TR-910

Multipurpose VHF Airband Radio

Operator, Installation and Technical Manual

JOTRON

Performance for Life

Safety Instructions
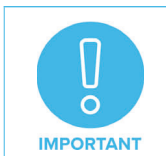
! IMPORTANT	**ELECTROSTATIC SENSITIVE DEVICE:** This equipment contains CMOS integrated circuits. Observe handling precautions to avoid static discharges which may damage these devices.

! CAUTION	**HEARING IMPAIRMENT HAZARD:** Avoid listening at high volume levels for long periods.

WARNING	**ELECTRICAL SHOCK HAZARD:** Do not open the equipment. Only qualified personnel should work inside the equipment.

Disclaimers

The information in this paper has been carefully checked and is believed to be accurate. However, Jotron AS assumes no responsibility for inaccuracies.

Jotron AS reserves the right to make changes without further notice to any products or modules described herein to improve reliability, function or design. Jotron AS does not assume any liability arising out of the application or use of the described product.

FCC Compliance Statement

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

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

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

— Reorient or relocate the receiving antenna.
— Increase the separation between the equipment and receiver.
— Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
— Consult the dealer or an experienced radio/TV technician for help.

ISED Canada Compliance Statement

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

This radio transmitter [TR-910 IC: 2131A-TR910] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Le présent émetteur radio [TR-910 IC: 2131A-TR910] a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué pour tout type figurant sur la liste, sont strictement interdits pour l'exploitation de l'émetteur.

Table 4: Antenna List

List of Antenna types / Liste des types d'antenne				
Antenna type	Antenna	Part No	Maximum Antenna Gain dBd	Impedance
Whip	$1/4\lambda$ Antenna (Man Portable kit)	86875	0.0	50
Whip	$1/4\lambda$ Antenna with cable (Vehicle kit)	97976	0.0	50
Whip	Generic	-	0.0	50
Dipole	Generic	-	0.0	50

Radio Frequency Radiation Exposure

NOTICE: This radio is intended for use in occupational/controlled conditions, where users have full knowledge of their exposure and can exercise control over their exposure to meet FCC/ISED limits. This radio device is NOT authorized for general population, consumer, or any other use.

The device antenna radiates RF energy only during transmit mode, and not during receive or idle mode. Do not transmit when any person(s) are within the specified separation distance as specified below from the antenna.

Man Portable (MP) and Vehicle (VE) Version:
This device complies with the FCC/ISED RF exposure limits with up to 50% talk - 50% listen duty factor and the separation distance as specified below.

To comply with FCC/ISED RF exposure limits for occupational/controlled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 40 cm from any persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

All Other Versions:
All other device versions comply with the FCC/ISED RF exposure limits with up to 100% talk - 0% listen duty factor and the separation distance as specified below.

To comply with FCC/ISED RF exposure limits for occupational/controlled exposure, the antenna(s) used for this transmitter must be installed on outdoor permanent structures to provide a separation distance of at least 140 cm from any persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Man Portable (MP) Version Operating Instructions
To ensure compliance with the RF exposure requirements the device must be placed to allow a minimum separation distance of 40 cm between the antenna and all persons during transmit mode operation as shown in figure 1.

Vehicle (VE) Version Antenna Installation
The vehicle antenna used for this transmitter must be installed external to a metal body vehicle and provide a separation distance of 40 cm from passenger and bystanders.
For optimum performance and compliance with RF exposure limits, mount the antenna in the center area of the roof as shown in figure 2.
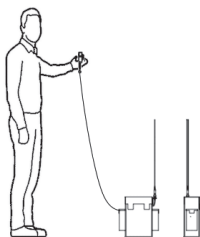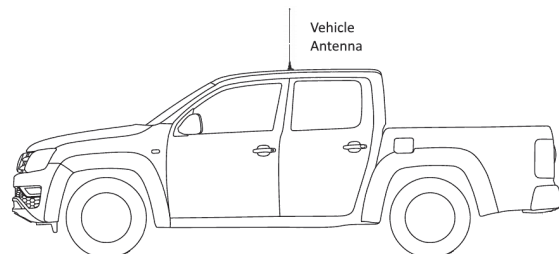
Figure 1: Operation of Man Portable

Figure 2: Installation of vehicle antenna

Exposition aux fréquences radio

AVIS: Cette radio est destinée à être utilisée dans un environnement professionnel et maitrisé, où les utilisateurs ont conscience de leur exposition et peuvent y exercer un contrôle pour répondre aux limites de la FCC/ISED. Ce dispositif radio n'est PAS autorisé pour le grand public ou toute autre utilisation par des consommateurs particuliers.

L'antenne émet de l'énergie RF seulement en phase de transmission, pas en mode de réception ou en mode inactif. Ne pas transmettre si quelqu'un se trouve dans les limites de distance indiquées en dessous de l'antenne.

Version Man Portable (MP) et Version Vehicle (VE):
Cet appareil est conforme aux limites d'exposition RF FCC/ISED avec un taux de service allant jusqu'à 50% parole - 50% écoute et la distance d'éloignement comme indiquée en dessous.

Pour être conformes aux limites professionnelles d'exposition RF FCC/ISED, les antennes utilisées pour ce transmetteur doivent être installées avec une distance d'éloignement d'au moins 40 cm pour toute personne et ne doivent pas être mises en fonctionnement assemblées avec d'autres antennes ou transmetteurs.

Autres Versions:
Toute autre version de cet appareil est conforme aux limites d'exposition RF FCC/ISED avec un taux de service allant jusqu'à 100% parole - 0% écoute et la distance d'éloignement comme indiquée en dessous.

Pour être conformes aux limites professionnelles d'exposition RF FCC/ISED, les antennes utilisées pour ce transmetteur doivent être installées en extérieur afin de respecter une distance d'éloignement d'au moins 140 cm pour toute personne et ne doivent pas être mises en fonctionnement assemblées avec d'autres antennes ou transmetteurs.

Mode d'Emploi de la Version Man Portable (MP)
Pour être conforme aux conditions d'exposition RF, cet appareil doit être placé en respectant une distance d'éloignement de 40 cm entre l'antenne et toute personne en mode de transmission comme illustré sur la figure 1.

Installation de l'Antenne en Version Vehicle (VE)
L'antenne de véhicule utilisée pour ce transmetteur doit être installée de manière externe au corps métal du véhicule et donner une distance d'éloignement de 40 cm aux passagers. Pour une performance optimale et une conformité aux limites d'exposition RF, monter l'antenne au milieu du toit comme illustré sur la figure 2.

Document Revision Log

AB	17.11.2021	Revised FCC/ISED statements	GAJ
AA	15.10.2021	Initial Issue	BA / GAJ
Rev.	**Issue Date (DD.MM.YY)**	**Reason for Issue**	**Author**

List of abbreviations and definitions

100Base-T	100Mbit/s physical Ethernet adapter to interface to twisted pair (copper wire) LAN. RJ45 connector is used and range is 100m.
A3E	Amplitude Modulation (double sideband with carrier)
AC	Alternating Current
AD	Analogue-to-Digital Converter
AF	Audio Frequency
AGC	Automatic Gain Control
AM	Amplitude Modulation
ATC	Air Traffic Control
BITE	Built-In Test Equipment
C/N	Carrier-to-Noise Ratio
DA	Digital-to-Analogue converter
dB	decibel
DSP	Digital Signal Processor
EMC	Electromagnetic Compatibility
EN	European Norm
ETSI	European Telecommunication Standardization Institute
Ethernet	Computer network, physical connection. (IEEE 802.3)
FW	Firmware, The control program stored in non-volatile memory of the embedded radio system
GP I/O/IO	General Purpose Input/Output/Input-Output
HW	Hardware
ICAO	International Civil Aviation Organization
IEC	International Electro-technical Commission.
IMO	International Maritime Organization
IF	Intermediate Frequency
IP	Internet Protocol
LAN	Local Area Network
LO	Local Oscillator
LOS	Line of Sight
LRM	Lowest Replaceable Module
LRU	Lowest Replaceable Unit
MIB	Management Information Base is a virtual database used for managing the objects (parameters) in a communications network. Most often associated with the Simple Network Management Protocol (SNMP). The MIB database is hierarchical (tree-structured). The software that performs the navigation in the MIB database is a MIB browser. The MIB database is Jotron proprietary and contains descriptions and definitions for all parameters in the radio. The MIB database is updated each time a new radio parameter is added or changed.
MHz	Mega Hertz
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
PA	Power Amplifier
PCB	Printed Circuit Board

ppm	Parts Per Million
PTT	Push-to-Talk
RCMS	Remote Control and Management System, usually an IP-based network to monitor and control radios and accessories (=RACS).
RF	Radio Frequency
RSSI	Received Signal Strength Indicator is a measurement of the power present or level of a received radio signal.
Rx	Receiver, Reception
RTP	Real-time Transport Protocol. Used for Voice Over IP (VoIP).
SDR	Software-Defined Radio is a system where components that traditionally have been implemented in hardware (e.g. mixers, filters, amplifiers, modulators/demodulators, detectors, etc.) now are implemented by means of software on an embedded computing devices, i.e. a Digital Signal Processor (DSP).
SIP	Session Initiation Protocol is an IETF-defined signaling protocol, widely used for controlling multimedia communication sessions such as voice and video calls over the Internet Protocol (IP). The protocol can be used for creating, modifying and terminating two-party (unicast) or multiparty (multicast) communication sessions consisting of one or several media streams.
S/N	Signal-to-Noise Ratio
SNMP	Simple Network Management Protocol is a UDP-based network protocol. It is used mostly in network management systems to monitor and control network connected devices like the Jotron radios. SNMP is a component of the Internet Protocol Suite as defined by the Internet Engineering Task Force (IETF). It consists of a set of standards for network management, including an application layer protocol, a database schema, and a set of data objects.
SQ	Squelch
SW	Software
TCP	Transmission Control Protocol
TCXO	Temperature Compensated Crystal Oscillator.
TRx	Transceiver
Tx	Transmitter, transmission
UDP	User Datagram Protocol
VCO	Voltage-controlled Oscillator
VHF	Very High Frequency (VHF is defined by the band 30-300 MHz). In the content of this book, it refers to the international communication band for air traffic control (118-137 MHz)
VOGAD	Voice Operated Gain-Adjusting Device is a type of automatic gain control for microphone/TX line amplification. It is used in radio transmitters to ensure correct modulation and to prevent clipping caused by overmodulation.
VoIP	Voice over IP (VoIP) is a general term for a family of transmission technologies for delivery of voice communications over IP networks such as the intranet/Internet or other packet-switched networks.
VSWR	Voltage Standing Wave Ratio

Contents

1 Introduction

1.1 Design

The TR-910 is a compact, high-quality radio available in a variety of configurations to meet the high demands of the ATC and Oil and Gas industries where a small, rugged and durable radio unit is needed. The radio has an all metal housing, making it very robust but still light enough to be carried as a manpack. It is a fully solid-state design based on a Software-Defined Radio (SDR) concept, making it very versatile, future proof and firmware upgradeable. It also includes a LAN interface for remote configuration and digital recording and is fully compliant to ED-137 with the VoIP option enabled.

