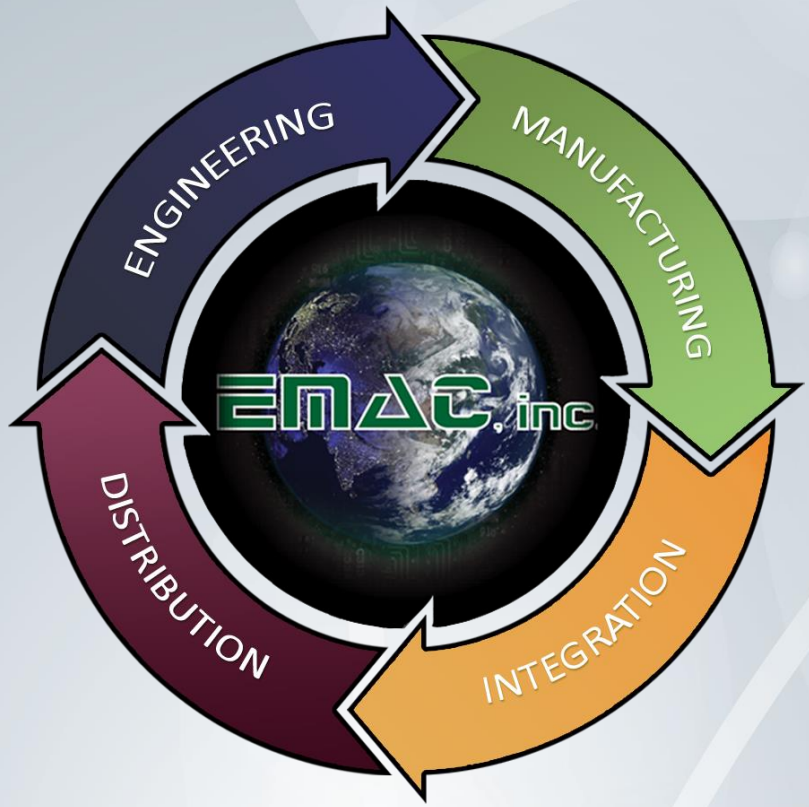
Equipment Monitor And Control



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Choosing the Right IOT Platform with Real World Examples

Presented by Eric Rossi
Engineering Manager
EMAC, Inc

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EMAC, Inc Overview

- **Engineering Services both Software & Hardware**
- **Integration Services (Box Builds, Wiring Panels, etc.)**
- **Manufacturer of Electronic Assemblies**
- **Sale of Off-The Shelf SBCs, SOMs, PPCs, Servers**

Seminar Overview

This Seminar looks at the six key aspects of IoT & IIoT designs (Processor / Power / Communication / Sensors / Software / Security) and provides a few real world examples of Custom and Off-The-Shelf IoT devices and how they are used.

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Six Key Aspects of IoT Designs

- **Processor**
- **Power Considerations**
- **Communication**
- **Sensors**
- **Software**
- **Security**

These Six Key Aspects can be used to determine Right IOT Platform. Usually Price and Power Consumption are the two most significant Iot Platform Constraints that direct selections in each of the above Aspects.

- **Power Considerations**
  - **Awake & Sleep Power Consumption**
  - **Battery Powered**
    - **Battery Life**
    - **Non-Rechargeable**
    - **Rechargeable**
      - **Li-Ion**
      - **NiCd, NiMH**
      - **Lead Acid**
      - **Energy Harvesting**
    - **Power Consumption**
  - **Non-Rechargeable Battery**
  - **AC Powered**

- **Processor**
  - **MCU (Microcontroller)**
  - **Integrated Radio MCU**
  - **Microprocessor**
    - **Low-End ARM (Single Core < 1GHz)**
    - **High End ARM (Multi Core >= 1GHz)**
    - **x86 Intel/AMD (Muti Core >= 1GHz)**

