ETL SEMICONDUCTOR

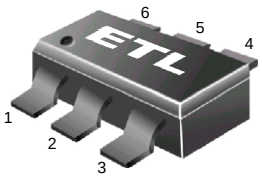
Dual Bias Resistor Transistors

NPN and PNP Silicon Surface Mount Transistors with Monolithic Bias Resistor Network

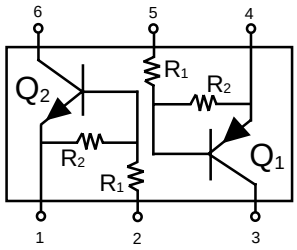
MUN5311DW1T1 Series

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. These digital transistors are designed to replace a single device and its external resistor bias network. The BRT eliminates these individual components by integrating them into a single device. In the MUN5311DW1T1 series, two complementary BRT devices are housed in the SOT–363 package which is ideal for low power surface mount applications where board space is at a premium.

- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- Available in 8 mm, 7 inch/3000 Unit Tape and Reel



SOT–363
CASE 419B STYLE1



MAXIMUM RATINGS (T_A = 25°C unless otherwise noted, common for Q_1 and Q_2, – minus sign for Q_1 (PNP) omitted)

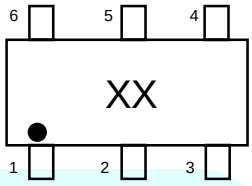
Rating	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	50	Vdc
Collector-Emitter Voltage	V_{CEO}	50	Vdc
Collector Current	I_C	100	mAdc

THERMAL CHARACTERISTICS

Characteristic (One Junction Heated)	Symbol	Max	Unit
Total Device Dissipation	P_D	187 (Note 1.)	mW
T_A = 25°C		256 (Note 2.)	
Derate above 25°C		1.5 (Note 1.)	mW/°C
		2.0 (Note 2.)	
Thermal Resistance – Junction-to-Ambient	$R_{\theta JA}$	670 (Note 1.)	°C/W
		490 (Note 2.)	
Characteristic (Both Junctions Heated)	**Symbol**	**Max**	**Unit**
Total Device Dissipation	P_D	250 (Note 1.)	mW
T_A = 25°C		385 (Note 2.)	
Derate above 25°C		2.0 (Note 1.)	mW/°C
		3.0 (Note 2.)	
Thermal Resistance – Junction-to-Ambient	$R_{\theta JA}$	493 (Note 1.)	°C/W
		325 (Note 2.)	
Thermal Resistance – Junction-to-Lead	$R_{\theta JL}$	188 (Note 1.)	°C/W
		208 (Note 2.)	
Junction and Storage Temperature	T_J, T_{stg}	–55 to +150	°C

1. FR–4 @ Minimum Pad 2. FR–4 @ 1.0 x 1.0 inch Pad

MARKING DIAGRAM



xx = Device Marking
(See Page 2)

DEVICE MARKING INFORMATION

See specific marking information in the device marking table on page 2 of this data sheet.

MUN5311DW1T1 Series

DEVICE MARKING AND RESISTOR VALUES

Device	Package	Marking	R_1(K)	R_2(K)	Shipping
MUN5311DW1T1	SOT–363	11	10	10	3000/Tape & Reel
MUN5312DW1T1	SOT–363	12	22	22	3000/Tape & Reel
MUN5313DW1T1	SOT–363	13	47	47	3000/Tape & Reel
MUN5314DW1T1	SOT–363	14	10	47	3000/Tape & Reel
MUN5315DW1T1 (Note 3.)	SOT–363	15	10	∞	3000/Tape & Reel
MUN5316DW1T1 (Note 3.)	SOT–363	16	4.7	∞	3000/Tape & Reel
MUN5330DW1T1 (Note 3.)	SOT–363	30	1.0	1.0	3000/Tape & Reel
MUN5331DW1T1 (Note 3.)	SOT–363	31	2.2	2.2	3000/Tape & Reel
MUN5332DW1T1 (Note 3.)	SOT–363	32	4.7	4.7	3000/Tape & Reel
MUN5333DW1T1 (Note 3.)	SOT–363	33	4.7	47	3000/Tape & Reel
MUN5334DW1T1 (Note 3.)	SOT–363	34	22	47	3000/Tape & Reel
MUN5335DW1T1 (Note 3.)	SOT–363	35	2.2	47	3000/Tape & Reel

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted, common for Q_1 and Q_2, – minus sign for Q_1 (PNP) omitted)

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
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	MUN5311DW1T1	I_{EBO}	–	–	0.5	mAdc
(V_{EB} = 6.0 V, I_C = 0)	MUN5312DW1T1		–	–	0.2	
	MUN5313DW1T1		–	–	0.1	
	MUN5314DW1T1		–	–	0.2	
	MUN5315DW1T1		–	–	0.9	
	MUN5316DW1T1		–	–	1.9	
	MUN5330DW1T1		–	–	4.3	
	MUN5331DW1T1		–	–	2.3	
	MUN5332DW1T1		–	–	1.5	
	MUN5333DW1T1		–	–	0.18	
	MUN5334DW1T1		–	–	0.13	
	MUN5335DW1T1		–	–	0.2	
Collector-Base Breakdown Voltage (I_C =10 µA, I_E = 0)		$V_{(BR)CBO}$	50	–	–	Vdc
Collector-Emitter Breakdown Voltage(Note 4.)(I_C =2.0 mA,I_B=0)		$V_{(BR)CEO}$	50	–	–	Vdc

3. New resistor combinations. Updated curves to follow in subsequent data sheets.
4. Pulse Test: Pulse Width < 300 µs, Duty Cycle < 2.0%

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted, common for Q_1 and Q_2, – minus sign for Q_1 (PNP) omitted)
(Continued)

Characteristic		Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS(Note 5.)						
DC Current Gain	MUN5311DW1T1	h_{FE}	35	60	–	
(V_{CE} = 10 V, I_C = 5.0 mA)	MUN5312DW1T1		60	100	–	
	MUN5313DW1T1		80	140	–	
	MUN5314DW1T1		80	140	–	
	MUN5315DW1T1		160	350	–	
	MUN5316DW1T1		160	350	–	
	MUN5330DW1T1		3.0	5.0	–	
	MUN5331DW1T1		8.0	15	–	
	MUN5332DW1T1		15	30	–	
	MUN5333DW1T1		80	200	–	
	MUN5334DW1T1		80	150	–	
	MUN5335DW1T1		80	140	–	
Collector-Emitter Saturation Voltage		$V_{CE(sat)}$	–	–	0.25	Vdc
(I_C = 10 mA, I_B = 0.3 mA)						
(I_C = 10 mA, I_B = 5 mA) MUN5330DW1T1/MUN5331DW1T1						
(I_C = 10 mA, I_B = 1 mA) MUN5315DW1T1/MUN5316DW1T1						
MUN5332DW1T1/MUN5333DW1T1/MUN5334DW1T1						
Output Voltage (on)		V_{OL}				Vdc
(V_{CC}= 5.0V, V_B = 2.5V,R_L= 1.0 kΩ)	MUN5311DW1T1		–	–	0.2	
	MUN5312DW1T1		–	–	0.2	
	MUN5314DW1T1		–	–	0.2	
	MUN5315DW1T1		–	–	0.2	
	MUN5316DW1T1		–	–	0.2	
	MUN5330DW1T1		–	–	0.2	
	MUN5331DW1T1		–	–	0.2	
	MUN5332DW1T1		–	–	0.2	
	MUN5333DW1T1		–	–	0.2	
	MUN5334DW1T1		–	–	0.2	
	MUN5335DW1T1		–	–	0.2	
(V_{CC}=5.0V,V_B=3.5 V, R_L=1.0kΩ)	MUN5313DW1T1		–	–	0.2	

