

D2-IPS Audio SOC

Digital Audio Amplifier Power Stage

FN7678
Rev 1.00
Mar 18, 2019

The D2-IPS family ([D2-24044](#)) device is a high performance, integrated Class-D amplifier power stage. The four power stage outputs are configurable as four separate Half-Bridge outputs, as two Full-Bridge outputs, or combinations of Half-Bridge and Full-Bridge. Individual power stage overload monitoring, on-chip temperature monitoring, and common alert logic outputs provide protection to integrate with the final system's controller.

Related Literature

For a full list of related documents, visit our website:

- [D2-24044](#) device page

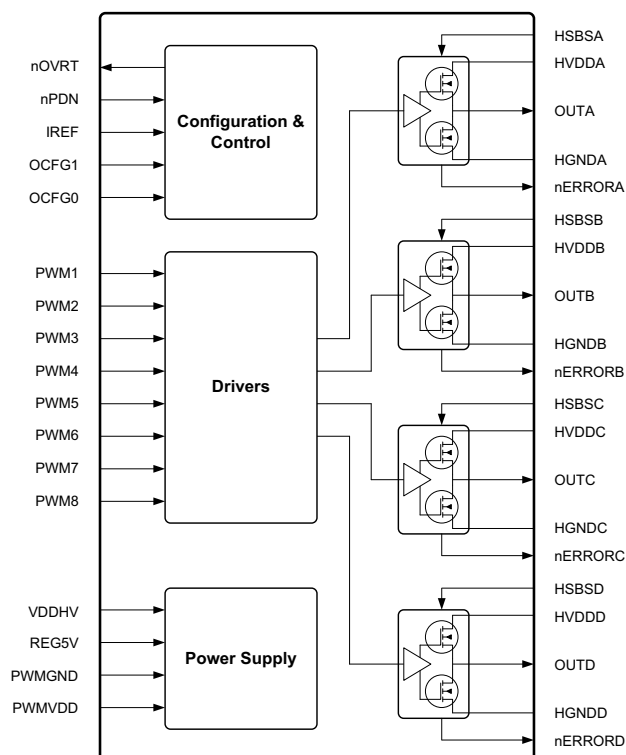
Features

- All digital class-D power stage
- Four configurable power stage outputs supporting:
 - 2 Channels, Bridged
 - 4 Channels, Half-Bridge
 - 2 Channels, Half-Bridge, plus 1 Channel, Bridged
- Output Power (bridged)
 - 25W (8Ω, <1% THD)
 - 30W (8Ω, <10% THD)
- Single HV supply - wide 9V-26V range, plus internally-generated gate drive supply
- Individual channel protection monitoring
- Temperature and undervoltage monitoring
- Efficient 38 Ld HTSSOP package

Applications

- PC/multimedia speakers
- Digital TV audio systems
- Portable device docking stations
- Powered speaker systems

Digital Amplifier Power Stage



Ordering Information

PART NUMBER (Note 3)	PART MARKING	APPLICATION SUPPORT	TEMP. RANGE (°C)	TAPE AND REEL (UNITS) (Note 1)	PACKAGE (Pb-Free)	PKG. DWG. #
D2-24044-MR	D2-24044-MR	Commercial	-10 to +85	-	38 Ld HTSSOP	M38.173C
D2-24044-MR-T	D2-24044-MR	Commercial	-10 to +85	2.5k	38 Ld HTSSOP	M38.173C

NOTES:

1. See [TB347](#) for details about reel specifications.
2. These Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). The Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.
3. For Moisture Sensitivity Level (MSL), see the [D2-24044](#) device page. For more information about MSL, see [TB363](#).

Table of Contents

Absolute Maximum Ratings	4
Thermal Information	4
Recommended Operating Conditions	4
Electrical Specifications	4
Performance Specifications	5
Pin Configuration	6
Pin Description	6
Typical Performance Characteristics.....	8
Full-Bridge Typical Performance Curves	8
Half-Bridge Typical Performance Curves	9
Functional Overview	10
Output Options	10
Power Supply Requirements.....	10
High Side Gate Drive Voltage	10
Supply Bypass Connection.....	10
REG5V	10
Input and Control Functions	11
PWM Inputs.....	11
nPDN Input Pin	11
nERRORA-D Output Pins.....	11
nOVRT Output Pin	11
IREF Pin.....	11
OCFG0, OCFG1 Input Pins	11
Protection.....	11
Short-Circuit and Overcurrent Sensing	11
Thermal Protection and Monitoring	12
Power Supply Voltage Monitoring	12
Output Mode Configurations	14
Typical Application Examples	17
2-Channel Full Bridge Example.....	17
2.1-Channel Example	18
4-Channel Half-Bridge Example	19

Absolute Maximum Ratings

Supply Voltage	
HVDD[A:D], VDDHV	0V to +28.0V
PWMVDD	0V to 4.0V
Input Voltage	
Any Input	-0.3V to PWMVDD + 0.3V

Thermal Information

Thermal Resistance (Typical)	θ_{JA} (°C/W)	θ_{JC} (°C/W)
38 Ld HTSSOP Package (Notes 4, 5)	29	1.3
Maximum Storage Temperature	-55°C to +150°C	
Pb-Free Reflow Profile	see TB493	

Recommended Operating Conditions

Temperature Range	-10°C to +85°C
High Voltage Supply Voltage, HVDD[A:D], VDDHV	9.0V to 26.5V
Digital I/O Supply Voltage, PWMVDD	3.3V
Minimum Load Impedance (HVDD[A:D] \leq 24.0V), Z_L	4 Ω

CAUTION: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions can adversely impact product reliability and result in failures not covered by warranty.

NOTES:

- θ_{JA} is measured in free air with the component mounted on a high-effective thermal conductivity test board with "direct attach" features. See [TB379](#).
- For θ_{JC} , the "case temp" location is the center of the exposed metal pad on the package underside.
- Absolute Maximum parameters are not tested in production.

Electrical Specifications

TA = +25°C, PWMVDD = 3.3V \pm 10%. All grounds at 0.0V. All voltages referenced to ground.

PARAMETER	TEST CONDITIONS	SYMBOL	MIN	TYP	MAX	UNIT
Digital Input High Logic Level		V_{IH}	2	-	-	V
Digital Input Low Logic Level		V_{IL}	-	-	0.4	V
High Level Output Drive Voltage (I_{OUT} at -Pin Drive Strength Current)		V_{OH}	PWMVDD-0.4	-	-	V
Low Level Output Drive Voltage (I_{OUT} at +Pin Drive Strength Current)		V_{OL}	-	-	0.4	V
Input Leakage Current	Pins 1, 2, 3	I_{IN}	-	-	± 10	μA
	PWM Input Pins (includes 100k Ω internal pull-down resistor current)		-	-	± 50	μA
Input Capacitance		C_{IN}	-	9	-	pF
Output Capacitance	All Outputs Except OUT[A:D]	C_{OUT}	-	9	-	pF
	OUT[A:D]		-	190	-	
Internal Pull-Up Resistance to PWMVDD (for nERRORA-D, nOVRT)			-	100	-	k Ω
Digital I/O Supply Pin Voltage, Current		PWMVDD	3	3.3	3.6	V
	Active Current		-	0.47	-	mA
	Power-Down Current		-	0.15	-	mA
3.3V (PWMVDD) BROWN-OUT DETECTION						
Logic Supply Undervoltage Threshold			-	2.6	-	V
Logic Supply Undervoltage Threshold Hysteresis			-	200	-	mV
Logic Supply Undervoltage Glitch Rejection			-	50	-	ns

Electrical Specifications

T_A = +25°C, PWMVDD = 3.3V ±10%. All grounds at 0.0V. All voltages referenced to ground.

