

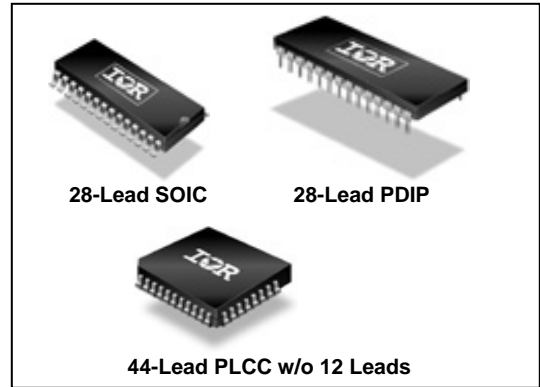
**IRS2136/IRS21362/IRS21363/IRS21365/  
IRS21366/IRS21367/IRS21368 (J&S) PbF**

**3-PHASE BRIDGE DRIVER**

**Features**

- Floating channel designed for bootstrap operation
- Fully operational to +600 V
- Tolerant to negative transient voltage, dV/dt immune
- Gate drive supply range from 10 V to 20 V (IRS2136/ IRS21368), 11.5 V to 20 V (IRS21362), or 12 V to 20 V (IRS21363/IRS21365/IRS21366/IRS21367)
- Undervoltage lockout for all channels
- Over-current shutdown turns off all six drivers
- Independent 3 half-bridge drivers
- Matched propagation delay for all channels
- Cross-conduction prevention logic
- Low side output out of phase with inputs. High side outputs out of phase (IRS213(6,63, 65, 66, 67, 68)), or in phase (IRS21362) with inputs
- 3.3 V logic compatible
- Lower di/dt gate drive for better noise immunity
- Externally programmable delay for automatic fault clear
- All parts are LEAD-FREE

**Packages**



**Applications:**

- \*Motor Control
- \*Air Conditioners/ Washing Machines
- \*General Purpose Inverters
- \*Micro/Mini Inverter Drives

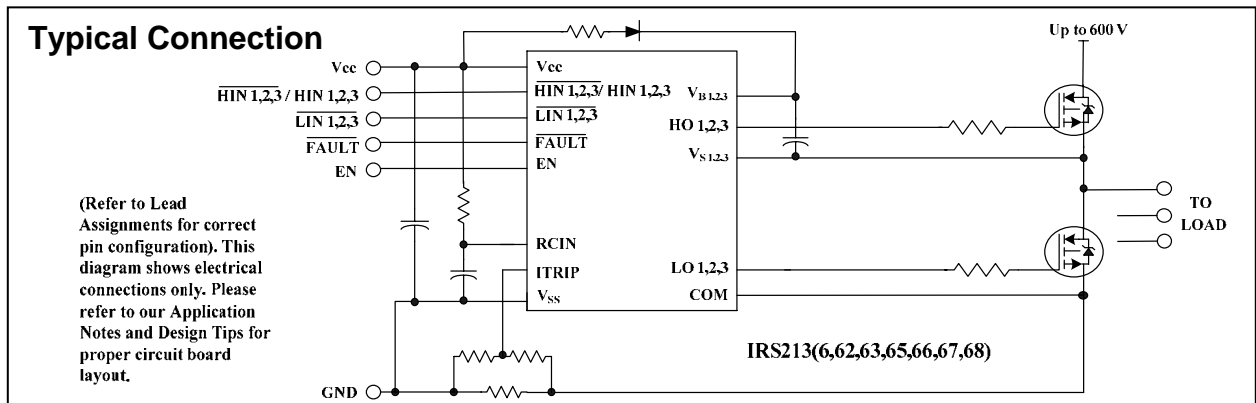
**Description**

The IRS2136x are high voltage, high speed power MOSFET and IGBT driver with three independent high side and low side referenced output channels for 3-phase applications. Proprietary HVIC technology enables ruggedized monolithic construction. Logic inputs are compatible with CMOS or LSTTL outputs, down to 3.3 V logic. A current trip function which terminates all six outputs can be derived from an external current sense resistor. An enable function is available to terminate all six outputs simultaneously. An open-drain FAULT signal is provided to indicate that an overcurrent or undervoltage shutdown has occurred. Overcurrent fault conditions are cleared automatically after a delay programmed externally via an RC network connected to the RCIN input. The output drivers feature a high pulse current buffer stage designed for minimum driver cross-conduction. Propagation delays are matched to simplify use in high frequency applications. The floating channels can be used to drive N-channel power MOSFETs or IGBTs in the high side configuration which operates up to 600 V.

**Feature Comparison: IRS2136x**

Part	IRS2136	IRS21362	IRS21363	IRS21365	IRS21366	IRS21367	IRS21368
Input Logic	HIN, LIN	HIN, LIN	HIN, LIN	HIN, LIN	HIN, LIN	HIN, LIN	HIN, LIN
$t_{on}$ (typ.)	530 ns	530 ns	530 ns	530 ns	200 ns	200 ns	530 ns
$t_{off}$ (typ.)	530 ns	530 ns	530 ns	530 ns	200 ns	200 ns	530 ns
$V_{IH}$ (min.)	2.5 V	2.5 V	2.5 V	2.5 V	2.5 V	2.5 V	2.5 V
$V_{IL}$ (max.)	0.8 V	0.8 V	0.8 V	0.8 V	0.8 V	0.8 V	0.8 V
$V_{ITRIP+}$	0.46 V	0.46 V	0.46 V	0.46 V	0.46 V	4.3 V	4.3 V
$V_{COU+}/V_{SSUV+}$	8.9 V	10.4 V	11.1 V	11.1 V	11.1 V	11.1 V	8.9 V
$V_{COU-}/V_{SSUV-}$	8.2 V	9.4 V	10.9 V	10.9 V	10.9 V	10.9 V	8.2 V

**Typical Connection**



### 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. The thermal resistance and power dissipation ratings are measured under board mounted and still air conditions. Zener clamps are included between  $V_{CC}$  & COM (25 V),  $V_{CC}$  &  $V_{SS}$  (20V), and  $V_{Bx}$  &  $V_{Sx}$  (20 V).

Symbol	Definition	Min.	Max.	Units	
$V_S$	High side offset voltage	$V_{B1,2,3} - 20$	$V_{B1,2,3} + 0.3$	V	
$V_B$	High side floating supply voltage	-0.3	625		
$V_{HO1,2,3}$	High side floating output voltage	$V_{S1,2,3} - 0.3$	$V_{B1,2,3} + 0.3$		
$V_{CC}$	Low side and logic fixed supply voltage	-0.3	25		
$V_{SS}$	Logic ground	$V_{CC} - 20$	$V_{CC} + 0.3$		
$V_{LO1,2,3}$	Low side output voltage	-0.3	$V_{CC} + 0.3$		
$V_{IN}$	Input voltage $\overline{LIN}$ , $\overline{HIN}$ , ITRIP, EN, RCIN	$V_{SS} - 0.3$	$V_{CC} + 0.3$		
$V_{FLT}$	$\overline{FAULT}$ output voltage	$V_{SS} - 0.3$	$V_{CC} + 0.3$		
dV/dt	Allowable offset voltage slew rate	—	50		V/ns
$P_D$	Package power dissipation @ $T_A \leq +25$ °C	(28 lead PDIP)	—	1.5	W
		(28 lead SOIC)	—	1.6	
		(44 lead PLCC)	—	2.0	
$R_{thJA}$	Thermal resistance, junction to ambient	(28 lead PDIP)	—	83	°C/W
		(28 lead SOIC)	—	78	
		(44 lead PLCC)	—	63	
$T_J$	Junction temperature	—	150	°C	
$T_S$	Storage temperature	-55	150		
$T_L$	Lead temperature (soldering, 10 seconds)	—	300		

### Recommended Operating Conditions

The input/output logic-timing diagram is shown in Fig. 1. For proper operation the device should be used within the recommended conditions. All voltage parameters are absolute referenced to COM. The  $V_S$  &  $V_{SS}$  offset ratings are tested with all supplies biased at a 15 V differential.

Symbol	Definition	Min.	Max.	Units	
$V_{B1,2,3}$	High side floating supply voltage	IRS213(6,68)	$V_{S1,2,3} + 10$	$V_{S1,2,3} + 20$	V
		IRS21362	$V_{S1,2,3} + 11.5$	$V_{S1,2,3} + 20$	
		IRS213(6,63,65,66,67)	$V_{S1,2,3} + 12$	$V_{S1,2,3} + 20$	
$V_{S1,2,3}$	High side floating supply voltage	Note 1	600		
$V_{CC}$	Low side supply voltage	IRS213(6,68)	10	20	
		IRS21362	11.5	20	
		IRS213(6,63,65,66,67)	12	20	
$V_{HO1,2,3}$	High side output voltage	$V_{S1,2,3}$	$V_{B1,2,3}$		
$V_{LO1,2,3}$	Low side output voltage	0	$V_{CC}$		
$V_{SS}$	Logic ground	-5	5		
$V_{FLT}$	$\overline{FAULT}$ output voltage	$V_{SS}$	$V_{CC}$		
$V_{RCIN}$	RCIN input voltage	$V_{SS}$	$V_{CC}$		

**Note 1:** Logic operational for  $V_S$  of (COM - 8 V) to (COM + 600 V). Logic state held for  $V_S$  of (COM - 8 V) to (COM -  $V_{BS}$ ). (Please refer to the Design Tip DT97-3 for more details).

### Recommended Operating Conditions - (Continued)

The input/output logic-timing diagram is shown in Fig. 1. For proper operation the device should be used within the recommended conditions. All voltage parameters are absolute referenced to COM. The  $V_S$  &  $V_{SS}$  offset ratings are tested with all supplies biased at a 15 V differential.

Symbol	Definition	Min.	Max.	Units
$V_{ITRIP}$	ITRIP input voltage	$V_{SS}$	$V_{SS} + 5$	V
$V_{IN}$	Logic input voltage $\overline{LIN}$ , $HIN$ (IRS213(6,63,65,66,67,68)), $\overline{LIN}$ , $HIN$ (IRS21362), EN	$V_{SS}$	$V_{SS} + 5$	
$T_A$	Ambient temperature	-40	125	°C

**Note 1:** HIN, LIN, EN and the ITRIP pin are internally clamped with a 5.2 V zener diode.

### Static Electrical Characteristics

$V_{BIAS}$  ( $V_{CC}, V_{BS1,2,3}$ ) = 15 V unless otherwise specified. The  $V_{IN}$ ,  $V_{TH}$ , and  $I_{IN}$  parameters are referenced to  $V_{SS}$  and are applicable to all six channels ( $HIN1,2,3/HIN1,2,3$  and  $\overline{LIN1,2,3}$ ). The  $V_O$  and  $I_O$  parameters are referenced to COM and  $V_{S1,2,3}$  and are applicable to the respective output leads: LO1,2,3 and HO1,2,3.