ELECTRICAL CHARACTERISTICS

(T_A = 25°C unless otherwise noted, common for Q_1 and Q_2, – minus sign for Q_1 (PNP) omitted) (Continued)

Characteristic		Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS(Note 5.)						
Output Voltage (off)		V_{OH}	4.9	–	–	Vdc
(V_{CC}=5.0V, V_B=0.5V, R_L=1.0kΩ)						
(V_{CC}=5.0V, V_B=0.050V, R_L=1.0kΩ)	MUN5330DW1T1					
(V_{CC}=5.0V, V_B=0.25V, R_L=1.0kΩ)	MUN5315DW1T1					
	MUN5316DW1T1					
	MUN5333DW1T1					
Input Resistor	MUN5311DW1T1	R_1	7.0	10	13	kΩ
	MUN5312DW1T1		15.4	22	28.6	
	MUN5313DW1T1		32.9	47	61.1	
	MUN5314DW1T1		7.0	10	13	
	MUN5315DW1T1		7.0	10	13	
	MUN5316DW1T1		3.3	4.7	6.1	
	MUN5330DW1T1		0.7	1.0	1.3	
	MUN5331DW1T1		1.5	2.2	2.9	
	MUN5332DW1T1		3.3	4.7	6.1	
	MUN5333DW1T1		3.3	4.7	6.1	
	MUN5334DW1T1		15.4	22	28.6	
	MUN5335DW1T1		1.54	2.2	2.86	
Resistor Ratio		R_1/R_2				
MUN5311DW1T1/MUN5312DW1T1/MUN5313DW1T1			0.8	1.0	1.2	
MUN5314DW1T1			0.17	0.21	0.25	
MUN5315DW1T1/MUN5316DW1T1			–	–	–	
MUN5330DW1T1/MUN5331DW1T1/MUN5332DW1T1			0.8	1.0	1.2	
MUN5333DW1T1			0.055	0.1	0.185	
MUN5334DW1T1			0.38	0.47	0.56	
MUN5335DW1T1			0.038	0.047	0.056	

