



Date: 17 July 2022

I.T.L. (PRODUCT TESTING) LTD.
FCC Radio Test Report
for
Questar Auto Technologies Ltd.
Equipment under test
Vehicle Telematics System
Connect Family

Tested by: _____

I. Mansky

Approved by: _____

M. Zohar

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(Product Testing) Ltd. This report relates only to items tested.



Measurement/Technical Report for Questar Auto Technologies Ltd. Vehicle Telematics System

Connect Family

FCC ID: 2A6DICONNECT

This report concerns: Original Grant

Equipment type: DSR
Part 15 Security/Remote Control Transmitter

Limits used: 47CFR15 Section 15.231 (a-d)

Measurement procedure used: ANSI C63.10-2013.

Prepared by:

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Applicant:

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1. General Information

1.1 Administrative Information

Manufacturer: Questar Auto Technologies Ltd.
Manufacturer's Address: Hamal 10, Rosh-Ha'ayin 48092, Israel
Tel: +972.3.767.1700
Manufacturer's Representative: Yair Shuvali
Equipment Under Test (E.U.T): Vehicle Telematics System
Equipment Model No.: Connect Family
Equipment Serial No.: Not designated
Date of Receipt of E.U.T: October 18, 2021
Start of Test: October 18, 2021
End of Test: March 2, 2022
Test Laboratory Location: I.T.L (Product Testing) Ltd.
1 Bat Sheva St., Lod 7120101
Israel
Test Specifications: FCC Part 15, Subpart C, Section 231 (a-d)

1.2 List of Accreditations

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), FCC Designation No. IL1005.
3. Industry Canada (Canada), IC File No.: 46405-4025; Site Nos. IC 4025A-1, IC 4025A-2.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.



1.3 Product Description

Type of Equipment							
☒	Stand Alone (Equipment with/without its own control provisions)						
☐	Combined (Equipment where radio part is fully integrated with another type of equipment)						
☐	Plug in card (Equipment intended for a variety of host systems)						
Intended Use				Condition of use			
☐	Fixed			Always of distance >2m from the people			
☒	Mobile			Always of distance >20cm from the people			
☐	Portable			Always of distance <20cm to human body			
Assigned frequency band				Above 70MHZ			
Operational frequencies				433.92MHZ			
Maximum rated output power				At transmitter 50Ω RF output connector [dBm]		~ 12dBm	
				Effective Radiated Power (for equipment without RF connector)		N/A	
Antenna Connection							
☐	Unique Coupling	☐	Standard Connection	☒	Integral	☐	With temporary RF connector
						☒	Without temporary RF connector
Antenna Gain				-2.9 dBi (-5.0dBd)			
Operating channel bandwidth				328kHz			
Type of modulation				GFSK			
Bit rate				250 kBaud			
Maximum test transmitter duty cycle				100%			
Transmitter power source							
☐	AC			Nominal rated voltage			
☒	DC			Nominal rated voltage		12VDC/24VDC from the car battery	
☒	Battery			Nominal rated voltage		3.6VDC rechargeable battery	

1.4 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 Test Facility

Emissions tests were performed at I.T.L.'s testing facility in Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is IL1005.



1.6 Measurement Uncertainty

Radiated Emission

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for
open site:

30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 4.96 dB

1 GHz to 6 GHz

Expanded Uncertainty (95% Confidence, K=2):

± 5.19 dB

>6 GHz

Expanded Uncertainty (95% Confidence, K=2):

± 5.51 dB

2. System Test Configuration

2.1 Justification

1. The E.U.T contains 433.92MHz transceiver
2. Final radiated emission tests were performed after exploratory emission testing that was performed in three orthogonal polarities to determine the “worst case” radiation.
3. According to screening results below, the “worst case” was at Z axis

Orientation	Frequency	Field Strength	2 nd Harmonic	3 rd Harmonic
	(MHz)	(dBuV/m)	(dBuV/m)	(dBuV/m)
Z axis	433.92	99.7	57.2	52.3(N.L)
Y axis	433.92	97.3	55.6	52.0(N.L)
X axis	433.92	97.0	55.7	52.3(N.L)

Figure 1. Screening Results

4. Evaluation performed when the E.U.T was powered by external DC power supply for charge mode as ”worst case” radiation

2.2 EUT Exercise Software

No special exercise software was used.

