















**MICROCHIP**

# **Обзор обновлений продукции**


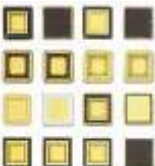






**Киев**

**апрель 2016**

# Приобретение компаний

 	 	 	 	 	 
Hampshire	R&E	HI-TECH	ZeroG	SST	Adv Silicon Products
Oct '08	Apr '09	Mar '09	Jan '10	Apr '10	Oct '10
Touch Screen Controllers	Security/ Life-Safety ASICs	Development Tools/ Compiler	Low Power Embedded Wi-Fi®	High-Density Flash/IP	Motor Drive Products

# Приобретение компаний

 	<b>LSS</b>	 	 	 
<b>MMT</b>	<b>LSS</b>	<b>Ident</b>	<b>Roving Networks</b>	<b>SMSC</b>
Feb '11	Oct '11	Feb '12	Apr '12	Aug '12
Assembly & Test Capacity Expansion	High-Speed ADC	Gesture Recognition and Proximity	Bluetooth® and Wi-Fi® Solutions	MOST® USB & Ethernet Wireless Audio PC Controllers

# Приобретение компаний

	 			
<b>Novocell</b>	<b>EqcoLogic</b>	<b>Supertex</b>	<b>ISSC</b>	<b>Micrel</b>
Jun '13	Nov '13	Apr '14	Sep '14	Aug '15
Non-Volatile-Memory IP	Equalizer and Coaxial Transceiver Products	High Voltage Mix signal Analog, LED Drivers, Medical & Industrial	Bluetooth IP Audio and Data ICs and Modules	Power Mgmt Linear Timing HS Comms Ethernet Wireless

# Приобретение компаний

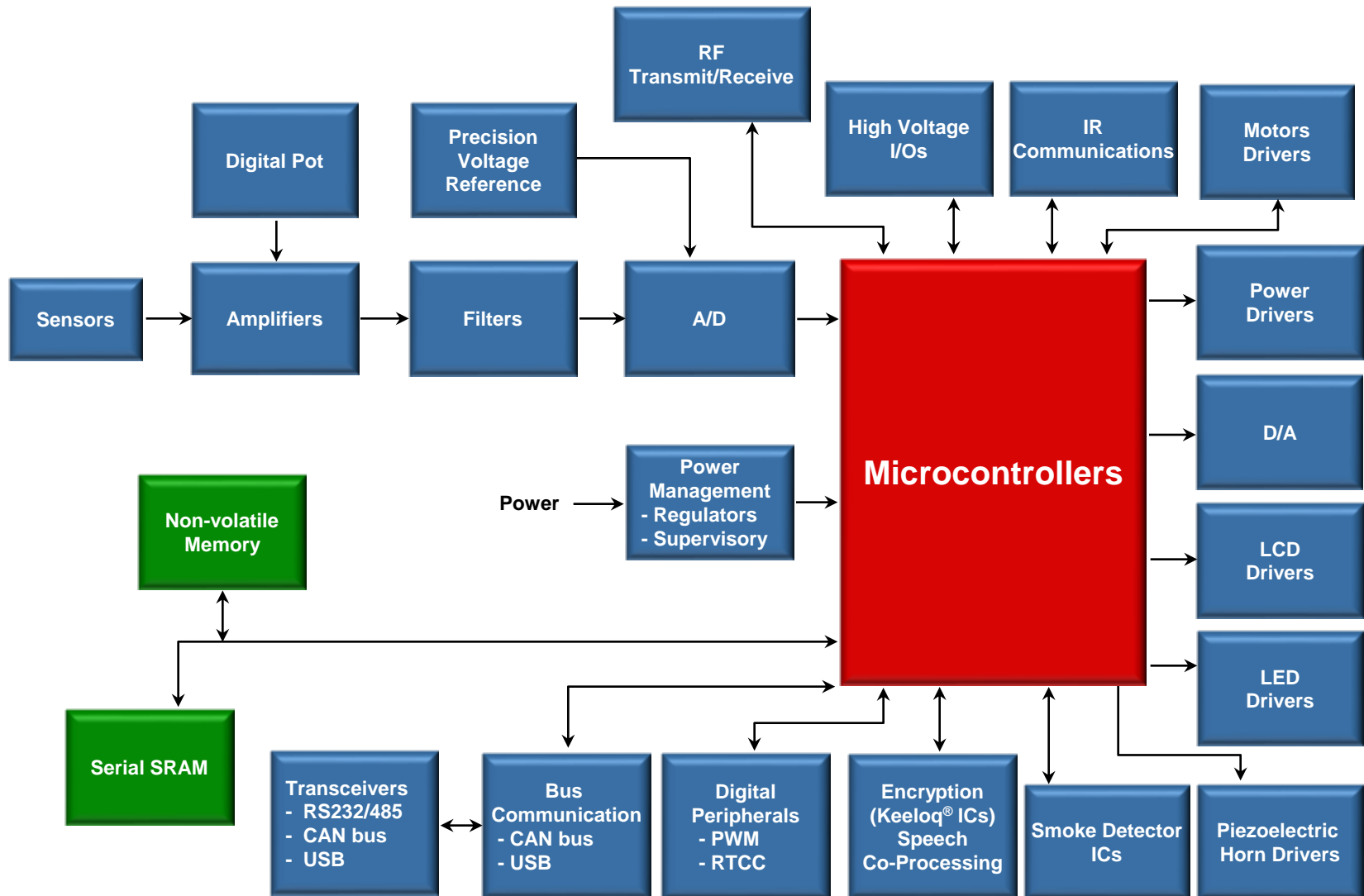


**Atmel**

Apr '16

8-, 32-bit MCU,  
Touch, Automotive, Wireless,  
SmartEnergy, Memory, Drivers &  
Sensors, Security, Programmable  
Logic, Analog, RadHard,

# Предоставляет комплексные решения



Wireless

LoRa Technology

Internet of Things

Ethernet

USB

Sensor Hub / Motion Monitor

Gesture

Touch

Video over Coax

USB Charging

USB Power Del.

Embedded I/O Controllers

8-bit MCU

16-bit MCU/DSC

Code Configurator

32-bit – PIC32/Harmony

High-Speed ADC

Analog Power Products

Digitally Enhanced Analog Power

Other Analog

Memory Products

Micrel High Level Overview

Clock and Timing Products

Supertex

Limited EOL Policy



**MICROCHIP**

# **Обновления по беспроводным технологиям**

**WiFi, Bluetooth, Sub-GHz**

[Return to Topics](#)

# Wireless Portfolio

Technology	Protocol	Markets	Market Driver	Network Stack	Freq.
<b>Embedded Wi-Fi</b>	IEEE 802.11 b/g/n	Widespread Commercial Industrial	Internet	TCP/IP	2.4GHz
<b>Embedded Bluetooth</b>	IEEE 802.15.1	Widespread Commercial Industrial	Smartphone	BT v2.1, BT Audio, BTLE	2.4GHz
<b>Embedded Wireless</b>	Proprietary or IEEE 802.15.4	Vertical HA, SEP, Sensors	Cost Local Network	MiWi, BT, ZigBee, RF4CE, LoRa	Sub-1GHz & 2.4GHz



# Wi-Fi Modules

**SSL  
support**

**Lower  
Power**

	MRF24WG0MA/B	RN1723	RN131 C/G	MRF24WN0MA/B
802.11 Radio	← b/g →			b/g/n (2.4GHz Only)
Tx Power	+18dBm	+12dBm	+18dBm	+18dBm
Power Consumption	4mA power save 95mA Rx 240 max Tx	4uA Sleep 15mA DOZE 40mA Rx 120mA Tx	4uA sleep 40mA Rx 200 max Tx	5uA sleep 64mA Rx 246mA max Tx
Antenna	u.FL / PCB	RF pad	Chip/u.FL	u.FL / PCB
TCP Stack	On PIC MCU	← Integrated →		On PIC MCU
MCU Support	16/32 bit PIC MCU	← Any 4/8/16/32 bit →		16/32-bit PIC MCU
Certifications	FCC/IC/EN/KC/ NC/Telec Wi-Fi Alliance	FCC/IC/EN KC/NCC Wi-Fi Alliance	FCC/IC/EN KC/NCC/Telec Wi-Fi Alliance	FCC/IC Others in progress



# RN1723-I/RM100

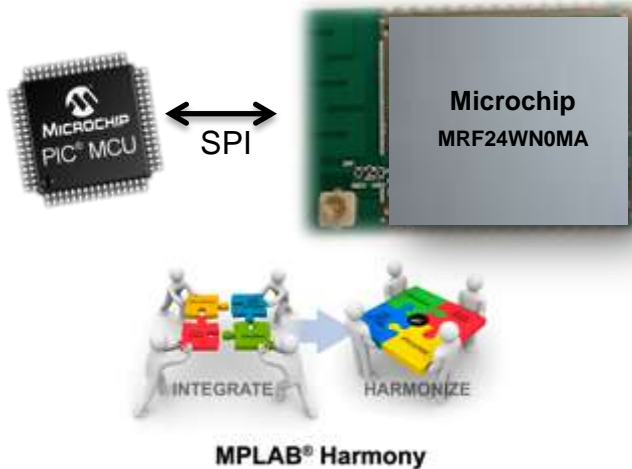
## Low-Power Wi-Fi Module

- RN-style “stack on-board”
- Ultra low power features:
  - Sleep (~ 4uA) / DOZE (Standby) (15mA)
  - ~ 40% faster IP address acquisition than RN171
- **SSL/TLS security runs on external MCU**
- FW/Data updates via UART supports **Linux and Mac**
- **Better (“faster”) SSID selection** in crowded networks
- New **Dynamic HMTL Web-Pages Support**
- Footprint compatible w/ RN171 – ***not FW compatible***
- Development Support: RN-1723-EK



***40% Lower published pricing***





## Complete Solution!

- Compatible with Harmony TCP/IP stack
- SPI Interface to Host MCU
- Optimized for Embedded Designs
- Compact size: 27 x 18 mm
- 2.4GHz only module
- Security: WPS, WPA-PSK, WPA2-PSK, WEP, TKIP

## Key Features

- HTTP Server, Client, SNTP, DHCP, DNS, [FTP](#), [TFTP](#), [SMTP](#), [SNMP](#), [Telnet](#)
- SSL/TLS [Server](#) and Client
- IPv4 & IPv6 supported
- [Multiple socket support](#)
- [RTOS support](#)
- Multiple demo examples

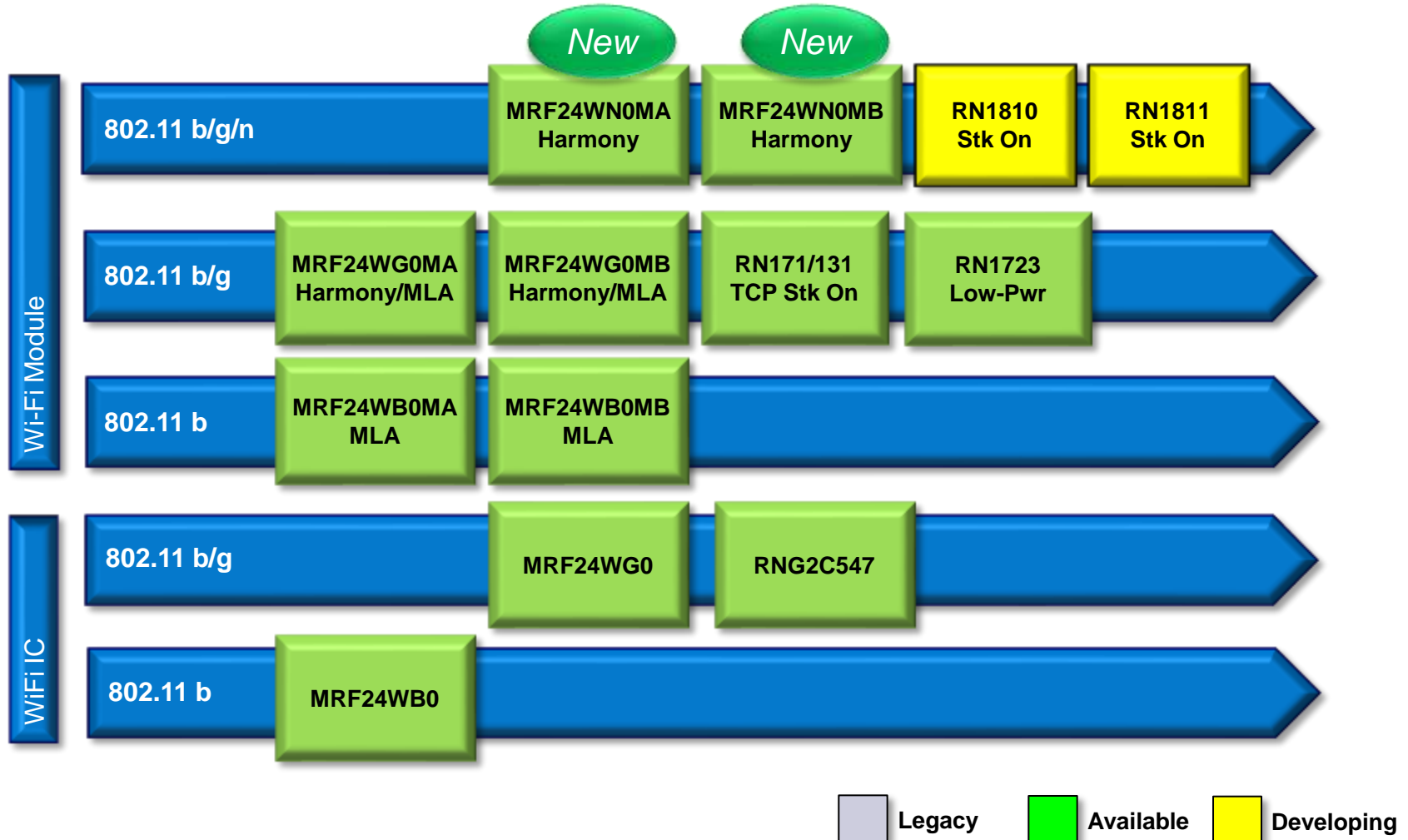


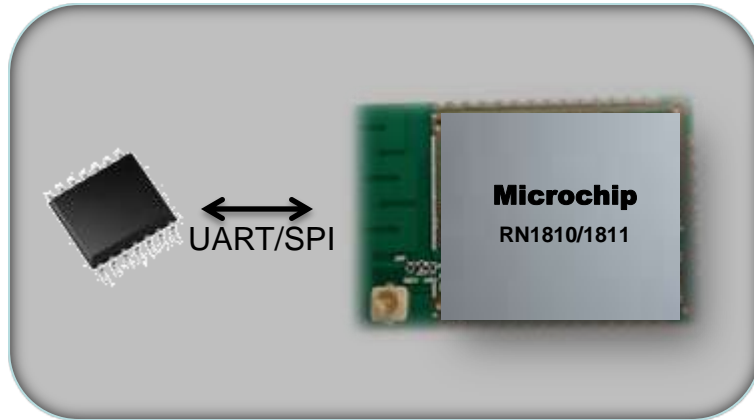
## Development Tool

- PICtail / PICtail Plus for Microchip dev. board compatibility
- [Harmony Compatible](#)
- Demo Code
- PN: AC164153; \$34.95



# WPD Wi-Fi Roadmap





## Key Features

- IEEE 802.11 b/g/n
- TCP/IP stack on the Module
- HTTP Server, Client, SNTP, DHCP, DNS
- SSL/TLS Client
- IPv4 & IPv6 supported

**Coming  
Soon!**

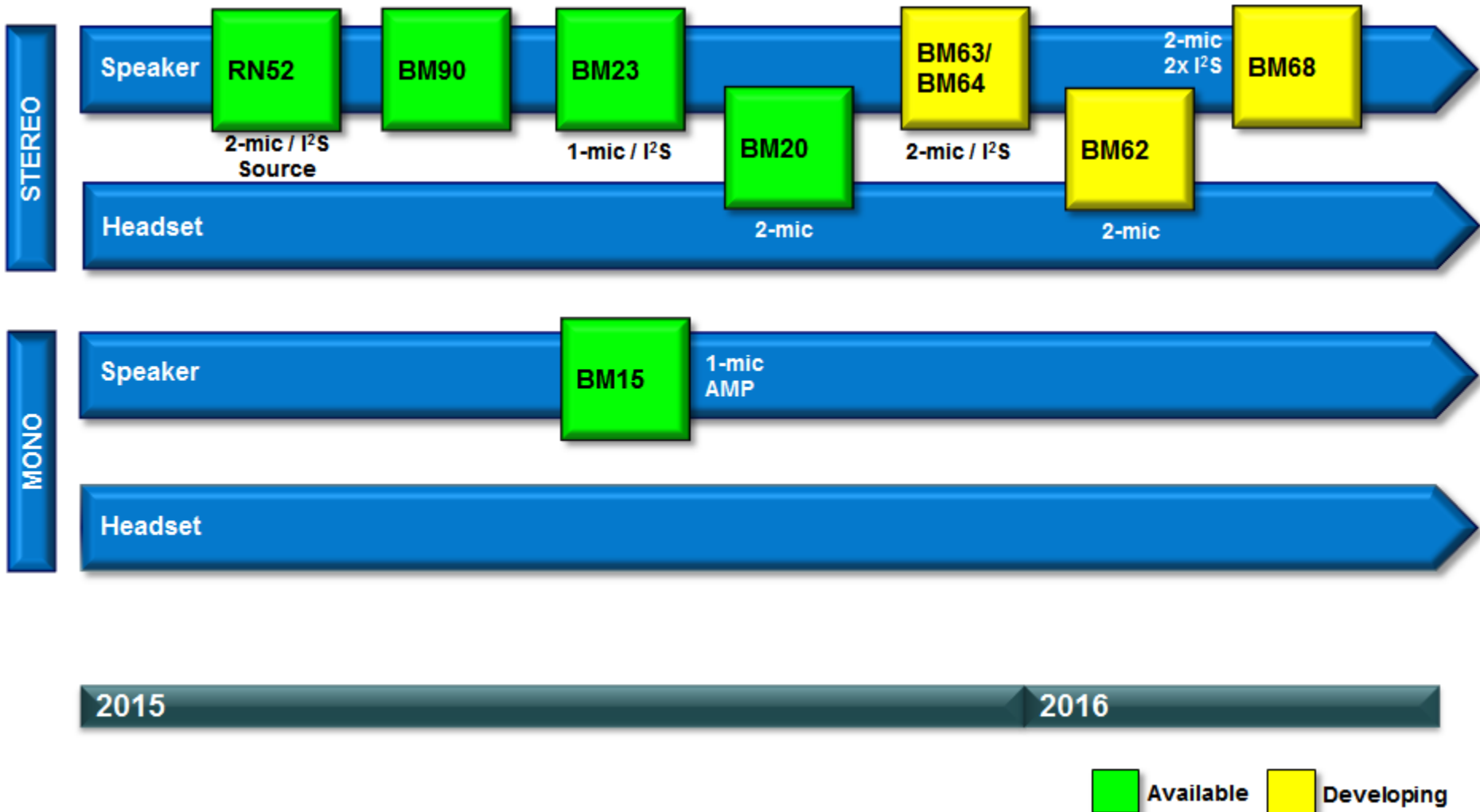


## Optimized Embedded Solution

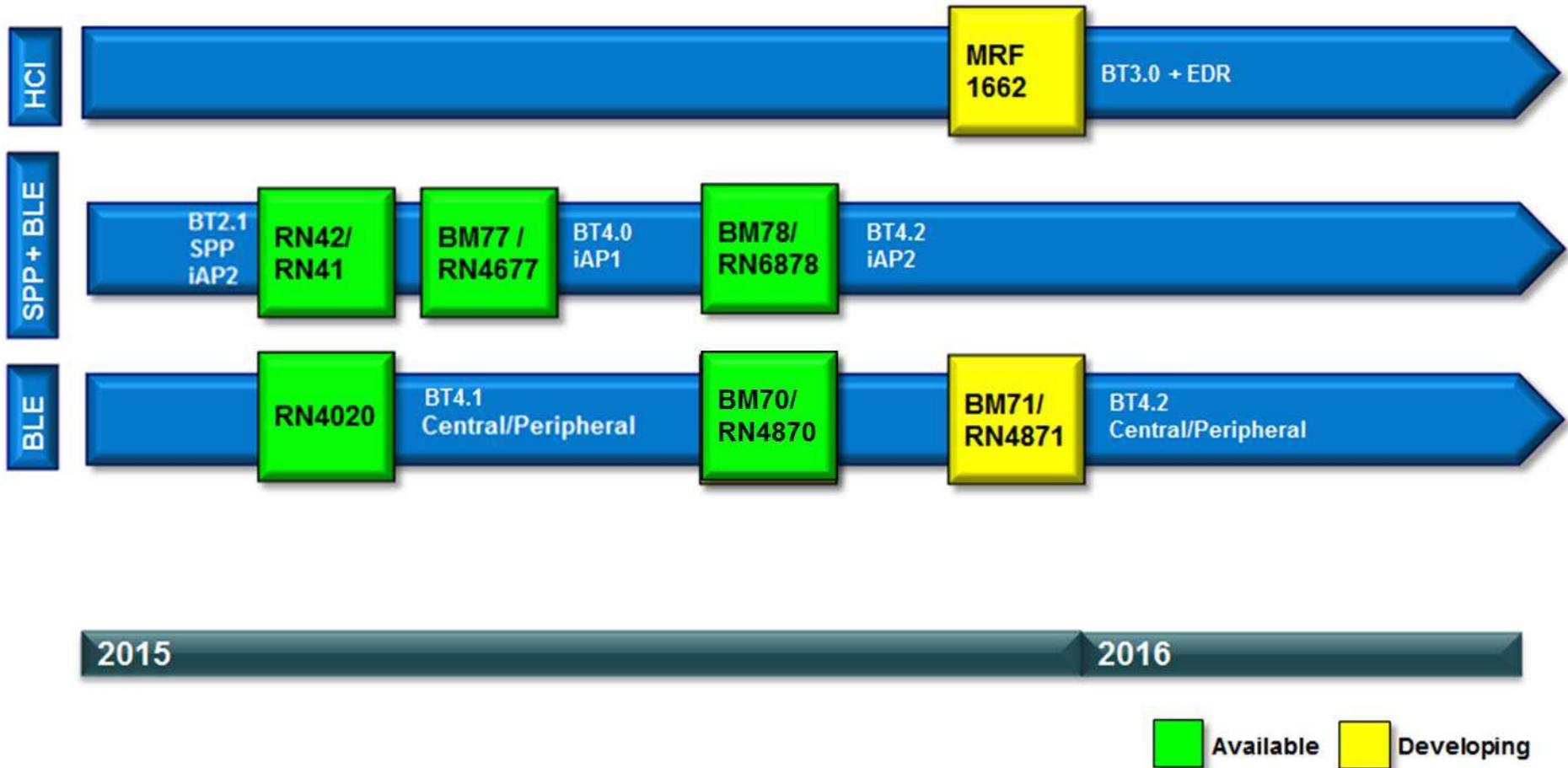
- **RN1810:** UART MCU interface, simple WiFly ASCII commands
- **RN1811:** SPI MCU interface, up to 10Mbps
- **Security**
  - WPS, WPA-PSK, WPA2-PSK, WEP, TKIP
- **PICtail / PICtail Plus Development Board**
  - Standalone mode and USB Interface
  - Demo code



# Bluetooth Audio Module Roadmap



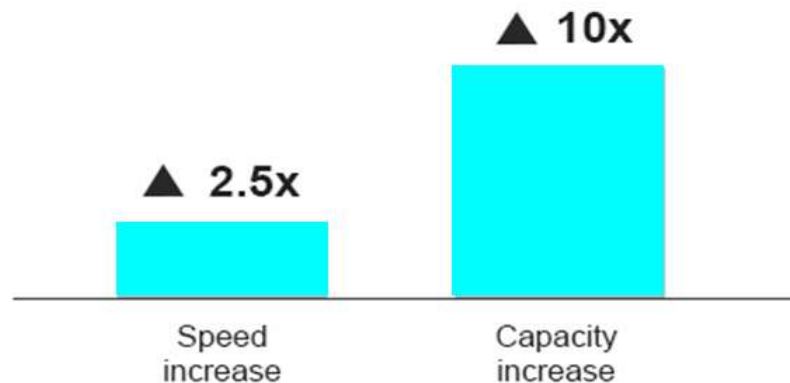
# Bluetooth Data Module Roadmap



# Bluetooth 4.2

- **Faster Data Sync**

- In 4.2, BTLE up to 2.5x higher throughput with a huge packet capacity increase – nearly 10x more versus previous versions.



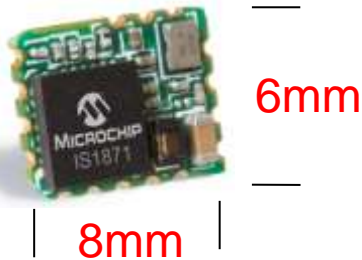
- **Highly Secure**

- Features FIPS-compliant encryption ensuring confidential data stays that way.
- LE Security Mode 1 Level 3 & 4 (Highest LE Security level)

# BM70/71/RN4870 BTLE Modules



**BM71  
Available  
soon!**



- **Complete solution**
  - Stack onboard
  - Shielded with Antenna options
- **UART command interface**
- **Bluetooth® 4.2 compliant**
  - Bluetooth SIG certified
- **Footprint compatible w/ BM77/RN4677 Dual-Mode**
- **Downloadable GUI for configuration (BMxx)**
- ***Certification testing completed!***



# Beacons

- *The BM70 and BM71 BTLE Modules support both iBeacon & Eddystone™*
  - *Standard beacons are provisioned at a particular spot (like a coat rack in a retail store)*
  - *When in proximity to a beacon it invokes an application (such as a loyalty app) on your phone.*
  - *The app can then communicate with the cloud and log that you are in the particular retail store and send you offers and incentive coupons.*
  - *There is no two-way communication with the beacon!*



iBeacon



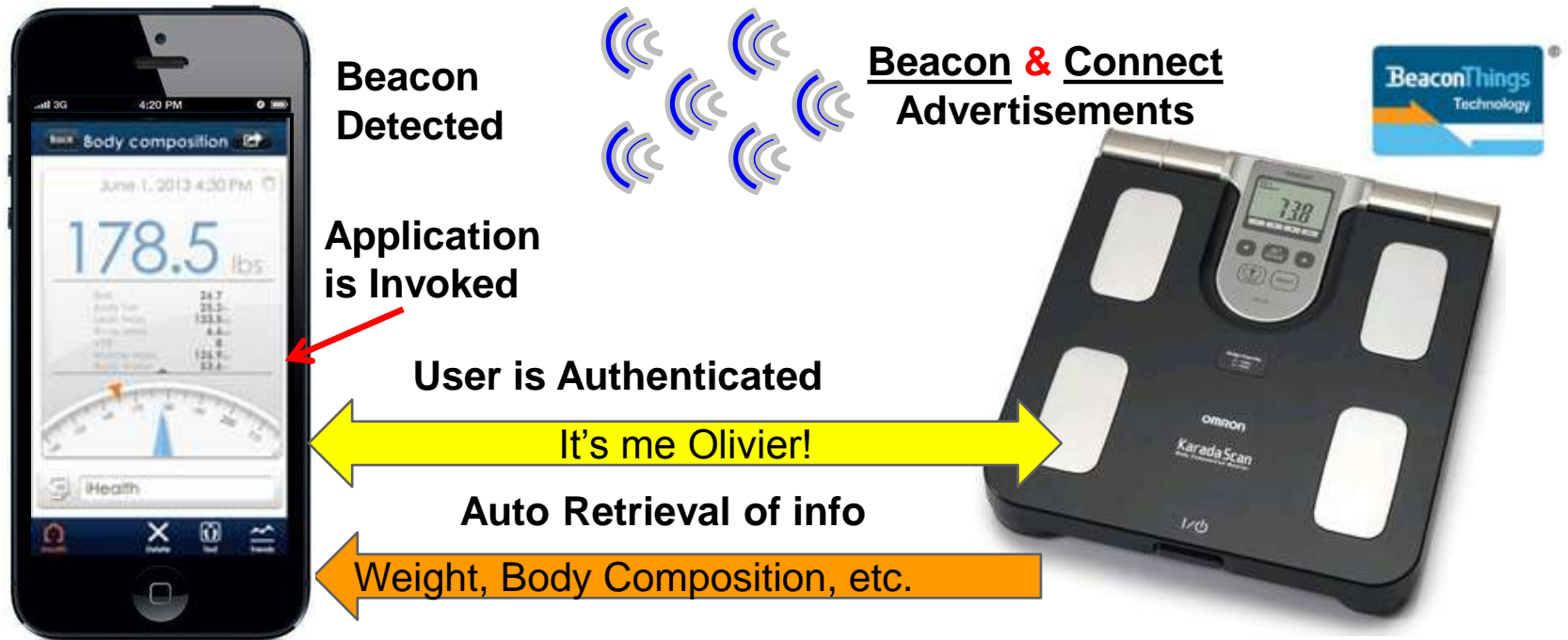
Eddystone™

# Beacons

- *BeaconThings® is a Firmware configuration in IS1870/IS1871 based products.*
- *It enables two way communication between the Smartphone and the Beacon enabled accessory.*
  - *It works like a standard Beacon and can invoke an app when an enabled Smartphone is near.*
  - *It works like a peripheral and can exchange data with the Smartphone App.*
- BeaconThings minimizes manual Intervention in App & Accessory Communication / Updates
- Target Applications: Health & Fitness, Home Automation, Industrial, etc.



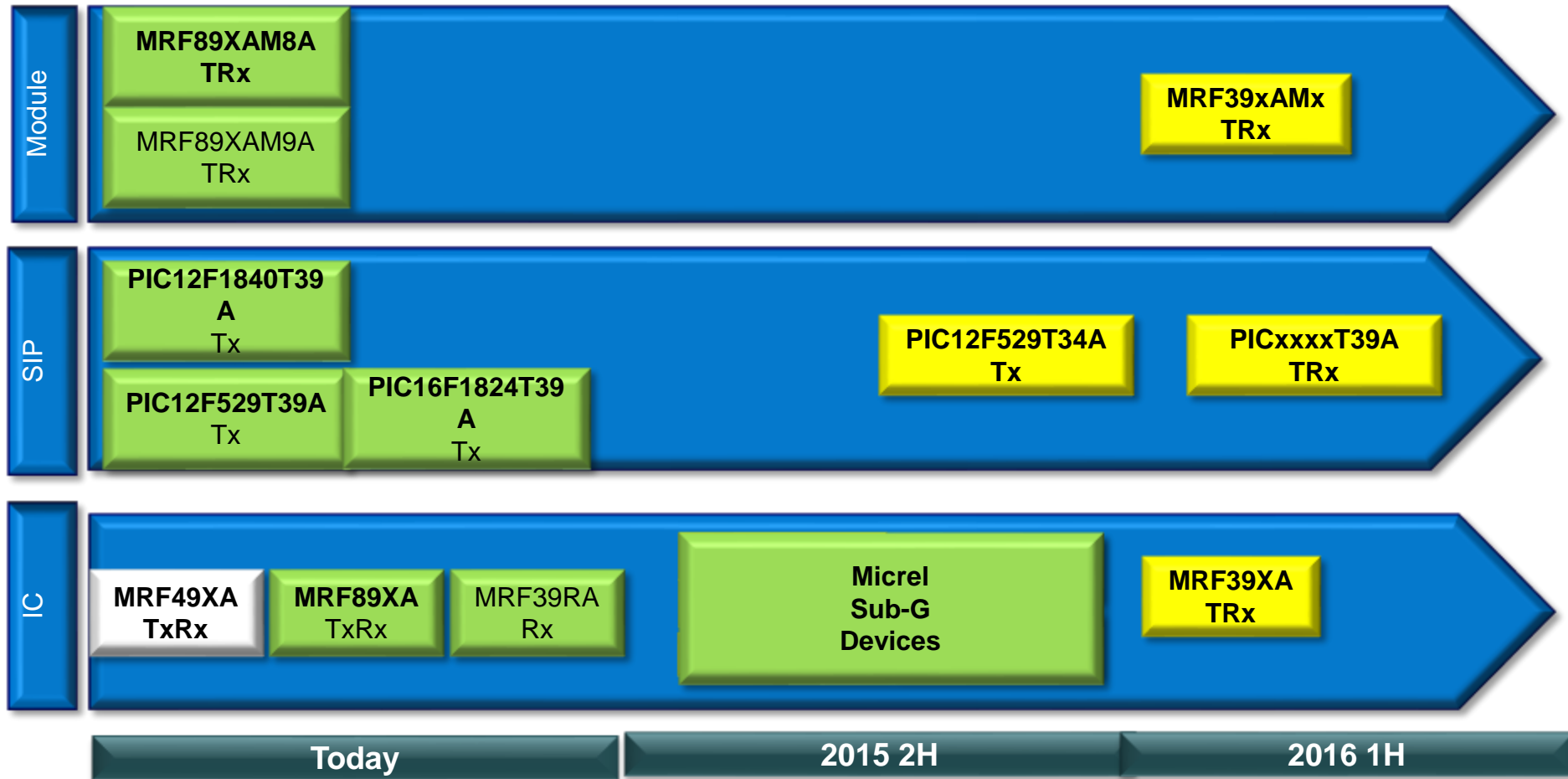
# How Does BeaconThings® Help You?



***Improved User Experience***



# Embedded Wireless (EWS) Portfolio



\* Legacy is not recommended for new design.

 Legacy  Available  Developing

# Micrel Additions to EWS

- **Sub Ghz Transmitter and Receiver ICs**

## Transmitters

MICRF112

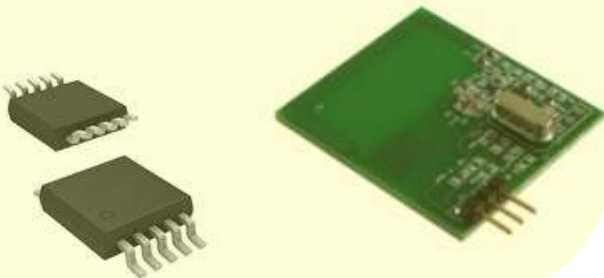
300-450Mhz, 1.8-3.6V

MICRF113

300-450Mhz, 1.8-3.6V

MICRF114

285-445Mhz, 1.8-3.6V



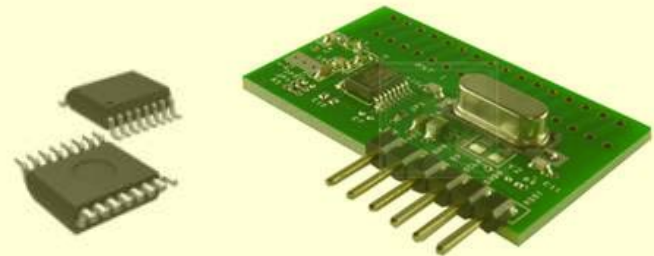
## Receiver

MICRF220

300-450Mhz, 3.0-3.6V

MICRF219A

300-450Mhz, 3.0-3.6V



# Benefit of Micrel Wireless

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- **Easy to use RF chips**
- **Low power consumption**
  - 0.05-0.2  $\mu$ A sleep or shut down mode
  - Auto-Polling mode to save power
- **Small form factor and low pin counts**
  - Tx: 6-10 pins, Rx: 16 pins
  - Tx: smallest 2x2mm, Rx: 5x6mm
- **Extended temperature range**
  - Extended 105C, or 125C for certain device
- **Competitive Price**

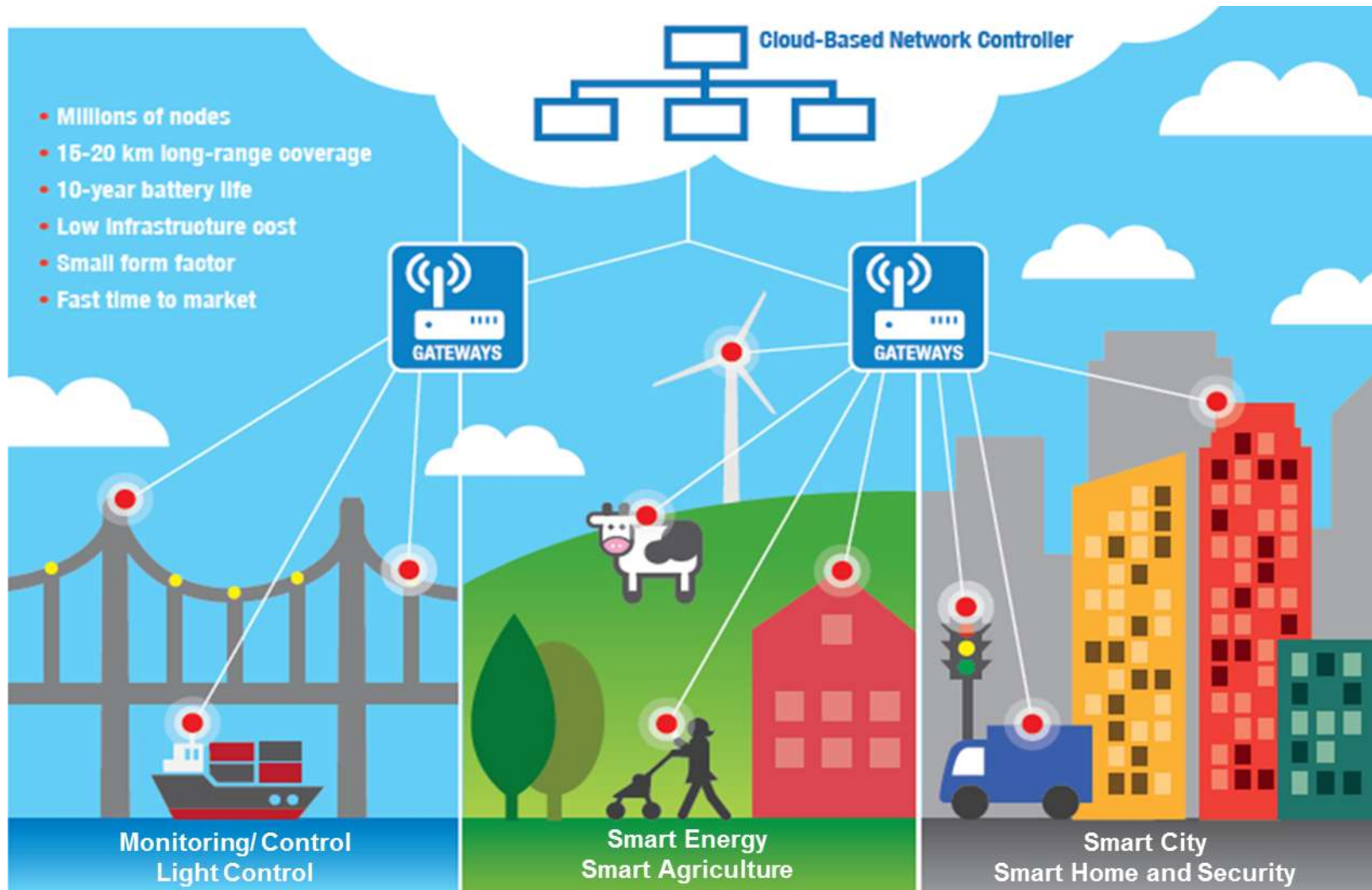
# What is **LoRa™ Technology?**

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- **Proprietary wireless technology developed by Semtech**
- **Long range and low power consumption**
  - At +14dbm output power, 868MHz:
    - Up to 5km range in urban environment, up to 15km suburban
    - >10 year battery life capability
- **Robust communication**
  - Not susceptible to interference from Wi-Fi, Bluetooth, GSM, LTE, etc
- **Improved network capacity**
  - Connect more nodes, 100k to 300k nodes

# LoRaWAN

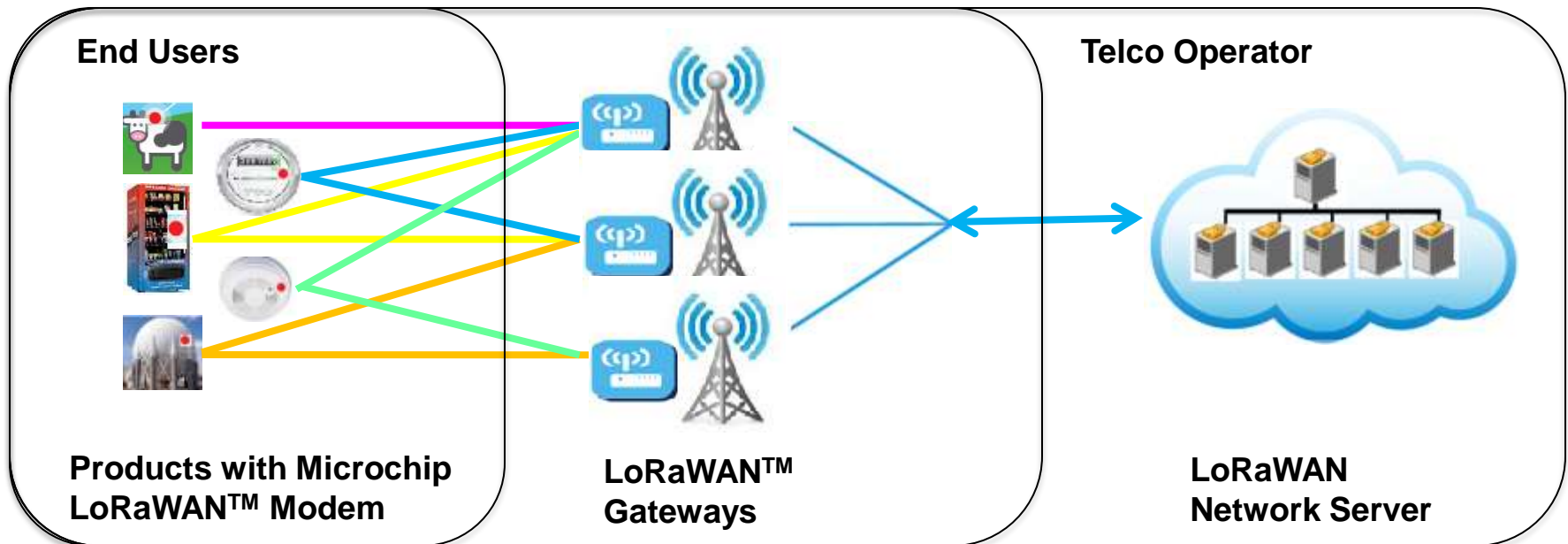
## Ideal for Internet of “Things”



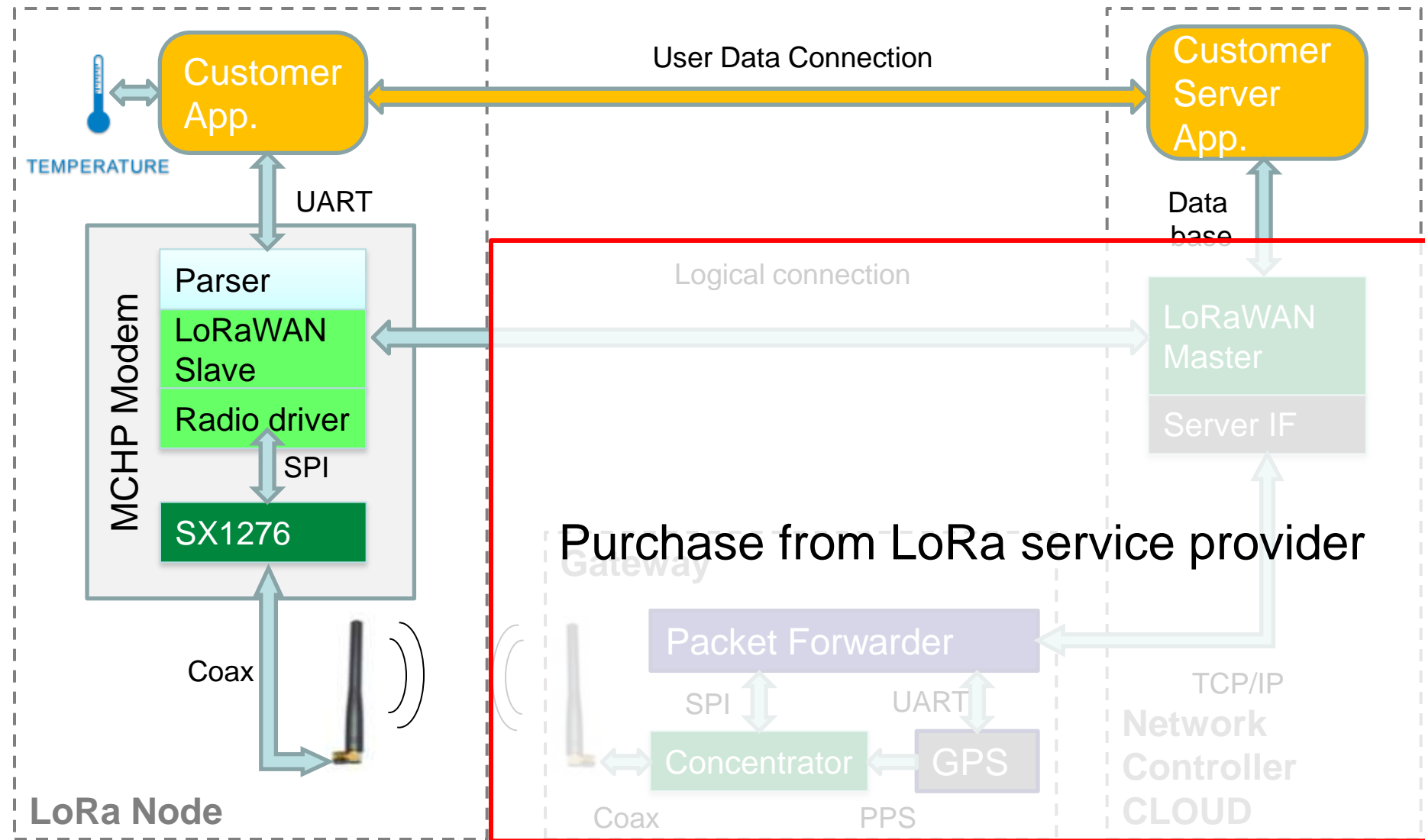
# Supports Private Networks

## Scalable & Flexible Architecture Options

- ❑ **Private Network**
  - ❑ Individually managed networks, total end-to-end ownership
- ❑ **Public Network**
  - ❑ Telco operator managed networks, servicing subscriber nodes
- ❑ **Hybrid Network**
  - ❑ Enterprise deployment of Nodes & Gateways, for specific area coverage
  - ❑ Provisioned to a commercial LoRaWAN server product



# Public Network





# LoRa™ Infrastructure Benefits

---

- **Star topology with two-way communications**
  - Minimizes synchronization overhead, saves power consumption from minimum synchronization and hops in mesh network
  - Not constrained to single application (ie, Zigbee)
- **Easily connect millions of nodes to LoRa concentrators**
- **Adaptive data rate feature on Network server**
  - Optimizes the network capacity, battery lifetime and creates a fully scalable system
- **Strong ecosystem established with partners**
- **Support local area network and nationwide deployment**



# Introducing RN2483-I/RM EU LoRaWAN™ Modem



## Complete Solution!

- Integrates LoRa™ Radio, PIC MCU & LoRaWAN Stack
- Pre-tested against all major LoRaWAN gateways & servers
- Simple ASCII Command Set
- Optimized for Embedded Designs
- Quick Time-to-Market
- IEEE globally unique address included

## Key Features

- LoRaWANv1.0 Class-A “Golden Unit” Stack
- Dual-band 434 & 868MHz, external antenna
- Integrated filtering and matching circuits
- I/O Expansion: 6x analog, 6x digital, UART, I2C
- Compact size: 27 x 18 x 3 mm
- European R&TTE Certifications



## Development Tools

- PICtail for Microchip MCU kits
- Mote for portable testing
- Both support USB Interface
- Example Code available





# LoRa™ Modem RF Features

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- **Tx output power:**
  - Up to +18 dBm @ 915 MHz (FCC) - Adjustable
  - +14 dBm @ 868 MHz (ETSI)
  - +10 dBm @ 433 MHz
- **High sensitivity: down to -148 dBm**
- **168 dB maximum link budget**
- **Tx current: 40 mA typ at +14 dBm**
- **Rx current: 14.2 mA typ**
- **Sleep mode/ low power down mode: 1 uA typ**
- **Excellent blocking immunity**
- **FSK and LoRa**
- **Programmable bit rate: 300bps – 5.5kbps (LoRa)**



**MICROCHIP**

**Internet of Things**

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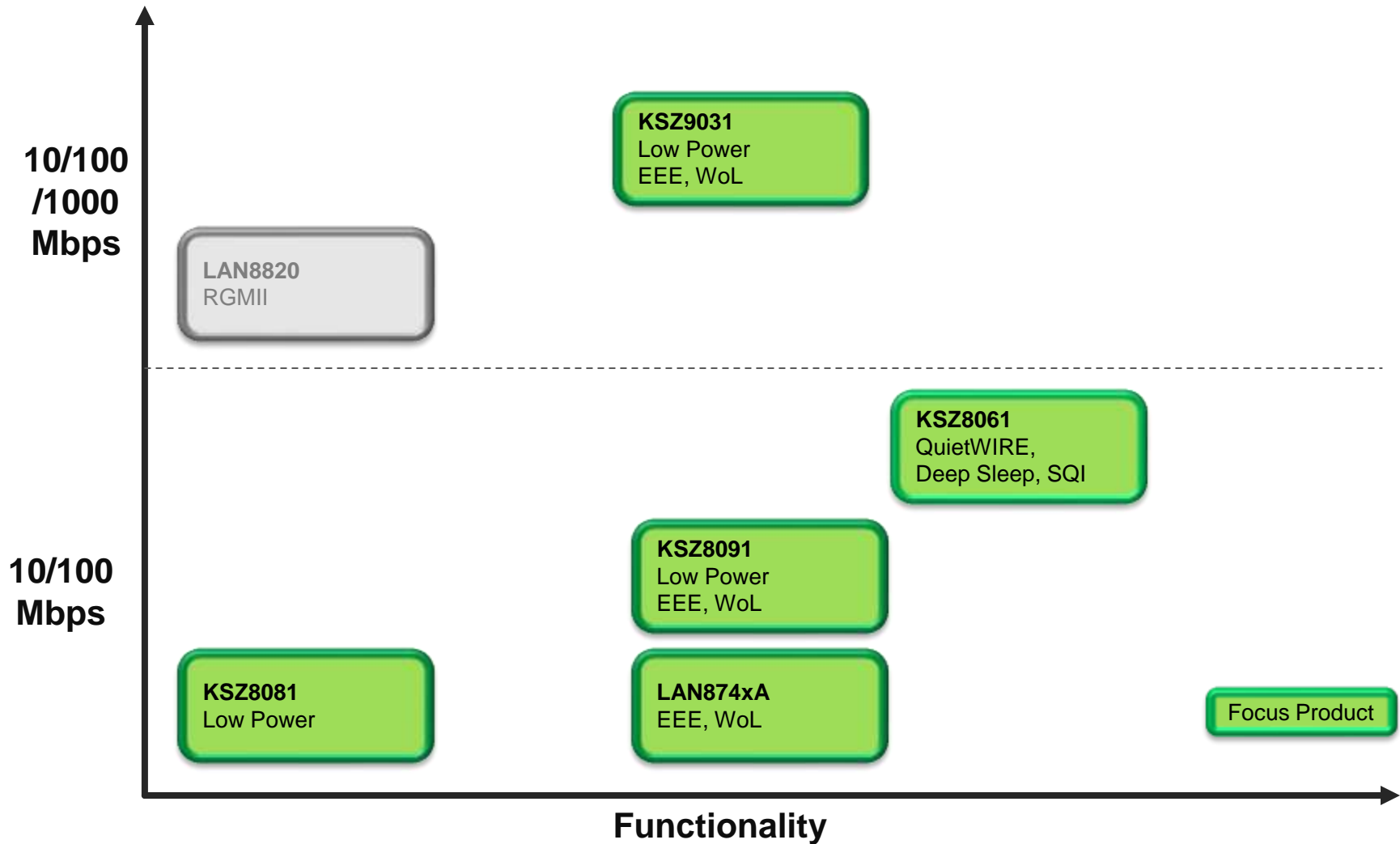


# **MICROCHIP**

## **Ethernet**

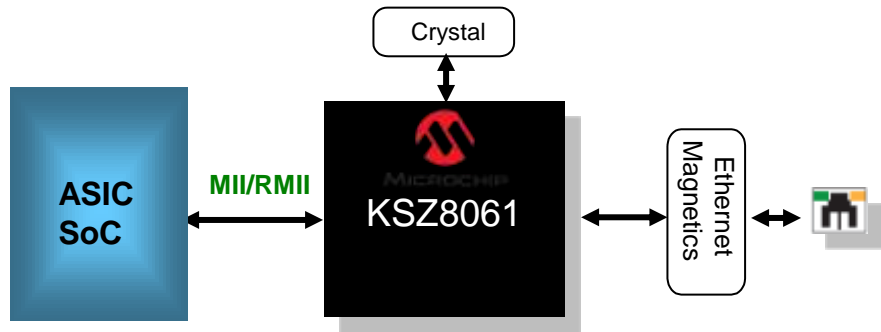
[Return to Topics](#)

# Ethernet Roadmap: PHYs



# KSZ8061

## Next Gen 10/100 PHY



### Target Applications

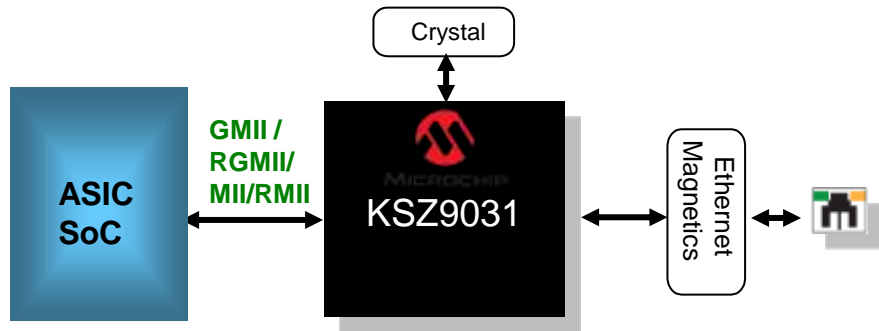
- Automotive
- Avionics, Train
- Industrial Controls
- Cameras, Sensors
- POS, Scanners
- Robotics
- Medical
- Printers
- UPS

**Extended Temp Range (-40 to +105C)**

- **Quiet-Wire®** programmable EMI Filter
- **LinkMD®** link quality indicator
- **Fast start-up and link**
  - Low-Fixed Latency
- **EtherGREEN™ Low-Power ~ 150mW total**
  - Ultra-Deep Sleep < 1uA
  - Signal detect wake-up
- **HP Auto-MDIX support with IEEE 802.3ab specs at 10/100 Mbps operation**
- **Extended Temp (105C)**
- **64-pin or 48-pin QFN**

# KSZ9031

## Next Gen GigE PHY



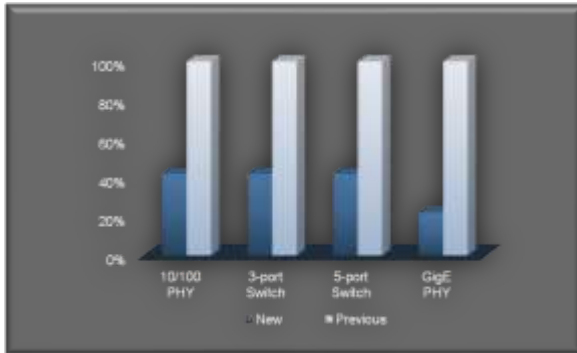
### Target Applications

- Industrial PC
- VoIP gateway
- SOHO/SMB router
- Industrial Networks
- Security/Inspection
- MFP Printers
- STB

Commercial (0 to +85C), Industrial (-40 to +85C)

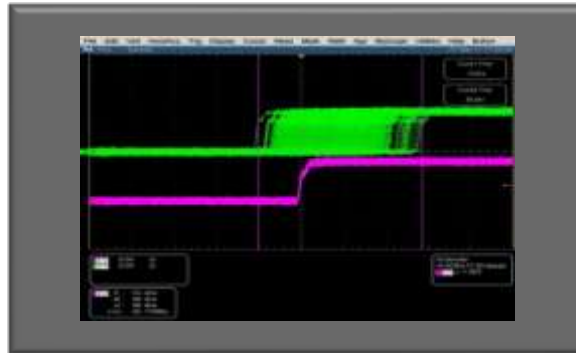
- **802.3az EEE and WoL**
- **Cable Diagnostics**
- **Low Power**
  - Voltage mode line driver
- **Built in switching and LDO regulator**
  - Operates from single 1.2, 2.5 or 3.3 volt supply
  - Variable I/O voltage support
    - 1.8V, 2.5V or 3.3V
- **Programmable LEDs (4)**
- **HP Auto-MDIX support with IEEE 802.3ab specs at 10/100/1000 Mbps operation**
- **Power Down modes**
- **64-pin or 48-pin QFN**

# Ethernet Technology Differentiators



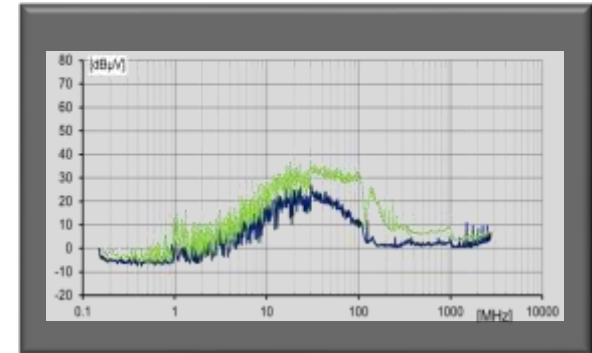
## Energy Efficient

- Ultra-low power Ethernet PHY
- **EtherGreen™** Advanced Power Management
- **Ultra Deep Sleep**  $\mu$ A Standby
- Highly Integrated, Reduced BOM, Small Packages



## Deterministic

- **EtherSynch®** IEEE 1588v2 / 802.1AS synchronization
- Fixed / Low Latency transmission
- AVB / Time Aware Traffic Scheduling



## Reliability

- **Quiet-WIRE®** Enhanced EMC
- **LinkMD®+** Diagnostics (SQI\*)
- Network Fault Recovery

- **Robust energy efficient Ethernet for time sensitive networks**

\* SQI – Signal Quality Indicator

# Quiet-WIRE® Enhanced EMC

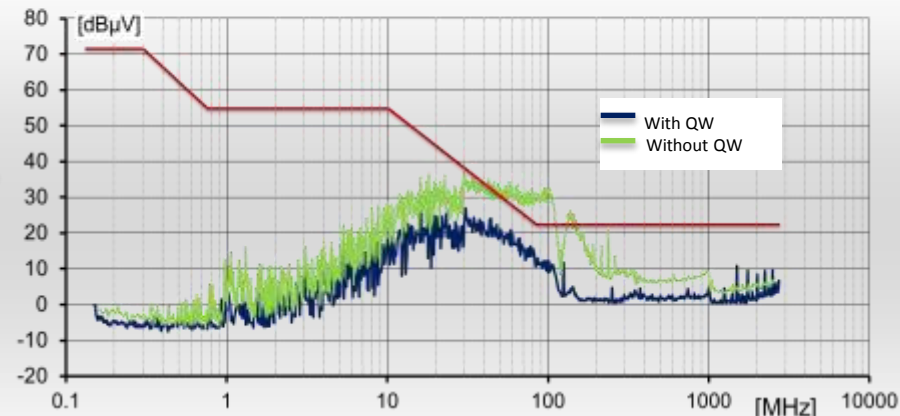
- **Reduced Radiated Emissions**

- Interoperable 100BASE-TX PHY technology
- Enables use of low cost unshielded cable for most stringent applications

- **Quiet-WIRE® Reduced Emissions**

- Meets CSPR22 / 25 limits over low cost Unshielded Twister-Pair eg. CAN
- Software programmable internal line filtering
- Boot strap option to enable / disable

Example: 10–20dB  
reduction > 30MHz



Example: IEC61967 RF Emissions

# Quiet-WIRE<sup>®</sup> Enhanced EMC

- **Enhanced Noise Immunity**

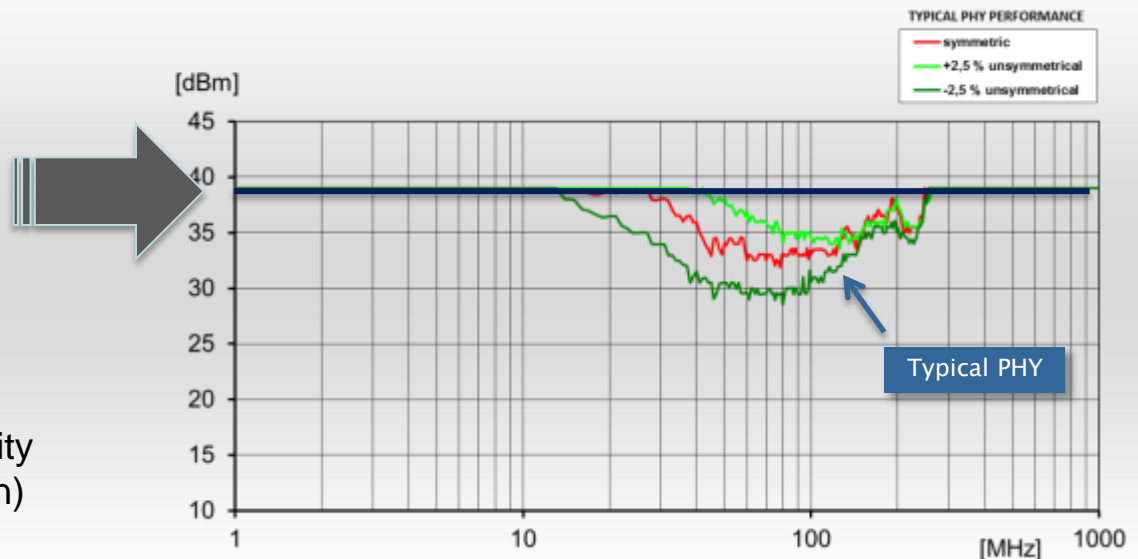
- Interoperable 100BASE-TX PHY technology
- Enables use of low cost unshielded cable for most stringent applications

- **Quiet-WIRE<sup>™</sup> Enhanced Immunity**

- Meets Automotive and Industrial limits, BCI, DPI, IEC61000-4 etc.
- Low cost UTP eg. 'CAN' or similar
- Extended cable reach, typically > 170m

