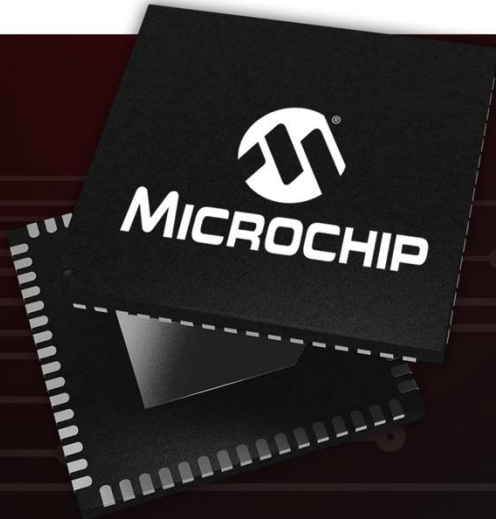




MICROCHIP



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



***Power is Not Simply Black or White, Microchip Highlights Analog/Digital Hybrid Power Supply
Philip Tseng, Embedded Solutions Engineer Manager
October 8, 2019***

電源不是只有黑白 類比/數位混合型電源強勢登場



Discover Your Power
Flexibility to Choose the
Desired Power Solution

POWER UP >

What Defines Intelligent Power?

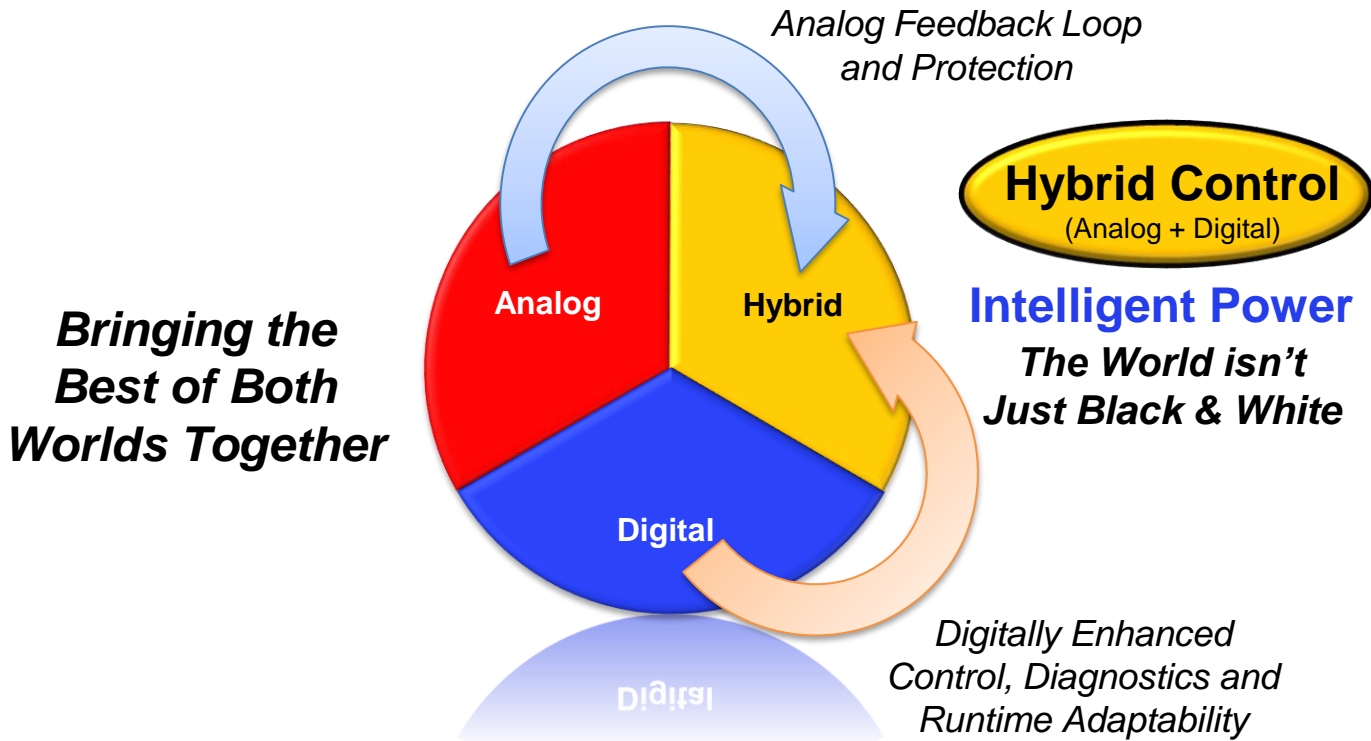
Sometimes
a cow is just a cow...



But sometimes
we need something else



Hybrid Control



What Defines Intelligent Power?

Power supply units which have one or more of the following features and/or characteristics:

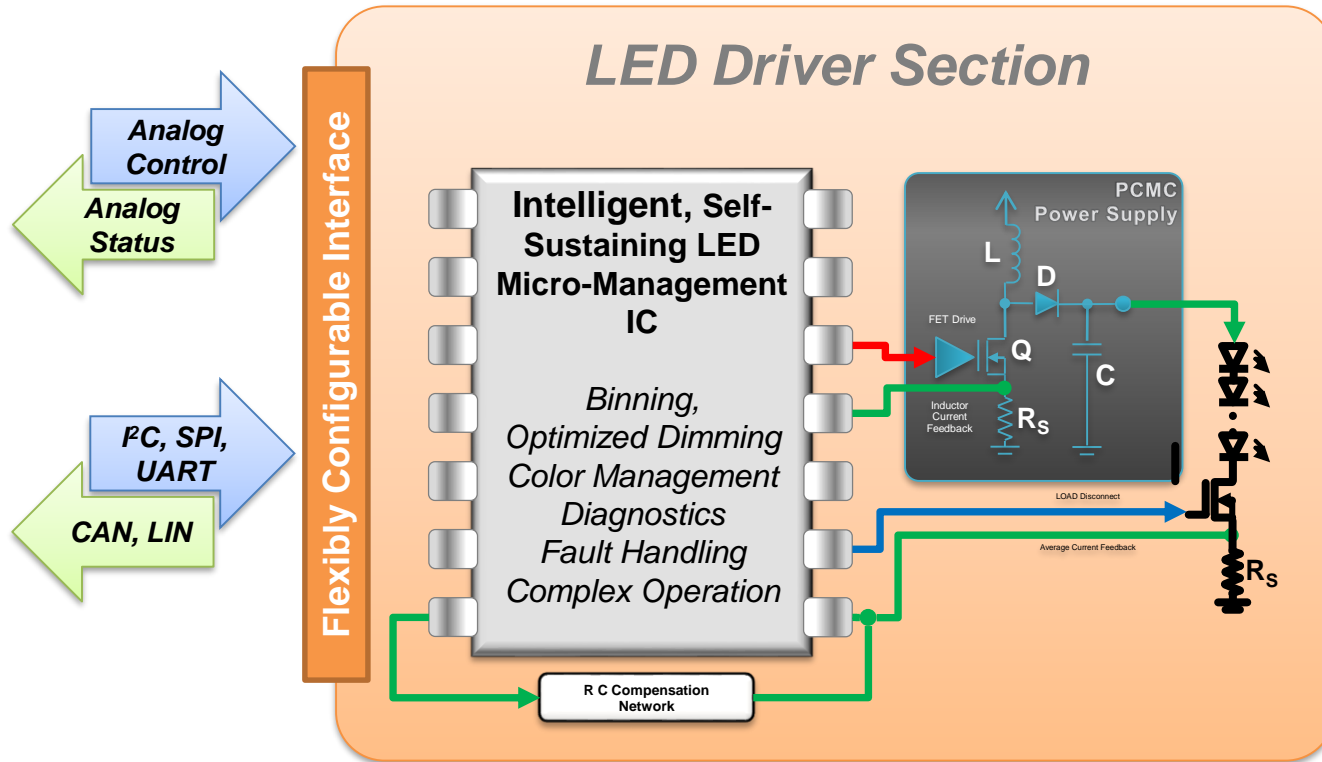
- **Product-Level Features**

- Enhanced features
 - Communication
 - Non-linear operation profiles
- Auto-adaptive behavior
 - Process synchronization
 - Self-tuning
 - Self-optimization
- Enhanced diagnostics
 - Failure prediction
 - Self-protection