Symbol	Definition	Min.	Typ.	Max.	Units	Test Conditions
$V_{IH}$	Logic "0" input voltage $\overline{LIN1,2,3}$ , $HIN1,2,3$ IRS213(6,63,65)	2.5	—	—	V	
	Logic "1" input voltage $HIN1,2,3$ IRS21362	—	—	—		
$V_{IL}$	Logic "0" input voltage $\overline{LIN1,2,3}$ , $HIN1,2,3$ IRS213(66,67,68)	2.5	—	—		
	Logic "1" input voltage $\overline{LIN1,2,3}$ , $HIN1,2,3$ IRS213(6,63,65)	—	—	0.8		
$V_{IL}$	Logic "0" input voltage $HIN1,2,3$ IRS21362	—	—	0.8		
	Logic "0" input voltage $\overline{LIN1,2,3}$ , $HIN1,2,3$ IRS213(66,67,68)	—	—	0.8		
$V_{IN,TH+}$	Input positive going threshold	—	1.9	—		
$V_{IN,TH-}$	Input negative going threshold	—	1	—		
$V_{EN,TH+}$	Enable positive going threshold	—	—	2.5		
$V_{EN,TH-}$	Enable negative going threshold	0.8	—	—		
$V_{IT,TH+}$ (6,62,63,66)	ITRIP positive going threshold	0.37	0.46	0.55		
$V_{IT,HYS}$ (6,62,63,66)	ITRIP hysteresis	—	0.07	—		
$V_{IT,TH+}$ (65,67,68)	ITRIP positive going threshold	3.85	4.3	4.75		
$V_{IT,HYS}$ (65,67,68)	ITRIP hysteresis	—	0.15	—		
$V_{RCIN, TH+}$	RCIN positive going threshold	—	8	—		
$V_{RCIN, HYS}$	RCIN hysteresis	—	3	—		
$V_{OH}$	High level output voltage, $V_{BIAS} - V_O$	—	0.9	1.4	lo = 20 mA	
$V_{OL}$	Low level output voltage, $V_O$	—	0.4	0.6		
$V_{CCUV+}$ (6,68)	$V_{CC}$ supply undervoltage positive going threshold	8	8.9	9.8		
$V_{CCUV-}$ (6,68)	$V_{CC}$ supply undervoltage negative going threshold	7.4	8.2	9		
$V_{CCUVHY}$ (6,68)	$V_{CC}$ supply undervoltage hysteresis	0.3	0.7	—		
$V_{BSUV+}$ (6,68)	$V_{BS}$ supply undervoltage positive going threshold	8	8.9	9.8		

**Static Electrical Characteristics - (Continued)**

$V_{BIAS}$  ( $V_{CC}, V_{BS1,2,3}$ ) = 15 V unless otherwise specified. The  $V_{IN}$ ,  $V_{TH}$ , and  $I_{IN}$  parameters are referenced to  $V_{SS}$  and are applicable to all six channels ( $\overline{HIN1,2,3}/ HIN1,2,3$  and  $\overline{LIN1,2,3}$ ). The  $V_O$  and  $I_O$  parameters are referenced to COM and  $V_{S1,2,3}$  and are applicable to the respective output leads: LO1,2,3 and HO1,2,3.

Symbol	Definition	Min.	Typ.	Max.	Units	Test Conditions
$V_{BSUV-}$ (6,68)	$V_{BS}$ supply undervoltage negative going threshold	7.4	8.2	9	V	
$V_{BSUVHY}$ (6,68)	$V_{BS}$ supply undervoltage hysteresis	0.3	0.7	—		
$V_{CCUV+}$ (62)	$V_{CC}$ supply undervoltage positive going threshold	9.6	10.4	11.2		
$V_{CCUV-}$ (62)	$V_{CC}$ supply undervoltage negative going threshold	8.6	9.4	10.2		
$V_{CCUVHY}$ (62)	$V_{CC}$ supply undervoltage hysteresis	0.5	1	—		
$V_{BSUV+}$ (62)	$V_{BS}$ supply undervoltage positive going threshold	9.6	10.4	11.2		
$V_{BSUV-}$ (62)	$V_{BS}$ supply undervoltage negative going threshold	8.6	9.4	10.2		
$V_{BSUVHY}$ (62)	$V_{BS}$ supply undervoltage hysteresis	0.5	1	—		
$V_{CCUV+}$ (63,65,66,67)	$V_{CC}$ supply undervoltage positive going threshold	10.4	11.1	11.6		
$V_{CCUV-}$ (63,65,66,67)	$V_{CC}$ supply undervoltage negative going threshold	10.2	10.9	11.4		
$V_{CCUVHY}$ (63,65,66,67)	$V_{CC}$ supply undervoltage hysteresis	—	0.2	—		
$V_{BSUV+}$ (63,65,66,67)	$V_{BS}$ supply undervoltage positive going threshold	10.4	11.1	11.6		
$V_{BSUV-}$ (63,65,66,67)	$V_{BS}$ supply undervoltage negative going threshold	10.2	10.9	11.4		
$V_{BSUVHY}$ (63,65,66,67)	$V_{BS}$ supply undervoltage hysteresis	—	0.2	—		
$I_{LK}$	Offset supply leakage current	—	—	50	$\mu A$	$V_B = V_S = 600 V$
$I_{QBS}$	Quiescent $V_{BS}$ supply current	—	70	120	mA	all inputs are in off state
$I_{QCC}$	Quiescent $V_{CC}$ supply current	—	2	3		
$V_{IN,CLAMP}$	Input clamp voltage (HIN, LIN, ITRIP and EN)	4.8	5.2	5.65	V	$I_{IN} = 100 \mu A$
$I_{LIN+}$ (6,62,63,65)	Input bias current (LOUT = HI)	—	110	150	$\mu A$	$V_{IN} = 4 V$
$I_{LIN-}$ (6,62,63,65)	Input bias current (LOUT = LO)	—	150	200		$V_{IN} = 0 V$
$I_{LIN+}$ (66,67,68)	Input bias current (LOUT = HI)	—	—	3		$V_{IN} = 4 V$
$I_{LIN-}$ (66,67,68)	Input bias current (LOUT = LO)	—	—	3		$V_{IN} = 0 V$
$I_{HIN+}$ (6,63,65)	Input bias current (HOUT = HI)	—	110	150		$V_{IN} = 4 V$
$I_{HIN-}$ (6,63,65)	Input bias current (HOUT = LO)	—	150	200		$V_{IN} = 0 V$
$I_{HIN+}$ (62)	Input bias current (HOUT = HI)	—	5	20		$V_{IN} = 4 V$
$I_{HIN-}$ (62)	Input bias current (HOUT = LO)	—	—	3		$V_{IN} = 0 V$
$I_{HIN+}$ (66,67,68)	Input bias current (HOUT = HI)	—	—	3		$V_{IN} = 4 V$
$I_{HIN-}$ (66,67,68)	Input bias current (HOUT = LO)	—	—	3		$V_{IN} = 0 V$
$I_{ITRIP+}$	“High” ITRIP input bias current	—	5	40		$V_{IN} = 4 V$
$I_{ITRIP-}$	“Low” ITRIP input bias current	—	—	1		$V_{IN} = 0 V$
$I_{EN+}$	“High” ENABLE input bias current	—	5	40		$V_{IN} = 4 V$
$I_{EN-}$	“Low” ENABLE input bias current	—	—	1		$V_{IN} = 0 V$

### Static Electrical Characteristics - (Continued)

$V_{BIAS}$  ( $V_{CC}, V_{BS1,2,3}$ ) = 15 V unless otherwise specified. The  $V_{IN}$ ,  $V_{TH}$ , and  $I_{IN}$  parameters are referenced to  $V_{SS}$  and are applicable to all six channels ( $\overline{HIN1,2,3}/HIN1,2,3$  and  $\overline{LIN1,2,3}$ ). The  $V_O$  and  $I_O$  parameters are referenced to COM and  $V_{S1,2,3}$  and are applicable to the respective output leads: LO1,2,3 and HO1,2,3.

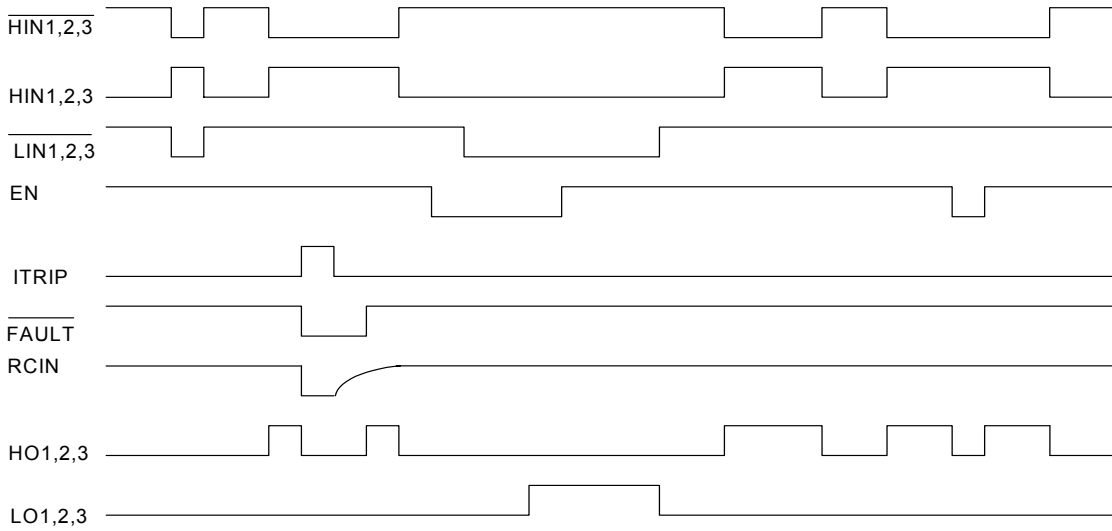
Symbol	Definition	Min.	Typ.	Max.	Units	Test Conditions
$I_{RCIN}$	RCIN input bias current	—	—	1	$\mu A$	$V_{RCIN} = 0 V$ or 15 V
$I_{O+}$	Output high short circuit pulsed current	120	200	—	mA	$V_O = 0 V$ , $PW \leq 10 \mu s$
$I_{O-}$	Output low short circuit pulsed current	250	350	—		$V_O = 15 V$ , $PW \leq 10 \mu s$
$R_{on\_RCIN}$	RCIN low on resistance	—	50	100	$\Omega$	$I = 1.5 mA$
$R_{on\_FAULT}$	$\overline{FAULT}$ low on resistance	—	50	100		

### Dynamic Electrical Characteristics

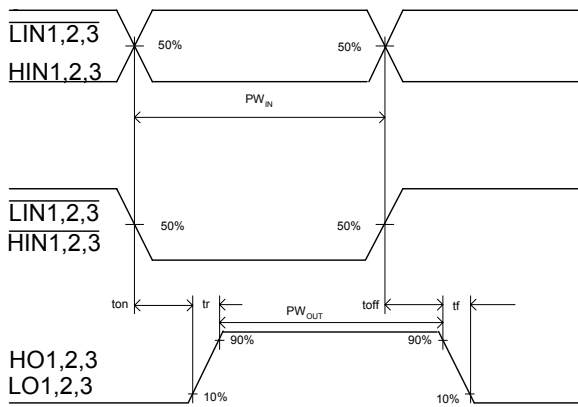
Dynamic Electrical Characteristics  $V_{CC} = V_{BS} = V_{BIAS} = 15 V$ ,  $V_{S1,2,3} = V_{SS} = COM$ ,  $T_A = 25^\circ C$  and  $CL = 1000 pF$  unless otherwise specified.

Symbol	Definition	Min.	Typ.	Max.	Units	Test Conditions
$t_{on}$	Turn-on propagation delay	400	530	750	ns	$V_{IN} = 0 V$ & 5 V
$t_{off}$	Turn-off propagation delay	400	530	750		
$t_{on}(66,67)$	Turn-on propagation delay	—	200	—		
$t_{off}(66,67)$	Turn-off propagation delay	—	200	—		
$t_r$	Turn-on rise time	—	125	190		
$t_f$	Turn-off fall time	—	50	75		
$t_{EN}$	ENABLE low to output shutdown propagation delay	350	460	650		$V_{IN}, V_{EN} = 0 V$ or 5 V
$t_{EN}(66,67)$	ENABLE low to output shutdown propagation delay	—	300	—		
$t_{ITRIP}$	ITRIP to output shutdown propagation delay	500	750	1200		$V_{ITRIP} = 5 V$
$t_{bl}$	ITRIP blanking time	—	400	—		$V_{IN} = 0 V$ or 5 V $V_{ITRIP} = 5 V$
$t_{FLT}$	ITRIP to $\overline{FAULT}$ propagation delay	400	600	950		
$t_{FILIN}$	Input filter time (HIN, LIN) (IRS213(6,62,63,65,68) only)	200	350	510		$V_{IN} = 0 V$ & 5 V
$t_{filterEN}$	Enable input filter time (IRS213(6,62,63,65,68) only)	100	200	—		
DT	Deadtime	190	290	420		$V_{IN} = 0 V$ & 5 V external dead time
MT	$t_{on}$ , $t_{off}$ matching time (on all six channels)	—	—	50	External dead time >420 ns	
MDT	DT matching (Hi->Lo & Lo->Hi on all channels)	—	—	60	External dead time 0 s	
PM	Pulse width distortion (pwin-pwout)	—	—	75	PW input=10 $\mu s$	
$t_{FLTCLR}$	$\overline{FAULT}$ clear time RCIN: R = 2 M $\Omega$ , C = 1 nF	1.3	1.65	2	ms	$V_{IN} = 0 V$ or 5 V $V_{ITRIP} = 0 V$

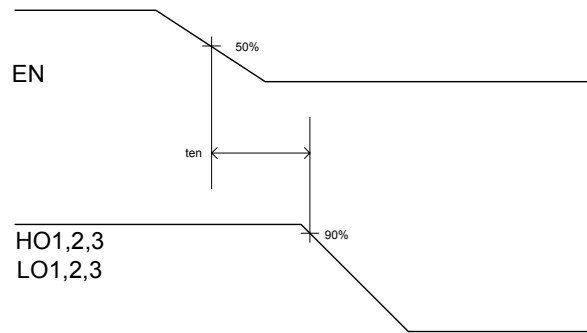
Note: For high side PWM, HIN pulse width must be  $\geq 500$  ns.



