International
IOR Rectifier

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IRS2052MPbF

2 CH Digital Audio Amplifier

Features

- 2 channel integrated analog input Class D audio amplifier driver
- Versatile protection control enabling latched, non-latched, or host controlled shutdown function
- Integrated clock oscillator
- Clipping detection
- External thermal sensor input
- On-chip thermal shutdown with warning
- Programmable over current protection
- Programmable dead-time generation
- Start and stop click noise reduction
- Under voltage protection
- High noise immunity

Note

The IRS2052M digital audio driver is a two channel version of IRS2092(S) with additional features, such as internal clock and over temperature protection. The IRS2052M features clipping detection outputs, on-chip over temperature detection, over temperature sensor inputs and a fault reporting output.

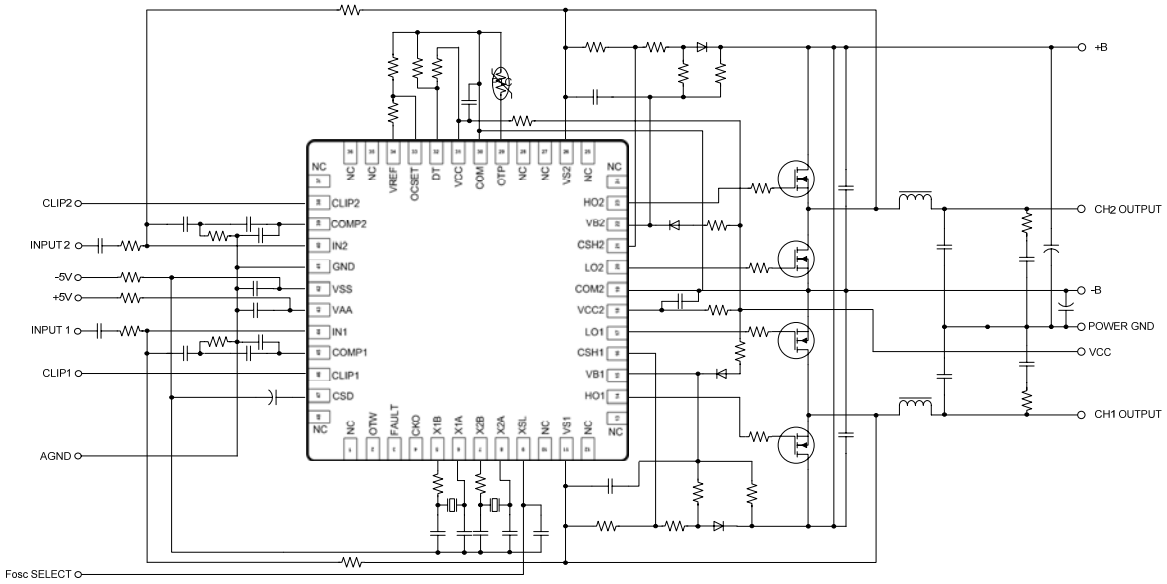
Product Summary

Topology	Half-Bridge
$V_{OFFSET\ (max)}$	+/- 100 V
I_{O+} & I_{O-} (typical)	0.5 A & 0.6 A
Selectable deadtime	45/65/85/105 ns
DC offset	<20 mV
OC protection delay	500 ns (max)
Shutdown propagation delay	250 ns (max)
Error amplifier open loop gain	>60 dB

Package

MLPQ48 (7x7 mm, 0.50 mm pitch)

Typical Connection



Description

The IRS2052M integrates two 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 2 channel Class D audio amplifier can be realized. The IRS2052M 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. The IRS2052M is a lead-free, ROHS compliant.

Qualification Information†

Qualification Level		Industrial††
		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.
Moisture Sensitivity Level		MSL2†††, 260°C (per IPC/JEDEC J-STD-020)
ESD	**Machine Model**	Class B (per JEDEC standard EIA/JESD22-A115)
	Human Body Model	Class 1B (per EIA/JEDEC standard JESD22-A114)
IC Latch-Up Test		Class I, Level A (per JESD78)
RoHS Compliant		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††, n=1-2	V_{Bn} -15	V_{Bn} +0.3	V
V_{Hon}	High side floating output voltage, n=1-2	V_{Sn} -0.3	V_{Bn} +0.3	V
V_{CSHn}	CSH pin input voltage, n=1-2	V_{Sn} -0.3	V_{Bn} +0.3	V
V_{CC}	V_{CC} low side fixed supply voltage††	-0.3	20	V
V_{CC2}	V_{CC2} low side fixed supply voltage††	-0.3	20	V
V_{Lon}	Low side output voltage, n=1-2	-0.3	V_{CC2} +0.3	V
V_{AA}	Floating input positive supply voltage††	(See I_{AAZ})	220	V
V_{SS}	Floating input negative supply voltage††	-1 (See I_{SSZ})	V_{AA} +0.3	V
V_{GND}	Floating input supply ground voltage	V_{SS} -0.3	V_{AA} +0.3	V
I_{IN-n}	Inverting input current †, n=1-2	-	±3	mA
V_{CSD}	SD pin input voltage	V_{SS} -0.3	V_{AA} +0.3	V
V_{COMPn}	COMP pin input voltage, n=1-2	V_{SS} -0.3	V_{AA} +0.3	V
V_{CLIPn}	CLIP pin input voltage	GND -0.3	V_{AA} +0.3	V
I_{CLIPn}	CLIP pin sinking current	-	5	mA
V_{FAULT}	FAULT pin input voltage	GND -0.3	V_{AA} +0.3	V
I_{FAULT}	FAULT pin sinking current	-	5	mA
V_{OTW}	OTW pin input voltage	GND -0.3	V_{AA} +0.3	V
I_{OTW}	OTW pin sinking current	-	5	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††	-	10	mA
I_{CCZ}	Low side V_{CC} supply zener clamp current††	-	10	mA
I_{CC2Z}	Low side V_{CC2} supply zener clamp current††	-	10	mA
I_{OTPZ}	OTP pin zener clamping current	-	1	mA
I_{BSZn}	Floating supply zener clamp current††, n=1-2	-	10	mA
I_{OREF}	Reference output current	-	5	mA
dV_{Sn}/dt	Allowable Vs voltage slew rate, n=1-2	-	50	V/ns
dV_{SS}/dt	Allowable Vss voltage slew rate†††	-	50	V/ms