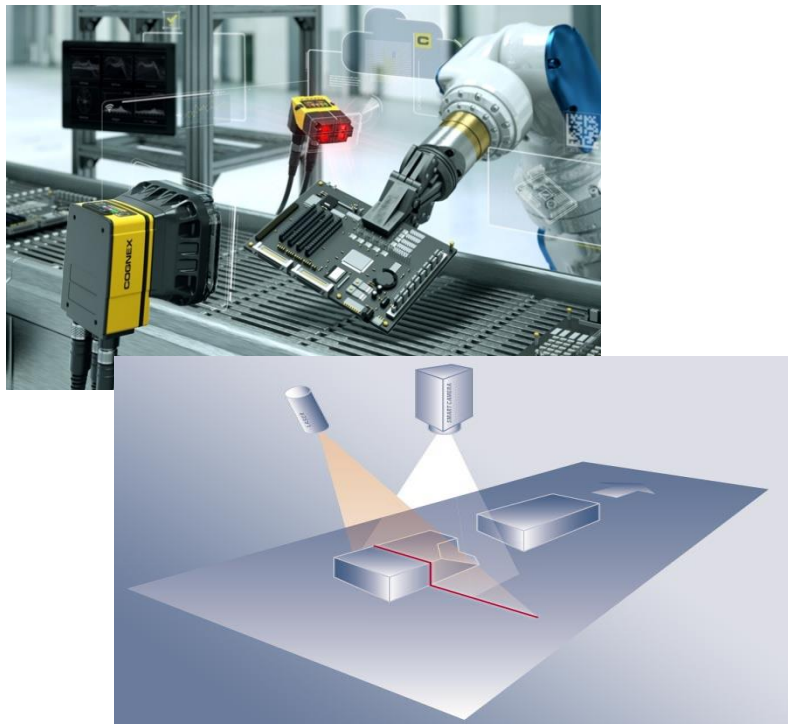
- **Product Management Aspects**

- Customization without hardware modification (e.g. programmable parameters)
- On-site tailoring (e.g. field-programmable operation modes)
- Field failure troubleshooting (e.g. diagnostics with error logs)

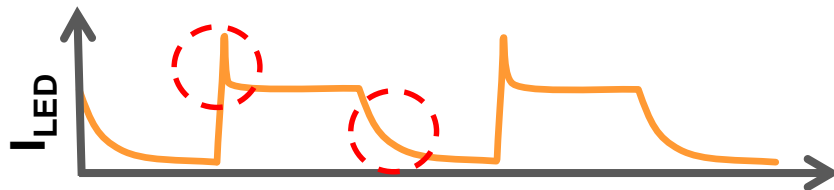
High-Level Product Concept



Professional Lighting Applications



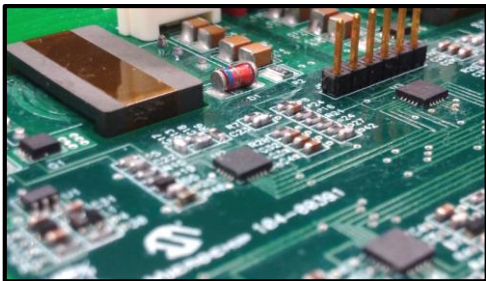
- **Industrial Image Processing**
 - Selectable spectrum (IR, UV, blue, red, green, wide-spectrum white)
 - Camera frame-rate desynchronization
 - Pulsed operation for reduced energy consumption
 - Communication and remote control
 - Long-term stability
 - Long-term availability



Microchip Hybrid PWM Controller Families

Highly Integrated Hybrid PWM Controllers (DEPA)

- **Dedicated, vertical applications**
 - DC/DC POL converters
 - USB port power
 - LED driver
 - Battery charger
- **Dedicated topologies**
 - Buck
 - Boost
 - Buck/Boost
 - Flyback, Ćuk, SEPIC



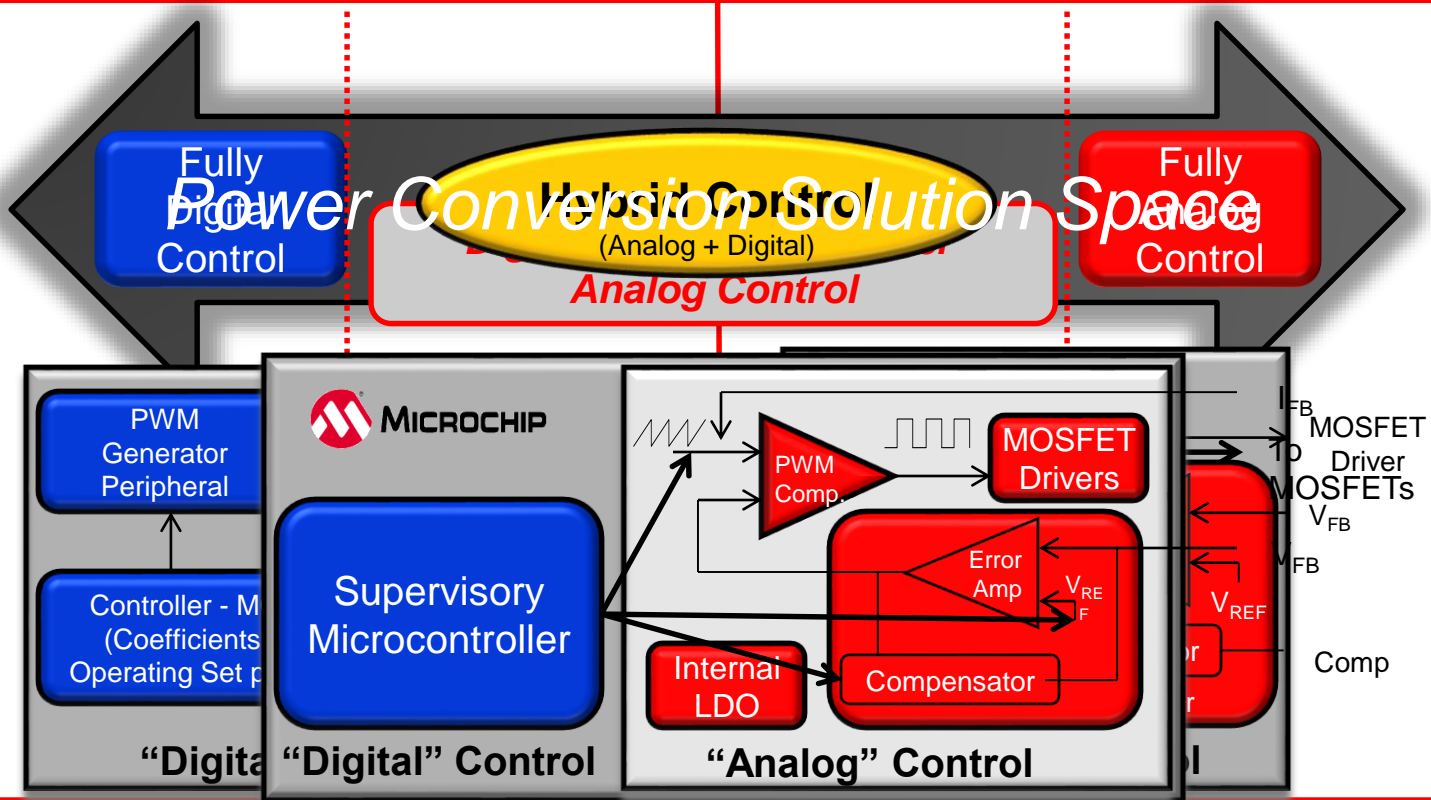
Discrete Hybrid PWM Controllers (CIP Hybrid Power)

