

SMJB5603T4G

Product Preview

ESBC Rated NPN Silicon Transistor

Features

- Low Equivalent On Resistance
- Very Fast Switch: 150 kHz
- Squared RBSOA: Up to 1500 V
- Avalanche Rated
- Low Driving Capacitance, No Miller Capacitance (Typ. 12 pF Capacitance at 200 V)
- Low Switching Losses
- Reliable HV Switch: No False Triggering due to High dv/dt Transients

Applications

- High-Voltage and High-Speed Power Switches
- Emitter-Switched Bipolar/MOSFET Cascode (ESBC)
- Smart Meters, Smart Breakers, HV Industrial Power Supplies
- Motor Drivers and Ignition Drivers

MAXIMUM RATINGS (T_J = 25°C unless otherwise stated)

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V _{CBO}	1500	V
Collector-Emitter Voltage	V _{CEO}	800	V
Emitter-Base Voltage	V _{EBO}	12	V
Collector Current	I _C	2	A
Collector Current (Pulse)	I _{CP}	3	A
Base Current	I _B	1	A
Base Current (Pulse)	I _{BP}	2	A
Power Dissipation (T _C = 25°C)	P _D	110	W
Operating and Junction Temperature Range	T _J	-55 to +125	°C
Storage Temperature Range	T _{STG}	-65 to +150	°C
Avalanche Energy (T _J = 25°C, 8 mH)	EAS	3.5	mJ

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

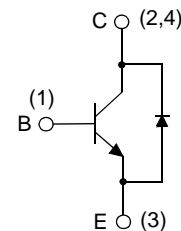
1. Figure of Merit.



ON Semiconductor®

www.onsemi.com

V _{CS(ON)}	Equiv. R _{DS(ON)}	I _C
0.131 V	0.261 Ω (Note 1)	0.5 A

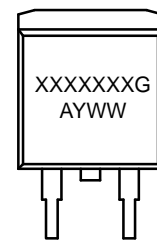


(Internal Schematic Diagram)

MARKING DIAGRAM



D²PAK
2 LEAD
CASE 418AJ



XXXXXX = Specific Device Code
 A = Assembly Location
 Y = Year
 WW = Work Week
 G = Pb-Free Package

ORDERING INFORMATION

Device	Package	Shipping
SMJB5603T4G	D2-PAK 2L (TO-263)	800 / Tape & Reel

This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.

SMJB5603T4G

THERMAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise stated) (Note 2)

Parameter	Symbol	Max	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.13	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	76.42	

2. Device mounted on FR-4 PCB, board size = 76.2 mm x 114.3 mm, land pattern 12.70 mm x 9.45 mm, trace size = 10 mil.

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise stated) (Note 3)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Collector-Base Breakdown Voltage	BV_{CBO}	$I_C = 0.5 \text{ mA}, I_E = 0$	1500	1689		V
Collector-Emitter Breakdown Voltage	BV_{CEO}	$I_C = 5 \text{ mA}, I_B = 0$	800	870		V
Emitter-Base Breakdown Voltage	BV_{EBO}	$I_E = 0.5 \text{ mA}, I_C = 0$	12.0	14.8		V
Collector Cut-off Current	I_{CES}	$V_{CE} = 1500 \text{ V}, V_{BE} = 0$		0.01	100	μA
Collector Cut-off Current	I_{CEO}	$V_{CE} = 800 \text{ V}, I_B = 0$		0.01	100	μA
Emitter Cut-off Current	I_{EBO}	$V_{EB} = 12 \text{ V}, I_C = 0$		0.05	500	μA
DC Current Gain	h_{FE}	$V_{CE} = 3 \text{ V}, I_C = 0.4 \text{ A}$	20	29	35	
		$V_{CE} = 10 \text{ V}, I_C = 5 \text{ mA}$	20	43		
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 0.25 \text{ A}, I_B = 0.05 \text{ A}$		0.16		V
		$I_C = 0.5 \text{ A}, I_B = 0.167 \text{ A}$		0.12		
		$I_C = 1 \text{ A}, I_B = 0.33 \text{ A}$		0.25		
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	$I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$		0.74	1.20	V
		$I_C = 2 \text{ A}, I_B = 0.4 \text{ A}$		0.85	1.20	
Input Capacitance	C_{IB}	$V_{EB} = 10 \text{ V}, I_C = 0, f = 1 \text{ MHz}$		745	1000	pF
Output Capacitance	C_{OB}	$V_{CB} = 200 \text{ V}, I_E = 0, f = 1 \text{ MHz}$		15		pF
Current Gain Bandwidth Product	f_T	$I_C = 0.1 \text{ A}, V_{CE} = 10 \text{ V}$		5		MHz
Diode Forward Voltage	V_F	$I_F = 0.4 \text{ A}$		0.76	1.20	V
		$I_F = 1 \text{ A}$		0.83	1.50	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