2.3 Special Accessories

No special accessories were needed to achieve compliance.

2.4 Equipment Modifications

No modifications were necessary in order to achieve compliance.

2.5 Configuration of Tested System

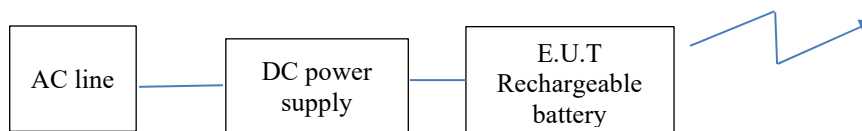


Figure 2. Configuration of Tested System



3. Radiated Measurement Test Setup Photos

See a separate file.

4. Average Factor Calculation

1. Burst duration in 100msec = 8.0msec
 2. Pulse duration and pulse period ratio = 1
 3. Average Factor = $20 \log \left[\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{burst duration}}{100\text{msec}} \times \text{Num of burst within 100msec} \right]$
- $$\text{Average Factor} = 20 \log \left[1 \times \frac{8.0}{100} \times 1 \right] = -21.9\text{dB}$$

Customer declaration



C1101 Transmit mode deceleration

C1101 Transmit slots declaration

Author: Yair Shuvaili

Version: 0.1

Maturity

☐ draft

☒ released

Revision History

Version	Change Description	Author	Date
0.1		Yair Shuvaili	01.03.22

C1101 Transmit data over the air

The data baud rat over the air is 19.2Kbit/sec
The data payload is 20Bytes 2-FSK

This gives approximately 8msec transmit duration time
The gap between each transmit period might be up to 7.5sec

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5. Periodic Operation

5.1 Test Specification

FCC, Part 15, Subpart C, Section 15.231(a)

5.2 Test Procedure

(Temperature (21°C)/ Humidity (52%RH))

The E.U.T operation mode and test setup are as described in Section 2 of this report.

5.3 Test Requirements and verdicts

Requirement	Rationale	Verdict
1. A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.	N/A	Complies
2. An automatically operated transmitter shall cease operation within five seconds after activation.	See Figure 4 below	Complies
3. Periodic transmissions at regular predetermined intervals are not permitted.	N/A	Complies
4. Polling or supervised transmissions to determine system integrity of transmitter used in security or safety applications shall not exceed more than 2 seconds per hour.	N/A	Complies
5. Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.	N/A	Complies
6. Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such setup information may include data.	N/A	Complies

5.4 Test Results

JUDGEMENT: Passed

See customer declaration on page 9

The EUT met the FCC Part 15, Subpart C, Section 15.231(a) specification requirements.

6. Field Strength of Fundamental

6.1 Test Specification

FCC, Part 15, Subpart C, Section 15.231(b)

6.2 Test Procedure

(Temperature (26°C)/ Humidity (54%RH))

The E.U.T was tested in the open site, placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

6.3 Test Limit

The field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental @3m (μ V/m)	Field strength of fundamental @3m (dB μ V/m)
40.66-40.70	2,250	67.0
70-130	1,250	61.9
130-174	¹ 1,250 to 3,750	61.9 to 71.5 ¹
174-260	3,750	71.5
260-470	¹ 3,750 to 12,500	71.5 to 81.9 ¹
Above 470	12,500	81.9

¹ Linear interpolation

* The limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions

** If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply

6.4 Test Results

JUDGEMENT: Passed by 4.6 dB

The EUT met the FCC Part 15, Subpart C, Section 15.231(b) specification requirements.

The details of the highest emissions are given in *Figure 3 to Figure 5*.



