

# SMAC

## SECURITY SYSTEM REFERENCE DESIGN

[www.silica.com](http://www.silica.com)



**Lights & Temperature Control**  
**Door & Window Monitoring**  
**Smoke Detector**  
**Remote Assistance**  
**Siren**  
**Video Surveillance**  
**Glass Breakage**  
**Mobile**

## SMAC SECURITY SYSTEM REFERENCE DESIGN

This reference design will help shorten time-to-market for embedded systems using an 10/100 Ethernet connection or/and SMAC (Simple Media Access Controller) wireless short range communication, video surveillance and GSM communication, based on the powerful 400 MHz i.MX27 (ARM926EJ-S) processor from Freescale Semiconductor. Thanks to the smart speed architecture, the i.MX27 is one of the leading products on the market in terms of mA per MHz and due to its high level of integration, designs will benefit through a low parts count.

This reference design uses i.MX27 as main CPU, managing the satellite modules – various sensors, keypad and switches – over SMAC wireless communication protocol, taking pictures – when an alarm event occurs/or in surveillance mode – over a video camera connected to the i.MX27 camera interface and sending information to the outside world over Ethernet and GSM module to a personal mobile phone as SMS message. Capturing, processing and displaying moving images are key features for consumer to industrial applications. i.MX27 with its integrated video hardware acceleration block supporting up to VGA full duplex encode/decode H264 and MPEG-4 will perform all these multimedia tasks without any impact on the ARM CPU left available for other functions.

In addition, an LCD display is used for settings and showing the system status. With an integrated LCD controller supporting up to 800 x 600 maximum resolution, i.MX27 will allow customers to have a rich and user-friendly interface.

Developers can use this modular reference design during the development phase and, if necessary, also receive the design documentation in order to integrate the board directly into their design. The reference component list offers both security and flexibility by listing essential components, recommended components and components that may be selected by the customer. The reference PCB (Printed Circuit Board) provides a verified example and an excellent starting point. Finally, the reference applications suite serves as development reference or starting point for own designs and software application development.

### APPLICATIONS

- Industrial
- Building automation
- Security
- Medical
- Networking

■ Door & Window monitoring PH3H6115A  
■ Lights & Temperature control  
■ i.MX27/Control pad  
■ Smoke detector  
■ Glass breakage MMA7260Q  
■ Mobile  
■ Video surveillance  
■ Siren  
■ Remote assistance MCF52211CAF80  
■ Wireless short range Communication (Zigbee/WPAN)  
■ Ethernet communication  
■ GSM

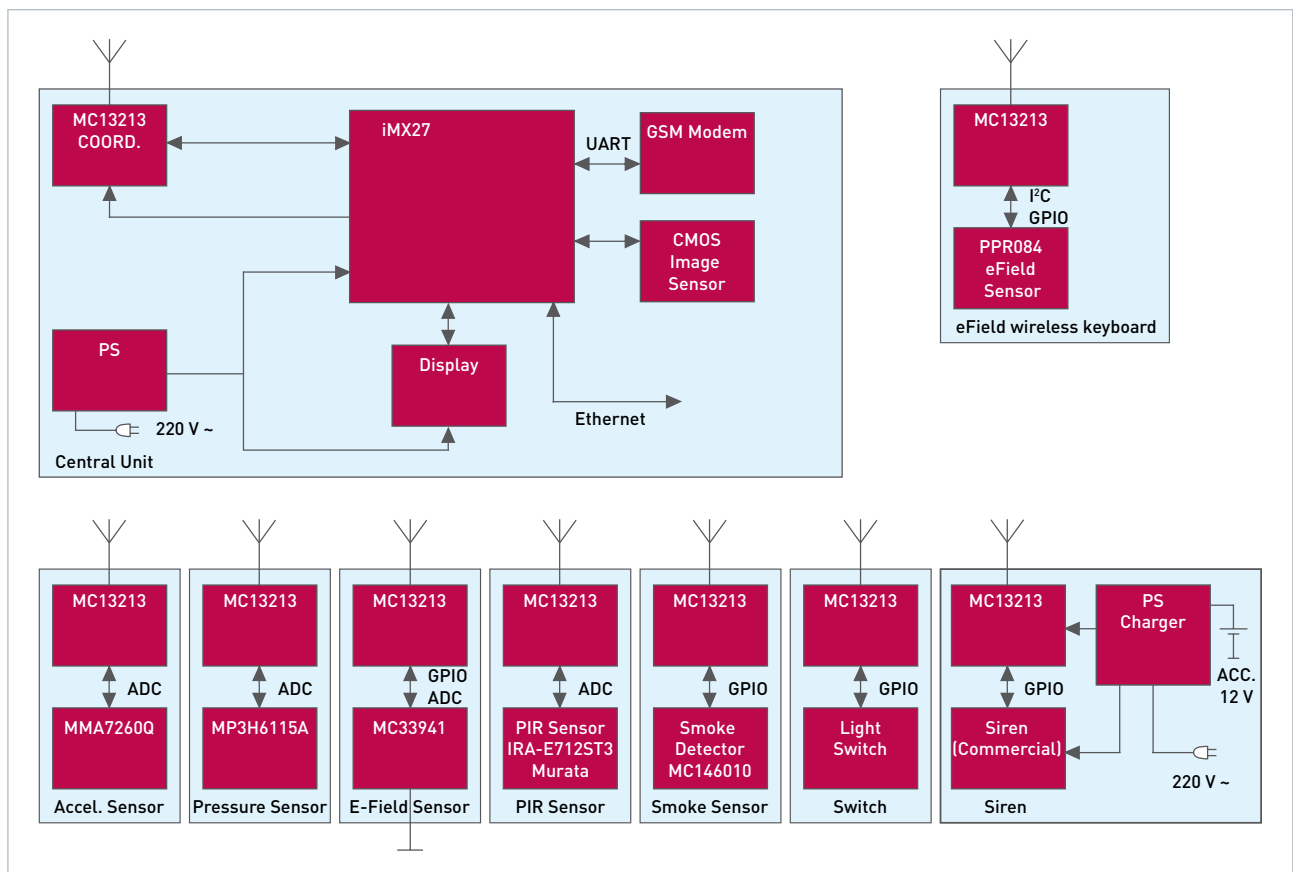
This reference design was developed based on Linux OS and Freescale SMAC software, in conjunction with supplying partners Freescale, Analog Devices, Diodes, International Rectifier, Maxim, Microchip, Micron, NXP, ON Semiconductors, Texas Instruments and design houses Phytect Messtechnik GmbH and Cores Electronics.



