

TM9456 Dual-Radio Installation and Programming Guide

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The European Union's Waste Electrical and Electronic Equipment (WEEE) Directive requires that this product be disposed of separately from the general waste stream when its service life is over. For more information about how to dispose of your unwanted Tait product, visit the Tait WEEE website at www.taitradio.com/weee. Please be environmentally responsible and dispose through the original supplier, or contact Tait Limited.

Tait Limited also complies with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive in the European Union.

In China, we comply with the Measures for Administration of the Pollution Control of Electronic Information Products. We will comply with environmental requirements in other markets as they are introduced.

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Preface

Scope of Manual

This manual describes the installation and programming of dual mobile radio systems. A dual-radio system is where two radio bodies are connected together, and then connected to a single control head.

The installation of accessories is described in the installation instructions provided with the equipment, and the relevant section in the service manual.

Document Conventions

Please follow exactly any instruction that appears in the text as an ‘alert’. An alert provides necessary safety information as well as instruction in the proper use of the product. This manual uses the following types of alert:



Warning This alert is used when there is a hazardous situation which, if not avoided, could result in death or serious injury.



Caution This alert is used when there is a hazardous situation which, if not avoided, could result in minor or moderate injury.

Notice This alert is used to highlight information that is required to ensure procedures are performed correctly. Incorrectly performed procedures could result in equipment damage or malfunction.



This alert is used to highlight significant information that may be required to ensure procedures are performed correctly, or draw your attention to ways of doing things that can improve your efficiency or effectiveness.

Within this manual, the following symbols are used to highlight differences between radios with a transmit power of more than 25 W and radios with a transmit power of 25 W:



This symbol highlights information that is relevant to radios with a transmit power of 30-50 W.



This symbol highlights information that is relevant to radios with a transmit power of 25 W.

Associated Documentation

The following associated documentation is available for this product:

- MAU-03046-xx TM9456 Dual-Radio Mobile Radio User's Guide
- MMB-00004-xx TM9300/TM9400 Service Manual
- 402-00101-xx T02-00073-AAAx Hand-Held Control Head Installation Instructions
- 3301A2xx TM9400 Dual Torso Programming Application Online Help

The characters **xx** represent the issue number of the documentation.

Technical notes are published from time to time to describe applications for Tait products, to provide technical details not included in manuals, and to offer solutions for any problems that arise.

All available TM9400 product documentation is published on the Tait support website.

Publication Record

Issue	Publication Date	Description
01	July 2016	First release

Safety and Regulatory Warnings



Warning Incorrect installation of your mobile radio may cause damage to your vehicle which may result in death or serious injury. You must read this manual before starting the installation!

You must also read and observe the safety information on radio operation provided in the safety and compliance information and the user's guide!

RF Exposure Hazard

To comply with FCC RF exposure limits:



For radios with a transmit power of 30-50 W:

- VHF radios must be installed using an antenna mounted centrally on the vehicle roof, with a gain of 2.15 dBi or 5.15 dBi.
- UHF and 800 MHz radios must be installed using an antenna mounted either centrally on the roof with a gain of 2.15 dBi or 5.65 dBi, or centrally mounted on the trunk with a gain of 5.65 dBi.



For radios with a transmit power of 25 W:

- The radio must be installed using an externally mounted antenna with a gain of either 2.15 dBi or 5.15 dBi.

In all cases, an antenna must not be mounted at a location such that any person or persons can come closer than 35 inches (0.9m) to the antenna.

Health Canada Warning Statement

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population; consult Safety Code 6, obtainable from the Health Canada website <http://www.hc-sc.gc.ca>.

Vehicle Manufacturer's Installation Instructions

Installation of this product in a vehicle must be performed according to the instructions provided by the vehicle manufacturer. For more information, refer to the vehicle manufacturer's website or contact the vehicle manufacturer's dealer.

MPT 1362 Code of Practice

Mobile radios should be installed in accordance with the MPT 1362 Code of Practice.

Safe Radio Mounting



Warning Mount the radio securely so that it will not break loose in the event of a collision. An unsecured radio is dangerous to the vehicle occupants.

- Mount the radio and the microphone where they will not interfere with the deployment of passenger airbags, the vehicle operator controls, the vehicle operator's view.
- Do not mount the radio vertically, with the control head facing down. This will violate compliance with the standards UL/CSA/EN 60950, Safety of Information Technology Equipment.



Caution The bottom surface of the radio and the heatsink fins can become hot during prolonged operation. When installing the radio, position the radio so that it is not possible for the radio user to touch the bottom surface of the radio and the heatsink fins.

Interference with Vehicular Electronics



Warning Some vehicular electronic devices may be prone to malfunction due to the lack of protection from RF energy when your radio is transmitting.

Examples of vehicular electronic devices that may be affected by RF energy are:

- electronic fuel injection systems
- electronic anti-skid braking systems
- electronic cruise control systems
- indicators.

If the vehicle contains such equipment, consult the vehicle manufacturer or dealer to determine whether these electronic circuits will perform normally when the radio is transmitting.

Preparation when Drilling Holes



Warning When drilling holes in the vehicle, check that drilling at the selected points will not damage existing wiring, petrol tanks, fuel lines, brake pipes, or battery cables.

Vehicles Powered by Liquefied Petroleum Gas



Warning Radio installation in vehicles powered by LPG (liquefied petroleum gas) with the LPG container in a sealed-off space within the interior of the vehicle must conform to the National Fire Protection Association Standard NFPA 58. This standard states that the radio equipment installation must meet the following requirements:

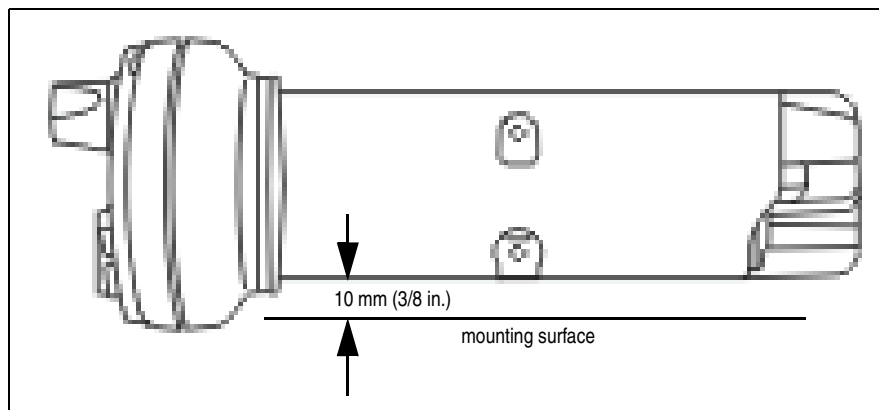
- The space containing the radio equipment shall be isolated by a seal from the space containing the LPG container and its fitting.
- Outside filling connections shall be used for the LPG container and its fittings.
- The LPG container space shall be vented to the outside of the vehicle.

Non-standard Radio Installations

The installation U-bracket has been designed so that there is enough airflow around the radio body to provide cooling.

If a non-standard installation method is used, care must be taken that sufficient heat can be dissipated from the heatsink fins and the ridged bottom surface of the radio.

For this to be achieved, there must be a gap of more than 3/8 inch (10 mm) between the bottom surface of the radio chassis and the mounting surface. This is illustrated in the following diagram:



IP54 Protection Class Considerations

A dual-radio system fulfils the requirements of the IP54 protection class.

Notice However, do not mount the radio in areas where it can be temporarily submerged from an accumulation of water or other liquids (e.g. when using a high-pressure cleaning device).

The IP54 protection class does not apply when:

- a remote interface is removed from the radio body or control head.
- the bungs are removed from the auxiliary connector or the cavity for the external options connector (fitting an auxiliary connector or external options connector will not restore the IP54 protection class)
- a grommet is not installed. For example, grommets on the radio connecting cable, control-head remote cable, and microphone cord.
- adding an accessory that is not rated to IP54, for example, a control-head interface box, or hand-held control-head remote interface box.

Negative Earth Supply

The radios are designed to operate only in a negative earth system.