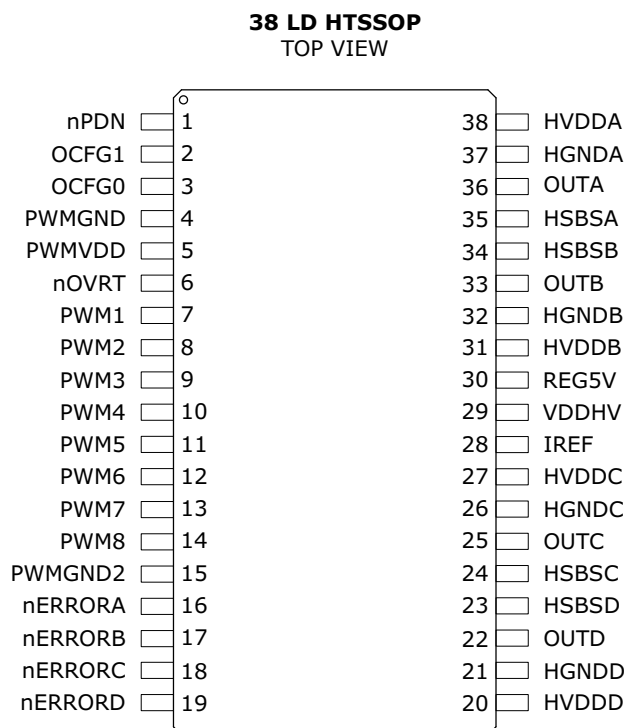
PARAMETER	TEST CONDITIONS	SYMBOL	MIN	TYP	MAX	UNIT
GATE DRIVE INTERNAL +5V BROWN-OUT DETECTION						
Gate Drive Supply Undervoltage Threshold			-	4.5	-	V
Gate Drive Supply Undervoltage Threshold Hysteresis			-	200	-	mV
Gate Drive Supply Undervoltage Threshold Glitch Rejection			-	50	-	ns
PROTECTION DETECT						
High Voltage Undervoltage Protection			-	7	9	V
Overcurrent Trip Threshold			-	4	-	A
Overcurrent De-glitch			-	2.5	-	ns
Short-Circuit Current Limit (Peak)			-	8	-	A
Overcurrent Response Time			-	20	-	ns
Thermal Shut-Down OTmax			-	140	-	°C
Thermal Warning Temperature OTmin			-	125	-	°C
Thermal Shut-Down Hysteresis			-	30	-	°C
Thermal Warning Hysteresis			-	20	-	°C

Performance Specifications

T_A = +25°C, PWMVDD = 3.3V ±10%. All grounds at 0.0V. All voltages referenced to ground. -

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
r _{DS(ON)} (MOSFETs @ +25°C)	r _{DS(ON)}	-	200	-	mΩ
r _{DS(ON)} Mismatch		-	1	-	%
PWM Switching Rate		-	384	-	kHz
Minimum PWM Pulse Width		-	3.5	-	ns
PWM Off Sensor Time		-	10	-	μs
PWM Input to Output Delay		-		50	ns
PWM Input to Output Delay Matching		-	3	-	ns
nPDN Input Off Delay	T _{PDNOFF}	-	1.4	-	ms
nPDN Input On Delay	T _{PDNON}	-	1.4	-	ms
POWER OUTPUT					
<1% THD, Bridged, Load = 8Ω, HVDD[A:D] = 24V	P _{OUT}	-	25	-	W
<10% THD, Bridged, Load = 8Ω, HVDD[A:D] = 24V	P _{OUT}	-	30	-	W
<1% THD, Half-Bridge, Load = 8Ω, HVDD[A:D] = 24V	P _{OUT}	-	7	-	W
<10% THD, Half-Bridge, Load = 8Ω, HVDD[A:D] = 24V	P _{OUT}	-	9	-	W
THD+N					
Load = 8Ω, Power = 25W, Bridged, 1kHz	THD+N	-	0.3	-	%
Load = 8Ω, Power = 1W, Bridged, 1kHz		-	0.05	-	%
SNR	SNR	-	110	-	dB
Efficiency (Load = 8Ω)		-	90	-	%

Pin Configuration



Pin Description

PIN	PIN NAME (Note 7)	TYPE	VOLTAGE LEVEL (V)	DESCRIPTION
1	nPDN	I	3.3	Power-down and mute input. Active low. When this input is low, all four outputs become inactive, their output stages float, and their output is muted. Internal logic and other references remain active during this power-down state.
2	OCFG1	I	3.3	Output configuration control select. OCFG0 and OCFG1 are logic inputs to select the output configuration mode of the output stages. Connects to either PWMGND ground or PWMVDD (+3.3V) through a nominal 10kΩ resistor to select the output configuration.
3	OCFG0	I	3.3	
4	PWMGND	GND	0	Low-voltage ground. Connects to ground of circuitry providing PWM inputs. Both PWMGND and PWMGND2 must be tied together to the same ground.
5	PWMVDD	P	3.3	Low-voltage power. This 3.3V supply connects to the same system low-voltage power used for providing PWM inputs.
6	nOVRT	O	3.3	Over-temperature warning output. Open drain, 16mA drive strength output with pull-up. Pulls low when active from over-temperature detection.
7	PWM1	I	3.3	PWM Input. Routes to output channel, dependent on output configuration settings.
8	PWM2	I	3.3	
9	PWM3	I	3.3	
10	PWM4	I	3.3	
11	PWM5	I	3.3	
12	PWM6	I	3.3	
13	PWM7	I	3.3	
14	PWM8	I	3.3	

Pin Description (Continued)

PIN	PIN NAME (Note 7)	TYPE	VOLTAGE LEVEL (V)	DESCRIPTION
15	PWMGND2	GND	0	Low-voltage ground. Connects to ground of circuitry providing PWM inputs. Both PWMGND and PWMGND2 must be tied together to the same ground.
16	nERRORA	O	3.3	Overcurrent protection output, channel A output stage. Open drain, 16mA drive strength output with pull-up. Pulls low when active from overcurrent detection of output stage.
17	nERRORB	O	3.3	Overcurrent protection output, channel B output stage. Open drain, 16mA drive strength output with pull-up. Pulls low when active from overcurrent detection of output stage.
18	nERRORC	O	3.3	Overcurrent protection output, channel C output stage. Open drain, 16mA drive strength output with pull-up. Pulls low when active from overcurrent detection of output stage.
19	nERRORD	O	3.3	Overcurrent protection output, channel D output stage. Open drain, 16mA drive strength output with pull-up. Pulls low when active from overcurrent detection of output stage.
20	HVDDD	P	HV	Output stage D high voltage supply power. A separate power pin connection is provided for each of the output stages. All of the HVDD[A:D] pins and the VDDHV pin connect to the system "HV" power source.
21	HGNDD	GND	HV	Output stage D high voltage supply ground. A separate ground pin connection is provided for each of the output stages. All of the HGND[A:D] pins connect to the system "HV" power ground (also see Note 8).
22	OUTD	O	HV	PWM power amplifier output, channel D.
23	HSBSD	I	HV	High side boot strap input, output channel D. Capacitor couples to the OUTD amplifier output.
24	HSBSC	I	HV	High side boot strap input, output channel C. Capacitor couples to the OUTC amplifier output.
25	OUTC	O	HV	PWM power amplifier output, channel C.
26	HGNDC	GND	HV	Output stage C high voltage supply ground. A separate ground pin connection is provided for each of the output stages. All of the HGND[A:D] pins connect to system "HV" power ground (also see Note 8).
27	HVDDC	P	HV	Output stage C high voltage supply power. A separate power pin connection is provided for each of the output stages. All of the HVDD[A:D] pins and the VDDHV pin connect to the system "HV" power source.
28	IREF	I	-	Overcurrent reference analog input used to set the overcurrent error to detect externally-set threshold. The pin needs to be connected to a 100kΩ resistor to ground to set the overcurrent threshold according to the specified limits.
29	VDDHV	P	+HV	High Voltage internal driver supply power. All of the HVDD[A:D] pins and the VDDHV pin connect to the system "HV" power source. The internal +5V supply regulators also operate from this VDDHV input.
30	REG5V	P	5	5V internal regulator filter connect. A +5V supply is internally generated from the voltage source provided at the VDDHV pin. REG5V is used for external connection of a decoupling capacitor.
31	HVDDDB	P	HV	Output stage B high voltage supply power. A separate power pin connection is provided for each of the output stages. All of the HVDD[A:D] pins and the VDDHV pin connect to the system "HV" power source.
32	HGNDB	GND	HV	Output stage B high voltage supply ground. A separate ground pin connection is provided for each of the output stages. All of the HGND[A:D] pins connect to the system "HV" power ground (also see Note 8).
33	OUTB	O	HV	PWM power amplifier output, channel B.
34	HSBSB	I	HV	High side boot strap input, output channel B. Capacitor couples to the OUTB amplifier output.
35	HSBSA	I	HV	High side boot strap input, output channel A. Capacitor couples to the OUTA amplifier output.

Pin Description (Continued)

PIN	PIN NAME (Note 7)	TYPE	VOLTAGE LEVEL (V)	DESCRIPTION
36	OUTA	O	HV	PWM power amplifier output, channel A.
37	HGND A	GND	HV	Output stage A high voltage supply ground. A separate ground pin connection is provided for each of the output stages. All of the HGND[A:D] pins connect to the system "HV" power ground (also see Note 8).
38	HVDDA	P	HV	Output stage A high voltage supply power. A separate power pin connection is provided for each of the output stages. All of the HVDD[A:D] pins and the VDDHV pin connect to the system "HV" power source.

NOTES:

- Unless otherwise specified all pin names are active high. Those that are active low have an "n" prefix, such as nERRORA.
- Thermal pad is internally connected to all 4 HGND ground pins (HGND A, HGND B, HGND C, HGND D). Any connection to the thermal pad must be made to the common ground for these 4 ground pins.

