Land Transport Authority

71 Chai Chee Street Singapore 468981
Tel: 1800 - CALL LTA (1800 - 2255 582) Fax: (65) 6396 1002

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Our ref: LTA/CFSM/TR255/19/0111

Tel: 6585 3213 Fax: 6585 3004

By Post & Fax (6248 1295)

CIRCULAR TO PROFESSIONAL INSTITUTIONS

Dear Sirs,

REVISED PROVISIONS FOR ARCHITECTURAL DESIGN CRITERIA SECTION 4.2

Who should know

Building owners, developers, architects and engineers

Effective Date

Immediate effect

Update of LTA Architectural Design Criteria Section 4.2 from Facilities Management System (FMS) to Commuter Facility Equipment Monitoring Services (CFEMS)

1. We are pleased to inform the industry that the Facilities Management System (FMS) under Commuter Facilities E&M Design Requirements under LTA Architectural Design Criteria (ADC) are superseded and replaced with Commuter Facility Equipment Monitoring Services (CFEMS) as per attached **Appendix A**.

2. All submissions made shall comply with the revised requirements as per Appendix A until such time a new ADC update is released.

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Enquiries

3. We would appreciate if you could convey the contents of this circular to the relevant members of your organisation and building owners/developers on the revised changes from FMS to CFEMS. If you or your members have any queries pertaining to this circular, please email to **Ron_Ong@lta.gov.sg or Natalie_Lim@lta.gov.sg**

Thank you.

Yours faithfully,

Foo Say Yaw
Deputy Director
Commuter Facilities &
Systems Management

RO/GKH

Land Transport Authority

Distribution List:

President Singapore Institute of Architects 79/79A/79B Neil Road Singapore 088904 President Association of Consulting Engineers Singapore 18 Sin Ming Lane #06-01 Midview City Singapore 573960 President Institution of Engineers, Singapore 70 Bukit Tinggi Road Singapore 289758 President Singapore Real Estate Developers Association 190 Clemenceau Avenue #07-01 Singapore Shopping Centre Singapore 239924 President Singapore Contractors Association Ltd 1 Bukit Merah Lane 2 Construction House Singapore 159760 President Board of Architects, Singapore 5 Maxwell Road #01-03 Tower Block, MND Complex Singapore 069110 President Professional Engineers Board 52 Jurong Gateway Road #07-03 Singapore 608550	Group Director Development Control Urban Redevelopment Authority 45 Maxwell Road The URA Centre Singapore 069118 Director Building Plan & Management Division Building and Construction Authority 52 Jurong Gateway Road #11-01 Singapore 608550 Director Planning & Design Development Division National Parks Board Singapore Botanic Gardens 1 Cluny Road Singapore 259569

RO/GKH

INTERFACING WITH COMMUTER FACILITY EQUIPMENT MONITORING SERVICES (CFEMS)

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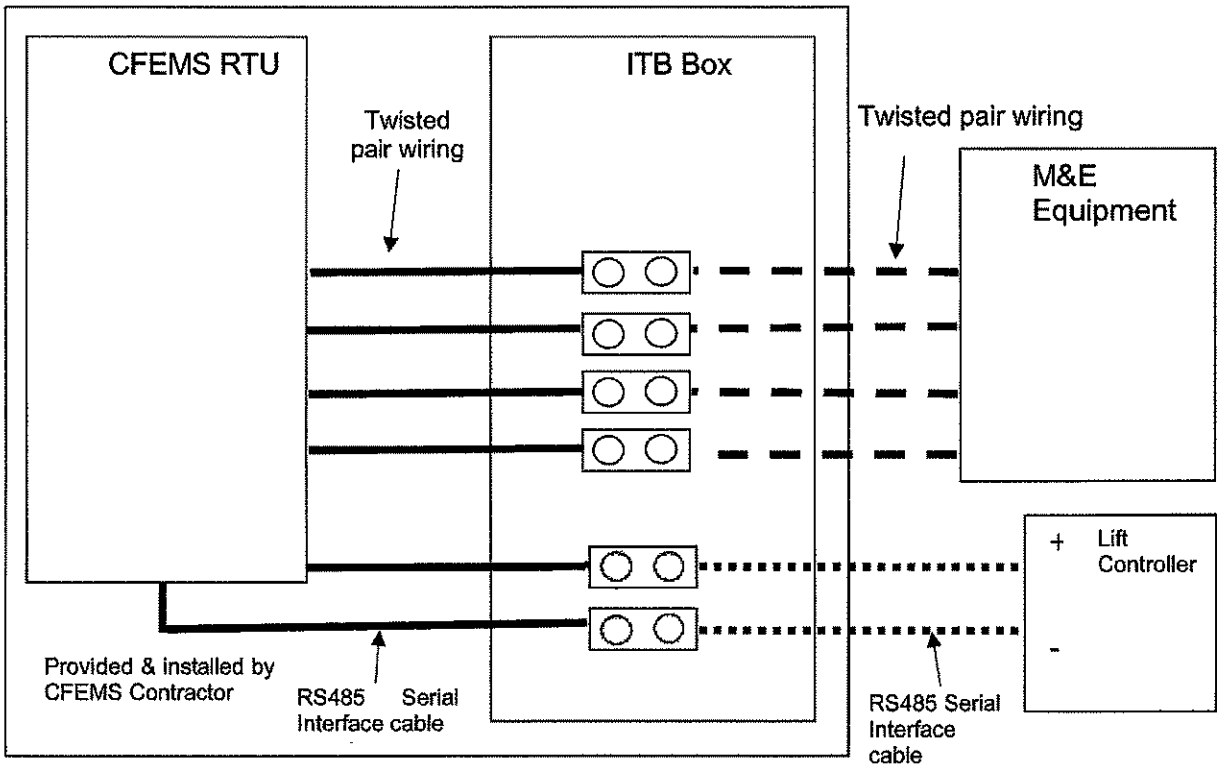
INTERFACING WITH COMMUTER FACILITY EQUIPMENT MONITORING SERVICES (CFEMS)

1.1 General

a) Where Commuter Facility Equipment Monitoring Services (CFEMS) is provided, the developer shall engage the LTA CFEMS Contractor to supply and install CFEMS, all equipment signals shall interface with the CFEMS system via CFEMS panel consisting of:
   - Interface Terminal Boards (ITBs)
   - Remote Terminal Unit (RTU) and its associated components

b) The developer shall provide attendance for testing and commissioning of CFEMS system which will be carried out by the CFEMS Contractor. Please see the diagram below showing the responsibilities of the CFEMS Contractor and Contractors (M&E Equipment / Lift).



Legend

Provided & installed by CFEMS Contractor

Provided & installed by Contractor (M&E Equipment)

Provided & installed by Contractor (Lift/Escalator)

Note: Twisted pair wiring to be voltage-free.

