MOTOROLA SOLUTIONS

ADVISOR™ TPG2200 TETRA Two-way Pager Product Information Manual

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Please note that certain features, facilities, and capabilities described in this document may not be applicable to or licensed for use on a specific system, or may be dependent upon the characteristics of a specific mobile subscriber unit or configuration of certain parameters. Please refer to your Motorola Solutions contact for further information.

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Notations Used in this Manual

The manual set is designed to give the reader more visual clues. The following graphic icons are used throughout the manual.

DANGER: The signal word DANGER with the associated safety icon implies information that, if disregarded, will result in death or serious injury.

WARNING: The signal word WARNING with the associated safety icon implies information that, if disregarded, could result in death or serious injury, or serious product damage.

CAUTION: The signal word CAUTION with the associated safety icon implies information that, if disregarded, may result in minor or moderate injury, or serious product damage.

ATTENTION: The signal word CAUTION may be used without the safety icon to state potential damage or injury that is not related to the product.

IMPORTANT: IMPORTANT statements contain information that is crucial to the discussion at hand, but is not CAUTION or WARNING. There is no warning level associated with the IMPORTANT statement.

NOTE: NOTICE contains information more important than the surrounding text, such as exceptions or preconditions. They also refer the reader elsewhere for additional information, remind the reader how to complete an action (when it is not part of the current procedure, for instance), or tell the reader where something is on the screen. There is no warning level associated with a notice.

Chapter 1

Product Overview

1.1
Advisor TPG2200 TETRA Two-way Pager Overview

With its enhanced coverage and extended battery life, the Advisor™ TPG2200 TETRA Two-way Pager ensures that you can reach the people who matter at the moments that matter.

Figure 1: ADVISOR TPG2200 TETRA Two-way Pager

The pager has a bright 2-inch color display and familiar Motorola Solutions radio user interface which allows you to quickly read and respond to alerts. With its lightweight and compact design, you can easily carry the pager around without fear of obstructions and you can even use it with one hand.

Also, the Advisor TPG2200 TETRA Two-way Pager is IP54-rated for dust and water protection. Therefore, it will continue to function even when exposed to rigors of tough environments.

The 1.8 W transmit power and increased static and dynamic sensitivity of the pager gives you enhanced coverage for better communication. And to ensure that your communication stays protected, it supports multiple encryption protocols, including the BSI Sim and Air Interface Encryption TETRA Encryption Algorithms (TEA) 1, 2, and 3.

> ⚠ **IMPORTANT:** The term *radio* used throughout this manual also refers to the pager and other radio communication devices.

The Advisor TPG2200 TETRA Two-way Pager specifications are available at https://www.motorolasolutions.com/tpg2200

1.2

Customer Programming Software

For information about Customer Programming Software, see the *TETRA Terminals CPS Plus Start-up User Guide*.

Chapter 2

Services and Features

Motorola Solutions offers a wide range of services and features. With this range, you can meet the requirements of mission-critical communications.

2.1

System Support

Your radio operates on the Dimetra IP 5.x, 6.x, 7.x and 8.x releases and Dimetra IP Compact. It also operates on previous versions of Dimetra; from Release 3.8 and on.

Your radio is designed to operate optimally on the Dimetra IP system. Your radio operates properly on all SwMIs that comply with the below list of IOP features defined by the TETRA And Critical Communications Association (TANDCCA). Official IOP certificates can be downloaded from the TANDCCA web page at http://www.tandcca.com/interoperability/interoperability-certificates-and-test-reports/.

TMO TIP:

- TIP Core TTR 001-01, TIP – Part 1: Core
- TIP SDS TTR 001-02, TIP – Part 2: Short Data Service
- TIP Auth TTR 001-04, TIP – Part 4: Authentication
- TIP FSSN TTR 001-07, TIP – Part 7: Fleet Specific Short Number
- TIP AIE TTR 001-11 TIP – Part 11: Air Interface Encryption
- TIP SI TTR 001-12, TIP – Part 12: Service Interaction
- TIP Enable/Disable TTR 001-13 TIP – Part 13: Enable or Disable
- TIP LIP TTR 001-19, TIP – Part 19: Location Information Protocol
- TIP Callout TTR 001-21, TIP – Part 21: Call Out

DMO TIP:

- TIP DCore TTR 002-01, DMO TIP – Part 1: DMO Core
- TIP DGate TTR 002-02, DMO TIP – Part 2: DMO Gateway
- TIP DRep TTR 002-03, DMO TIP – Part 3: DMO Repeater Type 1
- TIP DE2EE TTR 002-04, DMO TIP – Part 4: DMO End to End Encryption
- TIP DAIE TTR 002-05, DMO TIP – Part 5: DMO Air Interface Encryption

2.2

Trunked Mode Operation

Trunked Mode Operation (TMO) requires the switching and management infrastructure.

This operation mode enables various data communication types, such as short data service messages.

Figure 2: Trunked Mode Operation
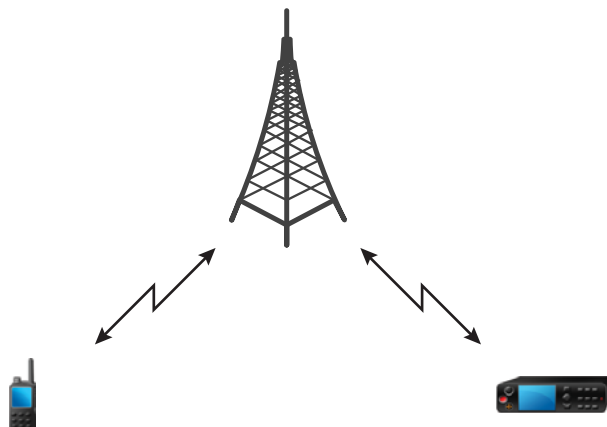
2.3
Direct Mode Operation

Direct Mode Operation (DMO) is a mode of simplex operation where radios communicate directly without the need of a network.

> **NOTE:** For those who use DMO mode, you are recommended to apply DMO SCK for data confidentiality.

Figure 3: Direct Mode Operation
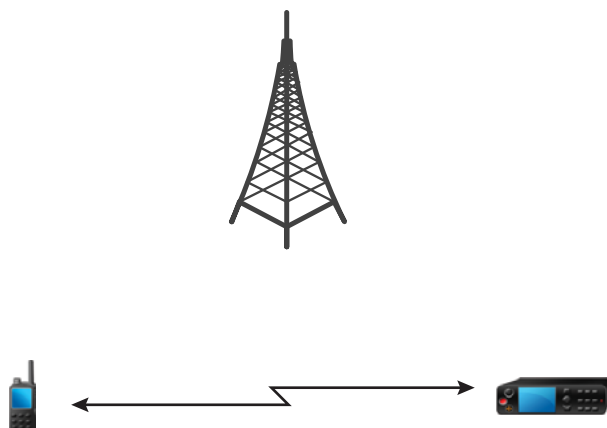
2.4
DMO Gateway and Repeater Communication

Your radio allows communicating in Direct Mode Operation (DMO) with a Trunked Mode Operation (TMO) group. This communication occurs through Interoperability (IOP) certified gateways.

A DMO repeater retransmits information received from one DMO radio to other DMO radios. Retransmission occurs over the DMO air interface.

For each DMO talkgroup, your radio allows operating in one of the following modes:

Radio to radio only
Your radio initiates communication only on a talkgroup directly and not through a gateway or repeater.

Specific gateway
Your radio can initiate communication on a talkgroup directly or through a specific gateway address that is specified for a talkgroup. The gateway address can be edited through your radio HMI.

Auto gateway
Your radio can initiate communication on the selected talkgroup directly with another radio. Your radio can also initiate communication through any available gateway that is detected as present.

Repeater
The talkgroup links to a DMO repeater.

Specific gateway and repeater
Your radio uses only the gateway with the specified gateway address for the talkgroup and/or a DMO repeater.

Automatic gateway and repeater
Your radio uses the first available gateway for a talkgroup and/or a DMO repeater.

All outgoing communication is placed through the gateway if the following conditions occur:

● Either a specific gateway or auto gateway mode is chosen.

● A suitable gateway is found.

Your radio attempts to set up communication directly if the following conditions occur:

● Communication setup through the gateway fails.

● A suitable gateway is not found.

When operating on a gateway and/or repeater, your radio indicates the communication mode.

2.4.1
Communication Through Repeaters

Radios that are out of range and cannot communicate directly with each other in Direct Mode Operation (DMO) can do it through the repeater. The repeater is a radio that repeats all communication on a chosen channel, and as a result increases radios DMO range.

Figure 4: Communication Through Repeaters
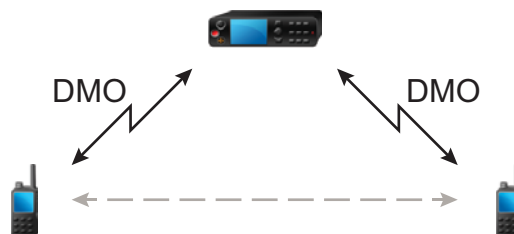
When your radio detects a potential repeater signal or connects to a repeater, it plays a tone, displays the `Repeater available` message, and shows an appropriate icon. When your radio loses connection with the repeater, it plays a tone, displays the `Repeater not available` message, and the repeater icon is blinking.

When your radio is on a Gateway mode, it switches to Gateway mode from TMO if your radio enters an emergency.

2.4.2
Communication Through Gateways

Gateway provides connectivity between radios operating in Direct Mode Operation (DMO) and the TETRA network, so that the DMO radios can communicate with radios operating in Trunked Mode Operation (TMO).

Figure 5: Communication Through Gateways
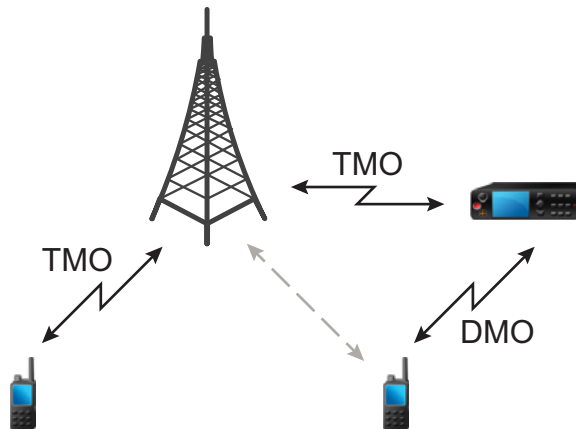
Radio behavior when radio detects a potential repeater signal or connects to a gateway:

- A tone sounds.
- The display shows `Gateway available`.
- The display shows an appropriate icon.

Radio behavior when radio loses connection with the gateway:

- A tone sounds.
- The display shows `Gateway available`.
- The display shows an appropriate icon.

Radio behavior when entering Local Site Trunking:

- A tone sounds.
- The display shows `Local Area Service`.

2.4.3
SDS Through DMO Gateways or Repeaters

Radios operating in Direct Mode Operation (DMO) can send the following message types to other radios through DMO Gateways or Repeaters:

- Short Data Service (SDS) Status

- SDS User-Defined Data Types 1, 2, 3

- SDS User-Defined Data Type 4 with or without SDS Transport Layer (SDS - TL)

- Global Navigation Satellite System (GNSS)/Global Positioning System (GPS) Local Information Protocol (LIP) messages

NOTE: The emergency trigger LIP report is sent to the currently selected talkgroup or to the configured destination. Applicable only for Direct Mode Operation (DMO) to Trunked Mode Operation (TMO) forwarding.

Both DMO Gateways and Repeaters can forward messages in Reservation and Idle mode. The supported forwarding directions are:

- DMO group address to TMO group address.

- TMO group address to DMO group address.

- DMO individual address to TMO group address.

- TMO individual address to DMO individual address.

2.4.4
Gateway and Repeater Synchronization

To communicate using gateways or repeaters, your radio requires synchronization with a gateway or a repeater.

A gateway or a repeater sends presence signals to radios. If a radio receives presence signals, it stays synchronized with the gateway or the repeater, which sends the signals. If a radio fails to receive a presence signal it does not immediately lose synchronization. Your radio waits for another successful presence for a time defined by your service provider. This function ensures that communications are not dropped due to temporary reception issues.

If a gateway or a repeater is unavailable or your radio is not synchronized with a gateway or a repeater, depending on the setup configured by your service provider, the following scenarios apply:

- Your radio falls back to Direct Mode Operation (DMO).

- No direct DMO communications are permitted.

2.5
Graceful Service Degradation Mode

NOTE: This feature is only available when enabled by your service provider.

The Graceful Service Degradation Mode (GSDM) provides best effort services when the radio enters a weak signal situation. It provides limited services to users where data circuit operation is no longer available in radio traffic mode.

The following services are available in GSDM:

- Call-Out message

- Short Data Service (SDS)

- Status message

> **NOTE:** If Uninterruptible Call-Out is enabled, your radio does not display the GDSM notification when in Call-Out protected mode.

2.6
Emergency Operations

Emergency Operations are used in critical situations.

The Man Down (henceforth known as Fall Alert) alert activates the Emergency Alarm service, depending on the service provider setting.

2.6.1
Emergency Alarm

The emergency alarm is a special status message sent to the infrastructure while starting the Emergency Operations. The pager may wait for infrastructure acknowledgment for this alarm and attempts retries.

Each time the pager enters the Emergency Operation, it sends an emergency alarm. When an emergency alarm is sent successfully, the respective audible tone sounds.

Emergency Alarm in DMO mode can be configured to send in all DMO modes or when your radio is synced through Gateway.

The message can be dispatched both in Trunked Mode Operation (TMO) and Direct Mode Operation (DMO).

2.6.2
SDS in Emergency Mode

Short Data Service (SDS) in Emergency Mode enables Status and/or SDS functionality during emergency mode.

If SDS in Emergency Mode is enabled, the **Message** menu is accessible for composing, sending, and viewing Status and/or SDS messages during emergency mode.

2.6.3
Emergency Destination in Local Site Trunking

This feature allows the radio to send emergency requests to a different destination. This transmission occurs while in local site trunking mode.

The supported emergency services are:

- Emergency Alarm
- Emergency Short Data Service (SDS) Status
- Location Information Protocol reports

2.7
Short Data Services

The radio supports the following Short Data Service (SDS) message types:

- SDS Status.
- SDS User Defined Data Types 1, 2, 3.

- SDS User Defined Data Type 4 with or without SDS Transport Layer (SDS - TL).

The feature supports the following addressing modes:

- Radio to radio.

  NOTE: Your radio can send templates only to dispatcher ISSI. Your radio cannot send templates to defined Calling Party ISSIs. Your radio can only reply with a template to the Calling Party ISSIs.

- Radio to external subscriber number (gateway address).

  NOTE: For SDS - TL, the message can be sent through the service center.

The radio provides a short data bearer service for both internal and external applications.

The radio supports SDS - TL services which provide end-to-end acknowledgments, delivery report requests, and message numbering for SDS user-defined data type 4 messages. The TL also provides SDS access for applications that do not request these transport layer services, however, use a Protocol Identifier (PI). The radio can send the delivery report by using an appropriate TETRA signaling, even if the originator requested a short report. The radio can support the old SDS - TL standard for operation on legacy systems, or for operation on other SwMIs.

An externally connected device may access the SDS services in the radio using AT commands and TNP1 protocol. An external application may use this service to send and receive SDS statuses, SDS user-defined data types 1, 2, 3, and 4.

