TI – Embedded Processing

China

2016

TEXAS INSTRUMENTS

TI Portfolios
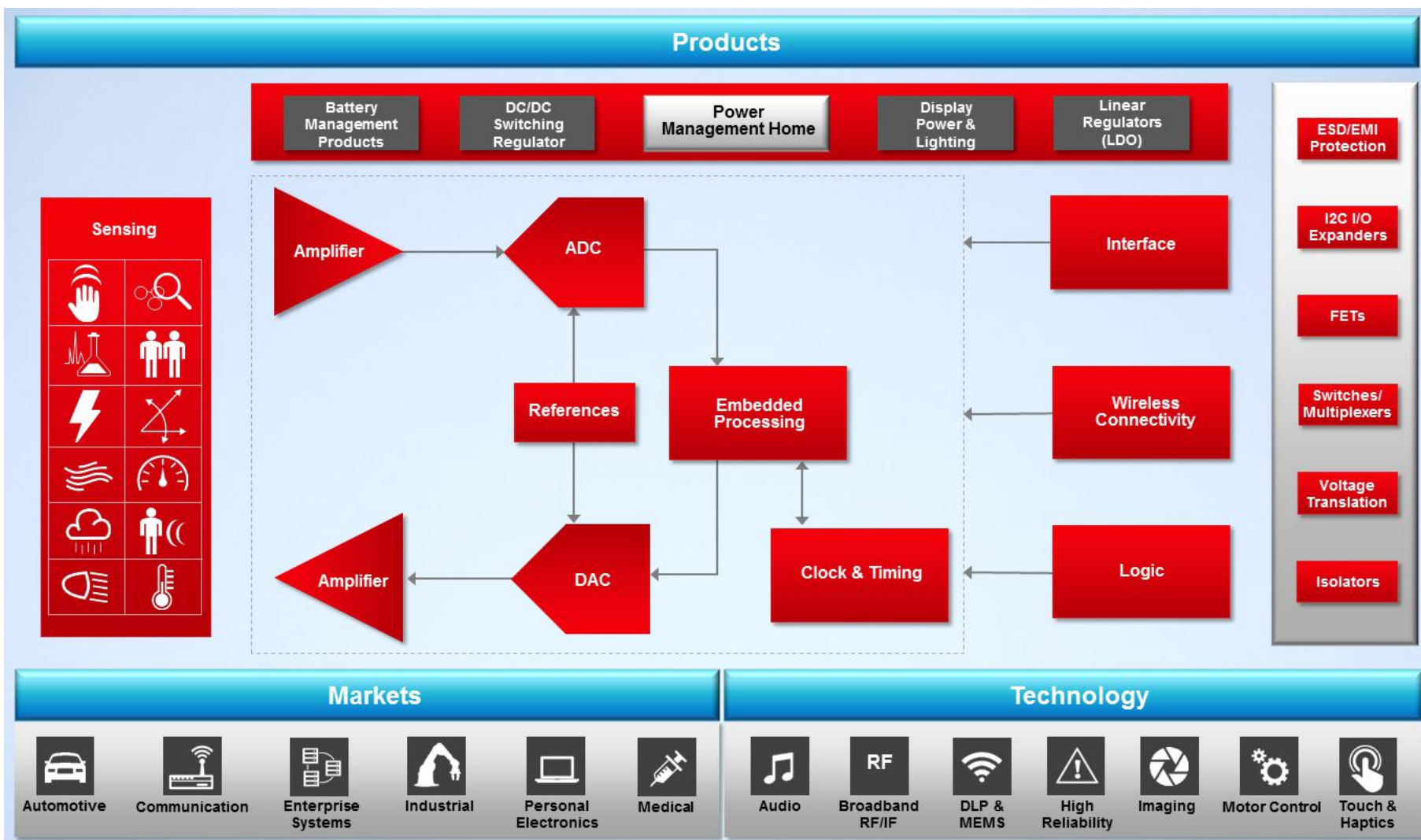
TI Focused Markets

Automotive
- ADAS
- Body electronics & lighting
- Infotainment & cluster
- Powertrain, hybrid electric & electric vehicles
- Passive Safety

Industrial
- Home Appliances
- Building Automation
- Factory Automation
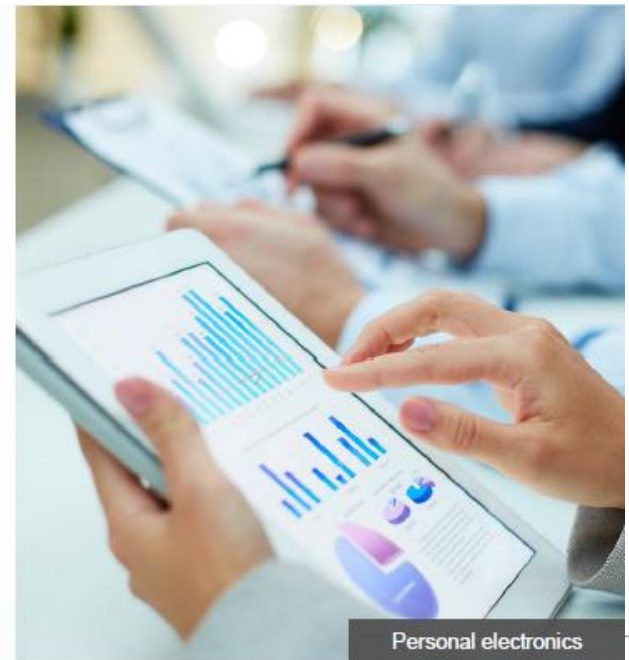- Motor Drives
- Smartgrid & Energy
- Power Delivery

Enterprise systems

Communications equipment

Personal electronics

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TI – Embedded Processing

Full-system design expertise with differentiated embedded processing **hardware and software**

Wireless connectivity

Broadest portfolio of easy to use, low power wireless connectivity solutions that connect anything, anywhere, anyway using Wi-Fi®, Bluetooth® Smart, ZigBee® and more

