WM2002

Stereo Headphone Driver with Wolfson myZone™ Ambient Noise Cancellation

DESCRIPTION

The WM2002 is a low power, high quality stereo headphone driver, delivering Wolfson's patented myZone™ ambient noise cancellation in a single-ended or BTL (bridge-tied-load) output configuration. The WM2002 supports analogue playback or voice input, and analogue or digital microphone inputs for noise-monitoring microphones.

Designed for embedded applications or incorporated within a stand-alone headset or headphone, the Wolfson myZone™ ANC noise cancellation engine performs ambient noise cancellation during a voice call or during music playback.

The ambient noise input is supported via single-ended or differential analogue microphone interfaces; digital microphone input is also supported. Up to 10 noise input microphones can be supported at once.

The WM2002 provides integrated power management, comprising a DC-DC converter, Charge Pump and LDO Regulators. Many different power supply configurations are thus supported. The entire device can be powered from a single cell AAA battery, or from 2xAAA cells, or from an external regulated supply.

System clocking is achieved using an on-chip oscillator. An external clock can be connected directly, if available.

The WM2002 is configured using programmable settings stored in an integrated non-volatile memory. The configuration stored in the OTP memory is enabled automatically at start-up. If required, the WM2002 can also be configured using register control accessed using a 2-wire serial control interface.