Absolute Maximum Ratings (Cont'd)

Symbol	Definition	Min.	Max.	Units
Pd	Maximum power dissipation @ $T_A \leq +25°C$ ††††	-	6	W
Rth_{JA}	Thermal resistance, Junction to ambient ††††	-	20	°C/W
T_J	Junction Temperature	-	150	°C
T_S	Storage Temperature	-55	150	°C
T_L	Lead temperature (Soldering, 10 seconds)	-	300	°C

† IN-1 and IN-2 contain clamping diode to GND.
†† VAA-VSS, VCC-COM, VCC2-COM2, VB1-VS1 and VB2-VS2 contain internal shunt zener diodes. 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}=V_{CC2}=12V, COM2=COM 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=1-2	V_{Sn} +10	V_{Sn} +14	V
V_{Sn}	High side floating supply offset voltage	†	200	V
V_{AA}	Floating input supply voltage	V_{SS} + 4.5	V_{SS} + 15	V
I_{AAZ}	Floating input positive 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=1-2	Vs	V_B	V
V_{CC}	Low side fixed supply voltage	10	15	V
V_{CC2}	Low side fixed supply voltage	10	15	V
$\lvert V_{CC}$-$V_{CC2}\rvert$	Low side voltages difference	-	1.2	V
V_{Lon}	Low side output voltage, n=1-2	0	V_{CC2}	V
V_{GND}	GND pin input voltage	V_{SS} †††	V_{AA} †††	V
V_{IN-n}	Inverting input voltage, n=1-2	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=1-2	V_{SS}	V_{AA}	V
C_{COMPn}	COMP pin phase compensation capacitor to GND, n=1-2	1	-	nF
V_{DT}	DT pin input voltage	0	V_{CC}	V
I_{OREF}	Reference output current to COM††	0.3	0.8	mA
V_{OCSET}	OCSET pin input voltage	0.5	5	V
V_{CSHn}	CSH pin input voltage, n=1-2	V_{Sn}	V_{Bn}	V
dV_{SS}/dt	Allowable V_{SS} voltage slew rate upon power-up††††	-	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}=V_{BS4} =12V, V_{SS}=V_{S1}=V_{S2}=COM=COM2=0V, V_{GND}=5V, V_{AA}=10V, C_L=1nF and T_A=25°C unless otherwise specified.

Symbol	Definition	Min	Typ	Max	Units	Test Conditions
Low Side Supply 1						
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	mA	V_{DT}=V_{CC}
$V_{CLAMPL1}$	Low side zener diode clamp voltage	19.6	20.4	21.6	V	I_{CC}=10mA
Low Side Supply 2						
I_{QCC2}	Low side quiescent current	-	-	4	mA	
$V_{CLAMPL2}$	Low side zener diode clamp voltage	19.6	20.4	21.6	V	I_{CC2}=10mA
High Side Floating Supply						
UV_{BS+n}	High side well UVLO positive threshold, n=1-2	8.0	8.5	9.0	V	
UV_{BS-n}	High side well UVLO negative threshold, n=1-2	7.8	8.3	8.8	V	
UV_{BSHYSn}	UV_{BS} hysteresis, n=1-2	-	0.2	-	V	
I_{QBSn}	High side quiescent current, n=1-2	-	-	1	mA	
I_{LKHn}	High to Low side leakage current, n=1-2	-	-	50	µA	V_{Bn}=V_{Sn} =200V
$V_{CLAMPHn}$	High side zener diode clamp voltage, n=1-2	14.7	15.3	16.2	V	I_{BSn}=5mA
Floating Input Supply						
UV_{AA+}	V_{AA} floating supply UVLO positive threshold from V_{SS}	8.2	8.7	9.2	V	GND pin floating
UV_{AA-}	V_{AA} 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_{QAASD}	Floating Input positive quiescent supply current in shutdown mode	-	1.5	3	mA	V_{CSD} =V_{SS}
I_{QAA10}	Floating Input positive quiescent supply current, positive input	-	7	10	mA	V_{IN-} = VSS+5.2V
I_{QAA11}	Floating Input positive quiescent supply current, negative input	-	5	8	mA	V_{IN-} = VSS+4.8V
I_{QAAST}	Floating Input positive quiescent supply current in start-up mode	-	8	12	mA	V_{CSD} =VSS+5.0V
I_{LKM}	Floating input side to Low side leakage current	-	-	50	µA	V_{AA}=V_{SS}=V_{GND}= 100V
V_{CLAMPM}	Floating supply zener diode clamp voltage	19.6	20.4	22.6	V	I_{AA}=5mA, V_{CSD} =V_{SS}

Electrical Characteristics (Cont'd)

Symbol	Definition	Min	Typ	Max	Units	Test Conditions
Audio Input (GND=0V, V_{AA}=5V, V_{SS}=-5V, COM=COM2=V_{CC}=V_{CC2}=-5V, V_{S1}=V_{S2}=CSH1=CSH2=-5V, DT=OCSET=-5V)						
V_{Osn}	CHn input offset voltage, n=1-2	-15	0	15	mV	
I_{BINn}	CHn input bias current, n=1-2	-	-	40	nA	
GBWn	CHn small signal bandwidth, n=1-2	-	9	-	MHz	C_{COMPn}=1nF, Rfn=0
V_{COMPn}	CHn OTA Output voltage, n=1-2	V_{AA}-1	-	V_{SS}+1	V	
g_{mn}	CHn OTA transconductance, n=1-2	-	100	-	mS	V_{IN-n}=10mV
G_{Vn}	CHn OTA gain, n=1-2	60	-	-	dB	
V_{Nrmsn}	CHn OTA input noise voltage, n=1-2	-	250	-	mVrms	BW=20kHz, Resolution BW=22Hz Fig.5
SRn	CHn slew rate, n=1-2	-	±5	-	V/us	C_{COMPn}=1nF
CMRRn	CHn common-mode rejection ratio, n=1-2	-	60	-	dB	
PSRRn	CHn supply voltage rejection ratio, n=1-2	-	65	-	dB	
$Vth+_{CLIPn}$	CHn clip detection positive threshold, n=1-2	0.85xV_{AA}	0.90xV_{AA}	0.95xV_{AA}	V	
$Vth-_{CLIPn}$	CHn clip detection negative threshold, n=1-2	0.05xV_{AA}	0.10xV_{AA}	0.15xV_{AA}	V	
t_{CLIPn}	CHn clipping detection propagation delay, n=1-2	-	40	-	ns	Note 1
$t_{CLIPmin}$	CHn clipping detection minimum output duration	-	3	-	us	Note 1
PWM comparator						
Vth_{PWM}	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	1.5	MHz	V_{CSD} =VSS+5V