Downlink SDS messages type 4 are presumed to contain a PI for identifying the target application. If an external application has registered with the radio for that PI, the radio delivers the message to the target application. The radio may receive downlink SDS messages that are successive retransmissions of a message already received and acknowledged by the radio. The radio does not display these messages, nor store in them in the inbox, nor send them to an external application.

2.7.1
Status Messages

You can select from a list of up to 4000 programmed alphanumeric aliases each of which corresponds to a status value. The valid range of uplink status values is a set of provisioned parameters. The radio sends status to the dispatcher ISSI configured in the user profile.

Your radio accepts status messages from addresses that it is monitoring. Your radio can be programmed with an appropriate text associated with each status value. Your radio notifies when a new status message has been received. On receiving an incoming status message, the stored text corresponding to the status value is extracted and placed in the text message buffer as a text message. Receiving a status causes your radio to display the message mail screen, which allows you quick access to read the message. A received status can be stored in your radio text message buffer.

The PEI provides access for external applications to send and receive status messages.

2.7.2
Text Messages

The radio supports an internal text messaging application using the TETRA Short Data Service Transport Layer (SDS-TL).

The encoding schemes supported in text messages are:

ISO 8859-1 (Latin-1)
American Standard Code for Information Interchange (ASCII) encoding scheme which includes letters and special characters needed for Western European languages.

2-byte Universal Character Set (UCS-2)
Unicode standard which defines a consistent method of encoding and decoding multilingual text such as Chinese and Korean characters.

Table 1: Maximum SDS Character with Encryptions

Encoding Scheme	Without OPTA and E2EE	Without OPTA and with E2EE[1]	With OPTA and without E2EE	With OPTA and E2EE[1]
7-bit	160	124 (121)	136	100 (97)
8-bit	140	109 (106)	116	85 (82)
16-bit	70	54 (53)	46	30 (29)

Besides the 7-bit, 8-bit, and 16-bit encoding schemes, the radio also supports the Smart 8-16 and Smart 7-8-16 encoding schemes. These two encoding schemes are auto-selected if your text input has a combination of 7-, 8-, or 16-bit characters.

NOTE: Usage of special characters or multilingual texts may reduce the maximum number of characters allowed.

The radio does not support SDS text messages editing. The radio sends the saved message to the dispatcher ISSI configured in the selected user profile. The radio can receive and reply with a predefined template to a message received from one of the 200 Calling Party ISSIs in the selected User Profile.

Incoming messages are stored in the **Inbox**, the following options are available:

Incoming text messages are stored in the **Inbox** whereas outgoing text messages are stored in **Outbox**, when the store and forward mechanism is not in place. When the store and forward feature is enabled and the messages go through the store and forward server, the short messages are stored regardless the delivery status. Whereas, long messages are stored only if delivered (even if only to the store and forward server).

NOTE:
Message protection functionality is enabled in the **Inbox** and **Call Out Inbox** folders. Users can only delete unprotected messages.

Delivery report is saved in the **Inbox** and in the associated message in **Outbox**. However, the report is deleted from the **Inbox** after viewing it.

The **Outbox** and **Inbox** do not share memory area. There are 10 user profiles and both of the **Outbox** and **Inbox** of each user profile can hold up to 250 messages. Depending on the combination of stored short and long messages in each of these user profiles folders, the maximum messages in **Inbox** or **Outbox** for all user profiles combined is also 250 messages. When you enter the **Messages** sub-menu, the number on the right side of **Inbox** and **Outbox** is indicating the number of the messages stored. If the **Outbox** is empty, then the radio displays **No Messages** notification.

2.7.2.1

Buffer Full Overwrite Policy

Upon receiving a text message, the radio places the text into a circular buffer. You are notified when a new text message is received and a quick access to read the message is provided. If a delivery report is

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[1] In E2EE SDS, a timestamp reduces the maximum size of the user data. See values in parentheses.

requested, the radio sends it upon receipt of the message by SDSTL. If a consumed report is requested, the radio sends it when you read the message.

> ✎ **NOTE:** If you read the message when the radio is out of service, the report may not be sent.

You can save incoming text messages. These messages can be sent.You can also protect the message from being deleted or from the overwriting policy of the radio.

For each message, you can verify its timestamp. The timestamp displayed is extracted from the SDS TL PDU. The timestamp is generated and inserted to the message by the SwMI.

2.7.2.2
SDS Messages Concatenation

This feature allows sending long text messages up to 1000 characters. Messages that are longer than 140 characters are divided and sent separately one after another. When a recipient receives all the parts of the message, it displays as one on the screen.

When the radio receives an SDS message and the **Inbox/Outbox** is full, the radio acts according to the **Buffer Full, Overwrite Policy** codeplug field settings.

When the text or status message is received and accepted, the radio retrieves actual time information from its internal clock.

The radio can reconstruct a long text message consisting of up to ten short messages. The maximum length of the message is 141-1000, what can be defined in the codeplug. The radio recombines the text segments independently of the order they have been received to the correct order of the original message. The message can be combined only if all their message reference number are correct and the segmented receiver timer is still valid.

You can send long text messages to an individual destination. However, sending long text messages to groups is not possible:

- Emergency Mode – you can receive SDS messages. To read the SDS messages the radio have to leave the emergency mode. Sending the SDS messages in the emergency mode is prohibited.

When a sending long and segmented text message, a timer is activated. If parts of the segmented message is missing when the timer ends, the radio displays the entire message with the unsuccessful fragment indicated as missing. Call-Out Incomplete Message is supported in the following features:

- Text Messages

- Call-Out

- Immediate Text Message

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2.7.3
Immediate Text Messages

> ✎ **NOTE:** This is a Software Selling Feature.

The Immediate Text Messaging feature enables your radio to receive and display text messages immediately. This feature is used for sending information of high importance from the console to radios.

When your radio receives an immediate text message, the following occurs:

- The immediate text message is stored in the **Inbox**.

- The content of the immediate text message is displayed.

- The relevant audio tone is played.

- If the periodic alert feature is enabled, the periodic alerting is active until you press the **Soft** key.

> **NOTE:** If this feature is disabled, the immediate text messages are processed as normal text messages.

When you reply or forward an immediate text message, the message is sent as a normal text message.

When your radio receives more than one immediate text message, the latest received immediate text message is displayed. All previous immediate text messages in the **Inbox** are not prompted.

> **NOTE:** The maximum length for receiving an immediate text message is 141-1000 characters.

If your radio is in the PIN Lock state, an immediate text message is displayed after you enter the correct PIN. The message remains on the screen until you press the **End**/**Home** key.

2.7.4
Home Mode Display Text Message

Your radio is provided with a feature that allows your service provider to send special text messages to the display. The message is limited to 24 characters. The message stays on the home screen until a new home mode display message is received. Power cycle your radio to replace the Home Display message to the predefined one.

2.7.5
Predefined Templates (ATS Entry Prompt)

This feature assists the radio in sending formatted messages with a predefined destination address (MSISDN, SSI, or TSI) for computer applications.

You can select a predefined entry prompt which defines a message format to help with the construction of a Short Data Service (SDS) message. The prompt definition is set in the codeplug. The definition sets areas that are read-only, areas that can be edited, and the type of characters that can be entered (numeric, alpha-numeric, or phone digits). Along with the message definition, the address to send the message is provided.

When you send the message, it is sent using SDS Transport Layer with the PI that is provisioned in the codeplug. A receipt report is requested.

The radio chains multiple predefined templates with the same Prompt ID into a single multifield template. The Predefined menu can store predefined and multifield templates. There is no indication to distinguish between the two, although an alternative solution is to define the template name which is displayed as the title of the template. However, this solution is subject to user configuration.

2.7.6
SDS Air Interface Aspects

The types of delivery reports available are standard report and short form report. The radio can be provisioned to send a short-form SDS - TL receive report when the originator of the message allows short-form report. The short form report uses a specially designated 16-bit SDS status value instead of SDS-REPORT. The radio can respond to a delivery response request automatically or manually although selection of report types through radio MMI is available only in manual response.

The radio supports SwMIs that employ store and forward service as indicated in the cell broadcast information. The radio supports use of a service center, which address is set in the radio. The store and forward operation is supported. However, the radio notifies you only on successful sending of the message. The radio does not wait for the report from the service center.

Downlink SDS messages types 1, 2, and 3 are always routed to the PEI when an AT application is registered. If no external application is registered, the message is discarded.

NOTE: The DMO SDS does not support type 1, 2, and 3 user-defined short messages.

2.7.7
SDS Encryption

Short data messages stored in a radio are protected against any unauthorized access. The stored data includes messages in the **Inbox**, **Outbox**, and stored call out messages.

The required protection against any unauthorized access through the MMI, PEI, or unintentional access by other means is carried out through the special mechanisms. The encryption of stored messages preventing from accessing the memory directly and the user authentication, protect SDS messages. Protected messages cannot be read on the radio MMI unless valid authentication occurs. For the user authentication, the existing radio PIN is used.

SDS messages received by the radio are encrypted before being stored in the Inbox. Store and Forward messages are encrypted before being saved in the **Outbox**.

Received call out messages are encrypted before being stored in the **CO Box**.

If the feature is enabled, then the radio prompts you to enter the PIN if any of the following menu items are selected from the MMI.

- **Messages → Inbox**.
- **Messages → Outbox**.
- **Messages → CO Box**.

Following successful PIN entry and access to the required messages, the radio does not require further PIN entries to access messages unless one of the following conditions has been met.

- Exiting from the radio menu.
- Turning off the radio.
- Changing the PIN from the MMI.

If you disable the PIN lock through the MMI or change the PIN, the protected messages are deleted. Before deleting the messages, you are prompted to ensure that the operation should proceed. If the PIN lock is changed through the PEI, all the protected messages stored in the **Inbox**, **Outbox**, and **CO Box** are deleted. On enabling the radio permanent disable, the access to the protected messages is lost.

2.7.8
SDS End-to-End Encryption

NOTE: This is a Software Selling Feature.

End-to-end Encryption (E2EE) provides customers with a higher degree of confidentiality than existing TETRA air interface data encryption.

The TETRA standard supports the air interface security that provides protection of the air interface. The information flow inside the infrastructure is not secured. When you require data protection for your data going through the infrastructure, you need your entire transport path to be encrypted.

This entire path encryption is called E2EE. The source and the destinations are supplied with the mechanism for encrypting and decrypting.

NOTE: The 260–275 MHz radios do not support the SDS end-to-end encryption.

In air interface encryption, the receiving Base Station decrypts data which travels clear within the system domain. For E2EE, the transmitting radio encrypts the data and the receiving radio or an E2E terminator located in the infrastructure decrypts the data.

E2EE protects the SDS/SDS-TL data services both in TMO and DMO. The following TETRA data types are protected.

● SDS type 4 with SDS - TL

● SDS type 4 without TL

For short data applications, the source data may come from an external application or from a task internal to the radio, such as text messages or GPS. The radio passes only the internal text messages and GPS data for encryption by its crypto-engine.

The encrypted short data service is established between two end points. One end point is terminated in the radio, and the other end point is terminated in a Short Data Encryption Gateway (SDEG) or another radio. The destination address specifies the encryption type, that is, whether the packets are transmitted as encrypted, clear, or dropped.

Figure 6: SDS End-to-End Encryption
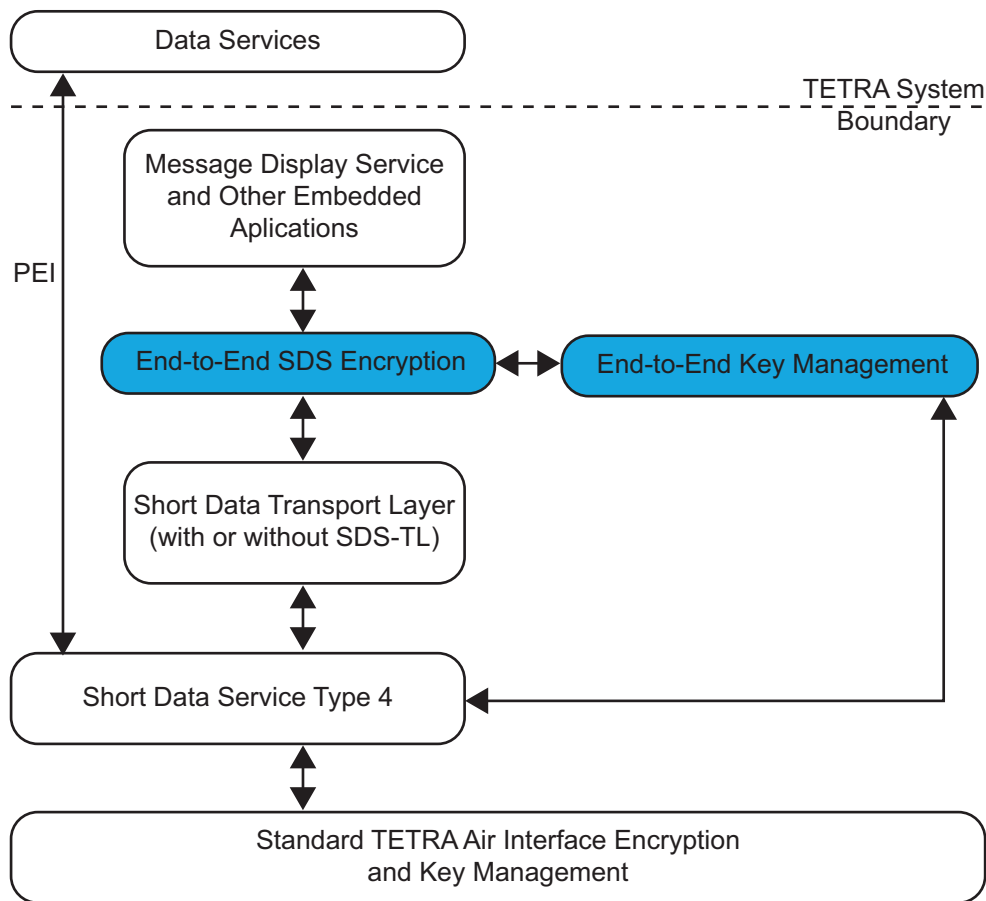
NOTE: Key Management Facility (KMF) can manage and support only one short data association and a key at the same time.

The radio selects the E2EE mode for the outgoing text message in accordance to the address association and requirements for the E2EE High Security Mode. Depending on codeplug settings, you can override the address association and select using the MMI menu whether an SDS is sent to clear or encrypted contact (Group or Private Number).

The radios support the high security mode configurable using the CPS. In this mode, the association that binds the address to a given cryptogroup is always mandatory.

If no cryptogroup associations exist, this condition means that the keys are not loaded. In such situation, the radio discards any outgoing or incoming message that is encrypted. You are alerted when this situation occurs.

This feature can only be disabled using the Key Variable Loader (KVL).

2.7.9
Store and Forward

This feature allows communicating with each other without being available at the same time. If the destination is not reachable, the message is stored in the system (if supported) until it is available or the expiration time is exceeded. The system is configured to delete the message after a preconfigured time and this time cannot be configured using the radio.

You can send the store and forward messages to an individual address or a group. Depending on the codeplug settings, if you choose to send it to the group, the message status is switched from **Store and Forward** to **Immediate**.

2.7.10
SDS Receive Failure Notification

When a radio fails to decrypt a received SDS message, it displays a notification including the ISSI of sender and reason for failure.

2.8
Security Services

The radio provides TETRA security features as described in the TETRA Security ETS 300 392-7 standard, TTR 001-11 TIP, and TTR 001-13 TIP.