Field Strength of Fundamental

E.U.T Description Vehicle Telematics System
Type Connect Family
Serial Number: Not designated

Specification: FCC, Part 15, Subpart C, 15.231(b)

Antenna Polarization: Horizontal/Vertical

Test Distance: 3 meters Detector: Peak

Freq.	Pol.	Peak Reading	Average Factor	Average Result	Peak limit	Average limit	Peak Margin	Average Margin
(MHz)	(V/H)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV/m)	(dBμV/m)	(dB)	(dB)
433.92	H	99.7	-21.9	77.8	100.8	80.8	-1.1	-3.0
433.92	V	89.6	-21.9	67.7	100.8	80.8	-11.2	-13.1

Figure 3. Field Strength of Fundamental - Average/Peak Results

Notes:

1. *Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.*
2. *“Average Result” (dBμV/m)=Peak Reading (dBμV/m) + Average Factor (dB).*

Field Strength of Fundamental

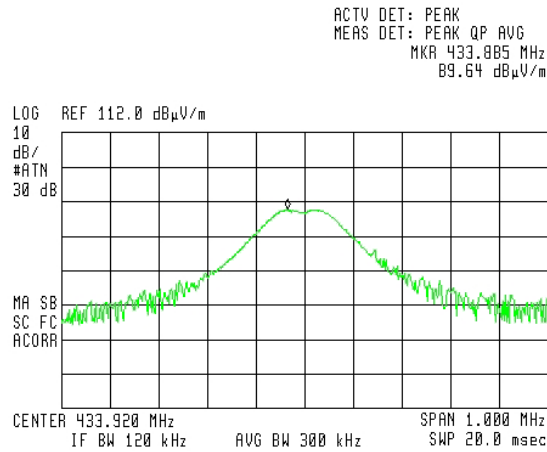


Figure 4. Field Strength of Fundamental - Vertical

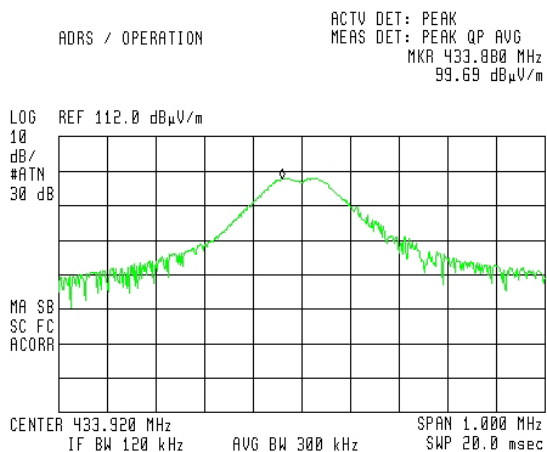


Figure 5. Field Strength of Fundamental - Horizontal



6.5 Test Instrumentation Used; Field Strength of Fundamental

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	HP	8542E	3906A00276	24 Feb. 2021	22 Feb. 2023
RF Filter Section	HP	85420E	3705A00248	24 Feb. 2021	22 Feb. 2023
Log periodic antenna	EMCO	3146	9505-4081	27 Apr. 2021	27 Apr. 2024
35m coaxial cable for oats	EIM (Huber Suhner)	RG214-11N(X2) RG214/U	-	August 04, 2021	August 04, 2022

Figure 6. Test Equipment Used

7. Field Strength of Spurious Emissions

7.1 Test Specification

FCC, Part 15, Subpart C, Section 15.231(b)

7.2 Test Procedure

(Temperature (21°C)/ Humidity (52%RH))

For measurements between 30.0MHz-1.0GHz:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. The frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly.

For measurements between 1.0GHz-5.0GHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 1.5 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The frequency range 1.0GHz -5.0GHz was scanned

7.3 Test Limit

Spurious emissions shall be attenuated to the average limits shown in next table or to the general limits shown in §15.209, whichever limit permits a higher field strength:

Fundamental frequency (MHz)	Field strength of spurious emissions@3m (µV/m)	Field strength of spurious emissions@3m (dBµV/m)
40.66-40.70	225	47.0
70-130	125	41.9
130-174	¹ 125 to 375	¹ 41.9 to 51.5
174-260	375	51.5
260-470	¹ 375 to 1,250	¹ 51.5 to 61.9
Above 470	1,250	61.9

¹ Linear interpolation

* The limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions

** If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)	Field strength (dBμV/m)	Field strength* (dBμV/m)@3m
0.009-0.490	2400/F(kHz)	300	48.5-13.8	128.5-73.8
0.490-1.705	24000/F(kHz)	30	33.8-23.0	73.8-63.0
1.705-30.0	30	30	29.5	69.5
30-88	100	3	40.0	40.0
88-216	150	3	43.5	43.5
216-960	200	3	46.0	46.0
Above 960	500	3	54.0	54.0

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

7.4 Test Results

JUDGEMENT: Passed by -22.0 dB

The EUT met the requirements of the FCC Part 15, Subpart C specification.

