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Achieving Low-Power with Power-Management

Zephyr Meetup - Orlando, FL
Oct 28th, 2026

Zephyr®

Agenda

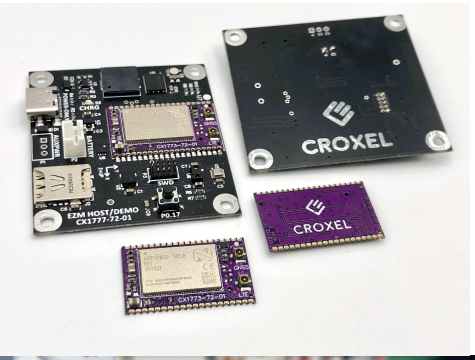
1. Introduction
2. System Power-Management
3. Device Runtime Power-Management
4. Device Power-Domains
5. Continued Power Measurement
6. Q&A

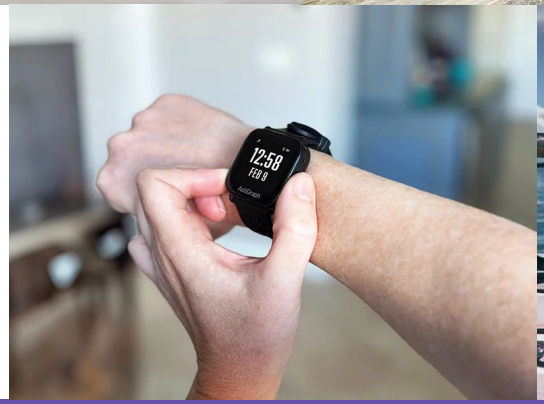
Introduction

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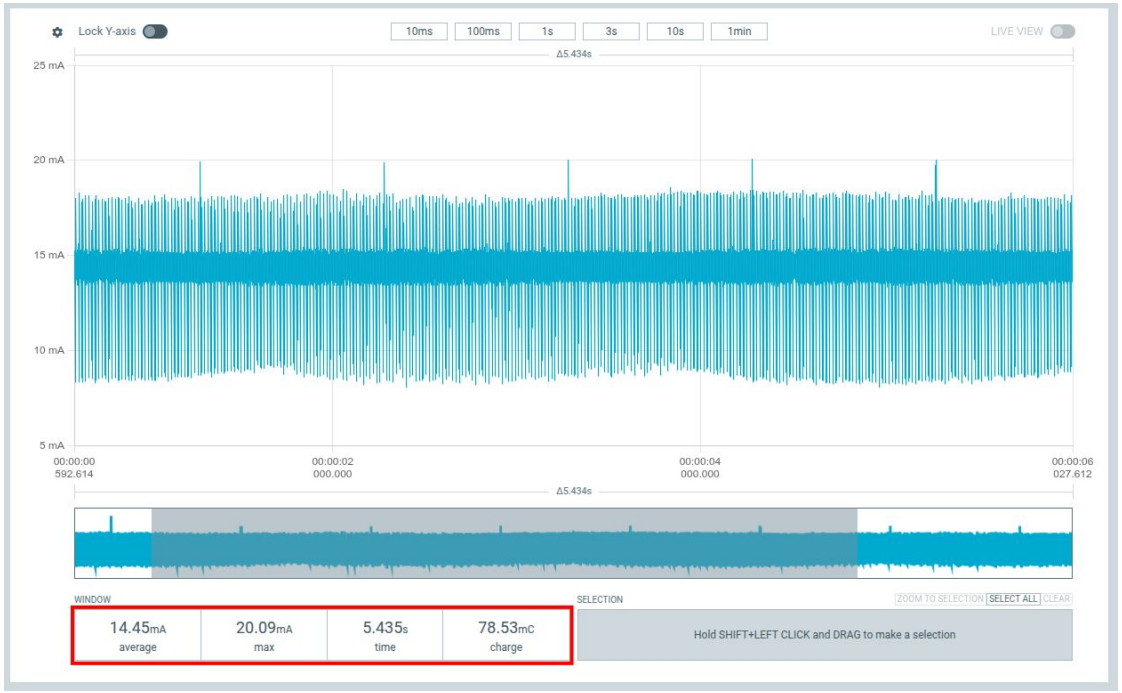






