APPLICATION NOTE

Confidex Survivor B™

This application note for Confidex Survivor B™ gives an insight to features that are available. For further information, please refer to the tag integrated circuit (IC) datasheet of EM4325 that is available on the following web page: http://www.emmicroelectronic.com Also trouble shooting information is provided in this guide for certain known cases.

PASSIVE / BATTERY ASSISTED PASSIVE OPERATION

Passive operation

The Confidex Survivor B™ can be set to operate in passive mode, and then it then operates as specified in EPCGlobal Class 1 Gen2 (ISO 18000-6C). Most of the special features of the IC EM4325 are not available, and the theoretical read range is only 3-5 meters. However, temperature can be measured, but not monitored in the passive mode. When the battery life time is exceeded, the tag will continue operating as a passive tag.

Battery assisted passive (BAP) operation

All the special features of the EM4325 are available when the tag is turned to BAP mode. The tag is EPCGlobal Class 3 Gen2 (ISO 18000-63 and 18000-64) compliant. Features in the BAP mode include temperature measuring, temperature monitoring, boosted read ranges up to 60 m and read range adjustment.

CUSTOM COMMANDS

Description

There are many custom commands implemented and they enable quick access to the tag Unique ID, reading temperature and to reset alarm conditions. All configuring tasks are available also by memory block writing and reading. To be able to use custom commands, suitable reader and software have to be used.

MEMORY BLOCK READING AND WRITING

Equipment and software to start with

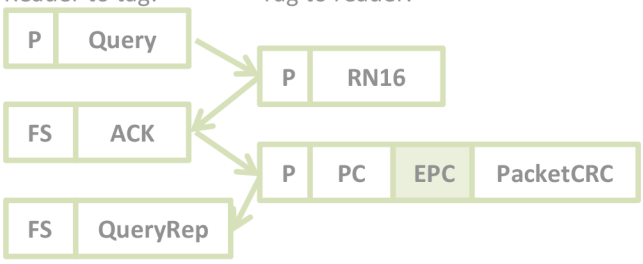
All EPCGlobal Gen2 readers should be suitable, but they all do not yet support certain parts of the EPC global Gen2 specification. Thus there might be problems to e.g. write in certain areas of memory, and there might be extended protocol control (XPC) be shown in front of the EPC code.

NordicID readers (e.g. Stix) with NordicID demo software version v119 are proven to operate correctly. The specific software can be requested from NordicID or from Confidex. From hand held readers e.g. Motorola 9190 with firmware 2.2.5009 is compatible from the XPC word point of view. More information about suitable readers and their softwares can be requested from EM Microelectronics or from Confidex.

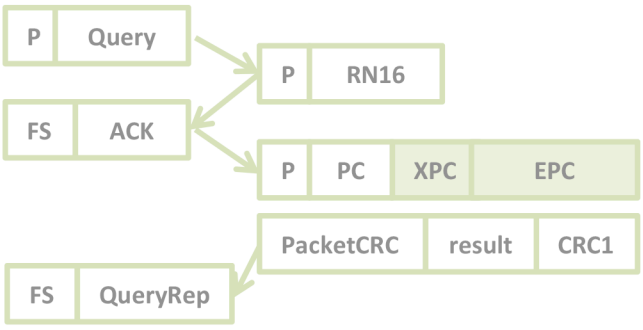
Known reader issue

EPCGlobal Gen2 specification describes two alternative tag replies for a tag, XI=0 and XI=1. Conventionally passive tags use XI=0 reply, but Survivor B uses the XI=1 reply. Readers should support both, but especially older readers with their softwares do not support the XI=1 replying format. Thus they result in a meaningless response. The two different one tag reply formats are illustrated below, shortening explanations can be found from EPC global Gen2 Specification, Figure 6.32.

XI=0 one tag reply:



XI=1 one tag reply (e.g. Survivor B):



What can be tried with the reader issue

To overcome this problem, it can be tried, if removing four first hexadecimal digits from the EPC code mask, would help. The value of the digits that should be removed is most often 0X0080.

BOOSTING THE READ RANGE

Factory setting

The tag IC is configured to default sensitivity, which results in up to 40 m theoretical read range.

Read range alternatives

There are four IC sensitivity options that can be selected by memory block writing or using custom commands. The read ranges are measured with Voyantic Tagformance measurement device, where reader sensitivity is not limiting the results. Thus achieving the same read range in the field requires a very sensitive reader. A bistatic reader antenna setup (separate antenna and port for transmit and receive) can also improve the read range. The sensitivity levels are:

Sensitivity level	Register value (bits)	Theoretical read range up to
Maximum sensitivity	00	60 m (200 ft)
Default sensitivity	01	40 m (130 ft)
Degraded sensitivity	10	
Minimum sensitivity	11	
(Passive operation)	*	4 m (13 ft)

*Instruction for turning the tag to passive mode can be found later in this document

The selected register value will be written into the User memory bank (=11) to the two least significant bits of the Battery management word 1 at Logical address 0xF1 = 241_{10}. Note that that the full 16 bit (4 hex) battery management word needs to be written at the time. E.g. writing value 0xE000 (=1110 0000 0000 0000_b) results in maximum sensitivity and 0XE003 in minimum sensitivity.

