

TRM-300 TETRA Radiomodem Integration Guide

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WASTE MANAGEMENT



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1 INTRODUCTION

This document provides instructions for the TRM-300 TETRA radiomodem hardware integration. It is intended to help the system integrator to integrate the TRM-300 into a remote final hardware application.

The document describes the mechanical, electrical and radiofrequency integration as well as the antenna installation.

The TRM-300 has not a user interface (display or keypad) and it is designed to be managed from a data application through the serial interface via AT commands or PPP connection. The equipment is ready to transmit and receive audio in PCM digital format.

For more information on the TRM-300 features or its accessories, see the *Functional Design Specification* (included in the *Technical Reference Documentation*).

For more information on the TRM-300 usage and software integration, see the *T2PRO_Programming Guide* (included in the T2PRO software tool) and the *Data Service Reference Guide* (included in the *Technical Reference Documentation*).

Before integrating the product, read carefully this guide.
Keep the guide for future reference, it contains important information.



NOTE:

This product is sensitive to electro-static discharge.
Therefore, ESD handling precautions are to be carefully observed.

2 REFERENCES

- [1] FCS1362:2010 UK Code of Practice for the installation of mobile radio and related ancillary equipment in land based vehicles
http://www.fcs.org.uk/my%20files/fcs_pdfs/codesofpractice/fcs1362_2010.pdf
- [2] Transmitter Module Equipment Authorization Guide, 996369 D01 Module Certification Guide v01r04
<https://apps.fcc.gov/kdb/GetAttachment.html?id=clpbilbTdDomywhbMgK6ng%3D%3D>

3 ABBREVIATIONS

EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
GPS	Global Positioning System
PCM	Pulse Code Modulation
PPP	Point to Point Protocol
RF	Radiofrequency
RSSI	Received Signal Strength Indication
SMT	Surface Mount Technology
TCF	Technical Construction File
TETRA	TErrestrial Trunked RAdio
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
VSWR	Voltage Standing Wave Ratio

4 GUARANTEE

PowerTrunk Inc. guarantees the repair or replacement, free of charge, of the products that present defects due to anomalies, according to the general guarantee conditions of PowerTrunk Inc.

PowerTrunk Inc. will not, under any circumstances, be held responsible for problems or damage caused by any accessory or auxiliary element that has not been approved or supplied by PowerTrunk Inc. for this product. It will not guarantee that this product will function in conjunction with an auxiliary unit or accessory that has not been approved or supplied by PowerTrunk Inc. for this product.

PowerTrunk Inc. will not be held responsible for damage caused by installation performed by staff who is not authorised by PowerTrunk Inc.

5 SAFETY PRECAUTIONS

5.1 GENERAL

PowerTrunk strongly recommends performing the integration by people with experience in the field of radiofrequency technologies.

PowerTrunk has approved a wide range of accessories for the terminal. These accessories have passed all types of tests that ensure their suitability and safety for the use for which they are intended. So, it is recommended only to use approved accessories.

For your safety, only allow PowerTrunk qualified staff to disassemble/repair the terminal or its accessories. If the disassemble/repair is not correct, it may be dangerous and will void the guarantee of the terminal.

Make sure that all specifications within this document are followed, especially concerning temperature, supply voltage and antenna parameters. Do not use the terminal without the TETRA antenna.

During prolonged operating periods in transmission mode high temperatures may be reached at the back of the equipment where the power amplifier heatsink is located. Burns may result if bare skin comes into contact with an uncovered antenna during radio transmissions.

Make sure that the final product operates according to the local regulations. As detailed in Chapter about Regulatory Compliance and Certifications, the equipment has been designed to fulfill the applicable compliance regulations.

5.2 EXPOSURE TO RADIOFREQUENCY ENERGY

This product makes use of radio spectrum and emits radiofrequency energy. Care should be taken when the product is integrated in systems. The exposure level is dependent on the radiating section (antenna used and its installation). Radiation performance is always the responsibility of the integrator.

The transmitter and antenna must not be situated or operated in conjunction with any other transmitter or its antenna. Failure to observe this warning could produce an RF exposure condition.



TRM-300 is restricted to occupational/controller use to safety RF energy exposure limits. This radio is NOT authorized for general population.

Use only accessories and antennas approved by PowerTrunk. Use of non-approved accessories and antennas may exceed RF energy exposure limits.

5.3 ELECTROMAGNETIC COMPATIBILITY

Most electronic devices are susceptible to electromagnetic interference if they are not properly shielded, designed or configured for electromagnetic compatibility.

Always respect the current regulations of the area you are in to avoid these compatibility conflicts. Turn off the terminal whenever its use is prohibited, when it may cause interference or be hazardous, for example, at hospitals or health care premises, where equipment sensitive to external RF radiation may be being used.

Aircraft

Follow all existing restrictions, according to the regulations of the airlines or the instructions of the crew.

Pacemakers

Pacemaker manufacturers recommend keeping a minimum safety distance between a radio terminal and a pacemaker, to avoid possible interferences with the latter. People with pacemakers should turn off the terminal immediately if, for any reason, it is suspected to cause interference.

Hearing aids or other medical devices

Some digital devices may interfere with these appliances. If this interference occurs, contact your service supplier or the manufacturer of the hearing aid or medical device.

5.4 VEHICLES

Although the equipment has been approved to assure its safety in a vehicular installation (e-mark), the RF signals may affect the electronic systems of motor vehicles that could be not well installed or protected, for example, electronic injection systems, electronic anti-locking brake systems (ABS), speed control systems or airbag systems. For further information, verify these aspects of your vehicle, or equipment that has been added, with the corresponding manufacturers.

PowerTrunk recommends do not place the terminal in the area above the airbag or in the area where it would inflate. Airbags inflate with great force and the terminal may be thrown, causing serious injury to the occupants of the vehicle.

The complete installation should be carried out in accordance with *FCS1362. UK Code of Practice for the installation of mobile radio and related ancillary equipment in land based vehicles* [1].

5.5 POTENTIALLY EXPLOSIVE ENVIRONMENTS

Disconnect the terminal when it is in an area where explosions may occur and obey all signs and instructions.

The areas where explosions may occur are usually, but not always, marked. These areas include fuel loading areas, such as ship decks, petrol stations, premises for storage and transport of motor fuel or chemical products, vehicles that use liquid gas petroleum and areas where the air contains chemical particles or elements, as grain, powder or metallic particles.

Sparks in these areas may cause explosions or fire, with the subsequent risk of injury or even death.

