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PROJECT: P0xxx	
DESCRIPTION: OPERATIONAL MANUAL FOR THE INTELETRACK 'GPS3' RU AND 'ONE TOUCH' CU version 3.0	

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INTRODUCTION

A train "smart telemeter" system consists mainly of two devices in radio communication with each other. The GPS3 is mounted at the rear end of the train on the buffer of the last wagon. For this reason it is called a "rear unit" (RU) or an "End-of-Train" device (EoT).

Figure 1: The GPS3 EoT monitor; also called the rear unit.

Figure 2: The Inteletrack GPS3 mounted onto a rear buffer.

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OPERATIONAL MANUAL FOR THE INTELETRACK 'GPS3' RU AND 'ONE TOUCH' CU version 3.0

The 'One Touch' is located in the cabin of the driver's locomotive and is also called a "cab unit" (CU) or a "Head-of-Train" device (HoT). The 'One Touch' features a vandal-proof interface with capacitive touch sensors.

Figure 3: The front panel of the 'One Touch' HoT monitor; also called the cab unit. The capacitive touch buttons, indicator LEDs and graphic display can be seen.

Figure 4: The Inteletrack 'One Touch' in a portable configuration inside a locomotive. This is usually a configuration used for testing and for use is some specified areas. The CU will usually be installed into a designated compartment within the locomotive.

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SETUP, INSTALLATION AND SYSTEM OPERATION

The 'One Touch' CU is mainly used by TFR as a fixed type HoT device. Therefore it will mostly be installed inside the locomotive cabin. The 'One Touch' CU will thus be fully mounted with its cables connected properly, so there is no need for the driver to do any cabling or installation work on it.

The GPS3 RU is a portable type EoT device. Therefore it may be removed from or attached to the rear buffer on the last wagon of the train. The clamp and lock attached to the RU is used to do this. Also, the rear brake pipe must be inserted to the GPS3's brake hose fitting in order to sense the brake pipe pressure and to be able to perform an emergency brake application (EBA). The GPS3 RU is light enough for one person to carry around and to mount onto and dismount from a buffer.

Figure 5: The 'One Touch' and GPS3 locations on a train.

Proper communication between the RU and CU is achieved by first matching the CU to the RU. The CU 'learns' the RU's ID and stores it into its memory. This will ensure that the CU only responds to messages from one particular RU (with such an ID). Pay attention to only take rear units from the charging room with a fully charged battery. The **battery in the rear unit will last approximately 40 hours** if it's a lead acid battery and fully charged. There are other options for the operating railway, but this is a good rule of thumb for battery capacity in this context. RUs can also be fitted with air turbine modules, also called **'airgens'**, which charges the battery continually if brake pipe pressure is above 350 kPa.

The cab unit must also be 'armed' for the emergency brake function to become active on the cab unit. On newer firmware versions of the CU's, an automatic arming sequence was added to force the driver to arm the EB before the CU will progress to the operating menu. The RU can now be attached to the rear buffer using its clamp. Also be sure to attach the brake pipe to the rear unit via glad-hand coupler. The cab unit will receive messages from the rear unit "**twice per minute**" according to AAR specifications. This message will contain the RU battery voltage, the brake line pressure at the end of the train, the GPS coordinates of the RU etc. The CU display will be updated according to the latest information that it has received over the radio communication channel.

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The cab unit will only send update messages to the rear unit once in every two minutes. The cab unit can also send a message to the rear unit to apply the emergency brake (EBA) if the emergency button on the cab unit's front panel has been pressed. This message will cause the rear unit to open the emergency valve, which will cause the air pressure to drop in trains utilizing air pressure for braking purposes. The valve open-time is usually specified by the operating railway.

There will probably be tests to ensure train integrity. These train integrity tests are used to ensure that the brake line is running through the entire length of the train without any discontinuities or faults. One train integrity test is to drop the pressure in the cab by a couple of kPa, around 20 to 50kPa. One would expect to receive a message from the rear unit to indicate that it detected this fall in pressure. If this message is received within reasonable time (time to total pressure drop in whole length of the train), then one may assume that the train is complete. If the pressure is built up to its nominal brake value, then a message should be transmitted to the cab unit again to indicate this.

The arming sequence may form part of these tests, with the auto-arming sequence in newer firmware versions forcing the user to first match the RU and CU by pressing the ON button on the RU. The CU will respond with an arming request to the RU, whereupon the RU will send an arming confirmation message to the CU. If the whole sequence was successful, the CU will progress to the normal operation menu, otherwise, the test must be repeated. Please take note of the reason why such a test was unsuccessful. This is an easy test to test the antenna and radio for faults.

Relevant information is also transmitted via GPRS to the operating railway's server for data analysis. The transmission intervals are predetermined and preprogrammed onto the rear unit. It will transmit on specified time intervals, distance intervals and on events such as EBA, charging etc.
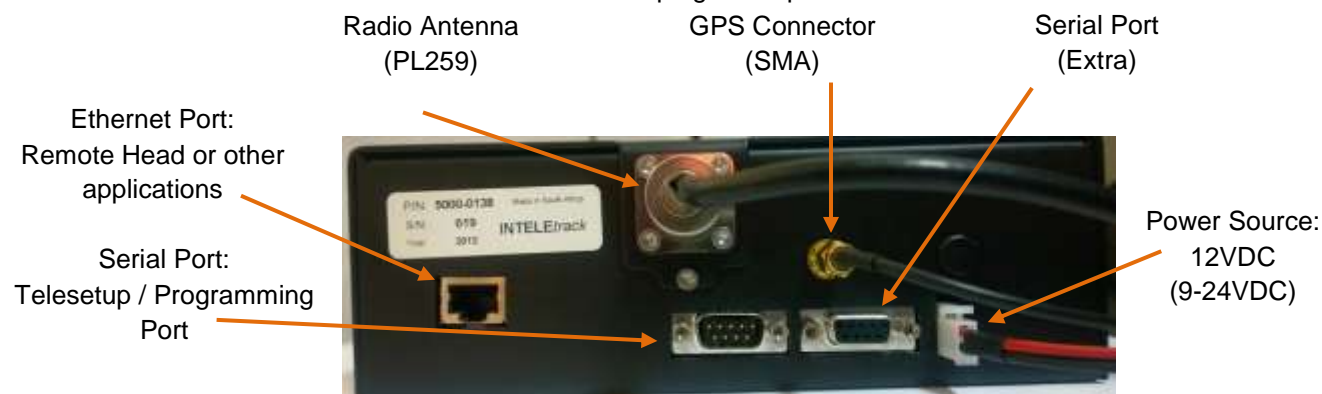
STEPS FOR INSTALLATION

