	Red
Lemo 3 Pin	4 Core Metvin
1	Blue
2	Red
3	Yellow
Lemo 4 Pin	4 Core Metvin
1	Blue
2	Red
3	Yellow
4	Green
Lemo 5 Pin	6 Core Metvin
1	Yellow
2	Green
3	Blue
4	Red
5	White
Lemo 6 Pin	6 Core Metvin
1	Yellow
2	White
3	Black
4	Red
5	Blue
6	Green
Lemo 7 Pin	6 Core Metvin
1	Yellow
2	Green
3	Blue
4	Red
5	Black
6	White
7	n/c

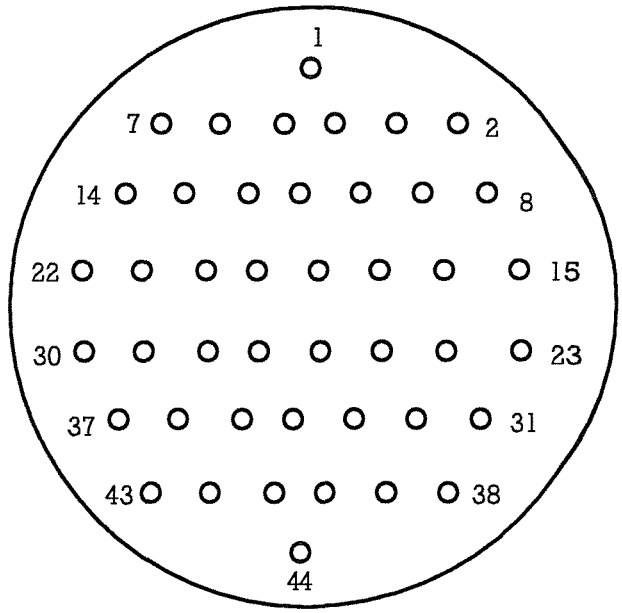
Note Lemo 7 pin connector does not obey the convention of all pins being connected

3.5. Main Cable Connector

44 Way Series 4 Lemo - FFA 5E 344 CNA C11 Cable RS Stock Number 367-779

Pin	Wire Colour	Pin	Wire Colour	Pin	Wire Colour
1	Green/Black	16	Brown	31	Red/Brown
2	Yellow/Green	17	Mauve	32	n/c
3	White/Black	18	Orange	33	n/c
4	Orange/Green	19	Pink	34	Blue/Black
5	Grey/Green	20	Light Blue	35	n/c
6	Yellow/Brown	21	Black	36	n/c
7	Grey	22	Brown/Black	37	Black/Mauve
8	Grey/Blue	23	Yellow	38	Orange/Blue
9	n/c	24	Green	39	White/Blue
10	n/c	25	Blue	40	Yellow/Blue
11	Red	26	Green/Red	41	White/Mauve
12	n/c	27	Blue/Red	42	Black/red
13	n/c	28	Yellow/Red	43	White/Red
14	White/Brown	29	Grey Brown	44	Green/Blue
15	White	30	Yellow/Mauve		