6 ESD HANDLING PRECAUTIONS

This product is sensitive to electro-static discharge. Therefore, ESD handling precautions are to be carefully observed:

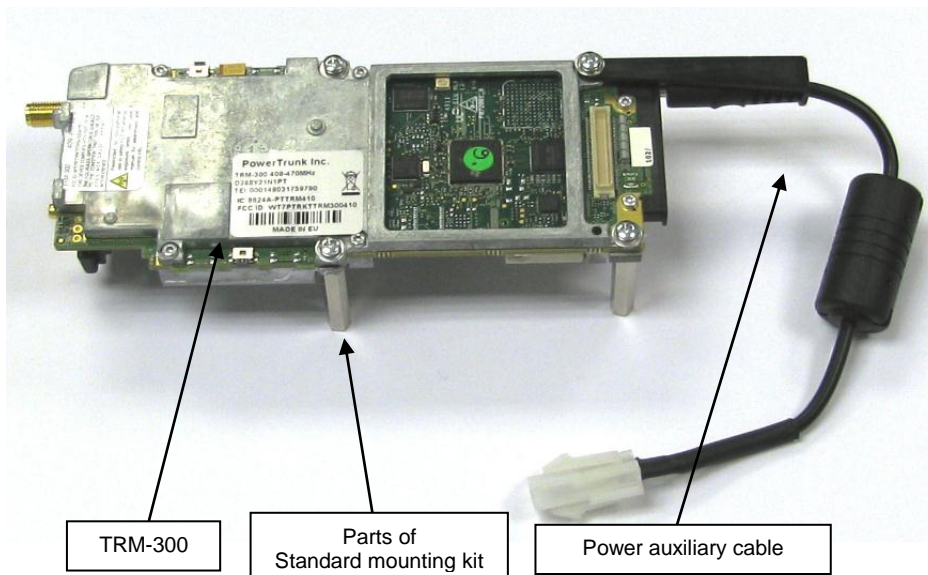
- Handle the product only while wearing a grounded wrist (or similar device) strap and working at a static free workstation.
- The product should be stored in an antistatic bag and in its original shipping packaging.
- If a wrist strap (or similar device) and static free workstation are not available, and the product must be handled, use the following procedure to reduce the possibility of ESD damage.
- To discharge any static charge from your body, place one hand in contact with a grounded surface before touching the product.
Keep your hand in contact with that grounded surface while handling the product. Do not touch any of the electronic components and pick up the board only at the edges.
- Do not set the board down on a worksurface.
- Return boards to anti-static bags as soon as possible.

7 PARTS REQUIRED FOR THE INTEGRATION

7.1 PARTS CONTAINED IN THE PACK

Check that the pack includes the following parts:

- TRM-300 enclosed in an anti-ESD bag.
- Power auxiliary cable.
- Standard mounting kit, which includes screws, washers and spacers.
- Integration Guide at CD format.



7.2 ADDITIONAL PARTS

In addition to the parts of the pack, the following PowerTrunk accessories, detailed in the *Functional Design Specification*, are recommended for the integration:

- 8VDC power cable.
- In case of availability of a voltage supply which is different from the TRM-300 nominal voltage, a Voltage Adapter.
- Serial communication + I/O + Switch Cable (RS232 and USB models).
- TETRA Antenna, which must be of the same frequency band as TRM-300.
- In case of a TRM-300 configuration with GPS, a GPS Antenna.
- In case of applications with multislot data service, a Thermal Dissipator Kit.

Besides, a computer with USB or RS232 ports and Windows XP or Windows 7 operating system is required, in which the following PowerTrunk software tools must be installed:

- Maintenance Kit.
- Programming Kit (which includes the *T2PRO_Programming Guide*).

8 MECHANICAL INTEGRATION

The following table defines the required environment conditions:

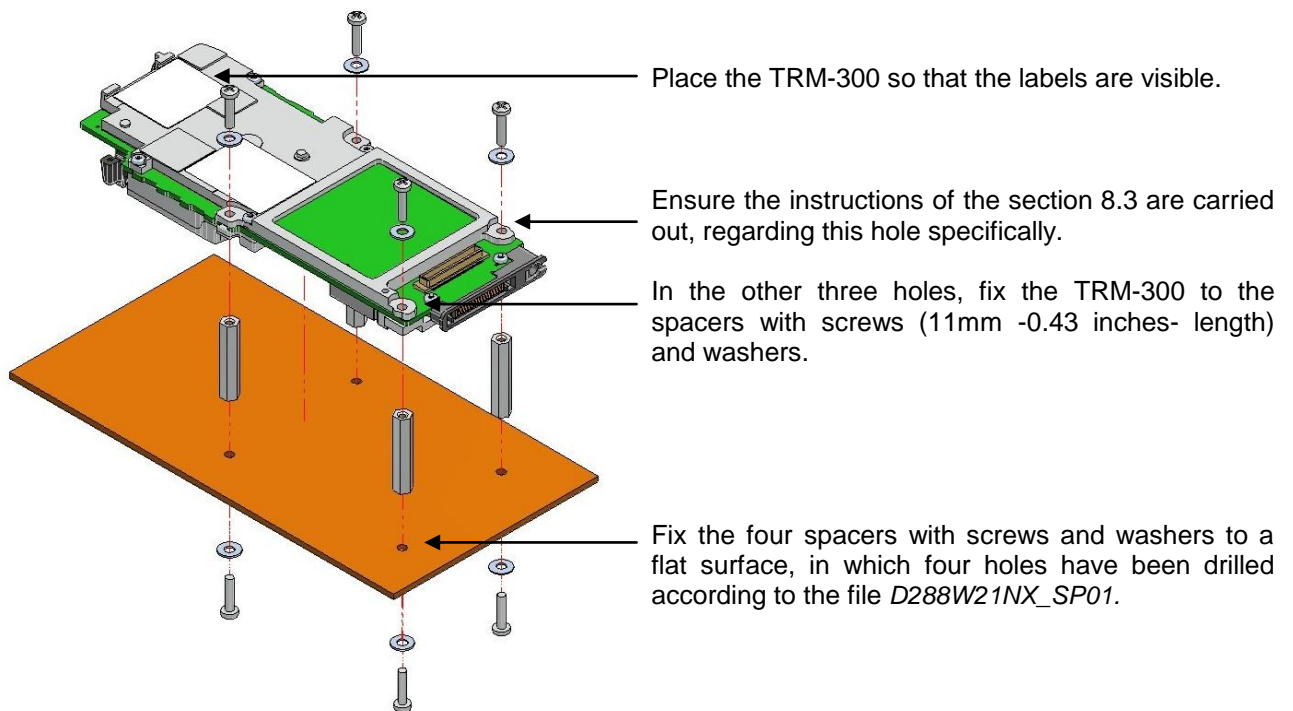
Parameter	Specification Limit
Operating temperature	From -30°C up to +60°C (from -22°F up to 140°F)
Storage temperature	From -40°C up to +85°C (from -40°F up to 185°F)

A mechanical enclosure is required of the integrator for environment protection.

There are two possible mountings for the TRM-300; standard mounting and mounting with heatsink.

8.1 STANDARD MOUNTING

PowerTrunk recommends its Standard Mounting Kit, which is included in the pack.



8.2 MOUNTING WITH HEATSINK

This mounting is required in case of applications with multislot data service, in order to optimize the thermal dissipation. The Programming Kit accessory is needed in order to configure the Terminal to maximize the data capacity of the channel. Pick *Mounting with heatsink* at the *Options -> Configuration* screen.

