

IR2113PBF-HX International Rectifier

General Description

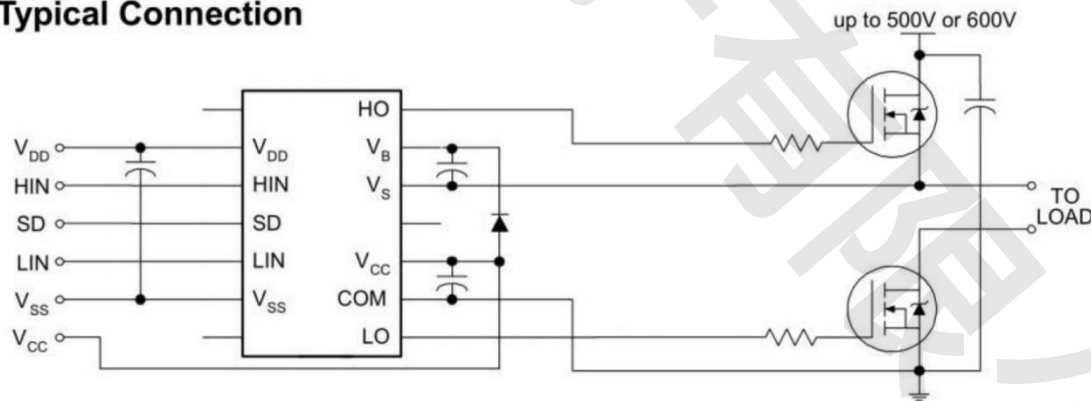
The IR2113PBF-HX PBF are high voltage, high speed power MOSFET and IGBT drivers with independent high and low side referenced output channels. Proprietary HVIC and latch immune CMOS technologies enable ruggedized monolithic construction. Logic inputs are compatible with standard CMOS or LSTTL output, down to 3.3V logic. 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 or 600 volts.

Features

- Floating channel designed for bootstrap operation
- Fully operational to +500V or +600V Tolerant to negative transient voltage dV/dt immune
- I Gate drive supply range from 10 to 20V
- I Undervoltage lockout for both channels
- I 3.3V logic compatible
- Separate logic supply range from 3.3V to 20V Logic and power ground $\pm 5V$ offset
- I CMOS Schmitt-triggered inputs with pull-down
- I Cycle by cycle edge-triggered shutdown logic
- I Matched propagation delay for both channels
- I Outputs in phase with inputs

PIN CONFIGURATIONS AND FUNCTIONS

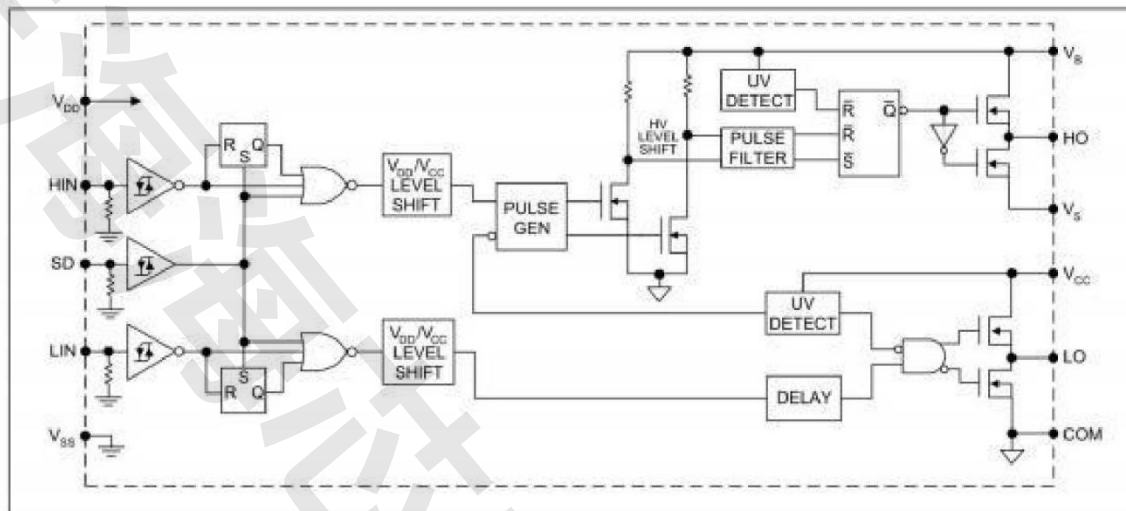
Typical Connection



(Refer to Lead Assignments for correct pin configuration). This/These diagram(s) show electrical connections only. Please refer to our Application Notes and DesignTips for proper circuit board layout.

Symbol	Description
VDD	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
VSS	Logic ground
V _B	High side floating supply
HO	High side gate drive output
V _S	High side floating supply return
VCC	Low side supply
LO	Low side gate drive output
COM	Low side return

BLOCK DIAGRAM



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.

Symbol	Definition	Min.	Max.	Units
V_B	High side floating supply voltage	-0.3	625	V
V_S	High side floating supply offset voltage	$V_B - 25$	$V_B + 0.3$	
V_{HO}	High side floating output voltage	$V_S - 0.3$	$V_B + 0.3$	
V_{CC}	Low side fixed supply voltage	-0.3	25	
V_{LO}	Low side output voltage	-0.3	$V_{CC} + 0.3$	
V_{DD}	Logic supply voltage	-0.3	$V_{SS} + 25$	
V_{SS}	Logic supply offset voltage	$V_{CC} - 25$	$V_{CC} + 0.3$	
V_{IN}	Logic input voltage (HIN, LIN & SD)	$V_{SS} - 0.3$	$V_{DD} + 0.3$	
dV_S/dt	Allowable offset supply voltage transient (figure 2)	—	50	V/ns
P_D	Package power dissipation @ $T_A \leq +25^\circ\text{C}$	—	1.6	W
		—	1.25	
R_{THJA}	Thermal resistance, junction to ambient	—	75	$^\circ\text{C/W}$
		—	100	
T_J	Junction temperature	—	150	$^\circ\text{C}$
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 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.

