Enabling Greater Features With Freescale Analog & Sensor Technology

AE339

Jan Krellner, Michelle Kelsey, Bob Johnson, Tim Tumilty
Agenda

► Overview of products featured
► Growth of sensor and analog applications
► Airbag deployment application
► Cellular applications
► Gaming applications
► Expanding to your applications

► FAE agenda
► What's new?
► Applications
► Tools
► Additional info
Follow along as our best system engineers illustrate a high-level of smart sensor and analog systems for diverse applications (accelerometers, pressure sensors, proximity sensors, power switching IC's, power management IC's and motion control IC's, cellular phones, portable media players, digital still cameras, gaming controllers). User-friendly software tools and applets are readily available for your diverse high-performance, high-quality, and high-reliability needs, often as free-ware!
Growth of Sensor and Analog Applications

► 2005: 25 Years of MEMS
► Vertical markets and applications
  • Automotive:
    ▪ Powertrain MAP/BAP
    ▪ Airbag deployment
    ▪ Tire pressure monitoring system
    ▪ Vehicle dynamic control
  • Consumer and Industrial
    ▪ Cellular phones
    ▪ Portable media devices
    ▪ Appliances
    ▪ Medical

► Over 25 years of SMARTMOS technology
► A premier supplier of highly integrated mixed-signal products
► Applications
  • Automotive
    ▪ Engine / transmission control
    ▪ Chassis, lighting and instrumentation
    ▪ Network communications interfaces
  • Industrial
    ▪ Speed control
    ▪ Torque control
    ▪ Motor control
  • Consumer
    ▪ Intelligent battery charging
    ▪ DC/DC converters
Superior Integration Capability

Proven IP Portfolio: SoC
- Power Management
- Connectivity
- Embedded Control/Memory
- Hi-Performance Analog

Diverse Sensing Technologies: SiP
- Inertial Sensors
- Pressure Sensors
- Electric Field Sensors

Freescale

Flexibility in Proven ASSP/ASIC and SiP/SoC Techniques Enables Fast and Low Risk Time to Market
A Well-Balanced Process
World Class Automotive Sensor Supplier

Freescale Air Bag Wins
History

How we got to where we are today. Competition benchmark point/counter-point. Application Blue-Ocean using analog and sensor enabled examples: airbag module, cell phones, gaming (Note: Product #'s and SW development support must be illustrated in each example).

► Airbags:
  • 10 yr. legacy - airbag modules
  • Accelerometer detects crash,
  • Squib (Analog content) deploys air bag
  • Analog/power supplies to airbag module (12 V, 5 V) = animated
  • Car network MUX health-check devices
  • SW enablement support
  • Q/A what of your application needs is like this??
Typical Sensor System Configuration

- DBUS Crush Zone Satellite
- DBUS Pressure Side Sat
- DBUS Inertial Side Sat
- Central ECU
- DBUS Crush Zone Satellite
- DBUS Pressure Side Sat
- DBUS Inertial Side Sat
Typical Initiator System Configuration

Passenger Vehicle with up to 16 Initiators

- Curtain Bag: 2 Ω, 1.2A, 2mS
- Side Bag: 2 Ω, 1.2A, 2mS
- Side Bag: 2 Ω, 1.2A, 2mS
- Curtain Bag: 2 Ω, 1.2A, 2mS

Pass 2 Stage Bag: 2 * 2 Ω, 1.2A, 2mS
Pass Pretensioner: 2 Ω, 1.2A, 2mS
Rear Pretensioner: 2 Ω, 1.2A, 2mS

Pass Knee Bolster: 2 Ω, 1.2A, 2mS
Driver Knee Bolster: 2 Ω, 1.2A, 2mS
Driver 2 Stage Bag: 2 * 2 Ω, 1.2A, 2mS
Driver Pretensioner: 2 Ω, 1.2A, 2mS
Rear Pretensioner: 2 Ω, 1.2A, 2mS

Side Bag: 2 Ω, 1.2A, 2mS
Side Bag: 2 Ω, 1.2A, 2mS
Curtain Bag: 2 Ω, 1.2A, 2mS
Airbag System Block Analysis
Application Challenges to Address

