# THALES

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# COMTRAC

# RADIO USER MANUAL

THALES GROUP INTERNAL

| Document Identifier | DTC | Entity Identifier | Revision |
|---|---|---|---|
| 3CU 04036 0026 PCZZA | 108 | 15900-9950 | 002 |

Template: 83410477-DOC-CAN-EN-008

## Follow-up of the evolutions

| LOG OF CHANGES | | | | |
|---|---|---|---|---|
| **Revision** | **Date** | **ECN #** | **Author** | **Modification** |
| **001** | 04-Nov-2019 | CCP00396209 | David Cammidge | First Release – Archive Only |
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|---|---|---|---|---|
| | **Name** | **Role** | **Date** | **Signature** |
| **Written by** | David Cammidge | Sr. Network Design Specialist | 25-Jun-2019 | N/A |
| **Verified by** | Chun Zhang | Technical Specialist | 27-Jun-2019 | Confirmed via ECN |
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# 1.    INTRODUCTION

## 1.1    SCOPE AND PURPOSE

This document is intended to provide an overview of the ComTrac Radio as well as basic information regarding installation.  It is intended to be submitted as an artefact for regulatory compliance.

## 1.2    TARGET AUDIENCE

The ComTrac Radio is an industrial grade device and not a consumer product. This manual is designed to be used by qualified technical support personnel with experience in the rail signalling environment.

## 1.3    ACRONYMS

| | |
|---|---|
| AC | Alternating Current |
| AP | Access Point |
| ARP | Address Resolution Protocol |
| CBTC | Communications-Based Train Control |
| dBi | decibel isotropic |
| dBm | decibel milliwatts |
| DC | Direct Current |
| EIRP | Effective Isotropic Radiated Power |
| EMC | Electromagnetic Comp ability |
| ESSID | Extended Service Set Identifier |
| FHSS | Frequency-Hopping Spread Spectrum |
| GND | Ground |
| ID | Identifier |
| IP | Ingress Protection |
| LAN | Local Area Network |
| LED | Light Emitting Diode |
| n/a | Not Applicable |
| MR | Mobile Radio |
| MRU | Mobile Radio Unit |

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| | |
|---|---|
| PFSE | Power Fibre Splice Enclosure |
| Rx | Receive |
| SFP | Small Form-factor Pluggable |
| STA | Station |
| TCTS | Thales Canada, Transportation Solutions |
| Tx | Transmit |
| QoS | Quality of Service |
| USB | Universal Serial Bus |
| WRU | Wayside Radio Unit |

## 1.4 REFERENCES

[1] 3CU 04019 0006 PCZZA    Software Defined Radio Phase 2 Thales Radio User's Guide

## 1.5 WARNING

Warnings are used throughout this document to emphasize important and critical information.

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**WARNING**

Warnings identify an installation, operating, maintenance procedure or statement that, if not strictly followed could result in death or serious injury to personnel, and/or damage to equipment.

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The following graphic symbols may be used with Warnings and Cautions in Thales Canada, Transportation Solutions (TCTS) documents:

| | |
|---|---|
|  | Caution or Warning |
|  | Laser Radiation |
|  | High Voltage |
|  | Hot Surface |

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## 2. OVERVIEW

The ComTrac Radio is used as a telecommunication device within the context of Communications-Based Train Control (CBTC) System. The radio incorporates the 802.11 FHSS standard to provide radio-to-radio communication using the unlicensed 2.4GHz spectrum in a mobile environment. It also provides fibre and LAN connectivity to pass data traffic from wayside to on-board networks.

Urban Rail
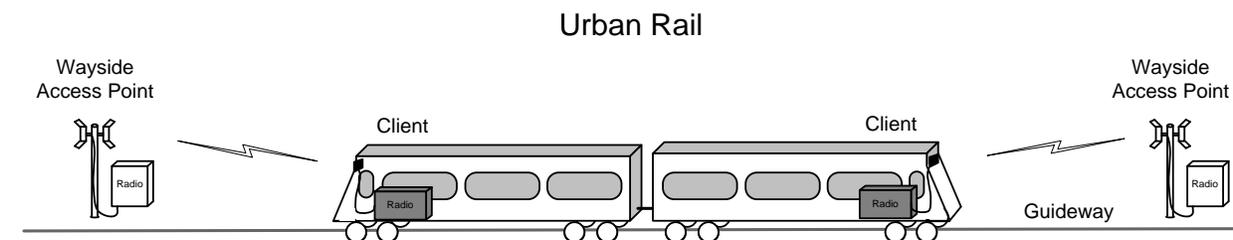


**Figure 1    Typical Radio Application**

There are two styles of the radio; a standalone unit and a die-cast unit. The standalone can be configured for all modes of operation. The die-cast is intended to be used as an access point only.

The term 'radio' is interchangeable with 'ComTrac Radio', 'access point' (AP), or 'mobile radio' (MR) within the context of this document.
Also, the term 'client' is interchangeable with mobile radio (MR), and the 'Wayside Radio Unit' (WRU) is interchangeable with access point.

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## 2.1 MODES OF OPERATION

### 2.1.1 Access Point

An access point (AP) is a mode of operation that allows connectivity, through bridging, from a wired local area network (LAN) to one or more clients.

To setup the radio in AP mode requires the AP configuration file to be selected. Refer to the Configuration section in [1] for further details.

