

KATHREIN Automotive GmbH & Co. KG, Roemerring 1, 31137 Hildesheim

December 21, 2015

To whom it may concern:

Subject: RF MPE EXPOSURE For FCC ID: 2ACC7LTECOMPB0

Product Name: Compensator US

Brand: KATHREIN Automotive

Model Number: LTECOMPB0

The MPE calculations for the model LTECOMPB0 were done for 3 Outside Antenna combinations and for each supported frequency band.

The calculations were done for the following frequency bands:

- Band 2 (1900 MHz)
- Band 4 (2100 MHz)
- Band 5 (850 MHz)
- Band 12/17 (700 MHz)
- Band 13 (700 MHz).
- Radiation Safety Calculated Combined Power Density

Outside Antenna combinations:

Ant 1:	DA GSS/TEL/TEL/SDARS LTE	9350090-01
Ant 2:	Telefonantenne1 Frontend Folie	9273669
Ant 3:	ECU-01 R1-US-3G / ANT 3G TEL GPS SDARS	9395306-01 + 9303036-03

A booster's uplink power must not exceed 1 watt equivalent isotropic radiated power (EIRP) for each band of operation. Composite downlink power must not exceed 0,05 watt EIRP for each band of operation (20.21(e)(8)(i)(D)). The following formula was used to calculate the equivalent isotropic radiated power:

$$\text{EIRP} = \text{Power Out (watt)} * \text{Duty Cycle Percent} * \text{Antenna Gain (non-log)} * \text{Coax loss (non-log)}$$

The power density (mW/cm<sup>2</sup>) is calculated using the following formula:

$$\text{Calculated Power Density} = 1000 * \text{EIRP (watt)} / (4 * \pi * (\text{Distance from Antenna (cm)})^2)$$

Yours Faithfully,



Name: Dr. Markus Hoffmeister

Title: Managing Director / CTO

Tel: +49 5121 99 814 61

Email address: [markus.hoffmeister@kathreinautomotive.com](mailto:markus.hoffmeister@kathreinautomotive.com)

**MPE Calculation**

FCC ID: 2ACC7LTECOMPB0

<b>Band 2</b>	Ant. 1	Ant. 2	Ant. 3
---------------	--------	--------	--------

**INPUT DATA**

Frequency (MHz)	1910	1900	1916
Pout ( W)	0,25119	0,25119	0,25119
Duty Cycle (%)	100	100	100
Ant. Gain (dBi)	3,15	-4,00	0,48
Coax Loss (dB) - Cable RTK031, length 1 m	0,80	0,80	0,80
Distance from Antenna (cm)	20	20	20

**RESULTS OF CALCULATIONS**

Ant. Gain less Coax. Loss (dBi)	2,35	-4,80	-0,32
EIRP (W)	0,4315	0,0832	0,2333
FCC Power Density Limit (mW/cm <sup>2</sup> )	1	1	1
Calculated Power Density (mW/cm <sup>2</sup> )	0,0859	0,0165	0,0464

**REFERENCE DATA**

Max. Pout + production tolerance (dBm)	24	24	24
Antenna Gain (non-log)	2,07	0,40	1,12
Coax. Loss (non-log)	0,83	0,83	0,83
General FCC Limit (mw/cm <sup>2</sup> )	1 *	1 *	1 *

\* Limits for General Population/Uncontrolled Exposure (FCC Part 1.1310)

<b>Band 4</b>	Ant. 1	Ant. 2	Ant. 3
---------------	--------	--------	--------

**INPUT DATA**

Frequency (MHz)	1724	1750	1724
Pout ( W)	0,15849	0,15849	0,15849
Duty Cycle (%)	100	100	100
Ant. Gain (dBi)	2,66	-5,00	0,28
Coax Loss (dB) - Cable RTK031, length 1 m	0,78	0,78	0,78
Distance from Antenna (cm)	20	20	20

**RESULTS OF CALCULATIONS**

Ant. Gain less Coax. Loss (dBi)	1,88	-5,78	-0,50
EIRP (W)	0,2443	0,0419	0,1413
FCC Power Density Limit (mW/cm <sup>2</sup> )	1	1	1
Calculated Power Density (mW/cm <sup>2</sup> )	0,0486	0,0083	0,0281

**REFERENCE DATA**

Max. Pout + production tolerance (dBm)	22	22	22
Antenna Gain (non-log)	1,85	0,32	1,07
Coax. Loss (non-log)	0,84	0,84	0,84
General FCC Limit (mw/cm <sup>2</sup> )	1 *	1 *	1 *

\* Limits for General Population/Uncontrolled Exposure (FCC Part 1.1310)

<b>Band 5</b>	Ant. 1	Ant. 2	Ant. 3
---------------	--------	--------	--------

**INPUT DATA**

Frequency (MHz)	840	849	849
Pout ( W)	0,25119	0,25119	0,25119
Duty Cycle (%)	100	100	100
Ant. Gain (dBi)	-0,26	-3,00	-3,26
Coax Loss (dB) - Cable RTK031, length 1 m	0,52	0,52	0,52
Distance from Antenna (cm)	20	20	20

**RESULTS OF CALCULATIONS**

Ant. Gain less Coax. Loss (dBi)	-0,78	-3,52	-3,78
EIRP (W)	0,2099	0,1117	0,1052
FCC Power Density Limit (mW/cm <sup>2</sup> )	0,56	0,57	0,57
Calculated Power Density (mW/cm <sup>2</sup> )	0,0418	0,0222	0,0209

