High and Low Side 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
- Undervoltage lockout for both channels
- 3.3 V and 5 V logic compatible
- Matched propagation delay for both channels
- Logic and power ground +/- 5 V offset
- Lower di/dt gate driver for better noise immunity
- Output source/sink current 4 A / 4 A
- RoHS compliant

Product Summary

V_{OFFSET}	600 V
$I_{O+/-}$	4 A / 4 A
V_{OUT}	10 V – 20 V
Ton/off (typ.)	170 & 170 ns

Description

The IRS2186(4) are high voltage, high speed power MOSFET and IGBT drivers with independent high-side and low-side referenced output channels. Proprietary HVIC and latch immune CMOS technologies enable ruggedized monolithic construction. The logic input is compatible with standard CMOS or LSTTL output, down to 3.3 V logic. The output drivers feature a high pulse current buffer stage designed for minimum driver cross-conduction. 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 V.

Package Options

8-Lead SOIC

8-Lead PDIP

14-Lead SOIC

14-Lead PDIP

Ordering Information

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRS2186SPBF	SO8N	Tube	95	IRS2186SPBF
IRS2186SPBF	SO8N	Tape and Reel	2500	IRS2186STRPBF
IRS21864SPBF	SO14N	Tube	55	IRS21864SPBF
IRS21864SPBF	SO14N	Tape and Reel	2500	IRS21864STRPBF
IRS2186PBF	PDIP8	Tube	50	IRS2186PBF
IRS21864PBF	PDIP14	Tube	25	IRS21864PBF

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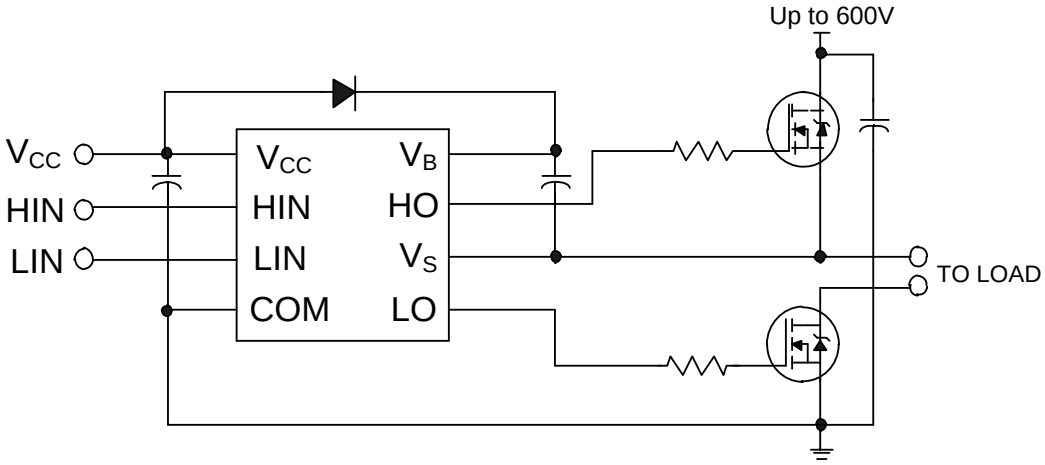
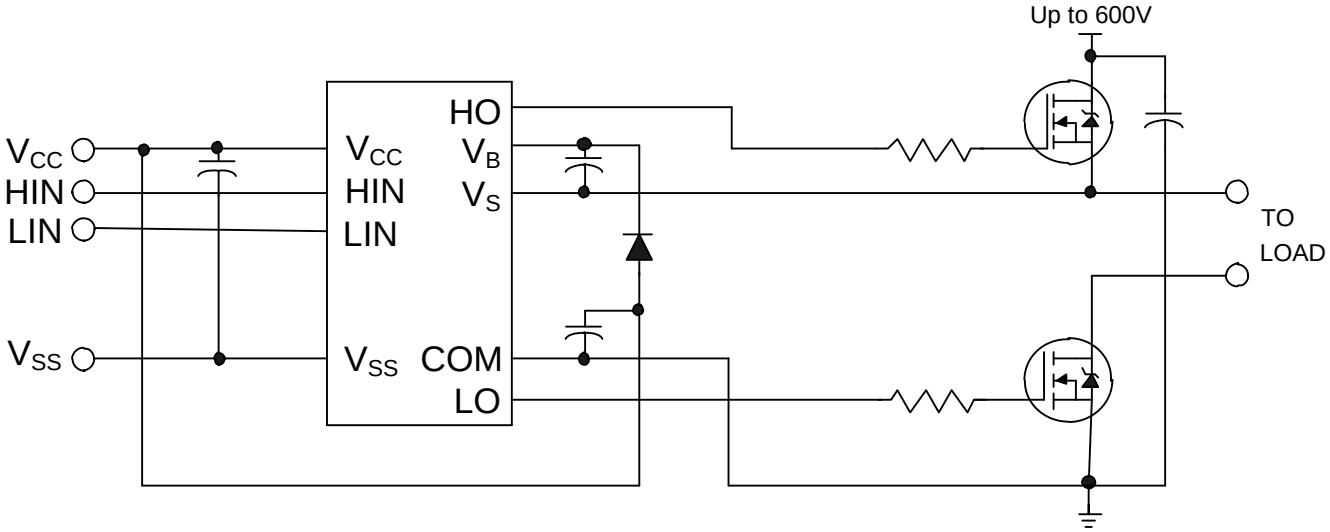
Typical Connection Diagram



IRS2186(S)



IRS21864(S)

(Refer to Lead Assignments for correct pin configuration). These diagrams show electrical connections only. Please refer to our Application Notes and Design Tips for proper circuit board layout.

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.

Symbol	Definition		Min.	Max.	Units
V_B	High side floating absolute voltage		-0.3	620 †	V
V_S	High side floating supply offset voltage		V_B - 20	V_B + 0.3	
V_{HO}	High side floating output voltage		V_S - 0.3	V_B + 0.3	
V_{CC}	Low side and logic fixed supply voltage		-0.3	20 †	
V_{LO}	Low side output voltage		-0.3	V_{CC} + 0.3	
V_{IN}	Logic input voltage (HIN & LIN)		V_{SS} - 0.3	V_{CC} + 0.3	
V_{SS}	Logic ground (IRS21864)		V_{CC} - 20	V_{CC} + 0.3	
dV_S/dt	Allowable offset supply voltage transient		—	50	V/ns
P_D	Package power dissipation @ $T_A \leq +25°C$	8 lead PDIP	—	1	W
		8 lead SOIC	—	0.625	
		14 lead PDIP	—	1.6	
		14 lead SOIC	—	1	
Rth_{JA}	Thermal resistance, junction to ambient	8 lead PDIP	—	125	°C/W
		8 lead SOIC	—	200	
		14 lead PDIP	—	75	
		14 lead SOIC	—	120	
T_J	Junction temperature		—	150	°C
T_S	Storage temperature		-50	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 rating is tested with all supplies biased at 15 V differential.

Symbol	Definition	Min.	Max.	Units
V_B	High side floating absolute voltage	V_S + 10	V_S + 20	V
V_S	High side floating supply offset voltage	††	600	
V_{HO}	High side floating output voltage	V_S	V_B	
V_{CC}	Low side and logic fixed supply voltage	10	20	
V_{LO}	Low side output voltage	0	V_{CC}	
V_{IN}	Logic input voltage (HIN & LIN)	V_{SS}	V_{CC}	
V_{SS}	Logic ground (IRS21864)	-5	5	
T_A	Ambient temperature	-40	125	°C

† All supplies are fully tested at 25 V and an internal 20 V clamp exists for each supply

†† Logic operational for V_S of -5 V to 600 V. Logic state held for V_S of -5 V to $-V_{BS}$ (Please refer to the Design Tip DT97-3 for more details)

Dynamic Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}) = 15 V, V_{SS} = COM, C_L = 1000 pF and T_A = 25 °C unless otherwise specified.

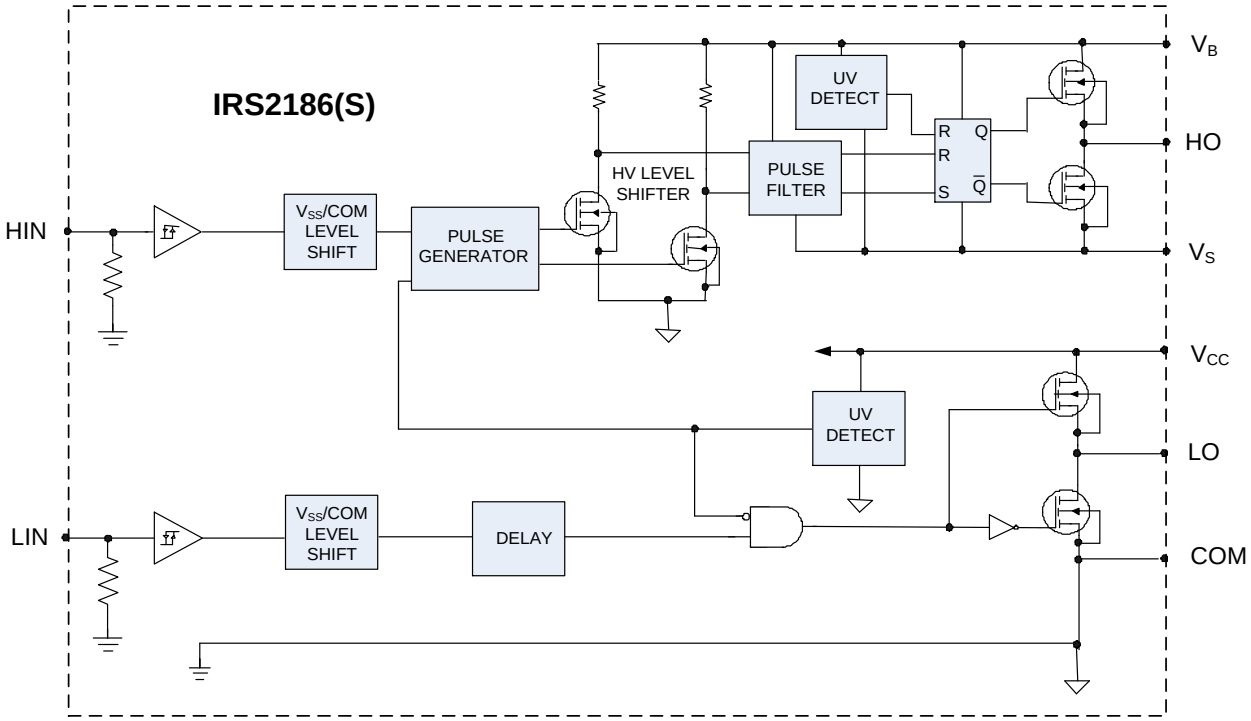
Symbol	Definition	Min.	Typ.	Max.	Units	Test Conditions
t_{on}	Turn-on propagation delay	—	170	250	ns	V_S = 0 V
t_{off}	Turn-off propagation delay	—	170	250		V_S = 0 V or 600 V
t_r	Turn-on rise time	—	22	38		V_S = 0 V
t_f	Turn-off fall time	—	18	30		
MT	Delay matching, HS & LS turn on/off	—	0	35		

