

KTL Test Report: 9001468

Applicant: Mark IV Industries Ltd., IVHS Division
6020 Ambler Drive
Mississauga, Ontario
L4W 2P1

Equipment Under Test: FTP Transponder

FCC ID: JQU800200

In Accordance With: **FCC Part 90, Subpart I**
Private Land Mobile Transmitter

Tested By: KTL Ottawa Inc.
3325 River Road, R.R. 5
Ottawa, Ontario K1V 1H2

Authorized By:

K. Colborne, RF Laboratory Supervisor

Date:

Total Number of Pages: 34

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FCC PART 90, SUBPART I
PRIVATE LAND MOBILE TRANSMITTER
PROJECT NO.: 9001468

EQUIPMENT: FTP Transponder
FCC ID: JQU800200

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PRIVATE LAND MOBILE TRANSMITTER
PROJECT NO.: 9001468

EQUIPMENT: FTP Transponder
FCC ID: JQU800200

Section 1. Summary of Test Results

Manufacturer: Mark IV Industries Ltd., IVHS Division

Model No.: FTP

Serial No.: None

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 90, Subpart I.

New Submission

Production Unit

Class II Permissive Change

Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.

See " Summary of Test Data".



NVLAP LAB CODE: 100351-0

TESTED BY: _____ DATE: _____
Russell Grant, Technologist

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This report applies only to the items tested.

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Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
RF Power Output	90.205	30W	-7.4 dBm	Complies
Audio Frequency Response	TIA EIA-603.3.2.6		N/A	Not Applicable
Audio Low-Pass Filter Response	TIA EIA-603.3.2.6		N/A	Not Applicable
Modulation Limiting	TIA EIA-603.3.2.6		N/A	Not Applicable
Occupied Bandwidth	90.210	K	Graph	Complies
Spurious Emissions at Antenna Terminals	90.210		N/A	Not Applicable
Field Strength of Spurious Emissions	90.210	70.6 dB μ V/m	60.3dB μ V/m	Complies
Frequency Stability	90.213		N/A	Not Applicable
Transient Frequency Behavior	90.214		N/A	Not Applicable

Footnotes For N/A's:

- (1) This equipment is not intended for voice transmissions.
- (2) This equipment uses an integral antenna.
- (3) An authorized bandwidth more than 40 kHz from the bandedge is not subject to frequency stability restrictions.
- (4) Transient frequency behaviour is not required for equipment in the 900 MHz band.

Test Conditions: Temperature: 20 °C
 Humidity: 30 %

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Section 2. General Equipment Specification

Transmitter

Supply Voltage Input: 3.6 V Lithium Battery

Frequency Range: 914.5 to 916.25 MHz

Tunable Bands: 1

Necessary Bandwidth: 6 MHz

Type(s) of Modulation: Carrier In/Off Keying

F3E (Voice)	F1D	F2D	D7W (QAM)	Other
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Data Rate(s): 500 kbps

Internal/External Data Source: Internal

Emission Designator: 6M00P1D

Output Impedance: Integral Antenna

RF Power Output (rated): -6 dBm

Duty Cycle: 45 to 55 %

Channel Spacing(s): Not Applicable

Operator Selection of Operating Frequency: None

Power Output Adjustment Capability: None

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Receiver

Frequency Range:	909.75 to 921.75 MHz
Tunable Bands:	1
Local Oscillator:	None
1st IF:	Not Applicable
2nd IF:	Not Applicable
Operator Selection of Operating Frequency:	None

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Description of Modifications For Class II Permissive Change

NOT APPLICABLE

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PRIVATE LAND MOBILE TRANSMITTER
PROJECT NO.: 9001468

EQUIPMENT: FTP Transponder
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Modifications Made During Testing

NOT APPLICABLE

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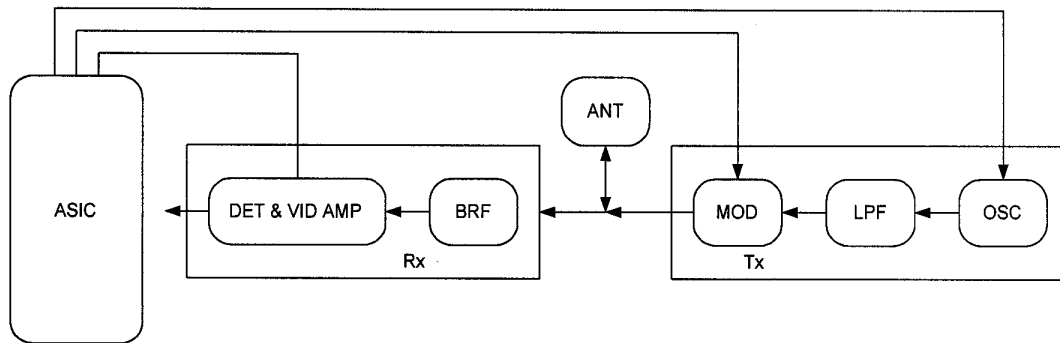
FCC PART 90, SUBPART I
PRIVATE LAND MOBILE TRANSMITTER
PROJECT NO.: 9O01468

EQUIPMENT: FTP Transponder
FCC ID: JQU800200

Theory of Operation

The transponder transmits and receives Manchester encoded data streams in the 915 MHz frequency band. On/off keying modulation is used.