Interfacing diagram between CFEMS Contractor & Contractors (M&E Equipment / Lift)

1.2 CFEMS Field Equipment

1.2.1 Electrical Requirements

a) The electrical requirements for the CFEMS field equipment is as follows:

(i) 1 no. of 20A single phase power supply isolator (For RTU)

(ii) 1 no. of 20A single phase power supply isolator (For CCTV System)

(iii) 1 no. of 20A single phase power supply isolator (For Spare)

1.2.2 Remote Terminal Unit

a) The remote site RTU (Field RTU) shall be housed in a panel with easy access for maintenance work with at least 25% spare panel space for future expansion.

b) Electrical requirements for the RTU will be 1 number of 20A single phase power supply isolator.

1.2.3 Cabling and Wire Terminations

For M&E equipment:

a) Solderless and screwless techniques shall be the preferred means of terminating conductors. Crimping or other standard industry practice may also be used.

b) All wire and cable terminals shall be properly numbered and labelled with descriptions of their functional purpose.

c) All cables used for CFEMS interfacing shall be as follows:

(i) Digital Input (DI) and Digital Output (DO), Digital Alarm (DA):
0.6mm diameter, single twisted pair screen signal cable

d) All cable screens for DI and AO shall be left floating at the equipment (auxiliary contacts, sensors etc) and shall be terminated in a common screen terminal on the terminal block.

e) The developer shall supply, install and terminate cables from M&E equipment to the ITB in the CFEMS panel.

For Lift:

f) The developer shall supply, install and terminate RS485 cables from the Lift controller panel to the CFEMS ITB.

g) The lift travelling cable provided by the contractor shall meet the following specifications:

Construction:

(i) 4 highly flexible PVC (polyvinyl chloride) insulated stranded cores for power application

(ii) 8 pairs of highly flexible PE (polyethylene) or PVC insulated stranded cores, each pair screened individually by an aluminium-laminated tape

(iii) 2 coaxial video cables

(iv) PVC outer sheath

Electrical Data:

Power Cores	
Rated voltage	: 300/500V
Cross Sectional Area (n x mm²)	: 4 x 1.50
Screened Cores	
Rated voltage	: 300/300V
Nominal Capacity	: 100 pF/m (f=1 MHz)
Nominal Impedance	: 75 ohm (f=1 MHz)
Nominal Attenuation	: <4.7 dB/100m (f=1 MHz)
Cross Sectional Area (n x mm²)	: 8 x 2 x 0.50
Coaxial video cable	
Nominal Capacity	: 67 pF/m (f=5 MHz)
Impedance	: 75 ± 3 ohm/m (f=5M Hz)
Nominal Attenuation	: <3.6 dB/100m (f= 5 MHz)
Thermal Properties:	
Operating Temperature Range	: 10°C to 70°C
Standard	: In accordance with BS (British Standards) 6977 or UL (Underwriters Laboratories) 62 or EN (European Standard) 50214

1.3 Equipment Status Monitoring

Equipment status monitoring points shall be in the form of voltage free, normally open contacts. All signals sent by any monitoring point shall be latched in order to ensure that the signal is able to be received by CFEMS. All equipment status monitoring points must be electrically isolated from power circuits.

1.4 Level Switches

Level switches shall be of magnetic type or other approved non-electrical type, for sensing of low liquid level in the tank. Switches shall have the snap action SPDT type contacts rated at 1.2/230V AC.

1.5 Voltage Transducers

Voltage transducers shall have an output of between 4 to 20 mA.

1.6 Schedule of Points

The CFEMS points to be provided, but not limited to, by the respective Contractors to be monitored are as follows:

1 RTU Panel
- Maintenance Key ON/OFF

2 M&E CF key switch status
- Maintenance Key ON/OFF

3 Lift key switch status
- Maintenance Key ON/OFF

4 Escalator key switch status
- Maintenance Key ON/OFF

5 Lift System
- For the CFEMS points, please refer to lift interface requirements with CFEMS (Table 1)

6 Closed Circuit Television System (CCTV)
- Main incoming supply status (230V AC)
- DVR Power status (12V DC)
- DVR Fail Alarm
- Hard disk full alarm
- Hard disk malfunction alarm
- Image loss alarm
- Camera supply status
- Camera trip alarm

7 Pump System
- Incoming supply status
- Individual pump power status
- Individual pump ON/OFF status
- Individual pump running status
- Individual pump trip alarm
- Individual pump high level alarm
- Individual pump low level alarm
- Incoming supply status for water level sensor(s)

8 Air Conditioning System (AC)
- Incoming supply status
- Individual AHU/PEU power status
- Individual CU/PEU ON/OFF status
- Individual CU/PEU trip alarm
- Individual CU/PEU temperature reading
- Overall space temperature reading

9 Mechanical Ventilation System (MV)

- Incoming supply status
- Individual MV power status
- Individual MV ON/OFF status
- Individual MV trip alarm

10 Escalator Status

- Escalator ON/OFF status
- Escalator Up direction status
- Escalator Down direction status
- Escalator Maintenance status

Escalator Controller

- Incoming power supply ON/OFF status
- Phase reverse/loss alarm
- Earth leakage alarm
- PCB board communication fault alarm
- Safety circuit Opened alarm
- Inverter fault alarm
- Inverter no run signal alarm
- UPS fault alarm

Escalator Drive Unit

- Main drive chain fault alarm
- Motor overload alarm
- Motor overheat alarm
- Motor overspeed alarm
- Motor reverse direction alarm
- Motor inconsistent speed alarm
- Gearbox oil level low alarm
- Mechanical brake status alarm
- Mechanical brake pad status alarm
- Auxiliary brake status alarm
- Auxiliary brake pad status alarm
- Exceed permitted stopping distance alarm

Escalator Handrail system

- Handrail speed -15% alarm, left
- Handrail speed -15% alarm, right
- Handrail inconsistent speed alarm, left
- Handrail inconsistent speed alarm, right
- Handrail tension/ Broken alarm, left
- Handrail tension/ Broken alarm, right
- Handrail inlet safety switch alarm, upper left
- Handrail inlet safety switch alarm, upper right
- Handrail inlet safety switch alarm, lower left
- Handrail inlet safety switch alarm, lower right

Steps and step chain

- Missing step alarm, upper
- Missing step alarm, lower
- Step sag safety switch alarm, upper
- Step sag safety switch alarm, lower
- Step chain tension alarm, left
- Step chain tension alarm, right
- Step upthrust safety switch alarm, upper
- Step upthrust safety switch alarm, lower

Landing and comb plate

- Floor plate opened alarm, upper
- Floor plate opened alarm, lower
- Comb plate safety switch alarm, upper left
- Comb plate safety switch alarm, upper right
- Comb plate safety switch alarm, lower left
- Comb plate safety switch alarm, lower right
- Flood sensor alarm