For this reference design the Simple MAC protocol was used to build up a star network, where the wireless main unit is linked to the i.MX27 through one of the six available UARTs.

Due to the fact, that all SMAC modules are biased by a 3 V battery and in order to reduce power consumption and hence increase battery life-time, the microcontroller is set in stand-by mode for a cycle of 30 minutes, but still active in case of an event. The star network set up can be modified over the keypad and LCD display, where the keypad is a fix or mobile module – connected over SMAC protocol.

The access to the main menu is password protected, which is also used to arm or disarm the system. In case of an alarm event (and if the system is armed), this is sensed by one of the sensors – accelerometer, pressure, smoke-detector, proximity, eField – which inform the system main unit based on the i.MX27 processor.



## SMAC Security System Reference Design

---

### IMPLEMENTED PROCESSOR ACTIVITIES

- Switch on the video camera
- Send video images over the Ethernet to a specified remote assistance point
- Send a SMS message over the GSM modem to a personal mobile phone, whose number can be set over the main menu
- Switch on all programmed lights
- Activate the sirene

By disarming the system all above activities will be switched off.

### KEY FEATURES

- Configuration of a star network using Simple MAC protocol
- Event sensing and managing through i.MX27 working on Linux OS
- Capturing, processing and displaying moving images with i.MX27 multimedia interface and accelerator
- Ethernet communication for moving images
- Implementation of SMS messages using GSM modem
- Full Linux source code for i.MX27 firmware

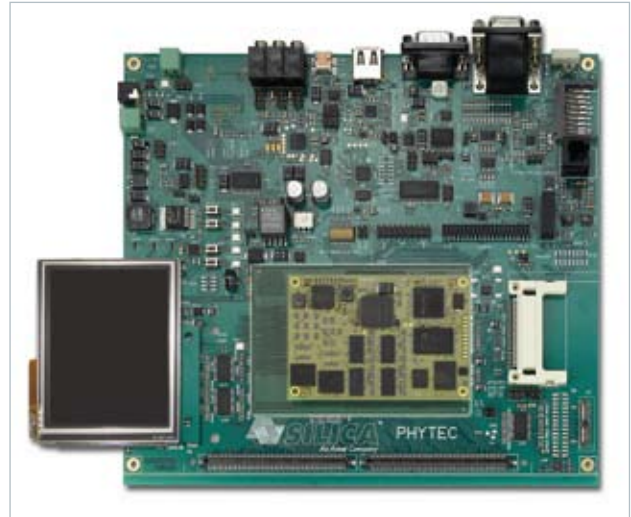
### ALARM SYSTEM BOX – REFERENCE DESIGN



## MAIN DATA MANAGEMENT UNIT BASED ON i.MX27 (i.EVOLUTION)\*

In response to the needs of design engineers tasked with pushing the performance, including many connectivity options and providing robust security in mobile device designs, Freescale i.MX27 multimedia applications processor is the optimal solution. Derived from the popular i.MX21 processor and based on the ARM926EJ-S™ core, the i.MX27 processor adds an h.264 D1 hardware codec for high-resolution video processing, an Ethernet 10/100 MAC, security, plug-and-play connectivity and more power management features.

This rich feature set makes it an excellent choice for Video and Voice-over-IP (VoIP) cordless and mobile phones, intelligent remote controls, point-of-sale terminals and many other wireless applications. All these advantages were fully used in this reference design, manufactured in a flexible modular architecture to help shorten development cycles.