3. Pulse test: pulse width = 20 μs , duty cycle $\leq 10\%$.

SMJB5603T4G

TYPICAL CHARACTERISTICS

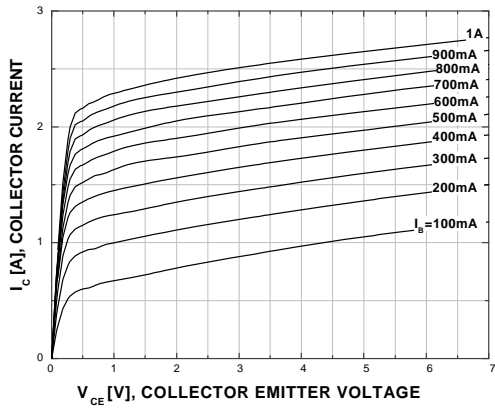


Figure 1. Static Characteristic

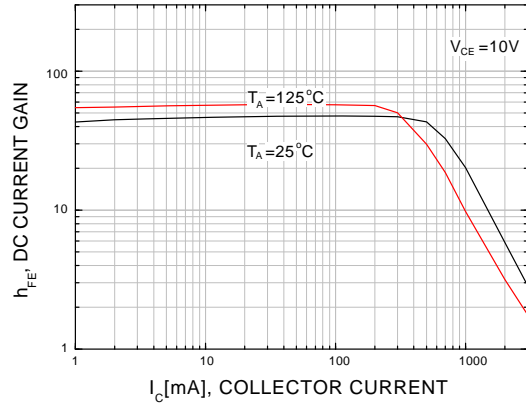


Figure 2. DC Current Gain

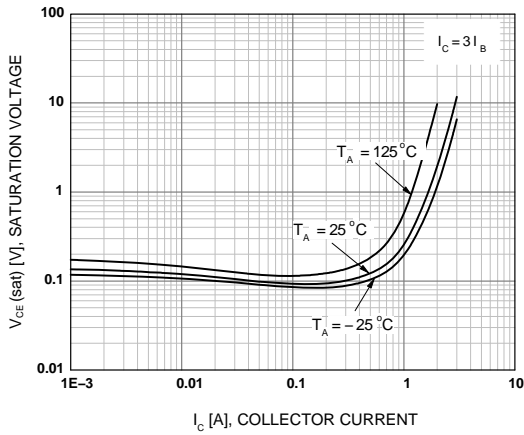


Figure 3. Collector-Emitter Saturation Voltage
 $h_{FE} = 3$

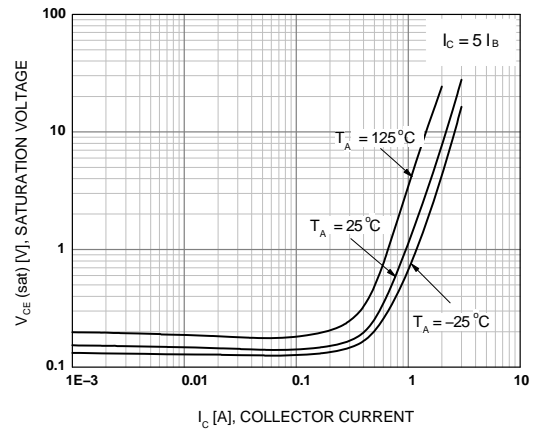


Figure 4. Collector-Emitter Saturation Voltage
 $h_{FE} = 5$

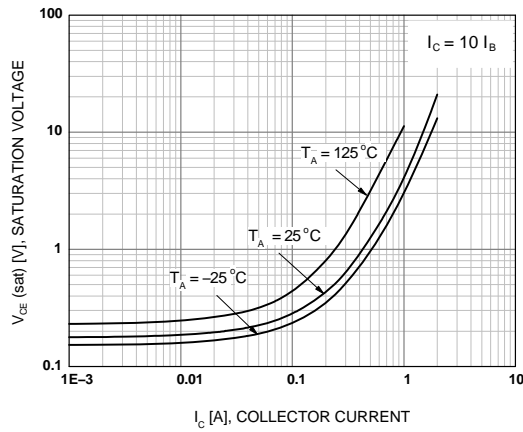


Figure 5. Collector-Emitter Saturation Voltage
