TDR880i Instruction Manual

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EADS
DEFENCE
& SECURITY

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Contents

1. INTRODUCTION

General

This document describes the TDR880i data radio, including the key technical data, hardware, installation, and features of the device.

The radio described in this manual is approved for use in the TETRA network. Contact your service provider for more information about networks.

When using the features in this radio, obey all laws and respect the privacy and legitimate rights of others.

Company policy

Our policy is one of continuous development; details of all technical modifications will be included with service bulletins. While every endeavour has been made to ensure the accuracy of this document, some errors may exist. If any errors are found by the reader, EADS Secure Networks Oy should be notified in writing.

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Typographic conventions

Notes (including cautions, tips, warnings and general notes) call your attention to information.

The following symbols are used in the notes:

WARNING:
Warnings alert to dangers which may cause loss of life, physical injury or ill health in any form.

CAUTION:
Cautions indicate possible damage to equipment or a possibility of loss of data.

Note:
Notes indicate additional information such as recommendations or tips.

1.

Task sequence symbol. Indicates the start of a procedure.

2. IMPORTANT SAFETY INFORMATION

Operating environment

Remember to follow any special regulations in force in any area and always switch off your radio when its use is prohibited or when it may cause interference or danger. Use the radio only in its normal operating positions.

To maintain compliance with radio frequency exposure guidelines, only use enhancements approved by EADS for use with this radio.

Using two TETRA devices in close proximity (in the same vehicle, for example) may cause them to interfere with each other. If you experience such interference, separate the two devices until the interference stops.

Medical devices

Operation of any radio transmitting equipment may interfere with the functionality of inadequately protected medical devices. Consult a physician or the manufacturer of the medical device to determine if they are adequately shielded from external RF energy or if you have any questions.

Switch off your radio in health care facilities or near medical devices when any regulations posted in these areas instruct you to do so. Hospitals or health care facilities may be using equipment that could be sensitive to external RF energy.

Pacemakers

Pacemaker manufacturers recommend that a minimum separation of 6 in. (15.3 cm) be maintained between a radio and a pacemaker in order to avoid potential interference with the pacemaker. These recommendations are consistent with independent research by and recommendations of Wireless Technology Research.

People with pacemakers should always keep the radio more than 6 in. (15.3 cm) from their pacemaker when the radio is switched on. If you have any reason to suspect that interference is taking place, switch off your radio immediately.

Hearing aids

Some digital wireless terminals may interfere with some hearing aids. If interference occurs, consult your service provider.

Vehicles

RF signals may affect improperly installed or inadequately shielded electronic systems in motor vehicles. These systems include, for example, electronic fuel injection systems, electronic antiskid (antilock) braking systems, electronic speed control systems, and air bag systems. For more information, check with the vehicle or additional-equipment manufacturer or its representative.

Only qualified personnel should service the radio or install the radio in a vehicle. Faulty installation or service may be dangerous and may invalidate any warranty that may apply to the radio.

Check regularly that all radio equipment in your vehicle is mounted and operating properly.

Do not store or carry flammable liquids, gases, or explosive materials in the same compartment as the radio or its parts and enhancements.

For vehicles equipped with an air bag, remember that air bags inflate with great force. Do not place objects, including installed or portable wireless equipment, in the area over the air bag or in the air bag deployment area. If in-vehicle wireless equipment is improperly installed and the air bag inflates, serious injury could result.

Aircrafts

Using or installing this radio in an aircraft is prohibited. Switch off your radio before boarding an aircraft. The use of wireless teledevices in an aircraft may be dangerous to the operation of the aircraft or disrupt the wireless telephone network, and may also be illegal.

Potentially explosive environments

Switch off the radio when in any area with a potentially explosive atmosphere and obey all signs and instructions.

Potentially explosive atmospheres include areas where you would normally be advised to turn off your vehicle engine. Sparks in such areas could cause an explosion or fire resulting in bodily injury or even death.

Switch off the radio near refuelling points such as gas pumps at service stations.

Observe restrictions on the use of radio equipment in fuel depots, storage and distribution areas, chemical plants, or where blasting operations are in progress.

Areas with a potentially explosive atmosphere are often, but not always, clearly marked. They include below-deck on boats, chemical transfer or storage facilities, vehicles using liquefied petroleum gas (such as propane or butane), and areas where the air contains chemicals or particles such as grain, dust, or metal powders.

Care and maintenance

The TDR880i data radio is a product of superior design and craftsmanship and should be treated with care. The suggestions below will help you fulfil any warranty obligations and enjoy this product for many years.

- Keep the radio and all its parts and accessories out of reach of small children.
- Keep the radio dry. Precipitation, humidity and all types of liquids or moisture can contain minerals that will corrode electronic circuits.
- Do not use or store the radio in dusty, dirty areas. Its moving parts can be damaged.
- Do not store the radio in hot areas. High temperatures can shorten the life of electronic devices, damage batteries and warp or melt certain plastics.
- Do not store the radio in cold areas. When it warms up (to its normal temperature), moisture can form inside, which may damage electronic circuit boards.
- Do not drop, knock or shake the radio. Rough handling can break internal circuit boards.
- Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the radio.
- Do not paint the radio. Paint can clog the moving parts and prevent proper operation.
- Use only the accessory antennas or other approved antennas. Unauthorised antennas, modifications or attachments could damage the phone and may violate regulations governing radio devices.

All of the above suggestions apply equally to the product, charger or any accessory.

Note:

The Global Positioning System

The Global Positioning System (GPS) is operated by the United States government, which is solely responsible for the accuracy and maintenance of the system. The accuracy of location data can be affected by adjustments to GPS satellites made by the United States government and is subject to change with the United States Department of Defense civil GPS policy and the Federal Radionavigation Plan. Accuracy can also be affected by poor satellite geometry.

Availability and quality of GPS signals may be affected by buildings and natural obstacles as well as weather conditions. The GPS receiver should only be used outdoors to allow reception of GPS signals. The GPS should not therefore be used for precise location measurement and you should never rely solely on location data from the GPS receiver.

3. DEVICE OVERVIEW

The TDR880i is used as a data-only radio allowing applications to send/receive SDS messages as well as use IP data services via a PEI-based serial interface. Simultaneous use of AT commands and IP data is not supported.

For data communications, a 9-pin RS232 D-connector is provided.

The TDR880i also provides a set of digital I/O lines that can be configured as inputs or outputs. The outputs can be controlled by SDS messages; the inputs can be used to trigger status message or location sending to predefined destinations.

For I/O lines, a 26-pin high density D-connector is provided.

The radio unit features a GPS receiver for positioning. An external active GPS antenna is required and a connector is provided for it. A passive antenna gain may not be enough and could damage the device by short circuiting the DC voltage provided through the GPS antenna connector for the external low noise amplifier.

The radio unit does not have an integrated TETRA antenna. Thus, a connector for an external antenna is provided. A a combined TETRA/GPS antenna can also be used.

