TAKRAD

Advanced tactical radio based on
SDR (Software Defined Radio) Technology

TAKRAD

Modern 21st century infantry is mechanized in most armies of the world. Armored vehicles bring infantry units to the area of operation where unloading parts go out into position and part of the vehicle crew remains in the vehicle to provide fire support. Until now, commanders wore two devices, one for communication with subordinates and the other for communication with superiors. The modern radio device for soldiers must ensure the simultaneous communication of soldiers within the squad and the communication of the squad leader towards their vehicle and towards the platoon commander. The same device on the platoon commander, in addition to communication to the squad leaders, must also provide via a mobile version connection to the intercom system of the vehicle and communication to the company commander's vehicle or to other platoon commanders. To enable all this, a soldier's radio must have two (2) PTT buttons and 5-6 speech groups on one speech channel / frequency depending on the structure, whether the platoon has 3 or 4 squads.

Also, today's modern soldier no longer needs only voice communication, but also more and more data communication. This primarily refers to the ability to send your GPS position which allows situational awareness (SA) to superiors, then to the use of digital maps and sending short messages (chat) and documents (file transfer) through the battlefield management system (BMS), to automatically send data from sensors around the soldier and on the soldier (e.g. NBCD) as well as to sending voice and visual MAN DOWN signalling, e.g. in case of injury. All specified communication must be protected, encrypted (COMSEC and TRANSEC).

Combat operations are sometimes carried out on difficult-to-access or configuration-demanding terrain (e.g. forested or urban areas), and during combat operations, soldiers or units may be alienated. Therefore, today's soldiers' radio devices must have MANET capability, the ability to automatically self-forming self-healing multi-hop network that automatically ensures greater coverage of the area by a quality radio signal.

Today's soldier's radio must be robust, resistant to vibration and shock (fall) as on a modern battlefield, a soldier's life depends on the proper functioning of his personal radio device. Significant force must be intentionally used to cause the antenna or audio connector to rupture. Also, the device must be easy to program for staff personnel and for use by a soldier. In this regard, the device must have in its kit a wireless PTT that mounts to the rifle as well as a chest switch that allows you to change all the most important functions of the device since the soldier during combat operations has no time or ability to manipulate the device mounted in the pouch on his chest or back.

Also, the device must have a quality high-capacity battery that will allow long-term use and thus increase survival.

From the above mentioned, it follows that a modern solder does not only need a simple device that provides only voice communication over short distances, but he needs a sophisticated software-defined radio like TAKRAD that supports all the above requirements of modern warfare.

Solder Radio Device (RAD) is a combat (battlefield) tactical radio device that provides simultaneous protected voice and data communication at the lowest tactical levels of infantry, mechanized and motorized units. It is intended for each soldier, and supports the simultaneous communication of two speech groups on one radio channel. This way each commander at all levels of the squad, platoon and company is simultaneously connected to the higher and lower level of command by only one RAD by creating a tactical radio network and also connects combat platforms (tent, BOV, etc.) with infantry or landing infantry elements.

Through narrowband and wideband waveform, it enables network self-forming self-healing multi-hop voice and data network, which provides greater coverage in the filed than the range of a single RAD. Because of that it is very effective in achieving uninterrupted communication in inaccessible and demanding urban battlefields.