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Problem: Default settings & Low-Power




```
$ west build -b frdm_mcxn947//cpu0 samples/basic/blinky
```

Power-Management Strategies

1. System Power-Management

2. Device Runtime Power-Management

3. Device Power-Domains

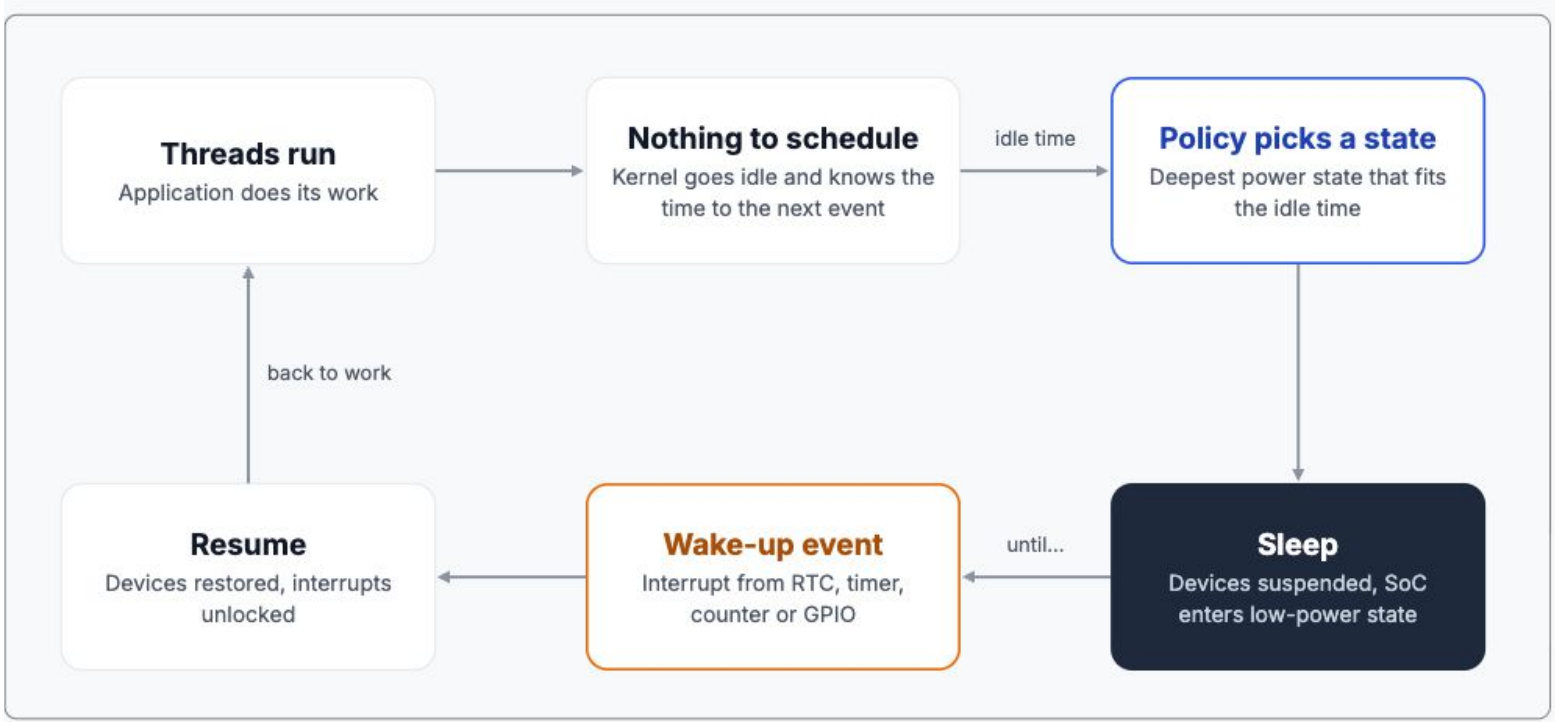
Power-Management Strategies

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3. Device Power-Domains

System Power Management

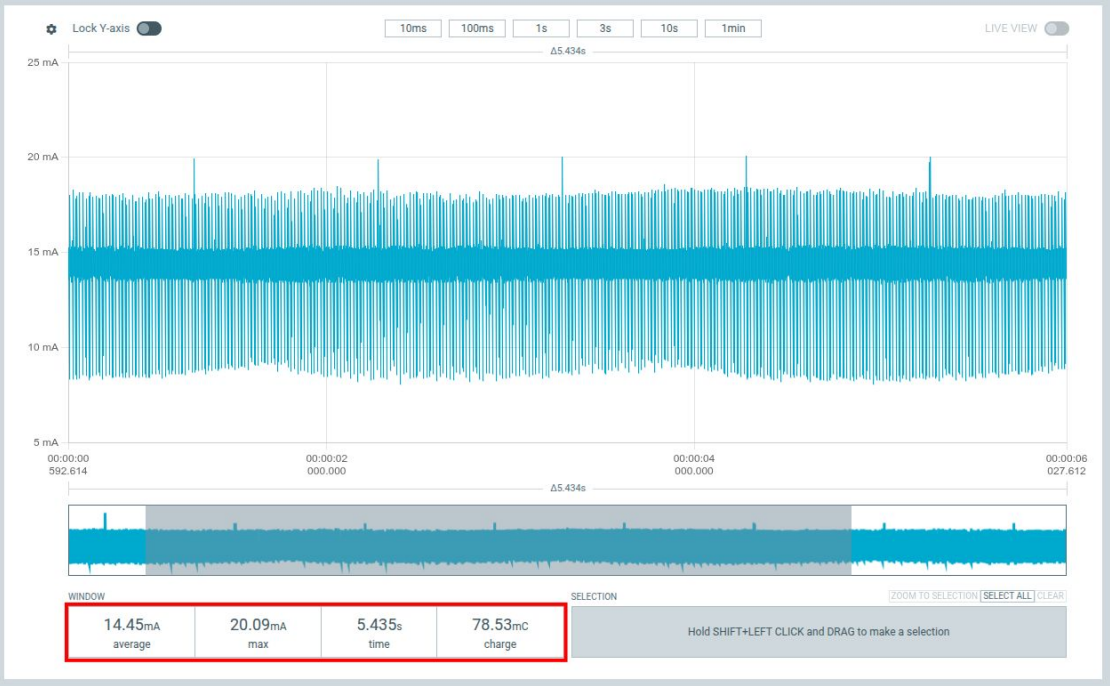


System Power Management

Board device-tree

```
power-states {
        sleep: sleep {
                compatible = "zephyr,power-state";
                power-state-name = "runtime-idle";
                min-residency-us = <10000>;
                exit-latency-us = <1>;
        };
        deepsleep: deepsleep {
                compatible = "zephyr,power-state";
                power-state-name = "suspend-to-idle";
                min-residency-us = <50000>;
                exit-latency-us = <10>;
        };
        powerdown: powerdown {
                compatible = "zephyr,power-state";
                power-state-name = "standby";
                min-residency-us = <80000>;
                exit-latency-us = <20>;
        };
};
```

System Power Management




```
$ west build -b frdm_mcxn947//cpu0 samples/basic/blinky
```

System Power Management




```
$ west build -b frdm_mcxn947//cpu0 samples/basic/blinky -- -DCONFIG_PM=y
```

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Power-Management Strategies

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Power-Management Strategies

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Device Runtime Power Management