TR-910 meets or outperforms all radio requirements specified in ETSI EN300676 and EN301489 (EMC). It supports both 25kHz and 8.33kHz channels in accordance with ICAO recommendations.

1.2 Applications

Listed below are some of the possible applications of the TR-910 radio:

- Installed as a desktop unit, with microphone and/or headphone connected to the front connector. An external loudspeaker can be connected to the transceiver unit if required.

- Man Portable version, enclosed in a shoulder/carrying bag, with battery pack, antenna and microphone (or headset) connected. An external battery charger can be connected for charging the battery pack as and when required.

- Internally mounted in a vehicle, with microphone connected to the front module connector. An external loudspeaker can be connected to the transceiver unit if required.

- Flush mounted on a horizontal or vertical plate, with microphone and/or headphone connected to the front connector. An external loudspeaker can be connected to the transceiver unit if required.

- Remote configuration and monitoring through the LAN interface via the Jotron Remote Control and Monitoring System (RCMS).

- With VoIP option is enabled, the TR-910 also fully supports ED-137 and facilitates up to two remote sessions and two recording streams. It is possible to expand this function by the inclusion of "Enhanced VoIP". This will increase the number of sessions to 4 and recording streams to 3.

1.3 Models covered by this manual

Table 7: Radio models covered by this manual

The following models /versions are covered by this manual				
Model	P/N	Output	Frequency	Mode
TR-910 Desktop Radio (DE)	103400DE	10 Watt	118-137 MHz	AM
TR-910 Man Portable Radio (MP)	103400MP	5 Watt	118-137 MHz	AM
TR-910 Vehicle Radio (VE)	103400VE	10 Watt	118-137 MHz	AM
TR-910 Last Resort Radio (LR)	103400LR	10 Watt	118-137 MHz	AM
TR-910 Subrack Radio (SR)	103400SR	10 Watt	118-137 MHz	AM
TR-910 Last Resort Subrack Radio (LR-SR)	103400LR-SR	10 Watt	118-137 MHz	AM

TR-910 Offshore Radio (OF)	103400OF	10 Watt	118-137 MHz	AM
TR-910 Multipurpose VHF Airband Radio (no accessories)	103400	10 Watt	118-137 MHz	AM

Table 8: Accessory list

Accessory list								
Supplied accessory X = Standard, O = Optional	Part No	TR-910 DE	TR-910 MP	TR-910 VE	TR-910 LR	TR-910 SR	TR-910 LR-SR	TR-910 OF
Hand Speaker Mic	103116	X	X	X	X	X	X	X
Console bracket	84084	X		X	X			X
Lock screws	84086	X (4x)	X (8x)	X (4x)				X (4x)
Mains cable w/plugs	92375	X	X		X	X	X	X
Power supply w/connector	84330	X			X			X
Antenna adapter BNC-N	80577	X			X			X
BU-872 Battery Unit	87130		X		X		X	
Fasten bracket	85779		X		X (2x)			
Patch Cable CAT6 S/FTP 0,15m Blue	101669		X		X			
Screw M4x8 T20	102281				X (8x)	X	X	
Serrated Lock Washer	102341		X (8x)		X (8x)	X	X	X (4x)
Antenna	86875		X					
Antenna bracket	85778		X					
Antenna cable w/connector	85781		X					
DC power cable	86026		X					
Power AC/DC with car lighter plug	86918		X					
Insert Carrying Bag	103617		X					
Shoulder/Carrying Bag	85636		X					
Cable Tie	92161		X (4x)					
Antenna with cable (Vehicle kit)	97976			X				
Antenna adapter FME - BNC	84605			X				
DC cable	84329			X				
External Speaker	85558			X				
Fuse Kit	103079			X				
Cable RG174 with BNC-male and N-female	83233				X			
Spacer M4x2mm	86652				X			
Support knob	97975				X			
RG-214 N-male Connector	86273					X	X	

Table 8: Accessory list

Accessory list								
Supplied accessory X = Standard, O = Optional	Part No	TR-910 DE	TR-910 MP	TR-910 VE	TR-910 LR	TR-910 SR	TR-910 LR-SR	TR-910 OF
XLR Connector, Female 3-pol	87315					X	X	
TR-910 2U/19" Subrack for SR						X		
TR-910 2U/19" Subrack for LR-SR							X	
Panel Mounting Plate	103477							X
Panel Mounting Bracket	103478							X (2x)
Screw M4x10 T20	102282							X (4x)
Screw M4x12 T20	88366							X (4x)
Antenna lightning protector	80322	O			O			O
Base antenna	91794	O						
Coax cable RG-213 - 30m	97898	O						
Discharge unit	86991		O		O		O	
N-connector for RG-213	98244	O						

1.4   Options

The transceiver may have the following additional functions if required. These options must be specified separately when ordering.

Table 9: Available radio options

Optional functions	Description	Part number
VoIP	Enables VoIP with 2 sessions and 4 recording streams	102253
Enhanced VoIP	Increase number of sessions to 4. Allows the use of 5ms packets for VoIP to reduce delay in a VoIP system. Requires VoIP option	102777
Extended frequency range	Extended operating frequency to 144.000 MHz	84360
G.729	Adds the possibility to use G.729 codecs for the audio streams in addition to G.711 to reduce bandwidth. Requires VoIP option	81432

2   Technical Specifications

2.1   General specifications

Table 10: General specifications

Parameter	Specifications	
	AM 25 kHz	**AM 8.33 kHz**
Frequency range	118.000 to 137.000 MHz (up to 144.000 MHz is optional)	
Frequency stability	$< \pm$ 1.0 ppm @ -20 °C to +55 °C, $< \pm$ 0.3 ppm @ 0 °C to +40 °C (ambient temperature)	
RF Modes	6K80A3EJN	5K00A3EJN
Audio Frequency Response	300 - 3400 Hz	300 - 2500 Hz
Data ports	100Base-TX (Ethernet/LAN), USB 2.0 (for service / setup only)	
Ethernet ports	1 x 100 Mbit network	
Protocols	UDP/IP: SNMP (v.1, 2 and 3), RTP, SIP, NTP, TFTP, DHCP, RTSP TCP/IP: Remote control (Jotron), RTP, SIP, HTTP, RTSP Serial: USB 2.0	
BITE monitoring	All relevant parameters for transceiver. Ref. BITE below.	
Pre-set channels	100	
RF impedance	50 Ω, BNC-connector	
Temperature range	-20 °C to +55 °C (operating), -40 °C to +70 °C (storage)	
Humidity	95 % @ +40 °C (non-condensing)	
Operating voltage	12 - 24 VDC, negative ground +30/-10 %	
Power consumption	At 10 W, 80 % modulation: < 60 W At idle: < 5.0 W @ 12 V, < 5.6 W @ 28 V At standby: < 1.3 mW @ 12 V, < 7.2 mW @ 28 V	
Heat dissipation	< 5 W @ Idle, < 50 W @ 10 W output power	
MTBF (MIL-HDBK-217F)	Ground Benign (GB): > 20 years / unit Ground Mobile (GM): > 10 years / unit	
MTTR	< 30 minutes at lowest replaceable unit	
Dimension	169 mm (W) * 244 mm (D) * 55 mm (H)	
Weight	1.95 kg	
Start-up time	< 10 s from power on until transceiver is available for use on all audio and control interfaces, including the IP interface.	

2.2   Transmitter specifications

Table 11: Transmitter specifications

Parameter	Specifications	
	AM 25 kHz	**AM 8.33 kHz**
Power output	10 W, Adjustable in 0.1 dB step down to 1 W (30.0 up to 40.0 dBm). Automatically reduced if high VSWR is detected.	
VSWR	1 : Infinity. Protected against shorted and open circuit	
Adjacent channel power	> 70 dBc	
Modulation depth	up to 95 %	
Distortion	< 2 % @ 85 % modulation	
In-band spurious emissions	$\leq$ -100 dBc (-60 dBm @ 10 W output)	
Harmonic emission	$\leq$ -80 dBc (-40 dBm @ 10 W output)	
Intermodulation attenuation	Typically $\leq$ -50 dBc, 3. Order intermodulation (EN300676,7.8)	
Power attack and release time	< 3 ms attack, < 2 ms release time	
Keying Time	< 10 ms	
Mic input	Support dynamic and electret types with adjustable sensitivity. Mic Bias is selectable	
Line input	600 Ω, -40 to +10 dBm, adjustable sensitivity, single ended	
AGC (VOGAD) range	> 30 dB	
Keying options	Mic/Headset connector, I/O connector (configurable input), SNMP, TCP/IP, RTP header	
Signal/Noise (Hum and noise)	> 40 dB	
Timeout	5 s to 5 min (300 s) in 5 s. steps (1 s from SNMP)	
Duty cycle	30 % Tx/Rx operation @ ambient below 40 °C	