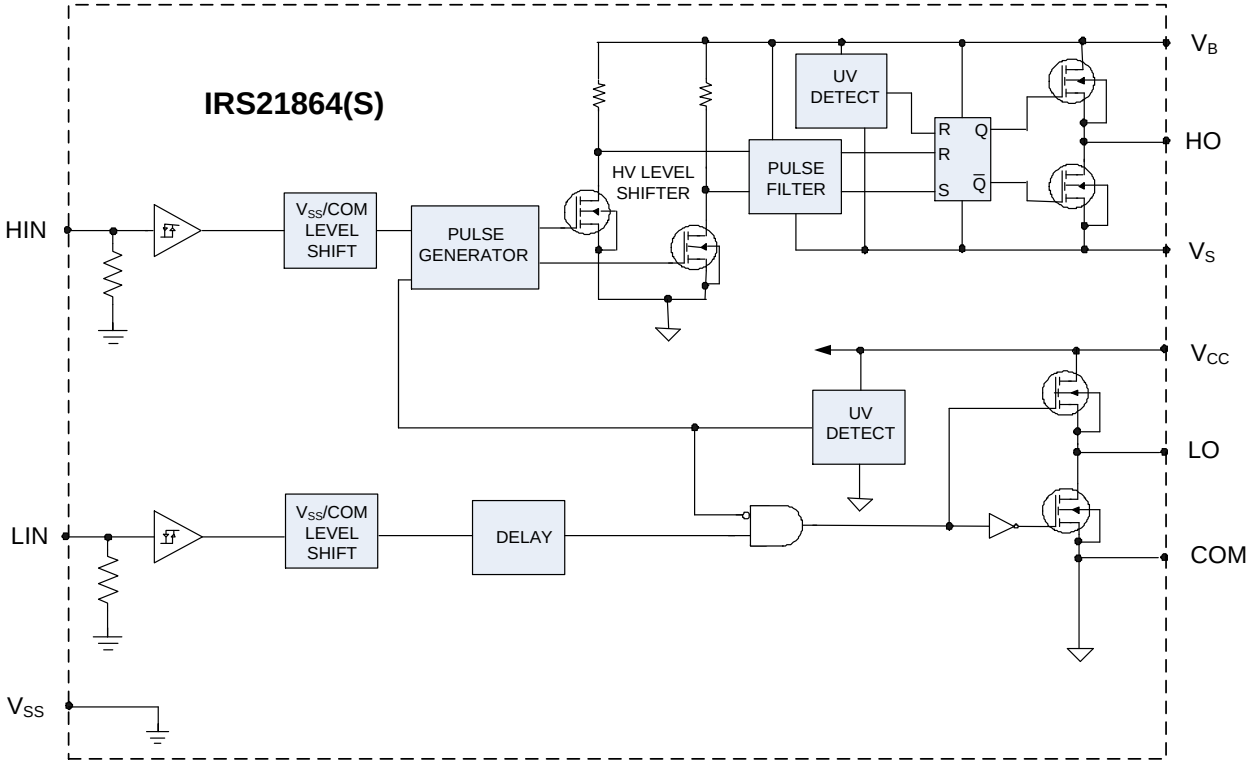
Static Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}) = 15 V, V_{SS} = COM, and T_A = 25 °C unless otherwise specified. The V_{IL}, V_{IH}, and I_{IN} parameters are referenced to V_{SS}/COM and are applicable to the respective input leads HIN and LIN. The V_O, I_O, and R_{ON} parameters are referenced to COM and are applicable to the respective output leads: HO and LO.

Symbol	Definition	Min.	Typ.	Max.	Units	Test Conditions
V_{IH}	Logic “1” input voltage	2.5	—	—	V	V_{CC} = 10 V to 20 V
V_{IL}	Logic “0” input voltage	—	—	0.8		
V_{OH}	High level output voltage, V_{BIAS} - V_O	—	—	1.4		I_O = 0 A
V_{OL}	Low level output voltage, V_O	—	—	0.15		I_O = 20 mA
I_{LK}	Offset supply leakage current	—	—	50	µA	V_B = V_S = 600 V
I_{QBS}	Quiescent V_{BS} supply current	20	60	150		V_{IN} = 0 V or 5 V
I_{QCC}	Quiescent V_{CC} supply current	50	120	240		
I_{IN+}	Logic “1” input bias current	—	25	60		V_{IN} = 5 V
I_{IN-}	Logic “0” input bias current	—	—	5		V_{IN} = 0 V
V_{CCUV+} V_{BSUV+}	V_{CC} and V_{BS} supply undervoltage positive going threshold	8	8.9	9.8	V	
V_{CCUV-} V_{BSUV-}	V_{CC} and V_{BS} supply undervoltage negative going threshold	7.4	8.2	9		
V_{CCUVH} V_{BSUVH}	Hysteresis	0.3	0.7	—		
I_{O+}	Output high short circuit pulsed current	2	4	—	A	V_O = 0 V, PW ≤ 10 µs
I_{O-}	Output low short circuit pulsed current	2	4	—		V_O = 15 V, PW ≤ 10 µs

Functional Block Diagram

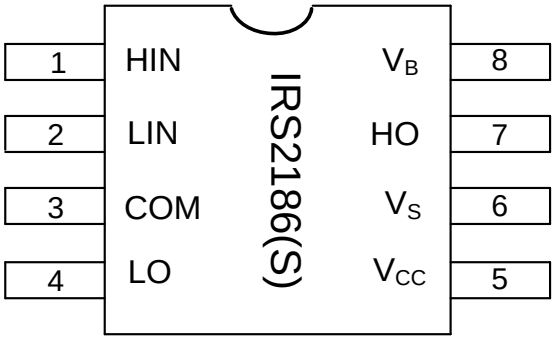




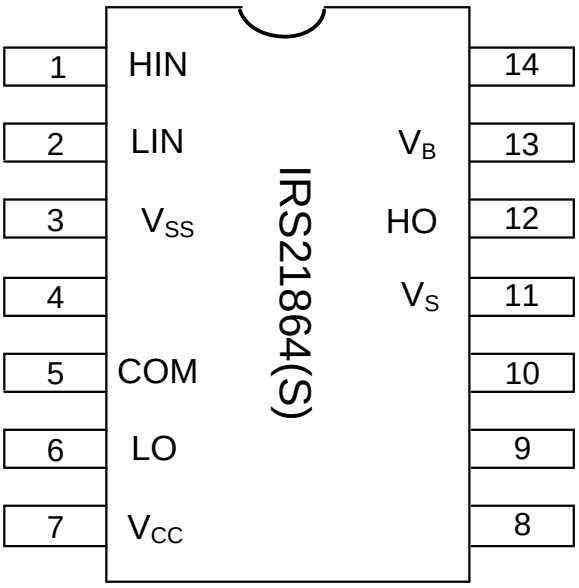
Lead Definitions

Symbol	Description
HIN	Logic input for high side gate driver output (HO), in phase
LIN	Logic input for low side gate driver output (LO), in phase
V_{SS}	Logic ground (IRS21864)
V_B	High side floating supply
HO	High side gate drive output
V_S	High side floating supply return
V_{CC}	Low side and logic fixed supply
LO	Low side gate drive output
COM	Low side return

Lead Assignments



8-Lead SOIC / 8-Lead PDIP



14-Lead SOIC / 14-Lead PDIP

Application Information and Additional Details

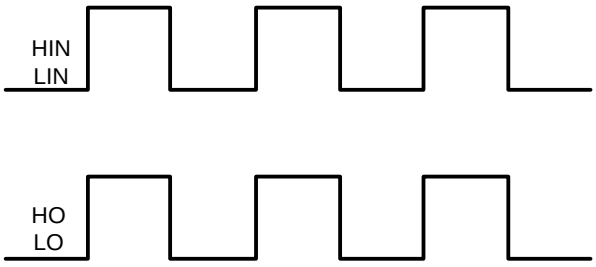


Figure 1. Input/Output Timing Diagram

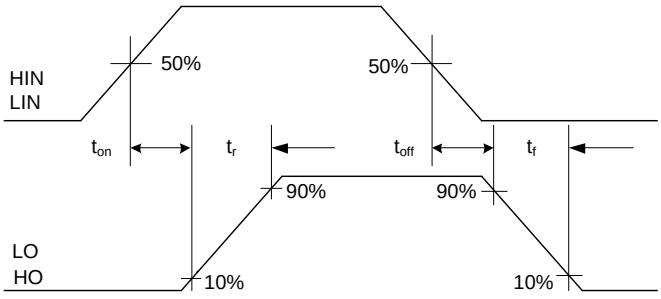


Figure 2. Switching Time Waveform Definitions

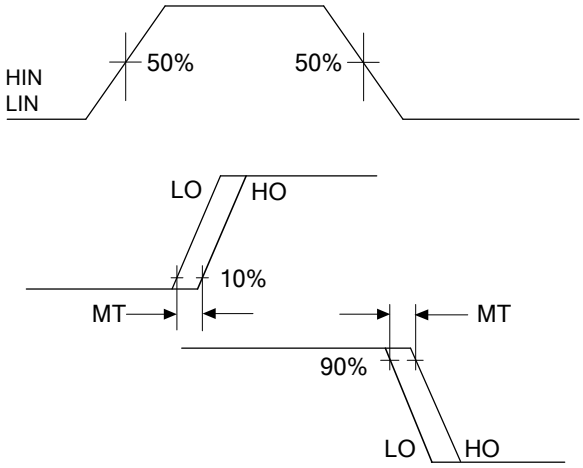


Figure 3. Delay Matching Waveform Definitions

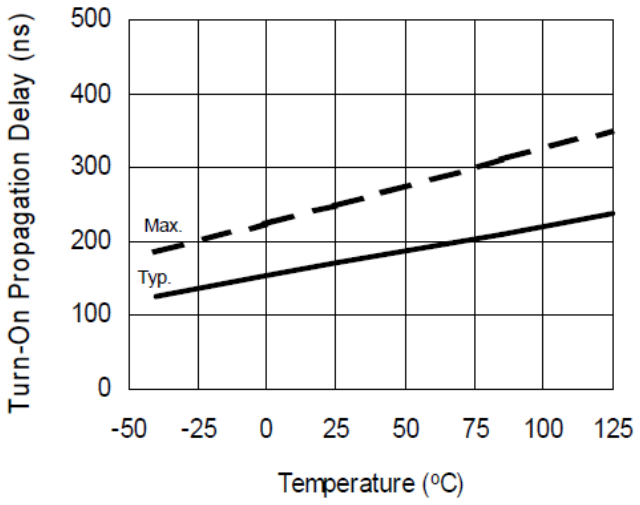


Figure 4A. Turn-On Propagation Delay vs. Temperature

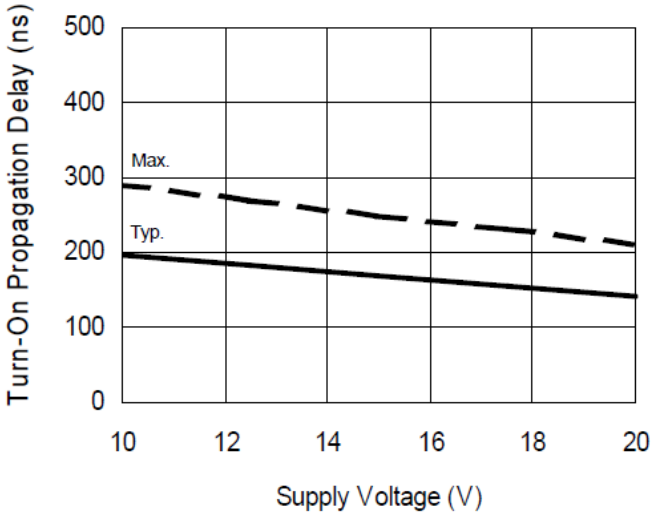


Figure 4B. Turn-on Propagation Delay vs. Supply Voltage

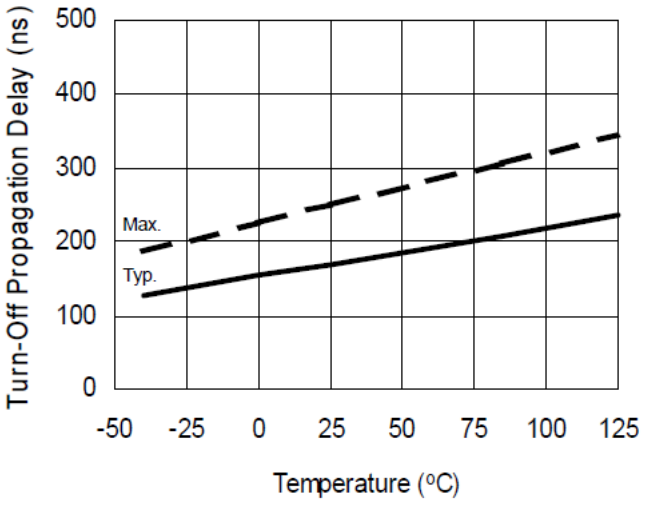


Figure 5A. Turn-Off Propagation Delay vs. Temperature

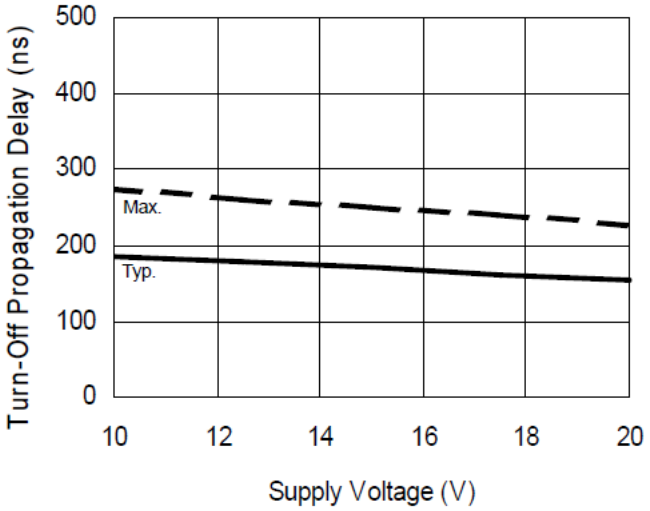
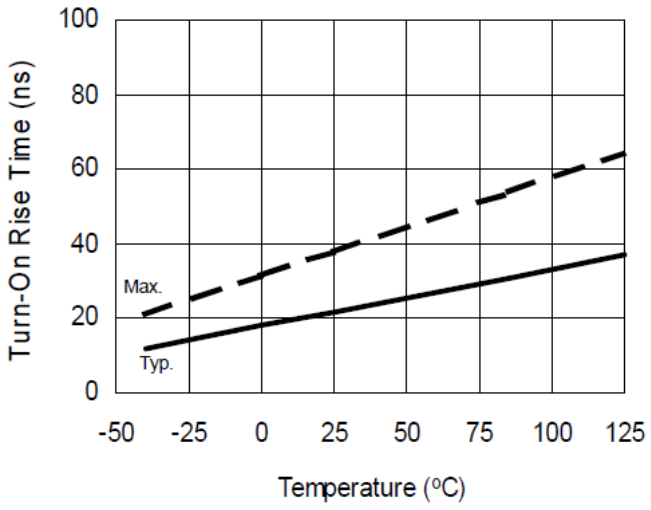


