March 2012

FJAFS1510A
ESBC™ Rated NPN Power Transistor

Applications

- High Voltage and High Speed Power Switch Application
- Emitter-Switched Bipolar/MOSFET Cascode Application (ESBC™)
- Smart Meter, Smart Breakers, SMPS, HV Industrial Power Supplies
- Motor Driver and Ignition Driver

ESBC Features (FDC655 MOSFET)

$V_{CS(ON)}$	I_C	Equiv $R_{CS(ON)}$
0.426 V	6 A	0.071 Ω *

- Low Equivalent On Resistance
- Very Fast Switch : 150KHz
- Avalanche Rated
- Low Driving Capacitance, no Miller Capacitance
- Low Switching Losses
- Reliable HV switch : No False Triggering due to High dv/dt Transients.

Description

The FJAFS1510A is a low-cost, high performance power switch designed to provide the best performance when used in an ESBC™ configuration in applications such as: power supplies, motor drivers, Smart Grid, or ignition switches. The power switch is designed to operate up to 1550 volts and up to 6amps while providing exceptionally low on-resistance and very low switching losses.

The ESBC™ switch is designed to be easy to drive using off-the-shelf power supply controllers or drivers. The ESBC™ MOSFET is a low-voltage, low-cost, surface mount device that combines low-input capacitance and fast switching, The ESBC™ configuration further minimizes the required driving power because it does not have Miller capacitance.

The FJAFS1510A provides exceptional reliability and a large operating range due to its square reverse-bias-safe-operating-area (RBSOA) and rugged design. The device is avalanche rated and has no parasitic transistors so is not prone to static dv/dt failures.

The power switch is manufactured using a dedicated high-voltage bipolar process and is packaged in a high-voltage TO-3PF package.

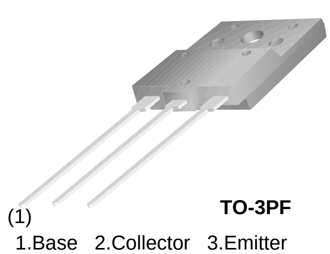


Figure 1. Pin Configuration

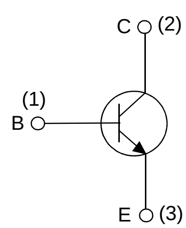


Figure 2. Internal Schematic Diagram

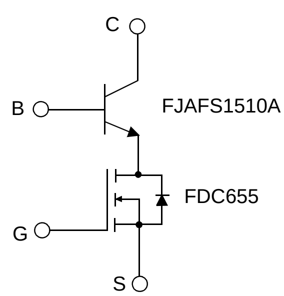


Figure 3. ESBC Configuration**

Ordering Information

Part Number	Marking	Package	Packing Method	Remarks
FJAFS1510ATU	J1510A	TO-3PF	TUBE	

* Figure of Merit

** Other Fairchild MOSFETs can be used in this ESBC application.

Absolute Maximum Ratings * T_a = 25°C unless otherwise noted

Symbol	Parameter	Value	Units
V_{CBO}	Collector-Base Voltage	1550	V
V_{CEO}	Collector-Emitter Voltage	750	V
V_{EBO}	Emitter-Base Voltage	6	V
I_C	Collector Current (DC)	6	A
P_C	Collector Dissipation (T_C = 25°C)	60	W
T_J	Operating and Junction Temperature Range	-55 to +125	°C
T_{STG}	Storage Temperature Range	-55 to +150	°C

* Pulse Test: Pulse Width = 5 ms, Duty Cycle ≤ 10%

Thermal Characteristics T_a = 25°C unless otherwise note

Symbol	Parameter	Max.	Units
$R_{\theta jC}$	Thermal Resistance, Junction to Case	2.08	°C/W

Electrical Characteristics T_a = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
I_{CES}	Collector Cut-off Current	V_{CB}=1400V, R_{BE}=0			100	μA
I_{CBO}	Collector Cut-off Current	V_{CB}=800V, I_E=0			10	μA
I_{EBO}	Emitter Cut-off Current	V_{EB}=4V, I_C=0			100	μA
BV_{EBO}	Base-Emitter Breakdown Voltage	I_E=500μA, I_C=0	6			V
h_{FE1} h_{FE2}	DC Current Gain	V_{CE}=5V, I_C=0.5A V_{CE}=5V, I_C=3A	15 7			
V_{CE}(sat)	Collector-Emitter Saturation Voltage	I_C=6A, I_B=1.5A, T_a=125°C		0.5		V
C_{ob}	Output Capacitance	V_{CB}=200V, I_E=0, f=1MHz		27		pF

