PRODUCT AND TECHNOLOGY NEWS FROM FUTURE ELECTRONICS



## APPLICATION SPOTLIGHT: Embedded, HMI and Displays

#### Renesas

High-Resolution HMI and Embedded Vision for Industrial, Home and Security Applications

PAGES 6-7

## Tianma

Superior Display Solutions PAGES 16-17

## Microsemi

Introducing Avalanche: Future Electronics' Lowest Cost Development Board for Microsemi PolarFire FPGAs

📵 PAGE 19

## AGDisplays

Design and Customize Your TFT LCD Solution PAGE 29



See All 3 Design Notes: pages 20 to 25

## **TABLE** OF CONTENTS

<b>APPLICATION SPOTLIGHT</b>			
Infineon	_	Standard Human Machine Interface Kits	3
NXP	Ð	See. Touch. Sense.	4-5
Renesas		High-Resolution HMI and Embedded Vision for Industrial, Home and Security Applications	6-7
SCHURTER	Ð	Metal Line Switches Glow with 7 Luminescent Multicolor Options	8
SCHURTER	Ð	Metal Pushbutton Switch with Capacitive Touch Sensor Technology	8
Mallory Sonalert		Omni-Directional Microphone Series	10
Infineon	Ð	Multi-Output PMIC with Integrated Sequencer	<b>1</b> 1
ON Semiconductor	Ð	Down to the Wire: PoE Converter and Controller Solutions	12
Vishay	Ø	SiC46X microBuck <sup>®</sup> Regulators Series: 4.5V to 60V Buck Regulators in a Nutshell	13
CUI Inc.	Ð	Next Generation DC Switching Regulators Maximize Economy and Performance	14
Susumu		Precision High Power Chip Resistors: HRG Series	14
Tianma		Superior Display Solutions	16-17
TE Connectivity		MULTIGIG RT 2 and MULTIGIG RT 2-R Connectors	18
Microsemi	Ø	Introducing Avalanche: Future Electronics' Lowest Cost Development Board for Microsemi PolarFire FPGAs	19
AGDisplays		Design and Customize Your TFT LCD Solution	29
Future Electronics		Analog Corner	30-31
Cypress	۲	PSoC <sup>®</sup> 6: Purpose-Built for the IoT	32
DESIGN NOTES			
Microsemi		The Case for RISC-V in the Industrial Market	20-21
NXP		Touch Solution	22-23
TE Connectivity		Expanding a Strong Foundation: "Ruggedizing" Connectors for Next-Generation Embedded Computing Applications	24-25
TECHNICAL VIEW			
Future Electronics		Primer to Cryptography and Embedded Security	26-28
ADS			
Future Display Solutions		Build with Quality	9
Future Electronics		Learn How You Can Leverage Future Electronics' System Design Center	10
Future Display Solutions/ Tianmna/AGDisplays		What to Consider When Designing in a Display	15

#### Current and previous versions of the virtual FTMs are available at www.FutureElectronics.com/FTM



To ensure you continue receiving future copies of FTM Register at www.FutureElectronics.com/FTM/Register



#### **Delight the Customer®**

Future Electronics' New Product Introduction (NPI) program is an important part of our commitment to servicing all of our customers' needs from prototype to production.

Look for the NPI icon to learn about the latest products and technologies available, and buy what you need in engineering quantities.



## Standard Human Machine Interface Kit: KIT\_XMC4x\_HMI\_OLED\_001



The HMI\_OLED-V1 board is an application expansion satellite card of Hexagon Application Kits. The satellite card along with a CPU board (e.g. CPU\_45A-V2 board) demonstrates the Human Machine Interface (HMI) capabilities of XMC4500. The main use case for this satellite card is to demonstrate the HMI features of XMC4500 device including the toolchain. The focus is safe operation under evaluation conditions. The board is not cost optimized and cannot be seen as reference design.

#### FEATURES

- Connection to CPU board via HMI satellite connector (80-pin)
- Micro SD card slot 4-bit SD card mode
- Passive matrix OLED display, size: 1.54", 160 x 128 pixel
- 2.5mm stereo receptacle for audio headsets
- Stereo audio codec TLV320AIC3204
- 2 touch buttons with LEDs
- I<sup>2</sup>C based IO expander with 8 channels
- Single side assembly of all parts
- 2 LEDs indicating power (3.3V, 13V)
- Power supply from CPU board via HMI satellite connector (80-pin)

## Standard Human Machine Interface Kit: KIT\_XMC45\_EE1\_002

The CPU board CPU\_45A-V3 houses the XMC4500 Microcontroller and three satellite connectors (HMI, COM, ACT) for application expansion. The board along with satellite cards (e.g. HMI\_OLED-V1, COM\_ETH-V1, AUT\_ISO-V1, MOT\_GPDLV-V boards) demonstrates the capabilities of XMC4500. The main use case for this board is to demonstrate the generic features of XMC4500 device including tool chain. The focus is safe operation under evaluation conditions. The board is neither cost nor size optimized and does not serve as a reference design.

#### FEATURES

- USB connector (Micro-AB USB)
- Cortex debug+ETM connector (20-pin)
- Cortex debug connector (10-pin)
- DriveMonitor2 connector (10-pin + 6-pin)
- HMI satellite connector (80-pin edge card)
- COM satellite connector (80-pin edge card)
- ACT satellite connector (80-pin edge card)
- Power scale connector (for power measurement)
- Infineon's linear 3.3V Power Regulator IFX1763
- Serial Flash memory, 32Mb, single/double/quad SPI
- LED for general purpose use (connected to P3.9)
- Potentiometer for ADC (connected to P14.1)
- 12MHz crystal and 32.768kHz crystal
- Reset button
- 2-pin DIP switch (hardware boot mode selection)



To buy products or download data, go to www.FutureElectronics.com/FTM

Most products featured in FTM are available in

engineering quantities. For more information

or to buy products herein, go to

www.FutureElectronics.com/FTM.

For immediate access to the WORLD'S LARGEST

AVAILABLE-TO-SELL INVENTORY go to

www.FutureElectronics.com.

Follow us on:

# **APPLICATION** SPOTLIGHT



#### APPLICATIONS

- Motor control and drives
- Motorcycles, e-bikes and small e-vehicles
- Solar energy systems
- Wind energy systems



- LED indicating active PORST (reset) signal
- 3 LEDs indication power (3.3V, 5V, 5V USB)

#### **APPLICATIONS**

- Motor control and drives
- Motorcycles, e-bikes and small e-vehicles
- Solar energy systems
- Wind energy systems



To buy products or download data, go to **www.FutureElectronics.com/FTM** 

## See. Touch. Sense.



Human Machine Interface (HMI) is where people and technology meet. We all use HMIs to monitor and manage machine applications ranging from user-friendly consumer products, home appliances and thermostats, to increasingly secure and reliable automotive driver interfaces, building elevators and access panels, bank kiosks, gas pumps, manufacturing operator panels, and data access terminals. NXP Semiconductor's extensive microcontrollers (MCUs), processors, sensors, tools and professional services enable cost-effective and forward-looking options for every HMI application.

Our expertise includes solutions for speech and voice recognition, video and graphics, touch and gesture control, vision and image analytics, and neural networks tools to enable deep machine learning in all these areas. Factors such as the evolution of industrial internet of things (IoT) and growing demand for smart automation solutions, and the need to efficiently monitor manufacturing plants are some of the factors driving the HMI market. An HMI improves productivity by providing a visual representation of a control system with real-time data acquisition. An HMI can also enable voice activated control of consumer and industrial devices.

Keeping up with such a fast-growing and everchanging technology and meeting consumer expectations isn't an easy feat for HMI design

and development teams. Consumer expectations are high. Take a look at your smartphone. Impressive graphics, right? You have a powerful mobile computer that fits in your pocket. It's a navigation system, audio/video player, and communication device that's available to you when you need it. And we expect them to look great.

#### Scalable Performance

NXP processing platforms enable new ways for customers to interact with technology through voice, video and touch. We offer the broadest portfolio of Arm<sup>®</sup>-based MCUs and processors that can drive the smallest, most power-efficient HMI that can be worn on a finger, to a digital sign that wows the world in New York City's Times Square. Within our microcontroller portfolio we provide a unified toolchain, MCUXpresso, with integrated drivers to ensure fast development times and smooth integration of audio and visual experience.

The LPC, Kinetis MCUs and the new i.MX RT (www.nxp.com/imxrt), based on Cortex<sup>®</sup>-M cores, deliver scale of performance from 20MHz to 600MHz, with options for integrated LCD up to 1024 x 768 and capacitive touch with TSI libraries, to simplify development.

The i.MX applications processors offer software scalable performance ranging from a single Arm Cortex<sup>®</sup>-A7 at 528MHz to four Arm Cortex<sup>®</sup>-A9 cores running up to 1.2GHz each. The next generation of i.MX will scale further up and down, and add ARMv8 technology in processes that are inherently more power efficient.

Most NXP MCU and processor HMI solutions include product options designed for use in harsh industrial environments, for always-on operation for up to 10 years, and with the product supply assurance of NXP's product longevity program (www.nxp.com/productlongevity).

#### i.MX Applications Processors

NXP's flagship HMI processor line, the i.MX Applications Processor, integrates a balanced set of graphics processing units with OpenCL computing and OpenVX vision extensions, powerful Arm cores with NEON vector processors, video encode and decode engines, 4K display controllers with High Dynamic Range (HDR), camera sensor inputs, advanced audio input and output, speech recognition and voice control solutions, and neural networks for machine vision, gesture recognition and natural language recognition.

Our expertise includes solutions for speech and voice recognition, video and graphics, touch and gesture control, vision and image analytics, and neural networks tools to enable deep machine learning in all these areas.

• Video Encode and Decode. By 2018, IP video will represent 79% of all global traffic. 4K display and High Dynamic Range (HDR) bring higher video guality and lower power consumption as markets shift from traditional set-top box to over-the-top (OTT) IP-based video on demand.

i.MX 6 application processors support a range of video encode and decode to deliver video on demand for a rich user experience (www.nxp.com/imx6).

•	Speech and Voice Control. 25-30% of ALL
	internet searches today are initiated by voice
	commands, and this number is growing rapidly
	Many home appliances and building controls
	are adding voice or other smart controls.