Figure 1 TDR880i radio unit

The unit provides various LED indications for the user (explained below from right to left):

- **Power On**: The LED is lit when the power is switched on. Note that this indicates the actual operational status of the unit, not the existence of a power supply. Even if the supply power is present, the LED is not lit unless the radio unit itself is switched on.
  If the red Power On LED is blinking, the unit is in sleep mode. For more information, see Sleep mode on page 16.
- **In Service**: The LED is lit when the radio has successfully registered in the system and the field strength is good enough for communications.
  If the green In Service LED is blinking, the unit is searching for the network.
- **GPS Fix**: When the GPS has a fix and is aware of its position, the LED is lit.
  If the green GPS Fix LED is blinking, the unit is searching for the GPS fix.

There is also a power on/off button.

SW upgrades or parametering is done via the I/O connector using cables made for this purpose. For more information, see Section I/O cable on page 12.

Accessories

The accessories are not included in the standard sales package. They are available as separate items and priced separately.

External AC Power Supply ACR-2E

The external power supply ACR-2E is used to supply +12 VDC for the device from AC mains.

The AC power supply has various mains plug options available (UK, US, IEC). It is also fitted with a DC cable with a matching connector allowing direct connection to the TDR880i.

The external AC power supply is intended for indoor use in weather protected dry conditions only.

The power supply is CE approved and conforms to EU EMC requirements.

The power supply is 12V providing max. 24 watts.

DC Power Cable CA-113

The DC power cable CA-113 has a matching connector for connection to the TDR880i. The other end of the cable is a plain wire (=no connector). The multi-threaded copper wire thickness should be at least AWG18 (equals to ~1.0mm copper diameter).

The cable includes an in-line fuse box and a fuse (5 amperes / 12 Volts).

Data Cable CA-109

The data cable is a serial null-modem cable equipped with D9 female connectors at both ends so that it can be used to connect the TDR880i to a PC serial port without any extra accessories.

Flashing and Parametering Adapter CA-115

The flashing and parametering adapter has a male (plug) 26-pin D-subminiature connector and an 8-pin RJ45 socket. This item is used in flashing environment together with a prommer and with a DAU-9S cable when parametering the TDR880i device.

Fixed TETRA Antenna Kit AN-7

The TETRA antenna is a dedicated fixed mount whip antenna for TETRA use, frequency band 380-400 MHz.

The antenna includes a cable with matching connector for connection to the TDR880i.

Note that in outdoor installation, the System Integrator is responsible for providing adequate lightning protection for the antenna line.

The TETRA antenna HR7775A sales package includes:

- Fixed mount base with an FME connector
- TETRA radiator 380-470 MHz 5dBi
- Cable, 5 meters, FME/TNC for TETRA mount base

Magnet Mount TETRA Antenna Kit AN-9

The magnet mount TETRA antenna kit has the same content as the AN-7 except that the antenna is equipped with a magnet mount base instead of a fixed one.

Magnet Mount GPS Antenna AN-5

The GPS antenna includes a 5 m cable and an integrated low noise amplifier. The power (+5 VDC) for the LNA is fed through the antenna cable from the TDR880i.

- Active gain of the GPS antenna is 27 dB and passive gain is 5 dBic @ zenith

Combined TETRA/GPS Antenna Kit AN-6

The combined TETRA/GPS antenna provides the same functionality as the separate fixed TETRA and GPS antennas together. The sales package HR7774A includes:

- GPS/TETRA base
- TETRA radiator 380-470 MHz 5dBi
- Cable 5 meters SMA/SMA for the GPS antenna
- Cable 5 meters FME/TNC for the TETRA antenna

PC Software

Parametering is based on the TETRA Programming Tool (TPT) software, in releases from the beginning of 2008 onwards with necessary modifications and additions to support new features.

CE marking in the TDR880i

The following figure shows where the CE marking can be found in the TDR880i.

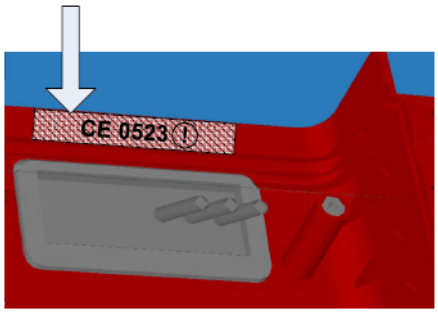

Figure 2 CE marking in the TDR880i

4. INSTALLATION

■ Safety warnings and cautions

WARNINGS:

1. If the device is installed in a vehicle, care must be taken on installation in vehicles fitted with electronic engine management systems and anti-skid braking systems. Under certain fault conditions, emitted RF energy may affect their operation. If necessary, consult the vehicle dealer/manufacturer to determine the immunity of vehicle electronic systems to RF energy.
2. The radio must not be operated in areas likely to contain potentially explosive atmospheres, for example petrol stations (service stations), blasting areas etc.
3. Operation of any radio transmitting equipment may interfere with the functionality of inadequately protected medical devices. Consult a physician or the manufacturer of the medical device if you have any questions. Other electronic equipment may also be subject to interference.

CAUTIONS:

1. Servicing and alignment must be undertaken by qualified personnel only.
2. Ensure all work is carried out at an anti-static workstation and that an anti-static wrist strap is worn.
3. Ensure solder, wire or foreign matter do not enter the radio, as damage may result.
4. Use only approved components as specified in the parts list.
5. Ensure all components, modules screws and insulators are correctly re-fitted after servicing and alignment. Ensure all cables and wires are repositioned correctly.
6. It is recommended that the radio is powered down either by pressing the power button or by controlling the dedicated PWR_ON_OFF I/O pin before disconnecting or switching off the radio's battery or other input power supply. This method ensures the integrity of the file system. Make sure that the power is really switched off (the powering down takes about 3 seconds after which the Power On LED goes off).

ESD protection

EADS requires that the TDR880i data radio's service points have sufficient ESD protection (against static electricity) when servicing the product. Any product which has its covers removed must be handled with ESD protection. To replace the covers, ESD protection must be applied. All electronic parts of the product are susceptible to ESD.

All ESD-sensitive parts must be packed in metallized protective bags during shipping and handling outside any ESD Protected Area (EPA).

Every repair action involving opening the product or handling the product components must be done under ESD protection.

ESD-protected spare part packages MUST NOT be opened/closed outside of an ESD Protected Area.

For more information and local requirements about ESD protection and ESD Protected Area, contact your local EADS After Market Services representative.

Environmental conditions

The TDR880i can be installed in an environment meeting the specifications shown in the following table.

Parameter	Range
Operating temperature	-20…+55°C **Note:** Avoid exposing to direct sunlight.
Humidity	Up to 95%, non-condensing
Vibrations and shocks	According to ETSI EN 300 019-2-5 V3.0.0 (5M3), installations only inside vehicles. According to ETSI EN 300 019-2-6 V2.1.2 (6M3)
IP Classification	IP44 (splash proof)
EMC & SAR	EMC approved according to EU regulations. SAR is not evaluated as the device is not a handheld device.

Table 1 TDR880i environmental conditions

Tools and installation materials

The TDR880i is mounted using ø 3mm screws (4 pcs). The screw type depends on the mounting material (metal/ wood/plastic).

Cable types, making of cables

All the cables should tolerate direct exposure to sunlight and common chemicals such as alcohol, isopropanol, petrol, sun lotion, insecticides etc.