Pin Layout of 44 way Lemo Connector



3.6. Buoy LID Junction Box Connections

3.6.1. Main Cable Connector

LID1 44 Way Series 4 Lemo - ERA 5E 344 CNL

Pin	Wire Colour Main Cable	Function	Pin	Wire Colour Spade Terminals	Connector Lemo
1	Red/Black	Air1 +v	1	Red	LJB4 pin 1
2	Red Brown	Air1 Signal	2	Red/Brown	LJB4 pin 2
3	Red/Green	Air1 0v	3	White	LJB4 pin 3
4	Red/Blue	Young1 Dir	4	Red/Blue	LJB5 pin 1
5	Orange/Black	Young1 Speed	5	Orange/Black	LJB5 pin 2
6	Orange/Brown	Young1 0v signal	6	Orange/Brown	LJB5 pin 3
7	Orange/Red	Young1 +v	7	Yellow	LJB5 pin 4
8	Orange/Green	Young1 0v	8	White	LJB5 pin 5
9	n/c				
10	n/c				
11	Orange/Blue	Compass Analog 0v	9	White	LJB1 pin 1
12	n/c				
13	n/c				
14	Green/Black	Compass Analog	10	Green/Black	LJB1 pin 2
15	Green/Brown	Sonic +v	11	Yellow	LJB2 pin 1
16	Green/Red	Sonic 0v	12	White	LJB2 pin 2
17	Green/Yellow	Sonic Serial A	13	Green/Yellow	LJB2 pin 3
18	Green/Blue	Sonic Serial B	14	Green/Blue	LJB2 pin 4
19	White/Black	Sonic GND	15	White/Black	LJB2 pin 5
20	White/Brown	Sonic Screen	16	White/Brown	LJB2 pin 6
21	White/Red	F/Light 0v	17	White	LJB6 pin 1
22	White/Green	F/Light +v	18	Yellow	LJB6 pin 2
23	White/Blue	RF Beacon 0v	19	White	LJB6 pin 3
24	Grey/Black	RF Beacon +v	20	Yellow	LJB6 pin 4
25	Grey/brown	Young2 Dir	21	Grey/Brown	LJB10 pin 1
26	Grey/Red	Young2 Speed	22	Grey/Red	LJB10 pin 2
27	Grey/Orange	Young2 0V Signal	23	Grey/Orange	LJB10 pin 3
28	Grey/Green	Young2 +v	24	Yellow	LJB10 pin 4
29	Yellow/Red	Young2 0v	25	White	LJB10 pin 5
30	Yellow/Green	Air2 +v	26	Red	LJB9 pin 1
31	Black/White	Air2 Signal	27	Black/White	LJB9 pin 2
32	n/c				
33	n/c				
34	Black/Orange	Air2 0v	28	White	LJB9 pin 3
35	n/c				
36	n/c				
37	Brown / Blue		29	n/c	
38	Black		30	n/c	
39	Red	Sonic +v	11		
40	Orange	Sonic 0v	12		
41	Yellow	Sonic Serial A	13		
42	Green	Sonic Serial B	14		
43	Grey	Sonic GND	15		
44	White	Sonic Screen	16		

3.6.2. SST 1 Connector

LID2 3 Way Series 3 Lemo - ERA 3E 303 CNL

Pin	Wire Colour	Function	Pin	Wire Colour	Connector
1	Red	SST1 +v	33	Red	LJB3 pin 1
2	White	SST1 0v	31	White	LJB3 pin 2
3	White/Green	SST1 Signal	32	White/Green	LJB3 pin 3

3.6.3. SST 2 Connector

LID3 3 Way Series 3 Lemo - ERA 3E 303 CNL

Pin	Wire Colour	Function	Pin	Wire Colour	Connector
1	Red	SST2 +v	36	Red	LJB8 pin 1
2	White	SST2 0v	34	White	LJB8 pin 2
3	White/ Orange	SST2 Signal	35	White/ Orange	LJB8 pin 3

3.6.4. SERIAL MONITOR Connector

LID4 5 Way Series 3 Lemo - ERA 3E 305 CNL

Pin	Wire Colour	Function	Pin	Wire Colour	Connector
1	Orange/Red	Ser Mon Sonic	37	Orange/Red	LJB7 pin 1
2	Orange/Green	Ser Mon MMet	38	Orange/Green	LJB7 pin 2
3	Orange/Blue	Ser Mon Form	39	Orange/Blue	LJB7 pin 3
4	White	Mon 0v I/P	40	White	LJB7 pin 4
5	Yellow	Mon +v I/P	41	Yellow	LJB7 pin 5

