ML10

microlise

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Battery pack safety

The ML10 contains a Li-ion battery pack. This is not user replaceable. If replacement is needed please contact Microlise Service.

CAUTION: RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. DISPOSE OF BATTERY ACCORDING TO THE INSTRUCTIONS.

Please note: Batteries must not be disposed of with normal household or business waste. Please dispose of inaccordance with local regulations in force for battery disposal.

FCC Rules

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.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Changes or modifications to the ML10 unit not expressly approved by Microlise 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.

R&TTE Directive

This device complies with the European Radio and Telecommunication Terminal Equipment (R&TTE) directive, including product safety and electrical interference directives.

xxxx

Industry Canada Regulations

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This device complies with Industry Canada licence-exempt RSS standard(s). 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.

Revision history

Issue 1.0	Initial draft for internal review.	09 February 2016
Issue 1.1	Update following internal review, additional information added regarding setting Bluetooth Classic and BLE to transmit continuously.	21 March 2016
Issue 1.2	Update to FCC warning statements, added ATEX/IECEx requirements	31 May 2016
Issue 1.3	Split out ATEX/IECEx requirements to separate document	13 June 2016
Issue 1.4	Correct reference on front page to product type	1 July 2016
Issue 1.5	Update to include Industry Canada Regulations warning	20 July 2016
Issue 1.6	Update to correct Block Diagram, added FCC Declaration	10 August 2016
Issue 1.7	Update to block diagram to include frequencies, update reference to WT32i module	9 November 2016

Contents

1 Overview

The **ML10 Tracking Unit** is battery backed, vehicle tracking and telematics unit utilizing GPS, GSM / GPRS, Bluetooth & BLE technology.

Units are supplied to customers pre-configured by Microlise with appropriate configurations along with wiring harnesses to suit the intended application.

2 Installation

The ML10 is designed for installation both within the vehicle cab and also for installation on a trailer.

Depending on the application the device may be permanently powered (e.g. an in cab installation) or powered only periodically (e.g. in a trailer tracking application only when the trailer is hooked up to a tractor unit.) However, in either application the unit is designed to make efficient use of the power available through the use of sleep modes when there is no activity.

When selecting a suitable mounting location, please be aware of:

- Excessive temperatures (operating temperature: -25°C to 55°C)
- Corrosive fluids
- Areas where the unit may obstruct the drivers view or impede operation of the vehicle
- Locations which may shield the unit and affect GPS and GPRS reception.
- Unit and antenna separation distance of at least 20 cm from all persons and other antennae or transmitters.

The installation must be carried out in accordance with FCS1362:2010 or later, by a competent auto-electrician.

3 Wiring

For basic in cab installations only the following wires need be connected:

ML10 primary connector pin no	Wire colour	Signal	In-line fuse* required
4M	Red	12V or 24V supply	2A
2M	Yellow	Ignition	1A
3M	Black	Ground	None

For bench testing, connect the red and yellow wires to a +12V or 24V supply and the black wire to 0V / Ground.

* Fuses and all replacements need to be automotive blade type ATO

4 Description of operation

Providing external power is applied, or the internal battery is sufficiently charged, and the unit is within GPS and GPRS coverage the unit will periodically (based on time and/or distance, and configuration) transmit location and telematics information to the relevant Microlise system.

If out of GPRS coverage then messages are stored into non-volatile Flash memory for transmission later when a GPRS connection can be established.

Whilst operating on external power the unit will charge the internal battery as required.

Two CAN interfaces are incorporated which are typically used to either listen for, or request information on automotive CAN busses.

The unit incorporates a RS232 interface which can be used for connection of a variety of peripherals, e.g. Mobile Data Terminals, refrigeration temperature monitoring equipment, printers, sensors or other devices.

A Dallas 1 wire interface is provided. This is typically used for driver identification via Dallas iButtons, but could also be used with any other device in the "1 wire" range.