ESBC Configured Electrical Characteristics * T_a = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
f_T	Current Gain Bandwidth Product	I_C=0.1A,V_{CE}=10V		15.4		MHz
It_f	Inductive Current Fall Time	V_{GS}=10V, R_G=47Ω, V_{Clamp}=500V, I_C=1A, I_B=0.1A, h_{FE}=10 L_C=1mH, SRF=350KHz		115		ns
t_s	Inductive Storage Time			670		ns
Vt_f	Inductive Voltage Fall Time			160		ns
Vt_r	Inductive Voltage Rise Time			95		ns
t_c	Inductive Crossover Time			130		ns
It_f	Inductive Current Fall Time	V_{GS}=10V, R_G=47Ω, V_{Clamp}=500V, I_C=5A, I_B=1A, h_{FE}=5 L_C=1mH, SRF=350KHz		12.5		ns
t_s	Inductive Storage Time			1100		ns
Vt_f	Inductive Voltage Fall Time			68		ns
Vt_r	Inductive Voltage Rise Time			110		ns
t_c	Inductive Crossover Time			150		ns
V_{CSW}	Maximum Collector Source Voltage at Turn-off without Snubber	h_{FE}=5, I_C=6A	1550			V
$I_{GS(OS)}$	Gate-Source Leakage Current	V_{GS}=±20V		1.0		nA
$V_{CS(ON)}$	Collector-Source On Voltage	V_{GS}=10V, I_C=6A, I_B=2A, h_{FE}=3 V_{GS}=10V, I_C=4A, I_B=1.3A, h_{FE}=3 V_{GS}=10V, I_C=2A, I_B=0.67A, h_{FE}=3 V_{GS}=10V, I_C=1A, I_B=0.2A, h_{FE}=5		0.426 0.213 0.162 0.141		V V V V
$V_{GS(th)}$	Gate Threshold Voltage	V_{BS}=$V_{GS,}$ I_B=250μA		1.9		V
C_{iss}	Input Capacitance (V_{GS}=V_{CB}=0)	V_{CS}=25V, f=1MHz		470		pF
$Q_{GS(tot)}$	Gate-Source Change V_{CB}=0	V_{GS}=10V, I_C=6A, V_{CS}=25V		9		nC
$r_{DS(ON)}$	Static Drain to Source On Resistance	V_{GS}=10V, I_D=6.3A V_{GS}=10V, I_D=6.3A, T_a=125°C V_{GS}=4.5V, I_D=5.5A		21 30 26		mΩ mΩ mΩ

* Used typical FDC655 MOSFET specifications in table. Table could vary if other Fairchild MOSFETs are used.

