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General Technical manual
AESS

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Product/Project: AESS	**Document no:** **TH1014** Rev.: A

Document title:

INSTRUCTION MANUAL

Document description:

This manual includes all necessary information for an elshaft system with LF90, LF120 and LF70

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1. General

1.1. Abbreviations, acronymes and definitions

ADC	Analog Digital Converter
AESS	Azimuth Electronic Shaft System
AES	Azimuth Electronic Shaft
ASC	Asynchronous/synchronous Serial Controller
CAN	Controller Area Network (License Bosch)
CMOS	Complementary Metal Oxide Silicon
CPU	Central Processing Unit
ES	Emergency steering
Flash	Non-volatile memory that may be electrically erased
IO	Input/Output
LED	Light Emitting Diode
OTP	One Time Programmable memory
PLL	Phase Locked Loop
PWM	Pulse Width Modulation
RAM	Random Access Memory
SSC	Synchronous Serial Controller
XRAM	On-chip extension RAM

1.2. Brief description

The Electronic Shaft System is a system for controlling follow up of control levers. This system integrates up to 8 double lever positions for 4 propulsion systems into one redundant network. Each control lever is a node in the network and consists of one control lever and an electronic unit. This is a fully autonomous system regarding all servo functions and man machine interfaces. The system administrates the master selection, slave positions and fault detection. The system will give throttle information to the supervisory system from the potentiometers on the levers. An additional gang on the potentiometers will give throttle and angle information to the AESS system.

2. Scope

This manual describes specifications, user manual, installation manual, functional description and maintenance procedures. All information needed for the product lifecycle is described in this manual.

3. System description

This system consists of 3 control levers and 3 electronic units configured as 1 system with 3 levers. The levers has double ganged potentiometer for signal input to supervisory system

3.1. Detailed description

3.1.1. Node Electronics

Processor
The processor is a 16-bit single–chip micro controller, C167CS from Infineon. This processor has many built-in resources well suited for this application.

- Clock Generation via on-chip PLL (factors 1:1/2/2.5/3/4/5)
- 4 Kbyte internal RAM
- 16 channel 10-bit A/D Converter
- Two 16-Channel Capture/Compare Units
- 4 channel PWM Unit
- Two Multi-functional General Purpose Timer Units with 5 Timers
- Two Serial Channels
- Two CAN interfaces
- Up to 16Mbyte External Address Space
- Five Programmable Chip-Select Signals
- Idle and Power Down Modes
- Programmable Watchdog Timer and Oscillator Watchdog
- Up to 111 General Purpose I/O Lines

The A/D converter is used for sampling of the shaft angle and throttle. The PWM unit is used for servo motor output. One serial channel is used for the debug interface. The CAN interface is used for CAN bus control.

Memory
Internal
- 4 Kbyte RAM

External
- 256 Kbyte Flash (Program)
- 2kbyte EEPROM (Calibration coefficients)
- 128 kbyte RAM

Motor drivers
The motor driver is an integrated full bridge motor drive circuit LMD18200. This circuit offers a set of built in protection features. In addition some external protection circuitry is designed in to give the following protection.
- Over voltage detection.
- Junction over temperature warning and shut down
- Shorted load protection
- Shoot through protection

Clutch drivers
The clutch driver is a International rectifier IR9410 (or similar). This is a MosFET transistor with a low threshold voltage. This allows direct logic control from the processor I/O line without expensive level converter circuitry.

Debug interface
The module does have a RS-232 interface for debugging and software download. This could be connected to a PC, running different terminal programs. Depending on the terminal program used different applications and tools will be loaded and executed. This enables simple debugging of user code and downloading program to Flash memory.

Shaft angle measurements
There is a sin/cos potentiometer indicating the angle. The A/D converter on the processor will sample this potentiometer. This is a 10-bit converter. The angle measurement resolution is 0.5°

Shaft throttle measurements
There is a linear potentiometer indicating the throttle. The A/D converter on the processor will sample this potentiometer. This is a 10-bit converter. The throttle measurement resolution is 0.25%

Master / slave control
The module will have a ***Master input***. This allows more than one module in a panel to be set to Master mode using a single button. The input is isolated from the rest of the module by an opto coupler.