\* more information on the i.Evolution development board: [www.silica.com/ievolution](http://www.silica.com/ievolution)

### BASEBOARD FEATURES

- USB OTG
- USB Host
- UART
- Compact Flash socket
- MMC/SD IO socket
- AC97 Codec for stereo audio and touch
- 1-wire connector
- Graphics interface for Sharp LCD, DVI interface and other displays
- Keypad connector
- Camera interface (direct interface to Phytex cameras; for others adaptor needed)
- Ethernet interface
- Power over Ethernet
- CAN interface
- JTAG connector
- Battery connector
- ZigBee™ connector for OEM module
- 400-pin expansion bus

### MODULE FEATURES PHYCORE-i.MX27

- Communication interfaces: 2 x UARTs; 2 x USB Host; 1 x USB OTG; 10/100 Ethernet; 1 x I<sup>2</sup>C
- 1 x MMC/SD
- 1-wire interface
- PCMCIA/compact flash interface
- SIM card interface
- ATA-6 HDD interface or capture interface (CMOS camera)
- Freescale i.MX27, ARM926EJ-S, 400 MHz
- Memory Management Unit (MMU)
- 128 MB DDR RAM (up to 256 MB)
- 64 Mbyte NAND Flash (up to 1 GB)
- NOR Flash 32 MB
- EEPROM I<sup>2</sup>C 4 kByte (up to 32 kB)
- Buffered SRAM 256 kB (up to 2 M)
- Real-time clock
- 10/100 MBit Ethernet
- Sound (line in/out; mic in)
- AD inputs (MC13783)
- Module dimension: 60 x 84 mm
- Available in extended temperature range (-30...+85 °C)

## SMAC NETWORK

From sensor networks to messaging, many devices rely on wireless communications for important application functionality. One low-power, short-distance wireless standard with great possibilities in applications from home automation to industrial control is ZigBee.

Freescale Semiconductor is not only a member of the ZigBee community, but it is very active in developing its own BeeStack ZigBee Protocol Stack and system in a package solution integrating an 8-bit MCU with the MC1320x transceiver into a single 9x9 mm LGA package. The MC1321X family offers a fully 802.15.4 compliant transceiver plus HSC08 MCU performance with full-function peripherals in one system in a package (SiP) solution to ease design of low cost wireless networks (WPAN). A single chip ZigBee device can also be used.

The MC13213 is an ideal solution for sensing and control applications that require point-to-point, star or mesh networking, by using Simple MAC, IEEE 802.15.4 compliant MAC or BeeStack ZigBee Protocol Stack. The BeeStack

ZigBee protocol, one of the smallest in the industry, allows device interoperability via standard profiles (home automation, smart energy and commercial building automation). It provides standard interfaces for actuators and sensors and has been designed for small to large networks (1000+ nodes). The stack is provided in header files and libraries.

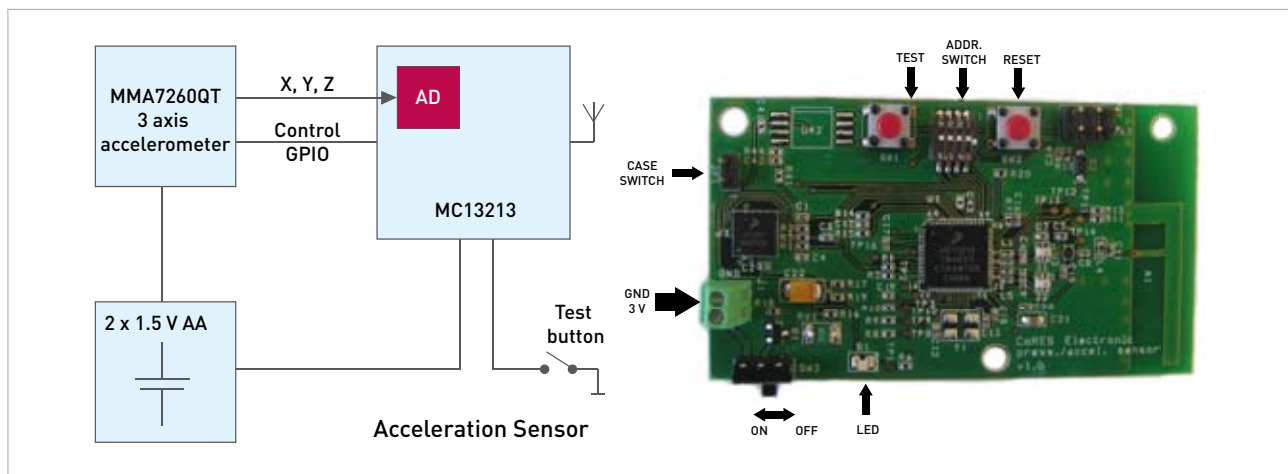
### COMMON PARTS FOR MODULES

- Radio
- Processor
- Buttons for reset
- Address switch
- The MC1321x contains a RF transceiver
  - 802.15.4 Standard compliant radio
  - Operates in the 2.4 GHz ISM frequency band
  - Low noise amplifier, 1 mW nominal output power
  - PA with internal voltage controlled oscillator (VCO)
  - Integrated transmit/receive switch, on-board power supply regulation and full spread-spectrum encoding and decoding

## ACCELEROMETER BOARD: DESCRIPTION – BLOCK DIAGRAM – MODULE

- Uses **Freescale MMA7260QT** 3 axis accelerometer
- Detection of tilt and vibration
- Self calibration at power-up
- Tilt detected by deviance of more than 15% from calibration value
- Vibration detected

The MMA7260QT 3 axis low cost capacitive micro-machined accelerometer features signal conditioning, a 1-pole low pass filter, temperature compensation and g-select which allows for the selection from 4 sensitivities. Zero-g offset full scale span and filter cut-off are factory set and require no external devices. This device includes a sleep mode that makes it ideal for handheld battery powered electronic devices.



