Cellocator Division
Pointer Telocation Ltd.

CelloTrack Nano and MultiSense User Guide

V4.3 1-June-2019

POINTER

CelloTrack nano

Cargo and light asset management

CELLOTRACK NANO

CelloTrack Nano Delivers

*Real Time Cargo & Asset **Visibility**, **Efficiency** and **Security***

- **Visibility**

Enables real-time awareness of cargo and asset location, condition, problems and delays using a portable gateway and short range **Wireless Sensor Network (WSN).**

- **Efficiency**

Ensures continuous recording, event-triggered logic and ‘management by exceptions’ through flexible programming of business rules to avoid supply chain mistakes, delays or damages and to lower insurance expenses.

- **Security**

Prevents losses due to theft, loss and misplacement using proximity, tampering and location sensing throughout the entire transport chain.

CelloTrack Nano

CelloTrack Nano™ Hub

Innovative, Smart and Compact asset monitoring device:

- **SiRFstarV** inside: multi GNSS (**GPS**, **Glonass**) with **AGPS** support
- **Internal sensors**: temperature, light, impact, movement, pressure, sound (microphone)
- Used as a **hub** for a Wireless Sensor Network via **BLE** interface
- **2G/3G/4G** communication to back-office application
- Advanced **MMI**: buzzer, status LEDs, multi-function buttons
- Low profile / compact and slick design (85x60x23mm, 96 gram)
- Dual **Tampering** detection
- **Long life rechargeable** Li-ion battery (up to 6 weeks of transport chain usage)
- Micro USB connector for **recharging** the battery
- OTA update for Firmware and configuration
- **IP 66** (dust and water jets), **UV** and **chemicals** protected

MultiSense Devices

A game changer in remote cargo & asset monitoring applications:

- Small, low cost device with rich **embedded sensing capabilities**:
  - Temperature
  - Humidity
  - Movement
  - Free Fall
  - Impact
  - Light
  - Open/Close door/window
- **BLE communication** forms a cost effective Wireless Network with the Nano and other CelloTrack family hubs
- **Long battery life** for more than **2 years** in common use case scenarios
- **Easy battery replacement** access (CR2450)
- Simple **pairing** with CelloTrack Nano
- On/Off **Button**
- **LED** indication for power on/off
- Small dimension (58.5 x 46 x 15mm, 26g including battery) and **IP 67** enclosure

While paired with CelloTrack Nano, MultiSense provides a wireless sensing capability to a remote location/facility where a wired interface is impractical. A Number of low cost MultiSense devices with Nano GW dramatically reduces system's TCO and improves monitoring efficiency

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Solution Overview

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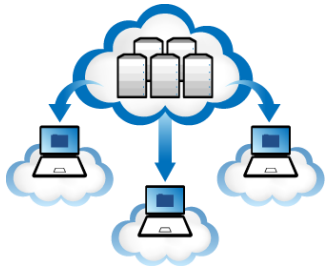
BLE

CelloTrack Nano

- ✓Smart Gateway
- ✓Up to 16 paired MultiSense
- ✓Limitless number of MultiSenses in Tag/Guest modes
- ✓Location
- ✓SOS
- ✓Check In / Check out
- ✓Temperature
- ✓Free Fall
- ✓Barometric pressure
- ✓Impact
- ✓Light
- ✓Dual tamper
- ✓Multi-functional cradle

GSM



Remote Management

MultiSense

- ✓Temperature
- ✓Humidity
- ✓Free Fall
- ✓Impact
- ✓Light
- ✓Open/Close Door
- ✓Internal logger

Multi Sensors


Cold Chain
Perishables
High-value luxury good
Pharmaceutical
Antique and Archeology
Portable Equipment
Logistics
Agriculture
Machines and Manufacturing
Warehouses Storage
CROWLEY
GPS

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System Operation

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CelloTrack nano terminology

- Active state = ON state = Unit is turned ON
- Inactive state = OFF state = Unit is turned OFF (the lowest power consumption)
- “Indications time window” = the time window that the LEDs and buzzer are active. After that time, they are shut down to save energy. This window opens after power up, reset and pressing one of the buttons. This size of this window is configurable.
- “Check-in” = A feature that when both buttons are pressed the unit sends it location with a check-in transmission reason.
- MultiSense pairing = When the operator wants the nano to be connected/linked/paired with a certain MultiSense unit, the nano and the MultiSense must first perform a pairing process, where the nano register the MultiSense MAC address in one place of its 16 cells table.
- BIST = Build-In Self-Test process, preformed after reset or power-up (battery connection).
- “Guest mode” = When this mode is enabled in the nano, it will communicate with any MultiSense in its range, forwarding its sensors data to the server.

User interface - Buttons

Buttons overview table while the unit is in active state:

Pressing Duration	Left button	Right button	Both simultaneously
T < 200mS	Ignored		
T > 200mS	Very short feedback from buzzer, Open the indications time window		
1 Sec > T > 200mS	-	-	Check-in event
2 Sec > T > 1 Sec	-		Check-in event
5 Sec > T > 2 Sec		Panic event	Check-in event
T > 5 Sec	Power-off unit	Panic event	MultiSense pairing window open

User interface - Buttons

Buttons:

- Every press on a button when the unit is active will get a short audible beep feedback by the buzzer, if enabled at parameter “Button press Buzzer feedback“.

- The **Right button** - **Panic button** (marked "**!**“):
  Pressing for 2 seconds or more (even if not released), followed by engagement feedback (configurable by Buzzer enable bits), A panic event will be sent to the server. ACK by the server will generate another reception feedback - configurable by “Panic was ACKed by server Buzzer feedback” bit.

- The **Left button – Power button** (marked “ ⏻ “):
  Short press (<5 seconds) will open the configurable size indication time window.
- Also, this button is turning the unit ON and OFF:
  - Turning ON - pressing 3 seconds while turned OFF. After that the system shall go to self test as described at this slide.
  - Turning OFF - pressing 5 seconds while turned on.
- At the end of that period, the turning ON/OFF take place even if the button is not released.

User interface - Buttons

Check in feature:

- Pressing simultaneously on both buttons for at least 1 second (and less than 5 seconds), followed by a 0.5 second buzzer beep every elapsed second if enabled at the PL, and/or LEDs feedback (configurable at the PL), and shall transmit the current location once.
- It is also related to set the baseline reference accelerometer position of the man down feature detailed in the programming manual.

MultiSense pairing feature:

- Pressing simultaneously on both buttons for more than 5 second will initiate the MultiSense in-field pairing process.

User interface - LEDs

Left LED – Battery and deviations:

- marked "[battery]" and "[triangle]" gives indication on the power/battery and deviations (as explained in next slide).
- When unit is turned ON, or a short press on left button (shorter than 5 seconds), or following reset command, all the following LED indications are restarted according to “nano indications time window”.
- Battery status: When unit is turned ON, short blink of 100mS every X seconds to show battery status according to the following legend:

Battery is 50-100% - Green:

Battery is 20-49% -Orange:

Battery is 0-19% - Red:

User interface - LEDs

Out of range indications on Left LED:

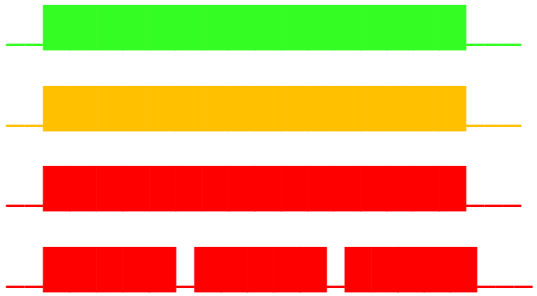
- When unit is turned ON, or a short press (shorter than 5 seconds) on left button is pressed, only the most severe indication from the following list is displayed once if that violation/deviation still exists.
- When any sensor creates an out-of-range (alert) event, and if enabled by a parameter in the PL, the left LED will signal a 3 seconds long continuous (once) or non-continuous pulse according to the following color scheme:

Light sensor out of range:

Accelerometer out of range:

Temperature out of range:

Geo-fence violation:



- "Light sensor out of range" means: light level of the local sensor crossed the "open/close package threshold" event.
- "Accelerometer out of range" means: orientation change event only.
- "Temperature out of range" means: local temperature sensor is either above the upper TH or below the lower TH.
- "Geo-fence violation" means: all the possible violation kinds supported and defined in legacy.

