4. CHANGING THE EPROM TO UPGRADE SOFTWARE

It may be at some time be necessary to change the software installed in the pilot in order to upgrade the functions of the pilot. To carry out this operation first ensure all power supplies to the pilot system are switched off.

4.1 930-628 Series Distribution Box

- Remove cover from 930-628 Distribution Box.
- Remove internal RFI Screen.
- With a small screwdriver ease the Eprom out from its socket and replace it with the updated device. Ensure no pins are bent or have failed to enter socket correctly. Check that PIN 1 of device (marked by an indent) is towards the right of the board.
- Reverse the above procedure to reassemble the distribution box.

4.2 System Checkout

- Restore power supplies to pilot system.
- Press **"Standby Pilot"** on the keyboard and the system should power up. The system may indicate a system fault F002. If so, press **'Off'** key and then power up again which will clear this condition.
- If the system will not stay powered up when standby key is pressed, it is almost certain that the Eprom in the distribution box has not been fitted correctly. Check and retest.

5. SYSTEM SUMMARY AND PRINCIPLES OF OPERATION

A block diagram of the 930-628 Control Unit is shown on page 19. This unit contains the Central Processing Unit, the motor control circuitry and acts as the main distribution box for the 707 Autopilot. As all units connected to this unit are considered as peripheral devices, therefore a discussion of this unit is sufficient to describe the operation of the Autopilot. Individual data sheets on all components units of the 707 Autopilot may be found at the end of this manual. A system configuration schematic showing all possible options is shown on page 11 .

A basic system consists of the following:

- a 930-578 Electronic Fluxgate Compass providing heading input.
- a 930-707 Keyboard Control connected to the Digital Port.
- a 930-807 Rudder Reference Unit providing rudder position information.
- a drive motor to actuate the craft's steering system (hydraulic or mechanical).

Remote controls are available for dodge and course change. Repeaters are also available for rudder position. A navigator port may be provided optionally so that the autopilot can be interfaced with a variety of navigation receivers enabling these to control the destination of the vessel. These ports can support 2 way communication in anticipation of future protocol developments.