Iz enables physical and wireless connection of various tactical smartphones and tablets, and ensures situational awareness through the display and sending of GPS positions, integration of various sensors, and the ability to send text messages, photos (images) and videos within the tactical radio network. This allows commanders to see where their soldiers are and what they are doing in real time with constant status updates.
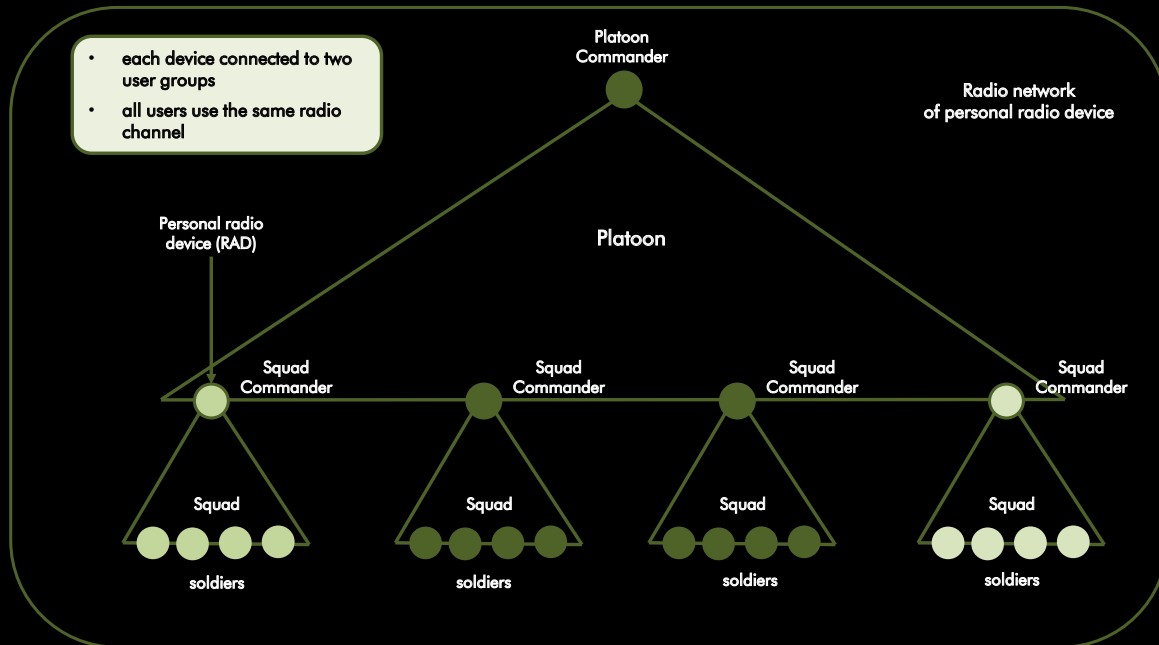
Radio Network of RAD *(Figure 1)* is a network of narrowband waveform and lower data through-put, which should ensure protected communication of all platoon members at distances up to 1 km.

This network connects combat platforms with landing elements, and provide the following services:

- Voice and data communication
- GPS position display,
- Situational Awareness (SA),
- Multi-hop capacity.

Figure 1: Soldier radio network diagram

- each device connected to two user groups
- all users use the same radio channel

Radio network of personal radio device

Platoon Commander

Personal radio device (RAD)

Platoon

Squad Commander

Squad Commander

Squad Commander

Squad Commander

Squad

soldiers

Squad

soldiers

Squad

soldiers

Squad

soldiers

Within the same radio channel, RAD provide communication with at least two user groups (superior and subordinate) thus eliminating the need for dual RAD.

Voice and data communication is transmitted between RADs in jumps through dynamic multi-hop capability *(Figure 2)* making it possible to achieve end-user communication at a greater distance than the range of a single RAD.

