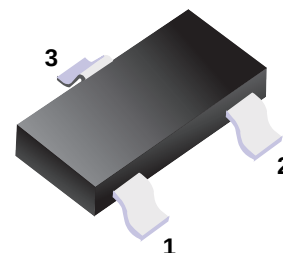


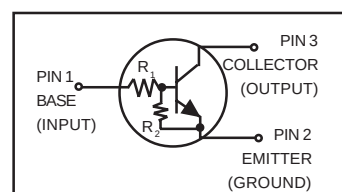
■ Bias Resistor Transistor NPN Silicon Surface Mount Transistor with Monolithic Bias Resistor Network

■ 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.
- Available in 8 mm embossed tape and reel. Use the Device Number to order the 7 inch/3000 unit reel. Replace "T1" with "T3" in the Device Number to order the 13 inch/10,000 unit reel.



■ Simplified outline(SOT-23)



This new series of digital transistors is designed to replace a single device and its external resistor bias network. The BRT (Bias Resistor Transistor) contains a single transistor with a monolithic bias network consisting of two resistors; a series base resistor and a base-emitter resistor. The BRT eliminates these individual components by integrating them into a single device. The use of a BRT can reduce both system cost and board space. The device is housed in the SOT-23 package which is designed for low power surface mount applications

■ Device Marking And Resistor Values

Device	Marking	R1(K)	R2(K)
MMUN2211	A8A	10	10
MMUN2212	A8B	22	22
MMUN2213	A8C	47	47
MMUN2214	A8D	10	47
MMUN2215	A8E	10	∞
MMUN2216	A8F	4.7	∞
MMUN2230	A8G	1.0	1.0
MMUN2231	A8H	2.2	2.2
MMUN2232	A8J	4.7	4.7
MMUN2233	A8K	4.7	47
MMUN2234	A8L	22	47
MMUN2235	A8M	2.2	47
MMUN2238	A8R	2.2	∞
MMUN2241	A8U	100	∞

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

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Collector-Base Voltage	V _{CBO}	50	Vdc
Collector-Emitter Voltage	V _{CEO}	50	Vdc
Collector Current	I _C	100	mAdc
Total Power Dissipation @ T _A = 25°C (Note 1.) Derate above 25°C	P _D	200 1.6	mW mW/°C
Thermal Resistance – Junction-to-Ambient (surface mounted)	R _{θJA}	625	°C/W
Operating and Storage Temperature Range	T _J , T _{stg}	–65 to +150	°C
Maximum Temperature for Soldering Purposes, Time in Solder Bath	T _L	260 10	°C Sec

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Collector-Base Cutoff Current (V _{CB} = 50 V, I _E = 0)	I _{CBO}	–	–	100	nAdc
Collector-Emitter Cutoff Current (V _{CE} = 50 V, I _B = 0)	I _{CEO}	–	–	500	nAdc
Emitter-Base Cutoff Current (V _{EB} = 6.0 V, I _C = 0)	I _{EBO}	–	–	0.5 0.2 0.1 0.2 0.9 1.9 4.3 2.3 1.5 0.18 0.13 0.2 4.0 0.1	mAdc
Collector-Base Breakdown Voltage (I _C = 10 μA, I _E = 0)	V _{(BR)CBO}	50	–	–	Vdc
Collector-Emitter Breakdown Voltage (Note 2.), (I _C = 2.0 mA, I _B = 0)	V _{(BR)CEO}	50	–	–	Vdc

ON CHARACTERISTICS (Note 2.)

DC Current Gain (V _{CE} = 10 V, I _C = 5.0 mA)	MMUN2211 MMUN2212 MMUN2213 MMUN2214 MMUN2215 MMUN2216 MMUN2230 MMUN2231 MMUN2232 MMUN2233 MMUN2234 MMUN2235 MMUN2238 MMUN2241	h _{FE}	35 60 80 80 160 160 3.0 8.0 15 80 80 80 160 160	60 100 140 140 350 350 5.0 15 30 200 150 140 350 350	– – – – – – – – – – – – – –	
Collector-Emitter Saturation Voltage (I _C = 10 mA, I _B = 0.3 mA) (I _C = 10 mA, I _B = 5 mA) MMUN2230/MMUN2231 (I _C = 10 mA, I _B = 1 mA) MMUN2215/MMUN2216 MMUN2232/MMUN2233/MMUN2234/ MMUN2235/MMUN2238		V _{CE(sat)}	–	–	0.25	Vdc

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

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS (Note 3.)					
Output Voltage (on) (V _{CC} = 5.0 V, V _B = 2.5 V, R _L = 1.0 k Ω)	V _{OL}	–	–	0.2	Vdc
MMUN2211		–	–	0.2	
MMUN2212		–	–	0.2	
MMUN2214		–	–	0.2	
MMUN2215		–	–	0.2	
MMUN2216		–	–	0.2	
MMUN2230		–	–	0.2	
MMUN2231		–	–	0.2	
MMUN2232		–	–	0.2	
MMUN2233		–	–	0.2	
MMUN2234		–	–	0.2	
MMUN2235		–	–	0.2	
MMUN2238		–	–	0.2	
(V _{CC} = 5.0 V, V _B = 3.5 V, R _L = 1.0 k Ω)		–	–	0.2	
(V _{CC} = 5.0 V, V _B = 5.0 V, R _L = 1.0 k Ω)		–	–	0.2	
MMUN2241		–	–	0.2	
Output Voltage (off) (V _{CC} = 5.0 V, V _B = 0.5 V, R _L = 1.0 k Ω) (V _{CC} = 5.0 V, V _B = 0.050 V, R _L = 1.0 k Ω) (V _{CC} = 5.0 V, V _B = 0.25 V, R _L = 1.0 k Ω)	V _{OH}	4.9	–	–	Vdc
MMUN2230					
MMUN2215					
MMUN2216					
MMUN2233					
MMUN2238					
Input Resistor	R ₁	7.0	10	13	kΩ
MMUN2211		15.4	22	28.6	
MMUN2212		32.9	47	61.1	
MMUN2213		7.0	10	13	
MMUN2214		7.0	10	13	
MMUN2215		3.3	4.7	6.1	
MMUN2216		0.7	1.0	1.3	
MMUN2230		1.5	2.2	2.9	
MMUN2231		3.3	4.7	6.1	
MMUN2232		3.3	4.7	6.1	
MMUN2233		15.4	22	28.6	
MMUN2234		1.54	2.2	2.86	
MMUN2235		1.54	2.2	2.88	
MMUN2238		70	100	130	
MMUN2241					
Resistor Ratio	R ₁ /R ₂	0.8	1.0	1.2	
MMUN2211/MMUN2212/MMUN2213		0.17	0.21	0.25	
MMUN2214		–	–	–	
MMUN2215/MMUN2216/MMUN2238		–	–	–	
MMUN2241		–	–	–	
MMUN2230/MMUN2231/MMUN2232		0.8	1.0	1.2	
MMUN2233		0.055	0.1	0.185	
MMUN2234		0.38	0.47	0.56	
MMUN2235		0.038	0.047	0.056	