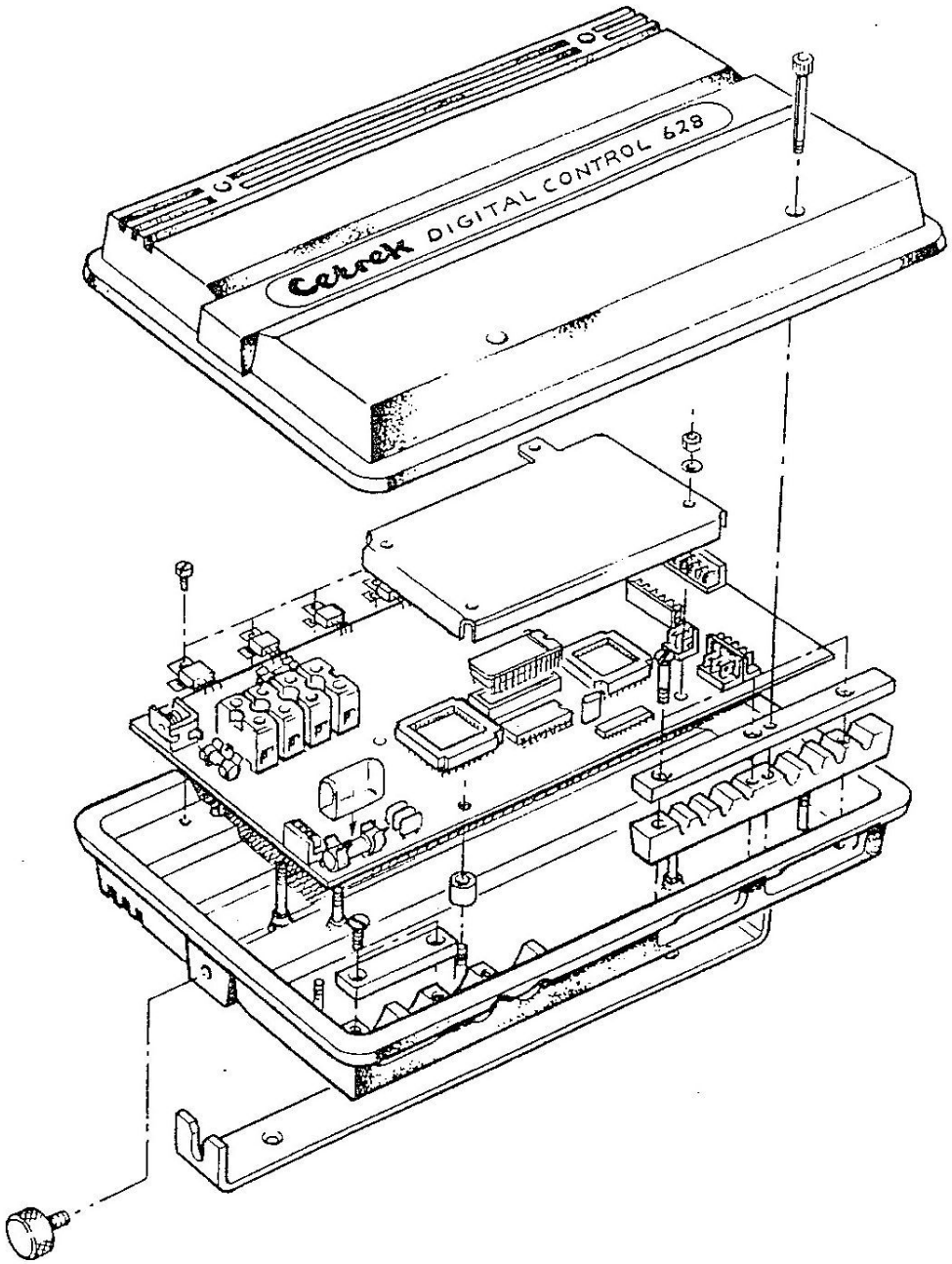
5.1 Hardware Overview

A block diagram of the principle data paths is shown on page 19.