Typical Performance Characteristics

Full-Bridge Typical Performance Curves

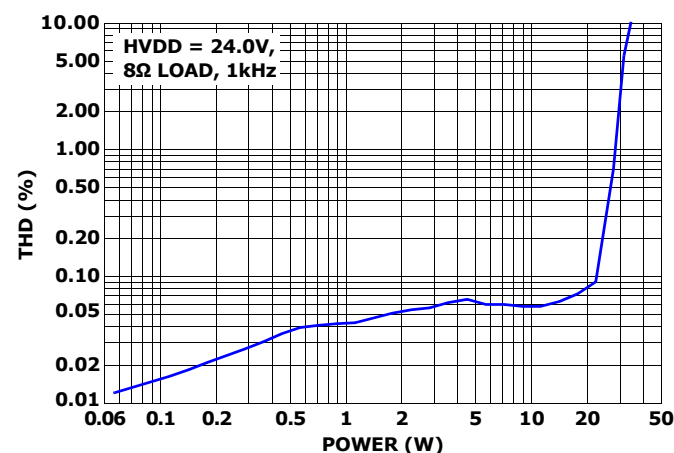


FIGURE 1. THD vs POWER, FULL-BRIDGE

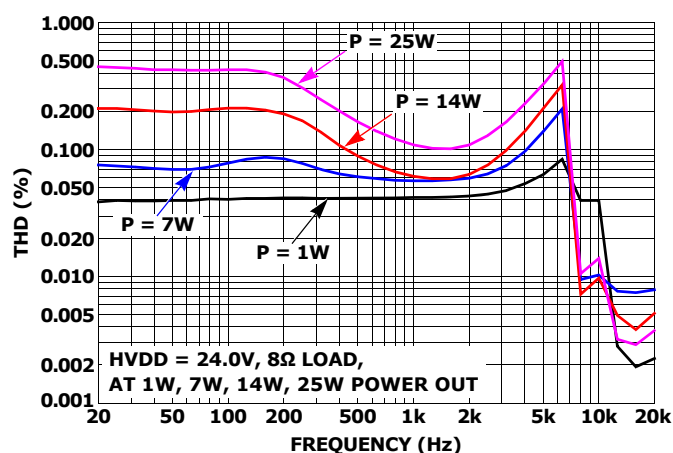


FIGURE 2. THD vs FREQUENCY, FULL-BRIDGE

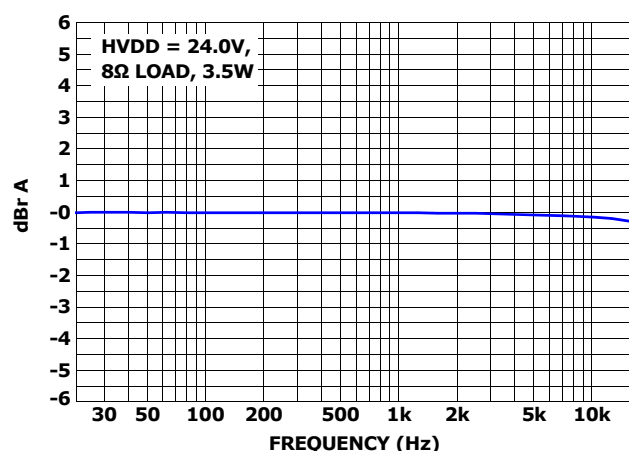


FIGURE 3. FREQUENCY RESPONSE, FULL-BRIDGE

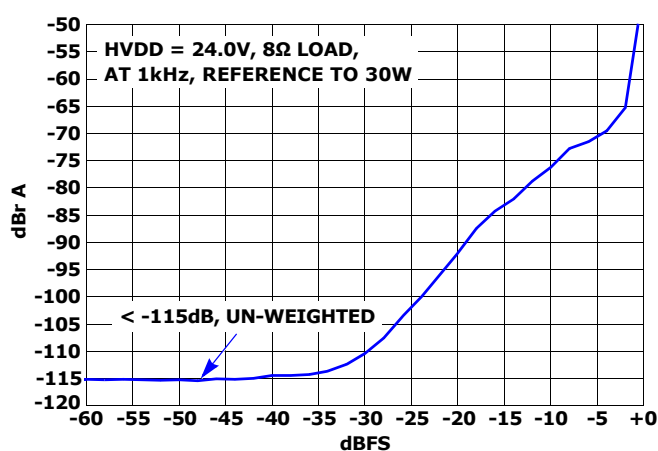


FIGURE 4. NOISE FLOOR, FULL-BRIDGE

Half-Bridge Typical Performance Curves

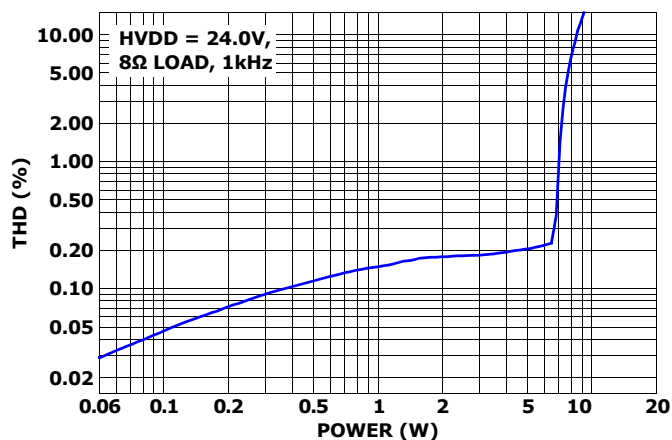


FIGURE 5. THD vs POWER, HALF-BRIDGE

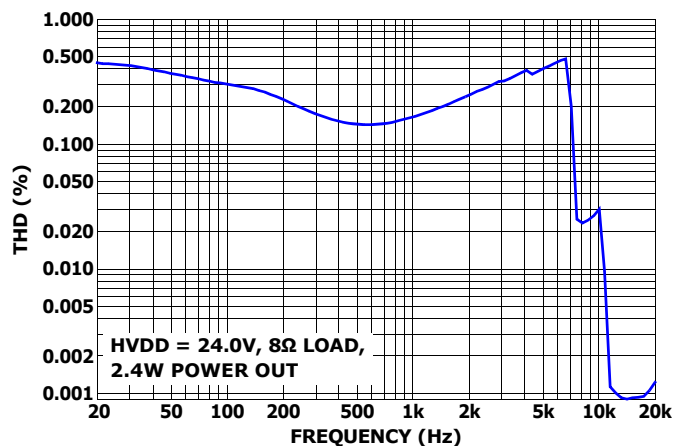


FIGURE 6. THD vs FREQUENCY, HALF-BRIDGE

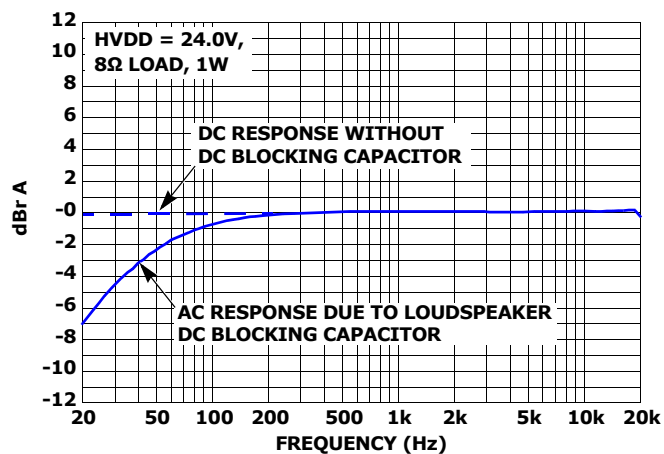


FIGURE 7. FREQUENCY RESPONSE, HALF-BRIDGE

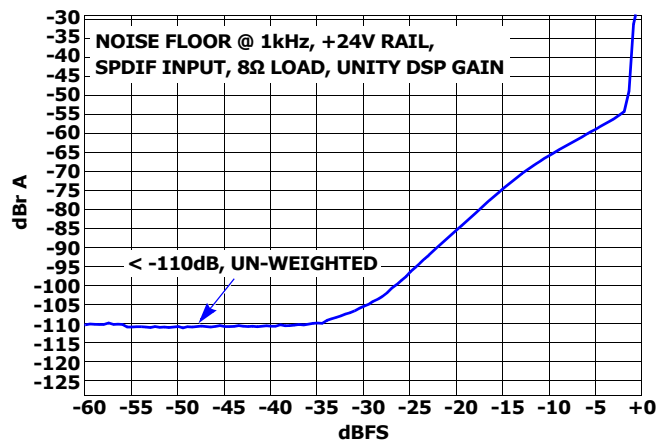


FIGURE 8. NOISE FLOOR, HALF-BRIDGE

Functional Overview

The devices include four independent output stages (Figure 9) that are each implemented using a high side (to the positive VDDHV supply) and a low side (to the HV supply ground) FET pair. Drivers and overcurrent monitoring are included in each of these four output stages. Depending on the selected configuration mode, these four stages can be used independently as single half-bridge outputs, or as pairs for full-bridge outputs.

