« IoT Made Easy » Webinars

Solutions From Sensors to Cloud

- **4 Sessions with end to end System approach**

<u>Session 1 (14 Sept, 2pm CET)</u>
« Power Efficient Solutions for your IoT Applications »
Keywords : Low Power, Analog, Mixed Signals, Power Management, MCU

SMART | CONNECTED | SECURE

<u>Session 2 (15 Sept, 2pm CET)</u>
« Connectivity Made Easy and Scalable for your IoT Application »
Keywords : Wireless and how to comply to Regulations & Certification, Chip down or module, Wired Solutions and Ethernet, Security and Robustness

<u>Session 3 (16 Sept, 2pm CET)</u>
« Security Matters… and How it is now so Easy »
Keywords : EN 303-645 from ETSI, Secure Element, Keys and how to protect them, Pre-provisionning, easy on-boarding, MOQ

<u>Session 4 (17 Sept, 2pm CET)</u>
« Scale your Business : from Easy Prototyping to Production »
Keywords : Software Development Framework, Applications drivers, Turnkey Solutions and Reference Designs, Github

- **6 Local Experts from Microchip Europe**

Miroslaw (Firmware), Johan (Connectivity), Tibor (Security), Tarek (MCU), Thierry (Analog), Markus (IoT)

Contact details of our 6 experts will be available at the end of this presentation

www.microchip.com/iot https://github.com/MicrochipTech

IoT Made Easy – Session 1/4

Power Efficient Solutions for your IoT Application

SMART | CONNECTED | SECURE

Session 1 (14 Sept, 2pm CET) : « Power Efficient Solutions for your IoT Applications »
Session 2 (15 Sept, 2pm CET) : « Connectivity Made Easy and Scalable for your IoT Application »
Session 3 (16 Sept, 2pm CET) : « Security matters… and How it is Now so Easy »
Session 4 (17 Sept, 2pm CET) : « Scale your Business : from Easy Prototyping to Fast Time to Market »

www.microchip.com/iot www.microchip.com/analog

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The Challenge We Will Resolve Today

Following good practices when designing a Power Efficient Sensor

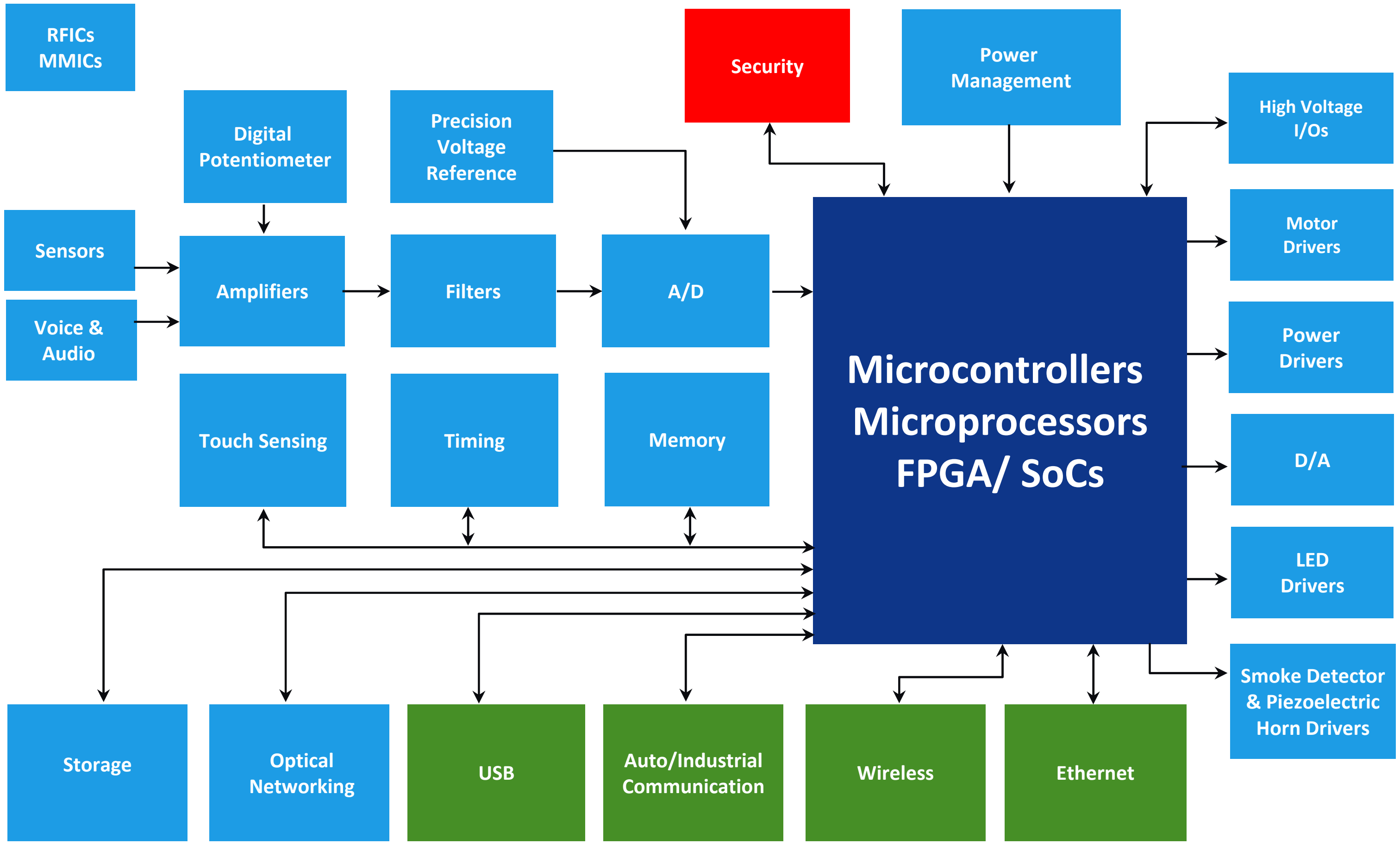
- **Analog design is about making compromise between several parameters, across many blocks made of multiple components**

