Data Sheet


## Description

Avago Technologies' AMRX-1510 provides an integrated solution for scrolling, directional navigation and push button selection in a compact and ultra-slim package. With ease of use in mind, AMRX-1510 is ideal for scrolling of menus in new handheld electronic devices, such as in mobile phones, music players, cameras, and entertainment consoles. Based on Avago Technologies' reflective optical technology, the motion sensor is non-contact and ensures reliable operations. The five tactile switches provide directional navigation and center selection from a list of menu. The aesthetic design of the scroll wheel is customizable to different colors and design features. Please refer to factory for further details.

## Applications

- Handheld electronic devices
- Mobile devices
- Digital cameras and camcorders
- Entertainment consoles
- Handheld GPS or navigation devices
- Portable audio and video players
- Photo printers


## Features

- Ultra-slim package
- Less than 2 mm height profile
- Typical 18.5 mm diameter
- Integrated with four directional switches and a center push button
- Integrated with scroll wheel for scrolling operation
- Built-in illumination ring
- Two-Channel Quadrature Output
- 45 Cycles Per Revolution (CPR)
- 1.8V / 3.3V TTL/CMOS Logic Compatible Single-ended Output
- Single 2.4 V to 3.3 V supply
- Simple Power Down feature
- Easy assembly, no signal adjustment required
- Connectivity through 15 -way 0.5 mm pitch FPC
- Customizable aesthetic design
- RoHS compliant

WARNING: These devices are Electrostatic Discharge (ESD) sensitive. The following precautions are strongly recommended. Ensure that an ESD approved carrier is used when units are transported from one destination to another. Personal grounding is to be worn at all times when handling these devices. Failure to observe proper ESD handling precautions will void all warranties. Refer to Avago Application Note A004R: Electrostatic Discharge Damage and Control.

| Part Number | Resolution (CPR) | Operating Temperature $\left({ }^{\circ} \mathrm{C}\right)$ | Output <br> Communication | Exterior Options | DC Supply <br> Voltage (V) |
| :---: | :---: | :---: | :---: | :---: | :---: |
| AMRX-1510-1BWA | 45 | -25 to +85 | 1.8 V CH A \& B | Dial: VM Chrome Finish; <br> Push Button: Matt Black; <br> LED : White; <br> Connectivity: FPC 15 -way 0.5 mm pitch | +2.4 to +3.3 |
| AMRX-1510-1AWB | 45 | -15 to +70 | 1.8 V CH A \& B | Dial: Black SF Rubber; <br> Push Button: High Gloss Black; <br> LED :White; <br> Connectivity: FPC 15 -way 0.5 mm pitch | +2.4 to +3.3 |
| AMRX-1510-1AWC | 45 | -25 to +85 | 1.8 V CH A \& B | Dial: High Gloss Black; <br> Push Button: High Gloss Black; <br> LED:White; <br> Connectivity: FPC 15 -way 0.5 mm pitch | +2.4 to +3.3 |
| AMRX-1510-1BBA | 45 | -25 to +85 | 1.8 V CH A \& B | Dial: VM Chrome Finish; <br> Push Button: Matt Black; <br> LED : Blue; <br> Connectivity: FPC 15 -way 0.5 mm pitch | +2.4 to +3.3 |
| AMRX-1510-1ABB | 45 | -15 to +70 | 1.8 V CH A \& B | Dial: Black SF Rubber; <br> Push Button: High Gloss Black; <br> LED : Blue; <br> Connectivity: FPC 15-way 0.5 mm pitch | +2.4 to +3.3 |
| AMRX-1510-1ABC | 45 | -25 to +85 | 1.8 V CH A \& B | Dial: High Gloss Black; <br> Push Button: High Gloss Black; <br> LED : Blue; <br> Connectivity: FPC 15 -way 0.5 mm pitch | +2.4 to +3.3 |
| AMRX-1510-2BWA | 45 | -25 to +85 | 3.3 VCHA \& B | Dial: VM Chrome Finish; <br> Push Button: Matt Black; <br> LED : White <br> Connectivity: FPC 15 -way 0.5 mm pitch | +2.4 to +3.3 |
| AMRX-1510-2AWB | 45 | -15 to +70 | 3.3 VCHA \& B | Dial: Black SF Rubber; <br> Push Button: High Gloss Black; <br> LED:White; <br> Connectivity: FPC 15 -way 0.5 mm pitch | +2.4 to +3.3 |
| AMRX-1510-2AWC | 45 | -25 to +85 | 3.3 VCHA \& B | Dial: High Gloss Black; <br> Push Button: High Gloss Black; <br> LED:White; <br> Connectivity: FPC 15-way 0.5 mm pitch | +2.4 to +3.3 |
| AMRX-1510-2BBA | 45 | -25 to +85 | 3.3 VCHA \& B | Dial: VM Chrome Finish; <br> Push Button: Matt Black; <br> LED : Blue; <br> Connectivity: FPC 15-way 0.5 mm pitch | +2.4 to +3.3 |
| AMRX-1510-2ABB | 45 | -15 to +70 | 3.3 VCHA \& B | Dial: Black SF Rubber; <br> Push Button: High Gloss Black; <br> LED : Blue; <br> Connectivity: FPC 15-way 0.5 mm pitch | +2.4 to +3.3 |
| AMRX-1510-2ABC | 45 | -25 to +85 | 3.3 VCHA \& B | Dial: High Gloss Black; <br> Push Button: High Gloss Black; <br> LED : Blue; <br> Connectivity: FPC 15-way 0.5 mm pitch | +2.4 to +3.3 |