User interface - LEDs

Charging indications on Left LED:

- When micro-USB connector is plugged-in and charging is in fact in progress, whether from charger (AC wall adaptor) or PC, the left LED will act as described in the table below:

Unit mode:		OFF (inactive)	ON (active)
During actual charging		**Constantly orange**	**Constantly orange**
After charge completion	Inside the "Indications time window"	**Constantly green**	Regular LEDs indications
	After (outside) the "Indications time window"		**Constantly green**
Battery Fault		**Constantly red**	**Constantly red**

- These indications have the highest priority and they override all other indications on this LED

User interface - LEDs

Right LED – Cellular/GPS status:

- marked "**GPS**" and "((•))".
- Two time slots of 5 seconds long each. The first one is for indications from cellular modem in green and the second one is for GNSS module indications in orange.
- Each pulse is 500mS ON and 500mS OFF.
- Cellular modem indications:

HSDPA/HSUPA (3G) communication:

GPRS/EDGE communication:

Registered (GSM-2G):

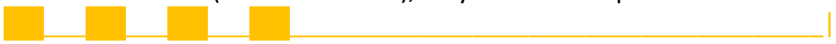
Not registered (no activated network found):

GNSS module indications:
Tracking good (Fix "Tight"):

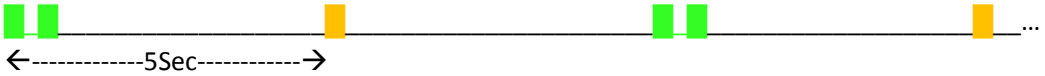
Tracking poor (Fix "Plain"):

Acquisition (from power-up to "Plain" or "Tight") :

No satellites at all ("no fix" after fix), only at the first operation and cannot be reached if using A-GPS:



For example the light for a GPRS communication and good tracking will look like that:



- All these indications are displayed only for the “nano indications time window" time. After that they are cleared and not displayed.

User interface - Buzzer

Buzzer types:

Buttons feedback beep = 20mS ON.

Short beep = 200mS ON.

Dual short beeps = 200mS ON, 200mS OFF, 200mS ON.

Dual long beeps = 1 Sec ON, 200mS OFF, 1 Sec ON.

Long beep = 2 Sec.

Buzzer logic:

- Upon power-up (turning ON) or system reset from any reason, short beep.
- After a successful BIST (Build-In Self-Test) process, dual short beeps.

If enabled in PL:

- Every valid pressing on buttons, will sound the "Buttons feedback beep" (20mS).
- Panic /Check-in event activation operates the beeps as explained in the programming manual.
- After Panic (special distress) event got acknowledged by the server, long beep.
- When any active sensors go out of the defined limits (all meanings of the "out-of-range" are explained in the programming manual), plus geo-fences (all legacy violation related to geo-fences are relevant here too), the unit shall sound short beeps every PL configurable time if the "Indications time window" is open/active.
- Short beep upon any power-up packet received from a paired/preregistered MultiSense.

See SR-RF pairing (and un-pairing) process related beeps at this slide.

Indications after power up (Build-In Self-Test)

- The unit will perform a Build-In Self-Test (BIST) upon any of the following cases:
  1. When battery is connected, while system was active before disconnection.
  2. After turning ON (moving unit from inactive to active mode, at the end of the 3 second press duration).
  3. Upon receiving a reset command.

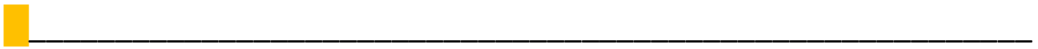
- The Build-In Self-Test (BIST) shall include GNSS module, Cellular modem basic (local) communication + SIM exists and battery.

Indications after power up (Build-In Self-Test)

After pressing the power button (left one) for >5 seconds, the unit will turn ON and perform a BIST (Build-In Self-Test) sequence. the indications will looks like that for the first 5÷10 seconds:

Initial feedback on the buzzer :

Initial feedback on the **left** LED :



If all tested component are OK, the indication on the **right** LED will look like :

and on the buzzer:

In case of GNSS module failure (Basic communication), the indication on the **right** LED :

In case of cellular modem failure (Basic communication + SIM card valid), on the **right** LED :

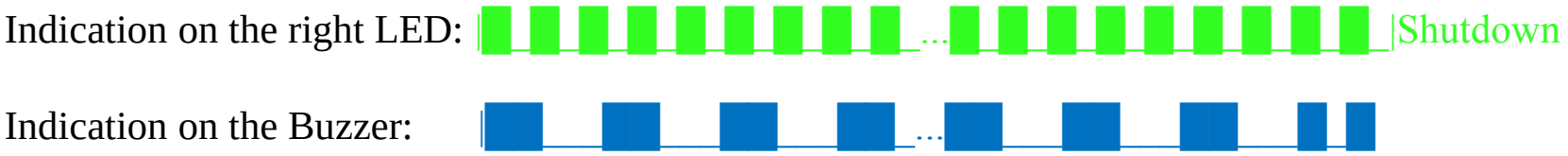
In case of battery failure, the indication on the **right** LED :

←----------first 5÷10 Seconds after turn ON----------→

- The priority of failures is in ascending order, battery is the highest. And only the highest priority is displayed.
- Timing of the failure blinks is 500mS ON and 500mS OFF.
- **All buttons pressing are blocked/ignored during the entire BIST period.**

Indications for shutdown sequence

- To shutdown the unit, the user should set the configuration bit in PL of address 2046.7 to ‘0’ and press the left button for > 5 seconds.
- When the user shut down the unit by pressing the power button and one of the configuration bits of "Transmission before shutdown" are enabled, the unit will push to the log the event message of Transmission-reason = 102 ("Activation mode change") with STR= 0 ("About to move to Inactive mode").
- If the unit is configured by the user to any form of immediate transmission method (i.e. "Active log event" and/or "Distress"), the unit will also initiate communication with the server and transmit its entire log too, while blinking the right LED (higher priority than all other indications) green at 200mS ON and 200mS OFF pace until completion and full shutdown.
- Buzzer will beep in 200mS ON and 800mS OFF along the first 30 seconds of the transmission.
- Anyway (if transmitting or not), a "Dual short beeps" shall be sound before actually going to inactive mode.



USB and charging

Usage:

Micro-B female USB connector, through which the unit can perform the following functions:

- Charging the internal battery from the supplied AC-adaptor or PC USB port.
- USB port serial communication for PL update.
- USB port serial communication for FW upgrade.

Charging:

The CelloTrack battery operates on a Li-Ion battery of 1300mAh nominal capacity.

The internal changer supports 2 level of charging speeds:

- The slow speed is used when the unit recognizes the source as "weak". It could be USB 1.0 PC port, weak AC-adaptors or weak car-adaptors.
- The charging current in this case is ~100mA so full charge time can sometimes be more than 10 hours.
- The faster speed is automatically chosen when the source is recognized to be able to supply enough current. Then the charging current in this case is ~330mA so full charge time will be less than 6 hours.

USB and charging

Charging modes:

The unit has 2 modes of charging:

- FW controlled – the nano FW decide when to start and stop charging. It charges the battery to a certain hardcoded high-level charge point (e.g. 90%) and then let the battery be consumed to the level of an hardcoded low-level charge point (e.g. 75%) before another charge cycle is started. In this way, the battery oscillates between 90% and 75% forever and the left LED turns (and stays) green after reaching 90% for the first time.
  To set this mode, set the parameter of "Charging Stop upon Battery Full detection" to "Stop charging".
  This mode of operation is more suitable for constantly powered systems and it keeps the battery health better in the long run.
- HW controlled – the charger chip decides when the battery has reached full charge (100%) and then stops charging it. Indication on left LED turns then from orange to green.
  This operation is restarted every 5 hours.
  To set this mode, set the parameter of "Charging Stop upon Battery Full detection" to "Keep charging".
  This mode is more suitable for systems that get charged from time to time, but the system is not powered constantly.

MultiSense

Overview:

- The MultiSense is a remote peripheral sensor communicating and configured by the CelloTrack-nano via a short-range RF link.
- There are 2 models of MultiSense: regular ones that can measure temperature called just "MultiSense" and "MultiSense-TH" which have combined temperature + humidity sensor.
- The MultiSense unit has the following sensors on it:
  1. Temperature sensor
  2. Humidity sensor (only in MultiSense-TH model)
  3. Hall effect magnetic sensor
  4. Ambient Light Sensor (ALS)
  5. Accelerometer sensor
- The system supports up to 16 fully programmable MultiSense units.
- If “Guest mode" is enabled in the parameter “Process ID tags not in the list”, the nano unit will also connect with MultiSense units not in its list, read their sensors and pass the data (in raw format) to the server. Only listed MultiSense units also gets configuration block and their readings are fully processed by the nano.

MultiSense

More information:

- The MultiSense is a configurable sleepy peripheral slave, which means it is configurable by the tools (via the nano) and it transmits according to the preconfigured policy.
- The nano, if enabled in parameter “Nano is master of several slave sensors enable” is always listening to RF links and intercepts MultiSense units.
- The RF range between the MultiSense and nano unit can reach more than 100m at open space (optimal conditions), and lower in various installations. All according to attenuation at 2.4GHz of the RF signal.
- If the MultiSense is not received by the nano for 5 x “Proximity & keep-alive transmission timer” it will report it as lost. (could be due to: Dead battery, shut-down, totally out-of-range or stolen).
- The battery of the MultiSense is the Lithium coin CR2450 (~600mAh) battery and its lifetime depends heavily on its configuration. Typically several months.
- MultiSense units can be intercepted by an updated cellular phone* but data is encrypted so it cannot be understood.
- The CelloTrack-nano cannot interface with other sensors in the market.

