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In this project, the prototyped air-c	oupled and ground-cou	ipled GPRs, that w	vere developed by the Proj	ject 0-4820, have been
upgraded. Special antenna shieldin	g structures have been	developed to guid	e the electromagnetic ener	rgy down into ground,
so that to prevent the GPRs from ra			•	
_				
devices several times, both the air-		-		
requirements. The FCC testing rep	orts by Nemko Inc. are	included in the ap	ppendix part of this report.	The testing reports
and other documents for FCC certi	ficate applications have	e been submitted to	o FCC and the GPR certif	icates are expected in
a few weeks.				
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Implementation of an FCC Compliant Radar-Part 1: Radar Development and FCC Testing

by

Richard Liu, Jing Li, Ying Wang, and Wei Ren

Technical Report 5-4820-01-1

Project Number: 5-4820-01
Project Title: Implementation of an FCC Compliant Radar

Performed in Cooperation with the Texas Department of Transportation and the Federal Highway Administration

by the

Subsurface Sensing Laboratory
Department of Electrical and Computer Engineering
University of Houston

November 2007

DISCLAIMERS

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Texas Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification or regulation.

University of Houston 4800 Calhoun Rd. Houston, TX 77204

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CHAPTER 1 INTRODUCTION

Two types of GPRs, an air-coupled GPR and a ground-coupled GPR, have been developed by the Project 0-4820. The air-coupled GPR is for asphalt and shallow concrete pavement measurement, and the ground-coupled GPR is for thicker concrete pavement and base layer detection. But they do not have FCC certification yet.

The main task of this project is to upgrade the circuit and antenna design of the developed GPRs so that the two types of GPRs can meet all FCC requirements while maintaining original performances. FCC testing is very strict. Fig. 1 shows FCC radiation limits received at a distance of 3m from the GPR set in the frequency range of 30MHz to 1GHz. The measurement must be carried out in all directions around the GPR set. If the radiation at any azimuth angle on any frequency exceeds the FCC limit, the GPR fails to get FCC certified.

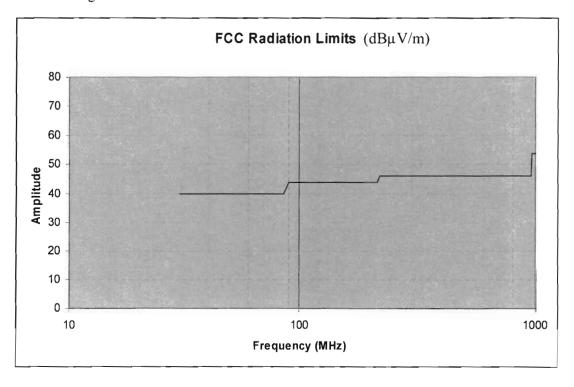


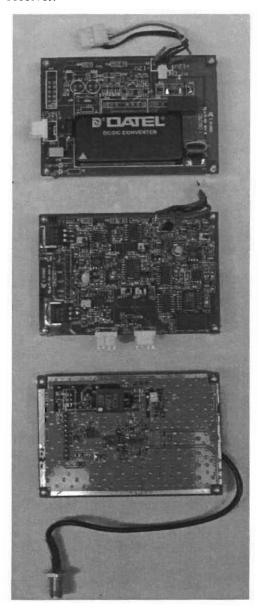
Figure 1 FCC Radiation Limit

It can be seen from Figure 1 that the FCC radiation level is about 40 dB μ V/m. If converted Volts it equals 0.0001V/m. This magnitude is even lower than the thermal noise level of general instruments. It is too hard to use microwave energy of this level to detect underground targets. The only solution is to design effective shielding structures to guide the GPR energy into ground and prevent the energy from radiating into the space above the ground. In this project, besides the design of the shielding devices, the GPR radiation power is also optimized. If the radiation power is too high, it will certainly exceed FCC limits, even with shielding devices. On the other hand, if the radiation power is too low, the GPR penetrating depth will be limited and fail to detect the targets.

CHAPTER 2 UPGRADED RECEIVER AND TRANSMITTER

2.1. Upgraded GPR Receiver Circuitry

In this project, the three parts of the receiver, power supply, time delay line, and sampling bridge, have been redesigned. Figures 2 and 3 show the developed PCB boards of the receiver.



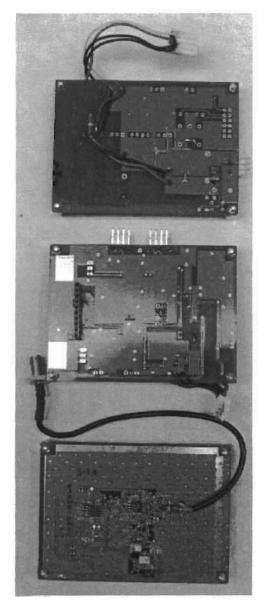
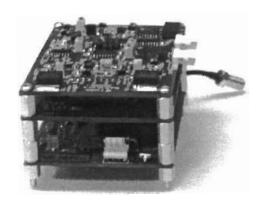


Fig. 2 Top view of receiver PCBs

Fig. 3 Bottom view of receiver PCBs

2.2 Installation of the PCB Boards

For the convenience of implementation, the developed receiver PCBs are stacked up and installed in a metal box to block them from outside electromagnetic interference.



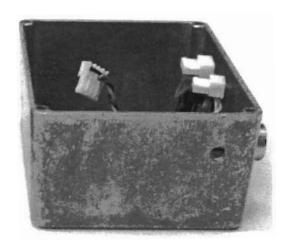


Figure 4 PCBs stacked up for installation

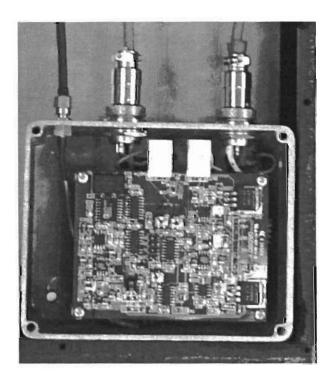


Figure 5 Circuit boards installed in the aluminum box

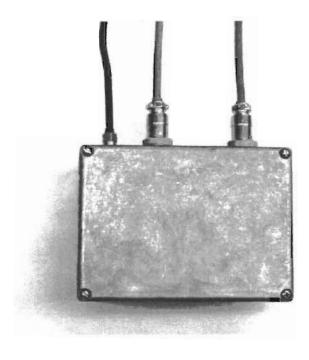


Figure 6 the receiver box is sealed

2.3 GPR Transmitter Board

Figure 7 and Figure 8 show the upgraded transmitter. In this design, the pulse shaping circuits re modified and the pulse width can be easily adjusted between 1ns to 8ns.

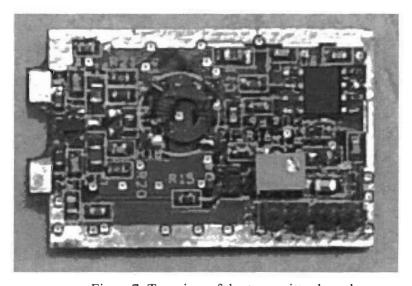


Figure 7 Top view of the transmitter board

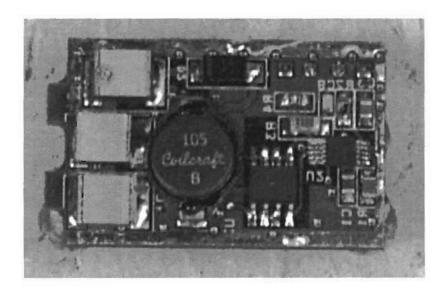


Figure 8 Bottom view of the transmitter board

2. 4 Ground-Coupled GPR

By installing the above receiver and transmitter with bow-tie antennas into a box, the ground-coupled GPR set is built, as shown in Figure 9.

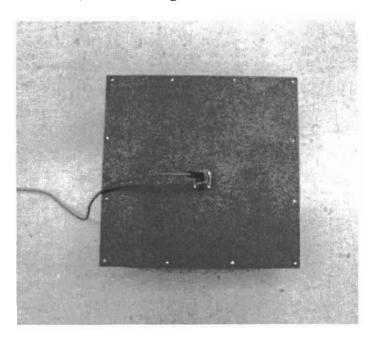


Figure 9 Developed Ground-coupled GPR

Figure 10 shows the electrical connection of the GPR system. Once the power is supplied, the GPR starts to work and the measured data can be stored in the laptop computer. When the GPR system is set up in a pushcart, it is ready to use, as shown in Figure 11.

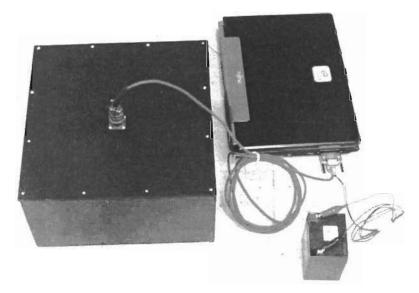


Figure 10 Electrical connection of the whole GPR system

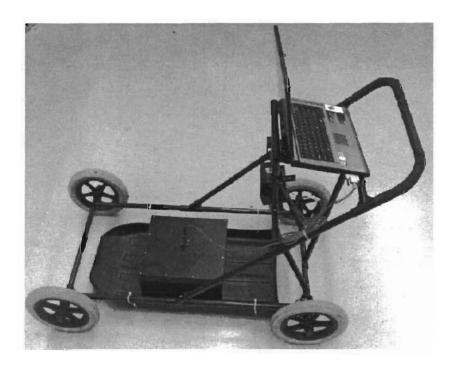


Figure 11 GPR application setup

2.5 Air-Coupled GPR

By installing the above receiver and transmitter with TEM horn antennas into a box, and adjusting the transmitting pulse to about 1ns, an air-coupled GPR system can be built, as shown in Figure 12.

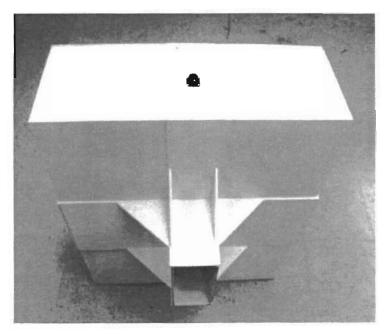


Figure 12 Top view of the air-coupled GPR

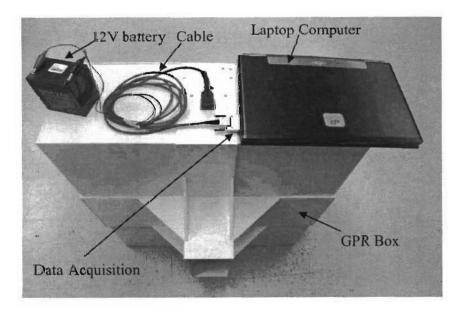


Figure 13 Electrical connection of the GPR system



Figure 14 Air-coupled GPR mounted on a vehicle in application

2.5 Current Status of the GPR Systems

By now, both the air-coupled and ground-coupled GPR systems have been upgraded and they are working. After searching for FCC testing agencies nationwide, The Nemko USA Inc. was selected, because 1) Nemko has had experience in GPR compliance testing; 2) Nemko is located in Dallas, TX, which facilitates our trips to do changes in case the GPR does not comply. The testing results will be given in the next chapter.

CHAPTER 3 FCC TESTING AND RESULTS

FCC testing is very time-consuming job. The digital signals coupled onto the GPR cables or leaking energy from the edges or slots of the GPR shielding cover can easily fail the GPR testing. After modify the GPR circuits, the shielding covers, the low-pass filters, and the absorbing materials several times, the unwanted radiation from low frequency digital noise was finally eliminated. Both the ground-coupled GPR and air-coupled GPR have complied with FCC rules and past all kinds of FCC testing. The FCC certificates will be obtained in about two months.

3.1 EMC Test of the Ground-Coupled GPR

Figure 15 shows the Nemko outdoor EMC test site with the GPR antenna sitting on a rotation table. The receiving antenna is mounted on a post three meters away from the GPR set. The measurement will be conducted for each angle from 0 to 360 degrees, and throughout the frequency range of 30MHz to 4GHz. If measured GPR signal strengths exceed FCC limits at any frequency at any antenna orientation angle, the GPR fails the testing. The GPR must be modified and all tests redone. Table 1 shows part of the final testing results.

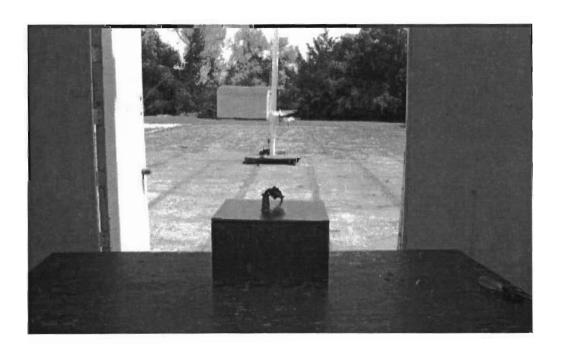


Figure 15 Nemko outdoor test site for EMC testing

Table 1 Part of the EMC test data for the ground-coupled GPR set



CFR 47, PART 15, SUBPART A CLASS A VERIFICATION REPORT NO.: 4451EUS1

EQUIPMENT: Ground Penetrating Radar

Test Data - Radiated Emissions, Electric Field, Test#REHE-01(cont)

				F	Radiate	d Emissi	ons Data	1				
omplet		~						labr#·	44E1		Torth, BEI	ue n
relimin		X	-					J00 # :	<u> 4401</u>		Tes:#: <u>RE</u> of	75-0
relimin	ary		•						Fage		ੁਧ	_
lient Na	ame	University	of Hous	ton								
UT Na	me :	Ground P	enetratin	g Radar								
UT Mo	del#.	J7W400										
UT Par	t#:	U7W400										
UT Ser	nai#:	None										
UT Co	nfg.:	Stand Alo	пе									_
pecifica	ation :	CFR47 P	ant 15, Si	ubpart 8,	Class A			Refere	nce:			
				-	1-0-1-0-1							
Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	P366		
Freq.	Pol.	Atten.	Reading	Factor	Loss	Gain	Reading	limit	DIII.	Fall	5_114e7500	
MHZ	(H/V)	(dB)	(dBuV)	(0B)	(05)	(05)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment	
200		0	37.6	14.8	5.5	27.9	30.0	43.5	-13.5		PEAK	
240	<u> </u>	0	39.5	15.7	5.9	27.9	33.2	48.4	-13.2		PEAK	
295	H	_0	41	18.2	ପ୍ରି.4	27.8	37.8	48.4	-පි.චි		PEAK	
49.1	H	0	34	9.6	2.3	28.5	17.4	39,0	-21.6	Pass	PEAK	
313	V	0	38.9	15	đ,8	27.9	32.8	46.4	-13.6	Pass		_
327	V	0	39.1	14.8	6.8	27.9	32.6	46.4	-13.8	Pass		
385	V	0	34.3	15.6	7.4	27.7	29.6	45.4	-16.8	Pass		
457	V	ū	33.6	16.9	8.5	28.1	30.9	45.4	-15.5			
508	V	0	30	17.4	8,9	28.1	28.2	45.4	-18.2	Pass		
583	V	0	31	18.4	9.5	27.8	31.1	46.4	-15.3	Pass		
816	V	Đ	32	19	9.7	27.9	32.8	48.4	-13.6	Pass		
820	V	0	29	22.3	11.8	27.5	35.8	46.4	-10.8	Pass		
310	H	0	44.9	15	6.8	27.9	38.8	46.4	-7 <u>.6</u>	Pass		
356	H	0	45.3	14.3	7.4	27.7	39.3	48.4	-7.1	Pass		
438	H	0	43.6	15.9	8.0	27.8	39.7	46.4	-6.7	Pass		
547	H	0	40.7	18.9	8.9	28.1	40 4	46.4	-6 <u>.0</u>	Pass		

3.2 Wireless Testing of the Ground-Coupled GPR

To conduct wireless radiation tests, the GPR antenna should sit on a certified sand pit as shown in Figure 16. The receiving antenna is still 3m away from the GPR antenna. The testing frequency range is 30MHz to 4000 MHz., and the GPR set must turn 360⁰ for each frequency step.



Figure 16 Nemko outdoor test site for wireless radiation testing

The first part of the measured results are shown in Table 2. The full testing results can be found in the Nemko testing report.

Table 2 Wireless radiation test data for the ground-coupled GPR Set

Nemko USA, Inc.

FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation

EQUIPMENT: U7W400

Test Report No.: 5113RUS1

Test Data - Radiated Emissions

					Radia	ted Emis	sions D	ata			
Comple	te	X						.iob #	5113		Test#: REHE-01
relimin			_						Page	***	of 11
	,		_						, -90		
Cient N	ame	Universit	y of Hous	ston							
EUT Na	me.	Ground (Radar							
EUT Me		UTW408									
UT Pa	rt # :										
EUT Se											
EUT Co	nfig	Transmit	ting over	sand pit							
pecific	ation :	CFR47 F	art 15. S	ІЗ льесси	Class B			Refere	nce:	15.209/1	5.539
od. An					deg. C):	22	•			Date:	10/11/07
icon A	nt.#:	1306	-	Humidit	_	40	•			Time:	9:00
og Ant	. # .	759	_	EUT Vo		12				Staff:	David Light
Bilog An	rt.#		_		equency :	do				Photo ID	
Dipole A	int.#:		_	Phase:		0	•		QP Bar	dwidth:	120 KHz
Cable#:		1522	_	Location	1:	Sand Pit					
reamp	# ;	762		Distance	P :	3 Meters					
.imiter#		na		Barome:	ric pressure:	1816					
Atten #:		na	_				•				
)etector	r#:	:659	-								
Meas.	Ant.	Atten.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass	
Freq	PoL		Reading	Factor	LOSS	Gain	Reading	mit	DIM.	Fall	
(MHZ)	(H/V)	(45)	(dBuV)	₹dB⟩	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(46)	Unc.	Comment
											0 degrees
73.7	V	D	41.8	8.9	3.1	27.5	28.3	40.0	-13.7	Pass	<u> </u>
දීල් රාම්	V	<u> </u>	32.5	9.6	3.5	27.4	18.2	40.0	-21.8	Pass	
110.6	V	0	48	11.4	3.8	27.6	35.6	43.5	-7.9	Pass	
122.9 135.2	V	0 8	48 448	11.9	3.8	27.6	34.1	43,5	-9.4	Pass	
147.4	V	0	46.8	13.5	4.2	27.7	34.0	43.5	-9.5	Pass	
198.6	V	D	40.8	14.7	5.1	27.9	36.8 40.9	43.5 43.5	-6.7 -2.6	Pass Pass	
208.9	V	0	48	14.0	5.5	27.9	38.5	43.5	-2.8 -5.8	Pass	
258.1	V	3	42.4	17.1	6.2	27.9	37.8	48.0	-8.2	Pass	
73.7	H	0	40.9	8.9	3.1	27.5	25.4	40.0	-14.6	Pass	
86	H	5	35	9.8	3.5	27.4	20.7	40.0	-19.3	Pass	
110.6	Н.	0	35	11.4	3.8	27.6	22.6	43.5	-20.9	Pass	
198.6	Н	8	43	147	5.1	27.9	34.9	43.5	-8.6	Pass	
208.9	H	8	40.7	14.9	5.5	27.9	33.2	43.5	-10.3	Pass	
245.8	Н	0	44.2	10.5	5.9	27.9	38.7	48.0	-7.3	Pass	

3.3 EMC Test of the Air-Coupled GPR

Figure 17 shows the set up for the air-coupled GPR EMC testing. Table 3 gives the first part of the final testing results.

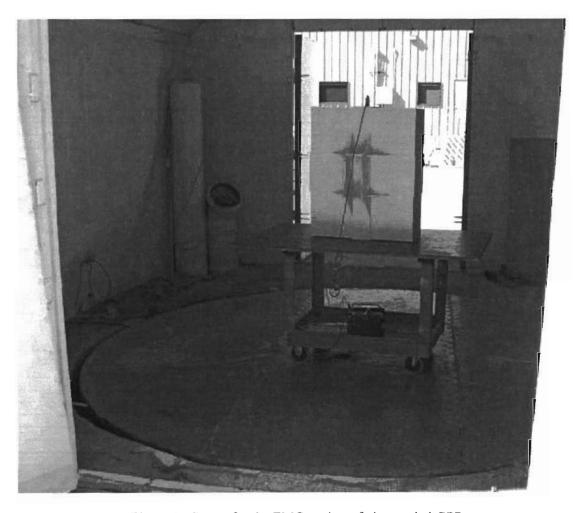


Figure 17 Set up for the EMC testing of air-coupled GPR

Table 3 Wireless radiation test data for the ground-coupled GPR set



CFR 47, PART 15, SUBPART A
CLASS A VERIFICATION

EQUIPMENT: U7W900 REPORT NO.: 5113EUS1

Test Data - Radiated Emissions

Meas	Ant	Atten	Meter	Antenna	Path	RF	Corrected	Spec	CR/SL	Pass	
Freq	Pd		Reading	Factor	Loss	Gain.	Reading	limit	Diff*	Fast	
(N#Hz)	(∺/√)	(dB)	(d8uV)	(₫B)	(dB)	(dB)	(dBuV/m)	(d⊜uV/m)	(dB)	Unc.	Comment
36 8	V	0	42	129	2 2	28.5	28.6	39 0	-10 4	Pass	
73 7		0	47	8.9	3 1	27.5	31.5	39 0	-7.5	Pass	
86	V	0	47	9.6	3.5	27.4	32.7	39 0	-6.3	Pass	
147.4		0	32.4	13.5	4.2	27.7	22.4	43.5	-21.1	Pass	
737	H	0	31	8.9	3.1	27.5	15.5	39 0	-23.5	Pass	
86	Н	0	32	9.6	3.5	27.4	17.7	39.0	-213	Pass	
122.9	Н	Ω	32	11.9	3.8	27.6	20 1	43.5	-23 4	Pass	
245 8	Н	0	33	16.5	5.9	27 9	27.5	46.4	-18 9	Pass	
					-						
CNACC	horn\All	TOMATE	DATASH	TOUDADE	MEV Rev C) vie	Documen	t Control	#ENO D	e sa n	ND USE

The spectrum was searched from 30 MHz to 1000 MHz. No digital emissions were detected beyond 245.8 MHz.

