Data Sheet August 1997 File Number 4268.2

14.4V Full Bridge Output Automotive 100W Subwoofer Amplifier

Description

The HIP100DCREF Reference Design is a 100W RMS subwoofer amplifier, using Class-D topology, designed to operate from the 12V battery in automotive applications. The full bridge outputs are controlled by an HIP4081 MOSFET driver unique for audio applications. One hundred watt continuous RMS power is achieved through the use of low impedance speakers. The design is part of Intersil's CoolAudio program that enables Customers to achieve a minimum time-to-market for audio end products. The reference design's circular configuration is designed for mounting directly onto the back of a typical speaker thus insuring minimum conducted or radiated interference (EMI/RFI). The amplifier has been designed to run continuously at rated power with no droop in output level.

This design is offered to Customers after execution of a Licensing agreement. At this time, Intersil will provide a documentation package containing 1) Circuit Description, 2) Schematics, 3) Test and Manufacturing Information, 4) A Bill of Material with all vendor and vendor part numbers, 5) Intersil's Engineering Support Contacts, 6) One Sample Amplifier board.

For more information, see us on the web, home page http://www.intersil.com. For technical assistance, call Central Applications at 1-800-442-7747, or email us at centapp@intersil.com.

Features

- 14.4VDC Operation
- Power Output (0.75W Load) . . . . . .100W RMS
- 20Hz to 900Hz Bandwidth . . . . . (±3dB)
- 0.1% Typical THD+N at 100Hz and 100W RMS
- High Efficiency, Full Bridge Output (Typical >95% at 100W RMS)
- Pop-Free Start-Up
- Remote On/Off
- Variable Input Sensitivity

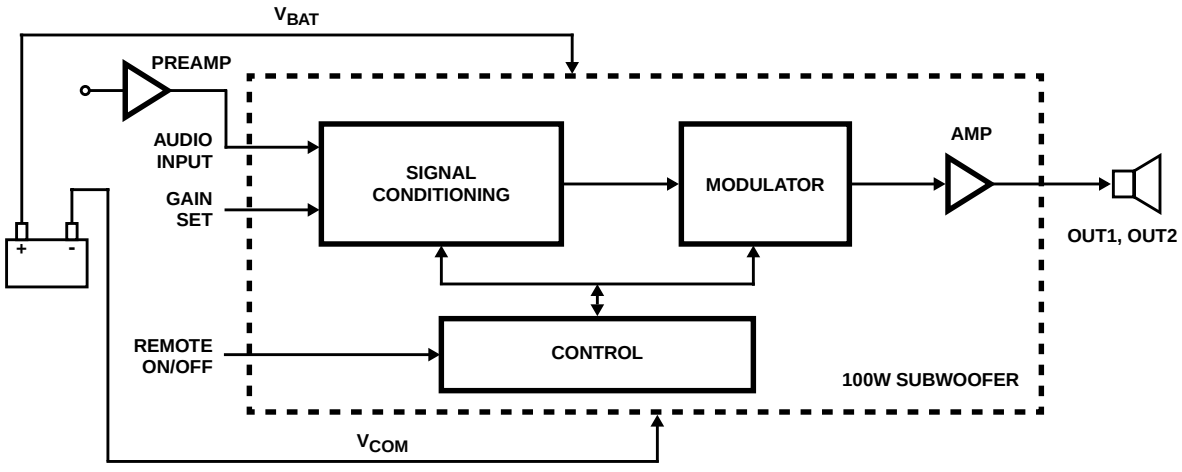
Applications

- Car Subwoofer Amplifier

Ordering Information

Contact Intersil licensing agents, Continental Far East or International Operations. See contact information provided

Reference Design Block Diagram



Absolute Maximum Ratings

Supply Voltage, V_{BAT} (Note 1) . . . . . -0.3V to 27V
All Other Pin Voltages (Note 1) . . . . . V_{GND} -0.3V to V_{BAT} +0.3V
OUT1, OUT2 Slew Rate 20V/ns
Audio Input, J3 . . . . . $5V_{RMS}$