► Single source voltage into multiple lines
► Adding greater functionality to end use products
► Adding motion detection
► Increasing battery life and efficiency—power consumption
► Flexibility—switching frequency, output current, choice of external components, communication interfaces
► Adding touch sensing
► Reducing component count
### Automotive Based Sensors for Consumer Applications

<table>
<thead>
<tr>
<th><strong>Acceleration</strong></th>
<th><strong>Pressure</strong></th>
<th><strong>Proximity Sensors</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fall detection</td>
<td>• Blood pressure</td>
<td>• Car occupant sensing</td>
</tr>
<tr>
<td>• Tilt control</td>
<td>• Barometer/altimeter</td>
<td>• Proximity detection</td>
</tr>
<tr>
<td>• Vibration</td>
<td>• Engine control</td>
<td>• Object detection</td>
</tr>
<tr>
<td>• Anti-theft devices</td>
<td>• HVAC applications</td>
<td>• Appliances</td>
</tr>
<tr>
<td>• Appliance balance</td>
<td>• Tire pressure</td>
<td>• Touch panels</td>
</tr>
<tr>
<td>• Airbags</td>
<td>• Water level</td>
<td></td>
</tr>
</tbody>
</table>

#### Proliferation of embedded control drives sensor demand

- FSL uniquely positioned with system-in-package (SiP) technology
- Leveraging high-volume, high-quality automotive manufacturing into consumer and industrial markets.
- Creating portfolio of highly integrated, easy-to-use acceleration, pressure and proximity sensors
## Power and Analog Focus

### Vertical Markets
- **Portable Power and Battery Management**
  - Portable media players/ MP3
  - GPS and navigation
  - Cell phone
  - Digital still camera/ digital video camera
  - Li-ion battery chargers
  - Portable instrumentation
  - Toys/ Games
  - Bluetooth headsets / cell phone accessories

### Horizontal Market
- **Power over Ethernet**
  - Set top box
  - Telecom
  - Li-ion battery chargers

### Flat Panel Displays / Lighting
- **Flat Panel Displays / Lighting**
  - LCD-TVs
  - Monitors
  - Notebooks
  - GPS/ Navigation
  - Medical/ Instrumentation displays
  - Portable DVD
  - Projection TV/ Projectors
  - Illumination

- **Graphics cards**
- **Servers**
- **Instrumentation/ medical**
Architecture and Technology
Acceleration Sensor Common Features

Two-Chip Solution

3-Axis Sensing Cell

Control IC

Sensing Axis

XYZ axis

XZ axis

XY axis

Z axis

X axis
In Production since May 2005

MMA7260QT Specifications

**Electrical**
- 1.5g/2g/4g/6g XYZ axis device
- Customer selectable g-range
- 2.2 V to 3.6 V operation
- Low current 500 µA
- Sleep mode (3 µA)
- Analog output
- Integral signal cond w/ low pass filter
- Bandwidth (400 Hz / 150 Hz)
- Fast power up response time (1 ms)

**Package**
- QFN-16, 6 x 6 x 1.45 mm
- RoHS compliant
- -20°C to +85°C operating temperature
Introducing the Analog Output MMA73x0L 3-Axis Low g Acceleration Sensors

► Features
- 3-axis analog output with g-select
  - MMA7360L (1.5g, 6g)
  - MMA7340L (3g, 12g)
  - MMA7330L (4g, 16g)
- Low current consumption at 400 uA
- 3 uA at sleep mode
- Low voltage operation at 2.2 V – 3.6 V
- Linear 0g freefall detect logic output
- Z-axis self test for freefall function check

► Package
- 14-pin 3 x 5 x 1 mm LGA
- LGA volume is 71 percent smaller than
- Quad Flat No-Lead (QFN) package
- Side by side die mount
- RoHS compliant
MMA7450L – Digital 3-Axis Accelerometer

► Features
- 8 bits I²C/SPI digital output
- Option of 10 bits I²C/SPI @ 8g
- 2.4 – 3.6 V VDD operation
- 1.8 V I/O compatible
- 450 uA I_{DD}, 5 uA at sleep mode
- Selectable full scale range (2g, 4g, 8g)
- Programmable threshold interrupt
- Acceleration signature detect
  - Single and double pulse detect
  - Programmable threshold and pulse time