Analyzer Settings: RBW=VBW=100 kHz Peak detector

3.4 Wireless Radiation Test of Air-Coupled GPR

Figure 18 shows the set up for the air-coupled GPR wireless radiation testing. Table 4 gives the first part of the final testing results.



Figure 18 set up for the air-coupled GPR wireless radiation testing

Table 19 Wireless radiation test data for the air-coupled GPR set

Nemko USA, Inc.

FCC PART 15, SUBPART F, Paragraph 15.509

Ultra Wide Band Operation

EQUIPMENT: U7W900

Test Report No.: 5113RUS2

Measurement Data - Radiated Emissions

					Radiat	ed Emis	sions Da	ta			
Complete Prelimina		X						Job # .	5113 Page		Test # : <u>REHE-01</u>
	~		•						rage		013
Client Na		University			4/						
EUT Nan		U7W900	ea groun	ia peneii	rating radar						
EUT Par		U7W900									
EUT Seri		None	_								
EUT Con		Elevated	12 inobe	a alama	eand pit						
COT COT	ilig.	Lievateu	TO ITICIS	S GLOVE	Samu pis			_			
Specifica	ation :	CFR47 P	art 15, S	Subpart E	3. Class B		_	Refere	ence :	15.509	
Rod. Ant	. #:		_	Temp. ((deg. C) "	24	_			Date:	10/29/07
Bigon An	t.#:	760		Humidit	y (%)	35				Time:	8:00
Log Ant.	#:	1034		EUT Vo	ltage :	12				Staff:	D. Light
Billog Ant	t.#:			EUT Fr	equency:	dc				Photo ID	
Dipole A	nt.#:			Phase:		na					100 KHz
Cable#:		1522		Location	-	DOATS					100 KHz
Preamp#		762		Distanc	e:	3 m			QP Ban	idwidth:	120 KHz
Limiter#:		na	_	Baromet	rio pressure;	1016	_				
Atten #:		na				,	-		- 6	O.	
Detector	₩:	1036		Note:	Ali measur	rements	are Peak	unless	otnerv	vise no	ted
Meas	AM.	Alten.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/S'L	Pass	
≔req.	Pol.										
			Reading	Factor	1.065	Gam	Reading	limm	OHT.	Fall	
(MHz)	(HW)	(dB)	Reading (dBuV)	Factor (dB)	L065 (dB)	Gain (08)	Reading (dBuV/m)	limit (aBuV/m)	Off. (dB)		Comment
(MHZ)	(HV)	(dB)					-	1000		문래	
(MHz) 43.6	(HV)	(dB)					-	1000		문래	Comment O degrees
			(dBcV)	(08)	(05)	(CB)	(dBuV/m)	(dBuV/m)	(dB)	Fall Unc.	
43.6	V	D	(dBcV) 47.5	(dB) 12.2	2.3	(08) 29.5	(glBuV/m) 33.5	(aBuV/m) 40.0	(dB) -6.5	Fall Unc. Pass	
43.6 74.4	V V V	0	(dBcV) 47.5 50.3 47 47.4	12.2 8.1 14.6 12.4	2.3 3.1 5.1 2.2	28.5 27.5 27.9 28.5	(dBuV/m) 33.5 34.0	(aBuV/m) 40.0 40.0	-6.0	Fall Unc Pass Pass	
43.6 74.4 189.6	V	0	47.5 50.3 47	12.2 8.1 14.6	2.3 3.1 5.1	(dB) 28.5 27.5 27.9	33.5 34.0 38.8 33.5 34.0	40.0 40.0 43.5	-6.5 -6.0 -4.7	Pass Pass Pass	
43.6 74.4 189.6 35.2 36.8 74.9	V V H H	0 0 0	(dBcV) 47.5 50.3 47 47.4 48 39	12.2 8.1 14.6 12.4 12.3 8.1	2.3 3.1 5.1 2.2 2.2 3.1	28.5 27.5 27.9 28.5 29.5 29.5	33.5 34.0 38.8 33.5 34.0 22.7	40.0 40.0 43.5 40.0 40.0 40.0 40.0	-6.5 -6.0 -4.7 -8.5	Pass Pass Pass Pass Pass	
43.6 74.4 189.6 35.2 36.8	V V H H	0 0	47.5 50.3 47 47.4 48	12.2 8.1 14.6 12.4 12.3	2.3 3.1 5.1 2.2 2.2	28.5 27.5 27.9 28.5 29.5	33.5 34.0 38.8 33.5 34.0	40.0 40.0 40.0 43.5 40.0 40.0	-6.5 -6.0 -4.7 -6.5 -6.0	Pass Pass Pass Pass Pass Pass	Q degrees
43.6 74.4 189.6 35.2 36.8 74.9 183	>	0 0 0 0 0 0	(dBcV) 47.5 50.3 47 47.4 48 39 40	12.2 8.1 14.6 12.4 12.3 8.1 14.4	(d8) 2.3 3.1 5.1 2.2 2.2 3.1 5.1	28.5 27.5 27.9 28.5 29.5 29.5 27.5 27.9	33.5 34.0 38.8 33.5 34.0 22.7 31.6	40.0 40.0 43.5 40.0 40.0 40.0 40.0 43.5	-6.5 -6.0 -4.7 -6.5 -6.0 -17.3 -11.9	Pass Pass Pass Pass Pass Pass Pass Pass	
43.6 74.4 189.6 35.2 36.8 74.9 183	V V V H H H H H V V	0 0 0 0 0	(dBcV) 47.5 50.3 47 47.4 48 39 40	12.2 8.1 14.6 12.4 12.3 8.1 14.4	(d5) 2.3 3.1 5.1 2.2 2.2 3.1 5.1	28.5 27.5 27.9 28.5 29.5 27.5 27.9 28.5	33.5 34.0 38.8 33.5 34.0 22.7 31.6	40.0 40.0 43.5 40.0 40.0 40.0 40.0 43.5	-6.5 -6.0 -4.7 -6.5 -6.0 -17.3 -11.9	Pass Pass Pass Pass Pass Pass Pass Pass	Q degrees
43.6 74.4 189.6 35.2 36.8 74.9 183	>	0 0 0 0 0	(dBcV) 47.5 50.3 47 47.4 48 39 40 44	12.2 8.1 14.6 12.4 12.3 8.1 14.4	(d5) 2.3 3.1 5.1 2.2 2.2 3.1 5.1 2.2 2.2	28.5 27.5 27.9 28.5 29.5 27.5 27.9 28.5 27.5 27.9	33.5 34.0 38.8 33.5 34.0 22.7 31.6 29.7 32.3	40.0 40.0 43.5 40.0 40.0 40.0 40.0 43.5 40.0 40.0	-6.5 -6.0 -4.7 -6.5 -6.0 -17.3 -11.9	Pass Pass Pass Pass Pass Pass Pass Pass	Q degrees
43.6 74.4 189.6 35.2 36.8 74.9 183 38 42 43.6	V V H H H H V V V	0 0 0 0	(dBcV) 47.5 50.3 47 47.4 48 39 40 44 46.4	12.2 8.1 14.6 12.4 12.3 8.1 14.4 12.3 12.1 12.1	2.3 3.1 5.1 2.2 2.2 3.1 5.1 2.2 2.3 2.3	(68) 28.5 27.5 27.9 28.5 27.5 27.5 27.9 28.5 28.5 28.5 28.5	(aBuvim) 33.5 34.0 38.8 33.5 34.0 22.7 31.6 29.7 32.3 32.8	40.0 40.0 43.5 40.0 40.0 40.0 40.0 43.5 40.0 40.0 40.0	-6.5 -6.0 -4.7 -6.5 -6.0 -17.3 -11.9 -10.3 -7.7 -7.2	Pass Pass Pass Pass Pass Pass Pass Pass	Q degrees
43.6 74.4 189.6 35.2 36.8 74.9 183 38 42 43.6 47.7	V V H H H H V V V V V V V V V V V V V V	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(dBcV) 47.5 50.3 47 47.4 48 39 40 44, 46.4 46.8	12.2 8.1 14.6 12.4 12.3 8.1 14.4 12.2 12.1 12.2	2.3 3.1 5.1 2.2 2.2 3.1 5.1 2.2 2.3 2.3 2.3	(68) 28.5 27.5 27.9 28.5 27.5 27.5 27.9 28.5 28.5 28.5 28.5 28.5	(aBuvim) 33.5 34.0 38.8 33.5 34.0 22.7 31.6 29.7 32.3 32.8 32.3	40.0 40.0 43.5 40.0 40.0 40.0 40.0 43.5 40.0 40.0 40.0 40.0	-6.5 -6.0 -4.7 -6.5 -6.0 -17.3 -11.9 -10.3 -7.7 -7.2 -7.2	Pass Pass Pass Pass Pass Pass Pass Pass	O degrees
43.6 74.4 189.6 35.2 36.8 74.9 183 38 42 43.6 47.7 72.3	V V H H H H V V V V V V V V V V V V V V	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(dBcV) 47.5 50.3 47 47.4 48 39 40 44, 46.8 46.5	12.2 8.1 14.6 12.4 12.3 8.1 14.4 12.2 12.1 12.2 8	(db) 2.3 3.1 5.1 2.2 2.2 3.1 5.1 2.2 2.3 2.3 2.3 2.3 3.1	28.5 27.5 27.9 28.5 27.5 27.5 27.5 27.9 28.5 28.5 28.5 28.5 28.5 28.5	(abuvim) 33.5 34.0 38.8 33.5 34.0 22.7 31.6 29.7 32.3 32.8 32.3 32.4	40.0 40.0 43.5 40.0 40.0 40.0 40.0 43.5 40.0 40.0 40.0 40.0 40.0 40.0	-6.5 -6.0 -4.7 -6.5 -6.0 -17.3 -11.9 -10.3 -7.7 -7.2 -7.6	Pass Pass Pass Pass Pass Pass Pass Pass	O degrees
43.6 74.4 189.6 35.2 36.8 74.9 183 38 42 43.6 47.7 72.3 189	V V V H H H H H V V V V V V V V V V V V	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(dBcV) 47.5 50.3 47 47.4 48 39 40 44, 46.4 46.8 46.5 48.8	12.2 8.1 14.6 12.4 12.3 8.1 14.4 12.2 12.1 12.2 12.1 12.2 8	(d5) 2.3 3.1 5.1 2.2 2.2 3.1 5.1 2.2 2.3 2.3 2.3 2.3 2.3 3.1 5.1	28.5 27.5 27.9 28.5 29.5 27.5 27.9 28.5 28.5 28.5 28.5 28.5 28.5 28.5 28.5	(gBuvim) 33.5 34.0 38.8 33.5 34.0 22.7 31.6 29.7 32.3 32.8 32.3 32.4 37.8	40.0 40.0 43.5 40.0 40.0 40.0 43.5 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40	-6.5 -6.0 -4.7 -6.5 -6.0 -17.3 -11.9 -10.3 -7.7 -7.2 -7.6 -5.7	Pass Pass Pass Pass Pass Pass Pass Pass	O degrees
43.6 74.4 189.6 35.2 36.8 74.9 183 38 42 43.6 47.7 72.3 189 35.2	V V V H H H H H V V V V V V V V V V V V	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(dBcV) 47.5 50.3 47 47.4 48 39 40 44.4 46.8 46.5 48.8 46	12.2 8.1 14.6 12.4 12.3 8.1 14.4 12.2 12.1 12.2 12.1 12.2 12.2 14.6 12.4	(d5) 2.3 3.1 5.1 2.2 2.2 3.1 5.1 2.2 2.3 2.3 2.3 2.3 2.3 2.3 2.3	28.5 27.5 27.9 28.5 29.5 27.5 27.9 28.5 28.5 28.5 28.5 28.5 27.9 28.5	(abuvim) 33.5 34.0 38.8 33.5 34.0 22.7 31.6 29.7 32.3 32.8 32.3 32.4 37.8 32.1	40.0 40.0 43.5 40.0 40.0 43.5 40.0 43.5 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40	-6.5 -6.0 -4.7 -6.5 -6.0 -17.3 -11.9 -10.3 -7.7 -7.2 -7.7 -7.6 -5.7 -7.9	Pass Pass Pass Pass Pass Pass Pass Pass	O degrees
43.6 74.4 189.6 35.2 36.8 74.9 183 38 42 43.6 47.7 72.3 189 35.2 40	V V V H H H H V V V V V V V H H H H	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(dBcV) 47.5 50.3 47 47.4 48 39 40 44,4 46.8 46.5 48.8 46	12.2 8.1 14.6 12.4 12.3 8.1 14.4 12.1 12.1 12.2 12.1 12.2 14.6 12.4 12.4	(d5) 2.3 3.1 5.1 2.2 2.2 3.1 5.1 2.2 2.3 2.3 2.3 2.3 2.3 2.3 2.3	28.5 27.5 27.9 28.5 29.5 27.5 27.9 28.5 28.5 28.5 28.5 27.9 28.5 27.9 28.5	(abuvim) 33.5 34.0 38.8 33.5 34.0 22.7 31.6 29.7 32.3 32.8 32.3 32.4 37.8 32.1 31.8	40.0 40.0 43.5 40.0 40.0 43.5 40.0 40.0 43.5 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40	-6.5 -6.0 -4.7 -6.5 -6.0 -17.3 -11.9 -10.3 -7.7 -7.2 -7.7 -7.6 -5.7 -7.9 -8.2	Pass Pass Pass Pass Pass Pass Pass Pass	O degrees
43.6 74.4 189.6 35.2 36.8 74.9 183 38 42 43.6 47.7 72.3 189 35.2 40 50	V V V H H H H V V V V V V H H H H H	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(dBcV) 47.5 50.3 47 47.4 48 39 40 44,4 46.4 46.8 46.5 48.8 46 46 40	12.2 8.1 14.6 12.4 12.3 8.1 14.4 12.1 12.1 12.2 12.1 12.2 12.1 12.2 12.4 12.4	(db) 2.3 3.1 5.1 2.2 2.2 3.1 5.1 2.2 2.3 2.3 2.3 2.3 2.3 2.3 2.3	28.5 27.5 27.9 28.5 29.5 27.5 27.9 28.5 28.5 28.5 28.5 27.9 28.5 27.9 28.5 27.9	(abuvim) 33.5 34.0 38.8 33.5 34.0 22.7 31.6 29.7 32.3 32.8 32.3 32.4 37.8 32.1 31.8 26.4	40.0 40.0 43.5 40.0 40.0 43.5 40.0 40.0 43.5 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40	-6.5 -6.0 -4.7 -6.5 -6.0 -17.3 -11.9 -10.3 -7.7 -7.2 -7.7 -7.6 -5.7 -7.9 -8.2 -13.6	Pass Pass Pass Pass Pass Pass Pass Pass	O degrees
43.6 74.4 189.6 35.2 36.8 74.9 183 38 42 43.6 47.7 72.3 189 35.2 40 50 155	V V V H H H H H H H H H H H H H H H H H		(dBcV) 47.5 50.3 47 47.4 48 39 40 44.4 46.4 46.8 46.5 48.8 46 46 40 30	12.2 8.1 14.6 12.4 12.3 8.1 14.4 12.1 12.1 12.2 12.1 12.2 12.1 12.2 12.4 12.4	(db) 2.3 3.1 5.1 2.2 2.3 3.1 5.1 2.2 2.3 2.3 2.3 2.3 2.3 2.3 2.3	28.5 27.5 27.9 28.5 29.5 27.5 27.9 28.5 28.5 28.5 28.5 28.5 28.5 28.5 28.5	(abuvim) 33.5 34.0 38.8 33.5 34.0 22.7 31.6 29.7 32.3 32.8 32.3 32.4 37.8 32.1 31.8 26.4 21.2	40.0 40.0 43.5 40.0 40.0 43.5 40.0 43.5 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40	-6.5 -6.0 -4.7 -6.5 -6.0 -17.3 -11.9 -10.3 -7.7 -7.2 -7.7 -7.6 -5.7 -7.9 -8.2 -13.6 -22.3	Pass Pass Pass Pass Pass Pass Pass Pass	O degrees
43.6 74.4 189.6 35.2 36.8 74.9 183 38 42 43.6 47.7 72.3 189 35.2 40 50 155 178	V V H H H H H H H H H H H H H H H H H H		(dBcV) 47.5 50.3 47 47.4 48 39 40 44.4 46.4 46.8 46.5 48.8 46 46 40 30 36	12.2 8.1 14.6 12.4 12.3 8.1 14.4 12.1 12.2 12.1 12.2 12.1 12.2 12.4 12.4	(db) 2.3 3.1 5.1 2.2 2.3 3.1 5.1 2.2 2.3 2.3 2.3 2.3 2.3 2.3 2.3	28.5 27.5 27.9 28.5 29.5 27.5 27.9 28.5 28.5 28.5 28.5 28.5 28.5 28.5 28.5	(abuvim) 33.5 34.0 38.8 33.5 34.0 22.7 31.6 29.7 32.3 32.8 32.3 32.4 37.8 32.1 31.8 26.4 21.2 27.2	40.0 40.0 43.5 40.0 43.5 40.0 43.5 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40	-6.5 -6.0 -4.7 -6.5 -6.0 -17.3 -11.9 -10.3 -7.7 -7.2 -7.7 -7.6 -5.7 -7.9 -8.2 -13.6 -22.3 -16.3	Pass Pass Pass Pass Pass Pass Pass Pass	O degrees
43.6 74.4 189.6 35.2 36.8 74.9 183 38 42 43.6 47.7 72.3 189 35.2 40 50 155	V V V H H H H H H H H H H H H H H H H H		(dBcV) 47.5 50.3 47 47.4 48 39 40 44.4 46.4 46.8 46.5 48.8 46 46 40 30	12.2 8.1 14.6 12.4 12.3 8.1 14.4 12.1 12.1 12.2 12.1 12.2 12.1 12.2 12.4 12.4	(db) 2.3 3.1 5.1 2.2 2.3 3.1 5.1 2.2 2.3 2.3 2.3 2.3 2.3 2.3 2.3	28.5 27.5 27.9 28.5 29.5 27.5 27.9 28.5 28.5 28.5 28.5 28.5 28.5 28.5 28.5	(abuvim) 33.5 34.0 38.8 33.5 34.0 22.7 31.6 29.7 32.3 32.8 32.3 32.4 37.8 32.1 31.8 26.4 21.2	40.0 40.0 43.5 40.0 40.0 43.5 40.0 43.5 40.0 40.0 40.0 40.0 40.0 40.0 40.0 40	-6.5 -6.0 -4.7 -6.5 -6.0 -17.3 -11.9 -10.3 -7.7 -7.2 -7.7 -7.6 -5.7 -7.9 -8.2 -13.6 -22.3	Pass Pass Pass Pass Pass Pass Pass Pass	O degrees

CHAPTER 4 CONCLUSIONS

This is a mid-term report for the two-year project. In this project, the preveously prototyped air-coupled and ground-coupled GPRs have been upgraded. Special antenna shielding structures have been developed to guide the electromagnetic energy down into ground and prevent the GPR energy from radiating into the air. Two types of low-pass filters have also been designed and developed to eliminate the digital signals coupled onto the cables. After repeating the "testing-and-modifing" process on the GPR devices for several times, both the air-coupled and ground-coupled GPR are now completely compliant with FCC requirements. The FCC testing reports by Nemko Inc. are included in the appendix part of this report. The testing reports and other documents for FCC certificate applications have been submitted to the FCC and the GPR certificates are expected to be received in a few weeks.

Appendix

FCC Testing Reports by Nemko Inc.

(Four reports included)

- 1. EMC Testing Report for 400MHz Ground-Coupled GPR
- Wireless Radiation Testing Report for 400MHz Ground-Coupled GPR
- 3. EMC Testing Report for 900MHz Air-Coupled GPR
- 4. Wireless Radiation Testing Report for 900MHz Air-Coupled GPR



ENGINEERING TEST REPORT

NUMBER: 4451EUS1

ON

Model No.(s):

Ground Penetrating Radar

IN ACCORDANCE WITH: CFR 47, PART 15, SUBPART B, CLASS A VERIFICATION

TESTED FOR:

University of Houston 4800 Calhoun Road Houston, Texas 77004

TESTED BY:

Nemko USA, Inc. 802 N. Kealy Lewisville, Texas 75057-3136

Total Number of Pages: 20

1 -- .