1 Preparing the Installation

This section contains the following information:

- [Installation Tools](#)
- [Unpacking and Checking the Equipment for Completeness](#)
- [Hardware and Firmware Compatibility](#)
- [Installation Considerations](#)
- [Installation Overview](#).

1.1 Installation Tools

The following tools are required to install the radio system:

- drill and drill bits
- 5mm (3/16 inch) flat-bladed screwdriver
- Torx T-10 screwdriver
- Torx T-20 screwdriver
- Pozidriv screwdriver
- 8 mm (5/16 inch) socket
- wire cutters/strippers
- RF connector crimp tool
- fuse crimp tool
- in-line RF power meter capable of measuring forward and reflected power at the operating frequency of each radio.

1.2 Unpacking and Checking the Equipment for Completeness

To install a dual-radio system, you require the following equipment. This equipment will usually be supplied in a mobile package like:

- TM9456-ZPJ0-AAUG-2CLB-AP: P25 Trk 136-174M 50W 762-870M 35W BNC Mic U-Crdl R6m E-Sprk Enc

1.2.1 Mobile package example:TM9456-ZPJ0-AAUG-2CLB-AP

- 2 x radio bodies; One radio body has the remote control head, microphone and a different remote interface. One radio body has the TDMA grounding strap.


TM9456-K5C0-AAUA-1CLB-AP P25 Trk 762-870M 35W BNC
Mic U-Crdl R6m E-Sprk Enc Dual-B 1of2


- T02-00014-XBAA TM9400 FullCrypto 35W 762-870MHz BNC
- TMAA10-06 TM External Speaker 10W for 30-50W Radio
- TMAA03-22 Install kit BNC 30-50W U-Cradle
- T02-00071-AAAB TM9400 Large Control Head Local Black
- T02-00005-AAAA TM Standard Microphone TDMA
- T02-00009-0103 Cable Shielded 8 Core with RJ45 Grommet 6m (20ft)
- T02-00071-CAAB TM9400 Large Control Head Primary Remote Terminated NTID=2 Black
- T02-00081-BBAA TM93/94 Control Head Remote Body End Multi Body Term No Bias
- TMAA04-05 Cable Ignition Sense 4m (13.12ft)
- TMAS050 SFE Key - P25 Conventional (CAI Included) (91/94)
- TMAS055 SFE Key - P25 Trunking Service (TMAS050 Prerequisite) (91/94)
- TMAS057 SFE Key - DES Encryption & Key Loading (91/94)
- TMAS058 SFE Key - AES Encryption (TMAS057 or 93 Prerequisite) (91/94)
- TMAS091 SFE Key - P25 Phase 2 Trunking (TMAS055 Prerequisite) (94)
- TMAS068 SFE Key - Multi Torso Support (91/94)

TM9456-B1C0-A0U0-1CLB-AP P25 Trk 136-174M 50W BNC
Mic U-Crdl R.6m E-Sprk Enc Dual-B 2of2

- T02-00014-PBAA TM9400 FullCrypto 50W 136-174MHz BNC
- TMAA10-06 TM External Speaker 10W for 30-50W Radio
- TMAA03-22 Install Kit BNC 30-50W U-Cradle
- T02-00009-0101 Cable Shielded 8 Core with RJ45 Grommet 0.6m (2ft)
- T02-00081-BAAA TM93/94 Control Head Remote Body End Multi Body Terminated+Bias
- TMAA04-05 Cable Ignition Sense 4m (13.12ft)
- TMAS050 SFE Key - P25 Conventional (CAI Included) (91/94)
- TMAS057 SFE Key - DES Encryption & Key Loading (91/94)
- TMAS058 SFE Key - AES Encryption (TMAS057 or 93 Prerequisite) (91/94)
- TMAS068 SFE Key - Multi Torso Support (91/94)

- 219-03736-00 CBL assy earth M4-M4 lug 500mm
- 345-00071-00 SCRW M4x10 P/H T20+slt BZ T/T

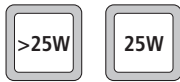
 External speakers are optional if a graphical control head with a speaker is used. External speakers with some spatial separation are useful in a dual-radio configuration to help confirm which torso is receiving.

 An ignition sense cable is optional.



Warning Danger of fire. The radio's protection mechanisms rely on the correct fuses on both the negative and positive power supply leads being present. Failure to fit the correct fuses may result in fire or damage to the radio.


The correct fuse types are:



- >25 W radios: 20 A fuses (Tait IPN 265-00010-81)
- 25 W radios: 10 A fuses (Tait IPN 265-00010-80).
- 2 x antennas* appropriate for your radio frequency band or bands, and antenna coaxial cable¹.

1.3 Hardware and Firmware Compatibility

- Control head firmware QCB1F_S00-33.01.xx.0000
- Handheld Control head firmware QCB2F_S00_33.01.xx.0000
- DSP firmware: this must match the version of 33.01.xx.0000 firmware supplied
- Radio firmware QMB1F_A00_33.01.xx.0000
- TM9400 Dual Torso programming application 3301A2xx

 'xx' denotes the current version.

1.4 Installation Considerations

Inspect the vehicle and determine the safest and most convenient position for mounting the radio bodies and control head, and routing the various cables.

Notice The radio bodies must be less than 0.5 m (1.6 ft.) apart.



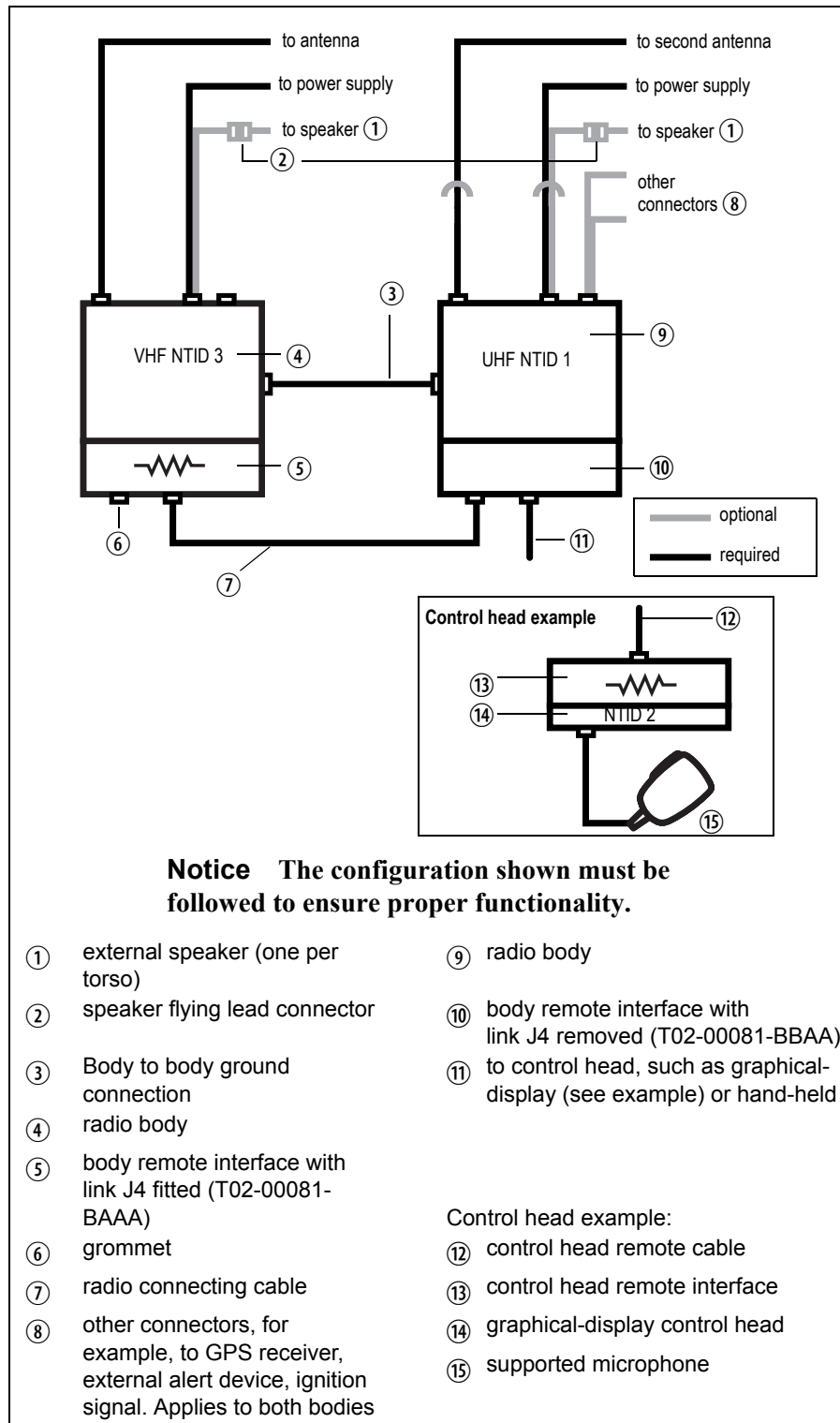
Caution If using accessories that do not provide IP54 protection (for example, control-head interface box, or hand-held control head remote interface box), a mounting position away from water, dust, and other environmental hazards should be selected.