MultiSense

Transmission policy:

- All the MultiSense units related to a nano system has the same configuration of the following timers:
    1. Relaxed (R) – parameter in PL: “Active sensors sampling relaxed timer“. Used when the temperature **and** humidity are within their (configurable) limits.
    2. Violation(V) - parameter in PL: “Active sensors sampling violating timer“. Used when the temperature **or** humidity are out of their (configurable) limits.
    3. Proximity(P) - parameter in PL: “Proximity & keep-alive transmission timer”. Used when no transmission occurred for more than P timer.
- If "TX on violations only" mode is enabled (configurable per MultiSense), the R timer shall be used for determine sensors sampling rate only (without transmission), but the V (when violation occurs) and P shall be working normally.
- Besides that, there are few asynchronous events that will cause a single transmission:
    1. Pressing the button.
    2. Impact or free-fall event generated by the accelerometer (crossing a pre-configured threshold).
    3. Sensing a change in the magnetic field (opening/closing of a door or window, that the permanent magnet is installed on).
    4. From FW version 4V50 and up, also crossing the light threshold to either direction (darkness ←→ light).

MultiSense

Below is a table of operation modes of transmission as a function of the Data logger and Tx-on-Violation modes:

Data Logger - mode	Tx-on-Violation - mode	Mode of operation	Timer-R (Relaxed)	Timer-V (Violation)	Timer-P (Proximity/ Keep-alive)
Disable	Disable	Real-time mode: Events are transmitted asynchronously, samples are transmitted periodically.	Sampling and transmission rate when no violation.	Sampling and transmission rate when there is a violation.	If P>R and P>V then transmissions according to P will never happen (otherwise it will sample and transmit according to P rate).
Disable	Enable	Tx-on-Violation mode: Events are transmitted asynchronously.	Internal sampling rate when no violation.	Transmission rate when there is a violation.	Transmission rate when no violation.
Enable	Disable	Logger mode: Events and samples are only logged internally.	Internal sampling (and logging) rate when no violation.	Internal sampling (and logging) rate when there is a violation.	Transmission rate of advertisements.
Enable	Enable	Logger mode with Tx-on-Violation enabled: Events are first logged and then transmitted immediately.	Internal sampling (and logging) rate when no violation.	Sampling, logging and transmission rate when there is a violation. Samples will be logged anyway.	Transmission rate of advertisements. (If there is a violation and V<P it will not be transmitted)

MultiSense

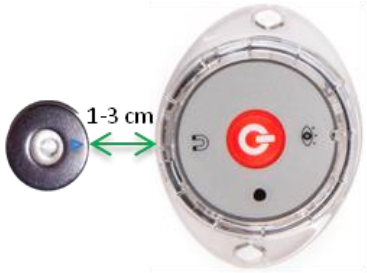
Precautions and warnings:

- The MultiSense should NOT be paired with more than 1 nano (in the same area), otherwise it will drop its chances for successful communication greatly.
- The “Guest mode” in the nano which is enabled by the “Process ID tags not in the list” parameter in the PL, should be used with great caution, because it then will connect with every MultiSense in its range, whether paired or not. This may prevent from other nano units to communicate with their paired units.
- The case is different if only nano units with this “Guest mode” enabled are in the same area, since they will race each other and the first one that “catches” the transmission will pass it (assuming it’s linked to the same server and operation).
- The MultiSense is intended to be attached to the tracked equipment and should not be worn on a human body or in the range of 20 cm from it.

MultiSense

Marking:

- The magnet icon symbolizes the location of the magnet sensor. The permanent magnet should be installed against it with distance of body-to-body of 1-3cm, while the small triangle on the magnet points to the icon in the MultiSense.
- The eye icon symbolizes the light sensor direction, to which the source of light should be directed.



Battery:

- Use only CR2450 size battery. Be careful not to install it at the wrong polarity as it could damage the unit.
- Choose the exact battery model and manufacturer of the battery according to the needed temperature range.
- To install a battery unscrew the upper half from the base half until the two triangles on the side are aligned and then pull it.

MultiSense

Button and blue LED:

- When battery is inserted, the unit always goes to active mode and the blue LED lights for 3 seconds.
- When active, every short press (up to 1 second long) triggers sampling + transmission and the blue LED blinks 5 times.
- When active, a long press (>4 seconds) will turn the unit OFF (inactive mode), accompanied by 3 blue LED blinks.
- When the unit is off (inactive mode), a long press (>4 seconds) will turn the unit ON and the blue LED lights for 3 seconds (same as battery insertion above).

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Step by step guides

POINTER

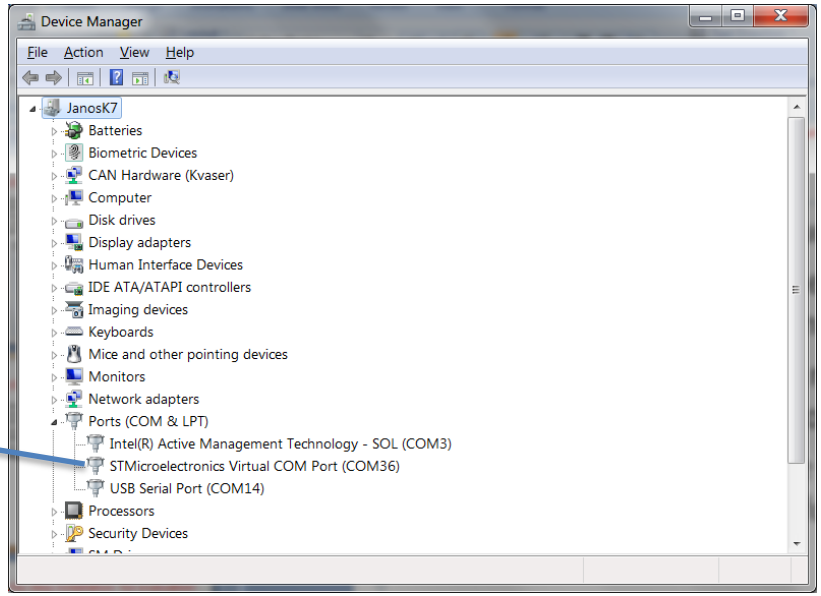
Step by step installation for evaluation

- The tools we provide for evaluation called “Evaluation Suite” and can be loaded from our internet site at this address (requires login with username+password).
- This set of tools include the following nano related tools:
  - The “Cellocator programmer” which is used to configure a single nano unit and its related MultiSense units. It also includes the nano editor screen.
  - The “Communication Center” which is used to get and interpreted / parse the messages sent by a nano unit via the cellular link and also to send some commands to the nano over the cellular link.
  - The “Serial CSF STK Flasher” which is used to perform local FW upgrades of the nano.
  - The “Communication Logger” which can be used to sniff on various serial communication links inside the nano board.

Step by step installation for evaluation

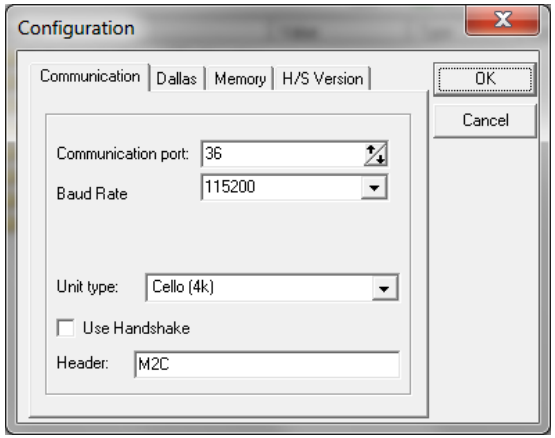
- Install the latest version of Cellocator's evaluation suite. Install it as an administrator.
- Select the 'Complete' installation type, and then next->next…
- Follow security instructions related to installation of the evaluation suite.
- The installation process will automatically install the "ST virtual COM port" windows driver if needed.
- After connecting the nano via the supplied micro-USB cable to the PC it will be recognized and windows will allocate it a new COM port.
- Windows will declare which COM port number has been allocated. Anyway, this port number can be found when opening the windows "Device manager" under "Ports (COM & LPT)" folder:

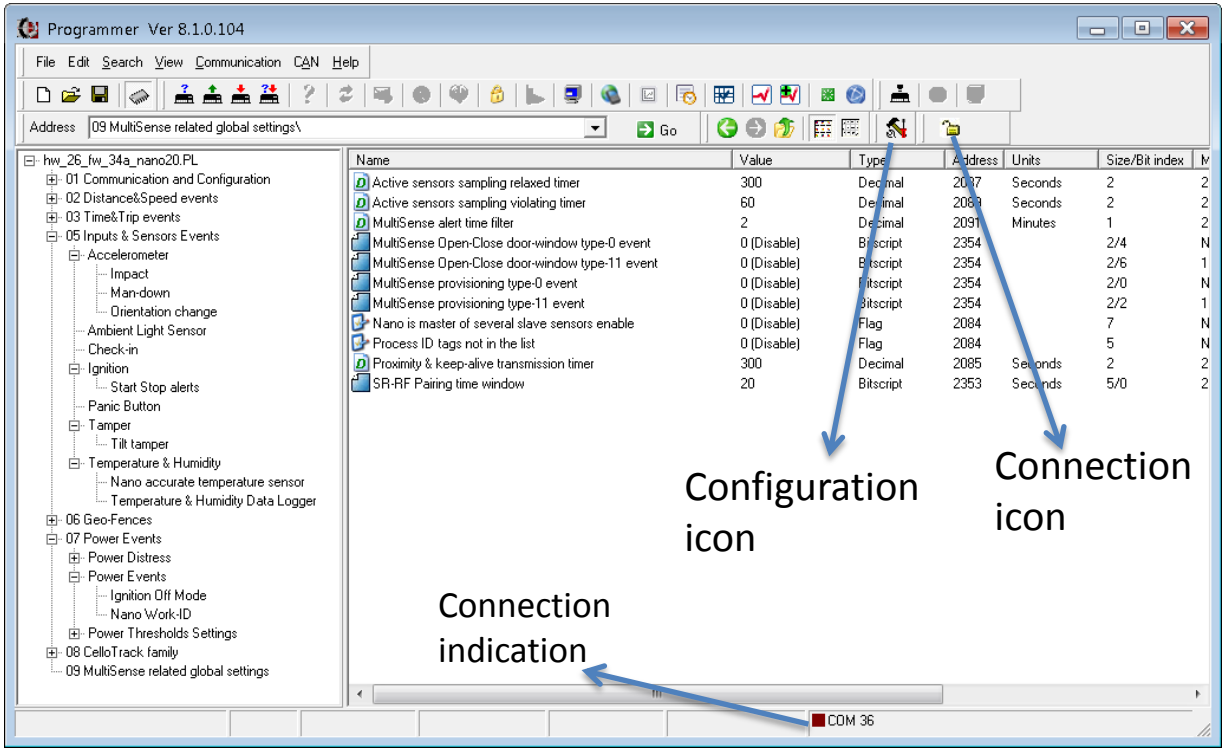
In this example the nano is at COM36



Step by step installation for evaluation

- Open Cellocator programmer utility. File open-> choose the latest nano PL file.
- For initial communication to begin, the nano COM port number should be set.
- Click on the “Configuration icon” (see below), select the “Communication” tab, and set the COM port number. Then choose Baud rate of 115200, and Unit type “Cello 4K”. Close by pressing the OK button.
- The “Connection icon” (lock icon) should show closed-lock now and the connection indication dot at the bottom of the window should turn from red to green.





Step by step installation for evaluation

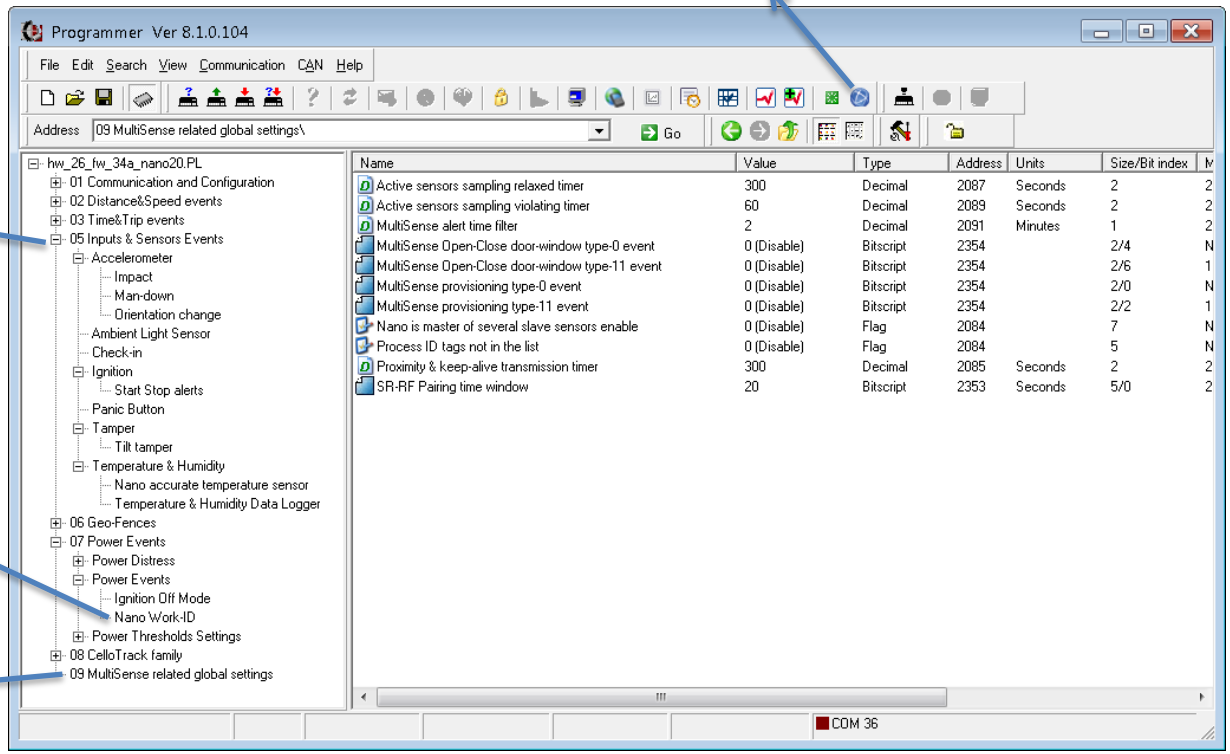
- The nano related parameters (on top of CelloTrack legacy parameters) resides in 2 areas. See the below screenshot.
- MultiSense units global settings is in separate folder (09). See below.
- All MultiSense units individual settings are under the “nano editor” screen. Press the “nano editor” icon to open it and then select the “Sensors configuration” tab.

nano editor icon

Inputs & Sensors folder including the nano specialized sensors and related functionality

