



MSA Safety

G1 SCBA made with Type 3 alternate power module installed

FCC 1.1307:2022

Bluetooth

LRR

RFID

Report: F3EN0124.0 Rev. 1, Issue Date: November 17, 2022



CERTIFICATE OF EVALUATION

Last Date of Evaluation: November 17, 2022

MSA Safety

EUT: G1 SCBA made with Type 3 alternate power module installed

RF Exposure Evaluation

Standards

Specification	Method
FCC 1.1307:2022	FCC 1.1307:2022

Results

Method Clause	Description	Applied	Results	Comments
(b)(3)(ii)(B)	Exemption From RF Exposure Evaluation	Yes	Pass	The G1 requires a minimum 1.4 cm separation distance.

Deviations From Evaluation Standards

None

Approved By:



Donald Facteau, Process Architect

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing

REVISION HISTORY



Revision Number	Description	Date (yyyy-mm-dd)	Page Number
01	Report was recalculated with 4 dBi gain for the LRR antenna.	2022-11-17	2, 8-10

ACCREDITATIONS AND AUTHORIZATIONS



United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Each laboratory is accredited by A2LA to ISO / IEC 17025, and as a product certifier to ISO / IEC 17065 which allows Element to certify transmitters to FCC and IC specifications.

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

European Union

European Commission – Recognized as an EU Notified Body validated for the EMCD and RED Directives.

United Kingdom

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Australia/New Zealand

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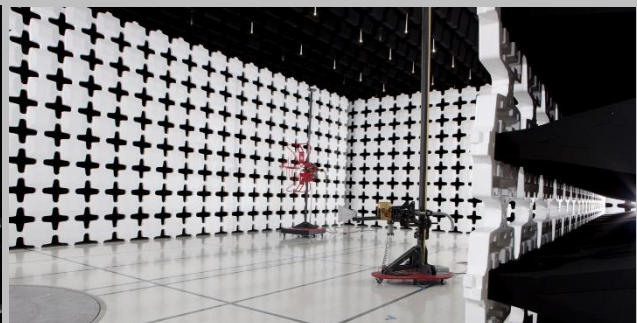
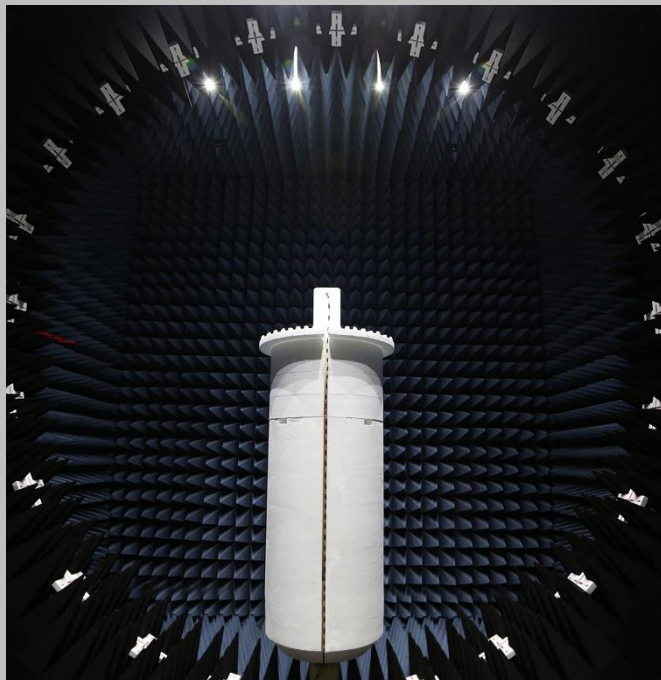
[Texas](#)

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FACILITIES



California Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Minnesota Labs MN01-11 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Oregon Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Texas Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Washington Labs NC01-05 19201 120 th Ave NE Bothell, WA 98011 (425)984-6600
A2LA				
Lab Code: 3310.04	Lab Code: 3310.05	Lab Code: 3310.02	Lab Code: 3310.03	Lab Code: 3310.06
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRR, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157



PRODUCT DESCRIPTION

Client and Equipment Under Evaluation Information

Company Name:	MSA Safety
Address:	1100 Cranberry Woods Road
City, State, Zip:	Cranberry Township, PA 16066
Evaluation Requested By:	Clint Fleming at MSA Safety and Dustin Morris at F3 Wireless
EUT:	G1 SCBA made with Type 3 alternate power module installed
Date of Evaluation:	11/17/2022

Information Provided by the Party Requesting the Evaluation

Functional Description of the Equipment:

The G1 self-contained breathing apparatus (SCBA), sometimes referred to as a compressed air breathing apparatus (CABA) or simply breathing apparatus (BA), is a device worn to provide breathable air in an atmosphere that is immediately dangerous to life or health, typically worn by Fire Fighters.

