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TELEKOM a.s.

Defence Systems Division

TK-Series

VHF/UHF Tactical Radio Station

Operator & Technical Manual

TK-41	TK-82	TK-110
Man-Portable	Vehicle-Mounted	Base Station

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1 Introduction and Scope

1.1 Purpose of This Manual

This Operator & Technical Manual provides comprehensive information for the installation, operation, maintenance, and basic troubleshooting of the TK-Series Tactical VHF/UHF Radio Stations manufactured by Telekom a.s., Defence Systems Division. The manual is intended for trained operators, system integrators, and authorized maintenance personnel.

All procedures described herein must be performed by qualified personnel in accordance with applicable national military regulations and unit-level SOPs. Modifications to the equipment not explicitly authorized by Telekom a.s. will void all applicable warranties and certifications.

1.2 Applicable Models

Model	Designation	Primary Application	NSN (Sample)
TK-41	Man-Portable Radio	Dismounted infantry, special operations, forward observers	5820-99-TK-41-001
TK-82	Vehicle-Mounted Radio	Wheeled/tracked vehicles, command vehicles, aircraft ground support	5820-99-TK-82-001
TK-110	Base Station Radio	Command posts, fixed installations, relay nodes	5820-99-TK-110-01

1.3 Conventions and Symbols

The following conventions are used throughout this manual:

WARNING	Indicates a hazard that, if not avoided, will or could result in death or serious injury.
CAUTION	Indicates a hazard that, if not avoided, may result in equipment damage or mission compromise.
NOTE	Provides supplementary information important for operation but not hazard-related.

2 Safety Information

2.1 General Safety Warnings

WARNING	Do not operate this equipment in the vicinity of blasting operations, explosive materials, or fueling operations. RF energy from the transmitter may detonate electric blasting caps or ignite flammable vapors.
CAUTION	Do not operate the TK-41 with a damaged or missing antenna. Transmitting without an antenna will cause severe damage to the RF output stage and may void certification.

The TK-Series equipment must be operated, stored, and disposed of in accordance with applicable national regulations. Only use accessories, antennas, and cables approved by Telekom a.s. for use with the respective model. Third-party accessories not listed in the approved accessories list (AAL-TK-2025) may cause RF interference, degraded performance, or damage to the unit.

2.2 RF Exposure

The TK-41 man-portable unit complies with applicable RF exposure limits for occupational use as specified in ICNIRP guidelines and NATO AMEDP-7. During transmission on the TK-41, maintain a minimum separation distance of 20 cm between the antenna and the body of the operator. For vehicle-mounted and base station installations, refer to the relevant installation guide for antenna placement requirements.

NOTE	Frequency hopping mode distributes RF energy across the frequency band, which may reduce peak RF exposure compared to fixed-frequency operation at the same nominal power level.
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2.3 Battery Safety

The TK-41 uses a rechargeable Lithium-Ion battery pack (P/N TK-BP-41). Observe the following precautions at all times:

- Do not short-circuit, puncture, crush, or expose the battery pack to temperatures above +70 °C.
- Use only Telekom a.s. approved chargers (P/N TK-CHG-01 or TK-CHG-02).
- Dispose of batteries in accordance with local regulations — do not incinerate.
- A swollen or leaking battery must be immediately removed from service and disposed of safely.
- In cold environments (below -20 °C), battery capacity will be reduced. Carry spare batteries.

WARNING	Lithium-Ion batteries can catch fire if damaged or improperly charged. Never leave charging batteries unattended in field conditions.
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3 System Overview

3.1 Architecture and Design Philosophy

The TK-Series represents Telekom a.s.'s fourth-generation tactical software-defined radio (SDR) platform. The architecture is based on a reconfigurable wideband RF front-end combined with an embedded digital signal processor (DSP) running the proprietary TK-OS real-time operating system. This design allows waveform and protocol updates to be deployed via secure firmware updates without hardware modification.

A key design objective of the TK-Series is the elimination of single-point-of-failure dependencies. Each unit is capable of operating as a network node and as a transparent relay simultaneously, enabling autonomous tactical mesh networking without reliance on fixed infrastructure. The mesh implementation is fully transparent to the operator — routing decisions are handled by the TK-OS network stack in real time.

