SIEMENS

ZRadio
User Manual

FCC WARNING

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 subpart B of the FCC rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. In order to comply with the FCC RF Exposure Requirements of section 1.1307, the antenna of the device must be installed such that a minimum separation distance of 20 cm is maintained between the antenna and any person.

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1. Information for the users

1.1. Introduction

The User Manual contains all essential information for the user to make full use of the ZRadio (Sx/F) system. This manual includes a description of the system functions and capabilities, contingencies and step-by-step procedures for system access and use.

1.1.1. Scope

This document describes the ZRadio Sx/F, referred to below simply as ZRadio.

1.1.2. Purpose

This document describes the features, benefits, structure, and function of the ZRadio system.

1.2. Acronyms and Abbreviations

Table 1: Acronyms and Abbreviations

Acronym / Abbreviation	Description
CHP	Channel Pair
EIRP	Equivalent, Isotropically Radiated Power
TCC	Track Coupling Coil
LBT	Listen before Talk
TXP	Transmit Power
OPM	Operation Mode
RID	RadioID
LED	Light-Emitting Diode
ZRadio-F*	Zub radio equipment car borne (vehicle side)
ZRadio-SX*	Zub radio equipment way side
Zub*	Train control system from Siemens

*German abbreviation

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1.3. References

Table 2: References

Reference Number	Reference Title	Document ID
[1]	ATP TGMT Zub Operation Manual ZRadio Manager	A6Z00043447756

1.3.1. Applicable PC programs

ZRadio manager application is used to configure and manage the ZRadio system.

Table 3: Applicable PC programs

Reference Number	Reference Title
[2]	ZRadio Manager

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2. Radio Equipment Wayside (ZRadio Sx) and On-board (ZRadio F)

The following components are required for successful data transmission via the radio link:

- ZRadio Sx module and track coupling coil
- ZRadio F module and vehicle coupling coil
- Interface to track/vehicle coupling coil for reading valid signal information
- Antenna for directional transmission and reception of radio telegrams along the line
- Lightning protection elements for discharging any high voltages at the antenna

Table 4: ZRadio Specification

Type	Definition
Application	Trainguard MT Zub wayside/on-board radio equipment
Mounting location	Signal apparatus case/top-hat rail
Dimensions	7.1 in x 1.3 ft x 4.6 in
Voltage range	18 V to 72 V
Power consumption	< 3.2 W (3.8 W for max. 30 ms when interrogating the track coupling coil)
Housing	Metal front panel 2 LEDs, HF antenna port Tele Typewriter [TTY]/RS422 interface Ethernet interface (ZRadio Sx only) 4 rotary coding switches

The ZRadio is externally powered at 24 V DC.

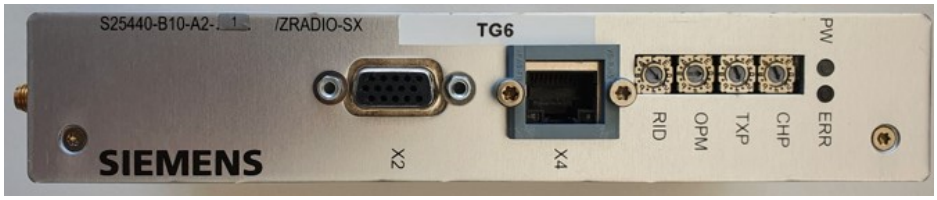

Figure 1: ZRadio Sx (Wayside)

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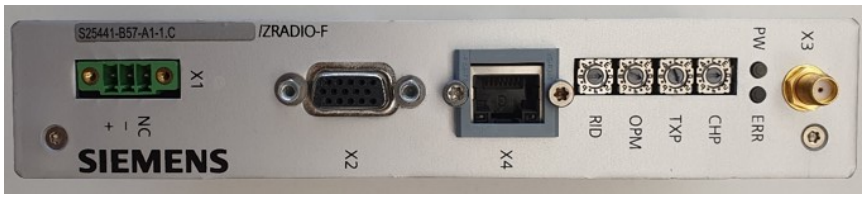

Figure 2: ZRadio F (On-board)

2.1. Explanation of LEDs on ZRadio

Pairing between the radio antenna and the ZRadio is established by the coaxial cable port. This port is connected to the other coaxial cable on the other side of the surge arrestor for ZRadio Sx.