- **How to make the right choices for my application ?
  What are good practices, the dos and don'ts when optimizing battery life ?
  How to gain agility and thus enable innovation ?
  How to control or even shorten my design cycle ?
  Insure the highest robustness ? Optimize my cost ?**

- **Where should I start ???**

- **Don't worry, we've got you covered with this session!**

Designing a Power Efficient IoT Sensor



Building a power efficient application requires system approach when defining your architecture and selecting components

A good strategy depends first and foremost on your application requirements

Solutions are often unique although there is always the temptation to get « inspired » from legacy block diagrams or reference designs

There is no « one size fits all »

Thanks to our system solution approach and broad portfolio (Analog, Smart, Secure & Connected), MICROCHIP has the devices, the tools and expertize to help you design the optimal solution

MICROCHIP

Designing a Power Efficient IoT Sensor

Step 1 : start with your power requirements

1 Is there a power source to recharge my battery ?

- Solar Panel ?
- Wall charger ?
- Energy harvesting ?
- Other ?

YES ▷

2a What rechargeable battery do I need ?

- Temperature range
- Capacity & aging
- Charge rate
- Self-discharge rate
- Internal impedance
- Reliability, life time.....
- …

NO ▽

▽

2b What non rechargeable battery do I need ?

- Temperature range
- Capacity & aging
- Self-discharge rate
- Internal impedance
- Reliability, life time.....
- …

▷

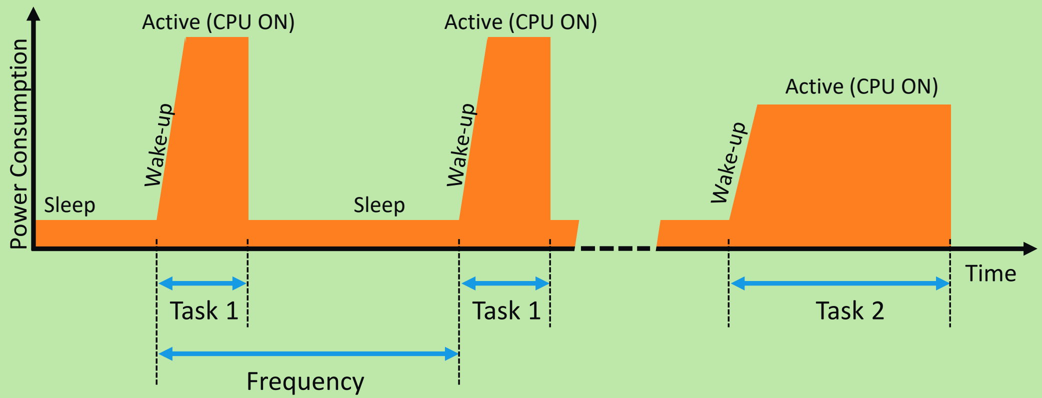
These multiple choices will heavily influence your Analog Signal Chain and Power Management
Thus your BOM and architecture
Don't worry, we have a solution

Designing a Power Efficient IoT Sensor

Step 2 : Define your power budget and select your battery

3 Define your Activity Profile

How long is your application active ? How often ?
What tasks get executed with which peripherals (connectivity, secure element, sensor..)?



4 Calculate your Power Budget

Based on Activity Profile, calculate how much power will be needed overall

5 Calculate your Battery Life

Evaluate battery life for different batteries, typical and max conditions.
If needed, test other options such as different radio or key components

BATTERY					BATTERY LIFE							
Brand Type PN	% of usage	Nominal Battery Voltage (used for PSU efficiency)	CAPACITY		CURRENT BUDGET		NOMINAL		MID-POINT		WORST CASE	
			Nominal	Worst Case	Nominal	Worst Case	RF CASE 1	RF CASE 2	RF CASE 1	RF CASE 2	RF CASE 1	RF CASE 2
Battery 1	70%	3.6V	2554.57mAh	1680.mAh	19.44µA	12.79µA	15.8 years	17.1 years	11.5 years	12.4 years	7.3 years	7.7 years
Battery 2												
Battery 3												

(green)	Match Target
(yellow)	Below but in Range
(red)	No Match

6 Select Your Battery !

Compare your data with Application Requirements
Find best compromise between capacity, power efficiency during Active Mode and/or Sleep Mode, size and cost
And that's it : you are done !

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Designing a Power Efficient IoT Sensor

Good practices

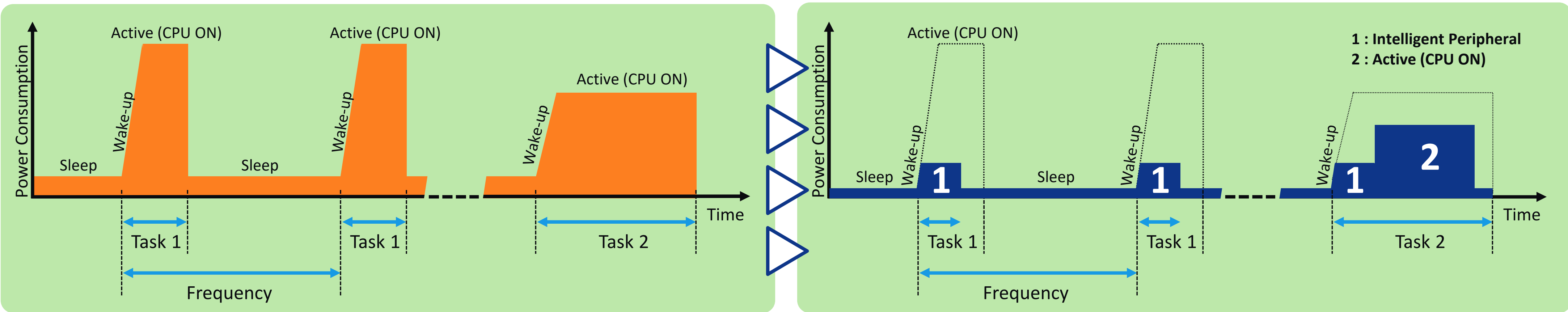
- **There is NO ONE SIZE FITS ALL**
  - Many options to select from : rechargeable or not, power source, type of battery with different characteristics and cost
  - An IoT Sensor with 90% of active time will have a completely different architecture compared to one operating 0.1% of the time!

