International
IOR Rectifier

Data Sheet No. PD-6.011E

IR2110

HIGH AND LOW SIDE DRIVER

Features

- Floating channel designed for bootstrap operation
  Fully operational to +500V
  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

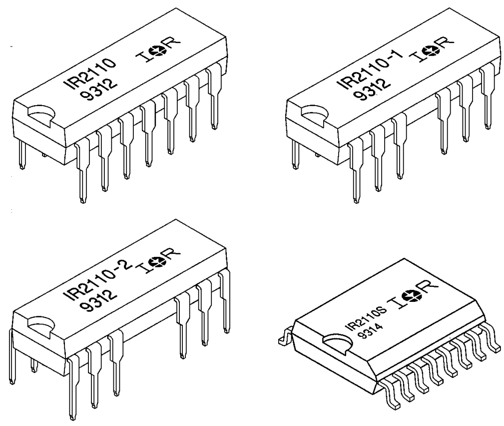
Description

The IR2110 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 500 volts.

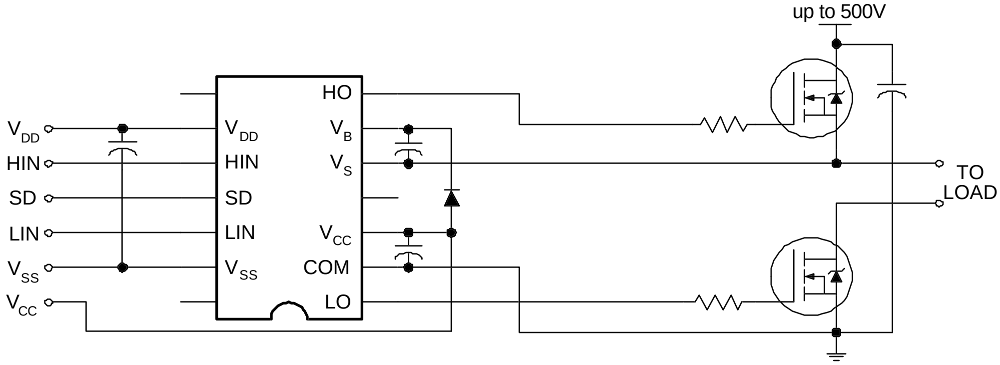
Product Summary

V_{OFFSET}	500V max.
I_O+/-	2A / 2A
V_{OUT}	10 - 20V
$t_{on/off}$ (typ.)	120 & 94 ns
Delay Matching	10 ns

Packages



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. Additional information is shown in Figures 28 through 35.

Parameter		Value		
Symbol	Definition	Min.	Max.	Units
V_B	High Side Floating Supply Voltage	-0.3	525	V
V_S	High Side Floating Supply Offset Voltage	V_B - 25	V_B + 0.3	V
V_{HO}	High Side Floating Output Voltage	V_S - 0.3	V_B + 0.3	V
V_{CC}	Low Side Fixed Supply Voltage	-0.3	25	V
V_{LO}	Low Side Output Voltage	-0.3	V_{CC} + 0.3	V
V_{DD}	Logic Supply Voltage	-0.3	V_{SS} + 25	V
V_{SS}	Logic Supply Offset Voltage	V_{CC} - 25	V_{CC} + 0.3	V
V_{IN}	Logic Input Voltage (HIN, LIN & SD)	V_{SS} - 0.3	V_{DD} + 0.3	V
dV_S/dt	Allowable Offset Supply Voltage Transient (Figure 2)	—	50	V/ns
P_D	Package Power Dissipation @ $T_A \leq$ +25°C (14 Lead DIP)	—	1.6	W
	(14 Lead DIP w/o Lead 4)	—	1.5	W
	(16 Lead DIP w/o Leads 5 & 6)	—	1.6	W
	(16 Lead SOIC)	—	1.25	W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient (14 Lead DIP)	—	75	°C/W
	(14 Lead DIP w/o Lead 4)	—	85	°C/W
	(16 Lead DIP w/o Leads 5 & 6)	—	75	°C/W
	(16 Lead SOIC)	—	100	°C/W
T_J	Junction Temperature	—	150	°C
T_S	Storage Temperature	-55	150	°C
T_L	Lead Temperature (Soldering, 10 seconds)	—	300	°C

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		Value		
Symbol	Definition	Min.	Max.	Units
V_B	High Side Floating Supply Absolute Voltage	V_S + 10	V_S + 20	V
V_S	High Side Floating Supply Offset Voltage	Note 1	500	V
V_{HO}	High Side Floating Output Voltage	V_S	V_B	V
V_{CC}	Low Side Fixed Supply Voltage	10	20	V
V_{LO}	Low Side Output Voltage	0	V_{CC}	V
V_{DD}	Logic Supply Voltage	V_{SS} + 5	V_{SS} + 20	V
V_{SS}	Logic Supply Offset Voltage	-5	5	V
V_{IN}	Logic Input Voltage (HIN, LIN & SD)	V_{SS}	V_{DD}	V
T_A	Ambient Temperature	-40	125	°C

Note 1: Logic operational for V_S of -4 to +500V. Logic state held for V_S of -4V to $-V_{BS}$.

Dynamic Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}, V_{DD}) = 15V, C_L = 1000 pF, T_A = 25°C and V_{SS} = COM unless otherwise specified. The dynamic electrical characteristics are measured using the test circuit shown in Figure 3.

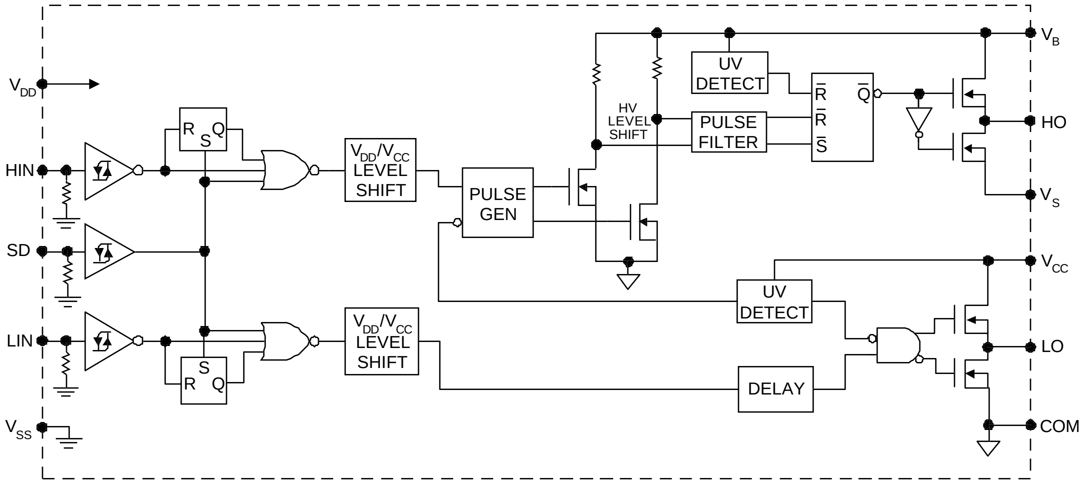
Parameter			Value				
Symbol	Definition	Figure	Min.	Typ.	Max.	Units	Test Conditions
t_{on}	Turn-On Propagation Delay	7	—	120	150	ns	V_S = 0V
t_{off}	Turn-Off Propagation Delay	8	—	94	125		V_S = 500V
t_{sd}	Shutdown Propagation Delay	9	—	110	140		V_S = 500V
t_r	Turn-On Rise Time	10	—	25	35		
t_f	Turn-Off Fall Time	11	—	17	25		
MT	Delay Matching, HS & LS Turn-On/Off	—	—	—	10		Figure 5

