

FMUN5311DW1 THRU FMUN5335DW1

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FMUN5311DW1 THRU FMUN5335DW1

Dual Bias Resistor Transistor NPN and PNP Silicon Surface Mount Transistor with Monolithic Bias Resistor Network

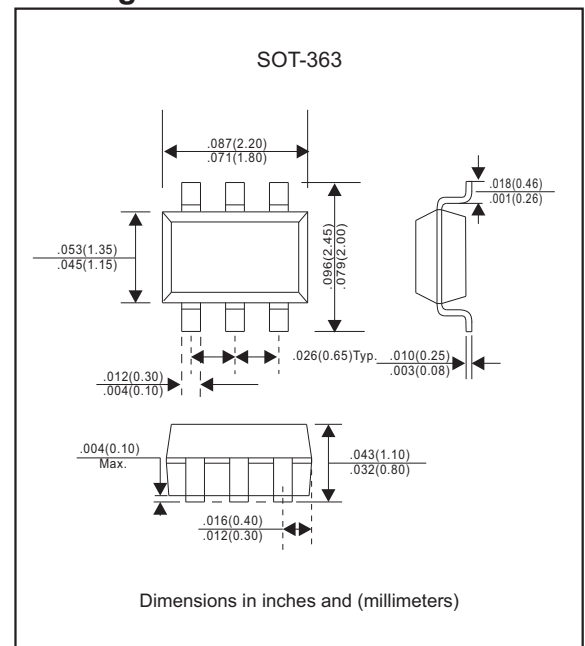
Features

- Simplifies circuit design
- Reduces board space
- Reduces component count
- Lead-free parts meet RoHS requirements
- Suffix "-H" indicates Halogen-free part, ex.FMUN5311DW1-H

Mechanical data

- Epoxy:UL94-V0 rated flame retardant
- Case : Molded plastic, SOT-363
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026
- Polarity : See Diagram
- Mounting Position : Any
- Weight : Approximated 0.006 gram

Package outline



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

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

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Electrical characteristics (AT $T_A=25^\circ\text{C}$ unless otherwise noted,
common for Q1 and Q2, – minus sign for Q1 (PNP) omitted) (Continued)

Characteristic		Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS (Note 4)						
DC Current Gain (VCE = 10 V, IC = 5.0 mA)	FMUN5311DW1 FMUN5312DW1 FMUN5313DW1 FMUN5314DW1 FMUN5315DW1 FMUN5316DW1 FMUN5330DW1 FMUN5331DW1 FMUN5332DW1 FMUN5333DW1 FMUN5334DW1 FMUN5335DW1	hFE	35 60 80 80 160 160 3.0 8.0 15 80 80 80	60 100 140 140 350 350 5.0 15 30 200 150 140	— — — — — — — — — — — —	
Collector-Emitter Saturation Voltage (IC = 10mA, IB = 0.3mA) (I C = 10mA, IB = 5mA) FMUN5330DW1/FMUN5331DW1 (I C = 10mA, IB = 1mA) FMUN5315DW1/FMUN5316DW1 FMUN5332DW1/FMUN5333DW1/FMUN5334DW1		VCE(sat)	—	—	0.25	Vdc
Output Voltage (on) (VCC = 5.0 V, VB = 2.5 V, RL = 1.0 kΩ)	FMUN5311DW1 FMUN5312DW1 FMUN5314DW1 FMUN5315DW1 FMUN5316DW1 FMUN5330DW1 FMUN5331DW1 FMUN5332DW1 FMUN5333DW1 FMUN5334DW1 FMUN5335DW1 FMUN5313DW1	VOL	— — — — — — — — — — — —	— — — — — — — — — — — —	0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	Vdc
Output Voltage (off) (VCC = 5.0V, VB = 0.5V, RL = 1.0 kΩ) (VCC = 5.0 V, VB = 0.05 V, RL = 1.0 kΩ) (VCC = 5.0 V, VB = 0.25 V, RL = 1.0 kΩ)	FMUN5330DW1 FMUN5315DW1 FMUN5316DW1 FMUN5333DW1	VOH	4.9	—	—	Vdc

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

FMUN5311DW1 THRU FMUN5335DW1

Electrical characteristics (AT $T_A=25^{\circ}\text{C}$ unless otherwise noted,
common for Q1 and Q2, – minus sign for Q1 (PNP) omitted) (Continued)

Characteristic		Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS (Note 4)						
Input Resistor	FMUN5311DW1	R_1	7.0	10	13	k Ω
	FMUN5312DW1		15.4	22	28.6	
	FMUN5313DW1		32.9	47	61.1	
	FMUN5314DW1		7.0	10	13	
	FMUN5315DW1		7.0	10	13	
	FMUN5316DW1		3.3	4.7	6.1	
	FMUN5330DW1		0.7	1.0	1.3	
	FMUN5331DW1		1.5	2.2	2.9	
	FMUN5332DW1		3.3	4.7	6.1	
	FMUN5333DW1		3.3	4.7	6.1	
	FMUN5334DW1		15.4	22	28.6	
	FMUN5335DW1		1.54	2.2	2.86	
Resistor Ratio	FMUN5311DW1/FMUN5312DW1	R_1/R_2	0.8	1.0	1.2	
	FMUN5313DW1					
	FMUN5314DW1		0.17	0.21	0.25	
	FMUN5315DW1/FMUN5316DW1		–	–	–	
	FMUN5330DW1/FMUN5331DW1		0.8	1.0	1.2	
	FMUN5332DW1					
	FMUN5333DW1		0.055	0.1	0.185	
	FMUN5334DW1		0.38	0.47	0.56	
	FMUN5335DW1		0.038	0.047	0.056	

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

FMUN5311DW1 THRU FMUN5335DW1

Electrical characteristics (AT $T_A = 25^\circ\text{C}$ unless otherwise noted,
common for Q1 and Q2, – minus sign for Q1 (PNP) omitted)

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector-Base Cutoff Current	($V_{CB} = 50\text{V}$, $I_E = 0$)	I_{CBO}	–	–	100	nAdc
Collector-Emitter Cutoff Current	($V_{CE} = 50\text{V}$, $I_B = 0$)	I_{CEO}	–	–	500	nAdc
Emitter-Base Cutoff Current ($V_{EB} = 6.0\text{V}$, $I_C = 0$)	FMUN5311DW1	I_{EBO}	–	–	0.5	mAdc
	FMUN5312DW1		–	–	0.2	
	FMUN5313DW1		–	–	0.1	
	FMUN5314DW1		–	–	0.2	
	FMUN5315DW1		–	–	0.9	
	FMUN5316DW1		–	–	1.9	
	FMUN5330DW1		–	–	4.3	
	FMUN5331DW1		–	–	2.3	
	FMUN5332DW1		–	–	1.5	
	FMUN5333DW1		–	–	0.18	
	FMUN5334DW1		–	–	0.13	
	FMUN5335DW1		–	–	0.2	
Collector-Base Breakdown Voltage ($I_C = 10\mu\text{A}$, $I_E = 0$)		$V_{(BR)CBO}$	50	–	–	Vdc
Collector-Emitter Breakdown Voltage(Note 3.)($I_C = 2.0\text{mA}$, $I_B = 0$)		$V_{(BR)CEO}$	50	–	–	Vdc

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

Resistor Values

Device	R1(K)	R2(K)	Device	R1(K)	R2(K)
FMUN5311DW1	10	10	FMUN5331DW1	2.2	2.2
FMUN5312DW1	22	22	FMUN5332DW1	4.7	4.7
FMUN5313DW1	47	47	FMUN5333DW1	4.7	47
FMUN5314DW1	10	47	FMUN5334DW1	22	47
FMUN5315DW1	10	∞	FMUN5335DW1	2.2	47
FMUN5316DW1	4.7	∞			
FMUN5330DW1	1.0	1.0			

