



Radio Frequency Exposure Evaluation Report

for

3SI Security Systems

Model: AT140704US

Asset Tracking and Alert Device

FCC ID: Q6KAT140704A

IC Certification Number: 5043A-AT140704A

Applied Rules and Standards

**CFR Part Part 1 (1.1307 &1.1310), Part 2 (2.1091),
FCC KDB 447498 D01 General 24 RF Exposure Guidance v05r02**

Industry Canada RSS-102, Issue 4 of March 2010

Report number: EMC-3SISE-038-14001-ATM_MPE_Rev0

DATE: 2014-12-03

1 Administrative Data

1.1 Identification of the Testing Laboratory Issuing the Test Report

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Acting Test Lab Manager	Franz Engert

1.2 Identification of the Client / Manufacturer

Applicant's Name:	3SI Security Systems
Street Address:	2055 N Brown Road, ste 225, Lawrenceville
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Country	USA
Contact Person:	Waldemar Sierocinski
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2 Equipment under Assessment

Marketing Name / Description:	Asset Tracking and Alert Device
Model Number:	AT140704US
FCC-ID :	Q6KAT140704A
IC Cert Number:	5043A-AT140704A
Product Description:	Asset Tracking and Alert Device equipped with 3G cellular radio module, beacon radio and GPS
Transmitter information:	<ol style="list-style-type: none"> 3G cellular radio module: Telit, model UE910-NAD, FCC-ID: RI7UE910NA, IC ID: 5131A-UE910NA, GSM 850/1900MHz, GPRS / EDGE multi-slot class 12/33 operation WCDMA / HSPA+ 850/1900/ MHz; 216.475 MHz / 219.6 MHz* / Beacon (US only), pulsed CW at 20% duty cycle; GPS 1575.42 MHz;
Co-located Transmitters/ Antennas?	<input checked="" type="checkbox"/> Yes (Cellular and Beacon) <input type="checkbox"/> No
Device Category:	<input checked="" type="checkbox"/> Fixed Installation <input type="checkbox"/> Mobile <input type="checkbox"/> Portable <input type="checkbox"/> mixed Mobile and Portable
Exposure Category:	<input type="checkbox"/> Occupational/ Controlled <input checked="" type="checkbox"/> General Population/ Uncontrolled
Antenna info w. rated gain:	<i>cellular internal:</i> inverted F Antenna, 850MHz: -6.8 dBi, 1900MHz: -1.9 dBi <i>cellular external:</i> Model: AU-3S-GSM of San Jose Technology Inc., 1 dBi, attenuation of 3m RG-174 antenna cable: ca. 3 dB; <i>beacon (pcb loop):</i> < - 10 dBi;
Rated Operating Voltage Range:	Vmin: 3.4V - Vmax: 4.2V
Rated Operating Temperature Range:	Tmin: -20°C/ Tmax: 60°C
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 or fixed 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.

Company	Description	Model #
3SI Security Systems	Asset Tracking and Alert Devices	AT140704US

Report reviewed by:

2014-12-03 Compliance Franz Engert
 (Compliance Manager)

Date	Section	Name	Signature
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Responsible for the Report:

2014-12-03 Compliance James Donnellan
 (Sr EMC Engineer)

Date	Section	Name	Signature
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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 cannot 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/cm² or W/m²)
 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 – for the portion of the cellular transmitter - based on the specified maximum conducted average output power of the cellular module incorporated in the EUT and thus – considering the peak antenna gain of the specified external antennae and the attenuation of the antenna cable - 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, see above.

Pmax is the target conducted output power plus the upper tolerance as specified for the integrated cellular module for the diverse transmission modes .

For the beacon transmitter the maximum output power value is taken from the relevant part 90 and part 95 emc reports being part of the exhibits filed for FCC/IC certification of this product;

Only the known worst cases with highest resulting average EIRP are listed per band.

Transmission Mode	Pmax (Target Power + Upper Tolerance)	Peak Gain + cable attenuation	Duty Cycle	EIRP, source based time averaged (EIRP _{max})	Total EIRP simultaneous transmissions intra-band (worst cases only)	FCC & IC Limit for Routine Environmental Evaluation Applicability, EIRP	Excluded?
	dBm	dBd	%	dBm	dBm	dBm	
GPRS 850 1TS	32.5+1	-2dBd	12.5	22.5	n.a.	33.9	yes
GPRS 850 2TS	32.5+1	-2dBd	25	25.5	n.a.	33.9	yes
GPRS 850 3TS	32.5+1	-2dBd	37.5	27.2	n.a.	33.9	yes
GPRS 850 4TS	32.5+1	-2dBd	50	28.5	n.a.	33.9	yes
WCDMA Bd V	23+1	-2dBd	100	22.0	n.a.	33.9	yes
GPRS 1900 1TS	29.5+1	-2dBd	12.5	19.5	n.a.	36.9	yes
GPRS 1900 2TS	29.5+1	-2dBd	25	22.5	n.a.	36.9	yes
GPRS 1900 3TS	29.5+1	-2dBd	37.5	24.2	n.a.	33.9	yes
GPRS 1900 4TS	29.5+1	-2dBd	50	25.5	n.a.	36.9	yes
WCDMA Bd II	23+1	-2dBd	100	22.0	n.a.	36.9	yes
Beacon				< - 6.0	n.a.	36.9	yes

highest powers within bands in bold letters;

Result: The transmitters in the equipment are categorically excluded from Routine Environmental Evaluation. There are no intra-band co-transmissions possible in the device.