- **Wireless Communication**
  - **Wifi (2.4GHz, LP, Avg Indoor Range ~150')**
  - **Bluetooth (5, VLP, Avg Indoor Range ~125)**
  - **Zigbee (VLP, Avg Indoor Range ~85')**
  - **Z-Wave (VLP, Avg Indoor Range ~85)**
  - **WAN**
    - **Lora (LP, miles depending on Antenna & Terrain**
    - **Cellular**
      - **LTE 4G (miles depending on Antenna & Terrain)**
      - **NB-IoT (VLP, miles depending on Antenna & Terrain)**
      - **CAT M (LP, many miles depending on Antenna & Terrain)**

Figure #1

	Long Range	Low Power	Continuous Availability	High Bandwidth	Low Latency
Ethernet	🔴	🔴	🔴	🟢	🟢
Wi-Fi	🟡	🔴	🔴	🟢	🟢
Cellular IoT	🟢	🟢	🟢	🟡	🔴
LoRa	🟢	🟢	🔴	🔴	🔴
BLE	🔴	🟢	🟡	🔴	🟢

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Figure #2

	Wi-Fi HaLow	Bluetooth low energy (5)	ZigBee	Thread	Sub-GHz IEEE 802.15.4
Max. data throughput	347 Mbps	2 Mbps	250 kbps	250 kbps	100 bps
Max. line-of-sight range*	N/A[1]	750 m	130 m	100 m[7]	4000 m
Power consumption	N/A[2]	Years from a coin cell	Years from a coin cell	Years from a coin cell	Years from a coin cell[8]
Mesh networking	Yes	Yes[4]	Yes	Yes	No
IP at the device node	Yes	Yes[5]	No	Yes	No
OC/mobile OS support	Yes	Yes	No	No	No
Infrastructure in place	Yes, routers[3]	Yes, mobiles[6]	No	No	No

1. Said to be greater than Bluetooth 5
2. Said to be comparable with Bluetooth 5

Figure #3


Traditional Cellular
Long Range
High Data Rates
Low Battery Life
High Cost
LPWAN (3-5B in 2022)
LoRa
Long Range
Low Data Rates
Long Battery Life
Low Cost
High Capacity Potential
Cat-M1
Long Range
High Data Rates
Low Battery Life
Medium Cost
Local Area Network
(Wi-Fi)
Short Range
High Data Rates
Low Battery Life
Medium Cost
Narrow-Band IoT
(NB-IoT)
Stationary Devices
Short Range (indoor coverage)
Low Data Rates
Good Battery Life
Low Cost
Personal Area Network
(Bluetooth®)
Very Short Range
Low data rates
Good Battery Life
Low Cost

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- **Sensors**
  - **Temperature/Humidity**
  - **Gas**
  - **Voltage/Current**
  - **Accelerometer/Magnetometer**
  - **Pressure**
  - **Flow**
  - **IR Motion**
  - **Door**
  - **Image Sensor/Camera**
  - **GPS**
  - **Etc.**

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- **Software**
  - **Operating System (OS)**
    - **Bare Metal**
    - **RTOS (FreeRTOS)**
    - **MicroPython**
    - **Linux**
    - **Windows**
  - **Protocols**
    - **WebSocket**
    - **MQTT (Message Queuing Telemetry Transport)**
    - **AMQP (Advanced Message Queuing Protocol)**
    - **HTTP/HTTPS (HyperText Transfer Protocol)**
    - **DDS (RT; Data Distribution Service)**

- **Security**
  - **Gateway**
  - **Cryptographic Accelerator (AES, DES, SHA, TLS, etc)**
  - **Arm TrustZone PSA (Isolation Technology; Separate Secure Register Set)**
  - **Secure Key Storage**
  - **True Random Number Generator (TRNG)**
  - **MCU is Secure Element Ready (Separate Dedicated MCU)**
  - **Trusted Platform Module (TPM)**
  - **Application Code & Libraries**

