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AND9112/D

BELASIGNA® R262 Prototyping Module User's Guide

The BelaSigna R262 prototyping module is a miniature, self−contained unit that can be integrated into a product or prototype to evaluate the performance of BelaSigna R262 "in−form−factor".

Key Features

The module is shown in Figure 1 and features:
- A miniature size of only 22 mm by 6 mm
- The 30−ball WLCSP version of BelaSigna R262 (BR262W30A103E1G)

- Two MEMS microphones spaced 10 mm apart (Knowles part number SPU0410HR5H−PB)
- Through−hole test points for external connections
- Configured to boot directly to the ROM application using the internal clock
- I^{2}C and GPIO signals available on test points
- An onboard I^{2}C EEPROM for optional custom application
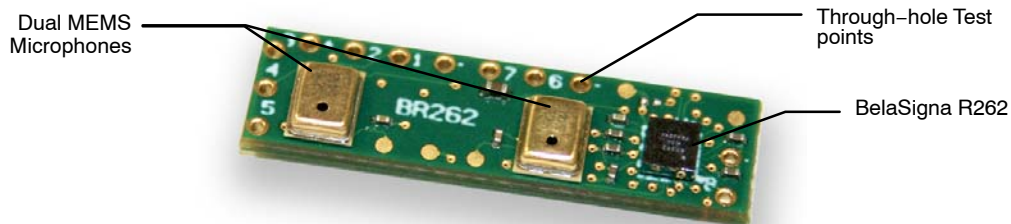
Figure 1. BelaSigna R262 Prototyping Module

Default Configuration

The prototyping module configures BelaSigna R262 to run off its internal oscillator and to boot directly into the ROM−based noise reduction algorithm. The module is pre−configured to simultaneously output two different algorithm turnings: a pure close−talk output on AO0, and an output that is close−talk mixed 60% towards far−talk on AO1. All that is required is to supply the module with 1.8 to 3.3 VDC (requires approximately 20 mA), and to connect the analog outputs to your in−form−factor design. Power is connected to VBAT (+) and GND (−). The prototyping module configures the ROM application as summarized in Table 1 when power is applied.

A description of all test points and a complete schematic and layout is available in Appendix A.

Table 1. BelaSigna R262 PROTOTYPING MODULE LSAD CONFIGURATION

Pin Name	Preset	Description
CLOCK_SEL (SPI_CLK/GPIO0)	7	Internal clock
BOOT_SEL (SPI_CS/GPIO1)	4	Active mode Talk distance selectable between close−talk and far−talk (5 cm − 500 cm)
CHAN_SEL (SPI_SERO/GPIO2)	3	Dual output noise reduction (two single−ended analog outputs) Channel 0 as per BOOT_SEL "Start of Range" (close−talk) Channel 1 as per BOOT_SEL and ALPHA_SEL
ALPHA_SEL (SPI_SERI/GPIO3)	4	Mixer set 60% between start and end of range

Connecting the Prototyping Module

The analog output signals are available on AO0 (6), AO1 (7), and GNDA (−). An optional momentary push−button control can be connected between GP5 (5) and GNDD (−) that can be used to swap the two processed outputs between AO0 and AO1. The pinout for the module, along with typical connections are illustrated in Figure 2. The analog outputs of the device can be connected to your system's analog inputs as single−ended signals using AO0 and GNDA and/or AO1 and GNDA. If the module is re−configured to output a mono, differential analog output by changing the CHAN_SEL resistors R4 and R5, via I^{2}C commands, or by loading a custom application, you can connect AO0 and AO1 to your system as a differential analog signal.

Note: The analog output impedance is 3 kΩ and is intended to drive a high−impedance (line−level) input, not speakers nor headphones directly. Refer to the BelaSigna R262 datasheet for more information on output stage characteristics.

You can also use the prototyping module as a digital microphone replacement outputting a stereo DMIC signal on test point GP4 (4), provided you supply an appropriate DMIC clock signal on the CLK (8) test point and re−configure the module's CLOCK_SEL resistive divider to match the provided clock frequency. Refer to the BelaSigna R262 datasheet for more information.
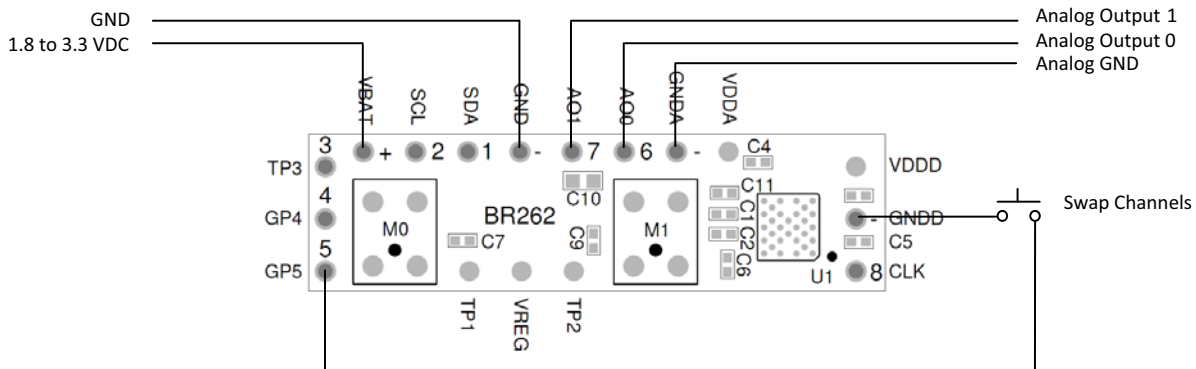