The TRM-300 chassis is supported on a heatsink with a thermal interface material between them. The height of the spacers must be chosen according to the thermal interface material thickness.

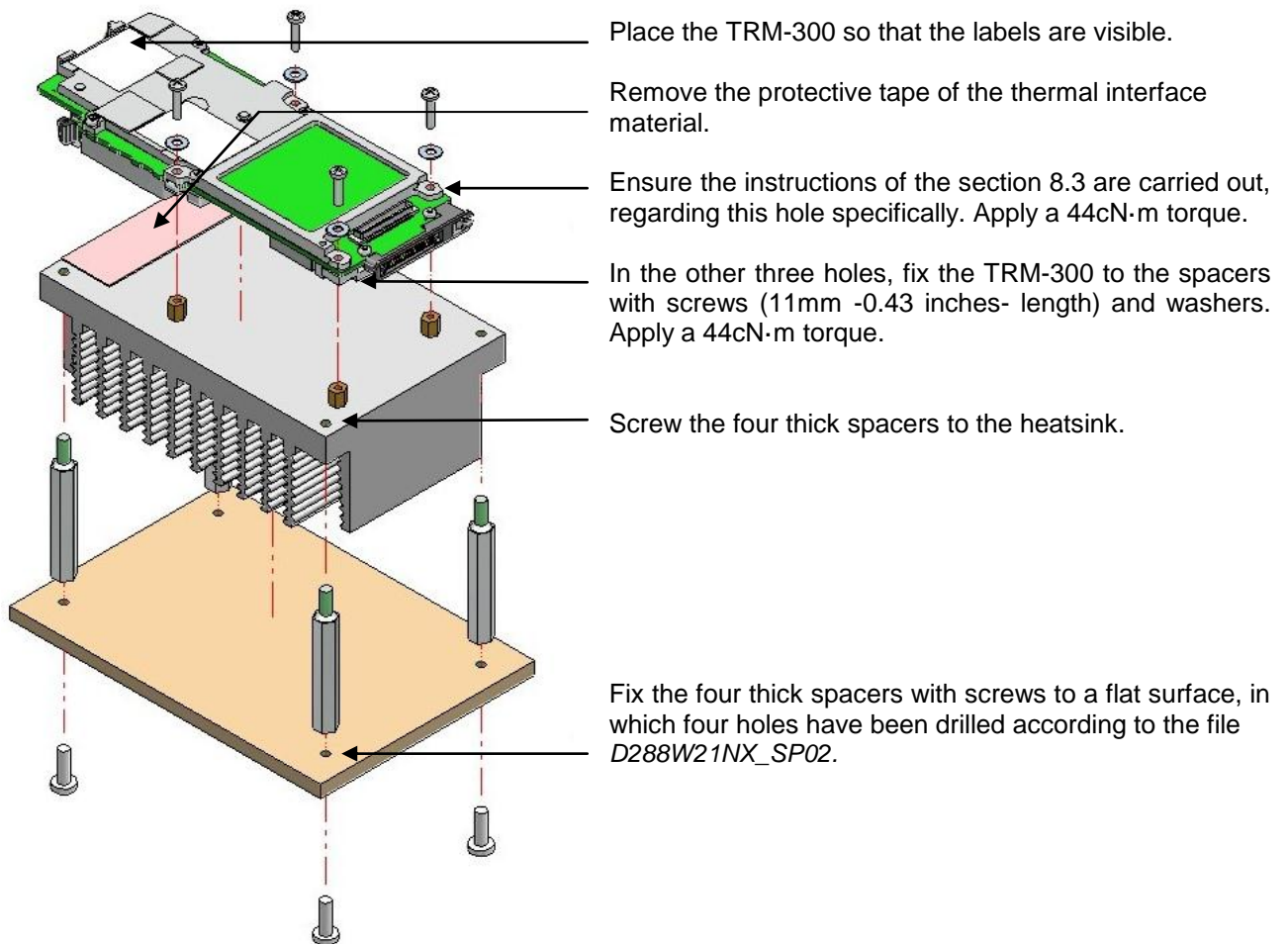
The thermal interface material must have a thermal resistance less than 0.75°C/W (inch²).

- The heatsink contact area must be perfectly flat. A flat contact area allows you to use a thinner layer of thermal interface material, which will reduce its thermal resistance.
- The pressure on the thermal interface material must be high (such as 30KPa), while still being reasonably easy to install.

The heatsink must have a thermal resistance less than 1.5°C/W and include a label with the text: "Warning – Hot surface – Do not touch" or an equivalent safety symbol.

In the case a fan is used, ensure the proper flow of air inside the mechanical enclosure.

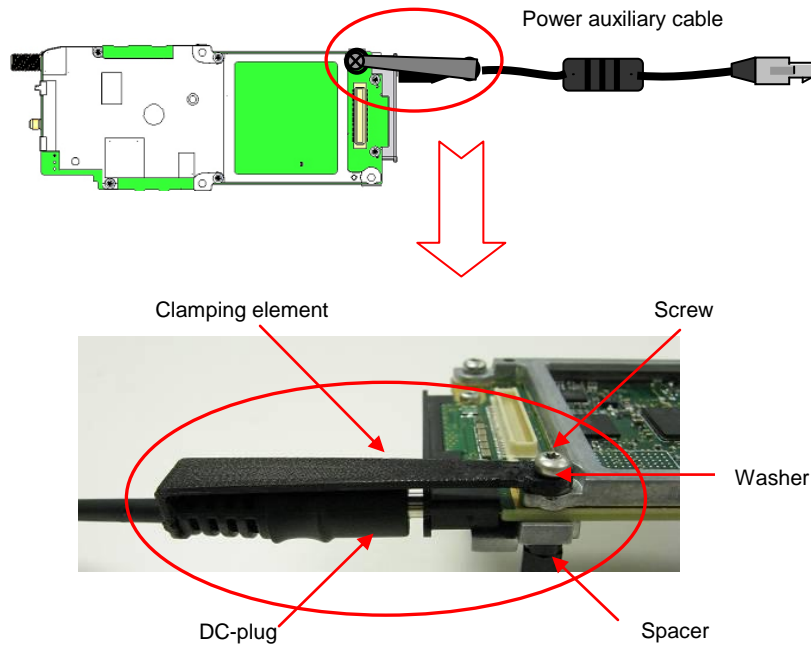
PowerTrunk recommends its Thermal Dissipator Kit accessory.



8.3 POWER AUXILIARY CABLE

This section is common to both mountings.

Insert the power auxiliary cable (DC-plug) in the TRM-300 power supply connector (DC-jack). Fix the clamping element to the TRM-300 and to the spacer with a screw (11mm -0.43 inches- length) and a washer, in order to assure the mechanical requirements.