2.3   Receiver specifications

Table 12: Receiver specifications

Parameter	Specifications	
	AM 25 kHz	**AM 8.33 kHz**
Sensitivity, AM@1µV/30% pd	> 12 dB SINAD (CCITT)	
Harmonic distortion	< 2 % @ 90 % AM (line output), Typically < 1 %	
Signal/Noise	> 55 dB @ +10 dBm input, 90 % modulation	
Effective bandwidth	$\pm$ 10 kHz	$\pm$ 3.5 kHz
Adjacent channel rejection (Adjacent channel selectivity) Typical figures	> 80 dB	> 70 dB
In-band spurious rejection	> 90 dB	
Intermodulation attenuation	$\geq$ 85 dB	
Image frequency rejection	> 110 dB	
IF frequency rejection	> 110 dB	
Blocking/desensitization	$\geq$ 100 dB @ 1 MHz offset, > 110 dB out-of-band signals	
Squelch system	Combination of RF level and Carrier/Noise (digital coherent squelch)	
Squelch RF level	-5 to +42 dBµV (-112 to -65 dBm)	
Squelch Signal/Noise	5 to 20 dB S/N @ 30 % modulation	
Squelch hysteresis	Typical 2 - 4 dB	
Squelch mute level	$\geq$ 70 dB	
Cross modulation rejection	> 100 dB @ 1 MHz frequency offset	
Dynamic range	> 125 dB (-110 to +15 dBm input signal)	
Audio AGC (AAGC)	30 % to 90 %, < 0.1 dB variation in output audio signal	
AGC range	-107 to +15 dBm	
AGC attack time	< 40 ms	
AGC decay time	< 50 ms	
Internal speaker amplifier	5 W @ 8 Ω	
Headset	8 to 32 Ω, > 100 mW	
External speaker amplifier	5 W @ 8 Ω	
Monitor output	600 Ω, -46 to 0 dBm @ 90 % modulation, single ended	
Permissible RF input level	5 V EMF	

2.4   Applicable standards

Table 13: Applicable standards

| Applicable standards	
Radio performance	ETSI EN 300 676-1 V1.5.2
	ICAO annex 10
Voice over IP	EUROCAE ED-137 (B, C) part 1,4 and 5
EMC	ETSI EN 301 489-1 V2.2.3
	ETSI EN 301 489-22 V2.1.1
	IEC/EN 60945 Ed.4 + Cor1:2008 (Protected)
FCC/ISED	FCC rule 15B and 87, ICES-003 and RSS-141
Shock & Vibration	ETSI EN 300 019-2-2 V2.4.1: Transportation
	ETSI EN 300 019-2-5 V3.1.1: Ground Vehicle Installations
	ETSI EN 300 019-2-7 V3.0.1: Portable and non-stationary use
Safety	IEC 62368-1:2014 + A11:2017
RoHS	EN 50581

3   Functional Description

3.1   Front panel controls and connector
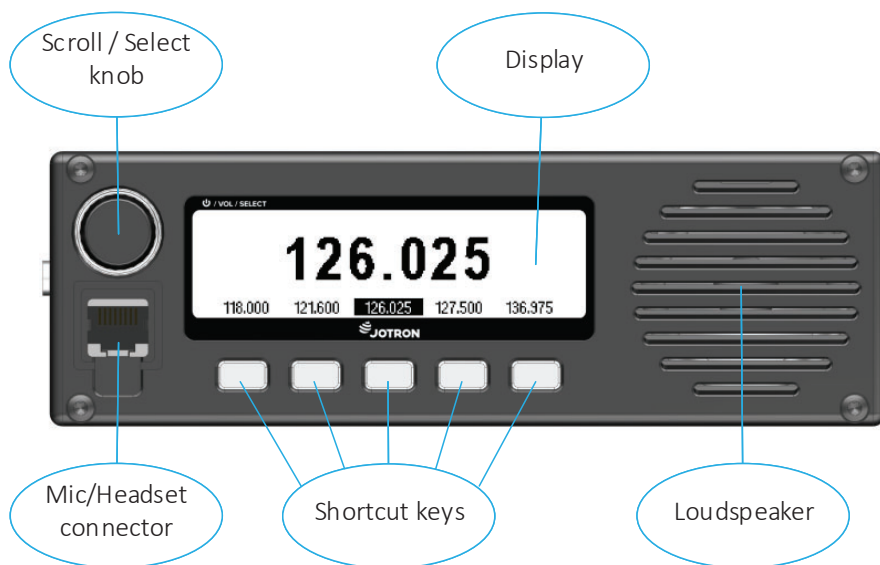
Figure 3: Front view of TR-910

3.1.1   Display

The display shows the most important operational parameters such as selected channel/frequency, modulation and indicator icons. In addition, the display will show various menus and submenus which can be navigated using the scroll/select knob and shortcut keys on the front panel.

The indicator icons appear at the left and right side of the display during operation. Some icons share position in the display and are with descending priority listed in the table below.

Table 14: Indicator icons

Icon	Description
Left side area:	
Tx	Indicates that the transceiver is keyed, and the radio is transmitting.
SWR	Indicates that the SWR on the antenna is above the threshold value (app. 3:1). The transmitter will reduce the output power to the predefined low power level in order to protect the output stage.

LP	Indicates that the radio transmitter is operating in low power mode (1 W / 30 dBm). The reason for switching to low power will be due to one of the following: • The BITE system, as a safety feature, has switched the radio to the low power setting due to a failure normally caused by high SWR, high temperature, or a low DC input voltage. • A signal to the radio, using the GPIO pin, is forcing the radio to the low power setting (e.g. a gas alarm). • The radio has been configured (forced) to low power, either by using the local menu or a via a remote control system.
	Indicates the received signal strength level RSSI (dBµV):
(bars)	> 34
(bars)	23 to 34
(bars)	12 to 23
(bars)	1 to 12
(bars)	-10 to 1
No icon	< -10
SQ	Indicates that the Squelch is open and/or a signal is received.
VoIP	Indicates that one or more VoIP sessions are active over the IP interface.
	Right side area:
⚠	Indicates an Alarm condition. The BITE system in the radio has discovered an internal value outside the normal operating range. See Failures and Corrective Actions chapter for details on BITE system alarms.
SB	Indicates that the transceiver is kept in standby, either by user input or because an alarm condition has been detected, and the transceiver is set up as a MAIN transceiver. In standby the transceiver will be disabled (not able to transmit nor receive). This condition normally requires that there is another (spare) transceiver that can take over the functionality of the transceiver.
🔋	Indicates the battery status if used with BU-872. See TR-910 Battery indicator chapter for details on battery icons.

3.1.2   Scroll/Select knob

The Scroll/Select knob is used for multiple purposes on the radio and has the following actions listed below: It can be rotated, or momentarily pressed.
In general, the use of the Scroll/Select knob is:

• Power - Press and hold to turn the device on or off.

- Volume control

- Menu navigation

- Value and parameter setting

3.1.3 Shortcut keys

In the home screen, the shortcut key functions are shortcuts to pre-stored frequencies. Otherwise, the function of the shortcut keys will change depending on active submenu. The display will indicate the function of each shortcut key, using text or icons.

3.1.4 Mic/Headset connector (RJ45)

The Mic/Headset connector is a RJ45 type connector and is used for connecting a Speaker Mic with PTT switch, or a headset with earpieces, microphone and PTT switch. TR-910 supports both dynamic and electret microphones and this is configurable through the **advanced settings/configuration/audio** menu.

Table 15: Mic/Headset connector, pin out

Mic/Headset connector		
Name	**Pin**	**Function**
Mic input	1	Microphone input. Support dynamic and electret types with adjustable sensitivity. Mic Bias is selectable (8 V via 2k2).
Mic GND	2	Microphone ground
Headset	3	Headset output, contains side-tone and received audio.
USB (+)	4	USB Data +
USB (-)	5	USB Data -
PTT	6	PTT input. Grounding this pin will key the transmitter
+5 VDC	7	+5 V supply for USB devices. Max 100 mA.
GND	8	Common ground

The connector also has an USB interface. This interface can be used for configuration of the radio through the Jotron MDT program. To use this interface a specific cable is required with the following connections to a standard Type A USB connector:

Table 16: USB pin out

USB cable	
Mic/Headset connector (RJ45)	**USB type A connector**
Pin 4 - USB Data +	Pin 3 D+
Pin 5 - USB Data -	Pin 2 D-
Pin 8 - GND	Pin 4 GND

3.2   Rear connections

Figure 4: Rear view of TR-910

3.2.1   Antenna connector (50 Ω BNC)

The antenna connector is of BNC type and shall be connected to an antenna with 50 Ω impedance suited for use in the operating frequency band, either connected directly or via a lightning arrestor. The arrestor is to protect the transceiver from lightning strikes. If other types of connectors are required adapters are readily available for N and TNC type connections.

3.2.2   DC input connector

The DC connector is of a rugged FF 250 quick connect type for easy connection in vehicles.
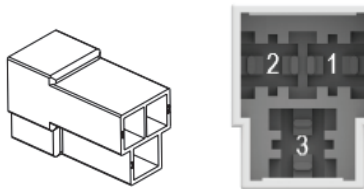

Figure 5: DC-connector

The Red wire is the positive connection and the Black wire is the negative connection (GND). When installed in a vehicle, the Green/Yellow wire is for connection to the ignition key voltage. When connected to the vehicle ignition, the radio will automatically turn on/off with the ignition key. For other types of installations this wire should be connected to the positive supply. The radio operates from a DC supply of +12 V to +28 V +/-10%.

Table 17: DC connector, pin out

DC input connector		
Name	Pin	Function
Red	1	Connected to + DC voltage
Black	2	Connected to ground
Green/Yellow	3	Ignition key + DC voltage sense

3.2.3   LAN connector (RJ45)

The LAN connector is of standard RJ45 type and can be connected to a switch, router or directly to a computer, using a standard Ethernet cable. The pin-out of the LAN connector are the standard pin-out used in most ethernet networks. This interface can be used for remote monitoring with the Jotron RCMS system. The LAN interface can also be used for recording and remote operation with the VoIP option enabled.

Table 18: LAN interface connector, pin out

LAN interface connector		
Name	Pin	Function
LAN_TXP	1	Tx data
LAN_TXN	2	Tx data
LAN_RXP	3	Rx data
LAN_D3P	4	NC
LAN_D3N	5	NC
LAN_RXN	6	Rx data
LAN_D4P	7	NC
LAN_D4N	8	NC

3.2.4   I/O connector (RJ45)

The I/O connector is a RJ45 type and contains different signals for connecting to external equipment. It can be used to connect an external speaker, and there are also 600 Ω audio input/output, available for connecting for example analog recording systems. It has also two configurable inputs/outputs which can be use as status indicators or input signals such as "Low Power" (frequently used in offshore installations) or as an external key input. This connector is also used to connect the battery package (BU-872) for communication between the radio and the battery package.

