WM9010

Low Power, Class G Stereo Headphone Driver

DESCRIPTION

The WM9010 is a low power stereo headphone driver designed for mobile handset and portable media player (PMP) applications. Class G amplifier technology is used to achieve high power efficiency and low quiescent current.

Stereo analogue inputs accept 1Vrms line level inputs; the Hi-Fi output drivers deliver up to 28mW into a 32Ω load.

An integrated charge pump circuit generates split-rail voltage supplies to power the ground-referenced headphone driver.

The WM9010 incorporates Wolfson Silent Switch™ technology to provide pop and click suppression whenever the WM9010 is enabled or disabled.

The WM9010 is supplied in a 12-pin CSP package.

FEATURES

- Hi-fi audio headphone drivers (104dB SNR - 'A' weighted)
- Stereo analogue audio inputs
- Ground-referenced, cap-less headphone outputs
- Integrated charge pump and oscillator circuits
- Low quiescent current
- RF noise suppression
- Pop and click suppression
- 12-pin CSP package (1.84 x 1.34 x 0.7mm)

APPLICATIONS

- Mobile Handsets
- Portable Media Players (PMP)
- Notebooks / Laptop computers
- LCD televisions

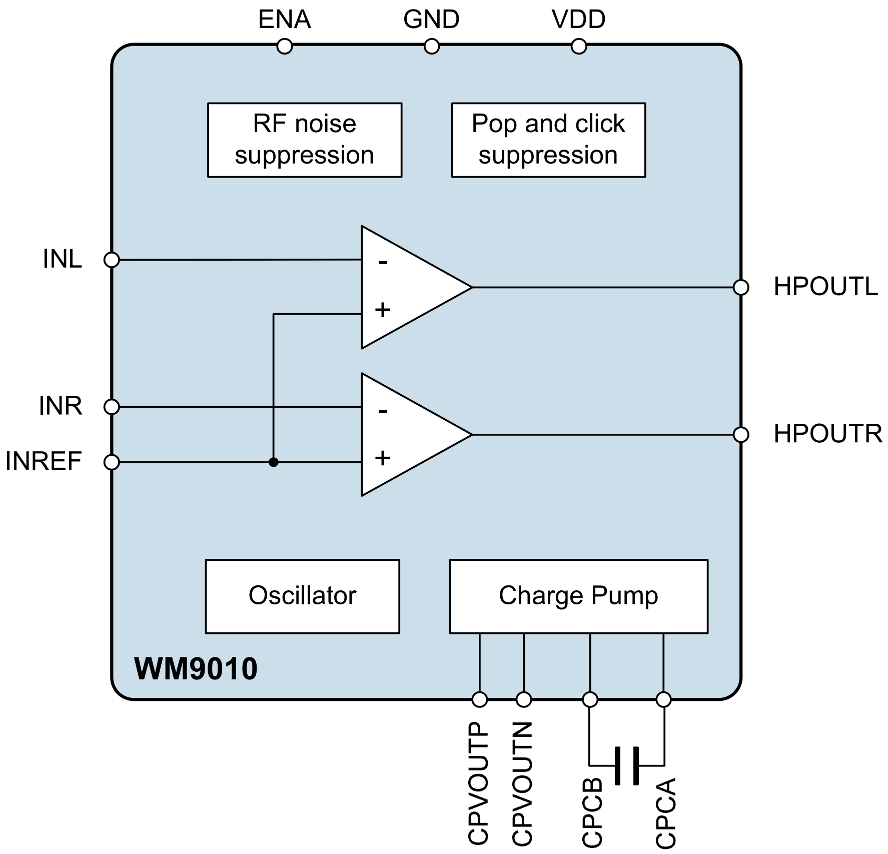
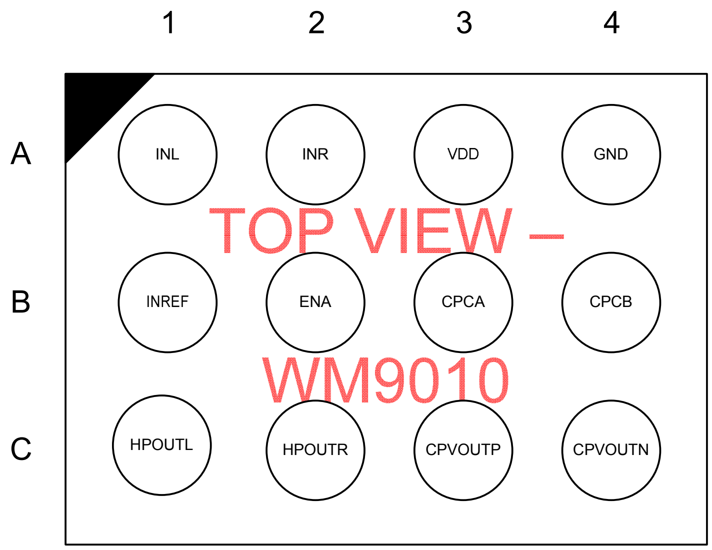