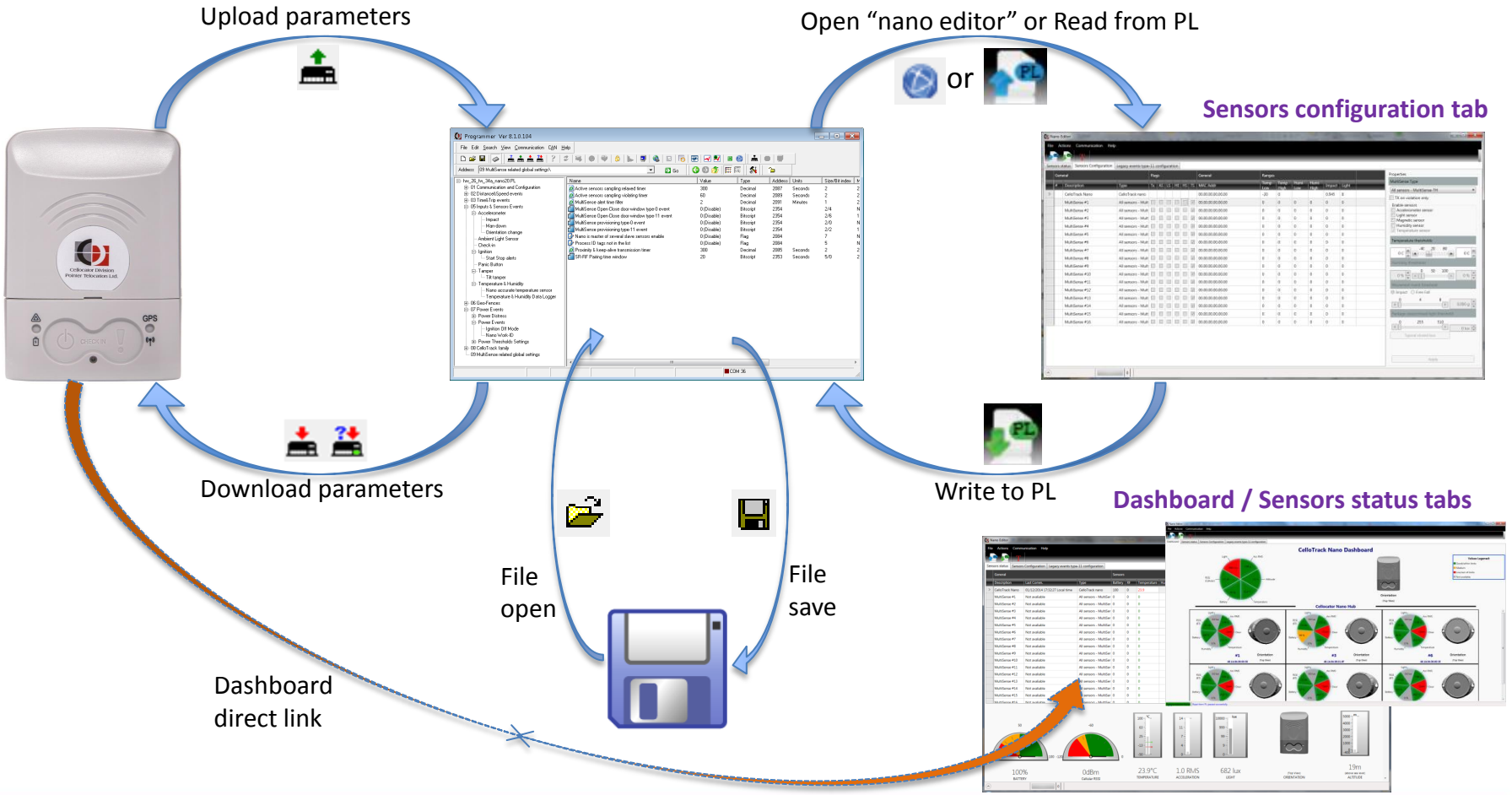
Nano Work-ID feature under Power Events

MultiSense related global settings in new folder



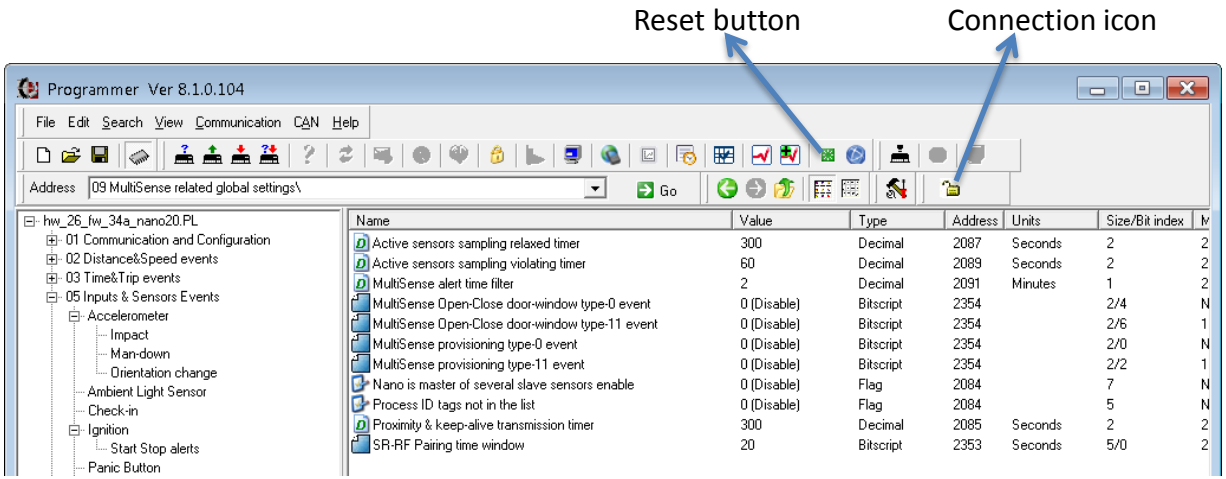
Step by step installation for evaluation

– The concept of operation and parameters flow between the 4 entities of HW, programmer screen, storage and “nano editor” screen is as follows:



Step by step installation for evaluation

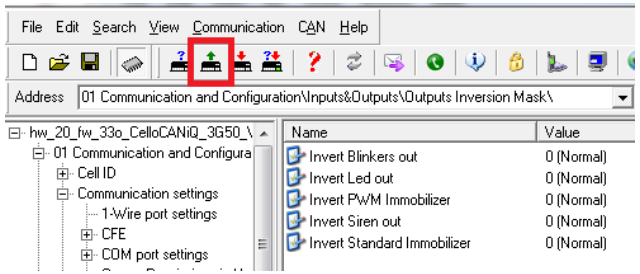
- If you want to pair a MultiSense to the nano, first verify that parameter “Nano is master of several slave sensors enable” is enabled.
- Go over the rest of the MultiSense parameters to fit your needs.
- If any of the above parameters are changed, it requires to reset the nano unit for the changes to take effect. If needed, press the green reset button.
- If reset takes place, the connection with nano is lost and should be restored manually after the reset sequence has completed (a beep is sound from the nano). Reconnection is performed by pressing the connection (lock) icon.



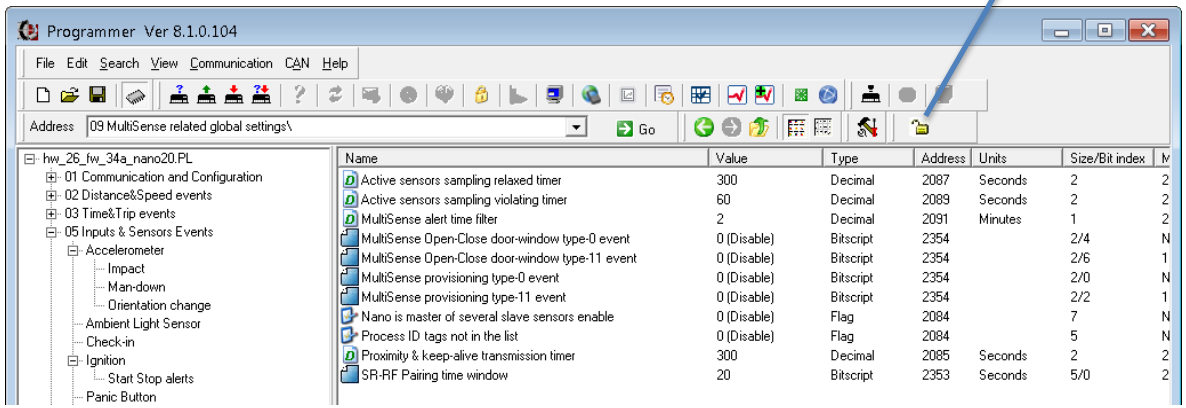
Step by step installation for evaluation

- To enter the nano to Pairing window, it is recommended to open the lock by pressing the “Connection icon” to disconnect the communication.
- Then disconnect the nano from the micro-USB cable.
- Press both nano buttons until sequence of 4 beeps and then a double-beep is sound from its buzzer.
- The left LED will start blinking orange. This means the paring window is open for the duration configured in “SR-RF Pairing time window” parameter.
- If any unknown to the nano MultiSense will be powered on (pushing the button for 5 seconds while unit is in OFF state, or battery insertion) in the vicinity, during this window, it will be paired.
- If successfully paired, a long beep (2 seconds) will be sound from nano buzzer.

After successful pairing, to view the newly paired MultiSense in the tool, you need to read the list from the Nano back to the PC by pressing the “Upload parameters” button. See below:



Connection icon



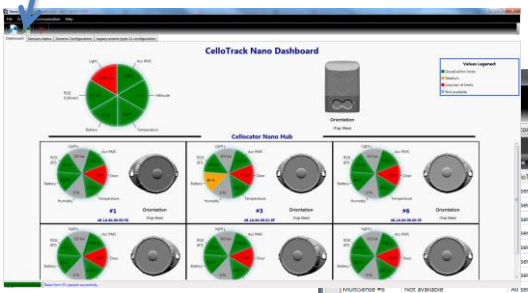
Step by step installation for evaluation

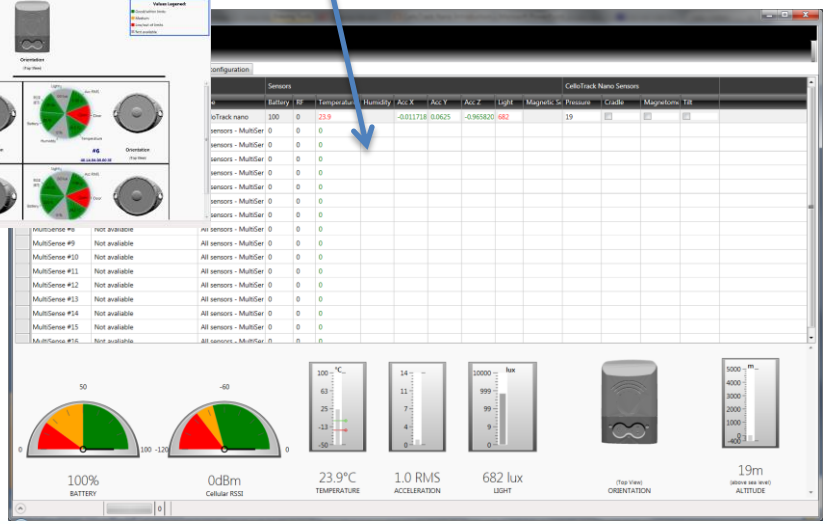
- Inside that pairing window, if any paired MultiSense (with this nano) is turned OFF, by pressing its button (when in ON mode) for >5 seconds, it will be “Unpaired”.
- The pairing window is prolonged after each successful pairing or un-pairing operation.
- When the window closed, the unit will either blink its right LED red shortly if nothing has been paired or unpaired, or reset itself if some MultiSense units have been paired or unpaired.
- After the reset, reconnect the USB cable and push the connection icon (the lock).
- Perform “Upload parameters” () to update the programmer on the newly paired MultiSense units.
- Open the nano editor () and you can see in both “Sensors status” and “Sensors configuration” tabs the new MultiSense status and configuration respectively.
- Select the desired line to focus on by clicking on it.