Radios:

Bluetooth - Used to update and configure the SCBA. Used to transmit voice. The Bluetooth module is no less than 63.9 mm from the user. (FCC ID: P9R-2564C)

RFID - Used to configure the SCBA - Distance to body ~59 mm. (FCC ID: P9R-10154953)

Optional - Sub-GHz Radio - This is used to transmit SCBA status information to a remote base station. It is 59.8 mm from the body. (FCC ID: RPN-10184341)

Max End Product Dimensions:

Height: 23.5 inch

Width: 10.75 inch

Depth: 6.5 inch to 10 inch depending on cylinder size.

Objective:

To demonstrate compliance with FCC Requirements for RF exposure for 1.1307 RF exempt devices

RF EXPOSURE CONDITION

The following RF Exposure conditions were used for the assessment documented in this report:	
Intended Use	Portable
Location on Body (if applicable)	Head/Torso
How is the Device Used	The G1 is used at a distance of less than 20 cm from the user.
Radios Contained in the Same Host Device	Bluetooth LRR RFID
Simultaneous Transmitting Radios	Bluetooth, LRR, RFID
Body Worn Accessories	None
Environment	General Population/Uncontrolled Exposure

EXEMPTION FROM RF EXPOSURE EVALUATION

OVERVIEW

With respect to the limits on human exposure to RF emissions provided in 47 CFR §1.1310, if equipment can be shown to qualify for an exemption pursuant to 47 CFR §1.1307(b)(3), an evaluation is not required.

COMPLIANCE WITH FCC 1.1310

Per 1.1307(b)(3), (i) 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): A single RF source is exempt if:

- (A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);
- (B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th}(mW) = \begin{cases} ERP_{20\text{ cm}}(d/20\text{ cm})^x & d \leq 20\text{ cm} \\ ERP_{20\text{ cm}} & 20\text{ cm} < d \leq 40\text{ cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\text{ cm}}\sqrt{f}}\right) \text{ and } f \text{ is in GHz};$$

And

$$ERP_{20\text{ cm}}(mW) = \begin{cases} 2040f & 0.3\text{ GHz} \leq f < 1.5\text{ GHz} \\ 3060 & 1.5\text{ GHz} \leq f \leq 6\text{ GHz} \end{cases}$$

- (C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

TABLE 1 TO §1.1307(b)(3)(i)(C)—SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$.
1.34-30	$3,450 R^2/f^2$.
30-300	$3.83 R^2$.
300-1,500	$0.0128 R^2 f$.
1,500-100,000	$19.2 R^2$.

EXEMPTION FROM RF EXPOSURE EVALUATION

(ii) For multiple RF sources: Multiple RF sources are exempt if:

- (A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).
- (B) in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Where:

a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(B) of this section for P_i , including existing exempt transmitters and those being added.

b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.

c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).

$P_{th,i}$ = the exemption threshold power (P_n) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i .

ERP_j = the ERP of fixed, mobile, or portable RF source j .

$ERP_{th,j}$ = exemption threshold ERP for fixed, mobile, or portable RF source j , at a distance of at least $\lambda/2\pi$ according to the applicable formula of paragraph (b)(3)(i)(C) of this section.

$Evaluated_k$ = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.

$Exposure Limit_k$ = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k , as applicable from §1.1310

The relationship between EIRP and ERP is:

$$ERP \text{ (dBm)} = EIRP \text{ (dBm)} - 2.14 \text{ dB}$$

Where EIRP is the sum of the conducted power (dBm) and the antenna gain (dBi).

EXEMPTION FROM RF EXPOSURE EVALUATION



ASSESSMENT

Radio	Transmit Frequency (MHz)	Conducted Output Power	Power Tolerance (dB)	Duty Cycle	Antenna Assembly Gain (dBi)	Minimum Separation Distance (cm)	Calculated Radiated Exposure Power (mW) ERP	Calculated Conducted Exposure Power (mW) dBm	Limit (mW)	Ratio
RFID	13.56	23 dBm	0.0	100.0%	0*	1.4	121.7	199.5	443**	0.45
Max Ratio										0.45

* 0 dBi was used as a worst case. The actual gain of a small loop antenna is much less than 0 dBi.

