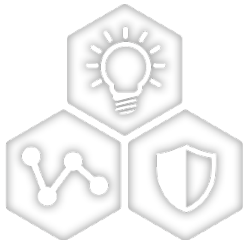


PAC194x/5x

*Device Family of Precision 9Vbus and 32Vbus
Power/Current Monitors with 16-Bit Resolution,
2 Alert Outputs, and I2C*



A Leading Provider of Smart, Connected and Secure Embedded Control Solutions



SMART | CONNECTED | SECURE

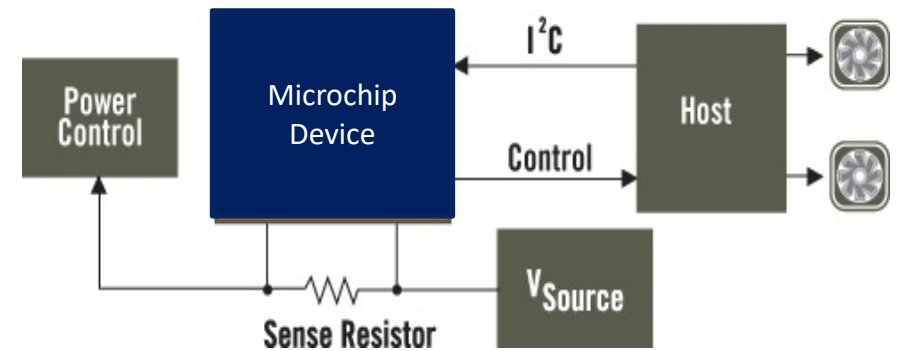
Mitch Polonsky
mitch.polonsky@microchip.com

August 25, 2021

PAC194x & PAC195x Family of Precision Multichannel Current/Power Monitors

What are these?

- Device sits across a sense resistor
- Measures current, voltage, and power
- Can be connected to higher voltage rail up to 40V
- Reports values to I2C/SMBus



PAC194x/5x 16-bit Multichannel Current/Power Monitors



Performance

- ✓ Power measurement over a wide dynamic range with 16-bits of resolution
 - ✓ 1% power measurement accuracy from less than 1 mA to over 10A



Power

- ✓ Supports low active, sleep and power down
 - ✓ 12 μ A active current @ 8 SPS for Portable Applications



Package

- ✓ WLCP option for low profile and space limited applications
 - ✓ 2.215mm x 2.17mm WLCSP, 3x3 QFN-16



Price

- ✓ Multichannel devices reduce BOM \$\$ vs use of multiple single channels
- ✓ No input filter required

PAC194x Power Monitor (0-9V) Applications

- **Data Center**

- Accelerator cards, FPGA, graphics, machine learning, inference

- **Portable electronics**

- Drones, VR headset, toys, telematics

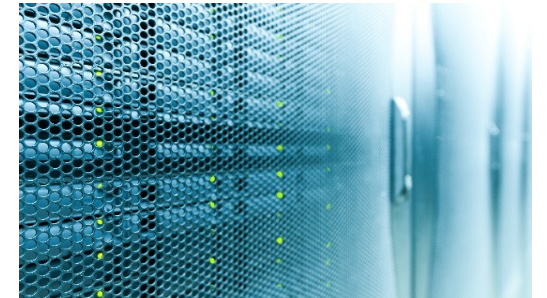
- **Computing**

- Laptops, docking, tablet, POS, embedded

- **IOT**

- Smart city, security, video doorbell

- **Windows, Linux, Python, Arduino drivers, and MCC drivers available**



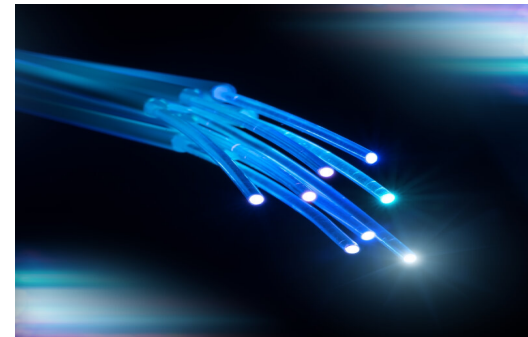
VR Headset



PAC195x Power Monitor (0-32V) Applications

- **Data Center**
 - Server backplane, hyperscale computing, edge computing
- **Optoelectronic Modules**
- **Telecommunications**
 - 5G remote radio unit (RRU), small cell
- **Networking**
- **Computing**
 - Laptops, docking, tablet, SSD, POS, embedded, USB C
- **Industrial**
- **Portable electronics (higher voltage)**