Typical Performance Characteristics

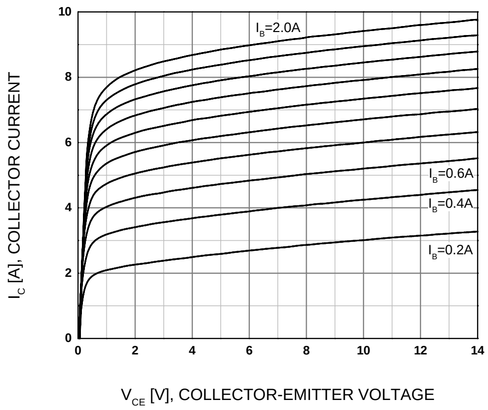


Figure 1. Static Characteristic

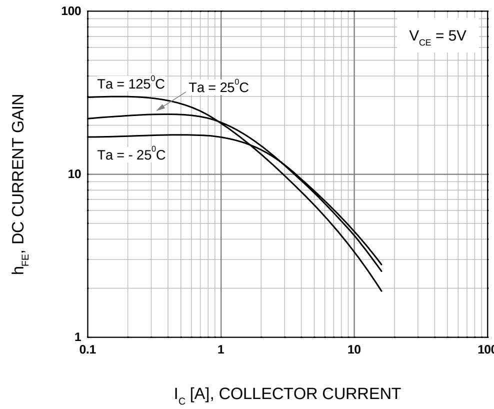


Figure 2. DC current Gain

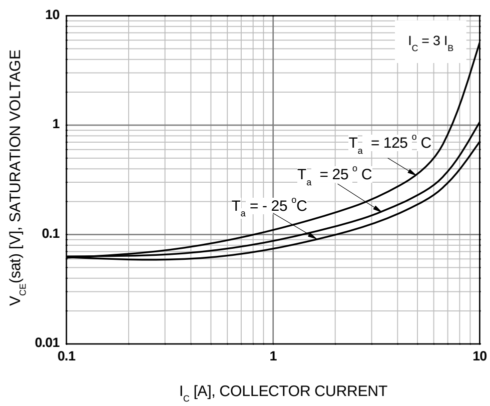


Figure 3. Collector-Emitter Saturation Voltage h_{FE}=3

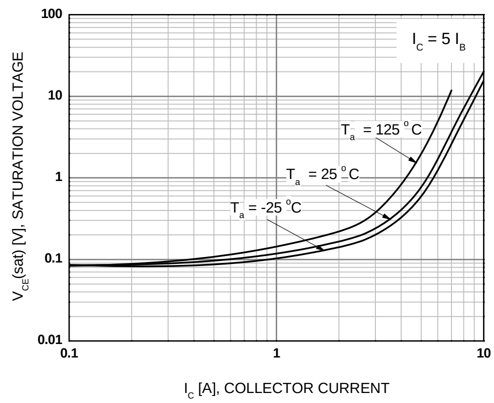


Figure 4. Collector-Emitter Saturation Voltage h_{FE}=5

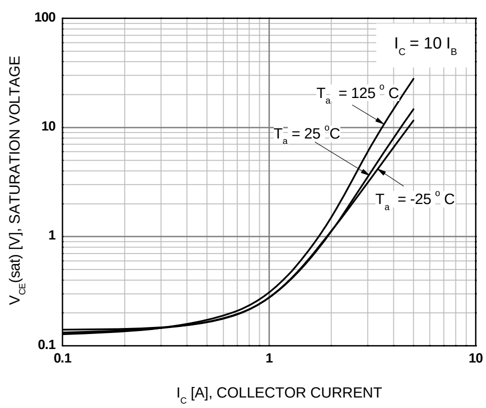


Figure 5. Collector-Emitter Saturation Voltage h_{FE}=10

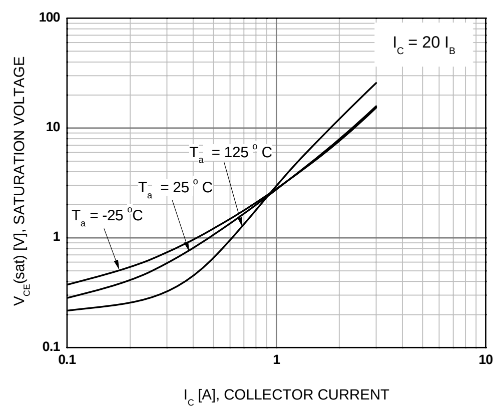


Figure 6. Collector-Emitter Saturation Voltage h_{FE}=20

Typical Performance Characteristics (Continued)