1. Not included in a typical dual-radio package. This equipment may need to be obtained or ordered separately.

1.5 Installation Overview

Figure 1.1 summarizes how the components in a dual-radio system are installed. For more detailed instructions, see “Installing a Dual-Radio System” on page 18.

Figure 1.1 TM9456 dual body installation overview



Notice The dual body solution will only operate as a system. The correct radio body interface must be connected to the corresponding radio, and both radios and body remote interfaces must be connected before the system will operate.

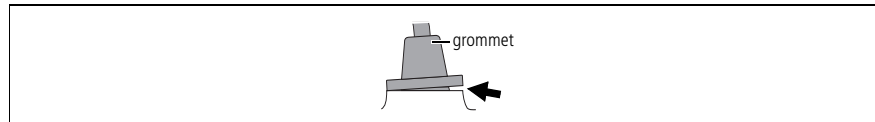
1.6 Removing and Installing Grommets

Grommets ensure that the radio system and all connections are sealed against water, dust and other environmental hazards. A dual-radio system requires a grommet in the unused remote-interface port (item ⑥ in [Figure 1.2 on page 17](#)). A dual-radio system also requires all cable grommets to be installed.

Removing a grommet

1. Using your thumb or forefinger, lift up one of the corners of the microphone grommet. Firmly (but gently) pull that corner until the seal comes away from the cavity. See [Figure 1.2](#).

Figure 1.2 Removing a grommet

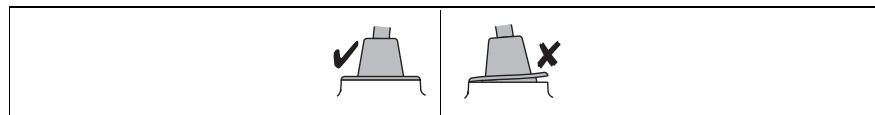


2. Repeat to expose another corner.
3. Pull the exposed corners back and remove the grommet.
4. If removing a cable grommet, slide the grommet along the cable to reveal the plug.

Installing grommets

1. If installing a cable grommet, slide the grommet along the cable.
2. Push two adjacent corners of the grommet into the socket cavity.
3. Squeeze the grommet and push the remaining corners into position.
4. Check that the grommet is seated correctly in the cavity. See [Figure 1.3](#).

Figure 1.3 Correct seating when installing a grommet



2 Installing a Dual-Radio System

This section describes how to install all components in a dual-radio system, including downloading NTIDs and removing link J4, installing the radio bodies and control head, connecting the radio system to a power source, and installing antennas and remote speakers.

2.1 Overview of Steps Required

Before you start, make sure you have all the necessary tools and components. See [page 13](#) for more information.

1. Check that all devices in the radio system have the same firmware, and the radio bodies have the necessary software features. See [“Checking the Firmware Versions and Software Features”](#) on [page 19](#).
2. Download Network IDs to all devices in the system. See [“Downloading Network IDs”](#) on [page 19](#).
3. Remove link J4 from the radio body interface that will be connected to the control head. See [“Removing Link J4”](#) on [page 21](#).
4. Assemble the body interfaces. See [“Assembling the Body Remote Interfaces”](#) on [page 22](#).
5. Mount the radio bodies. See [“Mounting the Radio Bodies”](#) on [page 23](#).
6. Install the radio connecting cable. See [“Installing the Radio Connecting Cable”](#) on [page 24](#).
7. Install the antennas. See [“Installing the Antennas”](#) on [page 26](#).
8. Connect the radios to a power source. See [“Connecting the Power Cables to a Power Source”](#) on [page 28](#).
9. Connect remote speakers (see [“Connecting Remote Speakers”](#) on [page 31](#)).
10. Install the control head or heads. See [“Installing the Control Head Solution”](#) on [page 31](#).
11. Install the fuses and check the installation. See [“Checking the Installation”](#) on [page 36](#).

2.2 Checking the Firmware Versions and Software Features

Check that the firmware version of all devices (radio bodies and control head) is the same. If not, upgrade the appropriate devices by connecting the control head directly to a radio body. For the firmware version and programming application version to use, see “[Hardware and Firmware Compatibility](#)” on page 15. For more information, click the Help [?] button from the programming application’s **Download** dialog (Tools > Download).

Check that both radio bodies have the software feature for Multi-Body Support enabled (default factory configuration). For more information, click the Help button from the programming application’s **Optional Features** dialog (Tools > Optional Features).

2.3 Downloading Network IDs

The Head and Bodies forming the radio system must have a unique NTID (Network ID) to successfully operate together. The following outlines the NTID requirements for a dual body, single control head system.

- ❗ If a dual body radio system has been ordered as a factory kit the NTIDs will be correctly pre-configured.
- ❗ The “Duplicate MAC Address” error indicates a problem with NTID configuration.
- ❗ If both devices have a standard configuration, the only required change is to switch the VHF body NTID from 1 to 3.
- ❗ NTIDs can only be set with a single body connected to the control head. If connecting using the body remote interface, only the T02-00081-BAAA interface can be used. This interface has bias fitted.

Figure 2.1 Example of NTID configuration values

Type	Name	NTID	Priority
Head (TMACxx)	Head	2	2
Body (TMBBxx)	VHF Radio	3	3
Body (TMBBxx)	UHF Radio	1	1

Note Only items for connected devices will be displayed.

12. For each body requiring an NTID update, connect the control head (the T02-00081-BAAA remote interface must be used) and apply power.

Notice Connect **one** radio body at a time. Do not attempt to download NTIDs if both radio bodies are connected together and have power applied.

13. Connect the control head microphone port to your PC.
14. Download NTID data.
15. Amend the NTID data as required.
16. Upload the NTID data.
17. Check that all required indicators are green.

2.4 Installing the Radio Bodies

To prepare and install the radio bodies, you must:

- remove link J4 from the radio body interface that will be connected to the control head. This is interface T02-00081-BBAA that is fitted to the UHF radio.
- assemble the body interfaces,
- mount the radio bodies, then
- install the radio connecting cable.

2.4.1 Removing Link J4

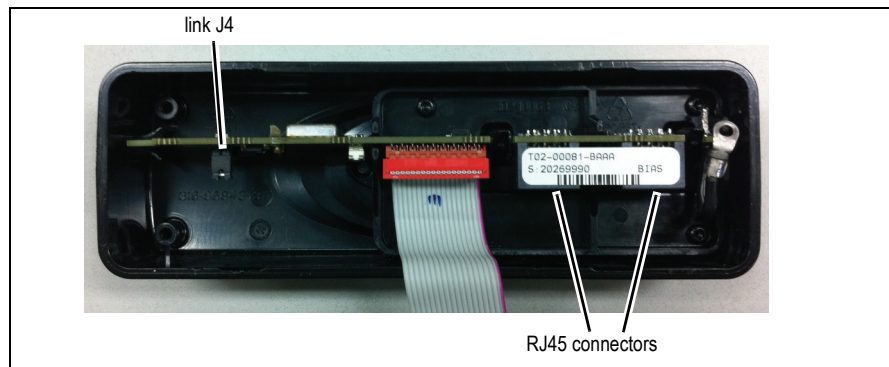
Each body remote interface is manufactured, by default, with a 120 Ω termination resistor across the RS485 signal lines. The control head remote also has this termination.