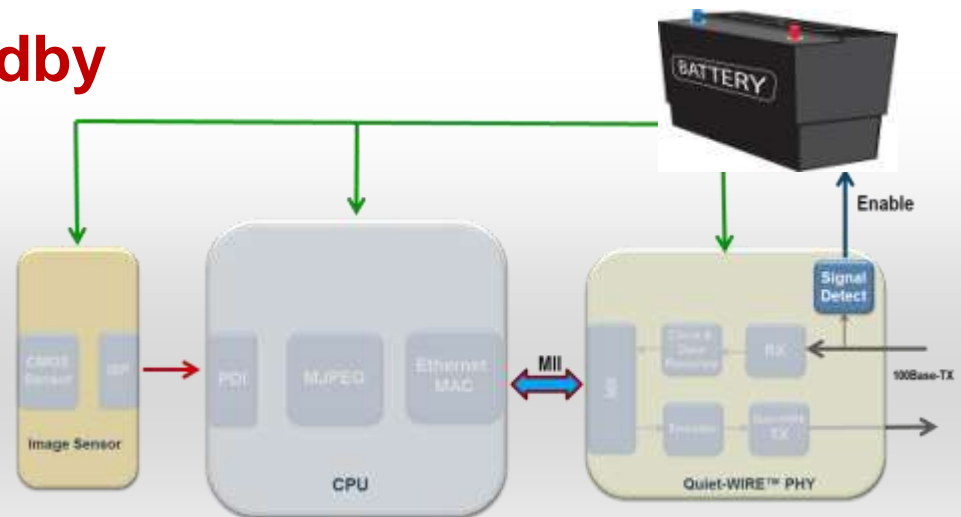
**KSZ8061 QW PHY**  
**Error Free**  
**1-1,000MHz / 39dBm**

Example: IEC62132 DPI Immunity  
(DPI = Direct Power Injection)



- **Patented low power PHY Technology**
- **Advanced Power Management**
  - Energy Detect Power Down
  - Flexible I/O Vdd supply
- **Ultra Deep Sleep Standby**
  - Signal Detect wake up

Less than 1uA  
Standby consumption



Example: Remote Sensor



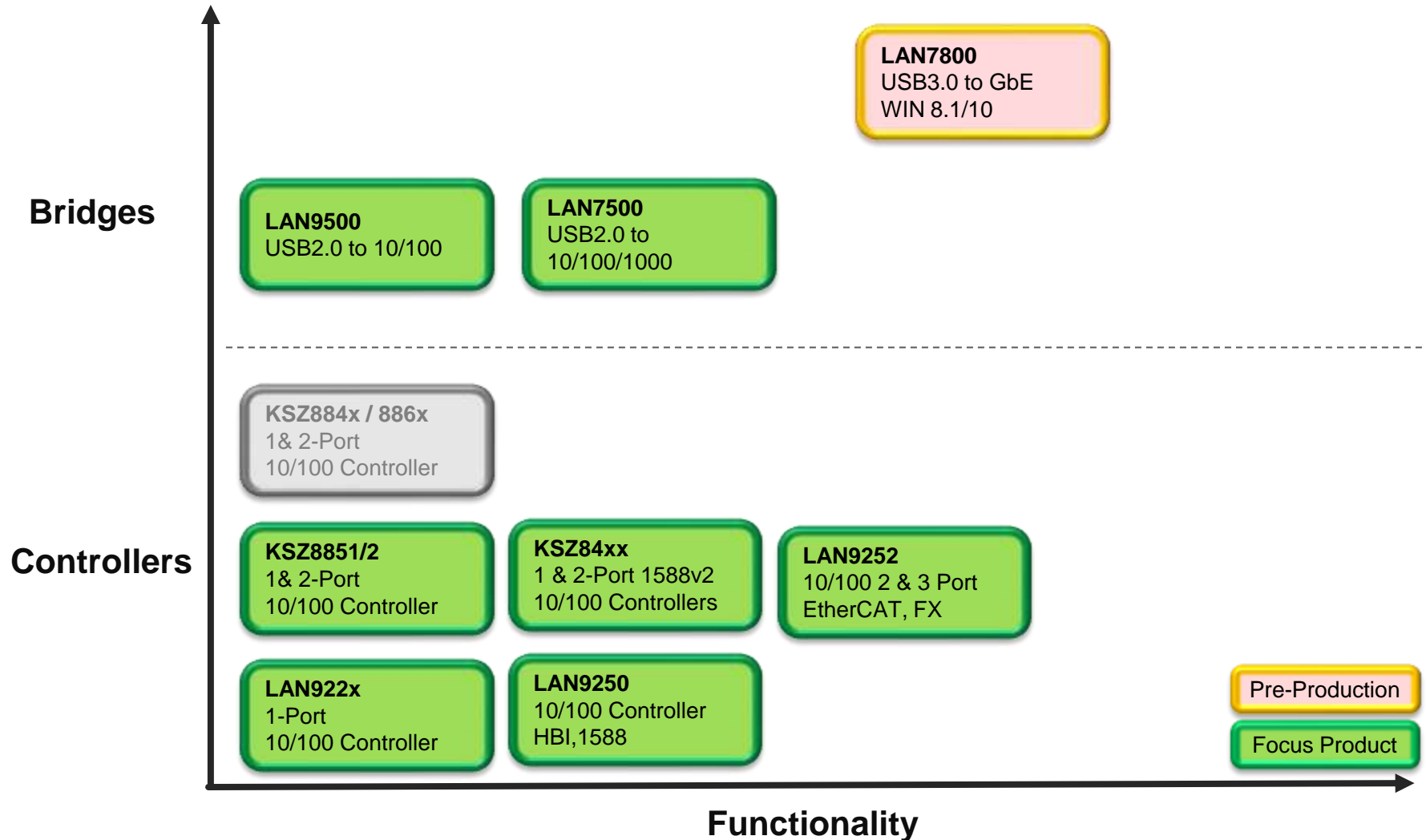
# Ethernet Transceivers

Product	KSZ8061 Quiet-WIRE®	KSZ8081	KSZ8091	LAN8710A	LAN8720A	LAN8740A	LAN8741A	LAN8742A	KSZ9031
Ethernet Bandwidth	10Base-T/ 100Base-TX								10/100/1000Base-T
Interrupt Pin	Yes + Signal Detect	Yes	Yes						Yes
Interface	MII/RMII				RMII	MII/RMII		RMII	MII/RGMII/GMII
Wake-on-LAN			Yes			Yes		Yes	Yes
EEE			Yes			Yes	Yes		Yes
Vdd IO	1.8/2.5/3.3	1.8/2.5/3.3	1.8/2.5/3.3	1.6-3.3	1.6-3.3	1.6-3.3	1.6-3.3	1.6-3.3	X cntlr
LinkMD Cable Diag	Yes + Signal Quality Indicator	X	X						Yes
Power Consumption*	170mW Total + uA standby	155mW Total	155mW Total	256mW Total	249mW Total	269mW Total	286mW Total	286mW Total	488mW Total
Packages	32/VQFN 48/VQFN	24/VQFN 32/VQFN 48/LQFP	24/VQFN 32/VQFN 48/LQFP	32/VQFN	24/QFN	32/QFN	32/QFN	24/QFN	48/VQFN 64/VQFN

Note: All products available in Commercial (0 to +85C) and Industrial (-40 to +85C) temperatures

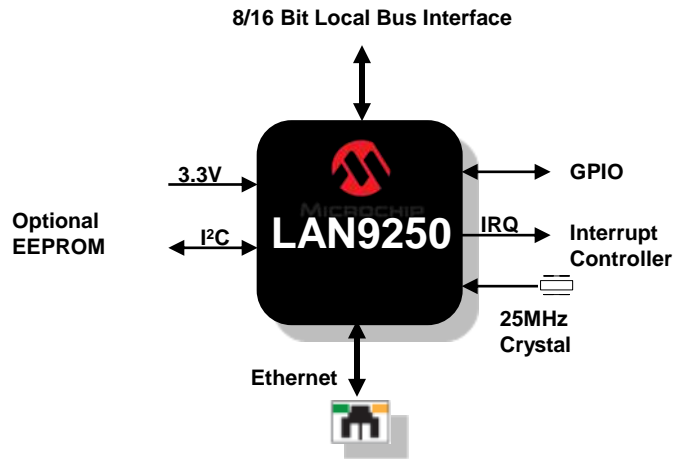
\* Includes Transformer

# Ethernet Roadmap: Bridges & Controllers



# LAN9250

## 10/100 Enet Controller



### Target Applications

- Industrial PC
- VoIP gateway
- SOHO/SMB router
- Telecom
- Financial Transactions
- Industrial Networks
- Power Grid/Meter
- Security / Surveillance
- Transportation
- Mill/Aero

Commercial (0 to +70C) Industrial (-40 to +85C) and  
Extended temp. (-40 to +105C) supported

- **IEEE 1588-2008 Compliant**
  - Supports UDP/IPv6 and layer 2
  - Transparent clocks
  - Smaller packet size
  - Increased update rate
- IEEE 802.3u 100Base-FX Fiber Interface
- **IEEE 802.3az EEE and WoL**
- **Cable Diagnostics**
- Optional EEPROM support via I²C
- Integrated regulator enables single 3.3V supply



# Ethernet Controller Selector

Product	ENC28J60	ENC624J600	KSZ8441	KSZ8462	KSZ885x	LAN9217	LAN9218	LAN9220	LAN9221	LAN9250
Ethernet Bandwidth	10Base-T	10Base-T/ 100Base-TX								
TX/RX RAM Buffer(Bytes)	8K	24K	12KB(RX) 6KB(TX)			16K	16K	16K	16K	16K
Interface	SPI	SPI, Parallel	8/16-bit	8/16-bit	SPI, 8/16-bit	16-bit	32-bit	16-bit	16-bit	SPI, 16-bit
IEEE 1588			Yes	Yes						Yes
Wake-on-LAN					Yes					Yes
EEE			Yes	Yes	Yes (8852)					Yes
# of Enet ports	1	1	1	2	1 or 2	1	1	1	1	1
LinkMD Cable Diag			Yes	Yes	Yes					Yes
Power Consumption*	590mW Total		330mW Total	330mW Total	330mW Total	540mW Total	540mW Total	540mW Total	522mW Total	
Packages	28/QFN 28/SOIC 300mil 28/SPDIP 28/SSOP 208mil	64/TQFP	64/LQFP	64/LQFP	32-QFN, 48/LQFP 128/PQFP	100/LQFP	100/LQFP	56/VQFN	56/VQFN	56/VQFN

\* Includes Transformer

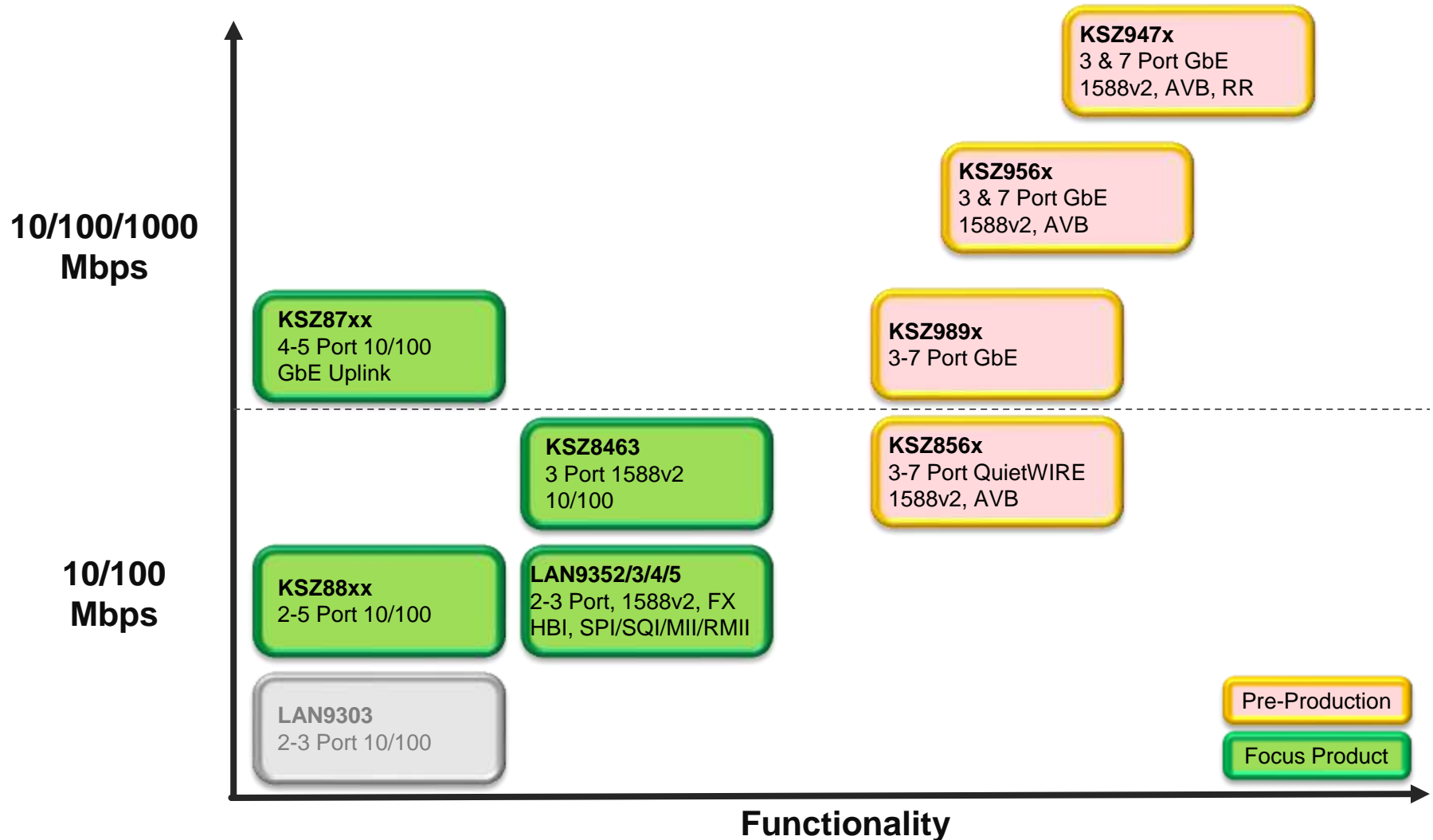


# Ethernet Bridge Product Selector Guide



Feature	LAN9730	LAN9500A	LAN9512	LAN9513	LAN9514	LAN7500
Ethernet Bridge	HSIC to 10/100	USB2.0 to 10/100	USB2.0 to 10/100	USB2.0 to 10/100	USB2.0 to 10/100	USB2.0 to 10/100/1000
USB Hub Ports	0	0	2	3	4	0
External PHY interface	MII	MII	-	-	-	-
NetDetach™ Technology	Yes	Yes	-	-	-	Yes
Wake-on-LAN	Yes	Yes	Yes	Yes	Yes	Yes
PME Support	Yes	Yes	-	-	-	Yes
Integrated Regulator	3.3V to 1.2V	3.3V to 1.2V	3.3V to 1.8V	3.3V to 1.8V	3.3V to 1.8V	None
Package	QFN56	QFN56	QFN64	QFN64	QFN64	QFN56
Power Typical Device Only (3.3V)	235mW	228mW	763mW	857mW	951mW	620mW

# Ethernet Roadmap: Switches



# 3-Port Switch Selector

Product	KSZ8863	KSZ8873	KSZ8463	LAN9303	LAN9353	LAN9354	LAN9355
<b>Ethernet Bandwidth</b>	10Base-T/ 100Base-TX /100Base-FX			10Base-T / 100Base-TX	10Base-T/ 100Base-TX /100Base-FX		
<b>Interface</b>	MII / RMII					RMII	MII
<b>Wake-on-LAN</b>			Yes		Yes	Yes	Yes
<b>EEE</b>			Yes		Yes	Yes	Yes
<b>Vdd IO</b>	1.8/2.5/3.3	1.8/2.5/3.3	1.8/2.5/3.3	3.3	1.6-3.3	1.6-3.3	1.6-3.3
<b>LinkMD Cable Diag</b>	Yes	Yes	Yes		Yes	Yes	Yes
<b>IEEE 1588</b>			Yes		Yes	Yes	Yes
<b>Power Consumption*</b>	520mW Total	520mW Total	330mW Total	640mW Total	555mW Total	555mW Total	555mW Total
<b>Packages</b>	48/LQFP	64/LQFP	64/LQFP	56/QFN	64/ QFN, 64/ TQFP	56/ QFN,	88/ QFN, 80/ TQFP

\* Includes Transformer



# 4 to 9-Port Switch Selector

Product	KSZ8864	KSZ8895	KSZ8795	KSZ8794	KSZ8775	KSZ8765	KSZ8999
<b>Ethernet Bandwidth</b>	10Base-T/ 100Base-TX /100Base-FX		10Base-T/ 100Base-TX w/ GigE Uplink				10Base-T/ 100Base-TX /100Base-FX
<b># of Enet Ports</b>	4	5	5	4	5	5	9
<b>Interface</b>	MII / RMII (x2)	MII / RMII (x2)	GMII / RGMII MII / RMII	RGMII MII / RMII	RGMII MII / RMII	GMII, RGMII MII / RMII	MII, SNI
<b>Wake-on-LAN</b>			Yes	Yes	Yes	Yes	
<b>EEE</b>			Yes	Yes	Yes	Yes	
<b>Vdd IO</b>	1.8/2.5/3.3	1.8/2.5/3.3	1.8/2.5/3.3	1.8/2.5/3.3	1.8/2.5/3.3	1.8/2.5/3.3	3.3
<b>LinkMD Cable Diag</b>	Yes	Yes	Yes	Yes	Yes	Yes	
<b>Power Consumption*</b>	253mW Total	435mW Total	560mW Total	430mW Total	460mW Total	560mW Total	1472mW Total
<b>Packages</b>	64/QFN	128/LQFP 128/ LQFP	80/ LQFP	64/QFN	80/LQFP	80/LQFP	208/ PQFP

\* Includes Transformer

# What is EtherCAT®

---

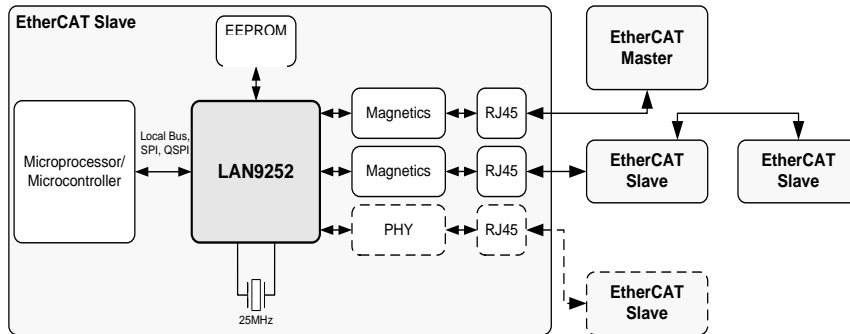
- **Industrial Ethernet**

- Ethernet for Control and Automation Technology

- **Advantages**

- Uses standard Ethernet cabling
  - Requires only low-cost slave controller
    - No dedicated card or co-processor
  - Flexible topologies w/ or w/o switches or hubs
    - Switch/Hub req'd if not only EtherCAT devices on network
  - Lower cost and easier to implement

# LAN9252 Features



## Target Applications

- Motor Motion Control
- Process / Factory Automation
- Communication Modules
- Interface cards
- Sensors
- Hydraulic & Pneumatic Valve systems
- Operator Interfaces

Commercial (0 to +85C) Industrial (-40 to +85C) and Extended temp. (-40 to +105C) supported

- **2/3-port EtherCAT slave**
  - 3 Field Bus Memory mgmnt units
  - 4 Sync managers
- **Interfaces to most 8/16/32-bit embedded controllers**
  - SPI/SQI PIC32MZ
- **Dual integrated 10/100 PHY's**
  - Auto-MDIX
- **Low power mode**
- **1.6V to 3.6V variable I/O voltage**
- **IEEE 802.3u 100Base-FX Fiber Interface**
- **Cable Diagnostics**
- **Integrated 1.2V regulator enables single 3.3V supply**



**MICROCHIP**

**USB Products**

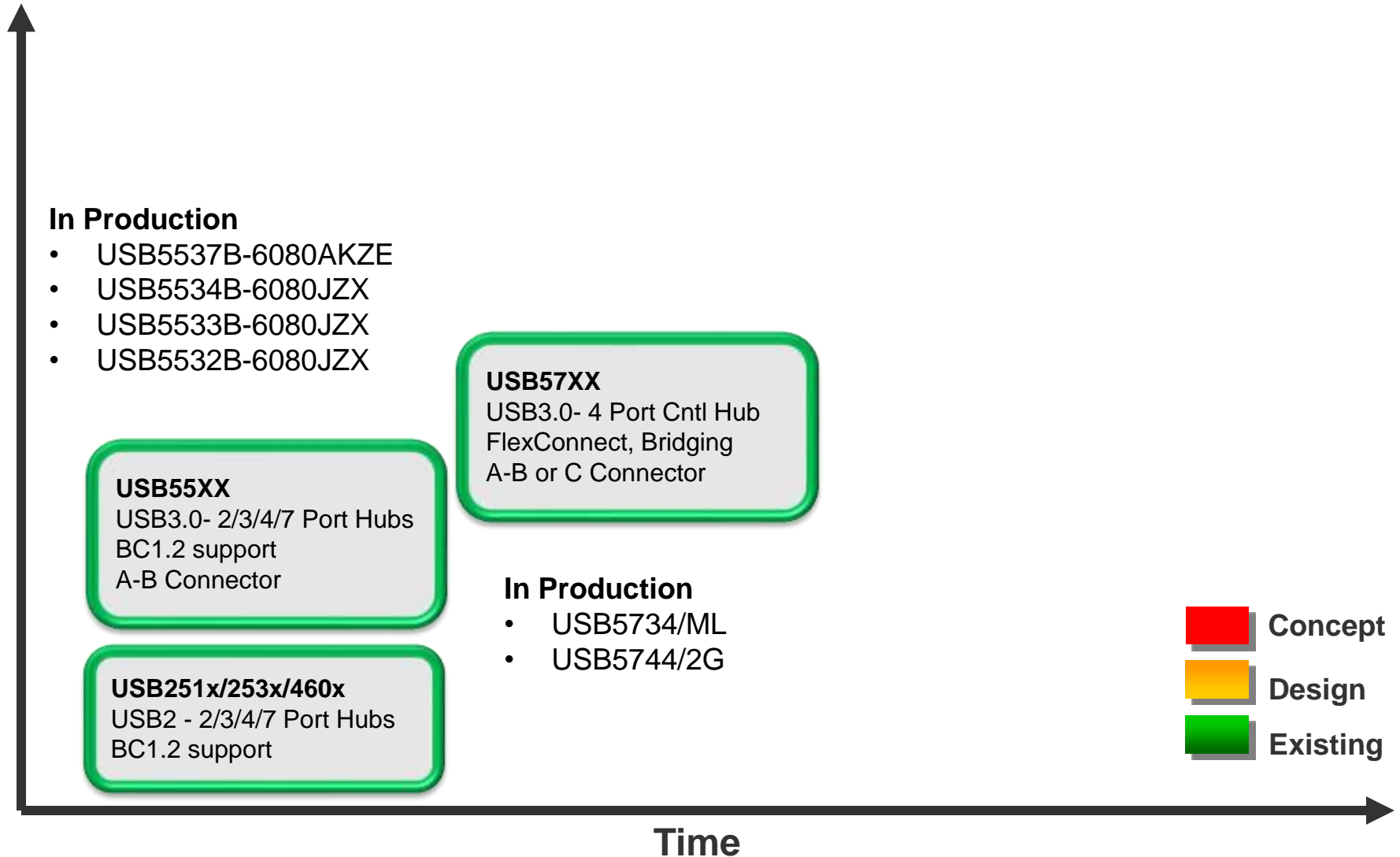
[Return to Topics](#)

# USB Transceivers Value Proposition

---

- **Broadest portfolio of USB transceivers**
- **High functionality in small package sizes**
- **Lowest standby current**
- **Unique integrated features:**
  - ESD and OVP
  - USB switch for high quality audio switch
  - Design savers:
    - PHY Boost for signal integrity (programmable)
    - VariSense for signal recognition (programmable)
  - Flexible clocking support
    - All major frequencies including ULPI Clock 60Mhz in, crystal resonator, and multi-frequency

# USB Hub Product Plans

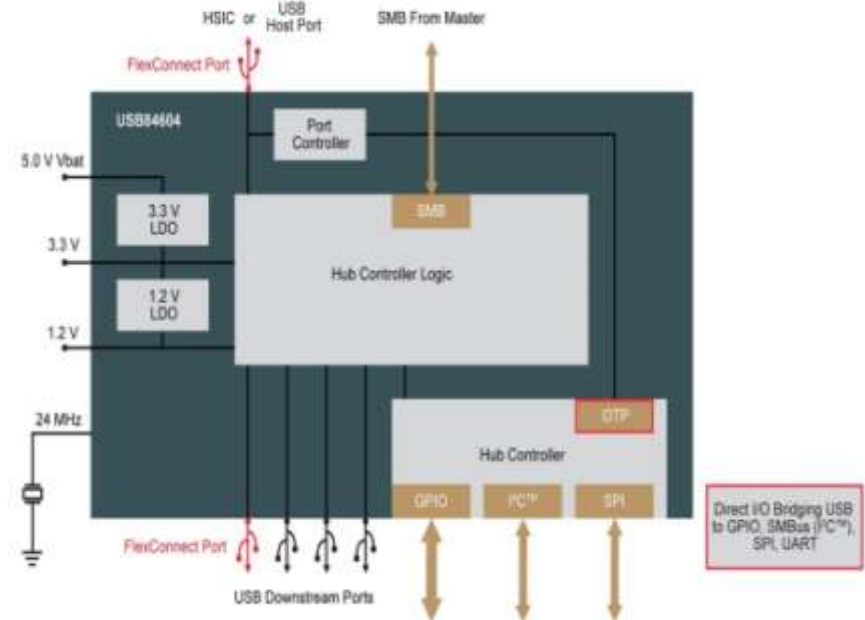


# USB2 Controller HUB (UCH) “Smart Hub”

- **What is a Smart hub?**
  - Standard hub functionality
  - Fully USB Compliant
  - USB Logo
  - But with additional features
- **Key features**
  - USB Bridging functionality
  - Enables “direct I/O bridging”
    - SMBus, GPIO, UART, SPI
  - Supports “Flex Connect”
    - OTG “like” port reversal
    - Port0 and Port1 reverse
  - Commercial, Industrial, and Automotive support

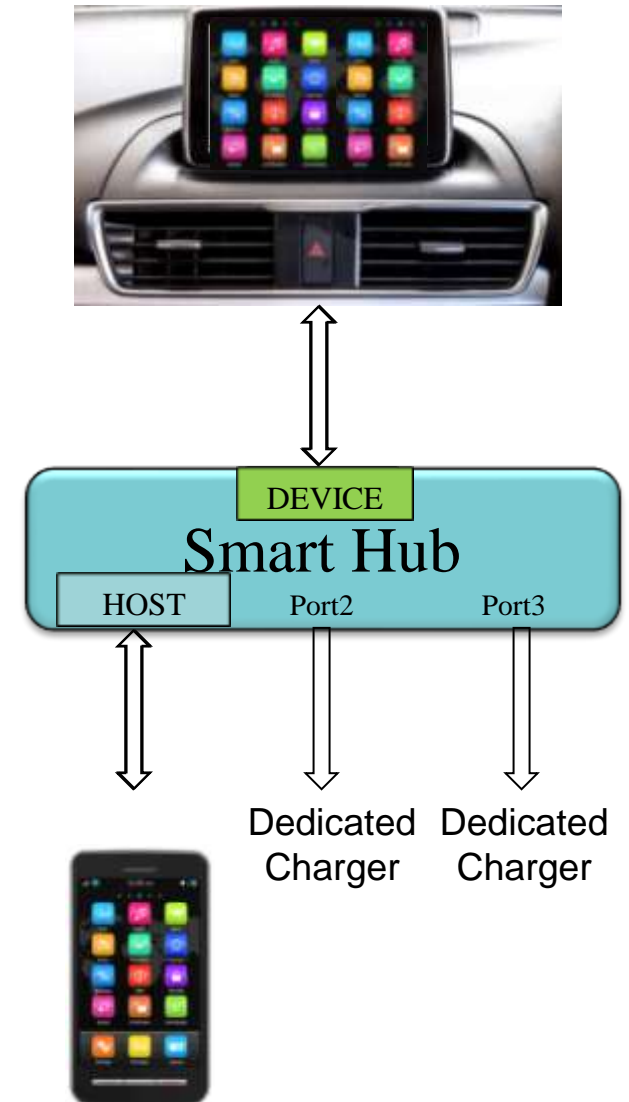


USB84604 Controller Hub with FlexConnect



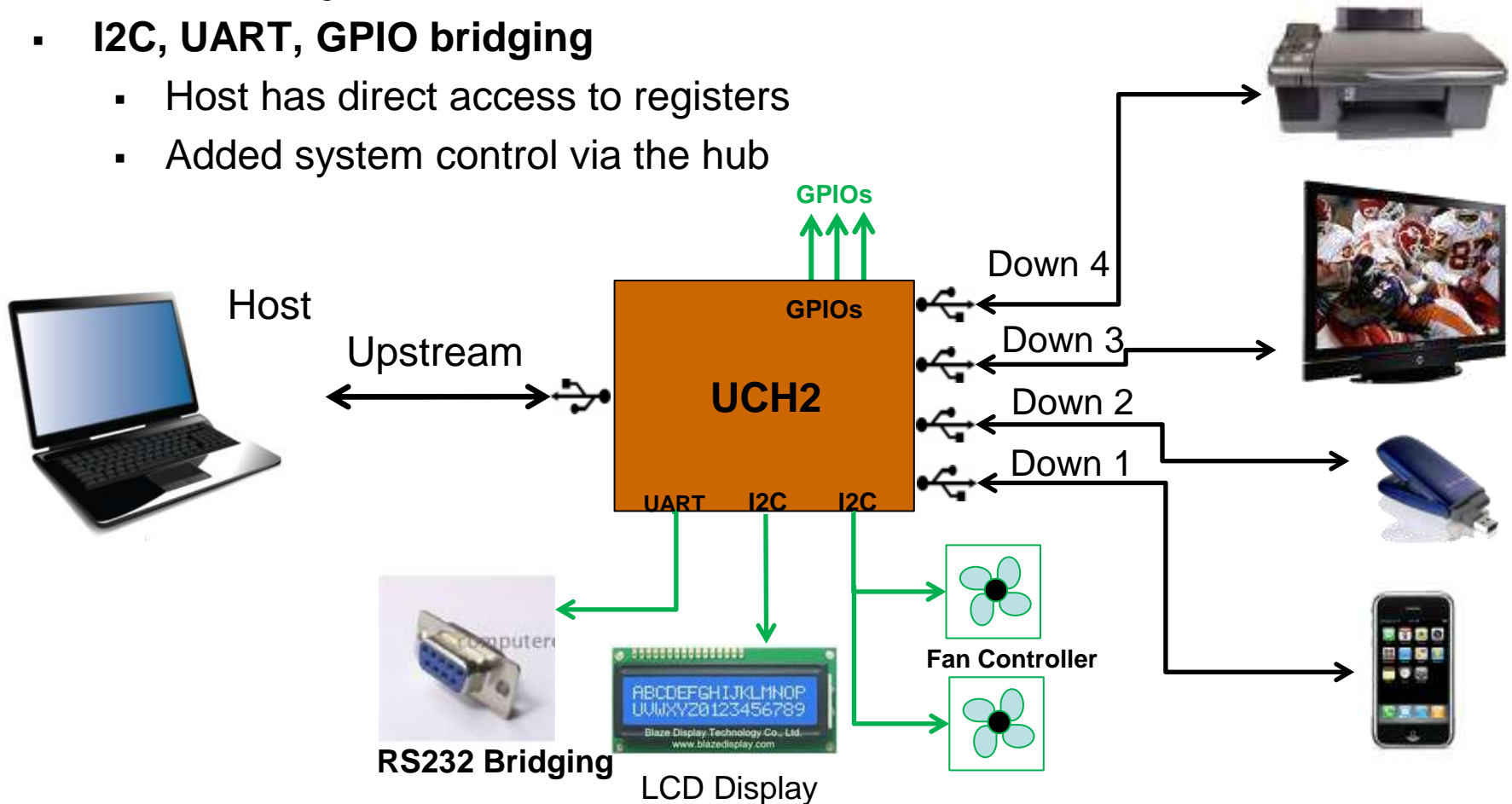
# ***FlexConnect Example #1***

- **A USB hub that can role swap between Host and Device**
  - Head Unit starts as Host
  - Cell phone becomes Host after negotiation with Head Unit



# USB Controller Hub?

- **More than just a USB Hub!**
- **I2C, UART, GPIO bridging**
  - Host has direct access to registers
  - Added system control via the hub



...also supports battery charging!

# USB3.0 HUB Product Line

Summary of our existing and proposed new USB57xx Family

Features	USB5734	USB5744	USB5537B 6080	USB5534B 6080	USB5537B 5000	USB5534B 5000
# of Downstream Ports (U3/U2)	4	4	4/3	4	3	2
Package	64QFN	56QFN	72QFN	64QFN	72QFN	64QFN
UCH (USB Controller Hub)	◆					
FlexConnect Supported	◆					
Custom Configuration - OTP, SPI, SMB	◆	◆	◆	◆	◆	◆
BC1.2, Apple, RIM, China, DCP, CDP	◆	◆	◆	◆	◆	◆
External Strapping Options (BC, PR, PD)*	◆	◆	PD Only	PD Only	PD Only	PD Only
Protouch Configuration Utility	PT2	PT2	PT1	PT1	PT1	PT1
SDK	◆	◆				
Industrial Temp (-40°C to 85°C)	◆	◆				
Design Process	65nm	65nm	130nm	130nm	130nm	130nm

\* PD = Port Disable

**New USB3.0 Smart Hub Products**



**MICROCHIP**

# **Motion Monitor and Sensor Hub**

**Motion Solutions**

[Return to Topics](#)

# Wide Range of Target Applications

**This creates an opportunity to take this technology into many different products**



Laptops/Tablets



Gaming



Remotes



Robots



Wearables



Physical  
Therapy



Toys



Stabilization/  
Positioning



Transportation



Smart Farms

# Motion Application Development Not Trivial!

---

- **Complex algorithms req'd to filter, compensate, and fuse the raw sensor data**
  - This requires specialized knowledge
  - Is also resource intensive
- **Most vendors focused on large OEMs**
  - Difficult to get support from some
  - Harder to get samples, technical support, distribution, etc.

Accelerometer



Gyroscope

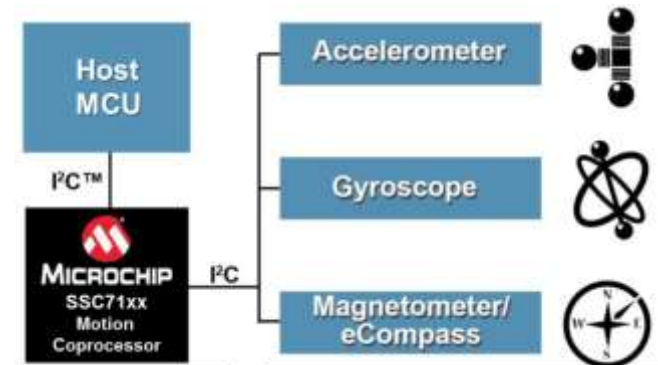
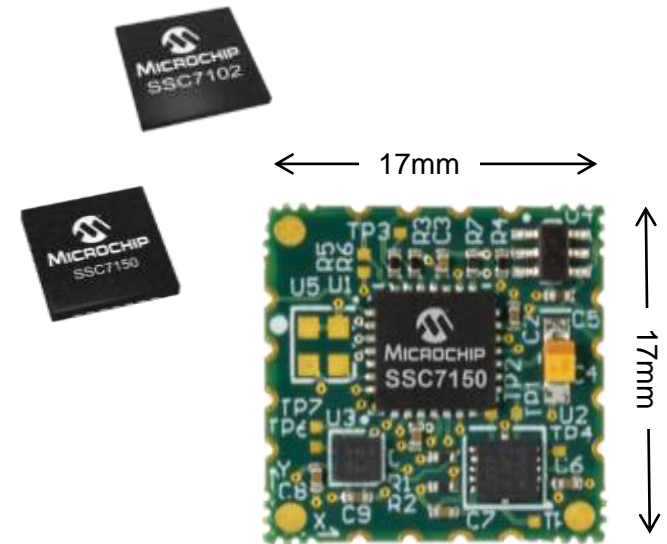


Magnetometer /  
eCompass

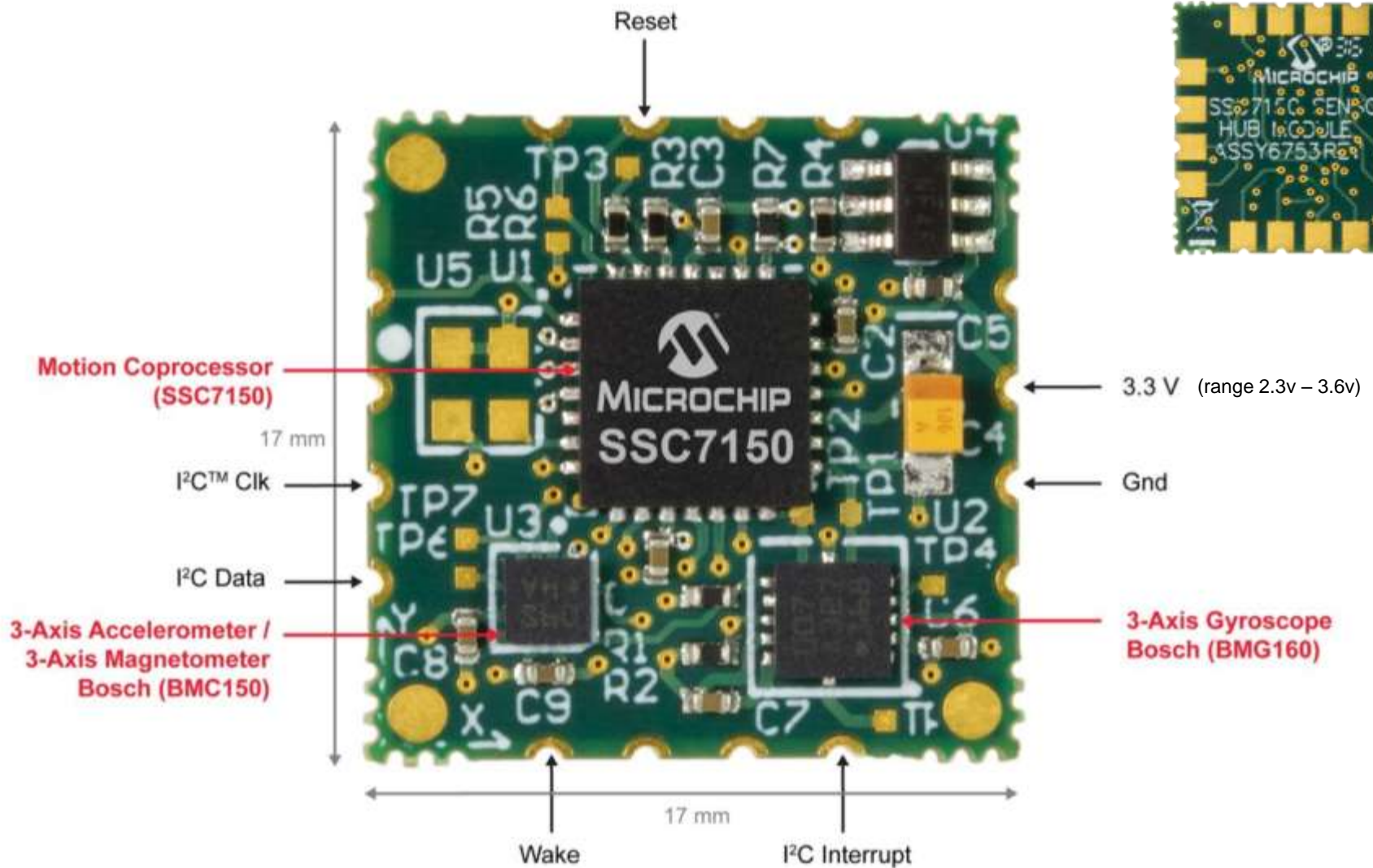


# What products do we have?

- **Motion Co-Processors**
  - SSC7102-AB00 - Windows® 8.x
  - SSC7150-AB0 – Embedded and IoT
- **MM7150 - Motion Module**
  - For embedded and IoT applications
- **Filters, compensates, and combines the raw sensor data**
  - Outputs position and orientation data to host MCU via I<sup>2</sup>C
- **Pre-programmed with sensor fusion algorithms**



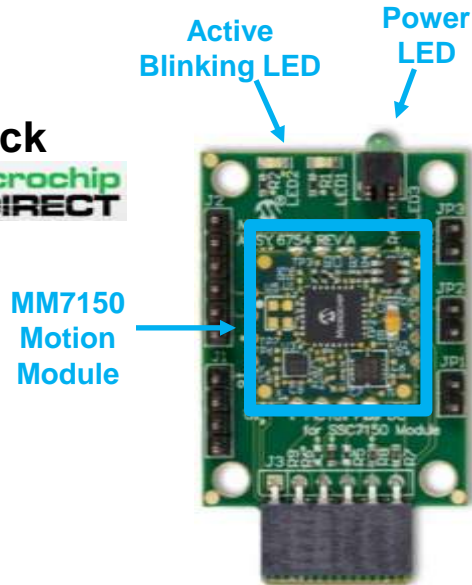
# MM7150 Motion Module



# Easy to Develop

In Stock

@ **microchip  
DIRECT**



**MM7150 PICtail™ Plus Daughter Board**  
(Part Number: AC243007)

**Explorer 16 Board**  
(Part Number: DM240001)

- Plugs directly into Explorer16 board
- Outputs raw sensor data, compensated sensor data, and positioning data
- Standardized API for most MCUs with I<sup>2</sup>C® to communicate with MM7150 Motion Module
- MPLAB project with sample code to communicate with the PICtail
- available now

- Large installed base
- Interface with various PIC® MCUs by swapping Plug-In-Modules (PIMs)
  - PIC MCU demo code provided
- C Reference Code provided (on Savo)
- Works with MPLAB® IDE, Programmer, Debugger, Compiler
- available now



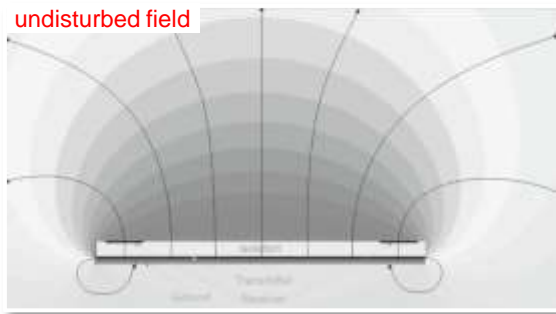
**MICROCHIP**

**GestIC**

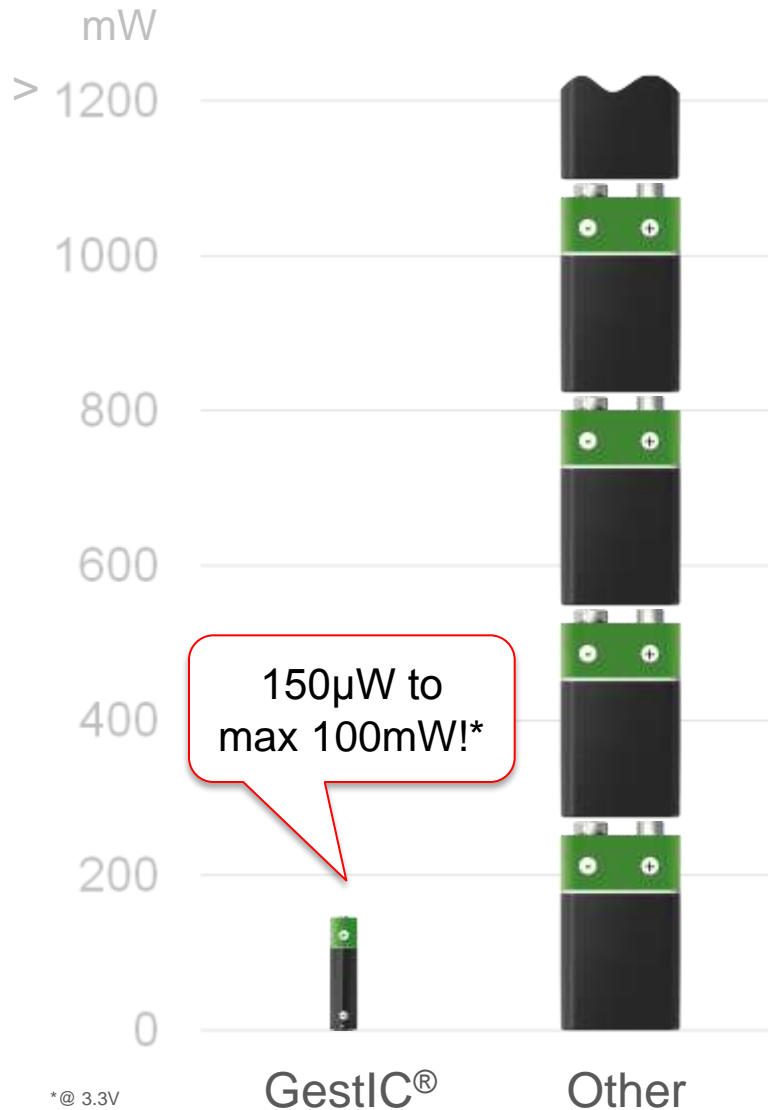
[Return to Topics](#)

# GestIC Technology Basics

- Utilizes Electrical Near Field (E-field) sensing for advanced proximity sensing
- E-Field generated by electrical charges
- Field distortion by a user translated into 3D tracking and gestures
- Very low power consumption since nearly no energy is transferred



# Battery Efficiency



**lowest power** consumption  
of any 3D sensing technology

up to **90% lower** than  
camera systems

**always-on** 3D sensing  
...even for mobile devices

# Key Features

fast

precise

robust

15  
0

0 to 15cm detection range



fast data sampling at 200Hz

32

32-bit signal processing unit



mouse-like resolution of 150dpi



70-130kHz range - no RF interference



no environmental influences



self wake-up at 150μW – *Low Power!*



Colibri Gesture Suite on-chip

# On-Chip Colibri Suite

## Features

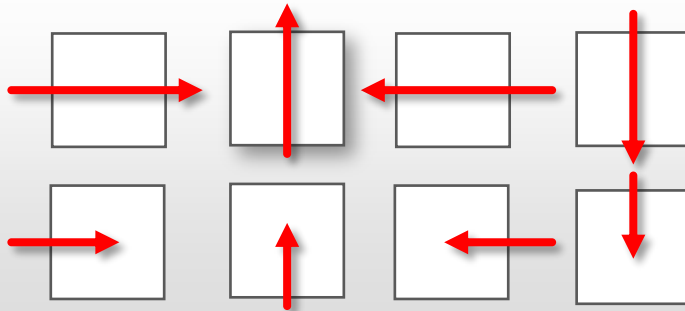


**Approach Detection**

Colibri Suite of GestIC features that are **pre-processed** on MGC3130

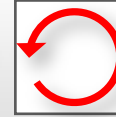


**Flick Gestures (8)**



**Circle Gestures (4)**

**NEW**



**Single**

**Airwheel**



**Position Tracking**

*Requires MGC3130*

**(xyz)**

**Symbol Gestures (TBD)**



*Requires MGC3130*



**NEW**

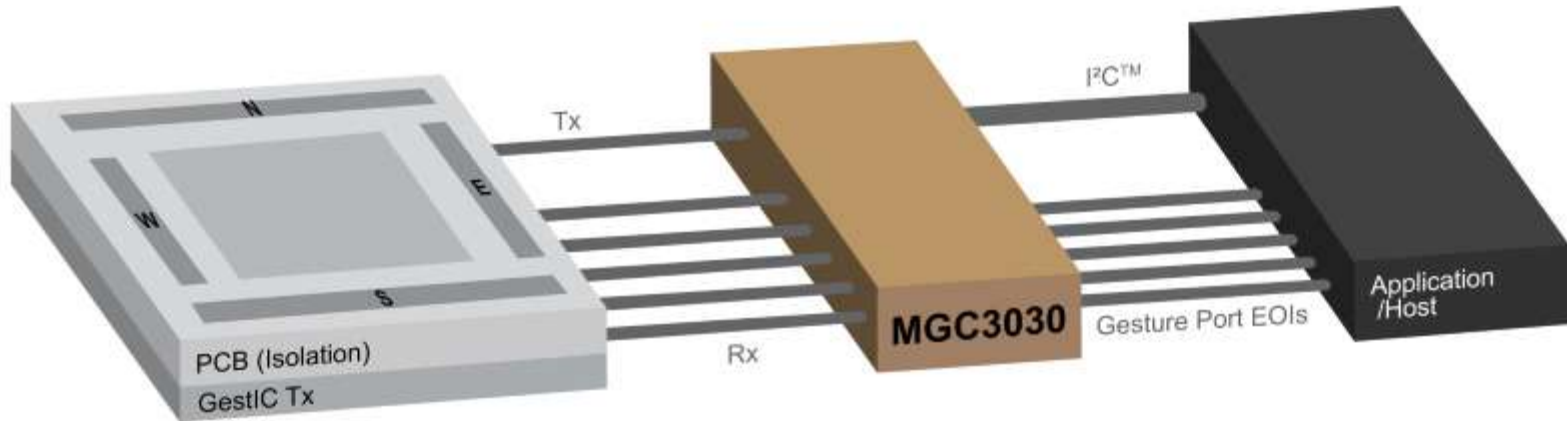
**Single Touch**

**(5 positions on electrodes)**

**+ Electrode Signals**



# Topology



**1. Electrodes**  
sense user action

**2. MGC3030**  
processes signals

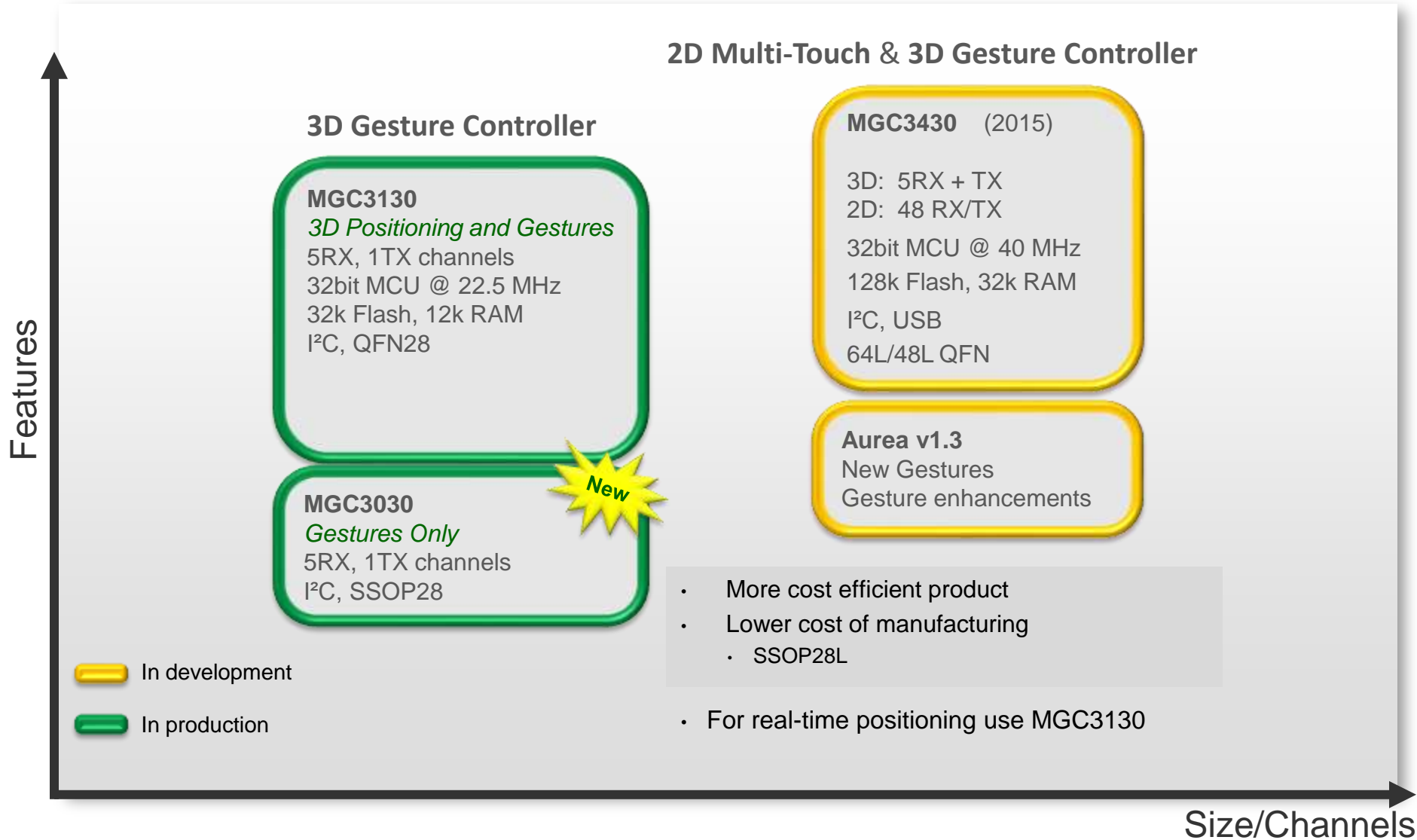
... or MGC3130

**3. Gesture output**  
to Application/Host

Gestures done right. MGC3x30.

# GestIC Roadmap

## 2D Multi-Touch and 3D Gesture



**It's all  
about gestures**

**Feature focused**

**Further  
simplified  
design in**

**One step  
design in**

- **I<sup>2</sup>C + EIO interface**

- Gesture Port = mapping of gestures to EIOs
- Gesture Port enables gestures for **ALL products**.