2.8.1
Terminal Equipment Identity

The Terminal Equipment Identity (TEI) is a unique identification number programmed in your radio at the factory. TEI cannot be later modified.

2.8.2
PIN/PUK User Authentication

In order to authenticate yourself, the radio supports a Personal Identification Number (PIN) and PIN Unblocking Key (PUK) mechanisms. These mechanisms prevent unauthorized access to the radio. The PIN/PUK operations are available from both MMI and PEI (using AT commands).

For the authentication purpose, the radio prompts you to enter a valid 4-digit PIN, before the radio allows you to access all the available services. The PIN is defined in the codeplug.

If the maximum number of consecutive failed attempts is reached, the radio is blocked and remains in this state until it is unblocked. The permissible number of consecutive failed attempts is defined in the codeplug. The blocked status is sustained regardless of turning off or battery removal.

When the radio is PIN locked, you have no or limited access to the radio services. The PIN is defined in the codeplug. The radio is unblocked either by entering the PUK or by using the CPS. The PUK can be entered through the MMI or through the PEI. The PUK is defined in the codeplug.

BSI PIN/PUK Authentication

When the radio has determined that BSI PIN/PUK is required, the radio prompts you to enter a valid BSI PIN before the radio allows you to access all the available services. The BSI PIN/PUK length is configurable by your service provider up to a maximum of 8-digit code.

The permissible number of consecutive failed attempts for BSI PIN is defined in by your service provider. When the radio is BSI PIN locked or BSI PUK blocked, you have no access to the radio services. As the BSI PIN and BSI PUK code is defined by your service provider, you are unable to change the BSI PIN/PUK code.

NOTE:
The radio is only able to support either PIN/PUK mechanism or BSI PIN/PUK mechanism at a time.

2.8.3
Authentication

Authentication establishes a level of a trust between a radio and SwMI. It is a challenge-response result protocol between two parties based on their common knowledge of a secret key (K) to verify the identity of each party.

The SwMI Authentication Centre (AuC) provides a single K for authentication, which is shared only with the radio. The SwMI always initiates Authentication. If set by the service provider, the radio can also authenticate the SwMI.

2.8.4
Air Interface Encryption

NOTE: This is a Software Selling Feature.

Enhanced Security consists of Trunked Mode Operation (TMO) Air Interface Encryption class 3G and DMO class 2.

The radio supports TETRA Air Interface Encryption (AIE) using the standard TETRA public encryption algorithms, as defined in TETRA Security ETS 300 392-7, TEA1, TEA2, and TEA3. The focus of cryptography in TETRA is the encryption key. TETRA AIE provides 12 000[8] key combinations.

TETRA TMO has three classes of encryption:

- Class 1 – clear (none)
- Class 2 – static key encryption (SCK)
- Class 3 – derived key encryption (DCK), sometimes called the dynamic key, the Common Cipher Key (CCK), and the Group Cipher Key (GCK)

TETRA Direct Mode Operation (DMO) has two classes of encryption: Class 1 and Class 2.

The security features supported in the radio depend on the security mode.

Table 2: Security Features Required Per Security Class

Security Feature	Mode			
	Security Class 1	Security Class 2	Security Class 3	Security Class 3G
Radio Initiated Authentication	Not Allowed	Not Allowed	Not Allowed	Not Allowed
SwMI Initiated Authentication	Optional	Optional	Mandatory	Mandatory
Mutual Authentication	Optional	Optional	Optional	Optional
Over-the-Air Rekeying (OTAR)	N/A	Optional	Mandatory	Mandatory
SCK AIE	N/A	Mandatory	N/A	N/A
DCK AIE	N/A	N/A	Mandatory	Mandatory
GCK AIE	N/A	N/A	N/A	Mandatory

> **NOTE:**
> In the current release, the radio does not support the following security features:

- Radio initiated authentication.
- Support for TEA4.
- Explicit authentication during Dynamic Group Number Assignment (DGNA).
- OTAR in foreign network.
- GCK AIE in foreign network.

2.8.4.1
Clear Radios (Class 1)

A radio can be configured as a clear radio. In such case, the radio identifies itself in registration as a Security Class 1 radio and does not support encryption. A Security Class 1 radio does not contain any encryption algorithms in its software.

2.8.4.2
Static Cipher Key Encryption (Class 2)

The radio supports static Air Interface Encryption (AIE) using a set of up to 32 Static Cipher Keys (SCK) shared by the Switching and Management Infrastructure (SwMI) and all authorized radios.

The radio then determines which static keys to use based on the SCK Number (SCKN) and SCK version number (SCK-VN) broadcast by the SwMI. A radio can be configured to support static key encryption. In such case, it identifies itself in registration as a Security Class 2 radio, and attempts to negotiate Security Class 2 encryption. Each radio then uses either the TEA1 or the TEA2 (TEA 3 for Asia and Pacific) Key Stream Generator (KSG) algorithm. Each radio contains only one of those algorithms in its software.

When Security Class 2 Encryption has been negotiated, encrypted PDUs are encrypted using SCK.

In Direct Mode Operation (DMO), the system manager may choose the SCK and the key may be distributed from the Trunked Mode Operation (TMO) SwMI using the Over-the-Air Rekeying (OTAR) mechanism or provided manually using Key Variable Loader (KVL).

2.8.4.3
Derived Cipher Key and Common Cipher Keys Encryption (Class 3)

Derived Cipher Key and Common Cipher Keys Encryption (DCK/CCK) are required to prevent overexposure of key material. Existing encryption systems use Static Cipher Keys (SCK), where one key is used for all radios and all communications.

Key material is often exposed and SCK logistics of changing keys consist in programming all radios and Base Stations. DCK is used for individually addressed TM-SDU (Service Data Unit). DCK/CCK encryption provides Derived Cipher Key (DCK) for uplink (from your radio to the BTS) communication and Common Cipher Key (CCK) for downlink (from the BTS to your radio) group communication. The DCK is derived from either the one-way or mutual authentication process and the CCK is received during the registry.

The radios supporting the dynamic key encryption identify themselves to the system as Class 3 radios during registry and attempt to negotiate Class 3 encryption. The radios support Over the Air Re-keying (OTAR) of the CCK by the system.

A clear radio can transmit and receive from encrypted radios. The system informs the encrypted radios that the communication is with a clear radio and they switch to clear operation. Class 2 and 3 radios can only act as described if they are allowed to operate in a lower class.

2.8.4.4
Group Cipher Keys Encryption (Class 3G)

For the Security Class 3G the system allows grouping addressed signaling using Group Cipher Keys (GCK) to cryptographically isolate talkgroups.

The downlink signaling is encrypted using Modified Group Cipher Key (MGCK) that is cryptographically derived from the Common Cipher Key (CCK) associated with the serving cell and the GCK associated with a given talkgroup. The Switching and Management Infrastructure (SwMI) does not change GCK and CCK simultaneously. Whenever a GCK change occurs, CCK changes are frozen for this time period.

The Derived Cipher Key (DCK) is derived from either the one way or mutual authentication process and the CCK is received during registry, whereas the GCK is received through Over-the-Air Rekeying (OTAR) mechanism only.

The radio supports over-the-air and manual provisioning of key associations that link a GCK to one or more Trunked Mode Operation (TMO) talkgroups, and manual provisionings of Key Association Group (KAG) to one or more Direct Mode Operation (DMO) talkgroups.

The system can provide the ability for the operator to group contiguous ranges of TMO Short Subscriber Identity (SSI). This case occurs where any talkgroup residing within the address range is assigned using the same GCK association. These ranges, referred to as Key Association Ranges (KAR), are used to convey the TMO talkgroup and GCK relationships to the relevant SwMI and radios responsible for GCK functions.

2.8.4.5
Over-the-Air-Rekeying

TETRA systems support GCK encryption for specific talkgroups:

- Group Over-the-Air-Rekeying (OTAR) of GCK.
- Group OTAR of fallback TM-SCK.
- Group OTAR of DM-SCK, including management of the cryptographic schedule of DM-SCKs.

The group OTAR mechanisms require a use of the group session key for OTAR (GSKO). The GSKO is delivered to the radio only by using individual OTAR and the session key for OTAR (KSO).

For the systems utilizing group OTAR, the fundamental system operation (regarding SCK/GCK OTAR) relies on the sites regular transmission. In other words, the sites are regularly broadcasting information regarding which security class and associated keys are in use. The sites transmit future versions of the respective keys to groups of radios belonging to the same cryptographic management group (CMG). The radios acquire the keys before the SwMI activates them. Then the air interface encryption service uses the keys. The sites also broadcast the current key that is in use which can be sent using OTAR mechanism to the radio on request.

> **NOTE:** When a radio has not received a new key before activation by the SwMI, the radio requests the missing keys.

Some systems adopt only individual OTAR methods for delivery of SCK and GCK to the radio. In such cases GSKO is not used. Some systems employ a mix of individual and group OTAR methods. The radio supports the complement to functionality required for supporting the superset of different SwMI behaviors, for example:

- Individual OTAR (using KSO) of SCK and GCK.
- Group OTAR (using GSKO) of SCK and GCK.
- Individual OTAR (using KSO) of GSKO.
- Secure DMO Key Management (via SwMI).
- Crypto Management Group.
- Storage of 10 KAG (equivalent to 30 DM-SCK).
- Storage of 16 GCK (includes current/future versions).
- Storage of 2 TM-SCK.
- Storage of Group Association attribute per Talkgroup.
- GCK Air Interface Encryption.
- Seamless key changes of GCK.
- Seamless security class changes to SC3G.

The SwMI can support the group OTAR feature. Where supported, the SwMI groups radios that share the same set of cryptographic key material into a specific crypto management group (CMG). Any radio belonging to the same CMG is addressed using a CMG GTSI. The primary purpose of the addressing is to transmit group OTAR messages conveying TM-SCK, DM-SCK and/or GCK. Any radio that supports TM-SCK group OTAR, DM-SCK group OTAR, or GCK group OTAR is assigned to a specific CMG.

Each CMG has a designated specific GSKO. The system deploys over the air a CMG GSKO (and CMG GTSI) to each radio belonging to the CMG. The GSKO is used as the sealing key for TM-SCK, DM-SCK, and GCK, when sent across the air interface. The SwMI can perform scheduled transmissions of the future TM-SCK addressed to each CMG. The radio requesting a TM-SCK triggers the site to schedule additional transmissions of the requested TM-SCKs. These transmissions are addressed to either the CMG GTSI that the radio belongs to or its ITSI.

The SwMI can perform scheduled background transmissions of the future GCKs addressed to each CMG. The radio requesting for a given GCK triggers the site to schedule additional transmissions of the current and the future versions associated of the requested GCK. These transmissions are addressed to either the CMG GTSI that the radio belongs to or its ITSI.

The SwMI can perform scheduled background transmissions of the current and the future DM-SCK addressed to each CMG. The radio requesting for a DM-SCK triggers the site to schedule additional transmissions of the requested DM-SCK. These transmissions are addressed to either the CMG GTSI that the radio belongs to or its ITSI.

2.8.4.6
Encryption Mobility

A Class 2 or Class 3 radio can operate on a lower class Switching and Management Infrastructure (depending on configuration). A radio that is provisioned not to allow operation on a lower class SwMI, does not register on such a cell.

A Class 2 or Class 3 radio moves to a cell that supports an SCK/CCK/GCK that the radio possesses, applies Air Interface Encryption (AIE) to the registration Protocol Data Unit (PDU). If no acknowledgment is received, the radio sends the registration in clear.

2.8.4.7
Encryption MMI

A Class 2 or Class 3 radio that is involved in a clear communication provides visual and audible indications. If enabled by the service provider, these indications indicate that the communication is not encrypted.

2.8.4.8
Air Interface Encryption Key Storage

The radio stores all the keys, SCK/CCK/DCK/GCK, in a sealed manner in non-volatile memory of the radio. However, they are not stored in the codeplug.

The radio supports loading of the SCK keys manually using the Key Variable Loader (KVL). By using a special key combination, you can delete the cipher keys in the radio. Depending on configuration, you may erase either all keys or only the short-term keys.

2.8.5
Secure DMO

The Secure Direct Mode Operation (DMO) feature guarantees key ciphered transmission in the DMO.

When DM-SCKs are provided by OTAR, you are informed in case the radio does not contain the complete set of SDMO keys. Whenever the radio enters DMO and the radio does not possess past and present DM-SCKs for all provisioned KAG and/or it has not yet successfully received SCK Subset Grouping Type, SCK Subset Number and SCK-VN information from the SwMI, then the radio:

- plays a special reject tone.

- prompts a message indicating **OTAR incomplete**.

The radio provides SDMO status information to the user from the MMI **DMOSCK Validity** submenu inside the **Security** menu (present only when configured in the codeplug):

- **DMO SCK is Valid** if DMO SCK OTAR is disabled and all DM-SCKs are provided using the KVL.

- **DMO SCK is Valid** if DMO SCK OTAR is enabled and the radio knows the current SCK information and has all the corresponding past and present DM-SCKs.

- **DMO SCK is Invalid** in all other cases.

The radio supports system management of SDMO keys. The radio using system managed SDMO requires the structure of DM-SCKs used for SDMO, the current active SCK Subset Number, and Version Number information to coordinate key schedules. The radio considers the last received variant of this information PDU as the most accurate indication of SDMO key configuration.

DMO SCK can only be used if Enhanced Security feature is purchased.

2.8.6
SIM Security

The SIM is an integrated circuit card that holds a filing system and an application. The SIM security feature is only available on the GMOI network.

The security of the SIM card is ensured by the means of the following security functionality groups:

● Voice End-to-End Encryption (E2EE) and related key management

● Network access parameters and authentication

● Key management for Air Interface Encryption (AIE)

● Operational Tactical Address (OPTA), modification, encryption, and transfer

● AES for E2EE of SIM Interface and SIM-Terminal Authentication

The application performs the following actions:

● Generation of Key Stream Segments (KSS)

● Synchronization for E2EE

● TETRA authentication algorithm based on K key on the SIM

● Key management for E2EE keys

● SIM interface encryption and authentication using the AES

The filing system holds the following items:

● Network access parameters as Individual Tetra Subscriber Identity (ITSI)

● Security class definition and authentication definition

● Integrated circuit card identifier

● SIM version number

● OPTA

The E2EE keys are also kept on the SIM. However, they are accessible for the SIM application only, thus E2EE key management is transparent to the radio.

The keys for AIE remain on the radio. The SIM application handles AIE key management.

2.8.7
Radio Disable or Enable

A dispatcher can disable or enable the radio remotely.

When disabled, the radio does not participate in any Short Data Service (SDS) activity and ignores all supplementary services sent on the down link. All visible and audible indications are disabled, and the radio appears to be turned off. All user inputs, such as key presses, are ignored, and the PEI interface is closed.

The radio continues to perform mobility management functions, such as roaming, to facilitate subsequent enabling or further disabling.

The radio stores the disabled or enabled state in the codeplug, so the unit remains in that state after turning on.

If the radio is in the disabled state, and receives an appropriate TETRA signaling for subscription enablement with the correct Short Subscriber Identity (SSI) and Mobile Network Identity (MNI), it restores to its normal operative state.

The TEI Query feature provides TEI information to the infrastructure during registration. This allows the dispatcher to disable radio by sending an appropriate TETRA signaling for equipment disable with the correct

TEI for this radio. Replacing the SIM card does not activate the radio. TEI Query feature is only available on GMOI network.

If the radio is in the equipment disabled state, and receives an appropriate TETRA signaling with the correct TEI, the radio restores to its normal operative state (if the subscription is also in the enabled state).