- **Time matters : START EARLY on Analog to maximize efficiency and savings**
  - Your application requirements drive your signal chain Precision and Power Budgets
  - Engaging with Analog & Power Management at the very last stage of your design leads to over specification, oversized battery and extra cost
  - The sooner your start, the higher the optimization and savings

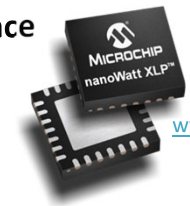
- **Implement SYSTEM APPROACH instead of considering components one by one**
  - Accurate Signal Chain
  - Low Power and efficient connectivity (see Webinar Session 2)
  - Secure Element to off load CPU when connectivity is on: less computing time (crypto) saves energy (see Webinar Session 3)
  - Ultra Low Power MCU with intelligent peripherals to minimize CPU activity thus Active mode (see Core Independent Peripherals and Sleep Walking)

Designing a Power Efficient IoT Sensor

System Approach : Ultra Low Power MCU



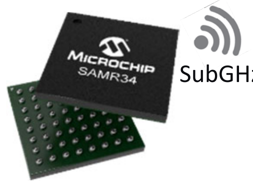
- **Extensive portfolio of over 360 Ultra Low Power MCUs to find the right balance of power consumption and performance**
  - 8-bit, 16-bit and 32-bit eXtreme Low Power (XLP) PIC® microcontrollers,
  - 32-bit SAML MCUs and SAMR34/SAM30 Wireless MCUs with picoPower® technology



www.microchip.com/xlp

- **Microchip's low-power technology enables MCU sleep currents down to 9 nA and run currents down to 25 µA/MHz**

- **Consistent low-power features, peripherals and tools for ease of migration**
  - Intelligent Peripherals : Core Independent CIP / Sleep Walking so peripherals runs autonomously in low power modes without CPU usage
  - Multiple power sources and clocking options - Multiple Power Domains
  - Fast context switch
  - Low Power Peripherals - Low Power Analog
  - Flexible Sleep Modes



SubGHz

www.microchip.com/sam-r34-r35

SubGHz

www.microchip.com/atsamr30m18

www.microchip.com/saml

www.microchip.com/xlp

MCU Battery Life Estimator : www.microchip.com/SWLibraryWeb/product.aspx?product=nanoWatt%20XLP%20Battery%20Life

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Designing A Power Efficient IoT Sensor

Full System Approach matters !

Analog

- Power Mgt — www.microchip.com/design-centers/power-management
- Sensors — www.microchip.com/sensors
- Amplifiers and Linear — www.microchip.com/design-centers/amplifiers-linear
- Data Converters — www.microchip.com/design-centers/data-converters
- Timing — www.microchip.com/design-centers/clock-and-timing

Analog - Key Strengths

- High accuracy
- High power efficiency
- Ultra low power consumption and low voltage operation
- High robustness
- Web Tools
- Support

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Get an Encompassing Overview of Our Analog and Interface Products

MPLAB MINDI Analog Simulator
MPLAB Analog Designer
ClockWorks Configurator
Check Services

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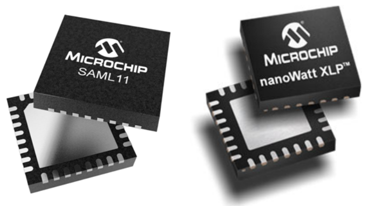
Smart



www.microchip.com/xlp

Connected

www.microchip.com/wireless

Secure

www.microchip.com/security

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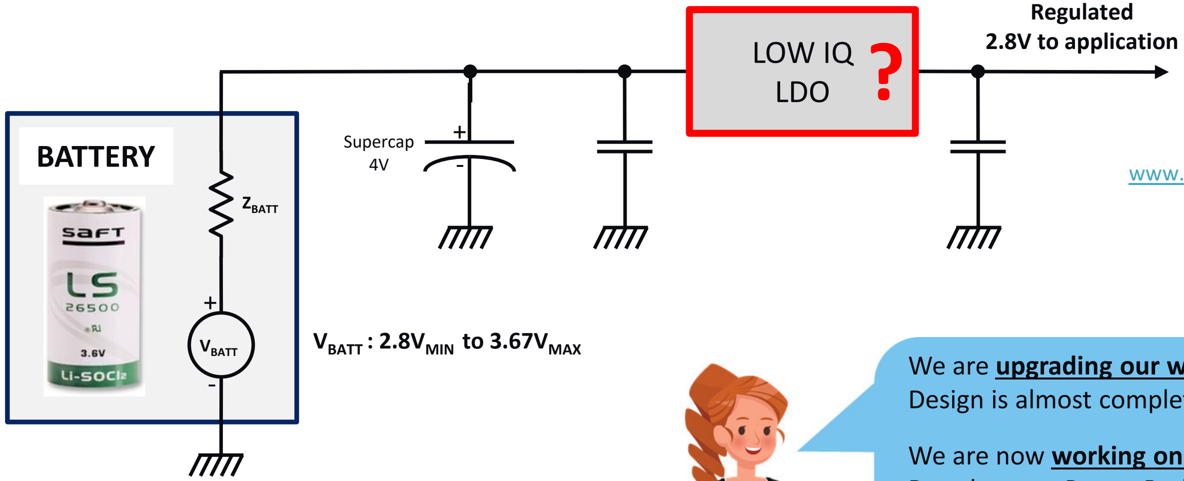
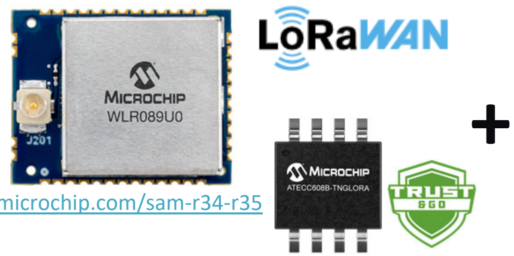
Real Life Example : Smart Water Meter