Digital PWM inputs are connected to the PWM input pins, where their signals are routed through the configuration select logic to the individual output FETs and drivers.

On-chip temperature and undervoltage monitoring, and individual per-output current monitoring provides protection and status reporting outputs to the system controller.

Upon application of power, the on-chip voltage sensors monitor presence of the required power voltages. Until all voltages are at their design specifications, the outputs remain off and floating.

After supply voltages are within limits and stable, the output configuration is set by the logic levels at the OCFG0 and OCFG1 input pins, and the PWM inputs are routed to their appropriate output stage FETs.

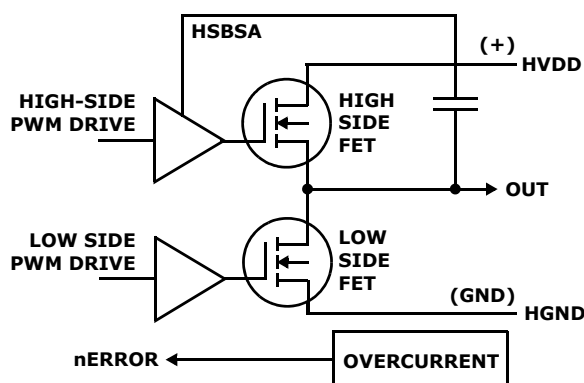


FIGURE 9. OUTPUT STAGE

Output Options

The D2-IPS family devices provide four configuration options for the outputs. These options are selected by strapping the OCFG0 and OCFG1 pins high or low. These defined configurations include:

- 2 Channels of Full Bridge, 4-Quadrant Outputs
- 2 Channels of Full Bridge, 2-Quadrant Outputs
- 4 Channels of Half-Bridge Outputs
- 2 Channels Half-Bridge, Plus 1 Channel Full Bridge

When a configuration is set that includes a full-bridge output, each input channel's PWM input signal is routed to the high and low side FETs, appropriate for that full bridge operation. Note however, that the device can be configured as four independent half-bridge outputs

(using mode "11" as described in the configuration assignment table on [page 14](#)) and two of those outputs can be used in a full bridge configuration, by connecting the appropriate PWM input pins to the input source. This configuration allows flexibility in applications that require combinations other than the four defined by the output configuration modes.

Power Supply Requirements

The device operates from two supply voltages:

- PWMVDD is a nominal 3.3V supply voltage and operates the logic and control.
- HVDD (HVDD[A:D], and VDDHV) is the "high voltage" used for operating the output power stages.

Individual HVDD and its ground (HGND) pins are included for each of the four power stage outputs, providing channel isolation and low impedance source connections to each of the outputs. A separate VDDHV pin is used for the output drivers, and is the source for the on-chip regulated 5V source needed for the drivers. All the HVDD/VDDHV pins connect to the same voltage source.

PWMVDD is the reference for the PWM inputs and device control logic, and is the same voltage as used by the PWM/system controller.

High Side Gate Drive Voltage

An on-chip bootstrap circuit provides the high-side gate drive voltage used by each output stage. A pin is included for each output channel (HSBS[A:D]) for connection of a capacitor (nominal, 0.22μF/50V) from this pin to that channel's PWM output. The charge pumping actions uses this capacitor to filter and hold this gate drive voltage, and enables amplifier operation without need of connection to an additional power supply voltage.

Supply Bypass Connection

Connect power supply bypass capacitors across each of the power supply connection pins, as follows:

- Four HVDD power pins and their respective HGND ground pins. These should be a parallel combination of a nominal 100μF and 0.1μF capacitors, located as close as possible to the HVDD/HGND pin pair.
- Connect a 0.1μF capacitor at the VDDHV pin.
- The PWMVDD power pin should include a 1μF and 0.1μF capacitor.

REG5V

The on-chip gate drive power supply operates from the VDDHV power input to produce the 5V supply voltage. The REG5V pin is used for external capacitor connection to filter this regulated voltage. A 1.0μF and 0.1μF capacitor should be connected to this pin, and the connection should be made as close as practical to the pin. Do not make any other connections to be made to this pin.

Input and Control Functions

PWM Inputs

Eight PWM input pins provide the PWM inputs to the amplifier's output stages. The PWM input pins are electrically single-ended and are referenced to the PWMVDD and PWMGND supplies.

PWM drive to the output stages is provided differentially on-chip, with the PWM input channels mapped to each of the high-side output FETs and the low-side output FETs that implement the individual power stages. Routing and assignment of the PWM input pins to the output FETs is defined by the configuration mode. Figures [11](#), [12](#), [13](#), and [14](#) show the mapping of these input pins to the outputs for each of the four configuration modes.

All eight input pins however are not always used in each of the configuration modes. For example, in mode "00", providing 3-level drive of two channels of full bridge outputs, or in mode "11" providing four independent half-bridge outputs, one PWM input is dedicated to each of the FETs. But in mode "01" that implements two 2-quadrant full-bridge outputs, only four PWM inputs are used, and the logical high/low states are routed to the FETs as needed.

nPDN Input Pin

The nPDN pin is a control input that is used to set the inactive (powered down) state, and also mute the outputs. It operates by turning off drive and internal sources to the PWM outputs, as well as turning off the PWM drive to those outputs.

When an overcurrent condition is detected on an output, causing its overcurrent protection to latch and turn off that output, asserting the nPDN input resets the device and clears this overcurrent state.

The nPDN pin is active low, and inactive when at logic high level.

nERROR-A Output Pins

Each of the four outputs includes an overload and overcurrent monitor. An overcurrent or overload condition asserts the nERROR output for that channel. These outputs are active low and open drain. Depending on the output mode configuration and need to monitor more than one output, these nERROR pins can be wire-or connected together.

nOVRT Output Pin

The nOVRT pin is an output that provides warning of a high temperature condition. It is an open drain, active low output. This pin only provides an indication for the high-temperature condition.

IREF Pin

The IREF pin is used to control the overcurrent monitoring threshold. A 100kΩ resistor connects from this pin to ground.

OCFG0, OCFG1 Input Pins

These two pins are used to define the configuration of the four output stages. They are connected to logic high (PWMVDD) or logic ground (PWMGND) to set their level. See ["Output Mode Configurations" on page 14](#) for additional reference and definition.

Protection

The D2-IPS family device includes monitors for protection of the system as well as the device itself. Certain levels of protection are managed on-chip, as shown in [Figure 10](#). Other protection is integrated at the system level through the system controller, and involves system design decisions based on:

- A short-circuit, over-temperature, or undervoltage event shuts down the outputs.
- Other operation depends on the PWM/system controller to properly manage full system protection operation.
- Power supply sensors shut down the device if supply voltages drop below their design thresholds.
- Overload and overcurrent monitors provide dual threshold status of high current conditions, providing both indication, and device shutdown if needed.
- Chip temperature monitoring provides dual threshold status of high temperature conditions, providing both indication, and device shutdown if needed.

Short-Circuit and Overcurrent Sensing

Each PWM output FET includes a dual-threshold overcurrent sensor. Multiple functions occur depending on detection of overcurrent conditions:

- The lower threshold is used to monitor fault conditions after the output stage filter inductor, such as shorts or overloads on the loudspeaker outputs.
- The higher threshold monitors fault conditions of the PWM output pin.
- The nERROR output asserts for the channel detecting the fault.
- For the lower level threshold, nERROR remains asserted only through the duration of the overcurrent event.
- For the higher level threshold, the output is shut down and its nERROR output is asserted. These outputs remain latched until the controller acknowledges the fault event by turning off the channel's PWM drive. (When the output is shutdown, its PWM output pin floats.)

Thermal Protection and Monitoring

An on-chip temperature sensor provides two temperature monitoring thresholds.

If the device reaches the lower threshold, the nOVRT output is asserted and provides a warning indication to an external controller. The low threshold setting provides indication only and does not have any effect on device operation.

- The lower high-temperature threshold (warning) is set at approximately +125°C.