This termination is only required at the ends of an RS485 network. In the case of a TM9456 dual-radio system, the UHF radio body with the two connections (to the control head and to the other radio body) is a node on the network and must have this termination removed.

To remove this termination, use your fingernail (or similar) to remove the jumper (shorting link) J4. Link J4 is located on the far side of the PCB, away from the RJ45 connectors (see [Figure 2.2](#)), and can be removed without removing the PCB.

This must only be removed on the body remote interface connected to the control head (item ⑩ in [Figure 1.1 on page 16](#)), and can only be removed when the interface is separate from the radio body. If the interface has already been installed, see “[Removing the Body Interface](#)” on [page 22](#).

Figure 2.2 Location of link J4

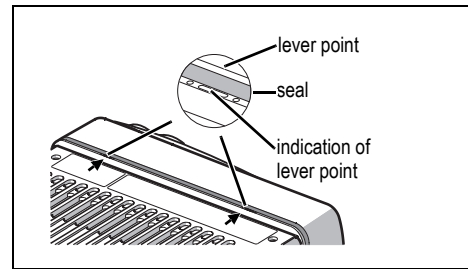


Removing the Body Interface

1. On the underside of the radio, insert a 5 mm (3/16 in.) flat-bladed screwdriver between the body interface and the seal, in the positions shown (Figure 2.3).

Insertion points and are lever points and are indicated on the radio chassis by a dot-dash-dot pattern (•—•).

Figure 2.3 Removing the body interface



Caution Take care that the seal is not damaged. Damage to this seal reduces environmental protection.

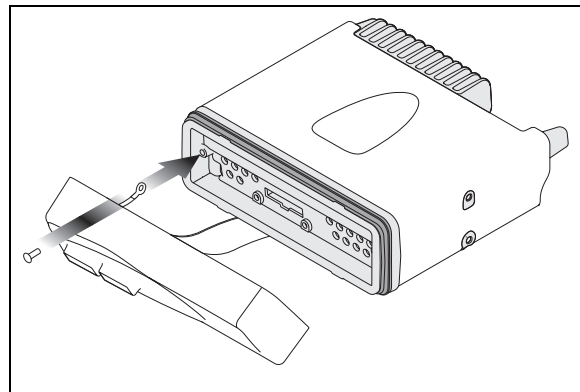
2. Use the screwdriver to lift the remote interface off the chassis clip, then repeat in the other position.
You should now be able to inspect, and if necessary remove, shorting link J4. It is not necessary to remove the body interface loom or the earthing tag to remove the link.

2.4.2 Assembling the Body Remote Interfaces

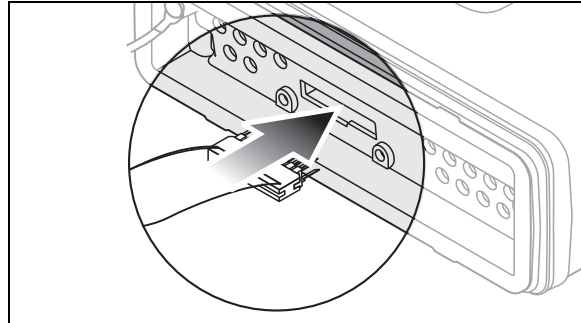
The following steps show how to connect a body remote interface to a radio body. Complete these steps for both radio bodies.

Notice One remote interface must have link J4 removed. See “[Removing Link J4](#)” on page 21 for more information. After you install the interface with link J4 removed, make sure you can identify that radio body when connecting the cables afterwards. If necessary, mark the radio body with an appropriate label or similar.

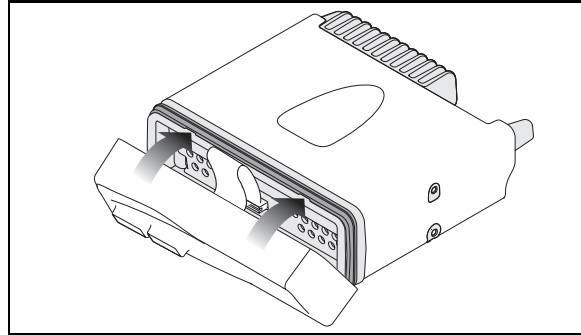
1. Screw the earthing tag onto the left screw boss on the radio chassis, using the Torx T-10 screw provided.



2. Plug the body-interface loom onto the control-head connector.



3. Insert the bottom edge of the control head onto the two clips in the front of the radio chassis, then snap into place.

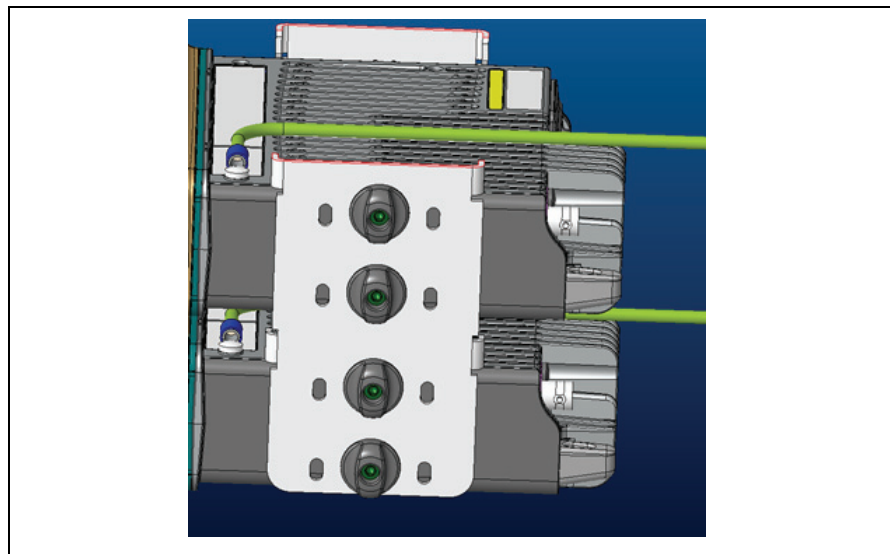


2.4.3 Mounting the Radio Bodies

Mount the two radio bodies less than 0.5 metres (1.6ft.) apart using the preferred mounting method (such as U-brackets, slide-in cradles, a stack mount, or security brackets).

The 219-03736-00 cable and mounting screws must be used to provide the required grounding between the two radio bodies. The cable is attached to each radio body by either a bottom mounting boss, or a side mounting boss (whichever is more convenient). An example is shown in [Figure 2.4](#).

Figure 2.4 Example of a Ground Strap Wiring on a Stack Mount

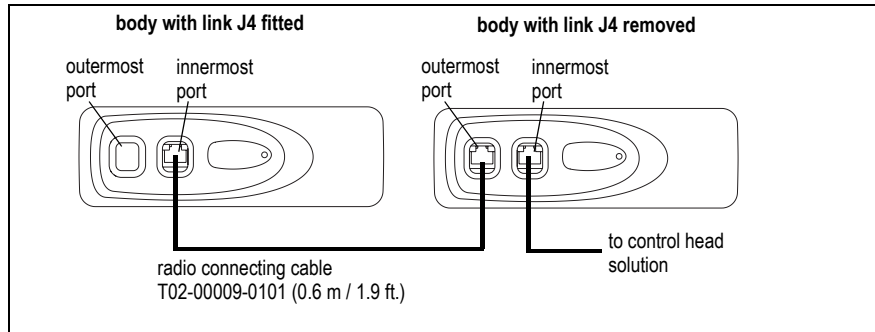


For more information, refer to the instructions included with the cradle or bracket installation kit.

2.4.4 Installing the Radio Connecting Cable

Figure 2.5 contains an overview of the connections between both radio bodies and the control head. For information on the pins and signals of all ports, see “Pins and Signals” on page 25.