Power cable

The power cable should be connected to a power supply (battery or other DC supply) that has a fuse on its output. If the output of the power supply is not fuse-protected, an in-line 5 A fuse must be installed in the power cable. The maximum recommended length of the power cable is 1.5 meters. If a longer cable is needed, the voltage drop and inductance of the cable should be taken into consideration; fast load transients may cause the input voltage to drop below the operational limits of the device.

- Cable diam. min. AWG18
- The pinout is given in Section Power supply on page 28.
- Recommended cable suppliers: Carol Cable, Dearborn, Belden, Alpha, West Penn Wire. A 2-wire (pair) cable is recommended.
- Connector suppliers: Tyco Electronics, Conec, Amphenol

I/O cable

The I/O cable is customer-specific. EADS does not provide any kind of I/O cable. All customer-specific I/O pins are 5V logic level compatible. The pinout is given in Section I/O lines on page 29. The maximum load for a single I/O line is 20 mA. Note that the total I/O load should be limited to 160 mA (all I/O pins combined).

- Recommended cable suppliers: Carol Cable, Dearborn, Belden, Alpha, West Penn Wire. A multi-wire cable is recommended, the cable size depends on the chosen connector (may vary from AWG20 to AWG28).
- Connector suppliers: Tyco Electronics, Conec, Amphenol

Data cable

The data cable has a standard null-modem cable pinout.

Signal name	DB-9 pin	DB-9 pin
TD (Transmit Data)	3	2
RD (Receive Data)	2	3
SG (Signal Ground)	5	5

Table 2 Data cable pinout (Data-only)

If an application uses a hardware flow control (RTS/CTS or DSR/DTR), and it is not possible to set the flow control to 'none' or 'XON/XOFF', the cable with the pinout illustrated in Figure 3 needs to be used (depending on the application, all the connections are not necessarily required; check the connections to be needed from the Guide of the application used).

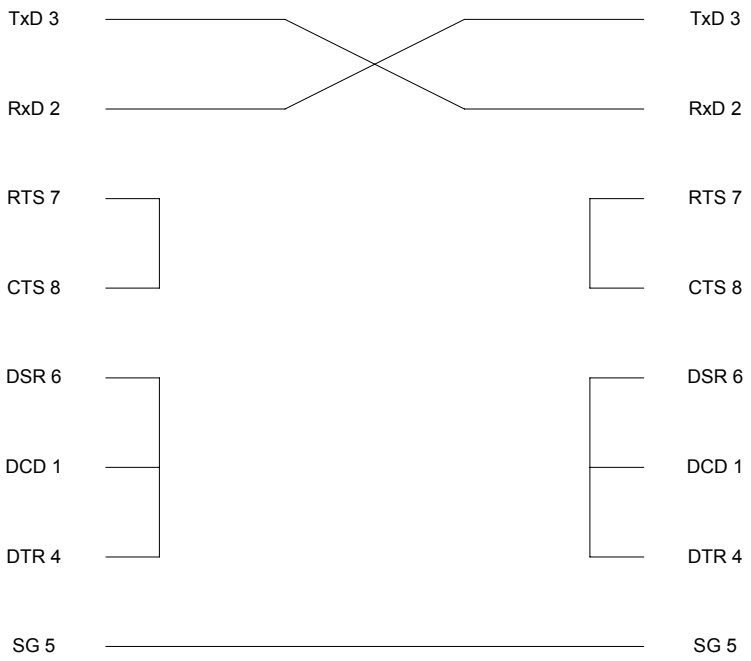

Figure 3 Null-modem cable wiring

TETRA RF cable

In the HR7774A TETRA/GPS antenna unit (sold as an accessory), the TETRA RF cable is TNC (plug) to FME (plug) type.

The TETRA RF cable should be 50 ohm and low loss type, especially when there is a need for a long cable. Use a proper cable size for the connector(s) selected, for example RG58C/U, RCG316U, or RG142B/U.

GPS RF cable

In the HR7774A TETRA/GPS antenna unit (sold as an accessory), the GPS RF cable is RG316 SMA (plug) to SMA (jack) type.

The GPS cable should be 50 ohm and low loss type, especially when there is a need for a long cable. Use a proper cable size for the connector(s) selected, for example RG58C/U, RCG316U, or RG142B/U.

■ Installation procedure

It is recommended that the parameter and network configuration of the radio is done before its installation.

Installing the TDR880i

1. Check and clean the surface the radio is to be installed on. Also ensure that the installation surface is flat.
2. Check that you have the tools, mounting screws suitable for the material the radio is to be installed on, and the accessories needed for the installation.
3. Remove the radio from the package and dispose of the packing materials according to local instructions.
4. Place the radio on the installation surface as recommended. Install the radio in a position where the connectors are pointing down and the flat side of the radio is fastened to the surface.
5. Fasten the radio using mounting screws and procedures suitable for the surface material. Do not overtighten the screws as this might break the plastic cover of the radio.
6. Connect the GPS antenna. **Optional**
   Accurate torque must be used for the RF connectors[1]:
   - for the GPS SMA connector, the torque needed is 0.9 Nm.
     See Section Lightning protection on page 14 for information on lightning protection.
     The GPS antenna is not needed if the GPS functionality of the radio is not used.
7. Connect the TETRA antenna.
   Accurate torque must be used for the RF connectors[1]:
   - for the TETRA FME connector, the torque needed is 2.0 Nm
     See Section Lightning protection on page 14 for information on lightning protection.
     The TETRA antenna is not needed if the TETRA functionality of the radio is not used.
8. Connect the IO cable. **Optional**
   IO cabling is not needed if the IO functionality of the radio is not used.
9. Connect the serial/AT cable. **Optional**
   The serial/AT cable is not needed if the AT functionality of the radio is not used.
10. Close the rubber plugs for the unused connectors excluding the power connector.
11. Ensure that all the cables coming to the radio are fastened in a manner that will not cause bending, twisting, pushing, pulling, or vibrating motion to the connectors of the radio.
12. Connect the power cable. The red Power On LED lights up.
13. If the GPS is ON, the green GPS LED (in the middle) starts blinking. If the GPS antenna is attached, the LED lights up when the radio has a GPS fix.
    See Section Tracking and positioning on page 16 for information on using the GPS functionality.
14. If the radio is configured with the network parameters, the green LED on the left starts blinking. If the TETRA antenna is attached and the radio is in network coverage, the LED lights up when the radio has network service.

Cabling

Connecting the power supply

DC input from 5A fused 12V or 24V battery system. Tighten the D-sub connector screws by hand.

Special considerations for vehicles, vessels etc.

Mount the device and all cables securely to the installation base in order to avoid product damage due to shocks and vibrations. Avoid sharp bending of cables, especially RF cables.

Lightning protection

Protect the antennas in particular from lightning using lightning rods or other methods.

1. When the TDR880i's own accessory antenna is used, the above-mentioned torque values are valid for both ends of the antenna cable (the TDR880i end as well as the antenna end). If you use other antennas/cables/connectors than the ones listed as TDR880i accessories, the valid torque values for those must be checked from their manufacturer. The above-mentioned values are valid for the TDR880i connectors in this case too. For more information on how to fix the TDR880i accessory antenna (including the valid torque value), see the leaflet provided with the antenna package.

