



DIGITAL FIELD UNIT (DFU)

ANALOGIC FIELD UNIT (AFU)

USER MANUAL



Ahead of the Curve<sup>SM</sup>

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## Guidelines for Safe and Efficient Use

Read this information before using your AFU, DFU.

Warnings, Cautions, and Important notices throughout this manual guide you to avoid injury, prevent equipment damage, and determine equipment use when varying components or configurations exist. Notes provide tips or additional information.

SERCEL is not responsible for damages or injuries that result from failure to observe the information provided.



WARNING

When a Warning or Caution appears with a lightning-bolt icon, as shown in this example, this is to indicate a potential hazard that may lead to bodily injury or even death.



CAUTION

When a Warning or Caution appears with an exclamation-point icon, as shown in this example, this is to indicate possible equipment damage or potential risk of misuse and incorrect operation.



IMPORTANT

Important notices appear in the manual to highlight information that does not affect the risk of bodily injury, death, or equipment damage, but is nevertheless important. These notices appear with a stop-sign icon, as shown in this example.

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## SUMMARY

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## Description

### DFU - Digital Field Unit

The DFU is the WiNG system's Digital Field Unit (ref. 10043828). It is a single channel autonomous field unit including a QuietSeis MEMS Sensor. It includes wireless communication capabilities to deliver its QC statuses and acquisition samples.

#### DFU Functions

- Ground acceleration recording
- Filtering, compression and time stamping of the data
- Offloading of recorded data in the rack
- Local data storage transmission on request
- Instrument and sensor tests
- Selectable low cut filter down to 0.15Hz



### AFU - Analogue Field Unit

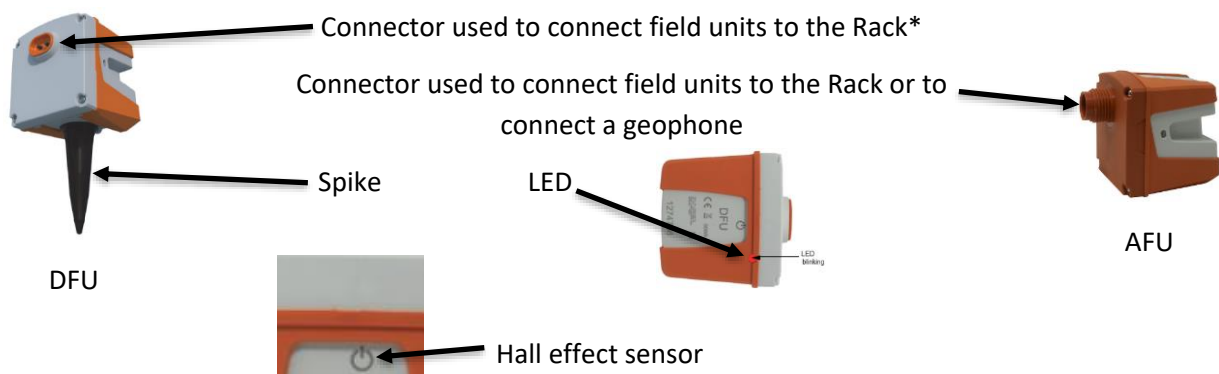
The AFU is the WiNG system's Analogue Field Unit (ref. 10042274). It is a single channel autonomous node including an external KCK2 connector for geophone. It includes communication capabilities to wirelessly deliver its QC status.

#### AFU Functions

- 24 bit A/D conversion of the signal
- Filtering, compression and time stamping of the data
- Local data storage and re-transmission if needed
- Instrument and sensor tests
- Selectable low cut filter down to 0.15Hz



Magnetic power stick (ref. 10045283) enabling to power ON & OFF the field units based on Hall effect.



\*Refer to "Harvesting & Charging the battery" chapter.

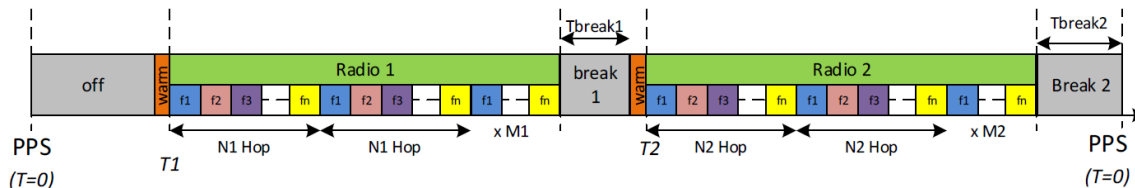
## Description of radio protocol

### 2,4GHZ RADIO TRANSCEIVER

#### Dual radio

The MAC manage 2 independent radios with a separate data flow and different radio modulation (LORA and GFSK). Only one of them can be used without GNSS synchronization (this radio should be used for a troubleshoot radio). LORA is used to communicate between DFU through FHSS (Frequency Hopping spread Spectrum) technical and transmit state of health and settings.