### 2.1.2 Client

Text client is an operational mode which provides wireless communication from the AP to its wired LAN(s), and is responsible to initiate roaming between AP's.

To setup the radio in client mode, requires the mobile radio configuration file to be selected. Refer to the Configuration section in [1] for further details.

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# 3.  SOFTWARE / CONFIGURATION INSTALLATION

There are two methods to download software and configuration to the radio, a local method where physical connectivity to the radio is available, and a remote method, such as on a network.

## 3.1  LOCAL DOWNLOAD PROCEDURE

This method requires a console connection to the administration port, as well as a USB drive formatted with FAT32 file system.

This procedure may be used to update the software and/or configuration files.

Refer to [1] for procedure.

## 3.2  REMOTE DOWNLOAD PROCEDURE

This method requires that the loader laptop or PC has access to a network connection, and there is connectivity to the radio requiring the upgrade.

This procedure may be used to update the software and/or configuration files.

Refer to [1] for procedure.

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# 4. PHYSICAL INTERFACES – STANDALONE VARIANT

## 4.1 CONSOLE PORTS

A console port is provided for each side. Side-A is interfaced through ADMIN-A, and the side-B is interfaced through ADMIN-B.

The console interface uses a standard female DB9.  The pin-outs are listed below.

When using a USB to serial adaptor, it is recommended to keep the serial cable portion as short as possible.

**Table 1          Console Port Pin Description**

| DB-9 Female Connector Pin Out | RS-232 Signal |
|---|---|
| 1 | Not Connected |
| 2 | RxD |
| 3 | TxD |
| 4 | DTR |
| 5 | Signal Ground |
| 6 | DSR |
| 7 | RTS |
| 8 | CTS |
| 9 | Not Connected |

**Table 2          Console Port Settings**

| Console Port | Default Port Settings |
|---|---|
| Bits Per Second | 115200 |
| Data Bits | 8 |
| Parity | None |
| Stop Bits | 1 |
| Flow Control | None |

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## 4.2 DISCRETE IO PORT

The discrete Input Output (IO) port, labelled AUX is currently not supported.

## 4.3 ETHERNET PORTS

These ports are shielded, RJ-45 ports that supports 10BaseT / 100BaseT / 1000BaseT Ethernet network connectivity. Short-circuit protection and 1500Vrms isolation is supported.

There are four ports per side:

- A-side has connectivity to the ports labelled 1-A thru 4-A

- B-side has connectivity to the ports labelled 1-B thru 4-B

## 4.4 FIBRE (SFP) PORTS

The radio contains two SFP slots. Ensure the transceiver modules are securely inserted and latched. The release bar should be in the down position when installed.

To connect the transceivers from one radio to another, cross-connect the transmit channel at each end to the receive channel at the opposite end, as shown below.
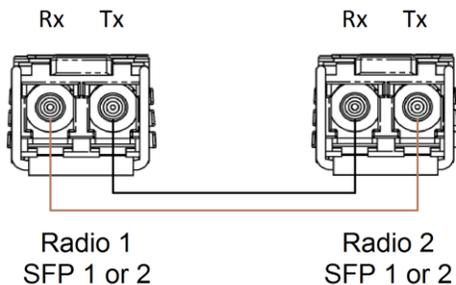


**Figure 2       Fibre Port Connection**

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The supported transceivers are listed below.

**Table 3        Supported Transceiver List**

| Fibre Type | Wavelength (nm) | TCTS Part Number | Comments |
|---|---|---|---|
| Single Mode (SM) | 1310 | 300-3-02363 | Recommended for new installations |
| Single Mode (SM) | 1310 | 300-3-02089 | |
| Multi-Mode (SM) | 1310 | 300-3-02090 | |

## 4.5    POWER INTERFACE

The power port is label as '12 VDC' and requires between 9-14Vdc to operate, with a minimum input current rating of 3A @12V.  There is reverse polarity protection.

The 'pin' on the radio is the positive connection, and the 'socket' negative.

**Table 4        Power Port Pin Description**

| DSUB Female Connector Pin Out | 12VDC |
|---|---|
| 1 (pin) | +Vdc |
| 2 (socket) | -Vdc |

The absolute maximum input voltage is 15V.
The -Vdc is electrically connected to chassis

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The following is a list of the suggested mating connector parts:

**Table 5    Power Port Mating Connector Parts List**

| Item | TCTS P/N | Thales Description | Manufacturer / P/N |
|---|---|---|---|
| Mating Connector | 702-3-1561 | CON-SHELL DESUB 2 PIN FML 2W2C | Conec / 302W2CPXX99A10X |
| Backshell | 702-3-01070-A | CON-BACKSHELL DE9 EMI | Conec / 165X13469X |
| Pin | 702-3-01080 | CONTACT-CRIMP MALE 16-20 AWG | Conec / 131C11019X |
| Socket | 702-3-01081 | CONTACT-CRIMP FEMALE 16-20 AWG | Conec / 132C11019X |

## 4.6    RF PORTS

There are four RF N-type female, 50 ohm connectors, labelled below.

For CBTC implementation, the following default antenna ports are identified below.

**Table 6    RF Port Description**

| RF Port | STA (MR) | AP |
|---|---|---|
| ANT 1 | Not used | Not used |
| ANT 2 | Not used | Not used |
| ANT 3 | Diversity (modem-0) | Main Antenna |
| ANT 4 | Diversity (modem-1) | Not used |

To avoid radio receiver saturation, the maximum input signal level to the radio should not exceed -10dBm.  The absolute maximum continuous input power is +10dBm.