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	600	
V_{HO}	High side floating output voltage	V_S	V_B	
V_{CC}	Low side fixed supply voltage	10	20	
V_{LO}	Low side output voltage	0	V_{CC}	
V_{DD}	Logic supply voltage	$V_{SS} + 3$	$V_{SS} + 20$	
V_{SS}	Logic supply offset voltage	-5 (Note 2)	5	
V_{IN}	Logic input voltage (HIN, LIN & SD)	V_{SS}	V_{DD}	
T_A	Ambient temperature	-40	85	°C

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

Note 2 : When $V_{DD} < 5V$, the minimum V_{SS} offset is limited to $-V_{DD}$.

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.

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		$V_S = 500V/600V$
t_{sd}	Shutdown propagation delay	9	—	110	140		$V_S = 500V/600V$
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	—	—	—	20		

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STATIC ELECTRICAL CHARACTERISTICS

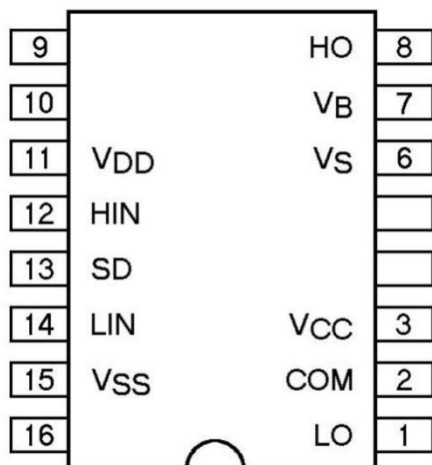
V_{BIAS} (V_{CC} , V_{BS} , V_{DD}) = 15V, T_A = 25°C and V_{SS} = COM unless otherwise specified.

The V_{IN} , V_{TH} and I_{IN} parameters are referenced to V_{SS} and are applicable to all three logic input leads: H IN, 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.

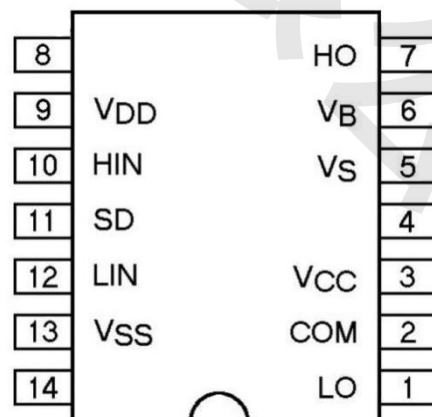
Symbol	Definition	Figure	Min.	Typ.	Max.	Units	Test Conditions
V_{IH}	Logic "1" input voltage	12	9.5	—	—	V	
V_{IL}	Logic "0" input voltage	13	—	—	6.0		
V_{OH}	High level output voltage, $V_{BIAS} - V_O$	14	—	—	1.2		$I_O = 0A$
V_{OL}	Low level output voltage, V_O	15	—	—	0.1		$I_O = 0A$
I_{LK}	Offset supply leakage current	16	—	—	50	μA	$V_B = V_S = 500V/600V$
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	$V_O = 0V$, $V_{IN} = V_{DD}$ $PW \leq 10 \mu s$
I_{O-}	Output low short circuit pulsed current	27	2.0	2.5	—		$V_O = 15V$, $V_{IN} = 0V$ $PW \leq 10 \mu s$