3.2 Model Variants

TK-41 — Man-Portable Radio

The TK-41 is designed for dismounted operations. It features a ruggedized housing, integrated keypad and display, and a side-mounted PTT (Push-To-Talk) button. The unit supports a standard NATO SMBUS connector for external power and data.

Power Input	Internal Li-Ion, 7.4 V / 5200 mAh
Weight	1.85 kg (with battery)
Dimensions (HxWxD)	220 x 92 x 55 mm

TK-82 — Vehicle-Mounted Radio

The TK-82 is optimized for vehicle integration. It separates the RF head unit from the control panel, allowing flexible installation in vehicles with limited dashboard space. Supports 12 V and 24 V vehicle power systems with reverse-polarity protection.

Power Input	12/24 VDC, vehicle power
Weight	3.4 kg (head unit)
Dimensions (HxWxD)	190 x 130 x 60 mm (head unit)

TK-110 — Base Station

The TK-110 provides high-power fixed or semi-fixed installation capability. It includes a rack-mount chassis option (1U/2U), dual redundant power supplies, and enhanced cooling for continuous duty cycle operation. Remote control via Ethernet.

Power Input	100–240 VAC or 24–48 VDC
Weight	6.2 kg
Dimensions (HxWxD)	482 x 133 x 250 mm (rack mount)

3.3 Frequency Coverage

The TK-Series covers the full military VHF and UHF bands as specified in STANAG 4204 and STANAG 4206. Coverage across the entire band is achieved without retuning or hardware reconfiguration. Channel spacing is software-selectable.

Band	Frequency Range	Channel Spacing	Channels
VHF	30–88 MHz	25 kHz	2,320
UHF-L	225–400 MHz	25 kHz	7,000
UHF-H	400–512 MHz	25 kHz	4,480

4 Technical Specifications

4.1 RF Performance

Frequency Range — VHF	30–88 MHz
Frequency Range — UHF	225–512 MHz
Channel Spacing	25 kHz (configurable: 8.33 / 12.5 / 25 kHz)
Frequency Accuracy	± 0.5 ppm (TCXO-stabilized)
Output Power — TK-41	0.5 / 1 / 3 / 5 W (switchable)
Output Power — TK-82	5 / 10 / 20 / 50 W (switchable)
Output Power — TK-110	5 / 25 / 50 / 100 W (switchable)
Modulation — Voice	FM (NBFM, 2.5 kHz deviation)
Modulation — Data	FSK, GMSK, 8-PSK, QAM-16 (waveform dependent)
Receiver Sensitivity	–113 dBm (12 dB SINAD, 25 kHz FM)
Intermodulation Rejection	> 75 dB
Spurious Emission	< –36 dBm (< 1 GHz), < –30 dBm (> 1 GHz) per ETSI EN 300 113
Antenna Impedance	50 Ω (SO-239 / TNC-F connector, model dependent)

4.2 Frequency Hopping

The TK-Series implements Adaptive Frequency Hopping (AFH) as specified in NATO STANAG 4204. The hopping pattern is generated by a cryptographically secure pseudo-random number generator (CSPRNG) seeded by the active frequency hopping key (FH-Key). The following parameters define hopping performance:

Hopping Rate	Up to 100 hops/second (configurable: 10 / 50 / 100 hps)
Hopping Set Size	25 to 2,320 channels (operator configurable)
Synchronization Method	GPS-aided or over-the-air sync (OTA-SYNC)
Sync Acquisition Time	< 2 seconds (GPS-aided), < 8 seconds (OTA)
Jamming Avoidance	Automatic bad-channel exclusion (up to 30% of hopping set)
Guard Time	0.5 ms inter-hop guard interval
FH-Key Length	256-bit (AES-256 based CSPRNG)
FH-Key Zeroization	Immediate on command or power loss (< 100 ms)

NOTE

GPS-aided synchronization requires a connected GPS receiver (P/N TK-GPS-01 or compatible NMEA-0183 source). When GPS is unavailable, OTA-SYNC is used automatically.

4.3 Encryption and Security

All TK-Series units implement hardware-accelerated encryption. The cryptographic module is physically separate from the main processor and is certified to FIPS 140-2 Level 2. Key loading is performed via a dedicated hardware

key-fill port (U-229/U compatible) or via the secure Ethernet management interface on the TK-110.

