

# RFD DESIGN

## RFD DINIO

Compact Telemetry Module with Isolated Serial Port



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## 1 Features & Overview

The RFD DINIO is a versatile, easy to use, long range wireless telemetry unit with 2 digital inputs, 2 digital outputs, and RS422/ RS485 serial communications. The DINIO's features include:

- Secure, encrypted over the air communications
- 6-33V (DC) input voltage range
- 2 opto-isolated digital inputs
- 2 clean contact isolated relay outputs
- Fully isolated RS422 / RS485 serial communications interface with switchable termination
- Simple one-button pairing sequence
- Compact DIN rail mounted enclosure
- Industrial temperature range (-20°C to +60°C)
- Modbus pass-through Support
- 8 x Status LEDs
- Slim profile (101 x 22.5 x 120mm)
- Australia, USA, and New Zealand compliant

### 1.1 DINIO Block Diagram

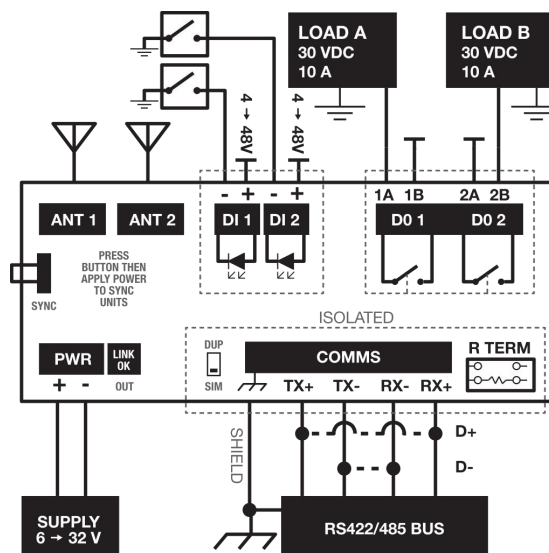


Figure 1-1 DINIO function block diagram

The DINIO module has this block diagram showing all connections on the side of the enclosure for easy reference whilst in the field.

## 2 Cautions and Warnings

### General Cautions

During operation there must be a separation distance of 20cm between all persons and the antenna.

Ensure that all used RF connectors are secure and properly terminated.

### When used in the US - FCC Caution

The user is cautioned that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This equipment complies with FCC's RF radiation exposure limits set forth for an uncontrolled environment. The antenna(s) used for this transmitter must be installed and operated to provide a separation distance of at least 20 cm from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter. Installers must ensure that 20cm separation distance will be maintained between the device (excluding its handset) and users.

**When used in Canada - ISED Caution**

This device complies with RSS 247 of the Industry Canada Rules. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This equipment complies with Canada radiation exposure limits set forth for uncontrolled environments. This equipment should be installed and operated with a minimum distance of 20cm (may be adjusted according to actual calculation result) between the radiator and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Déclaration d'IC sur l'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux radiations définies par le Canada pour des environnements non contrôlés. Cet équipement doit être installé et utilisé à une distance minimum de 20 cm entre l'antenne et votre corps.

Cet émetteur ne doit pas être installé au même endroit ni utilisé avec une autre antenne ou un autre émetteur

### 3 DINIO Pairing (Initial Setup)

The DINIO module is used in a pair with a companion DINIO module.

This initial setup or 'Pairing' proceed needs to be completed once during commissioning of the system. It is recommended that this is done in an office environment, where the pairing process can be monitored and verified, before taking units out to site.

The pairing process is follows:

1. (Optional) If required preconfigure modem settings to requirements via the RS422 port.
2. Prepare both DINIO units by connecting antennas to the 'ANT1' port of each unit. Position both DINIO units so they are approximately 10cm apart. Have power cables terminated, ready to connect.
3. While pressing the 'SYNC' button of one DINIO, Apply power to the unit.
4. Confirm the 'OK' LED is solid green, and the 'LINK' LED is flashing green, indicating it is in the pairing mode.
5. While pressing the 'SYNC' button of the other DINIO, apply power to the unit
6. Confirm the 'OK' LED is solid green, and the 'LINK' LED is flashing green indicating it is also in the pairing mode.
7. The two DINIO units will communicate with each other and exchange unique unit identifier keys. The units will generate a new unique sync key that is shared and stored in each unit.
8. Once the 'LINK' LED has become solid green, both DINIO units are paired.

