Maximum Permissible Exposure (MPE)

Related Submittal(s) / Grant (s)

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This is a Mobile device, the MPE is required.

According to §1.1310 and §2.1093 RF exposure is calculated.

This submittal(s) (test report) is intended to comply with Section Part 22, subpart H and Part 24, subpart E and Part27 subpart C & subpart L of the FCC CFR 47 Rules. And RSS-102 issue 4 For 47 CFR 1.1310 Radio frequency Radiation Exposure requirement.

Special Accessories

Not available for this EUT intended for grant.

Equipment Modifications

Not available for this EUT intended for grant.

Limitation

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-15000	/	/	1.0	30

F = frequency in MHz

* = Plane-wave equipment power density

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Averaging Time (minutes)
0.003-1	280	2.19	-	6
1-10	$280/f$	$2.19/f$	-	6
10-30	28	$2.19/f$	-	6
30-300	28	0.073	2*	6
300-1500	$1.585\ f^{0.5}$	$0.0042\ f^{0.5}$	$f/150$	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158\ f^{0.5}$	$4.21 \times 10^{-4}\ f^{0.5}$	$6.67 \times 10^{-5}\ f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
* Power density limit is applicable at frequencies greater than 100 MHz.

** Please note that R505 supports LTE Multiple Input. But it doesn't support Multiple Output. The "MIMO" only for LTE receive, not for LTE transmit.*

Maximum Permissible Exposure (MPE) Evaluation

802.11b Power Table

Frequency (MHz)	Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2412.00	12.91	0.00	12.91	0.0195	1
2437.00	12.95	0.00	12.95	0.0197	1
2462.00	12.91	0.00	12.91	0.0195	1

MPE Prediction (802.11b)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	12.95	(dBm)
Maximum peak output power at antenna input terminal:	19.72422736	(mW)
Duty cycle:	100	(%)
Maximum Pav :	19.72422736	(mW)
Antenna gain (typical):	2.79	(dBi)
Maximum antenna gain:	1.90107828	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2412	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.0074636	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.0074636 mW/cm2. This is below the uncontrolled exposure limit of 1 mW/cm2 at 2412MHz.

802.11g Power Table

Frequency (MHz)	Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2412.00	12.98	0.00	12.98	0.0199	1
2437.00	12.91	0.00	12.91	0.0195	1
2462.00	12.92	0.00	12.92	0.0196	1

MPE Prediction (802.11g)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	12.98	(dBm)
Maximum peak output power at antenna input terminal:	19.86094917	(mW)
Duty cycle:	100	(%)
Maximum Pav :	19.86094917	(mW)
Antenna gain (typical):	2.79	(dBi)
Maximum antenna gain:	1.90107828	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2462	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.0075154	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.0075 mW/cm2. This is below the uncontrolled exposure limit of 1 mW/cm2 at 2462.

802.11n_20M (Main)Power Table

Frequency (MHz)	Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2412.00	12.99	0.00	12.99	0.0199	1
2437.00	12.95	0.00	12.95	0.0197	1
2462.00	12.93	0.00	12.93	0.0196	1

MPE Prediction (802.11n_20M)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	12.99	(dBm)
Maximum peak output power at antenna input terminal:	19.90673339	(mW)
Duty cycle:	100	(%)
Maximum Pav :	19.90673339	(mW)
Antenna gain (typical):	2.79	(dBi)
Maximum antenna gain:	1.90107828	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2462	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.0075327	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.0075 mW/cm2. This is below the uncontrolled exposure limit of 1 mW/cm2 at 2462.

802.11n_20M(Aux) Power Table

Frequency (MHz)	Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2412.00	12.95	0.00	12.95	0.0197	1
2437.00	12.92	0.00	12.92	0.0196	1
2462.00	12.95	0.00	12.95	0.0197	1

MPE Prediction (802.11n_20M)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	12.95	(dBm)
Maximum peak output power at antenna input terminal:	19.72422736	(mW)
Duty cycle:	100	(%)
Maximum Pav :	19.72422736	(mW)
Antenna gain (typical):	2.79	(dBi)
Maximum antenna gain:	1.90107828	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2462	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.0074636	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.0074 mW/cm2. This is below the uncontrolled exposure limit of 1 mW/cm2 at 2462.