Decking

- Emergency stop alarm, upper
- Emergency stop alarm, middle
- Emergency stop alarm, lower
- Skirt panel safety switch alarm, upper left
- Skirt panel safety switch alarm, upper right
- Skirt panel safety switch alarm, middle left
- Skirt panel safety switch alarm, middle right
- Skirt panel safety switch alarm, lower left
- Skirt panel safety switch alarm, lower right
- Motion sensor fault alarm, upper
- Motion sensor fault alarm, lower

11 Generator System

- Genset main incoming supply status
- Genset battery charger fail alarm
- Genset run status
- Genset failure alarm
- Genset Auto/Manual status
- Genset day tank low fuel alarm
- Genset day tank high fuel alarm
- Genset storage tank low fuel alarm
- Genset storage tank high fuel alarm
- Genset high temperature alarm
- Genset low oil pressure alarm
- Genset overload alarm
- Genset overcurrent alarm
- Genset earth fault trip alarm
- Genset earth failure alarm

- Individual Phase Voltage Reading

12 Uninterruptible Power Supply (UPS) System
- On/Off Status

13 Fire Alarm System
- Fire alarm activated
- Fire alarm system incoming supply

14 Heat/ Smoke detection System
- Heat/ Smoke detection alarm activated
- Heat/ Smoke detection system incoming supply

15 Clean Gas Detection System
- Clean gas cylinder low pressure detected
- Clean gas system activated
- Clean gas panel summary trip alarm

16 Electrical System
- Powergrid main incoming supply alarm (3 phases)

17 Lighting System*
- Individual lighting circuit outgoing trip alarm (7pm to 7am)
- Outgoing RCCB trip alarm for motion sensor circuitry

* Contractor to submit Single Line Diagram to LTA for quantity of lighting points to be monitored.

1.7 Testing and Commissioning

The Contractor shall carry out the following tests:

(a) CFEMS field equipment test

(b) End-To-End-Test

1.7.1 CFEMS Field Equipment Test

The Contractor shall coordinate with the CFEMS contractor to carry out all necessary tests to verify that all equipment connected to the RTU at the CFEMS field equipment can be monitored before the start of End-to-End Test. This shall include the following;

(a) Verify via point-to-point test for all connections between field equipment ITB and RTU.

(b) Verify the correct operation of all functions including hardware and software function (RTU program etc) from the field equipment to the wireless modem.

1.7.2 End-to-End Test

(a) End-To-End test is carried out to verify the proper functioning of the CFEMS from the HMI GUI at the CFEMS backend system to the field equipment. This shall include the following;

(i) Activation by the Contractor of the field equipment to produce a status change that can be seen at the CFEMS backend system for DI points.

(ii) Activation by the Contractor of the field equipment to produce an alarm that can be seen at the CFEMS backend system for DA points.

(b) The Contractor shall coordinate with CFEMS Contractor for the test schedule and testing.

(c) The Contractor shall review all test procedures to be produced by the CFEMS Contractor.

1.8 Enclosures

1.8.1 Enclosures include equipment panels that houses CFEMS field equipment and Interface Terminal Box (ITB).

1.8.2 As a minimum, enclosures shall be made of 1.6mm electro-galvanised sheet metal with a surface finished of epoxy polyester coating.

1.8.3 The CFEMS panel to be provided by the developer and supplied by the CFEMS contractor shall be sized to a width of 600mm, height of 800mm and depth of 200mm.

1.8.4 The ITB to be provided shall be sized to a width of 600mm, height of 300mm and depth of 200mm.

1.8.5 The IP Code rating as specified in IEC 60529 shall be used for degrees of protection for all enclosures installed in the following areas;

(a) IP55 for enclosures that are installed indoors.

(b) IP65 for enclosures that are installed outdoors.

1.8.6 All metal enclosures shall be resistant to or protected against corrosion and rust.

1.8.7 The terminal blocks inside the enclosures shall meet the required standards of IEC 60 947-7-1.

1.8.8 All enclosures shall be labelled and the termination blocks inside the enclosures numbered.

1.8.9 Cables in the enclosures shall be labelled at both ends.

1.9 Connection to CFEMS

The Contractor shall provide PC or Notebook to be connected to the backend of the CFEMS Contractor to receive alarms detected by the CFEMS for their respective service. The Contractor shall subscribe to 3G mobile broadband wireless service from any Telco to connect and receive the alarms from the CFEMS backend. The CFEMS contractor shall load a program into the PC for the Contractor to view the alarm cases. The minimum configuration of the PC is as follows:

- The latest CPU or equivalent (minimum)
- 2GB RAM on board (minimum)
- 250GB Hard Disk (minimum)
- Monitor
- Operating System (MS-Windows 7 and above)
- CD ROM and USB
- Sound card + Speakers (optional)
- Anti-virus software

Training will be provided by the CFEMS Contractor to help the Contractor operate the application.

1.10 CCTV System Requirements

The CCTV system for CF equipment at commuter facilities shall comprise the following:

(a) CCTV camera(s) with housing to be installed at locations to be decided by the Superintending Officer;

(b) A standalone digital video recording system to be installed within enclosure with lockset;

(c) Software and hardware devices for management of CCTV system; and

(d) Associated components

The CCTV system shall be equipped with a backup battery system. The backup battery shall ensure that in the event of a power failure, the CCTV system shall continue to function for a minimum of two (2) hours without any deterioration or degradation of its performance.

1.10.1 The CCTV system cameras shall be dome-shaped, vandal-proof, of charge coupled device (CCD) 1/3" format, PAL colour system and shall be equipped with character generator capable of producing at least 16 user-defined alphanumeric characters for identification of the viewed areas.

1.10.2 The Contractor shall propose the location to install the CCTV system cameras which shall provide sufficient surveillance coverage and shall be subjected to the acceptance of the Superintending Officer.

1.10.3 The CCTV system cameras shall utilise varifocal lenses. The maximum aperture for the lens shall be at least f/1.4 and the aperture size range shall be such that the depth of field is not less than 2 m to infinity.

1.10.4 The CCTV system cameras shall have sufficient dynamic range to operate under varying conditions throughout the day, including bright sunlight and various lighting conditions. The CCTV system cameras shall be able to operate and produce usable pictures under a lighting level of 0.1 lux.

1.10.5 The CCTV system cameras shall be of day and night type and meet the following minimum specifications:

(a)	Video Output	:	1 Vpp Composite video signal with 0.3V sync pulse
(b)	Video Impedance	:	75 Ω
(c)	Horizontal Resolution	:	≥ 540 TVL (colour mode)
(d)	S/N Ratio	:	> 48dB (AGC off)
(e)	Minimum illumination	:	1 lux at colour mode
		:	0.1 lux at black/white mode
(f)	Ambient Temperature	:	Environmental ambient temperature of at least +45°C
(g)	Other Features	:	Automatic white balance

(h) Automatic iris control
(i) Automatic light control / Electronic light control
(j) Automatic beam control
(k) Automatic gain control
(l) Automatic black level adjustment
(m) Lens flare compensation
(n) Backlight compensation

(o) Electronic shutter function

1.10.6 If digital camera is proposed, the digital camera conforming to Profile S specifications of ONVIF shall be provided. The digital cameras shall have performance similar to that specified in Clause 1.7.1.5, and subject to review and acceptance.