Microcontrollers

Extensive portfolio of MCUs from the industry's lowest power consumption to optimized solutions for control and safety, all with unmatched analog and connectivity integration for a wide application base

Processors

Scalable processors, from single-core ARM® to integrated 12-core ARM and DSP solutions, with optimized peripherals and best-in-class open-source software offerings

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TI ENABLES CUSTOMER **INNOVATION**

1 Building **PROGRAMMABLE** microcontroller, connectivity and processor solutions that allow customer **DIFFERENTIATION**

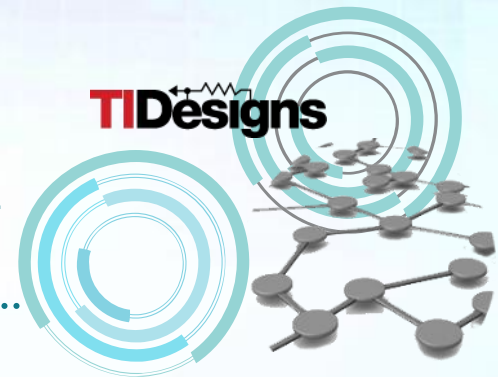Sitara™ processors

WiLink™ connectivity

2 Building **SPECIFIC** hardware accelerators, software and peripherals that are based on understanding **SPECIFIC NEEDS** of **SPECIFIC MARKETS**

MSP microcontrollers

3 Helping customers **INVENT** markets that don't even exist, by jumpstarting their designs with foundational software, 170 Embedded TI Designs, robust third party network and more.
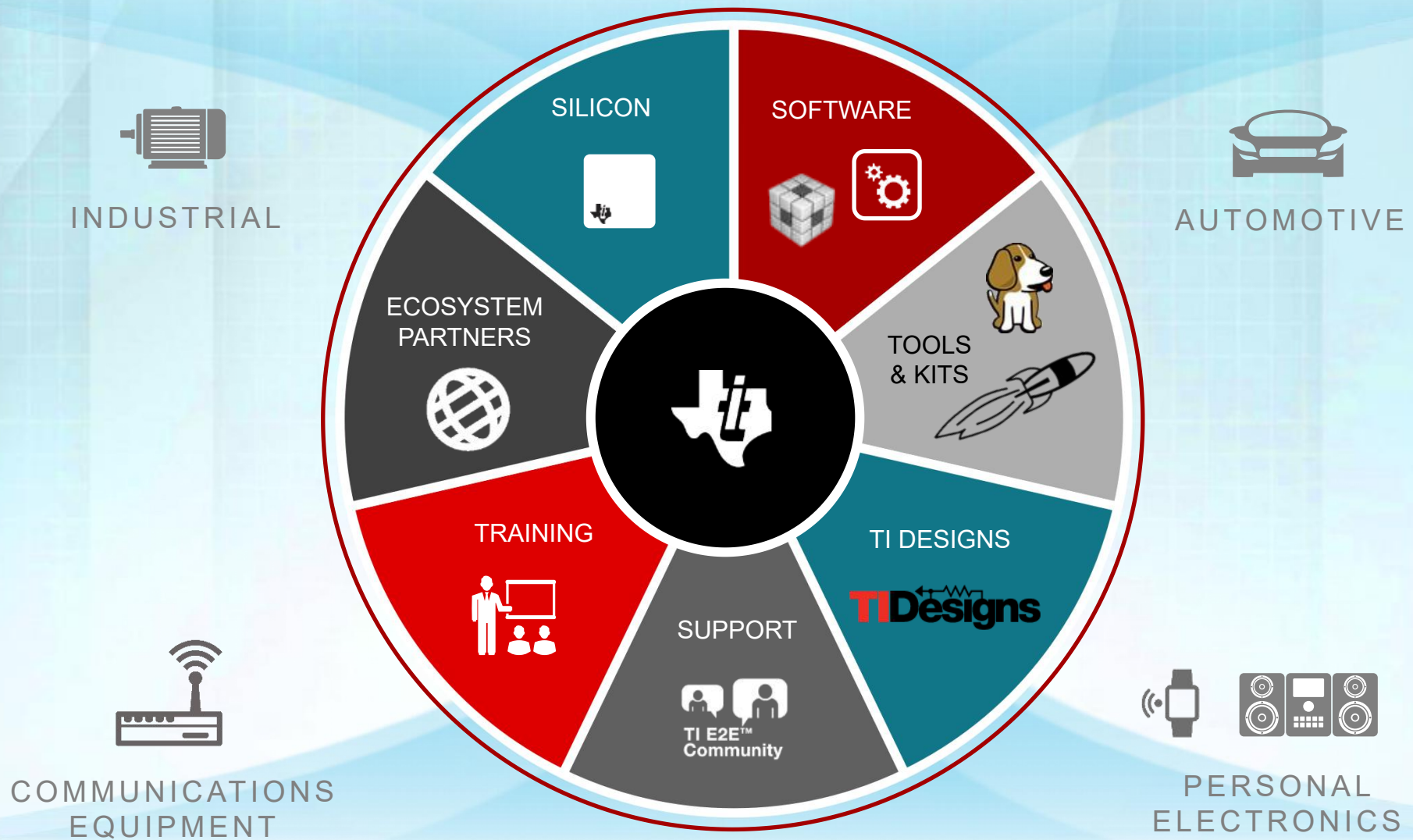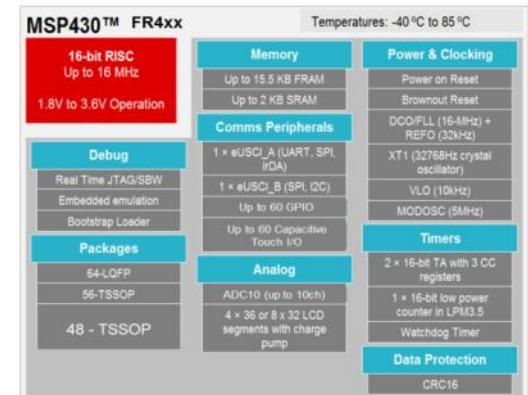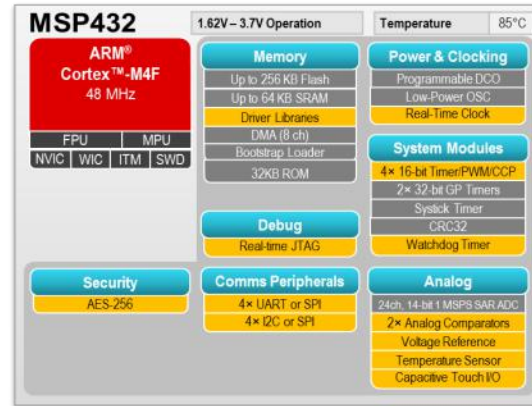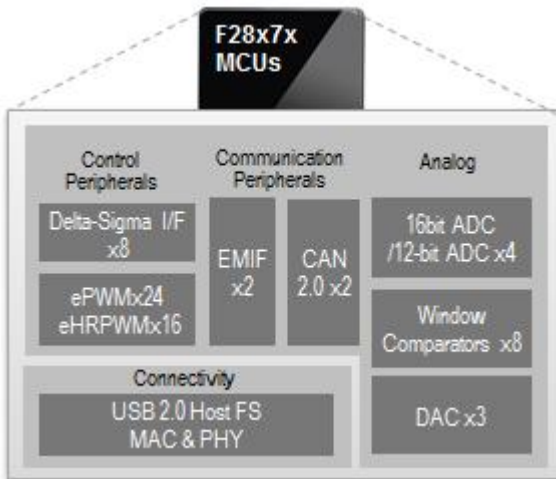
TI Embedded Processing