TABLE OF CONTENTS

PIN CONFIGURATION

The WM9010 is supplied in a 12-pin CSP format. The pin configuration is illustrated below, showing the top-down view from above the chip.



ORDERING INFORMATION

ORDER CODE	TEMPERATURE RANGE	PACKAGE	MOISTURE SENSITIVITY LEVEL	PEAK SOLDERING TEMPERATURE
WM9010ECSN/R	-40°C to +85°C	12-pin CSP (Pb-free, tape and reel)	MSL1	260°C

Note:

Reel quantity = 5000

PIN DESCRIPTION

PIN NO	NAME	TYPE	DESCRIPTION
A1	INL	Analogue Input	Left channel analogue input
A2	INR	Analogue Input	Right channel analogue input
A3	VDD	Supply	Positive supply
A4	GND	Supply	Ground
B1	INREF	Analogue Input	Input reference for INL and INR
B2	ENA	Digital Input	Device Enable / Mute control
B3	CPCA	Analogue Output	Charge pump fly-back capacitor pin
B4	CPCB	Analogue Output	Charge pump fly-back capacitor pin
C1	HPOUTL	Analogue Output	Left headphone output
C2	HPOUTR	Analogue Output	Right headphone output
C3	CPVOUTP	Analogue Output	Charge pump positive supply decoupling pin
C4	CPVOUTN	Analogue Output	Charge pump negative supply decoupling pin

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
Supply voltage (VDD)	-0.3V	2.5V
Voltage range digital input (ENA)	-0.7V	3.3V
Voltage range analogue inputs	-0.7V	VDD +0.7V
Operating temperature range, T_A	-40ºC	+85ºC
Junction temperature, T_{JMAX}	-40ºC	+150ºC
Storage temperature after soldering	-65ºC	+150ºC

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Supply Voltage	VDD	1.71	1.8	2.0	V
Ground	GND		0		V

ELECTRICAL CHARACTERISTICS

Test Conditions

VDD = 1.8V, INREF = GND = 0V, Load resistance = 16Ω, T_A = +25°C, 1kHz signal unless otherwise stated.

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Analogue Inputs (INL, INR)						
Maximum input signal level		Single-ended input		VDD/1.8		Vrms
Input resistance			15	20	25	kΩ
Input capacitance				3		pF
Headphone Output Path (HPOUTL, HPOUTR)						
Output Power	P_O	R_L = 32Ω; THD+N = 0.1%		27		mW
		R_L = 32Ω; THD+N = 1%		28		
		R_L = 16Ω; THD+N = 0.1%		32		
		R_L = 16Ω; THD+N = 1%		34		
Signal to Noise ratio	SNR	A-weighted (20Hz – 20kHz)	95	104		dB
Total Harmonic Distortion + Noise	THD+N	R_L = 32Ω; P_O = 20mW (20Hz – 20kHz)		-90		dB
		R_L = 32Ω; P_O = 5mW (20Hz – 20kHz)		-91		
		R_L = 16Ω; P_O = 20mW (20Hz – 20kHz)		-91	-81	
		R_L = 16Ω; P_O = 5mW (20Hz – 20kHz)		-87		
DC Offset				0.5	2	mV
Channel separation		R_L = 16Ω	80	87		dB
Mute attenuation		ENA = 0	95	110		dB
Power supply rejection	PSRR	100mV pk-pk @ 217Hz on VDD		75		dB
Maximum load capacitance		HPOUTL or HPOUTR			2	nF
Digital Input (ENA)						
Input high level			0.8 x VDD			V
Input low level					0.2 x VDD	V
Other Parameters						
Quiescent current	I_{VDD}	ENA = 1, Inputs grounded		750	1000	µA
Shutdown current	I_{VDD}	ENA = 0		0.9	2	µA
Start-up time				13		ms