- **Windows, Linux, Python and Arduino drivers, MCC drivers available**



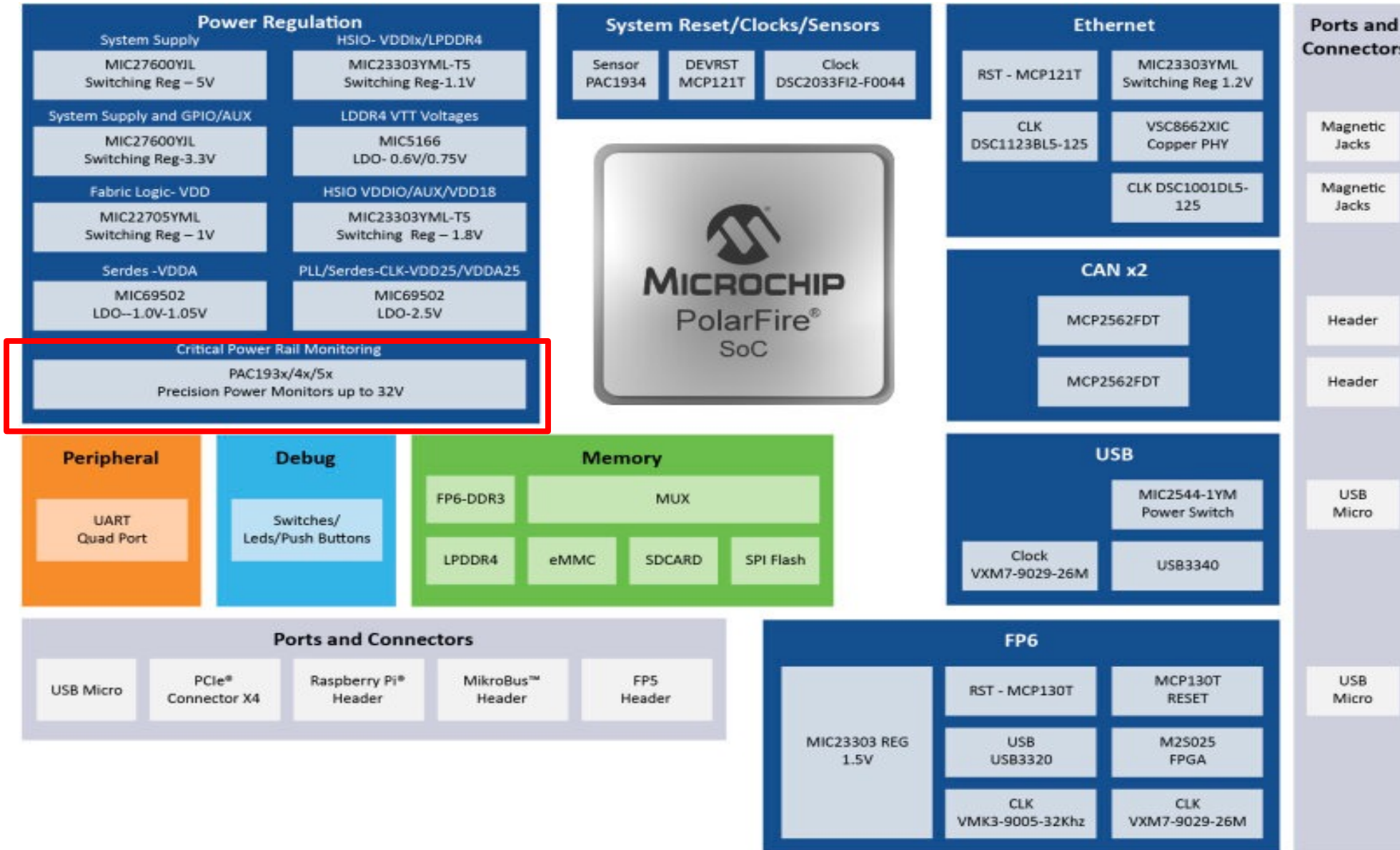
PAC194x/5x Key Features

- **16-bit resolution ADC for V_{Sense} and V_{Bus}**
 - Current and voltage measurements done simultaneously with independent ADCs
- **High-side current sense monitor: 1,2,3,4 channels**
- **V_{Bus} Options:**
 - 0V to $9V_{\text{Bus}}$, configurable for 0V to $4.5V_{\text{Bus}}$ range (PAC194x)