► Package
- 14-pin 3 x 5 x 0.8 mm LGA
- Side by side die mount
- RoHS compliant
- -20°C to +85°C operating temperature
Freescale Proximity Sensors

Electric-Field Technology Fundamentals
### Current Electric-Field Sensor Controller Portfolio

<table>
<thead>
<tr>
<th><strong>Product</strong></th>
<th><strong>Main Characteristics</strong></th>
<th><strong>No. of Channels</strong></th>
<th><strong>Packing</strong></th>
<th><strong>Operating Temperature</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>MC33794EK</td>
<td>120kHz generator, shield driver 9 electrodes +2 V_{REF} outputs 5V regulator, MCU support</td>
<td>11</td>
<td>54 pin SOICW</td>
<td>-40°C – 85°C</td>
</tr>
<tr>
<td>MC33941EG</td>
<td>Selectable from 60kHz to 240kHz Generator, shield driver 7 electrodes, 5V regulator</td>
<td>7</td>
<td>44-pin HSOP</td>
<td>0°C – 110°C</td>
</tr>
<tr>
<td>MC34940EG</td>
<td>Selectable from 60kHz to 240kHz Generator, shield driver 7 electrodes</td>
<td>7</td>
<td>24-pin SOICW</td>
<td>0 – 90°C</td>
</tr>
</tbody>
</table>
# MC34940EG(941) Features and Benefits

<table>
<thead>
<tr>
<th>Product Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 electrodes</td>
<td>Allows multiple functions with the same device. Replace several items on the BOM – reduces overall system cost.</td>
</tr>
<tr>
<td>High sensitivity</td>
<td>Allows detection of ice or presence of liquids. Good for touch screen applications.</td>
</tr>
<tr>
<td>Shield driver</td>
<td>Helps eliminate interference caused by metal connects. Allows for electrodes to be placed remotely, far from IC.</td>
</tr>
<tr>
<td>Tunable capacitance range</td>
<td>Allows for increasing or decreasing the sensitivity of the sensor for different electrodes.</td>
</tr>
<tr>
<td>Tunable response time</td>
<td>Choice of faster rise times (cost is overshoot) or slow rise time to achieve a smooth and stable signal.</td>
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<tr>
<td>Analog interface</td>
<td>Easier to parse data. Simplified interface to be used with MCU of choice.</td>
</tr>
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</table>
MC34940(941)EG Low Cost “E-Field Lite”

► Features
• Supports up to 7 electrodes
• Up to 28 touch pads and sliders
• Shield driver for driving remote electrodes through coaxial cables
• Critical internal nodes scaled and selectable for measurement
• High-purity sine wave generator tunable with external resistor
• +5V regulator to power external circuit (MC33941)
• 0° to 90°C (110°C for MC33941)
• 24-pin SOICW package

► Key Take-Aways
• The shield driver allows the electrodes to be remotely placed
• The high number of electrodes allows for design of multiple electrode interfaces from a single IC
• Capable of detecting objects at distances of 3” to 4” with proper electrode design
MC33794 – E-Field Imaging Device

► Features
- Supports up to 9 electrodes and 2 references or electrodes
- Shield driver for driving remote electrodes through coaxial cables
- +5.0 V regulator to power external circuit
- ISO-9141 physical layer interface
- Lamp driver output
- Watchdog and power-ON reset timer
- Critical internal nodes scaled and selectable for measurement
- High-purity sine wave generator tunable with external resistor

► Key Take-Aways
- The shield driver allows the electrodes to be remotely placed
- The high number of electrodes allows for design of multiple electrode interfaces from a single IC
- Capable of detecting objects at distances of up to 6" with proper electrode design
### MC33794EK Features and Benefits

<table>
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<tr>
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Enhancing Mobile Phones Features
Analog and Power Management Vision - Cellphones

**System Requirements**
- Battery management
- System power management
- Advanced video/graphics
- Add on features (Blutooth, WLAN)
- Application processor
- Authentication
- Fuel gauging

**Freescale AMPD Solutions**
- System buck regulators
- LDOs
- White LED boost/charge pump
- Li-Ion charger
- Li-Ion protection
- Fuel gauging
- Audio DAC/CODEC/amps
- Video encoder/amps
Sensor Cell Phone Vision - One Product, Multiple Functions