3.6.5. ARGOS AERIAL Connecto2r

LID5 TRIAXIAL Series 4 Lemo - PSA 4E 650 CTL C50

Cable - Coax RG 58 Destination - Connector T1

3.6.6. METEOSAT AERIAL Connector

LID6 TRIAXIAL Series 4 Lemo - PSA 4E 650 CTL C11

Cable - Coax URM 67 LE Destination - Connector T2

3.6.7. VHF AERIAL Connector

LID7 TRIAXIAL Series 4 Lemo - PSA 4E 650 CTL C50

Cable - Coax RG 58 Destination - Connector HF2

3.7. Buoy Mast Junction Box Connections

3.7.1. Main Cable Connector

MJB1 44 Way Series 4 Lemo - ERA 5E 344 CNL

Pin	Wire Colour Main Cable	Function	Pin	Wire Colour Spade Terminals	Connector Lemo
1	Red/Black	Air1 +v	1	Red	MJB2 pin 1
2	Red Brown	Air1 Signal	2	Red/Brown	MJB2 pin 2
3	Red/Green	Air1 0v	3	White	MJB2 pin 3
4	Red/Blue	Young1 Dir	4	Red/Blue	MJB3 pin 1
5	Orange/Black	Young1 Speed	5	Orange/Black	MJB3 pin 2
6	Orange/Brown	Young1 0v Signal	6	Orange/Brown	MJB3 pin 3
7	Orange/Red	Young1 +v	7	Yellow	MJB3 pin 4
8	Orange/Green	Young1 0v	8	White	MJB3 pin 5
9	n/c				
10	n/c				
11	Orange/Blue	Sonic Analog 0v	9	White	MJB5 pin 1
12	n/c				
13	n/c				
14	Green/Black	Sonic Analog	10	Green/Black	MJB5 pin 2
15	Green/Brown	Sonic +v	11	Yellow	MJB4 pin 1
16	Green/Red	Sonic 0v	12	White	MJB4 pin 2
17	Green/Yellow	Sonic Serial A	13	Green/Yellow	MJB4 pin 3
18	Green/Blue	Sonic Serial B	14	Green/Blue	MJB4 pin 4
19	White/Black	Sonic GND	15	White/Black	MJB4 pin 5
20	White/Brown	Sonic Screen	16	White/Brown	MJB4 pin 6
21	White/Red	F/Light 0v	17	White	MJB6 pin 1
22	White/Green	F/Light +v	18	Yellow	MJB6 pin 2
23	White/Blue	RF Beacon 0v	19	White	MJB7 pin 1
24	Grey/Black	RF Beacon +v	20	Yellow	MJB7 pin 2
25	Grey/brown	Young2 Dir	21	Grey/Brown	MJB8 pin 1
26	Grey/Red	Young2 Speed	22	Grey/Red	MJB8 pin 2
27	Grey/Orange	Young2 0v Signal	23	Grey/Orange	MJB8 pin 3
28	Grey/Green	Young2 +v	24	Yellow	MJB8 pin 4
29	Yellow/Red	Young2 0v	25	White	MJB8 pin 5
30	Yellow/Green	Air2 +v	26	Red	MJB9 pin 1
31	Black/White	Air2 Signal	27	Black/White	MJB9 pin 2
32	n/c				
33	n/c				
34	Black/Orange	Air2 0v	28	White	MJB9 pin 3
35	n/c				
36	n/c				
37	n/c				
38	n/c				
39	Red	Sonic +v	11		
40	Orange	Sonic 0v	12		
41	Yellow	Sonic Serial A	13		
42	Green	Sonic Serial B	14		
43	Grey	Sonic GND	15		
44	White	Sonic Screen	16		

3.8. Sensor Connectors

3.8.1. Sonic Auxiliary Connector

Hirose RM15WTR-8P to Lemo - Series 2 2 pin

Pin	Function	Wire Colour	Destination
1	n/c		
2	n/c		
3	Sonic 0v	White	SONIC1 pin 1
4	n/c		
5	Analog I/P 1	Green/Black	SONIC1 pin 2
6	n/c		
7	n/c		
8	n/c		

3.8.2. Sonic Serial Connector

Hirose RM15WTR-10P to Lemo - Series 2 6 pin

Pin	Function	Wire Colour	Destination
1	Supply +v	Yellow	SONIC2 pin 1
2	Serial -	Green/Yellow	SONIC2 pin 3
3	Serial +	Green/Blue	SONIC2 pin 4
4	Signal Ground	White/Black	SONIC2 pin 5
5	n/c		
6	n/c		
7	n/c		
8	n/c		
9	Supply 0v	White	SONIC2 pin 2
10	Chassis	n/c	

3.8.3. Young AQ Connector

5 Way Lemo Series 3

Pin	Function
1	Dir Signal
2	Speed Signal
3	Signal 0v
4	+5v
5	0v

3.8.4. SST Connector

3 Way Lemo Series 3

Pin	Function
1	+24v
2	0v
3	Signal

3.8.5. Air Temperature Connector

4 Way Lemo Series 3

Pin	Function
1	+24v
2	Signal
3	0v
4	n/c

3.8.6. Flashing Light Connector

2 Way Lemo Series 3

Pin	Function
1	0v
2	+18v
3	n/c

3.9. Test Cable for Sonic

Sonic Serial Connector

Hirose RM15WTR-10P to Lemo Series 3 6 pin

Pin	Function	Wire Colour	Destination
1	Supply +v	Yellow	SONIC2 pin 1
2	Serial -	Blue	SONIC2 pin 3
3	Serial +	Red	SONIC2 pin 4
4	Signal Ground	Black	SONIC2 pin 5
5	n/c		
6	n/c		
7	n/c		
8	n/c		
9	Supply 0v	Green	SONIC2 pin 2
10	Chassis	n/c	