Electrical Characteristics (Cont'd)

Symbol	Definition	Min	Typ	Max	Units	Test Conditions
Clock Oscillator						
$I_{CK1SINK}$, $I_{CK2SINK}$	X1B, X2B pins output sink current at V_{X1B}, V_{X2B} = 0.5V	-	-	20	mA	
$I_{CK1SOURCE}$, $I_{CK2SOURCE}$	X1B, X2B pins output source current at V_{X1B}, V_{X2B} = VAA – 0.5 V	-	-	-20	mA	
V_{OLCK1}, V_{OLCK2}	X1B, X2B pins low level output voltage	-	-	0.07	V	
V_{OHCK1}, V_{OHCK2}	X1B, X2B pins high level output voltage	-	-	9.95	V	
V_{ILCK1}, V_{ILCK2}	X1A, X2A pins input low voltage	-	-	2	V	
V_{IHCK1}, V_{IHCK2}	X1A, X2A pins input high voltage	8	-	-	V	
I_{IN1}, I_{IN2}	X1A, X2A pins input current	-	-	+/- 20	uA	
C_{IN1}, C_{IN2}	X1A, X2A pins input capacitance at X1A, X2A pins	-	1	-	pF	Note 1
t_{ONCK1}, t_{OFFCK1}, t_{ONCK2}, t_{OFFCK2}	Propagation delay time from X1A to X1B, X2A to X2B	-	40	-	ns	
Vth_{CKSL1}	CKSL pin threshold 1	$0.61xV_{AA}$	$0.67xV_{AA}$	$0.74xV_{AA}$	V	
Vth_{CKSL2}	CKSL pin threshold 2	$0.29xV_{AA}$	$0.33xV_{AA}$	$0.37xV_{AA}$	V	

Electrical Characteristics (Cont'd)

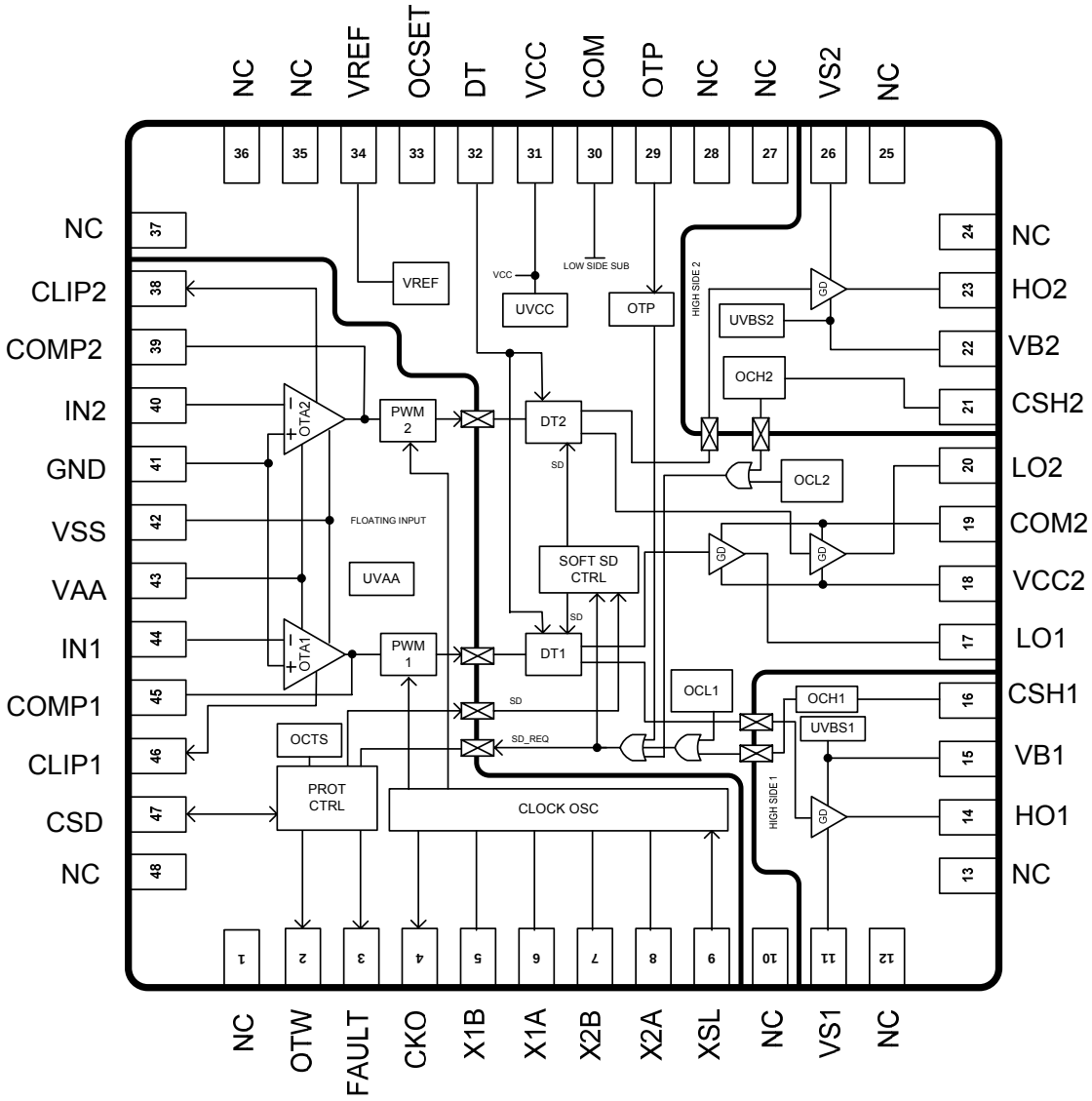
Symbol	Definition	Min	Typ	Max	Units	Test Conditions
Protection						
V_{REF}	Reference output voltage	4.8	5.1	5.4	V	I_{OREF} =0.5mA
Vth_{OCLn}	CHn low side OC threshold in Vsn, n=1-2	1.1	1.2	1.3	V	OCSET=1.2V
Vth_{OCHn}	CHn high side OC threshold in V_{CSHn}, n=1-2	1.1+ Vs	1.2+ Vs	1.3+ Vs	V	Vs=200V,
V_{ETO}	External OTP pin open circuit voltage	4.8	5.1	5.4	V	
V_{ETW}	External OTP pin warning threshold	1.1	1.4	1.6	V	
V_{ETSD}	External OTP pin shutdown threshold	2.3	2.8	3.3	V	
I_{ET}	External OTP bias sourcing current	0.43	0.65	0.87	mA	OTP=0V
T_W	On-chip thermal warning	-	T_{SD} -20	-	°C	Note 1
T_{SD}	ON-chip thermal shutdown	-	150	-	°C	
T_{WHYT}	On-chip thermal warning hysteresis	-	15	-	°C	
T_{SDHYT}	ON-chip thermal shutdown hysteresis	-	15	-	°C	
Vth1	CSD pin shutdown release threshold	$0.62xV_{AA}$	$0.70xV_{AA}$	$0.78xV_{AA}$	V	
Vth2	CSD pin self reset threshold	$0.26xV_{AA}$	$0.30xV_{AA}$	$0.34xV_{AA}$	V	
I_{CSD+}	CSD pin discharge current	70	100	130	µA	$V_{CSD} = V_{SS} + 7.5V$
I_{CSD-}	CSD pin charge current	70	100	130	µA	$V_{CSD} = V_{SS} + 7.5V$
V_{FAULT}	FAULT pin warning output voltage	-	GND	GND +0.1	V	$R_{PULL-UP}$ = 10k
V_{OTW}	OTW pin warning output voltage	-	GND	GND +0.1	V	$R_{PULL-UP}$ = 10k
t_{SSDn}	CHn soft shutdown propagation delay from $V_{CSD} < V_{SS} + Vth1$ to Shutdown	-	-	1.4	us	f_{PWM}=400kHz, Fig.2
t_{OCHn}	CHn propagation delay time from $V_{CSHn} > Vth_{OCHn}$ to Shutdown, n=1-2	-	-	800	ns	Fig.4
t_{OCLn}	CHn propagation delay time from Vsn> Vth_{OCL} to Shutdown, n=1-2	-	-	700	ns	Fig.3
P_{SD}	Shutdown timing	-	40	-	%	f_{PWM}=400kHz, Duty= 50%, Fig.2