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

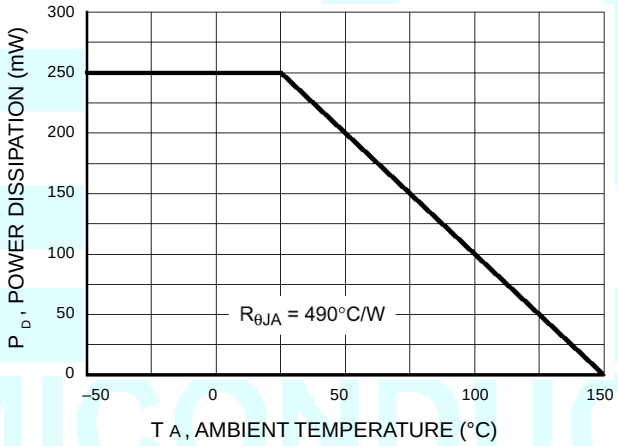


Figure 1. Derating Curve

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5311DW1T1 NPN TRANSISTOR

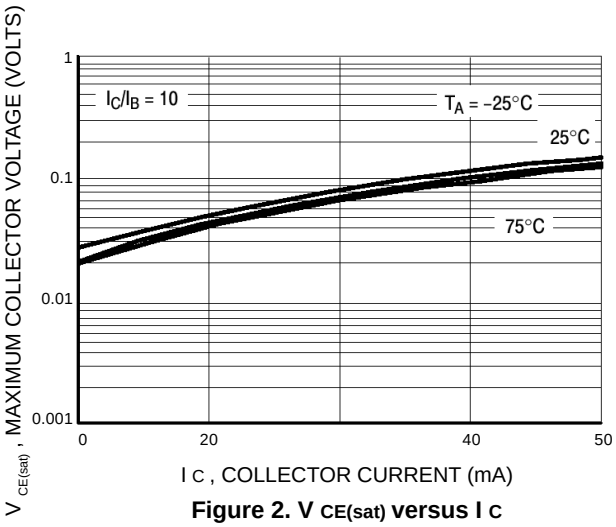


Figure 2. $V_{CE(sat)}$ versus I_C

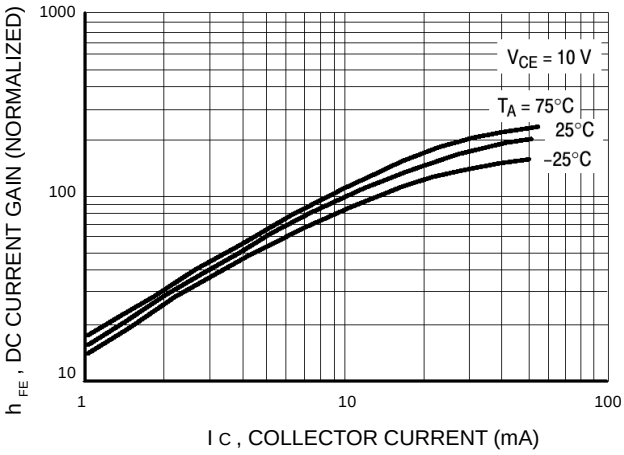


Figure 3. DC Current Gain

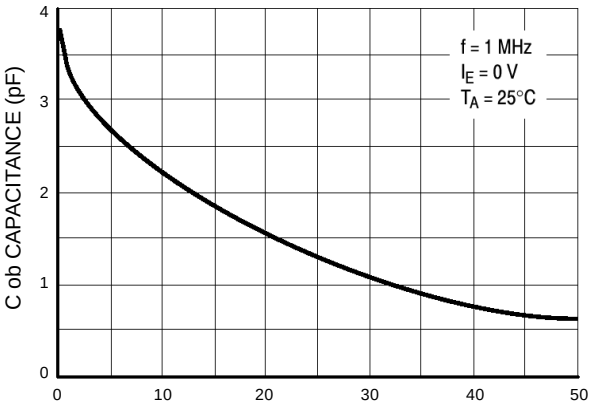


Figure 4. Output Capacitance

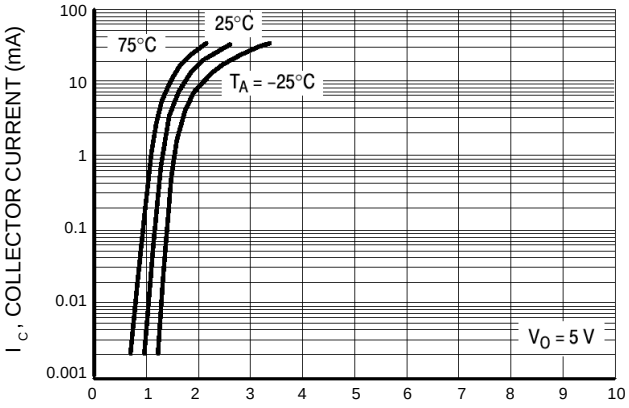


Figure 5. Output Current versus Input Voltage

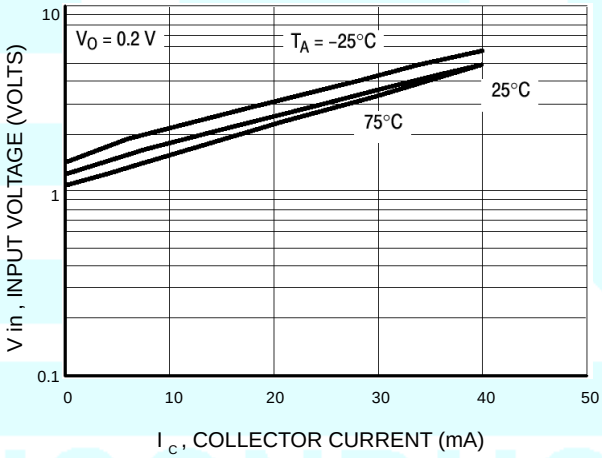


Figure 6. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5311DW1T1 PNP TRANSISTOR

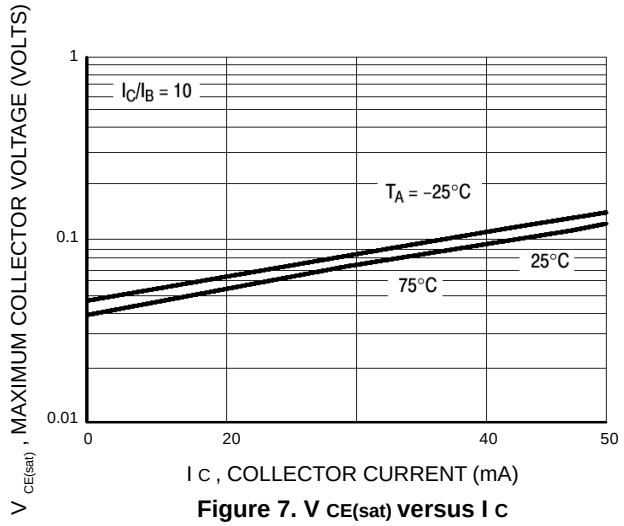


Figure 7. $V_{CE(sat)}$ versus I_C

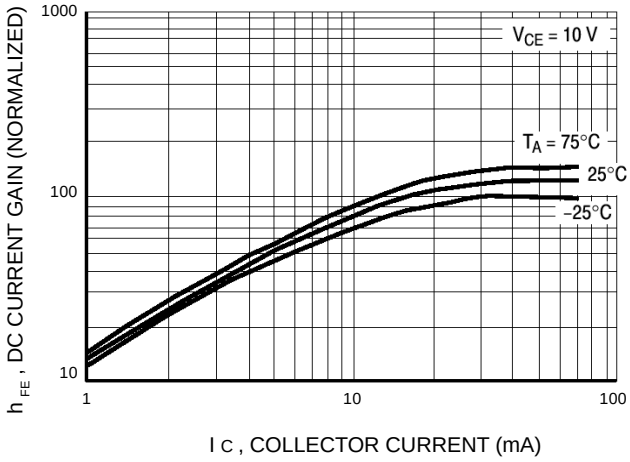


Figure 8. DC Current Gain

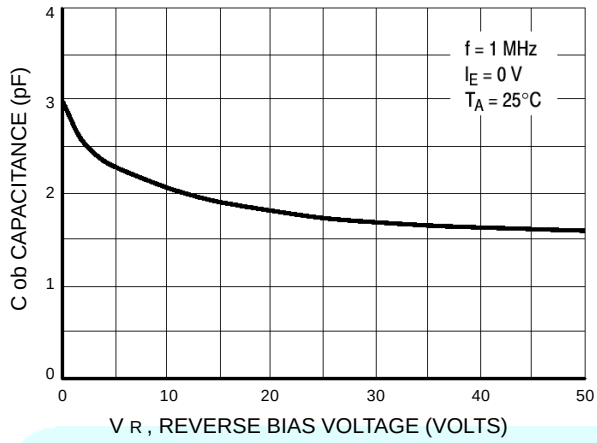


Figure 9. Output Capacitance

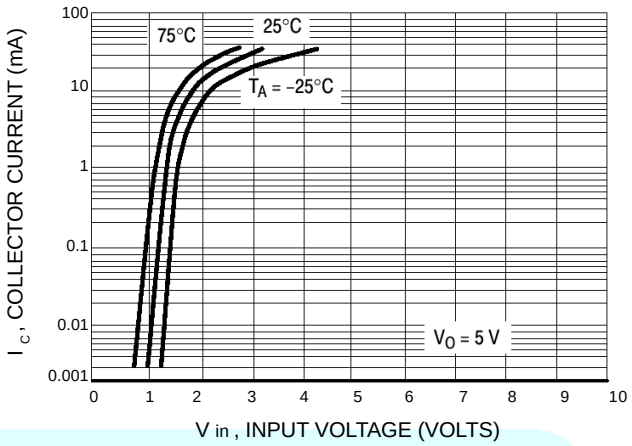


Figure 10. Output Current versus Input oltage

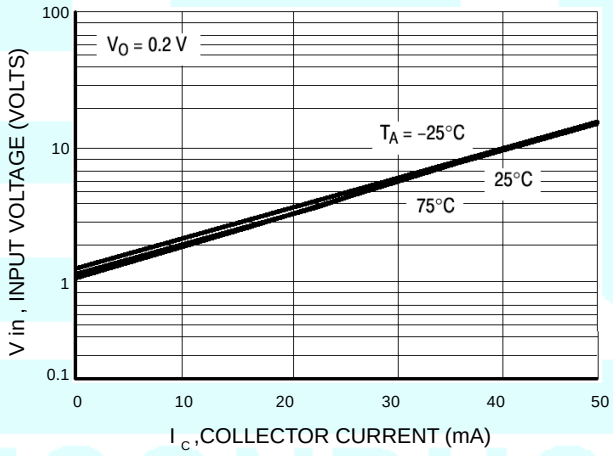


Figure 11. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5312DW1T1 NPN TRANSISTOR