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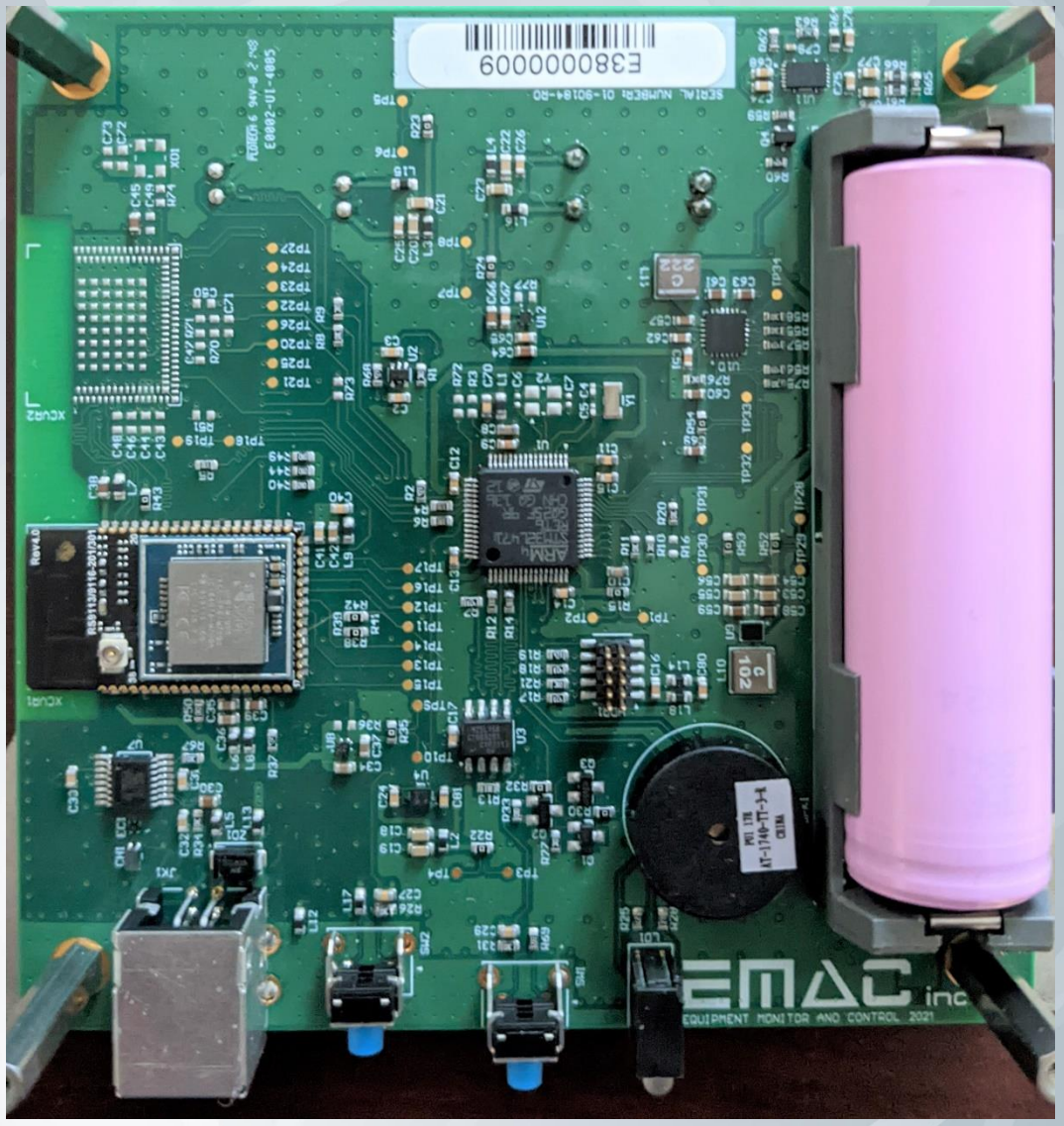
Case Study BFM

BFM – Bio-Chamber Fermentation Monitor

Monitoring of Bio-Chamber Fermentation Process in the making of Synthetic Leather



