



October 7, 2012

Federal Communications Commission
7435 Oakland Mills Road
Columbia, MD 21046

Ref: Eterna Maximum Duty Cycle over a 100 ms window

Dear Examiner,

Dust radios operate on a TDMA time schedule consisting of a continuous sequence of a minimum of 7.25 ms timeslots. In each timeslot radio's will do one of the following:

- 1) Remain inactive
- 2) Transmit a packet and potentially receive an acknowledge
- 3) Potentially receive a packet and transmit an acknowledge

When transmitting a packet, transmission duration during a timeslot varies as a function of the payload, with a maximum of 128 bytes. When receiving a packet the transmitted acknowledgement will be a maximum of 27 bytes. During network operation radios receive three times, for every transmit slot, and as a result the maximum possible duty cycle is created with the following sequence:

- 1) Transmit
- 2) Acknowledge
- 3) Acknowledge
- 4) Acknowledge
- 5) Transmit
- 6) Acknowledge
- 7) Acknowledge
- 8) Acknowledge
- 9) Transmit
- 10) Acknowledge
- 11) Acknowledge
- 12) Acknowledge
- 13) Transmit

A radio transmit consists of 4 stages:

- 1) Initialization: radio is prepared for transmit (transmitter is off)
- 2) Ramp up: transmitter is ramped to peak power
- 3) Transmit: from 0 to 128 bytes of data maximum + 5 bytes preamble/SFD
- 4) Ramp down: radio transmitter is turned off,

Where the data rate is 250 kbps +/- 40 ppm, or 32 us/byte.

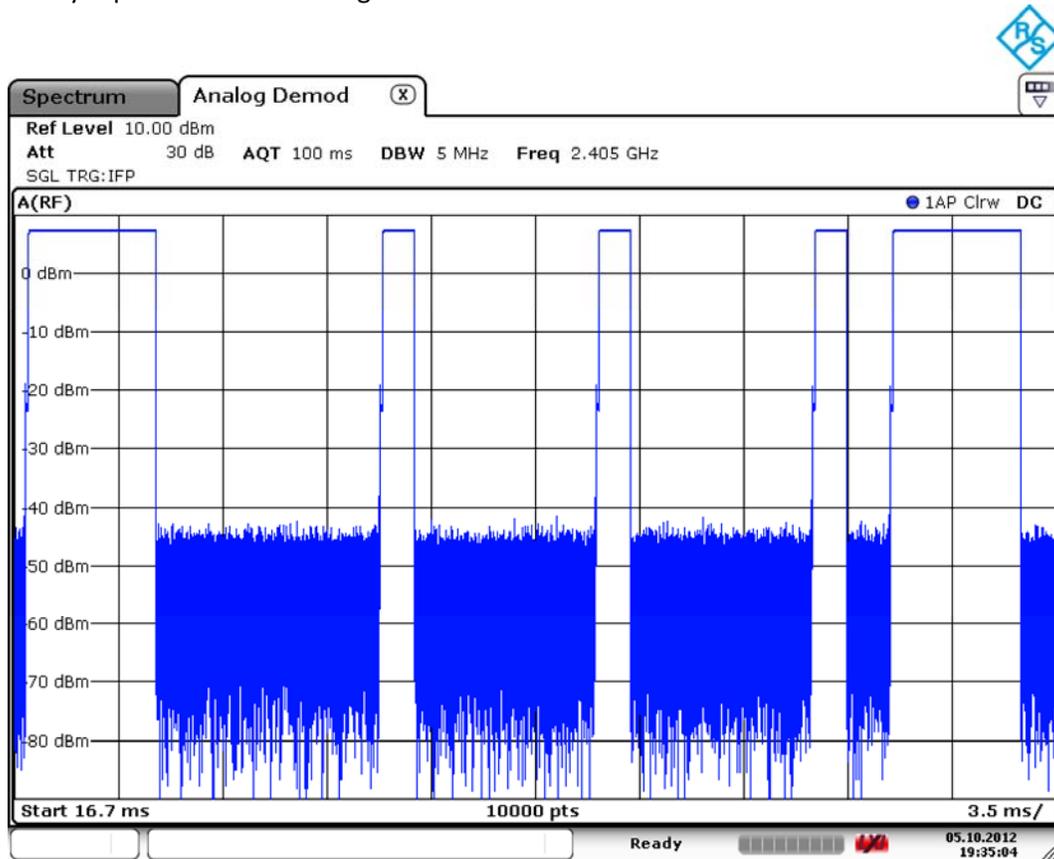
Ramp up and ramp down of the takes 77 us. Given the frequency of the messages the maximum duty time the radio can be transmitting over a 100 ms is:

$$\begin{aligned}
 \text{Max Tx on} &= 4 * \text{Transmit [128 bytes]} + 12 * \text{Acknowledge} \\
 &= 4 * [(128+5) * 32\text{us} + 77\text{us}] + 9 * [(24+5) * 32\text{us} + 77\text{us}] \\
 &= 4 * [4.333 \text{ ms}] + 12 * [1.101 \text{ ms}] \\
 &= 27.241 \text{ ms}
 \end{aligned}$$

Maximum duty cycle is therefore:

$$27.241 \text{ ms on} / 100 \text{ ms} = 27.241 \%$$

For reference a zero span capture of a 128 byte packet followed by three acknowledges and a 2nd 128 byte packet is shown in Figure 1:.



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Figure 1: Eterna Radio Timeslot transmission sequence Tx, Ack, Ack, Ack, Tx

Sincerely yours,

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