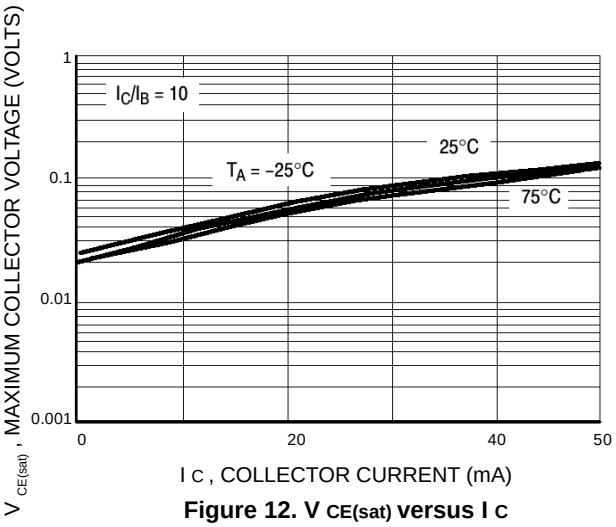


Figure 12. $V_{CE(sat)}$ versus I_C

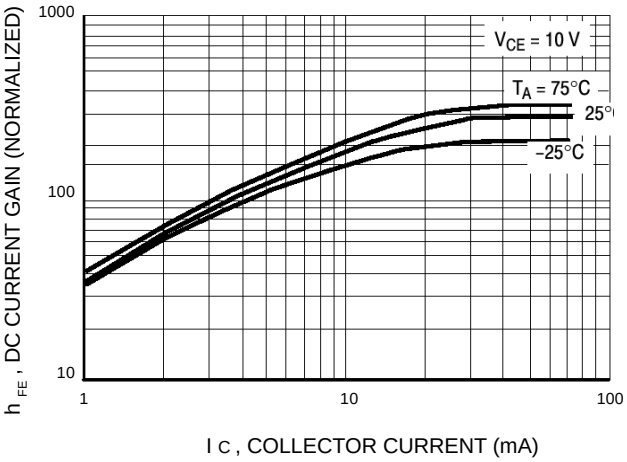


Figure 13. DC Current Gain

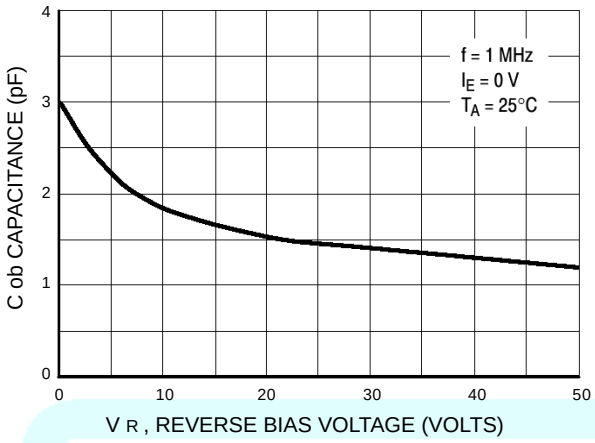


Figure 14. Output Capacitance

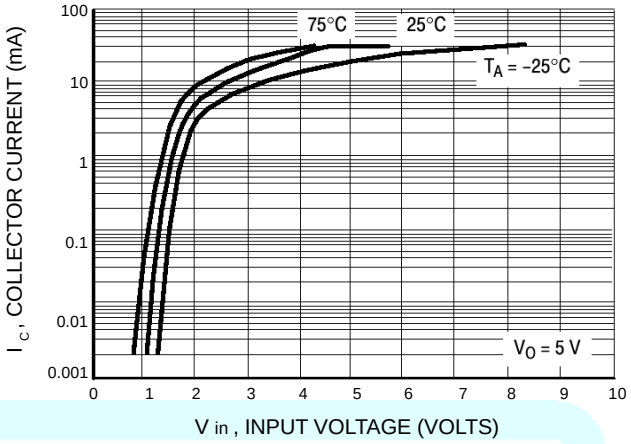


Figure 15. Output Current versus Input oltage

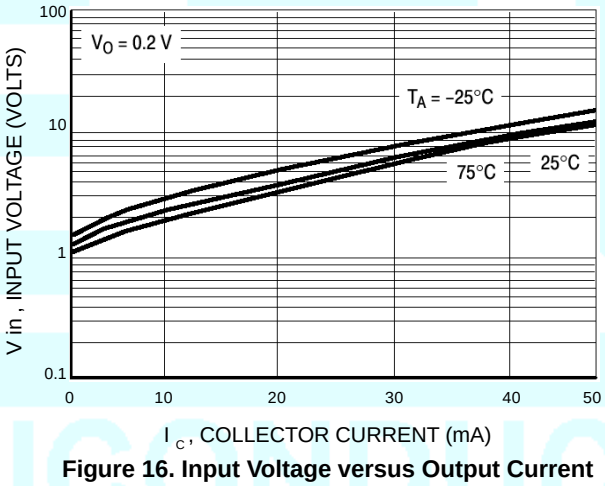


Figure 16. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5312DW1T1 PNP TRANSISTOR