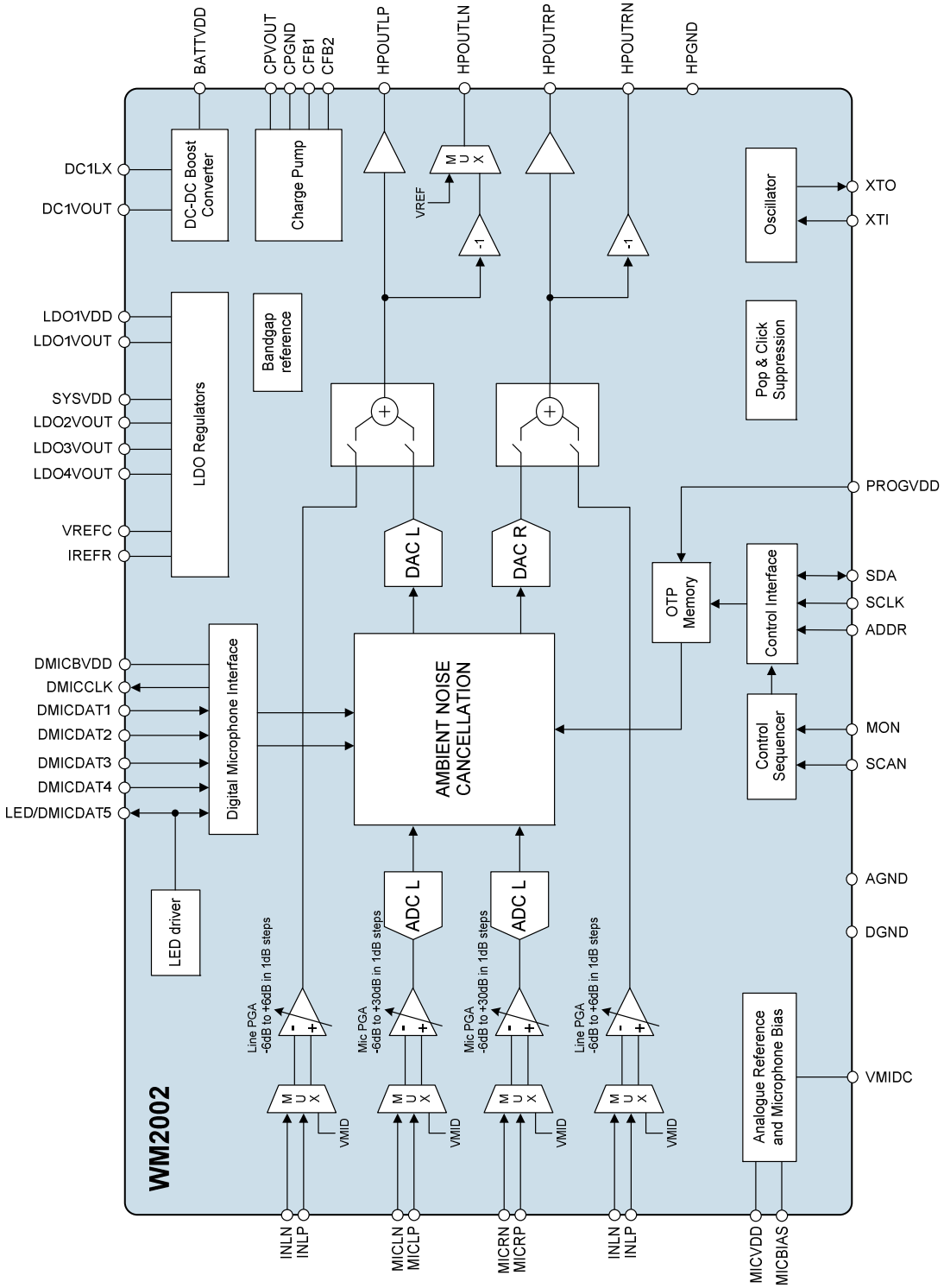
FEATURES

- Wolfson myZone™ Ambient Noise Cancellation (ANC)
  - >30dB (peak), 25dB (typical) ambient noise reduction*
  - Wide noise cancellation bandwidth (40Hz to 4kHz)*
  - * depending on acoustic configuration
  - Multiple banks of ANC coefficients can be programmed to support different operating conditions
- Audio inputs
  - Up to 10 analogue or digital microphones
  - Single-ended or differential analogue microphone input
  - 2 single-ended or 1 differential line input per channel
- Headphone driver (LDO4VOUT = 1.8V)
  - 45mW per channel into 16Ω load
  - 22mW per channel into 32Ω load
  - Single-ended or differential (BTL) drive configuration
  - -80dB THD+N for differential (BTL) drive
- Integration
  - On-chip DC-DC boost converter, charge-pump and LDOs
  - Flexible power supply options, including single cell battery (1 x AAA battery) or (2 x AAA/AAAA)
  - Internal crystal oscillator
- Miscellaneous
  - Monitor pin to select mute / talk-through modes
  - LED driver
  - Tone generator for audible status indication
  - Pop and click noise protection circuit
  - RFI suppression
  - 48-pin QFN package (7 x 7 x 0.75mm, 0.5mm pitch)

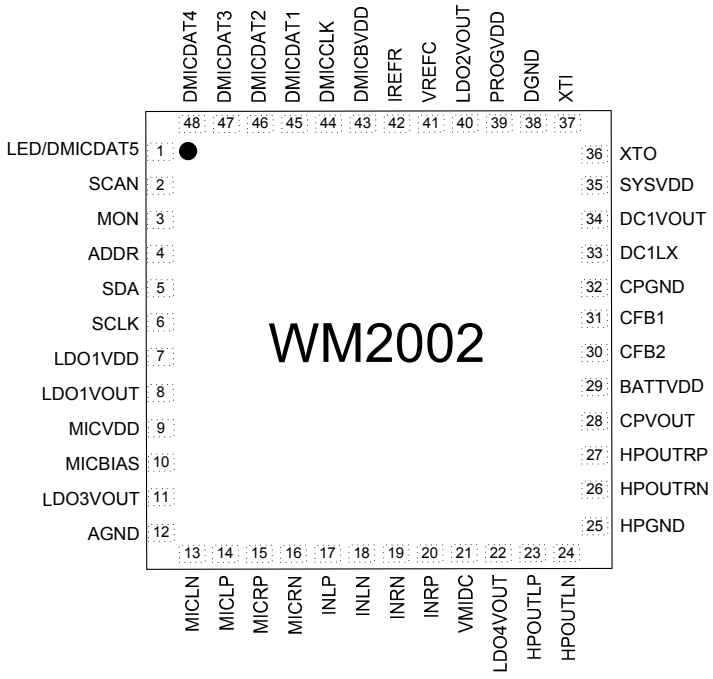
APPLICATIONS

- "Pod-style" stereo ear-buds, headsets, headphones with ANC
- "Supra-Aural" stereo headphones with ANC
- Mono/Stereo Bluetooth headsets with ANC

BLOCK DIAGRAM



PIN CONFIGURATION



ORDERING INFORMATION

DEVICE	TEMPERATURE RANGE	PACKAGE	MOISTURE SENSITIVITY LEVEL	PEAK SOLDERING TEMPERATURE
WM2002GEFL/V	-40°C to +85°C	48-pin QFN (Pb-free)	MSL3	260°C
WM2002GEFL/RV	-40°C to +85°C	48-pin QFN (Pb-free, tape and reel)	MSL3	260°C

