

FMUN2211 THRU FMUN2241

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FMUN2211 THRU FMUN2241

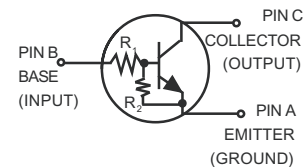
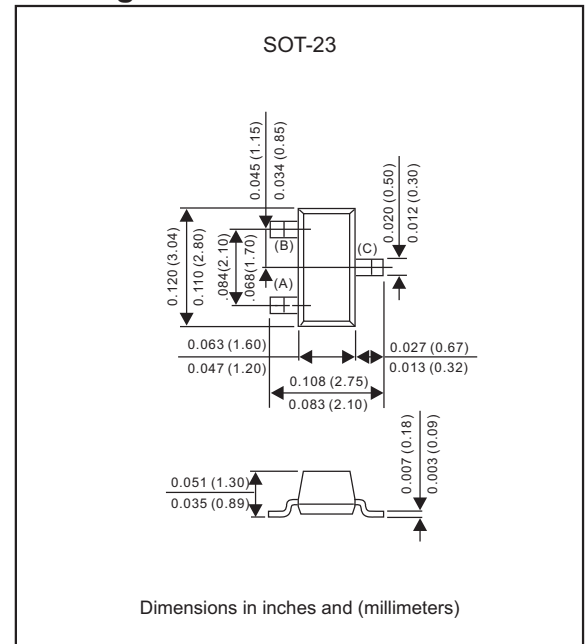
Bias Resistor Transistor
NPN Silicon Surface Mount Transistor
with Monolithic Bias Resistor Network

Features

- Simplifies Circuit Design.
- Reduces Board Space and Component Count.
- The SOT-23 package can be soldered using wave or reflow. The modified gull-winged leads absorb thermal stress during soldering eliminating the possibility of damage to the die.
- Lead-free parts for green partner, exceeds environmental standards of MIL-STD-19500 /228
- Suffix "-H" indicates Halogen-free part, ex.FMUN2211-H.

Mechanical data

- Epoxy:UL94-V0 rated flame retardant
- Case : Molded plastic, SOT-23
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026
- Mounting Position : Any
- Weight : Approximated 0.008 gram

Package outline**Maximum ratings** (AT $T_A=25^{\circ}\text{C}$ unless otherwise noted)

RATING	Symbol	Value	UNIT
Collector-Base voltage	V_{CBO}	50	V_{dc}
Collector-Emitter voltage	V_{CEO}	50	V_{dc}
Collector current	I_C	100	mA_{dc}
Total device dissipation FR-4 board $T_A = 25^{\circ}\text{C}$ (Note 1)	P_D	246	mW
Derate above 25°C		1.5	$^{\circ}\text{C/W}$

Thermal Characteristics

RATING	Symbol	Value	UNIT
Typical Thermal resistance Junction to ambient (Note 1)	$R_{\theta JA}$	508	$^{\circ}\text{C/W}$
Maximum Temperature for Soldering Purposes, Time in Solder Bath	T_L	260 10	$^{\circ}\text{C}$ Sec
Operating junction temperature range	T_J	-55 ~ +150	$^{\circ}\text{C}$
Storage temperature range	T_{STG}	-55 ~ +150	$^{\circ}\text{C}$

Note 1: Device mounted on a FR-4 glass epoxy printed circuit board using the minimum recommended footprint.

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Resistor Values

Device	R1(K)	R2(K)	Device	R1(K)	R2(K)
FMUN2211	10	10	FMUN2231	2.2	2.2
FMUN2212	22	22	FMUN2232	4.7	4.7
FMUN2213	47	47	FMUN2233	4.7	47
FMUN2214	10	47	FMUN2234	22	47
FMUN2215	10	∞	FMUN2235	2.2	47
FMUN2216	4.7	∞	FMUN2238	2.2	∞
FMUN2230	1.0	1.0	FMUN2241	100	∞

Electrical Characteristics (AT T_A=25°C unless otherwise noted)

Off Characteristics

Characteristic	Symbol	Min.	Typ.	Max.	UNIT
Collector-Base Cutoff Current $V_{CB} = 50V, I_E = 0$	I_{CBO}	-	-	100	nA _{dc}
Collector-Emitter Cutoff Current $V_{CE} = 50V, I_B = 0$	I_{CEO}	-	-	500	nA _{dc}
Emitter-Base Cutoff Current FMUN2211 $V_{EB} = 6.0V, I_C = 0$	I_{EBO}	-	-	0.5	mA _{dc}
FMUN2212		-	-	0.2	
FMUN2213		-	-	0.1	
FMUN2214		-	-	0.2	
FMUN2215		-	-	0.9	
FMUN2216		-	-	1.9	
FMUN2230		-	-	4.3	
FMUN2231		-	-	2.3	
FMUN2232		-	-	1.5	
FMUN2233		-	-	0.18	
FMUN2234		-	-	0.13	
FMUN2235		-	-	0.2	
FMUN2238		-	-	4.0	
FMUN2241		-	-	0.1	
Collector-Base Breakdown Voltage $I_C = 10\mu A, I_E = 0$	$V_{(BR)CBO}$	50	-	-	V _{dc}
Collector-Emitter Breakdown Voltage (2) $I_C = 2.0mA, I_B = 0$	$V_{(BR)CEO}$	50	-	-	V _{dc}

On Characteristics(2)

Characteristic	Symbol	Min.	Typ.	Max.	UNIT
DC Current Gain FMUN2211 $V_{CE}=10V, I_C=5.0mA$	h_{fe}	35	60	-	
FMUN2212		60	100	-	
FMUN2213		80	140	-	
FMUN2214		80	140	-	
FMUN2215		160	350	-	
FMUN2216		160	350	-	
FMUN2230		3.0	5.0	-	
FMUN2231		8.0	15	-	
FMUN2232		15	30	-	
FMUN2233		80	200	-	
FMUN2234		80	150	-	
FMUN2235		80	140	-	
FMUN2238		160	350	-	
FMUN2241		160	350	-	
Collector-Emitter Saturation Voltage $I_C=10mA, I_B=0.3mA$	$V_{CE(sat)}$	-	-	0.25	V _{dc}
FMUN2230/FMUN2231 $I_C=10mA, I_B=5.0mA$					
FMUN2215/FMUN2216/FMUN2232 $I_C=10mA, I_B=1.0mA$					
FMUN2233/FMUN2234/FMUN2235					
FMUN2238					

2. Pulse Test: Pulse Width <300us, Duty Cycle <2.0%

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Electrical Characteristics (AT $T_A=25^{\circ}\text{C}$ unless otherwise noted)(Continued)

Off Characteristics(3)

Characteristic			Symbol	Min.	Typ.	Max.	UNIT
Output Voltage (on)	FMUN2211	V _{CC} =5.0V, V _B =2.5V, R _L =1kΩ	V _{OL}	-	-	0.2	V _{dc}
	FMUN2212			-	-	0.2	
	FMUN2214			-	-	0.2	
	FMUN2215			-	-	0.2	
	FMUN2216			-	-	0.2	
	FMUN2230			-	-	0.2	
	FMUN2231			-	-	0.2	
	FMUN2232			-	-	0.2	
	FMUN2233			-	-	0.2	
	FMUN2234			-	-	0.2	
	FMUN2235	-		-	0.2		
	FMUN2238	-		-	0.2		
	FMUN2213	V _{CC} =5.0V, V _B =3.5V, R _L =1kΩ		-	-	0.2	
	FMUN2241	V _{CC} =5.0V, V _B =5.0V, R _L =1kΩ		-	-	0.2	
Output Voltage (off)		V _{CC} =5.0V, V _B =0.5V, R _L =1kΩ	V _{OH}	4.9	-	-	V _{dc}
	FMUN2230	V _{CC} =5.0V, V _B =0.05V, R _L =1kΩ					
	FMUN2215	V _{CC} =5.0V, V _B =0.25V, R _L =1kΩ					
	FMUN2216						
	FMUN2233						
	FMUN2238						
Input Resistor	FMUN2211		R1	7.0	10	13	kΩ
	FMUN2212			15.4	22	28.6	
	FMUN2213			32.9	47	61.1	
	FMUN2214			7.0	10	13	
	FMUN2215			7.0	10	13	
	FMUN2216			3.3	4.7	6.1	
	FMUN2230			0.7	1.0	1.3	
	FMUN2231			1.5	2.2	2.9	
	FMUN2232			3.3	4.7	6.1	
	FMUN2233			3.3	4.7	6.1	
	FMUN2234			15.4	22	28.6	
	FMUN2235			1.54	2.2	2.86	
	FMUN2238			1.54	2.2	2.86	
	FMUN2241			70	100	130	
	Resistor Ratio			FMUN2211/FMUN2212/FMUN2213	R1/R2	0.8	
FMUN2214		0.17	0.21	0.25			
FMUN2215/FMUN2216/FMUN2238		-	-	-			
FMUN2241		-	-	-			
FMUN2230/FMUN2231/FMUN2232		0.8	1.0	1.2			
FMUN2233		0.055	0.1	0.185			
FMUN2234		0.38	0.47	0.56			
FMUN2235		0.038	0.047	0.056			

3. Pulse Test: Pulse Width <300us, Duty Cycle <2.0%

Typical Electrical Characteristics (FMUN2211)