All functions are described in the table below:

Table 19: I/O connector, pin out

I/O connector					Max V	Max mA
Name	Pin	Function	Dir	Level		
EX-SPEAKER+	1	To external speaker+	O	5 W @ 8 Ω		
EX-SPEAKER-	2	To external speaker-	O	5 W @ 8 Ω		
MONITOR	3	To tape recorder etc. 600 Ω unbalanced	O	-46 to 0 dBm		

Table 19: I/O connector, pin out

I/O connector						
Name	**Pin**	**Function**	**Dir**	**Level**	**Max V**	**Max mA**
TxKey / GPIO	4	This I/O has four modes: **Mode 1:** Low Power (Gas alarm input). Force TX into low power mode by grounding this input. **Mode 2:** Open = Squelch closed (not receiving) Closed = Squelch open (receiving / Rxbusy) **Mode 3:** TxKey. Key the transmitter by grounding this input (PTT). **Mode 4:** Open = ALARM Closed = NO ALARM	I/O	0 to +5 V / Open collector. Referenced to GND (Pin 8)	28	50
BATT.COM	5	Communication interface to BU-872	I/O	0 to +5 V	5	1
LINE	6	Line input, 600 Ω unbalanced	I	-40 to +10 dBm	$\pm$15	
Rxbusy / GPIO	7	This I/O has four modes: **Mode 1:** Low Power (Gas alarm input). Force TX into low power mode by grounding this input. **Mode 2:** Open = Squelch closed (not receiving) Closed = Squelch open (receiving / Rxbusy) **Mode 3:** TxKey. Key the transmitter by grounding this input (PTT). **Mode 4:** Open = ALARM Closed = NO ALARM	I/O	0 to +5 V / Open collector. Referenced to GND (Pin 8)	28	50
GND	8	Common ground	-			

4 Installation

4.1 Introduction

The procedures for installing the radio transceiver is described in table below. It is recommended that these procedures are completed in the order shown.

- Initial inspection

- Install equipment

- Connect connectors as required

- Connect antenna

- Connect DC supply

4.2 Initial inspection

Items included in the package:

- TR-910 transceiver unit

- Memory stick or CD with Operators Manual and MDT software

- Accessories according to model and installation. See accessory list under Models covered by this manual chapter.

On receipt of the radio unit, remove all packaging and check that there is no damage to the equipment. If damage is evident, contact Jotron AS immediately and retain the original transit packaging.

4.3 Compass safe distance

The compass safe distance for TR-910 is minimum 140 cm.

4.4 Installation of TR-910
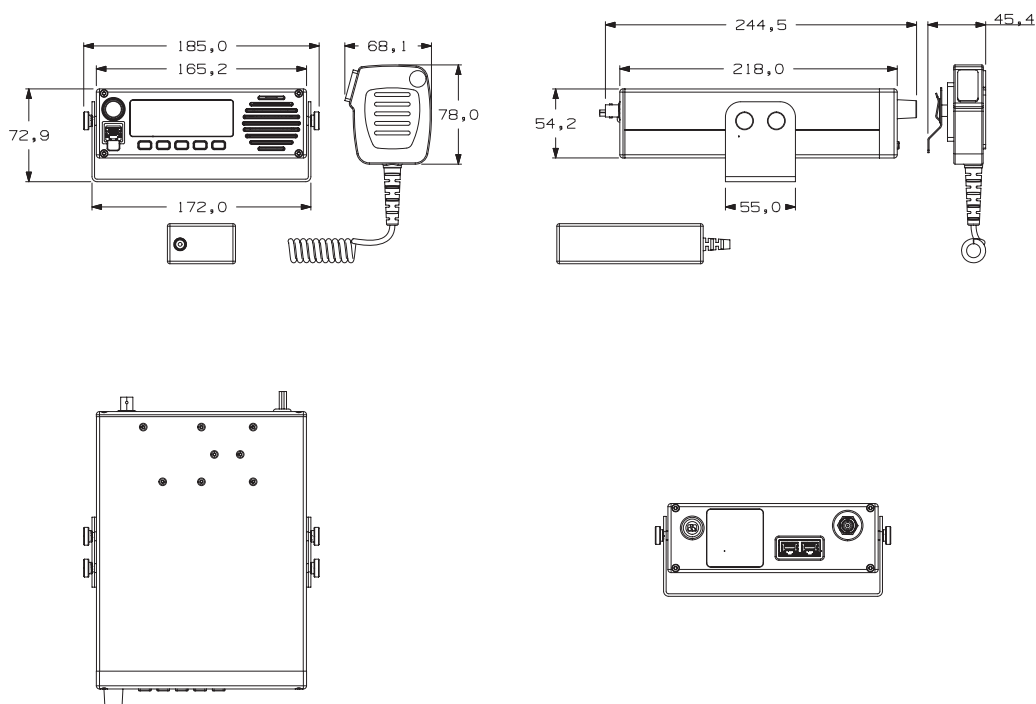
4.4.1 TR-910 Desktop Radio (DE)

TR-910 Desktop

Figure 6: TR-910 DE

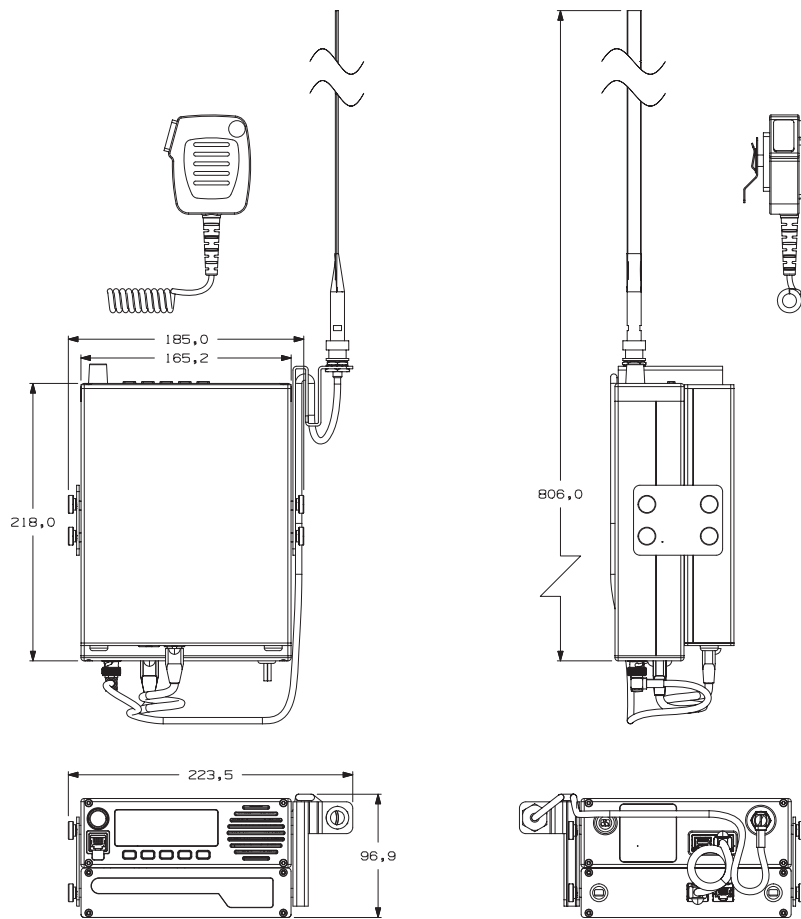### 4.4.2   TR-910 Man Portable Radio (MP)
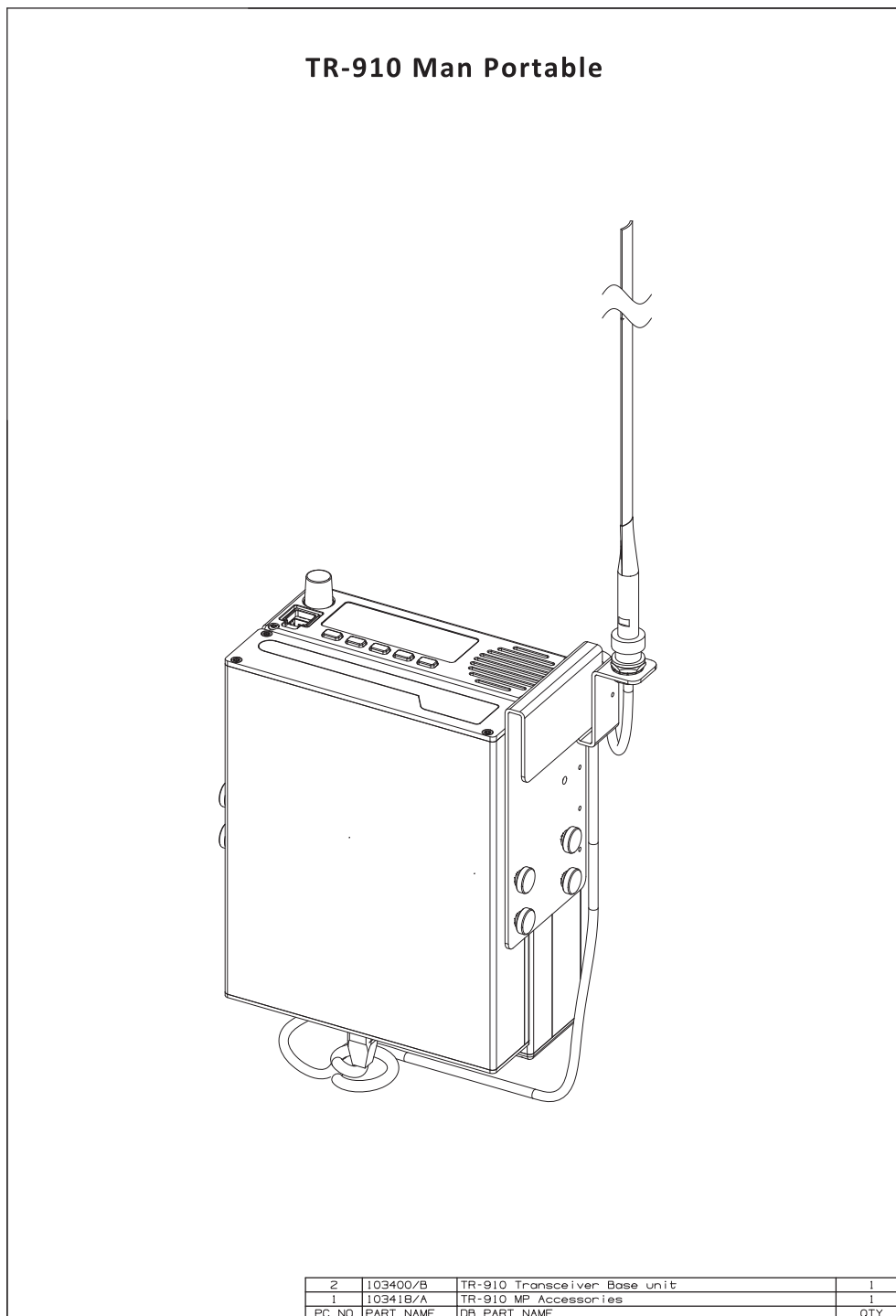
TR-910 Man Portable