Figure 2: The influence of Multi-hop capabilities on the range of RAD
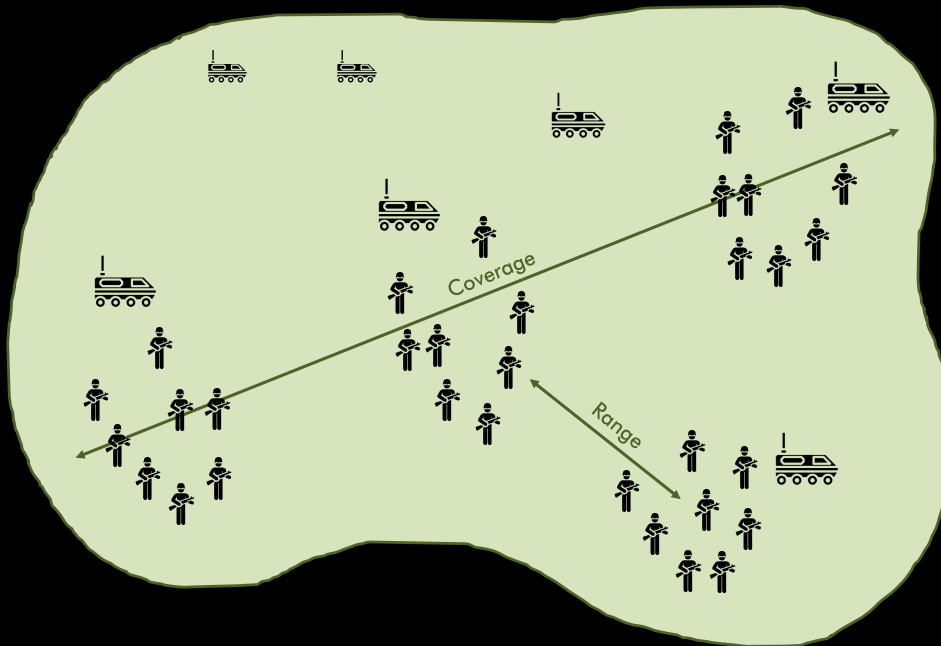
With the development of information technology and their application for military purposes, the requirements for the transfer of data from soldiers to platforms and commands and vice versa are growing. There is a growing need for information that a soldier receives from various sensors, and more and more often a soldier is also used as a sensor.

We present to you **TAKRAD,** an advanced tactical radio based on SDR (Software Defined Radio) technology.

TAKRAD

An advanced tactical radio

TAKRAD is advanced tactical radio based on SDR (Software Defined Radio) technology.

TAKRAD is a personal radio for a modern-day soldier with a superior SDR architecture that allows reliable and secure data and voice communication. TAKRAD is perfectly designed for military needs with its robust mechanical design and advanced electronics.

TAKRAD

TAKRAD is a tactical radio based on SDR technology intended for a dismounted soldier. The device is designed to be a natural connection of soldiers with the network, requires minimal involvement in radio usage, and allows mission focus.

The device enables simultaneous voice and data communication within two independent networks: simultaneous communication with lower and higher echelons. The modern SDR platform enables uninterrupted reliability and communication stability with the dismounted soldier with a high level of communication protection by implementing a certified crypto protocol (AES 256) and DSSS FH capabilities.

The open architecture of the radio allows easy integration of user's waveforms and cryptographic solutions and the possibility of interoperability. The dual independent SDR architecture allows simultaneous soldier communication and connectivity to sensors and peripherals using the LE BT (Low Energy Blue Tooth) built-in radio.

Built-in GPS with anti-jamming and anti-spoofing detection (**TAKRAD A** and **TAKRAD B**) gives the user a reliable position in combination with the built-in accelerometer (**TAKRAD A** and **TAKRAD B**), with predefined criteria automatically sends the user's position in case of serious injury.

The device is easy to integrate into various SA (Situational Awareness) and BMS (Battlefield Management System) solutions. The device comes with a basic BFT (Blue Force Tracking) solution as part of a programming application.

Audio MMI, which provides voice notifications about the device's status, significantly reduces the possibility of inadvertently revealing the user's position during the mission, and connectivity to BT PTT (Push to Talk) compatible with STANAG 4694 standard allows radio activation without removing hands from weapons.