802.11n_20M(MIMO) Power Table

Frequency (MHz)	Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2412.00	15.980	0.00	15.980	0.0396	1
2437.00	15.945	0.00	15.945	0.0393	1
2462.00	15.950	0.00	15.950	0.0394	1

MPE Prediction (802.11n_20M)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

MIMO only for multiple input. (Effect on receiving)

Maximum peak output power at antenna input terminal:	15.98	(dBm)
Maximum peak output power at antenna input terminal:	39.62780343	(mW)
Duty cycle:	100	(%)
Maximum Pav :	39.62780343	(mW)
Antenna gain (typical):	2.79	(dBi)
Maximum antenna gain:	1.90107828	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2462	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.0149951	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.015 mW/cm2. This is below the uncontrolled exposure limit of 1 mW/cm2 at 2462.

802.11n_40M(Main) Power Table

Frequency (MHz)	Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2422.00	12.96	0.00	12.96	0.0198	1
2437.00	12.91	0.00	12.91	0.0195	1
2452.00	12.89	0.00	12.89	0.0195	1

MPE Prediction (802.11n_40M)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	12.96	(dBm)
Maximum peak output power at antenna input terminal:	19.7696964	(mW)
Duty cycle:	100	(%)
Maximum Pav :	19.7696964	(mW)
Antenna gain (typical):	2.79	(dBi)
Maximum antenna gain:	1.90107828	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2437	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.0074808	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.0075 mW/cm2. This is below the uncontrolled exposure limit of 1 mW/cm2 at 2437.

802.11n_40M(Aux) Power Table

Frequency (MHz)	Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2422.00	12.95	0.00	12.95	0.0197	1
2437.00	12.95	0.00	12.95	0.0197	1
2452.00	12.91	0.00	12.91	0.0195	1

MPE Prediction (802.11n_40M)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	12.95	(dBm)
Maximum peak output power at antenna input terminal:	19.72422736	(mW)
Duty cycle:	100	(%)
Maximum Pav :	19.72422736	(mW)
Antenna gain (typical):	2.79	(dBi)
Maximum antenna gain:	1.90107828	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2437	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.0074636	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.0075 mW/cm2. This is below the uncontrolled exposure limit of 1 mW/cm2 at 2437.

802.11n_40M(MIMO) Power Table

Frequency (MHz)	Reading Power (dBm)	Cable Loss	Output Power (dBm)	Output Power (W)	Limit (W)
2422.00	15.965	0.00	15.965	0.0395	1
2437.00	15.940	0.00	15.940	0.0393	1
2452.00	15.910	0.00	15.910	0.0390	1

MPE Prediction (802.11n_40M)

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S = Power density

P = Power input to antenna

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna

MIMO only for multiple input. (Effect on receiving)

Maximum peak output power at antenna input terminal:	15.965	(dBm)
Maximum peak output power at antenna input terminal:	39.49116993	(mW)
Duty cycle:	100	(%)
Maximum Pav :	39.49116993	(mW)
Antenna gain (typical):	2.79	(dBi)
Maximum antenna gain:	1.90107828	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	2437	(MHz)
MPE limit for uncontrolled exposure at prediction	1	(mW/cm2)
Power density at predication frequency at 20 (cm)	0.0149434	(mW/cm^2)

Measurement Result

The predicted power density level at 20 cm is 0.0149 mW/cm2. This is below the uncontrolled exposure limit of 1 mW/cm2 at 2437.

Maximum Permissible Exposure (MPE) Evaluation

In this application we seek approval to the LTE/HSPA+ VoIP Router-R505. Based on the FCC OET Bulletin 65 Supplement C and 47 CFR §2.1091, we have concluded that the LTE/HSPA+ VoIP Router will comply with the FCC rules on RF exposure for mobile devices in cellular band and PCS band. The following analysis will demonstrate such compliance. The analysis will be done in two US bands.