- NXP has partnered with Amazon, Technexion and several front-end DSP partners to provide reference hardware and software that are already certified for voice at the module level (www.nxp.com/amazon).
- The Pico-Pi board, based on the i.MX 6UL and i.MX 7D, from Technexion is Googlecertified for Android Things designs. Enabling the Google Assistant on this platform can easily be achieved by downloading an application file.
- In addition, an NXP partner DSP Concepts has developed software for the Arm Cortex<sup>®</sup>-A cores cores in i.MX processors, to replace the DSP hardware front-end features.
- Machine Vision and Learning. Machines "see" and "hear" through multiple cameras, microphones and sensor inputs. Developers are migrating away from DSPs and ASICs to leverage Arm-based processors with GPUs. Software tools and reference designs enable advanced math processors (GPU, Arm NEON) for faster image processing.

NXP's extensive i.MX portfolio enable costeffective and forward-looking options for every HMI application. Ranging from the low cost i.MX 6ULL, to the mid-range i.MX 7Dual, to the high end i.MX 6QuadPlus/i.MX 6Dual Plus.

#### LPC Microcontrollers

Since the inception of LPC microcontrollers, over 10 years ago, NXP has continued to innovate around these Arm processors. Today the portfolio of more than 400 Arm-based powered MCUs is one of the broadest 32-bit Arm-based MCU portfolios: defined by exceptional ease of use, design flexibility, and advanced integration. The majority of the LPC microcontrollers incorporate an LCD interface, including our flagship product family the LPC546xx, and integration of capacitive touch within the LPC845 MCU family. The LPC546xx family of MCUs series MCUs are perfect for running emWIN-based embedded GUI solutions with a smartphone look and feel in HMI applications for factories, buildings, homes and infrastructure equipment.

#### LPC800 Series MCUs

Entry-Level, Low-Cost 8-Bit Alternative Arm Cortex<sup>®</sup>-M0+ based portfolio to address the market's migration from 8-bit architecture.

- Offered at 8-bit MCU pricing Improved power efficiency and portfolio
- scalability • Broad suite of software, solutions and tools
- modes and measures proximity changes

#### LPC54000 Series MCUs

The LPC54000 MCU series addresses the market's need for a scalable, mainstream Cortex-M4 based microcontroller portfolio.

- Wide range of power and performance scalability
- Unique security and protection from entry level to advanced feature integration
- and tools
- Up to 1024 x 768 resolution
- 24-bit LCD interface supports 24bpp (16M colors)
- 64K colors
- Dedicated LCD DMA controller • Hardware cursor support

#### For Easy Prototyping and Design NXP Provides:

- MCUXpresso IDE, SDK, and configuration tools
- LPCXpresso54628 development board OM13098
- (www.nxp.com/LPC546xx)
- Support from: Segger, emWIN, TouchGFX and Embedded Wizard to develop GUI applications





\*Some features varv across packages



# **APPLICATION SPOTLIGHT**

• Capacitive touch interface with up to nine capacitive buttons, operates in power saving

• Rich ecosystem with broad suite of software

• Palette table to display of up to 256 of

• LCD app notes and design recommendation

To buy products or download data, go to www.FutureElectronics.com/FTM

#### **Kinetis Microcontrollers**

Kinetis Microcontrollers provide scalable MCUs based on Arm Cortex-M0+/M4F/M7 technology. One platform, the Kinetis E series, brings enhanced ESD/EMC performance ideal for frequently-touched HMI appliance and industrial applications.

This solution includes software that is designed to work simply and seamlessly with NXP's capacitive touch sensing hardware available on Kinetis KE15Z MCUs. Enabling touch pads, slides and rotaries, provides a more intuitive and effective way for user interaction than traditional buttons.

#### Key Benefits of the NXP Touch Solution Include:

- Robust EMC performance, noise immunity with IEC61000-4-6 standard certification with the 3V and 10V tests
- Self-cap and mutual-cap modes supporting up to 6 x 6 matrix touch pads
- Effective performance even with liquid substances such as water, oil, and steam
- High sensitivity with a boost feature to use when the touch overlay on the user interface is thick (acrylic, glass)

#### For Easy Prototyping and Design, NXP Provides:

- NXP Touch Library is supported in the MCUXpresso SDK
- APIs for high-level touch applications, so the developer does not need to spend time on low level HW configuration
- Advanced filtering and integrating detection (AFID)/Signal Adaptive Filtering Algorithm (SAFA) key detectors for robustness guarantee
- Automatic touch IP registers configuration for robustness guarantee
- GUI visibility to make debug and test easy • Freedom Development Platform: FRDM-KE15Z
- (www.nxp.com/FRDM-KE15Z)
- Design guidelines and application notes

#### For more details, go to the Design Note on pages 22 and 23.

## **BENESAS BZ FAMILY OF ARM® MICROPROCESSORS HIGH-RESOLUTION HMI AND EMBEDDED VISION FOR INDUSTRIAL, HOME AND SECURITY APPLICATIONS**

The Renesas RZ family of ARM microprocessors (MPUs) enables high-resolution human-machine interface (HMI) and embedded vision with a range of single- and multi-core ARM Cortex®-A7, -A9 and -A15 cores with support for multiple cameras and displays with alpha blending, 2D/3D graphics, and H.264 video codecs. The RZ/A1 series of MPUs comes with up to 10 MB of on-chip SRAM, while the RZ/G1 series supports 3D graphics and full high-definition (FHD) video.

Linux, Android & QNX

### RZ/G1

#### Multi-core ARM Cortex-A7 & -A15



## RZ/A1

#### Linux & RTOS

#### Single-core ARM Cortex-A9 with Large Embedded RAM

- 2-chip HMI
- Easy MCU-like development with MPU performance



#### **Example Applications**

- High-end HMI displays
- 3D rendering for medical imaging
- Networked video camera systems
- Intelligent IoT end-points for face, object and gesture recognition
- Home automation gateways
- Ether CAT master with HMI
- 2-way video telephony

#### **Key Features**

- ARM Cortex-A7 and -A15 CPU cores in dual and quad configurations for power or performance optimization
- 3D graphics engine for image rendering, plus 1080p 60fps video codec
- Shared IP and memory map over entire RZ/G1 MPU series
- Extensive network of ecosystem partners

#### **Key Features**

- Execute in Place (XIP) from **QSPI** Flash 1000 DMIPS ARM Cortex-A9
- processor Up to 10 MB of on-chip SRAM for frame buffering or code
- execution Support for up to two independent LCD displays and 4-layer graphics overlays with support for alpha blending

## **Key Benefits**

flows

**Key Benefits** 

Enhance GUI expressiveness

Optimize your design to minimize

power dissipation or maximize

Easily handle complex embedded

vision and machine learning

Linux, Android, & QNX design

convolutional neural networks

algorithms, including

with 3D graphics and

multistream video

performance

- Performance of a microprocessor (MPU) with the design simplicity of a microcontroller (MCU)
- Lower BOM cost thanks to no external DRAM, reduced PCB layers, and simple voltage regulator requirements
- Accelerated time to market
- Linux, RTOS, or bare-metal design-flows





## **RZ/G1** HIGH-END GRAPHICS AND MULTISTREAM VIDEO

Renesas RZ/G1 Series MPUs enable rapid development of game-changing Linux, Android, and QNX-based embedded systems. Designed for use in home appliances and industrial, office, and medical equipment, the RZ/G1 Series extends the capabilities of the successful RZ/A1 Series MPUs to deliver high-end performance in applications such as graphics, multistream video, and embedded vision. The RZ/G1 Series features up to 1.5 GHz CPUs, 3D graphics acceleration, FHD H.264 video, and DDR3 memory interfaces for an ample performance margin.



#### DESIGN-IN 2D EFFECTS THAT LOOK ALMOST LIKE 3D RZ/A1 WITH TES GUILIANI-LITE PREPAID PLATFORM

TES Guiliani on RZ/A1 is a cross platform C++ framework to develop visually appealing user interfaces. With TES Guiliani on RZ/A1, you can create stunning graphical user interfaces for embedded systems within minutes. TES Guiliani can be used with all RZ/A1 embedded MPUs and evaluated with the Stream It! RZ solution kit. Even better, with the new "Prepaid by Renesas" TES Guiliani-lite program, no GUI framework licensing costs arise for Renesas RZ/A1 customers in production.

#### Prepaid by Renesas



- Design the HMI on a PC with the Guiliani WYSIWYG editor "GSE"
- Simulate the HMI application on the PC Seamlessly load and
  - execute the HMI application on the target system

"Prepaid by Renesas" is for RZ/A1 customers using FreeRTOS and e<sup>2</sup> studio



To apply for your free "Prepaid by Renesas" TES Guiliani-lite license for Renesas RZ/A1q visit: https://www.renesas.com/en-us/products/microcontrollers-microprocessors/rz/rza/tes-quiliani.html

**TES Guiliani-lite on RZ/A1 Platform** 

#### Stream It! RZ/A1

Check out the RZ/A1 TES Guiliani-lite prepaid platform on the Stream It! kit (ver. 2) available for purchase through Future Electronics: Manufacturer Part # YS-

**TREAM-IT-RZ-V2** 









## Metal Line Switches Glow with 7 Luminescent Multicolor Options

#### ELECTRONIC COMPONENTS

#### SCHURTER's MSM series, metal line pushbutton switches are capable of multiple illumination possibilities.

The illumination provides a homogeneous quality in a ring illuminated style, or complete actuator area illumination. Status indication is possible in 7 different colors in a single product.

The setting of the individual colors is particularly easy to realize by means of the wire connectors, which are conveniently coded. Three flat plug connectors are used to control the colors red, green and blue. By combining several flat plug connectors, the additive colors cyan, magenta, yellow or white can be created.

The CPS switch family caters to the latest

technology trend for robust momentary and

latching pushbutton switches while sporting

the series offers a predefined standard range

choose from, allowing the customer to adapt

with many visual and functional options to

the pushbutton or the switch in general, to

their individual electrical and mechanical

The CPS series is made of high-grade stainless

housings. The variable input supply voltage is

5VDC to 28VDC . Switching voltage is 42VAC/

60VDC max. Switching current is 100mA max.

A wide range of illumination options, starting

with the selection of a ring illuminated or area

illuminated version, are offered.

Operating temperature range is  $-20^{\circ}$ C to  $+60^{\circ}$ C.

steel in 16mm, 19mm and 22mm diameter

an elegant modern look. In addition to the

IK 09 and IP67 ingress protection ratings,

The new MSM multicolor family offers the same diameters as the standard ring illuminated version in 16, 19, 22 and 30mm. The switch family is IP67 and IK07 rated.