Figure 7: TR-910 MP

TR-910 Man Portable

2	103400/B	TR-910 Transceiver Base unit	1
1	103418/A	TR-910 MP Accessories	1
PC NO	PART NAME	DB PART NAME	QTY

Figure 8: TR-910 MP

TR-910 Man Portable

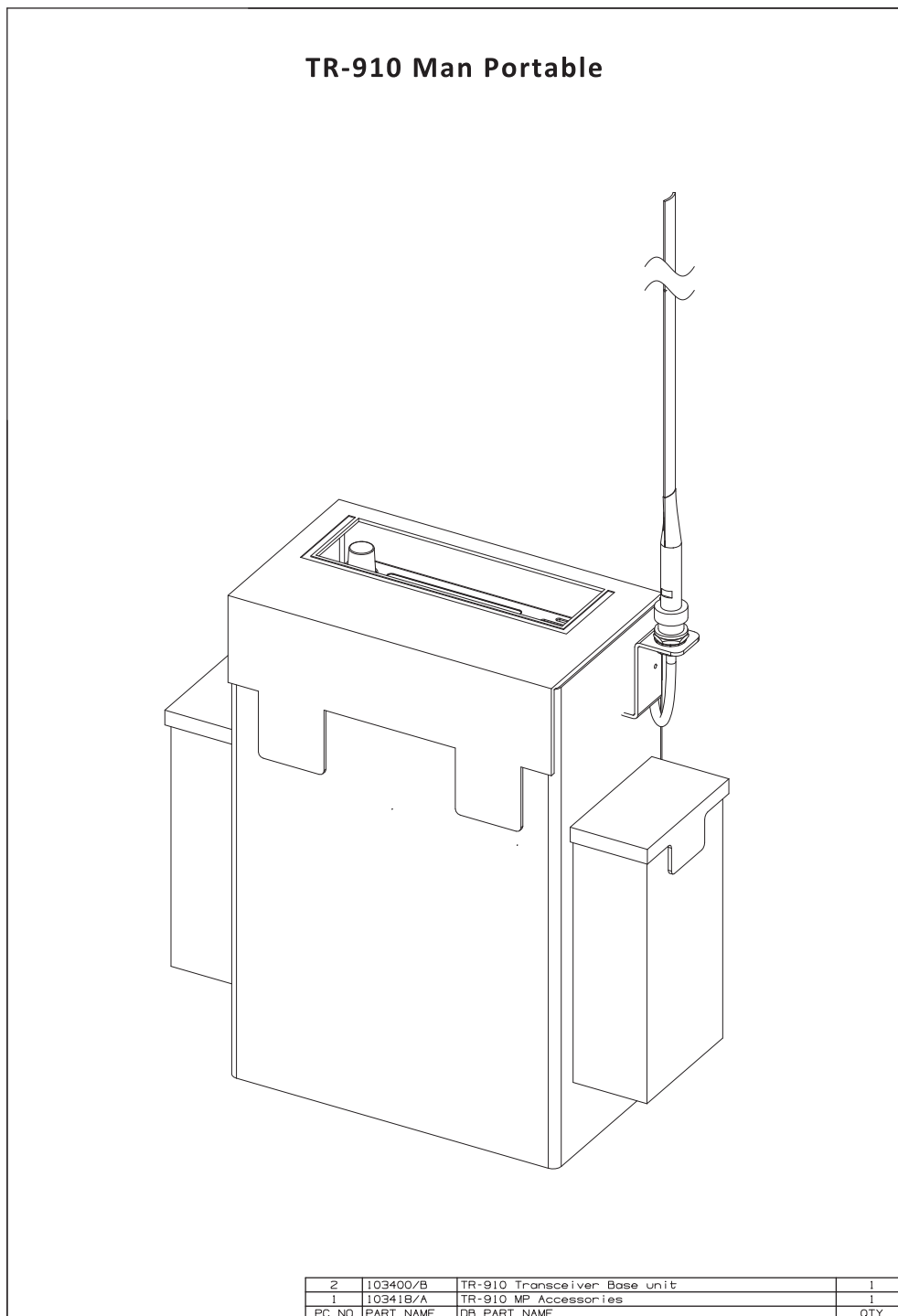| 2	103400/B	TR-910 Transceiver Base unit	1
1	103418/A	TR-910 MP Accessories	1
PC NO	PART NAME	DB PART NAME	QTY