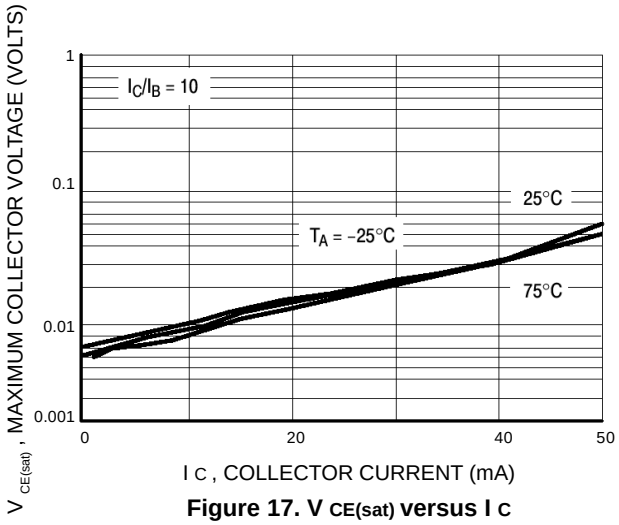


Figure 17. $V_{CE(sat)}$ versus I_C

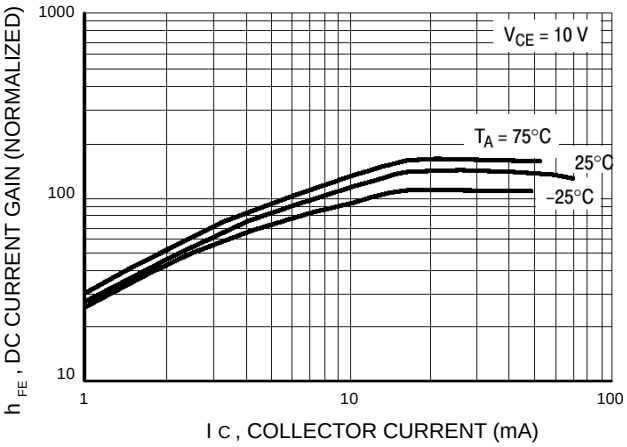


Figure 18. DC Current Gain

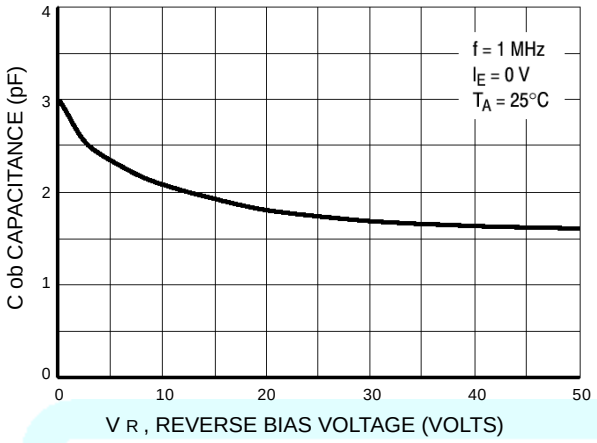


Figure 19. Output Capacitance

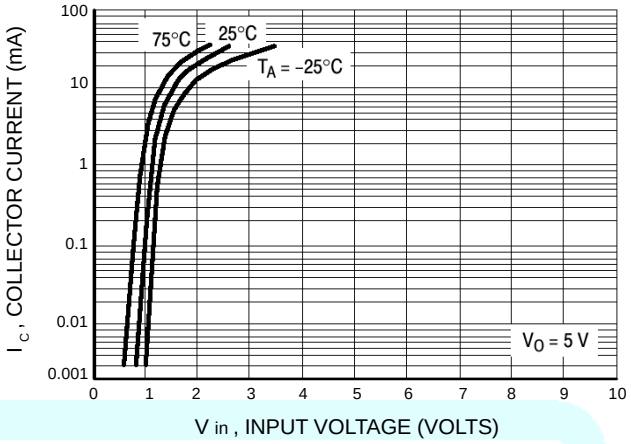


Figure 20. Output Current versus Input oltage

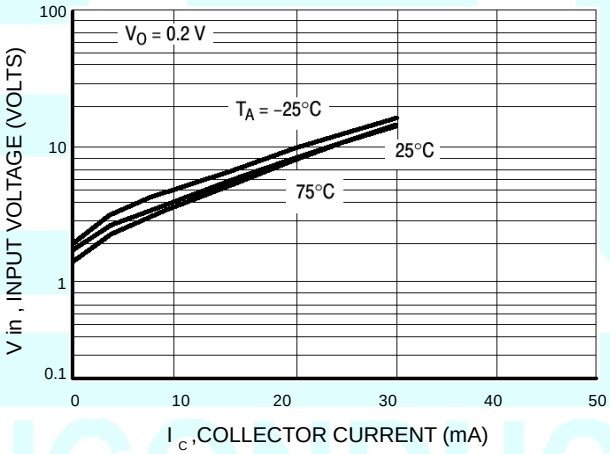


Figure 21. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5313DW1T1 NPN TRANSISTOR