Static Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}, V_{DD}) = 15V, T_A = 25°C and V_{SS} = COM 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 leads: HIN, LIN and SD. The V_O and I_O parameters are referenced to COM and are applicable to the respective output leads: HO or LO.

Parameter			Value				
Symbol	Definition	Figure	Min.	Typ.	Max.	Units	Test Conditions
V_{IH}	Logic "1" Input Voltage	12	9.5	—	—	V	
V_{IL}	Logic "0" Input Voltage	13	—	—	6.0		
V_{OH}	High Level Output Voltage, V_{BIAS} - V_O	14	—	—	1.2		I_O = 0A
V_{OL}	Low Level Output Voltage, V_O	15	—	—	0.1		I_O = 0A
I_{LK}	Offset Supply Leakage Current	16	—	—	50	µA	V_B = V_S = 500V
I_{QBS}	Quiescent V_{BS} Supply Current	17	—	125	230		V_{IN} = 0V or V_{DD}
I_{QCC}	Quiescent V_{CC} Supply Current	18	—	180	340		V_{IN} = 0V or V_{DD}
I_{QDD}	Quiescent V_{DD} Supply Current	19	—	15	30		V_{IN} = 0V or V_{DD}
I_{IN+}	Logic "1" Input Bias Current	20	—	20	40		V_{IN} = V_{DD}
I_{IN-}	Logic "0" Input Bias Current	21	—	—	1.0		V_{IN} = 0V
V_{BSUV+}	V_{BS} Supply Undervoltage Positive Going Threshold	22	7.5	8.6	9.7	V	
V_{BSUV-}	V_{BS} Supply Undervoltage Negative Going Threshold	23	7.0	8.2	9.4		
V_{CCUV+}	V_{CC} Supply Undervoltage Positive Going Threshold	24	7.4	8.5	9.6		
V_{CCUV-}	V_{CC} Supply Undervoltage Negative Going Threshold	25	7.0	8.2	9.4		
I_{O+}	Output High Short Circuit Pulsed Current	26	2.0	2.5	—	A	V_O = 0V, V_{IN} = V_{DD} PW ≤ 10 µs
I_{O-}	Output Low Short Circuit Pulsed Current	27	2.0	2.5	—		V_O = 15V, V_{IN} = 0V PW ≤ 10 µs

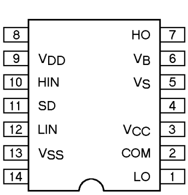
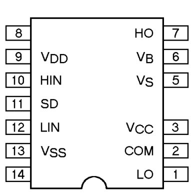
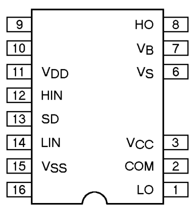
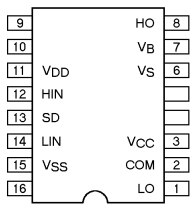
Functional Block Diagram



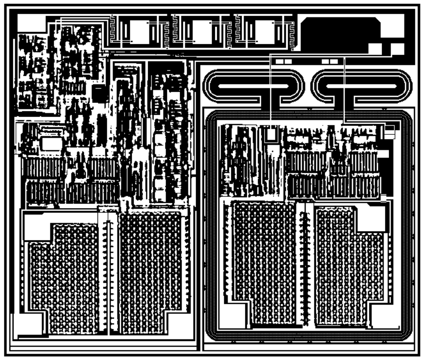
Lead Definitions

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

Lead Assignments

 14 Lead DIP	 14 Lead DIP w/o Lead 4	 16 Lead DIP w/o Leads 4 & 5	 16 Lead SOIC (Wide Body)
IR2110	**IR2110-1**	**IR2110-2**	**IR2110S**
Part Number			

Device Information

Process & Design Rule			HVDCMOS 4.0 µm
Transistor Count			220
Die Size			100 X 117 X 26 (mil)
Die Outline			
Thickness of Gate Oxide			800Å
Connections		Material	Poly Silicon
	First Layer	Width	4 µm
		Spacing	6 µm
		Thickness	5000Å
		Material	Al - Si (Si: 1.0% ±0.1%)
	Second Layer	Width	6 µm
		Spacing	9 µm
		Thickness	20,000Å
Contact Hole Dimension			8 µm X 8 µm
Insulation Layer		Material	PSG (SiO_2)
		Thickness	1.5 µm
Passivation (1)		Material	PSG (SiO_2)
		Thickness	1.5 µm
Passivation (2)		Material	Proprietary*
		Thickness	Proprietary*
Method of Saw			Full Cut
Method of Die Bond			Ablebond 84 - 1
Wire Bond		Method	Thermo Sonic
		Material	Au (1.0 mil / 1.3 mil)
Leadframe		Material	Cu
		Die Area	Ag
		Lead Plating	Pb : Sn (37 : 63)
Package		Types	14 & 16 Lead PDIP / 16 Lead SOIC
		Materials	EME6300 / MP150 / MP190
Remarks:	* Patent Pending		