Case Study BFM

- **BFM – Bio-Chamber Fermentation Monitor (completed)**
  - **Processor: ST Micro MCU**
  - **Power: Rechargeable 4.2V 3500mAh Li-Ion Battery**
  - **Communication: 2.4GHz Wifi**
  - **Sensors:**
    - **Temperature/Humidity**
    - **Gas: O2 & CO2**
    - **Accelerometer**
    - **Gas Gauge (Voltage/Current)**

Case Study BFM (Continued)

- Software: FreeRTOS, C, MQTT
- Security: Gateway
- Block Diagram

- Gateway
  - Processor: X86 i5 Embedded Server connected to multiple wireless APs
  - Software: Linux, MQTT, SQL Database, Webserver
  - Web Base User Interface

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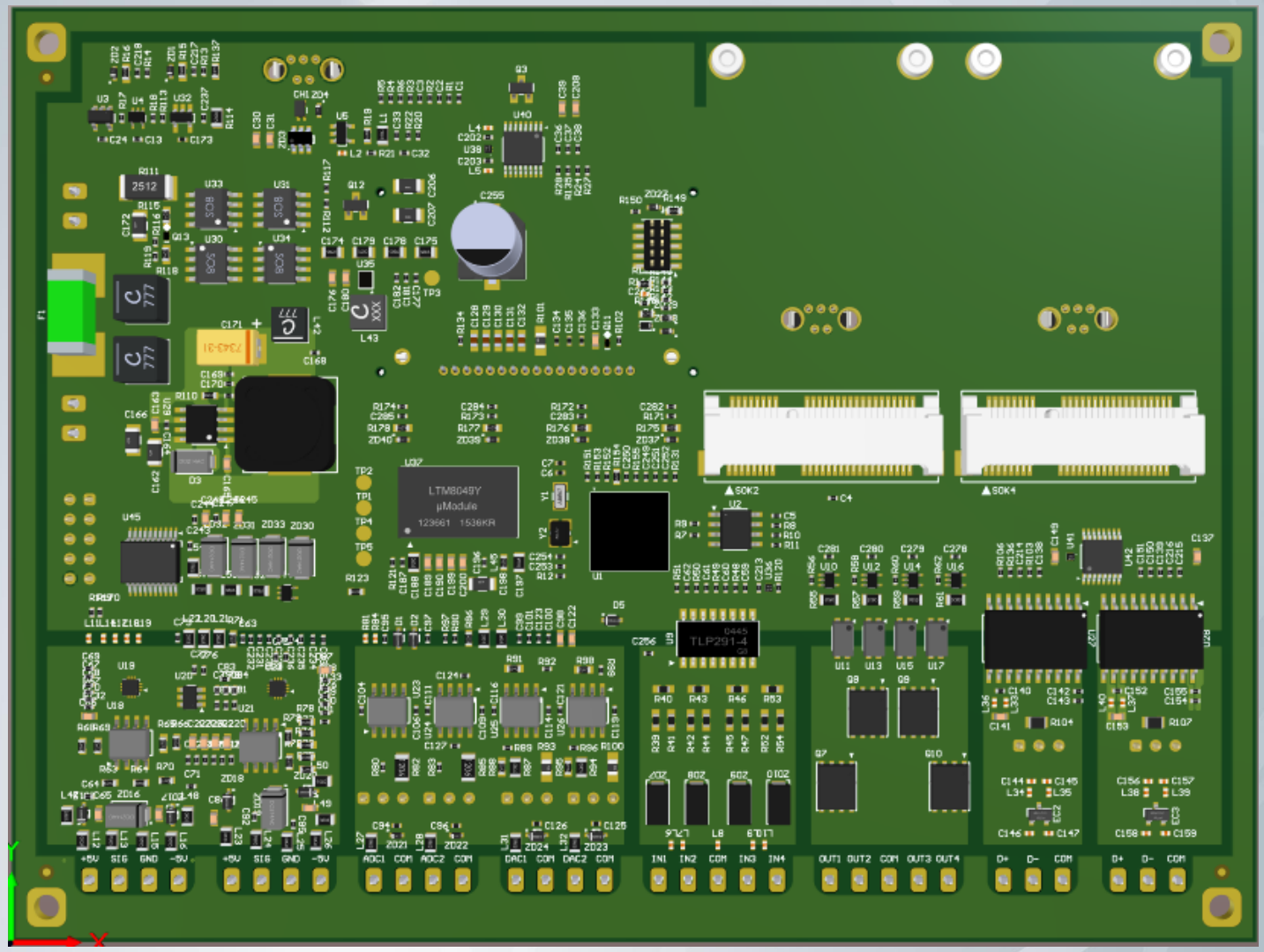
Case Study WFC