Customer’s initial demand

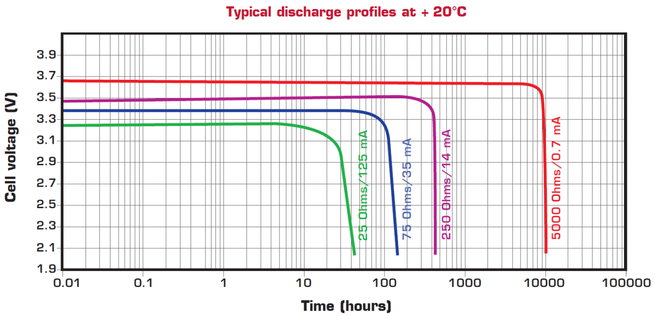


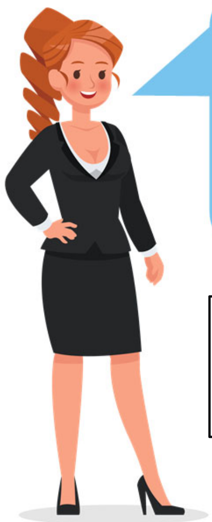


www.microchip.com/sam-r34-r35

www.microchip.com/trustgolora

Thierry, our Analog Expert





Customer

We are **upgrading our water meter with wireless** connectivity.
Design is almost completed with MCU and security.

We are now **working on power management** : target is 15 years battery life
Based on our Power Budget, we have done the maths as shown below and selected the Saft LS26500. So our **need : LOW IQ LDO at 1uA**.

Microchip, what could you propose to us ?

Average efficiency with LDO will be 60% with 10µA standby current,
1µA LDO IQ, 2µA leakage through Supercap.

$$\text{eff} = \frac{P_{OUT}}{P_{IN}} = \frac{V_{OUT} \cdot I_{OUT}}{V_{IN} \cdot (I_{OUT} + I_Q)}$$

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www.microchip.com/analog

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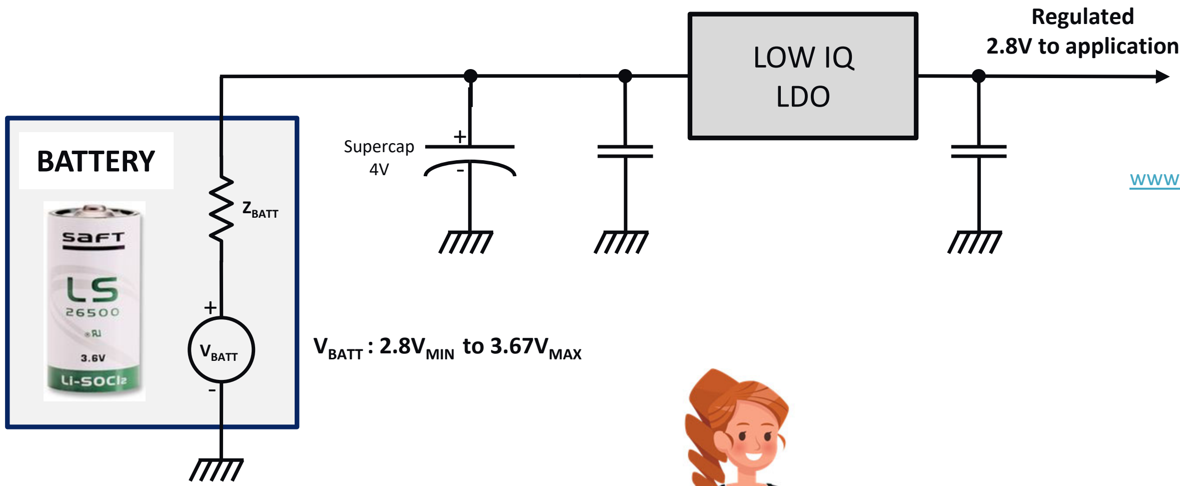
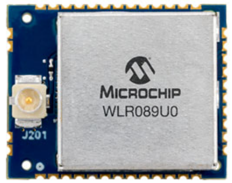
Real Life Example : Smart Water Meter

Microchip’s Total System Solution

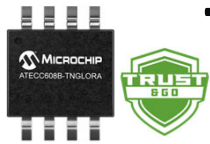


V_{BATT} : $2.8V_{MIN}$ to $3.67V_{MAX}$



LoRaWAN

www.microchip.com/sam-r34-r35



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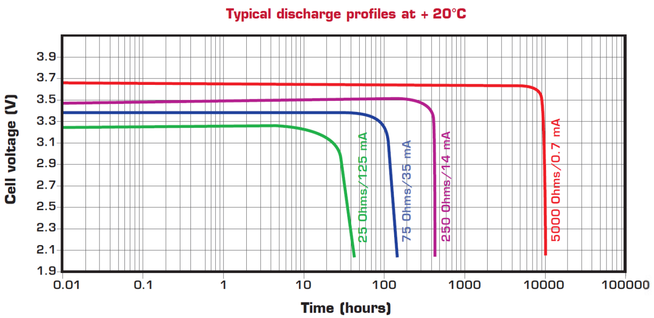

YES, we have the LDO that you requested.
This Saft LS26500 is the right choice for your proposed hardware topology

Average efficiency with LDO will be 60% with 10µA standby current, 1µA LDO IQ, 2µA leakage through Supercap.