TESTED BY:	Attur Juraleaha	DATE:	5/04/07
	Arturo Ruvalcaba, EMC Engineer	_	
APPROVED BY:	Buan Boyea	DATE:	5/07/07
	Brian Boyea, EMC Engineer	-	
	LAB CODE: 100426-0		

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EQUIPMENT: Ground Penetrating Radar

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EQUIPMENT: Ground Penetrating Radar

Section 1. Summary of Test Results

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 CFR 47, Part 15, Subpart B for Class A Digital Devices.

These tests were conducted using measurement procedures of ANSI C63.4-2003.

The equipment was tested for conducted emissions from 0.150 MHz to 30 MHz using a 50 microhenry line impedance stabilization network (L.I.S.N.) as described in ANSI C63.4-2003. Peripheral equipment was also operated through a 50 microhenry L.I.S.N.

The equipment was tested for radiated emissions from 30 MHz to 1000 MHz in accordance with the requirements of CFR 47, Part 15, Subpart B. Equipment with oscillator frequencies above 107 MHz were tested to the fifth harmonic or in accordance with the requirements of CFR 47, Part 15.33. Frequencies were initially identified in a large shielded room. Amplitude measurements were made on an outdoor Open Area Test Site. Details of the outdoor site are on file with the FCC.

Abstract:

Name of Test	Basic Standard	Results
Conducted Emissions (Mains port)	CFR 47, Part 15, Subpart B Para. No. 15.107	N/A
Radiated Emissions	CFR 47, Part 15, Subpart B Para. No. 15.109	Complies
Microwave Radiated Emissions	CFR 47, Part 15, Subpart B, Para. No. 15.109	N/A

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE: **NONE**

EQUIPMENT: Ground Penetrating Radar

Section 2. Equipment Under Test (E.U.T.)

Manufacturer: University of Houston

Name: Ground Penetrating Radar

Model Number: U7W400

Serial Number: None

Part Number: U7W400

Production Status: Production

E.U.T. Arrival Date: 05/02/07

Description of E.U.T.:

The impulse GPR is a device that is intentionally designed to directionally and locally radiate very small average electromagnetic power downwards into the ground to be detected. The developed GPR is composed of a pulse transmitter, a receiver, a transmitter antenna, a receiver antenna, and a laptop computer. Except the computer, all the components are installed in a plastic box. Once a 12VDC power is supplied, the GPR starts to work. To facilitate the FCC testing (Part 15), the GPR working environment and parameters are described below. When the GPR is at work, it is always setup on the ground surface to maximize the energy coupling into ground. The parameters of the developed GPR are given below:

- (1.) Dimension: 13.5 × 13.5 × 7.5 inch3;
- (2.) Power supply: 12 VDC @ 370mA;
- (3.) Center frequency: 400MHz;
- (4.) Radiation pulse time duration: 2.5ns
- (5.) Radiation pulse P-P amplitude: 500mV;
- (6.) System Clock: 50KHz

Clock, Oscillator, Highest Frequencies Utilized:

3.57MHz

Modifications Incorporated in E.U.T.:

See Following Page.



EQUIPMENT: Ground Penetrating Radar

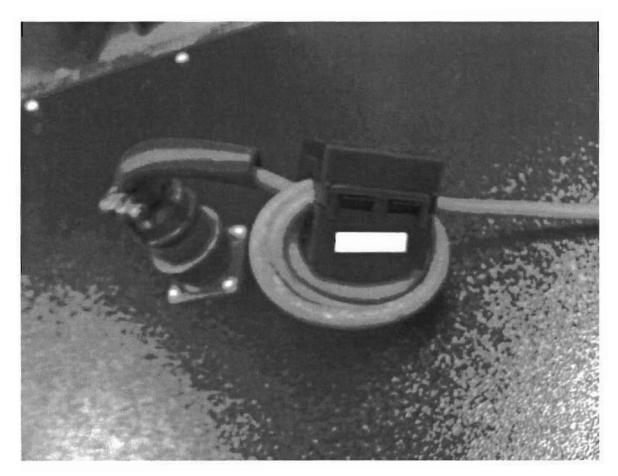
Modification Mod-01

Job#:	4451		Company	Name:	University of	Houston	
Date	Tech Int'ls	Mod. #	Details		Photograph	Include In R	eport
5/3/2007		Mod 1	Installed ferrite on cable.		Ø	☑ Yes [□ No
		-				☐ Yes 【	□ No
						☐ Yes [□ No
						☐ Yes [□ No
						☐ Yes [□ No
						☐ Yes [□ No



EQUIPMENT: Ground Penetrating Radar

Photos: Mod-01





EQUIPMENT: Ground Penetrating Radar

Justification:

The E.U.T. was configured for testing as per typical installation. Position and bundling of cables were investigated to establish maximum amplitude of emissions.

The following combinations were investigated to establish worst-case configuration:

Stand Alone

Exercise Program:

The E.U.T. exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to typical use.

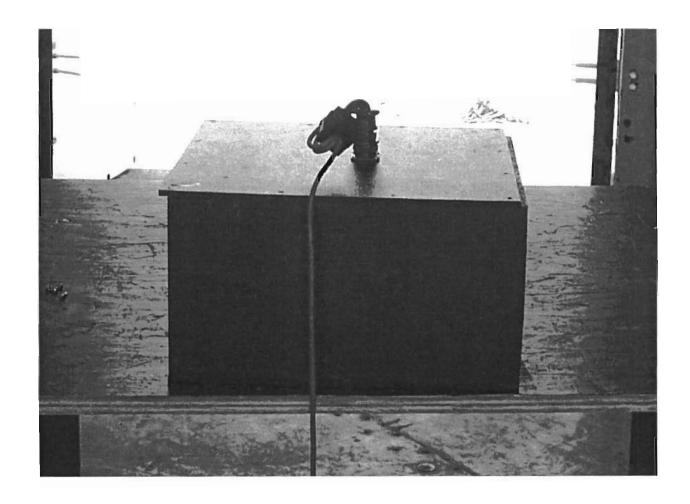
The EUT was in the following exercise mode:

Powered on, continuously transmitting.



EQUIPMENT: Ground Penetrating Radar

E.U.T. Photographs:

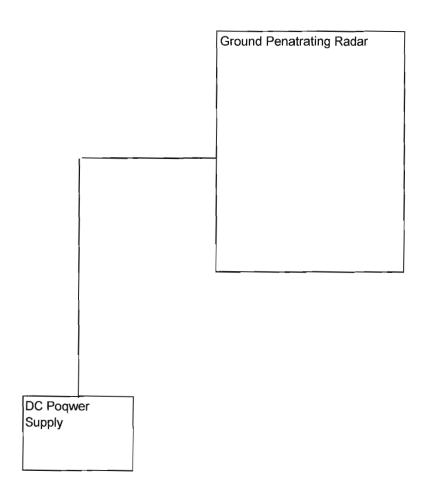




EQUIPMENT: Ground Penetrating Radar

Section 3. Equipment Configuration

Configuration of the Equipment Under Test (E.U.T.):



EQUIPMENT: Ground Penetrating Radar

Section 4. Conducted Emissions (Mains ports)

Note: Test Not Applicable. No AC Mains.

Purpose:

The test is intended to demonstrate the compliance of the Equipment Under Test (E.U.T.) to the limits for conducted disturbance as defined by CFR 47, Part 15, Subpart B, Class A.

Specification Limits:

Limits for conducted disturbance at the mains ports

Frequency Range (MHz)	Quasi-peak Limits (dBuV)	Average Limits (dBuV)
0.15 to 0.50	79	66
0.50 to 30	73	60

Method of Measurement (Procedure ANSI C63.4-2003):

Measurements were made using a spectrum analyzer with 10 kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with 9 or 10 kHz bandwidth, CISPR Quasi-Peak detector.

See Sections 7 and 8.

EQUIPMENT: Ground Penetrating Radar

Section 5. Radiated Emissions

Purpose:

The tests are intended to demonstrate the compliance of the Equipment Under Test (E.U.T.) to the limits for radiated emissions as defined by CFR 47, Part 15, Subpart B, Class A.

Specification Limits:

Limits for radiated disturbance of Class A

Frequency Range (MHz)	10m Limits (dBuV)		
30-88	39.1		
88-216	43.5		
216-960	46.4		
Above 960	49.5		

Notes:

- 1. The lower limit shall apply at the transition frequency.
- 2. Additional provisions may be required for cases where interference occurs.
- 3. The 3m limits are calculated as follows: $L_3 = L_{10} * 10/3$ where L_{10} is the limit at 10m specified in ?V/m

Method of Measurement (Procedure ANSI C63.4-2003):

The equipment was prescanned in a shielded room using a spectrum analyzer and broadband antenna. A list of frequencies was compiled for investigation in the open field. The equipment was then moved to an open area test site where amplitude measurements were made at a distance of 10 meters. The bandwidth was set to 100 kHz and the detector function was CISPR Quasi-Peak.

Any emissions above 1 GHz were measured with a horn antenna and low noise pre-amplifier at a distance of 3 meters.

See Sections 7 and 8.



EQUIPMENT: Ground Penetrating Radar

Test #:

REHE-01

Tested By:

Art Ruvalcaba

Date of Tests:

5/03/07

Test Conditions:

Test Voltage:

5VDC

Temperature:

32°C

Humidity:

41%

Test Results:

The E.U.T. complies.

TEST EQUIPMENT

Asset Number	Description	Manufacturer	Model Number	Serial Number	Last Cal	Cal Due
			- Italiiboi	1811A00		
1284	Analyzer	Нр	8566B	223	3/58/07	3/28/08
	ANTENNA,BIC	A.H.	SAS-			
1195	ONICAL	SYSTEMS	200/542	235	3/30/2007	3/29/2008
	ANTENNA,					
1311	LOG PERIODIC	EMCO	3146	1753	1/18/2007	1/18/2008
	Cable Assy,	Nemko	Site D			
1522	LAB 5 - D OATS	USA, Inc.	OATS	N/A	5/9/2006	5/9/2007
		Nemko				
1025	PREAMP, 25dB	USA, Inc.	LNA25	399	9/29/2006	9/29/2007
D Oats	Open Area Test	Nemko USA	None	D	03/28/07	03/28/08
	Site					



EQUIPMENT: Ground Penetrating Radar

Test Data - Radiated Emissions, Electric Field, Test#REHE-01

					Radiat	ted Emis	sions Da	ata			
Complet Prelimin		X						Job#:	4451 Page	1	Test # : <u>REHE-01</u> of2_
		11-1 3	-611								
lient N		University		_							
UT Na		Ground P	enetratin	<u>id Radai</u>							
EUT Mo		U7W400									
EUT Pai		U7W400									
EUT Sei		None Stand Alo									
EUT Co	niig. :	Siano Alo	ne								
Specifica	ation .	CFR47 Pa	art 15, Si	ubpart B	Class A			Refere			
Rod. Ant. #:		na		Temp. (deg. C):	28				Date :	05/03/07
Bicon Ar	nt.#:	<u>1195</u>		Humidit	y (%) .	<u>45</u>				Time :	9:30
og Ant.	#:	1311_		EUT Vo	ltage :	12 VDC				Staff:	Art Ruvalcaba
Bilog An	t.#:	<u>na</u>		EUT Fre	equency:	<u>N/A</u>	,			Photo ID	
Dipole A	nt.#:	na		Phase:		<u>N/A</u>	,				: 100 KHz
Cable#:		1522		Location	n:	D OATS					h <u>100 KHz</u>
Preamp	#:	1025		Distanc	e:	10m			QP Ban	dwidth:	120 KHz
_imiter#	:	na		Baromet	ric pressure:	1016					
Atten #:		na	_								
Detector	#:	1284									
Meas.	Ant.	Atten.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass	
Freq.	Pol.	Auton.	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	1
(MHz)	(H/V)	(40)	-	(dB)	(dB)						1_
		1 (QB)	I (aBuv) I	(ab)	(QB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
	V	(dB)	(dBuV)					-			
46,6	V	0	38.2	9.6	2.3	28.5	21.6	39.0 39.0	-17.4	Pass Pass	PEAK PEAK
46,6 50	V	0	38.2 46	9.6 9	2.3	28.5 27.9	21.6 29.8	39.0 39.0	-17.4 -9.2	Pass Pass	PEAK PEAK
46,6 50 52	V	0 0	38.2 46 52.7	9.6 9 9	2.3 2.7 2.7	28.5 27.9 27.9	21.6 29.8 36.5	39.0 39.0 39.0	-17.4	Pass	PEAK PEAK PEAK
46,6 50 52 53.2	V V V	0 0 0	38.2 46 52.7 58.6	9.6 9 9	2.3 2.7 2.7 2.7	28.5 27.9 27.9 27.9	21.6 29.8	39.0 39.0	-17.4 -9.2 -2.5	Pass Pass Pass	PEAK PEAK
46,6 50 52 53.2 53.21	V V V	0 0 0 0	38.2 46 52.7 58.6 53.7	9.6 9 9 9	2.3 2.7 2.7 2.7 2.7	28.5 27.9 27.9 27.9 27.9	21.6 29.8 36.5 42.4 37.5	39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5	Pass Pass Pass Fail	PEAK PEAK PEAK REFER TO QP
46,6 50 52 53.2 53.21 57	V V V	0 0 0	38.2 46 52.7 58.6 53.7 52.8	9.6 9 9 9 9	2.3 2.7 2.7 2.7	28.5 27.9 27.9 27.9	21.6 29.8 36.5 42.4	39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4	Pass Pass Pass Fail Unc.	PEAK PEAK PEAK REFER TO QP QP readings PEAK
46.6 50 52 53.2 53.21 57 60.8	V V V	0 0 0 0 0 0	38.2 46 52.7 58.6 53.7	9.6 9 9 9	2.3 2.7 2.7 2.7 2.7 2.7 2.7	28.5 27.9 27.9 27.9 27.9 27.9	21.6 29.8 36.5 42.4 37.5 36.4	39.0 39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5 -2.6	Pass Pass Pass Fail Unc. Pass	PEAK PEAK PEAK REFER TO QP QP readings PEAK
46.6 50 52 53.2 53.21 57 60.8 61.7	V V V V	0 0 0 0 0	38.2 46 52.7 58.6 53.7 52.8 48.6	9.6 9 9 9 9 8.8 8.5	2.3 2.7 2.7 2.7 2.7 2.7 2.7 3.0	28.5 27.9 27.9 27.9 27.9 27.9 27.8	21.6 29.8 36.5 42.4 37.5 36.4 32.3	39.0 39.0 39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5 -2.6 -6.7	Pass Pass Pass Fail Unc. Pass Pass	PEAK PEAK PEAK REFER TO QP QP readings PEAK PEAK
46.6 50 52 53.2 53.21 57 60.8	V V V V V	0 0 0 0 0 0 0 0 0	38.2 46 52.7 58.6 53.7 52.8 48.6 50.2	9.6 9 9 9 9 8.8 8.5 8.5	2.3 2.7 2.7 2.7 2.7 2.7 2.7 3.0 3.0	28.5 27.9 27.9 27.9 27.9 27.9 27.9 27.8 27.8	21.6 29.8 36.5 42.4 37.5 36.4 32.3 33.9	39.0 39.0 39.0 39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5 -2.6 -6.7 -5.1	Pass Pass Pass Fail Unc. Pass Pass Pass	PEAK PEAK PEAK REFER TO QP QP readings PEAK PEAK PEAK
46.6 50 52 53.2 53.21 57 60.8 61.7 49.1	V V V V V	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	38.2 46 52.7 58.6 53.7 52.8 48.6 50.2 58	9.6 9 9 9 9 8.8 8.5 8.5	2,3 2,7 2,7 2,7 2,7 2,7 2,7 3,0 3,0 2,3	28.5 27.9 27.9 27.9 27.9 27.9 27.9 27.8 27.8 28.5	21.6 29.8 36.5 42.4 37.5 36.4 32.3 33.9 41.4	39.0 39.0 39.0 39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5 -2.6 -6.7 -5.1 2.4	Pass Pass Pass Fail Unc. Pass Pass Pass Fail	PEAK PEAK REFER TO QP QP readings PEAK PEAK PEAK REFER TO QP QP readings
46.6 50 52 53.2 53.21 57 60.8 61.7 49.1 49.1	V V V V V V	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	38.2 46 52.7 58.6 53.7 52.8 48.6 50.2 58 56	9.6 9 9 9 9 8.8 8.5 8.5 9.6 9,6	2,3 2,7 2,7 2,7 2,7 2,7 3,0 3,0 2,3 2,3	28.5 27.9 27.9 27.9 27.9 27.9 27.8 27.8 28.5 28.5	21.6 29.8 36.5 42.4 37.5 36.4 32.3 33.9 41.4 39.4	39.0 39.0 39.0 39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5 -2.6 -6.7 -5.1 2.4 0.4	Pass Pass Pass Fail Unc. Pass Pass Pass Pass Unc.	PEAK PEAK PEAK REFER TO QP QP readings PEAK PEAK PEAK PEAK PEAK PEAK REFER TO QP QP readings
46.6 50 52 53.2 53.21 57 60.8 61.7 49.1 49.1	V V V V V V	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	38.2 46 52.7 58.6 53.7 52.8 48.6 50.2 58 56	9.6 9 9 9 9 8.8 8.5 8.5 9.6 9.6	2,3 2,7 2,7 2,7 2,7 2,7 2,7 3,0 3,0 2,3 2,3	28.5 27.9 27.9 27.9 27.9 27.9 27.8 27.8 28.5 28.5	21.6 29.8 36.5 42.4 37.5 36.4 32.3 33.9 41.4 39.4	39.0 39.0 39.0 39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5 -2.6 -6.7 -5.1 2.4 0.4	Pass Pass Pass Fail Unc. Pass Pass Pass Pass Pass Fail Unc.	PEAK PEAK PEAK REFER TO QP QP readings PEAK PEAK PEAK PEAK PEAK PEAK REFER TO QP QP readings
46.6 50 52 53.2 53.21 57 60.8 61.7 49.1 49.1 49.1 58.62	V V V V V V V V V V V V V V V V V V V	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	38.2 46 52.7 58.6 53.7 52.8 48.6 50.2 58 56	9.6 9 9 9 9 8.8 8.5 8.5 9.6 9.6	2,3 2,7 2,7 2,7 2,7 2,7 2,7 3,0 3,0 2,3 2,3 2,3	28.5 27.9 27.9 27.9 27.9 27.8 27.8 28.5 28.5 28.5 28.5	21.6 29.8 36.5 42.4 37.5 36.4 32.3 33.9 41.4 39.4	39.0 39.0 39.0 39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5 -2.6 -6.7 -5.1 2.4 0.4	Pass Pass Pass Fail Unc. Pass Pass Pass Pass Pass Fail Unc.	PEAK PEAK PEAK REFER TO QP QP readings PEAK PEAK PEAK PEAK PEAK PEAK REFER TO QP QP readings FERRITE ON CABLE PEAK PEAK
46.6 50 52 53.2 57 60.8 61.7 49.1 49.1 49.1 58.62 70	V V V V V V V V V V V V V V V V V V V	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	38.2 46 52.7 58.6 53.7 52.8 48.6 50.2 58 56	9.6 9 9 9 9 8.8 8.5 8.5 9.6 9.6	2,3 2,7 2,7 2,7 2,7 2,7 3,0 3,0 2,3 2,3 2,3 2,7 3,1	28.5 27.9 27.9 27.9 27.9 27.9 27.8 27.8 28.5 28.5 28.5 27.9 27.5	21.6 29.8 36.5 42.4 37.5 36.4 32.3 33.9 41.4 39.4 31.8 28.1 29.9	39.0 39.0 39.0 39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5 -2.6 -6.7 -5.1 2.4 0.4 -7.2 -10.9	Pass Pass Pass Fail Unc. Pass Pass Pass Fail Unc. Pass Pass Fail Pass Pass Pass Pass	PEAK PEAK PEAK REFER TO QP QP readings PEAK PEAK PEAK PEAK PEAK REFER TO QP QP readings FERRITE ON CABLE PEAK PEAK PEAK
46.6 50 52 53.2 53.21 57 60.8 61.7 49.1 49.1 49.1 58.62 70 75	V V V V V V V V V	0 0 0 0 0 0 0 0 0 0 0	38.2 46 52.7 58.6 53.7 52.8 48.6 50.2 58 56 48.4 44.5 46 47.5	9.6 9 9 9 9 8.8 8.5 8.5 9.6 9.6	2,3 2,7 2,7 2,7 2,7 2,7 3,0 3,0 2,3 2,3 2,3 2,7 3,1 3,1	28.5 27.9 27.9 27.9 27.9 27.8 27.8 28.5 28.5 28.5 27.9 27.5	21.6 29.8 36.5 42.4 37.5 36.4 32.3 33.9 41.4 39.4 31.8 28.1 29.9 31.9	39.0 39.0 39.0 39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5 -2.6 -6.7 -5.1 2.4 0.4 -7.2 -10.9 -9.1 -7.1	Pass Pass Pass Fail Unc. Pass Pass Pass Fail Unc. Pass Pass Fail Pass Pass Pass Pass Pass Pass	PEAK PEAK PEAK REFER TO QP QP readings PEAK PEAK PEAK PEAK PEAK REFER TO QP QP readings FERRITE ON CABLE PEAK PEAK PEAK PEAK
46.6 50 52 53.2 53.21 57 60.8 61.7 49.1 49.1 49.1 58.62 70 75 33.6	V V V V V V V V V		38.2 46 52.7 58.6 53.7 52.8 48.6 50.2 58 56 44.4 44.5 46 47.5 45.5	9.6 9 9 9 9 8.8 8.5 8.5 9.6 9.6 9.6	2.3 2.7 2.7 2.7 2.7 2.7 3.0 3.0 2.3 2.3 2.3 2.3 2.3	28.5 27.9 27.9 27.9 27.9 27.8 27.8 28.5 28.5 28.5 27.9 27.5 27.5 28.5	21.6 29.8 36.5 42.4 37.5 36.4 32.3 33.9 41.4 39.4 31.8 28.1 29.9 31.9 31.7	39.0 39.0 39.0 39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5 -2.6 -6.7 -5.1 2.4 0.4 -7.2 -10.9 -9.1 -7.1 -7.3	Pass Pass Fail Unc. Pass Pass Fail Unc. Pass Pass Fail Unc. Pass Fail Fail Fass Pass Pass Pass Pass Pass Pass Pass	PEAK PEAK PEAK REFER TO QP QP readings PEAK PEAK PEAK REFER TO QP QP readings FERRITE ON CABLE PEAK PEAK PEAK PEAK PEAK PEAK PEAK PEA
46.6 50 52 53.2 53.21 57 60.8 61.7 49.1 49.1 58.62 70 75 33.6 150	V V V V V V V V V V V V V V V V V V V		38.2 46 52.7 58.6 53.7 52.8 48.6 50.2 58 56 44.4 44.5 46 47.5 45.5 35.3	9.6 9 9 9 9 8.8 8.5 9.6 9.6 9.6 8.8 8.3 8.8 12.5 12.8	2.3 2.7 2.7 2.7 2.7 2.7 3.0 3.0 2.3 2.3 2.7 3.1 2.2 4.7	28.5 27.9 27.9 27.9 27.9 27.8 28.5 28.5 28.5 27.9 27.5 27.5 28.5	21.6 29.8 36.5 42.4 37.5 36.4 32.3 33.9 41.4 39.4 31.8 28.1 29.9 31.9 31.7 25.0	39.0 39.0 39.0 39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5 -2.6 -6.7 -5.1 2.4 0.4 -7.2 -10.9 -9.1 -7.1 -7.3 -18.5	Pass Pass Fail Unc. Pass Pass Fail Unc. Pass Pass Pass Fail Pass Pass Pass Pass Pass Pass Pass Pas	PEAK PEAK PEAK REFER TO QP QP readings PEAK PEAK REFER TO QP QP readings FERRITE ON CABLE PEAK PEAK PEAK PEAK PEAK PEAK PEAK PEA
46.6 50 52 53.2 53.21 57 60.8 61.7 49.1 49.1 58.62 70 75 33.6 150 211	V V V V V V V V V V V V V V V V V V V	0 0 0 0 0 0 0 0 0 0 0	38.2 46 52.7 58.6 53.7 52.8 48.6 50.2 58 56 44.4 44.5 46 47.5 45.5 35.3 43.7	9.6 9 9 9 9 8.8 8.5 8.5 9.6 9.6 8.8 8.3 8.8 12.5 12.8 15.1	2,3 2,7 2,7 2,7 2,7 2,7 3,0 3,0 2,3 2,3 2,3 2,7 3,1 2,2 4,7 5,5	28.5 27.9 27.9 27.9 27.9 27.8 28.5 28.5 28.5 27.9 27.5 28.5 27.5 28.5	21.6 29.8 36.5 42.4 37.5 36.4 32.3 33.9 41.4 39.4 31.8 28.1 29.9 31.9 31.7 25.0 36.4	39.0 39.0 39.0 39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5 -2.6 -6.7 -5.1 2.4 0.4 -7.2 -10.9 -9.1 -7.1 -7.3 -18.5 -7.1	Pass Pass Fail Unc. Pass Pass Fail Unc. Pass Pass Pass Fail Unc. Pass Pass Pass Pass Pass Pass Pass Pas	PEAK PEAK PEAK REFER TO QP QP readings PEAK PEAK REFER TO QP QP readings REFER TO QP QP readings FERRITE ON CABLE PEAK PEAK PEAK PEAK PEAK PEAK PEAK PEA
46.6 50 52 53.2 53.21 57 60.8 61.7 49.1 49.1 49.1 58.62 70 75 33.6 150	V V V V V V V V V V V V V V V V V V V		38.2 46 52.7 58.6 53.7 52.8 48.6 50.2 58 56 44.4 44.5 46 47.5 45.5 35.3	9.6 9 9 9 9 8.8 8.5 9.6 9.6 9.6 8.8 8.3 8.8 12.5 12.8	2.3 2.7 2.7 2.7 2.7 2.7 3.0 3.0 2.3 2.3 2.7 3.1 2.2 4.7	28.5 27.9 27.9 27.9 27.9 27.8 28.5 28.5 28.5 27.9 27.5 27.5 28.5	21.6 29.8 36.5 42.4 37.5 36.4 32.3 33.9 41.4 39.4 31.8 28.1 29.9 31.9 31.7 25.0	39.0 39.0 39.0 39.0 39.0 39.0 39.0 39.0	-17.4 -9.2 -2.5 3.4 -1.5 -2.6 -6.7 -5.1 2.4 0.4 -7.2 -10.9 -9.1 -7.1 -7.3 -18.5	Pass Pass Fail Unc. Pass Pass Fail Unc. Pass Pass Pass Fail Pass Pass Pass Pass Pass Pass Pass Pas	PEAK PEAK PEAK REFER TO QP QP readings PEAK PEAK REFER TO QP QP readings FERRITE ON CABLE PEAK PEAK PEAK PEAK PEAK PEAK PEAK PEA