LEAD ASSIGNMENTS

SOP-16



DIP-14



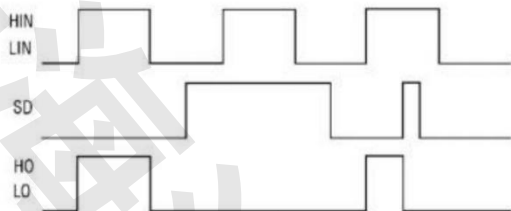


Figure 1. Input/Output Timing Diagram

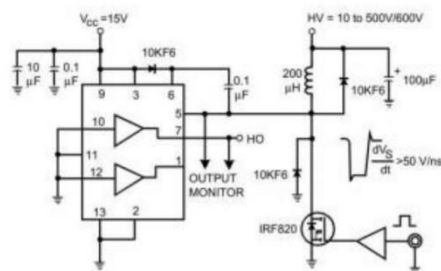


Figure 2. Floating Supply Voltage Transient Test Circuit

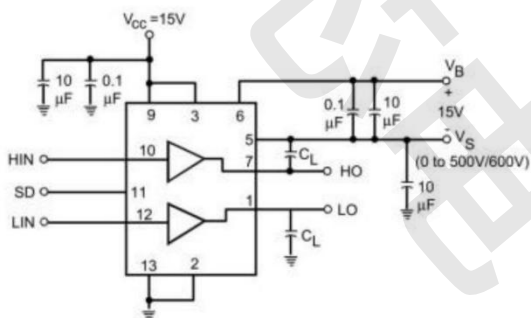


Figure 3. Switching Time Test Circuit

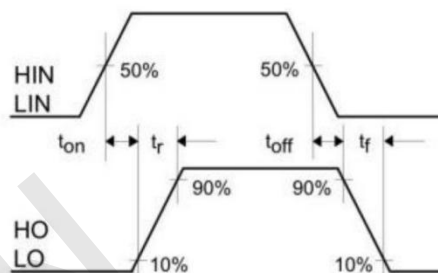


Figure 4. Switching Time Waveform Definition

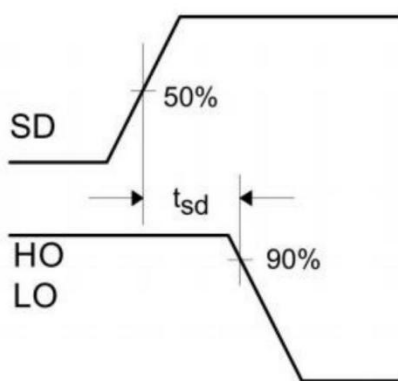


Figure 5. Shutdown Waveform Definitions

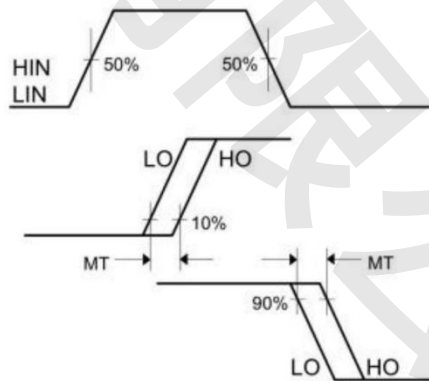


Figure 6. Delay Matching Waveform Definitions

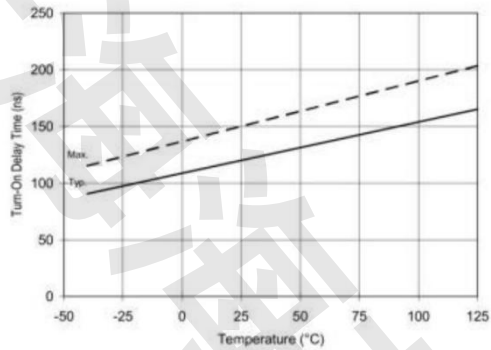


Figure 7A. Turn-On Time vs. Temperature

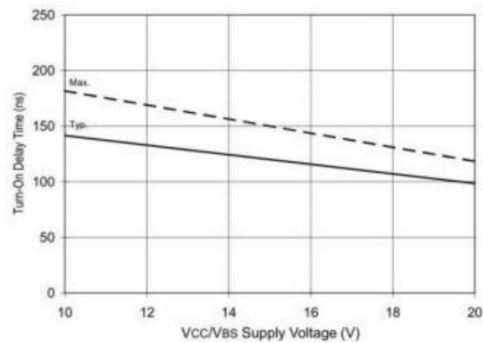
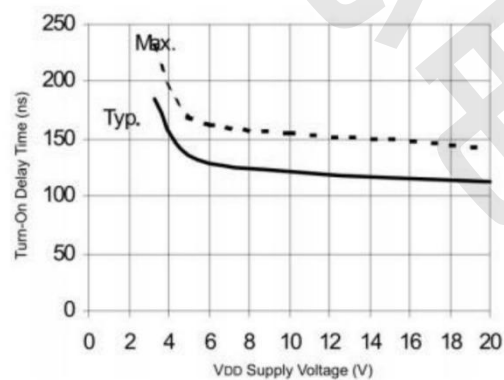
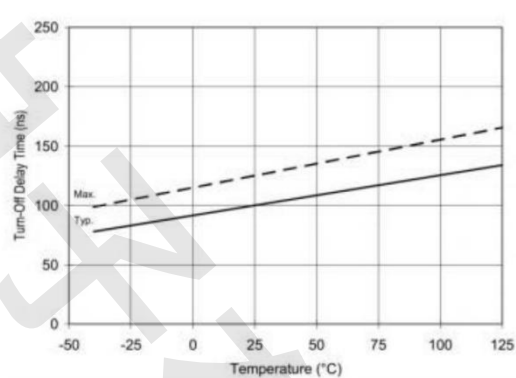
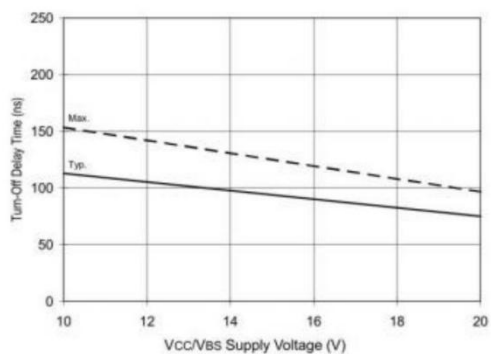
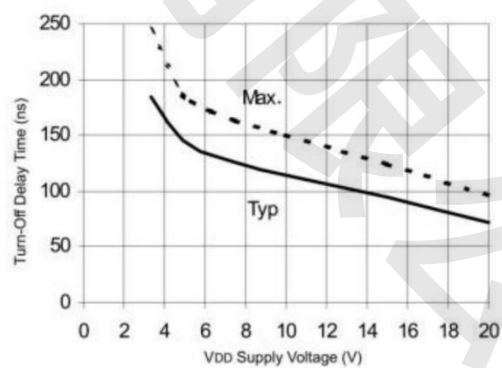
Figure 7B. Turn-On Time vs. V_{CC}/V_{BS} Supply VoltageFigure 7C. Turn-On Time vs. V_{DD} Supply Voltage

Figure 8A. Turn-Off Time vs. Temperature

Figure 8B. Turn-Off Time vs. V_{CC}/V_{BS} Supply VoltageFigure 8C. Turn-Off Time vs. V_{DD} Supply Voltage

