
Doc. Type:	Product
Sub. Type:	Specification
Status:	Rev 1.1 - Pre Release
P/N:	Newsteo TRP55
Author:	AC

Newsteo TRP55 Product Specification

Proprietary Notice: This document contains proprietary information of NEWSTEO SAS, and neither the document nor said proprietary information shall be published, reproduced, copied, disclosed or used for any purpose other than consideration of this document without the express written permission of a duly authorized representative of said company.

Revision history

Revision	Issue Date	Author	Comments
0.0		CK	Preliminary specification
0.1	November 20 th 2014	AC	First specification
0.2	November 24 th 2014	FP	Adding GPS position format + batteries configuration + autonomy
0.3	November 25 th 2014	AC	Memory autonomy Weight Included batteries Sticker Speed, Map creation, Product stop procedure
0.4	May 5 th 2015	HS	Product stop procedure Energy saving Satellite acquisition Map system description Cold mode explanation Beeping system
0.5	May 11 th 2015	HS	Current position (GPS coordinates) modified
1.1	December 23 th , 2015	AC	Autonomy Sticker design

Table of contents

1	Introduction	5
2	General TRP55 operation	5
2.1	Periodic measurements (tilt, accelerations, position, speed)	5
2.2	Shock measurement	6
2.2.1	Current position (GPS coordinates)	7
2.2.2	Earth's gravity	7
2.2.3	Scheme of the shock storage	7
2.3	Free fall measurement	8
2.4	Product settings	8
2.4.1	Operation modes	8
2.4.2	Settings	9
2.4.3	Factory settings	9
2.5	Product start-up procedure	9
2.6	Product stop procedure	10
2.7	LED status and indications	10
2.7.1	At product start up and stop	10
2.7.2	During operation	10
2.8	Memory download	10
3	Technical characteristics	11
3.1	General characteristics	11
3.2	Physical description	12
3.3	Performance of the GPS positioning	13
3.4	Performance of the accelerometer sensor	13
3.5	Performance of the temperature sensor	13
3.6	Power supply / Autonomy	13
4	Accessories	14
5	Certifications	14

Table of illustrations

Figure 1: Example of TRP55 recording	6
Figure 2: Example of shock measurement	7
Figure 3: Scheme of the shock storage	8
Figure 4: TRP55 picture	12
Figure 5: Sticker on the casing.....	12

1 Introduction

This specification describes the operation of the TRP55 tracker.

Main features:

- Integrated sensors:
 - o 3 axis accelerometer [-16g to +16g on 3 axis]
 - o Temperature sensor
 - o GPS module (GPS positioning)
- Measurements time stamped then stored in the Tracker flash memory
- Measurements can be downloaded to a Personal Computer through radio link. The PC has to be equipped with a Newsteo radio bridge (standard RF-to-USB Key) and the RF Monitor software.

2 General TRP55 operation

The TRP55 (GPS Tracker) is designed to supervise shocks suffered by a good during its transportation and its positioning. It also periodically measures the temperature.

It monitors the following parameters:

- Periodically (performed at a fixed frequency, same frequency for all the sensors, defined by the user) :
 - o Tilt (inclination of the product on 3 axis)
 - o Temperature
 - o GPS position + ground speed + azimuth

The autonomy estimations are based on a frequency of 1 hour.

- As event occurs :
 - o Shocks: when the acceleration threshold is exceeded on any axis, the event is recorded into the tracker memory : shock intensity and Energy calculation on each axis
 - o Free fall: when a free fall is detected, the product calculates the height of a free fall. The resulting landing shock will be measured and energy integrated as a Shock.
 - o GPS position + ground speed + azimuth

**NB: GPS position can be recorded if TRACKER GPS antenna is in situation to get the satellite signals
We will provide advice of use, information about the limitations according to the installation of Tracker.**

2.1 Periodic measurements (tilt, accelerations, position, speed)

The TRP55 periodically measures temperature, GPS position and the accelerations on its 3 axis to calculate the tilt of the product. The period of this measurement is set by the user, using RF Monitor, before the campaign starts. During the campaign, in record mode, all measurements are time stamped.