2.8.8
Radio Permanent Disable

📝 **NOTE:** This is a Software Selling Feature.

Radio Permanent Disable and Radio Permanent Disable v2 are features that are mutually exclusive.

Permanent disabling is intended to protect a network from attack from a compromised or faulty radio. It can be used when the radio has been compromised, or has been suspected of compromise for a long time. It is a one-way function and no equivalent enable is available. Then the radio should be recovered and reprogrammed before being used again by the service provider.

When the radio is permanently disabled, it becomes inoperable.

- All its MMI interfaces on the radio are disabled.
- All its security key material, that is GCK, GSKO, DMO SCKs, Ks, DCK, CCK, and TMO SCKs are deleted.
- All its codeplug is deleted.
- All its software is deleted.

The permanent disable should be invoked when it has been determined that a radio is unrecoverable. When a radio has been lost or stolen, the first step always is to stun the radio using temporary disable.

The permanent disable should be used with the deletion of the user radio record in the User Configuration Server and the deletion of the K-REF association of the disabled radio in the Provisioning Center and the Authentication Center. This deletion ensures that subscriber information is not downloaded into the Home Location Register if a restore of the UCS is performed.

The system operator has to also ensure that the radio K-REF association is also removed from the other Authentication Centers in the network, in cases where the K-REF pairs are duplicated across the network.

If this association is not removed, the radio could be assigned a new home zone that lies in a cluster where the K-REF association has not been deleted.

2.8.9
Radio Permanent Disable v2

📝 **NOTE:** This is a Software Selling Feature.

Radio Permanent Disable and Radio Permanent Disable v2 are features that are mutually exclusive.

When the radio is disabled using the permanent disable v2, it cannot be recovered over the air.

The radio appears to be inoperable if the following conditions are met:

- The radio accepts the permanent disable command.
- The permanent disable v2 flag is enabled in the codeplug.

Inoperable characteristics include the following items:

- All its MMI interfaces on the radio appear to be disabled.
- All its security key materials are deleted. The security key materials are GCK, GSKO, DMO SCKs, Ks, DCK, CCK, TMO SCKs, and End-to-End.

- The radio automatically enters programming mode upon powering attempts.

- The permanent disable flag is set in the codeplug.

Unlike in the permanent disable, a permanent disabled v2 radio can be re-enabled using the software selling dongle. If you have the software selling dongle, you can read the codeplug and clear the permanent disable flag.

> **NOTE:** To restore a radio that is disabled using the permanent disable v2, see *TETRA Terminals CPS Start-up User Guide* (Motorola Solutions Part Number: 6802974C10).

2.8.10
High Assurance Boot

The radio has a facility that ensures that the code and data flashed in the radio is authentic and has not been altered.

The hardware forces the High Assurance Boot (HAB) module to run at boot time. The module checks if all software comes from a trusted source. The radio is checking the signature of the code and data segments present in the radio using a public/private key mechanism.

If the HAB authentication of the flashed software fails, it does not allow the radio software to run.

2.9
TETRA Network Protocol 1

TETRA Network Protocol type 1 (TNP1) is a bridge protocol based on the TETRA layer 3 over the air protocol. The TNP1 supports all TETRA dispatch functionality.

In the Trunked Mode Operation (TMO), the TNP1 specifies a protocol for use over the PEI, that allows Terminal Equipment (TE) to have control over the TETRA services: mobility management, gshort data service, and supplementary services: send GNSS/GPS reports, software information, and battery state information. In addition, commands to access the radio configuration and storage parameters are available.

The system provides point-to-point IP connectivity allowing the following datagram exchanges:

- Radio ←→ External Equipment (TE) (for example PC).

- External Equipment (TE) ←→ Network (through radio).

TNP1 services can use one of two Point-to-Point Protocol (PPP) methods to connect from the terminal equipment to the radio, local mode, and wide mode. The TNP1 should be used in wide-mode wherever possible, to allow the parallel operation of TNP1-SDS services over a common PPP link.

If the transmit inhibit is entered, the radio drops the wide mode connection, thus the PEI goes back to AT mode. Then the TNP1 client detects this change and reinitiates the PPP session in local mode.

The radio disables the TNP1 session while being in the Direct Mode Operation (DMO).

AT commands are used to initiate the PPP service for TNP1 to operate. Once the PPP session is running all AT commands are blocked. When the PPP session is closed, AT commands are available.

2.9.1

TETRA Network Protocol 1 IP Addressing

Table 3: TETRA Network Protocol 1 (TNP1) IP Addressing

Addressing Mode	Description
Wide Mode	All TNP1 services are available including packet data transfer towards the SwMI. The address used is the dynamic address MS IP or configured statically.
Local Mode	All TNP1 services are available except packet data transfer. The addresses used are the two static addresses TE IP: 10.0.0.101 and MT IP: 10.0.0.100.
Port Addressing	The radio uses a fixed port address for reception and transmission of TNP1 packets. The port number is 4024.

2.10

Mobility Services

Terminal mobility is the ability of terminals to acquire, register, and operate on an appropriate TETRA network. If required, terminals can change cells with minimum interruption to services.

2.10.1

Main Control Channel Frequencies

The radio can find a wide range of main control channels. The radio maintains stored lists of carrier frequencies which are scanned in order.

1. A list of discrete entries of the last 32 control channels used by the radio.

2. A static list of up to 32 discrete frequencies specified by the operator that can be preprovisioned. The system operator can modify this list using the programming tool.

3. A frequency range specification, using a specific offset, that can be preprogrammed in the factory. The system operator can modify this range using the programming tool. Then the radio scans all frequencies in 25 kHz intervals in the specified range.

4. An extra frequency range specification. Having two separate range specifications allows for two non-contiguous blocks of frequencies or two different offsets.

The radio can use all four frequency lists to speed up registration process after a power cycle or loss of Trunked Mode Operation (TMO) coverage.

2.10.2

Channel Selection

Each TDMA frame on a given carrier comprises of four time slots, which any slot can be used as a physical channel.

The following types of physical channels are available:

● Traffic physical (TP) channel - used primarily for circuit call traffic.

● Control physical (CP) channel - dedicated only for signaling.

● Unallocated physical (UP) channel.

The following types of control channels are available:

- Main Control Channel (MCCH) - occupies the first slot of the main carrier.

- Secondary Control Channel (SCCH) - can be used to extend Control Channel capacity.

  NOTE: This is a Software Selling Feature.

The following types of SCCH are available:

- Common SCCH

- Assigned SCCH

In addition to the MCCH, a cell can have up to three common SCCHs, which could occupy slots 2, 3, and 4 in the main carrier. This solution allows the radio to distribute its population among up to four channels and so to increase Control Channel capacity at the expense of traffic channel capacity.

Until having received a specific parameter on a cell, the radio uses the MCCH. When the signal is received, each radio maps itself to a particular common SCCH, and that SCCH operates as the MCCH for the radio.

2.10.3
Multi-System Operation

The radio holds a list of up to 100 allowed network identities – Mobile Country Code (MCC) and Mobile Network Code (MNC) combinations, that are considered friendly networks. The first network in this list must be the radio home network.

Each network can have an associated name that can indicate to the user which network it is. The radio can perform initial cell selection and registration on these networks. Registration on any of these networks is performed using the radio Individual Short Subscriber Identity (ISSI) and without migration signaling. The same ISSI is used on all networks. You can limit registration to the home network only, or to a selected network only, and to ignore the other allowed networks.

In case the Base Transceiver Station (BTS) does not support the migration defined by ETSI standard, multi-system operation is only supported as follows:

You can change the network mode using the MMI. A top-level menu item called **Networks Sel** allows choosing between **Home Only**, **Select Net**, and **Any Net**. If the radio chooses a network different from the current one, the radio forces initial cell selection to find a cell that belongs to the home or the selected network. In the selected network option, a list of network names, where each network name corresponds to one of the MNIs in the list, is displayed. The network names are provisioned in the radio as part of provisioning of the MNI list. The network alias or MNI of the current network is displayed on the first line of the idle display.

Home Only
  In this mode the radio recognizes only the first system in the allowed list. As a result, the radio registers only on its home network, even if a foreign network is in range and is found first.

Select Network (Select Net)
  In this mode the radio recognizes only the system you selected in the list of allowed systems. As the result, the radio registers only on this selected network, even if another network is in range and is found first.

Any Network (Any Net)
  In this mode radio selects the network automatically where the home network is not available. The radio registers to any network that it finds that is already programmed into its codeplug list of networks, whereby no user manual selection is required. Network selection to another network is only performed at initial cell selection following a link fail and then only if the home network is not available. The radio uses its own ISSI.

The radio operates in all networks as it does in its home network. All communications are placed using SSI addresses, and it is the SwMI responsibility to reject communications for subscribers or groups that cannot be reached in the local system.

> **NOTE:** The telephony gateway interprets telephone numbers with the country code of the local country. For example, if you dial the number 01256-48-4566 in the UK, it is treated as if you dialed +44-1256-48-4566.

For description of other BTS supported migrating modes used, refer to Air Interface Migration and Dynamic Air Interface Migration sections.

2.10.4
Registration

On camping on a cell, the radio sends a registration request PDU to the SwMI, which includes a request to attach to the selected talkgroup.

If the registration and attachment succeed, the radio begins normal operation on the cell. If the registration attempt times out, or the SwMI rejects the registration for a temporary reason, another registration attempt is made. If both attempts fail, the radio attempts to camp on a different cell.

If the SwMI denies the registration request due to the location area rejection, the radio does not attempt to register again at this cell until the next power-on. The radio supports the modification of its subscriber class on receipt of a new subscriber class from the SwMI in the registration acknowledgment PDU. This subscriber class is used until turning off the radio or next Individual TETRA Subscriber Identity (ITSI) attach.

The radio does not send registration signaling when one of the following occurs:

- Roaming and registration fail before the radio receives the random access acknowledgment and the radio goes back to the last serving cell.

- The radio discovers a link failure on the serving cell, the link failure is shorter than the predefined timer and the radio is not in the transmit inhibit mode.

- The radio discovers a link failure on the serving cell and is in the transmit inhibit mode. In this case, the radio always goes back to the serving cell without registration and stays in the transmit inhibit mode until the mode is turned off.

> **NOTE:** When two or more scenarios occur at the same time, the radio registers with signaling.

If the radio discovers a link failure on the serving cell, a specific timer starts counting. If the link failure remains after the timer expires, then the radio acts as during a normal link failure. If the link failure ends before timer expires, then the radio goes back to the serving cell without registration. This mechanism ensures that unnecessary registration is avoided.

When a radio is out of the serving cell range for a period shorter than configured in the codeplug, then the radio does not register to go back in the range.

2.10.5
Congested Cell Handling

This feature is used only during initial registration and when roaming between sites. It is not used when camped on a site that has become busy or congested due to no free traffic channel to make or receive calls.

When the cell that the terminal is trying to register is congested, a special level-based algorithm is in the place. Depending on the level of congestion, the terminal is waiting for the registration or is rejected on that cell.

The terminal recognizes whether the cell is congested (Control Channel Congestion). The terminal tries to roam to not congested cells first, ranking congested ones as secondary. The cell congestion is one of the service level criteria.

The following cells are never marked as congested.

- Last suitable cell - if there are no other suitable cells during roaming or initial cell selection.
- Serving cell.

The feature is configurable using the Customer Programming Software (CPS).

2.10.6
Subscriber Class

When the radio powers up, or whenever it performs registration or roaming, it always uses its provisioned Subscriber Class (SC).

When the radio registers on a cell that does not support any of its SCs, it is active only in services that have the emergency priority.

2.10.7
RF Power Class Toggle

NOTE: This is a Software Selling Feature.

The RF power toggle is a radio-specific hardware feature enabling the radio to change the transmit power from Class 4 to Class 3L, or Class 4 to Class 3.

NOTE: Power Class 3 is only available on MTP6650.

Depending on the codeplug settings, you can toggle through the interface, between high power (Class 3L or Class 3) and normal RF power (Class 4).

The radio can be configured to switch automatically to Class 3L (1.8 W) or Class 3 on entering Direct Mode Operation (DMO) and to automatically switch to Class 4 (1 W) on entering Trunked Mode Operation (TMO).

Changing RF power class is performed immediately. The change can be done, for example, during an active communication. Such action may result in dropping the communication, as the selected power class setting can be insufficient to sustain the transmission.

2.10.8
Local Site Trunking

NOTE: This is a Software Selling Feature.

Local Site Trunking (LST) is a feature enabling a Base Station to operate stand-alone. The Base Station may enter the mode when the link from the local cell to the central switch has gone down. The radio limits functionality when the cell is in this mode.

NOTE: Whether a radio can register on cells in LST depends on the codeplug settings.

If system broadcasts indicate that system-wide services are not available (LST) on a cell, the radio registers on this cell only if there are no system-wide cells available.

Depending on the infrastructure settings, when the radio is operating on an LST cell, the radio may prevent you from invoking the Short Data Services (SDS) data.

Depending on the codeplug configuration, the radio may indicate entering the LST with the following notifications:

- Visible and audible
- Visible
- Audible
- None

To avoid unnecessary roaming and reduce congestion, Local Site Trunking Ignoring feature can be enabled. When Local Site Trunking Ignoring feature is enabled, the radio temporarily ignores the LST/WST parameter when selecting a site. However, the radio still takes other parameters such as the Radio Signal Strength Indicator (RSSI) level of the cell into consideration when deciding on roaming.

2.10.9
Cell Surveillance and Monitoring Threshold

The radio constantly calculates a normalized value that represents the signal strength of a cell. This value is used by the radios to determine if the cell is usable and when to leave the cell.

In the default case, when the radio is camped on a cell, it initiates link failure procedures, such as leave the cell, if this normalized signal strength value falls below zero. However, it is possible to configure the radio to allow this normalized value to be processed below zero using the Customer Programming Software (CPS); value can be set in 1 db steps up to -5 db. Reducing this value below zero allows the radio to maintain service on a weak cell where the radio is unable to roam to a better cell.

2.11
Supplementary Services

Following is the description of the TETRA Supplementary Services (SS) that the radio supports in the Trunked Mode Operation (TMO).

2.11.1
Transmit Inhibit Mode

The Transmit Inhibit (TXI) Mode is a mode in which the radio sends no radio transmissions. Activate this mode in RF sensitive areas, for example hospitals, airplanes, where safety can be jeopardized due to transmission radiation.

To activate, select **Menu → Networks → TXI Mode → Activate**.

In this mode, the radio does not transmit under any circumstances. All the functions and keys which cause transmission, for example registration to the network, changing talkgroup or folder, or sending SDS messages are disabled. Any transmission trial causes the radio to display `Not Allowed In TXI Mode` notification and to play a tone.

Your radio can still receive and displays any incoming SDS messages. These messages are stored in the **Inbox**.

When no danger to safety exists anymore, for example, when you leave the RF sensitive area, you can deactivate the TXI Mode and the radio returns to standard operation.

You can deactivate the mode by selecting **Menu** → **Networks** → **TXI Mode** → **Deactivate**, or pressing One-Touch Button.

> **NOTE:** RF Transmissions from the radio are prevented under the following conditions:
> - TXI Mode is activated.
> - Battery is removed.
> - The radio is turned off.

On entering or exiting the TXI mode, when the radio is camped on a cell, it sends a specially designated Short Data Service (SDS) status message. This SDS message indicates to the SwMI that the radio is entering or exiting TXI mode.

Mobility procedures that do not require the radio to send an uplink transmission are performed except for cell reselection.