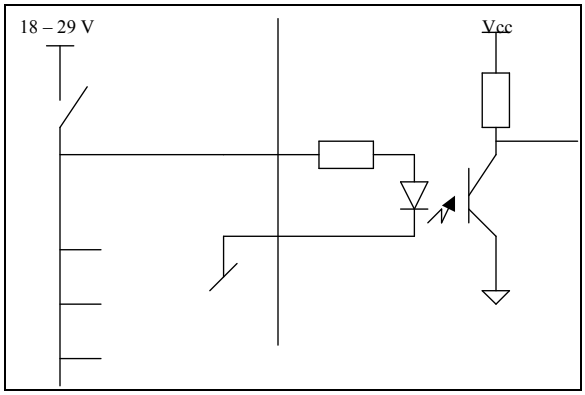


Figure 1 Master input

Spare output
The module is equipped with two relay outputs. This could be used for application specific purposes.

Maximum contact ratings:
Voltage:
Current:

3.1.2. Communication

Inter bus Communication
Non Return to Zero (NRZ) bit encoding (with bit-stuffing) for data communication on a differential two wire bus. NRZ encoding ensures compact messages with a minimum number of transitions and high resilience to external disturbance.

CAN will operate in extremely harsh environments and the extensive error checking mechanisms ensure that any transmission errors are detected. CAN uses and enhanced Carrier Sense, Multiple Access with Collision Detection Protocol (CSMA/CD). Unlike Ethernet, when frames are

transmitted at the same time, non-destructive bitwise arbitration allows the highest priority message to gain bus access.

3.1.3. CAN bus controller

The Inifineon C167-CS is chosen due to its built-in dual CAN controller. The processor will continuously monitor the CAN controllers and change active CAN bus if any error is detected. The CAN bus controller handles the completely autonomous transmission and reception of CAN frames in accordance with the CAN specification V2.0 part B (active), i.e. the on-chip CAN Module can receive and transmit standard frames with 11-bit identifiers as well as extended frames with 29-bit identifiers. The bit timing is programmable up to 1 Mbit/S. For this system the maximum transmission rate should not exceed 125 kbit/S, due to the cable length of the bus cable.

3.1.4. Bus Transceiver

Each of the two CAN controllers are connected to its own transceivers to enable a redundant CAN bus. The CAN bus transceivers are isolated with optocouplers.

3.1.5. Bus Cable

Shielding:	The Cable must be a shielded cable
Nr. of pairs:	2 twisted pairs.
Impedance:	120 ohm nom 108 ohm min. 132 ohm max.
Delay:	<= 5 ns/m
Cable cross section	>= 0.75 mm2

3.2. Software

3.2.1. Real time kernel

The software is based on a simple real time kernel to improve system reliability and handle resource priorities.

3.2.2. Communication task

A fieldbus network performs the interconnection between system units. The CAN fieldbus standard is selected due to its reliability, efficiency and widespread industrial use.
CAN is an advanced serial bus system that efficiently supports distributed, real-time control.

The control functions between system units are done by bus messages. The message types are:

- Process Data messages are used to exchange application data. Performs cyclic distribution of process data (i.e., setpoints). These are high priority CAN messages.
- Service Data messages are used to read and write of all system parameters stored in the system object dictionary. These data are transferred asynchronously (on demand). These are low priority CAN messages.
- Start-up initialisation.
- Communication sync messages.
- Exception (Error) messages

3.2.3. Servo loop task

The servo loop task performs the actuator (motor drive) control signals based on configuration parameters and setpoint data received in the Process Data messages.

3.2.4. Watch-dog

The Microcontroller provides a Watchdog Timer to allow recovery from software or hardware failure. If the software fails to service this timer before an overflow occurs, an internal reset sequence will be initiated. The watchdog timer will supervise the program execution, as it only will overflow if the program does not progress properly. The watchdog timer will also time out if a software error was due to hardware related failures. This prevents the controller from malfunctioning for longer than a user-specified time.

4. Specifications

4.1. Environment

Temperature	-25 til +70 degrades celsius
Shock	
Vibration	3-13.2Hz/+/- 1mm 13.2-100Hz/0,7g

4.2. Electric

Input Voltage:	24Vdc
Power consuption, idle:	120mA (Clutch on)
Power consuption, max	0.75A
Bus System:	Redundant CAN
Bus speed:	125kbps
Max bus length(@125kbps):	500m

5. Installation

5.1. Installation

Necessary tools:

- PC with a terminal emulator
- RS232 cable
- 8mm wrench
- Screw drivers

The cables between lever and electronic unit are 2m. Mount the electronic unit within this range from the lever. The electronic unit is mounted with two M6 bolts (not included) on the ends of the DIN rail.
Connect the cable between levers and electronic unit.
Connect external wiring according to wiring diagram LF12927 in appendix A

5.2. Configuration

5.2.1 Connectors on AESS boards

Connector J1 (Phoenix MC 1.5/12-GF-3,5)
General description:
Used for connection of lever motors, lever clutches and 24V supply. Mating cable connector: Phoenix MC 1,5/12-STF-3,5.

