FEC Remote Lighting Controller (RLC) Version 2

Type: FEC - HP0656

Technical Description

FEC RLC V2

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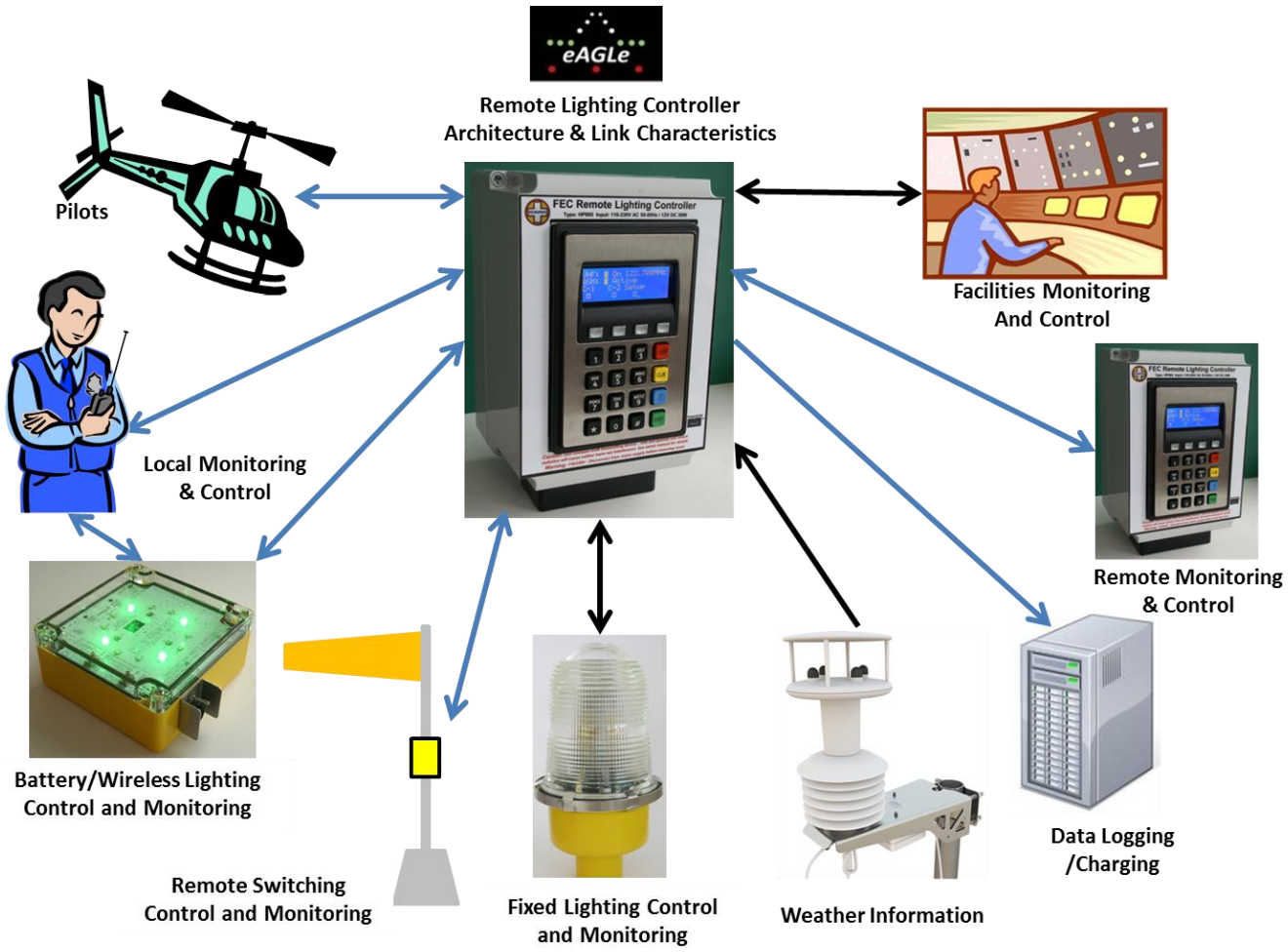
Powered by eAGLe Light Engines

® Interleader Limited

Document Revision Sheet

Issue	Date	Changes
1.0	24/02/2016	New Document



The RLC Architecture

Note that this document should be read in conjunction with:

1) The RLC User Manual
2) RLC Block Diagram, and
3) RLC Schematics

Contents

Remote Lighting Controller V2

Operational Overview

The Remote Lighting Controller (RLC) offers a unique combination of both VHF and GSM-SMS control and monitoring of helipad lights and peripheral equipment. The unit is available as VHF only, SMS only and combined VHF/SMS (standard). Options include a Remote/Mimic station to control or simply monitor the system and a Remote Switching Controller (RSC).

Part Numbers

HP0656	-	Standard full VHF & GSM equipped version
HP0657	-	VHF only version
HP0658	-	GSM only version

This document describes the fully configured version (HP0656) irrelevant sections can be ignored for the variants.

1. RLC Capabilities

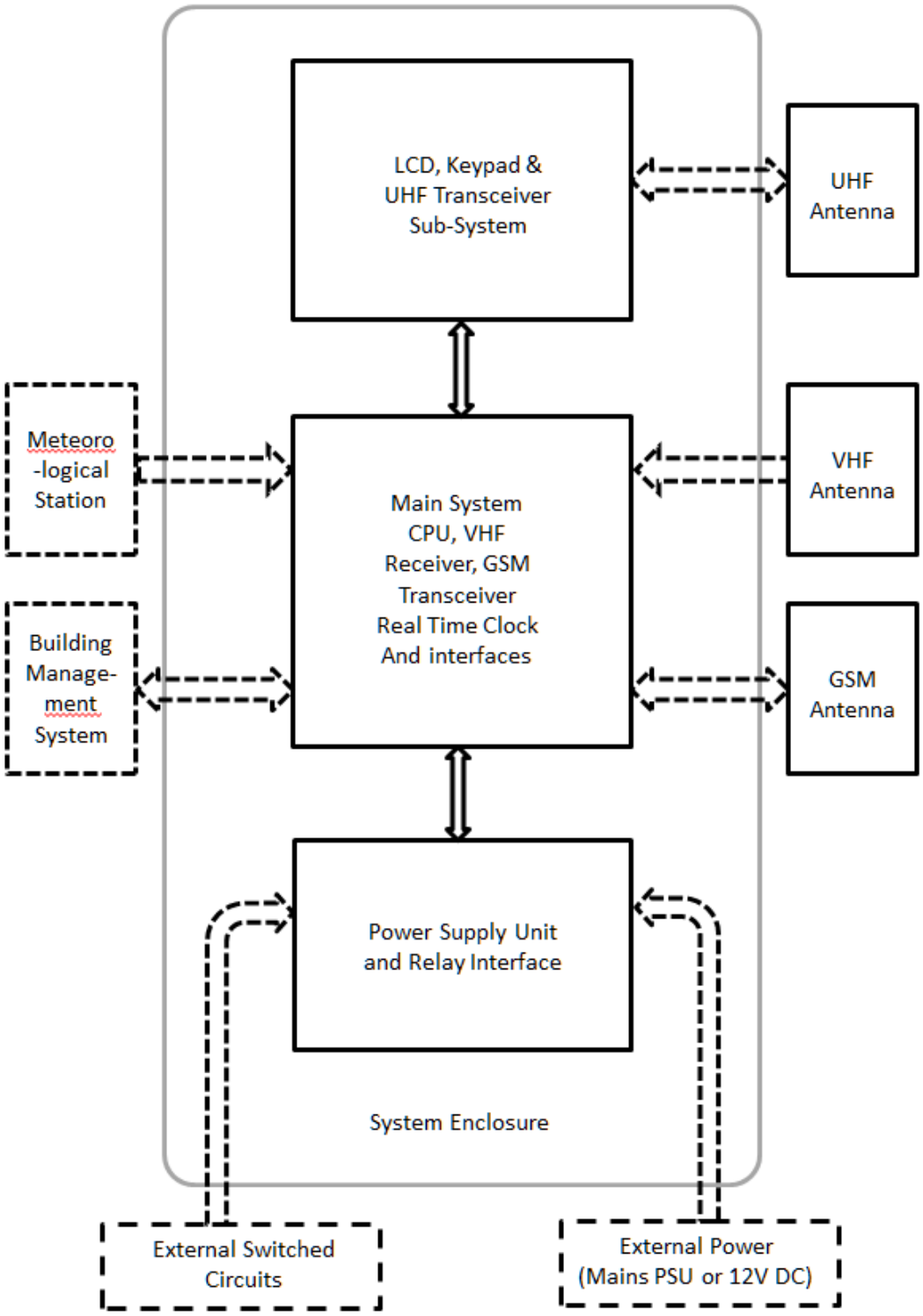
FEC's Remote Lighting Controller Version 2 (RLC V2) is an all new, fully digital design that combines ease of installation and use with sophisticated yet simple and secure configuration via the IP65 rated keypad and LCD display or via SMS.