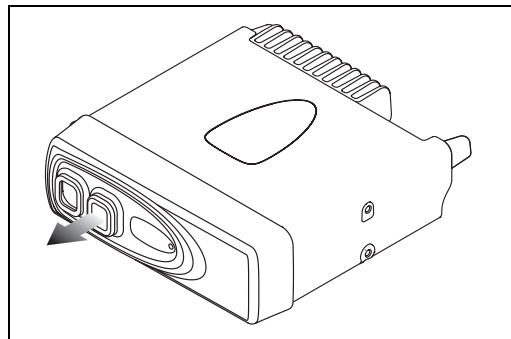
Figure 2.5 Overview of connections between radio bodies and control head



Detailed Steps

1. Remove all appropriate grommets. See “Removing and Installing Grommets” on page 17.

The outermost port of the radio body with link J4 fitted is not used. Leave the grommet installed in this port (item ⑥ in Figure 1.2 on page 17).



Notice If a radio body does not have link J4 removed, or you cannot identify the correct radio body to use, you will need to disassemble one or both interfaces. See “Removing the Body Interface” on page 22 for more information.

2. Attach one end of the radio connecting cable to the outermost port of the radio body with link J4 removed.




The innermost port of this radio connects to the control head solution.

3. Attach the other end of the radio connecting cable to the innermost port of the other radio body.
4. Install the cable grommets. See “Removing and Installing Grommets” on page 17.

Pins and Signals

The pinouts in [Table 2.1](#) are for the two RJ45 ports on the radio body interface, and single RJ45 port on the control head interface.

Table 2.1 Remote interface ports—pins and signals

	Pin	Name	Description
 front view 1	1	RX_AUDIO	Analogue receive audio – after volume control.
	2	13V8	Default setting is a switched +13V8 line.
	3	RS485+	RS485 data.
	4	AGND/PTT	Default setting is analogue ground.
	5	MIC AUDIO	Analogue electret mic input.
	6	RS485	RS485 data.
	7	DGND	Digital ground.
	8	ON/OFF	Radio on/off control.

2.5 Installing the Antennas

A separate antenna for each radio is recommended, rather than a single antenna configuration (such as a multi-band antenna with a duplexer or splitter). See “[Installation Overview](#)” on page 16. Use ground-independent antennas if no suitable ground plane is available.

It is important that the antennas are separated as far as possible from each other, such as opposite corners of the vehicle, to reduce interference. MPT 1362 recommends a separation of at least $\frac{1}{4}$ wavelength for transmit frequencies below 600 MHz and one wavelength for transmit frequencies above 600MHz. Use the largest separation requirement of the two radio bodies. See [Table 2.2](#) below, and [MPT 1362 Code of Practice](#) on page 10.

Notice You may need to install additional equipment such as filters if:

- your installation environment does not allow for proper separation,
- the channel frequencies of the two radios are similar, or
- after testing you experience poor performance or interference.

If any of the above cases apply to your installation, or you are unsure of the equipment to install, contact an antenna specialist for further advice.

Table 2.2 Approximate frequency to wavelength conversion

Band Name	Frequency (MHz)	Wavelength (cm)	1/4 Wavelength (cm)
A4 (lower range)	66	454	114
A4 (upper range)	88	341	85
B1 (lower range)	136	220	55
B1 (upper range)	174	172	43
H6 (lower range)	450	67	17
H6 (upper range)	530	57	14

Install the antennas according to the antenna manufacturer’s instructions. Good quality 50Ω coaxial cable must be used, such as RG58 or UR76.

Notice Route the cables in a manner that minimizes:

- coupling into the electronic control systems of the vehicle
- coupling of electric vehicle systems, such as alternators, into the radio

Avoid sharp bends in the cables. These distort the cable and alter its electrical characteristics.



Warning RF exposure hazard

To comply with FCC RF exposure limits:

1. Mount the antennas at a location such that no person or persons can come closer than 35 inches (0.9m) to the antenna.



2. For radios with a transmit power of 30-50 W:
 - VHF radios must be installed using an antenna mounted centrally on the vehicle roof, with a gain of 2.15 dBi or 5.15 dBi.
 - UHF radios must be installed using an antenna mounted either centrally on the roof with a gain of 2.15 dBi or 5.65 dBi, or centrally mounted on the trunk with a gain of 5.65 dBi.

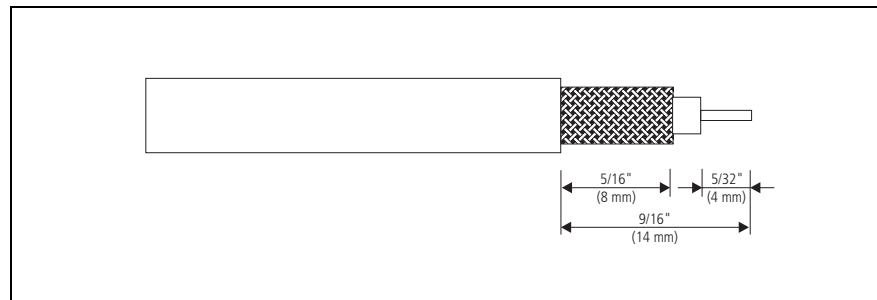


3. For 25 W radios, the radio must be installed using an externally mounted antenna with a gain of either 2.15 dBi or 5.15 dBi.

Terminating the Antenna Cable

1. Run one antenna cable (not supplied) from an antenna to the mounting location of the matching radio body. Cut the cable to length, allowing approximately 20 cm (8 in.) excess at the radio end.
2. Terminate the free end of the antenna cable with the mini-UHF plug or BNC plug (supplied) as shown in [Figure 2.6](#).
3. Repeat steps 1 and 2 for the other antenna and matching radio body.

Figure 2.6 Terminating the antenna cable

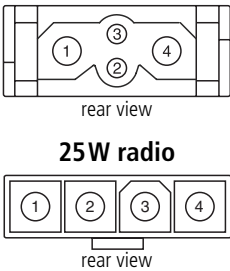


2.6 Connecting the Power Cables to a Power Source

To provide power to dual-radio systems, you must connect each radio body separately to a power source or sources. Dual-radio systems do not currently support a single lead-to-battery connection.

It is important to ensure that both radio bodies have a solid and secure power supply. Unexpected behaviour can arise if the power supply to one body operates at a lower voltage than the other, or is momentarily interrupted, as might occur with a poorly formed or intermittent wiring termination.

Table 2.3 Radio body power connector—pins and signals

Pinout	Pin	Signal name	Description	Signal type
 <p>>25W radio rear view</p> <p>25W radio rear view</p>	1	AGND	Earth return for radio body power source	Ground
	2	SPK-	External speaker output. Balanced load configuration	Analog
	3	SPK+	External speaker output. Balanced load configuration	Analog
	4	13V8 BATT	DC power input for radio body and control head	Power

Notice Each radio is designed to operate from a nominal 12V negative ground supply. Each radio may draw up to 15A of current. Each radio will tolerate a supply voltage range of 10.8V to 16.0V at the radio.

Selecting the Power Source

In passenger vehicles, the radio system is always connected directly to the battery.

In trucks, where direct connection to the battery is often not possible, each radio can be connected to a suitable terminal inside the fuse box that is connected directly to the battery.

24V-to-12V Converter

In vehicles with a supply voltage larger than 16.0V, such as many trucks, it is essential to provide a suitably rated 24V-to-12V converter. This will isolate the radios from excessive battery voltage and provide the correct DC operating conditions. Note that most 24V-to-12V converters already fitted are not rated sufficiently.

Standby Current

Table 2.4 Estimated current drain for the TM9456 radio systems

Radio System type	Completely off (e.g. off via ignition sense)	Stand-by (e.g. off via on/off key)	On (no backlight) but not transmitting or receiving	On (maximum backlighting)
TM9456 Dual body, single head	<8mA	approx. 120mA	approx. 200mA	approx. 250mA

Connecting the Power Cable

Notice Although it is possible to connect the radio system in line with the vehicle ignition, this is not recommended, as it may draw too much current and damage the vehicle wiring and steering column or ignition switch. This may also cause the supply voltage of the radio to drop below the specified level.

Notice Disconnecting the vehicle's battery may cause problems with some electronic equipment, such as vehicle alarms, engine management systems, and in-car entertainment systems. Check that the vehicle owner has the necessary information to make all electronic equipment function correctly after battery reconnection.