System Diagram



BRF - Band Reject Filter
LPF - Low Pass Filter
DET - Detector

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EQUIPMENT: FTP Transponder
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Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: Russell Grant	DATE: October 23, 1998

Test Results: Complies.

Measurement Data:

Frequency (MHz)	Measured Power (dBm)	Rated Power (dBm)	Measured/Rated (dB)
915	-7.4	-6	-1.4

This equipment uses an integral antenna. Therefore, the power output was measured using the power substitution method on the outdoor range at a distance of 3m. Spectrum analyzer set to 2 MHz RBW.

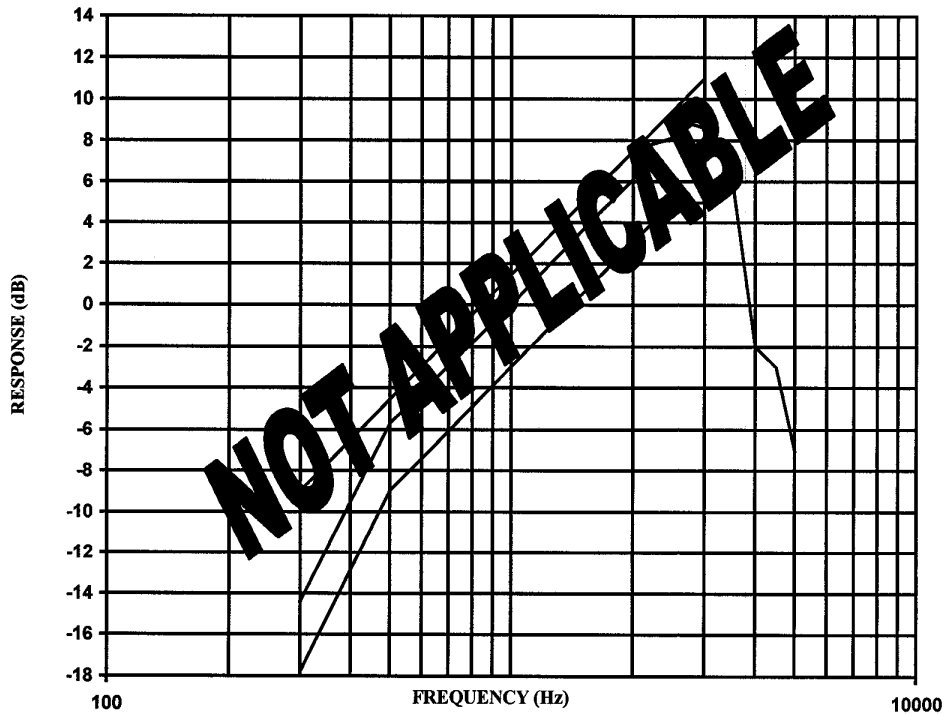
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EQUIPMENT: FTP Transponder
FCC ID: JQU800200

Section 4. Audio Frequency Response

NAME OF TEST: Audio Frequency Response	PARA. NO.: 2.987(a)
TESTED BY:	DATE:



Audio Frequency Response

Frequency	300	600	900	1.2 k	1.5 k	1.8 k	2.1k	2.3 k	2.6 k	3.0 k	3.5 k	4 k

Frequency	4.5 k	5 k	5.5 k	6 k	6.5 k	7 k	7.5 k	8 k	8.5 k	9 k	9.5 k	10 k

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Section 5. Audio Low-Pass Filter Response

NAME OF TEST: Audio Low-Pass Filter Response	PARA. NO.: 2.987(a)
TESTED BY:	DATE:



Audio Low-Pass Filter Response

Frequency	1k	3k	3.5k	4k	4.5k	5k	5.5k	6k	7k	8k	9k	10k

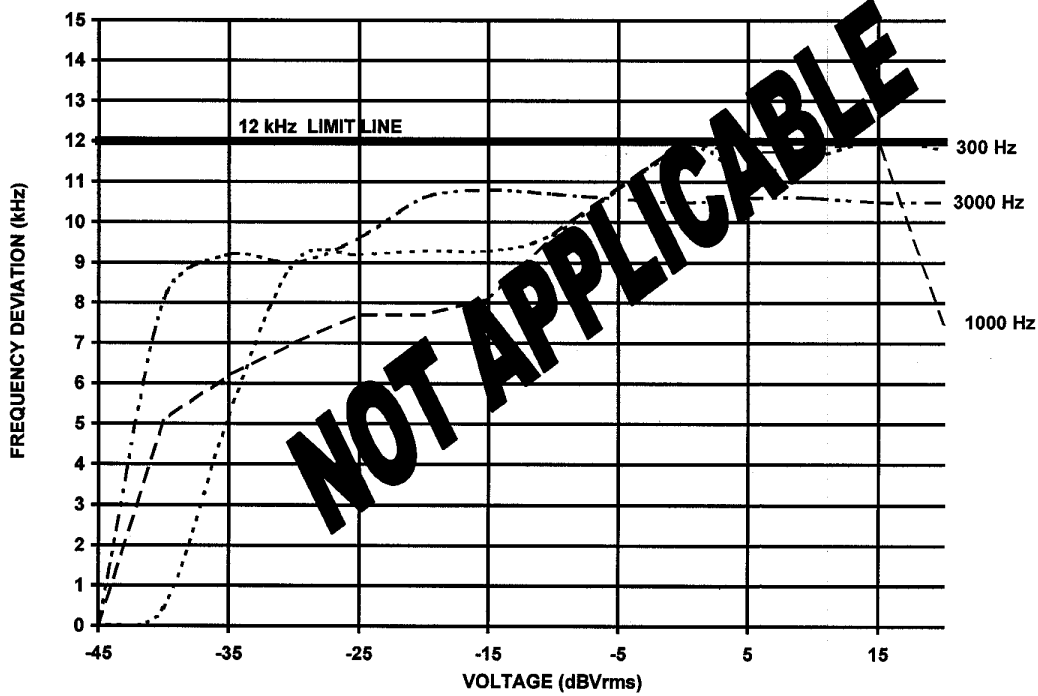
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EQUIPMENT: FTP Transponder
FCC ID: JQU800200

Section 6. Modulation Limiting

NAME OF TEST: Modulation Limiting	PARA. NO.: 2.987(b)
TESTED BY:	DATE:



Input	-45	-40	-35	-30	-25	-20	-15	-10	0	5	10	15	20
300 Hz	0	0.452	5.2	9	9.02	9.3	9.3	9.7	11.8	11.2	11.6	12	11.8
1 kHz	0	5.1	6.2	7	7.7	7.7	8.1	9.7	12	11.7	11.8	12	7.5
Limit	12	12	12	12	12	12	12	12	12	12	12	12	12
3 kHz	0	8.1	9.2	9	9.6	10.6	10.8	10.7	10.5	10.6	10.6	10.5	10.5

Maximum deviation for non-voice modulation _____ kHz.

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EQUIPMENT: FTP Transponder
FCC ID: JQU800200

Section 7. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: Russell Grant	DATE: October 23, 1998

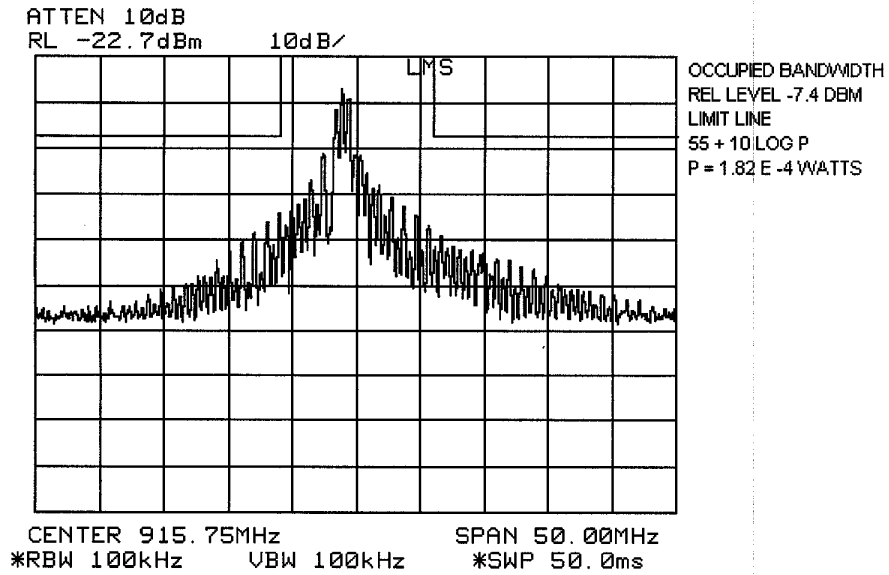
Test Results: Complies.

Test Data: See attached graph(s).

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EQUIPMENT: FTP Transponder
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Section 8. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY:	DATE:

Test Results: Complies/Does Not Comply.

Test Data: See attached graph(s).

NOT APPLICABLE

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EQUIPMENT: FTP Transponder
FCC ID: JQU800200

Section 9. Field Strength of Spurious Emissions

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: Russell Grant	DATE: October 23, 1998

Test Results: Complies.

Test Data: See attached table.