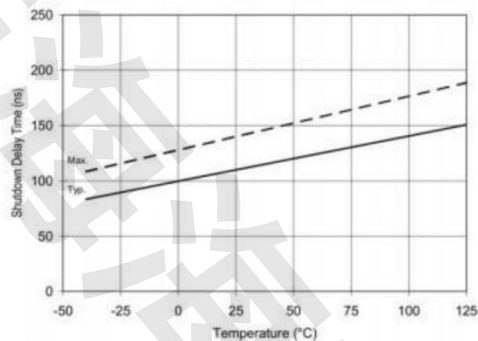


Figure 9A. Shutdown Time vs. Temperature

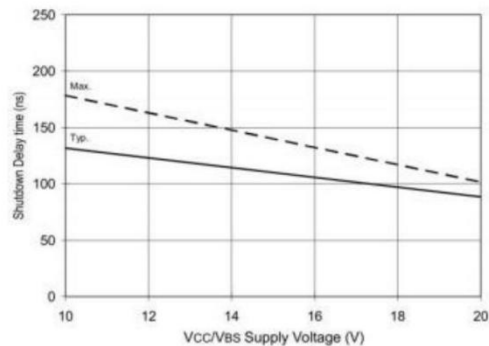


Figure 9B. Shutdown Time vs. V_{CC}/V_{BS} Supply Voltage

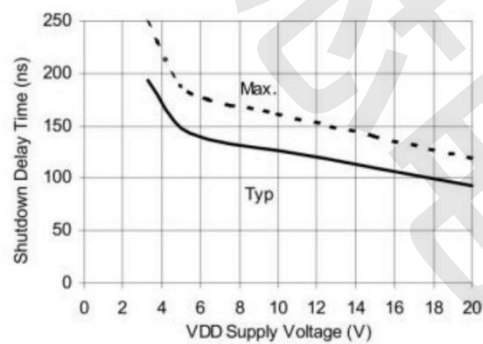


Figure 9C. Shutdown Time vs. V_{DD} Supply Voltage

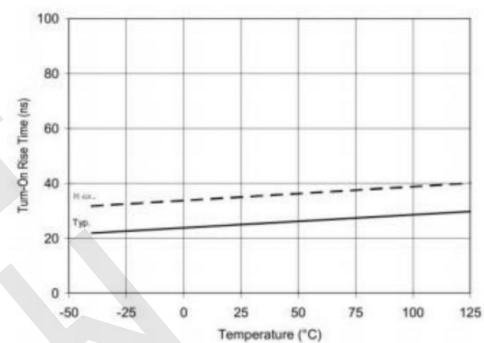


Figure 10A. Turn-On Rise Time vs. Temperature

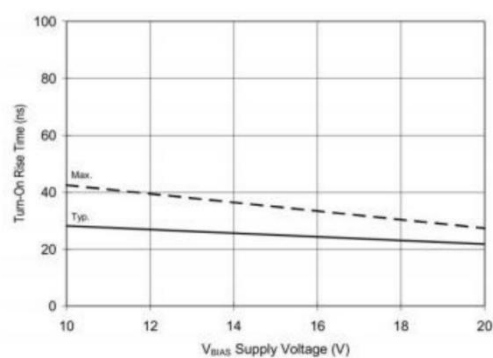


Figure 10B. Turn-On Rise Time vs. Voltage

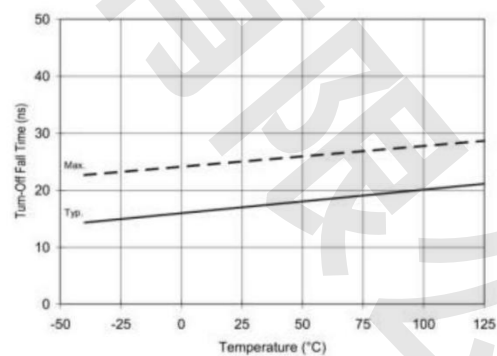


Figure 11A. Turn-Off Fall Time vs. Temperature

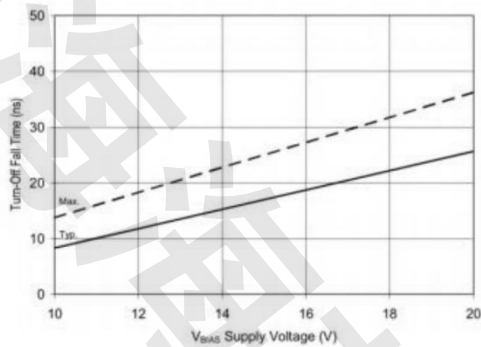


Figure 11B. Turn-Off Fall Time vs. Voltage

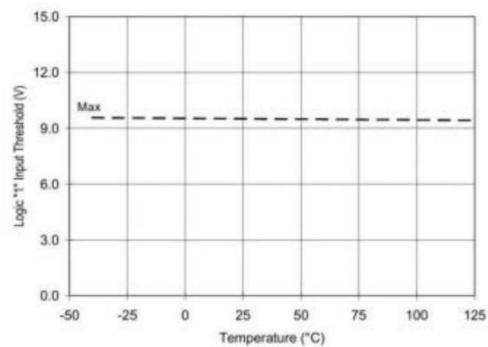


Figure 12A. Logic "1" Input Threshold vs. Temperature

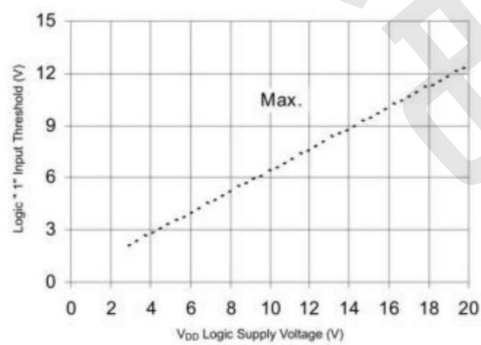


Figure 12B. Logic "1" Input Threshold vs. Voltage

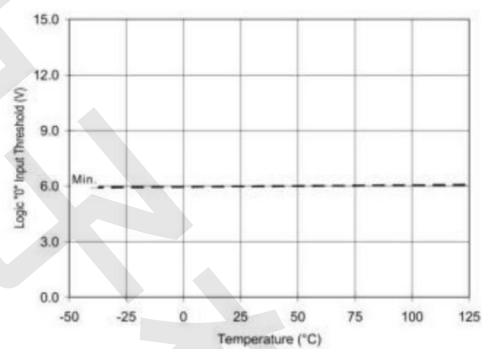


Figure 13A. Logic "0" Input Threshold vs. Temperature

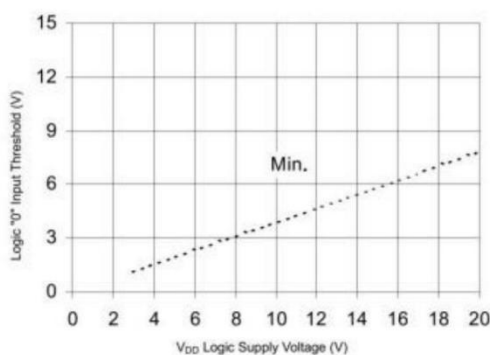


Figure 13B. Logic "0" Input Threshold vs. Voltage

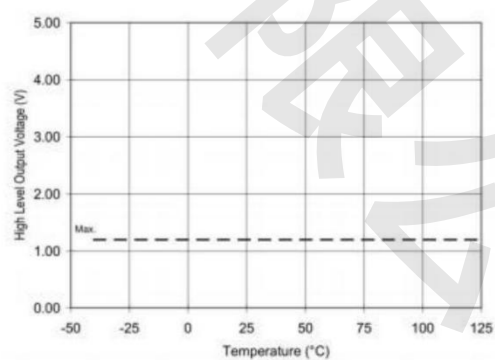