Note:

Reel quantity = 2,200

PIN DESCRIPTION

PIN	NAME	TYPE	DESCRIPTION
1	LED/ DMICDAT5	Analogue Output / Digital Input	Status LED output / LED Digital microphone data pin 5
2	SCAN	Digital Input	Digital control input (test functions) - normally tied to DGND
3	MON	Digital Input	Digital control input (changes ANC filter characteristics, selects mute or talk-through mode)
4	ADDR	Digital Input	Control interface address select
5	SDA	Digital Input/Output	Control interface data input / output
6	SCLK	Digital Input	Control interface clock input
7	LDO1VDD	Supply	LDO1 supply input
8	LDO1VOUT	Analogue Output / Supply	LDO1 output / Digital core supply
9	MICVDD	Supply	MICBIAS supply input
10	MICBIAS	Analogue Output	Bias supply for external microphones
11	LDO3VOUT	Analogue Output / Supply	LDO3 output / Analogue supply
12	AGND	Supply	Analogue supplies ground
13	MICLN	Analogue Input	Left channel inverting analogue noise cancelling mic input
14	MICLP	Analogue Input	Left channel non-inverting analogue noise cancelling mic input
15	MICRP	Analogue Input	Right channel non-inverting analogue noise cancelling mic input
16	MICRN	Analogue Input	Right channel inverting analogue noise cancelling mic input
17	INLP	Analogue Input	Left channel non-inverting differential line input (must be AC-coupled for single-ended operation)
18	INLN	Analogue Input	Left channel inverting differential line input (can be grounded for single-ended operation)
19	INRN	Analogue Input	Right channel inverting differential line input (can be grounded for single-ended operation)
20	INRP	Analogue Input	Right channel non-inverting differential line input (must be AC-coupled for single-ended operation)
21	VMIDC	Analogue I/O	Midrail voltage capacitor connection point
22	LDO4VOUT	Analogue Output / Supply	LDO4 output / Headphone driver supply
23	HPOUTLP	Analogue Output	Left headphone non-inverting output
24	HPOUTLN	Analogue Output	Left headphone inverting output
25	HPGND	Supply	Headphone driver ground
26	HPOUTRN	Analogue Output	Right headphone inverting output
27	HPOUTRP	Analogue Output	Right headphone non-inverting output
28	CPVOUT	Analogue Output	Charge pump output
29	BATTVDD	Supply	DC1 boost converter supply input / Battery supply
30	CFB2	Analogue I/O	Charge pump flyback capacitor connection
31	CFB1	Analogue I/O	Charge pump flyback capacitor connection
32	CPGND	Supply	Charge pump ground
33	DC1LX	Analogue I/O	DC1 boost converter inductor connection pin
34	DC1VOUT	Analogue Output	DC1 boost converter output
35	SYSVDD	Supply	System supply input
36	XTO	Analogue Output	Crystal drive output
37	XTI	Analogue Input	Crystal drive input or CMOS clock input
38	DGND	Supply	Digital supplies ground
39	PROGVDD	Supply	OTP Memory programming supply - normally tied to DGND
40	LDO2VOUT	Analogue Output / Supply	LDO2 output / OTP memory supply
41	VREFC	Analogue I/O	Voltage reference capacitor connection

PIN	NAME	TYPE	DESCRIPTION
42	IREFR	Analogue Input/Output	Current reference resistor connection
43	DMICBVDD	Supply	Digital buffer supply, including digital microphone interface
44	DMICCLK	Digital Output	Digital microphone interface clock
45	DMICDAT1	Digital Input	Digital microphone data pin 1
46	DMICDAT2	Digital Input	Digital microphone data pin 2
47	DMICDAT3	Digital Input	Digital microphone data pin 3
48	DMICDAT4	Digital Input	Digital microphone data pin 4

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings are stress ratings only. Permanent damage to the device may be caused by continuously operating at or beyond these limits. Device functional operating limits and guaranteed performance specifications are given under Electrical Characteristics at the test conditions specified.

ESD Sensitive Device. This device is manufactured on a CMOS process. It is therefore generically susceptible to damage from excessive static voltages. Proper ESD precautions must be taken during handling and storage of this device.