Operating Conditions

Supply Voltage, V_{BAT} (Relative to GND) . . . . . 13.7V to 14.4V
Voltage on V_{SS} 0V
Temperature Range . . . . . -40^oC to 60^oC

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

1. All voltages are relative to V_{GND}, unless otherwise specified.
2. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications

V_{BAT} = 14.4V, R_{LOAD} = 0.75Ω, V_{COM} = 0V

PARAMETER	SYMBOL	TEST CONDITIONS	$T_A = 25^oC$ TYP	UNITS
SUPPLY MEASUREMENTS				
V_{BAT} Quiescent Current	I_{BATQ}	Audio In = 0V, Remote = V_{BAT} = 14.4V	200	mA
REM On/OFF Quiescent Current (On)	I_{REM}	REM = V_{BAT}	6	mA
V_{BAT} Idle Current	$I_{BATIDLE}$	Audio In = 0V, REM = V_{COM} = 0V	0.25	mA
PSRR (V_{OUT1}-V_{OUT2})/(V_{BAT2_1}-V_{BAT2_2})	P_{SRR}	V_{BAT} = 13 ±10%	3	mV/V
Minimum Battery Supply Voltage, Rising	$V_{BATMINR}$	REM = V_{BAT}, P_{OUT} = 25W	8.9	V
Minimum Battery Supply Voltage, Falling	$V_{BATMINF}$	REM = V_{BAT}, P_{OUT} = 25W	8.6	V
OUTPUT MEASUREMENTS				
Maximum Output Power	P_{MAX}	V_{BAT} = 14.4V	100	W
Efficiency	$100WMAX_{EFF}$	V_{BAT} = 14.4V at terminals of PC board	95	%
	$50WMAX_{EFF}$	P_{OUT} Measured at terminals of PC board	90	%
	$10WMAX_{EFF}$		80	%
PERFORMANCE MEASUREMENTS				
Total Harmonic Distortion + Noise	$THD+N$	P_{OUT} = 50W at 100Hz	0.08	%
SNR	V_{SNR}	Relative to Full Scale Output	-60	dB
PSSR ($\Delta V_{OUT}/\Delta V_{BAT}$)	P_{SSR}	V_{BAT} = ±1V	3	mV/V
ADDITIONAL MEASUREMENTS				
Cutoff Frequency	F_{UPPER}		1000	Hz
Input Gain	I_{GAIN}	Measured at 100Hz	25.3	dB
Input Impedance	R_{IN}	Dependent upon setting of R_1	3.3 to 10	kΩ

Reference Board Connector Assignment

SYMBOL	DESCRIPTION
REM	The remote on/off signal for the amplifier. Connect to the switched 12V of car or radio. JP1, Pin 2
V_{BAT}	The amplifier output stage power source. Connect through a fuse directly to the battery. JP2, Pin 1
OUT+	The + polarity high power output. JP2, Pin 2
OUT-	The -polarity high power output. JP2, Pin 1
V_{COM}	The ground return for the amplifier. JP1, Pin 3
Jack	Audio Input, J3

