

## IRS2053MPbF 3 CH Digital Audio Amplifier

### Features

- 3 channel integrated analog input Class D audio amplifier drivers
- Versatile protection control enabling latched, non-latched, or host controlled shutdown function
- DC offset detection input
- Clipping detection
- Thermal sensor inputs
- Fault output
- Programmable over current protection
- Programmable dead-time generation
- Startup click noise reduction
- Under voltage protection
- High noise immunity
- RoHS compliant

### Note

The IRS2053M digital audio driver is a three channel Class D audio driver housed in a 48 pin MLPQ. The IRS2053M features clipping detection outputs, DC offset detection input, over temperature sensor inputs and a fault reporting output.

### Product Summary

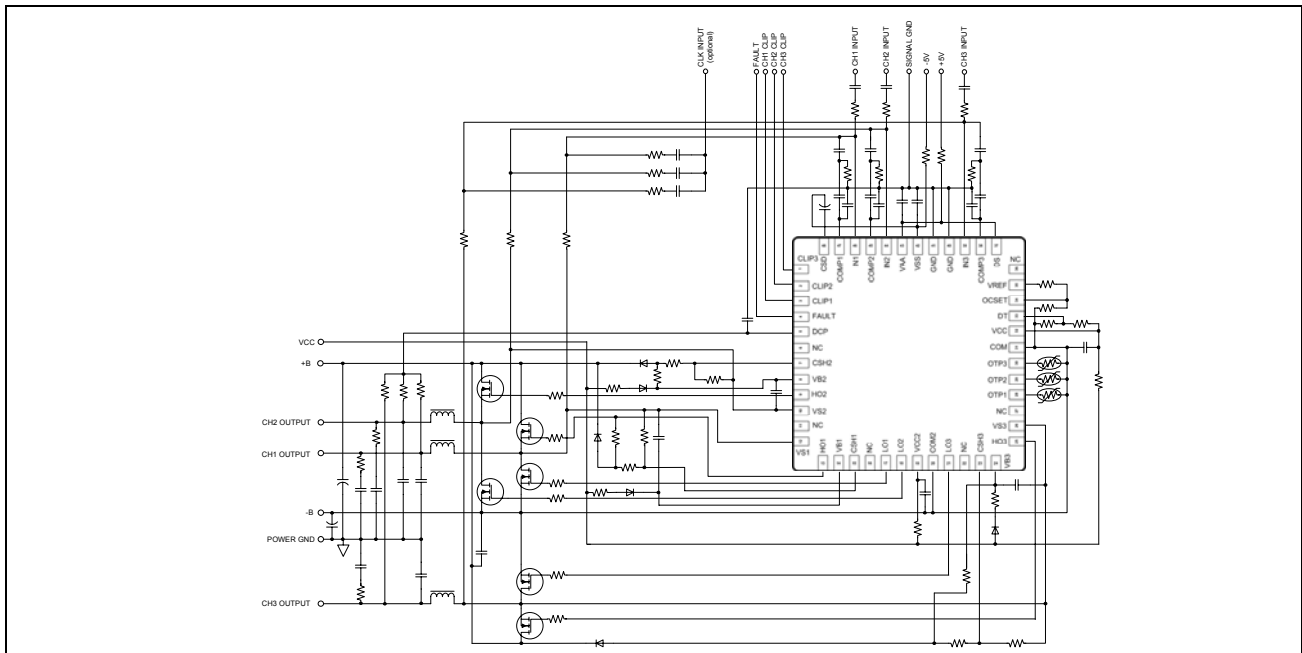
Topology	Half-Bridge
$V_{\text{OFFSET (max)}}$	+/- 100 V
$I_{\text{O+}} & I_{\text{O-}}$ (typical)	0.5 A & 0.6 A
Selectable deadtime	45/65/85/105 ns
DC offset	<20 mV
Error amplifier open loop gain	>60 dB

### Package



MLPQ48 (7x7 mm, 0.50 mm pitch)

### Typical Connection



<b>Table of Contents</b>	<b>Page</b>
Description	3
Qualification Information	4
Absolute Maximum Ratings	5
Recommended Operating Conditions	7
Electrical Characteristics	8
Functional Block Diagram	12
Input/Output Pin Equivalent Circuit Diagram	13
Lead Definitions	15
Lead Assignments	16
Application Information and Additional Details	17
Package Details	19
Tape and Reel Details	20
Part Marking Information	21
Ordering Information	22

## **Description**

The IRS2053 integrates three channels of high voltage, high performance Class D audio amplifier drivers with PWM modulators and protections. In conjunction with external MOSFET and external components, a complete 3 channel Class D audio amplifier can be realized. The IRS2053 is designed with floating analog inputs and protection control interface pin especially for half bridge topology. High and low side MOSFET are protected from over current conditions by a programmable bi-directional current sensing. Essential elements of PWM modulator section allow flexible system design. A small MLPQ48 package enhances the benefit of smaller size of Class D topology.

**Qualification Information<sup>†</sup>**

<b>Qualification Level</b>		Industrial <sup>††</sup>
		Comments: This family of ICs has passed JEDEC's Industrial qualification. IR's Consumer qualification level is granted by extension of the higher Industrial level.
<b>Moisture Sensitivity Level</b>		MSL2 <sup>†††</sup> , 260°C (per IPC/JEDEC J-STD-020)
<b>ESD</b>	<b>Machine Model</b>	Class A (per JEDEC standard EIA/JESD22-A115)
	<b>Human Body Model</b>	Class 1C (per EIA/JEDEC standard JESD22-A114)
<b>IC Latch-Up Test</b>		Class I, Level A (per JESD78A)
<b>RoHS Compliant</b>		Yes

† Qualification standards can be found at International Rectifier's web site <http://www.irf.com/>

†† Higher qualification ratings may be available should the user have such requirements. Please contact your International Rectifier sales representative for further information.

††† Higher MSL ratings may be available for the specific package types listed here. Please contact your International Rectifier sales representative for further information.

**Absolute Maximum Ratings**

Absolute Maximum Ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute voltages referenced to COM; all currents are defined positive into any lead. The Thermal Resistance and Power Dissipation ratings are measured under board mounted and still air conditions.