Measurements are recorded into the tracker memory with the following format:

YEAR	MONTH	DAY	HOUR	MIN	SEC	Ax(G)	Ay(G)	Az(G)	Angle X(°)	Angle Y(°)	Angle Z(°)	Temp (°C)
2014	10	6	15	16	22	-0.008	0.984	-0.055	-179.552	100.142	- 3.135	26.52

Figure 1: Example of TRP55 recording

NOTA: tilt and accelerations measurements inform as well the user of proper operation of the tracker during transportation. Upon delivery of transported goods, the user downloads the tracker contents and can check that periodic measurements are present, meaning that the tracker was actually monitoring potential shocks at any time, even if the report does not contain any of them.

GPS Position recording format (when acquisition passed). **If the acquisition does not pass, the packets are not recorded.**

YEAR	MONTH	DAY	HOUR	MIN	SEC	North	East	Speed (km/h)
2014	10	6	15	16	22	+/- 90.xxxxxx	+/- 180.xxxxxx	20

Optional Map positions:

- If the PC hosting RF Monitor is not connected to Internet, it won't be possible to generate a map. The report will include the listing of the GPS positions.
- If the PC is connected to the Internet, It is possible to use the Google Map API to generate a map redrawing the hole transportation with all the stoppings, the time staying in each place, the over thresholds about any axis, the exact hour and the place where every event occurred etc.

2.2 Shock measurement

This measurement is done by the internal 3 axis accelerometer. The measurement unit is the g (unitary gravitation).

The accelerometer sensor is constantly scanning at 3200Hz which guarantees that no shock can be missed. Once the user-defined threshold is exceeded, the following data are stored:

- Maximum shock level reached on each axis(g) and norm of the shock (g)
- Duration of the shock (ms)
- Energy on each axis (J / kg) and magnitude of the maximal acceleration vector (g)
- Current temperature
- Current position (GPS coordinates), **only acquired if the shock occurs more than 5 minutes after the last acquired position.** If the shock occurs less than 5 minutes after the last acquired position, the GPS position and the speed won't be recorded.

YEAR	MONTH	DAY	HOUR	MIN	SEC	TEMP	XMAX (G)	YMAX (G)	ZMAX (G)	Shock duration (ms)	Shock norm(G)	Ex(J/Kg)	Ey(J/Kg)	Ez(J/Kg)	Energy norm(J/Kg)
2009	3	4	10	52	48	28	8,1	7,6	6,575	1750	12,907	1650,1	884,744	1650,1	2495,682

YEAR	MONTH	DAY	HOUR	MIN	SEC	North	East	Speed (km/h)
2009	3	4	10	53	00	+/- 90.xxxxxx	+/- 180.xxxxxx	20

Figure 2: Example of shock measurement

2.2.1 Current position (GPS coordinates)

The TRP includes a GPS modem, GPS ceramic antenna and GPS antenna amplifier (+20 to +26dB) specifically tuned for GPS signals and filtering the neighbour GSM frequencies.

When the position acquisition process is started, the module starts in cold mode.

The GPS antenna amplifier is always activated, because this ensures the acquisition time is reduced to its minimum.

An energy saving system ensures that:

- If no satellite is seen after 90 seconds, the process is stopped and a next acquisition will be performed at the next periodic measurement.
- If at least 1 satellite is seen after 90 seconds, the acquisition process goes on for 1 additional minute and so on. If the position acquisition has succeeded, the user will hear 3 up beep sounds. Soon afterwards, a beep sound will be heard for each satellite detected by the TRP. The process will stop after 5 consecutive minutes.

To save additional energy, the TRP is equipped with an ultrasensitive accelerometer that indicates whether a movement occurred since last position acquisition.

If the TRP has detected any movement higher than 250mG, the position is not acquired once again. The last position acquisition will be kept.

If the GPS acquisition fails, the position packet is not stored.

2.2.2 Earth's gravity

The 1g of earth gravity is kept and displayed on RF Monitor when the TRP is displayed in "Live mode". If a shock occurs, the firmware (embedded program of the product) cancels the 1g earth's gravity. It means that the threshold set on the shock is the same on the 3 axis; it is independent from the gravity, and then independent from the direction of fixing it on the good.

2.2.3 Scheme of the shock storage

NOTA: if the acceleration threshold is set at a too low level (example 1.5g), there will be many recorded shock alerts which will quickly fill the tracker memory. By the way, the user will not get relevant information from this list of empty alerts.

To prevent this situation, the customer should make "shock tests" in live mode, with the TRP screwed in the final container, to determine a relevant threshold that should be used for long campaigns.