**Fig. 1. Input/Output Timing Diagram**



**Fig. 2. Switching Time Waveforms**



**Fig. 3. Output Enable Timing Waveform**

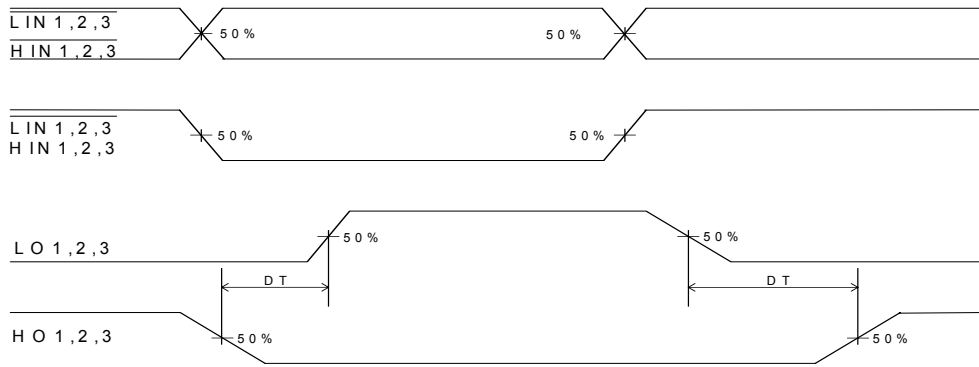


Fig. 4. Internal Deadtime Timing Waveforms

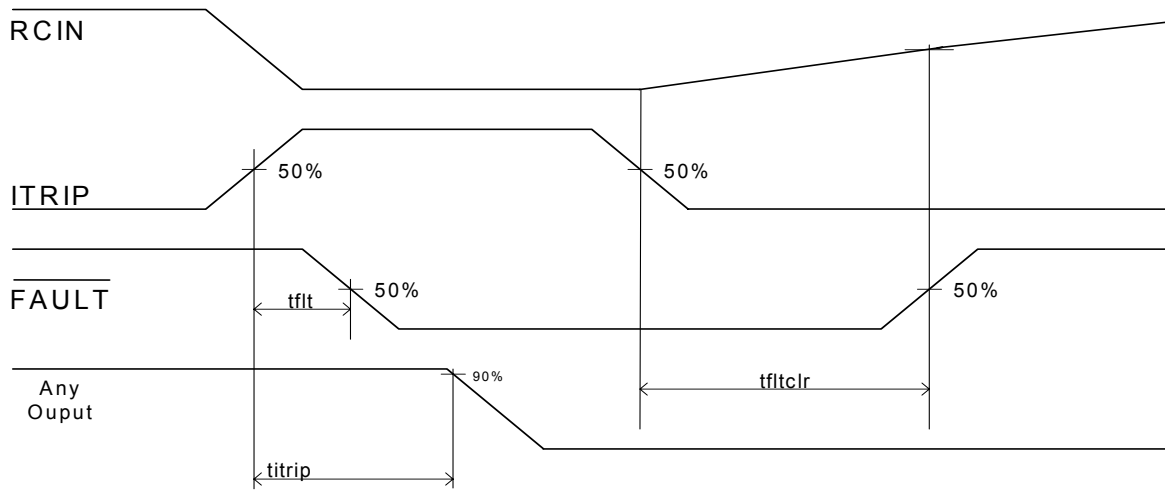


Fig. 5. ITRIP/RCIN Timing Waveforms

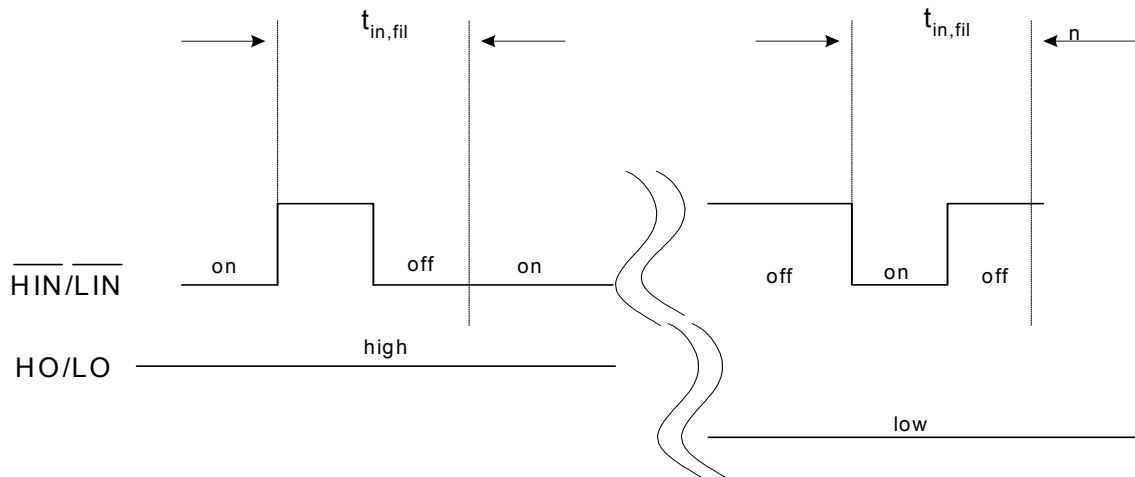


Fig. 6. Input Filter Function

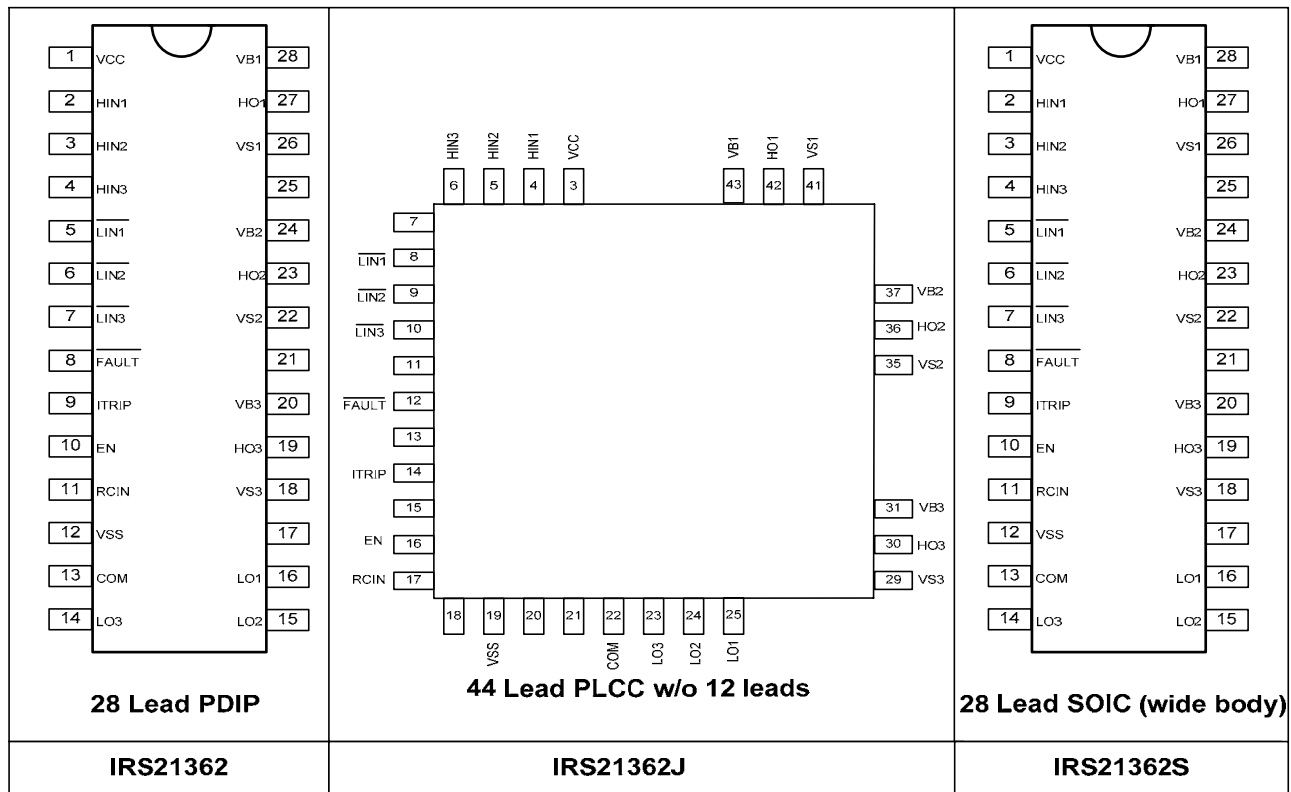
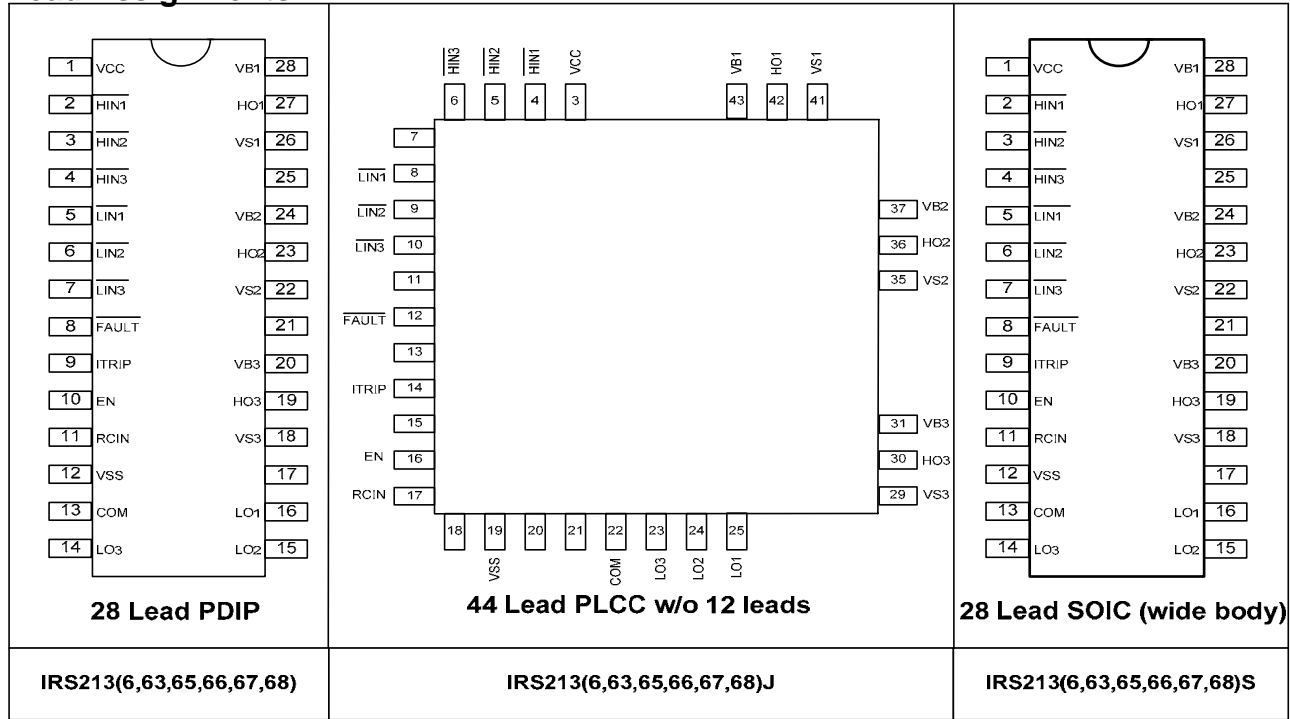
## Lead Definitions