Electrical Characteristics (Cont'd)

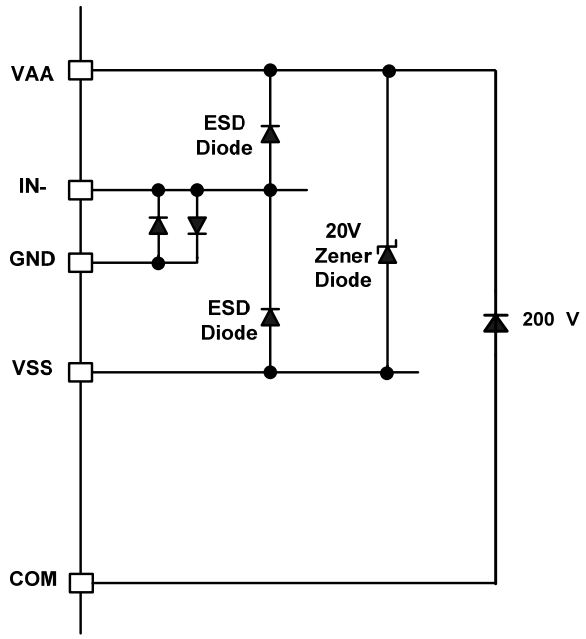
Symbol	Definition	Min	Typ	Max	Units	Test Conditions
Gate Driver						
Io+n	CHn output high short circuit current (Source) , n=1-2	-	0.5	-	A	Vo=0V, PW≤10µS, Note 1
Io-n	CHn output low short circuit current (Sink) , n=1-2	-	0.6	-	A	Vo=12V, PW≤10µS, Note 1
V_{OLn}	CHn low level out put voltage LO – COM, HO - VS, n=1-2	-	-	0.1	V	Io=0A
V_{OHn}	CHn high level out put voltage VCC – LO, VB - HO, n=1-2	-	-	1.4	V	
Ton0n	CHn high and low side turn-on propagation delay, n=1-2	-	350	-	ns	$V_{DT} = V_{CC}$
Toff0n	CHn high and low side turn-off propagation delay, n=1-2	-	325	-	ns	
tr	Turn-on rise time	-	25	50	ns	
tf	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	0.51xVcc	0.57xVcc	0.63xVcc	V	
V_{DT2}	DT mode select threshold 2	0.32xVcc	0.36xVcc	0.40xVcc	V	
V_{DT3}	DT mode select threshold 3	0.21xVcc	0.23xVcc	0.25xVcc	V	

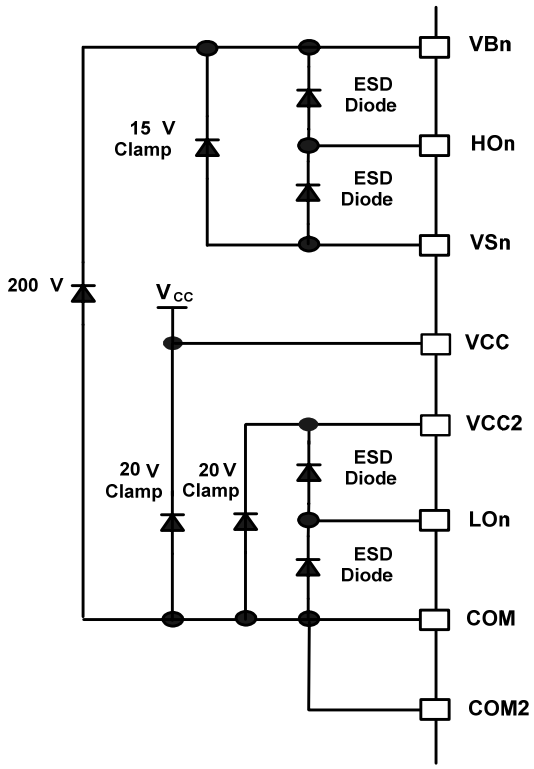
Note 1 Guaranteed by design, but not tested in production.