Figure 9: TR-910 MP
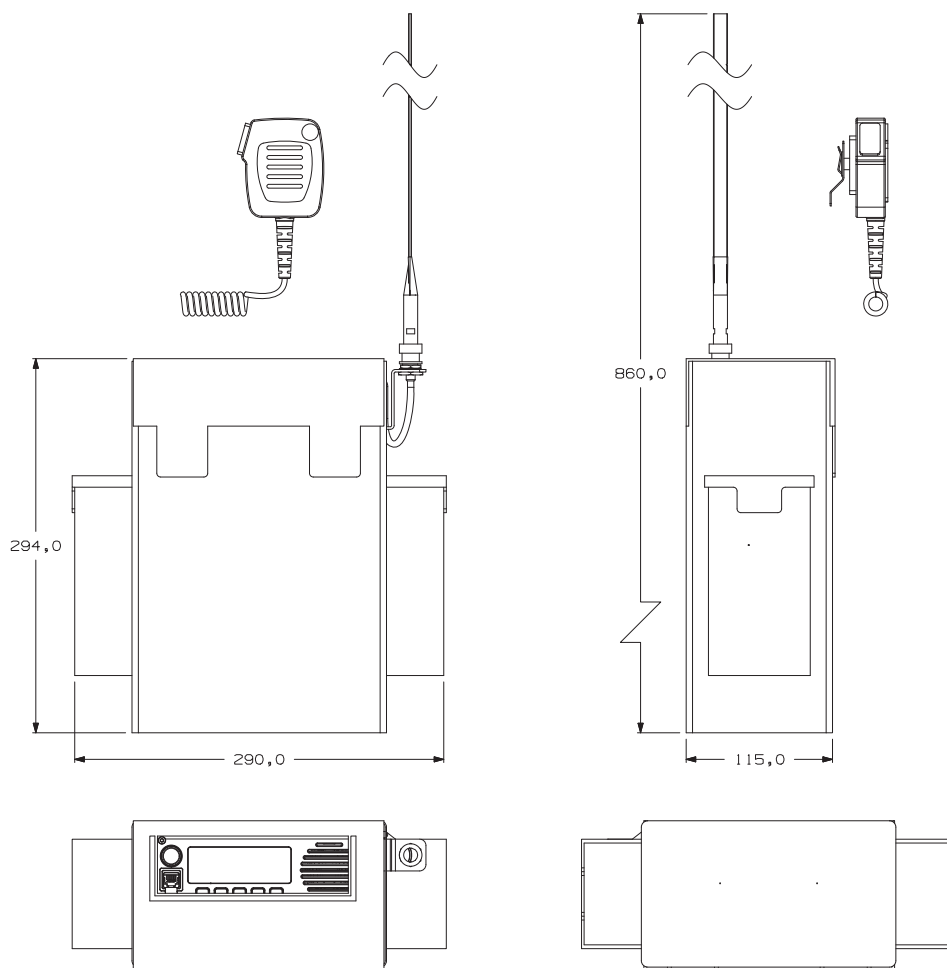
TR-910 Man Portable

Figure 10: TR-910 MP

4.4.3   TR-910 Vehicle Radio (VE)

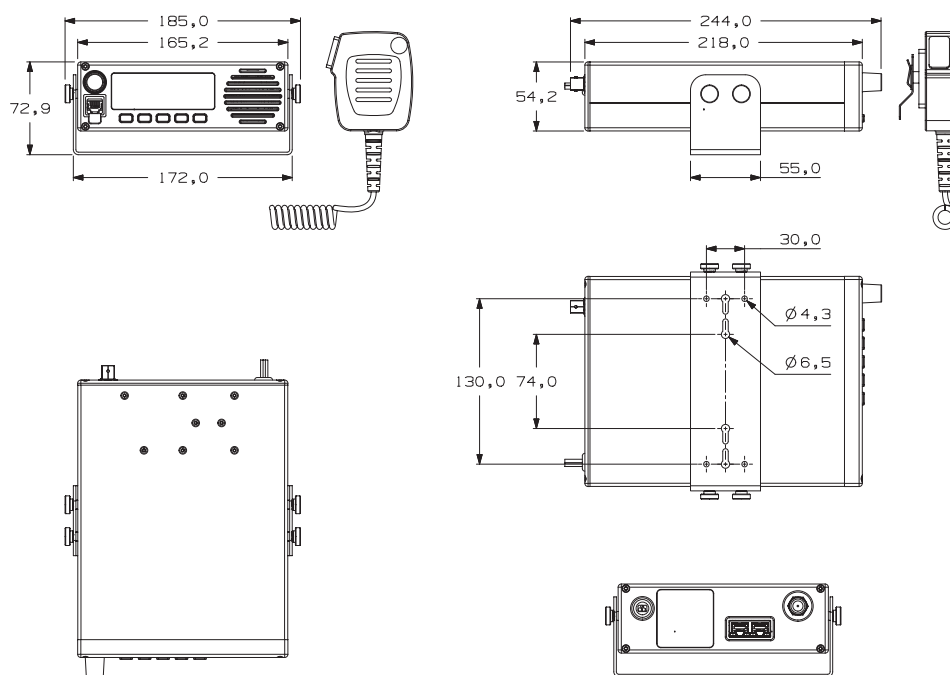## TR-910 Vehicle

Figure 11: TR-910 VE

4.4.4   TR-910 Last Resort Radio (LR)
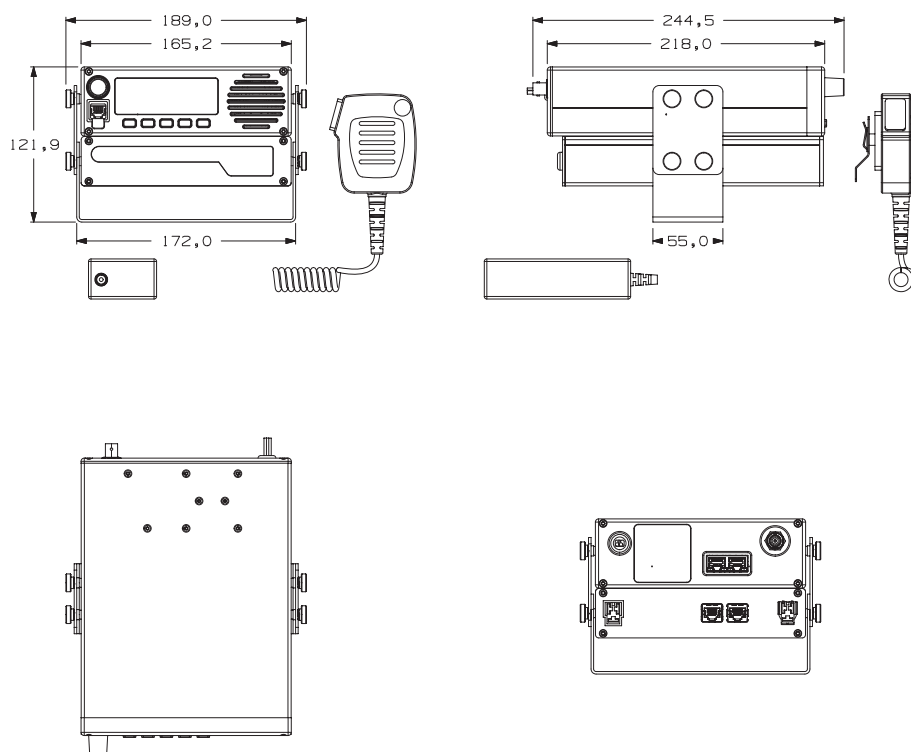
TR-910 Last Resort

Figure 12: TR-910 LR

4.4.5   TR-910 Subrack Radio (SR)
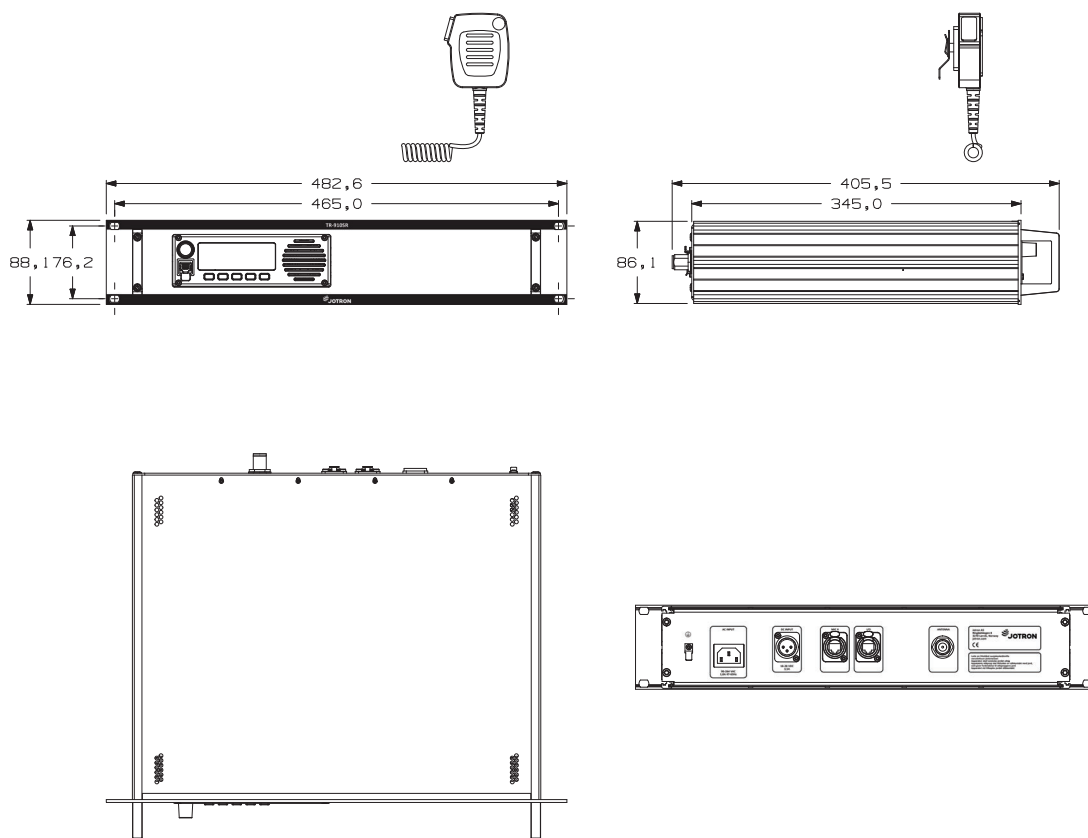
TR-910 Subrack

Figure 13: TR-910 SR

4.4.6 TR-910 Last Resort Subrack Radio (LR-SR)

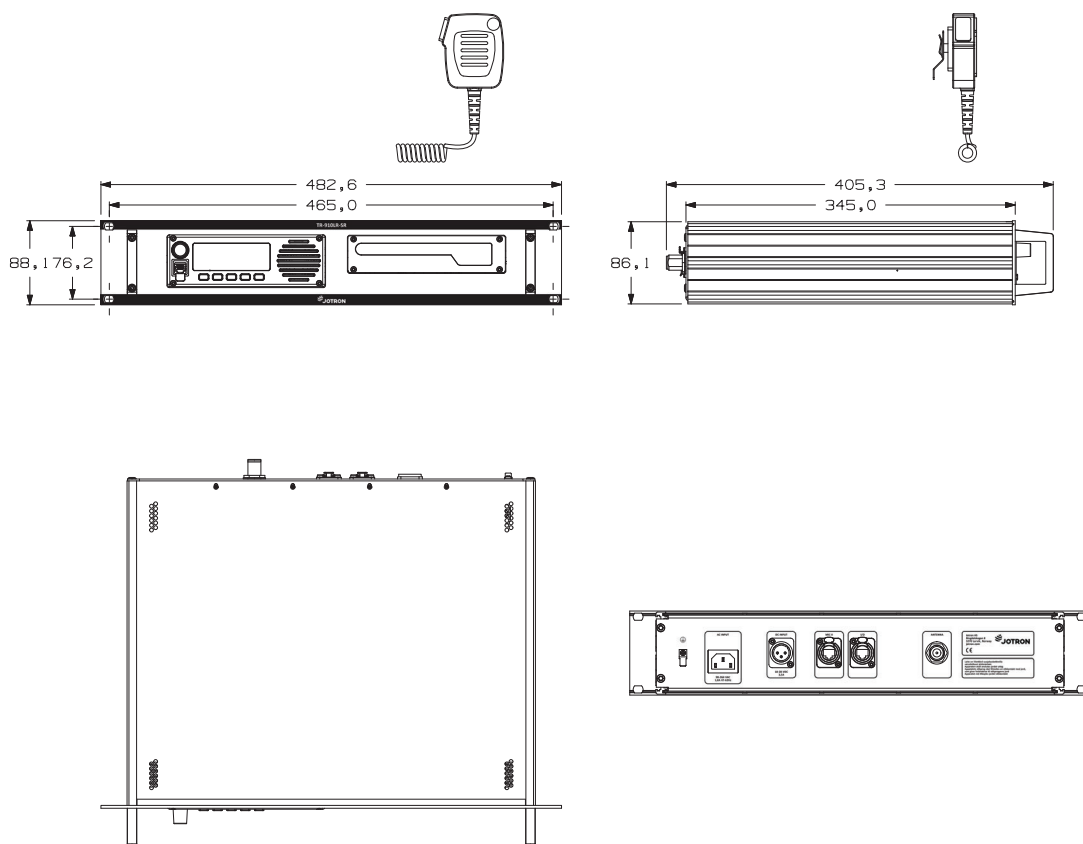## TR-910 Last Resort Subrack

Figure 14: TR-910 LR-SR

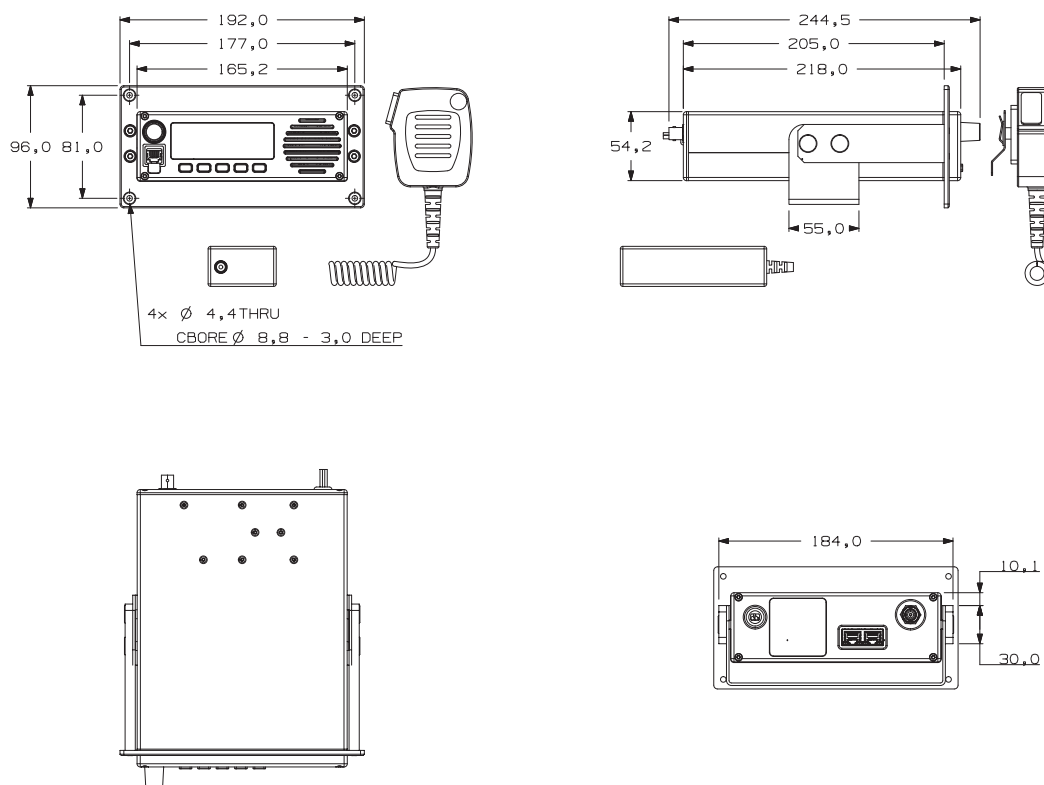**4.4.7   TR-910 Offshore Radio (OF)**

TR-910 Offshore

Figure 15: TR-910 OF

4.4.8   Antenna connection

The antenna should be of good quality with regards to gain and VSWR to obtain maximum performance. Make sure that the VSWR on the antenna is low, and that the cable from the transmitter to the antenna is of good quality to avoid mismatch and unnecessary losses. A cable loss of 1 dB is the same as reducing the power output of a 10 W transmitter to less than 8.5 W. Similarly, a cable loss of 2 dB is the same as reducing the output power to less than 7 W. In areas were thunderstorms and lightning are a problem, surge arrestors should be mounted between the antenna connector and the antenna cable. The arrestors should be good quality and be capable of handling the output power of the transmitter. The antenna input of the transceiver is the BNC-type antenna connector on the back of the transceiver unit.
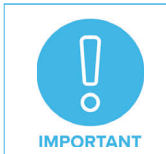
> **Electrical Safety Earthing:**
> In case of installation to external antenna, the antenna ground terminal must be permanently connected/verified with protective earthing conductor to the building earth by a skilled person.
>
> **IMPORTANT**

4.4.9   DC supply connection

If the unit is to be installed in a vehicle, the included fuse kit (103079) in the vehicle variant accessory kit shall be installed on the positive supply wire nearest the vehicle battery.

4.4.10   LAN connection

If the unit is to be connected to a local area network, this can be done by connecting a standard RJ45 patch cable from the LAN connector to the network switch or router. Using LAN enables remote monitoring by the Jotron RCMS system, remote VoIP recording and remote control with VoIP according to ED137.

4.4.11   I/O connection

Connect to the I/O connector preferably with the radio turned off.
The following remote signals are available on the rear I/O connector:

- External speaker (Pin 1 & 2) output line pair is for connecting an external speaker. This speaker output has a dedicated amplifier and the volume can be regulated independently from the internal speaker. **Note:** Ensure that the external speaker signals are not short circuit to ground or to each other.

- Monitor output (Pin 3) is an analog monitor output, 600 Ω single ended and referenced to ground, pin 8. This output can for instance be used for connecting an analog recorder. It will contain the received audio when receiving and the demodulated transmitted signal when transmitting.

- TxKey / GPIO (Pin 4) is used to force the transmitter into low power. This is often used offshore to force the unit into low power during gas alarm conditions. This pin can also be configured to have other functions, e.g. Tx key input.

- Battery communication interface (Pin 5) is the communication line between TR-910 and the BU-872 battery pack. TR-910 uses this interface to read the battery status from the battery unit and present this with a battery indicator on the front panel.

- Line input (Pin 6) is an analog audio input, 600 Ω single ended and referenced to ground, pin 8. This input can be connected to an audio source for modulating the transmitter.

- Rxbusy / GPIO (Pin 7) is a relay output, and the default function is alarm indication. It can also be configured to have other functions if desired. This is done through the setup menu of the transceiver.

5 Operating Instructions

5.1 Introduction

To configure the transceiver, several parameters may be set from the front panel to tailor the unit for different applications. This section details the parameters that are available from the unit front panel and explains the use of each parameter.

The transceiver contains no manual adjustments or switch settings. All parameters can therefore either be set from the front panel, using an external application, or both.

There are 4 access levels that can be selected to limit the user access to certain parameters.
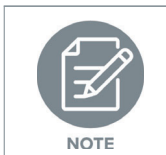
> **NOTE**
> The local user levels can be changed using a remote protocol (external application) or using the **access control** submenu. To be able to change the user level from the front panel, a PIN code must be entered first, the default PIN code is 1881

