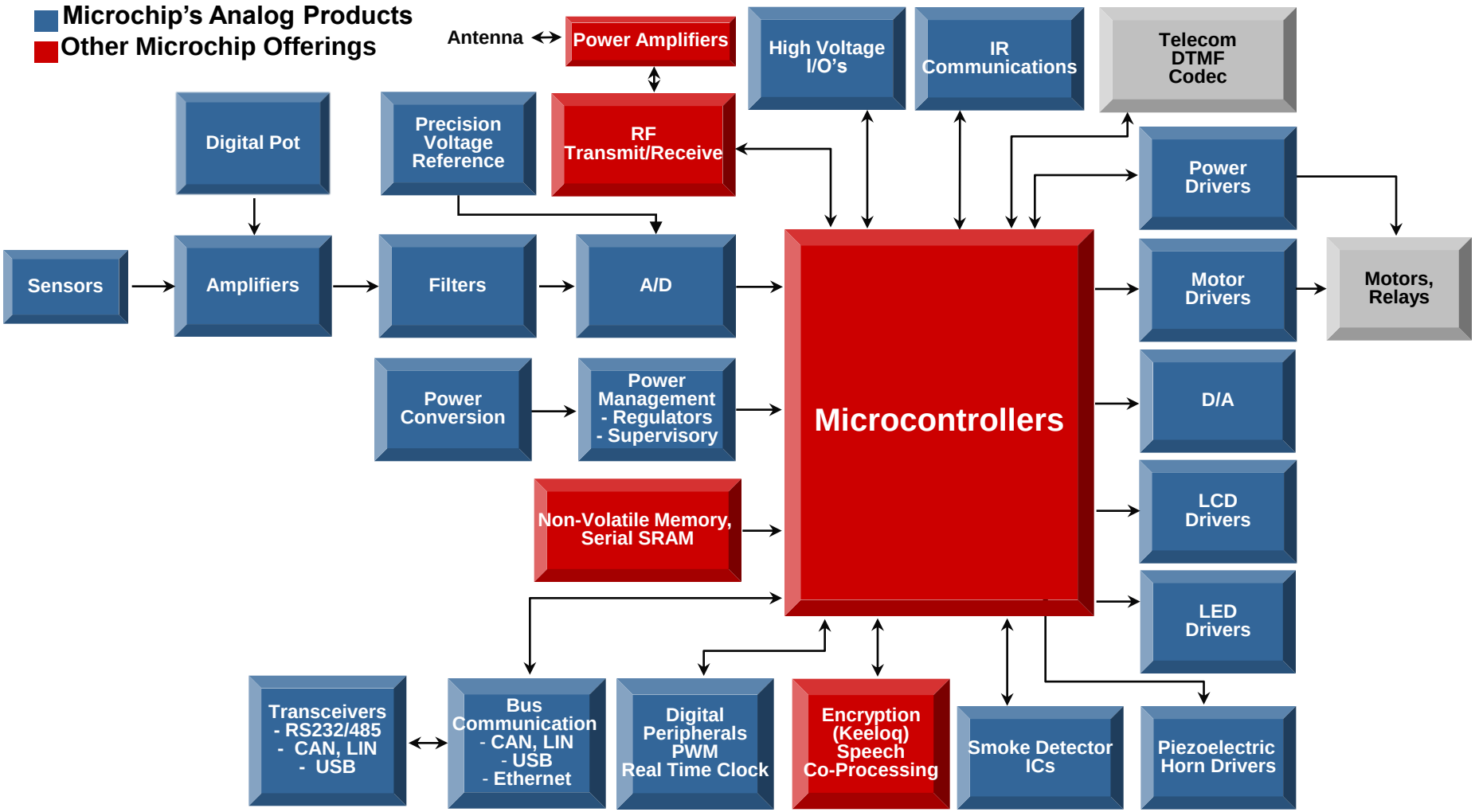
Masters 2015, Russia Analog Overview

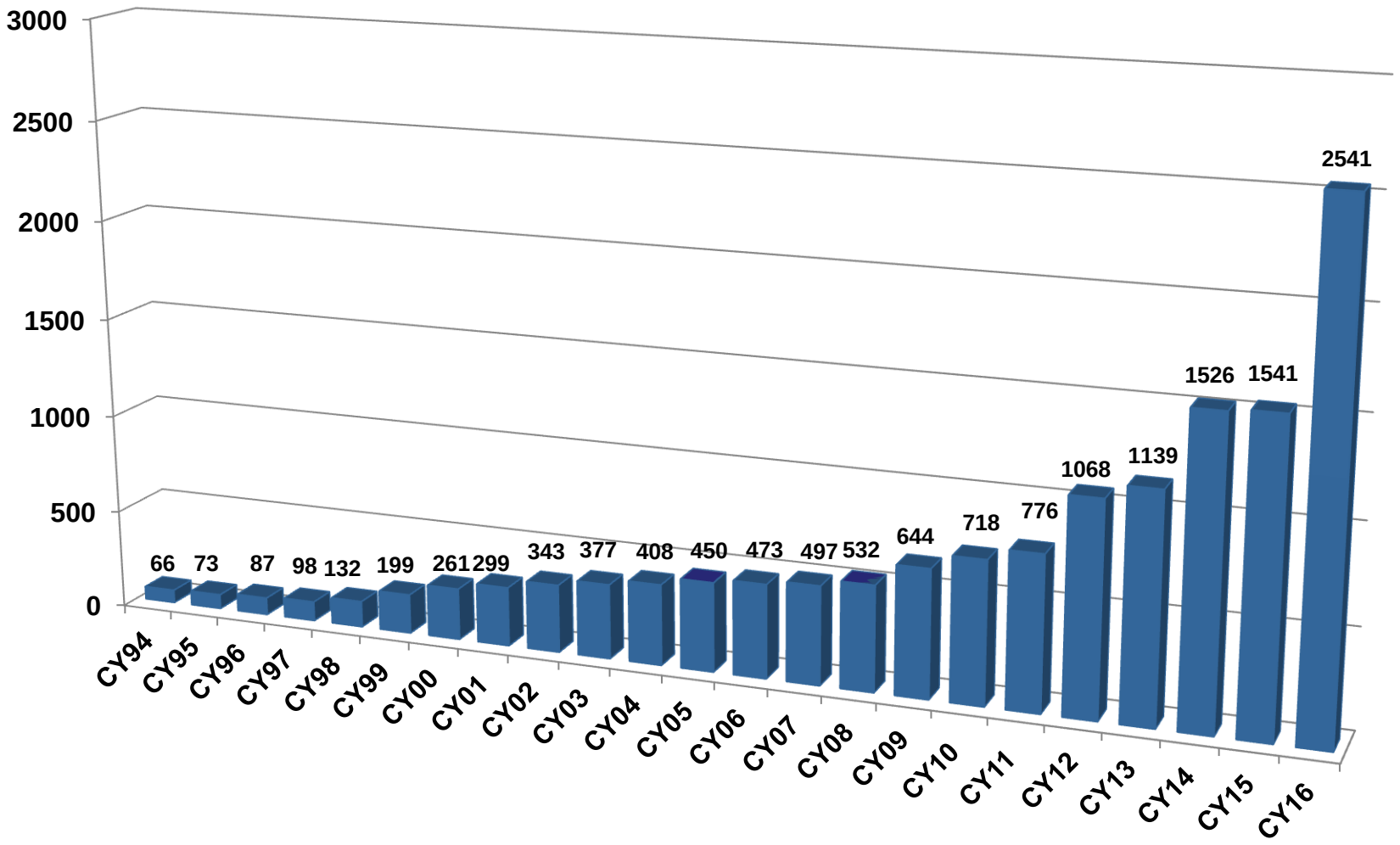
Mikhail Mishan

October 2015

Universe of Embedded Control Systems



Microchip Analog Product Portfolio Growth



Expanding Solutions

- Temperature Management
- Linear Products
- Power Management
- CAN/LIN Interface Products
- Motor Controllers
- A/D Converters
- Smoke Detectors

Analog & Interface Products

THERMAL MANAGEMENT

- Temperature Sensors
- Fan Control and Hardware Management

LINEAR

- Op Amps/INAs
- Comparators
- RF Power Amplifiers, PGA, SGA

SAFETY AND SECURITY

- Smoke Detector ICs
- Piezoelectric Horn Drivers

POWER MANAGEMENT

- Linear Regulators
- Switching Regulators
- Digitally-Enhanced & PWM Controllers
- Charge Pump DC/DC Converters
- Battery Management
- USB Port Power Controller
- System Supervisors Voltage Detectors
- Power MOSFET Drivers
- Power MOSFETs
- Updates

MIXED SIGNAL

- Pipelined A/D Converters
- Delta-Sigma & SAR A/D Converters
- Energy Measurement ICs
- Current/DC Power Measurement ICs
- Dual Slope / Display A/D Converters
- D/A Converters
- Digital Potentiometers
- Voltage References

INTERFACE

- CAN/LIN
- USB and I/O Expanders
- Ethernet
- Wireless
- Real Time Clock/Calendar

MOTOR DRIVER

- Stepper, DC and 3Φ Brushless
- Supertex

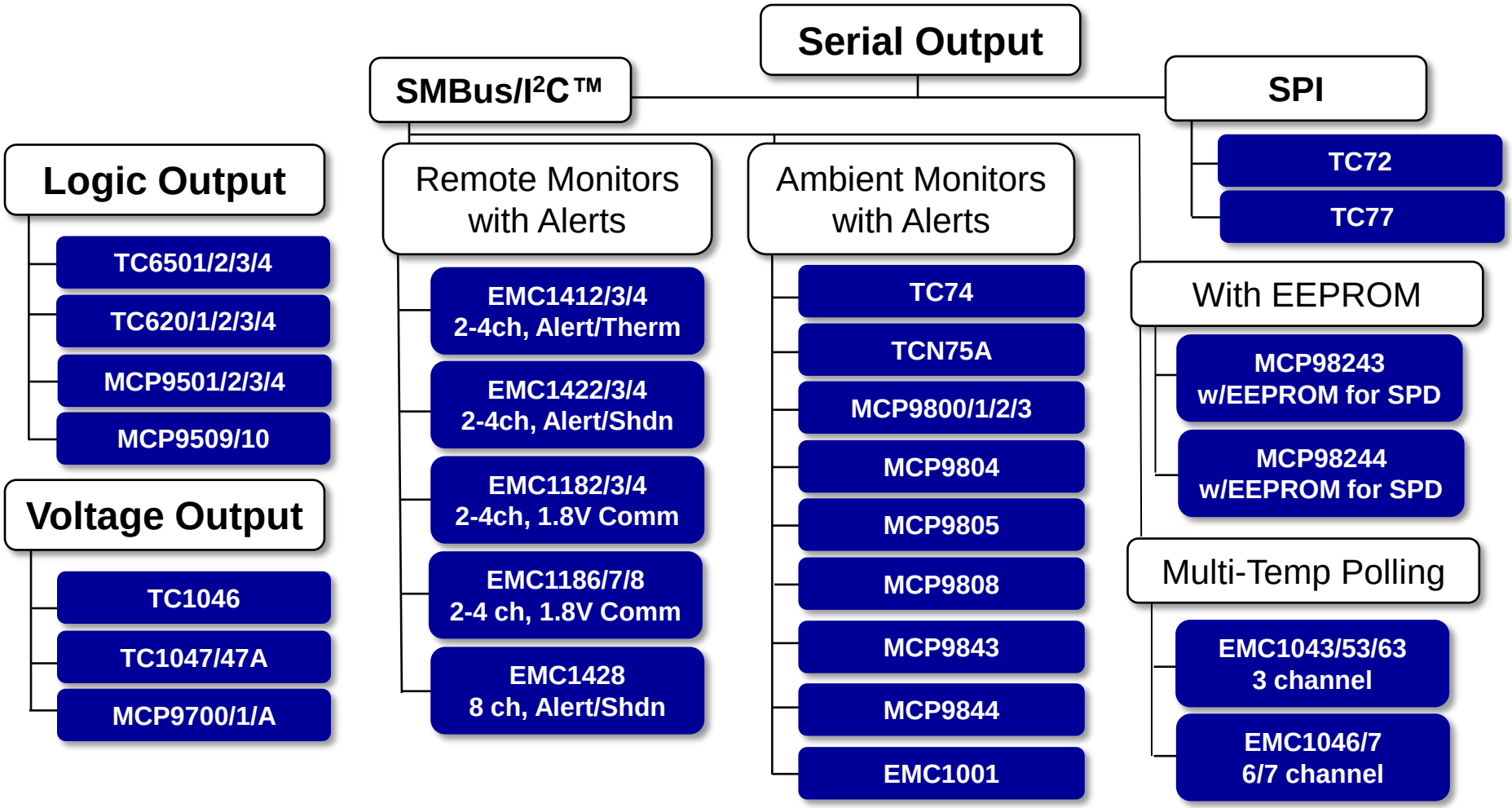
Demo & Eval Boards | Overview | End Equipments

Click on boxes to navigate

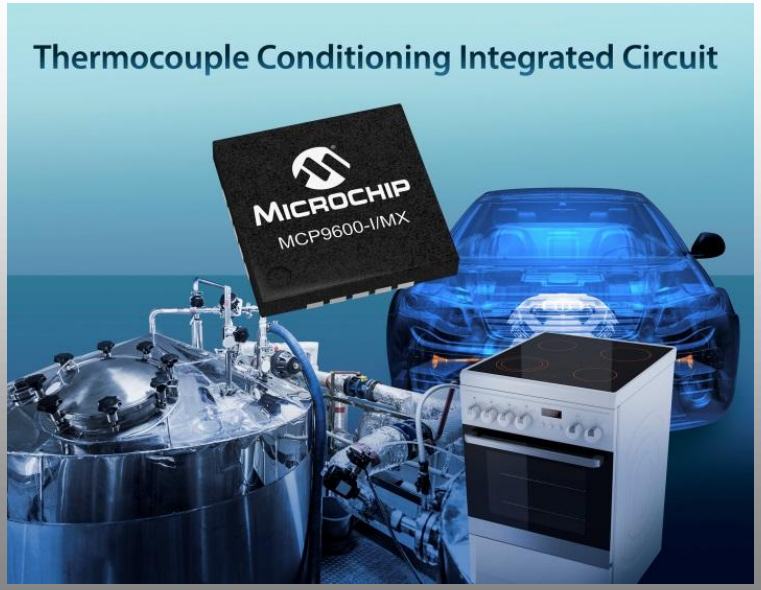
Thermal Management

- **Microchip offers complete, competitive product portfolio**
- **Ambient Sensors**
  - Digital Output: I^2C and SPI (MIC280)
  - Analog Output
  - Temp Switch
- **Multi-point Remote Temperature Monitoring**
- **Fan Speed Control**

Temperature Sensors



World's First Integrated Thermocouple Electromotive Force to Degrees Celsius Converter From Microchip Saves Design Effort, Space and Cost



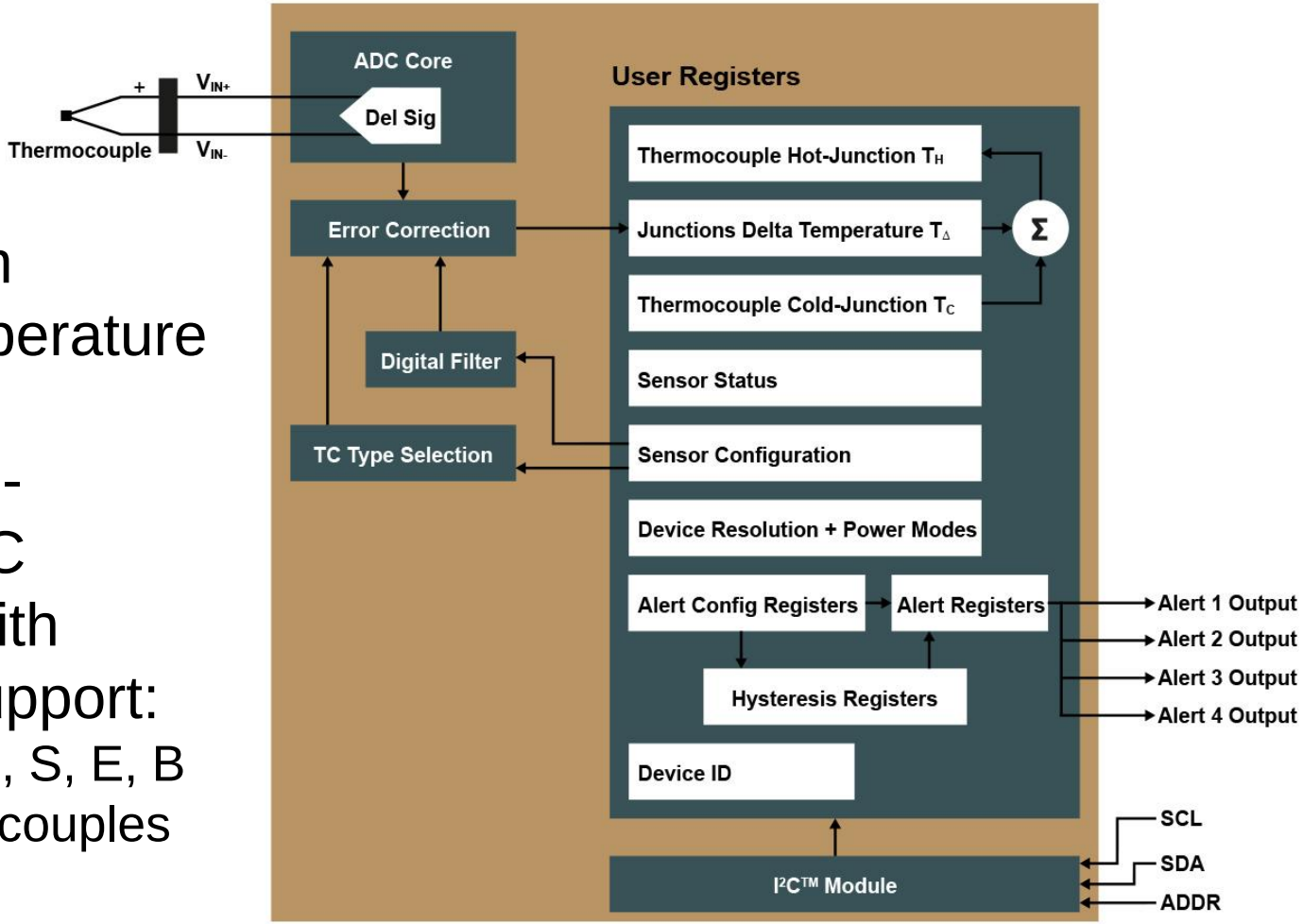
MCP9600
Thermocouple to ºC Converter

- **Fully integrated thermocouple EMF to I²C converter**
  - Provides 1ºC temperature accuracy
  - Reduces required expertise in analog, mixed signal, thermal management, and microcontroller design.
  - Integrated features simplify design, reduce development time and improve system performance.
- **Applications**
  - Boilers, furnaces, kilns, smelters
  - Ovens, refrigerators, freezers, water heaters
  - Temp. monitor of exhaust, cylinder head, general temperature monitoring
  - Thermal monitoring of motors, chemicals, furnaces

High Level of Integration

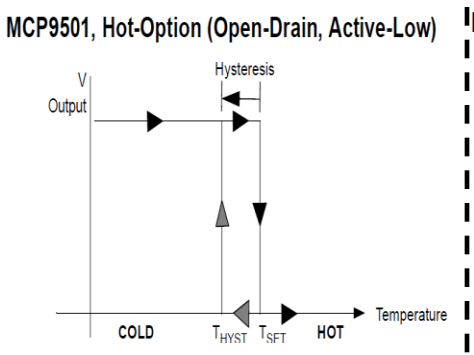
Integrates:

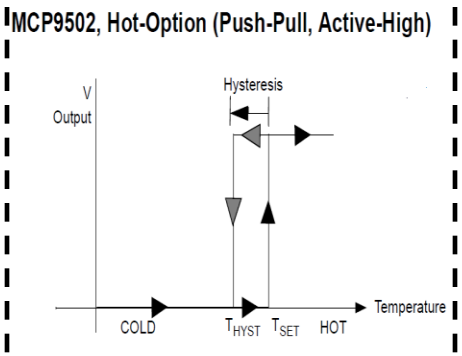
- Precision Instrumentation
- Precision Temperature Sensor
- Precision, High-Resolution ADC
- Math Engine with Firmware to Support:
  - Type K, J, T, N, S, E, B and R Thermocouples

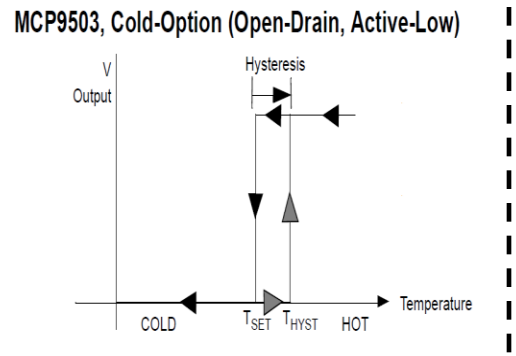


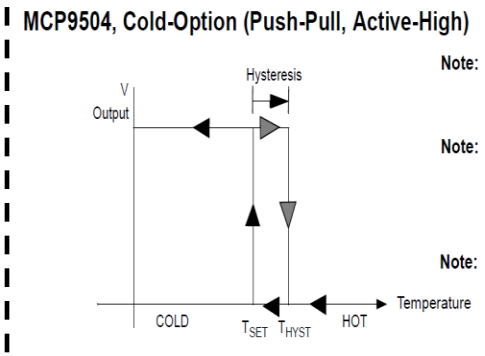
What is an Temperature Switch?

- **A temperature switch is a device that monitors ambient temperature and signals the system if the temperature is above or below a set temperature limit.**
  - The temperature limit can be set by the factory (MCP9501/2/3/4, TC6501/2/3/4)
  - The temperature limit can be set by the customer via an external resistor (MCP9509/10)









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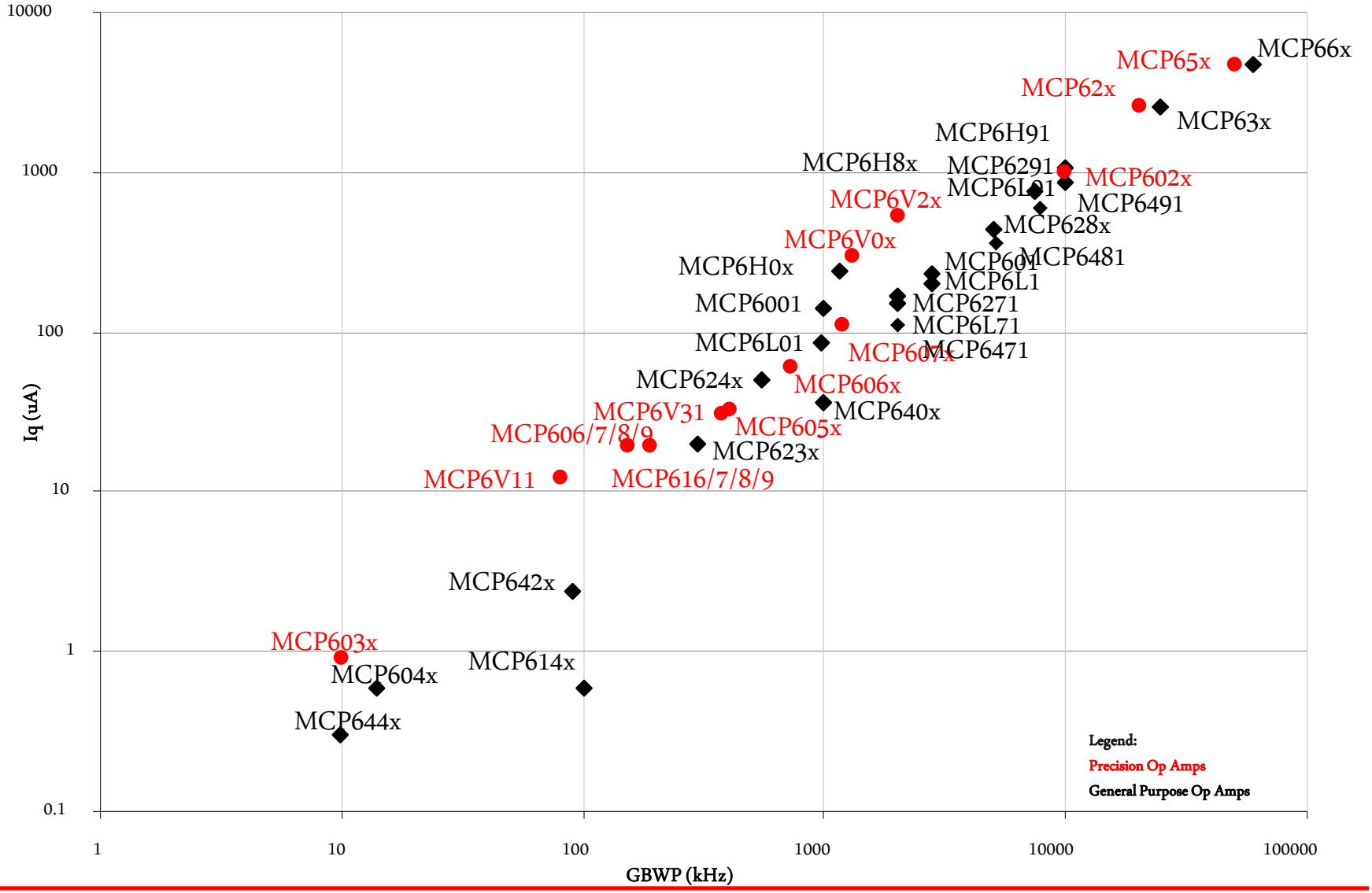
MCHP: Lowest current for given GBWP



Linear Products

- **Low Power MCP64xx family**
  - Low Quiescent Current (450 nA), 1-1.5mV Offset, low Bias Current (up to 125C)
- **Zero-Drift Amplifier:**
  - The #1 Key spec (Input Offset Drift) improved by 2-5 times
  - Beats the competition parts
- **INA portfolio**
  - MCP6N16 - Higher performance MCP6N11

Hot Product Update
Zero-Drift Amplifiers

MCP6Vxx

What Problem Does the MCP6Vxx Solve?

- **Applications Requiring Ultra High Precision**
  - Zero-Drift architecture provides superior performance
    - Ultra low initial offset, low offset drift, eliminates 1/f noise, superior common mode and power supply rejection
- **Space Constrained Applications**
  - Small packaging including SOT-23, SC-70, TDFN, MSOP and TSSOP

Microchip's Zero-Drift Op Amp Portfolio

- **MCP6V0x**
  - 1.3 MHz GBWP, industry leading offset performance, 2x3 TDFN smallest package
- **MCP6V2x**
  - 2 MHz GBWP, industry leading offset performance, available in popular MSOP
- **MCP6V1x**
  - 80 kHz GBWP, lowest power ZD amplifier on the market, SC-70 and SOT-23 singles
- **MCP6V3x**
  - 300 kHz GBWP, SC-70 and SOT-23 singles

Zero-Drift Design Win Examples

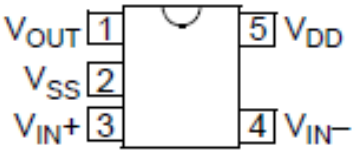
- Weight Scales
- Oxygen Sensor
- Temperature Transmitter
- Methane Detector
- Fire Detection
- Lighting
- Flow Meters
- Alcohol Tester
- Thermocouple Isolator
- Current Sensor
- Appliances
- Cryogenics
- Power Supplies
- Gas Meters

MCP6V1x High Performance Amplifiers

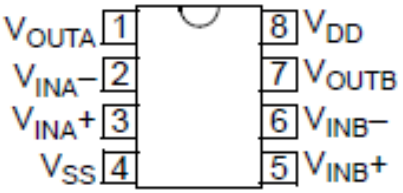
The Lowest Current per GBWP for a Zero-Drift Amplifier on the Market!