Figure 3: Situational Awareness (SA)
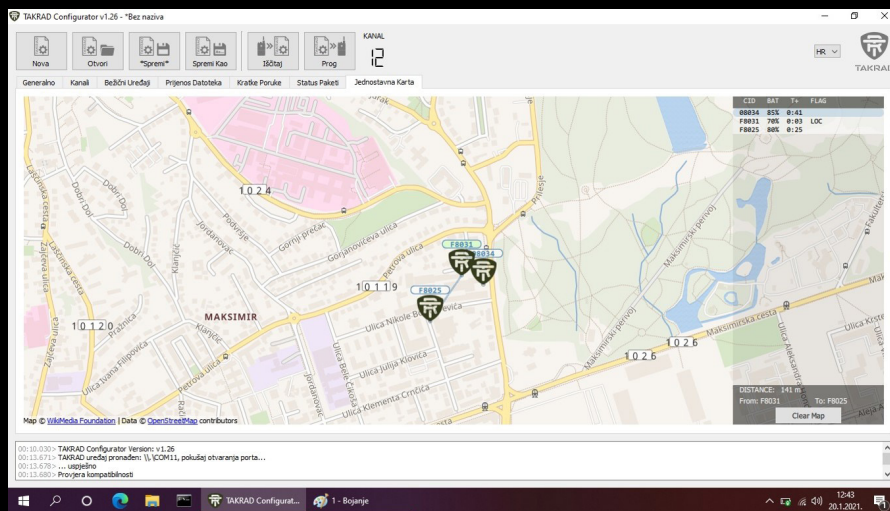
The device comes with two windows applications for programming and managing crypto keys.

The robust aluminium housing (MIL-STD 810), completed with state-of-the-art connectors, guarantees the device's longevity even in challenging conditions of use. The high-capacity battery allows all-day operation without the need for recharging.

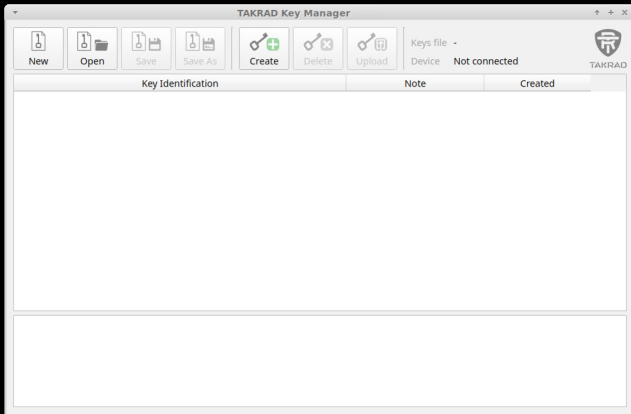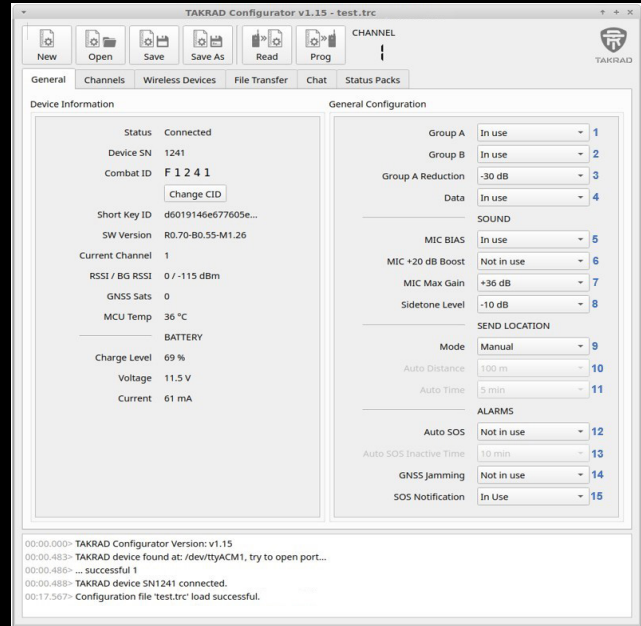

Figure 5: Programming Application

Figure 4: Cyrpto Application

TAKRAD comes in two versions **TAKRAD A** (Advanced) and **TAKRAD B** (Base).

Both versions are uncompromisingly well made and share the same mechanics and electronics and differ only in communication capabilities. Said so, the user is given a straightforward opportunity to switch, if necessary, from the B to A version because it is exclusively an SW upgrade without the need to send the radio to the manufacturer. **TAKRAD A** and **TAKRAD B** are compatible.

