MMI-TRAKR1 MPE Evaluation

1) Transmitter Duty Factor

We will first establish experimentally the transmit duration of the MMI-TRAKR1 device (FCC ID RG6-MMI-TRAKR1). We will then establish, again experimentally, the transmit intervals (over long observation times). Sliding averages of the measured data, over 5 minutes and 30 minutes windows (for "Controlled" and "Uncontrolled" cases respectively per FCC OET 65 Appendix A), will be calculated to obtain the minimum transmit intervals. The corresponding maximum duty factors will then be evaluated and used to estimate the MPE.

1.1) Transmit Duration

Measurement of a MMI-TRAKR1 transmission, in time domain, is shown below:

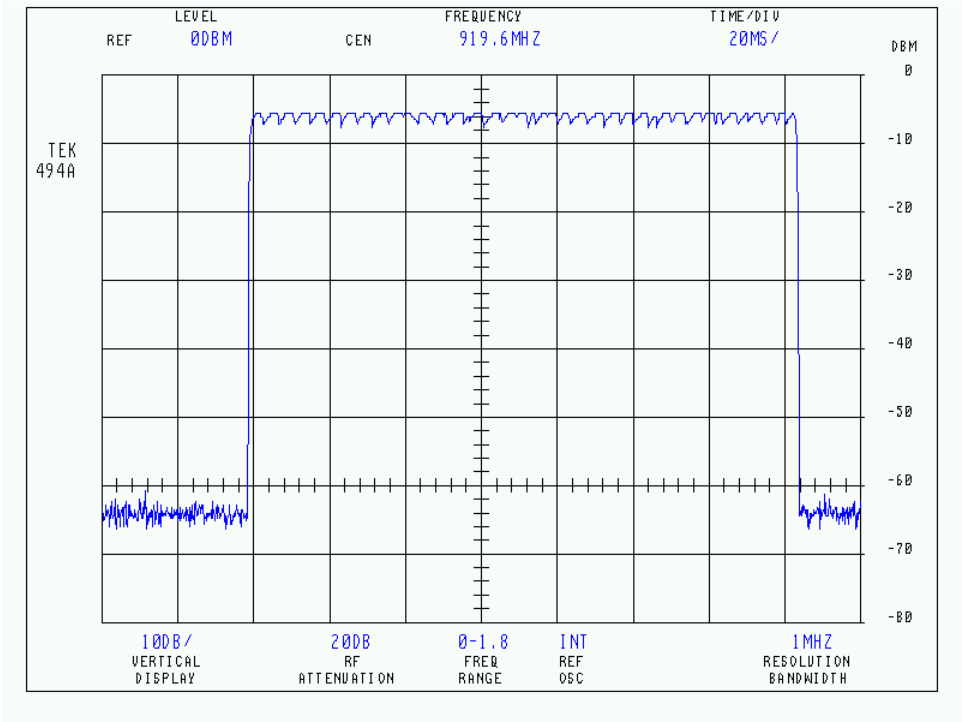

Figure 1) Measured MMI-TRAKR1 Transmission in Time Domain

The measured transmit duration is approximately 150 milliseconds (0.15 seconds). The result agrees well with the design value presented in the "Technical Description" document. The transmission is digitally controlled by crystal clock with parts-per-million stability. High repeatability can be expected throughout production runs and operating environment.

1.2) Transmit Interval

As described in the "Owner's Manual" and the "Technical Description" documents, the MMI-TRAKR1 can operate in one of two possible modes: "Normal" and "Emergency". A 0.15-second duration signal is transmitted approximately every 60 seconds in "Normal" mode; whereas an emergency-coded signal is transmitted (on the "emergency channel" which is not used for normal transmissions) approximately every 10 seconds, in additional to the emergency-coded "normal channel" signal every 60 seconds, under "Emergency" mode. Reception of an "Emergency" signal, by any receiver within range, will trigger a system-wide alert, followed by rapid search and rescue action, hopefully leading to a quick and happy conclusion.

We recorded the transmission timestamps from a MMI-TRAKR1 unit during two 2-hour long sessions, while operating in the "Normal" mode and in the "Emergency" mode respectively. We then calculated sliding averages of the transmit intervals using 5 minutes and 30 minutes windows, for both datasets. The minimum sliding average intervals from the "Emergency" mode data are then used to evaluate the duty factors for MPE estimates, since these values represent the "worst-of-the-worst" cases, infrequently as they may occur.

The measured transmit intervals are shown below.

Table 1) Sliding Average Transmit Interval (Seconds) – Normal Mode

	5 Minute Window	30 Minute Window
Minimum	49.50	58.58
Mean	60.13	60.05
Maximum	70.25	61.65

(Total Run Time: 130 Minutes)

Table 2) Sliding Average Transmit Interval (Seconds) – Emergency Mode

	5 Minute Window	30 Minute Window
Minimum	8.02	8.48
Mean	8.59	8.58
Maximum	9.26	8.72

(Total Run Time: 142 Minutes)

The result for the "Emergency" mode will be used for "worst case" MPE estimate. (Result for "Normal" mode is only included for completeness.)

