There is a general move towards GPS being a hosted application rather than a separate module, with processing taking place in the main processor of the equipment instead of having a dedicated processor in the module, and this is where chipsets with strong applications support will prove essential.

Solutions for RF and low power radio applications

An overview of recent products and technologies

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DT ELECTRONICS LTD

In recent years there has been an explosion in RF and wireless applications of all kinds, some conforming to industry standards such as Bluetooth® and WiFi while others are built to proprietary designs at unlicensed frequencies. Most wireless applications now use digital modulation techniques, so RF components are frequently used in modules that also incorporate microcontrollers and sophisticated DSP circuitry, which allows the engineer to interface to them digitally. DT Electronics offers a wide portfolio of products to suit this type of application, from world-class manufacturers including Atmel®, Gennum and Nemerix.

The architecture of an RF system can vary considerably depending upon application, but in general there are two basic types: the heterodyne system and the homodyne system. A heterodyne system consists of separate transmitter and receiver modules, which are often spatially separated. Sometimes a transmitter and receiver will share an antenna, and may also be combined into a transceiver unit where the transmit and receive modules share a common local oscillator (LO). In general a transmitter and receiver that are physically separate will form a one-way communication link, while a pair of transceivers will be used to form a two-way link. A homodyne system requires no LO, but instead mixes the outgoing and incoming signals to extract information that has been superimposed at some point along the radiated path, such as Doppler frequency shift or the code from a remote transponder.

Fig.1: RFID used in a card key

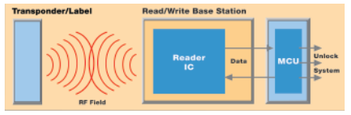

Fig.2: Block diagram of typical RFID subsystem

RFID

In the last couple of years radio frequency identification (RFID) has become much more widely utilised, and now finds use in a range of applications including key fobs for security and access control (Figure 1), industrial and retail inventory control, livestock identification, and smart cards for public transport systems. RFID is a homodyne system (Figure 2), consisting of a reader, or interrogator basestation, that both transmits the RF signal and receives the return signal, and a transponder that re-transmits the signal with an ID code superimposed, either as soon as it enters the field of the reader or when requested to do so. The transponder typically includes an IC and an optional capacitor and coil to form a resonant circuit.

RFID systems operate at several standard frequencies from 125kHz up to 2.45GHz, and the Atmel® range includes products designed for most of the commonly used bands:

- 125/134MHz

  Read-only with optional ISO 11784/85 compatibility

  Read/write with high security authentication algorithm, anti-collision function and up to 8kb user memory

- 13.56MHz – Read-write with features as above
- 868MHz and 915MHz

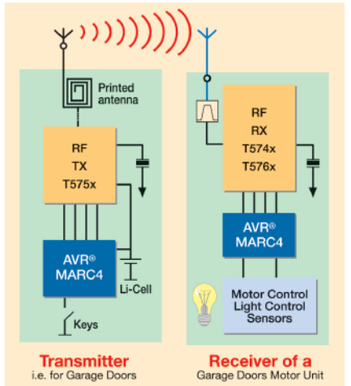

Fig.3: Simple uni-directional ISM system for garage door opener

ISM

A typical one-way (heterodyne) RF link for industrial, scientific and medical (ISM) applications is shown in Figure 3. These links find typical applications in home automation (such as automatic garage door openers, control of blinds and shutters, emergency systems for elderly people), remote weather station reporting. High data-rate Atmel® ISM products also support wireless audio communications.

Atmel®'s ISM portfolio covers all the standard bands from 250MHz up to 2.4GHz, with products compliant to European standard EN300 328/400 as well as US FCC CFR46 Part 15. The ICs integrate silicon germanium (SiGe) power amplifiers that provide output power levels of typically +14dBm maximum that can be increased up to +35dBm for extended link ranges.

In their simplest form, for example in controlling garage doors and air conditioning systems, only a single transmitter and a single receiver would be required to allow the equipment to be activated remotely. An external Flash-based AVR® or 4-bit low-power MARC4 microcontroller would be used in the transmitter circuit.

For more sophisticated mobile or handheld products, such as the transmission of outside temperature data, the arrangement shown in Figure 4 would be used, which includes an integral AVR® microcontroller core in the transmitter IC.

Operating at a frequency in the range 315 – 928MHz, the design uses a printed antenna to allow a small form factor package, and the IC can share a crystal with the MARC4 device to reduce the bill of materials.