SPECIFICATION	TAKRAD BASE	TAKRAD ADVANCE
FREQUENCY	225 - 450 MHz	
FREQUENCY STABILITY	+/- 0.5 ppm	
CHANNEL WIDTH	12,5 kHz; 25 kHz; 50 kHz;	12,5 kHz; 25 kHz; 50 kHz; 100 kHz; 500 kHz; 1,2 Mhz
CHANNEL BIT RATE	Up to 38.4 kbps	Up to 500 kbps
MANET	Voice	Voice + Data
NUMBER OF CHANNELS	16 (programmable)	
NUMBER OF GROUPS	2 – simultaneous communication with lower (GROUP A) and upper echelon (GROUP B)	
SIMULTANIOUS (VOICE A + VOICE B + DATA) TRANSMITION	YES	
MAN DOWN MODE	YES	

SPECIFICATION	TAKRAD BASE	TAKRAD ADVANCE
OPEN TERRAIN RANGE (RADIO AT NA 1,5 M HEIGHT)	Up to 2 km	
INTERNAL GPS RECEIVER WITH JAMMING/ SPOOFING DETECTION	YES	
GPS POSITION TRANSMITION	MAN / AUTO	
INTEGRATED AES-256 ENCRIPTION	YES	
INTEGRATED VOCODER	YES	
VOCODER BITRATE	2400 bps	
BATTERY	Li-Ion; 11,1V; 3350 mAh	
BATTERY CAPACITY	minimum 12h with 1:6 Tx:Rx ratio	
OUTPUT POWER	50mW do 2W, programmable	
KEYS	RIGHT: INFO; VOL +; VOL -; GROUP A; GROUP B; LEFT: POWER; CH+; CH-; FUNC; BATTERY LOCK mechanical key	
CONNECTORS	Antenna TNC, GPS SMA, Audio U-229, DATA USB port	
PROGRAMMING, KEY MANAGEMANT	Via programming APP, Win based	
WHISPER MODE	YES, integrated audio compressor with equalizer	

SPECIFICATION	TAKRAD BASE	TAKRAD ADVANCE
AUDIO NOTIFICATIONS	Battery capacity, working channel, power on, power off, SOS, CID, PLAIN / CYPHER mode	
WIRELESS PTT	YES, PTT-A, PTT-B i INFO	
SELFTEST	YES	
DIMENSIONS WITHOUT ANTENNA (mm)	Radio 111x75,0x32 Battery 85,5x75x32	
WIGHT WITH BATTERY AND ANTENNA	765 +/- 5 g	
SCHOCK PROOF	MIL-STD-810	
WATER AND DUST PROOF	IP 68	
TEMPERATURE RANGE	-30°C do +55°C	
IMERSION	1 m/120 min	
SW FEATURES	BFT/GPS, PC programming APP, CRYPTO programming APP	

DIMENSIONS with antenna

LENGTH	425 MM	
WIDTH	73 MM	
DEPTH	32 MM	
WEIGHT	0.765 KG	

Except for internal communication, thanks to integrated and exterior sensors (GPS, accelerometer, dosimeter, heart rate monitor etc.) **TAKRAD** offers detailed information on the location and physical condition of the soldier. **TAKRAD** also automatically recognizes dangerous situations (SOS - Man down Alert) and reports them using a robust security channel.

Connection to an outside terminal for display of multimedia information (pictures, maps, locations, chat) is simple, and simultaneously secure and reliable thanks to the integrated Bluetooth Low Energy system.

SDR architecture in **TAKRAD** device enables easy customization for the required purpose. By using the narrowband and broadband mode, the device ensures simultaneous work of several work groups, creation of self-forming and self-healing ad-hoc mesh networks.