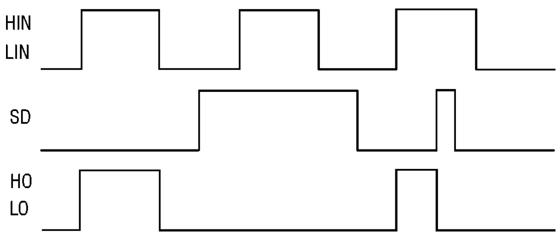


Figure 1. Input/Output Timing Diagram

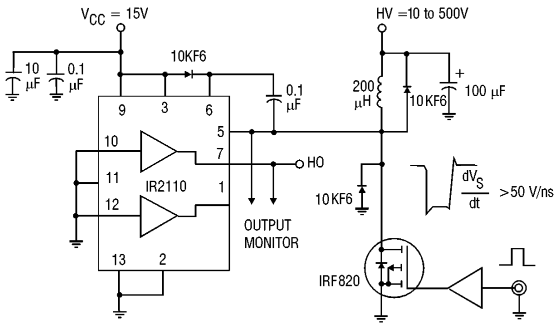


Figure 2. Floating Supply Voltage Transient Test Circuit

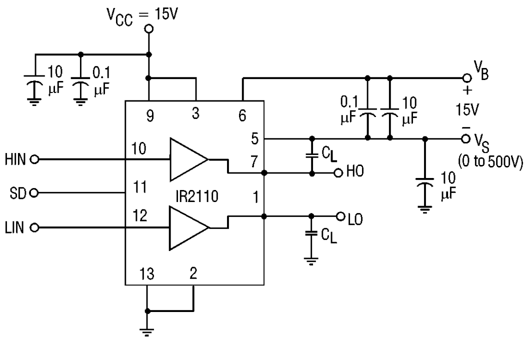


Figure 3. Switching Time Test Circuit

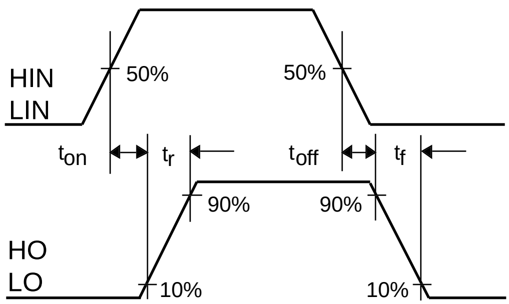


Figure 4. Switching Time Waveform Definition

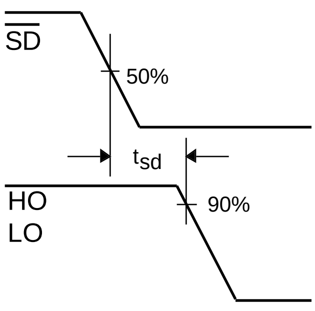


Figure 3. Shutdown Waveform Definitions

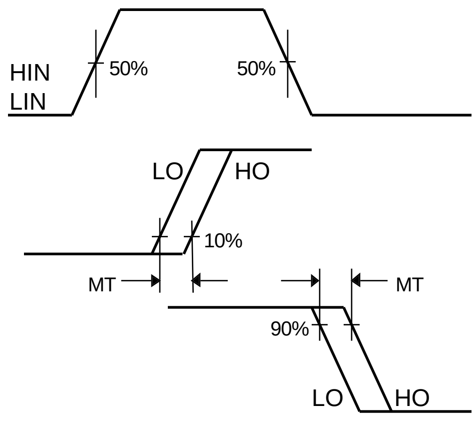


Figure 6. Delay Matching Waveform Definitions

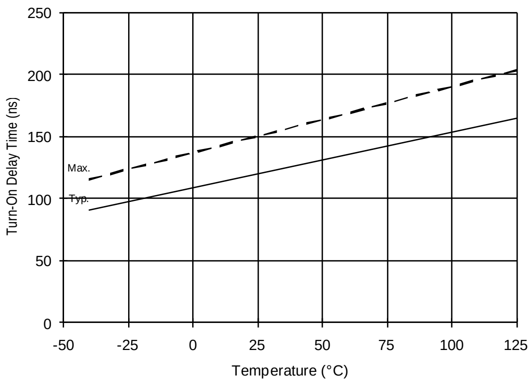


Figure 7A. Turn-On Time vs. Temperature

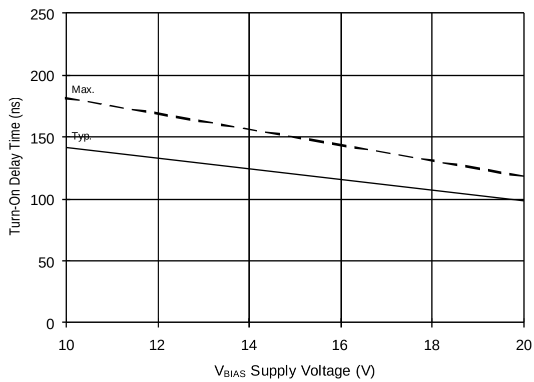


Figure 7B. Turn-On Time vs. Voltage

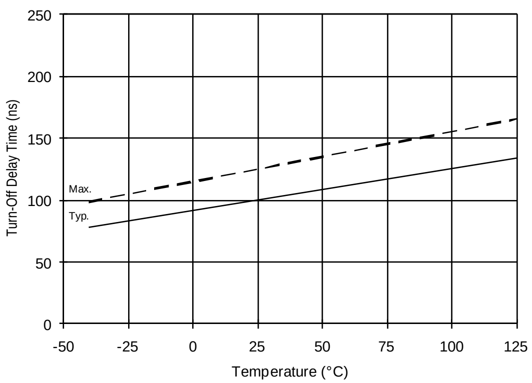


Figure 8A. Turn-Off Time vs. Temperature

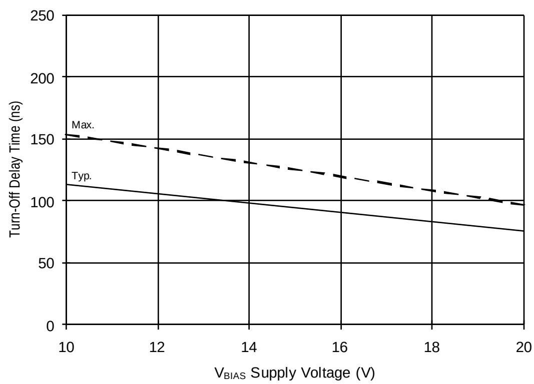


Figure 8B. Turn-Off Time vs. Voltage