TIDesigns

TI EP INNOVATIONS

Wireless Connectivity	First integrated sensor controller extends coin cell battery life for multiple years	First Internet-on-a-chip™ to securely connect to the cloud in minutes	First integrated single-chip Wi-Fi, Bluetooth and GNSS connectivity for automotive infotainment
	SimpleLink™ ultra-low power platform	SimpleLink Wi-Fi platform	WiLink™ 8Q
Microcontrollers	>20% power savings with FRAM MCUs	First complete on-chip motor and motion control software solution	85% reduction of processing latency on real-time control algorithms
	MSP430FRx	InstaSPIN™ technology	F28x7x
Processors	Support for multiple industrial protocols reduces BOM by 40%	First integrated digital radio front end on a small cell processor	First automotive package-on-package miniaturizes ADAS module
	Sitara™ AM335x / AM437x	66AK2L0x	TDAx

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TI DELIVERS **COMPLETE** PRODUCTS

INDUSTRIAL

AUTOMOTIVE

COMMUNICATIONS EQUIPMENT

PERSONAL ELECTRONICS

SILICON

SOFTWARE

ECOSYSTEM PARTNERS

TOOLS & KITS

TRAINING

SUPPORT

TI DESIGNS

TI EPD – MCU

F28x7x MCUs

Control Peripherals — Delta-Sigma I/F x8, ePWMx24 / eHRPWMx16
Communication Peripherals — EMIF x2, CAN 2.0 x2
Analog — 16bit ADC /12-bit ADC x4, Window Comparators x8
Connectivity — USB 2.0 Host FS MAC & PHY, DAC x3

MSP432 — 1.62V – 3.7V Operation — Temperature 85°C
ARM® Cortex™-M4F 48 MHz; FPU, MPU, NVIC, WIC, ITM, SWD
Memory — Up to 256 KB Flash, Up to 64 KB SRAM, Driver Libraries, DMA (8 ch), Bootstrap Loader, 32KB ROM
Power & Clocking — Programmable DCO, Low-Power OSC, Real-Time Clock
System Modules — 4× 16-bit Timer/PWM/CCP, 2× 32-bit GP Timers, Systick Timer, CRC32, Watchdog Timer
Debug — Real-time JTAG
Security — AES-256
Comms Peripherals — 4× UART or SPI, 4× I2C or SPI
Analog — 24ch. 14-bit 1 MSPS SAR ADC, 2× Analog Comparators, Voltage Reference, Temperature Sensor, Capacitive Touch I/O

MSP430™ FR4xx — Temperatures: -40 °C to 85 °C
16-bit RISC Up to 16 MHz; 1.8V to 3.6V Operation
Memory — Up to 15.5 KB FRAM, Up to 2 KB SRAM
Comms Peripherals — 1 × eUSCI_A (UART, SPI, irDA), 1 × eUSCI_B (SPI, I2C), Up to 60 GPIO, Up to 60 Capacitive Touch I/O
Debug — Real Time JTAG/SBW, Embedded emulation, Bootstrap Loader
Packages — 64-LQFP, 56-TSSOP, 48 - TSSOP
Analog — ADC10 (up to 10ch), 4 × 36 or 8 x 32 LCD segments with charge pump
Power & Clocking — Power on Reset, Brownout Reset, DCO/FLL (16-MHz) + REFO (32kHz), XT1 (32768Hz crystal oscillator), VLO (10kHz), MODOSC (5MHz)
Timers — 2 × 16-bit TA with 3 CC registers, 1 × 16-bit low power counter in LPM3.5, Watchdog Timer
Data Protection — CRC16

Product: TMS320F28x7x
Highest Perf. C2000 Family

Key Benefits:

- **C28x core with (CLA)**
- **Up to 4 channel 16-bit ADC**
- **Trigonometric Math Unit (TMU)**
- **8x Windowed Comparators**
- **8x Sigma Delta channels, 2x Filters/channel**

Where to Hunt:

Inverter, Servo, Robot, Factory automation, New Energy

Reference Design:

Industrial Drive Development Kit TMS320F2837xD controlCARD TMS320F2837xD Kit

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Product: MSP432
Ultra Low Power 32bit M4 MSP

Key Benefits:

- Ultra-low standby and active power, and fast wakeup
- Wide supply range: 1.62-3.7V,
- Integrated high-performance and low-power analog — Including 1MSPS 14-bit ADC

Where to Hunt:

Portable measurement, medical , wearable

Reference Design:

Target board, launch pad

Product: MSP430FR4133
FRAM 16K with LCD Controller

Key Benefits:

- low power LCD with Configurable Pin-out and On-chip Charge Pump
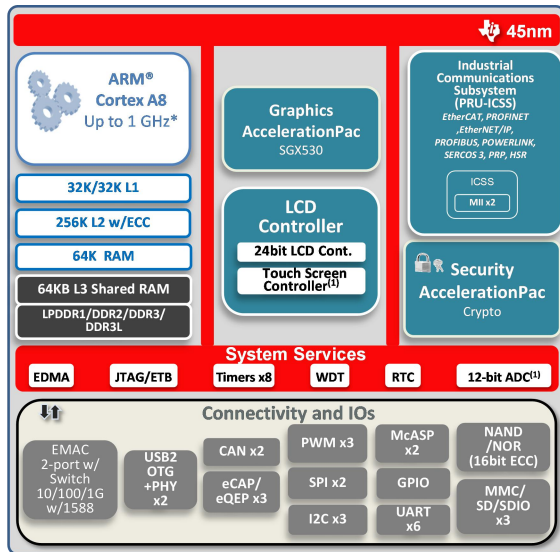- FRAM offers flexible platform
- Rich IO with touch funtion

Where to Hunt:

Flow meter, Aircon remote control, low power LCD display

Reference Design:

TIDM-FRAM-WATERMETER, TIDM-FRAM-THERMOSTAT, TIDM-REMOTE-CONTROLLER-FOR-AC

3

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TI EP – Catalog Processor

Product: AM335x
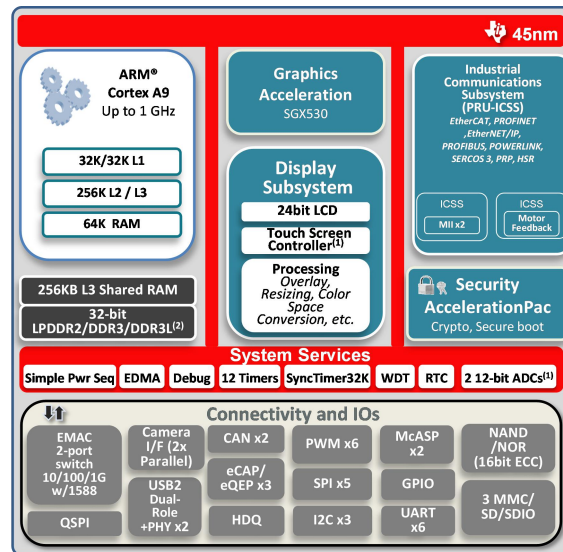**Cortex A8 Up to 1GHz**

Key Benefits:
- High performance A8 at ARM9/11 prices
- Rich peripheral integration reduces system complexity and cost
- Richest Cortex A8 portfolio in the market

Where to Hunt:
Industrial / Home Automation/PLC, HMI, Robotics, Test & Wifi Audio, Measurement, PMR, Concentrator

Reference Design:
TIDEP0008, TIDEP0032. More info: www.ti.com/am335x

Product: AM437x
Cortex A9 Up to 1GHz

Key Benefits:
- Single-cycle Vector Floating Point
- Dual camera & display signal processing
- Security: crypto & secure boot
- PRU-ICSS: simultaneous industrial Ethernet, motor feedback protocols & $\Sigma\Delta-$ modulation

Where to Hunt:
Industrial / Home Automation/PLC, EPOS, Robotics, Motor Control, Smart Grid, Test & Measurement

Reference Design:
TMDXIDK437X
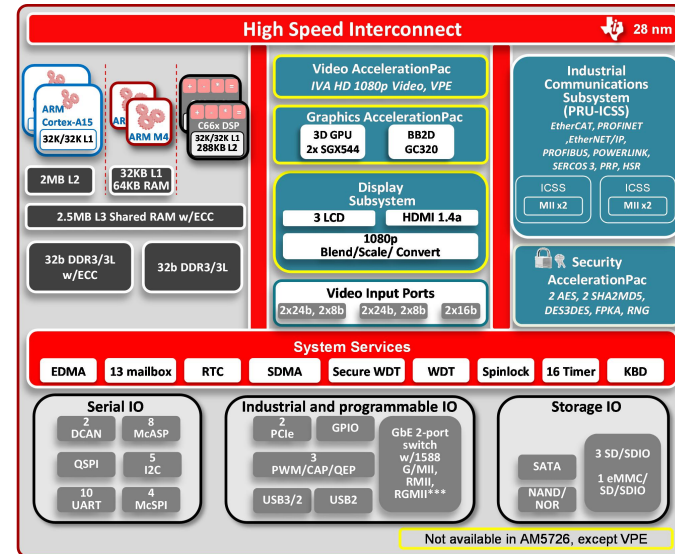
Product: AM57xx
Cortex A15 x1/x2 Up to 1GHz, C6x x1/x2 Up to 600MHz, M4 x1/x2

Key Benefits:
- Sitara's highest performance ARM device w/DSP accelerators
- 10,500 ARM Cortex-A15 DMIPS
- Upgraded graphics performance with HD Video support

Where to Hunt:
Industrial Automation, Robotics, HMI, Industrial PC, Digital Signage, Machine Vision, Medical Imaging

Reference Design:
- Eval. Module, TMDXEVM5728
- Industrial Development Kit, TMDXIDK5728 (avail. 4Q15)

