

1 Test Sample Description:

Product Name: SecureKey CSM

Functional Description: This SecureKey CSM is installed in a vehicle and a part of a vehicle immobilizer system and functions as the system in vehicle immobilizer with SecureKey FOB.

Power supply: 12VDC Car Battery

Transmitter Category: Fixed (Fixed RF source is one that is physically secured at one location, even temporarily, and is not able to be easily moved to another location while radiating.)

Mobile (A transmitting device designed to be used in non-fixed locations such that a separation distance greater than 20 centimeters is normally maintained between the RF source's radiating structure(s) and the body of the user and/or bystander.)

1st Radio BT:

Frequency Range: 2402 – 2480 MHz

Mode of operation: DTS (BLE)

Antenna Description: Manufacture custom built "F-Trace", Peak Gain: 1.443(dBi typ.)

2nd Radio UHF:

Frequency Range: 312.10 – 314.35 MHz, 433.58 – 434.42 MHz

Mode of operation: Periodic transmission

Antenna Description: TE Connectivity ANT-315-HETH, Peak Gain:-2.15dBi

Reference Standards

§ 1.1310: Radiofrequency radiation exposure limits.

§ 2.1093: Radiofrequency radiation exposure evaluation: portable devices.

§ 2.1091: Radiofrequency radiation exposure evaluation: mobile devices.

§ 1.1307(b)(3)(i)(b): For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section)

KDB 447498 D01 General RF Exposure Guidance v06

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2 RF Exposure Limits:

SecureKey CSM evaluated for RF radiation exposure according to the provisions of FCC §2.1091, MPE guidelines identified in FCC §1.1310 and FCC KDB 447498:2015.

TABLE 1 TO §1.1310(E)(1)—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(i) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*(100)	≤6
3.0-30	1842/f	4.89/f	*(900/f ²)	<6
30-300	61.4	0.163	1.0	<6
300-1,500			f/300	<6
1500-100,000			5	<6
(ii) 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
300-1,500			f/1500	<30
1,500-100,000			1.0	<30

Where f = frequency in MHz. * = Plane-wave equivalent power density.

Power density limit calculation for frequency range 300 – 1500 MHz:

The UHF 312.10 MHz limit.

S = $f/1500$ mW/cm², for General Population/Uncontrolled Exposure

S = $312.10/1500$ mW/cm², for General Population/Uncontrolled Exposure

S = 0.2081 mW/cm², for General Population/Uncontrolled Exposure

The UHF 314.35 MHz limit.

S = 0.2096 mW/cm², for General Population/Uncontrolled Exposure

The UHF 433.58MHz limit.

S = 0.29 mW/cm², for General Population/Uncontrolled Exposure

The UHF 434.42MHz limit.

S = 0.29 mW/cm², for General Population/Uncontrolled Exposure

3 Transmitters output power (EIRP):

EIRP calculated using antenna port conducted output power plus the associated antenna gain for BLE radio and converting the maximum field strength measured @3m to dBm for UHF radio. The table below shows the EIRP value for BLE and UHF radios in maximum transmission mode. Duty cycle correction factor added for BLE radio. The worst case value is highlighted below.

Radio/Mode	Frequency (MHz)	Conducted RF Output (dBm)	Max. antenna gain (dBi)	EIRP (dBm)	EIRP (mW)	Measured Power Density (mw/cm ²)	Limit Power Density (mw/cm ²)	Ratio (PD measured/PD Limit)
2.4 GHz DTS	2402	1.44	1.443	2.9	1.95	0.0004	1	0.0004
	2440	0.95		2.4	1.74	0.00036	1	0.00036
	2480	0.54		2.0	1.6	0.00032	1	0.00032
As per BLE IC data Sheet absolute max. output power		4.0	1.443	5.443	3.5019	0.00072	1	0.00072

Radio/Mode	Frequency (MHz)	Measured Radiated Peak Field Strength (E) @ 3m (dBμV/m)	Radiated EIRP EIRP(dBm)= [E(dBμV/m) – 95.3] (dBm)	EIRP (mW)	Measured Power Density (mw/cm ²)	Limit Power Density (mw/cm ²)	Ratio (PD measured/PD Limit)
UHF FSK	312.10	85.19	-10.11	0.0975	0.00002	0.2081	0.000096
	314.35	84.87	-10.43	0.0906	0.000018	0.2096	0.000086
	433.58	64.42	-30.88	0.000816	0.000000162	0.29	0.00000056
	434.42	64.39	-30.91	0.000811	0.00000016	0.29	0.00000056

3.1 Calculation Procedure

The procedure used to determine the RF power density was based upon a calculation for determining compliance with the MPE requirements.

The power generated by the transmitters used in this product was initially measured by a spectrum analyzer and the powers were recorded. Through use of the Friis transmission formula and knowledge of the maximum antenna gain to be used, the power density level is calculated at a distance of 20cm.

Friis Transmission Formula

Friis transmission formula: Power Density = (Pout*G) / (4πr²)

Power Density = (EIRP) / (4πr²)

Where,

Pd = Power Density (mW/cm²) π = 3.1416

EIRP = [Output power to antenna + antenna Gain (dBi)] mW

r = distance between observation point and center of the radiator (20 cm)

4 Conclusion:

Simultaneous Transmissions .This device contains multiple transmitters which can operate simultaneously; therefore the maximum RF exposure is determined by the summation of MPE ratios. The limit is such that the summation of MPE ratios is ≤ 1.0 .

Simultaneous Transmissions		
Radio	Mode	Worse transmission ratio
Radio#1	BLE	0.00072
Radio#2	UHF	0.000096
MPE Ratio Summation		0.000816
Result: Compliance is shown by the sum of the radio of the power densities ratio for all radios that can transmit simultaneously being less than 1. 0.000816 < 1		