Data Sheet ADXL345

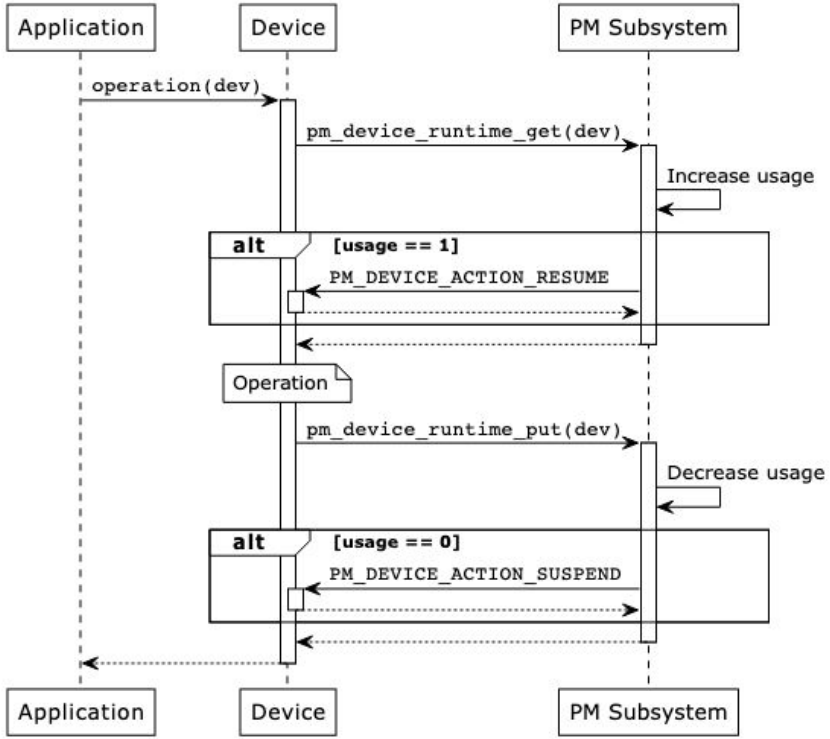
SPECIFICATIONS

Table 1.

Parameter	Test Conditions	Min	Typ[1]	Max	Unit
Output Change in Y-Axis		−2.10		−0.20	*g*
Output Change in Z-Axis		0.30		3.40	*g*
POWER SUPPLY					
Operating Voltage Range (V_S)		2.0	2.5	3.6	V
Interface Voltage Range ($V_{DD\ I/O}$)		1.7	1.8	V_S	V
Supply Current	ODR ≥ 100 Hz		140		µA
	ODR < 10 Hz		30		µA
Standby Mode Leakage Current			0.1		µA
Turn-On and Wake-Up Time[7]	ODR = 3200 Hz		1.4		ms
TEMPERATURE					
Operating Temperature Range		−40		+85	°C
WEIGHT					
Device Weight			30		mg

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Device Runtime Power Management



Device Runtime Power Management

Application side

```
/* Wake up the device */
ret = pm_device_runtime_get(dev);
...

/* Perform the action */
ret = sensor_sample_fetch(dev);
...

/* Let device go back to sleep */
ret = pm_device_runtime_put(dev);
```

Device-driver side

```
static int dev_pm_action(const struct device *dev,
                         enum pm_device_action action)
{
        switch (action) {
        case PM_DEVICE_ACTION_RESUME:
                /* Resume to measurement mode */
                return 0;
        case PM_DEVICE_ACTION_SUSPEND:
                /* Enter standby mode for low power */
                Return 0;
        default:
                return -ENOTSUP;
        }
}
```

Device Runtime Power Management

App-Module 1

```
/* Wake up the device */
ret = pm_device_runtime_get(dev);
...

/* Perform the
ret = sensor_sa
...

/* Let device g
ret = pm_device_
```