Notice If the battery is not disconnected, exercise extreme caution during the installation and install the fuses only when the installation is ready to be checked. For more information, refer to [“Checking the Installation” on page 36](#).

1. Disconnect the vehicle's battery unless specifically prohibited from doing so by the customer, vehicle manufacturer, agent, or supplier.

Notice Route the cables in a manner that minimizes coupling of electric vehicle systems such as alternators into the radio.

Notice Protect the power cables from engine heat, sharp edges and from being pinched or crushed.

2. Run the power cable between one radio's mounting position and the power source and cut it to length, allowing approximately 20 cm (8 in.) excess at the radio end.
3. Plug the power cable into the power connector of the radio.
4. Cut the negative (black) and the positive (red) wires where the in-line fuse holders will be placed (as close to the power source as possible).

Notice Do not install the fuses until the installation is ready to be checked. For more information, refer to [“Checking the Installation” on page 36](#).

5. Insert each end of the negative wire into each of the fuse crimp-terminals and crimp them to force the metal contacts onto the wires.
6. Push the two crimp-terminals into the clear plastic fuse cover. Close the cover while the next steps are completed.
7. Repeat steps 5 and 6 for the positive wire.
8. Connect the negative wire to the battery ground terminal.
9. Connect the positive wire to the battery positive terminal.
10. Repeat steps 2 to 9 for the other radio body.

Notice Do not install the fuses until the installation is ready to be checked. For more information, refer to [“Checking the Installation” on page 36](#).

Power During Radio Operation

It is important that both radio bodies power on at the same time. If that does not happen (for example, the Power On Mode is set to Power On in the programming application and power is applied to each body in sequence) you must turn the system off then on again via the on/off key. It is not recommended that you remove or apply power to a single radio body while operating the radio system.


If power to one radio body is disrupted, you must turn the system off then on again via the on/off key. If there is no power supply to one radio body after the radio system is switched on, the other body and control head will continue to operate as a single radio unit.

Notice The ignition signal may fail to turn the remaining radio body on and off if there is no power to one radio body. In this situation, the on/off key must be used to continue operating the radio.

2.7 Connecting Remote Speakers

You must connect remote speakers to the radio bodies if:

- using a hand-held control head, or
- using a control head with a graphical-display and you want to enhance or replace the control head's internal speaker.

 Spatially separated remote speakers are recommended to provide an easy indication of which radio body audio is being received on.

The remote speaker will only sound audio from the radio that it is connected to. Audio is never fed to a remote speaker from the other radio body. If a radio is at the background and dual receive is activated, the attached remote speaker will sound received audio from that radio at a reduced volume. If a radio is at the foreground, the attached remote speaker will sound received audio from that radio at normal volume, and audible indicators.

The following high-power remote speakers are recommended:

- TMAA10-06 high-power remote speaker for >25W radios
- TMAA10-03 high-power remote speaker for 25W radios.

If a different speaker is used, receptacles for the speaker pins of the power connector are provided with the installation kit. The installation kit also contains a flying lead connector that, when installed, enables the speaker to be easily removed and re-installed as required.

The speaker is connected to pins 2 (SPK-) and 3 (SPK+) of the power connector. See [Table 2.3 on page 28](#). For more information, refer to the installation instructions provided with the speaker, or to the relevant section of the service manual.

2.8 Installing the Control Head Solution

To install a single graphical-display control head, see [“Installing a Graphical Display Control-Head”](#) below.

To install a hand-held control head, see [“Installing a Hand-Held Control Head”](#) on page 35.

2.8.5 Installing a Graphical Display Control-Head

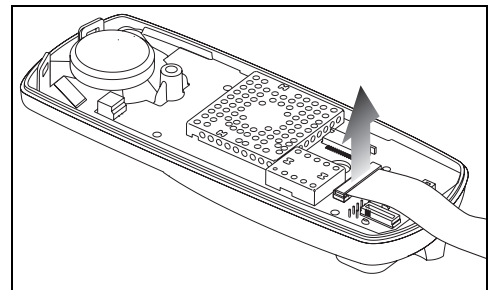
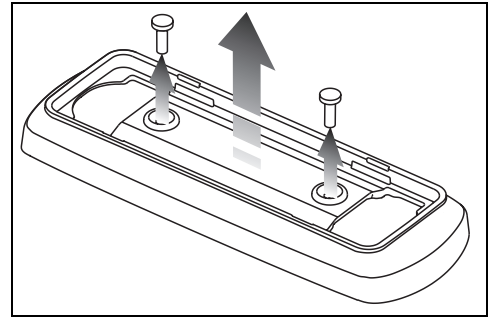
To install a single control head with graphical-display to dual-radio bodies:

- assemble the control-head interface.
- mount the control head using the U bracket, then
- install the remote cable.

Assembling the Control Head Interface

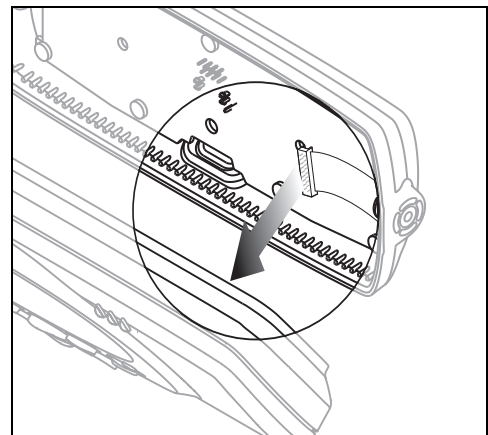
The following steps show how to connect the control head remote interface to the control head.

1. Undo the two Torx T-20 screws on the adaptor flange of the control head, and remove the adaptor flange.
2. Keep the two screws for step 6.
3. Unplug the control-head loom.
4. The adaptor flange and control-head loom are not used for the remote control-head installation.

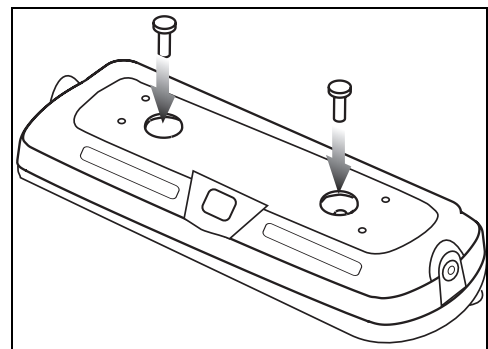


Notice You can change the control head orientation by changing the control-head loom to the opposite connector. For more information, refer to the remote control-head installation instructions (IPN 402-00020-xx, available from support.taitradio.com).

5. Plug the control-head interface loom into the connector on the control head.



6. Use the two Torx T-20 screws from the first step to fit the control-head remote interface to the control head.



Notice When fitting the control-head interface to the control-head, be careful not to damage the space-frame seal.

Mounting the Control Head

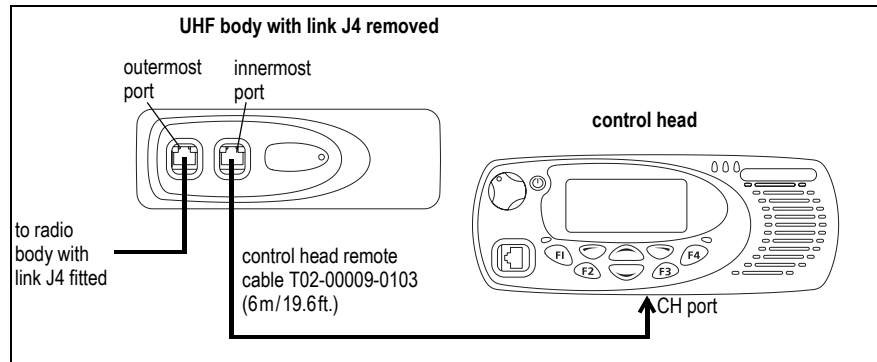
The remote U-bracket is used to install the remote control-head assembly on the dashboard or on any sufficiently flat surface.

Notice Check that the remote U-bracket is not distorted when the screws are tightened.