Symbol	Description
V <sub>CC</sub>	Low side supply voltage
V <sub>SS</sub>	Logic ground
HIN1,2,3 HIN1,2,3	Logic inputs for high side gate driver outputs (HO1,2,3), out of phase [IRS213(6,63,65,66,67,68)] Logic inputs for high side gate driver outputs (HO1,2,3), in Phase (IRS21362)
LIN1,2,3	Logic input for low side gate driver outputs (LO1,2,3), out of phase
FAULT	Indicates over-current (ITRIP) or low-side undervoltage lockout has occurred. negative logic, open-drain output
EN	Logic input to enable I/O functionality. I/O logic functions when ENABLE is high (i.e., positive logic). No effect on FAULT and not latched
ITRIP	Analog input for overcurrent shutdown. when active, ITRIP shuts down outputs and activates $\overline{\text{FAULT}}$ and RCIN low. when ITRIP becomes inactive, $\overline{\text{FAULT}}$ stays active low for an externally set time T <sub>FLTCLR</sub> , then automatically becomes inactive (open-drain high impedance).
RCIN	External RC network input used to define FAULT CLEAR delay, T <sub>FLTCLR</sub> , approximately equal to R*C. when RCIN>8 V, the FAULT pin goes back into open-drain high-impedance
COM	Low side gate drivers return
V <sub>B1,2,3</sub>	High side floating supply
HO1,2,3	High side gate driver outputs
V <sub>S1,2,3</sub>	High voltage floating supply return
LO1,2,3	Low side driver sourcing outputs

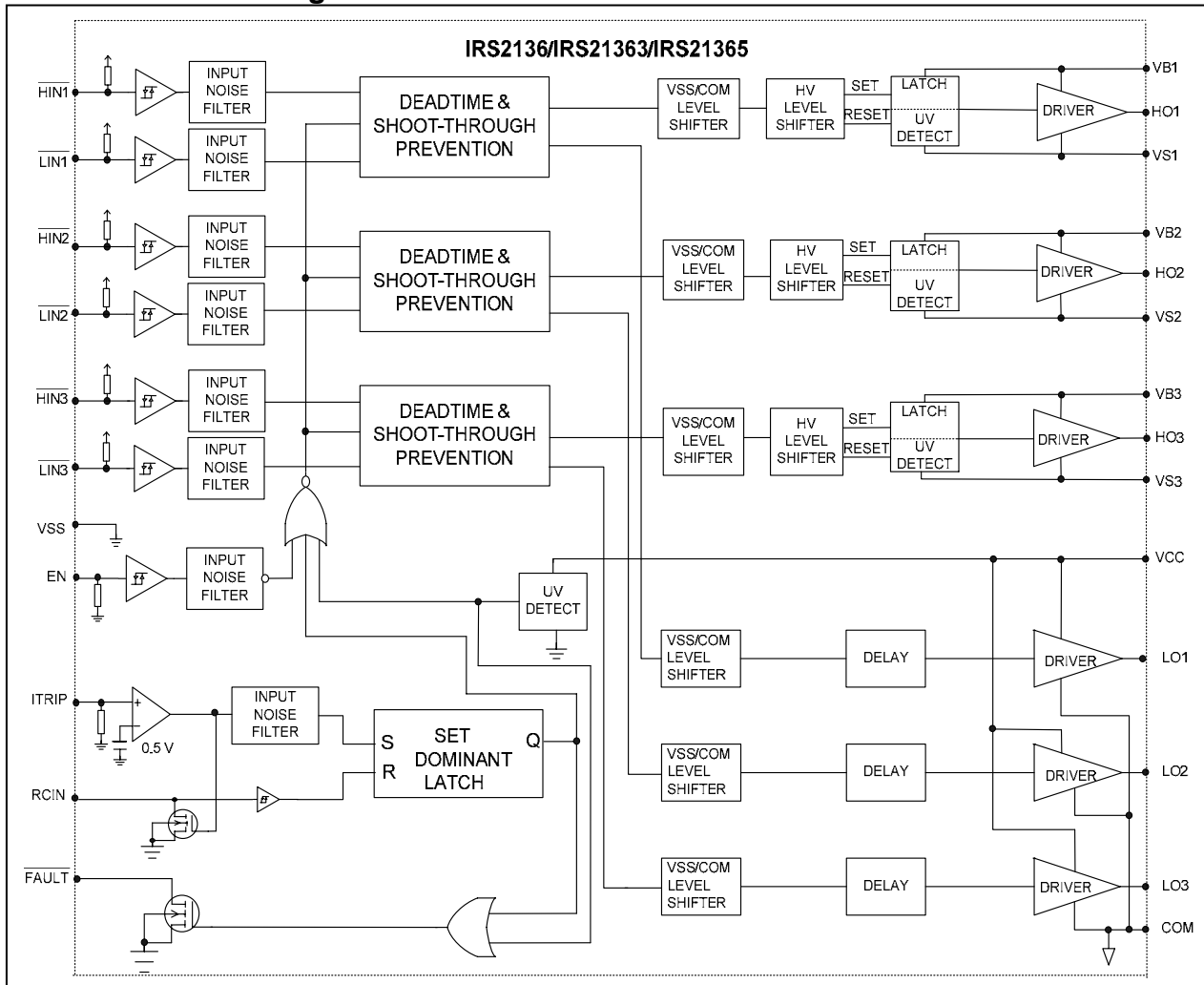
**Note:** LIN, HIN, EN, and ITRIP are internally clamped with a 5.2 V zener diode.