Figure 6: Application tactics
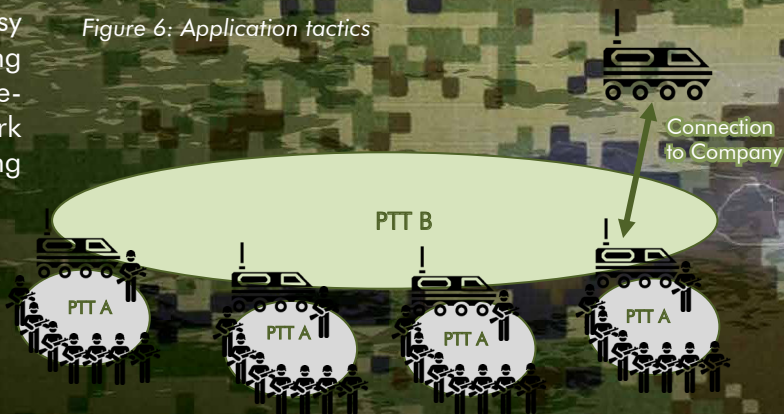
Connection to Company

PTT B

PTT A

PTT A

PTT A

PTT A

Exceptionally solid mechanical housing made of aluminium ensures reliable work in extreme conditions and compatibility with MIL STD 810 and IP 67. **TAKRAD** is a modern and long-term solution for C3 on tactical level. It is equipped with various telephone combinations, high capacity battery, various antennae and other accessories, depending on the user's needs.

Innovative solutions and modern technology with which **TAKRAD** was developed ensure competitiveness, and therefore, are an advantage in comparison to the leaders in communication radio devices.

DEVICE ELEMENTS

1   VHF UHF Antenna

2   GPS Antenna

3   Connectors – radio antenna, GPS antenna, NF (Headset), Data

4   Headset – different types available

5   LE BT radio antenna

6   Command buttons

7   SDR radio casing

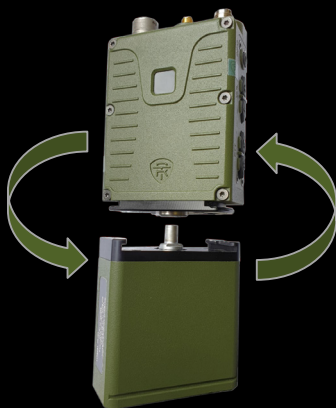**8**   Battery casing

1. 2.4 GHz Radio

2. INFO

3. VOL +

4. VOL -

5. Group A

6. Group B

7. Battery

VHF UHF Antenna	8
GPS Antenna	9
Audio	10
Data port	11
Power	12
CH +	13
CH -	14
FUNC	15
Battery Lock	16