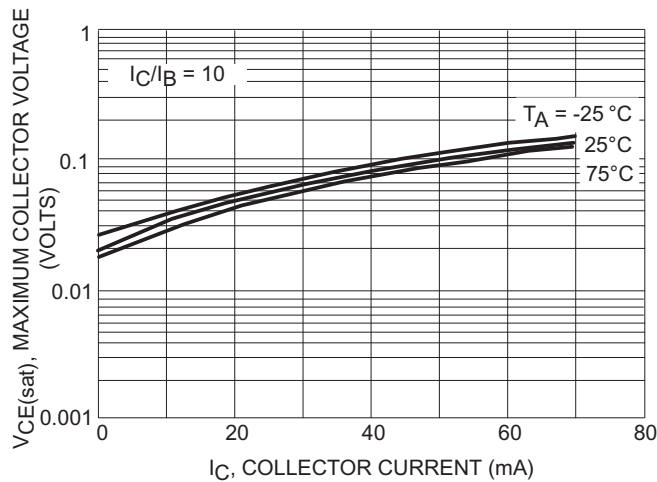
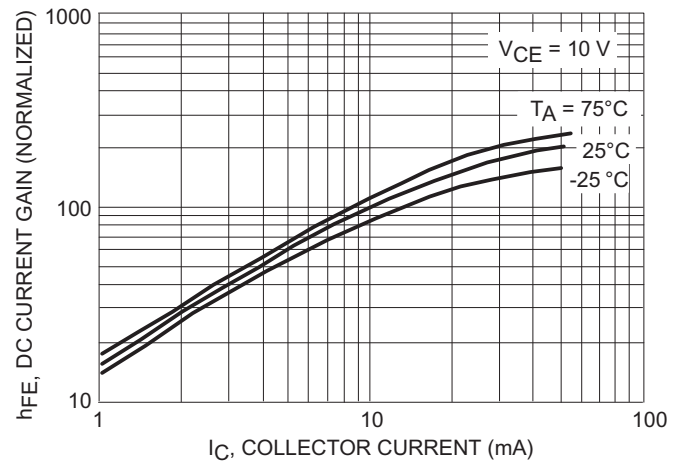
Figure 1. $V_{CE(sat)}$ vs. I_C 

Figure 2. DC Current Gain

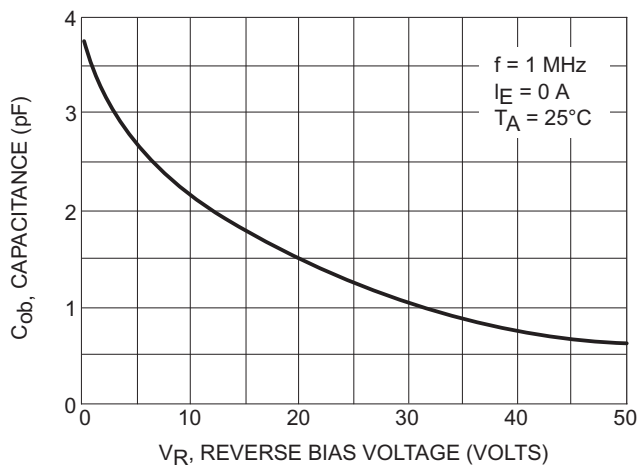


Figure 3. Output Capacitance

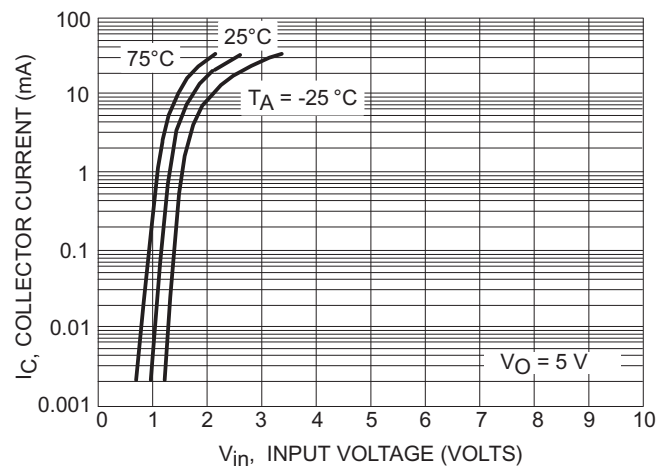


Figure 4. Output Current vs. Input Voltage

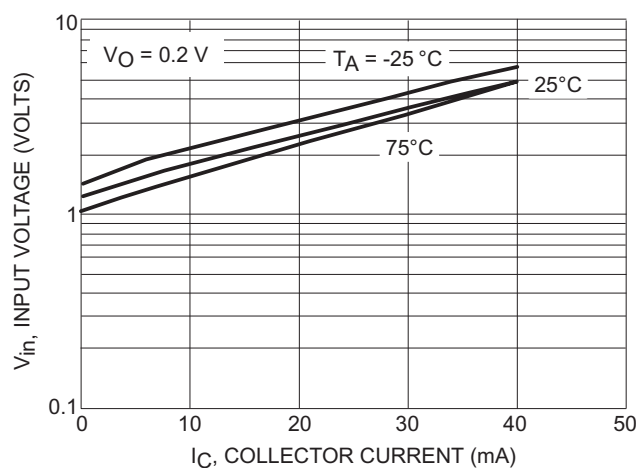


Figure 5. Input Voltage vs. Output Current

Typical Electrical Characteristics (FMUN2212)

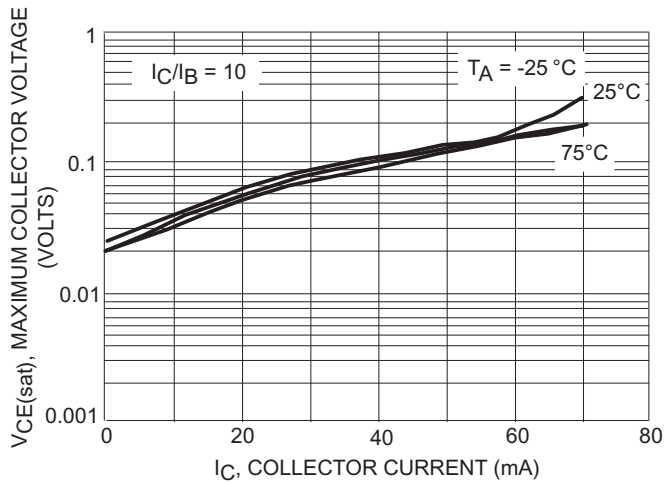
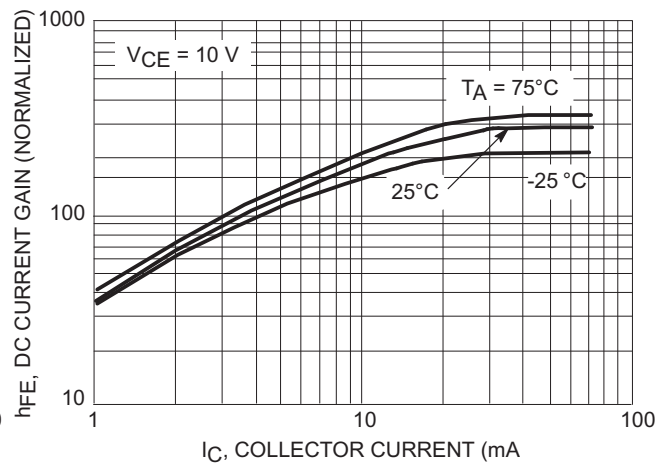
Figure 6. $V_{CE(sat)}$ vs. I_C 

Figure 7. DC Current Gain

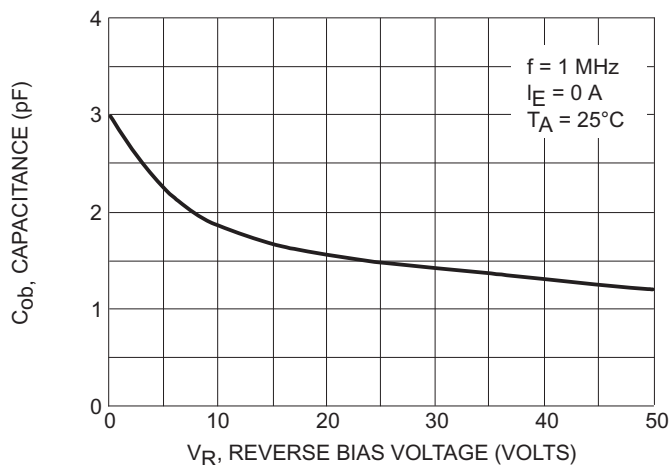


Figure 8. Output Capacitance

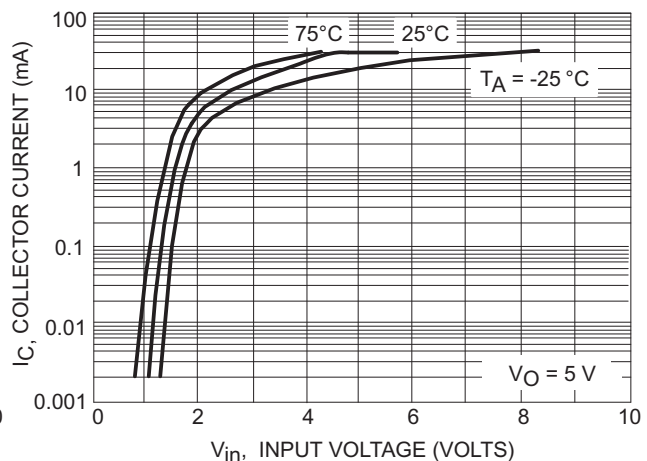


Figure 9. Output Current vs. Input Voltage

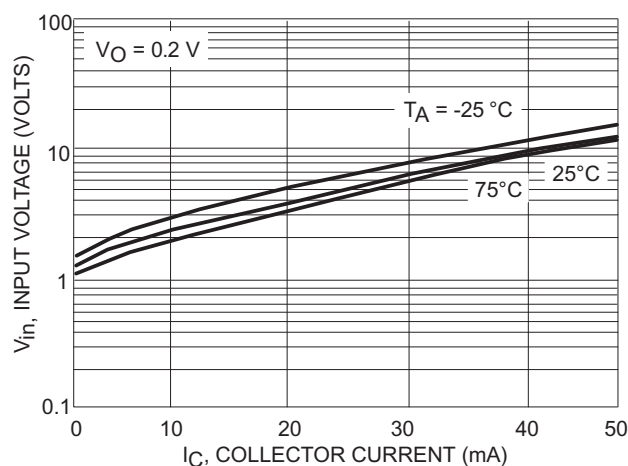


Figure 10. Input Voltage vs. Output Current

Typical Electrical Characteristics (FMUN2213)