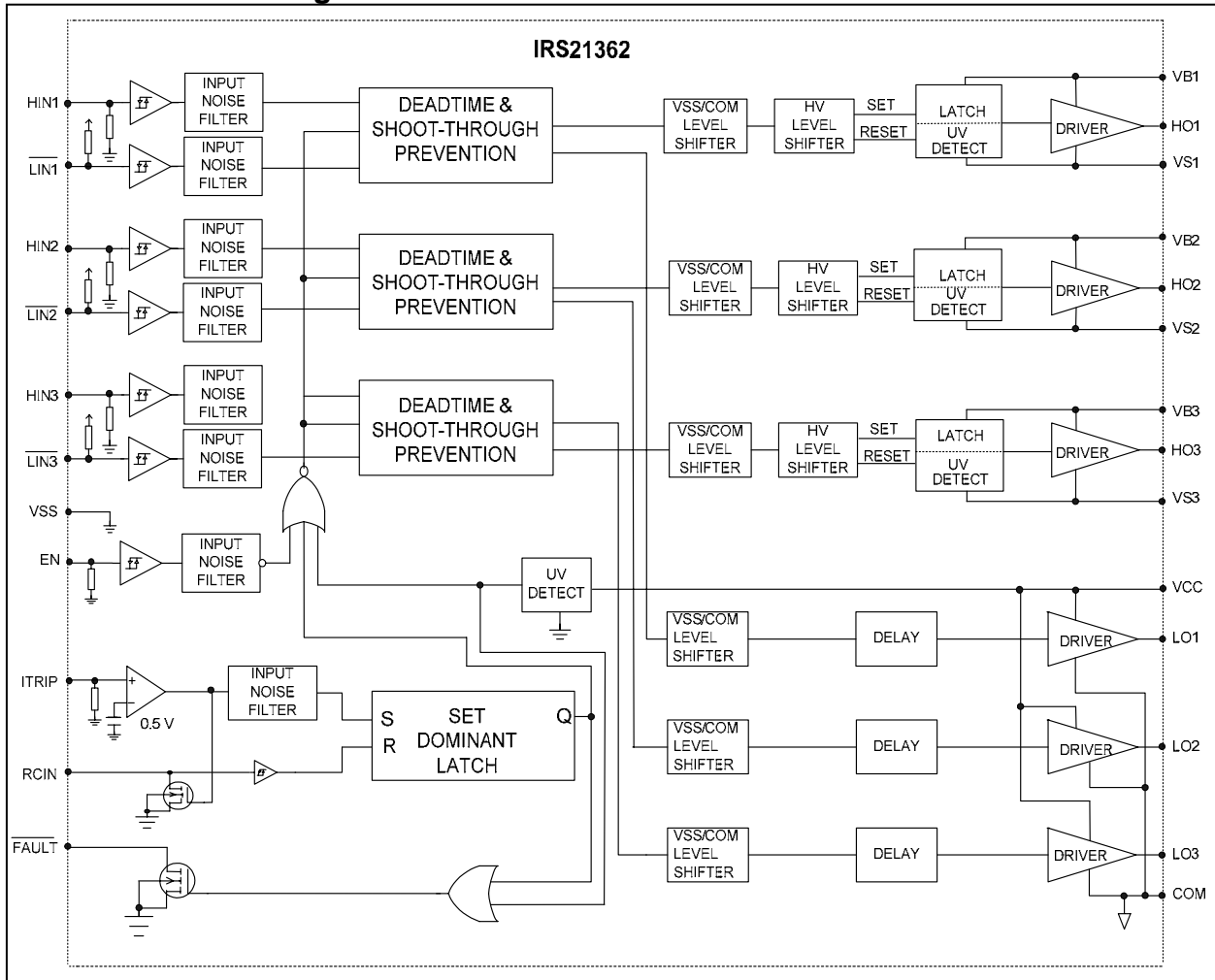
**Lead Assignments**



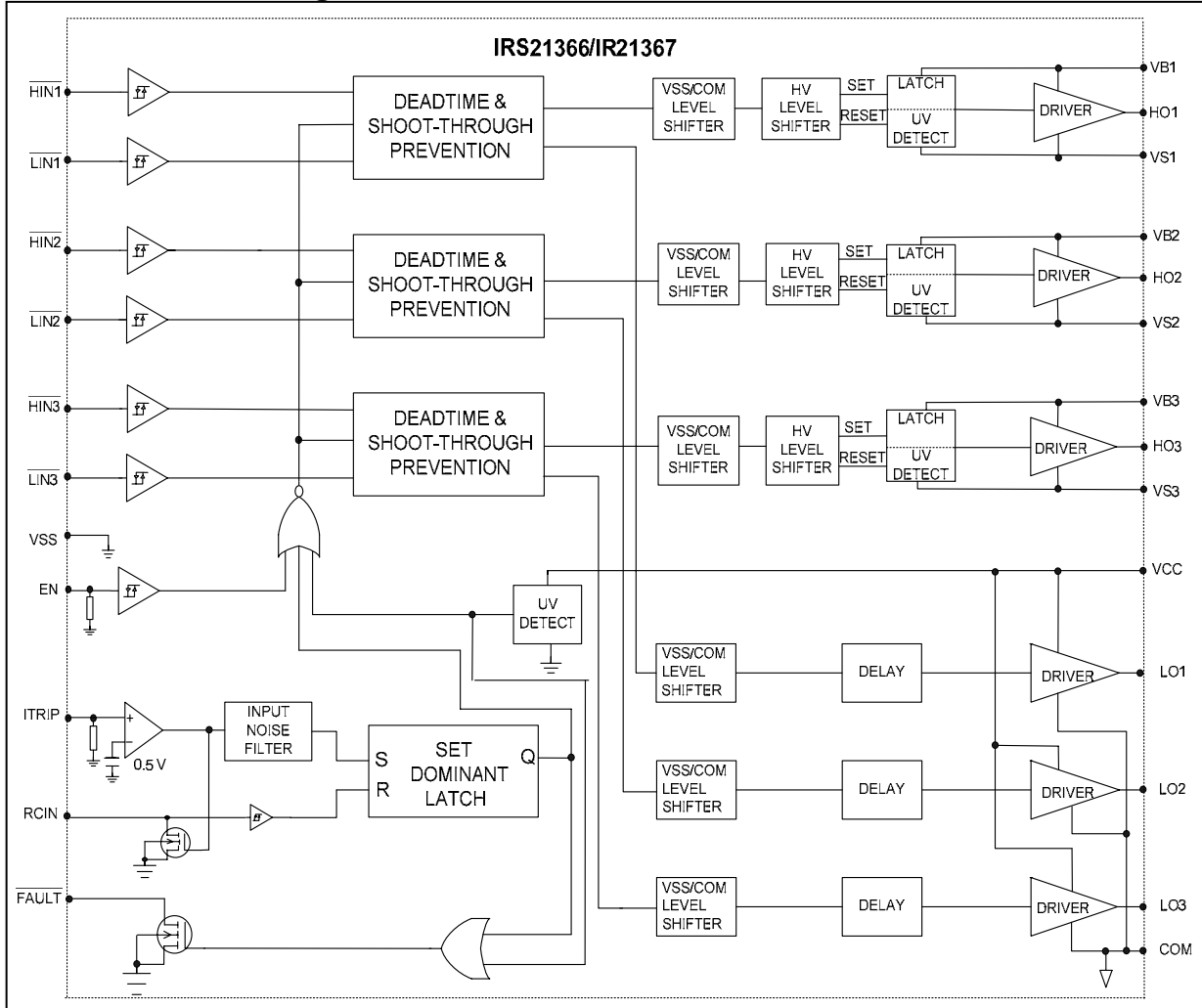
Functional Block Diagram



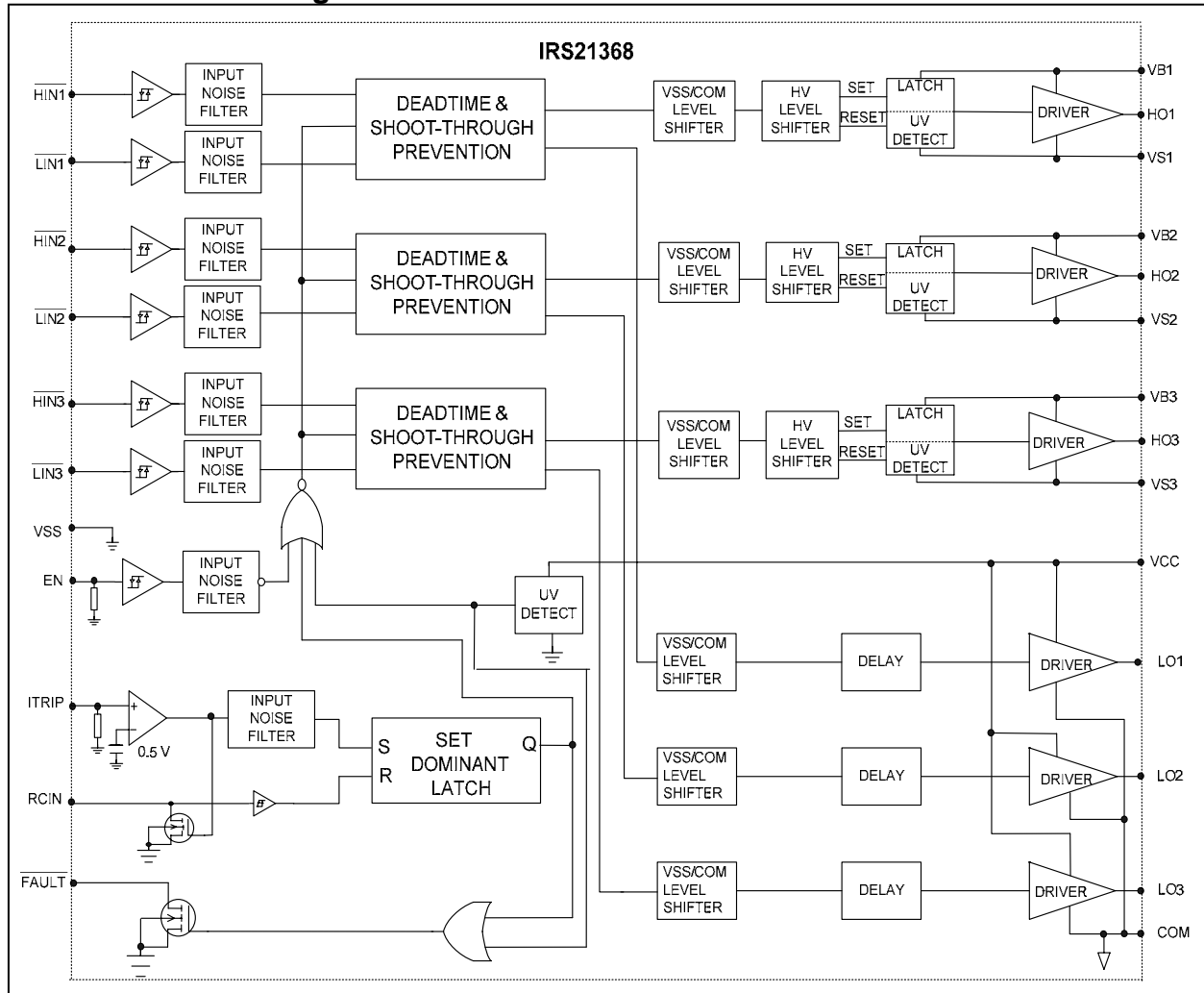
Functional Block Diagram



Functional Block Diagram



### Functional Block Diagram



VCC	VBS	ITRIP	ENABLE	FAULT	LO1,2,3	HO1,2,3
<UVCC	X	X	X	0 (note 1)	0	0
15 V	<UVBS	0 V	5 V	high imp	LIN1,2,3	0 (note 2)
15 V	15 V	0 V	5 V	high imp	LIN1,2,3	HIN1,2,3
15 V	15 V	>V <sub>ITRIP</sub>	5 V	0 (note 3)	0	0
15 V	15 V	0 V	0 V	high imp	0	0

**Note 1:** A shoot-through prevention logic prevents LO1,2,3 and HO1,2,3 for each channel from turning on simultaneously.

**Note 2:** UVCC is not latched, when  $V_{CC} > UVCC$ ,  $\overline{FAULT}$  returns to high impedance.

**Note 3:** When  $V_{BS} < UVBS$ , HO goes low. After  $V_{BS}$  goes higher than UVBS, HO stays low until a new falling IRS213(6,63,65,66,67,68) or rising IRS21362 transition of HIN.

**Note 4:** When  $ITRIP < V_{ITRIP}$ ,  $\overline{FAULT}$  returns to high-impedance after RCIN pin becomes greater than 8 V (@  $V_{CC} = 15 V$ ).

## 1 PCB Layout Tips

### 1.1 Distance from H to L Voltage

The IRS2136xJ package lacks some pins (see page 11) in order to maximizing the distance between the high voltage and low voltage pins. It's strongly recommended to place the components tied to the floating voltage in the respective high voltage portions of the device ( $V_{B1,2,3}$ ,  $V_{S1,2,3}$ ) side.

### 1.2 Ground Plane

To minimize noise coupling ground plane must not be placed under or near the high voltage floating side.

### 1.3 Gate Drive Loops

Current loops behave like an antenna able to receive and transmit EM noise (see Fig. 7). In order to reduce EM coupling and improve the power switch turn on/off performances, gate drive loops must be reduced as much as possible. Moreover, current can be injected inside the gate drive loop via the IGBT collector-to-gate parasitic capacitance. The parasitic auto-inductance of the gate loop contributes to develop a voltage across the gate-emitter increasing the possibility of self turn-on effect.

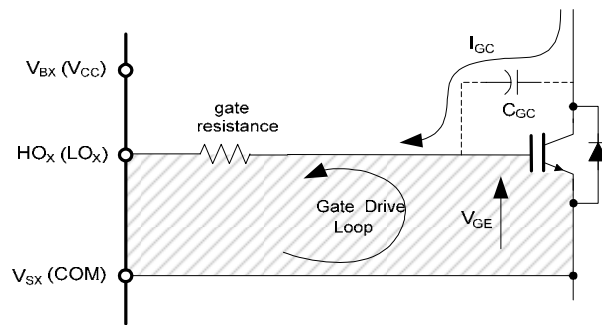


Fig. 7. Antenna Loops

### 1.4 Supply Capacitors

Supply capacitors must be placed as close as possible to the device pins ( $V_{CC}$  and  $V_{SS}$  for the ground tied supply,  $V_B$  and  $V_S$  for the floating supply) in order to minimize parasitic inductance/resistance.

### 1.5 Routing and Placement

Power stage PCB parasitic may generate dangerous voltage transients for the gate driver and the control logic. In particular it's recommended to limit phase voltage negative transients.

In order to avoid such undervoltage it is highly recommended to minimize high side emitter to low side collector distance and low side emitter to negative bus rail stray inductance. See DT04-4 at [www.irf.com](http://www.irf.com) for more detailed information.

Figures 8-28 provide information on the experimental performance of the IRS2136S HVIC. The line plotted in each figure is generated from actual lab data. A large number of individual samples were tested at three temperatures (-40 °C, 25 °C, and 125 °C) in order to generate the experimental (Exp.) curve. The line labeled Exp. consist of three data points (one data point at each of the tested temperatures) that have been connected together to illustrate the understood trend. The individual data points on the curve were determined by calculating the averaged experimental value of the parameter (for a given temperature).