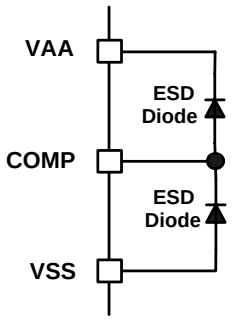
Functional Block Diagram

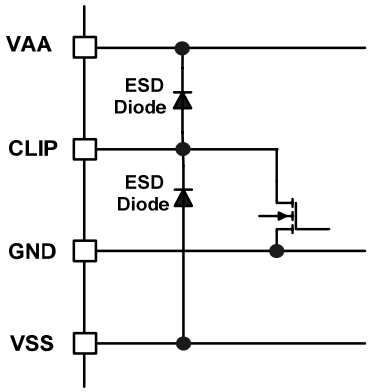


Input/Output Pin Equivalent Circuit Diagrams

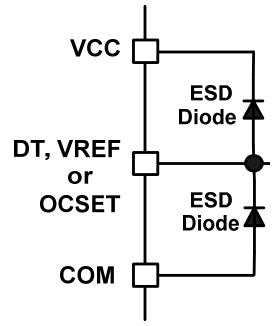


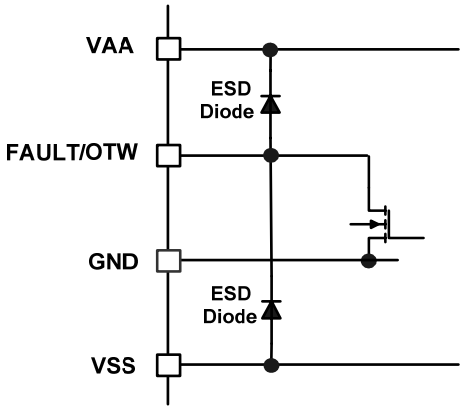


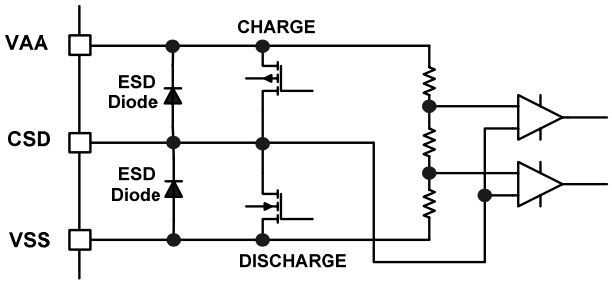


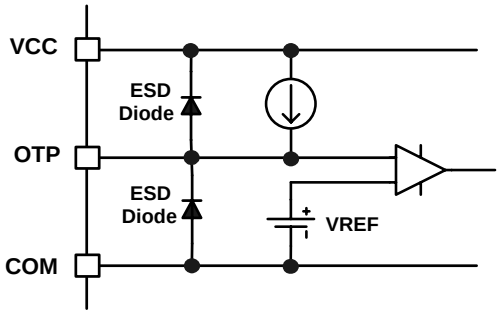


Input/Output Pin Equivalent Circuit Diagrams (Cont'd)