When changing the value of a parameter from the front panel, the new value is stored in a non-volatile memory when the user returns to the home screen, or automatically within a minute when there are no user actions. The user access levels are:

Table 22: User access levels

User access levels	
Restricted	Limits front panel operation to selecting pre-set channels and adjusting local audio output levels and display appearance. Use this level when the radio units are used from a remote position or in cases where the user should be restricted to use pre-set channels only (1 to 100).
Operator	The same functionality as restricted, but in addition the local user has full access to the operating frequency (store and recall).
Technician	This level gives the local user access to the most used installation specific parameters (line levels, output power, etc.) and should only be used when installing or maintaining the radio units.
SysOp	This level gives unlimited access to all parameters within the radio units and should be used by system experts when installing the radios initially or when the radios are in a secured area.

5.2 Note on frequency setting

The frequency is displayed according to the procedure described in ICAO annex 10. This is a way of setting the frequency in a mixed 8.33 kHz and 25 kHz environment. The frequency displayed does not always reflect the actual transmit or receive frequency but is the frequency used to orally communicate the frequency between

controllers and pilots.

Jotron radios automatically adjust to the correct bandwidth when setting a frequency as outlined in the table below:

Table 23: Illustration of auto bandwidth adjustment

Displayed frequency (MHz)	Actual frequency (MHz)	Bandwidth (kHz)
118.000	118.0000	25
118.005	118.0000	8.33
118.010	118.0083	8.33
118.015	118.0167	8.33
118.025	118.0250	25
118.030	118.0250	8.33
118.035	118.0330	8.33
118.040	118.0417	8.33
118.050	118.0500	25
118.055	118.0500	8.33
118.060	118.0583	8.33
118.065	118.0667	8.33
118.075	118.0750	25
118.080	118.0750	8.33
118.085	118.0833	8.33
118.090	118.0917	8.33
118.100	118.1000	25
…	…	…
136.975	136.9750	25
136.980	136.9750	8.33
136.985	136.9833	8.33

5.3   Basic Operation

5.3.1   Turning the unit ON/OFF

There are four basic screens in the transceiver: **Home screen, Volume screen, Function screen** and **Main menu**. When the transceiver is turned on, the home screen appears on the display. To turn the unit on, off or restart, follow these instructions:

- To turn the unit ON, press **scroll/select** for 1 second. The display lights up and, after showing a splash screen, the home screen appears.

- To turn the unit OFF, press **scroll/select** for 3 seconds to open the shutdown menu, then rotate to **Shutdown** and press the **Yes** shortcut.

- To restart the unit, press **scroll/select** for 3 seconds to open the shutdown menu, then rotate to **Restart** and press the **Yes** shortcut.

- In the unlikely event that the unit is frozen or unresponsive, press **scroll/select** for more than 10 seconds to force shut down.

5.3.2   Home screen - Channel shortcuts

The home screen is the starting point to operate the radio and appears when the radio is turned on. The home screen displays the operating frequency in the center, shortcut frequencies above corresponding shortcut keys with active shortcut highlighted at the bottom, and indicator icons when active at the right and left of the display. Select desired shortcut channel by pressing corresponding shortcut key.

5.3.3   Volume screen - Setting audio volume level
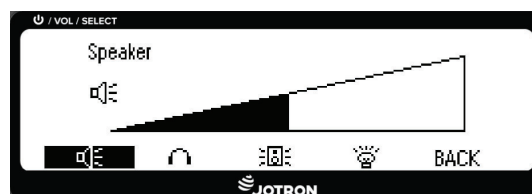
The volume settings are accessed by rotating scroll/select from the home screen. When opening the volume screen, the previously adjusted audio output is selected, except for the first time after boot. Then the audio output active with priority from left to right is selected. The integrated speaker is shown as the leftmost icon, and if a Mic/Headset or an external speaker is connected, the volume settings are accessible from the second and third icon from left. The fourth icon is display brightness/contrast and is described later in this section. The volume screen returns automatically after a few seconds of inactivity.

- Rotate **scroll/select** to open the volume screen.

- Selected audio output to adjust are highlighted and can be changed by pressing the corresponding shortcut.

- Rotate **scroll/select** to adjust volume.

- Press the selected audio output shortcut to toggle the output on or off.

5.3.4   Volume screen - Setting display brightness and contrast
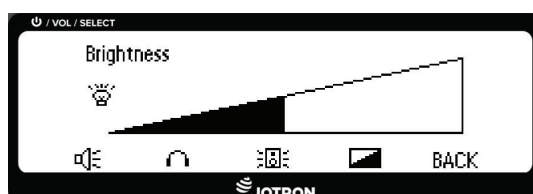
The display brightness and contrast are adjustable from the volume screen. The brightness setting applies to the display as well as the backlight of the scroll/select knob and shortcut keys.

- Rotate **scroll/select** to open the volume screen.