GFSK is used to communicate with an external equipment (WiNG Field Monitor box) through FHSS technical to send state-of-health data of several DFU, some of its own seismic data or receive settings.



*Time sharing with dual radio on 1 second.*

#### Frequency range and channel spacing

The frequency range covered by the equipment is 2402.5MHz up to 2478.5MHz, using 1MHz channel spacing. According to FCC rules FHSS (Frequency Hopping Spread Spectrum) scheme is used, on 20 different frequencies.

#### Data rate

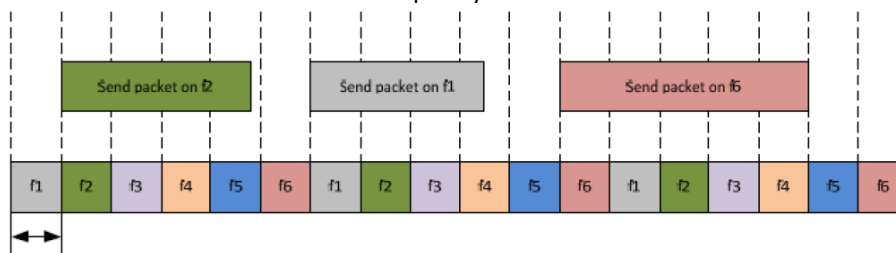
Data rate is 22.2Kbps with LORA modulation and 1Mbps with GFSK modulation.

#### FHSS

The FHSS operates on a set of frequencies. It uses one frequency for a fixed period of time and then switches to another channel. The next frequency is given by a pseudo-random sequence.

In order to communicate, the transmitter and the receiver have to use the same set of frequencies, the same frequency sequence defined by the Frequency key.

Transmitter and receiver are time synchronized thanks to the GNSS receiver module that delivered a PPS signal to the micro-controller. So both transmitter and receiver switch their frequency at the same time.



*Example of FHSS based on a set of 6 sequences.*

#### Listen Before Talk (LBT) and backoff

The LBT is based on a Channel Control Access mechanism. DFU radio measures the Received Signal Strength Indication (RSSI) before beginning packet transmission. If the RSSI is too high, the media is said "busy" and the DFU postpones the transmission for a random back off time.

## GPS configuration

List of allowed GNSS constellations (QZSS, GALILEO, BEIDOU, GLONASS, GPS)

- GPS Only is the default mode
- GPS Only + SBAS
- GLONASS only
- GPS+GLONASS+SBAS
- GPS+GLONASS+GALILEO
- GPS+GALILEO
- 

Navigation model

- Stationary (Default mode)
- Pedestrian

## Deployment

### AFU - Analogue Field Unit

Before connecting the geophone string to the AFU, it is important that the geophones are properly deployed in their correct position and orientation. For AFU, the connector should first be correctly oriented, then pushed straight in and pressed firmly against the socket. If a lock-ring is present on the geophone string connector, it should be tightened by hand only.



### DFU - Digital Field Unit



DFUs must be planted into the ground with base of the field unit level with the ground. DFUs may also be buried - no deeper than the TOP of the field unit. However, this will reduce GPS performance.

### Power-up the Field Unit

The Field Unit is powered from its internal battery, and it should be ensured that the battery is fully charged before deployment. The internal power supply of the Field Unit is enabled using the Power stick.



When the Field Unit is powered up, it will enter a power-up boot sequence, which should take about 1 minute to complete. The boot sequence is indicated by the Operation LED flashing very rapidly, this should take approximately 1 minute to complete.

Upon wakeup, the field unit will perform a test of the geophone string, including a tilt test to ensure that the geophones (for AFU) are correctly planted, therefore it is important that the geophones are not disturbed during this period, and that as little ground noise as possible is generated.

Completion of the boot and test phase is indicated by the Operation LED changing rate to 1 blink per second. This indicates that no faults were detected during the boot test.

In case of problems detected during startup, the LED will blink 2 times per second. If a fault is detected, the geophones and their planting should be investigated.

Once the AFU/DFU is in acquisition, the LED will blink 1 time per 4 seconds.

In order for the integral GPS receiver to receive the best possible signal, the AFU/DFU should be placed on the ground vertically, and as far away as possible from objects that may obstruct the receiver's view of the sky, such as trees or buildings.