#### **TECHNICAL DATA**

- 7 different color options with 1 switch
- Switching function: momentary
- Supply voltage: 24VDC
- Switching voltage: 250VAC/30VDC max.
- Switching current: 10A/100mA max. • Switching power: 2500W/3W

## **APPLICATIONS**

- Industrial machinery
- Vending and ticketing machines
- Pro-sound equipment
- Commercial food service appliances,
- e.g. espresso machines • Medical and dental equipment



Go to www.FutureElectronics.com/FT to download the SCHURTER Switch Product Overview.

## Metal Pushbutton Switch with **Capacitive Touch Sensor Technology**

#### **TECHNICAL DATA**

- Supply voltage: 5VDC to 28VDC (variable input voltage)
- Switching function: momentary or latching
- Switching voltage: 42VAC/60VDC max.
- Switching current: 100mA max. • Various illumination colors and color
- combinations possible

#### **APPLICATIONS**

- For indoor applications
- Industrial machinery
- Professional and home electronic equipment • Elevators and door opening/access
- control systems Medical equipment





## Future Display Solutions Can Handle ALL Your Needs





Features: High resolution, touch capable, handheld, clear video, and fast response. They can also operate on battery power.

Where would you use them? These devices are readable from a distance of 1 to 3 feet. Examples include smart handheld devices, motor controls, car audio systems, measurement instruments, and avionic instruments.







# Wearables Typical sizes are 0.5" to 2"

## Handheld Small to Medium Displays – 3.5" to 7.0"

strengthened glass.

product life.

Where would you use them? They are used in operating theaters, dental surgeries or anywhere UL listing monitors are required.

# Multimedia Displays 21" and above

When would you use them? These devices are readable from a distance of 6 to 15 feet. Typical examples include displays in shopping malls, airports, museums, video walls or advertising in stores.

FUTURE DISPLAY SOLUTIONS has years of combined experience and extensive resources available to you.

FUTURE DISPLAY SOLUTIONS has dedicated regional display engineering specialists available to travel to your location to help you design the perfect solution for your display.





requirements.

## **BUILD WITH QUALITY**

Features: Low resolution, low cost, high volume, long product life span, available in various colors and they can operate on battery power.

Where would you use them? Examples include wearables, handheld devices, stove controllers, microwaves, desk phones, and guitar tuners.

## Military and Industrial Rugged Medium Displays – 7" to 10.4"

Features: High resolution, touch capable, handheld, clear video, fast response and

Where would you use them? These devices are typically readable from a distance from 1 to 3 feet. Examples include military tablets, avionic flight bags, food service monitors, marine depth finders, car entertainment systems, and medical monitors.

## Medical Displays Typical sizes are 10.1" to 21.5"

Features: High resolution, touch capable, clear video, fast response and long

Features: High resolution, touch capable, clear video, fast response and long product

FUTURE DISPLAY SOLUTIONS offers a comprehensive selection of factory integrated LCDs with touch and single board computers from our franchised suppliers. Each of these solutions offers exceptional performance and solution size.

www.FutureElectronics.com/Displays

## **Omni-Directional Microphone Series**



The omni-directional microphone elements utilize electret condenser and dynamic technology, which is well-established within the microphone field. For industrial, medical, and consumer uses, these microphones provide excellent performance and ease of use in a small package at a low cost. All microphone elements in this series have an operating voltage range of 1V to 10V and are available with diameters ranging from 4 to 9.7mm.

Mallory Sonalert offers an array of termination options, including solder tabs, PC pins, wires, and solderless bullseye. Additionally, all microphone elements have a maximum impedance of  $2.2k\Omega$  and a Signal-to-Noise Ratio (S/N Ratio) of



These microphones are suitable for applications such as sound recognition, noise sensing, recording equipment, telecommunication equipment, and voice recognition devices. By adding these microphones to Mallory's product offerings, we are able to extend coverage to the audible products marketplace for consumer, industrial, medical, and military markets.

#### APPLICATIONS

- Sound recognition
- Noise sensing
- Recording equipment
- Telecommunication equipment
- Voice recognition devices



# Learn How You Can Leverage Future Electronics' System Design Center

Future Electronics offers the best solutions and service in the industry. Our Advanced Engineering Group together with our System Design Center is committed to assisting you with all your needs, whether schematic design or turnkey production.



PMO-4015MN-42HXQ PMOF-6027WN-44KDQ PMO-

PMO-4015PN-42KDQ	PMOF-6050P-36UQ
PMO-4015SN-42UQ	PMOF-6050S-44UQ
PMO-4530PN-47UQ	PMOF-9745P-39UQ
PMO-6022PN-48KDQ	PMOF-9745S-42UQ
PMO-6022SN-42UQ	PMOF-9745W-42UQ
PMO-6027P-40KDQ	PMOF-9767NP-46DQ
PMOF-6027NSN-36KDQ	PMOF-9767NS-40DQ

## Multi-Output PMIC with Integrated Sequencer



The IRPS5401 is a complete power management unit delivering up to 5 output voltages to processors, FPGAs and other multi-rail power systems. Four high efficiency configurable switching regulators and a Source/Sink Linear regulator provide the typical rails required such as core voltage, memory voltage and I/O voltages.

#### FEATURES

- Full power system including 5 integrated outputs
- 4A, 4A, 2A and 2A switching regulators
- 500mA source/sink linear regulator
- Single rail operation 5V to 12V
- Output range from 0.25V to 5.1V for outputs A-D and 0.5V to 3.6V for LDO
- Allows combining outputs and/or the use of an external PowerStage to increase output current to as high as 50A
- Emulated current mode control without external compensation
- Differential voltage sensing on switcher A for higher accuracy
- I<sup>2</sup>C / PMBus with integrated level shifter
- Advanced sequencing control
- Extensive PMBus command set of 74 commands
- Integrated current sensing and full telemetry including voltage, current, temperature and faults
- Rated for -40°C to +125°C T<sub>1</sub> operation
- Pb-Free, RoHS6, 7x7mm, 56-pin, 0.4mm pitch QFN

#### Typical PMIC Configuration





#### www.FutureElectronics.com

# **APPLICATION SPOTLIGH1**





#### **APPLICATIONS**

- High density ASIC, FPGA and CPU multi-rail systems
- Embedded computing systems
- Communications and storage systems
- Cinema projectors
- Antenna systems
- Security cameras
- Machine visions
- Point-to-point wireless access
- Mass spectrometers
- Instrumentation analyzers
- Sonar receiver probes
- Communications radios
- Printer control boards

#### **Evaluation Boards**





Board	Family	Description
EVAL_PS5401-INT	DC/DC Converter	5 output PMIC • 4A + 4A + 2A +2A + 0.5A
EVAL_PS5401-25A	DC/DC Converter	5 output PMIC with 25A PowerStage • 4A + 4A + 2A + 0.5A + 25A
EVAL_PS5401-40A	DC/DC Converter	5 output PMIC with 40A PowerStage • 4A + 4A + 2A + 0.5A + 40A

## Down to the Wire: PoE Converter and Controller Solutions

Ethernet

The Devices to Use:

Product

NCP1080/82

NCP1081/83

NCP1090/91/92

NCP1093/94

THINK

Aux Power Input (9 to 57V)

PoE-PD

PoE Shield

Evaluation

Board

NCP1080QBCGEVB NCP1080FLXGEVB

NCP1081SPCGEVB

NCP1083WIRGEVB

NCP1083QBCGEVB

NCP1090GEVB

NCP1094GEVB

Integrated DC-DC

Controller

Yes

Yes

No

No

#### **ON Semiconductor**®



Quite often we tend to primarily interact with electronic devices in a mobile or stationary state. Security cameras, controlled lighting, intercoms, and badge card entry scanners are all examples of devices that are removed from ample infrastructure but are not mobile. These remote devices need both power and data communication lines. In the last decade, Power Over Ethernet (PoE) has become a system that resolves the need for multiple connections. PoE is system that can safely and effectively transfer both power and data over a standard twisted pair cable within an Ethernet network. This standardized technology increases network device compatibility, ease of device deployment, device life cycle savings, system reliability, and safety.

ON Semiconductor offers a product family that represents a robust, flexible, and highly integrated solution. This IEEE compliant family is a flexible system that can be used as configurable DC-DC converters and controllers. Along with exceptional capabilities that enable applications to smoothly transition from non-PoE to PoE enabled networks, ON Semiconductor has also integrated this device into a shield for use with the modular IoT Development Kit. ON Semiconductor now offers industry leading solutions for all of your mobile, stationary, and remote devices.

#### DIFFERENTIATING FEATURES

- IEEE 802.3af/.3at compliant for new and existing PoE applications
- $\bullet$  Competitive advantage in: efficiency, thermal dissipation, BOM, and  $R_{\mbox{\tiny ON}}$
- Integrated DC-DC converter providing regulation to the application
- Extended power ranges for current operation (up to 1100 mA)
- $\bullet$  Cable ESD protection for hot swap events (3.0 kV)
- Non-standard 40W capability with .3at devices

#### The Tools to Help:

- PoE shield evaluation board for use with IoT development kit
- Full turn-key power supply design solutions
- BOM cost calculator
- Simulation models
- Design worksheet
- Layout guidelines



#### The Devices to Support: MOSFET Selection Guide

Do C Standard	Power	PoE Bridge	Primary FET	Clamp FET	Sync. FET	
FUE Stalluaru					5V <sub>OUT</sub>	12V <sub>OUT</sub>
	~ 7W	FDMQ8203	FDMA86151L	N/A	FDN537N	FDN86501LZ
IEEE802.3dl	15W	FDMQ8203	FDC86244	N/A	FDN537N	FDN86501LZ
IEEE802.3at	25.5W	FDMQ8205A 🛞	FDMS86102LZ	N/A	FDMC7692S	FDMC86520L
	60W	FDMQ8205A 🛞	FDMS86252L	FDMA86265P	FDMS8026S	FDMC86570L
POE++ (IEEE802.3Dt)	90W	FDMQ8205A 📀	FDMS86200	FDMC86265P	FDMS8025S	FDMS86540





VISHAY



Output Power

(W)

13

40

25

40

Description

PoE-PD and DC-DC

PoE-PD and DC-DC

High Power PoE-PD

Interface Controlle

High Power PoE-PD Interface Controller

## SiC46X microBUCK® SERIES IN A 4.5V TO 60V BUCK REGULATORS IN A NUTSHELL

© 2017 VISHAY INTERTECHNOLOGY, INC. ALL RIGHTS RESERVED.

## Next Generation DC Switching Regulators Maximize **Economy and Performance**



The next generation of non-isolated DC switching regulators, VX78-500, VX078-500, VX78-1000, and VX078-1000 series are extremely efficient, typically up to 96%, and balance maximizing economy while delivering a high level of performance as a direct alternative to using linear regulators.