Figure 14A. High Level Output vs. Temperature

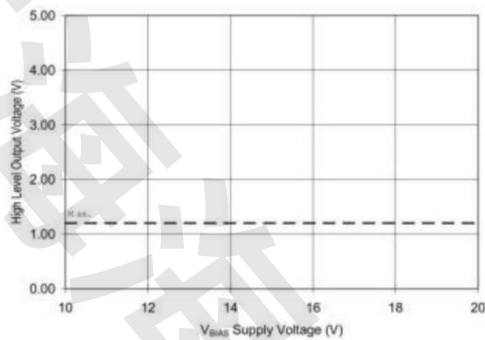


Figure 14B. High Level Output vs. Voltage

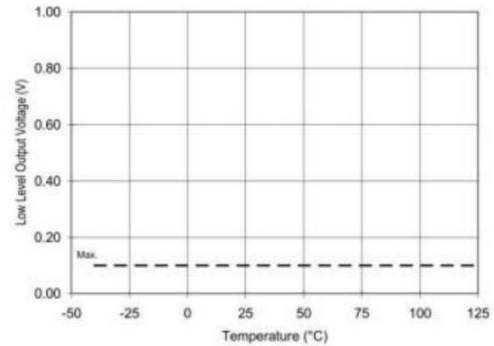


Figure 15A. Low Level Output vs. Temperature

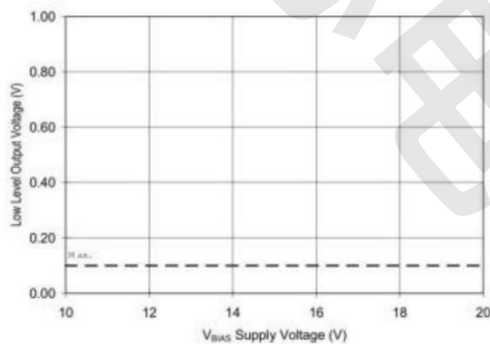


Figure 15B. Low Level Output vs. Voltage

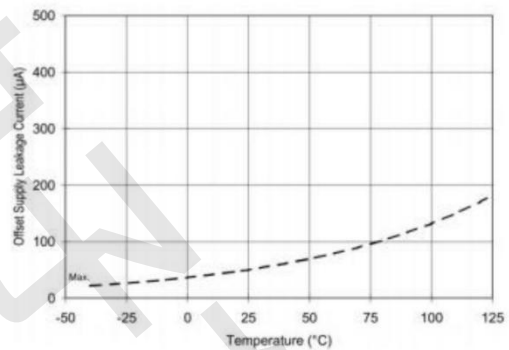


Figure 16A. Offset Supply Current vs. Temperature

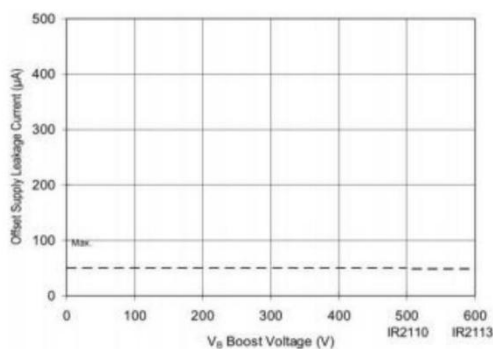


Figure 16B. Offset Supply Current vs. Voltage

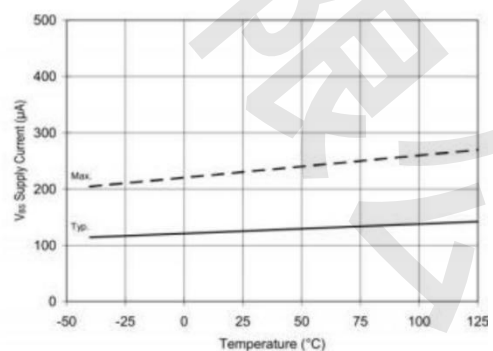


Figure 17A. V_{BS} Supply Current vs. Temperature

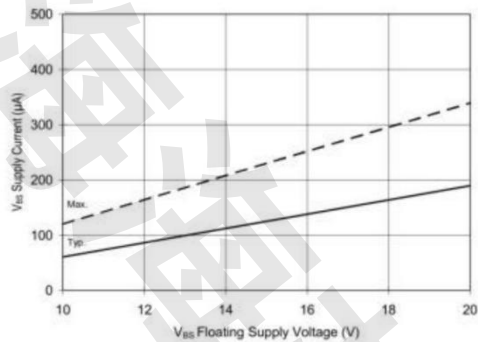
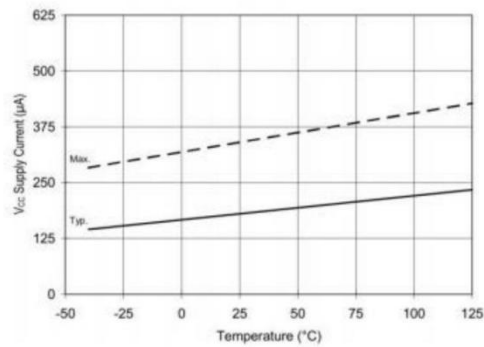
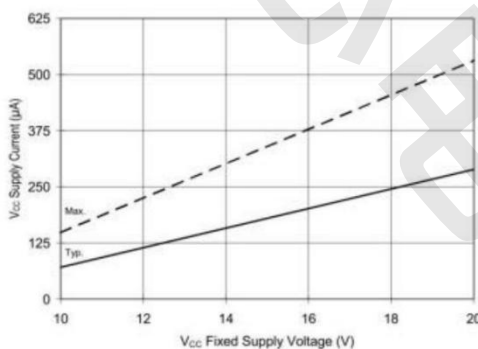
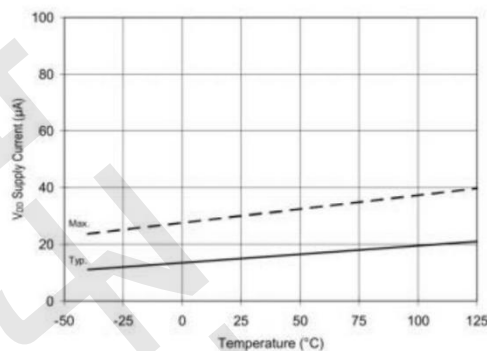
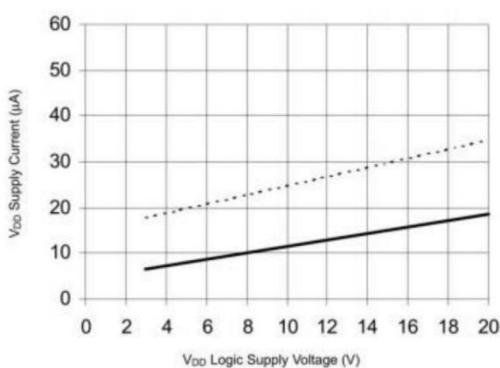
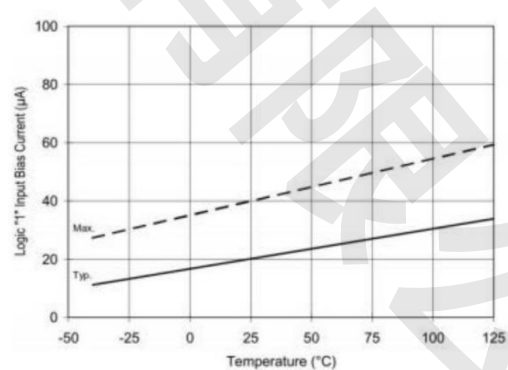
Figure 17B. V_{BS} Supply Current vs. VoltageFigure 18A. V_{CC} Supply Current vs. TemperatureFigure 18B. V_{CC} Supply Current vs. VoltageFigure 19A. V_{DD} Supply Current vs. TemperatureFigure 19B. V_{DD} Supply Current vs. V_{DD} Voltage