ACESSORIES

1. Group A
2. Group B
3. VOL -
4. INFO
5. VOL +
6. Headset
7. Radio (Audio)
8. Holder
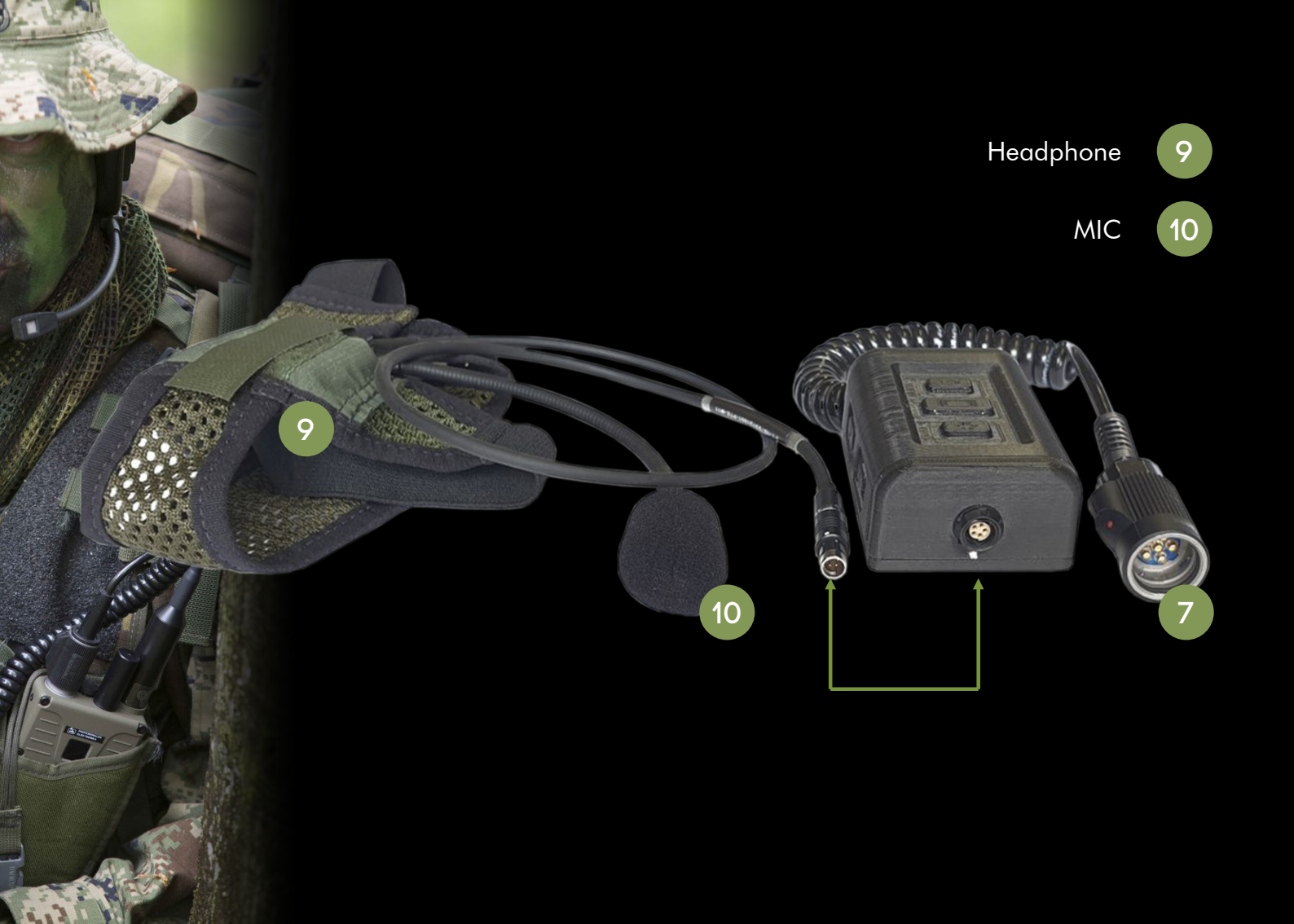
Headphone 9

MIC 10

9

10

7

TAKRAD is a modern radio device that offers many advantages with competitive prices, warranty conditions, and maintenance within the warranty and out of warranty period.

TAKRAD development was in close cooperation with the Croatian Military in charge of technical and tactical specifications.

In November 2020. Croatian Army and Navy extensively and rigorously field-tested radio, and it performed very well.

All requested technical and tactical specifications were met and satisfied.

TAKRAD holds a national RESTRICTED certificate issued by the national authority Information Systems Security Bureau .

We are currently developing mobile version of   it i sin prototype stage and performs well.

TAKRAD

AN ADVANCED TACTICAL RADIO BASED ON
SDR (SOFTWARE DEFINED RADIO) TECHNOLOGY

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BASICAL TECHNICAL INFO

Except for internal communication, thanks to integrated and exterior sensors (GPS, accelerometer, dosimeter, heart rate monitor etc.) **TAKRAD** offers detailed information on the location and physical condition of the soldier. **TAKRAD** also automatically recognizes dangerous situations (SOS – Man Down Alert) and reports them using a robust security channel.