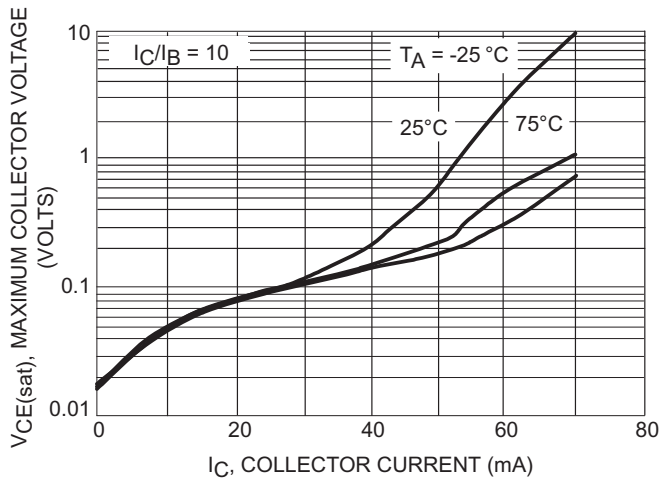
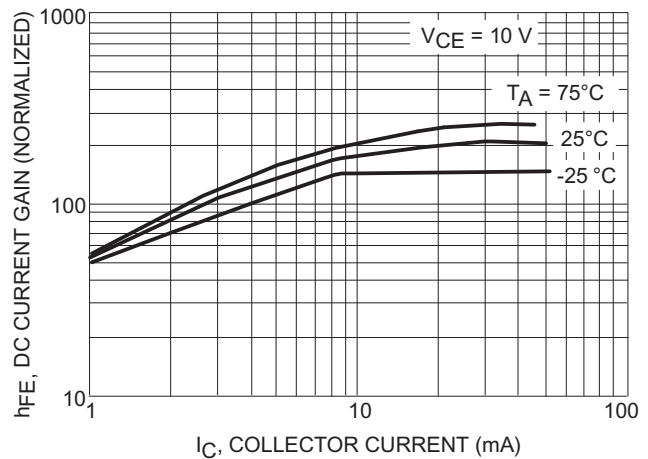
Figure 11. $V_{CE(sat)}$ vs. I_C 

Figure 12. DC Current Gain

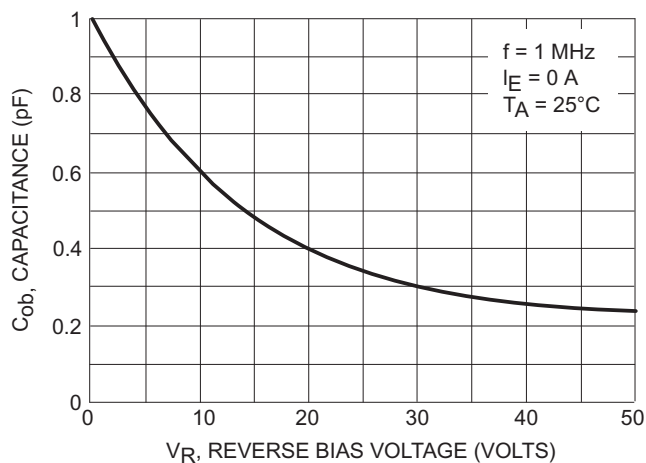


Figure 13. Output Capacitance

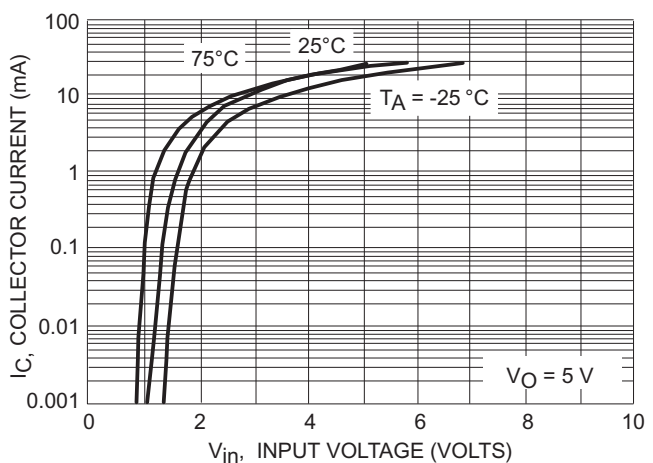


Figure 14. Output Current vs. Input Voltage

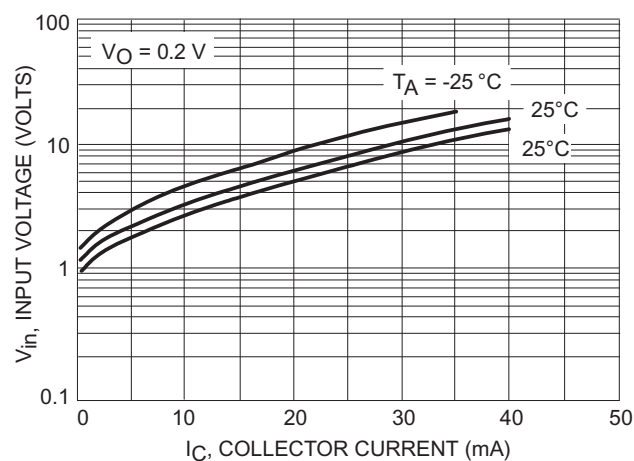


Figure 15. Input Voltage vs. Output Current

Typical Electrical Characteristics (FMUN2214)

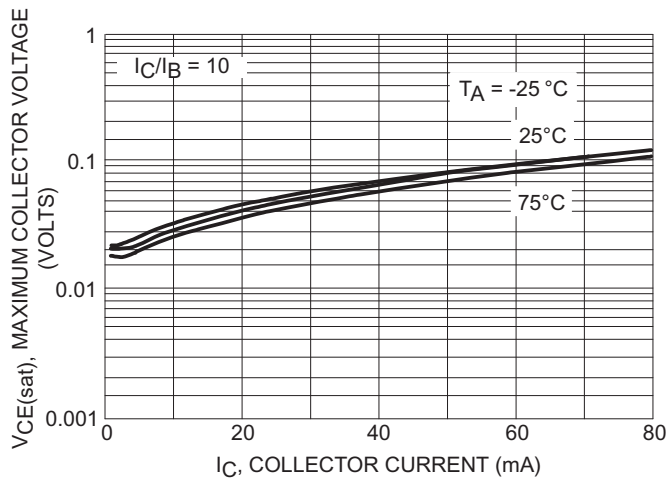
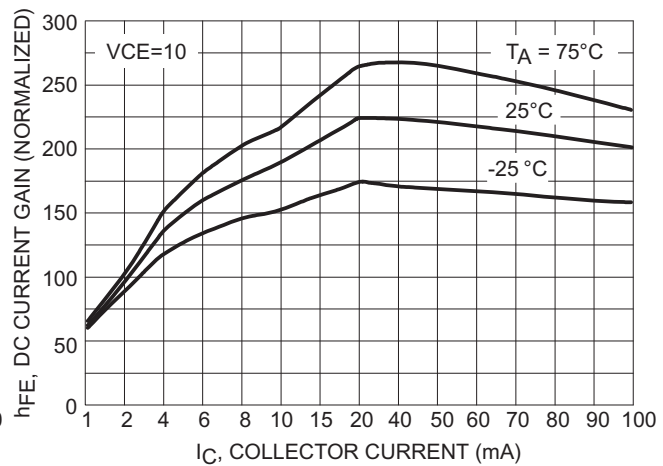
Figure 16. $V_{CE(sat)}$ vs. I_C 

Figure 17. DC Current Gain

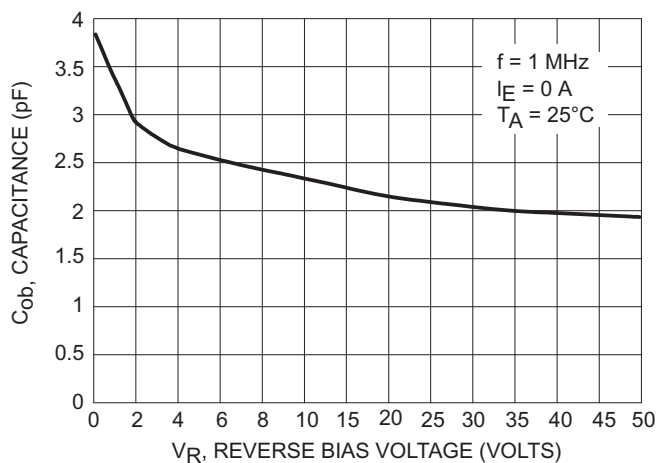


Figure 18. Output Capacitance

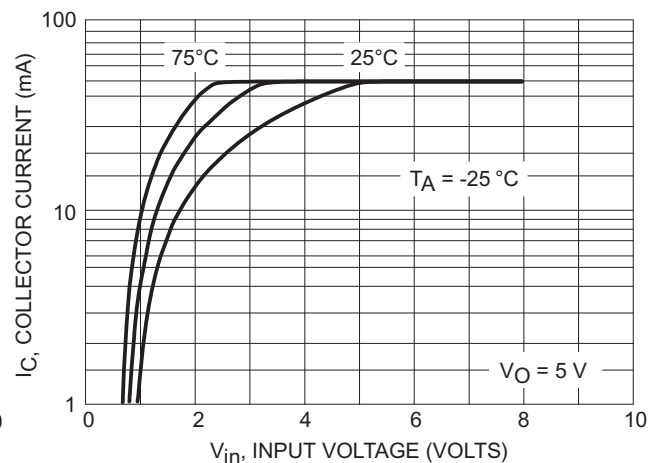


Figure 19. Output Current vs. Input Voltage

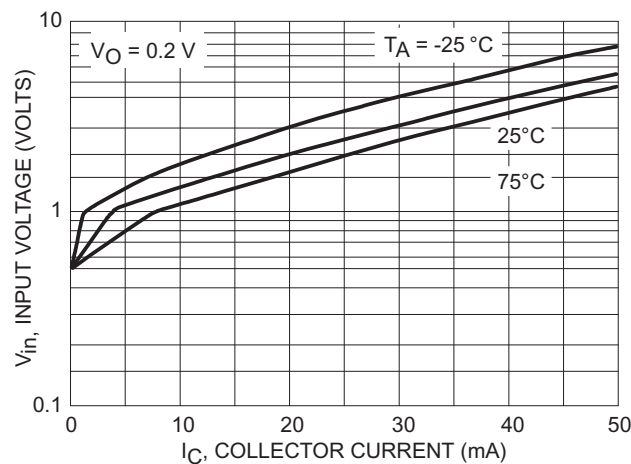


Figure 20. Input Voltage vs. Output Current

Typical Electrical Characteristics (FMUN2215)