Table 5: Front Panel of ZRadio

SN	Explanation
1	“PW” LED: power indication (green) “ERR” LED: error indication
2	CHP, TXP, OPM, RID: rotary coding switches
3	X4: Ethernet interface (ZRadio Sx only)
4	X2: TTY/RS422 interface For loading of firmware onto the modules
5	X3: antenna port (underside of housing)
6	X1: Power supply of the ZRadio Sx and TCC port (underside of housing) Transmission of signal information

2.2. Hardware parameters of ZRadio

The parameters described in this section are set using the hex rotary switches on the radio modem. The meaning of the setting switches (Figure 3) is identical on the ZRadio-F and the ZRadio Sx or ZRadio S except for the OPM switch. The specifications for the required setting of the modem are to be stored at the installation site of the respective ZRadio modem. If the setting is changed while the ZRadio is switched on, this leads to a restart of the device with the new parameters after a maximum of 5s.

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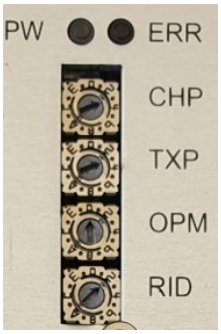

Figure 3: Hex rotary switch for setting the software parameters

2.2.1. Operating mode OPM at ZRadio F

The ZRadio knows four valid operating modes, with which the installation location and the IP addressing must be set before commissioning the Zub radio upgrade.

Table 6: ZRadio operating modes

OPM Code switch position	Operation mode	IP address
0	ZRadio F(A)	192.168.1.60
1	ZRadio F(B)	192.168.1.61
2	ZRadio F(A)	Configurable via web browser
3	ZRadio F(B)	Configurable via web browser
4..15	not allowed	

The standards are as follows:

ZRadio F(A) for : Drivers station A

Driver position 1/Cab 1 (or odd drivers position number)

ZRadio F(B) for : Drivers station B

Driver position 2/Cab 2 (or odd drivers position number)

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2.2.2. Operating mode OPM for ZRadio Sx

The type of IP addressing for the Ethernet interface is to be set on the ZRadio Sx with the coding switch according to Table 7.

Table 7: IP addressing ZRadio Sx

OPM Code switch position	IP address
0	IP address is obtained via DHCP server
1	IP address is obtained via DHCP server
2..14	192.168.1.x X=58+code switch position
15	not permitted

2.2.3. Transmission power TXP

The maximum transmission power EIRP(Equivalent, Isotropically Radiated Power) behind the antenna must not exceed certain limit values according to the applicable international regulations. For most countries in Europe, e.g., Germany, the maximum transmission power for the transmission method used here is limited to 10 dBm = 10 mW without separate restrictive measures for compatibility with third-party systems, such as LBT (Listen before Talk). In case of doubt, the current regulations for the country concerned should be obtained.

Depending on the components used, the power must be set on the radio modem using the coding switches in such a way that the maximum transmission power behind the antenna reaches the maximum permissible power as well as possible but does not exceed it. For this purpose, the antenna gain, and the attenuation of the components used between the radio modem and antenna, such as antenna cables, lightning protection modules, filters, must be considered. An additional attenuation of 0.1 dB is taken into account for each individual connector, which means that a complete connector has a typical attenuation of 0.2 dB.

For the components mentioned in this document, the attenuation for the connectors has already been taken into account and must not be included in the calculation a second time. The transmission power to be set must be specified for each vehicle type or each signal depending on the components used in a power budget (link budget) and specified in a data sheet for the respective place of use. This data sheet must be available as information in the area of the ZRadio modem, for example as a supplementary sheet or sticker in the signal switch box.