4. OPERATION

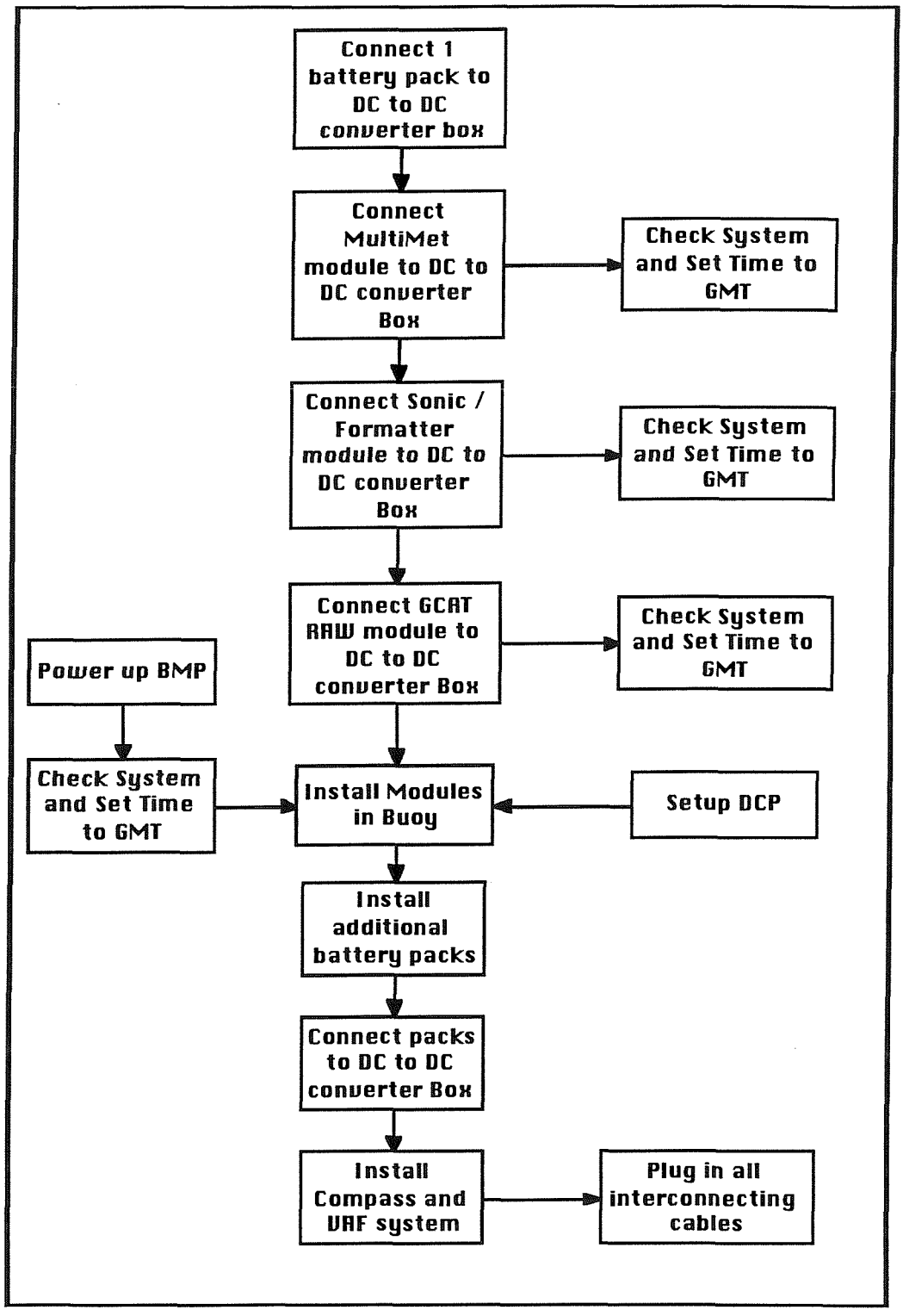
The buoy tower is normally unbolted from the buoy prior to transportation, to reduce the buoy's overall height while on the lorry.