1.10.7 The CCTV system cameras shall be easily accessible for maintenance purpose.

1.10.8 The CCTV system cameras shall avoid facing direct or reflected light sources. In the event that a camera would inevitably face a strong light source or direct sunlight permanently, filters shall be used to reduce the glare and to protect the camera from permanent damage.

1.10.9 The CCTV system cameras shall be housed in protective housings. The housings shall be designed to allow sufficient ventilation and heat dissipation for the cameras.

1.10.10 The housings for the CCTV system cameras shall be vandal resistant, and shall be sealed to at least IP54.

1.10.11 The camera cables between camera housing and main trunking shall be protected by flexible metal conduit. The flexible conduit, cables and bracket interface shall be easily removed and reinstated for maintenance.

1.10.12 Openings of ceiling panels for CCTV system camera mounting shall be covered with trimmers, etc. to improve their aesthetic appearance. The design and finishes of the trimmers and camera enclosure shall be subject to review and acceptance.

1.10.13 The DVR shall record the images of the CCTV system camera(s) continuously and the images shall be recorded for at least ninety (90) days, at a minimum of 6 frames per second and at a resolution of at least 704 x 576 pixels.

1.10.14 The DVR shall be equipped with a RJ-45 Ethernet port (or other interface port, subject to review and acceptance) for local and remote DVR configuration and management, viewing of live and recorded images, and retrieval and archival of recorded images using personal computer/notebook.

1.10.15 The DVR shall also be equipped with at least the following functions and facilities:

(a) Replay and normal play;
(b) Still field;
(c) Fast forward;
(d) Rewind;
(e) Stepping frame;
(f) Visual search – forward and reverse;
(g) Speed search and stop;
(h) Search between user defined date/time periods;
(i) Simultaneous record, replay and view of captured images;
(j) Event and alarm logs;
(k) 24-hour time and date stamp/identification;
(l) Removable internal storage medium for external monitoring; and
(m) An authentication mechanism to be proposed, and subject to review and acceptance, to ensure the integrity of all recorded images by allowing detection of any alteration or tampering made on the recorded images.

1.10.16 The Digital Video Recorder (DVR) shall be installed within an enclosure sealed to at least IP54.

1.10.17 Electrical requirements for the DVR will be 1 number of 20A single phase power supply isolator.

1.11 Software and Hardware Devices for Management of CCTV

1.11.1 The Contractor shall provide portable terminals such as laptops that are equipped with all necessary software, licences and connecting cables for the management and configuration of the CCTV, including anti-virus software.

1.11.2 The portable terminal that is equipped with all necessary software, licences and connecting cables for the management and configuration of the CCTV system, including anti-virus software.

1.11.3 The portable terminal for management and configuration of the CCTV shall have the following functions:

(a) Control and management functions specified in Clause 1.7.2.3 for the DVR;
(b) Select and playback selected live and recorded images from the DVR in various display formats, e.g. full screen and quad display;
(c) Download of selected recorded images from the DVR to archival media e.g. CD-R, thumb-drive, etc. It shall be possible to playback these downloaded archived images using open-source media player such as VLC media player.

The Lift Contractor shall provide three (3) RS485 ports in each lift controller. One serial link shall be used to communicate between the RTU and the lift controller, for IO status including digital/analog input data and digital output control. The Contractor shall ensure that the lift controller can communicate with the RTU, the functions and the protocol of the serial RS485 interface is as shown below. The Contractor shall label all the wires and crimped with ferrule at the RTU end, to be connected to RTU RS485 port. The Contractor shall terminate its RS485 end with 120 Ohm resistor.

Serial RS485 Port Interface for Lift IO Protocol:

LIFT		RTU (by CFEMS Contractor)
+	_____	+
-	_____	-
GND	_____	GND

The Lift Contractor shall provide two (2) numbers of RS485 cables (including one spare) from the lift controller to the RTU for each lift. The RS485 cable shall be type AWG 20, twisted pair with aluminium foil shielding. The cable shall be fire retardant with semi-rigid PVC sheathing. The Contractor shall develop user-friendly software compatible with the latest Windows software, come with USB converter for RS485 to communicate with and test the two serial interfaces with the lift controller through RS485 interface.

The Contractor shall provide all the equipment, for example, notebook for testing the RS485 port I/O points and signals interface board, required for the interfacing test.

RS485 Communication Protocol:

a) 38400 bps (bits per second)
b) 8 bit data
c) No parity.
d) 1 stop bit
e) +, - and GND
f) Lift controller shall reply within 100 milliseconds after CPU receives last packet of bytes

Please refer to Annex B for the Protocol from RTU to Lift Controller and Lift Controller to RTU.

CFEMS REQUIREMENTS

Table 1 shows all the various points required by CFEMS. This table also shows the voltage requirement and associated logic of each point.

The Contractor shall note the following:

(i) All wires for CFEMS, terminating on the lift controller circuits shall be marked with the designation of the CFEMS points (see Table 1) for ease of repairs and trouble shooting.

(ii) As can be seen from Table 1, all the voltage levels are in DC. The Contractor shall use a regulated power supply (with ripple less than 1%) or direct from a battery source (UPS battery). The regulated supply shall be 24V DC ±5% under load, measured at the connectors. However, the Contractor shall take the supply from a battery source for those points where detection is still needed when a power failure occurs (as shown in Table 1). The Contractor can group the points into groups of the same common return. The Contractor is to note that common return is positive unless otherwise stated in Table 1. For the group with same common return, the Contractor need only terminate the negative points on the terminal blocks and two common return points. Please refer to Annex C for points in detail.

ANNEX B

Protocol from RTU to Lift Controller and Lift Controller to RTU

Header	Data Length	Function Code	Sequence Number	Address No	Error Code	Data	CRC

Header (HD) - 2 Bytes in hex (0xA5A5)
Data Length (DL) - 1 Byte of no of bytes (payload) to follow except Cyclical Redundancy Check (CRC)
Function Code (FC) - 1 Byte of type of message

0x11 – Poll digital input status
0x12 – Poll analog input status
0x13 – Set digital output control

Sequence No (SN) - 1 Byte of sequence no in hex, high bytes goes first
Address No (AN) - 1 Byte of Lift Address i.e. 1 is for lift A, 2 is for lift B etc
Error code (EC) - 1 Byte of error code, to be sent if the received message has error (Data length error or function code error or CRC error)
Data (DD) - Data content
CRC - 2 Bytes of CRC (See Annex E)

Note: For Lift IO protocol, function codes 0x11, 0x12 and 0x13 are used.