ALL FMUN5311DW1 SERIES DEVICES

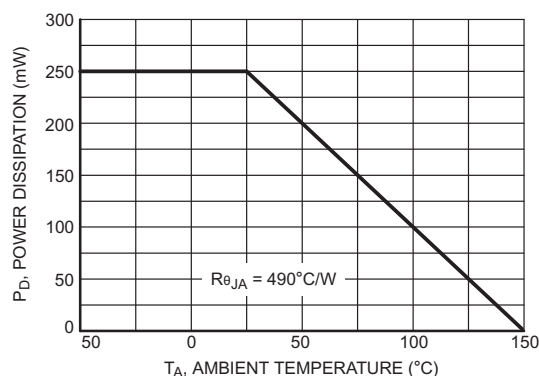


Figure 1. Derating Curve

Typical Electrical Characteristics (FMUN5311DW1)NPN

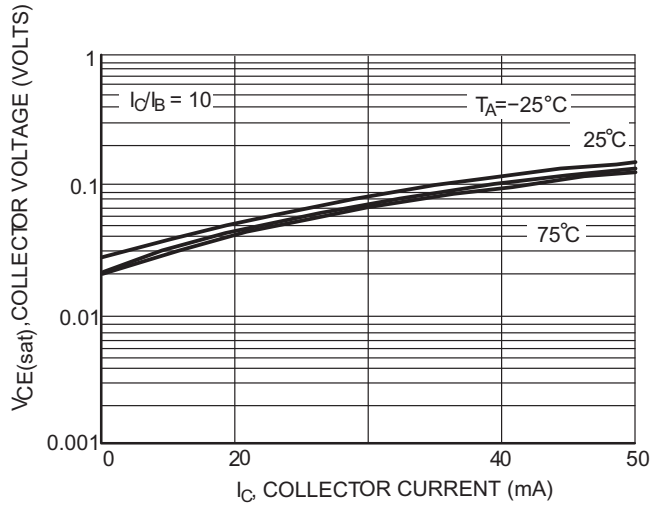


Figure 2. $V_{CE(sat)}$ versus I_C

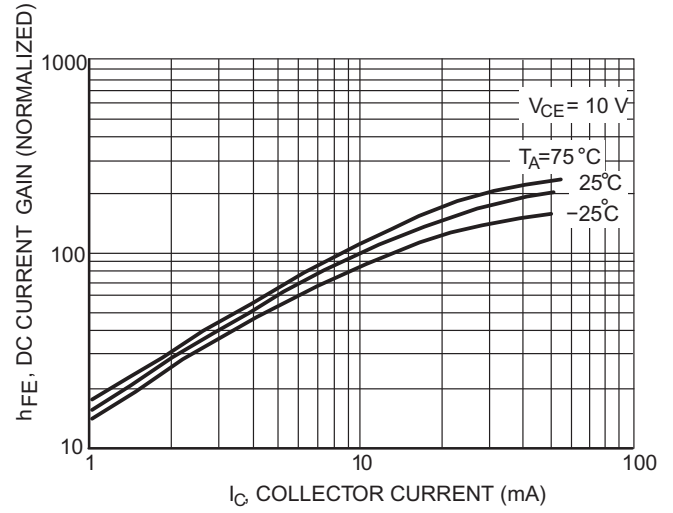


Figure 3. DC Current Gain

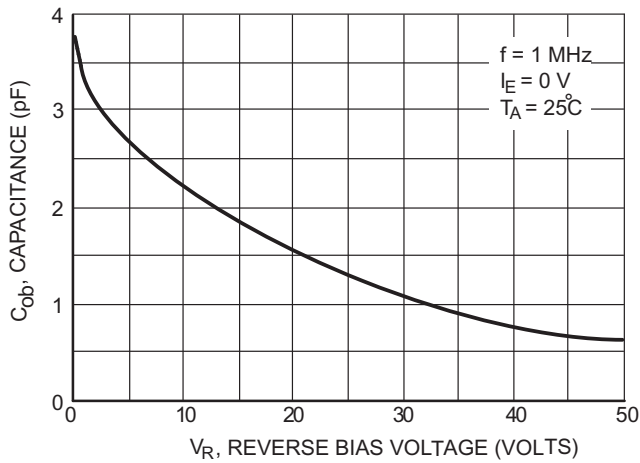


Figure 4. Output Capacitance

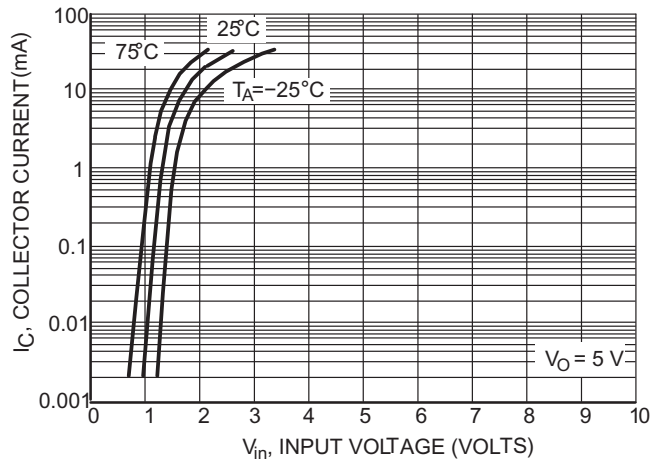


Figure 5. Output Current versus Input Voltage

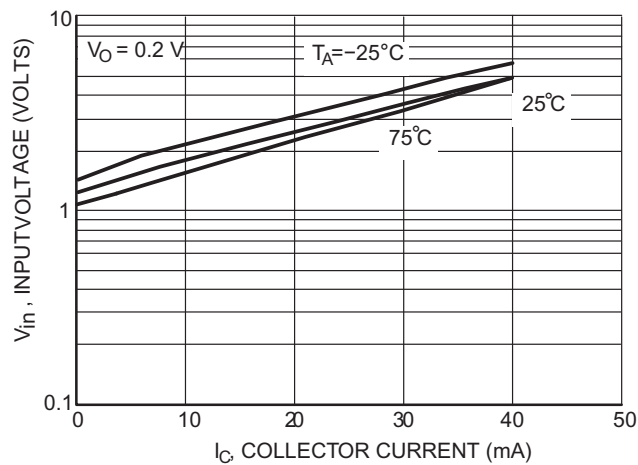


Figure 6. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5311DW1)PNP

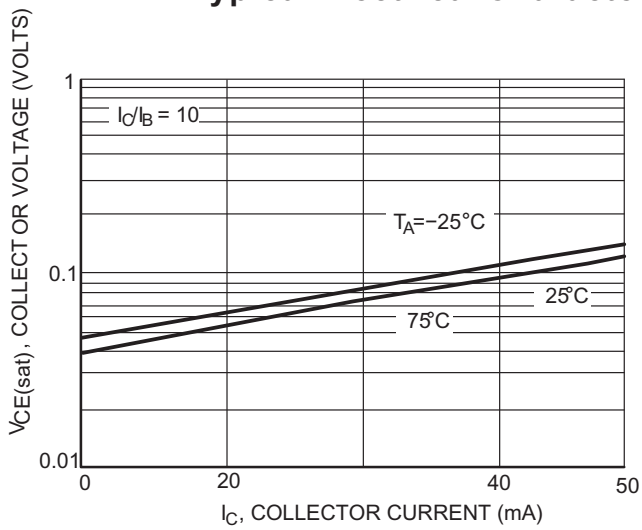


Figure 7. $V_{CE(sat)}$ versus I_C

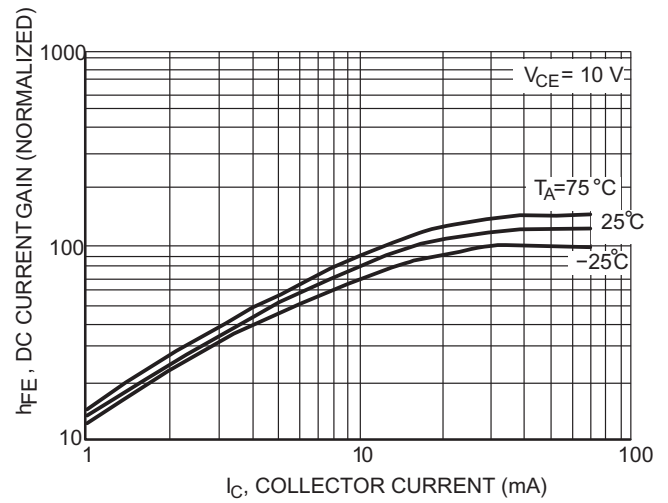


Figure 8. DC Current Gain

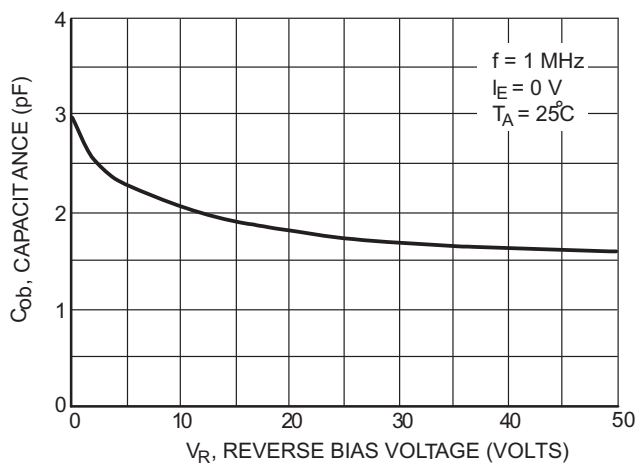


Figure 9. Output Capacitance

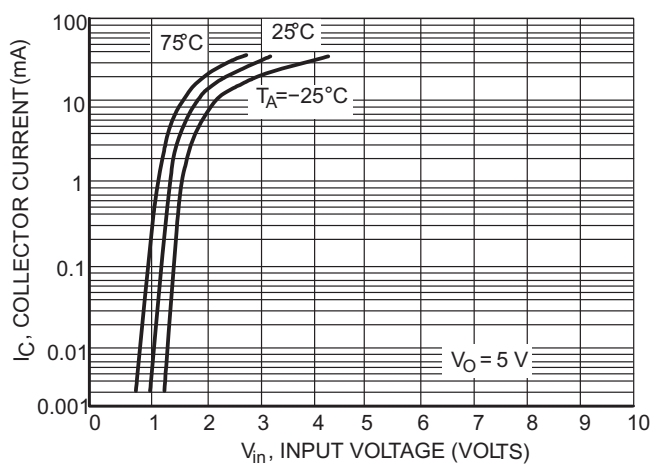


Figure 10. Output Current versus Input Voltage

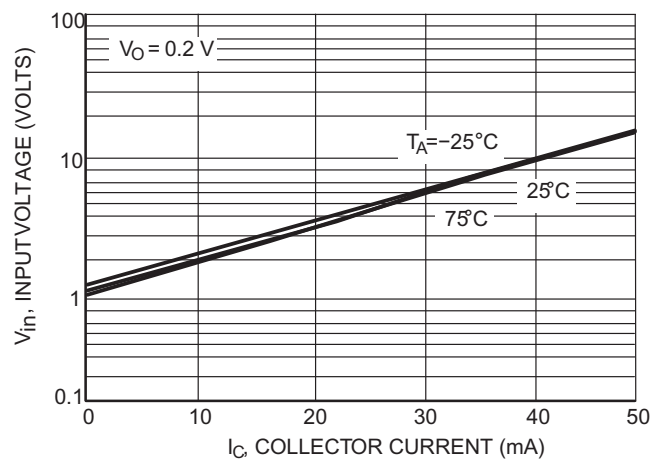


Figure 11. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5312DW1)NPN

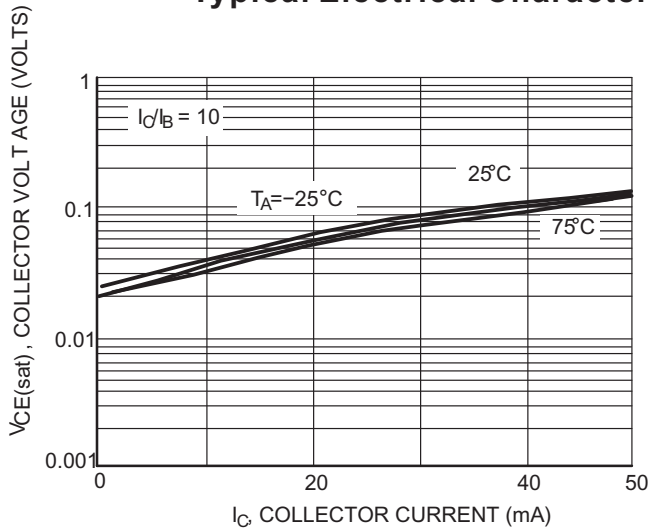


Figure 12. $V_{CE(sat)}$ versus I_C

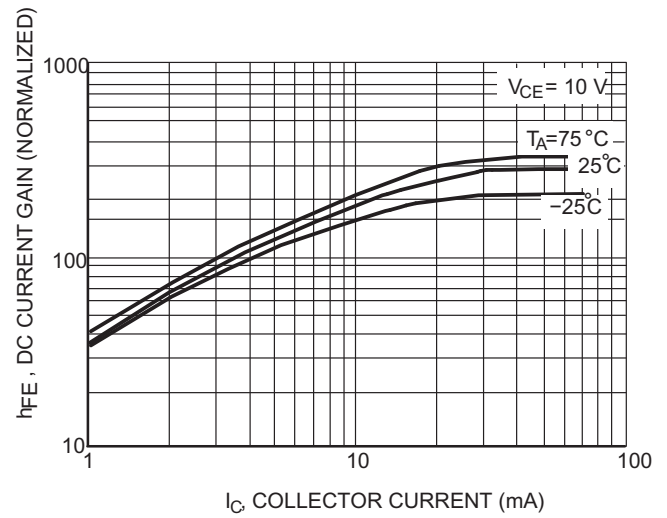


Figure 13. DC Current Gain

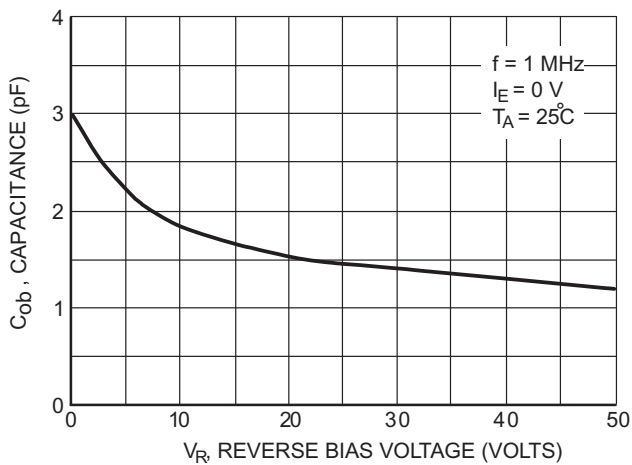


Figure 14. Output Capacitance

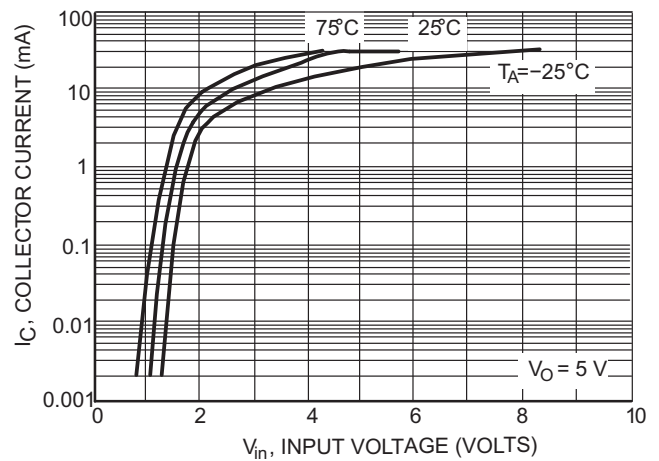


Figure 15. Output Current versus Input Voltage

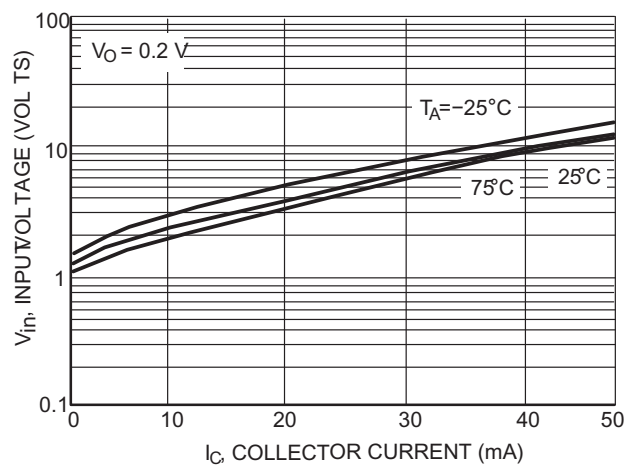


Figure 16. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5312DW1)PNP

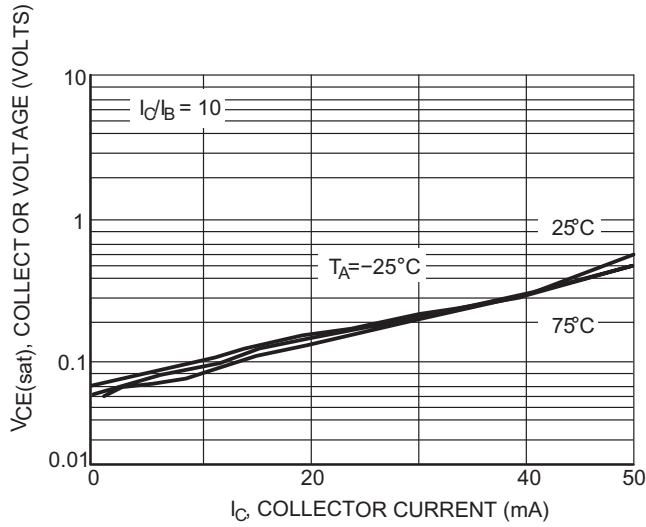


Figure 17. $V_{CE(sat)}$ versus I_C

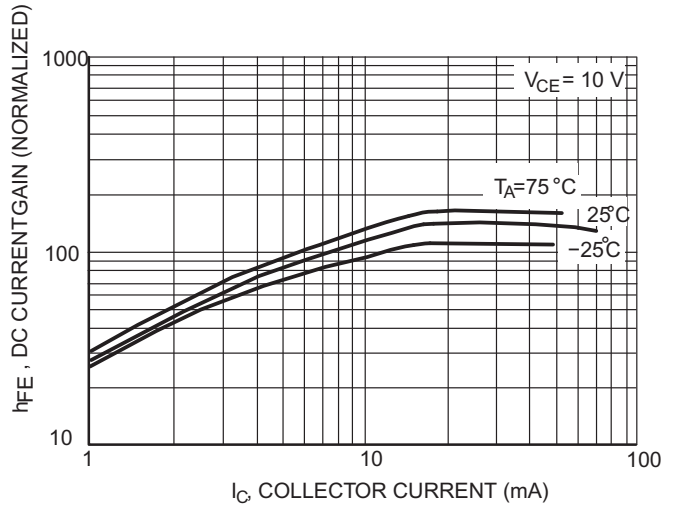


Figure 18. DC Current Gain

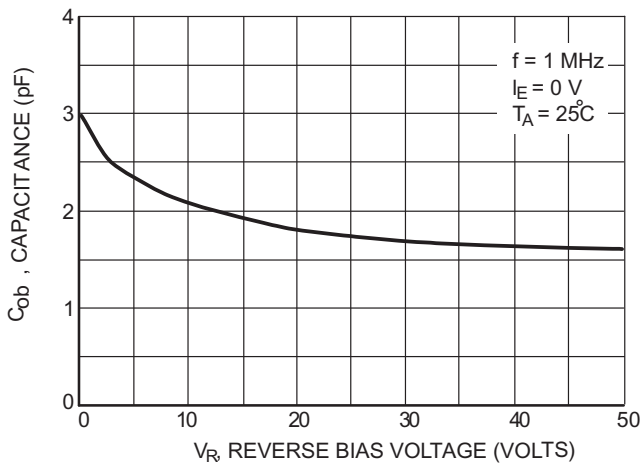


Figure 19. Output Capacitance

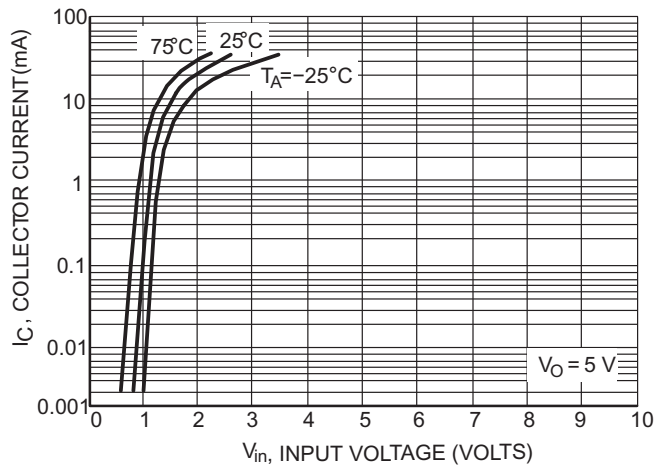


Figure 20. Output Current versus Input Voltage