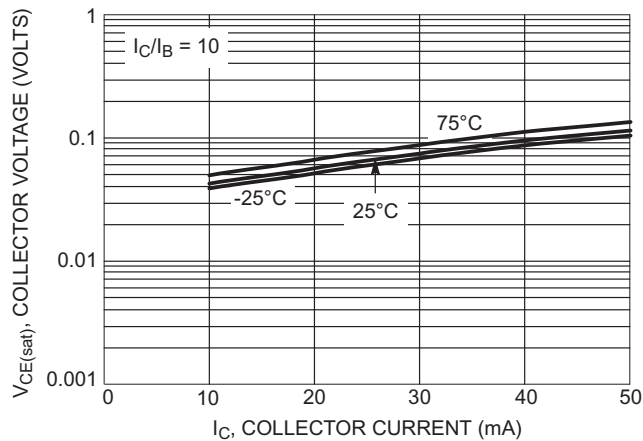
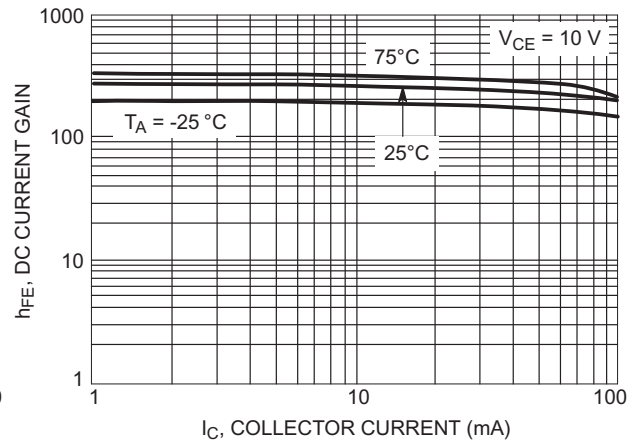
Figure 21. $V_{CE(sat)}$ versus I_C 

Figure 22. DC Current Gain

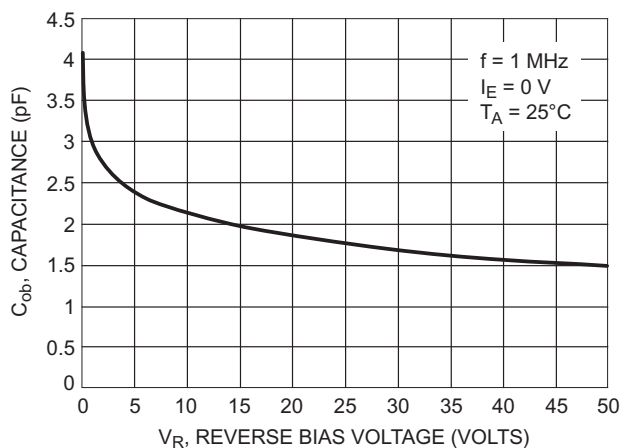


Figure 23. Output Capacitance

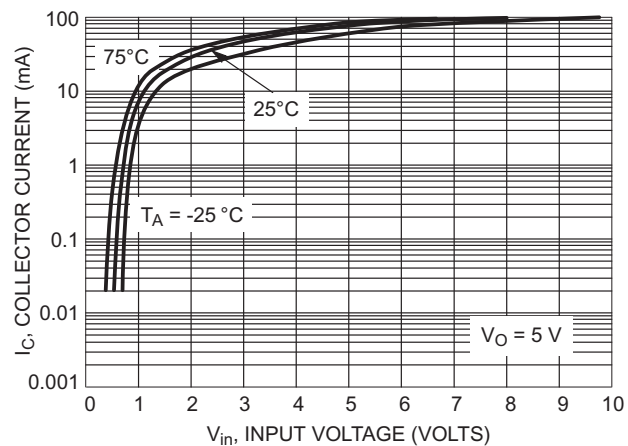


Figure 24. Output Current versus Input Voltage

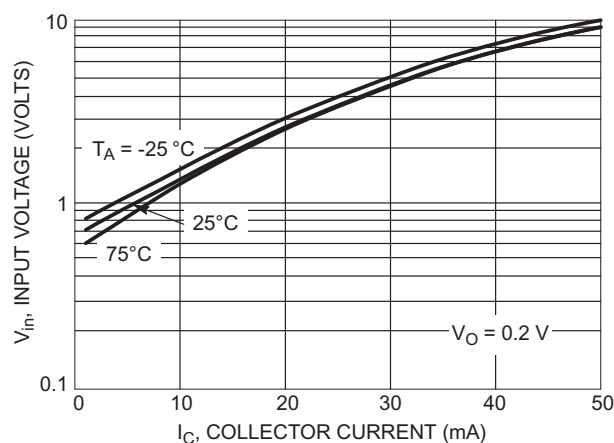


Figure 25. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN2216)

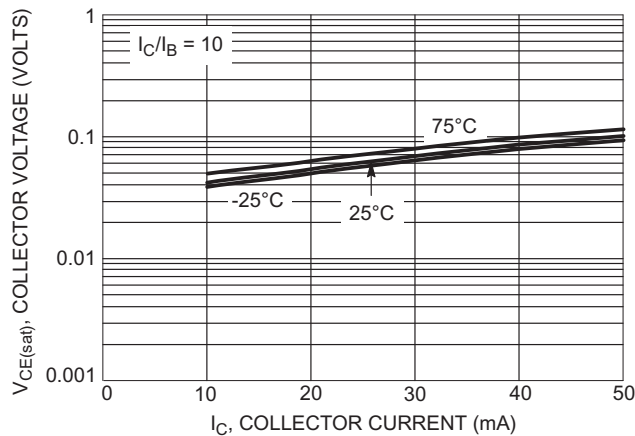
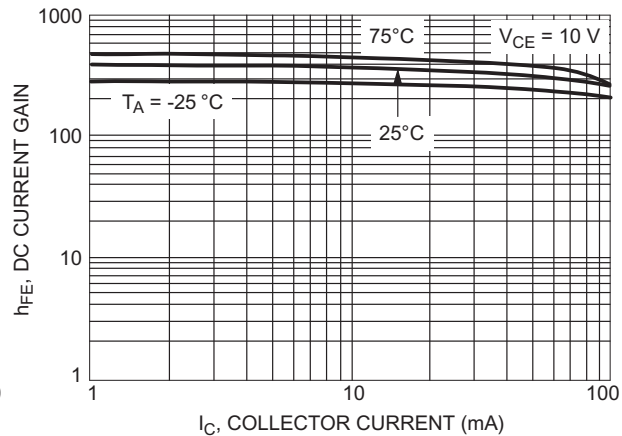
Figure 26. $V_{CE(sat)}$ versus I_C 

Figure 27. DC Current Gain

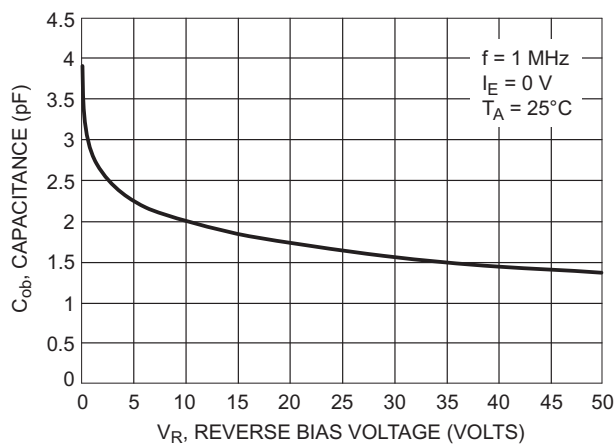


Figure 28. Output Capacitance

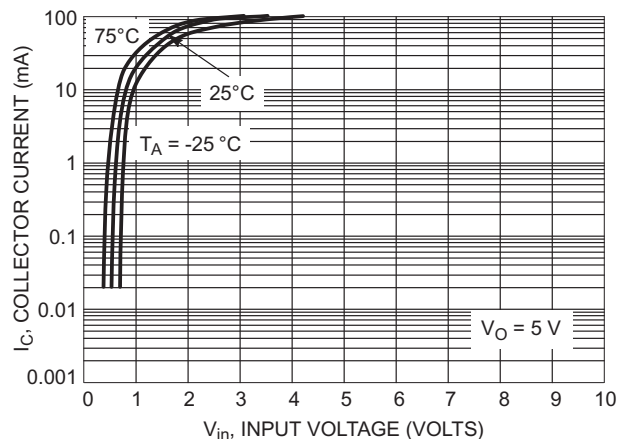


Figure 29. Output Current versus Input Voltage

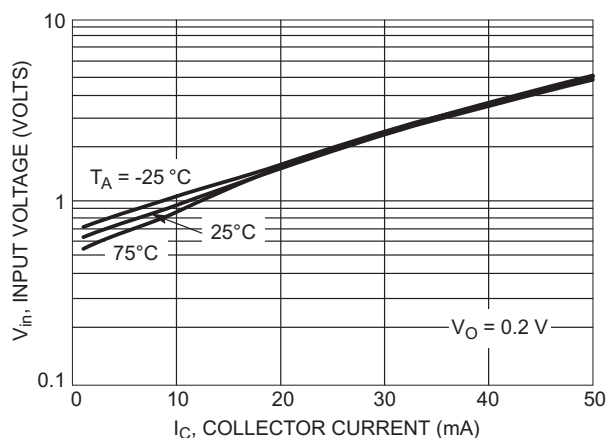


Figure 30. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN2230)

