

TEST REPORT

Test report no.: 1-4077/22-01-02-B

Testing laboratory

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Standard/s

特定無線設備の技術基準適合証明等に関する規則

Ordinance concerning Technical Regulations Conformity Certification etc. of Specified Radio Equipment

Article 2, Clause 1, Item 8

無線設備規則

Ordinance Regulating Radio Equipment

Article 49.14 and dedicated articles

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item	Transceiver module
Model name:	TCM 410J
Frequency:	928.35 MHz
Technology tested:	proprietary
Antenna:	external antenna
Power supply:	3.0 V DC
Temperature range:	-25°C to +85°C



This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorized:

Christoph Schneider
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2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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This test report replaces the test report with the number 1-4077/22-01-02-A and dated 2022-03-29.

2.2 Application details

Date of receipt of order: 2022-02-24

Date of receipt of test item: 2022-03-03

Start of test:* 2022-03-07

End of test:* 2022-05-04

Person(s) present during the test: -/-

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

2.3 Test laboratories sub-contracted

None

3 Standard/s

Test standard	Date	Description
---------------	------	-------------

Measurement was conducted by the following test method:

DSPR: Testing Procedure for specified low power devices for telemeter, telecontrol and data transmission system using 920MHz frequency band (20.12.2013 Version 2)

4 Test environment

Temperature:	T _{nom}	+22 °C during room temperature tests
	T _{max}	+85 °C all tests performed at room temperature
	T _{min}	-25 °C all tests performed at room temperature

Relative humidity content: 56 %

Barometric pressure: not relevant for this kind of testing

Power supply:	V _{nom}	3.0 V	DC
	V _{max}	3.3 V	DC
	V _{min}	2.7 V	DC

5 Test item

5.1 General description

Kind of test item	:	Transceiver module
Model name	:	TCM 410J STM 400J (not tested, see chapter 11 DoS)
S/N serial number	:	Cond. 433102000528, 433102000529, 433102000700, transmitter retest with 433102000700
Hardware status	:	DB-8
Software status	:	1.3.2.0
Firmware status	:	n/a
Frequency band	:	928.35 MHz
Type of radio transmission	:	modulated carrier
Type of modulation	:	FSK
Number of channels	:	1
Antenna	:	external antenna
Power supply	:	3.0 V DC
Temperature range	:	-25°C to +85°C

5.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report: 1-4077/22-01-01_AnnexB

6 Description of the test setup

Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

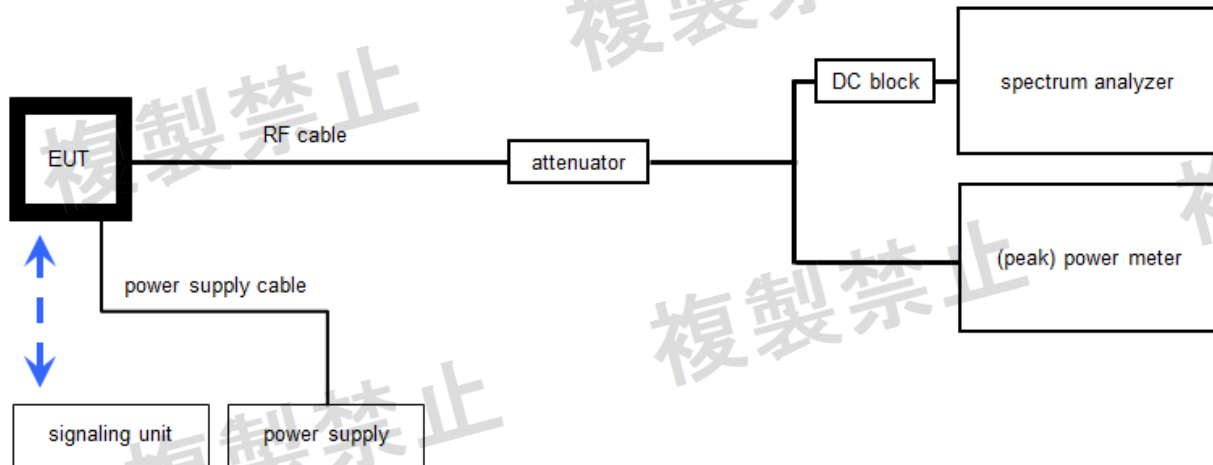
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Calibration Method

- (a) Calibration conducted by the National Institute of Information and Communications Technology (NICT) (hereinafter referred to as "NICT") or a designated calibration agency under Article 102-18 paragraph (1)
- (b) Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Act (Act No. 51 of 1992)
- (c) Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1).
- (d) Calibration, etc. conducted by using measuring instruments and other equipment listed in the right column of appended Table No. 3 of Radio Law(電波法) (related to Article 24-2, Article 38-3, and Article 38-8), which shall have been given any type of calibration, etc. listed above from (a) to (c)

6.1 Conducted measurements with voltage variation

Conducted measurements normal conditions



$OP = AV + CA$
 (OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:

$OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] \text{ (58.88 mW)}$

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Last Calibration	Calibration Authority	Calibration Method
1	n. a.	Signal analyzer	FSW26	Rohde&Schwarz	101455	300004528	14.12.2021	Rohde&Schwarz	c) DAkkS*2
2	n.a.	Signal analyzer	FSV30	Rohde&Schwarz	104365	300005923	14.12.2021	Rohde&Schwarz	c) DAkkS*2
3	n.a.	Power Sensor 10 MHz to 18 GHz	NRP-Z22	Rohde&Schwarz	100039	400000189	07.12.2021	Rohde&Schwarz	c) DAkkS*2
4	n. a.	Power Supply	HMP2020	Rohde & Schwarz	102219	300006192	08.04.2021	R&S	c) DAkkS*2

²calibration made according DAkkS requirements (formerly DKD calibration).