TI EP– Connectivity
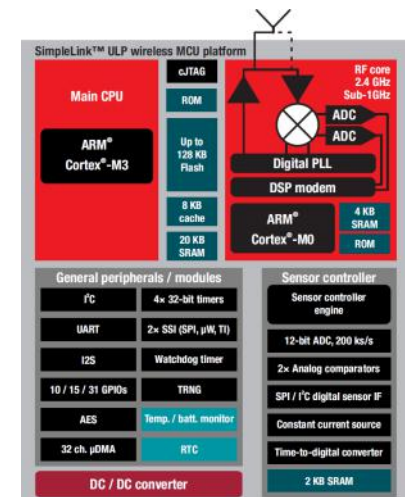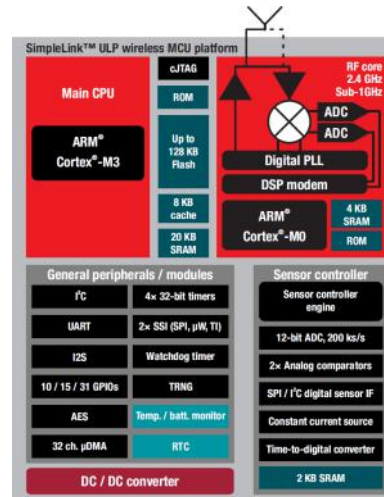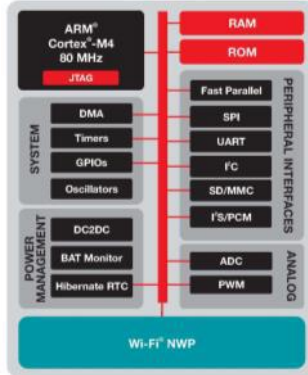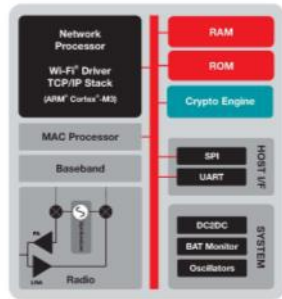
Product: CC31/32xx	Product: CC26xx	Product: CC13xx
Ultra Low Power WiFi+M4 SoC	**Ultra Low Power 2.4G+M3 SoC**	**Ultra Low Power Sub 1G+M3 SoC**
Key Benefits:	**Key Benefits:**	**Key Benefits:**
• Ultra Low Power • Security/On-Chip HW encryption • High Integration/SoC	• Ultra Low Power • High Integration/Small Size • Multi-standard platform	• Ultra Low Power • High Integration/Small Size • Sub 1G + 2.4G Dual Band Support
Where to Hunt:	**Where to Hunt:**	**Where to Hunt:**
Home automation & appliance, Safety and security, Smart energy, Door Camera, Industrial	iBeacon, Wearable, Remoter, Lighting, Automotive, Industrial Automation, Home Appliance	Metering, Security Alarm, ESL, Highway Tracking, Smoke Detector, Fault Indicator
Reference Design:	**Reference Design:**	**Reference Design:**
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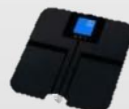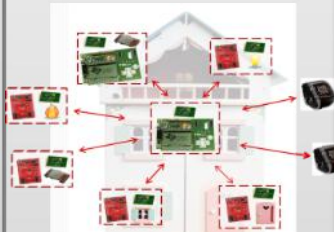
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Wireless Connectivity TI Designs *per Technology*

→ Use the hyperlinks below to get to more info

Bluetooth® Low Energy / Bluetooth® Dual Mode				WiFi®	Sub-1 GHz	ZigBee®
RS-485	Haptic Feedback	Gas Sensor	Keyfob	CC3200MOD LaunchPad CC3100MOD BoosterPack	ETSI Cat. 1 Receiver	Network Range Extender
Light Harvesting	BLE Light	Postage Stamp	Long Range	Smart Electric Meter	RF Layout Reference Design for 420-470 MHz	Home Automation Gateway
Mini Broadcaster	BLE to Wi-Fi gateway	USB Dongle	SensorTag	Smart Plug	RF Layout Reference Design for 868-930 MHz	Light Link Development Kit
Heart Monitor	Body Composition	Audio Sink	Display	Wi-Fi Camera		
Optical Heart Rate	Weight Scale	Audio Source	Led Audio	Audio Streaming CC3200 Battery Power		Low End In-Home Display
Pulse Oximeter	SensorTag iBeacon	CC256x EM	UART to BLE	Smart Plug	Home network	CC2538 EM

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TI – DLP® Products

Enterprise and Cinema Display

Pico Products
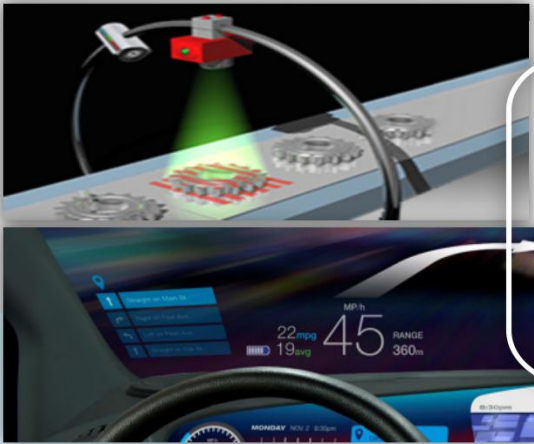
Embedded:
- – Advanced Light Control
- – Automotive
- – RF MEMS

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DLP Market Opportunities

Industrial
- Control Panels
- Human Machine Interface
- Machine Vision
- Spectroscopy
- 3D Printing
- Digital Light Exposure
- Intelligent Lighting

Medical
- Spectroscopy
- 3D Printing
- Digital Light Exposure
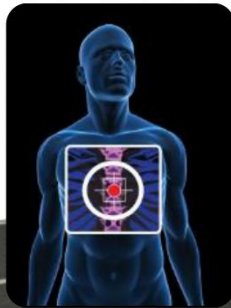
Enterprise: Digital Signage
- Interactive Surface
- Storefront Interactivity
- Retail Engagement

Enterprise
- Government
- Education
- Large Venue
- Cinema
- Mobile projection
- Laptops

Personal Electronics: Gaming
- Dual console Gaming
- Interactive Gaming
- Near-Eye Display
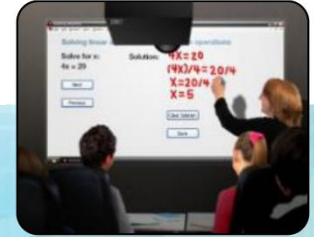
Personal Electronics
- Mobile Phones
- Tablets
- Camcorders
- Ultra Slim TV
- 3D Printing

