

Report Reference ID:	303872-5TRFWL
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Test specification:	Title 47 – Telecommunication Chapter I – Federal Communications Commission Subchapter D – Safety and special radio services Part 90 – Private land mobile services Subpart I – General technical standards
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Applicant:	TEKO Telecom Srl. Via Meucci, 24/a I-40024 Castel S. Pietro Terme (BO) (Italy)	
Apparatus:	Digital Donor Front End	
Model:	TDFE-7FL-4	
FCC ID:	XM2-DFE7FL	

Testing laboratory:	Nemko Italy Spa Via del Carroccio, 4 20853 Biassono (MB) – Italy Telephone: +39 039 2201201 Facsimile: +39 039 2201221
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Name and title		Date
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Specification: FCC 90

Section 1: Report summary

Test specification

Specifications

Part 90 - Private land mobile services

1.2 Statement of compliance

Compliance

In the configuration tested the EUT was found compliant

Yes 🖂 No □

This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Canada Inc. These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 90. Radiated tests were conducted in accordance with ANSI C63.4-2003.

1.3 **Exclusions**

Exclusions

None

1.4 Registration number

Test site FCC
ID number

176392 (3 m Semi anechoic chamber)

Test report revision history

•	
Revision #	Details of changes made to test report
TRF	Original report issued
R1TRF	

1.6 Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

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Specification: FCC 90

Section 2: Summary of test results

2.1 FCC Part 90, test results			
Part	Methods	Test description	Verdict
	§ 935210 D05v01 (4.2)	AGC threshold	Pass
	§ 935210 D05v01 (4.3)	Out of band rejection	Pass
§90.209 §90.219(e)(4)	§ 935210 D05v01 (4.4)	Occupied bandwidth	Pass
§90.205 §90.219(e)(1)	§ 935210 D05v01 (4.5)	Output power at RF antenna connector	Pass
§90.219(e)(2)	§ 935210 D05v01 (4.6)	Noise Figure	Pass
§90.543(c) §90.219(e)(3)	§ 935210 D05v01 (4.7)	Spurious emissions at RF antenna connector	Pass
§90.543(c) §90.219(e)(3)	§ 935210 D05v01 (4.9)	Radiated spurious emissions	Pass
§90.543(f) §90.219(e)(3)	§ 935210 D05v01 (4.9)	Radiated spurious emissions within 1559-1610 MHz band	Pass
§90.213	§ 935210 D05v01 (4.8)	Frequency stability	N/A a)

Notes:

a) NOT APPLICABLE: Modulation/frequency conversion circuitry not in use. No frequency change in EUT (input and output have same frequency)



Product: TDFE-7FL-4

Section 3: Equipment under test (EUT) and application details

3.1 Applicant of	details		
Applicant	Name:	Teko Telecom Srl	
complete	Federal		
business name	Registration	0018963462	
	Number (FRN):		
	Grantee code	XM2	
Mailing address	Address:	Via Meucci, 24/a	
•	City:	Castel S. Pietro Terme	
	Province/State:	Bologna	
	Post code:	40024	
	Country:	Italy	
	,	,	
3.2 Modular ed	quipment		
a) Single modular	Single modular approval		
approval	Yes ☐ No ⊠		
b) Limited single	Limited single modular approval		
modular approval	Yes □ No ⊠		
3.3 Product de	etails		
FCC ID	Grantee code:	XM2	
	Product code:	-DFE7FL	
Equipment class	B9B		
Description of	Booster		
product as it is	Model	TDFE-7FL-4	
marketed	name/number:		
	Serial number:	1003325001	
3.4 Application			
Type of	Original certi		
application		entification of presently authorized equipment	
	Original FCC	CID: Grant date:	
		nissive change or modification of presently authorized	
	equipment		



Specification: FCC 90

Section 3: Equipment under test

3.5 Composite/related equipment		
a) Composite	The EUT is a composite device subject to an additional equipment	
equipment	authorization	
	Yes ☐ No ⊠	
b) Related	The EUT is part of a system that operates with, or is marketed with,	
equipment	another device that requires an equipment authorization	
	Yes □ No ⊠	
c) Related FCC ID	If either of the above is "yes":	
	has been granted under the FCC ID(s) listed below:	
	is in the process of being filled under the FCC ID(s) listed below:	
	is pending with the FCC ID(s) listed below:	
	listed below:	
	i FCC ID:	
	ii FCC ID:	
c) Related FCC ID	If either of the above is "yes": has been granted under the FCC ID(s) listed below: is in the process of being filled under the FCC ID(s) listed below: is pending with the FCC ID(s) listed below: has a mix of pending and granted statues under the FCC ID(s) listed below: i FCC ID:	