$$\text{eff}=\frac{P_{OUT}}{P_{IN}}=\frac{V_{OUT}\cdot I_{OUT}}{V_{IN}\cdot(I_{OUT}+I_Q)}$$

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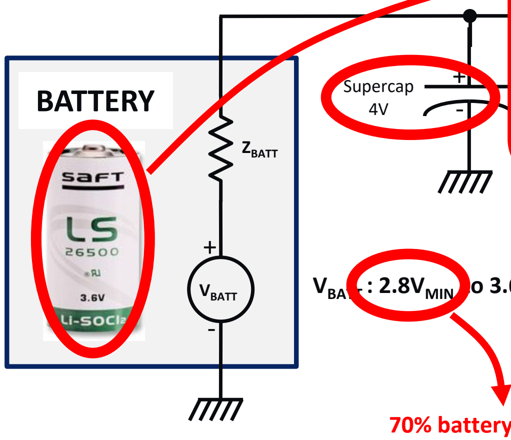
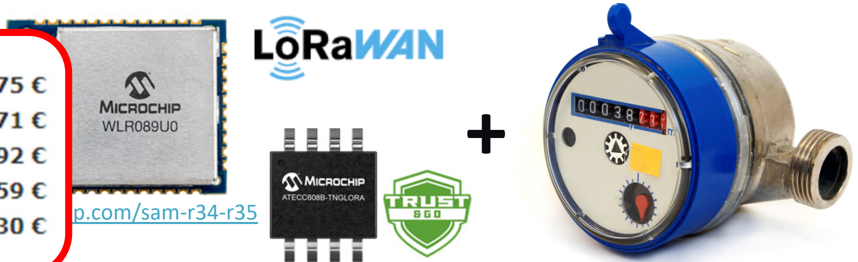
Real Life Example : Smart Water Meter

Microchip's Total System Solution



LS 26500		LS 17500	
1+	12,61 €	1+	7,75 €
5+	11,12 €	5+	6,71 €
10+	10,82 €	10+	5,92 €
25+	10,52 €	50+	5,59 €
50+	9,98 €	100+	5,30 €



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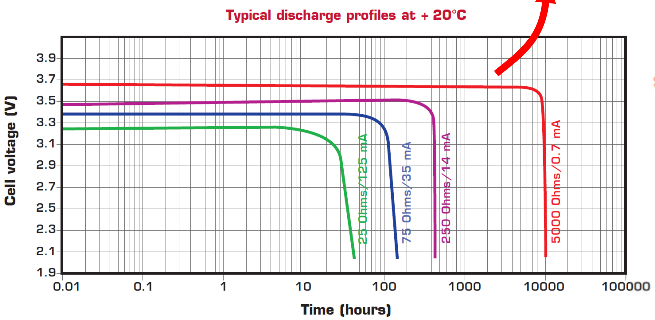
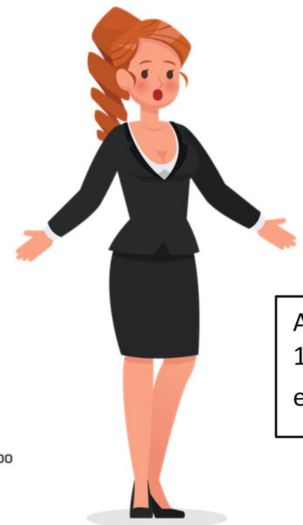
V_{BATT} : 2.8V_{MIN} to 3.67V_{MAX}

70% battery usage





We also have another solution increasing both
1. Your power efficiency (today at 60%)
2. And your battery usage (today at 70%)

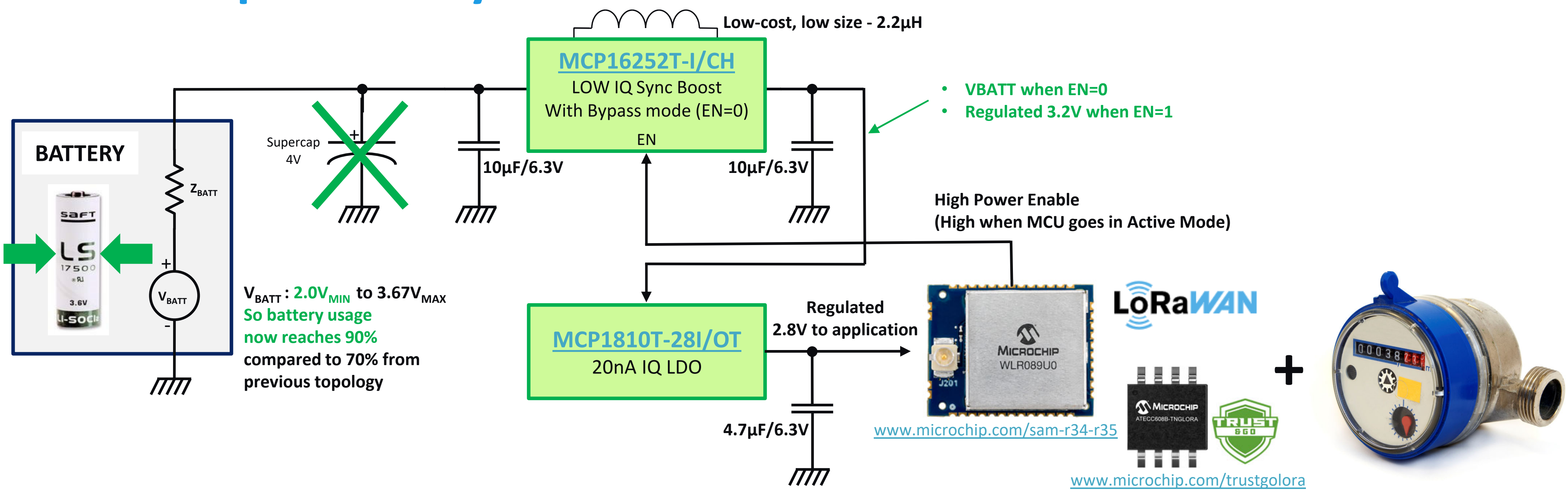
You would save space and reduce your system cost
Would you be interested ?