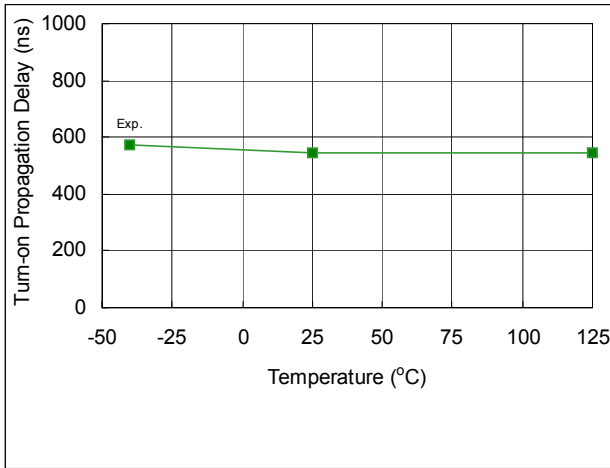


Fig. 8. Turn-On Propagation Delay vs. Temperature

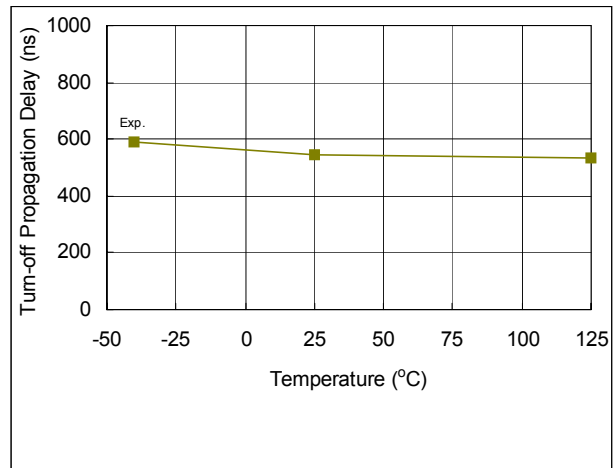


Fig. 9. Turn-Off Propagation Delay vs. Temperature

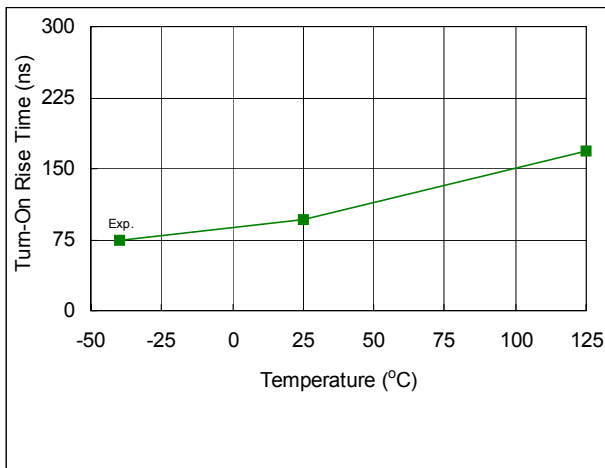


Fig. 10. Turn-On Rise Time vs. Temperature

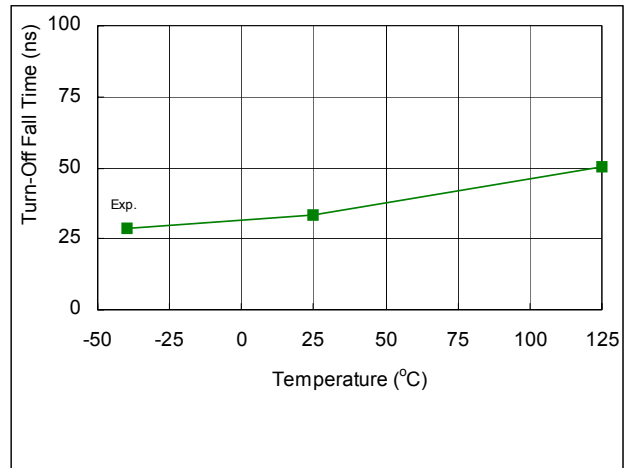


Fig. 11. Turn-Off Fall Time vs. Temperature

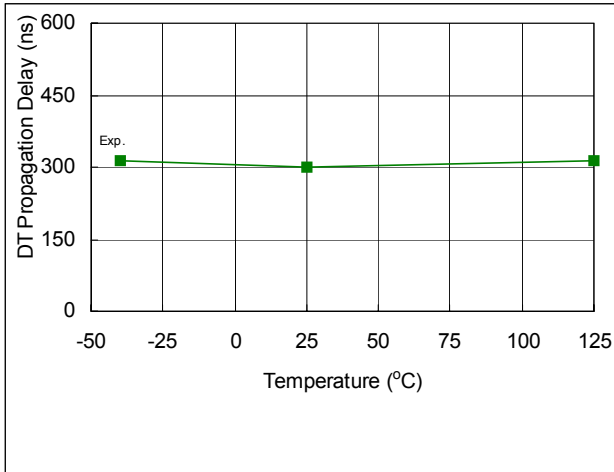


Fig. 12. DT Propagation Delay vs. Temperature

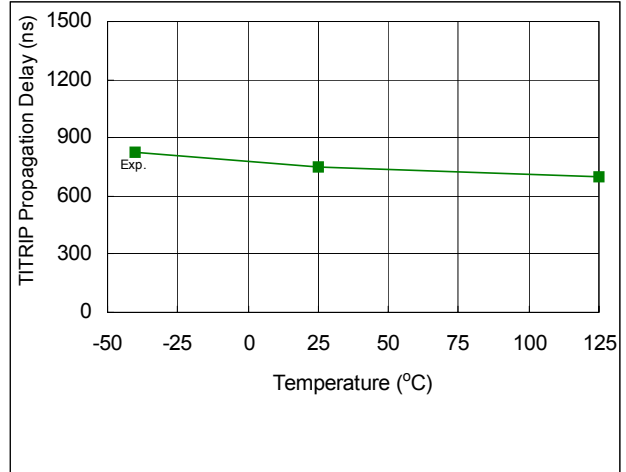


Fig. 13. TITRIP Propagation Delay vs. Temperature

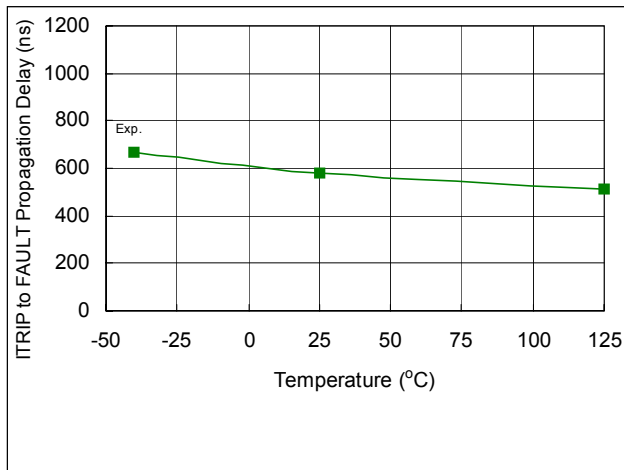


Fig. 14. ITRIP to FAULT Propagation Delay vs. Temperature

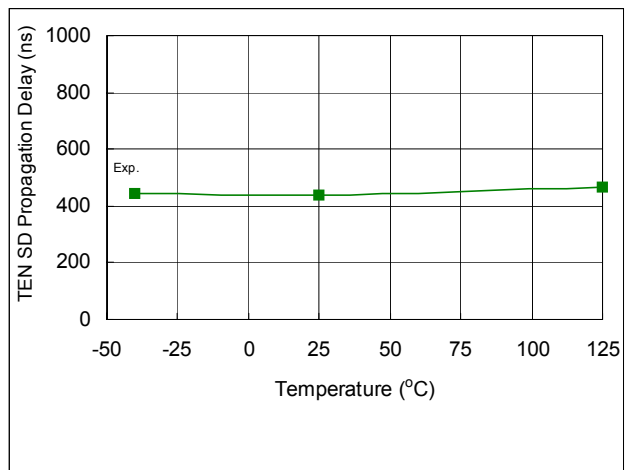


Fig. 15. TEN SD Propagation Delay vs. Temperature

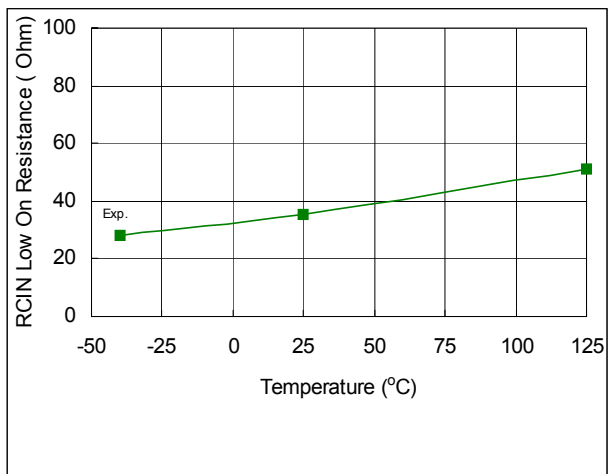


Fig. 16. RCIN Low On Resistance vs. Temperature

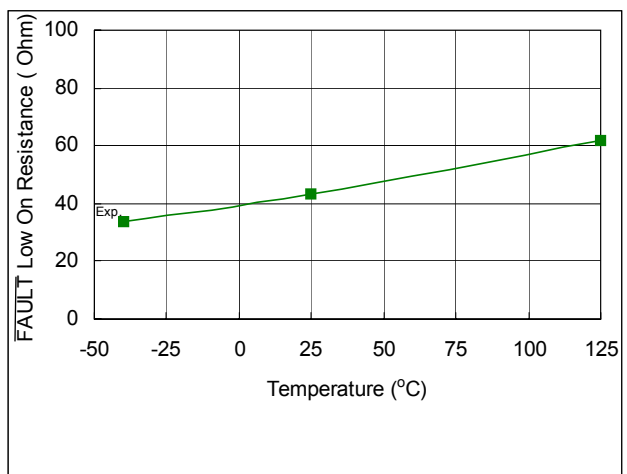


Fig. 17. FAULT Low On Resistance vs. Temperature



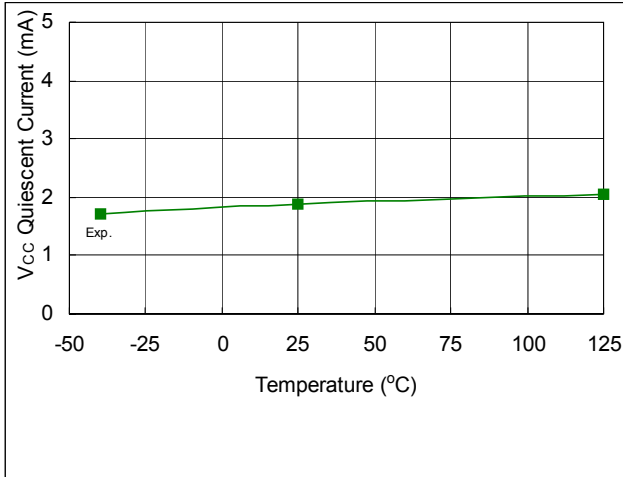


Fig. 18. V<sub>CC</sub> Quiescent Current vs. Temperature

