

# AI03 MIC&VR&LED 仕様書

## 1 概要

MEMSマイク、ボリューム、LEDを搭載したリーフである。MEMSマイクとボリュームはアナログ入力ピン、LEDはデジタル出力ピンでMCUリーフと接続される。

低消費電力を実現するためI2C Expander を制御することによりLCDの電源をロードスイッチによりオフすることが可能である。

## 2 リーフ仕様

### 2.1 ブロック図

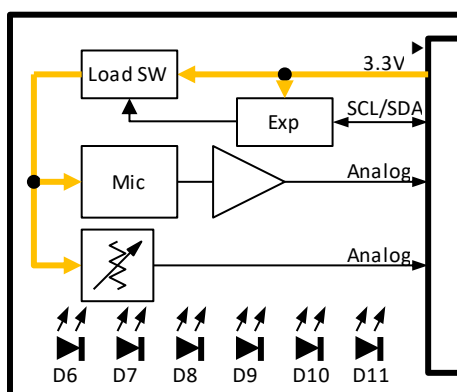


図 2.1 ブロック図

### 2.2 電源仕様

| Symbol | Parameter            | Condition | Min. | Typ.  | Max. |
|--------|----------------------|-----------|------|-------|------|
| Vdd    | Power Supply Voltage | —         | 2.7V | 3.3V  | 3.6V |
| Idd    | Operating current    | Active    | -    | 6.1mA | -    |
|        |                      | Sleep     | -    | 0.6uA | -    |

### 2.3 主要部品

| 部品番号      | 部品名          | 型番             | ベンダー名                   | 備考 |
|-----------|--------------|----------------|-------------------------|----|
| MK500     | マイク          | SPW2430HR5H-B  | Knowles                 | —  |
| VR500     | ボリューム        | ST-4ETA10kΩ    | Nidec Copal Electronics | —  |
| DS500-505 | LED          | SML-A12Y8TT86  | ROHM                    | —  |
| IC502     | I2C Expander | PCA9557RGVR    | Texas Instruments       | —  |
| IC503     | Load Switch  | XC8102AA01NR-G | TOREX                   | —  |

### 2.4 外観

| 表面 | 裏面 |
|----|----|
|    |    |

## 2.5 ピンアサイン

| Name | Function                              |
|------|---------------------------------------|
| A2   | マイク出力信号(アナログ) チップ抵抗の付け替えで A3 に設定可能。   |
| A3   | ボリューム出力信号(アナログ) チップ抵抗の付け替えで A0 に設定可能。 |
| D3   | LED 駆動 1                              |
| D4   | LED 駆動 2                              |
| D5   | LED 駆動 3                              |
| D6   | LED 駆動 4                              |
| D7   | LED 駆動 5                              |
| D8   | LED 駆動 6                              |
| SCL  | I2C 通信クロック                            |
| SDA  | I2C 通信データ                             |
| 3V3  | 3.3V 入力                               |
| GND  | GND                                   |

## 3 マイク(SPW2430HR5H-B)仕様

### 3.1 概要

| 項目              | 内容              |
|-----------------|-----------------|
| Type            | MEMS            |
| Direction       | Omnidirectional |
| Frequency Range | 100Hz ~ 10kHz   |
| Gain            | 0dB             |
| Interfaces      | Analog          |

### 3.2 電気的特性

#### 3.2.1 最大定格

| Parameter                 | Value           |
|---------------------------|-----------------|
| Operating Temperature     | -40°C to +100°C |
| Maximum Operation Voltage | 5.0V            |

#### 3.2.2 定格

| Symbol | Parameter                 | Condition                         | Min.       | Typ.       | Max.      |
|--------|---------------------------|-----------------------------------|------------|------------|-----------|
| Vdd    | supply voltage            | Internal Oscillator               | 1.5V       | -          | 3.6V      |
| Idd    | Supply Current            | Vdd=3.6V                          | -          | 75uA       | 110uA     |
| S      | Sensitivity               | 94 dB @ 1 kHz                     | -45 dBV/Pa | -42 dBV/Pa | -39dBV/Pa |
| SNR    | Signal to Noise Ratio     | 94 dB @ 1 kHz, A-weighted         | -          | 59dB(A)    | -         |
| THD    | Total Harmonic Distortion | 94 dB SPL @ 1kHz, S=Typ, Rload>2k | -          | 0.1%       | 0.2%      |
| -      | DC Output                 | Vdd=1.5V                          | -          | 0.66V      | -         |
| Zout   | Output Impedance          | @ 1 kHz                           | -          | -          | 450Ω      |