Operation in cellular band (1852.40– 1907.60 MHz)

The EIRP of LTE/HSPA+ VoIP Router-R505 in cellular band is 21.94dBm max at HSDPA Band 2mode. The resulted power density at a distance of 20 cm can be deducted as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBd)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)
HSDPA II	1852.40	9262	E2	V	114.23	9.85	9.90	5.56	14.18	33.00
				H	121.74	17.56	9.90	5.84	21.62	33.00
	1880.00	9400	E2	V	115.31	10.95	9.99	5.61	15.33	33.00
				H	121.71	17.57	9.99	5.61	**21.94**	33.00
	1907.60	9538	E2	V	115.20	10.87	10.07	5.66	15.28	33.00
				H	120.70	16.59	10.07	5.66	21.00	33.00

EIRP = 21.94dBm = 156.315 mW

Power Density = EIRP*Duty Cycle/($4\pi R^2$)

$=156.315*1/(4*\pi*20^2) = 0.03111$ mW/cm^2

Where Duty Cycle is 1 for HSDPA Band 2 operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

MPE limit = 1.0 mW/cm^2

As we can see the resulted power density is below the MPE limit, therefore LTE/HSPA+ VoIP Router-R505 in cellular band is compliant with the FCC rules on RF exposure.

Operation in cellular band (1712.40– 1752.60 MHz)

The EIRP of LTE/HSPA+ VoIP Router-R505 in cellular band is 23.87dBm max at HSDPA Band 4 mode. The resulted power density at a distance of 20 cm can be deducted as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBd)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)
HSDPA IV	1712.40	1312	E2	V	117.27	10.25	9.48	5.17	14.57	33.00
				H	126.78	19.81	9.90	5.84	**23.87**	33.00
	1732.60	1413	E2	V	117.52	10.51	9.54	5.20	14.85	33.00
				H	125.55	18.59	9.54	5.20	22.93	33.00
	1752.60	1513	E2	V	118.01	11.01	9.60	5.24	15.38	33.00
				H	125.01	18.06	9.60	5.24	22.43	33.00

EIRP = 23.87dBm = 243.781 mW

Power Density = EIRP*Duty Cycle/($4\pi R^2$)

$=243.781*1/(4*\pi*20^2) = 0.04852$ mW/cm^2

where Duty Cycle is 1 for HSDPA Band 4 operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

MPE limit =1.0 mW/cm^2

As we can see the resulted power density is below the MPE limit, therefore LTE/HSPA+ VoIP Router-R505 in cellular band is compliant with the FCC rules on RF exposure.

Operation in cellular band (826.40– 846.60 MHz)

The ERP of LTE/HSPA+ VoIP Router-R505 in cellular band is 21.02dBm max at HSDPA Band 5 mode. The resulted power density at a distance of 20 cm can be deducted as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBd)	Cable Loss (dB)	ERP (dBm)	Limit (dBm)
HSDPA V	826.40	4132	E2	V	115.37	29.01	-10.02	3.63	15.36	38.45
				H	120.92	34.66	-10.02	3.63	**21.02**	38.45
	836.60	4183	E2	V	114.30	28.04	-10.02	3.65	14.37	38.45
				H	120.54	34.31	-10.02	3.65	20.64	38.45
	846.60	4233	E2	V	114.21	28.06	-10.02	3.67	14.37	38.45
				H	120.20	34.00	-10.02	3.67	20.31	38.45

ERP = 21.02dBm = 126.474 mW

Power Density = EIRP*Duty Cycle/($4\pi R^2$)

$=126.474*1/(4*\pi*20^2) = 0.02517$ mW/cm^2

where Duty Cycle is 1 for HSDPA Band 5 operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

MPE limit =826.40/1500=0.55093mW/cm^2

As we can see the resulted power density is below the MPE limit, therefore LTE/HSPA+ VoIP Router-R505 in cellular band is compliant with the FCC rules on RF exposure.