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

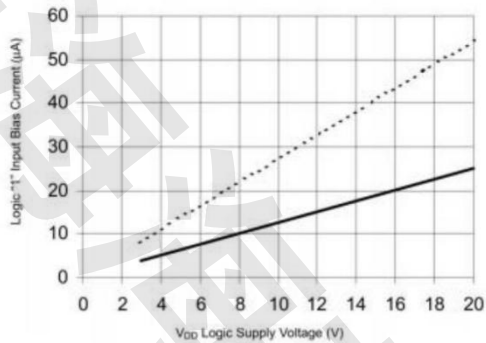


Figure 20B. Logic "1" Input Current vs. V_{DD} Voltage

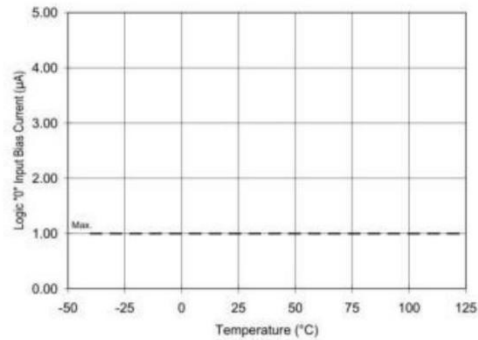


Figure 21A. Logic "0" Input Current vs. Temperature

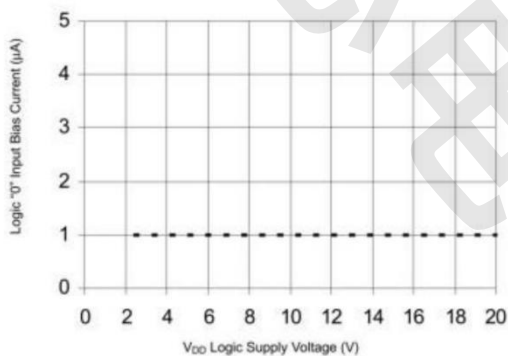


Figure 21B. Logic "0" Input Current vs. V_{DD} Voltage

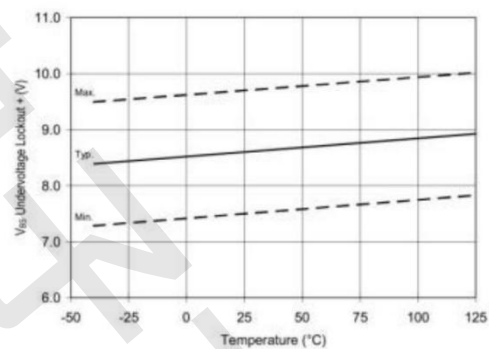


Figure 22. V_{BS} Undervoltage (+) vs. Temperature

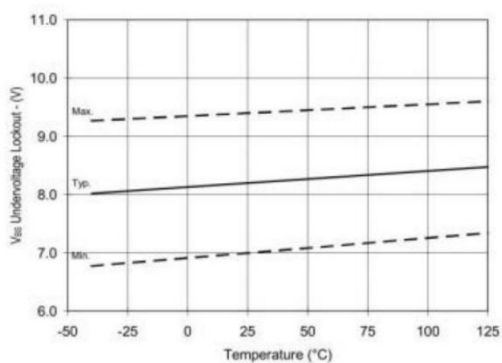


Figure 23. V_{BS} Undervoltage (-) vs. Temperature

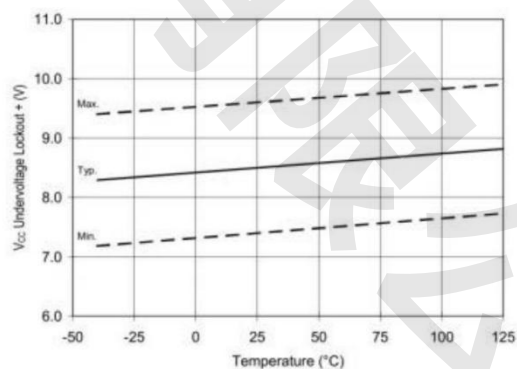


Figure 24. V_{CC} Undervoltage (+) vs. Temperature

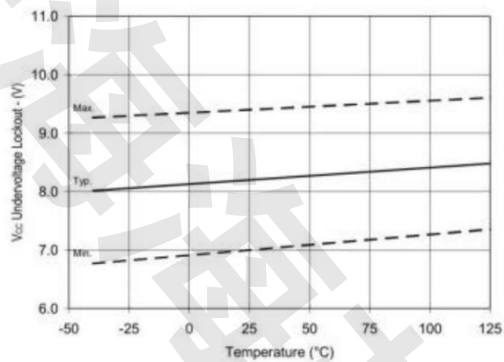


Figure 25. V_{CC} Undervoltage (-) vs. Temperature

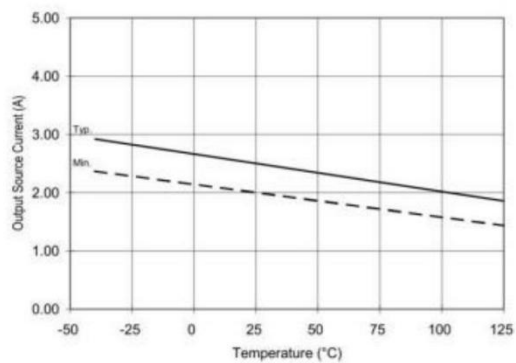


Figure 26A. Output Source Current vs. Temperature

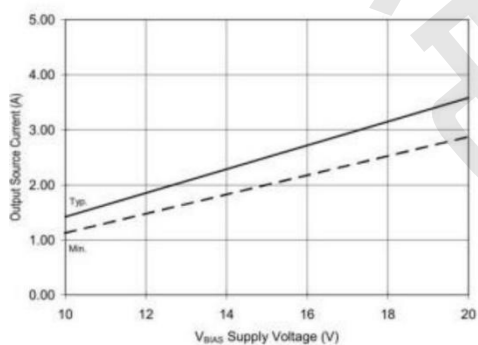


Figure 26B. Output Source Current vs. Voltage

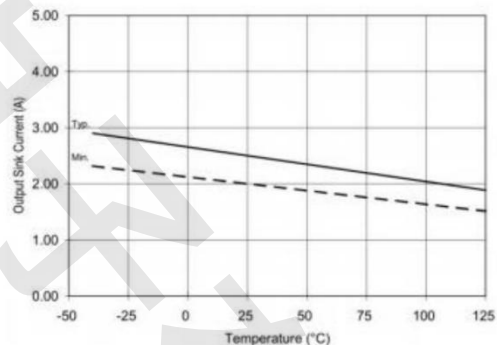


Figure 27A. Output Sink Current vs. Temperature