The unit incorporates six digital inputs. One is available for monitoring ignition status, another for engine run, the remainder are general purpose inputs which can be used for monitoring doors switches, panic buttons or other digital signals.

A real time clock is incorporated for time-stamping all events recorded by the unit.

The unit monitors its own internal temperature. Battery charging is only permitted when the temperature is within the specified limits of the battery pack.

The Bluetooth interface can be used for diagnostics, for connection to peripheral devices, e.g. a data terminal, and also for audio connection to a Bluetooth car kit for hands free voice calls.

A Bluetooth Low Energy interface is available for monitoring a variety if BLE devices and tags.

A USB OTG (on the go) port is provided. This can be used for diagnostics, but can also be used for connection to a range of USB host or slave devices.

The unit is fitted with internal GSM,GPS and Bluetooth antennas.

A microSD card may be fitted internal for applications requiring additional Flash storage capacity.

The built in accelerometer can be used to monitor harsh braking, acceleration, cornering, and any lean of the vehicle.

The built in modem supports four GSM frequency bands (850, 900, 1800 & 1900 MHz) and five UMTS frequency bands (2100, 1900, 850, 800, 900MHz). The 900 and 1800 MHz GSM bands are used in Europe, but are not operational in the USA. The 850 and 1900 MHz bands are the only bands used for GSM in the USA and Canada.

5 Antenna details

5.1 Bluetooth

The ML10 incorporates the Bluegiga WT32i Bluetooth module. This module has a built in chip antenna with a peak gain of 1.5 dBi.

5.2 GSM/UMTS

The ML10 incorporates an Antenova Rubra Penta-band SMD Antenna, with a peak gain of 3.8dBi at 180 MHz

5.3 BLE

The ML10 incorporates the Bluegiga BLE113 Bluetooth Low Energy module, with an on board antenna and a peak gain of 0.5dBi.
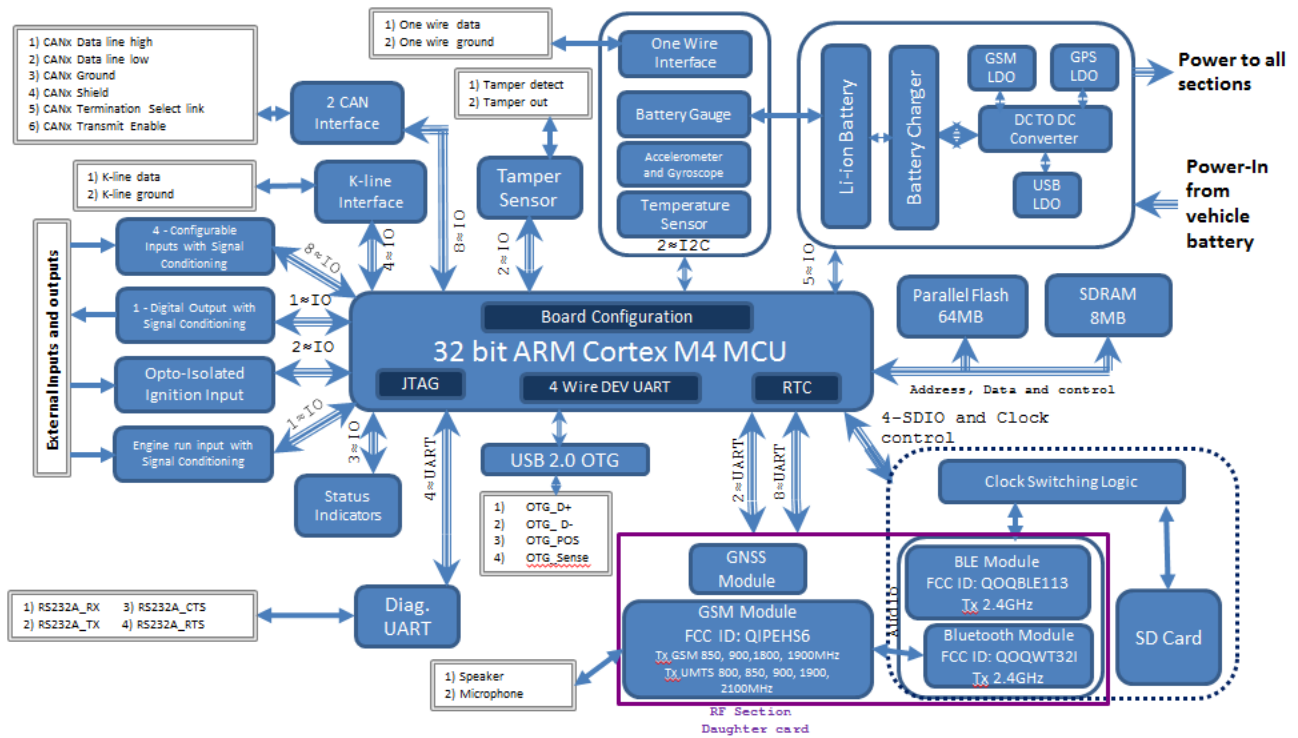
6 Tuning and serviceable parts