- **Maximum design flexibility across all power ranges and topologies**
 - Single stage converters
 - Multi-stage converters
 - Multi-rail converters
 - Multi-phase converters
- **Most flexible PWM configuration**
 - Single-ended, half-bridge, full bridge
 - Push-pull, redundant and phase shifting modes
- **Free configuration of all building blocks**



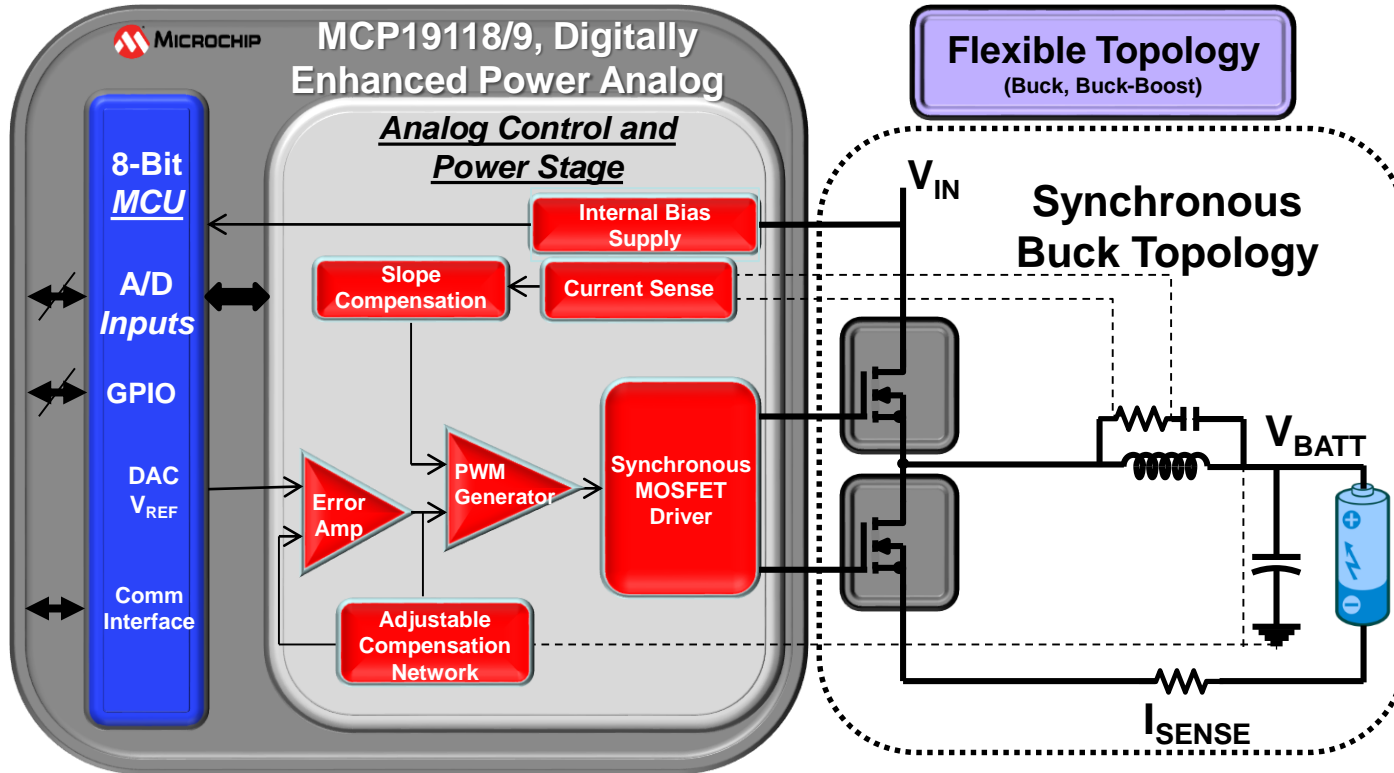
What is DEPA ?