## 4.7    USB PORTS

The Universal Serial Bus (USB) port is a shielded USB Standard A port that provides connectivity for USB-A port and USB-B port.  The interface supports USB 1.0 and 2.0 compliant storage devices, formatted with FAT32 file system.

Note:  Not all USB thumb drives are supported.

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# 5. PHYSICAL INTERFACES – DIE-CAST VARIANT

## 5.1 CONSOLE PORTS

The console ports are located underneath the removable face plate.

A console port is provided for each side. Side-A is interfaced through ADMIN-A, and the side-B is interfaced through ADMIN-B.

The console interface uses a standard female DB9.  The pin-outs are listed below.

When using a USB to serial adaptor, it is recommended to keep the serial cable portion as short as possible

### Table 7 Console Port Pin Description

| DB-9 Female Connector Pin Out | RS-232 Signal |
|---|---|
| 1 | Not Connected |
| 2 | RxD |
| 3 | TxD |
| 4 | DTR |
| 5 | Signal Ground |
| 6 | DSR |
| 7 | RTS |
| 8 | CTS |
| 9 | Not Connected |

### Table 8 Console Port Settings

| Console Port | Default Port Settings |
|---|---|
| Bits Per Second | 115200 |
| Data Bits | 8 |
| Parity | None |
| Stop Bits | 1 |
| Flow Control | None |

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## 5.2 ETHERNET PORT

This port is labelled on the top of the unit as 'ETHERNET'.

The interface is an M12 D-coded female connector that supports 10BaseT / 100BaseT Ethernet network connectivity. Short-circuit protection and 1500Vrms isolation is supported.  It also supports a mating connector with a push-pull or threaded locking mechanism.

In reference to the Standalone radio, this interface is internally connected to port 3-A, using a straight-through cable.

The following shows the pin-out as well as the signal definition.

**Table 9          Ethernet Port Description**

| M12 Pin #: | I/O Label |
|:---:|:---:|
| 1 | Tx+ |
| 2 | Rx+ |
| 3 | Tx- |
| 4 | Rx- |
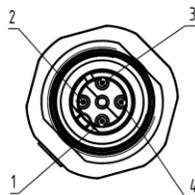


**Figure 3          Ethernet Port Pin-out**

The following table identifies patch cables to be used for maintenance purposes.

**Table 10          Ethernet Patch Cable List**

| Item: | TCTS P/N: |
|:---|:---:|
| Cable Assembly, 2m, M12 to RJ45 CAT5E | 403-3-00905 |
| Cable Assembly, 5m, M12 to RJ45 CAT5E | 403-3-00677 |

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| Document Identifier | DTC | Entity Identifier | Revision |
|:---:|:---:|:---:|:---:|
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### 5.3 FIBRE PORTS

There is one connector which contains two fibre interfaces, and is labelled 'FIBRE' on the top of the unit.

The connector is a Harting Han® 3 A with a locking feature, and uses an insert.

In reference to the Standalone radio, this interface is internally connected to the SFP ports, using a fibre cable. Type of fibre is dependent on the variant of die-cast unit.

The following shows the pin-out as well as the signal definition.

**Table 11        Fibre Port Pin Description**

| Fibre Port Pin # | I/O Label (ref. Standalone radio) |
|:---:|:---:|
| 1 | SFP 2, Tx |
| 2 | SFP 2, Rx |
| 3 | SFP 1, Tx |
| 4 | SFP 1, Rx |
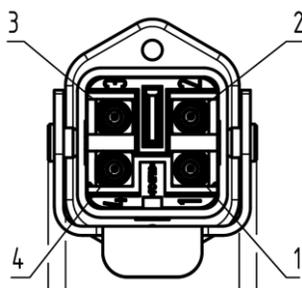


**Figure 4        Fibre Port Pin-out**

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The following identifies patch cable to be used between the radio and the PFSE;

**Table 12        Fibre Patch Cable List**

| Item | TCTS P/N |
|------|----------|
| Cable Assembly, SM SC/4X LC SPX, 1.5m | 403-3-00986 |
| Cable Assembly, MM SC/4X LC SPX, 1.5m | 403-3-00987 |

## 5.4    POWER INTERFACE

The power port is label as 'AC POWER INPUT' on the top of the unit.  The connector is a Harting series Han® 4 A, with a locking feature, and uses a 4 position (male) insert.

The following indicates the pin-out as well as the signal definition.

**Table 13        Power Port Pin Description**

| Power Connector Pin # | 120-240Vac |
|-----------------------|------------|
| 1 | Line |
| 2 | (no connect) |
| 3 | (no connect) |
| 4 | Neutral |
| GND ⏚ | Ground |
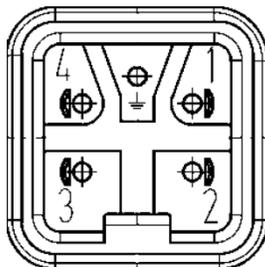


**Figure 5        Power Port Pin-out**

The following table identifies a 1.5 meter power cable assembly using flexible conduit to be used between the radio and the PFSE. It also identifies parts to create a bench or lab cable (wire not specified).