- **utilizes GestIC design-in tool set**

[www.microchip.com/gesticgettingstarted](http://www.microchip.com/gesticgettingstarted)

- AUREA SW suite (V1.2 or later)
- Reference designs / Electrode Design Guide
- Interface Manual
- Reference Host codes

- **SSOP28L package**

- Cost efficient manufacturing



# GestIC Development Kits

5" Reference Electrode  
Frontside view

5" Reference Electrode  
Backside view  
(no components)

MGC3x30 Unit

USB

I<sup>2</sup>C

I<sup>2</sup>C to USB Bridge  
Connection to PC / Aurea GUI / MGC3x30 /  
System Parameterization

Each Kit contains  
1 physical 5" Reference Electrode and  
design / gerber files for  
6 additional Reference Electrodes

**MGC3130 Hillstar Development Kit**  
PN: DM160218

**MGC3030 Woodstar Development Kit**  
PN: DM160226

**New**



# MICROCHIP

## Touch Solutions



[Return to Topics](#)

# Product Portfolio Overview

## 1D

Proximity,  
Keys and Sliders

## 2D

X-Y Screens/Pads  
Position and Gestures

## 3D

X-Y-Z Position  
3D Gestures

### Turnkey

#### MTCH1xx

1-2 Keys, Proximity  
Standalone Operation  
I<sup>2</sup>C interface,

#### MTCH6xxx

Single/Multi Touch  
2D gestures  
Lowest Power

#### MGC3xxx

3D Position Sensing  
Gesture Recognition  
GesturePort

#### CAPxxxx

3-14 Keys, Sliders  
Proximity  
I<sup>2</sup>C interface

### Firmware

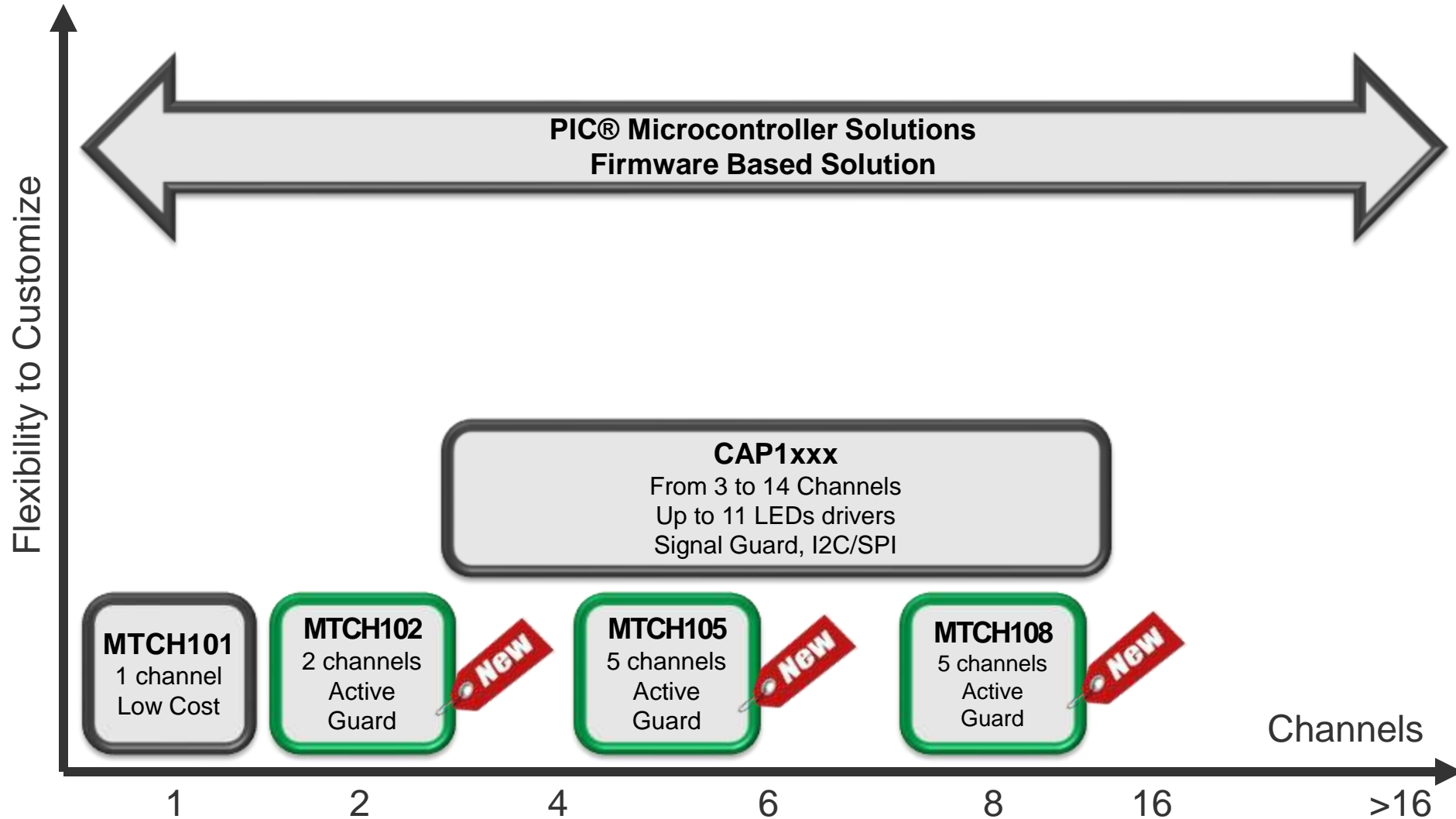
#### PIC<sup>®</sup> framework

Supports 8/16/32 bit  
Free download  
Complete Access  
Use Standard ADC  
Easy Integration

#### PIC<sup>®</sup> framework

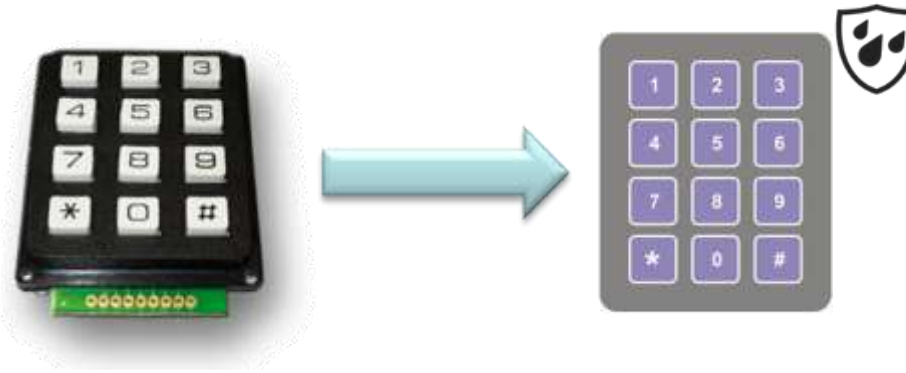
Supports 8/16/32 bit  
Royalty free License  
Complete Access  
Use Standard ADC  
Path to Integration

# Proximity/Keys/Slider



# MTCH1xx Turnkey Controller

***Easiest Capacitive Touch Controller for direct replacement of mechanical buttons!***

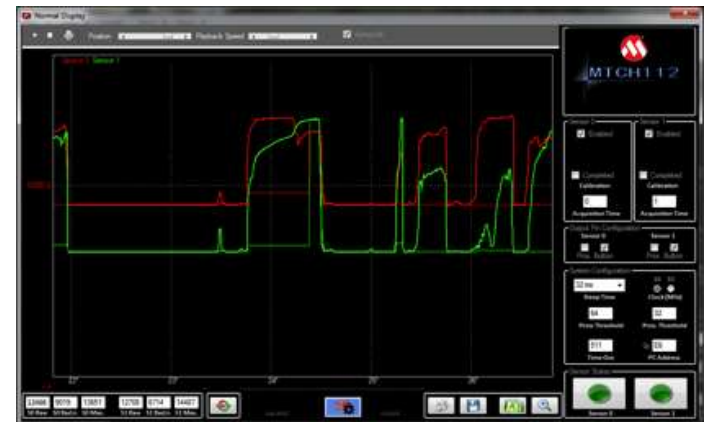
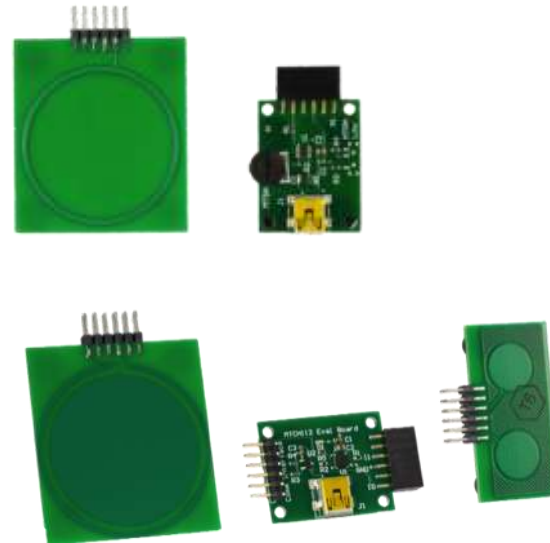


- **Up to 8 capacitive touch sensing buttons**
  - Buttons and proximity with Guard Option
  - One input – one output per button
- **Digital or I<sup>2</sup>C interface to any MCU**
  - HW only configuration
  - Digital outputs require no host software
- **High noise performance and water resistant**



# MTCH10x Evaluation Boards

- **MTCH101**
  - PN: [DM160220](#);
- **MTCH112**
  - PN: [DM160221](#);
- **MTCH108**
  - PN: [DM160229](#);





# CAP11/12xx Turnkey Touch Controller

---

- **Up to 14 capacitive sensing channels**
  - Supports proximity
  - Automatic recalibration
- **Setup using Graphical User Interface**
  - Programmable sensitivity w/ individual thresholds for each button
- **Available LED driver support**
  - Up to 11 LEDs in CAP11xx devices w/ easy setup via GUI
- **I<sup>2</sup>C/SPI Interface to any MCU**
- **Small Packages**
  - 8-pin 2x3 DFN to 32-pin QFN

# CAP1xxx Evaluation Boards

**USB** for GUI interface



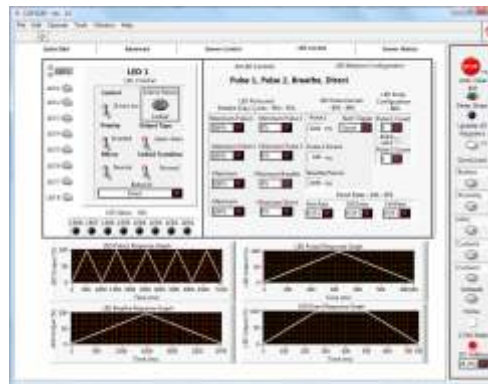
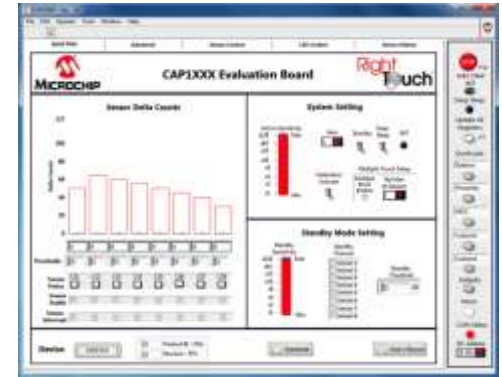
CAP1298 Evaluation Board  
PN: [DM160223](#)



CAP1188 Evaluation Kit  
PN: [DM160222](#)

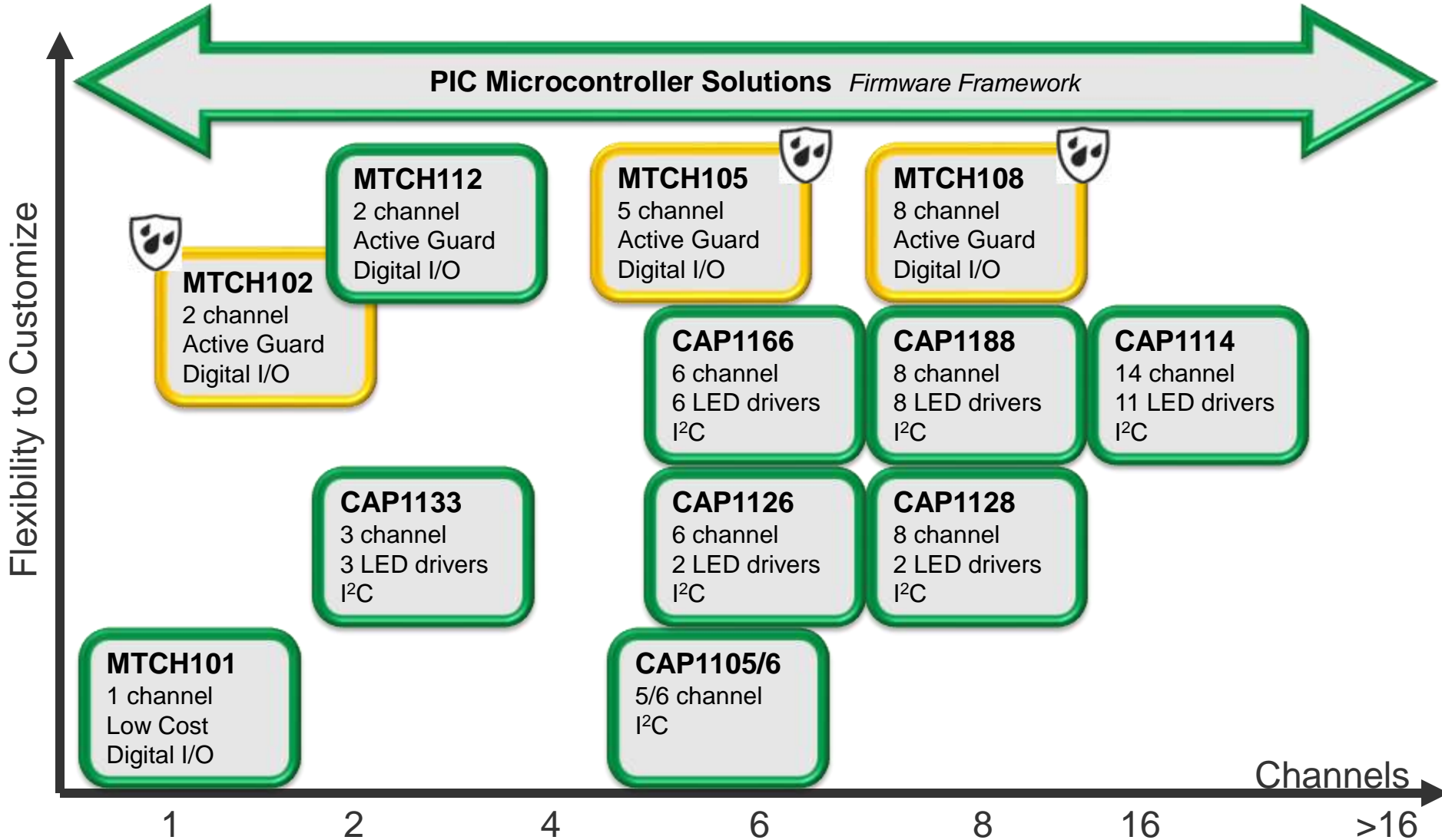
# Graphical User Interface (GUI)

- Check the signal from each sensor
- Tune the threshold for each sensor
- Change sensitivity and gain
- Set up the LED drivers
- Change any parameter available in the CAP controller
- Save the configuration to create the host driver

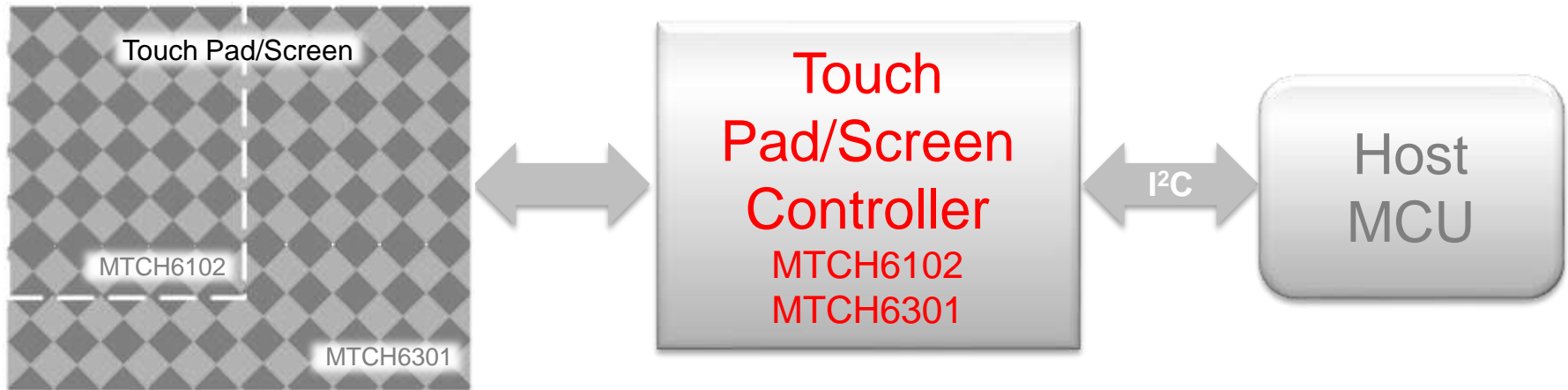


# Proximity, Keys, and Sliders

## mTouch and RightTouch



# Scalable Turnkey Touch Solutions



- **MTCH6102 for lowest power single touch and gestures**
  - Up to 15 channels (example 6 x 9)
- **MTCH6301 for multi-touch and gestures**
  - Supports 13 x 18 channels (approx. 4.3" size)
  - Up to 10 simultaneous touches
- **Works with PCB, FPC, glass & film sensors**
- **Built-in noise detection and filtering**

Update coming in June

- New features
- Better performance

# Touch Pad/Screen Tools

**DM320015** – for multi-touch and 2D gestures

+ PIC32-based Graphics



**DM320016** – for multi-touch and 2D gestures



**DM160219** - for low power single touch  
and gestures

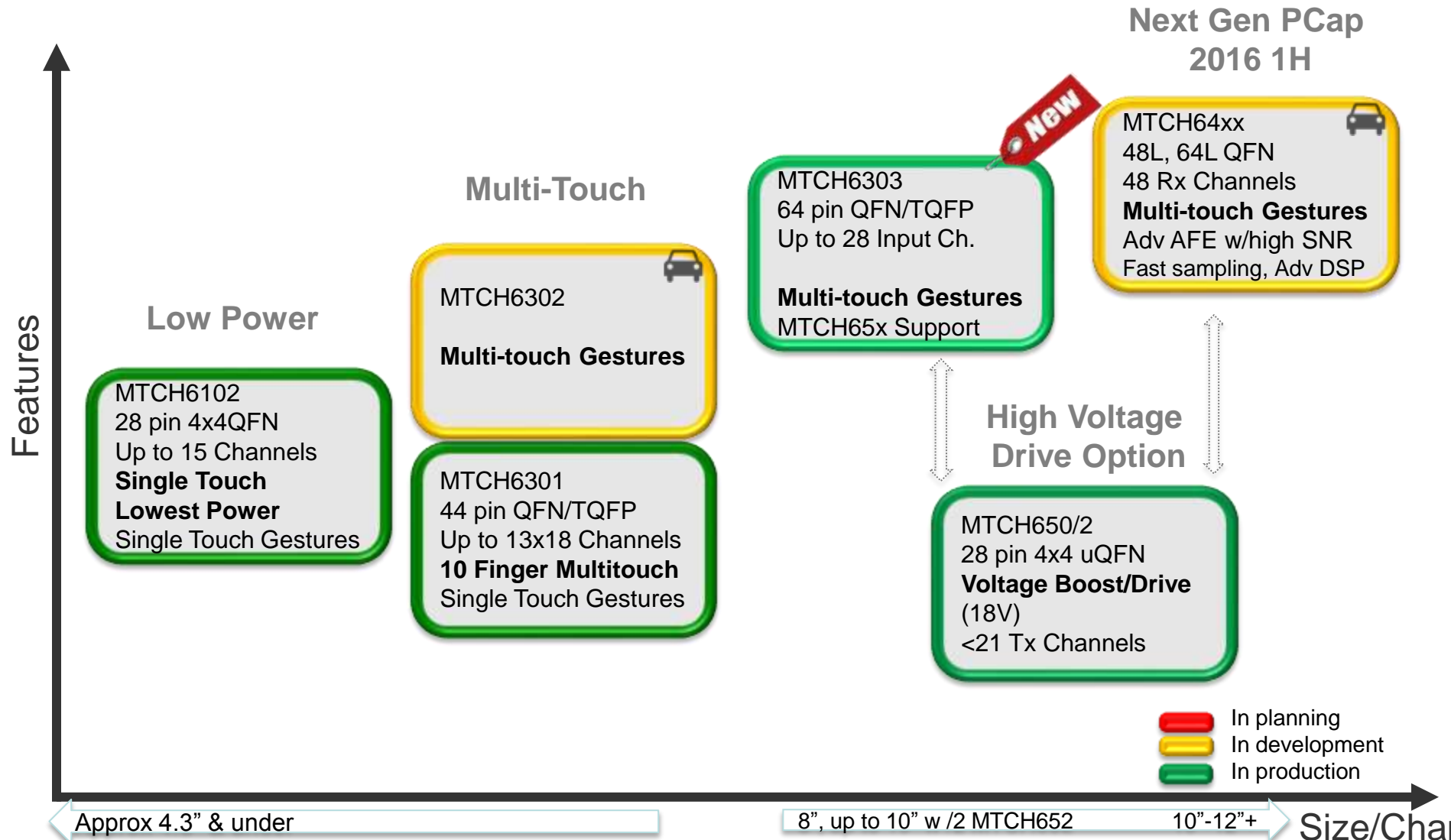
Draw

Utility

[Return to Topics](#)

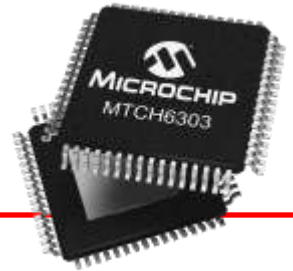
# Projected Capacitive

## X-Y Touch Sensing, Screens and Touch Pads



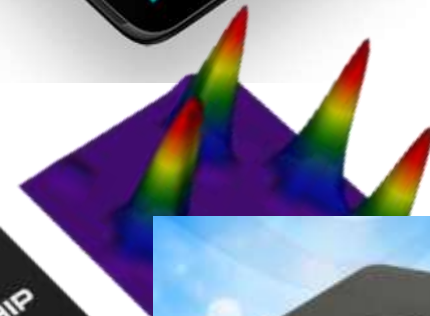


# MTCH6303



## New Multi-Touch PCap

- **Large Sizes:** Up to **10"** (down to 4")
- **Noise robust:** **10V** IEC61000-4-6)
- **Boost:** use MTCH652 for **18V** TX drive
- **Fast:** 5 Fingers @ **100hz\*\***
- **Integrated Gestures:** Tap, Swipe, **Pinch/Zoom**, Scroll
- **Both** **USB** and **I<sup>2</sup>C**
- **Flexible:** Based off of PIC32MX430F064H



\*\* speed and performance are sensor dependent



**MICROCHIP**

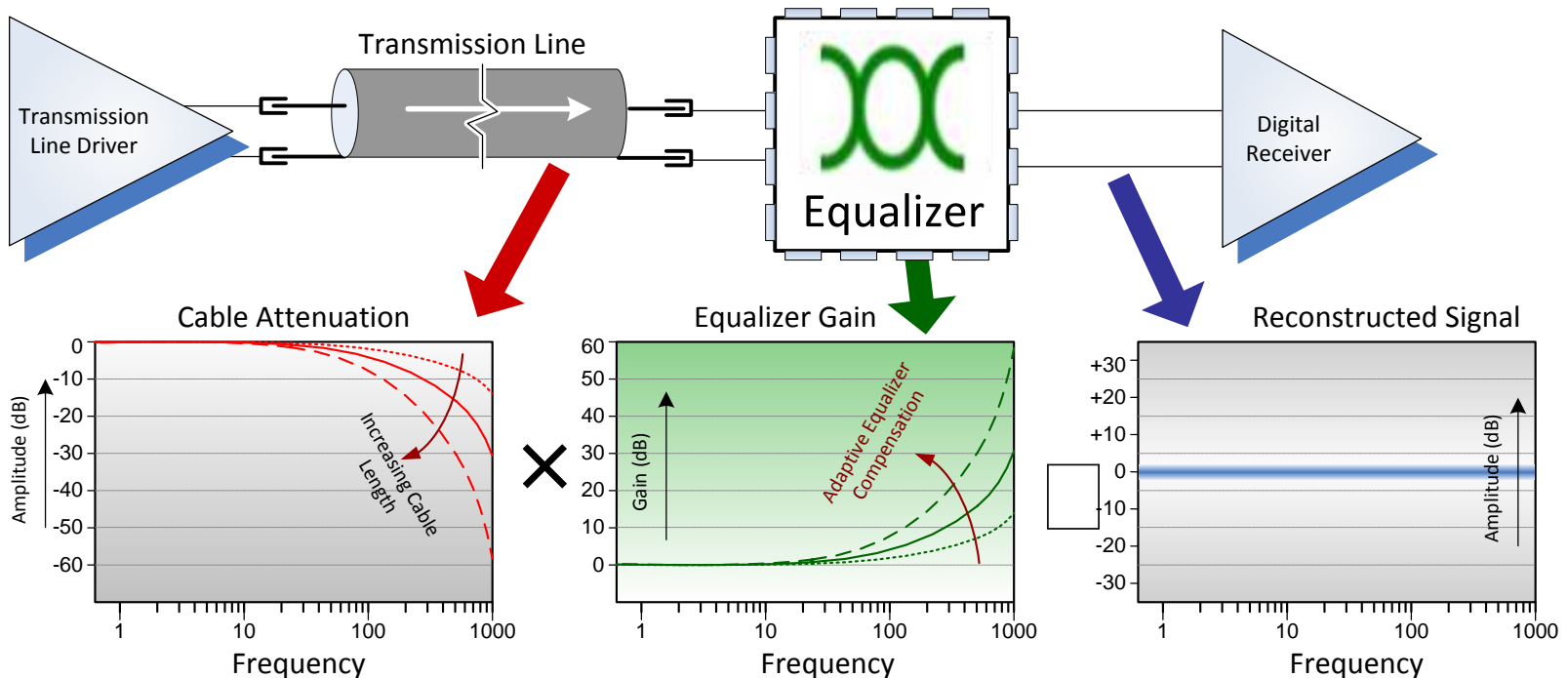
# **Video Over Coax**

**Ecqologic**

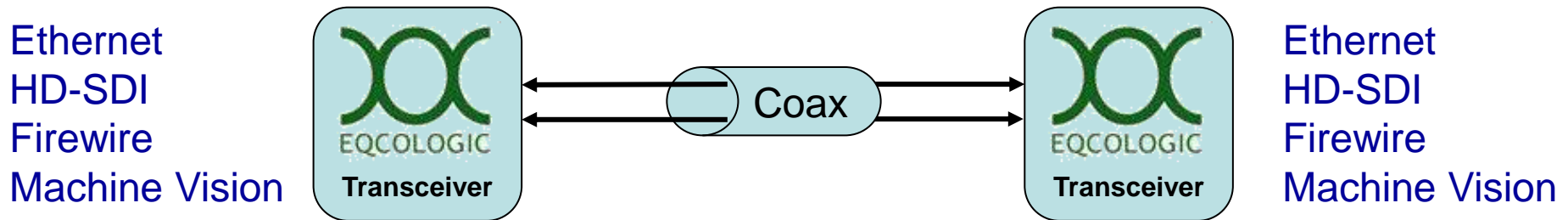
[Return to Topics](#)

# Ecqologic Equalizer

- Equalization technology overcomes degradation of digital signals due to attenuation over an electrical conductor
- Compensation applies to conductor length limitations, data rate restrictions or both



# Enables Re-Use Coax



- **Extends...**

- Ethernet and HD-SDI out to nearly 500m
- Firewire up to 50m
- Machine Vision up to 100m

**... All using existing Coax**

# End Products



**75Ω Firewire Over Coax Adapter  
(Part # EQCO-FW7501)**



**Firewire Over Coax for 50Ω Coaxial Cable  
(Part # EQCO-FW5001)**



**HD-SDI 1.5 Gbps and 3.0 Gbps Repeater  
(Part # EQCO-SDI-30-7502)**



**CoaXPress® CXP Evaluation Board - Receiver  
(Part # EVB-DBSUB1586)**



**CoaXPress® CXP Evaluation Board - Transmitter  
(Part # EVB-DBSUB1584)**



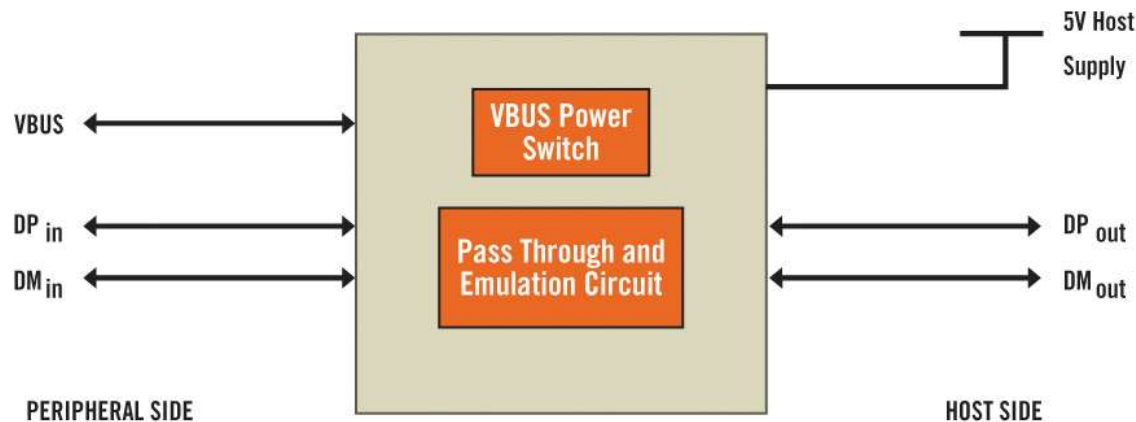
**MICROCHIP**

# **USB Port Power Controllers**

[Return to Topics](#)

# USB Port Power Controllers?

- VBUS power switch + USB switch
- Emulates a wall charger signature
- Current sensor to monitor performance



# What's the Challenge?

- Design a USB port to charge ***EVERYTHING!***



# USB100X

## USB Port Power Controllers

---

- **What is it?**
  - A USB charging port with wide compatibility
- **Why are we better and why we win?**
  - Program new charging emulation profiles
  - Dynamically allocation of power when required
  - Measure performance for best user experience

# USB Port Power controller

## Benefits (1 of 4)

---

- **Active cable compatibility**

- Lightning® connector compatibility is a must
- Apple® Lightning™ connector is an active cable often misidentified as a device

- **Up to 16W Charging**

- One of the few solutions to allow 16W charging for new devices including the iPhone® and iPad®
- Quicker charging (higher current) is possible

- **Popular Device Compatibility**

- Standard products prioritize Samsung and Apple® device charging
- Optional programmable profiles for wider compatibility



# USB Port Power controller

## Benefits (2 of 4)

---

- **Device Recognition / Learning mode**
  - Determine the best charging current & preferred devices
  - Device Recognition / use last profile
- **Ability to update charging profiles to accommodate new devices**
  - Protected 8 months into a 12 month cycle
- **Automatic port shutdown after charging**
- **USB Power allocated based on system needs**
  - Current sensor and programmable current limit
  - I2C / SMBus communication



# USB Port Power controller

## Benefits (3 of 4)

---

- **Dead Battery Charging**
  - No negotiation - supply min current (ie. 100mA)
  - Gives device CPU time to wake-up, detect a connection.
  - UCS discharges Vbus, begin normal negotiation
- **Current Measurement Capability**
  - Allows discovery of best charging current
  - Known device – Present latest charge profile
  - Update a profile
  - Power allocation



# USB Port Power controller

## Benefits (4 of 4)

---

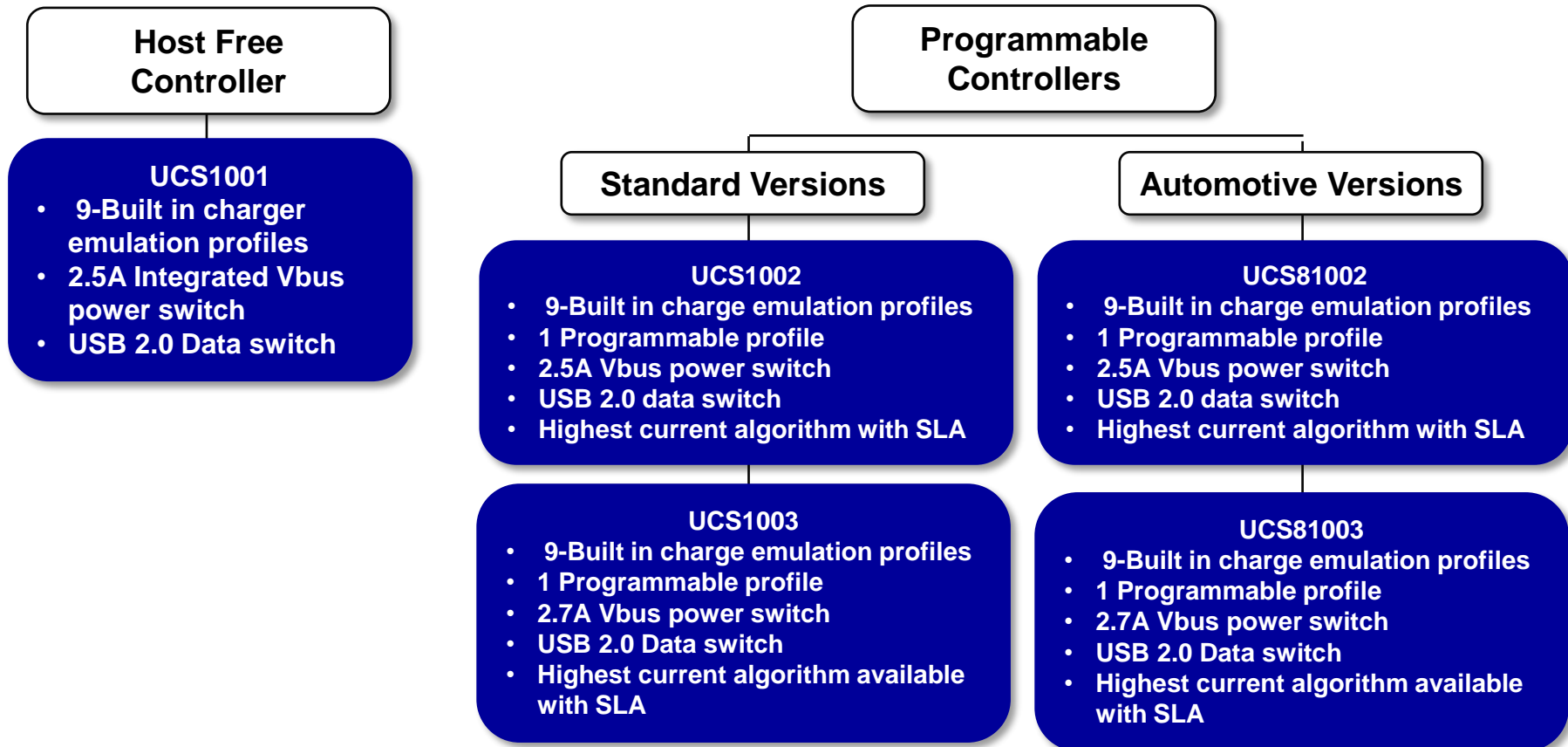
- **Provide for Future Proofing Your Design**
  - Preloaded charger emulation profiles for maximum compatibility coverage of peripheral devices
  - Optional programmable charger emulation profile for portable device support for fully host controlled charger emulation

### **Note: Phone replacement cycles\***

- Americans ~2 years
- 1/3 of Chinese ~1 year
- Average age of car 11.4 years\*\*

\* Recon Analytics 2011  
\*\* Polk Research Aug'13

# USB Port Power Controllers



# Evaluation Boards



USB2422 High-Speed  
USB 2.0 Single TT 2 Port  
Hub w/ UCS1002 Battery  
Charging  
PN: EVB-USB2422



UCS1002 Evaluation Board  
PN: ADM00497

UCS1001  
Evaluation Board  
PN: ADM00540





# MICROCHIP

## USB Power Delivery



[Return to Topics](#)

# Key Features of USB-C

---

- **Entirely new mechanical & electrical design: smaller!**
- **Identical USB-C connectors on both ends**
  - And symmetrical for single insertion success!
- **Optional: Power Delivery 2.0 (protocol) using Baseband PHY communication**
- **BC1.2 is succeeded by simpler resistor pull-up/pull-down ( $R_p/R_d$ ) relationship**
- **Four VBus pins/wires for low V-offset**
- **Versatile, allowing 3rd party protocols (Thunderbolt, Display Port, MHL, more!)**

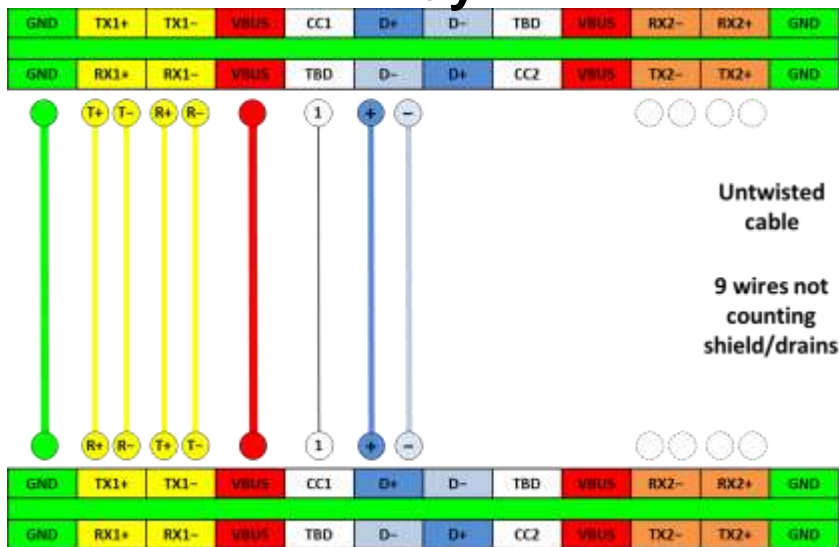
# Power Supply Options

Mode of Operation	Nominal Voltage	Maximum Current	Notes
USB2.0	5V	500mA	USB2.0 Spec
USB3.0/3.1	5V	900mA	USB3.x Spec
<i>USB BC1.2</i>	<i>5V</i>	<i>Up to 1.5A</i>	<i>Legacy Charging</i>
<b>USB-C Current @ 1.5A</b>	<b>5V</b>	<b>1.5A</b>	<b>Supports higher power devices</b>
<b>USB-C Current @ 3.0A</b>	<b>5V</b>	<b>3.0A</b>	<b>Supports higher power devices</b>
<b>USB PD</b>	<b>Configurable up to 20V</b>	<b>Configurable up to 5A</b>	<b>Directional control and power level management</b>

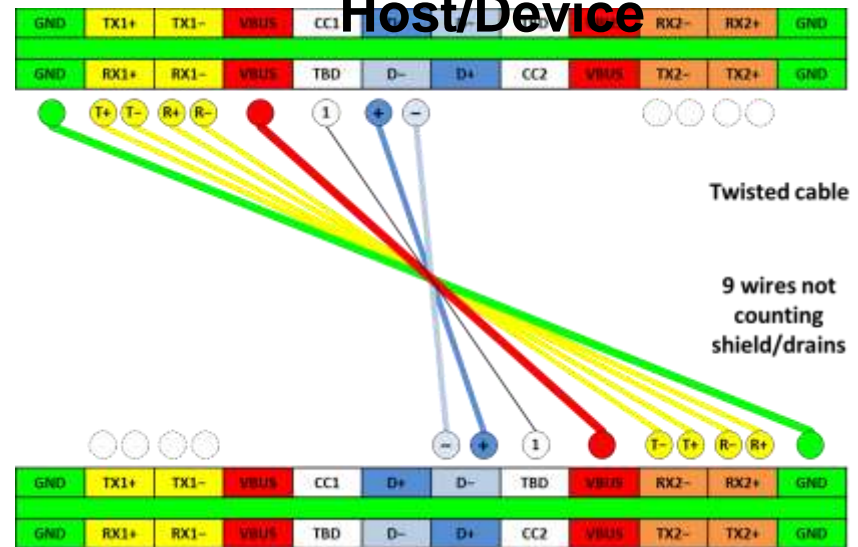
# USB-C Connector

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1-	VBUS	CC1	D+	D-	SBU1	VBUS	RX2-	RX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
GND	RX1+	RX1-	VBUS	SBU2	D-	D+	CC2	VBUS	TX2-	TX2+	GND

Consumer can plug either way



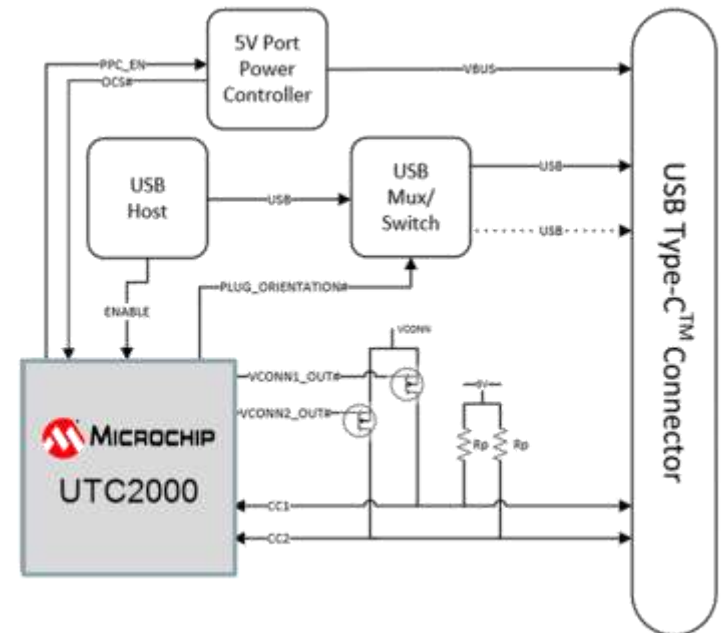
Connections resolved by Host/Device





# UTC2000 USB Type-C™ Controller

- **Transition:**
  - Existing USB Type-A → USB Type-C DFP
  - Existing USB Type-B → USB Type-C UFP
- **USB 2.0, USB 3.0, or USB3.1 compliant**
- **Supports up to 3.0A Charging profiles**
- **3x3mm QFN-16**
- **Integrated ADC for Voltage monitoring on CC Pins**
- **Minimal external components**
- **Works with Microchip's USB Controller Hubs**



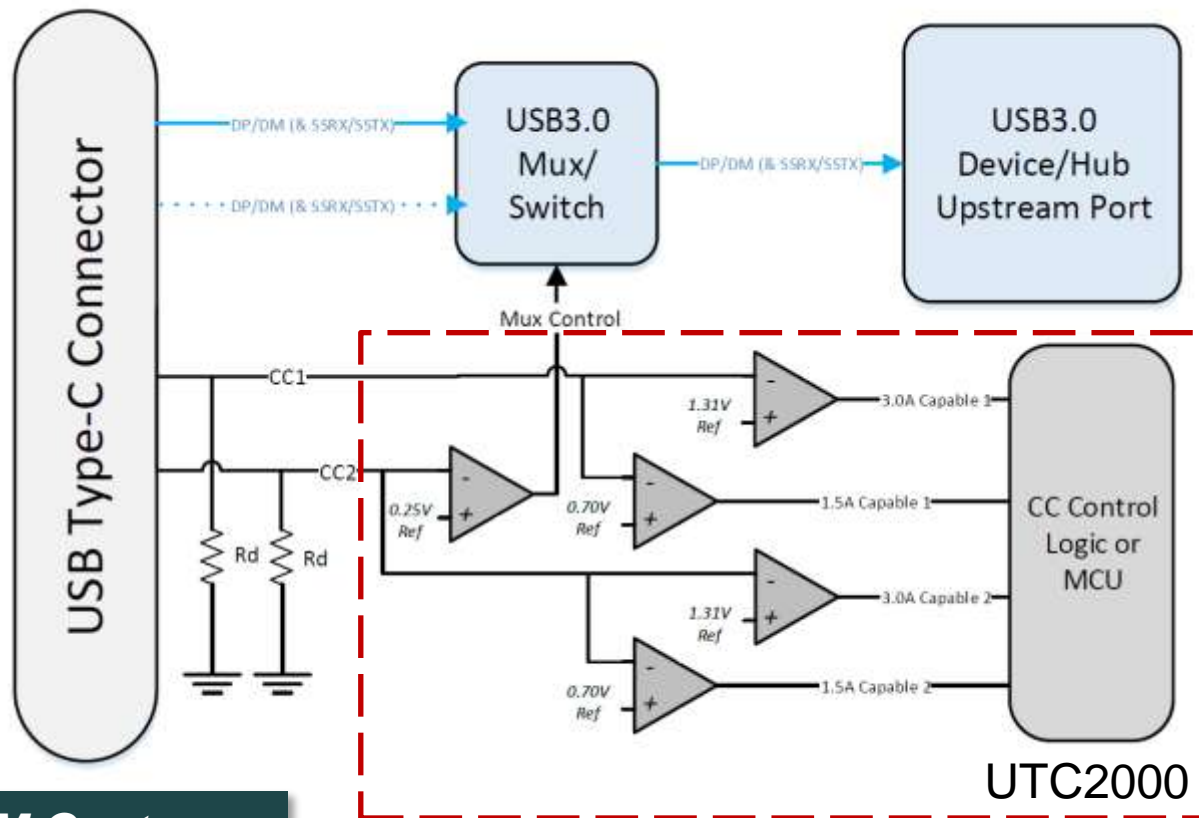
# Typical UFP Applications

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- **Mobile Devices Are Typically UFP**
  - Smartphone and Tablets
- **Default USB Type-C Charging Currents Do Not Require Controller (on UFP)**
  - USB2.0 500mA and USB3.0 900mA
- **UFP Responsible to Detect Higher Current Levels Above Default**
  - 1.5A and/or 3A of Current
  - Per USB Type-C Standard Specification
  - Some Controller Required to Support

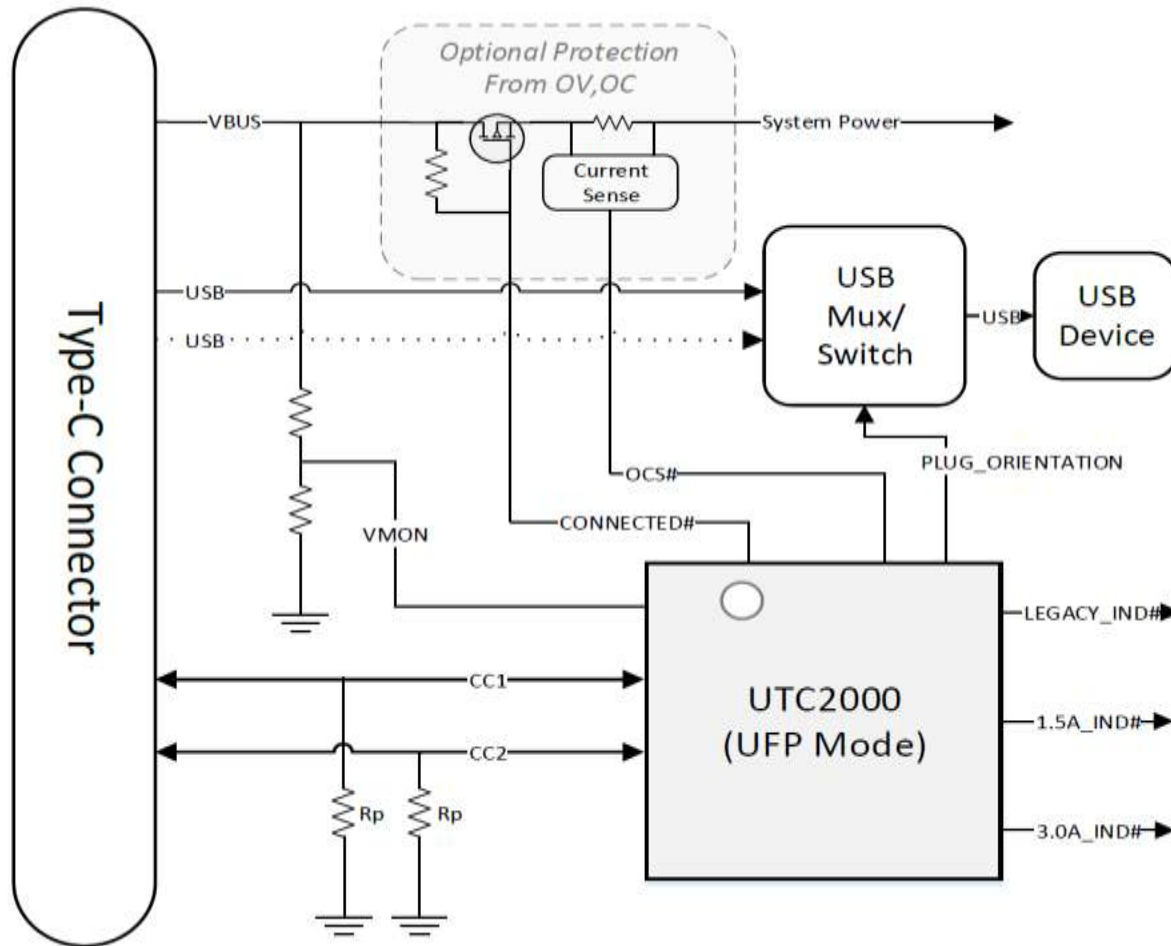
# Typical Discrete UFP Implementation

- Supports all Standard USB Type-C Charging Profiles
- Requires Careful Design to Ensure Compliance



**Low BOM Cost**

# UTC2000 UFP w/ Full Charging



***BOM Cost Reduction !***

# Application Examples

- **Notebook**
- **Monitor/Dock**
- **Devices (UFP only)**
- **USB Wall Charger**
- **Industrial Charging Cart**
- **Automotive**



# EVB-UTC2000

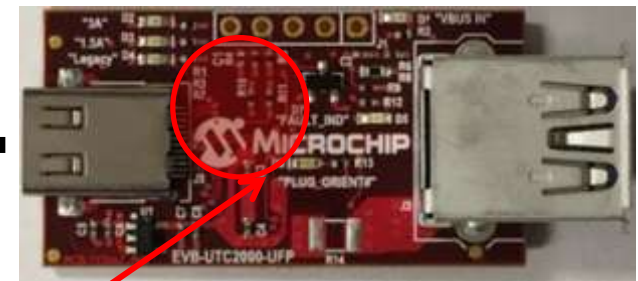
- **NEW Evaluation Kit Available NOW**
  - DFP Board
  - UFP Board
  - USB Type-C Cable

**DFP Board**



← **Plug Into Host**

**UFP Board**



*UTC2000 on backside*

**UTC2000**



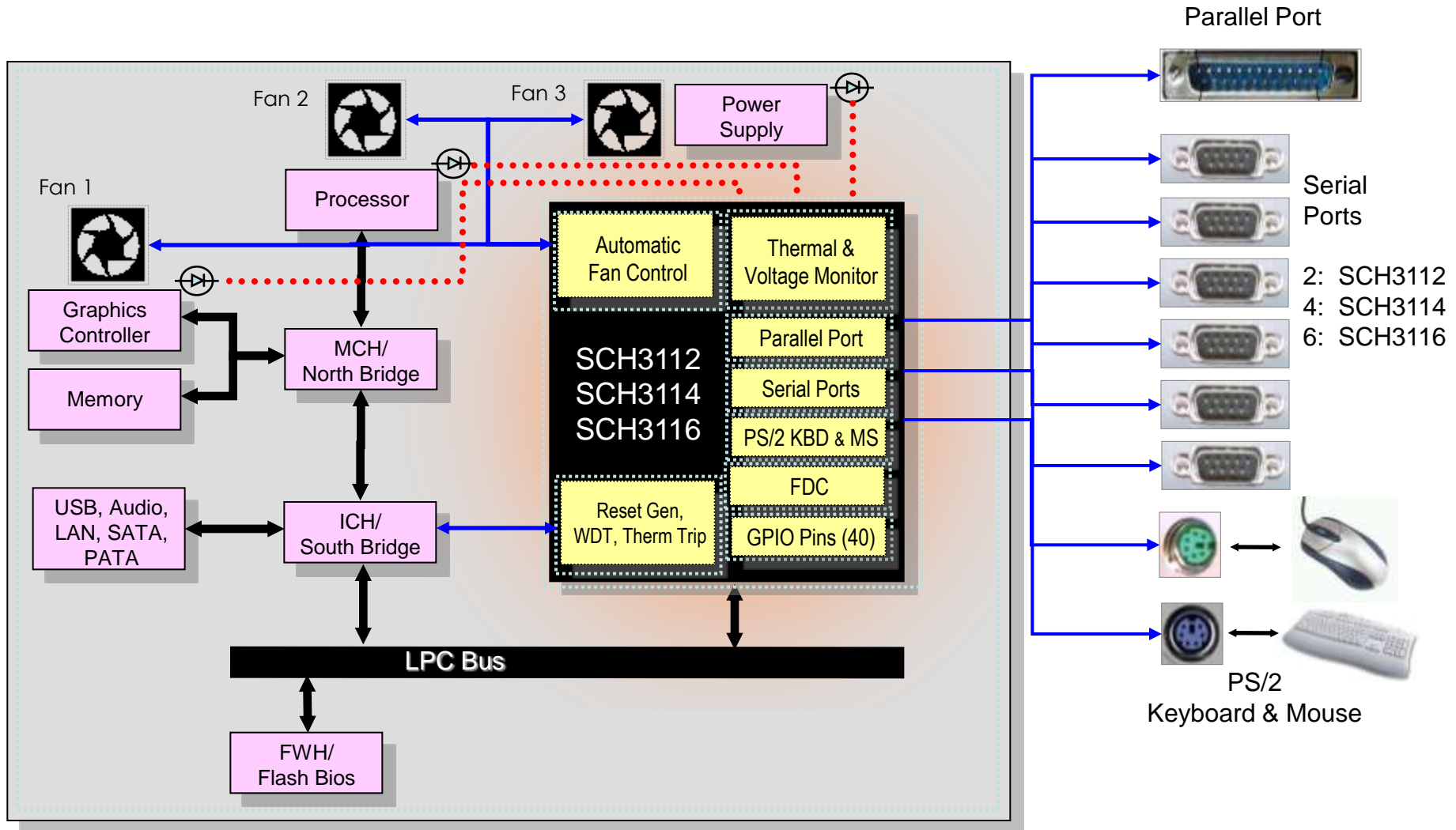
**MICROCHIP**

# **Embedded I/O Controllers**

**System Controller Hubs**

[Return to Topics](#)

# System Controller Hub System Diagram



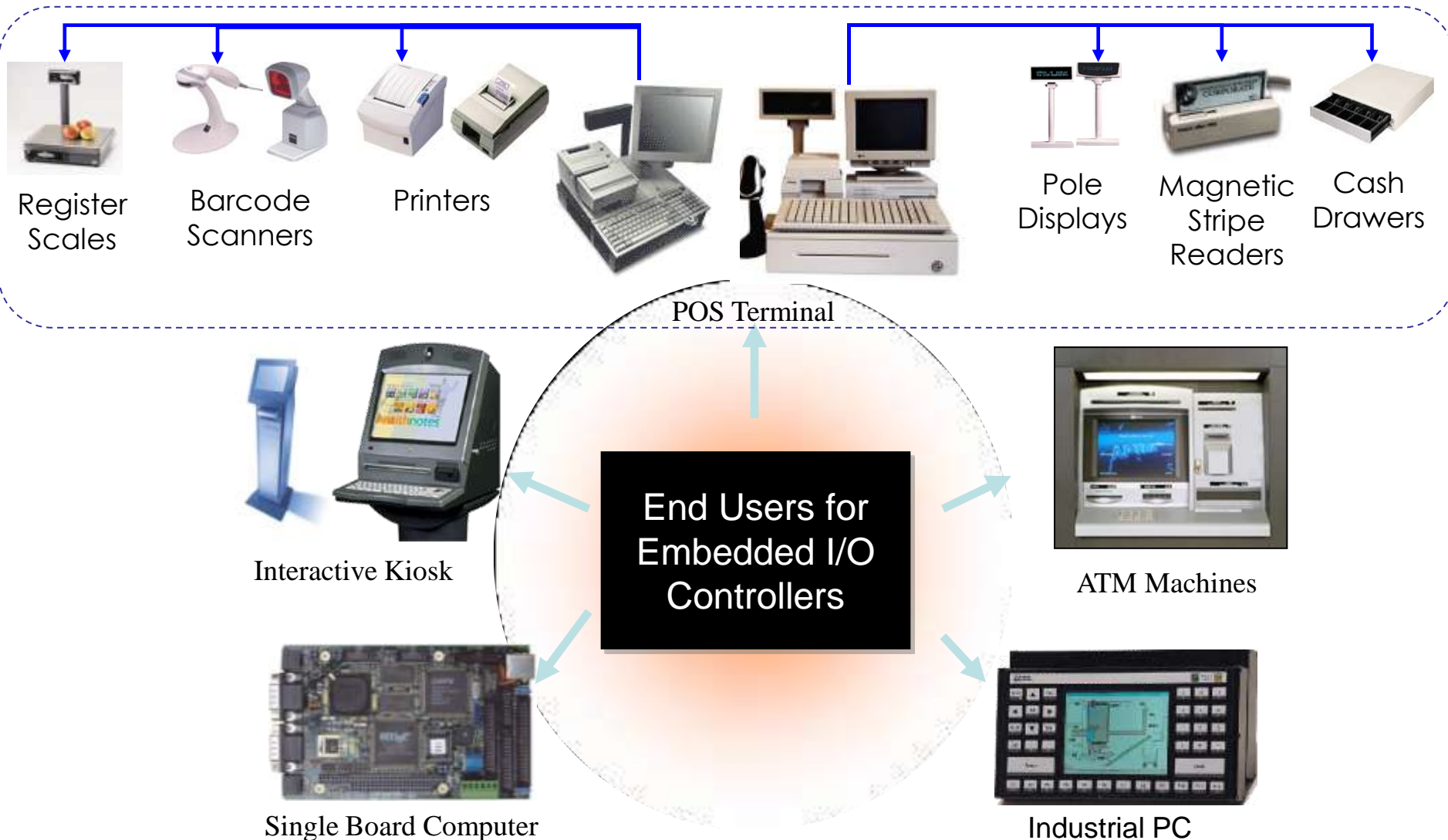


# SCH311x Family of Embedded I/O Controllers

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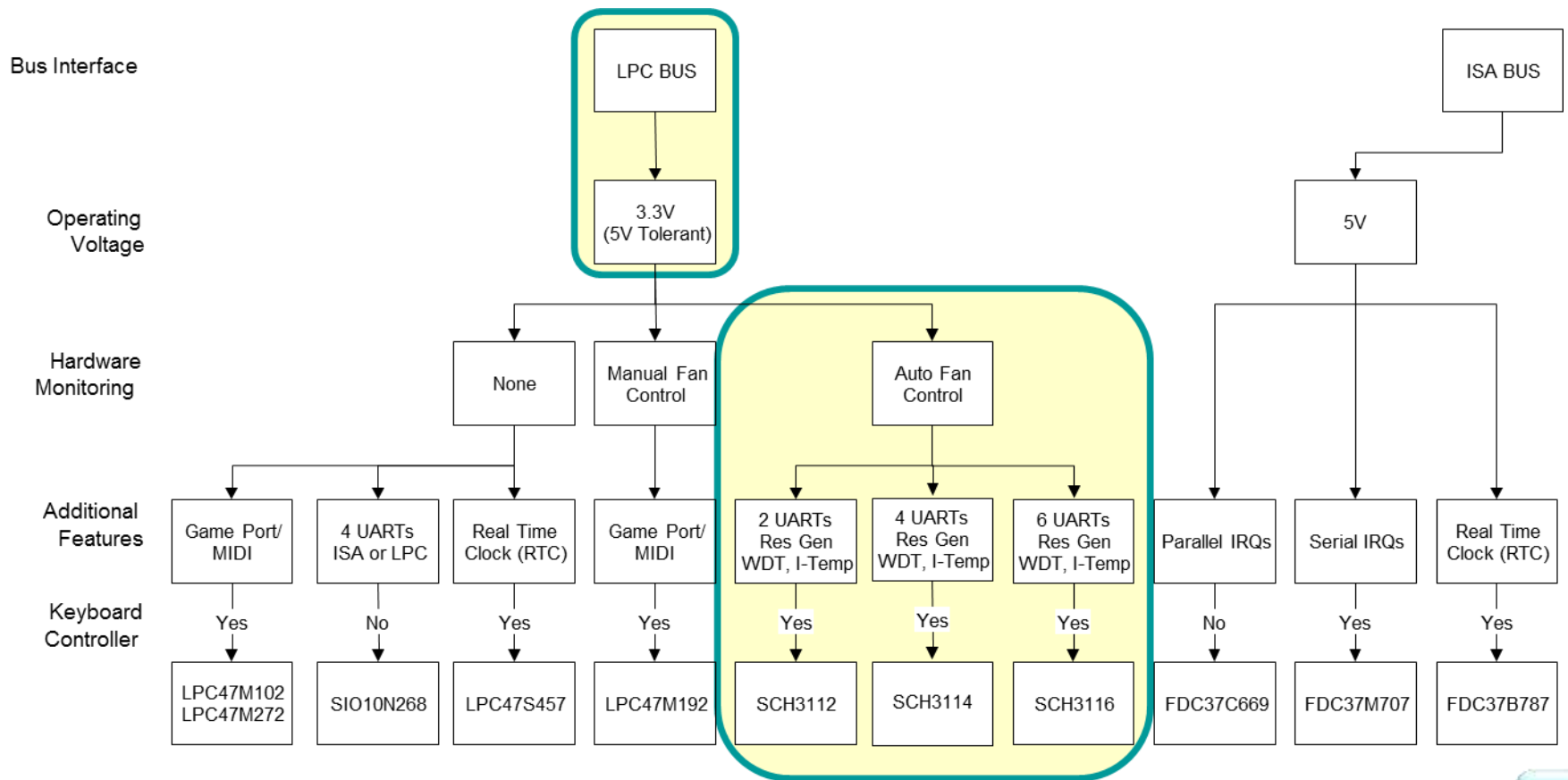
- **Industry's first Industrial-Temp Rated System Controller Hub**
- **Pin compatible 2-UART, 4-UART and 6-UART options**
  - Eliminates need for two SIO devices or SIO plus discrete UART chips
  - Supports data rates to 1.5Mbps and RS-485 Auto Direction Control Mode
- **Small footprint for small form factor designs**
  - 128-pin VTQFP package: 14 x 14 x 1.0 (mm)
  - Replaces need for 2-5 separate integrated circuits
- **Highest thermal and voltage monitoring accuracy levels for integrated Embedded I/O controller**
  - 1.5°C accuracy on thermal monitoring
  - Reset generator 5V threshold: 4.45V, tolerance: +/- 150mV
  - Reset generator 3.3/3.3 VTR threshold: 2.8V, tolerance: +/- 100mV

# Target Applications



# Embedded I/O Products

- x86-based architectures that support an LPC-Bus interface
- ISA-based SIO controllers are available for legacy I/O support





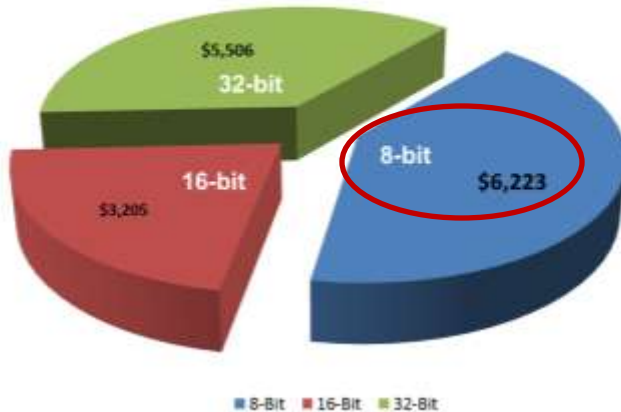
# **MICROCHIP**

## **8-bit MCU Update**

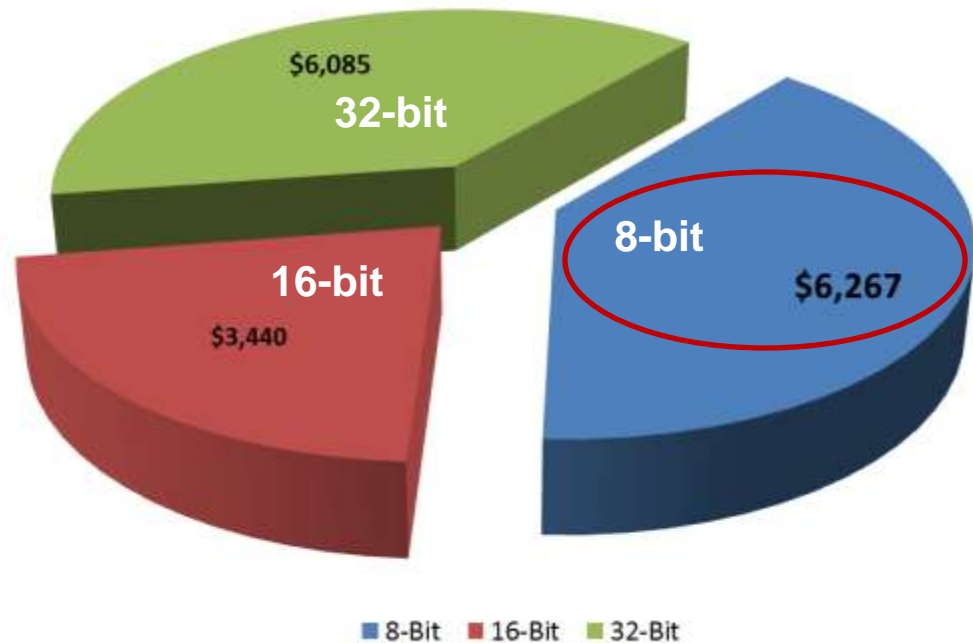
[Return to Topics](#)

# Still the Largest...

8- to 32-bit Market Size (2013)  
(In Millions of Dollars)\*



8- to 32-bit Market Size (2014)  
(In Millions of Dollars)\*



**Microchip re-gained #1 position in 8-bit MCU**

# Изменение парадигмы

- **Новые PIC контроллеры меняют “парадигму встраиваемых систем”**
  - Новые МК разрабатываются в возможность синтеза Функциональных Элементов
  - MIPS & МГц становятся менее важными
- **Реализация функций без отвлечения Ядра**
  - Взаимодействие Периферии независимой от ядра с аналоговой периферией
  - Гибкие взаимосвязи – ключевая особенность
  - Несколько **функций могут комбинироваться** в одном МК
- **Фокусируемся на решении инженерных задач**
  - Помните – нет “8-bit/16-bit/32-bit”, есть решение задачи
  - Помогает **уменьшить Цену, Уменьшить риски**

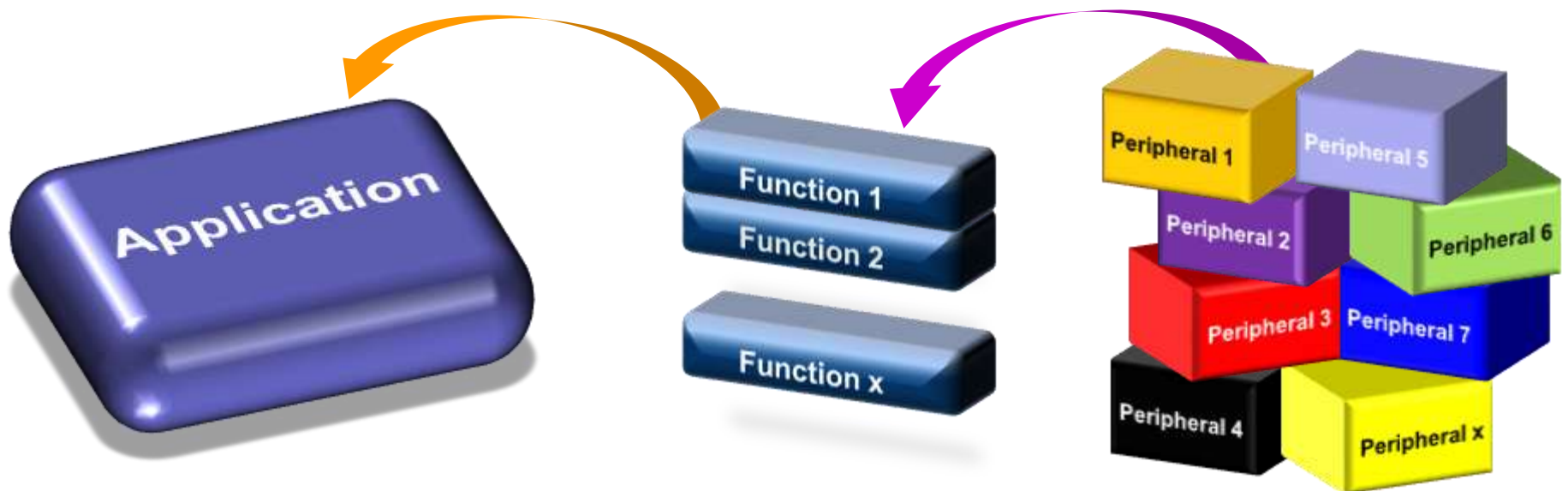
# Application Building Blocks

## Приложение состоит из функций

Приложение = Функция 1 + Функция 2 + Функция  
x ...

**Функция** это Сборка из **Периферий**

Функция x = Периферия 1 + Периферия 2 +  
Периферия x ...