If the radio is turned off in the TXI mode, on turning on, the radio asks whether to exit the TXI mode. If you choose **No**, the radio turns off.

2.11.2
Universal Time Display

The radio can present time information to the user. The time is derived from an internal clock. The radio maintains the clock both when the radio is powered on and powered off.

> **NOTE:** If the power is lost, for example due to the flat battery, the internal clock is not maintained.

To ensure the time displayed is accurate, the time is displayed only if within the last 48 hours either of the following events have occurred:

- The radio has received a network time update from the system.
- You have manually updated the time.

Also, as the internal clock is not maintained after a power loss event, the time is not displayed until either these events occur.

The feature is enabled or disabled and the default configuration can be set for the radio using the Customer Programming Software (CPS) or radio MMI.

The radio display supports the following:

- Twenty-four-hour and twelve-hour formats.
- DD/MM/YY, MM/DD/YY, DD-MON-YY, and YY/MM/DD date formats.

You can change the time and configuration information through the MMI, depending on the codeplug settings. Depending on configuration, system broadcast information can have higher priority than data entered manually. Thus time, date, and offset information entered from the MMI is overwritten, when data is received from the SwMI. The radio provides user indications upon crossing to another time zone, when a new Mobile Country Code (MCC) broadcast received.

2.12
Man Down (Fall Alert)

> **NOTE:** This is a Software Selling Feature.

Man Down (henceforth known as Fall Alert) alerts when no movement is detected for a predefined time interval.

If this condition is met, the radio alerts you with a Man Down (Fall Alert) pre-alert. If you do not disable the pre-alert condition by moving the radio, the radio switches to the Emergency Operation.

> **IMPORTANT:** If you receive a call out while pre-alert condition is active, exit from call out to Home screen before disabling the Man Down (Fall Alert) pre-alert condition.

If the radio is connected to the Home Station, Man Down (Fall Alert) pre-alert and alert are not triggered.

For easier localization of the radio, visual and audible indications are started until they are deactivated.

To exit Man Down (Fall Alert), exit the Emergency Mode by pressing and holding the **Exit** soft key.

> **CAUTION:** Use only Motorola Solutions predefined tones when Man Down (Fall Alert) is activated.

2.12.1
Man Down (Fall Alert) Operation

Man Down (henceforth known as Fall Alert) can be disabled or enabled from the menu or by OTB.

If the Man Down (Fall Alert) feature is deactivated with a One-Touch Button, the radio plays an audio tone once. If the feature is deactivated using the menu, the radio does not play the tone.

The Man Down (Fall Alert) feature is based on a sensor with low-power current consumption. When Man Down (Fall Alert) is enabled the sensor performs a self-test during powering on the radio. If the test fails, the radio notifies with a specific audio tone and status icon. The radio also notifies with the specific audio tone and status icon, when the Man Down (Fall Alert) device detects a failure during the activation of the feature.

If the feature is deactivated using radio MMI after the sensor failure is detected, the Man Down (Fall Alert) icon disappears and the tone is no longer played.

Depending on the CPS settings, extra audio and/or visual indications are available to help locate the radio. In such case, if the Man Down (Fall Alert) alarm is activated (emergency alarm started), the radio starts additional audio indication playing high and low frequency sounds continuously, with highest possible volume. The radio display and/or keypad may also start blinking.

2.13
Vibrate Mode

The vibrate menu allows you to determine if the pager vibrates, rings, or vibrates, and then rings when receiving a Short Data Service (SDS) message.

You can assign five vibration patterns using CPS, and apply the setting according to the user profile.

> **NOTE:** The vibration settings configured in a selected audio profile takes precedence over configuration in Vibrate Mode.

2.14
Energy Economy

Energy Economy (EE) is a mode of operation to save battery life. Your pager does not monitor all downlink time slots of the Main Control Channel. If the pager is in the charger, Energy Economy mode is not needed.

When in Energy Economy mode, the pager monitors one frame of the Control Channel and sleeps in one or several subsequent frames. You can select the Energy Economy mode through the Customer Programming Software (CPS), with the options of either **EG1** or **EG5**. Each Economy Group (EG) determines the number of frames that sleep. The pager communicates the selected Energy Economy mode to the SwMI.

2.15
SDS Remote Control

📝 **NOTE:** This is a Software Selling Feature.

The Short Data Service (SDS) remote control feature enables controlling a radio through Air Interface using SDS - TL bearer service. A controlling terminal, for instance, a controlling radio or SwMI controlling terminal, sends the SDS remote control messages with AT commands to a radio for its execution.

Figure 7: SDS Remote Control Overview
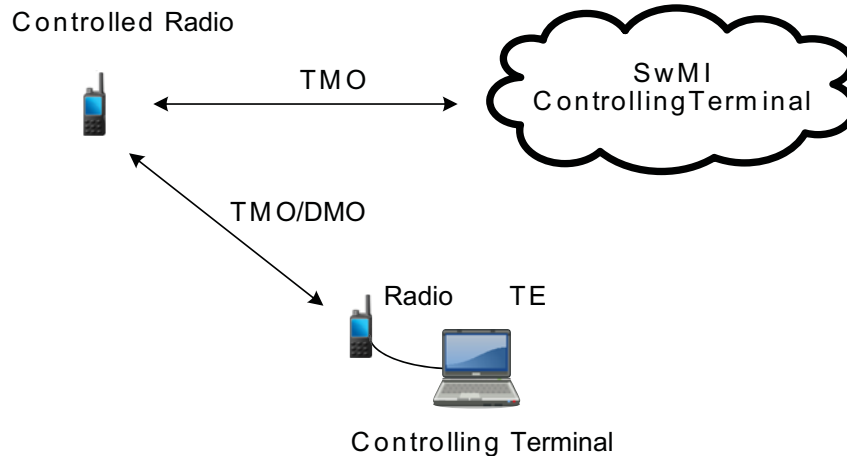
The SDS remote control functionality works in both Trunked Mode Operation (TMO) and Direct Mode Operation (DMO) and the remote control PDUs are sent using Terminal Equipment (TE).

You can use the feature only after a successful authorization, which requires entering a valid remote control PIN number.

The remote control messages can be sent to a group or individual radios.

A controlled radio receives over the air control information using SDS type 4 with Transport Layer (TL) on the specific PID number defined in the codeplug. If the received control message is originated from one of the Individual Short Subscriber Identities (ISSI) present on the radio authorized ISSI list, the radio executes received command and sends a response.

If configured by service provider upon the reception of SDS Remote Control Service (AT command) request, the radio gives an audio-visual notification.

The service provider has two options: **Limited SDS RC** and **Full SDS RC** modes.

The SDS remote control in the **Limited SDS RC** enables the following:

● Switching between TMO or DMO modes (read, change, notify) for individual radio and group using the **+CTOM** AT command.

● Selecting a talkgroup (read, change, notify) for individual radio and group using the **+CTGS** AT command.

● Reading and setting the scanning state using the **+CTSCAN** AT command.

● Collecting Network Information from individual radio - Network Registration Status and Cell Signal Quality using respectively the **+CREG** and **+CSQ** AT commands.

● Reading individual radio GPS position using the **+GPSPOS** AT command.

● Setting volume level for individual MT using the **+CLVL** AT command.

● Rebooting the radio using the **R** AT command.

● Retrieving the mobility log using the **+MCMLOG** AT command.

- Reading the SDS messages, and notifying new messages in Inbox/Outbox using the **+MCTSMSG** AT command.

- Retrieving the call-out messages using the **+MCCOMSG** AT command.

The SDS remote control in the **Full SDS RC** enables the radio to use most of the AT Commands. To see which AT Commands are not supported, refer to the *AT Commands Programmer`s Guide*.

2.16
Status Remote Control

Status Remote Control is a feature that provides limited control of the radio, unlike Short Data Service (SDS) Remote Control.

Only one type of remote control can be active on a radio; either SDS or Status.

The following tasks can be assigned remotely to a radio:

Play loud tone until user interaction
The radio plays a loud tone as in the Man Down (henceforth known as Fall Alert) feature until you unlock the keypad (if needed) and press the appropriate soft key labeled **Exit**. The tone is played through the speaker even if an accessory is attached.

The tone is not emitted when the radio is in one of the following states:

- Temporarily disabled

- Pseudo Off Mode

- Ambience Listening Mode

- Transmit Inhibit Mode (TXI)

- Emergency Mode

Send firmware version and TEI
The radio sends back an SDS message with its firmware version and TEI.

NOTE: If the sending Individual Short Subscriber Identity (ISSI) is not on the Allowed ISSIs list, the receiving radio ignores the task.

2.17
Call-Out

NOTE: This is a Software Selling Feature.
For those who use DMO mode, you are recommended to apply DMO SCK for data confidentiality.

A Call-Out is an alert sent to one or many recipients when an incident requires immediate attention. The Call-Out message can include an instruction to use a different talkgroup during the Call-Out or remain on the attached talkgroup. The timestamp of each Call-Out message is display on your radio. When configured in the Customer Programming Software (CPS), you are also able to group or ungroup Call-Out messages. You can select from a list of up to 1120 preprogrammed alphanumeric aliases each of which corresponds to a status value.

The following items are configurable in the Call-Out screen, when accessing the Call-Out message from the Call-Out Box.

- Severity

- Talkgroup alias

- TXI indication

- Text

- Timestamp

- Originating ISSI

- Triggering subaddress alias or Configurable Text for Individual Callout

- All matching subaddresses alias

- Call-out number

The types of Call-Out alerts are:

Normal
   An alert message sent by a dispatcher either to a single radio or to a group of radios.

Storm Plan
   An alert message sent by a dispatcher to a group of radios. To raise its reliability, it is sent several times. You are not able to respond to the Call-Out alert and any key press takes you to the information phase.

   The Call-Out mode is ended when the acknowledgment timer runs out, or when you press any key or softkeys (**Messages** and **Exit**), except for the **EMERGENCY** button, or the rotary knob.

Simple Call-Out
   An alert with the functionality similar to full Call-Out but without the information phase. There are two types of Simple Call-Out:
   With user receipt
   The Call-Out mode is ended when the acknowledgment timer runs out, or when you select **Accept**, **Reject**, or **Standby**. When you have responded to call out alert to the sender ISSI, pager shall auto send the same user response for call out alert to a predefined secondary ISSI where the secondary ISSI is different from the sender.

   Without user receipt
   The Call-Out mode is ended when the acknowledgment timer runs out, or when you press any key or softkeys (**Messages** and **Exit**).

Test Call-Out
   A special Call-Out alert sent by the dispatcher to test this feature. On receiving the Test Call-Out, the radio plays a tone and displays **Test Call-Out**. To respond and clear the alert, select **Test OK**.

When you receive the alert, the following responses are available.

- **Accept** – additional information from the dispatcher is displayed.

- **Reject** – display returns to the home display and the talkgroup is set to the one before the Call-Out.

You can address a Call-Out alert by:

- Individual Short Subscriber Identity (ISSI) – to an individual radio.

- Group Short Subscriber Identity (GSSI) – to a group of recipients.

All incoming and outgoing Call-Out messages are stored in **CO Box** (Call-Out Box) and can be managed through the Man-Machine Interface (MMI). You can protect Call-Out messages from being deleted or from the overwriting policy of the radio. The overwrite policy deletes the oldest one upon receipt of a new Call-Out message. When a new Call-Out arrives, the new Call-Out overrides the old Call-Out, even if it has not been responded. An ongoing Call-Out overrides the old one in any phase of the Call-Out alert. Also, the overwrite policy deletes unprotected Call-Out messages first before deleting protected ones.

There is a two-level structure for the alerts. First level is the main alert list, and the second one are all the messages associated with the alerts. Both lists are displayed chronologically with the newest on top. The capacity of the **CO Box** is a maximum of 500 Call-Out alert/response messages. There are a total of ten user profiles, and the capacity of the **CO Box** in each of these user profile depends on the combination of stored alert/response messages. The combination of stored messages cannot exceed 500 messages.

In normal mode, you can browse the **CO Box** and read all the Call-Out messages. In the Call-Out mode, you can only read the ongoing Call-Out messages.

The Call-Out service functions in two main phases:

Alert Phase

You receive the alert with the associated messages that you can respond to. These messages provide all the important information about an incident. LED and vibration patterns, and special tones notifies you when the alert is coming in. The tone volume range, duration and interval for each alert is configured in the codeplug and cannot be adjusted through the MMI. Indication profile for each sub-address is played in sequence. The conditions for stopping this tone (for example, upon pressing any key), duration of the indication and intervals in between each indication are configured in the codeplug. Also, an ongoing alert tone is paused on incoming Call-Out group call. A reminder indication starts when the entire sequence of indication is completed (if not stopped before). The time-stamp on the Call-Out alert indicates the time and date when the Call-Out is received.

> **NOTE:** This feature is only available when enabled by your service provider. If this feature is not enabled by the service provider, an alarm tone sounds to indicate the received message.

Information Phase

You are in the Call-Out mode and you may receive more messages about the incident with the text. You can also query for more information using the Call-Out text function which enables you to send a text message to the dispatcher host application. You are able to respond to a Call-Out by selecting a Call-Out template from a list of predefined replies. You may receive more info about the incident through subsequent text messages.

2.17.1
Call-Out Interactions

Transmit Inhibit Mode

In the transmit inhibit mode, you can receive Call-Out messages. The Call-Out alert message is displayed on the screen. You have the option to exit TXI Mode or exit the Call-Out prompt. In exiting TXI mode, your radio prompts you to accept or reject the Call-Out message. To continue in TXI mode, exit the Call-Out prompt instead.

DMO

The Call-Out feature is supported in DMO.

Gateway

The Call-Out feature is supported in Gateway.

Call-Out Test

The dispatcher can test the feature by using the Call-Out test. The radio then displays `Call-Out Test` and generates the alert tone. A **Soft** key is available in the MMI with the label `Test OK`. After responding to it, the display returns to the previous mode.

Storm plan alert is a special case of Call-Out. This alert is sent out to the larger group of people. You can respond to it with any key stroke. After responding, you proceed to the information phase. The storm plan alert is sent several times to raise reliability.

You can configure the storm plan severity to either Severity 0 or Severity 15 using the CPS.

2.17.2
Call-Out Reminder Phase

Your radio enters the Call-Out Reminder Phase after Alert Phase.

Call-Out Reminder Phase indicator:

- Reminder tone.

> **NOTE:** You can configure the Call-Out Reminder tone duration.

- Reminder Vibration

- LED Reminder - Blue.

- LCD backlight flashing reminder.

The Call-Out reminder indication stays active for the duration of the Call-Out Reminder Alerting Period. Pressing any key shall dismiss the reminder indication.

> **NOTE:** You can only select 0, 1, 2, 5, 10, 20, 30, 40, 50, and 60 minutes by using the menu. If you select a different value in the Customer Programming Software (CPS), the value displays in the menu. But you cannot select the value again after your radio select the value available in the menu.

The radio will display the Call-Out reminder phase with the following options:

- **Messages**, or

- **Exit**.

> **NOTE:** You can choose to dismiss the reminder phase instead of reading the missed Call-Out message. A message is considered read if a user responded while the message is considered unread if no response from the user.

You are allowed to configure the interval and duration parameters for the unread Call-Out reminder, per user profile.

2.18
Global Positioning System (GPS) Location Service

> **NOTE:** This is a Software Selling Feature.

The GPS Location Service feature uses information from GPS satellites orbiting the Earth to determine the approximate geographical location of your radio.