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KEY BENEFITS

- Double independent Software Defined Radio (SDR) architecture for narrowband and wideband custom waveforms, easy upgrading over USB interface via PC control application

- UHF SDR for simultaneous, full duplex multiple users voice and data over 225MHz-450 MHz frequency range

- 2.4 GHz SDR for short-range accessory DATA port and wireless remote control implemented Bluetooth Low Energy (BLE) for Command & Control (C2) systems

- Self-forming, self-healing, ad hoc complex radio network support

- Frequency hopping and Direct Sequence Spread Spectrum (DSSS) operation

- Secure embedded AES 256-bit encrypted voice, data and situational awareness for high mission effectiveness

- Integrated GPS receiver and accelerometer for automatic Position Location Information (PLI) and smart SOS/MAN DOWN detection

- Dual Push-to-Talk with dual-net function for easy integration with upper-echelon network

- Audible user friendly Human Machine Interface (HMI) for presets, channels and battery status. Additional customisation available

- User defined customizable waveforms and functionality

- Professional military connectors with heavy duty metallic housing meets IP68 and MIL-STD-810G

GENERAL SPECIFICATION

UHF Frequency Range:	225 to 450 MHz (other on request)
UHF RF Bandwidth:	12.5 kHz, 25 kHz, 100 kHz, 500 kHz or 1.2 MHz
Presets:	16 highly customised presets
Modulation:	constant envelope phase modulation (FSK, GMSK …)
Voice:	dual-net, unlimited listeners, High priority interrupt, VOX
Data:	simultaneous data and voice up-to 1 Mbps through the air
Location:	embedded GPS with automatic Position Location Information (PLI) and anti jamming/spoofing detection
Audible HMI:	language customizable with presets, channels and battery status
Graphical HMI:	tactical handheld device graphical control, Situation Awareness (SA), messaging over 2.4 GHz SDR
Battery:	rechargeable Lithium-Ion , >12 hour life time, 11.1V, 37.7 Wh
Architecture:	software defined radio (SDR)
Encryption:	certified 256-bit Advanced Encryption Standard (AES) hardware engine, keyfill over RS485 interface and DS-101 protocol

INTERFACES

Data:	over wire 9pin Fischer connector for USB 2.0, serial over USB, RS485 wireless 2.4 GHz SDR radio (BLE, custom protocol)
Audio:	standard 6-pin, MIL-DTL-55116C
UHF Antenna:	IP68 TNC connector
GPS Antenna:	IP68 SMA connector
Firmware update:	over USB
Keypads:	ON/OFF, PTT A, PTT B, INFO, VOLUME +, VOLUME -, CH +, CH -, FUNCTION
HMI:	customizable audio and graphical
Encryption:	certified 256-bit Advanced Encryption Standard (AES) hardware engine, keyfill over RS485 interface and DS-101 protocol

TRANSMITTER

UHF Power Output:	100 mW up to 2 W (20 dBm up to 33 dBm @ 50 Ω)
2.4 GHz Power Output:	1 mW up to 100 mW (0 dBm up to 20 dBm @ 50 Ω)
Frequency Stability:	± 1.0 ppm

RECEIVER

Sensitivity:	-122 dBm @ 12 dB SINAD in SOS mode
Noise Floor:	≤ -148 dBc/Hz
Audio input:	high impedance, automatic level control (ALC), noise gate (NG), high pass filter (HPF), wind noise reduction filter, low noise bias for microphone
Audio output:	32 Ω up to 1 kΩ, dynamic level compressor

INVIRONMENTAL

Shock and Vibration:	MIL-STD-810G ground mobile environment
Immersion:	2 meters MIL-STD 810G
Temperature:	operating: -30° C to +55° C storage: -40° C to +80° C MIL-STD-810G
EMI/RFI:	MIL-STD-461F
Sand/Dust/Salt/Fog/Rain:	MIL-STD-810G

DIMENSIONS (WITHOUT ANTENNA)

	RADIO	BATTERY
Length:	93.3 mm	75.5 mm
Width:	75.0 mm	75.0 mm
Depth:	39.0 mm	35.0 mm
Weight:	0.31 kg	0.32 kg