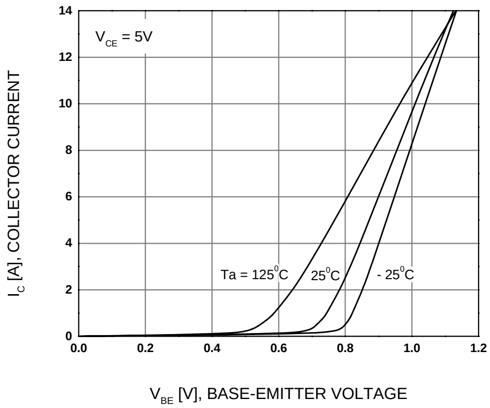


Figure 7. Base-Emitter On Voltage

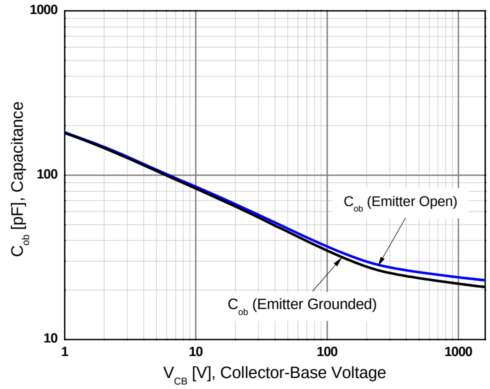


Figure 8. Capacitance

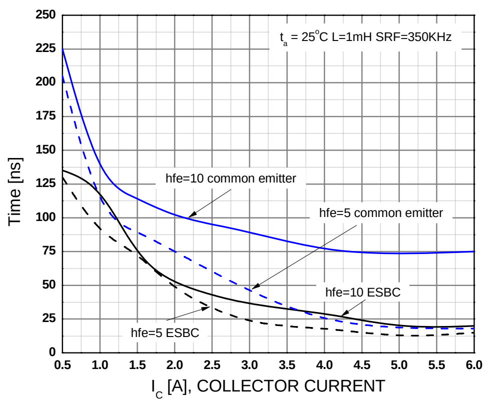


Figure 9. Inductive Load Collector Current Fall-time (t_f)

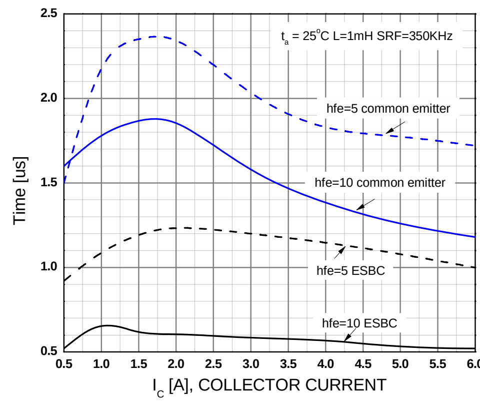


Figure 10. Inductive Load Collector Current Storage time (t_{stg})

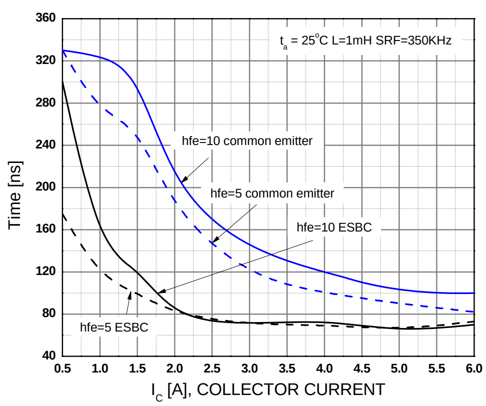


Figure 11. Inductive Load Collector Voltage Fall-time (t_f)

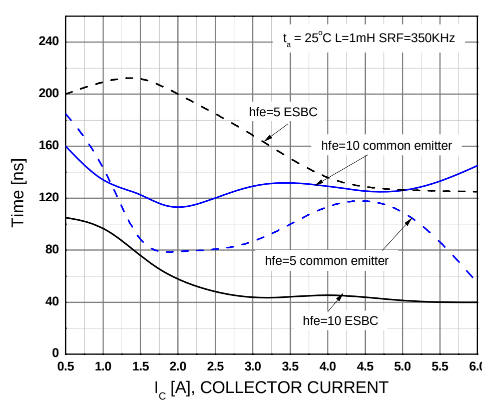


Figure 12. Inductive Load Collector Voltage Rise-time (t_r)

Typical Performance Characteristics (Continued)

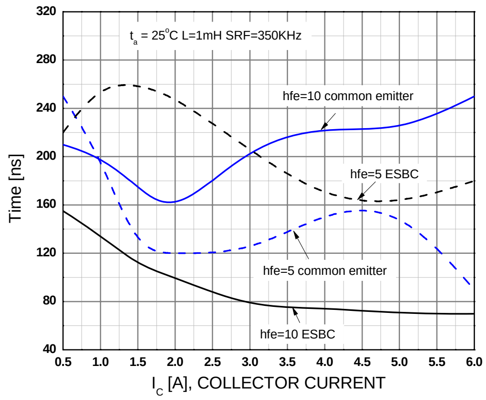


Figure 13. Inductive Load Collector Current/Voltage Crossover (t_c)