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2.2.4. Radio channel pair CHP

The Zub radio upgrade uses two different frequency channels for a route equipped with Zub222c, one for direction 1 and one for direction of travel 2. These two channels form a radio channel pair that can be configured with the ZRadio and set using a hex rotary coding switch. Table 18 lists the 16 adjustable radio channel pairs with the associated frequencies for directions 1 and 2. Refer Table 8 for selectable radio channel pairs. The radio channel pairs 10 or 11 should be preferred. Operation on the following individual channels should be avoided for the time being:

- Channel 21 and, to a limited extent, channels 20 and 22: On this frequency, microwave ovens in kitchens with quite high power can interfere with the radio channel. The radio channel can then be "blocked" for 10ms every 20ms.
- Channel 12, Channel 17, Channel 22:These channels are most affected by WiFi transmissions in private networks (default settings)

Table 8: Selectable Radio channel pairs

Frequency CH IEEE 802.15.4	Frequency GHz	Radio Channel Pair															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
11	2,405	1													1		
12	2,410														2		
13	2,415	2	1														
14	2.420																
15	2,425		2					1		1		1				2	2
16	2,430			1													
17	2,435																
18	2,440			2													
19	2,445				1												
20	2,450							2	1		1					1	
21	2,455				2	1											
22	2,460																
23	2,465					2	1										
24	2,470												1				
25	2,475					2		2	2					1			1
26	2,480										2	2	2	2			

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2.2.5. Facility identifier RID

The telegram traffic between the ZRadios is transmitted with a system identifier. One of 16 possible identifiers is selected with the RID parameter. A common, fixed system identifier for all ZRadios must be defined for a customer system. It must be ensured that two customer systems with the same system detection do not overlap in the radio range. Under certain circumstances, this could also lead to a security risk.

It must also be taken into account here that overranges can also result from incorrectly increased transmission power. The same system identifier can be used for customer systems with a minimum distance of > 5 km. Possible expansions of the existing routes must also be taken into account.

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3. Wi-Fi Patch Antenna

3.1. Function

The Wi-Fi patch antenna is used to transmit the track coupling coil information in advance to the vehicle. Signal aspect clearing from stop to proceed (change to a less restrictive signal aspect or radio infill) can thus be detected on the vehicle before reaching the transmission point and the braking curve to the transmission point can be canceled. *The WiFi patch antenna is installed at the signal so that it can transmit and receive the information in parallel with the signal's optical system and the installation space in front of the antenna is iron free +/- 30° in all directions. Antenna installation is done vertically with SMA connector.*

3.1.1. Antenna Datasheet

Antenna datasheet from HUBER+SUHNER (Manufacturer).

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Data Sheet

HUBER+SUHNER

SENCITY® Spot-S WiFi Antenna
1324.17.0098

Description

Small directional, planar, linear vertical polarized WiFi antenna with 8.5 dBi gain
WLAN IEEE 802.11 b/g - WiFi band 2.4 - 2.485 GHz
Rugged design, meets EN 50155 and EN 50125-3 railway standards
Fire retardant acc. to EN 45545-2 and NFPA130
For outdoor and indoor applications
Ingress protection IP 66 and IP 67

Wall mounting material included

Product Configuration

Technical Data

Electrical Data

	Band 1
Frequency (MHz)	2400 - 2500
VSWR	1.5
Impedance (Ohm)	50
Gain (dBi)	8.5
3dB beamwidth (h) (°)	75
3dB beamwidth (v) (°)	75
Composite power max (W)	30
Ambient temperature (°C)	25
Front to back ratio (dB)	12
Vertical electrical tilt (°)	0

Ports

	Port 1
Connector	N, jack (female)
Polarization	vertical
DC grounded	Yes

General Data

Mechanical Data

Dimensions (mm)	101 x 81 x 36 (Heigth x Width x Depth)
Weight (kg)	0.11
Windload	frontal: 15 N at 160 km/h , Wind speed survival: 220 km/h
Included mounting material	Wall mounting material

Environmental Data

Environmental conditions	indoor/outdoor
Operation temperature (°C)	-40 to 85
Storage temperature (°C)	-40 to 85
Transport temperature (°C)	-40 to 85
Flammability rating	EN 45545-2
2011/65/EU (RoHS - including 2015/863 and 2017/2102)	compliant
Lead-free soldered	yes
WEEE 2012/19/EU	special marking needed
REACH 1907/2006/EC	compliant

FLAMMABILITY: EN 45545-2 (2013) HL3 and NFPA130 (2013), also BS 6853 and DIN 5510-2
ENVIRONMENT: EN 50155 (2016) and EN 50125-3 (2003), also EN 60068 related

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Figure 4: Antenna datasheet part 1