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PRIVATE LAND MOBILE TRANSMITTER
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EQUIPMENT: FTP Transponder

FCC ID: JQU800200

Test Data - Radiated Emissions

Test Distance (meters) : 3		Range: A Tower		Receiver: 8566B		RBW: 100 kHz		Detector: Peak			
Freq. (MHz)	Ant. *	Pol (V/H)	Ant. HGT. (m)	Table (deg.)	RCVD Signal (dB μ V/m)	Ant. Factor (dB)**	Amp. Gain (dB)***	Dist. Corr. (dB)	Field Strength (dB μ V/m) [1]	Limit (dB μ V/m)	Margin (dB)
915	D/P	V			53.5	34.7			88.2		
915	D/P	H			49.1	34.7			83.8		
1830	H	V			71.6	31.1	-45.8		56.9	70.6	13.7
1830	H	H			72.9	31.1	-45.8		58.2	70.6	12.4
2745	H	V			69.6	34.0	-45.9		57.7	70.6	12.9
2745	H	H			72.2	34.0	-45.9		60.3	70.6	10.3
3660	H	V			57.7	40.2	-45.3		52.6	70.6	18.0
3660	H	H			51.5	40.2	-45.3		46.4	70.6	24.2
4575	H	V			52.1	40.0	-45.6		46.5	70.6	24.1
4575	H	H			48.0	40.0	-45.6		42.4	70.6	28.2

Notes:
 B/C = Biconical, B/L = Biconilog, L/P = Log-Periodic, H = Horn, D/P = Dipole
 * Re-measured using dipole antenna.
 ** Includes cable loss when amplifier is not used.
 *** Includes cable loss.
 () Denotes failing emission level.
 [1] Limit $55 + 10 \text{ Log } P = 55 + 10 \text{ Log } (1.82 \times 10^{-4}) = 17.6 \text{ dB}$
 $88.2 - 17.6 = 70.6 \text{ dB}\mu\text{V/m}$

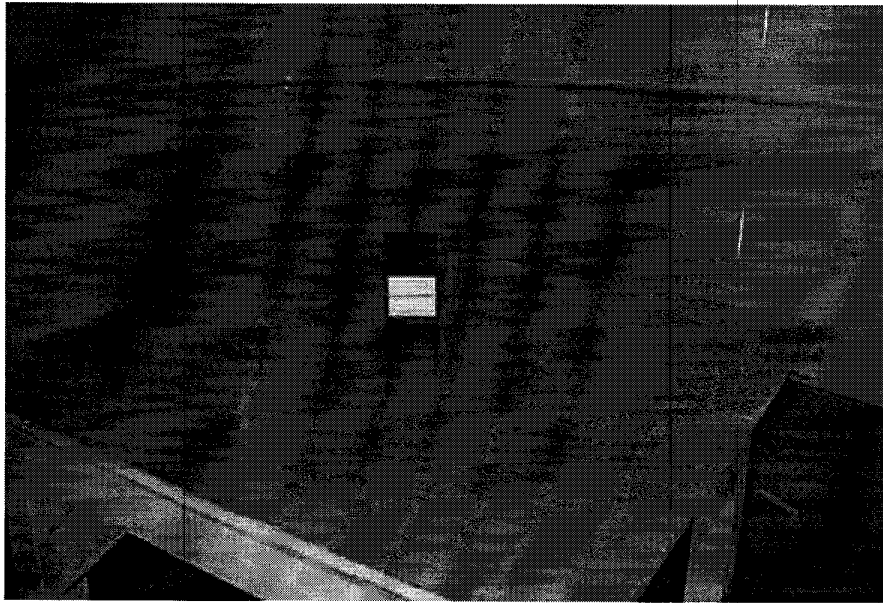
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EQUIPMENT: FTP Transponder
FCC ID: JQU800200

Photographs of Test Setup

Front View



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FCC ID: JQU800200

Section 10. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
TESTED BY:	DATE:

Test Results: Complies/Does Not Comply.

Measurement Data: See attached tables.

NOT APPLICABLE

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EQUIPMENT: FTP Transponder
FCC ID: JQU800200

Section 11. Transient Frequency Behaviour

NAME OF TEST: Transient Frequency Behaviour	PARA. NO.: 90.214
TESTED BY:	DATE:

Test Results: Complies/Does Not Comply.

Measurement Data: See attached graphs.

NOT APPLICABLE

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 PRIVATE LAND MOBILE TRANSMITTER
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EQUIPMENT: FTP Transponder
FCC ID: JQU800200

Section 12. Test Equipment List

CAL CYCLE	EQUIPMENT	MANUFACTURER	MODEL	SERIAL	LAST CAL.	NEXT CAL.	
1 Year	Spectrum Analyzer	Hewlett Packard	8565E	FA000981	May 20/98	May 20/99	
1 Year	Spectrum Analyzer-2	Hewlett Packard	8566B	2311A02238	July 22/98	July 22/99	
1 Year	Spectrum Analyzer Display-2	Hewlett Packard	8566B	2314A04759	July 22/98	July 22/99	
2 Year	Horn Antenna	EMCO #2	3115	4336	Oct. 30/97	Oct. 30/99	
1 Year	Dipole Antenna Set	EMCO	3121C	1029	Oct. 28/97	Oct. 28/98	