- Menu Navigation/Scroll
- Fall/Shock log (warranty)
- PowerSave ON/OFF
- Tap to Mute
- Virtual Mouse
- HDD Protection
- Intelligent Speaker phone
- Intelligent Ringer
- Motion dialing
- 3D gaming
- Pedometer
- E-Compass Tilt Compensation
- GPS backup
- Camera Stabilization
- Image Rotation
- Tap to Mute

Solutions with Additional Freescale Sensors:
- Altimeter/Barometric - Pressure Sensor
- Compass GPS -- Magnetic (Earth Field) Sensor
- Proximity (E-Field) for Touchpad / Fingerprint
- MEMS Microphone (1-4)
- RF MEMS

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Potential Product Functions with Inertial Sensor and uC

- Intelligent Ringer
- Motion dialing
- 3D gaming
- Pedometer
- E-Compass Tilt Compensation
- GPS backup
- Image Rotation
- Camera Stabilization
- Menu Navigation/Scroll
- Intelligent Speaker phone
- Tap to Mute
- Virtual Mouse
- HDD Protection
- PowerSave ON/OFF
- Fall/Shock log (warranty)
Freescale’s Proximity Solution

Capacitive Touch Screen
- Touch icons
- Linear sliders
- Rotational sliders
- Phone near ear detection

Hand Grip detection

Capacitive Touch Pad
Cell/Smart Phone Block Diagram – Target Applications

- **Sensors**
- **Analog/Mixed-Signal**
- **Digital**
- **Power**
- **Possible integration**

**Digital Baseband**
- CMOS Camera Module
- Video Encoder

**Apps/Graphics Processor**
- Buck
- ULV LDO

**RF Transceiver**
- PA Buck
- PA
- RF switch

**Battery Management**
- Buck/Boost
- OC/OVP
- Charger
- Fuel Gauge
- Authentication

**Analog Baseband**
- Stereo Class D Audio Amp
- Stereo Audio DAC

**Power Management**
- Buck/Boost
- OC/OVP
- Charger
- Fuel Gauge
- Authentication

**Analog**
- Stereo Audio DAC

**Mixed-Signal**
- CMOS Camera Module

**RF**
- RF switch

**Digital**
- Apps/Graphics Processor
- Digital Baseband

**Possible integration**
- Main LCD
- Secondary LCD/OLED

**Audio**
- Stereo Audio DAC

**Video**
- Encoder

**Camera Module**
- Lens Motor Driver

**HDD**
- White LED &/or OLED Driver

**LED Flash/Torch**
- Main LCD

**Memory**
- SIMM Card

**Operating System**
- Apps/Graphics Processor

**Processor**
- Processor

**Power Supplies**
- LDO
- LDO

**Accessories**
- USB

**External Connections**
- Video Amp
- Composite Video out

**Security**
- PMIC

**Authentication**
- (All Remaining PM/Analog functions)
Typical Battery Pack Block Diagram - Basic

Possibilities for integration
- Protection controller + FETs
Typical Battery Pack Block Diagram – Smart Battery

- Possibilities for integration
  - Fuel gauge + authentication
  - Authentication + Li-Ion protection
  - Fuel gauge + Li-Ion protection + authentication + protection FETs
Tilt for Scrolling

- Smooth scrolling user interface
- Not required to process scrolling
- Degree or speed of scroll can be the output
Image Rotation

- Orientation of phone is determined by system
- Degree of tilt is calculated
- Rotation of image is determined
Shock Detection and Impact Measuring

- Not limited to predetermined shock thresholds
- Simplified software solution
- Shock protection specific to your application

Typical Shock Signature

Finger Tap Detection
Tap on Table
Thrown on Table

MCU
Proximity Sensor
Accelerometer
Digital
Possible integration

QG8
MMA7450L

µC/Digital
Processing
• Software enables linear, projectile or rotational freefall detection
• Software calculates height of fall by sampling time duration of a fall
• Ensures protection of important data
• Enables increased warranty information
Human Motion Monitoring

- Sensing human motion with higher reliability
- Smaller integrated components for a small wearable sensing device
- Enables protection feature for elderly people or patients
- Enables context awareness

Human Motion Monitoring Signatures

- Sitting
- Fallen – Call for Help
- Laying Down
- Running
- Walking
- Walking up stairs
Pedometer