The margin between the emission level and the specification limit was -22.0 dB in the worst case at the frequency of 2169.6MHz, horizontal polarization.

For additional information see *Figure 7*.



Radiated Emission

E.U.T Description Vehicle Telematics System
Type Connect Family
Serial Number: Not designated

Specification: FCC Part 15, Subpart C

Antenna Polarization: Vertical/Horizontal Frequency range: 0.009MHz to 5GHz
Antenna: 3 meters distance Detectors: Peak, Average

Freq.	Pol.	Peak Reading	Average Factor	Average Result	Peak limit	Average limit	Peak Margin	Average Margin
(MHz)	(V/H)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV/m)	(dBμV/m)	(dB)	(dB)
867.84	H	57.2	-21.9	35.3	80.8	60.8	-23.6	-25.5
867.84	V	55.0	-21.9	33.1	80.8	60.8	-25.8	-27.7
2169.6	H	58.8	-21.9	36.9	80.8	60.8	-22.0	-23.9
2169.6	V	51.2	-21.9	29.3	80.8	60.8	-29.6	-31.5

Figure 7. Spurious Radiated Emission Results

Notes:

1. *Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.*
2. *“Average Result” (dBμV/m) = Peak Reading (dBμV/m) + Average Factor (dB).*

7.5 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 23, 2021	February 20, 2023
EMI Receiver	HP	8542E	3906A00276	February 24, 2021	February 22, 2023
RF Filter Section	HP	85420E	3705A00248	February 24, 2021	February 22, 2023
Biconical Antenna	EMCO	3110B	9912-3337	January 18, 2021	January 18, 2024



Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Log Periodic Antenna	EMCO	3146	9505-4081	January 20, 2021	January 20, 2023
Horn Antenna	ETS	3115	29845	May 25, 2021	May 25, 2024
Active Loop Antenna	EMCO	6502	9506-2950	May 03, 2021	May 03, 2022
Spectrum Analyzer	HP	8591E	3414U01226	February 21, 2021	February 21, 2023
35m coaxial cable for oats	EIM (Huber Suhner)	RG214-11N(X2) RG214/U	-	August 04, 2021	August 04, 2022
Full Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR
Antenna Mast	ETS	2070-2	9608-1497	NCR	NCR
Turntable	ETS	2087	-	NCR	NCR
Mast & Table Controller	ETS/EMCO	2090	9608-1456	NCR	NCR

Figure 8. Test Equipment Used



8. 20dB Bandwidth

8.1 Test Specification

FCC, Part 15, Subpart C, Section 15.231(c)

8.2 Test Procedure

(Temperature (21°C)/ Humidity (50%RH))

The transmitter unit operated with normal modulation. The spectrum analyzer was set to 30 kHz resolution BW and center frequency of the transmitter fundamental. The spectrum bandwidth of the transmitter unit was measured and recorded. The BW was measured at 20 dBc points.

8.3 Test Limit

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

8.4 Test Results

Specification: FCC Part 15, Subpart C: (15.231(c))

Bandwidth Reading	Specification
(kHz)	(kHz)
167.7	<1084

Figure 9. 20dB Bandwidth Test Results

JUDGEMENT: Passed by 923.2 kHz

For additional information, see *Figure 10*.