App-Module 2

```
/* Wake up the device */
ret = pm_device_runtime_get(dev);
...

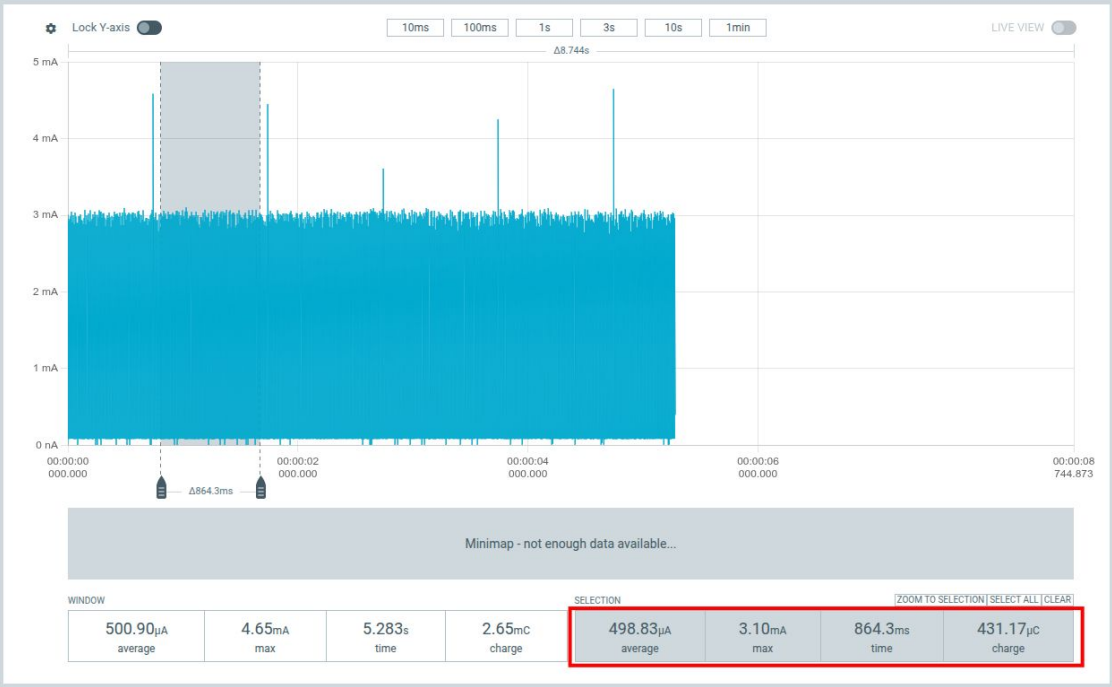
/* Perform the action */
ret = sensor_sample_fetch(dev);
...

/* Let device go back to sleep */
ret = pm_device_runtime_put(dev);
```

Device-driver side

```
static int dev_pm_action(const struct device *dev,
                         enum pm_device_action action)
{
        switch (action) {
        case PM_DEVICE_ACTION_RESUME:
                /* Resume to measurement mode */
                return 0;
        case PM_DEVICE_ACTION_SUSPEND:
                /* Enter standby mode for low power */
                Return 0;
        default:
                return -ENOTSUP;
        }
}
```

Device Runtime Power Management




```
$ west build -b nrf52840dk/nrf52840 samples/sensor/accel_polling --
-DCONFIG_SERIAL=n
```

boards/nrf52840dk_nrf52840.overlay

```
&arduino_spi {
        adxl345:adxl345@0 {
                compatible = "adi,adxl345";
                reg = <0x0>;
                status = "okay";
                spi-max-frequency = <1000000>;
        };
};

/{
        aliases {
                accel0 = &adxl345;
        };
};
```

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Device Runtime Power Management



boards/nrf52840dk_nrf52840.overlay

```
&arduino_spi {
	adxl345:adxl345@0 {
		compatible = "adi,adxl345";
		reg = <0x0>;
		status = "okay";
		spi-max-frequency = <1000000>;
	};
};

/{
	aliases {
		accel0 = &adxl345;
	};
};
```

```
$ west build -b nrf52840dk/nrf52840 samples/sensor/accel_polling --
-DCONFIG_PM_DEVICE=y -DCONFIG_PM_DEVICE_RUNTIME=y
```