a) Function code 0x11, poll digital input status

From RTU -
HD = 0xA5A5
DL = 0x03
FC = 0x11
SN = 0xFF
AN = Lift Address
CRC= 2 bytes
From Lift Controller -
HD = 0xA5A5
DL = n bytes
FC = 0x11
SN = 0xFF
AN = Lift Address
EC = 0x00 (no error)
0x01 – 0xFF (see Annex D - Error Code)
DD = 15 bytes
CRC= 2 bytes

Details of Data Requirements

Number Group (NG)	Group (G)	Number Point (NP)	Start Point (SP)	Value	Group (G)	Number Point (NP)	Start Point (SP)	Value
8 bit	8 bit	8 bit	8 bit	4 X 8 bits	8 bit	8 bit	8 bit	4 X 8 bits
0x02	0x01	0x04	0x01		0x02	0x04	0x01	

NG = Number of groups 0x02, refers to 2 groups of digital input (DI): battery backup points and non-battery backup point
G = Group 0x01, refers to battery backup digital input
NP = Number of bytes 0x04, refers to 4 bytes of data. Each byte represents 8 points.
SP = Starting point 0x01
Value = 4 bytes refer to 32 battery backup digital input points. Refer to detail of value for DI group
G = Group 0x02, refers to non-battery backup digital input
NP = Number of bytes 0x04, refers to 4 bytes of data. Each byte represents 8 points.
SP = Starting channel 0x01
Value = 4 bytes refer to 32 non-battery backup digital input points. Refer to detail of value for DI group

Details of Definition of DI Group
During transmission, Lift Controller will reply 4 byte of battery backup digital input data and 4 bytes of non-battery backup digital input data when RTU send Directive (DIR) function code.

Battery backup digital input bit definition:

Bit	7	6	5	4	3	2	1	0
Byte 1	P22	P17	P16	P15	P14a	P14	P13	P12
Byte 2			P11	P10	P38	P67	P26	P25
Byte 3	SPB13	SPB12	SPB11	SPB10	SPB09	SPB08	P29	P18
Byte 4	SPB21	SPB20	SPB19	SPB18	SPB17	SPB16	SPB15	SPB14

Non-battery backup digital input bit definition:

Bit	7	6	5	4	3	2	1	0
Byte 1	P32	P31	P30	P28	P24	P23	P21	P20
Byte 2	P52	P51	P50	P40	P37	P35	P34	P33
Byte 3	UPS	ARD	SPARE	P57	P56	P55	P54	P53
Byte 4	SPN08	SPN07	SPN06	SPN05	SPN04	SPN03	P36	UPDOWN

UPS remote testing – Set to high when the RTU instruct the lift to cut off

single phase supply to the UPS and the lift is successfully carried out instruction.

ARD – Set to high when the RTU instruct the lift to cut off supply to the lift and the lift has successfully carried out the instruction.

b) Function code 0x12, poll analog input status

From RTU -
HD = 0xA5A5
DL = 0x03
FC = 0x12
SN = 0xFF
AN = Lift Address
CRC= 2 bytes

From LC -
HD = 0xA5A5
DL = n bytes
FC = 0x12
SN = 0xFF
AN = Lift Address
EC = 0x00 (no error)
0x01 – 0xFF (see Annex D - Error Code)
DD = up to 250 bytes
CRC= 2 bytes

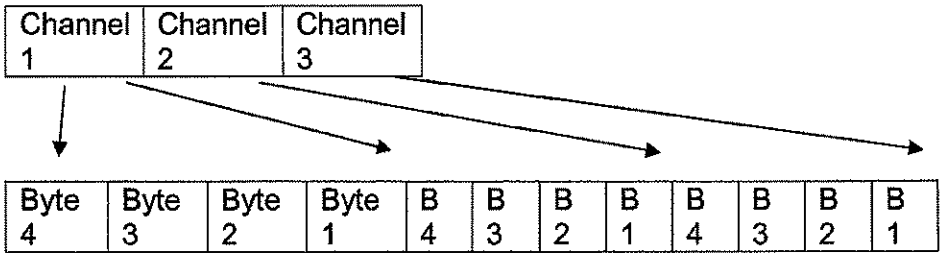
Details of Data Requirements

Number Group (NG)	Group (G)	Number Point (NP)	Start Point (SP)	Value
8 bit	8 bit	8 bit	8 bit	3 X 32 bits
0x01	0x03	0x03	0x01	

NG = Number of groups 0x01, refers to AI (0x03) groups
G = Group 0x03, refers to the analog input
NP = Number of channels 0x03, refers to 3 analog input channels
SP = Starting channel 0x01
Value = 12 bytes, each channel takes 4 bytes. Refer detail of value for AI group

Details of Definition for Analog Input (AI) Group

Lift Controller must send the engineering value (i.e. Short Floating Point Number IEEE STD 754, stored in 32 bit) of the analog input channel.
Each analog input channel will take 4 bytes.
During transmission, LC sends byte 4, 3, 2 and 1 of channel 1, 2 and 3.



Channel 1	ARDBAT
Channel 2	UPS BAT
Channel 3	UPS SENSOR (5V)

c) Function code 0x13, send digital output control

From RTU -
HD = 0xA5A5
DL = 9 bytes
FC = 0x13
SN = 0xFF
AN = Lift Address
DD = 6 bytes
CRC = 2 bytes

From LC -
HD = 0xA5A5
DL = 10 bytes
FC = 0x13
SN = 0xFF
AN = Lift Address
EC = 0x00 (no error)
0x01 – 0xFF (see Annex D - Error Code)
DD = 6 bytes
CRC = 2 bytes

Details of Data Requirements

Number Group (NG)	Group (G)	Number Point (NP)	Start Point (SP)	Value
8 bit	8 bit	8 bit	8 bit	2 X 8 bit
0x01	0x4	0x02	0x01	

NG = Number of group 0x01
G = Group 0x04, refers to the digital output
NP = Number of bytes 0x02, value field takes 2 bytes
SP = Starting point 0x01
Value = 2 bytes of value, which represents 16 output channels.

Details of Definition for Digital Output Group

Byte 1	Byte 2

Bit	7	6	5	4	3	2	1	0
Byte 1	OP7	OP6	OP5	OP4	OP3	OP2	OP1	OP0
Byte 2	SPO08	SPO07	SPO06	SPO05	SPO04	SPO03	SPO02	SPO01

OP0	Call lift up
OP1	Call lift down
OP2	On Lift
OP3	Off Lift
OP4	Off UPS
OP5	SPARE
OP6	On UPS
OP7	SPARE

ANNEX C

MONITORING POINTS IN DETAIL

Most of the points as shown in Table 1 are self-explanatory. Points which need further elaboration are found hereunder:

P11- Flood Sensor High Level Alarm

The Contractor shall provide a Flood Sensor High Level Alarm. When the level sensor does not detect water level in pit as high, P11 shall be low. When the level sensor detects high water level, P11 shall be high.