Key Features

- Traditional VHF Pilot Controlled Lighting (PLC) configuration
- Simple 25kHz/8.33kHz frequency setting through front panel – no fiddly switches
- Defined number of presses to activate Channels 1, 2 or 3
- Programmable timeout for VHF, keypad and GSM activation
- Each channel has fully independent time-out (10 seconds to 60 minutes)
- VHF operation can be remotely enabled/disabled for extra security
- FCC/EU approved, Integrated tri-band GSM Telemetry Engine for SMS control
- Secure PIN code protected SMS commands to monitor and control your installation
- Secure SMS status reporting – check out your installation before taking off
- Remotely activate Channels 1, 2 or 3 and have the status sent straight back to your mobile
- 3 Status relay contact outputs for BMS interface
- Auxiliary input for switching or BMS control of VHF receiver
- Three 20 Amp heavy duty relays in the box – Enables linked peripheral shutdown
- Local and remote test and diagnostics integrated into the unit
- Very low power consumption – Approx. 3W (idle) and less than 30W max. (including internal winter heater)
- Operates from 110-240V AC 50-60Hz or 12V DC (ideal for solar and batteries)
- Weather station interface for meteorological information from your helipad

2. The RLC System

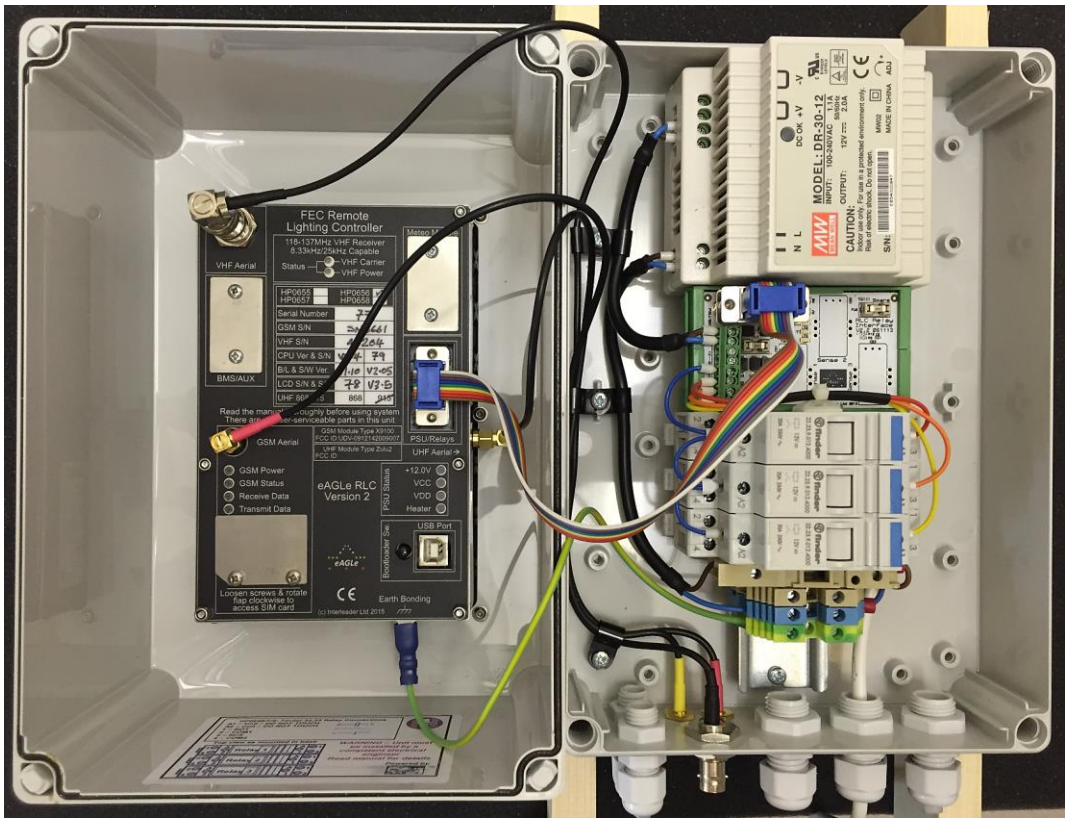
With the exception of the PSU, Relays and PSU & Relay Interface PCB, the main system PCB and all of the subsystems and radios are accommodated within the LCD and Keypad enclosure.



Subsequent sections cover the function of each element shown in the diagram above.

3. The RLC Enclosure

RLCs are typically deployed in external environments so have been designed to withstand these conditions. With the exception of the external power source, aerials and circuit connections, RLCs are completely self-contained.



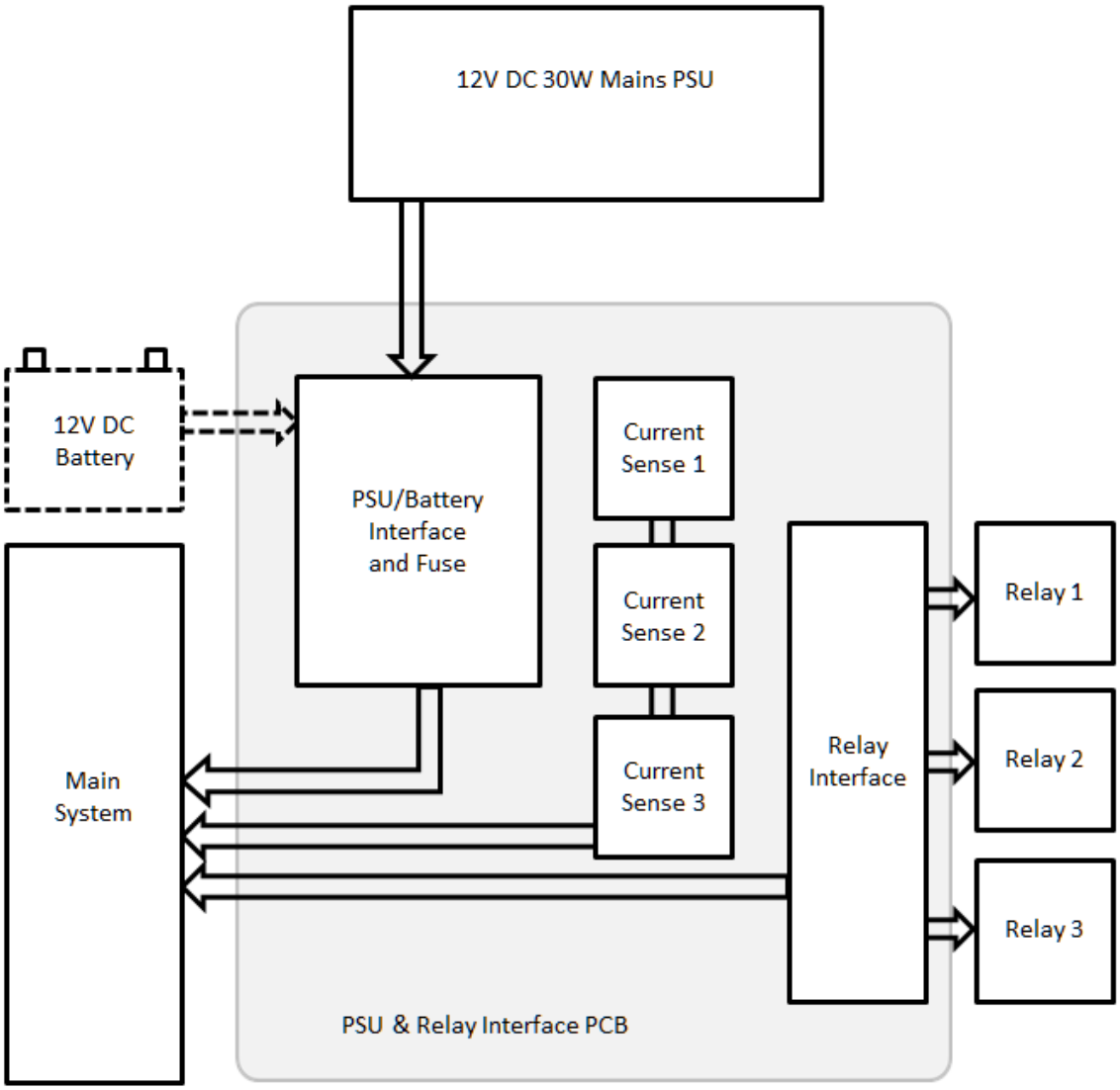
The enclosure is manufactured from ABS and is IP65 rated and all metal fittings are either of stainless steel or galvanised steel.