** This limit is from April 27, 2022 TCB Workshop, equation 4.3.1 c)

The information in the table above was obtained from:

The rated value was used in these calculations. Customer supplied information and Washington Laboratories report 13432-01 Rev 2.

Radio	Transmit Frequency (MHz)	Conducted Output Power	Power Tolerance (dB)	Duty Cycle	Antenna Assembly Gain (dBi)	Minimum Separation Distance (cm)	Calculated Radiated Exposure Power (mW) ERP	Calculated Conducted Exposure Power (mW) dBm	Limit (mW)	Ratio
LRR	902	26.89 dBm	N/A	0.6%	4	1.4	4.5	2.9	37.5	0.12
Max Ratio										0.12

The information in the table above was obtained from:

The rated value was used in these calculations. Customer supplied information and Eurofins report G0M-1708-6813-TFC091ME-V01.

Radio	Transmit Frequency (MHz)	Conducted Output Power	Power Tolerance (dB)	Duty Cycle	Antenna Assembly Gain (dBi)	Minimum Separation Distance (cm)	Calculated Radiated Exposure Power (mW) ERP	Calculated Conducted Exposure Power (mW) dBm	Limit (mW)	Ratio
Bluetooth	2402	8.65 dBm	N/A	100.0%	0.8	1.4	5.4	7.3	19.7	0.37
Max Ratio										0.37

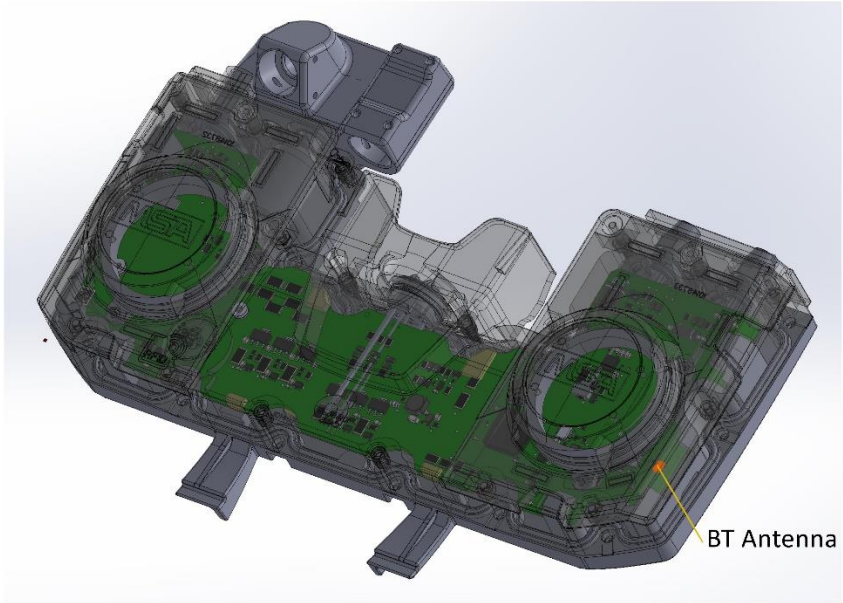
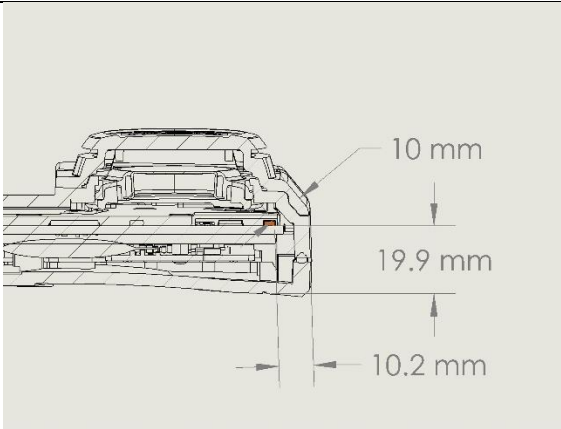
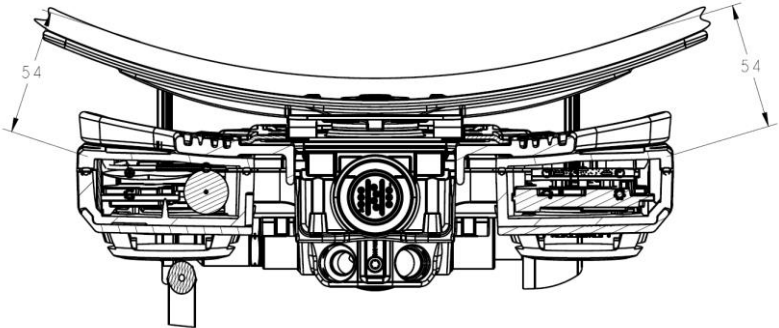
The information in the table above was obtained from:

The rated value was used in these calculations. Customer supplied information.