# Flexible Integration

## Function Enabling Building Blocks

### Intelligent Analog

Sensor Interfacing & Signal Conditioning

### Waveform Control

PWM Drive & Waveform Generation

### Timing & Measurements

Signal Measurement with Timing & Counter Control

### Logic & Math

Customizable Logic & Math Functions

### Safety & Monitoring

Hardware Monitoring & Fault Detection

### Communications

Wired, Wireless & Encryption

### User Interface

Capacitive Touch Sensing & LCD Control

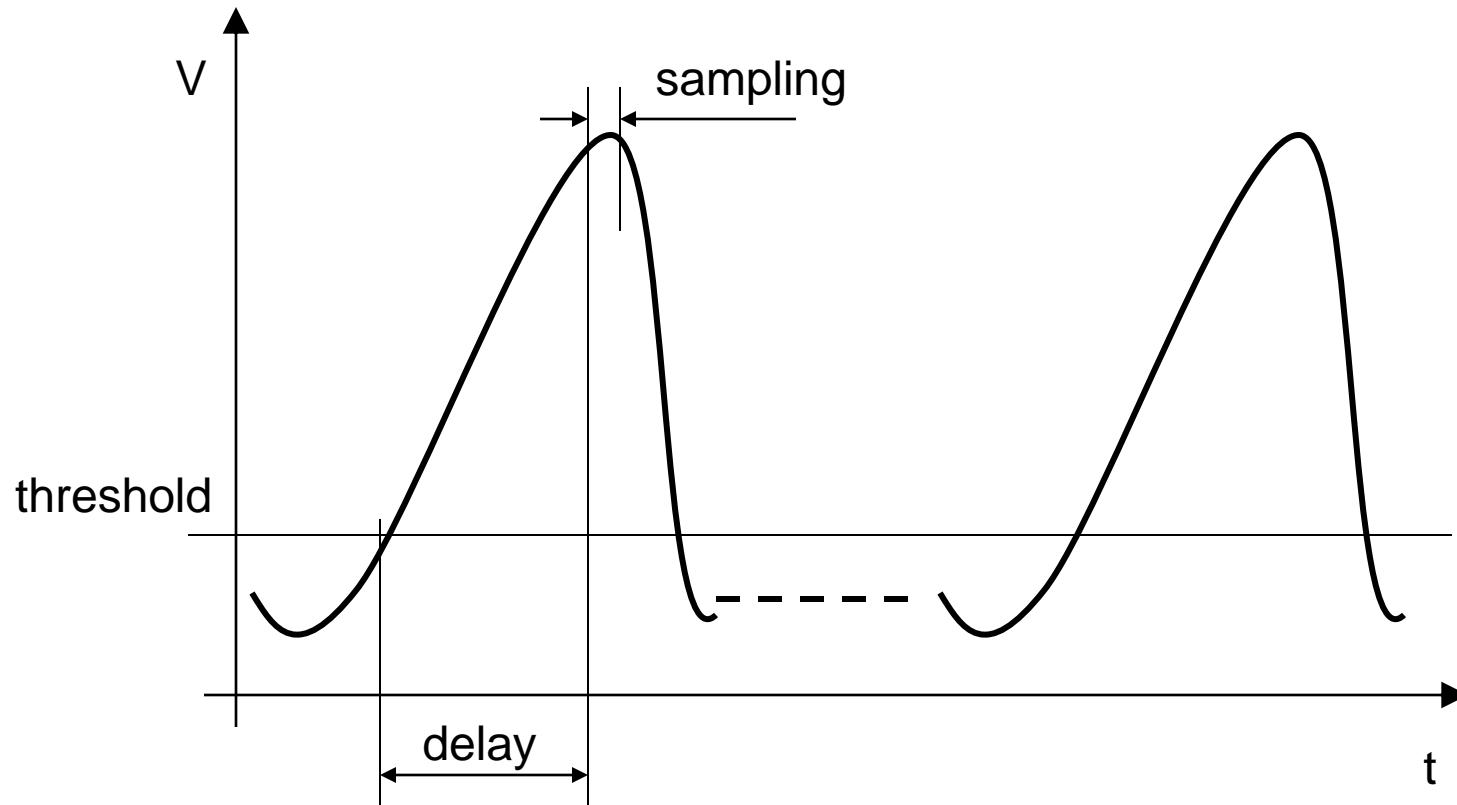
### Low Power & System Flexibility

XLP Low Power Technology, Peripheral & Interconnects

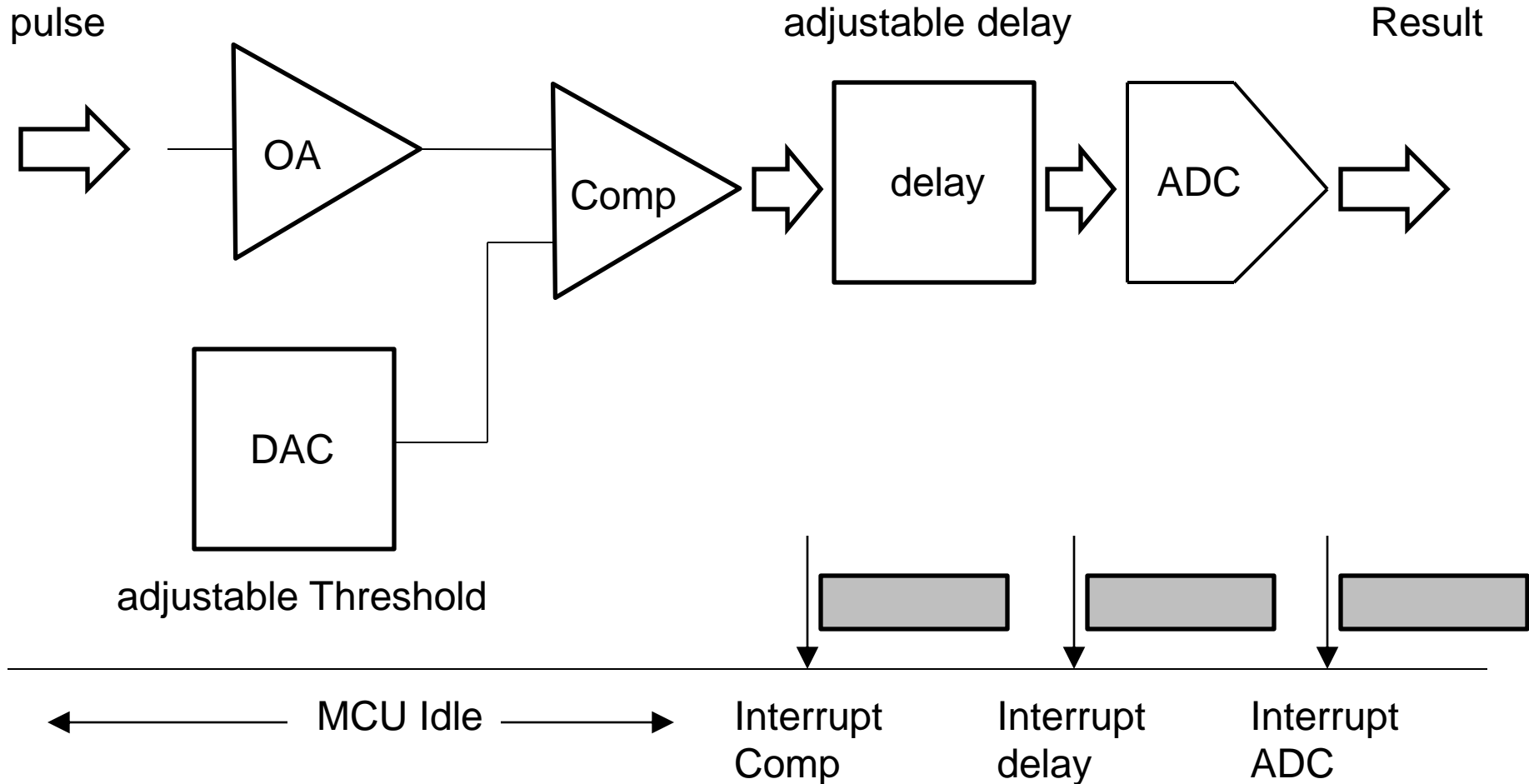
### 8-bit PIC Microcontrollers

CPU		Memory	
ADC	(Enhanced) Capture Compare PWM	High Endurance Flash (Data)	Configurable Logic Cell
ADC with Computation	Complementary Output Generator	IDLE & DOZE	Hardware Multiply
Comparators	Complementary Waveform Generator	Peripheral Module Disable	Math Accelerator
DAC	Data Signal Modulator	Peripheral Pin Select	Crystal Free USB
High Speed Comparators	Numerically Controlled Oscillator	eXtreme Low Power XLP Technology	CAN
Operational Amplifiers	Programmable Switch Mode Controller	Angular Timer	(E)USART
Ramp Generator	10-bit PWM	Charge Time Measurement	ETHERNET MAC
Slope Compensation	16-bit PWM	RTCC	I <sup>2</sup> C
Voltage Reference	Cyclical Redundancy Check	Signal Measurement Timer	LIN
Zero Cross Detect	Hardware Limit Timer	TEMP Indicator	SPI™
High Current I/O	Windowed WDT	8/16/20/24-bit Timers	Keeloq® Sub-GHz RF
LCD	mTouch		

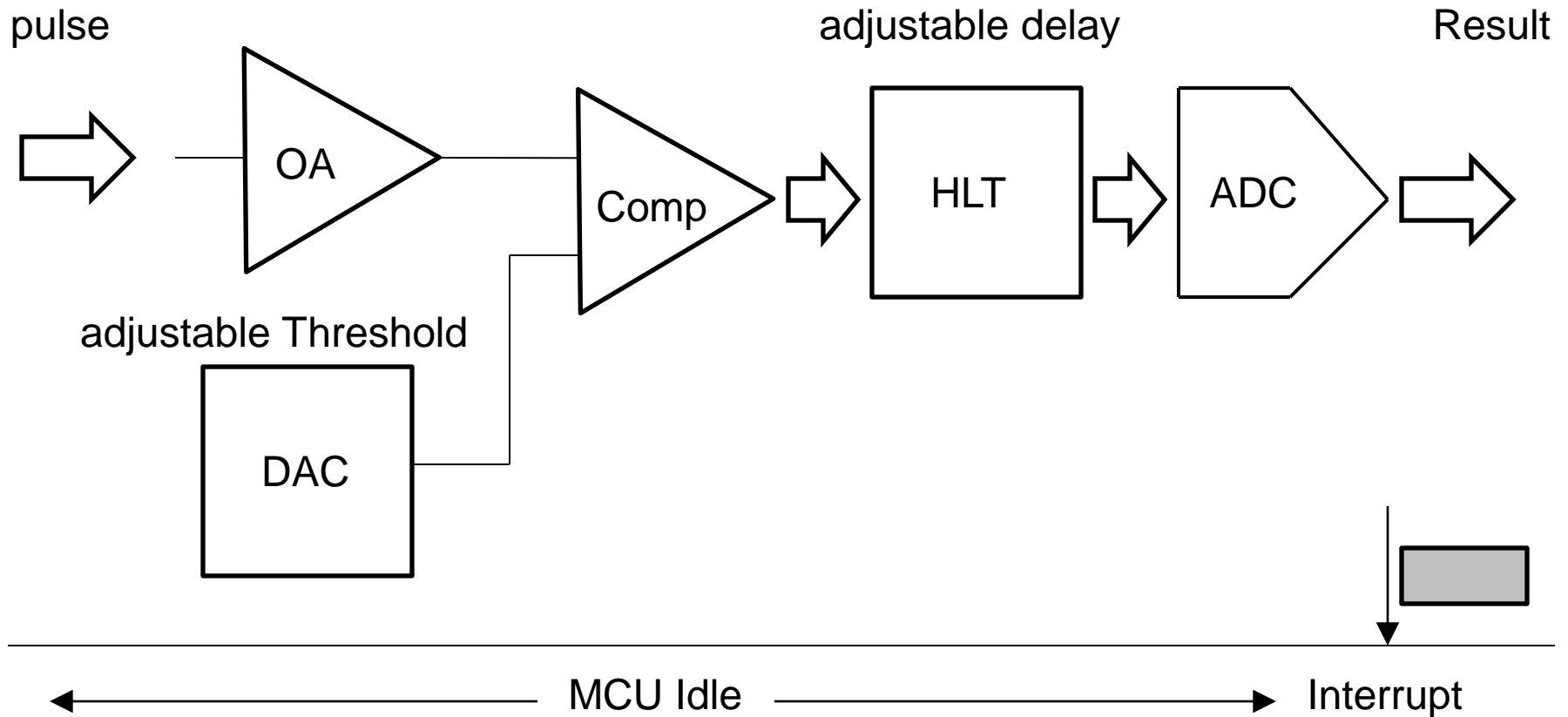
# ZEN: Pulse Amplitude Capture



# Chain Of Events



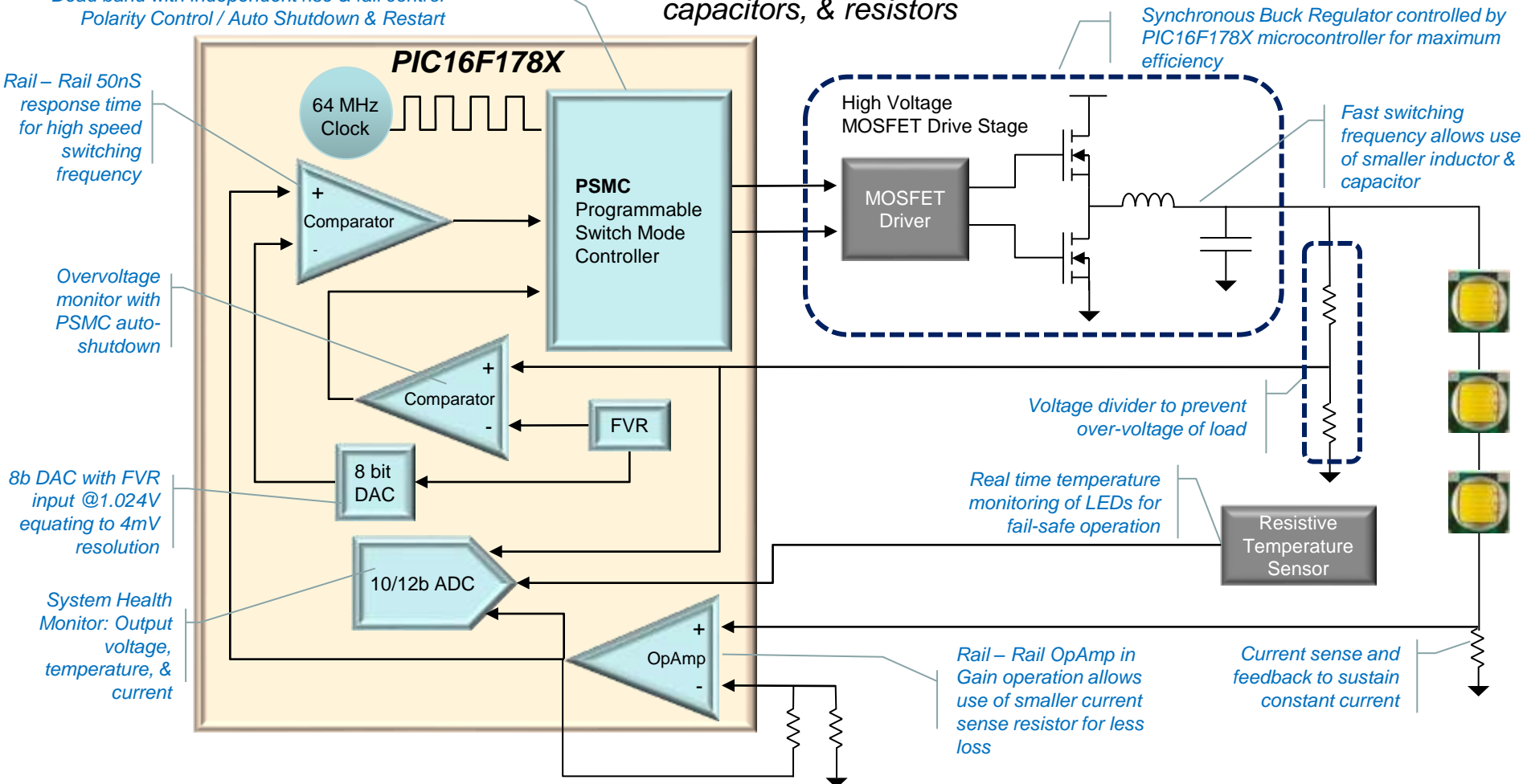
# CIP Chain Of Events



# Реализация функций

16-bit PWM with dedicated 64MHz clock  
6 steerable outputs or 3 steerable output pairs  
Blanking Control for transient filtering  
Independent rising/falling output control  
Dead band with independent rise & fall control  
Polarity Control / Auto Shutdown & Restart

- High Efficiency closed-loop control with fast switching speeds
- Cost effective integration with BOM reductions
  - OpAmp, Voltage Reference, reduced size of inductors, capacitors, & resistors





# Acronym & Peripherals Definitions

Summary 1 of 6

Learn more about Core Independent Peripherals & Intelligent Analog at [www.microchip.com/CIP](http://www.microchip.com/CIP)

## Intelligent Analog

Sensor Interfacing & Signal Conditioning

### ADC – Analog to Digital Converter

General purpose 8-/10-/12-bit ADC

### ADC<sup>2</sup> / ADCC–Analog to Digital Converter with Computation

General purpose 10-/12-bit ADC with automated analog signal computation (ex. Oversampling, averaging, etc.)

### Comp – Comparator

General purpose rail-to-rail comparator

### DAC – Digital to Analog Converter

Programmable voltage reference with multiple internal & external connections

### HC I/O – High Current I/O

Up to 50mA or 100mA current drive on select I/O pins

### HSComp – High Speed Comparator

General purpose rail-to-rail comparator with <50ns response time

### OPA – Operational Amplifier

General purpose OPAMP for internal and external signal source conditioning

### PRG – Programmable Ramp Generator

Analog ramp generator (with slope compensation) for Current/Voltage Mode power supplies

### SlopeComp – Slope Compensation

Slope compensation for Peak Current Mode power supplies

### VREF – Voltage Reference

Stable fixed voltage reference for use with integrated analog peripherals

### ZCD – Zero Cross Detect

AC high voltage zero crossing detection for simplifying TRIAC Control, Synchronized Switching Control, & Timing

# АЦП с вычислителем (ADC<sup>2</sup>)

10-/12-bit ADC with Automated Analog Signal Analysis

## АЦП с вычислителем

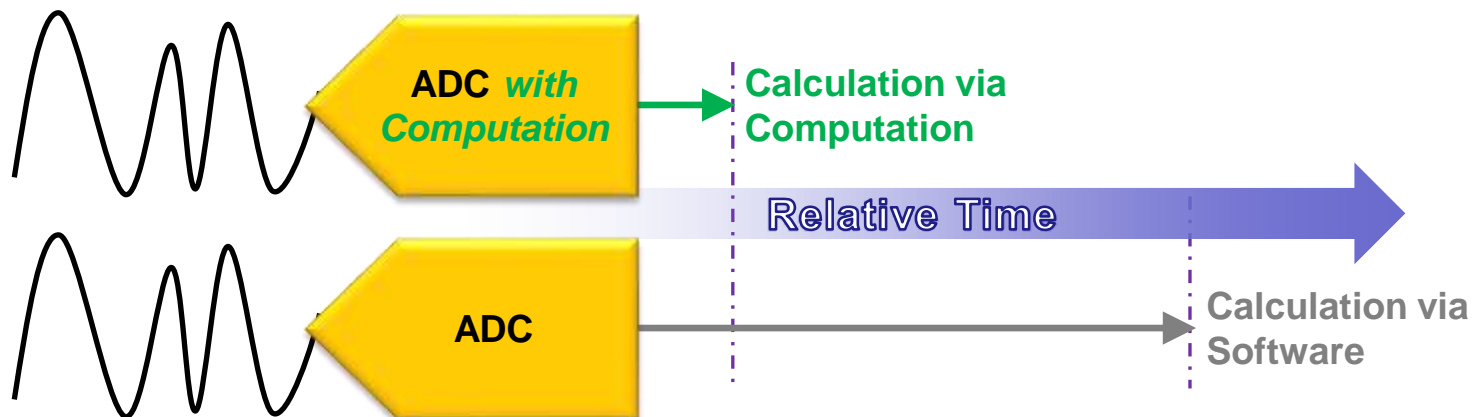
- ❑ 10-/12-bit АЦП общего применения с постобработкой данных
- ❑ Автоматизация математической обработки результата
  - ❑ Усреднение
  - ❑ Цифровая фильтрация
  - ❑ Сравнение с порогом
  - ❑ Передискретизация
- ❑ Вычисления работают в Sleep

## Достоинства

- ❑ Ускорение операций, которые обычно делаются программно
- ❑ Увеличение быстродействия и уменьшение размера кода
- ❑ Быстрая обработка емкостных кнопок
- ❑ Уменьшение потребления
- ❑ Не зависит от ядра
- ❑ Работает в SLEEP

## Примеры применения

- ❑ Датчики
- ❑ Фильтрация, обработка сигналов



Example: Traditional ADC versus ADC with MATHPAK

# Programmable Ramp Generator

Analog Ramp Generator with Slope Compensation

## Programmable Ramp Generator (PRG)

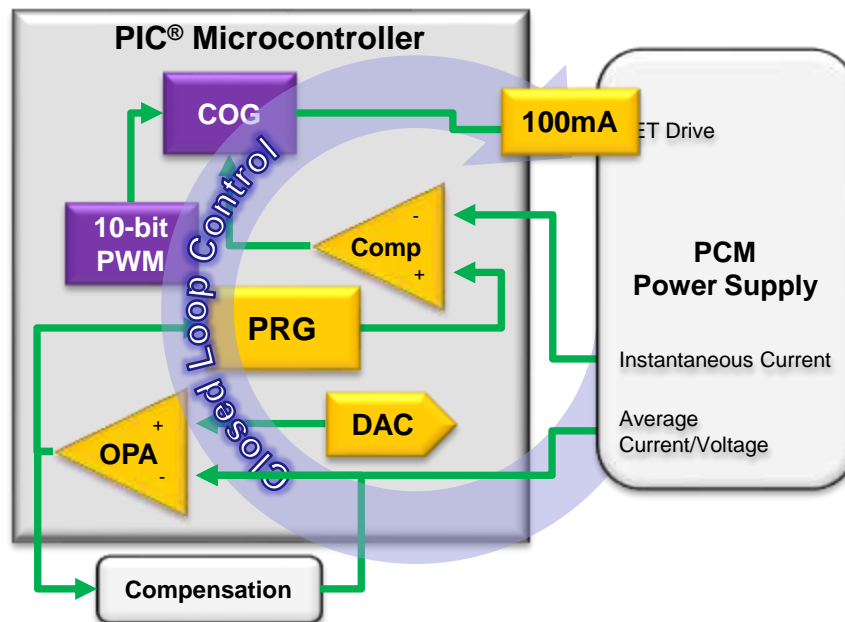
- ❑ Аналоговый формирователь пилообразного напряжения для Импульсных Источников Питания (SMPS)
- ❑ Создает независимый сигнал коррекции с регулируемым нарастанием и/или спада
- ❑ Гибкость внутриконтроллерных соединений

## Достоинства

- ❑ Гибкость дизайна ИИП
- ❑ Уменьшение стоимости
- ❑ Не зависит от ядра
- ❑ Работа в SLEEP

## Примеры применения

- ❑ Источники питания
- ❑ Светодиодное освещение
- ❑ Формирование треугольного сигнала для аналогового ШИМ-генератора с выравниванием по центру

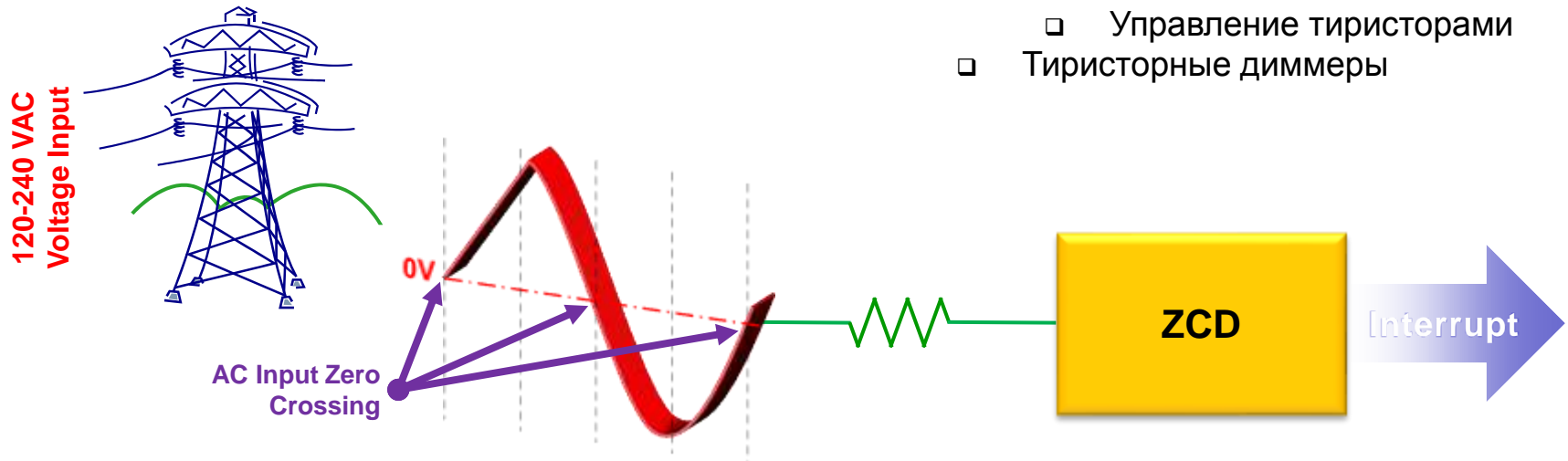


# Zero Cross Detect

## High Voltage AC Zero Crossing Detection

### Zero Cross Detect (ZCD)

- ❑ Определяет переход через Ноль входного напряжения
  - ❑ На выводе поддерживается постоянное напряжение
  - ❑ Не требуется внешних защитных элементов
- ❑ Определяет положительный или отрицательный сигнал (до резистора)
- ❑ Формирует прерывание при пересечении Нуля
- ❑ Устанавливает флаг
- ❑ Можно использовать для определения частоты сетевого напряжения
- ❑ Взаимодействие с другой периферией



### Достоинства

- ❑ Тиристорное управление
- ❑ Синхронизация управления реле
- ❑ Уменьшение стоимости
- ❑ Уменьшение размера ПП
- ❑ Независимая от ядра периферия
- ❑ Работа в SLEEP

### Примеры применения

- ❑ Сетевые источники питания
- ❑ Timing Control
- ❑ Бытовая техника
  - ❑ Управление тиристорами
- ❑ Тиристорные диммеры



# Acronym & Peripherals Definitions

Summary 2 of 6

Learn more about Core Independent Peripherals & Intelligent Analog at [www.microchip.com/CIP](http://www.microchip.com/CIP)

## Waveform Generation

### PWM Drive & Waveform Generation

#### **CCP / ECCP – (Enhanced) Capture Compare PWM**

1. CCP / ECCP: 10-bit PWM control with 16-bit capture & compare
2. ECCP: Addition of auto shut-down control

#### **COG – Complementary Output Generator**

Automated complementary output with control of key parameters such as: programmable rising/falling edge events, polarity, phase, precision dead-band, blanking, & auto shut-down

#### **CWG – Complementary Waveform Generator**

Automated complementary output with control of key parameters such as: dead-band and auto shut-down

#### **DSM – Data Signal Modulator**

1. Modulate a carrier signal with digital data to create custom carrier synchronized output waveforms
2. LED Dimming Engine Functionality via interconnection with 10-/16-bit PWM, DSM, & OpAmp

#### **NCO – Numerically Controlled Oscillator & 16-/20-bit Timer/Counter**

1. Precision linear frequency generator (@ 50% duty cycle) with 0.0001% step size of source input clock frequency
2. General purpose 16-/20-bit timer/counter

#### **PSMC – Programmable Switch Mode Controller & 16b Timer/Count**

1. 16-bit PWM with dedicated 64 MHz clock source and event triggering
2. Automated complementary output with control of key parameters such as: programmable rising/falling edge events, polarity, phase, precision dead-band, blanking, & auto shut-down
3. General purpose 16-bit timer/counter

#### **PWM – Pulse Width Modulation**

General purpose 10-bit PWM control

#### **16b PWM – Stand-alone 16-bit PWM & 16-bit Timer/Counter**

1. High resolution 16-bit PWM with edge and center aligned modes
2. General purpose 16-bit timer/counter



# Acronym & Peripherals Definitions

Summary 3 of 6

Learn more about Core Independent Peripherals & Intelligent Analog at [www.microchip.com/CIP](http://www.microchip.com/CIP)

## Timing & Measurements

### Signal Measurement with Timing & Counter Control

#### **AngTMR – Angular Timer**

Phase angle timer for measurement & control of rotational and periodic events (ex. Motor, AC Mains, TRIAC, etc.)

#### **CTMU – Charge Time Measurement Unit**

Time measurement unit that provides method for temperature sensing, time measurements (down to 1ns), and mTouch sensing

#### **HLT – Hardware Limit Timer & 8-bit Timer/Counter**

1. Hardware monitoring for missed periodic events and fault detection
2. General purpose 8-bit timer/counter with external reset capabilities

#### **NCO – Numerically Controlled Oscillator & 16-/20-bit Timer/Counter**

1. Precision linear frequency generator (@ 50% duty cycle) with 0.0001% step size of source input clock frequency
2. General purpose 16-/20-bit timer/counter

#### **PSMC – Programmable Switch Mode Controller & 16b Timer/Count**

1. 16-bit PWM with dedicated 64 MHz clock source and analog event triggering
2. Automated complementary output control of key parameters such as phase, dead-band, blanking, & auto shut-down states
3. General purpose 16-bit timer/counter

#### **RTCC – Real Time Clock & Calendar**

Maintains accurate clock & calendar timing with external 32.768 KHz crystal

#### **SMT – 24-bit Signal Measurement Timer & 24-bit Timer/Counter**

1. Accurate measurement of any digital signal including: period, duty cycle, time of flight; instantaneous vs. average measurements
2. General purpose 24-bit timer/counter

#### **TEMP – Temperature Indicator**

Provides relative temperature measurements utilizing the ADC

#### **16TMR – 16-bit Timer**

General purpose 16-bit timer/counter

#### **16b PWM – Stand-alone 16-bit PWM & 16-bit Timer/Counter**

1. High resolution 16-bit PWM with edge and center aligned modes
2. General purpose 16-bit timer/counter

# Angular Timer

Automatically Converts Timed Based Events to Degrees

## Angular Timer (AngTMR)

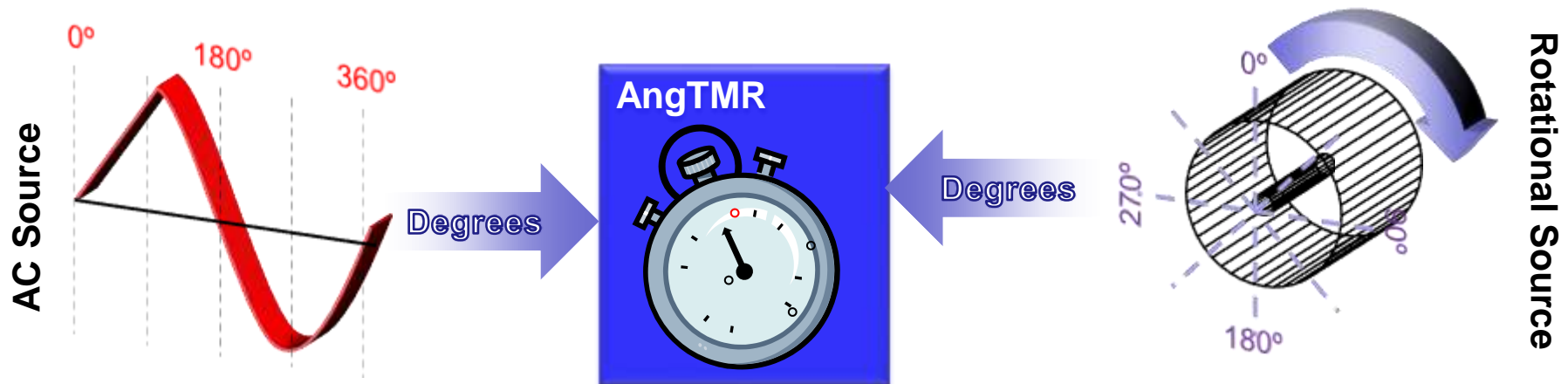
- Автоматически предоставляет преобразование фазы в угловые величины для управления вращающимися или периодическими событиями
  - Моторы, Сетевые устройства, Триаки,...
- Преобразование времени входного сигнала в угловые величины
- Формирование прерывания по углу
- Детектирования пропуска импульса
- Упрощает разработку кода
  - Программа оперирует значениями углов
  - Автоматическая подстройка изменения частоты
  - Проще вычисления

## Достоинства

- Высокая точность
- Увеличение быстродействия
- Уменьшение размера кода
- Независимая от ядра периферия
- Работа в SLEEP

## Примеры применения

- Управление двигателями (электрическими и внутреннего сгорания)
- Бытовая техника
- Освещение





# Acronym & Peripherals Definitions

Summary 4 of 6

Learn more about Core Independent Peripherals & Intelligent Analog at [www.microchip.com/CIP](http://www.microchip.com/CIP)

## Logic & Math

Customizable Logic & Math Functions

### CLC – Configurable Logic Cell

1. Integrated combinational & sequential logic
2. Custom interconnection & re-routing of digital peripherals

### MULT – Hardware Multiplier

MULTIPLY function of two 8-bit values with 16-bit result

### MathACC – Math Accelerator

1. MULTIPLY, ADD, ACCUMULATE functions of 8-bit/16-bit values with 35-bit result
2. Calculates a 16-bit PID function based on configurable  $K_p$ ,  $K_i$ ,  $K_d$  constants with a 34-bit result

## Safety & Monitoring

Hardware Monitoring & Fault Detection

### CRC/SCAN – Cyclical Redundancy Check with Memory Scan

1. Automatically calculates CRC checksum of Program / DataEE memory for NVM integrity
2. General purpose 16-bit CRC for use with memory and communications data

### HLT – Hardware Limit Timer & 8-bit Timer/Counter

1. Hardware monitoring for missed periodic events and fault detection of external hardware
2. General purpose 8-bit timer/counter with external reset capabilities

### WWDT – Windowed Watch Dog Timer

System supervisory circuit that generates a reset when software timing anomalies are detected within a configurable critical window

# Math Accelerator

## Hardware Accelerated Math Functions

### Math Accelerator (MathACC)

- ❑ MATH & PID функции
- ❑ Функции MULTIPLY, ADD, ACCUMULATE
  - ❑ 8-bit/16-bit значения с 35-bit результатом
- ❑ Четыре режима
  - ❑ Multiply and Accumulate (MAC)
  - ❑ Add and Multiply
  - ❑ Simple Multiplier
    - ❑ Знаковое и Без знаковое умножение
  - ❑ Программируемый PID Контроллер
    - ❑ 16-bit PID функции на основе конфигурируемых коэффициентов  $K_p$ ,  $K_i$ ,  $K_d$  с 34-bit результатом

### Достоинства

- ❑ Ускорение вычислений
- ❑ Уменьшение размера кода
- ❑ Ускорение PID управления
- ❑ Периферия Независимая от Ядра

### Примеры применения

- ❑ Управление двигателями
- ❑ Цифровая фильтрация
- ❑ Управление температурой и др.



## Обзор

Два основных режима:

- $ACC += (A + B) * C$ 
  - Без знаковое сложение/умножение без накопления
  - Знаковое сложение/умножение без накопления
  - Без знаковое сложение/умножение с накоплением
  - Знаковое сложение/умножение с накопления
- Вычисление PID (mode 101)
  - $PID = K_p + K_i/s + K_d*s$
- Управление режимами через PIDxCONbits.MODE

# Math Accelerator

## Цифровой КИХ фильтр

### Finite Impulse Response (FIR) Filter:

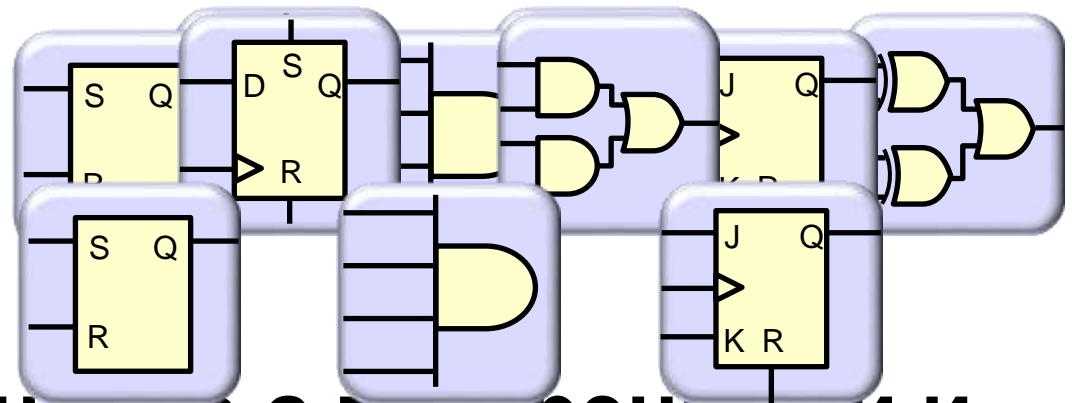
$$y[n] = b_0 * x[n] + b_1 * x[n-1] + \dots + b_k * x[n-k] \quad (\text{ACC} += A * B)$$



# Обзор CLC

- **CLC это периферия с конфигурируемыми базовыми логическими элементами**

- Комбинационная логика
- Триггеры
- Защелки

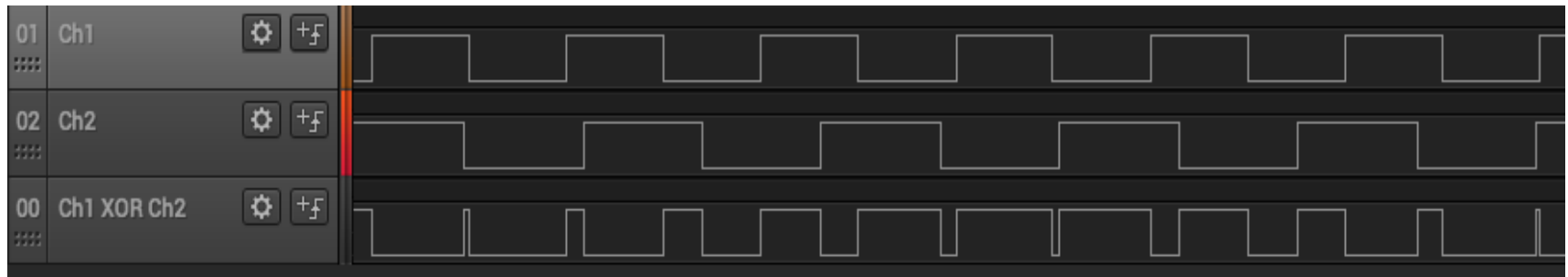
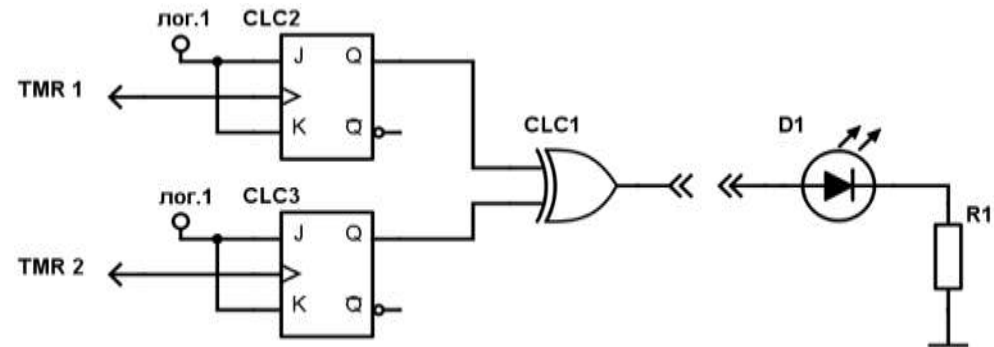
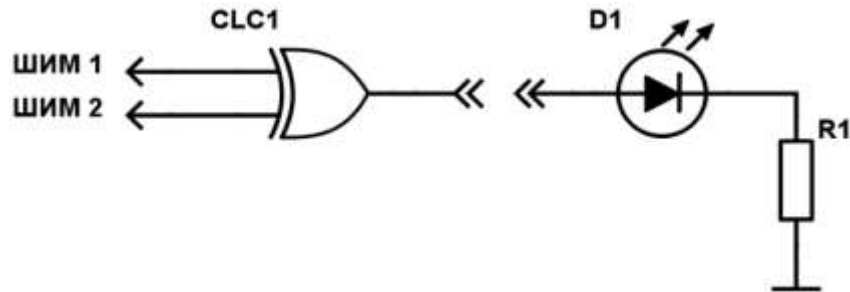


- **Гибкое соединение с внутренними и внешними сигналами**

# Примеры

## Мерцающий светодиод

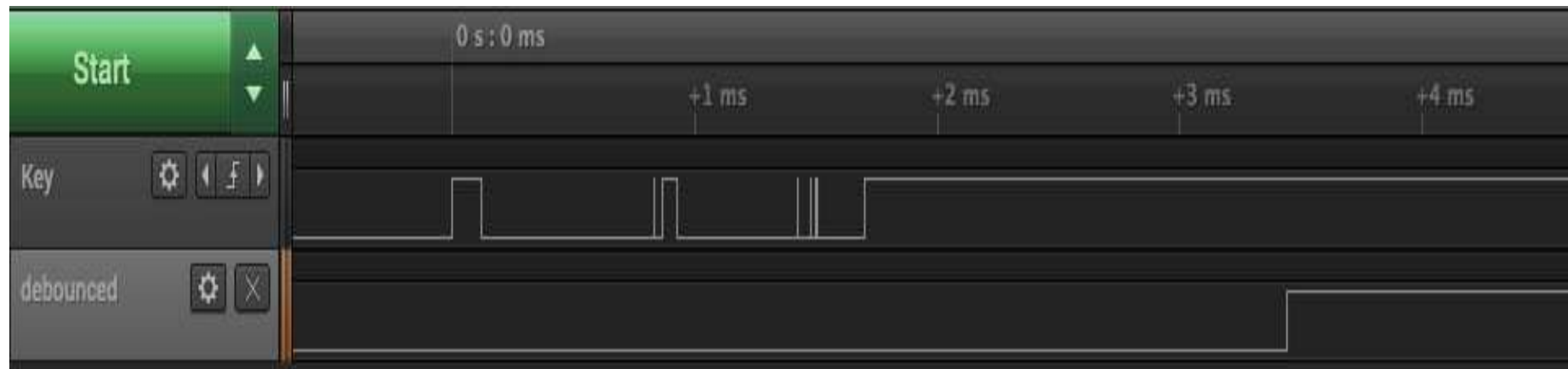
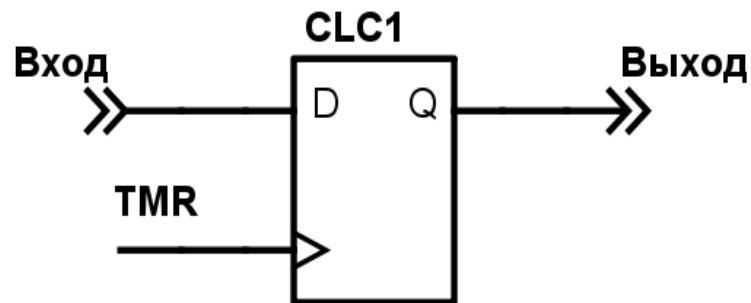
- Настраивается периферия
  - 1xТаймер и/или ШИМ
  - CLC
- Скважность меняется автоматически



# Примеры

## Подавление дребезга

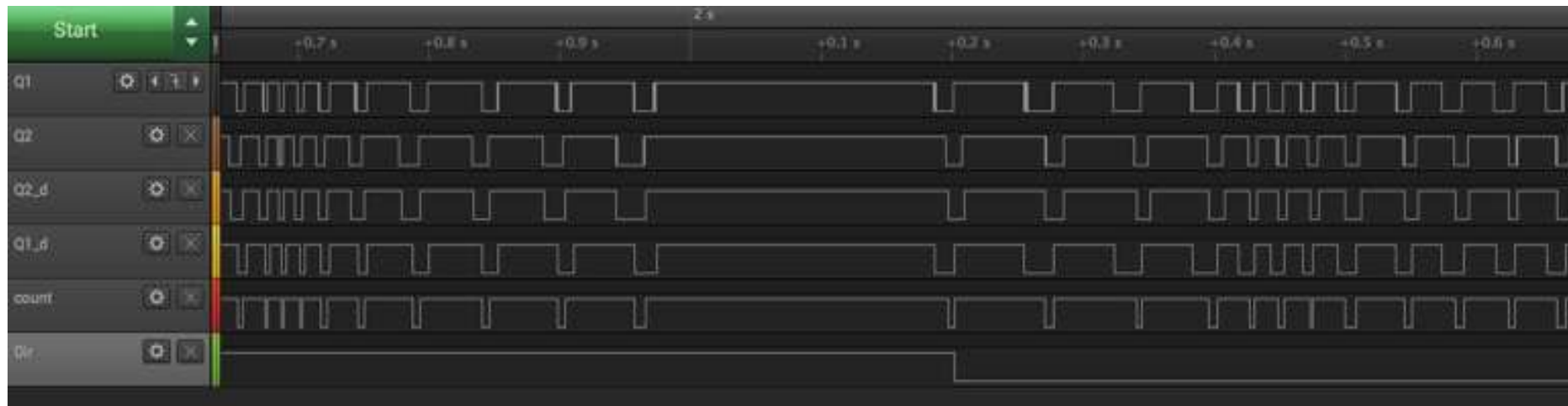
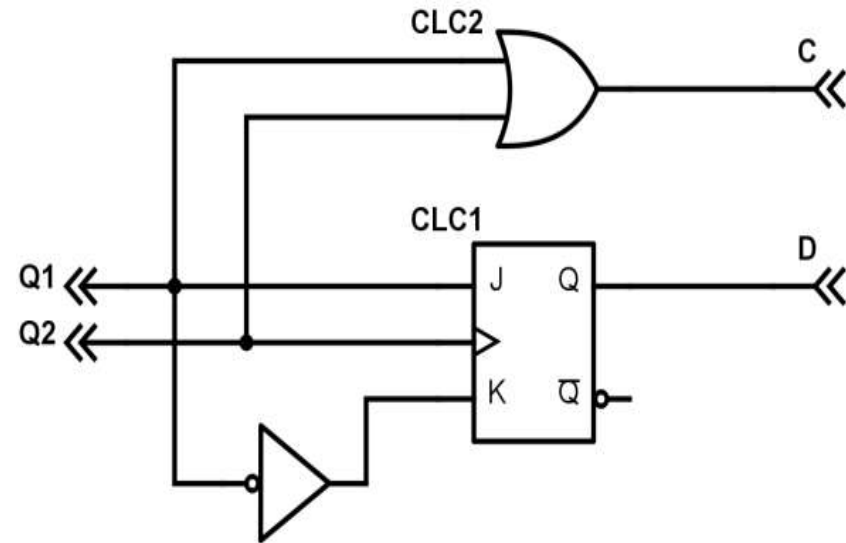
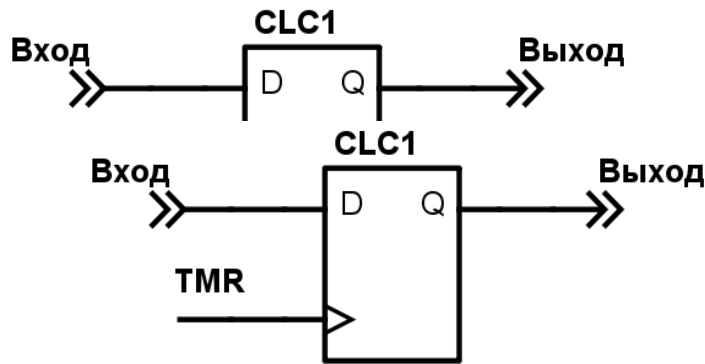
- Настраивается периферия
  - CLC



# Примеры

## Квадратурный декодер 1 + подавление дребезга

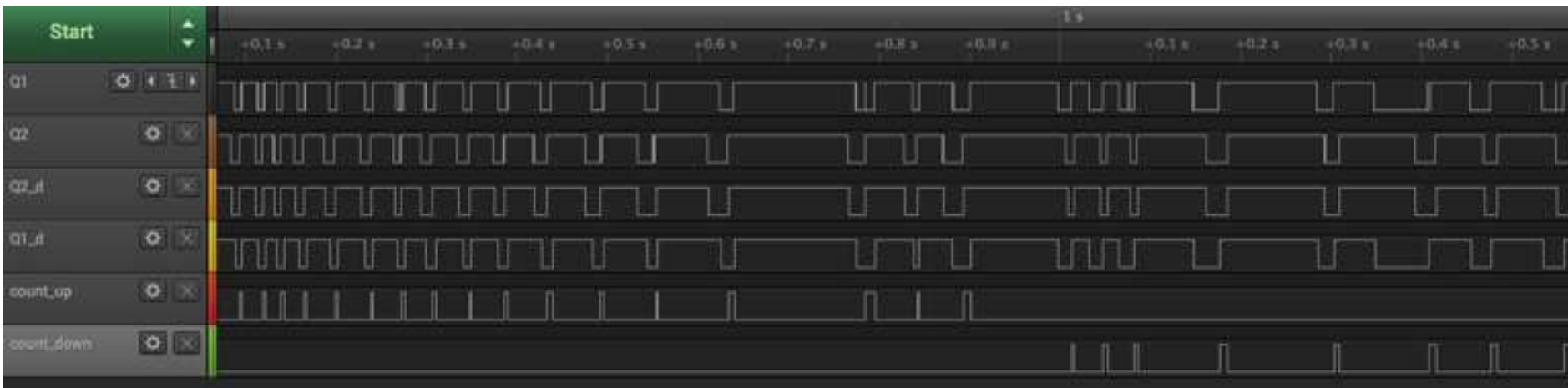
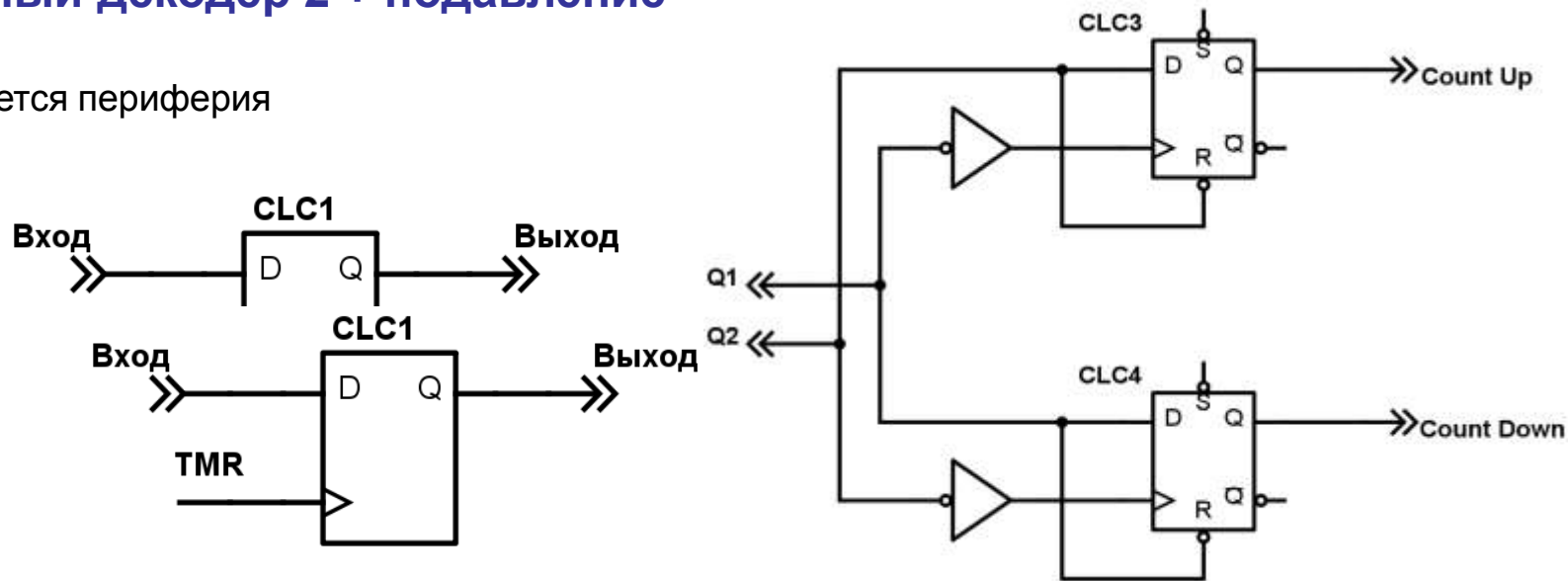
- Настраивается периферия
  - CLC



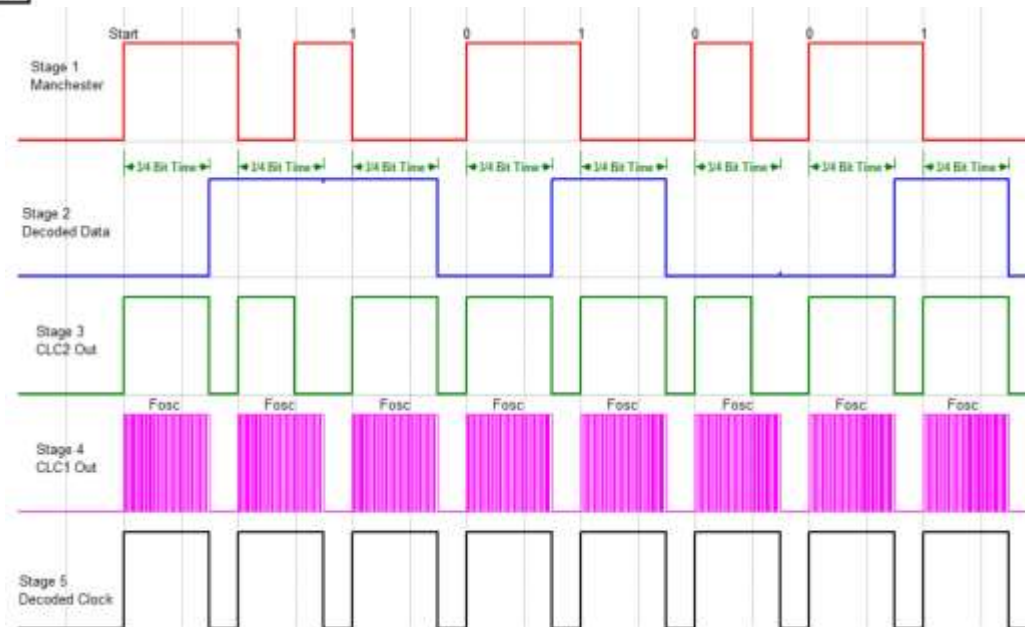
# Примеры

## Квадратурный декодер 2 + подавление дребезга

- Настраивается периферия
  - CLC



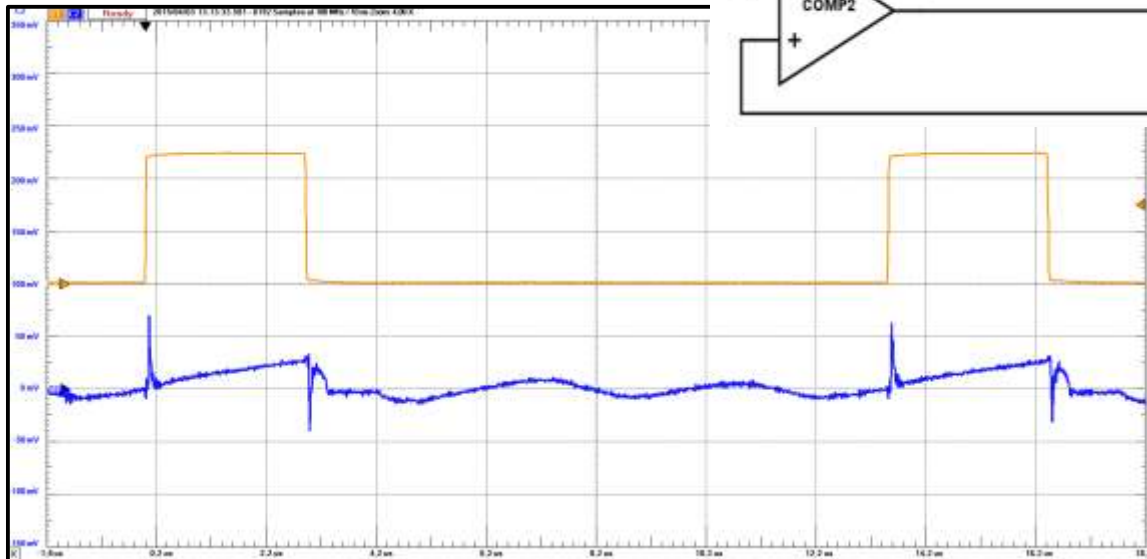
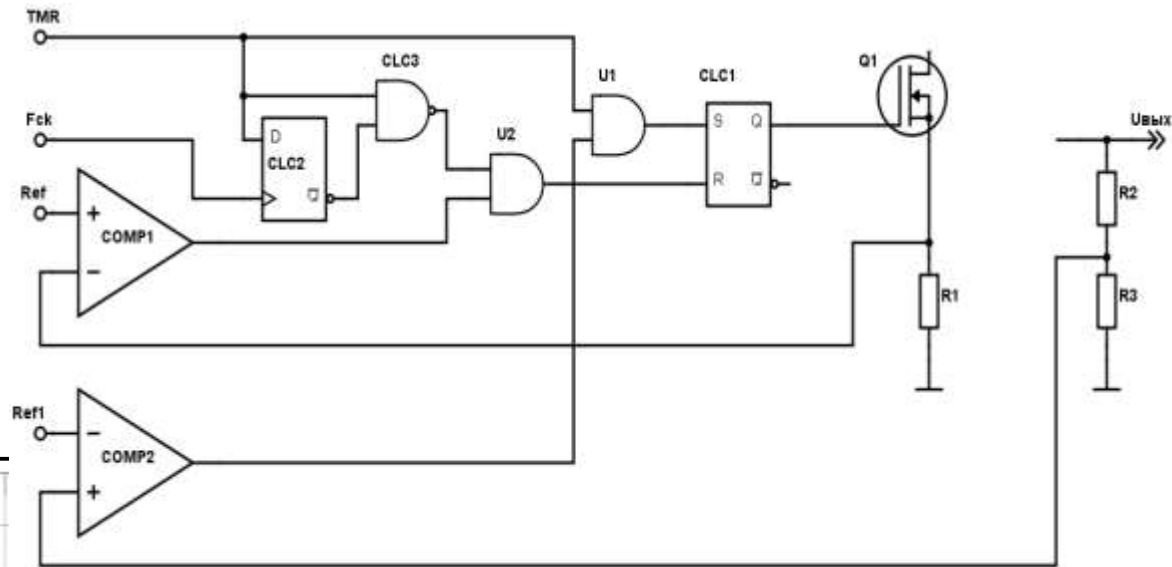
- CLC
- NCO



# Примеры

## Импульсный источник питания

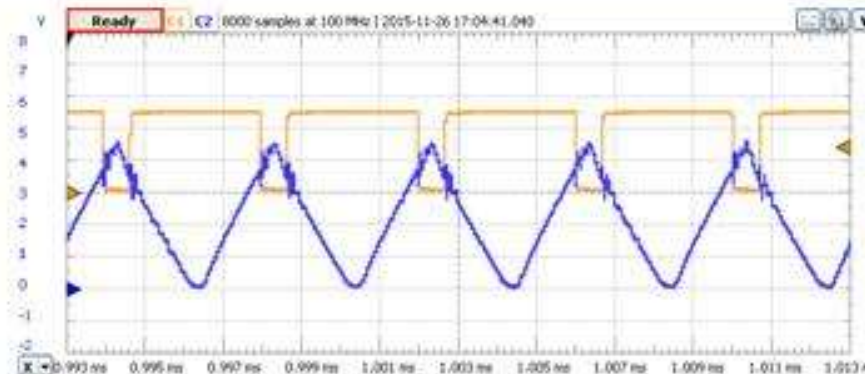
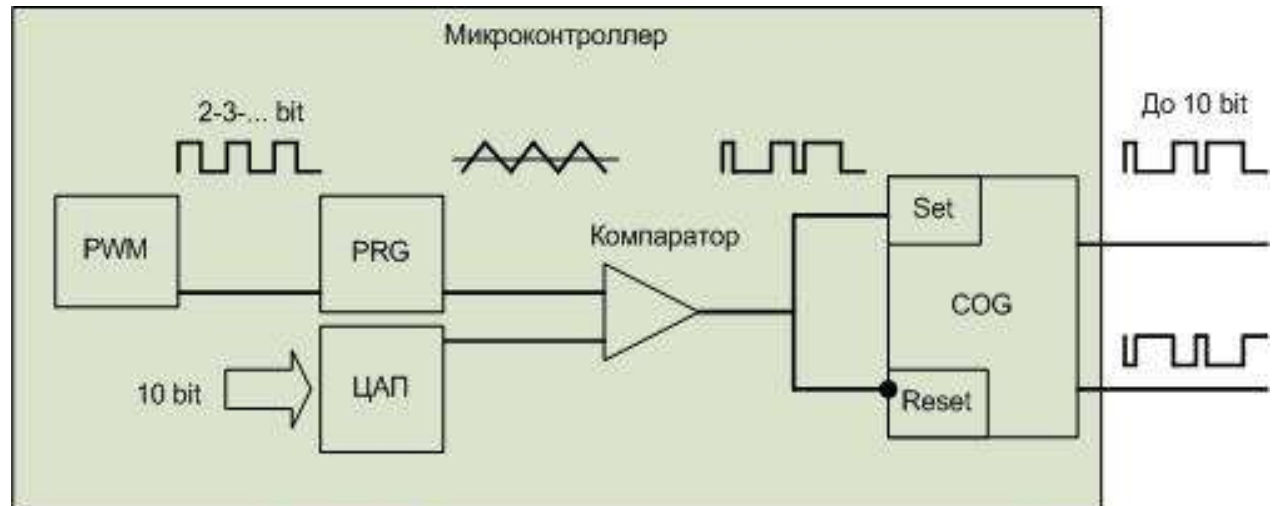
- Настраивается периферия
  - CLC
  - Компаратор



# Примеры

## Усилитель D-класса

- Настраивается периферия
  - ШИМ
  - Компаратор
  - COG
  - PRG
  - ЦАП





# Acronym & Peripherals Definitions

Summary 5 of 6

Learn more about Core Independent Peripherals & Intelligent Analog at [www.microchip.com/CIP](http://www.microchip.com/CIP)

## Communications

General, Industrial, Lighting, & Automotive

### **ACT – Active Clock Tuning for Crystal Free USB**

1. Auto-tuning of internal oscillator when connected to USB host (eliminates need for external crystal)
2. Tunes internal oscillator to match accuracy of external clock source

### **CAN – Controller Area Network**

Industrial and Automotive centric communication bus

### **LIN – Local Interconnect Network**

1. Industrial and Automotive centric communication bus
2. Support for LIN when using the EUSART

### **MAC – Ethernet Media Access Control**

10Mb/s Ethernet MAC for direct PHY interface

### **EUSART / AUSART – Enhanced/Addressable Universal Asynchronous Receiver Transceiver**

1. General purpose serial communications
2. Support for LIN when using the EUSART

### **I<sup>2</sup>C – Inter-Integrated Circuit**

General purpose 2-wire serial communications

### **SPI – Serial Peripheral Interface**

General purpose 4-wire serial communications

### **Keeloq® Sub-GHz RF – Encrypted RF Transmitter**

PIC MCU integrated sub-GHz RF transmitter with proprietary Keeloq® data encryption

### **USB – Universal Serial Bus**

Support for full-speed USB 2.0 device profiles



# Acronym & Peripherals Definitions

Summary 6 of 6

Learn more about Core Independent Peripherals & Intelligent Analog at [www.microchip.com/CIP](http://www.microchip.com/CIP)

## User Interface

Capacitive Touch Sensing & LCD Control

**HCVD – Hardware Capacitive Voltage Divider** 

Simplifies implementation & reduces overhead of mTouch sensing applications

**LCD – Liquid Crystal Display**

Highly integrated segmented LCD controller

**mTouch – Microchip Proprietary Capacitive Touch Technology**

1. Capacitive sensing for touch buttons & Sliders
2. Capacitive sensing for system measurements & detection (ex. Water level, intrusion detection, etc.)