The ML10 contains no user tunable parts. The ML10 contains no user serviceable parts.

7 LED Functions

The ML10 features LED function indicators visible from the front of the unit

8 Block diagram

1) CANx Data line high
2) CANx Data line low
3) CANx Ground
4) CANx Shield
5) CANx Termination Select link
6) CANx Transmit Enable

1) One wire data
2) One wire ground

1) Tamper detect
2) Tamper out

2 CAN Interface

One Wire Interface

Battery Gauge

Accelerometer and Gyroscope

Temperature Sensor

2≈I2C

Li-ion Battery

Battery Charger

GSM LDO

GPS LDO

Power to all sections

DC TO DC Converter

USB LDO

Power-In from vehicle battery

1) K-line data
2) K-line ground

K-line Interface

Tamper Sensor

External Inputs and outputs

4 - Configurable Inputs with Signal Conditioning

1 - Digital Output with Signal Conditioning

Opto-Isolated Ignition Input

Engine run input with Signal Conditioning

8≈IO

4≈IO

8≈IO

2≈IO

1≈IO

2≈IO

1≈IO

3≈IO

5≈IO

Board Configuration

32 bit ARM Cortex M4 MCU

JTAG

4 Wire DEV UART

RTC

Parallel Flash 64MB

SDRAM 8MB

Address, Data and control

4-SDIO and Clock control

Status Indicators

4≈UART

USB 2.0 OTG

2≈UART

8≈UART

1) OTG_D+
2) OTG_D-
3) OTG_POS
4) OTG_Sense

Clock Switching Logic

GNSS Module

BLE Module
FCC ID: QOQBLE113
Tx 2.4GHz

SD Card

GSM Module
FCC ID: QIPEHS6
Tx GSM 850, 900,1800, 1900MHz
Tx UMTS 800, 850, 900, 1900, 2100MHz

Bluetooth Module
FCC ID: QOQWT32I
Tx 2.4GHz

RF Section
Daughter card

1) RS232A_RX   3) RS232A_CTS
2) RS232A_TX   4) RS232A_RTS

Diag. UART

1) Speaker
2) Microphone

9 Configuration and diagnostics menu

To access the configuration and diagnostics menu a PC or laptop with a RS232 port (or a USB to RS232 adaptor) should be connected to the ML10 as follows:

ML10 primary connector pin no	ML10 signal	PC / laptop serial port pin no	PC serial port signal
4G	DTE-RX	3	Transmit
4H	DTE-TX	2	Receive
4F	Ground	5	Ground

On the PC or laptop execute a terminal program, e.g. Hyperterminal, and set the RS232 configuration as follows: *115200 baud, 8 bit, no parity, 1 stop bit*

By default the unit with a debug enabled firmware will output debug messages to the terminal program.

