International
IR Rectifier

IR2110L6

HIGH AND LOW SIDE DRIVER

Features

- Floating channel designed for bootstrap operation
  Fully operational to +600V
  Tolerant to negative transient voltage
  dV/dt immune
- Gate drive supply range from 10 to 20V
- Undervoltage lockout for both channels
- Separate logic supply range from 5 to 20V
  Logic and power ground ±5V offset
- CMOS Schmitt-triggered inputs with pull-down
- Cycle by cycle edge-triggered shutdown logic
- Matched propagation delay for both channels
- Outputs in phase with inputs

Product Summary

V$_{OFFSET}$	600V max.
I$_O$+/-	2A / 2A
V$_{OUT}$	10 - 20V
t$_{on/off}$ (typ.)	120 & 94 ns
Delay Matching	10 ns

Description

The IR2110L6 is a high voltage, high speed power MOSFET and IGBT driver with independent high and low side referenced output channels. Proprietary HVIC and latch immune CMOS technologies enable ruggedized monolithic construction. Logic inputs are compatible with standard CMOS or LSTTL outputs. 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 channel can be used to drive an N-channel power MOSFET or IGBT in the high side configuration which operates up to 600 volts.

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.

	Parameter	Min.	Max.	Units
V$_B$	High Side Floating Supply Voltage	-0.5	V$_S$ + 20	
V$_S$	High Side Floating Supply Offset Voltage	—	600	
V$_{HO}$	High Side Floating Output Voltage	V$_S$ - 0.5	V$_B$ + 0.5	
V$_{CC}$	Low Side Fixed Supply Voltage	-0.5	20	
V$_{LO}$	Low Side Output Voltage	-0.5	V$_{CC}$ + 0.5	V
V$_{DD}$	Logic Supply Voltage	-0.5	V$_{SS}$ + 20	
V$_{SS}$	Logic Supply Offset Voltage	V$_{CC}$ - 20	V$_{CC}$ + 0.5	
V$_{IN}$	Logic Input Voltage (HIN, LIN & SD)	V$_{SS}$ - 0.5	V$_{DD}$ + 0.5	
dV$_S$/dt	Allowable Offset Supply Voltage Transient (Figure 2)	—	50	V/ns
P$_D$	Package Power Dissipation @ T$_A$ ≤ +25°C	—	1.6	W
R$_{θJA}$	Thermal Resistance, Junction to Ambient	—	75	°C/W
T$_J$	Junction Temperature	-55	125	
T$_S$	Storage Temperature	-55	150	°C
T$_L$	Lead Temperature (Soldering, 10 seconds)	—	300	
	Weight	1.5 (typical)		g

Recommended Operating Conditions

The Input/Output logic timing diagram is shown in Figure 1. For proper operation the device should be used within the recommended conditions. The V_S and V_{SS} offset ratings are tested with all supplies biased at 15V differential. Typical ratings at other bias conditions are shown in Figures 36 and 37.

	Parameter	Min.	Max.	Units
V_B	High Side Floating Supply Absolute Voltage	$V_S + 10$	$V_S + 20$	
V_S	High Side Floating Supply Offset Voltage	-4	600	
V_{HO}	High Side Floating Output Voltage	V_S	V_B	
V_{CC}	Low Side Fixed Supply Voltage	10	20	V
V_{LO}	Low Side Output Voltage	0	V_{CC}	
V_{DD}	Logic Supply Voltage	$V_{SS} + 5$	$V_{SS} + 20$	
V_{SS}	Logic Supply Offset Voltage	-5	5	
V_{IN}	Logic Input Voltage (HIN, LIN & SD)	V_{SS}	V_{DD}	

Dynamic Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}, V_{DD}) = 15V, and V_{SS} = COM unless otherwise specified. The dynamic electrical characteristics are measured using the test circuit shown in Figure 3.

		$T_j = 25°C$			$T_j = -55$ to $125°C$		Units	Test Conditions
	Parameter	Min.	Typ.	Max.	Min.	Max.		
t_{on}	Turn-On Propagation Delay	—	120	150	—	260		$V_S = 0V$
t_{off}	Turn-Off Propagation Delay	—	94	125	—	220		$V_S = 600V$
t_{sd}	Shutdown Propagation Delay	—	110	140	—	235	ns	$V_S = 600V$
t_r	Turn-On RiseTime	—	25	35	—	50		$C_L = 1000pf$
t_f	Turn-Off Fall Time	—	17	25	—	40		$C_L = 1000pf$
MT	Delay Matching, HS & LS Turn-On/Off	—	—	10	—	—		$\|H_{t_{on}} - L_{t_{on}}\| / \|H_{t_{off}} - L_{t_{off}}\|$

Typical Connection
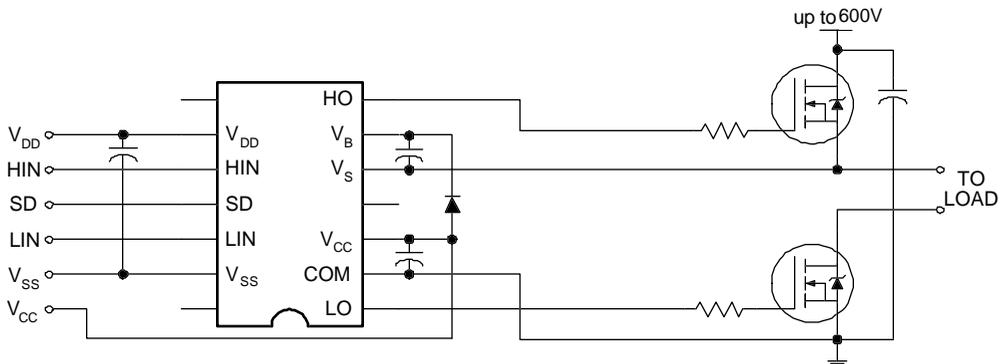
Static Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}, V_{DD}) = 15V, unless otherwise specified. The V_{IN}, V_{TH} and I_{IN} parameters are referenced to V_{SS} and are applicable to all three logic input pins: HIN, LIN and SD. The V_O and I_O parameters are referenced to COM or V_S and are applicable to the respective output pins: HO or LO.