Symbol	Definition	Min.	Max.	Units
$V_{Bn}$	High side floating supply voltage	-0.3	215	V
$V_{Sn}$	High side floating supply voltage <sup>††</sup> , n=1-3	$V_{Bn} - 15$	$V_{Bn} + 0.3$	V
$V_{Hon}$	High side floating output voltage, n=1-3	$V_{Sn} - 0.3$	$V_{Bn} + 0.3$	V
$V_{CSHn}$	CSH pin input voltage, n=1-3	$V_{Sn} - 0.3$	$V_{Bn} + 0.3$	V
$V_{CCn}$	Low side fixed supply voltage <sup>††</sup> , n=1-2	-0.3	20	V
$V_{LOn}$	Low side output voltage, n=1-3	-0.3	VCC2 + 0.3	V
$V_{AA}$	Floating input positive supply voltage <sup>††</sup>	(See $I_{AAZ}$ )	210	V
$V_{SS}$	Floating input negative supply voltage <sup>††</sup>	-1 (See $I_{SSZ}$ )	GND + 0.3	V
$V_{GND}$	Floating input supply ground voltage	$V_{SS} - 0.3$ (See $I_{SSZ}$ )	$V_{AA} + 0.3$ (See $I_{AAZ}$ )	V
COM2	Low side output supply return	-0.3	+0.3	V
$I_{IN-n}$	Inverting input current <sup>†</sup> , n=1-3	-	±3	mA
$V_{CSD}$	SD pin input voltage	$V_{SS} - 0.3$	$V_{AA} + 0.3$	V
$V_{COMPn}$	COMP pin input voltage, n=1-3	$V_{SS} - 0.3$	$V_{AA} + 0.3$	V
$V_{DS}$	DS pin input voltage	$V_{SS} - 0.3$	$V_{AA} + 0.3$	V
$V_{CLIPn}$	CLIP pin input voltage	$V_{SS} - 0.3$	$V_{AA} + 0.3$	V
$I_{CLIPn}$	CLIP pin sinking current	-	5	mA
$V_{FAULT}$	FAULT pin input voltage	$V_{SS} - 0.3$	$V_{AA} + 0.3$	V
$I_{FAULT}$	FAULT pin sinking current	-	5	mA
$V_{DCP}$	DCP pin input voltage	(See $I_{DCP}$ )	(See $I_{DCP}$ )	V
$I_{DCP}$	DCP pin sinking/sourcing current	-1	1	mA
$V_{DT}$	DT pin input voltage	-0.3	$V_{CC} + 0.3$	V
$V_{OCSET}$	OCSET pin input voltage	-0.3	$V_{CC} + 0.3$	V
$V_{OTPN}$	OTP pin input voltage	-0.3	$V_{CC} + 0.3$	V
$I_{AAZ}$	Floating input positive supply zener clamp current	-	20	mA
$I_{SSZ}$	Floating input negative supply zener clamp current	-	20	mA
$I_{CCZn}$	Low side supply zener clamp current <sup>†††</sup> , n=1-2	-	10	mA
$I_{BSZn}$	Floating supply zener clamp current <sup>†††</sup> , n=1-3	-	10	mA
$I_{OREF}$	Reference output current	-	5	mA
$dV_{Sn}/dt$	Allowable $V_s$ voltage slew rate, n=1-3	-	50	V/ns
$dV_{SS}/dt$	Allowable $V_{ss}$ voltage slew rate <sup>†††</sup>	-	50	V/ms

**Absolute Maximum Ratings (cont'd)**

Symbol	Definition	Min.	Max.	Units
Pd	Maximum power dissipation @ $T_A \leq +25^\circ\text{C}$	-	6.2	W
RthJA	Thermal resistance, Junction to ambient <sup>††††</sup>	-	20	°C/W
RthJC	Thermal resistance, Junction to case	-	3	°C/W
Tj	Junction Temperature	-	150	°C
Ts	Storage Temperature	-55	150	°C
Tl	Lead temperature (Soldering, 10 seconds)	-	300	°C

† IN-1-3 contains clamping diode to GND.

†† VAA-VSS, Vcc1-COM, Vcc2-COM2, VB1-VS1, VB2-VS2 and VB3-VS3 contain internal shunt zener diodes. Please note that the voltage ratings of these can be limited by the clamping current.

††† For the rising and falling edges of step signal of 10V. Vss=15V to 200V.

†††† According to JESD51-5. JEDEC still air chamber.

**Recommended Operating Conditions**

For proper operation, the device should be used within the recommended conditions below. The Vs and COM offset ratings are tested with supplies biased at  $V_{AA}-V_{SS}=10V$ ,  $V_{CC}=12V$  and  $V_B-V_S=12V$ . All voltage parameters are absolute voltages referenced to COM; all currents are defined positive into any lead.

Symbol	Definition	Min.	Max.	Units
$V_{Bn}$	High side floating supply absolute voltage, n=1-3	$V_{Sn} + 10$	$V_{Sn} + 14$	V
$V_{Sn}$	High side floating supply offset voltage	†	200	V
$I_{AAZ}$	Floating input positive supply zener clamp current	1	11	mA
$I_{SSZ}$	Floating input negative supply zener clamp current	1	11	mA
$V_{SS}$	Floating input supply absolute voltage	0	200	V
$V_{HOn}$	High side floating output voltage, n=1-3	$V_S$	$V_B$	V
$V_{CC}$	Low side fixed supply voltage	10	15	V
$V_{LOn}$	Low side output voltage, n=1-3	0	$V_{CC}2$	V
$V_{GND}$	GND pin input voltage	$V_{SS}^{+++}$	$V_{AA}^{+++}$	V
$V_{IN-n}$	Inverting input voltage, n=1-3	$V_{GND} - 0.5$	$V_{GND} + 0.5$	V
$V_{CSD}$	CSD pin input voltage	$V_{SS}$	$V_{AA}$	V
$V_{COMPn}$	COMP pin input voltage, n=1-3	$V_{SS}$	$V_{AA}$	V
$C_{COMPn}$	COMP pin phase compensation capacitor to GND, n=1-3	1	-	nF
$V_{DT}$	DT pin input voltage	0	$V_{CC}$	V
$I_{OREF}$	Reference output current to COM <sup>††</sup>	0.3	0.8	mA
$V_{OCSET}$	OCSET pin input voltage	0.5	5	V
$V_{CSHn}$	CSH pin input voltage, n=1-3	$V_{Sn}$	$V_{Bn}$	V
dVss/dt	Allowable Vss voltage slew rate upon power-up <sup>++++</sup>	-	50	V/ms
$f_{SW}$	Switching Frequency	-	800	kHz
$T_A$	Ambient Temperature	-40	125	°C

† Logic operational for Vsn equal to -5V to +200V. Logic state held for Vsn equal to -5V to - $V_{BSn}$ .

†† Nominal voltage for  $V_{REF}$  is 5.1V.  $I_{OREF}$  of 0.3 – 0.8mA dictates total external resistor value on VREF to be 6.3k to 16.7k ohm.

+++ GND input voltage is limited by  $I_{IN-n}$ .

++++ Vss ramps up from 0V to 200V.

**Electrical Characteristics**

$V_{CC}=V_{CC2}=V_{BS1}=V_{BS2}=V_{BS3}=12V$ ,  $V_{SS}=V_{S1}=V_{S2}=V_{S3}=COM=0V$ ,  $V_{GND}=5V$ ,  $V_{AA}=10V$ ,  $C_L=1nF$  and  $T_A=25^\circ C$  unless otherwise specified.