### 3.3 データシートリンク先

<https://www.knowles.com/subdepartment/dpt-microphones/subdpt-sisonic-surface-mount-mems>

ボリューム(ST-4ETA10kΩ)仕様

### 3.4 概要

| 項目                         | 内容             |
|----------------------------|----------------|
| Nominal resistance         | 10kΩ           |
| Resistance law             | Linear law (B) |
| Effective electrical angle | 210° (1 turn)  |

### 3.5 電気的特性

#### 最大定格

| Parameter                 | Value                                      |
|---------------------------|--|
| Operating Temperature     | -55°C to +125°C                            |
| Power ratings             | 0.25W (70°C) 0W (125°C)                    |
| Maximum Operation Voltage | 200V or power rating, whichever is smaller |

### 3.6 データシートリンク先

<https://www.nidec-copal-electronics.com/j/product/detail/00000171/>

## 4 LED(SML-A12Y8TT86)仕様

### 4.1 概要

| 項目             | 内容        |
|----------------|-----------|
| Package Type   | Side-view |
| Emitting color | Yellow    |

### 4.2 電気的特性

#### 4.2.1 最大定格

| Parameter             | Value             |
|-----------------------|-------------------|
| Operating Temperature | -40°C to +85°C    |
| Power Dissipation     | 54mW              |
| Forward Current       | 20mA              |
| Peak Forward Current  | 100mA (1/10,1kHz) |
| Reverse Voltage       | 5V                |

#### 4.2.2 定格

| Symbol         | Parameter           | Condition            | Min.  | Typ.  | Max.  |
|----------------|---------------------|----------------------|-------|-------|-------|
| V <sub>f</sub> | Forward Voltage     | I <sub>f</sub> =20mA | -     | 2.2V  | -     |
| I <sub>r</sub> | Reverse Current     | V <sub>r</sub> =5V   | -     | -     | 10uA  |
| λ <sub>d</sub> | Dominant Wavelength | I <sub>f</sub> =20mA | 586nm | 590nm | 594nm |
| I <sub>v</sub> | Luminous Intensity  | I <sub>f</sub> =20mA | 25mcd | 63mcd | -     |

### 4.3 データシートリンク先

<https://www.rohm.co.jp/products/led/chip-leds-mono-color-type/standard/sml-a12y8t-product>

## 5 I2C Expander (PCA9557RGVR)仕様

### 5.1 概要

| 項目         | 内容                     |
|------------|------------------------|
| Type       | Parallel Port Expander |
| GIO Port   | 8Port                  |
| IO         | 5V Tolerant            |
| Interfaces | I2C                    |

## 5.2 電気的特性

### 5.2.1 最大定格

| Parameter                 | Value          |
|---------------------------|----------------|
| Operating Temperature     | -40°C to +85°C |
| Maximum Operation Voltage | 6.0V           |

### 5.2.2 定格

| Symbol | Parameter      | Condition                | Min. | Typ.   | Max.  |
|--------|----------------|--------------------------|------|--------|-------|
| Vdd    | Supply Voltage | Internal Oscillator      | 2.3V | -      | 5.5V  |
| Idd    | Operating mode | 3.6V 100kHz              | -    | 1uA    | 4uA   |
|        | Standby mode   | 3.6V Vi=Vcc or GND, Io=0 | -    | 0.25uA | 0.9uA |

## 5.3 データシートリンク先

<http://www.tij.co.jp/product/jp/PCA9557/>

## 5.4 レジスタ

| Name             | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------------------|----|----|----|----|----|----|----|----|
| Control Register | 0  | 0  | 0  | 0  | 0  | 0  | B1 | B0 |