	Parameter	Tj = 25°C			Tj = -55 to 125°C		Units	Test Conditions
		Min.	Typ.	Max.	Min.	Max.		
V_{IH}	Logic "1" Input Voltage	3.1	—	—	3.3	—	V	V_{DD} = 5V
		6.4	—	—	6.8	—		V_{DD} = 10V
		9.5	—	—	10	—		V_{DD} = 15V
		12.5	—	—	13.3	—		V_{DD} = 20V
V_{IL}	Logic "0" Input Voltage	—	—	1.8	—	1.7	V	V_{DD} = 5V
		—	—	3.8	—	3.6		V_{DD} = 10V
		—	—	6	—	5.7		V_{DD} = 15V
		—	—	8.3	—	7.9		V_{DD} = 20V
V_{OH}	High Level Output Voltage, V_{BIAS} - V_O	—	0.7	1.2	—	1.5		V_{IN} = V_{IH}, I_O = 0A
V_{OL}	Low Level Output Voltage, V_O	—	—	0.1	—	0.1		V_{IN} = V_{IH}, I_O = 0A
I_{LK}	Offset Supply Leakage Current	—	—	50	—	250		V_B = V_S = 600V
I_{QBS}	Quiescent V_{BS} Supply Current	—	125	230	—	500	μA	V_{IN} =0V or V_{DD}
I_{QCC}	Quiescent V_{CC} Supply Current	—	180	340	—	600		V_{IN} =0V, or V_{DD}
I_{QDD}	Quiescent V_{DD} Supply Current	—	5	30	—	60		V_{IN} =0V, or V_{DD}
I_{IN+}	Logic "1" Input Bias Current	—	15	40	—	70		V_{IN} = V_{DD}
I_{IN-}	Logic "0" Input Bias Current	—	—	1.0	—	10		V_{IN} = 0V
V_{BSUV+}	V_{BS} Supply Undervoltage Positive Going Threshold	7.5	8.6	9.7	—	—		
V_{BSUV-}	V_{BS} Supply Undervoltage Negative Going Threshold	7.0	8.2	9.4	—	—		
V_{CCUV+}	V_{CC} Supply Undervoltage Positive Going Threshold	7.4	8.5	9.6	—	—	V	
V_{CCUV-}	V_{CC} Supply Undervoltage Negative Going Threshold	7.0	8.2	9.4	—	—		
I_{O+}	Output High Short Circuit Pulsed Current	2.0	—	—	—	—	A	V_O = 0V, V_{IN} = V_{DD} PW ≤ 10 μs
I_{O-}	Output Low Short Circuit Pulsed Current	2.0	—	—	—	—		V_O = 15V, V_{IN} = 0V PW ≤ 10 μs
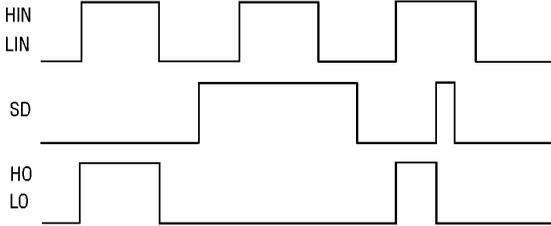
Figure 1. Input/Output Timing Diagram
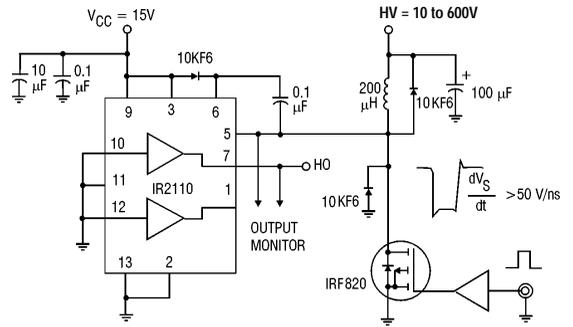
Figure 2. Floating Supply Voltage Transient Test Circuit
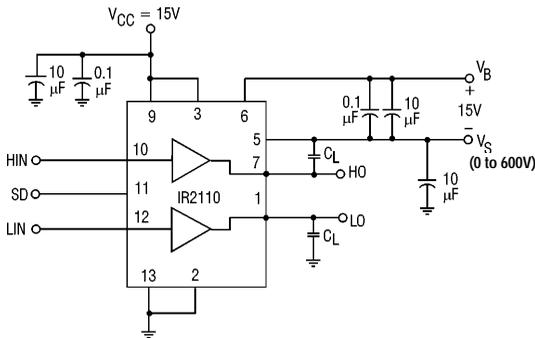
Figure 3. Switching Time Test Circuit
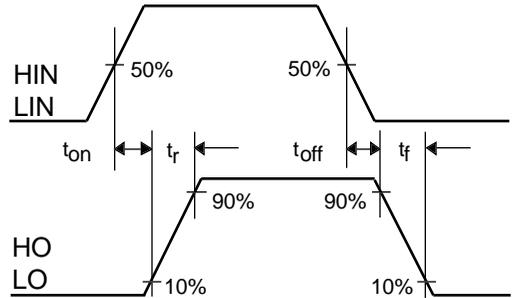
Figure 4. Switching Time Waveform Definition
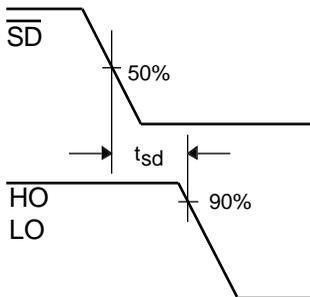
Figure 5. Shutdown Waveform Definitions
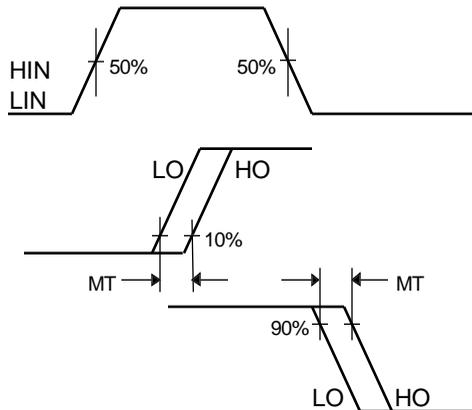
Figure 6. Delay Matching Waveform Definitions
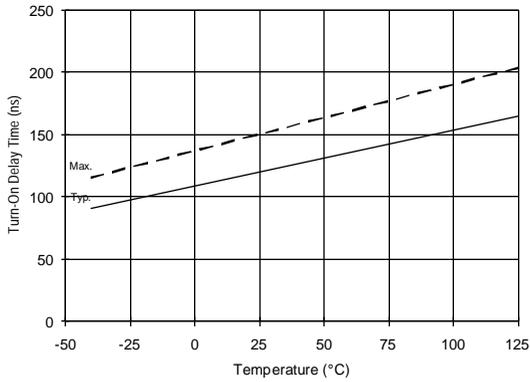
Figure 7A. Turn-On Time vs. Temperature
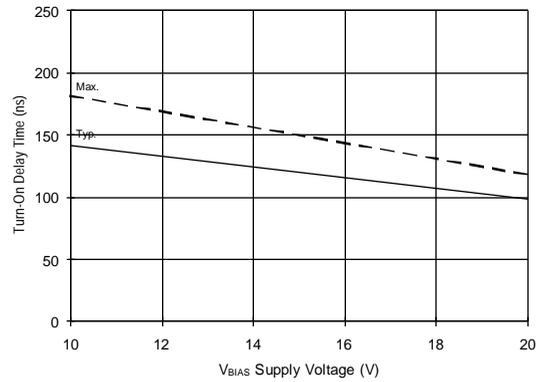
Figure 7B. Turn-On Time vs. Voltage
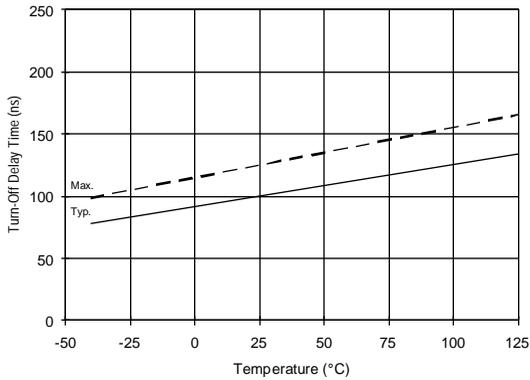