TERMINOLOGY

1. Signal-to-Noise Ratio (dB) – SNR is the difference in level between a full scale output signal and the device output noise with no signal applied, measured over a bandwidth of 20Hz to 20kHz. (No Auto-zero or Mute function is employed).
2. Total Harmonic Distortion (dB) – THD is the difference in level between a 1kHz reference sine wave output signal and the sum of the harmonics of the output signal. The amplitude of the fundamental frequency of the output signal is compared to the RMS value of the sum of the harmonics and expressed as a ratio.
3. Total Harmonic Distortion plus Noise (dB) – THD+N is the difference in level between a 1kHz reference sine wave output signal and all noise and distortion products in the audio band. The amplitude of the fundamental reference frequency of the output signal is compared to the RMS value of all other noise and distortion products and expressed as a ratio.
4. Channel Separation (L/R) (dB) – is a measure of the coupling between left and right channels. A full scale signal is applied to the left channel only, and the right channel amplitude is measured. Next, a full scale signal is applied to the right channel only, and the left channel amplitude is measured. The worst case channel separation is quoted; this is the difference in level between the full-scale output and the cross-channel output signal level, expressed as a ratio.
5. Power Supply Rejection Ratio (dB) – PSRR is a measure of ripple attenuation between a power supply rail and a signal output path. With the signal path idle, a small sine wave ripple is applied to power supply rail. The amplitude of the supply ripple is compared to the amplitude of the output signal generated and is expressed as a ratio.
6. Mute attenuation - This is a measure of the difference in level between the full scale output signal and the output with mute applied (ie. ENA = logic 0).
7. All performance measurements are carried out with 20kHz AES17 low pass filter for distortion measurements, and an A-weighted filter for noise measurement. Failure to use such a filter will result in higher THD and lower SNR and Dynamic Range readings than are found in the Electrical Characteristics. The low pass filter removes out-of-band noise; although it is not audible, it may affect dynamic specification values.

DEVICE DESCRIPTION

INTRODUCTION

The WM9010 is a low power stereo headphone driver designed for mobile handset and portable media player (PMP) applications. It is packaged in a 12-pin CSP.

The device comprises two analogue input pins, each accepting line signals up to 1Vrms. The signal path gain is fixed at 0dB. The headphone output drivers deliver up to 28mW into a 32Ω load.

The WM9010 incorporates Class G technology to achieve high efficiency and low quiescent current. An integrated charge pump circuit is used to generate the split (positive and negative) power rails from a single VDD supply. The ground-referenced headphone driver design reduces the device power consumption and also eliminates external DC-blocking capacitors on the audio output path.

The WM9010 is enabled when a logic high level is detected on ENA. Note that the ENA pin can support digital logic levels up to 2.7V.

Wolfson's Silent Switch™ technology is incorporated in order to minimise 'pop' noise whenever the WM9010 is enabled or disabled.

A power on reset circuit ensures correct start-up and shut-down when VDD is switched on or off. The WM9010 is held in reset when the ENA pin is held low, offering a low-power standby state.

Short circuit and thermal protection is also provided.

HEADPHONE DRIVER

The WM9010 has two analogue input pins, INL and INR. The input signals are referenced to the INREF pin, which is provided as a quiet ground reference connection. The maximum analogue input signal level varies with VDD, but is typically 0dBV (1Vrms) when VDD = 1.8V. This is suitable for single-ended connection to line level input signals.