The GPS Location Service availability, accuracy, and the position calculation time vary depending on the environment in which you use the radio. The GPS Location Service can assist your dispatcher or colleagues in many ways such as more efficient deployment of resources or locating your radio when you trigger your emergency service.

The radio can display the location information directly on the screen or send it over-the-air to your dispatcher to display it in the control center. Check your radio configuration details with your service provider.

> **IMPORTANT:** Where the signals from satellites are not available, the GPS Location Service does not work. This situation usually happens when your radio cannot establish a view of a wide area of open sky, for example, when your GPS antenna is covered or facing the ground. Such situations include being:
>
> - In underground locations
>
> - Inside buildings, trains, or other covered vehicles
>
> - Under any other metal or concrete roof or structure
>
> - Near a powerful radio or television tower
>
> - In extreme temperature outside the operating limits of your radio
>
> Even if your location information can be calculated in such situations, it may take longer to do so. Therefore, in any emergency situation, always report your location to your dispatcher. Where adequate signals from multiple satellites are available, your GPS Location Service feature provides a location, most probably near to your actual location.

The radio can be triggered to send Location Reports in various circumstances, for example:

- Upon a request

- Entering Emergency Mode

- At specified time intervals

- At specified distance intervals

The Location Reports are sent using Short Data Service (SDS).

If the Location Reports are sent using SDS with User-Defined Data Type-4 as a Transport Layer (SDS - TL), either the European Telecommunications Standards Institute (ETSI) Location Information Protocol (LIP) or Motorola Solutions Location Request/Response Protocol (LRRP) GPS Location Protocol is used. The LRRP GPS protocol either use SDS - TL (for added reliability) or Simple GPS with no SDS - TL (for saving air interface resources). GPS Protocol Identifiers are:

- LRRP SDS TL = 131

- LRRP Simple GPS = 3

- LIP GPS = 10

Location reports are sent in TMO. Your service provider can also provision location reports to be sent in Direct Mode Operation (DMO). If the radio is provisioned to provide user indications, the feature operational status is indicated on the radio display. Also, if configured by service provider, the radio gives an audio-visual notification upon reception of LIP command.

Depending on the radio configuration, viewing the radio position and the status of the visible satellites is available. The position may consist of longitude and latitude, UK, or Irish grid coordinates.

The GPS Location Service feature can be enabled or disabled as a whole using the Customer Programming Software (CPS). It is possible to configure the feature parameters using the CPS, or over the air. The CPS configuration provides a default profile. The commands received over the air may overwrite the default profile configuration. The profile assigned to the radio determines when to send location data, what data to send with what accuracy and to what address. All data requests and configuration commands received over the air are checked to confirm that they have come from a trusted source. Location reports are accepted only from authorized Individual Short Subscriber Identities (ISSI) or IPs, depending on the configured transport layer of SDS or Packet Data.

NOTE:
The Current GPS Cycle ends between 6th and 7th April 2019 at midnight Coordinated Universal Time (UTC). After this date, your service provider must reconfigure the Current GPS Cycle codeplug value to avoid malfunctions in GPS location reporting.

Ensure that the application receiving location messages uses valid addresses which are set up on radio as an authorized ISSI range. Otherwise the radio rejects all system position requests.

You can enable or disable the GPS Location Service through the radio interface. If this feature is disabled, the Location Service Configuration can be programmed to the following parameters:

Receiver
GPS Receiver is disabled. The radio responds to location requests by informing that location reporting is disabled.

Receiver and Location Protocol
GPS Receiver and Location Protocol are disabled. The radio does not respond to any location requests.

Once the GPS Location Service is re-enabled, the radio restores its location service.

The radio supports GNSS triggers functions, using LIP or LRRP, to report GNSS positions when the radio meets a set of criteria. Your service provider can set up the following triggers, together with their specific parameters:

Table 4: GPS Triggers

Trigger Type	Trigger Event
Power-up	Radio powers up in TMO.
Power-down	Radio powers down in TMO.
Emergency condition	Radio enters emergency operations.
Periodic	Given time interval after the last location report expires.
Moved	Radio position has changed by at least the distance defined (the radio checks the movement from the last known position at an interval).
TMO ON	Successful registration on entering TMO from DMO.
DMO ON	Before TMO deregistration, and before entering DMO.
Transmit Inhibit Mode (TXI) ON	Radio is about to enter TXI.
Transmit Inhibit Mode (TXI) OFF	Radio has successfully registered after leaving TXI.
Low battery	Radio detects its battery level has reached or fallen below the level specified by service provider.
Loss of GPS	Radio detects a loss of GPS for a minimum duration defined by service provider.
Recovery of GPS	Radio detects a recovery of GPS signal for a minimum duration defined by service provider.
Status entered (Status and RMS Status)	Radio sends a status defined in the codeplug for location reporting by pre-programming.
GPS ON	Positioning device has been switched ON.
GPS OFF	Positioning device in the radio is switched OFF.
Emergency Periodic Profile (LRRP only)	Radio is in emergency operation and given time interval after the last location report expires.

The **GPS** icon is displayed in the status area when GPS has a location fix. Optionally, your service provider may configure the radio to always display the **GPS** icon, even outside of GPS coverage or before the radio has acquired a location fix, that is, right after being powered on. In this configuration, the **GPS** icon blinks until a location fix is acquired.

2.18.1
Different Location Displays

Table 5: Different Location Displays

Latitude/Longitude	UK Coordinates	Irish Coordinates	UTM Coordinates	MGRS Coordinates
Time	Time	Time	Time	Time
Latitude	2-Letter Code	1-Letter Code	3-Letter Code	3-Letter Code and 2-Letter Code

Latitude/Longitude	UK Coordinates	Irish Coordinates	UTM Coordinates	MGRS Coordinates
Longitude	Easting and Northing Coordinate	Easting and Northing Coordinate	Easting and Northing Coordinate	Easting and Northing Coordinate
Altitude	Altitude	Altitude	Altitude	Altitude
Satellites	Satellites	Satellites	Satellites	Satellites

Table 6: Different Location Displays

Latitude/Longitude	UK Coordinates	Irish Coordinates
Time	Time	Time
Latitude	2-Letter Code	1-Letter Code
Longitude	Easting and Northing Coordinate	Easting and Northing Coordinate
Altitude	Altitude	Altitude
Satellites	Satellites	Satellites

- Time – Indicates when the last time the location was calculated. The time is provided in Universal Time Coordinated.

- Letter Code – Grid zone or square on the map for different coordinate standard.

- Latitude – Expressed in degrees, minutes, and seconds.

- Longitude – Expressed in degrees, minutes, and seconds.

- Number of satellites – Used to calculate the location. In general, more satellites provides better accuracy. The maximum is 12 satellites.

- Easting – Refers to the eastward-measured distance expressed in meters.

- Northing – Refers to the northward-measured distance expressed in meters.

> **NOTE:** Skipping each digit of easting and northing coordinates decreases the accuracy by the factor of 10.

2.18.2

GPS Accuracy

The GPS Location Service accuracy depends on the GPS coverage and the selected accuracy mode.

In good GPS coverage (at least -137 dBm or in open sky), the location accuracy presents as follows:

- In high accuracy mode, the accuracy is:
  - 5 m for 50% of location reports.
  - 10 m for 95% of location reports.
- In power optimized or normal mode, the accuracy is:
  - 20 m for 50% of location reports.

○ 50 m for 95% of location reports.

NOTE:
The presented values depend on variety of factors, for example the view on the sky. To optimize the GPS performance the radio should have the clearest possible view of the open sky.

The use of the high capacity battery is recommended, especially when high accuracy mode is used.

2.18.3
Location Report Backlog

Your radio can record location track when it is out of service, when in DMO, or when in TXI mode.

The location reports generated during this time are stored, and all location report backlog recordings are uploaded once your radio is back in service. Your radio can save up to a maximum of 180 location reports. The location report backlog function differently when in different mode:

Location Backlog Recording in Trunked Mode Operation (TMO)
Your radio starts recording location reports when radio is out of service in TMO Mode.

Your radio resumes the latest location reporting when TMO coverage is regained.

Location Backlog Recording in Direct Mode Operation (DMO)
Your radio starts recording location reports in DMO Mode.

Your radio resumes the latest location reporting when it switches back to TMO mode.

NOTE: This feature is only available when enabled by your service provider.

Location Backlog Recording in Transmit Inhibit Mode (TXI)
When your radio is in TXI mode, location reports are generated and recorded but not sent out.

Once your radio exits TXI mode and is within TMO coverage, the location reports are uploaded to the server.

2.19
User Profile Scanning

Your radio supports SDS scanning of 1–32 GSSIs which are configured in the selected user profile. Supported SDS scanning are Call Out, Status, and SDS.

By default, the scan functionality is always on and all the TMO talkgroups which are valid for the user profile shall be scanned. Before the user profile change, your radio reboots automatically to update the scanned members. Your radio displays `Radio Is Rebooting` before rebooting.

2.20
Speech Announcements

Speech Announcement is a pre-recorded message playback when your radio receives a Call-Out message.

NOTE: This is a Software Selling Feature.

Your radio plays a sequence of audio files when the following items are triggered:

● Keywords

NOTE: You can define the keywords that trigger the speech announcement feature.

● Responsible Alert Loop

- Remaining Alert Loops
- Severity
- Fixed Audio File

> **NOTE:**
>
> - Alarm loop audio files is played once, even if it is mapped to several alarm loops and Call-Out alerts.
> - You can enable and disable Speech Announcements in the menu.
> - You can configure Speech Announcements in each audio profile.
> - You can mute an ongoing Speech Announcement.
> - Speech Announcement stops when you accept or reject a Call-Out Alert.

Chapter 3

Man-Machine Interface

3.1
LED Indications

LED Patterns

The Message LED indicates Call-Out alert or message receiving statuses. The Status LED indicates other general statuses. Each user profile has preprogrammed LED patterns for the following indications:

- Call-Out Alert
- Message
- Status
- Event

> **NOTE:**
> - You can choose from nine LED patterns through the configuration tool. Contact your service provider to customize the LED patterns for your user profiles.
> - If configured, you can deactivate the blinking green LED indication in the radio Human Machine Interface (HMI).

Table 7: LED Status Indications

Indication	Status
Solid green	In use.
Blinking green	- Call-Out alert of reminder. - In service or idle. - Switching modes from TMO to DMO.
Solid red	- Out of service.
Blinking red	- Call-Out alert of reminder. - Failed Group Attachment. - Connecting to the network. - Switching modes from DMO to TMO.
Solid orange	- Radio is powering up. - Transmit inhibit in service. - Channel busy in DMO. - Radio interference in DMO.
Blinking orange	- Call-Out alert of reminder. - Incoming call.

Indication	Status
No indication	● Radio powered down.

> **NOTE:** Call-Out indications have a higher priority than normal indications like battery indications, coverage indications, and so forth.

Table 8: LED Message Indication

Indication	Status
Blinking blue	● Message received or missing. ● Call-Out received or missing.

Table 9: Battery Charging LED Indications

Indication	Status
Solid green	Battery fully charged.
Blinking green	Battery charged at 90%.
Solid red	Rapid or trickle charge.
Blinking red	Faulty or invalid battery.
Blinking orange	Battery is waiting to charge.

> **NOTE:**
> When you charge your radio in a multi-unit charger, the LED Power Indicator of the radio indicates the charge status of the battery.
>
> If you insert a radio with a deeply discharged battery into the multi-unit charger, the LED on the radio shows blinking red, indicating a charging error. Resolve this error by reinserting the radio.

3.2
Battery Charging Indications

When the radio is charging, it displays the Charger Mode screen. The screen displays an appropriate Battery Charge Progress icon and charging progress expressed in percentage. When the battery level drains and reaches the threshold, the radio displays `Low battery`.

> **NOTE:**
> The charging condition of a fully depleted battery only has its charging icon displayed after approximately 20–35 minutes. The red LED indicator serves as the primary indicator during the trickle charging state.
>
> To easily identify the charging status, check the Battery Charging LED Indicator. See LED Indications on page 49.

Figure 8: Charger Mode Screen
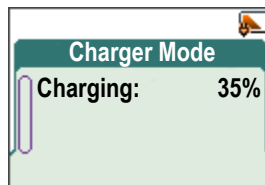
Table 10: Battery Icons

Battery Capacity						
0%–5%	5%–15%	15%–25%	25%–40%	40%–60%	60%–80%	80%–100%

Battery Charge Progress						
0%–5%	5%–15%	15%–25%	25%–40%	40%–60%	60%–80%	80%–100%

3.3
TPG2200 Controls and Indicators

The simple-to-use controls and indicators of the Advisor TPG2200 TETRA Two-way Pager allows you to quickly read and respond to alerts received on the radio.
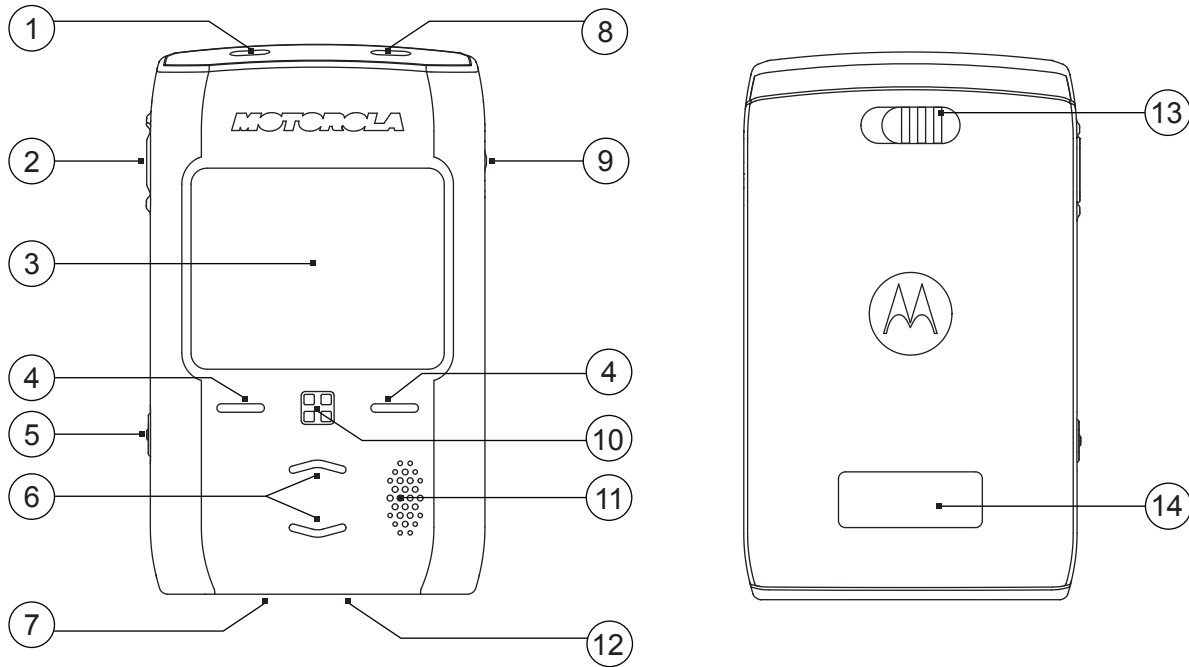
Table 11: Advisor TPG2200 TETRA Two-way Pager Controls and Indicators

Annotation	Description
1	LED Message Indicator Indicates incoming message or call-out.
2	**Power/Sleep/Wake** button ● Press and hold to turn the radio on or off. ● Press to lock or unlock the radio.
3	Full Color Display Bright 2 in. full color Quarter Video Graphics Array (QVGA) display.
4	**Soft** key Press **Left** or **Right** Soft key, to select the option that appears above.
5	**Mute/Shortcut** button ● Press and hold to add a shortcut for menu items. ● Press to temporarily stop the tone and LED indication of the active call out session.
6	**Up** or **Down** navigation button The **Up** or **Down** navigation button supports the following functions: ● List scrolling ● Navigating around the menu hierarchy

Annotation	Description
	• Increasing or decreasing the volume
	• Activating the assigned One-Touch Button feature
7	USB Connector The USB Type-C™ connector supports charging and programming. 📝 **NOTE:** When an active KVL device is connected to radio using the USB connector, the radio draws current consumption from the KVL device and start charging.
8	LED Coverage Indicator • Shows the coverage status while transmitting and receiving over the network. • Shows the battery status when the radio is charging.
9	Wrist Strap Holes
10	**Menu** button • Press and hold to display idle screen. • From the home screen, press to enter the main menu. • Used to enter context-sensitive menus. • Used as Right Navigation button for selected menu items.
11	Speaker
12	Input/Output Connector Provides enhanced coverage when the radio is docked on the Home Station.
13	**Battery Cover Lock** key • Slide to the left to unlock the battery cover. • Slide to the right to lock the battery cover.
14	Nameplate

3.4
Automatic Keypad Lock

The automatic keypad lock is a feature enabling the radio to lock its keypad automatically after a defined period. The radio allows activating or deactivating the feature using the MMI.