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Data Sheet

HUBER+SUHNER

SENCITY® Spot-S WiFi Antenna
1324.17.0098

IP RATING: IP 66 / IP 67 (IEC 60529)
SOLAR RADIATION: EN 50125-3:2004 §4.9, 1120 W/m² for 20h
AIR PRESSURE: EN 50125-3:2004 §4.2, Altitude Class A1 (up to 1400m)
AIR PULE PRESSURE: EN 50125-3:2004 §4.2, 1 kPa/s
RAIN: EN 50125-3:2004 §4.6, delivery rate: 6 mm/min
VIBRATION / SHOCK: EN 50125-3:2004 §4.13, position profile: "outside the track"
POLLUTION: EN 50125-3:2004 §4.11, pollution levels: 4B1, 4S1
CORROSION: MIL-F-14072 E Type 1 "exposed"
MECHANICAL IMPACT (HAMMER IMPACT): EN 60068-2-75 (IEC 62262/2002-02 IK06)

Material Data

Radome colour	RAL 7044 (grey)
Radome material	PC (Polycarbonate)

Related Products

9091.99.0238 Down_Sidetilt Bracket_SencitySpot-S outdoor
9091.99.0237 L-Bracket for SPOT-S antennas

Related Documents

Mounting instruction	DOC-0000287053
Painting instruction	DOC-0000256180
Security instruction	DOC-0000278984
Outline drawing	DOU-00135740
3D-model	DOC-0000344274

Additional Information

Following Declaration of Conformity for SENCITY® Spot-S antennas are available on request: * Industrial standards EN 60068 / EN 60529 / IEC 61373, ref. DOC-0000318049 * Railway rolling stock, environmental standards EN 50155 and fire behaviour EN 45545-2 NFPA130 ref. DOC-0000380375 * Railway trackside, environmental standards EN 50125-3 and fire behaviour EN 45545-2 ref. DOC-0000411396

HUBER+SUHNER is certified according to ISO 9001, ISO 14001, AS/EN9100, ISO/TS 16949 and IRIS. www.hubersuhner.com

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Figure 5: Antenna datasheet part 2

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3.2. Fault rectification for ZRadio infill function

3.2.1. LED Indications

The on-board and wayside ZRadio components include a green and a red LED for the indication of operating and error information

Table 9: ZRadio Fault rectification

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>If there are any assumed faults in the radio equipment, first check the ZRadio based on the LED indications:
If there is no fault, the green LED shows a steady or flashing light.
If there is a fault, the red LED shows a steady or flashing light.</td></tr>
<tr><td>2</td><td>Check the LED indications based on the table below:
<table>
<tr><th>ZRadio status (start-up)</th><th>LED indication</th></tr>
<tr><td>Switch-on of ZRadio</td><td>Green: on
Red: on</td></tr>
<tr><td>Start-up of ZRadio</td><td>Green: off Red: off</td></tr>
<tr><td>No product software loaded</td><td>Green: flashes at 1 Hz
Red: flashes at 1 Hz</td></tr>
</table>
<table>
<tr><th>ZRadio status (function)</th><th>LED indication</th></tr>
<tr><td>ZRadio is inactive (on-board variant only)</td><td>Green: flashes at 1 Hz
Red: off</td></tr>
<tr><td>ZRadio is in stand-by mode</td><td>Green: on
Red: off</td></tr>
<tr><td>ZRadio is in infill mode</td><td>Green: flashes at 10 Hz
Red: off</td></tr>
<tr><td>ZRadio is in fault mode because, during start-up, read-out of the track coupling coil has failed in line operation. Read-out of the track coupling coil is tried again after 5 s.</td><td>Green: off
Red: flashes at 1 Hz</td></tr>
<tr><td>ZRadio is in fault mode because start-up has failed due to incorrect configuration. Check the position of the OPM rotary coding switch.</td><td>Green: off
Red: flashes at 5 Hz</td></tr>
</table>
<table>
<tr><th>ZRadio status (event)</th><th>LED indication</th></tr>
<tr><td>Serial telegram or radio telegram received (only if ZRadio is not active)</td><td>Green: flashes once
Red: no change</td></tr>
<tr><td>Received serial telegram has an unknown telegram type or invalid attribute values (only if ZRadio is not active)</td><td>Green: no change
Red: flashes once</td></tr>
</table></td></tr>
</table>

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Step	Action
3	Observe the general rules for the replacement and handling of electronic components when replacing the ZRadio

3.2.2. Replacement of ZRadio

A faulty ZRadio is always to be replaced in its entirety.