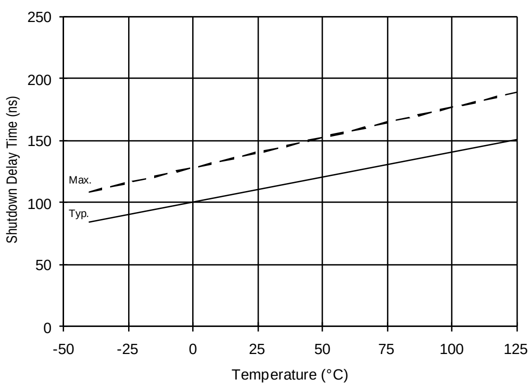


Figure 9A. Shutdown Time vs. Temperature

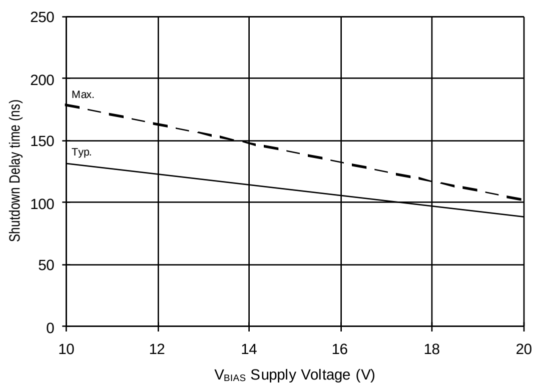


Figure 9B. Shutdown Time vs. Voltage

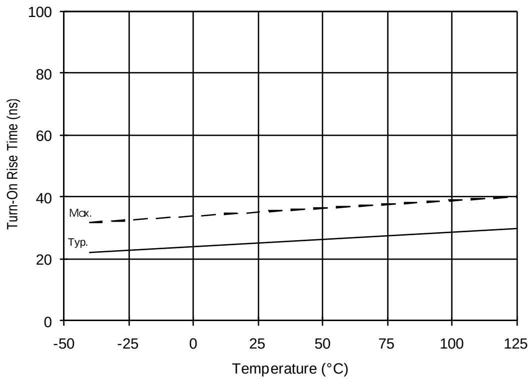


Figure 10A. Turn-On Rise Time vs. Temperature

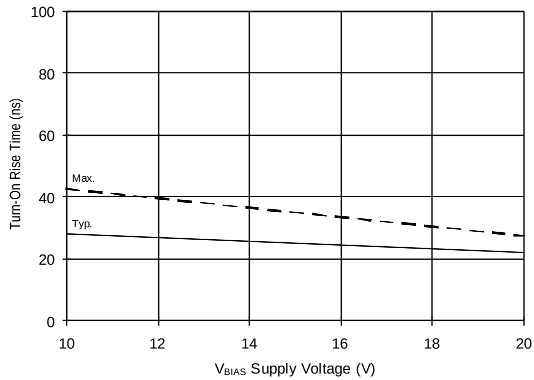


Figure 10B. Turn-On Rise Time vs. Voltage

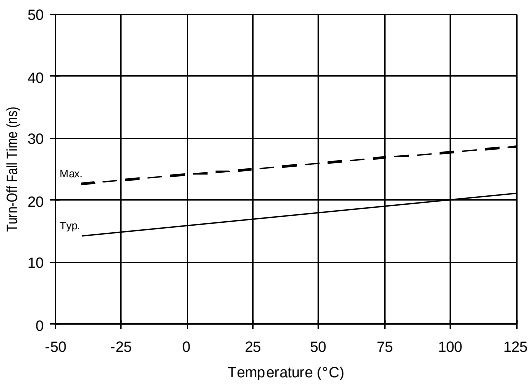


Figure 11A. Turn-Off Fall Time vs. Temperature

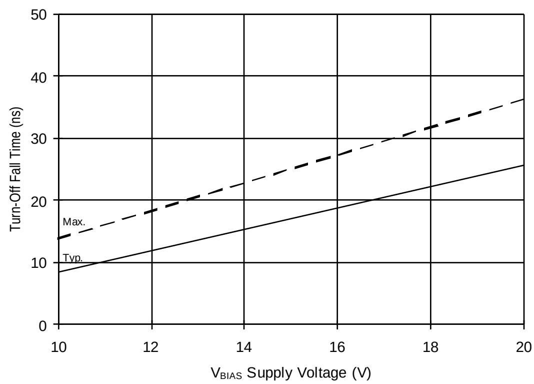


Figure 11B. Turn-Off Fall Time vs. Voltage

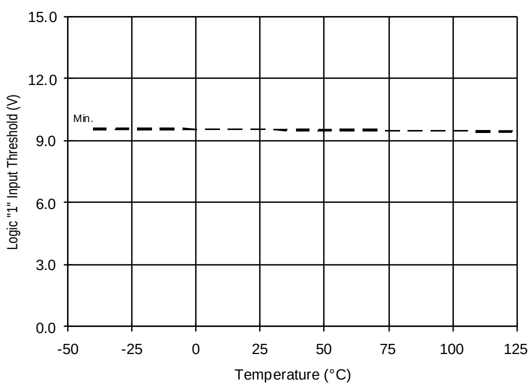


Figure 12A. Logic “1” Input Threshold vs. Temperature

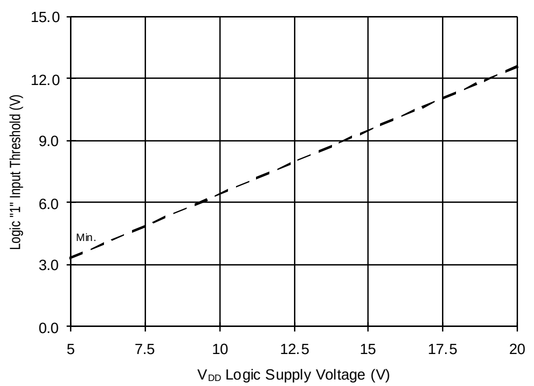


Figure 12B. Logic “1” Input Threshold vs. Voltage

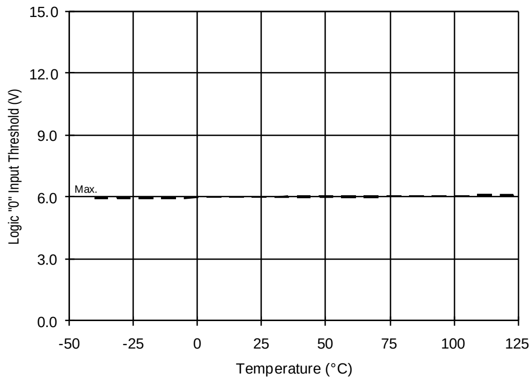


Figure 13A. Logic "0" Input Threshold vs. Temperature

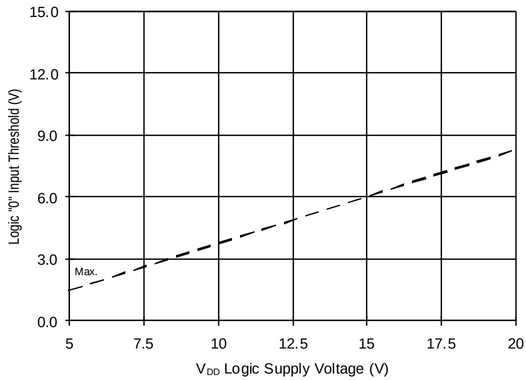