 $h_{FE} = 10$

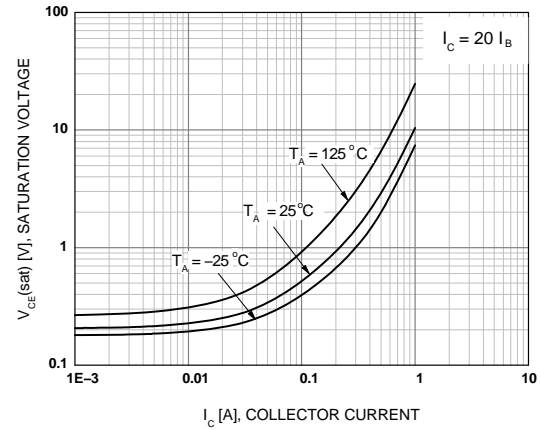


Figure 6. Collector-Emitter Saturation Voltage
 $h_{FE} = 20$

SMJB5603T4G

TYPICAL CHARACTERISTICS

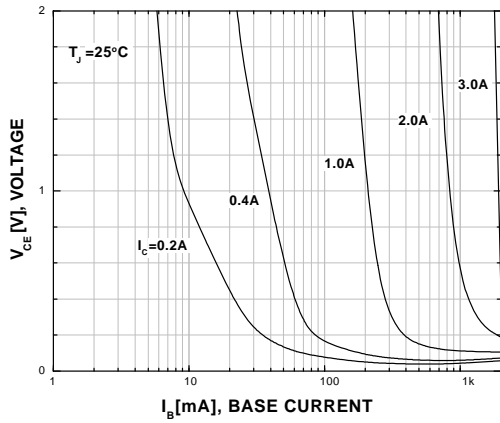


Figure 7. Typical Collector Saturation Voltage

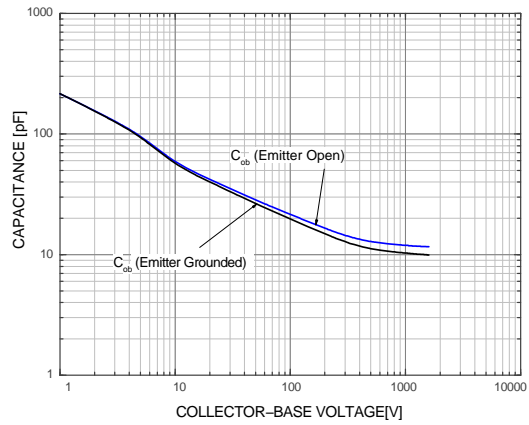


Figure 8. Capacitance

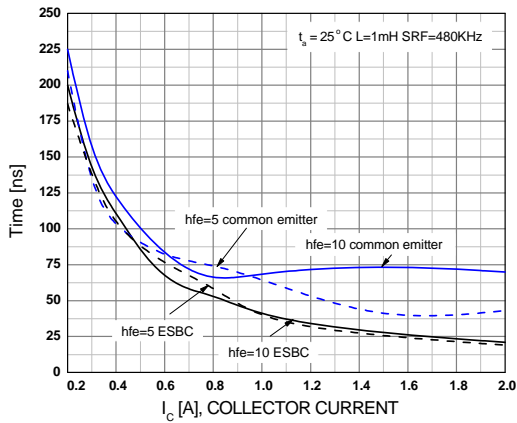


Figure 9. Inductive Load Collector Current Fall-Time (t_f)

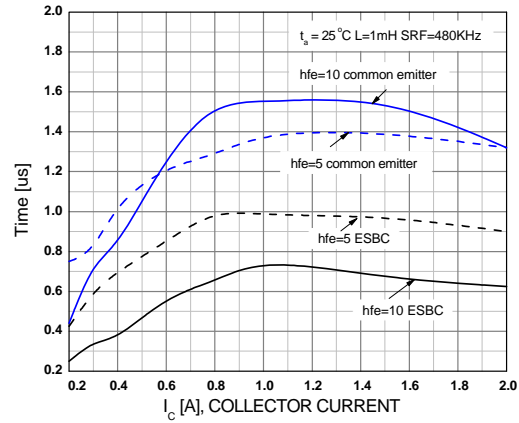


Figure 10. Inductive Load Collector Current Storage-Time (t_{stg})