Figure 8A. Turn-Off Time vs. Temperature
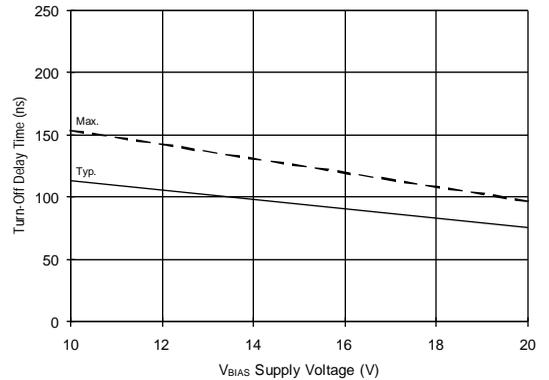
Figure 8B. Turn-Off Time vs. Voltage
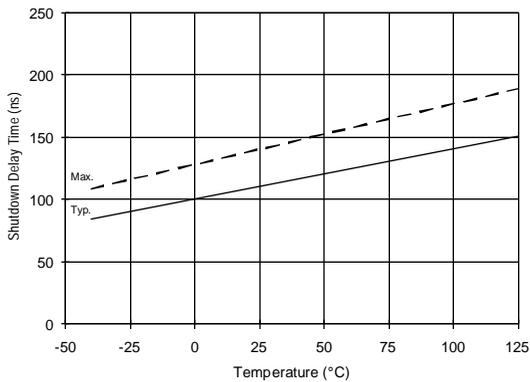
Figure 9A. Shutdown Time vs. Temperature
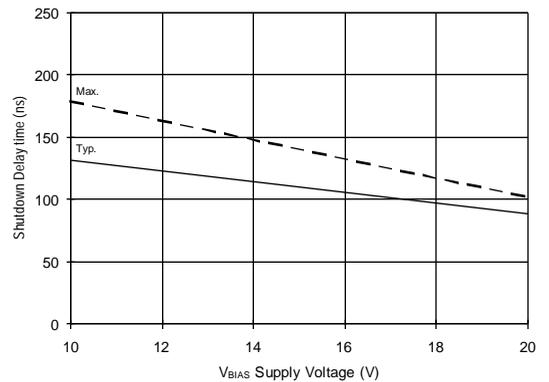
Figure 9B. Shutdown Time vs. Voltage
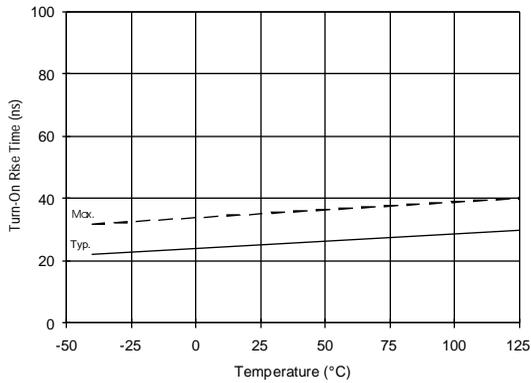
Figure 10A. Turn-On Rise Time vs. Temperature
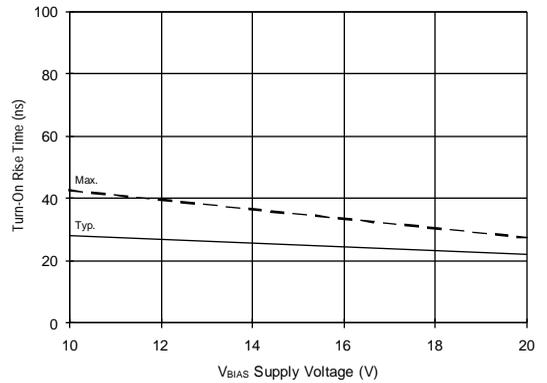
Figure 10B. Turn-On Rise Time vs. Voltage
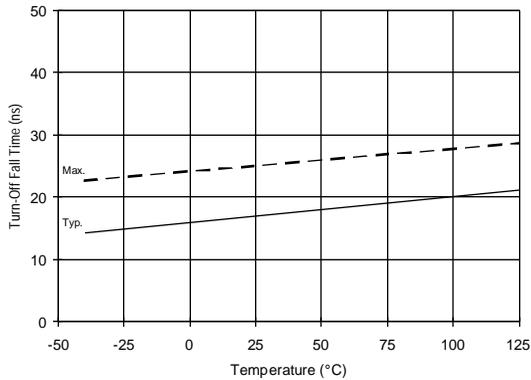
Figure 11A. Turn-Off Fall Time vs. Temperature
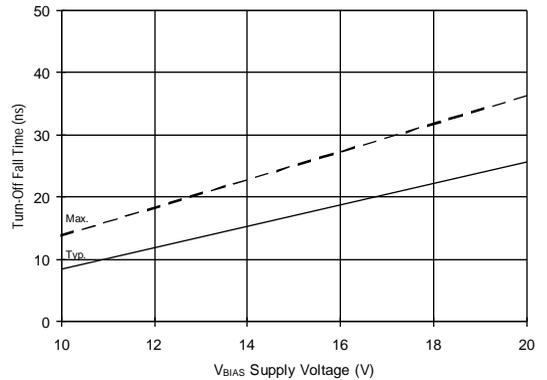
Figure 11B. Turn-Off Fall Time vs. Voltage
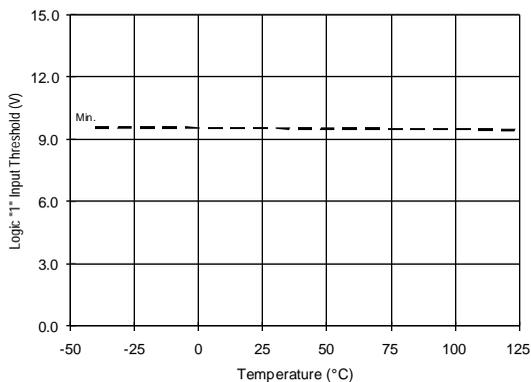
Figure 12A. Logic "1" Input Threshold vs. Temperature
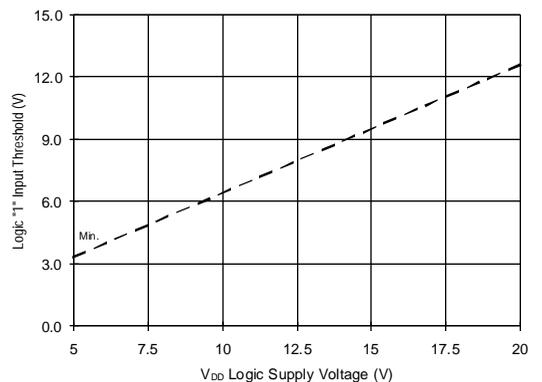
Figure 12B. Logic "1" Input Threshold vs. Voltage
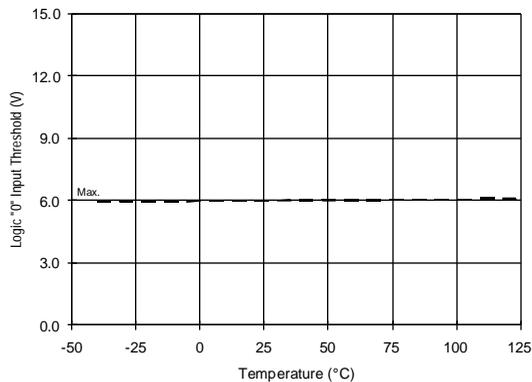
Figure 13A. Logic "0" Input Threshold vs. Temperature
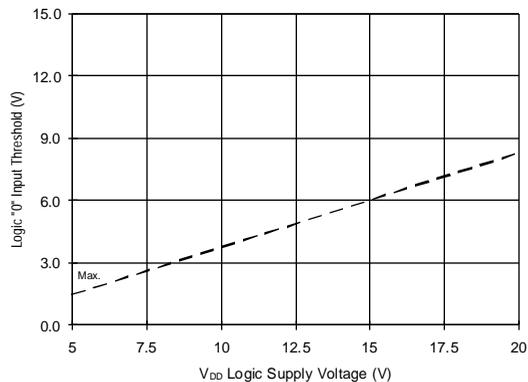
Figure 13B. Logic "0" Input Threshold vs. Voltage
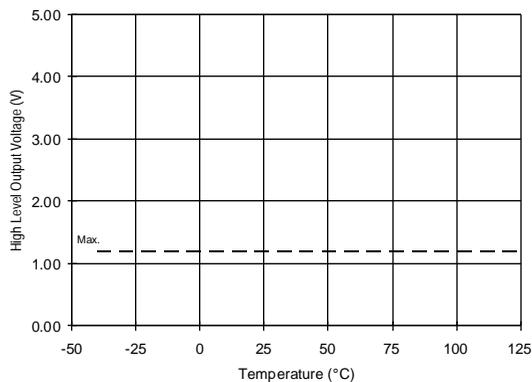