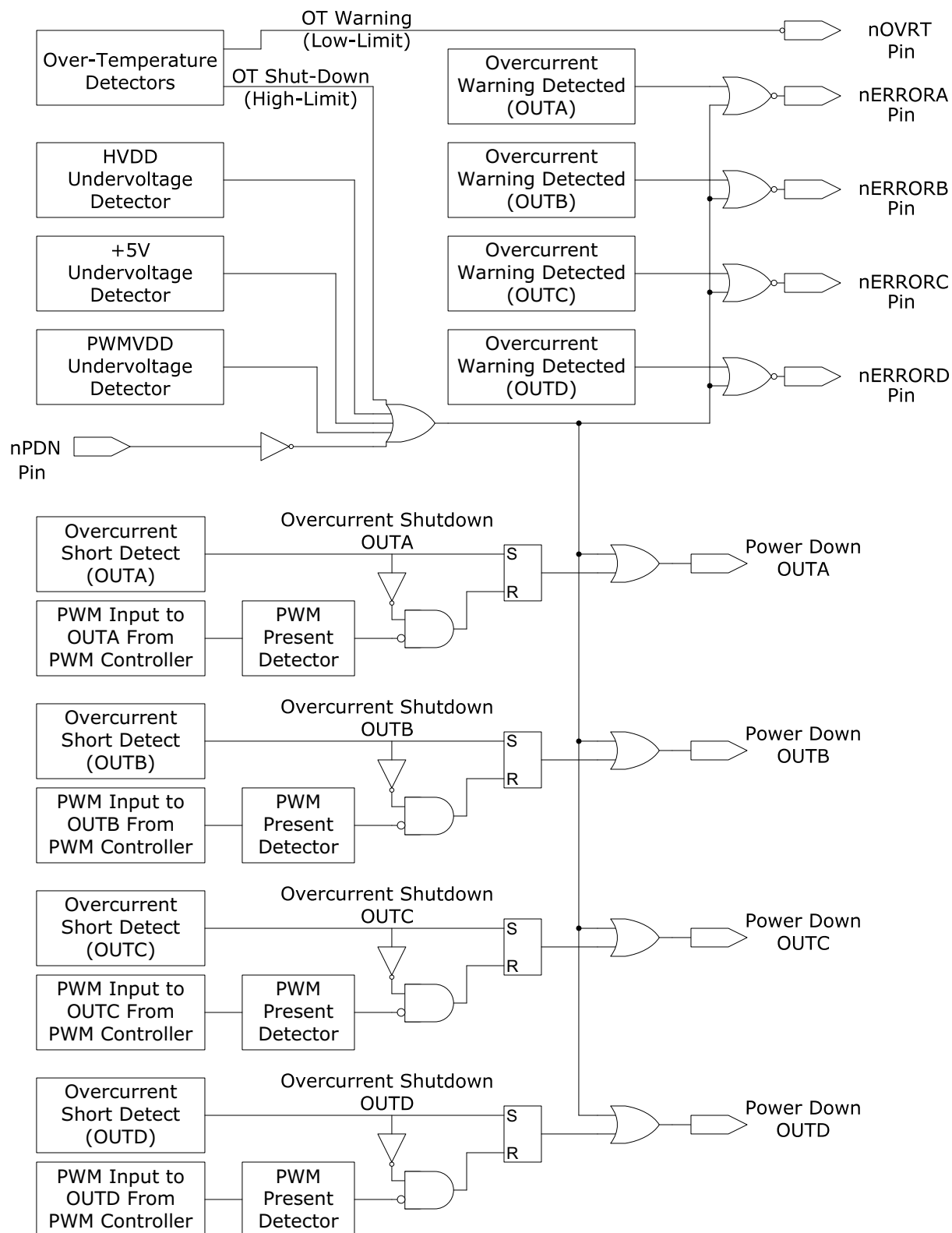
If the device reaches the higher threshold, it drives all four nERRORA-D outputs low (active) and shuts down the device, in addition to asserting the nOVRT output. This shutdown is non-latching, and operation resumes automatically when temperature returns to normal.

- The higher high-temperature threshold (over-temperature) is set at approximately +140°C.

Power Supply Voltage Monitoring

Undervoltage monitors are included for the output drive (HVDD) supply voltage, the on-chip generated gate drive (REG5V) supply voltage, and the low-level PWMVDD supply voltage. Detection occurs at approximately 2.5V for PWMVDD, approximately 4V for the gate drive supply, and approximately 7V for the HVDD supply. (Limits are listed in the electrical specification tables starting on [page 4](#).)

If any of the monitored voltages drop below their thresholds, the device shuts down its outputs and asserts all four of the nERROR outputs. Operation resumes normally after the undervoltage condition is cleared.



Overcurrent (OC) Shutdown: OC detect condition is latched, shutting down output. Latched shutdown is then cleared after overcurrent condition has cleared, AND PWM data clocking has stopped from PWM controller.

Output Mode Configurations

The D2-IPS family device supports four amplifier output configuration modes, utilizing the device's four power stage outputs.

Configuration selection is controlled by the OCFG0 and OCFG1 pins by connecting them to either a high (+3.3V, PWMVDD = 1) or low (ground = 0) level. Settings are chosen based on the output configuration and topology of the design. Their connections must be hard-connected on the design, and they must be dynamic or subject to change during system operation.

For each of the four configurations, the PWM input pin signals route to the individual FETs of each of the power stages to implement the channel drive and topology needed for those configurations. [Figures 11, 12, 13, and 14](#) show this routing of the PWM inputs to each of the power stages, and how the particular topology is implemented for that configuration. [Table 1](#) shows the configuration functions that are defined with the combinations of the OCFG pins, and these diagrams show the implementation that is listed in this table.

TABLE 1. D2-IPS FAMILY CONFIGURATION PWM AND OUTPUT CHANNEL ASSIGNMENTS

CONFIG PINS		CONFIG	CONFIGURATION DESCRIPTION	POWER STAGE OUTPUT				nERROR CHANNEL USE			
OCFG1	OCFG0			OUTA	OUTB	OUTC	OUTD	nERRORA	nERRORB	nERRORC	nERRORD
0	0	"00"	2-Channel Full Bridge 3-Level PWM Drive (Figure 11)	Output Channel 1		Output Channel 2		Connect (wire-or) nERRORA & nERRORB together. Use for Output Channel 1 Protect		Connect (wire-or) nERRORC & nERRORD together. Use for Output Channel 2 Protect	
				High-Side FET PWM Input Assignments							
				PWM1	PWM3	PWM5	PWM7				
				Low-Side FET PWM Input Assignments							
				PWM2	PWM4	PWM6	PWM8				
0	1	"01"	2-Channel Full Bridge, 2-Quadrant PWM Drive (Figure 12)	Output Channel 1		Output Channel 2		Connect (wire-or) nERRORA & nERRORB together. Use for Output Channel 1 Protect		Connect (wire-or) nERRORC & nERRORD together. Use for Output Channel 2 Protect	
				High-Side FET PWM Input Assignments							
				PWM1	PWM2	PWM3	PWM4				
				Low-Side FET PWM Input Assignments							
				PWM2	PWM1	PWM4	PWM3				
1	0	"10"	2-Channel Half-Bridge plus 1-Channel Full Bridge (Figure 13)	Output Ch. 1	Output Ch 2	Output Channel 3		nERRORA Use for Channel 1 Protect	nERRORB Use for Channel 2 Protect	Connect (wire-or) nERRORC & nERRORD together. Use for Output Channel 3 Protect	
				High-Side FET PWM Input Assignments							
				PWM1	PWM3	PWM5	PWM6				
				Low-Side FET PWM Input Assignments							
				PWM2	PWM4	PWM6	PWM5				
1	1	"11"	4-Channel Half-Bridge (Figure 14)	Output Ch. 1	Output Ch 2	Output Ch. 3	Output Ch 4	nERRORA Use for Channel 1 Protect	nERRORB Use for Channel 2 Protect	nERRORC Use for Channel 3 Protect	nERRORD Use for Channel 4 Protect
				High-Side FET PWM Input Assignments							
				PWM1	PWM3	PWM5	PWM7				
				Low-Side FET PWM Input Assignments							
				PWM2	PWM4	PWM6	PWM8				