1. Only remove RU from the charging room when the battery is fully charged.
2. The CU should be switched on and ready to communicate with the RU. On TFR locomotives, the CU will switch on when the loco is switched on and off when loco is switched off.
3. The CU automatically defaults to the RU selection menu.
4. Attach the RU to the rear buffer of the train. Attach the brake line to the RU as well.
5. A rear unit ID may be selected to arm the cab unit by the following:
   a. Select NEW ID, enter a new rear unit ID
   b. Select OLD ID, accept the ID or edit the ID
   c. Select a RU ID detected nearby at the bottom of the menu

6. Test the communications between the rear unit and cab unit with a train integrity test or standard communications (battery voltage value, air pressure value etc.).

7. If communication is working and the test successful, go to Step 8, or return to Step 1.
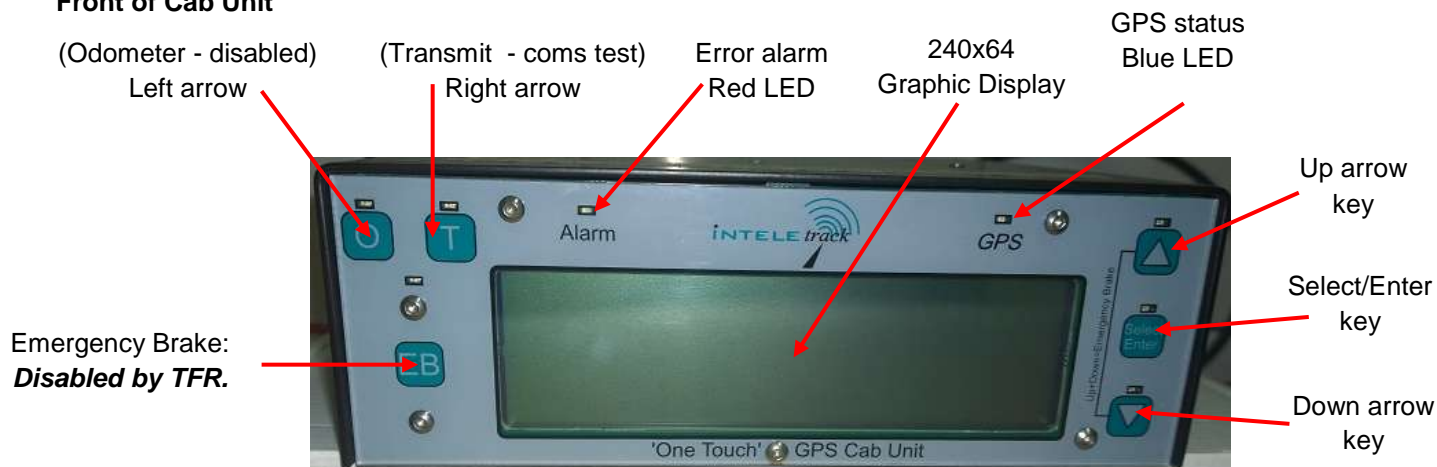8. The train should now be good to go.

THE CAB UNIT BASICS
LAYOUT AND STARTUP

Back of Cab Unit

Ensure that the Antenna and GPS are connected then plug in the power source.

Radio Antenna (PL259)
GPS Connector (SMA)
Serial Port (Extra)
Ethernet Port: Remote Head or other applications
Serial Port: Telesetup / Programming Port
Power Source: 12VDC (9-24VDC)

Front of Cab Unit

(Odometer - disabled) Left arrow
(Transmit - coms test) Right arrow
Error alarm Red LED
240x64 Graphic Display
GPS status Blue LED
Up arrow key
Select/Enter key
Down arrow key
Emergency Brake: *Disabled by TFR.*

Should an error or warning condition occur, this LED will flash

"EB" button has been *disabled* as a way to send an "open emergency valve" message

The GPS LED will flash while searching for signal. Once GPS lock is established, the LED will stay on

Plugging into power source switches on the CU automatically. Display shows black start-up screen.

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Indicates the current configuration of the CU hardware. This includes radio, display, GPS and other PCBs, as well as the type of enclosure.
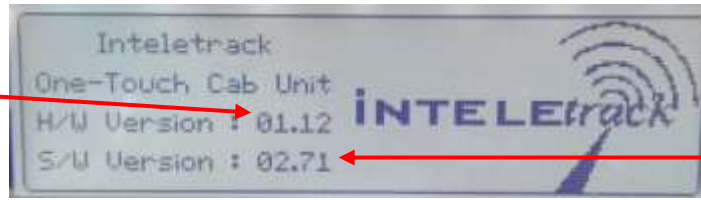
The current approved version of the firmware on the CU

Before Arming the CU

Once CU is switched on, these screens are displayed.

Alarm LED:
Red LED to indicate some kind of alarm condition, such as low brake pipe pressure

GPS LED:
Indicates if CU has valid GPS signal.
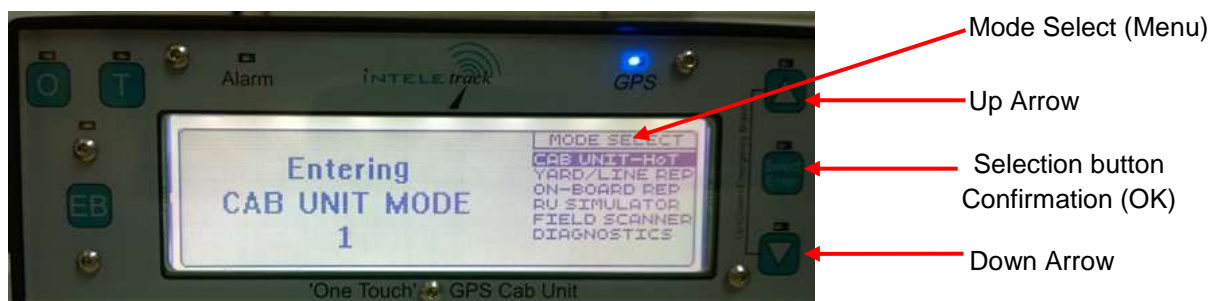Blue LED will stay ON when CU has valid GPS, otherwise no valid GPS

The system will boot up and these screens display (countdown from 10 to 0).