Wolfson tests its package types according to IPC/JEDEC J-STD-020B for Moisture Sensitivity to determine acceptable storage conditions prior to surface mount assembly. These levels are:

MSL1 = unlimited floor life at <30°C / 85% Relative Humidity. Not normally stored in moisture barrier bag.
MSL2 = out of bag storage for 1 year at <30°C / 60% Relative Humidity. Supplied in moisture barrier bag.
MSL3 = out of bag storage for 168 hours at <30°C / 60% Relative Humidity. Supplied in moisture barrier bag.

The Moisture Sensitivity Level for each package type is specified in "Ordering Information".

CONDITION	MIN	MAX
BATTVDD	-0.3V	+1.8V
SYSVDD, MICVDD, LDO1VDD, DMICBVDD	-0.3V	+3.6V
PROGVDD	-0.3V	+6.75V
Voltage range digital inputs	DGND - 0.3V	DMICBVDD + 0.3V
Voltage range analogue inputs	AGND - 0.3V	LDO3VOUT + 0.25V
Operating temperature range, T_A	-40ºC	+85ºC
Storage temperature after soldering	-65ºC	+150ºC

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
DC Boost converter input	BATTVDD	0.9		1.6	V
Digital buffer supply	DMICBVDD	1.4		2.5	V
MICBIAS supply	MICVDD	2.3	2.7	3.3	V
Digital core supply (LDO1)	LDO1VDD	1.1		3.3	V
System supply (LDO2, LDO3 and LDO4)	SYSVDD	2.0		3.3	V
OTP Memory programming supply (see Note 3)	PROGVDD	6.25	6.5	6.75	V
Ground	DGND, AGND, CPGND, HPGND		0		V

Notes:

1. Analogue and digital grounds must always be within 0.3V of each other.
2. All supplies are completely independent from each other (i.e. not internally connected).
3. The OTP Memory programming supply (PROGVDD) should only be present when programming the OTP. At other times, this pin should be tied to DGND.

TYPICAL APPLICATIONS

A typical application circuit is illustrated in Figure 1, showing the line inputs, ANC microphone inputs, and stereo headphone output.

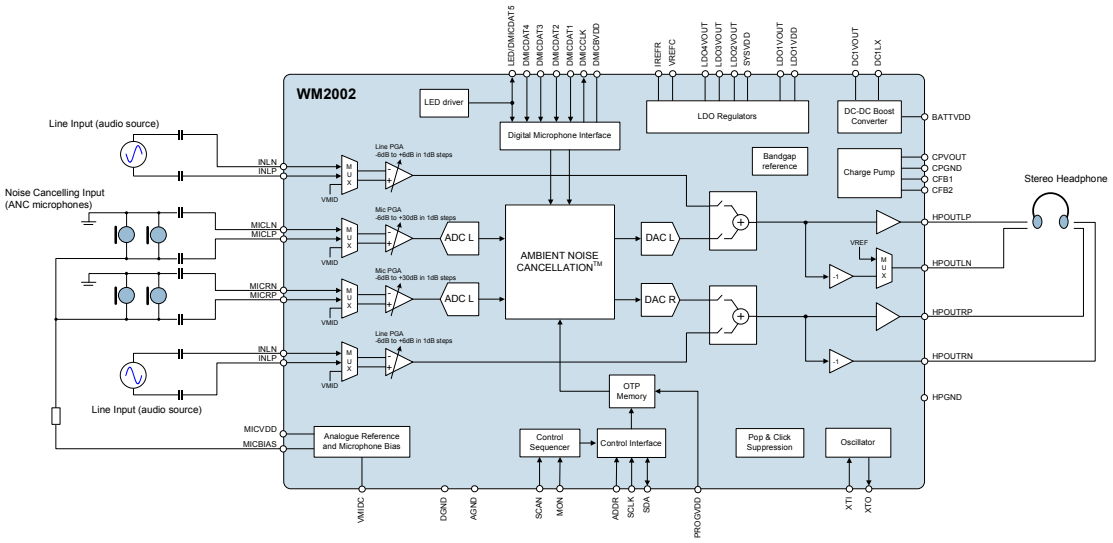


Figure 1 Typical Application

WOLFSON MYZONE™ AMBIENT NOISE CANCELLATION (ANC)

The Wolfson myZone™ (ANC) engine within the WM2002 improves the intelligibility of a voice call by using destructive interference to reduce the acoustic energy of the ambient sound.