Figure 5B. Turn-Off Propagation Delay vs. Supply Voltage



6A. Turn-On Rise Time vs. Temperature

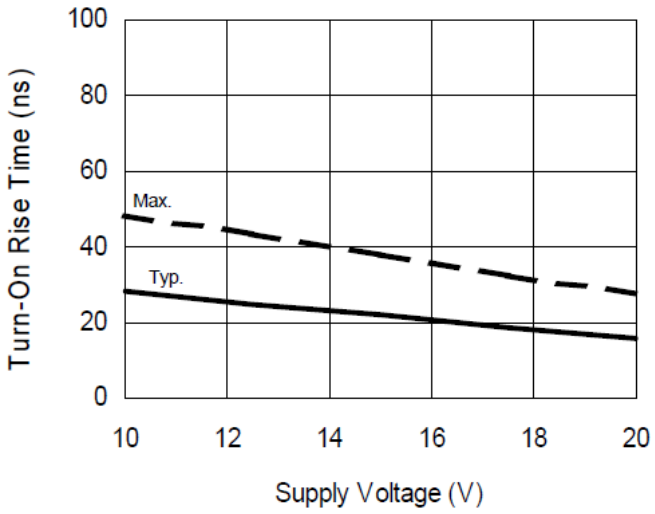


Figure 6B. Turn-On Rise Time vs. Supply Voltage

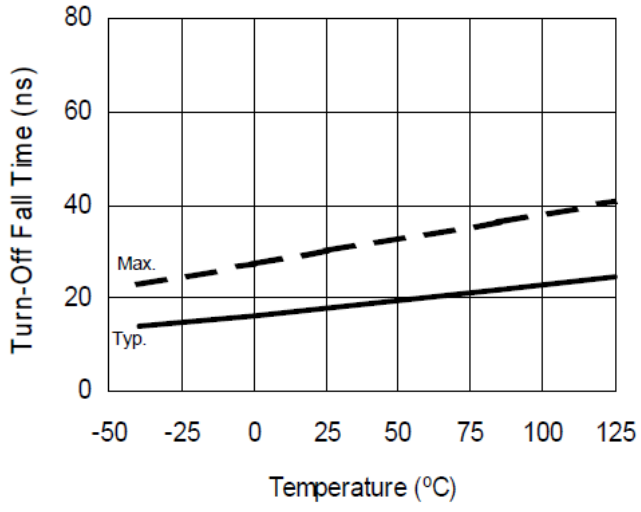


Figure 7A. Turn-Off Fall Time vs. Temperature

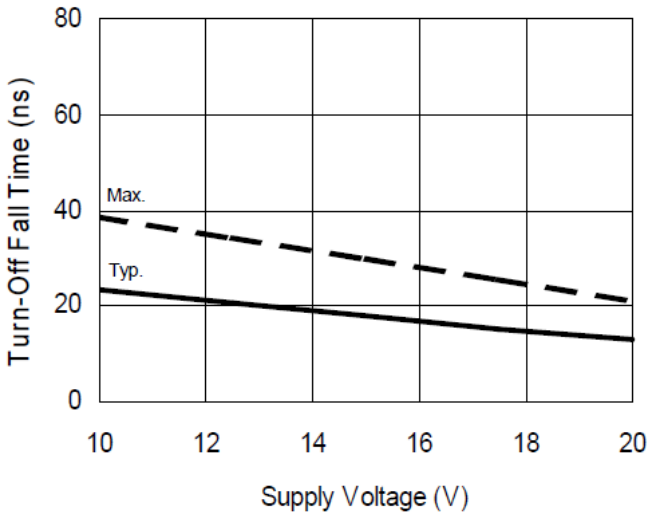


Figure 7B. Turn-Off Fall Time vs. Supply Voltage

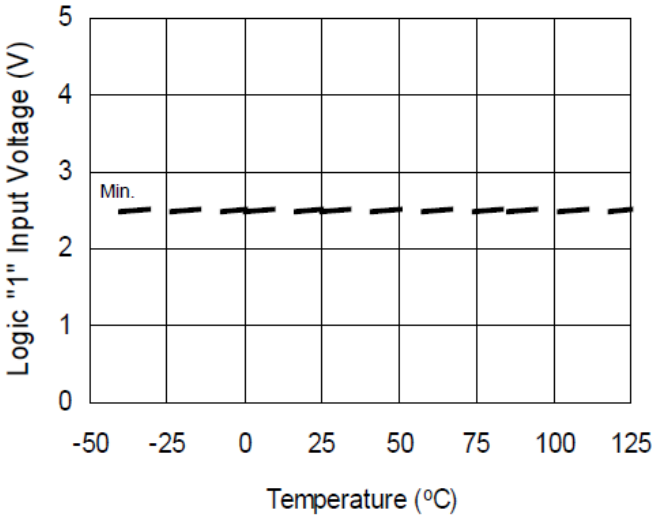


Figure 8A. Logic "1" Input Voltage vs. Temperature

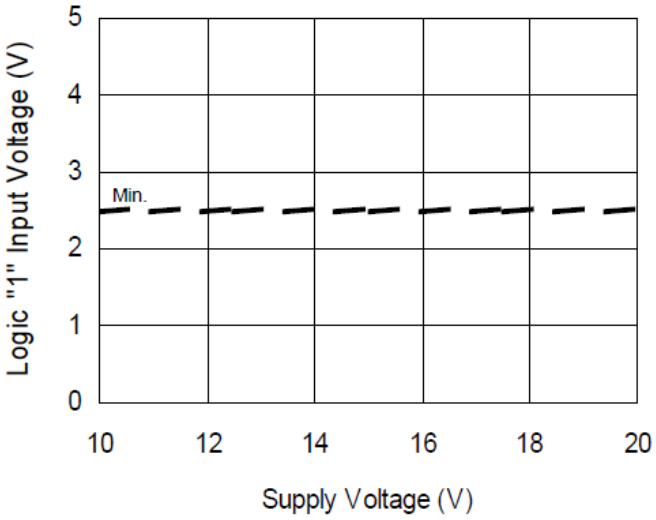


Figure 8B. Logic "1" Input Voltage vs. Supply Voltage

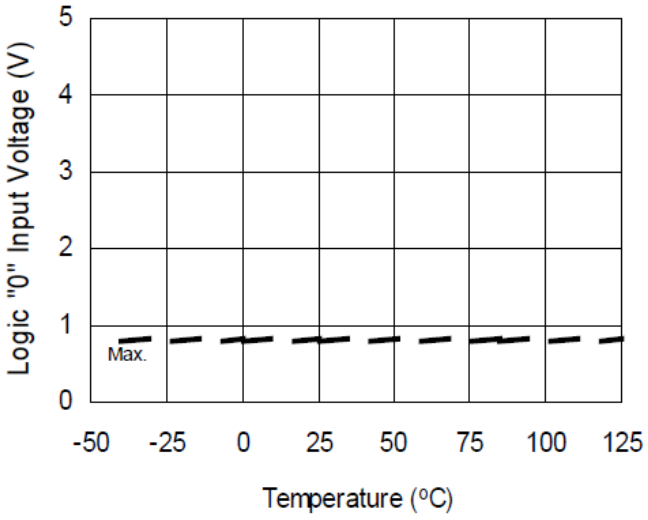


Figure 9A. Logic "0" Input Voltage vs. Temperature

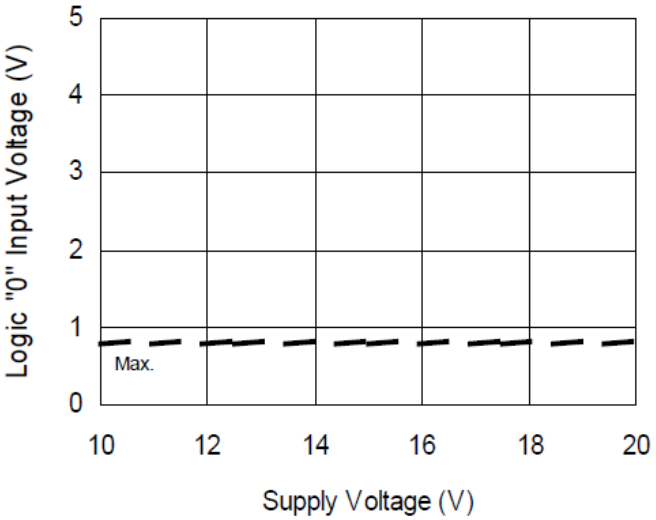


Figure 9B. Logic "0" Input Voltage vs. Supply Voltage

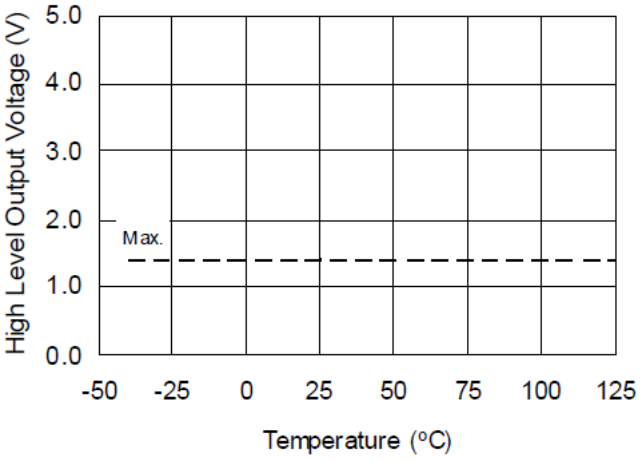


Figure 10A. High Level Output Voltage vs. Temperature (Io = 0mA)

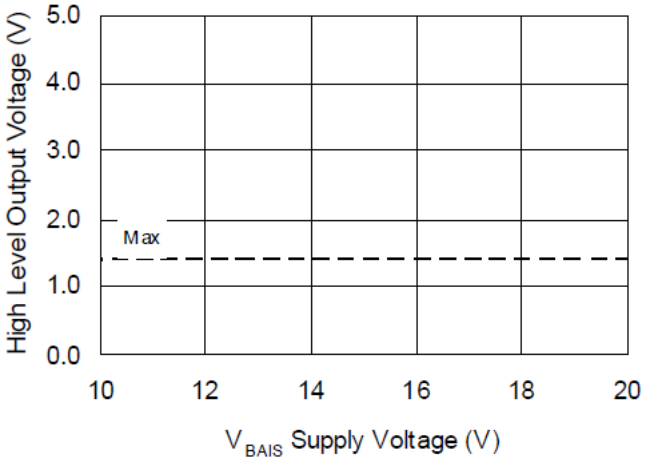


Figure 10B. High Level Output Voltage vs. Supply Voltage (Io = 0mA)