P12 – Lift Maintenance Switch

When the key operated switch is in the "Normal" position, P12 input shall be low. When the key operated switch is in the "Maintenance" position, P12 input shall be high and it shall disable the remote switching off of lift by CFEMS. The Contractor should ensure that the key cannot be removed when in the "Maintenance" position. The CFEMS requires that this key be inserted during the maintenance operation. This key can only be removed after the last personnel complete the maintenance operation.

P15, P16, P17 - Power Supply Detection

Three relays designated as (R1, R2, R3) shall be used to sense the power supply to the lift. Each of these relays shall sense a line to line voltage at 3 different locations, as shown in Table 1.

The Contractor shall house these three relays outside the lift controller in a transparent fronted box (with holes drilled on the cover for ventilation purpose). To safeguard those using the lift closet, the Contractor shall place the following sign on the front of the box:

DANGER RELAY TERMINALS ARE LIVE EVEN WHEN MAIN SWITCH IS OFF

These relays shall have normally open contacts. The Contractor shall wire one end of the contact to a battery source (UPS) and the other end to the respective sensing point. The sensing point for R1 is P15, R2 is P16 and R3 is P17. The cables for P15-P17 shall be housed in separate trunking. If this is not possible, screen cables shall be used.

P30, P31, P32, P34 - 4 Bits Error Code

These four points represent in binary code any lift faults occurring on the lift.

These 4 bits shall not be the same as the breakdown codes of the lift, but shall only represent final breakdown codes.

The Contractor shall group the final breakdown conditions according to the different categories as listed hereunder:

Output				Condition	Breakdown	Auto-reset
P34	P32	P31	P30			
0	0	0	1	(a)	Yes	No
0	0	1	0	(b)	No	Yes
0	0	1	1	(c)	Yes	No
0	1	0	0	(d)	No	Yes
0	1	0	1	(e)	Yes	No
0	1	1	0	(f)	No	Yes
0	1	1	1	(g)	(i) No (ii) No (iii) No	Yes Yes Yes
1	0	0	0	(h)	Yes	No

Conditions	Breakdown Conditions
(a)	Safety line (i) Any safety device tripped
(b)	Lift door-opening problem (i) Door failed to open at landing after two attempts, error code is issued after which (ii) Lift move to the another landing (for which a car or hall call is made) to try and so on

(iii)The error code cannot be cleared unless the doors can open at the landing where the problem occurred

(c) Lift speed controller failure

(d) Any hall button jammed

(i) Landing button(s) either up or down jammed for three minutes after which

(ii) Error code is issued. Lift move to the other landings. The fault code shall be set till the jammed button(s) is cleared.

(e) Miscellaneous Interface Card (MIC) boards failure

(i) Auxiliary Board failed

(f) Reverse phase or under-voltage

(i) Under or over voltage, reverse phase or one phase no supply occurred

(ii) If this fault is restored, the lift shall resume normal operation and the error code shall be cleared.

(g) Lift door-closing problem

(i) If the door cannot close due to object stuck in the sill or other reasons not due to (ii) or (iii) below, the lift shall try to close the door. After trying unsuccessfully to close the door for four (4) times the lift shall be parked with the door open and all outstanding car calls cancelled. The lift shall not be shut down. Subsequently if a new car call is registered, the lift shall try to close the door for another four (4) times, failing which the lift shall again be parked with door open and all car calls cancelled. This process shall be repeated. If after 10 minutes the door still cannot close the error code shall be set. Even though the error code is set the lift shall continue to try to close the door if a car call is registered as explained above. If the lift is successful in closing the door the error code shall be reset and the lift shall resume normal operation. Or

(ii) Safety edge is jammed for ten minutes or infra-red beam is broken (apply to safety edge using single beam infra-red light), the error code shall be set. Lift shall be taken out of group control if applicable but shall not be shut down. After fault has been cleared and there is new car call registered, lift should resume normal operation and error code should be cleared. Or

(iii) In the event the 2D/3D curtain door sensor is blocked for more than 10 minutes (adjustable), an error code will be set. The error code will be cleared once the blockage is removed.

(h) Shorting of door contacts (bypass)
Whenever the car or landing door lock(s) are shunted when the lift is in automatic mode the lift shall be rendered inoperative and this error code shall be set. The lift can only resume operation and the error code cleared when the shunt(s) are taken out.

For condition (e), MIC boards failure shall represent failure of auxiliary boards or certain parts of Mother board, whereby the CPU is still active.

Condition (f) may be a subset of condition (a). However, when condition (a) occurs due to condition (f), the code received by CFEMS must reflect condition (f) and not condition (a).

It is the Contractor responsibility to ensure that all final breakdowns shall be detectable by one of the above codes. The Contractor shall include a list of possible final breakdowns and their associated codes in the documentation submitted to SO Rep.

P35 - Lift Car Emergency Exit Cover

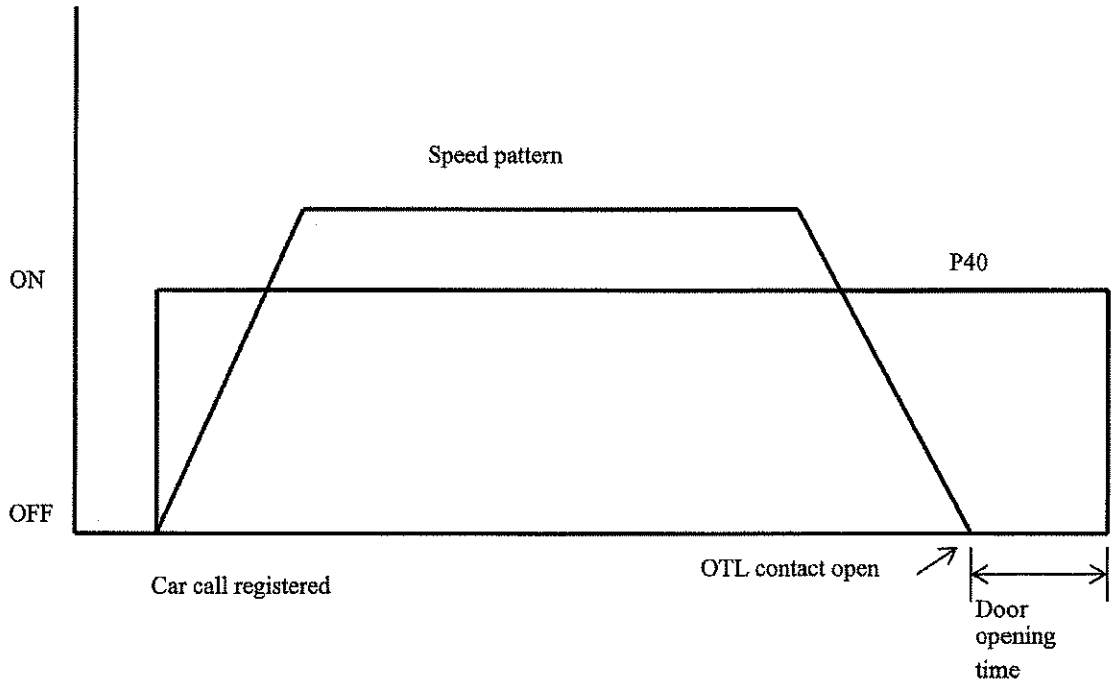
When the lift car emergency exit cover is opened, the alarm bell shall sound (P26 = 1) and the error code due to safety line problem (0001) shall be issued. The error code remains the same even when the trapped door is closed.