Figure 14A. High Level Output vs. Temperature
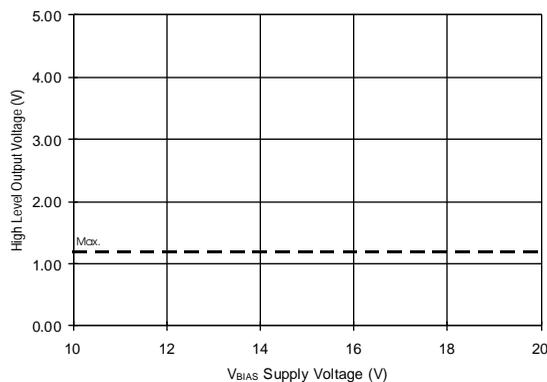
Figure 14B. High Level Output vs. Voltage
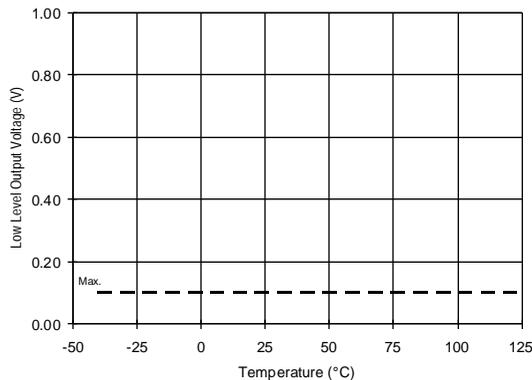
Figure 15A. Low Level Output vs. Temperature
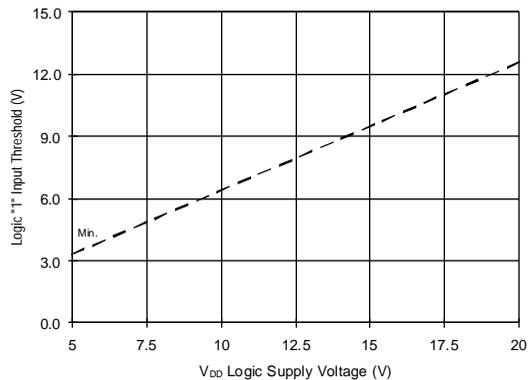
Figure 15B. Low Level Output vs. Voltage
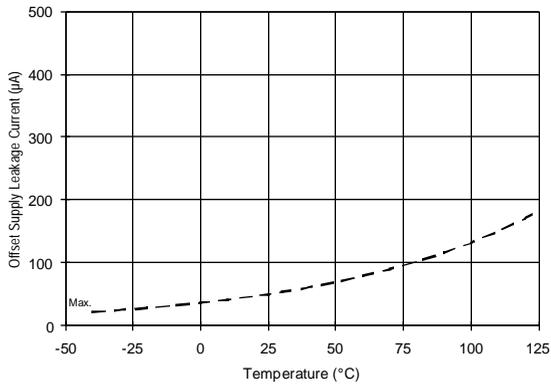
Figure 16A. Offset Supply Current vs. Temperature
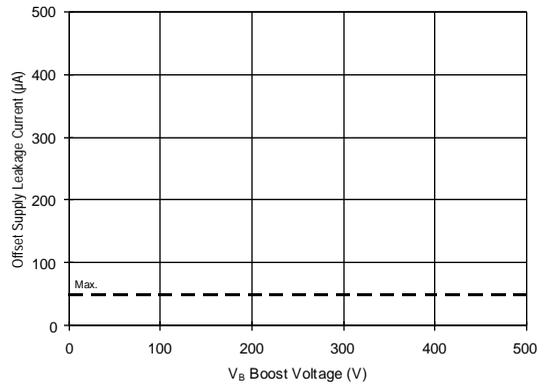
Figure 16B. Offset Supply Current vs. Voltage
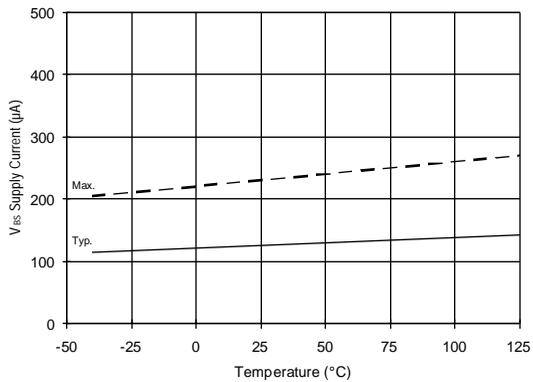
Figure 17A. V$_{BS}$ Supply Current vs. Temperature
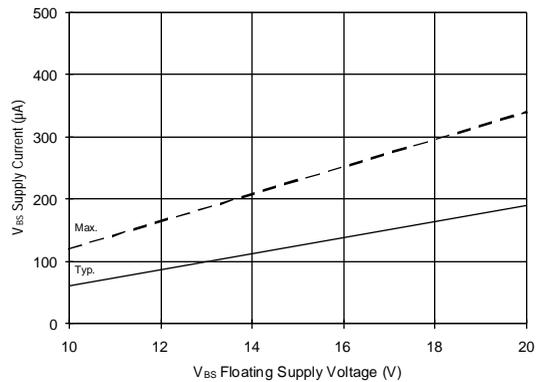
Figure 17B. V$_{BS}$ Supply Current vs. Voltage
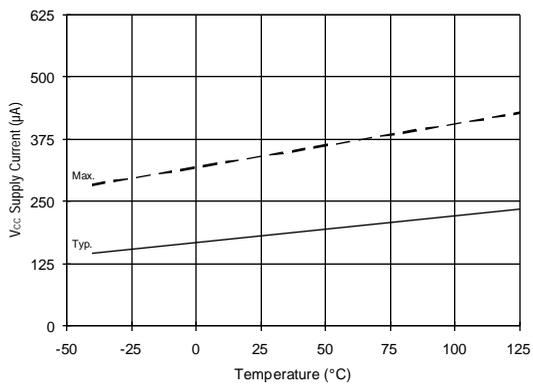
Figure 18A. V$_{CC}$ Supply Current vs. Temperature
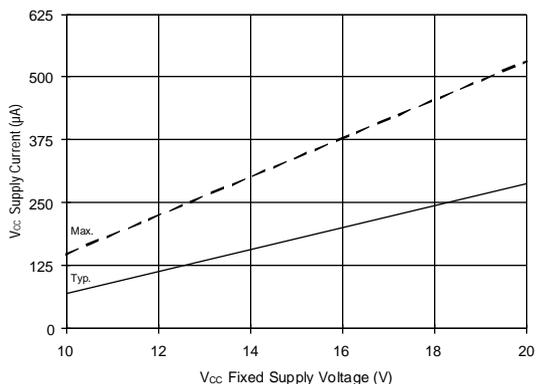
Figure 18B. V$_{CC}$ Supply Current vs. Voltage
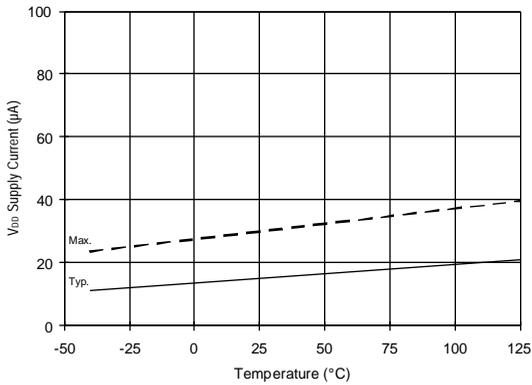
Figure 19A. V$_{DD}$ **Supply Current vs. Temperature**
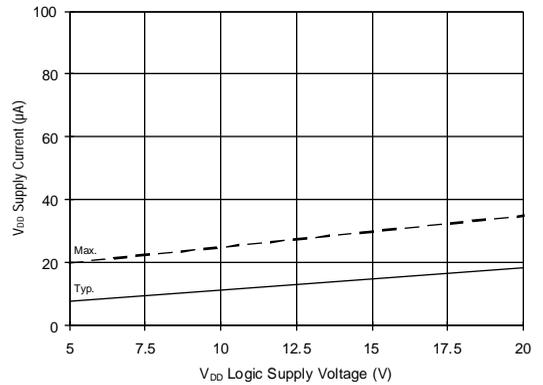
Figure 19B. V$_{DD}$ **Supply Current vs. Voltage**