Digitally-Enhanced Power Analog



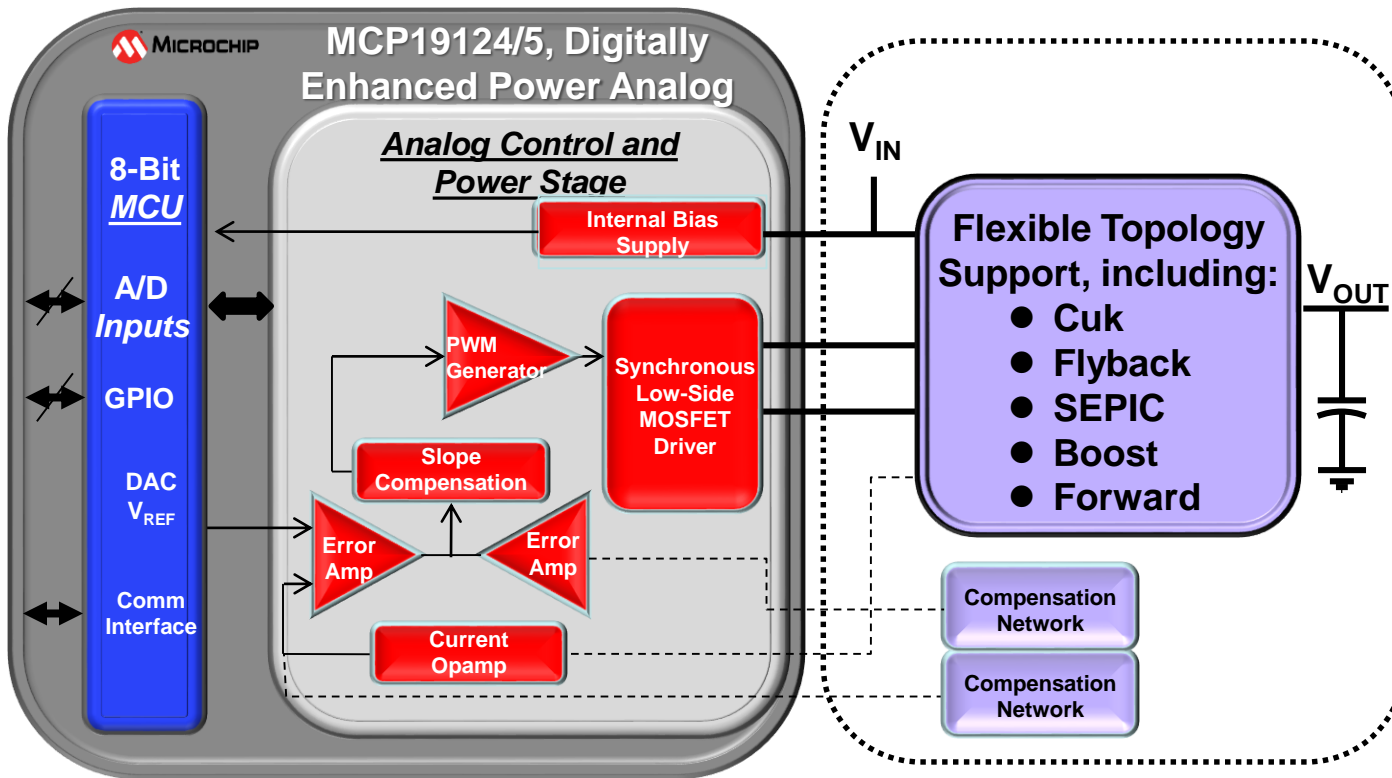
DEPA Introduction

MCP19118/19/22/23



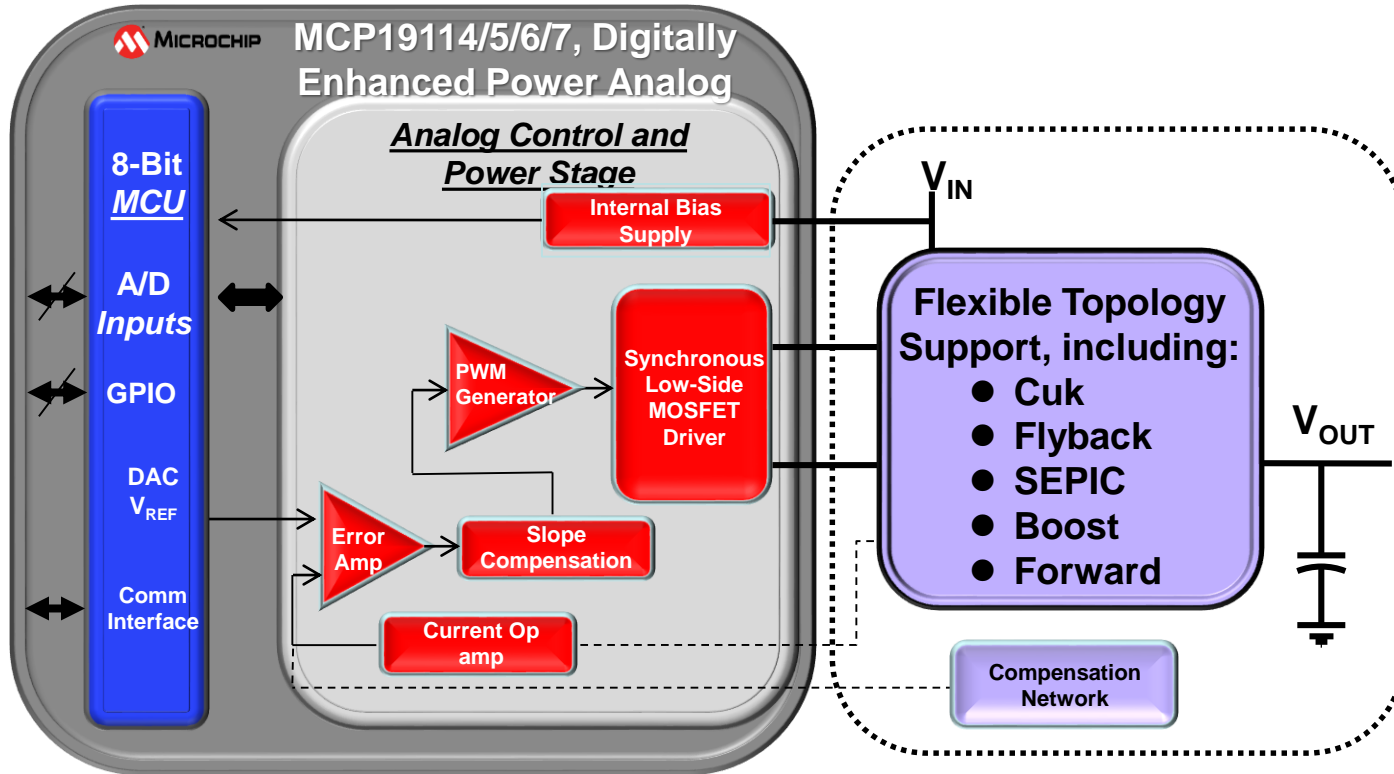
DEPA Introduction

MCP19124/19125

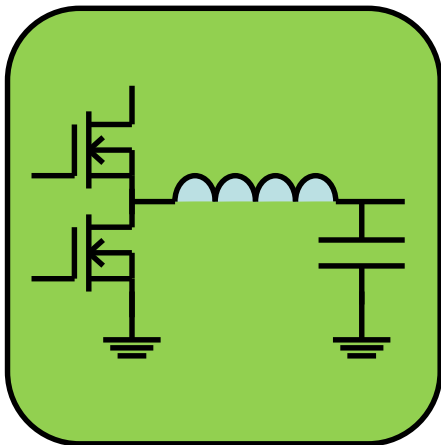


DEPA Introduction

MCP19116/19117

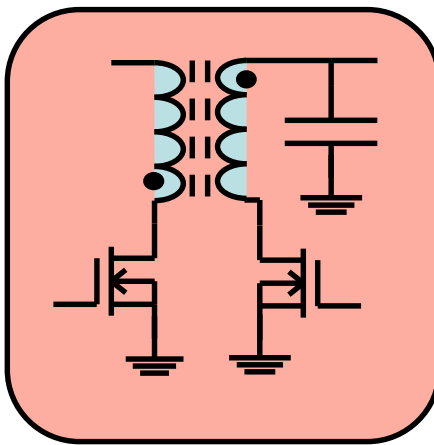


DEPA Topology Introduction



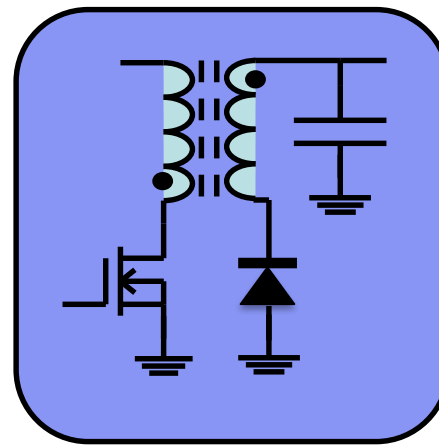
High and Low Side

MCP19118/9
MCP19122/3



Low Side
(with synchronous
rectification support)

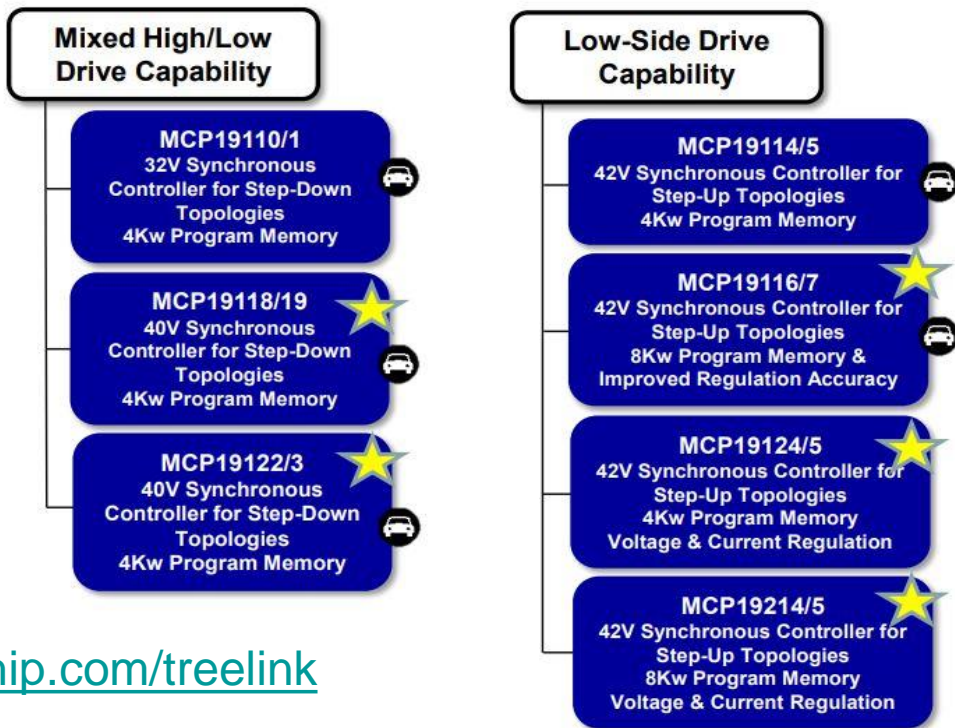
MCP19116/7
MCP19124/5



Low Side
(asynchronous
rectification support)