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**Table 14    Power Port Mating Connector Parts List**

| Item | TCTS P/N | Manufacturer / P/N |
|---|---|---|
| Cable Assembly | 403-3-00985 | Harting: 33520121500001 |
| Insert, with pins | 702-3-02147 | Harting:   09 20 004 2611 |
| Back shell (black) | | Harting:   19 37 003 1440 |
| Cable gland, M20 | | Harting:  19 00 000 51 55 |

Nominal input level is 100/240 Vac, 50/60Hz.
Operation voltage level is between 85-264Vac 47/63Hz.

The power interface is protected by an external, 5x20mm, replaceable fuse with a rating of 3.15A 250V time-lag.  TCTS part number for a replacement fuse is 600-3-00326.

## 5.5    RF PORT

There is one RF port located at the side of the unit, and is labelled as ANT-1 on the top of the unit.  There is a series internal bandpass filter, which provides rejection for frequencies outside of the 2.4 GHz band. Refer to the Specification section for the RF characteristics.

The RF port is an N-type female connector.

## 5.6    USB PORTS

The Universal Serial Bus (USB) ports are located underneath the removable face plate.

The USB port is a shielded USB Standard A port that provides connectivity for USB-A port and USB-B port.  The interface supports USB 1.0 and 2.0 compliant storage devices, formatted with FAT32 file system.

Note:  Not all USB thumb drives are supported.

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# 6. STATUS INDICATORS – STANDALONE UNIT

## 6.1 STATUS FAULT INDICATOR

The Status Fault LED indicator is used to indicate the operational status of the radio as indicated in the following table.  It is located on the front and center of the unit, and is labelled as STATUS.

**Table 15 Status LED Description**

| STATUS LED | Description |
|---|---|
| LED is Green | Radio is powered on and operating |
| LED is Orange | Radio is in a boot-up state |
| LED is Red | Radio is in a fault state |

## 6.2 ETHERNET PORTS

The LED status indicator states for the RJ-45 Ethernet ports are listed below.

**Table 16 Ethernet LED Description**

| RJ-45 Port LED | Description |
|---|---|
| LED is off | No RJ-45 electrical connectivity<br><br>- Cable disconnected<br>- Port speed mismatched |
| LED is on solid | Link has electrical connectivity with no data transfer. |
| LED flashing | Link has electrical connectivity with data transfer. |

## 6.3 WIRELESS NETWORK LINKS

The wireless network link uses a series of LEDs to indicate status.  Only the yellow bank of LEDs is currently utilized, which is located underneath ANT 4.  The green bank of LEDs is not functional.

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The following provides a description of their usage.

**Table 17        Wireless LED Description**

| LED Identifier | STA / AP | Description |
|---|---|---|
| Bar Graph Symbol | STA only | Wireless signal strength – refer to bar graph chart below |
| MODE | All | Off = wireless not configured<br>Flashing 50% duty cycle;<br>1 sec interval = Client<br>½ sec interval = Access Point |
| ASSOC | STA only | Wireless association state. ON when STA is associated |
| TxRx | All | Wireless Tx/Rx activity. |
| SEC | n/a | Not currently implemented |

**Table 18        Wireless Bar Graph Description**

| Bar Graph | Approximate Signal Level / Range (dBm) |
|---|---|
| ○○○○ | < -85 |
| ●○○○ | -85 to -65 |
| ●●○○ | -65 to -45 |
| ●●●○ | -45 to -25 |
| ●●●● | > -25 |

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# 7. STATUS INDICATORS – DIE-CAST UNIT

## 7.1 STATUS FAULT INDICATOR

The Status Fault LED indicator is used to indicate the operational status of the radio as indicated in the following table.  It is located on the front and center of the unit, and is labelled as STATUS.

**Table 19      Status LED Description**

| STATUS LED | Description |
|---|---|
| LED is Green | Radio is powered on and operating |
| LED is Orange | Radio is in a boot-up state |
| LED is Red | Radio is in a fault state |

## 7.2 WIRELESS NETWORK LINKS

The wireless network link uses a series of LEDs to indicate status, as identified by the removable faceplate.

Only the yellow bank of LEDs is currently utilized.  The green bank of LEDs is not functional.

**Table 20      Wireless LED Description**

| LED Identifier | STA / AP | Description |
|---|---|---|
| MODE | All | Off = wireless not configured<br>Flashing, 50% duty cycle;<br>    1 sec interval = Client<br>    ½ sec interval = Access Point |
| ASSOC | STA only | Wireless association state.<br>ON when STA is associated |
| TxRx | All | Wireless Tx/Rx activity. |
| SEC | n/a | Not currently implemented |

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## 8.      MAINTENANCE

Mounting the radio should include consideration for the maintenance strategy in terms of ease of complexity and time of radio replacement.

There are no serviceable parts within the radio.  This applies to both the Standalone and Die-cast units.

The Die-cast unit has an input fuse which is externally accessible and next to the input power connector.  Refer to Power Interface section for details.

---

**WARNING**

Do not allow foreign objects to be inserted in any connector or openings as damage may occur.

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## 9.  SAFETY

Warning!

LED or Laser components according to IEC 60825-1 (2001):
CLASS 1 LASER PRODUCT.
LIGHT EMITTING DIODE – CLASS 1 LED PRODUCT.