1. If precise positioning is required, predrill \varnothing 3mm (1/8 inch) pilot holes for the selfdrilling screws. Reduce the hole size in metal that is less than 1mm (1/32inch) thick.
2. Screw the remote U-bracket in the chosen mounting position using the self-drilling screws provided. Use all four screws provided.
3. Place the control-head assembly in the remote U-bracket and position it for a good viewing angle.
4. Screw the remote control-head assembly into position using the two thumb screws provided.

Figure 2.7 contains an overview of the connection between the radio bodies and the control head.

Figure 2.7 Connecting radio bodies to control head with graphical-display



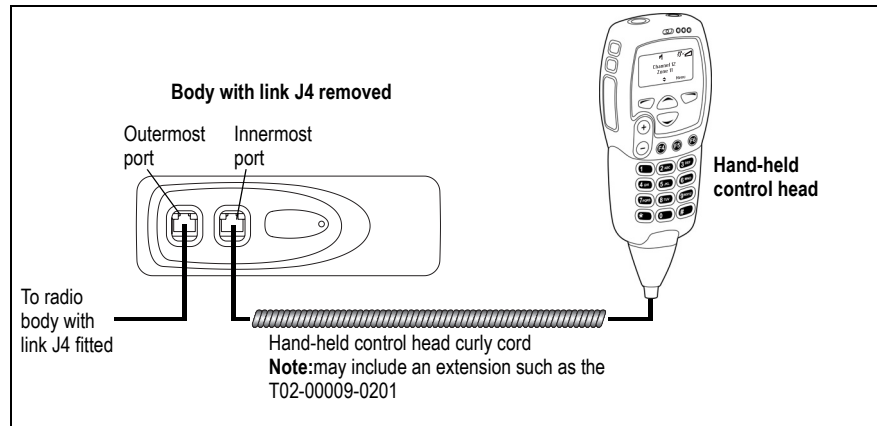
Notice If a radio body does not have link J4 removed, or you cannot identify the correct radio body to use, you will need to disassemble one or both interfaces. See [“Removing the Body Interface”](#) on page 22 for more information.

1. Attach one end of the control-head remote cable to the innermost port of the radio body with link J4 removed.
-  The outermost port of this radio body connects to the other radio body.
2. Attach the other end of the control-head remote cable to the rear port of the control head remote interface.
 3. Install the cable grommets. See [“Removing and Installing Grommets”](#) on page 17.

2.8.6 Installing a Hand-Held Control Head

Figure 2.8 contains an overview of the connection between the radio bodies and a hand-held control head.

Figure 2.8 Connecting radio bodies to hand-held control head



Notice If a radio body does not have link J4 removed, or you cannot identify the correct radio body to use, you will need to disassemble one or both interfaces. See “[Removing the Body Interface](#)” on page 22 for more information.

1. Attach the hand-held control head cord to the innermost port of the radio body with link J4 removed.



The outermost port of this radio body connects to the other radio body.

2. Install the cable grommet. See “[Removing and Installing Grommets](#)” on page 17.
3. Install the control head mounting clip in the most convenient location for the radio user.

2.9 Checking the Installation



Warning Danger of fire. The radio's protection mechanisms rely on the correct fuses on both the negative and positive power supply leads being present. Failure to fit the correct fuses may result in fire or damage to the radio.



The >25W radios use 20A fuses; the 25W radios use 10A fuses. For part numbers of the fuses, refer to “[Unpacking and Checking the Equipment for Completeness](#)” on page 13.

4. Insert the fuses into the power leads. The radio will turn on automatically at this point.
5. Switch the radio off then on again using the front panel control, but do not transmit.
6. Connect an in-line power meter between one radio and its antenna.
7. Transmit and measure the forward and reflected power levels. Less than 4% of the forward power should be reflected. If this is not achieved, check the installation, including the antenna length.
8. Start reducing the length of the antenna in steps of 0.1 inches to 0.2 inches (2 to 5 mm). Measure the power levels at each step.

Notice Some antennas are pre-tuned and must not be cut. Check with the manufacturers' instructions.

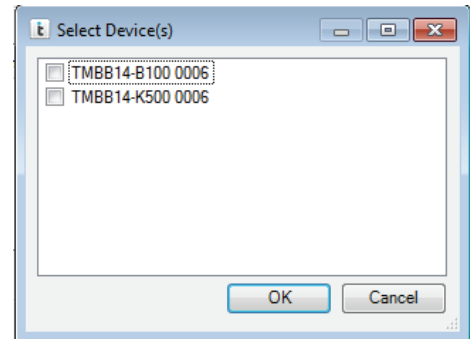
9. Once the reflected power levels are within tolerance, repeat steps 3, 4 and 5 for the second radio.
10. Test the dual-radio functions.
 - Compare the receive functions (such as sensitivity) of one radio, while the other radio is and is not transmitting. Ensure there is no significant difference.
 - Compare the transmit functions (such as coverage) of one radio, while the other radio is and is not transmitting.
 - Test all other functions, such as dual-receive. Check that those functions operate as expected.

If issues are found, move the radio bodies and/or antennas further apart and re-test.

3 Programming a Dual-Radio System

After you have downloaded the NTIDs (Network IDs) and assembled the system, you can program or read individual devices in the system. Each time you attempt to communicate with the radio system, the Select Device(s) dialog appears (an example is shown in Figure 3.1).

Figure 3.1 Select Device(s) dialog



This section contains the following information:

- [Connecting a Dual-Radio System to a PC](#)
- [Programming a Dual-Radio System](#)
- [Recommended Dual-Radio Settings](#)
- [Upgrading Radio Firmware](#)
- [Calibrating a Dual-Radio System](#)
- [Troubleshooting](#).

Important For required programming application and firmware versions for your radio system, see “[Hardware and Firmware Compatibility](#)” on page 15.

3.1 Connecting a Dual-Radio System to a PC

A dual-radio system connects to a PC via the control head. The exact connector to use depends on the control head solution.

Notice Do not attempt to connect the programming lead to an RJ45 socket on a radio body. This can cause damage to the connector and the radio.

- Single graphical-display control head: Unplug the standard or keypad microphone, and connect a PC to the microphone port.
- Hand-held control head: Use the tool provided in the TMAC70 kit or an 8mm AF Allen key to remove the rear programming connector cover, and connect a PC to the programming connector. For more information, refer to the instructions provided with the hand-held control head (see [“Associated Documentation” on page 8](#)).

3.2 Programming a Dual-Radio System

The following steps for programming a dual-radio system assume:


- all the devices in the system have supported versions of firmware, and you have installed supported versions of programming and calibration software. See [“Hardware and Firmware Compatibility” on page 15](#).
- all the devices in the system have unique network IDs. See [“Downloading Network IDs” on page 19](#).
- all radio bodies in the system have the required software features enabled. See [“Checking the Firmware Versions and Software Features” on page 19](#).

Step 1— Create a template file


1. Using the Dual Body Programming Application (3301A2xx), enter the information into the fields that are common between the radios. See [“Recommended Dual-Radio Settings” on page 40](#).
2. Click File > **Save**.
3. Enter a descriptive name for the template, for example, TM9456DualRadio_Master_File.

**Step 2—
Program each
device in the
system**

1. Using the Programming Application, open the template file created for the radio system.
2. Set the radio's **Band** (Specification form).
3. Enter a **Radio Name** (recommended).

 The length of the radio name restricts the length of all channel and group labels. Therefore a three-character radio name such as “UHF” or “VHF” is recommended, as it will allow group and channel labels up to 10 characters (such as “Channel 99”).

4. Add all information relating to the band selected in step 2, including channels (Channel Setup > Channels form) and groups (Scan Groups form).
5. Click File > **Save As** to save the device's file to disk as a new file.
6. Click Radio > **Program**.
7. In the Select Device(s) dialog, select the radio body that matches the Band selected in step 2. See [Figure 3.1](#).

 You cannot select more than one of the same device type (for example, two radio bodies). The Select Device(s) dialog will automatically select the radio body with the matching operating band (step 2).

8. Repeat steps 1 to 7 and program the other radio body.

3.3 Recommended Dual-Radio Settings

The programming configuration of all devices must be as similar as possible, with the exception of the operating band, radio name, channels and groups. If features relating to the user interface (such as function keys, radio menus, and backlighting), and other features like the security lock are different, there may be unexpected behaviour when powering on or switching between the radios.