 - 0V to $32V_{\text{Bus}}$, configurable for 0V to $16V_{\text{Bus}}$ range (PAC195x)
- **2 Alert outputs for OV, OC, OP, UC, UV**
- **On-chip power calculation and power accumulation registers**
- **I2C for 1.8V, 3.3V, or 5V comm (up to 3.4MHz)**
- **2.215mm x 2.17mm WLCSP, 3x3 QFN-16**

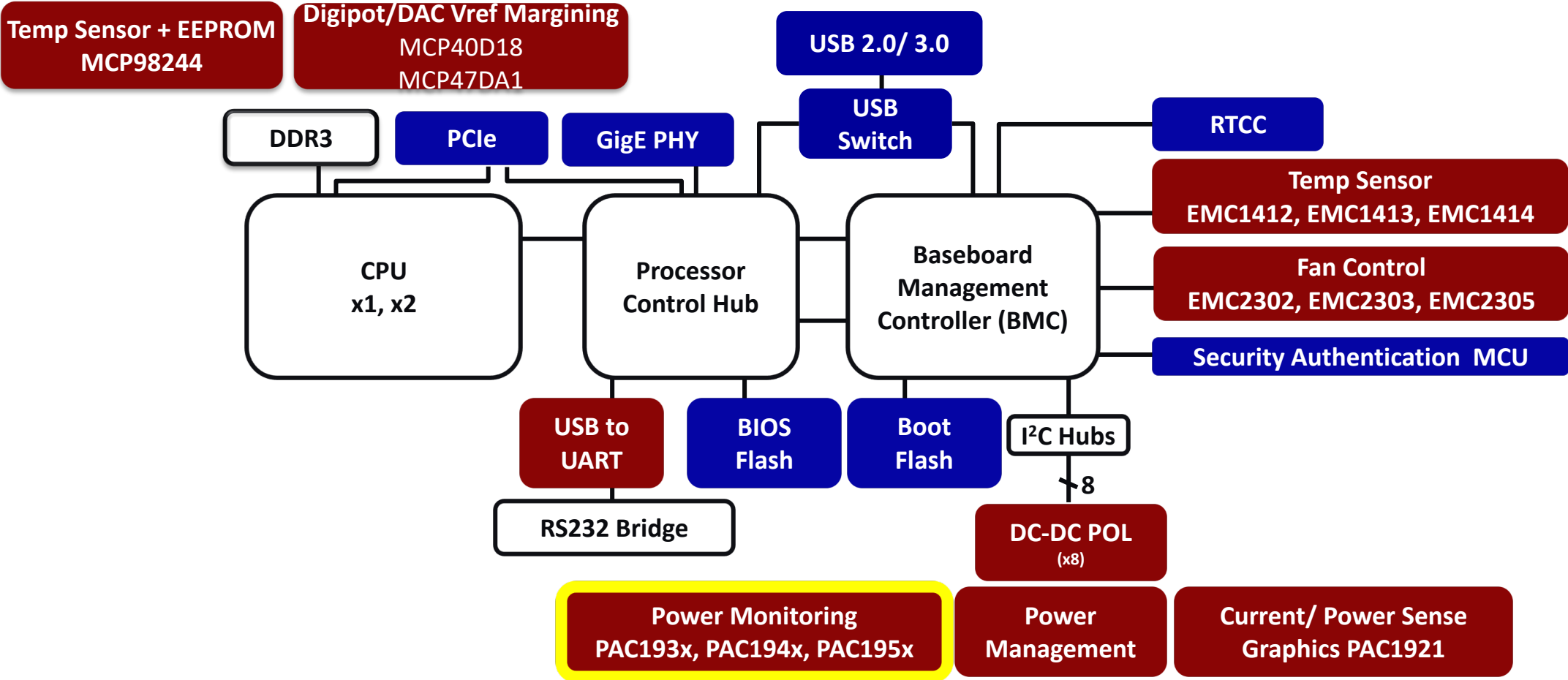
PAC194x/5x Key Features (cont)