Also, the beacon transmitter can be neglected for simultaneous transmission considerations due to it's very low output power.

5.2 Compliance with MPE (Power Density) limits

Limits:

S_{max} @ 824MHz = 0.55mW/cm² (824MHz is the worst case as lowest operating frequency in the cellular band);

S_{max} @ 1900MHz and @ 2400MHz = 1.0mW/cm²;

Taking the highest source base time averaged EIRP_{max} per band according to the table in section 5.1 above, applying the plane wave power density formula: $S = \text{EIRP}_{\text{max}} / 4 \cdot \pi \cdot r^2$ for the minimum distance of $r = 20\text{cm}$:

Highest source base time averaged EIRP with GPRS 850 MHz, 4TS: **28.5 dBm**;

Resulting maximum power density at 850MHz: **S(850MHz) = 0.14 mW/cm²**

Highest source base time averaged EIRP with GPRS 1900 MHz, 4TS: **25.5 dBm**;

Resulting maximum power density at 1900MHz: **S(1900MHz) = 0.07 mW/cm²**

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.

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

n.a. due to very low power of beacon transmitter.

5.4 Maximum allowed Antenna Gain - G_{max}

The maximum antenna gain to comply with the RF exposure limits as given in section 4 is provided through either

- the formula **G_{max}(RF_{exp}) = S_{max} * 4 * π * r² / P_{avg}**
- or
- by the maximum ERP/EIRP limits as per FCC parts 22/24/27 and RSS-132/133/139

respectively, whichever results in the lower gain value for the frequency band under consideration.

The maximum gain consideration is limited to the cellular transmitter in the device.

- r = distance between antenna and body (here: minimum for mobile and fixed applications = 20 cm);
- $G_{\text{max}}(\text{RF}_{\text{exp}})$ = max allowed peak gain to fulfil RF exposure limit;
- $G_{\text{max}}(\text{eirp})$ = max allowed peak gain to fulfil FCC and IC ERP/EIRP limits
- G_{max} = resulting maximum allowed gain (lower of $G_{\text{max}}(\text{RF}_{\text{exp}})$ and $G_{\text{max}}(\text{eirp})$)
- S_{max} = power density limit, see section 4;
- P_r = declared (rated) conducted output power upper tune-up tolerance limit value (of the integrated cellular module); antenna cable attenuation is not separately considered for this calculation;
- P_{avg} = P_r minus duty cycle factor; for duty cycle factor see table under section 5.1;

5.4.1 Result

Transmission Mode	Smax	Pr	Pavg	Gmax (RFexp)	FCC p22/24/27, RSS-132/133/139 EIRP limit	Gmax (eirp) (EIRP limit minus Pr)	Gmax (for r=20cm)
	mW/c m ²	dBm	dBm	dB	dBm	dB	dB
GPRS 850 1TS	0.55	32.5+1	24.5	9.92	40.6	7.1	3.92
GPRS 850 2TS	0.55	32.5+1	27.5	6.92	40.6	7.1	
GPRS 850 3TS	0.55	32.5+1	29.2	5.22	40.6	7.1	
GPRS 850 4TS	0.55	32.5+1	30.5	3.92	40.6	7.1	
WCDMA Bd V	0.55	23+1	24.0	10.42	40.6	16.6	
GPRS 1900 1TS	1.0	29.5+1	21.5	15.51	33	2.5	2.50
GPRS 1900 2TS	1.0	29.5+1	24.5	12.51	33	2.5	
GPRS 1900 3TS	1.0	29.5+1	26.2	10.81	33	2.5	
GPRS 1900 4TS	1.0	29.5+1	27.5	9.51	33	2.5	
WCDMA Bd II	1.0	23+1	24.0	13.01	33	9.0	

EDGE is not considered since it has always lower power than the GPRS GMSK mode.
 GSM 850 / GSM 1900 is actually the same mode as GPRS 850 and 1900 with.
 Antenna cable attenuations are not taken into account for the maximum gain calculations in this above table.

5.4.2 Summary

Maximum cellular antenna gain at 850MHz to meet the power density limit at 20cm distance is: **3.92 dBi**;
Maximum cellular antenna gain at 1900 MHz to meet the EIRP limit of 2W is: **2.5 dBi**;

6 Revision History

Date	Report Name	Changes to report	Report prepared by
2014-12-03	EMC-3SISE-038-14001-ATM_MPE	First official version	James Donnellan