### MMA7260QT FEATURES

- Analog output
- Selectable sensitivity (1.5 g/2 g/4 g/6 g)
- Low current consumption: 500  $\mu$ A
- Sleep mode: 3  $\mu$ A
- Low voltage operation: 2.2...3.6 V
- 6 x 6 x 1.45 mm QFN package
- High sensitivity (800 mV/g @ 1.5 g)
- Fast turn on time
- Integral signal conditioning with low pass filter
- Robust design, high shocks survivability
- Pb-free terminations
- Environmentally preferred package
- Low cost

### MMA7260QT BENEFITS

- Flexibility to select 1.5 g, 2 g, 4 g and 6 g of acceleration for multifunctional applications
- Low power for extended battery life

- Fast power-up response time
- Sleep mode is ideal for handheld battery powered electronics
- Low component count – saves cost, saves space
- Highly sensitive with low noise
- Adaptable functionality
- High frequency and resolution for accurate fall, tilt, motion, positioning, shock and vibration sensing

### SELECTED APPLICATIONS NOTES

**AN3461:** Tilt sensing using linear accelerometers

**AN3751:** Frequency analysis in the industrial market using accelerometer sensors

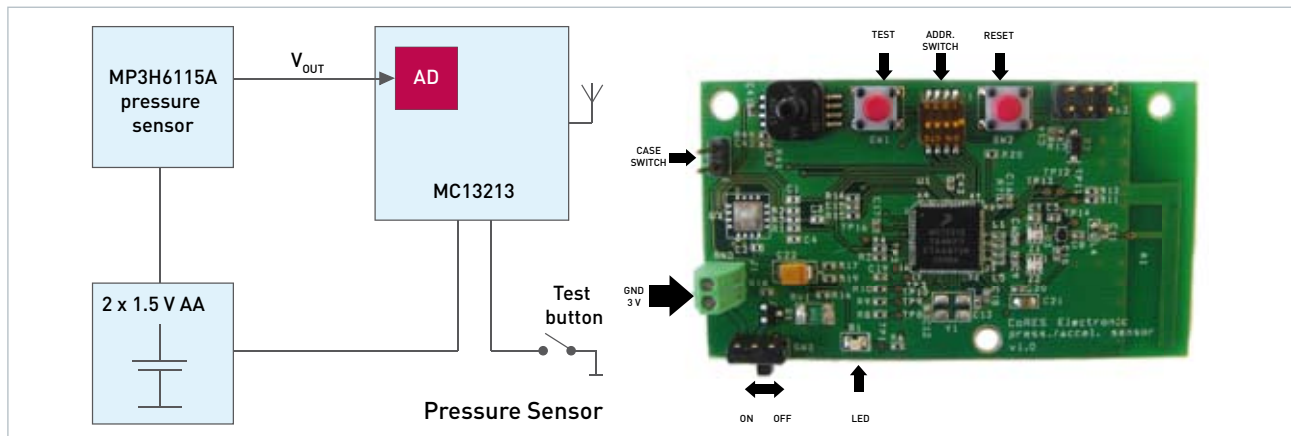
**AN1612:** Shock and mute pager applications using accelerometers

**AN3111:** Soldering the QFN stacked die sensors to PC board

# SMAC Security System Reference Design

## PRESSURE SENSOR: DESCRIPTION – BLOCK DIAGRAM – MODULE

- Uses **Freescale MP3H6115A** pressure sensor
- Self calibration at power up
- Detection of increase in measured value is greater than 10%
- Environmental control of sensitive electronic equipment



Freescale supplies a very large pressure sensor portfolio containing a wide variety of pressure ranges, diverse packaging and porting options. MEMS-based pressure sensors provide robust solutions for the appliance, medical, consumer, industrial and automotive markets.

The Freescale MP3H6115A series sensor is designed to sense absolute air pressure. Freescale's sensor integrates on-chip, bipolar op amp circuitry and thin film resistor networks to provide a high output signal and temperature compensation. The small form factor and high reliability of on-chip integration make the Freescale sensor a logical and economical choice for every system designer.

### FEATURES

- 1.5% maximum error over 0...+85 °C
- Improved accuracy at high temperature
- Ideally suited for microprocessor or microcontroller-based systems
- Temperature compensated from -40°...+125 °C
- Durable thermoplastic (PPS) surface mount package