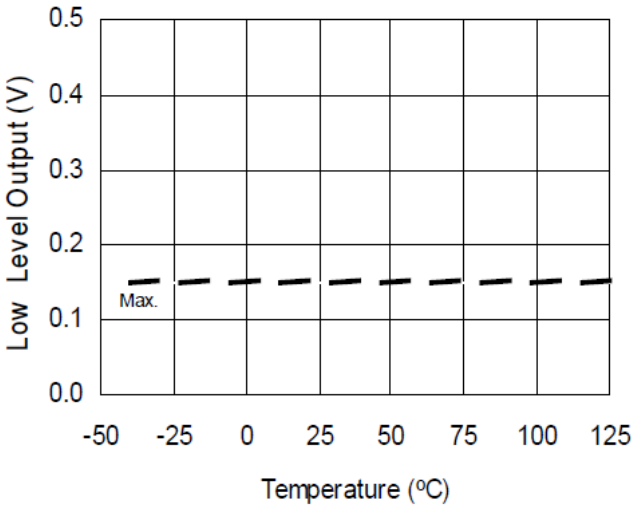


Figure 11A. Low Level Output vs. Temperature

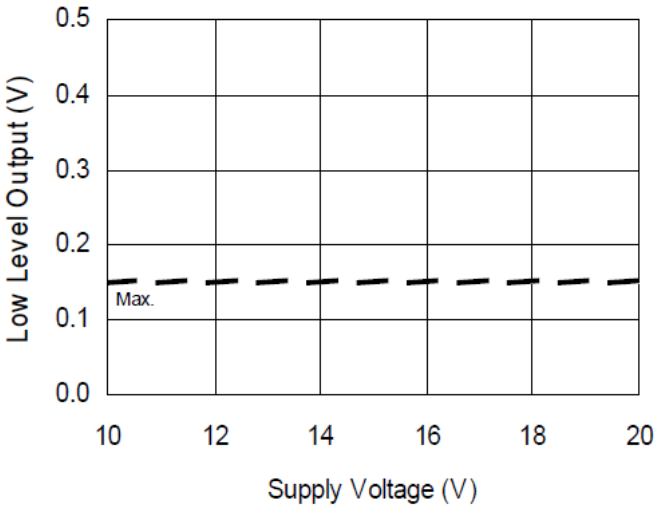


Figure 11B. Low Level Output vs. Supply Voltage

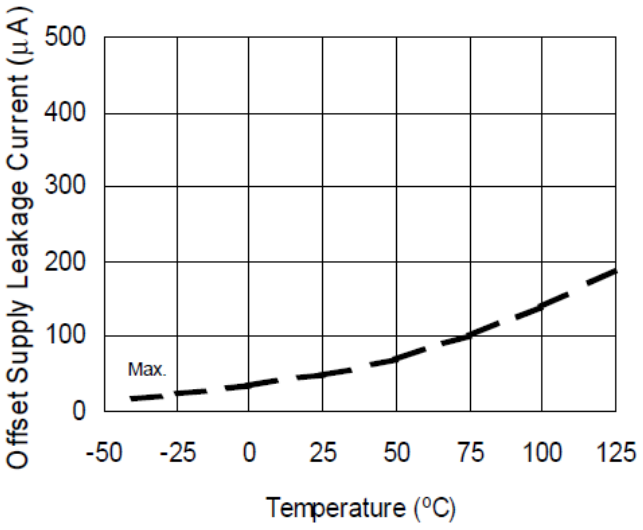


Figure 12A. Offset Supply Leakage Current

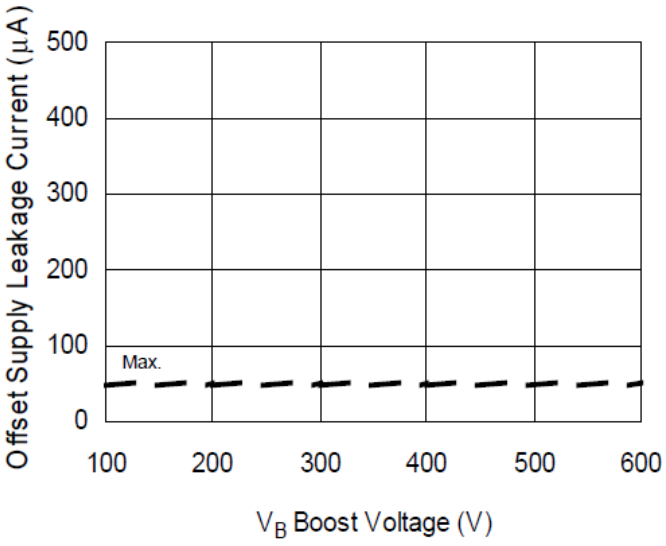


Figure 12B. Offset Supply Leakage Current vs. V_B Boost Voltage

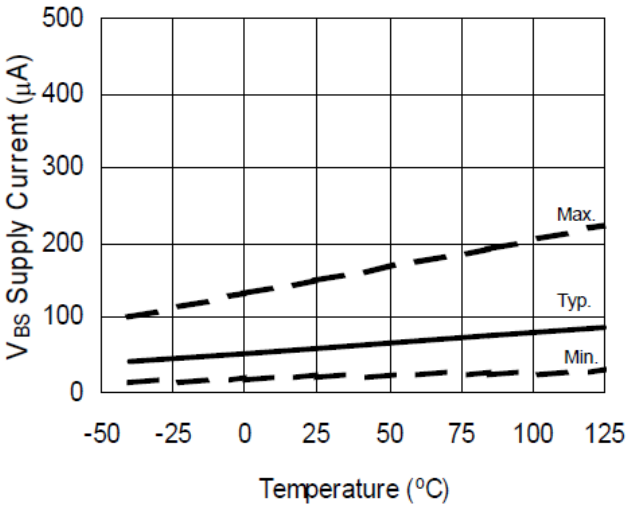


Figure 13A. V_{BS} Supply Current vs. Temperature

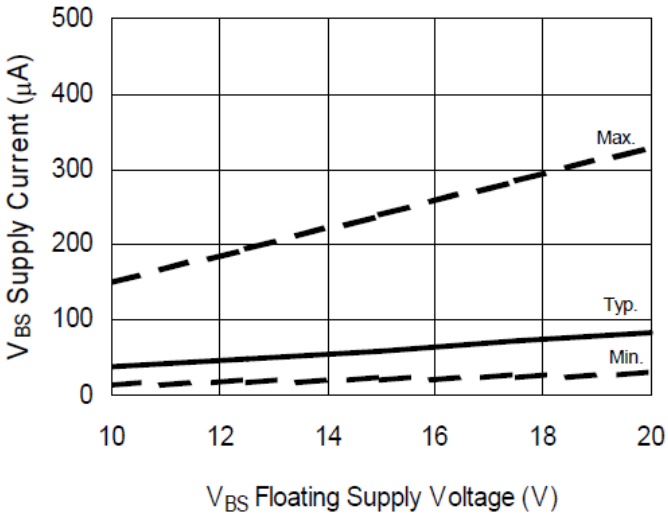


Figure 13B. V_{BS} Supply Current vs. V_{BS} Floating Supply Voltage

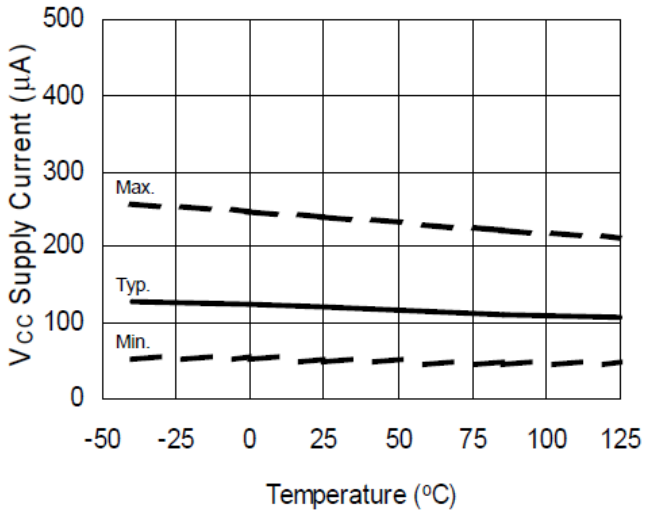


Figure 14A. V_{CC} Supply Current vs. Temperature

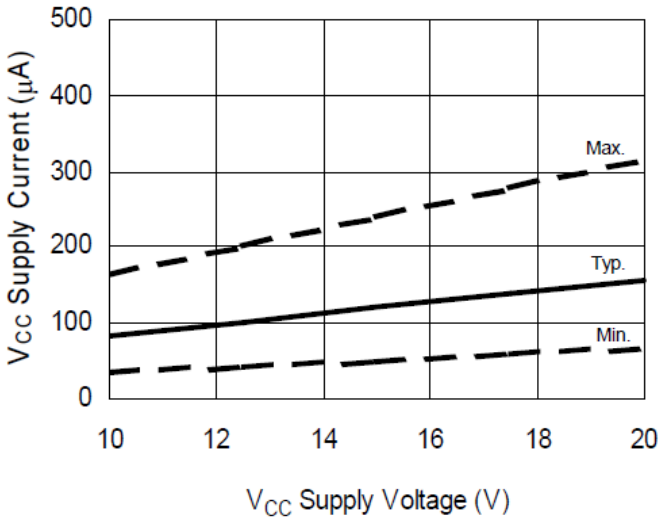


Figure 14B. V_{CC} Supply Current vs. Supply Voltage

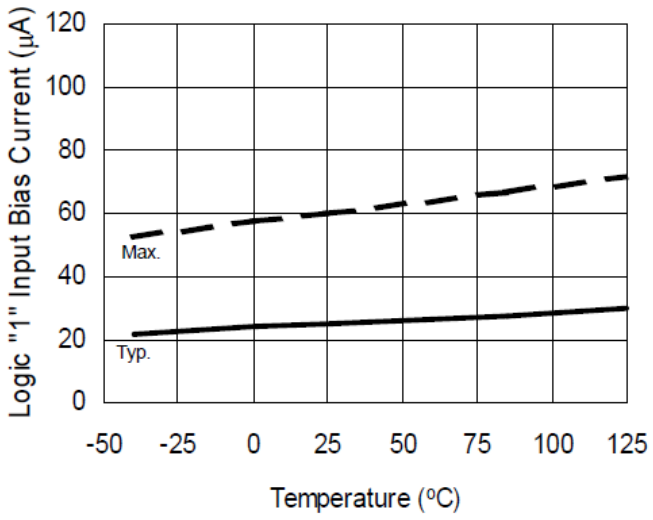


Figure 15A. Logic "1" Input Bias Current vs. Temperature

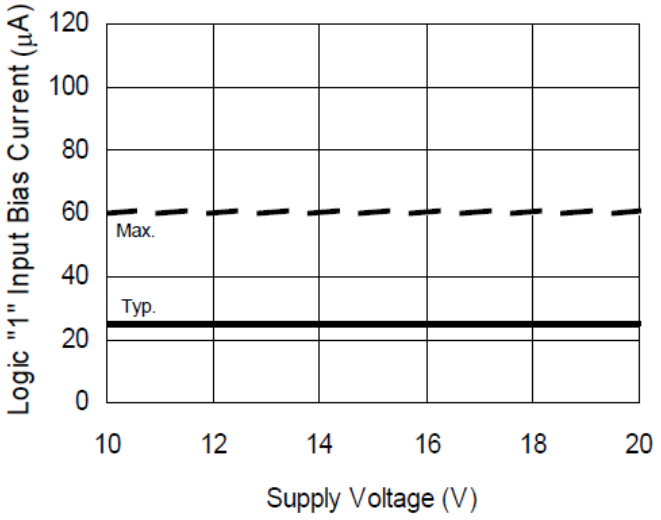


Figure 15B. Logic "1" Input Bias Current vs. Supply Voltage

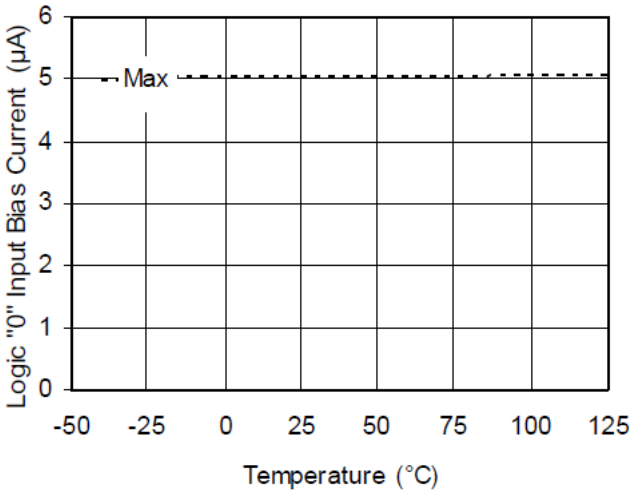


Figure 16A. Logic "0" Input Bias Current vs. Temperature

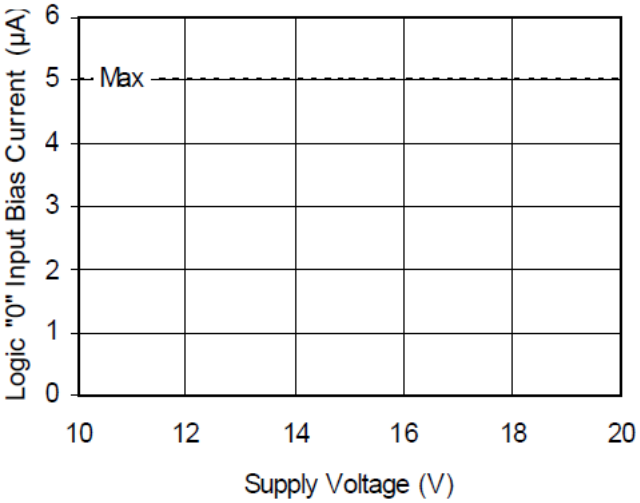


Figure 16B. Logic "0" Input Bias Current vs. Voltage

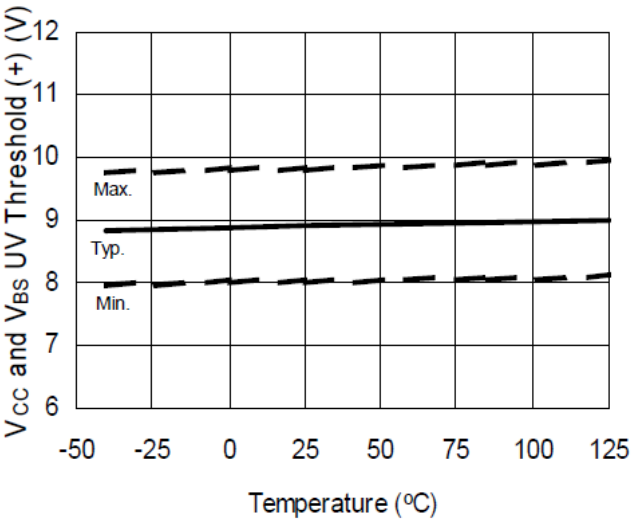


Figure 17. V_{CC} and V_{BS} Undervoltage Threshold (+) vs. Temperature