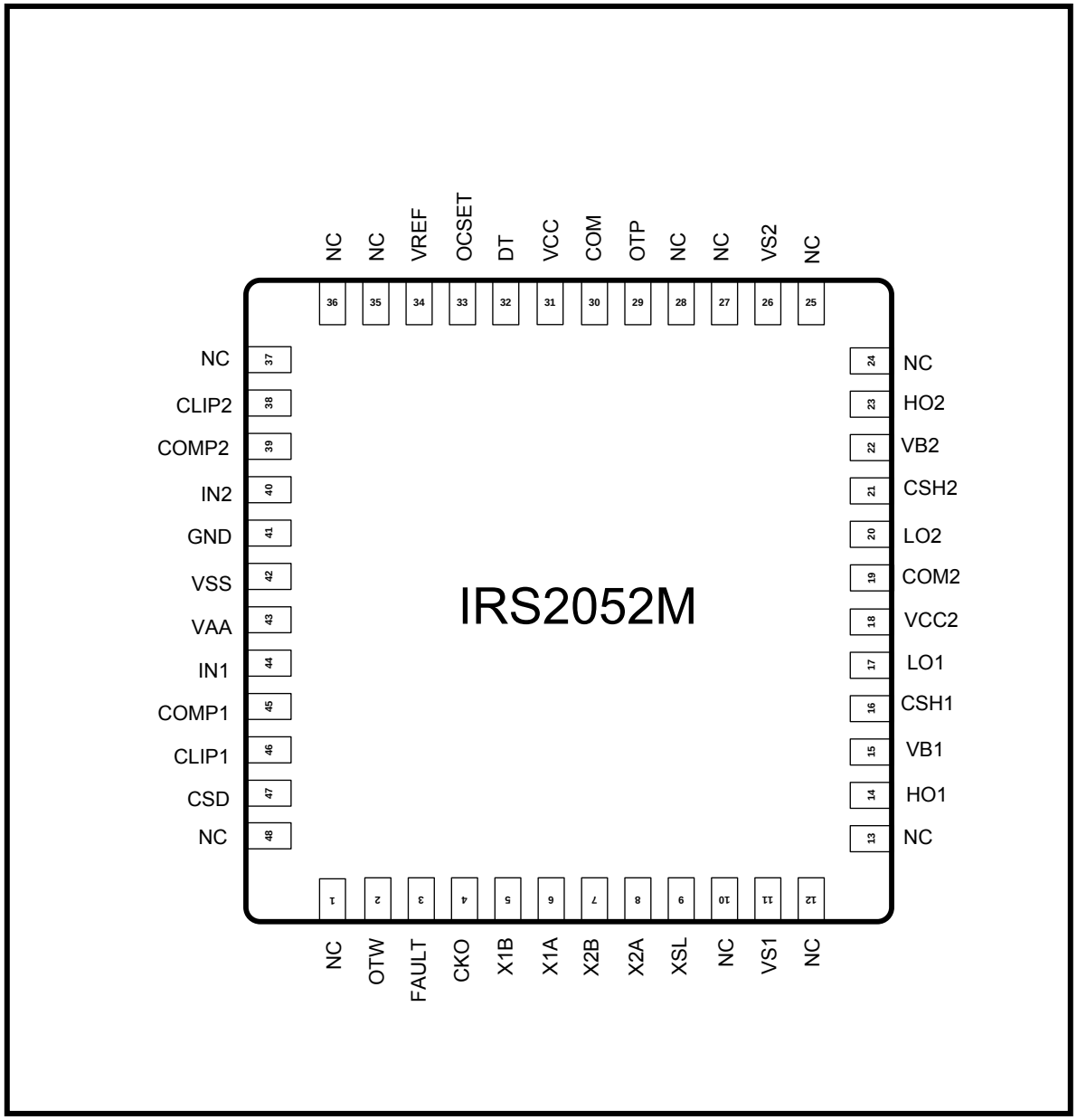
Lead Definitions

Pin #	Symbol	I/O	Description
1	NC		
2	OTW	O	On-chip over temperature warning output
3	FAULT	O	Fault reporting output
4	CKO	O	Clock output
5	X1B	O	Clock oscillator output 1
6	X1A	I	Clock oscillator input 1
7	X2B	O	Clock oscillator output 2
8	X2A	I	Clock oscillator input 2
9	XSL	I	Clock oscillator select (VAA: osc 1, GND: osc 2, VSS: No sync)
10	NC		
11	VS1	I	CH1 High side floating supply return
12	NC		
13	NC		
14	HO1	O	CH1 High side output
15	VB1	I	CH1 High side floating supply
16	CSH1	I	CH1 High side over current sensing input, referenced to VS1
17	LO1	O	CH1 Low side output
18	VCC2	I	Low side gate drive supply
19	COM2	I	Low side gate drive supply return
20	LO2	O	CH2 Low side output
21	CSH2	I	CH2 High side over current sensing input, referenced to VS2
22	VB2	I	CH2 High side floating supply
23	HO2	O	CH2 High side output
24	NC		

Lead Definitions (Cont'd)

Pin #	Symbol	I/O	Description
25	NC		
26	VS2	I	CH2 High side floating supply return
27	NC		
28	NC		
29	OTP	I	Over temperature sensor input, referenced to COM
30	COM	I	Low side gate drive supply return
31	VCC	I	Low side gate drive supply
32	DT	I	Deadtime program, reference to COM
33	OCSET	I	Low side OCP threshold, referenced to COM
34	VREF	O	5.1V reference voltage output for OCSET
35	NC		
36	NC		
37	NC		
38	CLIP2	O	Clipping detection output CH2, open drain, referenced to GND
39	COMP2	O	CH2 PWM comparator input
40	IN2	I	CH2 inverting audio input
41	GND	I	Input reference GND
42	VSS	I	Floating input negative supply
43	VAA	I	Floating input positive supply
44	IN1	I	CH1 inverting audio input
45	COMP1	O	CH1 PWM comparator input
46	CLIP1	O	Clipping detection output CH1, open drain, referenced to GND
47	CSD	I/O	Protection control
48	NC		

Lead Assignments (MLPQ48_7x7mm)