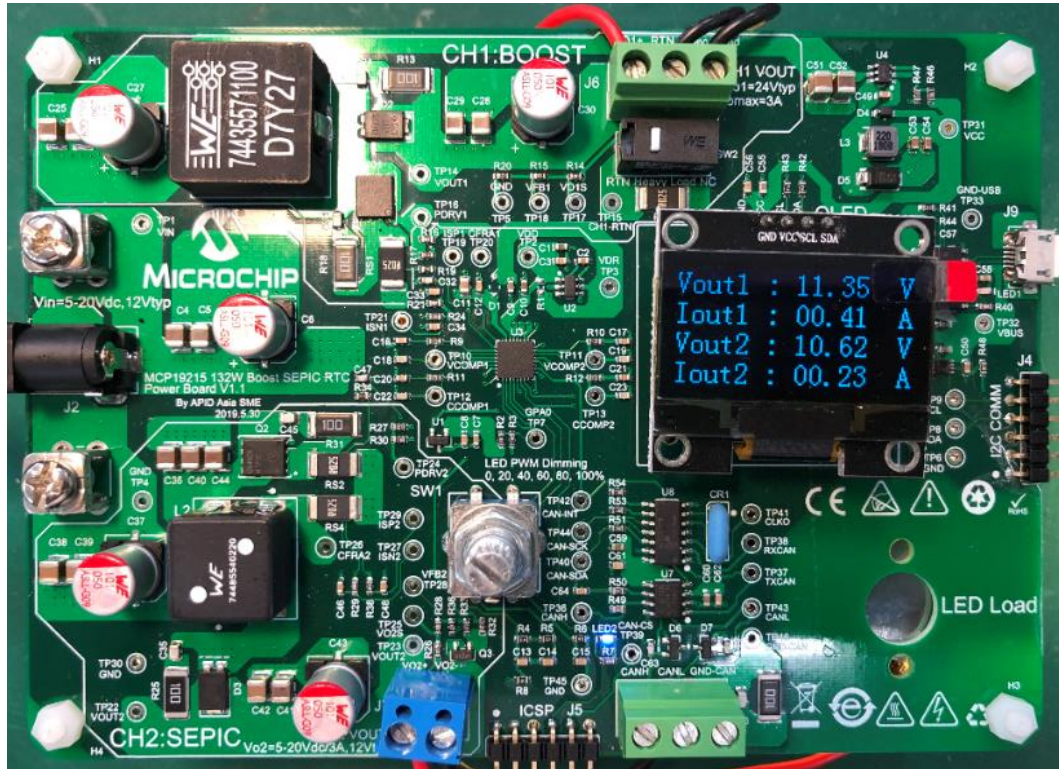
MCP19214/5

DEPA Controller Families



www.microchip.com/treelink

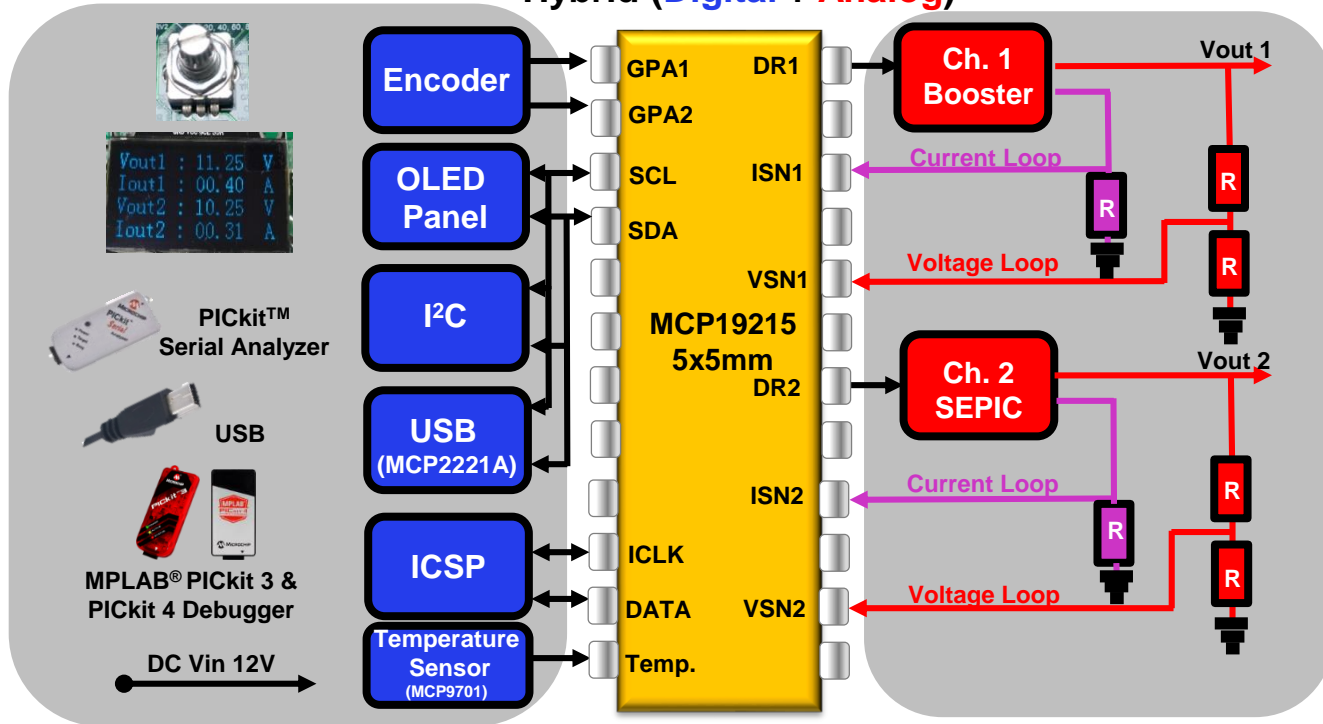
MCP19215 Demo Board



W 100mm
L 140mm

Demo Board Block Diagram MCP19215

Hybrid (Digital + Analog)



Hybrid PWM Controllers Tools Ecosystem

1. **Demonstration and Evaluation Board MCP19xxx**
2. **Evaluation Board Schematic and Source Code**
3. **Design and Simulation Tools**



**MPLAB® Harmony
Graphics Suite
(MHGS)**

**GUIs
MCP19xxx**



**MPLAB PICKit™ 3 &
PICKit 4 In-Circuit Debugger**

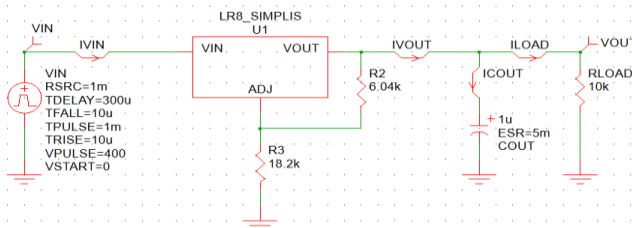


**MPLAB ICD 3 &
ICD 4 In-Circuit Debugger**

MPLAB[®] Mindi[™] Analog Simulator



- **Enable analog circuit design with Microchip**
 - Engineers can test ideas, changes or tradeoffs in simulation prior to creating hardware
 - Problems can be found in simulation, saving time and effort from hardware fixes
 - Hardware bugs can be compared to analog simulation results to help troubleshoot development problems



www.microchip.com/Mindi

MPLAB[®] MINDI[™] Analog Simulator

MPLAB MINDI Main Window

File Edit View Simulator Place Probe Probe AC/Noise Hierarchy Monte Carlo Tools Help