## Notes:

1. For different product options, customized products and technical documents, please contact factory at mido.trsc@avagotech.com

FPC connection is compatible with bottom contact type FPC ZIF connector:
3. Recommended ZIF connector : MOLEX 52893-1595 ( 2 mm height), KYOCERA 6239-015 (1.5mm height), 6238-015 (1.1 mm height) \& etc
4. The ESD rating is subjected to the dial finishing option (refer to Table 2).

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Table 1. Absolute Maximum Ratings ${ }^{[1,2]}$

| Parameter | Symbol | Limits | Units/Standard |
| :--- | :--- | :--- | :--- |
| DC Supply Voltage | $\mathrm{V}_{C C}$ | 1.8 to +4.5 | V |
| Output Voltage | $\mathrm{V}_{0}$ | 1.5 to +4.0 | V |
| PDN Input Voltage | $\mathrm{V}_{\text {Pup }}$ | +1.2 to $+\mathrm{V}_{C C}$ | V |
| Operating temperature ${ }^{[3]}$ | $\mathrm{T}_{\text {op }}$ | -25 to 85 | ${ }^{\circ} \mathrm{C}$ |
| Storage Temperature | $\mathrm{T}_{\text {stg }}$ | -40 to 85 | ${ }^{\circ} \mathrm{C}$ |

## Notes:

1. Stresses greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is stress rating only, and functional operation of the device at these or at any other conditions above than those indicated in the operational sections of this specification is not implied.
2. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
3. Operating temperature range is subjected to customized finishing or coating.

Table 2. ESD Ratings ${ }^{[1]}$

|  | Dial Finishing |  |
| :--- | :--- | :--- |
|  | Option A (VM Chrome) | Option B (Black SF Rubber) \& C (High Gloss Black) |
| Air Discharge | $\mathbf{2 k V}$ | 5 kV |
| Contact Discharge | 2 kV | 4 kV |

Note:

1. Based on IEC-61000-4-2.

Table 3. Recommended Operating Condition

| Parameter | Symbol | Condition | Values |  |  | Units | Notes |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Min | Typ. | Max |  |  |
| Ambient Temperature | Tamb |  | -25 | 25 | 85 | ${ }^{\circ} \mathrm{C}$ | 1 |
| DC Supply Voltage | $V_{\text {cC }}$ |  | +2.4 |  | +3.3 | V | 2 |
| PDN Minimum Voltage for Logic HIGH | $V_{\text {PDN_IH }}(\mathrm{min})$ |  | +1.2 |  | $V_{\text {cC }}$ | V | 3 |
| PDN Maximum Voltage for Logic LOW | $V_{\text {PDN_IL }}(\max )$ |  |  |  | 0.4 | V | 3 |
| Count Frequency |  |  |  | 112.5 | 8k | Hz | (Velocity (rpm) xN )/60, 4 |
| Rotary Dial Speed | SRPM |  |  |  | 150 | rpm | 4 |

## Notes

1. Except for Black SF Rubber coating options.
2. LED forward voltage, $\mathrm{V}_{\mathrm{F}}=2.8 \mathrm{~V}$ typical.
3. Set PDN input pin to logic HIGH for normal operation and logic LOW to power down the device.
4. Typical value is referred to mechanically permissible speed, while maximum value is referred to electrically permissible speed.

## Table 4. Electrical Characteristics

Electrical Characteristics over Recommended Operating Range, typical at $25^{\circ} \mathrm{C}$

| Parameter | Symbol | Condition | Values |  |  | Units | Notes |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Min | Typ. | Max |  |  |
| VCC Supply Current | ICC |  |  | 7 | 10 | mA | 1 |
|  |  |  |  | 30 |  | mA | 2 |
| Power Down Current Consumption | IPDN |  |  |  | 4 | $\mu \mathrm{A}$ |  |
| Power Down State Output Leakage Current | $\mathrm{l}_{02}$ |  |  | <0.01 |  | $\mu \mathrm{A}$ |  |
| Output High Voltage | $\mathrm{V}_{\mathrm{OH}}$ | $\mathrm{I}_{\text {OH }}=-230 \mu \mathrm{~A}$ | 1.5 |  | 2.9 | V | 3 |
|  |  |  | 2.4 |  | 3.3 | V | 4 |
| Output Low Voltage | $\mathrm{V}_{01}$ | $\mathrm{I}_{0 \mathrm{~L}}=2.4 \mathrm{~mA}$ |  |  | 0.2 | V |  |
|  |  | $\mathrm{l}_{0 \mathrm{~L}}=8 \mathrm{~mA}$ |  |  | 0.4 | V |  |
| PDN Turn On Delay | $t_{\text {D_PDN_ON }}$ |  |  |  | 1500 | ns |  |
| PDN Turn Off Delay | tD_PDN_OFF |  |  |  | 150 | ns |  |
| Quadrature Outputs Rise Time | $\mathrm{tr}_{\mathrm{r}}$ |  |  | 500 |  | ns | 5 |
| Quadrature Outputs Fall Time | $\mathrm{tf}_{\mathrm{f}}$ |  |  | 250 |  | ns | 5 |
| 5-way Switch Contact Resistance |  | At 3VDC, 1mA |  |  | 300 | $\mathrm{m} \Omega$ |  |
| Insulation Resistance for 5-way Switch and Rotary Dial |  | DC100V 1 min between terminals | 110 |  |  | $\mathrm{M} \Omega$ |  |
|  |  | DC100V 1 min between <br> Rotary Dial and terminals | 110 |  |  | $\mathrm{M} \Omega$ |  |
|  |  | DC 500V 1 min between terminals | 550 |  |  | $\mathrm{M} \Omega$ |  |
|  |  | DC 500V 1 min between Rotary Dial and terminals | 550 |  |  | $\mathrm{M} \Omega$ |  |
| Withstand Voltage for 5-way Switch and Rotary Dial |  | AC120V for 1 sec between Rotary Dial and terminals |  |  | 1 | mA | No spark; No Trip Current |
|  |  | AC120V for 1 sec between terminals |  |  | 1 | mA | No spark; No Trip Current |
|  |  | AC500V for 1 sec between Rotary Dial and terminals |  |  | 10 | mA | No spark; <br> No Trip Current |
|  |  | AC500V for 1 sec between terminals |  |  | 10 | mA | No spark; No Trip Current |

Notes:

1. Without illumination LED.
2. With illumination LED.
3. Refer to I/O Voltage Option 1 (on page 7).
4. Refer to I/O Voltage Option 2 (on page 7).
5. $\mathrm{At} \mathrm{C}_{\mathrm{L}}=33 \mathrm{pF}$.

