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Radio Test Report

FCC Part 22

FCC Part 24

Model: TL10001-40L1
(Host device containing FCC ID L2C0041TR)

COMPANY:	Delphi Product & Service Solutions (DPSS) 5820 Delphi Drive, Building D Troy, MI 48098
TEST SITE(S):	Elliott Laboratories 41039 Boyce Road. Fremont, CA. 94538-2435
REPORT DATE:	February 16, 2010
REISSUED:	February 25, 2010
FINAL TEST DATES:	December 21 and 23, 2009

AUTHORIZED SIGNATORY:

Mark Briggs

Mark Briggs
Staff Engineer
Elliott Laboratories

A2LA ACCREDITED

Testing Cert #2016-01

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REVISION HISTORY

Rev#	Date	Comments	Modified By
-		First release	
1	2/25/2010	Revised model number from TL10000 to TL10001-40L1	Mark Briggs

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SCOPE

Tests have been performed on the Delphi Product & Service Solutions (DPSS) model TL10001-40L1, pursuant to the relevant requirements of the following standard(s) in order to obtain device certification against the regulatory requirements of the Federal Communications Commission.

- Code of Federal Regulations (CFR) Title 47 Part 2
- CFR 47 Part 22
- CFR 47 Part 24

Radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI TIA-603-C August 17, 2004 and as outlined in Elliott Laboratories test procedures.

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the Delphi Product & Service Solutions (DPSS) model TL10001-40L1 installed in the specific host system and therefore apply only to the tested sample. The sample was selected and prepared by John Highberg of Delphi Product & Service Solutions (DPSS).

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, the device requires certification. Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested sample of Delphi Product & Service Solutions (DPSS) model TL10001-40L1 complied with the requirements of the standards and frequency bands declared in the scope of this test report.

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS

FCC Part 22

FCC	Canada	Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics					
§2.1033 (c) (5) §22	RSS 132	824.2 – 848.8 MHz	-	-	Pass
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 § 22.913(a)	RSS-132 4.4	RF power output at the antenna terminals (Peak output power)	2.06 W (Note 1)	N/A	N/A
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 § 22.913(a)	RSS-132 4.4	ERP	3.02 Watts erp	7 Watts erp	Pass
§2.1033 (c) (4) §2.1047 § 22.917(b)	RSS 132 4.5.1.1	Emission types	Note evaluated – covered by the original application.		
		Emission mask			
	RSS GEN 4.4.1	99% Bandwidth			
§2.1049		Occupied Bandwidth			
Transmitter spurious emissions					
§2.1051 §2.1057 §22.917	RSS 132 4.5	At the antenna terminals	Note evaluated – covered by the original application.		
§2.1053 §2.1057 §22.917	RSS 132 4.5	Field strength			
Other details					
§2.1055 §22.355	RSS-132 4.3	Frequency stability	Note evaluated – covered by the original application.		
§2.1093	RSS 102	RF Exposure	Refer to separate SAR report.		
§2.1033 (c) (8)	RSP 100 7.2 (a)	Final radio frequency amplifying circuit's dc voltages and currents for normal operation over the power range	Note evaluated – covered by the original application.		

Notes

1. Output power is taken from the test report used for the original filing of the device upon which the Change in ID application for FCC ID

FCC Part 24

FCC	Canada	Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics					
§2.1033 (c) (5) § 24	RSS-133	1850.2 – 1909.8 MHz	-	-	Pass
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 § 24.232(c)	RSS-133 6.4	RF power output at the antenna terminals	0.90 W (Note 1)	N/A	N/A
§2.1033 (c) (6) §2.1033 (c) (7) §2.1046 § 24.232(c)	RSS-133 6.4	EIRP	0.475 W	2 Watts eirp	Pass
§2.1033 (c) (4) §2.1047 §24.238 (b)	RSS-133 6.5	Emission types	Note evaluated – covered by the original application.		
		Emission mask			
	RSS GEN 4.4.1	99% Bandwidth			
§2.1049 §24.238 (b)		Occupied Bandwidth			
Transmitter spurious emissions					
§2.1051 §2.1057 §24.238	RSS-133 6.5	At the antenna terminals	Note evaluated – covered by the original application.		
§2.1053 §2.1057 §24.238	RSS-133 6.5	Field strength			
Other details					
§2.1055 §24.235	RS 102	Frequency stability	Note evaluated – covered by the original application.		
§2.1093		RF Exposure	Refer to separate SAR report.		
§2.1033 (c) (8)	RSP 100 7.2 (a)	Final radio frequency amplifying circuit's dc voltages and currents for normal operation over the power range	Note evaluated – covered by the original application.		