Typical Performance Curves

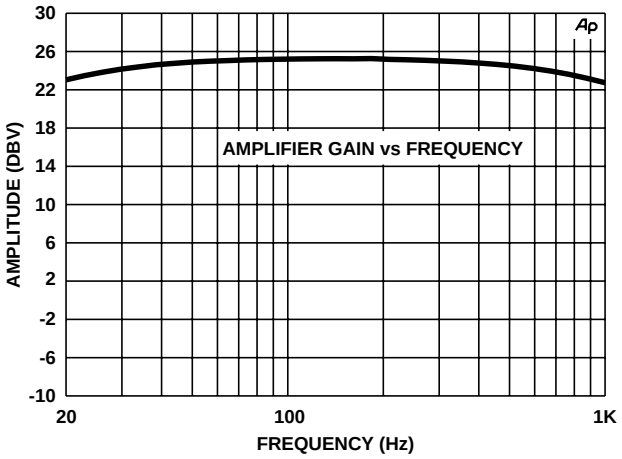


FIGURE 1. FREQUENCY RESPONSE

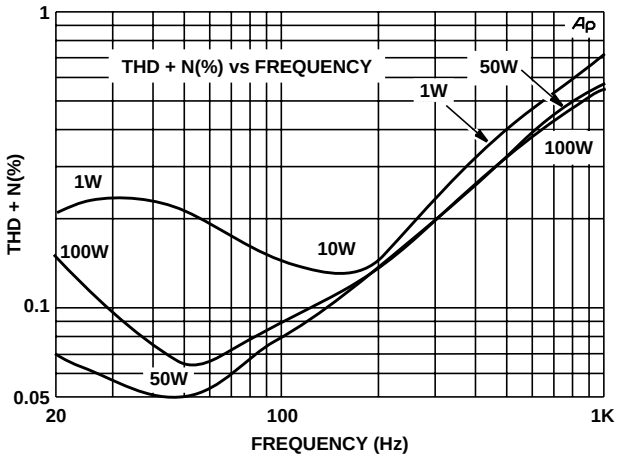


FIGURE 2. THD +N (%) vs FREQUENCY

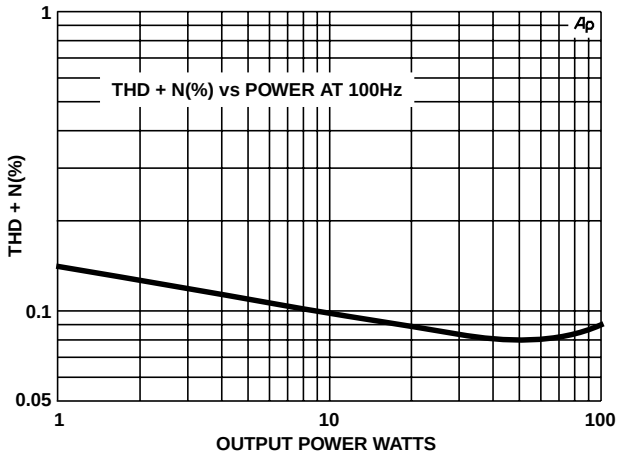
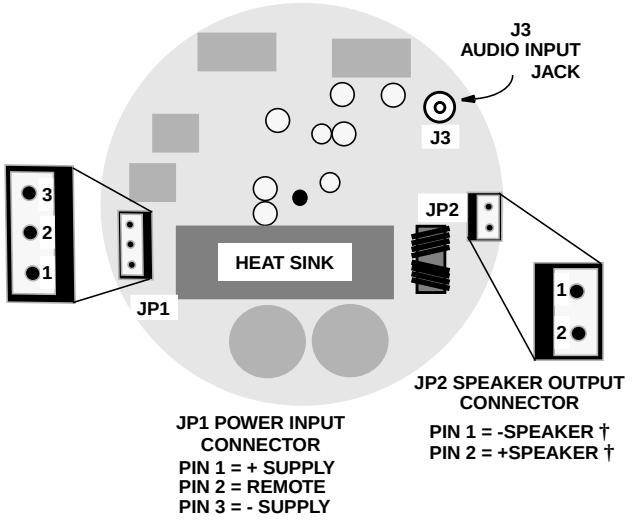


FIGURE 3. THD+N vs POWER

Reference Board Physical Layout



† Damage will occur if either speaker lead is connected to ground.