- Press the brightness shortcut, and repeat to toggle between brightness and contrast.

- Rotate **scroll/select** to adjust brightness or contrast.

5.3.5   Function screen - Recall channel

The function screen is used to recall prestored channels, change frequency and other functions as indicated above the function shortcut keys.

- Press **scroll/select** to open the function screen.

- Rotate **scroll/select** up and down the channel list.

- Press **scroll/select** or the **RCL** shortcut to select and return to the home screen, or;

- Rotate **scroll/select** to the top of the list and press the **BACK** shortcut to return.

5.3.6   Function screen - Setting squelch level

The TR-910 has a S/N squelch which automatically adapts itself to the background noise, so normally there will be no need for adjustment during normal operation. The value is in dB S/N and the default value is 12 dB. The value can be adjusted between 5 dB and 20 dB. Low values will increase the risk for false squelch lift which can be annoying. In most cases the default value of 12 dB will be the best choice.

- Press **scroll/select** to open the function screen.

- Press the **SQL** shortcut to open the squelch setting screen.

- Rotate **scroll/select** to adjust the threshold level.

- Press the **ENABLE** or **DISABLE** shortcut to toggle the squelch on or off.

5.3.7   Function screen - Setting frequency and channel store

The frequency setting screen is used to select or store frequency to a channel. Up to 100 channels can be stored and the first five channels are available as shortcuts in the home screen.

To select a frequency:

- Press **scroll/select** to open the function screen.

- Press the **FREQ** shortcut to open the frequency setting screen.

- Rotate **scroll/select** to change the frequency and use the arrow keys for changing position of the adjustment.

- Press the **SELECT** shortcut to select the frequency, or;

Alternatively, to store a frequency to a channel:

- Press the **STORE** shortcut to open the channel store screen.

- Rotate **scroll/select** to select any channel position. Channel 1 - 5 is visible on the home screen.

- Press the **STORE** shortcut to store the current frequency. If the channel already contains a frequency, it can be cleared or overwritten.
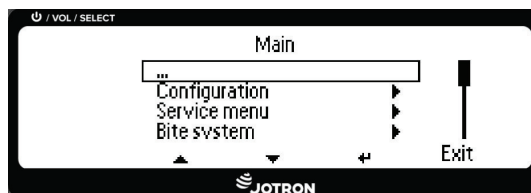
5.3.8   Function screen - Show radio information
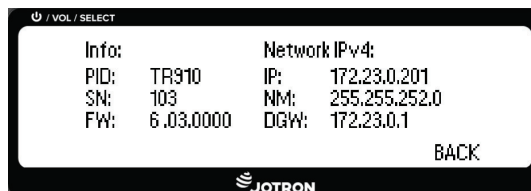
Display information about the radio identification, firmware and hardware release, system up-time and LAN address.

- Press **scroll/select** to open the function screen.

- Press the **INFO** shortcut to open the info screen.

5.3.9   Function screen - Advanced settings menu

For advanced settings, open the main menu. For details, see the following sections.

- Press **scroll/select** to open the function screen.

- Press the **MENU** shortcut to open the main menu with advanced settings.

- Navigate with **scroll/select** and shortcut keys. To go up/back in the meny tree navigate to the top of the list with the ... entry.

6 Advanced settings

Under the menu selection from the user menu, several submenu groups are available depending on the user level.

The submenus and details for them are shown in the following sections.

Table 24: Submenus available

| Submenu	Access level	Description
Configuration	SysOp, Technician	Settings of parameters like line levels, modulation, power setting etc. Typically, these settings are done during the installation of the radio.
Service menu	SysOp	Setting of system parameters like language, access level, calibration etc.
Bite system	SysOp, Technician	Displays internal measurements and information about any active alarms.
Configuration	All	Displays information about firmware and hardware release, system up-time and radio identification.

6.1   Configuration group
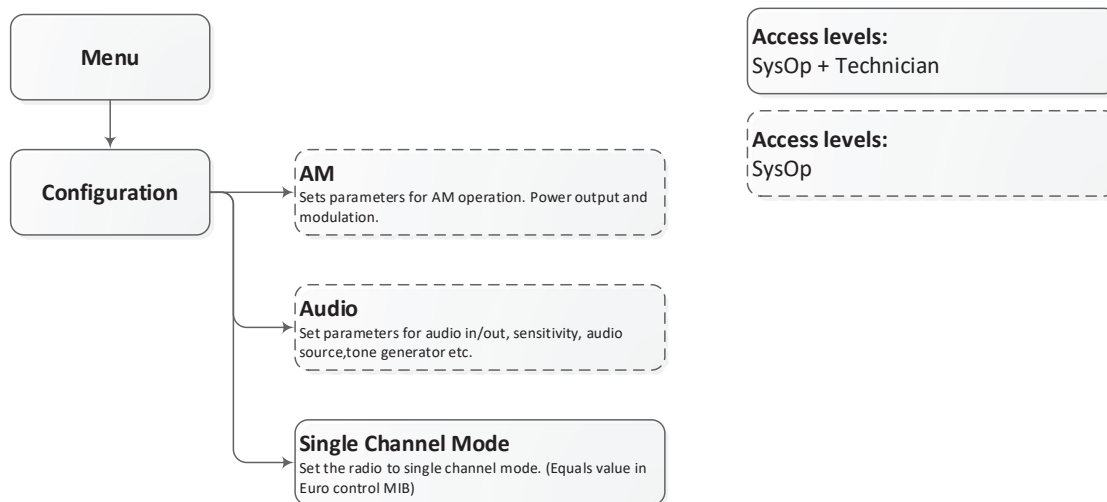
Figure 16: Configuration group

6.1.1   AM

- **Output power**

  - **Range:** 30.0 - 40.0 dBm, 0.1 dB step
  - **Default:** 40.0 dBm (10 W)
  - **Details:** Set the output power. Max. level depends on radio model: 37.0 dBm for TR-910 MP, 40.0 dBm for TR-910 (All others).

- **Modulation %**

  - **Range:** 10.0 - 95 %, 1 % step
  - **Default:** 85 %
  - **Details:** Set the modulation depth for AM operation. Use default for best performance with regards to intelligibly and adjacent channel performance.

6.1.2   Audio

- **Input source**

  - **Range:** Auto | Line | Mic | Modgen | VoIP (Availability of certain choices may depend on options enabled)
  - **Default:** Auto
  - **Details:** The input source determines from where the audio is applied to the transmitter.
    Auto: Uses line input from any of the audio input sources that keys the radio (Line, Mic. or VoIP [ED137]).
    PTT from microphone: **Mic**

PTT from I/O: **Line**
PTT from RTP: **VoIP**
Line: Uses the 600 Ω line interface as the audio source.
Mic: Uses the microphone input as the audio source.
Modgen: Uses the internal modgen as audio input source – see also Modgen frequency.
VoIP: Uses the IP interface as the audio source.

- **Mic sensitivity**

  – **Range:** -40 to 0 dB in 1 dB steps

  – **Default:** -21 dB

  – **Details:** Set the VOGAD sensitivity for the microphone connected to the front panel connector. Use this setting to increase or decrease the gain if needed. Setting depends on microphone used.

- **Mic Bias**

  – **Range:** On | Off

  – **Default:** On

  – **Details:** Enabled or disables microphone bias on the microphone connector (pin 1). When set to On, there will be a 8 V bias available on the microphone input pin. Used for electret microphones that requires a bias voltage.

- **Headset / Speaker Mic**

  – **Range:** Headset | Speaker Mic

  – **Default:** Speaker Mic

  – **Details:** This setting selects the use of an external speaker mic, like the Jotron 81339, or a headset. Normally a headset has much higher sensitivity than the speaker mic, and this setting adjusts the output power level of the **Mic/headset** connector on the front panel. Always select **Headset** if a headset is used. If left in **Speaker Mic** mode, the power output will be much higher and the audio volume in the headset may be too loud. Listening at high volume levels for long periods may lead to temporary or even permanent hearing impairment.

- **Line sensitivity**

  – **Range:** -40 to 10 dBm in 1 dB steps

  – **Default:** -22 dBm

  – **Details:** Set the VOGAD sensitivity of the 600 Ω line input. This setting determines where the VOGAD (automatic gain control) start to operate. Thus, if it is set to -22 dBm, levels above -22 dBm will be modulated with 85% (default setting). For levels below -22 dBm the modulation will decrease linearly.

- **Monitor output**

  – **Range:** Headphone, Monitor line, VoIP (Availability of certain choices depends on options enabled)

  – **Default:** Headphone, Monitor line

- **Details:** Set where the monitor output signal and the received audio is routed. Can be set to any of the headset connector, the 600 Ω monitor line output and VoIP output. The TX monitor signal is the demodulated signal detected on the output of the transmitter (true sidetone).

- **Monitor level**

  - **Range:** -46 to 0 dBm in 1 dB steps
  - **Default:** -10 dBm
  - **Details:** Set the peak monitor level output in dBm for the monitor output on the I/O connector.

- **Audio mute level**

  - **Range:** No audio | -30 to 0 dBm in 5 dB steps
  - **Default:** No audio
  - **Details: No audio:** Use this setting to completely mute the demodulated audio while transmitting. **-30 dB to 0 dB:** Set the desired level for sidetone or to monitor the transmitter during transmission relative to the received audio level.

- **Modgen frequency**

  - **Range:** 100 Hz to 5000 Hz in 1 Hz steps
  - **Default:** 1000 Hz
  - **Details:** Set the frequency of the internal modulation generator. Used in conjunction with the Audio input source when it is set to Modgen for test purpose.

- **AF AGC (Rx)**

  - **Range:** On | Off
  - **Default:** Off
  - **Details:** Set the automatic AF gain control on or off. Setting AF AGC on will lead to constant audio output when the received signals have varying modulation depth. This will enhance the audio quality for signals with a low modulation. For VoIP it is recommended to set the audio AGC to On as this will enhance the quality of the audio for the remote user.

6.1.3   Single channel mode

- **Single channel mode**

  - **Range:** Enabled | Disabled
  - **Default:** Disabled
  - **Details:** Set the radio to 'Single channel mode'. In this mode it is not possible to change the frequency from the front panel.