3.6 Sample inf	ormation
Receipt date:	2016-03-14
Nemko sample ID number:	

3.7 EUT techn	ical specifications
Operating band:	Down Link: 769–775 MHz, Up Link: 799-805 MHz
Operating frequency:	Wideband
Modulation type:	P25, FM
Occupied bandwidth:	Standard
Channel spacing:	standard
Emission designator:	F1E, F1D, F3E
RF Output	Down Link: N.A. (The EUT does not transmit over the air in the down-link direction) Up Link: 26dBm
Gain	Down Link: N.A. (The EUT does not transmit over the air in the down-link direction) Up Link: 64dB
Antenna type:	External Antenna is not provided, equipment that has an external 50 Ω RF connector
Power source:	100-240 Vac



Specification: FCC 90

Section 3: Equipment under test

3.8 Accessories and	d support equipment
The following information id	entifies accessories used to exercise the EUT during testing:
No other FCC-ID equipmen	t are used to exercise the EUT during testing
Item # 1	
Type of equipment:	Master Unit - Subrack
Brand name:	Teko Telecom srl
Model name or number:	SUB-TRX-PSU
Serial number:	101083001
Nemko sample number:	
Connection port:	
Cable length and type:	
Item # 2	
Type of equipment:	Master Unit – Management Module
Brand name:	Teko Telecom srl
Model name or number:	TSPV-R
Serial number:	081300017
Nemko sample number:	
Connection port:	LAN port
Cable length and type:	
Item # 3	
Type of equipment:	Master Unit – Power Supply
Brand name:	Teko Telecom srl
Model name or number:	TPSU/AC
Serial number:	100012286
Nemko sample number:	
Connection port:	
Cable length and type:	
Item # 4	
Type of equipment:	
Brand name:	
Model name or number:	
Serial number:	
Nemko sample number:	
Connection port:	
Cable length and type:	



Product: TDFE-7FL-4

3.9 Operation of the EUT during testing

Details:

In up-link direction, normal working at max gain with max RF power output.

3.10 EUT setup diagram

In this system, DFE is the EUT. As described in "Operational description", DFE can be connected directly to optical system or Service Front end. Signal generator is linked directly to the RF input connector of the EUT, so the system doesn't use another equipment (under another FCC ID) to exercise the EUT.

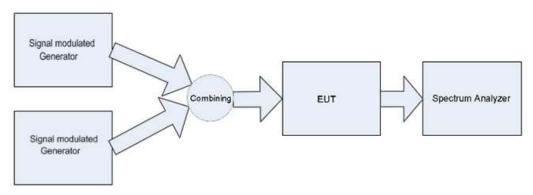
Test setup for output power, occupied bandwidth, spurious emissions:



Procedure

Connect the signal modulated generator to the input of the EUT, so that the EUT works at the max gain. Raise the input level to the EUT until reach the maximum output power. Connect the spectrum analyzer to the RF output connector of the EUT.

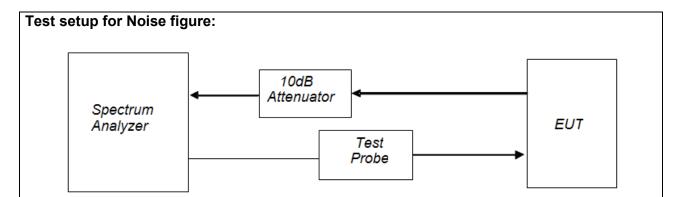
Test setup for intermodulation:



Procedure

Connect two signal modulated generators to the input of the EUT, so that the two input signals are same level. The EUT works at the max gain. Raise the input level to the EUT until reach the maximum output power. Connect the spectrum analyzer to the RF output connector of the EUT. At maximum drive level, for each modulation applies two tones for fulfill two tests (high-band edge and low-band-edge)





Procedure

Connect the EUT with the spectrum analyzer as described in the picture below. Connect the "Output Noise Source" spectrum analyzer with the RF input connector of the Remote Unit. Connect the output RF connector with the spectrum analyzer. Between spectrum analyzer and Remote Unit use a "Noise Source" (Test probe), so the noise of reference is generated. Set the EUT at max gain.



Product: TDFE-7FL-4

Section 4: Engineering considerations

4.1 Modificatio	ns incorporated in the EUT
Modifications	Modifications performed to the EUT during this assessment None ☑ Yes ☐, performed by Client ☐ or Nemko ☐ Details:
4.2 Deviations	from laboratory tests procedures
Deviations	Deviations from laboratory test procedures None Yes - details are listed below:
4.3 Technical j	udgment
Judgment	None



Specification: FCC 90

Section 5: Test conditions

5.1 Deviations from laboratory tests procedures

No deviations were made from laboratory test procedures.

5.2 Test condition	tions, power source and ambient temperatures
Normal temperature, humidity and air pressure test conditions	Temperature: 15–30 °C Relative humidity: 20–75 % Air pressure: 86–106 kPa
	When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.
Power supply range:	The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.