Web View Schematic Editor Waveform Viewer


File View

Add Directory Sync to Active

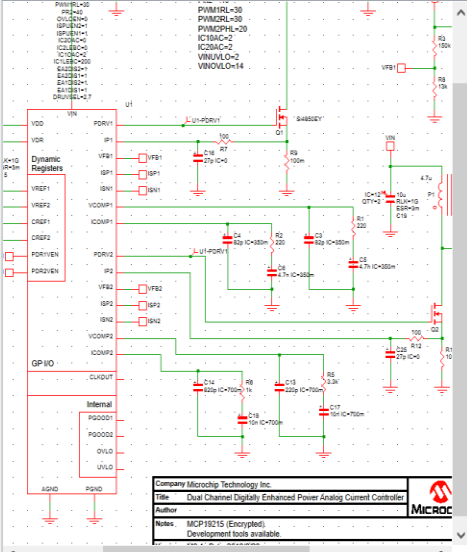
- > MCP1632
- > MCP19117
- > MCP19119
- > MCP19125
- ▼ MCP19215
 - > SIMPLIS_Data
 - > TMP
 - ▼ MCP19215_AC_Transient.sxsch
 - ▼ MCP19215_Startup.sxsch

Part Selector Command Shell File View

MPLAB MINDI

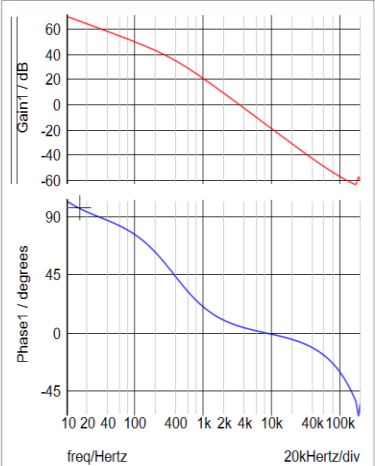


C:\Users\A24670\Documents\MPLAB Mi...P19215\MCP19215_AC_Transient.sxsch



Company Microchip Technology Inc.
Title Dual Channel Digitally Enhanced Power Analog Current Controller
Author
Notes MCP19215 (Encrypted)
Development tools available.

simplics_ac1 (C:\Users\A24670\...MCP19215_AC_Transient.sxsch)