The ANC engine is configured using parameters that are determined during product development and programmed on integrated OTP memory. The configuration settings are specific to the acoustic properties of the target application. The primary acoustic elements in an application are typically the microphones and the speaker, but other components such as the plastics and the PCBs also have significant importance to the acoustic coefficient data.

Note that the WM2002 configuration parameters are determined during development and are programmed in the OTP memory during production calibration. These parameters are application-specific, and must be recalculated following any change in the design of the acoustic elements of that application. Any mismatch between the acoustic coefficient data and the target application will give inferior ANC performance.

The ANC engine employs digital circuits to process the ambient noise (microphone) signals; these inputs are digitized by two Analogue to Digital Converters (ADCs), then filtered and processed in accordance with the acoustic parameters programmed into the WM2002. The noise cancellation signals are then output via two Digital to Analogue Converters (DACs) and mixed with the received voice or audio playback (line) signals.

The ANC engine can support multiple noise cancellation filter coefficients, to enable best performance under different ambient noise conditions and different audio playback conditions. Other user-selectable options are also available, such as mute/talk-through modes.

Noise cancellation is applied selectively to different audio frequency bands; a low frequency limiter ensures that the ANC algorithms deliver noise reduction in the most sensitive frequency bands, without introducing distortion in other frequency bands.

The ANC engine is adaptive to different ambient noise levels in order to provide the most natural sound at the headphone audio output. It also incorporates a noise gating function, which ensures that the noise cancellation performance is optimised across a wide range of input signal conditions.