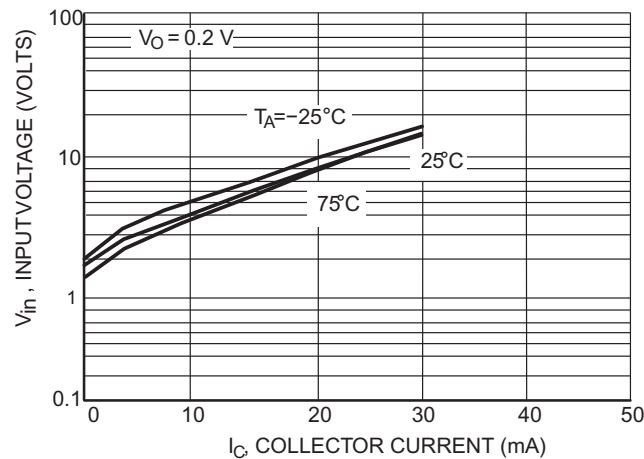


Figure 21. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5313DW1)NPN

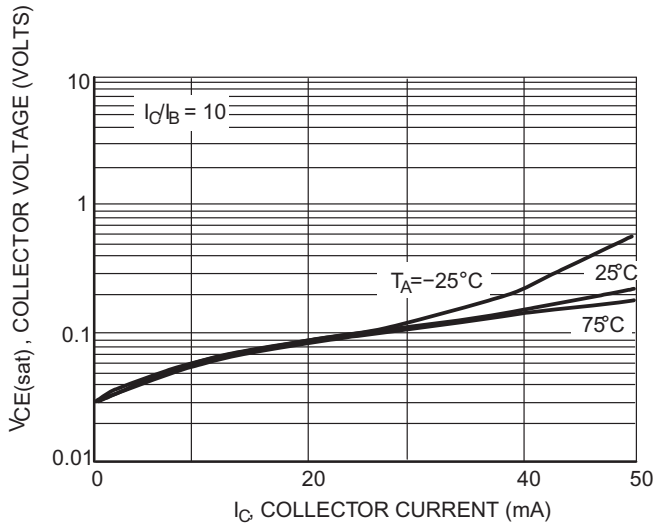


Figure 22. $V_{CE(sat)}$ versus I_C

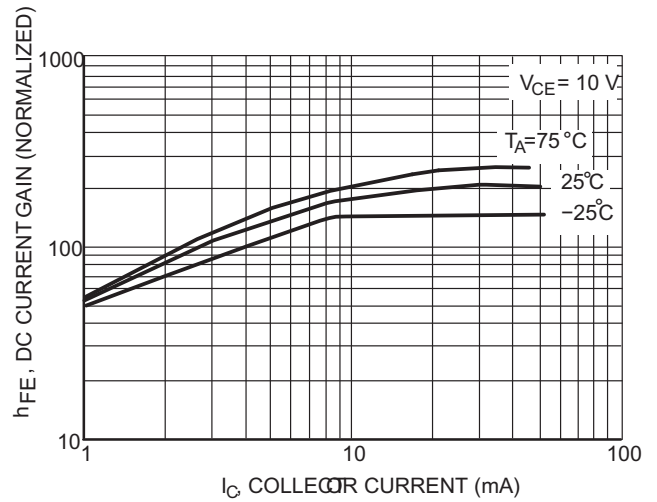


Figure 23. DC Current Gain

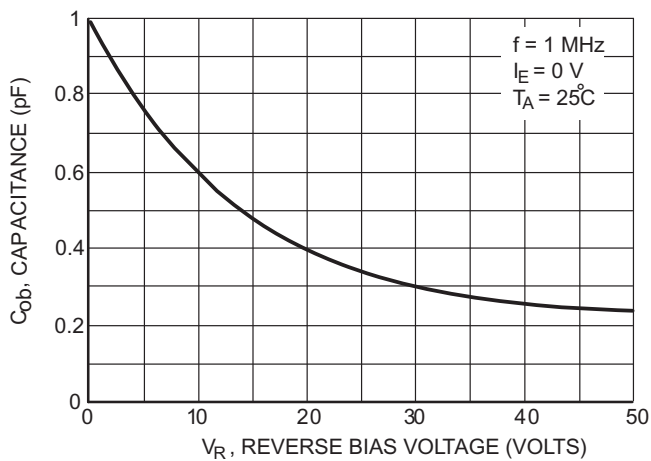


Figure 24. Output Capacitance

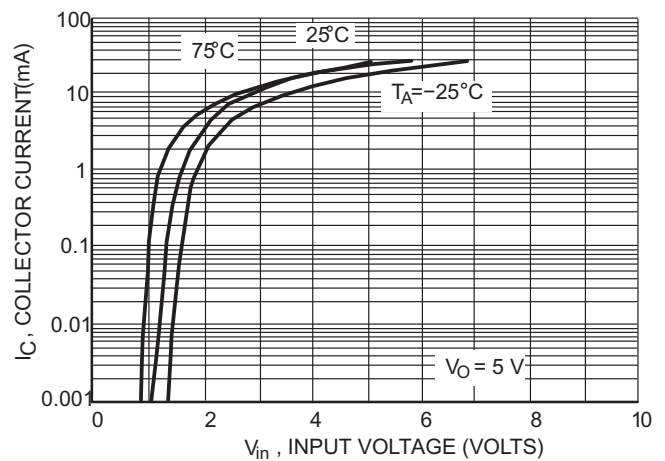


Figure 25. Output Current versus Input Voltage

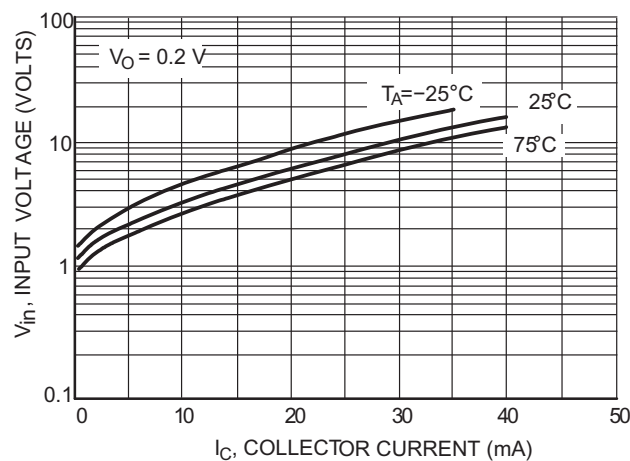


Figure 26. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5313DW1)PNP

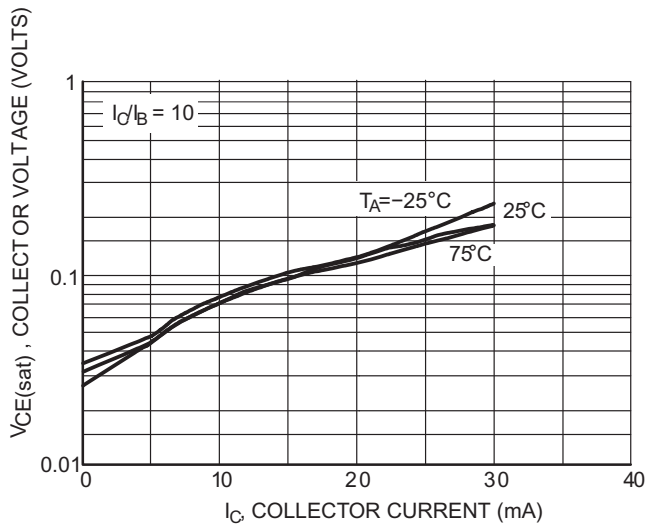


Figure 27. $V_{CE(sat)}$ versus I_C

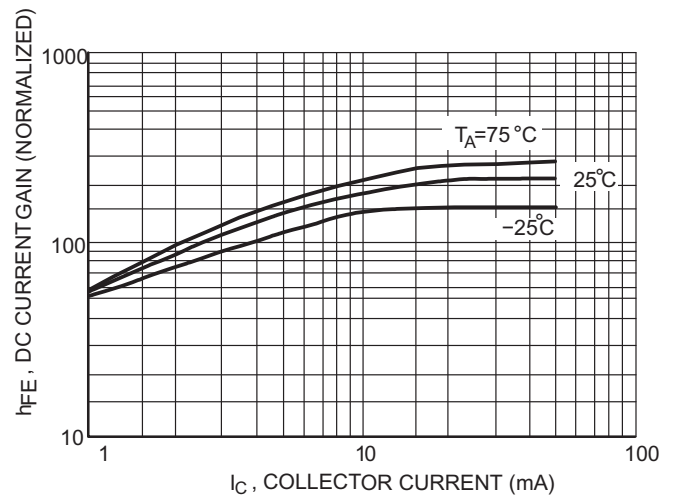


Figure 28. DC Current Gain

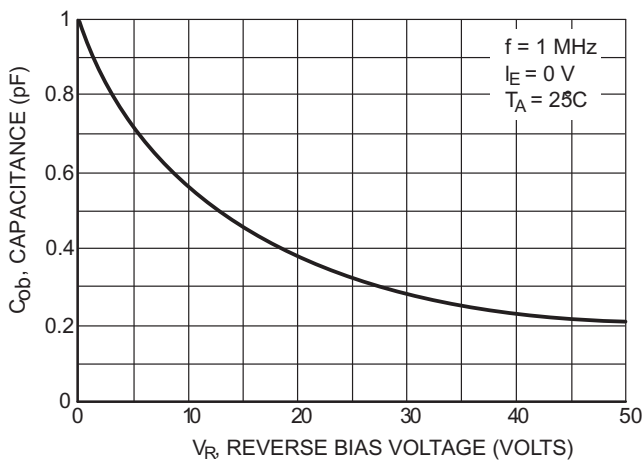


Figure 29. Output Capacitance

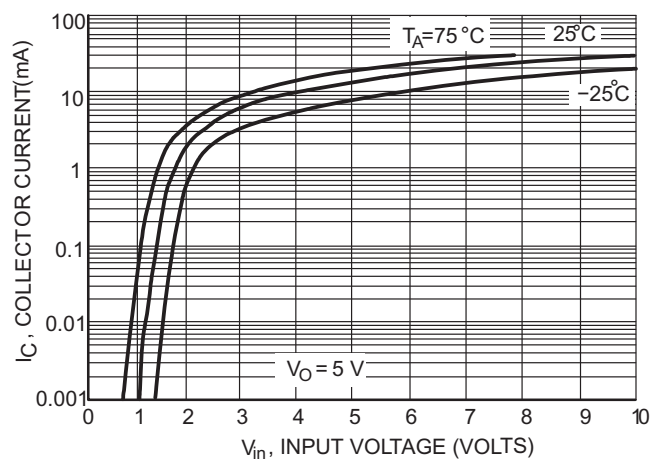


Figure 30. Output Current versus Input Voltage

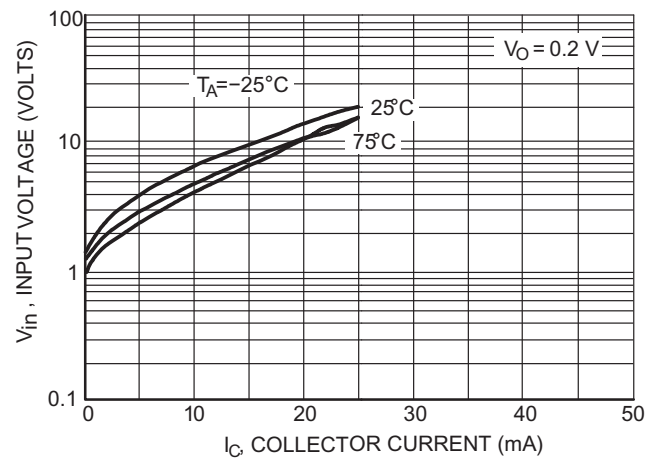


Figure 31. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5314DW1)NPN

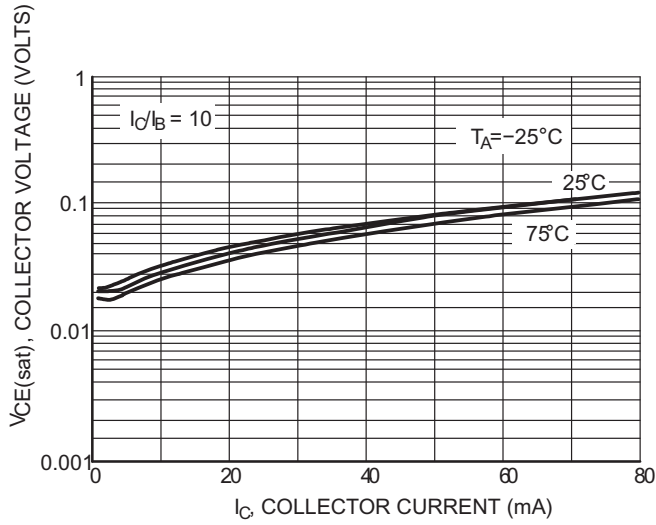


Figure 32. $V_{CE(sat)}$ versus I_C

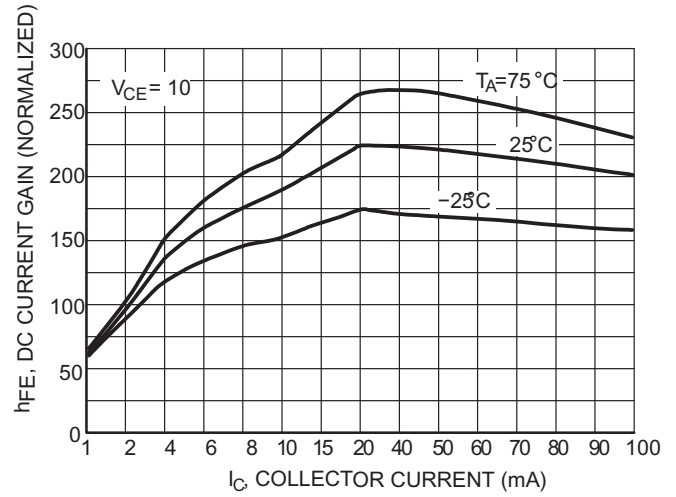


Figure 33. DC Current Gain

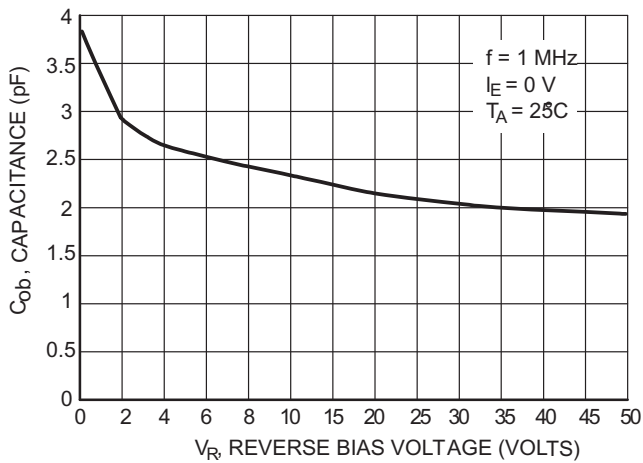


Figure 34. Output Capacitance

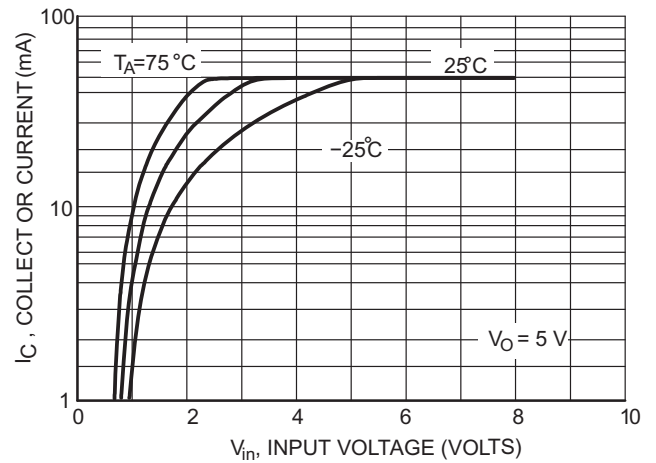


Figure 35. Output Current versus Input Voltage

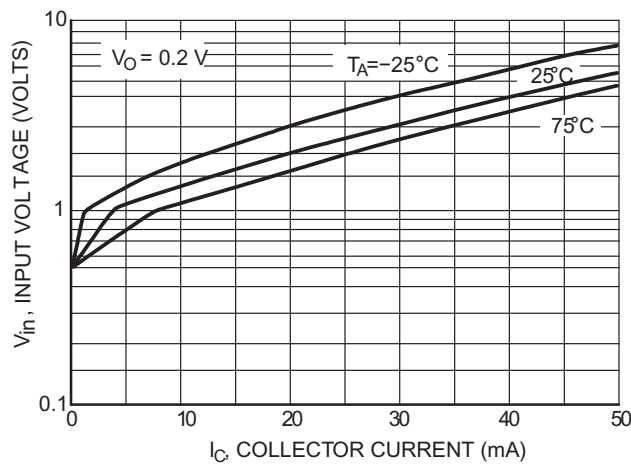


Figure 36. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5314DW1)PNP

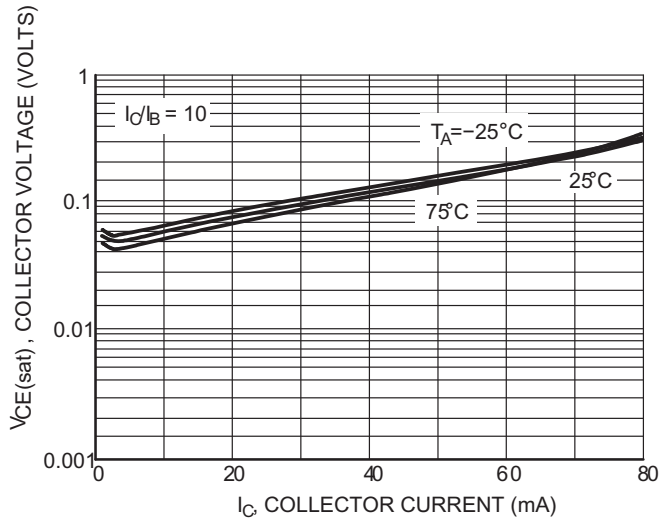


Figure 37. $V_{CE(sat)}$ versus I_C

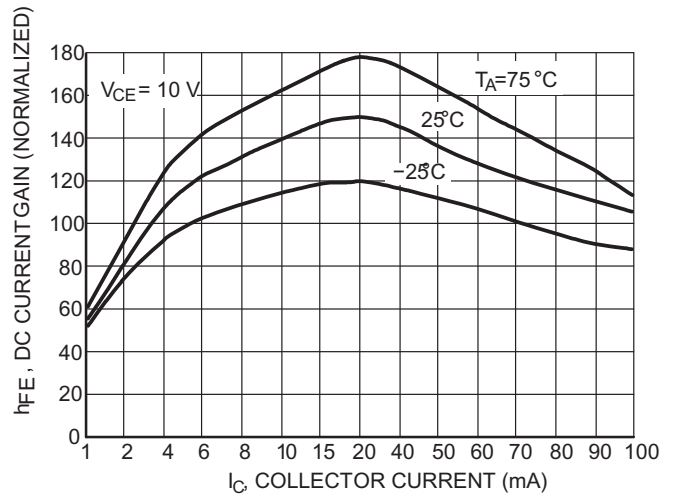


Figure 38. DC Current Gain

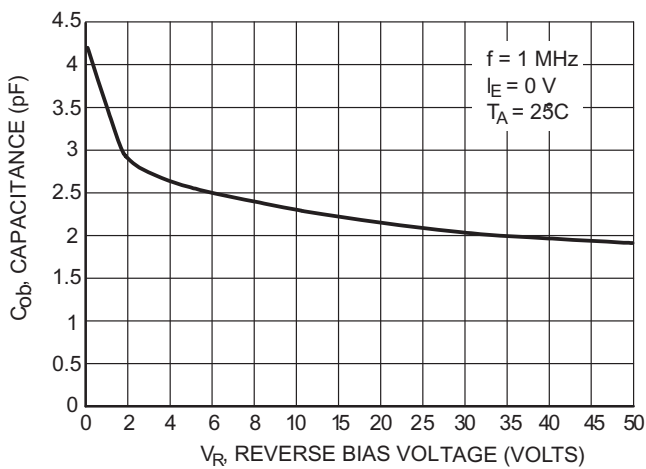


Figure 39. Output Capacitance

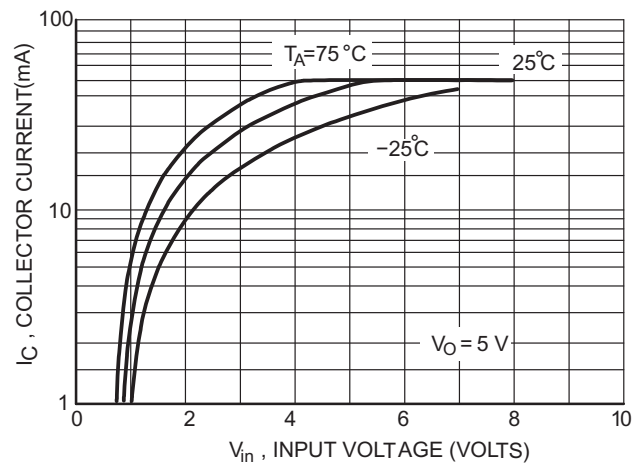


Figure 40. Output Current versus Input Voltage