FIGURE 4. AMPLIFIER CONNECTOR CONFIGURATION

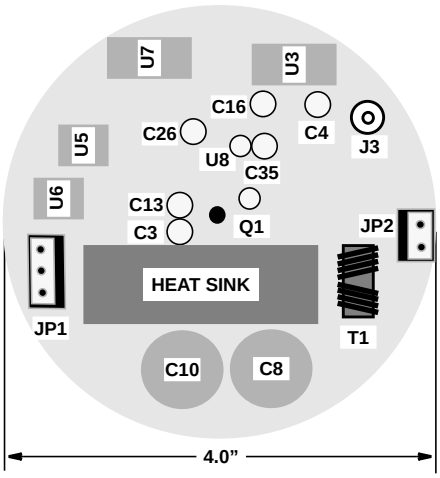


FIGURE 5. AMPLIFIER DIMENSIONS AND LAYOUT

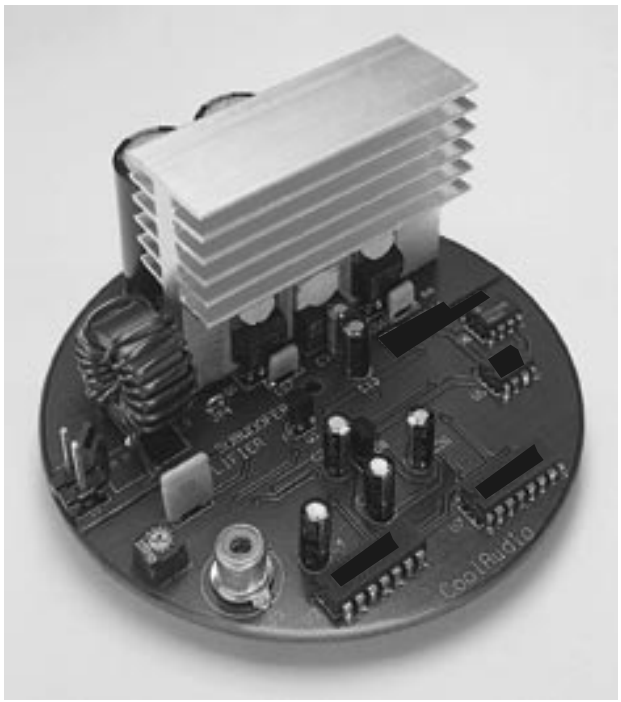


FIGURE 6. AMPLIFIER PHOTOGRAPH

Electromagnetic Compatibility

FCC requirements for electromagnetic compatibility are meant to prevent one piece of equipment from generating noise which would interfere with another piece of equipment used in the same proximity. The requirements address both radiated emissions, noise transmitted though the air, and conducted emissions, noise transmitted through power and signal lines. Because the Intersil HIP100DCREF is designed for use in automotive applications, it qualifies as an exempted device under FCC regulations section 15.103. Additionally, the design has a clocking frequency below 1.705MHz, eliminating the FCC requirements for radiated emissions testing. Accordingly, any and all equipment built with the HIP100DCREF design will not need to be qualified to FCC requirements, unless other electronics are incorporated with clocking frequencies greater than 1.075MHz or it is used with residential power.

The question of electromagnetic compatibility is, however, still important. Some pieces of electronic equipment are more sensitive to electromagnetic noise than the FCC limits. Intersil has undertaken the responsibility to design this product to minimize interoperability problems with other equipment like FM receivers and TVs which may be used adjacent to the HIP100DCREF. Engineering testing has demonstrated emissions well below FCC limits and characterized sensitivity levels of other consumer electronic equipment.

The HIP100DCREF has been successfully tested to the limits of FCC Part 15 for digital devices operating in a residential environment. The European standards for the “Generic Limit, Residential” classification are comparable and reasonably correlate to the FCC limits. The radiated emissions were measured from 30MHz to 1000MHz at a distance of 3 meters with both horizontally and vertically polarized antennas and compared to the FCC limits below.

Frequency	Emission Limit
30MHz - 88MHz	100µV = 40dBuV
88MHz - 216MHz	150µV = 43.5dBuV
216MHz - 960MHz	200µV = 46dBuV
960MHz - 1000MHz	500µV = 54dBuV

The European limits, measured at distance of 10 meters are:

Frequency	Emission Limit
30MHz - 230MHz	30µV/M
230MHz - 1000MHz	37µV/M

The emissions data presented in Figure 7 shows the worst case, vertical polarized antennas for the HIP100DCREF. Note two sets of data were combined to show this worst case condition from 30MHz to 1000MHz. Common data from each set of data is shown only once. Antenna data and file data is show above each segment, i.e., 30MHz to 200MHz and 200MHz to 1000MHz.