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The following screen appears and defaults to "CAB UNIT-HoT" under "MODE SELECT" menu.

On right hand side of the CU display, there is a menu titled "MODE SELECT".
To select another option, other than the default "CABUNIT-HOT", use the up or down arrows to scroll to the option. Select the required highlighted option by pressing "Select / Enter" button.

Mode Select (Menu)

Defaults to CAB UNIT-HoT

These modes are disabled

Before countdown has completed, DIAGNOSTICS may be selected for technical analysis.

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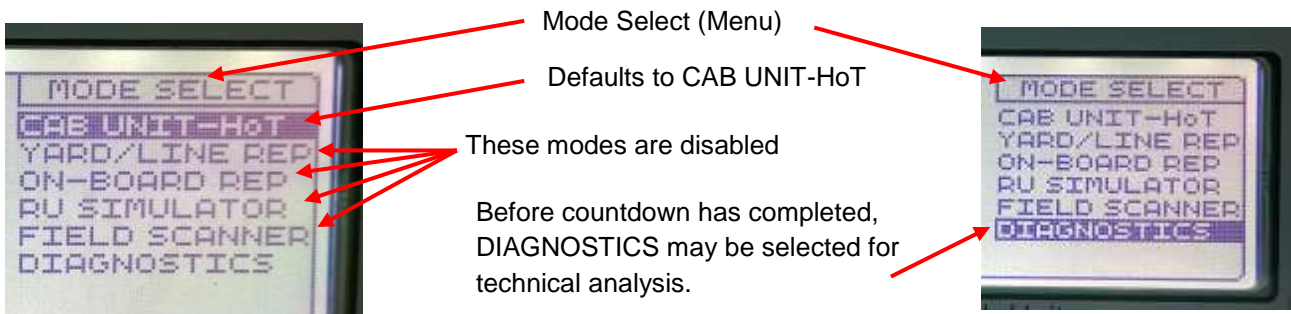
OPERATING THE CAB UNIT

This screen will display once the countdown is complete, waiting for user input.This screen is used to connect Cab Unit (CU) with a Rear Unit (RU), which is established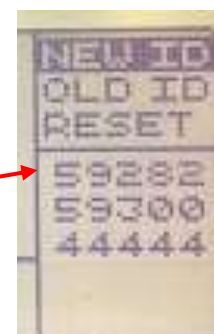 by inputting a new RU ID or selecting an already armed RU ID displayed in the menu. Selecting the "RESET" option will reboot the system.

NEW ID

The above images show RU IDs beneath the operating menu, which means that within the vicinity of the CU, there are RUs that are detected and can be selected to match with.

Select "NEW ID" to input a new ID number. After pressing "Select/Enter", the first digit of the 5-digit ID number will be highlighted. Press the up or down arrow to scroll to the correct number from 0-9. The active menu is now the ID number selection, not the operating menu (with "NEW ID", "OLD "ID" and "RESET").

By pressing "Select/Enter", the number will be selected and the next number will be selected and highlighted. Repeat the steps until you have entered all the numbers. To get out of this screen press "Select/Enter" until you reach the menu, then use the arrow button to move up and down the menu.

For illustration purposes, let's match with an RU with ID 59308, but with an RU with ID 59309 within communication range. **The pre-programmed RU ID number can be found on the brass ID plate on the aluminium air-block. See Figure 32 for an overview description of the RU.**

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Directly after selecting "NEW ID", the ID selection menu is entered

Nearby RU has ID 59309

Press "UP" and/or "DOWN" buttons until the desired digit is displayed

Press "Select Enter" when desired digit is displayed

Press "UP" and/or "DOWN" buttons until the desired digit is displayed

Press "Select Enter" when desired digit is displayed

Press "UP" and/or "DOWN" buttons until the desired digit is displayed

Press "Select Enter" when desired digit is displayed

Press "UP" and/or "DOWN" buttons until the desired digit is displayed

Press "Select Enter" when desired digit is displayed

Press "UP" and/or "DOWN" buttons until the desired digit is displayed

Press "Select Enter" when desired digit is displayed

Status of ID is "NOT ARMED". Therefore, the RU arming routine must still be done

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"STATUS: NOT ARMED" appears under the numbers.   This means that the selected RU is not armed and an 'arming' message from the rear unit is needed to progress to the main operating menu. This can only be done by pressing the button on the rear unit after the correct RU ID has been selected and the CU is waiting for the arming sequence to commence.

 Once an RU ID number has been input, on the right side of the screen the following menu appears. Select "ARM" to match and arm with a RU. Should the number be incorrect, or to input another RU ID number, select "EDIT", input the number and press "Select/Enter" and continue, or press "EXIT" to go back to the previous menu.

When the ID number is correct and to arm, select "ARM" and press "Select/Enter". The following screen appears. Should you not want to continue with this screen, press "Select/Enter" to abort this action.

When the CU receives a normal RU update message, it will progress to a new screen reminding the user that the RU arming sequence remains to be done before normal operations can commence.

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When receiving the first packet of the arming sequence, the CU will display "ARM NOW", indicating successful reception of the first RU packet and transmission of the CU confirmation message. At this point, the CU will wait for a designated amount of time (12 seconds) before confirming or failing the arming procedure.

ARMING PROCEDURE FAILED

There is provision to indicate the failure of the arming procedure on the CU. The CU display will revert to the "Please ARM" screen to be able to repeat the arming procedure. This will usually happen when too much time has passed since pressing the "arm" or "ON/OFF" button on the RU.

ARMING PROCEDURE SUCCESSFUL

There is provision to indicate the success of the arming procedure on the CU. Also, the CU will not progress to the normal operating menu unless it has been armed successfully.

Make sure that the CU has been matched and armed with the correct RU.