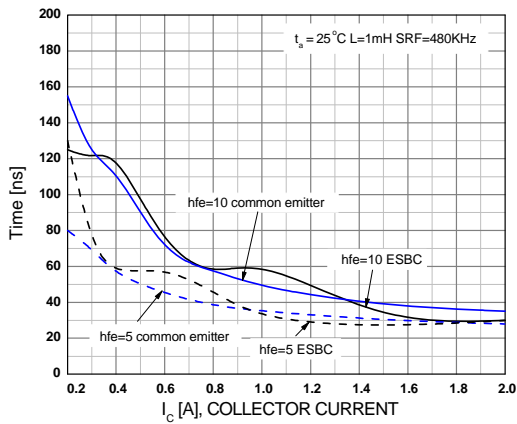


Figure 11. Inductive Load Collector Voltage Fall-Time (t_f)

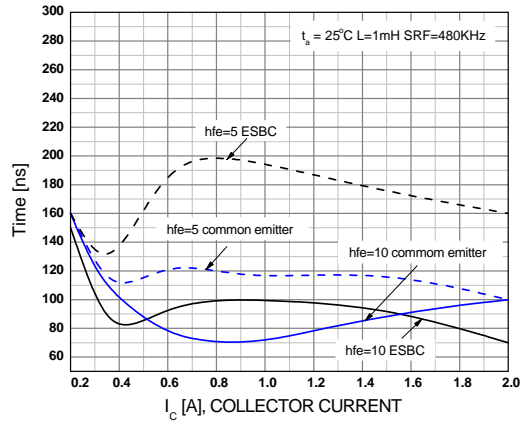


Figure 12. Inductive Load Collector Voltage Rise-Time (t_r)

TYPICAL CHARACTERISTICS

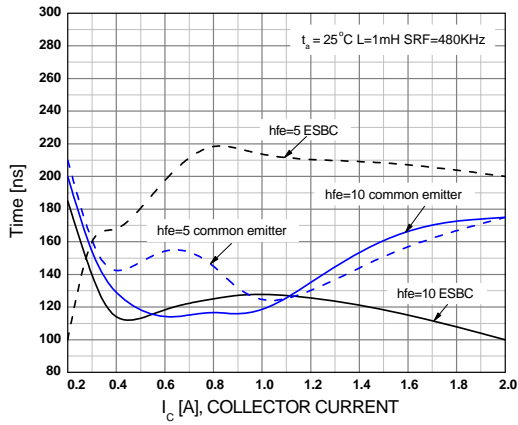


Figure 13. Inductive Load Collector Current / Voltage Crossover (t_c)

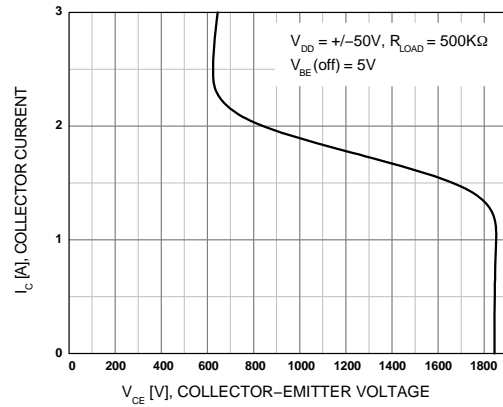


Figure 14. BJT Reverse Bias Safe Operating Area

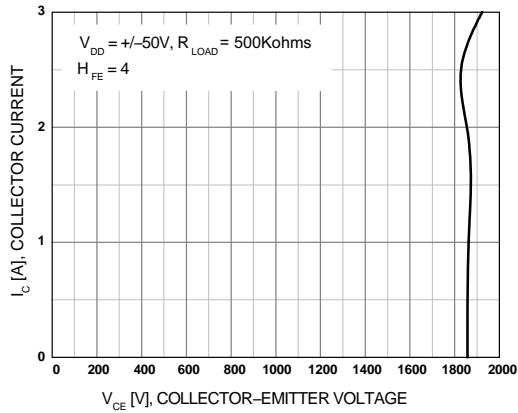


Figure 15. ESBC RBSOA

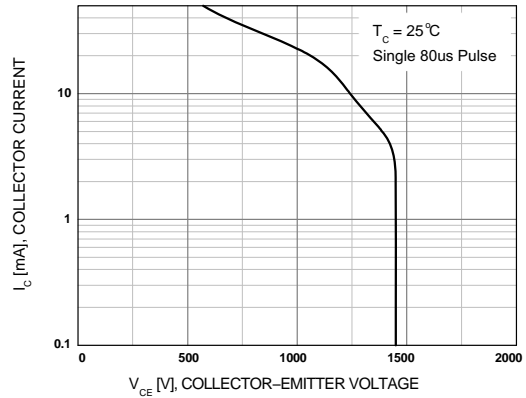


Figure 16. Crossover Forward Bias Safe Operating Area (FBSOA)