8.4 CARE AND MAINTENANCE

The following recommendations will help increasing the useful life of your terminal and protecting the cover of your guarantee:

- Do not use the terminal in dirty or dusty places. The electronic components could be damaged.
- Do not expose the terminal to extreme temperatures, for example by a window with direct sunlight. The terminal should be situated away from heat sources such as radiators, heat registers, stoves or other equipment that produce heat. The high temperatures may reduce the useful life of the electronic components.
- Do not keep the terminal in cold places. When the device returns to its normal temperature, moisture may form inside, which may damage the electronic components.
- Do not hit or drop the terminal. The electronic components and the mechanical parts may break.
- Do not place any heavy object on top of the terminal or on its power cable. The electronic components and the mechanical parts may break.
- Do not insert any object in the grooves of the terminal. The electronic components could be damaged
- Install the terminal in a well-ventilated place.

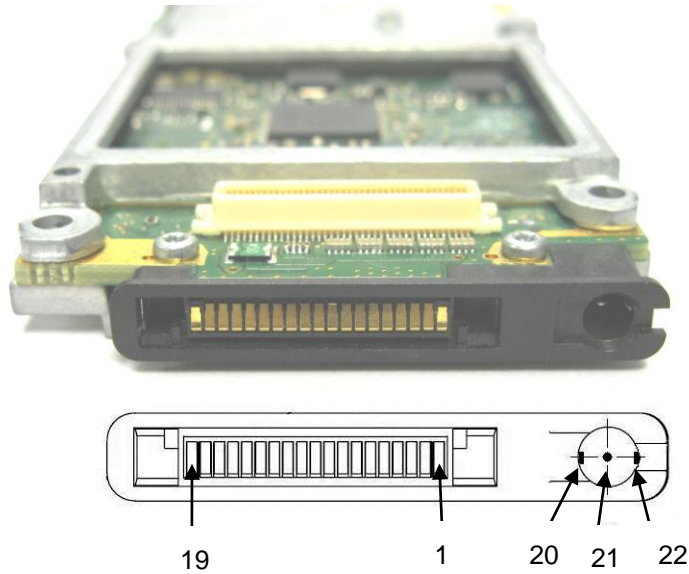
9 ELECTRICAL INTEGRATION

The following table defines the required electrical conditions:

Parameter	Specification Limit
Operating supply voltage	From 6.3V up to 8.4V (7.4V nominal)
Supply current	Up to 3.5A of peak value

The TRM-300 auxiliary connector contains the power supply connector (DC-jack) and the I/O connector. It is an AVX semicustom socket connector (model 58-9157-019-000-094S) with the pin-out according to the following table and drawing. The application mating I/O connector would be an AVX semicustom plug (or the model 58-9157-019-000-085 SMT plug along with any standard cover 30-9157-9700-00-xxx; or the model 58-9157-019-000-086 SMT right angle plug).

N	Name	I/O	Electrical interface	Description
1	GND	---	0 v	Ground
2	UART1.TX	O	Digital 0 – 3.3 v	UART Tx
3	UART1.RTS	I	Digital 0 – 3.3 v	UART RTS
4	UART1.DCD	O	Digital 0 – 3.3 v	UART DCD
5	UART1.RX	I	Digital 0 – 3.3 v	UART Rx
6	UART1.CTS	O	Digital 0 – 3.3 v	UART CTS
7	UART1.DTR	I	Digital 0 – 3.3 v	UART DTR
8	GPS.LOGGER	O	Digital 0 – 3.3 v	GPS data
9	POWER_OUT	O	Analog 0 – 7.4 v, I < 250 mA	Power controlled output
10	SW_ON_OFF	I	Digital 0 – 3.3 v	Switch on/off
11	SW_ON_OFF	I	Digital 0 – 3.3 v	They are internally connected
12	SIG_IN	I	Digital 0 – 3.3 v HiZ, look it up in 9.3.2	Digital input signal
13	SIG_OUT	O	Digital 0 – 3.3 v Open colector, look it up 9.3.2	Digital output signal
14	EXTPCM_FS	O	Digital 0 – 3.3 v	Audio PCM frame sync
15	EXTPCM_DX	O	Digital 0 – 3.3 v	Audio PCM transmit data
16	EXTPCM_DR	I	Digital 0 – 3.3 v	Audio PCM receive data
17	EXTPCM_CLK	O	Digital 0 – 3.3 v	Audio PCM transmit clock, 512 KHz
18	ID_BOTTOM	I	Analog 0 to 3.3 v, 47KΩ pull-up to 3.3 v internally	Accessory detector
19	GND	---	0 v	Ground
20	GND	---	0 v	Ground
21	DC_IN	I	6.3 to 8.4 v, nominal value = 7.4 v I < 3.5 A	Power supply
22	GND	---	0 v	Ground



9.1 GROUNDING

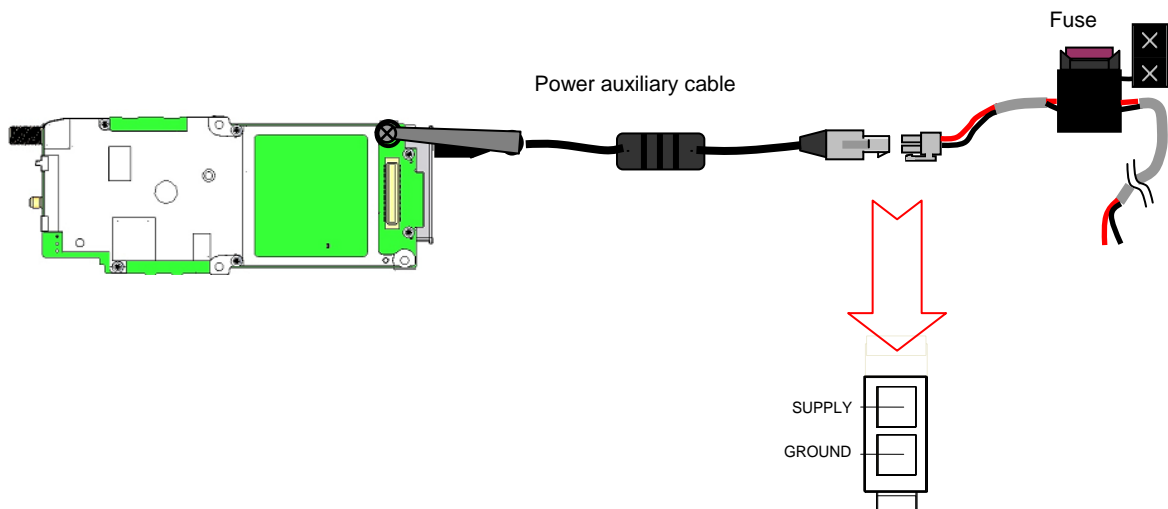
There is only one common ground for the power supply and I/Os in the TRM-300. That is, there are no separate analog/digital ground pins in the auxiliary connector.

All ground pins must be connected together in the final application.

9.2 POWER SUPPLY

The TRM-300 is powered by the hardware application in which it is integrated, always through the PowerTrunk power auxiliary cable.