Utilizing switching technology, the models are footprint compatible with TO-220 package LM78XX and LM79XX model regulators and unlike linear regulators, do not reguire a heat sink. This makes them ideal for use in portable devices, battery-fed equipment, and embedded designs where board space is at a premium and energy efficiency is a concern.

The encapsulated VX78 series and open frame VXO78 series, suited for positive or negative output applications, both offer 500mA and 1A output current options and have no-load input

currents as low as 0.2mA. Packaged in an ultracompact, 3-pin SIP footprint, the encapsulated models measure just 0.45 x 0.29 x 0.40in (11.60 x 7.55 x 10.16mm), while the open frame models have even smaller dimensions of 0.39 x 0.28 x 0.43in (10.00 x 7.20 x 11.00mm).

The 500mA series accept a wide range of input voltages up to 4.75 to  $36V_{pc}$ , while the 1A series accommodate input voltage ranges up to 6 to 36V<sub>DC</sub>. Nominal output voltages of 3.3, 5, 9, 12, or  $15V_{pc}$ , are also available depending upon the series. Operating temperatures for all models range from -40°C up to +71°C at full load, derating to 60% load at +85°C.

These non-isolated DC/DC converters also feature low ripple and noise, continuous short circuit protection, and UL 60950-1 and CSA safety certifications, along with the CE mark. All models carry a minimum MTBF of 2.000.000 hours at +25°C ambient, calculated per MIL-HDBK-217F.



www.FutureElectronics.com/FTM



#### **FEATURES**

- 0.5A for VX78-500/VX078-500
- 1.0A for VX78-1000/VX078-1000 current output
- -40 to +85°C temperature range
- Pin compatible with LM78XX and LM79XX linear regulators
- Wide input voltage range
- Suited for negative and positive output applications
- No load input current as low as 0.2mA
- Short circuit protection
- Low ripple and noise
- Efficiency up to 96%
- UL and CSA safety approvals

## Precision High Power Chip Resistors: HRG Series



#### Susumu, the leader in thin film chip resistor technology, has introduced another high power precision chip resistor series, the HRG series.

The HRG series is another innovative resistor derived from the RG technology. Unlike Susumu's other high power resistor, the PRG series which has long side terminals, the HRG series has conventional short side wraparound terminals. The proprietary resistor design and enlarged bottom terminals allow the HRG series to handle 4 times the power of the original RG series. Yet, the HRG series retains the original RG series' precision electrical characteristics and superb reliability.

With two series of high power chip resistors, the HRG series (short side terminal) and the PRG series (long side terminal), Susumu can meet any customer requirements for high power precision resistors.

#### **FEATURES**

- EIA standard size 3216 (1206 in inches) and power rating: 1W
- Thin film construction: low noise, excellent high frequency performance
- Absolute resistor tolerance: 0.1%, 0.5%
- Temperature coefficient of resistance:
- ±25ppm/°C, 50ppm/°C Maximum drift for load life (+70°C, 1000 hours)
- at rated power):  $\pm 0.25\%$ • Maximum drift for temperature humidity bias (+85°C, 85% relative humidity, 1000 hours):
- ±0.1% • Maximum drift after 1000 cycles (-55°C to +125°C): ±0.1%
- Maximum drift for high temperature exposure (+155°C, 1000 hours): ±0.1%
- RoHS compliant (100% lead-free), anti-sulfur and automotive O200





#### APPLICATIONS

- Power supplies
- Power switching
- Automotive braking systems
- Test and measurement equipment
- Motor deflection circuits
- Sensor applications
- Batteries
- Electric car charging boards

volution of SSM Chip Resistor Power Handling Capa



- Display S
- Resolution
- Interface
- Viewing
- Touchscr
- Integrati
- Optical E
- Power C
- Tempera

**Future Display Solutions** selects manufacturers and integrators with proven track records for great quality, supply chain capabilities and product documentation.

Contact



For quality displays with and without PCap Touch





Sunlight



# **BUILD WITH QUALITY**

#### WHAT TO CONSIDER WHEN DESIGNING IN A DISPLAY:

lize	Response Time
on	• Controller
	• Single Board Computer
Readable	• Cables
Angle	• Air Gap
een	Surface Treatment
ion	<ul> <li>Strengthened Glass</li> </ul>
londing	Bezel Design
onsumption	• Graphic Overlays
ture Range	• Gaskets and Sealing

AVOID PIXEL FAILURES, DUST BETWEEN LAYERS, CRACKED GLASS, END OF LIFE PARTS. LINE DOWN ISSUES OR EXTRA ENGINEERING **COSTS FROM HAVING TO REDESIGN YOUR DISPLAY!** 

Whether your project is for Medical, Military, Marine, POS, Transportation or Multi-Media,

**Build with Quality** 

**Future Display Solutions now!** 

For quality integration including tablets. NVIS backlights, or strengthened glass





# **Superior Display Solutions** for Customers



Tianma America, Inc. (TMA), a Tianma Group company, supplies customers around the globe with many high quality display solutions manufactured by the Tianma factories in China and Japan. In 1984 Tianma began manufacturing TN-LCDs in China and in 1991, Tianma Japan released the first color TFT LCD for laptops in the world. Today as a leading manufacturer of small-medium sized displays, TMA's objective is to provide the best display solutions for customers. Tianma America's team of experienced marketing, sales and engineering professionals combined with the Tianma Group's manufacturing resources and their cuttingedge display technologies positions the company to offer their global partners and customers a wide selection of display solutions.

#### For more information or to buy products, go to www.FutureElectronics.com/FTM

1.66"



## AM OLED PCAP TFT HIGH BRIGHT EBN SFT LTPS HIGH RESOLUTION **STN WIDE TRANSFLECTIVE**

# 

## **MULTIGIG RT 2 and MULTIGIG RT 2-R Connectors**



#### Modular Connector System for VPX Applications Supporting Data Rates to 10Gb/s

The MULTIGIG RT 2 connector, the standard for VITA 46, supports data rates up to 10Gb/s and represents a huge step forward in the world of rugged computing and C4ISR enabling technology. The modular connector system features a protected backplane connector and uses a pinless interface and wafer-based design in place of pin contacts. The connector system also offers built in ESD features enabling field serviceability, is extremely light weight and is fully qualified for VITA 46 environments.

#### **Quad-Redundant Contact System to Meet** VITA 72 Shock and Vibration Protocols

MULTIGIG RT 2-R connectors designed to meet VITA 72 environmental performance, while leveraging all the technical and economic benefits of VITA 72 VPX. Quad-redundant contact system increases reliability in a high vibration environment by providing double the points of contact versus our standard MULTIGIG RT 2 connector.

The connectors consist of interlocking left end and right end signal modules (half or full), center signal modules, and stand-alone modules available in vertical receptacles (backplane application) and right-angle plugs (daughtercard application), and complementary mechanical guide assemblies (available in size 7.2mm, 9.0mm, or 10.8mm). The guide assembly consists of a guide pin (used with receptacles) and a guide module (used with plugs). The guide assembly provides blind mating and misalignment for the connectors. The 9.0mm and 10.8mm guide assemblies also provide keying and are available with or without an internal contact for electrostatic discharge (ESD) protection.

The modules are capable of being stacked in any configuration with limitations, to a maximum length of 120 between guide assemblies. These connectors perform at two separate density levels: Tier 1 and Tier 2.

Each module has 6, 8, or 10 rows of eye-of-needle compliant pin signal contacts with 20.3 or 25.4 centerline spacing (profile size). A right-angle plug module having 7 rows with 20.3 centerline spacing is also available for Tier 2 only to accommodate special applications used by the VMEbus International Trade Association (VITA). The signal contacts, along with the ground contacts (in Tier 1 modules only) and ESD contacts (if using the 9.0mm or 10.8mm guide assembly with ESD contact), provide sequencing for each group of modules.



#### FEATURES

- Quad-redundant contact system supports high levels of shock/vibration
- Compliant to VITA 46 for Open VPX applications
- Supports Ethernet, Fibre Channel, Infini Band applications, PCIe and Serial RapidIO high speed protocols
- Modular, lightweight connector system
- Robust "pinless" interface
- Differential, single-ended and power
- Ruggedized guide hardware available
- Supports 0.8in card slot pitches
- VITA 46 compliance enables upgrade in existing VPX applications
- Can be combined with high power modules (VITA 62), RF modules (VITA 67) and Optical modules (VITA 66)

#### APPLICATIONS

- Ground defense
- Electronic systems/C41SR
- Commercial and military arospace
- Missile defense Space





MULTIGIG RT, TE Connectivity, TE connectivity (logo) are trademarks. VPX isa trademark of VITA.



The Avalanche Development Kit allows developers to quickly prototype for the lowest power mid-range FPGA platform in the market. At the heart of the kit is a 300k LE (logic element) PolarFire™ non-volatile FPGA from Microsemi.

The Avalanche Kit is loaded with several key components including the Panasonic WIFI module PAN9320, Microchip 64Mb of Serial Flash, Alliance 4Gb DDR3 Synchronous DRAM, Microsemi VSC8531 Gigabit Ethernet

#### **PolarFire's Best in Class Capabilities**

- Lowest power
- Cost optimized 12.76G SERDES-based FPGA
- Lowest cost DDR4 and high-speed I/O solutions
- Smallest form factors
- 11 X 11mm 100KLE
- 11 x 14.5mm 200KLE
- 16 x 16mm 300KLE
- Built-in cryptographic processor
- SEU immune fabric
- Non-volatile, instant on
- 2-5x more 3.3V I/O









PHY, Embedded FlashPro5, USB2 UART and programming for the PolarFire FPGA. In addition, there is a Microchip 6-channel, Delta Sigma Analog to Digital Converter, Halo Power Inductor and Fast Jack.

Coupled with the PolarFire FPGA are 3 industry-leading interface standards to enabling engineers to implement virtually any design they can imagine, Sullins Arduino<sup>™</sup> compatible shield, mikroBUS<sup>™</sup> socket, and Pmod connector/Interface.

There are hundreds, if not thousands, of peripherals that can be connected to the Avalanche Kit.



Order your AVMPF300TS-00 board today!