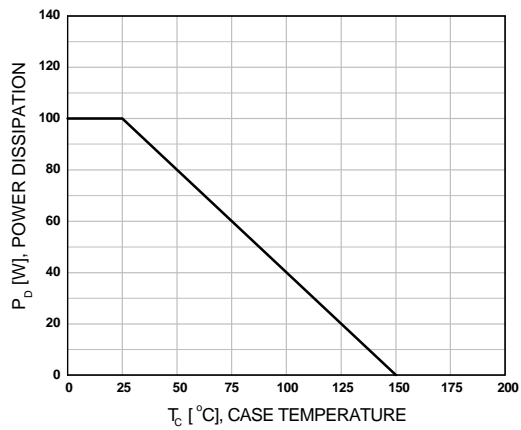


Figure 17. Power Derating

Test Circuits

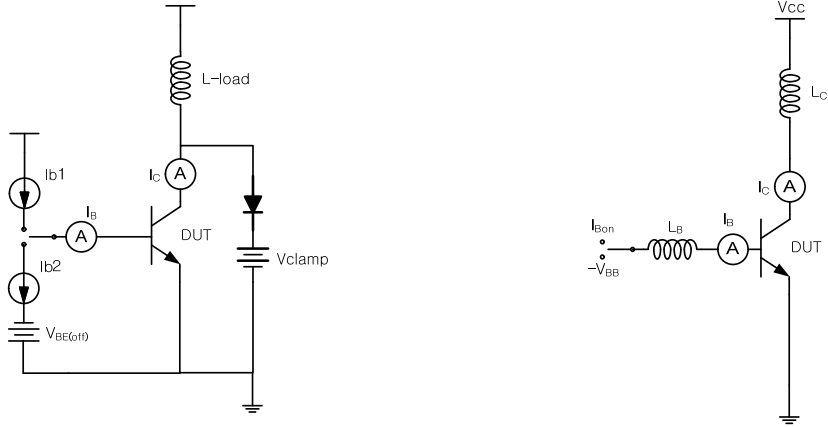


Figure 18. Test Circuit for Inductive Load and Reverse Bias Safe Operating

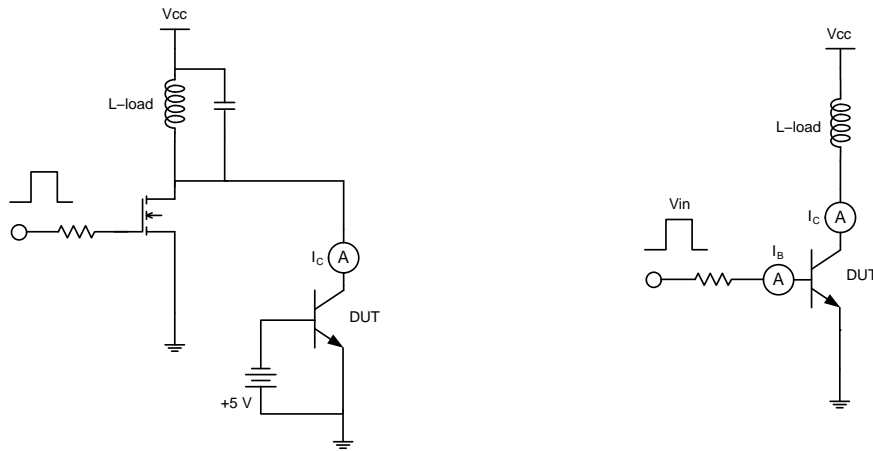


Figure 19. Energy Rating Test Circuit

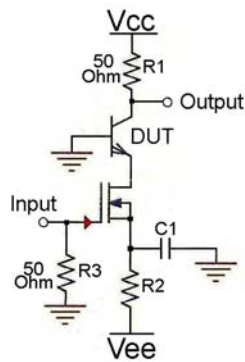


Figure 20. f_T Measurement

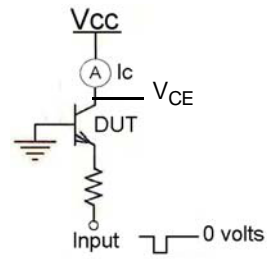


Figure 21. FBSOA

SMJB5603T4G

Test Circuits (Continued)