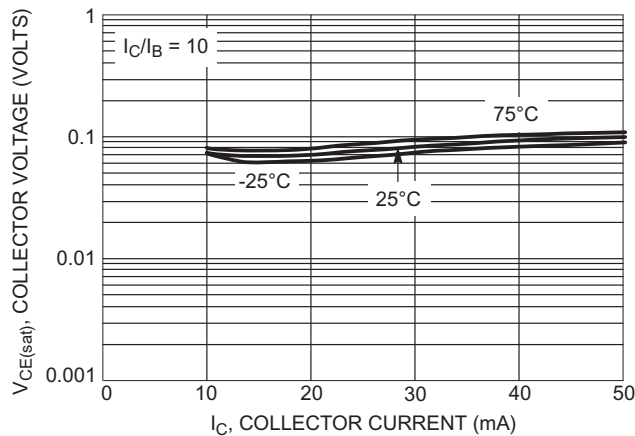
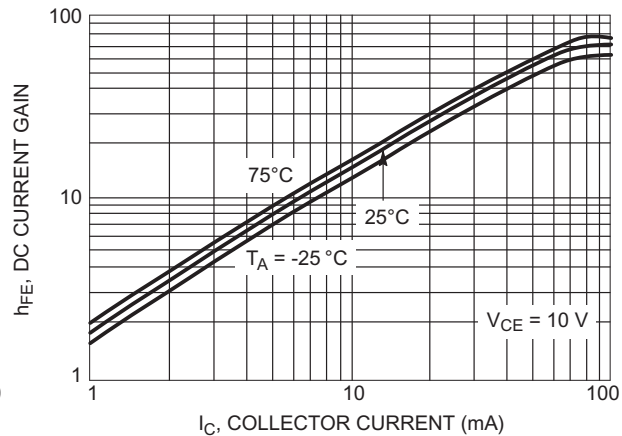
Figure 31. $V_{CE(sat)}$ versus I_C 

Figure 32. DC Current Gain

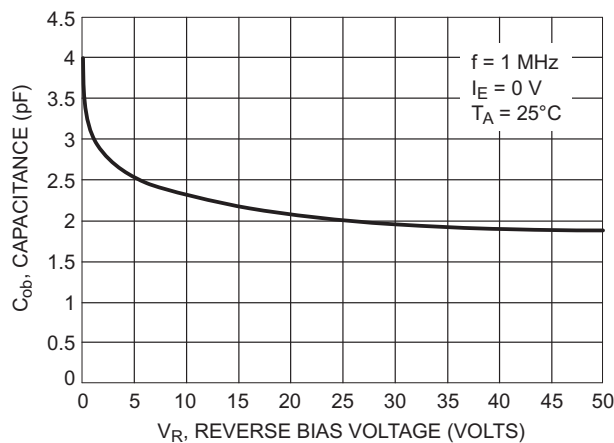


Figure 33. Output Capacitance

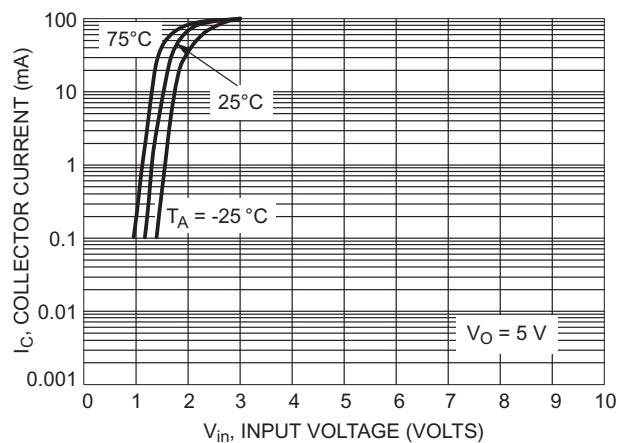


Figure 34. Output Current versus Input Voltage

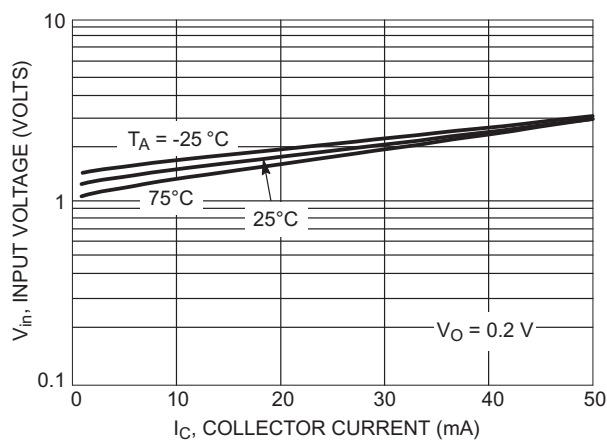


Figure 35. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN2231)

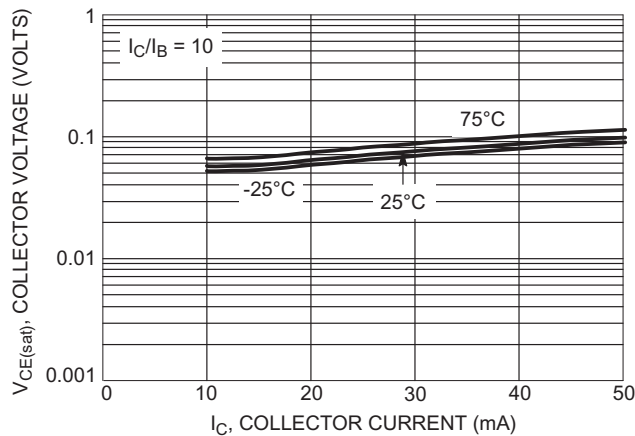
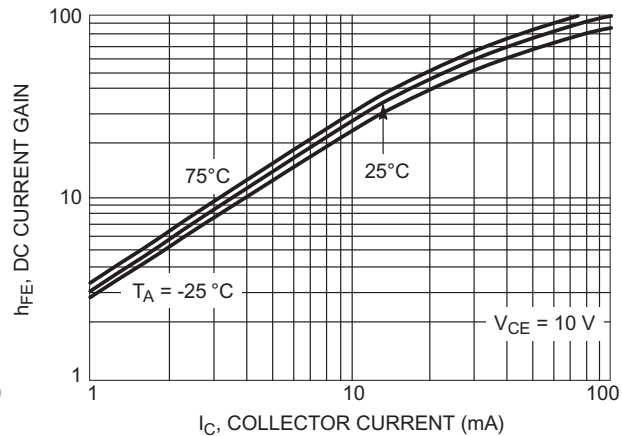
Figure 36. $V_{CE(sat)}$ versus I_C 

Figure 37. DC Current Gain

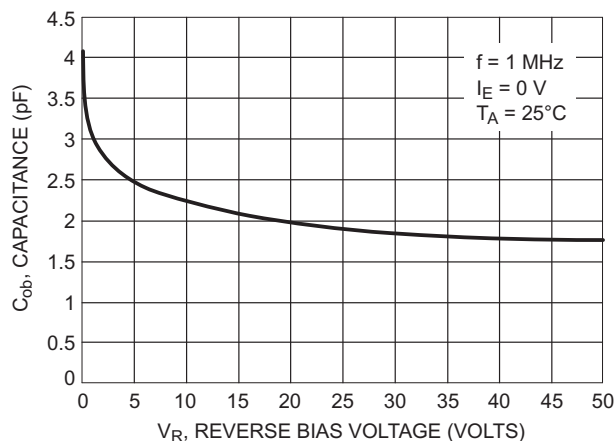


Figure 38. Output Capacitance

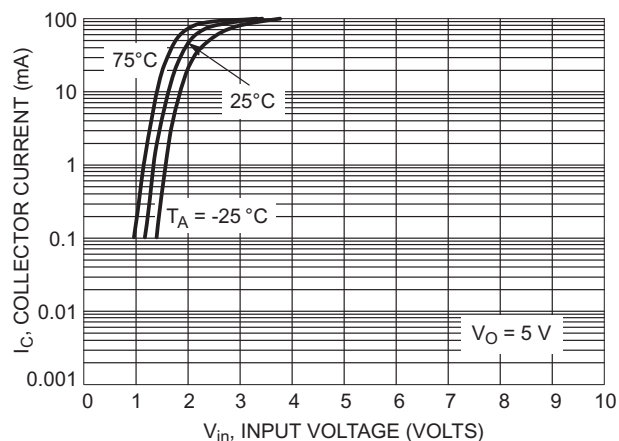


Figure 39. Output Current versus Input Voltage

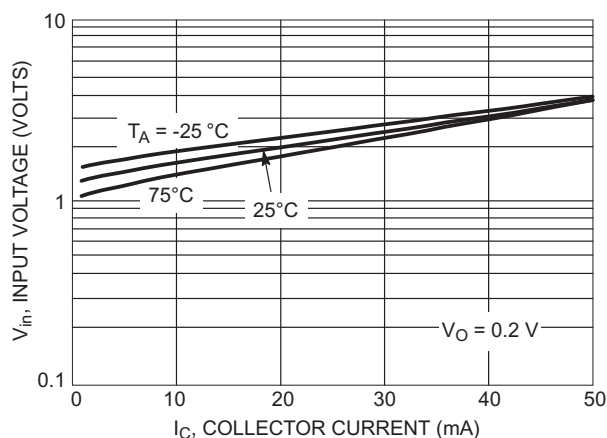


Figure 40. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN2232)