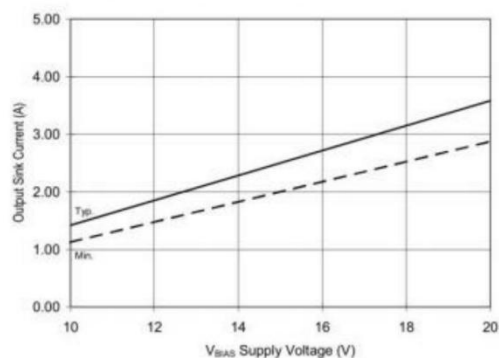


Figure 27B. Output Sink Current vs. Voltage

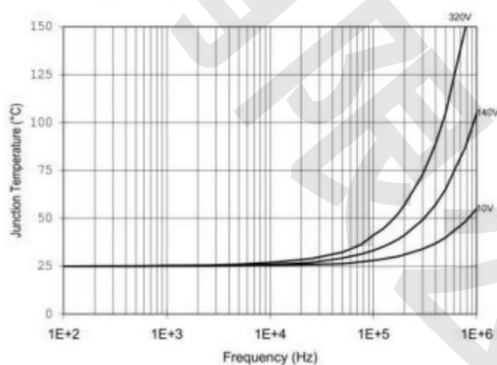


Figure 28. T_J vs. Frequency (IRFBC20)
 $R_{GATE} = 33\Omega$, $V_{CC} = 15V$

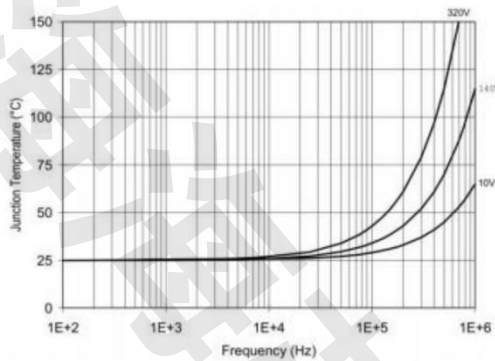


Figure 29. TJ vs. Frequency(IRFBC30)
RGATE = 22Ω, VCC = 15V

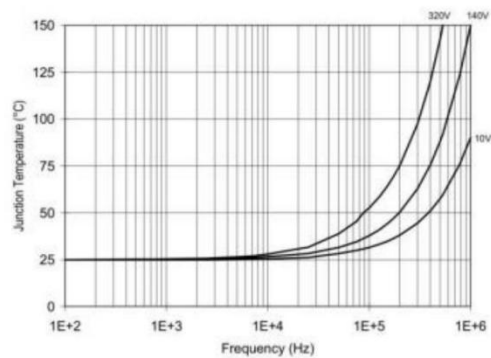


Figure 30. TJ vs. Frequency (IRFBC40)
RGATE = 15Ω, VCC = 15V

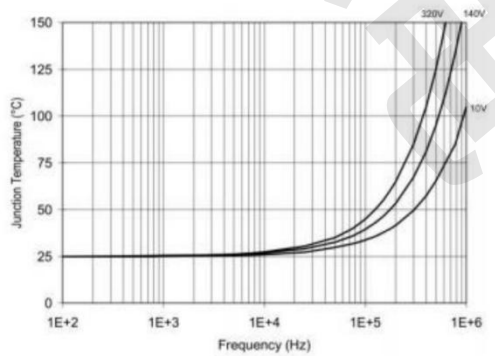


Figure 31. TJ vs. Frequency (IRFPE50)
RGATE = 10Ω, VCC = 15V

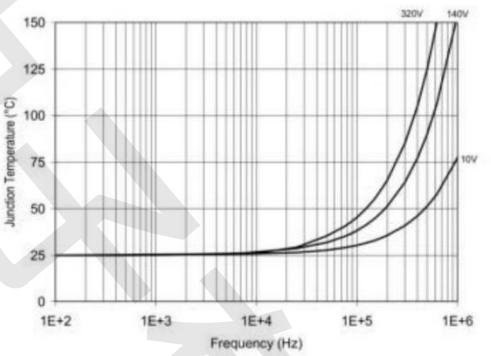


Figure 32. TJ vs. Frequency (IRFBC20)
RGATE = 33Ω, VCC = 15V

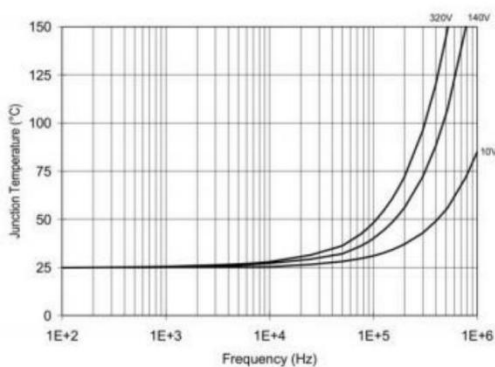


Figure 33. TJ vs. Frequency (IRFBC30)
RGATE = 22Ω, VCC = 15V

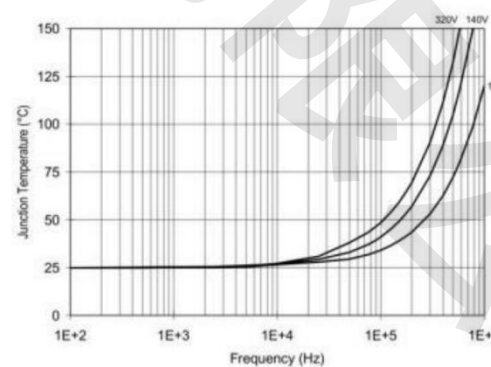


Figure 34. TJ vs. Frequency (IRFBC40)
RGATE = 15Ω, VCC = 15V

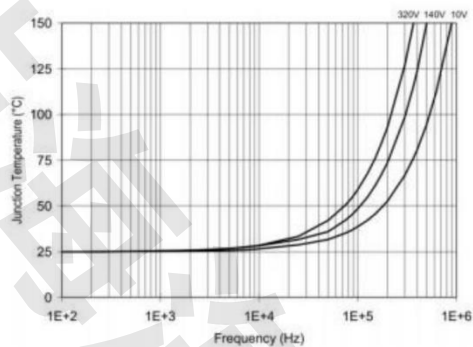


Figure 35. T_J vs. Frequency (IRFPE50)
RGATE = 10Ω, VCC = 15V

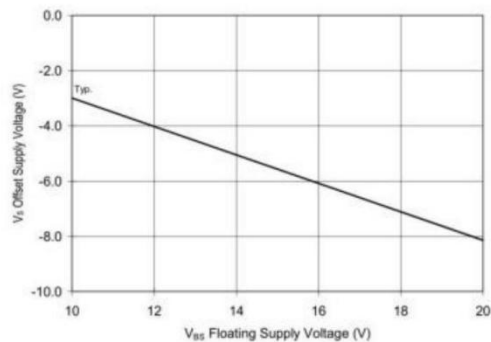


Figure 36. Maximum VS Negative Offset vs.