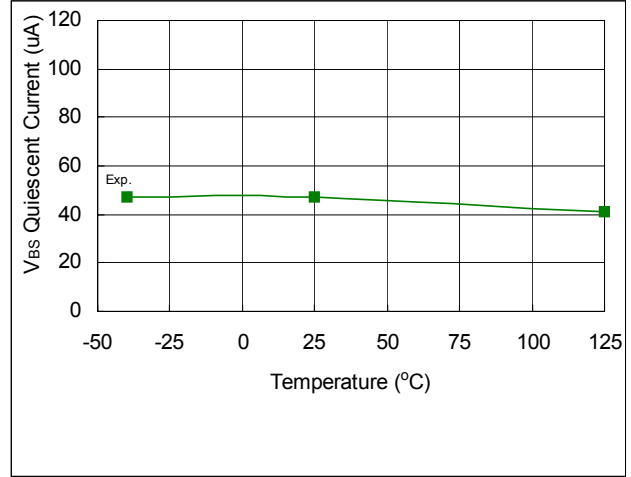


Fig. 19. V<sub>BS</sub> Quiescent Current vs. Temperature

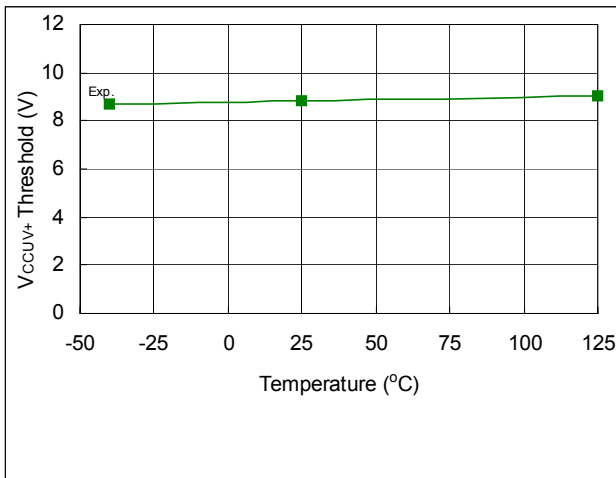


Fig. 20. V<sub>CCUV+</sub> Threshold vs. Temperature

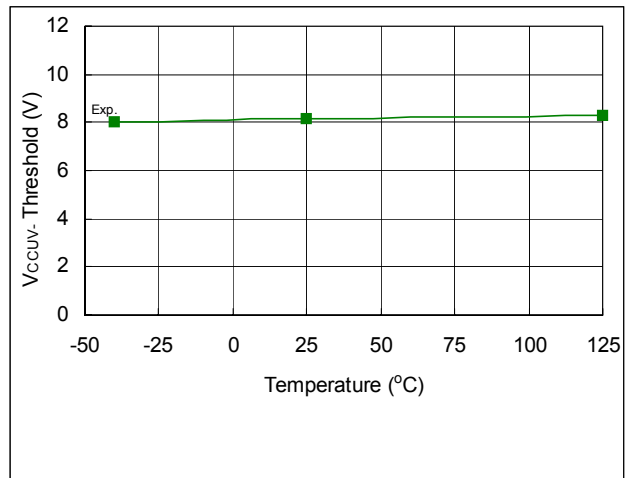


Fig. 21. V<sub>CCUV-</sub> Threshold vs. Temperature

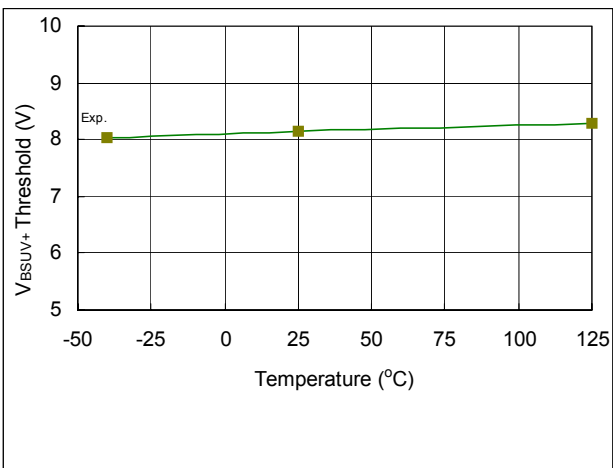


Fig. 22. V<sub>BSUV+</sub> Threshold vs. Temperature

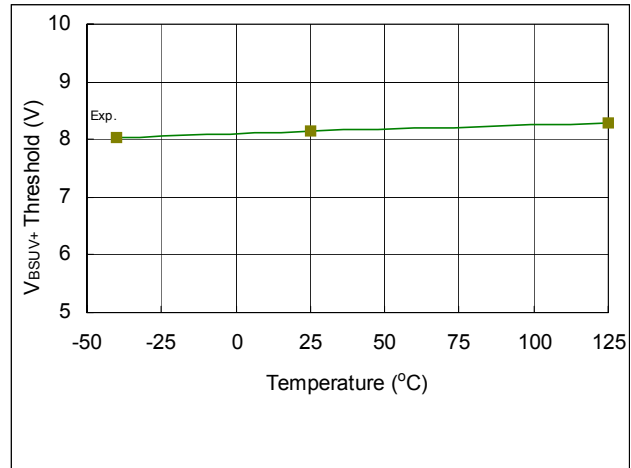


Fig. 23. V<sub>BSUV-</sub> Threshold vs. Temperature

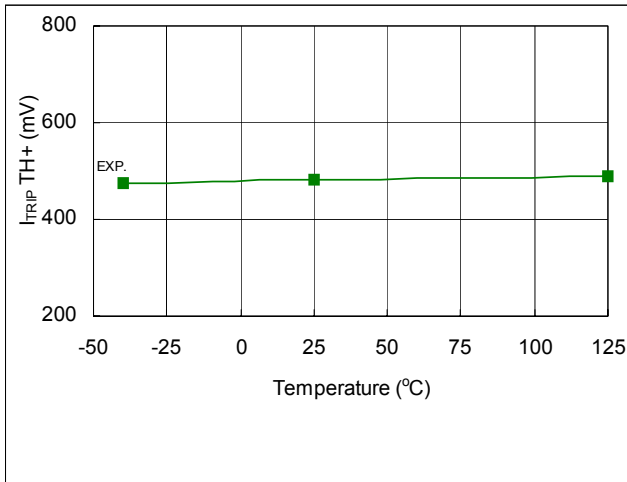


Fig. 24.  $I_{TRIP\ TH+}$  vs. Temperature

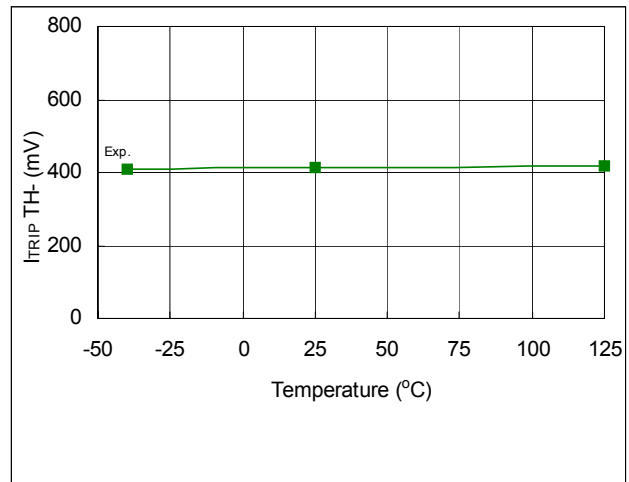


Fig. 25.  $I_{TRIP\ TH-}$  vs. Temperature

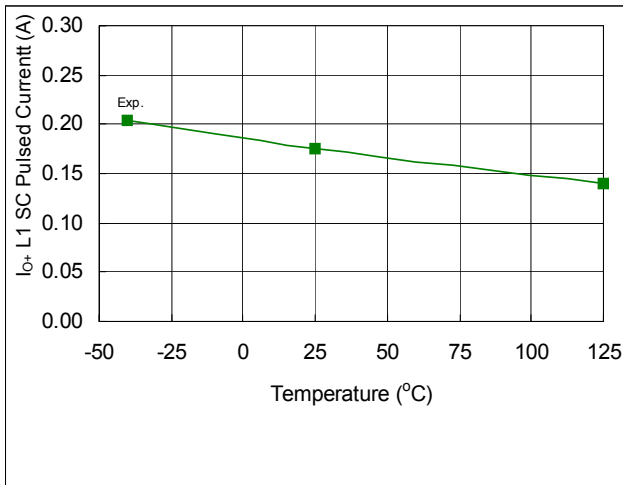


Fig. 26.  $I_{O+ L1\ SC}$  Pulsed Current vs. Temperature

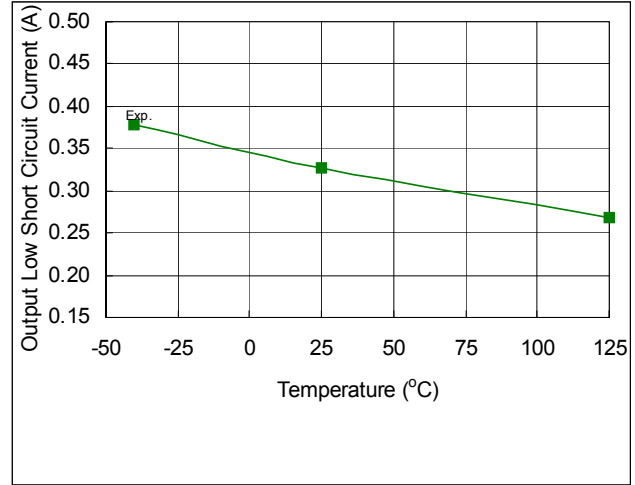


Fig. 27.  $I_{O- L1\ SC}$  Pulsed Current vs. Temperature

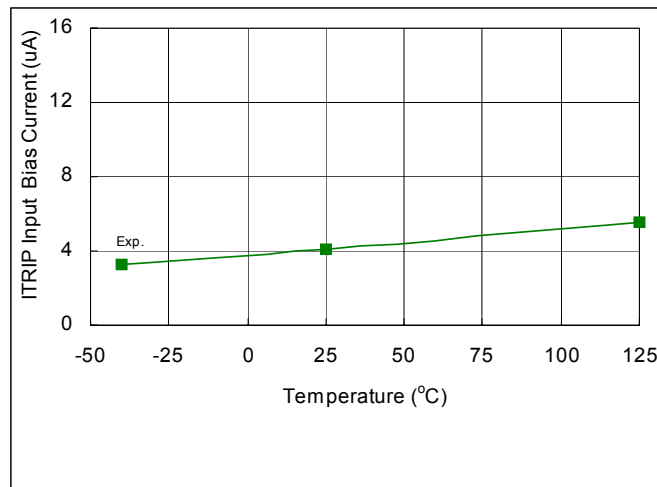
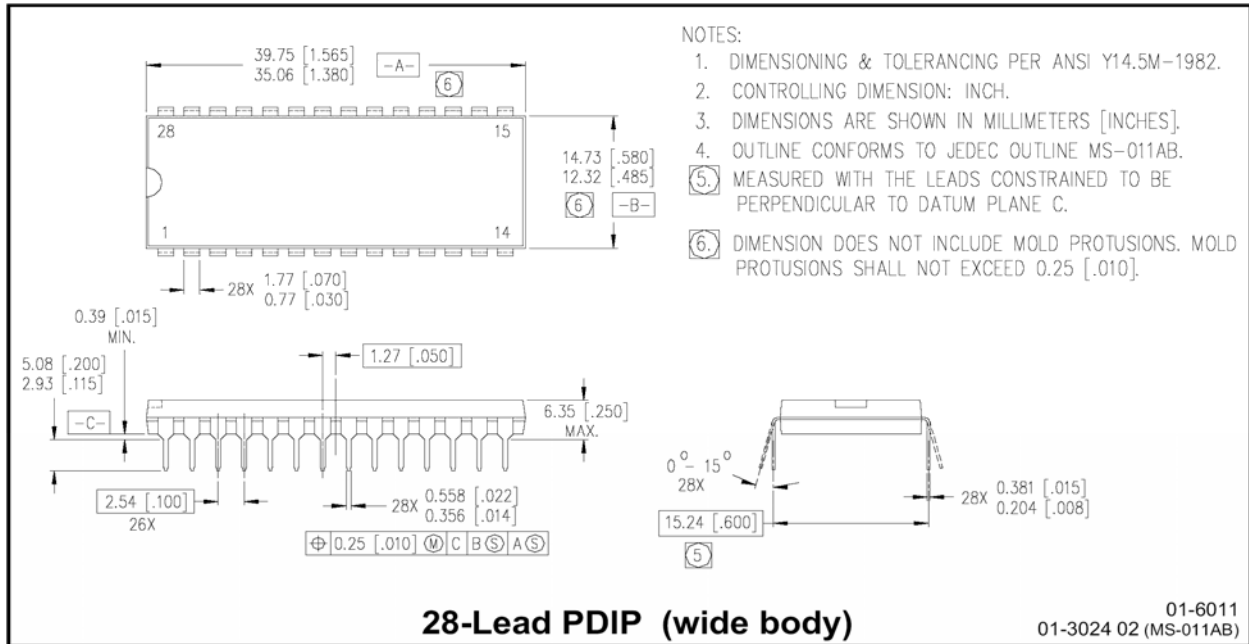
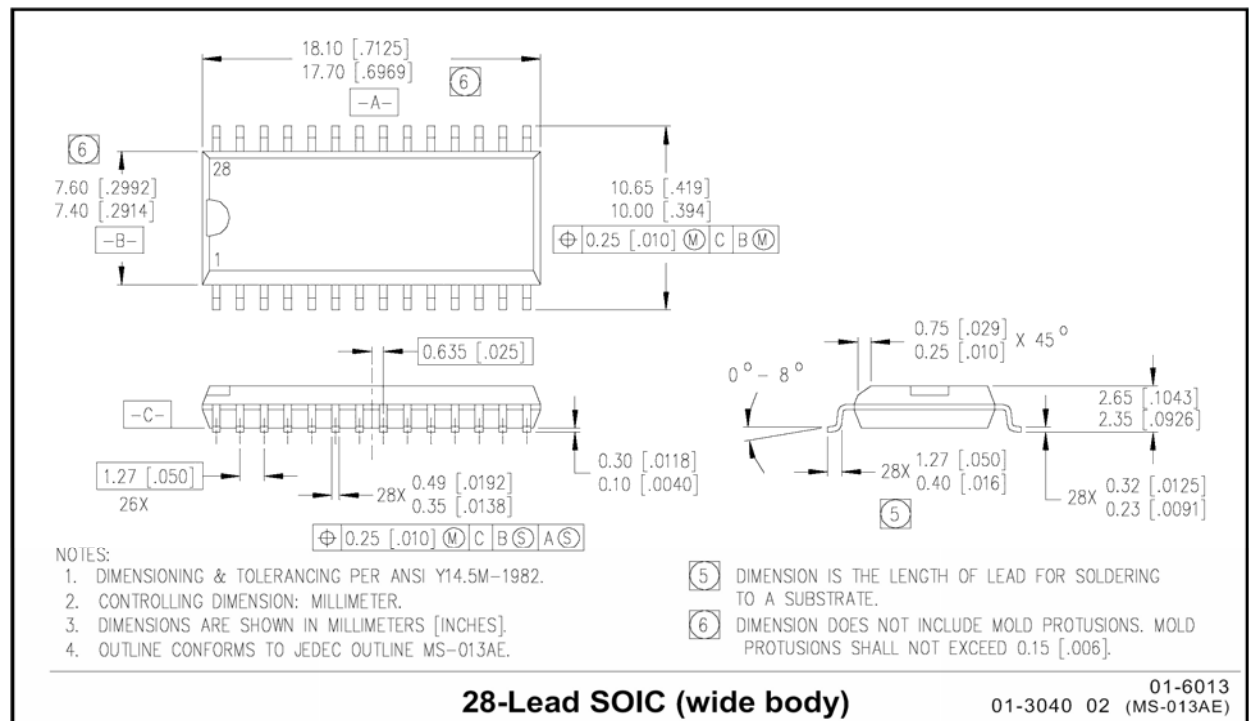