## Low Power & System Flexibility

XLP Low Power Technology, Peripheral & Interconnects

**DOZE – Power Saving Mode**

Ability to run the CPU core slower than the system clock used by the internal peripherals

**HEF – High Endurance Flash**

128B Non-volatile data storage with High Endurance 100k R/W cycles

**IDLE – Power Saving Mode**

Ability to put the CPU core to sleep while the internal peripherals continue to operate from the system clock

**PMD – Peripheral Module Disable**

Peripheral power disable hardware module to minimize power consumption of unused peripherals

**PPS – Peripheral Pin Select**

I/O pin remapping of digital peripherals for greater design flexibility and improved EMI board layout

**XLP – eXtreme Low Power Technology** 

Industry leading low power technology (LF variants only – unless otherwise noted)

# Idle & Doze Modes

## Scalable Performance & Power Consumption

### Idle Mode

- ❑ CPU останавливает выполнение инструкций
- ❑ Периферия продолжает работать
- ❑ Уменьшение потребления при продолжении управления системой

### Doze Mode

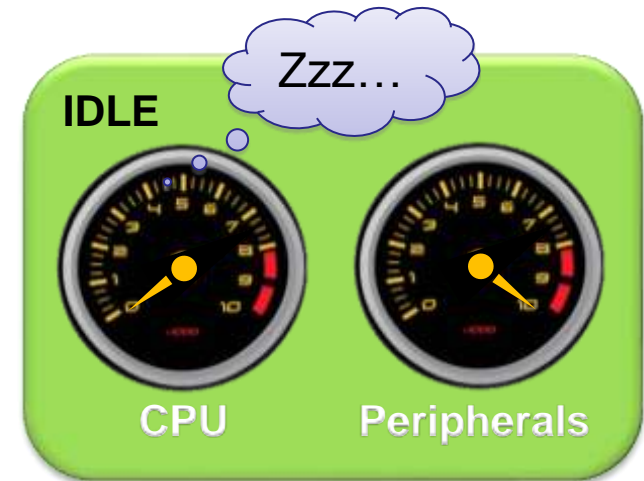
- ❑ Различная тактовая частота для ядра и периферии
- ❑ Масштабирование производительности ядра и периферии
- ❑ Достижение баланса между производительностью и потреблением энергии

### Достоинства

- ❑ Продление срока службы батарей
- ❑ Уменьшение потребления для сетевых устройств

### Примеры применения

- ❑ Потребительская электроника
- ❑ Датчики дыма и CO
- ❑ Батарейные приборы
- ❑ Приборы с требованиями минимального потребления в ждущем режиме



# Peripheral Module Disable

Eliminates Power Consumption of Unused Peripherals

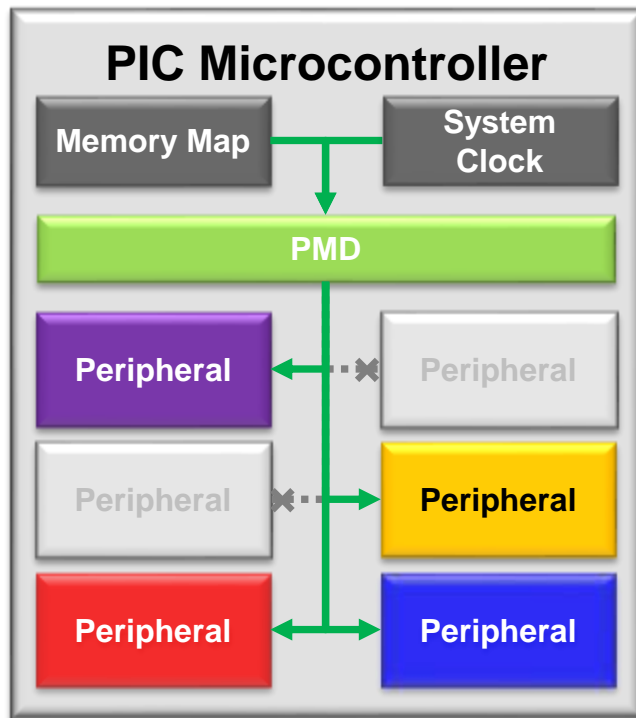
## Peripheral Module Disable

Режим 1:

- Индивидуальное отключение периферии
  - Отключает периферию от памяти

Режим 2:

- Выключение тактирования всей периферии



## Достоинства

- Нулевое потребление выключенной периферии
- Оптимизация потребления
- Увеличение срока работы от батарей
- Уменьшение потребления для сетевых устройств

## Примеры применения

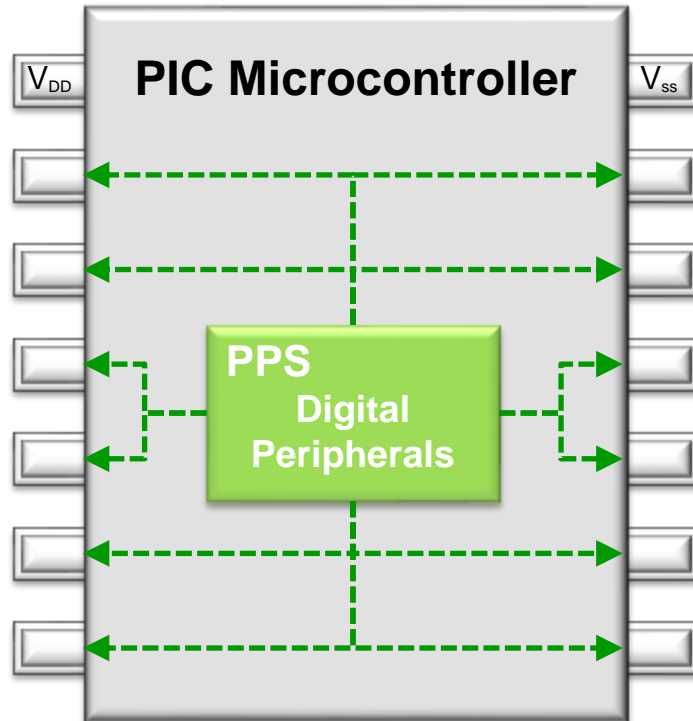
- Батарейные приборы
- Приборы с требованиями минимального потребления в ждущем режиме

# Peripheral Pin Select

## I/O Pin Remapping of Digital Signals

### Peripheral Pin Select (PPS)

- ❑ Конфигурирование любого цифрового модуля на любой пин
- ❑ Предоставляет больше возможностей по оптимизации
- ❑ Гибкая настройка функций
- ❑ Подключение одной периферии к нескольким И/О
- ❑ Переключение во время работы



### Достоинства











- ❑ Оптимальное использование периферии
- ❑ Упрощает смену МК
- ❑ Оптимизация трассировки

### Примеры применения

- ❑ Системы требующие высокой интеграции
- ❑ Переход с устаревших МК
- ❑ Приборы требующие оптимальной трассировки ПП и минимальных размеров



*<Click on product family for details>*

6 Pin	8 Pin	14 Pin	18/20 Pin
<div>Full Family Released to Production</div> <div>Partial Family Release to Production</div> <div>In Development</div> <div>Concept (subject to change)</div>			<b>PIC18(L)FxxK22</b> 8KB-16KB/256B EE/256B-512B 5V, ADC, ECCP, EUSART, SPI/I <sup>2</sup> C 
		<b>PIC1x(L)F176x</b> 7KB – 14KB / HEF / 512B – 1KB: ADC, 10b DAC, HSComp, OpAmps, PRG, HLT, 16b PWM, ZCD, COG, PPS, DSM, 100mA I/O, EUSART, SPI/I <sup>2</sup> C 	
		<b>PIC16(L)F170x</b> 3.5KB – 14KB / HEF / 512B – 1KB: ADC, 8b DAC, HSComp, OpAmps, COG, ZCD, CLC, PPS, EUSART, SPI/I <sup>2</sup> C 	
	<b>PIC16(L)F161x</b> 3.5KB – 14KB / HEF / 256B – 1KB: ADC, DAC, Comps, CCP, PWM, CWG, CLC, HLT, AngTMR, SMT, WWDT, CRC/SCAN, ZCD, MathACC, PPS, 100mA I/O, EUSART, SPI/I <sup>2</sup> C 		
	<b>PIC16(L)F183xx</b> 3.5KB – 28KB / 256B EE / 256B – 2KB ADC, 5b DAC, Comparators, CCP, PWM, CWG, NCO, CLC, PPS, EUSART, 2x(SPI/I <sup>2</sup> C), IDLE/DOZE, PMD 		
	<b>PIC1xF(HV)75x</b> 1.75KB – 3.5KB / 0EE / 64B – 128B ADC, 5/9bit DAC, COG, HSComp, CCP, OpAmps, SlopeComp, 50mA I/O	<b>PIC16F527/570</b> 1.5KB -3KB / 64B EE / 68B-132B ADC, Comparators, OpAmps 	
	<b>PIC1xLF155x</b> 3.5KB – 14KB / HEF / 256B – 512B Dual ADC, PWM, EUSART, SPI/I <sup>2</sup> C 		
	<b>PIC1x(L)F150x</b> 1.75KB – 14KB / HEF / 64B – 512B ADC, 5b DAC, Comparators, PWM, CWG, NCO, CLC, EUSART, SPI/I <sup>2</sup> C 		
<b>PIC10(L)Fxxx</b> 384B – 896B / 0EE / 16B – 64B Smallest form factor with CIPs 	<b>PIC1x(L)F157x</b> 1.75KB – 14KB / HEF / 128B – 1KB ADC, 5b DAC, Comparators, CWG, TEMP, 16b PWM, PPS, EUSART 		



# 8-bit PIC<sup>®</sup> Microcontrollers

## General Purpose Family Highlights – *High Pin Count*

[<Click on product family for details>](#)

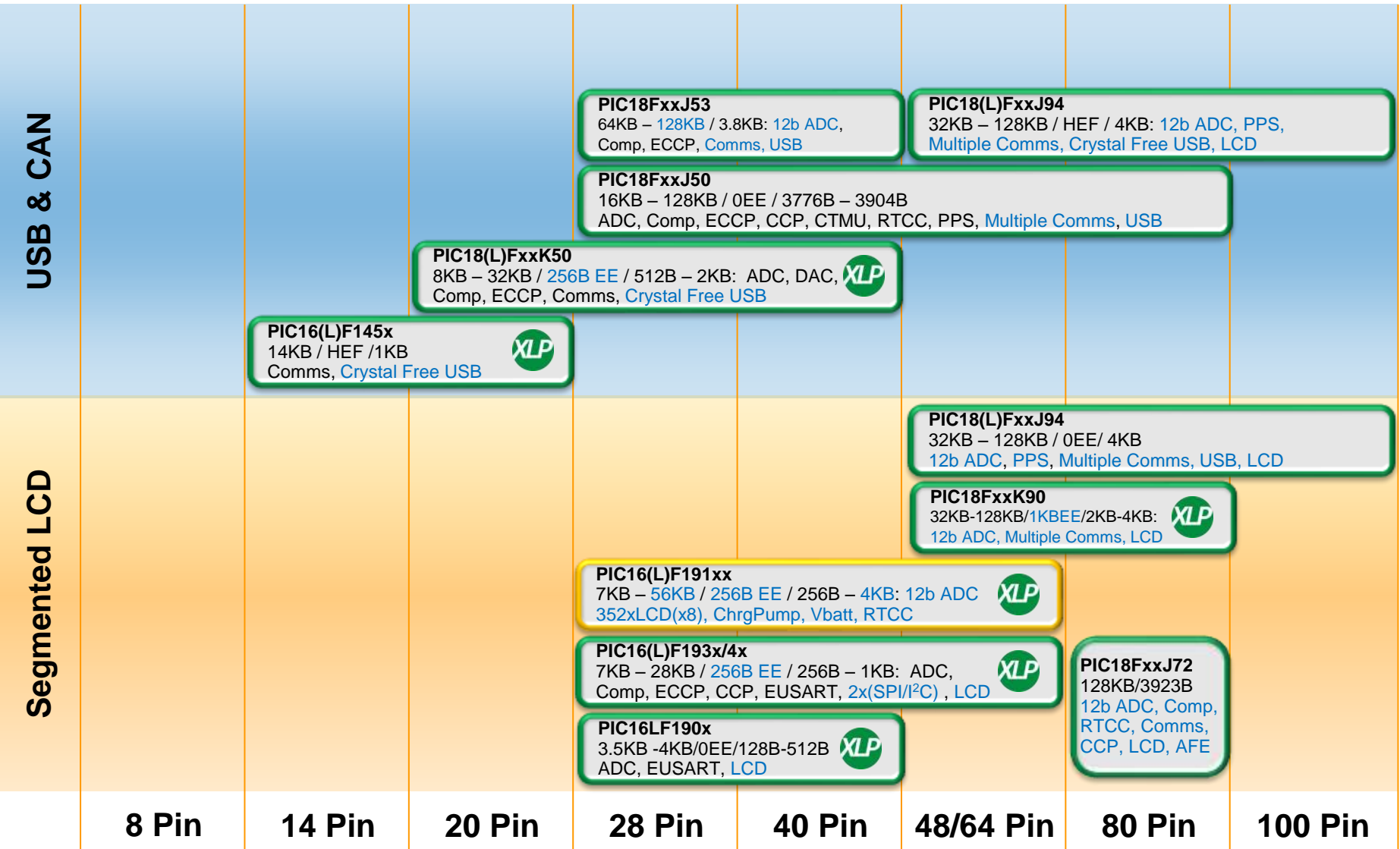
		<b>PIC18(L)FxxJ94 (64/80/100pin)</b> 32KB – 128KB / 0EE / 4KB: <a href="#">12b ADC</a> , Comp, ECCP, CCP, RTCC, CTMU, <a href="#">PPS</a> , <a href="#">4xEUSART</a> , <a href="#">2x(SPI/I<sup>2</sup>C)</a> , <a href="#">USB</a> , <a href="#">LCD</a>	
<b>PIC18(L)FxxK22 (28/40/64/80pin)</b> 8KB – 128KB / 256B – 1KB EE / 512B – 4KB <a href="#">5V</a> , <a href="#">ADC</a> , <a href="#">ECCP</a> , <a href="#">CCP</a> , <a href="#">CTMU</a> , <a href="#">RTCC</a> , <a href="#">2xEUSART</a> , <a href="#">2x(SPI/I<sup>2</sup>C)</a>			<b>XLP</b>
<b>PIC18(L)FxxK40 (28/40/64pin)</b> 16KB-128KB/256B-1KBEE/1KB-4KB: <a href="#">ADC<sup>2</sup></a> , <a href="#">DAC</a> , <a href="#">Comp</a> , <a href="#">PWM</a> , <a href="#">CCP</a> , <a href="#">CWG</a> , <a href="#">HLT</a> , <a href="#">WWDT</a> , <a href="#">CRC</a> , <a href="#">ZCD</a> , <a href="#">PPS</a> , <a href="#">5xEUSART</a> , <a href="#">3x(SPI/I<sup>2</sup>C)</a> , <a href="#">IDLE/DOZE</a> , <a href="#">PMD</a>		<b>Hardware CVD</b>	<b>XLP</b>
<b>PIC1x(L)F177x</b> 7KB – 28KB / HEF / 512B – 2KB: <a href="#">ADC</a> , <a href="#">10b DAC</a> , <a href="#">HSComp</a> , <a href="#">OpAmps</a> , <a href="#">PRG</a> , <a href="#">HLT</a> , <a href="#">16b PWM</a> , <a href="#">ZCD</a> , <a href="#">COG</a> , <a href="#">PPS</a> , <a href="#">DSM</a> , <a href="#">100mA I/O</a> , <a href="#">EUSART</a> , <a href="#">SPI/I<sup>2</sup>C</a>			<b>XLP</b>
<b>PIC16(L)F178x</b> 3.5KB – 28KB / 256B EE / 256B – 2KB <a href="#">12b ADC</a> , <a href="#">5/8b DAC</a> , <a href="#">HSComp</a> , <a href="#">OpAmp</a> , <a href="#">CCP</a> , <a href="#">PSMC</a> , <a href="#">EUSART</a> , <a href="#">SPI/I<sup>2</sup>C</a>			<b>XLP</b>
<b>PIC16(L)F171x</b> 7KB – 28KB / HEF / 512B – 1KB: <a href="#">ADC</a> , <a href="#">5/8b DAC</a> , <a href="#">HSComp</a> , <a href="#">OpAmps</a> , <a href="#">COG</a> , <a href="#">NCO</a> , <a href="#">CCP</a> , <a href="#">PWM</a> , <a href="#">ZCD</a> , <a href="#">CLC</a> , <a href="#">PPS</a> , <a href="#">EUSART</a> , <a href="#">SPI/I<sup>2</sup>C</a>			<b>XLP</b>
<b>PIC16(L)F188xx</b> 7KB-56KB/256BEE/512B-4KB: <a href="#">ADC<sup>2</sup></a> , <a href="#">DAC</a> , <a href="#">PWM</a> , <a href="#">CWG</a> , <a href="#">NCO</a> , <a href="#">HLT</a> , <a href="#">WWDT</a> , <a href="#">CRC</a> , <a href="#">CLC</a> , <a href="#">ZCD</a> , <a href="#">PPS</a> , <a href="#">EUSART</a> , <a href="#">2x(SPI/I<sup>2</sup>C)</a> , <a href="#">IDLE/DOZE</a> , <a href="#">PMD</a>		<b>Hardware CVD</b>	<b>XLP</b>
<b>PIC1xLF156x</b> 14KB / HEF / 1KB <a href="#">Dual ADC</a> , <a href="#">PWM</a> , <a href="#">EUSART</a> , <a href="#">2x(SPI/I<sup>2</sup>C)</a>		<b>Hardware CVD</b>	<b>XLP</b>
<b>PIC16F527/570</b> 1.5KB – 3KB / 64B EE / 68B – 132B <a href="#">ADC</a> , <a href="#">Comparators</a> , <a href="#">OpAmps</a>			<b>XLP</b>
<b>28 Pin</b>	<b>40 Pin</b>	<b>48/64 Pin</b>	<b>80/100 Pin</b>



# 8-bit PIC<sup>®</sup> Microcontrollers

General Purpose Families with *Specialized Features*

<Click on product family for details>





# 8-bit PIC<sup>®</sup> Microcontrollers

## General Purpose Families with *Specialized Features*

<Click on product family for details>

	Pin Count							
	8 Pin	14 Pin	20 Pin	28 Pin	40 Pin	48/64 Pin	80 Pin	100 Pin
Intelligent Analog				<b>PIC16(L)F178x</b> 3.5KB-28KB/256B EE/256B-2KB 12bADC,DAC,HSComp,OpAmp,PSMC				
				<b>PIC1x(L)F176x/7x</b> 7KB -28KB / HEF /512B-2KB ADC,10b DAC, HSComp, OpAmps, PRG, COG, 16b PWM, ZCD,100mA				
				<b>PIC16(L)F170x/1x</b> 3.5KB – 28KB / HEF / 256B – 1KB: ADC, 5/8b DAC, HSComp, OpAmps, COG, ZCD, NCO, PPS, CLC				
	<b>PIC1xF(HV)75x</b> 1.75KB -3.5KB/64B-128B:ADC, 5/9bit DAC, COG, HSComp, OpAmps, SlopeComp,50mA		<b>PIC16F527/570</b> 1.5KB -3KB/64BEE/68B-132B ADC, Comparators, OpAmps					
mTouch				<b>PIC18(L)FxxK40</b> 16KB -128KB/256B-1KBEE/1KB-4KB Large Memory, 5V, IDLE/DOZE				
	<b>Hardware CVD</b>		<b>XLP</b>		<b>PIC16(L)F188xx</b> 7KB – 56KB/256BEE/512B – 2KB Peripheral Rich, IDLE/DOZE			
					<b>PIC16(L)F1512/3</b> 3.5KB – 7KB / 128B – 256B ADC,CCP,2xEUSART,2x(SPI/I <sup>2</sup> C)			
	<b>PIC1xLF155x</b> 3.5KB – 14KB / HEF / 256B – 1KB Dual ADC, PWM, EUSART, 2x(SPI/I <sup>2</sup> C)							
	8 Pin	14 Pin	20 Pin	28 Pin	40 Pin	48/64 Pin	80 Pin	100 Pin





**MICROCHIP**

# **16-bit MCU Update**

[Return to Topics](#)

- **16-bit Sigma-Delta ADC**
  - High dynamic range & high resolution
  - More information (3 $\mu$ V) eliminates need for amplifier
- **12-bit ADC**
  - Ultra-high speed data capture at 10 Msps
  - High speed sensors, touch, communications
- **10-bit DACs**
  - Analog control loops, stereo audio
  - Stimulus or thresholds
- **Operational Amplifiers**
  - Analog control loops, Microphone pre-amp, Signal conditioning
  - 2.5 MHz Gain-Bandwidth, low power mode
- **Internal Analog Connection Switch Matrix**
- **472 Segment LCD Driver with Voltage Boost**



**Part Number:**  
**DM240015**

# PIC24FJ128GB204

## Data Protection for Low Power Applications

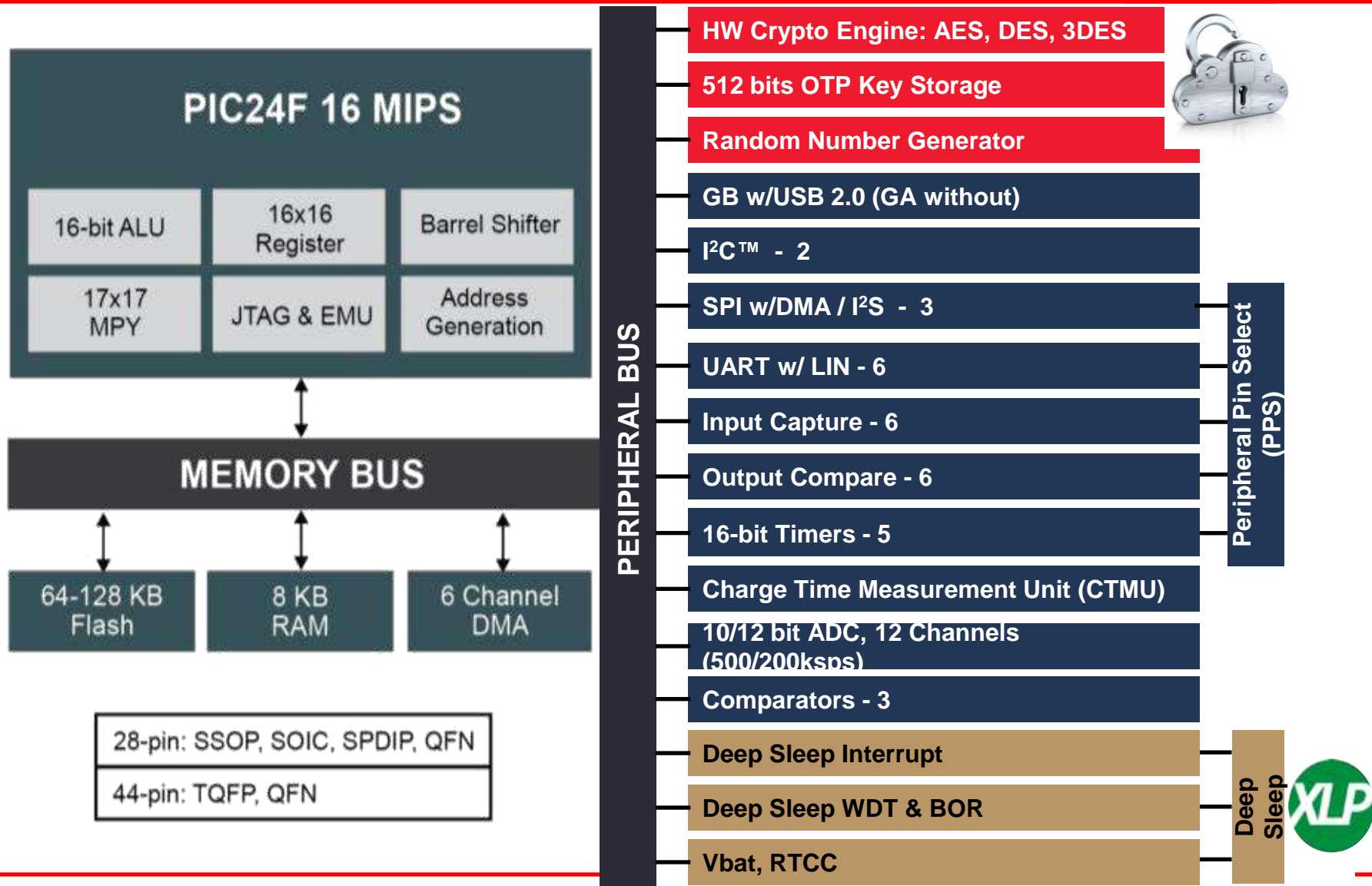
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- **Data Protection in Embedded Applications**
  - Secure Data Transfer & Storage
  - Hardware crypto engine (Industry standard AES, DES, 3DES)
    - Up to 256-bit AES
    - Encryption & Decryption & Authentication
  - Random Number Generator (RNG)
    - Reach a Higher Level of Data Security
    - Reduces Possibility for Hacking
  - One-Time-Programmable (OTP) Key Storage
    - 512 bits OTP Storage
    - Stores up to 4 AES Keys or 8 DES Keys
- **eXtreme Low Power Extends Battery Life**
  - 18 nA Sleep, 200  $\mu$ A/MHz Run
- **Connection to USB or Wireless Protocols**
  - Integrated USB 2.0 Device, Host, OTG
  - Easy Connection to Certified Modules for WiFi, ZigBee, Sub GHz, Bluetooth LE



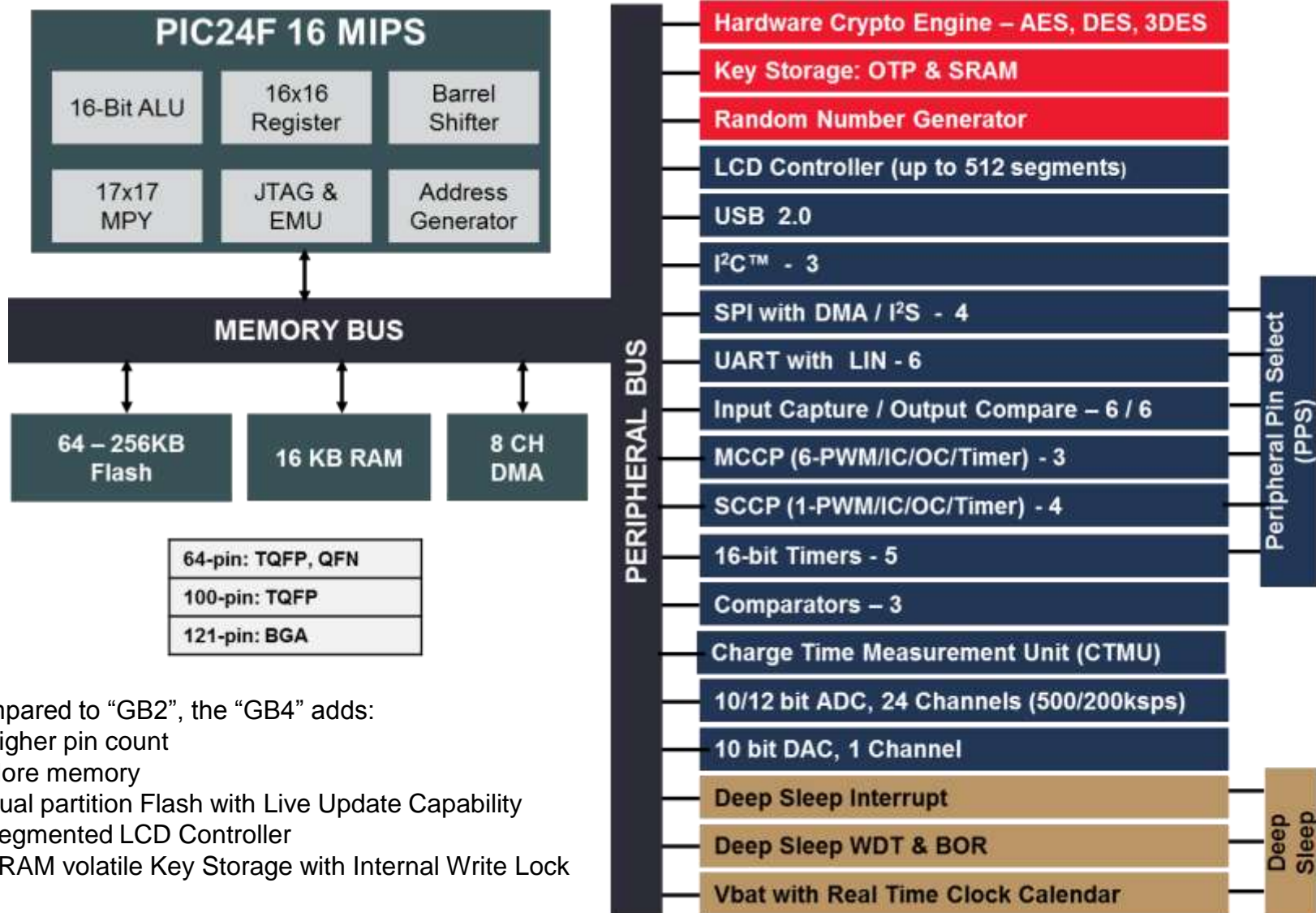
GB204 PIM (USB)  
GA204 PIM (no USB)

# PIC24FJ128GB204 Family Block Diagram





# PIC24FJ256GB412 Family Block Diagram



Compared to “GB2”, the “GB4” adds:

- Higher pin count
- More memory
- Dual partition Flash with Live Update Capability
- Segmented LCD Controller
- SRAM volatile Key Storage with Internal Write Lock



# PIC24FJ1024GA/GB10

## Large Memories

- 1MB ECC Flash and 32KB RAM
- ### Dual Partition Flash w/ Live Update

- Permits execution from one partition while writing to another

## Analog Features

- 24 Ch ADC @ 200ksps
- 3 Analog Comparators
- Charge Time Measurement Unit

## Low Power Modes

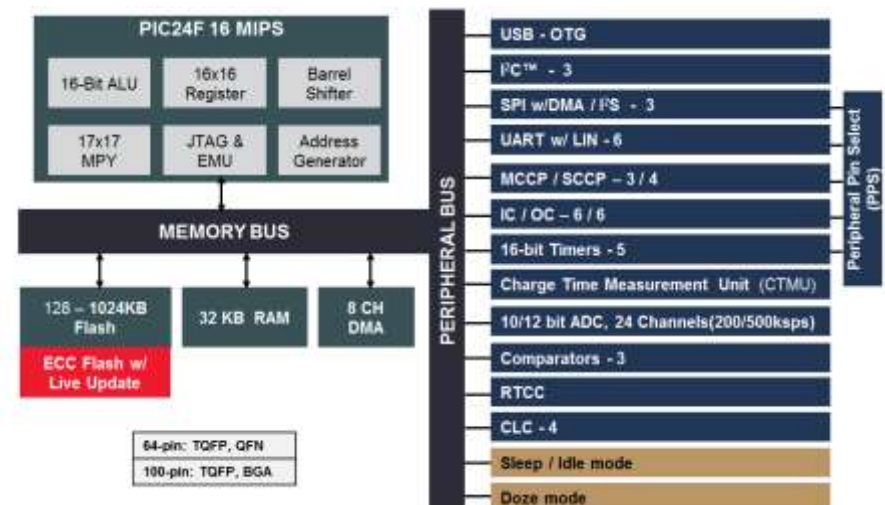
- Run: 190  $\mu$ A/MHz @ 3V
- Sleep: 3.2  $\mu$ A @ 25C

## Packaging

- QFN (8x8mm)

## Applications:

- Electric Meters, Voltage/Current monitor, Process control, user I/F, Data Logger/monitor
- Gaming, Thermostats, HVAC control, Finger print scanner
- Wearable fitness, handheld devices





# dsPIC33EP512M710

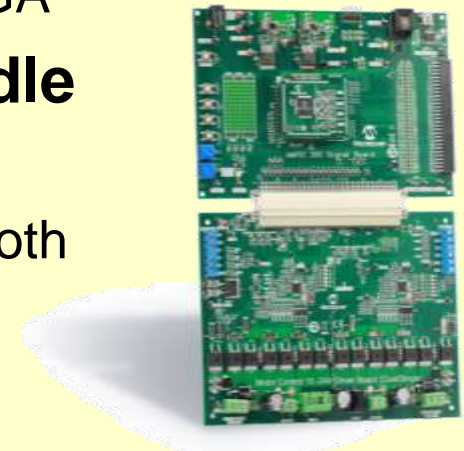
## *Dual Motor Control, Dual CAN, Dual ADC*

- **Key Features**

- 12 motor control PWMs to run 2 motors independently
- Dual ADC – 49 channels – can be independently configured as 10bit (1.1Msps) or 12-bit (500Ksps)
- 4x Integrated Op-Amps – smaller designs w/ lower BOM cost
- PTG – programmable sequencer for scheduling complex sequences of tasks
- 44, 64 and 100 pin – TQFP, QFN and TFBGA

- **Low-Voltage Motor Control Dev Bundle**

- PN: DV330100
- Modular design supports dual motors and both 3V or 5V designs



# dsPIC33EV 5V Family

- **5V Operation for more noise immunity**
- **70MIPS including DSP acceleration**
- **Advanced Peripherals and Integrated Analog**
  - 6 PWMs, Op-Amps and 12b ADC for Motor Control
  - HW CTMU and SW CVD for Sensing Apps (incl. touch)
- **Rich communication peripherals for Automotive**
  - Integrated CAN options
  - First device with SENT module
- **Increased Rel. and Safety**
  - 1<sup>st</sup> DSC w/ ECC Flash
  - Deadman and Windowed WD Timers
  - Up to 150C Q100 Grade 0 for Automotive

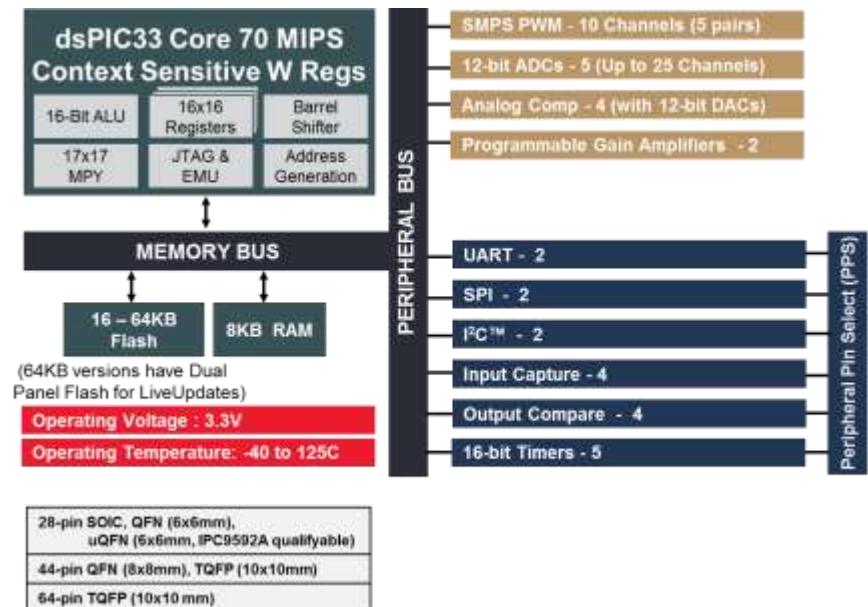


dsPIC33EV 5V CAN-LIN Starter Kit  
(Part # DM330018)



# dsPIC33EP “GS” Series

- **Next gen Digital Power with 70 MIPS (up from 40 MIPS)**
  - dsPIC33EP64GS506 - More memory and pins (up to 64 pins & 64KB Flash)
  - dsPIC33EP32GS203 - Cost Effective Digital Power (28 pins, 16-32KB)
  - Much more competitive in terms for performance and price
- **Flexible Power Conversion**
  - More nonlinear and adaptive algorithms to help optimize energy efficiency (70 MIPS)
- **Target Application**
  - PFC in AC/DC supply, DC/DC power supplies, HID control, UPS
  - Solar inverter, HID ballast, high-end Automotive/Industrial LED lighting, Power over Ethernet, and wireless charging





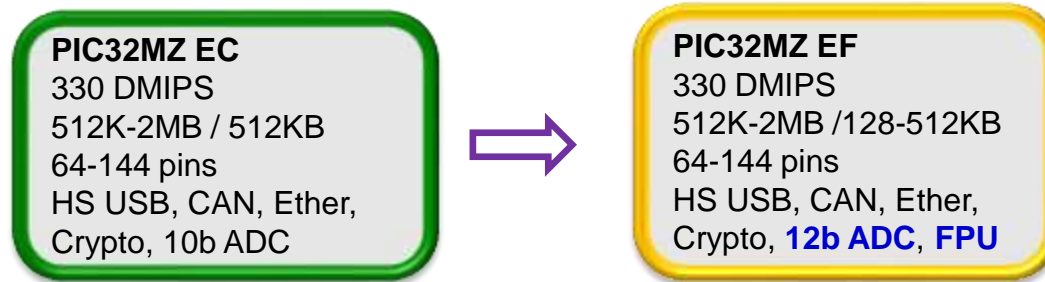
**MICROCHIP**

**PIC32 Update**

[Return to Topics](#)

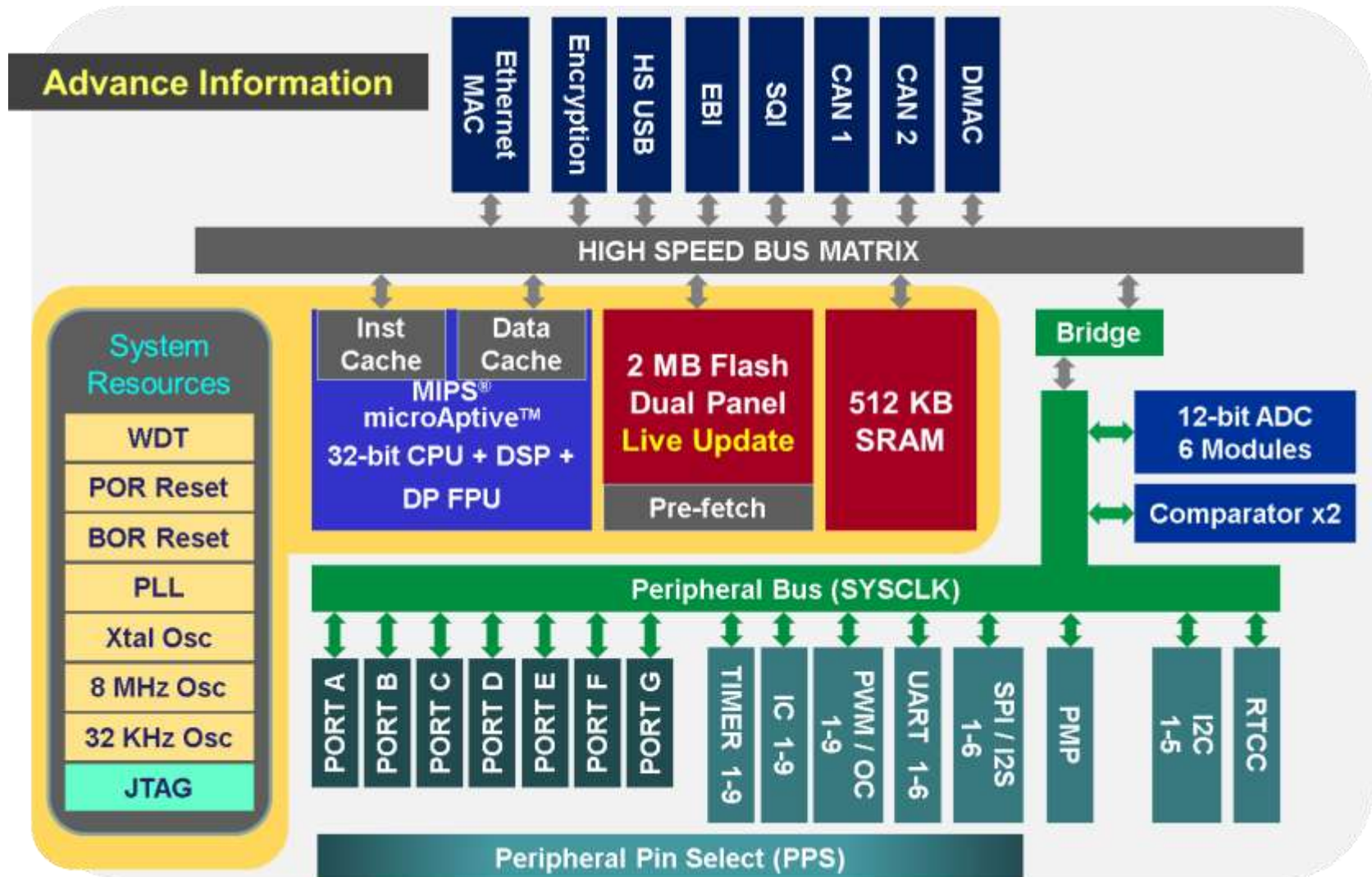
# PIC32MZ EF Update

- PIC32MZE<sup>EF</sup> is an expansion on the PIC32MZE<sup>EC</sup> product line with a **Floating Point Unit (FPU)** and a **12 bit ADC**.



- 100% pin compatible with the PIC32MZE<sup>EC</sup> Portfolio.
- Engineering samples are now in full validation.
  - PIC32MZ EF E-temp A2 Rev

# PIC32MZ EF Family Block





# PIC32MZ EF

## ADC, FPU Highlights

### ADC Features:

- 12-bit / Up to 48 Input Channels
- 18 MSPS through put
  - 5 converters 3.125 MSPS per converter and one shared at 2.94 MSPS
- Typical AC Characteristics
  - Differential Non-linearity  $\pm 1$  LSB
  - Integral Non-linearity  $\pm 3$  LSB
  - Gain Error  $\pm 8$  LSB

### ADC- Benefits:

- Single-ended and/or differential inputs
- Can operate during Sleep mode
- Supports touch sense applications
- Two dedicated ADC modules can be combined in turbo mode to provide double conversion rate (clock sources for combined ADC modules must be synchronous)
- Six digital filters supporting two modes:
  - Oversampling mode
  - Averaging mode

### Floating Point Unit (FPU)- Features:

- Executes 1:1 Core:FPU clock ratio
- Single and double precision IEEE 754 compliant FPU
- Dedicated 7-stage pipeline, operating in parallel with core integer pipeline
- Supports both MIPS32 and microMIPS instructions

### Floating Point Unit (FPU)- Benefits:

- Improves code density and performance on applications that require complex computations.
- Most instructions execute with 1 cycle throughput and 4 cycle latency.

### FPMark Benchmarking Results

Workload	MCU(No FPU)	PIC32MZ(W/FPU)	Ratio (FPU vs NOFPU)
atan-1k	44.32	1062.13	23.97
blacks-sml-n500v20	0.81	1.69	2.09
horner-sml-1k	18.07	419.95	23.24
linear_alg-sml-50x50	1.02	8.45	8.28
loops-all-tiny	3.49	29.23	8.38
radix2-sml-2	50.98	363.31	7.13
xp1px-sml-c100n20	19.44	53.36	2.74
ray-64x48at4s	0.03	0.53	17.67
nnet-data1	4.21	29.56	7.02
Geometric mean of scores	4.04	33.73	8.35

<http://www.eembc.org/fpmark/>



# PIC32MZ EF Family

**200MHz / 330 DMIPS, Up to 2MB Flash / 512KB RAM**

Core	Flash RAM	Packages	Analog Modules	Timing Resources	Communication Modules	External Data Access	Other Modules
MIPS microAptiv™ 200 MHz 330 DMIPS  MMU, DSP, DP FPU, DMA	2 MB 512 KB	64L TQFP 64L QFN 9x9mm 100L TQFP 144L TQFP 144L LQFP 124L VTLA	12-bit ADC 6 Converters @ 4 Msps each 24 - 48 Ch  2 Analog Comparators	9 Timers 9 Input Capture 9 output Compare RTCC	6 UART 4-5 I2C 4-6 SPI / I2S  1 HS USB + PHY 1 10/100 EMAC 0 or 2 ECAN 2.0b	SQI PMP EBI	Hardware Crypto Module  PPS
	1 MB 512KB						
	1 MB 256 KB						
	512 KB 128 KB						

*V1.07 – February 2016*

- Top Bug Fixes
- PIC32MZ DA EA support
- GFX Lib and MHGC
  - “Flashy” GFX Demos
  - WVGA LCCG support
  - External memory support
  - Thumbnail view for screens
- Updates to static drivers
- RTOS support for FPU
- Updates to TCP/IP SSL/TLS
- chipKIT BSPs (2) and demo applications
- Segger emWin Pro library archive
- Pin Diagram and Pin Table Export
- Configuration Import/Export/Move/Copy
- BT SPP demo Display support



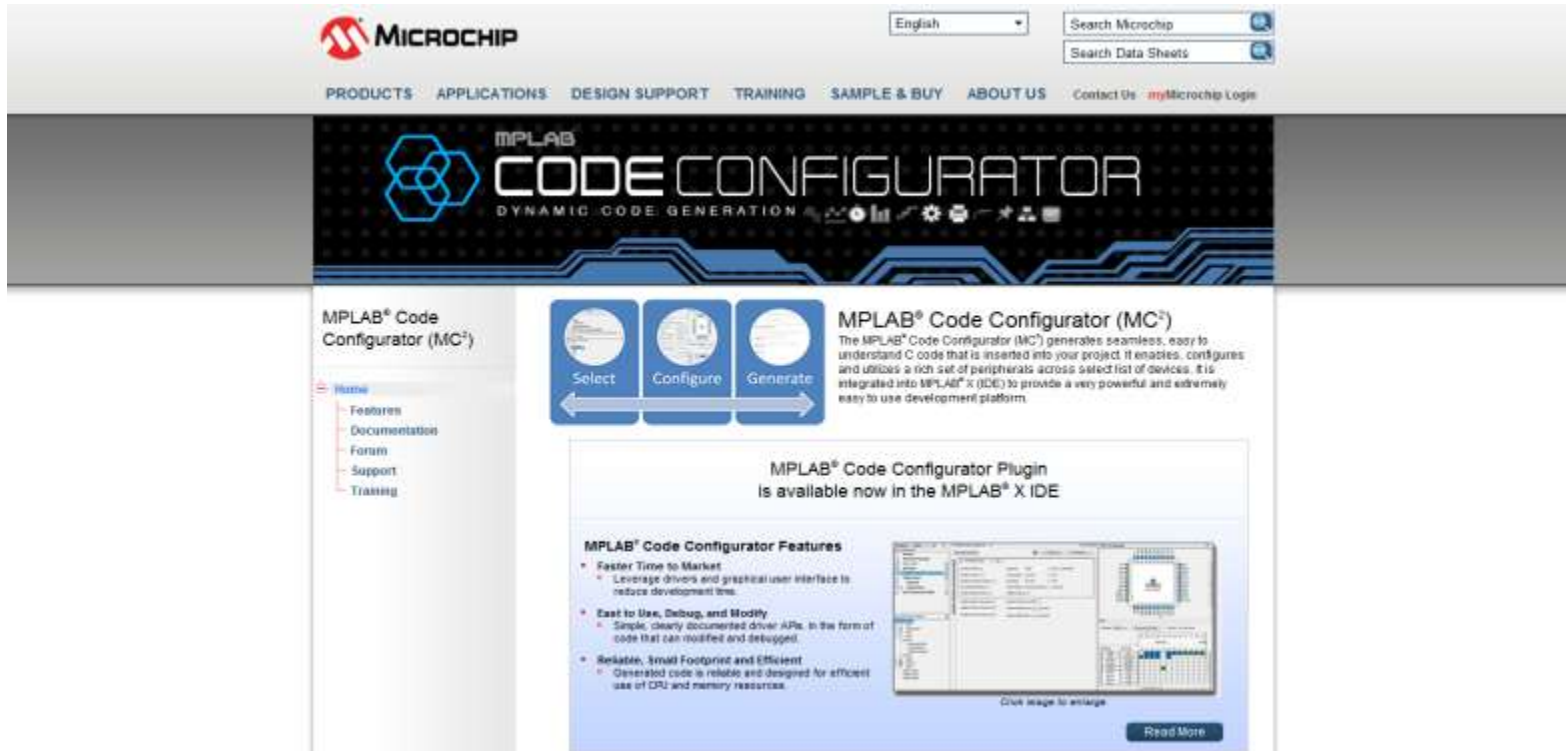


**MICROCHIP**

# **MPLAB® Code Configurator**

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# MPLAB® Code Configurator

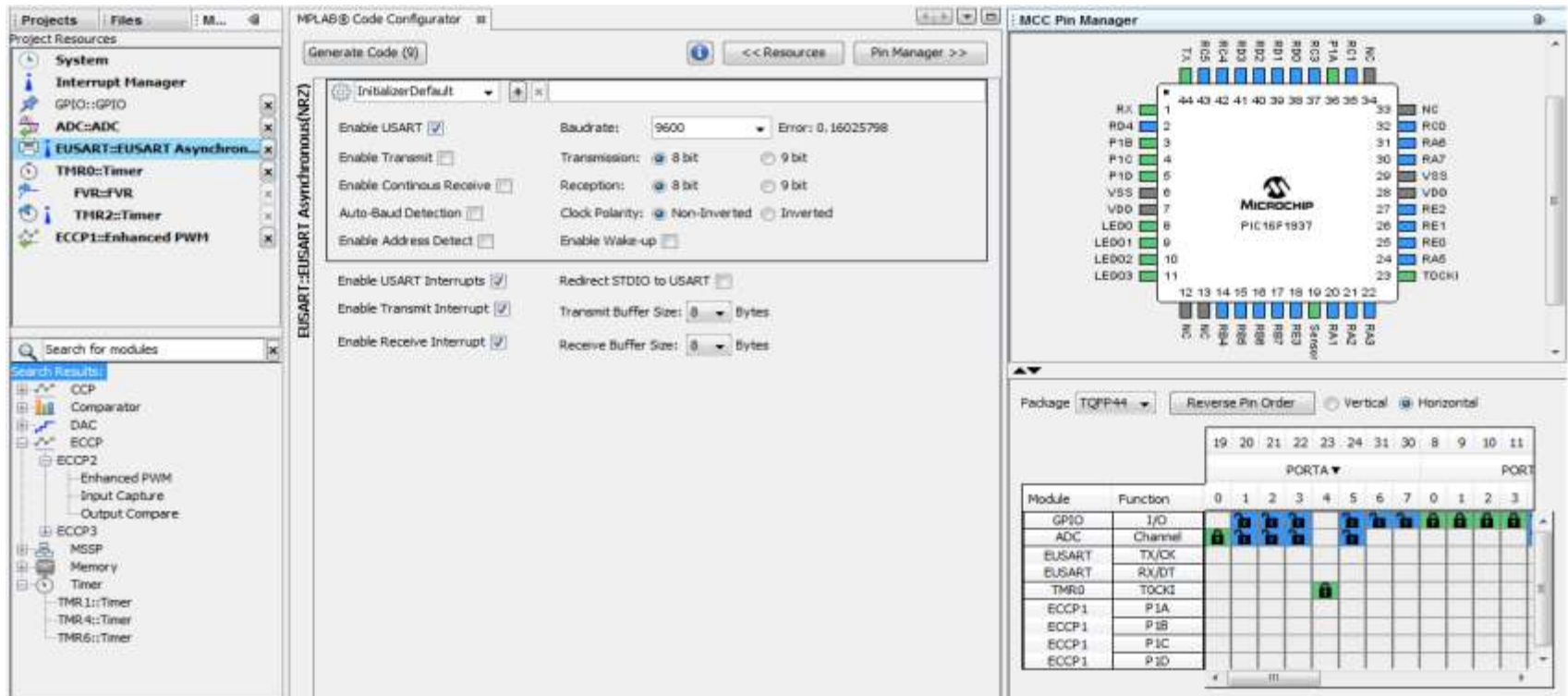


- Innovative new easy to use plug-in tool for [MPLAB® X IDE](http://www.microchip.com/mplabxide)
- Generates seamless, easy to understand drivers and initializers that are inserted into your project
- Easy migration between similar products and peripherals

<http://www.microchip.com/mcc>



# MPLAB® Code Configurator



- Easy to use GUI that dynamically generates code for peripherals, device configurations and I/Os.
- Integrated into MPLAB® X (IDE) to provide a very powerful and extremely easy to use development platform.
- Simplifies the device initialization and helps drastically reduce time to market



**MICROCHIP**

**MCP37231-200**

**High-Speed ADC**

[Return to Topics](#)

# MCP37231 High-Speed A/D

---

- **Lowest power 16-bit ADC at 200Msps**
  - <500mW compared to >1W of other suppliers
- **Among highest accuracy**
  - ~74dB SNR, ~90dB SFDR
  - On-chip decimation filters; additional 2-3 dB improvement
- **High speed mux with fractional delay recovery**
- **Integrated Digital Down-converter (option)**
  - Enables mixing down of sampled input frequency
  - CW beam forming for sonar or ultrasound applications (8-ch mode)
  - Improves system complexity and power usage

# Typical Applications

- **Communications**

- Test equipment
- Base stations
- Broadband wireless
- Antenna array systems



- **Aerospace**

- **Military**

- **Industrial**

- Test equipment

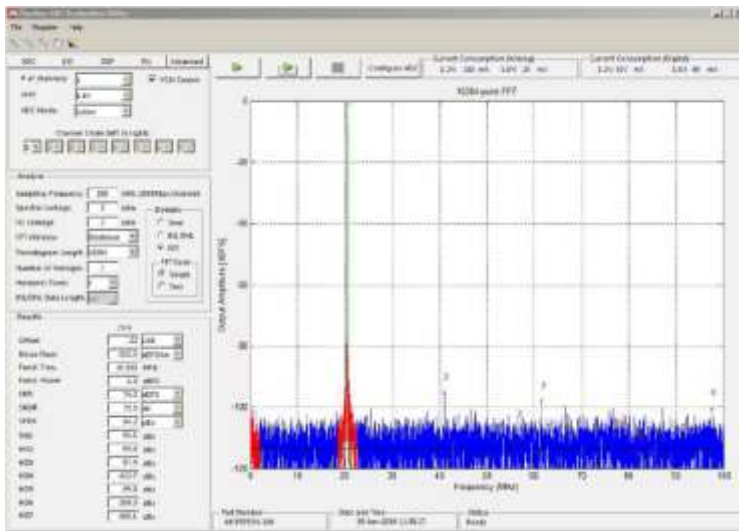
- **Medical**

- Scanners
- Low-integration ultrasound



# MCP37xxx Evaluation Tool

- **MCP37xxx Evaluation Tool**
  - MCP37xxx-200 Evaluation Board (ADM00505)
  - MCP37xxx Data Capture Card (ADM00506)
  - PC Graphical User Interface



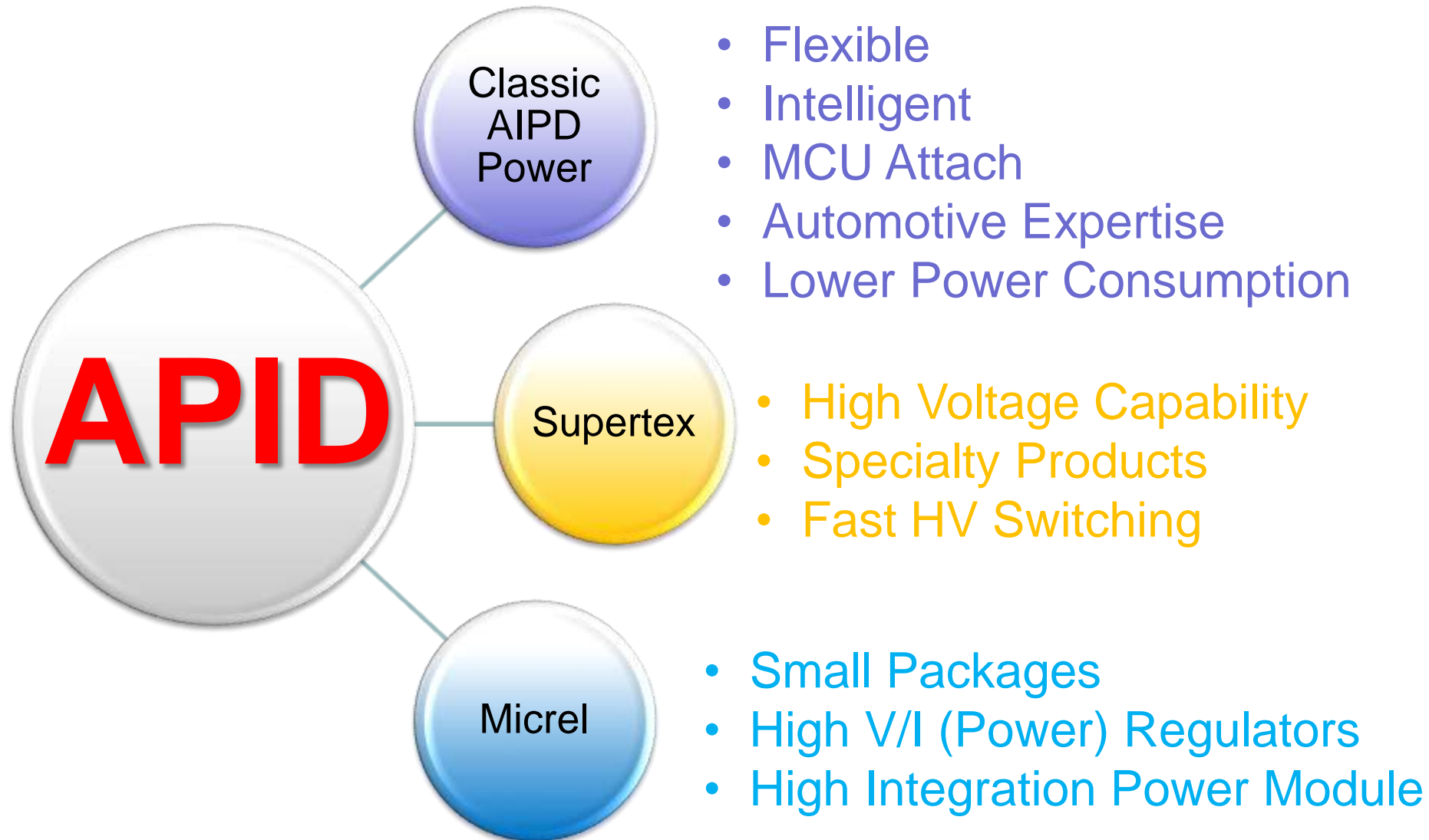


**MICROCHIP**

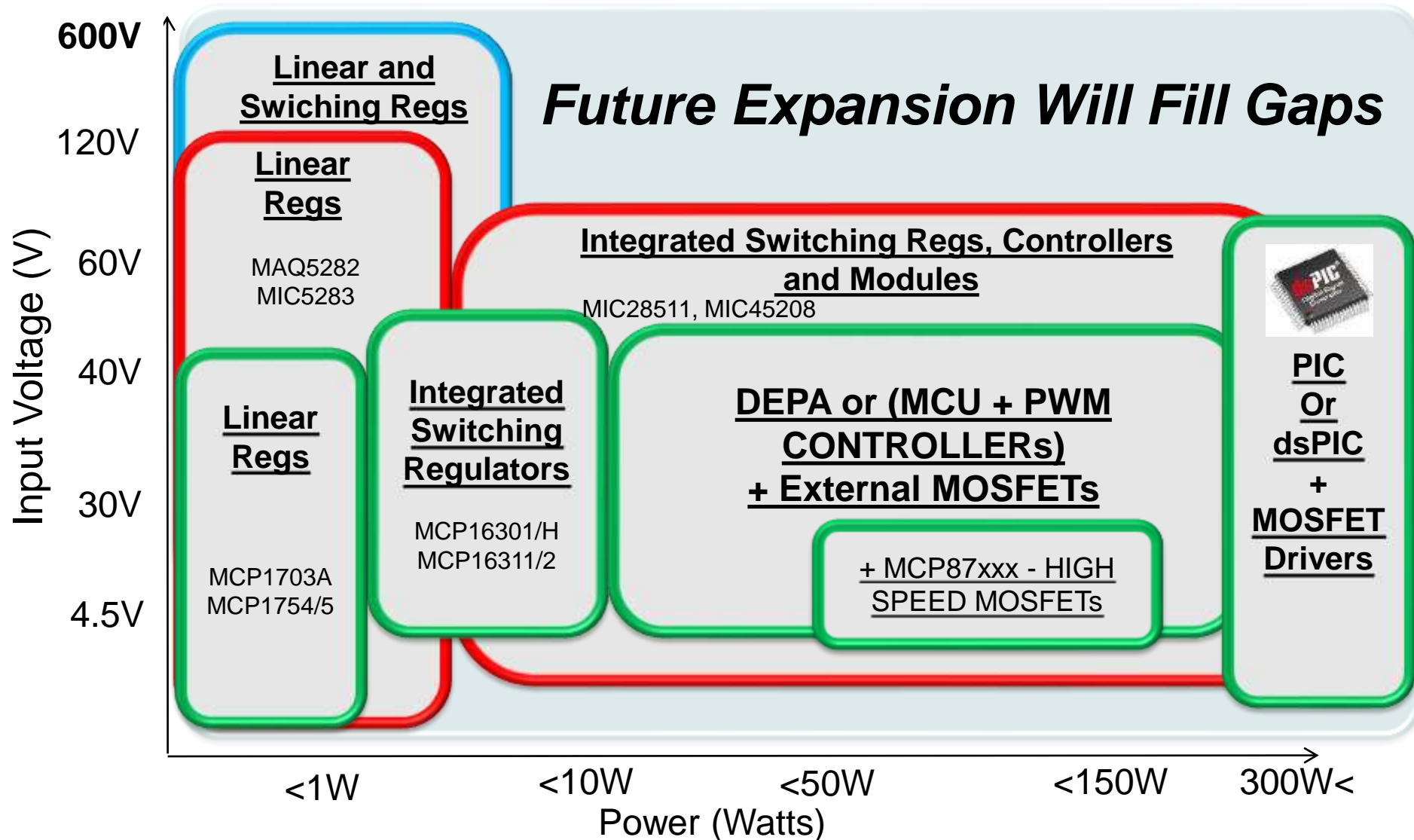
# **Analog Power Products**

[Return to Topics](#)