On hitting the "Esc" key the following menu will appear:

```
                    Main Menu


           1 - Debugs
           2 - Logs
           3 - View Config
           4 - Status Screen
           5 - Configure
           6 - Download
           7 - Telematic Event Data
           8 - Telematic Summary Data
           9 - Advanced Menu
           b - Performance Counters Screen



Enter option >
```

Press '4' to select the "Test" screen as follows:

```
                    Status Screen


ML10 Time         :26/02/16,13:28:13
IMEI              :357042060142099        EHS6: 03.001
Ver               :0.1.2Beta      crc 0x8280 size:452668
Sig Q             :14 = 45 Percent
GPRS              :Connected
IP                :192.168.68.165
IMSI              :234159154198744
ICCID             :89441000302693188005
SRVR              :172.17.144.97          Connected       5432
Power Retain      :7200   Sleep: 43200=0  Re-try: 6
VIN               :                       DriverId :Unknown
Tacho VIN         :

GPSVer            :HW:00080000    SW:2.01 (75331)
Latitude          : 53.01376342   Power          :On (13.37v)
Longitude         : -1.31467056   Ignition       :On
GPSFix            :TRUE FC 25     Ch1 'Camera'   :Low    (DPD)
Num Sats          :11             Ch2 'Unknown'  :High   (DPU)
Speed             :  0.000000     Ch3 'Unknown'  :High   (DPU)
Course            :  0.000000     Ch4 'PTO'      :High   (DPU)
Distance          :0000000000     Shut Down      :7200s
GPS Antenna       :0              Batt Capacity  :unknown (3.87v)
GPS err (fHacc)   :0.50           Charge State   :Charging
GPS AvCNO         :44.57          ▯
```

For advanced options, press '9'. The following menu will then appear:

```
                    Advanced Menu


              a - Direct GSM
              b - Direct GPS
              c - Direct Bluetooth
              d - Device Tests
              e - Device Info
              f - Current Settings
              g - Upload
              h - Erase Config
              i - Erase Reports
              j - Erase DataStore
              k - Erase Debugs
              l - Immediate Reset
              m - Erase ASSET
              n - Power supply control
              p - Upgrade GSM
              q - Proprietary CAN debug
              r - Telematic Debug
              s - DFM Debug
              u - Vehicle Activation
              w - Set Speed Derived Distance
              y - Prod Test



Enter option >
```

To return to the "Main Menu" press "Esc"..

9.1 Establishing a GPRS connection and monitoring the GPS stream

Select menu options '9 a' for a "Direct GSM" connection.

Once selected, AT commands may be sent directly to the integral GSM modem.

e.g. type "AT+CGATT=1" (without double quotes) to put the modem into auto attach mode for GPRS testing.

```
                      Direct GSM


at+cgatt=1
OK
▮
```

Press "Ctrl" "d" to switch to the GPS stream and "Ctrl" "a" to switch back to the GSM modem, if needed.

```
$GNRMC,133143.00,A,5300.82578,N,00118.88024,W,0.000,,260216,,,D*77
$GNRMC,133143.25,A,5300.82578,N,00118.88024,W,0.000,,260216,,,D*70
$GNRMC,133143.50,A,5300.82578,N,00118.88024,W,0.000,,260216,,,D*72
$GNGGA,133143.50,5300.82578,N,00118.88024,W,2,11,0.86,69.8,M,47.4,M,,0000*67
$GNRMC,133143.75,A,5300.82578,N,00118.88024,W,0.000,,260216,,,D*75
$GNGSA,A,3,05,07,13,15,20,28,30,21,08,24,18,,1.45,0.86,1.18*11
$GNGSA,A,3,,,,,,,,,,,,,1.45,0.86,1.18*1A
$GPGSV,4,1,14,05,33,186,48,07,07,064,37,08,09,023,43,13,89,336,48*77
$GPGSV,4,2,14,15,46,289,50,18,16,318,40,20,51,254,48,21,14,299,40*73
$GPGSV,4,3,14,24,14,244,41,28,52,103,48,30,36,065,48,33,28,198,42*79
$GPGSV,4,4,14,38,28,198,45,49,29,172,46*7C
$GLGSV,3,1,09,65,72,184,28,66,42,317,18,72,22,152,26,74,37,043,*62
$GLGSV,3,2,09,75,86,220,24,76,28,223,,82,07,330,18,83,14,022,27*60
$GLGSV,3,3,09,84,01,070,*56
$GNRMC,133144.00,A,5300.82578,N,00118.88024,W,0.000,,260216,,,D*70
$GNRMC,133144.25,A,5300.82578,N,00118.88024,W,0.000,,260216,,,D*77
$GNRMC,133144.50,A,5300.82578,N,00118.88024,W,0.000,,260216,,,D*75
$GNGGA,133144.50,5300.82578,N,00118.88024,W,2,11,0.86,69.8,M,47.4,M,,0000*60
$GNRMC,133144.75,A,5300.82578,N,00118.88024,W,0.000,,260216,,,D*72
$GNGSA,A,3,05,07,13,15,20,28,30,21,08,24,18,,1.45,0.86,1.18*11
```