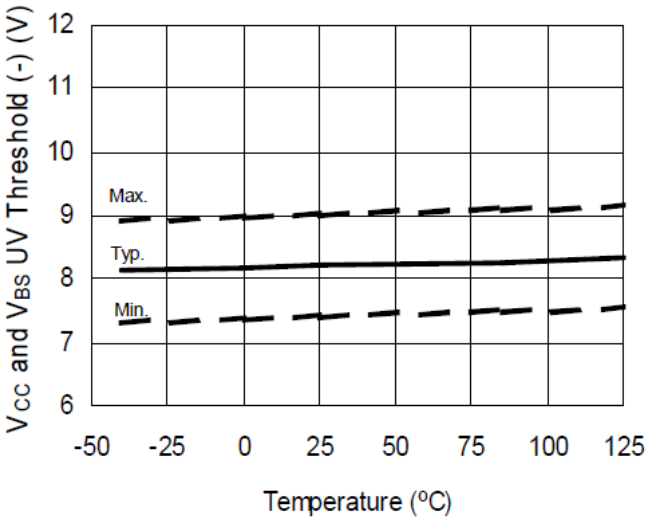


Figure 18. V_{CC} and V_{BS} Undervoltage Threshold (-) vs. Temperature

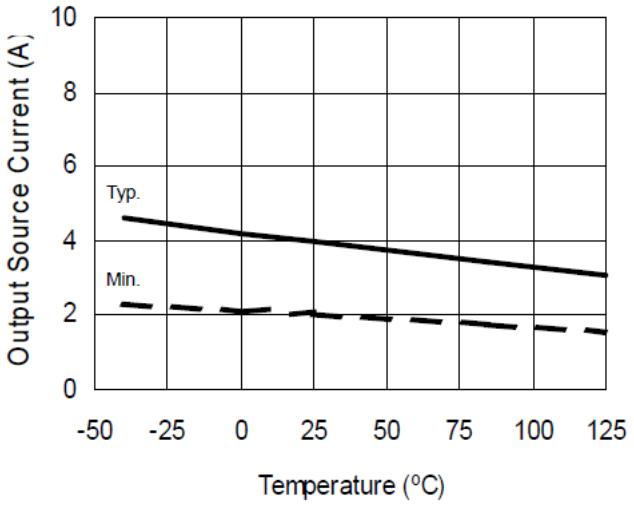


Figure 19A. Output Source Current vs. Temperature

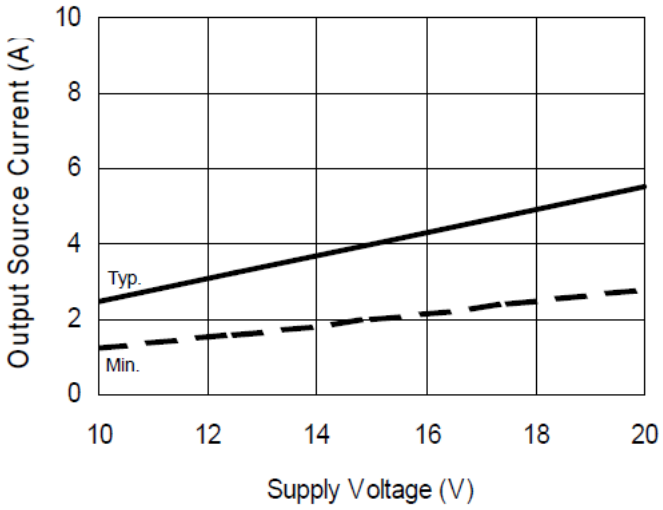


Figure 19B. Output Source Current vs. Supply Voltage

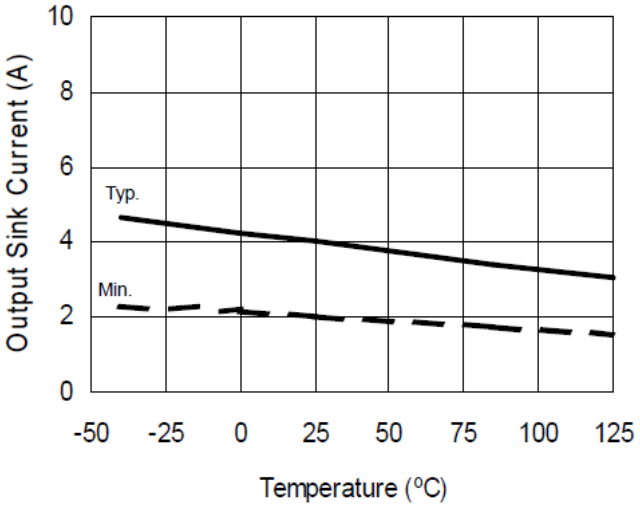


Figure 20A. Output Sink Current vs. Temperature

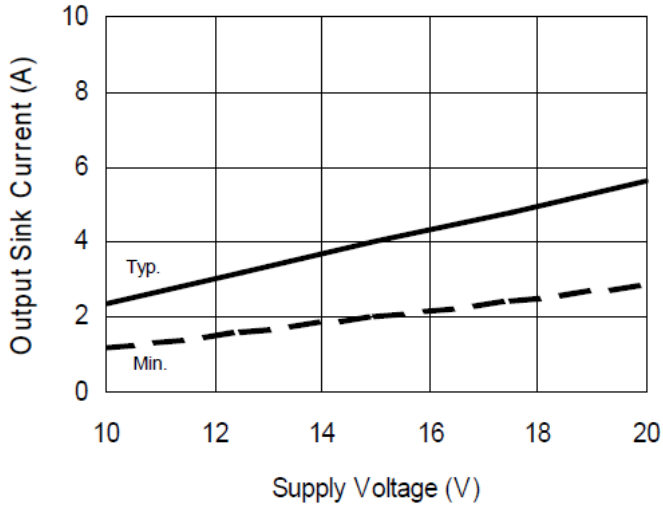


Figure 10B. Output Sink Current vs. Supply Voltage

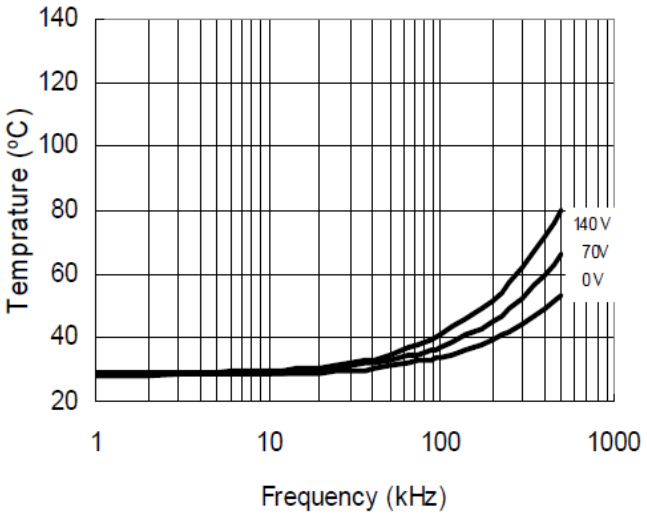


Figure 21. IRS2186 vs. Frequency (IRFBC20)
R_{gate} = 33Ω, V_{CC} = 15V

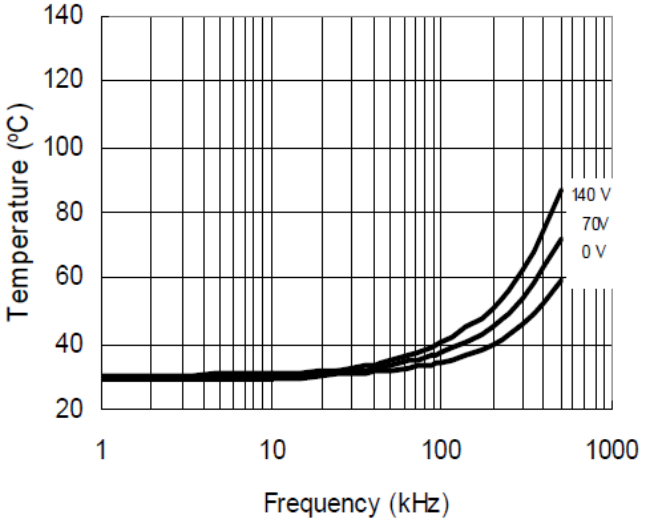


Figure 22. IRS2186 vs. Frequency (IRFBC30)
R_{gate} = 22Ω, V_{CC} = 15V

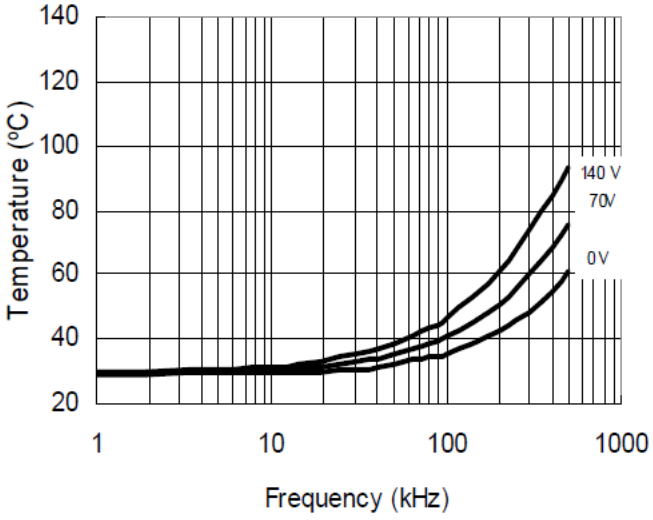


Figure 23. IRS2186 vs. Frequency (IRFBC40)
R_{gate} = 15Ω, V_{CC} = 15V

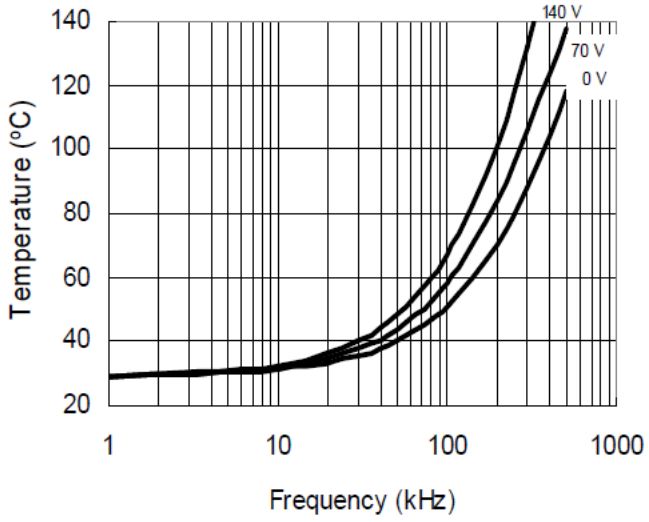


Figure 24. IRS2186 vs. Frequency (IRFPE50)
R_{gate} = 10Ω, V_{CC} = 15V

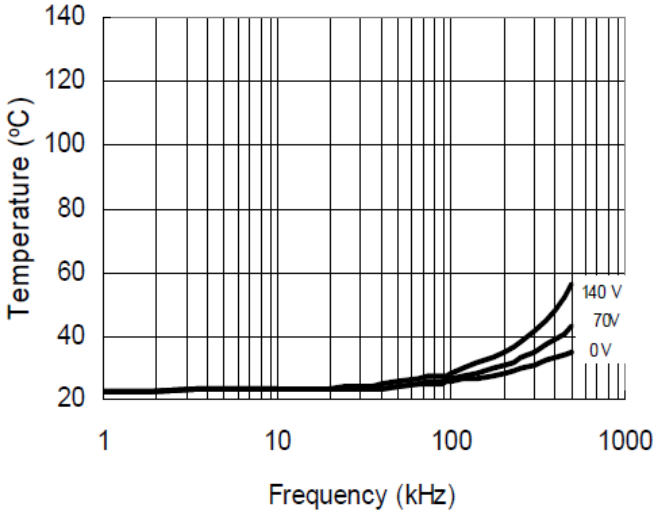


Figure 25. IRS21864 vs. Frequency (IRFBC20)
R_{gate} = 33Ω, V_{CC} = 15V

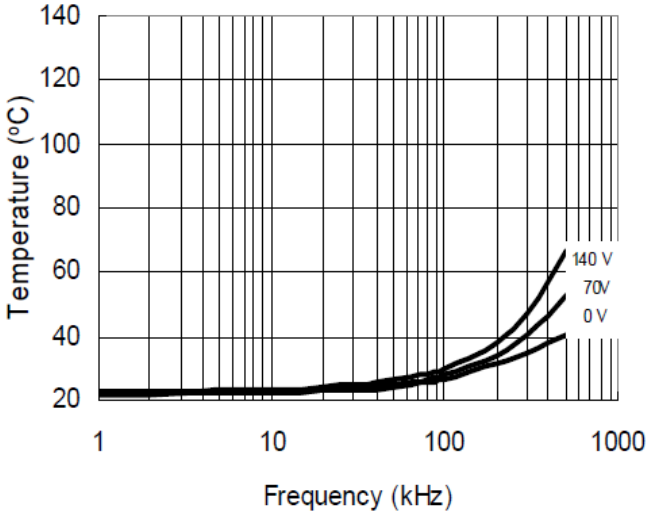


Figure 26. IRS21864 vs. Frequency (IRFBC30)
R_{gate} = 22Ω, V_{CC} = 15V

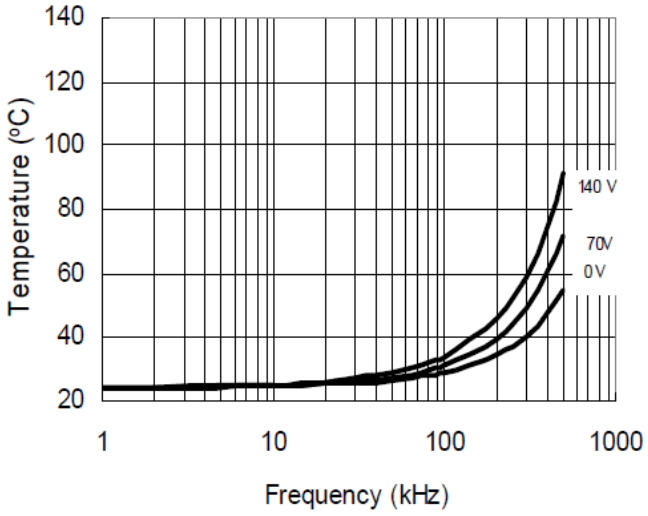


Figure 27. IRS21864 vs. Frequency (IRFBC40)