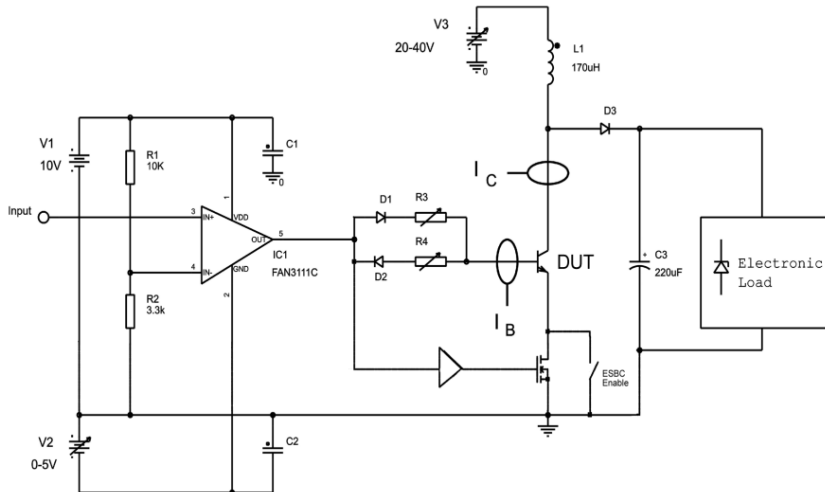


Figure 22. Simplified Saturated Switch Driver Circuit

Functional Test Waveforms

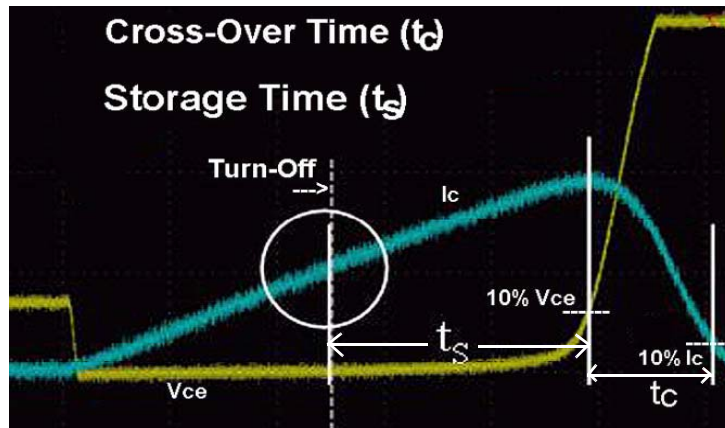


Figure 23. Crossover Time Measurement

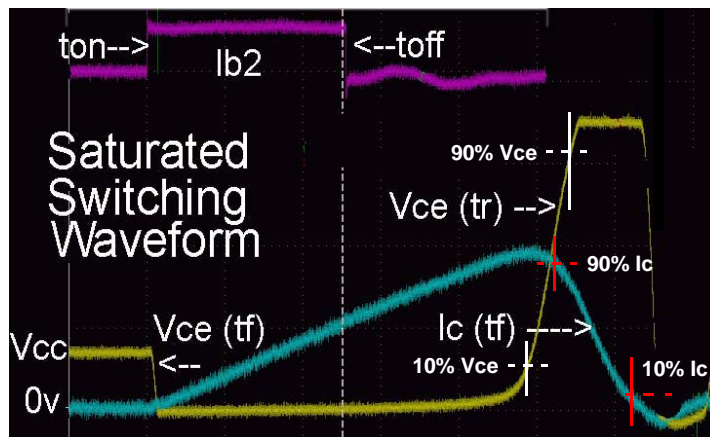


Figure 24. Saturated Switching Waveform

Functional Test Waveforms (Continued)