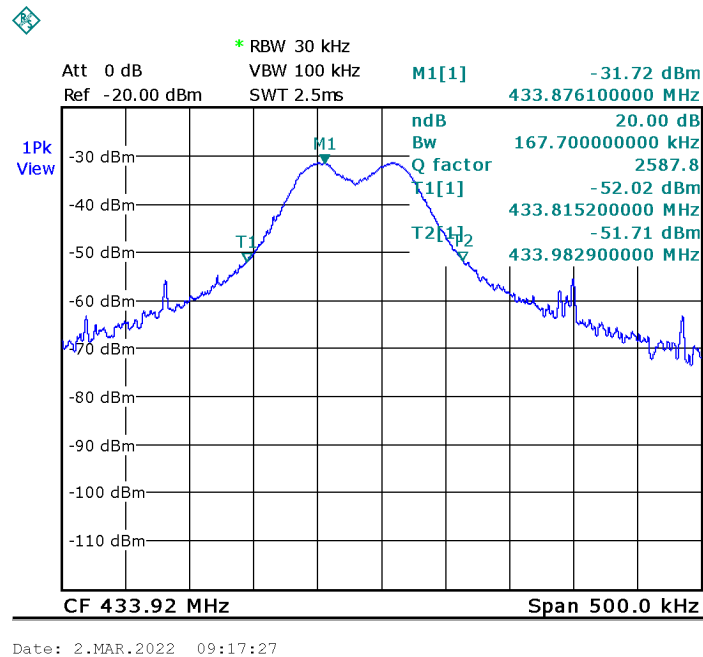


Figure 10. 20dB Bandwidth Results

8.5 Test Equipment Used; 20dB Bandwidth

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	HP	8542E	3906A00276	24 Feb. 2021	February 22, 2023
RF Filter Section	HP	85420E	3705A00248	24 Feb. 2021	February 22, 2023
Log Periodic Antenna	EMCO	3146	9505-4081	27 Apr. 2021	27 Apr. 2024

Figure 11. Test Equipment Used



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9. Antenna Information

Antenna Gain: -2.9 dBi (-5.0dBd)



10. Appendix A - Correction Factors

10.1 For ITL #1911 OATS RF Cable

Frequency (MHz)	Cable Loss (dB)		Frequency (MHz)	Cable Loss (dB)
1.0	0.5		450.00	5.83
10.00	1.0		500.00	6.33
20.00	1.34		550.00	6.67
30.00	1.5		600.00	6.83
50.00	1.83		650.00	7.17
100.00	2.67		700.00	7.66
150.00	3.17		750.00	7.83
200.00	3.83		800.00	8.16
250.00	4.17		850.00	8.5
300.00	4.5		900.00	8.83
350.00	5.17		950.00	8.84
400.00	5.5		1000.00	9.0

10.2 For ITL #1840 Anechoic Chamber RF Cable

Frequency (MHz)	Cable Loss (dB)		Frequency (MHz)	Cable Loss (dB)
1000.0	-1.4		10000.0	-6.0
1500.0	-1.7		10500.0	-6.2
2000.0	-2.0		11000.0	-6.2
2500.0	-2.3		11500.0	-6.0
3000.0	-2.6		12000.0	-6.0
3500.0	-2.8		12500.0	-6.1
4000.0	-3.1		13000.0	-6.3
4500.0	-3.3		13500.0	-6.5
5000.0	-3.6		14000.0	-6.7
5500.0	-3.7		14500.0	-7.0
6000.0	-4.0		15000.0	-7.3
6500.0	-4.4		15500.0	-7.5
7000.0	-4.7		16000.0	-7.6
7500.0	-4.8		16500.0	-8.0
8000.0	-5.0		17000.0	-8.0
8500.0	-5.1		17500.0	-8.1
9000.0	-5.6		18000.0	-8.2
9500.0	-5.8			

10.3 For ITL # 1075 Active Loop Antenna

Frequency (MHz)	MAF (dBs/m)	AF (dB/m)
0.01	-33.1	18.4
0.02	-37.2	14.3
0.03	-38.2	13.3
0.05	-39.8	11.7
0.1	-40.1	11.4
0.2	-40.3	11.2
0.3	-40.3	11.2
0.5	-40.3	11.2
0.7	-40.3	11.2
1	-40.1	11.4



Frequency (MHz)	MAF (dBs/m)	AF (dB/m)
2	-40.0	11.5
3	-40.0	11.5
4	-40.1	11.4
5	-40.2	11.3
6	-40.4	11.1
7	-40.4	11.1
8	-40.4	11.1
9	-40.5	11.0
10	-40.5	11.0
20	-41.5	10.0
30	-43.5	8.0