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

TYPICAL ELECTRICAL CHARACTERISTICS MMUN2211

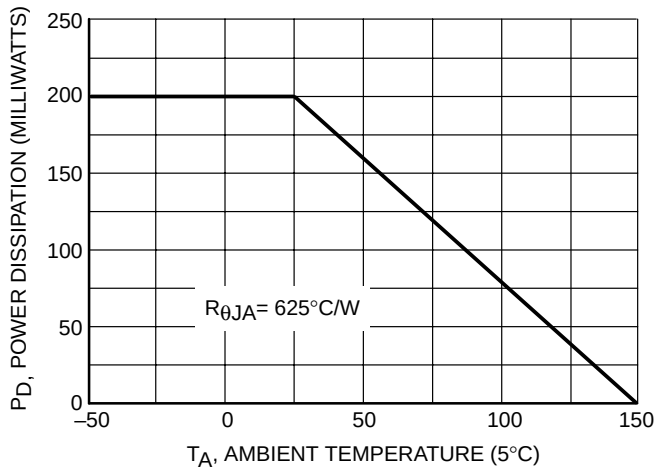


Figure 1. Derating Curve

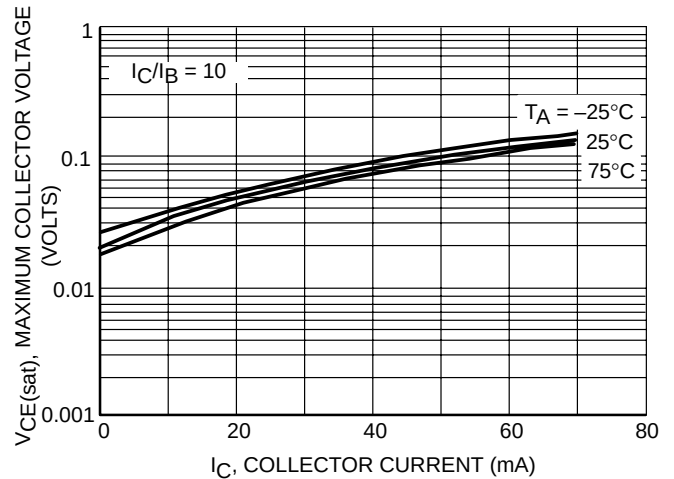


Figure 2. $V_{CE(sat)}$ vs. I_C

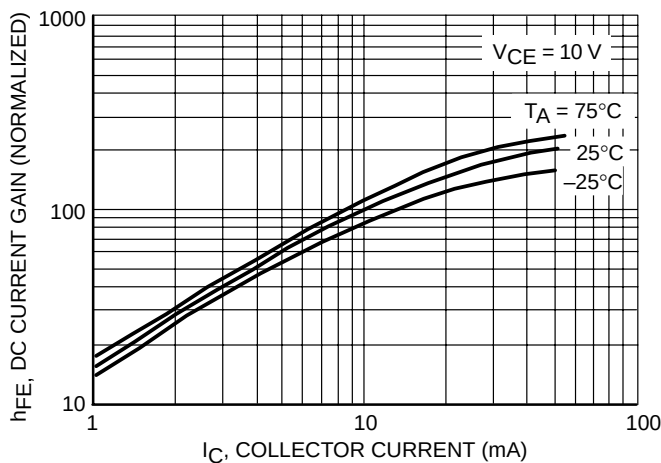


Figure 3. DC Current Gain

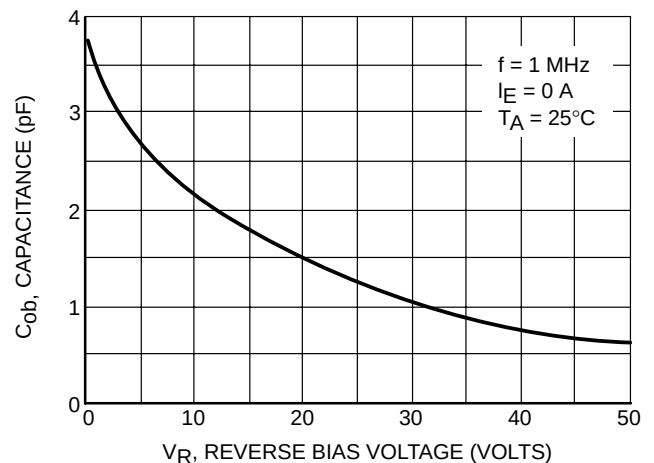


Figure 4. Output Capacitance

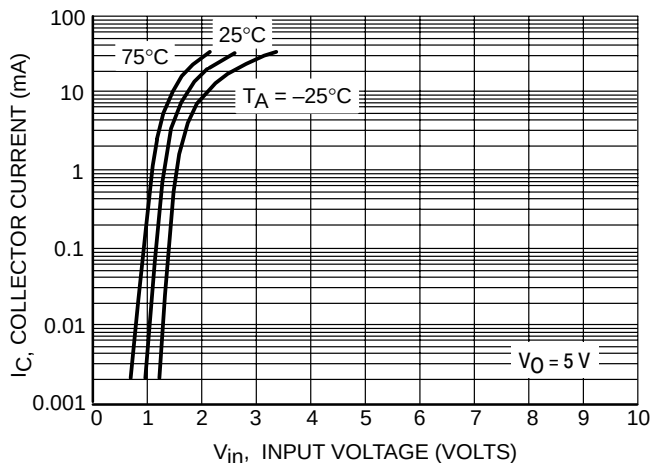


Figure 5. Output Current vs. Input Voltage