R_{gate} = 15Ω, V_{CC} = 15V

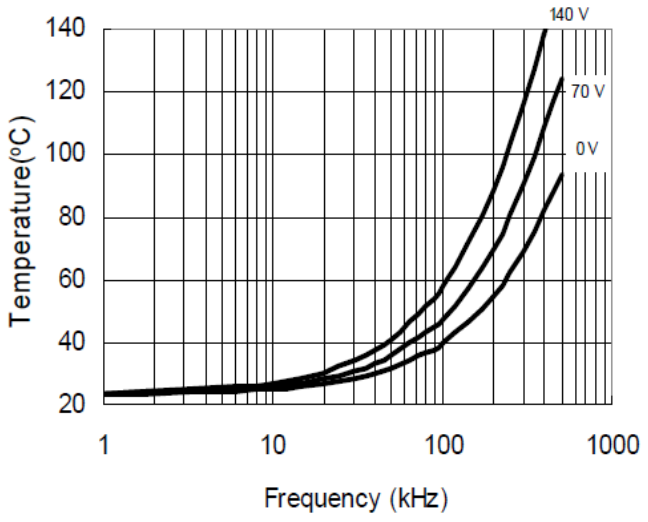


Figure 28. IRS21864 vs. Frequency (IRFPE50)
R_{gate} = 10Ω, V_{CC} = 15V

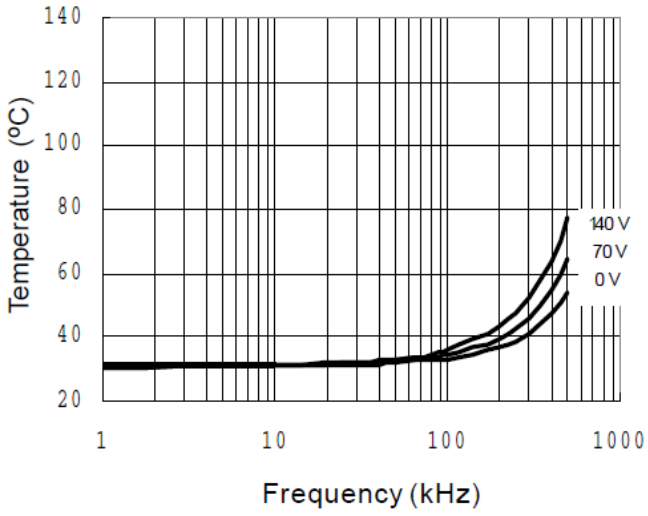


Figure 29. IRS2186S vs. Frequency (IRFBC20)
R_{gate} = 33Ω, V_{CC} = 15V

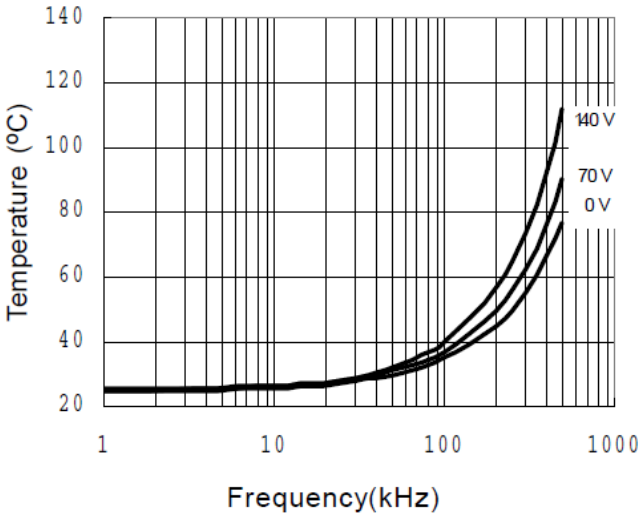


Figure 30. IRS2186S vs. Frequency (IRFBC30)
R_{gate} = 22Ω, V_{CC} = 15V

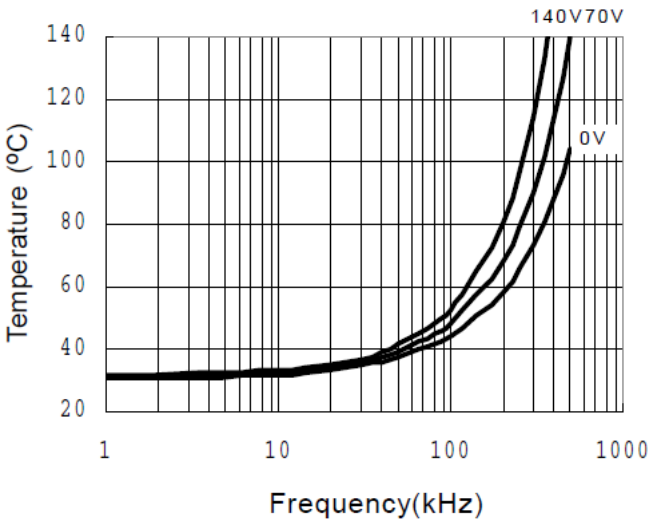


Figure 31. IRS2186S vs. Frequency (IRFBC40)
R_{gate} = 15Ω, V_{CC} = 15V

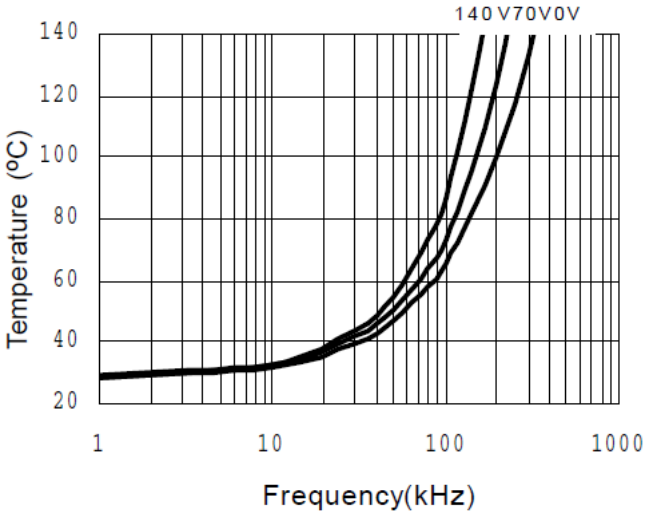


Figure 32. IRS2186S vs. Frequency (IRFPE50)
R_{gate} = 10Ω, V_{CC} = 15V

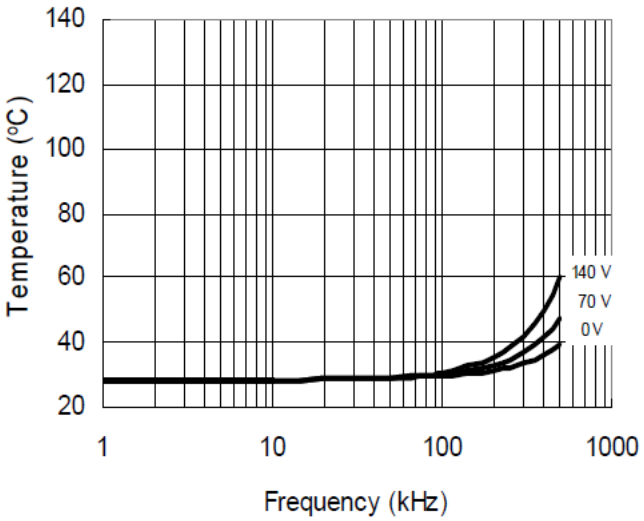


Figure 33. IRS21864S vs. Frequency (IRFBC20)
R_{gate} = 33Ω, V_{CC} = 15V

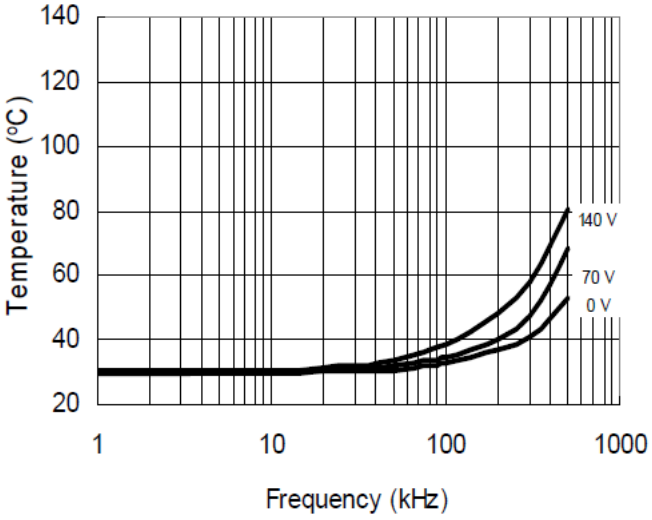


Figure 34. IRS21864S vs. Frequency (IRFBC30)
R_{gate} = 22Ω, V_{CC} = 15V

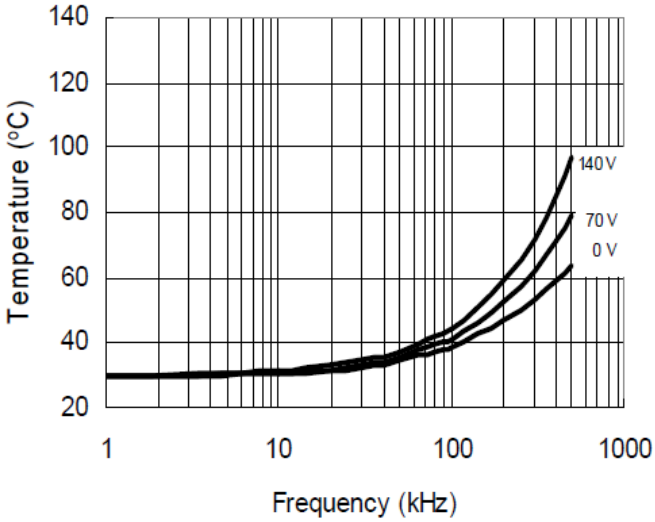


Figure 35. IRS21864S vs. Frequency (IRFBC40)
R_{gate} = 15Ω, V_{CC} = 15V

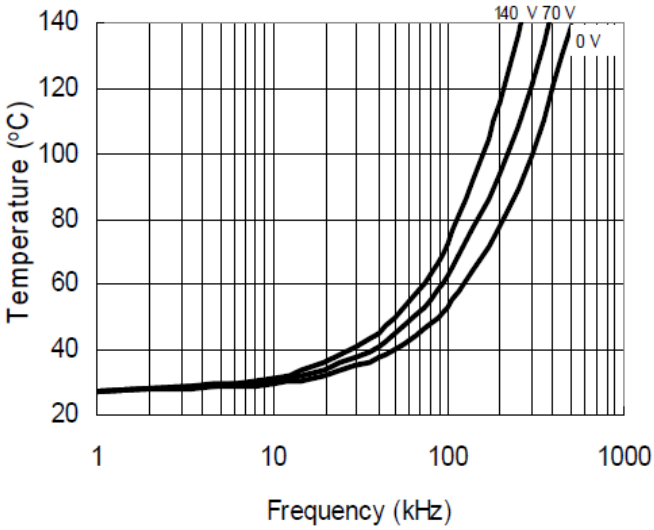
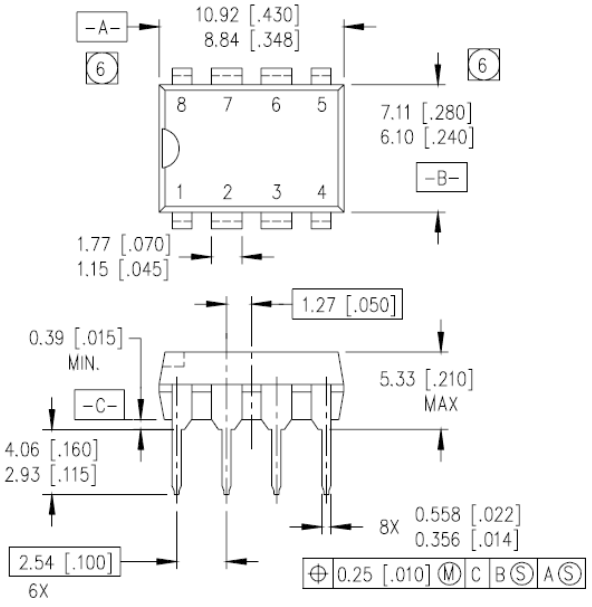
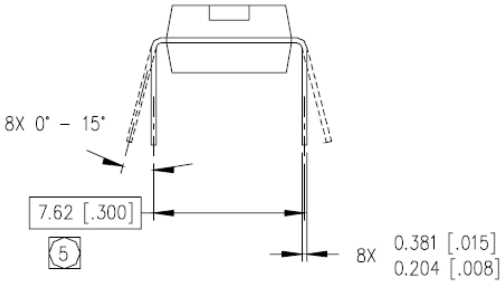


Figure 36. IRS21864S vs. Frequency (IRFPE50)
R_{gate} = 10Ω, V_{CC} = 15V

Package Details: PDIP8, SO8N

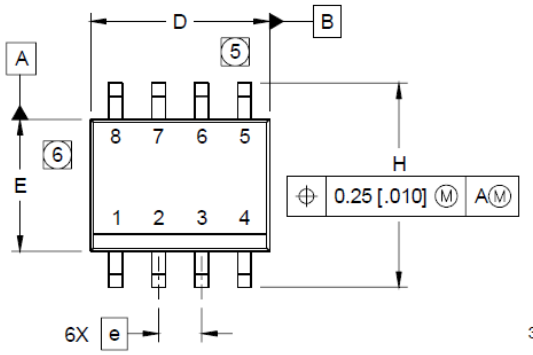


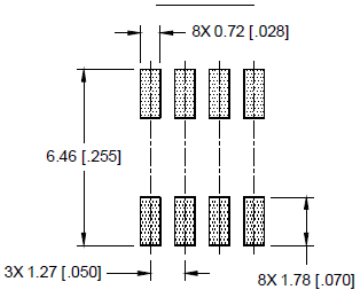