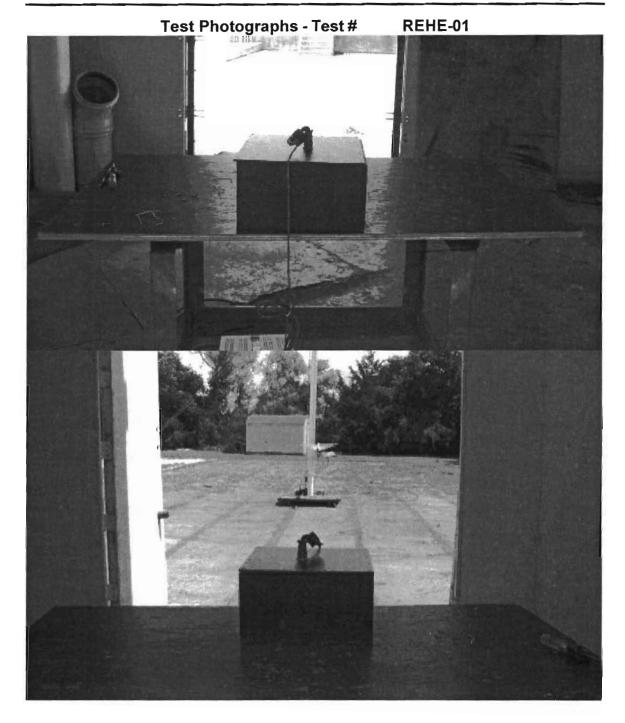
EQUIPMENT: Ground Penetrating Radar

Test Data -Radiated Emissions, Electric Field, Test#REHE-01(cont)

Complet		X	-					Job#:	4451		Test#:_ of	REHE-0
relimin	ary		-						Page		_ of _	2
Client N	ame :	University	of Hous	ston								
UT Na	me:	Ground P	enetratir	g Radar								
UT Mo	del#:	U7W400										
UT Pa	rt # :	U7W400										
UT Se	rial#:	None										
UT Co	nfig. :	Stand Alc	one									
pecifica	ation :	CFR47 P	art 15, S	ubpart B,	Class A			Refere	nce :			
Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass		
Freq.	Pol.	Atten.	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail]	
(MHz)	(H/V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)		(dB)	Unc.	Comment	
200	Н	0	37.6	14.8	5.5	27.9	30.0	43.5	-13.5	Pass	PEAK	
240	Н	0	39.5	15.7	5.9	27.9	33.2	46.4	-13.2	Pass	PEAK	
295	H	0	41	18.2	6.4	27.8	37.8	46.4	-8.6	Pass	PEAK	
49.1	Н	0	34	9.6	2.3_	28.5	17.4	39.0	-21.6	Pass	PEAK	
313_		0	38.9	15	6.8	27.9	32.8	46.4	-13.6	Pass		
327	V	0	39.1	14.6	6.8	27.9	32.6	46.4	-13.8	Pass		
385	<u>V</u>	0	34.3	15.6	7.4	27.7	29.6	46.4	-16.8	Pass		
457	V	0	33.6	16.9	8.5	28.1	30.9	_46.4	-15.5	Pass		
508		0	30_	17.4	8.9	28.1	28.2	46.4	-18.2	Pass		
563		0	31	18.4	9.5	27.8	31.1	46.4	-15 <u>.3</u>	Pass		
616	V	0	32	19	9.7	27.9	32.8	46.4	-13.6	Pass		
820		0	29	22.3	11.8	27.5	35.6	46.4	-10.8	Pass	├	
310	Н	0	44.9	15	6.8	27.0	20.0	46.4	7.6	Dane		
356	- П -	0	45.3	14.3	7.4	27.9 27.7	38.8 39.3	46.4 46.4	-7.6 -7.1	Pass		
438	Н	0	43.6	15.9	8.0	27.8	39.7	46.4	-6.7	Pass Pass		
547	H	0	40.7	18.9	8.9	28.1	40.4	46.4	-6.0	Pass		
<u> </u>		<u> </u>	1		5.0		,,,,,	-10.4	0.0	1 433	 	
				\vdash								
				\longrightarrow								
				 								
			-	 							 	
				\vdash								



EQUIPMENT: Ground Penetrating Radar



EQUIPMENT: Ground Penetrating Radar

Section 6. Microwave Radiated Emissions

Note: Not Applicable, No Freq. above 107MHz

Purpose:

The tests are intended to demonstrate the compliance of the Equipment Under Test (E.U.T.) to the limits for radiated emissions as defined by CFR 47, Part 15, Subpart B, Class A.

Specification Limits:

Limits for radiated disturbance of Class A

Frequency Range (MHz)	10m Limits (dBuV)	
30-88	39.1	
88-216	43.5	
216-960	46.4	
Above 960	49.5	

Notes:

- 1. The lower limit shall apply at the transition frequency.
- 2. Additional provisions may be required for cases where interference occurs.
- 3. The 3m limits are calculated as follows: $L_3 = L_{10} * 10/3$ where L_{10} is the limit at 10m specified in ?V/m

Method of Measurement (Procedure ANSI C63.4-2003):

The equipment was prescanned in a shielded room using a spectrum analyzer and broadband antenna. A list of frequencies was compiled for investigation in the open field. The equipment was then moved to an open area test site where amplitude measurements were made at a distance of 10 meters. The bandwidth was set to 100 kHz and the detector function was CISPR Quasi-Peak.

Any emissions above 1 GHz were measured with a horn antenna and low noise pre-amplifier at a distance of 3 meters. The bandwidth was set to 1 MHz and the detector function was average.

CFR 47, PART 15, SUBPART A
CLASS A VERIFICATION

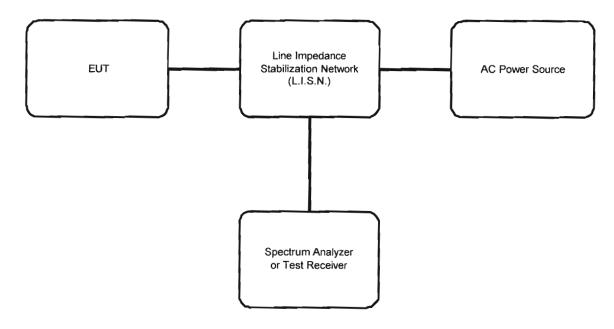
REPORT NO.: 4451EUS1 EQUIPMENT: Ground Penetrating Radar

Section 7. Test Methods and Block Diagrams.

Conducted Emissions (Mains Ports)

- ?? Applicable Test Standard: CFR 47, FCC Pt 15, Subpart B
- ?? The test set-up is as per the test configuration diagram.
- ?? The E.U.T. is configured as typically used.
- ?? The E.U.T. and any accessories are operated with typical load conditions.
- ?? Conducted power line measurements are made from 150 kHz to 30 MHz.
- ?? For each current carrying conductor of each power cord associated with the E.U.T., the emission closest to the limit is recorded.
- ?? Initial measurements are made using a spectrum analyzer with 10 kHz RBW, peak detector. If emissions are below the Average limit, the unit is deemed to be compliant.
- ?? Any emissions within 6dB of the quasi peak limit are measured using a test receiver with 9 kHz bandwidth, CISPR quasi-peak detector.
- ?? Bandwidths used on the test receiver are those specified in CISPR 16-1.

Test Configuration - Power line Conducted Emissions:





CFR 47, PART 15, SUBPART A
CLASS A VERIFICATION
REPORT NO.: 4451EUS1
EQUIPMENT: Ground Penetrating Radar

Radiated Emissions

Test Method - Radiated Emissions:

- ?? Applicable Test Standard: CFR47, FCC Pt 15, Subpart B
- ?? The test set-up in the shielded room is as per the test configuration diagram.
- ?? The E.U.T. is configured as typically used.
- ?? The E.U.T. and any accessories are operated with typical load conditions.
- ?? Radiated emissions measurements are made from 30 MHz to 1000 MHz.
- ?? The equipment was prescanned in the shielded room using a spectrum analyzer and broadband antenna to produce a list of frequencies to be investigated in the open area test site.
- ?? The equipment is then set-up on an open area test site.
- ?? Variations in antenna height, antenna polarization, and E.U.T. azimuth are explored to produce the emission that has the highest amplitude relative to the limit.
- ?? The frequencies noted in the preliminary test are investigated on the open-air site where amplitude measurements are made.
- ?? If ambient signal field strength is high at 10 meter, the measurements may be performed at 3 meter and extrapolated to the requisite distance.
- ?? If less than six emissions are better than 20 dB below limit, the noise level of the measuring instrument at representative frequencies is also reported.
- ?? Any emissions above 1 GHz are measured using a horn antenna and low noise pre-amplifier at a distance of 3 meters. The bandwidth was set to 1 MHz and the detector function was average.



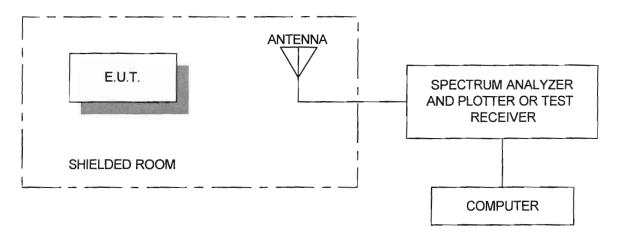
CFR 47, PART 15, SUBPART A CLASS A VERIFICATION

REPORT NO.: 4451EUS1

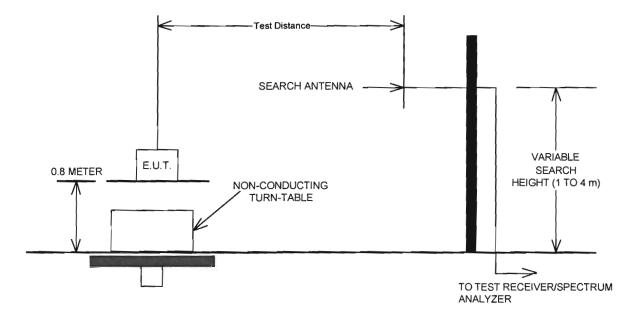
EQUIPMENT: Ground Penetrating Radar

Test Configuration - Radiated Emissions:

Radiated Pre-scan:



Outdoor Test Site for Radiated Emissions:





EQUIPMENT: Ground Penetrating Radar

Section 8. Labeling Requirements

Your product has successfully complied with 47 CFR FCC Part 15.B Class A requirements.

FCC Class A Label:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

In addition to placing the above label on your product, the three items that are required to be included in your product's manual are:

(1) For a Class A digital device or peripheral, the instructions furnished to the user shall include the following or similar statement, placed in a prominent location at the front of the manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

- (2) The user's manual must caution the user that changes or modifications not expressly approved by the party responsible for compliance (you/your company) could void the user's authority to operate the equipment.
- (3) The instruction manual must include appropriate instructions on the <u>first page</u> of the manual concerning installation of the device or special accessories (special cabling, shields, adapters) that must be used with the device. An appropriate caution statement should warn the user to utilize the special accessories supplied with the equipment for continued FCC compliance.



Nemko Test Re	eport:	5113RUS1		
Applicant:		University of Houston 4800 Calhoun Road Houston, TX 77004 USA		
Equipment Und	der Test:	U7W400		
In Accordance	With:	FCC Part 15, Subpart F, P Ultra Wide Band Operation Ground Pentrating Radar	aragrapl	n 15.509
Tested By:		Nemko USA Inc. 802 N. Kealy Lewisville, TX 75057		
TESTED BY:	David Light, Senior V	Vireless Engineer	DATE: _	15 October 2007
APPROVED BY:	1,	Cartwell Frontline Manager	DATE: _	19 October, 2007

Total Number of Pages: 25

FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation

Test Report No.: 5113RUS1

EQUIPMENT: U7W400

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SECTION 3.	RADIATED EMISSIONS	7
SECTION 4.	TEST EQUIPMENT LIST	22
ANNEX A TE	ST DIAGRAMS	23

EQUIPMENT: U7W400

FCC PART 15, SUBPART C, Paragraph 15.509
Ultra Wide Band Operation

Test Report No.:

5113RUS1

Section 1. Summary Of Test Resul	Section 1.	Summary	Of Test	Result
----------------------------------	------------	---------	---------	--------

Manufacturer:

The University of Houston

Model No.:

U7W400

Serial No.:

Preproduction

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 15, Subpart C, Paragraph 15.509 for ultra wide band operation. All tests were conducted using measurement procedure ANSI C63.4-2003. Radiated Emissions were made with the antenna positioned on the ground screen of an open area test site with the EUT positioned on a 4 foot by 4 foot dry sand pit

\times	New Submission		Production Unit
	Class II Permissive Change	\boxtimes	Pre-Production Unit
	THIS TEST REPORT RELATES ONLY TO	THE IT	EM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE. NONE See "Summary of Test Data".



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This report applies only to the items tested.

FCC PART 15, SUBPART C, Paragraph 15.509
Ultra Wide Band Operation

EQUIPMENT: U7W400 Test Report No.: 5113RUS1

Summary Of Test Data

NAME OF TEST	PARA. NO.	RESULT
Conducted Emissions	15.207	NA
Pulse Repetition Frequency	15.509	Complies
Definition of UWB	15.203(a)/15.209(a)	Complies
Radiated Emissions	15.509(d)	Complies
Radiated Emissions	15.509(e)	Complies
Peak Emission at f _M	15.509(f)	Complies

Footnotes For N/A's:

The device is battery powered.

EQUIPMENT: U7W400

FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation

Test Report No.:

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Section 2. General Equipment Specification

Frequency Range: Single

Operating Frequency(ies) of Sample: 200 MHz to 460 MHz (10 dB BW)

Tunable Bands: Single

20 dB Occupied Bandwidth: 260 MHz

User Frequency Adjustment: None

Integral Antenna Yes No

FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation

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EQUIPMENT: U7W400

Description of Device Tested

Ground Penetrating Radar System

System Diagram

Refer to separate exhibit.

EQUIPMENT: U7W400

FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation

Test Report No.:

5113RUS1

Section 3. Radiated Emissions

NAME OF TEST: Radiated Emissions PARA. NO.: 15.509(d)&(e)

TESTED BY: David Light DATE: 12 October 2007

Minimum Standard:

Para no. 15.509

Limits below 960 MHz (15.209 and 15.509):

Frequency (MHz)	Field Strength Limits (microvolts/m)	Measuring RBW	Distance (Meters)		
0.009-0.490	2400/F(kHz)	1 kHz	300		
0.490-1.705	24000/F(kHz)	10 kHz	30		
1.705-30.0	30	10 kHz	30		
30-88	100	100 kHz	3		
88-216	150	100 kHz	3		
216-960	200	100 kHz	3		

Limits above 960 MHz (15.509)

Frequency	E.I.R.P.	Measuring RBW	Distance
(MHz)	(dBm)		(Meters)
960-1610	-65.3	1 MHz	3
1610-1990	-53.3	1 MHz	3
1990-3100	-51.3	1 MHz	3
3100-10600	-41.3	1 MHz	3
Above 10600	-51.3	1 MHz	3
1164-1240	-75.3	1 kHz	3
1559-1610	-75.3	1 kHz	3

E.I.R.P limits converted from field strength during measurements per 15.521(g)

Maximizing Emission Levels:

The emissions were scanned from 30 MHz to 4000 MHz.