### Control Register Field Descriptions

| B1 | B0 | REGISTER           |
|----|----|--------------------|
| 0  | 0  | Input Port         |
| 0  | 1  | Output Port        |
| 1  | 0  | Polarity Inversion |
| 1  | 1  | Configuration      |

| Name       | Control | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------------|---------|----|----|----|----|----|----|----|----|
| Input Port | 00h     | I7 | I6 | I5 | I4 | I3 | I2 | I1 | I0 |

### Input Port Register Field Descriptions

| Field  | Description  |
|--------|--|
| I[7:0] | The input port register (register 0) reflects the incoming logic levels of the pins, regardless of whether the pin is defined as an input or an output by the configuration register. It only acts on read operation. Writes to these registers have no effect. The default value, X, is determined by the externally applied logic level.<br>Before a read operation, a write transmission is sent with the command byte to signal the I2C device that the input port register will be accessed next. |

| Name        | Pointer | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------|---------|----|----|----|----|----|----|----|----|
| Output Port | 01h     | O7 | O6 | O5 | O4 | O3 | O2 | O1 | O0 |

## Output Port Register Field Descriptions

| Field  | Description  |
|--------|--|
| O[7:0] | The output port register (register 1) shows the outgoing logic levels of the pins defined as outputs by the configuration register. Bit values in this register have no effect on pins defined as inputs. In turn, reads from this register reflect the value that is in the flip-flop controlling the output selection, not the actual pin value. |

| Name               | Pointer | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|--------------------|---------|----|----|----|----|----|----|----|----|
| Polarity Inversion | 02h     | N7 | N6 | N5 | N4 | N3 | N2 | N1 | N0 |

## Polarity Inversion Register Field Descriptions

| Field  | Description  |
|--------|--|
| N[3:0] | The polarity inversion register (register 2) allows polarity inversion of pins defined as inputs by the configuration register. If a bit in this register is set (written with 1), the corresponding port pin's polarity is inverted. If a bit in this register is cleared (written with a 0), the corresponding port pin's original polarity is retained. |

| Name          | Pointer | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---------------|---------|----|----|----|----|----|----|----|----|
| Configuration | 03h     | C7 | C6 | C5 | C4 | C3 | C2 | C1 | C0 |

## Configuration Register Field Descriptions

| Field  | Description   |
|--------|---|
| C[7:0] | The configuration register (register 3) configures the directions of the I/O pins. If a bit in this register is set to 1, the corresponding port pin is enabled as an input with high impedance output driver. If a bit in this register is cleared to 0, the corresponding port pin is enabled as an output. |

## 6 Load Switch(XC8102AA01NR-G)仕様

### 6.1 概要

| 項目   | 内容                          |
|------|-----------------------------|
| 保護回路 | 過電流保護回路とフォールドバック(フの字)回路を内蔵。 |

### 6.2 電気的特性

#### 6.2.1 最大定格

| Parameter                 | Value          |
|---------------------------|----------------|
| Operating Temperature     | -40°C to +85°C |
| Maximum Operation Voltage | 6.5V           |

#### 6.2.2 定格

| Symbol | Parameter      | Condition                     | Min.  | Typ.  | Max.   |
|--------|----------------|-------------------------------|-------|-------|--------|
| Vdd    | Supply Voltage | Internal Oscillator           | 1.2V  | -     | 6.0V   |
| Ron    | スイッチオン抵抗       | 2.9V                          | -     | 0.35Ω | 0.475Ω |
| Ilim   | 制限電流           | VIN ≥ 2.9V, VOUT = VIN - 0.8V | 400mA | 480mA | -      |

|        |                |                  |   |        |        |
|--------|----------------|------------------|---|--------|--------|
| Ishort | 短絡電流           | VCE=VIN, VOUT=0V | - | 30mA   | 75mA   |
| Idd    | Operating mode | 4.0V             | - | 3.8uA  | 6.5uA  |
|        | Standby mode   | 6V               | - | 0.01uA | 0.10uA |

### 6.3 データシートリンク先

<https://www.torex.co.jp/products/load-switches/series/?name=xc8102>

### 6.4 省電力制御

MIC&VR&LEDは、I2Cエクスパンダを制御してロードスイッチにより電源をオフできる回路を実装する。

## 7 変更履歴

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