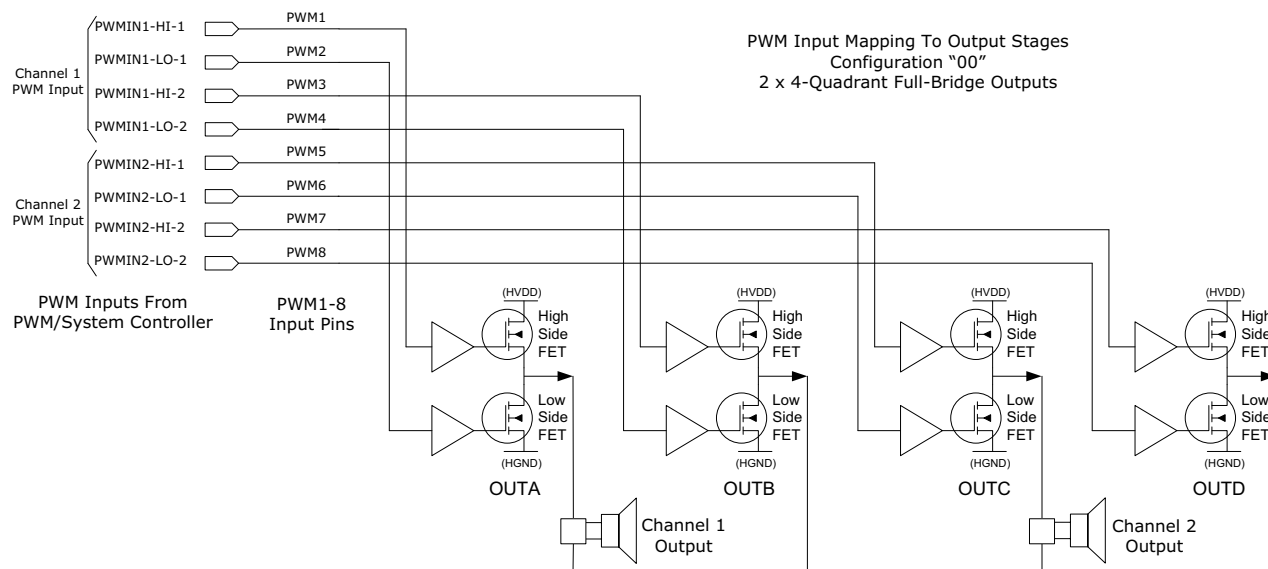


FIGURE 11. CONFIGURATION "00" PWM INPUT-TO-OUTPUT POWER STAGE MAPPING

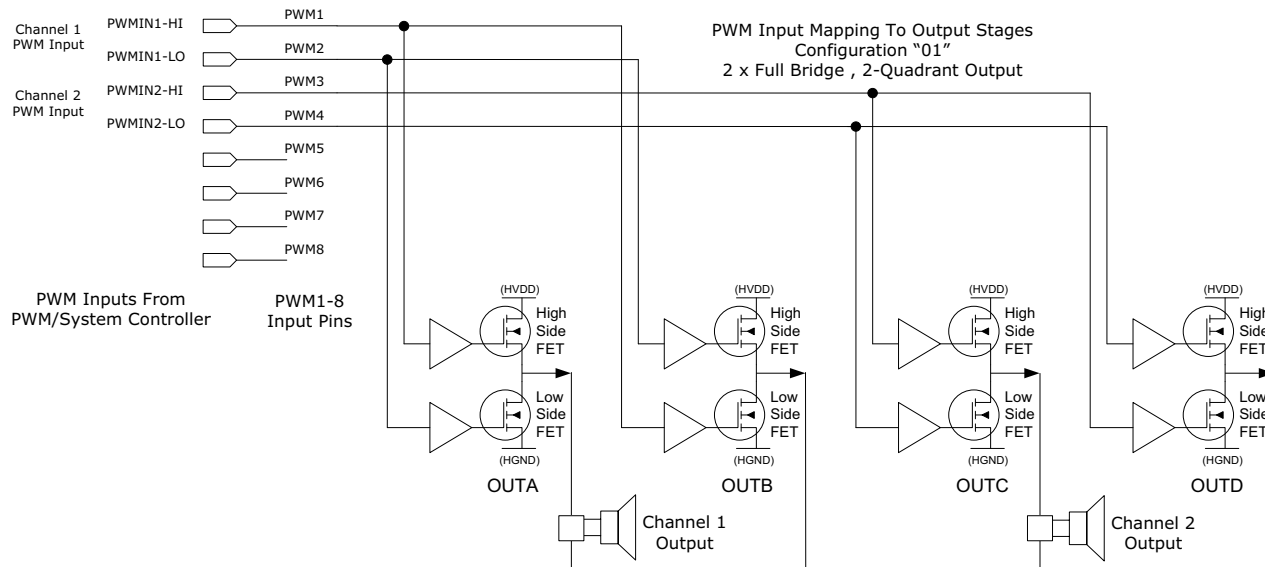


FIGURE 12. CONFIGURATION "01" PWM INPUT-TO-OUTPUT POWER STAGE MAPPING

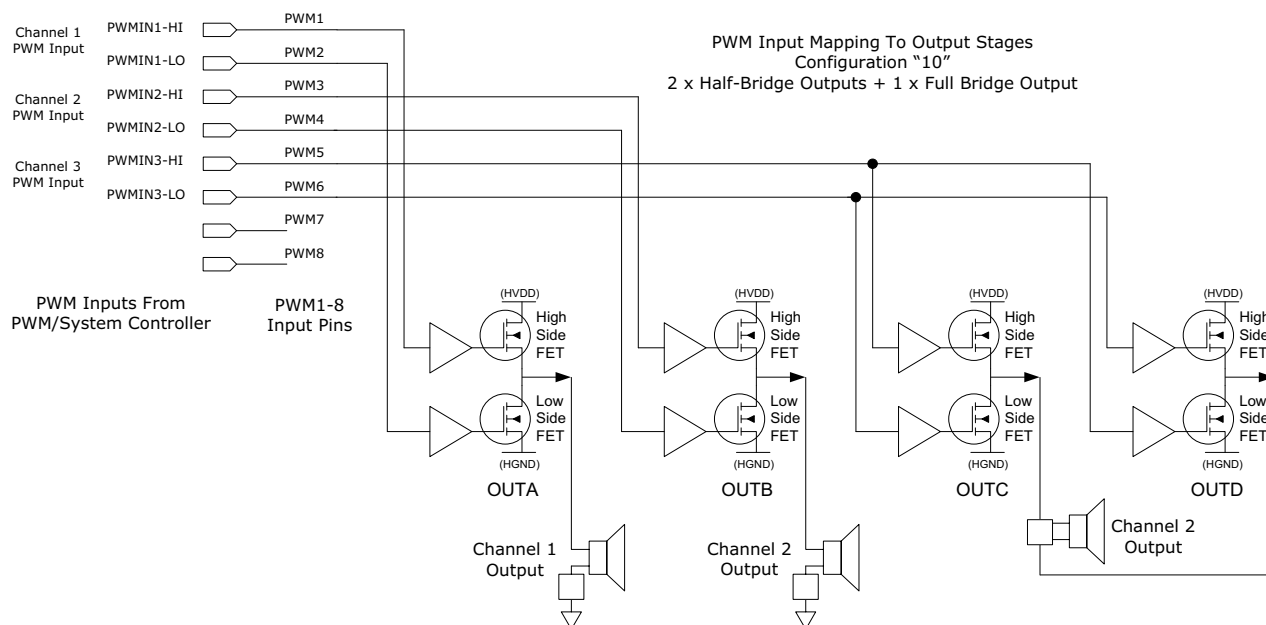


FIGURE 13. CONFIGURATION "10" PWM INPUT-TO-OUTPUT POWER STAGE MAPPING

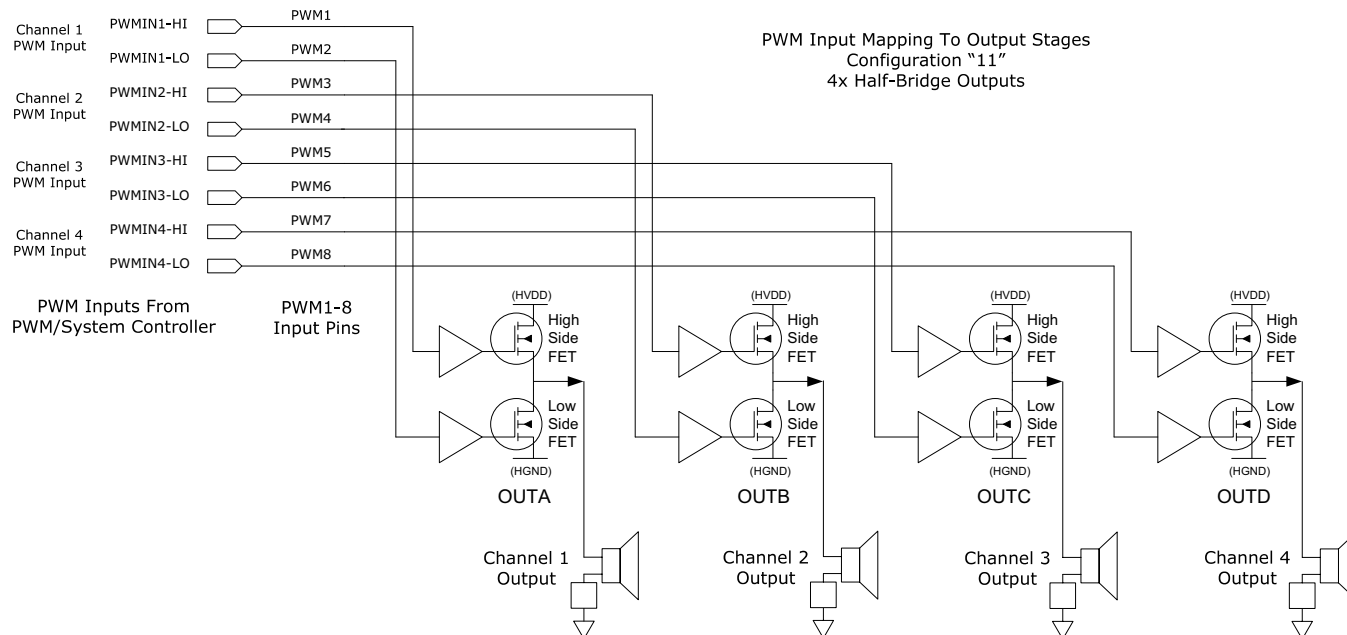


FIGURE 14. CONFIGURATION "11" PWM INPUT-TO-OUTPUT POWER STAGE MAPPING

Typical Application Examples

These examples show functional circuit examples of typical applications using the D2-IPS family device. (Note: These examples are provided to show typical applications only and are not intended to represent complete production-qualified reference designs.)