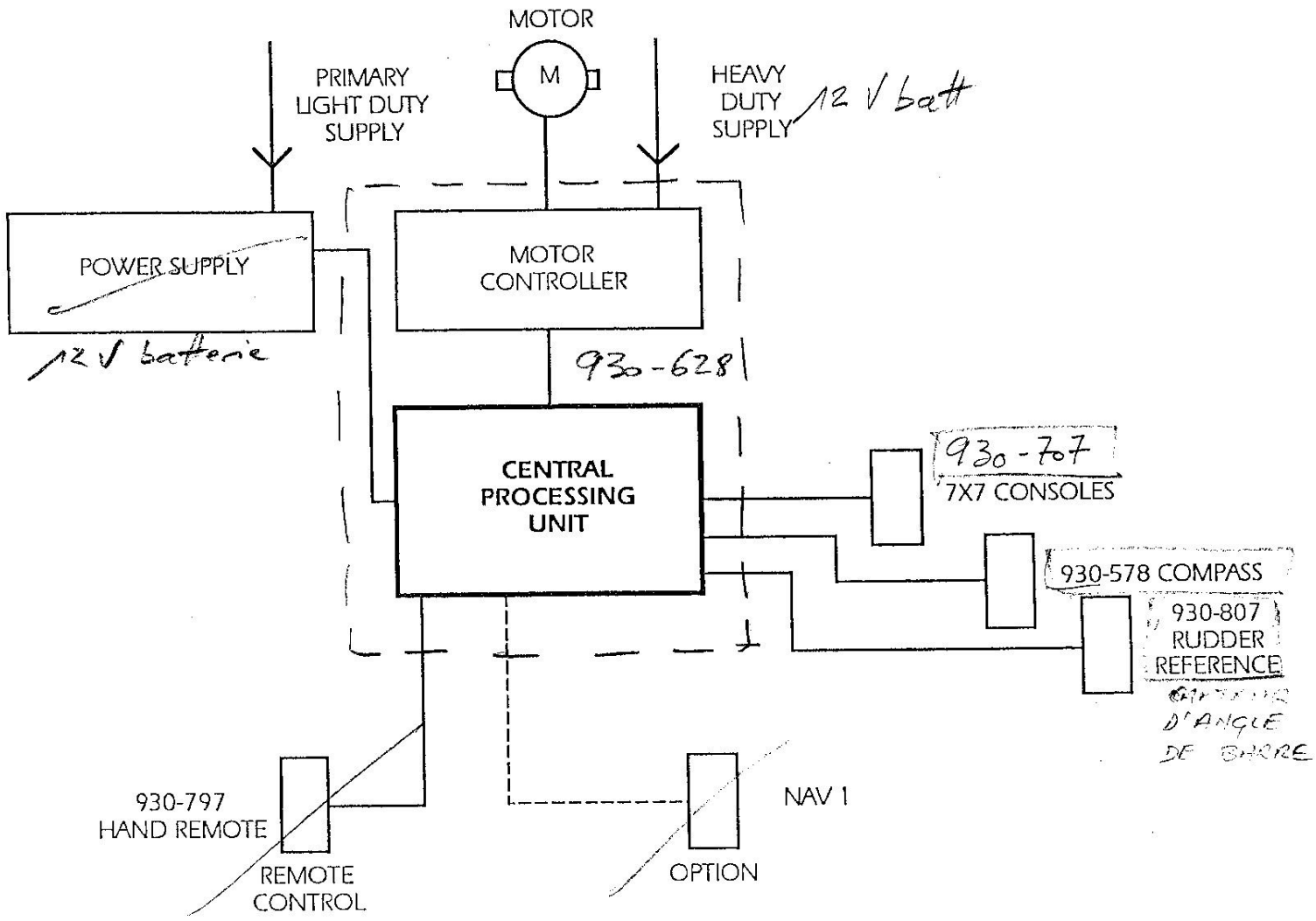
The Microprocessor Unit (MPU) used in the 930-628 control unit is an HPC 46003 16 bit device chosen for its superior performance in process control applications. Of particular importance is its high speed data processing and context switching capability and its on-chip facilities which reduce chip count and improve reliability. The MPU operates with a 12 MHz clock. The majority of remaining logic on the controller board is contained in an XC2064 Programmable Gate Array (PGA) which is configured at power up. Neither the MPU nor the PGA are mask programmed so that field servicing is possible with standard devices.

Two Universal Asynchronous Comm. Controllers (UART) are used for serial data communication. One, contained within the MPU, provides two way links between the 930-628 Control Unit and the various peripheral units (compass, consoles, etc) while the other , configured in the PGA handles the Navigation Port. Data transfer via these units is interrupt driven.

An 11 channel TLC541 Analogue to Digital Converter (ADC) provides input for the various analogue signals (motor speed, rudder reference, and battery voltage) and is also interrupt driven.


Cervex DIGITAL CONTROL 628

930-628 DISTRIBUTION BOX
SYSTEM BLOCK DIAGRAM, EXTERNAL CONNECTIONS



Message transfer over the Digital Port is carried out using a special **Cetrek** Serial Data Protocol.

The Navigation Port UART may be configured for 1200 (NMEA 0180/2) or 4800 (NMEA 0183) Baud and 8 data bits with or without parity. These Ports are optocoupler isolated to comply with NMEA specification.

The motor controller uses Field Effect Transistor (FET) switching with logic to implement freewheel, brake, port and starboard commands. A fail safe circuit controls the clutch drive and the motor supply via a mechanical relay. This relay shuts down the controller board in the event of failure of the logic supply. Adjustable current limiting is incorporated by means of a pot (VR1) which is preset at the factory. The controller generates a motor speed signal for the processor unit. Pulse width Modulated (PWM) speed control is accomplished entirely in software.

ABSOLUTE MAXIMUM RATINGS OVER OPERATING TEMPERATURE RANGE.

Supply Voltage	12 volts DC
All input voltages (except NAV Ports)	0 to 5 volts DC
NAV Ports	-15 to +15 volts DC (Nominal 0 to 5v)
Max. motor drive current	Factory preset to 12 amp limit
Storage Temperature	-55 to +85°C
Operating Temperature (Ambient)	0 to 50°C

6. TROUBLESHOOTING GUIDE

6.1 General Principles and Cautions

1. Never connect or disconnect wiring to the terminal blocks without first turning off the supply. The line drivers in particular can be seriously damaged if shorted out inadvertently.