---

### WARNING – FIBRE OPTIC INTERFACES

LED LIGHT
DO NOT STARE INTO THE BEAM OR VIEW DIRECTLY WITH OPTICAL
INSTRUMENTS (e.g. lens, microscope).

---

For Die-Cast unit only;

---

### WARNING

Proper precaution MUST be exercised when touching and working on the equipment, as AC voltage may be present when working on the Die-cast unit.

The Die-cast unit contains high voltages on the input wiring / fusing and printed circuit board.  Do not attempt to open the Die-cast unit for servicing.

Hot Surface.  Surface may be Hot under elevated ambient temperature.

---

The Standalone unit has no hazardous voltages present.

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# 10.    INSTALLATION

The radio is not a consumer product, and therefore installation must be conducted by qualified personal, based on drawing approval by TCTS.

## 10.1    STANDALONE UNIT

The standalone variant of the radio has two mounting methods; using the mounting feet, or securing directly to the bottom.

The mounting feet can accept a No. 10 (M5) screw.

Securing to the bottom side uses No. 10-32 screws.  Maximum depth is 11/32" (8.5mm).

Refer to Figure 3 for mounting details.  (Cable tie down bar is not exactly as shown).

It is recommended for the radio to be thermally connected to a metal base plate to aid in transferring heat to the environment.

It is recommended to tie down the cables leading to / from the unit, so that vibration is minimized / eliminated to the cables / connectors.

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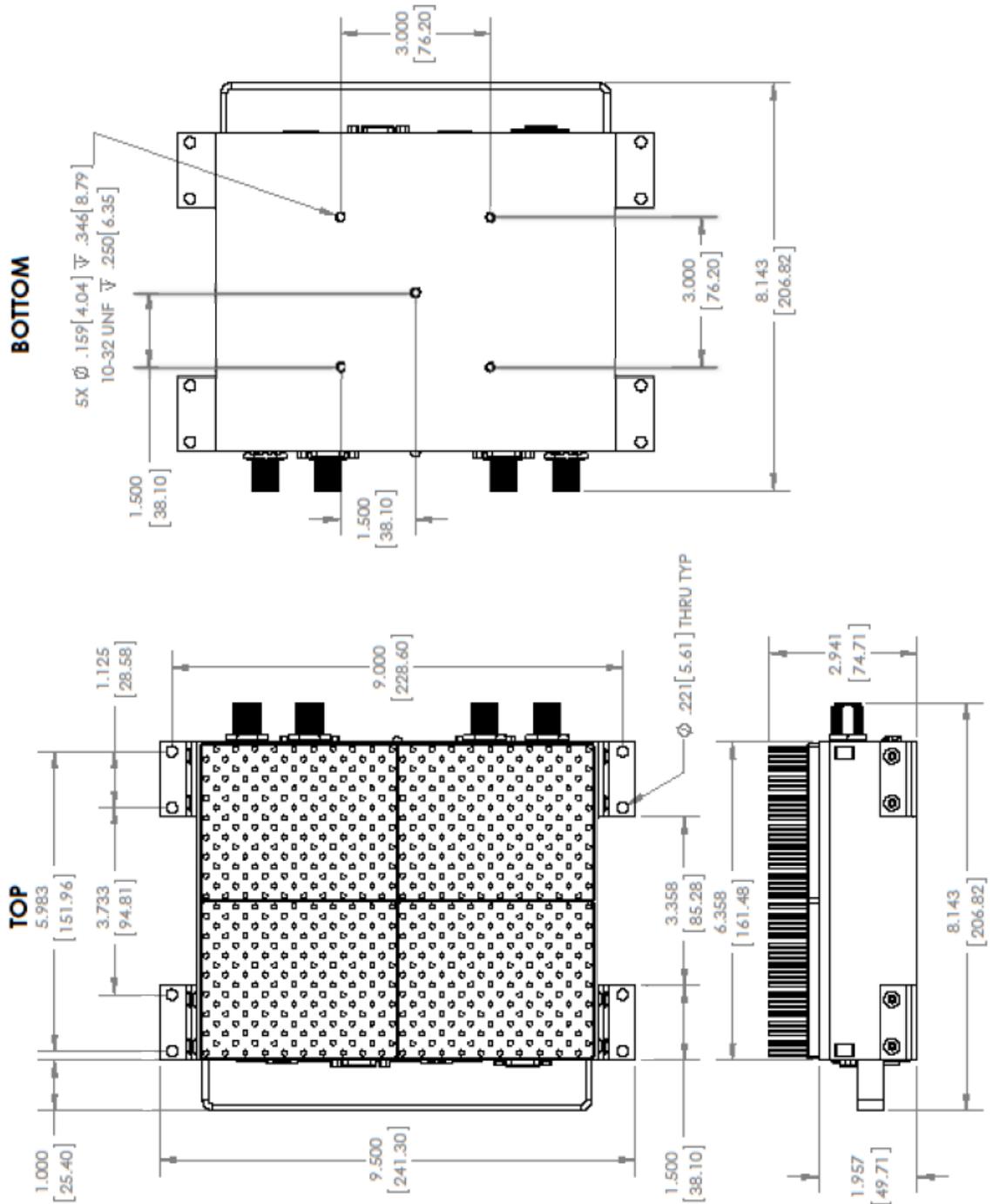| Document Identifier | DTC | Entity Identifier | Revision |
|---|---|---|---|
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**Figure 6    Mounting Dimensions – Standalone Unit**

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## 10.2    DIE-CAST UNIT

The die-cast variant of the radio is designed for an outdoor environment, and has IP66 / NEMA 4X ratings. It also has a solar shield option. Contact TCTS for further details.