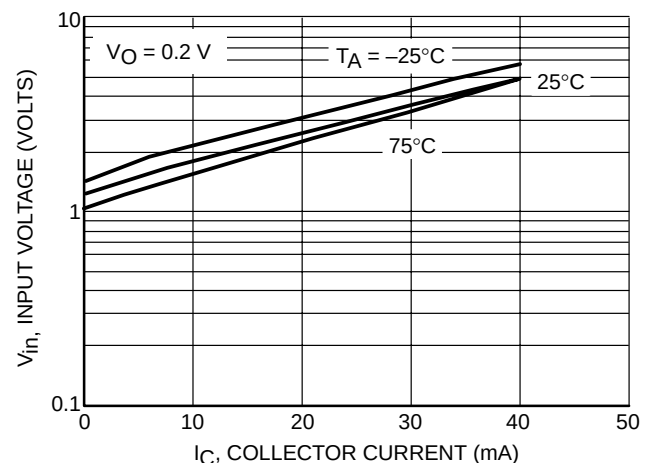


Figure 6. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS MMUN2212

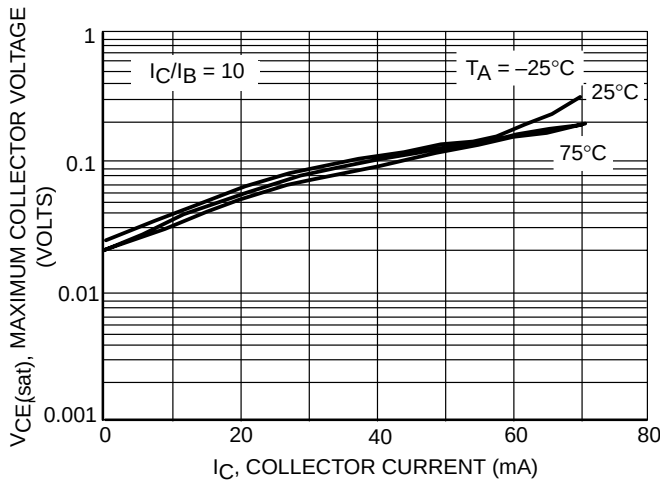


Figure 7. $V_{CE(sat)}$ vs. I_C

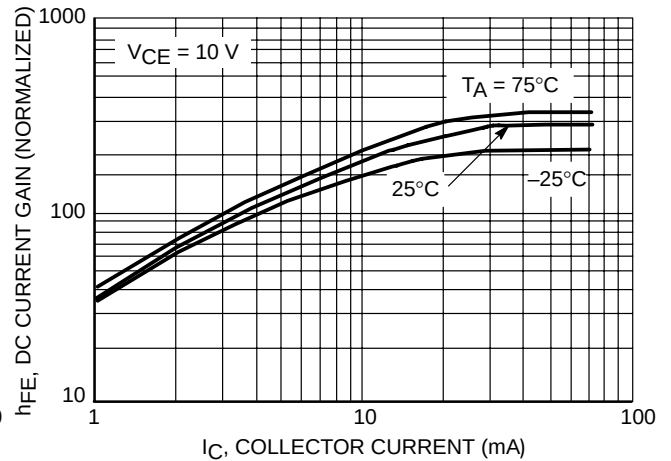


Figure 8. DC Current Gain

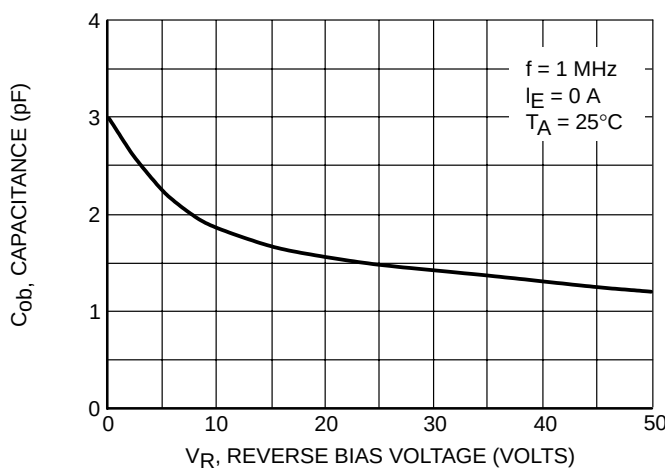


Figure 9. Output Capacitance

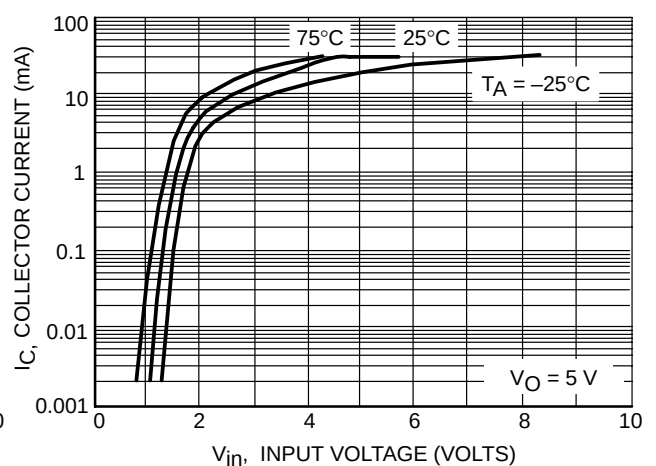


Figure 10. Output Current vs. Input Voltage

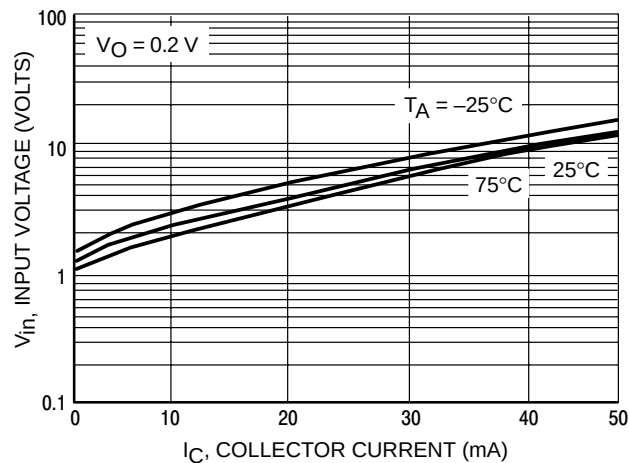