- **Zero-Drift Architecture**
  - Low voltage offset, 8 µV maximum
  - Low offset drift, 50 nV/°C
  - No 1/f noise
  - High CMRR/PSRR (~120 dB minimum)
- **Low Power**
  - 11 uA max (per amplifier) for 80 kHz GBWP
- **Small Packages**
  - SOT-23, SC-70, MSOP, TDFN, TSSOP

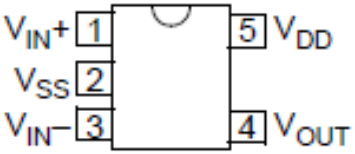
MCP6V11
SOT-23



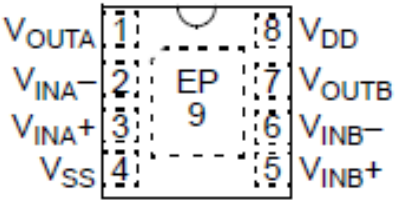
MCP6V12
MSOP



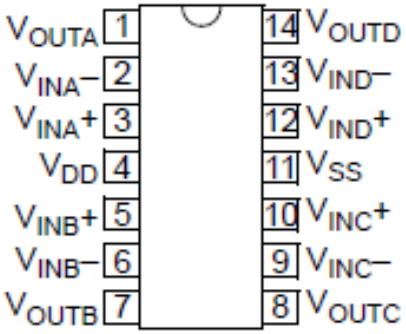
MCP6V11U
SC70, SOT-23



MCP6V12
2x3 TDFN*

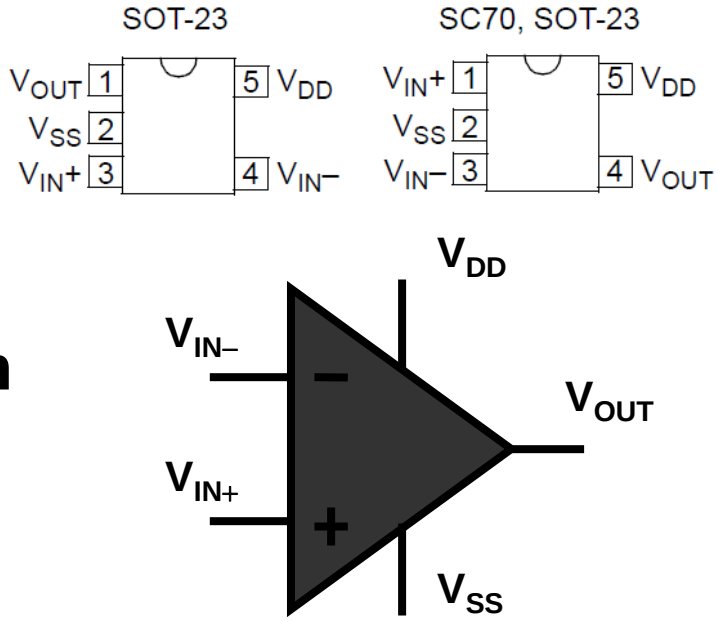


MCP6V14
TSSOP



MCP6V91/1U Package/Pinout Offerings

- **Zero-Drift Architecture**
  - Low voltage offset, 9 µV maximum
  - Low offset drift, 17 nV/°C
  - No 1/f noise
  - High CMRR/PSRR (~117 dB minimum)
- **Low Power for Given Bandwidth**
  - 1.1 mA max for 10 MHz GBWP
- **Enhanced EMI Rejection**
  - EMIRR at 1.8 GHz: 93 dB
- **Small Packages**
  - 5-pin SOT-23 and 5-pin SC-70

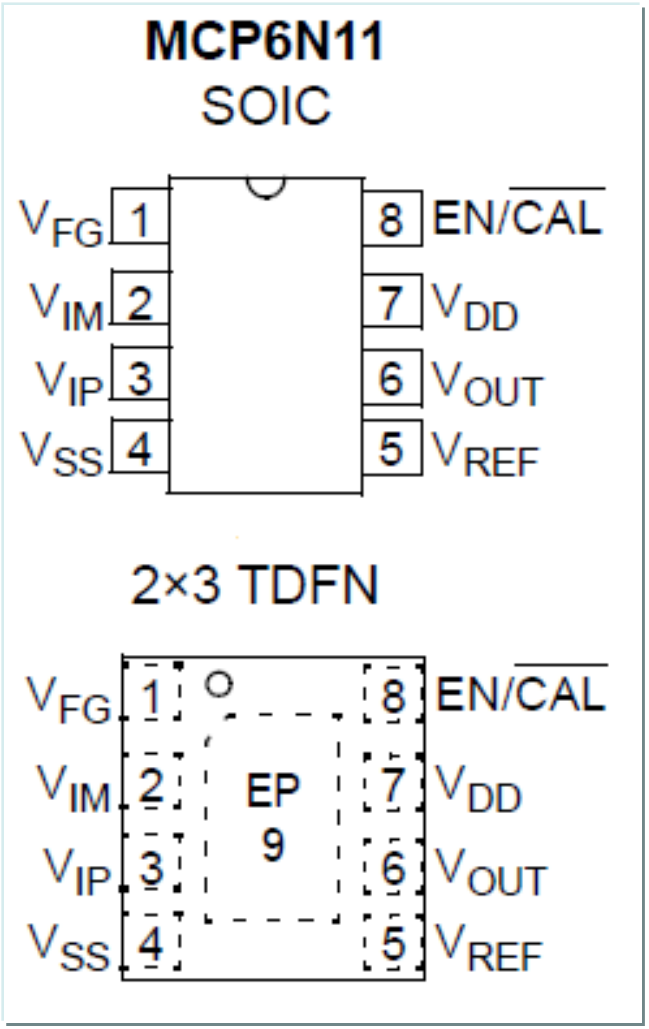


Instrumentation Amplifiers

- **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

MCP6N11 Instrumentation Amp

- **Rail to rail input/output**
- **Gain set by 2 ext resistors**
- **GBWP of 500kHz (typical)**
- **Supply current: 800 uA**
- **Calibration/Enable Pin**
  - Featuring mCal Technology
  - Offset voltages from 350uV up to 3mV, depending on Gmin
- **Op voltage: 1.8 to 5.5V**



Hot Product Update
MCP642x
EMI Hardened Amplifiers

What Problem Does the MCP642x Solve?

- **Power savings**
  - Low quiescent current helps extend battery life
- **Low leakage current helps keep the input error voltage low**
  - Sensors with high output impedance, end applications that go through accelerated life tests at high temperature
- **Enhanced EMI Rejection**
  - Reduces the input offset voltage error due to EMI signals at the input

MCP64xx Op Amps

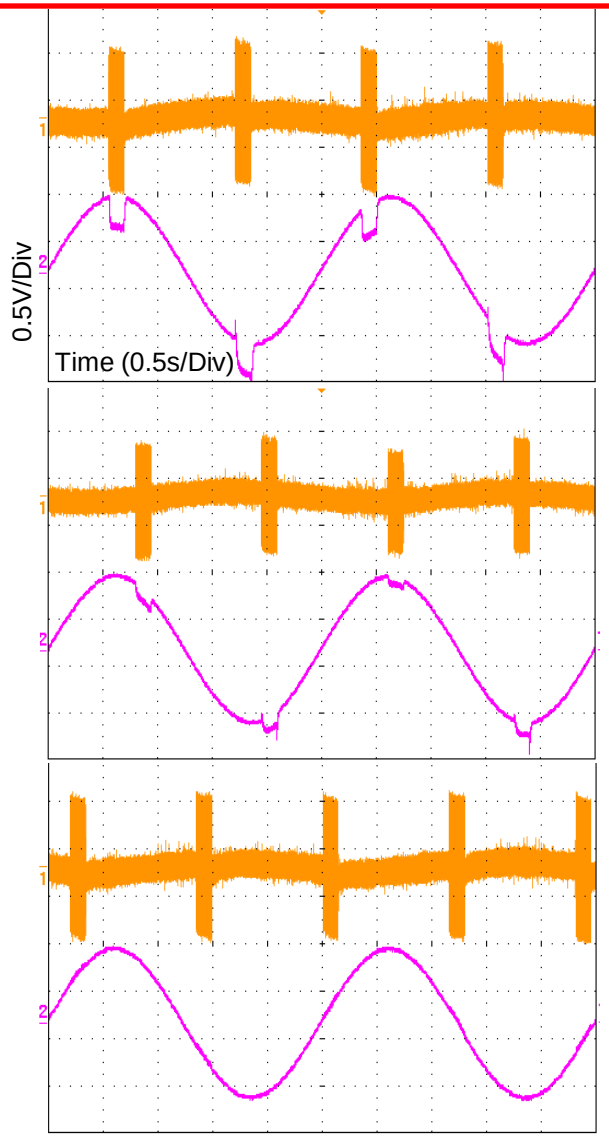
Product	# per Package	GBWP (kHz)	Iq Max (uA)	Vos Max (uV)	Operating Voltage Range (V)	Temp. Range	Rail-To-Rail	Packages
MCP644x	1/2/4	9	0.65	4500	1.4 - 6.0	E Temp	In/Out	SC-70, SOT-23, MSOP, SOIC, TDFN, TSSOP
MCP642x EMI Hardened	1/2/4	90	5.5	1000	1.8 - 5.5	E Temp	In/Out	SC-70, SOT-23, MSOP, SOIC, TSSOP
MCP640x	1/2/4	1000	70	4500	1.8 - 6.0	E & H Temp	In/Out	SC-70, SOT-23, SOIC, TDFN, TSSOP
MCP647x	1/2/4	2000	200	1500	2.0 - 5.5	E Temp	In/Out	SC-70, SOT-23, MSOP, SOIC, TDFN, TSSOP
MCP648x	1/2/4	4000	400	1500	2.2 - 5.5	E Temp	In/Out	SC-70, SOT-23, MSOP, SOIC, TDFN, TSSOP
MCP649x	1/2/4	7500	800	1500	2.4 - 5.5	E Temp	In/Out	SC-70, SOT-23, MSOP, SOIC, TDFN, TSSOP

Performance degradation Caused by EMI

The pink waveform shows the output of a standard amplifier without external filtering, when a cell phone signal is used to introduce EMI

With external filtering, the output of the standard amplifier shows some improvement

EMI hardened amplifier (MCP6424), (without external filtering), shows significant improvement and predicable EMI rejection at the output.



For Whom Does It Solve It?

- **Battery powered Systems**
  - Security Systems
    - Contact Sensors, IR Detectors, Smoke/CO Detectors, Alarm Systems
  - Temperature Sensing
  - Assets Protection systems
    - Shock Detections, Portable Tracking Systems
  - Toys/ Gaming devices
- **Metering**
  - Flow meters, Gas Meters, Water Meters
- **Data loggers**
- **RFID Readers**
- **Medical**
  - Insulin Pumps, Blood Pressure Meters with wireless comm.,

MCP642x Key Features

	MCP642x
Low Vos (max., mV)	1
PSRR (typ., dB)	90
Low Ibias (typ., pA)	1
CMRR (typ., dB)	90
Supply Voltage Range (V)	1.8 - 5.5
Low Supply Current (max., µA)	5
GBWP (kHz)	90
Slew Rate (V/µs)	0.05
EMIRR @ 1.8 GHz (typ., dB)	97
Packages	SC70, SOT23, MSOP, TDFN, TSSOP, SOIC

MCP642x Demo board

- **The Evaluation Board is intended to support EMIRR measurements and show the capability of the MCP6421 EMI enhanced operational amplifier.**

Demo Board#: ADM00443

- **It can be used for signal acquisition from sensors. Example: Pressure sensor**

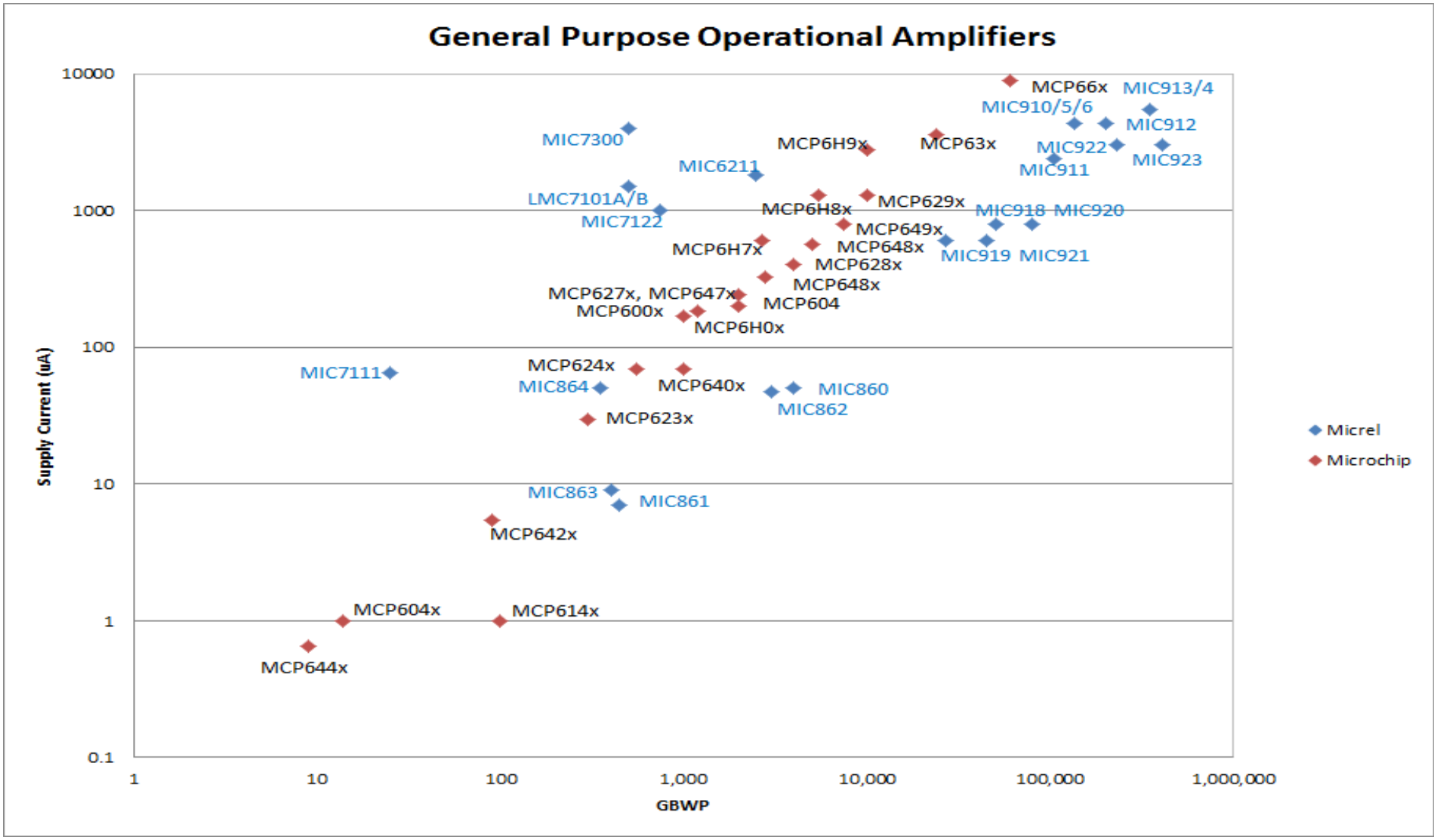
Design Win Examples

- **Application: Headphones**
  - Function: Current Sensing
  - Device: MCP6421
  - Location: Americas
  - Reason for win: Low offset voltage with EMI Rejection

Design Win Examples

- **Application: Smoke Detector with wireless communication**
  - Function: Sensor signal amplification
  - Device: MCP6422
  - Location: Americas
  - Reason for the win: Overall low current consumption and EMI rejection

Micrel Addition



Operational Amplifiers

- **How do these fit within our current portfolio?**
  - All Micrel devices fit in the general purpose Op Amp portfolio. They are high speed (up to 410MHz) and high voltage (up to 32V) devices
  - Mostly singles, some duals, a triple
- **Are these considered proprietary or commodity?**
  - Commodity

Comparators

- **MCP654x**
  - Both push-pull and open-drain outputs
  - Slow comparators
  - Low power
- **MCP65R4x**
  - Adds a bandgap reference to the MCP654x comparator
- **MCP656x**
  - Both push-pull and open-drain outputs
  - 100x faster than the MCP654x

Micrel’s Comparators

Comparators

- **How do these fit within our current portfolio?**
  - Considerable overlap with existing portfolio
  - One higher voltage device (36V), various Vref options
- **Are these considered proprietary or commodity?**
  - Commodity

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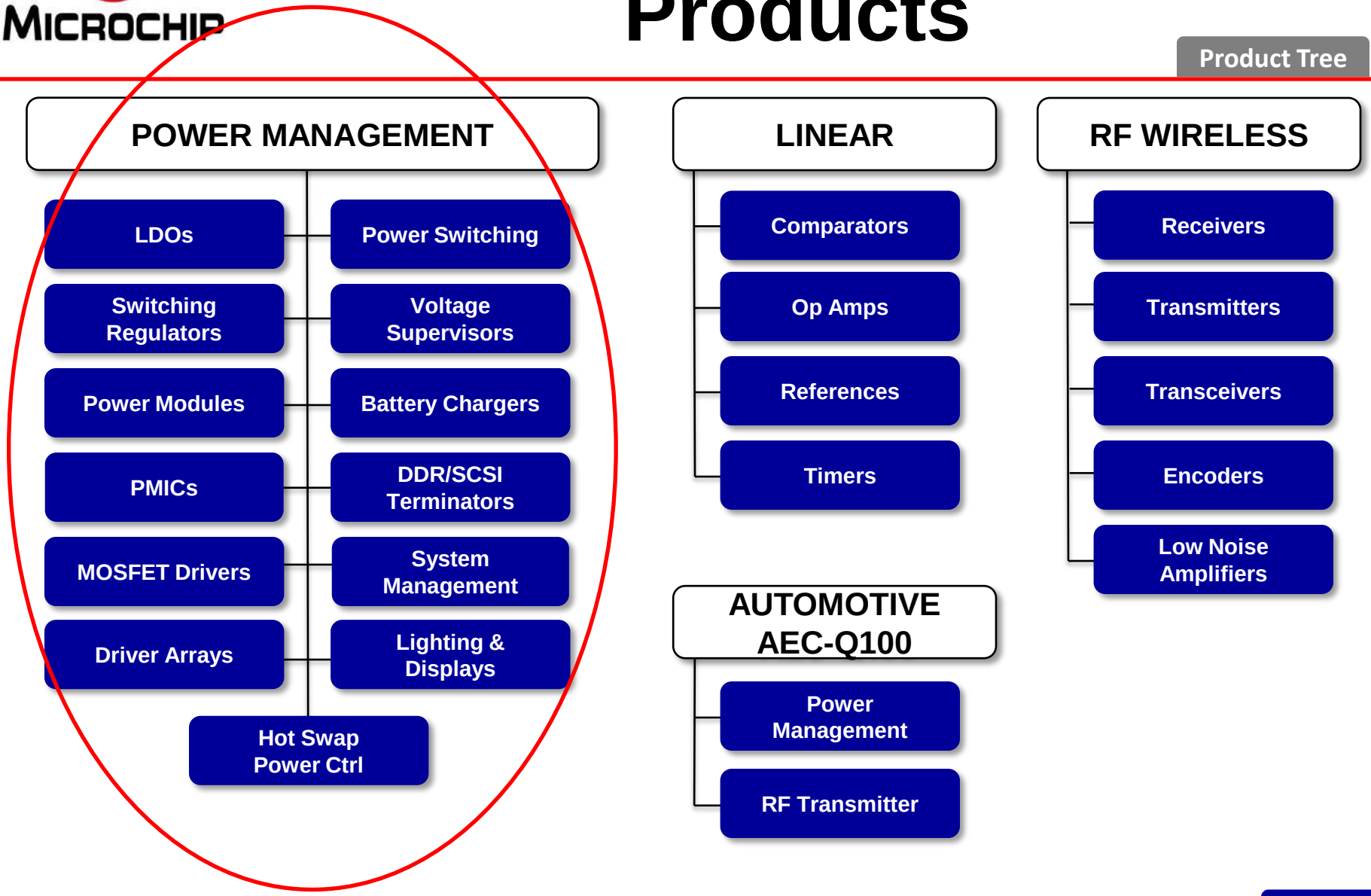
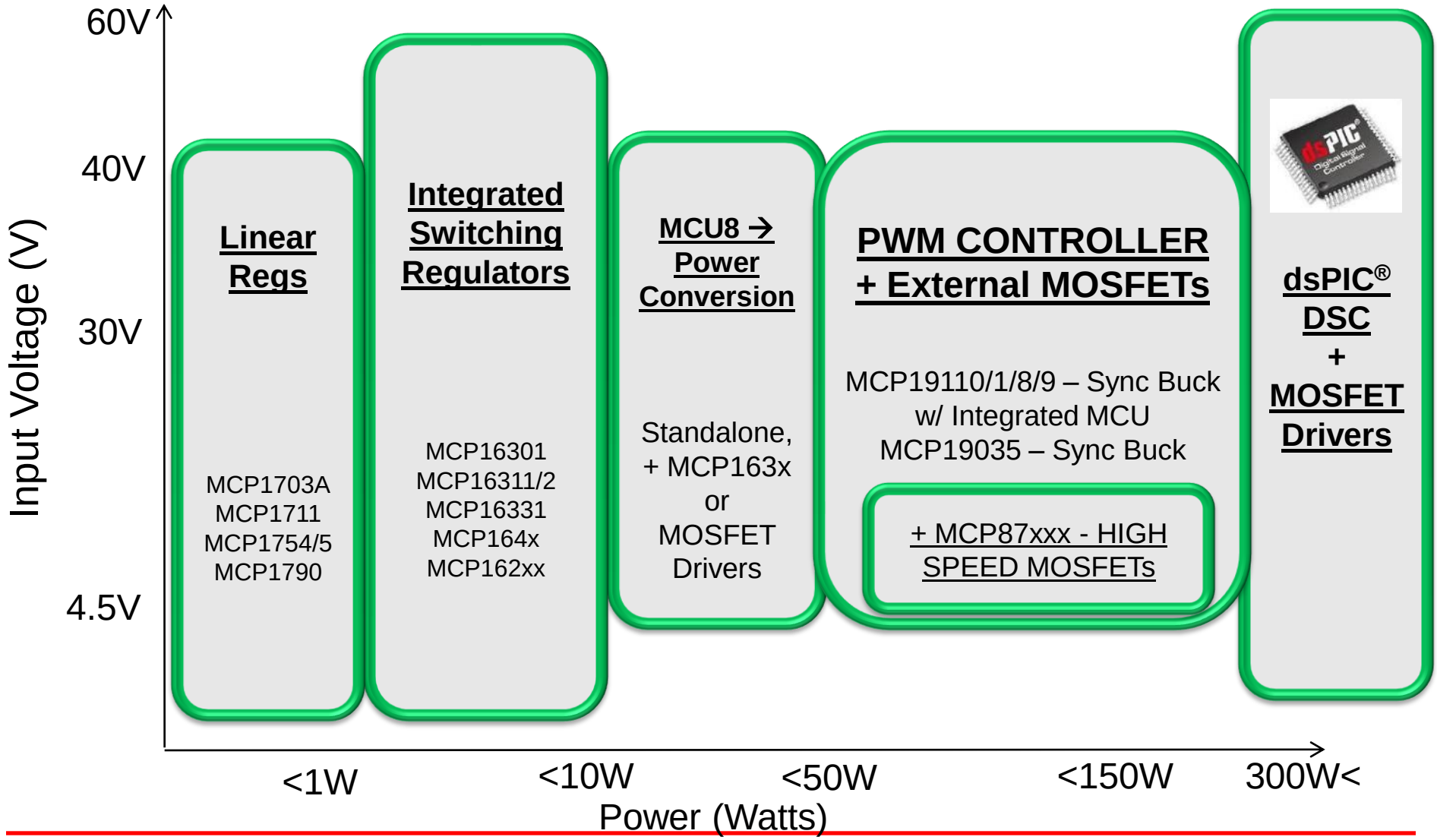
Micrel Linear & Power Products

Product Tree

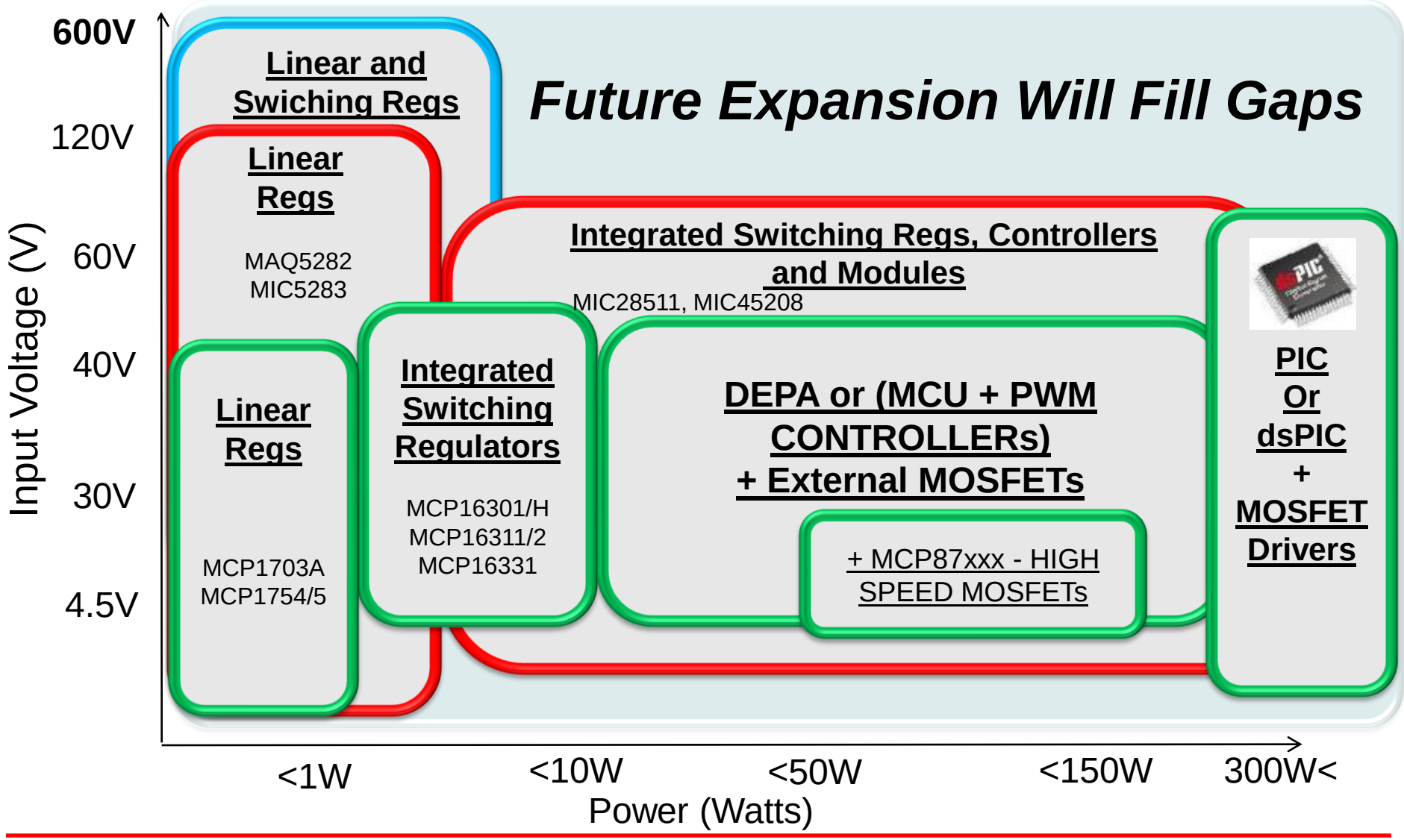


<< BACK

Power Management from Microchip orginally



Microchip Power managment with Micrel



Key IPs that makes the difference!

What Micrel do better than others?