Figure 13B. Logic "0" Input Threshold vs. Voltage

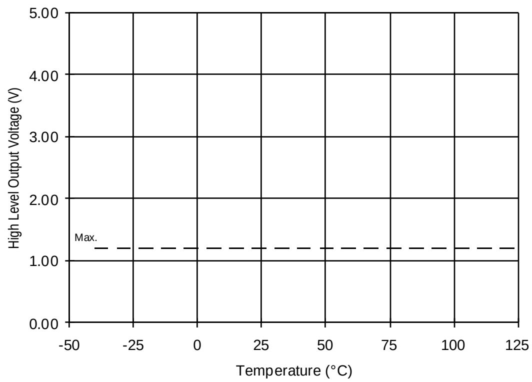


Figure 14A. High Level Output vs. Temperature

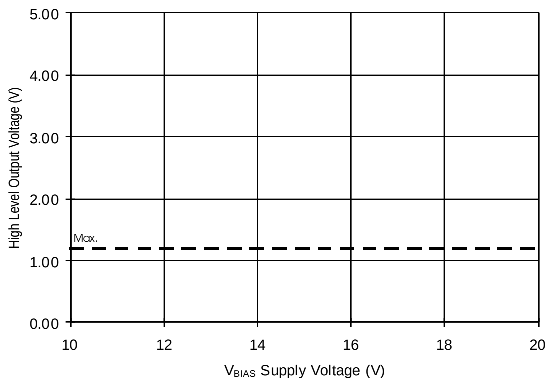


Figure 14B. High Level Output vs. Voltage

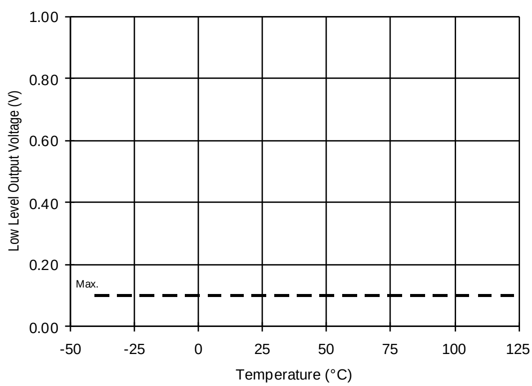


Figure 15A. Low Level Output vs. Temperature

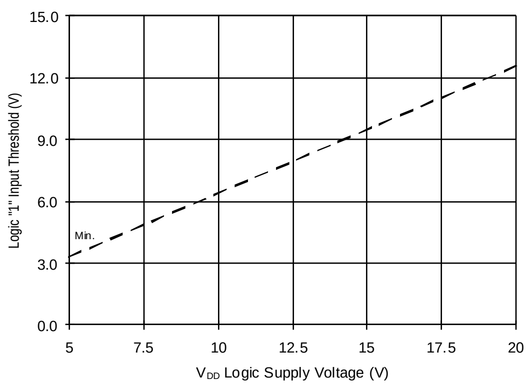


Figure 15B. Low Level Output vs. Voltage

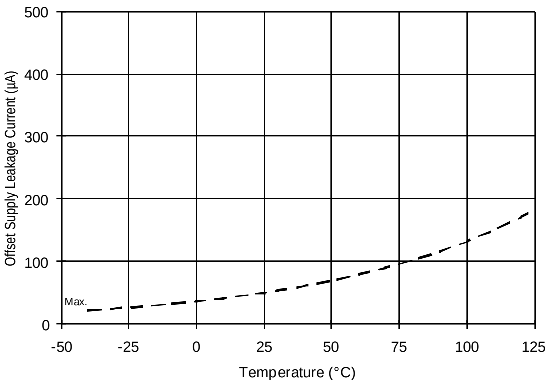


Figure 16A. Offset Supply Current vs. Temperature

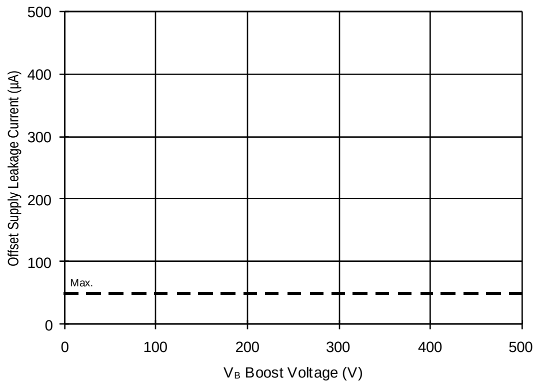


Figure 16B. Offset Supply Current vs. Voltage

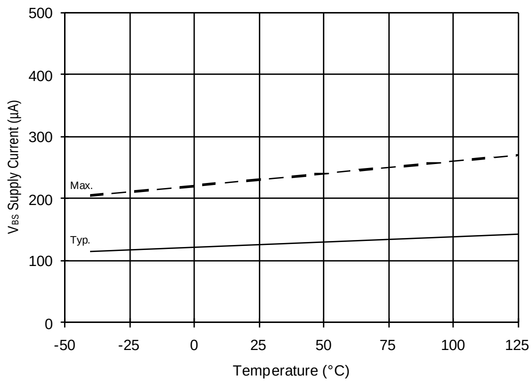


Figure 17A. V_{BS} Supply Current vs. Temperature

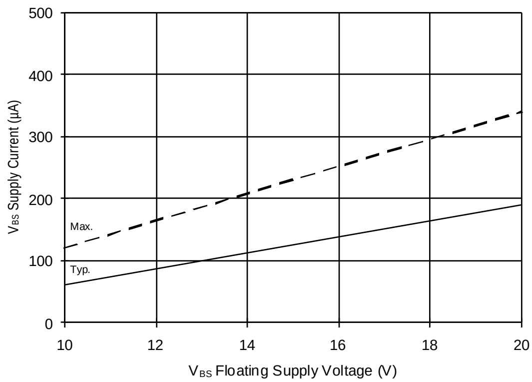


Figure 17B. V_{BS} Supply Current vs. Voltage

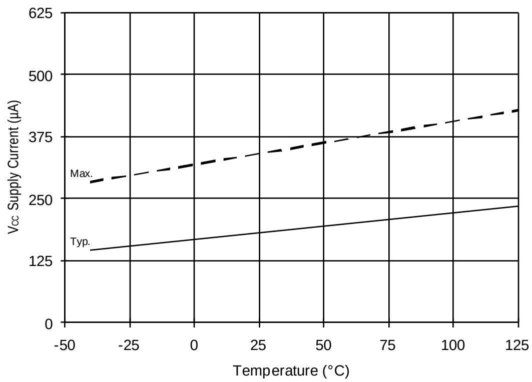


Figure 18A. V_{CC} Supply Current vs. Temperature