Figure 11. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS MMUN2213

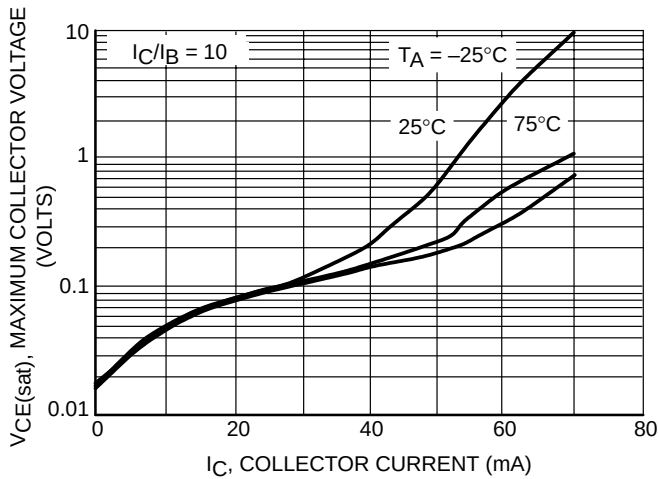


Figure 12. $V_{CE(sat)}$ vs. I_C

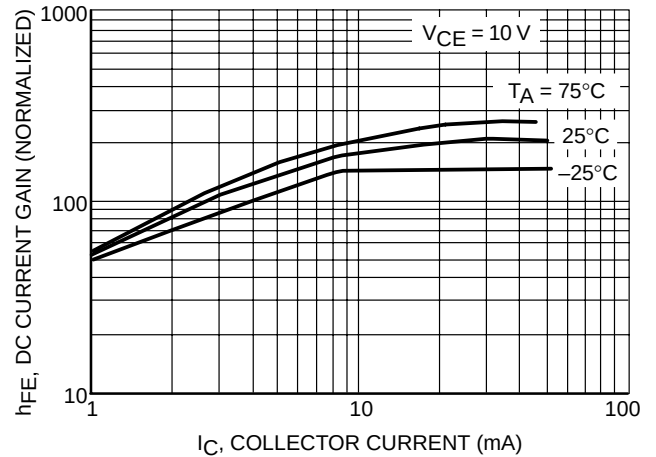


Figure 13. DC Current Gain

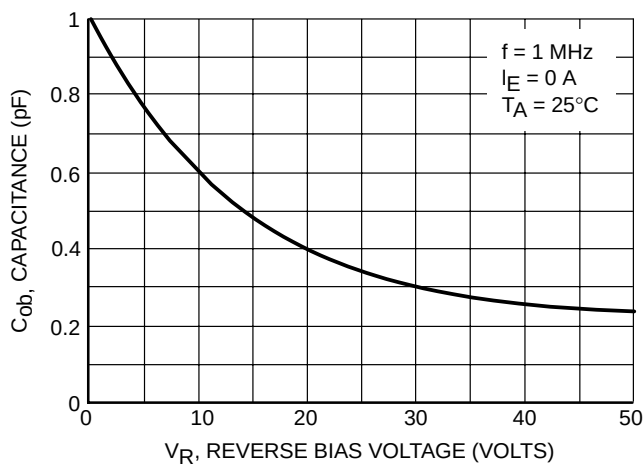


Figure 14. Output Capacitance

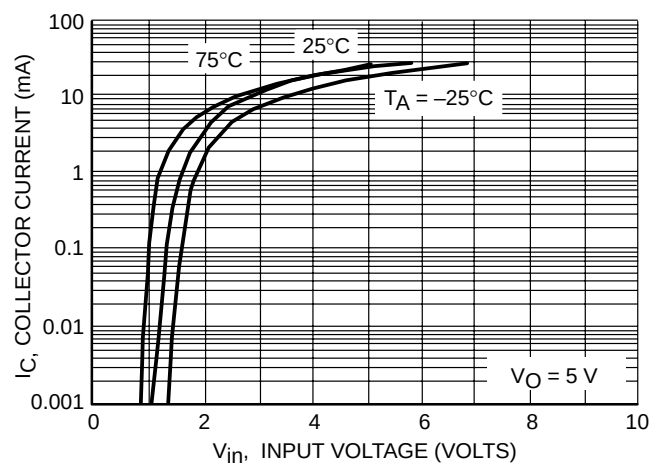


Figure 15. Output Current vs. Input Voltage

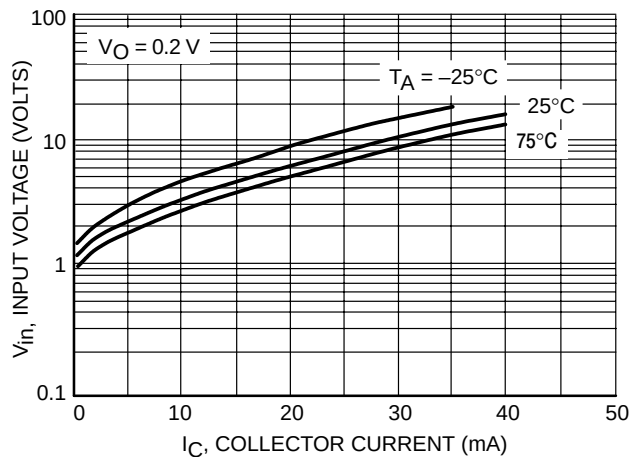