The DINIO units store the sync key in non-volatile memory and recall this on each power up.

Should a DINIO unit need to be replaced at some stage, the pairing process will need to be repeated.

## 4 DINIO Terminal Connections

The DINIO module features pluggable connectors for all individual wire connections and RP-SMA connectors for the antennas. The plug connections and descriptions are listed below.

Pin	Connector	Description
PWR IN +	3 Pin Plug	Device Power Input +
PWR IN -	3 Pin Plug	Device Power Input - (Antenna connector ground)
LINK OK	3 Pin Plug	Digital Output. Active LOW when radio linked.
DI 1+	2 Pin Plug	Digital Input 1 +
DI 1-	2 Pin Plug	Digital Input 1 -
DI_2+	2 Pin Plug	Digital Input 2 +
DI_2-	2 Pin Plug	Digital Input 2 -
DO 1A	4 Pin Plug	Digital Output Relay 1, side A
DO 1B	4 Pin Plug	Digital Output Relay 1, side B
DO 2A	4 Pin Plug	Digital Output Relay 2, side A
DO 2B	4 Pin Plug	Digital Output Relay 2, side B
GND	5 Pin Plug	RS422 / RS485 Ground Reference Line
TX+	5 Pin Plug	RS422 non-inverting TX output / RS485 A(+)
TX-	5 Pin Plug	RS422 Inverting TX output / RS485 B(-)
RX-	5 Pin Plug	RS422 Inverting RX input / RS485 B(-)
RX+	5 Pin Plug	RS422 non-inverting RX input / RS485 A(+)

ANT1	RP-SMA	Primary RF Antenna. Always connect to antenna
ANT2	RP-SMA	Secondary (Diversity) Antenna. Connect if required.



## 5 Terminal Connection Details

### 5.1 POWER INPUT / LINK STATUS OUTPUT

The DINIO requires a DC supply voltage in the range of 6V to 32V DC to operate. The power connection is made through a 3 pin pluggable connector.

The DINIO has built-in undervoltage and overvoltage protection. When the applied voltage falls outside these ranges, the internal protection circuitry disconnects the power supply from the incoming voltage.

On Power up, the LINK OK output is OFF (Open Circuit). Once the radio link between has been established, the LINK output switches ON (Pull to V-). This output can be fed into other monitoring equipment to monitor the status of the radio link.

Should a loss of radio link occur, the LINK output switches OFF.

### 5.2 DIGITAL INPUTS

The DINIO provides two independent optically isolated Digital inputs.

Each input connects via a 2 pin plug connector.

Each digital input will register the 'ON' stage with a DC voltage greater than 3.5V is applied. The digital inputs will consume 2mA of current (wetting current) independently of the voltage applied.

The digital inputs are protected should the user connect the digital input with reversed polarity.

### 5.3 DIGITAL OUTPUTS

The DINIO provides two independent isolated clean contact relay outputs.

The relay contacts are single pole, normally open in the OFF state. The relay contacts close in the ON state.

A single 4 pin pluggable connector is provided for connection to the relays.

Note : Should a loss of radio link occur, the digital outputs will automatically switch OFF.

### 5.4 SERIAL COMMUNICATIONS PORT

The serial communications port on the DINIO can be configured to operate from 1,200 bps to 115,200 bps, with configurable parity and stop bit.

Care must be taken by the communication system designer to keep data packets to be smaller than 3,200 bytes. This is required as the serial communications port has no hardware handshaking capability. The use of command / response and polling protocols such as Modbus are recommended.

Note: The DINIO is shipped with the communications port set to 9,600 baud, no parity, and 1 stop bit.

#### 5.4.1 RS422 CONNECTION

RS422 is a 4 wire full duplex communications bus between a single master node and multiple slaves (single bus driver, multiple receivers).