The Mains 12V Power Supply Unit (PSU), PSU and Relay Interface PCB, Power Relays and mains connectors are all mounted on a DIN rail in the bottom of the base of the enclosure (right side of photo above).

The main processor, radios, LCD display and keypad are all mounted inside the LCD and Keypad Enclosure (left side of photo above). This is joined to the PSU and Relay Interface PCB via a 9 way ribbon cable.

VHF, GSM and UHF (if this option is fitted) aerial cables are brought out to the base of the unit where the 3 mains cable glands and 2 signal cable glands (Meteo and BMS) are:

4. Enclosure Base



The enclosure base includes:

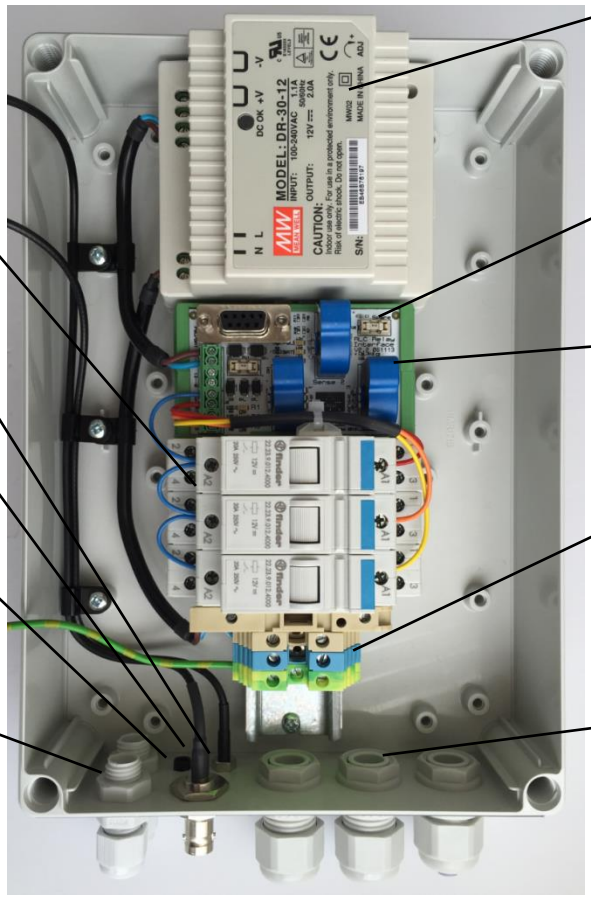
1) Mains connectors (and line fuse)
2) 12V DC 30W mains PSU
3) 3 off 20A Power Relays
4) PSU and Relay Interface PCB
5) Interface to the Main System including: 12V DC in, 5V DC out, relay switching and secondary current sensing.

Optionally, the PSU and Relay Interface PCB can be fitted with 3 off secondary current sensors for measuring the AC current in the switched mains secondary circuits. These readings are used to determine fault conditions.

The PSU and Relay Interface PCB has provision for connecting an external 12V battery enabling the system to be independent of a mains supply. The battery can be charged from, for example, a solar cell.

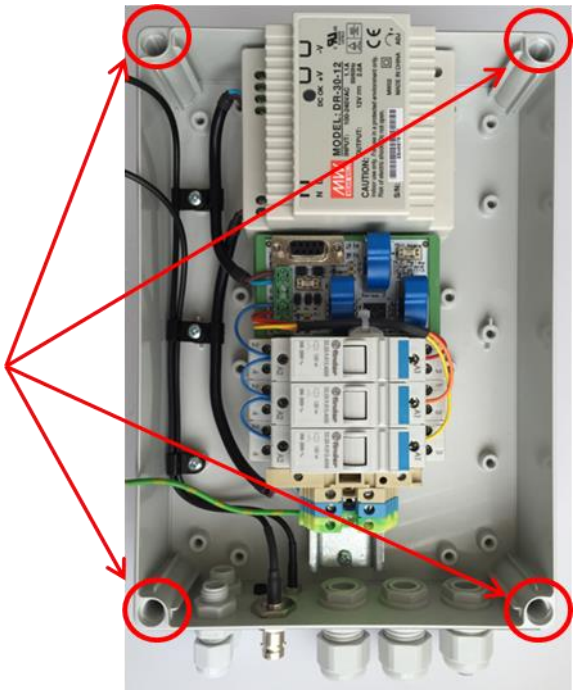
The physical layout of the base is shown over.

The arrangement of the base units is shown below (V4 Enclosure).



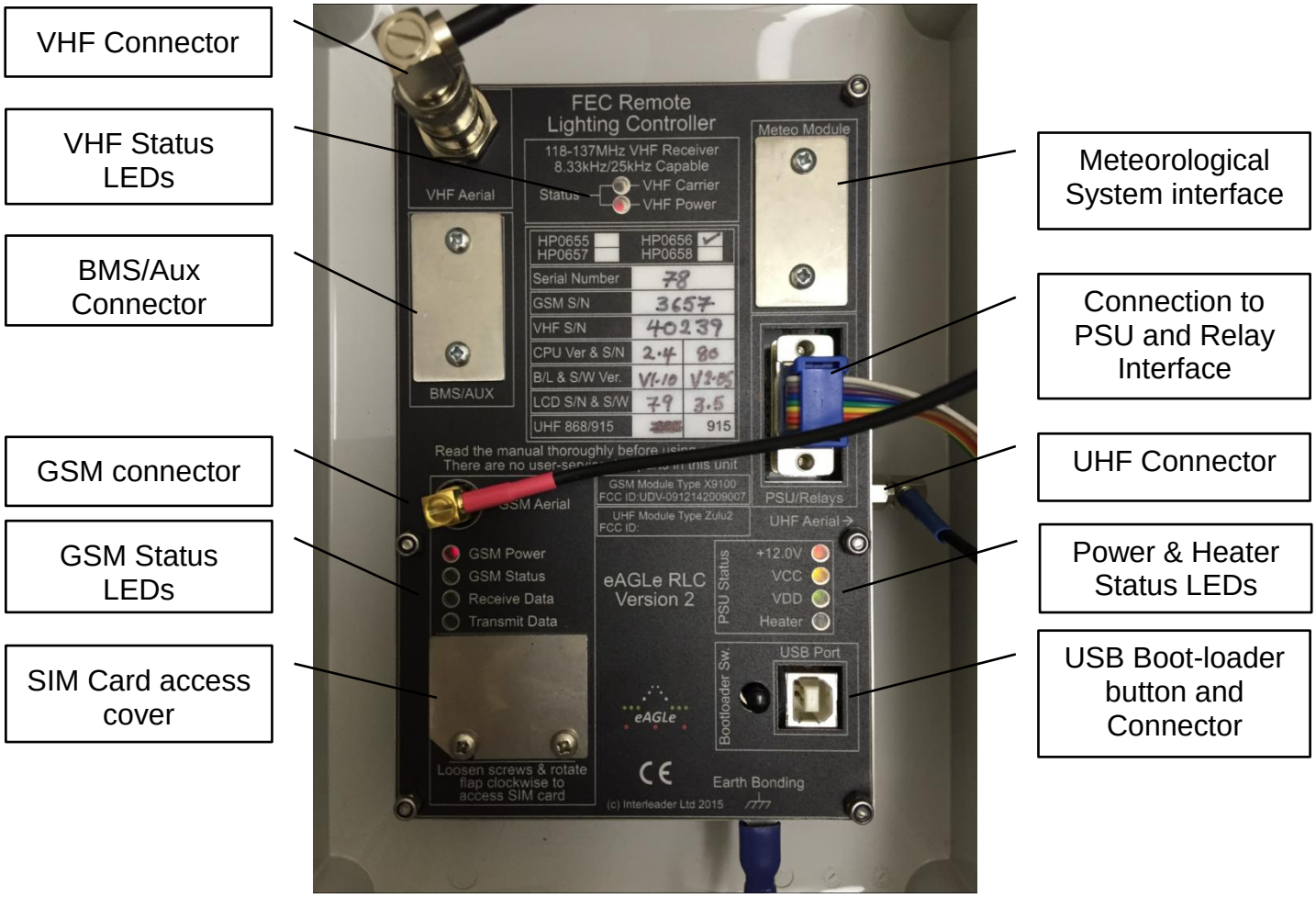
As shipped both of the signal cable glands (Meteo and Aux./BMS) and one of the mains cable glands are blanked off to maintain the IP integrity of the enclosure.