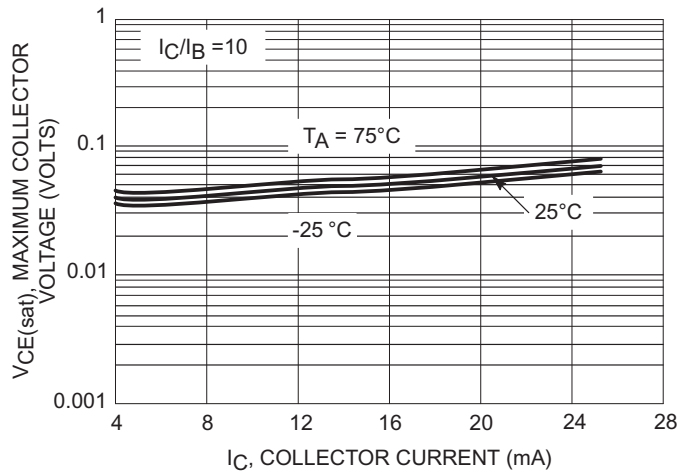
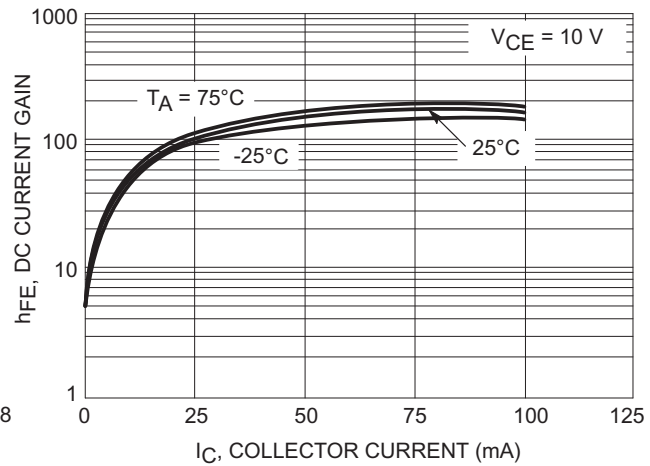
Figure 41. $V_{CE(sat)}$ vs. I_C 

Figure 42. DC Current Gain

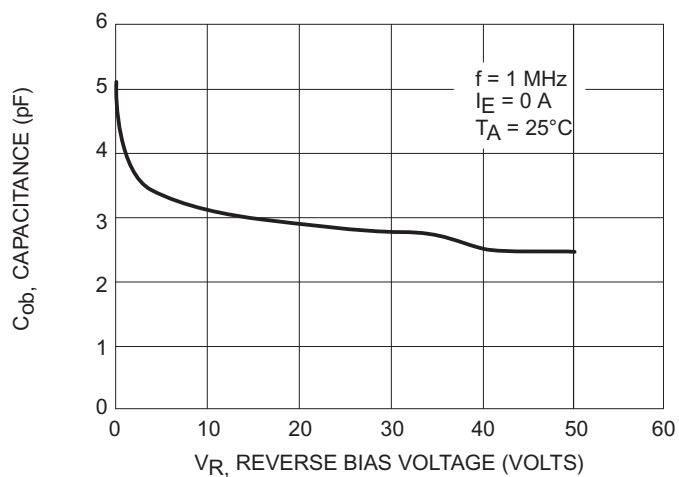


Figure 43. Output Capacitance

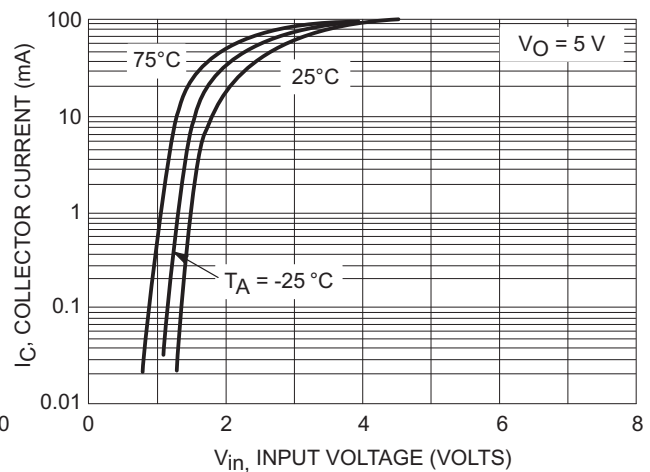


Figure 44. Output Current vs. Input Voltage

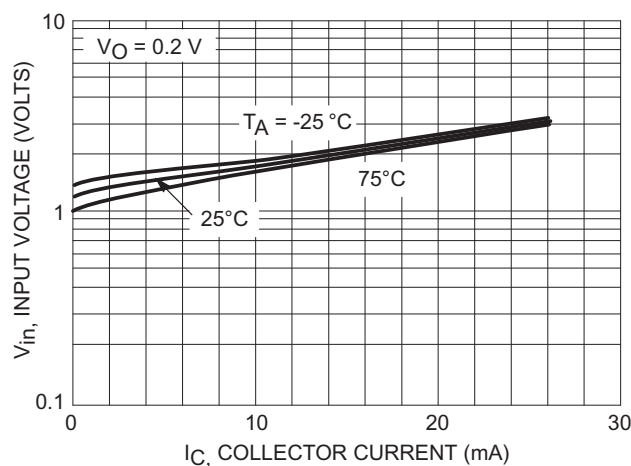


Figure 45. Output Voltage vs. Input Current

Typical Electrical Characteristics (FMUN2233)

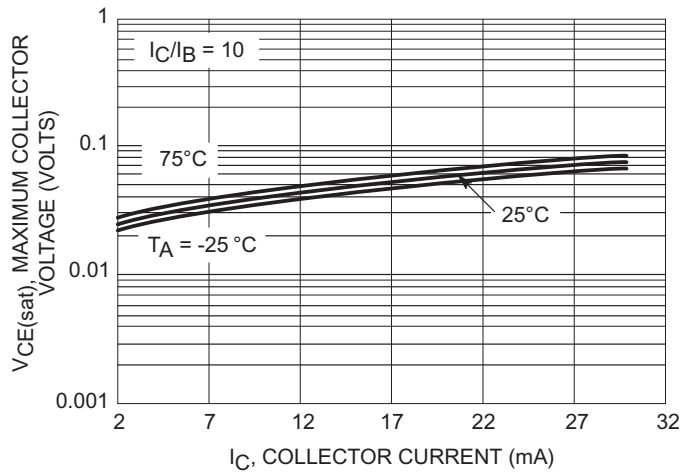
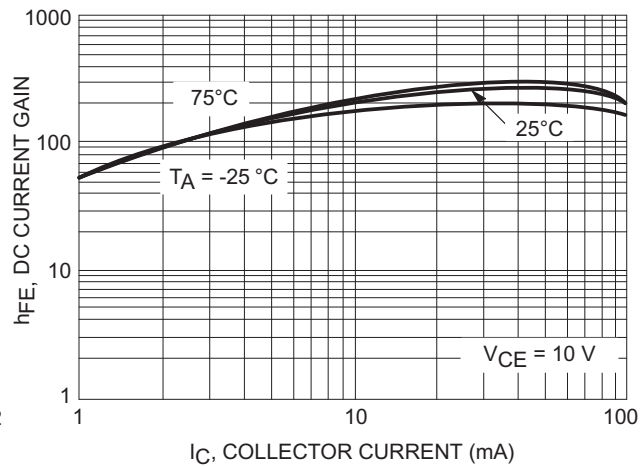
Figure 46. $V_{CE(sat)}$ vs. I_C 