Notes

1. Output power is taken from the test report used for the original filing of the device upon which the Change in ID application for FCC ID

MEASUREMENT UNCERTAINTIES

ISO Guide 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2) and were calculated in accordance with NAMAS document NIS 81 and M3003.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
Radiated emission (substitution method)	dBm	25 to 40,000 MHz	± 2.5 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Delphi Automotive Systems model TL10001-40L1 is a telemetrics device with data modem that is installed into automobiles to perform wireless data logging of parameters such as vehicle speed, diagnostics trouble codes (DTCs), and GPS location. The system uses a cellular modem with modular approval under FCC ID: L2C0041TR.

Testing has been performed on the final product containing the L2C0041TR module to determine the erp/eirp as required under Parts 22 and 24 of the FCC rules.

The sample was received on December 21, 2009 and tested on December 21 and 23, 2009. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number	FCC ID
Delphi Automotive Systems	TL10001-40L1	Data Modem containing radio module	-	L2C0041TR

OTHER EUT DETAILS

The antenna is integral to the device.

ENCLOSURE

The host device enclosure is constructed of an ABS plastic material. It measures approximately 56cm wide by 75cm deep by 24cm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at Elliott.

SUPPORT EQUIPMENT

No support equipment was used during testing.

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
DLC	12Vdce	2 wires	unshielded	3

EUT OPERATION

During testing, the EUT was configured using an external cell simulator to transmit at maximum power on a single time slot. The conducted output power was verified to be at the expected power level based on the original test report filed with the module. The EUT was rotated through all three orthogonal axes to determine the orientation that produced the highest eirp/erp.

TESTING

GENERAL INFORMATION

Radiated emissions measurements were taken at the Elliott Laboratories Anechoic Chambers and/or Open Area Test Site(s) listed below. The sites conform to the requirements of ANSI C63.4: 2003 *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz* and CISPR 16-1-4:2007 - *Specification for radio disturbance and immunity measuring apparatus and methods Part 1-4: Radio disturbance and immunity measuring apparatus Ancillary equipment Radiated disturbances*. They are on file with the FCC and industry Canada.

Site	Registration Numbers		Location
	FCC	Canada	
Chamber 4	211948	IC 2845B-4	41039 Boyce Road Fremont, CA 94538-2435
Chamber 5	211948	IC 2845B-5	

Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements.

RADIATED EMISSIONS MEASUREMENTS

Receiver radiated spurious emissions measurements are made in accordance with ANSI ANSI C63.4:2003 by measuring the field strength of the emissions from the device at a specific test distance and comparing them to a field strength limit. Where the field strength limit is specified at a longer distance than the measurement distance the measurement is extrapolated to the limit distance.

Transmitter radiated spurious emissions are initially measured as a field strength. The eirp or erp limit as specified in the relevant rule part(s) is converted to a field strength at the test distance and the emissions from the EUT are then compared to that limit. Emissions within 20dB of this limit are the subjected to a substitution measurement.

All radiated emissions measurements are performed in two phases. A preliminary scan of emissions is conducted in either an anechoic chamber or on an OATS during which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed across the complete frequency range of interest and at each operating frequency identified in the reference standard. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode).

During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit. For transmitter spurious emissions, where the limit is expressed as an effective radiated power, the eirp or erp is converted to a field strength limit.

Final measurements are made on an OATS or in a semi-anechoic chamber at the significant frequencies observed during the preliminary scan(s) using the same process of rotating the EUT and raising/lowering the measurement antenna to find the highest level of the emission. The field strength is recorded and, for receiver spurious emissions, compared to the field strength limit. For the final measurement the appropriate detectors (average, peak, normal, sample, quasi-peak) are used. For receiver measurements below 1GHz the detector is a Quasi-Peak detector, above 1GHz a peak detector is used and the peak value (RB=VB=1MHz) and average value (RB=1MHz, VB=10Hz) are recorded.