Ripple Blocker™	Unique, Awarded noise filter and Ultra Low Drop LDO **Applications: RF, Analog, GPS, Camera etc…**
Hyper Speed Control™	Unique DCDC Architecture => Small passives, low EMI, Ultra High Speed regulation, High Voltage Drop regulation **Applications: Industrial, Telecom**
Hyper Light Load™	Unique DCDC Architecture => High Efficiency at any load, Low current consumption **Applications: Everything that needs low standy consumption**
Complex Power Sequencing	Unique DCDC Architecture => allows any type of power-up/down sequencing **Applications: FPGA, CPUs, DDRx Memories**
High Efficiency LDO (HeLDO™) Integrated Inductor	Unique DCDC Architecture with internal ultra low noise LDO => allows ultra fast, low noise, high efficiency power. As easy as an LDO to use! **Applications: FPGA, CPUs, RF, Analog, GSM/GPRS/3G modems etc…**
High Voltage LDO (up to 120V)	LDO with 120V input capability with ultra low current consumption! **Applications: Automotive, High input voltage applications (such as 48V) etc…**
Ultra Low Input LDO	Ultra Low Input LDO with Ultra Low drop for high-speed systems. **Applications: FPGA, CPUs, DDRx Memories**
Ultra Precise Current Limiting Switches	Ultra precise current limiting protection **Applications: USB, hotswap, Power ORing**

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**
  - Family of low power LDOs
  - Broad range of automotive qualified LDOs
  - Excellent high performance products

LDO Operating Voltage and Load Current

120V

30V

AUTOMOTIVE QUALIFIED

Switching Regulators

Switching Regular Product Line Summary

- **Micrel switching regulator strength**
  - Higher voltage (up to 75V) and current capability (up to 12A)
  - Higher switching frequency (8 MHz) 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 start-up boost regulators
  - Q100 Qualified

MCHP Buck Regulator Highlights

	MCP16331	MCP16301/H	MCP16311/2
Mode	PWM	PWM	PWM/PFM or PWM
Architecture	Non-Synchronous	Non-Synchronous	Synchronous
Input Voltage Range (V)	4.4 -50V	4 – 30 4.7 – 36	4 – 30
Output Voltage Range (V)	2-24	Adjustable 2 – 15	Adjustable 2 – 24
Current Output (mA)	500	600	1000
Quiescent Current (µA)	1700	2000	44 (PFM)
Switching Frequency (kHz)	500	500	500
Features	Shutdown	Shutdown	Shutdown
Packages*	SOT23-6 2x3 TDFN-8	SOT23-6	MSOP-8 2x3 TDFN-8
AEC-Q100 Qualified	Yes	Yes	Yes

MCHP Boost Regulator Highlights

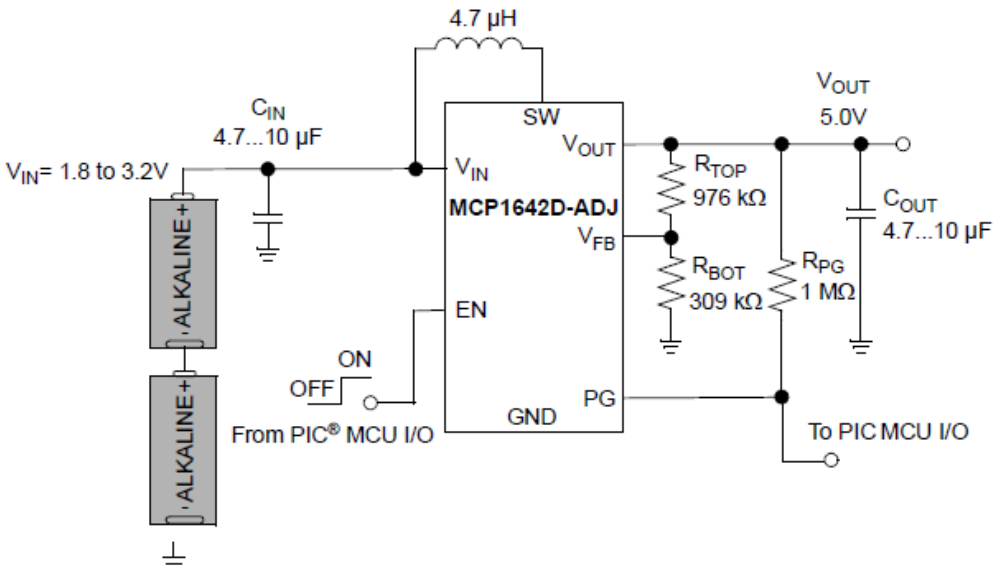
	MCP1623/4	MCP16251/2	MCP1640/B/C/D	MCP1642B/D	MCP1661
Architecture	Synchronous	Synchronous	Synchronous	Synchronous	Non-Synchronous
Mode	PWM or PWM/PFM	PWM/PFM	PWM or PWM/PFM	PWM	PWM
Start-up Voltage	0.65V	0.82V	0.65V	0.65V	2.3V
Input Voltage	0.35V – 5.5V	0.35V – 5.5V	0.35V – 5.5V	0.5V – 5V	2.4V – 5.5V
Output Voltage	2V – 5.5V	1.8V – 5.5V	2V – 5.5V	1.8V – 5.5V 1.8V, 3V, 3.3V, 5V	5.5 – 32V
Peak Input Current Limit	425 mA	650 mA	850 mA	1.8A	1.3A
Quiescent Current (µA)	19/220	4	19/220	400	250
Switching Frequency	500 kHz	500 kHz	500 kHz	1 MHz	500 kHz
Shutdown	True Load Disconnect	Input to Output Bypass or True Load Disconnect	Input to Output Bypass or True Load Disconnect	Input to Output Bypass or True Load Disconnect	Input to Output Bypass
Packages	SOT23-6*	SOT23-6* 2x3 TDFN-8**	SOT23-6* 2x3 DFN-8**	MSOP-8 2x3 DFN-8	SOT23-5 2x3 TDFN-8
Key Attributes	Lowest Cost	Lowest Quiescent	Highest Performance	High Current Output	High output voltage

Ideal for Single Cell Alkaline/Lithium Applications

*,** - Pin-to-pin compatible packages

MCP1642 synchronous boost

- **Synchronous Architecture**
- **Up to 96% Typical Efficiency**
- **1MHz PWM Operation**
- **1.8A Typical Peak Input Current**
  - I_{OUT} > 175 mA @ 3.3V VOUT, 1.2V VIN
  - I_{OUT} > 600 mA @ 3.3V VOUT, 2.4V VIN
  - I_{OUT} > 800 mA @ 5.0V VOUT, 3.3V VIN
- **Low Start-up Voltage: 0.65V @1mA load**

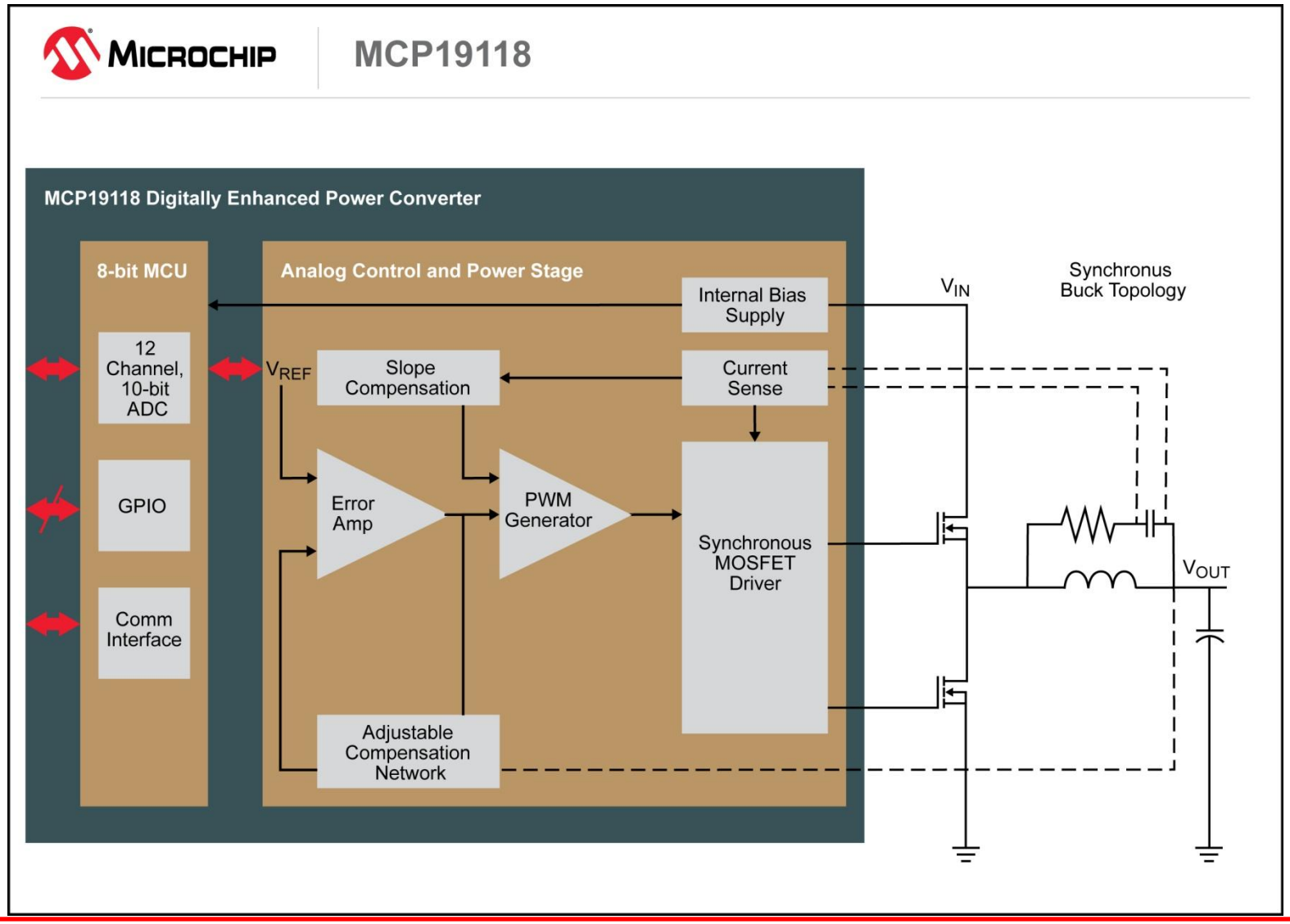


- **Low Operating Input: Down to 0.35V**
- **Adjustable Output Voltage:1.8V to 5.5V**
  - Fixed options: 1.8V, 3V, 3.3V, 5V
- **Shutdown Options**
  - True Load Disconnect Option (MCP1642B)
  - Input to Output Bypass Option (MCP1642D)
- **2x3 DFN or MSOP-8**

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

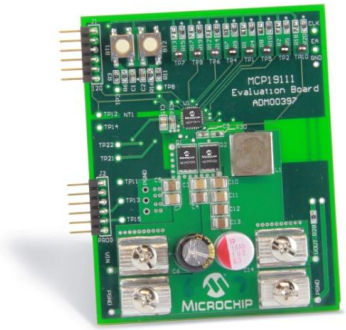
NEW!

	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	**4.5-40V**
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^2C	I^2C, PMBus™ Compliant	I^2C, PMBus™ Compliant
GPIO Available	Yes (10 / 12)	Yes (10 / 14)	Yes (10 / 14)

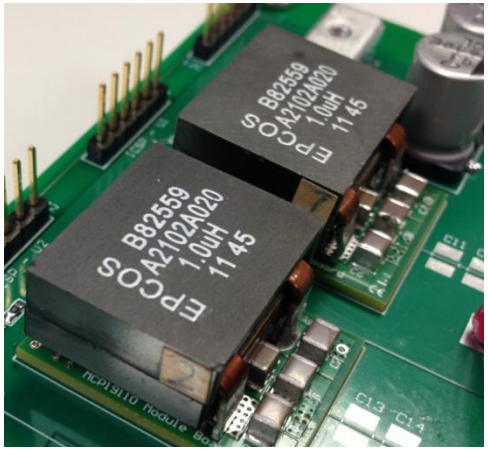
*** With resistive divider network for voltage feedback signals**

Typical Applications

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



MCP19111 Evaluation Board
(Part # ADM00397)

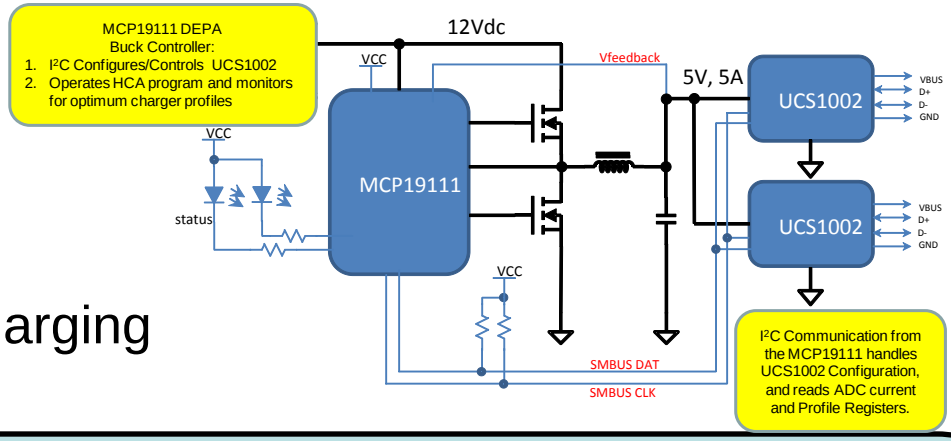


Embedded Power Conversion

- **Embedded Power Conversion**
  - $V_{IN} = 12V_{DC}$
  - $V_{OUT} = 1.2V_{DC}$ @ ~25A
  - Target Market: Networking/Server
  - Core Value:
    - Configurability over I²C™/PMBus™ communication interface
      - Supports late-stage design changes, manufacturability, and adjustments due to field-reliability data
    - Adjustable, on-the-fly, compensation supports component aging.

USB Power Port

- **USB Power → MCP19111 + UCS1002**
  - V_{IN} = 12V_{DC}
  - V_{OUT} = 5V @ ~5A
  - Target Market:
    - Automotive, USB-Charging

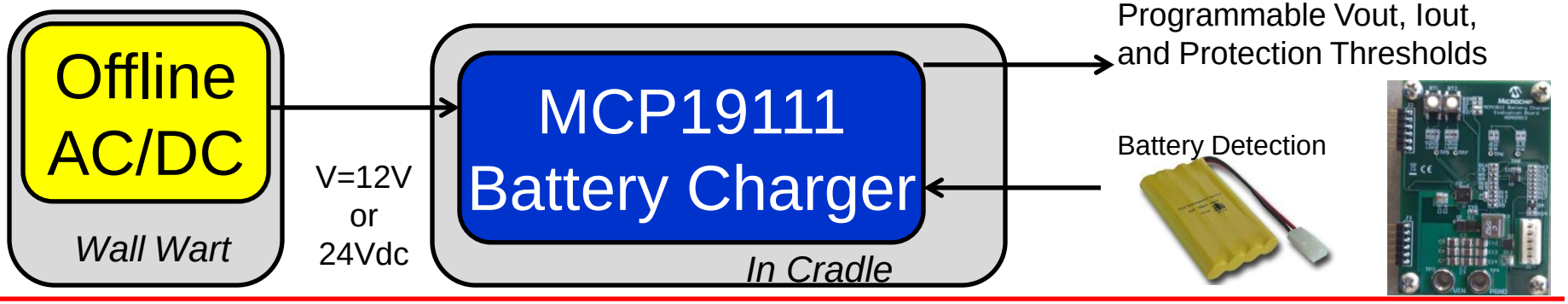


- Core Value:
  - UCS1002 offers USB Charger Emulation, including a programmable Emulation profile for solution ‘future-proofing’
  - MCP19111 generates USB-compliant 5V supply, and its fully-programmable MCU can store additional Charger Emulation Profiles which are communicated to the UCS1002 via SMBus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

Battery Charging

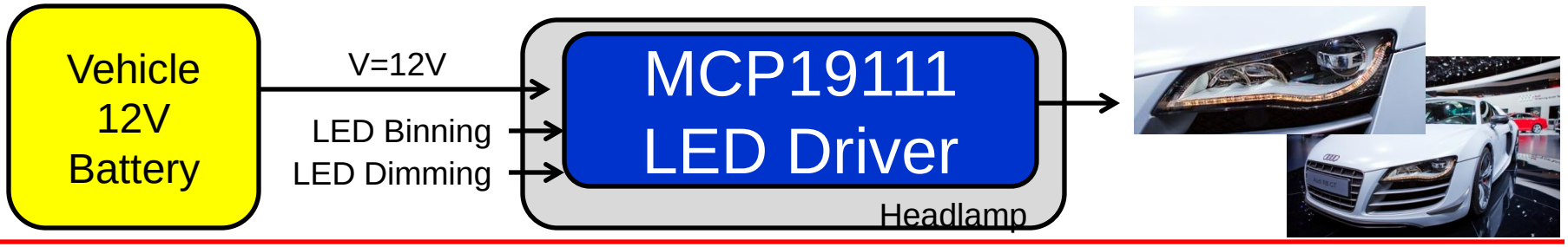
- **Battery Charging**
  - Chemistry: NiMH
  - V_{IN} = 12 or 24V_{DC}
  - V_{OUT} = 8 - 12V_{DC} (8 Cells), Adj. Current
  - Target Market: Radio-Controlled Vehicles
  - Core Value:
    - Standardized Battery-Charger architecture that's scalable to support wide portfolio of battery configurations and charging profiles. Includes battery detection and adjustable protection features.

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



LED Lighting

- **LED Lighting**
  - V_{IN} = 12V_{DC} (from Battery)
  - V_{OUT} = 3-6V_{DC} (~1-2 LEDs)
  - I_{OUT} = Adj., 350mA-1.5A (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**

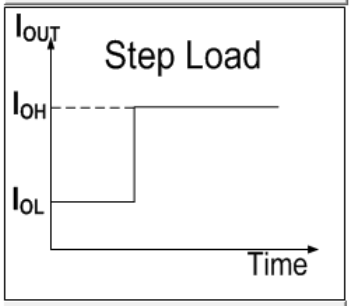
MICROCHIP

MCP19111 DESIGN ANALYZER

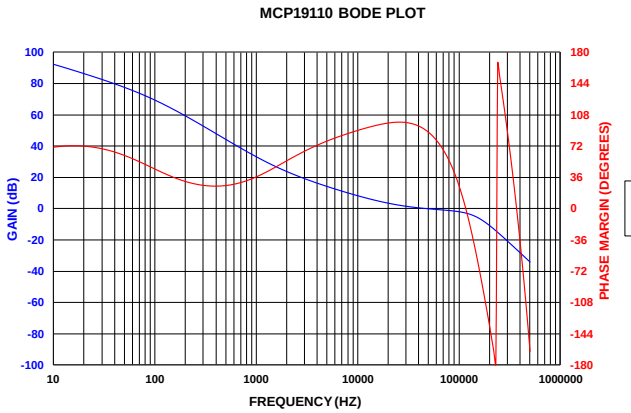
Input Parameters for Design

Parameter	Designator	Value	Units	Notes
Input Voltage	V_{IN}	12	V	$4.5 \le V_{IN} \le 30$
Output Voltage	V_{OUT}	1.8	V	$0.6 \le V_{OUT} \le 3.6$
Output Current	I_{OUT}	30	A	$0 \le I_{OUT} \le 30$
Switching Frequency	Fs	300	kHz	$100 \le Fs \le 1200$
Input Voltage Ripple	V_{RIN}	100	mV	
Minimum Input Voltage	V_{IN_MIN}	12	V	$4.5 \le V_{IN\_MIN} \le V_{IN}$
Step Load Parameters				
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



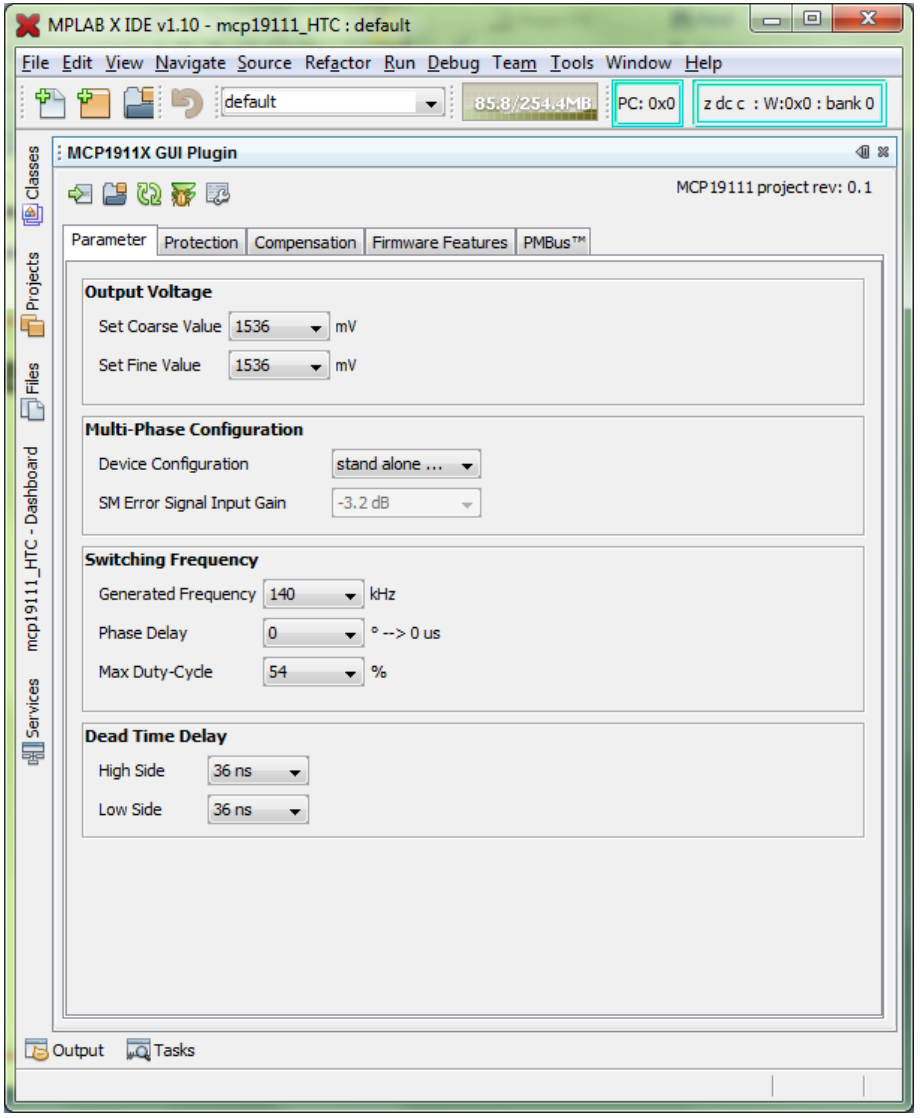
Use Recommended Components and Compensation



Power Supply Evaluation MCP19111

- **GUI available to simplify programming for a <u>standard power supply</u> applications**
  - GUI resides in MPLABX (plugin)
  - Supports PICKIT3 and ICE3 Program/ Debug

- **<u>Standard Firmware</u> for Power Supply application**



Unique Strengths

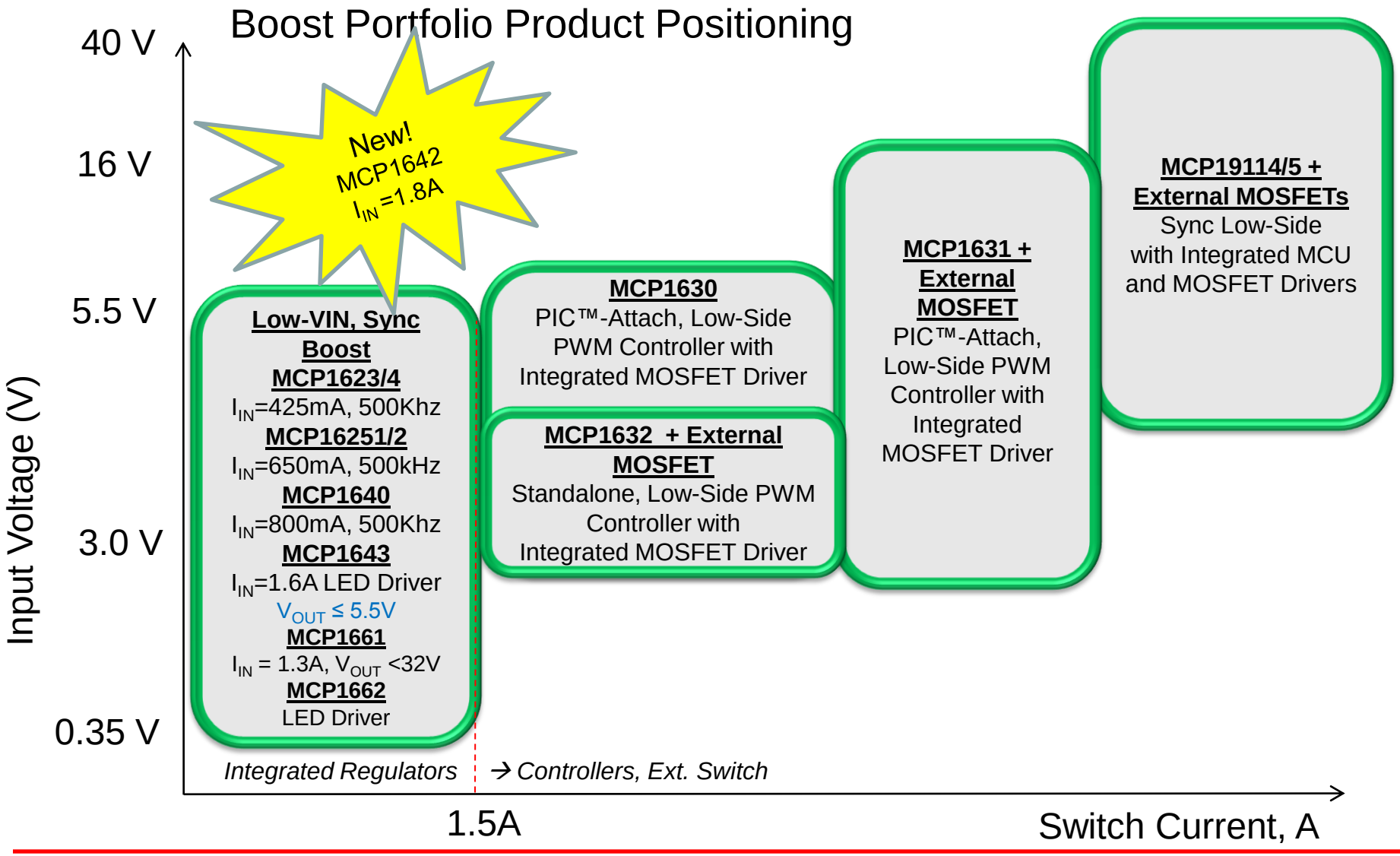
- **Supports “special” application, load, and operating behavior requirements**
- **Multiple power conversion topologies including boost, flyback, synchronous flyback, SIPC and Cuk-based topologies supported**
- **Supports both fixed-frequency and quasi-resonant mode switch to improve EMI performance**
- **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

Return to Topics

DC/DC Power Conversion



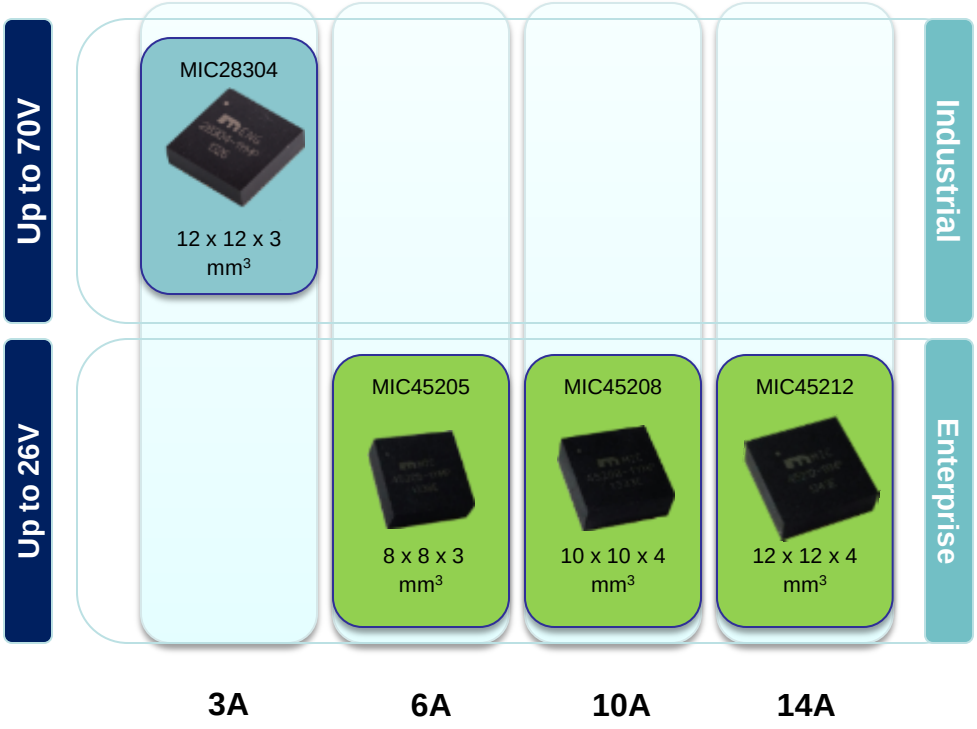
Low Voltage Boost Family

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

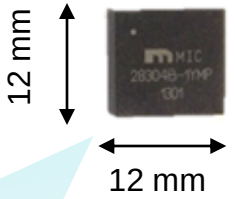
*,** Packages are pin-to-pin compatible
For Higher output voltages, consider MCP1661/2

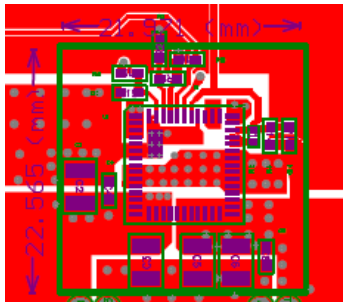
Fully Integrated Modules

High Power Density and Space Saving

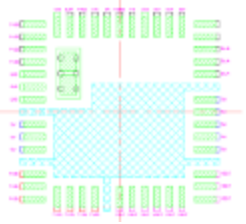


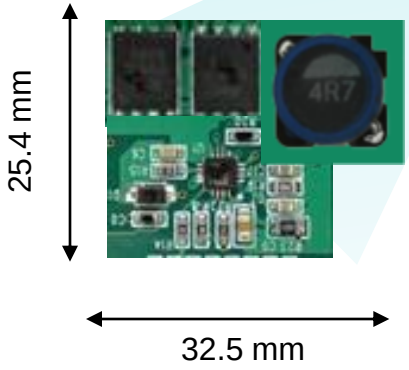
Simple Land Patterns Optimized for Thermal Performance and Eliminates Assembly Issues





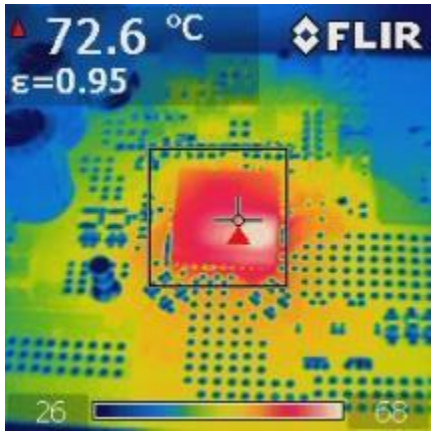
MIC45208



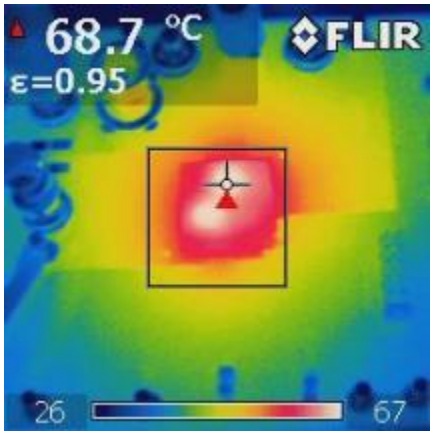


Total Area: 496mm²

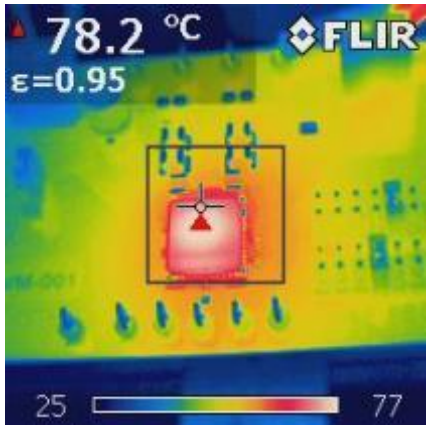
Excellent Thermal Performance



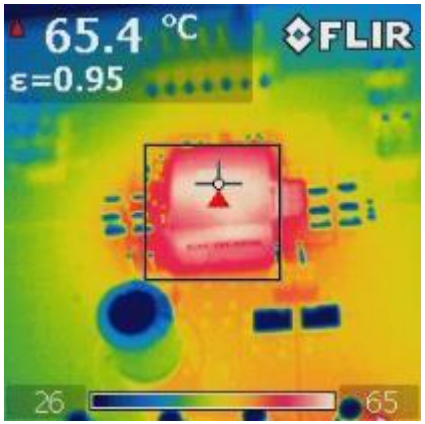
Competitor “I”