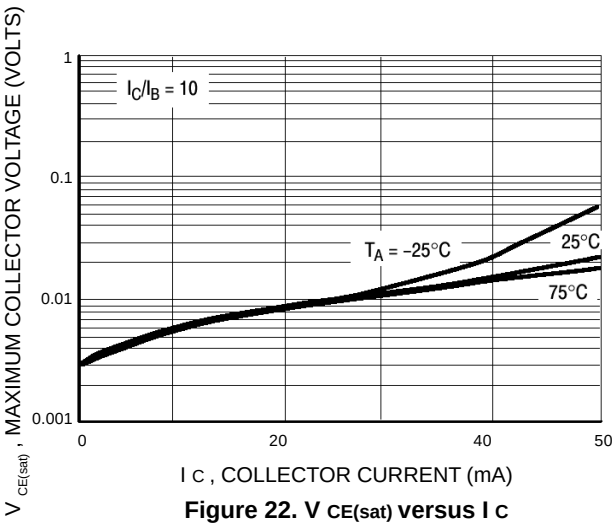


Figure 22. $V_{CE(sat)}$ versus I_C

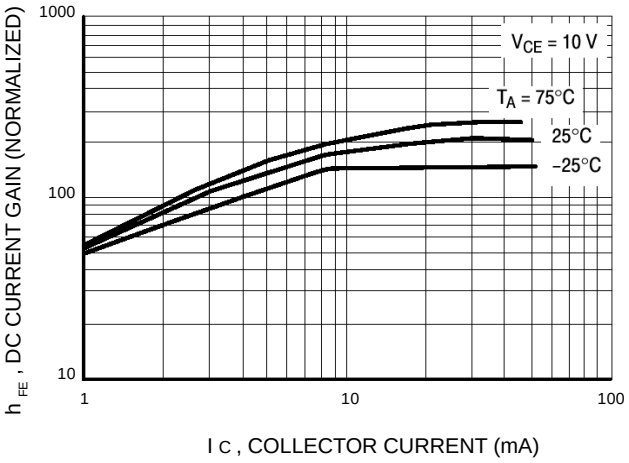


Figure 23. DC Current Gain

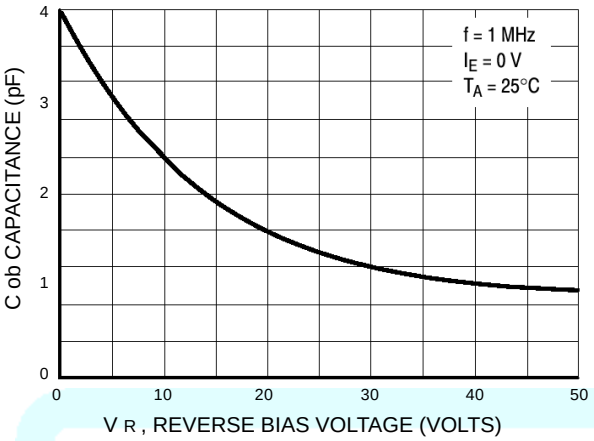


Figure 24. Output Capacitance

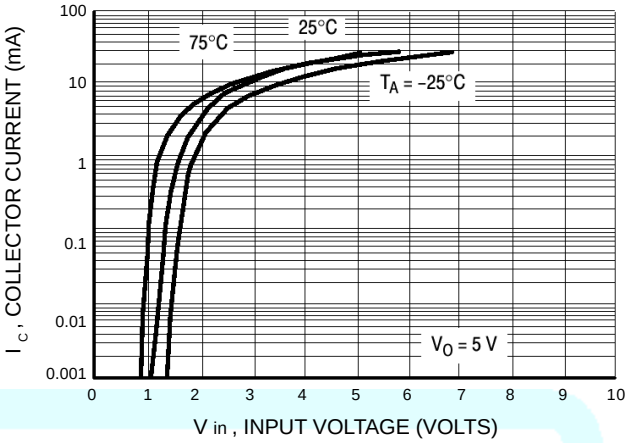


Figure 25. Output Current versus Input oltage

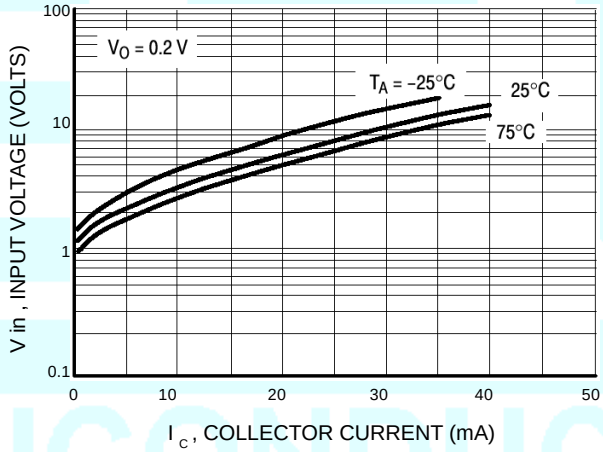


Figure 26. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5313DW1T1 PNP TRANSISTOR

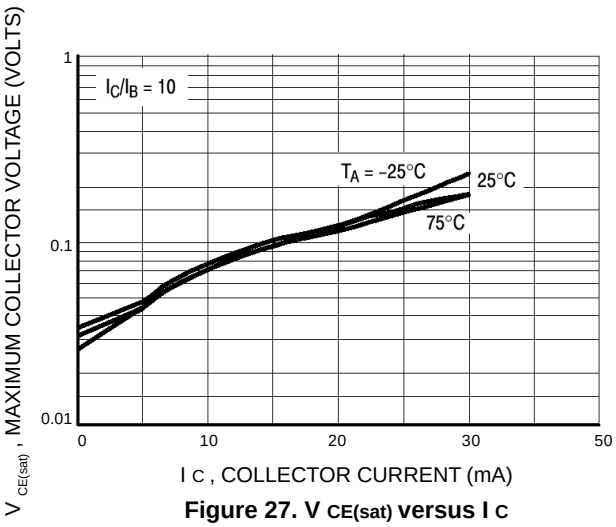


Figure 27. V CE(sat) versus I C

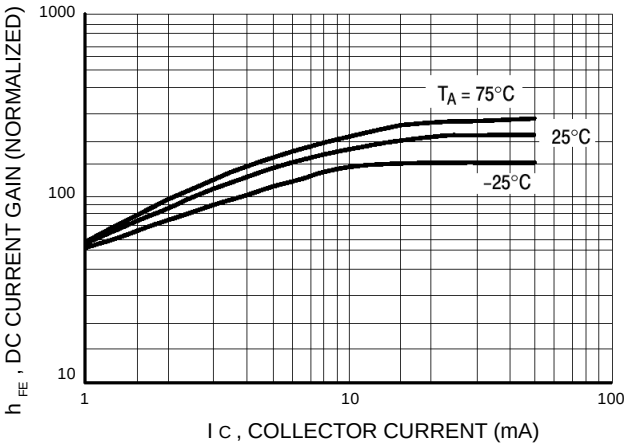


Figure 28. DC Current Gain

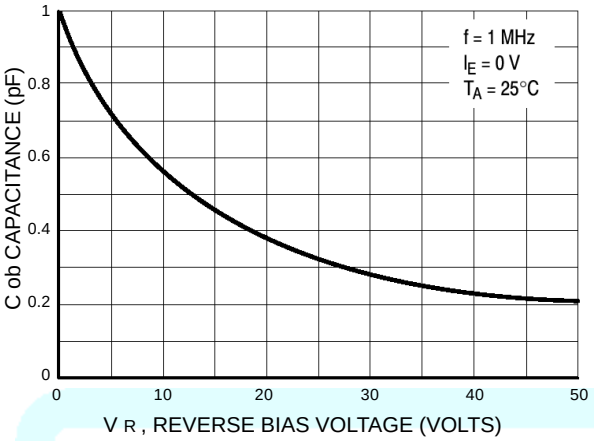


Figure 29. Output Capacitance

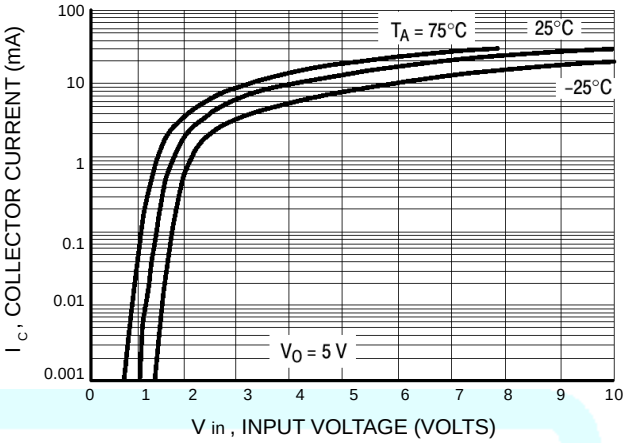


Figure 30. Output Current versus Input oltage

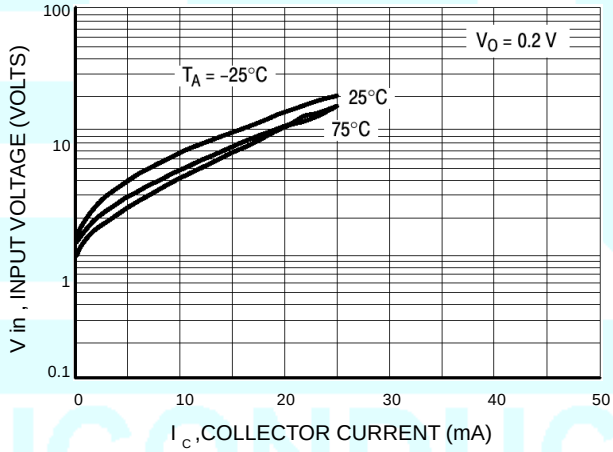


Figure 31. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5314DW1T1 NPN TRANSISTOR