7 Summary of measurement results

<input checked="" type="checkbox"/>	No deviations from the technical specifications were ascertained
<input type="checkbox"/>	There were deviations from the technical specifications ascertained
<input type="checkbox"/>	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC identifier	Description	verdict	date	Remark
ARIB STD-T108 V.1.4	920MHZ-BAND TELEMETER, TELECONTROL AND DATA TRANSMISSION RADIO EQUIPMENT	See tests	2022-04-26	-/-

	Test Case	temperature conditions	power source voltages	Mode	C	NC	NA	NP	Remark
	Frequency tolerance	Nominal	Nominal	CW	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
		Nominal	Low		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Nominal	High		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Occupied bandwidth	Nominal	Nominal	MC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
	Antenna power	Nominal	Nominal	MC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
	Adjacent channel leakage power	Nominal	Nominal	MC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
	Transmitter Spurious emissions	Nominal	Nominal	MC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
	Receiver Spurious emissions	Nominal	Nominal	RX	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
	Transmission time control equipment	Nominal	Nominal	-/-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not rated / Will be declared by manufacturer
	Carrier sense	Nominal	Nominal	-/-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	EIRP <3dBm
	Interference prevention function	Nominal	Nominal	-/-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not rated / Will be declared by manufacturer
	Connection to telecommunication circuit	Nominal	Nominal	-/-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-/-
	Antenna diagrams	Nominal	Nominal	TX	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed; MC = Modulated carrier; CW = Clean wave; NM = Normal mode

7.1 Additional comments

Reference documents: Operational_Description.pdf

Special test descriptions: None

Configuration descriptions: see below

7.1.1 antenna list (provided by customer):

- ANT 300, helical antenna, 2.15dBi gain
- AND 300J, helical antenna, 2.15dBi gain
- Whip antenna. 64mm, -3.89dBi gain
- USB400J , top loaded PCB spiral antenna, 1.14 dBi gain
- ANT-GXM602, "758-0965", monopole antenna, 2.14dBi gain
- 2J520, "758-0961", monopole antenna, 2.14dBi gain
- MC0114033, "758-0910", monopole antenna, 1dBi gain
- USB 400J (mirrored), top loaded PCB spiral antenna, 1.17dBi gain
- 1019-010A, /2 monopole, L type, 3dBi gain
- 1019-008A, /2 monopole, straight type, 3dBi gain
- ME467XSAXX, /2 monopole, straight type, 2dBi gain
- MC0114052-A-WH-SMA, "0758-0911", 2dBi gain.
- GA.111.101111, "0758-0975", monopole antenna, 1.92 dBi gain

8 RF measurements

8.1 Transmitter test results

8.1.1 Frequency deviation

Measurement parameter:

Measurement parameter	
Spectrum Analyzer:	RBW=VBW=10Hz
Additional EUT parameters:	Unmodulated carrier

Results (normal voltage):

	$f_{TX} = 928.35 \text{ MHz}$	-/-	-/-
Frequency offset [kHz]	-2.163	-/-	-/-
Offset [ppm] related to f_{TX}	-2.33	-/-	-/-

Results (low voltage):

	$f_{TX} = 928.35 \text{ MHz}$	-/-	-/-
Frequency offset [kHz]	-2.183	-/-	-/-
Offset [ppm] related to f_{TX}	-2.35	-/-	-/-

Results (high voltage):

	$f_{TX} = 928.35 \text{ MHz}$	-/-	-/-
Frequency offset [kHz]	-2.207	-/-	-/-
Offset [ppm] related to f_{TX}	-2.38	-/-	-/-

Limit:

Limit	The frequency tolerance shall be within $\pm 20 \text{ ppm}$ ($\pm 18.57 \text{ kHz}$)
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8.1.2 Occupied frequency bandwidth

Measurement parameter:

Measurement parameter	
Spectrum Analyzer:	RBW = VBW = 1 kHz Integrated occupied power bandwidth measurement function (99%)
Additional EUT parameters:	Modulated carrier

Results (normal voltage):