For transmitter spurious emissions, the radiated power of all emissions within 20dB of the calculated field strength limit are determined using a substitution measurement. The substitution measurement is made by replacing the EUT with an antenna of known gain (typically a dipole antenna or a double-ridged horn antenna), connected to a signal source. The output power of the signal generator is adjusted until the maximum field strength from the substitution antenna is similar to the field strength recorded from the EUT. The erp of the EUT is then calculated.

INSTRUMENTATION

An EMI receiver as specified in CISPR 16-1-1 is used for radiated emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 7000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary.

For measurements above the frequency range of the receivers and for all conducted measurements a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis.

Measurement bandwidths for the test instruments are set in accordance with the requirements of the standards referenced in this document.

Software control is used to correct the measurements for transducer factors (e.g. antenna) and the insertion loss of cables, attenuators and other series elements to obtain the final measurement value. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are exported in a graphic and/or tabular format, as appropriate.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the EUT antenna port or receiving antenna and the test receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A combination of biconical, log periodic or bi-log antennas are used to cover the range from 30 MHz to 1000 MHz. Broadband antennas or tuned dipole antennas are used over the entire 25 to 1000 MHz frequency range as the reference antenna for substitution measurements.

Above 1000 MHz, a dual-ridge guide horn antenna or octave horn antenna are used as reference and measurement antennas.

The antenna calibration factors are included in site factors that are programmed into the test receivers and instrument control software when measuring the radiated field strength.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

Table mounted devices are placed on a non-conductive table at a height of 80 centimeters above the floor. Floor mounted equipment is placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. The EUT is positioned on a motorized turntable to allow it to be rotated during testing to determine the angel with the highest level of emissions.

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH

Measurements of radiated field strength are compared directly to the specification limit (decibel form). The receiver and/or control software corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor is used when measurements are made at a test distance that is different to the specified limit distance by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40*LOG_{10} (D_m/D_s)$$

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

SAMPLE CALCULATIONS –RADIATED POWER

The erp/eirp limits for transmitter spurious measurements are converted to a field strength in free space using the following formula:

$$E = \frac{\sqrt{30 P G}}{d}$$

where:

E = Field Strength in V/m
P = Power in Watts
G = Gain of isotropic antenna (numeric gain) = 1
D = measurement distance in meters

The field strength limit is then converted to decibel form (dBuV/m) and the margin of a given emission peak relative to the limit is calculated (refer to *SAMPLE CALCULATIONS –RADIATED FIELD STRENGTH*).

When substitution measurements are required (all signals with less than 20dB of margin relative to the calculated field strength limit) the eirp of the spurious emission is calculated using:

$$P_{EUT} = P_S - (E_S - E_{EUT})$$

and

$$P_S = G + P_{in}$$

where:

P_S = effective isotropic radiated power of the substitution antenna (dBm)
P_{in} = power input to the substitution antenna (dBm)
G = gain of the substitution antenna (dBi)
E_S = field strength the substitution antenna (dBm) at eirp P_S
E_{EUT} = field strength measured from the EUT

Where necessary the effective isotropic radiated power is converted to effective radiated power by subtracting the gain of a dipole (2.2dBi) from the eirp value.

Appendix A Test Equipment Calibration Data

TX Radiated, 21-Dec-09

Manufacturer	Description	Model #	Asset #	Cal Due
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	15-Oct-10
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1657	23-May-10
Rohde & Schwarz	Power Sensor, 1 uW-100 mW, DC-18 GHz, 50ohms	NRV-Z51	1070	06-Apr-10
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1290	22-Oct-10
EMCO	Antenna, Horn, 1-18GHz	3115	868	10-Jun-10

TX Radiated, 23-Dec-09

Manufacturer	Description	Model #	Asset #	Cal Due
Rohde & Schwarz	Power Sensor, 1 uW-100 mW, DC-18 GHz, 50ohms	NRV-Z51	1070	06-Apr-10
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1290	22-Oct-10
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1549	04-Jun-10
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	10-Feb-10
Compliance Design	Tuned Dipole Antenna	Roberts (400-1000MHz)	1896	16-Dec-11