Figure 2. BelaSigna R262 Prototyping Module Typical Connections

Operating the Prototyping Module

The default configuration of the prototyping module provides the widest noise reduction adjustment range (close−talk to far−talk) by selecting preset 4 on the BOOT_SEL input, and is pre−configured to simultaneously output two different algorithm tunings: a pure close−talk output on AO0, and an output that is close−talk mixed 60% towards far−talk on AO1. The processed outputs from these two algorithm tunings are available as single−ended analog outputs on AO0 − GNDA, and AO1 − GNDA. The application will swap the output channels when GP5 is momentarily pulled low. If a momentary push−button is connected between GP5 and GNDD, pressing and releasing this button will swap the two processed outputs between AO0 and AO1.

Close−Talk

Close−talk mode aggressively filters noise and manages gain to pick up speech within 5 to 10 cm from the microphone array, effectively attenuating both speech and noise that is farther away. This mode is suitable for mobile handsets and radios where the speech source is very close to the microphones and the noise level can be quite high; up to 90 dB SPL. Noise reduction performance in this mode ranges from 20 to 30 dB SNR improvement (SNR−I), depending on the type of noise.

Close−Talk Mixed 60% Towards Far−Talk

The second, mixed mode of close−talk mixed 60% towards far−talk is similar to the core near−talk mode and features excellent noise reduction in applications where the speech source is located slightly further away from the microphones; typically 50 to 100 cm. This mode is suitable for handsfree devices and performs well in noise levels up to 70 dB SPL. Expected noise reduction performance in this mode is 10 to 20 dB SNR−I, depending on the type of noise.

Refer to the AND9109/D − BelaSigna R262 Getting Started Guide for details on the different algorithm modes and performance metrics.

Module Positioning

The speech source can come from any direction (normally in front of the microphones), as long as it is within the "working sphere" of the current algorithm mode. For close−talk mode, the mouth reference point (MRP) should be located between 5 and 10 cm from the microphones.

For close−talk mixed 60% towards far−talk, the MRP should be located between 50 and 100 cm from the microphones.

Acoustic Design

If the prototyping module is replacing an existing microphone, the old microphone should be removed and the module should be mounted as close as possible to the original microphone location.

The device casing should be modified or manufactured such that there is an appropriate acoustic path to the two microphones on the module. Two holes roughly 0.5 to 1 mm in diameter should be drilled in the casing 10 mm apart above the sound ports of the onboard microphones. If possible a rubber or foam isolation gasket should be installed between the microphones and the device casing.

Electrical Considerations

The analog output(s) of the module can be connected directly to any existing microphone input but keep in mind that it may be necessary to lower any existing microphone pre−amplification.

Care should be taken to properly shield the module and the analog outputs if your product involves radio frequencies. Use coaxial or shielded cable when connecting the analog outputs of the module, and if necessary, wrap the module with foil tape.

Customizing the Prototyping Module

If you would prefer to have the default tunings to be something other than close−talk and close−talk mixed 60% towards far−talk, you can change the values of the resistive dividers on the BOOT_SEL (R3 and R4) and ALPHA_SEL (R7 and R8) inputs. A component placement diagram showing the locations of the various resistors is illustrated in Figure 3. Refer to the BelaSigna R262 datasheet for more information on BOOT_SEL and ALPHA_SEL inputs, and the resistive divider values required to achieve specific presets.

If you would like to re−configure the module to use the DMIC interface, you must supply an appropriate DMIC clock signal on the CLK test point and re−configure the module's CLOCK_SEL resistive divider (R1 and R2) to match the provided clock frequency. A stereo DMIC signal will be output on test point GP4. Refer to the BelaSigna R262 datasheet for more information on the supported DMIC clock frequencies, and the resistive divider values required to select them.

If you would like to re−configure the module to output a differential analog signal, you must adjust the resistive dividers on the CHAN_SEL input (R5 and R6) to select preset 0 or preset 5. Refer to the BelaSigna R262 datasheet for more information on the CHAN_SEL input and the resistive divider values required to achieve specific presets.