Once the AFU/DFU has achieved GPS lock, it will immediately begin acquiring data. The exception to this would be if the working hours have been so configured that the AFU/DFU would normally be in sleep mode at the time of the deployment. The table below gives a full description of the AFU/DFU LED patterns.

AFU / DFU Behaviour	LED Pattern
Field Unit to OFF	blinks for 3 sec before shutdown
Waiting for Acquisition	1 blink / sec
Acquisition in progress	1 blink / 4 sec
Acquisition failure due to Major error	double blink / 2 sec continuous
Rack connected	LED ON
STORAGE state	1 blink intense / 500 ms



## Harvesting & Charging the battery

The Harvesting & Charging Rack application provides an interface to Charge, Update, Troubleshoot and Harvest data from field units

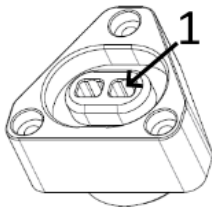
The Charger & Harvesting rack performs several functions. It allows:

- Simultaneous Data Harvesting and Battery Charger of field units
- Configuration and Testing of field units
- Features a display controller showing the status of each field unit
- 36 slots per rack
- Networked with DCM
- Standalone mode with reduced functionality

### WING CHARGER & HARVESTING RACK connector

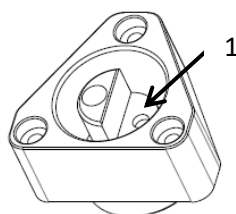
Interface connection for :

Rack DFU (10045410)



Connector DFU (10042801)

Rack AFU (10045411)



Connector AFU (10042799)




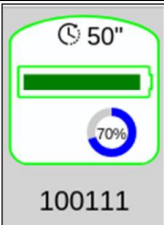
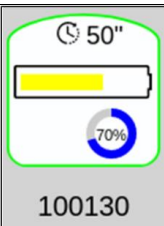
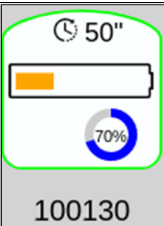

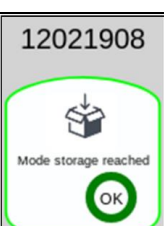
Connect field units to the Rack. The LED on the Field Unit will remain lit. See the WiNG Installation Manual, section fixing Field Units to Rack

The Harvesting & Charging Rack Graphic display (application) provides a graphic view of Field Units status.

The application allows you to Charge, Update, Troubleshoot, and Harvest data from Field Units.



The table below indicates the legend for the Harvesting & Charging rack icons

Icon	Definition
 <p>100124</p>	Indicates Battery OK. Harvest OK.
 <p>100111</p>	Indicates Harvest is ongoing.
 <p>100130</p>	→ Battery is Charging (battery level above 30% but not yet complete charge).
 <p>100130</p>	→ Low Battery level (0 - 30%)
 <p>100124</p>	Indicates field unit charge is not possible due to high/low temperature.
<p>12021908</p> 	Storage mode is enabled and unit is ready to unplug.

## Maintenance



IMPORTANT

In order to clean field unit power input plugs, only use fresh water. Do not use any aggressive chemicals (like petrol or gasoline) liable to attack plastic. Prior to connecting any plug, make sure there is no water inside connectors.



Electrostatic discharge:

Use the following guidelines to provide a static-free repair station that will preclude any ESD-related damage to electronic circuits:

- All spare parts (circuit boards and ESD sensitive devices) should be stored and transported in static- shielding bags.
- Unless the repair station rests on a conductive floor, chairs or stools should rest on a grounded, rigid-type, static-dissipative floor mat.
- Use a static-dissipative table mat.
- Wear a static-control wrist strap or foot grounder.
- Provide common-point grounding for all conductive items (including personnel and soldering iron tip).
- To control the discharge rate and protect workers from electric shocks, both the table mat and wrist strap should be grounded through a 1-MΩ resistor. The mat should be connected to the same earth ground point as the wrist strap.
- Wear static-dissipative garments.

### Battery



CAUTION



Use only the type of battery provided by Sercel: **WING FIELD UNIT PACK BATTERY 50WH, ref. 10042109**

Caution: risk of explosion if the battery is replaced by an incorrect type.

Do not put the battery in a fire or a hot oven. Do not crush or cut the battery as this could cause an explosion.

- 1- Shut down the Field Unit using the Power stick.
- 2- Untighten the 4 SCREWS DELTA PT 40x16 on cover (screw head type : TORX T20).