Figure 47. DC Current Gain

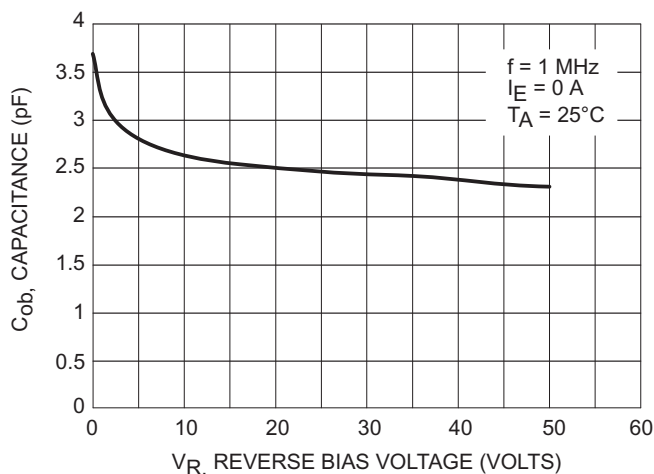


Figure 48. Output Capacitance

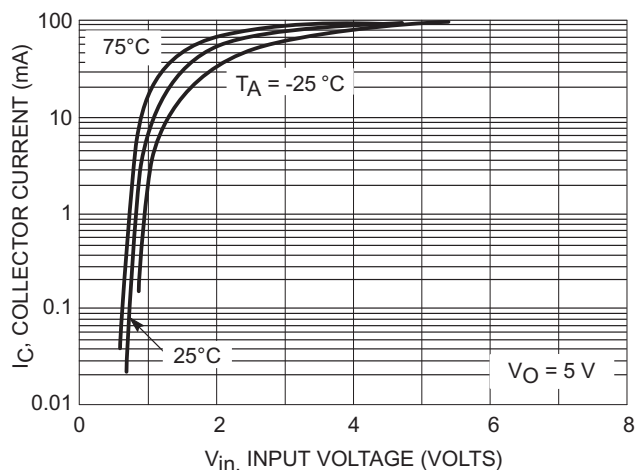


Figure 49. Output Current vs. Input Voltage

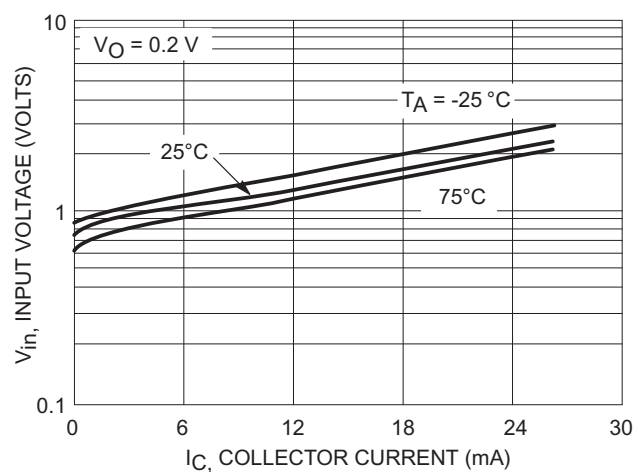


Figure 50. Input Voltage vs. Output Current

Typical Electrical Characteristics (FMUN2234)

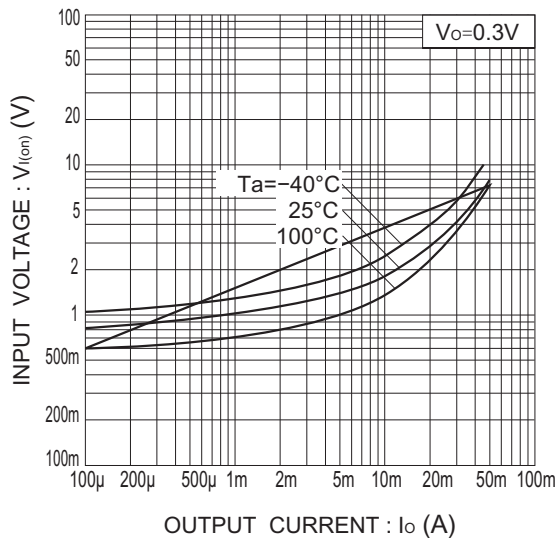


Fig.51 Input voltage vs. output current (ON characteristics)

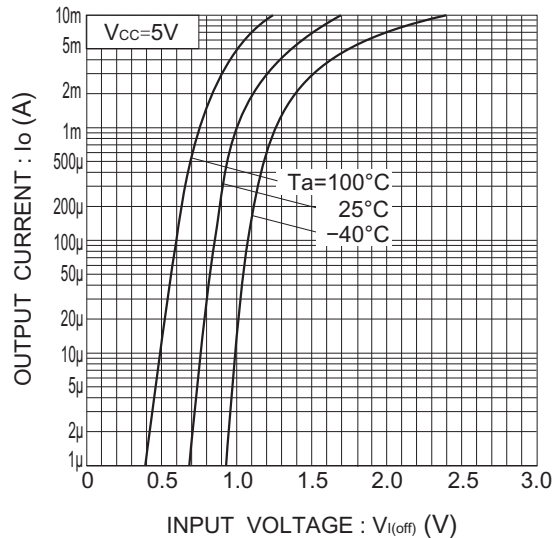


Fig.52 Output current vs. input voltage (OFF characteristics)

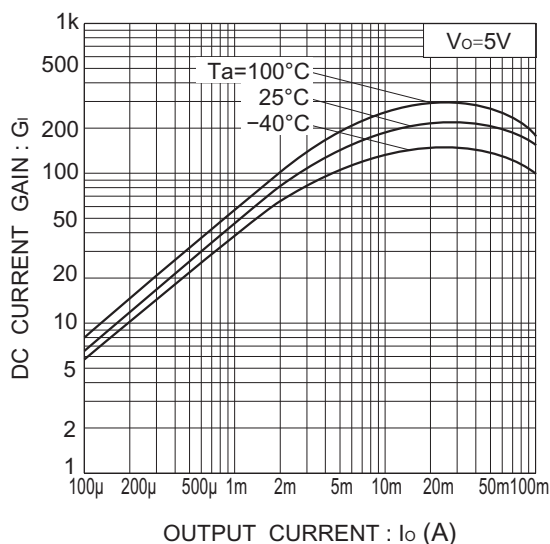


Fig.53 DC current gain vs. output current

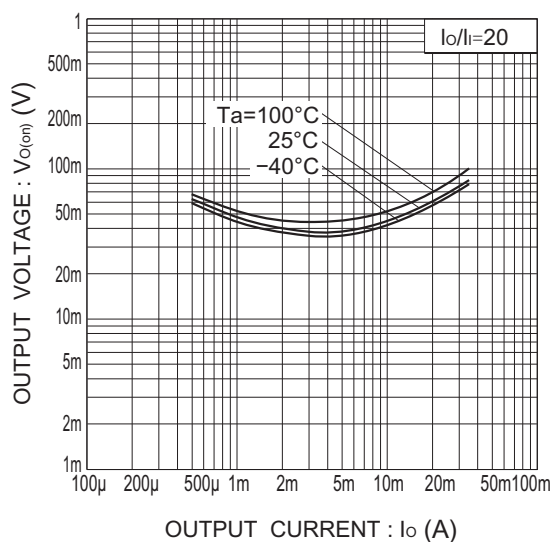


Fig.54 Output voltage vs. output current

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Typical Application For NPN BRTs

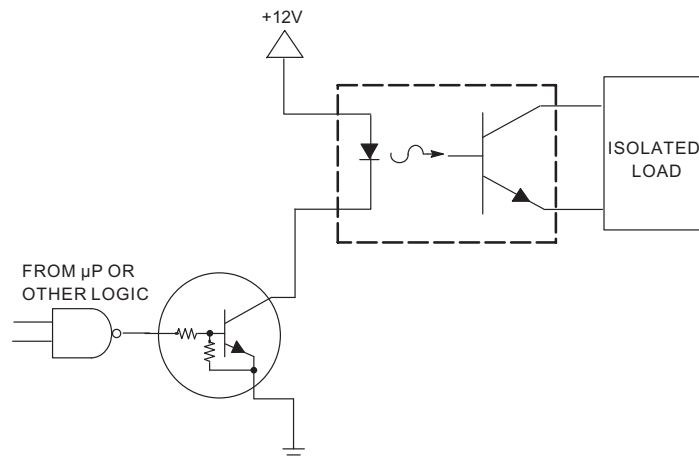


Figure 55. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

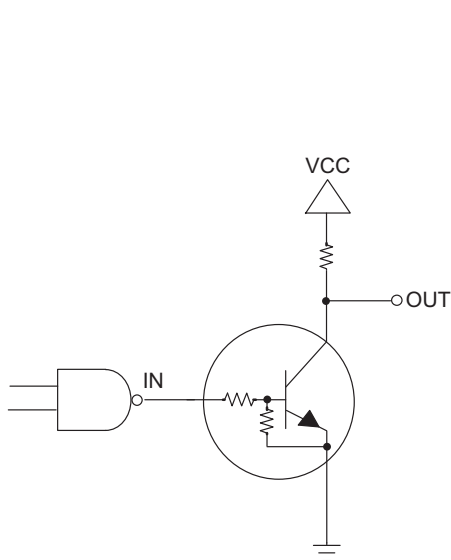


Figure 56. Open Collector Inverter: Inverts the Input Signal

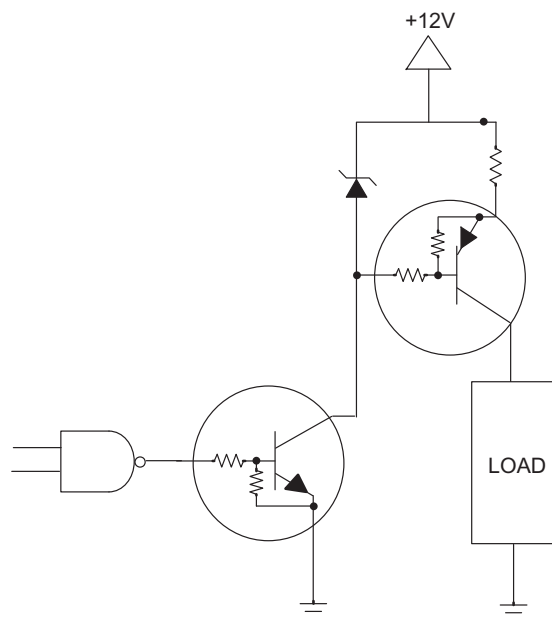
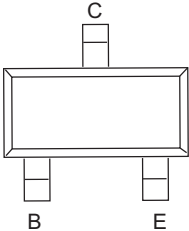
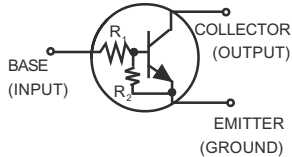


Figure 57. Inexpensive, Unregulated Current Source

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Pinning information

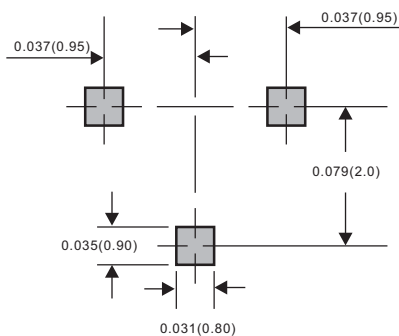
Pin	Simplified outline	Symbol
PinB Base PinC Collector PinE Emitter		