2. When installing or changing wiring always double check the colour coding before switching on the supplies.

3. Do not use a simple voltmeter to attempt to check powered up Digital logic lines or signal lines except as specifically described in the following discussion.

4. Ensure that all cable screens are properly earthed.

The 930-628 distribution box electronics consists of the 100-208 PCB.

6.2 Troubleshooting Outline

1. System will not power up	Check Pilot supplies present Check Fuse 1 Check wiring to ON (BN) and OFF (V) terminals. Check 930-628 ON (BN) terminal = 4 to 5 volts and changes to 0 volts when 930-707 **"Standby Pilot"** button is pressed. Check that the OFF (V) terminal goes to +5v when **"Standby Pilot"** is pressed. If not: suspect 100-208 board or console. Check SS+ appears on Port Terminal V+ when **"Standby Pilot"** pressed. If not: then 100-208 fault likely.
2. 707 display activates momentarily then blank-system power down	The Fail Safe Watchdog is causing system powerdown. A fatal fault has been detected on the 100-208 board. Remove top cover and internal shield cover. Visually check that the two socketed chips (IC13 MPU , IC11 Eprom, and IC9 PGA) are installed securely.Check for any loose material that may cause shorts. Replace 100-208.

3. Pilot completes power up but displays System Faults which can be reset and do not immediately recur.

This may happen very occasionally in an otherwise normal system due to a momentary loss of synchronization during power up or noise spikes. The self test software reports all errors of this type to help anticipate potential problems. Unless this happens repeatedly it is of little concern.

4. Pilot completes power up sequence but displays a System Fault which cannot be reset.

Normally this can be traced to a wiring error. System faults F198 and F225 indicate a malfunction of the rudder position signal. Check rudder reference unit and wiring in the 930-628.

5. System powers down for no apparent reason and cannot be restarted.

See 1 and 2 on page 21.

6. System powers down when Transmitter or other RF device is keyed; or if a device needing current is operated (electric windlass etc).

This could occur if RF energy is being injected into the power cables or by radiation injection into system components at very high levels. The 707 Autopilot has been exhaustively tested to withstand RF injection and radiation at levels far above those considered safe to personnel. Antenna mismatch yielding high SWR can cause dangerous conditions and in the interest of operator safety the radio installation should be inspected immediately.

A more normal situation can occur if the Radio transmitter or other high current unit is being supplied from the same battery as the Pilot. When the device is operated it may be causing the battery voltage to drop below that required to maintain the Pilot. Once a power loss has occured, the fail-safe watchdog has been designed to power down the system. This would be particularly noticeable if the battery had a bad cell or corroded connections. Separate batteries are recommended.

7. Pilot engages but motor does not drive.	Check supply to motor controller. Check fuse FS3 . Check that relay (left rear of 100-208 board) switches when going from STANDBY to PILOT. If not, suspect relay fault or Regulator (REG2) fault. Suspect faulty motor. Test by powering motor directly.
8. Motor drives one way only.	Centre helm and re-check. Could indicate FET drive transistor failure or 100-208 logic failure. Replace 100-208.
9. Motor drives both ways but lacks power.	Low battery voltage. Motor cable or supply cable too small. Motor faulty. Check brushes etc. On hydraulic systems check hydraulic fluid level.
10. Motor drives hard over when pilot engaged	Indicates phasing error on rudder reference (wiring incorrect) or motor cable reversed. (See 930-807 data sheet).
11. System Fault 224 occurs	Indicates that a rudder command has been issued by the pilot but no rudder movement has been sensed via the rudder reference unit. Check fuse FS3 ; check motor wiring. Suspect motor fault, check bushes etc. Suspect rudder reference fault. Check unit and wiring. Check for motor drive fault as discussed above.
12. Error messages appear in connection with navigator (NMEA) input:	SYSTEM ERROR EE13: Indicates that no signals have been received on the NAV Port. Check that Navigator is sending data. An LED is provided on the 100-208 board which flashes to indicate data reception on the NAV input. If the LED is not flashing then no data is being transmitted from the navigator. Check wiring. A two wire cable should be connected to SIG+ and SIG-. If in doubt about sense then reverse the cable. Normally a coax cable should be connected with centre conductor to SIG+ and the outer conductor connected to SIG-.