Preparation of the buoy before deployment usually involves bolting the tower to the buoy hull, attaching clamps, cables and sensors to the tower and hull. The internal system modules are prepared and placed in the buoy central canister. All internal cables are connected and the central canister lid is then secured in place. Finally the mooring components are prepared and attached to the buoy, although this depends on the method of deployment to be used.

Preparation for each system involves checking that the storage media are blank or erased and that each systems general setup is correct. This includes checking that any secondary batteries in the module are fully charged. Finally each unit must be powered up to initialise and synchronise the processor to GMT time. Only the compass and VHF system, which need no preparation, and the transmitter and BMP systems, which have internal batteries, can be installed without continuous power. All the other systems must be kept powered after setup including while they are installed in the buoy i.e. Formatter / Sonic, MultiMet, and GCAT Raw data system must be kept connected to the DC to DC converter box which has at least one Battery pack attached. After the systems have been setup, they can be placed in the buoy and the remaining interconnecting cables connected up.

RS232 outputs from the systems are then monitored via a connector on the lid of the central canister to check correct operation of the buoy.

4.1. Module Installation Flow Diagram



5. SPECIFICATION

5.1. General

Characteristic	Specification
Duration	70 days
Max. Latitude	70 degrees (restriction due to magnetic compass)
Buoy Orientation	Into wind(± 90°) to provide best acceptance window for sonic head
Data transmission	Meteosat, Argos and VHF
Positioning	Argos and Flashing light
Power	Internally Battery Powered
Land based systems	Ground Receiving station for Meteosat data and VHF systems Data replay facilities for Eprom logger and Flash EEprom cards.

5.2. Mechanical Hardware Specification

Diameter	3 Metres
Overall height	3.8 Metres - including sensors
Height above waterline	2.5 Metres to annular ring 3.3 Metres to top of sensors
Weight in air	938 Kg
Weight Tower + Clamps + Junction Box + Lifting Bar	108 Kg
Hull with Central Canister	620 Kg
Hull with Central Canister + contents	850 Kg

5.3. Payload

Module	Weight	Capacity
Sonic Processor / Formatter	14 Kg	DSP ECAT PC 16 Mbyte Eprom Logger DSP GCAT PC 4 Mbyte Flash Card
MultiMet	15.25 Kg	8 Mbyte Eprom Logger
Transmitter Box	28 Kg	Argos / Meteosat
Buoy Motion Package	20.3 Kg	DSP GCAT PC 4 Mbyte Flash Card Half tube height Battery 24 V, 125 Ampere hours
GCAT Raw data Logger	4.25 Kg	DSP GCAT PC 4 Mbyte Flash Card
VHF Radio Modem	1.75 Kg	RLC220 Radio Modem 153 Mhz 500 mW
DC to DC Converters	2.5 Kg	
Compass	3 Kg	DigiCOURSE Model 255
Battery Packs 5 off	23 Kg per housing	Two 24V, 148 Ampere hours per housing
Flashing Light Battery Pack	15 Kg	18V, 100 Ampere hours

5.4. MultiMet Sensors

Sensors	System Measurements	Number	Manufacturer
Air temperature	Range 0 - 35 °C Accuracy 0.1°C Resolution ±0.005 °C	2 off	IOS
Sea Surface Temperature	Range 0 - 35 °C Accuracy 0.1 °C Resolution ±0.005	2 off	IOS
AQ Wind Monitor Wind Speed	Range 0-40 m/sec Accuracy 0.1m/sec Resolution 0.001m/sec	1 Off	R. M.Young
Wind Direction	Range 0 - 355 ° Accuracy 0.08 °		
Compass model 225	Range 0-360 ° Resolution 1.387 °	1 Off	DigiCOURSE

5.5. Wind Stress system.

Single Board DSP 286 with 16M Bytes Eprom data storage

Sampling Frequency - 20.833 Hz

Processing - 12 Sections of 1024 points, using software FFT to compute Wind Speed Spectrum

Sensors	System Measurements	Number	Manufacturer
Solent Sonic Anemometer	Range 0 - 60 M/sec Accuracy <30m/sec ±1.5%, >30m/sec ± 3%	1 Off	Gill Research
Compass model 225	Range 0-360° Resolution 1.387	1 Off	DigiCOURSE

5.6. Satellite Data Formatter to Argos & Meteosat.

Single Board DSP GCAT with 4M Bytes Flash EEprom data storage on PCMCIA Card

Continuously monitors output data streams from MultiMet and Wind Stress systems.