Toggling the BAP mode on and off

Note that the BAP mode has to be restarted to complete the change of the sensitivity setting. BAP mode is turned on and off by writing to address 0x10D (=269_{10}) value 0X0000 (off) and 0x0001 (on).

MEASURING TEMPERATURE

Feature description

The temperature measurement range available is -40…+60°C with typical accuracy +-1.0°C. Over the ISO range for cold chain the accuracy is +-0.6°C. The sensor is inside the plastic housing, and thus makes delay to the temperature sensing. In some cases the temperature can be different inside the housing compared to the temperature in the tag surroundings. Thus the temperature measurement feature has to be applied with own risk for measurement error.

Custom sensor and simple sensor

The temperature monitoring feature can be used with custom parameters in the custom sensor mode, and ISO/IEC 18000-6:2010 specified temperature sensor formats are available in the simple sensor mode.

Simple sensor settings

In the simple sensor mode there are two temperature ranges available, 14°C wide and 28°C wide. The center temperature can be selected from eight alternatives. Other user selectable parameters are e.g. sampling accuracy (±0.5°C / ±1°C / ±2°C), sampling frequency (16 options in the range from 5 minutes to 8 hours), high and low temperature limits in the selected temperature range and how many consecutive limit exceeding samples are required to trigger an alarm.

Custom sensor settings

The custom sensor settings are similar to the simple sensor settings but with less limitations. The temperature measurement range available is from -40°C to +60°C. User adjustable parameters are e.g.:

- high and low temperature limits
- sampling interval
- how many consecutive temperature limit exceeding samples are needed to raise an alarm
- monitor delay that defines when the first measurement will be performed

MONITORING TEMPERATURE

Temperature monitoring

During monitoring phase, Confidex Survivor B™ will measure temperature independently with desired interval. If predefined upper limit or lower limit is violated longer than accepted, a time stamp and violation length is stored to tag memory and an alarm is raised. The alarm condition will stay until the user resets the alarm. This allows users to detect the interruption point in a cold chain with any commercial UHF RFID reader anytime during transportation and storage. Please note that the sensor is inside the tag housing and thus the monitored temperature follows the surrounding temperature slowly. Monitoring can be done only when the tag is set to be in the BAP mode.

Initialization*

Confidex Survivor B™ needs to be initialized before attaching it to a monitored item. Initialization includes for example setting the desired temperature limits, setting label clock (has to be set to be able to start monitoring), setting measurement interval, defining monitoring start delay, etc.

Calibration and fine trimming

Note that the temperature sensor of Confidex Survivor B™ is not calibrated and thus calibration fine trimming is recommended to have relevant measurement results.

*For exact specifications, please refer to the EM4325 IC datasheet.

TAG CONFIGURATION EXAMPLE

Configuration target

The target in this example is to configure a tag into BAP mode with maximum sensitivity. The tag monitors temperature and raises an alarm if the temperature goes below 0°C or exceeds 40°C. Tag sensitivity in logical word F1 has to be set first and then BAP mode word 10D has to be toggled to implement the desired sensitivity.

Logical word address (hex)	Logical word address (dec)	Contents	Value to be written (hex)	Explanation
EC	236	Temp Sensor Control Word 1	0x4400	Two measurements below 0°C trigger an alarm
ED	237	Temp Sensor Control Word 2	0x44A0	Two measurements above +40°C trigger an alarm
EE	238	Temp Sensor Control Word 3	0x4002	Sampling every 2 seconds
EF	239	Temp Sensor Calib. Word	?	Temp Sensor fine trimming possibility -4°C…+3.75°C
F0	240	I/O Control Word	0x0000	Ensures that BAP mode can be toggled
F1	241	Battery Management Word 1	0xE00X	X is {0,1,2,3} depending on the selected BAP sensitivity
F2	242	Battery Management Word 2	0x8001	LSB enables BAP control (1=enabled)
100	256	Sensor Data (MSW)	Read Only	Writing something to Sensor Data (MSW) triggers a manual temperature measurement. Value can be achieved by reading the register after writing. This register contains information about alarms and the temperature reading. Also monitoring indicator (on or off) is included here.
101	257	Sensor Data (LSW)	Read Only	Contains information about aborted temp measurements, under temp count and over temp count.
102	258	UTC Clock (MSW)	0x8000	UTC Clock value must be non-zero to enable monitoring. The UTC Clock can be set only if none of the alarms in Sensor Data (MSW) are set.
103	259	UTC Clock (LSW)	0X0000	
10D	269	BAP Mode Word	0x000X	X=0 BAP Mode off, X=1 BAP Mode on