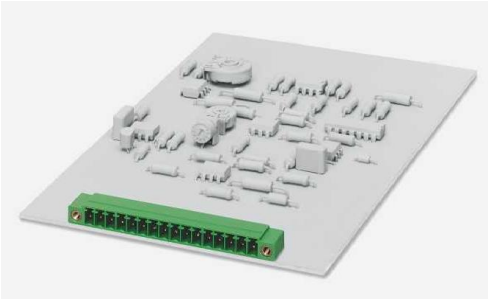


Figure 2 Picture of header Phoenix MC 1.5/12-GF-3,5

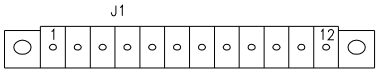


Figure 3 Connector J1 with pin numeration, seen from mating side.

CONNECTOR J1	
Pin number	**Signal to be connected**
1	Motor 2, positive terminal (-)
2	Motor 2, negative terminal (+)
3	Clutch 2, positive terminal (+)
4	Clutch 2, negative terminal (-)
5	Motor 1, positive terminal (+)
6	Motor 1, negative terminal (-)
7	Clutch 1, positive terminal (+)
8	Clutch 1, negative terminal (+)
~~9~~	Electroluminescent display, positive terminal (+)
10	Ground for Electroluminescent display (-)
11	Ground for 24 Volt supply
12	24 V DC supply

Table 1 pin configuration for header J1

Connector J2 (Phoenix MC 1.5/12-GF-3,5)
General description:
Used for connection of linear potentiometers mounted on the levers. Mating cable connector: Phoenix MC 1,5/12-STF-3,5.

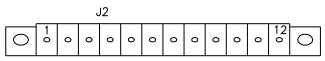


Figure 4 Connector J2 with pin numeration, seen into connector on board.

CONNECTOR J2	
Pin number	**Signal to be connected**
1	Potentiometer 2 , positive terminal (+,)
2	Potentiometer 2, wiper, **NC**
3	Potentiometer 2, negative terminal (-)
4	No connection
5	Potentiometer 1, positive terminal (+, pin 1)
6	potentiometer , wiper
7	Potentiometer 1, negative terminal (-, pin 3)
8	No connection
9	No connection
10	No connection
11	No connection
12	No connection

Table 2 pin configuration for header J2

Connector J3 (DIN41651-14p) (not mounted on this system)
General description:
J3 is for connection of display board via flat cable. Mating cable connector: AMP 1-215882-4 or similar.

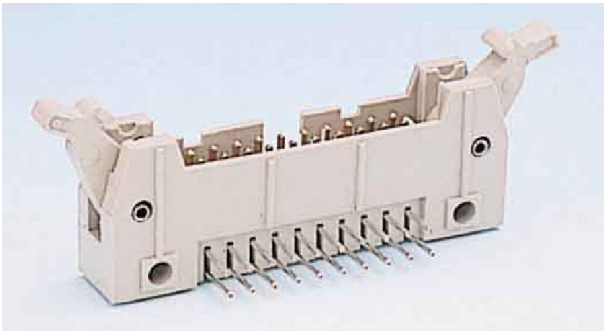


Figure 5 Picture of connector J3

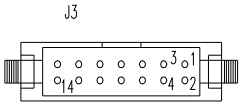


Figure 6 Connector J3 with pin numeration. Seen into connector on board.

CONNECTOR J3- display board connector	
Pin number	**Signal to be connected**
1	No connection
2	No connection
3	Ground
4	Serial clock input
5	Ground
6	Load data input 1

7	Ground
8	Load data input 2
9	Ground
10	Serial Data Input
11	Ground
12	VCC (5V from AESS board)
13	Ground
14	VCC (5V from AESS board)

Table 3 pin configuration for connector J3 (display board)

Connector P1 (9 pins DSUB Female-RS232)
General description:
Used for connection of PC via the RS232 port. Mating cable connector: AMP 747904-2 or similar.