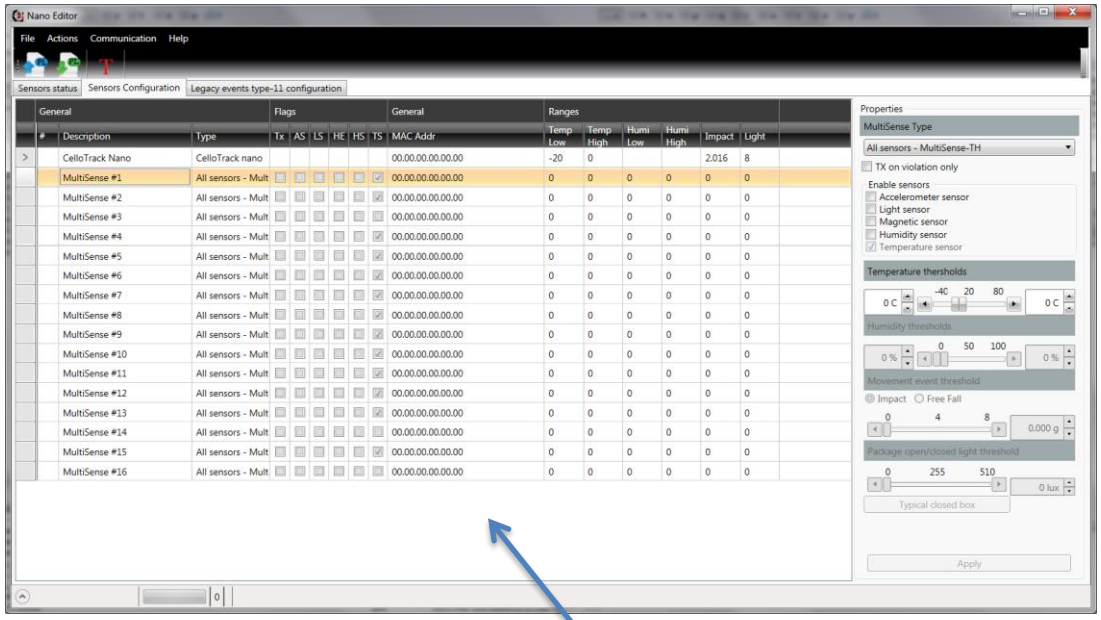
Step by step installation for evaluation

The first tab is a dashboard showing an overview status, in real-time, of the system components.

The second tab shows the current status, in real-time, of selected device, nano or one of the MultiSense units.







The third tab is a configuration screen where some of the Nano parameters and the individual settings of each MultiSense unit can be changed. (also support multiple edits in single operation)

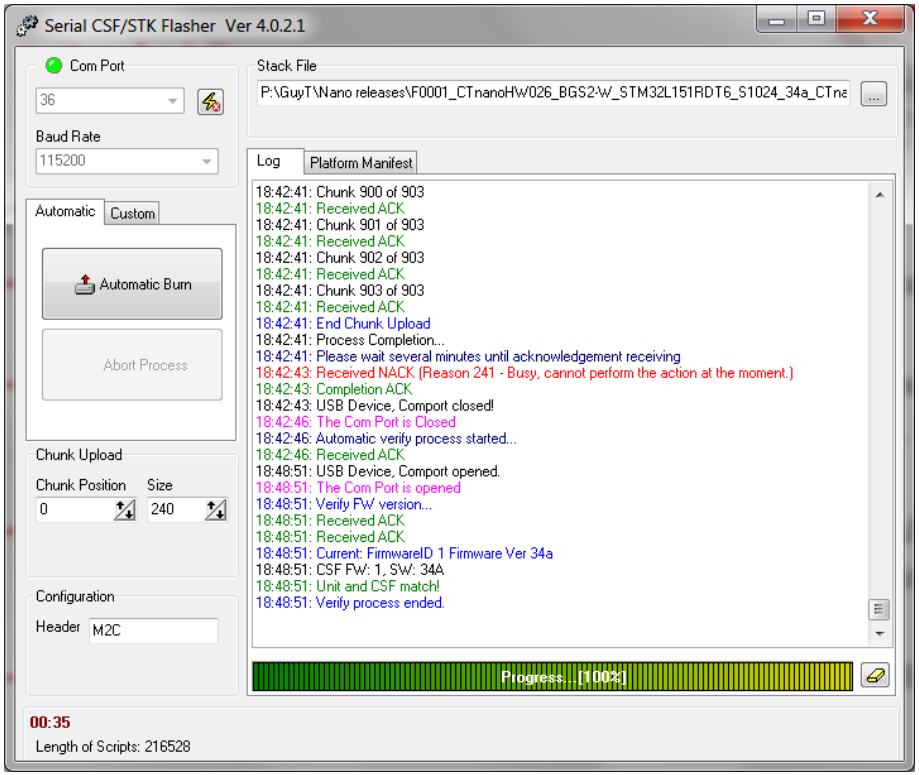
Step by step installation for evaluation

The 4th tab is a configuration screen for setting each legacy (type-0) event, whether to be sent also in an “Encapsulated” way over type-11 message or not.

Description	Base Address	Bit Offset	Type
TR #4: Emergency (Distress) mode by command	541	0	Disable
TR #6: Engine Activated (Security Event)	541	4	Disable
TR #8: Location change detected on Ignition is Off	542	0	Disable
TR #31: Reply to Command	547	6	Disable
TR #32: IP changed / connection up	548	0	Disable
TR #33: GPS Navigation Start	548	2	Disable
TR #34: Over-speed Start	548	4	Disable
TR #35: Idle Speed Start	548	6	Disable
TR #36: Distance	549	0	Disable
TR #38: GPS Factory Reset (Automatic only)	549	4	Disable
TR #41: GPS Navigation End	550	2	Disable
TR #42: End of Over-speed	550	4	Disable
TR #43: End of Idle Speed	550	6	Disable
TR #44: Timed Event	551	0	Disable
TR #53: Driving Stop Event	553	2	Disable
TR #69: Driving Start Event	557	2	Disable
TR #81: Main Power Low Level	560	2	Disable
TR #84: Halt (movement end) event	561	0	Disable
TR #85: Go (movement start) event	561	2	Disable
TR #87: Main Power Connected (be unconditionally log	561	6	Disable
TR #88: Main Power High Level	562	0	Disable
TR #89: Backup Battery Connected, In Cellotrack3G Pow	562	2	Disable
TR #99: Harsh Braking Sensor Triggered	564	6	Disable
TR #100: Sudden Course Change Sensor Triggered	565	0	Disable
TR #101: Harsh Acceleration Sensor Triggered	565	2	Disable
TR #158: Tamper switch Active Event	579	4	Disable
TR #159: Tamper switch Inactive Event	579	6	Disable
TR #190: No Modem Zone entry	587	4	Disable
TR #191: Geo-HOT Spot violation	587	6	Disable
TR #200: Modem's Auto Hardware Reset (AHR)	590	0	Disable
TR #202: Wake Up event	590	4	Disable
TR #203: Pre-Hibernation event	590	6	Disable
TR #204: Vector (course) change	591	0	Disable
TR #206: Jamming detection	591	4	Disable

Step by step nano FW upgrade

- To update the FW version of the CelloTrack nano device, you will need the tool called “Serial CSF STK Flasher” (separate installation from the evaluation tools).
- Close all application that might open the nano COM port, like Cellocator programmer etc.
- Open the tool, direct it to the nano’s COM port number and press the lightning icon: .
- If communication is OK, the “Com Port” light will change from red to green.
- Select the desired CSF file by pressing on The ... button.
- Push the “Automatic Burn” button.
- Follow the on screen instructions to the completion of the process.
- The whole process takes around 7 minutes.
- At completion, the COM port is reconnected by the tool.
- Just close the application or disconnect and connect to another unit.



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Overview about Type-11 integration

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Messaging concept in CelloTrack-nano

- All functionality of the CelloTrack nano events uses Type-0 legacy events and/or the advanced Type-11 messages, all according to the configuration bits per feature.
- Each nano specialized feature will have these 4 bits of configuration:

Bit 3	Bit 2	Bit 1	Bit 0
Type - 11		Type - 0	
Logged	"Active log event"	Logged	Distress

- Type-0 could also be "Active log event" or not, depending at the global (one per system) bit of "Enable Active Events" (at address 0000.0 of the PL).