Figure 16. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS MMUN2214

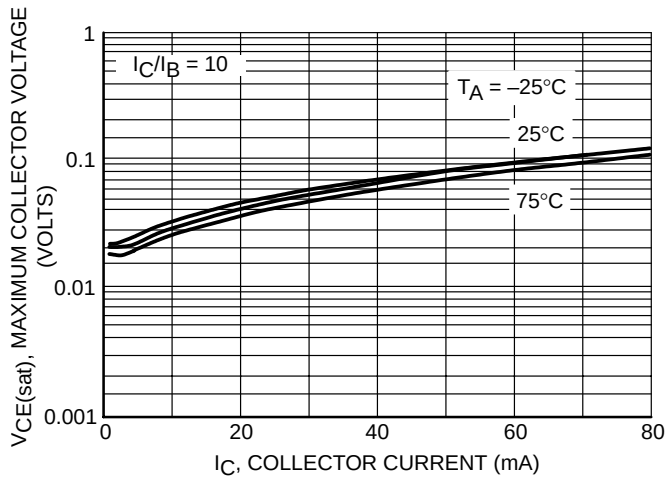


Figure 17. $V_{CE(sat)}$ vs. I_C

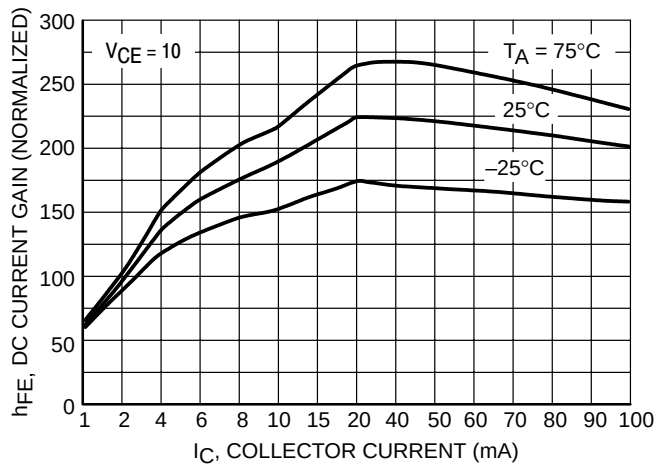


Figure 18. DC Current Gain

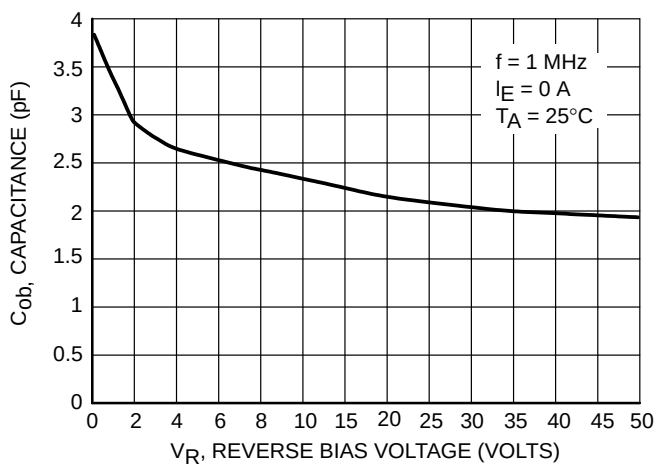


Figure 19. Output Capacitance

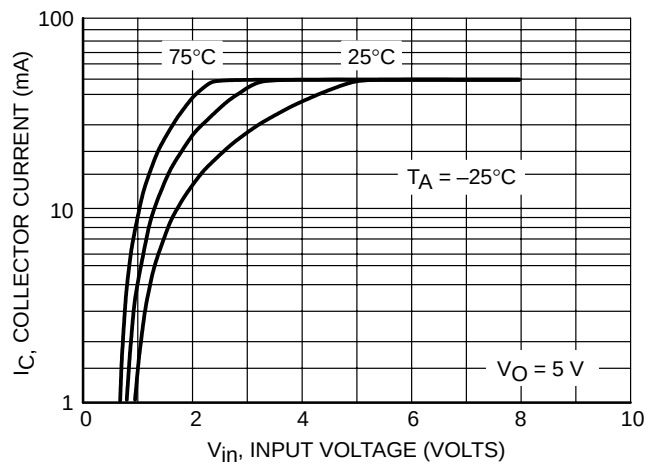


Figure 20. Output Current vs. Input Voltage

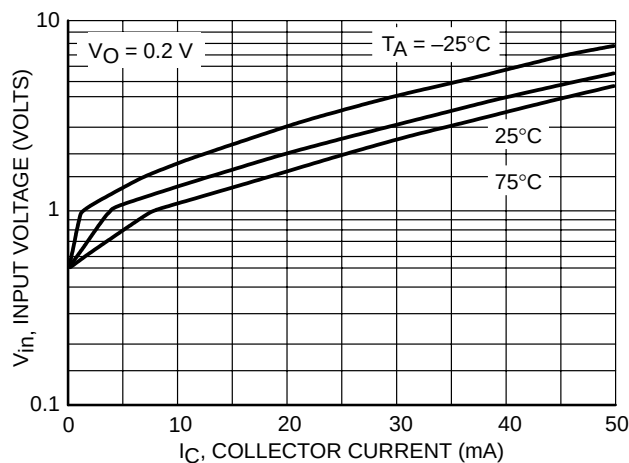


Figure 21. Input Voltage vs. Output Current

TYPICAL ELECTRICAL CHARACTERISTICS MMUN2232