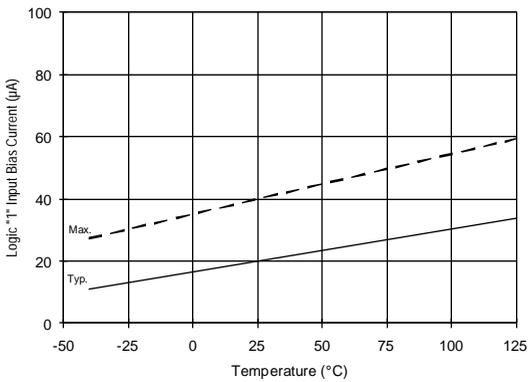
Figure 20A. Logic "1" Input Current vs. Temperature
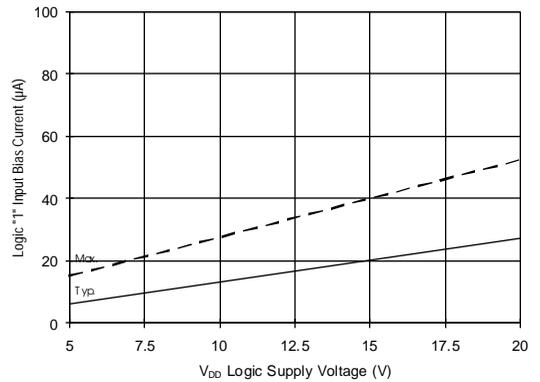
Figure 20B. Logic "1" Input Current vs. Voltage
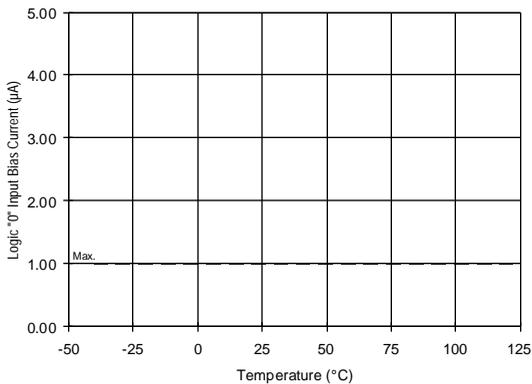
Figure 21A. Logic "0" Input Current vs. Temperature
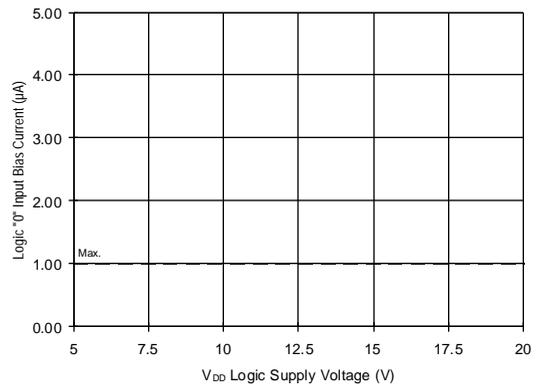
Figure 21B. Logic "0" Input Current vs. Voltage
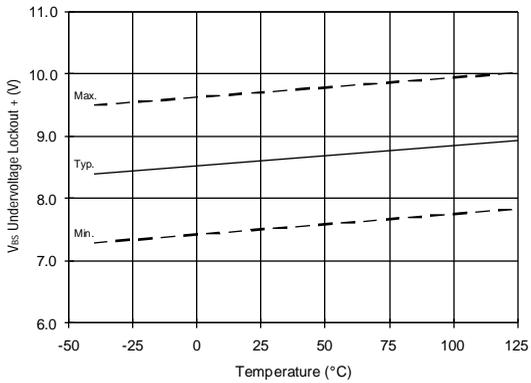
Figure 22. V_{BS} Undervoltage (+) vs. Temperature
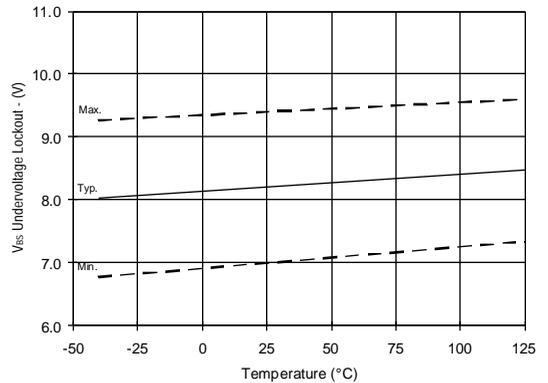
Figure 23. V_{BS} Undervoltage (-) vs. Temperature
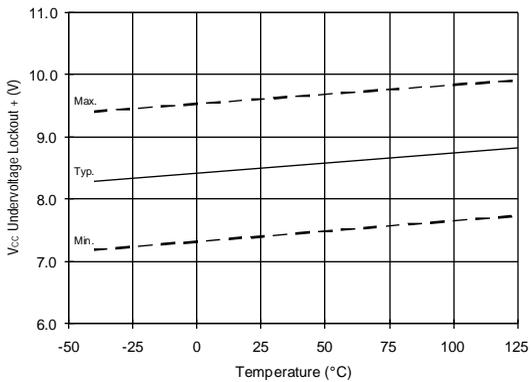
Figure 24. V_{CC} Undervoltage (+) vs. Temperature
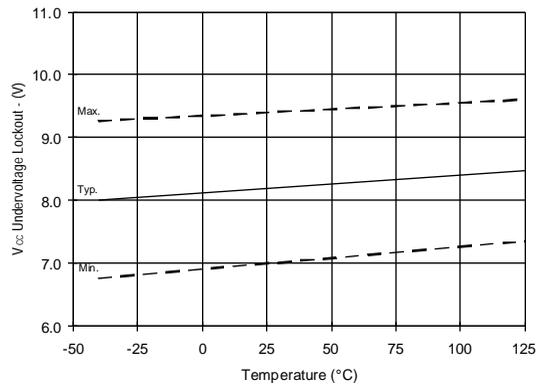
Figure 25. V_{CC} Undervoltage (-) vs. Temperature
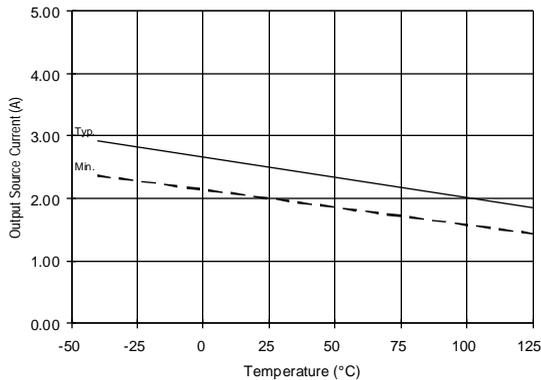
Figure 26A. Output Source Current vs. Temperature
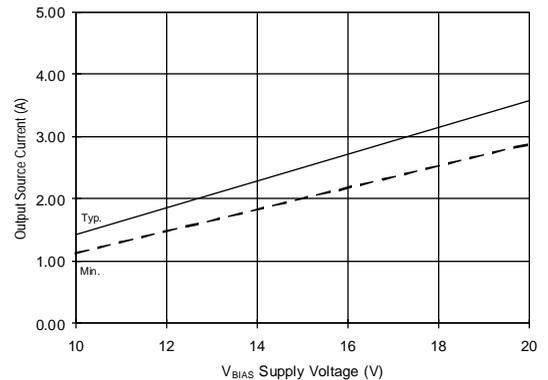
Figure 26B. Output Source Current vs. Voltage
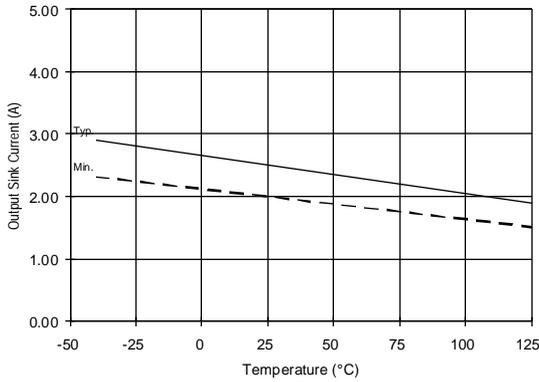
Figure 27A. Output Sink Current vs. Temperature
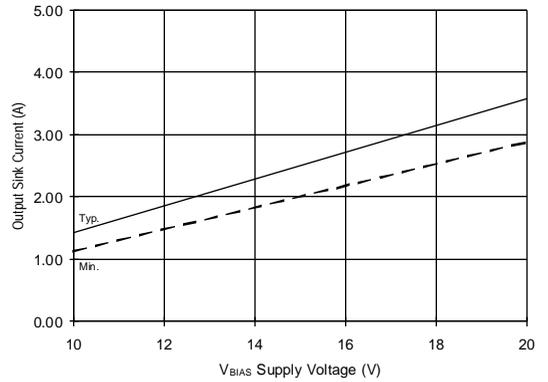