RECOMMENDED EXTERNAL COMPONENTS

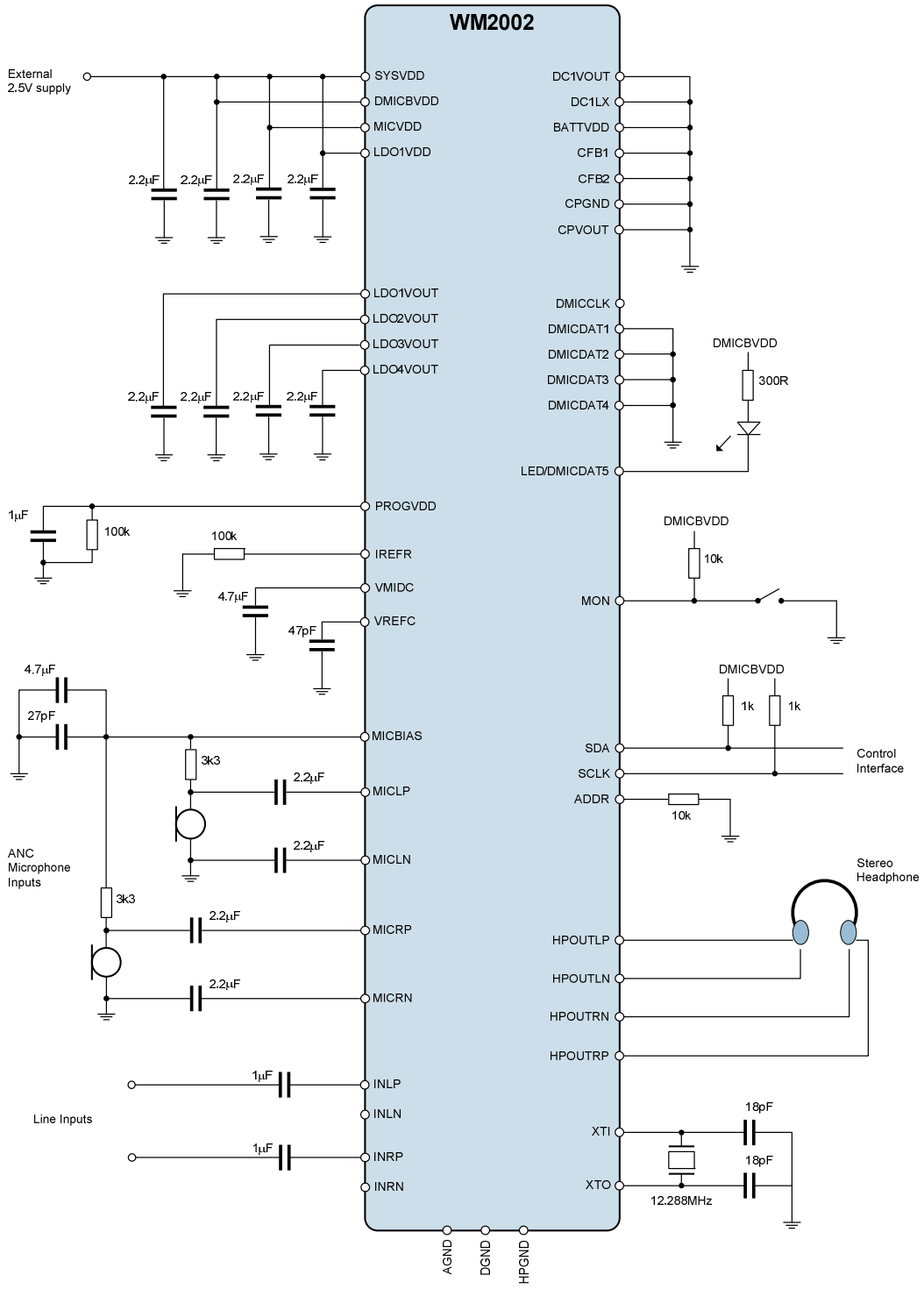


Figure 2 External Components Diagram

The recommended external components are illustrated in Figure 2. This shows the external connections to the audio inputs/outputs, clocking crystal and power management circuits.

Note that Figure 2 shows the recommended device configuration for use with a 2.5V external supply. In this example, the DC1 boost converter and the Charge Pump are not used.

In other cases where the DC1 boost converter and Charge Pump circuits are used (for example, when the WM2002 is powered from a single AAA battery), some additional external components are required, as shown in Figure 3.