NOTES:
1. DIMENSIONING & TOLERANCING PER ANSI Y14.5M–1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE CONFORMS TO JEDEC OUTLINE MS–001AB.
5. MEASURED WITH THE LEADS CONSTRAINED TO BE PERPENDICULAR TO DATUM PLANE C.
6. DIMENSION DOES NOT INCLUDE MOLD PROTUSIONS. MOLD PROTUSIONS SHALL NOT EXCEED 0.25 [.010].



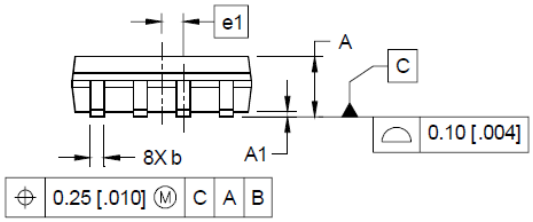
8-Lead PDIP

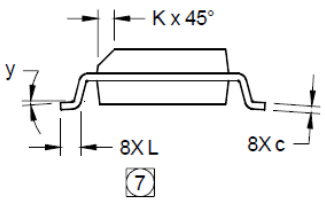
01-6014
01-3003 01 (MS-001AB)





DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.0532	.0688	1.35	1.75
A1	.0040	.0098	0.10	0.25
b	.013	.020	0.33	0.51
c	.0075	.0098	0.19	0.25
D	.189	.1968	4.80	5.00
E	.1497	.1574	3.80	4.00
e	.050 BASIC		1.27 BASIC	
e 1	.025 BASIC		0.635 BASIC	
H	.2284	.2440	5.80	6.20
K	.0099	.0196	0.25	0.50
L	.016	.050	0.40	1.27
y	0°	8°	0°	8°





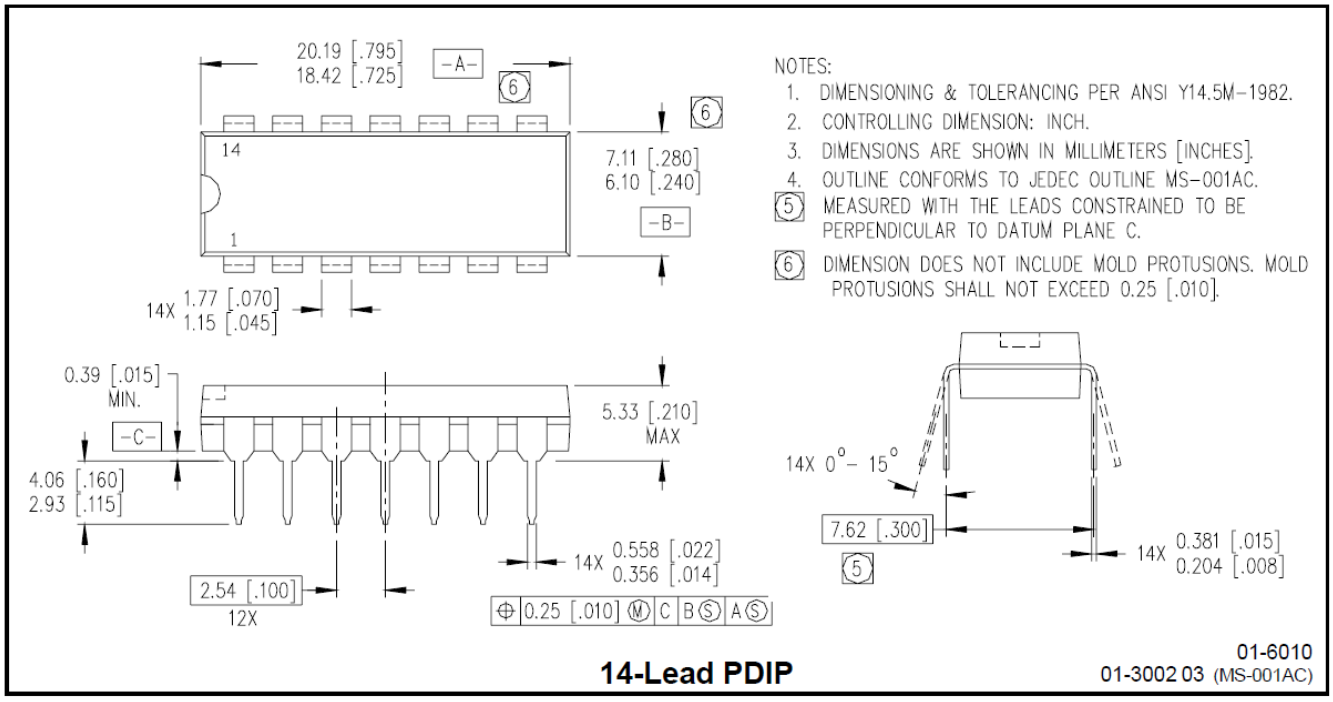
NOTES:
1. DIMENSIONING & TOLERANCING PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
4. OUTLINE CONFORMS TO JEDEC OUTLINE MS-012AA.

5. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.15 [.006].
6. DIMENSION DOES NOT INCLUDE MOLD PROTRUSIONS. MOLD PROTRUSIONS NOT TO EXCEED 0.25 [.010].
7. DIMENSION IS THE LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE.

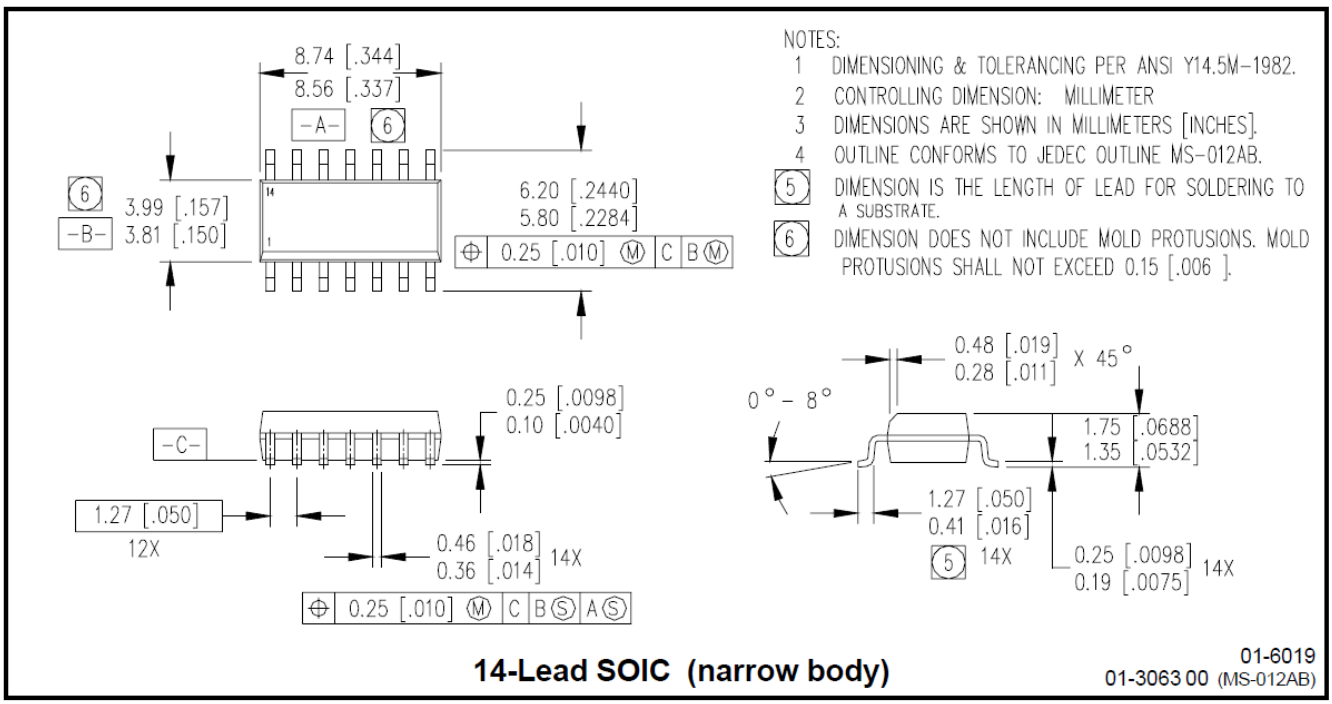
8-Lead SOIC

01-6027
01-0021 11 (MS-012AA)