For more information or to buy products, go to www.FutureElectronics.com/FTM

# **DESIGN** NOTE

#### The Case for RISC-V in the Industrial Market By: Ted Marena, Director of SOC/FPGA Product Marketing & Business Development Microsemi, Vice-Chair RISC-V Marketing Committee



The industrial market has many unique needs that are not present in other vertical markets. Characteristics such as longevity of supply, long life product cycles, robust and reliable technologies, just to name a few. These designs also want technology that they can depend on for support for long periods of time. When it comes to processors being used in the industrial segment, there is a major shift which designers should be aware of. This new processor ecosystem is called RISC-V. Microsemi is a leading vendor adopting RISC-V. They have recently introduced their Mi-V RISC-V ecosystem which consists of tools, processor cores, solutions and more (www.Mi-V.org).

Today, the vast majority of processor architectures is an Intel x86 variation or an ARM, mainly A class processor. Although it is unlikely these processors will not be very popular in the future, the RISC-V processor ecosystem is poised for rapid growth in the industrial market. The RISC-V processor is founded not on an architecture but on a fixed instruction set (ISA). The design of the processor architecture is flexible. You can use an architecture that has some operations accelerated in hardware or a processor designed for lower power consumption. All of the variations in the RISC-V micro architecture are acceptable because the ISA is fixed. To enable broad use of RISC-V, the RISC-V foundation, froze the instruction set in 2014 so the market could dictate the processor architectures. The RISC-V organization is a non-profit foundation controlled by more than a hundred member companies, including many tier-1 organizations. It directs the future development of HW/SW specifications and the ecosystem, and drives the adoption of the RISC-V ISA. With the ISA set in stone, engineers can now implement processor architectures optimized for their requirements.



**Mi-V Ecosystem Components** 

Most industrial designs are leveraging Linux for their operating systems. Because of this market shift, designers and architects are free to choose any processor which is supported by Linux. In addition, with the widespread adoption of Linux, it is rendering the choice of the ISA and the processor itself to be simplified. If the processor supports Linux, then it can be considered. With each new version of ARM processors, the instruction set tends to grow. This actually requires new versions of Linux to support the newer architectures. Because the RISC-V ISA is frozen, code migration from one RISC-V core to another is much more seamless than migrating from one ARM to another. Because of the dominant Linux OS, the industrial market can rapidly adopt RISC-V as a new standard open architecture for direct native hardware implementations. This is one of the main reasons RISC-V is attractive for the industrial market. However, there are additional factors which make RISC-V more attractive than other processor architectures, even if you do not use Linux in your design. These can be summarized as follows:

#### Why RISC-V?

Simplicity: Because the ISA is fixed and contains less than 50 instructions and multiple standard extensions, it offers a stable, clean-slate design platform with clear and secure separation between User and Privileged modes. Designs are very simple to develop because all of the instructions have been frozen. Additions to the standard instruction set are made through extensions—not new ISA versions—for additional stability in future designs. These few instructions allow simple architectures to be created, which in turn leads to very cost effective and power-efficient processors. The industrial market can benefit from the fixed ISA and count on this consistency for years to come.

Portability: Designs which could ramp into high volume will benefit from the portability of RISC-V. Start a design in an FPGA with a soft gate version



Microsemi<sup>®</sup> IGLOO<sup>®</sup>2 FPGA

of a RISC-V core and begin shipping the product. **Because the software** will be completely portable across all devices that have a RISC-V core, this creates "royalty-free" processor sub-system RTL code that can be implemented in hardware. Designers can modify, adapt, and migrate their design to the best platform available for their product. If the selected FPGA becomes obsolete, there is no need to rewrite the software code. You have the entire source RTL. Simply retarget this to another FPGA. Alternatively, if the volumes reach high enough levels, simply retarget the RTL source to an ASIC without paying any royalty fees! This is simply not possible with an ARM or x86 type processor.

Certification and Safety: For industrial designs which require functional safety, RISC-V's flexibility enables unique solutions. For example, one could design a system with multiple, functionally-equivalent cores autonomously designed for the ultimate in redundancy. One core could be the Microsemi RV32IM, and the other core could be a functionally-equivalent, yet completely different, in-house design. RISC-V also allows complete flexibility over the micro architecture, so one could provide single event upset (SEU) protective measures for data and instruction cache memory. Many other safety prevention techniques can be used because RISC-V allows access to the RTL. For industrial designs which must be certified, providing the RTL for the RV32IM from Microsemi will enable inspection so the core can be more easily certified. These are the key benefits of the RISC-V ISA. Now, you may be asking yourself, "OK, how do I learn more about using a RISC-V core for my next design?" There are several places to get started. For background information about RISC-V and its member organizations, go to www.riscv.org. If you want to simply jump into a design and begin coding for a RISC-V core, head over to Microsemi's Github site, github.com/ RISCV-on-Microsemi-FPGA. Microsemi was the first FPGA vendor to offer an open architecture RISC-V IP core and a comprehensive software IDE solution. Designers can deploy the RISC-V IP core in multiple flash based FPGAs, including the PolarFire FPGAs, IGLOO2 and SmartFusion2 devices. These devices also enable one to store the boot code for the RV32IM in secure eNVM which could prevent malware or a root kit from being installed. Embedded engineers can leverage the benefits of this open HDL architecture in their custom FPGA designs by using the Libero SoC Design Suite.

If you just want to review a RISC-V core and write software executable Industrial designers now have a compelling new alternative processor code, Microsemi has created a series of reference designs. My favorite and architecture to consider with the mainstream adoption of RISC-V. If you the least expensive is for the Creative board RISC-V reference design, as run Linux in your system, selecting an appropriate RISC-V device provides shown in the following figure. By leveraging the **Future Electronics** you a compelling alternative to ARM. The advantages of design portability, Creative development kit and an Arduino touch screen display, Microsem retargeting to different hardware and lower power can benefit virtually has implemented their RV32IM core and compiled source code to run a every industrial application. Customers can also count on the fixed ISA to tic-tac-toe game. For software code development, the Eclipse-based Soft ensure longevity of the architecture. The RISC-V processor is especially Console integrated development environment (IDE) hosted on a Linux or compelling for applications where functional safety, certification and security Windows platform provides complete development support, including a C is important. For industrial engineers who prefer to collaborate and are or C++ compiler and debugger capability. able to leverage the open source community, RISC-V is the logical choice. Regardless of your reason, there is no doubt that using a RISC-V core To buy products or download data, go to www.FutureElectronics.com/FTM unleashes a new generation of innovation for embedded industrial designers.





# **DESIGN** NOTE

# IGLOO2 Core RISC-V Tic-Tac-Toe 書意音者 日子 AEG

The complete reference design can be created by purchasing the Creative board (www.FutureElectronics.com/CreativeDevelopmentBoard) and the Arduino shield display (www.adafruit.com/products/1651). Together, these cost only \$135. The Microsemi RISC-V IP core, Libero SoC development software, and the Soft Console IDE can all be downloaded free of charge from the Microsemi Github site.



#### Creative RISC-V board with IGLOO2 FPGA Block Diagram

# **DESIGN** NOTE

#### **NXP** Touch Solution By: Jonson Chen, SZ China



#### Introduction

The user interface of a product is a key element that design engineers need to address to provide a compelling user experience. Touch pads, sliders and rotaries offer a more intuitive and effective way of user interaction than traditional buttons. And, designing a touch-based user interface is simplified with the NXP Touch solution. This solution includes software that is designed to work simply and seamlessly with NXP's capacitive touch sensing hardware IP TSI that's available on Kinetis KE15Z MCUs. Key benefits of the NXP Touch solution include:

- Robust EMC performance, noise immunity with IEC61000-4-6 standard certification with the 3V and 10V tests
- Self-cap and mutual-cap modes, supporting more than 49 touch keys.
- Liquid tolerance, effective performance even with liquid substances such as water, salt water, oil, cold steam, etc.
- High sensitivity with a sensitivity boost feature when the touch overlay on the user interface is thick (acrylic, glass)

#### **Understanding the Hardware TSI Measurement**

Touch sensing interface (TSI) provides touch sensing detection on capacitive touch sensors. The external capacitive touch sensor is typically formed on PCB and the sensor electrodes are connected to TSI input channels through the I/O pins in the device.

KE15Z TSI supports 2 kinds of touch sensing methods, the self-capacitive mode and the mutual-capacitive mode, as showing in the figure below.





#### **TSI Mutual-Cap Mode Sensor Structure**



#### Self-Capacitive Mode

The self-capacitive mode requires a single pin for each touch sensor and measures the capacitance on an electrode connected to a single TSI channel. It then converts the capacitance into a digital count by driving average current on the electrode and measuring the charge/discharge times.

The self-capacitive mode is simple, easy for touch board layout, and allows customer to design different touch pad shapes and maximize touch functionality. The typical applications of the self-capacitive mode include buttons, sliders and rotaries. Furthermore, as the self-capacitance mode tends to emit electric fields in all directions, it provides better proximity range than the mutual capacitive mode because the electric fields of the mutual mode have certain direction. KE15Z TSI self-capacitive mode offers sensitivity boost feature and supports up to 35cm proximity distance which can meet typical customer requirements in home appliance. Considering the waterproof buttons, the self-capacitive mode is preferred as it supports the shield feature which can eliminate the water impacts.

Inside the TSI IP module, the TSI scan is operated by non-overlapping clock ph1 and ph2 and a trans-conductance amplifier. There're two phases controlled by the ph1 and ph2 respectively for the TSI scan module:

- Sample phase: The switch ph1 controls the sample phase, when ph1 turns on, the external touch electrode Cx is charged by vdd3v.
- Charge phase: The switch ph2 controls the charge phase, when ph1 turns off then ph2 turns on, the charge on the capacitor Cx flows to the internal integrated capacitor Ci, which generates the average current Icx.

#### TSI Self-Cap Mode Block Diagram



#### **Mutual-Capacitive Mode**

Mutual capacitive mode measures the capacitance between two electrodes connected to two TSI channels. One of the TSI channels is used as a transmit (TX) channel and the other as a receive (RX) channel.

In general, the mutual capacitive mode has lower measurement time than the self-capacitive mode. As the mutual capacitive mode detects the finger touch by the XY coordinates, it's an efficient way to implement the key matrix using less TSI channels compared to the self-capacitive mode. Furthermore, the mutual capacitive mode is preferred for the multiple buttons at one time applications.

There're two phases controlled by the switching clock for the TSI mutual capacitive mode:

- Charge phase: The switch ph1 controls the charge phase, when ph1 turns on, the transmit channel outputs pulses which is coupled through the mutual capacitance Cm. Receiver converts the received voltage pulse (Vpre+ $\Delta$ V) to the current Icharge through the resistor Rs.
- Discharge phase: The switch ph2 controls the discharge phase, when ph1 turns off then ph2 turns on, the transmit channel changes the voltage from Vdd5v to 0V. Receiver converts the received voltage change (Vpre- $\Delta$ V) to the current Idischarge through Rs.