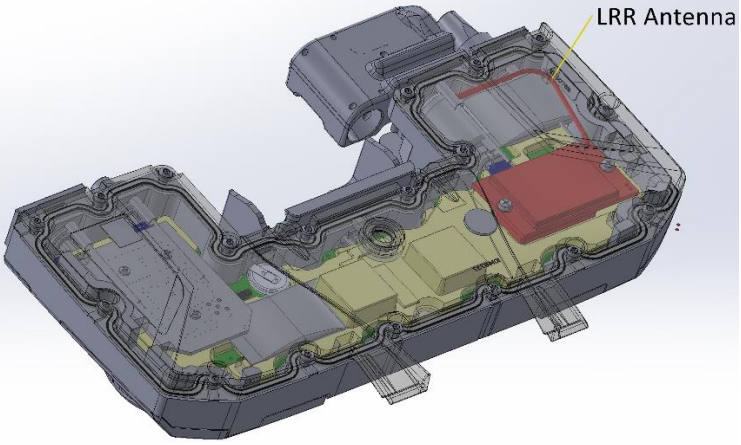
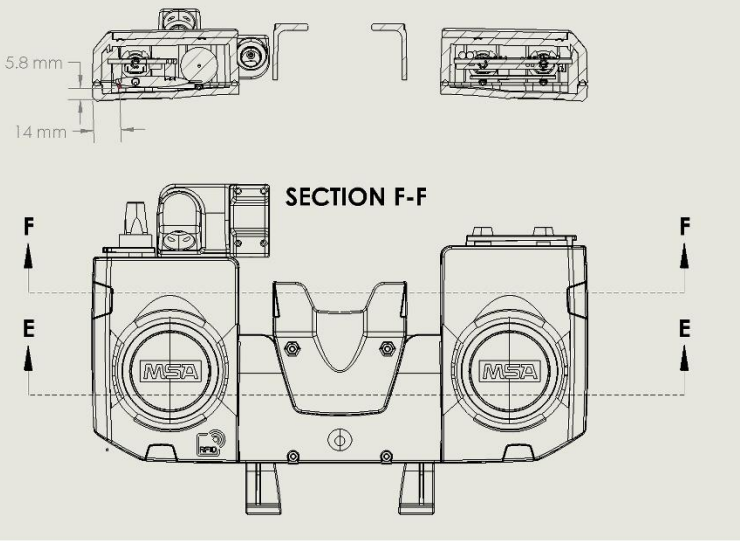
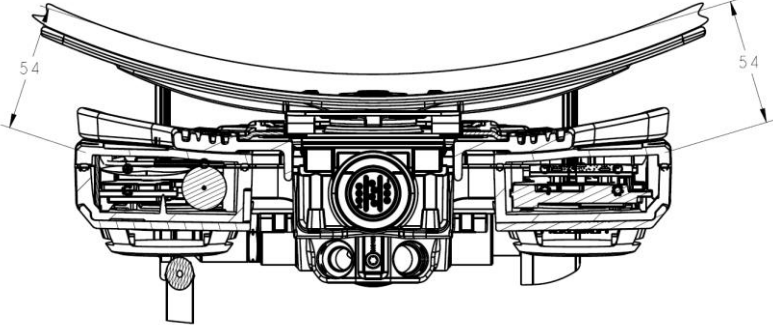
Sum of Maximum Ratios	Limit	Compliant
1.00	1	Yes

Evaluator: Jay Whitworth

Total distance from G1 Bluetooth Antenna to User: 63.9mm

	
19.9 mm from Bluetooth Antenna to Power Module Enclosure	
54 mm from Power Module enclosure to user	

Total distance from G1 Long Range Radio to User: 59.8 mm:

	
<p>5.8 mm from Bluetooth Antenna to Power Module Enclosure</p>	
<p>54 mm from Power Module enclosure to user</p>	

VC-Timing

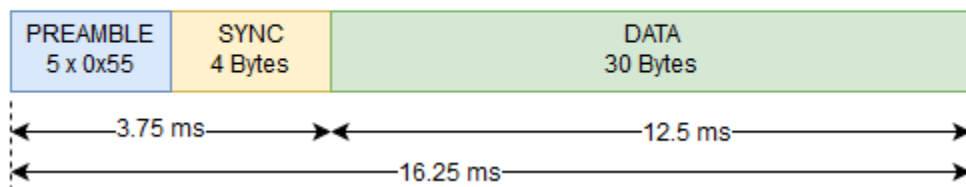
US VC-Timing

The following diagram shows the timing constraints for the Rx/Tx cycle. After reception of a packet (Rx), the transmission of the reply (Tx) must occur within the 50 ms time frame.