### SELECTED APPLICATIONS NOTES

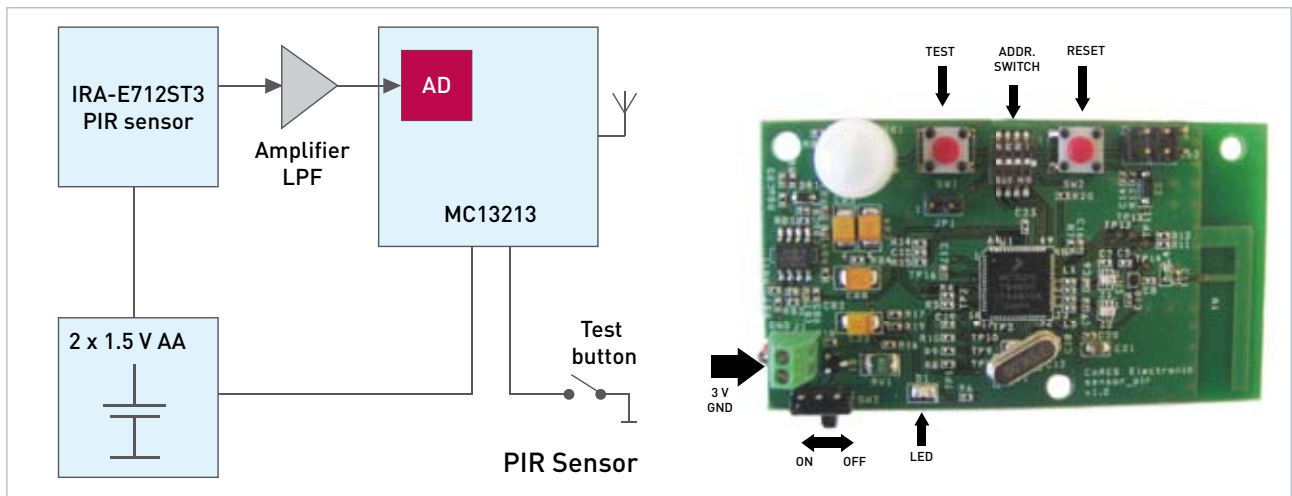
**AN1326:** Barometric pressure measurement using semiconductor pressure sensors

**AN3150:** Soldering recommendations for pressure sensor devices

**AN1984:** Handling Freescale pressure sensors

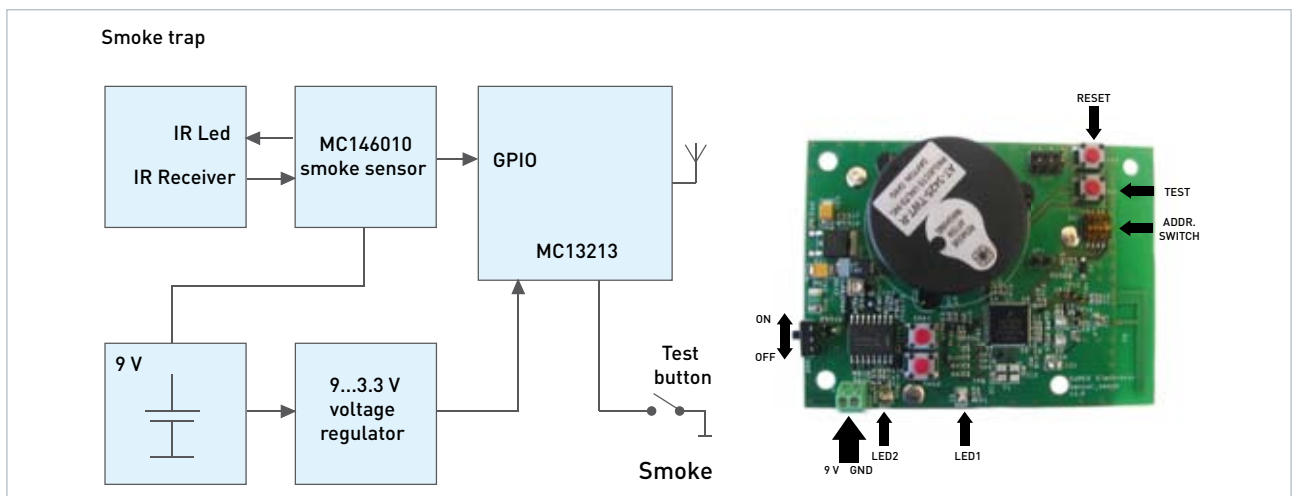
**PIR SENSOR: DESCRIPTION – BLOCK DIAGRAM – MODULE**

- Uses **IRA-E712ST3** PIR sensor from Murata
- Low voltage rail-to-rail op amp
- Amplifying and low-pass filtering
- Comparison done with fixed value tuned experimentally for optimal detection