Figure 27B. Output Sink Current vs. Voltage
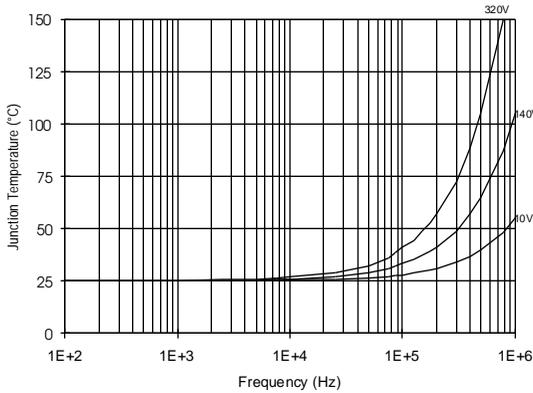
Figure 28. IR2110L6 T_J vs. Frequency (IRFBC20)
R_{GATE} = 33Ω, V_{CC} = 15V
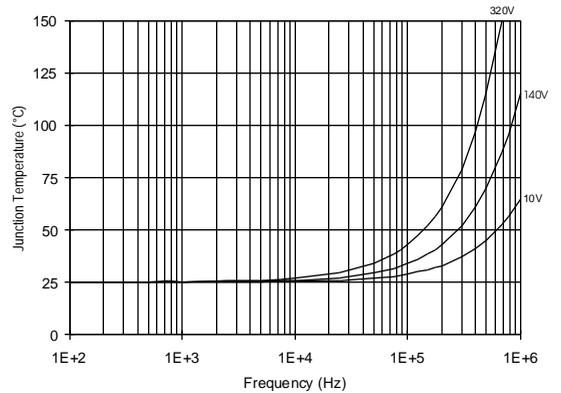
Figure 29. IR2110L6 T_J vs. Frequency (IRFBC30)
**R_{GATE} = 22Ω, V_{CC} = 15V**
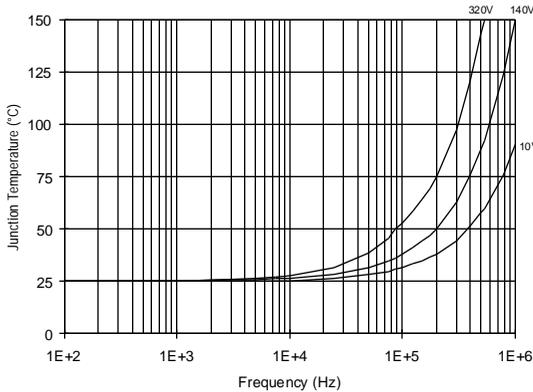
Figure 30. IR2110L6 T_J vs. Frequency (IRFBC40)
R_{GATE} = 15Ω, V_{CC} = 15V
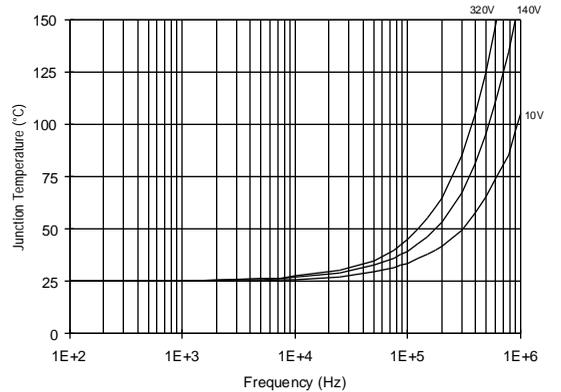
Figure 31. IR2110L6 T_J vs. Frequency (IRFPE50)
R_{GATE} = 10Ω, V_{CC} = 15V
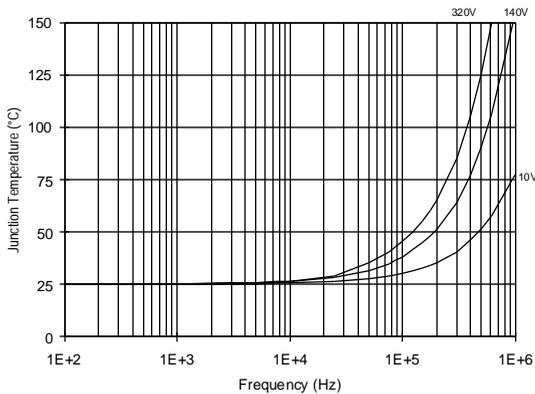
Figure 32. IR2110L6ST$_J$ vs. Frequency (IRFBC20)
R$_{GATE}$ = 33Ω, V$_{CC}$ = 15V
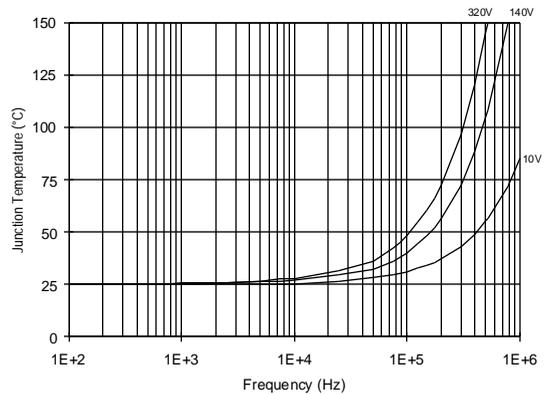
Figure 33. IR2110L6ST$_J$ vs. Frequency (IRFBC30)
R$_{GATE}$ = 22Ω, V$_{CC}$ = 15V
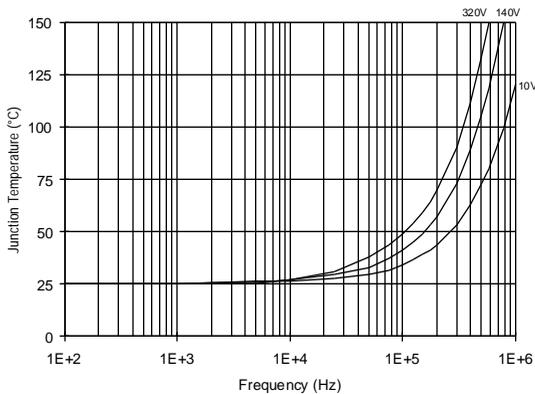
Figure 34. IR2110L6ST$_J$ vs. Frequency (IRFBC40)
R$_{GATE}$ = 15Ω, V$_{CC}$ = 15V
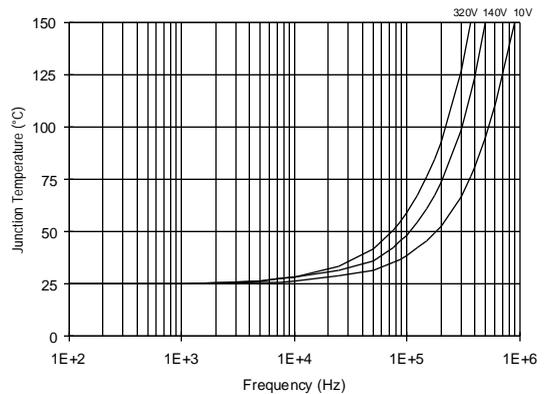
Figure 35. IR2110L6ST$_J$ vs. Frequency (IRFPE50)
R$_{GATE}$ = 10Ω, V$_{CC}$ = 15V
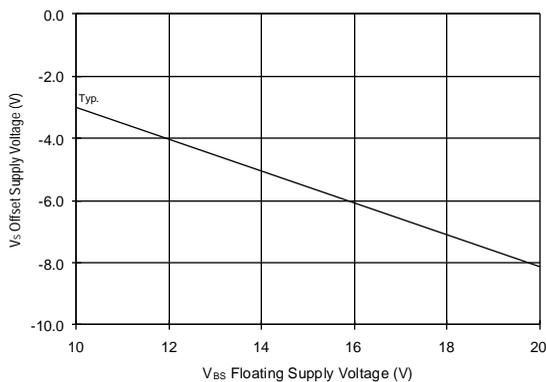
**Figure 36. Maximum V$_S$ Negative Offset vs.**
**V$_{BS}$ Supply Voltage**
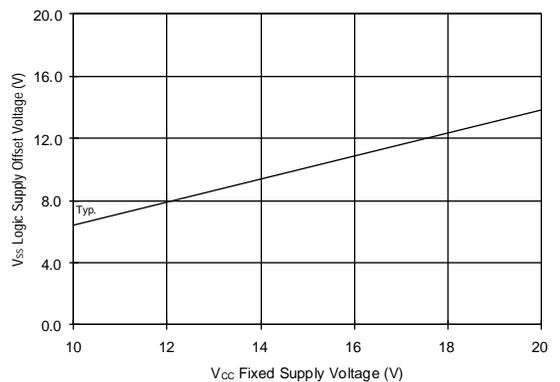
Figure 37. Maximum V$_{SS}$ Positive Offset vs.
**V$_{CC}$ Supply Voltage**