The headphone output drivers are capable of driving up to 28mW into a 32Ω load such as a stereo headset or headphones. The outputs are ground-referenced, eliminating any requirement for AC coupling capacitors. This is achieved by having separate positive and negative supply rails powered by an on-chip charge pump.

A pop-suppression circuit ensures that DC offsets are minimised, suppressing 'pop' noise and reducing power consumption. To obtain optimal DC offsets, the device should be powered on with no signal on the input pins.

It is recommended to connect a zobel network to the headphone output pins HPOUTL and HPOUTR for best audio performance in all applications. The components of the zobel network have the effect of dampening high frequency oscillations or instabilities that can arise outside the audio band under certain conditions. Possible sources of these instabilities include the inductive load of a headphone coil or an active load in the form of an external line amplifier. The capacitance of lengthy cables or PCB tracks can also lead to amplifier instability. The zobel network should comprise of a 20Ω resistor and 100nF capacitor in series with each other, as illustrated in Figure 1.

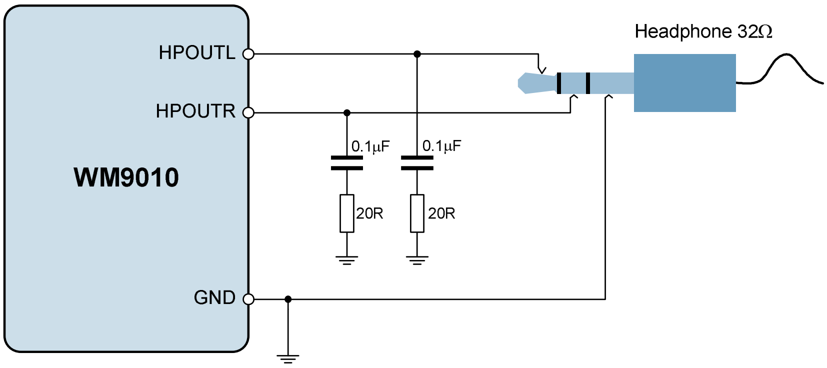


Figure 1 External Connections for HPOUTL and HPOUTR

CHARGE PUMP

The WM9010 incorporates a charge pump circuit, which generates the supply rails for the headphone output drivers. The charge pump is powered from VDD, and generates split rails CPVOUTP and CPVOUTN. The circuit is adaptive according to the audio signal conditions, supporting the Class G operation and ensuring optimum circuit configuration at all times. The switching clock for the charge pump is generated internally.

The external connections for the charge pump are illustrated in Figure 2. A fly-back capacitor is connected between the CPCA and CPCB pins. De-coupling capacitors are required on CPVOUTP and CPVOUTN. An input decoupling capacitor may also be required at VDD, depending upon the system configuration.

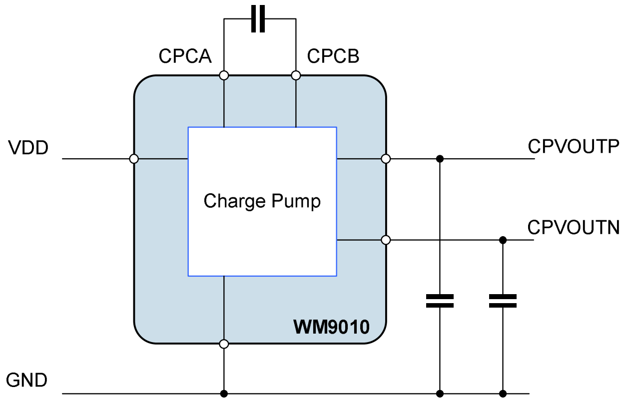


Figure 2 External Connections for Charge Pump

APPLICATIONS INFORMATION

RECOMMENDED EXTERNAL COMPONENTS

Figure 3 provides a summary of recommended external components for WM9010. Note that the actual requirements may differ according to the specific target application.