Automotive
- Head-Up Display
- Center Console Display
- Headlights

● Video and Data Display   ● Advanced Light Control

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DLP Customer Engagement Model in China

DLP TEXAS INSTRUMENTS	Optical Engine Manufacturers	System Integrators / ODMs	OEM's / Brands

Controller & PMIC delivered to System Integrator

Controller & PMIC

YOUNG Optics · SEKONIX · Butterfly · SOLIDPRO · iVIEW LIMITED · APAC Opto · Ongine · UneedElectro · SHENZHEN ANHUA OPTOELECTRONICS TECHNOLOGY CO.,LTD · DO · ASIA OPTICAL

DMD

KEYENCE · Optoma · LG · AUTODESK · Brookstone · PHILIPS · INNOIO · XGIMI · CooLUX 酷乐视 · ZTE · SK telecom

TI's Role: Chip Maker	**Design Support**	**Integration Support**	**Business Facilitator**

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TI – Focused Market Sectors & TI Design

TI Designs reference designs

More than 1,500 TI Designs to jumpstart system designs

TIDesigns

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Key industrial sectors:

- Building automation
- Factory automation
- Motor drives
- Smart grid and energy

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Key automotive sectors:

- Advanced driver assistance systems
- Body electronics and lighting
- Infotainment and cluster
- Powertrain, hybrid electric and electric vehicles

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TI Design – System Level Sales Tools

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Leveraging System Engineering Expertise

To increase sockets/project & strengthen TI's competitive advantage

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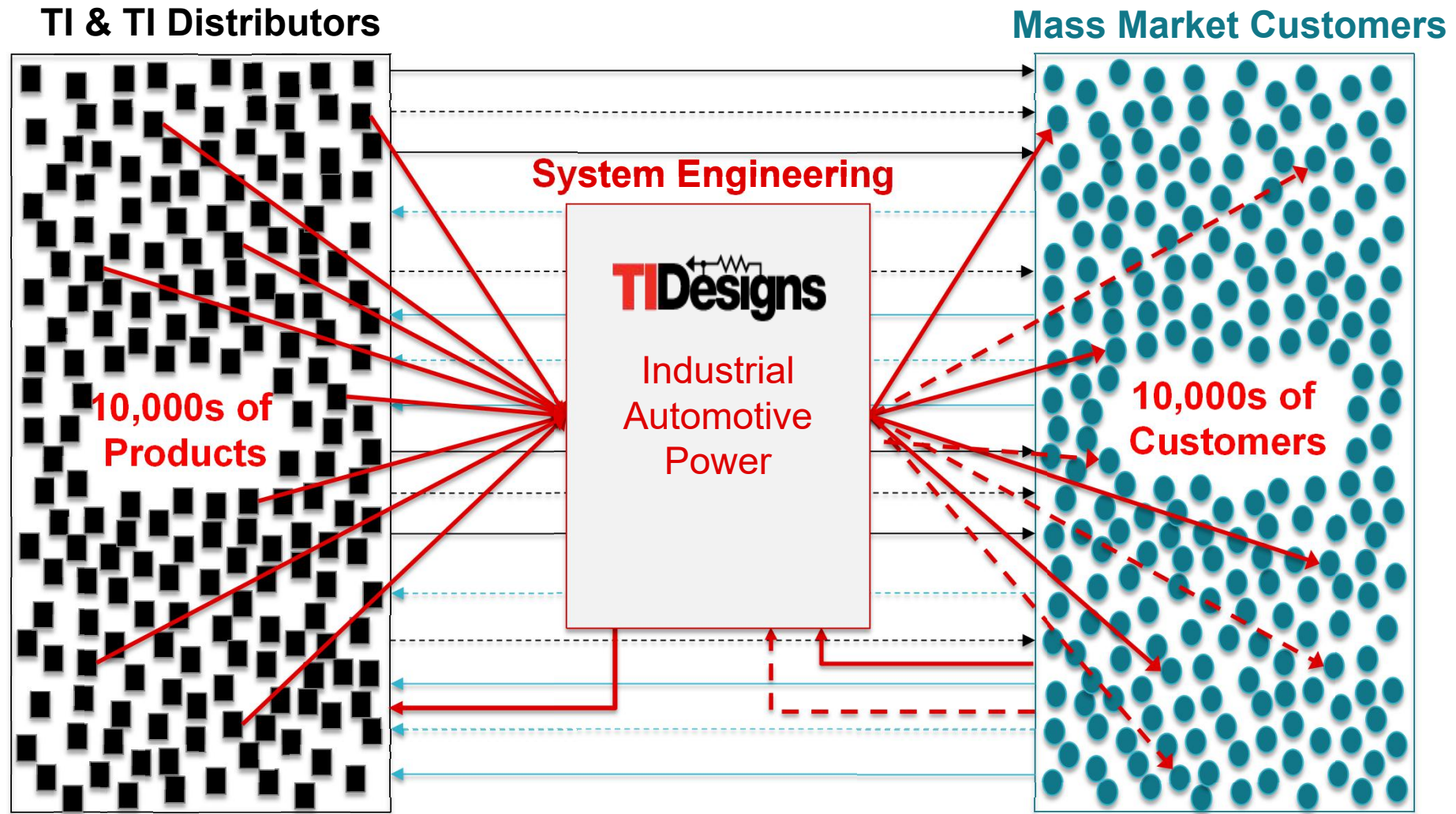
TI Designs execution: outpacing competition

Industrial EE focus TI Designs
Released vs Downloads (Cumulative)

Cumulative _x000d_Downloads

- 1Q14: 37, 107,000 approx
- 2Q14: 56, 291,000 approx
- 3Q14: 73, 395,000 approx
- 4Q14: 107, 521,343
- 1Q15: 143, 655,318
- 2Q15: 180, 789,293
- 3Q15: 210
- 4Q15: 237

Analog Competitor A
- 185 Industrial reference designs
- 91 are EE focus

Analog Competitor M
- 100 Industrial reference designs
- 60 are EE focus

Only EE focus TI Designs shown
Many more product focus TI Designs available

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EtherCAT Master Reference Design for AM57x Gb Ethernet and PRU-ICSS
TIDEP-0079