2-Channel Full Bridge Example

This example ([Figure 15](#)) uses configuration mode "01" to provide two full-bridge loudspeaker output channels. The PWM controller provides input into four PWM input pins.

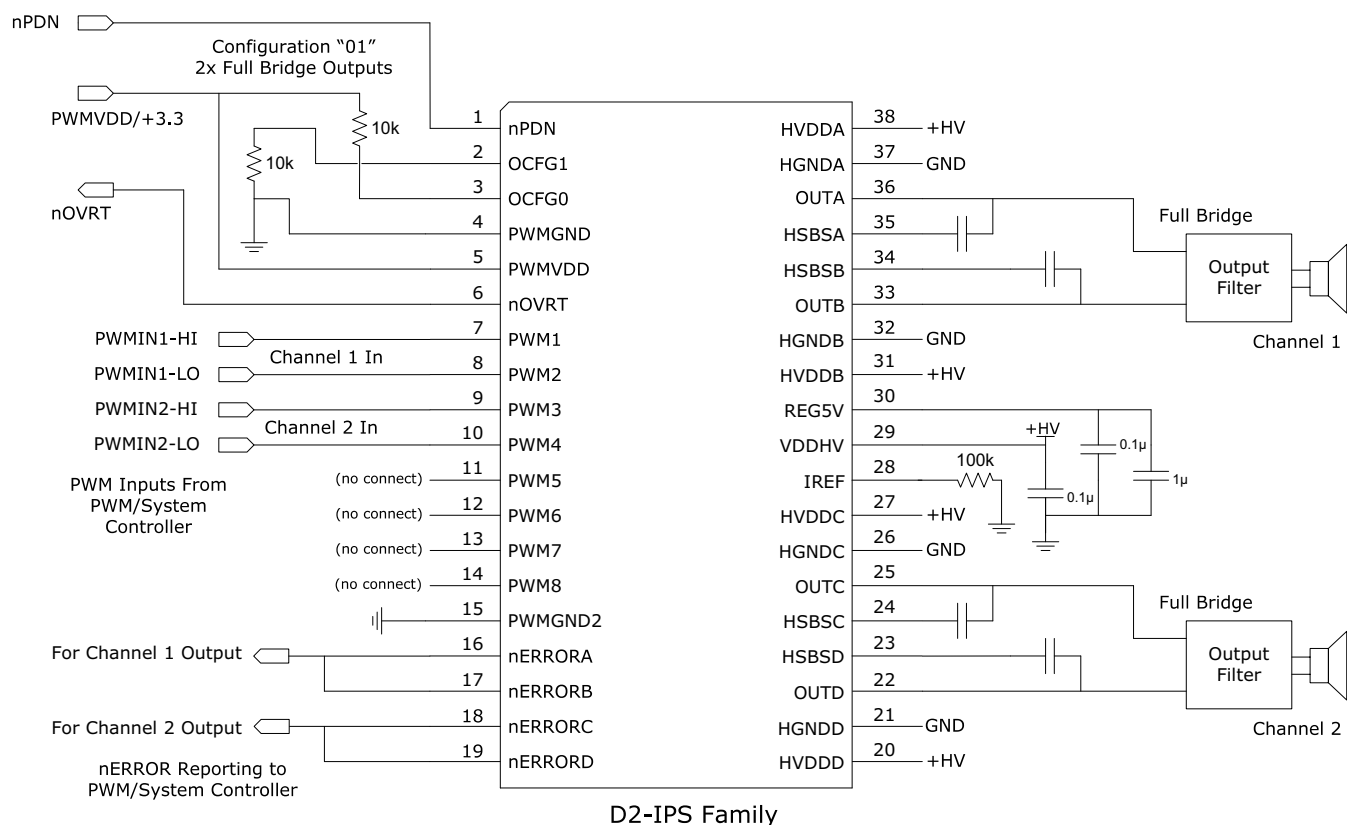


FIGURE 15. 2-CHANNEL FULL BRIDGE EXAMPLE

2.1-Channel Example

This example (Figure 16) uses configuration mode "10" to provide two independent half-bridge loudspeaker output channels, plus one full-bridge loudspeaker output channel. The PWM controller provides input into all eight PWM input pins.

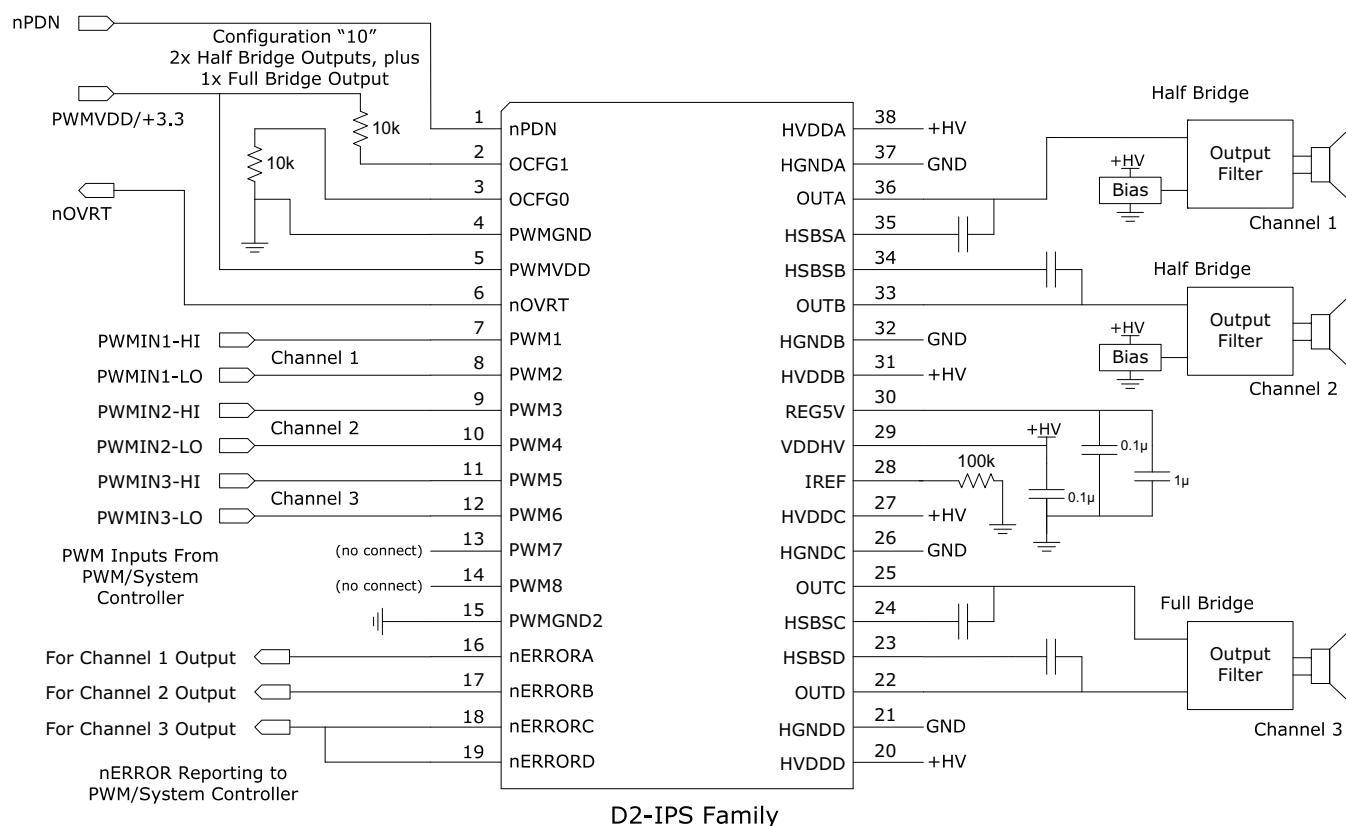


FIGURE 16. 2-CHANNEL HALF BRIDGE PLUS 1-CHANNEL FULL BRIDGE EXAMPLE

4-Channel Half-Bridge Example

This example (Figure 17) uses configuration mode "11" to provide four independent half-bridge loudspeaker output channels. The PWM controller provides input into all eight PWM input pins.