NA: Not Applicable
 NCR: No Cal Required

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FCC PART 90, SUBPART I
PRIVATE LAND MOBILE TRANSMITTER
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ANNEX A

EQUIPMENT: FTP Transponder
FCC ID: JQU800200

ANNEX A
TEST METHODOLOGIES

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FCC PART 90, SUBPART I
 PRIVATE LAND MOBILE TRANSMITTER
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 ANNEX A

EQUIPMENT: FTP Transponder
FCC ID: JQU800200

NAME OF TEST: RF Power Output**PARA. NO.: 2.985**

Minimum Standard: Para. No. 90.205(a). The maximum allowable station ERP is dependent upon the stations HAAT and required service area and will be authorized in accordance with Table 1 of 90.205(d).

Method Of Measurement:Detachable Antenna:

The peak power at antenna terminals is measured using an in-line peak power meter. Power output is measured with the maximum rated input level.

Integral Antenna:

If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation $GP/4\pi R^2 = E^2/120\pi$ and proceeding as follows:

$$P = \frac{E^2 R^2}{30G} = \frac{E^2 3^2}{30G}$$

where,

P = the equivalent isotropic radiated power in watts

E = the maximum measured field strength in V/m

R = the measurement range (3 meters)

G = the numeric gain of the transmit antenna in relation to an isotropic radiator

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FCC PART 90, SUBPART I
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ANNEX A

EQUIPMENT: FTP Transponder
FCC ID: JQU800200

NAME OF TEST: Audio Frequency Response	PARA. NO.: 2.987(a)
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Test Method: TIA/EIA-603

Minimum Standard: TIA/EIA-603, Para. 3.2.6 from 300 Hz to 3000 Hz. The transmitter audio frequency response shall have a nominal 6 dB per octave pre-emphasis characteristic.

NAME OF TEST: Audio Low-Pass Filter Frequency Response	PARA. NO.: 2.987(a)
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Test Method: TIA/EIA-603

Minimum Standard: TIA/EIA-603

NAME OF TEST: Modulation Limiting	PARA. NO.: 2.987(a)
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Test Method: TIA/EIA-603

Minimum Standard: TIA/EIA-603

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FCC PART 90, SUBPART I
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 ANNEX A

EQUIPMENT: FTP Transponder
FCC ID: JQU800200

NAME OF TEST: Occupied Bandwidth**PARA. NO.: 2.989**

Minimum Standard: Para. No. 90.210, see table 1 below for applicable mask.

Table 1

Frequency Band (MHz)	Mask for equipment with Low Pass Filter	Mask for equipment without Low Pass Filter
Below 25	A or B	A or C
25 - 50	B	C
72 - 76	B	C
150 - 174	B, D or E	C, D or E
150 Paging only	B	C
220 - 222	F	F
421 - 512	B, D or E	C, D or E
450 paging only	B	H
806 - 821/ 851 - 866	B	G
821 - 824/ 866 - 869	B	H
896 - 901/ 935 - 940	I	J
902 - 928	K	K
929 - 930	B	G
Above 940	B	C
All other bands	B	C

Test Method:

RBW: 1% of emission bandwidth in 0 - 1 GHz range. 1 MHz at frequencies above 1 GHz.
 VBW: ⇒ RBW

The spectrum is search up to 10 times the fundamental frequency.

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ANNEX A

EQUIPMENT: FTP Transponder
FCC ID: JQU800200

NAME OF TEST: Field Strength of Spurious**PARA. NO.: 2.993**

Minimum Standard: Para. No. 90.210, see table 1 for applicable mask.

Calculation of Field Strength Limit

An example of attenuation requirement of $50 + 10 \text{ Log } P$ is equivalent to -20 dBm (1×10^{-5} Watts) at the antenna terminal. We determine the field strength limit by using the plane wave relation.

$$GP/4\pi R^2 = E^2/120\pi$$

For emissions $\leq 1 \text{ GHz}$:

$G = 1.64$ (Dipole Gain)

$P = 10^{-5}$ Watts (Maximum spurious output power)

$R = 3\text{m}$ (Measurement Distance)

$$E = \frac{\sqrt{30GP}}{R} = E = \frac{\sqrt{30 \times 1.64 \times 10^{-5}}}{3} = 0.00739 \text{ V / m} = 77.4 \text{ dB}\mu\text{V / m}$$

For emissions $> 1 \text{ GHz}$:

$G = 1$ (Isotropic Gain)

$P = 1 \times 10^{-5}$ Watts (Maximum spurious output power)

$R = 3\text{m}$ (Measurement Distance)

$$E = 77.4 - 20 \text{ Log} \sqrt{1.64} = 75.2 \text{ dB}\mu\text{V / m@3m}$$

MASK	Spurious Limit	FS Limit Below 1 GHz	FS Limit Above 1 GHz
A,B,C,G,H,I	-13dBm	84.4 dB μ V/m@3m	82.2 dB μ V/m@3m
D,J	-20dBm	77.4 dB μ V/m@3m	75.2 dB μ V/m@3m
E,F,K	-25dBm	72.4 dB μ V/m@3m	70.2 dB μ V/m@3m

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FCC PART 90, SUBPART I
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ANNEX A

EQUIPMENT: FTP Transponder
FCC ID: JQU800200

NAME OF TEST: Frequency Stability**PARA. NO.: 2.995**

Minimum Standard: Para. No. 990.213. The transmitter carrier frequency shall remain within the assigned frequency below in ppm.