The mounting holes accommodate No. 12 (M6) size screw.
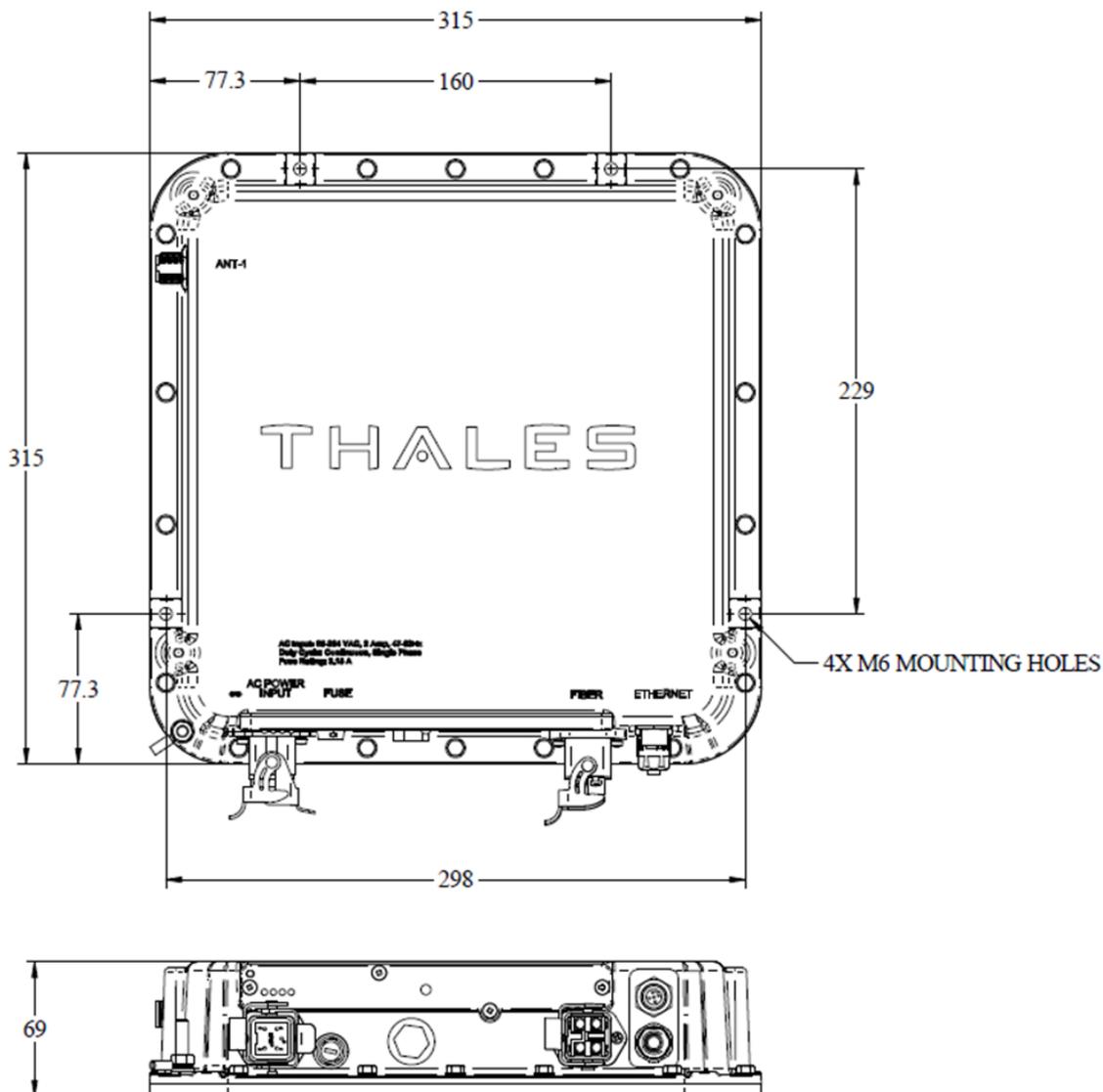


**Figure 7    Mounting Dimensions – Die-cast Unit**

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## 11.     EMC CONSIDERATIONS

To ensure the radio is compliant with EMC emission standards, the radio must be connected to ground.  It is recommended to use a braided cable kept as short as practical for this purpose.  Maximum length between bonding points should be less than 1 meter.

For the Standalone variant, this connection is located on the side of the unit, using the screw location with the open area around / underneath the screw head. It is identified by a ground symbol.  The mounting screw is a No. 8 (4mm) and comes with the unit. Locking hardware is needed.

For the Die-cast variant, this connection is located at the corner near the power connector, and is identified by a ground symbol. The size of the grounding bolt is a No. 6 (3.5mm) and comes with locking hardware and an N10, #16-14, crimp terminal ring.

This connection is also necessary to comply with safety standards.

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# 12. DEPLOYMENT CONSIDERATIONS

In the context of CBTC deployment, careful considerations for bandwidth usage must be taken into account for traffic passing over the wireless interface. Quality of Service (QoS) is a mechanism to help prioritize CBTC traffic verses diagnostic and other types of traffic, is implemented and configurable. Refer to the QoS section in [1] for further details.

