Radio Frequency Exposure Evaluation Report

for

Teledyne Controls

Wireless Groundlink® – Quick Access Recorder

FCC ID: SYK-WQAR-364-4R
IC ID: 11369A-WQAR3644R
model number: 2243800-364

Applied Rules and Standards

CFR Part Part 1 (1.1307 &1.1310), Part 2 (2.1091),
FCC OET Bulletin 65 (1997-01) Supplement C (2001-01),
FCC KDB 447498 D01 General 24 RF Exposure Guidance v05r01

Industry Canada RSS-102, Issue 4 of March 2010

Report number: EMC_TELED-004-12001_364_MPE_Rev1

DATE: 2014-01-27

1 Administrative Data

1.1 Identification of the Testing Laboratory Issuing the Test Report

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RF Exposure Lab Manager:	Josie Sabado

1.2 Identification of the Client

Applicant's Name:	Teledyne Controls
Street Address:	501 Continental Boulevard
City/Zip Code	El Segundo, CA 90245
Country	USA
Contact Person:	Fariz Kalim
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2 Equipment under Assessment

Marketing Name / Description:	**Wireless Groundlink® – Quick Access Recorder**
FCC-ID:	**SYK-WQAR-364-4R**
IC certification no.:	**11369A-WQAR3644R**
Model Number (IC model number):	**2243800-364**
Product Description:	3G radio transceiver equipment intended for aircraft on-ground-communication with airline operator back office, based on multiple (identical) pre-certified 3G cellular radio modules. (details see below). The given model 2243800-364 (the EUT) is equipped with 2 pairs of identical cellular radio modules (total of 4 modules). The 2 main antenna outputs (UFL) of each pair of modules are routed to one of the 2 external SMA antenna connectors over a 2:1-combiner. See details below.
HW / SW Version :	2243800-364 / 711745 D
Technology / Type(s) of Modulation:	see the following spec of the incorporated cellular module:
Integrated Module Info:	Sierra Wireless Airprime MC8705; HW Rev 1.0, SW Rev. T1.0.3.2 FCC ID: N7NMC8705; IC ID: 2417C-MC8705 • 850/900/1800/1900Mhz GSM/GPRS/EDGE; GSM&GPRS&EDGE(MCS-1-4): GMSK; EDGE(MCS-5-8): 8PSK; Multislot class 12 supported for both, GPRS and EGPRS; • 850/900/1700/1900/2100 MHz WCDMA / HSPA+; HSDPA Category 14 data rate - 21 Mbps; HSUPA Category 6 data rate - 5.76 Mbps; modulation: all QPSK (no QAM in uplink for given data rates); • 2 UFL antenna connectors, one for main and one for rx diversity
Operating Frequency Ranges (MHz) / Channels:	GSM 850: 824.2-848.8; 125 channels; PCS 1900: 1850.2-1909.8; 300 channels; FDD II: 826.4 - 846.6; 278 channels; FDD V: 1852.4 – 1907.6; 103 channels;
Antenna details:	PanguTech LLC, model: JQRD-0018-AGDPU; peak gain: 2dBi nom.; multiple band 800/900/1800/1900/2100MHz; vertical polarized; omni-directional; SMA connector; The documented total loss from the 3G module's UFL connectors to the external antenna over the 2:1-combiner is 3.33dB @ 850MHz and 4.43dB @ 1900MHz;
Rated Operating Voltage (V DC):	110V (Low) / 116V (Nominal) / 122V (Max), 360-800Hz
Rated Operating Temperature Range:	–10°C ~ +55°C
Co-located Transmitters/ Antennas?	■ Yes (all 4 cellular radio modules operate independently and may transmit simultaneously) ☐ No

Device Category:	■ Fixed Installation ☐ Mobile (mark mobile if both possible) ☐ Portable ☐ mixed Mobile and Portable
Exposure Category:	☐ Occupational/ Controlled ■ General Population/ Uncontrolled
Test Sample Status:	Prototype

3 Assessment

This RF Exposure evaluation report provides information about compliance of the below identified device with the RF Exposure limits for mobile devices as defined in FCC CFR Part 1 (1.1307 &1.1310), Part 2 (2.1091) and IC standard RSS-102 under given conditions (measured or rated RF output power, antenna gain, distance towards human body, multiple transmitter information as presented by the applicant).
In addition, maximum antenna gain or minimum distance towards the human body is calculated, respectively, where relevant.

The device meets the limits as stipulated by the above given FCC and IC rule parts based on available specifications and described use case.