The power auxiliary cable connector is a 2 pin Molex Mini-Fit Jr.™ Plug (model 5559-39-01-2021) with the pin-out according to the following drawing. The application mating connector would be a 2 pin Molex Mini-Fit Jr.™ Receptacle (model 5557-39-01-2020). Avoid a reverse polarity connection.



The power supply must be capable of supplying at least 3.5A. The TRM-300 does not have protection for over-current, so the hardware application should include, at least, a 4A fuse. *PowerTrunk recommends its 8VDC power cable accessory.*

Check voltage level prior to applying power to the TRM-300. The specified voltage shall be that measured at the point of connection of the power auxiliary cable to the TRM-300.

The operating voltage must not fall below the specification limit under any circumstances. Take into consideration the current consumption when transmitting at full power.

The operating voltage must not rise above the specification limit under any circumstances.

In case of availability of a voltage supply which is different from the TRM-300 nominal voltage, a voltage adapter is required.

PowerTrunk recommends its 12VDC Adapter accessory (if the TRM-300 is intended for operation from the usual types of regulated lead-acid battery power source of vehicles) *and its 100-240VAC Adapter accessory* (if the TRM-300 is intended for operation from the AC mains).

The ripple on the operating voltage must not exceed 80mV on the load.

9.3 DATA AND CONTROL INTERFACE

9.3.1 Serial Interface

A UART is available, which provides one asynchronous channel with handshaking capability (RTS, CTS, DTR and DCD, in addition to TxD and RxD) and a maximum data rate of 115200 bits/sec.

It supports the industry standard RS232 connection, but an external level converter is required. It can also be converted to USB through a bridge controller.

In both cases the external electronics must isolate the connection if the TRM-300 is switched off. For it, the pin 9 signal can be used to control that external electronics. If a 47KΩ resistance is connected between the pin 18 and ground, and afterwards the TRM-300 is switched on, then the pin 9 signal will be activated, providing the TRM-300 supply voltage (7.4V nominal).

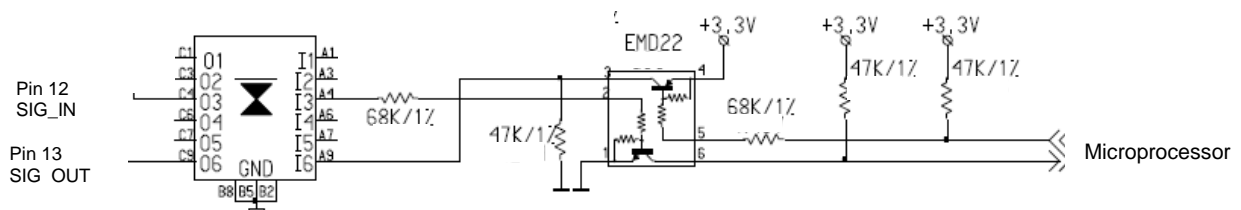
The usage of the port can be configured with the PowerTrunk Programming Kit (which includes the *T2PRO_Programming Guide*).

9.3.2 Programmable Input/Output Interface

A digital input signal and a digital output signal are available for applications that require them. The usage of this interface can be configured with the PowerTrunk Programming Kit.

The input signal can be configured to send a status message whenever it is active-high (3.3V) during an established time. The application must generate the digital input signal voltage.

The output signal can be configured to be active-high (3.3V) during an established time whenever a certain status message is received. It can also be inactive-low (0V) whenever other status message is received.



Unidirectional TVS
Maximum Reverse Working Voltage = 5V

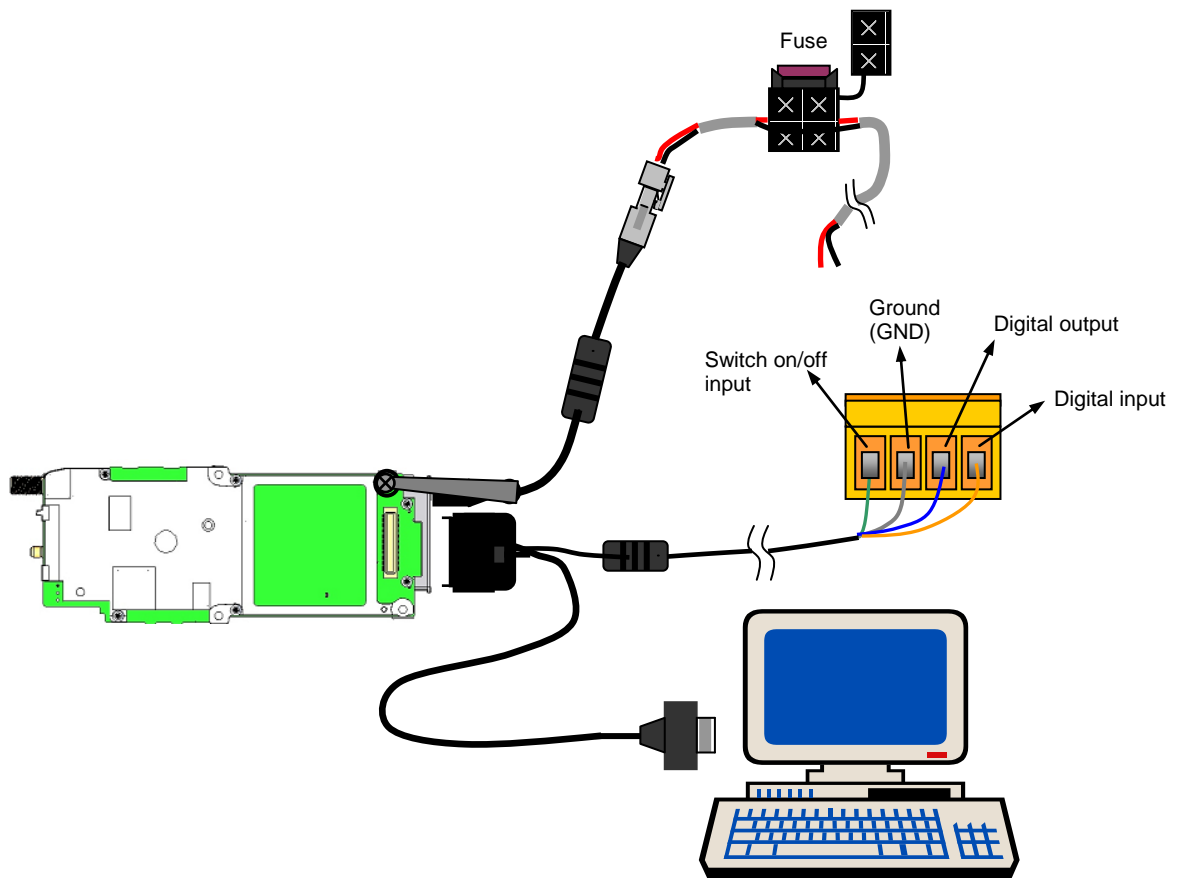
9.3.3 Switch on/off Interface

An input signal is available to switch on/off the TRM-300.