**REFERENCE DATA**

Max. Pout + production tolerance (dBm)	24	24	24
Antenna Gain (non-log)	0,94	0,50	0,47
Coax. Loss (non-log)	0,89	0,89	0,89
General FCC Limit (mw/cm <sup>2</sup> )	f/1500 *	f/1500 *	f/1500 *

\* Limits for General Population/Uncontrolled Exposure (FCC Part 1.1310)

f = Frequency in MHz

<b>Band 13</b>	Ant. 1	Ant. 2	Ant. 3
----------------	--------	--------	--------

**INPUT DATA**

Frequency (MHz)	770	779	770
Pout ( W)	0,15849	0,15849	0,15849
Duty Cycle (%)	100	100	100
Ant. Gain (dBi)	0,75	-4,00	-6,07
Coax Loss (dB) - Cable RTK031, length 1 m	0,50	0,50	0,50
Distance from Antenna (cm)	20	20	20

**RESULTS OF CALCULATIONS**

Ant. Gain less Coax. Loss (dBi)	0,25	-4,50	-6,57
EIRP (W)	0,1679	0,0562	0,0349
FCC Power Density Limit (mW/cm <sup>2</sup> )	0,51	0,52	0,51
Calculated Power Density (mW/cm <sup>2</sup> )	0,0334	0,0112	0,0069

**REFERENCE DATA**

Max. Pout + production tolerance (dBm)	22	22	22
Antenna Gain (non-log)	1,19	0,40	0,25
Coax. Loss (non-log)	0,89	0,89	0,89
General FCC Limit (mw/cm <sup>2</sup> )	f/1500 *	f/1500 *	f/1500 *

\* Limits for General Population/Uncontrolled Exposure (FCC Part 1.1310)

f = Frequency in MHz



<b>Band 12/17</b>	Ant. 1	Ant. 2	Ant. 3
-------------------	--------	--------	--------

**INPUT DATA**

Frequency (MHz)	720	719	720
Pout ( W)	0,15849	0,15849	0,15849
Duty Cycle (%)	100	100	100
Ant. Gain (dBi)	-0,38	-2,50	-3,59
Coax Loss (dB) - Cable RTK031, length 1 m	0,48	0,48	0,48
Distance from Antenna (cm)	20	20	20

**RESULTS OF CALCULATIONS**

Ant. Gain less Coax. Loss (dBi)	-0,86	-2,98	-4,07
EIRP (W)	0,1300	0,0798	0,0621
FCC Power Density Limit (mW/cm <sup>2</sup> )	0,48	0,48	0,48
Calculated Power Density (mW/cm <sup>2</sup> )	0,0259	0,0159	0,0124

**REFERENCE DATA**

Max. Pout + production tolerance (dBm)	22	22	22
Antenna Gain (non-log)	0,92	0,56	0,44
Coax. Loss (non-log)	0,90	0,90	0,90
General FCC Limit (mw/cm <sup>2</sup> )	f/1500 *	f/1500 *	f/1500 *

\* Limits for General Population/Uncontrolled Exposure (FCC Part 1.1310)

f = Frequency in MHz

## Radiation Safety – Combined Radiation from Amplifier and Cell Phone

### Calculated Power Density and Minimum Safe Distance for Cellular Phones (Uplink)

#### INPUT DATA

Frequency (MHz)	1910	1724	840	770	720
Radiated Power ( W)	1	1	1	1	1
Duty Cycle (%)	100	100	100	100	100
Distance from Antenna (cm)	20	20	20	20	20

#### RESULTS OF CALCULATIONS

EIRP (W)	1	1	1	1	1
FCC Power Density Limit (mW/cm <sup>2</sup> )	1	1	0,56	0,51	0,48
Calculated Power Density (mW/cm <sup>2</sup> )	0,20	0,20	0,20	0,20	0,20

### Calculated Power Density and Minimum Safe Distance for Amplifier (Downlink)

#### INPUT DATA

Frequency (MHz)	1960	2132	881	751	737
Max. Pout + production tolerance (dBm)	2,00E-06	2,00E-06	2,00E-06	2,00E-06	2,00E-06
Duty Cycle (%)	100	100	100	100	100
Ant. Gain (dBi) - Worst Case	5	5	5	5	5
Coax Loss (dB) - Cable RTK031, length 1 m	0,80	0,78	0,52	0,50	0,48
Distance from Antenna (cm)	20	20	20	20	20

#### RESULTS OF CALCULATIONS

Ant. Gain less Coax. Loss (dBi)	4,2	4,22	4,48	4,50	4,52
EIRP (W)	7,59E-06	7,55E-06	7,11E-06	7,08E-06	7,05E-06
FCC Power Density Limit (mW/cm <sup>2</sup> )	1	1	0,59	0,50	0,49
Calculated Power Density (mW/cm <sup>2</sup> )	1,51E-06	1,50E-06	1,41E-06	1,41E-06	1,40E-06

### Calculated Combined Power Density for Amplifier and Phone at 20 cm

Determined by most limiting factors → Power Density UL >> Power Density DL

FCC Power Density Limit (mW/cm <sup>2</sup> )	1	1	0,59	0,50	0,49
Combined Power Density for Phone and Amp (mW/cm <sup>2</sup> )	0,20	0,20	0,20	0,20	0,20