Grounding

The TDR880i is connected to the negative ground of the vehicle/vessel via the power supply cable.

Starting up

Starting up after flash / parametrization

1. Remove the parametrization/flash cable.
2. Power down the device by pressing the power button.
3. If you have to check the GPS and/or network functionality, connect the antennas. **Optional**
4. Power up the device by pressing the power button again.
5. Make sure that the red Power On LED is lit. This tells you that the device is powered on and the root software is running.

Verifying the AT functionality

1. Connect the RS232 cable (AT) to the AT interface of the device and to the COM port of the computer.
2. Open a serial connection to the device using an appropriate program, for example the HyperTerminal.
3. Execute the AT info command. Check that the device replies with OK as in the following sequence:
   > AT
   OK.

Verifying the parametrization functionality

1. Power down the device.
2. Connect the CA-115 adapter and the DAU-9S cable.
3. Start the TETRA Programming Tool (TPT).
4. Power up the device.
5. From the **Connections:** drop down menu, select the connection type as **FBUS**.
6. Select **File** →**Scan Product**. The TPT should recognize the TDR880i and allow the parametrization of the device.

5. FEATURE GUIDE

Feature overview

Based on the EADS TETRA i-range platform, the TDR880i contains a lot of functionality common to this product family. This document focuses on the new features and major feature changes introduced in the TDR880i product. Thus the common TETRA features are not described in depth here.

The main new features of the TDR880i are:

- Tracking capability of the location history (see Section Tracking and positioning on page 16)
- Configurable low power consumption mode with time and periodical capabilities - the sleep mode (see Section Sleep mode on page 16)
- Possibility to route GPS output as NMEA through the AT port (see Section NMEA output on page 17)
- Enhanced clock recovery after power failure (see Sections Time recovery on page 17 and Recovery from power failure on page 18)
- Enhanced temperature protection by controlling the RF and extension chip powering in heating conditions (see Section Temperature protection on page 18)
- Configurable group management with background scanning and the ability to use FACCH for messaging when available (see Section Load management (group management + FACCH) on page 18)
- I/O line bound Alert condition management feature with configurable OTA notification and configuration options (see Section Alert condition and notification feature on page 18)

Tracking and positioning

The TDR880i can be configured to send its location information periodically to the controller that needs to keep track of the location history. When the TDR880i is in service, the location information is sent as SDS messages.

When the TDR880i is out of service and the GPS tracking functionality is enabled, the TDR880i stores the location information in permanent memory until it is back in service again. The tracking information is then sent to the controller as SDS messages.

The SW component that provides the tracking functionality in the TDR880i is called the GPS Tracking Server (GTS).

Note: Due to the background nature of this feature, it should be noted that when this feature is configured and activated, it takes partial control over the GPS circuit powering and in certain situations prevents the powering down the GPS circuit. In cases where the power consumption should be turned to an absolute minimum, or complete control of the GPS circuit is required, this feature should be turned off.

Sleep mode

The sleep mode functionality adds a special *timed hibernation* possibility for the product. In general this means that the product can be set to low-power consumption mode - e.g. sleep - for a specified amount of time. In this mode, the device is aware of its internal clock and powering events, but has turned down all other external PEI / RF interfaces.

When using this feature, the device can be configured to hibernate for a certain time or the time periods can be defined when the device is operational and when it hibernates.

It should be noted that the sleep mode itself does not include calendar functionality, and the given time parameters are treated as absolute values of specified time units like minutes.

Sleep mode activation

Sleep mode can be activated by passing a configuration message to the device which defines sleep and optional wake time. See PARAMETER REFERENCE (TDR880I SPECIFIC PARAMETERS) on page 20 for Sleep mode parameter information.

Sleep mode termination

Sleep mode is terminated - either temporarily or permanently - if at least one of the following conditions occur:

Termination time reached
The Sleep mode service periodically checks the current time and date to resolve the possible wake-up condition. When the specified time is reached, the device is started up into operative mode.

Power switched ON by the end user
Powering the TDR880i can be controlled either by pressing the power button or raising the external fixed power IO pin. If the device is powered on when Sleep mode is configured, the device will boot up into operative mode and remain in that state for a fixed time of 10 minutes. If the Sleep Mode configuration is not updated during this period, the Sleep Mode continues execution as previously configured.

Power failure
When the main power is returned after a power loss, the device will boot up and check the time settings of the device. If the power loss caused a reset to the Real Time Clock (RTC), the device is powered to a fully operative mode, and the RTC recovery routine is started. During this mode, the all Sleep mode settings are temporarily cancelled until the correct time/date are recovered. After the successful retrieval of the correct time, the Sleep mode functionality continues execution as configured.

Note: Sleep mode cannot be terminated through the AT / OTA interface when the device is in the hibernate mode. Such termination always requires interfacing the power switching functionality or the main power itself.

NMEA output

The TDR880i provides two ways of routing the NMEA output from the GPS module directly to the AT interface. Both require an AT command for initiation. To enable the GPS, use the following AT command (if the GPS is not enabled by default using the parameter settings of the TDR880i):

AT+CXGPSC=value

value 1 activates and 0 disables the GPS

Periodic Output:
The end user may request the device to enter a state where NMEA is queried periodically from the GPS facilities and routed to the AT channel at a speed of 9600 b/sec. To enable this mode, the end user must use the following command.
AT+CXGPSPLR=value

values 1-30 equals time in seconds, value 0 disables periodic output

Direct Timed Output:
In this mode the device routes the 4800 b/sec. NMEA output directly to the AT output for a specified period of time. In order to turn this mode on, the following AT command must be used.
AT+CXNMEARD=password, value

password parametrized, value between 1-65536

Note: During the period of direct routing, the AT channel is not available.

Note: After the NMEA redirect period ends, the GPS is disabled.

Time recovery

If the radio has been out of main power and has consumed all the power stored in the backup batteries, the in-device main clock resets. At the next startup the condition is recognised and the TDR880i starts to recover the clock state. During the recovery process, the following steps are taken:

1. The device tries to connect into the network and receives the current network time.
2. If the network does not provide the main time within 10 minutes, the network recovery is continued and the device tries to recover the time from the GPS signal.

Note: At any time during the recovery, the end user is able to set the time using the AT interface, but if the network recovery is activated, it supersedes other recovery functions.

Note: TDR880i utilizes UTC time (Coordinated Universal Time).

Recovery from power failure

The TDR880i is powered by an external DC supply (10.6 - 32 V).

The device powers on if the external input voltage rises to within the operational limits (10.6 - 32 V). If the TDR880i is shut down using the power button or through the dedicated POWER ON_OFF I/O pin and there is no cutoff from an external power supply, the device will not power up unless the button is pressed or the external I/O is toggled.

The TDR880i powers on after it recovers from an external power supply failure. The power status is held in the memory in order to get to the same state it was in before the power failure. If the device was shut down using the power button or through the dedicated POWER ON_OFF I/O pin before the external power supply failure, the SW will take care of shutting down the device again after the recovery (the device was intentionally shut down before the power failure).