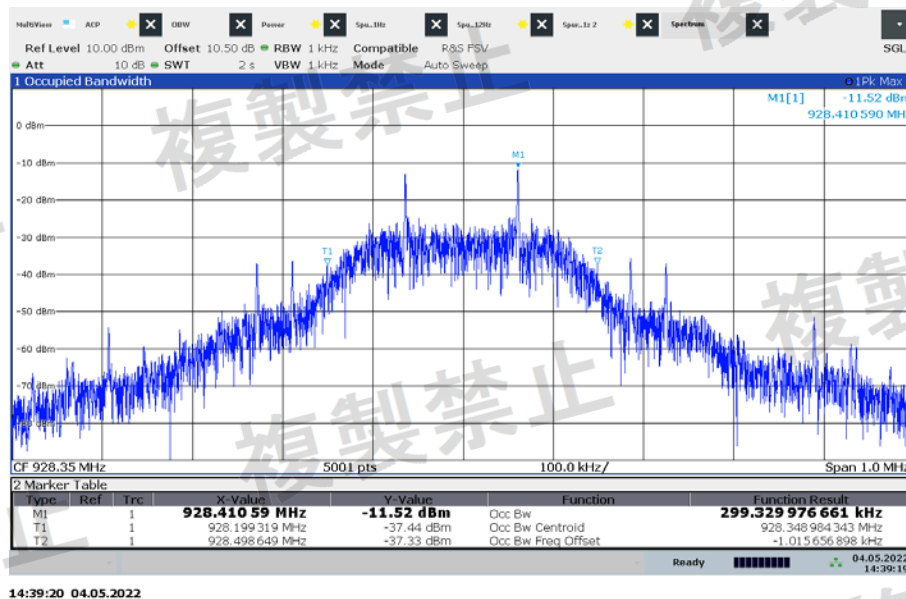
	$f_{TX} = 928.35 \text{ MHz}$	-/-	-/-
Occupied bandwidth [kHz]	299.329	-/-	-/-

Limit:

Limit	It shall be $(100 \cdot n) \text{ kHz}$ or less (n is a number of unit radio channels constituting the radio channel and is an integer from 1 to 5); (EUT uses 3 radio channels)
-------	---

Plots of measurements:

Plot 1: 928.35 MHz



8.1.3 Antenna power

Measurement parameter:

Measurement parameter	
Measurement instrument:	Power Meter
Additional EUT parameters:	Modulated carrier

Results (normal voltage):

	$f_{TX} = 928.35 \text{ MHz}$	-/-	-/-
Antenna power [dBm]	-5.90	-/-	-/-
Radiated power [dBm]	-2.90*	-/-	-/-

Results (low voltage):

	$f_{TX} = 928.35 \text{ MHz}$	-/-	-/-
Antenna power [dBm]	-5.93	-/-	-/-
Radiated power [dBm]	-2.93*	-/-	-/-

Results (high voltage):

	$f_{TX} = 928.35 \text{ MHz}$	-/-	-/-
Antenna power [dBm]	-5.89	-/-	-/-
Radiated power [dBm]	-2.89*	-/-	-/-

*) calculated value based on Antenna power (conducted, using the R&S NRP-Z22 which includes a 10dB attenuator) and on antenna with highest gain (3 dBi)

Limit:

Limit	1 mW (0 dBm) or less (conducted power) Tolerance for antenna power: +20% / -80% Conducted power + Gain: max. 1.2mW (0.8dBm)
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8.1.4 Adjacent channel leakage power

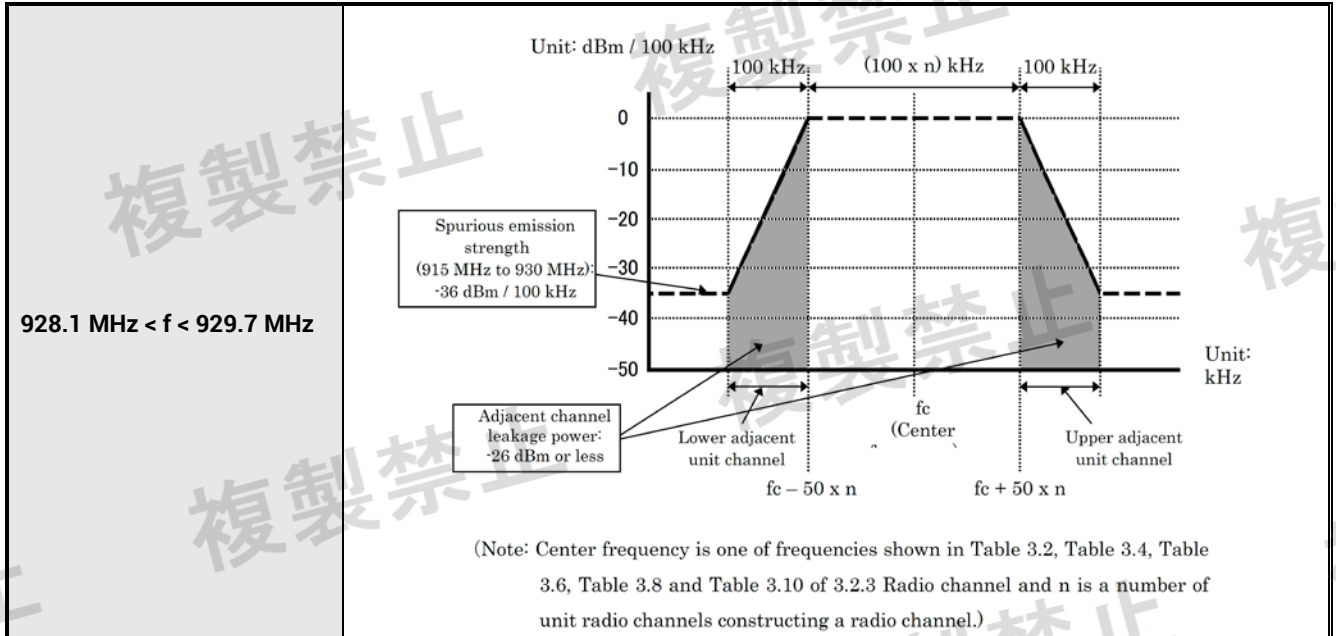
Measurement parameter:

Measurement parameter	
Spectrum Analyzer:	RBW = VBW = 100 kHz
Additional EUT parameters:	Modulated carrier

Results:

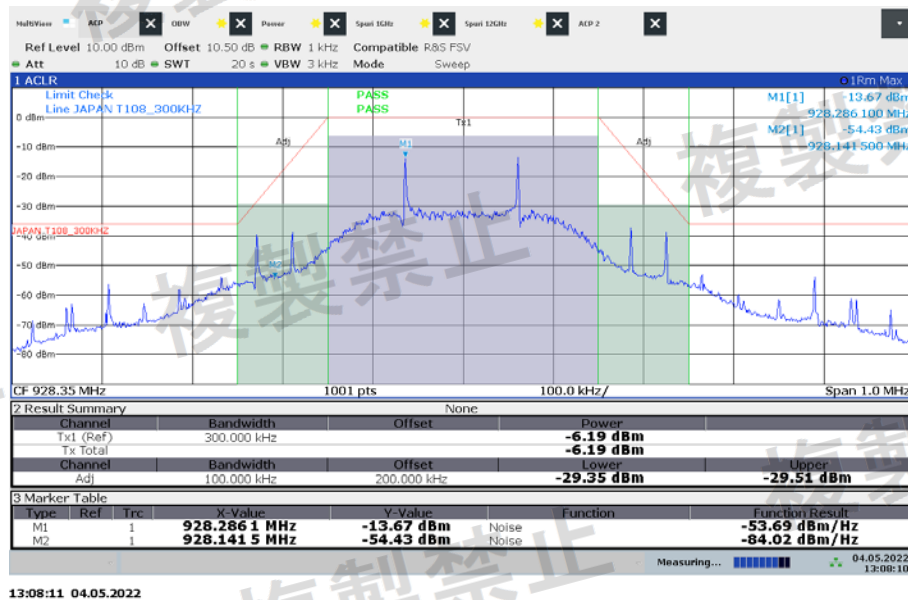
	$f_{TX} = 928.35 \text{ MHz}$	-/-	-/-
Mask limit (see plots)	Compliant	-/-	-/-
Adjacent channel leakage power Lower channel	-29.35 dBm	-/-	-/-
Adjacent channel leakage power Upper channel	-29.51 dBm	-/-	-/-

Limit:



Plot:

Plot 1: 928.35 MHz



8.1.5 Transmitter spurious emissions

Measurement parameter:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz / 1 MHz
Video bandwidth:	100 kHz / 1 MHz
Trace-Mode:	Max Hold
Additional EUT parameters:	Modulated carrier

Results:

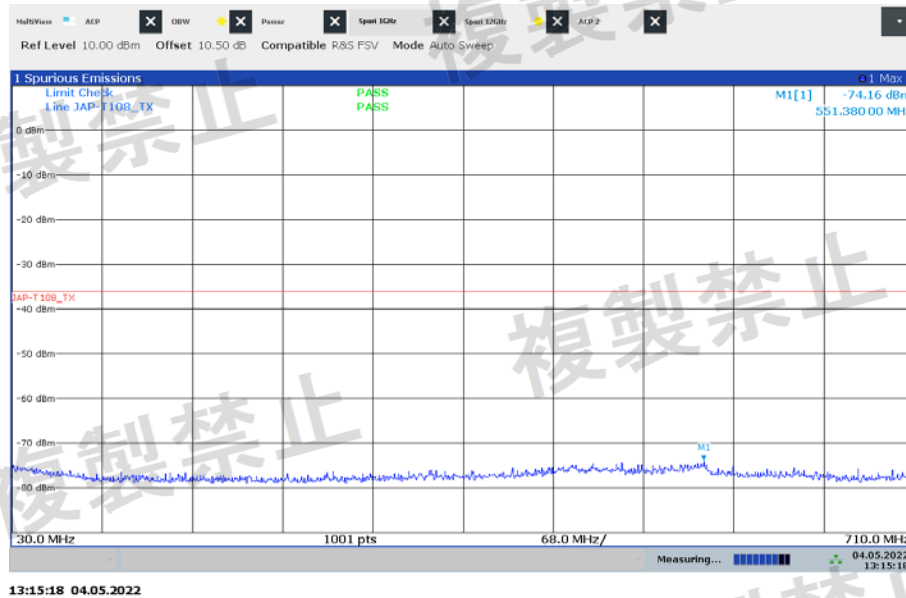
	$f_{TX} = 928.35 \text{ MHz}$		-/-		-/-	
Found peaks:	F [MHz]	Level [dBm]	-/-	-/-	-/-	-/-
	See plots		-/-		-/-	

Limit:

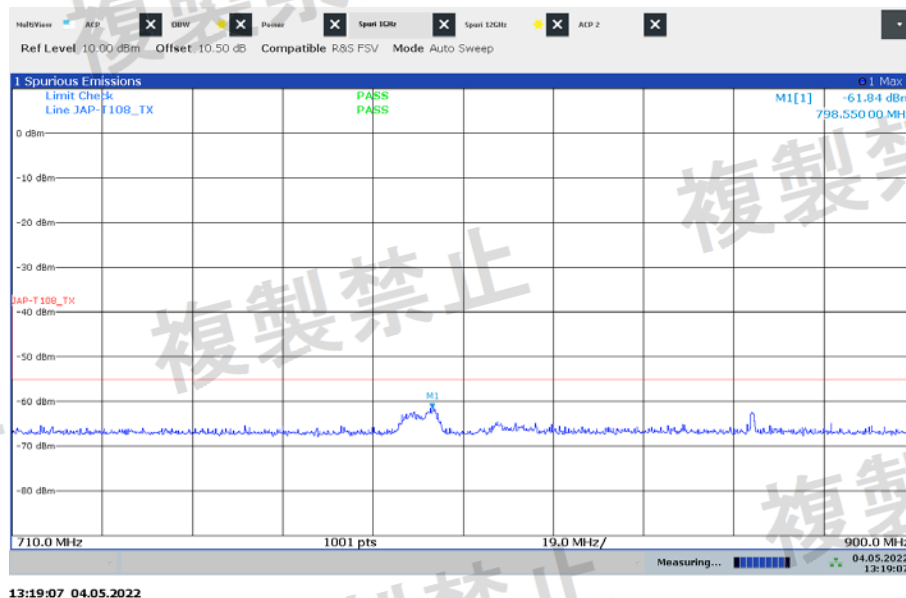
Limit	Table 3-16 Permissible Values for Spurious Emission / Unwanted Emission Intensity (Antenna input)		
	Frequency band	Spurious emission / Unwanted Emission Intensity (average power)	Reference bandwidth
	$f \leq 710 \text{ MHz}$	-36 dBm	100 kHz
	$710 \text{ MHz} < f \leq 900 \text{ MHz}$	-55 dBm	1M Hz
	$900 \text{ MHz} < f \leq 915 \text{ MHz}$	-55 dBm	100 kHz
	$915 \text{ MHz} < f \leq 930 \text{ MHz}^*$ (Except for $ f-f_c \leq (200+100 \times n) \text{ kHz}$ if bandwidth of unit radio channel is 200 kHz, except for $ f-f_c \leq (100+50 \times n) \text{ kHz}$ if bandwidth of unit radio channel is 100 kHz. Except for $ f-f_c \leq (100+100 \times n) \text{ kHz}$ if frequency band is $915.9 \text{ MHz} \leq f \leq 916.9 \text{ MHz}$ and $920.5 \text{ MHz} \leq f \leq 922.3 \text{ MHz}$. Where n is a number of unit radio channels constituting the radio channel and is an integer from 1 to 5)	-36 dBm	100 kHz
	$930 \text{ MHz} < f \leq 1000 \text{ MHz}$	-55 dBm	100 kHz
	$1000 \text{ MHz} < f \leq 1,215 \text{ MHz}$	-45 dBm	1M Hz
	$1,215 \text{ MHz} < f$	-30 dBm	1M Hz
	* Permissible Values for Unwanted Emission Intensity in $915 \text{ MHz} < f \leq 925 \text{ MHz}$ shall be -55 dBm/100 kHz, on and before July 24, 2012.		

Plots:

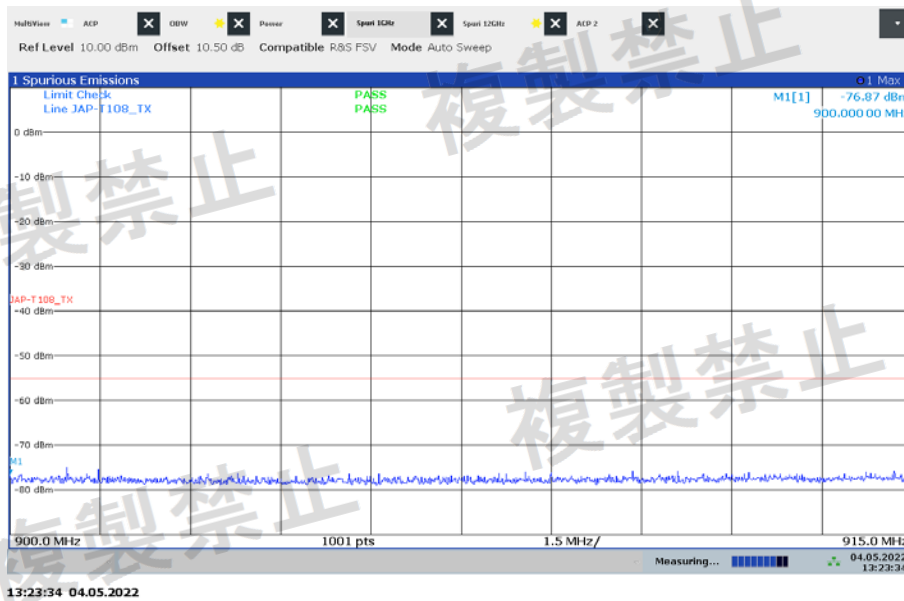
Plot 1: 30MHz – 710MHz



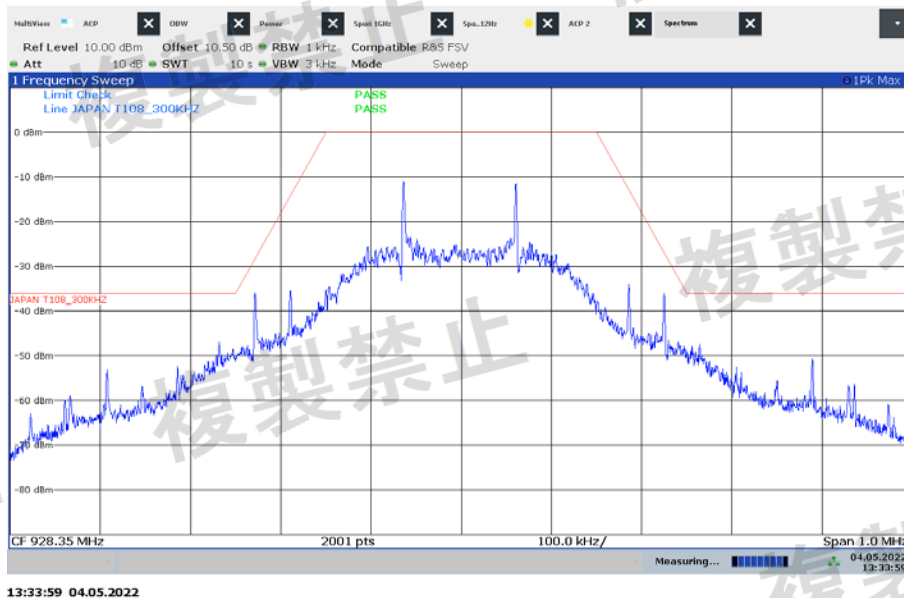
Plot 2: 710MHz – 900MHz



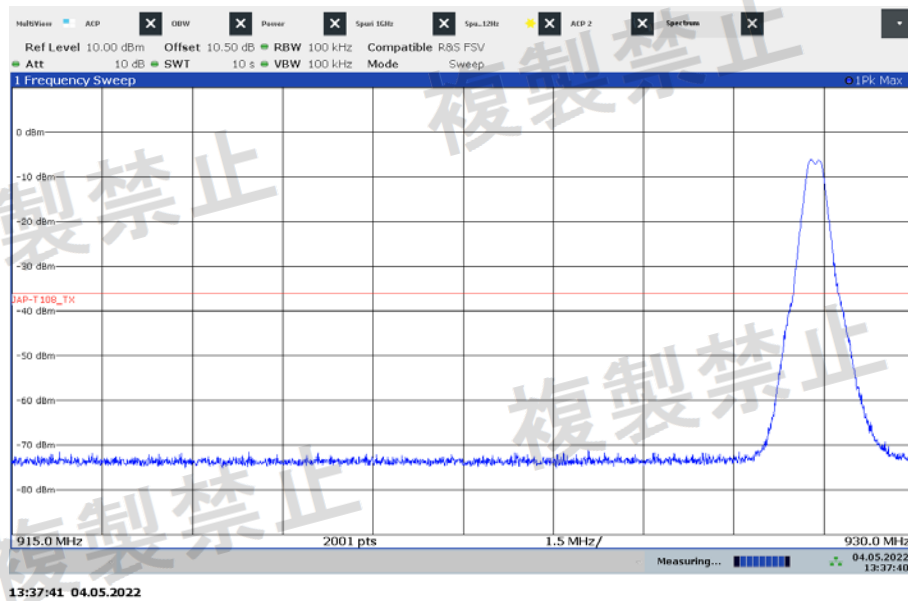
Plot 3: 900MHz – 915MHz



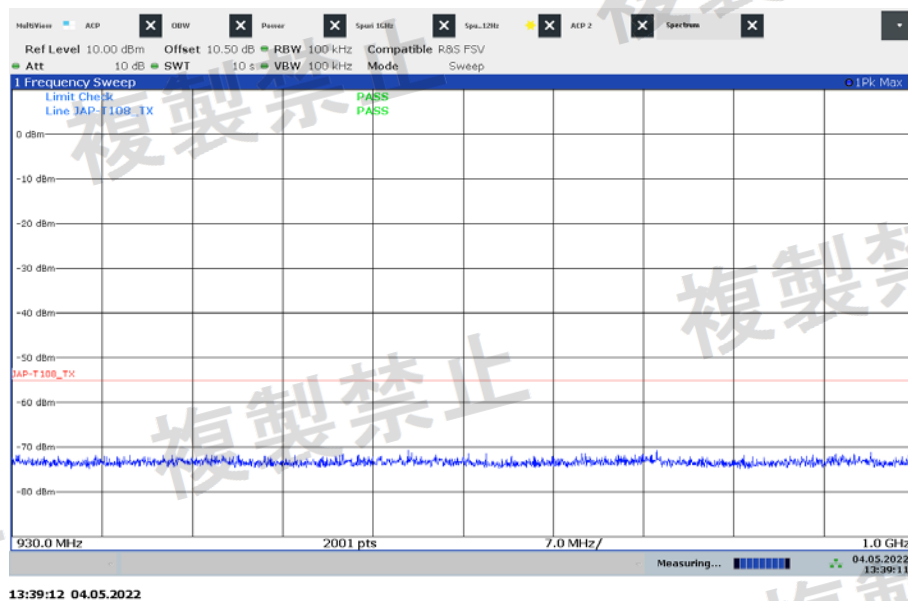
Plot 4: 928.35MHz



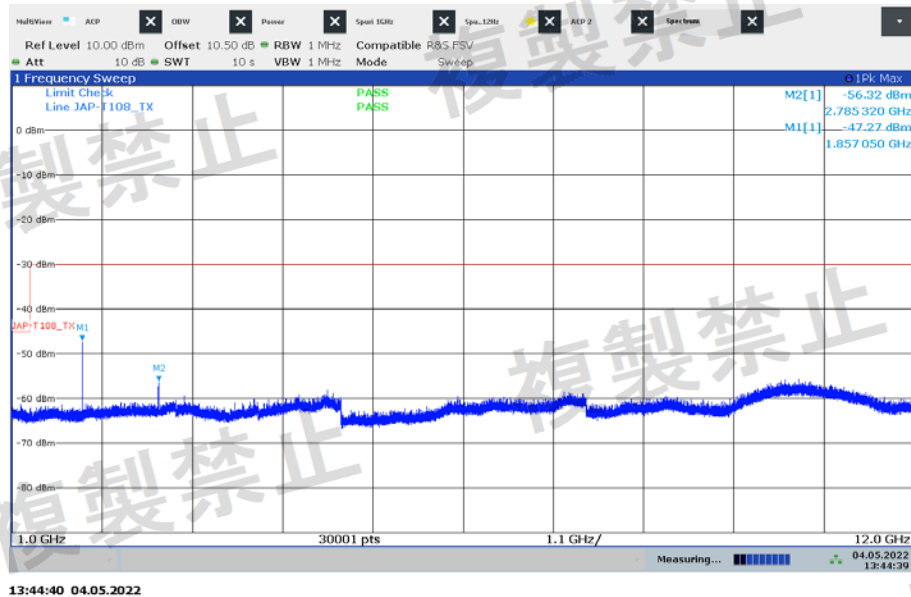
Plot 5: 915MHz – 930MHz



Plot 6: 930MHz – 1GHz



Plot 7: 1GHz – 12GHz