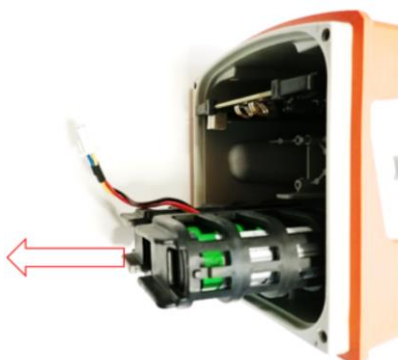


- 3- Unplugged the battery connector from the electronic board.

BATTERY CONNECTOR



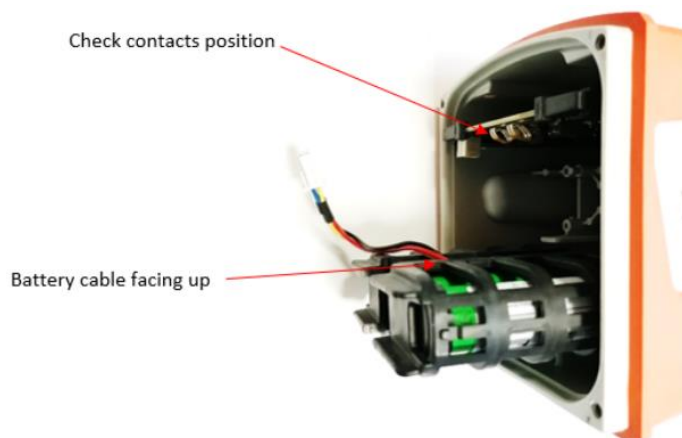
- 4- Pull battery out.



- 5- Put the new battery in the two shock absorbers.



- 6- Place BATTERY PACK in place, take care of the orientation of both parts.



- 7- Connect the battery connector to the electronic board.

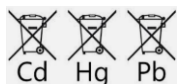
- 8- Close the Field Unit using a HAND CLAMP to press the two parts together, and tighten the 4 SCREWS DELTA PT 40x16 (screw head type: TORX T20 ; torque 2,1Nm).





Do not discard Sercel product batteries in the trash.

CAUTION



This product contains sealed batteries and must be disposed of properly. For more information, contact your local recycling/reuse or hazardous waste center.

## Specifications

	AFU - Analogue Field Unit	DFU - Digital Field Unit
Operating Voltage	3,6V	
Battery autonomy	> 960 hours (40 days 24hr/7day) Pathfinder enabled > 1200 hours (50 days 24hr/7day) Pathfinder disabled	
Dimensions (HxWxD):	231mm X 112mm X 137mm	231mm X 112mm X 118mm
Weight	760g	780g (no spike), 830g (with spike)
Operating Environment	IP68	
Operating Temperatures	-40°C to +60°C	
Storage Temperatures	-40°C to +60°C	
Battery charge temperatures	0°C to +30°C	
Pollution degree	II	
Altitude functioning	< 2000m	
Radio data rates	LORA: 22kbps ang GFSK: 1Mbps	
Radio Frequency Characteristics:		
Frequency band	2402 – 2478 MHz	
Spreading method	LORA/GFSK FHSS	
Number of channels	3x20	
Radiated output power	14dBm	
Supported GNSS Constellations	GPS, GLONASS	

## Regulatory Information

### European Union Statement

Sercel products meet the essential requirements of Directives

- RED 2014/53/UE (Radio)
- 2014/ 30/UE (EMC)
- 2014/35/UE (Low Voltage)
- 2011/65/UE (ROHS).



The WiNG DFU & AFU are a class-A devices. In residential areas, the user may be requested to take appropriate measures in the event of RF interference caused by this device.

IMPORTANT

### FCC US Statement

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation

**Note:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This equipment complies with FCC's radiation exposure limits set forth for an uncontrolled environment under the following conditions :

1. This equipment should be installed and operated such that a minimum separation distance of 20cm is maintained between the radiator (antenna) and user's/nearby person's body at all times.
2. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

#### IC Canadian Statement

SERCEL products comply with Industry Canada EMI Class A requirements according to ICES-003 and RSS Gen.

Les produits SERCEL sont conformes aux exigences Classe A de l'Industrie Canada selon les normes NMB-003 et CNR Gen.

**Note** These devices comply with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

1. These devices may not cause interference; and
2. These devices must accept any interference, including interference that may cause undesired operation of the device.

This equipment complies with RSS102's radiation exposure limits set forth for an uncontrolled environment under the following conditions :

1. This equipment should be installed and operated such that a minimum separation distance of 20cm is maintained between the radiator (antenna) and user's/nearby person's body at all times.
2. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.