• Increasing features with pedometer application
• Stride length, speed, running status can be an output

Typical Walking Signature

Stride Length
Number of Steps
Calories burned
Running
Walking
Frequency of Steps
Distance Traveled

2.5 miles
2 mph
162 calories

Stride Length, speed, running status can be an output.
Enhancing Portable Media Players
MP3/PMP Simplified Block Diagram

- Fuel Gauge
- Battery
- Charger
- Memory
- buck Converter
- buck Converter
- buck Converter
- boost Converter
- Core
- I/O µC/Digital Processing
- Prox. Sensor
- Acc. Sensor
- LCD
- Display Driver
- VCOM
- LED Driver
- UI Controller
- Audio amplifier
- Buttons
- Backlight
- Sensors
- Analog/Mixed-Signal
- Digital
- Power
- LDO
- LDO
- LDO
- LDO
- LDO
- LDO
- LDO
- LDO
- LDO
PMIC for Portable Media Player (Cinnamon)

- Highly integrated power management IC
- 2 step-down DC/DC converter
- 1 step-up/step-down DC/DC converter
- 1 step-up DC/DC converter
- Switching charger with dual inputs (USB, line)
- 10 LDO’s
- I²C interface

Single source, multiple outputs
PMIC for Portable Media Player

- Step-up DC/DC for LED backlight control
- All internal FETs
- Internal compensation

Low external component count
PMIC for Portable Media Player

- Step-up/Step-down DC/DC converter
- Seamless mode transition
- Internal FETs and compensation circuitry

Great innovation
PMIC for Portable Media Player (Cinnamon)

Extended battery life due to very accurate charging
Ultra Low Iq Buck with adjustable “Z” Factor (MC34726)

- PWM, PFM and 100% duty cycle operating modes with smooth auto transitioning
- Unique “Z” Factor adjustment for mode transition programming
- <25uA Ultra Low Iq in PFM mode
- 300/600mA output current variants
- I2C data bus version for dynamic output voltage adjustment and control
- -40 to +85DegC Temperature range
- SOT23-5, 2x2DFN-6/8 ultra thin 0.6mm WLCSP-5
Ultra Low Noise Audio Sub system

- Ultra high performance Class D audio amplifier using FSL Patented topology for speaker phone
- 1W into 8Ohm Load Class D operation
- High PSRR at 217Hz (>85dB)
- Integrated 3 Way Mixer/Multiplexer for 2x Stereo and 1x Mono inputs
- I2C Data bus
  - Mode control
  - Volume control
  - Input selection
- Click and Pop Suppression
- Short circuit & Thermal shutdown protection
- TQFN-28 and WLCSP-5x5

In Definition
SAMPLES Q3 07

Typical Application
1W Class D Mono audio amplifier

- 2.8V to 5.5V Power Supply,
- Output Power : 1W into 8ohm load, 3.6V Supply,
- System Clock Input 3.6MHz – 33MHz,
- Enable input
- Single Bypass Cap for Biasing (Integrated Low Noise BandGap),
- Integrated Dithering in Modulator to avoid inband tone generation during audio idle
- Click and Pop Suppression
- Modulation frequency up to 4.125MHz :
  - improved output noise,
  - Improved efficiency

- 2 programming Pins (PGM1 and PGM) to set modulator sampling speed (fmod),
  - 00 = disable
  - 01 = fmod = sysclk / 4
  - 10 = fmod = sysclk / 6
  - 11 = fmod = sysclk / 8
Battery pack IC

- Fully integrated solution for smart Battery packs
  - 1&2 Cell Li-Ion protection controller
  - MCU for fuel gauging and Authentication
  - Fuel gauge analog front end for V, I and T measurement/accumulation
  - Flash, EEPROM and SRAM memory
  - 1-Wire (Optional I2C) data bus
- Dedicated 16-bit precision Sigma delta ADC for current measurement
- 10-bit ADC for volt and temp
- On Chip 0.5% accuracy oscillator
- Li-Ion protection function drives high side N-FETs
  - All protection hardware controlled
  - Up to 28V over voltage protection
  - Over Chg/Dischg/Current/Temp protection

- Freescale S08 8-bit microcontroller core with full development support tool availability