## Table 5. Mechanical Characteristics

Mechanical Characteristics over Recommended Operating Range, typical at $25^{\circ} \mathrm{C}$

| Parameter | Symbol | Condition | Values |  |  | Units |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Min | Typ. | Max |  |
| Rotational Life | RLIFE | Rotational Speed= $=100 \mathrm{RPM}$ |  | $2 \times 10^{5}$ |  | cycles |
| Switch Click Life | Clife | Push Location = on cover top, at switch location <br> Push Force $=200 \mathrm{gf}$ |  | $5 \times 10^{5}$ |  | times |
| Permissible Rotational Angle | $\theta$ A |  |  | 360 |  | $\mathrm{m}^{\circ}$ |
| 5 -way switch button |  |  |  |  |  |  |
| -Stroke |  |  |  | 0.19 |  | mm |
| -Operation force |  |  |  | 200 |  | gf |
| Overall Mass | MovR |  |  | 0.002 |  | kg |

## Table 6. Encoding Characteristics

Encoding Characteristics over Recommended Operating Range, typical at $25^{\circ} \mathrm{C}$. The typical values are average over the full rotation.

|  |  |  | Values |  |  |  |
| :--- | :--- | :---: | :---: | :---: | :---: | :--- |
| Parameter | Symbol | Condition | Min | Typ. | Max | Units |
| Output Resolution | N |  |  | 45 |  | CPR |
| Pulse width Error | $\Delta P$ |  |  |  | $\pm 50$ | ${ }^{\circ} \mathrm{e}$ |
| Logic State Width Error | $\Delta S$ |  |  |  | $\pm 50$ | ${ }^{\circ} \mathrm{e}$ |
| Phase Error |  |  |  |  | $\pm 15$ | ${ }^{\circ} \mathrm{e}$ |

## Functional Block Diagram



Notes:

1. R1 is the current-limiting resistor for LEDs.

Figure 1. Functional Block Diagram

## Scroll Wheel Output Waveform



Notes:

1. $\mathrm{CH} A=$ Channel $\mathrm{A} ; \mathrm{CH} B=$ Channel $; \mathrm{T}=$ electrical cycle; $\mathrm{P}=$ pulse width $; \phi=$ phase.

Figure 2. Output Waveform

## Package Dimensions



Notes:

1. 3rd Angle Projection.
2. Unless otherwise specified, all dimensions are in mm.
3. Compatible with SMT ZIF bottom contact type FFC/FPC connectors for connectivity.

Figure 3. Package Dimensions

## Electrical Connections

| Pin | Symbol | Description |
| :--- | :--- | :--- |
| 1 | VLED | LED Anode |
| 2 | PDN | Power Down Control. LOW: Activate Power Down |
| 3 | S1 | Connect to Switch 1 (S1) |
| 4 | S2 | Connect to Switch 2 (S2) |
| 5 | S5 | Connect to Switch 5 (S5) |
| 6 | GND_SW | Common Ground for S1,S2,S3,S4,S5 |
| 7 | S4 | Connect to Switch 4 (S4) |
| 8 | S3 | Connect to Switch 3 (S3) |
| 9 | GND | Supply Ground |
| 10 | VCC | Supply Voltage |
| 11 | CH A | Channel A |
| 12 | CH B | Channel B |
| 13 | NC | Not Connected |
| 14 | NC | Not Connected |
| 15 | NC | Not Connected |

## Ordering Information