Note that if a power failure of an external power supply occurs when the device was intentionally powered off either by pressing the power button or by controlling the PWR_ON_OFF I/O pin, the device will not recover from the power failure situation if the power failure time (the time when the external power supply is off) is shorter than ca. 15 seconds. The device can be powered on by pressing the power button or by controlling the PWR_ON_OFF pin.

If the device has lost main power and runs out of backup power, the main clock of the device resets. In this case the Time Recovery sequence is started during the next startup. See Section Time recovery on page 17.

When the device has no power, the I/O lines are in an undefined state. Use external pull-up and pull-down resistors in the I/O lines if the I/O should have a defined state in power off. Note also that the Power On indicator, In Service, and Over-temperature indication signals are driven high but are in high-Z when not driven. These signals should not have an external pull-up resistor in order to get a valid result (there is a weak pull-down in each signal line). An external pull-down resistor is recommended to be used in these signals. After recovering from a power failure, the I/O lines are driven to the state they were in before the power failure. The only pins that do not behave this way are the GPS fix and In Service indication pins. These I/O pins indicate the real status of the GPS or TETRA service availability.

Temperature protection

The device monitors its internal temperature and shuts down the transmitter power in the event of overheating. An overheating indication will be sent over an AT command interface (and indicated by I/O line).

After a sufficient drop in internal temperature, the device returns the transmitter to normal operation, and indicates this event to an external application by the I/O line and by AT indication.

Load management (group management + FACCH)

While the TDR880i cannot establish outbound individual calls or accept them, it is able to register and scan group traffic. Group management in the TDR880i is done exactly the same way as in the THR880i (TETRA handportable radio) product. During the group connectivity, the TDR880i can utilize FAC channel (FACCH) in SDS sending when there is no other traffic.

Alert condition and notification feature

The TDR880i can be configured to monitor I/O line changes and to react to them by setting an alert condition into the system. Depending on the configuration, the action taken may be a single shot SDS message to a defined address, continuous sending until the alert condition is removed, or an SDS notification requiring acknowledgement before turning off the alert condition.

In addition to immediate and Alert dedicated SDS sending, the TDR880i can be configured to include alert status information into LIP messaging.

AT commands

AT commands can be used to manage and control the functionality of the TDR880i.

For a complete list of the AT commands, please refer to the document *AT command set for EADS TETRA products,* version 2.0.

Note: AT passwords cannot contain quotation marks ("... ").

Note: The data connection must be disconnected before removing the data cable.
If the data cable is removed before the data connection is disconnected, the connection will stay reserved and new connection attempts will fail.

I/O lines functionality

The TDR880i includes a 26-pin high density D-connector in which certain pins can be used as indications of the device state or as directly configurable I/O between the device and a remote unit.

Power On output, active high:
The Power On signal indicates the power status of the device. It will be held inactive until the device has booted up properly and is ready to operate (e.g. ready to receive a command via the AT interface).
Note that in the power off state this PIN is not driven by the TDR880i. Note that this signal is not driven actively to the low state when the device is powered on. The device has a weak pull-down on board. Use an external pull-down resistor in a harsh environment.

In Service output:
The line indicates the status of the radio signal reception. When the terminal has successfully registered in the system and is receiving a good enough signal for communications, this line is active. Note that this signal is not driven actively to the low state when the device is powered on. The device has a weak pull-down on board. Use an external pull-down resistor in a harsh environment.

GPS Fix output:
This line is active when the GPS receiver is enabled and has a good enough satellite fix for positioning.

Over Temp output:
The output is active when the device in unable to communicate due to overheating. The output will go inactive when the temperature is back within specified limits. Note that this signal is not driven actively to the low state when the device is powered on. The device has a weak pull-down on board. Use an external pull-down resistor in a harsh environment.

Power Control input:
The TDR880i can be toggled on/off by an external application. To toggle the power on/off: set this pin to 5V for 500 ms and then set it back to 0V.

DC output:
Can be used as a DC power supply to external devices. This output is taken directly from the DC input of the TDR880i and just routed to one of the pins. The maximum output current should be limited to 500 mA. There is no additional regulation or intelligence[1]. The DC voltage is always present when an external power supply is connected to the DC power connector.

Programmable IO pins:
In addition to the fixed output and input lines, the TDR880i contains twelve programmable IO lines which can be configured to control actions in the device. Possible actions for the pins are:

- Status message sending, which can be used in conjuction with status LIP trigger
- SDS-4 message sending
- raising the Alert condition

The last one can be further configured as described later on in this document.

1. Some filtering may be necessary for ESD/EMC.

6. PARAMETER REFERENCE (TDR880I SPECIFIC PARAMETERS)

Sleep mode

Sleep mode has the following parameters:

Parameter	Description	Values
Operating Mode	periodic / one-shot	0 = off 1 = periodic 2 = one shot
Sleep Time	Time to hibernate (minutes)	0<n<65536
Wake Time	Time to remain in operational mode after previous wake-up (minutes)	0<n<65536
Activation time	Countdown time before entering the specified configuration (minutes)	0<n<65536

Table 3 Sleep mode parameters

* The maximum wake- and sleep time duration is approximately 45 days and the minimum 1 minute.

The Sleep mode functionality can be configured using the Tetra Programming Tool (TPT) in the parametrization phase, the PEI/AT interface or OTA using an SDS configuration message from a predefined SSI.

Tetra Programming Tool (TPT)

The TPT can be used to configure the Sleep mode feature in two ways:

- to configure the set of SSI from which the configuration SDS messages are allowed
- to configure the actual parameters required by the Sleep mode functionality

Allowed SSI configuration

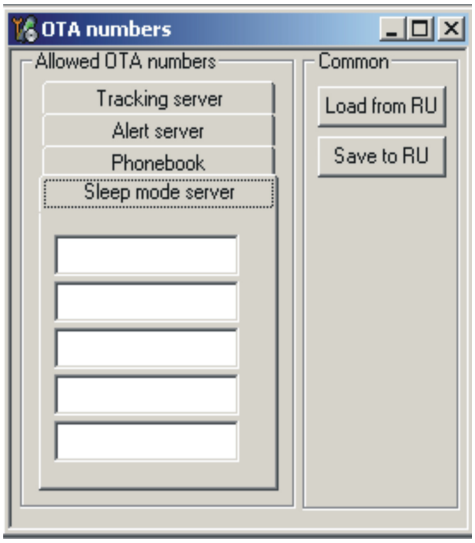

Figure 4 Sleep mode OTA numbers

The end user can insert five different numbers into the Sleep mode **OTA numbers** fields. The OTA configuration of the Sleep mode functionality is allowed from these numbers.

Parametrization of Sleep mode functionality

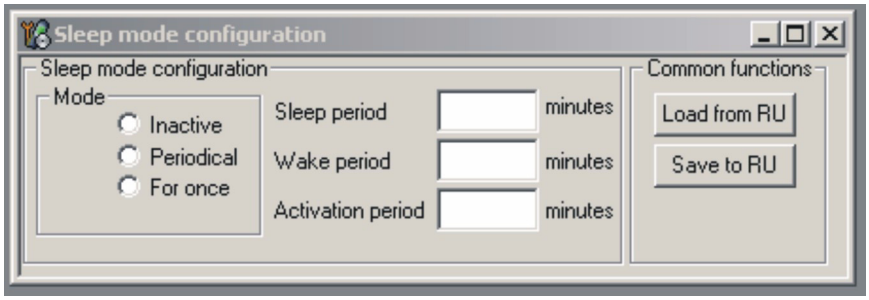

Figure 5 Sleep mode configuration

In TPT configuration, the user is able to select the Operating mode, Sleep, Wake, and Activation periods as defined in the Sleep mode parameters.