**SMOKE SENSOR: DESCRIPTION – BLOCK DIAGRAM – MODULE**

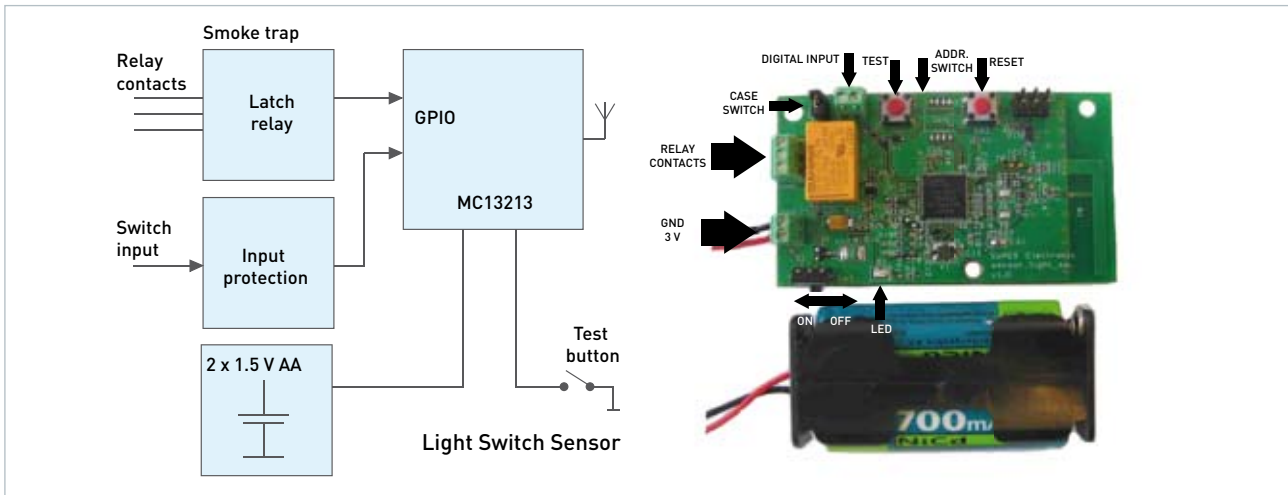
- Uses **Freescale MC146010** smoke sensor
- Sensibility adjustment with trim potentiometer
- Digital output of the sensor generates interrupt on the  $\mu\text{C}$
- Local piezo siren for alarm and alive tones driven directly by the sensor



# SMAC Security System Reference Design

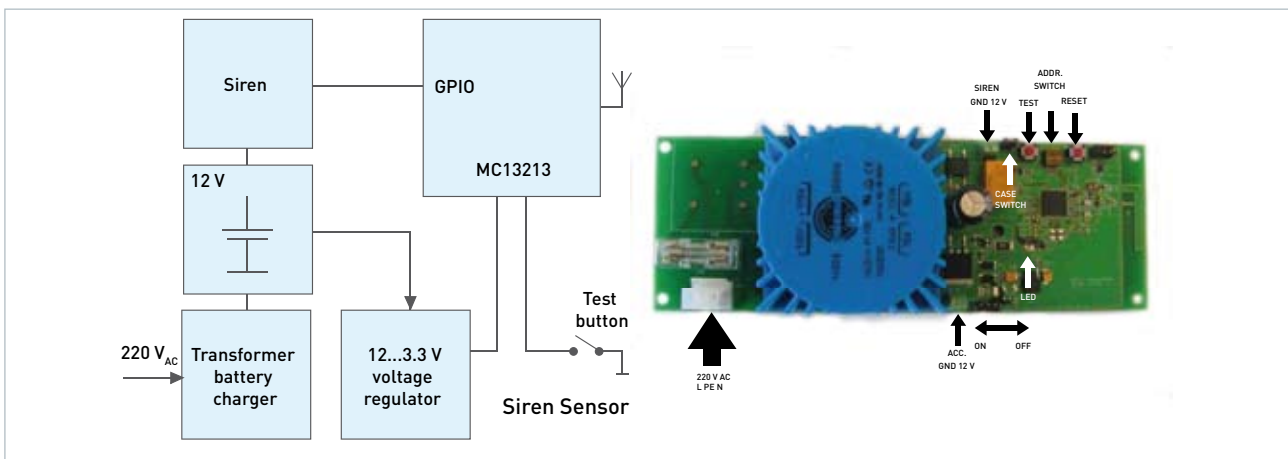
## LIGHT SWITCH SENSOR: DESCRIPTION – BLOCK DIAGRAM – MODULE

- Uses **latch relay** for reduced power consumption
- Supplementary input for magnetic sensor with overvoltage protection



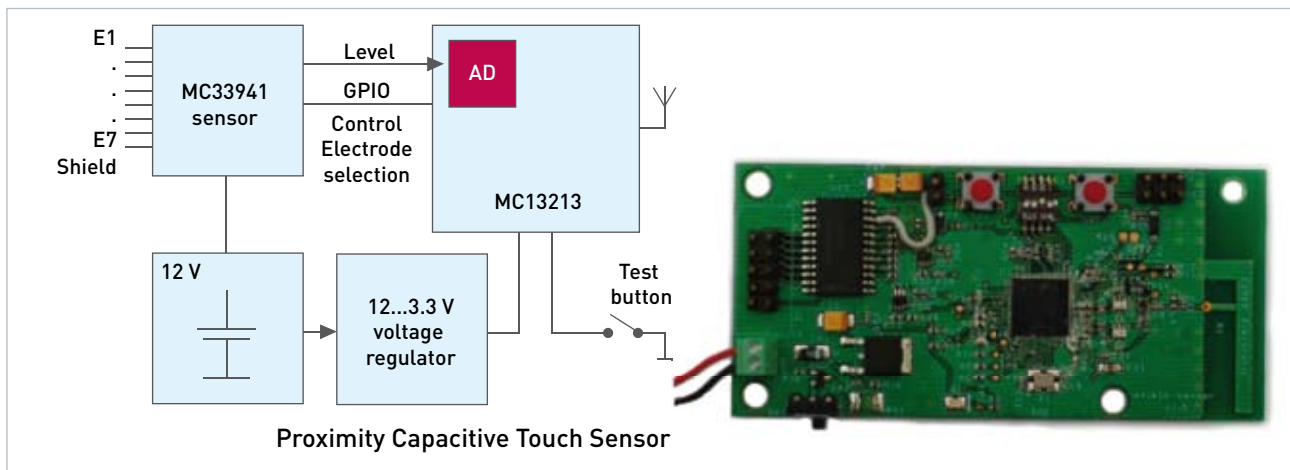
## SIREN SENSOR: DESCRIPTION – BLOCK DIAGRAM – MODULE