Encryption Algorithm	AES-256 (GCM mode for data, CFB for voice)
Certification	FIPS 140-2 Level 2
Key Storage	Tamper-evident secure enclave (up to 128 key slots)
Key Loading Interface	U-229/U fill connector (DTD, KYK-13 compatible)
Zeroization	Manual, scheduled, or triggered (tamper/low-power)
Authentication	HMAC-SHA-256 message authentication
Traffic Flow Security	Continuous transmission (CT) mode optional
COMSEC Alarm	Visual and audible alert on key expiry or sync loss

4.4 Environmental Ratings

Standard	MIL-STD-810H
Operating Temperature	−40 °C to +70 °C (TK-41, TK-82); −30 °C to +55 °C (TK-110)
Storage Temperature	−51 °C to +85 °C
Humidity	5% to 95% relative humidity, non-condensing (MIL-STD-810H, Method 507.6)
Vibration	MIL-STD-810H, Method 514.8, Category 4 (vehicle) and 20 (aircraft)
Shock	MIL-STD-810H, Method 516.8, Procedure I (Functional), Procedure IV (Transit)
Immersion (TK-41)	IP67 — submersion to 1 m depth for 30 minutes
Immersion (TK-82, TK-110)	IP65 — dust-tight, water-jet resistant
EMI/EMC	MIL-STD-461G, RE102, RS103, CE102
Altitude	Operational to 4,500 m ASL; storage to 15,000 m ASL

4.5 Power and Battery

TK-41 Battery Type	Li-Ion, 7.4 V / 5200 mAh (P/N TK-BP-41)
TK-41 Operating Time	> 12 h (5% Tx / 5% Rx / 90% Standby); > 6 h (50/50)
TK-41 Charge Time	< 3 h (standard charger); < 90 min (rapid charger)
TK-41 External Power	10–32 VDC via SMBUS/J9 connector
TK-82 Power Input	10–32 VDC (vehicle), max 25 A at 50 W output
TK-110 AC Input	100–240 VAC, 50/60 Hz, single phase, < 8 A
TK-110 DC Input	24–48 VDC (optional DC-DC module)
Power Saving Mode	Configurable sleep / reduced-power monitoring mode

5 Controls and Connectors

5.1 TK-41 Man-Portable Unit

The TK-41 front panel provides all primary operator controls. The unit is designed for single-hand operation with gloves. Key controls are identified below:

Item	Label	Function
1	PWR	Power ON/OFF; long press (3 s) for zeroization
2	CH+/CH-	Channel increment/decrement in preset channel mode
3	VOL+/VOL- _	Audio output volume adjustment (12 levels)
4	MODE	Cycle through operating modes: FIXED / FH / SCAN / RELAY
5	PTT	Push-to-talk; side-mounted large button, also via J3 accessory port
6	DISP	2.4" transfective color LCD: channel, mode, signal strength, battery
7	J1	NATO SMBUS / external power (MIL-DTL-38999, 6-pin)
8	J2	U-229/U COMSEC key fill port
9	J3	Headset/accessory port (6-pin, compatible with NATO standard headsets)
10	J4	GPS input (SMA-F, NMEA-0183 at 4800/9600/38400 baud)
11	ANT	Antenna connector — TNC-F, 50 Ω

NOTE The zeroization function (long press PWR for 3 s) immediately erases all loaded crypto keys and hopping sets. This action is irreversible. A distinct "ZZ" tone confirms zeroization. Use only when operationally required.

5.2 TK-82 Vehicle-Mounted Unit

The TK-82 consists of two main assemblies: the RF Head Unit (HU-82) and the Remote Control Head (RCH-82), connected by a standard RCH cable (up to 10 m). The RCH-82 mounts on the vehicle dashboard and provides full operator control. Additional connectors on the HU-82 include:

ANT1 / ANT2: Dual antenna ports (SO-239, 50 Ω) for MIMO or antenna diversity configurations

J5 — Power: Vehicle power connector (Deutsch DT06-4S, 10–32 VDC, 25 A rated)