Functional Block Diagram
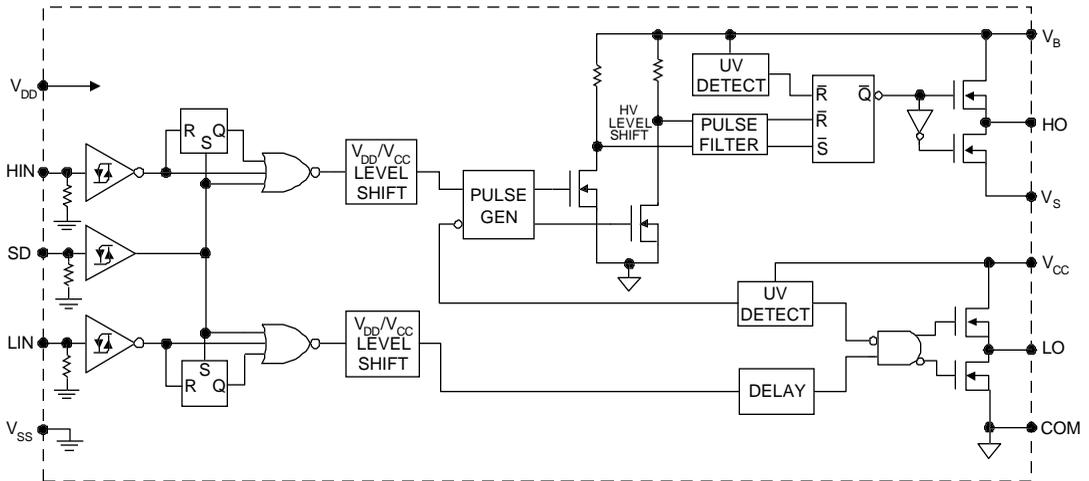
Lead Definitions