# Power Analog Portfolio



# Microchip Power Conversion Portfolio



# LDO Product Line Summary

---

- **Micrel LDO strength**

- Up to 120V LDO regulators
- Cost effective high current LDOs
- Known for its 1A, 2A, 3A and 5A LDOs
- Multi-channel LDOs
- Ripple Blockers

- **Classic APID LDO strength**

- Known for its family of low power LDOs
- Broad range of automotive qualified LDOs
- Excellent high performance products



# LDO Portfolio

Type	Max Input Voltage	Ouput Current													
		< 100 mA	~ 150 mA		~ 200 mA		~ 300 mA		~ 400 mA	~ 500 mA		~ 1.0 A	~ 1.5 A	~ 3.0 A	> 3.0 A
		Single	Single	Dual	Single	Dual	Single	Dual		Single	Dual				
Standard Type	5.5 V	MIC5253	MIC536x MIC5301	MIC5310 MIC532x	MIC5367	MIC538x	MIC5504 MIC5303	MIC531x	MIC5325	MIC5524 MIC5319	MIC5355 MIC5356	MIC37120 MIC37122	MIC69151 MIC69153	MIC69301 MIC69302	MIC68400 MIC69502
	6.0 V	TC1070 TC2054	MIC5252 MIC525x TC1186 TC2185	MIC5254	~ 300mA		MIC5249 MIC5318 MCP1824S TC1107		~ 500mA	MIC5353 TC1262 MCP1725		MI3710x MCP1726 MCP1826	MIC35152 MIC3715x MCP1727 MCP1827	MIC3730x MIC47300	MIC3750x MIC49500
	7.0/8.0V	MIC5232													MIC29311
High performance															
Low Iq (<2uA)	-	MIC5231	MCP1711		MCP1810 MCP1703				~ 500mA	MIC47050					
High PSRR (>80dB)	-	MIC5281 MCP1790	MIC5308		MIC94310		MIC5309 MCP1755		~ 500mA	MIC94325		MIC47100			
Small Package	-		MIC536x MCP1711	MIC538x	MIC536x		MIC550x	MIC5399	~ 500mA	MIC5524					
Med Input	12V - 22V	MIC5231 MIC5203	MIC5205 MIC5225 MCP1754		MCP1702		MCP1755			MIC5219 MIC5209		MIC3910x	MIC3915x	MIC2931x MIC3930x	MIC2951x MIC3950x
High Input	>24V	MIC528x MIC5233 MCP1790	MIC528x ** MIC295x MCP1804		MIC2954				MIC2920x	MIC5239		MIC294xA	MIC2915x	MIC2930x	MIC2950x MIC2975x

# Switching Regular Product Line Summary

---

- **Micrel switching regulator strength**

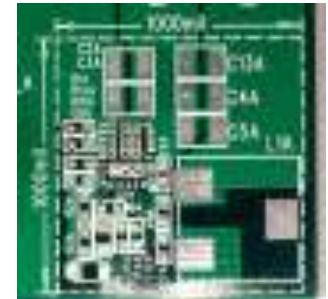
- Higher voltage and current capability
- Higher switching frequency allows small inductor designs
- Multi-phase and Multi-channel switching regulators

- **Classic APID switching regulator strength**

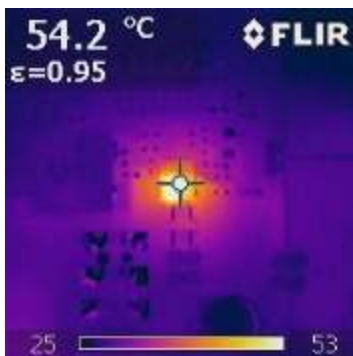
- Built-in Intelligence
- Optimized, High-efficiency power conversion
- Low power, low startup voltage regulators

# High Efficiency and High Power Density Switchers

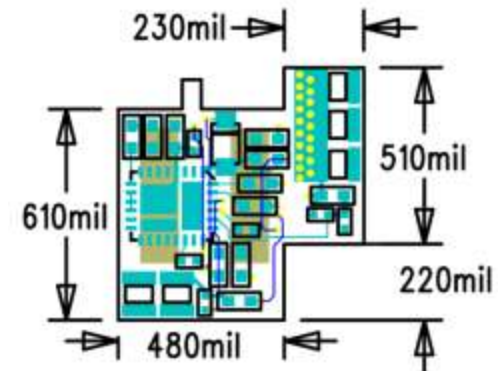
- Support up to 12A in Small Power Package
- Lower System Cost
- Easy Design
- Excellent Thermal Performance
- High Efficiency



1"X1" size on single side PCB

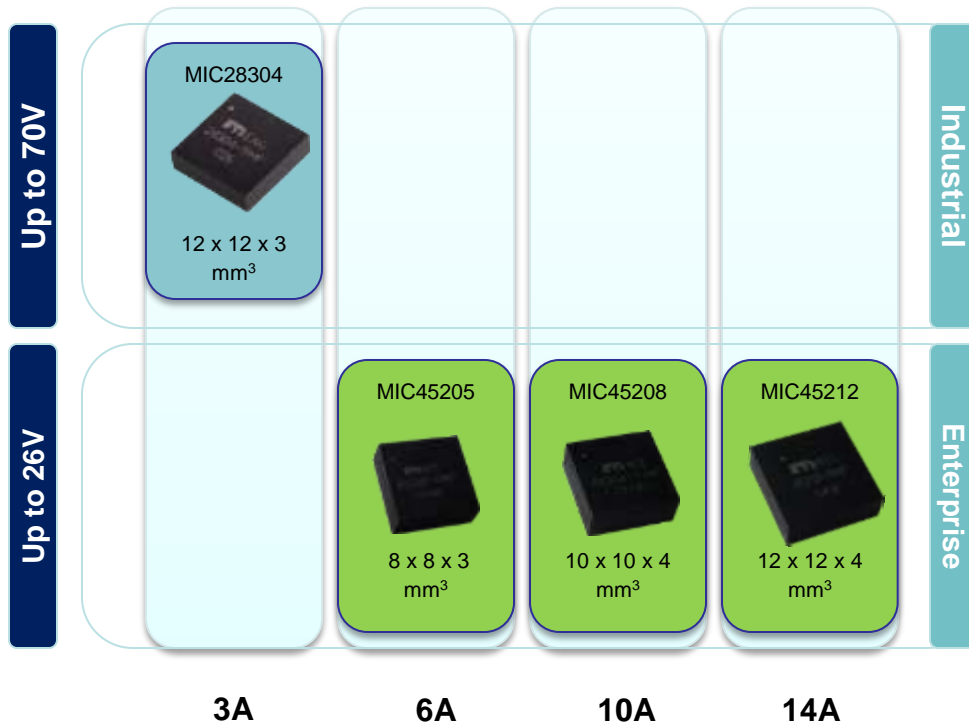


12V to 1V, 12A at 600KHz  
Room Temp, No Airflow  
MIC24056 raise only 27°C at 12A



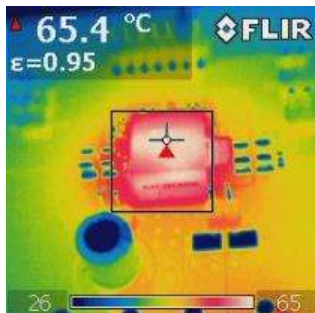
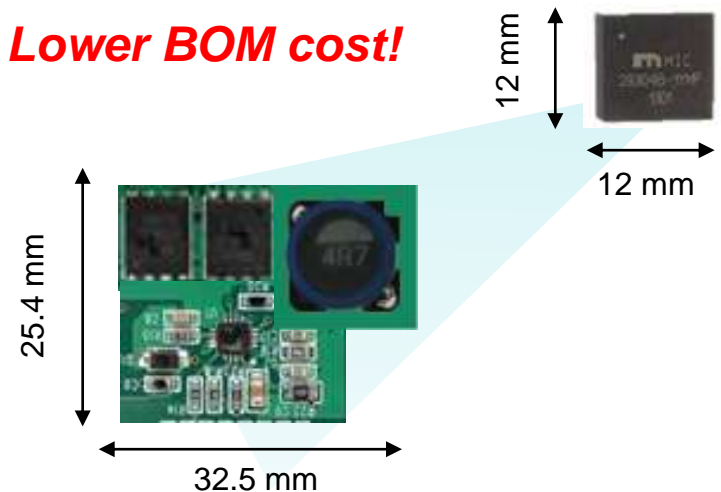
0.41 in<sup>2</sup> size on  
double side PCB

# Fully Integrated Power Modules



Simple Land Patterns Optimized for Thermal Performance and Eliminates Assembly Issues

**Lower BOM cost!**



**Superior Thermal Performance!**

**Excellent EMI Performance!**



# MIC45116 20V, 6A Power Module

## Features:

### Ease of use Integrated Power Module

- Integrated Controller, MOSFETs and Power Inductor 
- Reduces external component count
- Fixed 600kHz Switching Frequency
- > 93% Efficiency capable
- 0.8V to .85xVin Output Voltage Range
- -40°C to +125°C Junction Temp
- HyperLight Load Mode - MIC45116-1
- Hyper Speed Mode – MIC45116-2

### Packaging

- QFN (8x8mm)

### Evaluation Board

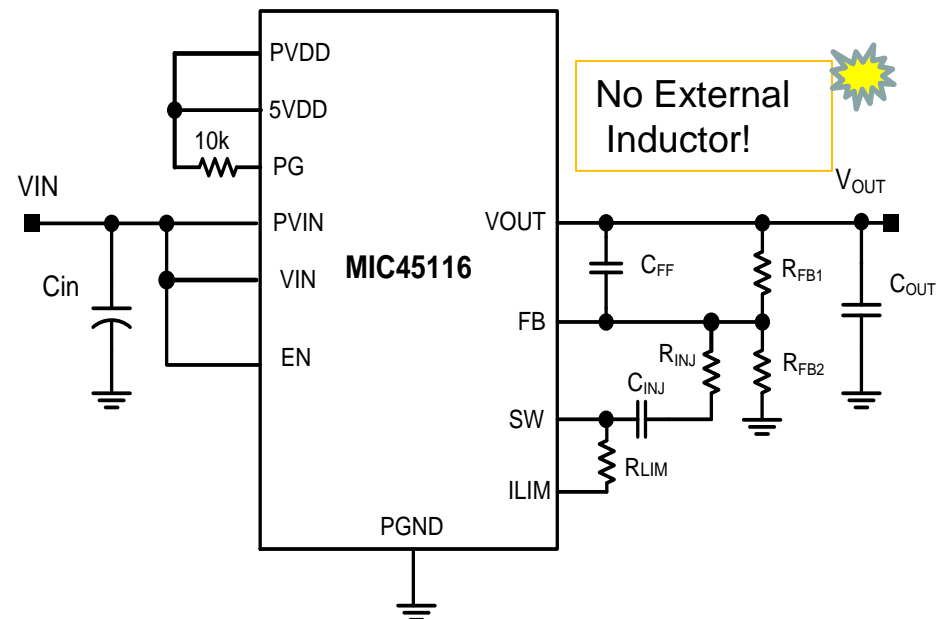
- MIC45116-1YMP EV
- MIC45116-2YMP EV

## Applications:

- Telecom
- Networking Switches & Routers
- DC – DC Power Distribution

### High Power Density Applications!

- FPGAs, Processors, Industrial





# MIC45404

## 19V/5A Ultra-Low Profile DC to DC Power Module

### Features:

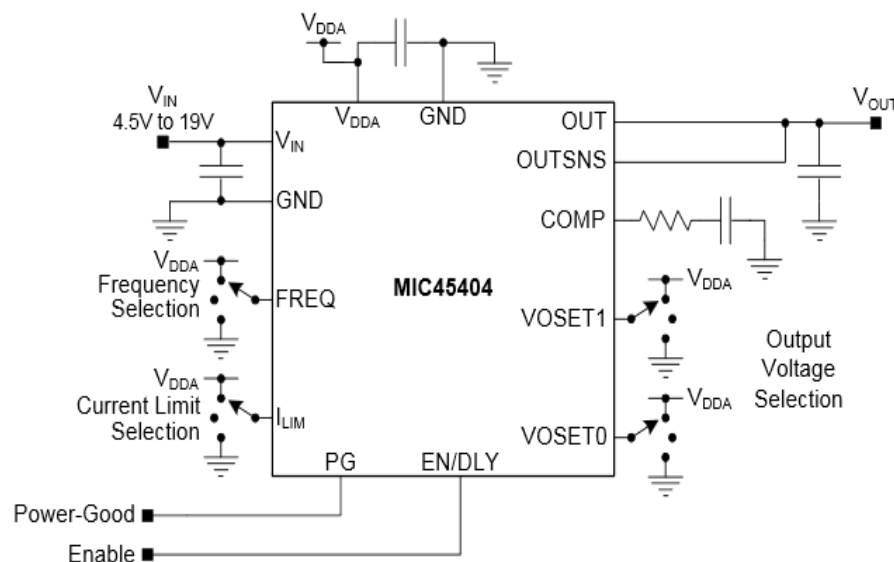
- Wide Input Supply Voltage: 4.5V-19V ★
- Output Current: Up to 5A
- Pin-Selectable Output Voltages: 0.7V-3.3V
- Supports Pre-Biased Start-up ★
- 82% Peak Efficiency at 12Vin, 0.9Vout ★
- Internal Soft Start
- Thermal Shutdown
- -40C to 125C Junction Temperature ★

### Packaging

- 54L QFN (6x10mm)

### Applications:

- FPGAs, Low-Voltage ASIC Power
- Telecom
- Network Switchers and Routers
- Server Storage
- DC Power Distribution
- Solid State Drives



MIC45404 12V 5A DC-to-DC Converter

# MIC24046 19V, 5A Switching Reg.

## Features:

### Ease of use Switching Regulator

- Integrated Controller, MOSFETs and Feedback Resistors
- Pin Programmable:  $V_{OUT}$ ,  $F_{SW}$ ,  $I_{OUT}$  Limit
- 9 programmable  $V_{OUT}$  settings
- 3 Switching Frequency Options
- 3 Current Limit Options
- Reduces external component count
- -40°C to +125°C Junction Temp

### Packaging

- QFN- 20 (3x3mm)

### Evaluation Board

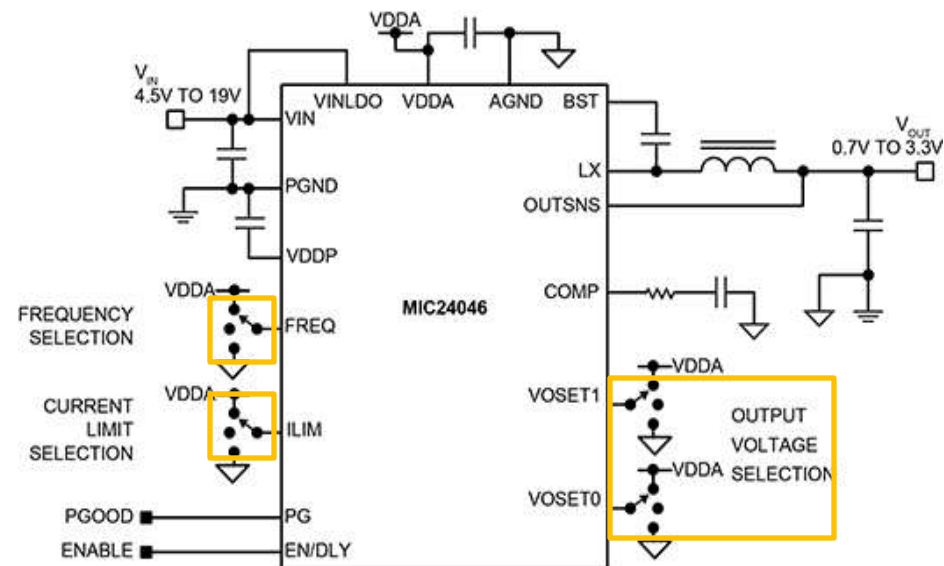
- MIC24046YFL EV

## Applications:

- Telecom
- Networking Switches & Routers
- DC – DC Power Distribution

### High Power Density Applications!

- FPGAs, Processors, Industrial

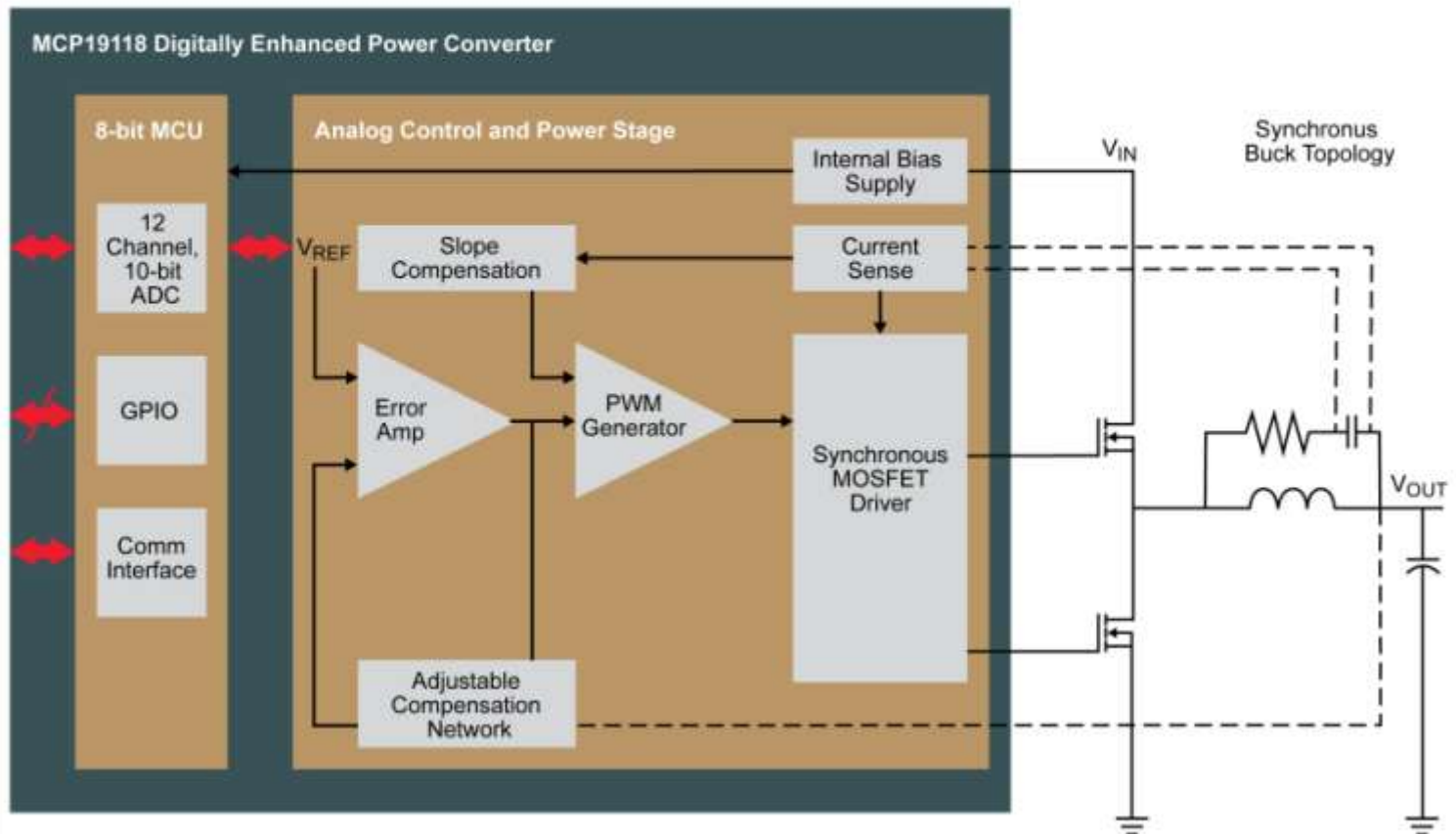


# Hybrid Controllers

---

- **UNIQUE: Analog Performance with Digital Flexibility!**
- **Excellent Transient Performance**
  - Responds quickly to step-changes in current
- **Digital Interface**
  - Offering COMMUNICATION and CONFIGURABILITY!
- **Wide Input Voltage Operating Range**
- **Integration → Small & Standalone**
  - Analog PWM Controller, MCU, Synchronous MOSFET Driver, and bias LDO

# Simplified Block Diagram MCP19119





# MCP19118/9 and the Digitally Enhanced Power Analog Portfolio

NEW!

	MCP19114/5	MCP19110/1	MCP19118/9
Integrated PIC™ MCU	Yes	Yes	Yes
Power Topologies Supported	Boost, SEPIC, Ćuk, Sync Flyback	Sync Buck	Sync Buck
Input Operating Voltage	4.5 – 42V	4.5 - 32V	<b>4.5-40V</b>
Output Voltage	1V – 200V*	0.6V – 90%* $V_{IN}$	0.6V – 90%* $V_{IN}$
Compensation Network	External	Internal	Internal
Switching Freq	32kHz – 2MHz, Quasi-Resonant Mode	100kHz – 1.6MHz	100kHz – 1.6MHz
Flash Memory	4kW	4kW	4kW
Communication Interface	I <sup>2</sup> C	I <sup>2</sup> C, PMBus™ Compliant	I <sup>2</sup> C, PMBus™ Compliant
GPIO Available	Yes (10 / 12)	Yes (10 / 14)	Yes (10 / 14)

\* With resistive divider network for voltage feedback signals



# MCP1501 High-Precision Voltage Reference

## Features:

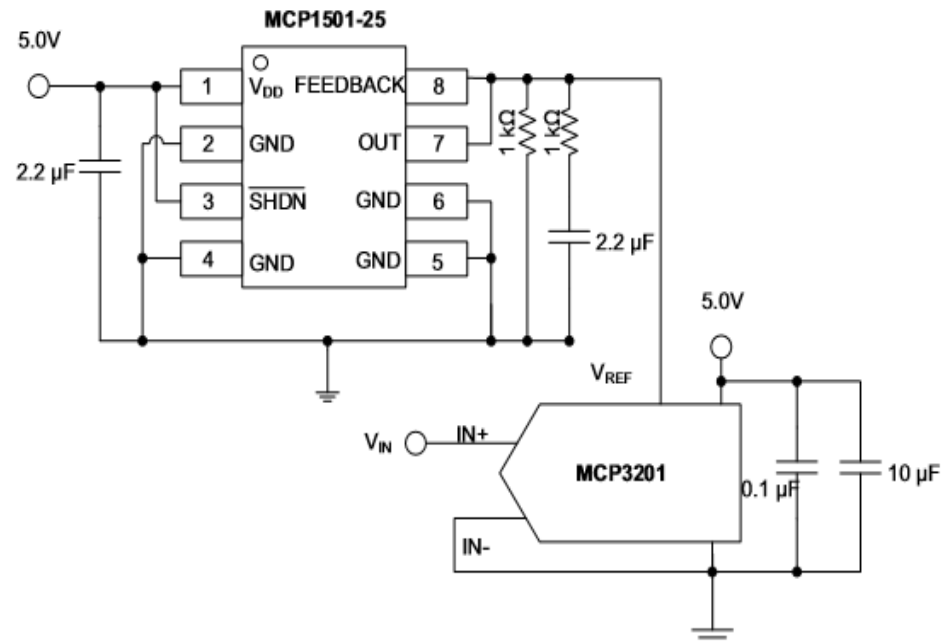
- Initial accuracy: 0.08% ★
- Temperature coefficient: 10ppm/C typical and 50 ppm/C max
- Line regulation: 50ppm/V
- Load regulation: 40-70ppm/mA
- Output noise: <20uVp-p ★
- Shutdown operating current: 205nA
- Source/sink: 20mA
- 8 voltage options: 1.024V, 1.25V, 1.8V, 2.048V, 2.5V, 3V, 3.3V, 4.096V ★
- -40C to +125C Junction Temp

## Packaging

- 8L (2x2mm) WDFN, 6L SOT-23, 8L SOIC

## Applications:

- Data acquisition systems
- Medical equipment
- Industrial Controls
- Sensor Conditioning
- Portable instrumentation
- Precision Reference for standalone ADC





# PAC1921 High-Side Power/Current Sensor

## Features:

- Configurable Measurement Type Output: Power, Current, or Bus Voltage ★
- Configurable Voltage Output(3V, 2V, 1.5V, 1V)
- Power Measurements provided to microcontroller with ADC inputs ★
- Second Order Delta-Sigma ADC with 11bit or 14 bit resolution ★
- Selectable current gain: 1X-128X
- 2 Wire digital, I2C compatible
- Bus range 0V-32V ★
- Power Supply: 3V-5.5V

## Packaging

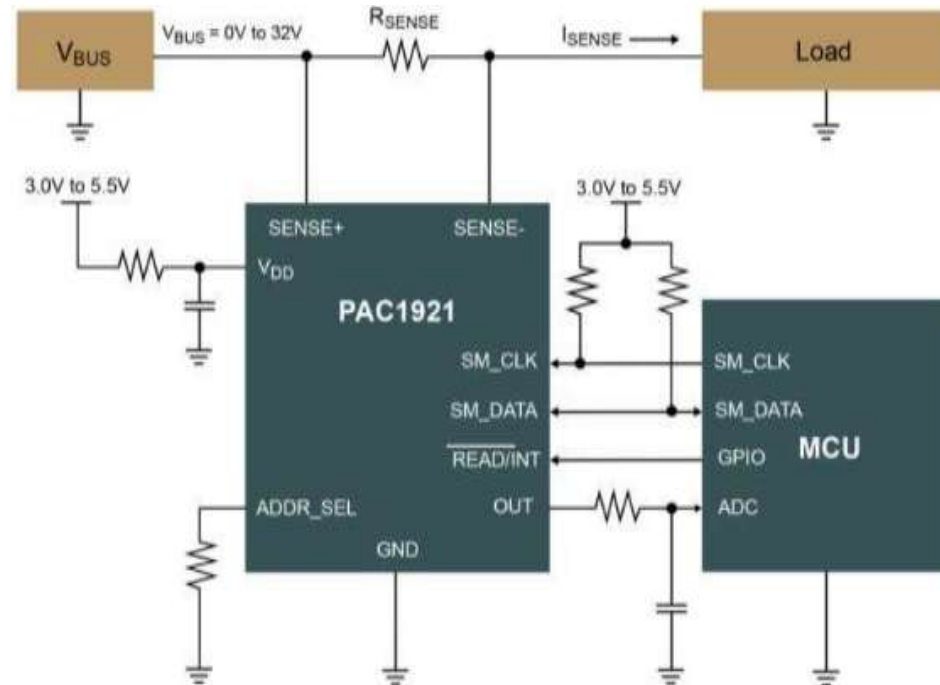
- 10L VDFN (3x3mm)

## Evaluation Board

- ADM00592

## Applications:

- Networking
- Power Supplies
- Servers
- Industrial Automation
- Power Distribution





# MCP14A0153/4/5

## Single Low Side Mosfet Driver

### Features:

- High Peak Output Current: 1.5A
- Wide Input Supply Voltage: 4.5V-18V
- Low Shoot-Through/Cross Conduction Current ★
- High Capacitive Load Drive Capability - 1000pF in 11.5ns ★
- Low Voltage Threshold Input(0.8V-2V) ★
- Latch-up Protected: Withstands 500mA reverse current

### Packaging

- 8L MSOP/SOIC, 8L TDFN (2x3mm)

### Applications:

- Switch Mode Power Supplies
- Pulse Transformer Drive
- Line Drivers
- Level Translator
- Motor and Solenoid Drive





# MCP39F521

## Single-Phase Power Monitoring IC with I2C Interface

### Features:

- Power Monitoring Accuracy of 0.1% ★  
Error Across 4000:1 Dynamic Range
- Dedicated Zero Crossing Detection (ZCD) pin ★
- Built-in Calculations ★
  - Active, Reactive, Apparent Power
  - True Root Mean Square(RMS) Current, RMS Voltage
- Low-Drift Internal Voltage Reference 10ppm/C
- I2C Interface, up to 400kHz
- -40C to 125C Junction Temperature

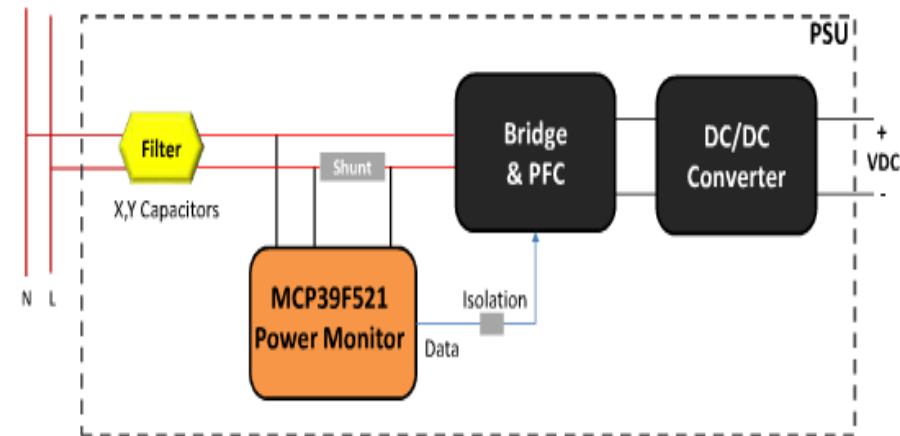
### Packaging

- 28L QFN (5x5mm)
- Demo Board ADM00686

### Applications:

- Home Automation Power Monitoring
- Industrial Lighting Power Monitoring
- Real-Time Input Power Measurement of AC/DC Supplies
- Intelligent Power Distribution Units
- DC Power Distribution
- Solid State Drives

1- $\Phi$  Power





# MCP39F511N

## Single-Phase Power Monitoring IC with Neutral Monitoring

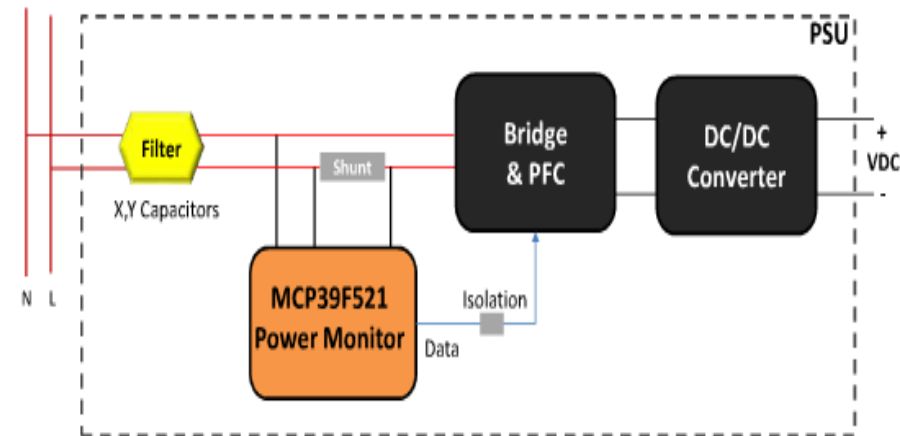
### Features:

- Power Monitoring of Two Loads ★
- Capable of 0.5% error across 4000:1 dynamic range
- Built-In Calculations: ★
  - Active, Reactive, Apparent Power
  - True RMS Current, RMS Voltage
  - Line Frequency, Power Factor
- Dedicated Zero Crossing Detection (ZCD) Pin ★
- Dedicated PWM Output Pin
- Low-Drift Internal Voltage Reference: 10 ppm/°C typical
- 28-lead (5x5mm) QFN package
- Extended Temperature Range -40°C to +125°C
- Demo Board ADM00706

### Applications:

- Home Automation Power Monitoring
- Industrial Lighting Power Monitoring
- Real-Time Input Power Measurement of AC/DC Supplies
- Intelligent Power Distribution Units
- DC Power Distribution
- Solid State Drives

1- $\Phi$  Power





**MICROCHIP**

# **Digitally-Enhanced Power Analog Controllers**

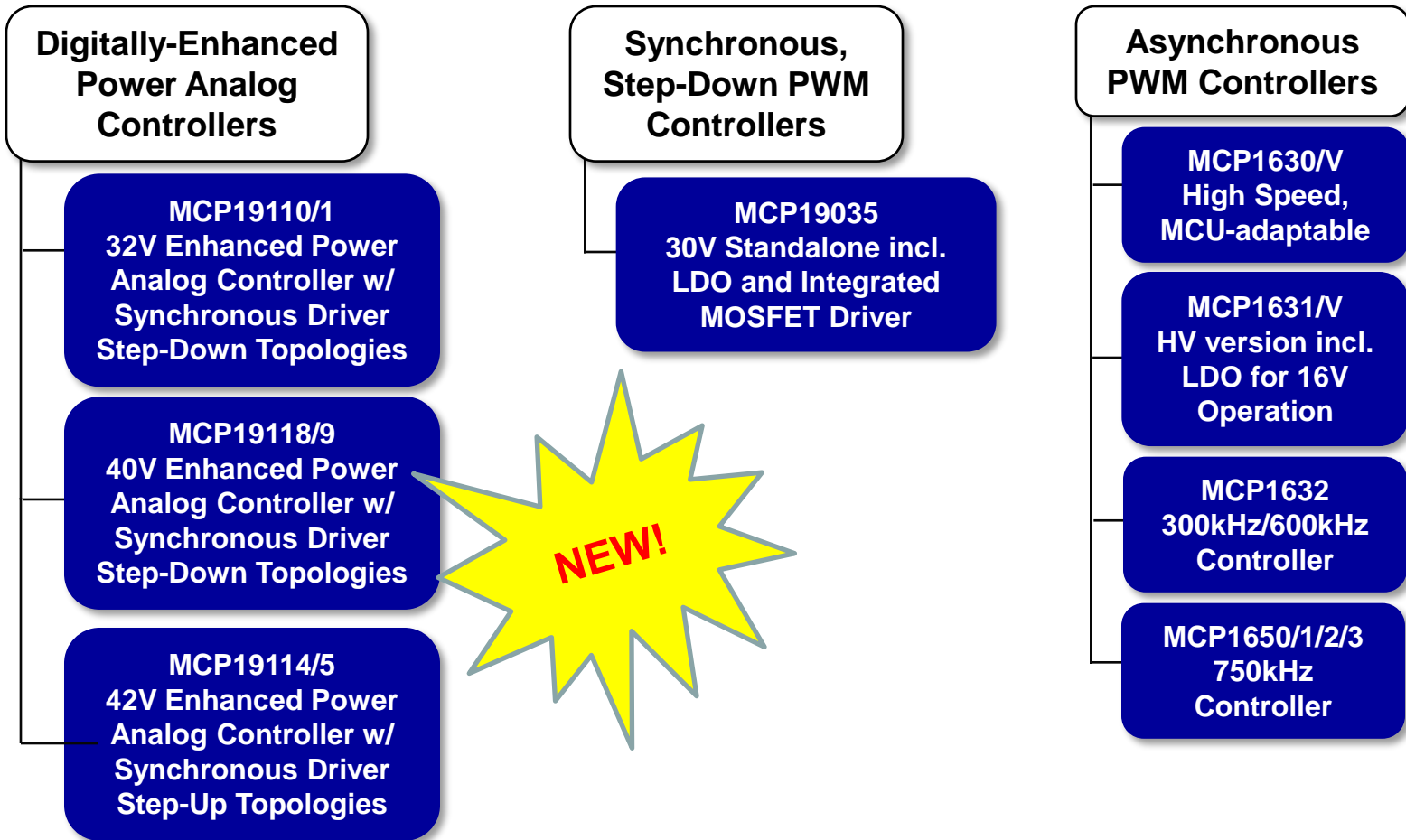
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# Hybrid Controllers

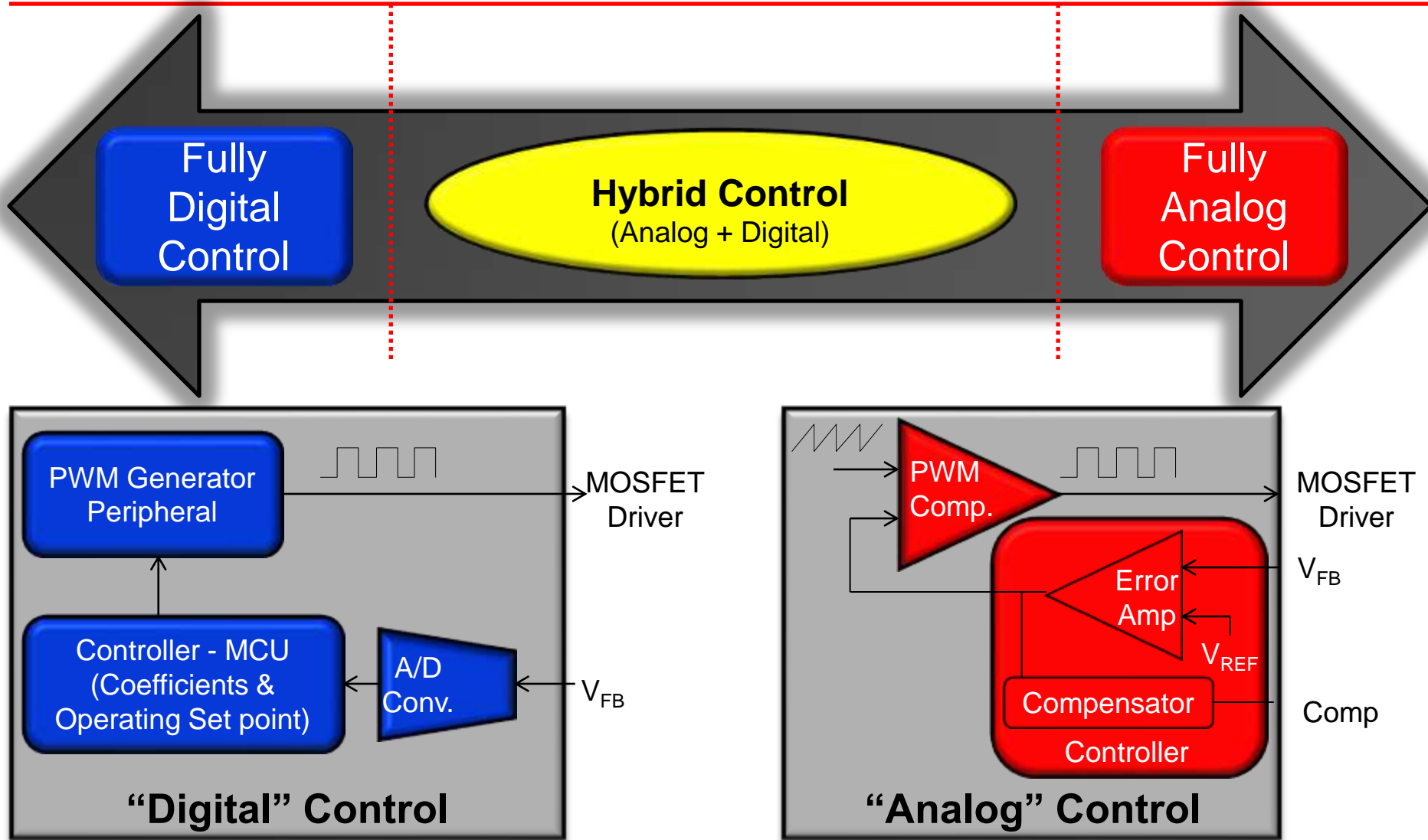
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- **UNIQUE: Analog Performance with Digital Flexibility!**
- **Excellent Transient Performance**
  - Responds quickly to step-changes in current
- **Digital Interface**
  - Offering COMMUNICATION and CONFIGURABILITY!
- **Wide Input Voltage Operating Range**
- **Integration → Small & Standalone**
  - Analog PWM Controller, MCU, Synchronous MOSFET Driver, and bias LDO

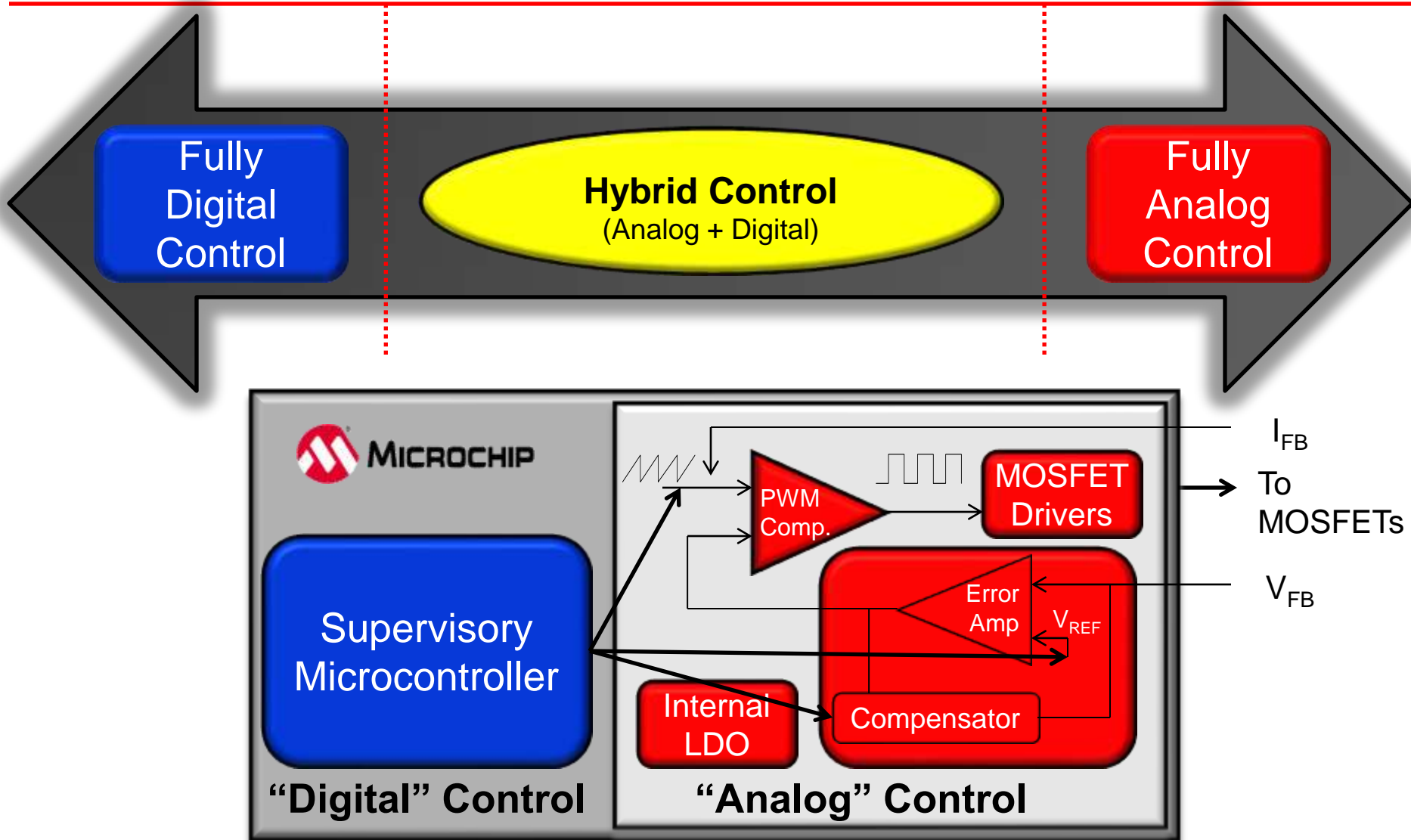
# Digitally-Enhanced and PWM Controllers



# What is Digitally-Enhanced Power Analog?



# What is Digitally-Enhanced Power Analog?



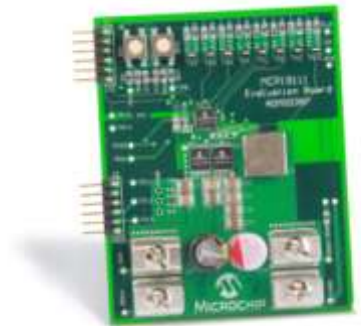
# Analog Performance with Digital Flexibility

---

- **Excellent Transient Performance**
  - Responds quickly to step-changes in current
- **Digital Interface**
  - Offering COMMUNICATION and CONFIGURABILITY!
- **Wide Input Voltage Operating Range**
- **Integration → Small & Standalone**
  - Analog PWM Controller, PIC™ MCU, Synchronous MOSFET Drivers, and bias LDO, Low-Side Controller

# Typical Applications

- Power Supplies, Point-of-Load
- Power Supply Modules
- USB Power
- Battery Chargers
- LED Drivers



MCP19111 Evaluation Board  
(Part # ADM00397)



# Embedded Power Conversion

- **Embedded Power Conversion**

- $V_{IN} = 12V_{DC}$
- $V_{OUT} = 1.2V_{DC} @ \sim 25A$
- Target Market: Networking/Server

- Core Value:

- Configurability over I<sup>2</sup>C™/PMBus™ communication interface
  - Supports late-stage design changes, manufacturability, and adjustments due to field-reliability data
- Adjustable, on-the-fly, compensation supports component aging.



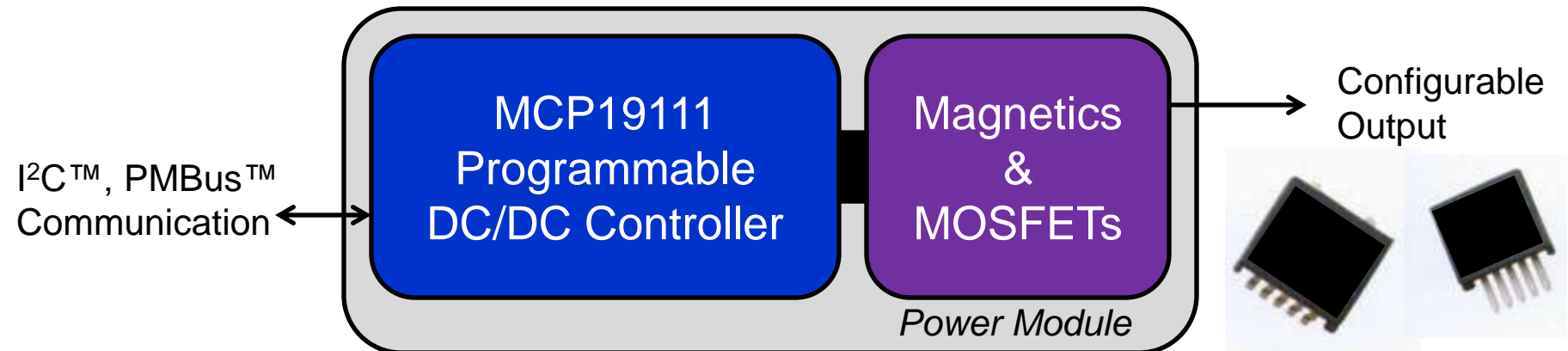
# Power Module

- **Fully-Integrated Power Module IC**

- $V_{IN} = 5-24V_{DC}$
- $V_{OUT} = 0.8 - 5V_{DC}$
- Target Market: Drop-in Power Conversion

- Core Value:

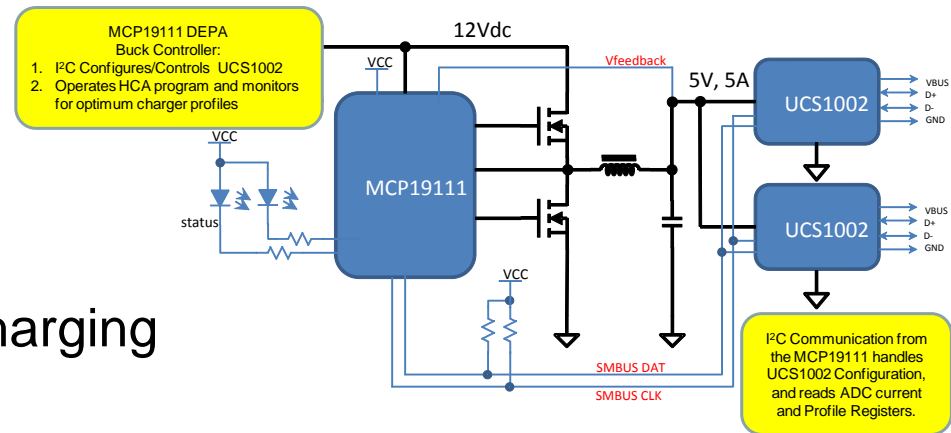
- Optimized Inventory Management, Single-stock item programmed per end-customer specification.



# USB Power Port

## • USB Power → MCP19111 + UCS1002

- $V_{IN} = 12V_{DC}$
- $V_{OUT} = 5V @ \sim 5A$
- Target Market:
  - Automotive, USB-Charging



- Core Value:
  - UCS1002 offers USB Charger Emulation, including a programmable Emulation profile for solution 'future-proofing'
  - MCP19111 generates USB-compliant 5V supply, and its fully-programmable MCU can store additional Charger Emulation Profiles which are communicated to the UCS1002 via SMBus interface

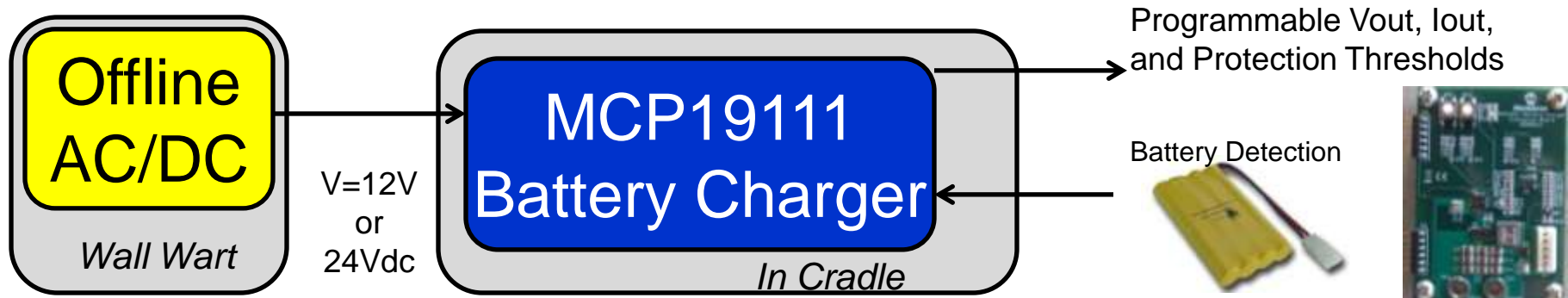
# Battery Charging

## ● Battery Charging

- Chemistry: NiMH
- $V_{IN} = 12 \text{ or } 24V_{DC}$
- $V_{OUT} = 8 - 12V_{DC}$  (8 Cells), Adj. Current
- Target Market: Radio-Controlled Vehicles

Typical Operating Range	
$V_{IN}$	12-24V
$V_{OUT}$	3 – 20V
$I_{OUT}$	Adj.
Chem	NiMH, Li-Ion

- Core Value:
  - Standardized Battery-Charger architecture that's scalable to support wide portfolio of battery configurations and charging profiles. Includes battery detection and adjustable protection features.



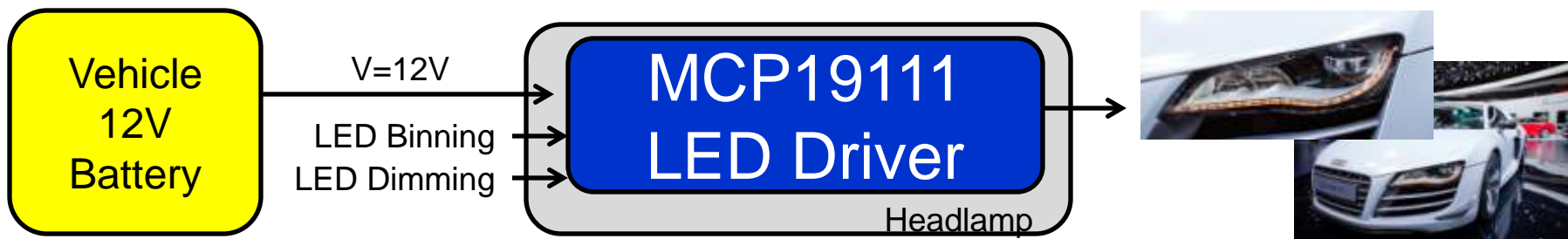
# LED Lighting

## • LED Lighting

- $V_{IN} = 12V_{DC}$  (from Battery)
- $V_{OUT} = 3-6V_{DC}$  (~1-2 LEDs)
- $I_{OUT} = \text{Adj.}, 350\text{mA}-1.5\text{A}$  (typ)
- Target Market: Automotive, Headlamp (Fog-light)


### • Core Value:

- LED loads are complex, requiring advanced power conversion functions, including PWM Dimming and LED Binning capability.
- Standardized architecture, used across multiple end-customers
- Rapid support of changing standards and technologies (LEDs)

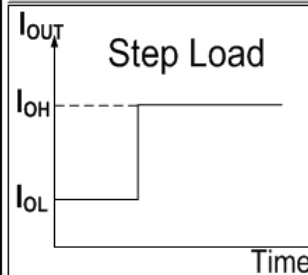


# Design Analyzer MCP19110/1

- Excel-based Design Guide!
- Define application inputs to define passive component (L's & C's) and refine the compensation

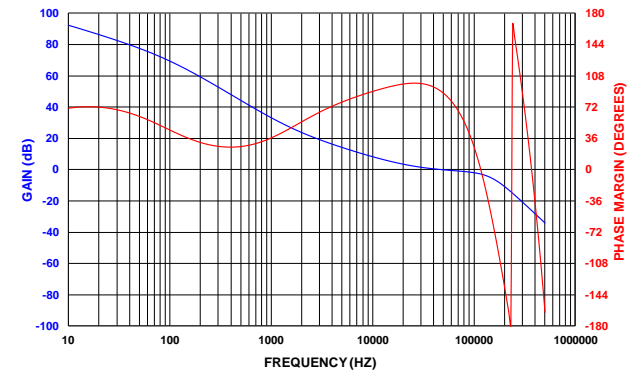
 <b>MICROCHIP</b>				
<b>MCP19111 DESIGN ANALYZER</b>				
<b>Input Parameters for Design</b>				
Parameter	Designator	Value	Units	Notes
Input Voltage	$V_{IN}$	12	V	$4.5 \leq V_{IN} \leq 30$
Output Voltage	$V_{OUT}$	1.8	V	$0.6 \leq V_{OUT} \leq 3.6$
Output Current	$I_{OUT}$	30	A	$0 \leq I_{OUT} \leq 30$
Switching Frequency	$F_S$	300	kHz	$100 \leq F_S \leq 1200$
Input Voltage Ripple	$V_{RIN}$	100	mV	
Minimum Input Voltage	$V_{IN\_MIN}$	12	V	$4.5 \leq V_{IN\_MIN} \leq V_{IN}$
<b>Step Load Parameters</b>				
High Output Current	$I_{OH}$	7.5	A	
Low Output Current	$I_{OL}$	2.5	A	
Output Voltage Overshoot		100	mV	

Use Default EVAL Board Components and Compensation



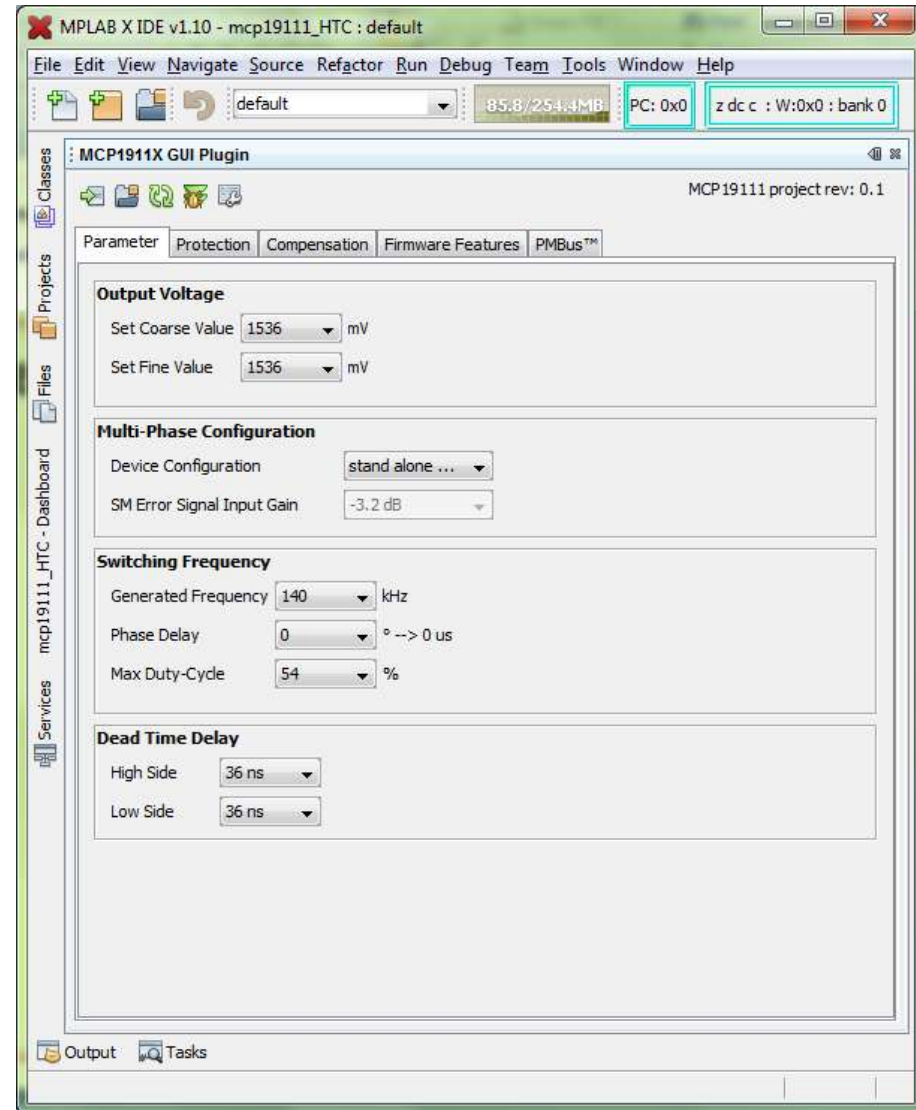
Use Recommended Components and Compensation

MCP19110 BODE PLOT



# Power Supply Evaluation MCP19111

- GUI available to simplify programming for a standard power supply applications
  - GUI resides in MPLABX (plugin)
  - Supports PICKIT3 and ICE3 Program/ Debug
- Standard Firmware for Power Supply application



# Unique Strengths

- Supports “special” application, load, and operating behavior requirements
- Multiple power conversion topologies including boost, flyback, synchronous flyback, SIPC and Cuk-based topologies supported
- Supports both fixed-frequency and quasi-resonant mode switch to improve EMI performance
- On-board MCU may be used as a general purpose controller after initial setup of Analog Power Controller



MCP19114 Evaluation Board  
**PN: ADM00578 US\$49.99**



**MICROCHIP**

## **Other Analog Products**

**Zero-Drift and Instr. Amps  
Thermal Management**

[Return to Topics](#)



# MCP9600 Integrated Thermocouple Interface IC

## Features:

### Highly Integrated!



- Precision Instrumentation Amp
- Precision Temp Sensor
- Precision High Resolution ADC
- Integrated Cold-Junction Compensation
- Math Engine Supports common thermocouple types: K, J, T, N, S, E, B & R



## Packaging

- MQFN-20 (5x5)

## Evaluation Board

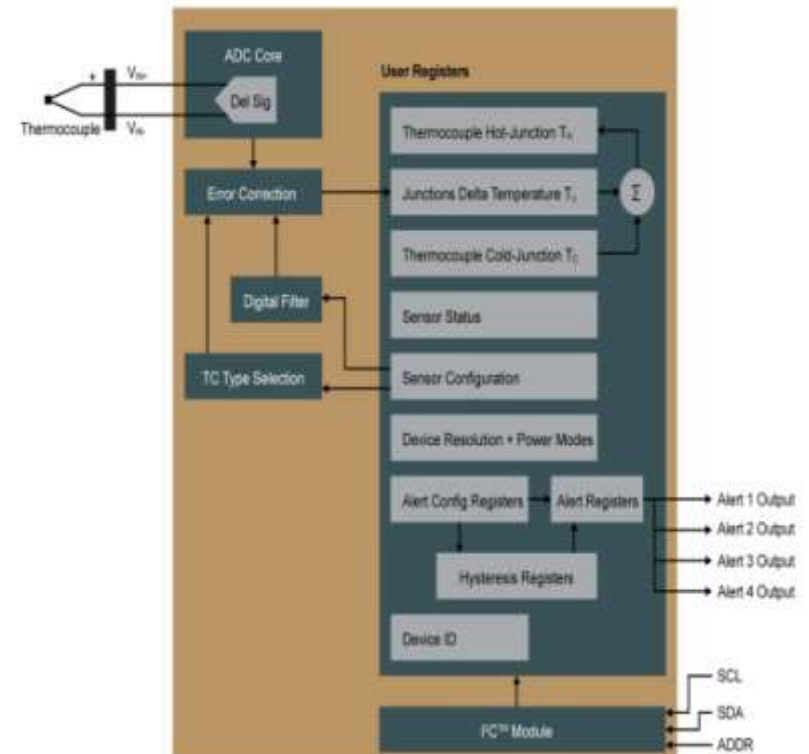
- ADM00665

## Applications:

- Boilers, Water Heaters, Ovens, Freezers, Automotive, Petro-chemical



(Check your thermocouple sales)



# Zero-Drift Amplifiers

---

- **Applications that require ultra-high precision**
  - Ultra-low initial and low offset drift provides better common mode and power supply rejection
- **Microchip correction methods**
  - Auto-Zero - Nulling amps
  - Chopper-Stabilized - Auxiliary amps w/ chopped inputs/outputs
- **Target Applications**
  - Precision Portable and Medical Instrumentation, Sensor Conditioning and Temperature Measurement
- **Zero-drift family**
  - MCP6V0x (1.3MHz) and MCP6V2x (2MHz) provide industry leading performance
  - MCP6V1x - Lowest cost and lowest power 80kHz GBWP
  - MCP6V3x – 300kHz GBWP in SC70 and SOT23

# Instrumentation Amplifiers

---

- **Specialized version of an op amp but w/o a feedback loop**
  - Closed loop makes them better for differential gain and common mode rejection applications
  - Extraction of small signals in presence of large voltage or noise
- **Target Applications**
  - Products that interface to real-world sensors like: Temperature, Pressure, Bio-Sensors, Strain Gauges and Photodiodes
- **Microchip solutions**
  - MCP6N11 utilize mCal and provide low operating voltage and small packaging
  - MCP6N16 are Zero-Drift and provide better performance and enhanced EMI rejection