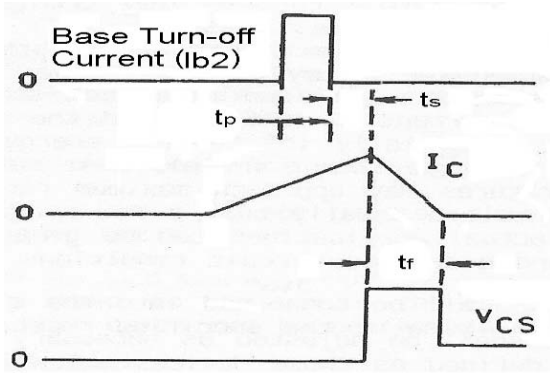


Figure 25. Storage Time - Common Emitter Base Turn-off (I_{b2}) to I_C Fall-Time

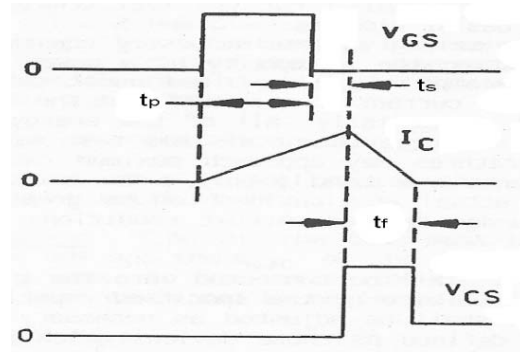
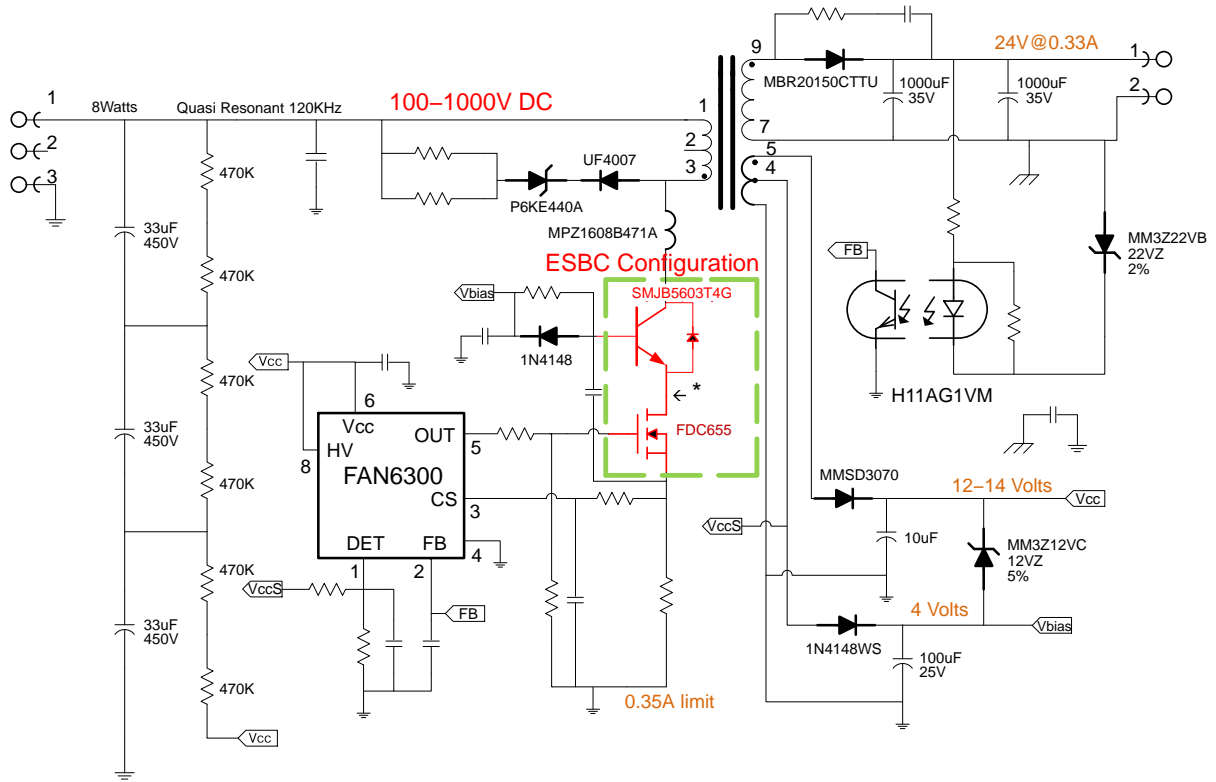