Fig. 28.  $I_{TRIP\ Input\ Bias\ Current}$  vs. Temperature

**Case Outlines**

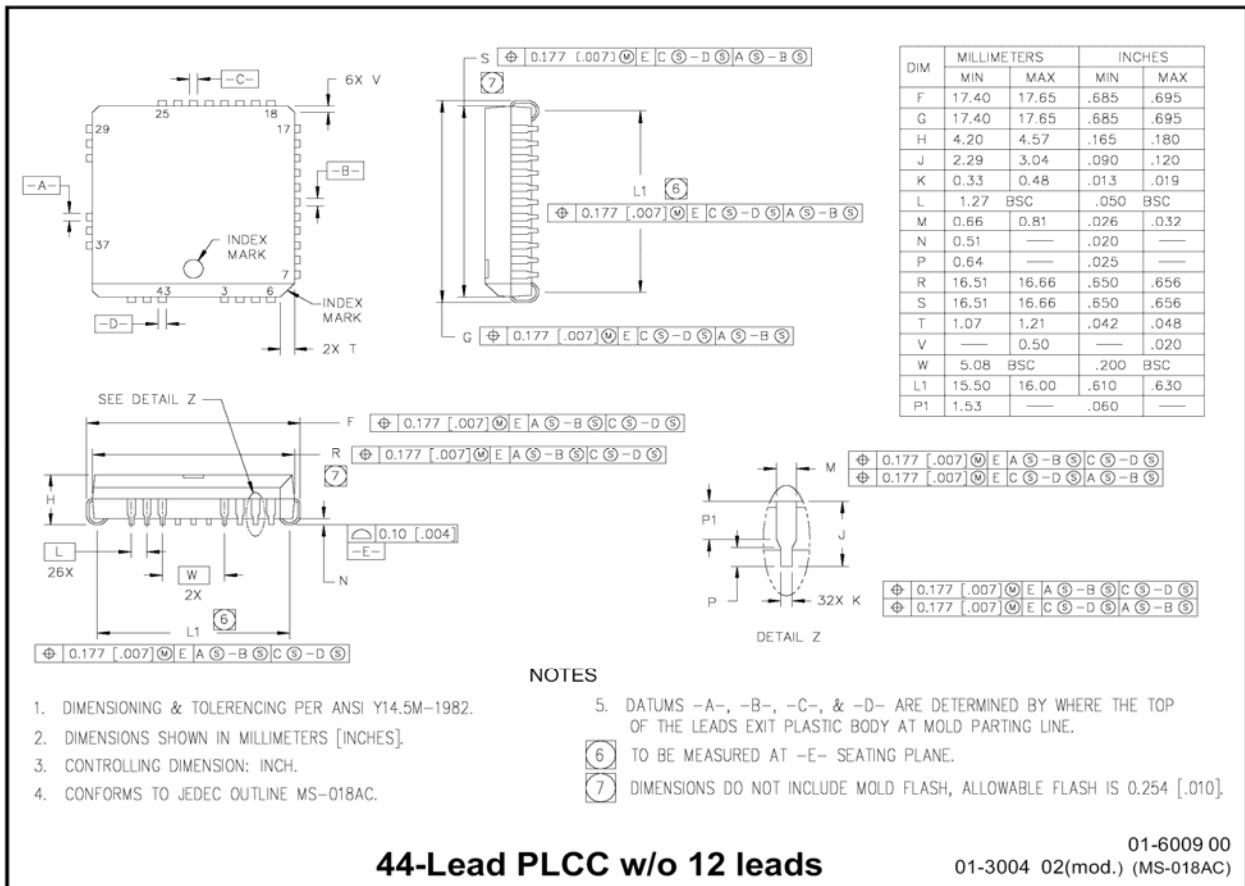


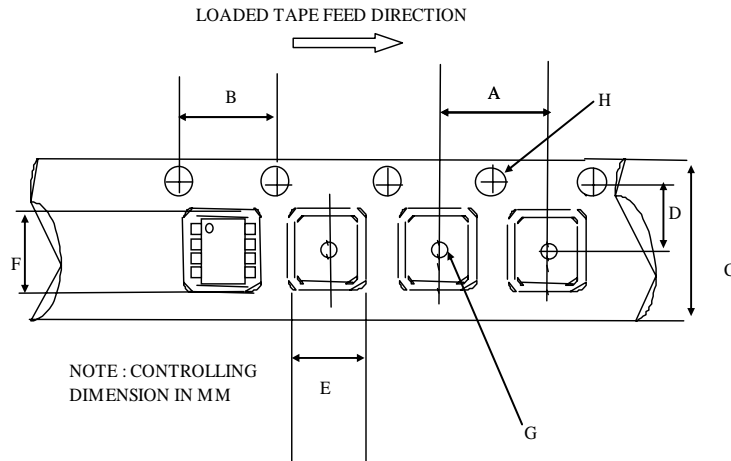
**28-Lead PDIP (wide body)**



**28-Lead SOIC (wide body)**

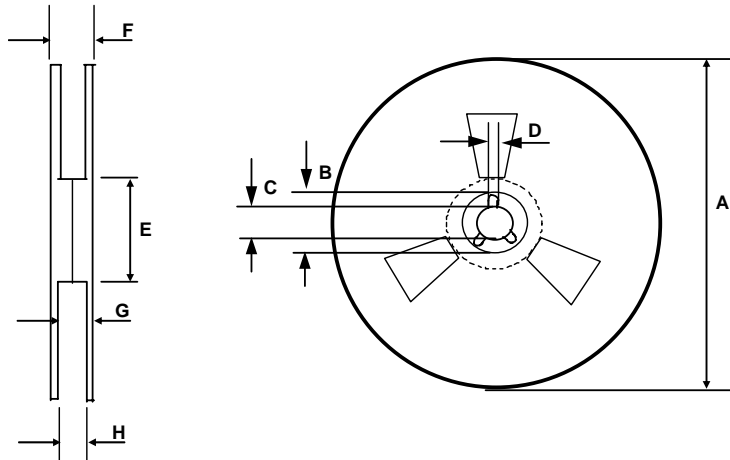
Case Outlines





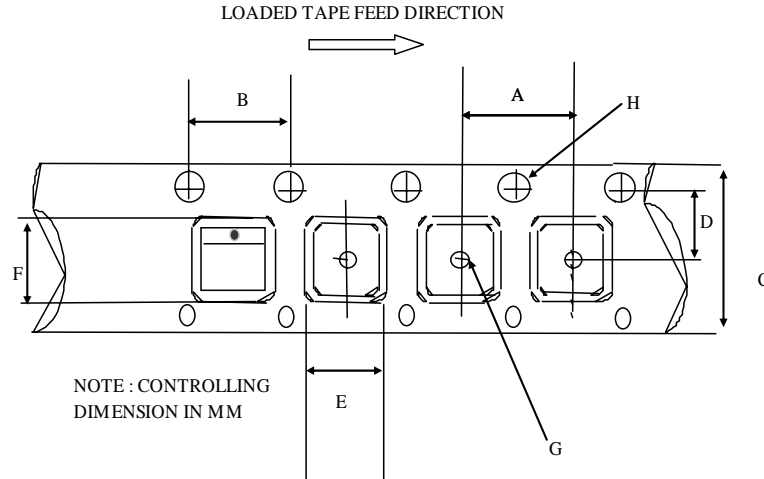
CARRIER TAPE DIMENSION FOR 28SOICW

Code	Metric		Imperial	
	Min	Max	Min	Max
A	11.90	12.10	0.468	0.476
B	3.90	4.10	0.153	0.161
C	23.70	24.30	0.933	0.956
D	11.40	11.60	0.448	0.456
E	10.80	11.00	0.425	0.433
F	18.20	18.40	0.716	0.724
G	1.50	n/a	0.059	n/a
H	1.50	1.60	0.059	0.062



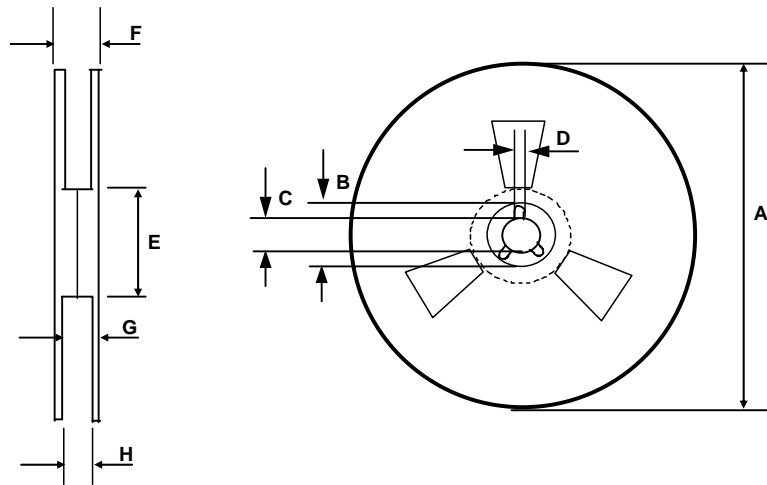
REEL DIMENSIONS FOR 28SOICW

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	30.40	n/a	1.196
G	26.50	29.10	1.04	1.145
H	24.40	26.40	0.96	1.039



CARRIER TAPE DIMENSION FOR 44PLCC

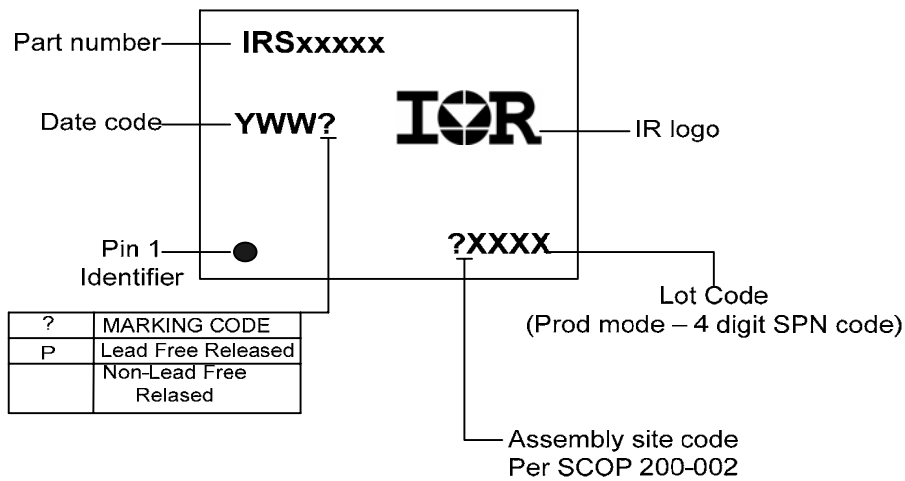
Code	Metric		Imperial	
	Min	Max	Min	Max
A	23.90	24.10	0.94	0.948
B	3.90	4.10	0.153	0.161
C	31.70	32.30	1.248	1.271
D	14.10	14.30	0.555	0.562
E	17.90	18.10	0.704	0.712
F	17.90	18.10	0.704	0.712
G	2.00	n/a	0.078	n/a
H	1.50	1.60	0.059	0.062



REEL DIMENSIONS FOR 44PLCC

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	38.4	n/a	1.511
G	34.7	35.8	1.366	1.409
H	32.6	33.1	1.283	1.303

**LEAD-FREE PART MARKING INFORMATION**



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 28-Lead PDIP IRS21368PbF  
 28-Lead SOIC IRS2136SPbF  
 28-Lead SOIC IRS21362SPbF  
 28-Lead SOIC IRS21363SPbF  
 28-Lead SOIC IRS21365SPbF  
 28-Lead SOIC IRS21366SPbF  
 28-Lead SOIC IRS21367SPbF  
 28-Lead SOIC IRS21368SPbF  
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