If you would like to re−configure the module to load a custom application from the EEPROM, you must load a valid custom application onto the EEPROM and remove resistor R4 to have the module boot from EEPROM. Refer to the BelaSigna R262 datasheet for more information on the BOOT_SEL input and the resistive divider values required to achieve specific presets. Contact your local ON Semiconductor support representative for more information about custom applications.

APPENDIX A

For your convenience, the prototyping module has many test points. Signals that are intended to be interfaced to external devices are provided on through−hole test points. All of the available test points are summarized in Table 2.

Table 2. BelaSigna R262 PROTOTYPING MODULE TEST POINT DESCRIPTIONS

Test Point Name	Designator	Description
VBAT	+	Main module power supply (1.8 to 3.3 VDC, 20 mA)
SCL	2	I2C clock
SDA	1	I2C data
GND	–	Main module ground
AO1	7	Channel 1 analog output
AO0	6	Channel 0 analog output
GNDA	–	Analog ground (internally connected to GND)
VDDA		Internal 2.0 V power supply
VDDD		Digital power supply (internally generated)
GNDD	–	Digital ground (internally connected to GND)
CLK	8	Optional input clock
TP2		Microphone 1 test point
VREG		Internal 1.0 V power supply
TP1		Microphone 0 test point
GP5	5	Optional GPIO input (SWAP_CHAN)
GP4	4	Optional DMIC output
TP3	3	Reset
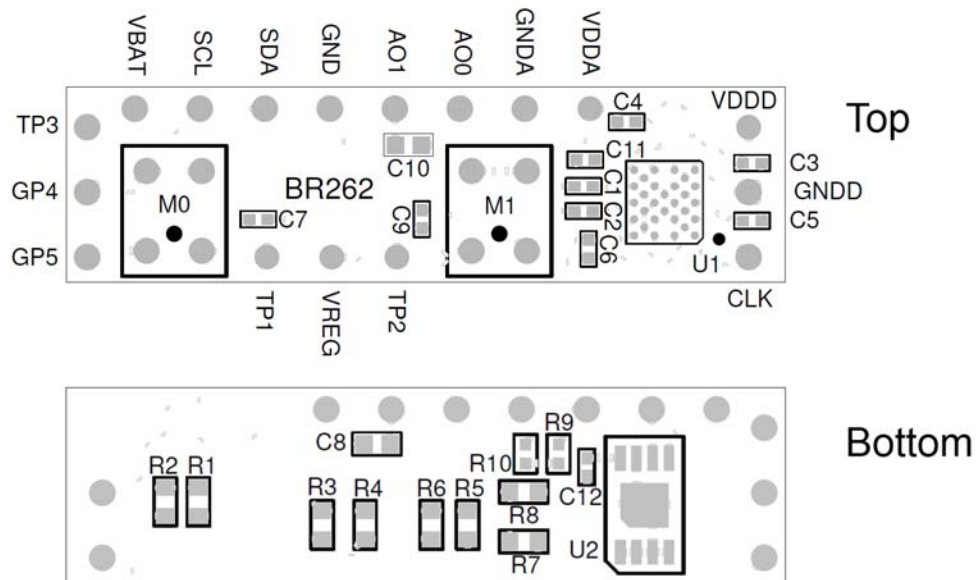
Figure 3. Component Placement Diagram
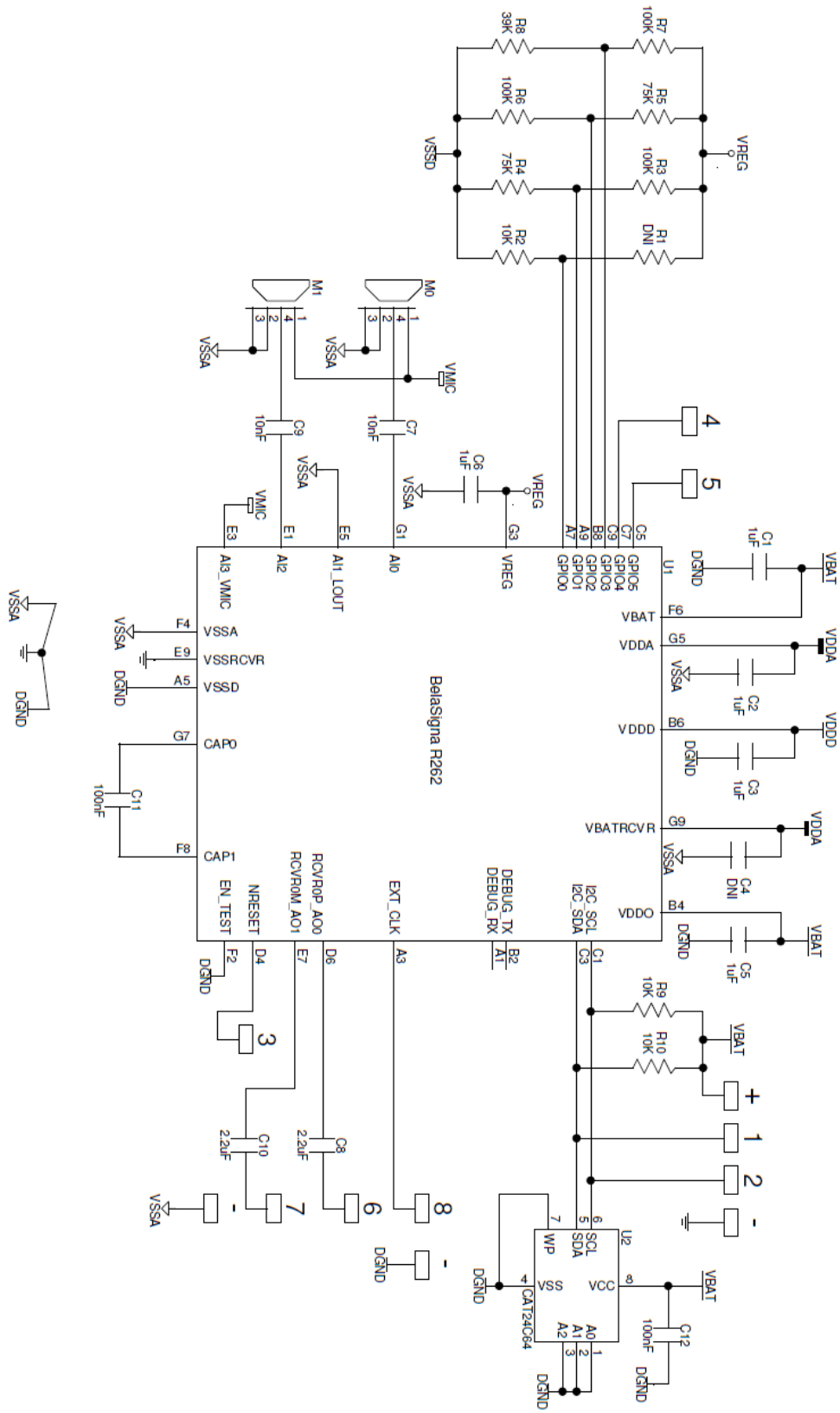
Figure 4. BelaSigna R262 Prototyping Module Schematic
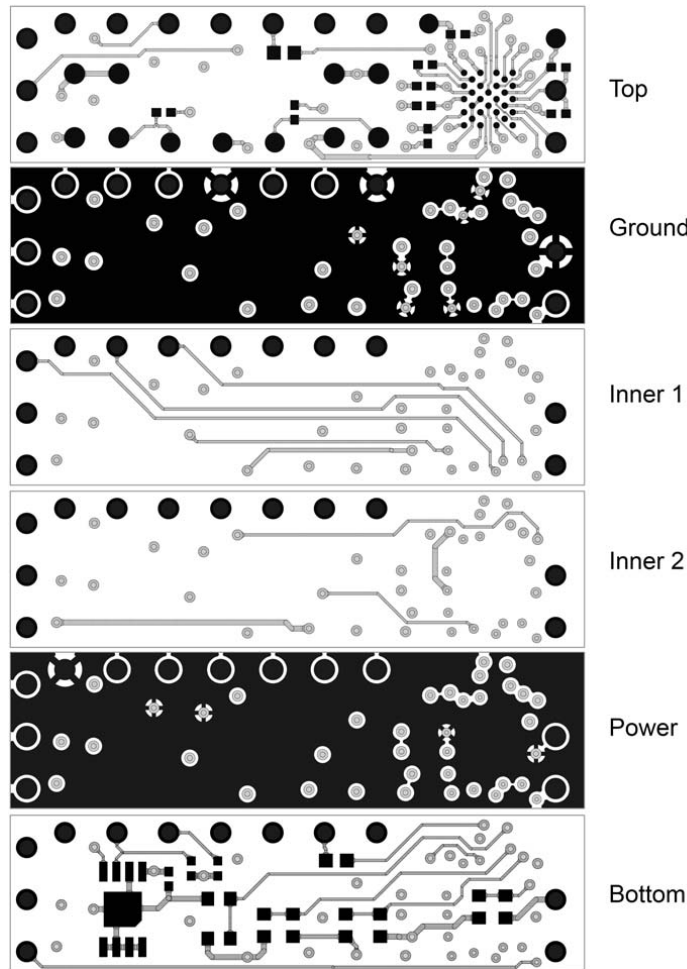
Figure 5. BelaSigna R262 Prototyping Module Layout
(view from top to bottom)

Company or Product Inquiries

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