SYSTEM ERROR EE12: Indicates loss of navigator signal or an incorrect format.

Check that correct format has been entered.

Check Data output from Navigator, (see discussion on the previous page for system error EE13), check wiring.

If this message occurs repeatedly then suspect bad wiring connection, noise on line, or fault in Navigator.

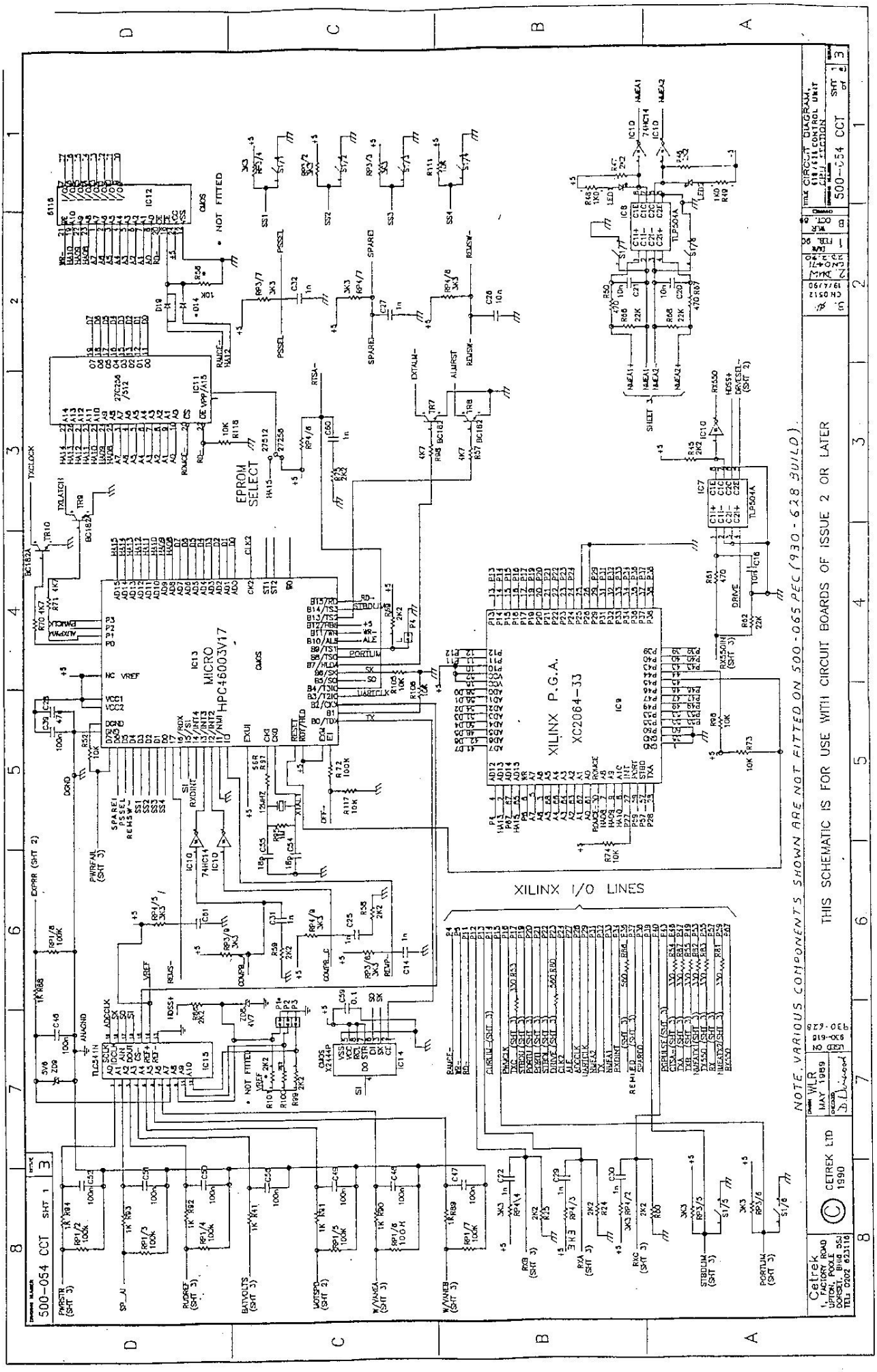
This fault will reset automatically if signal input resumes.