Company	Description	Model #
Teledyne Controls	Wireless Groundlink® – Quick Access Recorder	2243800-362

Report reviewed by:

Date	Section	Name	Signature
2014-01-27	Compliance	Franz Engert (Test Lab Manager)	Digitally signed by Franz Engert DN: cn=Franz Engert, c=US, o=CETECOM, ou=Complience, email=franz.engert@cetecom.com Date: 2014.01.27 12:22:31 -08'00'

Responsible for the Report:

Date	Section	Name	Signature
2014-01-27	Compliance	Josie Sabado (Test Lab Manager)	

The test results of this test report relate exclusively to the test item specified in Section3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

4 RF Exposure Limits and FCC and IC Basic Rules

For the specific described radio apparatus the following basic limits and rules apply for both, FCC and IC where not indicated differently.

4.1 Maximum Permissible Exposure (MPE) Limits acc. to FCC 1.1310(e) / RSS-102, cl. 4.2:

Frequency Range (MHz)	Power density (mW/cm^2)	Averaging time (minutes)
300 – 1500	f (MHz) /1500	30 (IC:6)
1500 – 100.000 (IC:1500 – 150000)	1.0	30 (IC:6)

4.2 Routine Environmental Evaluation Categorical Exclusion Limits acc. to FCC 2.109(c) / RSS-102, cl. 2.5 (rounded to 1 decimal point):

Operating frequency < 1.5GHz: excluded if ERP < 1.5W / 31.8dBm (IC: 2.5W / 34.0dBm EIRP);
Operating frequency > 1.5GHz: excluded if ERP < 3.0W / 34.8dBm (IC: 5.0W / 37.0dBm EIRP);

4.3 EMC Output Power Limits (ERP/EIRP) acc. to FCC part 22/24/27 / IC RSS-132, RSS-133, RSS-139 (to be additionally taken into account for maximum antenna gain considerations)

part 22: 7W ERP / 38.5dBm (IC: 11.5W / 40.6dBm EIRP)
part 24: 2W EIRP / 33.0dBm
part 27: 1W EIRP / 30.0dBm

Per KDB 447498 D01 FCC allows calculative estimation of RF exposure for mobile applications when routine environmental evaluation categorical exclusion applies and also for fixed applications. When categorical exclusion can not be claimed for mobile applications MPE measurement is required for TCB approval.

RSS-102 of Industry Canada does generally not require RF exposure evaluation for fixed or mobile applications which stay below the given exclusion limits.

4.4 RF Exposure Estimation (MPE Estimation)

Having available the source based average output power and peak antenna gain or the ERP/EIRP of the specified device and for a known minimum distance of it's radiating structures from the body of persons according to it's use cases (at least 20cm) the power density at that distance can be estimated by the following formula for plane-wave equivalent conditions (far-field conditions), when ground reflection is neglected.

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density (mW/cm^2 or W/m^2)
P = power input to the antenna (mW or W)
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 (cm or m)

5 Evaluations

The following calculations are based on the the specified maximum conducted average output power of the cellular module incorporated in the EUT and thus – considering the given peak antenna gain of the documented antennae - resulting in the theoretical worst case maximum average ERP/EIRP, because all measured conducted average values are lower.

5.1 Routine Environmental Evaluation Applicability

Based on the theoretical maximum average ERP/EIRP as calculated from the specified maximum conducted average output power of the incorporated cellular module (PR, see below), plus the specified peak antenna gain, minus the loss of the cable and connectors between the module's RF output and the external antenna connector.

In addition source based time averaging over the TDMA multiframe is taken into account for GSM/EDGE operation as well as power contribution from simultaneously operating transmitters;

Pr is the declared (rated) conducted output power upper tune-up tolerance limit value (of the integrated cellular module);