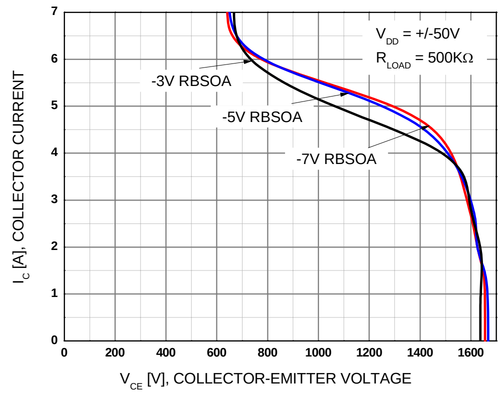


Figure 14. Reverse Bias Safe Operating Area

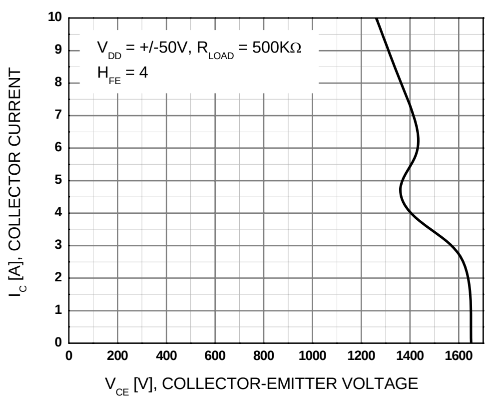


Figure 15. ESBC RBSOA

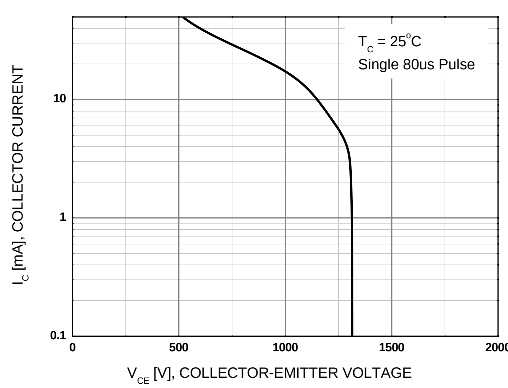


Figure 16. Forward Bias Safe Operating Area

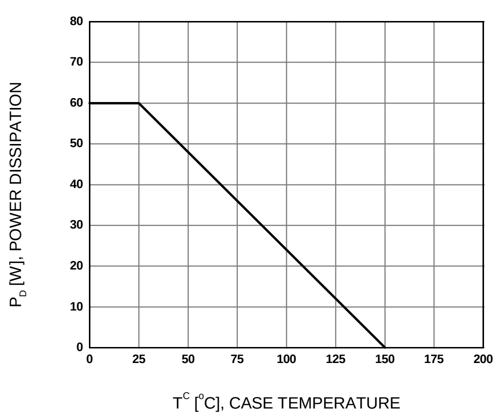


Figure 17. Power Derating

Test Circuits

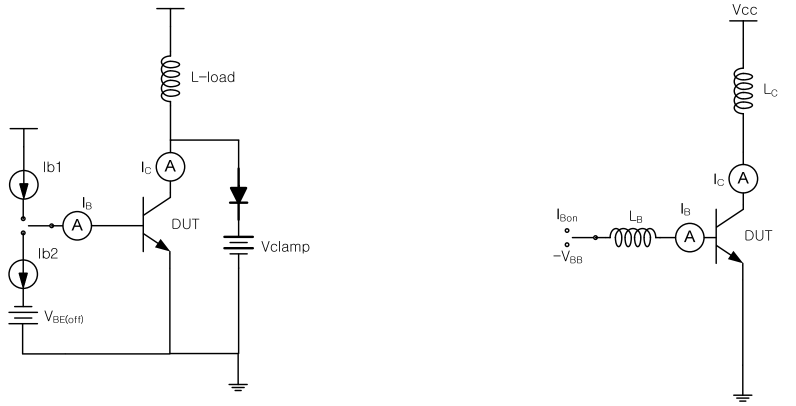


Fig1. Test Circuit For Inductive Load and Reverse Bias Safe Operating

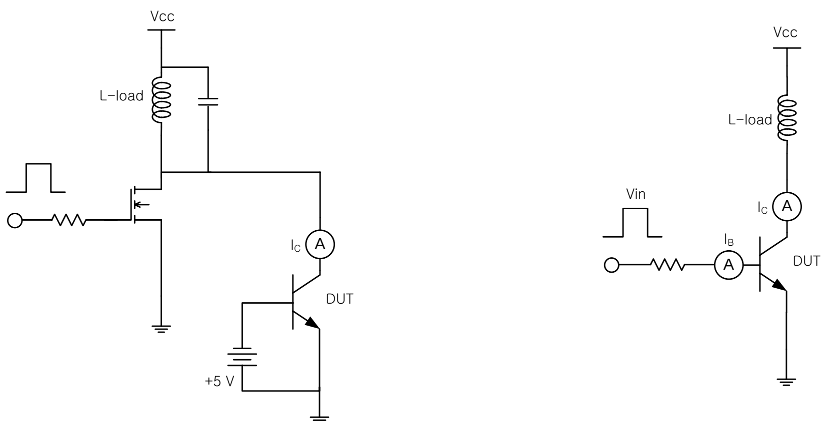


