

## Ultra Low Power CODEC for Portable Audio Applications

### DESCRIPTION

The WM8903 is a high performance ultra-low power stereo CODEC optimised for portable audio applications.

The device features stereo ground-referenced headphone amplifiers using Wolfson 'Class-W' amplifier techniques - incorporating an innovative dual-mode charge pump architecture - to optimise efficiency and power consumption during playback. The ground-referenced outputs eliminate headphone coupling capacitors. Both headphone and line outputs include common mode feedback paths to reject ground noise.

Control sequences for audio path setup can be pre-loaded and executed by an integrated sequencer to reduce software driver development and eliminate pops and clicks via Wolfson's SilentSwitch™ technology.

The analogue input stage can be configured for single ended, pseudo-differential or fully differential inputs. Up to 3 stereo microphone or line inputs may be connected. The input impedance is constant with PGA gain setting.

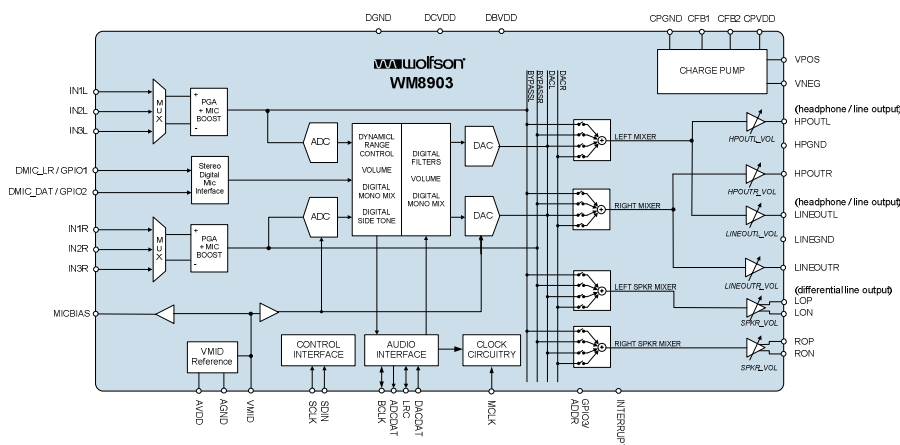
A stereo digital microphone interface is provided, which can also be mixed with the mic/line signals at the output mixers.

A dynamic range controller provides compression and level control to support a wide range of portable recording applications. Anti-clip and quick release features offer good performance in the presence of loud impulsive noises.

Common audio sampling frequencies are supported from a range of external clocks, including 3MHz, 12MHz or 24MHz.

The WM8903 can operate directly from a single 1.8V switched supply. For optimal power consumption, the digital core can be operated from a 1.2V supply