Symbol	Definition	Min	Typ	Max	Units	Test Conditions
<b>Low Side Supply 1</b>						
$UV_{CC+}$	Vcc supply UVLO positive threshold	8.4	8.9	9.4	V	
$UV_{CC-}$	Vcc supply UVLO negative threshold	8.2	8.7	9.2	V	
$UV_{CCHYS}$	$UV_{CC}$ hysteresis	-	0.2	-	V	
$I_{QCC}$	Low side quiescent current	-	5	8	mA	$V_{DT}=V_{CC}$
$V_{CLAMPL1}$	Low side zener diode clamp voltage	19.0	20.4	21.6	V	$I_{CC1}=10mA$
<b>Low Side Supply 2</b>						
$I_{QCC2}$	Low side quiescent current	-	4.2	8	mA	
$V_{CLAMPL2}$	Low side zener diode clamp voltage	19.6	20.4	21.6	V	$I_{CC2}=10mA$
<b>High Side Floating Supply</b>						
$UV_{BS+n}$	High side well UVLO positive threshold, n=1-3	8.0	8.5	9.0	V	
$UV_{BS-n}$	High side well UVLO negative threshold, n=1-3	7.8	8.3	8.8	V	
$UV_{BSHYSn}$	$UV_{BS}$ hysteresis, n=1-3	-	0.2	-	V	
$I_{QBSn}$	High side quiescent current, n=1-3	-	0.5	1	mA	
$I_{LKHn}$	High to Low side leakage current, n=1-3	-	-	50	$\mu A$	$V_{Bn}=V_{Sn}=200V$
$V_{CLAMPn}$	High side zener diode clamp voltage, n=1-3	14.7	15.3	16.2	V	$I_{BSn}=5mA$
<b>Floating Input Supply</b>						
$UV_{AA+}$	$VA+$ , $VA-$ floating supply UVLO positive threshold from $V_{SS}$	8.2	8.7	9.2	V	GND pin floating
$UV_{AA-}$	$VA+$ , $VA-$ floating supply UVLO negative threshold from $V_{SS}$	7.7	8.2	8.7	V	GND pin floating
$UV_{AAHYS}$	$UV_{AA}$ hysteresis	-	0.5	-	V	GND pin floating
$I_{QAA0}$	Floating Input positive quiescent supply current in shutdown mode	-	1	3	mA	$V_{CSD}=V_{SS}$
$I_{QAA10}$	Floating Input positive quiescent supply current, positive input	-	12	25	mA	$V_{IN-}=V_{SS}+5.2V$
$I_{QAA11}$	Floating Input positive quiescent supply current, negative input	-	9	20	mA	$V_{IN-}=V_{SS}+4.8V$
$I_{QAA2}$	Floating Input positive quiescent supply current in start-up mode	-	20	35	mA	$V_{CSD}=V_{SS}+5.0V$
$I_{LKM}$	Floating input side to Low side leakage current	-	-	50	$\mu A$	$V_{AA}=V_{SS}=V_{GND}=100V$
$V_{CLAMPM}$	Floating supply zener diode clamp voltage	19.6	20.4	21.6	V	$I_{AA}=5mA$ , $V_{CSD}=V_{SS}$



**Electrical Characteristics (cont'd)**

Symbol	Definition	Min	Typ	Max	Units	Test Conditions
<b>Audio Input</b> ( $V_{GND}=0$ , $V_{AA}=5V$ , $V_{SS}=-5V$ , $COM=COM2=VCC=VCC2=-5V$ , $VS1=VS2=VS3=-5V$ , $CSH1=CSH2=CHS3=-5V$ , $DT=OCSET=-5V$ )						
$V_{OSn}$	CHn input offset voltage, n=1-3	-18	0	18	mV	
$I_{BINn}$	CHn input bias current, n=1-3	-	-	40	nA	
GBWn	CHn small signal bandwidth	-	9	-	MHz	$C_{COMPn}=1nF$ , $Rfn=0$
$V_{COMPn}$	CHn OTA Output voltage, n=1-3	$V_{AA}-1$	-	$V_{SS}+1$	V	
$g_{mn}$	CHn OTA transconductance, n=1-3	-	100	-	mS	$V_{IN-n}=10mV$
$G_{Vn}$	CHn OTA gain, n=1-3	60	-	-	dB	
$V_{Nrmsn}$	CHn OTA input noise voltage, n=1-3	-	250	-	mVrms	BW=20kHz, Resolution BW=22Hz Fig.5
SRn	CHn slew rate, n=1-3	-	$\pm 5$	-	V/us	$C_{COMPn}=1nF$
CMRRn	CHn common-mode rejection ratio, n=1-3	-	60	-	dB	
PSRRn	CHn supply voltage rejection ratio, n=1-3	-	65	-	dB	
$V_{th+CLIPn}$	CHn clip detection positive threshold, n=1-3	$0.85xV_{AA}$	$0.90xV_{AA}$	$0.95xV_{AA}$	V	
$V_{th-CLIPn}$	CHn clip detection negative threshold, n=1-3	$0.05xV_{AA}$	$0.10xV_{AA}$	$0.15xV_{AA}$	V	
$t_{CLIPn}$	CHn clipping detection propagation delay, n=1-3	-	40	-	ns	
$t_{CLIPmin}$	CHn clipping detection minimum output duration	-	3	-	us	
<b>PWM comparator</b>						
$V_{thPVM}$	PWM comparator threshold in COMP	-	$(V_{AA} - V_{SS})/2$	-	V	
$f_{OTAn}$	CHn COMP pin star-up local oscillation frequency, n=1-3	0.6	1.0	-	MHz	$V_{CSD} = V_{SS}+5V$