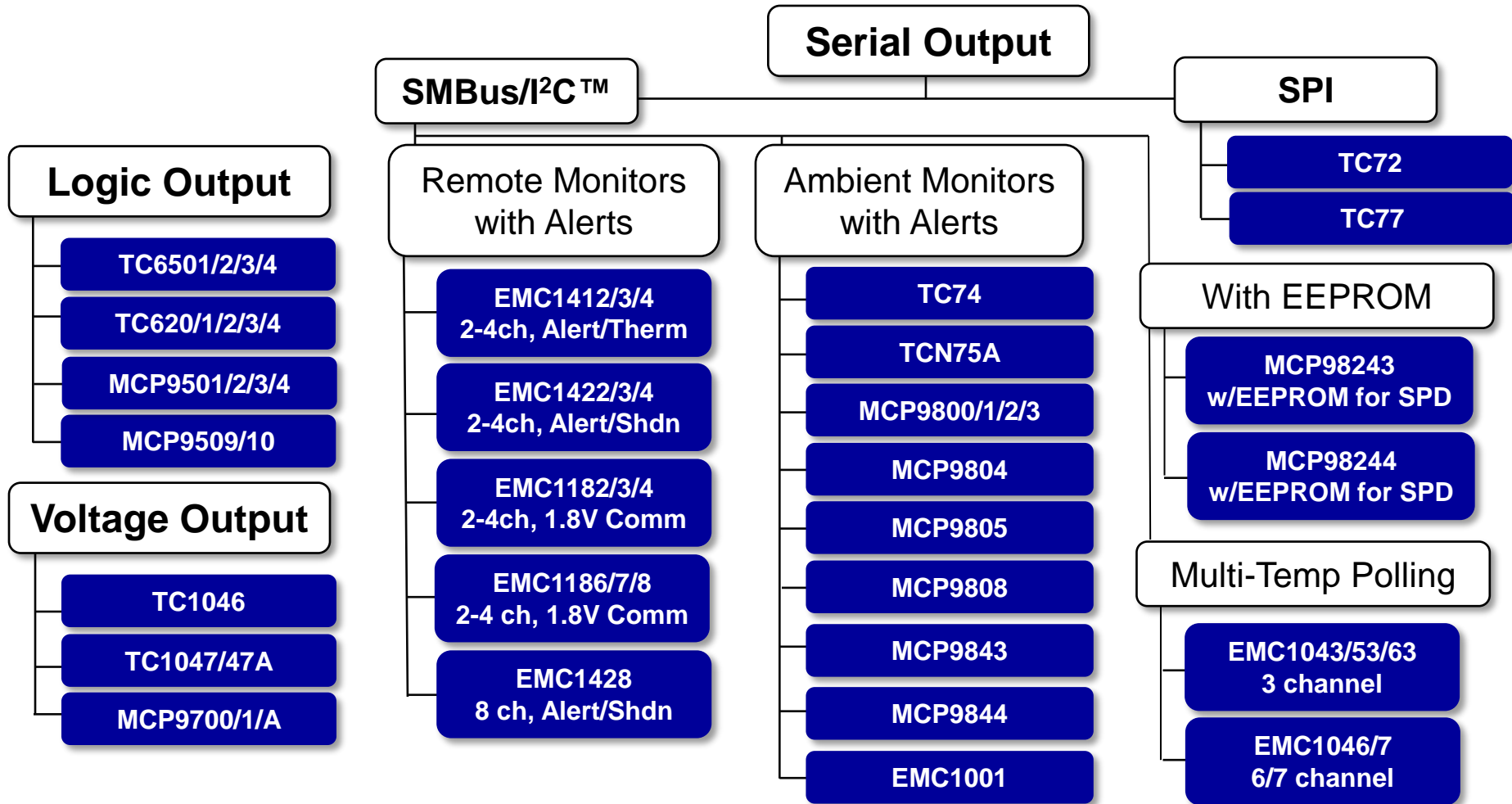


# Low Voltage Boost Regulators

	MCP1623/4	MCP16251/2	MCP1640/B/C/D	MCP1643	MCP1642B/D
<b>Mode</b>	PWM or PWM/PFM	PWM/PFM	PWM or PWM/PFM	PWM	PWM
<b>Start-up Voltage (V)</b>	0.65	0.82	0.65	0.65	0.65
<b>Input Voltage (V)</b>	0.35 – 5.5	0.35 – 5.5	0.35 – 5.5	0.35 – 5.5	0.35 – 5.5
<b>Peak Switch Current (mA)</b>	425	650	850	1600	1800
<b>Quiescent Current (μA)</b>	19	4	19	-	400
<b>Switching Frequency (kHz)</b>	370 - 630	425 - 575	425 - 575	850 - 1150	850 - 1150
<b>Shutdown</b>	True Load Disconnect	Input to Output Bypass or True Load Disconnect	Input to Output Bypass or True Load Disconnect	True Load Disconnect	Input to Output Bypass or True Load Disconnect
<b>Packages*</b>	SOT23-6*	SOT23-6* 2x3 TDFN-8**	SOT23-6* 2x3 DFN-8**	MSOP-8 2x3 DFN-8	MSOP-8 2x3 DFN-8
<b>Key Attributes</b>	Lowest Cost	Lowest Quiescent Current	Highest Performance	LED Driver $V_{REF} = 120$	Highest Current Capability

\*, \*\* Packages are pin-to-pin compatible  
For Higher output voltages, consider MCP1661/2

# Temperature Sensors





**MICROCHIP**

# Memory Products

[Return to Topics](#)

# SQL Flash Family

---

- **4-bit multiplexed I/O**
  - Industry standard serial protocol w/ backward compatibility to SPI Flash
- **Operating frequency up to 104 MHz**
  - > 400 Mb/sec sustained Read
- **Voltage offerings in 3.0V and 1.8V**
- **Densities from 4 Mbit to 64 Mbit**
- **Software Block Protection capability**
- **One Time Programmable Security ID**
- **8-SOIC, 8-Contact WSON, 16-SOIC, 24-TFBGA, KGD & WLCSP package options**

# Migration to SQL

Current Part	Recommended Upgrade	Board Layout/ Footprint Change	Firmware Change
SST25V016B-75-4I-S2AF (8-lead SOIC)	SST26VF016B-104I/SM (8-lead SOIJ) <sup>1</sup>	No	Yes
SST25V016B-75-4I-QAF (WSON)	SST26VF016B-104I/MF (WDFN) <sup>2</sup>	No	Yes
Any SST25V016B	SST26VF016B-104I/SN (8-lead SOIC) <sup>3</sup>	Yes	Yes
SST25V032B-75-4I-S2AF (8-lead SOIC)	SST26VF032B-104I/SM (8-lead SOIJ) <sup>1</sup>	No	Yes
SST25V032B-75-4I-QAE (WSON)	SST26VF032B-104I/MF (WDFN) <sup>2</sup>	No	Yes
Any SST26VF032B	SST26VF032B-104I/TD (TBGA) <sup>4</sup>	Yes	Yes

1. SOIC and SOIJ are different designators for the same package.
2. WSON and WDFN are different designators for the same package.
3. 8-lead SOIC is a new 150 mil SOIC package available for SST26VF016B/016BA
4. TBGA is a new package available for SST26VF032B/032BA

- Default state of SQL Flash on POR is standard SPI Mode
- Full details in migration document; search for '[20005354A](#)' on [Microchip.com](http://Microchip.com)



*New Vertical  
Group!  
Coming soon!*

**MICROCHIP**

**Military and Aerospace**

[Return to Topics](#)

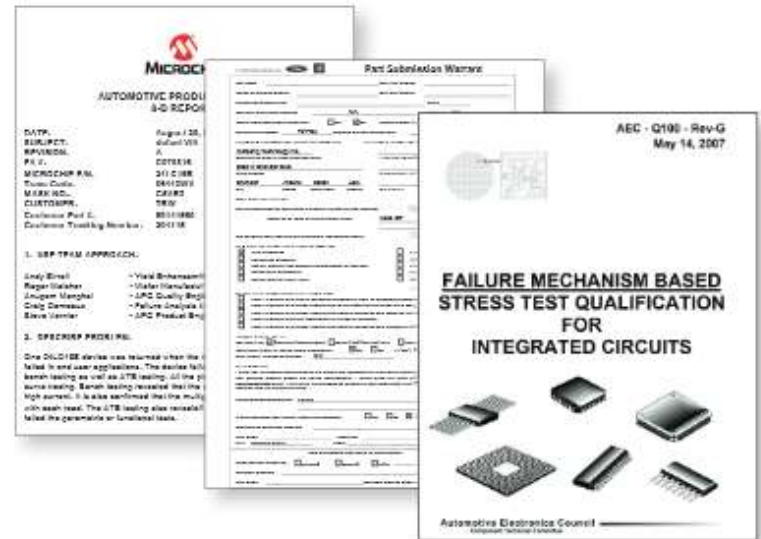
# Current Capabilities

---

- **Wide range of products qualified for Automotive – need low-temp testing**
- **MMT – Already producing military grade packaging for other suppliers**

# Quality Capabilities

- Zero defect
- Advanced Product/Process Quality Planning (APQP)
- AEC0-Q100 stress testing
  - Need only extend to -55C
- Product Part Approval Process (PPAP)
- 8D Reporting
- Product change notifications



*> 20 years supporting automotive market!*

# High-Temp Products



- **8-bit PIC MCUs**

- PIC1xF6xx
- Several PIC18F and all PIC18FxxK80 (w/ CAN)

- **16-bit PIC MCU/DSCs**

- PIC24HJ and dsPIC33FJ products

- **Serial Memory**

- 25LCxxx Serial EEPROMs

- **Low-Power Analog**

- MCP9700 temp sensor
- MCP64xx Op Amps

# Automotive Qualified

---

- **Micros**

- 8-bit and 16-bit PIC® MCUs and DSCs

- **Thermal Management**

- Temp Sensors

- **Power Management**

- Switching/LDO Regulators and PWMs
- Charge Pumps DC/DC Conv
- Supervisors
- Power MOSFET Drivers

- **Linear**

- Op Amps
- Comparators

- **Mixed Signal**

- SAR / Delta-Sig ADCs
- Energy Measurement ICs
- DACs
- Digipots

- **Interface**

- Touch Controllers
- CAN / LIN Transceivers
- IrDA encoders
- Port Expanders
- UART to USB Bridge

- **Memory**

- Serial EEPROM, SRAM and Flash
- Parallel Flash

# High-Speed ADC

- **Lowest power 16-bit ADC at 200Msps**
  - <500mW compared to >1W of other suppliers
- **Among highest accuracy**
  - ~74dB SNR, ~90dB SFDR
- **Current Status**
  - Initial low-temp testing results look promising





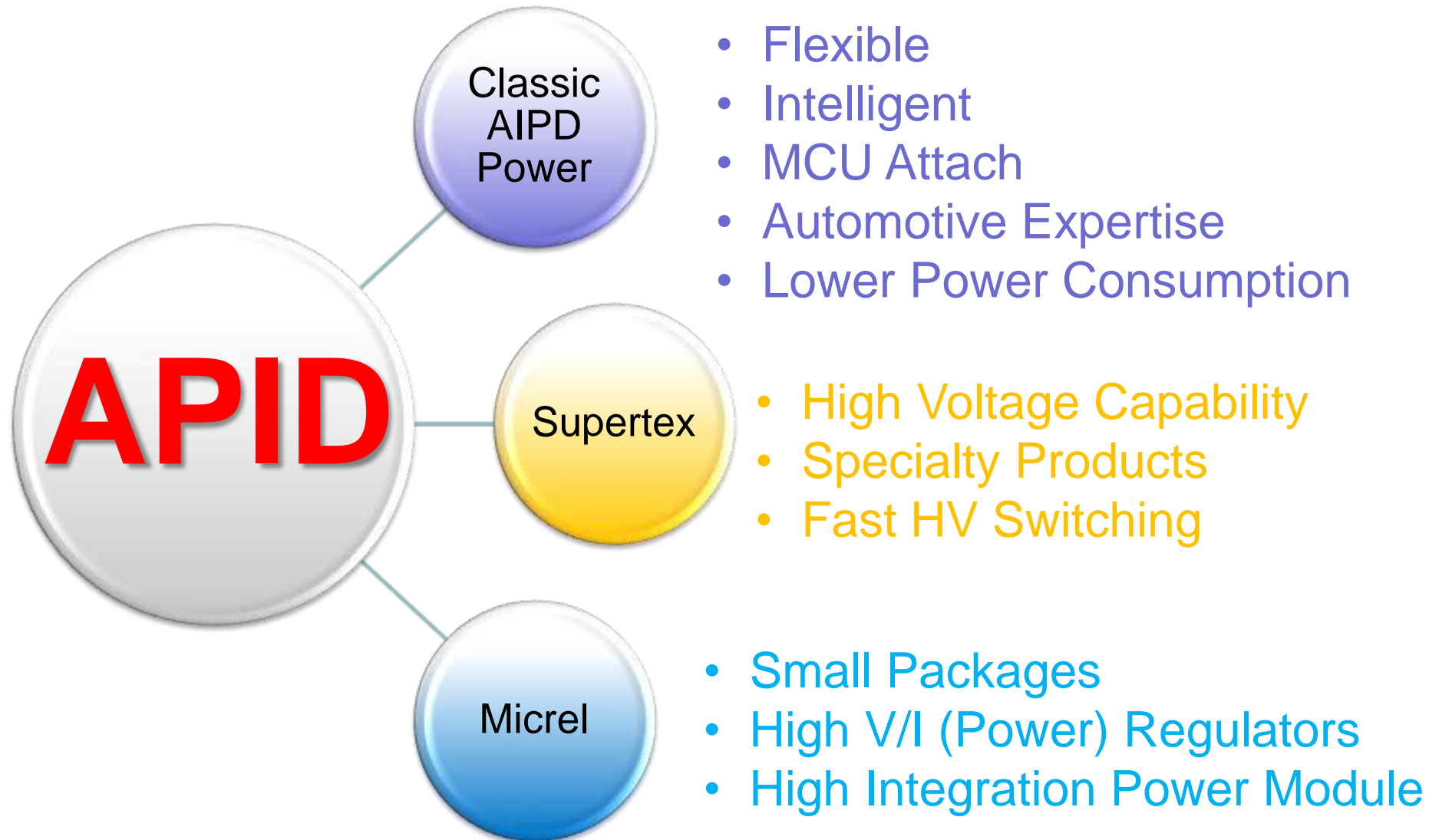
**MICROCHIP**

# **Micrel High Level Product Overview**

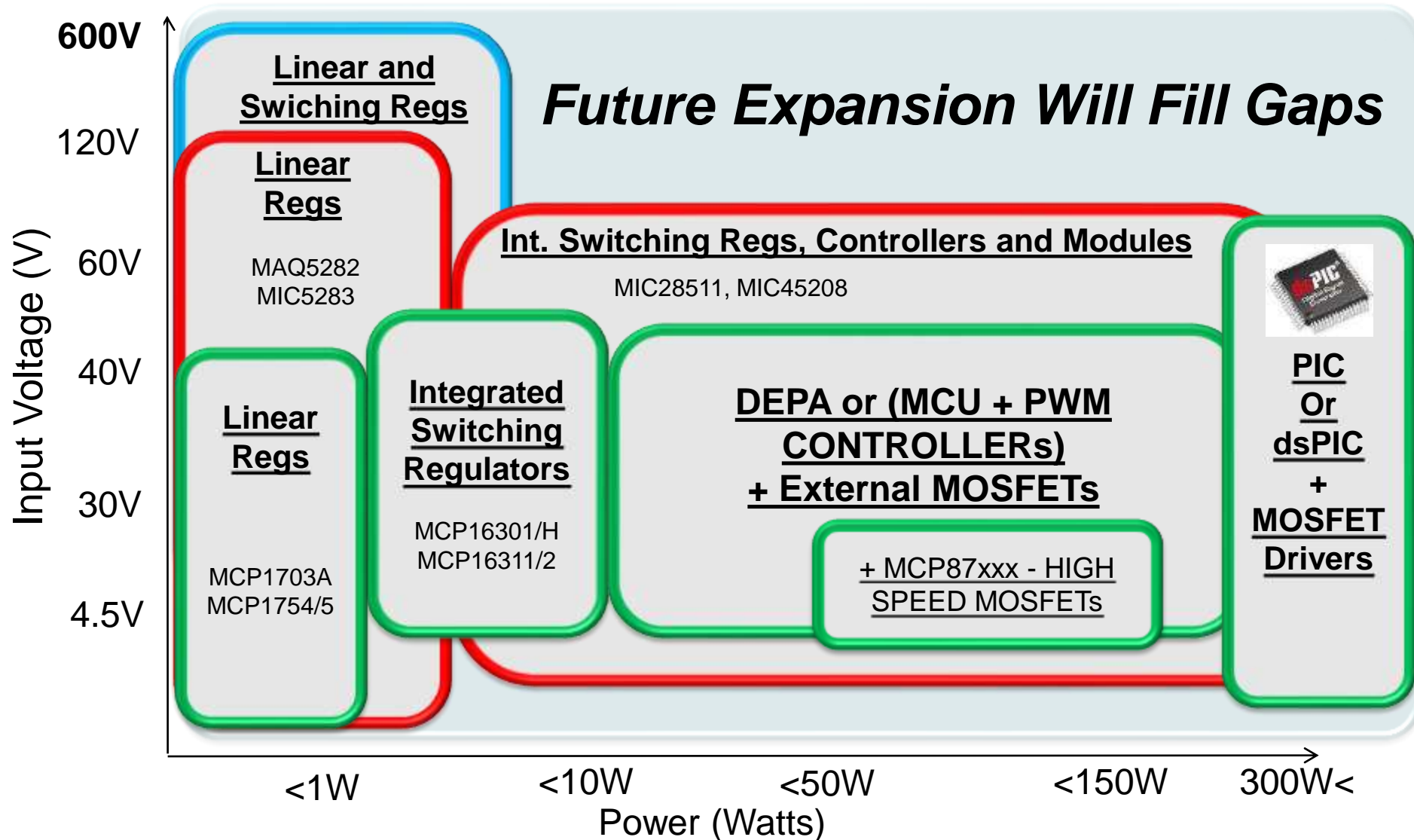
**January 2016**

[Return to Topics](#)

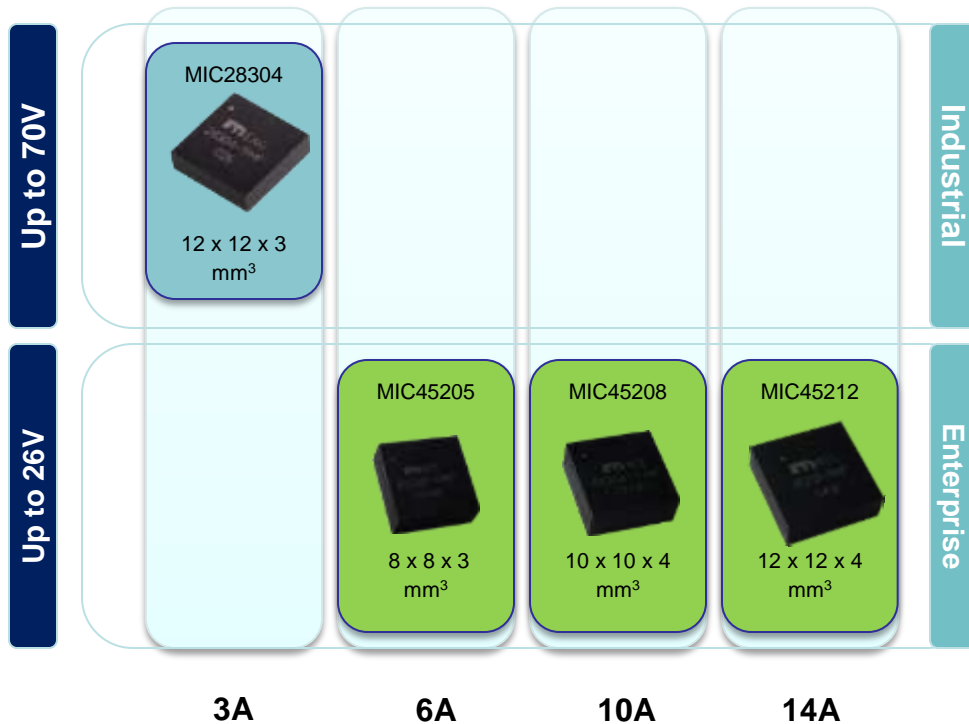
# Analog Power Portfolio



# Microchip Power Conversion Portfolio

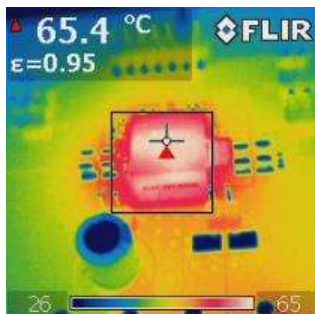
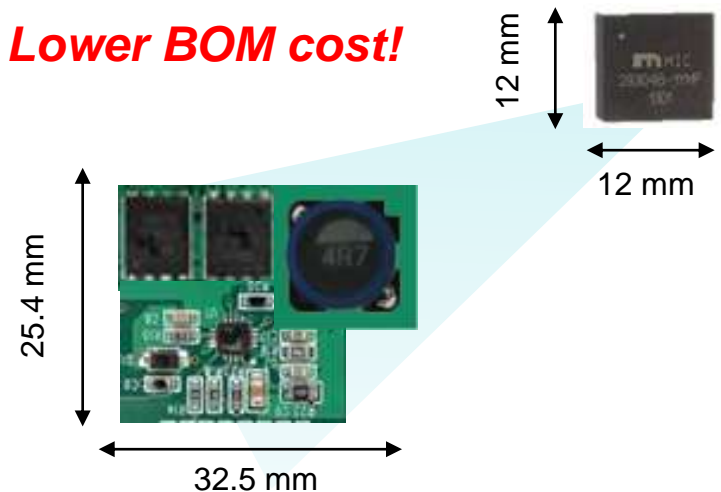


# Fully Integrated Power Modules



Simple Land Patterns Optimized for Thermal Performance and Eliminates Assembly Issues

**Lower BOM cost!**



**Superior Thermal Performance!**

**Excellent EMI Performance!**



# MIC24046 19V, 5A Switching Reg.

## Features:

### Ease of use Switching Regulator

- Integrated Controller, MOSFETs and Feedback Resistors
- Pin Programmable:  $V_{OUT}$ ,  $F_{SW}$ ,  $I_{OUT}$  Limit
- 9 programmable  $V_{OUT}$  settings
- 3 Switching Frequency Options
- 3 Current Limit Options
- Reduces external component count
- -40°C to +125°C Junction Temp

## Packaging

- QFN- 20 (3x3mm)

## Evaluation Board

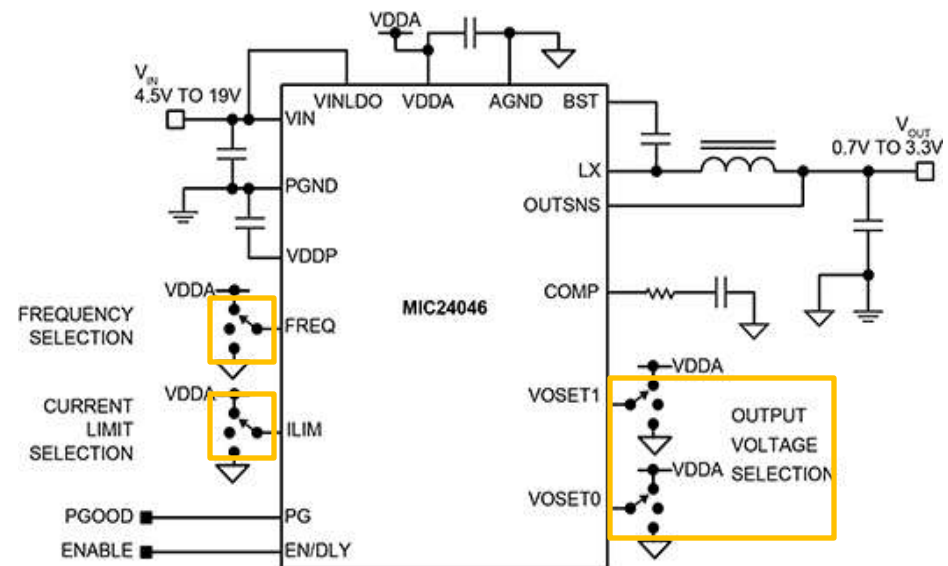
- MIC24046YFL EV

## Applications:

- Telecom
- Networking Switches & Routers
- DC – DC Power Distribution

## High Power Density Applications!

- FPGAs, Processors, Industrial



# MIC45116 20V, 6A Power Module

## Features:

### Ease of use Integrated Power Module

- Integrated Controller, MOSFETs and Power Inductor
- Reduces external component count
- Fixed 600kHz Switching Frequency
- > 93% Efficiency capable
- 0.8V to .85xVin Output Voltage Range
- -40°C to +125°C Junction Temp
- HyperLight Load Mode - MIC45116-1
- Hyper Speed Mode – MIC45116-2

### Packaging

- QFN (8x8mm)

### Evaluation Board

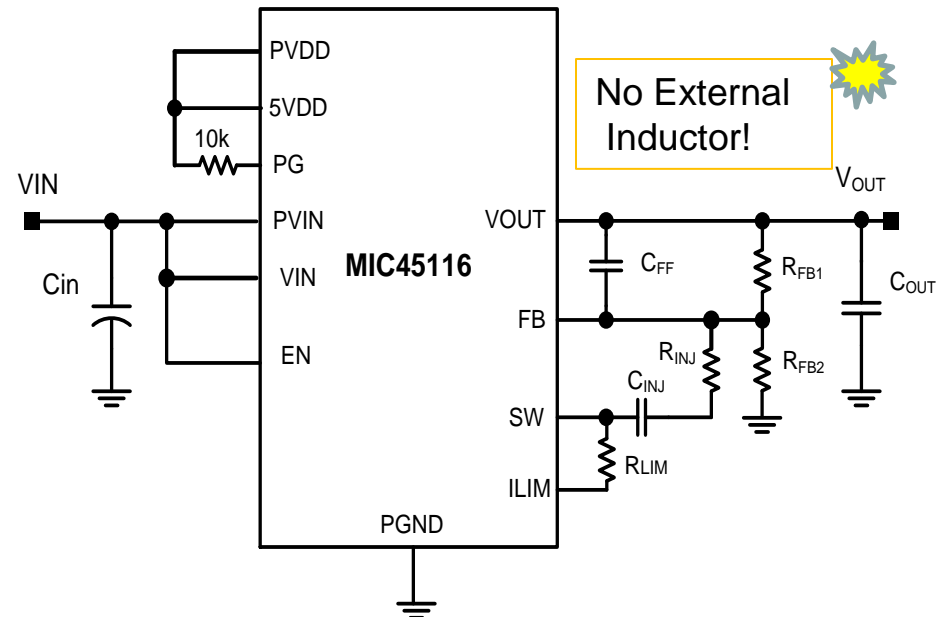
- MIC45116-1YMP EV
- MIC45116-2YMP EV

## Applications:

- Telecom
- Networking Switches & Routers
- DC – DC Power Distribution

### High Power Density Applications!

- FPGAs, Processors, Industrial





# MIC45404

## 19V/5A Ultra-Low Profile DC to DC Power Module

### Features:

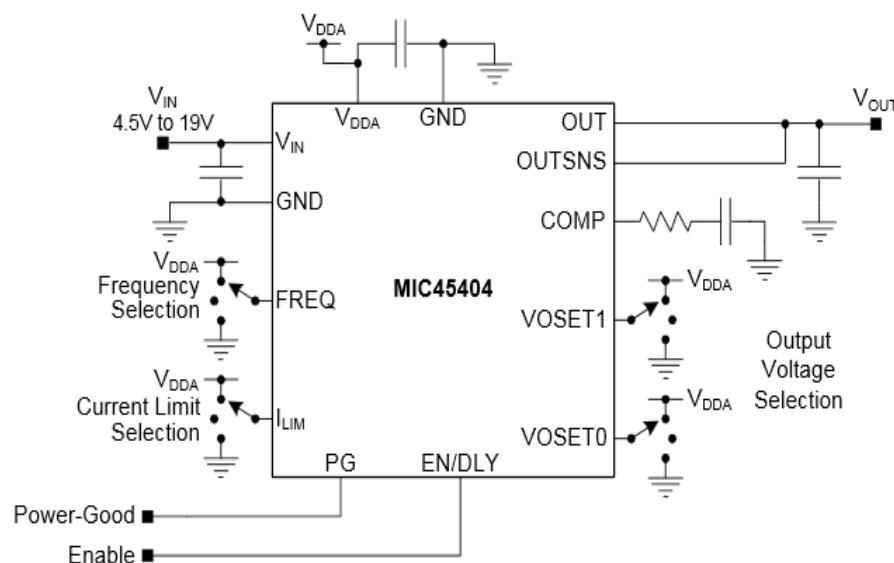
- Wide Input Supply Voltage: 4.5V-19V ★
- Output Current: Up to 5A
- Pin-Selectable Output Voltages: 0.7V-3.3V
- Supports Pre-Biased Start-up ★
- 82% Peak Efficiency at 12Vin, 0.9Vout ★
- Internal Soft Start
- Thermal Shutdown
- -40C to 125C Junction Temperature ★

### Packaging

- 54L QFN (6x10mm)

### Applications:

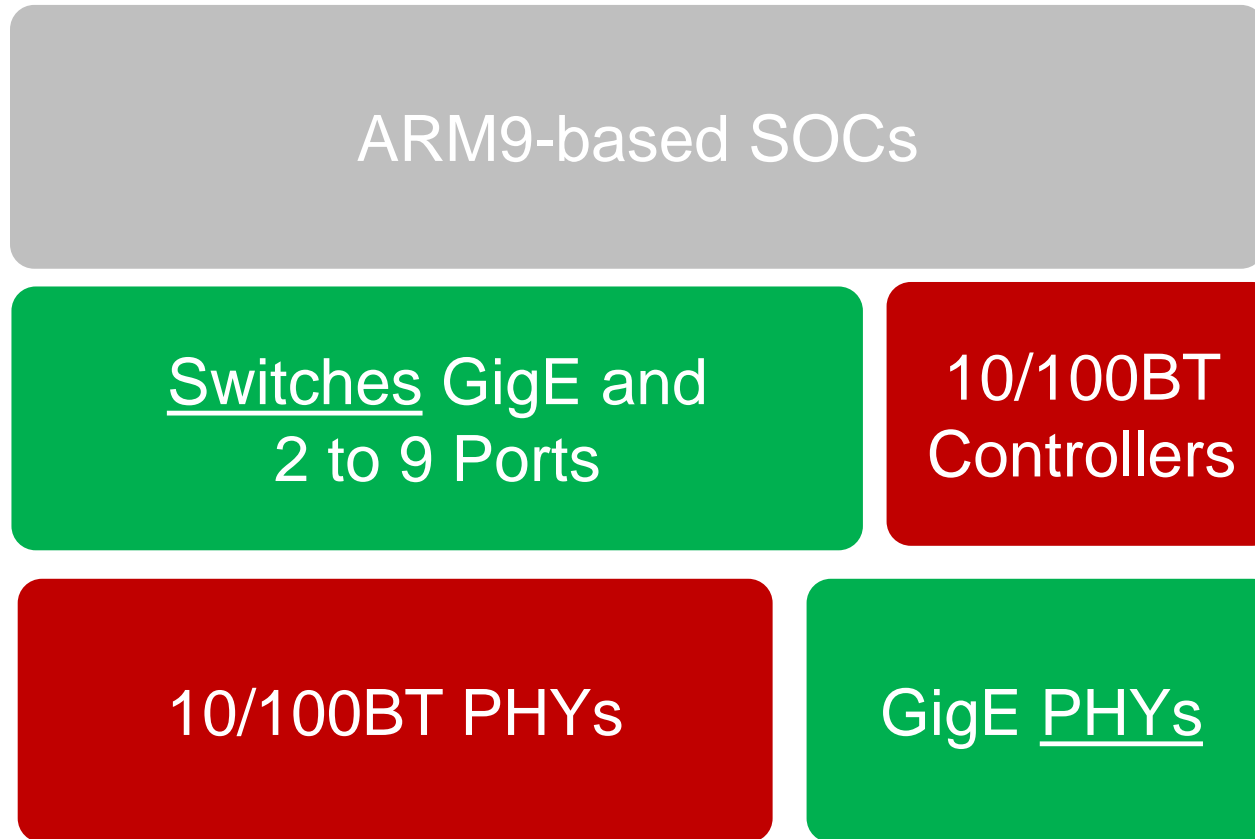
- FPGAs, Low-Voltage ASIC Power
- Telecom
- Network Switchers and Routers
- Server Storage
- DC Power Distribution
- Solid State Drives



MIC45404 12V 5A DC-to-DC Converter

# Micrel Ethernet Fit with Microchip

---



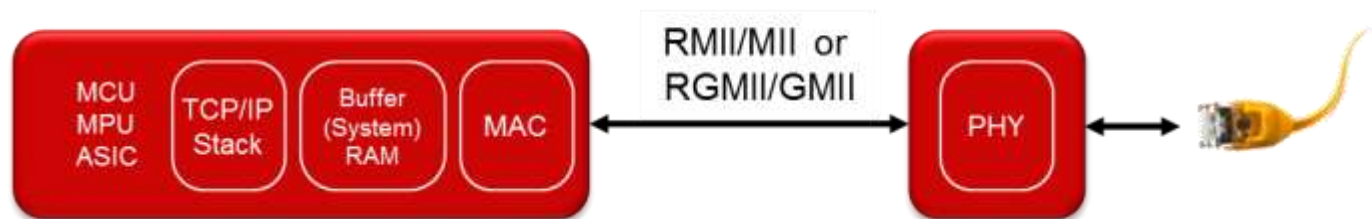
**Micrel Value-Add**

**Overlap**

**De-focus**

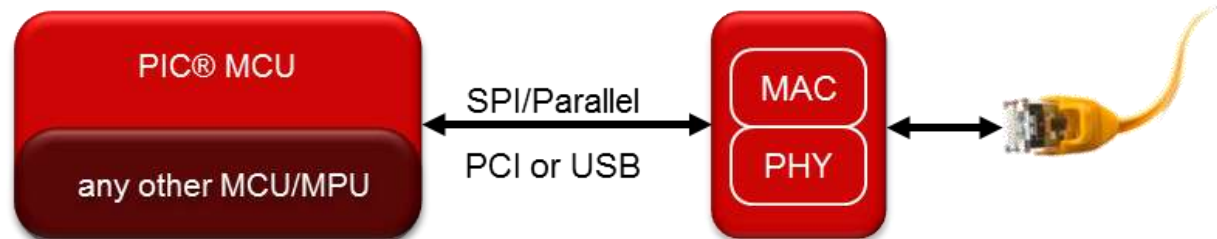
# Ethernet PHYs

- **10/100Base-Tx PHY**
  - Established customer base on both sides – allow customers to choose
- **For new designs consider:**
  - KSZ9031 for GigE PHY opportunities
  - KSZ8081/91 is lowest power consumption for high-volume, cost sensitive opportunities
  - KSZ8061 with Quiet-WIRE for stringent industrial & automotive applications



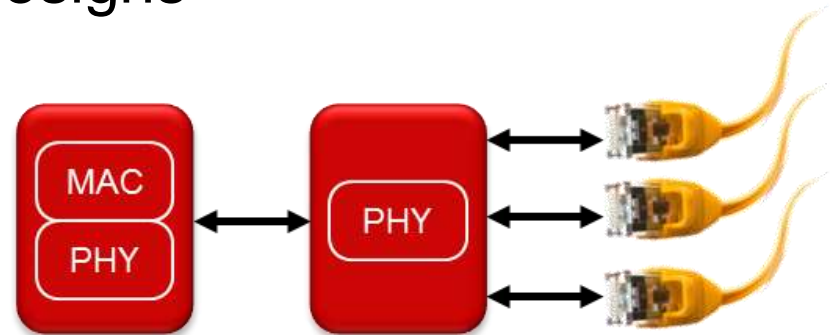
# Controllers & Bridges

- Microchip is leader; Micrel has no USB-to Ethernet bridge products
- For new designs consider:
  - KSZ8851 – SPI Interface
    - ENC28J60/ENC624J600 still lowest cost of entry w/ SPI!
  - KSZ8852 – 2-Port 8/16-bit Host Interface
  - KSZ84xx/LAN925x – 1588v2 for low power consumption industrial Ethernet opportunities



# Ethernet Switches

- **Micrel is recognized leader in Ethernet switches**
  - Higher 2 to 9 port count devices
- **For new designs consider:**
  - KSZ8863 is lowest cost 3-port managed switch
  - LAN9352/3/4/5 for IEEE 1588v2 3-port switch opportunities in industrial Ethernet designs
  - KSZ87xx for GigE switch designs

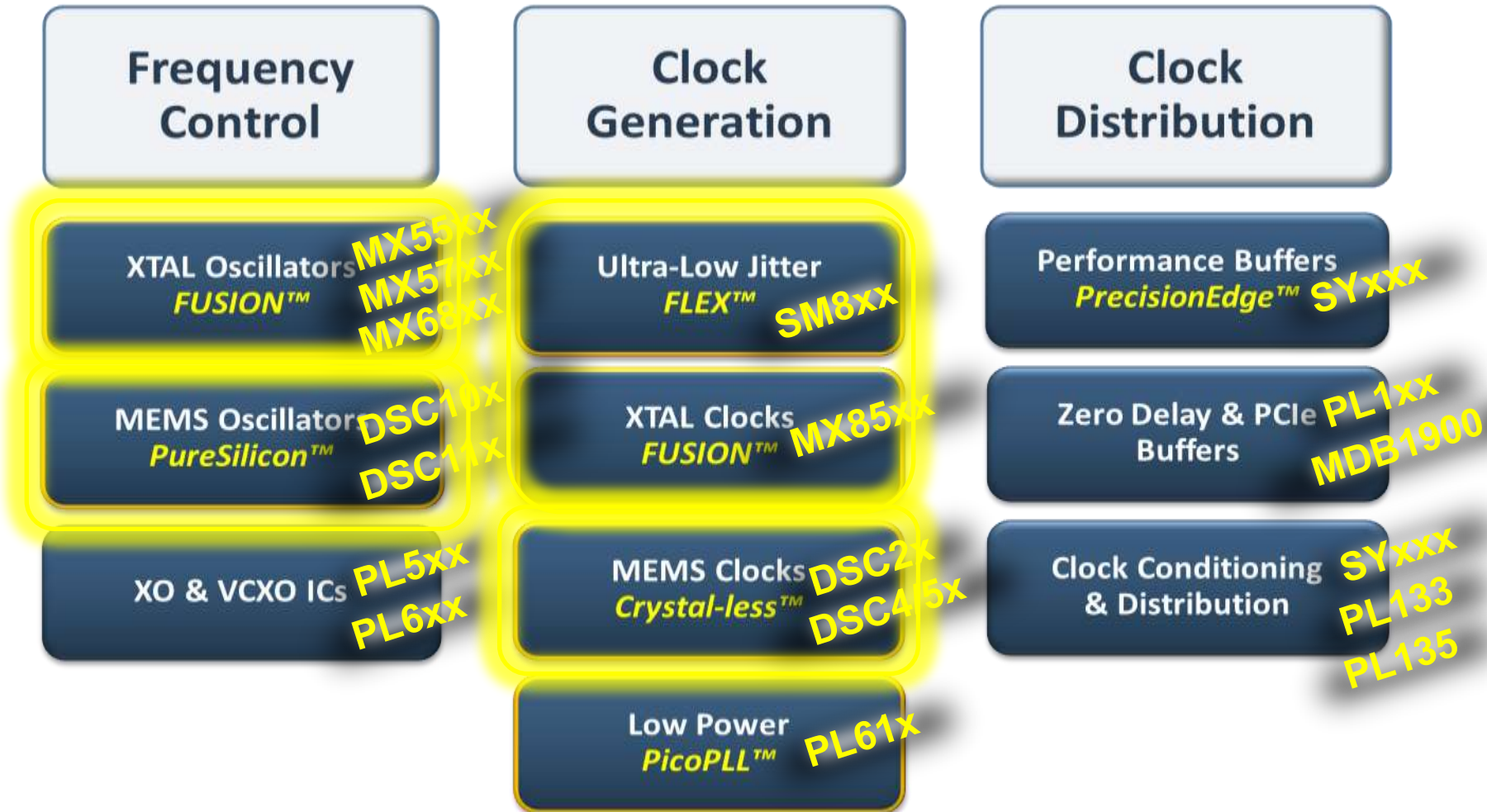


# Ethernet in General

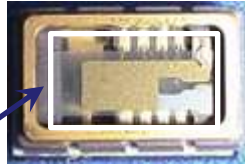
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- **Microchip now provides a broader Ethernet portfolio for our customers**
- **No plans to EOL any Ethernet products as a result of the acquisition**
  - Customers NEED NOT panic!
  - Only supporting existing customers for VoIP products

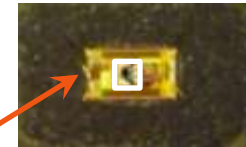
# Clock & Timing Portfolio



# Benefits of MEMS



Quartz Crystal Oscillator in  
Metal+Ceramic Package



MEMS Oscillator in  
Plastic Package



## Performance: Stability & Jitter

- Up to 10ppm frequency stability
- Temperature grades up to -55 to 125°C
- Less than 0.5 ps phase noise jitter

## Higher Reliability

- Full AEC-Q100, JEDEC qualification
- 1.2 FIT rates vs. 20 FIT for crystal
- 50 000G shock and 70G vibration

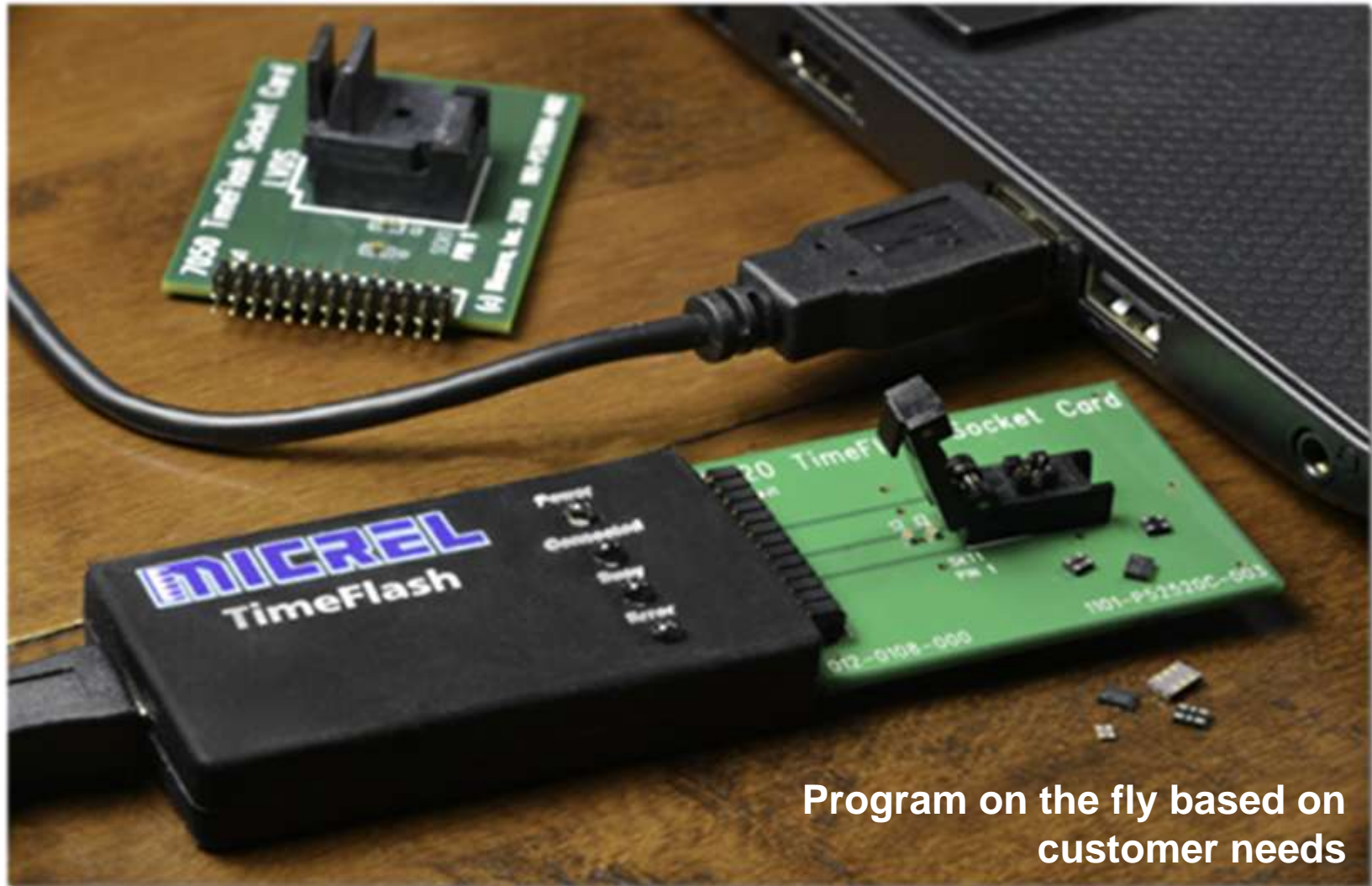
## Cost Effective

- Semiconductor supply chain, without mechanical handling steps of crystal
- On CMOS pricing trend, scaling with chip geometry

## Faster Time to Market

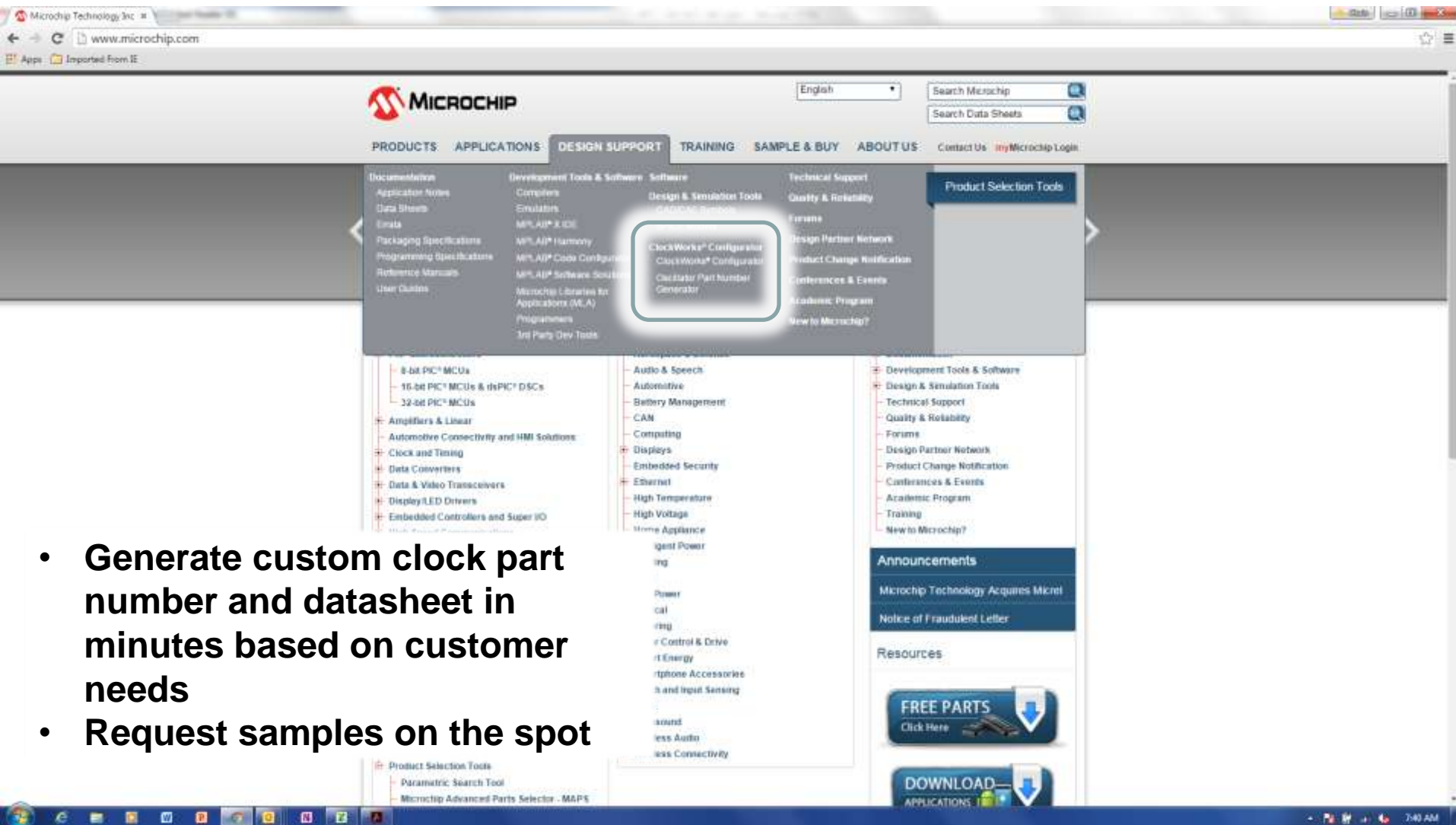
- 2-4 weeks production lead time
- Engineering samples programmable in 1 sec with full production performance

# TimeFlash Programming Kit



Program on the fly based on  
customer needs

# ClockWorks® Configurator



The screenshot shows the Microchip website interface. The top navigation bar includes links for PRODUCTS, APPLICATIONS, DESIGN SUPPORT, TRAINING, SAMPLE & BUY, and ABOUT US. The DESIGN SUPPORT section is expanded, showing various tools and resources. The ClockWorks® Configurator is highlighted in a blue box within the Design & Simulation Tools category. Below the navigation bar, there are several sections including Product Selection Tools, Announcements, and Resources. The bottom of the page shows a Windows taskbar with various application icons.

- **Generate custom clock part number and datasheet in minutes based on customer needs**
- **Request samples on the spot**

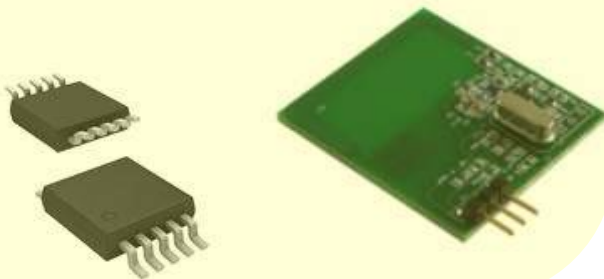
- **Sub G Transmitter and Receiver ICs**

## Transmitters

MICRF112  
300-450Mhz, 1.8-3.6V

MICRF113  
300-450Mhz, 1.8-3.6V

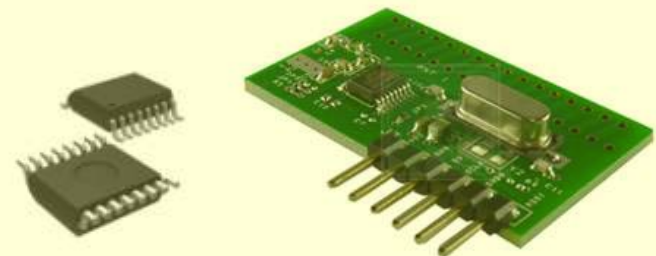
MICRF114  
285-445Mhz, 1.8-3.6V



## Receiver

MICRF220  
300-450Mhz, 3.0-3.6V

MICRF219A  
300-450Mhz, 3.0-3.6V



## *Micrel-Related Information*



### Wireless

- RF Remotes Presentation HOT

### Networking

- Micrel to SMSC Ethernet Controller Cross Reference HOT

### Mixed Signal Products

## Timing and Communications Landing Page

### Timing and Communications

- Timing and Communications Products Sales Training - Oct 2015 HOT
- Timing and Communications Product Overview - Sep 2015 HOT
- Sales\_FAE-training\_Module 1\_Micrel\_TCG\_Introduction HOT

### Analog Power

- Microchip\_Micrel LDO Product Table - October 2015 HOT
- Analog Power Update after Micrel - October 2015 HOT
- MIC45116 Power Modules Overview - October 2015 HOT
- MIC24046 High Performance Switching Regulator Overview HOT
- Micrel-Microchip Complementary Product Training\_Channel Overview HOT



### General

- Analog Power Update after Micrel - October 2015 HOT
- MIC24046 High Performance Switching Regulator Overview HOT
- Distribution FAQ - Micrel HOT
- Micrel-Microchip Complementary Product Training\_Channel Overview HOT
- Micrel - Linear\_Power\_Interactive\_Product\_Selector HOT



**MICROCHIP**

# **Power and Linear Solutions**

**Focus Areas**

[Return to Topics](#)

# Linear Regulators

---

- **Micrel LDO strength**

- Up to 120V LDO
- Cost effective high current LDOs
- Known for 1A, 2A, 3A and 5A LDOs
- Multi-channel LDOs
- Ripple Blockers

- **MCHP LDO strength**

- Known for low power LDOs
- Broad range of automotive qualified LDOs
- Excellent high performance products



# Switching Regulator

---

- **Micrel switching regulator strength**

- High voltage and current capability
- High switching frequency allows small inductor designs
- Multi-phase and Multi-channel switching regulators

- **Classic MCHP switching regulator strength**

- Built-in Intelligence
- Optimized, High-efficiency power conversion
- Low power, low startup voltage regulators

# Switching Controller

---

- **Micrel switching controller strength**

- Up to 75V capable
- Broad selections for buck conversion

- **Classic MCHP PWM controller strength**

- PIC MCU attached
- Broad range of reference design and application specific demo systems in lighting, battery charging and power management
- Automotive qualified
- Digital enhanced solutions

# USB and Load Switch

- **Micrel load switch and USB protection/switch Strength**

- Expand Microchip offerings in power system design
- Complete USB system with port protection

- **Classic MCHP USB charging Strength**

- Highly integrated USB charger solutions
- Automotive qualified USB charger products



# MOSFET Drivers

---

- **Micrel MOSFET driver strength**

- Up to 50V single low-side drivers
- Up to 32V dual low-side drivers
- Quad low-side drivers
- High-side driver
- Up to 600V half and full-bridge drivers
- Small packages

- **Class MCHP MOSFET driver strength**

- Broad range low-side driver from 0.5A to 12A
- Strong PIC MCU and dsPIC DSC solutions and market presence

# Motor Drivers

---

- **Micrel motor driver strength**

- Expand from the MOSFET driver family
- Up to 600V high voltage capability
- Strong reference designs
- Opportunities in emerging markets

- **MCHP motor driver strength**

- Fully integrated solutions
- MCU attached drivers
- Automotive qualified solutions
- Relationship with automotive and industrial leading OEMs

# Higher Voltage/Current/Power

---

- **Micrel strength**

- Micrel offers competitive regulator and module products (including inductors) today
- Integrates control, drive and sensing
- Highest power density solution in the market
- Package solutions

- **Microchip strength**

- Unique digitally enhanced PWM controller family and high performance low FOM MOSFET for similar applications
- Broad portfolio of intelligent analog products for future expansion

# Lighting & Displays Products

---

- **Micrel LED driver strength**

- Offers broad range low to mid range LED Backlight
- Automotive qualified LED driver
- Simple low voltage linear LED driver
- Application specific drivers - display and flash drivers

- **Microchip LED driver strength**

- Strong position in offline LED drivers
- Intelligent, programmable LED driver for industrial and automotive applications
- Complete solution from digital control and simple boost IC

# Additional Product Lines

---

- **Linear – Comparators, OP-Amps, Voltage Reference**
  - Combine with classic MSLD portfolio
  - 36V comparator with various Vref options
  - Shunt architecture vs series architecture (Microchip voltage references)
- **Fan Control/Temp Sensors**
  - Combine with classic MSLD fan controller and temperature sensors
  - MIC280 – Dual sensor with LM75 compatibility

# Additional Product Lines

---

- **Driver Array**

- High voltage (50V+) and current (0.5A) driver array from logic-level signal to power load

- **PMIC**

- Application specific power management product family is new addition to APID

- **Hot Swap**

- New product family under APID

- **Supervisor**

- Combine with classic APID portfolio

# Additional Product Lines

---

- **Battery Charger**

- Combine with classic APID battery chargers

- **DDR Terminators**

- New product line under APID
- Interesting areas for Microchip sales team to explore: industrial computing, appliance, printers, etc.
- Support up to DDR4

- **I/O Expanders**

- Combine with classic APID I/O expanders



### Analog Cross Reference

Part Number	Steel Case <sup>®</sup>	Fluorinated Case <sup>®</sup>	Comments
AE18	8IC207		
AE19	8IC207		
AE18	8IC209		
UC0807	8IC361		
UC0806	8IC309		
UC0801	8IC361		
UC0801	8IC361		
UC0803	8IC363		
UC0801	8IC361		
UC0803	8IC363		
UC0801	8IC361		
UC0801	8IC204		
UC0801	8IC361		
UC0801	8IC204		
UC0803	8IC363		

Part Number	Steel Case*	Fusible Case*	Comments
ACM75	9C375		
ACM75M100	9C375M100		
ACM75	9C375		
ACM75M100	9C375M100		
ACM80	9C380		
ACM10	9C310		
ACM11	9C311		
ACM13	9C313		
ACM17		MC20M17	
ACM22	9C322		
ACM30	9C330		
ACM45	9C345		
ACM50	9C350		
ACF200		MC220A	MC220A has improved $I_{AS}$ and higher output current than
ACF200		MC220B	MC220B is a much smaller package, has improved $I_{AS}$ and higher output current than
ACF200		MC220	MC220 is a much smaller package, has improved $I_{AS}$ and higher output current than
ACF200		MC220A	MC220A is a much smaller package
ACF200		MC220	MC220 has improved $I_{AS}$ and wide input range
ACF200		MC220M1000	MC220M has higher output current than

## Analog Cross Reference

The screenshot shows the Microchip Technology website. The top navigation bar includes the Microchip and Micrel logos, a search bar, and links for English, 简体中文, 繁体中文, and 繁體中文. Below the navigation bar is a blue banner with the text "Microchip Technology Acquires Micrel". The main content area features a large image with the text "Microchip Technology Acquires Micrel" and "Press Release". Below the image are links for "Micrel Customer Letter", "Micrel Supplier Letter", "Welcome Letter to Micrel Employees", and "Ray Zinn's Letter to Employees". The right sidebar contains a "QUICK LINKS" section with various links.

## Online Simulation and Solution Finder





**MICROCHIP**

# Limited EOL Policy

[Return to Topics](#)

# Limited EOL Policy!



VP of Engineering

“...simple redesign can take half an engineering man-year...”

“...a complex redesign takes much more, maybe 5X the effort...”

Microchip supports customers with products through their life cycle... not ours!