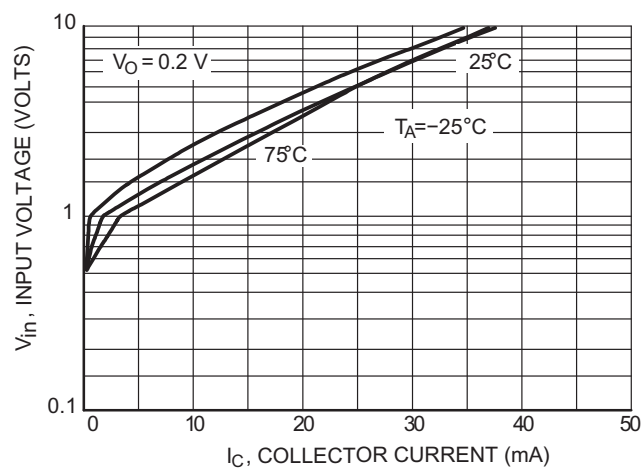


Figure 41. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5315DW1)NPN

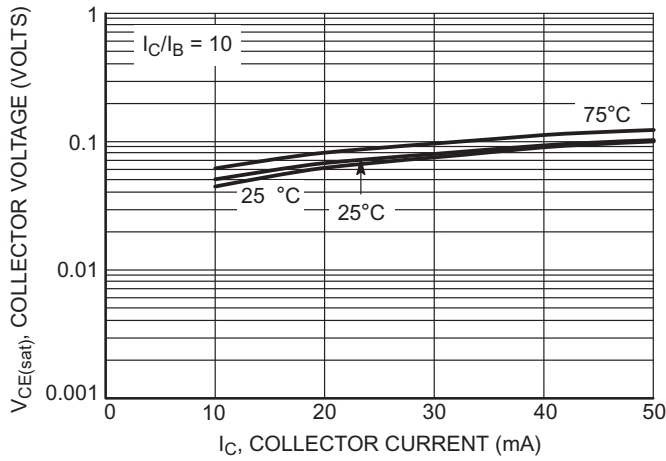


Figure 42. $V_{CE(sat)}$ versus I_C

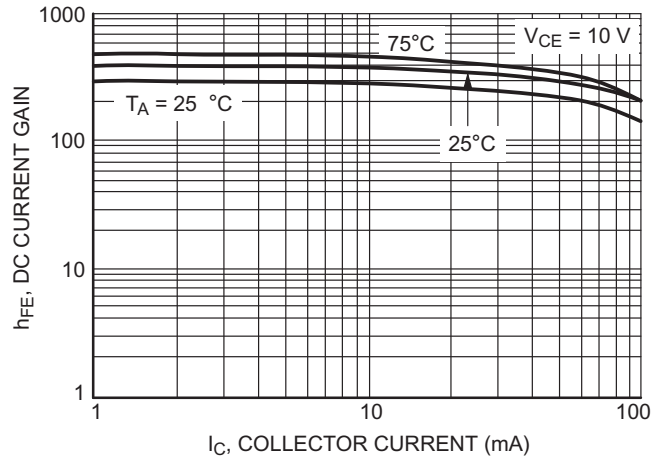


Figure 43. DC Current Gain

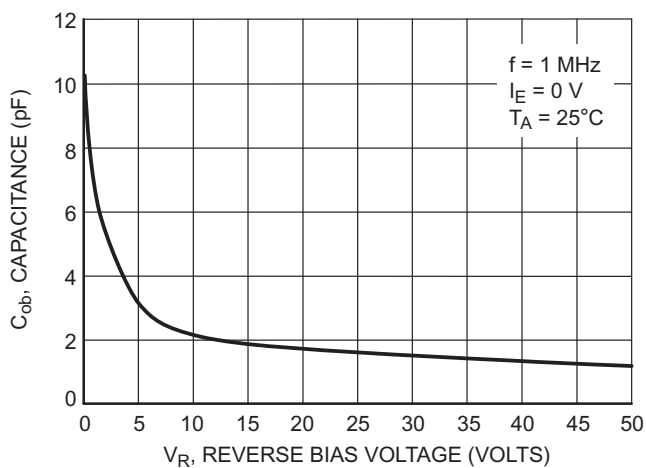


Figure 44. Output Capacitance

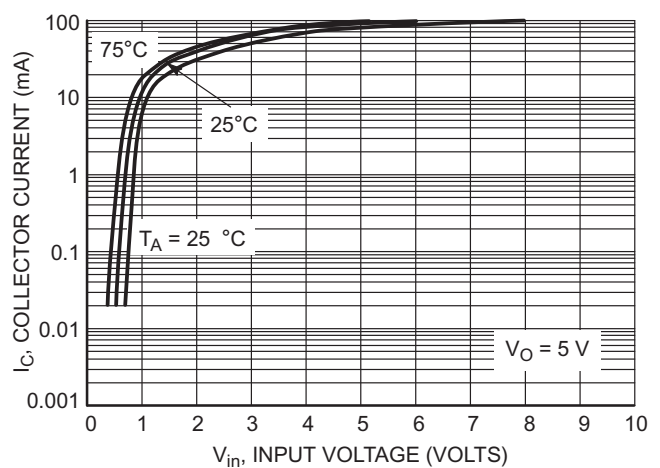


Figure 45. Output Current versus Input Voltage

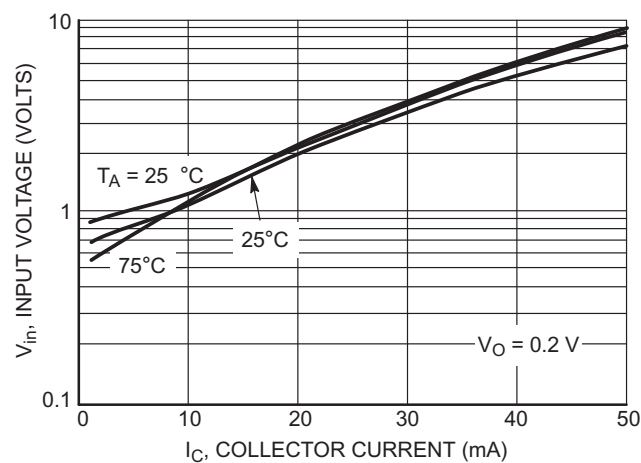


Figure 46. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5315DW1)PNP

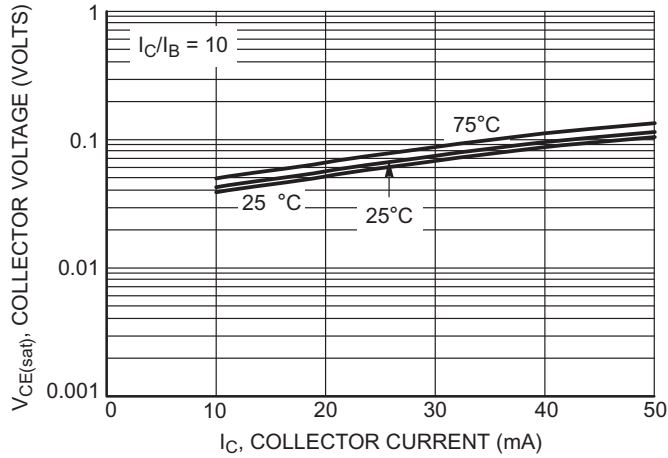


Figure 47. $V_{CE(sat)}$ versus I_C

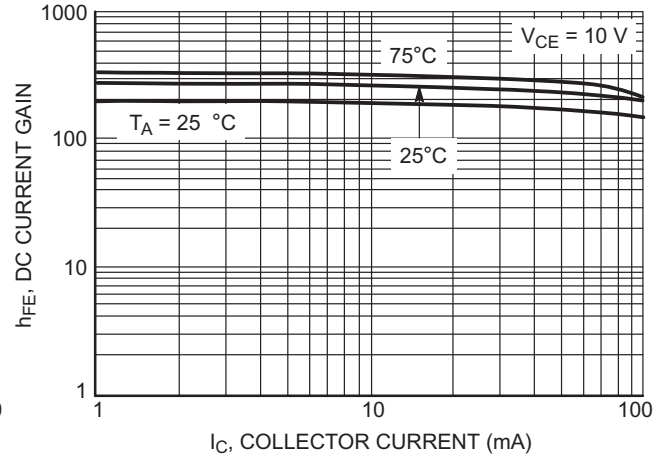


Figure 48. DC Current Gain

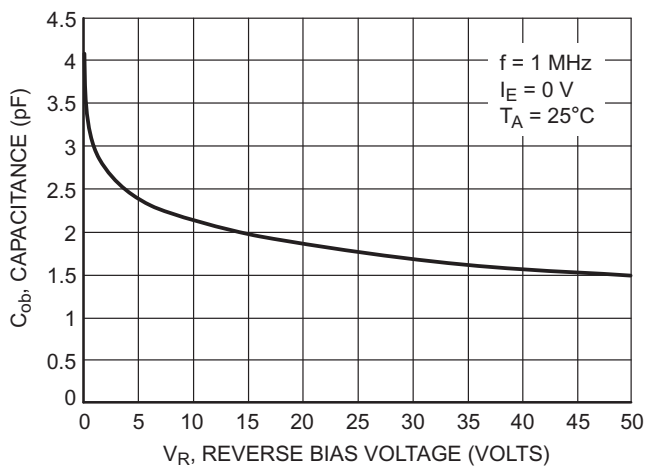


Figure 49. Output Capacitance

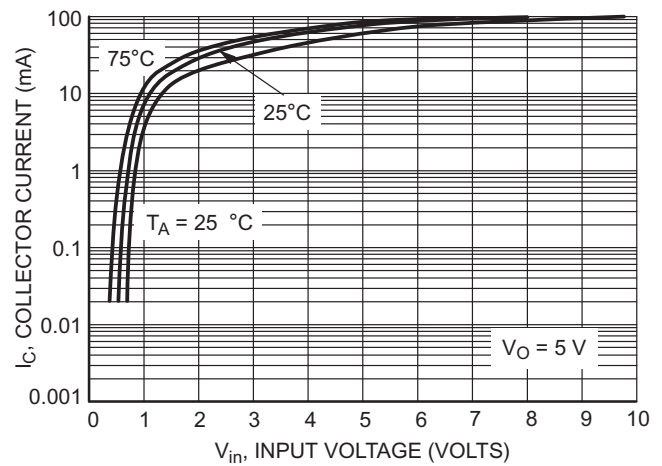


Figure 50. Output Current versus Input Voltage

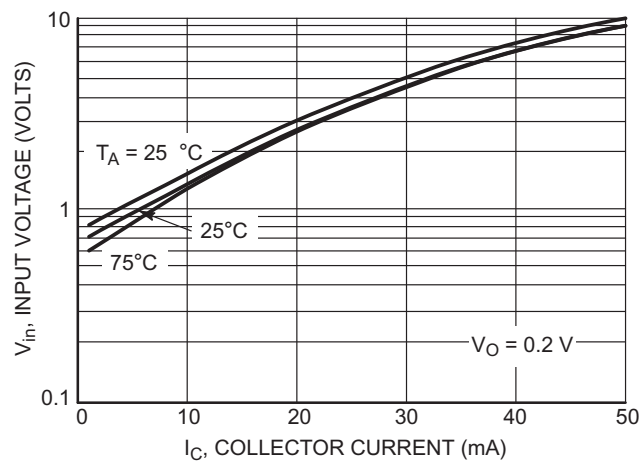


Figure 51. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5316DW1)NPN

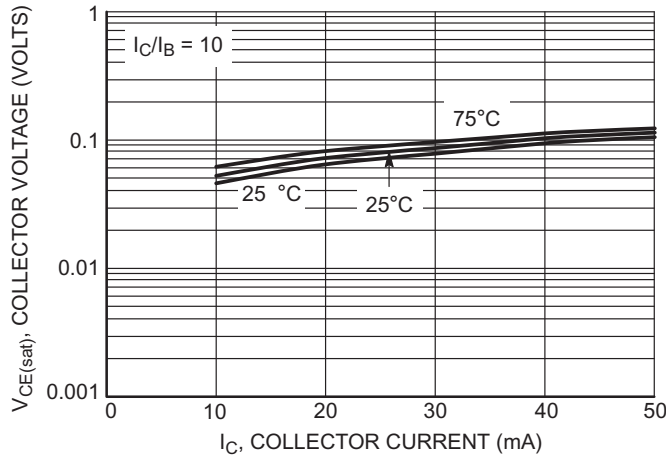


Figure 52. $V_{CE(sat)}$ versus I_C

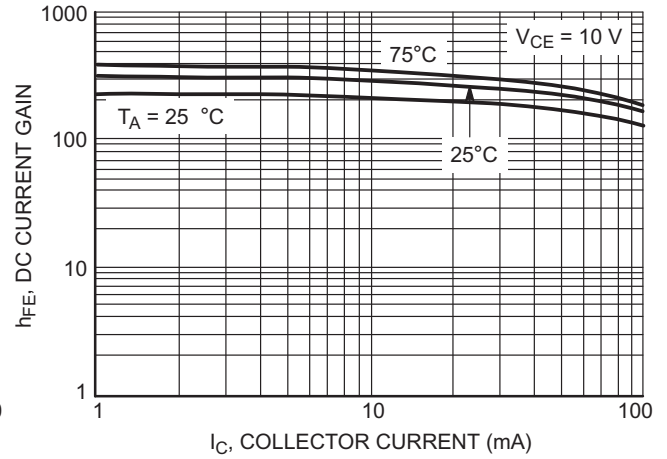


Figure 53. DC Current Gain

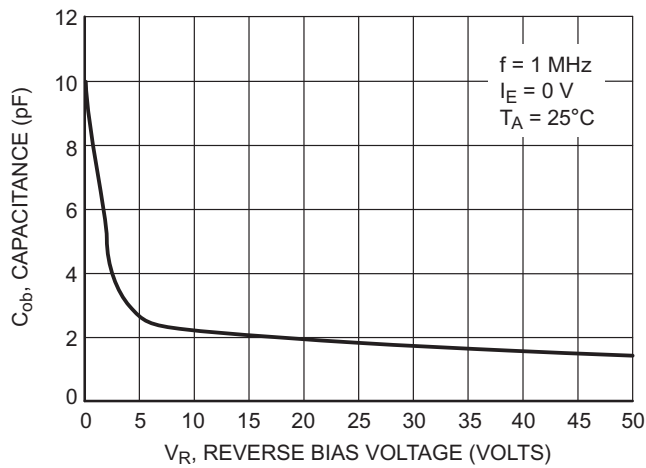


Figure 54. Output Capacitance

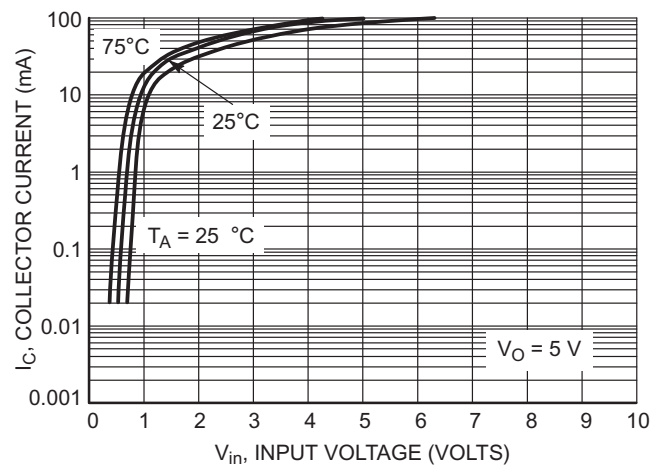


Figure 55. Output Current versus Input Voltage

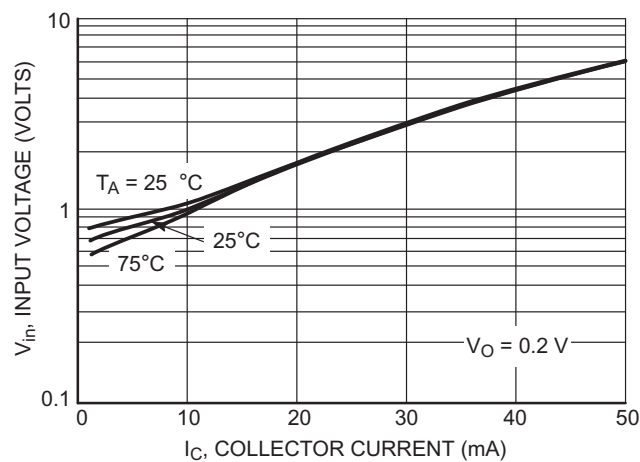


Figure 56. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5316DW1)PNP

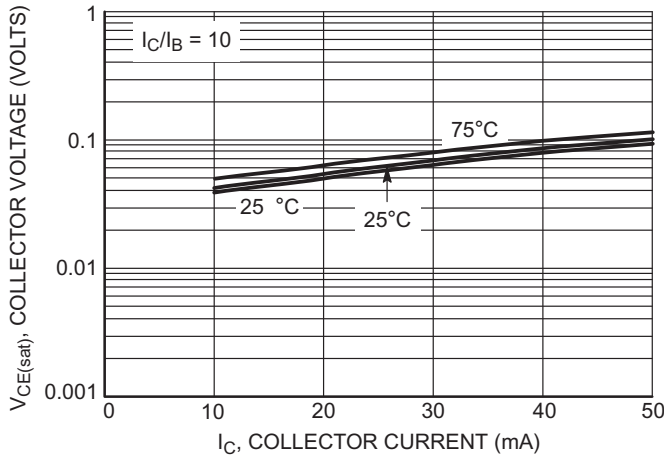


Figure 57. $V_{CE(sat)}$ versus I_C

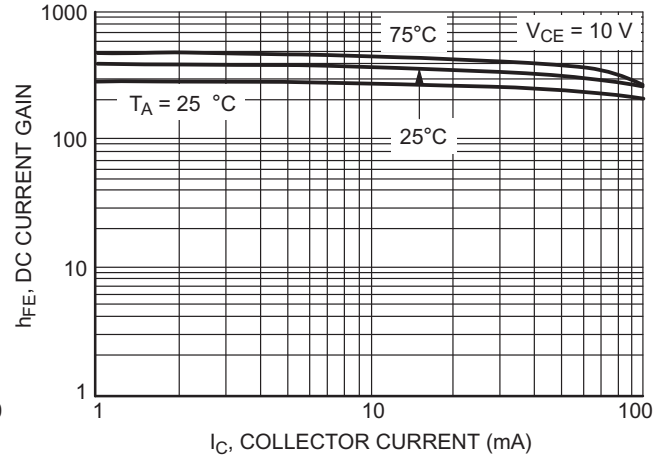


Figure 58. DC Current Gain

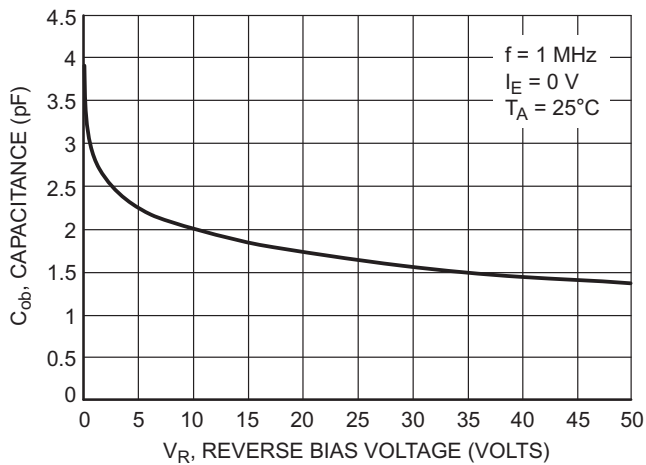


Figure 59. Output Capacitance

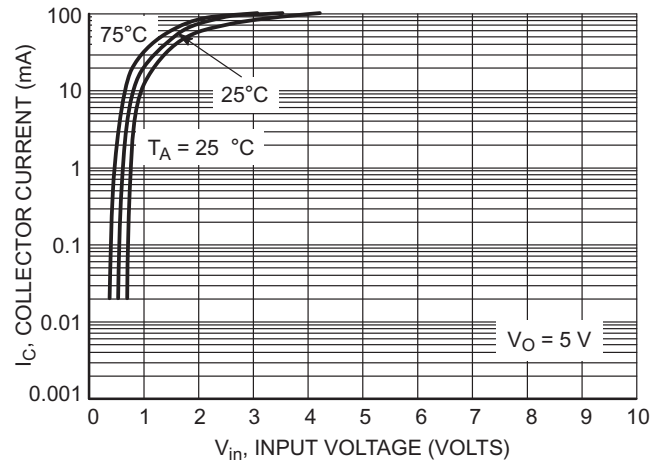


Figure 60. Output Current versus Input Voltage

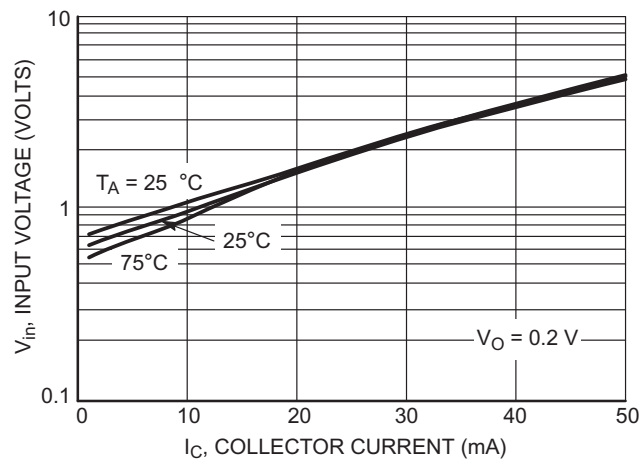