Application Information and Additional Details

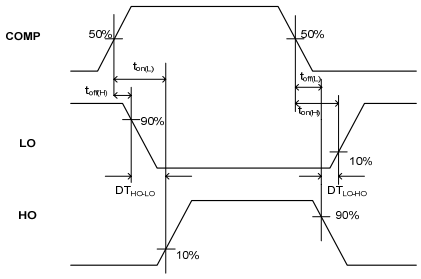


Figure 1 Switching Time Waveform Definitions

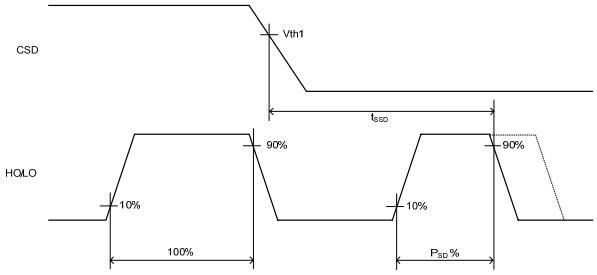


Figure 2 CSD to Shutdown Waveform Definitions

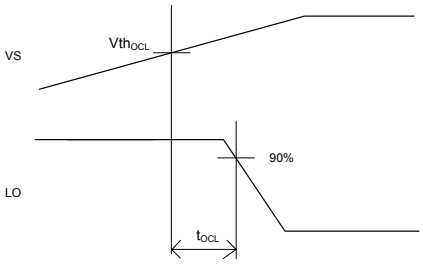


Figure 3 V_S > Vth_{OCL} to Shutdown Waveform

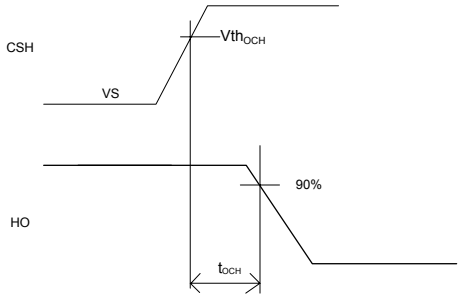


Figure 4 V_{CSH} > Vth_{OCH} to Shutdown Waveform

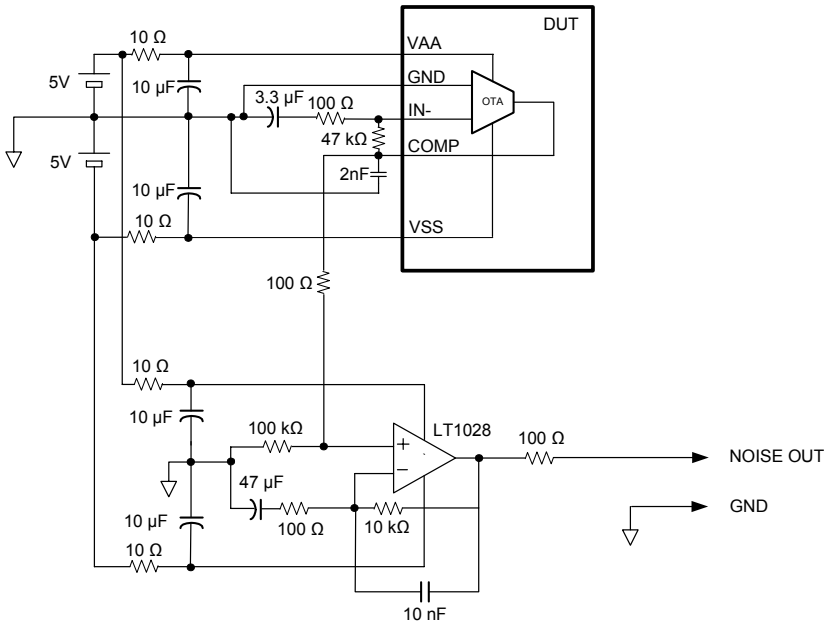
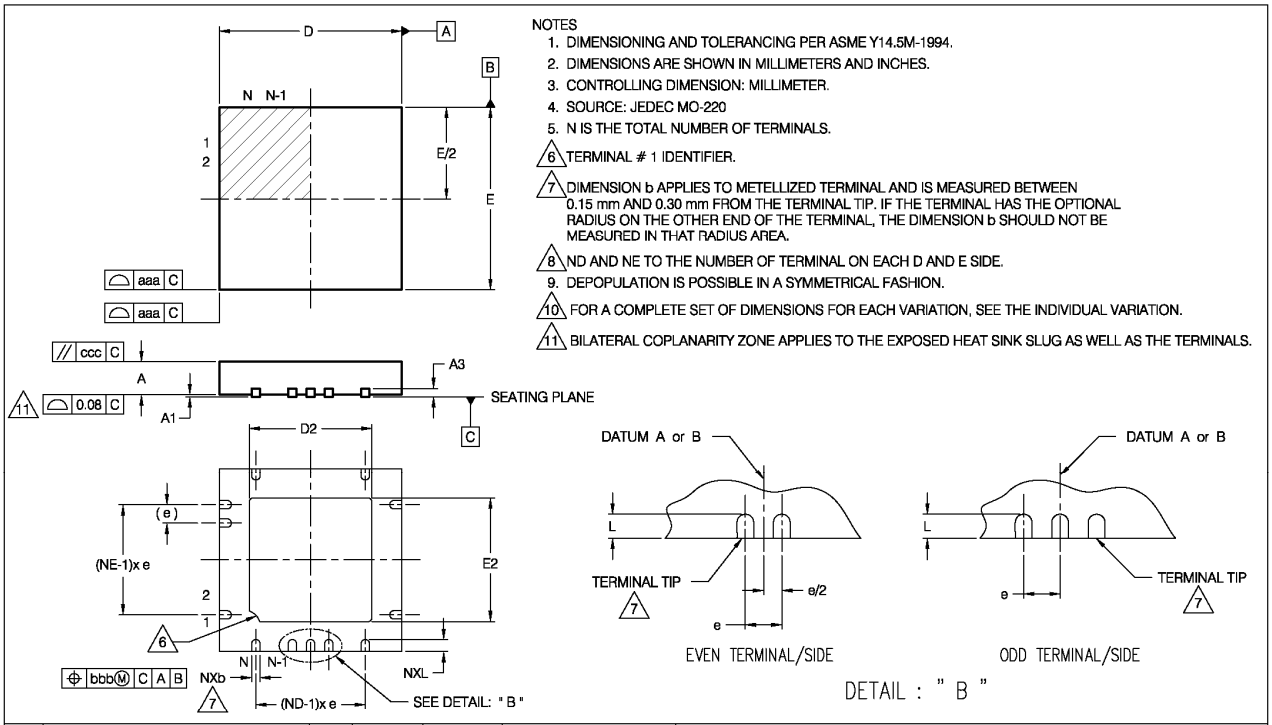


Figure 5: OTA input noise voltage mesurent circuit

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. C.

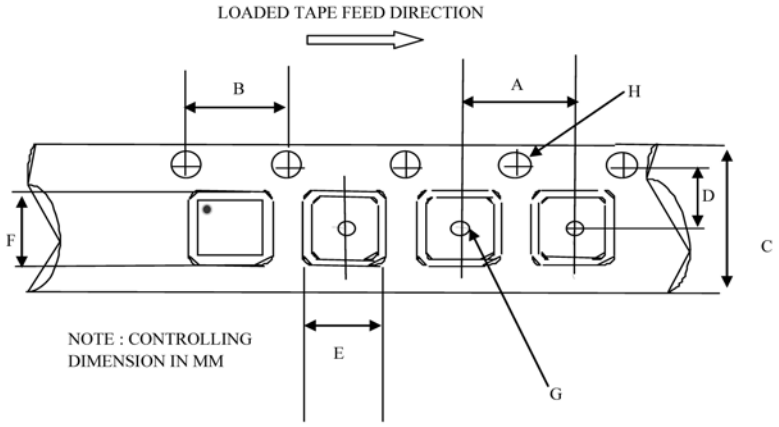
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE: IN INCHES
TOLERANCES ARE:
DECIMALS
.X = +/-
.XX = +/-
.XXX = +/-
.XXXX = +/-
.XXXXX = +/-
ANGLES
∠ = +/- .5°