Section 5: Test conditions, continued

5.3 Measurement uncertainty

Nemko S.p.A. measurement uncertainty has been calculated using the standard CISPR 16-4-2 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modeling – Uncertainty in EMC measurements". All calculations can be found in Nemko S.p.A. document WML1002.

5.4 Test equ	ipment			
Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
Vector Signal Generator	Agilent	N5172B EXG	MY53051238	Jun 2018
Vector Signal Generator	Agilent	E4438C ESG	MY45094485	Ago 2016
Spectrum Analyzer	Agilent	N9030A PXA	MY53120882	Jun 2016
Network Analyzer	Agilent	E5071C ENA	MY46106183	Jun 2016
Power Source	Agilent	346B	4124A17612	Ago 2018
V-network	R&S	ESH2-Z5	872 460/041	11/2016
Trilog Broad Band Antenna 25-2000 MHz	Schwarzbeck	VULB 9168	VULB 9168-242	06/2018
Trilog Broad Band Antenna 25-8000 MHz	Schwarzbeck	VULB 9162	VULB 9162-25	07/2018
Antenna 1-18 GHz	Schwarzbeck	STLP 9148	STPL 9148-123	06/2018
Double ridge waveguide horn	RFspin	DRH40	061106A40	08/2016
Preamplifier 18-40 GHz	Miteq	JS44	1648665	12/2016
Broadband preamplifier 1-18 GHz	Schwarzbeck	BBV 9718	9718-137	10/2016
EMI receiver 20 Hz ÷ 8 GHz	R&S	ESU8	100202	04/2016
EMI receiver 20 Hz ÷ 3 GHz	R&S	ESCI	100888	09/2016
Hydraulic revolving platform	Nemko	RTPL 01	4.233	NCR
Turning-table	R&S	HCT	835 803/03	NCR
Antenna mast	R&S	HCM	836 529/05	NCR
Controller	R&S	HCC	836 620/7	NCR
Spectrum Analyzer 9kHz ÷ 40GHz	R&S	FSEK	848255/005	11/2016
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	09/2016
Shielded room	Siemens	10m control room	1947	NCR
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	70	NCR
Shielded Room	Siemens	3m semi-anechoic chamber	3	NCR
Motor controller	Emco	1051-25	9012-1559	NCR
Motor controller	Emco	1061-1.521	9012-1508	NCR
Antenna Tower	Emco	2071-2	9601-1940	NCR
Controller pole/table	Emco	2090	9511-1099	NCR

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use (*) Equipment supplied by manufacturer's



Appendix A: Test results

Clause 935210 D05v01 (4.2) AGC threshold

Measure of EUT AGC Threshold

Test date: 2016-03-16
Test results: Pass

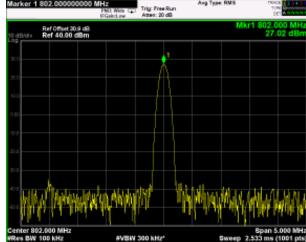
Special notes

The results are the same both with maximum and minimum pass-band of the digital filter: the bandwidth of the signal is lower than minimum pass-band.

Test data







CW signal, nominal input signal +1 dB



Specification: FCC 90

Clause 935210 D05v01 (4.3) Out of band rejection

Out of Band Rejection – Test for rejection of out of band signals.

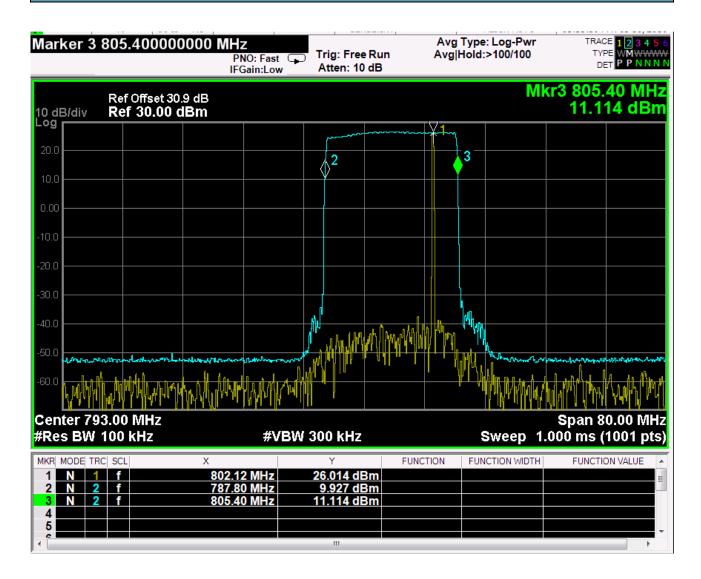
Test date: 2016-03-16

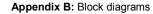
Test results: Pass

Special notes

To demonstrate compliance with these requirement on whole band, maximum pass-band of the digital filter is applied.