Data to send out to the RS422 bus is transmitted over the TX+ and TX- pins. Data is received on the RS422 bus on the RX+ and RX- pins.

RS422 communications can be set to be simplex (SIM) or duplex (DUP) In simplex mode, the RS422 port is limited to be transmitting OR receiving. In duplex mode, the RS422 communication can be transmitting AND receiving at the same time. Use the serial mode switch (DIP switch next to 5 pin terminal) to select simplex (SIM) or duplex (DUP) mode as required.

When the DINIO module is at the end of a long RS422 bus and there are no other devices on the bus providing bus termination, then the termination switch should be set to ON (down position). In RS422 mode, the termination is connected across the RX bus (RX+ and RX-) only.

Note: the RS422 bus termination is an active type, which biases the RS422 RX bus to the correct idle state while there is no traffic on the bus.

Note: For modem configuration and firmware update a 422 duplex (DUP) connection is required.

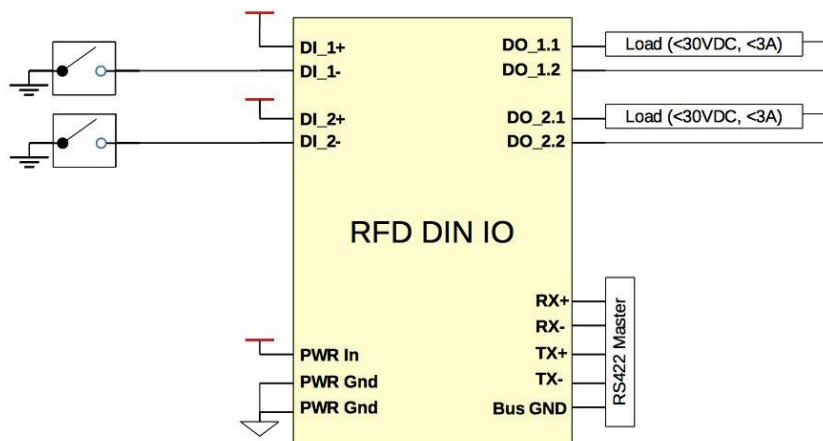


Figure 5-2 RS422 interface connection schematic

**5.4.2 RS485 CONNECTION**

RS485 is a 2 wire half-duplex multi-drop bus. Each device on the bus transmits only when required, and then releases the bus for other users.

During installation the Transmitter and Receiver pins must be connected together at the 5 pin connector as shown below

TX+ and RX+ are joined together and become the A or + line of the RS485 bus.

TX- and RX- are joined together and become the B or - line of the RS485 bus.

When the DINIO module is at the end of a long RS485 bus and there are no other devices on the RS485 bus providing bus termination, then the termination switch should be set to ON (down position).

When using RS485 communications, the serial mode switch (Single DIP switch next to 5 pin terminal) MUST be set to simplex (SIM) mode.

Note: the RS485 bus termination is an active type, which biases the RS485 bus to the correct idle state while there is no traffic on the bus.

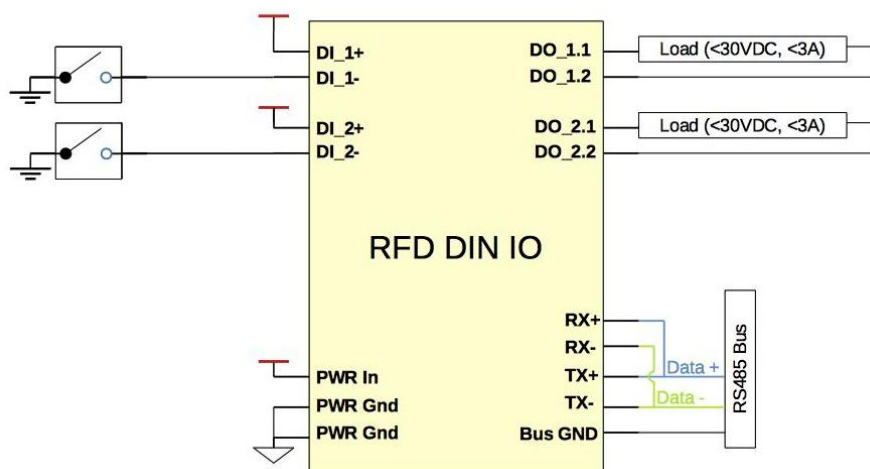


Figure 5-3 RS485 interface connection schematic

## 5.5 MODBUS Support

The DINIO rail supports MODBUS pass-through only. It provides a transparent telemetry link and isolated IO interface.