- Latch relay for siren driving
- Sealed lead acid battery backup
- Charger for battery



## E-FIELD TOUCH SENSORS: DESCRIPTION – BLOCK DIAGRAM – MODULE

- Uses **MC33941** eField touch sensors
- Electrodes are polled at 10 ms interval
- Initial values are measured and saved at power up to allow for different geometric and materials used
- Detection based on deviation greater than 15%



The MC33941 is intended for cost-sensitive applications where non-contact sensing of objects is desired. When connected to external electrodes, an electric field is created. The MC33941 detects objects in this electric field. The IC generates a low-frequency sine wave, which is adjustable by using an external resistor and is optimised for 120 kHz. The sine wave has very low harmonic content to reduce harmonic interference. The MC33941 also contains support circuits for a microcontroller unit to allow the construction of a two-chip system.

### FEATURES

- Supports up to 7 electrodes
- Shield driver for driving remote electrodes through coaxial
- High-purity sine wave generator tunable with external resistor
- Response time tunable with external capacitor
- +5 V regulator to power external circuit
- Can support up to 28 touch pad sensors [2 way multiplexing]
- Extended temperature range: -40...+110 °C

### SELECTED APPLICATIONS NOTES

- AN3456:** Generating a supply rail for the MC34941 in low voltage systems
- AN1985:** Touch panel applications using the MC34940/ MC33794 e-Field IC

# SILICA OFFICES

## AUSTRIA

Avnet EMG Elektronische Bauelemente GmbH  
Schönbrunner Str. 297 - 307 • A-1120 Wien  
Phone: +43 1 86642-0 • Fax: +43 1 86642-350  
wien@silica.com

## BELGIUM

Avnet Europe Comm. VA  
Eagle Building • Kouterveldstraat 20B  
B-1831 Diegem  
Phone: +32 2 709 90 00 • Fax: +32 2 709 98 10  
diegem@silica.com

## CZECH REPUBLIC (SLOVAKIA)

Avnet  
Argentinská 38/286 • CZ-170 00 Praha 7  
Phone: +420 2 34091031 • Fax: +420 2 34091030  
praha@silica.com

## DENMARK

Avnet Nortec A/S  
Ellekær 9 • DK-2730 Herlev  
Phone: +45 43 22 80 10 • Fax: +45 43 22 80 11  
herlev@silica.com

## ESTONIA

Avnet Europe Comm. VA  
Ehitajate tee 114 • 13517 Tallinn  
Phone: +372 625 79 91 • Fax: +372 625 79 95  
tallinn@silica.com

## FINLAND

Avnet Nortec Oy  
Pihatormä 1B • FIN-02240 Espoo  
Phone: +358 20 749 9200 • Fax: +358 20 749 9280  
helsinki@silica.com

## FRANCE (TUNISIA)

Avnet EMG France SA  
6/8, rue Ambroise Croizat • ZAE Les Glaises  
F-91127 Palaiseau Cedex  
Phone: +33 1 64 47 29 29 • Fax: +33 1 64 47 00 84  
paris@silica.com

## Avnet EMG France SA

Parc Club du Moulin à Vent • Bât 40  
33, rue du Dr. G. Lévy • F-69693 Vénissieux Cedex  
Phone: +33 4 78 77 13 60 • Fax: +33 4 78 77 13 99  
lyon@silica.com

## Avnet EMG France SA

Technoparc • Bât E • 4, avenue des Peupliers  
F-35510 Cesson Sévigné  
Phone: +33 2 99 83 84 85 • Fax: +33 2 99 83 80 83  
rennes@silica.com

## Avnet EMG France SA

Parc de la Plaine 35 • avenue Marcel Dassault -  
BP 5867 • F-31506 Toulouse Cedex 5  
Phone: +33 5 62 47 47 60 • Fax: +33 5 62 47 47 61  
toulouse@silica.com

## GERMANY

Avnet EMG GmbH  
Gruber Str. 60 C • D-85586 Poing  
Phone: +49 8121 777 02 • Fax: +49 8121 777 531  
muenchen@silica.com

## Avnet EMG GmbH

Rudower Chaussee 12 a • D-12489 Berlin  
Phone: +49 30 214882-0 • Fax: +49 30 214882-33  
berlin@silica.com

## Avnet EMG GmbH

Berliner Platz 9 • D-44623 Herne  
Phone: +49 2323 96466-0 • Fax: +49 2323 96466-60  
herne@silica.com

## Avnet EMG GmbH

Wolfenbütteler Str. 22 • D-38102 Braunschweig  
Phone: +49 531 22073-0 • Fax: +49 531 2207335  
braunschweig@silica.com

## Avnet EMG GmbH

Gutenbergstraße 15 • D-70771 Leinfelden-Echterdingen  
Phone: +49 711 78260-01 • Fax: +49 711 78260-200  
stuttgart@silica.com