Operation in LTE band (1712.5 – 1752.5 MHz)

The EIRP of LTE/HSPA+ VoIP Router in **LTE band 4 5MHz /QPSK/RB 1** is 23.30dBm max at LTE mode. The resulted power density at a distance of 20 cm can be deducted as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBd)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)
5MHz BW LTE-Band 4 (QPSK RB 1 Offset 24)	1712.5	19975	E2	V	113.82	9.30	9.48	5.33	13.45	30.00
				H	123.99	19.66	9.48	5.84	**23.30**	30.00
	1732.5	20175	E2	V	113.78	9.28	9.54	5.37	13.45	30.00
				H	122.69	18.38	9.54	5.37	22.56	30.00
	1752.5	20375	E2	V	113.91	9.43	9.60	5.40	13.63	30.00
				H	121.23	16.94	9.60	5.40	21.15	30.00

EIRP = 23.30dBm = 213.796mW

Power Density = ERP*Duty Cycle/($4\pi R^2$)

=213.796*1/($4*\pi*20^2$) = 0.04255 mW/cm^2

where Duty Cycle is 1 for LTE band 4 5MHz /QPSK/RB 1 operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

MPE limit = 1.0 mW/cm^2

As we can see the resulted power density is below the MPE limit, therefore LTE/HSPA+ VoIP Router-R505 in cellular band is compliant with the FCC rules on RF exposure.

Operation in LTE band (1712.5 – 1752.5 MHz)

The EIRP of LTE/HSPA+ VoIP Router-R505 in **LTE band 4 5MHz /16QAM/RB 1** band is 23.34dBm. max. The resulted power density at a distance of 20 cm can be deducted as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBi)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)
5MHz BW LTE-Band 4 (16QAM RB 1 Offset 24))	1712.5	19975	E2	V	114.59	10.07	9.48	5.33	14.22	30.00
				H	124.03	19.70	9.48	5.84	**23.34**	30.00
	1732.5	20175	E2	V	113.85	9.35	9.54	5.37	13.52	30.00
				H	122.80	18.49	9.54	5.37	22.67	30.00
	1752.5	20375	E2	V	114.61	10.13	9.60	5.40	14.33	30.00
				H	122.16	17.87	9.60	5.40	22.08	30.00

EIRP = 23.34 dBm = 215.774 mW

Power Density = EIRP*Duty Cycle/($4\pi R^2$)

=215.774*1/($4*\pi*20^2$) = 0.4295mW/cm^2

where Duty Cycle is 1 for LTE band 4 5MHz /16QAM/RB 1 operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

MPE limit = 1.0 mW/cm^2

As we can see the resulted power density is below the MPE limit, therefore LTE/HSPA+ VoIP Router-R505 in PCS band is compliant with the FCC rules on RF exposure.

Operation in LTE band (1715 – 1750 MHz)

The EIRP of LTE/HSPA+ VoIP Router-R505 **LTE band 14 10MHz /QPSK/RB 1** band is 22.41 dBm. max. The resulted power density at a distance of 20 cm can be deducted as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBd)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)
10MHz BW LTE-Band 4 (QPSK RB 1 Offset 0)	1715	20000	E2	V	112.26	7.74	9.49	5.34	11.89	30.00
				H	120.79	16.46	9.49	5.84	20.11	30.00
	1732.5	20175	E2	V	113.34	8.84	9.54	5.37	13.01	30.00
				H	121.61	17.30	9.54	5.37	21.48	30.00
	1750	20350	E2	V	114.71	10.23	9.60	5.40	14.43	30.00
				H	122.50	18.21	9.60	5.40	**22.41**	30.00

EIRP = 22.41dBm = 174.181mW

Power Density = ERP*Duty Cycle/($4\pi R^2$)

=174.181*1/($4*\pi*20^2$) = 0.03467 mW/cm^2

where Duty Cycle is 1 for LTE band 14 10MHz /QPSK/RB 1 operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

MPE limit = 1.0 mW/cm^2

As we can see the resulted power density is below the MPE limit, therefore LTE/HSPA+ VoIP Router-R505 in LTE band is compliant with the FCC rules on RF exposure.