Table 2

Frequency Band (MHz)	Fixed And Base Stations	Mobile Stations	
		> 2 Watts o/p pwr	< 2 Watts o/p pwr
Below 25	100	100	200
25 - 50	20	20	50
72 - 76	5	-	50
150 - 174	5	5	5
220 - 222	0.1	1.5	1.5
421 - 512	2.5	5	5
806 - 821	1.5	2.5	2.5
821 - 824	1.0	1.5	15
851 - 866	1.5	2.5	2.5
866 - 869	1.0	1.5	1.5
869 - 901	0.1	1.5	1.5
902 - 928	2.5	2.5	2.5
929 - 930	1.5	-	-
935 - 940	0.1	1.5	1.5
1427 - 1435	300	300	300
Above 2450	-	-	-

NAME OF TEST: Transient Frequency Behaviour**PARA. NO.: 2.214****Minimum Standard:****Transient Frequency Behaviour for Equipment Designed to Operate on 25 kHz Channels**

Time intervals ^{1,2}	Maximum Frequency difference ³ (kHz)	Frequency ranges (MHz) All equipment					
		Base station and portable radios			Mobile Radios		
		150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)	150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
t ₁ ⁴	± 25	5.0	10.0	20.0	5.0	10.0	5.0
t ₂	± 12	20.0	25.0	50.0	20.0	25.0	20.0
t ₃ ⁴	± 25	5.0	10.0	10.0	5.0	10.0	5.0

Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz & 6.25 kHz Channels

Time intervals ^{1,2}	Maximum Frequency difference ³ (kHz)	Frequency ranges (MHz) All equipment		
		150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
t ₁ ⁴	± 12.5 / ± 6.25	5.0	10.0	20.0
t ₂	± 6.25 / ± 3.125	20.0	25.0	50.0
t ₃ ⁴	± 12.5 / ± 6.25	5.0	10.0	10.0

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ANNEX B

EQUIPMENT: FTP Transponder
FCC ID: JQU800200

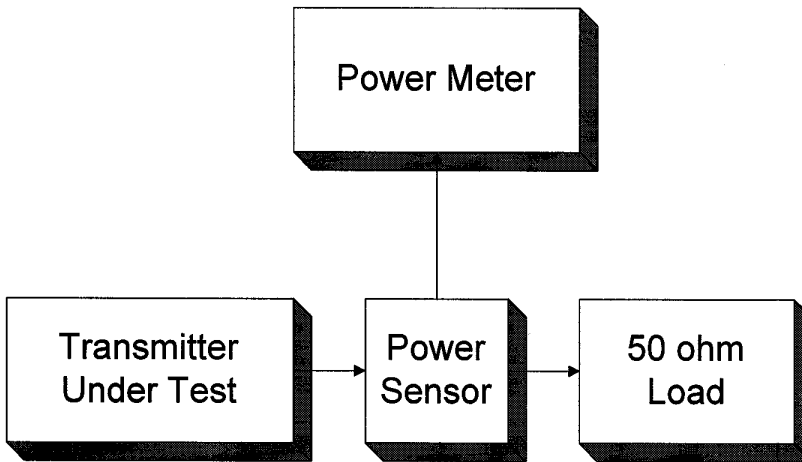
ANNEX B
TEST DIAGRAMS

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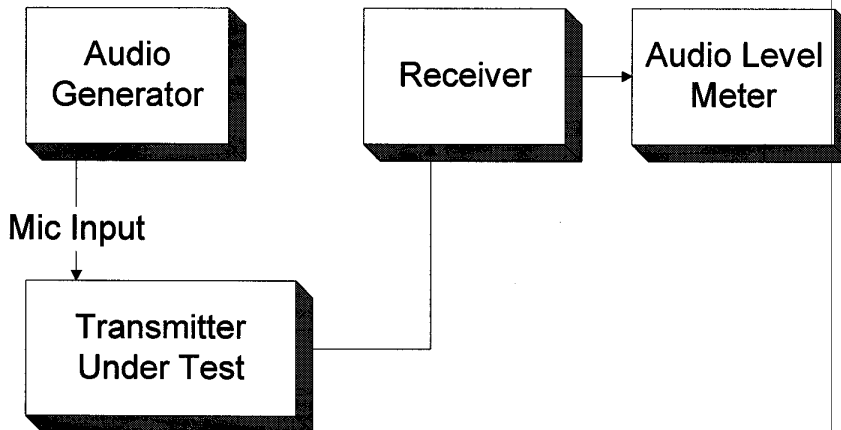
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ANNEX B