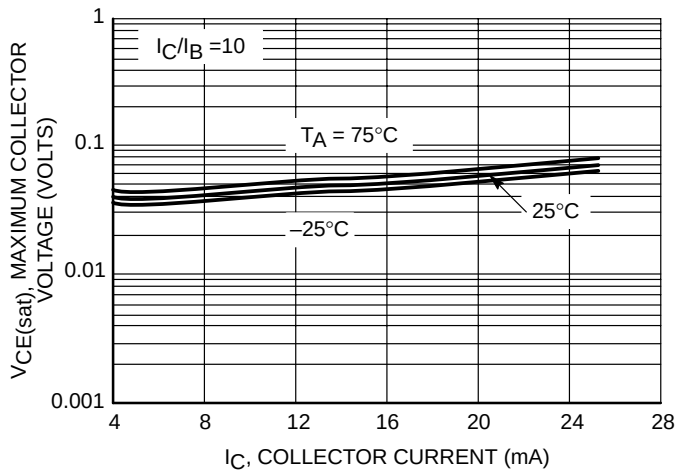


Figure 22. $V_{CE(sat)}$ vs. I_C

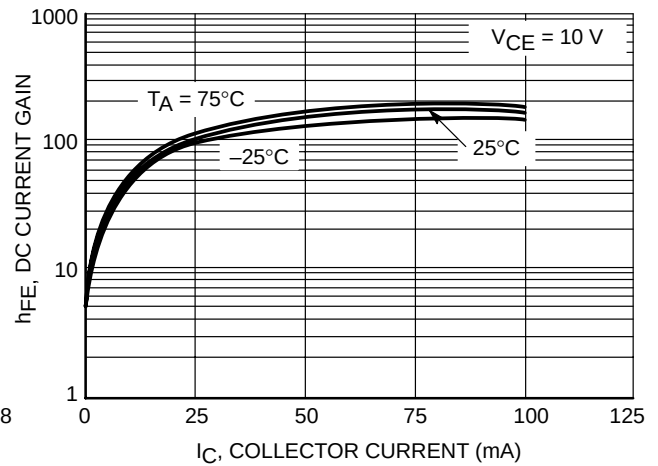


Figure 23. DC Current Gain

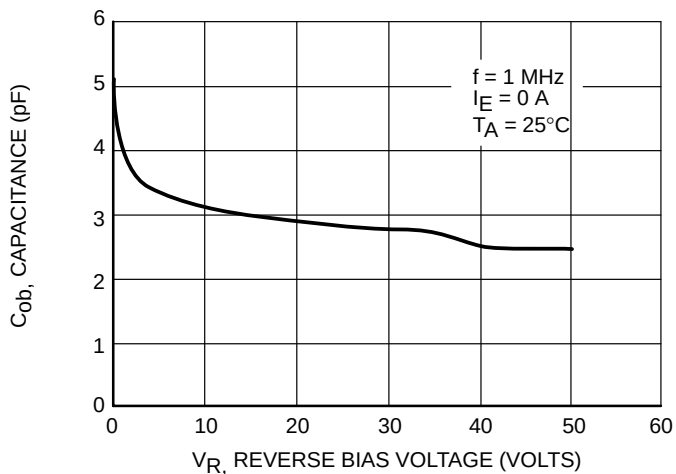


Figure 24. Output Capacitance

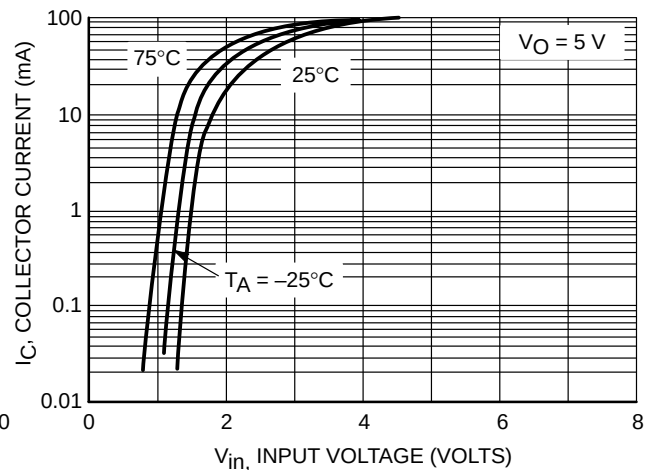


Figure 25. Output Current vs. Input Voltage

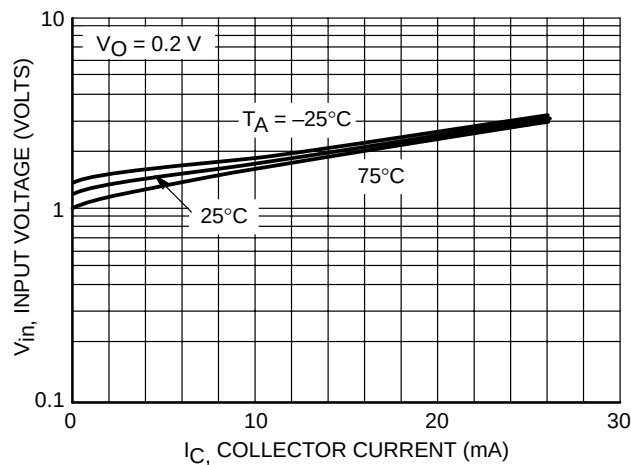


Figure 26. Output Voltage vs. Input Current

TYPICAL ELECTRICAL CHARACTERISTICS MMUN2233