Test data







Specification: FCC 90

Clause 90.209, 90.219(e)(4) Occupied bandwidth

§ 90.219(e)(4)

A signal booster must be designed such that all signals that it retransmits meet the following requirements:

- (i) The signals are retransmitted on the same channels as received. Minor departures from the exact provider or reference frequencies of the input signals are allowed, *provided that* the retransmitted signals meet the requirements of § 90.213.
 - (ii) There is no change in the occupied bandwidth of the retransmitted signals.
- (iii) The retransmitted signals continue to meet the unwanted emissions limits of § 90.210 applicable to the corresponding received signals (assuming that these received signals meet the applicable unwanted emissions limits by a reasonable margin).

Test date: 2016-03-16

Test results: Pass

Special notes

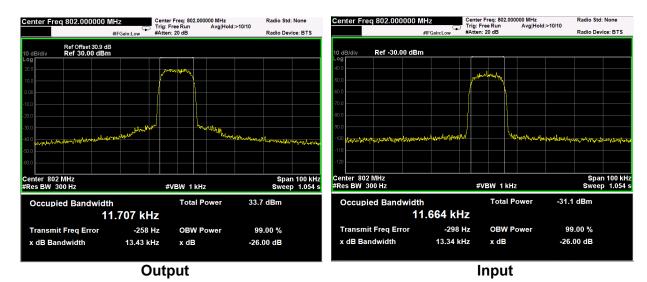
The results are the same both with maximum and minimum pass-band of the digital filter: the bandwidth of the signal is lower than minimum pass-band.

Product: TDFE-7FL-4

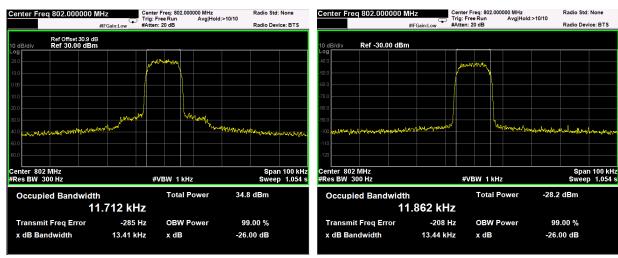
Occupied bandwidth, continued

Test data

11K signal, nominal input signal



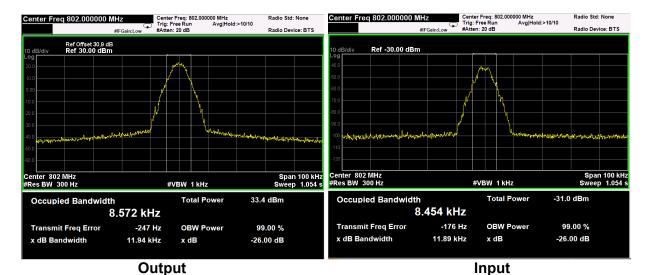
11K signal, nominal input signal + 3dB



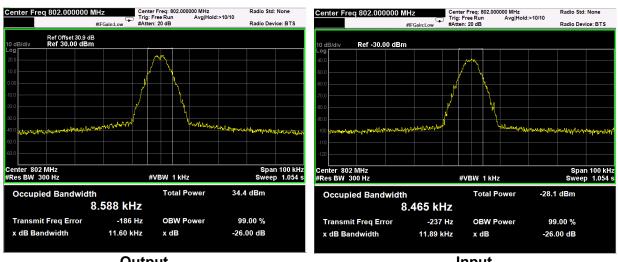
Output Input



P25 signal, nominal input signal



P25 signal, nominal input signal + 3dB



Output Input



Product: TDFE-7FL-4

Clause 90.205, 90.219(e)(1) Output power at RF antenna connector

§ 90.205

Applicants for licenses must request and use no more power than the actual power necessary for satisfactory operation. Except where otherwise specifically provided for, the maximum power that will be authorized to applicants whose license applications for new stations are filed after August 18, 1995 is as follows in FCC Part 90.205 (a) through (r).

§ 90.219(e)(1)

The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.

Test date: 2016-03-16

Test results: Pass

Special notes

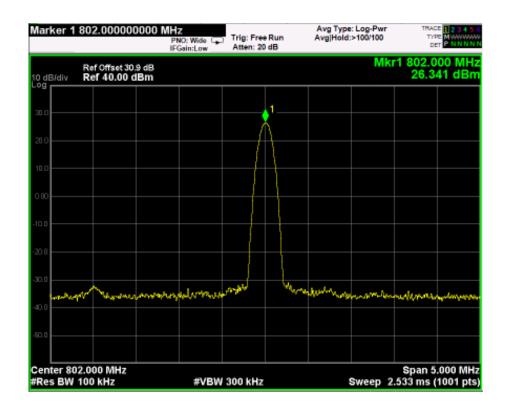
The results are the same both with maximum and minimum pass-band of the digital filter: the bandwidth of the signal is lower than minimum pass-band.