Typical Application

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Features

► Input Li+ or 2AA Battery
  • 1.6V to 5.5V (7V absmax)
► 8 DC-DC Switching REGS
► High efficiency
  • Synchronous topologies
  • Integrated MOSFETS (except REG7)
  • Up to 2MHz f_s
  • Automatic Pulse Skipping Mode
  • Integrated compensation (REGs1, 3, 6, & 8)
  • +/-2% Accuracy
► 1µA Shutdown Mode
► Extensive Protection
  • Input UVLO, Output UVP/OVP, OCP
► I2C Control & Monitoring
  • ON/OFF control for REG Groups
  • CCD sequencing
  • Dynamic Voltage Scaling
  • LED back light control
  • Output UV/OV
  • Soft Start time for each REG

APPLICATIONS:
Digital Still Camera
Standard 8-Channel PMIC

56LD 7x7mm² QFN
Enhancing GAMING
E-field Enhancing Gaming

- Proximity Detection
- Touch Detection
- Replace resistive touch pads
- Multiple key detection

MC34940EG(941)
MMA73x0L Enhancing Gaming

- Fall Detection
- Menu Navigation/Scroll
- Motion detection
- Shock Measurement
- Pedometer
- Tilt Detection and Control
- Golf Swing Analysis
- Rotation Detection
- Tap Detection
- PowerSave ON/OFF
- Punching Bag Detection
- Baseball Bat Swing Detection

Solutions with Additional Freescale Sensors:

- Proximity (E-Field) for Touchpad / Fingerprint
- MEMs Microphone (1-4)
- RF MEMs

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Detecting All your Motion Sensing Needs

MMA73x0L 3-Axis Accelerometer

- Smaller package
- g-Select in the sensitivities needed
- Freefall detect pin
- Lower current consumption

Security Monitoring
HDD Protection
Motion Detection
Pedometer
User Interface
Rotational Acceleration
Freefall Detection
Shock Detection

Shock Signature
Freefall Signature
Tilt Signature
Charger for 1-cell Li-ion - Overview of Features

► Complete charger for 1-cell Li-ion batteries
  • Integrated pass element, current sensor and reverse-blocking diode
► 28V input voltage tolerance with OVP
► 0.5% voltage accuracy
► 5% current accuracy
► Charge current up to 1.2A
  • Factory programmed or w/ external R
► Factory programmable end-of-charge current
► Charge current thermal fold-back
► Optional battery temperature monitor (NTC)

► Enable input
► Internal programmable safety timer
► Flexible indication outputs
► Accepts USB bus power
► LDO mode operation with auto battery detect
► Operating temperature range:
  • -40°C to 85°C
► 2x2 DFN-8 or 2x3 DFN-8

PINOUT

<table>
<thead>
<tr>
<th>VIN</th>
<th>1</th>
<th>8</th>
<th>BAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT2</td>
<td>2</td>
<td>7</td>
<td>A1</td>
</tr>
<tr>
<td>STAT1</td>
<td>3</td>
<td>6</td>
<td>A2/STAT3/DIN</td>
</tr>
<tr>
<td>EN</td>
<td>4</td>
<td>5</td>
<td>GND</td>
</tr>
</tbody>
</table>
Where Does It Fit in System?

Cradle/Travel Charger

- AC/DC Converter
- Charger IC

In-unit Charger

- System Loads
- 1-Cell Li-Ion Battery Pack
Example Application Circuits

Simple Charger with a Single LED indicator

DSC cradle/travel charger driving a bi-color LED and w/ NTC interface
Travel Charger Target Applications

Dual-Color LED (Green/Red)

Three Battery Terminals (+/T/-)
Travel Charger Application Circuit

- 28V Rating
- 2.6V to 10V operating voltage
- Internal timer
- Thermal foldback
- 4.2V ± 0.5%
- 5% current accuracy
- Drives dual-color LED (6mA) w/ blinking options
- Enable input
- 2X3 DFN PKG
- NTC interface
Additional Features

► Trickle charge for fully discharged batteries
► Reliable EOC detection
► Recharge as battery being discharged
► No error w/ any pin connection sequence between +/T/- battery terminals
► Human interaction carefully considered
► Smart battery-presence detection
► Accepting any type of dc sources
► Low thermal mode w/ CC/CV ac/dc adapter
► LED Indications:
  • Power on – Red, Green, Yellow, Black
  • Charging – Red
  • charge completed – Green
  • Error – Yellow (fast blinking optional)
  • No battery – Slow yellow blinking
## User Selectable Parameters