Intersil Corporation

100W AMP TEST

Date:	04/29/97	Time:	13:31:49.35			Time:	15:54:50.91
Technician:	G. WURM	Test Equip.:	EMC30	SPECS		Test Equip.:	EMC30
Test Method :	FCC CLASS B DIGITAL	Test Number:	003	1) FCCRADB.S30		Test Number:	006
Equipment:	100W Amp	Sensor Loc.:	3 METER	EMC-30 SETTINGS		Sensor Loc.:	3 METER
Mode of Op. :	ALL POWER,40Hz, 2A	Sensor Pol.:	VERTICAL	Detector	QuasiPeak	Sensor Pol.:	VERTICAL
Serial No.:		Ext. Atten.:	0 dB	Bandwidth	CISPR	Ext. Atten.:	0 dB
				Dwell	N/A	DATA FILE:	REHFVERT.D32
Comment:	ALL POWER, 40Hz, SPEAKER LOAD, 2 AMP POWER LOAD	DATA FILE:	RE2AVERT.D32	RF Atten.	0 dB	ANTENNA FILES:	LOGPERID.A30:
		DATA FILE:	RE2A40HL.D32	IF Atten.	0 dB		
		ANTENNA FILES:	BICON84.A50				

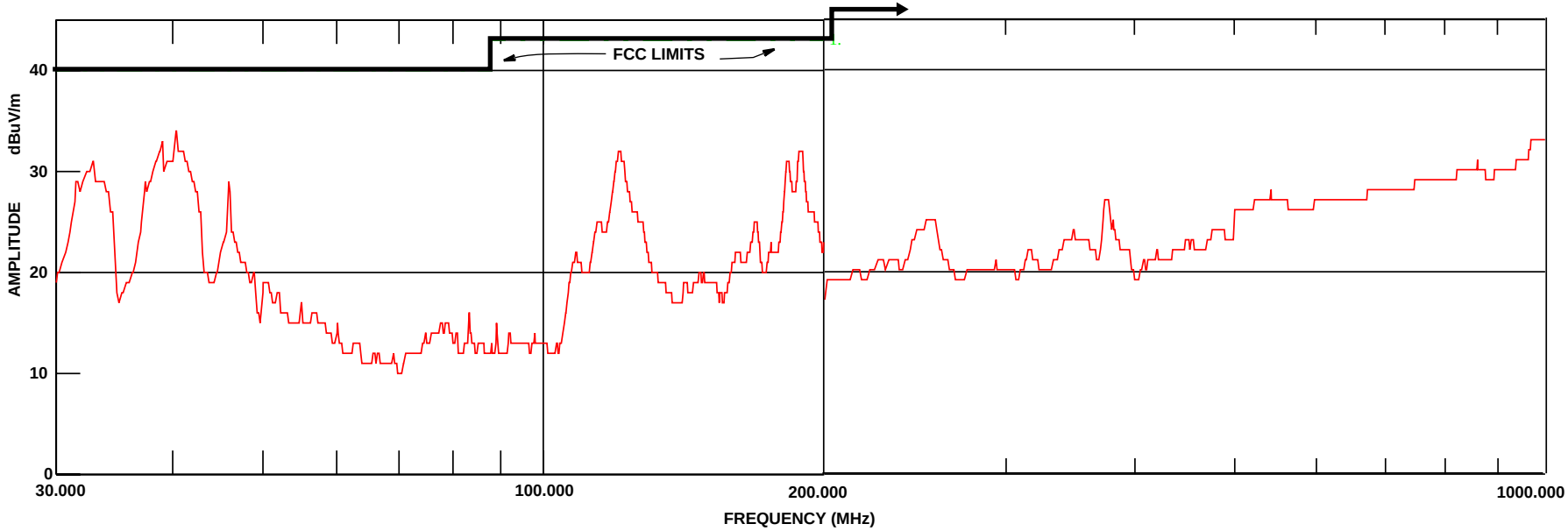


FIGURE 7. COMBINED EMI CURVES

Authorized Intersil Licensing Agents

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