As the integrated Ci is charged/discharged by the amplified current from receiver, the voltage Vci ramps on Ci, when the Vci becomes larger than the pre-setting Vp, the comparator will stop this TSI scan round and the digital filter will record the sample result as TSICNT.

#### Software Development Based on NXP Touch

NXP Touch software is designed to speed development of your touch can get your touch evaluation kit: FRDM-KE15Z, FRDM-TOUCH applications and is ideal for use with KE15Z TSI IP. Available as a source code, this software features touch detection algorithms and is ideally suited FRDM-KE15Z is an ultra low-cost development platform, offers two self-cap for RTOS based applications. NXP Touch software employs a modular buttons on board, and compatible with Freedom touch shield FRDM-TOUCH architecture with a variety of touch centric controls, modules, and electrode FRDM-TOUCH provides more touch patterns for promotion and customer data objects, enabling integrated and customizable features. evaluation, including 4 mutual cap buttons, 1 touch slide and 1 touch rotary.

NXP Touch software is based on a layered architecture with data types resembling an object-oriented approach and uses plain C language to configure electrodes, modules and controls. The library code is well suited for use in RTOSbased multi-tasking applications and in C++ object-oriented applications.

The touch sensing algorithms contained in the library use a dedicated touch sensing interface (TSI) module available on the Kinetis KE15Z MCU to detect finger touch, movement or gestures.





FUTURE

# **DESIGN** NOTE



#### NXP Touch Software Block Diagram

#### **Touch Evaluation Kit**

If you're interested in evaluating NXP touch solution for your product, you



# **DESIGN** NOTE

#### Expanding a Strong Foundation: "Ruggedizing" Connectors for Next-Generation Embedded Computing Applications By: Matthew R. McAlonis, Development Engineering Manager, TE Connectivity Global Aerospace



More. That's the essence of "pushing the performance envelope." For designers of embedded computer systems in military and aerospace applications, it means higher speed processing to handle the ever-increasing complexity of signals intelligence and networked warfare. This, in turn, requires connectors not only capable of handling the high data rates, but also offering increased ruggedness to provide reliable operation in

harsh environments.

Even as designers pursue higher processing loads and more rugged components, two other trends affect the design of connectors. The first is to address SWaP—size, weight, and power consumption—to create systems that are smaller, lighter, and more capable. In high performance aircraft, whether manned or unmanned, where space is always at a premium, weight has a direct relationship to flight times and payload, and efficient power distribution helps allow for smaller power-generation components. Thus, it is no surprise that system designers are obsessed with SWaP.

The other important trend is the use of commercial off-the-shelf (COTS) components—ensuring product availability when you need it. Even a new design can be COTS-based by taking as building blocks well-established and field-proven technology.

New levels of connector ruggedization can take two forms: (1) an entirely new connector or (2) an upgrade to an existing connector. Option 1 gives the most freedom, but at the expense of legacy product designs and standards. Option 2 allows backwards compatibility with existing connectors and board designs.

The TE Connectivity (TE)Fortis Zd connector is an example of Option 1. Even though the connector is relatively new, it has its roots in COTS. This connector, designed around military pedigree MIL-DTL-55302 Mini-Box contacts, is a new design that offers higher speeds (12+ Gb/s) and high levels of ruggedness. The connector has

been considered for several standards, and finds applications where performance trumps meeting a standard.

> An example of Option 2 is seen in TE's MULTIGIG RT 2 connector, which is discussed in detail below.



Figure 1: A typical VITA 46 6U VPX configuration uses the MULTIGIG RT 2 connector. The use of wafers in the MULTIGIG RT 2 daughtercard connector helps create a lightweight, versatile, pinless connector design.

#### **Torture Testing a Connector Design**

For standards-based embedded computing, VITA 46 and 47 have been standards for measuring compliance and performance. These standards define mechanical systems packaging requirements as well as test requirements for shock, vibration, temperature, and other environmental stresses that systems in general and connectors in particular must withstand.

Ruggedized connectors, such as the MULTIGIG RT 2 connector specified for VITA 46 VPX systems, must meet VITA 47 requirements. More recently, some companies in the industry have looked to understand margin beyond VITA 47 to even more stressful testing of connectors. The VITA 72 Working Group has created new levels of testing—torture testing, as it were connectors well beyond the needs of anticipated application hazards. And in doing so, the tests led to improvements in connector design. One of the connectors tested was the MULTIGIG RT 2 connector.

The connector uses a pinless design: wafers in the daughtercard half and split-beam, spring contacts in the backplane side. By eliminating pins and the problems of stubbing and bent pins, the pinless design helps to increase reliability and prevent damage during card handling and mating. The wafer-based design of the daughtercard allows each wafer to be individually configured: single ended, differential, or power, or even hybrids. While VITA 46 specifies the types of

connector modules for each module zone (P0through P6), the wafer design gives designers the potential to mix and match wafers if necessary. A significant benefit for meeting SWaP issues is that the MULTIGIG RT 2 connector is the lightest VPX connector available—owing in large part to the lightweight wafer and connector construction.

#### **Testing a Connector's Mettle**

Figure 2 shows one of the major differences in vibration testing between the VITA 47 standard and VITA 72 requirements, based on testing criteria created by Mercury Systems and the VITA 72 Working Group. RL3 is essentially the same as VITA 47's V3. RL3 + 3dB substantially increases the vibration level. This higher power spectral density subjects connectors to much greater stress, increasing the potential for contact fretting and plating wear caused by the vibration-induced movement of contacts against each other. These higher vibration levels were also run for longer exposure times than in the prior VITA 46/VITA 47 testing. The general test sequence was:

• RL3 Random Vibration: 1 hour per axis

• RL3 + 3dB Random Vibration: 1 hour per axis • RL3 + 3dB Random Vibration: 12 hours, Z axis



Figure 2: Testing performed by the VITA 72 working group subjected connectors to much more stressful testing with the RL3 + 3dB level random vibration

Upon examination of the product tested by the VITA 72 working group, the original MULTIGIG RT 2 connector performed remarkably well; however, select locations along the 6U card showed high levels of wear, suggesting an enhanced contact solution would be desired.

Conventional connector wisdom says increasing the points of contact at the separable interface is effective because multiple contact points provide redundancy, thus increasing the reliability of the connection. Some have suggested that the sweet

spot is four points of contact. For example if the probability of contamination affecting the contact resistance is, say, 0.01 on a given contact, the probability for all four points of a four-point contact being simultaneously affected is (0.01)<sup>4</sup> or 10<sup>-8</sup>! This illustrates the power of redundancy. Part of the redesign included a major enhancement in the mated contact pairs while maintain ing backward compatibility with the existing design. In the original connector, each contact spring beam makes a single point of contact with the wafer pads. In the newer version, the contacts have been redesigned so that each beam makes two points of contact—termed guad redundant—roughly doubling the contact patch area. Figure 3 shows the original and redesigned contacts.



Figure 3: Original and guad redundant MULTIGIG RT 2

An important feature of the new enhanced design is that the contact beams and areas on the two beams are not symmetrical to one another. The difference in contact beam lengths means that each beam has unique frequency modes in response to vibration, helping to eliminate the possibility of both beams achieving a resonance simultaneously. Even with increased contact points, the new enhanced contact system does not increase mating forces while helping maintain reliable contact under extreme vibration levels

The wafers in the mating half were also slightly modified to take full advantage of the new beam design. Because two of the four contact points on the split beams are deeper, the signal pads on the wafer were extended 1.2mm to maintain at least 2mm of contact wipe during mating, to maintaining quad redundancy throughout the entire mating range of the original design.

#### **Test Results**

Figure 4 shows the results of a 6U VPX module when "torture tested" to the levels as specified in Figure 2. To inspect for indications of contact wear, each connector module was dissected and visually reviewed for signs of contact wear on both the original and modified contact systems. Although most of the contacts in the 6U arrangement are able to withstand this extreme vibration environment, there are specific contact locations that are susceptible to fretting wear. Most important, the wear that was experienced with the original contact design practically disappears with the new quad-redundant design. Interestingly, the choice of guide hardware also influences performance.

The role of guide hardware in helping ruggedize a connector is often overlooked. The primary purpose of the hardware is to help the mating process by providing card slot keying and initial alignment of the connector halves. Many guide posts and modules are economically manufactured using a die cast process. To fulfill the keying and guiding function, post and receptacle can have fairly generous manufacturing tolerances common for die cast parts. As a result, the guides play a reduced role in restricting motion during shock and vibration.

Machined guide hardware is gaining attention for challenging applications because the more precise fit has shown to reduce fretting motion. A precision fit in combination with a circumferential grounding spring helps stabilize the connectors in a high vibration environment, as shown in Figure 4.



igure 4. Comparison between highest wear locations from each 6U VPX test sample when subjected to the "torture test" led by the VITA 72 working group. Both contact design and accessory hardware influence connector performance in high vibration environments



# **DESIGN** NOTE



Figure 5: Contacts after 10,000 mating cycle durability testing show acceptable contact surfaces.

#### VITA Compatibility and Designing **Connectors for Reliability**

Since the MULTIGIG RT 2-R connector has the same board footprint and mating interface, it is a drop-in replacement for the original VITA 46 connector. The guad redundant backplane connector can mate with the original daughtercard connectors—the main difference being that it maintains unique contact wiping distances on all four points of contact. For a new daughtercard connector mating with an original backplane connector, the main difference is an additional 1.2mm contact wipe during mating, which offers greater margin for system insertion tolerances.

#### New or Upgraded?

In looking for a more rugged connector for embedded computing, both the Fortis Zd and MULTIGIG RT 2-R connectors offer robust performance. The Fortis Zd connector is an example of a new connector using reliable, legacy contact technologies and a contact density about 20% higher than the MULTIGIG RT 2 connector's (900 vs. 728). It thus is a good choice for applications not requiring standardsbased (VITA) compatibility. But for those with a large investment in VPX systems, the Fortis Zd connector is not usually an option. VPX standards have a robust ecosystem. The MULTIGIG RT 2-R connector is a high-performance example of expanding the options for an industry-standard design for an even more rugged future.

Fortis Zd, MULTIGIG RT, TE Connectivity, TE connectivity (logo) are trade-marks. VPX isa trademark of VITA.