Specification: FCC 90

Output power at RF antenna connector

CW signal, nominal input signal

Test data					
Direction	Modulation	Frequency (MHz)	RF output Power (dBm)	RF output channel Power (W)	RF output Power (W/MHz)
Down-link	CW	802,0	26,34	0,43	0,043



Test result

Gmax antenna gain (dBi) = 39 - 26.34 = 12.66 dBi

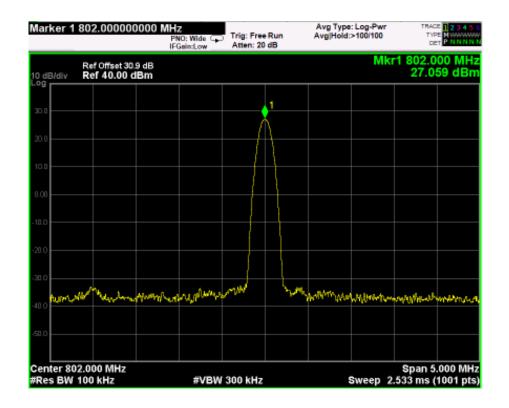
EIRP = 26.34 + 12.66 = 39 dBm

ERP = 39 - 2.14 = 36.86dBm = 4.85W < 5 W ERP



CW signal, nominal input signal + 3dB

Test data					
Direction	Modulation	Frequency (MHz)	RF output Power (dBm)	RF output channel Power (W)	RF output Power (W/MHz)
Down-link	CW	802,0	27,06	0,51	0,051





Product: TDFE-7FL-4

Clause 935210 D05v01 (4.6) Noise figure

§ 90.219(e)(2)

The noise figure of a signal booster must not exceed 9 dB in either direction.

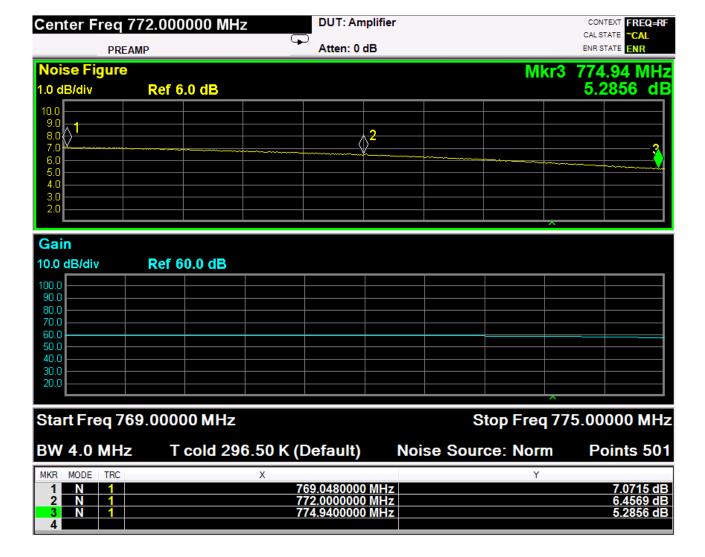
Test date: 2016-03-16

Test results: Pass

Special notes

In the Digital Front-End, only down-link measurement can be performed (test probe is connect to antenna port)

To demonstrate compliance with these requirement on whole band, maximum pass-band of the digital filter is applied.





Specification: FCC 90

Clause 90.543(c), 90.219(e)(3) Spurious emissions at the antenna terminal

§ 90.543(c)

Out-of-band emission limit. On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least 43 + 10log (P) dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

§ 90.219(e)(3)

Spurious emissions from a signal booster must not exceed –13dBm within any 100 kHz measurement bandwidth.

Test date: 2016-03-16
Test results: Pass

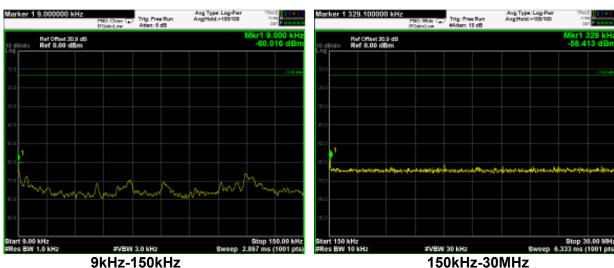
Special notes

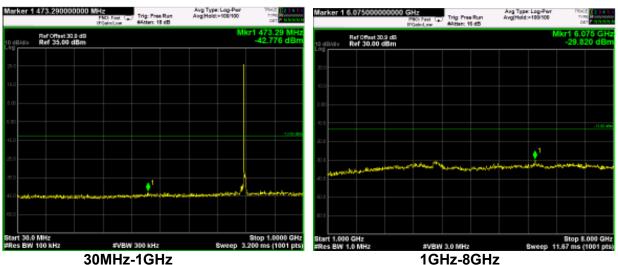
The results are the same both with maximum and minimum pass-band of the digital filter: the bandwidth of the signal is lower than minimum pass-band.