Once testing is complete press "Esc" to return to the "Advanced Menu" and "Esc" again to return to the "Main Menu".

Note: Pressing "Esc" when in any "Direct … " mode will cause the unit to resume normal tracking operations and close any GPRS connection or GSM call.

9.2 Establishing a voice call, using a Bluetooth headset

1. From the main menu select "9" then "c" to access the Direct Bluetooth interface.

```
                    Direct Bluetooth



READY.
```

2. Type "AT" (without quotes) and check for response "OK"

If pairing with the Bluetooth headset has been carried out previously, then skip steps 2 to 12 and jump to step 13.

3. Type the following commands to clear any previous pairing:

   SET BT PAIR *

   SET RESET

4. Check for Bluegiga copyright message and "READY"

```
                    Direct Bluetooth


READY.
AT
OK
SET BT PAIR *
SET RESET
WRAP THOR AI (6.0.0 build 952)
Copyright (c) 2003-2014 Bluegiga Technologies Inc.
READY.
```

5. Type the following commands:9pair 00:1d:df:9c:dc:1e

   SET BT CLASS 200408

   SET PROFILE HFP-AG ON

   SET BT AUTH * 0000

6. Set the headset into discoverable mode by holding the silver button pressed for 6 seconds. The led should then flash red / blue.

7. Type the following command set:

   PAIR 00:23:7F:7D:AB:8D   *(replace "00:23:7F:7D:AB:8D" with the MAC address of headset being used)*

8. Check for the response:

   PAIR 00:23:7F:7D:AB:8D OK

```
SET BT CLASS 200408
SET PROFILE HFP-AG ON
SET BT AUTH * 0000
PAIR 00:1D:DF:9C:DC:1E
PAIR 00:1d:df:9c:dc:1e OK
```

9. Enter the following command:

   CALL 00:23:7F:7D:AB:8D 111E HFG-AG

   And look for the CONNECT 0 response.

```
CALL 00:1D:DF:9C:DC:1E 111E HFP-AG
CALL 0
CONNECT 0 HFP-AG 1
```

10. Power down the ML10 and the hands free kit, and then turn back on. They will re-pair once they are both turn on again.

11. Select menu option "9 c" for "Direct Bluetooth"

12. Press the volume up and down on the handsfree kit, if correctly paired it will display on the screen.

```
                     Direct Bluetooth


READY.
HFP-AG 0 VOLUME 12
HFP-AG 0 VOLUME 13
HFP-AG 0 VOLUME 14
HFP-AG 0 VOLUME 13
HFP-AG 0 VOLUME 12
```

   If this message is not displayed, the ML10 and handsfree kit have not re-pair, repeat from step 7 to pair the devices again.