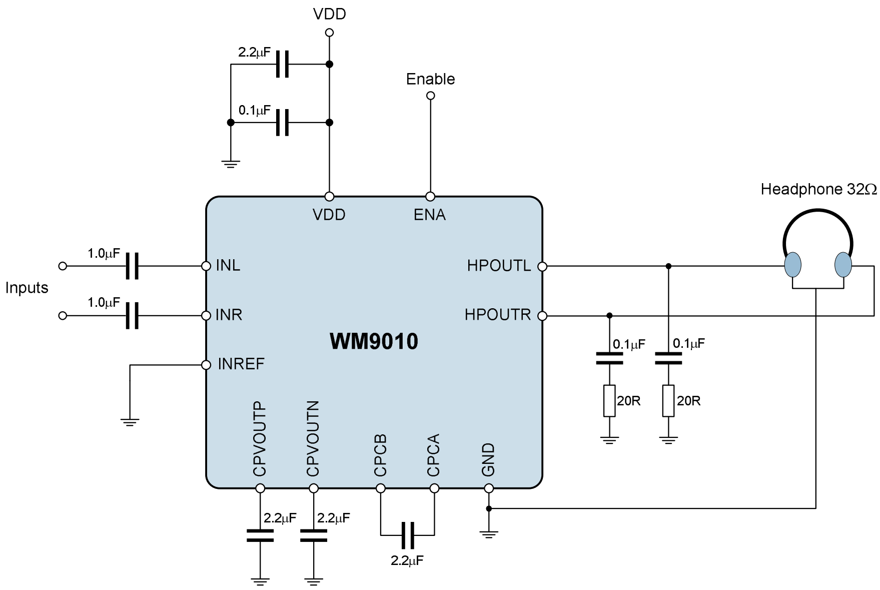


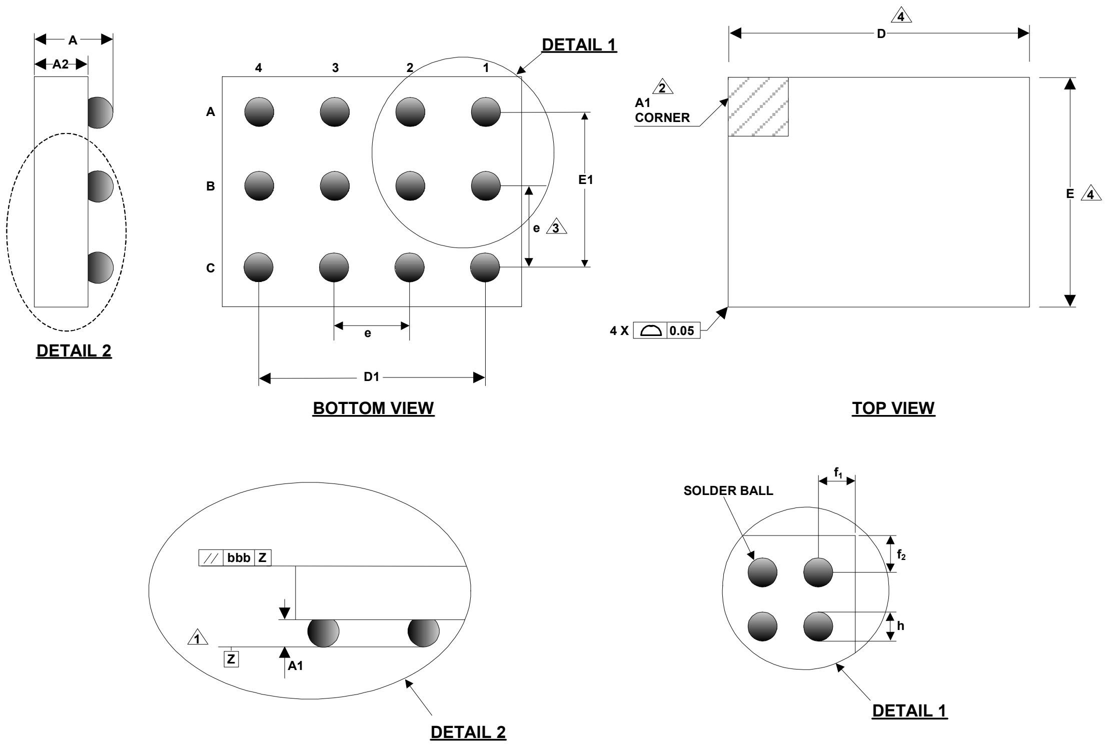
Figure 3 WM9010 Recommended External Components Diagram

PCB LAYOUT CONSIDERATIONS

Poor PCB layout will degrade the performance and be a contributory factor in EMI, ground bounce and resistive voltage losses. All external components should be placed as close to the WM9010 device as possible, with current loop areas kept as small as possible.