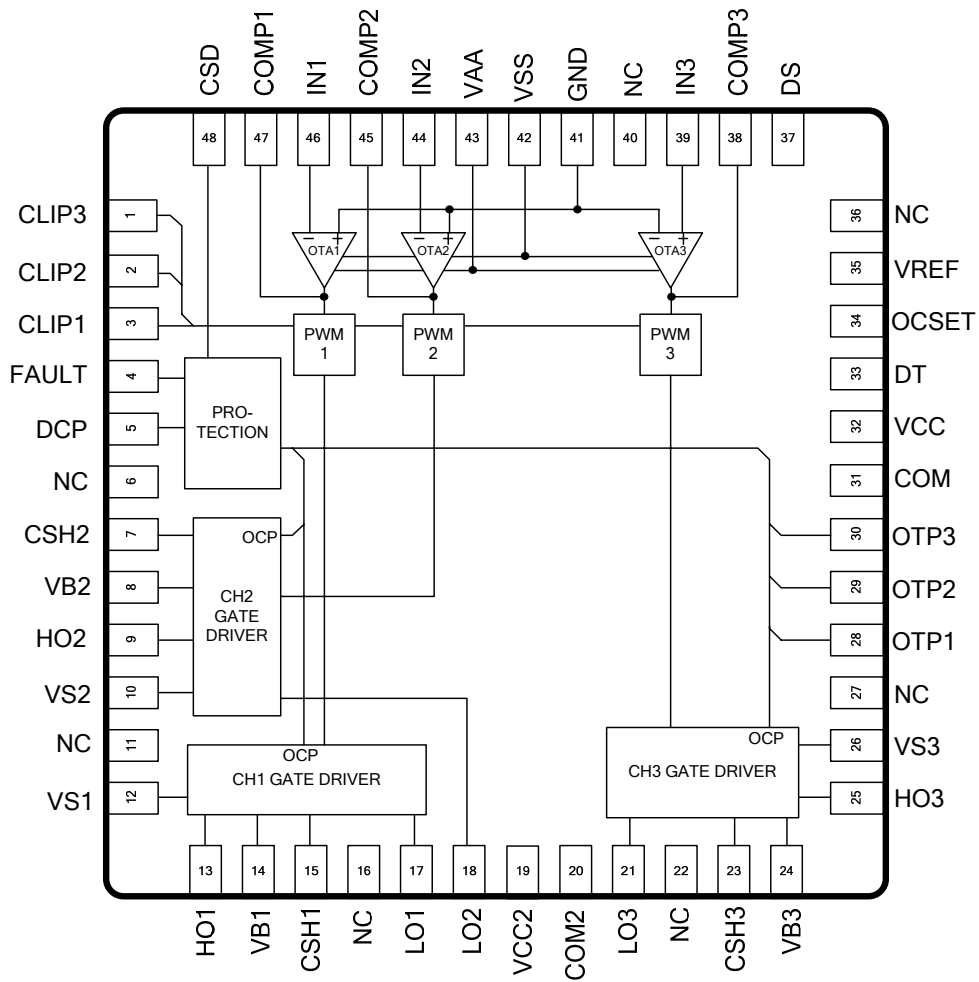
**Electrical Characteristics (cont'd)**

Symbol	Definition	Min	Typ	Max	Units	Test Conditions
<b>Protection</b>						
$V_{REF}$	Reference output voltage	4.8	5.1	5.4	V	$I_{OREF} = 0.5mA$
$V_{th_{OCLn}}$	CHn low side OC threshold in $V_{sn}$ , n=1-3	1.1	1.2	1.3	V	OCSET=1.2V
$V_{th_{OCHn}}$	CHn high side OC threshold in $V_{CSHn}$ , n=1-3	1.1+ Vs	1.2+ Vs	1.3+ Vs	V	Vs=200V
$V_{DCP+}$	DCP pin positive detecting threshold		1.3		V	
$V_{DCP-}$	DCP pin negative detecting threshold		-1.3		V	
$V_{DCPZ+}$	DCP pin positive clamping voltage		3.0		V	
$V_{DCPZ-}$	DCP pin negative clamping voltage		-2.5		V	
$V_{OTPN}$	CHn OTP pin threshold, n=1-3		2.8		V	
$I_{OTPN}$	CHn OTP bias sourcing current, n=1-3		0.6		mA	OTPN=0V
$V_{CSDH}$	CSD pin shutdown release threshold	$0.62xV_{AA}$	$0.70xV_{AA}$	$0.78xV_{AA}$	V	
$V_{CSDL}$	CSD pin self reset threshold	$0.26xV_{AA}$	$0.30xV_{AA}$	$0.34xV_{AA}$	V	
$I_{CSD+}$	CSD pin discharge current	70	100	130	$\mu A$	$V_{CSD} = V_{SS} + 5V$
$I_{CSD-}$	CSD pin charge current	70	100	130	$\mu A$	$V_{CSD} = V_{SS} + 5V$
$t_{SDn}$	CHn shutdown propagation delay from $V_{CSD} > V_{SS} + V_{th_{OCH}}$ to Shutdown	-	-	250	ns	
$t_{OCHn}$	CHn propagation delay time from $V_{CSHn} > V_{th_{OCHn}}$ to Shutdown, n=1-3	-	-	500	ns	Fig.4
$t_{OCLn}$	CHn propagation delay time from $V_{sn} > V_{th_{OCL}}$ to Shutdown, n=1-3	-	-	500	ns	Fig.3
$t_{OCLFAULT}$	CH1 propagation delay time from $V_{s1} > V_{th_{OCL}}$ to FAULT	-	285	-	ns	