Competitor “L”



Competitor “T”

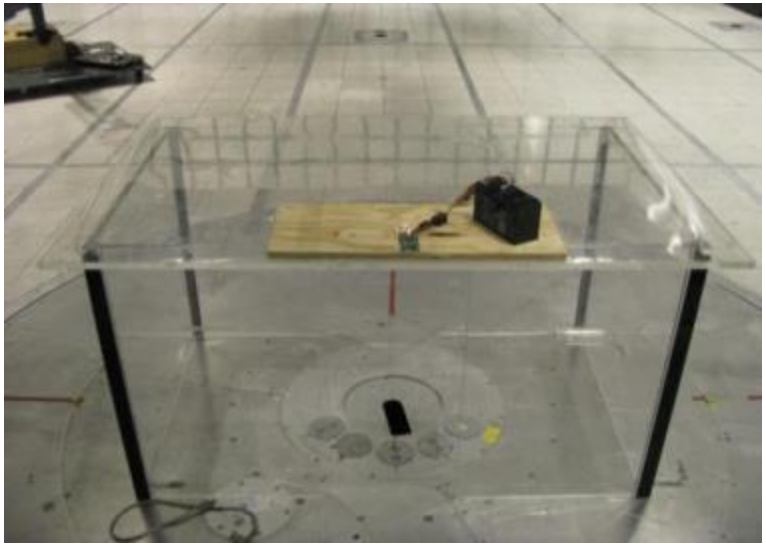


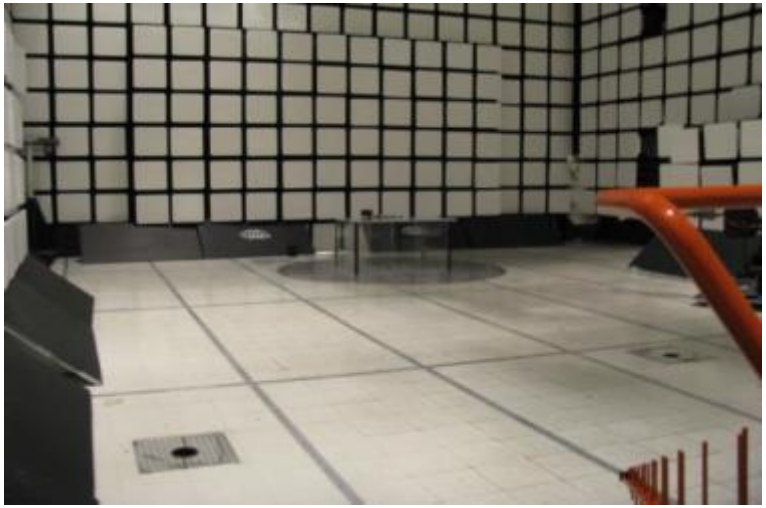
MIC45212

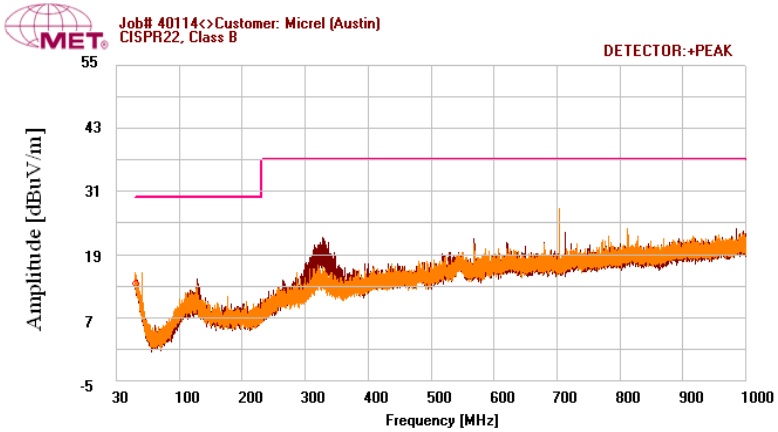
Operating Conditions:
Vin=12V, Vout=1.2V, f=600kHz, Iout=10A,
Ta = 25C,
Based on standard evaluation board by each vendor (size varies)

Micrel’s Module Offers Superior Thermal Performance versus the Competition

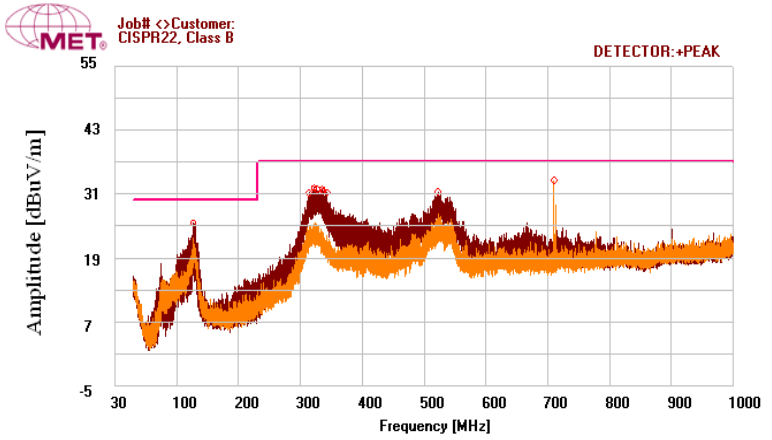
Excellent EMI Performance (CISPR22, Class B)







12V_3.3V_1A With Snubber



12V_3.3V_8A With Snubber

POWER MODULES Family (Integrated Inductor)

Part Number	I_{OUT} Max	V_{IN}	V_{OUT}	F_{SW}	Topology	IQ_{TYP} Non switching	Power Good Output	Duty Cycle Max	Package	Comments/Other Features
MIC33030	0.4A	2.7-5.5V	0.7V-3.6V	8MHz	Hyper Light Load™	21uA	-	85%	2.5x2x1.1mm	Low IQ
MIC33050	0.6A	2.7-5.5V	0.4V-89%*V_{IN}	4MHz	Hyper Light Load™	20uA	-	89%	3x3x0.9mm	Low IQ
MIC3385	0.6A	2.7-5.5V	1V-5V	8MHz	LOWQ™ Mode	19uA	-	100%	3x3.5x0.9mm	LOWQ™ mode driven by input pin
MIC33153	1.2A	2.7-5.5V	0.65V-3.6V	4MHz	Hyper Light Load™	22uA	•	80%	3x3.5x1.1mm	
MIC38150	1.5A	3-5.5V	1V VIN-1.2V	2.5MHz max	HeLDO™	1mA	-	1.2V_{DROP} max	4x6x0.9mm	High Efficiency LDO™ for Low EMI, High-Speed regulation, Low Noise
MIC38300	3A	3-5.5V	1V VIN-1.2V	2.5MHz max	HeLDO™	1mA	-	1.2V_{DROP} max	4x6x0.9mm	High Efficiency LDO™ for Low EMI, High-Speed regulation, Low Noise
MIC28304-1	3A	4.5-**70V**	0.9V-24V	200-600kHz	Hyper Light Load™	0.4mA	•	85%	12x12x3mm	AnyCap™ stable, no compensation, Low EMI EN55022,ClassB
MIC28304-2	3A	4.5-**70V**	0.9V-24V	200-600kHz	Hyper Speed Control™	2.1mA	•	85%	12x12x3mm	AnyCap™ stable, no compensation, Low EMI EN55022,ClassB
MIC28303-1	3A	4.5-**50V**	0.9V-24V	200-600kHz	Hyper Light Load™	2.1mA	•	85%	12x12x3mm	AnyCap™ stable, no compensation, Low EMI EN55022,ClassB
MIC28303-2	3A	4.5-**50V**	0.9V-24V	200-600kHz	Hyper Speed Control™	2.1mA	•	85%	12x12x3mm	AnyCap™ stable, no compensation, Low EMI EN55022,ClassB
MIC45205-1	6A	4.5-**26V**	0.8V-5.5V	200-600kHz	Hyper Light Load™	0.35A	•	85%	8x8x3mm	No compensation, CISPR22,ClassB compliant
MIC45205-2	6A	4.5-**26V**	0.8V-5.5V	200-600kHz	Hyper Speed Control™	2.1mA	•	85%	8x8x3mm	No compensation, CISPR22,ClassB compliant
MIC45208-1	10A	4.5-**26V**	0.8V-5.5V	200-600kHz	Hyper Light Load™	0.4mA	•	85%	10x10x4mm	No compensation, CISPR22,ClassB compliant
MIC45208-2	10A	4.5-**26V**	0.8V-5.5V	200-600kHz	Hyper Speed Control™	2.1mA	•	85%	10x10x4mm	No compensation, CISPR22,ClassB compliant
MIC45212-1	14A	4.5-**26V**	0.8V-5.5V	200-600kHz	Hyper Light Load™	0.37mA	•	85%	12x12x4mm	No compensation, CISPR22,ClassB compliant
MIC45212-2	14A	4.5-**26V**	0.8V-5.5V	200-600kHz	Hyper Speed Control™	2.1mA	•	85%	12x12x4mm	No compensation, CISPR22,ClassB compliant

Analog & Interface Products

THERMAL MANAGEMENT

- Temperature Sensors
- Fan Control and Hardware Management

LINEAR

- Op Amps/INAs
- Comparators
- RF Power Amplifiers, PGA, SGA

SAFETY AND SECURITY

- Smoke Detector ICs
- Piezoelectric Horn Drivers

POWER MANAGEMENT

- Linear Regulators
- Switching Regulators
- Digitally-Enhanced & PWM Controllers
- Charge Pump DC/DC Converters
- Battery Management
- USB Port Power Controller
- System Supervisors Voltage Detectors
- Power MOSFET Drivers
- Power MOSFETs
- Updates

MIXED SIGNAL

- Pipelined A/D Converters
- Delta-Sigma & SAR A/D Converters
- Energy Measurement ICs
- Current/DC Power Measurement ICs
- Dual Slope / Display A/D Converters
- D/A Converters
- Digital Potentiometers
- Voltage References

INTERFACE

- CAN/LIN
- USB and I/O Expanders
- Ethernet
- Wireless
- Real Time Clock/Calendar

MOTOR DRIVER

- Stepper, DC and 3Φ Brushless
- Supertex

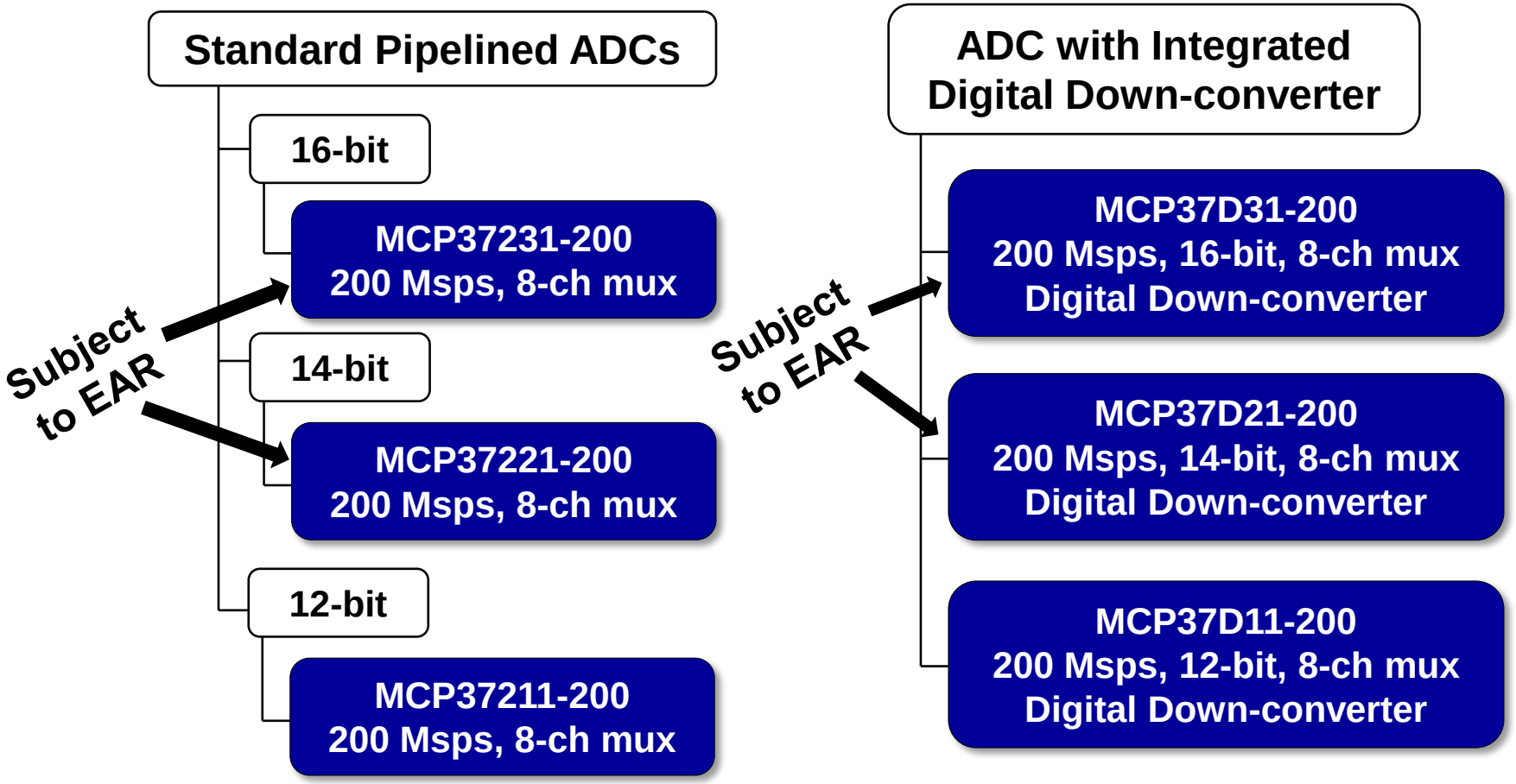
Demo & Eval Boards | Overview | End Equipments

Click on boxes to navigate

USB Bridge Family
UART, SPI, I2C/SMBus

Feature	MCP2200	MCP2210	MCP2221
MCU Interface	UART	SPI	I2C/SMBus/UART
USB Speed	Full Speed	Full Speed	Full Speed
Max Recommended UART Rate	1Mbps	N/A	115.2kbps
Hardware Flow Control Pin	Yes	N/A	No
UART Pin Polarity Inversion Capable	Yes	N/A	No
Internal Oscillator	No	No	Yes
TX Buffer Size	128	64	64
RX Buffer Size	128	64	64
GPIO	8	9	4
256 bytes EEPROM	Yes	Yes	No
ADC/DAC Peripheral	No	No	Yes
Package Options	20 Lead QFN, SOIC, SSOP	20 Lead QFN, SOIC, SSOP	14 Lead PDIP, SOIC, TSSOP 16 Lead QFN

Pipelined A/D Converters

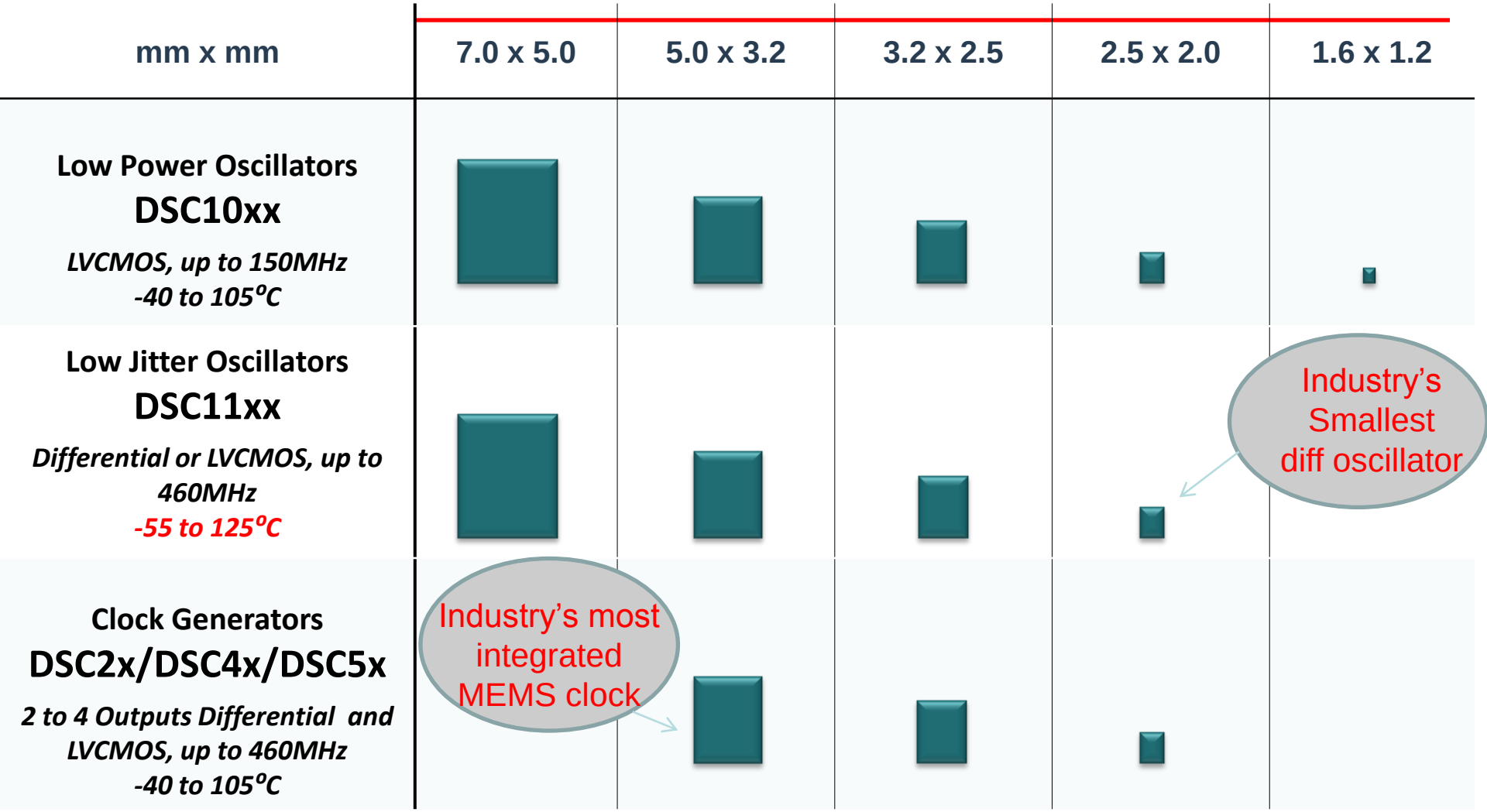


MCP372x1-200 Standard ADCs

- **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**
  - Gives 2-3dB SNR improvement per filter
- **8-ch mux with fractional delay recovery**
- **Noise-shaping requantizer (12-bit)**
- **VTLA & small 8x8 BGA* packages**

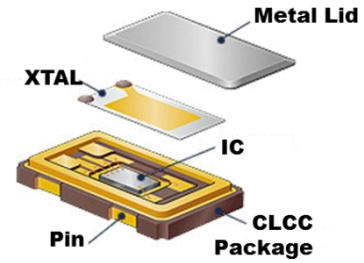
***Coming 2015**

MEMS Oscillators

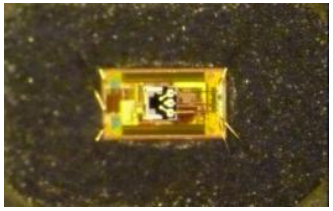


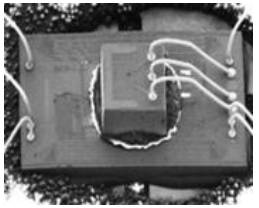
All MEMS products are AEC-Q100 Capable, PPAP package ready for selected parts

Benefits of MEMS over Traditional Quartz



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 125ºC
- 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

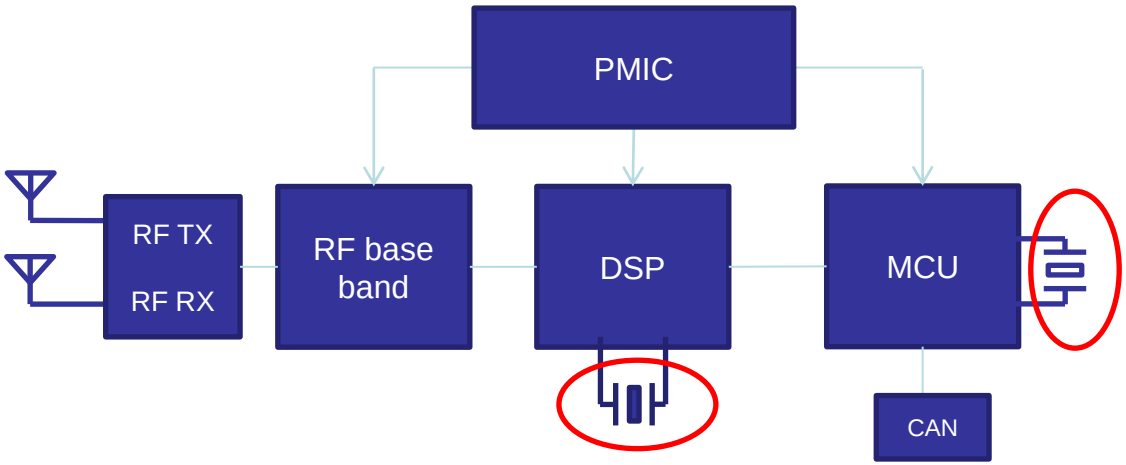
Faster Time to Market

- 2-4 weeks production lead time
- Engineering samples programmable in1 sec with full production performance

Intermission - Timeflash Demonstration Video

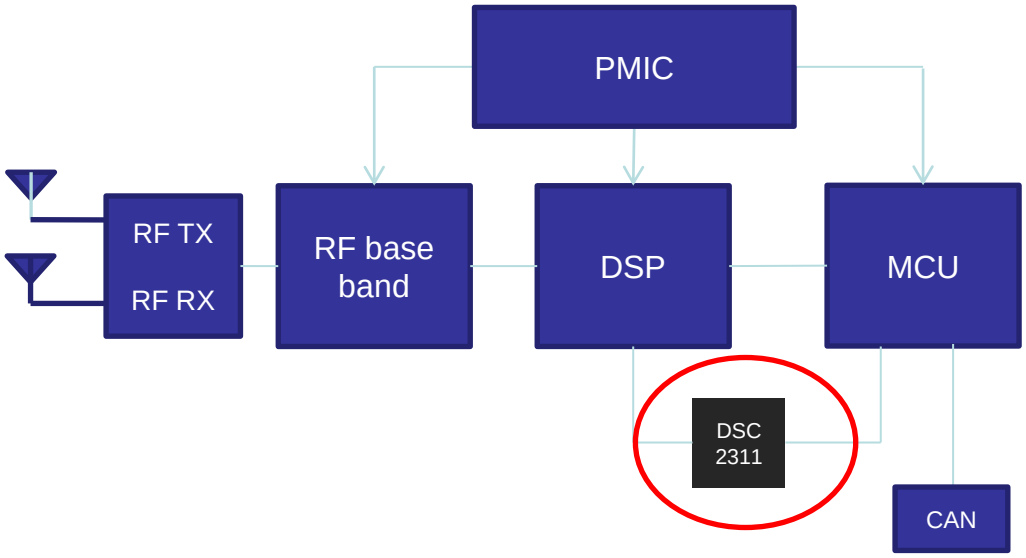
System Challenges with Crystal Based Solution

77GHz Long Range Radar

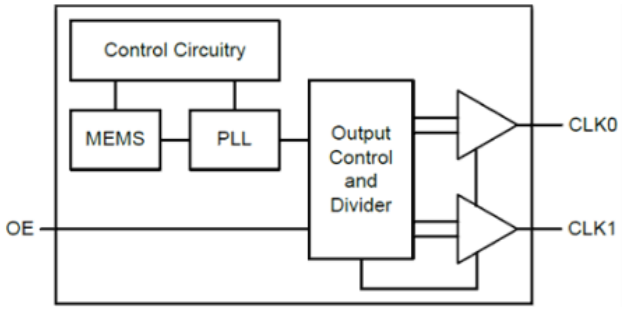


- Frequency drift at high temperature
- Limited board space
- Higher failure rate than other semiconductor components on board
- Higher cost for small package
- Long product lead time

MEMS Solution Advantage



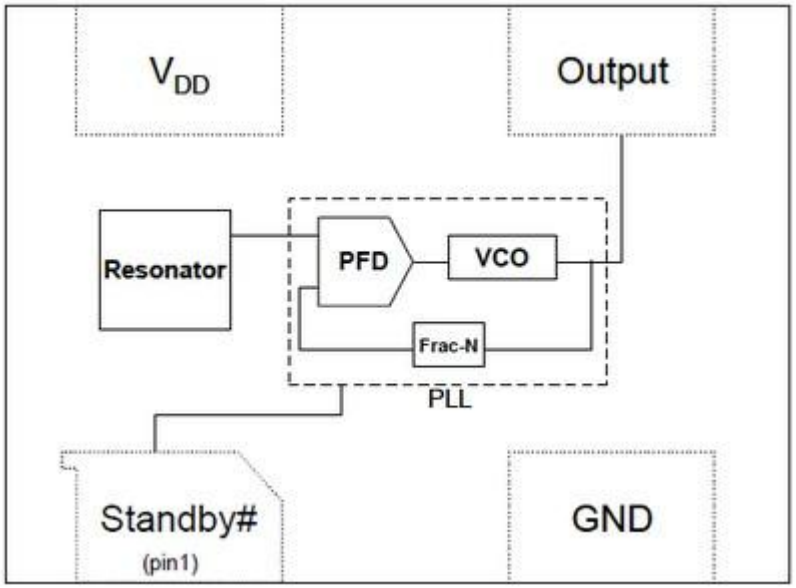
DSC2311KM2



- ±25ppm from -55°C to 125°C, AEC-Q100 grade 1 qualified.
- Space saving 2.5x2.0mm 6-pin DFN replacing two crystals/oscillators
- Semiconductor grade reliability. 50K G Shock, 50G vibration
- Cost competitive
- 4 weeks production lead time

DSC1001

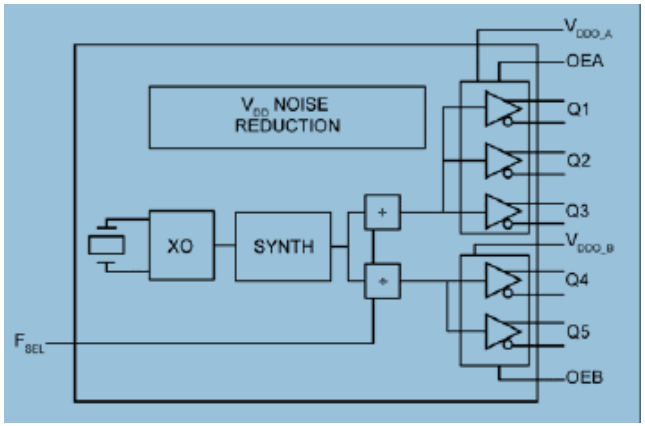
- Frequency Range: 1 to 150MHz
- Exceptional Stability over Temperature
  - ±10 PPM, ±25 PPM, ±50 PPM
- Operating voltage of 1.7V to 3.6V
- Operating Temperature Range
  - Ext. Industrial -40°C to 105°C
  - Industrial -40°C to 85°C
  - Ext. Commercial -20°C to 70°C
  - Commercial 0°C to 70°C
- Low Operating and Standby Current
  - 5mA Operating (40MHz)
  - 15µA Standby
- Ultra Miniature Footprint
  - 2.5mm x 2.0mm x 0.85mm
  - 3.2mm x 2.5mm x 0.85mm
  - 5.0mm x 3.2mm x 0.85mm
  - 7.0mm x 5.0mm x 0.85mm
- MIL-STD 883 Shock and Vibration Resistant
- Pb-Free, RoHS, Reach SVHC Compliant
- AEC-Q100 Reliability Qualified

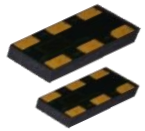


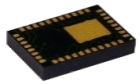
FUSION
Ultra-low Jitter Oscillators and Clocks

Integrated crystal and multiple outputs offer 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







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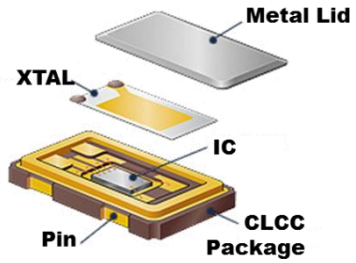

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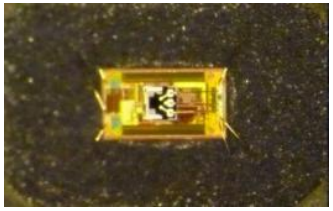

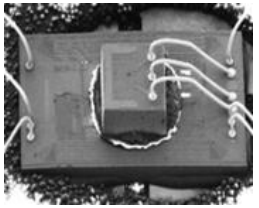

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Motion Monitor and Sensor Hub

Motion Solutions

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!