Fig2. Energy Rating Test Circuit

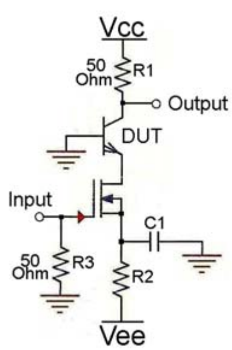


Fig3. Ft Measurement

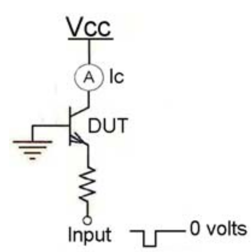


Fig4. FBSOA

Test Circuits (Continued)

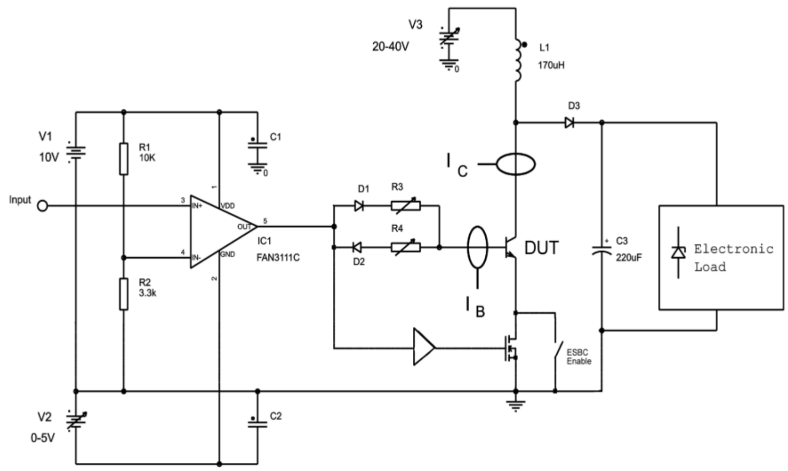


Figure 5. Simplified Saturated Switch Driver Circuit

Functional Test Waveforms

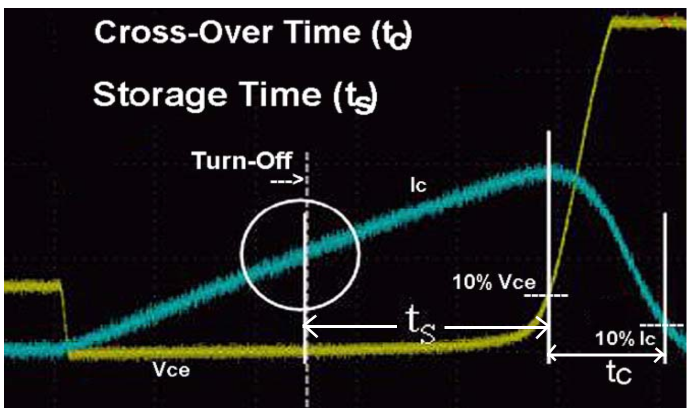


Figure 1. Crossover Time Measurement

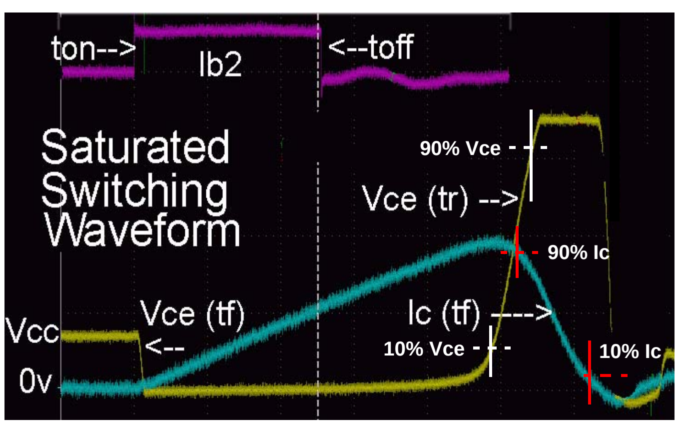


Figure 2. Saturated Switching Waveform

Functional Test Waveforms (Continued)