Average efficiency with LDO will be 60% with 10µA standby current, 1µA LDO IQ, 2µA leakage through Supercap.

$$eff = \frac{P_{OUT}}{P_{IN}} = \frac{V_{OUT} \cdot I_{OUT}}{V_{IN} \cdot (I_{OUT} + I_Q)}$$

Real Life Example : Smart Water Meter

Microchip's Total System Solution



New Efficiency:
- 73% in Sleep Mode
- 81% in Active Mode

Battery life is improved by over 15% leading to much lower Total System Cost and smaller system !

Real Life Example : Smart Water Meter

Going the extra mile for your application

Options	HW Schematic	Efficiency in Sleep	Efficiency in Active	Total Efficiency	Battery Life	System Cost
Option 1 Initial demand	MCP1810 Low IQ LDO + Supercap	Best	Good Due to higher battery cut-off voltage	Good Due to higher battery cut-off voltage	Worst	Worst Due to extra cost from battery and supercap
Option 2 Microchip Proposal	MCP16252 Boost MCP1810 Low IQ LDO	Very Good	Very Good	Very Good	Very Good	Best

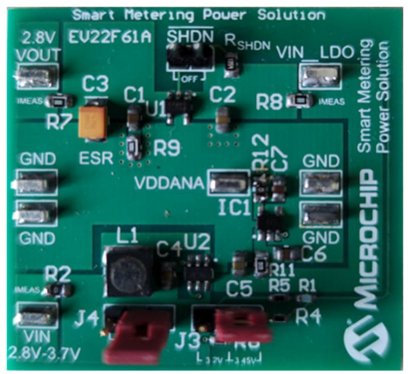
Real Life Example : Smart Water Meter

Going the extra mile for your application

Options	HW Schematic	Efficiency in Sleep	Efficiency in Active	Total Efficiency	Battery Life	System Cost	Ripple Rejection
Option 1 Initial demand	MCP1810 Low IQ LDO + Supercap	Best	Good Due to higher battery cut-off voltage	Good Due to higher battery cut-off voltage	Worst	Worst Due to extra cost from battery and supercap	Very Good
Option 2 Microchip Proposal	MCP16252 Boost MCP1810 Low IQ LDO	Very Good	Very Good	Very Good	Very Good	Best	Good

Yes indeed. We also took the initiative to measure Noise (Ripple rejection). It is key for Wireless performance. When having a **System Approach, robustness matters !**

We have done the maths, simulations and tests.
We now have **more solutions for you to consider, giving you further options**



Real Life Example : Smart Water Meter

Going the extra mile for your application

Options	HW Schematic	Efficiency in Sleep	Efficiency in Active	Total Efficiency	Battery Life	System Cost	Ripple Rejection
Option 1 Initial demand	MCP1810 Low IQ LDO + Supercap	Best	Good Due to higher battery cut-off voltage	Good Due to higher battery cut-off voltage	Worst	Worst Due to extra cost from battery and ...	Very Good
Option 2 Our 1st Proposal	MCP16252 Boost MCP1810 Low IQ LDO	Very Good	Very Good	Very Good	Very Good	Best (Best Cost)	Good
Option 3 Microchip Proposal for platforming	MCP16251 Boost MIC94310 RippleBlocker™ MIC94062 Load Switch MCP1810 Low IQ LDO	Best	Best	Best (Extend RF options to end customers)	Very Good	Very Good	Best
Option 4 Microchip Proposal for best price plus performance	MCP16252 Boost MIC94310 RippleBlocker™ MIC94062 Load Switch MCP1810 Low IQ LDO	Very Good	Best	Very Good	Best	[illegible] (Best compromise for LoRaWAN™)	Best

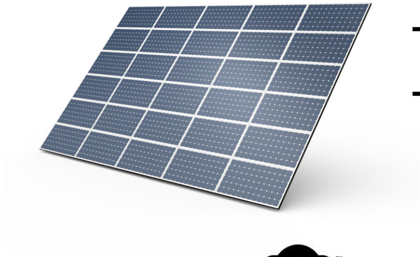
Option 3 could support more powerful radio allowing platforming (LoRaWAN™/NB-IoT/LTE-M…)
Option 4 provides best price / performance / battery life compromise for targeted LoRaWAN™ radio
Pick the option which best suits you !
Note : Option 1 (starting point here of our discussion) was actually the worst option

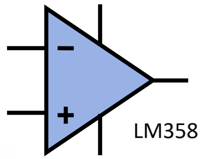
Real Life Example : Alarm System

Going the extra mile for your application

- **Support triggered thru Design Check (Online Design Review Services)**

- **Battery operated alarm system with sensor based on the SAMD20E16-AU + WINC1500 Wi-Fi Network Controller**





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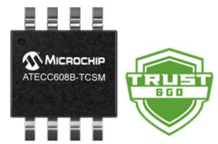

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- **From simple request (schematic review) to more robust and more efficient application**
  - **Review done with system approach**
  - **MCP6L02 rather than LM358. Lower Power MCU**
  - **Battery life discussion**
  - **Turnkey solution for even faster time to market**

Microchip Going the Extra Mile for You

Analog made easy for <u>your</u> application

Requirements define your Activity Profile and Power Budget

Calculate your <u>Battery Life</u>

BATTERY					BATTERY LIFE							
Brand Type PN	% of usage	Nominal Battery Voltage (used for PSU efficiency)	CAPACITY		CURRENT BUDGET		Typical Value		Mid-Point		Max. Value	
			Typ	Max	Typ	Max	RF CASE 1	RF CASE 2	RF CASE 1	RF CASE 2	RF CASE 1	RF CASE 2
Battery 1	70%	3.6V	2554.57mAh	1680.mAh	19.44µA	12.79µA	15.8 years	17.1 years	11.5 years	12.4 years	7.3 years	7.7 years
Battery 2												
Battery 3												