The enclosure base is mounted with fixing screws In the corners of the base outside of the sealing gasket (picture right)



5. Enclosure Front

The keypad & LCD enclosure mounted in the enclosure front contains the Main System, comprising: System CPU, LCD & Keypad and sub-processor, VHF Receiver, GSM and UHF Transceivers, Meteorological and BMS interfaces and a Real Time Clock.



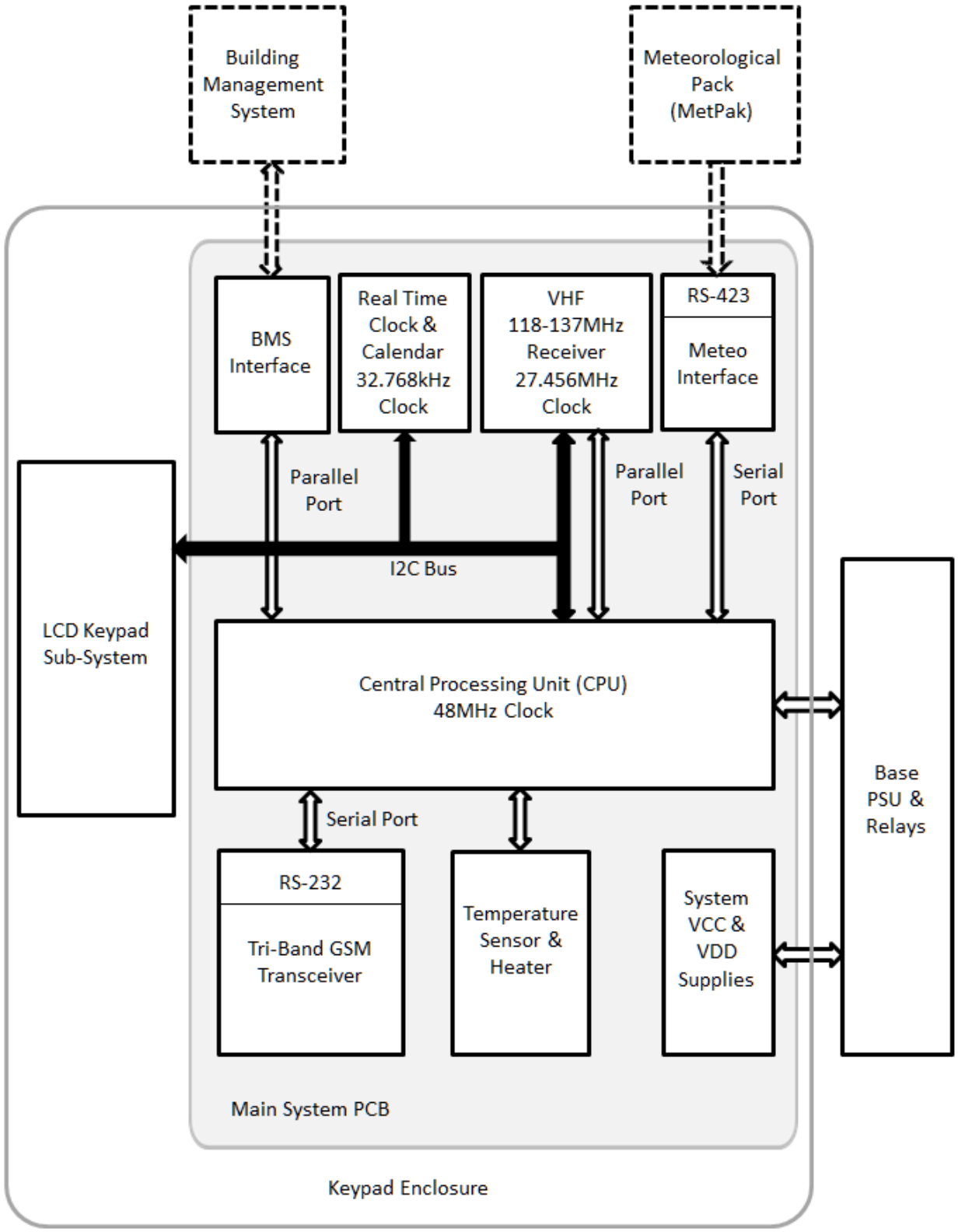
Both the Meteo and BMS interface connectors are fitted as standard but as they are user options, the systems are shipped with them blanked off (as above).

The UHF link is also an option and only supplied if specified at the time of order.

There is an access cover over the SIM on the GSM module which is the only user accessible part of the system.

There are no user serviceable parts in the main system enclosure.

6. Main System



Note: VHF and GSM Aerial connections are not shown on the above

7. Main Circuit Board

The main circuit board is a double sided, through-hole plated, 1.6mm FR4 construction with a white solder resist, black silk screen and ENIG finish. The PCB is RoHS and LR S-94V0 compliant.