WFC – Water Flow Controller

Monitor & Control of Water Distribution & Metering



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Case Study WFC

- WFC – Water Flow Controller (in design)
  - Processor: ST Micro MCU
  - Power: Non-Rechargeable 3.6V 19Ah Lithium Battery
  - Communication: 2x 4G LTE Cell Modems & RS485
  - Sensors:
    - 2x Hydraphone
    - 2x A/D (Pressure & Flow)
    - GPS
  - Software: MicroPython, Python
  - Security: Customer Defined
  - Block Diagram

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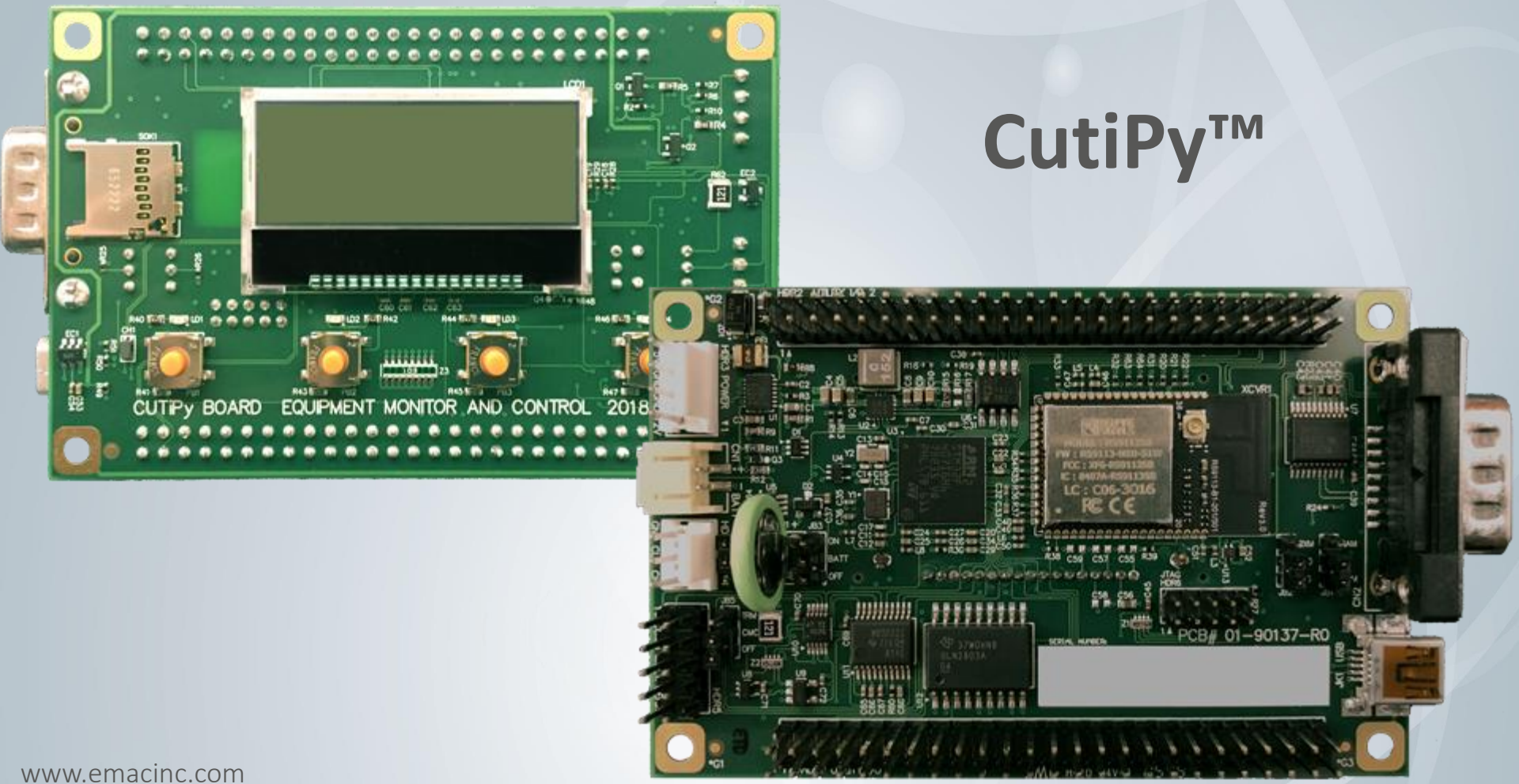
EMAC Off-The-Shelf IOT Products