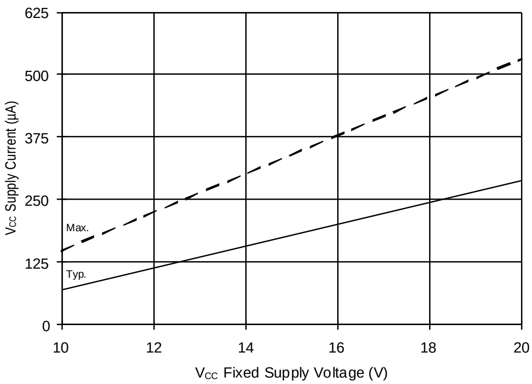


Figure 18B. V_{CC} Supply Current vs. Voltage

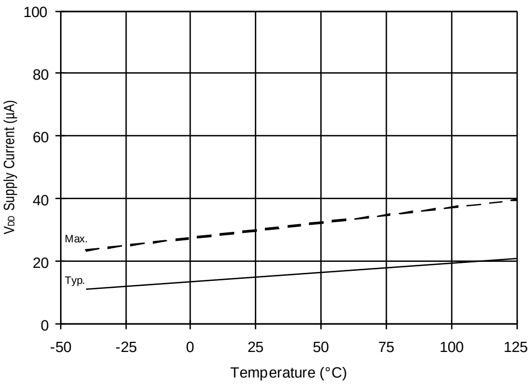


Figure 19A. V_{DD} Supply Current vs. Temperature

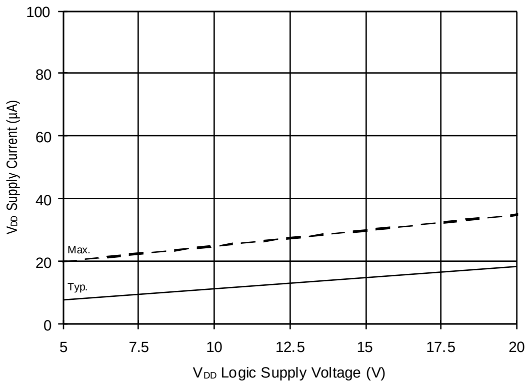


Figure 19B. V_{DD} Supply Current vs. Voltage

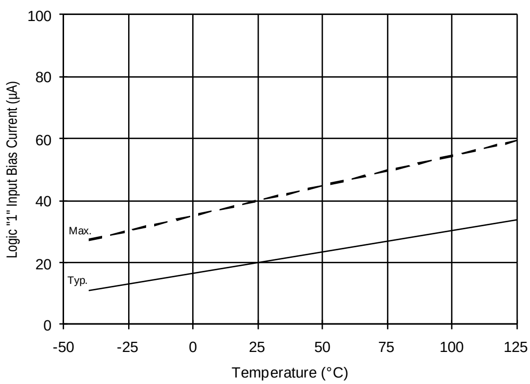


Figure 20A. Logic "1" Input Current vs. Temperature

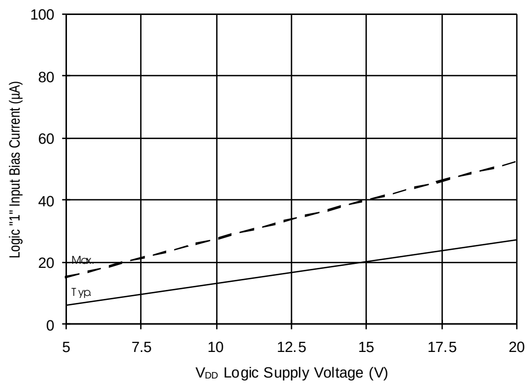


Figure 20B. Logic "1" Input Current vs. Voltage

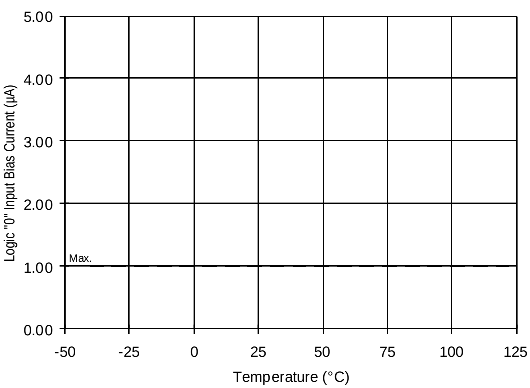


Figure 21A. Logic "0" Input Current vs. Temperature

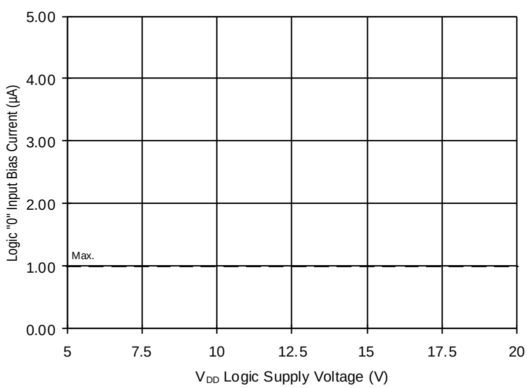


Figure 21B. Logic "0" Input Current vs. Voltage

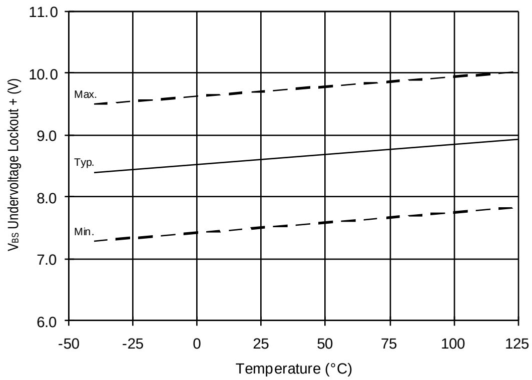


Figure 22. V_{BS} Undervoltage (+) vs. Temperature

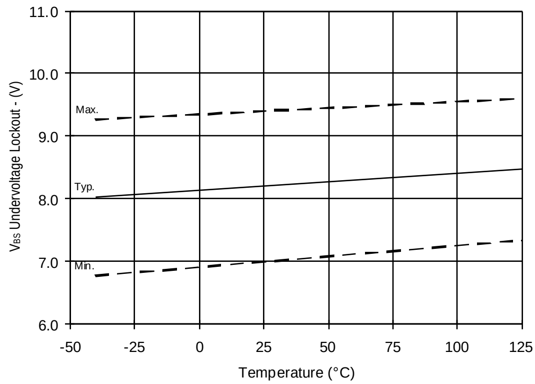


Figure 23. V_{BS} Undervoltage (-) vs. Temperature