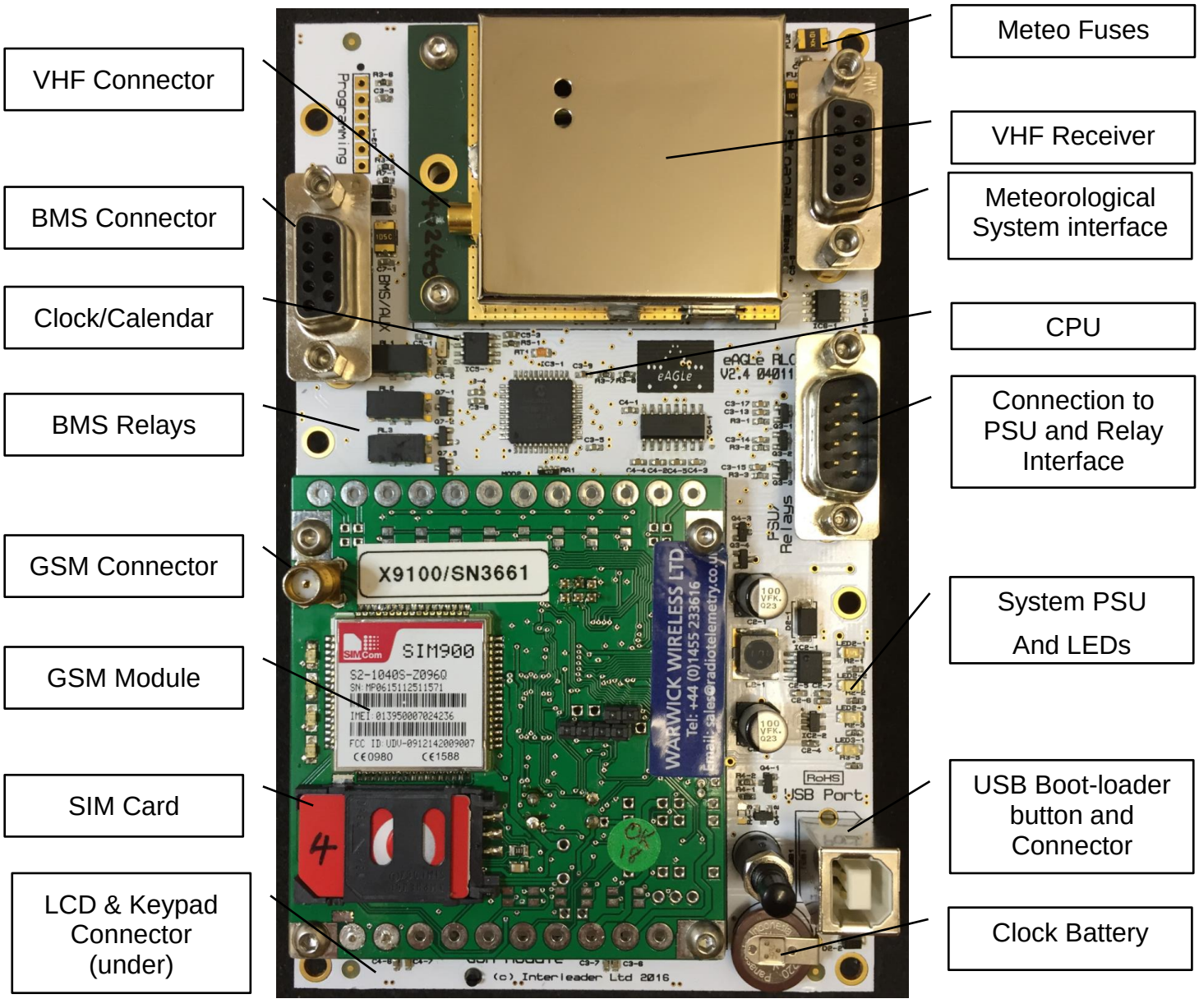
The circuit board performs a number of functions:

1) Provides the usual electrical connections
2) Acts as the main interconnect for peripherals, and
3) Provides enclosure heating through a surface mount heater array

All components and assembly are lead-free RoHS compliant.

The VHF and GSM modules plug directly into the main CPU board and are secured by screws into captive threaded pillars. This allows for field swap-out or upgrade.

To maintain the operational integrity of the main system should a peripheral fail, self-resetting fuses are included in all of the power feed lines.



8. Central Processing Unit and Sensors

Hardware

The operation of the RLC is under the control of a Microchip PIC47J53 processor.

The processor has a 128k code space and 16k of RAM and runs at a clock speed of 48MHz (internally generated). The clock is shared with the USB interface.

Configuration information for the device is held at the top of code space and is never re-written.

A manufacturer's Block Diagram of the processor is shown in Appendix A.

Software

The software controlling the CPU is written in a structured and compiled Basic with small sections of assembler where required.

There are two parts to the software:

1) Resident Bootloader, and
2) The main operational code

The bootloader is permanently installed in the 1st 4k of code space and is never re-written.

The purpose of the bootloader is to enable the main code to be loaded from a PC via a standard USB interface. This enables field upgrades or special versions of code to be loaded by users without any special equipment or knowledge.

The CPU performs the following functions:

1) Basic background functions of the unit, including:
    a. Monitoring supply voltage and enclosure temperature
    b. Running the internal heater as required
    c. Re-loading new software
    d. Maintaining a log of running and max/min statistics for diagnostics
2) Managing access to the system setup and configuration details:
    a. Setting up and testing the radios
    b. Maintaining the GSM numbers for Operator, Agency and Mimic
    c. Setting up and testing the peripheral interfaces
    d. Setting up the relay mapping, timeout and logic of the three channels
    e. Setting operational parameters and units (e.g. reporting units of the meteorological reports)
    f. Maintaining the security access PIN codes
3) Managing the real-time activation of the system:
    a. Continually monitoring the VHF and GSM radios and keypad for activations
    b. Checking the validity of the user requested activations
    c. Performing the activation and circuit testing of the demanded activity
    d. Reporting the changed status and (where fitted) meteorological data
    e. Managing the differential time-out of the channels

System & Sub-Systems Functions

System Power Supplies

The main CPU board includes sub power supplies for VCC (5.0V) and VDD (3.3V) and a trickle charger for the RTC battery back-up.

CPU

On start-up the CPU reads the boot-loader switch and, if active, enters the boot-loader mode. In this mode new software can be loaded from a PC via the USB port.

If the boot-loader switch is not active then the main operational code is run. Configuration settings are retrieved from non-volatile memory and the system is configured as required and enters normal operational mode waiting for activation.

Building Management System (BMS) Interface

There are three small signal, single pole, normally open relays used to signal faults in their respective main relay circuits. If, as part of the channel setting, a fault is detected then the relevant relay is closed.

The interface also includes an (Aux)iliary digital input line. This line, which is impedance and voltage limit protected, is monitored by the host CPU and, under software configuration, can be used to either provide an input to trigger channels or as a system disable input (most often used by a BMS system to disable the system in manned, operational hours at an aerodrome).

Real Time Clock (RTC)

There are two real time clocks in the RLC, the master RTC on the main CPU and a second on the GSM module.

The master RTC is calibrated and set as part of the test and setup process at the time of manufacture. The RTC has a battery back-up supply which is charged all the time the RLC is powered.

The RTC records the time/date that power is lost and restored and, if the Operator number is active, sends and SMS reporting these times.

On power up the master RTC updates the time and date of the GSM RTC.

VHF Receiver

The VHF receiver is a fully synthesised digital design specifically designed to operate in the 118-137MHz Airband.

The receiver is controlled by an Atmel processor which configures the synthesised receiver and provides the communication and status interface to the main CPU.

There are two types of interface to the host CPU; I2C and dedicated logic lines. Receiver settings are made from the CPU via the I2C bus interface. The dedicated logic lines include the Power Select and Carrier Detect lines.

The most critical settings include the frequency the receiver is to be tuned to and the detected signal level at which the dedicated Carrier Detect line will be made active.

All of the receiver characteristics (including for example the bandwidth) have been defined at the design stage and incorporated into the processor's software. These are not accessible.

Once the receiver has been configured and made active the desired frequency is constantly monitored and as the signal level exceeds the set threshold the Carrier Detect line made active.

Signal filtering and detector timing is performed in software by the main CPU.

Meteorological System Interface

The RLC is designed to provide power to and accept a serial data stream from a Gill Instruments MetPak meteorological reading system. The serial interface is RS-243.

GSM Module

A tri-band GSM transceiver module and interface is mounted on the main CPU. The module contains its own power supply unit (derived from the main 12V system power), GSM radio module, CPU, Real Time Clock and RS-232 interface to the main host.

The main CPU board has full power feed control to the GSM module (to allow power cycling if required) and an RS-232 interface. The GSM module operates autonomously – on power-up it logs on to the GSM network determined by the SIM used. The local CPU continuously monitors network connection and if it is lost, automatically re-tries for connection.

There is an agreed, fixed, serial protocol between the GSM and host CPUs enabling messages to be sent and received and control to be maintained by the host.

All SMS text messages received by the module have the time and date received appended to them and are then passed to the host CPU which receives them into an interrupt driven buffer for processing. All messages sent from the host to the GSM module are buffered by the GSM module and have the time and date of transmission appended to them as they are sent.

Heater

To ensure that the system is always kept above 0^{C}, the temperature of the main CPU PCB is monitored and used by the CPU to control an array of power resistors.