Operation in LTE band (1715 – 1750 MHz)

The EIRP of LTE/HSPA+ VoIP Router-R505 in **LTE band 4 10MHz /16QAM/RB 1** is 23.73 dBm max at LTE mode. The resulted power density at a distance of 20 cm can be deducted as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBd)	Cable Loss (dB)	EIRP (dBm)	Limit (dBm)
10MHz BW LTE-Band 4 (16QAM RB 1 Offset 0)	1715	20000	E2	V	113.23	8.71	9.49	5.34	12.86	30.00
				H	121.55	17.22	9.49	5.84	20.87	30.00
	1732.5	20175	E2	V	114.11	9.61	9.54	5.37	13.78	30.00
				H	121.59	17.28	9.54	5.37	21.46	30.00
	1750	20350	E2	V	115.58	11.10	9.60	5.40	15.30	30.00
				H	123.82	19.53	9.60	5.40	**23.73**	30.00

EIRP = 23.73dBm = 187.499mW

Power Density = ERP*Duty Cycle/($4\pi R^2$)

=187.499*1/($4*\pi*20^2$) = 0.04698 mW/cm^2

where Duty Cycle is 1 for LTE band 4 10MHz /16QAM/RB 1 operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

MPE limit =1.0 mW/cm^2

As we can see the resulted power density is below the MPE limit, therefore LTE/HSPA+ VoIP Router-R505 in LTE band is compliant with the FCC rules on RF exposure.

Operation in LTE band (706.5 – 713.5 MHz)

The ERP of LTE/HSPA+ VoIP Router-R505 in **LTE band 17 5MHz /QPSK/RB 1** is 18.04dBm max at LTE mode. The resulted power density at a distance of 20 cm can be deducted as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBd)	Cable Loss (dB)	ERP (dBm)	Limit (dBm)
5MHz BW LTE-Band 17 (QPSK RB 1 Offset 24)	706.5	23755	E2	V	114.03	24.89	-7.86	3.31	13.72	34.77
				H	120.59	31.74	-7.86	5.84	**18.04**	34.77
	710	23790	E2	V	110.67	21.70	-7.86	3.33	10.51	34.77
				H	117.30	27.80	-7.86	3.33	16.61	34.77
	713.5	23825	E2	V	112.21	23.40	-7.86	3.34	12.20	34.77
				H	118.90	28.75	-7.86	3.34	17.54	34.77

ERP = 18.04dBm = 63.680mW

Power Density = ERP*Duty Cycle/($4\pi R^2$)

=63.680*1/($4*\pi*20^2$) = 0.01268 mW/cm^2

where Duty Cycle is 1 for LTE band 17 5MHz /QPSK/RB 1 operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

MPE limit =706.5/1500=0.471 mW/cm^2

As we can see the resulted power density is below the MPE limit, therefore LTE/HSPA+ VoIP Router-R505 in LTE band is compliant with the FCC rules on RF exposure.

Operation in LTE band (706.5 – 713.5 MHz)

The ERP of LTE/HSPA+ VoIP Router-R505 in **LTE band 17 5MHz /16QAM/RB 1** is 20.52dBm max at LTE mode. The resulted power density at a distance of 20 cm can be deducted as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBd)	Cable Loss (dB)	ERP (dBm)	Limit (dBm)
5MHz BW LTE-Band 17 (16 QAM RB 1 Offset 24)	706.5	23755	E2	V	114.80	25.66	-7.86	3.31	14.49	34.77
				H	121.60	32.75	-7.86	5.84	19.05	34.77
	710	23790	E2	V	112.59	23.62	-7.86	3.33	12.43	34.77
				H	120.56	31.06	-7.86	3.33	19.87	34.77
	713.5	23825	E2	V	113.61	24.80	-7.86	3.34	13.60	34.77
				H	121.88	31.73	-7.86	3.34	**20.52**	34.77

ERP = 20.52dBm = 112.720mW

Power Density = ERP*Duty Cycle/($4\pi R^2$)

=112.720*1/($4*\pi*20^2$) = 0.02244 mW/cm^2

where Duty Cycle is 1 for LTE band 17 5MHz /16QAM/RB 1 operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

MPE limit =706.5/1500=0.471mW/cm^2

As we can see the resulted power density is below the MPE limit, therefore LTE/HSPA+ VoIP Router-R505 in LTE band is compliant with the FCC rules on RF exposure.