The information displayed on the CU will only be from the matched (and armed) RU. Also, the emergency brake can only be applied if the CU has been armed with the RU and only the matched (and armed) RU will open the emergency brake valve.

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PREVIOUSLY ARMED ID

To select "OLD ID", press "Select/Enter", and an ID number of a previously matched RU may appear in the 5-digit ID number area if the ID that is stored in memory is still valid. The ID number of a RU is stored in memory after matching and arming, and is available to restore the connection if needed.

When selecting an ID to work with that has been armed previously, status is "ARMED"

"STATUS: ARMED" is now being displayed, because a CU must first be armed with a RU in order for the memory to be stored. Now, it only needs to receive a normal update from the RU to go to the normal operating menu. The display will show a "Waiting for Match" message in this case.
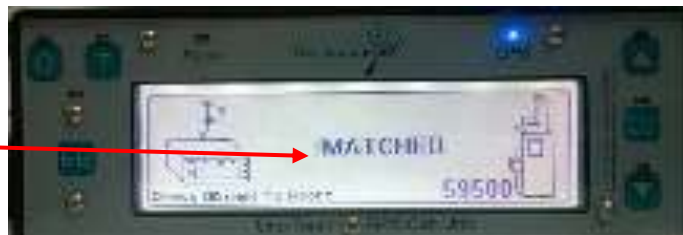
"Waiting for Match" when arming with a previously armed RU ID

"MATCHING" when receiving a message from selected RU ID. CU sends arming confirmation message.

"MATCHED" when receiving an arming confirmation message from the RU. Unit is now matched and armed

The arming sequence is as follows:

- The CU waits until an 'arming' message from the RU is received.
- The CU then responds by sending an 'update request' to the RU.
- If this message is received by the RU within a pre-set time, the RU will react by sending an 'arming confirmed' message to the CU.
- The CU will only be armed with this RU if this message has been detected within a pre-set time.

The arming sequence not only confirms that the two-way communication between CU and RU is working properly, but also is the only way to enter into the operating menu if the CU must communicate with a new RU. The arming sequence may therefore be used as a 'confirmation-of-communication' test.

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RESET

"RESET" can be used at any time in the setup menus

Press Reset and the Unit restarts and resets all parameters and screen will show "00000" and will display "Status: Not Armed". Any detected RU IDs will be displayed at the bottom of the menu screen for easier selection.

ENTERING NORMAL OPERATING DISPLAY

If the CU has been armed, the following screen will be displayed:

Straight-line GPS distance from RU to CU. Will only display if both CU and RU have valid GPS signal.

CU is armed

Previous train length

Manually enter the train length

The **train length** must be input as a pre-requisite for the continuity tests that will follow later. Use arrow keys to move up and down the menu to select the required field, just as with selecting a new ID. Should the previous length of the train be the same, press "Select/Enter" to use this as current train length and progress to the normal operating menu.

GPS length determined by CU

In this case, GPS distance was chosen. Now, the length must be accepted in order to progress

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Select GPS : If the RU and CU **both have GPS lock**, the CU will determine the ***straight-line distance*** between the two and display this length as a selection option. If required this length can be changed by pressing "Select/Enter", then input new length and press "Select/Enter".

After the train length has been selected, the CU will enter the normal operation menu displaying all the necessary operational parameters from the RU and CU for the user, as shown below.

NORMAL OPERATING DISPLAY

After the train length has been entered, the above screen will be displayed. This is how the display will look in normal operation. The pressure at the RU, the RU battery hours remaining and train length are some of the most important details that the train drivers can use. Use the "UP" arrow key as a shortcut to view GPS coordinates. Press "DOWN" arrow key to return to previous menu.

The driver must familiarize him- or herself with this normal operating menu. This is where all the necessary information is displayed about the train with regards to the telemeter system. From the list below, the driver must be able to determine the best course of action in a given situation.

The most important information for the driver are:
- the brake pipe pressure,
- the CU Status message,
- the RU battery status as translated to maximum hours left,
- and the train length.

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The CU Status message on the display indicates to the driver the state of the EoT-system (based on communication messages between CU and RU). Roughly speaking, it can be described as the health of the train.

Possible messages include:

- TRAIN OK
    - The system detects no evidence of the train being parted
    - There is no immediate concern from a train integrity point for the driver.
    - If CU and RU speed differes by less than 10 kph **AND** displacement deviation is less than 100 meters
- CAUTION
    - A temporary doubt of train completeness
    - There are some parameters out of the normal expected range, such as a speed difference between the CU and RU due of the message intervals of the RU.
    - Most of the time it will be displayed because of low pressure while slowing down or braking, or when standing still.
    - It means that the driver must be aware of one or more discrepancy, but that there is not yet a serious concern to be had for the train's intergrity.
    - If CU and RU speed differes by more than 10 kph **OR** displacement deviation is more than 100 meters
- TRAIN ERROR
    - There is sufficient evidence to warn that the train has become parted
    - The driver must give immediate attention to the telemeter system, because some serious fault is being experienced, such as the train length being longer than expected
    - If CU and RU speed differes by more than 10 kph **AND** displacement deviation is more than 100 meters
- No GPS Fix
    - Either the CU or RU, or both the RU and CU, does not have a valid GPS fix.
    - This is generally used for train integrity checks, such as detecting the difference in RU and CU speed, calculating if the train length is out of bounds etc.

From this 'normal operating' display, pressing "Select/Enter" will go to the menu system. Menu selections according to sub-systems can be found on the right side of the display. These may be use for various technical purposes, such as the "Point Clear" function.

EMERGENCY BRAKE APPLICATION (EBA)

Press the up and down arrows together

RU emergency
valve closed (X)

This method of sending an EBA message to the RU to open up the EBA valve needs confirmation from the driver/operator. "Emergency Brake?" will be displayed for a short amount of time. Within this time, the "Select/Enter" button must be pressed in order to confirm the action to be taken.