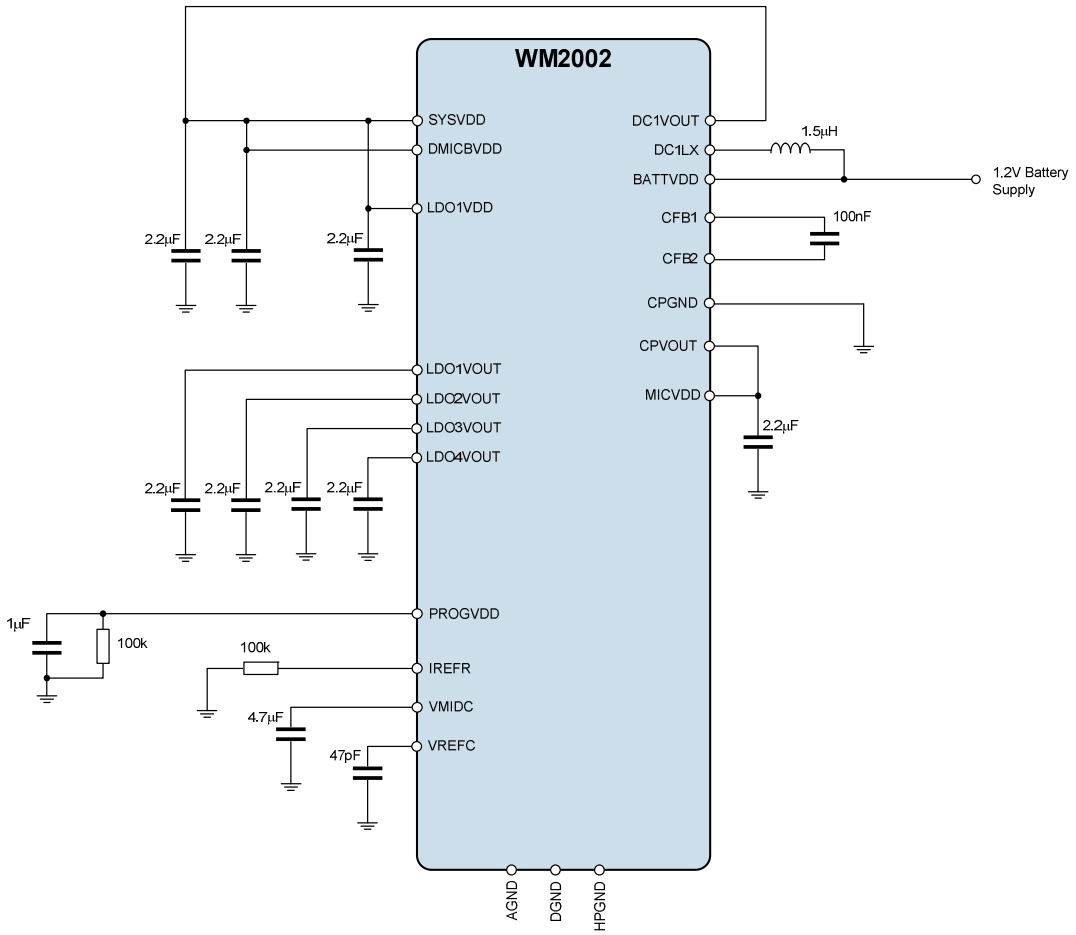
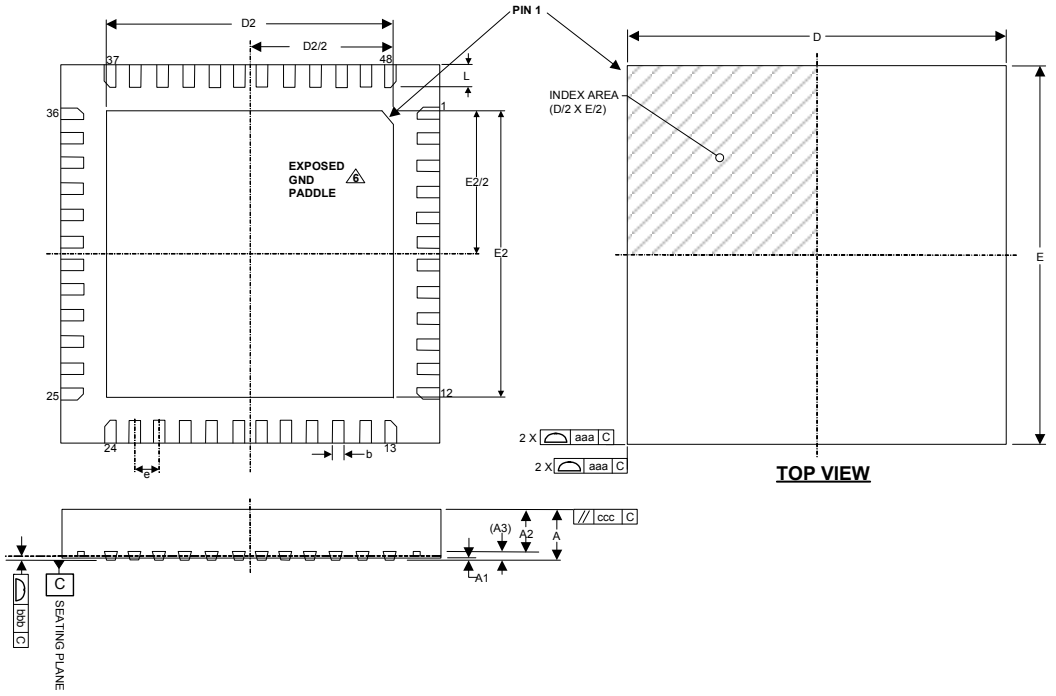


Figure 3 External Components - DC1 Boost Converter and Charge Pump

PACKAGE DIMENSIONS

FL: 48 PIN QFN PLASTIC PACKAGE 7 x 7 x 0.75 mm BODY, 0.50 mm LEAD PITCH **DM079.A**



Symbols	Dimensions (mm)			
	MIN	NOM	MAX	NOTE
A	0.7	0.75	0.8	
A1	0	0.035	0.05	
A2	-	0.55	0.57	
A3		0.203 REF		
b	0.20	0.25	0.30	1
D		7.00 BSC		
D2	5.55	5.65	5.75	
E		7.00 BSC		
E2	5.55	5.65	5.75	
e		0.5 BSC		
L	0.35	0.4	0.45	
Tolerances of Form and Position				
aaa	0.10			
bbb	0.08			
ccc	0.10			
REF	JEDEC, MO-220			

NOTES:
1. DIMENSION b APPLIED TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15 mm AND 0.30 mm FROM TERMINAL TIP.
2. ALL DIMENSIONS ARE IN MILLIMETRES
3. THE TERMINAL #1 IDENTIFIER AND TERMINAL NUMBERING CONVENTION SHALL CONFORM TO JESD 95-1 SPP-002.
4. COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
5. THIS DRAWING IS SUBJECT TO CHANGE WITHOUT NOTICE.
6. REFER TO APPLICATIONS NOTE WAN_0118 FOR FURTHER INFORMATION.

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