PACKAGE DIMENSIONS

B: 12 BALL W-CSP PACKAGE 1.840 x 1.340 x 0.7mm BODY, 0.50 mm BALL PITCH **DM078.A**



Symbols	Dimensions (mm)			
	MIN	NOM	MAX	NOTE
A	0.675	0.7	0.725	
A1	0.187	0.2	0.213	
A2	0.488	0.500	0.512	
D	1.820	1.840	1.860	
D1		1.500 BSC		
E	1.320	1.340	1.360	
E1		1.000 BSC		
e		0.500 BSC		3
f_1	0.160			
f_2	0.160			
h		0.267		

NOTES:
1. PRIMARY DATUM -Z- AND SEATING PLANE ARE DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
2. A1 CORNER IS IDENTIFIED BY INK/LASER MARK ON TOP PACKAGE.
3. 'e' REPRESENTS THE BASIC SOLDER BALL GRID PITCH.
4. THIS DRAWING IS SUBJECT TO CHANGE WITHOUT NOTICE.
5. FOLLOWS JEDEC DESIGN GUIDE MO-211-C.

IMPORTANT NOTICE

Wolfson Microelectronics plc ("Wolfson") products and services are sold subject to Wolfson's terms and conditions of sale, delivery and payment supplied at the time of order acknowledgement.

Wolfson warrants performance of its products to the specifications in effect at the date of shipment. Wolfson reserves the right to make changes to its products and specifications or to discontinue any product or service without notice. Customers should therefore obtain the latest version of relevant information from Wolfson to verify that the information is current.

Testing and other quality control techniques are utilized to the extent Wolfson deems necessary to support its warranty. Specific testing of all parameters of each device is not necessarily performed unless required by law or regulation.

In order to minimize risks associated with customer applications, the customer must use adequate design and operating safeguards to minimise inherent or procedural hazards. Wolfson is not liable for applications assistance or customer product design. The customer is solely responsible for its selection and use of Wolfson products. Wolfson is not liable for such selection or use nor for use of any circuitry other than circuitry entirely embodied in a Wolfson product.

Wolfson's products are not intended for use in life support systems, appliances, nuclear systems or systems where malfunction can reasonably be expected to result in personal injury, death or severe property or environmental damage. Any use of products by the customer for such purposes is at the customer's own risk.

Wolfson does not grant any licence (express or implied) under any patent right, copyright, mask work right or other intellectual property right of Wolfson covering or relating to any combination, machine, or process in which its products or services might be or are used. Any provision or publication of any third party's products or services does not constitute Wolfson's approval, licence, warranty or endorsement thereof. Any third party trade marks contained in this document belong to the respective third party owner.

Reproduction of information from Wolfson datasheets is permissible only if reproduction is without alteration and is accompanied by all associated copyright, proprietary and other notices (including this notice) and conditions. Wolfson is not liable for any unauthorised alteration of such information or for any reliance placed thereon.

Any representations made, warranties given, and/or liabilities accepted by any person which differ from those contained in this datasheet or in Wolfson's standard terms and conditions of sale, delivery and payment are made, given and/or accepted at that person's own risk. Wolfson is not liable for any such representations, warranties or liabilities or for any reliance placed thereon by any person.

ADDRESS:

Wolfson Microelectronics plc

26 Westfield Road

Edinburgh

EH11 2QB

United Kingdom

Tel :: +44 (0)131 272 7000

Fax :: +44 (0)131 272 7001

Email :: sales@wolfsonmicro.com

REVISION HISTORY

DATE	REV	ORIGINATOR	CHANGES
18/02/11	4.0	CT/JMacD	Product status updated to Production Data
			Max and Min Electrical Characteristics Figures added.
	4.0	JMacD/IS	Bandwidth specifications added to SNR and THD+N in Electrical Characteristics