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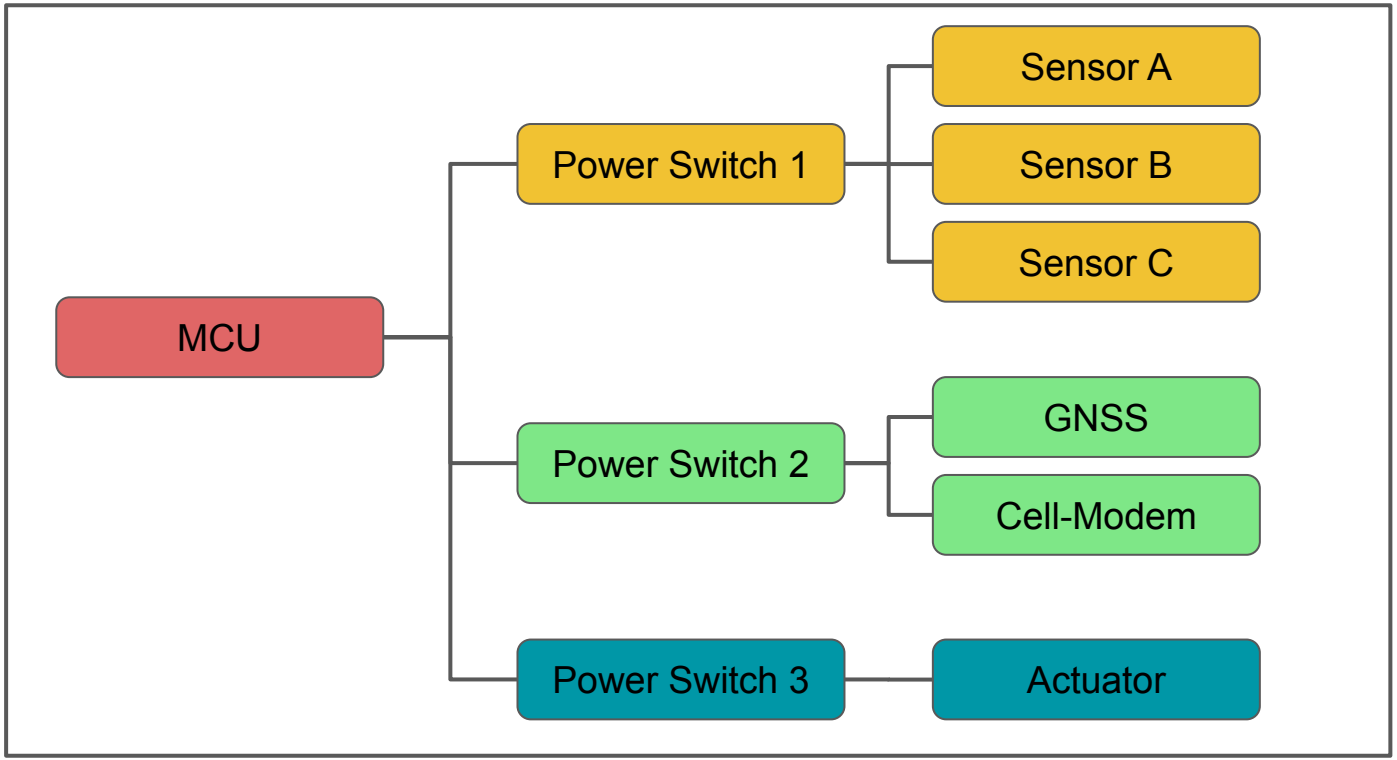
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Device Power-Domains



Device Power-Domains

Board device-tree

```
modem_dcdc: modem_dcdc {
        compatible = "power-domain-gpio";
        enable-gpios = <&gpio1 1 GPIO_ACTIVE_HIGH>;
        #power-domain-cells = <0>;
        startup-delay-us = <100000>;
        off-on-delay-us = <500000>;
};

...

&uart30 {
        modem: modem {
                compatible = "nordic,nrf93m1";
                power-domains = <&modem_dcdc>;
        };
};
```

Device-driver side

```
static int dev_pm_action(const struct device *dev,
                         enum pm_device_action action)
{
        switch (action) {
        case PM_DEVICE_ACTION_RESUME:
                /* Resume to measurement mode */
                return 0;
        case PM_DEVICE_ACTION_SUSPEND:
                /* Enter standby mode for low power */
                return 0;
        case PM_DEVICE_ACTION_TURN_ON:
                /* Power-on setup */
                return 0;
        case PM_DEVICE_ACTION_TURN_OFF:
                /* Prepare for shutdown */
                return 0;
        default:
                return -ENOTSUP;
        }
}
```