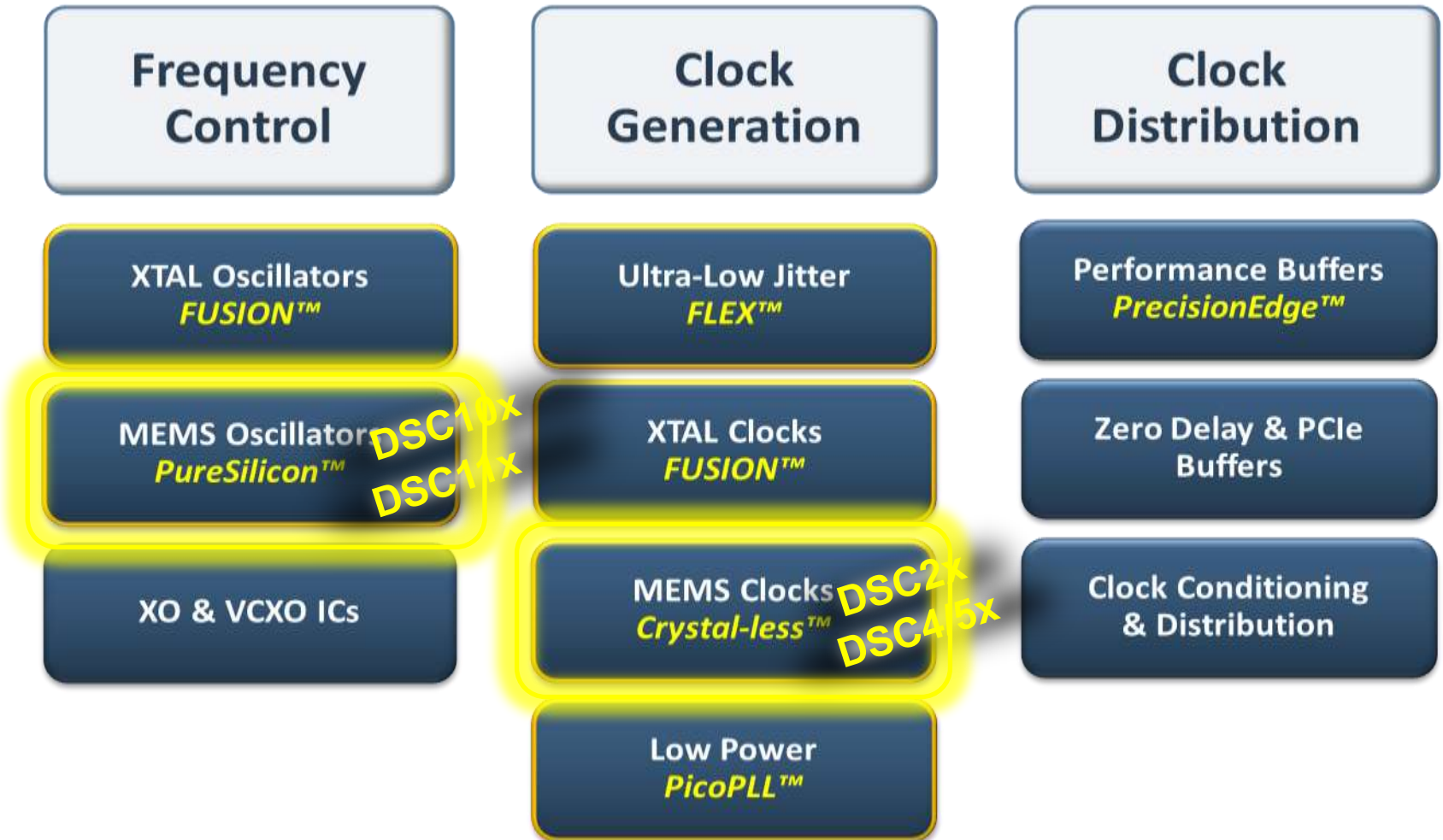


**MICROCHIP**

# **Clock and Timing Products**

[Return to Topics](#)

# Clock & Timing Portfolio



# MEMS Products

**PureSilicon™**  
**Low Power Oscillators**  
DSC10xx  
*LVC MOS, up to 150MHz*  
*1.8V to 3.3V*



- Standard package, drop-in replacement to crystal oscillators
- Smallest differential oscillator on the market (2.5x2.0mm)
- -55 to 125°C
- AEC-Q100 capable, PPAP document ready for selected parts

**PureSilicon™**  
**Low Jitter Oscillators**  
DSC11xx  
*Diff or LVC MOS up to*  
*460MHz*

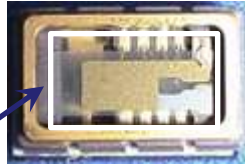


**Crystal-less™**  
**Clock Generators**  
DSC2xxx/DSC400/DSC5xx  
*up to 4 Outputs Diff and*  
*LVC MOS up to 460MHz*

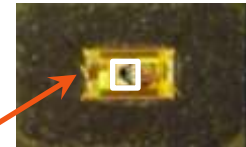


- Highly integrated clock gen with no external crystal
- Multiple outputs at different frequencies
- Save board space and BOM cost

# Benefits of MEMS



Quartz Crystal Oscillator in  
Metal+Ceramic Package



MEMS Oscillator in  
Plastic Package



## Performance: Stability & Jitter

- Up to 10ppm frequency stability
- Temperature grades up to -55 to 125°C
- Less than 0.5 ps phase noise jitter

## Higher Reliability

- Full AEC-Q100, JEDEC qualification
- 1.2 FIT rates vs. 20 FIT for crystal
- 50 000G shock and 70G vibration

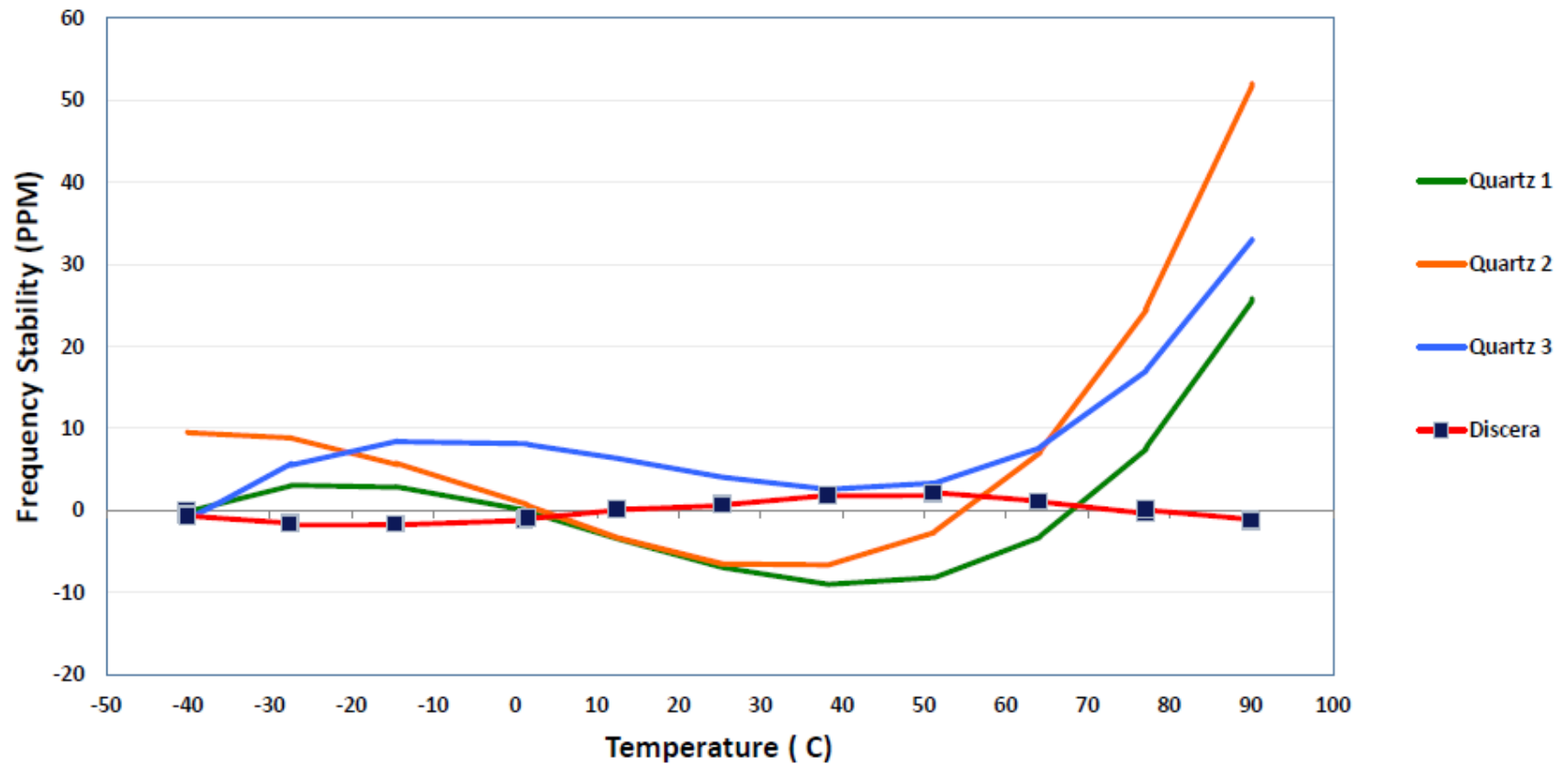
## Cost Effective

- Semiconductor supply chain, without mechanical handling steps of crystal
- On CMOS pricing trend, scaling with chip geometry

## Faster Time to Market

- 2-4 weeks production lead time
- Engineering samples programmable in 1 sec with full production performance

# Better Frequency Stability



# Best in Class Reliability

	Discera MEMS Oscillators	Quartz Oscillators	Improvement over Quartz	Test Condition
<b>MECHANICAL SHOCK</b>	50,000G	100G	<b>500 x</b>	MIL-STD-883; Method 2002
<b>VIBRATION</b>	70G	15G	<b>4.6 x</b>	MIL-STD-883; Method 2007
<b>FIT (Failure in Time)</b>	1.2	29	<b>24 x</b>	Confidence level = 90%
<b>MTBF</b>	1822MHR	90MHR	<b>24 x</b>	Confidence level = 90%
<b>DPPM</b>	< 10	100	<b>10 x</b>	Over Production Lifetime

# MEMS Oscillators

- **DSC10XX/DSC100X Low Power CMOS Oscillator**
  - As low as 3-mA Supply Current
  - Drop in Compatibility to quartz based products
  - Accurate stability down to 10ppm
- **DSC11X1/2/3/4 Low-Jitter Precision Oscillators**
  - As low as 0.3psec RMS Jitter
  - CMOS/LVPECL/LVDS/HCSL outputs
  - Drop in Compatibility to quartz based products
  - 2.5x2.0mm package (Only a few quartz suppliers offer)
  - Accurate stability down to 10ppm
- **DSC300X Ultra-miniature Precision Oscillators**
  - Industries smallest oscillator
  - 1.6mmx1.2mm CMOS output

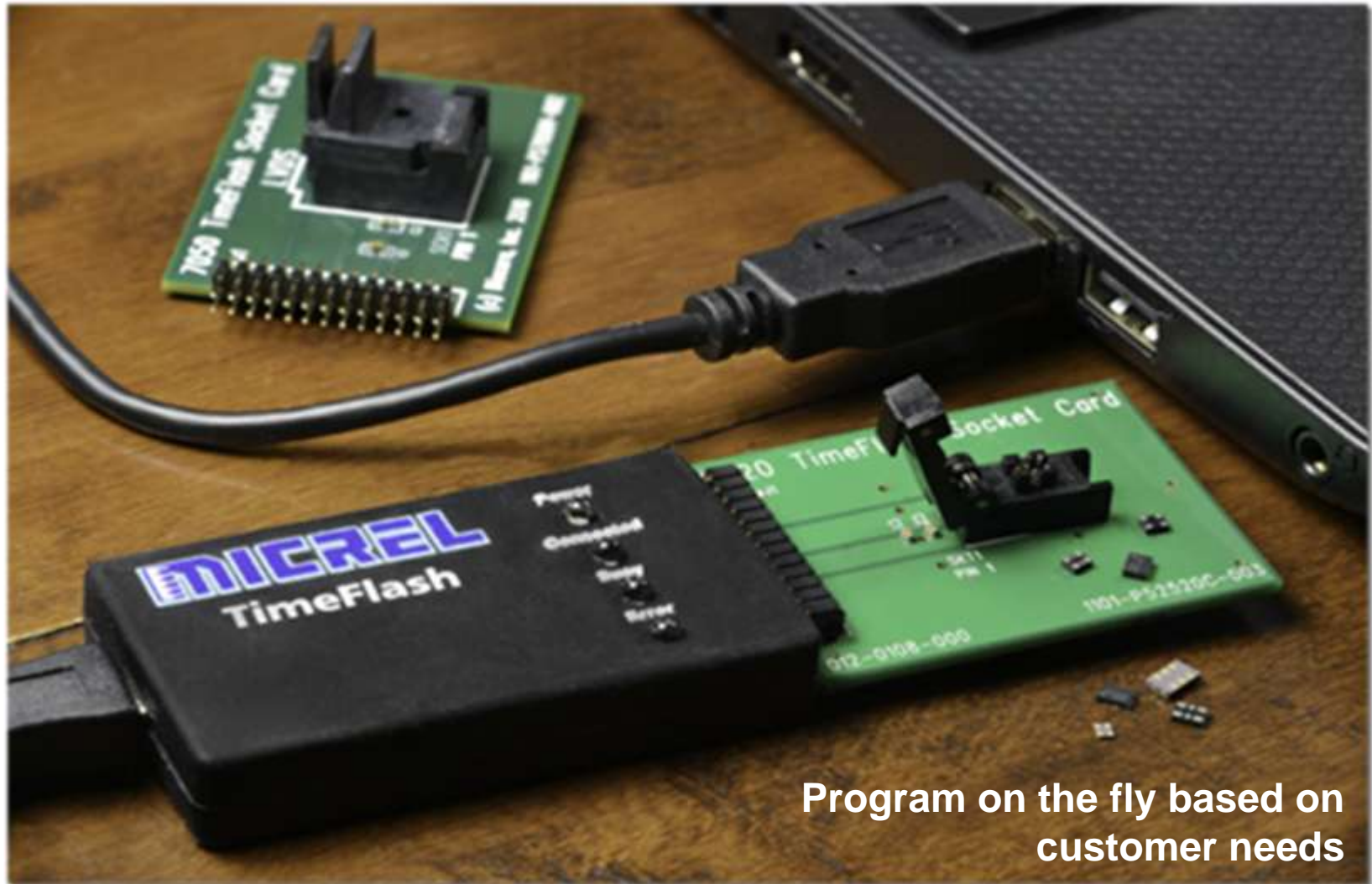
Best in Class Reliability  
(Shock and Vibration)  
Wide Temp Range

# MEMS Oscillators

## ● Pin to Pin Drop-in for Quartz

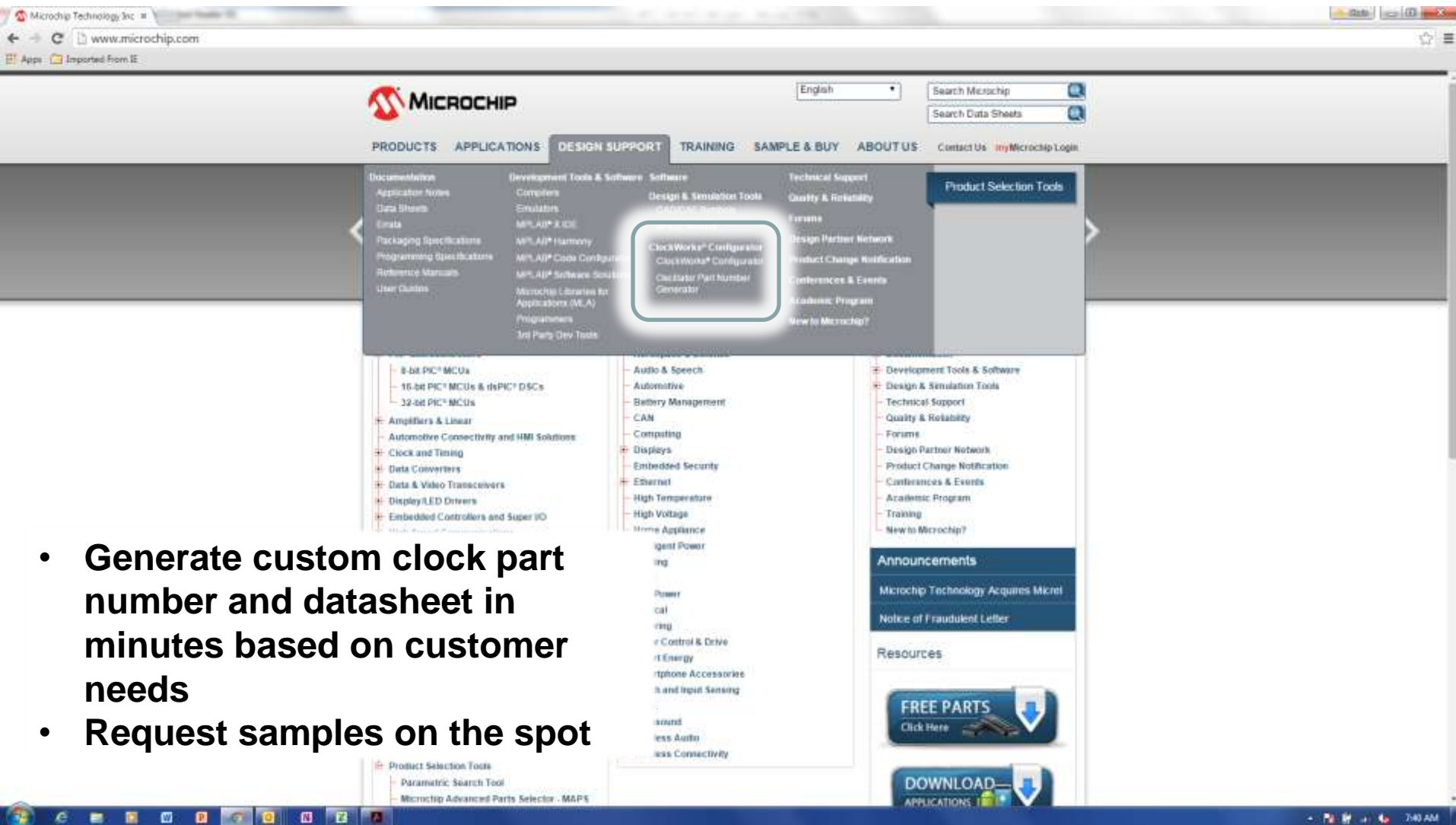
Family	Output Freqs (MHz)	Voltage (V)	Stability (PPM)	Temp Range (C)	Output Type	Package (mm)	Key Feature
<a href="#">DSC1001</a>	1.0-150	1.7-3.6	10-50	-40~+105	CMOS	2.5x2.0 to 5.0x7.0	15pF Load Low Power
<a href="#">DSC1003</a>	1.0-150	1.7-3.6	10-50	-40~+105	CMOS	2.5x2.0 to 5.0x7.0	25pF Load Low Power
<a href="#">DSC1004</a>	1.0-150	1.7-3.6	10-50	-40~+105	CMOS	2.5x2.0 to 5.0x7.0	40pF Load Low Power
<a href="#">DSC1018</a>	1.0-150	1.65-1.95	10-50	-40~+85	CMOS	2.5x2.0 to 5.0x7.0	Ultra Low Power (3mA)
<a href="#">DSC1025</a>	1.0-150	2.3-3.7	10-50	-40~+85	CMOS	2.5x2.0 to 5.0x7.0	Ultra Low Power (3mA)
<a href="#">DSC1028</a>	1.0-150	2.6-3.0	10-50	-40~+85	CMOS	2.5x2.0 to 5.0x7.0	Ultra Low Power (3mA)
<a href="#">DSC3001</a>	1.0-150	1.7-3.6	25-50	-40~105	CMOS	1.6x1.2	Ultra Miniature Package
<a href="#">DSC1101/DSC1121</a>	2.3-170	2.25-3.6	10-50	-55~+125	CMOS	2.5x2.0 to 5.0x7.0	Low Jitter (0.5ps RMS)
<a href="#">DSC1102/DSC1122</a>	2.3-425	2.25-3.6	10-50	-55~+125	LVPECL	2.5x2.0 to 5.0x7.0	Low Jitter (0.5ps RMS)
<a href="#">DSC1103/DSC1123</a>	2.3-425	2.25-3.6	10-50	-55~+125	LVDS	2.5x2.0 to 5.0x7.0	Low Jitter (0.5ps RMS)
<a href="#">DSC1104/DSC1124</a>	2.3-425	2.25-3.6	10-50	-55~+125	HCSL	2.5x2.0 to 5.0x7.0	Low Jitter (0.5ps RMS)

# TimeFlash Programming Kit



Program on the fly based on  
customer needs

# ClockWorks® Configurator

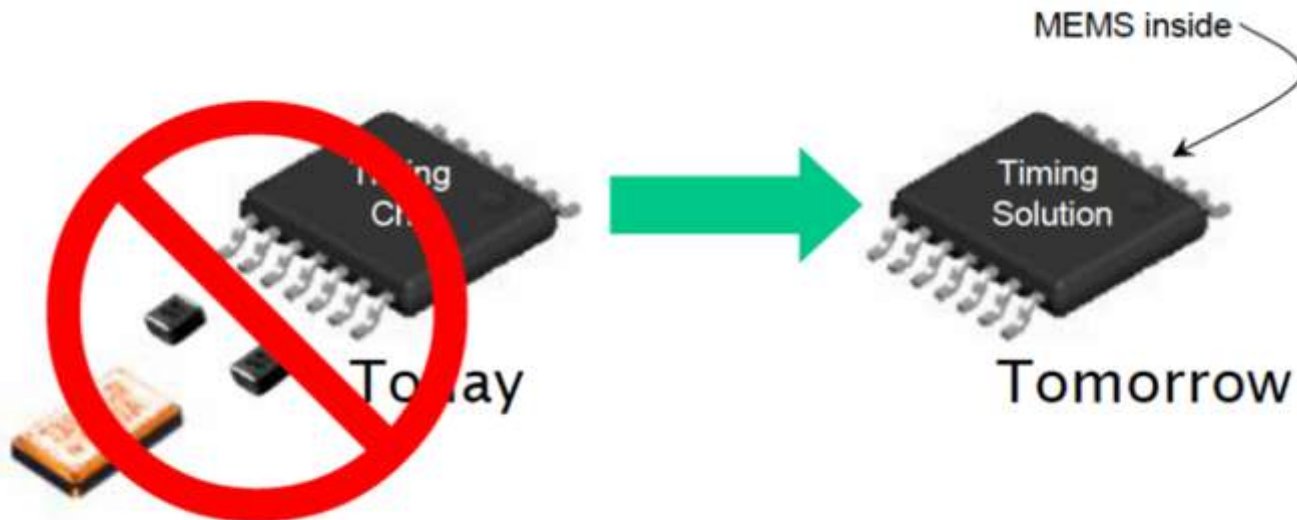


The screenshot shows the Microchip website interface. The top navigation bar includes links for PRODUCTS, APPLICATIONS, DESIGN SUPPORT, TRAINING, SAMPLE & BUY, and ABOUT US. The DESIGN SUPPORT section is expanded, showing various tools and resources. The ClockWorks® Configurator is highlighted in a box within the Design & Simulation Tools section. Below the navigation bar, there are several product categories listed, including 8-bit PIC® MCUs, 16-bit PIC® MCUs & dsPIC® DSCs, 32-bit PIC® MCUs, Amplifiers & Linear, Automotive Connectivity and HMI Solutions, Clock and Timing, Data Converters, Data & Video Transceivers, Display/LED Drivers, Embedded Controllers and Super I/O, Audio & Speech, Automotive, Battery Management, CAN, Computing, Displays, Embedded Security, Ethernet, High Temperature, High Voltage, Home Appliance, Intelligent Power, Industrial, Motor Control & Drive, Smart Energy, Telephone Accessories, and Vision and Input Sensing. The right sidebar contains sections for Product Selection Tools, Announcements, and Resources.

- **Generate custom clock part number and datasheet in minutes based on customer needs**
- **Request samples on the spot**

# Crystal-less™ Clock Generation

- Fewer components
- Less board space
- Improved reliability
- Reduced cost
- Complete timing solutions in a single package

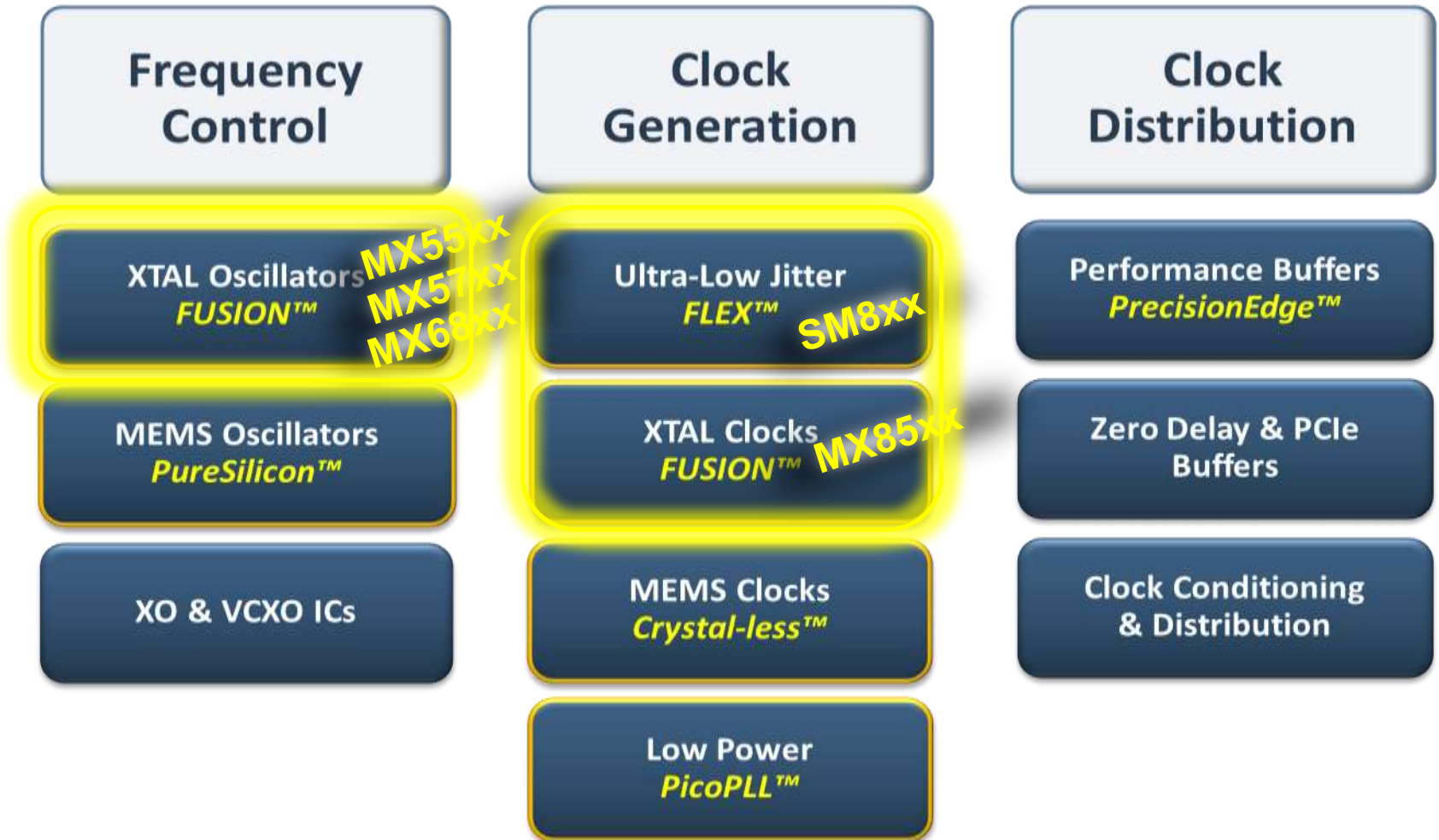




# Crystal-less™ Clock Generators

Status	P/N	Chipset / Standard	Frequency Standard	Brief Description	market / applications	Pack Type
Production	DSC2311	Custom, Factory Configurable	N/A	Factory customizable for any frequency	Embedded, Consumer, Networking	6-TDFN
	DSC2xxx					14-QFN
Production	DSC591-03	BMC family	50.000	Fixed frequency, selectable drive	Server, Enterprise Networks	14-QFN
	DSC592-03					6-TDFN
Production	DSC556-03	PCIe family	100.000	Industry Standard, widely used is multiple applications. 556-03 is lowest price point and supports gen.1 only All other parts support gen2 and gen3	Networking Embedded Consumer	14-QFN
Production	DSC557-03					14-QFN
Production	DSC557-04					20-QFN
Production	DSC557-05					20-QFN
Sampling	DSC571-04	XAUI family	100/125/156.25	This industry standard is applicable in 10G Ethernet applications, routers, server cards, ...	Networking	20-QFN
Evaluation	DSC571-05					20-QFN
Sampling	DSC531-03	SAS family	100/150	Storage specific applications mainly in expansion cards and SSD	Storage	14-QFN
Evaluation	DSC532-03					20-QFN
Evaluation	DSC520-03	Video oIP	24/25/27	Space & BOM saving solution; replace xtals	Consumer	6-TDFN

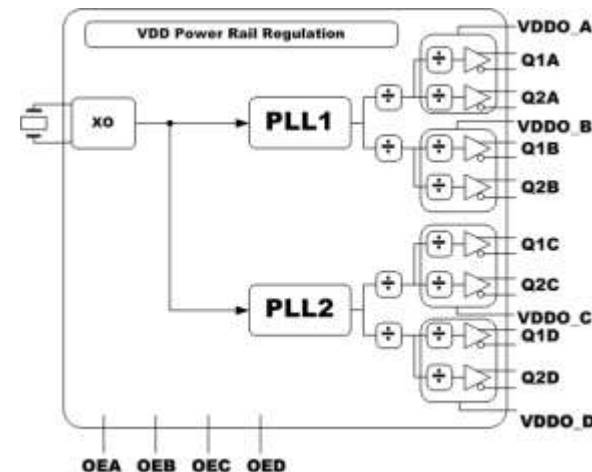
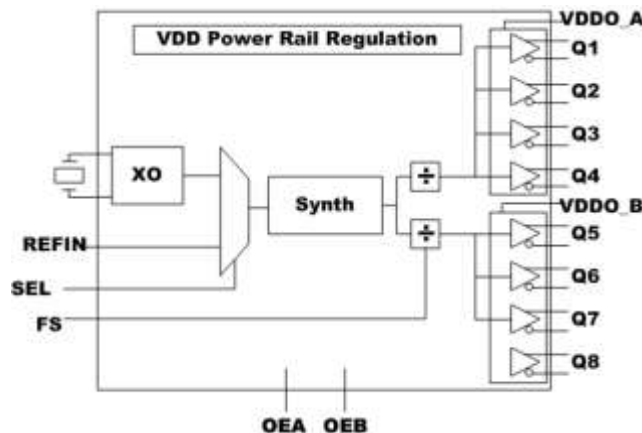
# Clock & Timing Portfolio



# Ultra-Low Jitter Clocks

- Highly integrated and flexible multi-output

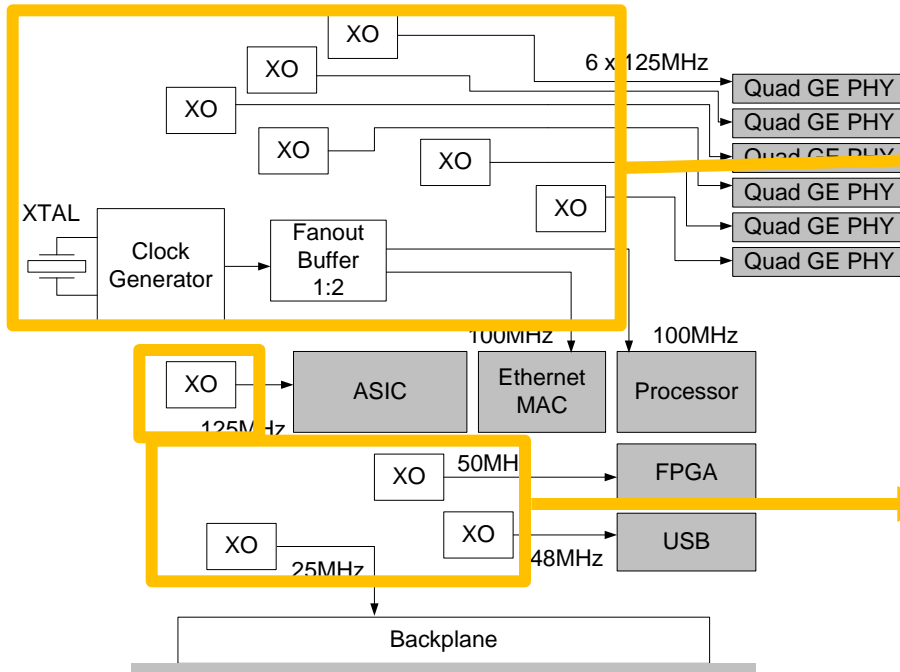
	SM802	SM803/813
Output Logic	LVDS, LVPECL, HCSL, LVCMOS	
Number of outputs	8	12
Vddo banks	2	4
Jitter (fs) 12kHz-20MHz	200	160/120
Frequency	Any frequency programmable to 850MHz	Any frequency programmable to 850MHz
Package	16 to 44 pin QFN	48 and 84 pin QFN



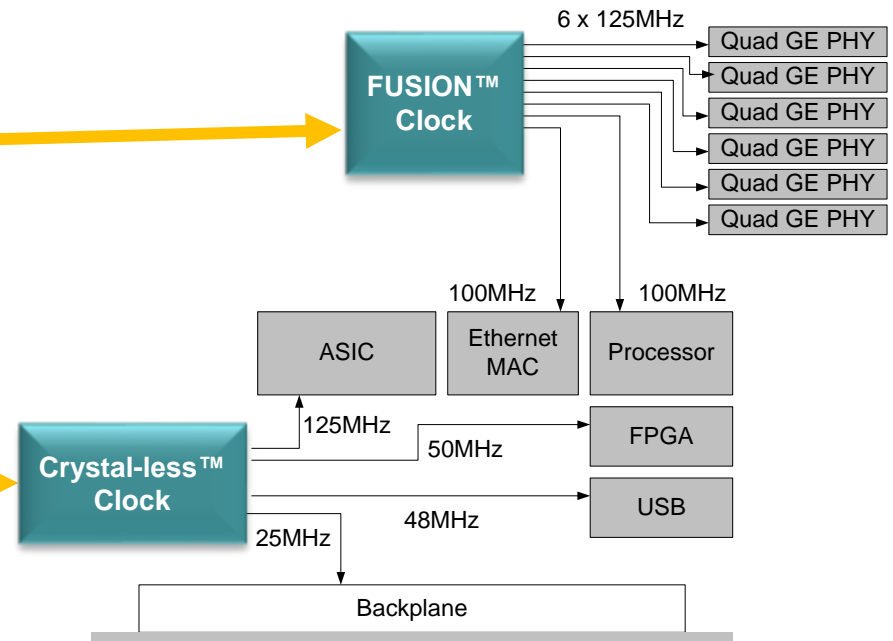
# BOM Cost Reduction

Complicated, messy discrete clock tree:  
**12 components** ...

...replaced with Microchip's integrated  
solution: **2 devices!**



*High density GbE switch*

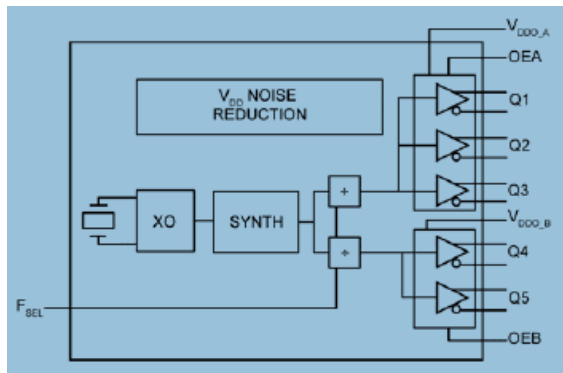


- ✓ Simplified customer design
- ✓ Lowered system BOM cost
- ✓ Accelerated time-to-market

# Ultra-Low Jitter Clocks w/ Integrated XTAL

- Integrated crystal and multiple outputs for a complete clock tree in a single package

	MX55/57	MX68	MX85
Output Logic	LVDS, LVPECL, HCSL, LVCMOS		
Jitter (fs)	180fs	47	200
Outputs	1	1	Up to 5
Frequency	Programmable to 850MHz	156.25/125/100/50 MHz	Programmable to 850MHz
Size(mm)	5x3.2 5x7	5x7	5x7



# Typical Applications

- **Security and Video Surveillance**

- Rugged outside
- Small package with integration

- **Enterprise Storage**

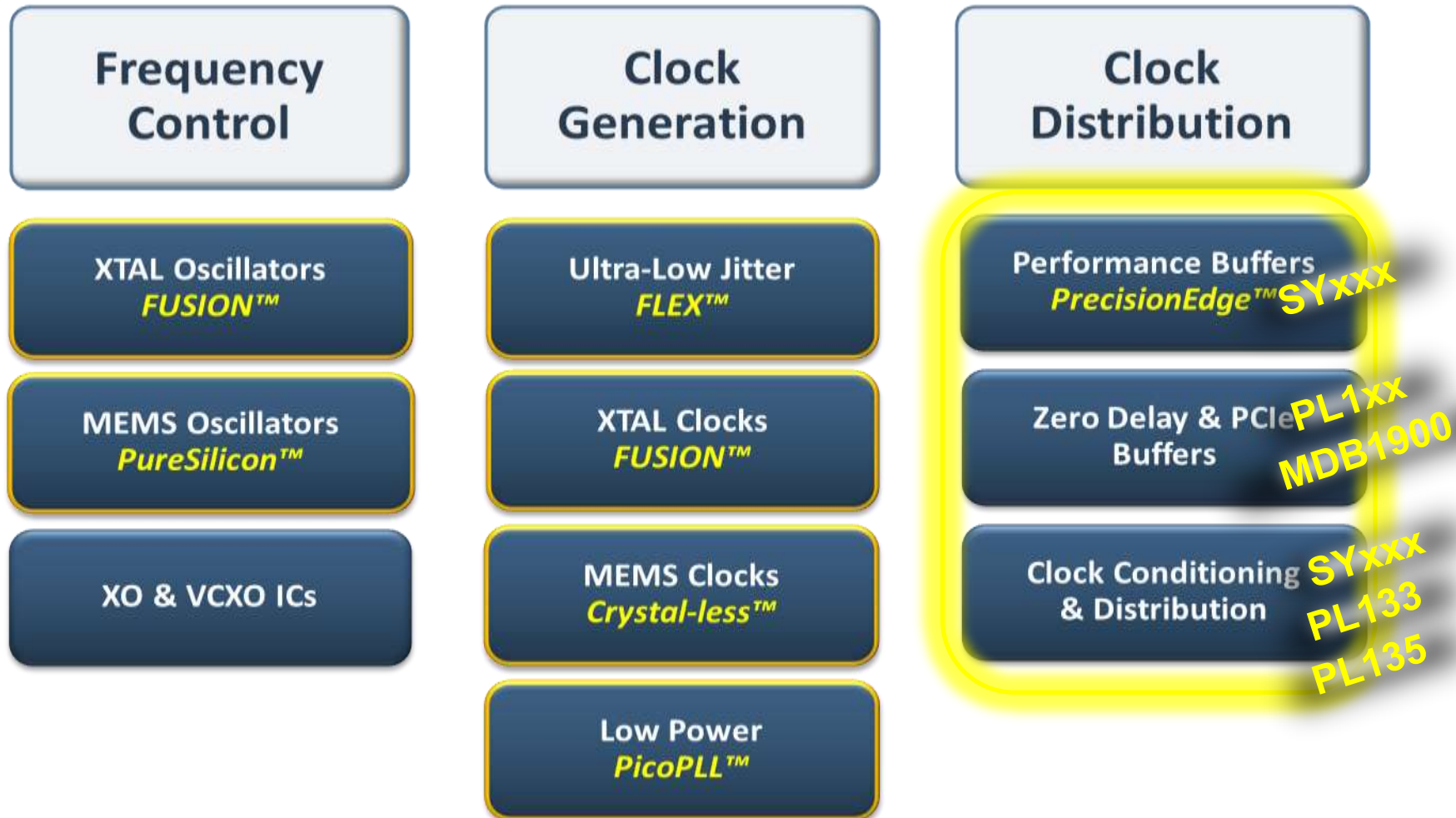
- RAID Controller Card
- Enterprise or consumer SSD

- **Automotive**

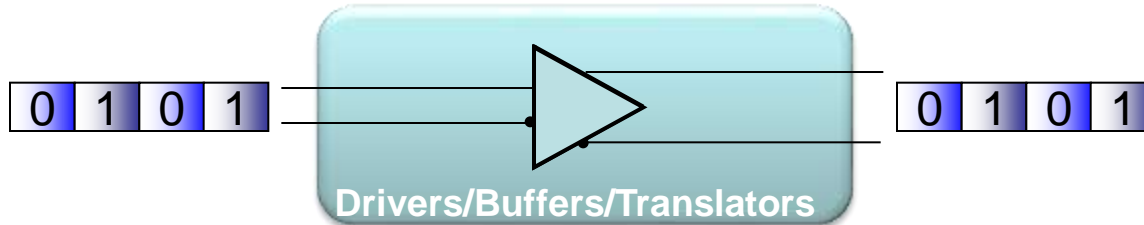
- Automotive Diagnostics
- Infotainment and Connectivity
- Smart Actuators for transmission and engine controls



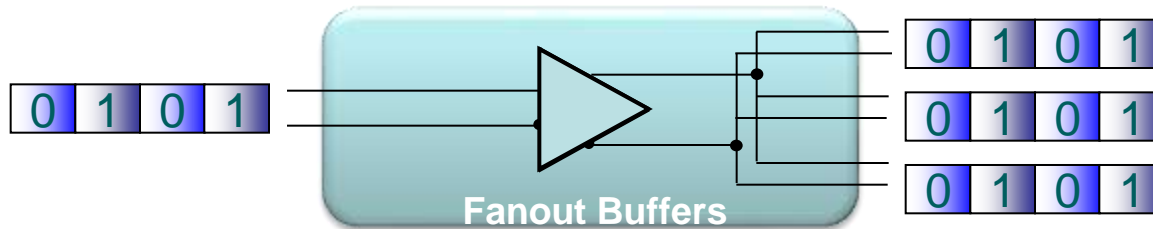
# Clock & Data Distribution



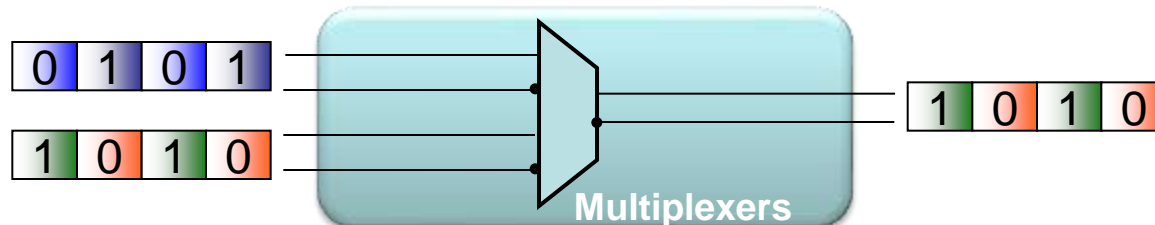
# Clock & Data Distribution Products



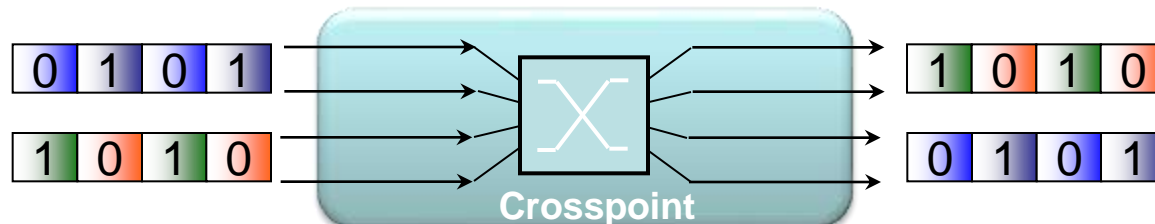
- 1, 2, 4, or 6 channel buffers
- Single-ended  $\leftrightarrow$  Differential



- 2, 4, 6, 10...22 outputs

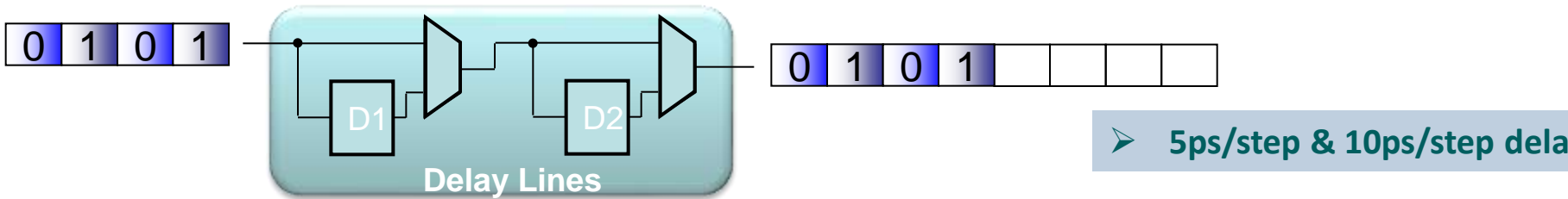
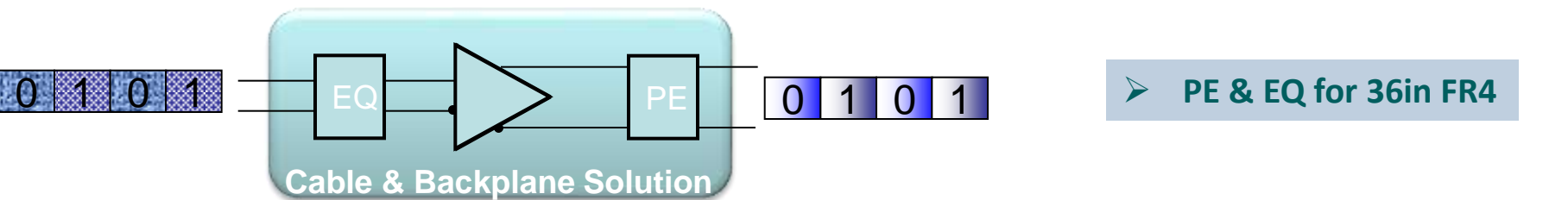
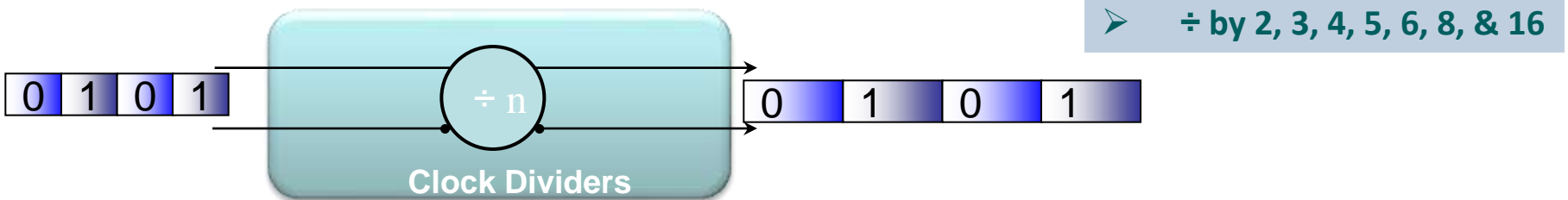


- 2, 4 or 8 inputs















- 2x2 & 4x4
- w/ & w/o EQ

# Clock & Data Distribution Products (cont'd)



# Complete PCIe Solutions

	1-Output	2-Output	4-Output	8-Output
PCIe CLK Generators	 <b>PL602-2X</b> <ul style="list-style-type: none"> <li>• 6-SOT/8-SOP</li> <li>• 2.5V ~ 3.3V</li> <li>• 25/100/125/200MHz</li> </ul>	 <b>PL60203X</b> <ul style="list-style-type: none"> <li>• 16-QFN</li> <li>• 2.5V ~ 3.3V</li> <li>• 25/100/125/200MHz</li> </ul>	 <b>PL602041</b> <ul style="list-style-type: none"> <li>• 24-QFN</li> <li>• 2.5V ~ 3.3V</li> <li>• 25/100/125/200MHz</li> </ul>	 <b>PL60208X</b> <ul style="list-style-type: none"> <li>• 44-QFN</li> <li>• 2.5V ~ 3.3V</li> <li>• 25/100/125/200MHz</li> </ul>
PCIe CLK Gen. with EMI		<div> <u>Replaces</u>            ICS557-03, IDT5V41065 ,            IDT5V41235            Pericom, On Semi, and            Cypress footprints as well         </div>	 <b>PL60704X</b> <ul style="list-style-type: none"> <li>• 24-QFN, 2.5V ~ 3.3V</li> <li>• 25/100/125/200MH</li> <li>• Programmable SST</li> </ul>	 <b>PL60708X</b> <ul style="list-style-type: none"> <li>• 44-QFN, 2.5V ~ 3.3V</li> <li>• 25/100/125/200MH</li> <li>• Programmable SST</li> </ul>
Crystal-less PCIe CLK Gen.	 <b>DSC1124</b> <ul style="list-style-type: none"> <li>• 6-pin DFN, 2.5x2.0mm</li> <li>• 2.5V ~ 3.3V</li> <li>• 100-460MHz</li> </ul>	 <b>DSC557-03</b> <ul style="list-style-type: none"> <li>• 16-TSSOp, 14-QFN</li> <li>• 2.5V ~ 3.3V</li> <li>• 100-460MHz</li> </ul>	 <b>DSC557-05</b> <ul style="list-style-type: none"> <li>• 20QFN</li> <li>• 2.5V ~ 3.3V</li> <li>• 100-460MHz</li> </ul>	
PCIe Buffers		 <b>SY75572</b> <ul style="list-style-type: none"> <li>• 16-QFN</li> <li>• 3.3V</li> <li>• 200fs Phase Jitter</li> </ul>	<div> <u>Second source</u>            IDT557-06            IDT5V41067A         </div>  <b>SY75576</b> <ul style="list-style-type: none"> <li>• TSSOP20</li> <li>• 3.3V</li> <li>• 200fs Phase Jitter</li> </ul>	 <b>SY75578</b> <ul style="list-style-type: none"> <li>• 5x5-QFN32</li> <li>• 3.3V</li> <li>• 200fs Phase Jitter</li> </ul>



**MICROCHIP**

**Supertex**

[Return to Topics](#)

# LED Drivers

## General Purpose

HV9801A

HV9803B

HV9805

HV9861A

HV9910B

HV9910C

HV9918

HV9919B

HV9921/2/3

HV9925

HV9930

HV9931

## Backlighting

HV9803

HV9911

HV9912

HV9961

HV9963

HV9967B

HV9980

HV9982

HV9989

## Sequential Linear

CL8800

CL8801

### Automotive

AT9917

AT9919

AT9932

AT9933

## Linear Regulators

CL2

CL25

CL220

CL320

CL325

CL330

CL520

CL525

CL6

CL7

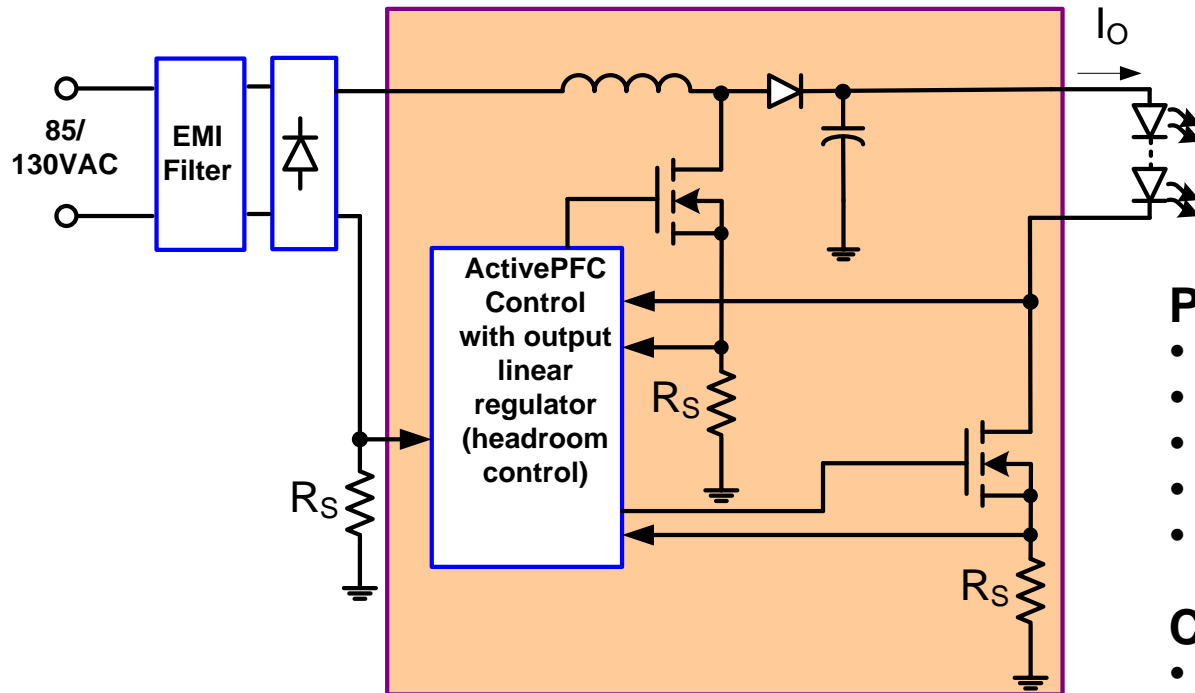
**NEW!**

# HV9805 Features

---

- **PFC Boost converter (1<sup>st</sup> stage)**
  - rated for 25W(120VAC), 50W(230VAC)
  - no auxiliary winding required for  $V_{DD}$  supply, simple inductor
- **Linear post-regulator (2<sup>nd</sup> stage)**
  - control constant LED string current ( $\pm 4\%$ )
  - low headroom voltage design, high efficiency
  - protects LED load from bus overvoltage

# Active PFC: Boost with Headroom Control



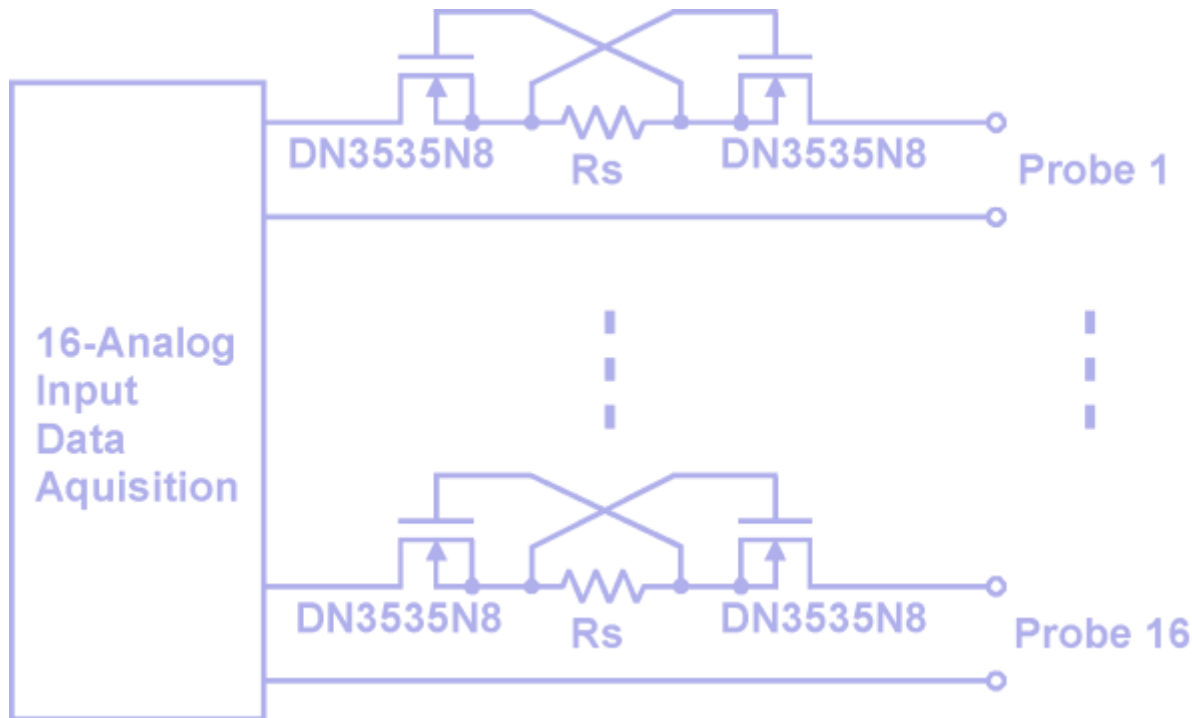
## Pros:

- No 100/120Hz flicker (!)
- Short circuit protection
- Great efficiency
- Low EMI
- Low cost

## Cons:

- High LED string voltage
- Lack of design flexibility

## DN3535N8 for Data Acquisition



The DN3535N8 are used as current limiters to protect the low voltage measurement circuitry

An external source resistor is used to set the current limit value

### Key Features:

- High voltage: 350V
- Low  $R_{ds(on)}$ : 10  $\Omega$
- Small package: SOT-89
- Depletion mode
- Low capacitance

## Voltage Limiter for Farm Equipment

Transient Requirements for Farm Equipment  
Transients are capable of up to 106V / 35A for hundreds of ms

Conventional protection is to clamp the high voltage transients using large suppressors

With 35Amps, PC board traces can be damaged unless made very wide

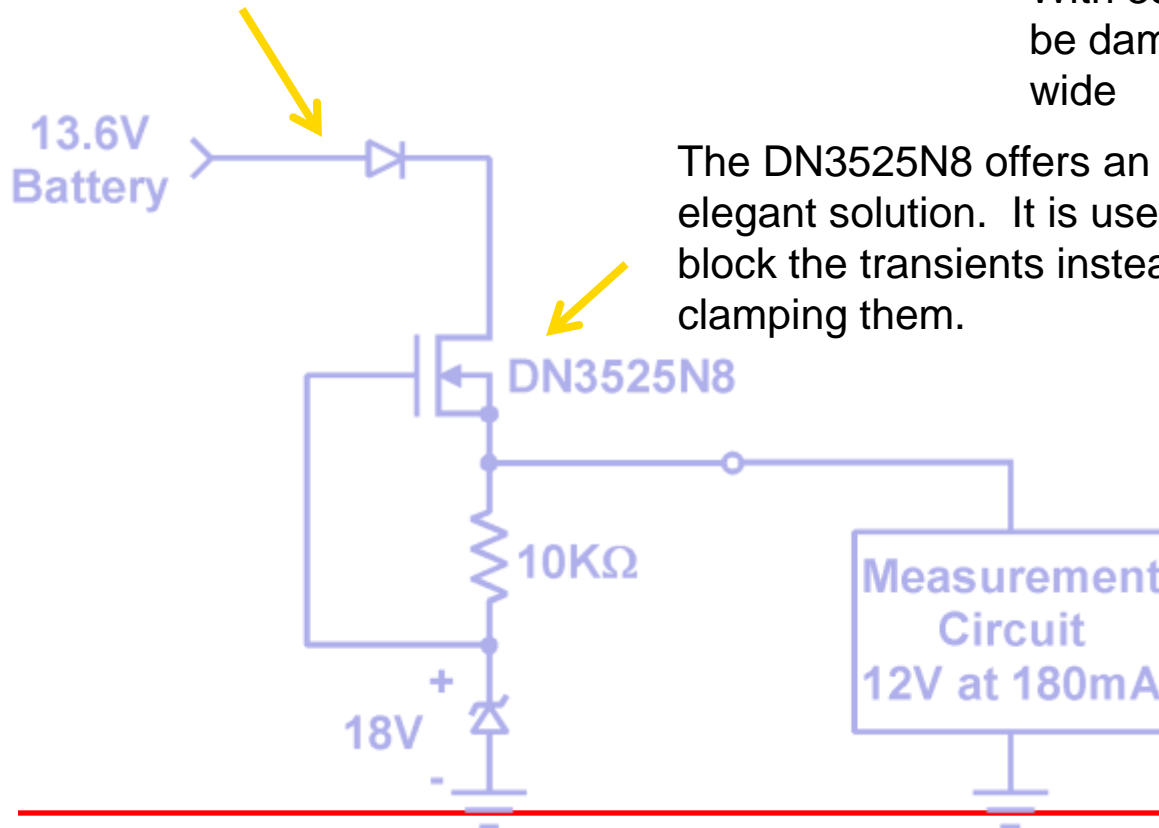
### Key Features:

High voltage: 250V  
Small package: SOT-89  
Depletion mode  
No add'l supply req't

The DN3525N8 offers an elegant solution. It is used to block the transients instead of clamping them.

The 250V FET can easily handle the 106V transient. During normal operation

The  $6\Omega$   $R_{ds(on)}$  will only drop 1.1V under full load.

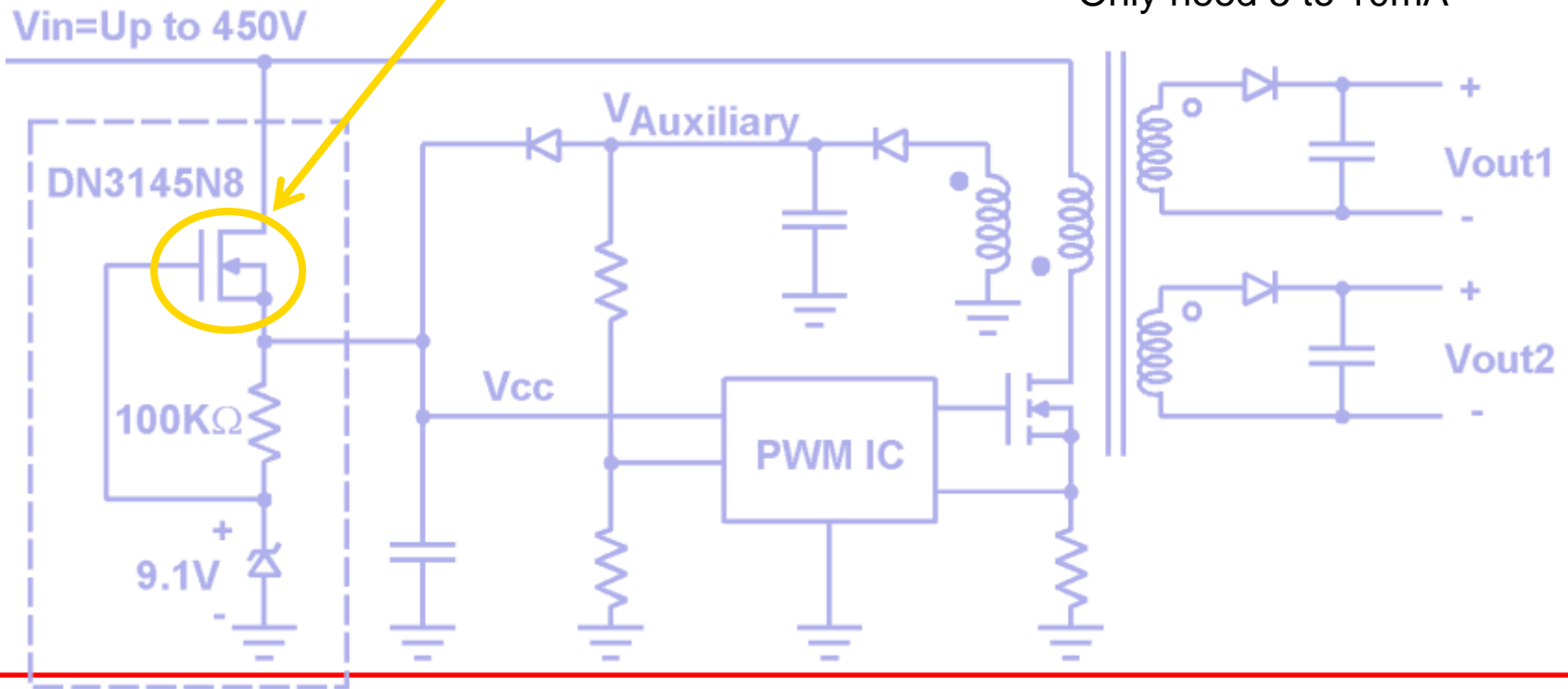


## SMPS Start-Up Circuit

DN3145N8 used in a start-up circuit for a small power supply in a down hole application

### Key Features:

- 450V rating
- Small SOT-89 package
- Only need 5 to 10mA



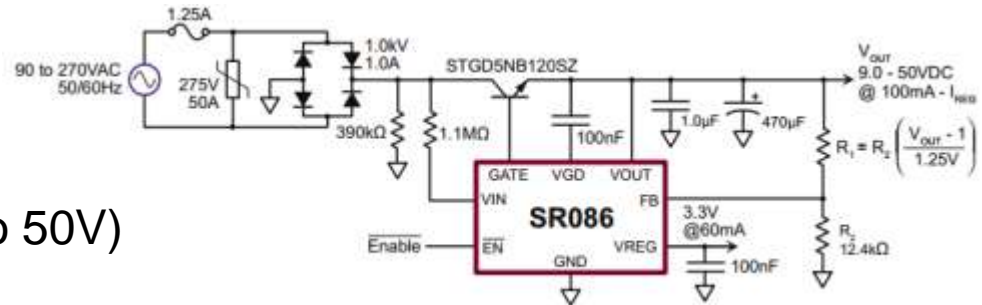
# Specialty ICs

## Inductorless Off-Line Regulator ICs

Device	V <sub>IN</sub> (VAC)	Adjustable V <sub>OUT</sub> (V)	Fixed V <sub>OUT</sub> (V)	I <sub>OUT</sub> max (mA)	Load Regulation (%/mA)	Package Options	Application Notes	Demoboards
<a href="#">SR086</a>	80 - 285	9.0 - 50	3.3	100	0.025	8-Lead SOIC w/ Heat Slug	-	<a href="#">SR086DB1</a>
<a href="#">SR087</a>	80 - 285	9.0 - 50	5.0	100	0.017	8-Lead SOIC w/ Heat Slug	-	<a href="#">SR087DB1</a>
<a href="#">SR10</a>	80 - 285	6.0 - 28	6.0, 12, 24	60	-	8-Lead SOIC	<a href="#">AN-H65</a>	<a href="#">SR10DB1</a>

## Features:

- Efficient operation without magnetics
- No high voltage capacitors
- Adjustable main output voltage (9.0 to 50V)
- Additional 3.3V internal regulator
- Up to 100mA combined output current
- Single BOM for 120VAC/230VAC
- Built-in soft start
- Less than 200mW standby power
- Operating Temperature Range: -40°C to +125°C
- Package Options: SOIC-8 w/Heat Slug





**MICROCHIP**

***Thank you!***

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