Figure 26. Storage Time - ESBC FET Gate (off) to I_C Fall-Time

SMJB5603T4G

Very Wide Input Voltage Range Supply



* Make short as possible

Figure 27. 8 W; Secondary-Side Regulation: 3 Capacitor Input; Quasi Resonant

Driving ESBC Switches

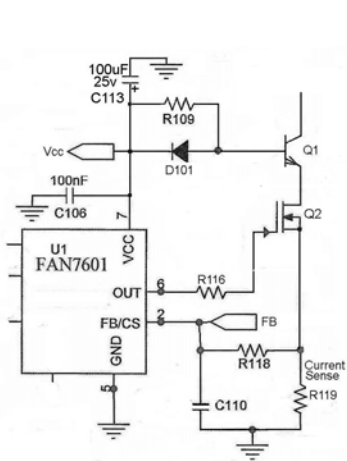


Figure 28. V_{CC} Derived

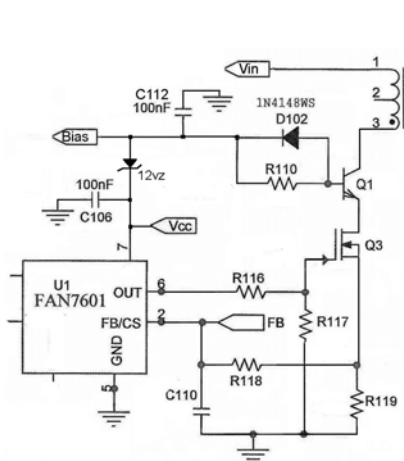


Figure 29. V_{bias} Supply Derived

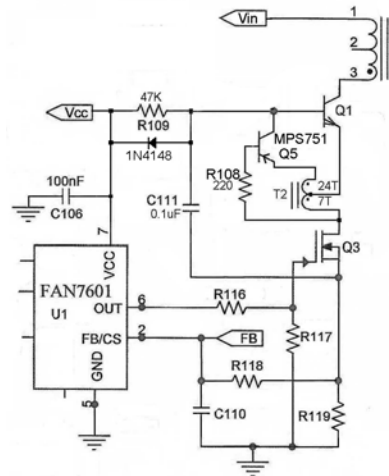
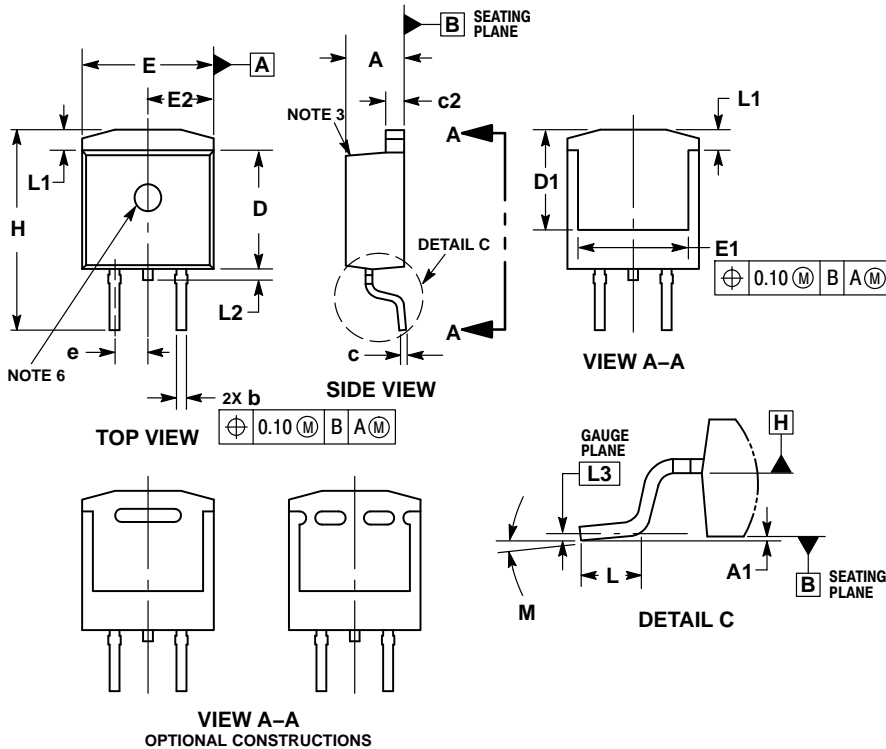


Figure 30. Proportional Drive

SMJB5603T4G

PACKAGE DIMENSIONS

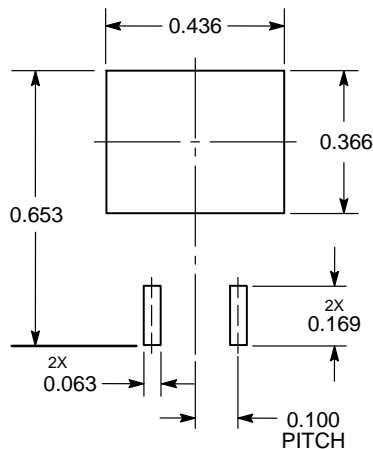
D²PAK-3 (TO-263, 3-LEAD) CASE 418AJ ISSUE B



NOTES:


1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. CHAMFER OPTIONAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
5. THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1 AND E1.
6. OPTIONAL MOLD FEATURE.

RECOMMENDED SOLDERING FOOTPRINT*



DIMENSIONS: INCHES

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local
Sales Representative