For measurements below 960 MHz the emissions were made using a CISPR Quasipeak detector IF BW = 100 kHz

For Frequency above 960 MHz and outside the below frequency bands, the emissions were measured using EMI RMS detector, RBW=1MHz, VBW=10 MHz

For frequencies fall inside 1164-1240 and 1559-1610 MHz, the emissions were measured using EMI RMS Detector, RBW = 1 KHz, VBW = 1 MHz

Note: The above tests were performed with the EUT raised 5 cmfrom the ground as its intended use. The EUT was tested in 8 positions (every 45°)

Test Results: Complies

Measurement Data: See attached table(s).

FCC PART 15, SUBPART C, Paragraph 15.509
Ultra Wide Band Operation

EQUIPMENT: U7W400 Test Report No.: 5113RUS1

					Radiat	ted Emis	sions D	ata				
Complet	te	X	_					Job#:	5113	1	Test #: REHE-01	
Prelimin	ary		-						Page	1	of _	11
Client N		Liminamente	. of Unio	4								
EUT Na		University Ground C										
EUT Mo		U7W400	oupled r	Nauai								
EUT Par		0111100										
EUT Sei												
EUT Co		Transmitt	ing over	sand pit								
Specification		CFR47 P	art 15, S					Refere	nce :	15.209/1		
Rod. An		1000	-		deg. C):	22				Date :	10/11/07	
Bicon A		1306	-	Humidit		40				Time :	9:00	
Log Ant.		759	-	EUT Vo	•	12				Staff:	David Light	
Bilog An			-	Phase:	equency:	dc			OD Da	Photo ID:	120 KHz	
Dipole A Cable#:	MIL#:	1522	-	Location		Sand Pit			QP Ba	ndwidth:	120 KHZ	
Cable#. Preamp	#.	762	-	Distance		3 Meters						
Limiter#		na	-		ric pressure:	1016						
Atten #:		na	-	Daloniei	ne pressure.	1010						
Detector		1659	-									
			•									
Meas.	Ant.	Atten.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass		
Freq.	Pol.		Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	ł	
(MHz)	(H / √)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment	
70.7			44.0	0.0	2.4	07.5	20.0	40.0	40.7	- B	0 degrees	
73.7 86	V	0	41.8 32.5	8.9 9.6	3.1	27.5	26.3 18.2	40.0	-13.7 -21.8	Pass		
110.6	V	0	48	11.4	3.5	27.6	35.6	43.5	-7.9	Pass		
122.9	-v	0	46	11.9	3.8	27.6	34.1	43.5	-9.4	Pass		
135.2	V	0	44.8	12.7	4.2	27.7	34.0	43.5	-9.5	Pass	 -	
147.4	V	0	46.8	13.5	4.2	27.7	36.8	43.5	-6.7	Pass	 	
196.6	v	0	49	14.7	5.1	27.9	40.9	43.5	-2.6	Pass		
208.9	V	0	46	14.9	5.5	27.9	38.5	43.5	-5.0	Pass		
258.1	V	0	42.4	17.1	6.2	27.9	37.8	46.0	-8.2	Pass		
73.7	Н	0	40.9	8.9	3.1	27.5	25.4	40.0	-14.6	Pass		
86	H	0	35	9.6	3.5	27.4	20.7	40.0	-19.3	Pass		
110.6	Н	0	35	11.4	3.8	27.6	22.6	43.5	-20.9	Pass		
196.6	Н	0	43	14.7	5.1	27.9	34.9	43.5	-8.6	Pass		
208.9	Н	0	40.7	14.9	5.5	27.9	33.2	43.5	-10.3	Pass		
245.8	Н	0	44.2	16.5	5.9	27.9	38.7	46.0	-7.3	Pass		
								 			 	
	-									 	 	
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										_		

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Ultra Wide Band Operation

EQUIPMENT: U7W400 Test Report No.: 5113RUS1

I COL E	Jala -	Naulat	ca Liii	133101	1						
Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass	
Freq.	Pol.	Atten.	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	
(MHz)	(H/V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
											0 Degrees
301	V	0	34	19.6	6.8	27.9	32.5	46.0	-13.5	Pass	
326	V	0	35.8	15.9	6.8	27.9	30.6	46.0	-15.4	Pass	
432	V	0	32.2	16	8.0	27.8	28.4	46.0	-17.6	Pass	
459	V	0	33	16.3	8.5	28.1	29.7	46.0	-16.3	Pass	
301	Н	0	37.5	19.6	6.8	27.9	36.0	46.0	-10.0	Pass	
321	Н	0	39.3	15.9	6.8	27.9	34.1	46.0	-11.9	Pass	
371	Н	0	45	15.3	7.4	27.7	40.0	46.0	-6.0	Pass	
431	Ι	0	45	16	8.0	27.8	41.2	46.0	-4.8	Pass	
460	Η	_0	37	16.8	8.5	28.1	34.2	46.0	-11.8	Pass	
490	Н	0	38.3	17.9	8.5	28.1	36.6	46.0	-9.4	Pass	
536	Ή	0	36.8	17.6	8.9	28.1	35.2	46.0	-10.8	Pass	
688	H	0	29.5	19.9	10.4	27.8	32.0	46.0	-14.0	Pass	
750	Ι	0	27	20.8	11.1	27.7	31.2	46.0	-14.8	Pass	
											45 degrees
73.7	٧	0	48.1	8.9	3.1	27.5	32.6	40.0	-7.4	Pass	
86	V	0	45.6	9.6	3.5	27.4	31.3	40.0	-8.7	Pass	
110.6	V	0	44.2	11.4	3.8	27.6	31.8	43.5	-11.7	Pass	
122.9	V	0	44.7	11.9	3.8	27.6	32.8	43.5	-10.7	Pass	
135.2	V	0	43.7	12.7	4.2	27.7	32.9	43.5	-10.6	Pass	
147.4	V	0	44.7	13.5	4.2	27.7	34.7	43.5	-8.8	Pass	
196.6	V	0	43.6	14.7	5.1	27.9	35.5	43.5	-8.0	Pass	
208.9	V	0	42.1	14.9	5.5	27.9	34.6	43.5	-8.9	Pass	
258.1	V	0	35.2	17.1	6.2	27.9	30.6	46.0	-15.4	Pass	
73.7	Н	0	42.4	8.9	3.1	27.5	26.9	40.0	-13.1	Pass	
86	Н	0	45.9	9.6	3.5	27.4	31.6	40.0	-8.4	Pass	
110.6	Н	0	40	11.4	3.8	27.6	27.6	43.5	-15.9	Pass	
196.6	Н	0	42.5	14.7	5.1	27.9	34.4	43.5	-9.1	Pass	
208.9	Н	0	40.4	14.9	5.5	27.9	32.9	43.5	-10.6	Pass	
245.8	Н	0	39.4	16.5	5.9	27.9	33.9	46.0	-12.1	Pass	

EQUIPMENT: U7W400

FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation 5113RUS1

Test Report No.:

Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass) i
Freq.	Pol.	Atten.	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	
(MHz)	(H/ √)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
											45 degrees
301	V	0	25	19.6	6.8	27.9	23.5	46.0	-22.5	Pass	
326	V	0	30	15.9	6.8	27.9	24.8	46.0	-21.2	Pass	
432	V	0	40	16	8.0	27.8	36.2	46.0	-9.8	Pass	
459	V	0	39	16.3	8.5	28.1	35.7	46.0	-10.3	Pass	
301	H	0	41.2	19.6	6.8	27.9	39.7	46.0	-6.3	Pass	
321	Ι	0	41	15.9	6.8	27.9	35.8	46.0	-10.2	Pass	
340	Ι	0	39.9	14.9	6.8	27.9	33.7	46.0	-12.3	Pass	
431	H	0	39.7	16	8.0	27.8	35.9	46.0	-10.1	Pass	
460	Ι	0	43	16.8	8.5	28.1	40.2	46.0	-5.8	Pass	
490	Ι	0	36.5	17.9	8.5	28.1	34.8	46.0	-11.2	Pass	
536	I	0	37.6	17.6	8.9	28.1	36.0	46.0	-10.0	Pass	
688	Η	0	31	19.9	10.4	27.8	33.5	46.0	-12.5	Pass	
750	H	0	30	20.8	11.1	27.7	34.2	46.0	-11.8	Pass	
											90 degrees
73.7	\ \	0	52	8.9	3.1	27.5	36.5	40.0	-3.5	Pass	
86	V	0	52	9.6	3.5	27.4	37.7	40.0	-2.3	Pass	
110.6	V	0	52.6	11.4	3.8	27.6	40.2	43.5	-3.3	Pass	
122.9	V	0	50.4	11.9	3.8	27.6	38.5	43.5	-5.0	Pass	
135.2	>	0	51	12.7	4.2	27.7	40.2	43.5	-3.3	Pass	
147.4	V	0	50.4	13.5	4.2	27.7	40.4	43.5	-3.1	Pass	
196.6	\ \	0	50	14.7	5.1	27.9	41.9	43.5	-1.6	Pass	
208.9	V	0	49.3	14.9	5.5	27.9	41.8	43.5	-1.7	Pass	
226.2	\ \	0	49	16	5.9	27.9	43.0	46.0	-3.0	Pass	
258.1	V	0	45.4	17.1	6.2	27.9	40.8	46.0	-5.2	Pass	
73.7	Ι	0	40	8.9	3.1	27.5	24.5	40.0	-15.5	Pass	
86	H	0	33	9.6	3.5	27.4	18.7	40.0	-21.3	Pass	
110.6	Н	0	34	11.4	3.8	27.6	21.6	43.5	-21.9	Pass	
122.9	Н	0	41	11.9	3.8	27.6	29.1	43.5	-14.4	Pass	
196.6	Н	0	44.8	14.7	5.1	27.9	36.7	43.5	-6.8	Pass	
208.9	Н	0	46	14.9	5.5	27.9	38.5	43.5	-5.0	Pass	
245.8	H	0	45	16.5	5.9	27.9	39.5	46.0	-6.5	Pass	

EQUIPMENT: U7W400

FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation

Test Report No.:

5113RUS1

Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass	
Freq.	Pol.	Atten.	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	
(MHz)	(H/V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
											90 Degrees
301	V	0	41	19.6	6.8	27.9	39.5	46.0	-6.5	Pass	
321	V	0	44.6	15.9	6.8	27.9	39.4	46.0	-6.6	Pass	
328	V	0	44	15.9	6.8	27.9	38.8	46.0	-7.2	Pass	
385	V	0	44.2	15.6	7.4	27.7	39.5	46.0	-6.5	Pass	
488	V	0	40.3	19.4	8.5	28.1	40.1	46.0	-5.9	Pass	
554	V	0	38.1	19.5	9.5	27.8	39.3	46.0	-6.7	Pass	
682	V	0	34.6	19.9	10.4	27.8	37.1	46.0	-8.9	Pass	
785	V	0	24	21	11.1	27.7	28.4	46.0	-17.6	Pass	
917	V	0	23	23.2	12.1	27.9	30.4	46.0	-15.6	Pass	
301	Н	0	42.3	19.6	6.8	27.9	40.8	46.0	-5.2	Pass	
325	Н	0	48.3	15.9	6.8	27.9	43.1	46.0	-2.9	Pass	
350	Н	0	46.6	15	7.4	27.7	41.3	46.0	-4.7	Pass	
400	Н	0	42.8	16.1	8.0	27.8	39.1	46.0	-6.9	Pass	
450	Н	0	37.6	16.3	8.5	28.1	34.3	46.0	-11.7	Pass	
540	Н	0	32	17.5	8.9	28.1	30.3	46.0	-15.7	Pass	
											135 degrees
73.7	V	0	53	8.9	3.1	27.5	37.5	40.0	-2.5	Pass	
86	V	0	50.3	9.6	3.5	27.4	36.0	40.0	-4.0	Pass	
110.6	V	0	48.1	11.4	3.8	27.6	35.7	43.5	-7.8	Pass	
122.9	V	0	47	11.9	3.8	27.6	35.1	43.5	-8.4	Pass	
135.2	V	0	50	12.7	4.2	27.7	39.2	43.5	-4.3	Pass	
147.4	V	0	49.5	13.5	4.2	27.7	39.5	43.5	-4.0	Pass	
196.6	V	0	45.5	14.7	5.1	27.9	37.4	43.5	-6.1	Pass	
208.9	V	0	44	14.9	5.5	27.9	36.5	43.5	-7.0	Pass	
226.2	V	0	43.4	16	5.9	27.9	37.4	46.0	-8.6	Pass	
258.1	V	0	40	17.1	6.2	27.9	35.4	46.0	-10.6	Pass	

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Ultra Wide Band Operation

Test Report No.: 5113RUS1

Test Data – Radiated Emissions

EQUIPMENT: U7W400

Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass	}
Freq.	Pol.	Atten.	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	
(MHz)	(H/ V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
											135 degrees
73.7	Н	0	40.6	8.9	3.1	27.5	25.1	40.0	-14.9	Pass	
86	H	0	39	9.6	3.5	27.4	24.7	40.0	-15.3	Pass	
110.6	Н	0	38.2	11.4	3.8	27.6	25.8	43.5	-17.7	Pass	
122.9	Н	0	37	11.9	3.8	27.6	25.1	43.5	-18.4	Pass	
196.6	Н	0	37.4	14.7	5.1	27.9	29.3	43.5	-14.2	Pass	
208.9	H	0	37.6	14.9	5.5	27.9	30.1	43.5	-13.4	Pass	
245.8	H	0	42.5	16.5	5.9	27.9	37.0	46.0	-9.0	Pass	
301	V	0	45	19.6	6.8	27.9	43.5	46.0	-2.5	Pass	
321	V	0	46	15.9	6.8	27.9	40.8	46.0	-5.2	Pass	
328	V	0	46.5	15.9	6.8	27.9	41.3	46.0	-4.7	Pass	
385	V	0	46	15.6	7.4	27.7	41.3	46.0	-4.7	Pass	
488	V	0	38.6	19.4	8.5	28.1	38.4	46.0	-7.6	Pass	
554	V	0	35.4	19.5	9.5	27.8	36.6	46.0	-9.4	Pass	
682	V	0	34	19.9	10.4	27.8	36.5	46.0	-9.5	Pass	
785	V	0	26	21	11.1	27.7	30.4	46.0	-15.6	Pass	
917	V	0	31	23.2	12.1	27.9	38.4	46.0	-7.6	Pass	
301	Н	0	44	19.6	6.8	27.9	42.5	46.0	-3.5	Pass	
325	Н	0	48.3	15.9	6.8	27.9	43.1	46.0	-2.9	Pass	
350	Н	0	46.8	15	7.4	27.7	41.5	46.0	-4.5	Pass	
400	Н	0	46.7	16.1	8.0	27.8	43.0	46.0	-3.0	Pass	
450	H	0	40.6	16.3	8.5	28.1	37.3	46.0	-8.7	Pass	
540	H	0	36.6	17.5	8.9	28.1	34.9	46.0	-11.1	Pass	

FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation

EQUIPMENT: U7W400 Test Report No.: 5113RUS1

Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass	
Freq.	Poi.	Atten.	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	ļ
(MHz)	(H/V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
											180 Degrees
73.7	V	0	43.4	8.9	3.1	27.5	27.9	40.0	-12.1	Pass	
86	V	0	36	9.6	3.5	27.4	21.7	40.0	-18.3	Pass	
110.6	V	0	39.4	11.4	3.8	27.6	27.0	43.5	-16.5	Pass	
122.9	V	0	39.5	11.9	3.8	27.6	27.6	43.5	-15.9	Pass	
135.2	V	0	42	12.7	4.2	27.7	31.2	43.5	-12.3	Pass	
147.4	V	0	47	13.5	4.2	27.7	37.0	43.5	-6.5	Pass	
196.6	V	0	44.1	14.7	5.1	27.9	36.0	43.5	-7.5	Pass	
208.9	V	0	45	14.9	5.5	27.9	37.5	43.5	-6.0	Pass	
258.1	V	0	39.8	17.1	6.2	27.9	35.2	46.0	-10.8	Pass	
73.7	Н	0	38.5	8.9	3.1	27.5	23.0	40.0	-17.0	Pass	
86	Н	0	33.9	9.6	3.5	27.4	19.6	40.0	-20.4	Pass	
110.6	Н	0	37.4	11.4	3.8	27.6	25.0	43.5	-18.5	Pass	
122.9	Н	0	34.8	11.9	3.8	27.6	22.9	43.5	-20.6	Pass	
135.2	Н	0	33.7	12.7	4.2	27.7	22.9	43.5	-20.6	Pass	
172	Н	0	32.1	14.3	4.7	27.8	23.3	43.5	-20.2	Pass	
196.6	Н	0	40.1	14.7	5.1	27.9	32.0	43.5	-11.5	Pass	
208.9	Н	0	39.4	14.9	5.5	27.9	31.9	43.5	-11.6	Pass	
245.8	H	0	44.2	16.5	5.9	27.9	38.7	46.0	-7.3	Pass	
258	Н	0	47.8	17.1	6.2	27.9	43.2	46.0	-2.8	Pass	
270.6	Н	0	46	18.1	6.2	27.9	42.4	46.0	-3.6	Pass	
282.9	Н	0	46	18.7	6.4	27.8	43.3	46.0	-2.7	Pass	
295.2	Н	0	44	18.8	6.4	27.8	41.4	46.0	-4.6	Pass	
301	V	0	35.2	19.6	6.8	27.9	33.7	46.0	-12.3	Pass	
325	V	0	33.7	15.9	6.8	27.9	28.5	46.0	-17.5	Pass	
368	V	0	33.1	15.1	7.4	27.7	27.9	46.0	-18.1	Pass	
490	V	0	32.7	17.9	8.5	28.1	31.0	46.0	-15.0	Pass	
301	Н	0	39.1	19.6	6.8	27.9	37.6	46.0	-8.4	Pass	
330	Н	0	46	15.3	6.8	27.9	40.2	46.0	-5.8	Pass	
392	Н	0	44.5	15.9	7.4	27.7	40.1	46.0	-5.9	Pass	
460	Н	0	45.6	16.8	8.5	28.1	42.8	46.0	-3.2	Pass	
544	Н	0	42.6	17.5	8.9	28.1	40.9	46.0	-5.1	Pass	

EQUIPMENT: U7W400

FCC PART 15, SUBPART C, Paragraph 15.509
Ultra Wide Band Operation

Test Report No.:

5113RUS1

Meas. Freq.	Ant. Pol.	Atten.	Meter	Antenna	Path	l 5-		1	ا مصنصا	_	1
Freq.	Pol.				raui	RF	Corrected	Spec.	CR/SL	Pass	1
			Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	
(MHz)	(H/V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
73.7	V	0	51.8	8.9	3.1	27.5	36.3	40.0	-3.7	Pass	225 degrees
86	V	0	49.3	9.6	3.5	27.4	35.0	40.0	-5.0	Pass	
110.6	V	0	50.8	11.4	3.8	27.6	38.4	43.5	-5.1	Pass	
122.9	V	0	49.9	11.9	3.8	27.6	38.0	43.5	-5.5	Pass	
135.2	V	0	48.2	12.7	4.2	27.7	37.4	43.5	-6.1	Pass	
147.4	V	0	46.3	13.5	4.2	27.7	36.3	43.5	-7.2	Pass	
196.6	V	0	46.7	14.7	5.1	27.9	38.6	43.5	-4.9	Pass	
208.9	V	0	44	14.9	5.5	27.9	36.5	43.5	-7.0	Pass	
258.1	V	0	37.8	17.1	6.2	27.9	33.2	46.0	-12.8	Pass	
73.7	Н	0	42.3	8.9	3.1	27.5	26.8	40.0	-13.2	Pass	
86	Н	0	32.3	9.6	3.5	27.4	18.0	40.0	-22.0	Pass	
110.6	Н	0	36	11.4	3.8	27.6	23.6	43.5	-19.9	Pass	
122.9	Н	0	37	11.9	3.8	27.6	25.1	43.5	-18.4	Pass	
135.2	Н	0	36.2	12.7	4.2	27.7	25.4	43.5	-18.1	Pass	
172	Н	0	37	14.3	4.7	27.8	28.2	43.5	-15.3	Pass	
196.6	Н	0	38.5	14.7	5.1	27.9	30.4	43.5	-13.1	Pass	
208.9	Н	0	36	14.9	5.5	27.9	28.5	43.5	-15.0	Pass	
245.8	Н	0	39.8	16.5	5.9	27.9	34.3	46.0	-11.7	Pass	
258	Н	0	42.2	17.1	6.2	27.9	37.6	46.0	-8.4	Pass	
270.6	Н	0	42	18.1	6.2	27.9	38.4	46.0	-7.6	Pass	
282.9	Н	0	42.6	18.7	6.4	27.8	39.9	46.0	-6.1	Pass	
295.2	Н	0	43.8	18.8	6.4	27.8	41.2	46.0	-4.8	Pass	