- **Selectable sampling rates up to 5.12 ksps**
 - 12 μ A active current for 8 SPS
 - 1024 SPS for 4 channels
 - Burst mode
- **V_{Sense} full scale flexibility: 50mV, 100mV settings**
- **Software: WIN10 E3, DFX, Linux, Arduino, Python**

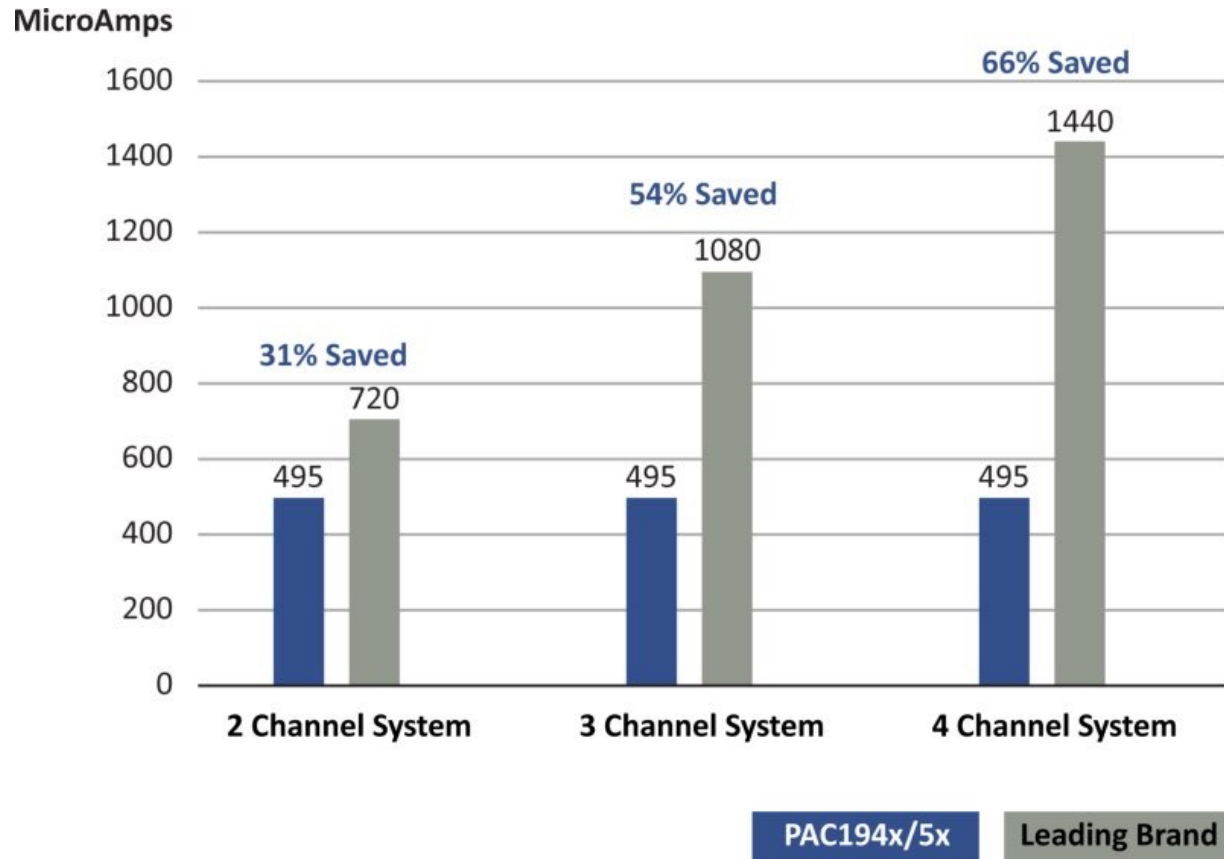
FPGA Applications Diagram: PAC194x/5x



Servers, Computing, Mass Storage



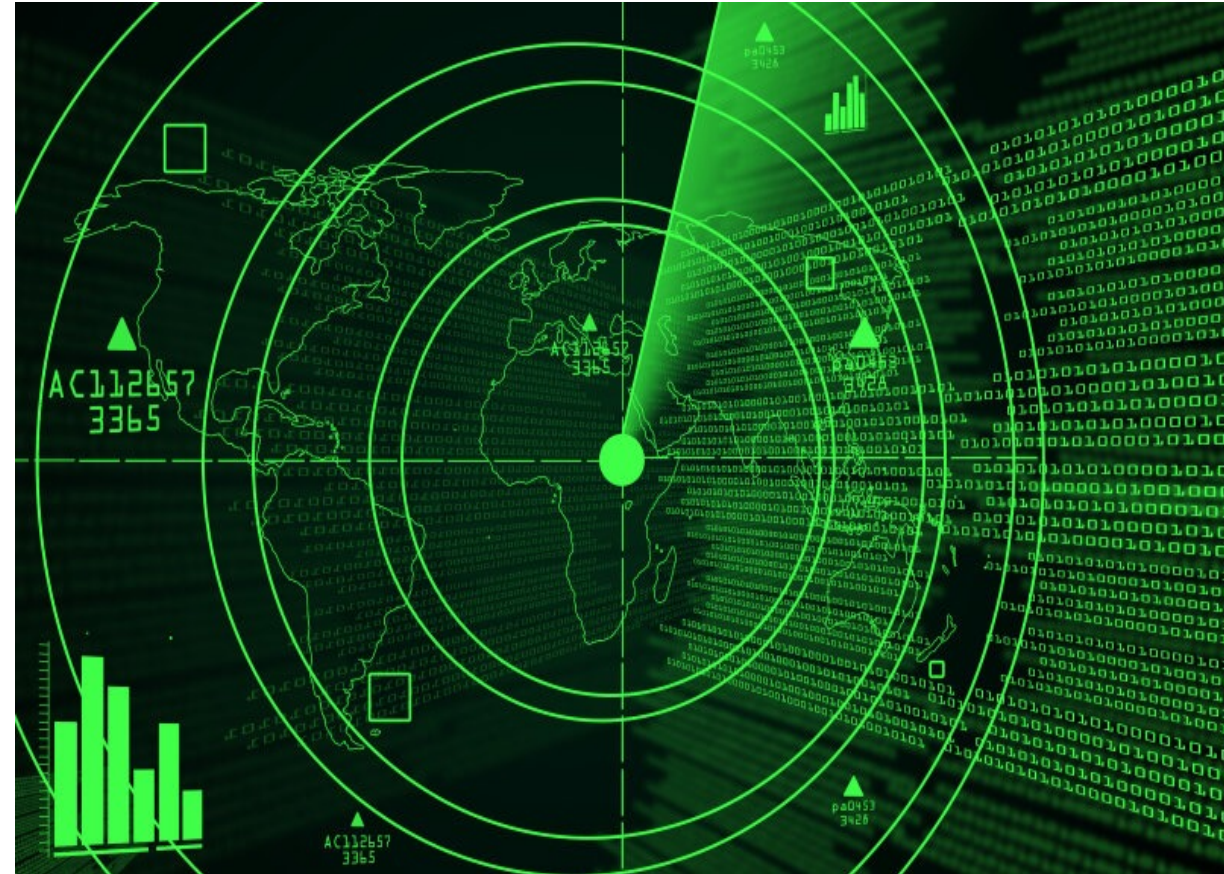
Overcome High Power Consumption



- Downside to power monitors- we burn power to measure power
- A single power monitor can consume up to 360uA or more
- **HOWEVER**, by using a multichannel monitor, the system will save 31% or more system power (Compared to reuse of that single device)

Improve Event Detection with Two Flexible Alert Outputs

- Define, capture, warn, and report
- Dedicate alerts to separate subsystem events
OR
- Dedicate one alert to voltage and one alert to spurious current
- Measure or mask over-voltage, over-current, over-power, under-current and under-voltage