13. Type "RING", then press the answer button the handsfree kit when it rings.

14. Check for the response:

   HFP-AG 0 CONNECT

```
RING
CONNECT 1 SCO
HFP-AG 0 RINGING
HFP-AG 0 CONNECT
```

15. Press "Ctrl" "a" to switch to "Direct GSM" mode

16. Type the following commands:

   ATD01773537000;   *(Change the phone number to suit. Note the trailing ";")*

17. A voice call should now be established.

18. To end the GSM call type "ATH"

19. To end the Bluetooth audio connection press "Ctrl" "b", then type "HANGUP"

Once testing is complete press "Esc" to return to the "Advanced Menu" and "Esc" again to return to the "Main Menu".

Note: Pressing "Esc" when in any "Direct … " mode will cause the unit to resume normal tracking operations and close any GPRS connection or GSM call.

9.3   Scanning for BLE devices

20. From the main menu select "9" then "c" to access the Direct Bluetooth interface.

21. Press Crtl + c to enter the BLE test screen.

```
BLE Test Screen

Idle


Press :-
 1 - Start scanning
 2 - Start transmitting 2402
 3 - Start transmitting 2480
```

22. Select "1" to Start Scanning

Any BLE devices in range will be displayed on screen with the RSSI and last time they were registered.

```
BLE Test Screen

Scan results:
Address                 RSSI    Rx Time
eb:8d:c1:f4:ac:e4       -75     29/02/16,12:28:15
50:8c:f4:8c:8a:d5       -90     29/02/16,12:28:12
88:e7:38:16:89:c6       -82     29/02/16,12:28:13
b1:4b:fc:a5:50:d4       -87     29/02/16,12:28:17


Press :-
 1 - Start scanning
 2 - Stop scanning
```
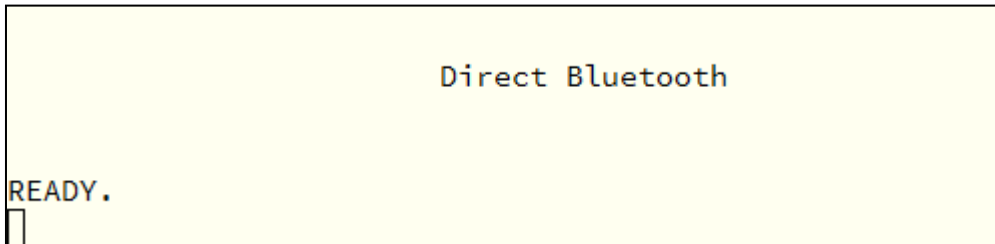
Note: Pressing "Esc" when in any "Direct … " mode will cause the unit to resume normal tracking operations and close any GPRS connection or GSM call.

9.4 Setting Bluetooth in permanent transmit mode

1. From the main menu select "9" then "c" to access the Direct Bluetooth interface.

```
                    Direct Bluetooth



READY.
```

2. Type "AT" (without quotes) and check for response "OK"

3. Type "TEST TXSTART [channel frequency] 0xFF3F [modulation frequency]"

     Where channel frequency is expressed in MHz (2402 – 2480)

     And modulation frequency is in a range from 0 – 327676, expressed in values between 0 – 256
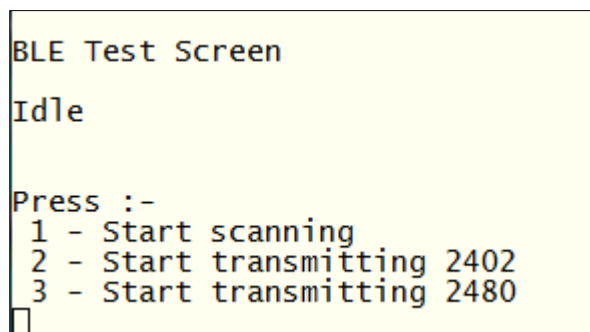
Eg. "TEST TXSTART 2402 0xFF3F 0"

4. To stop transmiting type "PAUSE" into the Direct Bluetooth screen.

Note: Pressing "Esc" when in any "Direct … " mode will cause the unit to resume normal tracking operations and close any GPRS connection or GSM call.