Table 10: ZRadio replacement steps

Step	Procedure
1	Switch off the power supply of the signal apparatus case.
2	Remove the interface cables from the ZRadio.
3	Replace the ZRadio and reconnect the cables.
4	Set the rotary coding switches to the customer-specific positions
5	Switch on the radio equipment.
6	Check proper operation based on the LED indications.

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4. General Technical Conditions

4.1. Ambient conditions

4.1.1. Power supply

The radio module receives their power separately from the power supply of the signal box (24V DC). The TGMT Zub track coupling coils receive their power inductively from the passing vehicle coupling coil.

4.1.2. Ambient Temperature

On account of the low power consumption during operation no significant heat dissipation occurs. For the TGMT Zub wayside equipment, the following ambient temperature ranges are defined:

- ZRadio-Sx: -40°F to +158°F (-40°C…+70°C)
- Radio-antenna: -40°F to +176°F (-40°C…+80°C)

In order to ensure correct functionality, this temperature range must be observed, i.e., the ambient temperature must be within this range.

The TGMT Zub wayside equipment complies with [EN 60068-2]

- Part 2-1: Tests - Test A: Cold
- Part 2-2: Tests - Test B. Dry heat
- Part 2-14: Tests - Test N: Change of temperature

4.1.3. Humidity

The following humidity stresses apply in the installation room of the signal boards:

- Annual average = 75% rel. humidity
- 30 days in the year continuously 95% rel. humidity
- On the remaining days occasionally 85% relative humidity
- Infrequent and light condensation

These values comply with [EN 60068-2]

- Part 2-30: Tests - Test Db: Damp heat, cyclic.

The above-mentioned operation related infrequent and light condensation causes no malfunctions or failures.

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4.1.4. Degree of protection

The TGMT Zub wayside equipment;

- ZRadio-Sx, Interface board (will be installed in a cabinet) comply rating IP54 [IEC 60529]).
- The track coupling coil and the radio antenna comply with the rating IP67 [IEC 60529].

4.1.5. Altitude

The TGMT Zub wayside equipment is designed for altitudes of -1,312 ft to +6,562 ft (-400 m to +2,000 m) above sea level and thus conforms to the Standard [EN 50125-3].

4.1.6. External Shock and Vibration

The wayside equipment withstands the mechanical stresses occurring at the installation site without any functional impairment and without any change in its operating position.

The TGMT Zub wayside equipment complies with the vibration and shock loads in accordance with [EN 60068-2]

- Part 2-6: Tests - Test Fc: Vibration (sinusoidal)
- Part 2-64: Tests - Test Fh: Vibration, broadband random
- Part 2-27: Tests - Test Ea and guidance: Shock (ZRadio-Sx; TCC)

The mechanical stress occurring at the installation sites for the units of the TGMT Zub wayside equipment must not exceed the values stated in the standard.

4.1.7. Limit values

The reliability of the TGMT Zub wayside equipment is not impaired if the permitted limit values are reached briefly. Constant or long-term operation at the limit values or beyond the limit values results in reduced reliability and is not permitted.

4.1.8. EMC conditions

The components of the TGMT Zub wayside equipment fulfill the directives [2004/108/EC] and [2006/95/EC], [1999/5/EC].

The TGMT Zub wayside equipment satisfies the EMC requirements of the standard [EN 50121-4] Product standard.

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4.1.9. Earthing and lightning protection

Earthing and lightning protection has to be done according to the project wide earthing concept.

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5. 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.

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 to 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.

Changes or modifications to this product not authorized by Siemens Mobility Inc. could void the electromagnetic compatibility (EMC) and wireless compliance and negate your authority to operate the product.

This product has demonstrated EMC compliance under conditions that included the use of compliant peripheral devices and shielded cables between system components. It is important that you use compliant peripheral devices and shielded cables between system components to reduce the possibility of causing interference to radios, televisions, and other electronic devices. In order to comply with the FCC RF Exposure Requirements of Section 1.1307, the antenna of this device must be installed such that a minimum separation distance of 20 cm is maintained between the antenna and any person.

Responsible party (contact for FCC matters only):

Siemens Mobility, Inc.
One Penn Plaza
New York, NY 10119
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