# BlueRobin? An Ultra-Low Power Wireless Data-Link

**The world is going wireless and several standards are now available for different purposes of data communications. When it comes to data-link with long-life battery operated systems IAR System's BlueRobin™ sets new standards.**

To be reachable at any time and worldwide – this demand of modern age is reached by wireless telephones. Mobile phones are booming and have been implemented in our daily life. Triggered by this trend everything seems to go wireless now. We see WiFis – Wireless LANs to connect PCs with each other even in private homes, Bluetooth™ to link Mobile systems with each other like cell-phones with PCs, Remote-Key entries in cars, system which open car doors or trunks, GPS systems to locate and guide. Alarm-systems don't need wires any more, Sport-Systems allow pulse monitoring and speed measurement without cables and so on.

Often we look for the one ideal solution for all RF connections. But there is not just one ideal solution. GSM and UMTS are standards for the mobile market, Bluetooth™ is a new standard for handheld systems to transmit data and speech. There is also BlueRobin, an IAR Systems development, which is a new RF data link specially designed for long-life battery (single lithium cell).

SEMIS

This transmission protocol was specially developed for a digital, robust and reliable wireless data transmission with extremely low power consumption. Due to these restriction it is not targeted for high data rates and it operates unidirectionally.

BlueRobin systems consist of one or more clearly identifiable transmitters, which typically send data packets once per second to one or more receivers. A high degree of reliability can be reached even with a uni-directional connection by a complex algorithm for redundant data transmission. On one hand this reduces size and cost of the system, and on the other, it reduces the current consumption significantly. In standardised modules the following current consumption was achieved. A Transmitter module consumes 75 µA and a Receiver needs only 50 µA if only one module is received. The so called Economy-Mode, in which the number of data packages is decreased, reduces this value even further. The transmission distance is up to 100 metres for these current consumption values.

It is now possible to generate transmitting sensor systems with very low current consumption, which operate for years on a single lithium battery. The data link can be used to transmit measurement data in industrial units from hard to reach places to a central display and processing unit. The transmission of signals from sensing units in an alarm system can be transmitted without the necessity to install a complex wiring harnesses. But this is only possible if a reliable wireless system with long battery life exists. The efficient transmission of pulse, speed or similar data in sport-systems is another application, where BlueRobin fits perfectly. Data can be collected directly on the human body, e.g. by a chest trap and transmitted to a monitoring system or a watch. Similar units can be used for medical and rehabilitation purposes. With the transmission distance up to 100 metres, an acceptable ratio of power/distance allows enough freedom. Modules for even larger distances could be developed, but the longer the distance, the more power has to be used.

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The transmission protocol uses the open 868 MHz ISM band. For the hardware standard HF components are used to keep costs as low as possible. A Texas Instruments MSP430 Low Power processor is used for the protocol implementation. The protocol stack consists of a transmitting section, implemented in transmitter units or slaves, and a receiver section, implemented in receiver units or masters.

Each transmitter is identified by a Sub-ID and a ID. The Sub-ID is a value of 0..15 and identifies the type of transmitter, or for all means, the type of sensor. Additionally each transmitter holds a 16-bit ID to identify it. A slave might have, e.g. Sub-ID 3 and ID 32563, to identify it as a temperature sensor and to identify the sensor number in the receiving system. After a power up a BlueRobin transmitter sends data provided by a sensing application in typically one-second intervals.

A receiver can be 'linked' to up to 32 slaves in the system. During a initialisation phase a receiver is 'virtually linked' to any transmitter in range. After that initialisation phase only transmitters which are 'linked' are acknowledged. Signals from foreign BlueRobin systems are ignored.

There are two types of basic BlueRobin networks possible, ID-based systems or Sub-ID based systems. In a ID-based system all 'linked' systems are the same type of sensors, e.g. temperature sensors. Only the ID, which needs to be unique to the individual sensor, identifies different transmitters in the system.

The Sub-ID bases system requires each transmitter in the system to hold a different ID, e.g. 1 for a temperature sensor, 2 for a speed sensor, 3 for a light-sensor and so on. Ideally there is only one type of sensor in each BlueRobin network, however there are also mixed networks, where some transmitters hold the same Sub-ID but there are several Sub-ID's in the system.

Sub-ID based system minimised data collisions within the system. Why is that so? We do have to take a closer look on the functionality of the system for that.

Each transmitter sends so called fixed data package about once a second. Different Sub-ID system have a different cycle times. The different transmitters are not synchronised among each other.