EQUIPMENT: U7W400

FCC PART 15, SUBPART C, Paragraph 15.509
Ultra Wide Band Operation

Test Report No.:

5113RUS1

Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass	
Freq.	Pol.	Atten.	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	
(MHz)	_(H/V)	(dB)_	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
											225 degrees
301	V	0	35.2	19.6	6.8	27.9	33.7	46.0	-12.3	Pass	
325	>	0	42.5	15.9	6.8	27.9	37.3	46.0	-8.7	Pass	
368	>	0	40.6	15.1	7.4	27.7	35.4	46.0	-10.6	Pass	
490	\ 	0	38.3	17.9	8.5	28.1	36.6	46.0	-9.4	Pass	
301	Ι	0	41.3	19.6	6.8	27.9	39.8	46.0	-6.2	Pass	
330	Н	0	45	15.3	6.8	27.9	39.2	46.0	-6.8	Pass	
392	Н	0	46.2	15.9	7.4	27.7	41.8	46.0	-4.2	Pass	
460	Ι	0	43.9	16.8	8.5	28.1	41.1	46.0	-4.9	Pass	
544	I	0	41.5	17.5	8.9	28.1	39.8	46.0	-6.2	Pass	
730	Ι	0	34.5	20.8	10.7	27.6	38.4	46.0	-7.6	Pass	
830	H	0	22	22.5	11.8	27.5	28.8	46.0	-17.2	Pass	
											270 degrees
73.7	٧	0	39.6	8.9	3.1	27.5	24.1	40.0	-15.9	Pass	
86	V	0	36	9.6	3.5	27.4	21.7	40.0	-18.3	Pass	
110.6	V	0	42	11.4	3.8	27.6	29.6	43.5	-13.9	Pass	
122.9	V	0	46	11.9	3.8	27.6	34.1	43.5	-9.4	Pass	
135.2	V	0	44	12.7	4.2	27.7	33.2	43.5	-10.3	Pass	
147.4	V	0	45.8	13.5	4.2	27.7	35.8	43.5	-7.7	Pass	
159.8	V	0	42.6	14.3	4.7	27.8	33.8	43.5	-9.7	Pass	
172.1	V	0	43.4	14.3	4.7	27.8	34.6	43.5	8.9	Pass	
184.4	V	0	40	14.6	5.1	27.9	31.8	43.5	-11.7	Pass	
196.6	V	0	44.5	14.7	5.1	27.9	36.4	43.5	-7.1	Pass	
208.9	V	0	43.4	14.9	5.5	27.9	35.9	43.5	-7.6	Pass	
221.4	V	0	40	15.7	5.5	27.9	33.3	46.0	-12.7	Pass	
233.7	V	0	39.2	16.2	5.9	27.9	33.4	46.0	-12.6	Pass	
258.1		0	37.5	17.1	6.2	27.9	32.9	46.0	-13.1	Pass	
270.6	V	0	37.5	18.1	6.2	27.9	33.9	46.0	-12.1	Pass	
282.9	V	0	38.4	18.7	6.4	27.8	35.7	46.0	-10.3	Pass	

EQUIPMENT: U7W400

FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation

Test Report No.:

5113RUS1

Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass	
Freq.	Pol.	Atten.	Reading	Factor	Loss	Gain	Reading	fimit	Diff.	Fail	
(MHz)	(H/V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
											270 degrees
73.7	Н	0	39.3	8.9	3.1	27.5	23.8	40.0	-16.2	Pass	
86	Ι	0	35	9.6	3.5	27.4	20.7	40.0	-19.3	Pass	
110.6	Н	0	34.6	11.4	3.8	27.6	22.2	43.5	-21.3	Pass	
122.9	Н	0	34.5	11.9	3.8	27.6	22.6	43.5	-20.9	Pass	
196.6	H	0	41.5	14.7	5.1	27.9	33.4	43.5	-10.1	Pass	
208.9	H	0	37.3	14.9	5.5	27.9	29.8	43.5	-13.7	Pass	
245.8	Н	0	33.9	16.5	5.9	27.9	28.4	46.0	-17.6	Pass	
258	Н	0	35.2	17.1	6.2	27.9	30.6	46.0	-15.4	Pass	
295.2	H	0	43.1	18.8	6.4	27.8	40.5	46.0	-5.5	Pass	
301	V	0	33.3	19.6	6.8	27.9	31.8	46.0	-14.2	Pass	
333	V	0	40.4	15.3	6.8	27.9	34.6	46.0	-11.4	Pass	
350	V	0	42.9	15	7.4	27.7	37.6	46.0	-8.4	Pass	
400		0	40.2	16.1	8.0	27.8	36.5	46.0	-9.5	Pass	
488	V	0	38.9	19.4	8.5	28.1	38.7	46.0	-7.3	Pass	
616	V	0	38	18.9	9.7	27.9	38.7	46.0	-7.3	Pass	
730	V	0	34	20.8	10.7	27.6	37.9	46.0	-8.1	Pass	
950	V	0	28	23.6	12.9	27.5	37.0	46.0	-9.0	Pass	
301	H	0	35	19.6	6.8	27.9	33.5	46.0	-12.5	Pass	
325	H	0	42	15.9	6.8	27.9	36.8	46.0	-9.2	Pass	
350	Н	0	41.3	15	7.4	27.7	36.0	46.0	-10.0	Pass	
400	H	0	44.8	16.1	8.0	27.8	41.1	46.0	-4.9	Pass	
480	H	0	42	19.4	8.5	28.1	41.8	46.0	-4.2	Pass	
516	Η	0	37.5	17.3	8.9	28.1	35.6	46.0	-10.4	Pass	
616	Н	0	37	18.9	9.7	27.9	37.7	46.0	-8.3	Pass	
750	Н	0	29	20.8	11.1	27.7	33.2	46.0	-12.8	Pass	

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Ultra Wide Band Operation

Test Report No.:

EQUIPMENT: U7W400

5113RUS1

Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass	
Freq.	Pol.	Atten.	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	
(MHz)	(H∕V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
											315 degrees
73.7	V	0	52	8.9	3.1	27.5	36.5	40.0	-3.5	Pass	
86	V	0	51	9.6	3.5	27.4	36.7	40.0	-3.3	Pass	
110.6	V	0	47	11.4	3.8	27.6	34.6	43.5	-8.9	Pass	
122.9	V	0	49.6	11.9	3.8	27.6	37.7	43.5	-5.8	Pass	
135.2	V	0	45	12.7	4.2	27.7	34.2	43.5	-9.3	Pass	
147.4	V	0	45.6	13.5	4.2	27.7	35.6	43.5	-7.9	Pass	
159.8	V	0	39	14.3	4.7	27.8	30.2	43.5	-13.3	Pass	
172.1	V	0	40.6	14.3	4.7	27.8	31.8	43.5	-11.7	Pass	
184.4	V	0	43.6	14.6	5.1	27.9	35.4	43.5	-8.1	Pass	
196.6	V	0	48	14.7	5.1	27.9	39.9	43.5	-3.6	Pass	
208.9	V	0	45.8	14.9	5.5	27.9	38.3	43.5	-5.2	Pass	
221.4	V	0	41.2	15.7	5.5	27.9	34.5	46.0	-11.5	Pass	
233.7	V	0	39.9	16.2	5.9	27.9	34.1	46.0	-11.9	Pass	
258.1	V	0	35.5	17.1	6.2	27.9	30.9	46.0	-15.1	Pass	
270.6	V	0	31.2	18.1	6.2	27.9	27.6	46.0	-18.4	Pass	
282.9	V	0	26.9	18.7	6.4	27.8	24.2	46.0	-21.8	Pass	
73.7	Н	0	40	8.9	3.1	27.5	24.5	40.0	-15.5	Pass	
86	Н	0	36	9.6	3.5	27.4	21.7	40.0	-18.3	Pass	
110.6	H	0	32	11.4	3.8	27.6	19.6	43.5	-23.9	Pass	
122.9	H	0	34	11.9	3.8	27.6	22.1	43.5	-21.4	Pass	
196.6	Н	0	37.8	14.7	5.1	27.9	29.7	43.5	-13.8	Pass	
208.9	Н	0	40.5	14.9	5.5	27.9	33.0	43.5	-10.5	Pass	
245.8	Н	0	42.4	16.5	5.9	27.9	36.9	46.0	-9.1	Pass	
258	Н	0	41.6	17.1	6.2	27.9	37.0	46.0	-9.0	Pass	
295.2	Н	0	41.8	18.8	6.4	27.8	39.2	46.0	-6.8	Pass	

FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation

EQUIPMENT: U7W400

Test Report No.: 5113RUS1

Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass	
Freq.	Pol.	Atten.	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	
(MHz)	(H/V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
											315 degrees
301	V	0	37.5	19.6	6.8	27.9	36.0	46.0	-10.0	Pass	
333	V	0	36	15.3	6.8	27.9	30.2	46.0	-15.8	Pass	
350	V	0	36.3	15	7.4	27.7	31.0	46.0	-15.0	Pass	
400	V	0	38.4	16.1	8.0	27.8	34.7	46.0	-11.3	Pass	
488	V	0	39.5	19.4	8.5	28.1	39.3	46.0	-6.7	Pass	
616	V	0	39	18.9	9.7	27.9	39.7	46.0	-6.3	Pass	
730	V	0	35.3	20.8	10.7	27.6	39.2	46.0	-6.8	Pass	
950	V	0	25.5	23.6	12.9	27.5	34.5	46.0	-11.5	Pass	
301	Н	0	38.4	19.6	6.8	27.9	36.9	46.0	-9.1	Pass	
325	Н	0	44.3	15.9	6.8	27.9	39.1	46.0	-6.9	Pass	
350	Н	0	45.8	15	7.4	27.7	40.5	46.0	-5.5	Pass	
400	Н	0	41	16.1	8.0	27.8	37.3	46.0	-8.7	Pass	
480	Н	0	40	19.4	8.5	28.1	39.8	46.0	-6.2	Pass	
516	Н	0	43.3	17.3	8.9	28.1	41.4	46.0	-4.6	Pass	
616	Н	0	37	18.9	9.7	27.9	37.7	46.0	-8.3	Pass	
750	Н	0	30	20.8	11.1	27.7	34.2	46.0	-11.8	Pass	

FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation
Test Report No.: 5113RUS1

EQUIPMENT: U7W400

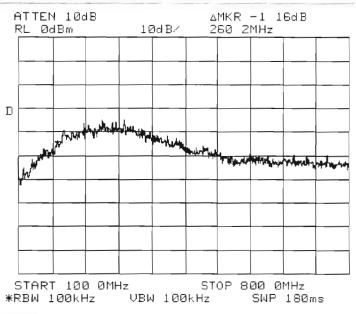
	Radiated Emissions Data											
Comple Prelimin		X						Job#:	5113 Page	11	Test # : <u>REHE-01</u> of 1	
Client N EUT Na EUT Mo	me : odel # :	University Ground C U7W400										
EUT Se EUT Co	rial#:	Transmitti	ng over	sand pit								
Specific Rod. An Bicon A Log Ant Bilog Ar Horn Ar Cable#: Preamp Limiter# Atten #: Detecto	nt. #: nt.#: .#: nt.#: nt.#: #:	993 1019 1016	Paragrap	Temp. (Humidit EUT Vo EUT From Phase: Location Distance	deg. C): y (%): ultage: equency:	22 40 12 dc 0 Sand Pit 3 Meters 1016		Refere	ence :	15.209/1 Date : Time : Staff : Photo ID:	09/20/07 9:00 David Light	
Meas. Freq.	Meter Reading	Antenna Factor	Path	RF Gain	EIRP Correction	EIRP		Spec. limit	CR/SL Diff.	Pass Fail		
(MHz)	(dBuV)	(dB)	(dB)	(dB)		(dBm)		(dBm)	(dB)	Unc.	Comment	
1050 1540 1620	33 37 33.4	22.7 24.3 24.3	0.2 0.2 1	29.8 32.9 32.9	95.2 95.2 95.2	-69.1 -66.6 -69.4		-65.3 -65.3 -53.3	-3.8 -1.3 -16.1	Pass Pass Pass		
1920 2060	33.2 32.7	28.5 28.5	1	33.1 33.1	95.2 95.2	-65.6 -66.1		-53.3 -51.3	-12.3 -14.8	Pass Pass		
2940 3120 3910	32.6 32.1 31.8	29.7 29.7 31.6	1.2 1.2 1.3	33.3 33.3 33.6	95.2 95.2 95.2	-65.0 -65.5 -64.1		-51.3 -41.3 -41.3	-13.7 -24.2 -22.8	Pass Pass Pass		
1167 1230	15.4	22.7	0.2	29.8 29.8	95.2 95.2	-86.7 -101.1		-75.3 -75.3	-11.4 -25.8	Pass Pass		
1560 1608	20 3.5	24.3 24.3	1	32.9 32.9	95.2 95.2	-82.8 -99.3		-75.3 -75.3	-7.5 -24.0	Pass Pass		
			The	e EUT w	The spectr as rotated a Worst		ng taken	at every	45 degr	ees		
\EMCS	hare\All	TOMATE	DATASH	TSIRAL	DEMEV Rev C	` xls	Documer	nt Control	#EMC:	OS EM RA	AD HEE	

FCC PART 15, SUBPART C, Paragraph 15.509
Ultra Wide Band Operation

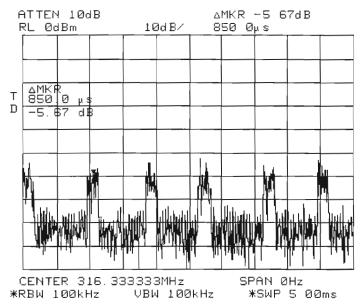
Test Report No.: 5113RUS1

EQUIPMENT: U7W400

10 dB Bandwidth



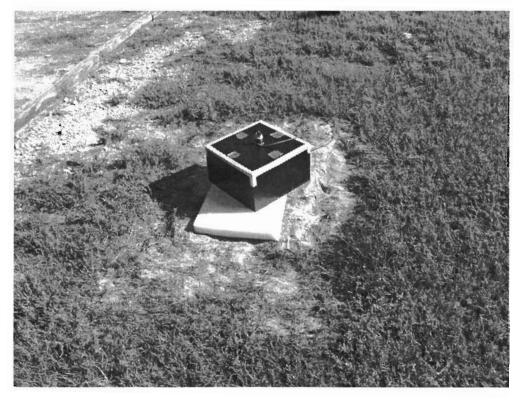
Pulse Repetition



Test Report No.: 5113RUS1

Test Setup Photographs





EQUIPMENT: U7W400

FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation

Test Report No.:

5113RUS1

Section 4. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1306	Antenna biconical	Nemko USA, Inc. BCON 30300	212	03/30/07	03/29/08
759	ANTENNA, LOG PERIODIC	A.H. SYSTEMS SAS-200/510	556	03/30/07	03/29/08
1522	Cable Assy, LAB 5 - D OATS	Nemko USA, Inc. Site D OATS	N/A	11/01/06	11/01/07
762	27dB GAIN PREAMP	Nemko USA, Inc. 27dB LNA	946	10/15/06	10/15/07
1629	CABLE, 6 ft	MEGAPHASE 10311 1GVT4	N/A	03/05/07	03/04/08
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	05/26/06	05/26/08
1659	Spectrum Analyzer	Rhode & Schwarz FSP	973353	01/24/07	01/24/09
993	Horn antenna	A.H. Systems SAS-200/571	XXX	08/31/07	08/31/09
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	05/01/07	04/30/08

FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation
Test Report No.: 5113RUS1

EQUIPMENT: U7W400

ANNEX A TEST DIAGRAMS

FCC PART 15, SUBPART C, Paragraph 15.509 Ultra Wide Band Operation

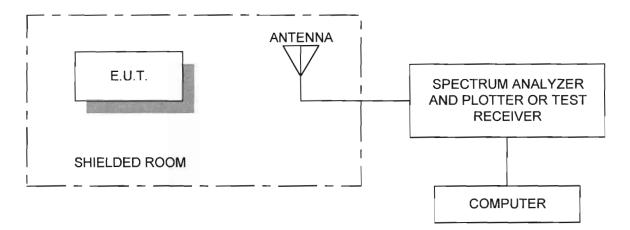
Test Report No.:

5113RUS1

EQUIPMENT: U7W400

EQUITIVE OF VETO

Radiated Prescan



EQUIPMENT: U7W400

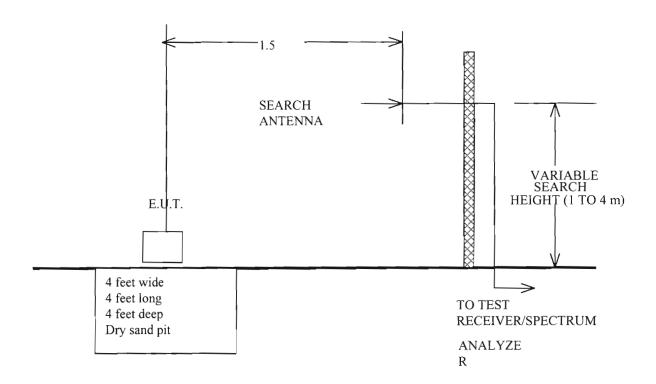
FCC PART 15, SUBPART C, Paragraph 15.509

Ultra Wide Band Operation

Test Report No.:

5113RUS1

Test Site For Radiated Emissions





ENGINEERING TEST REPORT

NUMBER: 5113EUS1

ON

Model No.: U7W900

IN ACCORDANCE WITH: CFR 47, PART 15, SUBPART B, CLASS A VERIFICATION

TESTED FOR:

University of Houston 4800 Calhoun Road Houston, Texas 77004

TESTED BY:

Nemko USA, Inc. 802 N. Kealy Lewisville, Texas 75057-3136

Total Number of Pages: 20

11/11/11

TESTED BY:	Wanel Cl	DATE:	10/30/07
	David Light, Senior Wireless Engineer		
APPROVED BY:	Leturo Juvalealia	DATE:	11/19/07
	Arturo Ruvalcaba, EMC Engineer		
	LAB CODE: 100426-0		

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CFR 47, PART 15, SUBPART A CLASS A VERIFICATION

EQUIPMENT: U7W900 REPORT NO.: 5113EUS1

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SECTION 2.	EQUIPMENT UNDER TEST (E.U.T.)	4
SECTION 3.	EQUIPMENT CONFIGURATION	7
SECTION 4.	RADIATED EMISSIONS	8
SECTION 5.	TEST METHODS AND BLOCK DIAGRAMS.	12
SECTION 6.	LABELING REQUIREMENTS	14

CFR 47, PART 15, SUBPART A CLASS A VERIFICATION

EQUIPMENT: U7W900 REPORT NO.: 5113EUS1

Section 1. Summary of Test Results

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 CFR 47, Part 15, Subpart B for Class A Digital Devices.

These tests were conducted using measurement procedures of ANSI C63.4-2003.

The equipment was tested for radiated emissions from 30 MHz to 1000 MHz in accordance with the requirements of CFR 47, Part 15, Subpart B., Paragraph 15.33. Frequencies were initially identified in a large shielded room. Amplitude measurements were made on an outdoor Open Area Test Site. Details of the outdoor site are on file with the FCC.

Abstract:

Name of Test	Basic Standard	Results
Conducted Emissions	CFR 47, Part 15, Subpart B Para. No. 15.107	N/A
(Mains port)		
Radiated Emissions	CFR 47, Part 15, Subpart B Para. No. 15.109	Complies

Note: The EUT is powered by a 12 Vdc battery

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE: **NONE**



EQUIPMENT: U7W900 REPORT NO.: 5113EUS1

Section 2. Equipment Under Test (E.U.T.)

Manufacturer: University of Houston

Name: U7W900

Model Number: U7W900

Serial Number: None

Production Status: Prototype

Description of E.U.T.:

The impulse GPR is a device that is intentionally designed to directionally and locally radiate very small average electromagnetic power downwards into the ground to be detected.

The developed GPR is composed of a pulse transmitter, a receiver, a transmitter antenna, a receiver antenna, and a laptop computer. Except the computer, all the components are installed in a plastic box. Once a 12VDC power is supplied, the GPR starts to work.

Clock, Oscillator, Highest Frequencies Utilized:

50 kHz, 12.28 MHz



EQUIPMENT: U7W900 REPORT NO.: 5113EUS1

Justification:

The E.U.T. was configured for testing as per typical installation. Position and bundling of cables were investigated to establish maximum amplitude of emissions.

The following combinations were investigated to establish worst-case configuration:

Stand Alone

Exercise Program:

The E.U.T. exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to typical use.