Lead Symbol	Description
V_{DD}	Logic supply
HIN	Logic input for high side gate driver output (HO), in phase
SD	Logic input for shutdown
LIN	Logic input for low side gate driver output (LO), in phase
V_{SS}	Logic ground
V_B	High side floating supply
HO	High side gate drive output
V_S	High side floating supply return
V_{CC}	Low side supply
LO	Low side gate drive output
COM	Low side return

Case Outline and Dimensions — MO-036AB
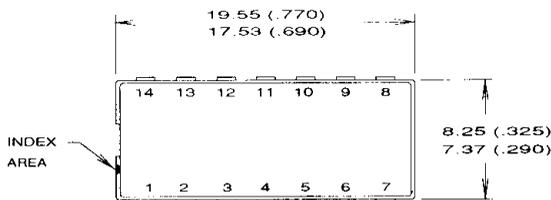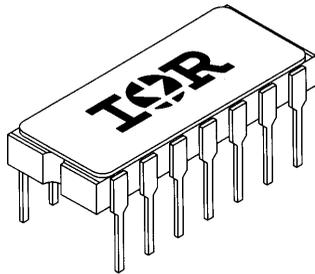
Pin Assignment
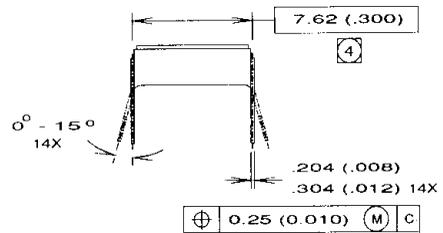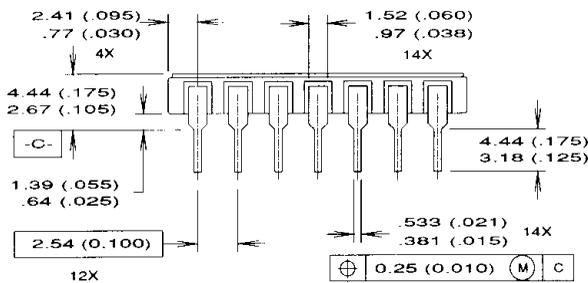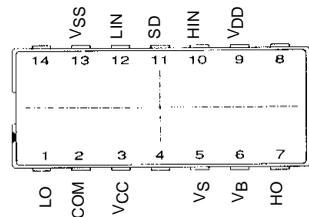
NOTES:

1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.

2 CONTROLLING DIMENSION : INCH.

3 DIMENSIONS ARE SHOWN IN MILLIMETERS   (INCHES).

4 DIMENSION IS TO CENTER OF LEADS WHEN FORMED PARALLEL.

5 OUTLINE CONFORMS TO JEDEC OUTLINE MO-036AB.

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