QFN (MLPQ, MLF) PACKAGE OUTLINE

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

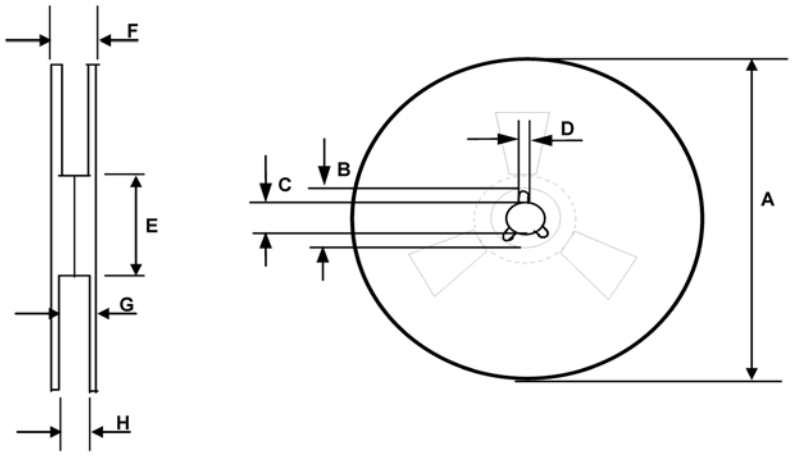
SYMBOL	VKKD-4NJ1					
	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.80	0.90	1.00	.032	.035	.039
A1	0.00	0.02	0.05	.000	.0008	.0019
A3	0.20 REF			.008 REF		
b	0.18	0.25	0.30	.0071	.0098	.0118
D2	5.40	5.55	5.65	.213	.219	.222
D	7.00 BSC			.276 BSC		
E	7.00 BSC			.276 BSC		
E2	5.40	5.55	5.65	.213	.219	.222
L	0.30	0.40	0.50	.012	.016	.020
e	0.50 PITCH			.020 PITCH		
N	48			48		
ND	12			12		
NE	12			12		
aaa	0.15			.0059		
bbb	0.10			.0039		
ccc	0.10			.0039		
ddd	0.05			.0019		

Tape and Reel Details: MLPQ 7X7



CARRIER TAPE DIMENSION FOR 48MLPQ7X7

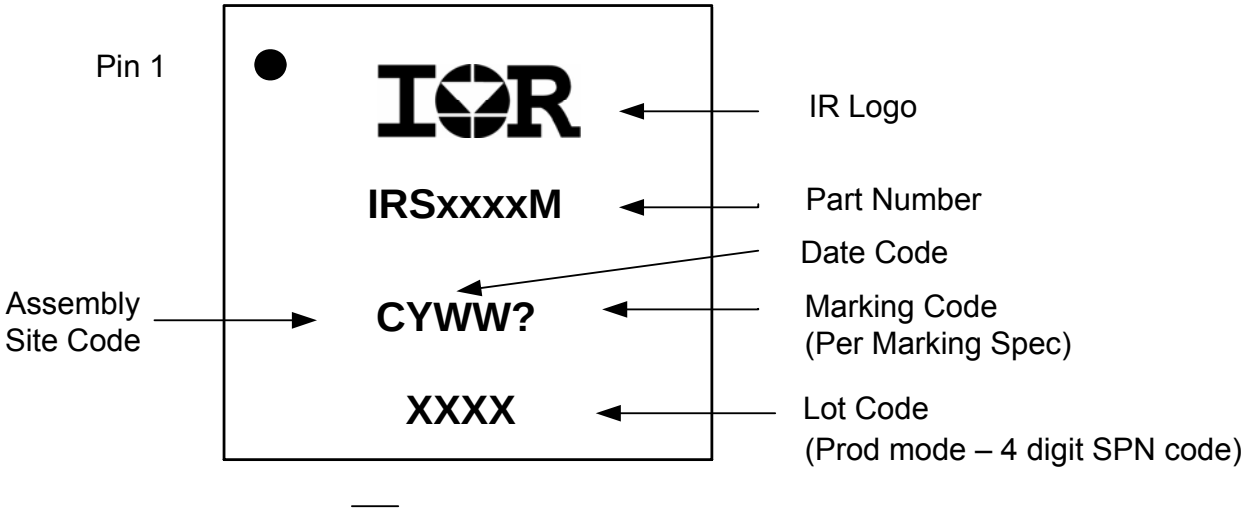
	Metric		Imperial	
Code	Min	Max	Min	Max
A	11.90	12.10	0.474	0.476
B	3.90	4.10	0.153	0.161
C	15.70	16.30	0.618	0.641
D	7.40	7.60	0.291	0.299
E	7.15	7.35	0.281	0.289
F	7.15	7.35	0.281	0.289
G	1.50	n/a	0.059	n/a
H	1.50	1.60	0.059	0.062



REEL DIMENSIONS FOR 48MLPQ7X7

	Metric		Imperial	
Code	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	
IRS2052M	MLPQ 48 7x7	Tape and Reel	3000	IRS2052MTRPBF

For technical support, please contact IR's Technical Assistance Center
http://www.irf.com/technical-info/

WORLD HEADQUARTERS:
233 Kansas St., El Segundo, California 90245
Tel: (310) 252-7105

LifeElectronics
Живое партнерство

ООО «ЛайфЭлектроникс» **“LifeElectronics” LLC**

ИНН 7805602321 КПП 780501001 Р/С 40702810122510004610 ФАКБ "АБСОЛЮТ БАНК" (ЗАО) в г.Санкт-Петербурге К/С 30101810900000000703 БИК 044030703

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- *Специальные условия для постоянных клиентов.*
- *Подбор аналогов.*
- *Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.*

- *Приемлемые сроки поставки, возможна ускоренная поставка.*
- *Доставку товара в любую точку России и стран СНГ.*
- *Комплексную поставку.*
- *Работу по проектам и поставку образцов.*
- *Формирование склада под заказчика.*

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- *Тестирование поставляемой продукции.*
- *Поставку компонентов, требующих военную и космическую приемку.*
- *Входной контроль качества.*
- *Наличие сертификата ISO.*

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- *Техническую поддержку проекта.*
- *Защиту от снятия компонента с производства.*
- *Оценку стоимости проекта по компонентам.*
- *Изготовление тестовой платы монтаж и пусконаладочные работы.*

Тел: +7 (812) 336 43 04 (многоканальный)
Email: org@lifeelectronics.ru

www.lifeelectronics.ru