1.3) Duty Factor

The maximum duty factors, to be used for “worst case” MPE estimates, are summarized below:

Table 3) Maximum Duty Factors (Emergency Mode)

5 Minute Averaging Window	30 Minute Averaging Window
1.87% (0.15 / 8.02)	1.77% (0.15 / 8.48)

2) Protection from User Alteration

The MMI-TRAKR1 does not contain any user serviceable part, and does not permit user alteration to any system setting. The user can only select one of three functions through a single push-button switch: ON, OFF, and EMERGENCY. The internal battery is charged wirelessly through a dedicated charger. All settings are finalized at the factory before the unit is released for shipment. Settings are protected by password and encryption (AES). Any change in setting requires return-to-factory, or by authorized personnel using proprietary equipment.

3) Worst Case MPE Estimate

In addition to the experimentally verified duty factor values from section 1 above, we also need to examine the geometry to be used for MPE estimate.

As illustrated in the “Owner’s Manual” document, the user organization is instructed to permanently attach the included cradle to the user’s outer garment shoulder area, then securely strap the MMI-TRAKR1 unit to the cradle:

Figure 2) Manufacturer-Specified Mounting Configuration for MMI-TRAKR1

The closest distance between the center of the antenna and any user body part is typically 4 centimeters.

On the other hand, the MMI-TRAKR1 unit, mounted inside its cradle, could in principle be attached to a flat surface, as illustrated below:

Figure 3) Possible Mounting Configuration for MMI-TRAKR1 (NOT RECOMMENDED)

The closest distance between the center of the antenna and any user body part is then typically 1.5 centimeters.

Although this mounting configuration is not recommended, the supplied components would not prevent the user from choosing this way. This therefore represents the "worst case" scenario. In reality, since the users are professional people employed by professional organizations (which will keep the equipment properly deployed and maintained), this situation would only serve to evaluate the worst case MPE (as a result of improper use of manufacturer-supplied components).

The wavelength at the frequency of interest (915 MHz) is about 33 centimeters. The observation distance (1.5 cm, or even 4 cm) is only a small fraction of a wavelength. Therefore the "near field" provision on pages 31 and 32 of OET Bulletin 65 (97-01 Edition) is applicable. Specifically, equation (19) on page 32, in conjunction with the measured parameters presented in previous sections of this document, will be used to estimate the power density at the body. The results will be compared to the MPE limits provide in Appendix A of OET 65, specifically Table 1 on page 67.

The worst-case MPE (Maximum Permissible Exposure) estimates, for “Controlled Exposure” (5 minute averaging) and “Uncontrolled Exposure” (30 minute averaging), are shown below:

Table 4) Worst-Case MPE (Maximum Permissible Exposure) Estimates (mW/cm^2)

		Estimate	Limit
Controlled Exposure		0.265	3.05
Uncontrolled Exposure		0.25	0.61
For All Cases:	Frequency	915 MHz	
	Power to Antenna	1000 mW	
	Antenna Height	7.5 cm	
	Distance to Antenna	1.5 cm	
	Duty Factor	As measured (EMERGENCY mode)	

This MPE evaluation shows that exposure from the MMI-TRAKR1 (FCC ID RG6-MMI-TRAKR1) device is comfortably below even the “Uncontrolled Exposure” limit, in spite of the choice of an infrequent operating mode, and a non-recommended and therefore highly improbable mounting geometry, for “worst case” scenario.

This device FCC ID: **RG6-MMI-TRAKR1**

Prepared By: R. Ramirez

Date: 3/8/2023

The maximum power that the transmitter is capable of is **10.40** mW Applied duty cycle? **yes**

Using the following formula from section 4.3.1 of KDB 447498 at test separation distances ≤ 50 mm

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] * [√f(GHz)]

When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

Duty Cycle
1.87%

Max Peak Power (dBm)	Min Separation distance (mm)*	Frequency (Ghz)
27.45	15	0.902

Value
0.66

"Value" shall be **≤ 3.0 for 1-g** SAR and **≤ 7.5 for 10-g** extremity SAR

< 50mm power limits for above frequency and distance

1-g power limit	10-g power limit
158	395

This device FCC ID: **RG6-MMI-TRAKR1**

Prepared By: R. Ramirez

Date: 3/8/2023

The maximum power that the transmitter is capable of is **10.02** mW Applied duty cycle? **yes**

Using the following formula from section 4.3.1 of KDB 447498 at test separation distances ≤ 50 mm

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] * [√f(GHz)]

When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

Duty Cycle
1.87%

Max Peak Power (dBm)	Min Separation distance (mm)*	Frequency (Ghz)
27.29	15	0.915

Value
0.64

"Value" shall be **≤ 3.0 for 1-g** SAR and **≤ 7.5 for 10-g** extremity SAR

< 50mm power limits for above frequency and distance

1-g power limit	10-g power limit
157	392

This device FCC ID: **RG6-MMI-TRAKR1**

Prepared By: R. Ramirez

Date: 3/8/2023

The maximum power that the transmitter is capable of is **8.71** mW Applied duty cycle? **yes**

Using the following formula from section 4.3.1 of KDB 447498 at test separation distances ≤ 50 mm

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] * [√f(GHz)]

When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

Duty Cycle
1.87%

Max Peak Power (dBm)	Min Separation distance (mm)*	Frequency (Ghz)
26.68	15	0.927

Value
0.56

"Value" shall be **≤ 3.0 for 1-g** SAR and **≤ 7.5 for 10-g** extremity SAR

< 50mm power limits for above frequency and distance

1-g power limit	10-g power limit
156	389