AT interface

Parametrization of the Sleep mode functionality:

Description	Command	Response
Sleep mode off	+CXSLMS=0	OK
Sleep mode configuration	+CXSLMS=[mode], ,[waketime],[sleeptime], [Activation time]	OK, FAIL

Table 4 Sleep mode parametrization: AT interface

SDS interface

Parametrization of the Sleep mode functionality over an SDS message requires that the message format presented below is used.

Field	Type
Protocol Identifier	SDS_TL_GENERAL_OTA_ID
Sub-protocol Identifier	SDS_TL_SLEEPMODE_OTA_ID [
Message Length	unsigned byte. Note! Includes both protocol identifiers and the payload length
Payload	char[n] : [mode],[sleeptime],[waketime],[activation time]

Table 5 Sleep mode parametrization: SDS interface

After a new configuration is retrieved, a special acknowledgement message is sent to the configuration sender. The format of the acknowledgement is as follows:

Field	Description
Protocol Identifier	SDS_TL_GENERAL_OTA_ID
Sub-protocol Identifier	SDS_TL_SLEEPMODE_OTA_ID [
Message Length	1 byte
Status	1 = success 0 = failure

Table 6 Acknowledgement message format

Note: The acknowledgement message requires that at least the protocol and sub-protocol identifiers are correct.

Location tracking

The Tracking feature has the following configuration options:

- Enable/disable tracking feature
- Maximum total amount of entries in track
- Time interval between stored tracks - the time trigger - expressed as minutes
- Distance delta between stored tracks - the distance trigger - expressed as meters

Parameter	Description	Values
Enable/Disable	Execution control	0 = off 1 = enabled
Maximum Amount of entries	Amount of entries reserved for track storing.	0<=200<=500
Time Trigger	Time delta between stored locations	0<x<(2^31)-1
Distance Trigger	Distance delta between stored locations	0<x<(2^31)-1

Table 7 Location tracking parameters

Tetra Programming Tool (TPT)

The TPT can be used to configure the Location tracking feature in two ways:

- to configure the set of SSI from which the configuration SDS messages are allowed
- to configure the actual parameters required by the Tracking functionality

Allowed SSI configuration

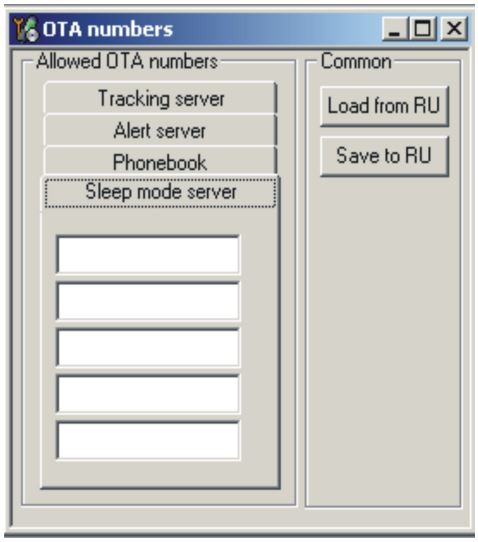

Figure 6 Tracking OTA numbers

The end user can insert five different numbers into the Tracking **OTA numbers** fields. The OTA configuration of the Tracking functionality is allowed from these numbers.

Parametrization of Tracking feature

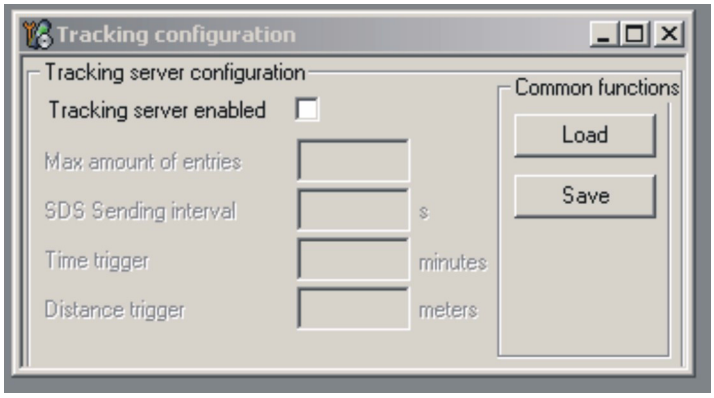

Figure 7 Tracking configuration

In TPT configuration, the user can enable/disable the feature, select track storage size, default SDS intervals on track transmission, and both the time and distance triggers for collecting location information into track.

AT interface

Parametrization of the Tracking functionality:

Description	Command	Response
Configuration	+CXGTSP=<Password>,<Tracking enabled>[,<Max amount of entries>,<SDS interval>,<Timer trigger>,<Distance trigger>]	OK, ERROR
Read configuration	+CXGTSP?	

Table 8 Tracking parametrization: AT interface

SDS interface

Parametrization of the Tracking functionality over an SDS message requires that the message format presented below is used.

Field	Type
Protocol Identifier	SDS_TL_GENERAL_OTA_ID
Sub-protocol Identifier	SDS_TL_GTS_OTA_ID
PDU Type	4 bits : 0000
Tracking Enabled	4 bits : 0000 = disabled, 0001 = enabled
SDS Sending interval	8 bits : interval in seconds
Max amount of entries	16 bits : value range 200>=n<=500
padding	8 bits
padding	8 bits
Time trigger	32 bits : 0 = disabled, >0 = trigger interval in minutes
Distance trigger	32 bits : 0 = disabled, >= distance change in meters

Table 9 Tracking parametrization: SDS interface

After a new configuration is retrieved, a special acknowledgement message is sent to the configuration sender. The format of the acknowledgement is as follows:

Field	Description
Protocol Identifier	SDS_TL_GENERAL_OTA_ID
Sub-protocol Identifier	SDS_TL_GTS_OTA_ID
PDU type	4 bits : 0000

Result code	4 bits : 0000 = OK, 0001 = invalid parameters, 0010 = Failed due buffer IO error

Table 10 Acknowledgement message format

Alerting feature

The Alerting feature configuration is divided into two parts:

- general parametrization available for all alerts
- alert specific parameters

The generic configuration parameters are:

- LIP inclusion, giving the possibility to include alert statuses into LIP messaging
- Acknowledgement allowed from all numbers

The alert specific parameters are:

- IO line bound to alert
- Alert handling: None, SDS-1 or SDS-4 messaging when alert condition occurs
- Handling including one shot messaging, continuous - until alert condition is removed, until successful sending or special acknowledge required before clearing the condition
- Encoding of the message (SDS-4)
- Status value or SDS-4 payload
- Lifetime of the alert
- Destination address into which the alert messages are sent

Tetra Programming Tool (TPT)

The Alerting feature can be configured using the Mobile Parametrization view shown in the following figure.