CutiPy™

EMAC Off-The-Shelf IOT Products

- **CutiPy**
  - **The CutiPy™ is a low-power IOT board with multiple Sensor Inputs & I/O capability that can be powered from a Li-Ion rechargeable battery.**
  - **Processor: MCU STM32F407IGH6 ARM Cortex-M4**
  - **Power: 5V or Rechargeable Li-Ion Battery**
  - **Communication: Wifi, BLE, CAN, RS232/485, USB**
  - **Sensors: A/D, I2C, SPI**
  - **Software: MicroPython, FreeRTOS, MQTT, Modbus**
  - **Security: AES, DES, CRC/TRNG**

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EMAC Off-The-Shelf IOT Products

MitiPy™

EMAC Off-The-Shelf IOT Products

- **MitiPy**
  - **The Mitipy™ Industrial IoT microcontroller was created to simplify connecting devices & machines to the multitude of Industrial type systems**
  - **Processor: MCU STM32F407IGH6 ARM Cortex-M4**
  - **Power: 8V to 36V or Power Over Ethernet (POE)**
  - **Communication: Wifi, BLE, Cell Modem, Lora, CAN, Ethernet, RS232/485, USB**
  - **Sensors: A/D, I2C, SPI, GPS**
  - **Software: MicroPython, FreeRTOS, MQTT, Modbus**
  - **Security: AES, DES, CRC/TRNG**