J6 — Data: RS-232 / RS-422 serial data interface, 115200 baud max

J7 — Ethernet: RJ-45 10/100 BASE-T, for IP-based control and data routing

J8 — GPS/PPS: GPS and 1PPS input for timing synchronization

J9 — COMSEC: U-229/U compatible key fill connector

5.3 TK-110 Base Station

The TK-110 is available in rack-mount (1U control unit + 1U PA module) and transit-case configurations. All connectors are located on the rear panel:

RF OUTPUT: N-Type female, 50 Ω, rated to 200 W peak

RF INPUT (RX): SMA-F, 50 Ω , for external receive antenna (optional)

AC MAINS: IEC C14 connector, 100–240 VAC

DC INPUT: Anderson PowerPole 75A, 24–48 VDC (with optional DC module)

ETH 1 / ETH 2: RJ-45, 10/100/1000 BASE-T, primary/redundant management and data

COM 1 / COM 2: DE-9 RS-232 serial interfaces

SYNC IN/OUT: BNC, 1PPS / 10 MHz external reference for timing

KEY FILL: U-229/U COMSEC connector + USB Type-A (secure USB key loading)

ALARM: Dry contact relay output for external alarm systems (2-pin terminal block)

6 Operation

6.1 Startup Procedure

Perform the following checks before initial startup:

1. Inspect the antenna connector and antenna for physical damage. Replace if damaged.
2. Verify battery charge level is adequate (minimum 25% for field deployment).
3. Confirm that required COMSEC keys have been loaded (check KEY indicator on display).
4. For TK-82/TK-110: verify power cable connections and polarity before applying power.

Startup Sequence:

1	<p>Press PWR</p> <p>Press PWR button briefly. The unit will initiate POST (Power-On Self-Test), indicated by the display showing "INIT..." and a sequence of diagnostic codes.</p>
2	<p>POST Completion</p> <p>Successful POST results in a single audible beep and the main channel display. If POST fails, error codes are shown — refer to Section 8 (Troubleshooting).</p>
3	<p>Verify Display</p> <p>Confirm display shows correct channel, mode, and encryption status. A "KEY" indicator confirms crypto keys are loaded and valid.</p>
4	<p>Select Mode</p> <p>Use the MODE button to select the desired operating mode (FIXED, FH, SCAN, or RELAY).</p>
5	<p>Check Frequency</p> <p>In FIXED mode, verify the selected channel/frequency is correct. In FH mode, confirm the hopping set indicator is active.</p>
6	<p>Conduct Radio Check</p> <p>Conduct a radio check with a known station before operational deployment.</p>

6.2 Frequency Programming

The TK-Series supports two frequency management methods: direct frequency entry and preset channel programming. Preset channels are the recommended method for tactical operations as they allow rapid channel changes and reduce operator error.

Direct Frequency Entry (FIXED mode):

- Press MODE until FIXED is displayed.
- Press and hold CH+ for 2 seconds to enter frequency edit mode.
- Use CH+/CH- to scroll through digits; use VOL+/VOL- to change the selected digit value.
- Press PTT briefly to confirm the entered frequency. The unit will retune and confirm.

Preset Channel Loading (via PC Programming Tool):

For operational pre-deployment programming, connect the TK unit to a PC running TK-PROG v3.2 or later via the J6 serial interface or J7 Ethernet (TK-110). Programming files (.tkp) can be encrypted and digitally signed to prevent unauthorized modification. Refer to the TK-PROG User Guide (DOC-TK-PROG-UG-EN) for detailed instructions.

6.3 Frequency Hopping Mode

Frequency Hopping (FH) mode provides significant protection against interception and jamming. All radios in a FH net must share an identical FH-Key and be time-synchronized before communication is possible.

CAUTION	Entering FH mode without a valid FH-Key loaded will result in no communication capability. Verify KEY indicator status before switching to FH mode.
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1. Ensure FH-Key is loaded (KEY indicator active on display).
2. Ensure all net members are time-synchronized (GPS-aided recommended).
3. Press MODE until "FH" is displayed.
4. The display will show "SYNC" until synchronization with the net is established.
5. Once synchronized, the HOP indicator will flash at the hopping rate.
6. Operate normally. FH operation is transparent to voice and data traffic.

6.4 Encryption Key Management

COMSEC key management is a critical operational security responsibility. Key loading, handling, and disposal must comply with unit COMSEC SOPs and applicable national COMSEC regulations.

