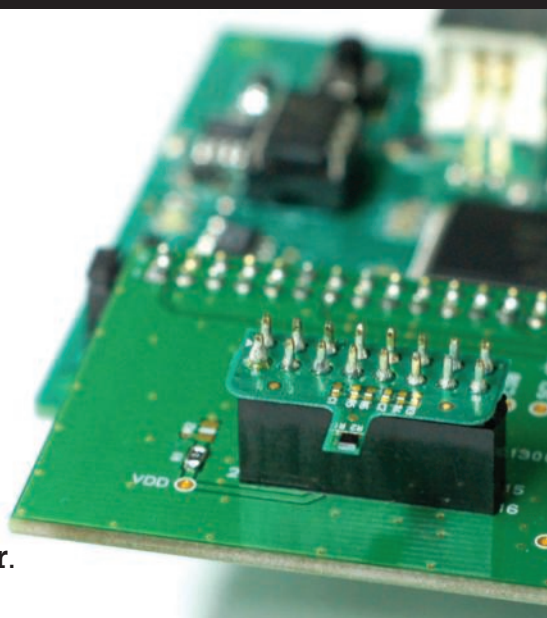
Sensing market opportunities

A leading edge mixed signal and analogue process is enabling innovative sensors for a range of applications. By **Graham Pitcher**.



The evaluation kit for the MXM1120 digital Hall sensor

Korean semiconductor company MagnaChip has a chequered history stretching back three decades. Originally the system ic division of Hynix, which was created when LG Semiconductor and Hyundai Semiconductor merged, MagnaChip was spun off as a standalone company in 2004. While Hynix retained the memory side of the business, MagnaChip focused on analogue and mixed signal technology.

Business issues saw MagnaChip confront a number of problems. Plans to float the company on the New York Stock Exchange faltered and a downturn in its fortunes saw it filing for Chapter 11 bankruptcy protection in the US. Following a couple of changes of ownership, the company appears to be back on its feet; the planned IPO took place in 2011 and MagnaChip is now valued at around $600million.

YJ Kim, executive vice president and general manager of the displays solution division, said: "There are three divisions: power solutions; display solutions; and semiconductor manufacturing services. Revenues are split at about 20%, 40% and 40% respectively."

Intelligent sensors

The company has just released a number of new products, including the MXsensor range of intelligent sensors and the MXG1300 e-Compass sensor family. Both ranges are said to take advantage of what MagnaChip calls its 'distinctive' mixed signal and analogue technology, based on running analogue and mixed signal manufacturing for 30 years. "We are now offering a 0.18µm process," said Kim. "It might not be world class when compared to a digital process, but it is for mixed signal devices. Our process is one of the most advanced sub micron processes for analogue devices and one of the smallest geometries used to manufacture sensors."

Apart from building sensors themselves, MagnaChip is integrating building blocks to enable more intelligent devices. Kim says this is due to more than 10 years experience in dealing with mobile device developers, as well as advances in its process expertise.

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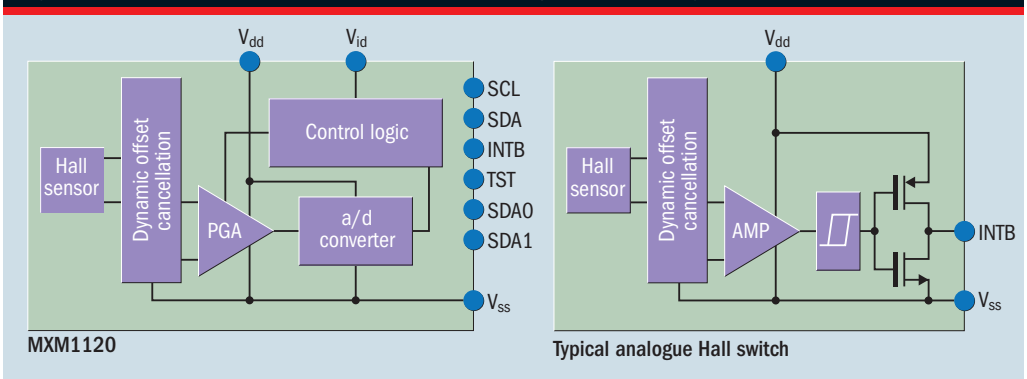
Dr Seong Min Choe

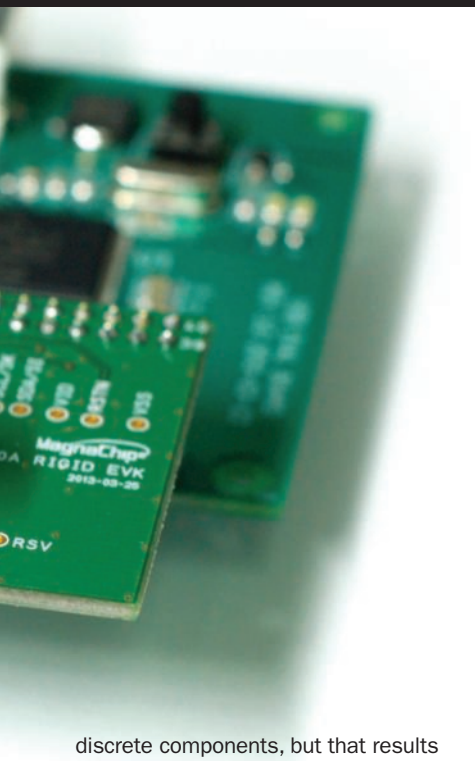
Kim claims MagnaChip has a leading position in the analogue market. "According to iSuppli," he said, "MagnaChip has the most capacity at 0.18µm. But we also have the ability to manufacture analogue devices on a 0.11µm process, so we're ahead of the competition and believe that will give us market leadership for a while."