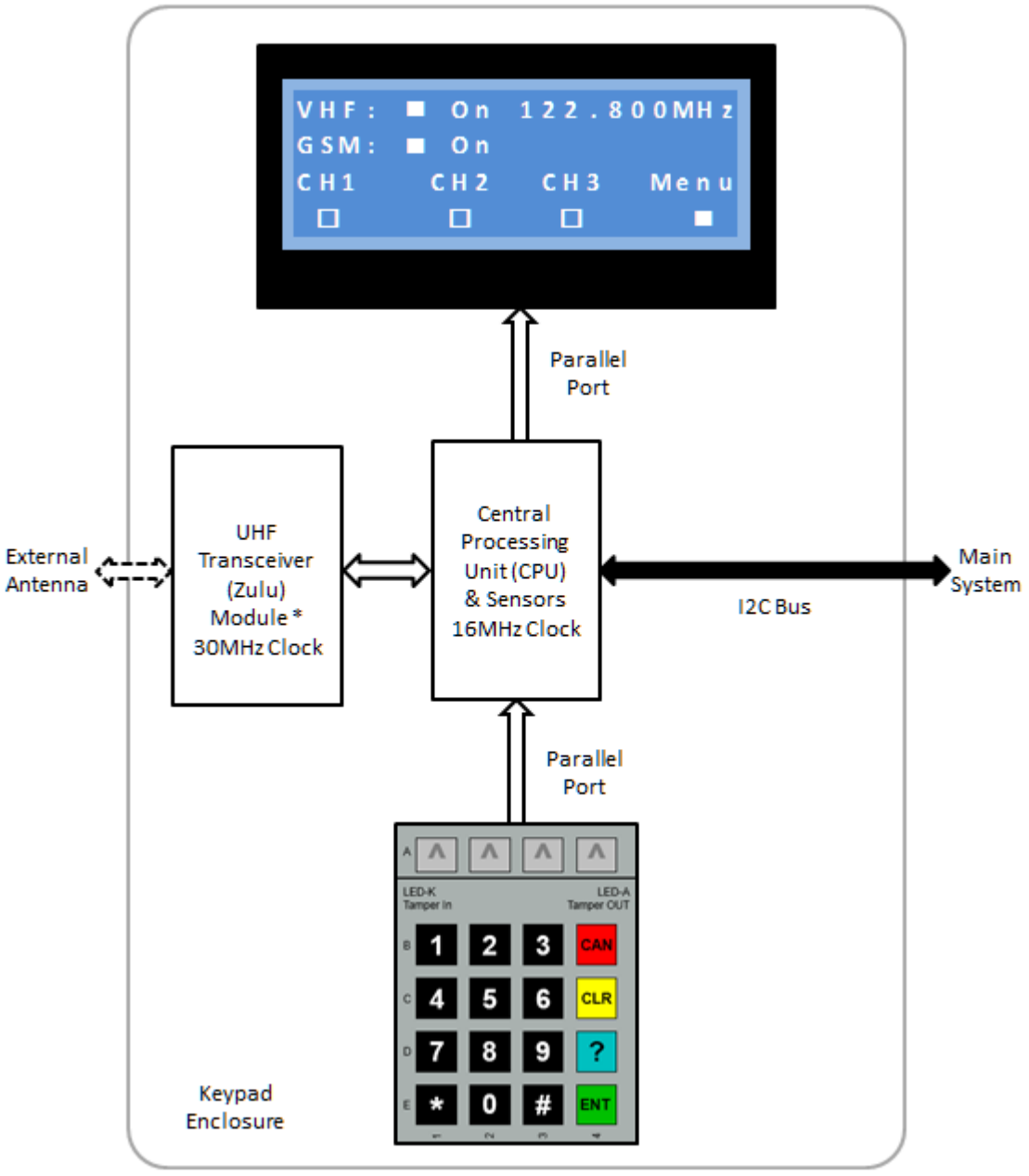
Interface to the LCD & Keypad Sub-System

The LCD and keypad interface board is powered from the VCC (5.0V) supply. The communication is over the I2C serial interface. The main CPU acts as bus master and the LCD & keypad processor as slave.

The physical interface is via an RJ11 6/6 cable and connectors.

9. LCD & Keypad Interface

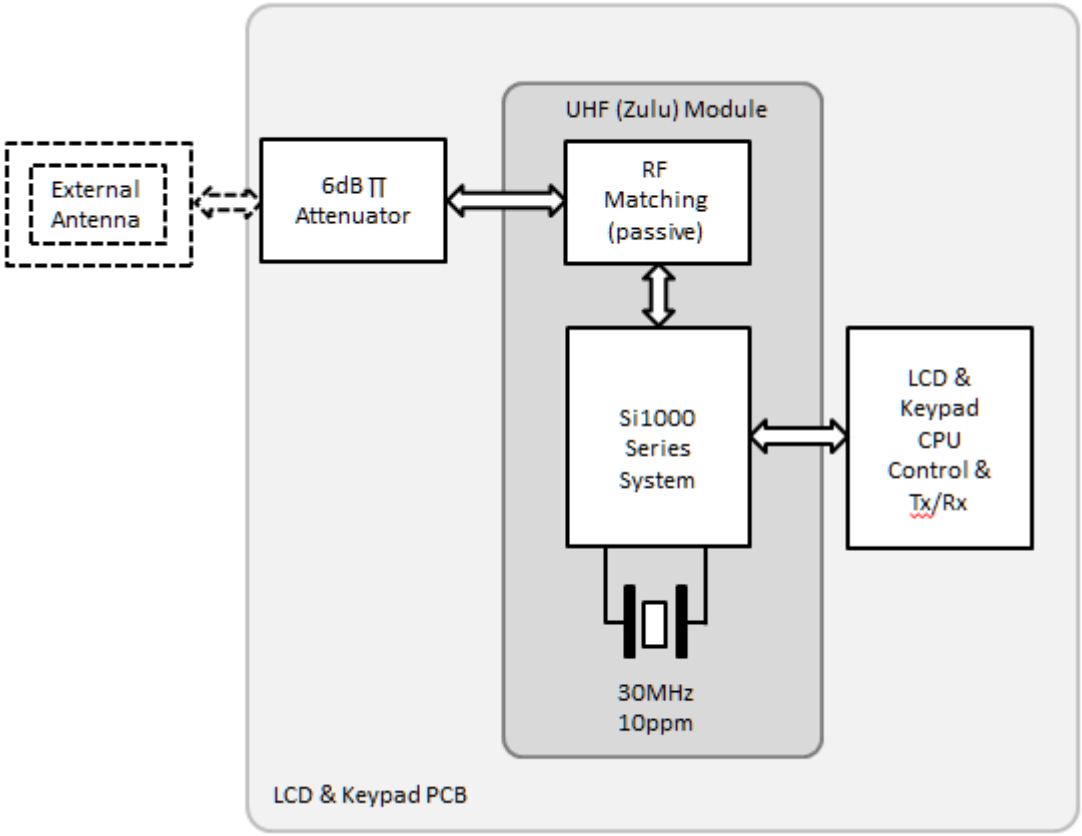
The LCD & keypad Interface comprises a CPU (PIC18F5K20) and optionally a UHF (868MHz EU or 915MHz USA) 'Zulu' transceiver module. The power from and data interface to the LCD & Keypad Interface is via the RJ11/I2C bus. Both the LCD and keypad interfaces are conventional parallel ports and communication to the Zulu module is via a serial interface.



The LCD & keypad CPU performs all of the tasks required to manage the formatting of the screen, reading the keypad and acts as a translation between the CPU/I2C interface and the Zulu/RS232 interface.

10. UHF Transceiver – Zulu Module

The LCD & Keypad Interface is fitted with an RF Solutions Zulu 2 UHF transceiver operating in either the 868MHz (European) or 915MHz (USA) license exempt bands.



The transceiver includes a central processor and all of the circuitry required for a complete wireless modem. The transceivers are pre-set at the factory to either of the two frequency bands and cannot be changed after installation.

The transceivers need to operate with a 'paired' device (usually HEMS-Star battery portable helipad lights). Pairing means that both devices have been set up exactly the same (e.g. same frequency) and that their unique addresses are complimentary.