Appendix B Test Data

T77798 3 Pages

Client:	Delphi Product and Service	Job Number:	J76151
Model:	Vertically Integrated Device	T-Log Number:	T77798
		Account Manager:	Christine Krebill
Contact:	John Highberg		-
Emissions Standard(s):	FCC Part 22/24	Class:	-
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Delphi Product and Service

Model

Vertically Integrated Device

Date of Last Test: 12/21/2009

Client:	Delphi Product and Service	Job Number:	J76151
Model:	Vertically Integrated Device	T-Log Number:	T77798
		Account Manager:	Christine Krebill
Contact:	John Highberg		
Standard:	FCC Part 22/24	Class:	-

FCC Part 22/24
Power (EIRP)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

All measurements were made with the EUT's antenna connected. The EUT was tested in three orientations on the center channel in each band. The top and bottom channels in each band were evaluated with the EUT in the orientation that produced the highest field strength in that band. The EUT was configured using the Agilent Call Box to transmit at maximum power on one time slot.

Radiated measurements are made with the EUT located on a non-conductive table, 3m from the measurement antenna.

Ambient Conditions:

Temperature: 22 °C
Rel. Humidity: 45 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	Output Power (ERP)	FCC P22 7W erp	Pass	3W erp
1	Output Power (EIRP)	FCC P24.23(c) 2W eirp	Pass	0.5W eirp

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Radio Test Data

Client:	Delphi Product and Service	Job Number:	J76151
Model:	Vertically Integrated Device	T-Log Number:	T77798
		Account Manager:	Christine Krebill
Contact:	John Highberg		
Standard:	FCC Part 22/24	Class:	-

Run #1: Output Power
EUT Field Strength Measurements and Substitution Measurements

Date: 12/21/2009 Engineer: Mark Hill Location: FT#5 PCS
Date: 12/23/2009 Engineer: Mark Hill Location: FT#4 GSM850

EUT Field Strength

Frequency	Level	Pol	FCC		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
GSM850 Band									
824.200	122.4	V	-	-	Pk	354	1.0	EUT Flat	
824.200	129.4	H	-	-	Pk	154	1.0	EUT Flat	
824.200	133.8	H	-	-	Pk	148	1.0	EUT on Edge	
824.200	126.8	V	-	-	Pk	23	1.0	EUT on Edge	
836.600	134.0	H	-	-	Pk	148	1.0	EUT on Edge	
848.800	133.5	H			Pk	153	1.0	EUT on Edge	
PCS Band									
1850.200	122.3	H	-	-	Pk	330	2.8	EUT Flat	
1850.200	125.8	V	-	-	Pk	0	1.0	EUT Flat	
1850.200	126.4	H	-	-	Pk	161	2.1	EUT on Edge	
1850.200	121.5	V	-	-	Pk	248	1.3	EUT on Edge	
1880.200	126.0	H	-	-	Pk	119	2.5	EUT on Edge	
1909.800	123.2	H	-	-	Pk	276	2.5	EUT on Edge	

Substitution measurements
Horizontal

Frequency	Substitution measurements			Site	EUT measurements				
								eirp	erp
MHz	Pin[1]	Gain[2]	FS[3]	Factor[4]	FS[5]	eirp (dBm)	erp (dBm)	W	W
824.200	-0.7	2.2	99.9	98.4	133.8	35.4	33.2		2.089
836.600	-0.7	2.2	99.4	97.9	134.0	36.1	33.9		2.455
848.800	-0.7	2.2	98.0	96.5	133.5	37.0	34.8		3.020
1850.200	-1.1	8.3	106.8	99.6	126.4	26.8		0.475	
1880.200	-1.2	8.3	106.7	99.6	126.0	26.5		0.442	
1909.800	-1.2	8.1	106.6	99.7	123.2	23.5		0.224	

Note 1:	Pin is the input power (dBm) to the substitution antenna
Note 2:	Gain is the gain (dBi) for the substitution antenna.
Note 3:	FS is the field strength (dBuV/m) measured from the substitution antenna.
Note 4:	Site Factor - this is the site factor to convert from a field strength in dBuV/m to an eirp in dBm.
Note 5:	EUT field strength as measured during initial run.

Appendix C Photographs

Uploaded as a separate exhibit