EQUIPMENT: FTP Transponder
FCC ID: JQU800200

Para. No. 2.985 - R.F. Power Output



Para. No. 2.987(a) - Audio Frequency Response

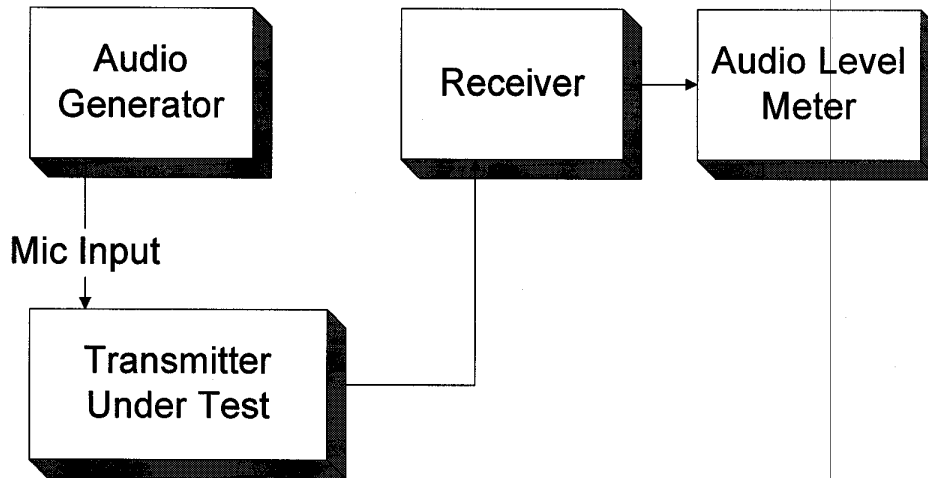


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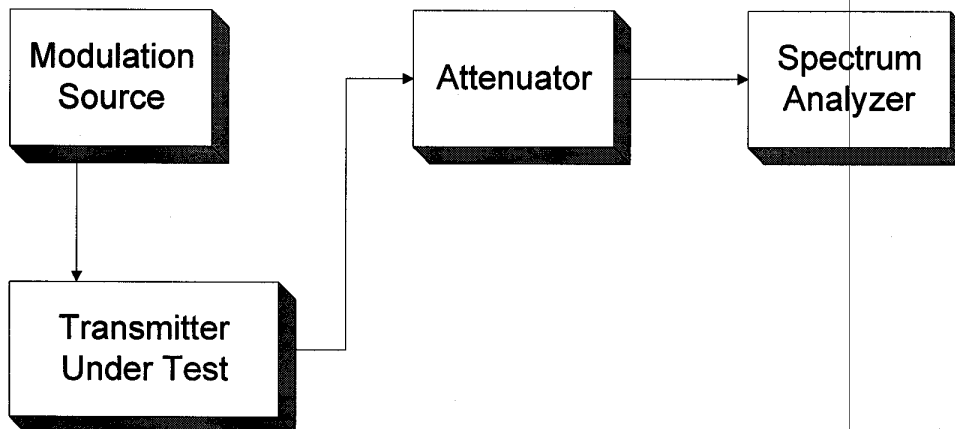
FCC PART 90, SUBPART I
PRIVATE LAND MOBILE TRANSMITTER
PROJECT NO.: 9001468
ANNEX B