TI Designs

Features

- Demonstrates use of EtherCAT Master on AM572x processor
- Supports use of either Gb switch (CPSW) or PRU-ICSS for EtherCAT master
- Built using the highly-portable industry-accepted Acontis EC-Master stack
- EtherCAT Class A or Class B master stack according to ETG. 1500 specification

Benefits

- Example for implementing EtherCAT master on both the Gb switch (CPSW) and the PRU-ICSS Ethernet ports for design flexibility
- Highly portable Acontis stack combined with high-performance Sitara AM57x CPU provides a flexible EtherCAT master solution
- Cycle CPU consumption 20us for CPSW and 26us on ICSS-PRU
- This reference design is tested on the TMDXIDK5728 board and includes documentation, software, demo application, and HW design files

Target Applications

- Factory Automation & Controls: PLC, DCS & PAC: Communication Module
- Factory Automation & Controls: PLC, DCS & PAC: CPU (PLC Controller)

Tools & Resources

- **TIDEP0079**
- **Design Guide**
- **Design Files:** Schematics, BOM, Gerbers, Software, and more
- **Device Datasheets:**
  - AM5728BABCXA
  - TMDXIDK5728

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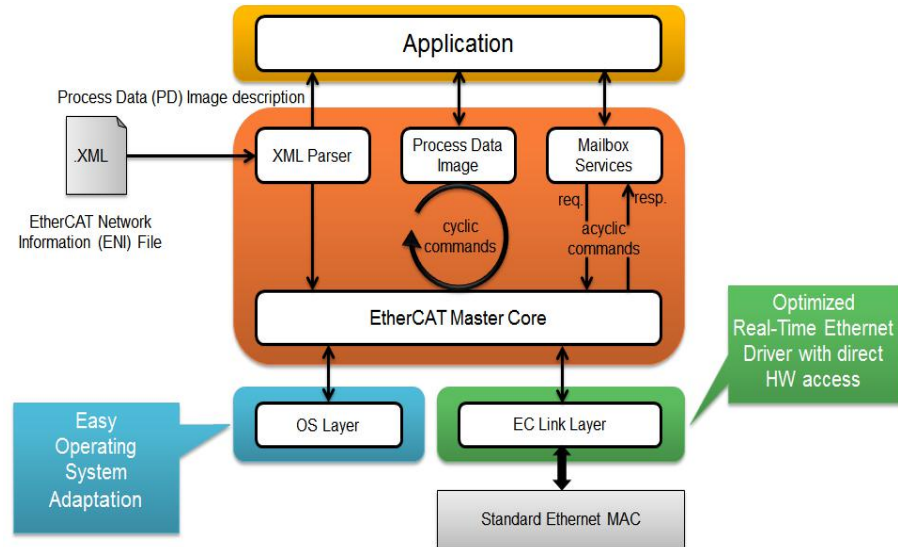
TIDA-00262 Optimized Automotive 1M Pixel Camera Module Design for Uncompressed Digital Video over Coax

Features:

- Demo originally designed with Imager Manufacturer Aptina to show switching power supply and FPDLinkIII interoperability with their imagers.

  - Similar designs in process with Sony and Omnivision.

- Space optimized design fits on a single PCB 20x20 mm

- Power supply optimized for small size and high efficiency

- Aptina AR0140AT 1Mpixel image sensor - 10/12bit raw image data rate

- Single coax connector for digital video, power, control and diagnostics

- Diagnostic and Built In Self Test (BIST) for ASIL B Applications

- This circuit is tested and includes design considerations and BOM analysis

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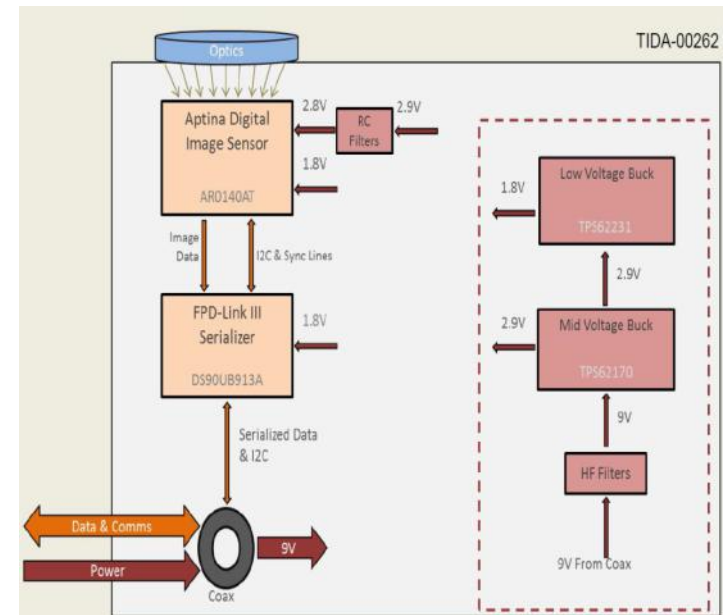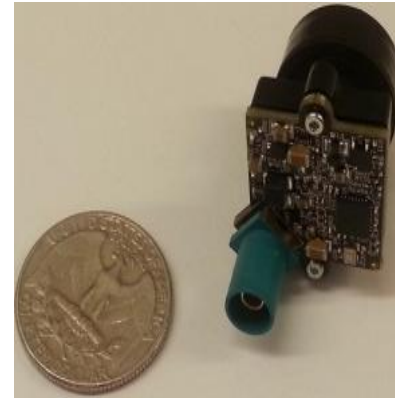
TIDA-00480 Automotive Hall Sensor Rotary Encoder

Features:

- Demo originally designed for Tier 1 looking at replacement alternatives for mechanical Knobs.
  - Extremely simple, reliable, and low-cost
- Greater design flexibility and ESD immunity, over mechanical encoder modules
- 66-pole magnet provides 132 detections per 360° of rotation (1 per 2.7°)
- >20kHz Hall Effect sensor bandwidth provides low 15µs latency
- Digital sensing and digital signaling offer noise immunity