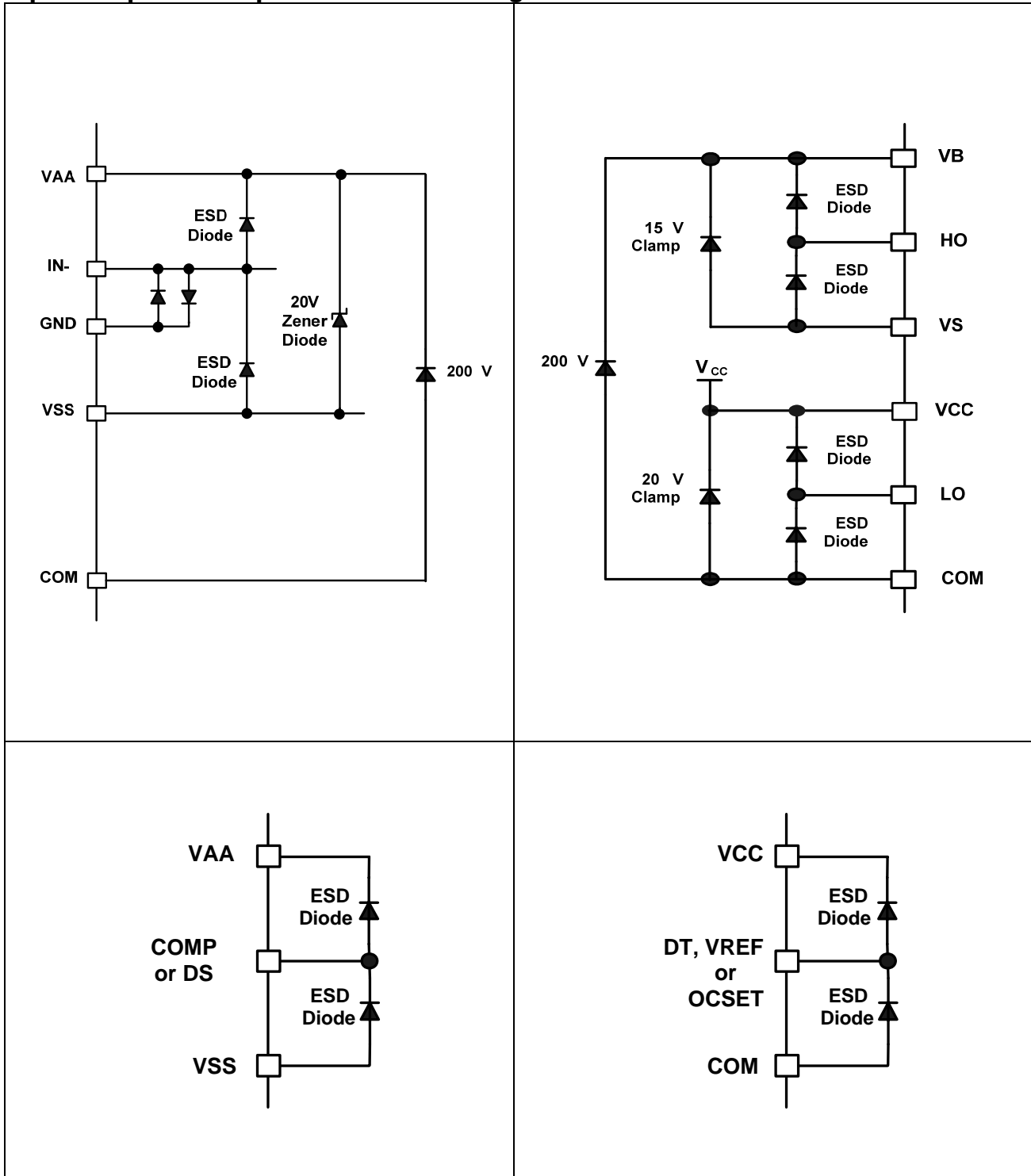
**Electrical Characteristics (cont'd)**

Symbol	Definition	Min	Typ	Max	Units	Test Conditions
<b>Gate Driver</b>						
$I_{o+n}$	CHn output high short circuit current (Source), n=1-3	-	0.5	-	A	$V_o=0V$ , $PW \leq 10\mu S$
$I_{o-n}$	CHn output low short circuit current (Sink), n=1-3	-	0.6	-	A	$V_o=12V$ , $PW \leq 10\mu S$
$V_{OLn}$	CHn low level out put voltage LO – COM, HO - VS, n=1-3	-	-	0.1	V	$I_o=0A$
$V_{OHn}$	CHn high level out put voltage VCC – LO, VB - HO, n=1-3	-	-	1.4	V	
$T_{on0n}$	CHn high and low side turn-on propagation delay, n=1-3	-	350	-	ns	$V_{DT} = V_{CC}, V_{DS}=V_{AA}$
$T_{off0n}$	CHn high and low side turn-off propagation delay, n=1-3	-	325	-	ns	
$T_{on1n}$	CHn high and low side turn-on propagation delay, n=1-3	-	145	-	ns	$V_{DT} = V_{CC}, V_{DS}=V_{SS}$
$T_{off1n}$	CHn high and low side turn-off propagation delay, n=1-3	-	100	-	ns	
$t_r$	Turn-on rise time	-	25	50	ns	
$t_f$	Turn-off fall time	-	20	40	ns	
$DT1n$	CHn deadtime: LOn turn-off to HOn turn-on ( $DT_{LO-HO}$ ) & HOn turn-off to LnO turn-on ( $DT_{HO-LO}$ )	30	45	60	ns	$V_{DT} > V_{DT1}$ ,
$DT2n$	CHn deadtime: LOn turn-off to HOn turn-on ( $DT_{LO-HO}$ ) & HOn turn-off to LOn turn-on ( $DT_{HO-LO}$ )	45	65	85	ns	$V_{DT1} > V_{DT} > V_{DT2}$ ,
$DT3n$	CHn deadtime: LOn turn-off to HOn turn-on ( $DT_{LO-HO}$ ) & HOn turn-off to LOn turn-on ( $DT_{HO-LO}$ )	60	85	110	ns	$V_{DT2} > V_{DT} > V_{DT3}$ ,
$DT4n$	CHn deadtime: LOn turn-off to HOn turn-on ( $DT_{LO-HO}$ ) & HO turn-off to LOn turn-on ( $DT_{HO-LO}$ ) $V_{DT} = V_{DT4}$	80	105	145	ns	$V_{DT} < V_{DT3}$
$V_{DT1}$	DT mode select threshold 1	$0.51 \times V_{CC}$	$0.57 \times V_{CC}$	$0.63 \times V_{CC}$	V	
$V_{DT2}$	DT mode select threshold 2	$0.32 \times V_{CC}$	$0.36 \times V_{CC}$	$0.40 \times V_{CC}$	V	
$V_{DT3}$	DT mode select threshold 3	$0.21 \times V_{CC}$	$0.23 \times V_{CC}$	$0.25 \times V_{CC}$	V	
$V_{th_{DS}}$	DS pin input threshold	$0.4 \times V_{AA}$	$0.5 \times V_{AA}$	$0.6 \times V_{AA}$	V	$V_{SS} = 0V$