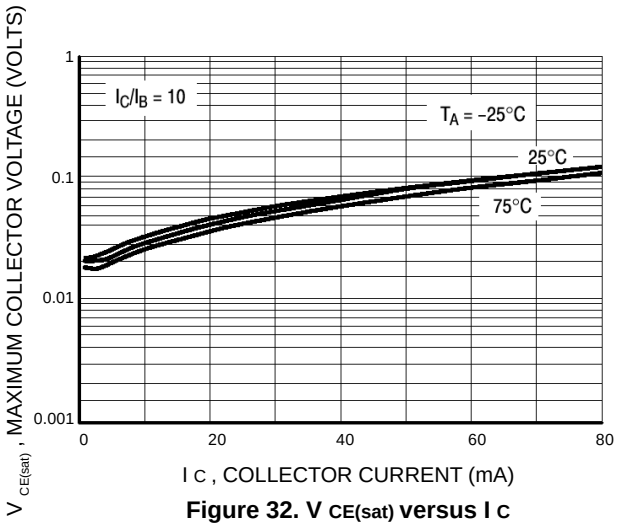


Figure 32. $V_{CE(sat)}$ versus I_C

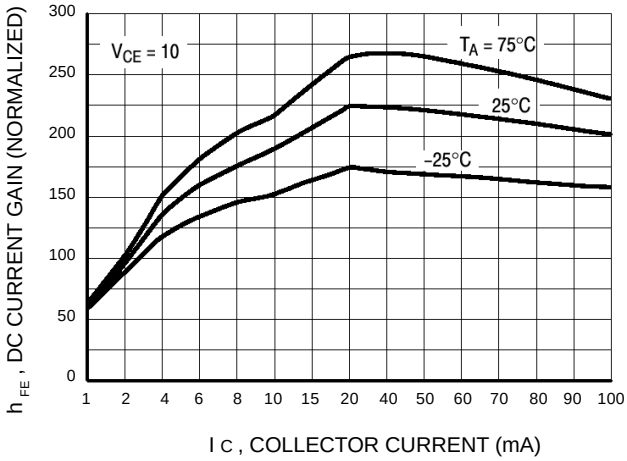


Figure 33. DC Current Gain

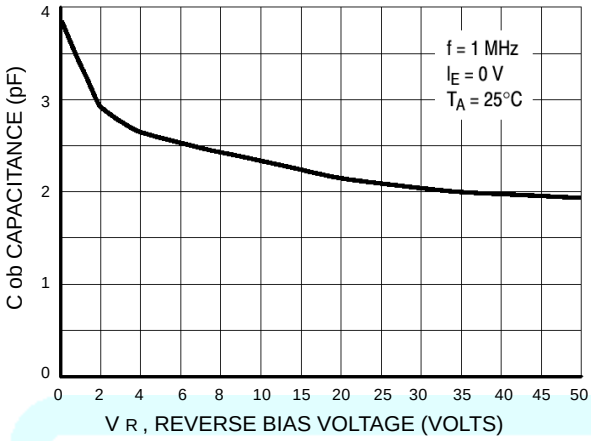


Figure 34. Output Capacitance

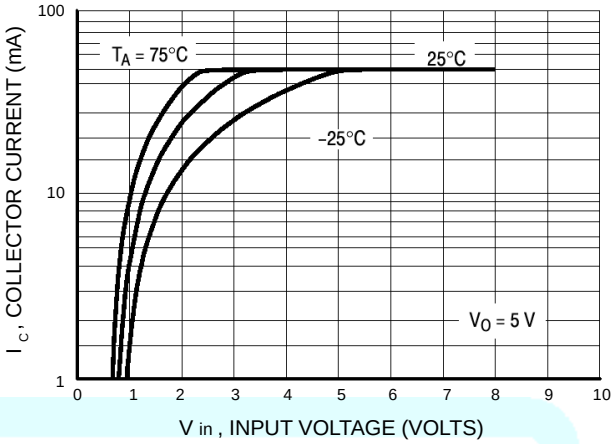


Figure 35. Output Current versus Input oltage

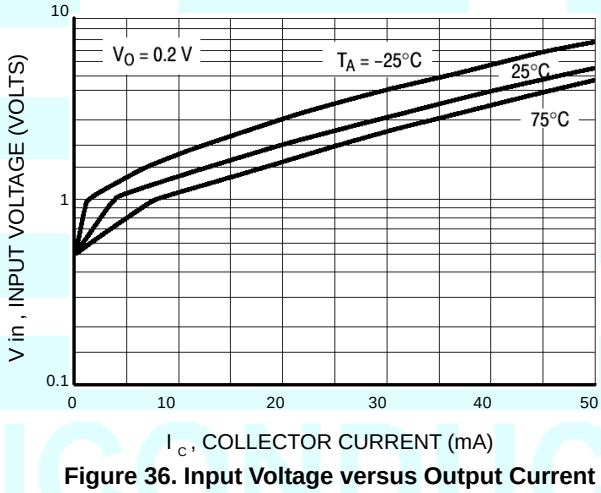


Figure 36. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5314DW1T1 PNP TRANSISTOR