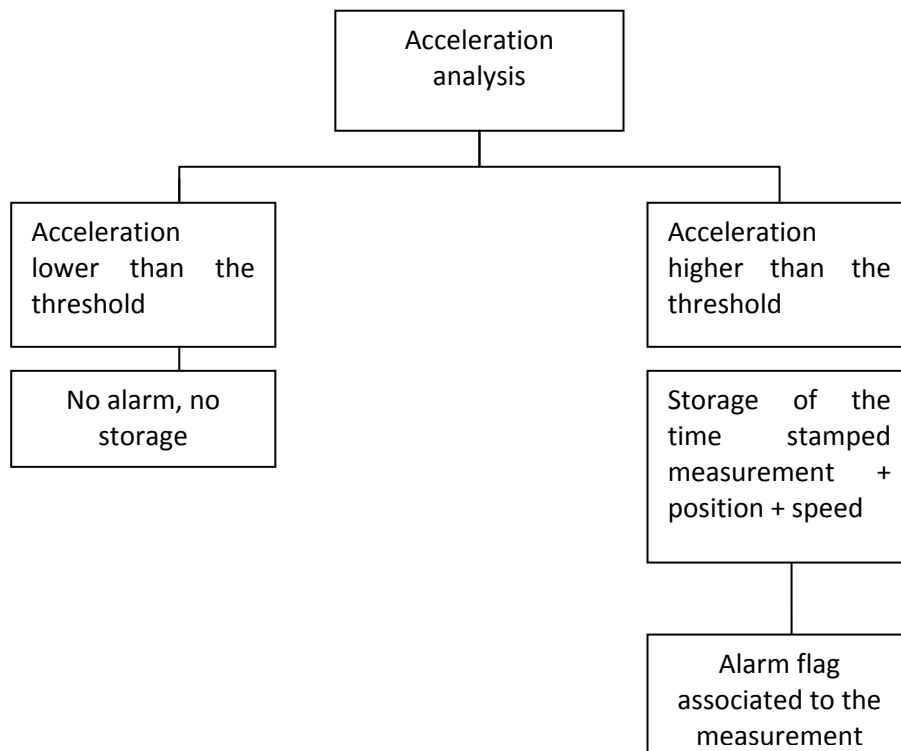


Figure 3: Scheme of the shock storage

2.3 Free fall measurement

This measurement is done by the same 3 axis accelerometer. The measurement unit is the centimetre. During the duration of a free fall, the accelerometer detects “no acceleration”. This duration enables the TRP to calculate the height of this free fall¹, assuming that the starting velocity is almost null.

2.4 Product settings

2.4.1 Operation modes

The TRP product can be used following two modes. Each mode needs its own firmware to operate properly.

- **Live / Record** (like a video recorder):
 - **This is the default recommended mode for TRP**
 - **In live mode, the user can “play with the product” and see measurements**
 - **Before sending the product for its campaign, the user activates the RECORD mode**
 - When record is activated, the TRP records the measurements in its memory.
 - During RECORD mode, the TRP is sending PRESENCE packets every minute, so the user can see the product on RF Monitor and send commands.
 - When the campaign is ended, the user stops the RECORD, and the product is back in live mode, sending measurements every 10s for example,
 - The user can download on the PC all the stored measurements when he asks.

¹ White Paper available on demand

Remark: in Record mode, the TRP sends a radio presence packet every minute. It allows detecting it on RF Monitor. It is also possible to start the record campaign in *silent mode*. Then, the TRP doesn't send any radio packet as soon as it starts recording.

The Silent mode shall be used if a complete absence of radio transmission is needed (Ex: during air transportation). At the end of the recording period, to download the data, it is necessary in this case to use the function "*Find products in silent mode*" on RF Monitor in order to stop recording.

- **Monitoring** (real time monitoring applications):
 - The TRP sends in real time its measurements to the PC. If a measurement is not received by the PC, it stores it inside its internal memory and sends it to the PC on the next communication opportunity.

Changing the mode requires a PC with RF-to-USB Key and RF Monitor to send commands.