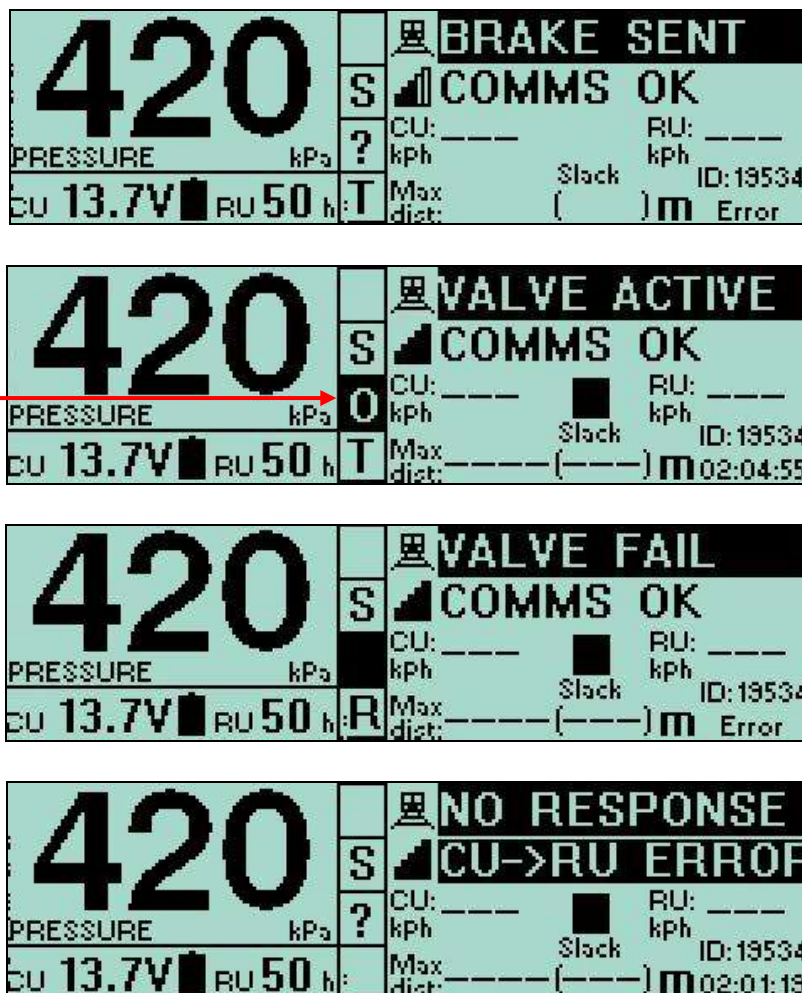## EMERGENCY BRAKE APPLICATION

STATUS: Version 3.0

Inteletrack CC

RU emergency
valve open (O)
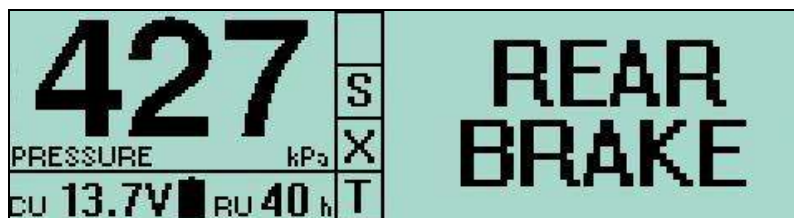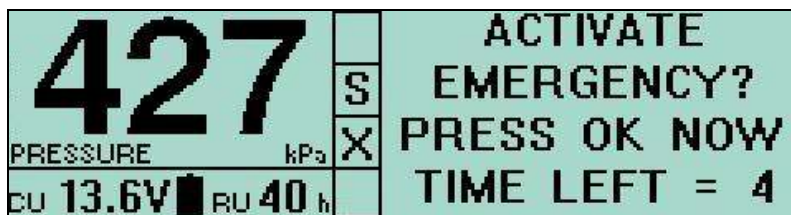
Figure 6: The 'One Touch' display.

By pressing the two arrow keys simultaneously (*wait for confirmation*), the cab unit will send a radio message to the rear unit to open the emergency brake valve, displaying as "REAR BRAKE". If the message has been successfully received, the RU will open the valve and send a message back to indicate this. This reply message will be displayed on-screen by displaying "VALVE ACTIVE" if the valve opened successfully. If the valve failed to open, it will display "VALVE FAIL". If the message was not received by the rear unit in a certain time, this error will be displayed as "NO RESPONSE CU->RU ERROR".

RU emergency
valve open (O)

CU Status
message is
"EMERGENCY"

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ODOMETER/POINT CLEAR

The driver may at some point want to determine whether the entire train has passed a certain point on the track. The 'Odometer/Point Clear' function may help to determine this. A prerequisite of this function is that the train length is known. This can be entered manually by the driver or calculated from the GPS coordinates *if the train is in a straight line.* The train length is also needed before the cab unit will proceed to the main menu.
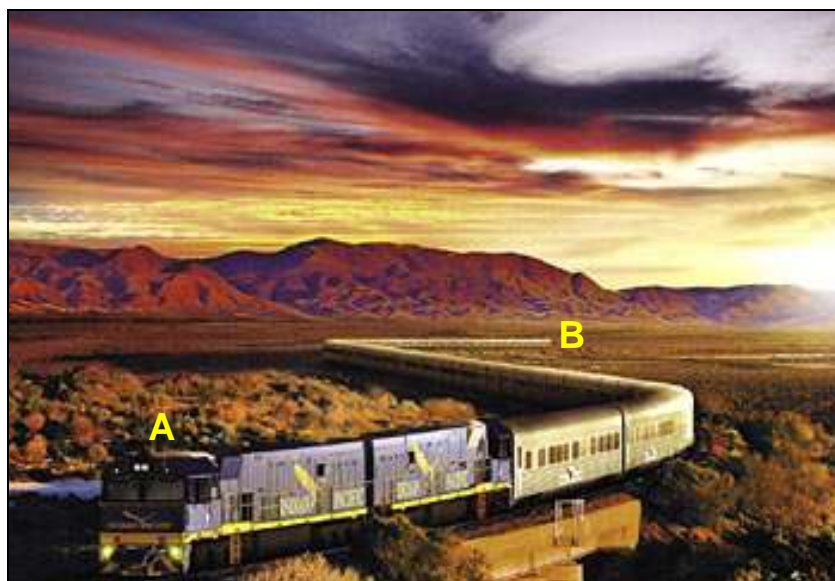

Figure 7: The driver can determine if the entire length of the train has passed a point with the 'Odometer/Point Clear' function.