The DINIO does not encode or decode the Modbus protocol.

The DINIO's digital inputs, outputs and internal status information are NOT available as Modbus registers within the DINIO.

## 6 Electrical Ratings

### 6.1 General

Specification	Description
Antenna Connector	2 x RP-SMA
Power / IO Connectors	Pluggable Screw Terminal – 2.5mm <sup>2</sup> terminals
Indicator LEDS	RX, TX, DI 1, DI 2, DO 1, DO 2, OK, LINK
DIN Rail Specification	EN60715
Operating Temperature	-20°C -> 60°C
Humidity	0 to 95% RH (non condensing)

### 6.2 Power Supply Input

Parameter	Min	Typical	Max	Units
Nominal Supply Voltage	6	12-24	32	VDC
Undervoltage disconnect	5.5	5.7	6	VDC
Overvoltage disconnect voltage	33	34.5	36	VDC
Maximum Peak Current (6V Vin and radio transmitting)	-	-	600	mA
Idle Current (12V Vin) – Relays OFF	-	65	-	mA
Idle Current (12V Vin) – Relays ON	-	110	-	mA
Average Operating Current (12V Vin) – Relays OFF	-	90	-	mA

### 6.3 LINK OK Status Output

Parameter	Min	Typical	Max	Units
LINK OK Output Load (30V DC)	-	0.5	-	A
LINK OK Open Circuit Voltage	-	-	48	V

Note : The LINK OK output is NOT ISOLATED. It is referenced to the V- terminal.

### 6.4 Digital Inputs

Parameter	Min	Typical	Max	Units
Input Trigger Voltage	2	3.5	4	VDC
Input (wetting) Current	-	2mA	-	mA
Maximum Input Voltage	-	-	50	VDC
Maximum Reverse Voltage	-	-	50	VDC
Electrical Isolation Voltage	-	2000	-	VDC

### 6.5 Digital Outputs

Parameter	Min	Typical	Max	Units
Relay Contact Load (30V DC)	-	5	-	A
Relay Contact Carry Current	-	-	10	A
Relay Contact Mechanical Life	-	10,000,000	-	Operations
Relay Contact Electrical Life (5A 30VDC)	-	100,000	-	Operations
Electrical Isolation Voltage	-	2000	-	VDC

## 6.6 Isolated RS485 & RS422 Communication Port

Parameter	Min	Typical	Max	Units
Noise Immunity	-0.2	-	0.2	V
Receiver input Differential Voltage	-7	-	12	Vcm
Maximum Differential Line Voltage	-30	-	30	V
RS422 / RS485 Data Rate	1,200	9,600	115,200	bps
RS422 / RS485 Port Isolation	-	2000V	-	VDC

## 6.7 Antenna Ports

Note – The antenna ports are NOT isolated. The Connector housings are directly connected to the PWR - terminal of the power supply input.



## 7 Status Indicators

The RFD DIN IO has 8 indicator LED's as described below.

Green / RED LED's indicate device health status. Orange LED's indicate device activity.

Indicator	Colour	Meaning
OK	Green	Device Power is OK
LINK	Red / Orange /Green	Green Flashing: In Sync Mode Green Solid: Link OK / Greater than -82dBm RX Orange Slow Flash: Link OK / -83 to -93dBm RX Orange Fast Flash: Link OK / -94 to -104dBm RX Red Fast Flash: NO Link / Less than -105dBm RX
RX	Orange	RS422 / RS485 port data received
TX	Orange	RS422 / RS485 port data transmit
DI 1	Orange	Input 1 is ON (Voltage applied to Input)
DI 2	Orange	Input 2 is ON (Voltage applied to Input)
DO 1	Orange	Output 1 is ON (Relay Contact is Closed)
DO 2	Orange	Output 2 is ON (Relay Contact is Closed)

## 8 Antenna Connections

The DINIO contains the RFD 900x radio modem for radio communication and I/O control.