Processing - Averages '1 minute Mean' MultiMet datasets over period corresponding to Sampling period of Wind Stress System. Formats data in preparation for sending via Argos and Meteosat

Sensors	System Measurements	Number	Manufacturer
Argos PTT UHF 88	Position Accuracy < 300 m	1 Off	Argos/WS Oceans
	Data Transmission rate ~ 3hrs (satellite visibility dependant)		
	Data capacity 32 bytes * 4 (Multiplexed over 4 consecutive transmissions)		
Meteosat DCP 6812/003	Data Transmission Rate, Hourly	1 Off	Hays Space Technology Ltd.
	Data capacity 256 Bytes		

5.7. Buoy Motion Package.

Sensors	System Measurements	Number	Manufacturer
3 Components Accelerometer	Heave, Surge and Sway	1 Off	SE Systems CMD
Solid State Rate Gyro	Pitch and Roll	3 Off	Murata Gyrostars
Inclinometers	Pitch and Roll	2 Off	Penny & Giles
3 Axis fluxgate compass	Buoy Heading	1 Off	Thorn EMI
AQ Wind Monitor	Wind Speed & Direction	1 Off	R. M. Young

Single Board DSP GCAT with 4M Bytes Flash Eprom data storage on PCMCIA Card

Sampling Frequency - 4 Hz

Processing - The initiation of a record would be determined by whether any of the following criteria were satisfied :-

Wind Speed	Number of (10 min) Records
0 - 5 m/s Mean Wind speed	4
5-10 m/s Mean Wind speed	10
10-15 m/s Mean Wind speed	13
15-20 m/s Mean Wind speed	12
>20 m/s Mean Wind speed	8

6. REFERENCES

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3). Clayson, C.H. and Pascal, R.W. 1994, Sonic Buoy - Sonic Processor Handbook, IOSDL Internal Document, 61 pp

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7. APPENDICES

7.1. Connectors For Sonic Buoy

MULTIMET MODULE		LEMO 'E' SERIES FIXED
MET1	COMPASS	ERA 3E 310 CNL
MET2	POWER SENSORS	ERA 3E 310 CNL
MET3	SST 2	ERA 3E 303 CNL
MET4	AIR TEMP 2	ERA 3E 304 CNL
MET5	YOUNG AQ 2	ERA 3E 305 CNL
MET6	YOUNG AQ 1	ERA 3E 305 CNL
MET7	AIR TEMP 1	ERA 3E 304 CNL
MET8	SST 1	ERA 3E 303 CNL
MET9	POWER CPU	ERA 3E 314 CNL
MET10	DATA O/P RS232	ERA 3E 302 CNL

FORMATTER / SONIC MODULE		LEMO 'E' SERIES FIXED
FS1	METEOSAT O/P RS232	ERA 3E 305 CNA
FS2	SONIC RS485	ERA 3E 306 CNL
FS3	MONITOR	ERA 3E 306 CNL
FS4	RAW DATA O/P	ERA 3E 308 CNL
FS5	MULTIMET RS232	ERA 3E 302 CNL
FS6	SPARE	ERA 3E 305 CNL
FS7	POWER FORMATER / SONIC	ERA 3E 310 CNL
FS8	ARGOS O/P RS232	ERA 3E 307 CNL

BMP MODULE		LEMO 'E' SERIES FIXED
BMP1	POWER+24V	ERA 3E 303 CNL
BMP2	YOUNG AQ I/P	ERA 3E 305 CNL
BMP3	METEOSAT RS232	ERA 3E 305 CNL
BMP4	ARGOS RS232	ERA 3E 307 CNL

DCP MODULE		LEMO 'E' SERIES FIXED
T1	ARGOS AERIAL	TRIAXIAL PSA 4E 650 CTL
T2	METEOSAT AERIAL	TRIAXIAL PSA 4E 650 CTL
T3	N/C	ERA 2E 305 CNL
T4	ARGOS DATA I/P RS232	ERA 2E 307 CNL
T5	POWER +24V	ERA 2E 303 CNL
T6	METEOSAT DATA I/P RS232	ERA 2E 306 CNL