In a non-synchronised system, data collisions are possible. Due to it's digital nature and check functions data collisions are clearly identified by BlueRobin. Should it happen that the primary data package is unusable, the system relies on a second, a redundancy package. A complex algorithm assures that the redundancy package is usable even if two BlueRobin transmit with the same base timing. Statistics show that the used algorithm provides a high level of security that one sent data package, is transmitted within a closed BlueRobin system.

Should the fixed data package be disrupted, the receiver calculates the timing of the redundancy package and tracks the data there. The sample diagram above show this case for transmitter 1 and 2. Due to the different Sub-ID's and timing, this collision will not happen during the next second cycle. That is why Sub-ID based systems are more reliable.

However, there are certainly influences from outside, where disturbances can destroy data packages. There might be foreign transmitters sending on the same frequency in a rhythmic pattern. Or of course, there might be

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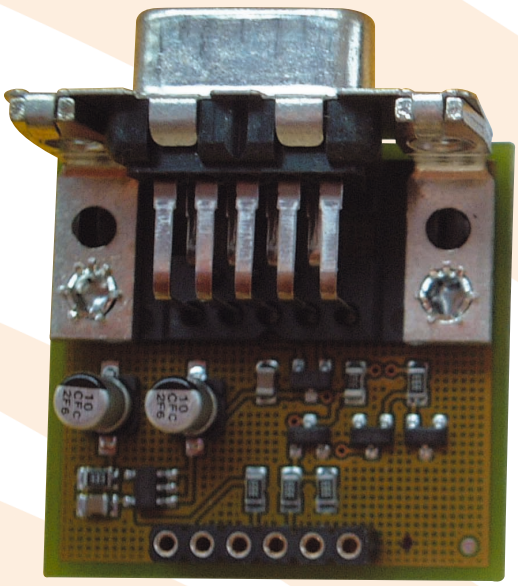
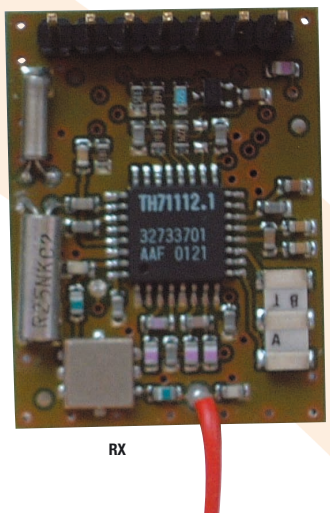


PC Adapter



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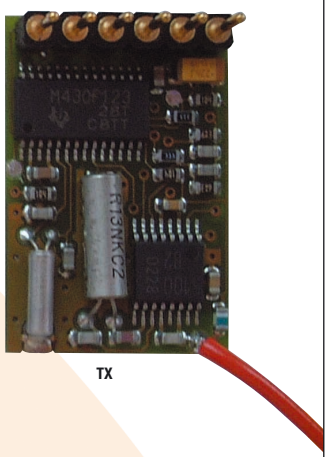

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other BlueRobin systems co-existing in the area. There are several more features embedded in the protocol to provide a high degree of security that a data package is transmitted once a second.

There are different generations of the transmission protocol available already. Generation 1 is in production in various OEM products and has proven to be very reliable. It does support 8 bit of net-data and up to 32 transmitters. BlueRobin is marketed in a licensing model to customers. HF design support and application support can be provided.

Due to different customer requirements BlueRobin Generation 2 allows the transmission of doubled user-data-rate at almost the same current consumption. To launch Generation 2 into the market, off-the-shelf systems are provided with BlueRobin Standard Modules G2. These modules are complete assembled RF and micro controller units on small PCB's. The modules are available in any low quantity. The modules can be connected to a host system via a UART interface. Hereby, the host system is collecting measurement values and calculates them and uses the BlueRobin module to transmit the data. This is an easy and cost efficient solution for small and medium size applications.

IAR BlueRobin G2 transmits data that changes at a rate that can be monitored by the human eye. Possible uses are Heart Rate Monitors and Speedometers. Operating in the 868 MHz license free band, the system has approval for European use. The data channel is error corrected and has a 9600 baud interface to the integrated microcontroller. Only 75 µA at 2.5 to 3.6 Volts power is required. A range of 40 to 100 metres is achieved using simple antennas. 32 Transmitters can be supported by a single Receiver. Individual Transmitters can be switched to transmit 2 bytes every 1 to 32 seconds in order to further save power.

Low/Medium volume users can use standard modules or the starter kit. The source code and circuit diagrams are available for licensing by medium or high volume users.

Should power matter, BlueRobin is the solution of choice. This IAR System technology allows to built reliable, digital, RF systems which live for years on single lithium batteries.

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