Test data: Spurious emissions at RF antenna connector

CW signal – First Channel (799,025MHz)

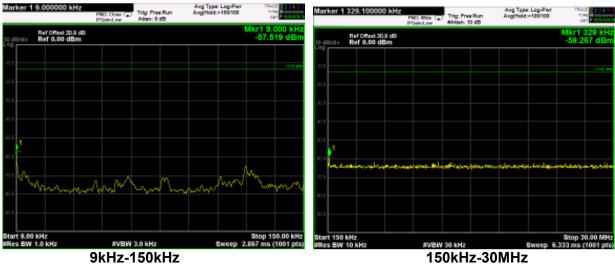




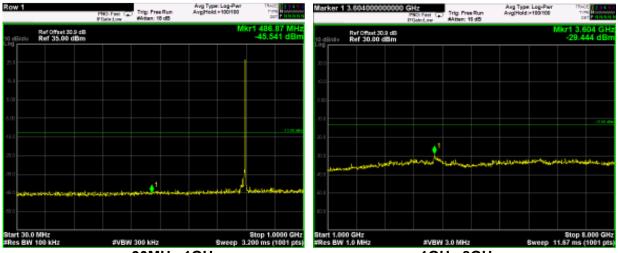
1GHz-8GHz



CW signal – Middle Channel (802,0MHz)



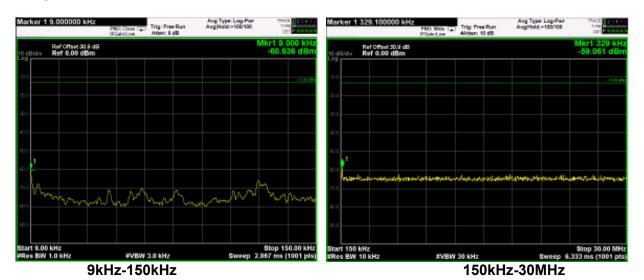


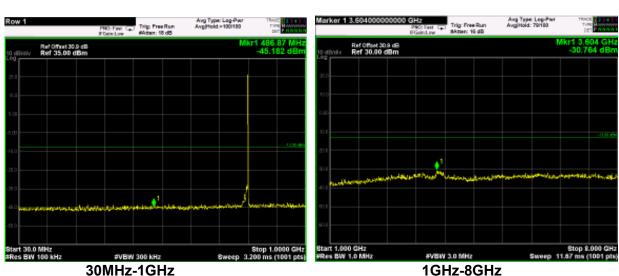


1GHz-8GHz 30MHz-1GHz



CW signal – Last Channel (804,975MHz)

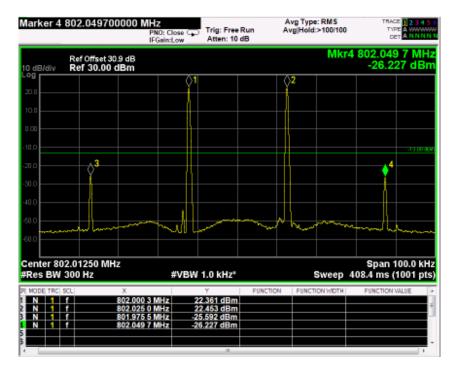




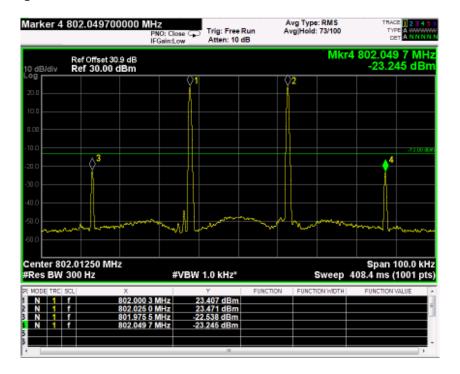


Test data: Spurious emissions at RF antenna connector: intermodulation

Nominal input signal



Nominal input signal + 3dB





Product: TDFE-7FL-4

Clause 90.543(c), 90.219(e)(3) Spurious emissions radiated

§ 90.543(c)

Out-of-band emission limit. On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least 43 + 10log (P) dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

§ 90.219(e)(3)

Spurious emissions from a signal booster must not exceed –13dBm within any 100 kHz measurement bandwidth.

Test date: 2016-03-15
Test results: Pass

Special notes

The results are the same both with maximum and minimum pass-band of the digital filter: the bandwidth of the signal is lower than minimum pass-band.



Specification: FCC 90

Radiated spurious emissions, continued

Test data

The D.U.T. was positioned according to the radiated emissions set-up

The D.U.T. antenna connector was terminated by a 50 Ω shielded dummy load.