Gain1 / dB

Phase1 / degrees

freq/Hertz 20kHertz/div

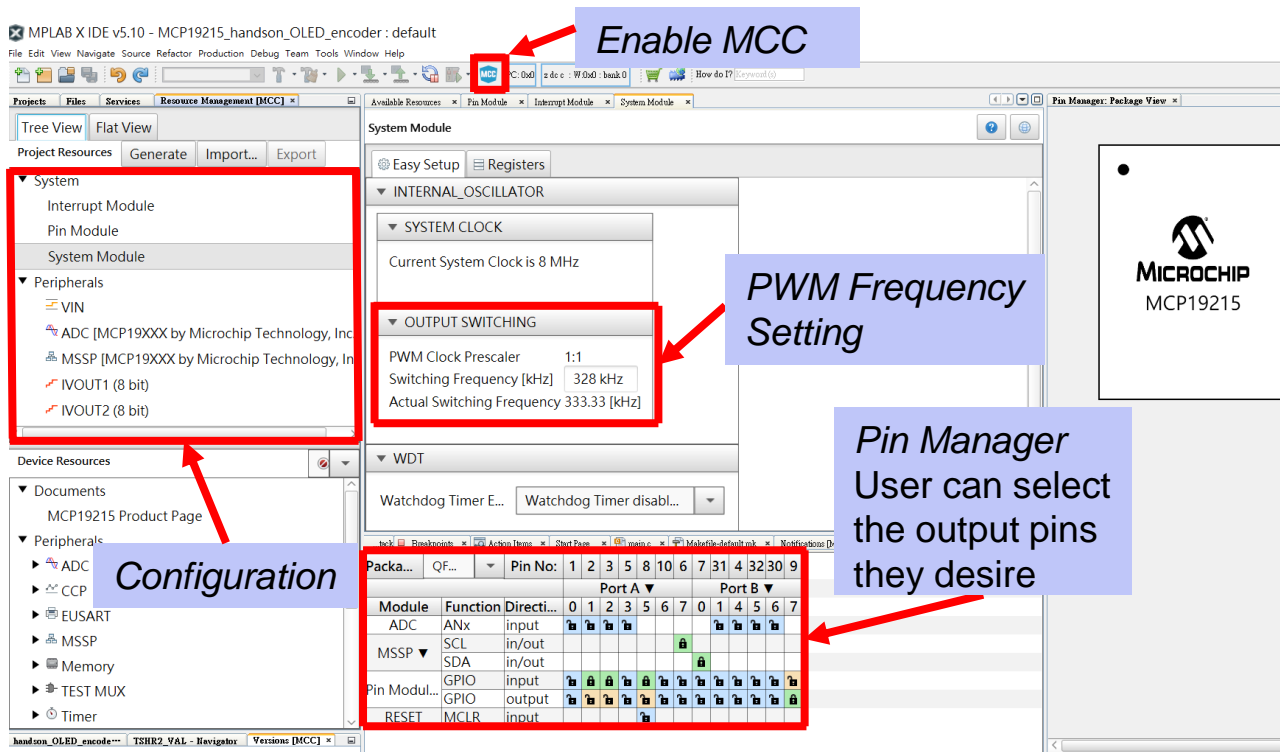
Label Legend Curve label Name

Gain1 Gain1 Gain Crossover

Phase1 Gain1 Gain Margin

X=15.1825 Y=97.0631 Phase1 Group=simplics_ac1

MPLAB® Code Configurator MCP19215

Enable MCC

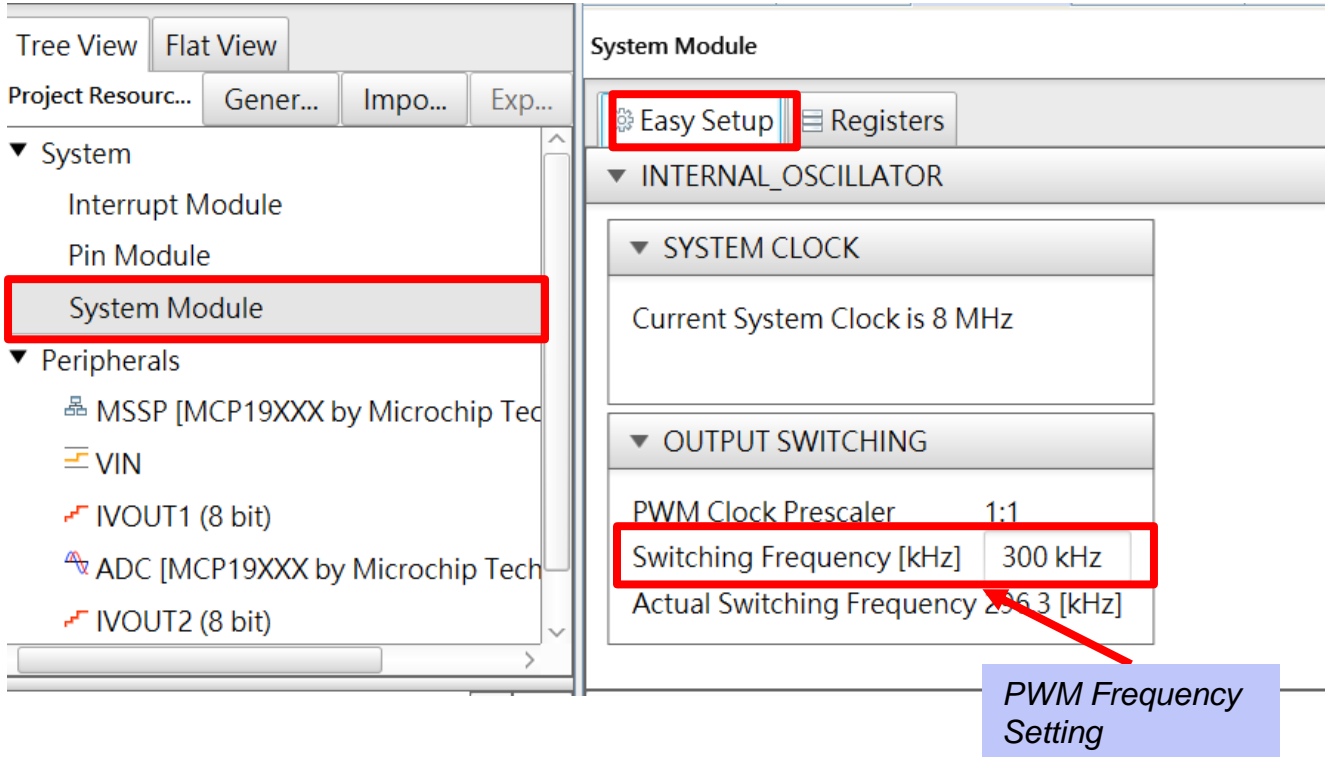
Configuration

PWM Frequency Setting

Pin Manager
User can select the output pins they desire

Module	Function	Direct...	Port A							Port B						
			0	1	2	3	5	6	7	0	1	4	5	6	7	
MSSP	SCL	in/out														
	SDA	in/out														
Pin Modul...	GPIO	input														
	GPIO	output														
RESET	MCLR	input														

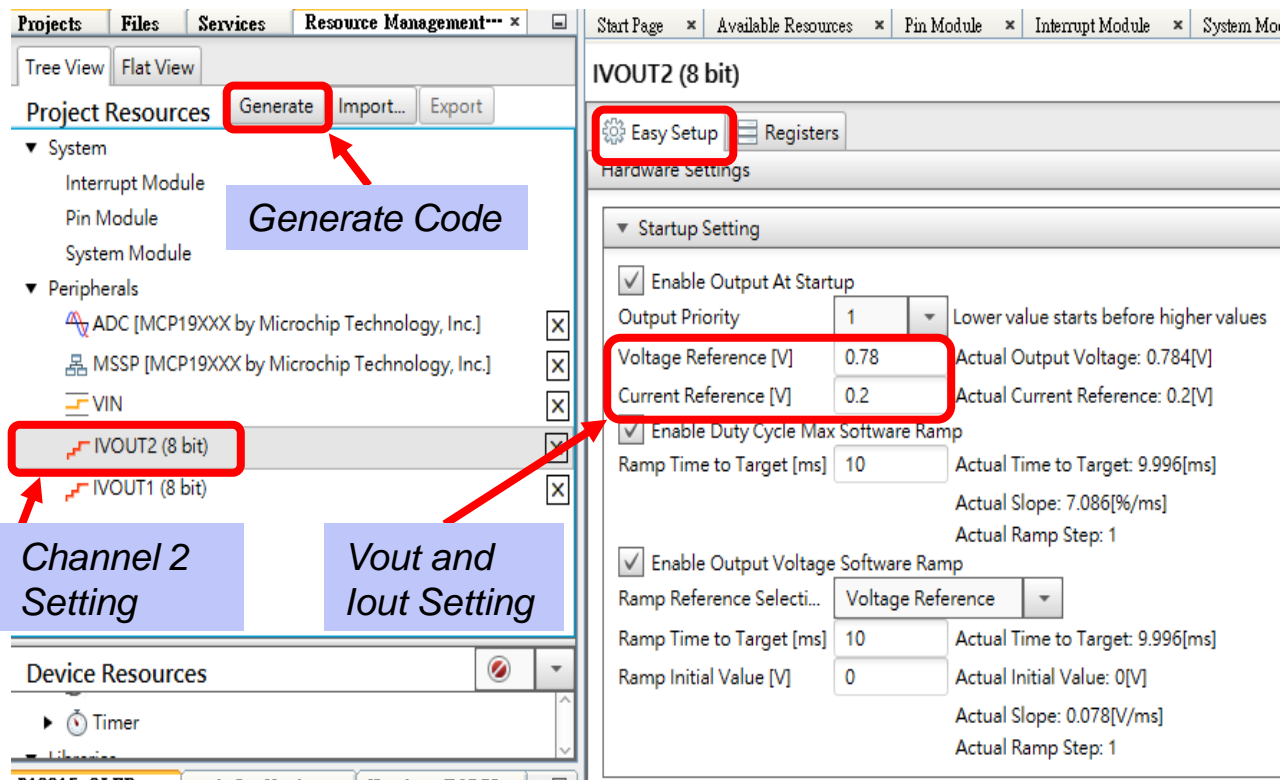
MPLAB® Code Configurator PWM Frequency Setting



The screenshot displays the MPLAB Code Configurator interface. On the left, the 'System Module' is selected in the project tree. The main window shows the 'Easy Setup' tab for the 'INTERNAL_OSCILLATOR' module. Under the 'SYSTEM CLOCK' section, the current system clock is 8 MHz. Under the 'OUTPUT SWITCHING' section, the 'Switching Frequency [kHz]' is set to 300 kHz, and the 'Actual Switching Frequency' is 296.3 kHz. A red box highlights the 'Switching Frequency [kHz]' field, and a blue callout box points to it with the text 'PWM Frequency Setting'.

Parameter	Value
Current System Clock	8 MHz
PWM Clock Prescaler	1:1
Switching Frequency [kHz]	300 kHz
Actual Switching Frequency	296.3 [kHz]

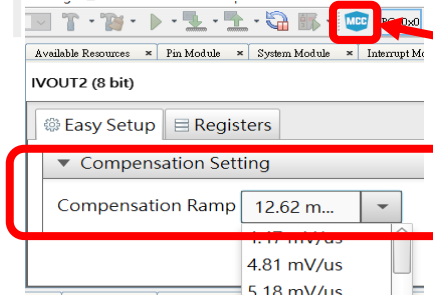
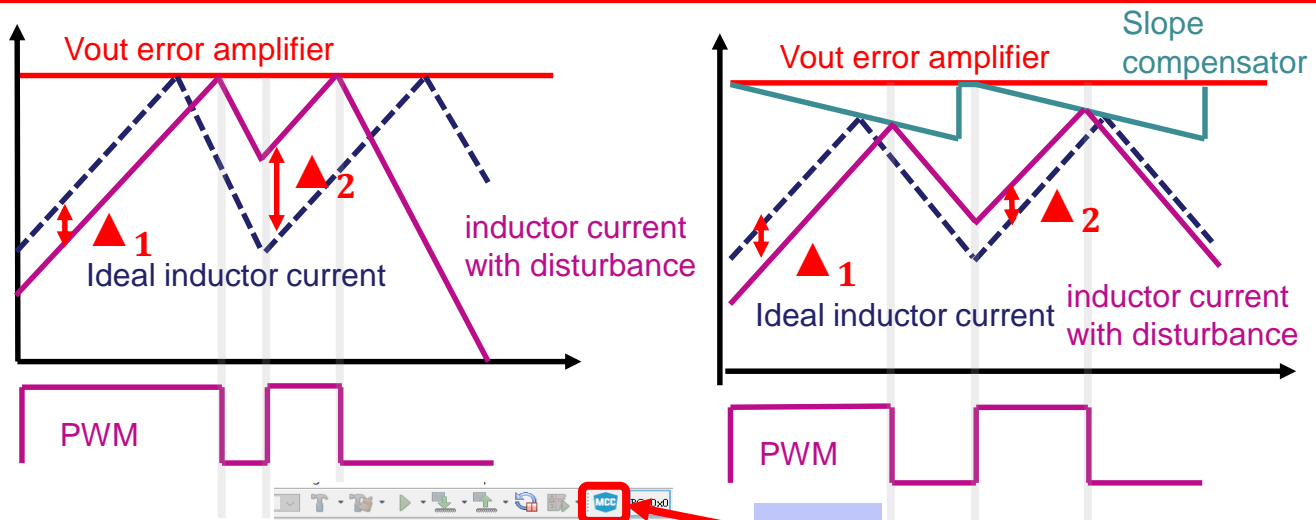
MPLAB® Code Configurator Vout / Iout Setting