2.4.2 Settings

Configuration of the product must be done in Live mode or in Monitoring mode. The user has to set:

1. The Shock threshold (in g). An alarm will be recorded if an acceleration, on any axis, is greater than this threshold.
2. The temperature thresholds (in °C). An alarm will be recorded if a measurement is smaller or greater than those thresholds.
3. The periodic record frequency (from 1 minute up to 4 hours)
4. Set the tracker's time. **GMT time is recommended for international transportation. It is essential to set it.**

Other remarks:

- **Only measurements that have already been downloaded to a PC can be removed.**
- **When the memory is full, the Tracker stops recording to be sure not to erase the beginning of the campaign. In fact, the risk of losing parcels is higher at the end of transportation than at the departure.**
- **Before starting a new campaign it is recommended to delete the measurements already stored (if any) in the Tracker.**

2.4.3 Factory settings

The product is delivered in Record mode, in hibernation status.

The user has to sweep the magnet on the product, following a starting procedure (described below)

Factory record period:

- Record period : 15 minutes
- Live period: 10 seconds (to pass in Live period, the user has to stop the recording, through RF Monitor).

2.5 Product start-up procedure

The product is delivered with batteries inside, in hibernate mode.

To start the product, the user has to sweep 3 times a magnet on it and to check that the LED is properly blinking:

- First time the magnet is swept : the LED blinks red
- Second time : orange
- Third time : green

Then the TRP starts a recording campaign.

If you stop this procedure at any step before the led signal, then the TRP will go back in hibernate mode.

2.6 Product stop procedure

To stop the product, sweep the magnet once above the SYS AREA label; the three LEDs blink simultaneously in orange during three seconds max. This is the time window during which the 'Stop' procedure can be processed.

If this timeout of three seconds is elapsed, it will force a periodic measure transmission.

Then, leave the magnet above the SYS AREA label until the "Batt." LED is lighted GREEN on (approximately 1 second) and the others are powered off. Then, release the magnet.

One beep signal is also emitted when this step is done.

Leave the magnet above the SYS AREA label until "Radio" LED is lighted ORANGE on and the others are powered off. Then, release the magnet.

Two beep signals are also emitted when this step is done.

Leave the magnet above the SYS AREA label until "Alert" LED is lighted RED on and the others are powered off. Then, release the magnet.

Three beep signals are also emitted when this step is done.

If the procedure is quite applied, the three LEDs blink simultaneously in RED during three seconds, then power off. The campaign is then stopped and the TRP55 is switched in its 'Hibernate' mode.

If you stop this procedure at any step before the led signal, then the TRP will go back in recording mode.

2.7 LED status and indications

2.7.1 At product start up and stop

See § [2.5 Product start-up](#) and § [2.6 Product stop procedure](#).

2.7.2 During operation

The LED blinks every minute and gives the status of the alert level:

- The product has never been on alert: blinks GREEN, one time
- The product is in alarm or has been in alarm since the last time the measurements have been downloaded on PC: blinks RED, one time

After sweeping the magnet on, the 3 leds blink simultaneously for 3 seconds. Nextly, the three LEDs switch alternatively (every second) in GREEN light for 90 seconds.

2.8 Memory download

When the TRP is in LIVE mode or RECORD mode, the user can download the memory content, using the RF-to-USB KEY and RFMonitor software.

1. Click on Download on the RF Monitor software
2. All the measurements are then downloaded and available:
 - a. In the database included in RF Monitor. It is then possible to use filters to sort the data.

- b. In a CSV file (compliant with Excel)
- c. In a PDF report

To start a new campaign, it is recommended to delete first the previous data and then to set the Tracker in Record mode.

If the user downloads the data while the TRP is in RECORD mode, then the report will contain intermediate data, and the campaign will go on as soon as the download finishes.

3 Technical characteristics

3.1 General characteristics

General characteristics	
RTC	Real Time Clock integrated for measurement time stamping. Resolution: 1s Maximum drift : 2 minutes / month at 25 °C The time is set in production.
Operating temperature range	-40°C to 60°C with lithium batteries -10°C to +50°C with alkaline batteries Recommended temperature range for maximizing product autonomy: +5°C to +35°C.
Flash memory	16 Mbits Flash meaning 129000 measure blocks (Periodic measure takes 2 blocks, Shocks takes 3 blocks) For example, it allows in a single measure campaign of 22 months: <ul style="list-style-type: none">- 1 tilt, temperature and position measurements every hour (32 000 records)- 32 200 shock records
Wireless communication	Operating on the ISM band, Short Range Device This device is designed for European market (uses 868MHz band).
Antennas	Internal antenna for ISM (radio) Internal antenna for GPS
RF range	100 meters in free space
ILS	Magnet sensor for user actions : <ul style="list-style-type: none">- wakeup of the product in hibernate mode- take of a measure outside of the frequency measure set- save energy turning on the product only when the user needs it