Figure 61. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5330DW1)NPN

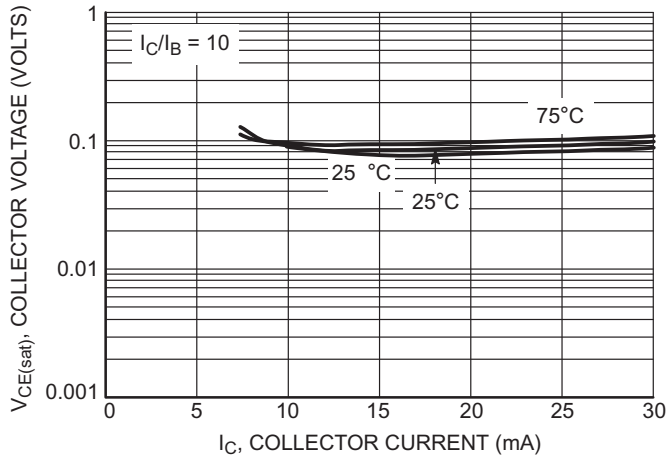


Figure 62. $V_{CE(sat)}$ versus I_C

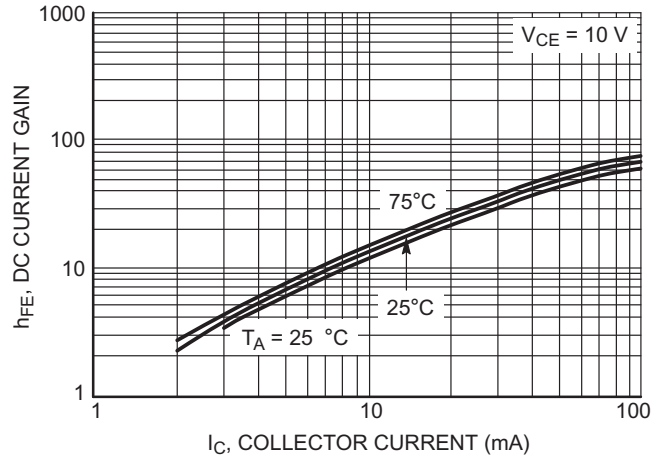


Figure 63. DC Current Gain

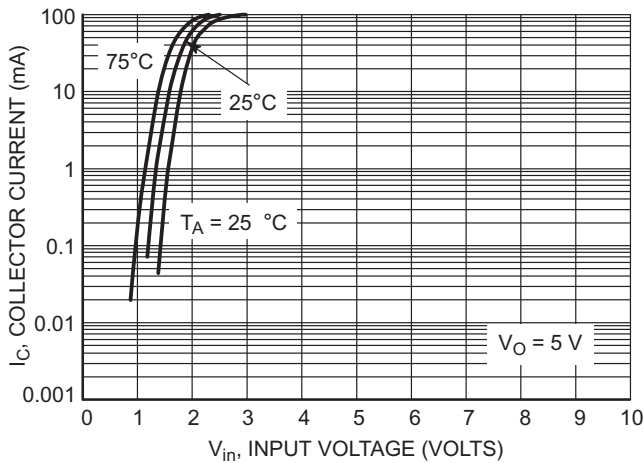


Figure 64. Output Current versus Input Voltage

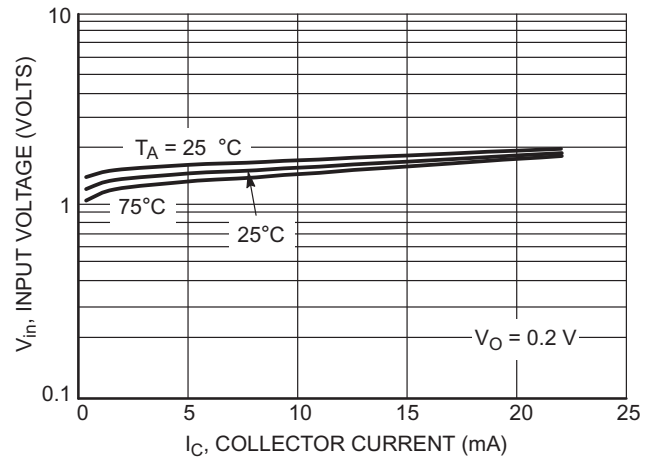


Figure 65. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5330DW1)PNP

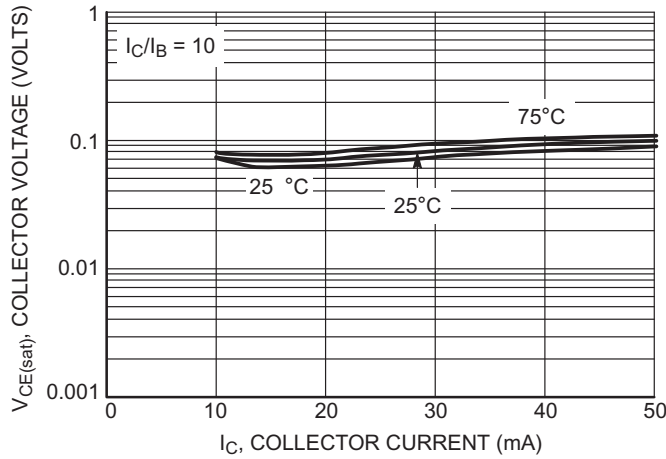


Figure 66. $V_{CE(sat)}$ versus I_C

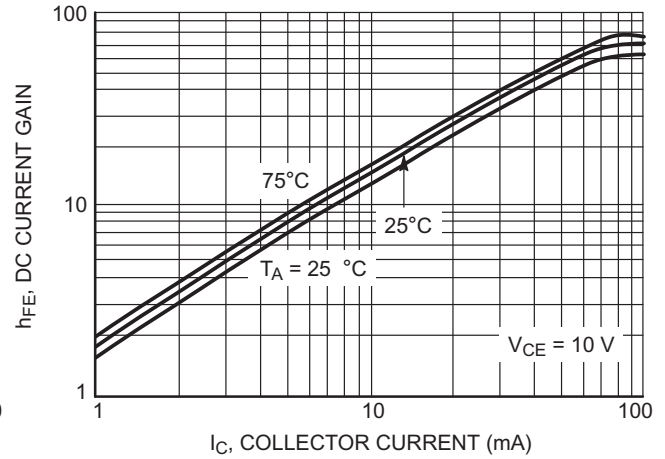


Figure 67. DC Current Gain

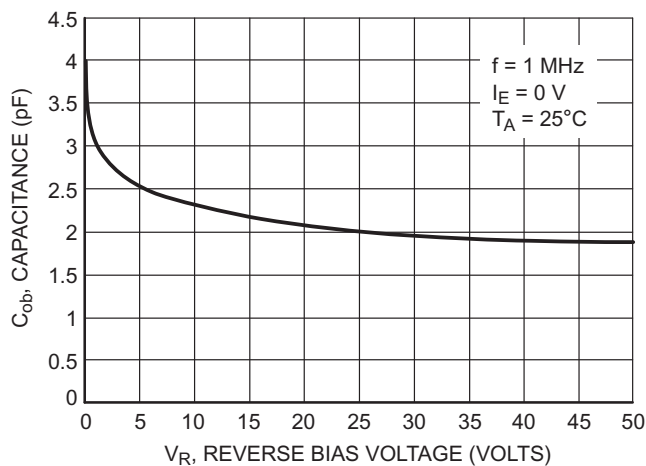


Figure 68. Output Capacitance

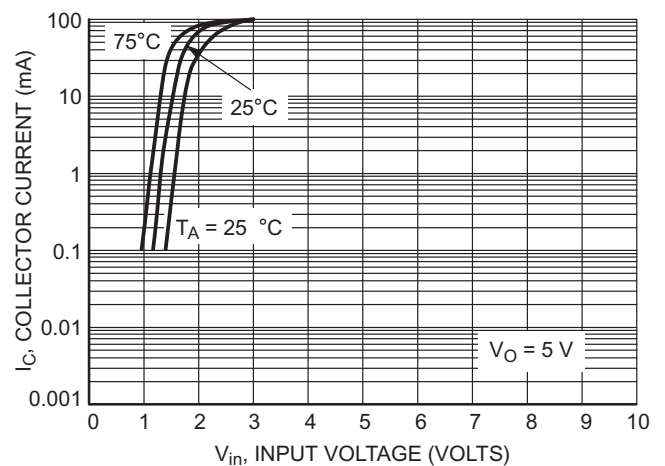


Figure 69. Output Current versus Input Voltage

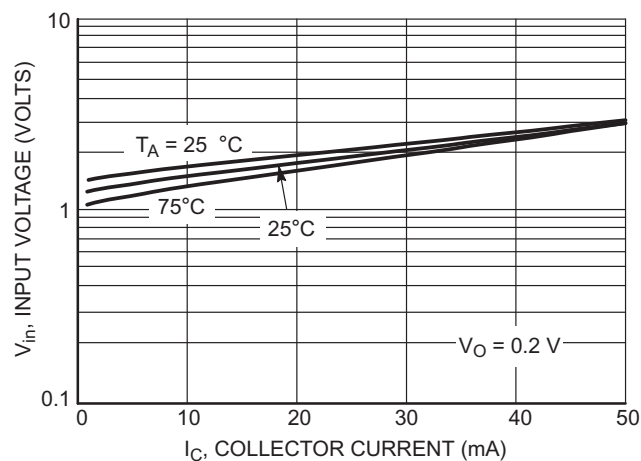


Figure 70. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5331DW1)NPN

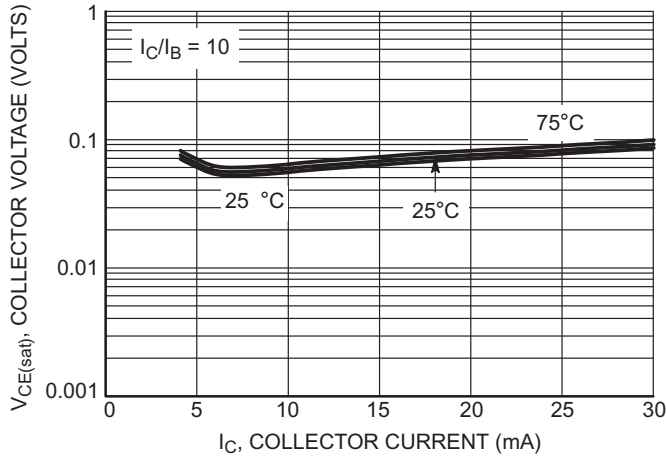


Figure 71. $V_{CE(sat)}$ versus I_C

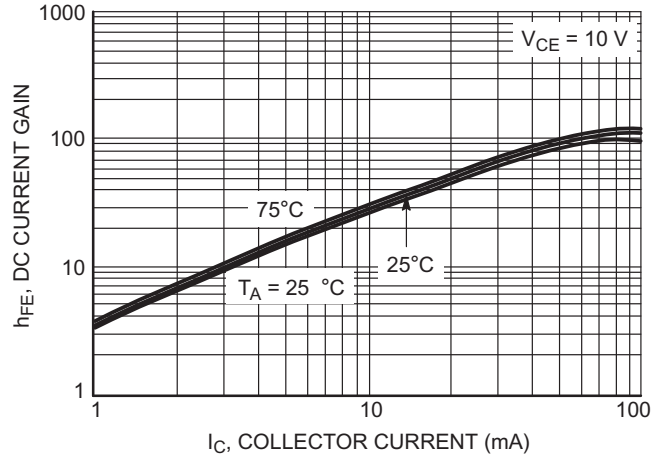


Figure 72. DC Current Gain

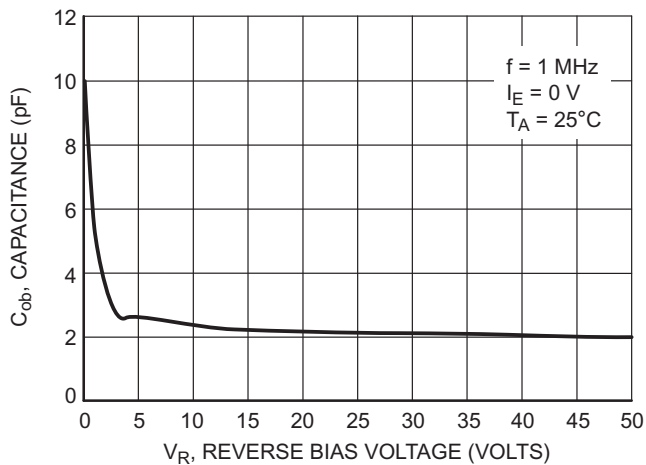


Figure 73. Output Capacitance

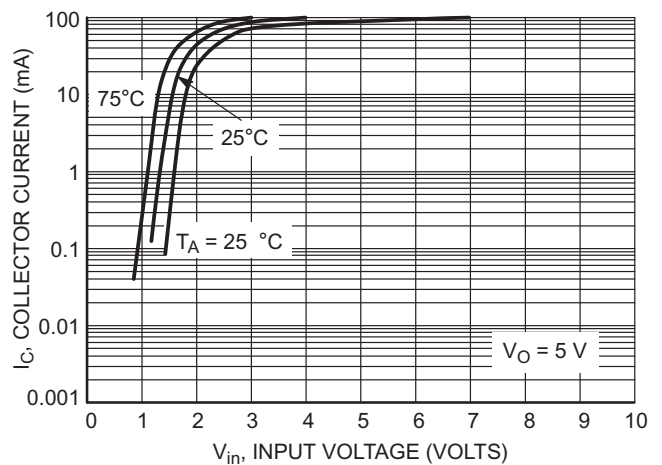


Figure 74. Output Current versus Input Voltage

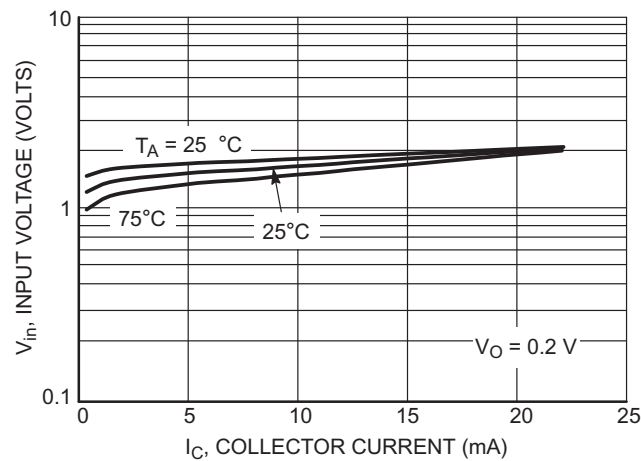


Figure 75. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5331DW1)PNP

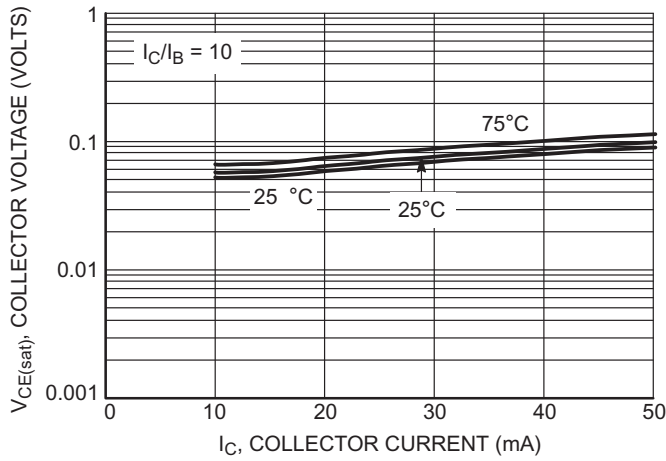


Figure 76. $V_{CE(sat)}$ versus I_C

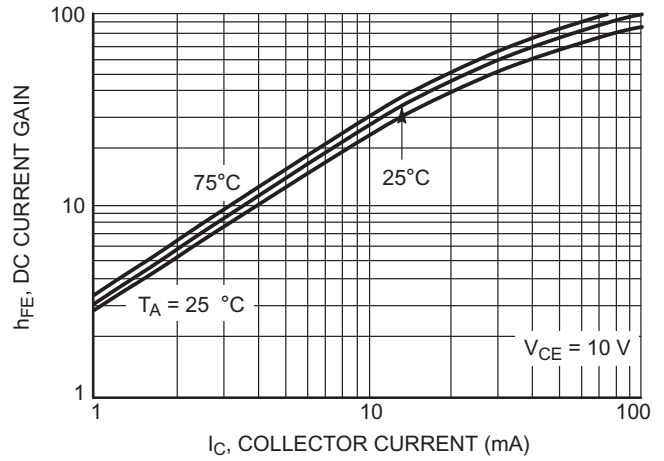


Figure 77. DC Current Gain

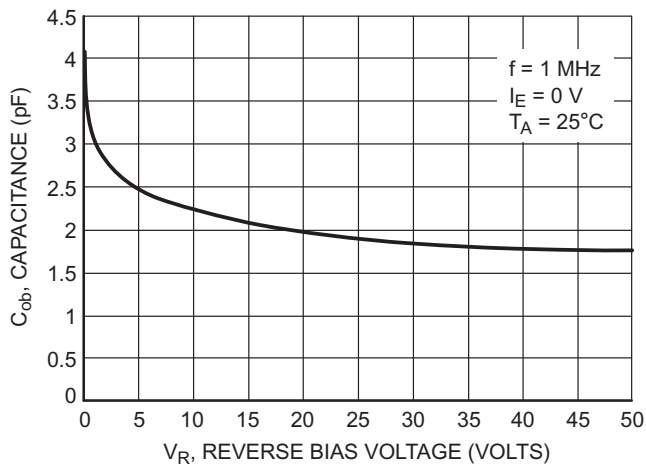


Figure 78. Output Capacitance

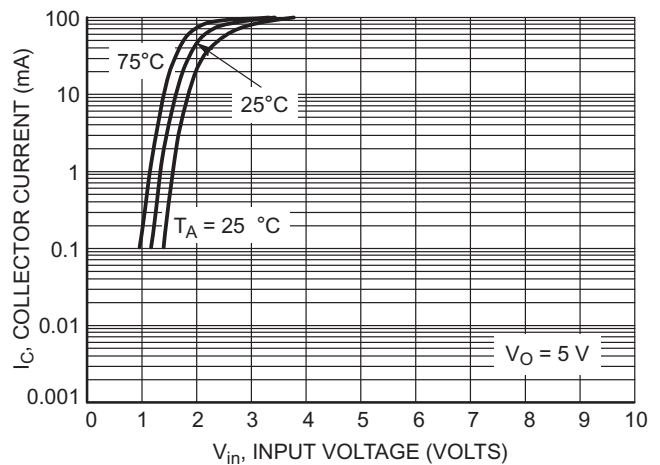


Figure 79. Output Current versus Input Voltage

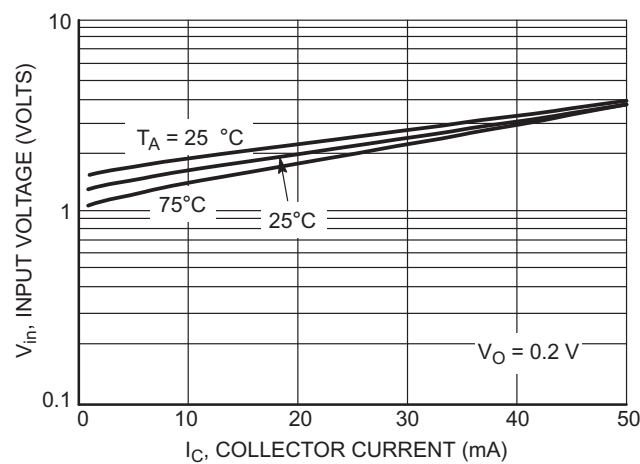


Figure 80. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5332DW1)NPN