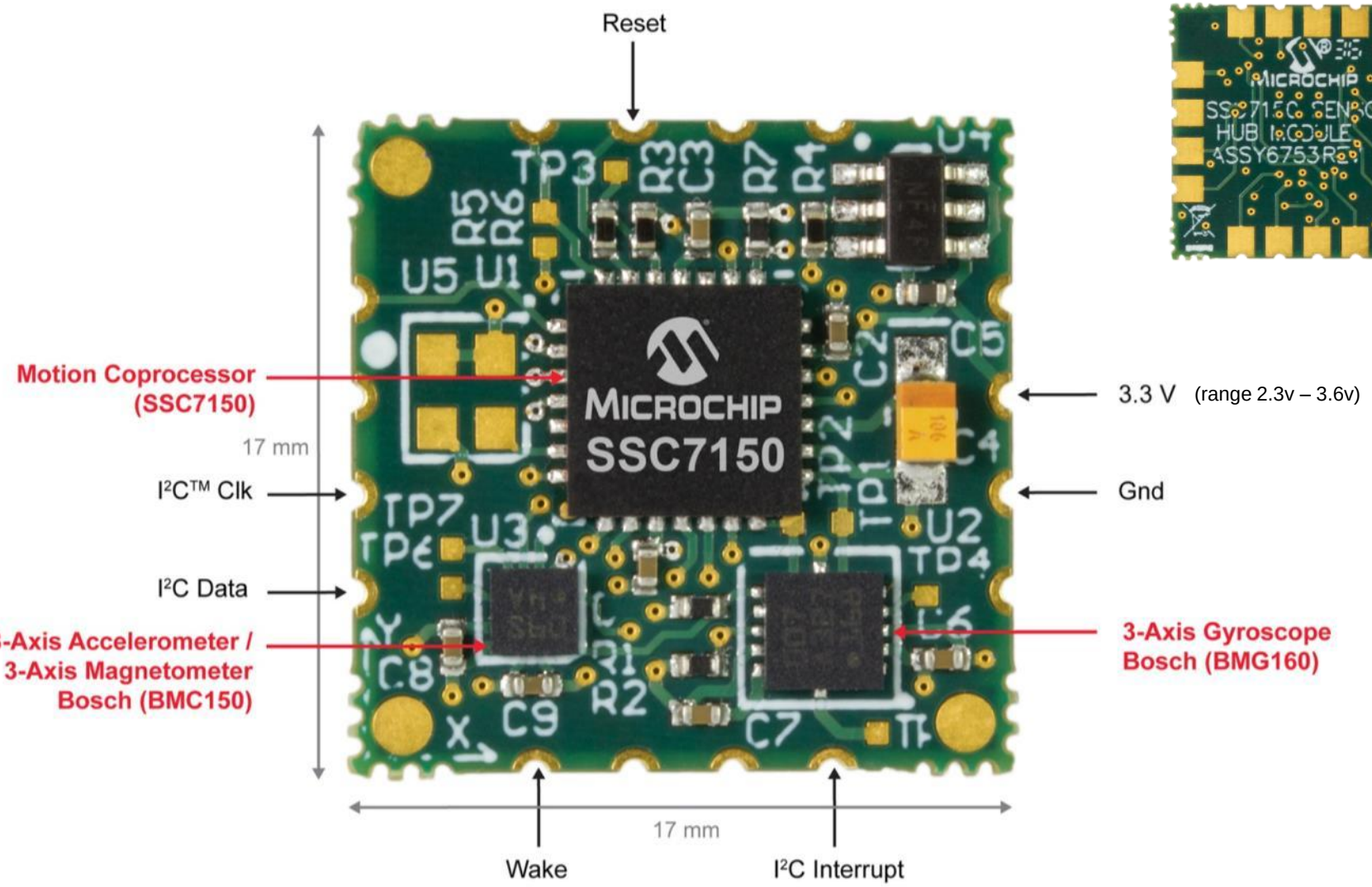
- **Complex algorithms req'd to filter, compensate, and fuse the raw sensor data**
  - This requires specialized knowledge
  - Is also resource intensive
- **Most vendors focused on large OEMs**
  - Difficult to get support from some
  - Harder to get samples, technical support, distribution, etc.

MM7150 Motion Module

- **Powered by the SSC7150 Motion Coprocessor**
  - Filter, compensate and fuse raw 9-axis sensor data
- **Comes pre-populated with 3-axis accelerometer, 3-axis magnetometer, and 3-axis gyroscope from Bosch**
- **Small size 17mm x17mm**
- **Single sided – can be soldered down**
- **Factory programmed and calibrated**
- **Self-calibrating during operation**
- **Suitable for battery powered applications**
  - Consume 13ma active – 70ua sleep
- **Outputs position & motion data over standard I²C™ connection**
  - Works with most MCU/MPUs with I²C

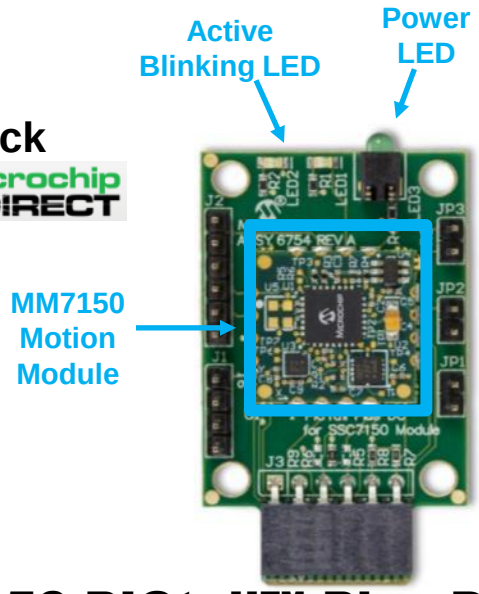
The MM7150 Motion Module makes it easy to add motion & position capability

MM7150 Motion Module



Easy to Develop

In Stock @ microchip DIRECT



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

- Plugs directly into Explorer16 board
- Outputs raw sensor data, compensated sensor data, and positioning data
- Standardized API for most MCUs with I²C® to communicate with MM7150 Motion Module
- MPLAB project with sample code to communicate with the PICtail
- $50 USD, quantity 1, available now

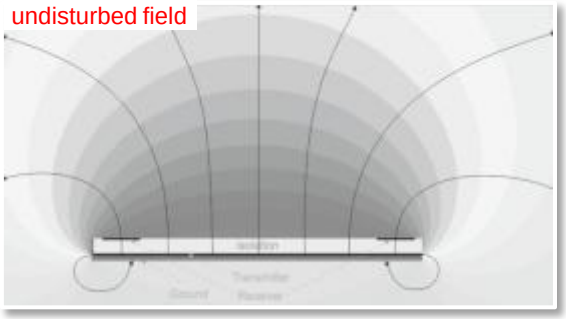
Explorer 16 Board (Part Number: DM240001)

- 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
- $ 129.99 USD, quantity 1, available now

GestIC

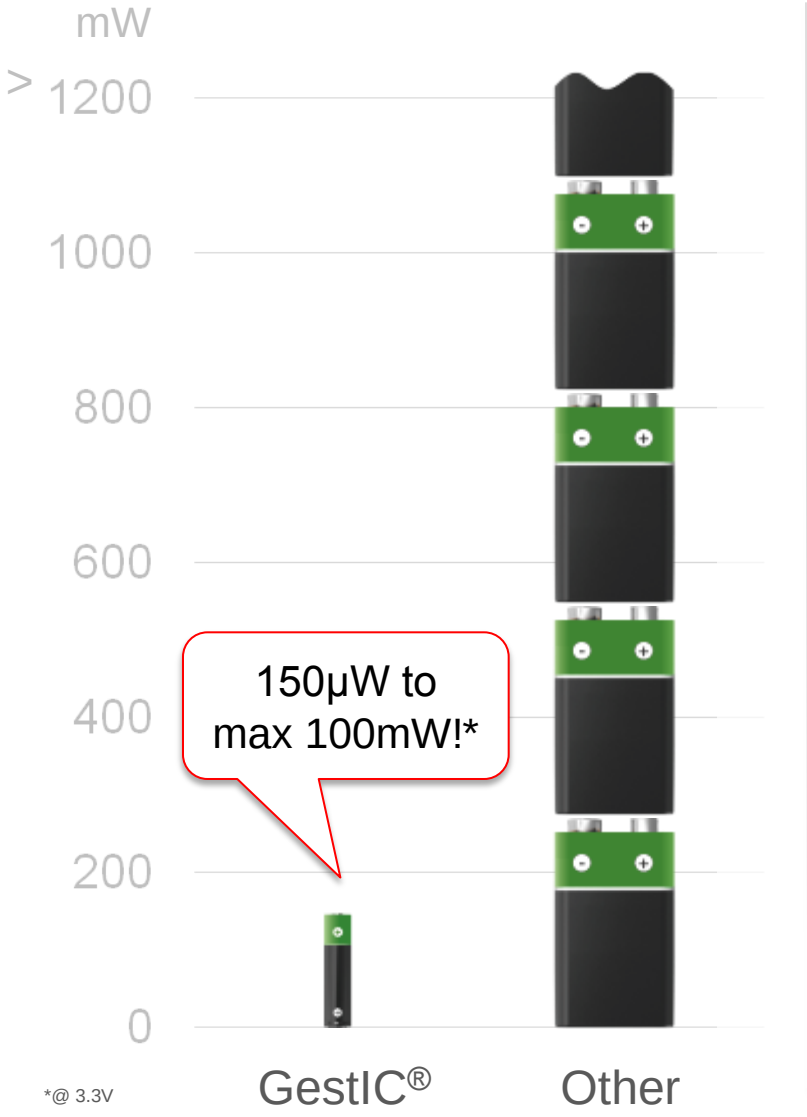
GestIC Technology Basics

- 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



Demo

Battery Efficiency



lowest power consumption

of any 3D sensing technology

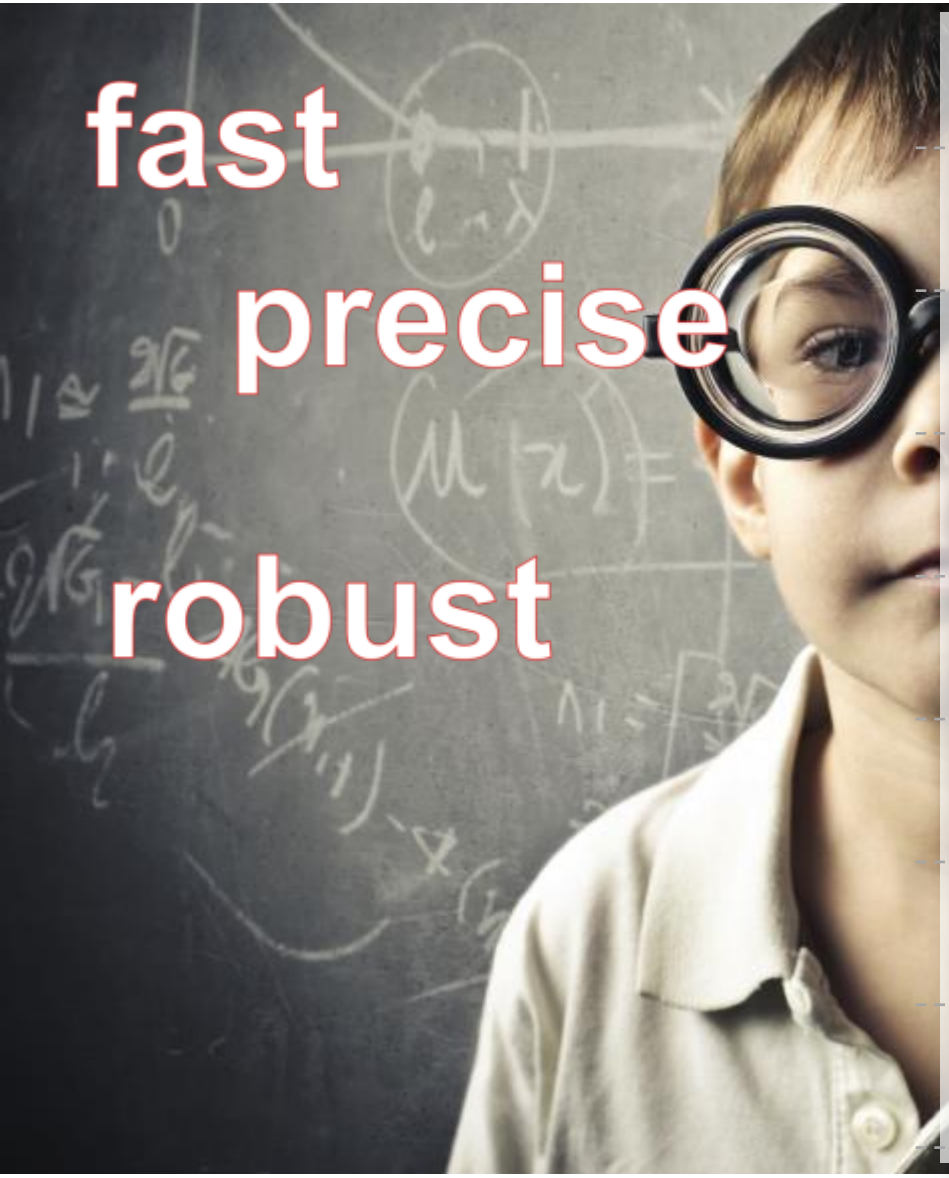
up to **90% lower** than

camera systems

always-on 3D sensing

…even for mobile devices

Key Features

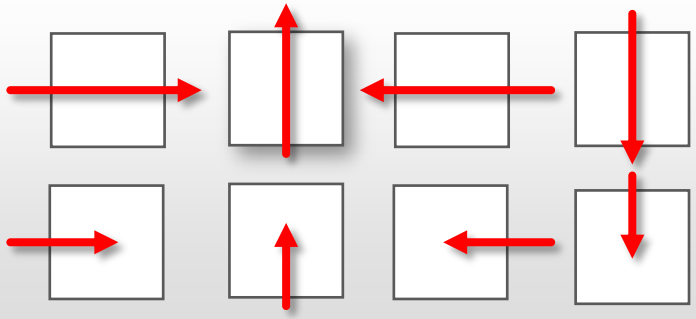


- 0 to 15cm detection range
- fast data sampling at 200Hz
- 32-bit signal processing unit
- mouse-like resolution of 150dpi
- 70-130kHz range - no RF interference
- no environmental influences
- self wake-up at 150µW – *Low Power!*
- Colibri Gesture Suite on-chip

On-Chip Colibri Suite
Features

Approach Detection

Flick Gestures (8)



Position Tracking (xyz)

Requires MGC3130

NEW

Single Touch (5 positions on electrodes)

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

Circle Gestures (4) NEW

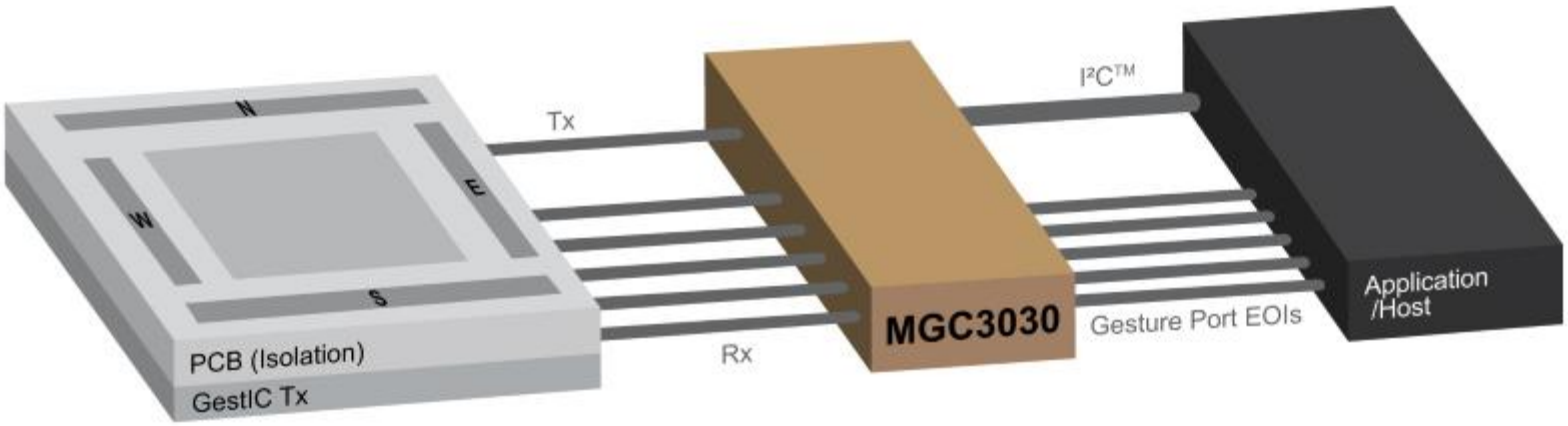
Single Airwheel

Symbol Gestures (TBD)

Requires MGC3130

+ Electrode Signals

Topology



1. **Electrodes** sense user action

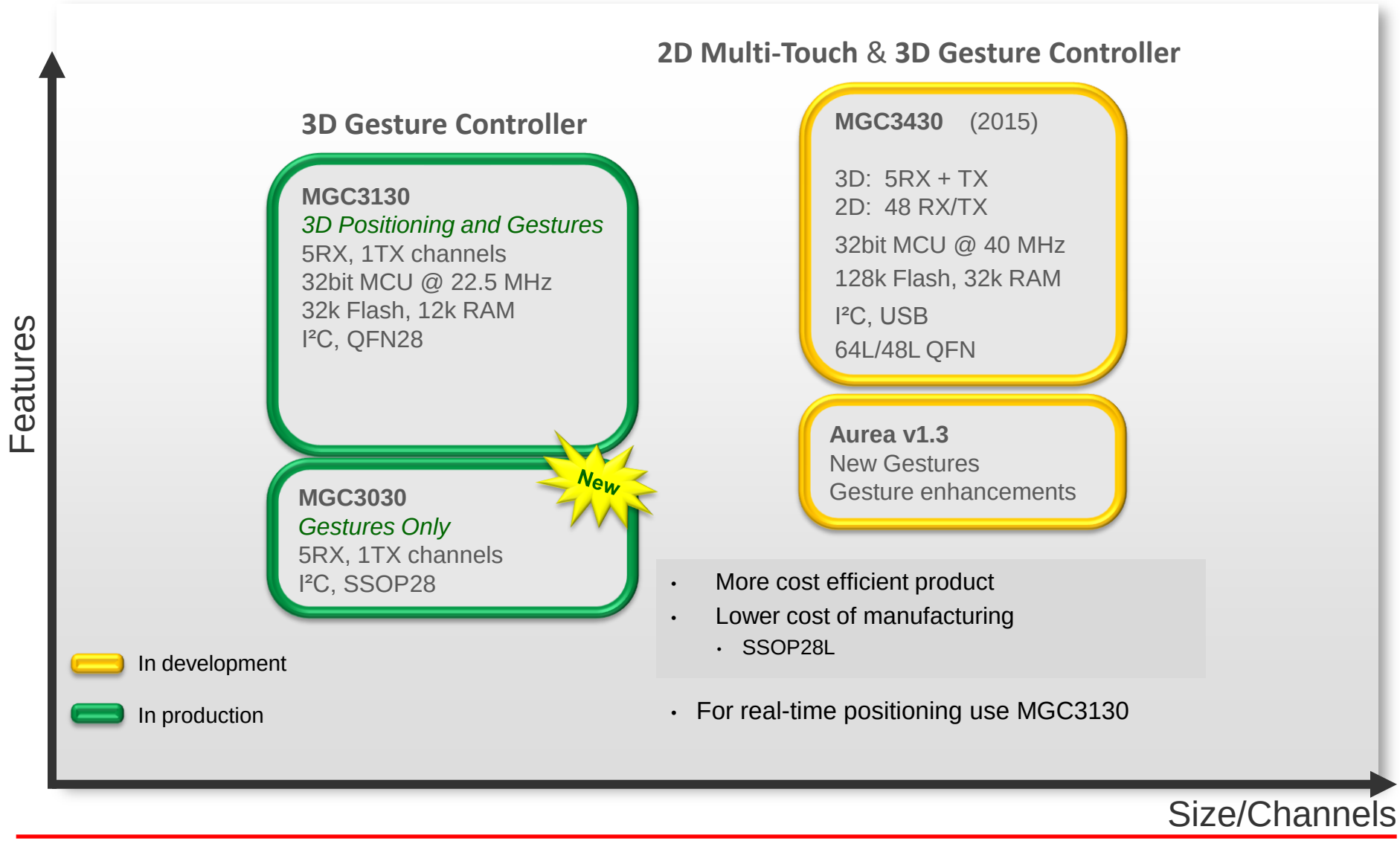
2. **MGC3030** processes signals

… or MGC3130

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

Gestures done right. MGC3x30.

GestIC Roadmap
2D Multi-Touch and 3D Gesture



MGC3030

It's all about gestures

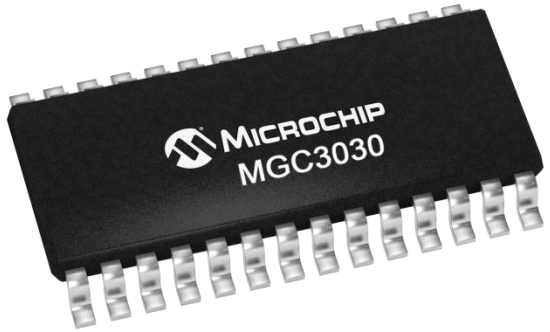
Feature focused

Further simplified design in

One step design in

- **I²C + EIO interface**
  - Gesture Port = mapping of gestures to EOIs
  - Gesture Port enables gestures for **ALL products**.

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

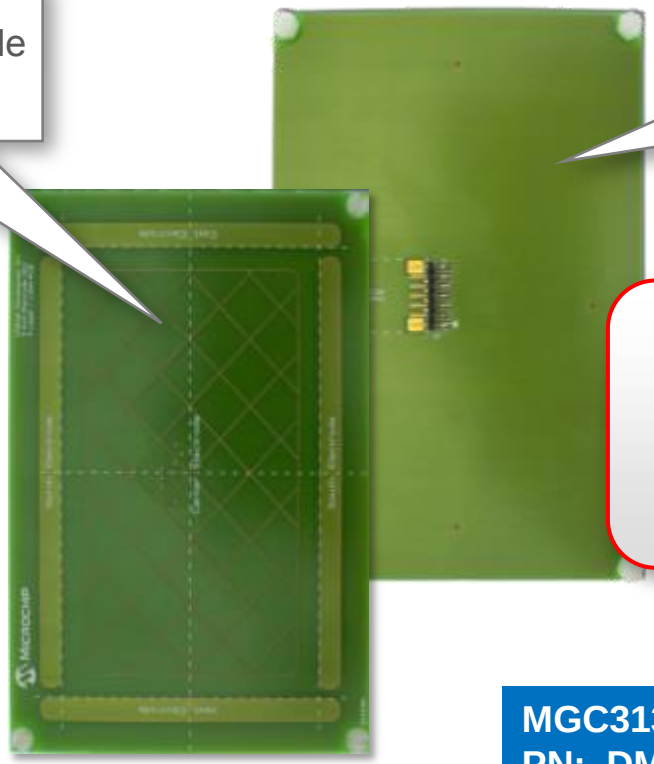


GestIC Development Kits

5” Reference Electrode
Frontside view

5” Reference Electrode
Backside view
(no components)

MGC3x30 Unit



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

I²C to USB Bridge
Connection to PC / Aurea GUI / MGC3x30 / System Paramterization

MGC3130 Hillstar Development Kit
PN: DM160218
Price: $179.99

MGC3030 Woodstar Development Kit
PN: DM160226
Price: $139

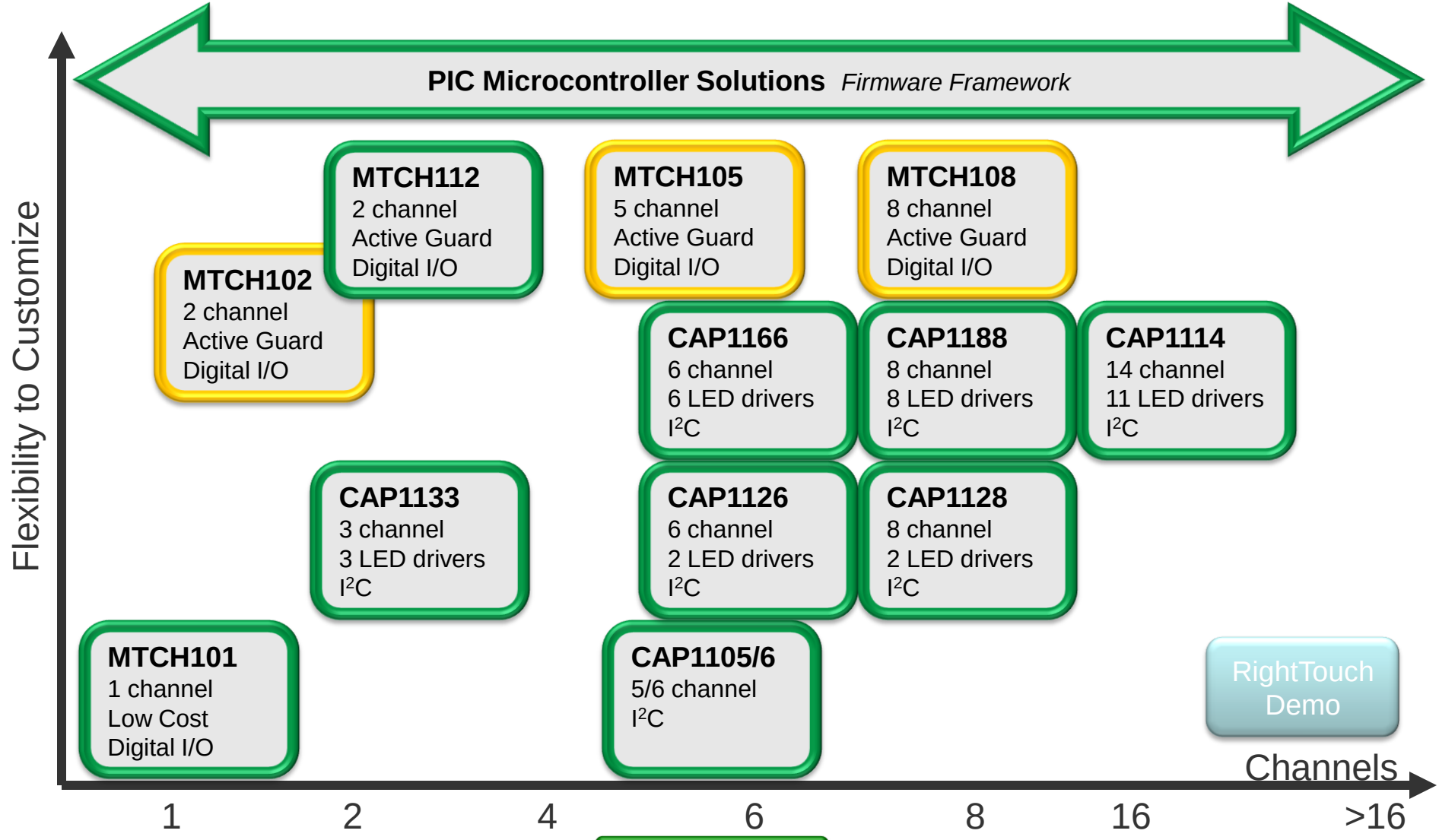
New

<

MICROCHIP

Low Power Touch Pads & Screens

Proximity, Keys, and Sliders
mTouch and RightTouch



Return to Topics

USB Keypad w/ mTouch™

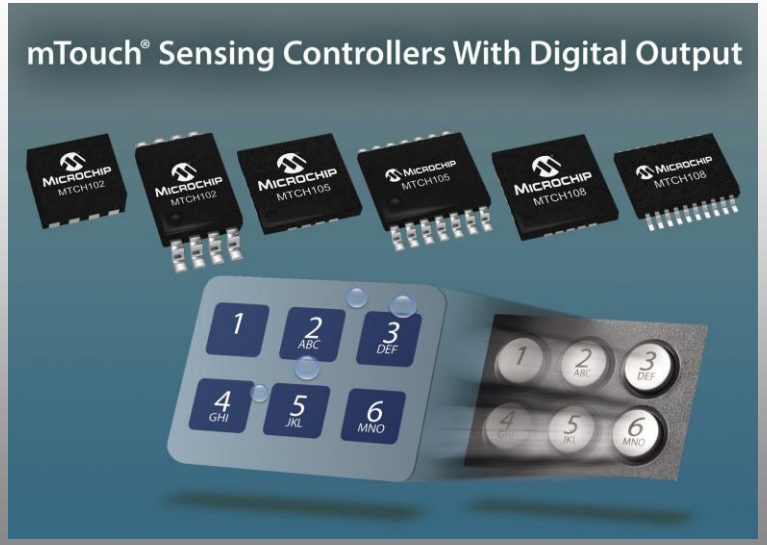
- **All features driven by PIC16F1459**
  - Crystal free USB operation
- **18 touch buttons using Capacitive Voltage Divider (CVD) technique**
- **LED backlight with proximity sensing ON and auto power OFF**
- **USB HID interface**
- **Plug and play**
- **Development Made Easy**
- **Low-cost development experience**
- **Start with the FREE download**
  - Schematics & ‘C’ source code
- **Easily modified to your specific application needs**

Demo

Return to Topics

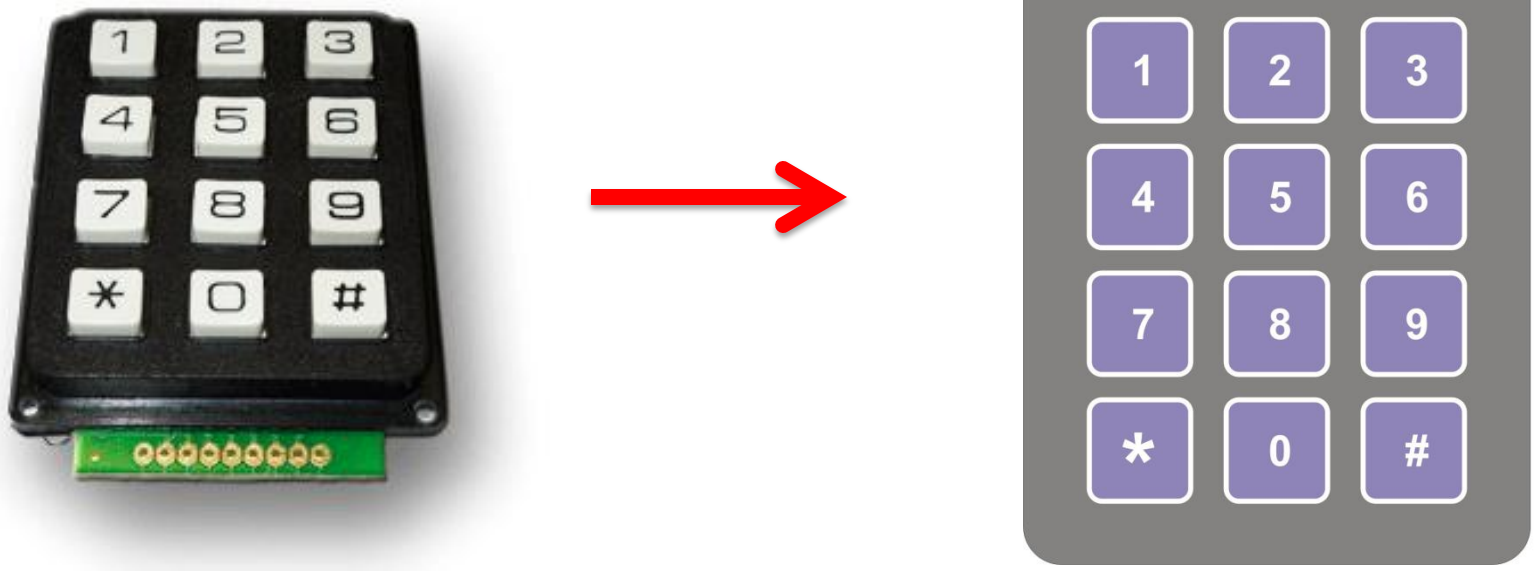
<

New MTCH102, MTCH105 and MTCH108



What is the MTCH10x family?