All FEC controlling devices have the address of FEC000. All FEC controlled devices have the address of FEC001. Arbitration of commands is carried out at a higher, secured level (see later wireless command section)

The modules act in two modes:

1) Normal – data is sent between two 'paired' modems and their hosts, and
2) AT – The configuration mode which enables certain parameters to be set (e.g. baud rate)

The Normal mode of operation is the default state.

Entering the AT mode is only possible by the OEM under PIN controlled conditions. Users of the equipment have no way of accessing the AT mode. The antenna is a externally mounted whip.

For 915MHz FCC systems, both the RLC and antenna cable are supplied with reverse SMA connectors to ensure matching of the antenna and RLC.

11. Operation

The RLC exists in one of two states:

1) Setup
2) Normal Operation

Setup

The Setup state is entered via the keypad and is PIN code protected. There is a hierarchical level of access to the Setup state:

User	None
Operator	The basic management level of privilege allowing configuration of a wide range of parameters
FEC	As above plus the ability to reset the Operator PIN
OEM	As above plus the ability to reset the FEC PIN and perform a number of configuration tasks (e.g. set the unit's serial number) and diagnostics

A number of management functions can also be performed via SMS (controlled by PIN code).

As a safety feature, 10 minutes after Setup mode is entered, irrespective of activity, the system will automatically quit Setup and resume Normal Operation in the last state set. This is to ensure that the system is not accidentally left out of operation.

Normal Operation

In Normal Operation the system is in an endless loop checking for activations and/or time-outs of previously activated channels or a request to enter set-up mode. The system will also continue to perform background house-keeping tasks (e.g. the heater).

While in this mode the system will also read and respond to SMS commands, either by setting or un-setting channels as requested or by providing status information or carrying out certain management tasks (see user manual for full description).

Channel Activation

When an activation command is received it is first checked for validity (keypad and SMS only) to confirm a valid User Type and related PIN code. If the command is valid the following actions are taken:

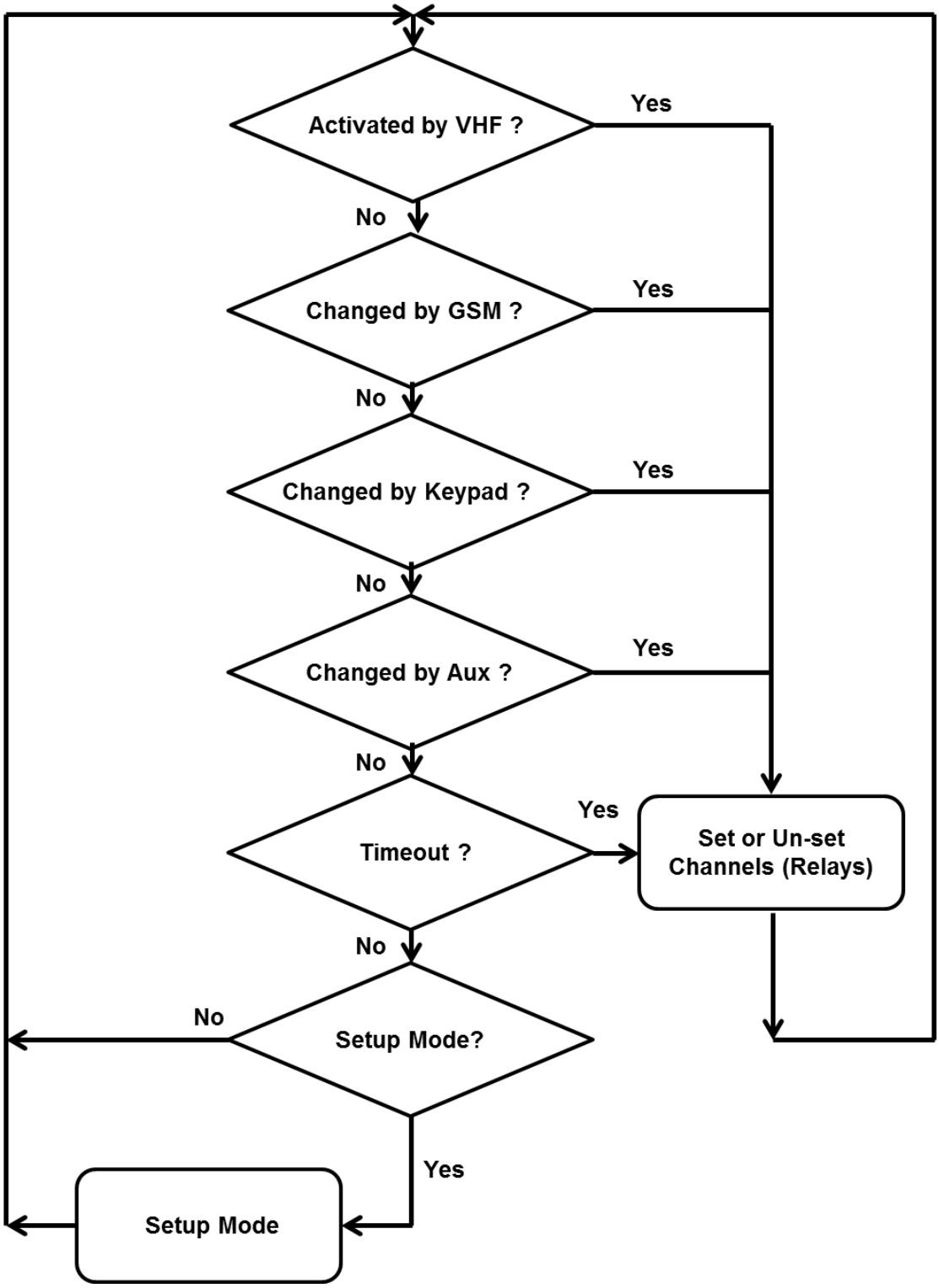
> ***Perform the Command*** – Set the channel active and the timer running as defined in the configuration tables previously set by the Operator,
>
> ***Test the Outcome*** – Measure that the system has responded correctly to command (this is achieved by measuring at least measuring the current in the power relay primaries and, if fitted, by validating the current flowing in the circuit secondary and comparing to stored results), and
>
> ***Reporting the Result*** -
>
> Confirm the result, including appending the weather information if the optional MetPak is fitted, via SMS to the Operator, User (if set via SMS), Mimic Panel and Agency numbers if defined.
>
> If an error is detected this is also confirmed by making the relevant BMS relay active.

Channel De-activation

Channels are normally de-activated when the timer for each channel times out and can also be deactivated by SMS (on an individual channel basis), via the Aux input (if that has been used to set channels) or via the keypad (de-activates all channels).

Main Operational Loop

The basic flow-chart of the Normal Operational loop is shown below.