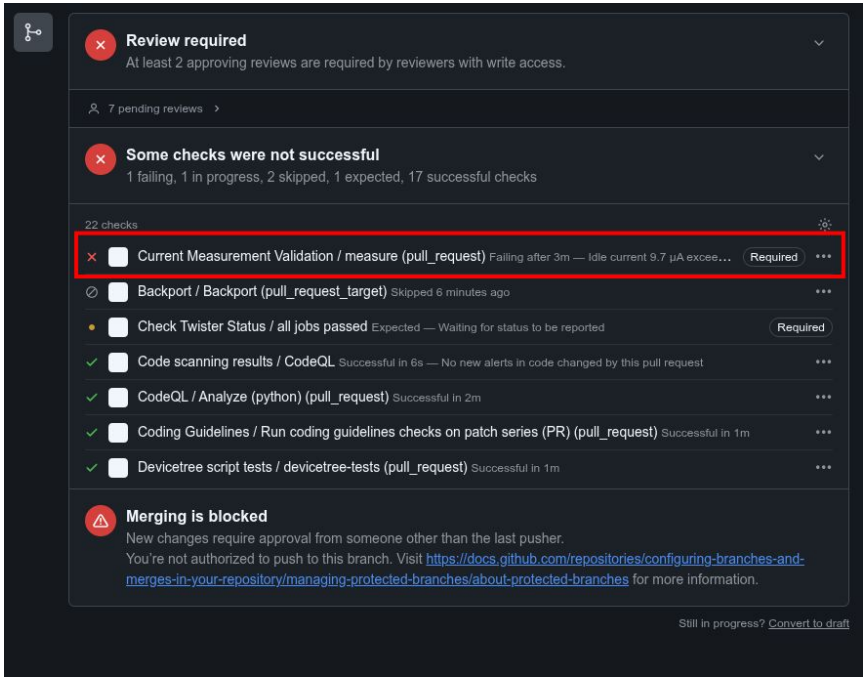
Power-Management Strategies

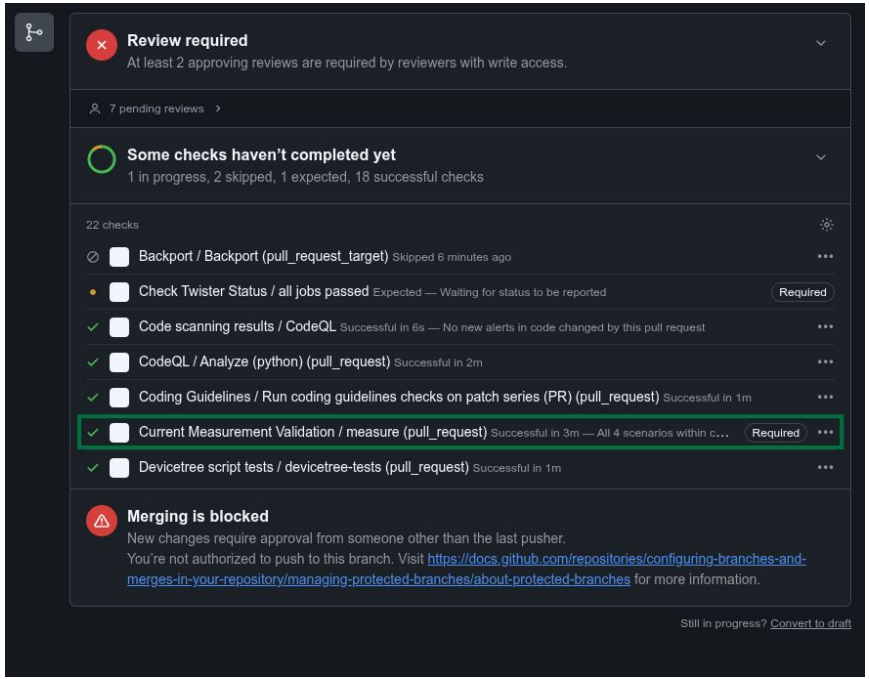
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4. Continued Measurements