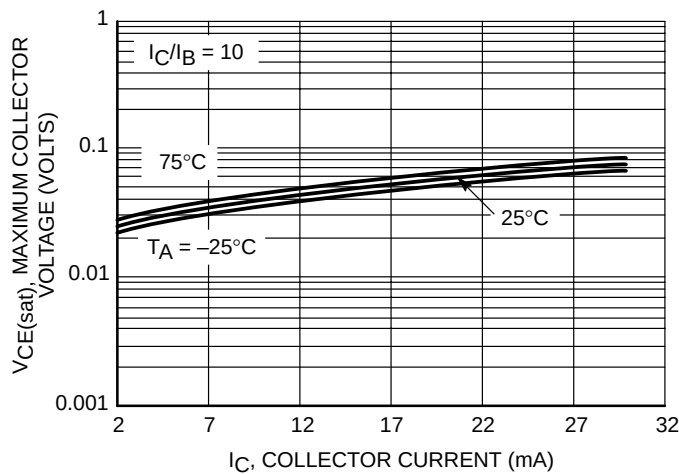


Figure 27. $V_{CE(sat)}$ vs. I_C

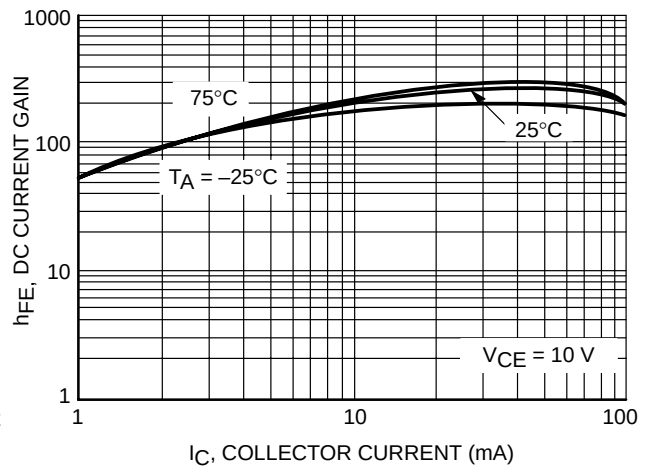


Figure 28. DC Current Gain

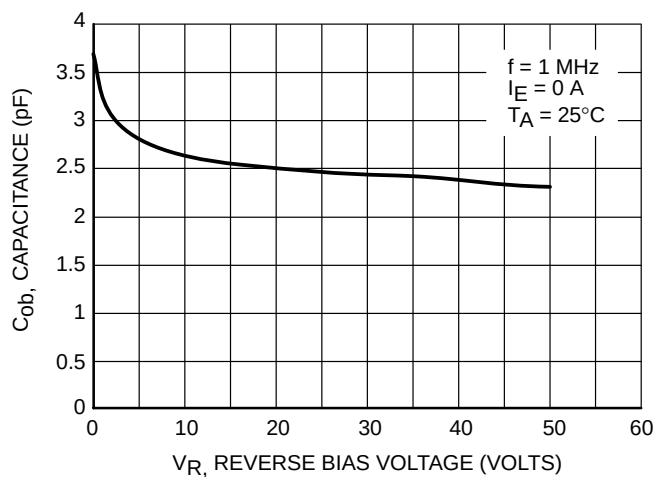


Figure 29. Output Capacitance

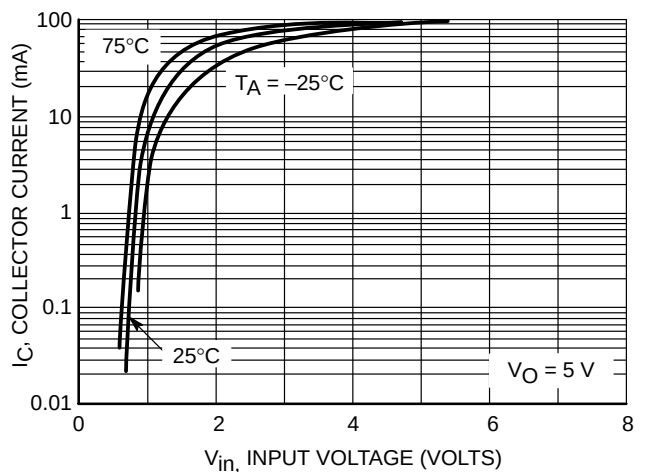


Figure 30. Output Current vs. Input Voltage

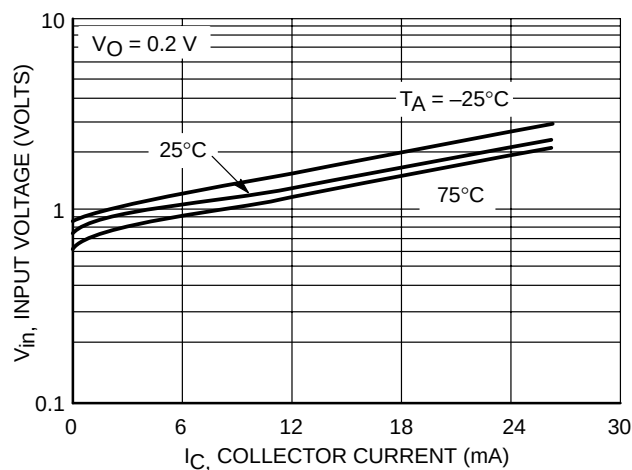


Figure 31. Input Voltage vs. Output Current

TYPICAL APPLICATIONS FOR NPN BRTs

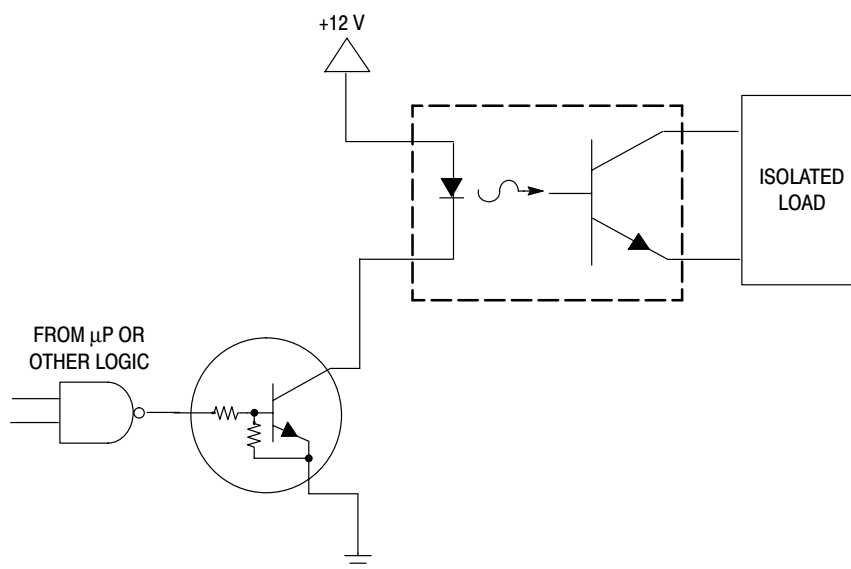