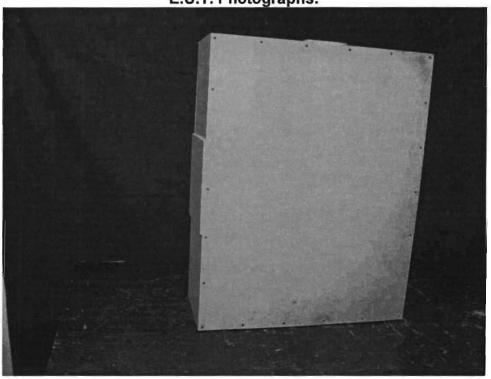
The EUT was in the following exercise mode:

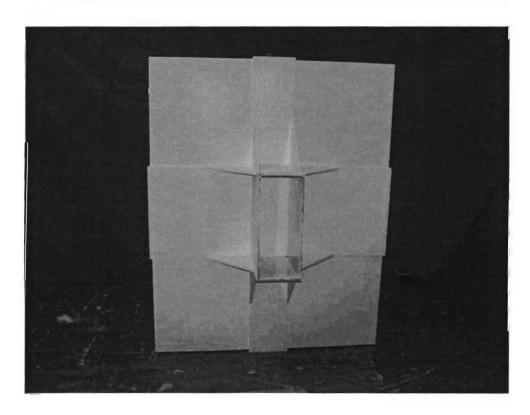
Powered on, continuously transmitting.



EQUIPMENT: U7W900 REPORT NO.: 5113EUS1

E.U.T. Photographs:



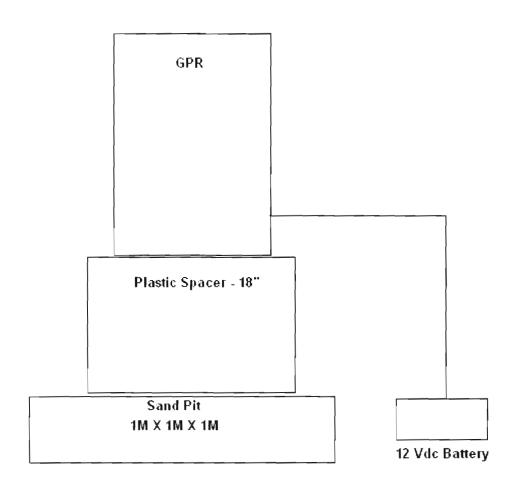




EQUIPMENT: U7W900 REPORT NO.: 5113EUS1

Section 3. Equipment Configuration

Configuration of the Equipment Under Test (E.U.T.):





EQUIPMENT: U7W900 REPORT NO.: 5113EUS1

Section 4. Radiated Emissions

Purpose:

The tests are intended to demonstrate the compliance of the Equipment Under Test (E.U.T.) to the limits for radiated emissions as defined by CFR 47, Part 15, Subpart B, Class A.

Specification Limits:

Limits for radiated disturbance of Class A

Frequency Range (MHz)	10m Limits (dBuV)
30-88	39.1
88-216	43.5
216-960	46.4
Above 960	49.5

Notes:

- 1. The lower limit shall apply at the transition frequency.
- 2. Additional provisions may be required for cases where interference occurs.
- 3. The 3m limits are calculated as follows: L_3 = L_{10} * 10/3 where L_{10} is the limit at 10m specified in μ V/m

Method of Measurement (Procedure ANSI C63.4-2003):

The equipment was prescanned in a shielded room using a spectrum analyzer and broadband antenna. A list of frequencies was compiled for investigation in the open field. The equipment was then moved to an open area test site where amplitude measurements were made at a distance of 10 meters. The bandwidth was set to 100 kHz and the detector function was CISPR Quasi-Peak.

Any emissions above 1 GHz were measured with a horn antenna and low noise pre-amplifier at a distance of 3 meters.



EQUIPMENT: U7W900 REPORT NO.: 5113EUS1

Test #: REHE-01

Tested By: David Light

Date of Tests: 29 October 2007

Test Conditions:

Test Voltage: 12 Vdc

Temperature: 20°C

Humidity: 41%

Test Results:

The E.U.T. complies.

TEST EQUIPMENT

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1306	Antenna biconical	Nemko USA, Inc. BCON 30300	212	03/30/07	03/29/08
759	ANTENNA, LOG PERIODIC	A.H. SYSTEMS SAS-200/510	556	03/30/07	03/29/08
1522	Cable Assy, LAB 5 - D OATS	Nemko USA, Inc. Site D OATS	N/A	10/04/07	10/04/08
791	PREAMP, 25dB	Nemko USA, Inc. LNA25	398	05/01/07	04/30/08
1659	Spectrum Analyzer	Rhode & Schwarz FSP	973353	01/24/07	01/24/09



EQUIPMENT: U7W900 REPORT NO.: 5113EUS1

Test Data -Radiated Emissions

Meas.	Ant.	Atten.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass	
Freq.	Pol.]	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	
(MHz)	(H/V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
36.8	V	0	42	12.9	2.2	28.5	28.6	39.0	-10.4	Pass	
73.7	V	0	47	8.9	3.1	27.5	31.5	39.0	-7.5	Pass	
86	V	0	47	9.6	3.5	27.4	32.7	39.0	-6.3	Pass	
147.4	V	0	32.4	13.5	4.2	27.7	22.4	43.5	-21.1	Pass	
73.7	Н	0	31	8.9	3.1	27.5	15.5	39.0	-23.5	Pass	
86	Н	0	32	9.6	3.5	27.4	17.7	39.0	-21.3	Pass	
122.9	Н	0	32	11.9	3.8	27.6	20.1	43.5	-23.4	Pass	
245.8	Н	0	33	16.5	5.9	27.9	27.5	46.4	-18.9	Pass	
											l

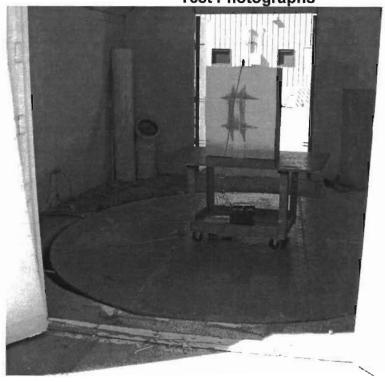
The spectrum was searched from 30 MHz to 1000 MHz. No digital emissions were detected beyond 245.8 MHz.

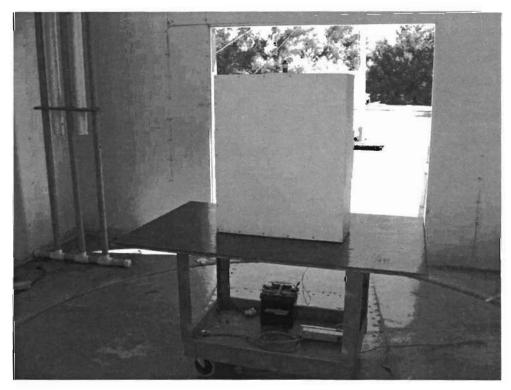
Analyzer Settings: RBW=VBW=100 kHz Peak detector



EQUIPMENT: U7W900 REPORT NO.: 5113EUS1









EQUIPMENT: U7W900 REPORT NO.: 5113EUS1

Section 5. Test Methods and Block Diagrams.

Radiated Emissions

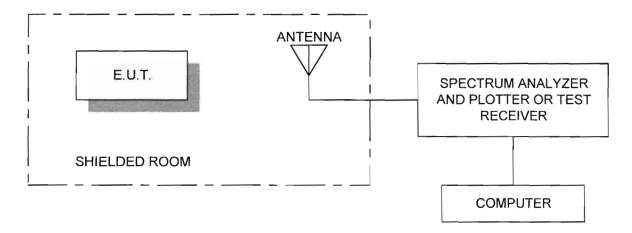
Test Method - Radiated Emissions:

- Applicable Test Standard: CFR47, FCC Pt 15, Subpart B
- The test set-up in the shielded room is as per the test configuration diagram.
- The E.U.T. is configured as typically used.
- The E.U.T. and any accessories are operated with typical load conditions.
- Radiated emissions measurements are made from 30 MHz to 1000 MHz.
- The equipment was prescanned in the shielded room using a spectrum analyzer and broadband antenna to produce a list of frequencies to be investigated in the open area test site.
- The equipment is then set-up on an open area test site.
- Variations in antenna height, antenna polarization, and E.U.T. azimuth are explored to produce the emission that has the highest amplitude relative to the limit.
- The frequencies noted in the preliminary test are investigated on the open-air site where amplitude measurements are made.
- If ambient signal field strength is high at 10 meter, the measurements may be performed at 3 meter and extrapolated to the requisite distance.
- If less than six emissions are better than 20 dB below limit, the noise level of the measuring instrument at representative frequencies is also reported.
- Any emissions above 1 GHz are measured using a horn antenna and low noise pre-amplifier at a distance of 3 meters. The bandwidth was set to 1 MHz and the detector function was average.

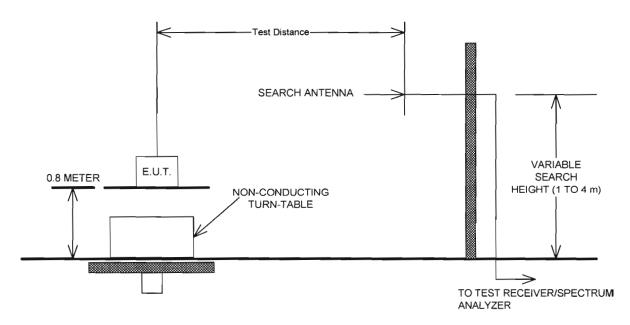


EQUIPMENT: U7W900 REPORT NO.: 5113EUS1
Test Configuration - Radiated Emissions:

Radiated Pre-scan:



Outdoor Test Site for Radiated Emissions:





EQUIPMENT: U7W900 REPORT NO.: 5113EUS1

Section 6. Labeling Requirements

Your product has successfully complied with 47 CFR FCC Part 15.B Class A requirements.

FCC Class A Label:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

In addition to placing the above label on your product, the three items that are required to be included in your product's manual are:

(1) For a Class A digital device or peripheral, the instructions furnished to the user shall include the following or similar statement, placed in a prominent location at the front of the manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

- (2) The user's manual must caution the user that changes or modifications not expressly approved by the party responsible for compliance (you/your company) could void the user's authority to operate the equipment.
- (3) The instruction manual must include appropriate instructions on the <u>first page</u> of the manual concerning installation of the device or special accessories (special cabling, shields, adapters) that must be used with the device. An appropriate caution statement should warn the user to utilize the special accessories supplied with the equipment for continued FCC compliance.



Nemko Test Re	port:	5113RUS2		
Applicant:		University of Houston 4800 Calhoun Road Houston, TX 77004 USA		
Equipment Und (E.U.T.)	er Test:	U7W900		
In Accordance \	With:	FCC Part 15, Subpart F Ultra Wide Band Operat Ground Pentrating Rada	ion	oh 15.509
Tested By:		Nemko USA Inc. 802 N. Kealy Lewisville, TX 75057		
TESTED BY:	David Light, Senior \	Mireless Engineer	DATE:	30 October 2007
APPROVED BY:		Cartuill Frontline Manager	DATE:	13 November 2007

Total Number of Pages: 19

FCC PART 15, SUBPART F, Paragraph 15.509

Ultra Wide Band Operation

EQUIPMENT: U7W900 Test Report No.: 5113RUS2

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SECTION 3.	RADIATED EMISSIONS	7
SECTION 4.	TEST EQUIPMENT LIST	16
ANNEX A TE	ST DIAGRAMS	17

FCC PART 15, SUBPART F, Paragraph 15.509
Ultra Wide Band Operation

EQUIPMENT: U7W900 Test Report No.: 5113RUS2

Section 1. Summary Of Test Results

Manufacturer: The University of Houston

Model No.: U7W900

Serial No.: Preproduction

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 15, Subpart F, Paragraph 15.509 for ultra wide band operation. All tests were conducted using measurement procedure ANSI C63.4-2003. Radiated Emissions were made with the antenna positioned on the ground screen of an open area test site with the EUT positioned on a 4 foot by 4 foot dry sand pit

\boxtimes	New Submission		Production Unit
	Class II Permissive Change	\boxtimes	Pre-Production Unit
	THIS TEST REPORT RELATES ONLY TO	THE IT	EM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE. NONE

See "Summary of Test Data".



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This report applies only to the items tested.

FCC PART 15, SUBPART F, Paragraph 15.509
Ultra Wide Band Operation

5113RUS2

EQUIPMENT: U7W900 Test Report No.:

Summary Of Test Data

NAME OF TEST	PARA. NO.	RESULT
Conducted Emissions	15.207	NA
Pulse Repetition Frequency	15.509	Complies
Definition of UWB	15.203(a)/15.209(a)	Complies
Radiated Emissions	15.509(d)	Complies
Radiated Emissions	15.509(e)	Complies
Peak Emission at f _M	15.509(f)	Complies

Footnotes For N/A's:

The device is battery powered.

FCC PART 15, SUBPART F, Paragraph 15.509

Ultra Wide Band Operation

EQUIPMENT: U7W900 Test Report No.: 5113RUS2

Section 2. General Equipment Specification

Frequency Range:

Operating Frequency(ies) of Sample:

163 to 877 MHz (10 dB BW)

Tunable Bands:

Single

20 dB Occupied Bandwidth:

1752 MHz

User Frequency Adjustment:

None

Integral Antenna Yes No

FCC PART 15, SUBPART F, Paragraph 15.509

Ultra Wide Band Operation
Test Report No.: 5113RUS2

EQUIPMENT: U7W900

Description of Device Tested

The impulse GPR is a device that is intentionally designed to directionally and locally radiate very small average electromagnetic power downwards into the ground to be detected.

The developed GPR is composed of a pulse transmitter, a receiver, a transmitter antenna, a receiver antenna, and a laptop computer. Except for the computer, all the components are installed in a plastic box. Once a 12VDC power is supplied, the GPR starts to work.

System Diagram

Refer to separate exhibit.

FCC PART 15, SUBPART F, Paragraph 15.509

Ultra Wide Band Operation

Test Report No.:

5113RUS2

Section 3. Radiated Emissions

NAME OF TEST: Radiated Emissions

PARA. NO.: 15.509(d)&(e)

TESTED BY: David Light

EQUIPMENT: U7W900

DATE: 29 October 2007

Minimum Standard:

Para no. 15.509

Limits below 960 MHz (15.209 and 15.509):

Frequency	Field Strength	Measuring RBW	Distance
(MHz)	Limits		(Meters)
	(microvolts/m)		
0.009-0.490	2400/F(kHz)	1 kHz	300
0.490-1.705	24000/F(kHz)	10 kHz	30
1.705-30.0	30	10 kHz	30
30-88	100	100 kHz	3
88-216	150	100 kHz	3
216-960	200	100 kHz	3

Limits above 960 MHz (15.509)

Frequency	E.I.R.P.	Measuring RBW	Distance
(MHz)	(dBm)		(Meters)
960-1610	-65.3	1 MHz	3
1610-1990	-53.3	1 MHz	3
1990-3100	-51.3	1 MHz	3
3100-10600	-41.3	1 MHz	3
Above 10600	-51.3	1 MHz	3
1164-1240	-75.3	1 kHz	3
1559-1610	-75.3	1 kHz	3

E.I.R.P limits converted from field strength during measurements per 15.521(g)

Maximizing Emission Levels:

The emissions were scanned from 30 MHz to 10,000 MHz.

For measurements below 960 MHz the emissions were made using a Peak or CISPR Quasi-peak detector IF BW = 100 kHz

For Frequency above 960 MHz and outside the below frequency bands, the emissions were measured using EMI RMS detector, RBW=1MHz, VBW=10 MHz

For frequencies fall inside 1164-1240 and 1559-1610 MHz, the emissions were measured using EMI RMS Detector, RBW = 1 KHz, VBW = 1 MHz

Note: The above tests were performed with the EUT raised 18 inchesfrom the ground as typical of its intended use. The EUT was tested in 8 positions (every 45°) over a sand pit. 1M x 1M X 1M

Test Results:

Complies

FCC PART 15, SUBPART F, Paragraph 15.509

Ultra Wide Band Operation
Test Report No.: 5113RUS2

EQUIPMENT: U7W900 Test Report N

					Radiat	ed Emis	sions Da	ita			
Comple	te	X						Job#:	5113		Test # : REHE-01
Prelimin	ary		-						Page	1	of <u>5</u>
Client N	ama :	Linivoroit	of Hou	oton							
EUT Na		University Air couple		_	rating radar					_	
EUT Mo		U7W900	ca groun	ia periet	rating radar						
EUT Pa	rt # :	U7W900									
EUT Se	rial#:	None									
EUT Co	nfig. :	Elevated	18 inche	s above	sand pit						
Specific		CFR47 P	art 1 <u>5,</u> S		B, Class B			Refere	ence :	15.509	
Rod. An					(deg. C) :	24	_			Date :	10/29/07
Bicon A		760		Humidi		35	-			Time :	8:00
Log Ant		1034		EUT V		12	-			Staff:	D. Light
Bilog An					equency:	dc	-			Photo ID	
Dipole A Cable#:	\III.#.	1522		Phase: Locatio		na DOATS	-				: 100 KHz
Preamp	# ·	762		Distanc		3 m	-				100 KHz 120 KHz
Limiter#		na			ric pressure:	1016	-		QF Dai	idwidti.	120 KHZ
Atten #:		na		Daronic	no pressure.	1010	-				
Detector		1036		Note:	All measur	rements	are Peak	unless	otherv	wise no	ted
Mana	A-1	A#00	Mater	Astanas	Dett	DC	0		ODIO	Descri	
Meas. Freq.	Ant. Pol.	Atten.	Meter Reading	Antenna Factor	Path Loss	RF Gain	Corrected Reading	Spec.	CR/SL Diff.	Pass Fail	1
(MHz)	(H/V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment
(10.11.12)	(, , , ,	1/	(4661)	(45)	(45)	(45)	(dbd*/////	(abaviiii)	(05)	OHD.	0 degrees
43.6	V	0	47.5	12.2	2.3	28.5	33.5	40.0	-6.5	Pass	U degrees
74.4	V	0	50.3	8.1	3.1	27.5	34.0	40.0	-6.0	Pass	
189.6	V	0	47	14.6	5.1	27.9	38.8	43.5	-4.7	Pass	
35.2	Н	0	47.4	12.4	2.2	28.5	33.5	40.0	-6.5	Pass	
36.8	H	0	48	12.3	2.2	28.5	34.0	40.0	-6.0	Pass	
74.9	Н	0	39	8.1	3.1	27.5	22.7	40.0	-17.3	Pass	
183	<u>H</u>	0	40	14.4	5.1	27.9	31.6	43.5	-11.9	Pass	
											45 degrees
38		0	44	12	2.2	28.5	29.7	40.0	-10.3	Pass	
42	V	0	46.4	12.1	2.3_	28.5	32.3	40.0	<u>-7.7</u>	Pass	
43.6 47.7		0	46.8	12.2	2.3	28.5	32.8	40.0	-7.2	Pass	
72.3		0	46.5 48.8	12 8	2.3 3.1	28.5 27.5	32.3 32.4	40.0 40.0	-7.7 -7.6	Pass Pass	
189		0	46.6	14.6	5.1	27.9	37.8	43.5	-7.6 -5.7	Pass	
35.2		0	46	12.4	2.2	28.5	32.1	40.0	-7.9	Pass	
40	H	0	46	12	2.3	28.5	31.8	40.0	-8.2	Pass	
50	H	0	40	11.6	2.7	27.9	26.4	40.0	-13.6	Pass	
155	Н	0	30	14.3	4.7	27.8	21.2	43.5	-22.3	Pass	
178	Н	0	36	14	5.1	27.9	27.2	43.5	-16.3	Pass	
207	Н	0	38	15.6	5.5	27.9	31.2	43.5	-12.3	Pass	
280	H	0	35	20	6.4	27.8	33.6	46.0	-12.4	Pass	
\EMCS	hare\AU	TOMATE\	DATASH	HTS\RAI	DEMEV Rev	C.xls	Documen	t Control	#EMC [OS EM R	AD HFE