3.2 Physical description



Figure 4: TRP55 picture

Casing	
Colour	Black
Material	Plastic (thermoplastic ASA Acrylonitrile styrene acrylate)
Casing features	The casing integrates 2 holes for fixation on a wall or inside a parcel. Possibility to fix the TRP with 4 screws (not supplied). Possibility to use a belt to fix the casing.
Dimensions (Flanged lid included)	Length 139.85 mm Width 96.52 mm Height 33.02 mm
Weight	About 250g (batteries included)
IP level	IP67



Figure 5: Sticker on the casing

3.3 Performance of the GPS positioning

The internal modem has a resolution better than 5m, and up to 2m, depending on GPS signal quality:

- American Army can reduce on purpose the signal precision to avoid rocket guidance in strategic areas.
- If the TRP is placed vertically and/or in metallic container and/or in buildings or tunnels, the signal strength is badly affected and the position precision is reduced.

Ground speed: from 0 to 155 km/h, resolution of ± 5 km/h.

Azimuth : from 0 to 360°, resolution of $\pm 3^\circ$.

3.4 Performance of the accelerometer sensor

Accelerometer	
Sensor	1 accelerometer measuring 3 axis (XYZ)
Sensor range	Shock : -16g to +16g on each axis Tilt : -1g to +1g on each axis and corresponding angles
Resolution	14 bits – 3.9 mg
Accuracy at 25°C	$\pm 0,5g$ from -16g to +16g (without crosstalk) If a shock is over this range, the TRP will clamp to 16g and store this measurement. Magnitude of vector's shock can be up to 22.6g
Noise	65 mg (typical)
Calibration	Calibration done in factory by the manufacturer
Drift of the accuracy	Possible drift of 10 mg / year on each axis for 4 years, not guaranteed after 4 years
Bandwidth	1600 Hz

3.5 Performance of the temperature sensor

Temperature	
Sensor	1 temperature sensor
Sensor range	-40°C to 85°C
Accuracy	$\pm 0,3^\circ\text{C}$ from [-30°C ... +70°C] $\pm 1^\circ\text{C}$ from [- 40°C ... -30°C] and [+70°C ... +85°C]
Resolution	0.1 °C
Calibration	Calibration done in factory by the manufacturer
Long term drift	Smaller than the product resolution for a 4 years period of use
Response time	Less than 10 minutes in a ventilated area (ventilation of 1m/s) About 1 hour in a non-ventilated area

3.6 Power supply / Autonomy

Minimum autonomy:

In worst conditions, which means when all position acquisitions fail, all the time, which consumes the more energy, the autonomy of the system reaches:

- 3.3 months with alkaline batteries
- 9 months with lithium batteries 3.6V AA batteries

Duration given with a periodic measure every hour.

Multiple chemistry technology system:

The TRP supports both chemistry in the 3xAA support:

- alkaline 1.5V AA low cost low temperature range offering around 2Ah capacity
- lithium 1.5V AA chemistry higher cost, easy to buy, around 3Ah capacity
- lithium 3.6V AA batteries , higher cost, ultra wide temperature range , around 6Ah capacity

General characteristics	Wide Temperature	Ambient temperature
Power supply	3 x AA size Thionyl Lithium 3.6V	3 x AA size Alkaline battery (1.5V)
Operating Temp Range	-40 to +60°C (up to 85°C peak but the enclosure can be damaged)	-10°C to + 50°C
Autonomy @25°C	Typical: 3 months (up to 6 months if the GPS transmission quality is good)	Typical: 1.5 month (up to 3 months if the GPS transmission quality is good)
Battery provider	Newsteo	Any provider (supermarket)
User replaceable	Yes, battery holder, respect polarity	Yes, battery holder, respect polarity

To access the battery compartment, unscrew the 4 front screws.

Always replace batteries together and never mix used and new batteries, or batteries of different chemistry.

The product is delivered with **3xAA Alkaline Batteries**.

The use of alkaline batteries will not reduce the product's performances, but only the autonomy.

4 Accessories

Each product is delivered with **3xAA Alkaline Batteries**.

5 Certifications

Products certified for radio use in Europe, on the frequency of 868 MHz (ISM band, Short Range Device). For use in another area, check with local authorities.