Messaging concept in CelloTrack-nano

- This will enable the user to select between the following options:

  Type-11 options:
  0= Disable
  1= "Active Log Event"
  2= Logged

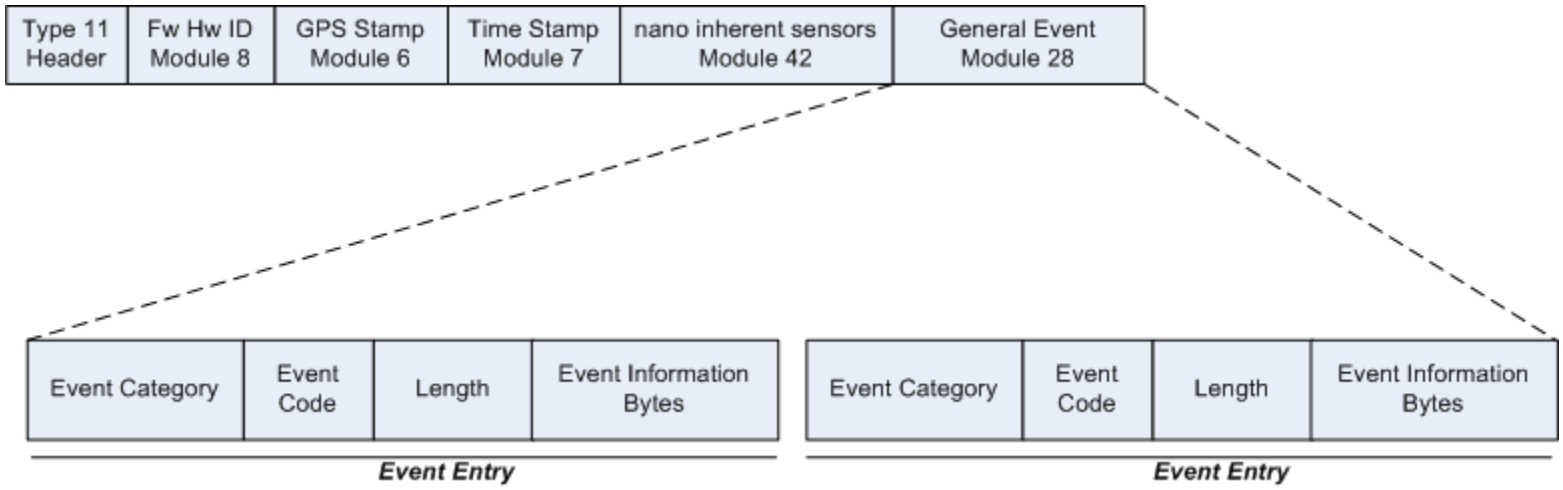
  Type-0 options:
  0= Disable (the global "Active log event" bit will be ignored)
  1= Distress (the global "Active log event" bit will be ignored)
  2= Logged
  3= Logged & Distress (not a recommended setting if the "Active log event" bit is set, it will cause sending 2 messages per the event).

- The log memory supports both types simultaneously, as a continuous and united space.

Note: When "Active log event" is used, the unit turn on the GNSS and wait for a fix (up to 90 seconds timeout), if fixed is achieved, both the GPS stamp and time stamps of the event are overridden.

Type-11 message structures

- The “General Event Message is a Type 11 message designed to reflect system events and notifications towards the server. The message is built as follows:



- Modules 8, 6, 7 and 42 are mandatory fields, and always come first in this exact order, everything else (module 28 is just an example here) shall come after that.
- For more details go to the “Cellocator Wireless Communication Protocol” document on section 5.

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Parsing example

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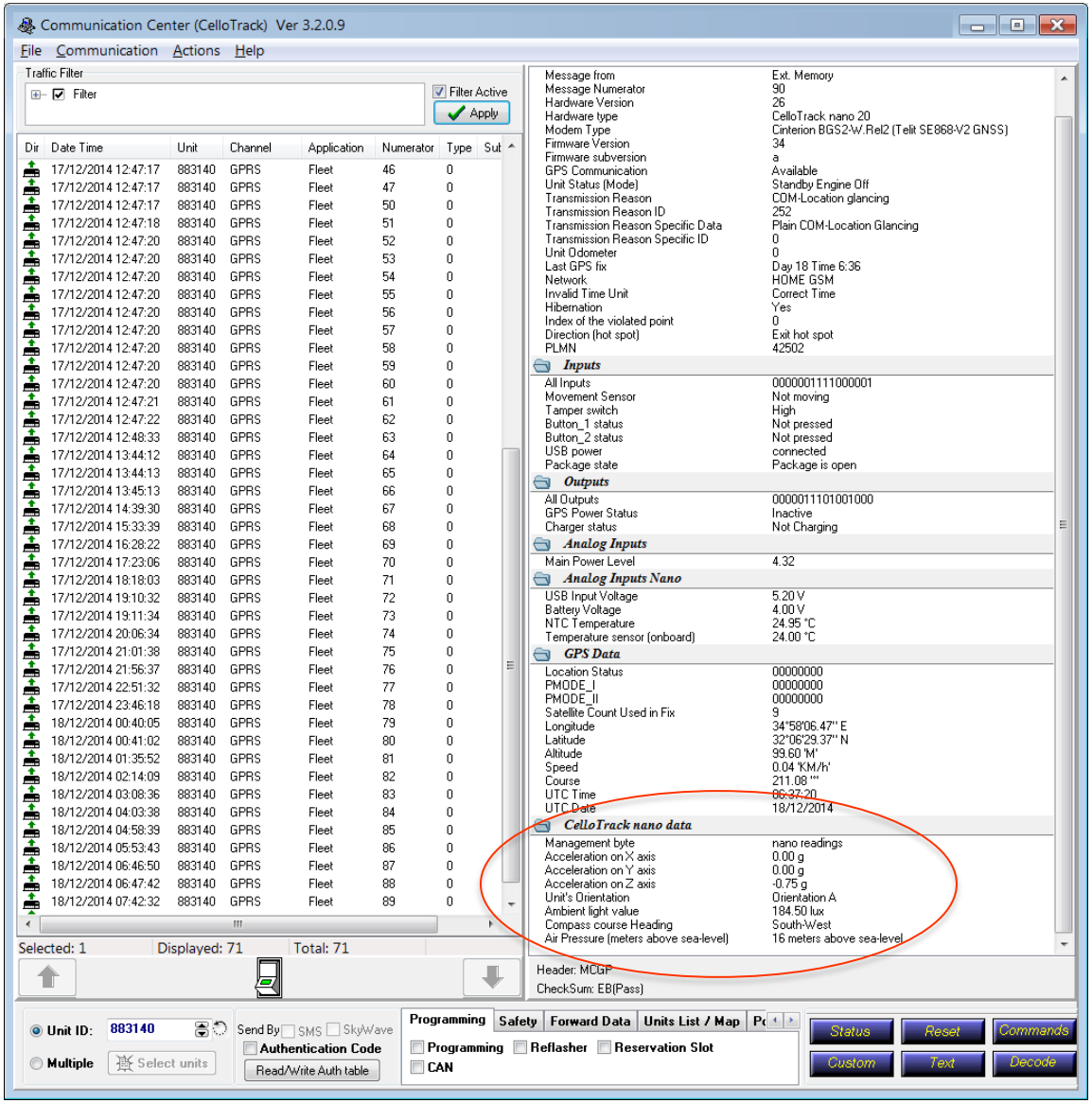
Example of an Type-0 message parsing

This is an example of type-0 message with the CelloTrack-nano internal sensors data fields, passed over the “Multi-purpose bytes (33-38)” aka Dallas bytes.



Example of an Type-0 message parsing

```
4D43475000C4790D0008815A1A220400
A600FC01C103480706DDF49718000000
0000D1E2620DA491000000093A44A303
8A175703E826000001000000640E1425
06120CDE07EB
```

Are parsed as follows:

00: nano readings

00: X= 0g , Y=0g

D1: Z= signed (0xD)= (-3) = -3*0.25g = -0.75g

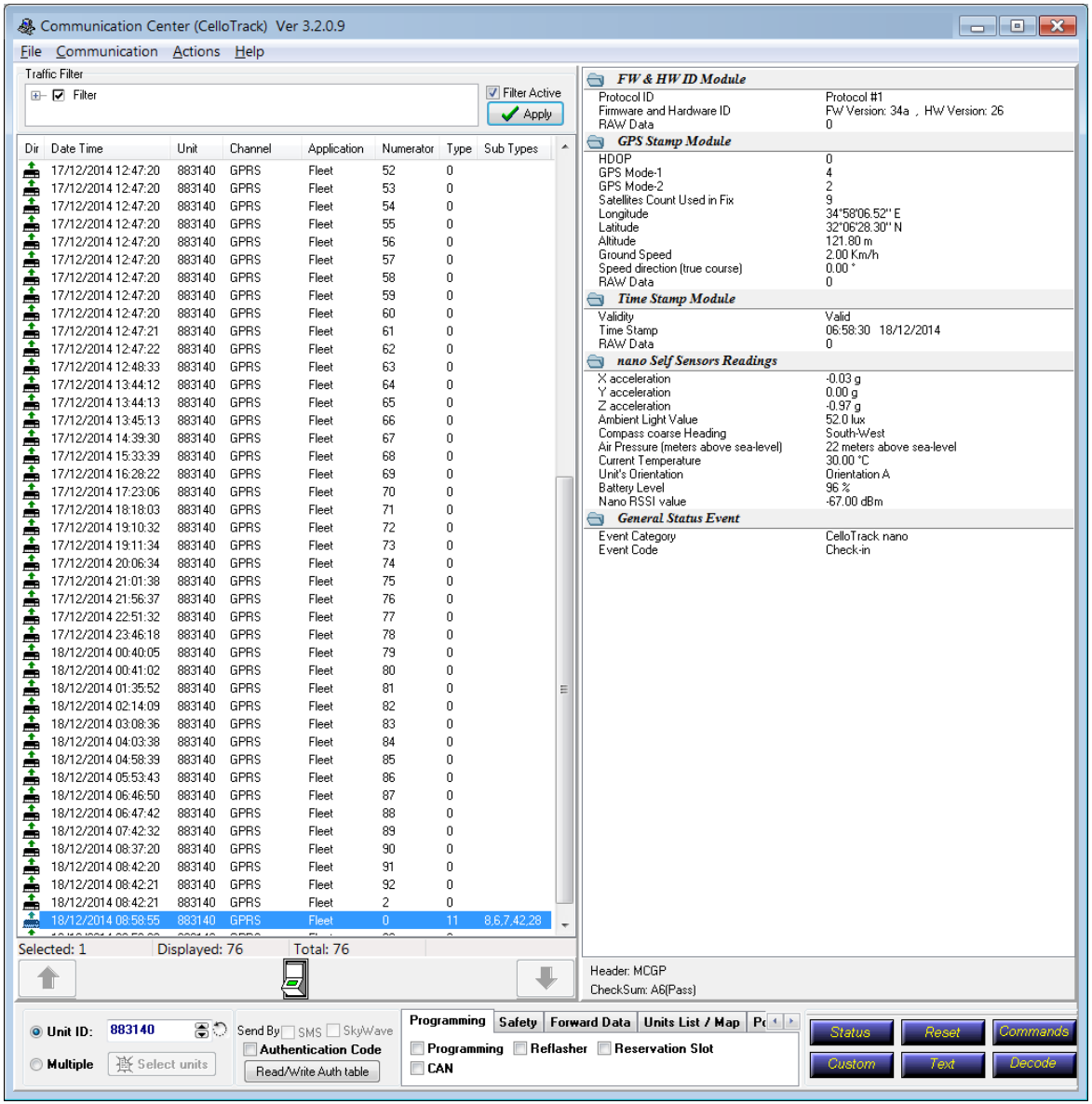
E2 and 62: ADC= 0x2E2= 738 *0.25 = 184.5 lux

0D: Altitude = 13*32-400 = 16m

Byte no.	Description								Containing
	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	
...	...								...
33	Multi-purpose bytes area management byte in nano: 0x00 = nano readings 0x01 = nano event 0x02 = MultiSense event ...								0x00= nano readings
34	Bits [7÷4]: Slow filtered X Acceleration, limited to +1.75g÷-2g and shrunk to "SINT4 format". (LSB= 0.25g, so 0111 = +1.75g, 1111 = -0.25g etc.)				Bits [3÷0]: Slow filtered Y Acceleration, limited to +1.75g÷-2g and shrunk to "SINT4 format". (LSB= 0.25g, so 0111 = +1.75g, 1111 = -0.25g etc.)				
35	Bits [7÷4]: Slow filtered Z Acceleration, limited to +1.75g÷-2g and shrunk to "SINT4 format". (LSB= 0.25g, so 0111 = +1.75g, 1111 = -0.25g etc.)				**(Infrastructure)** Bit [3]: If unit has valid/relevant compass reading (Byte 37.bits4÷7 ≠0) then this bit represent "orientation A"=0 or "orientation B"=1. Bits [2÷0]: Reserved = 000				
36	ADC raw reading of Ambient Light in 12-bit (LSB)								In nano 10 = 0
37	**(Infrastructure)** Bits [7÷4]: Compass 1/8 direction: 0= Irrelevant reading 1= North 2= North-East 3= East 4= South-East 5= South 6= South-West 7= West 8= North-West				Bits [3÷0]: ADC raw reading of Ambient Light in 12-bit (MSB)				In nano 10 = 0
38	Average of 2 last samples Pressure, translated to meters above sea-level, UINT8 format, where 400m **below** sea-level is =0 and the value is divided by 32, i.e. 200→6000m.								In nano 10 = 0
...	...								...

Example of an Type-11 message parsing

This is an example of type-11 message with the mandatory modules and also module 28 for conveying the actual event.



Example of an Type-11 message parsing

4D4347500BC4790D00088100004C000000000008060000012201 1A000613
0000040209524 4A30384155703942F00000200000707000 11E3A06120C0E
2A0F008EFF0C007BF0D0607C102C010160BD1C0A000101000B004000000
00A6

Are parsed as follows:

Module 8 – HW and FW IDs.

Module 6 – GPS stamp.

Module 7 – GPS Time stamp

2A: Module 42

0F, 00: Length=15 bytes

8E, FF: (SINT16) X= -114 * 250μg= -0.0285g

0C, 00: (SINT16) Y= 12 * 250μg= 0.003g

7B, F0: (SINT16) Z= -3973 * 250μg= -0.99325g

D0, 60: ADC= 0x0D0= 208 *0.25 = 52 lux

7C, 10: Altitude = 0x107C→4220/10-400= +22m

2C, 01: Temperature= 0x12C/10 = 30°C

01: Infrastructure

60: Battery level= 96%

BD: Cellular RSSI= -67dBm

1C: Module 28

0A, 00: Length=1

01: Number of entries=1

01, 00: Event category= nano

0B, 00: Event Code= Check-in

04: Length of data=4 bytes

00000000: Reserved (4 bytes)

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Templates and expected battery life

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About templates

In the PL file, there is a new feature that enables the user to quickly set a typical use case configuration, that can be later fine tuned if needed.

This is done by using ready made templates. Currently we have 7 of them and they can be selected by pressing the file → Select Template from the main screen, or from the template icon in the Nano editor screen.

For example: Template #1 is intended for long shipments, with paired MultiSense units, with transmission every 15 minutes (“almost live tracking”).

Under nominal conditions, with 4 paired MultiSense units, the expected battery life of the Nano is around 6.5 days.

Another example: Template #3 is a typical legacy use case of CelloTrack-T, using only type-0 messages, but with addition of MultiSense units.

Under nominal conditions, with 4 paired MultiSense units, the expected battery life of the Nano is around 48 days.

About templates

Template number:	#1	#2	#3	#4	#5	#6
Template name:	**Long shipment with MS** almost live-tracking	**Long shipment without MS** almost live-tracking	**Typical CelloTrack-T users** improved tracking	**Long shipment with MS**, offline tracking (15-25 C)	**High value goods** (3rd party shipper)	**Land shipment - cold chain 2-8C** (food, Pharmaceutical, flowers, antiques)
Scenario:	**Nano**: Tx every 15 min, **MS**: Sample every 1 min, Tx every 15 min	**Nano**: Tx every 15 min	**Nano**: Tx every 24 hours, **MS**: Sample every 1 min, Tx every 1 hour	**Nano**: Live tracking 8h per day, logging location every 5 min **MS**: Tx every 5 min	**Nano**: Tx every 15 min	**Nano**: Tx every 15 min, **MS**: Tx every 5 min
	7 days	7 days	40 days	6 days	7 days	6 days
	36 months	NA	42 months	30 months	NA	30 months

- Where temperature wasn't mentioned, the battery performance is valid for +20°C
- The templates above and battery performances are based on calculated parameters (tens of parameters)

FCC Compliance Statement

This device 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 residential installations. 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 and television reception. However, there is no guarantee that interference will not occur in a particular installation. If this device does cause such interference, which can be verified by turning the device off and on, the user is encouraged to eliminate the interference by one or more of the following measures:

– Re-orient or re-locate the receiving antenna.
– Increase the distance between the device and the receiver.
– Connect the device to an outlet on a circuit different from the one that supplies power to the receiver.
– Consult the dealer or an experienced radio/TV technician.

WARNING! *Changes or modifications to this unit 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 two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference that may be received or that may cause undesired operation.

This device complies with Industry Canada license-exempt RSS standards. 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.
(Le present appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisee aux deux conditions suivantes :(1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioelectrique subi, meme si le brouillage est susceptible d'en compromettre le fonctionnement.).

To comply with FCC Section 1.1310 for human exposure to radio frequency electromagnetic fields and IC requirements, implement the following instruction:
A distance of at least 20 cm. between the equipment and all persons should be maintained during the operation of the equipment.

Table of products

Product name	P/N	HVIN	FVIN
CelloTrack Nano 20	GC9770001-000	A	34
CelloTrack Nano 20 3G	GC9771004-000	B	34
CelloTrack Nano 10	GC9770002-000	A	34
CelloTrack Nano 10 3G	GC9771003-000	B	34
CelloTrack Nano 10 LTE C1-NA	GC9771011-000	A	34
CelloTrack Nano 20 LTE C1-NA	GC9771010-000	B	34
MultiSense	715-50100	C	4
MultiSense-TH	715-50200	D	4

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Thank You!

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