If the pins 10 and/or 11, which are internally connected, are left in open-circuit then the TRM-300 will be switched off. If they are connected to ground, then the TRM-300 will be switched on.

For the data and control interfaces, shielded interconnecting cables are required in order to minimize the possibility of RF interference.

PowerTrunk recommends its RS232, I/O & Switch Cable accessory and its USB, I/O & Switch Cable accessory.



10 RF AND ANTENNA INTEGRATION

10.1 TETRA ANTENNA

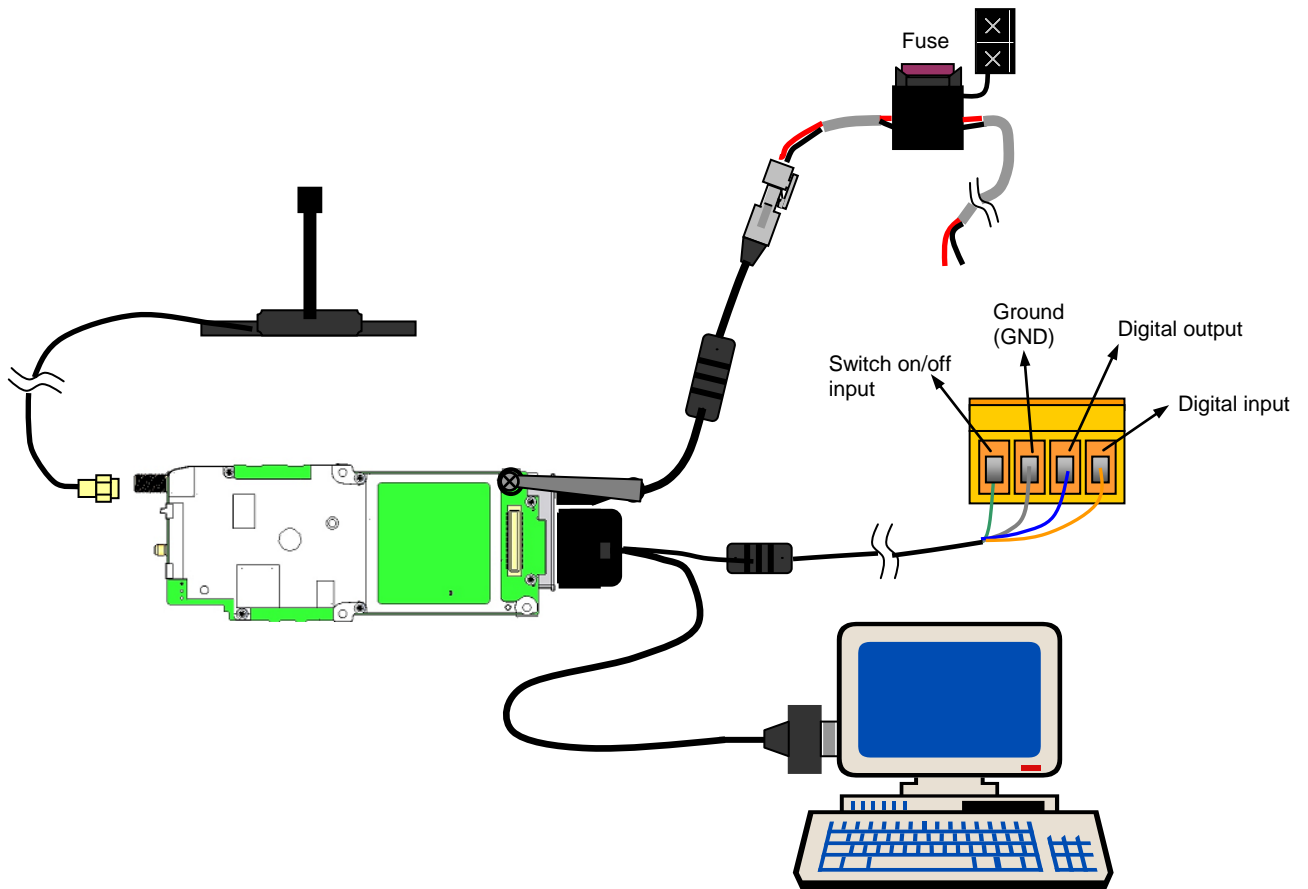
The TRM-300 TETRA antenna connector is a female SMA jack. The application mating connector should be a male SMA plug. In order to install it, consult document *D288W21NX_SP04*.

The following table defines the required radiofrequency conditions:

Parameter	Specification limit
TETRA Antenna RF impedance	VSWR < 2 :1 50ohm
TETRA Antenna RF power	3W for 380-430MHz & 410-470MHz 1.8W for 806-870MHz

The antenna RF impedance is specified on the same frequency band as TRM-300.

PowerTrunk recommends its TETRA Antenna accessory.