Transmission Mode	**Pr**	**peak gain**	**attenuation (total cable & connector loss)**	**duty cycle**	**EIRP, source based time averaged (EIRPmax)**	**total EIRP simultaneous transmissions intra-band (worst cases only)**	**FCC & IC Limit for** Routine Environmental Evaluation Applicability, EIRP	**excluded?**
	dBm	dBi	dB	%	dBm	dBm	dBm	
GSM 850	33.0	2.0	-3.33	12.5	22.67	n.a.	33.9	yes
GPRS 850 1TS	33.0	2.0	-3.33	12.5	22.67	n.a.	33.9	yes
GPRS 850 2TS	33.0	2.0	-3.33	25	25.67	n.a.	33.9	yes
GPRS 850 3TS	**33.0**	**2.0**	-3.33	**37.5**	**27.37**	**33.37**	**33.9**	**yes**
GPRS 850 4TS	27.0	2.0	-3.33	50	25.35	n.a.	33.9	yes
EDGE 850 1TS	28.0	2.0	-3.33	12.5	17.67	n.a.	33.9	yes
EDGE 850 2TS	28.0	2.0	-3.33	25	20.67	n.a.	33.9	yes
EDGE 850 3TS	28.0	2.0	-3.33	37.5	22.37	n.a.	33.9	yes
EDGE 850 4TS	28.0	2.0	-3.33	50	23.67	n.a.	33.9	yes
WCDMA Bd V	24.0	2.0	-3.33	100	22.67	n.a.	33.9	yes
GSM 1900	30.0	2.0	-4.4	12.5	12.6	n.a.	36.9	yes
GPRS 1900 1TS	30.0	2.0	-4.4	12.5	12.6	n.a.	36.9	yes
GPRS 1900 2TS	30.0	2.0	-4.4	25	15.6	n.a.	36.9	yes
GPRS 1900 3TS	30.0	2.0	-4.4	37.5	23.3	n.a.	36.9	yes
GPRS 1900 4TS	26.0	2.0	-4.4	50	20.6	n.a.	36.9	yes
EDGE 1900 1TS	28.0	2.0	-4.4	12.5	16.6	n.a.	36.9	yes
EDGE 1900 2TS	28.0	2.0	-4.4	25	19.6	n.a.	36.9	yes
EDGE 1900 3TS	28.0	2.0	-4.4	37.5	21.3	n.a.	36.9	yes
EDGE 1900 4TS	28.0	2.0	-4.4	50	22.6	n.a.	36.9	yes
WCDMA Bd II	24.0	2.0	-4.4	100	21.6	n.a.	36.9	yes

* worst case: simultaneous transmission of all 4 cellular module with GPRS 850MHz 3TS.
Summing up the worst case max output powers provides a conservative estimate.

Result: The equipment is categorically excluded from Routine Environmental Evaluation, also for the worst case of simultaneous transmission all incorporated transmitters with the highest output power mode.

5.2 Compliance with MPE (Power Density) limits

Limits:
Smax @ 824MHz = 0.55mW/cm^2 (824MHz is worst case as lowest operating frequency in the cellular band);
Smax @ 1900MHz = 1.0mW/cm^2;

The highest source base time averaged EIRPmax per band calculated with the rated peak antenna gain values are taken from the table in section 5.1 above;
The highest power density is resulting from the formula: $S = EIRPmax / 4*\pi*r^2$;
The power density is calculated for the minimum distance r = 20cm;

Highest source base time averaged EIRP with GPRS 850 MHz, 3TS, single transmitter: 27.37dBm;
Resulting maximum power density at 850MHz: **S(850MHz) = 0.109mW/cm^2**

Highest source base time averaged EIRP with GPRS 850 MHz, 3TS, 2 simultaneous transmisions, accumulated EIRP: 33.37dBm;
Resulting maximum power density at 850MHz: **S(850MHz) = 0.432mW/cm^2**

Highest source base time averaged EIRP with GPRS 1900 MHz, 3TS, single transmitter: 21.3dBm;
Resulting maximum power density at 1900MHz: **S(1900MHz) = 0.027mW/cm^2**

Result: The equipment fulfills the MPE limits for the minimum distance between the antenna and the human body of 20cm, for the rated peak antenna gain and also for the worst case of simultaneous transmission of all 4 transmitters within the same band.

5.3 Simultaneous Transmission MPE Test Exclusion (per KDB 447498 D01)

According to the manufacturer the 4 identical cellular radio modules incorporated within the device operate independently from each other. From this a theoretical worst case of simultaneous transmission of all 4 transmitters with the highest output power mode (GPRS 850MHz with 3 timeslots in uplink) within the same band is assumed, although this is very unlikely to happen in reality.

Highest power density to the limit ratio for 850MHz: 0.109mW/cm^2 / 0.55mW/cm^2 = **0.198**

Σ of Power Density (MPE) ratios = 4 x 0.198 = 0.79 < 1

Result: The equipment is excluded from simultaneous transmission MPE test.

6 Revision History

Date	Change Description	Revision
2014-01-08	n.a.	initial
2014-01-27	Amendments reg. limits and rules in section 4; Corrections due to presentation of additional output power information excluding the product from rf exposure routine evaluation;	Rev. 1