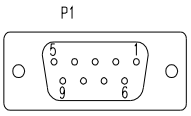


Figure 7 Connector P1 (female) with pin numeration. Seen into connector on board.

CONNECTOR P1- RS232	
Pin number	**Signal to be connected**
1	No connection
2	TX-RS232
3	RX-RS232
4	No connection
5	Ground
6	No connection
7	No connection
8	No connection
9	No connection

Table 4 pin configuration for P1 (RS-232)

Connector P2 (9 pins DSUB Male-CAN1)
General description:
Used for connection of CAN bus no. 1. Mating cable connector: AMP 747905-2 or similar.

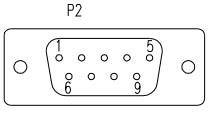


Figure 8 Connector P2 (male) with pin numeration. Seen into connector on board.

CONNECTOR P2- CAN 1	
Pin number	**Signal to be connected**
1	No connection
2	CAN1_L
3	Isolated ground (ISOGND)
4	No connection
5	No connection
6	CAN1_V- = ISOGND
7	CAN1_H
8	No connection
9	No connection

Table 5 pin configuration for connector P2 (CAN 1)

Connector P3 (9 pins DSUB Male-CAN2)
General description:
Used for connection of CAN bus no. 2. Mating cable connector: AMP 747905-2 or similar.

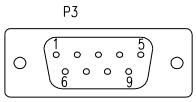


Figure 9 Connector P3 (male) with pin numeration. Seen into connector on board.

CONNECTOR P3- CAN 2	
Pin number	**Signal to be connected**
1	No connection
2	CAN2_L
3	Isolated ground (ISOGND)
4	No connection
5	No connection
6	CAN2_V- = ISOGND
7	CAN2_H
8	No connection
9	No connection

Table 6 pin configuration for connector P3 (CAN 2)

Connector P4 (15 pins DSUB Female-inputs/outputs)
General description:
P4 is used for connection of different control signals. Some pins are spare inputs and outputs. All signals are galvanic isolated from AESS board and from each other by means of magnetic coupling (relays) or optocouplers, *except* the dimming signal for electroluminescent film (pins 4 and 8), which is referenced to the same ground as the AESS board. Mating cable connector: AMP 747908-2 or similar.

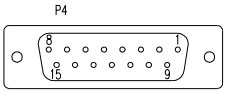


Figure 10 Connector P4 (female) with pin numeration. Seen into connector on board.