## Avnet EMG GmbH

Carl-Zeiss-Str. 14 - 18 • D-65520 Bad Camberg  
Phone: +49 6434 9046 30 • Fax: +49 6434 90 46 33  
badcamberg@silica.com

## HUNGARY

Avnet  
Montevideo u. 2/B • H-1037 Budapest  
Phone: +36 1 43 67215 • Fax: +36 1 43 67213  
budapest@silica.com

## ITALY

Avnet EMG Italy S.r.l.  
Via Manzoni 44, I-20095 Cusano Milanino MI  
Phone: +39 049 8073689 • Fax: +39 049 773464  
milano@silica.com

## Avnet EMG Italy S.r.l.

Viale dell' Industria, 23 • I-35129 Padova (PD)  
Phone: +39 055 4360392 • Fax: +39 049 773464  
padova@silica.com

## Avnet EMG Italy S.r.l.

Via Panciatichi, 40 • I-50127 Firenze (FI)  
Phone: +39 055 4360392 • Fax: +39 055 431035  
firenze@silica.com

## Avnet EMG Italy S.r.l.

Via Scaglia Est, 144 • I-41100 Modena (MO)  
Phone: +39 059 351300 • Fax: +39 059 344993  
modena@silica.com

## Avnet EMG Italy S.r.l.

Via Zoe Fontana, 220 • I-00131 Roma Tecnocittà  
Phone: +39 06 4131151 • Fax: +39 06 4131161  
roma@silica.com

## Avnet EMG Italy S.r.l.

Corso Susa, 242 • I-10098 Rivoli (TO)  
Phone: +39 011 204437 • Fax: +39 011 2428699  
torino@silica.com

## NETHERLANDS

Avnet B.V.  
Takkebijsters 2 • NL-4817 BL Breda  
Phone: +31 (0)76 57 22 700 • Fax: +31 (0)76 57 22 707  
breda@silica.com

## NORWAY

Avnet Nortec AS  
Hagaløkkveien 7 • Postboks 63 • N-1371 Asker  
Phone: +47 6677 3600 • Fax: +47 6677 3677  
asker@silica.com

## POLAND (LATVIA/LITHUNIA)

Avnet EM Sp. z o.o.  
ul. Woloska 18 • PL-02-675 Warszawa  
Phone: +48 22640 2351 • Fax: +48 22640 2354  
warszawa@silica.com

## PORTUGAL

Avnet Iberia SA  
Candal Parque • R. 28 de Janeiro, 350  
P- 4400-335 Vila Nova de Gaia  
Phone: +351 223 77 95 02/04 • Fax: +351 223 77 95 03  
porto@silica.com

## RUSSIA (BELARUS, UKRAINE)

Avnet  
Korovinskoye Chaussee 10 • Building 2  
Office 25 • RUS-127486 Moscow  
Phone: +7 495 9371268 • Fax: +7 495 9372166  
moscow@silica.com

## Avnet

Polustrovsky Prospect, 43, of.525  
RUS-195197 Saint Petersburg  
Phone: +7 (812) 635 81 11 • Fax: +7 (812) 635 81 12  
stpetersburg@silica.com

## SLOVENIA (BULGARIA, CROATIA, BOSNIA, MACEDONIA, SERBIA/MONTENEGRO, ROMANIA)

Avnet  
Dunajska c. 159 • SLO-1000 Ljubljana  
Phone: +386 (0)1 560 9750 • Fax: +386 (0)1 560 9878  
ljubljana@silica.com

## SPAIN

Avnet Iberia SA  
C/Chile,10 • plta. 2ª, ofic 229 • Edificio Madrid 92  
E-28290 Las Matas (Madrid)  
Phone: +34 91 372 71 00 • Fax: +34 91 636 97 88  
madrid@silica.com

## Avnet Iberia SA

C/Mallorca, 1 al 23 • 2ª plta.1A • E-08014 Barcelona  
Phone: +34 93 327 85 30 • Fax: +34 93 425 05 44  
barcelona@silica.com

## Avnet Iberia SA

Plaza Zabalgane, 12 • Bajo Izqda.  
E-48960 Galdácano (Vizcaya)  
Phone: +34 944 57 27 77 • Fax: +34 944 56 88 55  
bilbao@silica.com

## SWEDEN

Avnet Nortec AB  
Esplanaden 3D • BOX 1830 • S-17127 Solna  
Phone: +46 8 587 461 00 • Fax: +46 8 587 461 01  
stockholm@silica.com

## SWITZERLAND

Avnet EMG AG  
Bernstrasse 392 • CH-8953 Dietikon  
Phone: +41 43 322 49 49 • Fax: +41 43 322 49 50  
dietikon@silica.com

## TURKEY (GREECE, EGYPT)

Avnet  
Bayar Cad. Gülbahar Sok. Nr 17/111-112  
TR- 34742 Kozytagi/Istanbul  
Phone: +90 216 361 89 58 • Fax: +90 216 361 89 27  
istanbul@silica.com

## UNITED KINGDOM (IRELAND)

Avnet EMG Ltd.  
Avnet House • Rutherford Close  
Meadway Stevenage, Herts • SG1 2EF  
Phone: +44 (0)1438 788310 • Fax: +44 (0)1438 788262  
stevenage@silica.com