The screenshot displays the MPLAB Code Configurator interface. On the left, the 'Project Resources' tree shows 'IVOUT2 (8 bit)' selected. A red box highlights the 'Generate' button, with a blue callout 'Generate Code' pointing to it. Another red box highlights 'IVOUT2 (8 bit)', with a blue callout 'Channel 2 Setting' pointing to it. A third red box highlights the 'Easy Setup' button, with a blue callout 'Vout and Iout Setting' pointing to it. The right pane shows the 'IVOUT2 (8 bit)' configuration, with 'Voltage Reference [V]' and 'Current Reference [V]' fields highlighted by a red box and a blue callout 'Vout and Iout Setting'.

Parameter	Value	Actual Value
Enable Output At Startup	<input checked="" type="checkbox"/>	
Output Priority	1	Lower value starts before higher values
Voltage Reference [V]	0.78	Actual Output Voltage: 0.784[V]
Current Reference [V]	0.2	Actual Current Reference: 0.2[V]
Enable Duty Cycle Max Software Ramp	<input checked="" type="checkbox"/>	
Ramp Time to Target [ms]	10	Actual Time to Target: 9.996[ms]
		Actual Slope: 7.086[%/ms]
		Actual Ramp Step: 1
Enable Output Voltage Software Ramp	<input checked="" type="checkbox"/>	
Ramp Reference Selecti...	Voltage Reference	
Ramp Time to Target [ms]	10	Actual Time to Target: 9.996[ms]
Ramp Initial Value [V]	0	Actual Initial Value: 0[V]
		Actual Slope: 0.078[V/ms]
		Actual Ramp Step: 1

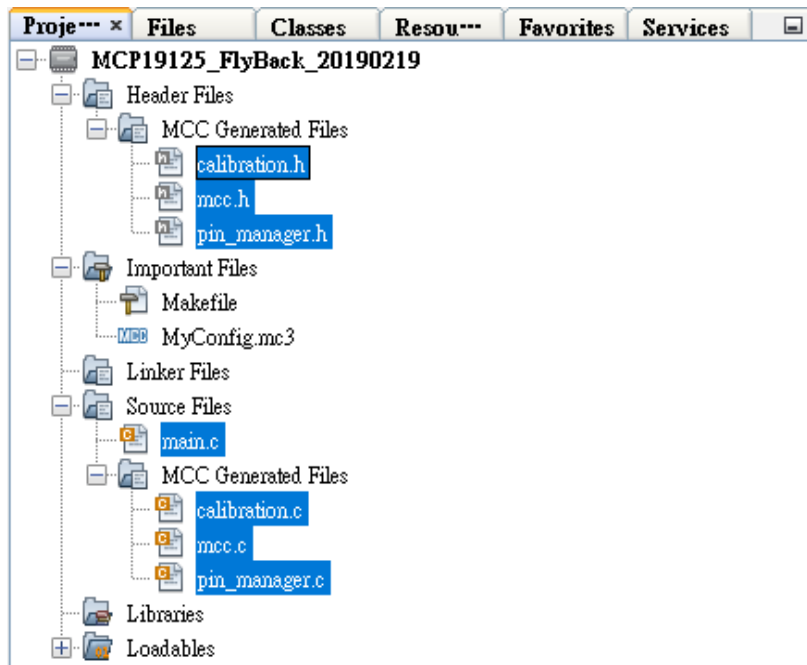
PRG Slope Compensator Sub-Harmonic Oscillation



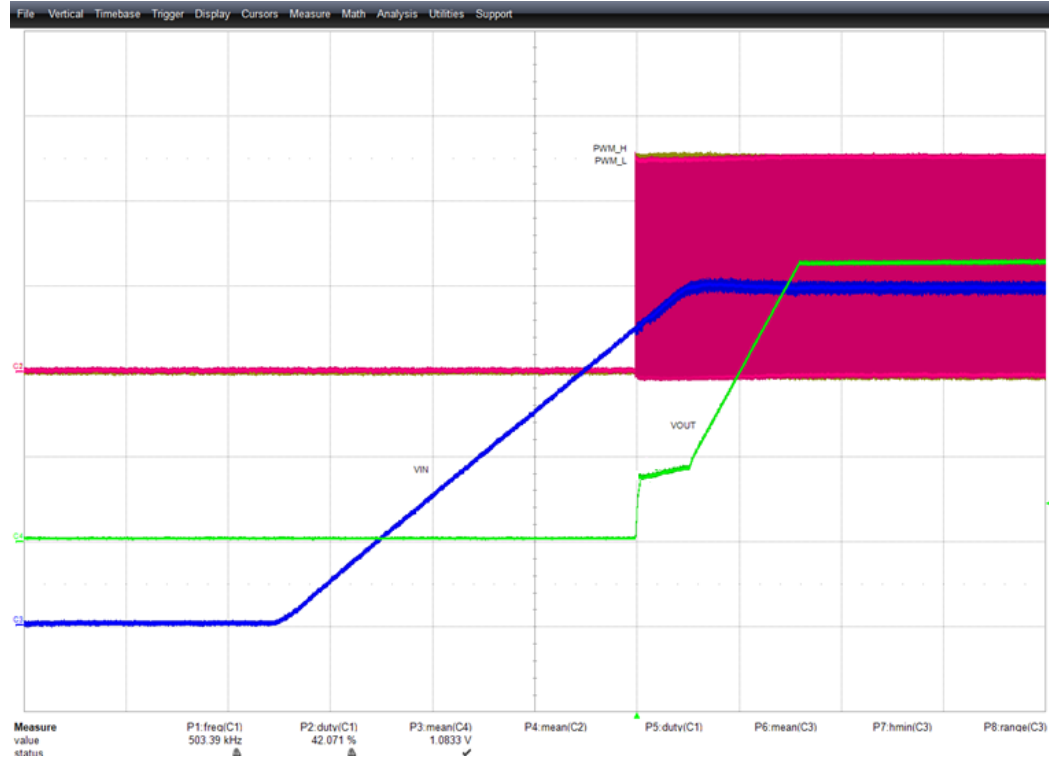
Slope Compensation
4.47~478.33 mV/us

The Files Generated

- **main.c**
- **MCC generate files:**
 - **mcc.c**
 - **mcc.h**
 - Pin_manager.c
 - Pin_manager.h



Measurement / Start Up Signal



Summary

- **Power is not simply black or white**
- **Hybrid power controller advantages**
- **How to implement hybrid power system**
- **Microchip hybrid power solutions update**
- **Design tools introduction**



MICROCHIP

Thank you!