From Figure 7, one can see that the train is running over a small bridge. Let's say the driver wants to know when the last wagon has passed over this bridge. By pressing the 'O' button on the Cab Unit after the locomotive has passed over the bridge, the CU starts to count the distance covered by the locomotive from the point where the button has been pushed. Point A is the point to be cleared. By using the Doppler-effect (GPS speed), the instant that the *distance covered by the locomotive (and last wagon) is larger than the train length*, the Cab Unit will display a message to indicate to the driver that the train has cleared the point.

Figure 8: Train Length is important for the Point Clear function.
Be sure to enter the correct train length as explained previously.

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There are two ways to be able to execute the "Point Clear" function:

- Using the system menu
- Using the 'O' button on the CU front panel as shortcut.

RU Movement indicator 'S' means train is stationary

Figure 9: If the correct length has been saved, the driver may use the Point Clear function to see the distance to drive until the point has been cleared.

POINT CLEAR ROUTINE

RU Movement indicator 'M' Means train is moving

Figure 10: Point clear routine entered.
Train length is 233m and RU is 173m from the mark where the countdown has started.

Figure 11: Point clear routine.
Train length is 233m and RU is 92m from the mark where the countdown has started.

Figure 12: Point clear routine.
Train length is 233m and RU is 15m past the mark where the countdown has started.
This means the last wagon is past the marker coordinates, but not past the 100m safe mark.

Figure 13: Point clear routine.
Train length is 233m and RU is 104m past the mark where the countdown has started.
This means the last wagon has past the marker coordinates and the 100m safe mark.
The CU status message will now display "POINT CLEAR" to confirm.

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Figure 14: Point clear routine.

Train length is 233m and RU is 302m past the mark where the countdown has started.

"POINT CLEAR" is replaced by a "CAUTION" message,

because the "POINT CLEAR" status time-out has been reached.

The countdown will be as follows:
- Display train length (seed)
- Display the distance from the point to be cleared to the rear unit (updated every second)
  - For example, display "-100 meter" if the distance from Point A to RU is 100m, the RU hasn't passed the point yet.
  - For example, display "20 meter" if the distance from Point A to RU is 20m, but the RU has passed the point.
- Display POINT CLEAR for 3 seconds when the RU has passed the point by 100 meters or more.

NOTES ON THE MENU AND DESCRIPTION OF ITS STRUCTURE

The menu as described in the Quick Reference Manual is somewhat outdated. To describe the new menu structure and its functions, the Quick Reference Manual will still serve as the basis of understanding, but the purpose of this section is to provide the most up-to-date descriptions of new functions and the structure of the menu.

The Structure

1. COMMS - The Cab Unit (CU) sends a 'request for-update' message to the Rear Unit (RU). When the RU receives this message, it will immediately send a message to the CU with updated parameters. This is also accessible via the shortcut 'T' button on the CU front panel.

2. ODO - If GPS is available and the train length is known (required before menu is accessible), the distance that still needs to be covered for the RU to reach the point where the CU was when this function was entered into will be displayed. After the RU has covered more than 100 meters past that point, an alarm will sound and 'POINT CLEAR' will be displayed.

3. ALARMS - This function is used to switch off the buzzer when an ERROR state is detected. When a normal state has been entered into, the buzzer will automatically be functional again (not buzzing – waiting for alarm condition).

4. L.C.D

   a. BRIGHT – Turns on the display backlight to its brightest setting.
   b. MEDIUM – Turns on the display backlight to a medium brightness setting.
   c. DARK – Turns off the display backlight.

5. GPS – Updates the right half of the display with the RU and CU GPS coordinates

6. RESET

   a. RESET - The unit is restarted. Power remains on.

7. SYSTEM

   a. SHOW DIAG – Technical screen. This shows all the technical info – GPS coordinates, VSWR, RSSI, RU speed, time, odometers, voltage level etc.
   b. TEST PTT – transmits a signal to warm up the radio. No message is transmitted.
   c. EXIT MENU
   d. VSWR 1.0 – calibrates the VSWR readings according to a matched dummy load.

8. EXIT – Returns to the normal operation menu

OPERATING THE REAR UNIT

The driver of the train has a relatively easy job with the rear unit. The rear unit only requires mounting and inspection for proper operation. The maintenance function for the rear unit is reserved for the approved and trained technical personnel. The rest of this section will only cover visual inspection of the rear unit to ensure proper operation on the train.
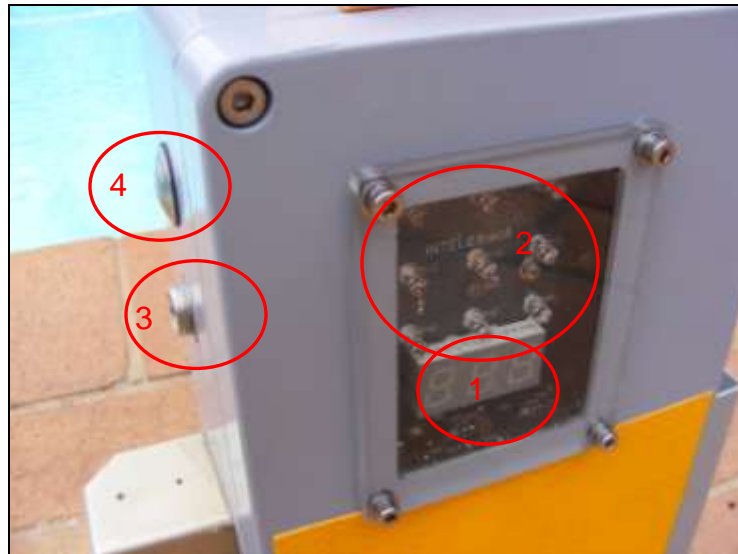
SWITCHING ON THE REAR UNIT

Figure 15: The GPS3 7-segment display [1], flasher [2], charger socket [3] and push-button [4].

Figure 16: By pressing and holding the push-button on the RU, the unit is switched on. Release button when "ON" is displayed on the 7-segment display.

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Figure 17: After the RU has been switched on, "VEr" is displayed on the 7-segment display. The version number of the firmware used is displayed next.