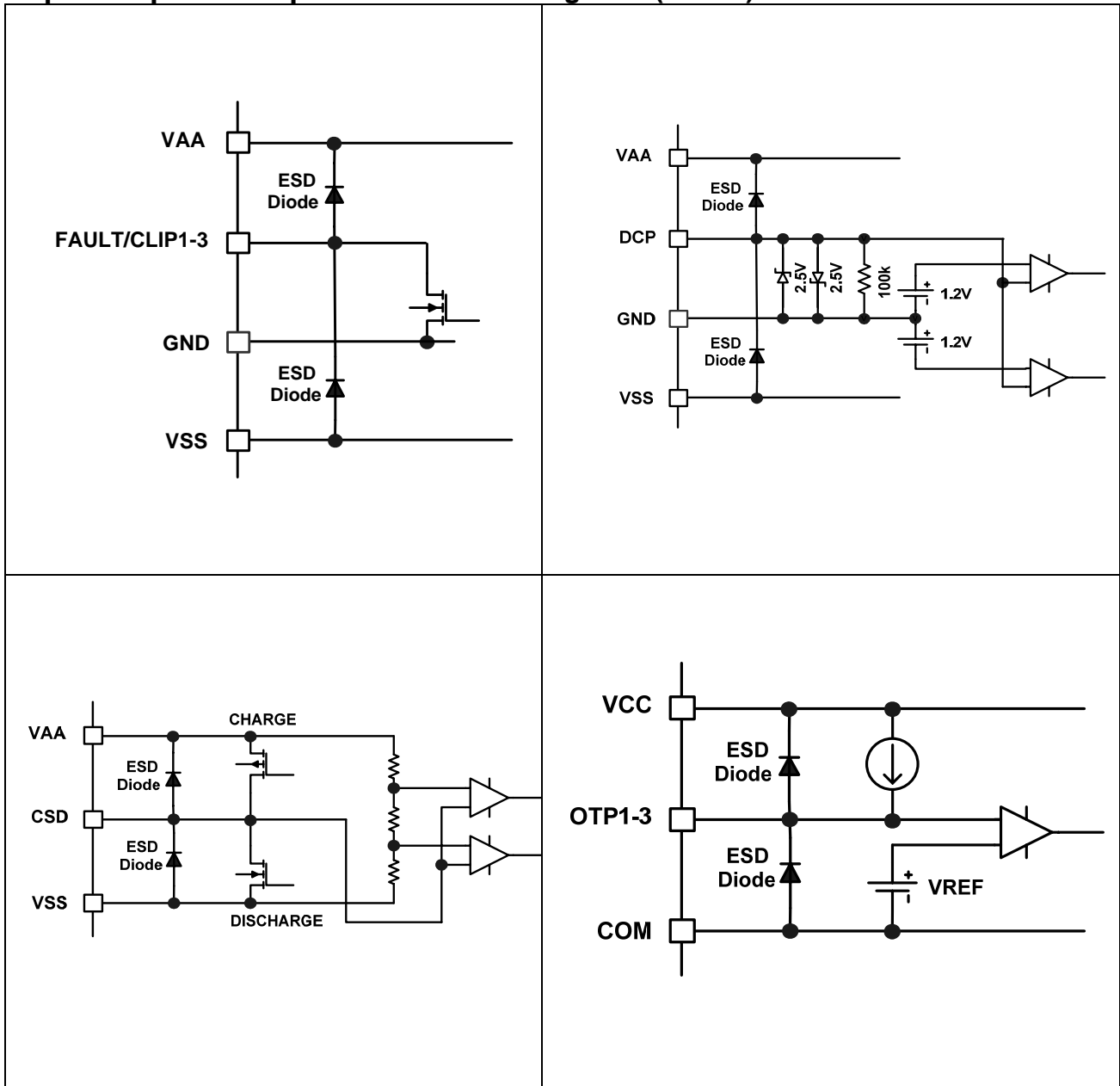
**Functional Block Diagram**



**Input/Output Pin Equivalent Circuit Diagrams**



**Input/Output Pin Equivalent Circuit Diagrams (cont'd)**

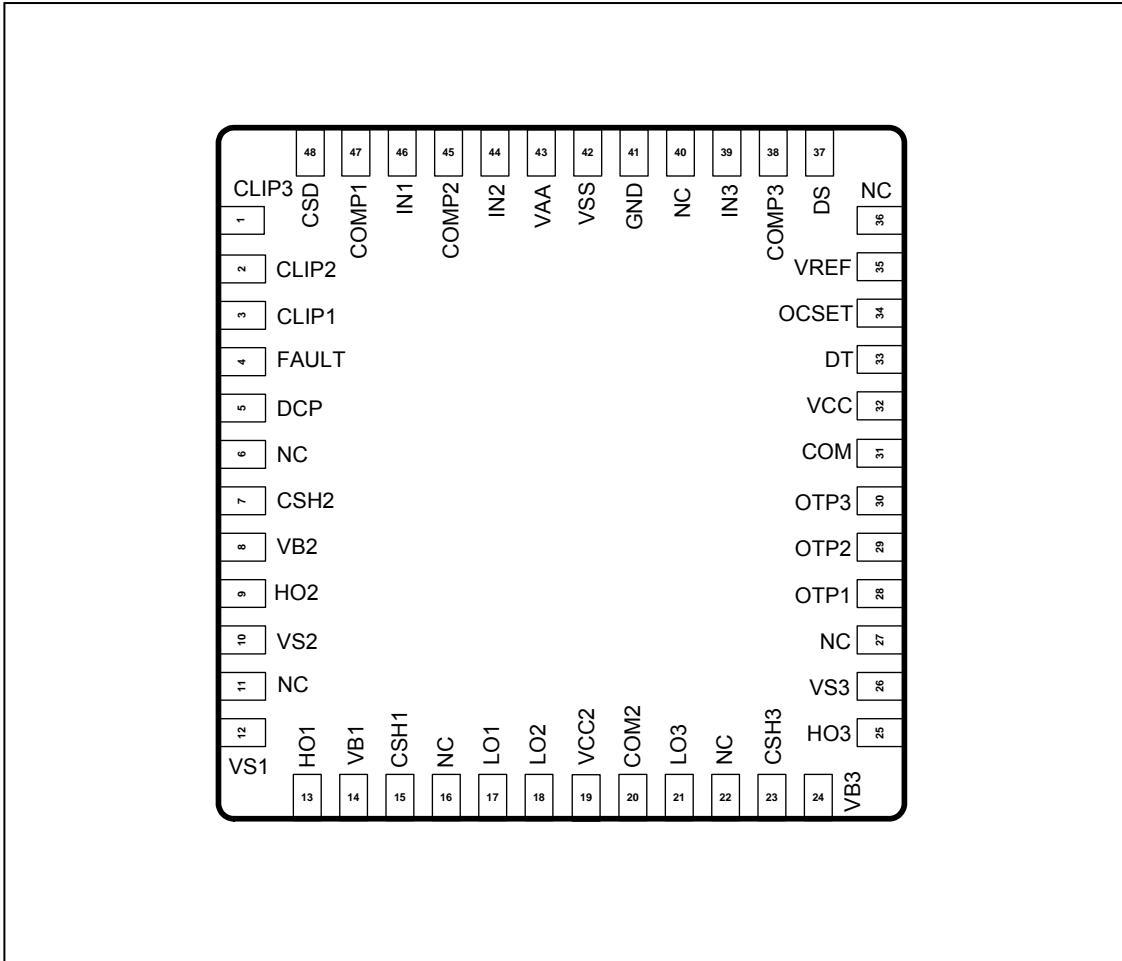


**Lead Definitions**

Pin #	Symbol	Description
1	CLIP3	Clipping detection output CH1, open drain, referenced to GND
2	CLIP2	Clipping detection output CH2, open drain, referenced to GND
3	CLIP1	Clipping detection output CH3, open drain, referenced to GND
4	FAULT	Fault output, open drain, referenced to GND
5	DCP	DC offset protection input
6	NC	
7	CSH2	CH2 High side over current sensing input, referenced to VS2
8	VB2	CH2 High side floating supply
9	HO2	CH2 High side output
10	VS2	CH2 High side floating supply return
11	NC	
12	VS1	CH1 High side floating supply return
13	HO1	CH1 High side output
14	VB1	CH1 High side floating supply
15	CSH1	CH1 High side over current sensing input, referenced to VS1
16	NC	
17	LO1	CH1 Low side output
18	LO2	CH2 Low side output
19	VCC2	Low side gate drive supply
20	COM2	Low side gate drive supply return
21	LO3	CH3 Low side output
22	NC	
23	CSH3	CH3 High side over current sensing input, referenced to VS3
24	VB3	CH3 High side floating supply

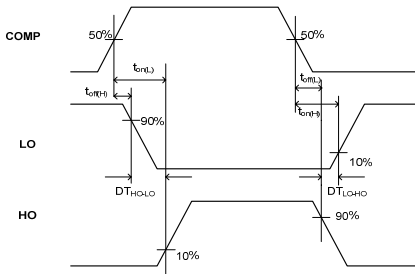
Pin #	Symbol	Description
25	HO3	CH3 High side output
26	VS3	CH3 High side floating supply return
27	NC	
28	OTP1	Over temperature sensor input 1
29	OTP2	Over temperature sensor input 2
30	OTP3	Over temperature sensor input 3
31	COM	Low side gate drive supply return
32	VCC	Low side gate drive supply
33	DT	Deadtime program, reference to COM
34	OCSET	Low side OCP threshold, referenced to COM
35	VREF	5.1V reference voltage output for OCSET
36	NC	
37	DS	Propagation delay select (VAA: Normal, VSS: Shorter)
38	COMP3	CH3 PWM comparator input
39	IN3	CH3 inverting audio input
40	NC	
41	GND	Input reference GND
42	VSS	Floating input negative supply
43	VAA	Floating input positive supply
44	IN2	CH2 inverting audio input
45	COMP2	CH2 PWM comparator input
46	IN1	CH1 inverting audio input
47	COMP1	CH1 PWM comparator input
48	CSD	Protection timer capacitor