If the feature is enabled, after a defined time of inactivity the keypad locks automatically. Any user activity restarts the **Automatic Keypad Lock** timer. When the keypad locks automatically, the radio displays **Keypad auto locked**. You can change the time value required for the automatic lock through the MMI.

3.5
One-Touch Buttons

The One-Touch Button feature allows you to activate a feature by a long key press of the **Up** or **Down** navigation keys. Your service provider can assign one-touch functions to these keys.

Table 12: One-Touch Button Features

Feature	Description
Activation of Covert Mode	Turns Covert Mode on or off.
Call-Out Box	Displays the list of call-out sessions.
Change Audio Profile	Changes to the specific audio profile.
Change Font Level	Increases the font size by one level.
Change User Profile	Changes to a specific User Profile.
Display Operational-Tactical Address (OPTA)	Displays the OPTA.
Flip Display	Rotates the display by 180°.
Location Information Protocol (LIP) Report	Sends a message with the location of the radio to a dedicated address or Selected Talkgroup (DMO Only).
Message Inbox	Displays the list of messages in the Inbox.
Reset to Default	Resets the radio to its default settings.
Scroll User Profile	Changes to another User Profile by scrolling through the available User Profiles.
Selecting Audio Profiles	Changes the audio profile of the radio.
Send Predefined Template (PDT)	Sends a predefined message to a dedicated address.
Send Status Message	Sends a dedicated status message to a dedicated address.
Send User-Defined Template (UDT)	Sends a user-defined message to a dedicated address.
Toggle Backlight Intensity	Regulates the backlight intensity.
Toggle BSI Encryption Enabled or Disabled	Enables or disables BSI encryption.
Toggle DMO or TMO	Toggles between TMO and DMO modes.
Toggle Extra Zoom	Turns Extra Zoom on or off.
Toggle Man Down (Fall Alert) On or Off	Turns the Man Down (henceforth known as Fall Alert) feature on or off.
Toggle RF Power Class	Toggles the RF Power Class between high and normal.
Toggle Transmit Inhibit Mode (TXI)	Turns TXI on or off.
Unassigned	The radio displays `Unassigned Button` when no feature is assigned to this button.
Universal Time Display	Displays universal time on the home screen.
User Profile List	Displays the list of available User Profiles.
Shortcuts List	Displays the list of shortcuts.

3.6
Display

This section presents the default home screen elements of the radio.

Figure 9: Default Home Screen with Icons
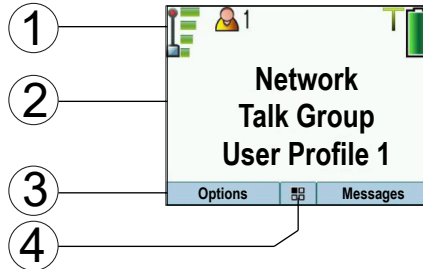
Table 13: Display

Annotation	Description
1	Status icon area
2	Text display area
3	Soft key area
4	Menu/Context sensitive icon

The color of the Soft key area changes according to the mode the radio is in.

Table 14: Colors of the Soft Key Area

Color	Mode or State
Light blue	Normal TMO and DMO Modes
Light red	Emergency Mode
Olive	Local Site Trunking Mode
Yellow	Call Out – Standby
Red	Call Out – Alert
Green	Call Out – Accepted
Blue	Radio Messaging Service (RMS)

3.6.1
Status Icons

Status icons appear when your radio is engaged in certain activities or when you have activated certain features.

Depending on your service provider settings, status icons can appear in normal or large size. By default, they are large on the home screen and normal when browsing though the radio menu.

Table 15: Status Icons

Icon	Description
Trunked Mode Operation (TMO)	
	Unit Not Attached – Indicates that there are unattached Talkgroups in the radio.
	Trunked Mode Operation
or	In Service
or	No Service
or	Signal Strength – The more bars, the stronger the signal.
HI or	RF Power – Indicates that High RF Power is enabled. Shows the signal strength. The more bars, the stronger the signal.
	Migration – Indicates that the radio is registered to a foreign network.
Direct Mode Operation (DMO)	
	Direct Mode – Indicates that radio is in Direct Mode (radio-to-radio communication).
	DMO Gateway Communication Mode – Indicates that gateway is selected. The icon has the following status: ● Solid – when the radio is synchronized with the gateway. ● Blinking – when the radio is not synchronized or during attachment. ● No icon – during radio-to-radio and repeater communication.
	DMO Repeater Communication Mode – Indicates that the **Repeater** or **GW + Rep** option in DMO Mode is selected. The icon has the following status: ● Solid – when the radio has detected the repeater (for example, when the radio receives a presence signal). ● Blinking – when the radio has not detected the repeater or during attachment. ● No icon – during a radio-to-radio and gateway communication.
General Icons	
	Graceful Service Degradation Mode
	Selected User Profile – Indicates one out of four user profiles which you can select.
	All Tones Off – Indicates that: ● Volume is set to 0 (when **Volume Adj. Mode** is set to **Common**). ● All Tones is set to Off (when **Volume Adj. Mode** is set to **Individual**)
	Vibrate Only – Indicates that the radio vibrates to alert you of an incoming message.

Icon	Description
	Vibrate then Ring – Indicates that the radio vibrates and then rings to alert you of an incoming message.
	GPS ● Solid – the radio has a location fix. ● Blinking – the radio is acquiring a location fix. This feature is an optional setting and may not be enabled on your radio.
	Battery Strength – Shows the charge of your battery.
	Battery Charging – Indicates that the battery is charging.
	New Message Has Arrived – Indicates that a new message has arrived from a different user profile.
	New Message in Inbox – Indicates that you have unread messages in your **Inbox**.
	Man Down (henceforth known as Fall Alert) Active – Indicates that the Man Down (Fall Alert) feature is active.
	Man Down (Fall Alert) Alert – Indicates that the Man Down (Fall Alert) feature is active. This icon has the following status: ● Blinking – pre-Alert; the radio signalizes Man Down (Fall Alert) conditions. To exit the pre-Alert state, change the conditions. ● Solid – the radio enters Alert mode.
	Man Down (Fall Alert) Failure – Indicates that the Man Down (Fall Alert) device failed.
	Snooze – Indicates that the periodic notice is snoozed.
	Call-Out – Indicates Call-Out alert.
	Call-Out Alert Arrived – Indicates a receipt of a new Call-Out message.
	Call-Out Alert Unread – Indicates unread alert in the **CO Box**.
	Unread New Call-Out – Indicates the new message in other user profiles. The number on the icon represents the user profile with unread messages.
	Encryption Off Blinking – Indicates that the SIM Card E2EE is disabled in DMO and TMO Modes.
	SIM End-to-End Encryption (E2EE) in TMO Indicates that the SIM Card E2EE is enabled in TMO Mode.
or	SIM End-to-End Encryption (E2EE) in DMO Indicates that the SIM Card E2EE is enabled in DMO Mode. Numbers *1* and *2* point to the type of DMO Encryption keys that has been selected.

Icon	Description
	Keys Locked – Indicates that keys are locked.
	Remote Control – Indicates that the radio is being remotely controlled and some commands are being executed in the background. For example, when the radio is being controlled by special SDS messages or triggered to send a GNSS location report.

3.6.2
Idle Display

The terminals provide access to all services from the main idle display.

Your service provider can configure the idle display. The idle display can show the following:

- Icons on the status area (top line):
  - Status icons in Trunked Mode Operation (TMO) signal level icon.
  - Battery level displayed at all times.

    > ✎ **NOTE:** The terminal periodically repeats the audible and visible indication of low battery.

- Displays three to four lines depending upon the font size, and the icon bar. The content of these lines depends on Configurable Idle Screen settings. The default is as follows:
  - Line 1: Network status or network identification (`No Service` or MCC/MNC or MCC/MNC Alias).
  - Line 2: Selected Group Folder.
  - Line 3: Selected Group.
  - Lines 4, 5: Home Mode Display Text (if available).
  - Line 5: Time and Date (if available).

    > ✎ **NOTE:** In case the time and date information for a specific language cannot be displayed in one line in the zoom or standard mode, the information is displayed in two lines. The time and date overwrite the second line of Home Mode Display if any.

- Soft key labels and optional menu icon.
- An optional wallpaper background.

3.6.3
Configurable Idle Screen

Your service provider can configure the information that is displayed on the idle screen below the status icon area. The displayed information depends on your radio configuration and services supported.

- Audio Profile Name
- BSI Registration Status
- Home Mode
- Individual Short Subscriber Identity (ISSI)
- Last Sent Tactical Availability
- Network (No Service, or Mobile Country Code (MCC)/Mobile Network Code (MNC), or Networks Alias)
- Operational-Tactical Address (OPTA)
- Radio Status

- Range

- RMS/FMS

- Selected User Profile

- Talkgroup Alias

- Time and Date

- Volume

Order and visibility of these items are also subject of the Configurable Idle Screen settings.

3.6.4
Display Features

Your radio utilizes colors to highlight certain special situations:

- When in the call-out mode (alert received state, standby state, accept the state).

The radio has four font size levels that you can choose using the menu.

The backlight can be provisioned to operate in one of the following modes:

Semi-Auto
Pressing a provisioned One-Touch Button toggles the on/off state of the backlight. The backlight is also turned off automatically when the backlight timer runs out.

Auto
Pressing any key automatically turns on the backlight.

The backlight remains on until the backlight timer runs out, or if a provisioned One-Touch Button is pressed to turn it off. You can also toggle between the modes using the menu.

Your radio supports an option to display a screen saver when the radio has been idle for a set time, or when you explicitly activate it. The screen saver consists of an image, which can be provisioned from any GIF image, a text string, which can also be provisioned, and the date and time. When the screen saver is being displayed, any key input or incoming service causes the screen saver to deactivate.

3.6.5
Languages Supported

Table 16: Languages Supported

Language	Advisor TPG2200 TETRA Two-way Pager
English	Yes
Arabic	Yes
Chinese (simplified)	Yes
Chinese (traditional)	Yes
Croatian	Yes
Danish	Yes
Dutch	Yes
Finnish	Yes
French	Yes
German	Yes

Language	Advisor TPG2200 TETRA Two-way Pager
Greek	Yes
Hebrew	Yes
Hungarian	Yes
Italian	Yes
Japanese	Yes
Korean	Yes
Norwegian	Yes
Macedonian	Yes
Mongolian	Yes
Polish	Yes
Portuguese	Yes
Lithuanian	Yes
Russian	Yes
Latin American Spanish	Yes
European Spanish	Yes
Swedish	Yes
User defined	Yes

3.6.6
Assignable Softkeys Functions

Users can configure the softkeys functionality with a list of predefined menu items.

The assigned functions on the softkeys are only operational while in idle screen. Both left and right softkeys should be configurable in CPS, with the following options to choose from:

NOTE: If both left and right softkeys are configured to the same functionality, then only the left softkey is visible.

- Shortcuts
- CO Box
- Messages (original in right softkey)
- Options (original in left softkey)
- User Profile
- Audio Profile
- Settings
- Display
- My Info
- Networks (for TMO/DMO switching)

NOTE: This configurable is NOT OTB, thus limited to selected menu items only.

3.7
Description of Tones

Motorola Solutions TETRA terminal supports audible user notification, tones.

Tones for events are divided into three categories:

- Keypad – for events triggered by key-press.
- Alert – for events triggered by an application.
- Callout – for events triggered by Call-Out alert.

A category may have many or few associated events.

The number of tones is limited to eight .wav files. A specific tone may be used for indicating several different events. You can use CPS to upload, delete, and allocate user tones in user profile settings.

The "right" tone or event loudness is an objective matter. Motorola Solutions TETRA terminal tones architecture is highly flexible and allows you to adjust the level of every tone-event (such as valid keypress) individually, and at the same time to adjust the level of all events associated with a tone category.

3.8
Volume Adjustment Mode

The Volume Control Mode is configurable using the Customer Programming Software (CPS).

You can configure the maximum volume offsets (dB) and the volume range (dB) through CPS. The field is **Audio Settings** → **User Profile**. The volume control in the radio is divided into 13 steps, from 0 to 14. If for example, the **vol. range** is set to 39, each step on the volume indication bar is 3 dB.

3.9
Audio Features

Different audio quality and adaptive audio parameters can be configured according to the working environment.

The demand of audio quality changes according to the working environment. For example, an airport worker experiences different audio quality at various sites. Working in the field is noisier compared to inside the airport.

3.9.1
Audio Profiles

Audio profiles can be used to adjust the audio settings of the radio to fit different operating environments.

You can select the corresponding audio profiles which are mapped to "User Profiles" generated in CPS. It is possible to enable and customize up to four audio profiles using CPS (**Audio Settings** → **User Profile**). The following parameters can be changed in a User Profile:

- Tone offset and ranges
- Vibrate Alert
- LED On/Off state

> **NOTE:** Audio Profile names in the Radio MMI correspond to the Profile Alias/Name parameter value for the corresponding User Profile in CPS.

Using the CPS you can create an audio profile using the four User Profiles. You can also enable/disable an audio profile in the codeplug and give an alias/name to a particular profile configured in the codeplug.

The audio profiles are created and maintained independent of each other. Creating or modifying one audio profile does not have any impact on the others.

The radio enables toggling audio profiles using the menu or using the One-Touch Button.

3.9.1.1
Discrete Audio Profile

If you enable the Discrete Call-Out for the specific audio profile, your radio plays the Discrete Call-Out indication when receiving the call-out.

NOTE: The Discrete Call-Out indication plays only once even with multiple subaddresses.

The Speech Announcement plays after the Discrete Call-Out indication. Your radio enters Reminder state with an LCD screen and vibration indication, but without the tone.

3.10
User Profile

User Profile is the user-specific configuration of the pager.

You are able to select among different predefined profiles to receive messages from different sources and get indicated in different ways. You can select from up to 10 predefined user profiles which are configured in CPS. You are not allowed to modify user profiles from the pager MMI. The user selection of profile shall be kept between power cycles.