To buy products or download data, go to www.FutureElectronics.com/FTM

# TECHNICAL VIEW

#### Primer to Cryptography and Embedded Security By: Cheong Wei Chua, System Program Manager, Future Electronics

Hacking, cloning, and counterfeiting are risks which many electronic manufacturers need to contend with. Some manufacturers have implemented mechanical systems or labels to protect their products, but these trivial mechanisms do not deter counterfeiters if the rewards are large. Hence, suppliers of crypto solutions offer embedded security to counter these risks. However, it is a challenge for design engineers to not only understand the applications, but the basic theory of cryptography. This primer serves to explain key cryptography concepts which are the building blocks of embedded security.

There are two basic ideas around security. The first one is authentication which means making sure that the client in question is authentic. The second is data protection; that means data is transmitted confidentially (via encryption) and that the integrity has not been compromised. For example, data can be maliciously replaced or modified during transmission.



#### The Challenge

Let's start with a basic problem statement. Bob would like to send a private message to Alice through a channel. However, the channel is not secure; as a consequence Eve could listen in on the channel and get the message.



The solution would be to encrypt the message before sending it though the channel. Once Alice receives the message, she would decrypt

#### The Solution Private Message Encryption Bob Bob Everyption Everyption Construction Decryption Construction Constructio

the message. No one else can decrypt the message unless they have the key as illustrated below.



In crypto language, plaintext refers to the message which Bob wants to share with Alice. He uses a scheme and a key to scramble the message. This encryption process results in a ciphertext which Eve is unable to unscramble. Alice, on the other hand, was privy to the scheme and key, and therefore is able to decrypt the ciphertext to obtain the original plaintext. The next section talks about the different classical ciphers.

#### The Shift Cipher

One of the earliest ciphers that was used is the Shift Cipher. This cipher was also used by Julius Caesar for his personal correspondence, hence the name Caesar's cipher. The idea is to shift the plaintext by a fixed amount. In this simple example, "o" becomes "Q"and "n" becomes "P" after shifting by 2 places. So Bob encrypts using Key = 2, and Alice will reverse shift the ciphertext by 2 when she receives it.



Eve can methodically try shifting all the letters in the alphabet. This brute force approach works as they are only 25 keys to try before breaking the code!

#### The Substitution Cipher

In order to deter a brute force approach, another scheme based on assigning an arbitrary ciphertext for each plaintext is shown in the following example:

Plaintext	Ciphertext
a	L
b	Q
с	Р
d	Μ
Z	1

Hence, for Bob to encrypt his message, all he has to do is look up the ciphertext letter in the table. For example, if "cab" is the plaintext, then "PLQ" is the ciphertext. Since Alice also knows the cipher, she could easily decrypt the ciphertext.

However Eve does not have the table, thus she will not be able to decrypt the message easily. And if she wants to endeavor to use a brute force approach there are 26! or 403291461126605635584000000 attempts in order for her to break the code.

#### The Weakness of the Substitution Cipher

Nevertheless Eve remains undeterred. She has another trick up her sleeve. She can exploit the fact that certain letters in the English language are used more frequently than others. If we look at a ciphertext, we can count the occurrence of each letter, and compare that to the frequency of letters in a regular text.

In the following table, we can see that the most

frequent letter in the English language is E, followed by T, A and O.



Thus all Eve needs to do is to match the frequency of letters that occur in the ciphertext with the established frequency of regular English text!

For example, if we calculated the frequency of ciphertext and found that the occurrences of the following in decreasing order is "p, b, a, t and m", it is likely that these letter correspond to the letters "e, t, a, o and i" respectively as these are the most common letters in English!

#### Classical to Modern Cryptography

The shift and substitution cipher form the basis of classical cryptography. It can be done by hand to some degree. Modern cryptography is based on the same principles but with the advent of computers, automation allows ciphers to become much more complex.

#### **Modern Ciphers**

The two most important ciphers in modern cryptography are: 1.Data Encryption Standard (DES) 2.Advanced Encryption Standard (AES)

DES was developed by IBM in 1976 when the US Government wanted a standardized cipher for their secret documents. The development of DES was actually the origin of modern cryptographic research. But DES was short lived because the key length was too short. For example, if the key was 56-bits long, there are 256 possible keys. With the advent of faster computers, machines were designed to simply apply brute force to crack the code. The response was to increase the key length to 128-bits and to introduce Triple DES. However, in 1990, Biham and Shamin discovered differential cryptanalysis which exploited the fact that DES was not truly random! With DES effectively cracked, a new cipher was required. In an open competition, which saw the world's best cryptologists, the Rijndael cipher

# Symmetric Encryption

#### The Solution to Symmetric Key Cryptography Drawback: Public Keys

In 1976, Diffie and Hellman published a paper to address this challenge. The approach was to use one key for encryption and different key for decryption. Here is how it works. Bob sends out a public key. Everyone including Alice and Eve would obtain this key freely. Alice then uses Bob's public key to encrypt her plaintext. Everyone is privy to this ciphertext but only Bob can decrypt the ciphertext because Bob is the only one who has the corresponding private key. The magic happens because of the pairing of public and private keys. The private key must never be shared. This scheme is also known as asymmetric key cryptography.



was selected in 2001 to become the Advanced Encryption Standard which is widely known as AES today. Nearly 20 years have passed, and and no one has yet to come up with a practical way to break AES. It was chosen because it can be implemented in software and hardware, and it is fast, flexible and future-proof.

#### The Drawback of AES: How to Share the Secret Key?

# TECHNICAL VIEW

As shown below, both Alice and Bob share a secret key. What if Alice were in India and Bob were in Africa? Just how would they share the key? Bob can't email the key to Alice as Eve is eavesdropping. Alice and Bob would have to meet physically to agree on a secret key. Obviously this is problematic if we always had to meet in person to establish the secret keys. This is the drawback of symmetric key cryptography. DES and AES use symmetric key cryptography.





#### Asymmetric Key Cryptography: Authentication and Non-repudation

Another use of asymmetric key cryptography is authentication and non-repudation. Alice can use her private key to sign a plaintext. When Bob receives the ciphertext, he uses Alice's public key to decrypt the message. He can only succesfully decrypt the message if it was truly encrypted/signed by Alice. Eve would not have been able to sign the message as Alice since Eve does not have the private key. Furthermore, Alice cannot deny that the ciphertext orginated from her as her key is her signature. This is known as non-repudation.



#### RSA Public Key<sup>1</sup>

One of the most popular public pey ciphers is RSA which is named after the creators: Rivest, Shamir, and Adleman. The idea uses the fact that it is difficult to factor large numbers. Here is the recipe of RSA:

. Choose two different large random prime numbers *p* and *q* 



To buy products or download data, go to www.FutureElectronics.com/FTM

# TECHNICAL VIEW

## Primer to Cryptography and Embedded Security

#### 2. Calculate n = pq

- *n* is the modulus for the public key and the private keys
- 3. Calculate the totient:  $\phi(n) = (p-1)(q_1)$
- 4. Choose an integer *e* such that  $1 < e < \phi(n)$ is coprime to  $\phi(n)$  ie: *e* and  $\phi(n)$  share no factors other than 1;  $gcd(e \phi(n)) = 1$ • *e* is released as the public key exponent
- 5. Compute *d* to satisfy the congruence relation  $de = 1 \pmod{\phi(n)}$  ie:  $de = 1 + k\phi(n)$  for some integer k

• *d* is kept as the private key exponent The **public key** is made of the modulus *n* and the public (or encryption) exponent *e* The **private key** is made of the modulus *n* and the public (or decryption) exponent *d* which must be kept a secret

#### **Encrypting Messages**

Alice gives her public key (n and e) to Bob and keeps her private key secret. Bob wants to send message M to Alice.

First he turns **M** into a number *m* smaller than *n* by using an agreed-upon reversible protocol known as a padding scheme. He then computes the ciphertext *c* corresponding to:  $c = m^e \mod n$ 

This can be done quickly using the method of exponentiation by squaring. Bob then sends *c* to Alice.

#### **Decrypting Messages**

Alice can recover *m* from *c* by using her private key d in the following procedure:  $m = c^d \mod n$ 

Given m, she can recover the original message **M** Source: https://simple.wikipedia.org/wiki/RSA\_(algorithm)

Another public key cipher introduced recently is Elliptic Curve Cryptography (ECC). It uses the "dot" function, and it is faster to compute than the RSA. Thus is it gaining popularity.



In Table 1, from NSA, one can see that in order to achieve a security strength of AES-128, ECC only needs a 256-bit public key whereas RSA would need 3072 bits.

Another way to compare RSA and ECC performance is to look at the time it takes to break the security. Clearly, the graph shows that ECC is more efficient as it uses a short key length to achieve the same level of security as RSA.



Security Comparison for Various Algorithm-Key Size Combinations (Source NSA)

	Convertere Dite	Symmetric Encryption	Minimum Size (Bits) of Public Keys		
	Security Bits	Algorithm	RSA	ECC	
	80	Skipjack	1024	160	
	112	3DES	2048	224	
	128	AES-128	3072	256	
	192	AES-192	7680	384	
	256	AES-256	15360	512	

Table RSA ECC DES AES 180, 224, 256, 320, 512 1024, 2048, 3072 56.128 128, 192, 256 Key length (bits) Fast Execution speed Slow Slow Fast Authentication/ Yes Yes No No non-repudation Gaining popularity Obsoleting Future-proof Comments Need longer keys

#### Symmetric vs Asymmetric Key Cryptography

Asymetic key cryptography is great as Alice and Bob do not need to physically meet to exchange keys. It is also be used to verify and non-repudate the user. So why do we still use AES? The shortcoming of asymmetric key cryptography is that it is too slow to encrypt sizeable messages Instead, Bob sends the symmetric key to Alice using the public key cryptography, then use the symmetric key to encrypt the bulky messages.

The idea is to take advantage of the:

#### Speed of symmetric key cryptography and Security of asymmetric key cryptography

The summary of how the asymmetric and symmetric cryptography compare is seen in Table 2.

#### Embedded Security

Suppliers such as NXP, Infineon, Microchip and Renesas provide security solutions like anticloning and Secure Boot by employing modern cryptography. In addition to that, they make tamper resistant hardware to ensure keys/data which reside in these devices cannot be read or compromised.

#### Conclusion

This paper has outlined the basics of classical and modern cryptography. It explains why asymmetric and symmetric cryptography are both needed in modern day security. While AES provides a fast encryption algorithm, it depends on the fact that both parties are privy to the secret key. Hence the introduction of RSA or ECC which enables users to share the AES key. Finally, these encryption algorithms provide the basis of authentication and data integrity.