Antenna port A1 is the primary antenna connection. This port must be used in all applications.

The second antenna (A2) is used for applications requiring antenna diversity. Using the A2 antenna port is optional and is not required for all application. The A2 antenna port may be left disconnected if not used.

The DINIO module has **Female RP-SMA connectors** for each antenna.

Antennas must be of 50 ohms design impedance at the required ISM band frequencies.

Note: For best RF performance the number of adapters and/or length of coaxial cable should be kept to a minimum. Coaxial cable should be of 50 ohm impedance at the operating frequency of the system and where available low loss variants should be used.

## 9 Internal Radio Configuration and Updates

The DINIO contains a preconfigured RFD900x modem that has been factory configured for the DINIO product.

The DINIO's modem parameters can be changed and firmware updated from a computer terminal program via the RS422 DUP interface using a USB to RS422 adapter. The RF Design Modem Tools application provides a basic graphical interface for this purpose.

All relevant AT commands and Modem tools instructions can be found in the firmware datasheets and other documents in useful links.

**Note:** Regular interruption of the radio link may indicate interference on the modem operating frequency. In order to run two DINIO pairs within RF range of each other it is required that the two pairs be set to different frequency settings to minimise interference. This can be done by altering the band parameter of the required modems.

## 10 Modem Specifications

Performance	
RF Data Rate	12 - 224 kbps. Configurable.
Over the Air Encryption	AES 128 bit
Indoor Range	500m – 1km (2dBi monopole Antennas)
Line-Of-Sight Range	Antenna/Environment Dependent. 8-15km with 3dBi dipoles antennas and uncluttered line of sight.
Transmit Power	+30dBm nominal. Configurable from 0dBm to 30dBm
Receiver Sensitivity	-103dBm for $10^{-5}$ Bit Error Rate

See the RFD900 datasheet in useful links for detailed information and specifications on the radio.

## 11 Compliance Information

Compliance	
Radio	AS4268 : 2017 FCC 47CFR 15.247 FCC 47CFR Part 1.1307 FCC 47CFR 1.1310 IC RSS247
EMC	AS/NZS CISPR32: 2015 FCC PART 15 SUBPART B : 2018 ICES-003 Issue 6 : 2017

## 12 Mechanical

The RFD DIN IO Rail Enclosure is made from a combination of Self-extinguishing PC and ABS plastics.

The DINIO's compact overall dimensions with a narrow form factor permit the user to reduce the amount of cabinet space required, saving precious space in crowded equipment panels and cabinets.

Parameter	Description
Dimensions	101 x 22.5 x 120 mm [L x W x H]
DIN Rail Specification	EN60715
Enclosure Material	PC/ABS
IP Rating	IP 20