### BLOCK DIAGRAM



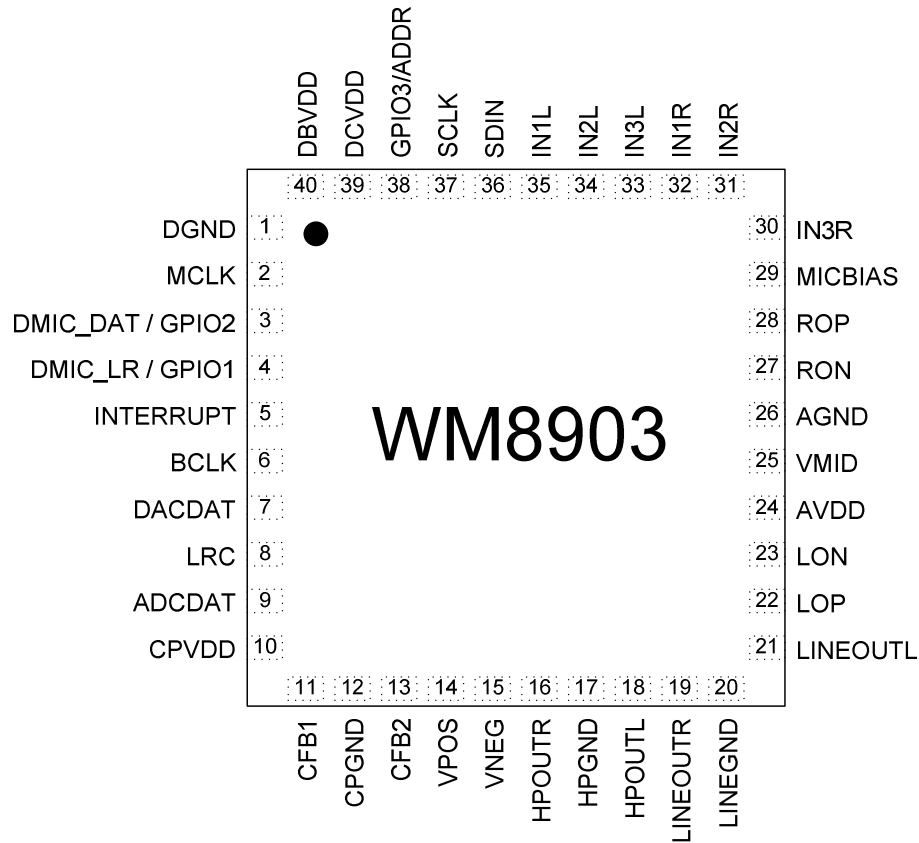
### FEATURES

- 5mW power consumption for DAC to headphone playback
- DAC SNR 96dB typical, THD -86dB typical
- ADC SNR 93dB typical, THD -80dB typical
- Control sequencer for pop-free start-up and shut-down
- Single register write for default start-up sequence
- Stereo digital microphone input
- 3 single ended inputs per stereo channel
- 2 pseudo differential inputs per stereo channel
- 1 fully differential mic input per stereo channel
- Digital Dynamic Range Controller (compressor / limiter)
- Digital sidetone mixing
- Ground-referenced headphone driver
- Ground-referenced line outputs
- Stereo differential line driver for direct interface to WM9001 speaker driver
- 40-lead 5x5mm QFN package

### APPLICATIONS

- Portable multimedia players
- Multimedia handsets
- Handheld gaming

**PIN CONFIGURATION**



**ORDERING INFORMATION**

DEVICE	TEMPERATURE RANGE	PACKAGE	MOISTURE SENSITIVITY LEVEL	PEAK SOLDERING TEMPERATURE
WM8903LGEFK/V	-40°C to +85°C	40-lead QFN (5x5x0.55mm, lead-free)	MSL3	260°C
WM8903LGEFK/RV	-40°C to +85°C	40-lead QFN (5x5x0.55mm, lead-free, tape and reel)	MSL3	260°C

**Note:**

Tube quantity = 95  
 Reel quantity = 3,500

**PIN DESCRIPTION**

PIN	NAME	TYPE	DESCRIPTION
1	DGND	Supply	Digital ground (return path for DCVDD and DBVDD)
2	MCLK	Digital Input	Master clock for CODEC
3	GPIO2/ DMIC_DAT	Digital Input/Output	GPIO2 / Digital microphone data input
4	GPIO1/ DMIC_LR	Digital Input/Output	GPIO1 / Digital microphone clock output
5	INTERRUPT	Digital Output	Interrupt output
6	BCLK	Digital Input/Output	Audio interface bit clock
7	DACDAT	Digital Input	DAC digital audio data
8	LRC	Digital Input/Output	Audio interface left / right clock (common for ADC and DAC)
9	ADCDAT	Digital Output	ADC digital audio data
10	CPVDD	Supply	Charge pump power supply
11	CFB1	Analogue Output	Charge pump flyback capacitor pin
12	CPGND	Supply	Charge pump ground
13	CFB2	Analogue Output	Charge pump flyback capacitor pin
14	VPOS	Analogue Output	Charge pump positive supply decoupling (powers HPOUTL/R, LINEOUTL/R)
15	VNEG	Analogue Output	Charge pump negative supply decoupling (powers HPOUTL/R, LINEOUTL/R)
16	HPOUTR	Analogue Output	Right headphone output (line or headphone output)
17	HPGND	Analogue Input	Headphone ground
18	HPOUTL	Analogue Output	Left headphone output (line or headphone output)
19	LINEOUTR	Analogue Output	Right line output 1 (line output)
20	LINEGND	Analogue Input	Line-out ground
21	LINEOUTL	Analogue Output	Left line output 1 (line output)
22	LOP	Analogue Output	Left differential output positive side
23	LON	Analogue Output	Left differential output negative side
24	AVDD	Supply	Analogue power supply (powers analogue inputs, reference, ADC, DAC, LOP, LON, ROP, RON)
25	VMID	Analogue Output	Midrail voltage decoupling capacitor
26	AGND	Supply	Analogue power return
27	RON	Analogue Output	Right differential output negative side
28	ROP	Analogue Output	Right differential output positive side
29	MICBIAS	Analogue Output	Microphone bias
30	IN3R	Analogue Input	Right channel input 3
31	IN2R	Analogue Input	Right channel input 2
32	IN1R	Analogue Input	Right channel input 1
33	IN3L	Analogue Input	Left channel input 3
34	IN2L	Analogue Input	Left channel input 2
35	IN1L	Analogue Input	Left channel input 1
36	SDIN	Digital Input/Output	Control interface data input / 2-wire acknowledge output
37	SCLK	Digital Input	Control interface clock input
38	GPIO3 /ADDR	Digital Input/Output	GPIO3 / control interface address selection
39	DCVDD	Supply	Digital core supply
40	DBVDD	Supply	Digital buffer supply (powers audio interface and control interface)

## 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
AVDD, DCVDD	-0.3V	+2.5V
DBVDD,	-0.3V	+4.5V
CPVDD	-0.3V	+2.2V
HPOUTL, HPOUTR, LINEOUTL, LINEOUTR	(CPVDD + 0.3V) * -1	CPVDD + 0.3
Voltage range digital inputs	DGND -0.3V	DBVDD +0.3V
Voltage range analogue inputs	AGND -0.3V	AVDD +0.3V
Temperature range, T <sub>A</sub>	-40°C	+85°C
Storage temperature after soldering	-65°C	+150°C