	Match Target
	Below but in Range
	No Match

Computation with several batteries

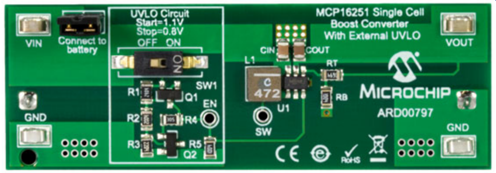
Build your Architecture with Treelink Selection tool

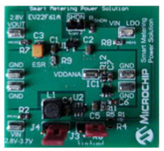
MPLAB MINDI ANALOG SIMULATOR

Simulate

MPLAB ANALOG DESIGNER

New iteration if needed





Select hardware boards you need
Connect. And Validate your Architecture

Job is done

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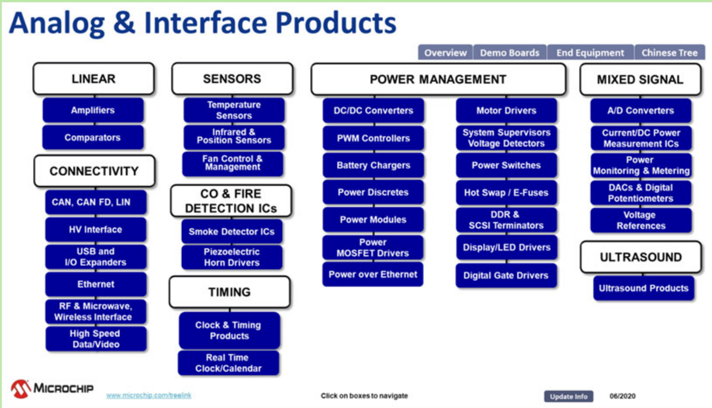
Analog made easy for your application : Online Tools

1



« Select » with Treelink www.microchip.com/treelink

2

MPLAB MINDI ANALOG SIMULATOR

« Verify »

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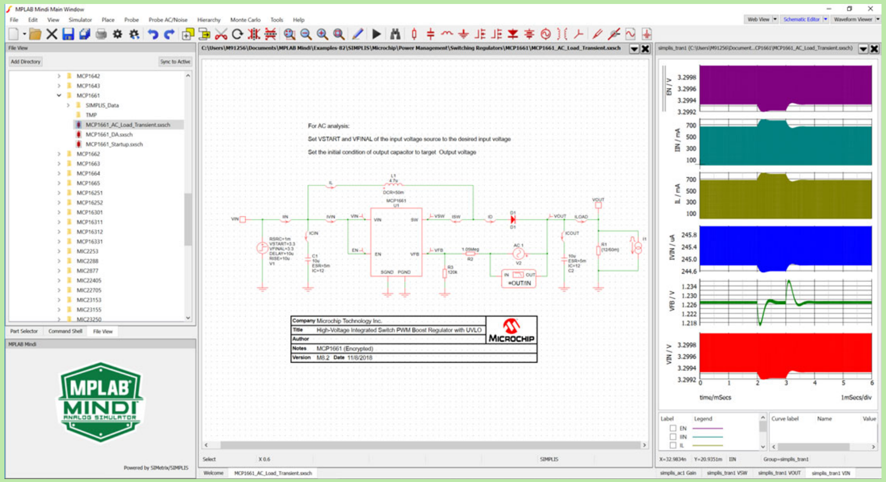

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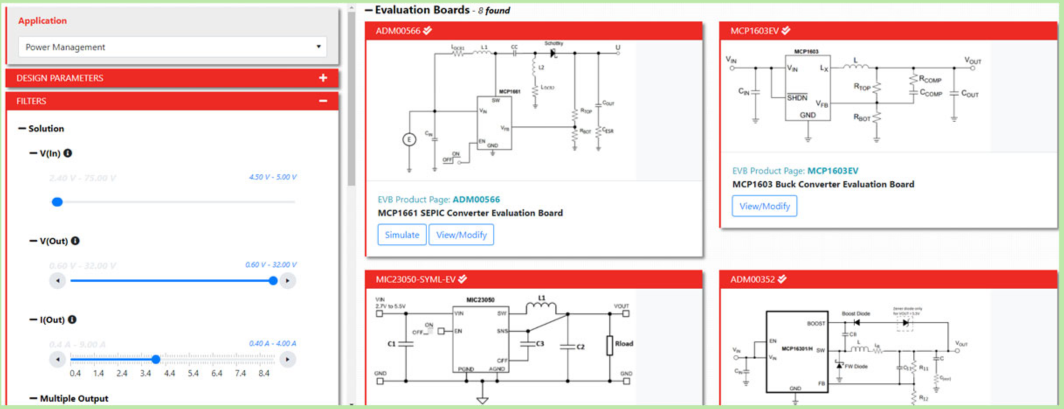

MPLAB ANALOG DESIGNER

« Design »

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4

« Support »