**Lead Assignments**

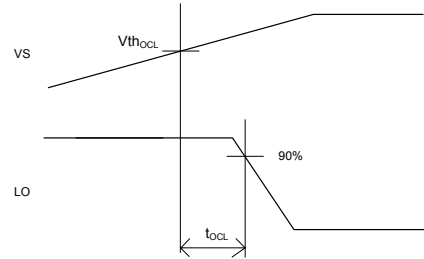




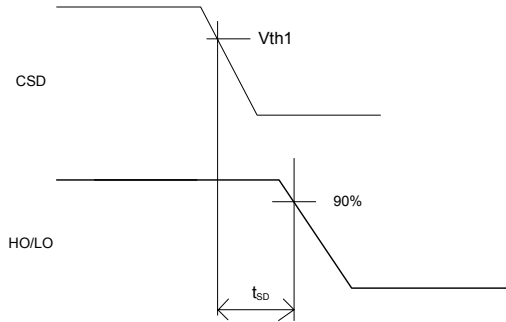
**Application Information and Additional Details**



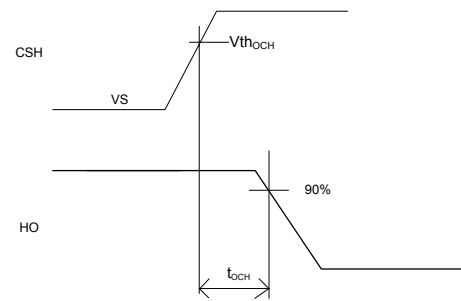
**Figure 1 Switching Time Waveform Definitions**



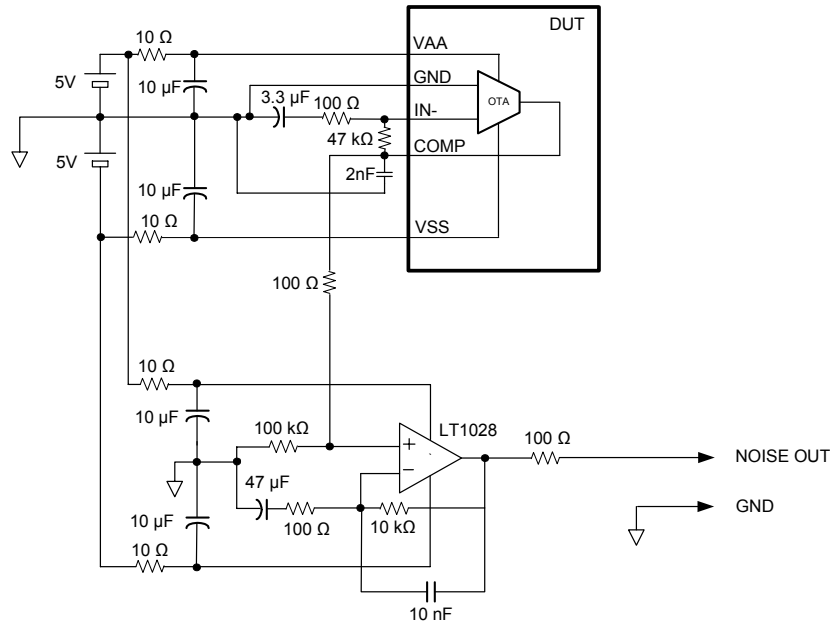
**Figure 3  $V_s > V_{thOCL}$  to Shutdown Waveform**



**Figure 2 CSD to Shutdown Waveform Definitions**

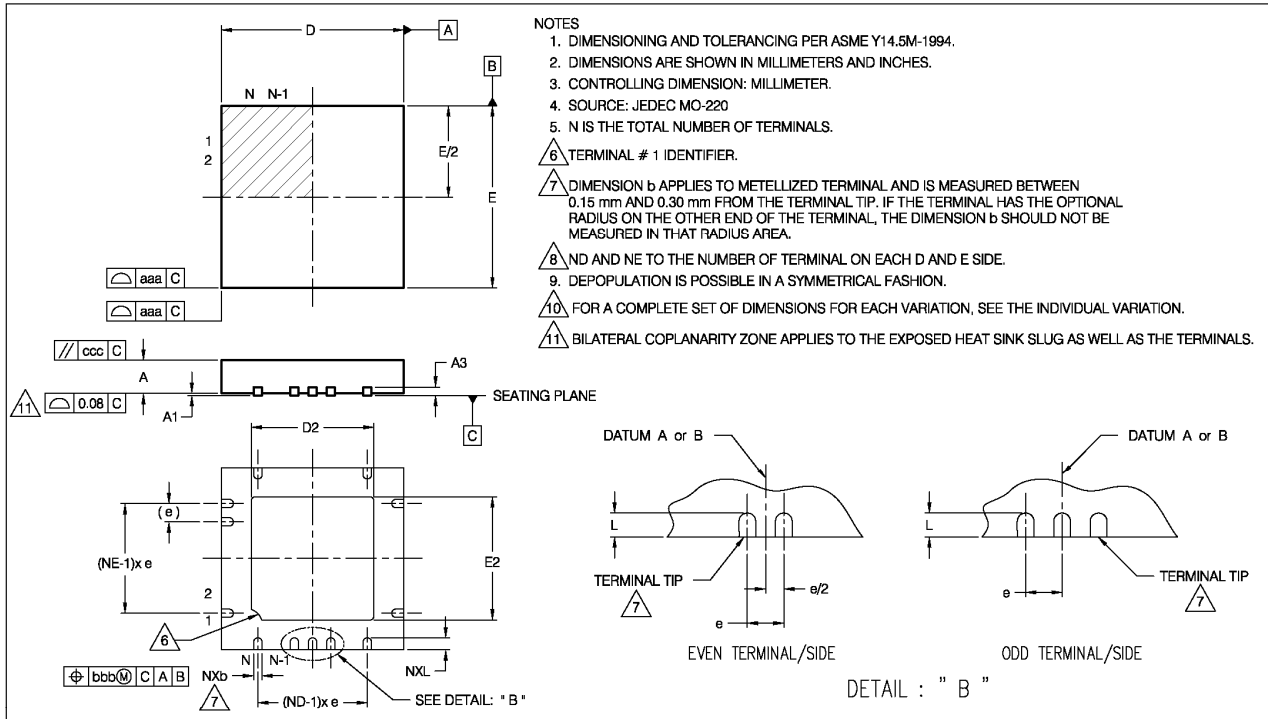


**Figure 4  $V_{CSH} > V_{thOCH}$  to Shutdown Waveform**



**Figure 5: OTA input noise voltage measurement circuit**

Package Details: MLPQ 7X7



VER.	ESCN NUMBER	BY	DATE	APPROVAL INITIALS
7	REVISED PER ESCN 0421-06	GCR	8/7/06	
8	REVISED PER ESCN 37678	GCR	12/6/06	
9	REVISED PER ESCN 37834	GCR	1/8/07	
10	REVISED PER ESCN 38363	GCR	2/5/07	
11	REVISED PER ESCN 45228	GCR	2/2/09	
12	REVISED PER ESCN 45324	GCR	2/19/09	A. B.