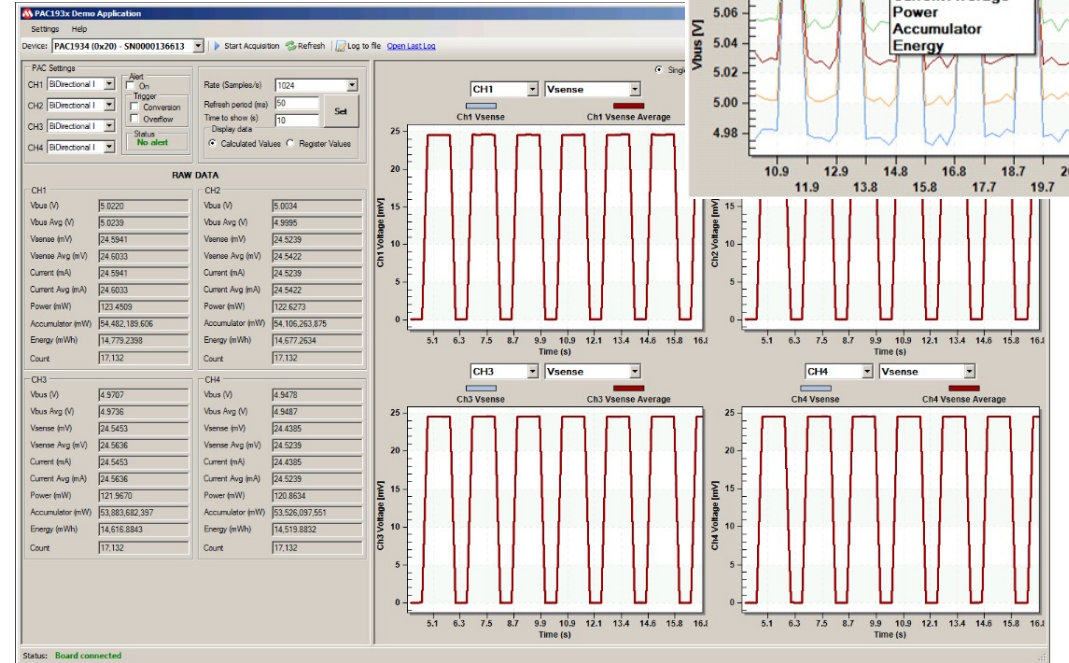
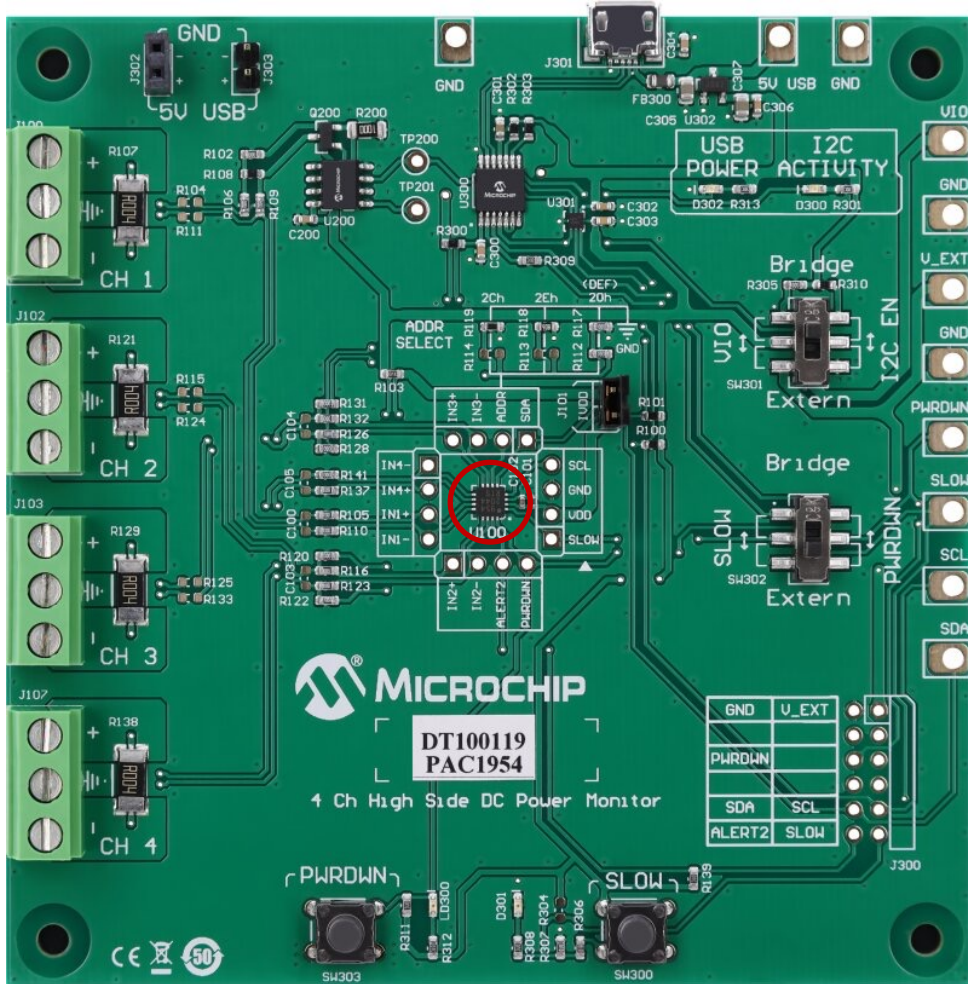