On offer from MagnaChip's foundry business are mixed signal and analogue processes ranging from the HL80, a 0.8µm process supporting 5V operation to four 0.13µm HL13 processes. The HL13G supports 1.2, 2.5 and 3.3V, while the HL13P is 1.2, 2.5 and 5V tolerant. Also available are the HL13 triple gate, running at 1.2, 1.8 and 3.3V, and the HL13 low noise, available for 1.2 and 3.3V. The 0.11µm HL11 is a triple gate process tolerating 1, 1.8 and 5V, while the HL13 edmos (extended drain mos) 9V process is being planned.

The recently launched sensors are products of MagnaChip's displays solutions division. Dr Seong Min Choe, team manager of new market development for the division, said the sensors take advantage of particular aspects of the process technology: "Our nmos process results in very low noise; much less than from a standard process and around four times better than the industry average. It is possible to reduce noise using

Fig 1: How the MXM1120 compares with a typical analogue Hall switch





discrete components, but that results in increased power consumption for the sensor."

The low 1/f noise performance of the process – measured by plotting input referred noise against frequency – is enabled through the use of special elements implanted into the transistor channel.

Kim reinforced the comment. "The most difficult part is to get the low noise operation. It is difficult to get high performance when operating from a 1.8V power supply."

MagnaChip's MXsensor families, which include Hall sensors and e-compasses, are aimed at applications ranging from smartphone to medical devices. The intelligent sensors offer small form factors through multifunction integration enabled by 0.18µm process.

Alongside MagnaChip's 0.18µm process technology, the MXM1120 series (see fig 1) uses proprietary Hall technology. With an i2c interface and a 10bit a/d controller, the devices also feature an embedded logic controller. Devices in the series features an additional interrupt output, allowing programmable Brp and Bop parameters (Bop is the magnetic operate point, at which a positive magnetic field will switch the sensor on. Brp is the magnetic release point, where removal of the magnetic field switches the sensor off).

These features are said to enable of the sensor to be ported to different systems, allowing engineers to implement value added functions through programming. Flip covers for handheld devices are an example. MagnaChip says these require a magnetic sensor that can not only cope with the deviations in quality of magnets, but also with such things as unintended opening of the device's cover. The self calibration program can ignore the magnet flux deviations, while 10bit magnetic field measurement can reject unintended actions.

"Our MXM1120 Hall sensor provides flexible programming capabilities and other competitive features that will allow us to address the growing business opportunity of digitised smart applications," said Kim.

Dr Choe added: "The sensors feature self calibration to cope with deviation of the magnetic field. This saves cost because it allows the use of inexpensive magnets. The devices also have a higher immunity to rfi."

Following a new direction

Meanwhile, the MXG1300 e-compass (see fig 2) is being targeted at the smartphone and tablet market. MagnaChip says that, as smartphones and tablets integrate more navigation and augmented reality features, the e-Compass market is expected to grow significantly.

Dr Choe said that while the device was small, it offered high dynamic range – four times better than similar devices – along with power consumption benefits. "It also operates over temperatures ranging from -30 to 85°C. "This is close to the industrial temperature range, which means designers of industrial systems can specify a commercial device."

"We believe the time is right to launch the MXG1300 as the market is demanding a more cost effective solution"
YJ Kim

Looking at the competition, Dr Choe said most e-compasses feature 14bit resolution. "Leading edge parts are moving to 16bit," he noted. "That's not easy, but we have perfected a 16bit a/d converter block from IP which has been with the company for a long time."

With a dynamic range of ±4900µT, the e-compass has a resolution of 0.6 µT/lsb at 14bit and 0.15 µT/lsb at 16bit. A measuring time of 7.2ms is claimed and the device can output data at either 8Hz or 100Hz.

Typically drawing 280µA at 8Hz, the MXG1300 has a low power mode, which reduces operating current to 150µA. This mode creates wider power management flexibility by extending the battery life of mobile devices.

"We believe the time is right to launch the MXG1300 as the market is demanding a more cost effective solution," said Kim. "With the advantage of our proprietary 0.18µm process technology and capacity at our fab, MagnaChip will continue to provide the consumer with constantly evolving e-Compass solutions."

For the future, MagnaChip is focused on lower power consumption to extend battery operating life. "If we are to reduce power consumption," Kim concluded, "then operating voltage must also be reduced. That will mean analogue functions must run from a 1.8V supply. We will have this ability with our 0.11µm process."

Fig 2: Block diagram of the MVG1300