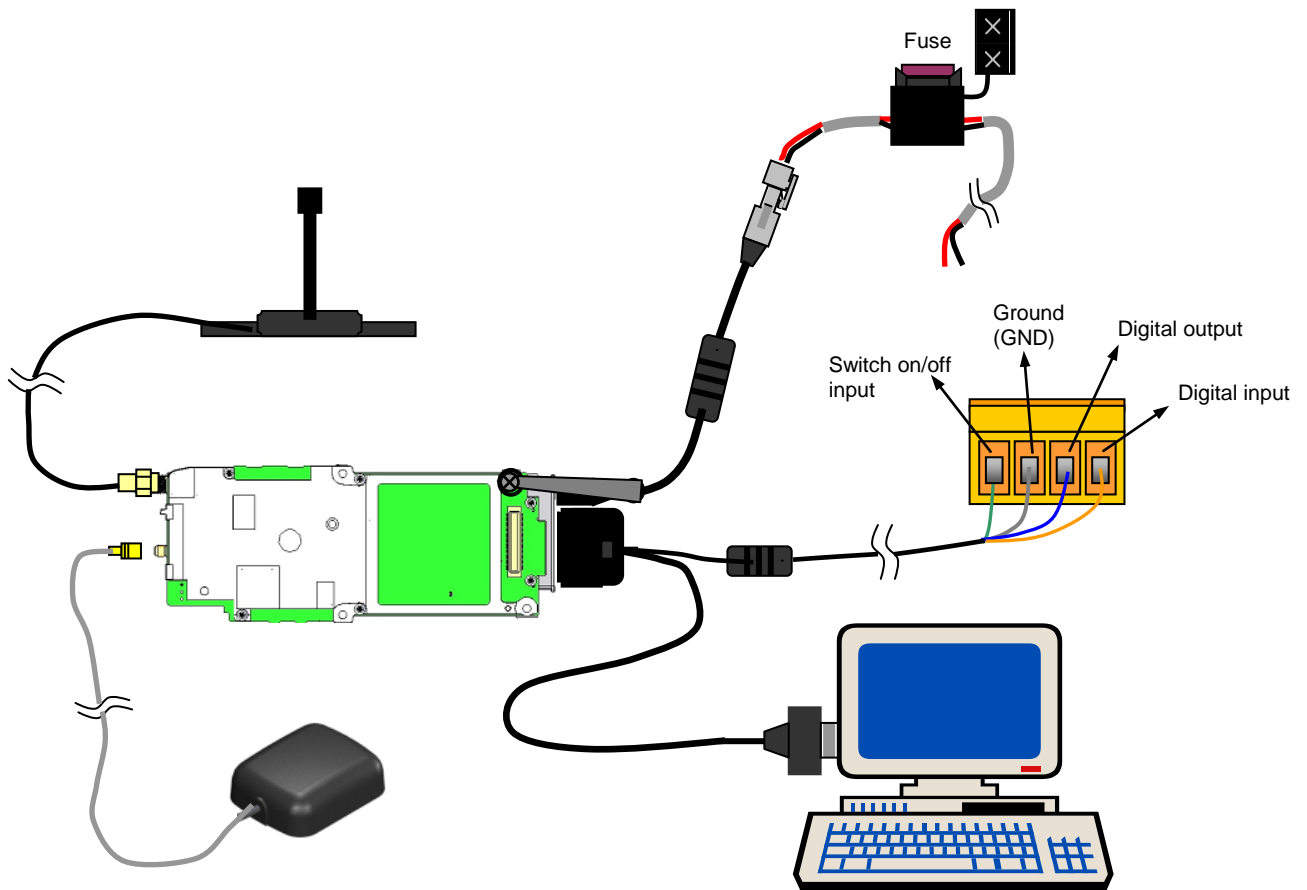
10.2 GPS ANTENNA

In case of a TRM-300 configuration with GPS, the terminal supplies power to an active GPS antenna through the TRM-300 GPS antenna connector which is a male SMC jack. The application mating connector should be a female SMC plug. In order to install it, consult document *D288W21NX_SP03*.

The following table defines the required conditions:

Parameter	Specification limit
GPS Antenna supply voltage	3.0V
GPS Antenna supply current	Up to 15mA

PowerTrunk recommends its GPS Antenna accessory.



By programming, you can configure various parameters to send the GPS position to a central application which will manage this location information.

Consult your services supplier for how to configure your terminal for this service.

The GPS technology uses radio signals from earth orbiting satellites to establish the location co-ordinates. Maximizing the view of clear, unobstructed sky is essential for optimum performance.

In places where adequate signals from multiple satellites are not available (usually because a view of a wide area of the sky could not be established) the GPS feature of your terminal will not work. Such situations include but are not limited to:

- Underground locations.
- Inside of buildings, trains, or other covered vehicles.
- Under any other metal or concrete roof or structure.
- Between tall buildings or under dense tree-cover.

10.3 ANTENNA INSTALLATION

The antennas must be placed in areas with a good RF field, where the signal strength is adequate. Relocate the antennas in order to avoid near field obstructions or to get appropriate polarization.

Regarding the cable needed between each antenna and the TRM-300, use low-loss coaxial cables and connectors, with 50 ohm characteristic impedance. Every additional cable, adapter, and connector increases the loss of signal power.

Electronic devices can cause interference, which affects the performance of the TRM-300. Do not place the antennas close to electronic devices or other antennas.

Using two TETRA terminals nearby may cause interference between them, for example when these two devices are in the same vehicle. If this happens, separate the terminals until the interference disappears.

When designing the hardware application in which the TRM-300 is integrated, it is important to take care of TETRA RF emissions. Do not place any sensitive components near the TETRA antenna, such as the GPS antenna.

At high or exposed sites, the use of a lightning arrester is recommended. Should a lightning strike occur, most of the energy should be diverted to ground leaving the product with little or no damage.

11 START-UP AND CHECK

Once you have prepared the TRM-300 integration according to the previous sections, you can switch on the computer and the radiomodem, according to section 9.3.3.

Programming Kit accessory, which includes the *T2PRO_Programming Guide*, is needed in order to configure the terminal according to the TETRA network. The terminal will be operative when it has successfully registered on the system. In case of detection of error mode, check that the terminal is properly programmed.

The TRM-300 has two indicator lights on the Main_PCB, one on each side and both showing the same information. They indicate the Terminal status regarding TETRA operation, according to the following table:

Indicator lights on the Main_PCB	
	<i>Registration Information</i>
Without light	Non operative terminal
Slowly flashes red	On standby and out of service
Flashes orange and red	With pending events and out of service
Slowly flashes green	On standby and registered on the network
Flashes orange and green	With pending events and registered on the network
Slowly flashes orange	Programming mode

In case of a TRM-300 configuration with GPS, a third indicator light is present on the GPS_PCB. It indicates the Terminal status regarding to GPS operation, according to the following table:

Indicator light on the GPS_PCB	
	<i>Position information</i>
Without light	Non operative Terminal or searching satellites
Slowly flashes green or Steady green	GPS Position Fixed

PowerTrunk recommends its Maintenance Kit accessory, which allows to verify:

- The integration critical aspects (by means of the sensors located into the TRM-300):
 - o Operating temperature. See section 8.
 - o Operating supply voltage. See section 9.
A specific test allows measuring the voltage under the circumstance of standby mode (maximum voltage) and the voltage under the circumstance of transmitting at full power (minimum voltage), which is sufficient to verify if the power cable length and the power supply are appropriate.
 - o TETRA Antenna RF impedance. See section 10.1.
Besides, the previous test provides an approximate value of reflected power under the circumstance of transmitting at full power, which is sufficient to verify if an antenna of the same frequency band as TRM-300 is connected.
- TETRA Antenna installation:
 - o Registration information.
 - o RF power in transmission.
 - o Frequency and RSSI in reception, together with neighbour cells information.

- GPS Antenna installation:
 - o Position and speed information.
- Information about Terminal
- Serial port communication, by use of this software tool itself.

12 REGULATORY COMPLIANCE AND CERTIFICATIONS

12.1 ABOUT THE FINAL PRODUCT

PowerTrunk agrees on the document *Transmitter Module Equipment Authorization Guide* [2].

A transmitter with a modular or limited modular grant can be installed in different end-use products (referred to as a host, host product, or host device) by the grantee or an integrator; and the host may not require additional testing or equipment authorization for the transmitter functions provided by that specific module or limited module.

This device is offered as a limited single-modular transmitter, subject to the licensed radio services rules. Its compliance with IC and FCC rules can be demonstrated only for:

- Specific hosts, which must provide an external power supply regulation.
The integrator shall be responsible for ensuring that the proper power supply is employed.
- Professional installation of the end-use product, which is consistent with having a standard antenna connector.
The installer shall be responsible for ensuring that the proper antenna is employed.
- If used in a "portable" application, then the integrator is responsible for passing additional "as installed" testing; SAR (Specific Absorption Rate) testing, with results submitted to the FCC for approval prior to selling the integrated unit.

If used in a "mobile" or "fixed" application, the information in Section 12.4 must be included in the integrator user manual and an appropriate warning label must be placed on the host unit adjacent to the antenna.