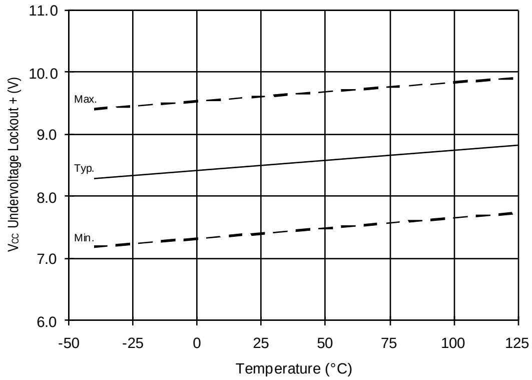


Figure 24. V_{CC} Undervoltage (+) vs. Temperature

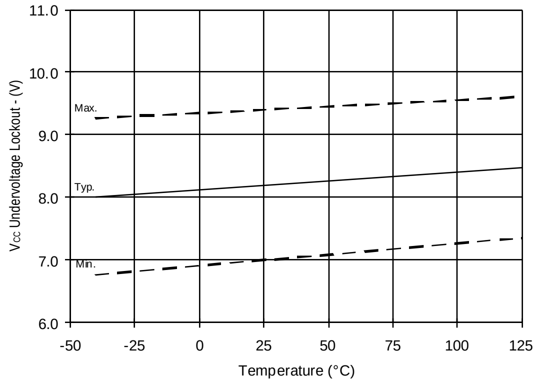


Figure 25. V_{CC} Undervoltage (-) vs. Temperature

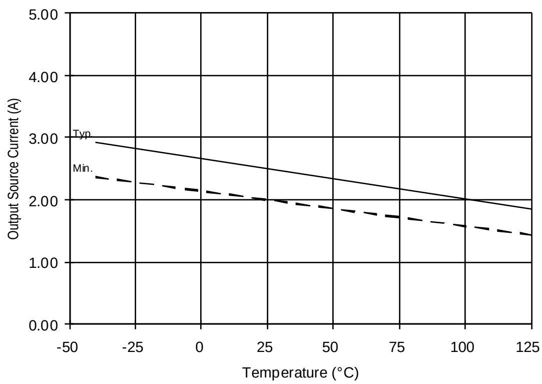


Figure 26A. Output Source Current vs. Temperature

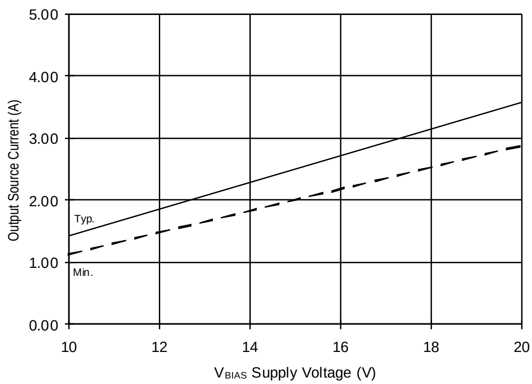


Figure 26B. Output Source Current vs. Voltage

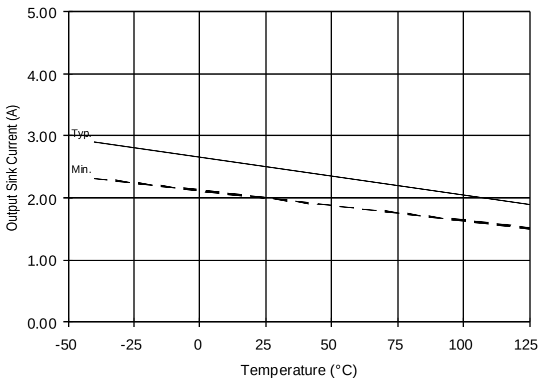


Figure 27A. Output Sink Current vs. Temperature

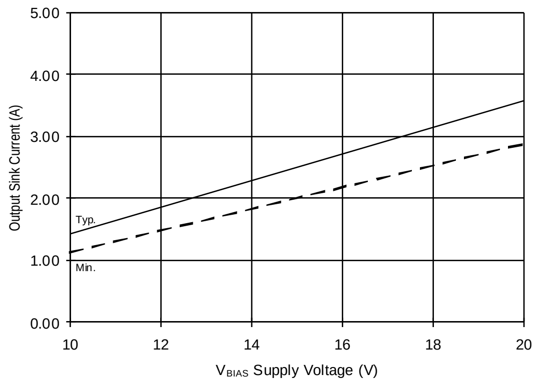


Figure 27B. Output Sink Current vs. Voltage

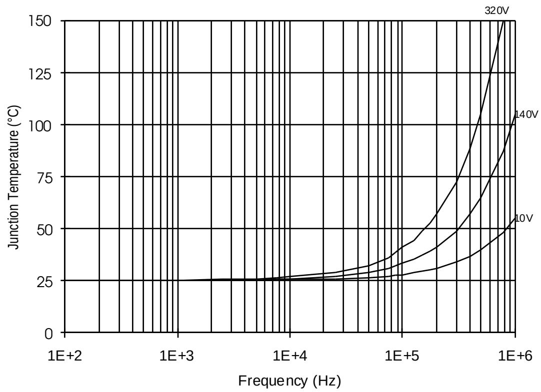


Figure 28. IR2110 T_J vs. Frequency (IRFBC20)
R_{GATE} = 33Ω, V_{CC} = 15V

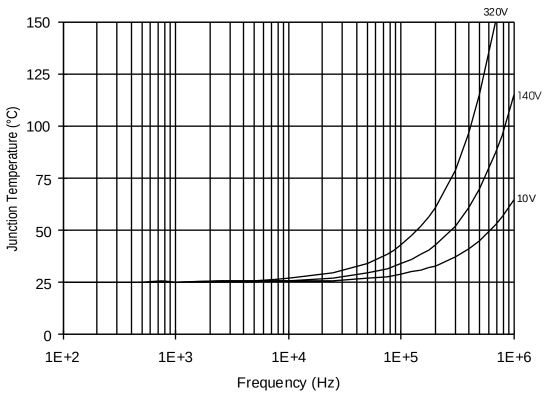


Figure 29. IR2110 T_J vs. Frequency (IRFBC30)
R_{GATE} = 22Ω, V_{CC} = 15V

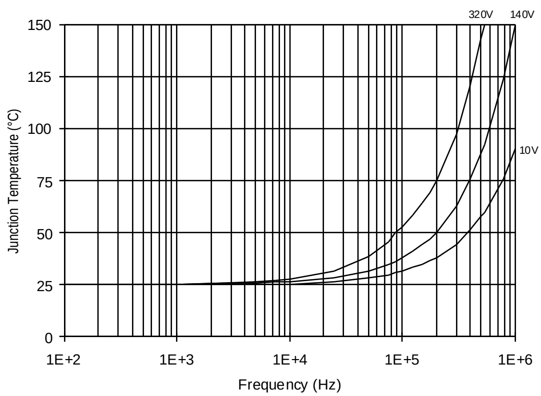


Figure 30. IR2110 T_J vs. Frequency (IRFBC40)