Transceivers (Smart RF)

For more demanding applications, such as advanced toys, alarm systems and automatic meter reading, which require one or more bi-directional links, additional intelligence and other features are required. The example in Figure 5 shows an alarm system that uses both uni-directional and bi-directional links. The design is very robust and has low power consumption with an intelligent standby mode that enables long battery life, while the high power output allows long distance ranges to be covered. The integration of the AVR® microcontroller into the bi-directional transmitters enables the use of small housings.

Even more sophisticated is the wireless game controller system, for which a reference design (Figure 6) is available, based on the ATR2406 2.4GHz transceiver. This is suitable for worldwide use in the unlicensed ISM band, and utilises a proprietary frequency hopping spread spectrum (FHSS) scheme to minimise interference with Bluetooth® and WLAN that operate in the same band. Multi-user functionality (point-to-multipoint) is supported, with data rates of up to 1.152Mb/s. Average power consumption is low, thanks to the burst mode of operation, and the range is up to 30m indoors and up to 150m out of doors.

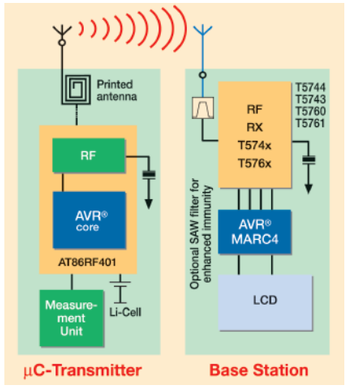

Fig.4: Sophisticated uni-directional system using micro-transmitter with integral AVR® core

IEEE 802.11 WLAN (WiFi)

The Atmel® product range includes a full set of integrated media access controller (MAC) + baseband, power amplifiers and single-chip access points for IEEE 802.11b/g WLAN at 2.4GHz and 802.11a at 5.0 - 5.8GHz.

Bluetooth®

Gennum produces a range of Bluetooth® headset and keyboard products based around the Cambridge Silicon Radio (CSR) BlueCore2 technology. The GR2312 GENBlue module combines CSR's world-beating single-chip technology with Gennum's own state-of-the-art integrated thin-film passives chip and high density interconnect/packaging capability, to produce a fully integrated module providing a complete system for data and voice communications. The device is fully compliant to the Bluetooth® specification v1.1 for class 2 operation, with the power control function supported, and contains the BlueCore HCI software stack, internal 8Mb flash, 16MHz crystal, and an integrated RF balun and bandpass filter. The GR2312 operates from a single 3V supply voltage with low power consumption. The surface mount package measures 12mm x 12mm x 2.0 mm maximum and is compatible with standard 0.8mm BGA package interface.

Latest additions to the range are the GENBlue GR2316 and GR2320 – these are both the same basic module but the GR2320 is fitted with an on-board antenna. The GR2316 is one of the smallest modules available for this application, and provides maximum flexibility for a wide range of data and voice communications applications. Bluetooth® v1.1 compliant and FCC and CE certified, the module offers Class 2 operation and features an integrated voice CODEC, BlueCore HCI software stack, internal 8Mb flash, and16MHz crystal. The package is compatible with standard 1.0mm BGA package interface, and the GR2316 measures 14.5mm x 14.5mm x 3mm, while the GR2320 size is 23mm x 14.5mm x 3mm. Temperature range is -20°C to +85°C, and the operating voltage range is +2.2V to +3.6V DC. CSR zone tools can be used for profiling, but standard profiles are also available.

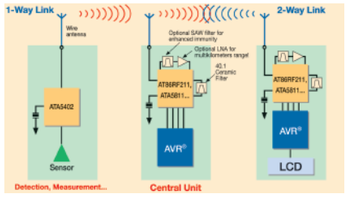

Fig.5: Alarm system using uni-directional and bi-directional links

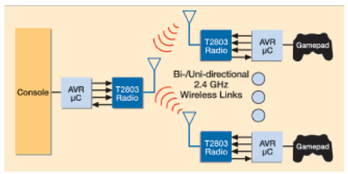

Fig.6: Reference design for wireless game controller based on the ATR2406 2.4GHz transceiver

GPS

Like other wireless applications, satellite navigation or GPS is a rapidly growing sector. In-car navigation is becoming widely available, as are hand-held personal navigators, while in the USA the 911 Directive aims to put GPS into every mobile handset to enable the tracing and automatic location of emergency calls. DT Electronics features GPS chipsets from both Atmel® and Nemerix in its product range. Nemerix chipsets feature exceptionally low power consumption suitable for handheld applications, while those from Atmel® have the advantage of sophisticated software support.