The following settings are recommended for a dual-radio system. Use this table when setting up a template file, before programming the system (see “Programming a Dual-Radio System” on page 38).

Table 3.1 Recommended dual-radio settings

Field/Feature	Location	Comments
Radio Name	Specifications form	The radio name, if used, should be different for both radio bodies in the system.
Power On Mode	Startup/Shutdown form	The power on mode must be the same for all devices in the system.
Power-up on Last Active Body	Startup/Shutdown form	This check box must be the same for all devices in the system.
Reset on Error	Startup/Shutdown form	The Reset on Error check box must be the same for all devices in the system.
Security Lock on Power Up and Security PIN	Startup/Shutdown form	If the security PIN is enabled, it must be enabled (and have the same PIN) for all devices in the system.
PTT fields	PTT form	PTT settings for both radio bodies are used when in dual-transmit mode and the radio user presses the PTT. Care should be taken if programming PTT behaviour differently between the radio bodies. PTT settings are typically set the same for all devices in the system.
Startup (Channel or Group)	Startup/Shutdown form	You can program this option for the foreground radio (the radio body with the lowest NTID) to start on a specific channel or group each time the radio system is turned on. You can also program this option for the background radio to default to a specific channel or group after the radio system is turned on, and the radio user subsequently switches the active radio or enables dual receive.
Key Settings	Function Ctrl Settings form	Add the Dual Body Mode and Single Body Mode actions to separate keys, or Dual/Single Body Mode to a single key. (recommended) Add the Switch Active Radio action to a different function key.

Table 3.1 Recommended dual-radio settings

Field/Feature	Location	Comments
Other Function Key Settings and the Radio Menu	Radio Menu form	The radio's function key settings and menu must be the same for all devices in the system.
Left Selection Key and Scroll Keys	Function Ctrl Settings form	If options are programmed for the left selection key and/or scroll keys, they must be the same for all devices in the system.
UI Preferences	UI Preferences form	UI preferences must be configured identically for all devices in the system. For example, backlighting, keypress tones, the RSSI icon, and the default dialling type.
Programmable I/O	Programmable I/O form	<p>Programmable I/O pins will only be activated on the radio body where the input or output is connected to.</p> <p>Some I/O functions and pins may not operate as expected in a dual body configuration (for example: "output F1 to F6 key status", or any actions assigned to the CH_GPIO1 control head output).</p>

3.4 Upgrading Radio Firmware

The download dialog (from the programming application, click Tools > **Download**) contains a column called NTID. This shows the network ID for each device. When reporting a radio system's configuration, the table will list the various types of firmware for all devices in the system.

Notice Reporting the configuration will also show SCT (System Configuration Table) files for each device, which must exist for a radio system. These files are the result of downloading network IDs (see ["Downloading Network IDs" on page 19](#)). Do not attempt to delete these files.

When you download firmware to hardware of a particular type (for example, the target hardware shows as a radio body), it will be sent to all devices in the system of the same hardware type. The firmware will be downloaded to each device in sequence.

For more information, click the Help [?] button from the programming application's Download dialog (Tools > Download).

3.5 Calibrating a Dual-Radio System

TM9456 dual-radio systems do not support calibration of the radio system as a whole. The system must first be disassembled to a single head/single body configuration. If calibration is required after repair, the radio body must be calibrated outside of the system before re-installation.

3.6 Loading Encryption Keys

Encryption keys can be loaded into a dual-radio system by using a device such as the EnableProtect Key Fill Device. The process of loading encryption keys into a dual-radio system using a Key Fill Device is as follows:

1. Make sure that the radio you want to key fill is the active radio. Do this by using the “Switch active radio” function key or menu option.
2. Plug the Key Fill Device into the control head and complete the key fill operation.
3. Unplug the Key Fill Device from the control head.
4. Activate the second radio using the “Switch active radio” function key or menu option.
5. Plug the Key Fill Device into the control head and complete the key fill operation for the second radio.

3.7 Limitations

The following functions are not supported or have limited functionality in a dual-radio system.

OTAP	Over-the-air programming is not supported. The radio must be configured by connecting the radio directly to a PC and using the programming application.
OTAR	Over-the-air re-keying is not supported.
Emergency	It is not possible to synchronize both radios during emergency cycling operation, when a callout phase requiring an acknowledgement is programmed. Callouts should either be removed, or emergency operation should only be configured on a single radio.

3.8 Troubleshooting

If reporting the configuration shows only two devices when three are expected, or the Select Device(s) dialog does not appear when reading or programming the radio system:

- Make sure all cables are connected correctly, and securely.
- Make sure power is applied to both radio bodies.
- One or more devices may not have the correct system configuration table of Network IDs. Re-download the table to all devices in the system. See [“Downloading Network IDs” on page 19](#).

If a “Duplicate MAC Address” message appears on the radio display, you must uninstall the radio to a single-head single-body system and use the Device Configuration > Advanced option in the download to change the Network IDs. For more information, see [“Downloading Network IDs” on page 19](#).

If an “incorrect band” message appears when attempting to program a radio body, the band of the selected device to program is different to the band selected in the programming application. Either change the **Band** field on the Specifications form, or select the matching radio body in the Select Device(s) dialog.

If an “unlicensed feature” message appears in the programming application, or the LEDs on one or both radio bodies flash on and off when powering up the system, optional features (for example, Multi-Body Support) may not be enabled. For more information, see [“Checking the Firmware Versions and Software Features” on page 19](#).

4 Quick Reference

- All components are present and are the correct versions of hardware and firmware. See pages 13 to 15.
- The system configuration table is downloaded to the control head and radio bodies. See “[Downloading Network IDs](#)” on page 19.

Record the NTIDs assigned

Head (TMBCxx)	Head	
Body (TMBBxx)	VHF Radio	
Body (TMBBxx)	UHF Radio	

- Link J4 is removed from the radio body connected to the control head. See “[Removing Link J4](#)” on page 21.
- The correct remote interfaces are installed on the radio bodies and control head. See page 22 and page 31.
- For each body remote interface, the earthing tag is attached onto the radio chassis. See page 22.
- Antennas are connected to both radio bodies. See page 26.
- The cables are attached into the correct ports. See page 31.
- All grommets are installed. See page 17.
- There is a solid and secure power supply to both radio bodies. See page 26.
- The correct fuses are fitted to the power supply leads. See page 36.
- The radio system is programmed so the user can access dual-radio features. See “[Programming a Dual-Radio System](#)” on page 38.

Glossary

This glossary contains an alphabetical list of terms and abbreviations related to dual-radio systems. For information about other radio terms, consult the glossary provided with the relevant documentation.

background radio	The radio in a dual-radio system that is not currently showing on the radio display, or is showing in a smaller font.
control head	The device in a radio system that provides the user-interface.
crossband linking cable	A cable that connects the auxiliary ports of the two radio bodies.
device	A component (control head or radio body) in a radio system . A device is known as target hardware when upgrading radio firmware.
dual body mode	The function on a dual-radio system that enables you to turn on dual receive and dual transmit
dual-radio system	A control head connected to two radio bodies .
dual receive	A state in a dual-radio system where the system receives on both the foreground radio and background radio simultaneously.
dual transmit	A state in a dual-radio system where the system transmits on both the foreground radio and background radio simultaneously. Dual transmit includes dual receive .
foreground radio	The radio in a dual-radio system that is currently showing on the radio display, or showing in a larger font.
Network ID (NTID)	The unique identifier that is assigned to each device in a radio system .
primary radio	The radio body in a dual-radio system with the NTID.
radio	A radio body , when connected directly or indirectly with a control head .
radio body	The device in a radio system that provides standalone transmit and receive on a single operating band, and also other functionality such as digital processing. Also known as a torso.
radio system	See dual-radio system . Either one control head connected to multiple radio bodies, one radio body connected to multiple control heads.

single body mode	The function on a dual-radio system that enables you to return to single receive and single transmit.
single receive and single transmit	A state in a dual-radio system where the system transmits and receives on the foreground radio only.
system configuration table	The table that is downloaded to every device in a radio system . The table contains information about the system, including all devices, device names, NTIDs, and priorities.

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