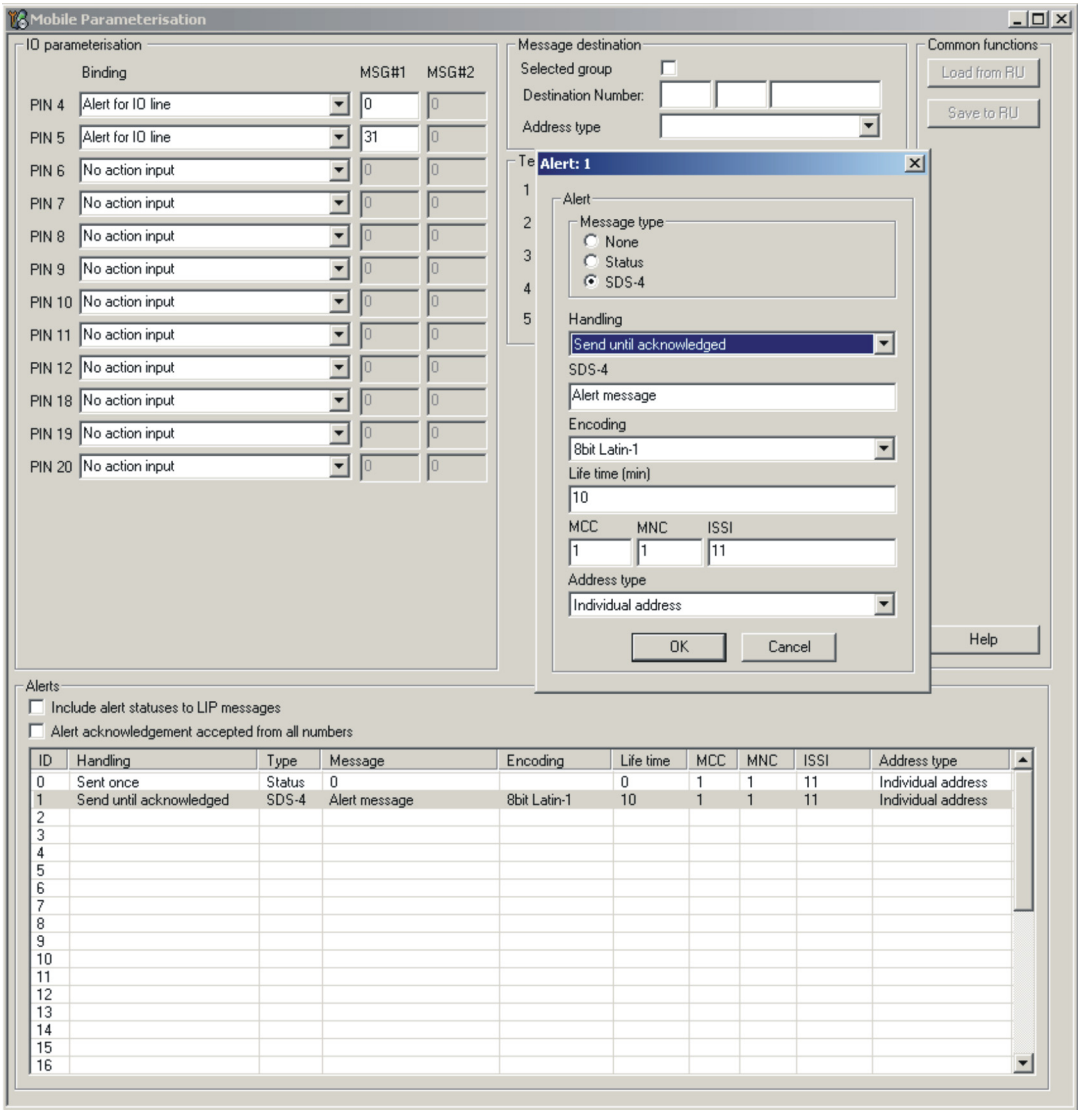

Figure 8 Alerting - Mobile Parametrization view

Explanation of parametrization:

- The **IO parametrisation** area allows binding between external IO line to trigger alert condition. Target alert can be selected.
- In the **Alerts** area there are 32 individual alerts which can be configured using the shown dialog to:
  - Send a status message on alert
  - Send an SDS-4 on alert
  - Configure the message contents and destination address

In addition to the previous, messaging can be configured (using the **Handling** field) to:

- Try to send once on alert
- Send messages as long as the alert is active - e.g. IO line is active
- Send until sending is accepted by the network
- Require an acknowledgement for the alert message

For alerting conditions the feature can also be configured to:

- Include Alert statuses into LIP messages' extended user data field
- Allow alert acknowledgements from all numbers (not only the destination numbers)

AT interface

Parametrization of the Alerting Feature:

Description	Command	Response
Read Alert Status	+CXALERT?	+CXALERT: <alert in 32 hexadecimal coding>, (<alert statuses 1=on 0=off, starting with alert 0, grouped in 4 alerts>)
Test	+CXALERT=?	-

Table 11 Alerting: AT interface

SDS interface

Parametrization of the Alert functionality over an SDS message requires that the message format presented below is used. Note that OTA supports the configuration of a single alert per message. Configuring multiple alerts requires the usage of multiple messages.

Field	Type
Protocol Identifier	0x46
Sub-protocol Identifier	0x5
PDU Type	4 bits : 0011
LIP Enabled and Allowed for all numbers	4 bits : 0000 = both disabled, 0001 = LIP enabled, 0010 = Allowed from all numbers, 0011 = Both enabled
Sub block count	8 bits : Number of sub-blocks, single block update supported currently
Sub block ID	8 bits : reserved
Sub block size	8 bits : reserved
Message type	8 bits : 0x0 = No message, 0x01 = SDS-1, 0x02 = SDS-4
Reserved	8 bits
SDS-4 Message length	16 bits : Conditional, see message type.
SDS-4 Protocol ID	8 bits: reserved. 0x00. Conditional, see message type.
SDS-4 Message type	8 bits: 0x03. Conditional, see message type.
SDS-4 Message reference	8 bits: 0x01. Conditional, see message type.
SDS-4 Coding scheme	8 bits: 0x01. Conditional, see message type.
SDS-4 Message	60 chars. Conditional, see message type.
SDS-4 <reserved padding>	16 bits.
Destination address: TETRA number	32 bits.
Destination address: MCC	16 bits.
Destination address: MNC	16 bits.
Destination address: TETRA Number Type	8 bits.
Destination address: reserved fields	24 bits.
SDS-1 status value	16 bits. Conditional, see message type.
Lifetime	16 bits. Alert lifetime in minutes.
Interval	16 bits. 0x001E = Default 30 seconds. Reserved.
Message sending mode	8 bits. 0x00 = one shot, 0x01 = Continous, 0x02 = Until success, 0x03 Requires acknowledgement
Alert number	8 bits. Number of the alert to configure : 0<n<32

Table 12 Alerting: SDS interface

After a new configuration is retrieved, a special acknowledgement message is sent to the configuration sender. The format of the acknowledgement is as follows:

Field	Description
Protocol Identifier	SDS_TL_GENERAL_OTA_ID, 0x46
Sub-protocol Identifier	0x05
PDU type	4 bits : 0000
Result code	4 bits : 0000 = OK, 0001 = invalid parameters, 0010 = Failed due buffer IO error

Table 13 Acknowledgement message format

7. CONNECTOR INTERFACES

Power supply

The power input cable must be fuse-protected (5A / 32V). Use wire size AWG 18 or larger.