P36 – Signal Board DC Supply

This is the DC supply to the RS485 Signal board. When there is no DC supply to the RS485 Signal board, P36 shall be low. When there is DC supply to the RS485 Signal board, P36 shall be high.

P40 - Any Car Call

The Contractor shall provide the signal pattern of the car call signal as shown below:



Where there is more than one car-call, the signal shall continue until the last car-call is answered.

P52, P53---P57 - 6 Bits Lift Position Code

The Contractor shall group the lift position into 6 bits binary code as shown below:

Output					Condition
P57(MSB)	P55	P54	P53	P52(LSB)	
0	0	0	0	1	Lift at 1st Landing
0	0	0	1	0	Lift at 2nd Landing
0	0	0	1	1	Lift at 3rd Landing

The Contractor is to note that notwithstanding the fact that the lift position is depicted through the above points, the bottom and top positions shall still be terminated at points P50-, P51- on plugs T1 and T3 respectively. These two points shall be high when the lift is at the ground and top floor respectively. **Please note that the requirement is to detect landing and not storey.**

P75A- UPS CURRENT SENSING POINT

Annex D gives the connection diagram as well as the design requirements for the UPS voltage sensor. The Contractor shall submit any calculation or experimental results for the approval of the final design of the voltage sensor. The Contractor shall mount this sensor in the UPS set. The mounting arrangement shall be subjected to SO's approval.

OUTPUT (OP) POINTS

The OP points are used to control the lift. The function of each of these points is summarised below:

Point Name	Function
OP0	Call lift to top floor
OP1	Call lift to down floor
OP2	On Lift
OP3	Off Lift
OP4	Off UPS
OP5	SPARE
OP6	On UPS
OP7	SPARE

OPO ± - This point is used to call the lift to the top floor

OP1 ± - This point is similar to the previous point, except that this point once activated will cause the lift to travel to the ground floor.

OP2 ±, OP3 ± - These two points shall be used by the RTU to initiate the ARD test to lift controller. Point OP3 shall be used to switch off the power supply to the lift so that the ARD will take over. Point OP2 shall be used to switch on the supply after the testing. In the event of ARD failure, the Regulated supply M+ & M- should still remain during ARD operation. This supply should be available as long as the SPPL supply is available.

The Contractor shall use these two points in conjunction with two relays or any other method (to be approved by SO Rep) which shall produce the desired results. The contractor is to take note that once OP3 is activated, the ARD must take over. Upon activating OP3 to switch off the lift, the lift shall issue the error code 0110 (P34, P32, P31, P30) to the CFEMS and the code shall clear when OP2 is activated to turn on the lift. The relay designation control OP2 and OP3 are RO4 RO3 respectively.

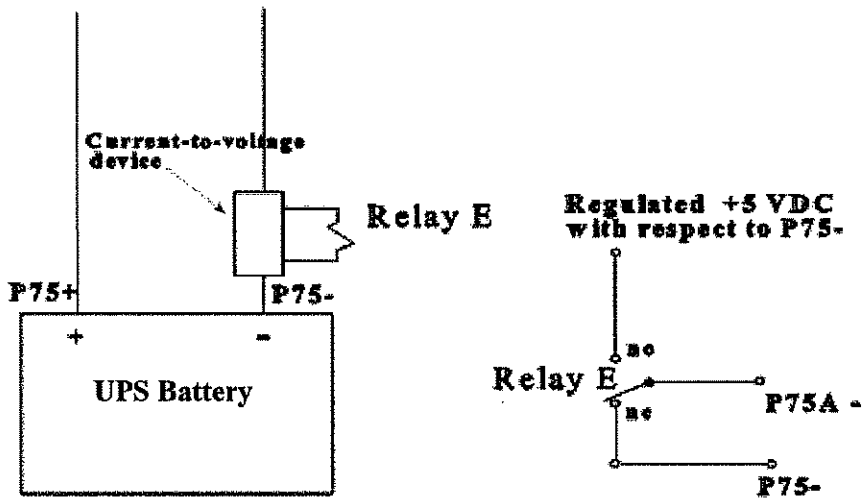
OP4 ± - This point is used to test the UPS. The Contractor shall switch off the single phase supply of the UPS when this point is activated.

OP6± - This point is used by the RTU to inform Lift Controller to restore single phase supply to UPS.

ANNEX D

UPS Current Sensor

1. UPS Current Sensor, (P75A- & P75-) - used to detect the flow of current when the UPS is **on inverter only.**



NOTE

1. The current-to-voltage device is made up of any electronic circuitry (eg. op-amp, current transducer..etc) that will energise Relay E when 3 Amp or more (adjustable with a port) is discharged by the battery during **inverter mode**. Any value below 3 Amp will not cause this device to work.
2. The contacts of the Relay E of rating 1 Amp are connected as shown on the above right.
3. The cable connection of P75A- and P75-, which is laid from UPS to lift controller, shall use screened cable with one end of the screen wire connected to earth. P75- shall be used exclusively for this purpose. It shall be different from the source requirement of the controller, which in this case shall be named as EB-.

How it works:

1. UPS is on **inverter mode** with a discharge current of 3 Amp or more at 24VDC.
2. The current-to-voltage device will cause Relay E to energise.
3. The regulated +5 VDC and 100 mA or above will appear across P75A- and P75.
4. When UPS battery is at charging mode, Relay E shall not energised.
5. P75A- with respect to P75- must be at zero volts when Relay E is not energised.

ANNEX E

Error Code

Error Code	Description
0x00	No Error
0x01	Data Length Error. Mismatched with actual data.
0x02	Device Address Error.
0x03	Function Code Error. Unsupported Function code.
0x04	Sequence Number Error. Current Sequence Number less than previous Sequence Number.
0x05	Control Request failed.
0xFF	CRC Error

ANNEX F

CRC Generation (To Be Coordinated with CFEMS Contractor)

The CRC employed is a CRC-16 and it is calculated using the following polynomial:-

$$CRC\text{-}16 = X^{16}+X^{15}+X^{2}+1$$

The Cyclical Redundancy Check (CRC) field is two bytes (transmitted least significant byte first), containing a 16–bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error results.

The CRC is started by first preloading a 16–bit register to all 1's. Then a process begins of applying successive 8–bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits, and the parity bit, do not apply to the CRC.

During generation of the CRC, each 8–bit character is exclusive ORed with the register contents. Then the result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB was a 1, the register is then exclusive ORed with a preset, fixed value. If the LSB was a 0, no exclusive OR takes place.