The MTCH10x are the easiest Capacitive Touch Controller for direct Mechanical Buttons Replacement



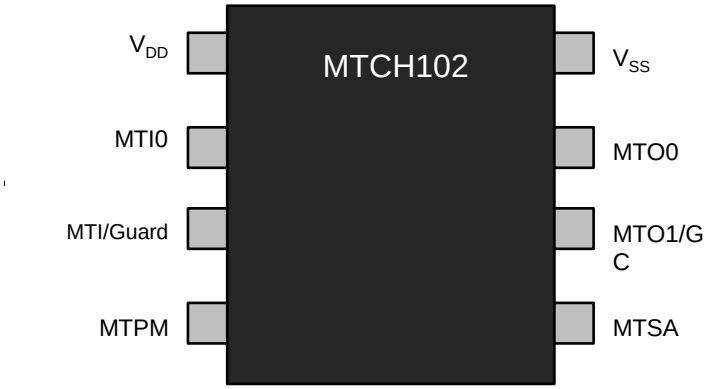
Product Highlights

Product:

- Up to 8 buttons
- Buttons and Proximity with Guard Option
- One Input – One Output
- No SW – Only HW configuration
- No Host SW as Digital Outputs
- High Noise Performance: Passed 10V RMS
- Water Resistance

Very Simple Configuration

- **MTSA: Sensitivity level – VSS biggest**
- **MTPM: Power Mode – VSS lowest Power**
- **GC: VSS = Guard Active**



Digital outputs for Direct Mechanical buttons replacement

Supports Water Resistance

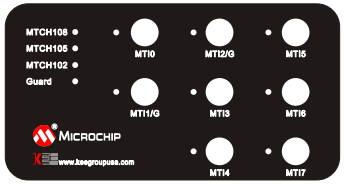
Features & Memory

MTCH108
8 x Input / Guard Option
8 x Output
Adjustable Sensitivity
Low Power Mode

MTCH105
5 x Input / Guard Option
5 x Output
Adjustable Sensitivity
Low Power Mode

MTCH102
2 x Input / Guard Option
2 x Output
Adjustable Sensitivity
Low Power Mode

MTCH101
1 x Input
1 x Output
Adjustable Sensitivity
Low Power Mode



DM160229 @ $29.95
Available Nov 15

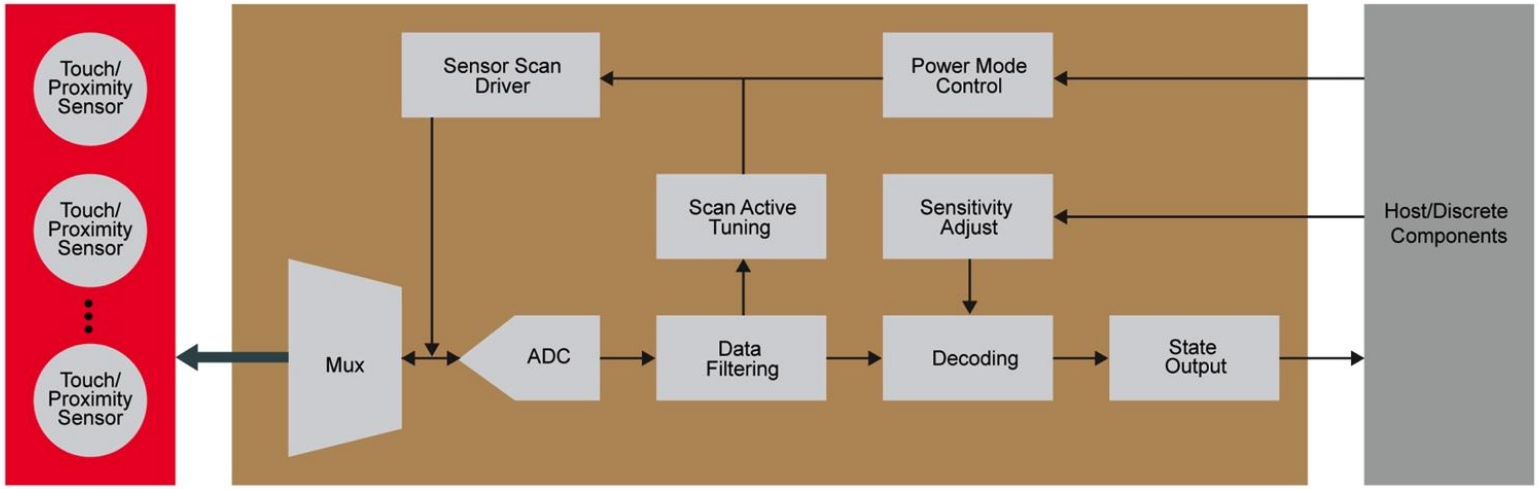
6 Pin

8 Pin

14 Pin

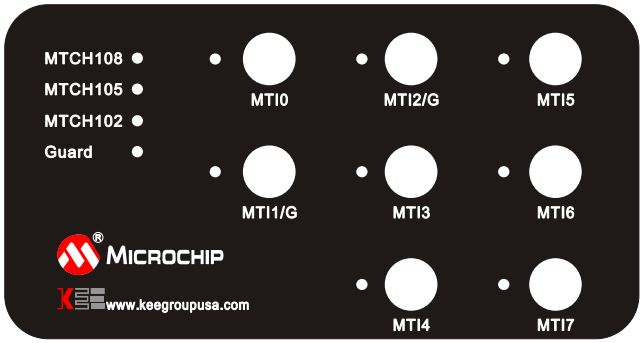
20 Pin

Block Diagram



Demo Board

- **Use MTCH108 with Guard On**
  - So MTI2 is inactive
- **Print for MTCH102 and MTCH105**
- **$29.95, available in November**



Water Resistance

- **No Trigger when Drop of water**
- **Cannot work if covered with Water**
  - Metal Over Cap

Hot Product Update
DN2470

Depletion-Mode N-Channel MOSFET for High Voltage Linear Regulation

October 2015

Customer Problem Solved

For: LDO Front-End Requiring HV Input

- **Problem: LDOs Can't Naturally Interface to Offline Input**
  - Input Voltage Range, Transient Issues Prevent Offline Function
  - Step-Down Requires a Lot of Parts for Simple Line Interface Applications

DN2470 Solution and Benefits

- **Normally-On MOSFET, Voltage Drop Dictated by Zener Voltage**
  - Limits Input Voltage to LDO to Acceptable Level
  - Provides High Voltage and Transient Survivability to LDO
- **Suitable for Applications Seeking Low Part Count, Low Noise, High Accuracy Offline Regulation with Linear Power**

Depletion Mode MOSFETs

- Switches Providing Low Voltage to High Voltage Interface for Protection and Start-Up Circuits
- Normally On Device, Require a Negative Gate-Source to Turn-Off

Depletion MOSFET Family

Part Number	BVDSX Min (V)	RDS(ON) Max (Ω)	VGS(OFF) Min (V)	VGS(OFF) Max (V)	IDSS @ VGS = 0V		Package Options
					Min (mA)	Max (mA)	
DN1509	90	6	-1.8	-3.5	300	-	SOT-23 SOT-89
DN2450	500	10	-1.5	-3.5	700	-	TO-252 SOT-89
DN2470	700	42	-1.5	-3.5	500 (Typ.)	-	TO-252
DN2530	300	12	-1.0	-3.5	200	-	TO-92 SOT-89
DN2535	350	25	-1.5	-3.5	150	-	TO-92 TO-220
DN2540	400	25	-1.5	-3.5	150	-	TO-92 TO-220 SOT-89
DN2625	250	3.5	-1.5	-2.1	3300	-	TO-252 8-SOIC (Dual)
DN3135	350	35	-1.5	-3.5	180	-	SOT-23 SOT-89
DN3145	450	60	-1.5	-3.5	120	-	SOT-89
DN3525	250	6	-1.5	-3.5	300	-	SOT-89
DN3535	350	10	-1.5	-3.5	200	-	SOT-89
DN3545	450	20	-1.5	-3.5	200	-	TO-92 SOT-89
DN3765	650	8	-1.5	-3.5	200	-	TO-252
LND01	9	1.4	-0.8	-3.0	300	-	SOT-23
LND150	500	100	-1.0	-3.0	1	3	SOT-23 TO-92

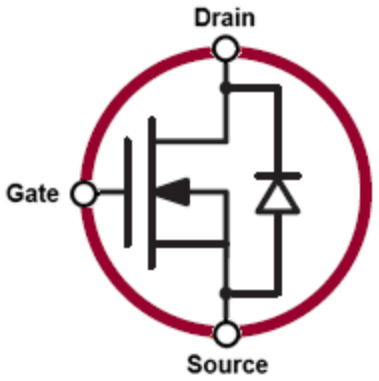
DN2470 Depletion MOSFET Product Details

Description

The DN2470 is a linear friendly depletion-mode (typically ON) switch. This device is free from thermal runaway and thermally induced secondary breakdown

Features

- High Voltage Rating=700V, Linear Capable
- Avalanche Tolerant (Evaluation System Survives Lighting Strike Test to 2kV)
- $R_{DS(ON)}$=42Ω - Supports 10-50mA Offline Load Current
- Thermally Friendly TO-252 (D-Pak)
- $R_{TH,JC}$ = 2.4°C/W

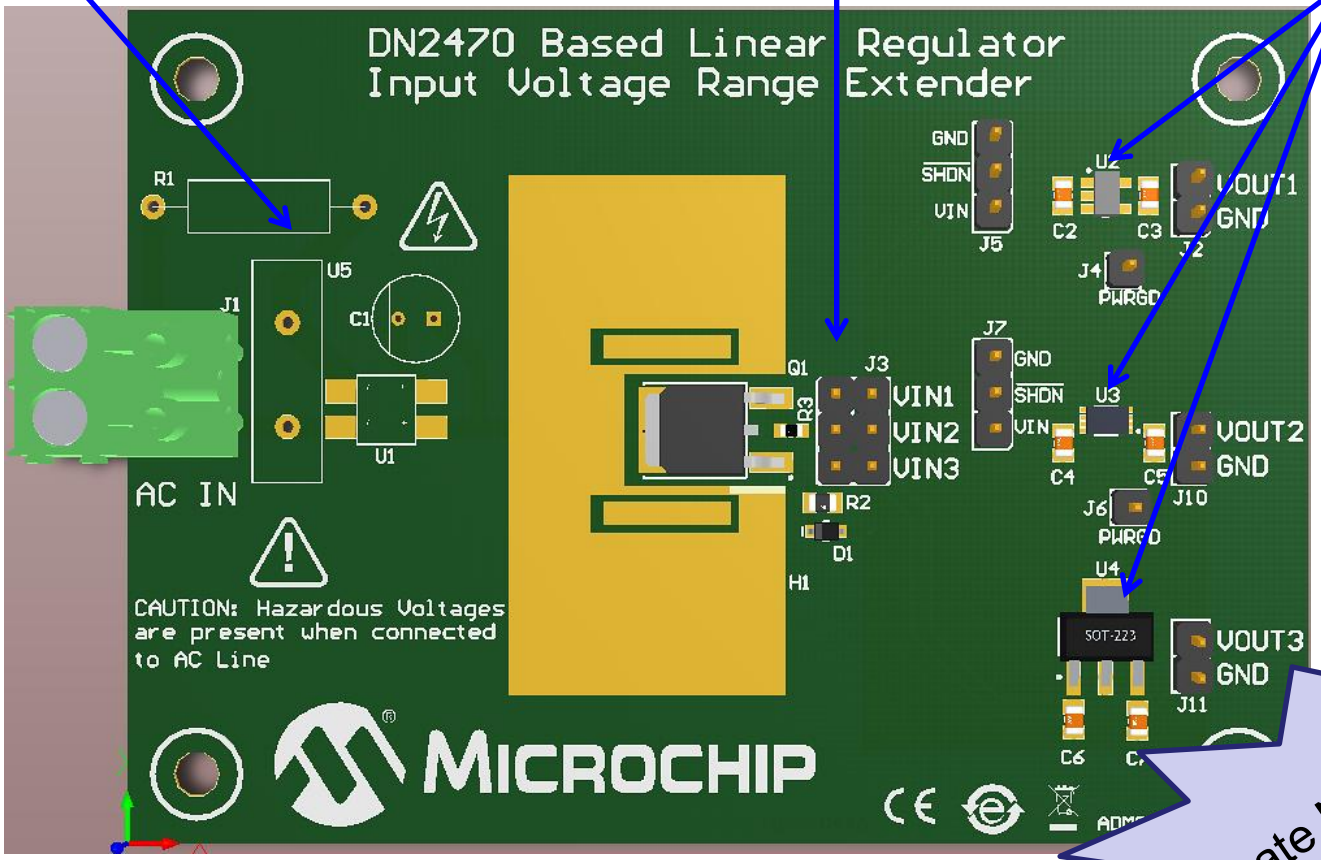


DN2470 Based Linear Regulator Input Voltage Range Extender

Transient Protection

LDO Selection

LDOs



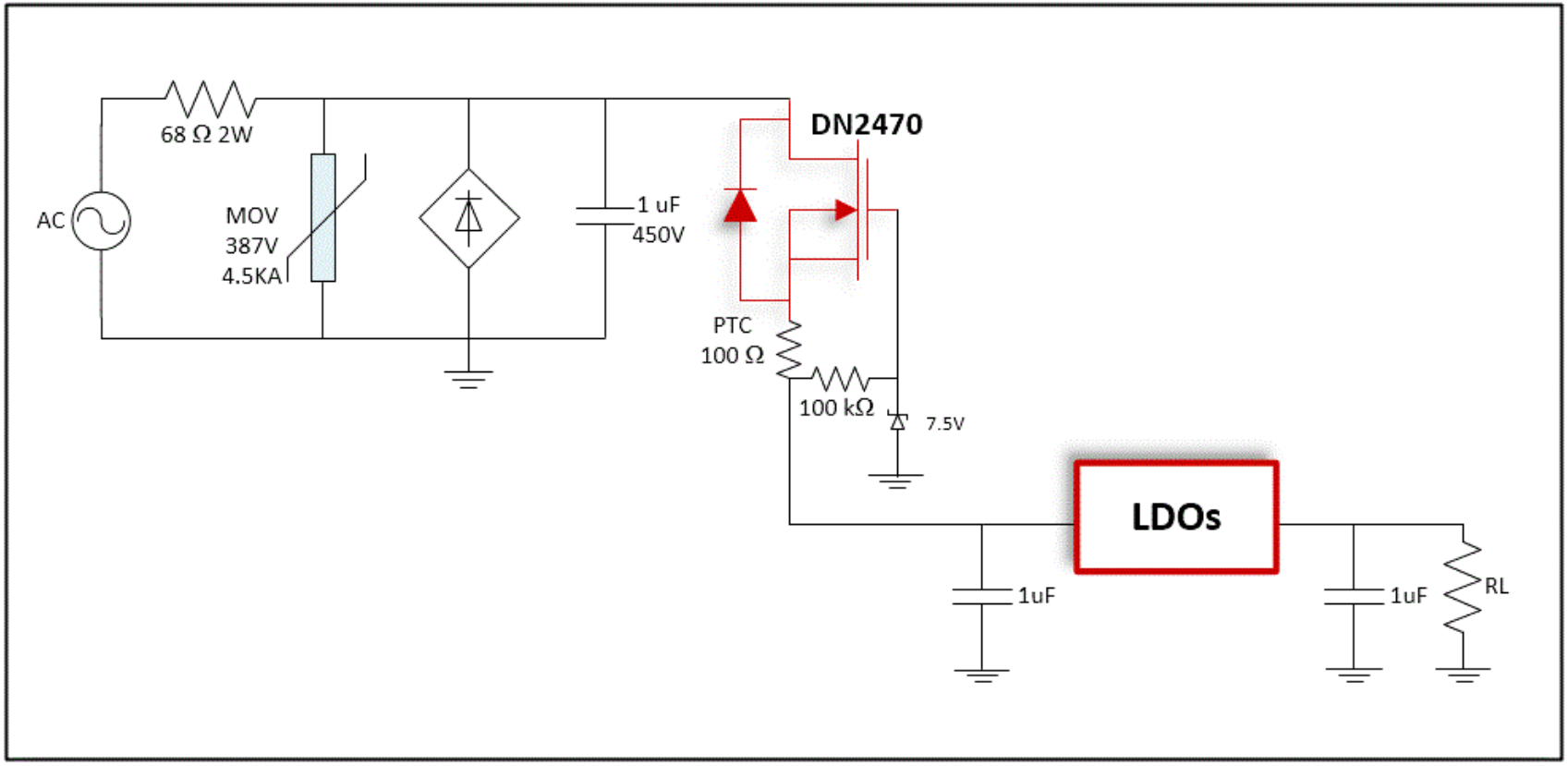
Late Nov. '15

DN2470 Based Linear Regulator Input Voltage Range Extender

- **Features**
  - Absolute Max Input Voltage: 700V
  - 120 & 230 VAC Offline Regulator
    - Minimum output current: 10mA
    - Maximum output current thermally limited
    - Transient survivablity: 2.5kV
  - Over-temperature protection
  - Output voltage range 3-5V
  - 3 different selectable LDOs
  - Good thermal impedence (27.4 °C/W, junction to ambient) enables offline function

DN2470 Based Linear Regulator Input Voltage Range Extender

BLOCK DIAGRAM:

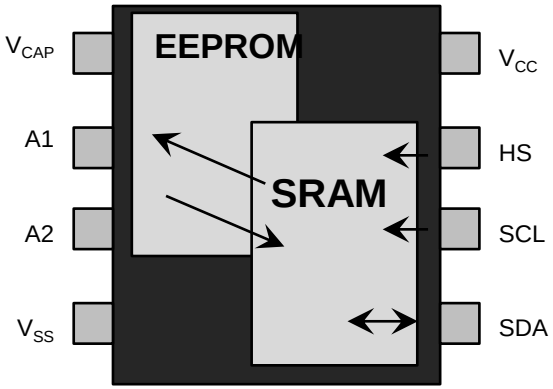


EERAM
47x04, 47x16

Sales Training Presentation

What is EERAM?

EERAM is an SRAM with a shadow EEPROM in one package



- 4Kb, 16Kb I2C (1MHz)
- 3.0V, 5.0V Options
- Unlimited Writes to SRAM
- Automatically Stores Data at power down
- No Battery Needed (needs ext. capacitor)
- Data auto recalled to SRAM on Power-Up

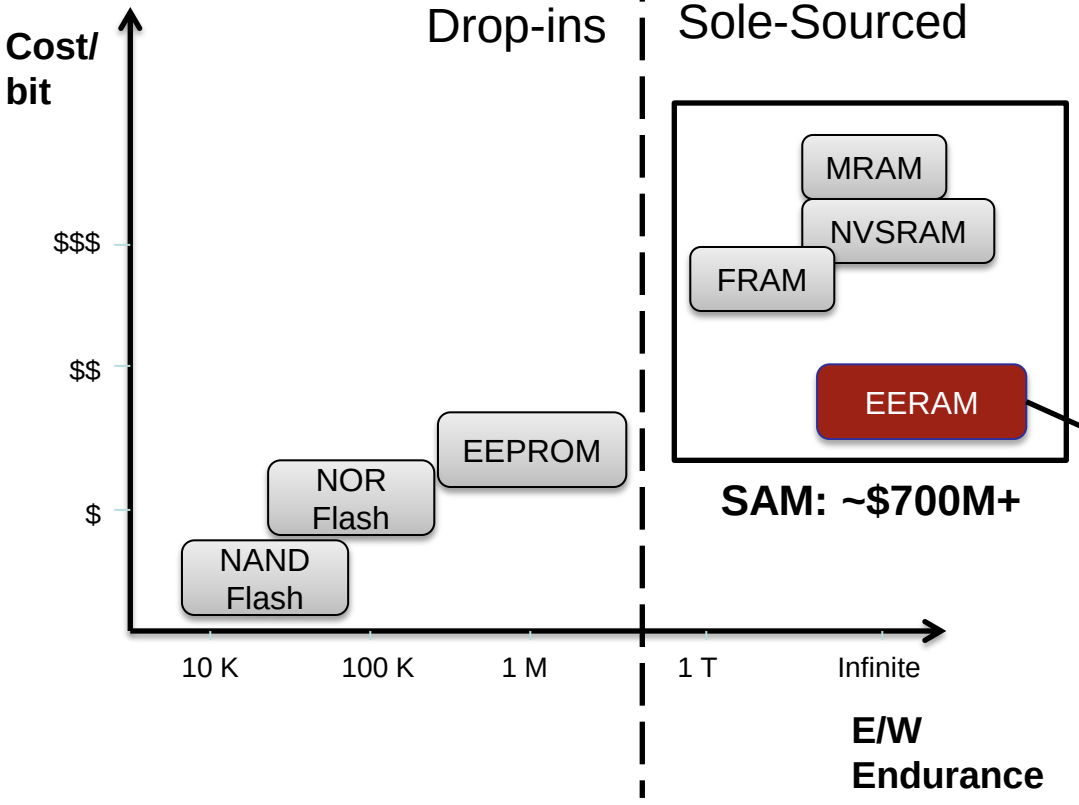
Combines Two Proven Technologies

"Reliability of an EEPROM with the Performance of an SRAM"

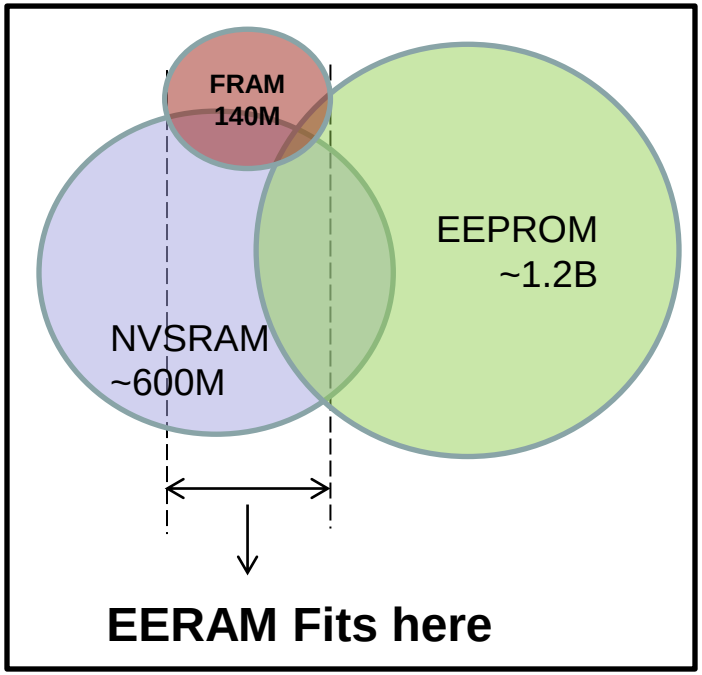
EERAM Market Position
Where does it fit?

Floating Gate
Broad Market
Lower Costs
Limited Endurance
Drop-ins

RAM Based
Niche Market
Zero Write Times
Infinite Endurance
Sole-Sourced



SAM: ~$700M+



EERAM

1. **Significantly Less Expensive**
2. No need of external battery
3. Low Power

Product Highlights

Product:

- 4Kb, 16Kb I2C Interface
- 2.7V-3.6V; 4.5V-5.5V
- 1MHz Max Clock

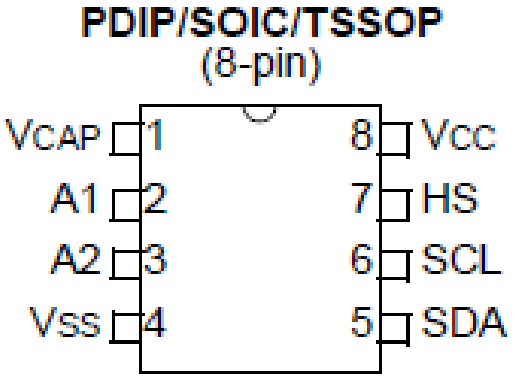
Read/Write and Modes:

- Infinite Read and Writes to SRAM Array
- 1M+ Store Cycles to EEPROM
- Automatic Store to EEPROM on power down
- Automatic Recall to SRAM array on power up

Other Features:

- Event Detect Flag/Pin
- Write Protection from 1/64th of array to whole memory

- Industrial and Automotive Temps (Automotive Qualified)



Where is EERAM Useful?

Applications Needing:

Ultra Fast Writes, Random Access

Unlimited Endurance

Preserve Data Reliably through Power Loss

Comparing NVSRAM technologies

Attribute	EERAM	FRAM	NVSRAM	MRAM
Manufacturer	Microchip (47XXX)	Cypress (CY15XX), Fujitsu (MB85xx)	Cypress (CY14XX)	Everspin (MR25XX)
Desnity	1Kb - 16Kb	4Kb - 2Mb	64Kb -1Mb	256Kb - 4Mb
Bus (Max Speed)	I2C (1MHz)	I2C (1MHz), SPI (20MHz)	I2C (3.4MHz), SPI (40MHz)	SPI (40MHz)
Voltage	2.7-3.6V, 4.5-5.5V	2.7-3.6V, 4.5-5.5V	2.7-3.6V, 4.5-5.5V	2.7V-3.6V
Max Temp Range	-40C to 125C	-40C to 85C	-40C to 85C	-40C to 125C
Data Retention	200+ Years	151 Years	20 Years	20 Years
AECQ-100	Grade 1	Grade 3	NA	Grade 1
Endurance	Unlimited	1 trillion +	Unlimited	Unlimited
Cost	$	$$	$$$	$$$$
Min Capacitor	15uF	Not needed	270uF	Not needed
Standby Current	40uA	3uA	250uA	115uA

Applications

Metering – Energy, Gas, Water

- Secure, Continuous logging of consumption data
- In field updates of features and pay scale tables

Automotive

- Black Box Data Recorder, Data Logging
- Last Set Point Recorder (Seat Position, Wiper etc)
- ABS, Air Bags, Sensors, Seats, Black Box, Transmission

Printers, ATM, Kiosks, POS

- Log Printer Head Position, Record Ink Details
- Buffer Memory
- Record Number of Prints, Start Up Configuration

Any application that needs unlimited writes, instant writes, and data stored securely during power loss is a good fit for EERAM

EERAM in Metering

EERAM allows meters to write consumption data **1000x more frequently than EEPROMs**

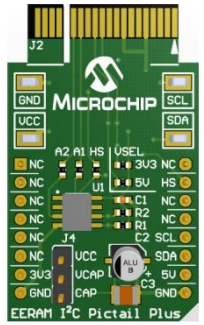
More accurate consumption data

Real Time Data Logging – Modern meters need data to be written as frequently as **~2 times per second**.