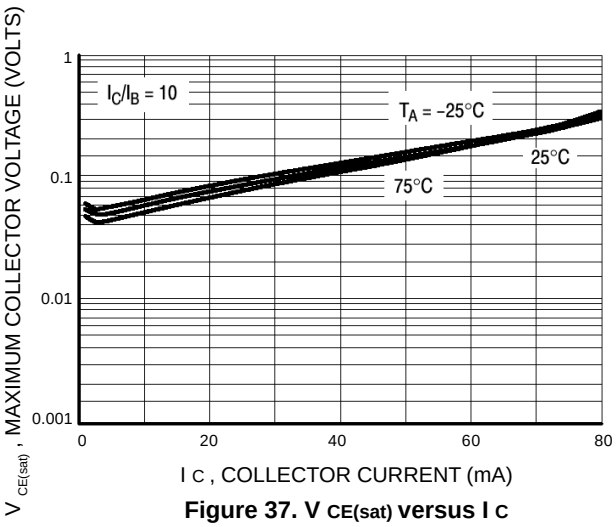


Figure 37. $V_{CE(sat)}$ versus I_C

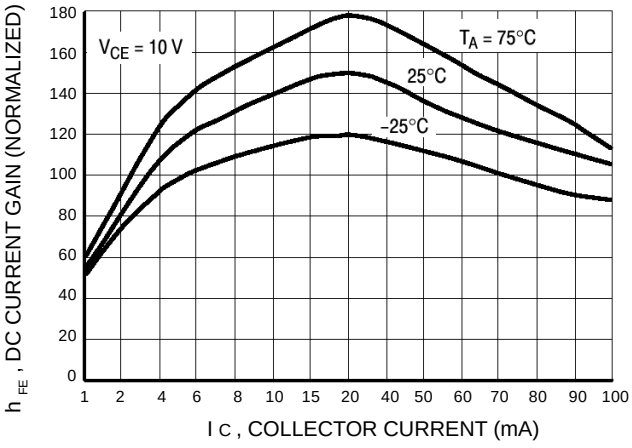


Figure 38. DC Current Gain

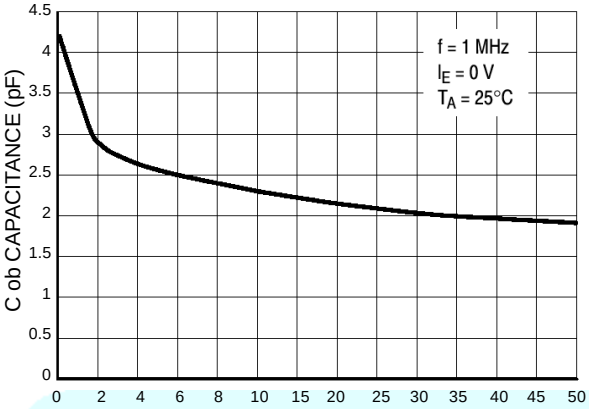


Figure 39. Output Capacitance

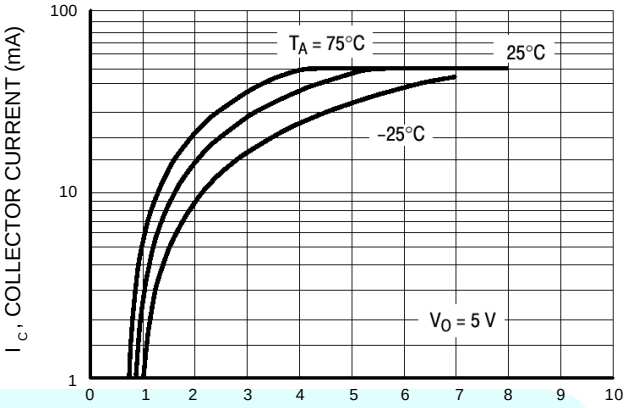


Figure 40. Output Current versus Input oltage

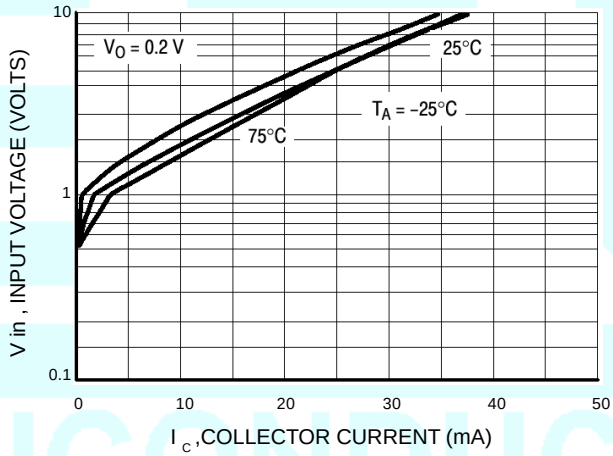


Figure 41. Input Voltage versus Output Current

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5315DW1T1

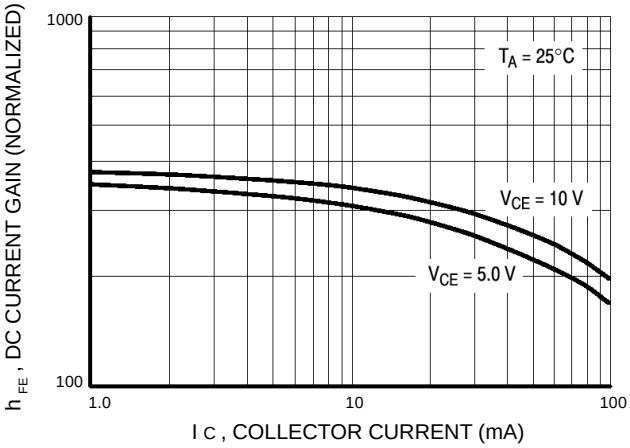


Figure 42. DC Current Gain–PNP

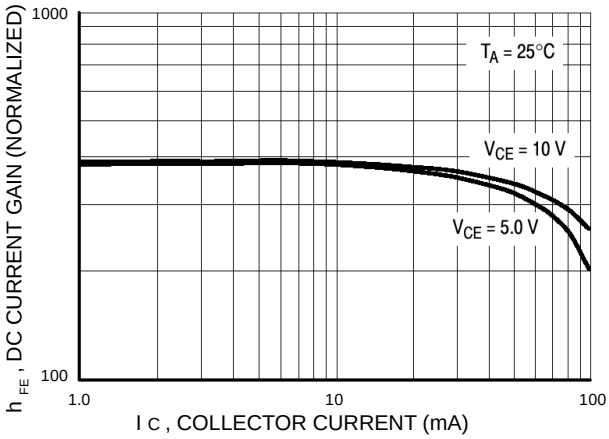


Figure 43. DC Current Gain–NPN

TYPICAL ELECTRICAL CHARACTERISTICS – MUN5316DW1T1

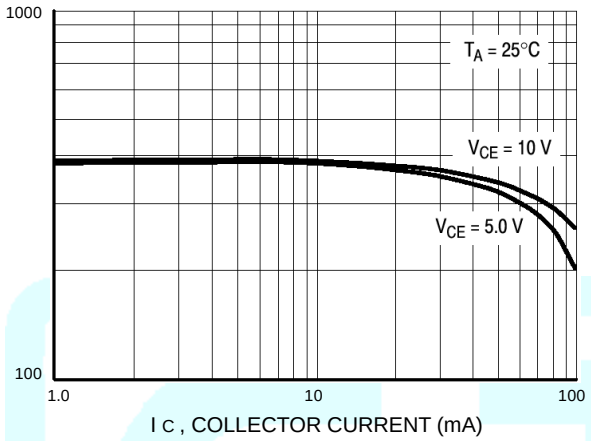


Figure 44. DC Current Gain–PNP

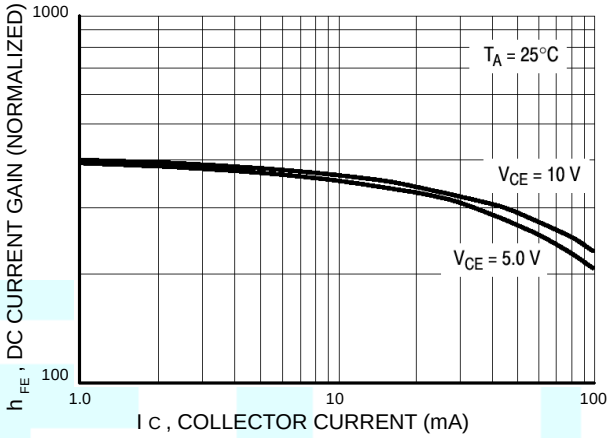


Figure 45. DC Current Gain–NPN