<table>
<thead>
<tr>
<th>#</th>
<th>Current $I_{CHG}$ (mA)</th>
<th>Recharge Threshold (V)</th>
<th>Trickle Charge Threshold (V)</th>
<th>EOC Current (%$I_{CHG}$)</th>
<th>Charge Time Limit (Hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50</td>
<td>4.00</td>
<td>2.7</td>
<td>5%</td>
<td>4.6</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>4.05</td>
<td>2.9</td>
<td>10%</td>
<td>6.8</td>
</tr>
<tr>
<td>3</td>
<td>150</td>
<td>4.10</td>
<td>3.1</td>
<td>15%</td>
<td>13.7</td>
</tr>
<tr>
<td>4</td>
<td>200</td>
<td>4.15</td>
<td>3.3</td>
<td>20%</td>
<td>No Limit</td>
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<tr>
<td>5</td>
<td>250</td>
<td></td>
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<tr>
<td>6</td>
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<td></td>
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<td>650</td>
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<td>750</td>
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<td>15</td>
<td>950</td>
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High-Voltage Dual-Input Chargers (Maranello)
Development Tools
Documentation and Tools

Fact Sheets
MMA73X0LFS
SNSRSOLUTIONTMFS
GSELECTACNSFS
MMASERIESFS
ZSTARBOARDFS

Datasheets
MMA73x0L
Preliminary D/S
MMA7450L

Data Book
DL200

Selector Guide
SG1010

Application Notes
AN3397 Position Algorithms
AN3390 Brake Lamp
AN3447 AutoZero Calibration
AN3376 MMA73x0L Eval Boards

► Sales Tools – Evaluation Tools, Demo boards

Sensor CD
ZSTAR
Human Fall
Ref Design
STAR
Eval Boards
Accelerometer Development Tools

**KIT3396MMA73x0L Evaluation Kit**

- Evaluation Board
- Software Available
- Connectors
- CD-ROM

**Order Number:**

- KIT3396MMA7360L
- KIT3396MMA7340L
- KIT3396MMA7330L
Accelerometer Development Tools

**RD3152MMA7260Q Reference Design**

- Evaluation Board
- Software Available
- Connectors
- CD-ROM

*Order Number: RD3152MMA7260Q*
RD3473MMA7360L Reference Design
- MMA7360L Evaluation Board
- Software Available
- Connectors
- CD-ROM

Order Number: RD3473MMA7360L
MC34940EG Demo/Evaluation Kit

Order Number: DEMO1985MC34940E

Demo Kit Content:
- Evaluation Board
- Software Available
- Connectors
- CD-ROM
MC33941EG Evaluation Kit

Order Number: KITMC33941EVM

Demo Kit Content:
- Evaluation Board
- Software Available
- Improved GUI
- Connectors
- CD-ROM

Sample electrode board demonstrates keys, linear and rotational sliders, and proximity pad.

E-field Development Tools
MC33794 Demo/Evaluation Kit

Order Number: KIT33794EKEVM

Demo Kit Content:
- Evaluation Board
- Software Available
- Connectors
- CD-ROM
USB TO I2C Interface

- USB Type B connector
- MON08 header for μC programming
- SCI interface connector
- Jumper for selecting I2C interface voltage i.e. 3.3V or 5V
- SPI interface connector
- Data from PC USB port
- Data to PMIC
- Speed up to 75 KHz

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USB TO I2C GUI

- Friendly and easy to use GUI for reading and writing data to PMICs.
- Up to 8 bytes to send and receive including the address.
The user can name his/her commands containing up to 7 bytes.

You can also name each of the bytes to be sent.

There’s no limit for saving commands but the restriction is that commands are sent one by one.
USB TO I2C GUI

► Commands can be sent manually. Also the GUI offers the possibility to generate a sequence of commands, inserting timers between them.

► The user can save, load, play and reset different sequences of commands.

► The user can monitor the information sent and received thru the Tx and Rx terminal windows.
Customer Evaluation & Prototype Kit

PC Software

MCxxxxx Eval Board

USB-to-1-Wire Interface Board

1-Wire Bus Cable