Upon profile selection, the pager is attached to a specified Trunked Mode Operation or Direct Mode Operation talkgroup with a predefined volume setting, operation mode and refreshed with the status area icon displaying the index of the selected user profile.

Each user profile has own message box to save exchanged messages, but the current status ID translation tables, Call-out template table, and text message templates are shared by all user profiles. The pager has two messages boxes for normal text message and translated status, and Call-out respectively.

3.11
Test Page

Only authorized persons can use the Test Page option and this option must be enabled in the codeplug.

NOTE: If Test Page option is not enabled in the codeplug, you can only access the Key Variable Loader (KVL) mode option. When using a KVL device (a portable device used to load encryption keys to a secure entity), set the baud rate to 19200 bits/second.

Use the following key sequence to access the test page: **Up → Down → Up → Down → Menu/Shortcut**.

The following information is available in the test page:

- **Ver Info** – Version Information – displays software or hardware version information.
  - **Build Date** – software build (a compiled version of software).
  - **CP Ver** – Codeplug version.
  - **DSP Ver** – Signaling Processor Software version.
  - **Host Ver** – Application Software version.
  - **HardwareID** – hardware identification number.
  - **EquipID** – TETRA Equipment Identity (TEI).
  - **LLS version** – Local Language Package version.

- **Addresses**
  - ○ **Home MNI** – country identification code, network code.
  - ○ **Group ID** – number of the currently selected talkgroup.
  - ○ **Own ISSI** – Own Individual Short Subscriber Identity.
  - ○ **ASSI** – Alias Short Subscriber Identity.
- **Err Logs** – Error Logs – displays information about software errors.
- **Cells Info** – Cell Information – displays information about the foreground and background cells (BTS sites). This menu displays the RSSI levels of the cells.
- **Cell Lists** – Displays frequency lists.
  - ○ Frequency **List1** (32 variable frequencies)
  - ○ Frequency **List2** (32 fixed frequencies)
  - ○ Frequency **List3** (comprehensive hunt)
  - ○ Frequency **List4** (comprehensive hunt)
- **Data Svc** – Data Services – allows access to the air tracer enable, the conformance tests, and the KVL mode.
  - ○ **Air Tracer**
  - ○ **Conf Test** – Conform test.
  - ○ **KVL Mode**

    NOTE: You can exit KVL Mode by power cycle.

  - ○ **E2E Key Del**
  - ○ **MS Logging**
- **CE Monitor** – Circulator Eliminator Monitor.
- **Key Info** – Key Information allows your radio to display security information for the following conditions:
  - ○ For the serving cell:
    - ■ **Curr Cell SC** – Security class of the serving cell, that is Security Class 1, Security Class 2, Security Class 3, Security Class 3 with Group Cipher Key (GCK).
  - ○ For the group OTAR:
    - ■ **CMG GSSI** – Crypto-Management Group (CMG) group of MSs with common key material
  - ○ For SDMO and TM-SCK OTAR:
    - ■ **SCK SubsGrType** – SDMO SCK Subset Grouping Type.
    - ■ **Curr Subs Info** – current SDMO SCK Subset Number and SCK-VN.
    - ■ **Fallback TMSCK** – current Fallback TMO SCK, that is SCKN and SCK-VN attributes.
    - ■ **SCK List** – list all SCKs stored in your radio, that is SCKN and SCK-VN attributes.

      NOTE: When checking for SDMO key information in your radio, the SDMO KAG range in the AuC is from 0 to 9, and the range in your radio is from 1 to 10.
  - ○ For the GCK:
    - ■ **Full GCK-VN** – current Full GCK-VN.
    - ■ **GCK List** – list all GCKs stored in your radio, that is GCKN and GCK-VN attributes.

3.12
Radio Info

Depending on the codeplug configuration the manufacturer, type, and serial number information is available. The information is available through the service page accessible from the MMI.

The Radio Info provides the following data:

- Manufacturer
- Model Number

  NOTE: The manufacturer and model number information is displayed only on radios distributed under Motorola Solutions trademark.

- Release Name – the version of radio software.
- Individual Short Subscriber Identity (ISSI) – the ISSI that is in use. If a SIM Card is present, the ISSI is read from the card, otherwise it is taken from the codeplug.
- TETRA Equipment Identity (TEI) – the TEI is displayed as a hexadecimal number.
- Serial number – Motorola Solutions serial number is displayed only on radios distributed under Motorola Solutions trademark.
- OPTA – if the BSI SIM support is disabled, no OPTA information is displayed.
- Birth OPTA - the original OPTA ID stored in the BSI SIM card.
- Comment - Optional user-defined label for administrative purposes.

3.13
Hardware Test

This mode allows performing basic hardware tests and share the results immediately on the display.

NOTE: The hardware test mode is only for use by authorized persons.

Use the following key combinations to access the hardware test: **Left** soft key, **RIGHT** soft key (hold both simultaneously) and then press **On/Off** key.

Appendix A

Service Information – EMEA

Service orders are dealt with by two centres: European Radio Support Centre (ERSC) and European Systems and Components Centre (ESCC). This section contains contact details to service centers in Europe, Middle East, and Africa.

European Radio Support Centre (ERSC)

ERSC provides a remote Technical Support Service to help customers resolve technical issues and quickly restore their systems. The centre handles service orders for subscribers and accessories. This team of highly skilled professionals is available to the customers that have current ERSC service agreements in place. For further information and to verify whether your current service agreement entitles you to benefit from this service, contact your local customer support.

To contact ERSC, use the following EIA Integrated Call Center details:

E-mail: ersc@motorolasolutions.com.

Telephone: +49 (0)30 6686 1555

European Systems and Components Centre (ESCC)

ESCC provides a repair service for infrastructure equipment. Customers requiring a repair service should contact the Customer Information Desk and obtain a Return Material Authorization number. Unless advised otherwise, the equipment should then be shipped to the following address:

Motorola Solutions Systems Polska Sp.z o.o ul. Czerwone Maki 82, 30-392 Krakow, Poland.

E-mail: escc.admin@motorolasolutions.com.

Telephone: +49 (0)30 6686 1404

Monday to Friday, 08:00am–06:00pm (CET)

Table 17: Service Information — Telephone Numbers to EIA Integrated Call Center

Country	Telephone Number
Austria	1206091087
Denmark	43682114
France	157323434
Germany	6950070204
Italy	291483230
Lithuania	880030828
Netherlands	202061404
Norway	24159815
Portugal	800552277
Russia	810800228 41044 (Alternative 8108001201011)
South Africa	800981900
Spain	912754787

Country	Telephone Number
United Kingdom	2030277499
Other Countries	+42 0533336946

Parts Identification and Ordering

To get help in identification of non-referenced spare parts, contact your local Motorola Solutions Customer Care Organization.

To request replacement parts, kits and assemblies, place orders directly through your Motorola Solutions local distribution organization or through https://shop-business.motorolasolutions.com/.

EIA Test Equipment Support

For information related to support and service of Motorola Solutions Test Equipment, contact your local Motorola Solutions Customer Care Organization.

For customers in Germany, contact the Equipment Service Group in Germany:

Telephone: +49 (0) 6128 702179

Fax: +49 (0) 6128 951046

Latest Versions of Manuals

To download the latest versions of technical manuals, see https://learning.motorolasolutions.com/.

Submit Your Comments

If you have any comments or would like to report a problem regarding Motorola Solutions publications, send an e-mail to: escc.admin@motorolasolutions.com.

Appendix B

Service Information for APAC

This topic contains contact details to service centers in Asia and Pacific region.

Technical Support

Technical support is available to assist the dealer/distributor in resolving any malfunction, which may be encountered. Initial contact should be by telephone wherever possible. When contacting Motorola Solutions Technical Support, be prepared to provide the product model number and the serial number.

Further Assistance from Motorola Solutions

You can also contact the Customer Help Desk through the website: http://www.motorolasolutions.com/ en_xp/products. If a unit requires further complete testing, knowledge and/or details of component level troubleshooting or service than is customarily performed at the basic level, send your radio to a Motorola Solutions Service Center as listed in the following table:

Table 18: Service Information – Telephone Numbers and Addresses of the Asia and Pacific Motorola Solutions Centers

Country	Telephone Number	Address
Singapore	+65-6352-6383	**Motorola Solutions Singapore Pte. Ltd,** c/o Azure Engineering, 49 Jalan Pemimpin, #03-11 APS Industrial Building, Singapore 577203 Contact: Alvin Tan E-mail: alvin.tan@motorolasolutions.com Contact: Gan Saw See E-mail: gan.sawsee@motorolasolutions.com
Malaysia	+603-7809-0000	**Motorola Solutions Sdn. Bhd.** Level 14, Persoft Tower, No. 68, Pesiaran Tropicana, 47410 Petaling Jaya, Selangor Darul Ehsan, Malaysia Contact: Koh Tiong Eng E-mail: A21001@motorolasolutions.com
Indonesia	+62-21-3043-5239	**PT. Motorola Solutions Indonesia** 30th Floor, Gedung BRI II, Suite 3001, Jl. Jend. Sudirman Kav. 44-46, Jakarta 10210, Indonesia Contact: Eko Haryanto E-mail: Eko.Haryanto@motorolasolutions.com

Country	Telephone Number	Address
Thailand	Tel: +662-653-220 Fax: +668-254-5922	**Motorola Solutions (Thailand) Ltd.** 142 Two Pacific Place Suite 2201, 3220 Sukhumvit Road, Klongtoey, Bangkok 10110 Contact: Nitas Vatanasupapon E-mail: Nitas@motorolasolutions.com
India	+91-9844218850	**Motorola Solutions India Pvt. Ltd.** C/o Communication Test Design India Private Limited, #4, 5 Maruthi Industrial Estate, Rajapalya, Hoodi Village, Bangalore - 560048, India Contact: K. Umamaheswari E-mail: umamaheshwari@motorolasolutions.com
China	+86-10-8473-5128	**Motorola Solutions (China) Co. Ltd.** No. 1 Wang Jing East Road, Chao Yang District, Beijing, 100102, P.R. China Contact: Sophy Wang E-mail: C18170@motorolasolutions.com
Hong Kong	852-2966-4823	**Motorola Solutions Asia Pacific Ltd.** Unit 1807-1812, 18/F, Two Harbourfront, 22 Tak Fung Street, Hunghom, Kowloon, Hong Kong Contact: Judy Leung E-mail: Judy.Leung@motorolasolutions.com
Philippines	Tel: +632 858-7500 Fax: +632 841-0681	**Motorola Communications Philippines, Inc.** Unit 2102, One Global Place Building, 5th Ave., Bonifacio Global City, Taguig, Philippines 1634. Contact: Arthur Nieves E-mail: Arthur.Nieves@motorolasolutions.com
Korea	+822-3497-3649	**Motorola Solutions Korea, Inc.** 9th Floor, Hibrand Building, 215, Yangjae-Dong, Seocho-Gu, Seoul, 137-924, Korea. Contact: KS Kwak E-mail: r45321@motorolasolutions.com
Taiwan	+886-2-8729 8000	**Motorola Solutions Taiwan, Ltd.** 8F, No. 9, Songgao Rd.,

Country	Telephone Number	Address
		Taipei 110, Taiwan (R.O.C.) Contact: Michael Chou E-mail: ftpe239@motorolasolutions.com
Australia	+613-9847-7725	**Motorola Solutions Australia Pty. Ltd.** 10 Wesley Court, Tally Ho Business Park, East Burwood Victoria 3151, Australia. E-mail: servicecentre.au@motorolasolutions.com

Piece Parts

Some replacement parts, spare parts, and/or product information can be ordered directly. If a complete Motorola Solutions part number is assigned to the part, it is available from Motorola Solutions Service Organization. If no part number is assigned, the part is not normally available from Motorola Solutions. If a list of parts is not included, that means that no user-serviceable parts are available for that kit or assembly.

Customer Programming Software has no capability to tune your radio. Tuning your radio can only be performed at the factory or at the appropriate Motorola Solutions Repair Center. Component replacement can affect your radio tuning and must only be performed by the appropriate Motorola Solutions Repair Center.

All orders for parts/information should include the complete Motorola Solutions identification number. All part orders should be directed to your local Motorola Solutions Service Organization. See your latest price pages.

Parts Identification and Ordering

Request for help in identification of non-referenced spare parts should be directed to the Customer Care Organization of Motorola Solutions local area representation. Orders for replacement parts, kits, and assemblies should be placed directly on a Motorola Solutions local distribution organization.

Service Information for Americas

This topic contains contact details to service centers in Latin America and Caribbean region.

Technical Support

To request technical support, go to https://businessonline.motorolasolutions.com, **Contact Us**.

Some replacement parts, spare parts, and/or product information can be ordered directly. If a complete Motorola Solutions part number is assigned to the part, it is available from Motorola Solutions. If no part number is assigned, the part is not normally available from Motorola Solutions. If the part number is appended with an asterisk, the part is serviceable by Motorola Solutions Depot only. If a list of parts is not included, that means that no user-serviceable parts are available for that kit or assembly.

Warranty and Repairs

Table 19: Service Information – Telephone Numbers and Addresses of Latin America Radio Support Centers

Country	Telephone Number	Address
Colombia	571- 376-6990	Motorola Solutions de Colombia Service Centre Torre Banco Ganadero Carrera 7 No. 71-52 Torre B piso 13 Oficina 1301 Bogota
Mexico	5252576700	Motorola Solutions de México Service Centre Bosques de Alisos #125 Col. Bosques de las Lomas CP 05120 Mexico DF

Piece Parts

To order parts in Latin America and the Caribbean contact your local Motorola Solutions CGISS representative.

Table 20: Service Information – Telephone Numbers and Addresses of Latin America Motorola Solutions Centers

Country	Telephone Number	Address
Argentina	5411-4317-5300	Motorola Solutions Argentina Ave. del Libertador 1855 B1638BGE, Vicente Lopez Buenos Aires
Brasil	5511-3847-668	Motorola Solutions Ltda Av. Chedid Jafet

Country	Telephone Number	Address
		222 Bloco D Conjuntos 11,12,21,22 E 41 Condominio Millennium Office Park 04551-065- Vila Olimpia, Sao Paulo
Chile	562-338-9000	Motorola Solutions Chile S.A. Av. Nueva Tajamar 481 Edif. World Trade Center Of. 1702, Torre Norte Las Condes Santiago
Colombia	571-376-6990	Motorola Solutions Colombia LTDA. Carrera 7 #71-52 Torre A, Oficina 1301 Bogotá
Costa Rica	506-201-1480	Motorola Solutions de Costa Rica Parque Empresarial Plaza Roble Edificio El Portico, 1er Piso Centro de Negocios Internacional Guachepelin, Escazu San Jose
Ecuador	5932-264-1627	Motorola Solutions del Ecuador Autopist Gral. Rumiñahui, Puente 2 Conjunto Puerta del Sol Este-Ciudad Jardin Pasa E, Casa 65 Quito
Mexico	52-555-257-6700	Motorola Solutions de México, S.A. Calle Bosques de Alisos #125 Col. Bosques de Las Lomas 05120 México D.F.
Peru	511-211-0700	Motorola Solutions del Peru Ave. República de Panama 3535 Piso 11, San Isidro Lima 27
USA	954-723-8959	Motorola Solutions, Inc. Latin American Countries Region 789 International Parkway Sunrise, FL 33325
Venezuela	58212-901-4600	Motorola Solutions de Los Andes C.A. Ave. Francisco de Miranda Centro Lido, Torre A Piso 15, El Rosal Caracas, 1060