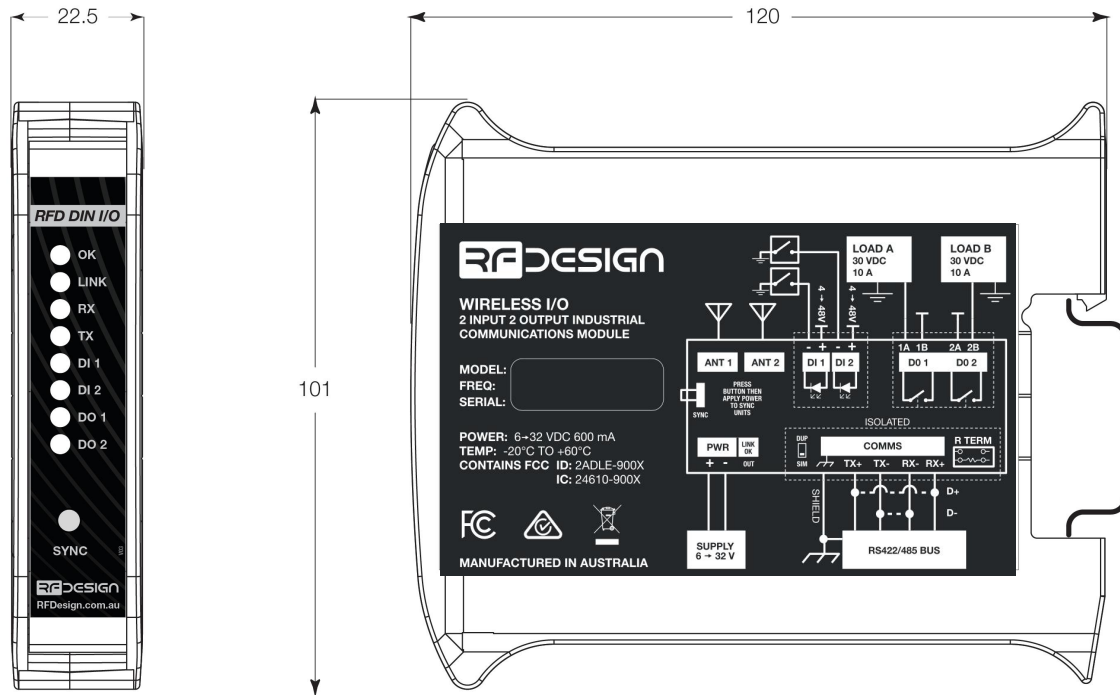


Figure 12-1 DINIO dimensions

## 13 Ordering Information

The **RFD DIN IO** can be ordered from RF Design directly online at <http://store.rfdesign.com.au>

Item	RFDesign Order Code
RFD DINIO-US FCC Compliant 902-928MHz 1W	RFD-DINIO-US
RFD DINIO-AU Australia 915-928MHz	RFD-DINIO-AU
RFD DINIO-NZ New Zealand 922-928MHz	RFD-DINIO-NZ

Antennas, Adaptors, and RF cables to suit the DINIO are also available as listed below

Item	RFDesign Order Code
Antenna 900MHz 2dBi Monopole	<a href="#">ANT-900-1/4W-RPSMA</a>
Antenna 900MHz 3dBi Monopole	<a href="#">ANT-900-1/2W-RPSMA</a>
Antenna 900MHz 6dBi Omni (N)	<a href="#">ANT-900-6dBi-OMNI-N</a>
Antenna 900MHz 6dBi Yagi	<a href="#">ANT-900-YAGI-3EL-6dBi</a>
Adaptor Connector RPSMA-N Male	<a href="#">ADAPTOR-RPSMA(F)-N(M)</a>
RF Cable – RPSMA(M) to RPSMA(F) 50cm	<a href="#">CABLE-RPSMA-EXT-50cm</a>
RF Cable – N Male to N Male – 5m	<a href="#">CABLE-RG58-N(M)-N(M)-5M</a>
RF Cable – SMA-RP R/A to N Female Bulkhead 500mm	<a href="#">CABLE-SMA-RP-R/A-N-(F)-BKD-50cm</a>

## 14 Related Documents/Useful Links

Resource	Description
<a href="#">RFD Documents Link</a>	Link to all RFD documents including FAQs and datasheets
<a href="#">RFD900 Datasheet</a>	Telemetry modem datasheet
<a href="#">RFD Tools Manual</a>	Modem configuration tools
<a href="#">RFD900 P2P Network Manual</a>	P2P Firmware guide
<a href="#">RFD Tools</a>	RFD modem tools download
<a href="#">Modem Firmware</a>	RFD modem firmware links



## 15 Revision History

Revision	Description	Date	Author
V1.0	Initial Release	10-10-2018	GVA
V2.0	Revised for prototype evaluation units	11-03-2019	GFS
V2.1	Updated with compliance detail	11-10-2019	GFS
V2.2	Updates and formatting	13-05-2020	Various