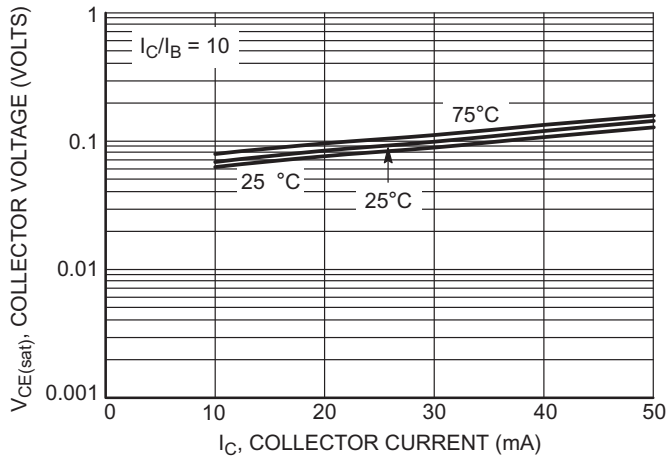


Figure 81. $V_{CE(sat)}$ versus I_C

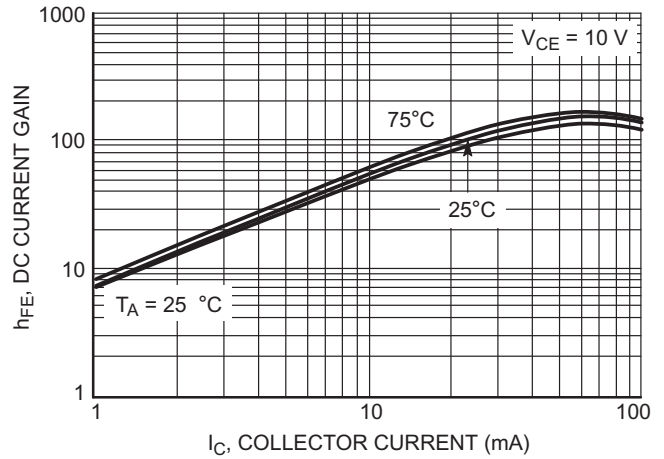


Figure 82. DC Current Gain

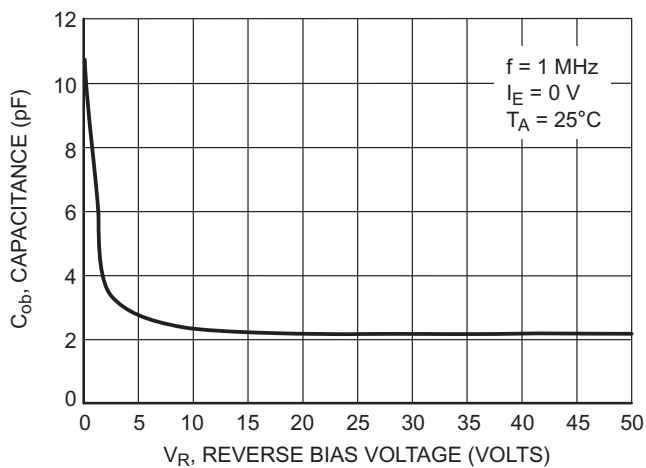


Figure 83. Output Capacitance

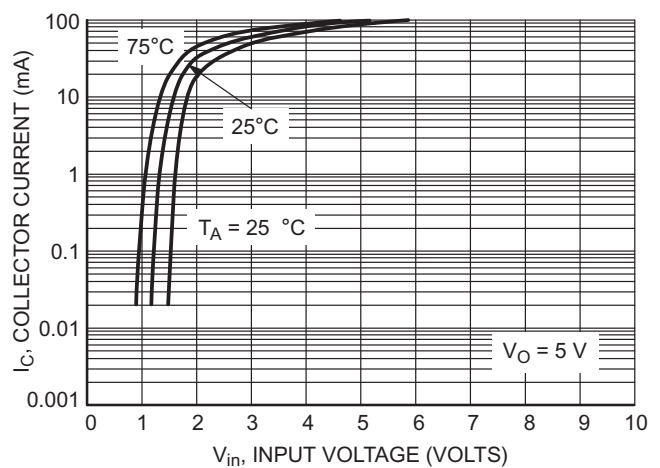


Figure 84. Output Current versus Input Voltage

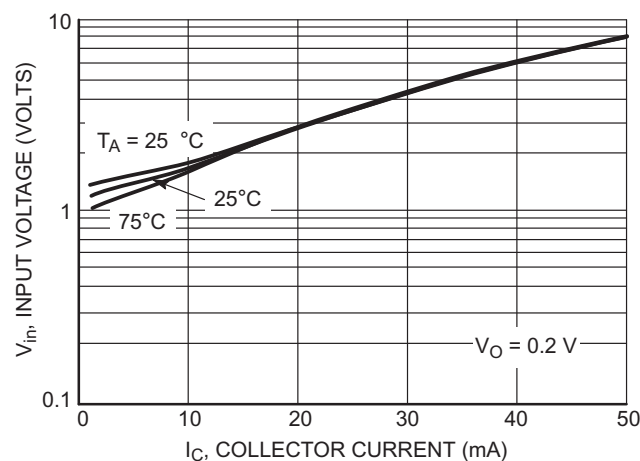


Figure 85. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5332DW1)PNP

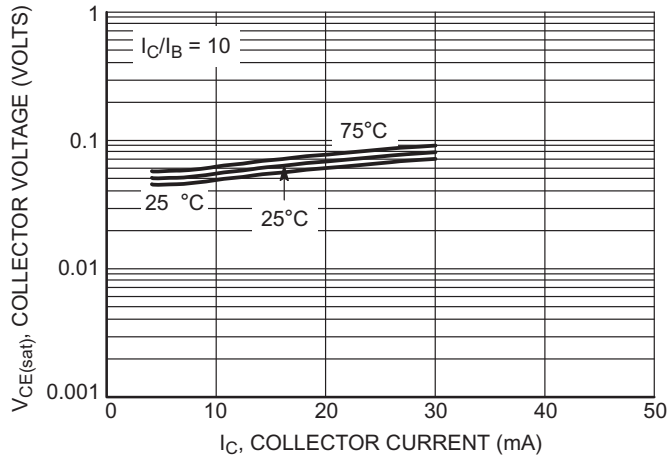


Figure 86. $V_{CE(sat)}$ versus I_C

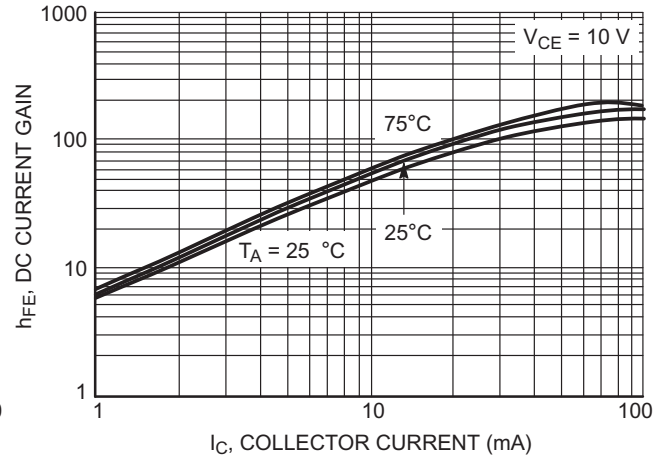


Figure 87. DC Current Gain

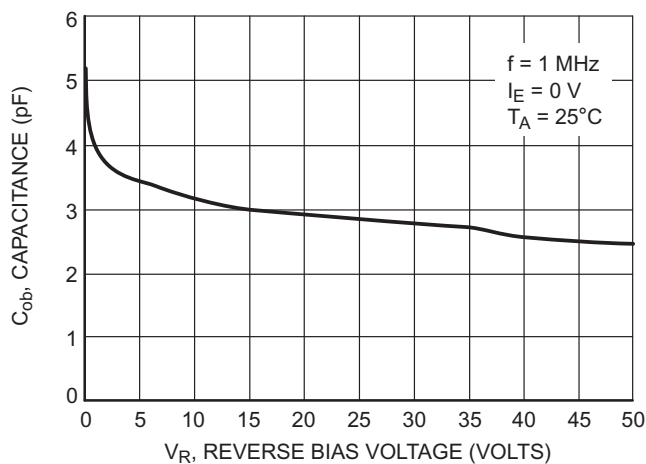


Figure 88. Output Capacitance

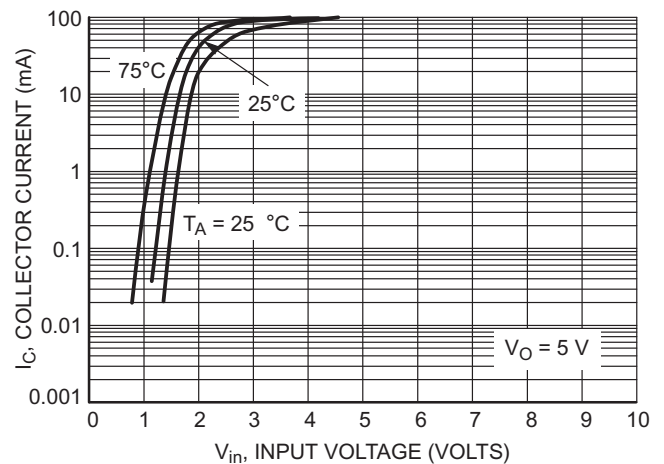


Figure 89. Output Current versus Input Voltage

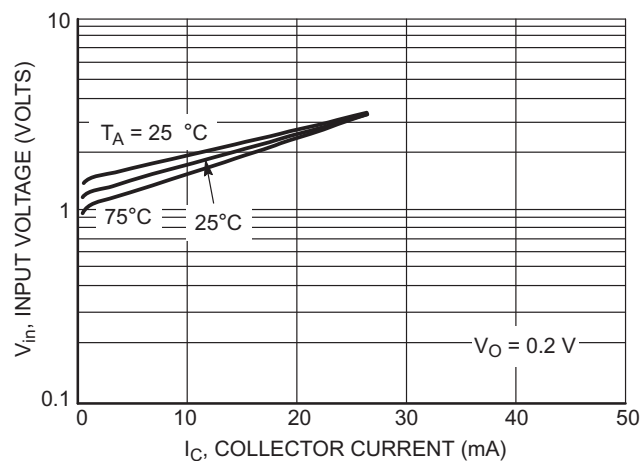


Figure 90. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5333DW1)NPN

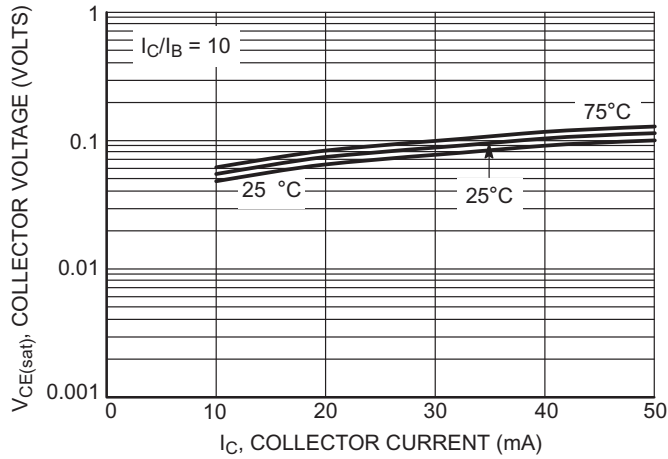


Figure 91. $V_{CE(sat)}$ versus I_C

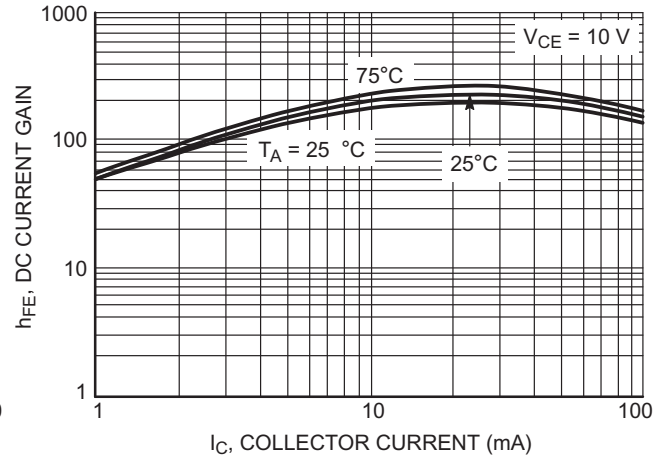


Figure 92. DC Current Gain

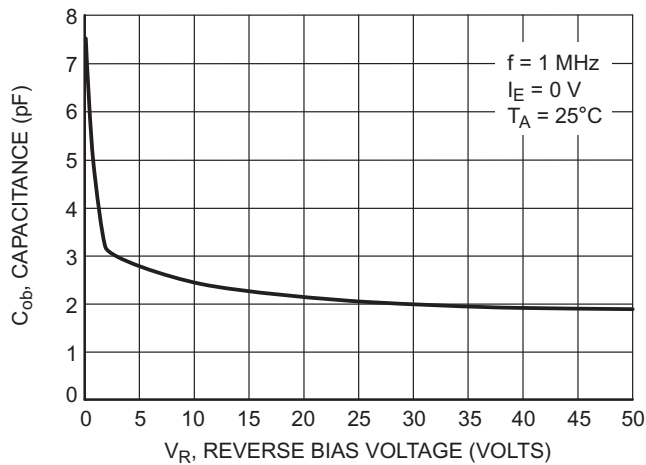


Figure 93. Output Capacitance

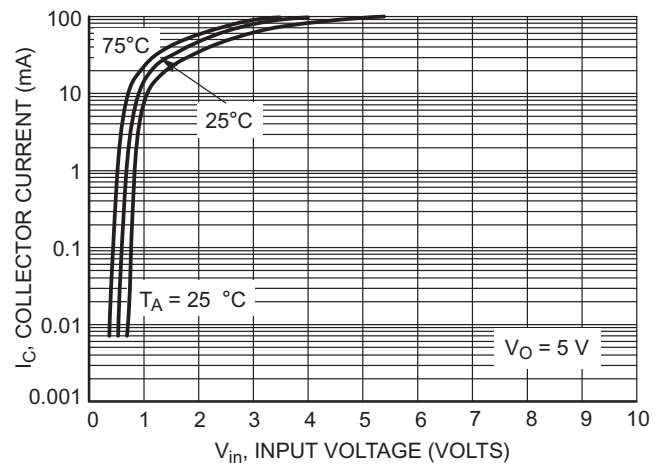


Figure 94. Output Current versus Input Voltage

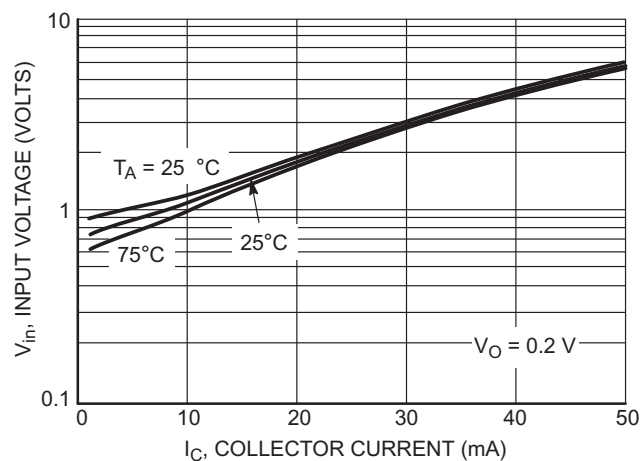


Figure 95. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5333DW1)PNP

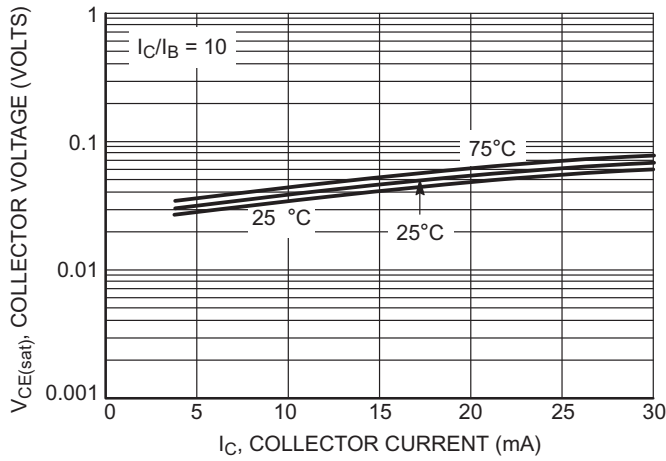


Figure 96. $V_{CE(sat)}$ versus I_C

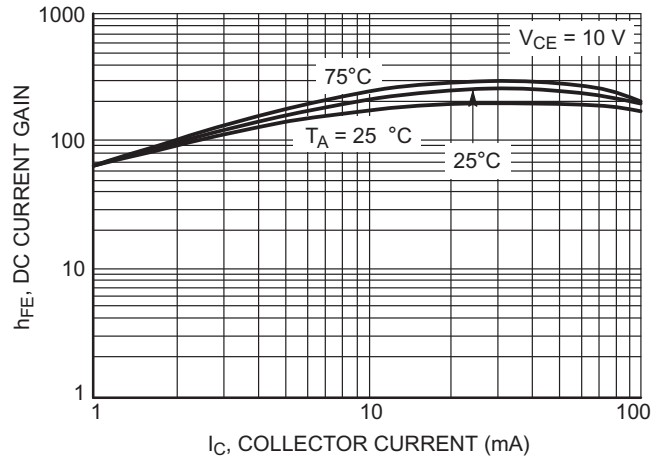


Figure 97. DC Current Gain

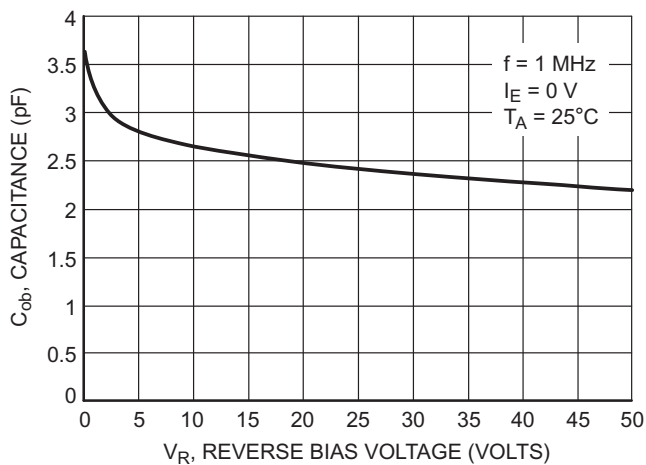


Figure 98. Output Capacitance

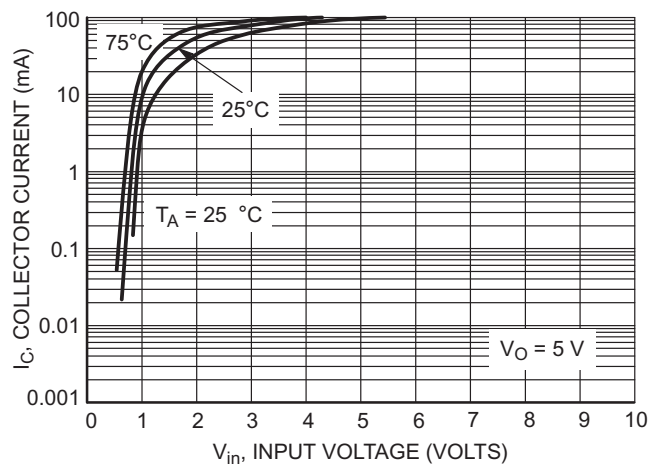


Figure 99. Output Current versus Input Voltage

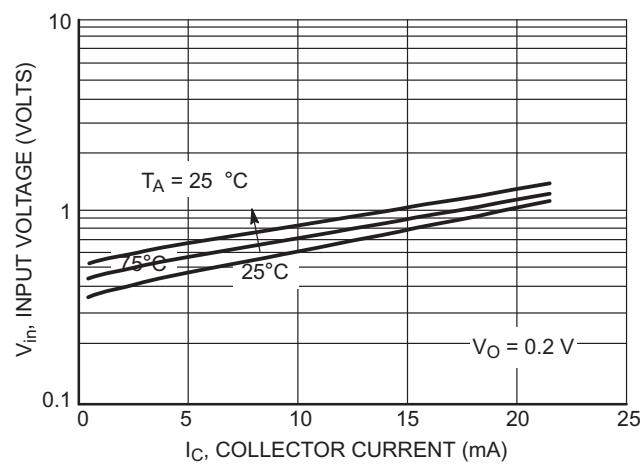


Figure 100. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5334DW1)NPN

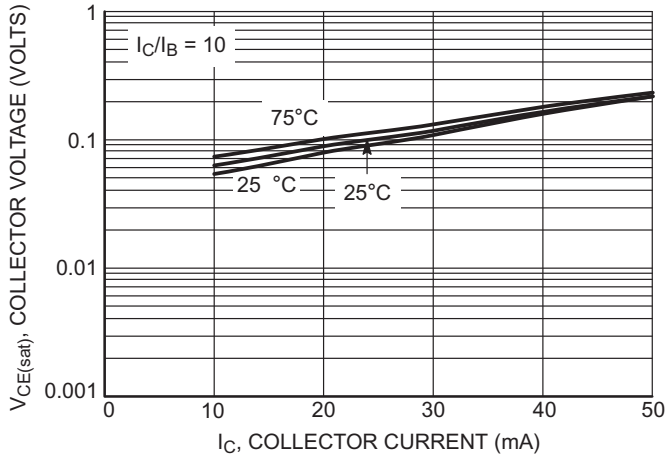