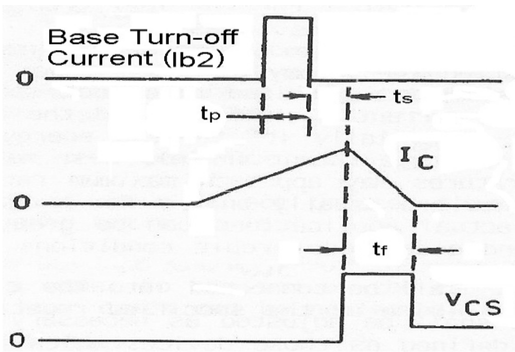


Figure 3. Storage Time - Common Emitter Base turn off (Ib2) to Ic Fall-time

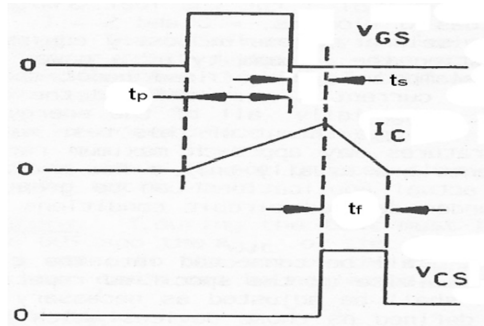
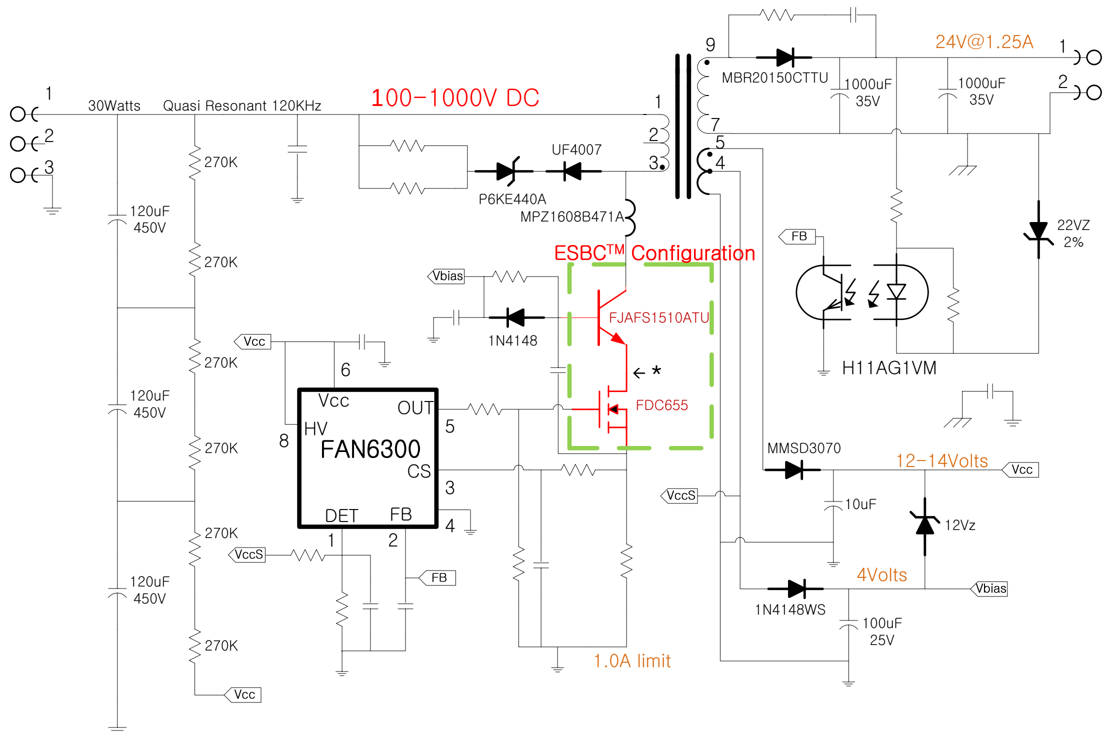