Feature	Benefit
Fast data-writing speed	Protects against data loss in the event of a power failure
Read/write Cycle Endurance	Permits Data Collection at frequent intervals
Back-up via Capacitor	Eliminates the need for a battery back-up to preserve data

EERAM allows users to write to it continuously

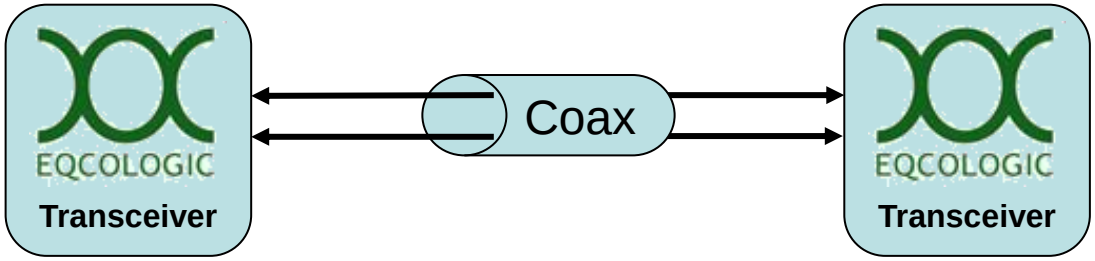
EERAM Tools and Support



- **EERAM PICtail™ Plus Board – Dec' 15**
  - Evaluate EERAM quickly
  - PICtail™ Plus connector allows you to connect to Explorer 16 Board.
- **EERAM Driver Code with PIC – Jan'16**
- **PM3 Support – Dec' 15**
- **App Note: Choosing the right capacitor for your design (type, size, tolerance, etc.) – Jan' 16**
- **App Note: Recommended Usage of I2C EERAM – Dec' 15**

Enables Re-Use Coax

Ethernet
HD-SDI
Firewire
Machine Vision



Ethernet
HD-SDI
Firewire
Machine Vision

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

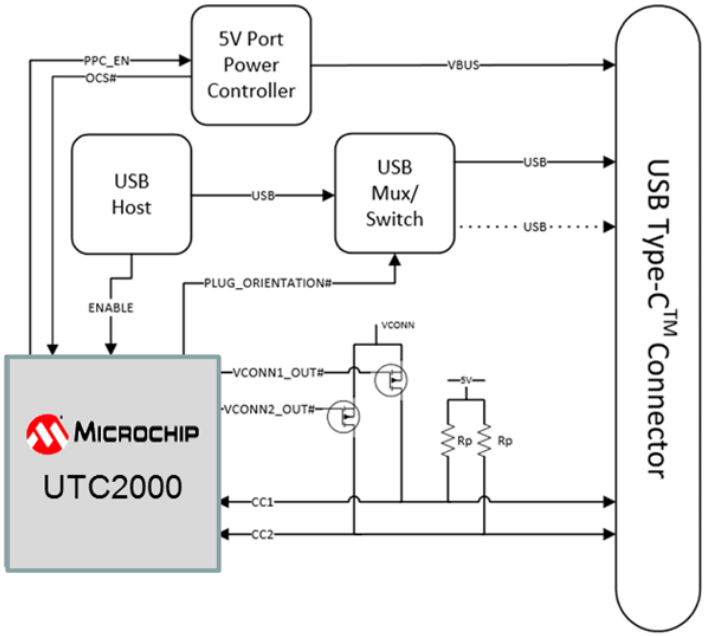
... All using existing Coax

MICROCHIP

USB Power Delivery

UTC2000 USB Type-C™ Controller

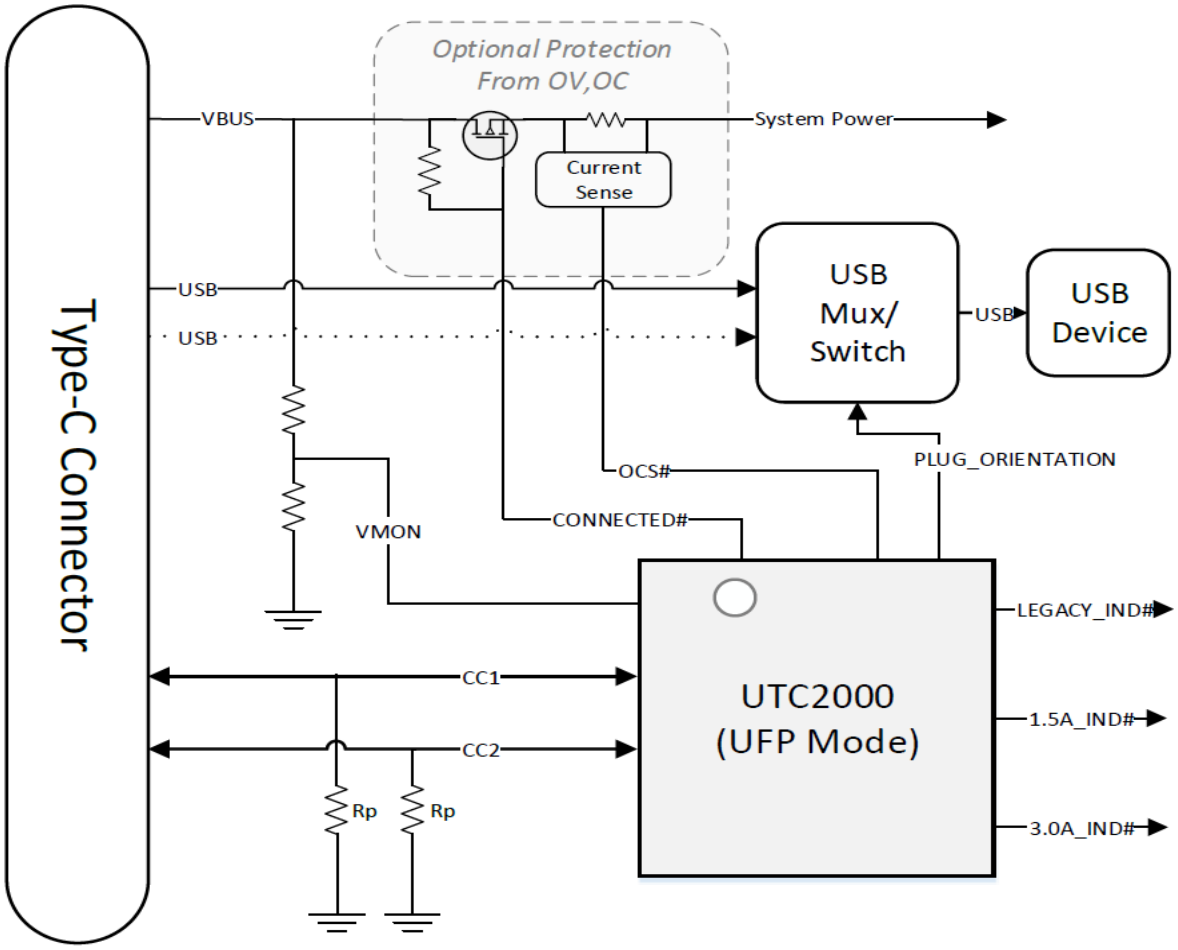
- **Transition:**
  - Existing USB Type-A ➔ USB Type-C DFP
  - Existing USB Type-B ➔ USB Type-C UFP
- **USB 2.0, USB 3.0, or USB3.1 compliant**
- **Supports up to 3.0A Charging profiles**
- **3x3mm QFN-16**
- **Integrated ADC for Voltage monitoring on CC Pins**
- **Minimal external components**
- **Works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



Typical UFP Applications

- **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

UTC2000 UFP w/ Full Charging



BOM Cost Reduction !

Application Examples

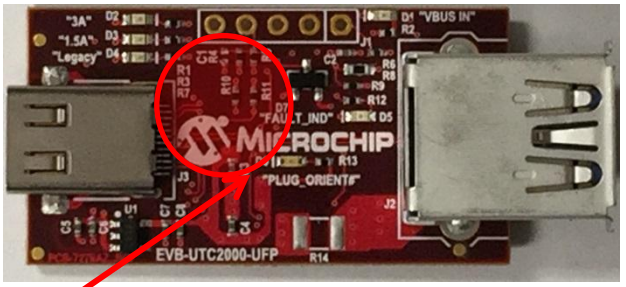
- Notebook
- Monitor/Dock
- Devices (UFP only)
- USB Wall Charger
- Industrial Charging Cart
- Automotive

EVB-UTC2000

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

DFP Board

UFP Board



UTC2000 on backside

Plug Into Host

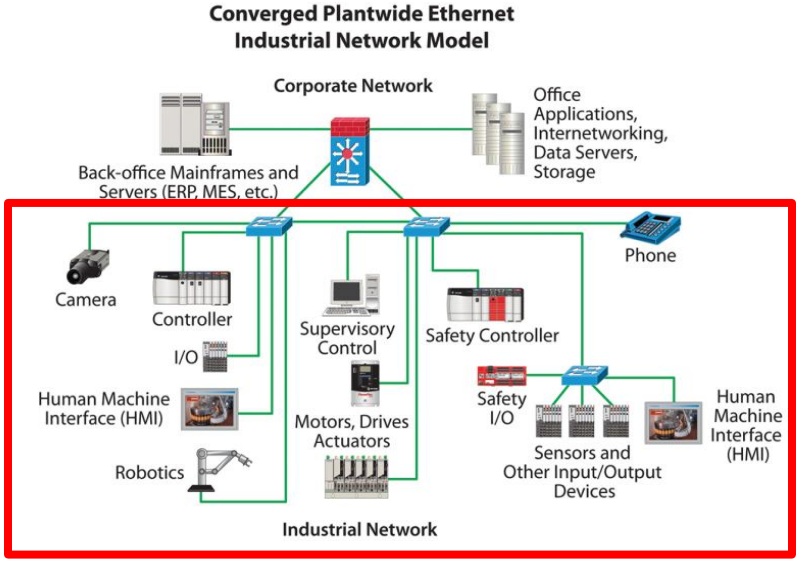
UTC2000

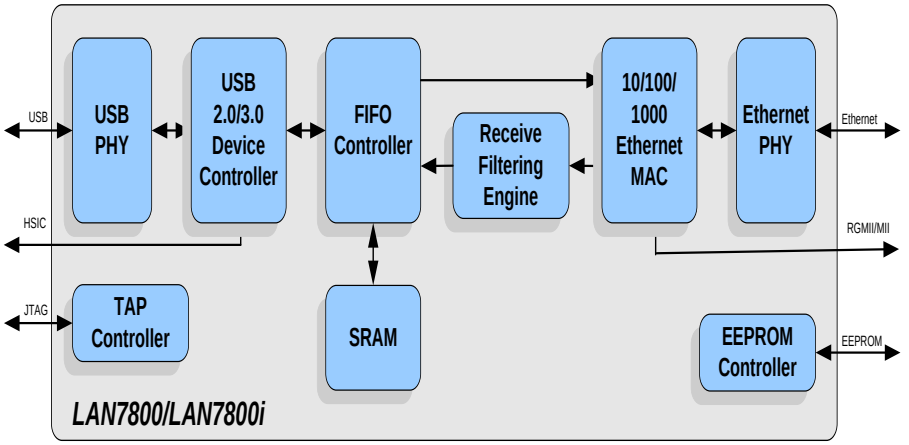
Wired Connectivity

Ethernet and USB

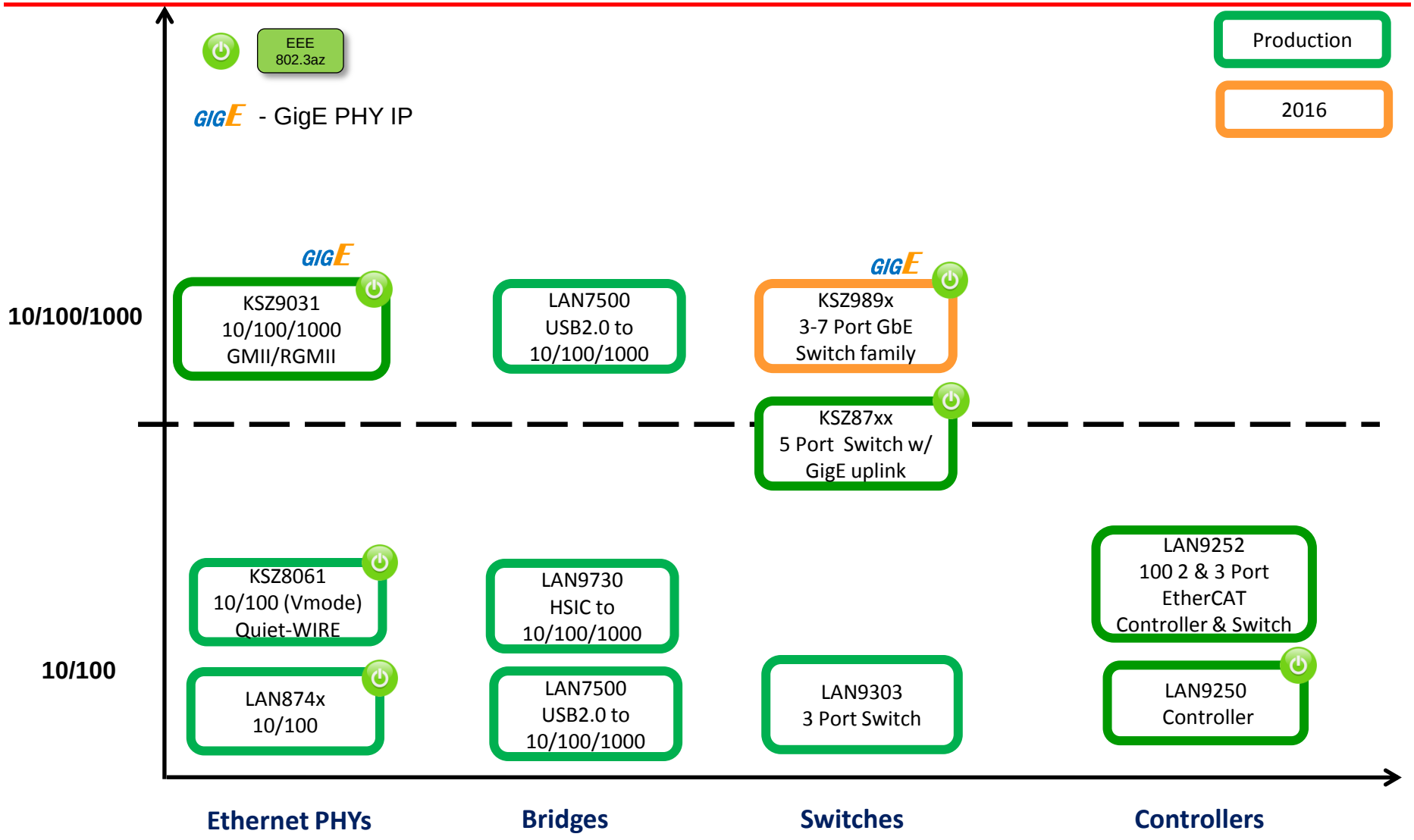
Ethernet - What's New

- **EtherCAT for Industrial Applications (now)**
  - Industrial protocol developed by Beckhoff
  - Target applications for motor / motion control
- **Next generation 2&3 Port Switches (now)**
  - 1588v2 Precision Time Stamp Protocol
  - Cable diagnostics
  - 100FX Fiber support
  - WoL & Energy Efficient Ethernet
- **Gigabit Ethernet solutions**
  - LAN7800 – USB3.0 to 10/100/1000 Ethernet - mid 2016
  - KSZ9031 – GigE PHY – available now!
    - GMII/RGMII
    - Cable Diagnostics
    - Voltage driven for low power
    - WoL & Energy Efficient Ethernet



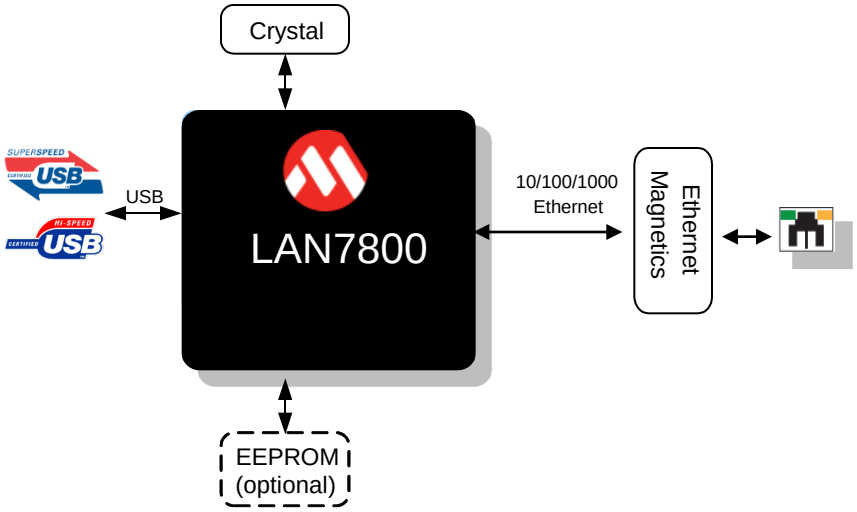


Ethernet Roadmap



LAN7800
USB3.0 to Gigabit Enet

New!



Target Applications

- PC Docking
- Port Replicators
- USB to eNet Dongle
- Digital Signage
- Networked Printers
- Netbook/Tablet
- PVR, STB
- Digital TV
- SoC Reference Platforms

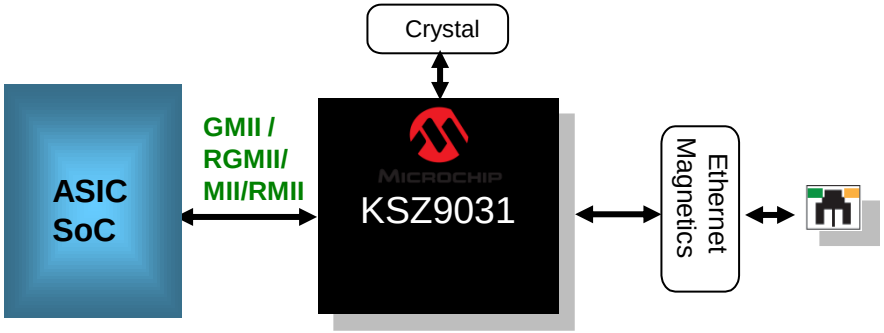
Commercial (0 to +85C) and Industrial (-40 to +85C) temperature supported

- **Single-chip, USB 3.0 to 10/100/1000**
- **Fully supports IEEE 802.3/802.3u**
- **Implements NetDetach™ and WoL support for reduced system power consumption**
- **Supports PCI-like PME Wake up**
- **Supports Win8's Connected Standby with flexible address filtering modes, Wakeup packet support, ARP and NS offload**
- **Supports EEPROM-less operation for reduced BOM costs**
- **UniClock Technology requires single 25 MHz crystal for both USB and Ethernet**
- **Energy Efficient Ethernet 802.3az**
- **Cable Diagnostics**

ES: Feb '16

KSZ9031
Next Gen GigE PHY

New!



Target Applications

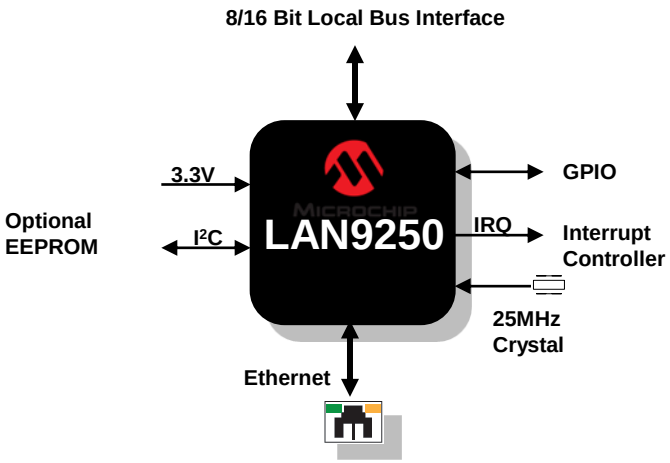
- Industrial PC
- VoIP gateway
- SOHO/SMB router
- Industrial Networks
- Security/Inspection
- MFP Printers
- STB

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**

LAN9250
10/100 Enet Controller

New!



Target Applications

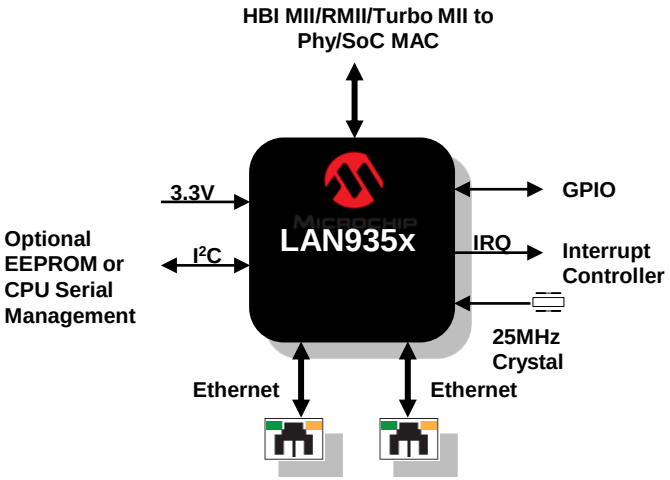
- •Industrial PC
- •VoIP gateway
- •SOHO/SMB router
- •Telecom
- •Financial Transactions
- •Industrial Networks
- • Power Grid/Meter
- •Security / Surveillance
- •Transportation
- •Mill/Aero

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**

LAN9352/53/54/55
2/3 Port Switches

New!



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

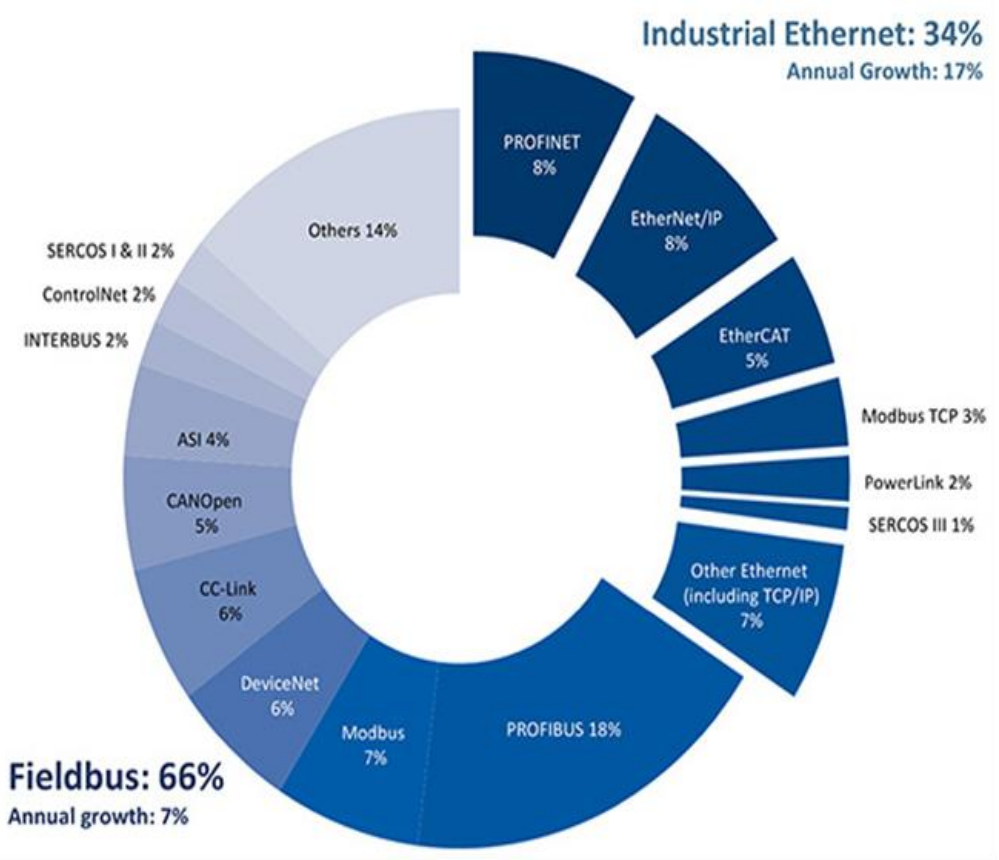
- **IEEE 1588-2008 Compliant**
  - ***UDP/IPv4/IPv6 and layer 2***
  - ***Transparent and Boundary clocks,***
  - ***Smaller packet size***
  - ***Increased update rate***
- **IEEE 802.3u 100Base-FX Fiber Interface**
- ***IEEE 802.3az EEE and WoL***
- ***Cable Diagnostics***
- **Optional EEPROM or external SoC serial management support via I^2C**
- **Virtual PHY support to simplify s/w development**
- **Integrated regulator enables single 3.3V supply**

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

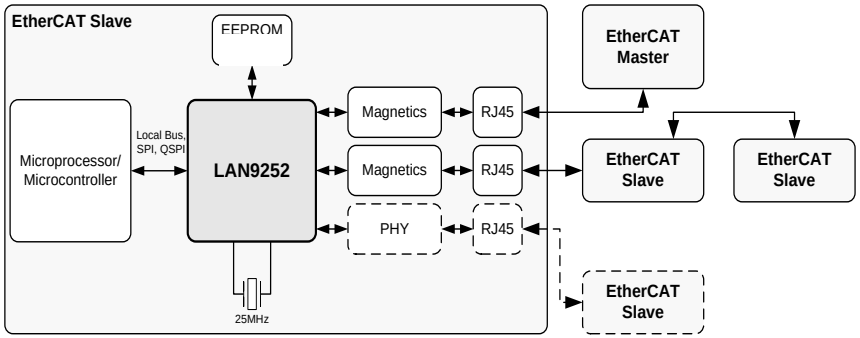
Why EtherCAT® Tech.?