EIRP limits pertaining to the region where installed must not be exceeded. The use of a spreadsheet is recommended to ensure compliance to this limit, as well to ensure the RF link is balanced. Recommend to calculate the WRU's power setting first, as this is typically what limits the power level setting for the system. See details in the following section for calculating the RF transmit power setting.

Consecutive WRUs should have a different hop sequence in order to reduce co-channel interference. Refer to notes in the Wireless Parameter section in [1] for details.

The ComTrac Radio contains a network identifier, and is the same for all radios deployed in the region. Both the client and access points are to have the same ESSID. Refer to the Wireless Parameter section in [1] for configuration.

The same also applies to the wireless security type and key parameters.

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## 12.1 WAYSIDE RADIO UNIT

The WRU is positioned along the guideway. Spacing and placement is determined by an RF survey to ensure continuous overlapping RF coverage.

The ComTrac radio standalone variant can be housed in an outdoor rated enclosure, along with an AC/DC power supply and bandpass filter.

Alternatively, the die-cast variant can be deployed on its own. It contains the AC/DC power supply and bandpass filter.

Typical antenna is the Andrew Flat Planar Array Microceptor, QD-2402, with 16 dBi.
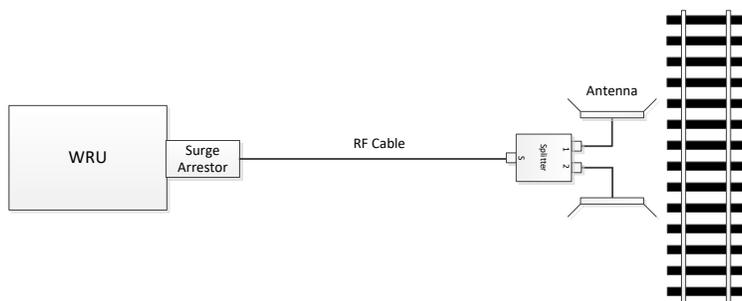
Typical two antenna system is show below.



**Figure 8        Access Point Radio Installation – Two Antennas**

Typical four antenna system, servicing difference tracks (areas), is shown below.



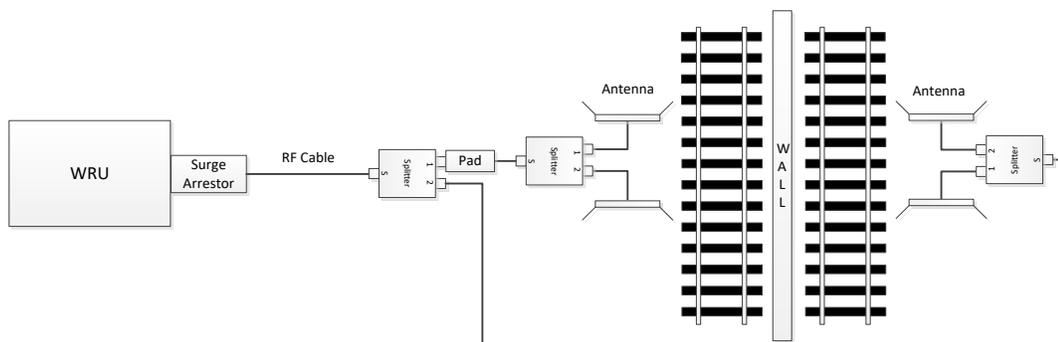**Figure 9        Access Point Radio Installation – Four Antennas**

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### 12.1.1 Assess Point Power Setting

When installing the WRU radio, the power level must be set in order to not exceed the maximum output power and/or EIRP requirements for the region of deployment, which is measured at the antenna output.

In the four antenna system, the antennas closer to the WRU will have a slightly higher output signal level if there is less cabling (less link loss). The use of an attenuator (or pad) should be used to balance the antenna system. The value of the pad is determined by the difference in the link budge (link loss) between the two antenna systems.

For FCC compliance of Point-to-Multipoint Communication;

 - The maximum output power from the intentional radiator (radio) is +30 dBm (1 watt), delivered to an antenna with a maximum gain of 6dBi. This equates to a maximum EIRP of +36dBm (4 watts).

 - If using directional antenna with a gain greater than 6 dBi, then the conducted output power from the radio is reduced by the additional gain above 6 dBi.

Example: If using a directional antenna with a gain of 16 dBi, then the maximum power applied to the antenna port will be +36 – 16 = +20 dBm. [or; (6-16) +30 dBm = +20dBm].

The transmitters (radio) output power can be calculated by factoring the additional loss, and increasing this value to a maximum of +30 dBm.

Example: Using the 16 dBi gain antenna example above, and considering the losses for one 2-way splitter of 3.5 dB (power + insertion loss), a surge suppressor of 0.5 dB (insertion + coupling loss), and total cabling of 2 dB (cable losses), then the transmitter output power level is +20 +3.5 +0.5 + 2 = +26 dBm.

## 12.2 MOBILE RADIO UNIT

The MRU, or client radio, is situated on a train, and is connected to one of the two independent vehicle on-board computer replicas. There will be one MRU at each end of the train. The antennas for each MRU are connected at one end of the train only, and setup with diversity. Each radio is powered by an independent direct current (DC) power supply.

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The link budget for each antenna connection must be the same to ensure antenna diversity is optimized. This means the antenna cable type and length must be the same.