Figure 18: The version number of the firmware loaded on this PCB is "1.24".

More information on currently approved firmware version 1.39:

- The RU uses a VHF/UHF radio for communications and can only use FFSK modulation (AAR).
- The RU is equipped with a GPS, GPRS and VSWR module.
- The RU can measure the brake line pressure and open the valve in case of emergency.
- Being equipped with a Friendcom radio, the RSSI can be measured.
- The unit may be fully charged in the charging rooms while still switched on.
- The shutdown procedure requires the GPS3 to lie still and flat on its bracket (or backside) and the vandal-proof switch to be pressed for about 30 seconds to enter shutdown mode.

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THE 7-SEGMENT DISPLAY

Figure 19: The dot indicators. GPS [1], GPRS acknowledged [2], processor running [3].

On the dot indicators:

1. If [1] is flashing, then the GPS module is receiving GPS messages from the satellites. If [1] stays on, no valid GPS signal available yet.
2. If [2] is going on for a short time (about 10 seconds, depending on the network) and then off again, the GPRS module is functioning. The indicator dot turns ON when a message is transmitted and OFF again when a response message is received from the network. The intervals between transmissions can be adjusted.
3. If [3] is constantly turning ON and OFF, then the microprocessor is running.

ARMING ON THE REAR UNIT

The CU must be armed with the RU in order to be able to open the emergency brake valve and in order to progress to the normal operating menu in new CU firmware versions.

Arming on the RU is done by pressing the "ON/OFF" push-button. After pressing this button, the RU will send arming messages to the CU as already described. On the RU, the 7-segment display will go through a few factors to display its status to the user, which are brake pipe pressure, battery voltage and VSWR.

Figure 20: Normal RU display.

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Figure 21: First menu shows pressure value as 000 (kPa).

Figure 22: Second menu shows pressure units.

Figure 23: Third menu shows voltage value as 12.5V.

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Figure 24: Fourth menu shows 'bAt', indicating that the voltage displayed is that of the RU power source.
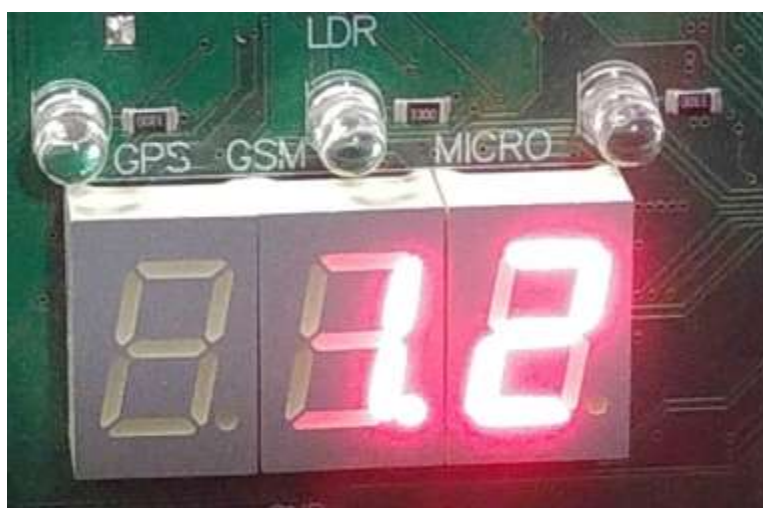

Figure 25: Fifth menu shows VSWR value as 1.2.

Figure 26: Sixth menu shows 'USr', indicating VSWR ratio.

THE FLASHER CIRCUITRY

Figure 27: The flasher circuit actually detecting bad light and flashing.
The indicator dots indicate bad GPS signal and processor running.

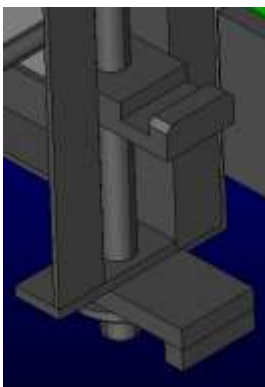*Figure 28:* The flasher circuit actually detecting bad light and flashing.

STATUS: Version 3.0

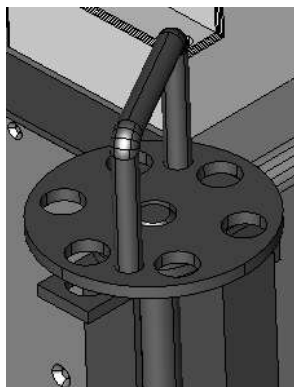Inteletrack CC

Figure 29: The flasher circuit actually detecting bad light and flashing.

Figure 30: The flasher indicated on the CU.
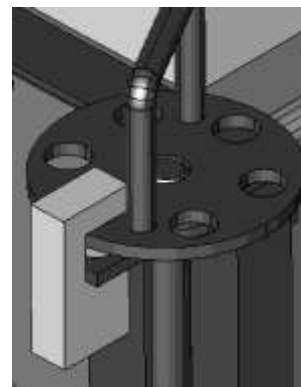

FITTING THE RU ONTO A WAGON BUFFER
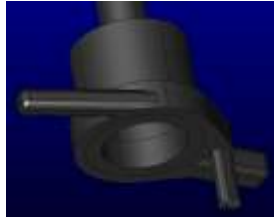
Fit the clamp arms into the buffer hole.

Tighten the rear unit to the buffer.

Lock the rear unit in place.

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Connect the rear air hose connector to the train for pressure or vacuum working.