Operation in LTE band (709 – 711 MHz)

The ERP of LTE/HSPA+ VoIP Router-R505 in **LTE band 17 10MHz /QPSK/RB 1** is 15.40dBm max at LTE mode. The resulted power density at a distance of 20 cm can be deducted as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBd)	Cable Loss (dB)	ERP (dBm)	Limit (dBm)
10MHz BW LTE-Band 17 (QPSK RB 25 Offset 12)	709	23780	E2	V	109.44	20.42	-7.86	3.32	9.24	34.77
				H	115.46	26.15	-7.86	5.84	12.45	34.77
	710	23790	E2	V	109.44	20.47	-7.86	3.33	9.28	34.77
				H	116.09	26.59	-7.86	3.33	**15.40**	34.77
	711	23800	E2	V	108.01	19.08	-7.86	3.33	7.89	34.77
				H	114.64	24.95	-7.86	3.33	13.76	34.77

ERP = 15.40dBm = 34.674mW

Power Density = ERP*Duty Cycle/($4\pi R^2$)

=34.674*1/($4*\pi*20^2$) = 0.00690 mW/cm^2

where Duty Cycle is 1 for LTE band 17 10MHz /QPSK/RB 1 operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

MPE limit =709/1500=0.473mW/cm^2

As we can see the resulted power density is below the MPE limit, therefore LTE/HSPA+ VoIP Router-R505 in LTE band is compliant with the FCC rules on RF exposure.

Operation in LTE band (709 – 711 MHz)

The ERP of LTE/HSPA+ VoIP Router-R505 in **LTE band 17 10MHz /16QAM/RB 1** is 16.99dBm max at LTE mode. The resulted power density at a distance of 20 cm can be deducted as follows:

EUT Mode	Frequency (MHz)	CH	EUT Pol.	Antenna Pol.	SPA Reading (dBuV)	S.G. Output (dBm)	Antenna Gain (dBd)	Cable Loss (dB)	ERP (dBm)	Limit (dBm)
10MHz BW LTE-Band 17 (16 QAM RB 1 Offset 0)	709	23780	E2	V	111.96	22.94	-7.86	3.32	11.76	34.77
				H	118.55	29.24	-7.86	5.84	15.54	34.77
	710	23790	E2	V	110.86	21.89	-7.86	3.33	10.70	34.77
				H	117.59	28.09	-7.86	3.33	16.90	34.77
	711	23800	E2	V	110.90	21.97	-7.86	3.33	10.78	34.77
				H	117.87	28.18	-7.86	3.33	**16.99**	34.77

ERP = 16.99dBm = 50.003mW

Power Density = ERP*Duty Cycle/($4\pi R^2$)

=50.003*1/($4*\pi*20^2$) = 0.00995 mW/cm^2

where Duty Cycle is 1 for LTE band 17 10MHz /16QAM/RB 1 operation and R is 20 cm.

The MPE limit for General Population/Uncontrolled Exposure is shown in the FCC OET Bulletin 65 Supplement C and can be calculated as follows:

MPE limit =709/1500=0.473 mW/cm^2

As we can see the resulted power density is below the MPE limit, therefore LTE/HSPA+ VoIP Router-R505 in LTE band is compliant with the FCC rules on RF exposure.

Operation if simultaneous transmission is applicable

As per KDB 447498, if transmitter of usage in mobile exposure conditions that allow simultaneous transmission, then the following combinational table of calculation in determination for simultaneous transmission of MPE compliance are needed to be presented as required by FCC.

HSDPA II + IEEE 802.11g

Antenna No.		Total	1	2
Tx Status			On	On
Frequency	MHz		1880	2412
MPE Limit	mW/cm^2		1.00	1.00
Max % MPE	%	3.3	2.6	0.8
Power	(W)	0.176	0.156	0.020
Antenna Gain	dBi		0.77	2.79
EIRP	(W)	0.17	0.131	0.038
X	(cm)		4.0	0.0
Y	(cm)		0.0	1.7
Sector			FALSE	FALSE
Arc			FALSE	FALSE
θ_1	degs	input	-120	-120
θ_2			60	60
θ_1		actual	-120	-120
θ_2			60	60