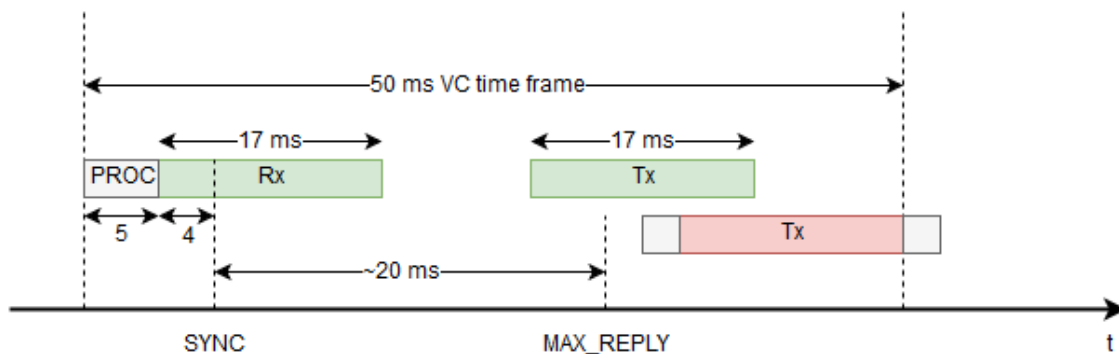
If that time frame is exceeded, the base will not properly receive the packet, or the transmission will even collide with the next base transmission.

LRR data frame format and transmission time

2-(G)FSK, 19.2 kbaud



The transmission time for a packet with a size of 30 bytes and a baud rate of 19.2 kbaud (=19.2 kbit/s with 2-FSK) can be calculated as 12.5 ms. The preamble and sync word consist of 9 bytes (5 sync, 4 preamble) and they contribute another 3.75 ms transmission time. The overall packet transmission time can be specified as 17 ms.



If we set the **MAX_REPLY** time, measured from the SYNC event to **no larger than 20 ms**, then we have a buffer of 4 ms until the end of our VC time frame ($5 + 4 + 20 + 17 - 50 = -4$).

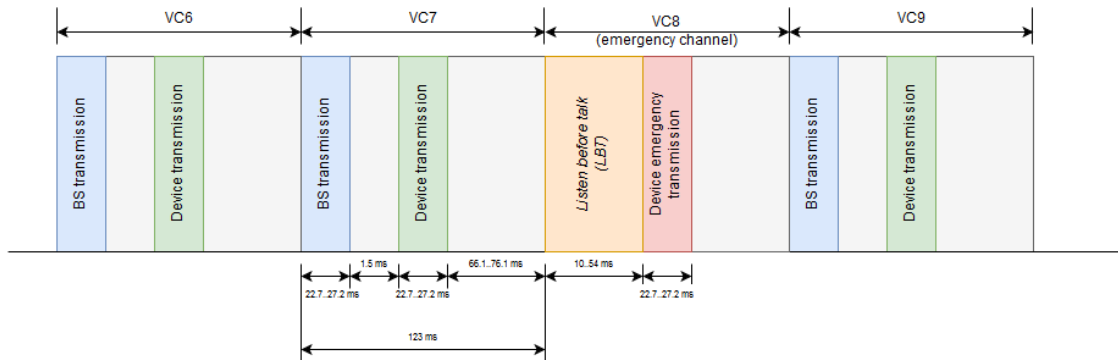
Note: "PROC" in the above diagram symbolises some processing time of the base station, which was measured experimentally. Note 2:

- VC 54 is the base info VC that sends "base full" information if more than 50 devices are logged on. It is therefore not allocatable.

Timing

The following diagram shows the timeslots used in the TDMA scheme.

The base station (BS) initiates a VC by transmitting a data packet. This triggers the device to transmit a response in the time window afterwards.



Duty Cycle Calculation for Long Range Radio:

Duty Cycle:

- 16.25 ms every 3.2 seconds
- 16.25 % worse case in any 100 ms window
- $16.25 / 3200 = 0.51\%$ averaged

End of Test Report