WARNING	COMSEC key material must be handled in accordance with national COMSEC regulations. Loss, compromise, or unauthorized disclosure of key material must be reported immediately to the COMSEC custodian.
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Keys are loaded via the J2 (TK-41) or J9 (TK-82/TK-110) U-229/U fill connector using a DTD or KYK-13 compatible fill device. The unit supports up to 128 key slots organized as Traffic Encryption Keys (TEKs) and Transmission Security Keys (TSKs).

6.5 Mesh Network Operation

When multiple TK-Series units are operating in the same area, the TK-OS automatically forms a tactical mesh network. Each unit simultaneously acts as a radio node and a transparent relay, extending the effective range of the network without any operator intervention.

Max Mesh Nodes	Up to 64 nodes per mesh domain
Routing Protocol	Proprietary adaptive link-state routing (TK-MESH v2)
Relay Latency	< 15 ms per hop (voice), < 50 ms per hop (data)
Max Relay Hops	7 hops (configurable 1–7)
Mesh Mode Selection	Automatic (default) or manual relay designation
Inter-domain	TK-110 can serve as a mesh gateway between two mesh domains

6.6 Shutdown Procedure

- Complete or terminate all active radio calls.
- If operating in FH mode, press MODE to return to FIXED mode to log departure from the net (unit SOP dependent).

- Press PWR briefly to initiate shutdown. The display will show "SHUTDOWN..." for 5 seconds.
- If required by operational orders, perform zeroization by holding PWR for 3 seconds until the "ZZ" tone.
- Disconnect external power and antenna. Return equipment to its carry bag or vehicle mount.

7 Maintenance

7.1 Scheduled Maintenance

Interval	Task	Level
Before each use	Visual inspection of housing, connectors, antenna; verify battery charge; check display and PTT function	Operator
Weekly	Clean connectors with approved contact cleaner; inspect gaskets and seals; cycle battery fully (discharge/charge)	Operator
Monthly	Functional RF test on all frequency bands; verify encryption module self-test; inspect antenna contacts; firmware version check	Maintainer
Annually	Full calibration check; RF output power verification; battery capacity test; gasket replacement; MIL-STD-810H subtest spot checks	Depot / OEM
3 Years	Full depot-level overhaul; replace all elastomeric seals; battery pack replacement; component-level inspection	Depot / OEM

7.2 Cleaning Procedures

Use only approved cleaning materials to avoid damage to seals, coatings, and display surfaces:

Housing (exterior): Wipe with lint-free cloth dampened with isopropyl alcohol (IPA ≥ 70%). Do not immerse in solvent.

Display: Wipe gently with dry microfibre cloth. Do not apply solvents to display surface.

Connectors: Clean with approved contact cleaner (P/N TK-CCL-01) and a soft brush. Apply thin coat of dielectric grease to mated connectors.

Antenna contacts: Clean with IPA on cotton swab. Inspect for corrosion; replace connector if corroded.

Battery contacts: Clean with pencil eraser or contact cleaner. Ensure contacts are dry before inserting battery.

CAUTION	Do not use acetone, trichloroethylene, or other aggressive solvents on any part of the TK-Series equipment. These will damage plastic housings, display coatings, and gasket materials.
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7.3 Battery Maintenance

Li-Ion battery packs (P/N TK-BP-41) have a service life of approximately 500 full charge-discharge cycles or 3 years, whichever comes first. The following practices will maximize battery service life:

- Store batteries at 40–60% charge when not in use for extended periods.
- Avoid fully discharging the battery — the unit will warn at 15% and initiate shutdown at 5%.
- Do not charge in ambient temperatures above +45 °C or below –10 °C.
- Record battery cycle count and replacement date in the unit's equipment log.
- Replace batteries showing capacity below 70% of rated capacity.

8 Troubleshooting

This section covers common fault indications and recommended corrective actions at the operator and unit maintainer level. Faults not resolved by the procedures below require depot-level or OEM service.