PAC194x Opens the Door for Low Voltage Applications

- Measures 9V directly without additional circuitry
- 16-bits of resolution on the voltage bus of dual Li-Ion battery
- Includes configuration for single cell applications at 0 to 4.5V with the same 16-bits of precision



Getting Started



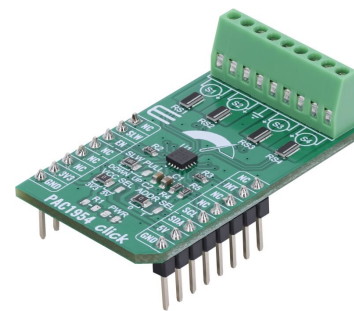
Current / Power Monitoring Demo Board & GUI

Part #	Description	1k Price	Demo Board #	Board Price
PAC1944T-E/J6CX	4 Channel PowerMonitor w/ Accumulation	\$1.47	EV40S84A	\$59
PAC1954T-E/J6CX	4 Channel PowerMonitor w/ Accumulation	\$1.47	DT100119	\$59

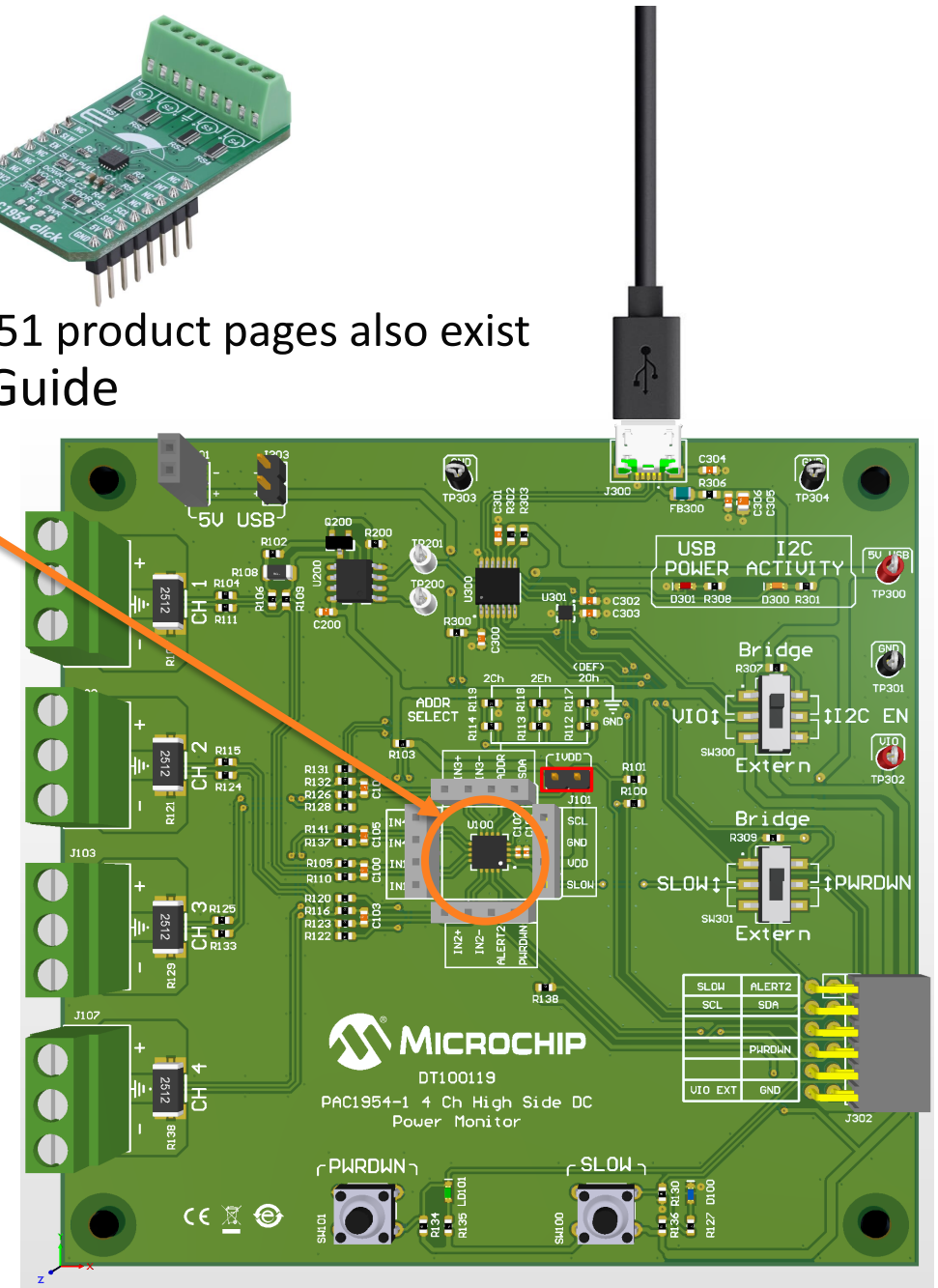


PAC194x/5x Resources

- PAC1944 product page: [link](#)
- PAC1954 product page: [link](#)
 - PAC1943, PAC1942, PAC1951 PAC1953, PAC1952, & PAC1951 product pages also exist
- PAC194X/195X Microsoft Windows 10 Driver User's Guide
- Software
 - 8/16-bit PIC and AVR Platforms
 - Python Library and Application
 - Demo Application
 - Windows 10 Device Driver
 - Windows 10 Energy Metering and Driver Interface Utility
- Evaluation boards
 - PAC1944 EV40S84A
 - PAC1954 DT100119
 - Click Boards
 - [PAC1944 Click | Mikroe](#)
 - [PAC1954 Click | Mikroe](#)
- Video ([link](#))
- Or contact Sales at...



PAC1954



Current/Power Monitoring Mkt Trends/Insights

- **Data center computing has more than quintupled between 2010 and 2018. However, the amount of energy consumed by the world's data centers grew only six percent during that period, thanks to improvements in energy efficiency**
(<https://www.datacenterknowledge.com/energy/study-data-centers-responsible-1-percent-all-electricity-consumed-worldwide>)
 - **Precision power measurement on key functional blocks allow systems to effectively allocate and minimize power**
- **Integrated ADCs on MCUs are not precision quality. ENOB (effective number of bits) is the attribute of importance**
 - This drives a need for more discrete precision current/power monitoring to meet the performance and reliability needs of customers
- **In handhelds and portable electronics, space and extending battery life continue to be critical for system design. Some clients address these challenges by monitoring and switching power loads based on current/power consumption.**
 - To offset the power consumption from the added current monitoring, multiple channel current/power monitors are used. A four-channel power monitor will consume 66% less power than four separate single current monitors

Thanks for your attention

Have a great day.