HSDPA IX + IEEE 802.11g

Antenna No.		Total	1	2
Tx Status			On	On
Frequency	MHz		1712.4	2412
MPE Limit	mW/cm^2		1.00	1.00
Max % MPE	%	6.1	5.5	0.8
Power	(W)	0.264	0.244	0.020
Antenna Gain	dBi		0.51	2.79
EIRP	(W)	0.31	0.274	0.038
X	(cm)		4.0	0.0
Y	(cm)		0.0	1.7
Sector			FALSE	FALSE
Arc			FALSE	FALSE
θ_1	degs	input	-120	-120
θ_2			60	60
θ_1		actual	-120	-120
θ_2			60	60

HSDPA V + IEEE 802.11g

Antenna No.		Total	1	2
Tx Status			On	On
Frequency	MHz		826.4	2412
MPE Limit	mW/cm^2		0.55	1.00
Max % MPE	%	4.0	3.3	0.8
Power	(W)	0.146	0.127	0.020
Antenna Gain	dBi		1.42	2.79
EIRP	(W)	0.13	0.091	0.038
X	(cm)		4.0	0.0
Y	(cm)		0.0	1.7
Sector			FALSE	FALSE
Arc			FALSE	FALSE
θ_1	degs	input	-120	-120
θ_2			60	60
θ_1		actual	-120	-120
θ_2			60	60

LTE Band 4 5MHz (QPSK RB 1 / Offset 24) + WIFI 802.11g

Antenna No.		Total	1	2
Tx Status			On	On
Frequency	MHz		1750	2412
MPE Limit	mW/cm^2		1.00	1.00
Max % MPE	%	5.7	5.0	0.8
Power	(W)	0.234	0.214	0.020
Antenna Gain	dBi		0.71	2.79
EIRP	(W)	0.29	0.252	0.038
X	(cm)		4.0	0.0
Y	(cm)		0.0	1.7
Sector			FALSE	FALSE
Arc			FALSE	FALSE
θ_1	degs	input	-120	-120
θ_2			60	60
θ_1		actual	-120	-120
θ_2			60	60

LTE Band 4 10MHz (16QAM RB1 Offset 0) + WIFI 802.11g

Antenna No.		Total	1	2
Tx Status			On	On
Frequency	MHz		1750	2412
MPE Limit	mW/cm^2		1.00	1.00
Max % MPE	%	5.4	4.7	0.8
Power	(W)	0.202	0.182	0.020
Antenna Gain	dBi		1.14	2.79
EIRP	(W)	0.27	0.236	0.038
X	(cm)		4.0	0.0
Y	(cm)		0.0	1.7
Sector			FALSE	FALSE
Arc			FALSE	FALSE
θ_1	degs	input	-120	-120
θ_2			60	60
θ_1		actual	-120	-120
θ_2			60	60

LTE Band 17(5MHz QPSK RB 1 Offset24) + WIFI 802.11g

Antenna No.		Total	1	2
Tx Status			On	On
Frequency	MHz		713.5	2412
MPE Limit	mW/cm^2		0.48	1.00
Max % MPE	%	5.4	4.7	0.8
Power	(W)	0.175	0.155	0.020
Antenna Gain	dBi		1.39	2.79
EIRP	(W)	0.15	0.113	0.038
X	(cm)		4.0	0.0
Y	(cm)		0.0	1.7
Sector			FALSE	FALSE
Arc			FALSE	FALSE
θ_1	degs	input	-120	-120
θ_2			60	60
θ_1		actual	-120	-120
θ_2			60	60

LTE Band 17(10MHz 16QAM RB1 Offset 24)+ WIFI 802.11g

Antenna No.		Total	1	2
Tx Status			On	On
Frequency	MHz		713.5	2412
MPE Limit	mW/cm^2		0.48	1.00
Max % MPE	%	2.8	2.1	0.8
Power	(W)	0.181	0.161	0.020
Antenna Gain	dBi		5.09	2.79
EIRP	(W)	0.09	0.050	0.038
X	(cm)		4.0	0.0
Y	(cm)		0.0	1.7
Sector			FALSE	FALSE
Arc			FALSE	FALSE
θ_1	degs	input	-120	-120
θ_2			60	60
θ_1		actual	-120	-120
θ_2			60	60

** Please note that the table of calculation only present the combination that yield the worst-case scenario.*

- End of Report -