This exterior label can use wording such as the following:

"Restricted to occupational use to safety FCC RF energy exposure limits. See user manual for awareness and control information".

A host product is required to comply with all applicable IC and FCC equipment authorizations regulations, requirements and equipment functions not associated with the transmitter module portion.

To ensure compliance with all non-transmitter functions, the host manufacturer is responsible for ensuring compliance with the module installed and fully operational.

If the application hardware or software changes, the integrator is responsible for verifying the effect, and if needed, to perform all required actions again.

Modular or limited modular grant for transmitters under the rules for licensed devices is permitted for the following conditions:

- i. The modular transmitter is a completely self-contained radiofrequency transmitter device, designed to be incorporated into another device. It doesn't consist of a radio front end and a transmitter control element.
- ii. Once given the above limitations, the modular transmitter respects the following guidelines for good engineering practice:
 - The radio elements have their own shielding.
 - The modular transmitter has buffered modulation/data inputs to ensure that the device will comply with IC and FCC requirements with any type of input signal.

- The modular transmitter has been tested in a stand-alone configuration, i.e., it hasn't been inside another device during testing for compliance with IC and FCC requirements.
- The modular transmitter is labeled with a permanently affixed label, with its IC and FCC identification number.

If the identification number is not visible when the modular transmitter is installed inside another device, then the outside of the device into which it is installed must also display a label referring to the enclosed modular transmitter.

This exterior label must contain the following text:

“Contains FCC ID: xxxnnn
Contains IC: yyyyy-zzzzz”

Where xxxnnn is FCC ID number and yyyyy-zzzzz is IC certificate number which can be found in section 12.3 for the corresponding frequency band.

The integrator user manual must also contain clear instructions on how end users can find and/or access the module and the IC and FCC ID.

- The modular transmitter complies with any specific rules or operating requirements that ordinarily apply to a complete transmitter and the manufacturer provides adequate instructions along with the device to explain any such requirements.
- iii. The grantee is required to provide to other parties and end users, clear documented instructions describing the conditions, limitations and procedures for third-parties to use and/or integrate the modular transmitter into a host device.
- iv. The grantee is responsible for full compliance.
- v. Licensed grant conditions shall be listed on the grant.
- vi. The modular transmitter manual must provide clear instructions explaining to the integrator the labeling requirements and integrator user manual instructions that are required.
- vii. Licensed modular transmitters must be compliant to all specific applicable licensed radio service rules.

12.2 FREQUENCY RANGE

For Federal Communication Commission (FCC), the frequency range is:

Modulation	D288Y21NxPT (FCC ID WT7PTRKTTRM300410)
TETRA	450-470 MHz
TI D-LMR	409-430 MHz 450-470 MHz

For Industry Canada (IC), the frequency range is:

Modulation	D288Y21NxPT (IC 8624A-PTTRM410)
TETRA	409-430 MHz 450-470 MHz
TI D-LMR	409-430 MHz 450-470 MHz

This device may contain functions that are not operational in U.S Territories except as noted in the certification filing. The grant has extended frequencies as noted in the certification filing and Section 2.927(b) applies to this authorization.

The equipment complies with 47 CFR Part 90.203 (e), in that the operator can not directly program the transmit frequencies using the normal accessible external controls”

Access scheme is Time division multiple access (TDMA) with 4 physical channels per RF channel.

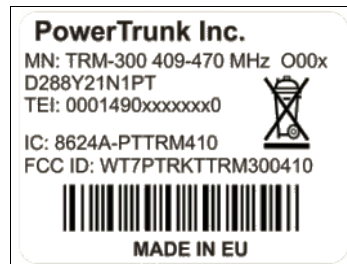
RF Channel Bandwidth (Channel spacing) is 25 KHz. So, the equipment meets a spectrum efficiency of one voice channel per 6.25 KHz of channel bandwidth.

Modulation scheme is $\pi/4$ -shifted Differential Quaternary Phase Shift Keying ($\pi/4$ -DQPSK) with 18Ksym/sec. modulation rate, equivalent to 36Kbits/sec. So, the equipment meets a data rate on each physical channel of 9000bits/sec. per 6.25 KHz of channel bandwidth.

Unapproved modifications or changes to this equipment may cause harmful interference unless the modifications are expressly approved by PowerTrunk Inc. In this case, the user could lose the authority to operate with this equipment.

12.3 IDENTIFICATION LABELS

The equipment is supplied with an identification label where the model, the IC Certificate number and the FCC ID are displayed depending on the frequency work band.



12.4 INFORMATION ON SAFETY AND ELECTROMAGNETIC COMPATIBILITY

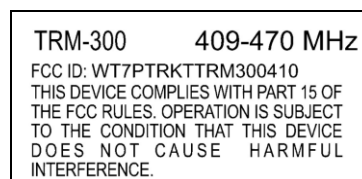
The equipment has been designed to fulfil the applicable compliance regulations.

The equipment complies with the applicable Parts of the FCC Title 47 of the Code of Federal Regulation and Industry Canada (IC) RSS-119 Standard.

This device complies with part 15 of the FCC Rules and Industry Canada ICES-003. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The following labels will be placed in conspicuous view on the TRM-300:



CAN ICES-3 (B)/NMB-3(B)

12.5 RF EXPOSURE AND SAR REQUIREMENTS

Under Industry Canada regulations and FCC rules, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada or FCC. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

The antenna used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

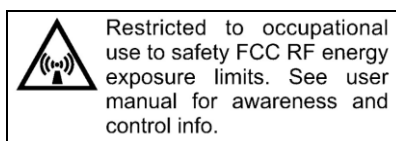
- For D288Y21NxPT model, when used with an 8 dBi gain antenna must be installed to provide a separation distance of at least 25 cm (10 in.) from any person(s) during normal operation in order to comply with the FCC or IC RF exposure requirements.

Failure to observe these restrictions will result in exceeding the FCC or IC RF exposure limits.

All the instructions detailed in this manual must be followed in order to ensure compliance with SAR and RF exposure limits.

Users can obtain Canadian information on RF exposure and compliance at the Industry Canada RSS-102 standard text.

The following label will be placed in conspicuous view on the TRM-300:



TRM-300 is restricted to occupational/controller use to safety RF energy exposure limits. This radio is NOT authorized for general population. Use only accessories, batteries and antennas approved by PowerTrunk Inc. Use of non-approved accessories, batteries and antennas may exceed RF energy exposure limits and/or occupational SAR values.

12.6 EXTERNAL INTERFACE SPECIFICATION

The next table summarizes the technical parameters for interfacing external data sources to TRM-300 terminal.

Port Type	Connector	Load specification
Radio frequency	Antenna connector	Impedance: 50 ohms
Audio input (PCM)	Auxiliary connector	Hi-Z, Digital 0 - 3.3 Volts.
Audio output (PCM)	Auxiliary connector	Hi-Z, Digital 0 - 3.3 Volts.
Data port (UART)	Auxiliary connector	Hi-Z, Digital 0 - 3.3 Volts. Maximum data rate 115200bps