FCC PART 15, SUBPART F, Paragraph 15.509

Ultra Wide Band Operation
Test Report No.: 5113RUS2

EQUIPMENT: U7W900

					rauiate0	d Emissi	ons Data	1				
omplet		X	_					Job#:	5113		Test#:	REHE-01
relimin	ary		-						Page	2	- of	5
lient Na	ame :	University	v of Hous	ton								
UT Na					ating radar							
UT Mo		U7W900			<u> </u>							
UT Par	t#:	U7W900								<u>-</u>		
UT Ser	ial#:	None										
UT Co	nfig. :	Elevated	18 inche	s above	sand pit							
pecifica	ation :	CFR47 P	art 15, S	ubpart B	Class B			Refere	nce :	15.509)	
Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass		
Freq.	Pol.	Atten.	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail	ĺ	
(MHz)	(H/V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment	
											90 degr	ees
38	V	0	44	12	2.2	28.5	29.7	40.0	-10.3	Pass		
42	V	0	46.7	12.1	2.3	28.5	32.6	40.0	-7.4	Pass		
46.4		0	44.9	12.1	2.3	28.5	30.8	40.0	-9.2	Pass		
54	V	0	39.4	10.9	2.7	27.9	25.1	40.0	-14.9	Pass		
75_	V	0	48.8	8.2	3.1	27.5	32.6	40.0	-7.4	Pass		
35.4	H	0	44.3	12.4	2.2	28.5	30.4	40.0	-9.6	Pass		
42	Н	0	44	12.1	2.3	28.5	29.9	40.0	-10.1	Pass		
177	H	0	38	14.3	5.1	27.9	29.5	43.5	-14.0	Pass		
206	Н	0	37	15.8	5.5	27.9	30.4	43.5	-13.1	Pass		
295	H	0	35	19.5	6.4	27.8	33.1	46.0	-12.9	Pass		
		 _	 	100					- 12.2		135 deg	rees
36.8	V	0	41.4	12.3	2.2	28.5	27.4	40.0	-12.6	Pass		
41.2	V	0	45	12.1	2.3	28.5	30.9	40.0	-9.1	Pass		
46.5	V	0	44.6	12.1	2.3	28.5	30.5	40.0	-9.5	Pass		
53.1	V	0	41.7	11.1	2.7	27.9	27.6	40.0	-12.4	Pass		
75.2		0	42	8.2	3.1	27.5	25.8	40.0 46.0	-14.2	Pass		
265 35.2	H	0	35.2 43	17.8 12.4	2.2	27.9 28.5	31.3 29.1	40.0	-14.7 -10.9	Pass Pass		
40.8	<u>-</u> н	0	44.7	12.4	2.3	28.5	30.5	40.0	-9.5	Pass		
48.3	H	0	38.8	11.8	2.3	28.5	24.4	40.0	-15.6	Pass		
171	- 	1 0	38	13.9	4.7	27.8	28.8	43.5	-14.7	Pass	+	
'''		 ~	1	10.0	7.7	27.0	20.0	10.0	14.7	. 400	180 deg	rees
37.8	V	0	37.6	12.1	2.2	28.5	23.4	40.0	-16.6	Pass	1.55 458	
43.3	V	0	44	12.2	2.3	28.5	30.0	40.0			1	
51.6	V	0	42.6	11.3	2.7	27.9	28.7	40.0	-11.3	Pass		
71	V	0	44.8	7.9	3.1	27.5	28.3	40.0	-11.7	Pass		
195	V	0	39.8	14.4	5.1	27.9	31.4	43.5	-12.1	Pass		
35.3	Н	0	39	12.4	2.2	28.5	25.1	40.0	-14.9	Pass		
42	Н	0	40.1	12.1	2.3	28.5	26.0	40.0	-14.0	Pass		
50.5	Н	0	35.9	11.4	2.7	27.9	22.1	40.0	-17.9	Pass	_	
195	Н		33	14.4	5.1	27.9	24.6	43.5	-18.9	Pass		

FCC PART 15, SUBPART F, Paragraph 15.509

Ultra Wide Band Operation

EQUIPMENT: U7W900 Test Report No.: 5113RUS2

Radiated Emissions Data												
Complet	te	X						Job#:	5113		Test#	REHE-0
Prelimin			•					000 # .	Page	3	of	5
	ich y								rage		- 0, -	
Client N	ame :	University	of Hous	ton								
UT Na	me :	Air couple	d ground	d penetra	ating radar							
EUT Mo	del#:	U7W900										
UT Pa	rt # :	U7W900										
UT Se	rial#:	None										
UT Co	nfig. :	Elevated	18 inche	s above	sand pit							
Specific	ation :	CFR47 Pa	nd 15 C	ibpart B	Class B			Refere	nco :	15.509		
pecilic	allon .	CFR47 Pa	ait 15, 5	ubpart b.	, Class B			. Releie	nce.	15.508	<u> </u>	
Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass		
Freq.	Pol.	Atten.	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail		
(MHz)	(H/V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment	
											225 degr	ees
38	V	0	41	12	2.2	28.5	26.7	40.0	-13.3	Pass		
44	V	0	45	12.2	2.3	28.5	31.0	40.0	-9.0	Pass		
52	V	0	44	11.3	2.7	27.9	30.1	40.0	-9.9	Pass		
40	V	0	44	12	2.3	28.5	29.8	40.0	-10.2	Pass		
85	V	0	38.4	9.6	3.5	27.4	24.1	40.0	-15.9	Pass		
195	\ \	0	39.5	14.4	5.1	27.9	31.1	43.5	-12.4	Pass		
32.8	Н	0	33.9	12.9	2.2	28.5	20.5	40.0	-19.5	Pass		
36	H	0	39.6	12.3	2.2_	28.5	25.6	40.0	-14.4	Pass		
42.1	Н	0	39.8	12.2	2.3	28.5	25.8	40.0	-14.2	Pass		
50.7	H	0	32.4	11.4	2.7	27.9	18.6	40.0	-21.4	Pass		
195	Н	0	38	14.4	5.1	27.9	29.6	43.5	-13.9	Pass	070	
07		 _ 	4.4	40.4		00.5	00.0	10.0	40.0		270 degr	ees
37	V	0	41	12.1	2.2	28.5	26.8	40.0	-13.2	Pass		
44	V	0	45	12.2	2.3	28.5	31.0	40.0	-9.0	Pass		
51	V	0	44	11.4	2.7	27.9	30.2	40.0	-9.8	Pass		
70 113	V	0	42 37	7.9	3.1	27.5	25.5 25.0	40.0	-14.5	Pass		
255		0	32.6	11.8 17.3	6.2	27.6 27.9	28.2	43.5 46.0	-18.5 -17.8	Pass Pass		
35	H	0	43	12.4	2.2	28.5	29.1	40.0	-10.9	Pass		
41.5		0	43.4	12.1	2.3	28.5	29.3	40.0	-10.9	Pass		
50	Н Н	0	39.6	11.6	2.7	27.9	26.0	40.0	-14.0	Pass		
195	Н	0	40	14.4	5.1	27.9	31.6	43.5	-11.9	Pass		
		 		,			31.0	.5.5		. 400	315 degr	ees
37	V	0	40	12.1	2.2	28.5	25.8	40.0	-14.2	Pass	2.0 20g1	
44	V	ō	45	12.2	2.3	28.5	31.0	40.0	-9.0	Pass		
53	V	0	42.4	11.1	2.7	27.9	28.3	40.0	-11.7	Pass		
195	V	0	36	14.4	5.1	27.9	27.6	43.5	-15.9	Pass		
35	Н	0	42	12.4	2.2	28.5	28.1	40.0	-11.9	Pass		
42	Н	0	42	12.1	2.3	28.5	27.9	40.0	-12.1	Pass	_	
52	Н	0	38	11.3	2.7	27.9	24.1	40.0	-15.9	Pass		
195	Н	0	39	14.4	5.1	27.9	30.6	43.5	-12.9	Pass		

FCC PART 15, SUBPART F, Paragraph 15.509

Ultra Wide Band Operation 5113RUS2 Test Report No.:

EQUIPMENT: U7W900

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					Radiate	d Emiss	ions Dat	a					
Comple		X	_					Job#:	5113		Test # : REHE-0		
Preliminary			-						Page	4	of5		
Client N	ame :	University	y of Hous	ton									
EUT Name :		Air coupled ground penetrating radar											
EUT Model#:		U7W900											
EUT Part # : EUT Serial # :		U7W900											
		None											
UT Co	nfig. :	Elevated	18 inches	s above	sand pit								
Specific	ation :	CFR47 Part 15, Subpart B, Class B Reference: 15.509											
			1	A -1	D. #	DE			00/01				
Meas. Freq.	Ant.	Det.	Meter	Antenna	Path	RF Cain	Corrected	Spec.	CR/SL	Pass			
rreq. (MHz)	Pol. (H/V)	Atten. (dB)	Reading (dBuV)	Factor (dB)	Loss (dB)	Gain (dB)	Reading (dBuV/m)	limit (dBuV/m)	Diff. (dB)	Fail Unc.	Comment		
(1011 12)	(1// / /	(00)	(dbdv)	(00)	(ub)	(00)	(dbdv/iii)	(dBdV/III)	(GB)	I Onc.	0 degrees		
320	V	-	36	18.2	6.8	27.9	33.1	46.0	-12.9	Pass	0 degrees		
323	-v	0	37	17.6	6.8	27.9	33.5	46.0	-12.5	Pass	 		
800	V	0	30	17.7	11.8	27.5	32.0	46.0	-14.0	Pass			
387	H	0	33	16.2	7.4	27.7	28.9	46.0	-17.1	Pass			
445	H	0	33	17.7	8.0	27.8	30.9	46.0	-15.1	Pass			
800	H	0	28	17.7	11.8	27.5	30.0	46.0	-16.0	Pass			
	- ''-	 			71.0	27.0	50.0	10.0	10.0	1 455	45 degrees		
320	V	0	31	18.2	6.8	27.9	28.1	46.0	-17.9	Pass	15 469.555		
400	V	0	33	16.6	8.0	27.8	29.8	46.0	-16.2	Pass			
800	V	0	28	17.7	11.8	27.5	30.0	46.0	-16.0	Pass			
320	H	0	35	18.2	6.8	27.9	32.1	46.0	-13.9	Pass			
370	Н	0	37	15.5	7.4	27.7	32.2	46.0	-13.8	Pass			
460	Н	0	36.3	16.9	8.5	28.1	33.6	46.0	-12.4	Pass			
800	Н	0	29	17.7	11.8	27.5	31.0	46.0	-15.0	Pass			
											90 degrees		
320	V	0	29	18.2	6.8	27.9	26.1	46.0	-19.9	Pass			
400	V	0	30	16.6	8.0	27.8	26.8	46.0	-19.2	Pass			
800	V	0	29	17.7	11.8	27.5	31.0	46.0	-15.0	Pass			
320	Н	0	35.6	18.2	6.8	27.9	32.7	46.0	-13.3	Pass			
400	H	0	38	16.6	8.0	27.8	34.8	46.0	-11.2	Pass			
800	Н	0	30	17.7	11.8	27.5	32.0	46.0	-14.0	Pass	105 1		
200	\ <u>,</u>	 	20.4	40.0		27.9	20.5	40.0	15.5	De la	135 degrees		
320	V	0	33.4	18.2	6.8		30.5	46.0	-15.5				
800	V	0	34 28	16.6	8.0	27.8	30.8	46.0	-15.2	Pass	 		
800 320		33	28	17.7 18.2	11.8	27.5 27.9	30.0	46.0	-16.0	Pass			
400	H	0	36	16.6	6.8 8.0	27.8	32.8	46.0 46.0	-15.9 -13.2	Pass			
800	H	0	28	17.7	11.8	27.5	30.0	46.0	-16.0	Pass			
300		 	20	17.7	11.0	21.5	30.0	40.0	-10.0	rass			

Document Control #EMC DS EM RAD HFE

FCC PART 15, SUBPART F, Paragraph 15.509

Ultra Wide Band Operation

EQUIPMENT: U7W900 Test Report No.: 5113RUS2

Radiated Emissions Data													
Complete Preliminary		X Job #:						5113		Test #:REHE-01			
		Pa							Page	5	of <u>5</u>		
Client Na		University of Houston											
EUT Name :		Air coupled ground penetrating radar U7W900											
EUT Model # : EUT Part # :		U7W900											
EUT Serial # :		None											
EUT Cor		Elevated 18 inches above sand pit											
		Florence to interior exert series by											
Specifica	ation :	CFR47 Part 15, Subpart B, Class B Reference : 15.509											
Meas.	Ant.	Det.	Meter	Antenna	Path	RF	Corrected	Spec.	CR/SL	Pass			
Freq.	Pol.	Atten.	Reading	Factor	Loss	Gain	Reading	limit	Diff.	Fail			
(MHz)	(H/V)	(dB)	(dBuV)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	Unc.	Comment		
- 000		 -	- 20	10.0		27.9	33.1	46.0	-12.9	Pass	180 degrees		
320	V	0	36 35	18.2	7.4	27.7	30.1	46.0	-15.9	Pass			
350		0	32	15.4 16.6	8.0	27.8	28.8	46.0	-17.2	Pass			
400 800	$\frac{v}{v}$	0	28	17.7	11.8	27.5	30.0	46.0	-16.0	Pass			
320		-	28	18.2	6.8	27.9	25.1	46.0	-20.9	Pass			
380	— <u>''</u> —	0	32	15.7	7.4	27.7	27.4	46.0	-18.6	Pass			
420	- н	0	32.5	16	8.0	27.8	28.7	46.0	-17.3	Pass			
800		0	28	17.7	11.8	27.5	30.0	46.0	-16.0	Pass			
1 000		— <u> </u>		,	71.0			1010			225 degrees		
320	V	0	30	18.2	6.8	27.9	27.1	46.0	-18.9	Pass			
400	V	0	30	16.6	8.0	27.8	26.8	46.0	-19.2	Pass			
800	V	0	28	17.7	11.8	27.5	30.0	46.0	-16.0	Pass			
320	Н	0	32	18.2	6.8	27.9	29.1	46.0	-16.9	Pass			
450	Н	0	32.6	18	8.5	28.1	31.0	46.0	-15.0	Pass			
800	Н	0	28.6	17.7	11.8	27.5	30.6	46.0	-15.4	Pass			
								12.2			270 degrees		
320	V	0	29	18.2	6.8	27.9	26.1	46.0	-19.9	Pass			
400	V	0	30	16.6	8.0	27.8	26.8	46.0	-19.2	Pass			
800	<u></u>	0	28	17.7	11.8	27.5	30.0	46.0	-16.0	Pass			
320	<u>Н</u>	0	33 35	18.2 17.7	6.8 8.0	27.9 27.8	30.1 32.9	46.0 46.0	-15.9 -13.1	Pass			
445 510	 H	0	34	16.8	8.9	28.1	31.6	46.0	-14.4	Pass			
800	<u>н</u>	0	29	17.7	11.8	27.5	31.0	46.0	-15.0	Pass			
300		 	-23	17.7	1.0		- 51.0	75.0		. 400	315 degrees		
320		0	31	18.2	6.8	27.9	28.1	46.0	-17.9	Pass			
445	V	0	30	17.7	8.0	27.8	27.9	46.0	-18.1	Pass			
510		0	31	16.8	8.9	28.1	28.6	46.0	-17.4	Pass			
800	V	0	28.7	17.7	11.8	27.5	30.7	46.0	-15.3	Pass			
320	Н	0	34	18.2	6.8	27.9	31.1	46.0	-14.9	Pass			
510	Н	0	34	16.8	8.9	28.1	31.6	46.0	-14.4	Pass			
800	H	0	28	17.7	11.8	27.5	30.0	46.0	-16.0	Pass			

FCC PART 15, SUBPART F, Paragraph 15.509

Ultra Wide Band Operation

EQUIPMENT: U7W900 Test Report No.: 5113RUS2

Measurement Data - Radiated Emissions

					Radiat	ted Emis	sions D	ata				
Complete Preliminary		X						Job#:	5113 Page	Test # : <u>REHE-01</u> of 1		
Client N	lame :	University	of Hous	ston								
EUT Name:		Ground C	oupled F	Radar								
EUT Model #:		U7W900										
EUT Pa	rt#:	U7W900										
EUT Serial #:		None										
EUT Co	nfig. :	Transmitti	ng over	sand pit								
Specific	ation :	CFR 47, F	Paragrap	h 15.509	9			Reference: 15.209/15.509				
Rod. Ar	nt. #:				deg. C):	24	•		10/29/07			
Bicon A	nt.#:			Humidit		35	•	Date : 10/29/07 Time : 14:00				
Log Ant	.#:			EUT Vo		12	•			Staff:	David Light	
Bilog Ar			EUT Frequency :				-			Photo ID:		
Horn Ar		993					•					
Cable#:		1019 Location:				Sand Pit	•					
Preamp	#:	1016		Distanc	e:	3 Meters	•					
Limiter#	! :			Baromet	ric pressure:	1016	•					
Atten #:							•					
Detecto	r#:	1036										
Meas.	Meter	Antenna	Path	RF	EIRP	EIRP	Γ	Spec.	CR/SL	Pass		
Freq.	Reading	Factor	Loss	Gain	Correction			limit	Diff.	Fail		
(MHz)	(dBuV)	(dB)	(dB)	(dB)		(dBm)		(dBm)	(dB)	Unc.	Comment	
1050	34	22.7	0.2	29.8	95.2	-68.1		-65.3	-2.8	Pass		
1559	34.2	24.3	0.2	32.9	95.2	-69.4		-65.3	-4.1	Pass		
1620	34.2	24.3	1	32.9	95.2	-68.6		-53.3	-15.3	Pass		
1920	34	28.5	1	33.1	95.2	-64.8		-53.3	-11.5	Pass		
2060	33.4	28.5	1	33.1	95.2	-65.4		-51.3	-14.1	Pass		
2940	34.5	29.7	1.2	33.3	95.2	-63.1		-51.3	-11.8	Pass		
3500	33	29.7	1.2	33.3	95.2	-64.6		-41.3	-23.3	Pass	L	
9500	32.2	37.1	4	33.6	95.2	-55.5		-41.3	-14.2	Pass		
1107	15	22.7	0.2	29.8	95.2	97.1		-75.3	11.0	Door		
1167 1230	15 14	22.7	0.2	29.8	95.2	-87.1 -88.1		-75.3 -75.3	-11.8 -12.8	Pass Pass		
1230	14	22.1	0.2	29.0	90.2	-00.1		-/3.3	-12.0	Pass	 	
1560	18	24.3	11	32.9	95.2	-84.8		-75.3	-9.5	Pass		
1608	20	24.3	1	32.9	95.2	-82.8		-75.3	-7.5	Pass		
-					The spectru	ım was se	arched to	10 GHz				
			Th	e EUT w	as rotated a	nd a readi	ng taken	at every	45 degr	ees		
						d emissio						
\FMC9	Share\All	TOMATEVE	DATASE	ITS\RAF	EMEV Rev C	: xls	Documer	nt Control	#FMC.	DS EM RA	ND HEE	

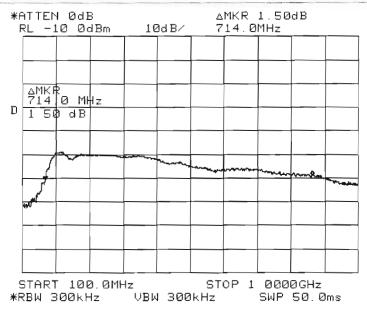
EIRP (dBm) = Meter reading (dBuV)+ AF(dB) + Path loss (dB) - Gain (dB) - 95.2 (dB)

Ultra Wide Band Operation 5113RUS2

Test Report No.:

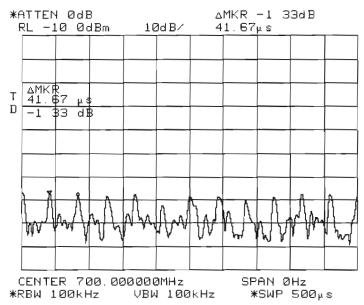
EQUIPMENT: U7W900

10 dB Bandwidth



Markers at 163 MHz and 877 MHz

Pulse Repetition

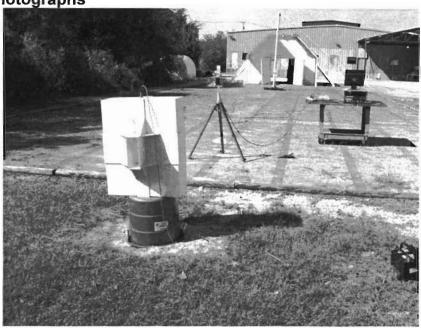


Test Report No.:

5113RUS2

Test Setup Photographs

EQUIPMENT: U7W900





FCC PART 15, SUBPART F, Paragraph 15.509

Ultra Wide Band Operation Test Report No.: 5113RUS2

EQUIPMENT: U7W900

Section 4. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
760	Antenna biconical	Electro Metrics MFC-25	477	01/19/07	01/19/08
1034	ANTENNA,LP	A.H. SYSTEMS SAS-200/510	121	03/30/07	03/29/08
762	27dB GAIN PREAMP	Nemko USA, Inc. 27dB LNA	946	11/12/06	11/12/07
1522	Cable Assy, LAB 5 - D OATS	Nemko USA, Inc. Site D OATS	N/A	10/04/07	10/03/08
993	Horn antenna	A.H. Systems SAS-200/571	XXX	08/31/07	08/31/09
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	05/01/07	04/30/08
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	05/26/06	05/26/08
1019	CABLE, 9.5m	Nemko USA, Inc. RG223	N/A	CBU	N/A

FCC PART 15, SUBPART F, Paragraph 15.509

Ultra Wide Band Operation
Test Report No.: 5113RUS2

EQUIPMENT: U7W900

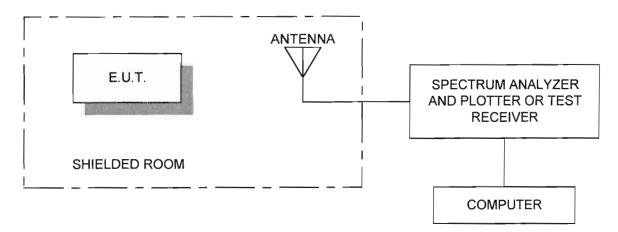
ANNEX A TEST DIAGRAMS

FCC PART 15, SUBPART F, Paragraph 15.509 Ultra Wide Band Operation

EQUIPMENT: U7W900

Test Report No.: 5113RUS2

Radiated Prescan



FCC PART 15, SUBPART F, Paragraph 15.509
Ultra Wide Band Operation

Test Report No.:

5113RUS2

EQUIPMENT: U7W900

Test Site For Radiated Emissions