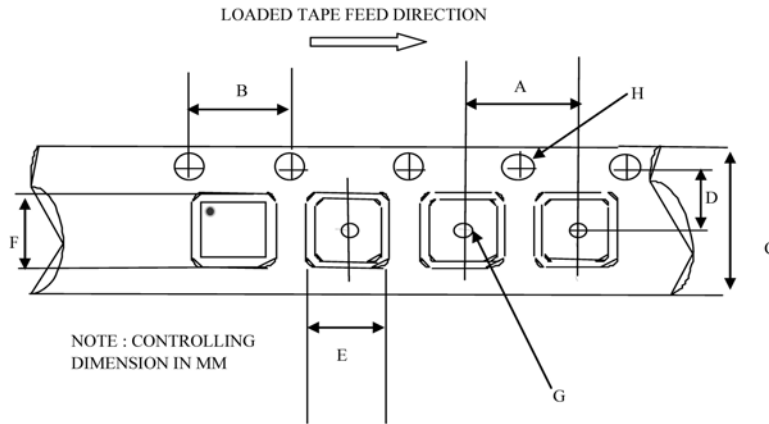
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE: IN INCHES  
TOLERANCES ARE:  
DECIMALS  
.X = +/-  
.XX = +/-  
.XXX = +/-  
.XXXX = +/-  
.XXXXX = +/-  
ANGLES  
∠ = +/- .5°

QFN (MLPQ, MLF) PACKAGE OUTLINE

DRAWN BY	G. C. RAMOS 5/4/04	IR INTERNATIONAL RECTIFIER		
APPROVED BY	A. CALICDAN	EL SEGUNDO, CALIFORNIA		
SIGNATURE & DATE	A. Calicdan 2/19/09	CAD GENERATED		
DO NOT SCALE DRAWING	SCALE ENLGMT	SHEET	DRAWING NO.	VER.
		1 / 3	01-3086	12

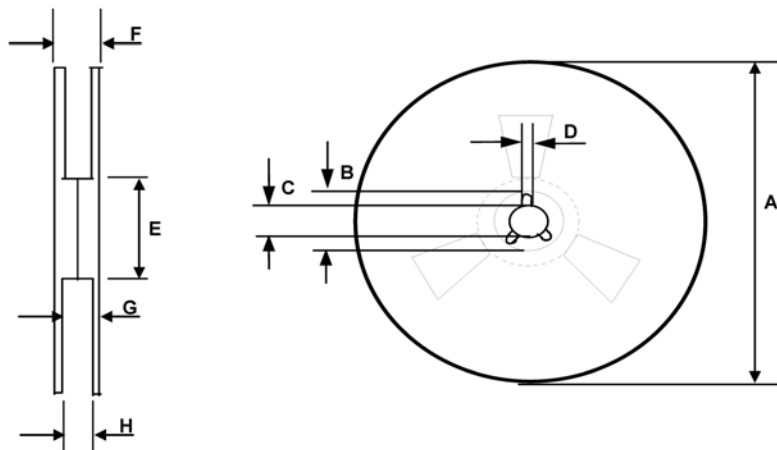
VKKD-4NJ1					
MILLIMETERS			INCHES		
MIN	NOM	MAX	MIN	NOM	MAX
0.80	0.90	1.00	.032	.035	.039
0.00	0.02	0.05	.000	.0008	.0019
0.20 REF			.008 REF		
0.18	0.25	0.30	.0071	.0098	.0118
5.40	5.55	5.65	.213	.219	.222
7.00 BSC			.276 BSC		
7.00 BSC			.276 BSC		
5.40	5.55	5.65	.213	.219	.222
0.30	0.40	0.50	.012	.016	.020
0.50 PITCH			.020 PITCH		
48			48		
12			12		
12			12		
0.15			.0059		
0.10			.0039		
0.10			.0039		
0.05			.0019		

**Tape and Reel Details: MLPQ 7X7**



CARRIER TAPE DIMENSION FOR 48MLPQ7X7

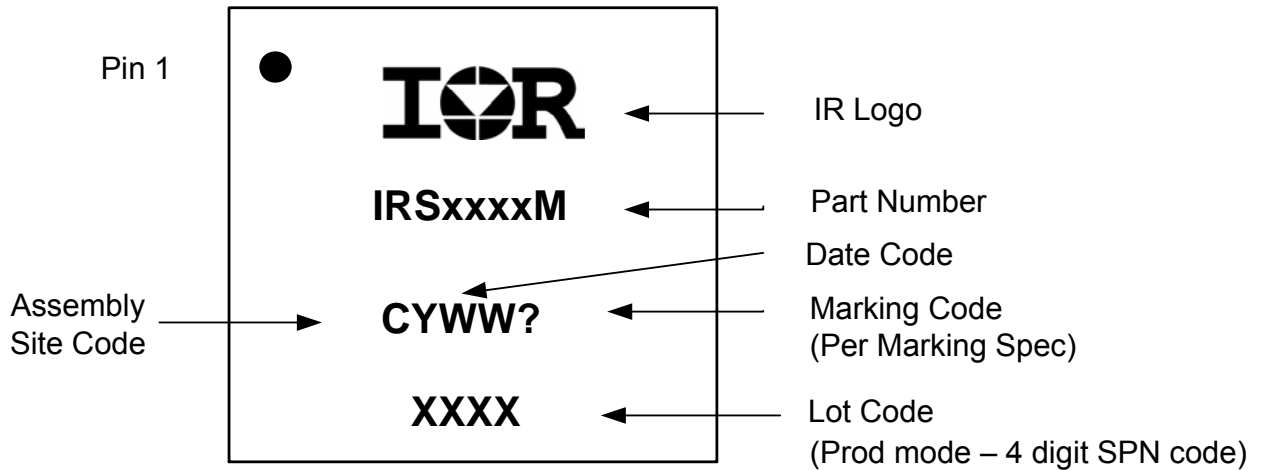
Code	Metric		Imperial	
	Min	Max	Min	Max
A	11.90	12.10	0.474	0.476
B	3.90	4.10	0.153	0.161
C	15.70	16.30	0.618	0.641
D	7.40	7.60	0.291	0.299
E	7.15	7.35	0.281	0.289
F	7.15	7.35	0.281	0.289
G	1.50	n/a	0.059	n/a
H	1.50	1.60	0.059	0.062



REEL DIMENSIONS FOR 48MLPQ7X7

Code	Metric		Imperial	
	Min	Max	Min	Max
A	329.60	330.25	12.976	13.001
B	20.95	21.45	0.824	0.844
C	12.80	13.20	0.503	0.519
D	1.95	2.45	0.767	0.096
E	98.00	102.00	3.858	4.015
F	n/a	22.4	n/a	0.881
G	18.5	21.1	0.728	0.83
H	16.4	18.4	0.645	0.724

**Part Marking Information**



**Ordering Information**

Base Part Number	Package Type	Standard Pack		Complete Part Number
		Form	Quantity	
IRS2053M	MLPQ 48 7x7	Tube / Bulk	52	IRS2053MPBF
		Tape and Reel	3000	IRS2053MTRPBF

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<http://www.irf.com/technical-info/>

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