Package Details: PDIP14, SO14N

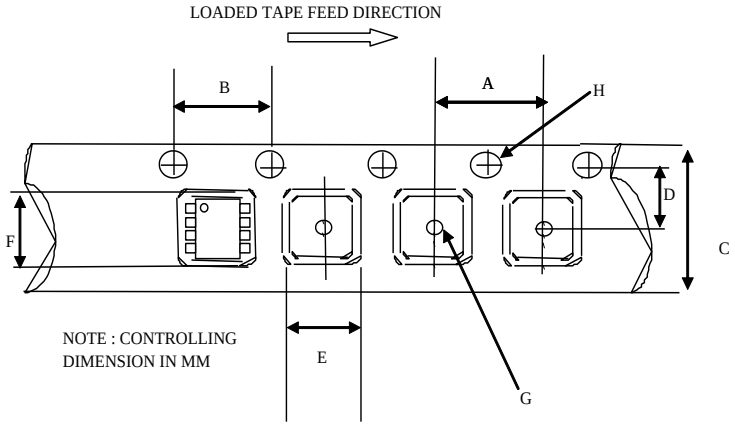


14-Lead PDIP 01-6010 01-3002 03 (MS-001AC)



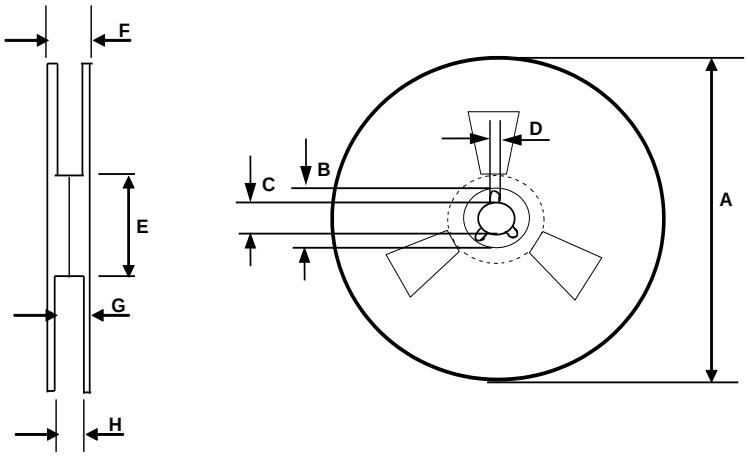
14-Lead SOIC (narrow body) 01-6019 01-3063 00 (MS-012AB)

Tape and Reel Details: SO8N



CARRIER TAPE DIMENSION FOR 8SOICN

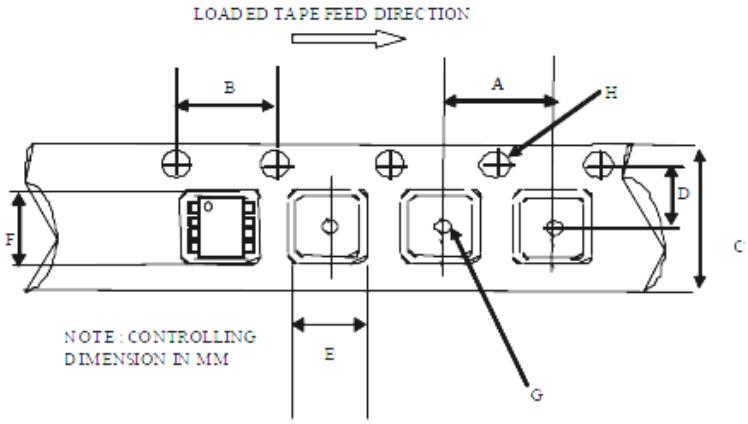
	Metric		Imperial	
Code	Min	Max	Min	Max
A	7.90	8.10	0.311	0.318
B	3.90	4.10	0.153	0.161
C	11.70	12.30	0.46	0.484
D	5.45	5.55	0.214	0.218
E	6.30	6.50	0.248	0.255
F	5.10	5.30	0.200	0.208
G	1.50	n/a	0.059	n/a
H	1.50	1.60	0.059	0.062



REEL DIMENSIONS FOR 8SOICN

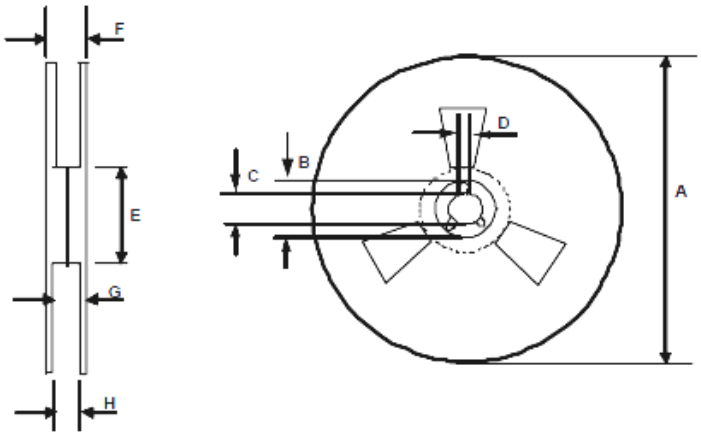
	Metric		Imperial	
Code	Min	Max	Min	Max
A	329.60	330.25	12.976	13.001
B	20.95	21.45	0.824	0.844
C	12.80	13.20	0.503	0.519
D	1.95	2.45	0.767	0.096
E	98.00	102.00	3.858	4.015
F	n/a	18.40	n/a	0.724
G	14.50	17.10	0.570	0.673
H	12.40	14.40	0.488	0.566

Tape and Reel Details: SO14N



CARRIER TAPE DIMENSION FOR 14SOICN

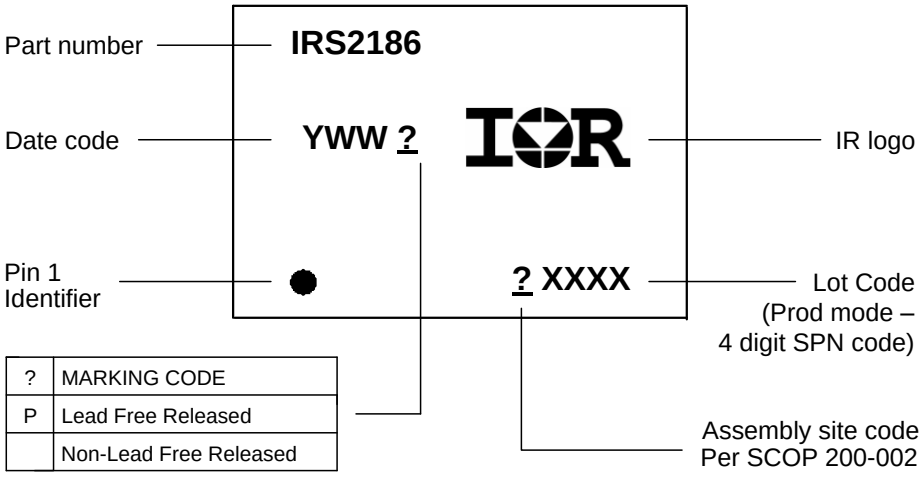
	Metric		Imperial	
Code	Min	Max	Min	Max
A	7.90	8.10	0.311	0.318
B 3	.90	4.10	0.153	0.161
C	15.70	16.30	0.618	0.641
D	7.40	7.60	0.291	0.299
E	6.40	6.60	0.252	0.260
F	9.40	9.60	0.370	0.378
G	1.50	n/a	0.059	n/a
H	1.50	1.60	0.059	0.062



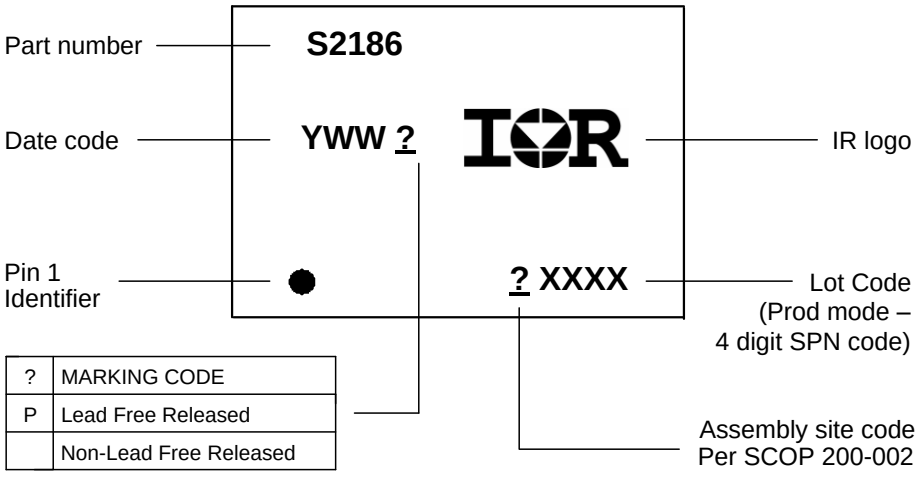
REEL DIMENSIONS FOR 14SOICN

	Metric		Imperial	
Code	Min	Max	Min	Max
A	329.60	330.25	12.976	13.001
B	20.95	21.45	0.824	0.844
C	12.80	13.20	0.503	0.519
D	1.95	2.45	0.767	0.096
E	98.00	102.00	3.858	4.015
F	n/a	22.40	n/a	0.881
G	18.50	21.10	0.728	0.830
H	16.40	18.40	0.645	0.724

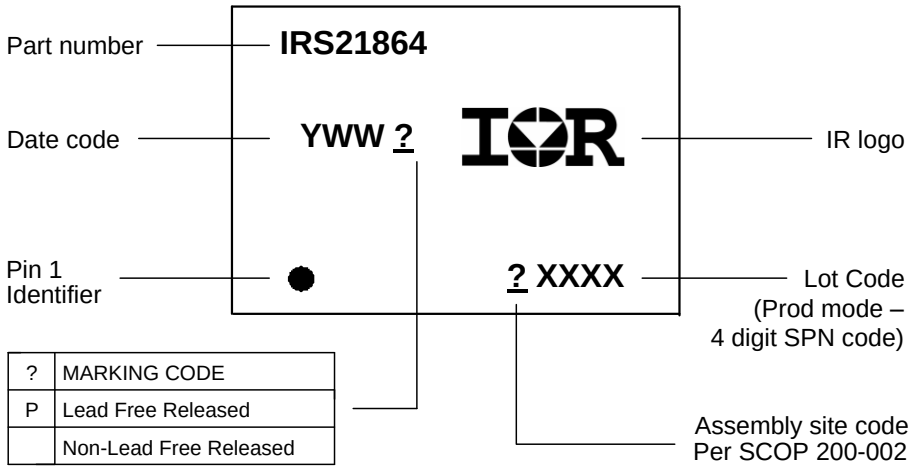
Part Marking Information



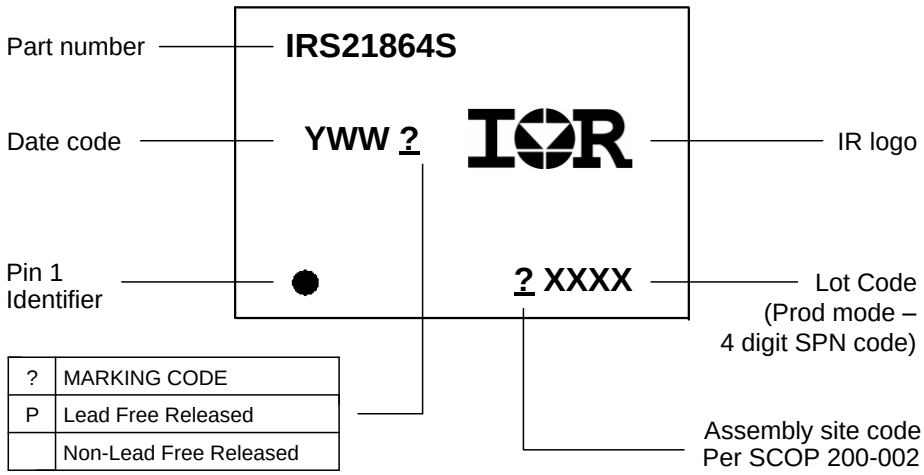
8-Lead PDIP



8-Lead SOIC



14-Lead PDIP



14-Lead SOIC