8.1.6 Receiver spurious emissions

Measurement parameter:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz / 1 MHz
Video bandwidth:	100 kHz / 1 MHz
Trace-Mode:	Max Hold
Additional EUT parameters:	Modulated carrier

Results:

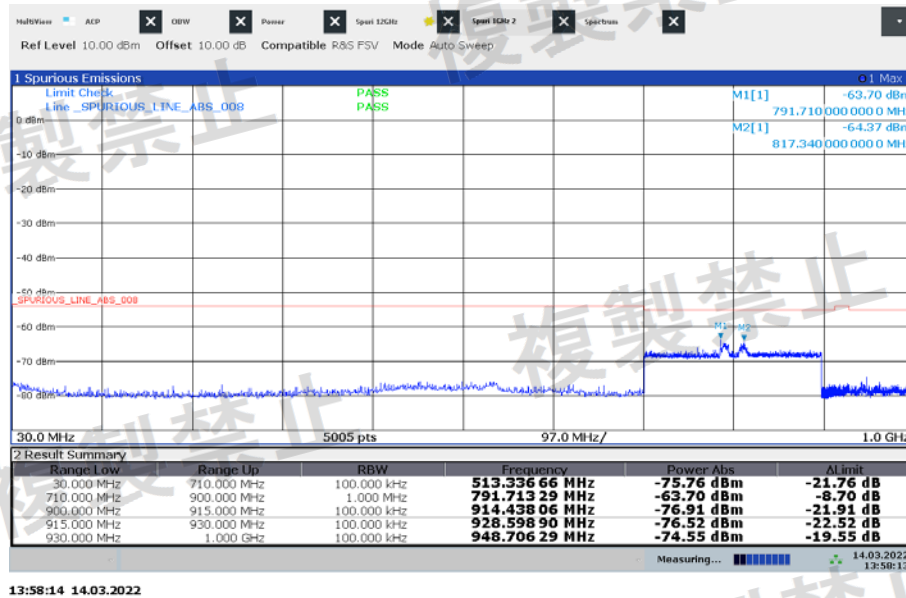
	rx mode		-/-		-/-	
Found peaks:	F [MHz]	Level [dBm]	-/-	-/-	-/-	-/-
	See plots		-/-		-/-	

Limit:

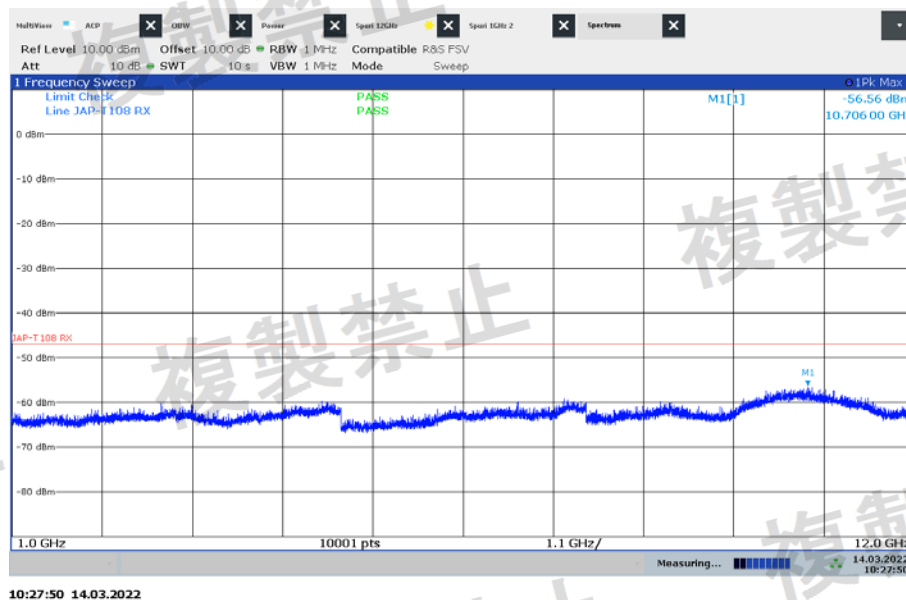
Limit	Frequency band	Limit on Secondary Radiated Emissions (Antenna input)	Reference bandwidth
	$f \leq 710 \text{ MHz}$	-54 dBm	100 kHz
	$710 \text{ MHz} < f \leq 900 \text{ MHz}$	-55 dBm	1 MHz
	$900 \text{ MHz} < f \leq 915 \text{ MHz}$	-55 dBm	100 kHz
	$915 \text{ MHz} < f \leq 930 \text{ MHz}$	-54 dBm	100 kHz
	$930 \text{ MHz} < f \leq 1000 \text{ MHz}$	-55 dBm	100 kHz
	$1000 \text{ MHz} < f$	-47 dBm	1 MHz

Plots:

Plot 1: 30MHz-1GHz



Plot 2: 1GHz-12GHz



9 Observations

No observations except those reported with the single test cases have been made.

10 Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
GUE	GNSS User Equipment
ETSI	European Telecommunications Standards Institute
EN	European Standard
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
IC	Industry Canada
PMN	Product marketing name
HMN	Host marketing name
HVIN	Hardware version identification number
FVIN	Firmware version identification number
EMC	Electromagnetic Compatibility
HW	Hardware
SW	Software
Inv. No.	Inventory number
S/N or SN	Serial number
C	Compliant
NC	Not compliant
NA	Not applicable
NP	Not performed
PP	Positive peak
QP	Quasi peak
AVG	Average
OC	Operating channel
OCW	Operating channel bandwidth
OBW	Occupied bandwidth
OOB	Out of band
DFS	Dynamic frequency selection
CAC	Channel availability check
OP	Occupancy period
NOP	Non occupancy period
DC	Duty cycle
PER	Packet error rate
CW	Clean wave
MC	Modulated carrier
WLAN	Wireless local area network
RLAN	Radio local area network
DSSS	Dynamic sequence spread spectrum
OFDM	Orthogonal frequency division multiplexing
FHSS	Frequency hopping spread spectrum
GNSS	Global Navigation Satellite System
C/N₀	Carrier to noise-density ratio, expressed in dB-Hz

11 Declaration of Similarity (provided by customer)**EnOcean**
Self-powered IoT**Declaration of Similarities and Differences
Of the Models STM 400J and TCM 410J****Module Difference Description between STM 400J and TCM 410J**

Both mentioned modules are based on the same hardware platform. The product variations carry different firmware, which offers different functionality for the end user. The parts of the firmware, which define the radio properties, are the same in all firmware variations.

The Sensor Transceiver Module STM 400J enables the realization of wireless and maintenance free sensors and actuators such as room operating panels, motion sensors or valve actuators for heating control. It's Power supply is typically provided by an external energy harvester, e.g. a small solar cell (e.g. EnOcean ECS 3x0) or a thermal harvester. An energy storage device can be connected externally to bridge periods with no supply from the energy harvester. A voltage limiter avoids damaging of the module when the supply from the energy harvester gets too high. The module provides a user configurable cyclic wake up. After wake up a radio telegram (input data, unique 48 bit sensor ID, checksum) will be transmitted in case of a change of any digital input value compared to the last sending or in case of a significant change of measured analogue values (different input sensitivities can be selected). In case of no relevant input change a redundant retransmission signal is sent after a user configurable number of wake-ups to announce all current values. In addition a wake up can be triggered externally.

The Transceiver Module TCM 410J is a radio transceiver module enabling the realization of gateways for EnOcean 928 MHz radio systems. It provides a bi-directional radio interface and a bi-directional serial interface. Radio messages are sent transparently through the serial interface in both directions from and to an externally connected host processor or host PC. In addition, control commands can be sent from the host, e.g. to configure the repeater functionality or to manage Smart Ack functions.

Sincerely,

15-March 2022

Date, Signature
(EnOcean GmbH / Darius Draksas / Head of electronics)

12 Document history

Version	Applied changes	Date of release
-/-	Initial release	2022-03-22
A	OBW limit information added	2022-03-29
B	re-test of the transmitter measurements in chapter 8.1.2 to 8.1.5 on modified Hardware (higher output level)	2022-05-05

END OF TEST REPORT