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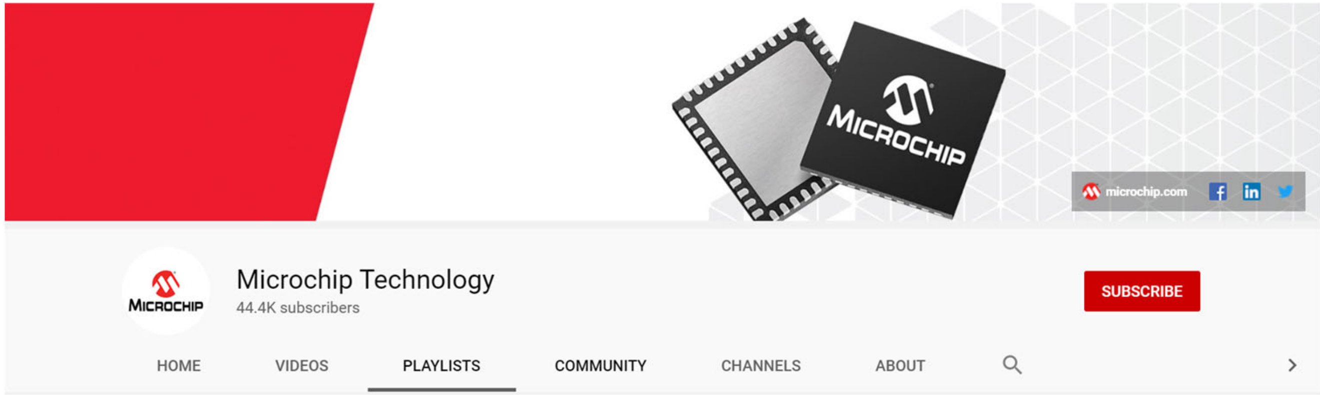
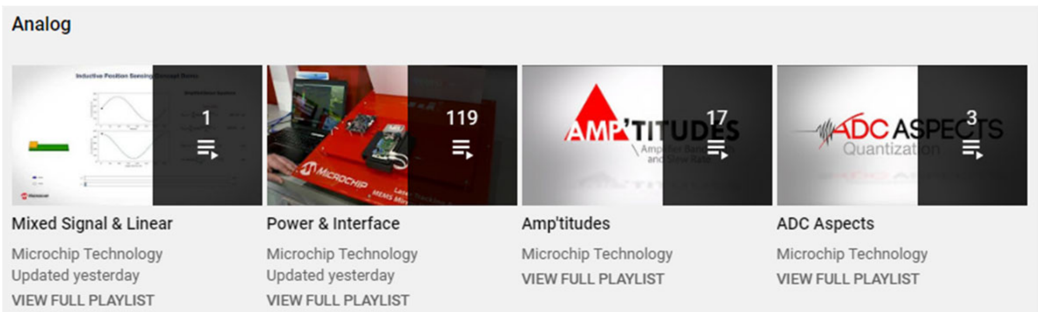
For the Curious Ones… and Geeks Like Me

Microchip YouTube Channel





Improve Your Circuit Design Experience with the MPLAB® Mindi™ Analog Simulator (34' video)

www.youtube.com/user/MicrochipTechnology/playlists

www.microchip.com/analog

Conclusion: Power Efficiency In IoT Is Complex

But Microchip has the solutions Made Easy for you

- **To maximize power efficiency and savings, engage EARLY with Analog design**

- **Start with POWER BUDGET**
- **Implement SYSTEM APPROACH**
- **Adjust your design until you FIND THE RIGHT COMPROMISE FOR YOUR APPLICATION (cost / performance / integration)**

- **Microchip has everything you need for Analog: products, software tools and support**

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  - Wireless, Ethernet LAN, PoE, MPU…
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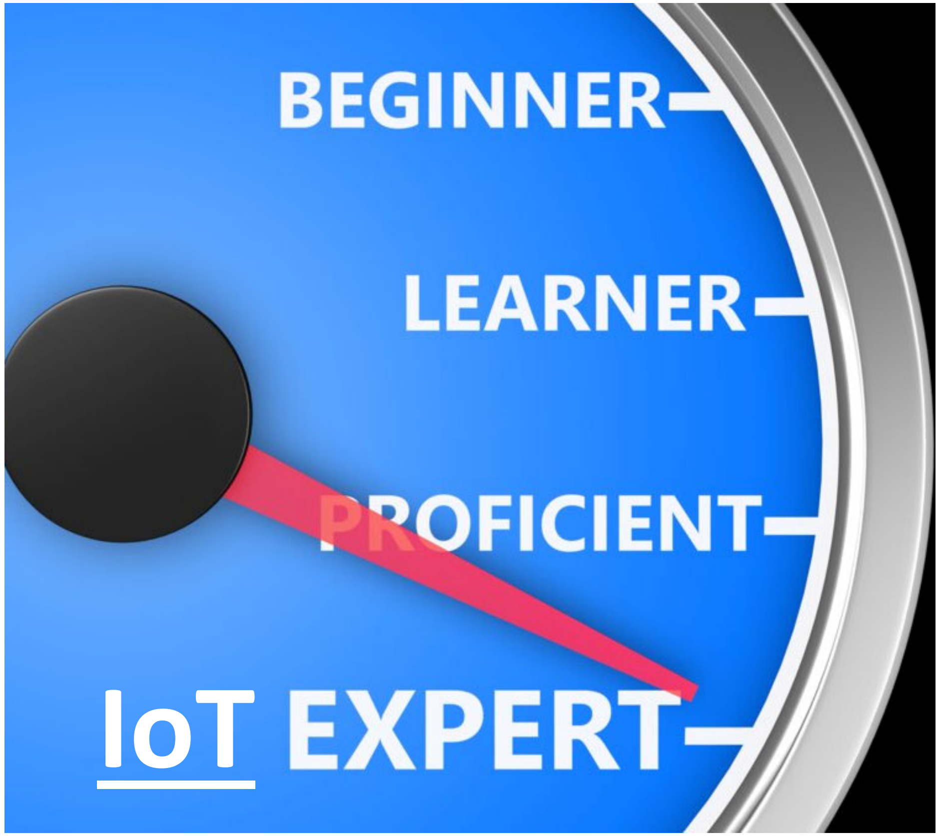
- **Github**
  - https://github.com/MicrochipTech
- **Microchip YouTube Channel**
  - www.youtube.com/user/MicrochipTechnology
- **Design Partner:**
  - https://get.microchipdirect.com/design-partner-ecosystem/
- **And your friendly and Local Microchip team !**



Let’s Go For Q&A

Ask our Experts now !

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