VBS Supply Voltage

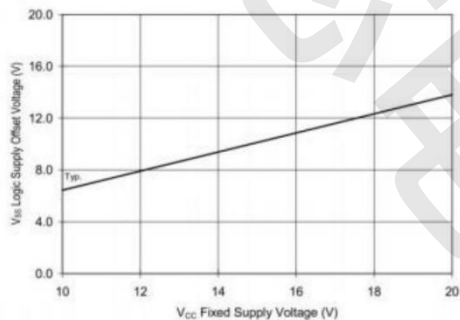
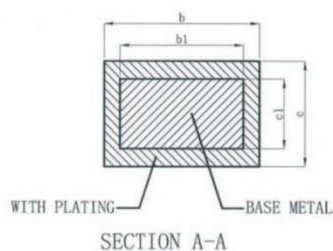
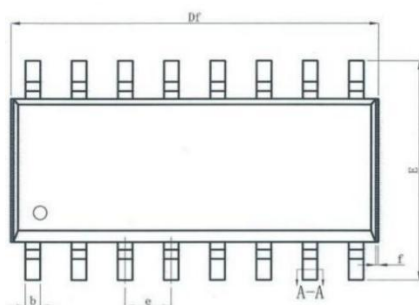
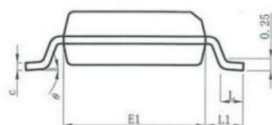
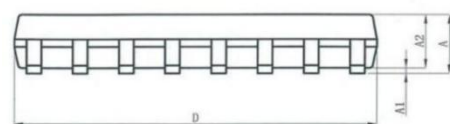


Figure 37. Maximum VSS Positive Offset vs.
VCC Supply Voltage

DIMENSIONAL DRAWINGS

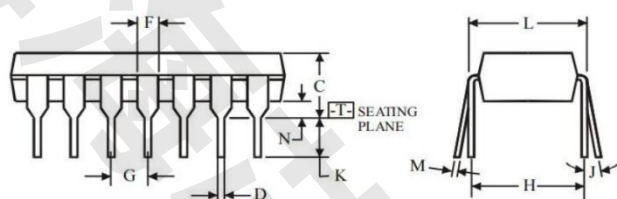
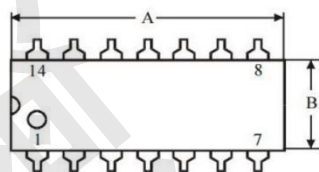
SOP-16



symbol	millimeter		
	Min	Nom	Max
A	—	—	2.65
A1	0.10	0.20	0.30
A2	2.20	2.30	2.40
b	0.39	—	0.47
b1	0.38	0.41	0.43
c	0.25	—	0.30
c1	0.24	0.25	0.26
D	10.10	10.20	10.30
Df	10.20	—	10.70
E	10.26	10.41	10.60
E1	7.40	7.50	7.60
e	1.27BSC		
L	0.55	—	0.85
L1	—	1.40	—
θ	0°	—	8°
f	0.05	—	0.20



DIP-14



$\oplus 0.25 (0.010) \text{ T}$

NOTES:

- Dimensions "A", "B" do not include mold flash or protrusions.
Maximum mold flash or protrusions 0.25 mm (0.010) per side.

Symbol	Dimension, mm	
	MIN	MAX
A	18.67	19.69
B	6.1	7.11
C		5.33
D	0.36	0.56
F	1.14	1.78
G	2.54	
H	7.62	
J	0°	10°
K	2.92	3.81
L	7.62	8.26
M	0.2	0.36
N	0.38	