- Ethernet for Control Automation Technology
  - Market is forecasted to grow 17% annually
- EtherCAT® technology is the fastest growing Industrial protocol
- EtherCAT technology reaches new dimension in network performance by optimizing messaging within each Ethernet frame
- Hardware-driven architecture with minimal performance dependencies on software stack
- Over 3000 EtherCAT Association members worldwide



Source: HMS January, 2015

LAN9252 Features



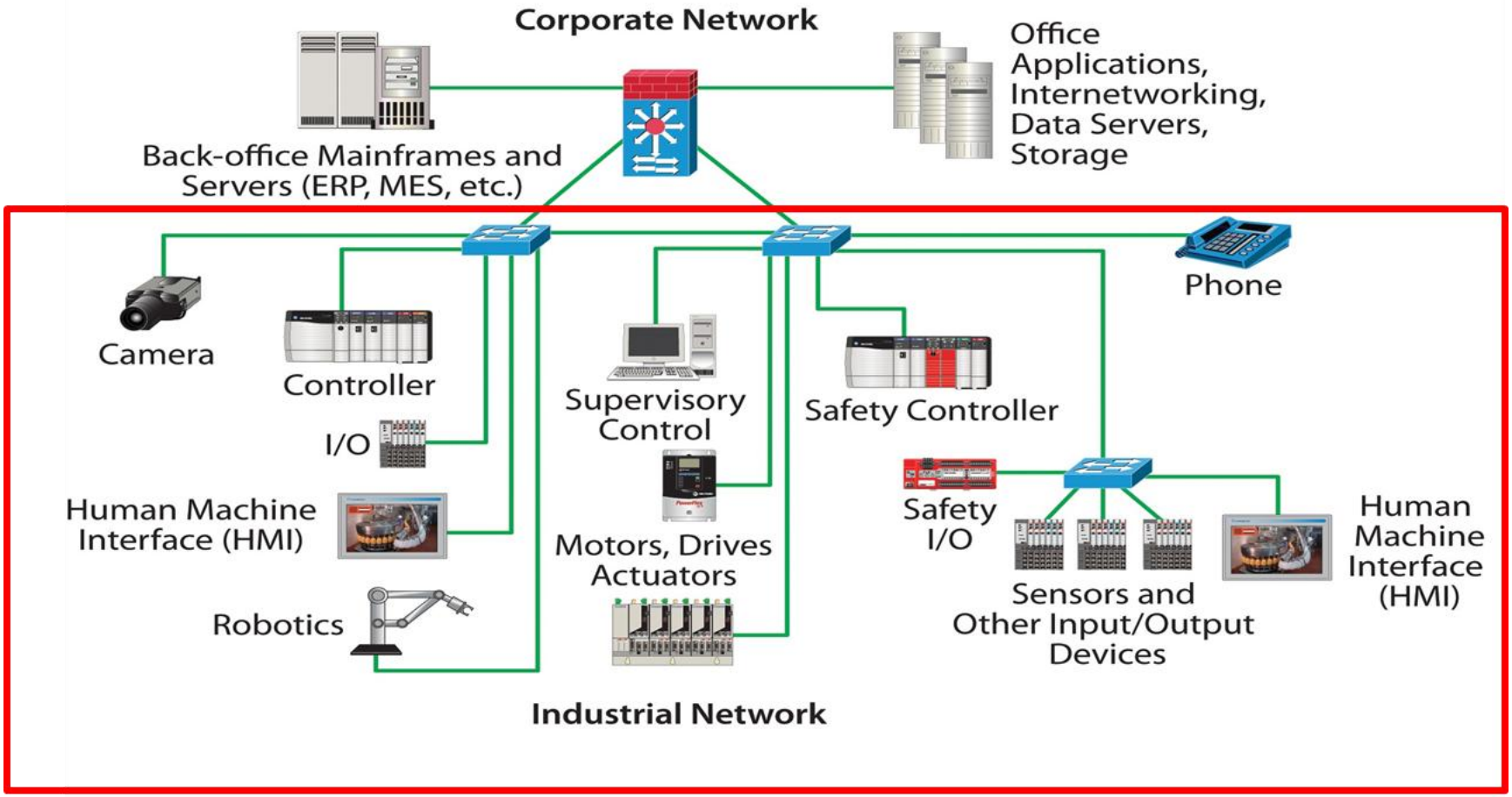
Target Applications

- 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**

Ethernet Industrial Network Model



Ethernet Value Proposition

- **Strong brand name in market**
  - Large install base across all product groups
    - Customers give MCHP 1st call for new designs
      - Qualifying a “new” vendor and device costs $50k-$100k
  - Long history in servicing Ethernet market
  - Quality, highly integrated products
  - Excellent support including LANCheck
  - Reliable supplier with solid performance and track record in supply chain management

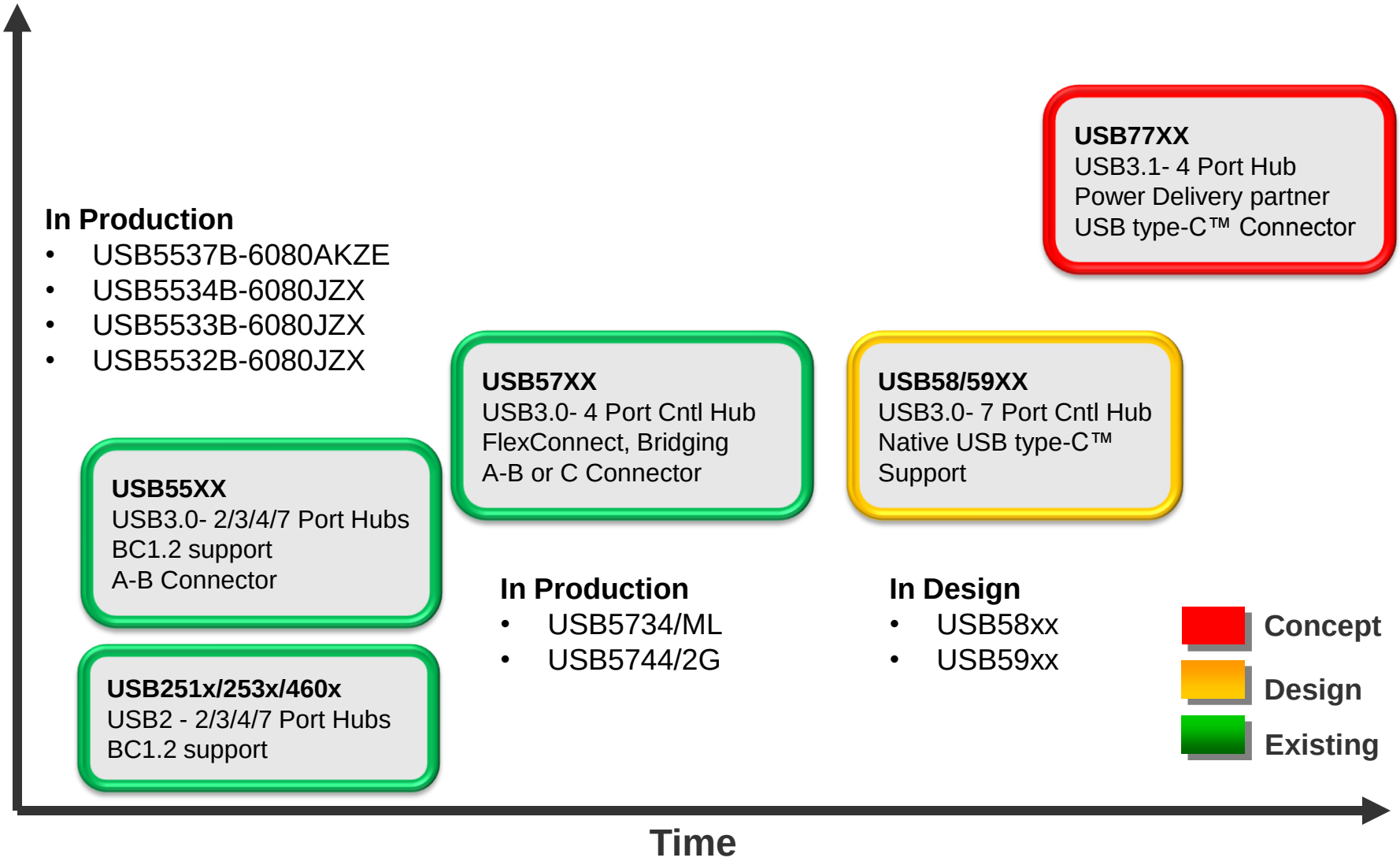
- **Products provide unique and differentiating features**
- **Reference designs featuring PIC processors**

USB Products

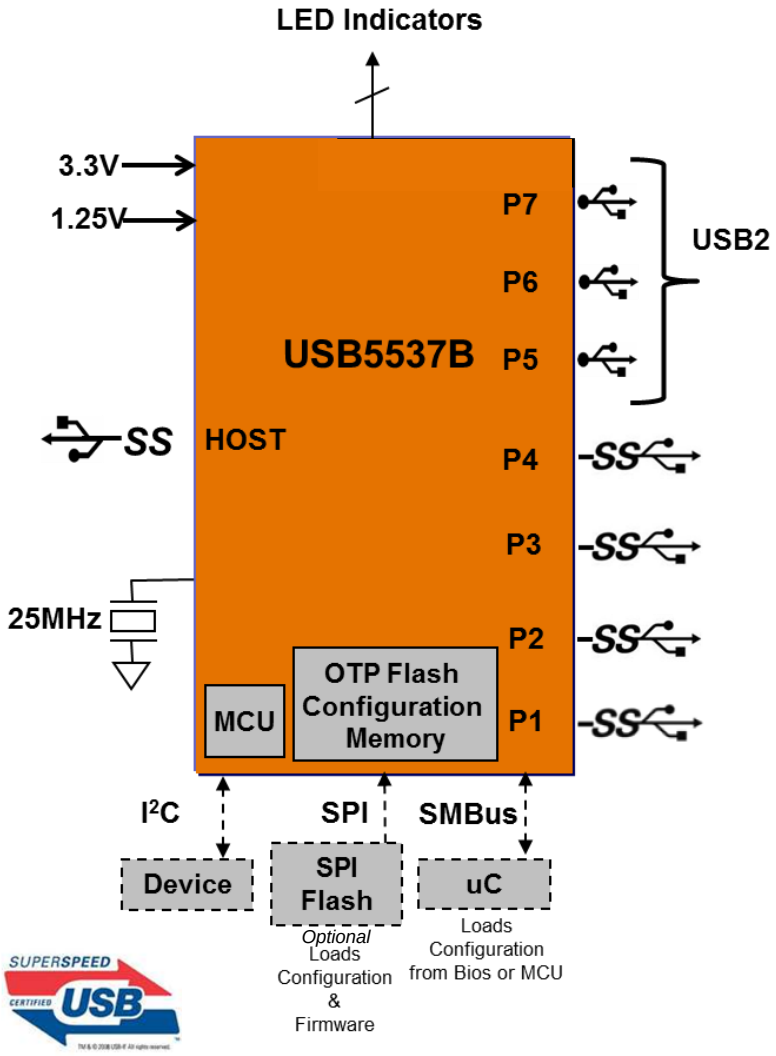
USB Transceivers Value Proposition

- **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



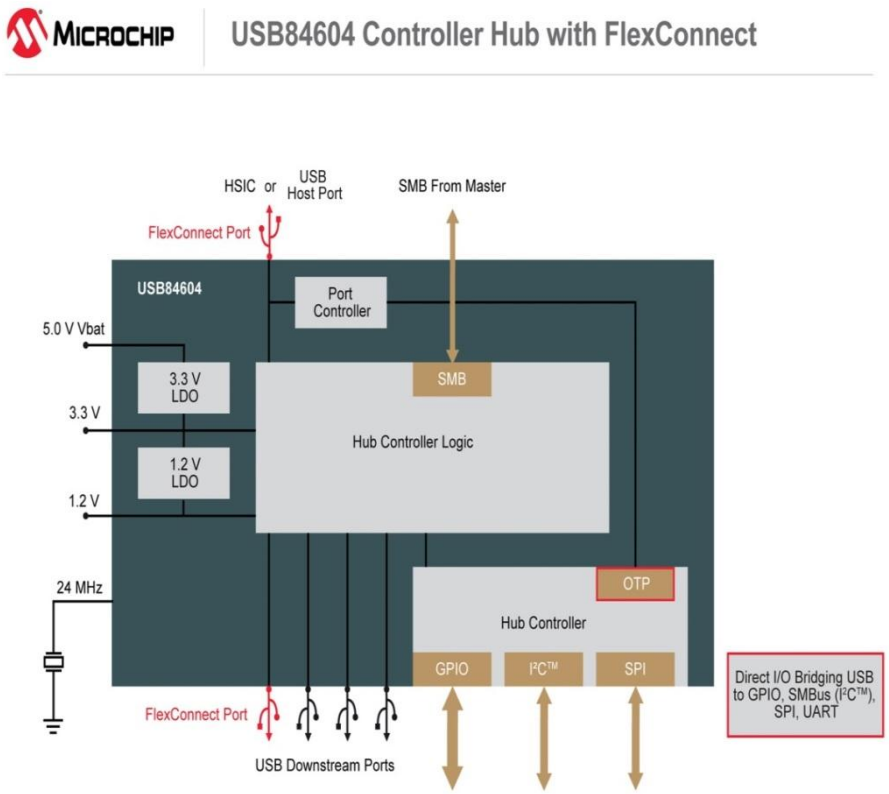
USB553XB – USB 3.0 Hub Family



- 2,3, 4 USB 3.0 Ports
  - USB5537 - 3 USB 2.0 Ports
- Supports USB 2.0 Link Power Management (LPM)
- On board configuration flash OTP
- USB Battery Charging 1.2 & Apple Charging, China Charging, RIM
- Multiple-TT for USB 2.0 traffic
- Preserve PortMAP, PortSWAP, PHYBoost and TrueSpeed features
- On-chip RXEQ to preserve cable length and 5Gbps signal integrity
- Optimized for 2-layer PCBs
- 72 QFN package (10x10mm)
- 64 QFN package (9x9mm)

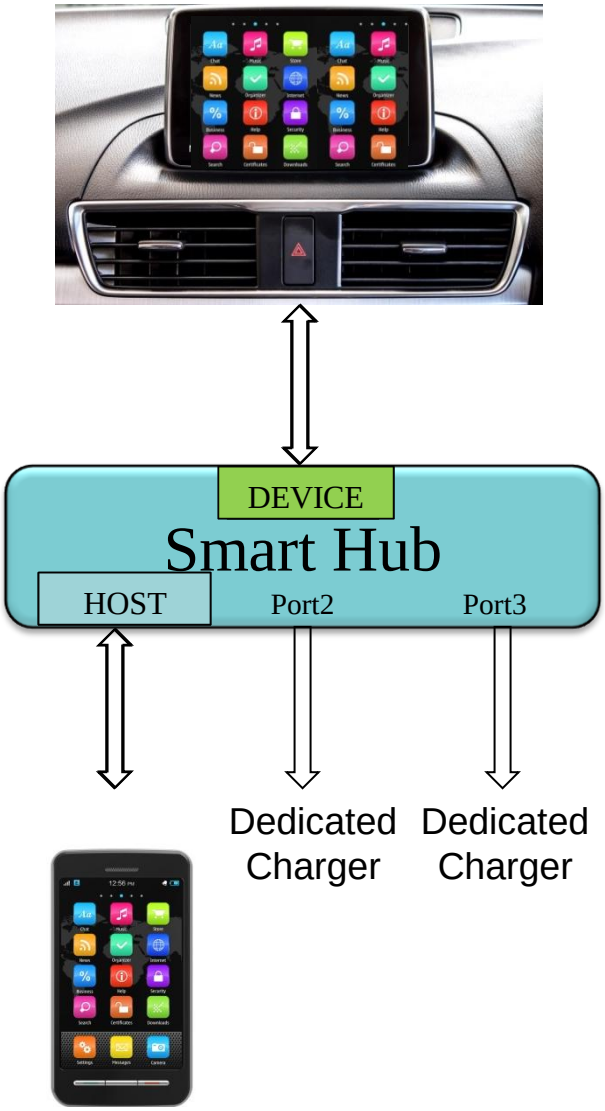
USB2 Controller HUB (UCH) “Smart Hub”

- **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

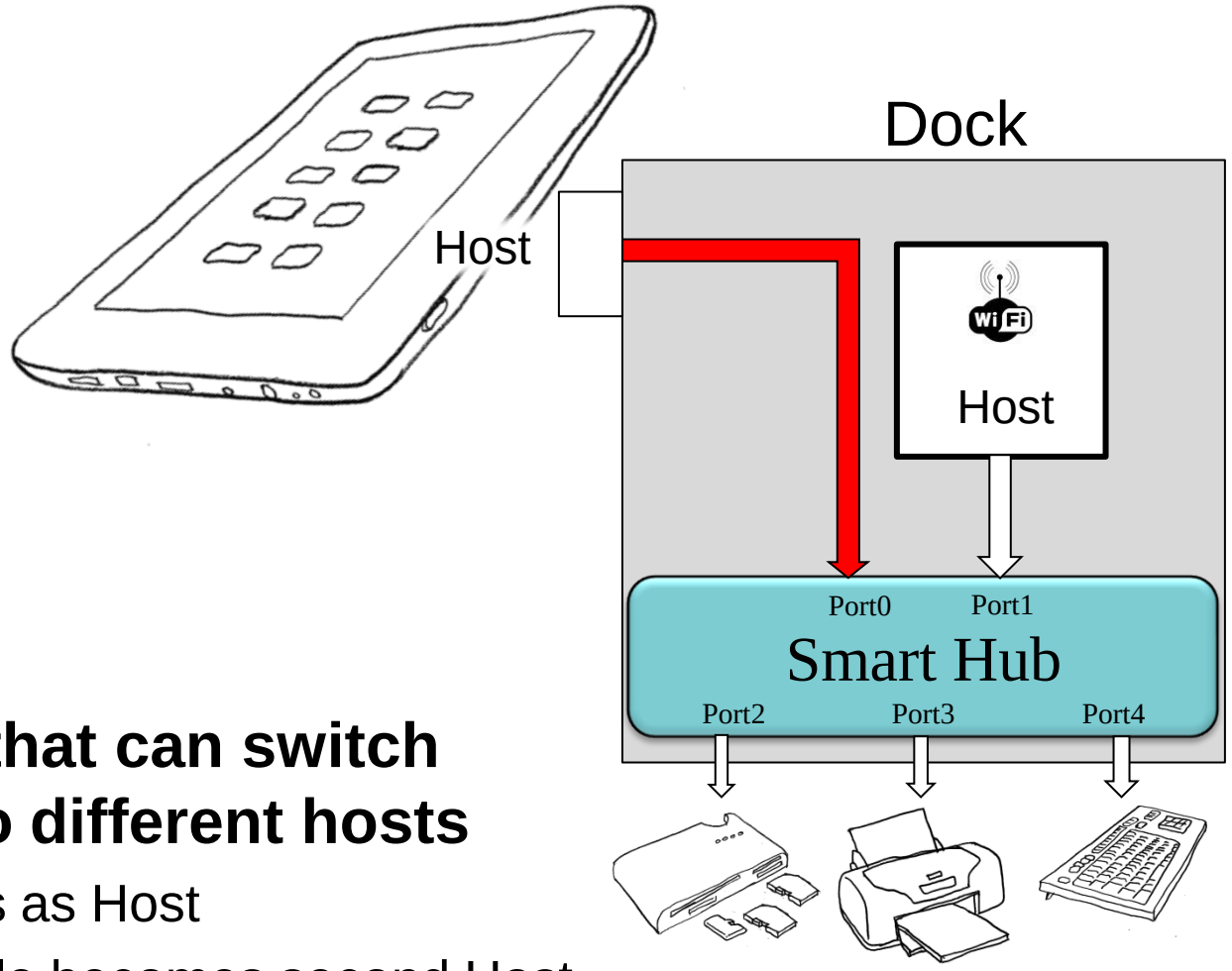


FlexConnect Example #1

- **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



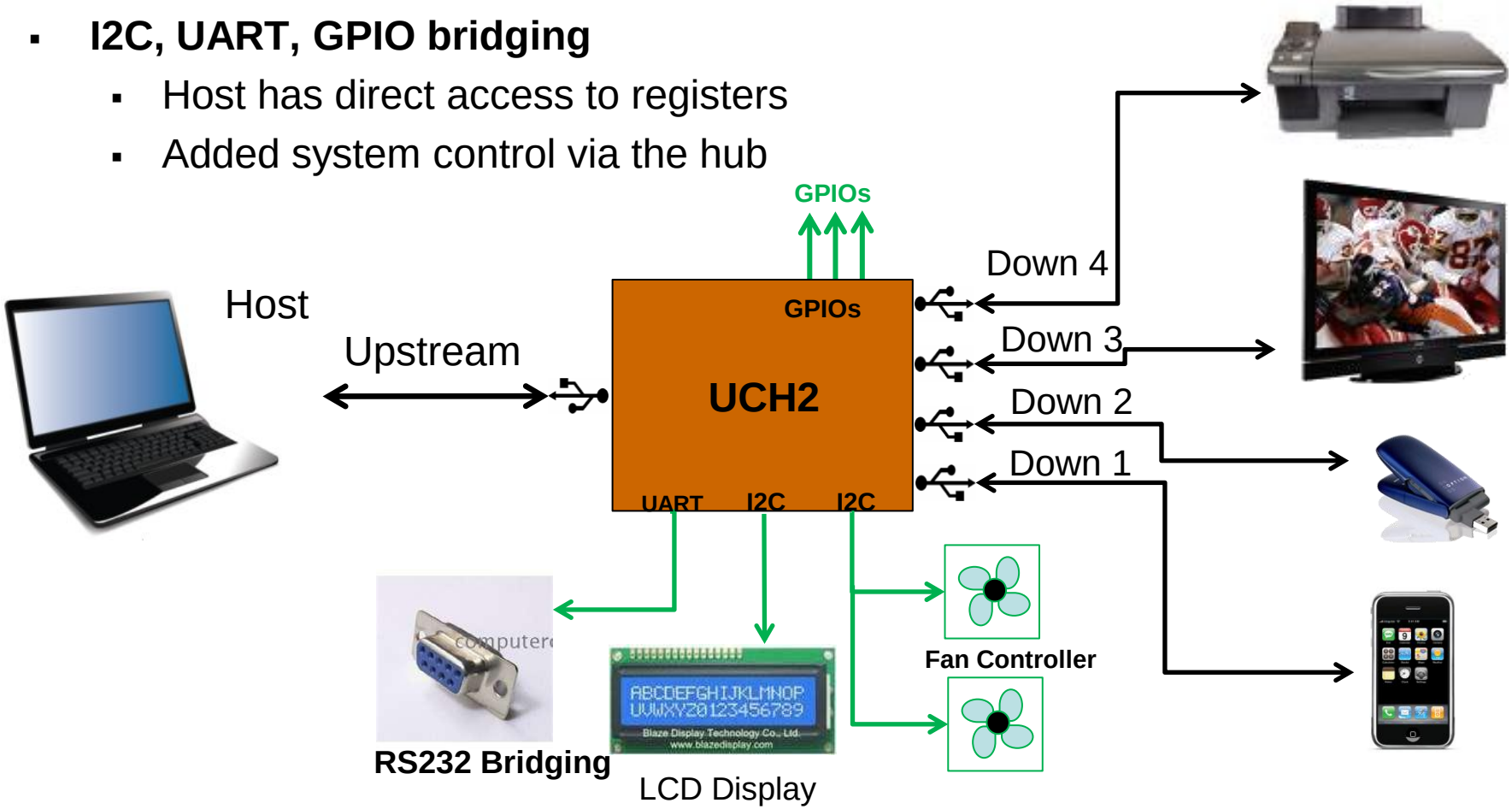
FlexConnect Example #2



- **A USB hub that can switch between two different hosts**
  - Tablet starts as Host
  - WiFi® Module becomes second Host

USB Controller Hub?

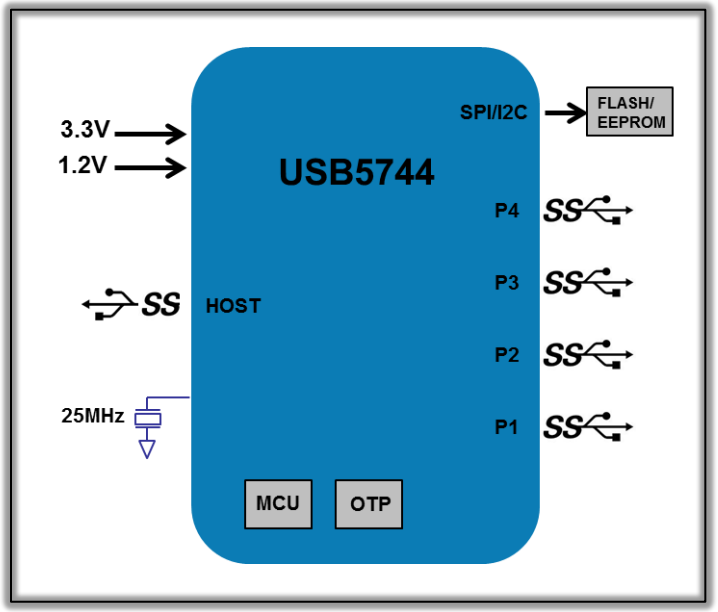
- **More than just a USB Hub!**
- **I2C, UART, GPIO bridging**
  - Host has direct access to registers
  - Added system control via the hub



…also supports battery charging!

USB5744 – Improving on Success

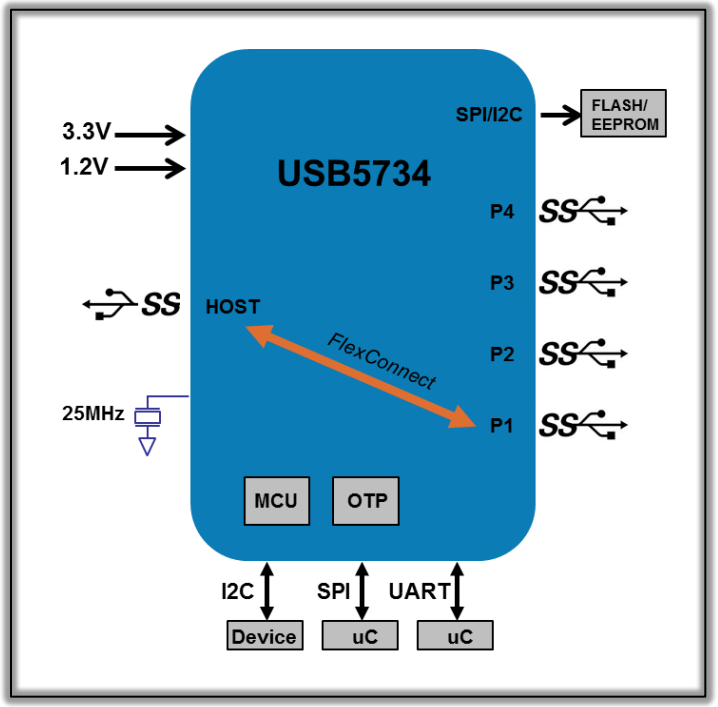
- **Smaller package, less pins**
  - 7 x 7 mm 56 pin QFN / 0.4mm pitch
- **Lower Power**
- **Better Signal Integrity (JTOL)**
- **Faster OTP programming**
- **Better built in diagnostics tools**
  - Fine grain control of 5 parameters
  - Generation of eye diagrams



- **Common configuration options enabled by “straps” without requiring OTP programming**
  - BC enable, Non-Removeable Port enable, Port Disable

USB5734 – Leading with New Functionality

- **First USB3 Controller hub**
  - USB to I2C/SPI/GPIO bridge support
- **VSM support**
- **USB Link Power Management**
- **FlexConnect**
- **Predefined "Use Cases"**
  - Full HW 9pin UART interface
  - BC indicators – BC enabled, BC1.2
  - LED indications – USB1.1, 2.0, 3.0
  - FlexConnect
  - I2C Bridging



➢ ***Samples Available NOW, RTP Q2CY15***

USB3.0 HUB Product Line

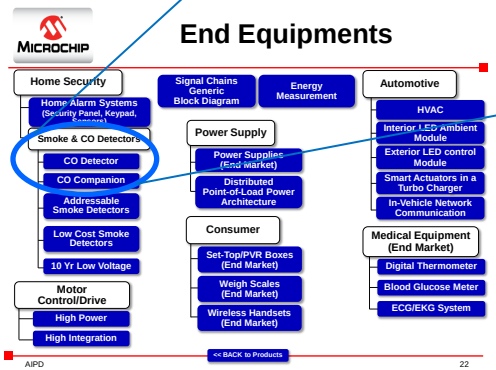
Summary of our existing and proposed new USB57xx Family

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 Confguration Utility	PT2	PT2	PT1	PT1	PT1	PT1
SDK	♦	♦				
Industrial Temp (-40°C to 85°C)	♦	♦				
Design Process	65nm	65nm	130nm	130nm	130nm	130nm

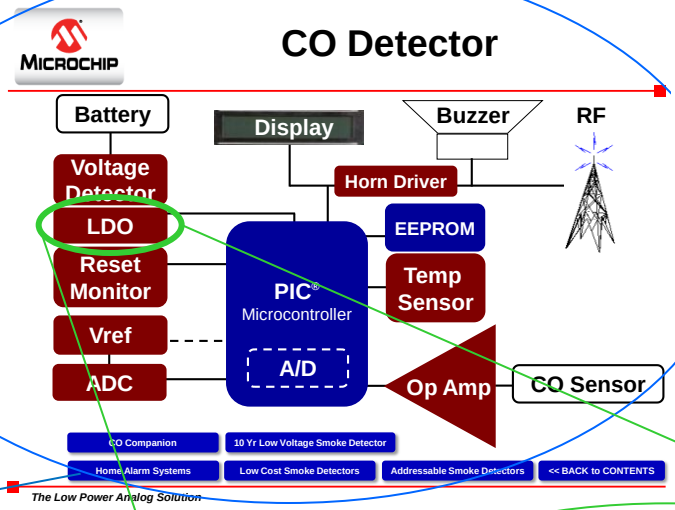
* PD = Port Disable

New USB3.0 Smart Hub Products

Treelink Tool ‘End Equipments’

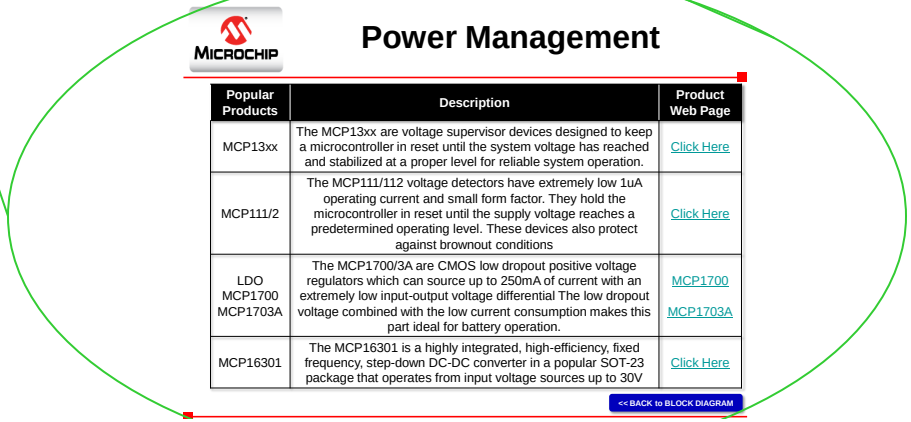


To view an application, click on its block



Click on the block to view recommended product information.

“Back to contents” button takes you back to the *Market Segment* page



Popular Products	Description	Product Web Page
MCP13xx	The MCP13xx are voltage supervisor devices designed to keep a microcontroller in reset until the system voltage has reached and stabilized at a proper level for reliable system operation.	Click Here
MCP111/2	The MCP111/112 voltage detectors have extremely low 1uA operating current and small form factor. They hold the microcontroller in reset until the supply voltage reaches a predetermined operating level. These devices also protect against brownout conditions	Click Here
LDO MCP1700 MCP1703A	The MCP1700/3A are CMOS low dropout positive voltage regulators which can source up to 250mA of current with an extremely low input-output voltage differential The low dropout voltage combined with the low current consumption makes this part ideal for battery operation.	MCP1700 MCP1703A
MCP16301	The MCP16301 is a highly integrated, high-efficiency, fixed frequency, step-down DC-DC converter in a popular SOT-23 package that operates from input voltage sources up to 30V	Click Here

“Back to block diagram” button takes you back to the *Typical System Diagram* page

Thank You