Symptom / Display Code	Probable Cause	Corrective Action
Unit fails to power on	Depleted battery; faulty power connection	Charge or replace battery; check external power cable and polarity
POST error — code E01	DSP initialization failure	Power cycle unit. If fault persists, return for depot service
POST error — code E07	Crypto module self-test failure	Reload COMSEC keys. If fault persists, COMSEC module may require depot replacement
POST error — code E12	GPS module not responding	Check GPS antenna connection. Use OTA-SYNC for FH operation if GPS unavailable
Display shows "NO KEY"	No COMSEC key loaded or key zeroized	Load appropriate COMSEC keys via fill device. Contact COMSEC custodian
FH mode — "SYNC" displayed continuously	Time synchronization failure; FH-Key mismatch	Verify all net members use identical FH-Key; check GPS sync source; retry OTA-SYNC
Poor audio / high noise floor	Damaged antenna; incorrect squelch setting; interference	Inspect and replace antenna; adjust squelch; verify operating frequency
"TX FAULT" displayed	High VSWR — antenna or cable fault	Check antenna connection; replace antenna. Do not continue to transmit
Battery drains rapidly	Aged battery; high TX duty cycle; cold temperature	Test battery capacity; replace if below 70%; carry spare battery
Unit restarts unexpectedly	Power supply voltage drop; thermal shutdown	Check power supply current capability; verify operating temperature limits

NOTE If the unit has been submerged or exposed to extreme conditions, allow it to dry completely in a warm, dry environment before powering on. Do not apply external heat.

9 NATO STANAG Compatibility

The TK-Series is designed from the outset for seamless interoperability within NATO and partner-nation tactical radio networks. Compliance with the following STANAG documents is verified and certified as part of the standard delivery configuration:

STANAG	Title	TK-Series Compliance Notes
STANAG 4204	HAVE QUICK II Frequency Hopping	Full HAVE QUICK II waveform support; interoperable with compliant NATO equipment
STANAG 4206	UHF Communication for Aircraft	SATURN waveform support for UHF airband; AM voice and data
STANAG 4677	Tactical Data Links — Link 11/16 Interface	Link 11 modem built-in; Link 16 via external terminal
STANAG 4579	IP Interoperability	Native IP stack; IPv4/IPv6 routing; compatible with tactical IP gateways
STANAG 4285	HF/VHF Data Modem Waveform	Supported in VHF band via software waveform module (optional)
AEP-67	Software Defined Radio Architecture	TK-OS compliant with AEP-67 waveform API; third-party waveform loading supported

NOTE Interoperability certifications are verified at Telekom a.s. in-house test facilities and, where required, at designated NATO interoperability test authorities. Certification letters available upon request.

10 Abbreviations and Glossary

AES-256	Advanced Encryption Standard, 256-bit key length	POST	Power-On Self-Test
AFH	Adaptive Frequency Hopping	PTT	Push-To-Talk
CSPRNG	Cryptographically Secure Pseudo-Random Number Generator	RCH-82	Remote Control Head for the TK-82 vehicle-mounted variant
COMSEC	Communications Security	RF	Radio Frequency
DSP	Digital Signal Processor	SDR	Software-Defined Radio
FH	Frequency Hopping	SINAD	Signal-to-Interference-Noise-And-Distortion ratio
FIPS 140-2	Federal Information Processing Standard 140-2 — Security Requirements for Cryptographic Modules	SMA	SubMiniature version A (RF connector standard)
FSK	Frequency Shift Keying	STANAG	Standardization Agreement (NATO)
GMSK	Gaussian Minimum Shift Keying	TCXO	Temperature-Compensated Crystal Oscillator
HU-82	Head Unit for the TK-82 vehicle-mounted variant	TEK	Traffic Encryption Key
IP	Ingress Protection (per IEC 60529), also Internet Protocol depending on context	TNC	Threaded Neill-Concelman (RF connector standard)
MIMO	Multiple-Input Multiple-Output antenna configuration	TSK	Transmission Security Key
MIL-STD-810H	US Military Standard for Environmental Engineering Considerations and Laboratory Tests	UHF	Ultra High Frequency (300 MHz – 3 GHz)
NBFM	Narrow-Band Frequency Modulation	VSWR	Voltage Standing Wave Ratio
NSN	NATO Stock Number	VHF	Very High Frequency (30 MHz – 300 MHz)
OEM	Original Equipment Manufacturer	ZZ / Zeroization	The irreversible process of erasing all cryptographic key material from a device
OTA-SYNC	Over-The-Air Synchronization		

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