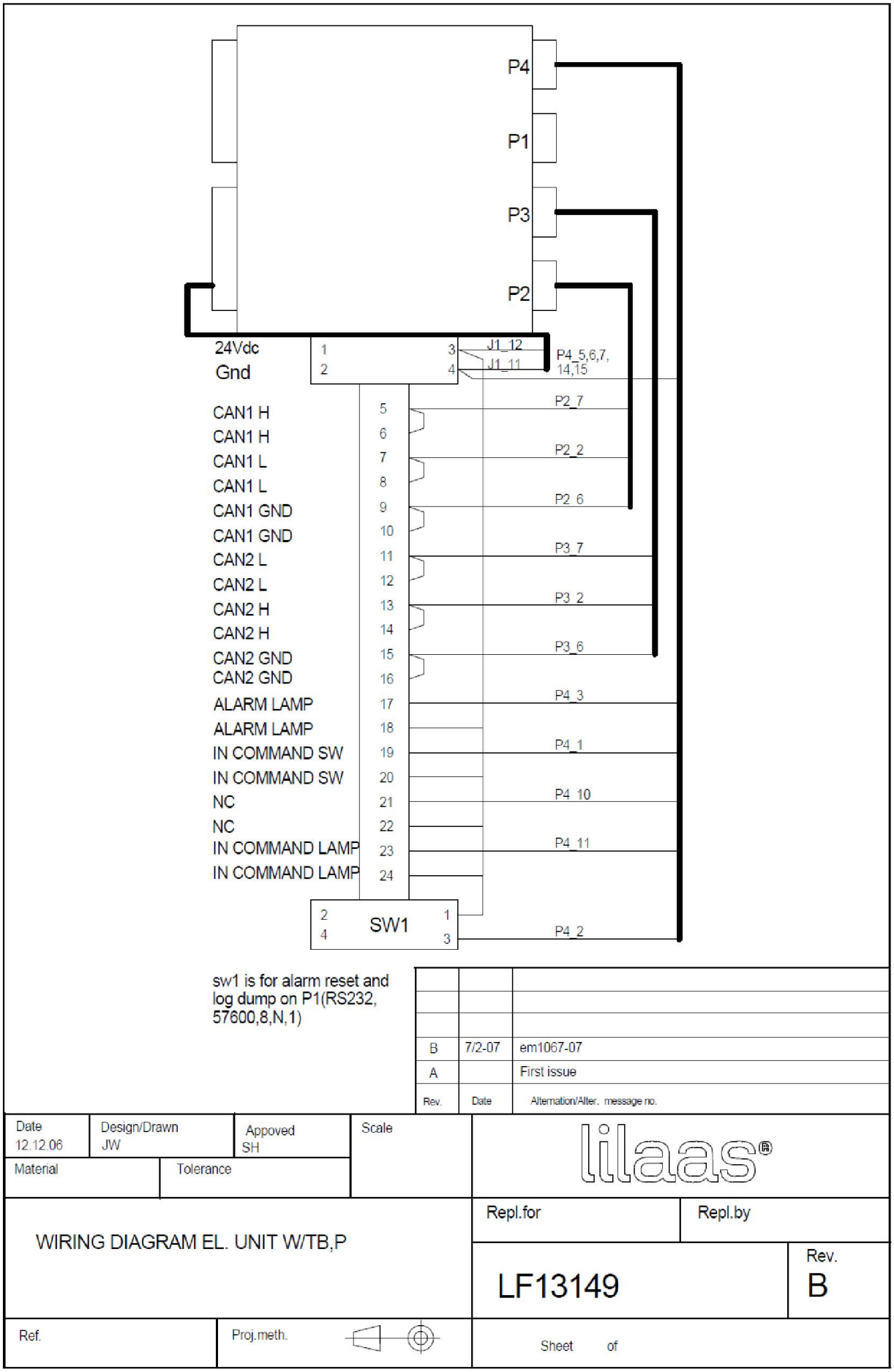
CONNECTOR P4- general inputs/outputs	
Pin number	**Signal to be connected**
1	In Command, positive terminal (+10 to 24V DC)
2	SW1, positive terminal (+10 to 24V DC)
3	Alarm, terminal 1
4	Dimming signal to electroluminescent film (0-5V)
5	In Command, negative terminal (-)
6	SW1, negative terminal (-)
7	Alarm, terminal 2
8	AESS Ground, reference for dimming signal to electroluminescent film
9	Spare input 1, positive terminal (+10 to 24V DC)
10	Spare input 2, positive terminal (+10 to 24V DC)
11	In command indicator, terminal 1
12	No connection
13	Spare input 1, negative terminal (-)
14	Spare input 2, negative terminal (-)
15	In command indicator, terminal 2