Figure 101. $V_{CE(sat)}$ versus I_C

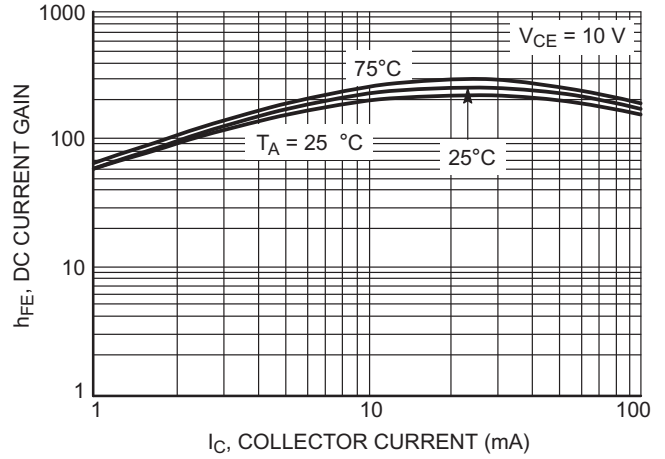


Figure 102. DC Current Gain

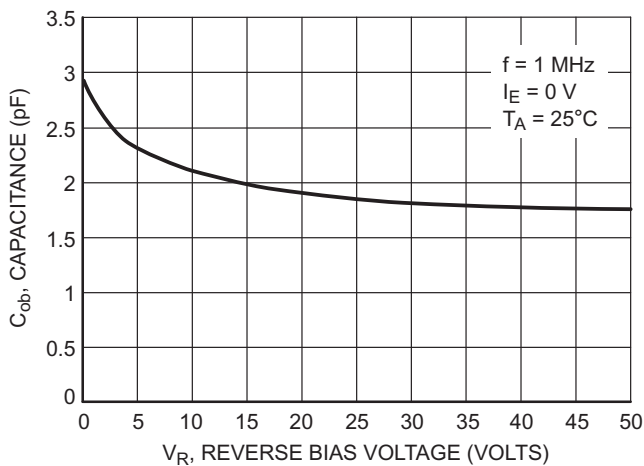


Figure 103. Output Capacitance

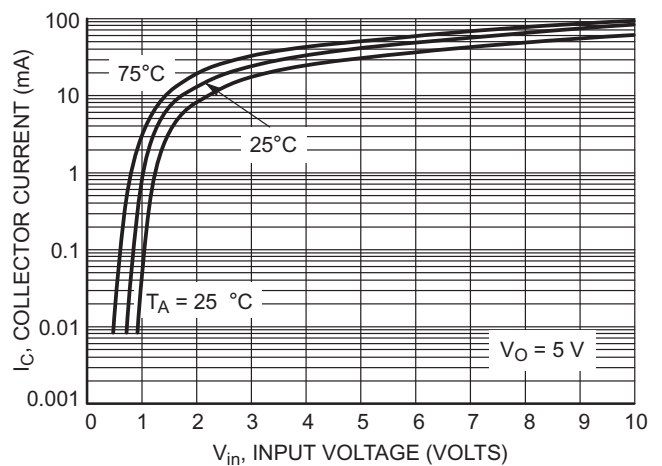


Figure 104. Output Current versus Input Voltage

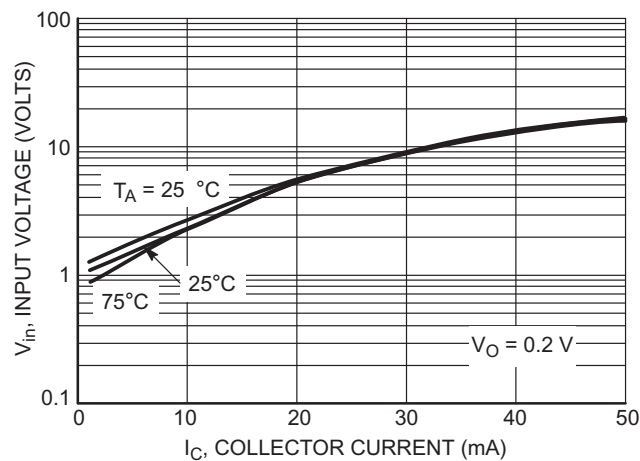


Figure 105. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5334DW1)PNP

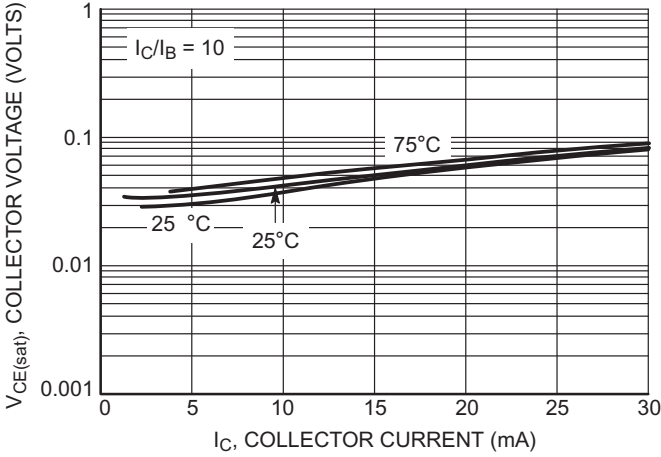


Figure 106. $V_{CE(sat)}$ versus I_C

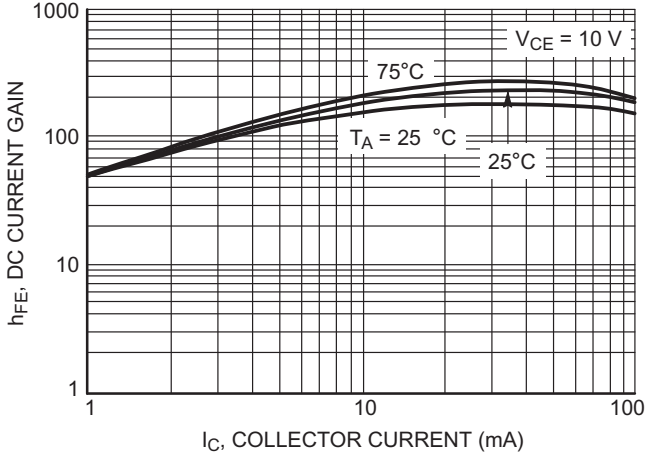


Figure 107. DC Current Gain

Typical Electrical Characteristics (FMUN5335DW1)NPN

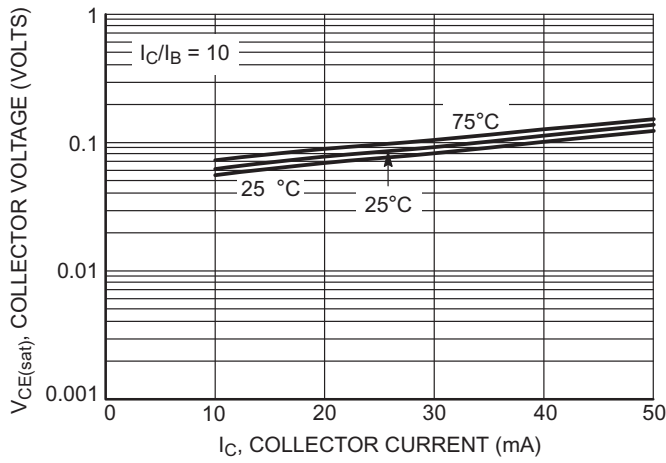


Figure 108. $V_{CE(sat)}$ versus I_C

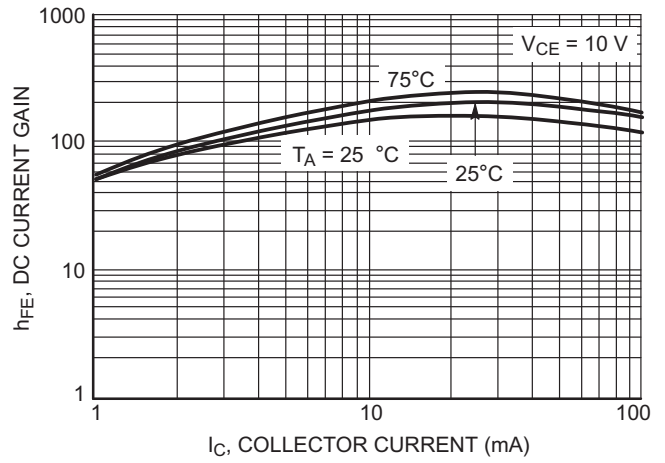


Figure 109. DC Current Gain

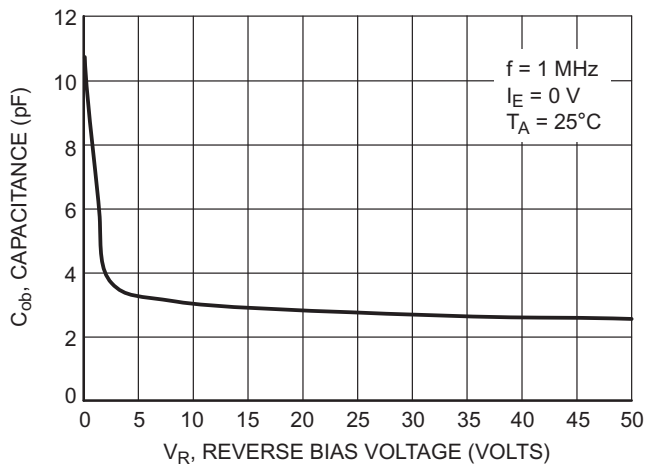


Figure 110. Output Capacitance

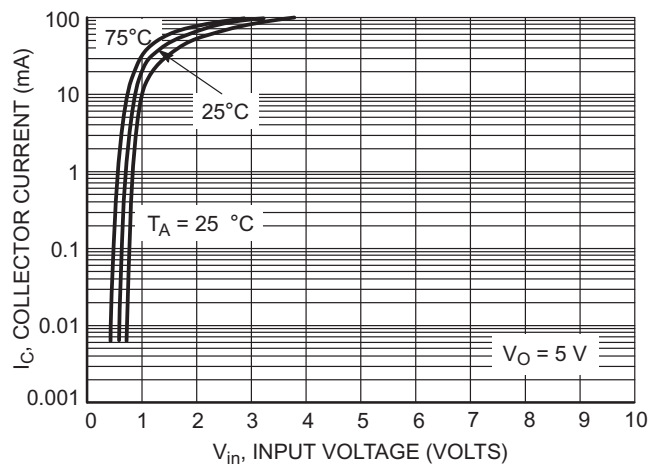


Figure 111. Output Current versus Input Voltage

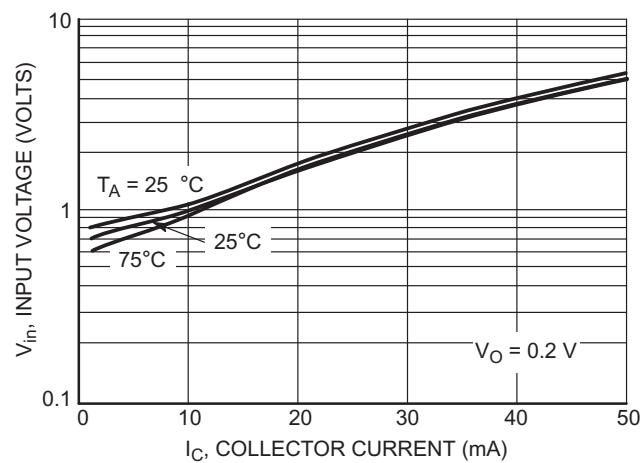


Figure 112. Input Voltage versus Output Current

Typical Electrical Characteristics (FMUN5335DW1)PNP

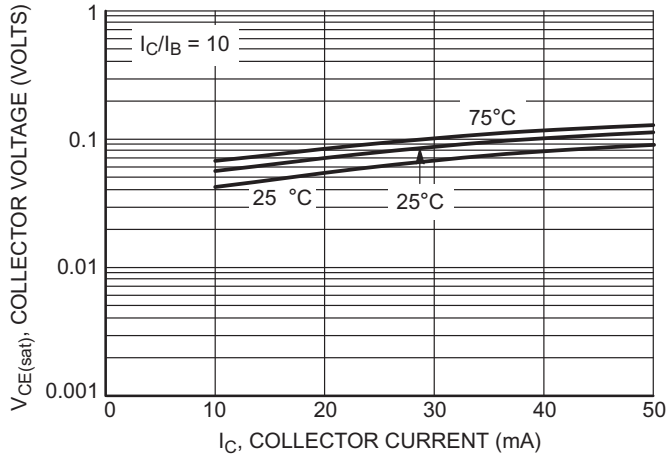


Figure 113. $V_{CE(sat)}$ versus I_C

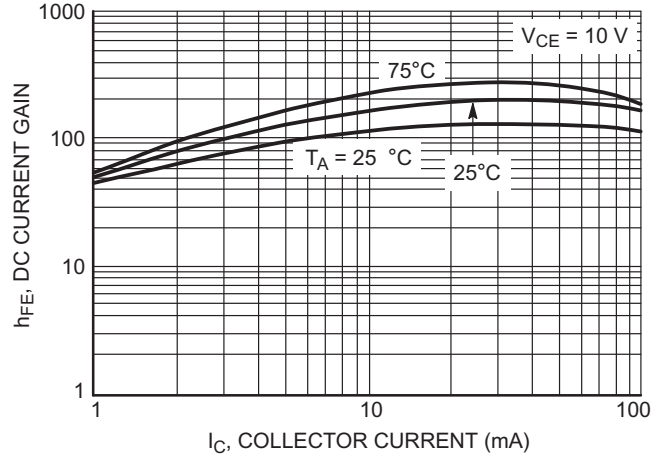


Figure 114. DC Current Gain

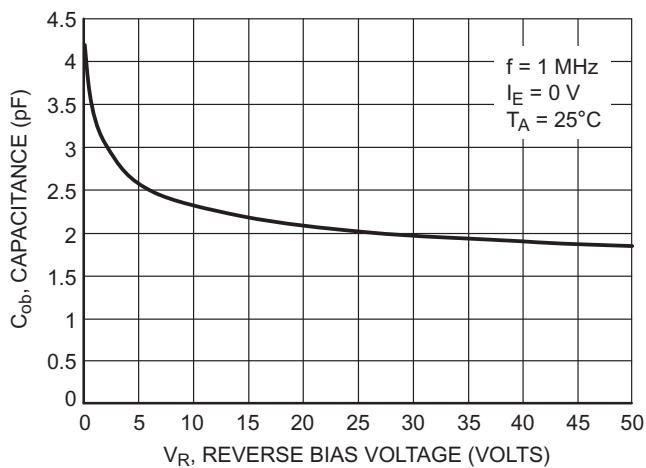


Figure 115. Output Capacitance

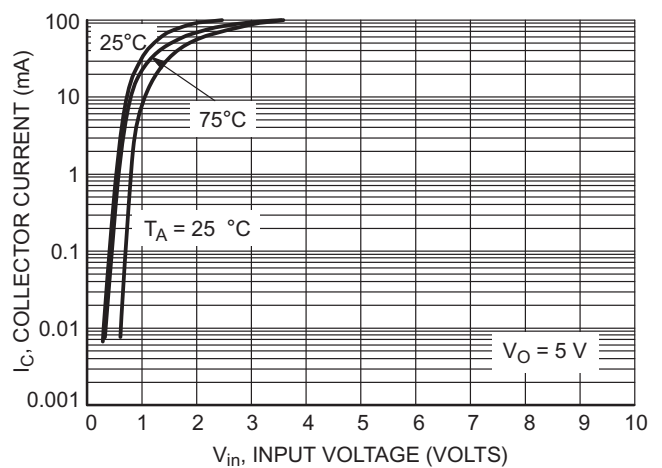


Figure 116. Output Current versus Input Voltage

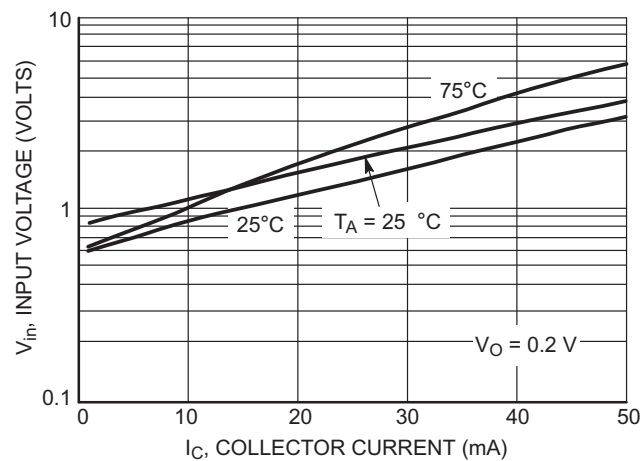
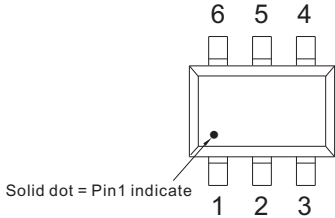
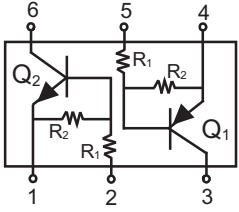


Figure 117. Input Voltage versus Output Current

FMUN5311DW1 THRU FMUN5335DW1

Pinning information

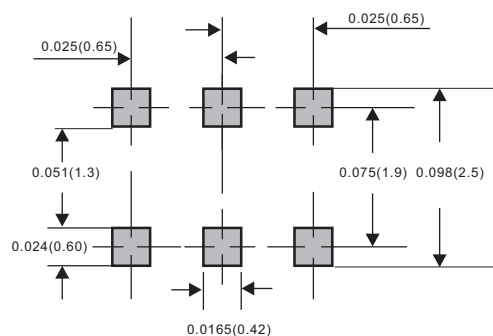
Pin	Simplified outline	Symbol
Pin1 Emitter 2 Pin2 Base 2 Pin3 Collector 1 Pin4 Emitter 1 Pin5 Base 1 Pin6 Collector 2	 Solid dot = Pin1 indicate	