R_{GATE} = 15Ω, V_{CC} = 15V

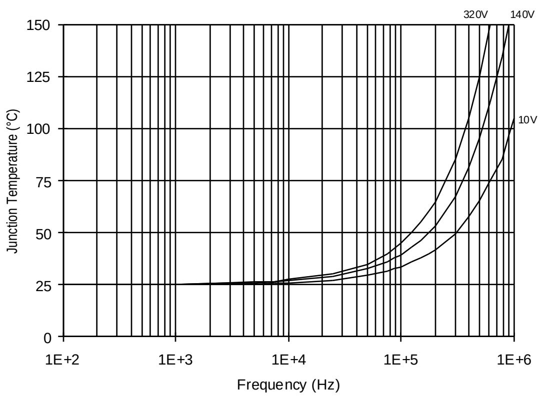


Figure 31. IR2110 T_J vs. Frequency (IRFPE50)
R_{GATE} = 10Ω, V_{CC} = 15V

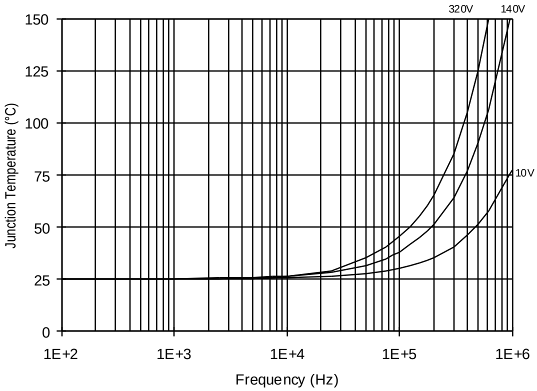


Figure 32. IR2110S T_J vs. Frequency (IRFBC20) R_{GATE} = 33Ω, V_{CC} = 15V

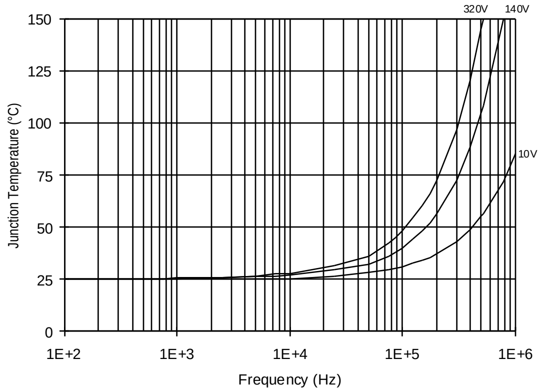


Figure 33. IR2110S T_J vs. Frequency (IRFBC30) R_{GATE} = 22Ω, V_{CC} = 15V

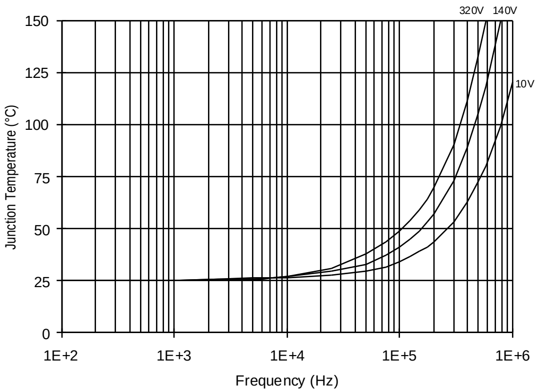


Figure 34. IR2110S T_J vs. Frequency (IRFBC40) R_{GATE} = 15Ω, V_{CC} = 15V

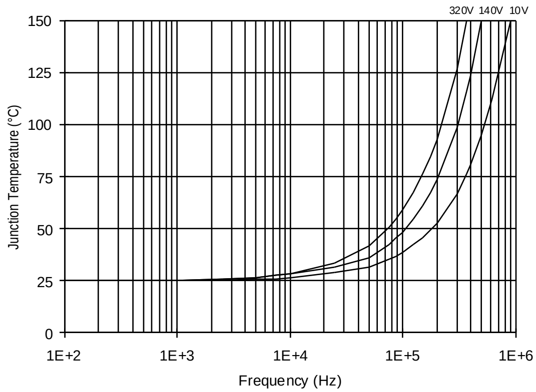


Figure 35. IR2110S T_J vs. Frequency (IRFPE50) R_{GATE} = 10Ω, V_{CC} = 15V

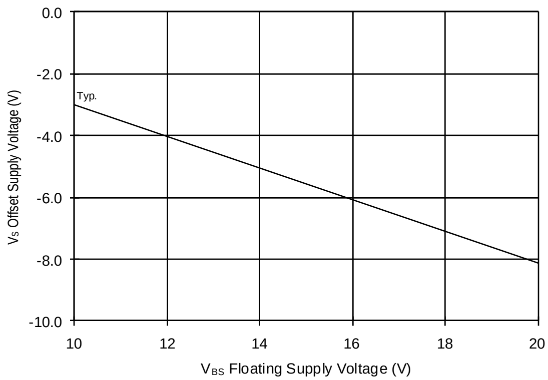


Figure 36. Maximum V_S Negative Offset vs. V_{BS} Supply Voltage

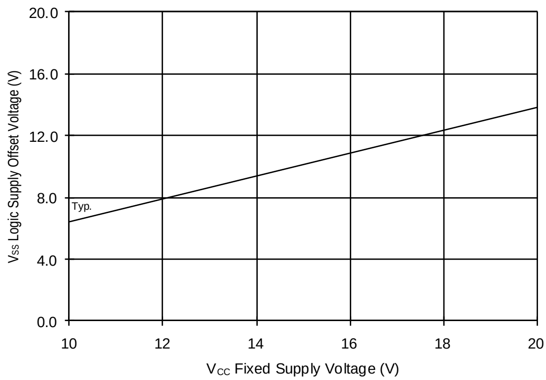


Figure 37. Maximum V_{SS} Positive Offset vs. V_{CC} Supply Voltage