9.5 Setting BLE in permanent transmit mode

1. From the main menu select "9" then "c" to access the Direct Bluetooth interface.

2. Press Crtl + c to enter the BLE test screen.

3. Select option 2 to transmit at 2402 MHz, and option 3 to transmit at 2480MHz

```
BLE Test Screen

Idle


Press :-
 1 - Start scanning
 2 - Start transmitting 2402
 3 - Start transmitting 2480
```

Note: Pressing "Esc" when in any "Direct … " mode will cause the unit to resume normal tracking operations and close any GPRS connection or GSM call.

10 Technical specification

Item	Specification
Power Supply	6 – 32 V dc or internal 2.4Ahr 3.7V Li-ion battery
Current Consumption Sleep: Operating:	 < 2mA < 2A
Supported interfaces:	RS232 x 1 Dallas 1 wire Engine run Ignition Isolated ignition Analog / digital inputs x 4 CAN bus interface x 2 USB host / slave OTG port Bluetooth (HF-AG and SPP) BLE Accelerometer 3V SIM card interface
GSM/GPRS/UMTS Modem: GPRS:	 GSM Quad band (850, 900, 1800, 1900 MHz bands supported) UMTS Penta band (2100, 1900, 850, 800, 900MHz bands supported) Multi-slot Class 12
GPS Receiver: Channels: Accuracy: Antenna supply:	 High-sensitivity, L1 frequency, C/A code GPS / GLONASS / BeiDou 72 channels, SBAS (WAAS, EGNOS, MSAS support) 2.5m CEP 3V output for active antennas
Mechanical Dimensions: Weight:	 180mm x 40mm x 115mm approx. 400g
Environmental Operating temperature: Storage temperature: Ingress protection:	 -40°C to +85°C -40°C to +85°C IP69K

11 EU Declaration of Conformity

DECLARATION OF CONFORMITY

We,

Microlise Ltd

Of: Farrington Way, Eastwood, Nottingham, NG16 3AG

Declare under our sole responsibility that the products:

Vehicle tracking and telematics unit model numbers:
ML10-A, ML10-B, ML10-C, ML10-D, ML10-E, ML10-F, LL3, 334/G8518

to which this declaration relates, are in conformity with the following standards and / or other normative documents:

Health (Art 3.1(a)):   EN 62311:2008

Safety (Art 3.1(a)):   IEC 60950-1:2005 + A2:2013
                         IEC 60950-22:2005 UL 60950-22

EMC (Art 3.1(b)):   ETSI EN 301 489-1: V1.9.2
                         ETSI EN 301 489-3: V1.6.1
                         ETSI EN 301 489-17: V2.2.1
                         ETSI EN 301 489-24: V1.5.1

Spectrum (Art 3.2):   ETSI TR 102 070-2 v1.1.1 (6.7)

Other (incl. Art 3.3):   N/A

We hereby declare that all essential radio test suites have been carried out and the above named products are in conformity to all the essential requirements of the Radio Equipment Directive 2014/53/EU.

The technical documentation relevant to the above equipment will be held at:
Microlise Limited, Farrington Way, Eastwood, Nottingham, NG16 3AG, United Kingdom

Ian Dickinson, Director of Technical Services.
24 May 2016

12 FCC Declaration

The ML10 is a tracking unit containing three pre-approved radio modules:

Gemalto EHS6 3G M2M Module - FCC ID: QIPEHS6
BlueGiga WT32i Bluetooth Module - FCC ID: QOQWT32I
BlueGiga BLE113 Module. – FCC ID:QOQBLE113

These modules are co-located and therefore intermodulation testing was carried out and a new FCC ID was applied to the host device, no other changes to the modules was made and therefore test results can be carried forward.

To comply with FCC's RF radiation exposure limits for general population/uncontrolled exposure, the antenna(s) used for this transmitter must be installed 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.