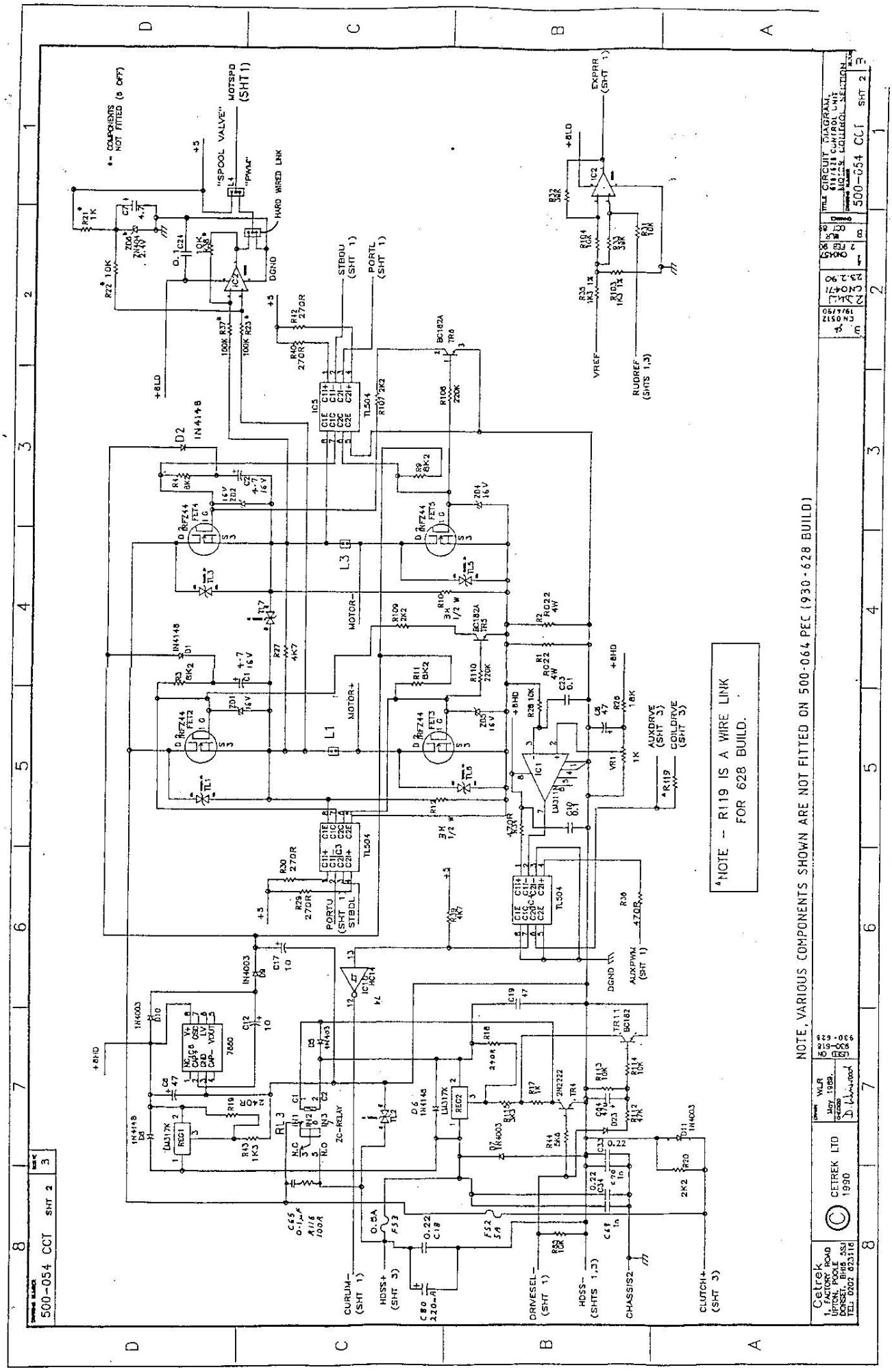
It should be noted that not all navigator manufacturers adhere to the NMEA recommendations. If you suspect this may be causing a problem consult the Navigator manufacturer.