# REAR UNIT SLEEP AND SHUTDOWN ROUTINES

To shut down the RU manually or put the RU into sleep mode manually, the unit must first detect that the brake pipe pressure is 0 kPa, in other words, in a safe condition if still on the train. The RU must first enter sleep mode before it can be shutdown manually. If the user wants to enter sleep mode on the RU, press and hold the RU push-button until just after the RU arming routine has scrolled through and indicates "SLP" on the 7-segment display. This indicates that the RU is checking if it's safe to enter sleep mode.
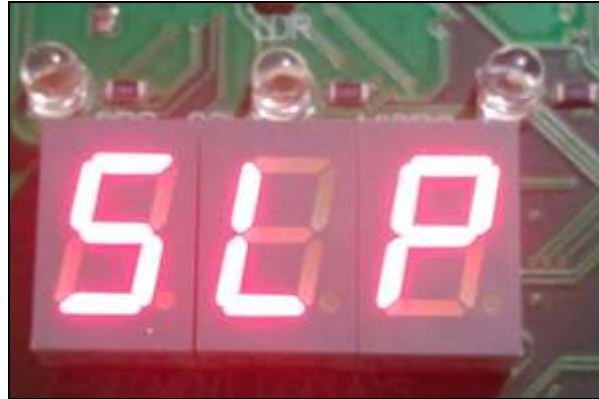
If safe to enter sleep mode, "SLP" will fall away and three dots will appear.
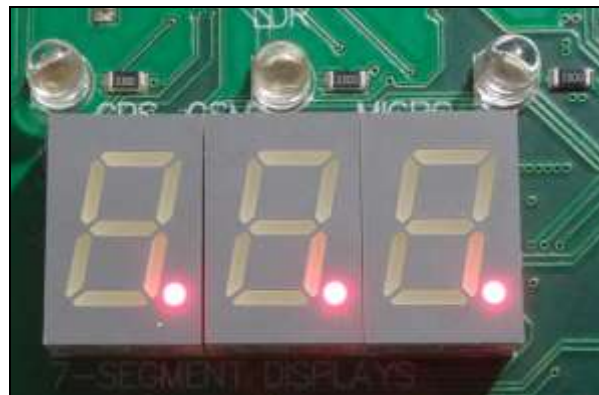
If it is unsafe to enter sleep mode, such as the pressure being any value except 0 kPa, the RU will not enter sleep mode and instead display and error message displayed as "Err".
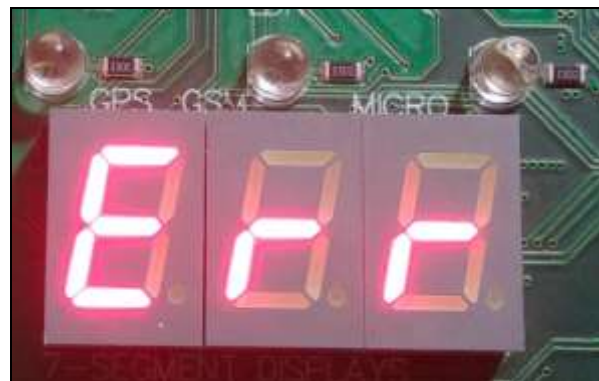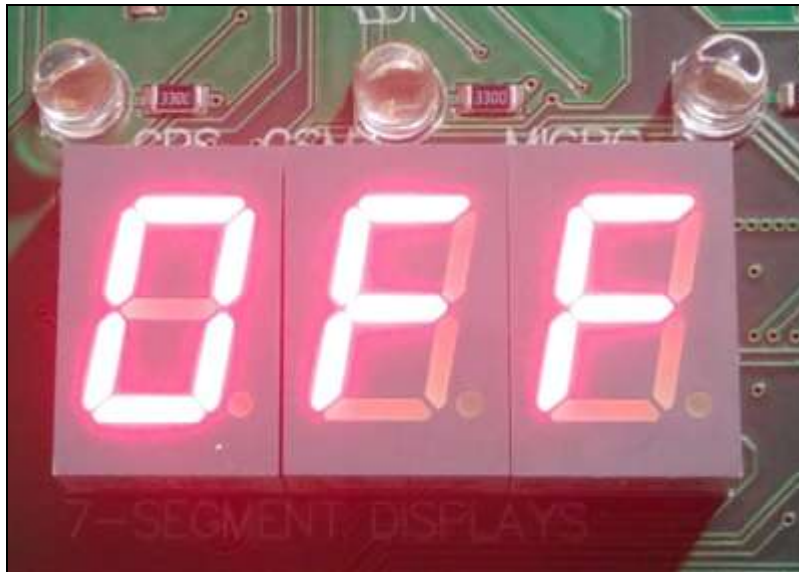

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Release the RU push-button to stay in sleep mode. If wanting to shut down the RU, keep holding the RU push-button until the "OFF" message is displayed. This will be approximately 30 seconds of time to keep the push-button pressed in.

OTHER METHODS

The RU will enter sleep mode when the RU is measuring 0 kPa and it is lying flat for greater than 30 minutes. A rear unit will wake up if a matched CU communicates with it.

The RU will shut down automatically to protect the battery from deep discharging when the battery voltage reaches 10.8V or below. If fully charged, a good lead-acid battery will last, from fully charged to automatic shutdown, for approximately 40 hours.

When the RU is placed on a charger and the air pressure is 0 kPa, the unit will also enter sleep mode. This is usually done in a charging room.

WHAT HAPPENS IN SLEEP MODE?

Basically, the only difference between sleep mode and normal mode is that the radio transmissions are disabled, but it is still able to receive signals.

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CHARGING THE REAR UNIT

Figure 31: The rear unit charger with charge indicator module attached.

The charge indicator module was specifically developed in order to assist with determining if the RU battery has been fully charged. The LEDs specify the following:

- BLUE
    - Power indicator
    - Indicates whether the indicator module receives power from the charger
- RED
    - No battery is detected
- YELLOW
    - Indicates that a battery is detected and is still being charged
- GREEN
    - Indicates that a battery is detected and is fully charged

Figure 32: The rear unit parts.

OTHER DIAGNOSTIC INFORMATION

GPS INFORMATION

Sometimes, it might be necessary to check on the GPS status of the CU, RU or both. The CU makes provision for this in two ways:

- through the system menu when normal operating screen is displayed, or
- by pressing the "UP" button as shortcut when normal operating screen is displayed.

Figure 33: Getting to GPS information from the operational menu.

Figure 34: The GPS information displayed with other information.
Here it is clear to see that both CU and RU have valid GPS coordinates.

AIR TURBINE (AIRGEN)

Some RUs may be equipped with airgens, which basically means that the RU battery will remain in a charging state while the RU is operating normally for the whole voyage. In this way, the driver has one less parameter to worry about. But how does the driver know if the RU on the train is equipped or not with an airgen?

RU maximum hours left has been halved

(AIR) next to "RU" indicates that RU is equipped with airgen. Battery capacity is halved as conservative measure.

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