EQUIPMENT: FTP Transponder
FCC ID: JQU800200

Para. No. 2.987(b) - Modulation Limiting



Para. No. 2.989 - Occupied Bandwidth

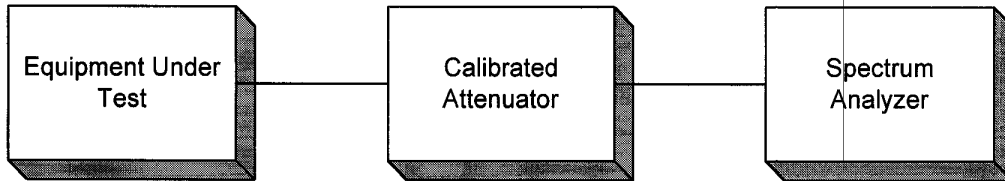


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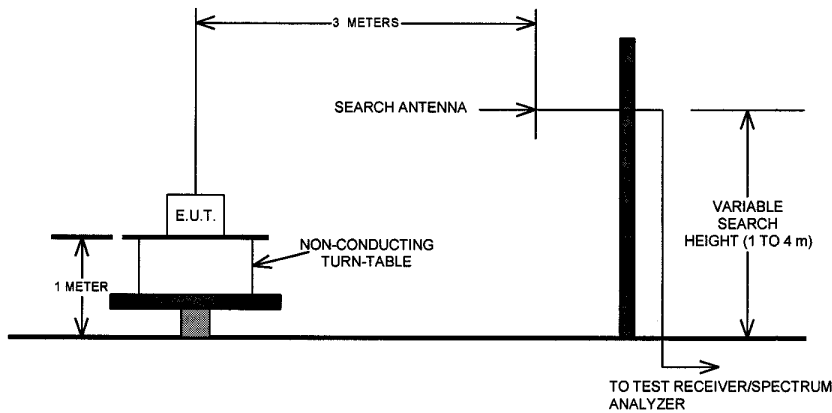
FCC PART 90, SUBPART I
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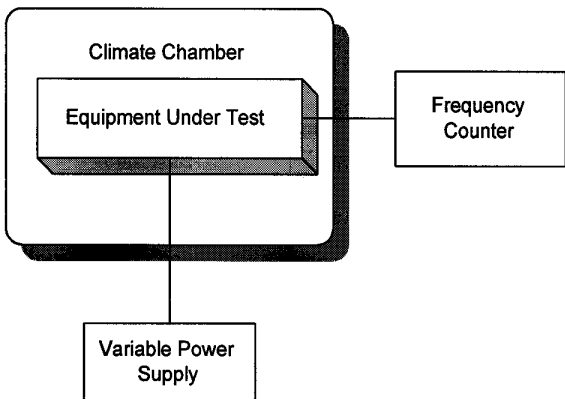
Para. No. 2.991 - Spurious Emissions at Antenna Terminals



Para. No. 2.993 - Field Strength of Spurious Radiation



Para. No. 2.995 - Frequency Stability

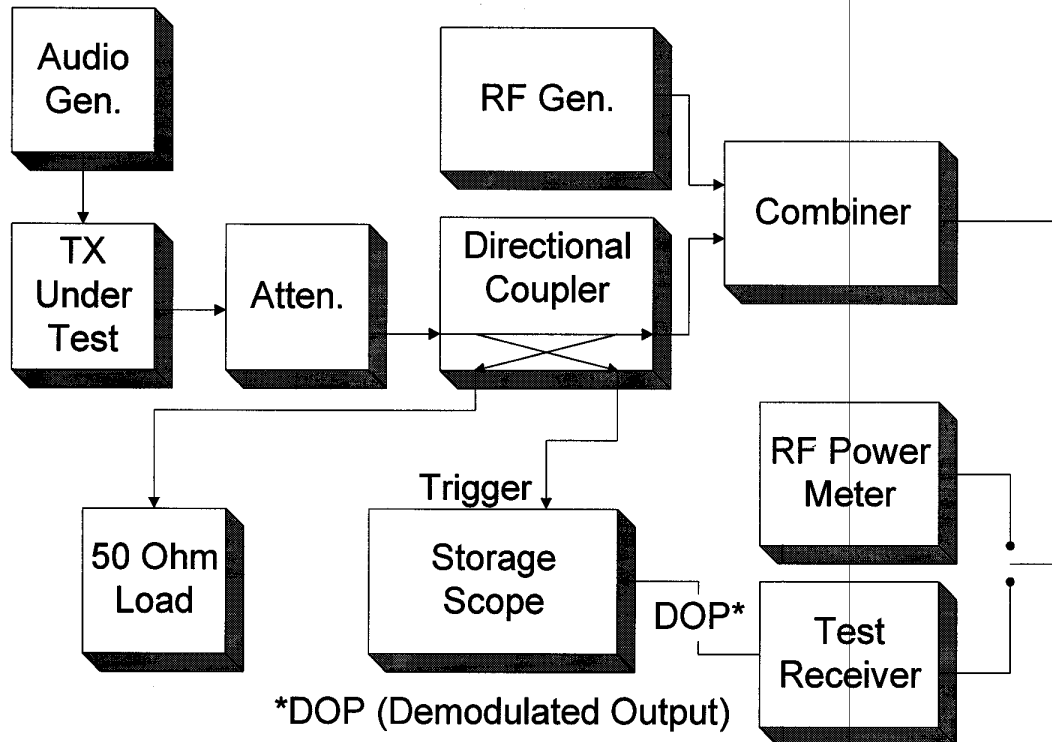


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FCC PART 90, SUBPART I
PRIVATE LAND MOBILE TRANSMITTER
PROJECT NO.: 9001468
ANNEX B

EQUIPMENT: FTP Transponder
FCC ID: JQU800200

Para. No. 90.214 - Transient Frequency Behaviour



Voice

This measurement was made using measurement procedure TIA/EIA Land Mobile FM or PM Communications Equipment Measurement and Performance Standards TIA/EIA-603 February 1993 Telecommunications Industry Association (American National Standard ANSI/TIA/EIA-603-1992 Approved: October 27, 1992) Para. no. 2.2 Methods of Measurement for Transmitters Para. no. 2.2.19 Transient Frequency Behaviour (page no. 83).

Data

This measurement was made using measurement procedure TIA/EIA Digital C4FM/CQPSK Transceiver Measurement Methods TSB102.CAAA Para. no. 2.2.17 Transient Frequency Behaviour (page no. 74).