Marking

Type number	Marking code
FMUN2211	A8A
FMUN2212	A8B
FMUN2213	A8C
FMUN2214	A8D
FMUN2215	A8E
FMUN2216	A8F
FMUN2230	A8G
FMUN2231	A8H
FMUN2232	A8J
FMUN2233	A8K
FMUN2234	A8L
FMUN2235	A8M
FMUN2238	A8R
FMUN2241	A8U

Suggested solder pad layout

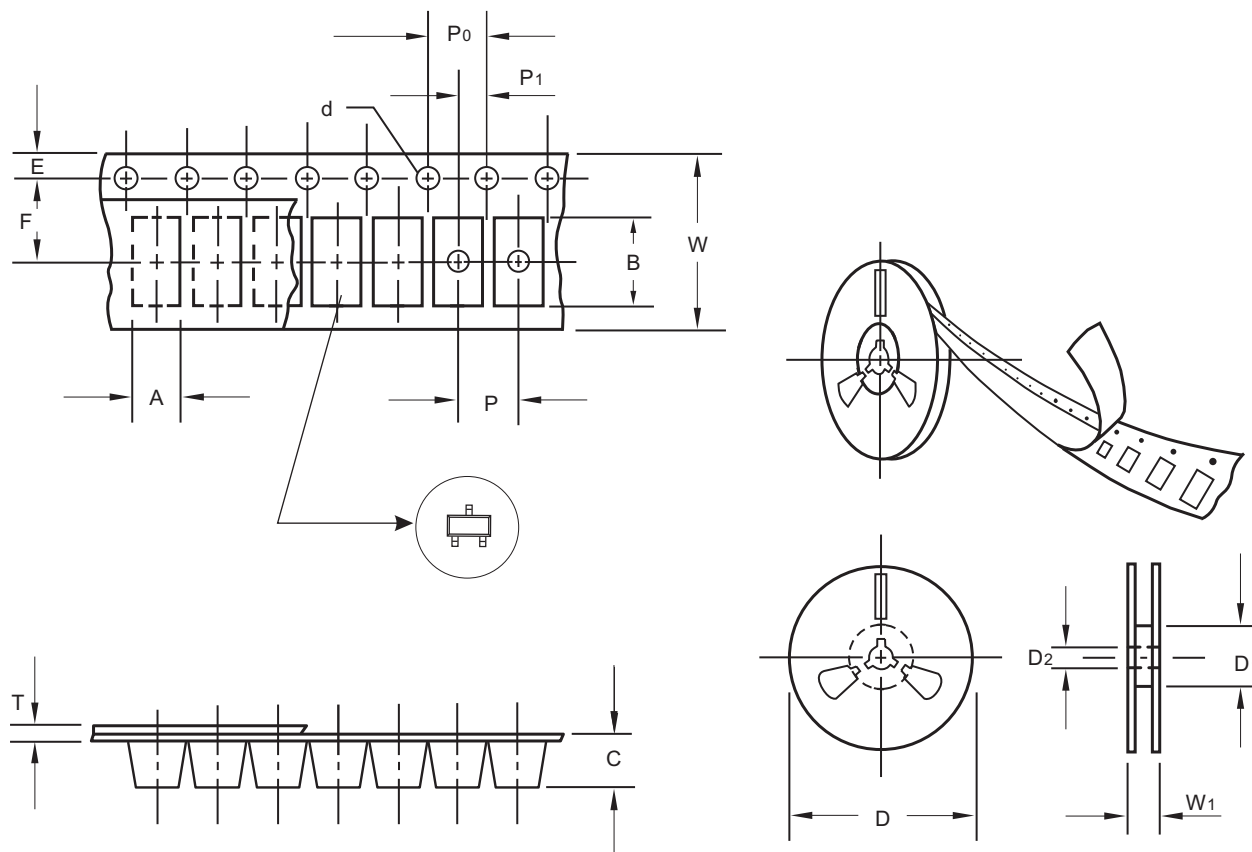
SOT-23



Dimensions in inches and (millimeters)

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Packing information



unit:mm

Item	Symbol	Tolerance	SOT-23
Carrier width	A	0.1	3.15
Carrier length	B	0.1	2.77
Carrier depth	C	0.1	1.22
Sprocket hole	d	0.1	1.50
13" Reel outside diameter	D	2.0	-
13" Reel inner diameter	D1	min	-
7" Reel outside diameter	D	2.0	178.00
7" Reel inner diameter	D1	min	55.00
Feed hole diameter	D2	0.5	13.00
Sprocket hole position	E	0.1	1.75
Punch hole position	F	0.1	3.50
Punch hole pitch	P	0.1	4.00
Sprocket hole pitch	P0	0.1	4.00
Embossment center	P1	0.1	2.00
Overall tape thickness	T	0.1	0.23
Tape width	W	0.3	8.00
Reel width	W1	1.0	12.0

Note: Devices are packed in accordance with EIA standard RS-481-A and specifications listed above.

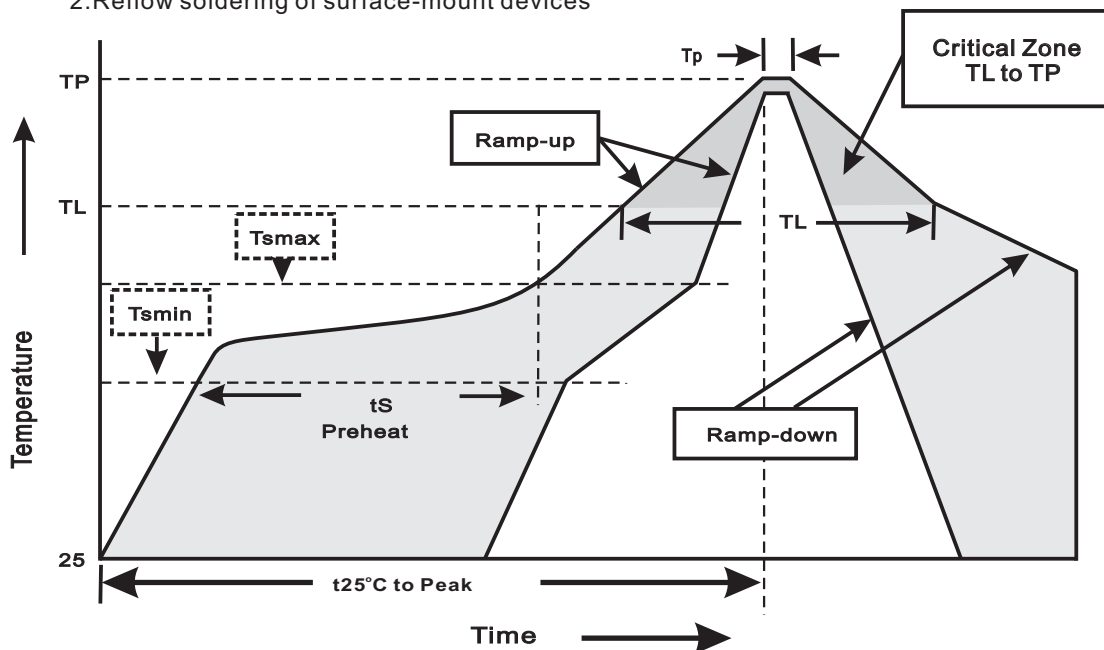
FMUN2211 THRU FMUN2241

Reel packing

PACKAGE	REEL SIZE	REEL (pcs)	COMPONENT SPACING (m/m)	BOX (pcs)	INNER BOX (m/m)	REEL DIA, (m/m)	CARTON SIZE (m/m)	CARTON (pcs)	APPROX. GROSS WEIGHT (kg)
SOT-23	7"	3,000	4.0	30,000	183*183*123	178	382*262*387	240,000	11.6

Suggested thermal profiles for soldering processes

- 1.Storage environment: Temperature=5°C~40°C Humidity=55%±25%
- 2.Reflow soldering of surface-mount devices



3.Reflow soldering

Profile Feature	Soldering Condition
Average ramp-up rate(T_L to T_P)	$<3^{\circ}\text{C}/\text{sec}$
Preheat -Temperature Min(T_{smin}) -Temperature Max(T_{smax}) -Time(min to max)(t_s)	150°C 200°C 60~120sec
T_{smax} to T_L -Ramp-upRate	$<3^{\circ}\text{C}/\text{sec}$
Time maintained above: -Temperature(T_L) -Time(t_L)	217°C 60~260sec
Peak Temperature(T_P)	255°C-0/+5°C
Time within 5°C of actual Peak Temperature(t_P)	10~30sec
Ramp-down Rate	$<6^{\circ}\text{C}/\text{sec}$
Time 25°C to Peak Temperature	$<6\text{minutes}$

FMUN2211 THRU FMUN2241**High reliability test capabilities**

Item Test	Conditions
1. Steady State Operating Life	$P_o=246\text{mW}$ Test Duration:1000hrs
2. High Temperature Reverse Bias	$T_j=150^\circ\text{C}$, $V_{ce}=80\%$ related volage, 1000hrs
3. Temperature Cycle	$-55^\circ\text{C}(15\text{min})$ to $150^\circ\text{C}(15\text{min})$ Air to Air Transition Time<20sec Test Cycles: 1000cycle
4. Autoclave	$P=2\text{atm}$ $T_a=121^\circ\text{C}$ $\text{RH}=100\%$ Test Duration: 96hrs
5. High Temperature Storage Life	$T_a=150^\circ\text{C}$ Test Duration: 1000hrs
6. Solderability	245°C ,5sec
7. High Temperature High Humidity Reverse Bias	$T_a=85^\circ\text{C}$, 85%RH, $V_{ce}=80\%$ related volage, 1000hrs
8. Resistance to Soldering Heat	260°C ,10sec