Continued Measurements

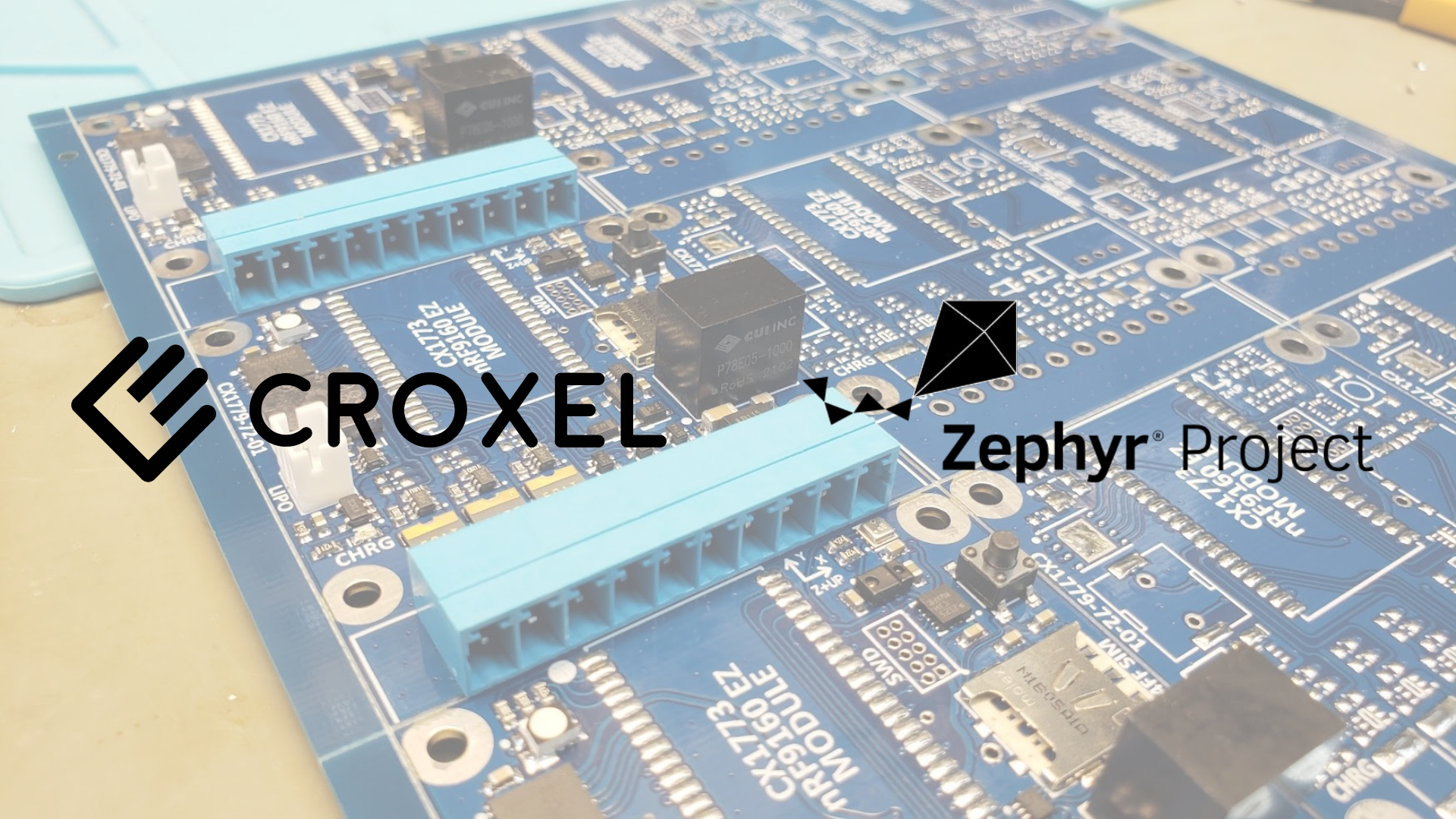




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4. Continued Measurements


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