## **Design and Customize Your TFT LCD Solution** with AGDisplays

For over a decade AGD isplays has been a leading provider of high quality LCD enhancement products and services for the industrial markets. We provide a one stop shop with immediate turnkey capability for LCD upgrades and design work. Our extensive product offering includes creating new and enhancing existing designs, LCD ruggedization and simple or complex integration work. At AGDisplays, our teams work hard to become your trusted partner.







Table 2

For more information or to buy products, go to www.FutureElectronics.com/FTM

# **ANALOG** CORNER

#### Drivers



#### BCR401U/402U:

The BCR401U/402U monolithically integrates a transistor,

regulator (CCR) for LED driving. The devices regulate with a preset 10mA/20mA nominal current that can be adjusted with external resistor up to 100mA. It is designed for driving 0.25W LEDs in strings and will reduce current at increasing temperatures to self-protect. Operating as a series linear CCR for LED string current control they can be used in applications with supply voltages up to 40V.

CL88020: Sequential Linear LED Driver

The CL88020 LED driver integrated circuit (IC) is an

8.5W of LED power from a 120VAC nominal input

voltage. CL88020 is designed to drive a long string of

inexpensive, low current LEDs directly from the AC mains.

A basic driver circuit consists of Microchip Technology

rectifier. Two to four additional components are optional

for various levels of transient protection, also with a low

(OTP). No capacitors, EMI filters, or power factor correction

cost NTC to assure remote over-temperature protection

circuits are needed unless the optional reduced light

output ripple feature is desired.

Inc.'s CL88020 LED driver IC, six resistors and a bridge

off-line sequential linear LED driver designed to provide



## **Linear Constant Current Regulators**

diodes and resistors to function as a constant current

#### FEATURES

- LED constant current regulator using PNP emitter-follower
- Up to 100mA output current adjustable with an external resistor
- Up to 750mW power dissipation in SOT26
- Parallel devices to increase regulated current
- Preset 10mA/20mA ±10% constant current
- 40V maximum supply voltage
- Negative temperature coefficient (NTC) reduces I<sub>out</sub> with increasing temperature
- Up to 25kHz PWM dimming

#### FEATURES

- 120VAC ±15% input voltage
- Programmable over-temperature protection
- Four taps with two current set resistors
- Typical line regulation of -12% to +0%
- 8.5W output power
- TRIAC dimmer compatible
- 8-Lead SOIC package with heat slug
- 1k MSRP: \$0.93

#### MICROCHIP

#### **Power Regulation, Conversion and Management**



#### ISL91211: Highly Integrated Triple/Quad Output PMIC

The ISL91211 highly integrated PMIC delivers 91% efficiency at 1.1V output voltage for application processors, GPUs, FPGAs and high performance system power. The PMIC's low R<sub>DS(on)</sub> MOSFETs and programmable PWM frequency allows designers to use fewer low-profile external components, enabling a 50mm<sup>2</sup> power supply that is 40% smaller than competing solutions. The ISL91211 leverages Intersil's latest R5<sup>™</sup> modulation technology to provide the industry's fastest single-cycle transient response and highest switching frequency (4MHz) during load transients. Ouiescent current is only 62µA while the ISL91211 is regulating the output voltage.

MAX77650/MAX77651: Ultra-Low Power

The MAX77650 and MAX77651 feature single inductor

provide three independently programmable power rails

from a single inductor, 150mA LDO, and three current

maximize available board space. For design flexibility,

the MAX77650 operates up to 3.3V and the MAX77651

operates up to 5V—both include an analog multiplexer

(MUX) output for safe battery monitoring, making them

ideal for low power designs.

sink drivers to reduce overall component count and

PMIC with 3-Output SIMO and Charger

multiple output (SIMO) buck-boost regulators that

#### FEATURES

- 5A maximum current per phase up to 20A with four phases
- 2.5V to 5.5V input voltage range
- Independent dynamic voltage scaling for each output
- Output voltage remote sensing
- Soft start and full protection against under-voltage, over-voltage, overcurrent, and over-temperature
- R5 modulator architecture balances current loads with smooth phase adding and dropping
- Automatic diode emulation mode for 91% efficiency at 1.1V output voltage
- ±0.7% system accuracy
- I<sup>2</sup>C and SPI programmable output from 0.3V to 2V
- 2.551 x 3.670mm 54 ball WLCSP package

#### FEATURES

- Smart Power Selector<sup>™</sup> Li+/Li-Poly charger
- 150mA LDO and 3-channel current sink driver
- Programmable fast-charge current from 7.5mA to
- 300mA
- Programmable termination current from 0.375mA to 45mA
- 19.2mm<sup>2</sup> total solution size
- 3-Output buck-boost regulator
- 5.6µA operating current (3 SIMO channels + LDO)
- Programmable battery regulation voltage from 3.6V to 4.6V
- I<sup>2</sup>C compatible interface and GPIO
- 1k MSRP: \$1.99

#### **Power Regulation, Conversion and Management**



#### PI3543-00-LGIZ: Cool-Power ZVS Buck **Regulator and LED Driver**

The PI354x-00 is a family of high input voltage, wide input range DC-DC ZVS buck regulators integrating controller, power switches, and support components all within a high density system-in-package (SiP). The PI354x-00 products are designed to operate within an SELV compliant system with steady state operation limited to 60V. The PI354x-00 products allow for transient voltage conditions up to 70V before shutdown is triggered. The integration of a highperformance zero-voltage switching (ZVS) topology, within the PI354x-00 series, increases point of load performance providing best in class power efficiency. The PI354x-00 requires only an external inductor, two voltage selection resistors and minimal capacitors to form a complete DC-DC switching mode buck regulator.

Sensors

#### Color and Lumen Maintenance Manage

The AS7220 calibrated CCT and lumen maintenance smart lighting manager is equipped with an advanced cognitive lighting engine (CLE) to optimize CCT and lumen and color maintenance via a combination of PWM and/or 0V to 10V controls with dimming ballasts. Configurable single CCT lifetime target values are stored by the luminaire manufacturer within the attached flash EPROM, or are selectable using an I<sup>2</sup>C port expander. Target lumen output lux-criteria are similarly configurable and are used by the AS7220 to correlate internal lux to manage PWM mapping to allow automatic compensation for lumen output to be maintained over the life of the light.

Smart Sensor

I<sup>2</sup>C Interface

**Tunable Lighting Smart System Sensor** 

Sensor-integrated intelligence directs white-tunable and

amu

Chip scale solution for lifetime CCT/lumen output

closed-loop sensing

Calibrated for life autono







daylighting systems for higher accuracy, faster design

am





intersil





# ANALOG CORNER

#### AS7220: Calibrated CCT and Lumen Maintenance Smart Lighting Manager

#### AS7225: Tunable White and Daylighting

The AS7225 tunable white and daylighting smart sensor/director incorporates an embedded digital tri-stimulus chromatic 'calibrated-for-life' nano-optic sensor providing direct CIE1931 XYZ and CIE 1976 u'v' coordinate mapping. Adaptive algorithmic support enables a companion microprocessor to implement closed-loop, autonomous adjustment of variable CCT and daylight responsive LED lamps and luminaires. The AS7225 arrives pre-calibrated, and is designed for rapid integration into white-tunable and daylight responsive luminaire designs, delivering directives to the local microprocessor via an industry-standard I<sup>2</sup>C bus.

#### VCNL4200: High Sensitivity Long Distance Proximity and Ambient Light Sensor with

VCNL4200 integrates a high sensitivity long distance proximity sensor (PS), ambient light sensor (ALS), and

#### **FEATURES**

- High efficiency HV ZVS buck topology
- Constant voltage or constant current operation
- Power-up into pre-biased load
- Two phase interleaving
- Output over-voltage protection and over-temperature protection
- -40°C to +125°C operating range (T<sub>i</sub>)
- 36V to 60V input voltage range with transient events up to 70V<sub>IN</sub>
- Constant current error amplifier and reference
- Parallel capable up to 3 regulators
- Input over/under-voltage lockout (OVLO/UVLO)
- User adjustable soft start and tracking

#### **FEATURES**

- XYZ tri-stimulus chromatic sensing
- 12-bit resolution for precise control down to 1%
- Presets configurable into flash memory, or via I<sup>2</sup>C port expander
- Calibrated nano-optic silicon interference filters
- Delivers algorithmic closed loop target point white CCT and lumen output tuning (single CCT)
- 0°C to +85°C operating temperature range
- 4.5 x 4.7 x 2.5mm 20-pin LGA package
- 10k MSRP: \$2.81

#### **FEATURES**

- Smart XYZ tri-stimulus chromatic sensing
- Simple register-based commands for supervisory functions
- 20-pin 4.5 x 4.7 x 2.5mm LGA package
- I<sup>2</sup>C interface
- Readable registers for CIE 1931 and 1975 color-point coordinates, CCT, duv and lux
- Calibrated nano-optic silicon interference filters
- 0°C to +85°C operating temperature range
- 5k MSRP: \$2.40

#### FEATURES

- Up to 1.5m proximity distance
- Supports low transmittance (dark) lens design
- I<sup>2</sup>C bus output interface
- 2.5V to 3.6V operation voltage
- Filtron<sup>™</sup> technology for robust background light cancellation
- Low power consumption I<sup>2</sup>C (SMBus compatible) interface
- -40°C to +85°C temperature compensation
- 8.0 x 3.0 x 1.8mm surface mount package



To buy products or download data, go to www.FutureElectronics.com/FTM

#### MAILROOM - PLEASE RECYCLE.

If undelivered to the addressee, please route to the purchasing department or fax this back page to toll free number, 1-800-645-2953



## **PSoC® 6: PURPOSE-BUILT FOR THE IoT**

#### **LOWEST POWER**

Advanced ultra-low-power 40-nm process

Dynamic voltage and frequency scaling (DVFS with PLL/FLL)

Active power as low as 22µA/MHz (Cortex®-M4)

#### **PSoC POSSIBILITY**

Bluetooth 5.0 radio with 2-Mbps data throughput Software-defined peripherals Industry-leading CapSense®

#### SCALABLE SECURITY

Secure boot

Hardware-based Trusted Execution Environment (TEE) with secure data storage

Advanced cryptographic accelerator block supports ECC, AES128, SHA1/2/3

## What are you waiting for? Get started today with the PSoC 6 BLE Pioneer Kit





Register to qualify for a

FREE PSoC 6 BLE Pioneer Kit (CY8CKIT-062-BLE)

Go to: http://bit.ly/PSoC6BLE2017