Figure 4. Storage Time - ESBC FET Gate (off) to Ic Fall-time

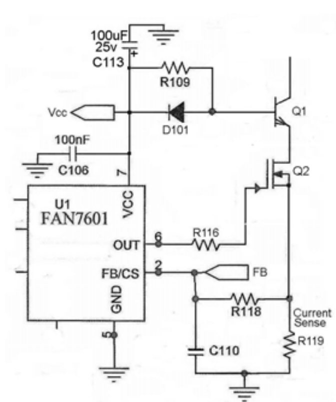
Very Wide Input Voltage Range Supply

- 30watt; SecReg: 3 cap input; Quasi Resonant

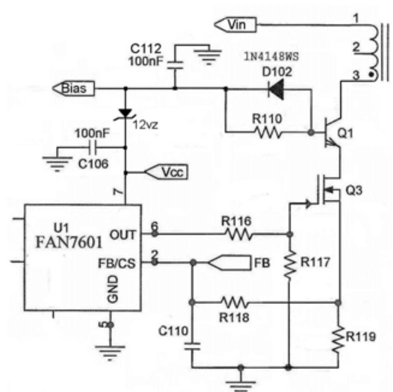


* Make short as possible

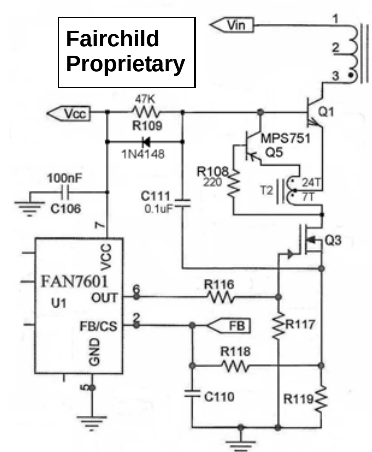
Driving ESBC Switches



Vcc Derived



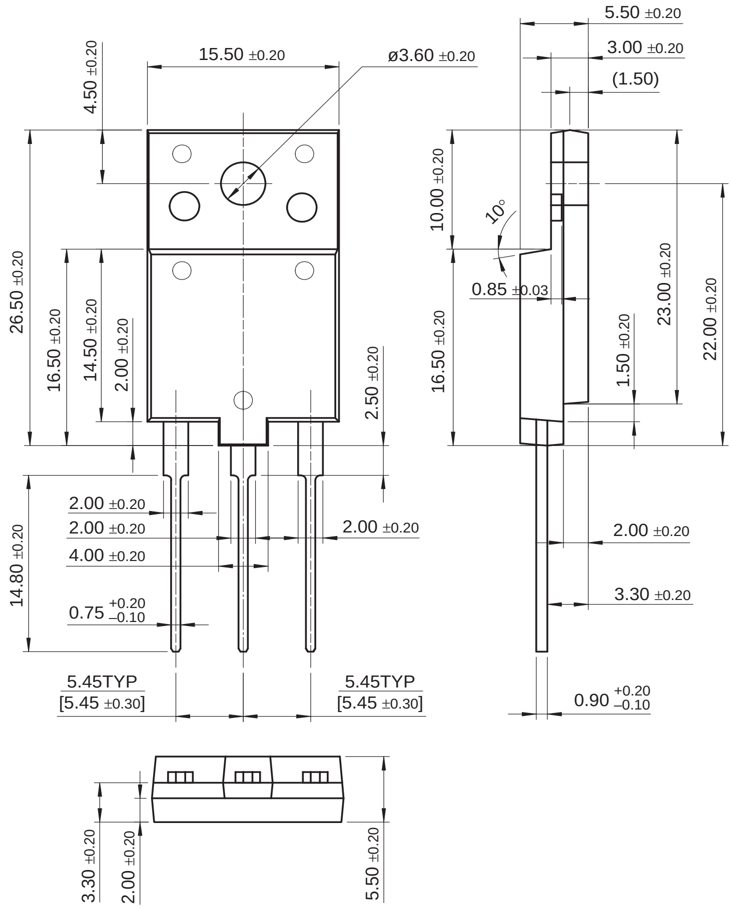
Vbias Supply Derived



Proportional Drive

Physical Dimensions

TO-3PF



Dimensions in Millimeters

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RapidConfigure™
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2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

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