This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8–bit character is exclusive ORed with the register's current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the characters of the message have been applied, is the CRC value.

A procedure for generating a CRC is:

1. Load a 16–bit register with FFFF hex (all 1's). Call this the CRC register.
2. Exclusive OR the first 8–bit byte of the message with the low–order byte of the 16–bit CRC register, putting the result in the CRC register.
3. Shift the CRC register one bit to the right (toward the LSB), zero–filling the MSB. Extract and examine the LSB.
4. (If the LSB was 0): Repeat Step 3 (another shift). (If the LSB was 1): Exclusive OR the CRC register with the polynomial value A001 hex (1010 0000 0000 0001).
5. Repeat Steps 3 and 4 until 8 shifts have been performed. When this is done, a complete 8–bit byte will have been processed.
6. Repeat Steps 2 through 5 for the next 8–bit byte of the message. Continue doing this until all bytes have been processed.
7. The final contents of the CRC register is the CRC value.
8. When the CRC is placed into the message, its upper and lower bytes must be swapped as described below.

Placing the CRC into the Message

When the 16–bit CRC (two 8–bit bytes) is transmitted in the message, the high-order byte will be transmitted first, followed by the low-order byte.

Lift Monitoring Points by CFEMS system

TABLE 1

POINT	DESCRIPTION	VOLTAGE	LOGIC	SENSING REQUIRED EVEN DURING POWER FAILURE	REMARKS*
P11	Flood Sensor HIGH Level Switch	DEPENDS ON UPS BATTERY VOLTAGE	P11 IS HIGH when sensor detects high water level	YES	
P12	LIFT MAINTENANCE(LM) SWITCH		P12 IS HIGH WHEN KEY IS INSERTED	YES	OP2 SHOULD PULSED WHEN LM IS TURNED ON
P14	ARD SWITCH	DEPENDS ON ARD BATTERY VOLTAGE	P14 IS LOW WHEN ARD IS MANUALLY SWITCHED OFF	YES	CONTRACTOR TO PROVIDE P14 + & P14- AT THE SWITCH
P15	INCOMING POWER (provided by Electrical Contractor)	DEPENDS ON UPS BATTERY VOLTAGE	SENSING OF ONE PHASE OF THE 3-PHASE SUPPLY BEFORE MAIN SWITCH. IF SUPPLY IS ON, P15 IS HIGH	YES	IT SHALL MONITOR SUPPLY ACROSS 1ST & 2ND PHASE
P16	ISOLATOR POWER	"	SENSING OF ONE PHASE OF THE 3-PHASE SUPPLY AFTER MAIN SWITCH. IF SUPPLY IS ON, P16 IS HIGH.	YES	IT SHALL MONITOR SUPPLY ACROSS 2ND & 3RD PHASE
P17	CONTROLLER POWER	"	SENSING OF ONE PHASE OF THE 3-PHASE SUPPLY AFTER CONTROLLER SWITCH. IF SUPPLY IS ON P17 IS HIGH	YES	IT SHALL MONITOR SUPPLY ACROSS 1ST & 3RD PHASE
P20	DOOR OPENING	24V DC	P20 IS HIGH WHEN DOOR IS OPENING	NO	
P21	RUNNING CONFIRMATION	"	P21 IS HIGH WHEN LIFT IS RUNNING	NO	
P22	LEVELLING INDICATION	DEPENDS ON UPS BATTERY VOLTAGE	P22 IS LOW WHEN LIFT IS LEVEL AT LANDING	YES	SEPARATE INDUCTOR SHOULD BE PROVIDED
P23	DOOR SWITCH	24V DC	P23 IS LOW WHEN ANY LANDING DOOR IS OPENED	NO	
P24	GATE SWITCH	"	P24 IS LOW WHEN CAR DOOR IS OPENED	NO	
P25	CAR DOOR ONE THIRD OPENED	DEPENDS ON UPS BATTERY VOLTAGE	P25 IS HIGH WHEN THE CAR DOOR IS MORE THAN 1/3 OPENED	YES	FOR PASSENGER TRAPPED CASES, IF P25 = 1, WE ASSUME HE/SHE IS RELEASED FROM THE CAR.
P26	ALARM BELL	"	P26 IS HIGH WHEN ALARM BELL SOUND	YES	CONTRACTOR TO PROVIDE 1 POINT P26+ THE NEGATIVE RETURN IS P75- WHICH IS ALREADY PROVIDED

POINT	DESCRIPTION	VOLTAGE	LOGIC	SENSING REQUIRED EVEN DURING POWER FAILURE	REMARKS*
P28	FIRE LIFT SWITCH (if applicable)	24V DC	P28 IS HIGH WHEN FIRE LIFT SWITCH IS ACTIVATED	NO	
P30 P31 P32	) 4 BITS LIFT FAULT CODE))	24V DC	) AS GIVEN IN THE SPECIFICATIONS))	NO NO NO	
P34	)		)	NO	
P35	TRAP DOOR	24V DC	P35 IS HIGH WHEN CAR TRAP DOOR IS OPENED	NO	P35 once activated can only be reset by the LM key or when main switch is off.
P36	SIGNAL BOARD DC SUPPLY	DC	P36 IS HIGH WHEN SIGNAL BOARD HAS DC SUPPLY	NO	
P40	ANY CAR CALL	"	P40 IS HIGH WHEN IF THERE IS ANY CAR CALL, P40 IS LOW WHEN THE LAST CAR CALL IS ANSWERED	NO	
P50	LIFT AT 1ST FLOOR	"	P50 IS HIGH IF LIFT IS AT 1ST FLOOR	NO	
P51	LIFT AT TOP FLOOR	"	P51 IS HIGH IF LIFT IS AT TOP FLOOR	NO	
P52 P53 P54 P55 P56	))))) 6 BITS BINARY CODE) FOR LIFT POSITION)))	))))) ")))	))))) AS GIVEN IN THE SPECIFICATIONS)))	))))) NO)))	
P57	)	)	)	)	
P73	ARD BATTERY	DEPENDS ON ARD BATTERY VOLTAGE	ACROSS ARD BATTERY		
P75	UPS BATTERY	DEPENDS ON UPS BATTERY	ACROSS UPS BATTERY		CONTRACTOR TO PROVIDE POINTS P75+ P75-
P75A	UPS CURRENT SENSOR		SEE ANNEX C		
OP0	TO CALL LIFT TO TOP FLOOR		SEE SPECIFICATIONS		
OP1	TO CALL LIFT TO GROUND FLOOR		"		
OP2	TO RESTORE POWER SUPPLY TO LIFT		"		
OP3	TO CUT OFF POWER SUPPLY TO LIFT		"		BREAKDOWN ERROR CODE 0110 MUST BE ISSUED (REFER TO 4 BIT ERROR CODE).
OP4	TO CUT OFF SINGLE PHASE SUPPLY TO UPS				
OP6	RESTORE SINGLE PHASE SUPPLY TO UPS				