Marking

Type number	Marking code
FMUN5311DW1	11
FMUN5312DW1	12
FMUN5313DW1	13
FMUN5314DW1	14
FMUN5315DW1	15
FMUN5316DW1	16
FMUN5330DW1	30
FMUN5331DW1	31
FMUN5332DW1	32
FMUN5333DW1	33
FMUN5334DW1	34
FMUN5335DW1	35

Suggested solder pad layout

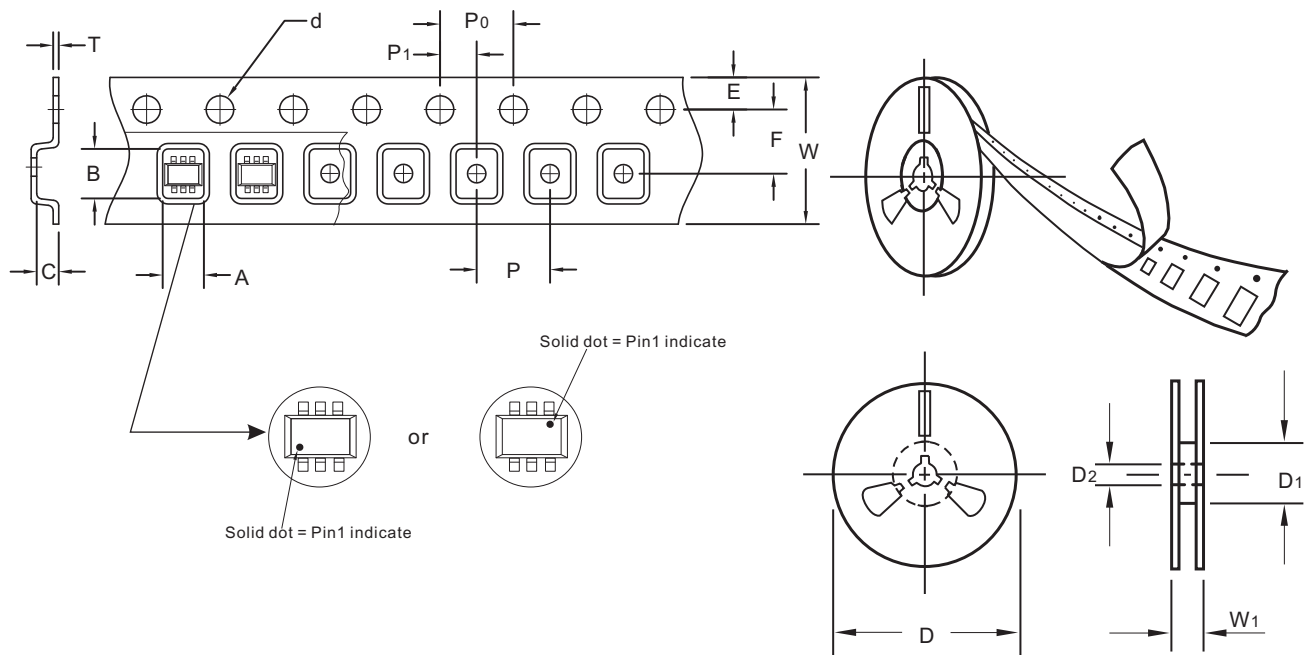
SOT-363



Dimensions in inches and (millimeters)

FMUN5311DW1 THRU FMUN5335DW1

Packing information



unit:mm

Item	Symbol	Tolerance	SOT-363
Carrier width	A	0.1	2.25
Carrier length	B	0.1	2.55
Carrier depth	C	0.1	1.20
Sprocket hole	d	0.1	1.50
13" Reel outside diameter	D	2.0	-
13" Reel inner diameter	D ₁	min	-
7" Reel outside diameter	D	2.0	178.00
7" Reel inner diameter	D ₁	min	54.40
Feed hole diameter	D ₂	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	P ₀	0.1	4.00
Embossment center	P ₁	0.1	2.00
Overall tape thickness	T	0.1	0.23
Tape width	W	0.3	8.00
Reel width	W ₁	1.0	12.3

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

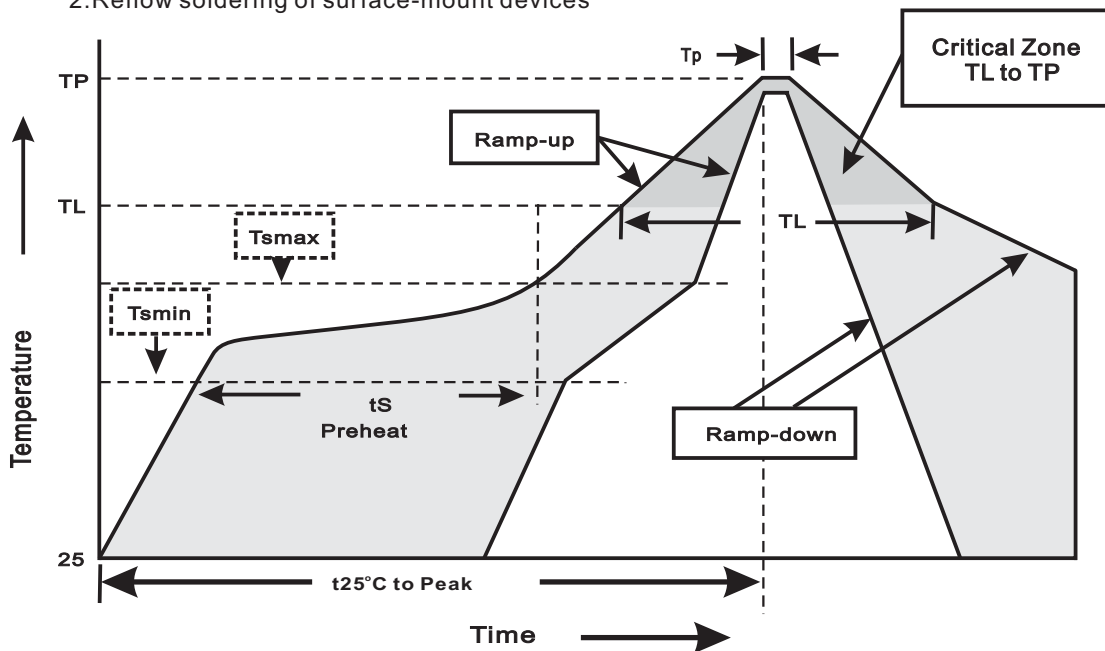
FMUN5311DW1 THRU FMUN5335DW1

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-363	7"	3,000	4.0	30,000	183*123*183	178	382*257*387	240,000	9.5

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°C/sec
Preheat -Temperature Min(T _{smmin}) -Temperature Max(T _{smmax}) -Time(min to max)(t _s)	150°C 200°C 60~120sec
T _{smmax} to T _L -Ramp-upRate	<3°C/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°C/sec
Time 25°C to Peak Temperature	<6minutes

FMUN5311DW1 THRU FMUN5335DW1**High reliability test capabilities**

Item Test	Conditions
1. Steady State Operating Life	$P_o=187\text{mW}$ 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	$P=2\text{atm}$ $T_a=121^\circ\text{C}$ $RH=100\%$ 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