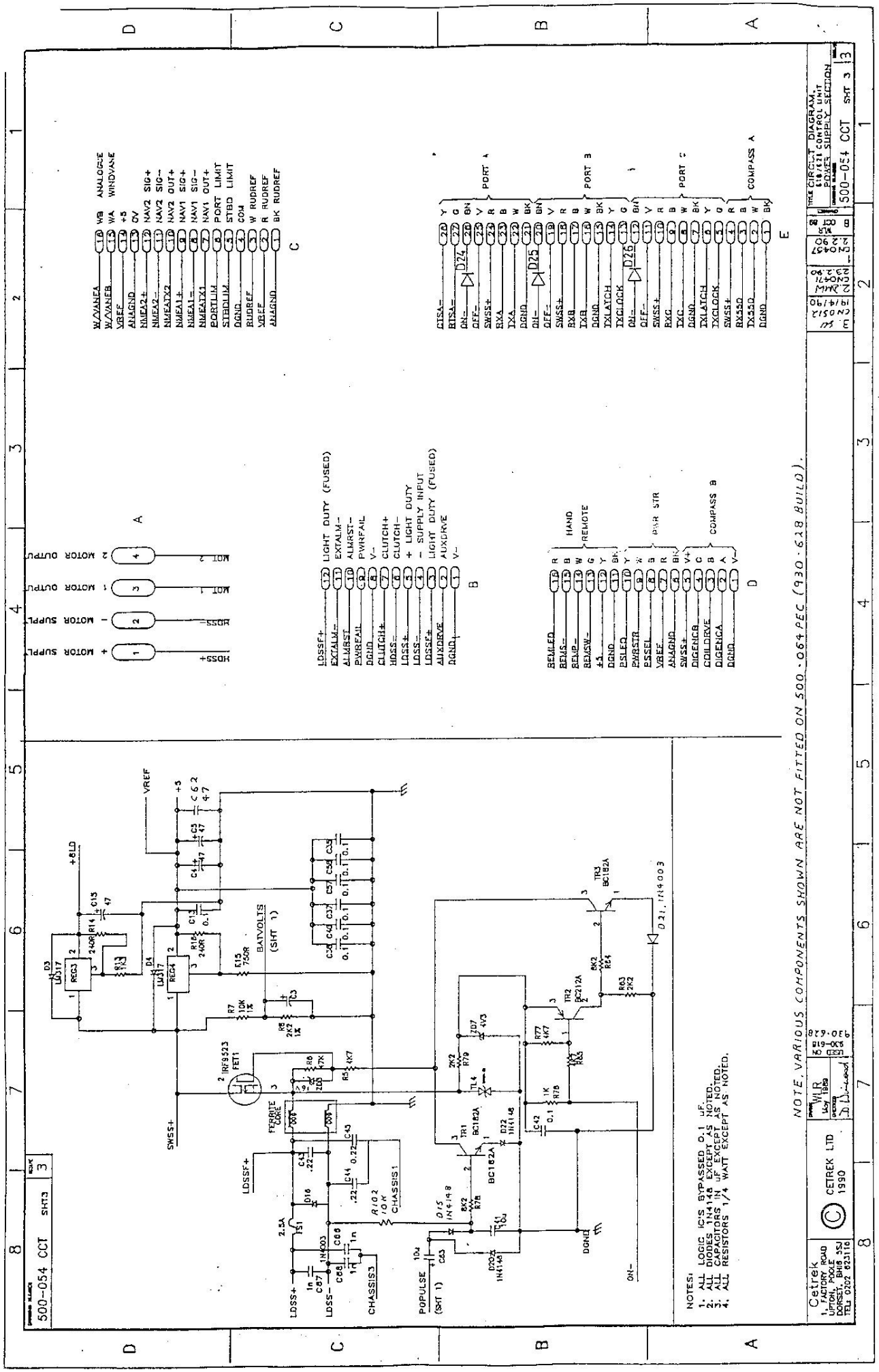
It may be found that the system will work satisfactorily with another NMEA protocol i.e. 0180 or 0182 if 0183 gives data errors.