COMPASS MODULE		LEMO 'E' SERIES FIXED
COMP1	ANALOGUE O/P	ERA 3E 302 CNL
COMP2	POWER	ERA 3E 303 CNL
COMP3	DIGITAL O/P	ERA 3E 310 CNL

RAW DATA GCAT MODULE		LEMO 'E' SERIES FIXED
GR1	POWER +24V	ERA 3E 303 CNL
GR2	SONIC RS232 I/P	ERA 3E 308 CNL
GR3	SONIC RS232 0/P	ERA 3E 308 CNL

RAW DATA VHF		FIXED
HF1	POWER +24V, SONIC RS232 I/P	CANNON 19 WAY
HF2	VHF ARIAL	BNC

DC-DC CONVERTER MODULE		LEMO 'E' SERIES FIXED
PR1	BATTERY 1	ERA 3E 305 CNL
PR2	BATTERY 2	ERA 3E 305 CNL
PR3	BATTERY 3	ERA 3E 305 CNL
PR4	BATTERY 4	ERA 3E 305 CNL
PR5	BATTERY 5	ERA 3E 305 CNL
PR6	BATTERY 6	ERA 3E 305 CNL
PR7	COMPASS POWER	ERA 3E 302 CNL
PR8	CPU POWER(MULTIMET)	ERA 3E 314 CNL
PR9	SENSOR POWER (MULTIMET)	ERA 3E 310 CNL
PR10	DCP POWER	ERA 3E 303 CNL
PR11	RF BEACON- F/LIGHT POWER	ERA 3E 304 CNL
PR12	FORMATTER / SONIC POWER	ERA 3E 310 CNL
PR13	RAW DATA GCAT POWER	ERA 3E 302 CNL
PR14	BMP POWER	ERA 3E 302 CNL
PR15	SPARE	ERA 3E 302 CNL

MAIN BATTERY PACKS		LEMO 'E' SERIES
BATT1	24V SUPPLY	ERA 3E 305 CNA
BATT2	24V SUPPLY	ERA 3E 305 CNA
BATT3	24V SUPPLY	ERA 3E 305 CNA
BATT4	24V SUPPLY	ERA 3E 305 CNA
BATT5	24V SUPPLY	ERA 3E 305 CNA
BATT6	24V SUPPLY	ERA 3E 305 CNA

FLASHING LIGHT BATTERY PACK		LEMO 'E' SERIES FIXED
FL1	18V SUPPLY	ERA 3E 302 CNA

LID CONNECTORS		LEMO 'E' SERIES FIXED
LID1	MAIN CABLE	ERA 5E 344 CNL
LID2	SST1	ERA 3E 303 CNL
LID3	SST1	ERA 3E 303 CNL
LID4	MONITOR	ERA 3E 305 CNL
LID5	ARGOS	TRIAXIAL PSA 4E 650 CTL
LID6	METEOSAT	TRIAXIAL PSA 4E 650 CTL
LID7	VHF	TRIAXIAL PSA 4E 650 CTL

LID JUNCTION BOX		LEMO 'E' SERIES FIXED
LJB1	SONIC ANALOGUE	ERA 2E 302 CNL
LJB2	SONIC SERIAL	ERA 2E 306 CNL
LJB3	SST 1	ERA 3E 303 CNL
LJB4	AIR TEMP 1	ERA 3E 304 CNL
LJB5	YOUNG AQ 1	ERA 3E 305 CNL
LJB6	FLASHING LIGHT	ERA 3E 304 CNL
LJB7	SERIAL MONITOR	ERA 3E 305 CNA
LJB8	SST 2Y	ERA 3E 303 CNL
LJB9	AIR TEMP 2	ERA 3E 304 CNL
LJB10	YOUNG AQ 2	ERA 3E 305 CNL

MAST JUNCTION BOX		LEMO 'E' SERIES FIXED
MJB1	MAIN CABLE	ERA 5E 344 CNL
MJB2	AIR TEMP 1	ERA 3E 304 CNL
MJB3	YOUNG AQ 1	ERA 3E 303 CNL
MJB4	SONIC SERIAL	ERA 3E 306 CNL
MJB5	SONIC ANALOGUE	ERA 3E 302 CNL
MJB6	FLASHING LIGHT	ERA 3E 303 CNL
MJB7	SPARE	ERA 3E 302 CNL
MJB8	YOUNG AQ 2	ERA 3E 305 CNL
MJB9	AIR TEMP 2	ERA 3E 304 CNL

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