10.4 For ITL #1356 Biconical Antenna

Frequency (MHz)	AF (dB/m)
30	13.00
35	10.89
40	10.59
45	10.63
50	10.12
60	9.26
70	7.74
80	6.63
90	8.23
100	11.12
120	13.16
140	13.07
160	14.80
180	16.95
200	17.17

10.5 For ITL # 1349 Log Periodic Antenna

Frequency (MHz)	AF (dB/m)
200	11.58
250	12.04
300	14.76
400	15.55
500	17.85
600	18.66
700	20.87
800	21.15
900	22.32
1000	24.22

10.6 For ITL # 1352 1-18 Horn Antenna

Frequency (GHz)	AF (dB/m)	Frequency (GHz)	AF (dB/m)
0.75	25	9.5	38
1.0	23.5	10.0	38.5



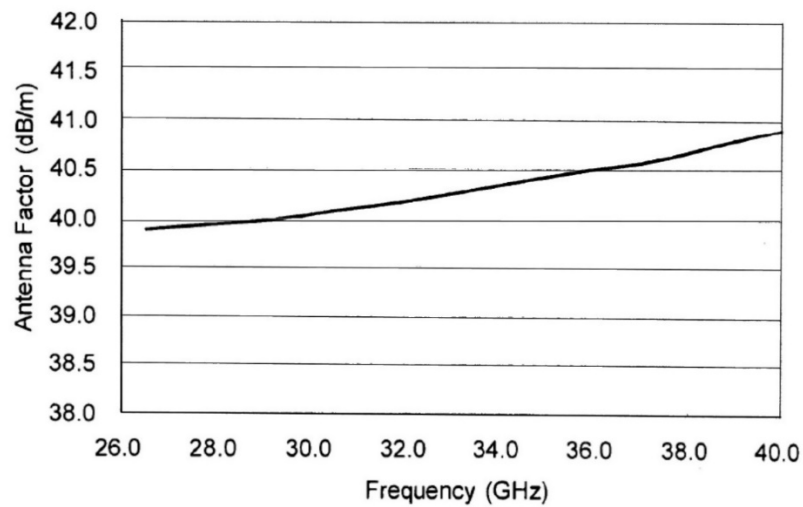
Frequency (GHz)	AF (dB/m)		Frequency (GHz)	AF (dB/m)
1.5	26.0		10.5	38.5
2.0	29.0		11.0	38.5
2.5	27.5		11.5	38.5
3.0	30.0		12.0	38.0
3.5	31.5		12.5	38.5
4.0	32.5		13.0	40.0
4.5	32.5		13.5	41.0
5.0	33.0		14.0	40.0
5.5	35.0		14.5	39.0
6.0	36.5		15.0	38.0
6.5	36.5		15.5	37.5
7.0	37.5		16.0	37.5
7.5	37.5		16.5	39.0
8.0	37.5		17.0	40.0
8.5	38.0		17.5	42.0
9.0	37.5		18.0	42.5

10.7 For ITL # 1353 18-26.5 GHz Horn Antenna

Frequency (MHz)	Measured antenna factor dB/m
18000	32.4
18500	32.0
19000	32.3
19500	32.4
20000	32.3
20500	32.8
21000	32.8
21500	32.7
22000	33.1
22500	33.0
23000	33.1
23500	33.8
24000	33.5
24500	33.5
25000	33.8
25500	33.9
26000	34.2
26500	34.7

The antenna factor shall be added to the receiver reading in dB μ V to obtain field strength in dB μ V/m.

10.8 For ITL # 1777 26.5-40 GHz Horn Antenna



10.9 For Horn Antenna Model: SWH-28

CALIBRATION DATA

3 m distance

Frequency MHZ	Measured antenna factor dB/m
18000	32.4
18500	32.0
19000	32.3
19500	32.4
20000	32.3
20500	32.8
21000	32.8
21500	32.7
22000	33.1
22500	33.0
23000	33.1
23500	33.8
24000	33.5
24500	33.5
25000	33.8
25500	33.9
26000	34.2
26500	34.7

¹⁾ The antenna factor shall be added to receiver reading in dB μ V to obtain field strength in dB μ V/m.

End of Test Report