The spectrum was searched from 30 MHz to 1 GHz (RBW 100 kHz) & 1 GHz (RBW 1 MHz) to the tenth harmonic of the carrier.

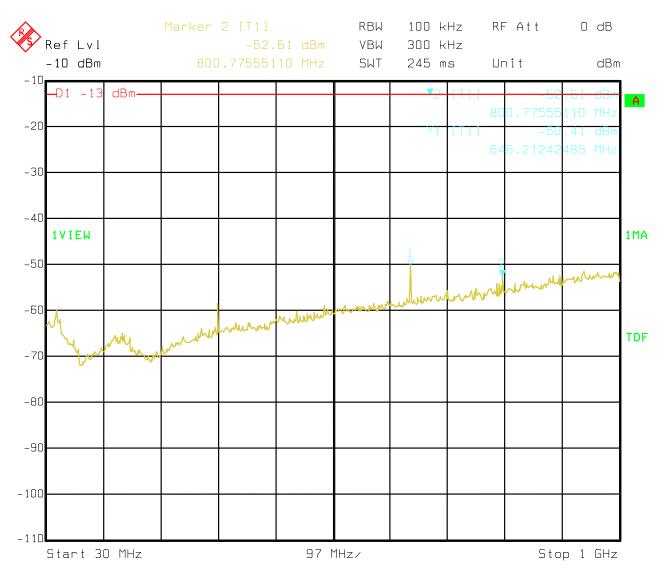
There were no emissions detected above the noise floor which was at least 20 dB below the specification limit.

Spurious emissions measurement results:

Frequency (MHz)	Polarization. V/H	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Low channel	VIII	(αυμν/ιιι)	(αυμν/ιιι)	(u <i>b)</i>
LOW CHAINICI				
Mid channel		L		L
High channel				
_				

Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

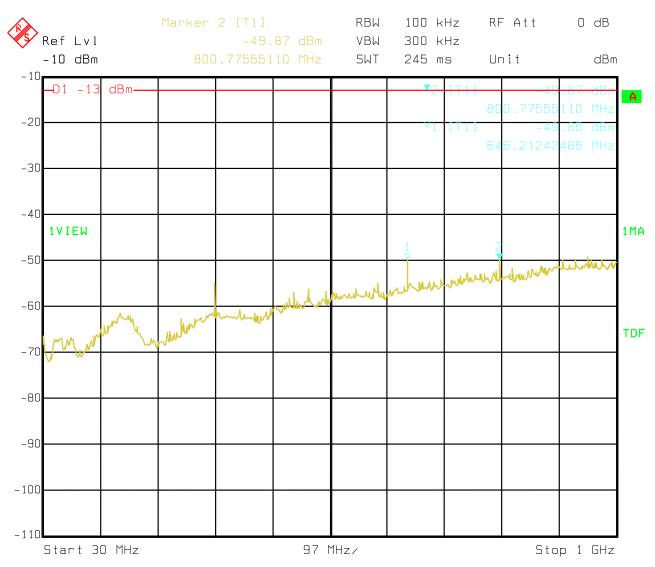




Date: 15.MAR.2016 12:19:59

30MHz-1GHz - H Pol

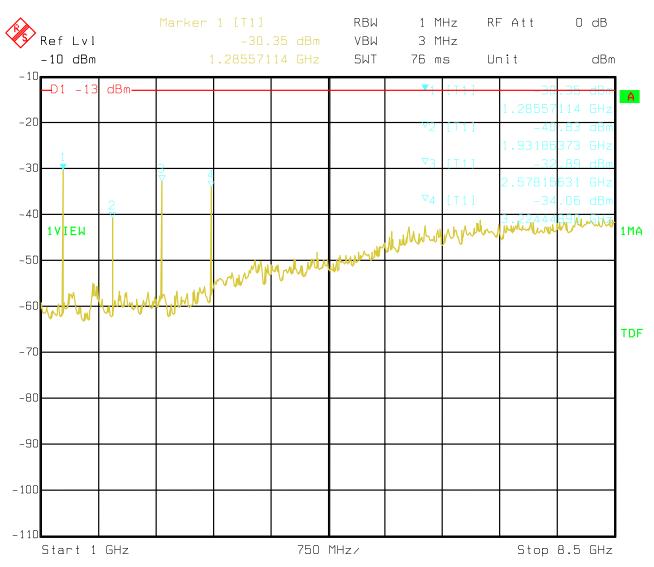




Date: 15.MAR.2016 12:24:36

30MHz-1GHz - V Pol

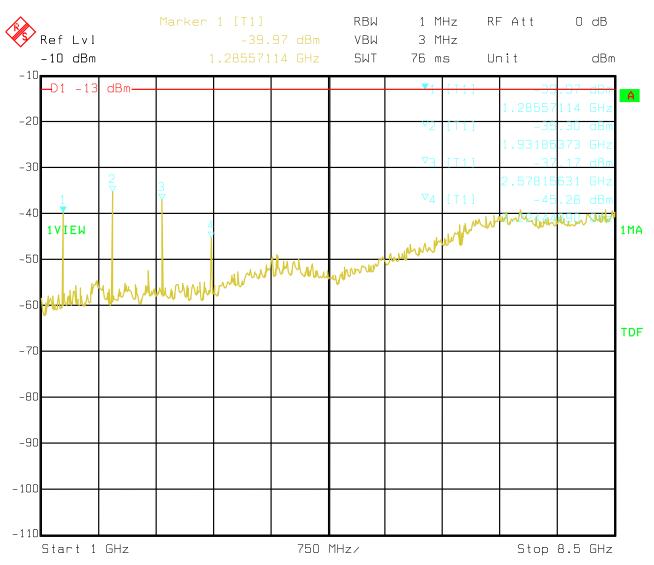




Date: 15.MAR.2016 12:51:50

1GHz-8GHz - H Pol





Date: 15.MAR.2016 12:44:38

1GHz-8GHz - V Pol



Product: TDFE-7FL-4

Clause 90.543(f) Radiated spurious emissions within 1559–1610 MHz band

§ 90.543(f)

For operations in the 763-775 MHz and , 793-805 MHz bands, all emissions including harmonics in the band 1559–1610 MHz shall be limited to $-70~\mathrm{dBW/MHz}$ equivalent isotropically radiated power (EIRP) for wideband signals, and $-80~\mathrm{dBW}$ EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation

Note:

Method of measurement according to TIA-603-C (EIRP in GNSS band: 1.556 to 1.610 GHz) . Δ Band = 51 MHz, Correction Factor calculated at central band 1604.5 MHz. in Fraunhofer Region.

Test date: 2016-03-15
Test results: Pass

Special notes

- The spectrum was searched from 1559–1610 MHz.
- All measurements were performed using a peak detector.
- The measurements were performed at the distance of 3 m.
- RBW was set to 1 MHz and VBW was wider than RBW



Result of U.L. 26 dBm, 802.0 MHz,

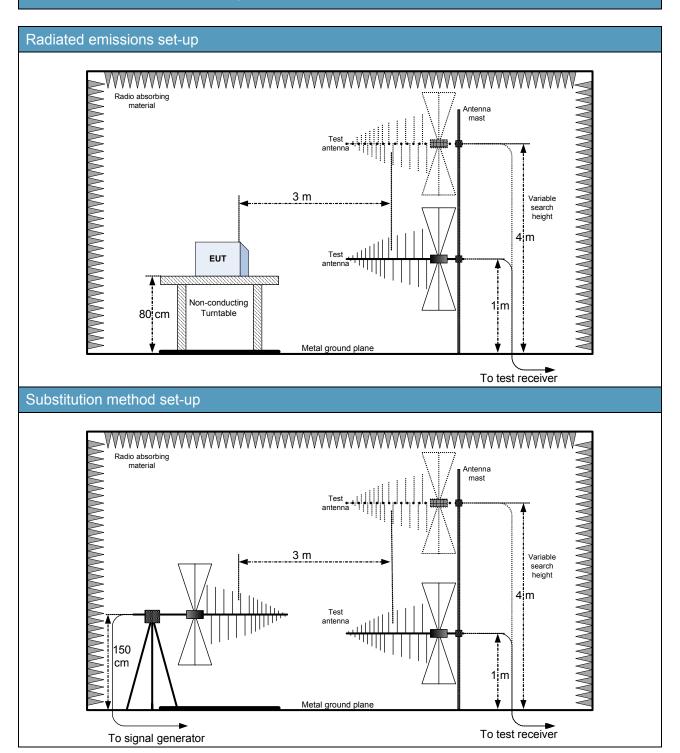


Spurious emission	s measurement results:			
Frequency (MHz)	Polarization. V/H	Result Eirp (dBm)	Limit eirp (dBm)	Margin (dB)
1563.49	V(max. eirp)	-53.08	-50	-3.08

Limit used for discrete emissions: -80 dBw = -50 dBm



Appendix B: Block diagrams of test set-ups

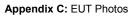




Appendix C: EUT Photos

Photo Set up







Nemko



Specification: FCC 90







Photo EUT







Specification: FCC 90







Appendix C: EUT Photos Product: TDFE-7FL-4

Specification: FCC 90

Label EUT

TEKO TELECOM

MODEL: TDFE-7FL-4 FCC ID: XM2-DFE7FL

WARNING. This is NOT a CONSUMER device. This is a 90,219 Class B signal booster. It is designed for installation by FCC LICENSEES and QUALIFIED INSTALLERS. You MUST have an FCC LICENSE or express consent of an FCC Licensee to operate this device. You MUST register Class B signal boosters (as defined in 47 CFR 90,219) online at www.fcc.gov/signal-boosters/registration. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.