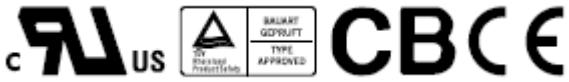
12. Summary Specification

- Controller modes: 4 - VHF PCL, GSM/SMS, Keypad or Aux
- VHF Frequency Range: 118 to 137 MHz
- Channel spacing (V2 Receiver): 8.33kHz
- VHF Sensitivity: > -90dBm
- Frequency selection: Any channel within the Air Band
- VHF aerial: BNC - External remote mounted (Not supplied)
- GSM Bands: Tri-Band
- Network: Operators choice subject to coverage
- Tariff: Account (recommended) or pre-pay
- GSM aerial: SMA Connector for remote mounted aerial (supplied)
- UHF aerial (If UHF option selected): SMA Connector for remote mounted aerial (supplied)
- BMS Output 3 relay (normally open – Max 5W/24V DC/0.25A peak)
- BMS/Aux input 1 (high impedance 12V output – ground to operate)
- Degree of protection: IP65 (general)
- LCD and Keypad protection: IP65 and 'vandal resistant'
- Unit operating temperature: -25^{o}C to +50^{o}C
- System Storage temperature: -25^{o}C to +80^{o}C
- Compliance: ROHC Compliant except exempt items (radios)
- Operating voltage (AC): 100-240V AC 50-60Hz
- Electrical Protection (RLC not circuits) 5A 20mm Fuse
- Operating voltage (DC): 12V DC
- Max voltage range (DC): 10V – 15V DC
- Power (standby – LCD Backlight On): 12V DC: 3 watts (approx.) 240V AC: 9.10W
- Power (standby – LCD Backlight Off): 12V DC: 2.25 watts (approx.) 240V AC: 8.33W
- Power (all relays active): 12V DC: 6.25 watts (approx.) 240V AC: 11.55W
- Power (GSM transmitting): 12V DC: 10 watts (maximum)
- Max power consumption: DC/AC: 30 watts (including optional winter heater)
- Relay capacity: 3 off 20A Relays (1 NO, 1NC)
  DIN rail mounting
- Cable Entry (Mains): 3 off M16 Cable glands – 10mm max cable diameter
- Cable entry (MetPak) V4 Enclosure: M12 Cable gland
- Cable entry (Aux/BMS) V4 Enclosure: M12 Cable gland
- Monitoring (Option) Measurement of Secondary Circuit Current
- Size: Height - 11" (280mm)
  Depth - 6.5" (165mm)
  Width - 7" (180mm)
- Enclosure material: ABS
- Weight (with shipping packaging): 2.5kg 5.5lbs (3.9kg 8.6lbs)

13. Electrical Specification (Mains Power Supply Unit)

The Mains PSU fitted is a 30 watt unit identified on the PSU enclosure.

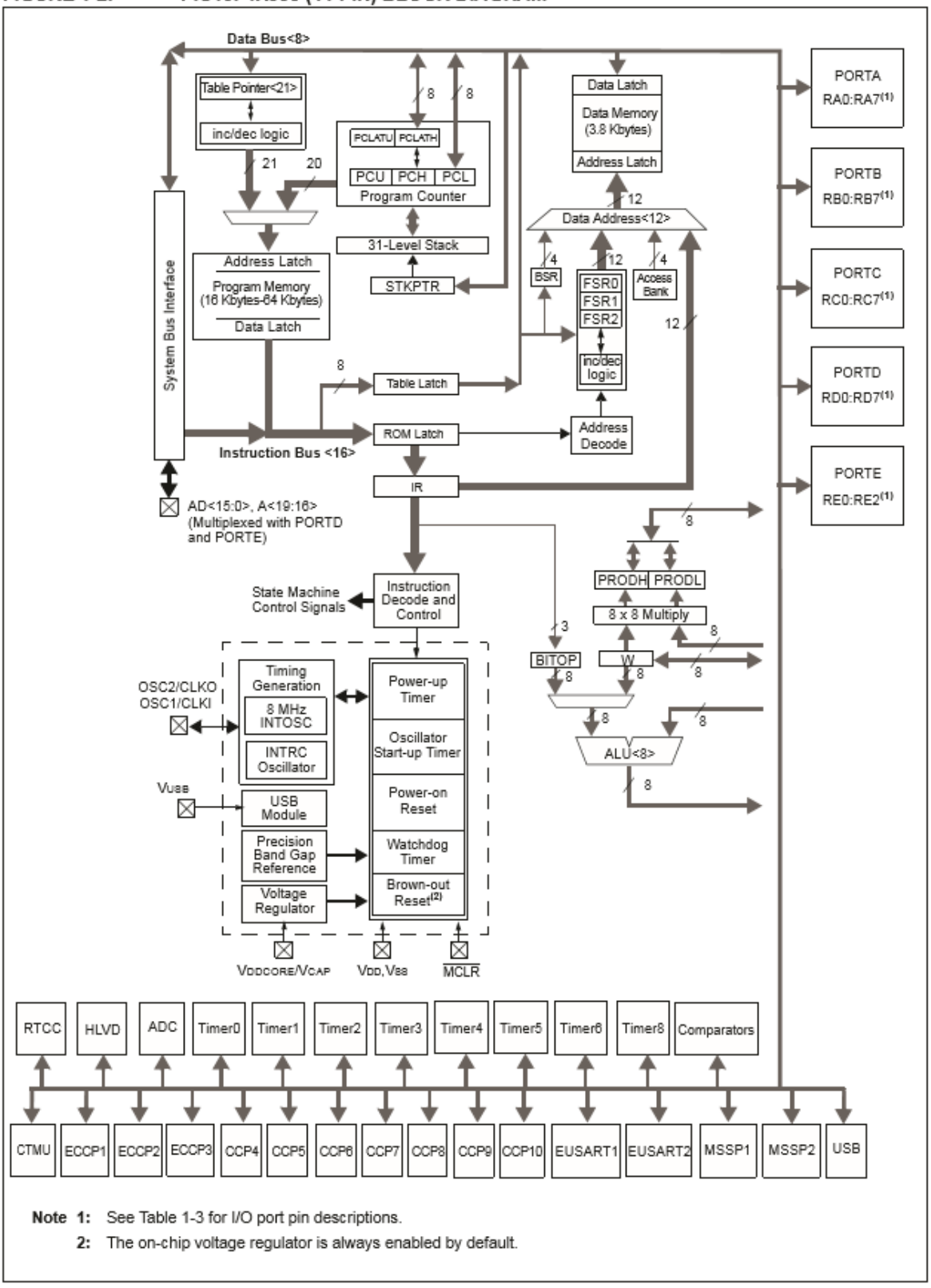
- Manufacturer: Meanwell
- Manufacturers Model No.: DR-30-12
- Universal AC input/Full range 100-240V AC 50-60 Hz
- Input current: 1.1A
- Protections: Short circuit/Over load/Over voltage
- Cooling by free air convection
- Can be installed on DIN rail TS-35/7.5 or 15
- Isolation class
- LED indicator for power on
- 100% full load burn-in test
- Approvals:



All specifications are manufacturer's data

14. Appendix A – Microchip 47J53 Block Diagram

FIGURE 1-2: PIC18F4XJ53 (44-PIN) BLOCK DIAGRAM



Note 1: See Table 1-3 for I/O port pin descriptions.
2: The on-chip voltage regulator is always enabled by default.

15. Appendix B - UHF Radio Modem Specification

The Modem has the following specification.

Parameter	**Value**	
	UK/EU/ROW 868 MHz	USAA 915MHz
Manufacturer:	RF Solutions Ltd. UK	RF Solutions Ltd. UK
Modem Type:	ZULU-2-M868-SO	ZULU-2-M915-SO
Nominal Frequency Band:	868MHz	915MHz
Frequency Options:	868.400, 868.900, **869.450**, 869.600 and 869.800 MHz	915.000, 915.100, **915.200**, 915.300MHz
Frequency Set to:	869.450MHz	915.200MHz
Bandwidth per Channel:	100kHz	100kHz
Deviation:	45kHz	45kHz
Power Output Set	100mW (20dBm)	0.74mW (-1.3dBm)
Maximum RF Input Power	+10dBm	+10dBm
Receiver sensitivity:	Max –121dBm (-102dBm (Max) to -109dBM (Min) at 56kbps)	Max –121dBm (-102dBm (Max) to -109dBM (Min) at 56kbps)
RLC & PC Controller Range:	Up to 2km depending on RLC aerial positioning and terrain	TBC
Addressing:	24bit secure data protocol	24bit secure data protocol
Addressing Schema:	One to Many	One to Many
RF Baud Rate:	56kbps	56kbps
Modem Data Rate:	19.2kbps	19.2kbps
Modulation:	Frequency Shift Keying (FSK)	Frequency Shift Keying (FSK)
Operating Temperature:	-40C to +85C	-40C to +85C
Compliance:	CE (see table below)	Compliance for FCC is to 47 CFR part 15.249

RF Channel Selection

The EU standard sets maximum power transmission limits dependent on frequency, bandwidth and application. A rough guidance applicable to the ZULU channel numbers is given below

Channel Number	**Frequency Centre (MHz)**	**EU Power Allowance mW/dBm**	**Notes**
0	868.400	25/14	Applicable standard - EN300-220
1	868.900	25/14	
2	**869.450**	**100/20**	
3	869.600	100/20	
4	869.800	25/14	

All specifications are manufacturer’s data

End of Document