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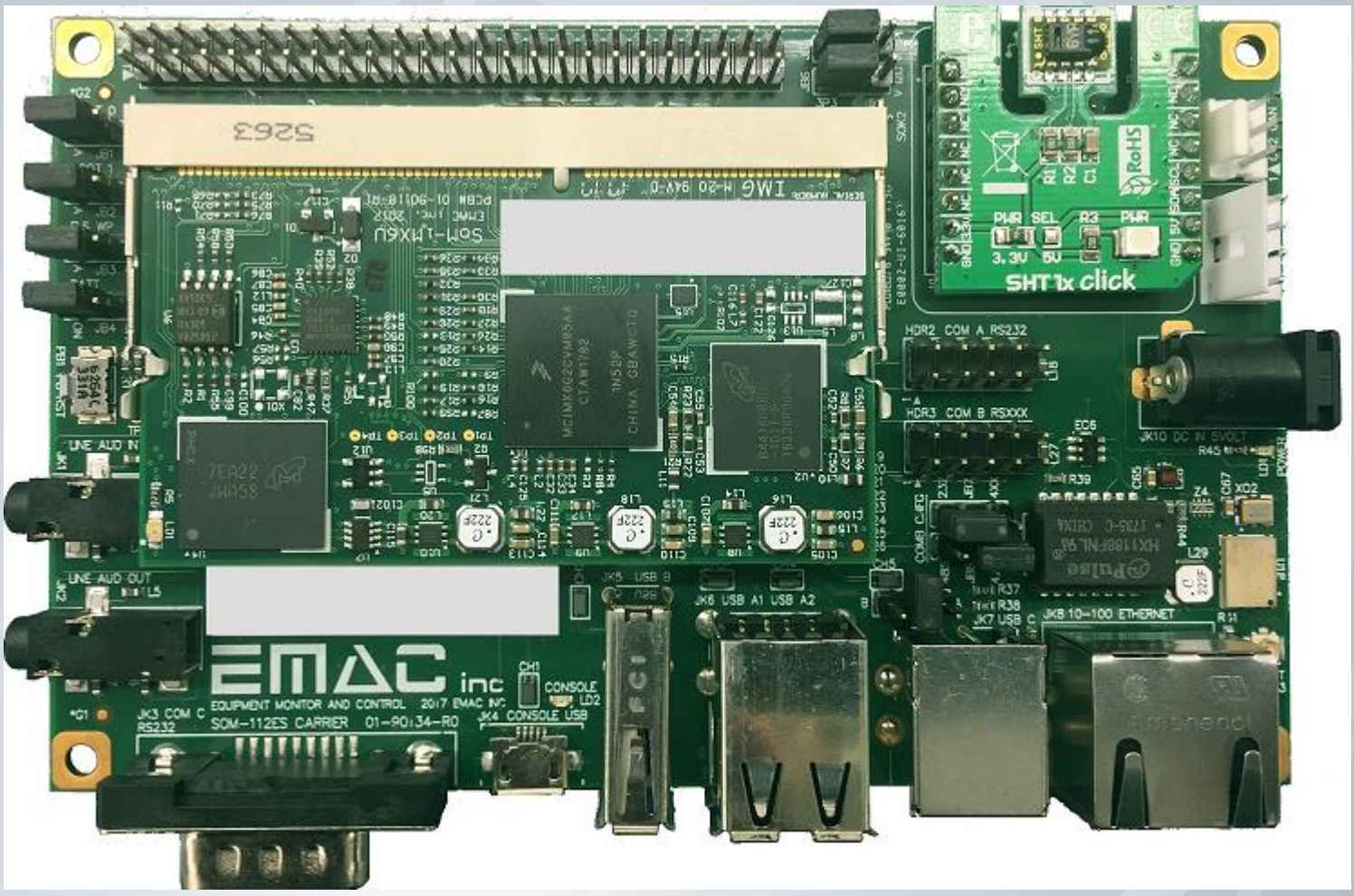
DEV-IOT6U



EMAC Off-The-Shelf IOT Products

- **DEV-IOT6U**
  - **The DEV-IOT6U is a Linux IoT Dev Kit is based on EMAC's SoM-iMX6U System on Module & SOM-112ES carrier board. The SoM-iMX6U is based on an ARM Cortex A7 processor with a Sleep Mode of 3.5mA.**
  - **Processor: NXP iMX6U A7 528MHz Processor**
  - **Power: 5V**
  - **Communication: Wifi, BLE, CAN, USB, Ethernet, RS232/485**
  - **Sensors: A/D, I2C, SPI, MikroBUS**
  - **Software: Linux, MQTT, Modbus, etc.**
  - **Security: SSL/SSH, AES, DES, CRC/TRNG, etc**

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EMAC's OEM products are designed and manufactured in the USA.

Case Study #3
Water Purity Device

- Power Source
  - 12V Wall Power Supply
  - Non-Rechargeable Battery (6x AA Cell battery pack)
- ST Micro ARM Cortex M4 Processor
- MicroPython OS
- Wifi & Bluetooth Radios (Redpine)
- IBM Bluemix Cloud
- 3 Independent Power Modes
  - Processor, Radio, Analog Sleep