SYSTEM ERROR EE10: This indicates a navigator alarm (loss of lock etc.) usually due to operation in weak signal areas. This message will reset automatically when alarm clears.

SYSTEM ERROR EE11: This results from an internal message buffer overflow. This condition indicates that data is being received by the interface however the format or timing is incorrect. Check navigator set-up and wiring.


CIRCUIT DIAGRAM, 618/611 CONTROL UNIT
500-054 CCT
THIS SCHEMATIC IS FOR USE WITH CIRCUIT BOARDS OF ISSUE 2 OR LATER
NOTE. VARIOUS COMPONENTS SHOWN ARE NOT FITTED ON 500-065 PCB (930-628 BUILD).
XILINX I/O LINES
XILINX P.G.A.
XC2064-33
MICRO
HPC46003V17
EPROM SELECT
Cetrek
CETREK LTD
1990


500-054 CCT SHT 2
CETREK LTD 1990
Cetrek
1, FACTORY ROAD
UPTON, POOLE
DORSET, BH16 5SU
TEL 0202 623116
NOTE, VARIOUS COMPONENTS SHOWN ARE NOT FITTED ON 500-064 PEC (930-628 BUILD)
*NOTE - R119 IS A WIRE LINK FOR 628 BUILD.
* = COMPONENTS NOT FITTED (S OFF)
"SPOOL VALVE"
"PWM"
HARD WIRED LINK
MOTSPD (SHT 1)
EXPRR (SHT 1)
STBDU (SHT 1)
PORTL (SHT 1)
PORTU (SHT 1)
STBDL
VREF
RUDREF (SHTS 1,3)
MOTOR+
MOTOR-
AUXDRIVE (SHT 3)
COILDRIVE (SHT 3)
AUXPWM (SHT 1)
CURLIM- (SHT 1)
HOSS+ (SHT 3)
DRIVESEL- (SHT 1)
HOSS- (SHTS 1,3)
CHASSIS2
CLUTCH+ (SHT 3)
+8HD
+8LD
DGND
ZC-RELAY


NOTE, VARIOUS COMPONENTS SHOWN ARE NOT FITTED ON 500-064 PEC (930-628 BUILD).
500-054 CCT SHT 3
CIRCUIT DIAGRAM, 618/621 CONTROL UNIT POWER SUPPLY SECTION
500-054 CCT SHT 3
Cetrek
CETREK LTD
1990
NOTES:
1. ALL LOGIC ICS BYPASSED 0.1 uF.
2. ALL DIODES 1N4148 EXCEPT AS NOTED.
3. ALL CAPACITORS IN uF EXCEPT AS NOTED.
4. ALL RESISTORS 1/4 WATT EXCEPT AS NOTED.
ANALOGUE
WINDVANE
NAV2 SIG+
NAV2 SIG-
NAV2 OUT+
NAV1 SIG+
NAV1 SIG-
NAV1 OUT+
PORT LIMIT
STBD LIMIT
COM
W RUDREF
R RUDREF
BK RUDREF
PORT A
PORT B
PORT C
COMPASS A
COMPASS B
LIGHT DUTY (FUSED)
EXTALM-
ALMRST-
PWRFAIL
CLUTCH+
CLUTCH-
+ LIGHT DUTY
- SUPPLY INPUT
LIGHT DUTY (FUSED)
AUXDRIVE
HAND
REMOTE
PWR STR
MOTOR OUTPUT
MOTOR SUPPLY
VREF
BATVOLTS
(SHT 1)
SWSS+
LOSSF+
LOSS+
LOSS-
CHASSIS1
CHASSIS3
POPULSE
DGND