It is recommended that all the power cable pins are connected as in Table 2 below.

Figure 9 Power supply connector

Pin	Name	IN/OUT	Voltage level	Notes
1	DC_JACK	in	10,6 - 32 V	Voltage input pin
2	DC_JACK	in	10,6 - 32 V	Voltage input pin
3	NC	-	-	DO NOT CONNECT
4	NC	-	-	DO NOT CONNECT
5	DC_JACK	in	10,6 - 32 V	Voltage input pin
6	GND	gnd	0 V	Ground pin
7	GND	gnd	0 V	Ground pin
8	GND	gnd	0 V	Ground pin
9	GND	gnd	0 V	Ground pin

Table 14 Power supply connector pinout (DB9 female)

AT interface

Figure 10 AT interface connector

Pin	Signal	IN/OUT	Notes
1	NC		Not connected
2	RX	in	RS-232 RX input to TDR880i
3	TX	out	RS-232 TX output from TDR880i
4	NC		Not connected
5	GND	gnd	GND

Table 15 AT interface connector pinout (D89 male)

6-9	NC		Not connected

Table 15 AT interface connector pinout (D89 male) (Continued)

I/O lines

The system connector is a female 26-pin high density D-connector. The signals listed in Table 4 are provided through the I/O connector. The connector geometry is Tyco 6-748481-7 compatible.

Figure 11 I/O connector

Pin	Name	IN/OUT	Voltage level	Notes
1	EXT_VOUT	out	10,6 - 32 V	Input voltage fed from power input connector to this pin (internally fused, 2A). Max allowed current should be limited to 500 mA.
2	Reserved	in	N/A	Reserved, do not connect
3	+5V	out	+5 V	5V output voltage, max 100mA load
4	GEN IO	in/out	TTL	User configurable IO pin.
5	GEN IO	in/out	TTL	User configurable IO pin.
6	GEN IO	in/out	TTL	User configurable IO pin.
7	GEN IO	in/out	TTL	User configurable IO pin.
8	GEN IO	in/out	TTL	User configurable IO pin.
9	GEN IO	in/out	TTL	User configurable IO pin.
10	GEN IO	in/out	TTL	User configurable IO pin.
11	GEN IO	in/out	TTL	User configurable IO pin.
12	GEN IO	in/out	TTL	User configurable IO pin.
13	IN_SERVICE	out	TTL	Tetra radio operational, active high. May require an external pull-down resistor, depending on the customer's usage. A weak pull-down on board.
14	BSI	in	(2,78 V)	Battery Size Indicator. Do not connect.
15	GND		GND	Ground pin
16	MBUS	in/out	(2,78 V)	MBUS serial bus
17	GND		GND	Ground pin
18	GEN IO	in/out	TTL	User configurable IO pin.
19	GEN IO	in/out	TTL	User configurable IO pin.
20	GEN IO	in/out	TTL	User configurable IO pin.
21	GPS FIX	out	TTL	GPS fix indicator, output only, active high
22	POWER_ON_IND	out	TTL	Device operational, active high. Left floating when device is powered off or set low (0V). (May require external pull-down resistor, depends on customer's usage.)
23	OVERTEMP	out	TTL	Over-temperature indicator, active high. May require an external pull-down resistor, depending on the customer's usage. A weak pull-down on board.
24	PWR_ON_OFF	in	TTL	External Power ON/OFF control, 500 ms pulse input, active high

Table 16 I/O connector pinout (DB26 female)

25	FBUS_RX	in	(2,78 V)	FBUS serial bus RX line
26	FBUS_TX	out	(2,78 V)	FBUS serial bus TX line

Table 16 I/O connector pinout (DB26 female) (Continued)

GPS antenna

The GPS connector type is SMA female, 50 Ω. The GPS antenna connector feeds 5 VDC out from the RF connector. Therefore, do not use passive antennas because those might short circuit the DC voltage output and damage the device. The maximum load for the 5 VDC feed is 50 mA.

Figure 12 GPS antenna connector

TETRA antenna

The TETRA connector type is TNC female, 50 Ω.

Figure 13 TETRA antenna connector

8. TECHNICAL DATA

The following table lists the TDR880i technical specifications.

Frequency:	TX 380-390 MHz RX 390-400 MHz
RF Output power	EN 300392-2 compliant, power class 4 (1W)
Dimensions (w x h x d), mm	205 mm x 87 mm x 32 mm
Weight	230 g
Power supply requirements	+12/+24 VDC, continuous power 24W (10.6 - 32 V)
Power consumption	Note that all figures are subject to change. Device Peak Power: <20 W TETRA Call: 3,6 W, full tx power (average power) GPS: 540 mW (in addition to other power consumption when on) Idle:840 mW Sleep: 600 mW Shut down: <1 mW
Operating temperature	-20 to +55°C
Humidity:	Up to 95%, non-condensing
IP classification	IP44 (splash proof)
I/O lines	16, inclusive of the various indications
Vibrations and shocks	According to ETSI EN 300 019-2-5 V3.0.0 (5M3), installations only inside vehicles. According to ETSI EN 300 019-2-6 V2.1.2 (6M3)
EMC & SAR	EMC approved according to 2004/108/EC. SAR is not evaluated as the device is not a handheld device.
TETRA antenna connector	TNC female, 50 Ω
GPS antenna connector	SMA female, 50 Ω
Data connector	9-pin D-Sub, RS-232 levels.
Parametering connector	No separate connector, functionality included in the I/O connector.
I/O connector	Female 26-pin high density D-connector.

Table 17 Technical data

9. GLOSSARY

This section explains the abbreviations that are used in this document.

AT	: Attention command language
AWG	: American Wire Gauge
D-connector	: D-shaped multi-pole connector
EMC	: Electromagnetic Compatibility
EPA	: ESD Protected Area
ESD	: Electrostatic Discharge
ETSI	: European Telecommunications Standards Institute
FACCH	: Fast Associated Control Channel
FME	: For Mobile Equipment
GPS	: Global Positioning System
GTS	: GPS Tracking Server
I/O	: Input/output
LED	: Light Emitting Diode
LNA	: Low Noise Amplifier
NMEA	: National Marine Electronics Association
OTA	: Over-the-air Technology
PEI	: Peripheral Equipment Interface
RF	: Radio Frequency
RTC	: Real-time Clock
SAR	: Specific Absorption Rate
SDS	: Short Data Service
SMA	: SubMiniature version A
SSI	: Short Subscriber Identity
TETRA	: Terrestrial Trunked Radio
TNC	: Threaded Neill-Concelman
TPT	: TETRA Programming Tool
TTL	: Transistor-Transistor Logic
TX	: Radio transmitter
UTC	: Coordinated Universal Time
VDC	: Direct voltage