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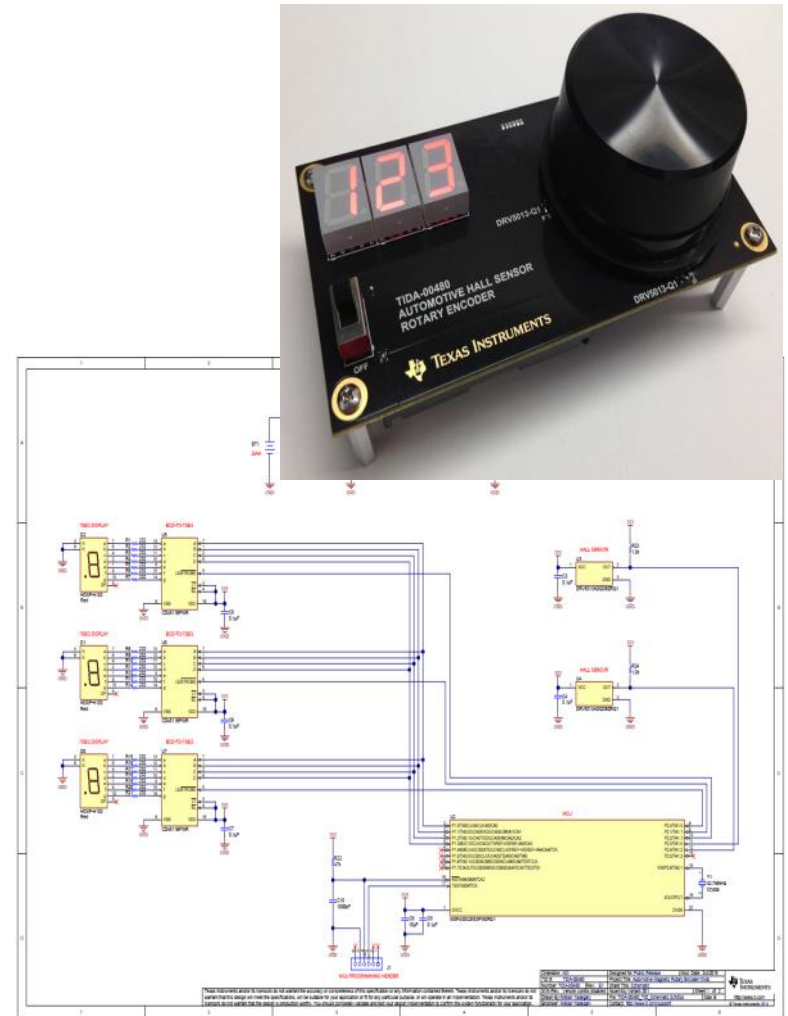
Impact of deep EE expertise: @ C Auto Tier 1
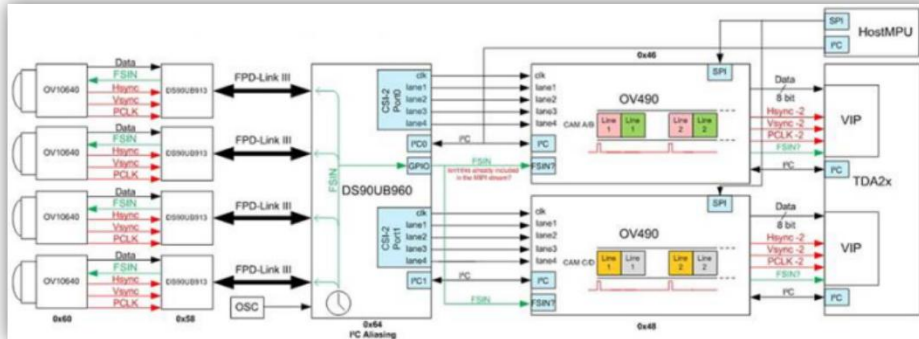
TIDA-00455

Automotive ADAS 4 Camera Hub with integrated ISP and DVP outputs

*In partnership with C and Omnivision
3 month project, completed May 6th, 2015*
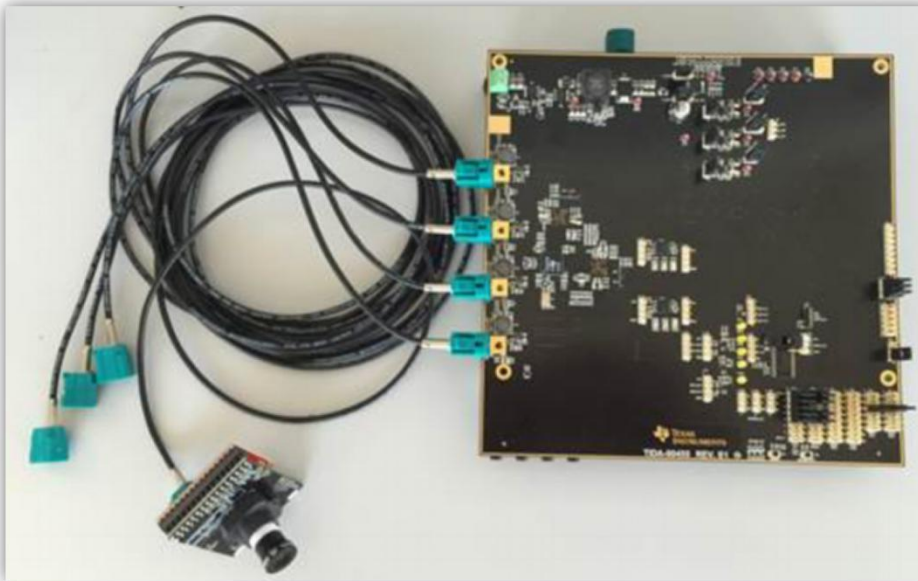
Results

A-Sample for C's platform development
*~$70 of TI content per system
32 sockets, 13 different TI devices
$360M LNR (½ Analog, ½ EP)*

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Thank You!

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In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have *not* been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		Applications	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		