The distance between the two antennas is recommended to be greater than 5 wavelengths apart. One wavelength (λ) is about 12 cm.

Typical antenna is the Huber+Suhner Linear polarized antenna, 1324.17.0098, 8.5 dBi or 1324.99.0025, 8.5 dBi.

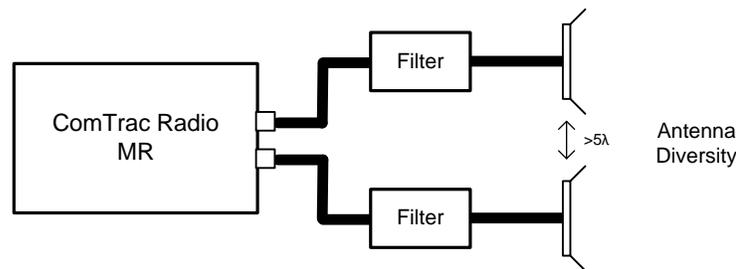Typical on-board installation is shown below.



**Figure 10      Mobile Radio Installation**

## 12.2.1    Mobile Power Setting

When installing the mobile radio, the power level must be set in order to not exceed the maximum output power and/or EIRP requirements for the region of deployment, which is measured at the antenna output. In the configuration above, only one antenna will be transmitting at any given time.

For mobile radio power level setting, the output power level should be the same as what is set for the WRU, in order to produce a balanced RF link (same power level seen by the both receivers).

For FCC compliance of Point-to-Multipoint Communication;

 - The maximum output power from the intentional radiator (radio) is +30 dBm (1 watt), delivered to an antenna with a maximum gain of 6dBi. This equates to a maximum EIRP of +36dBm (4 watts).

 - If using directional antenna(s) with a gain greater than 6 dBi, then the conducted output power from the radio is reduced by the additional gain above 6 dBi.

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Example:  If using a directional antenna with a gain of 8.5 dBi, then the maximum power applied to the antenna port will be +36 – 8.5 = +27.5 dBm.

The radio output power can be calculated by factoring the additional loss, and increasing this value to a maximum of +30 dBm.

Example:  Using the 8.5 dBi gain antenna example above, and considering the losses for one bandpass filter of 2 dB (power + insertion loss), and total cabling of 2 dB (cable losses), then the transmitter output power level is +27.5 +2 + 2 = +31.5 → +30 dBM max.

However, in this case where the mobile radios power level can be set higher than the WRU, use the WRUs power level setting for the mobile to ensure a balanced RF link.

### 12.2.2    Antenna Diversity

Antenna diversity is used on the MRU installation and configuration only.  The testing of the installation must take this into consideration when measuring RF signals, as the active transmit antenna port may change.

Refer to [1] for further details.

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# 13. REGULATORY COMPLIANCE NOTES

Electronic Emission Notices

This device complies with Part 15 of the FCC rules, ETSI 300-328, and CE.

Operation of these devices is subject to the following conditions:

1. This device may not cause harmful interference.

2. This device must accept any interference received, including interference that may cause undesired operation.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and

2. This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'industrie Canada applicables aux appareils radio exempts de licence.  L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage, et

2. L'appareil doit accepter tout brouillage radioélectrique subi, même si ce brouillage est susceptible d'en compromettre le fonctionnement.

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme a la norme NMB-003 du Canada.

FCC Radio Frequency Interference Statement

This equipment has been tested and found to comply within the limits for a Class DSS digital device, pursuant to Part 15 of the FCC rules.  These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.  This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the

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instruction manual, may cause harmful interference to radio communications.  Operation of this equipment in a residential area is likely to cause harmful interference in which cases the user will be required to correct the interference at his/her own expense.

FCC Information Statements

Changes or modifications not expressly approved by Thales could void the user's authority to operate the equipment.

Note:  This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.  This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.  Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

The intended use of the ComTrac Radio is not for the general public.  It is for industry/commercial use in Thales Communications-Based Train Control (CBTC) systems and cannot be sold retail, to the general public or by mail order.

The ComTrac Radio requires professional installation, as the installed unit requires special programming (configuration is based on site specific parameters) during system deployment and access must be limited (secure) due to safety requirements.

FCC and IC RF Exposure Warning Statement

The antennas used for this transmitter must be installed to provide a separation distance of at least 25 cm from all persons and not be co-located with any other antenna or transmitters except as described in this manual.

Les antennes utilisées pour cet émetteur doit être installe pour fournir une distance de séparation d'au moins 25 cm de toute personne et ne pas être co-localises avec une autre antenne ou émetteur sauf tel que décrit dans ce manuel.

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# APPENDIX A:    LABELLING INFORMATION FOR STANDALONE VARIANT



Model: 3CU10385AAAA   CE
FCC ID: 2AO3U3CU10385
IC : 23653-3CU10385

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

THALES   CBTC RADIO
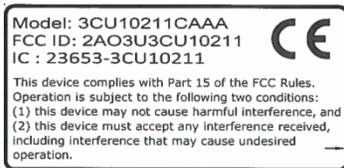P/N 3CU10385AAAA      S/N XXXXXX    ICS 04

Note:  Same label location for 3CU10385AAAA and ABAA models

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# APPENDIX B: LABELLING INFORMATION FOR DIE-CAST VARIANT



Note: Same label location for 3CU10211CAAA and BZAA models

**END OF DOCUMENT**

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