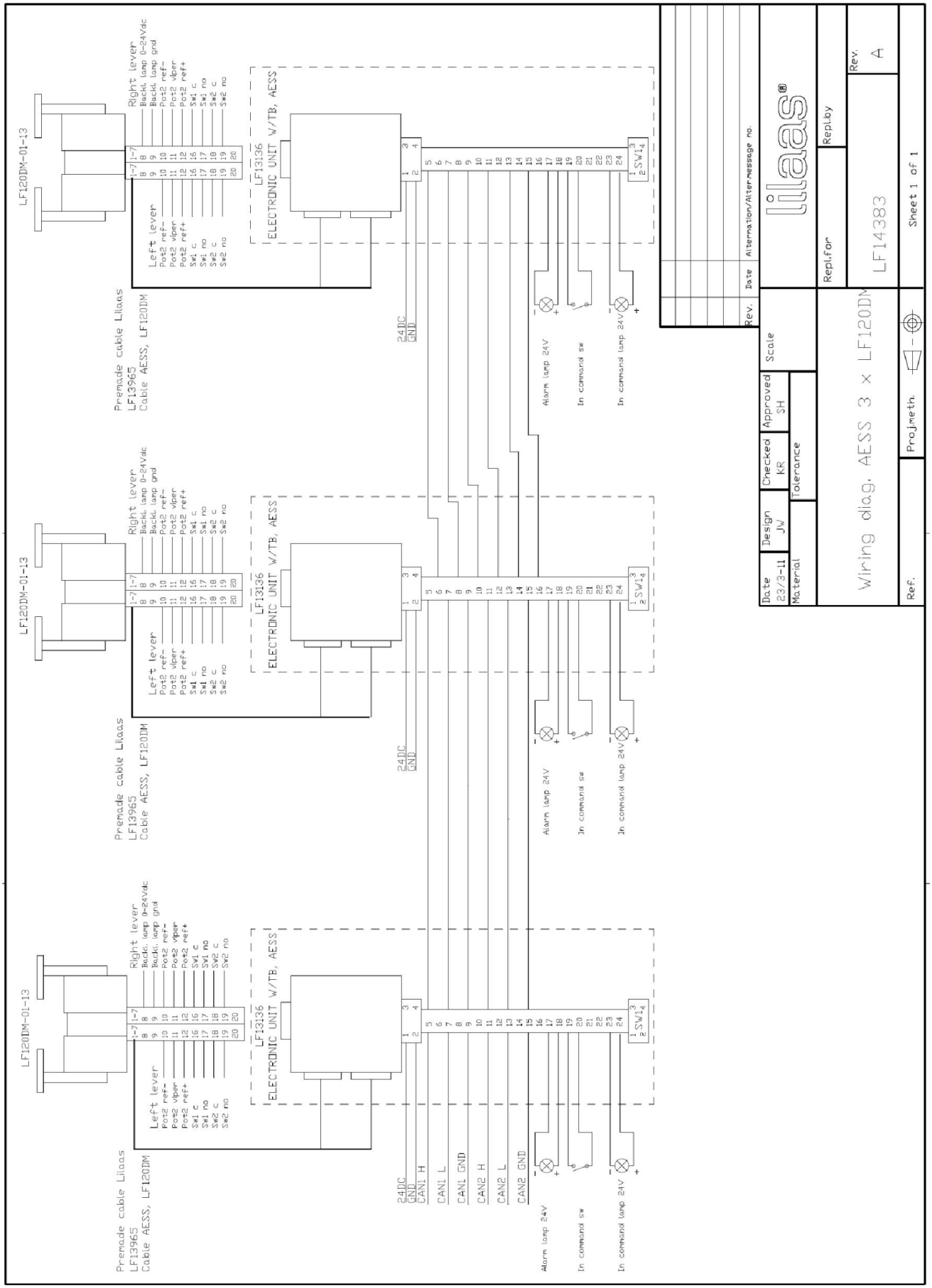
Table 7 pin configuration

6. Maintenance

This system is designed to be maintenance free. However it is recommended to perform the calibration routine and the functional test described in 5.7.3 and 5.7.4 once a year.

8.1. Wiring diagrams


P4
P1
P3
P2
24Vdc
Gnd
1
2
3
4
J1_12
J1_11
P4_5,6,7,
14,15
CAN1 H
CAN1 H
CAN1 L
CAN1 L
CAN1 GND
CAN1 GND
CAN2 L
CAN2 L
CAN2 H
CAN2 H
CAN2 GND
CAN2 GND
ALARM LAMP
ALARM LAMP
IN COMMAND SW
IN COMMAND SW
NC
NC
IN COMMAND LAMP
IN COMMAND LAMP
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
P2_7
P2_2
P2_6
P3_7
P3_2
P3_6
P4_3
P4_1
P4_10
P4_11
2
4
SW1
1
3
P4_2
sw1 is for alarm reset and log dump on P1(RS232, 57600,8,N,1)
B 7/2-07 em1067-07
A First issue
Rev. Date Alternation/Alter. message no.
Date 12.12.06
Design/Drawn JW
Appoved SH
Scale
Material
Tolerance
lilaas®
WIRING DIAGRAM EL. UNIT W/TB,P
Repl.for
Repl.by
LF13149
Rev. B
Ref.
Proj.meth.
Sheet of


LF120DM-01-13
Left lever
Right lever
Backl. lamp 0-24Vdc
Backl. lamp gnd
Pot2 ref-
Pot2 viper
Pot2 ref+
Sw1 c
Sw1 no
Sw2 c
Sw2 no
Premade cable Lilaas
LF13965
Cable AESS, LF120DM
LF13136
ELECTRONIC UNIT W/TB, AESS
24DC
GND
CAN1 H
CAN1 L
CAN1 GND
CAN2 H
CAN2 L
CAN2 GND
Alarm lamp 24V
In command sw
In command lamp 24V
Rev.
Date
Alternation/Alternessage no.
lilaas
Scale
Approved SH
Checked KR
Design JW
Tolerance
Date 23/3-11
Material
Repl.for
Repl.by
Rev. A
LF14383
Wiring diag. AESS 3 x LF120DM
Ref.
Projmeth.
Sheet 1 of 1