Figure 32. Level Shifter: Connects 12 or 24 Volt Circuits to Logic

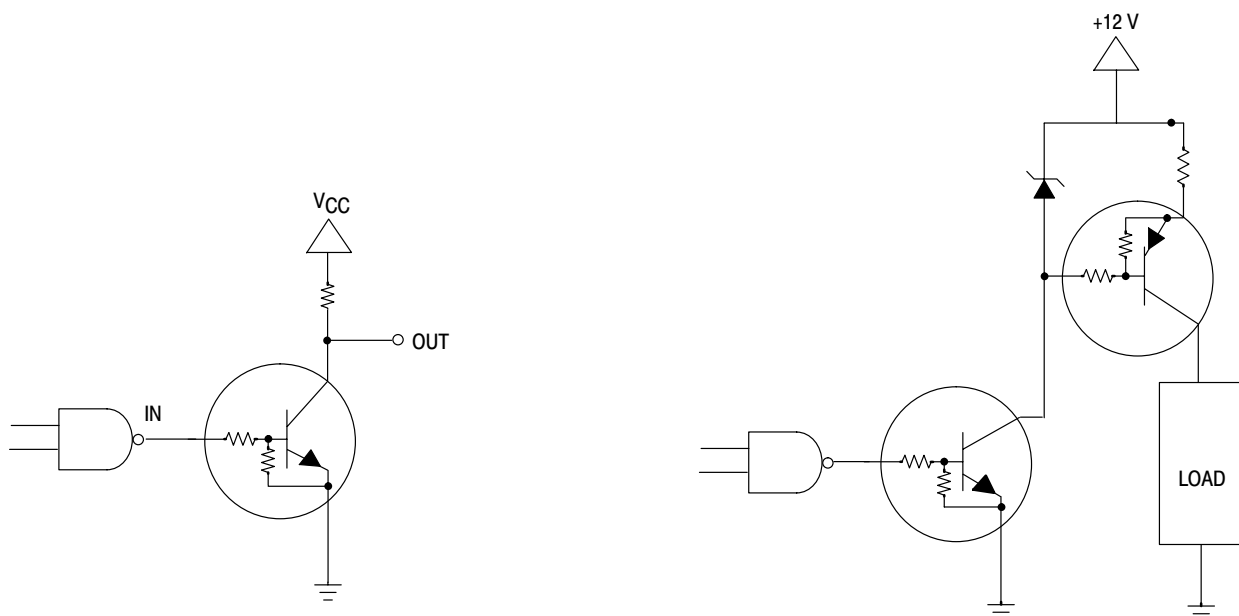
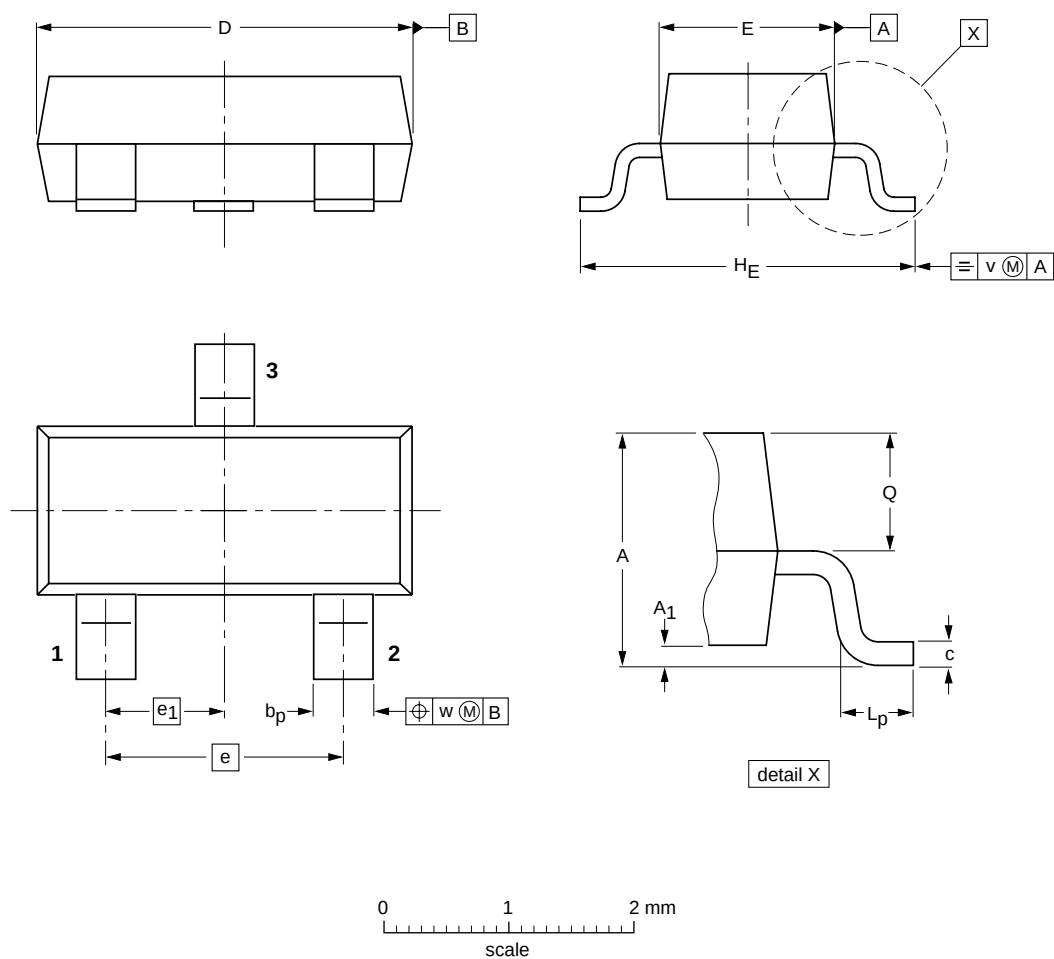


Figure 33. Open Collector Inverter: Inverts the Input Signal

Figure 34. Inexpensive, Unregulated Current Source

SOT-23



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₁ max.	b _p	c	D	E	e	e ₁	H _E	L _p	Q	v	w
mm	1.1 0.9	0.1	0.48 0.38	0.15 0.09	3.0 2.8	1.4 1.2	1.9	0.95	2.5 2.1	0.45 0.15	0.55 0.45	0.2	0.1