Reference: Response to ATCB Questions on SR-640-101 (KL7-600R-V2)
Date: September 30, 2002
From: Rod Thorne, Savi Technology

With respect to the issues raised in your recent correspondence, please find our responses inserted after each of your questions.

*1) Please explain the purpose of 2 identical transmitters in the unit. The theory of operation does not bring up this issue. Are they ever expected to transmit at the same time? If so, how does this affect the measurements made?*

Two separate antennas are connected to identical transmitter and receiver circuits. They are both polarized horizontally, but perpendicular to each other in the azimuthal plane to cover a 360-degree arc. They never transmit at the same time.

Receiver circuits for both polarizations are enabled continuously, and the unit with the stronger RSSI (Received Signal Strength Indication) is selected for data processing.

The transmitter functions are time shared between the two antennas in the following manner:

a. For the Wake-up function, transmission is performed on one antenna for less than 2.5 seconds, followed by transmission on the second antenna for less than 2.5 seconds, with a total transmission under 5 seconds, as in 15.231(a).
b. Hello and Sleep commands are transmitted alternately on the two antennas, alternating packet by packet.

*2) It appears that the data/control signals measured were higher than the wakeup signal. Was this expected since the reports states that the wakeup signals was to meet 15.231(a), while the data/control was to meet 15.231(e)?*

Although the Wakeup Signal is classified as a command signal with a duration of under 5 seconds per 15.231(a), its peak amplitude is purposely reduced relative to the Hello and Sleep commands to restrict the range of responding tags and ensure that they can be controlled by Hello and Sleep.

Further, the Wake-Up signal is not pulsed and so the peak and average levels of this signal are not significantly different. The Hello and Sleep commands are pulsed, with a duty cycle of 10%, so the peak and average levels are significantly different. Although it was not measured, the average value of the Wake-Up signal would be approximately 4-6dB higher than that of the Hello and Sleep commands.

It was found that Hello and Sleep have satisfactory range at the lower power levels used for data (per 15.231(e)). The only reason for classifying the Wakeup Signal as 15.231(a) is to permit the use of the longer transmission, which allows the Tag receiver to conserve battery power by sampling less frequently.

*3) The theory of operation provided information with respect to meeting the requirements of 15.231(a) & 15.231(e). In specific please address the following concerns:*

*a) The information is somewhat ambiguous in relation to the hello and sleep transmission. The information supplied shows that this does transmission does not last longer than 5 seconds. However, does this 5 second limitation always exist, no matter how many tags respond (given that only a certain number of responses will occur in the 5 second window? Please explain*

The Hello & Sleep transactions with responding tags are automatically limited to 5 seconds of transmission. Any tags which are not put to sleep during that time will be flagged in the log of those responding. The operator must initiate a second transaction, also limited to 5 seconds, in order to process such stragglers. Alternatively, an automated command will be initiated over the network.

*b) Please give an explanation on how long tags usually take to respond given the anti-collision algorithm. Also, what is the anticipated time that the EUT takes between the wake up command and "hello/sleep" transmissions.*

After receiving the Hello command, tags respond by transmitting their ID in one of up to 255 randomly selected time slots of 57 msec width each. The anti-collision algorithm determines the slot number for each tag based on its ID number and internal clock counter, with a random increment to spread the transaction uniformly over the interval. The average tag response time after receiving a Hello is then half of the interval time. This can range from 28.5 msec up to several seconds. (Note: the duration of the tag ID packet is 9.44 msec.) The duration between the end of the WakeUp transmission and the beginning of the Hello/Sleep transmission is a random delay depending on the anti-collision algorithm. It ranges from about 60 msec to several seconds.

*c) Earlier versions of the EUT also had an additional type of transmissions in the case that some tags do not respond. Please explain if this device has this and if so, please provide detail on this transmission classification, plots, etc.*

A previous product stated that an Alarm Condition would be declared under the definition of 15.231(a,4) in the event that not all tags responded. Such a condition would permit EUT transmission to re-try until the alarm was cleared. In practice, this mode was not found essential to operation, and was deleted from the current model.