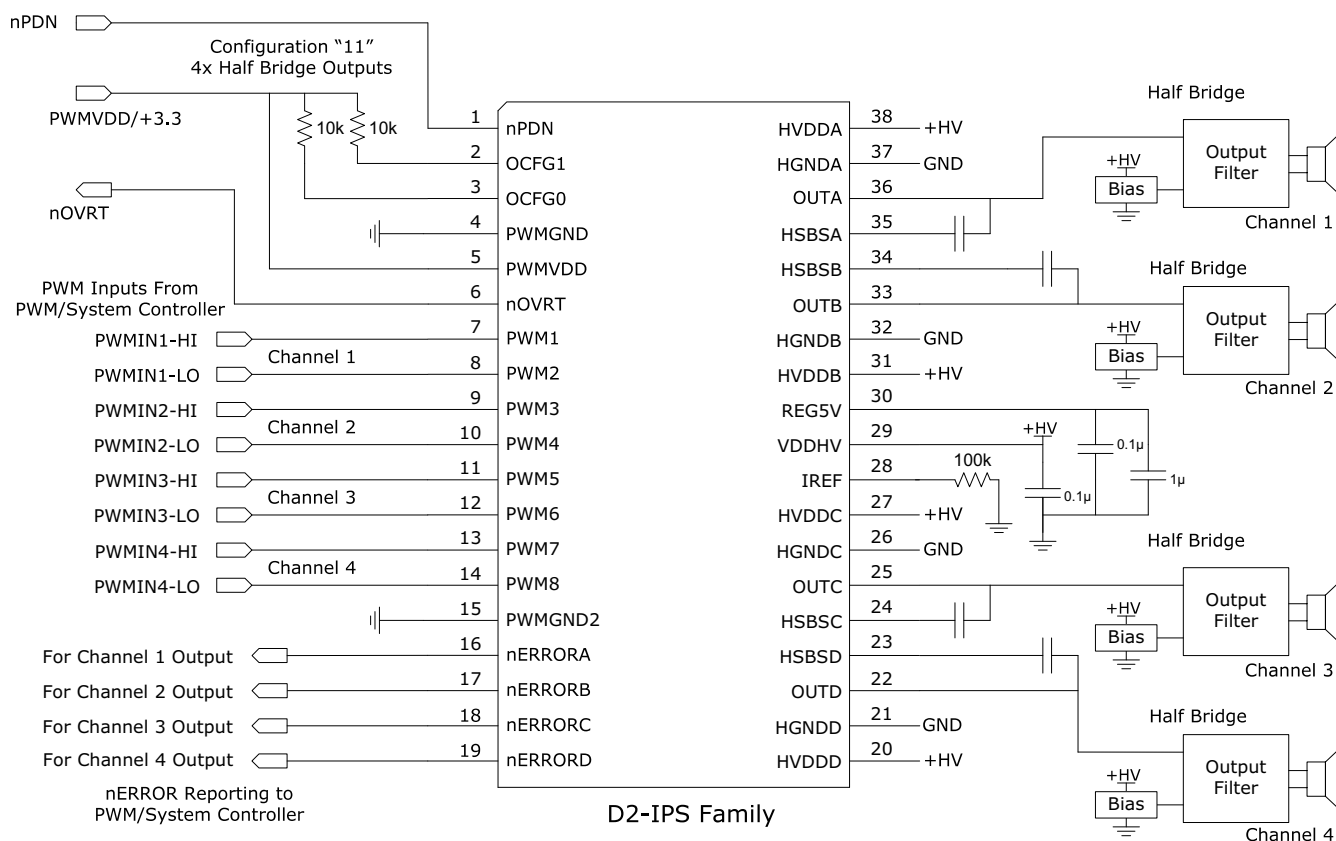


FIGURE 17. 4-CHANNEL HALF BRIDGE EXAMPLE

Revision History

The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Visit our website to make sure you have the latest datasheet revision.

DATE	REVISION	CHANGE
Mar 18, 2019	FN7678.1	Updated title to "D2-IPS Audio SOC". Updated "D2-24044" to "D2 IPS Family". Removed About Intersil section. Updated disclaimer.
Sep 3, 2010	FN7678.0	Initial Release

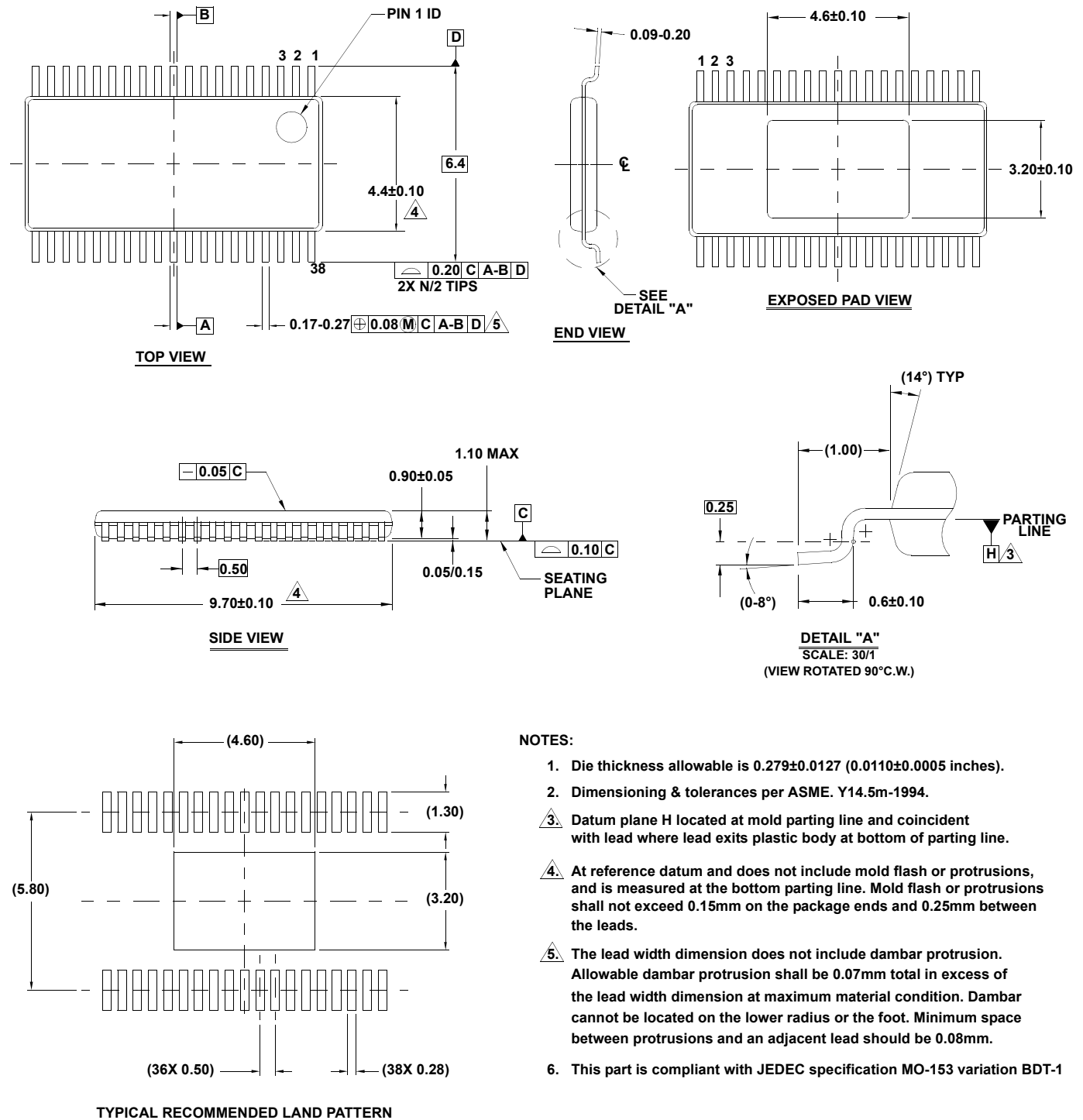
Package Outline Drawing

For the most recent package outline drawing, see [M38.173C](#).

M38.173C

38 LEAD HEAT-SINK THIN SHRINK SMALL OUTLINE PLASTIC PACKAGE (HTSSOP)

Rev 0, 4/10



NOTES:

1. Die thickness allowable is 0.279±0.0127 (0.0110±0.0005 inches).
2. Dimensioning & tolerances per ASME. Y14.5m-1994.
3. Datum plane H located at mold parting line and coincident with lead where lead exits plastic body at bottom of parting line.
4. At reference datum and does not include mold flash or protrusions, and is measured at the bottom parting line. Mold flash or protrusions shall not exceed 0.15mm on the package ends and 0.25mm between the leads.
5. The lead width dimension does not include dambar protrusion. Allowable dambar protrusion shall be 0.07mm total in excess of the lead width dimension at maximum material condition. Dambar cannot be located on the lower radius or the foot. Minimum space between protrusions and an adjacent lead should be 0.08mm.
6. This part is compliant with JEDEC specification MO-153 variation BDT-1

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.

6. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.