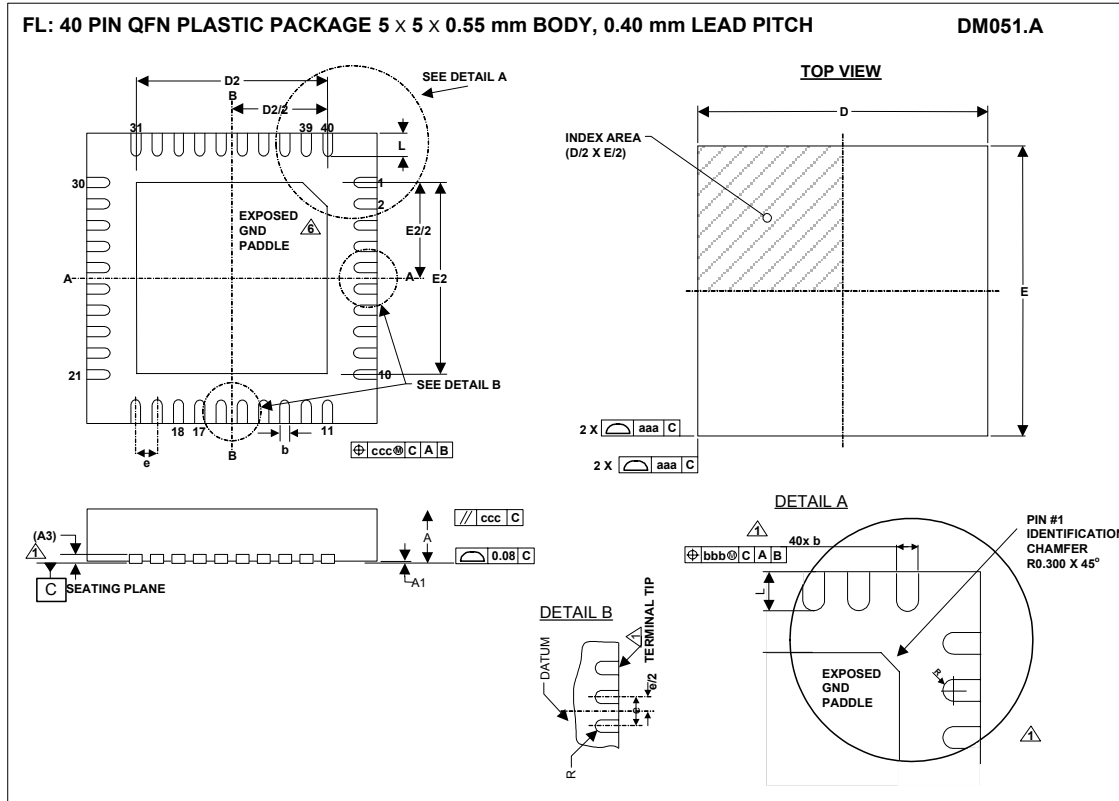
### Notes

1. Analogue and digital grounds must always be within 0.3V of each other.
2. All digital and analogue supplies are completely independent from each other, there is no restriction on power supply sequencing.
3. HPOUTL, HPOUTR, LINEOUTL, LINEOUTR are outputs, and should not normally become connected to DC levels. However, if the limits above are exceeded, then damage to the WM8903 may occur.

## RECOMMENDED OPERATION CONDITIONS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Digital supply range (Core)	DCVDD	1.14		1.89	V
Digital supply range (Buffer)	DBVDD	1.42		3.6	V
Analogue supplies range	AVDD	1.71		2.0	V
Charge pump supply range	CPVDD	1.71		2.0	V
Ground	DGND, AGND, CPGND		0		V
Operating Temperature (ambient)	T <sub>A</sub>	-40	+25	+85	°C

**PACKAGE DIMENSIONS**



Symbols	Dimensions (mm)			NOTE
	MIN	NOM	MAX	
A	0.50	0.55	0.60	
A1	0	0.02	0.05	
A3		0.203 REF		
b	0.15	0.20	0.25	1
D		5.00 BSC		
D2	3.55	3.6	3.65	2
E		5.00 BSC		
E2	3.55	3.6	3.65	2
e		0.4 BSC		
L	0.35	0.4	0.45	
<b>Tolerances of Form and Position</b>				
aaa		0.15		
bbb		0.10		
ccc		0.10		
REF:		JEDEC, MO-220		

- NOTES:
1. DIMENSION b APPLIED TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.25 mm AND 0.30 mm FROM TERMINAL TIP.
  2. FALLS WITHIN JEDEC, MO-220.
  3. ALL DIMENSIONS ARE IN MILLIMETRES
  4. THIS DRAWING IS SUBJECT TO CHANGE WITHOUT NOTICE.
  5. REFER TO APPLICATIONS NOTE WAN\_0118 FOR FURTHER INFORMATION.

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