GSI510, IGT5E10CS

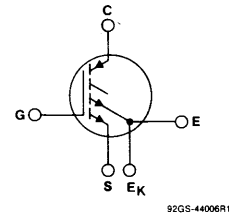
File Number **2326**

Current Sensing IGT™ Transistors
Insulated Gate Bipolar Transistors

10 A, 500 V
$r_{DS(on)}$ = 0.27 Ω

Features:
- *Low $V_{CE(sat)}$ - 2.5 V typ. @ 10 A*
- *Ultra-fast turn-on - 100 ns typical*
- *Polysilicon MOS gate - voltage controlled turn on/off*
- *High current handling - 10 A @ 100° C case*
- *Current sensing pilot*

TERMINAL DIAGRAM

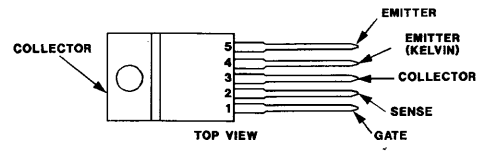


N-CHANNEL ENHANCEMENT MODE

The GSI510 and/or IGT5E10CS Series IGT™ Transistor (Insulated Gate Bipolar Transistor) is a MOS-gate turn on/off power switching device combining the best advantages of power MOSFETs, bipolar transistors, and current sensing pilots. The result is a device that has the high input impedance of MOSFETs and the low on-state conduction losses similar to bipolar transistors. The device design and gate characteristics of the IGT™ Transistor are also similar to power MOSFETs. An important difference is the equivalent $r_{ds(on)}$ drain resistance which is modulated to a low value (10 times lower) when the gate is turned on. The much lower on-state voltage drop also varies only moderately between 25° C and 150° C offering extended power handling capability.

The IGT™ Transistor is ideal for many high-voltage switching applications operating at low frequencies and where low conduction losses are essential, such as AC and DC motor controls, power supplies and drivers for solenoids, relays, and contactors.

TERMINAL DESIGNATION



TO-220 (5 LEAD)

MAXIMUM RATINGS

COLLECTOR-EMITTER VOLTAGE (V_{GE} = 0 V)	V_{CES}	500	V
COLLECTOR-GATE VOLTAGE (R_{GE} = 1 MΩ)	V_{CGR}	500	V
CONTINUOUS DRAIN CURRENT	I_C		
At T_c = 100° C		10	A
At T_c = 25° C		18	A
PULSED COLLECTOR CURRENT	I_{CM}•	40	A
GATE-EMITTER VOLTAGE	V_{GE}	±25	V
TOTAL POWER DISSIPATION	P_D		
At T_c = 25° C		75	W
Derate Above 25° C		0.6	W/° C
OPERATING AND STORAGE JUNCTION TEMPERATURE RANGE	T_J, T_{stg}	-55 to +150	°C
THERMAL RESISTANCE, JUNCTION-TO-CASE	$R_{\theta JC}$	1.67	°C/W
MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES	T_L		
1/8 inch from case for 5 seconds		260	°C

•Repetitive Rating: Pulse width limited by maximum junction temperature.
Gate control turn-off not allowed above 50 amperes.

Harris Semiconductor IGBT product is covered by one or more of the following U.S. patents:

4,364,073	4,417,385	4,430,792	4,443,931	4,466,176	4,532,534	4,567,641
4,587,713	4,618,872	4,620,211	4,631,564	4,639,754	4,639,762	4,641,162
4,644,637	4,682,195	4,684,413	4,717,679	4,794,432	4,801,986	4,803,533
4,809,045	4,810,665					

ELECTRICAL CHARACTERISTICS T_C = 25° C *Unless Otherwise Specified*

CHARACTERISTIC		TEST CONDITIONS	LIMITS MIN.	LIMITS TYP.	LIMITS MAX.	UNITS
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage	BV_{CES}	V_{GE} = 0 V, I_C = 25 μA	500	—	—	V
Collector Cut-off Current	I_{CES}	V_{CE} = Max. Rating, V_{GE} = 0 V, T_C = 25° C	—	—	250	μA
		V_{CE} = Max. Rating x 0.8, V_{GE} = 0 V, T_C = 150° C[1]	—	—	4	mA
Gate-Emitter Leakage Current	I_{GES}	V_{GE} = ±20 V	—	—	±500	nA
ON CHARACTERISTICS[2]						
Gate Threshold Voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 250 μA	2	4	5	V
		T_C = 25°C	—	2.5	—	
		T_C = 150°C				
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	V_{GE} = 15 V, I_C = 10 A, T_C = 25°C	—	2.5	2.7	
		V_{GE} = 15 V, I_C = 10 A, T_C = 150°C	—	2.8	—	
		V_{GE} = 10 V, I_C = 10 A, T_C = 25°C	—	2.9	—	
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{ies}	V_{GE} = 0 V	—	1050	—	pF
Output Capacitance	C_{oes}	V_{CE} = 25 V	—	340	—	
Reverse Transfer Capacitance	C_{res}	f = 1 MHz	—	10	—	
SWITCHING CHARACTERISTICS[2] (See Figs. 8 & 9)						
Turn-On Delay Time	$t_{d(on)}$	Resistive Load, T_J = 125°C	—	100	—	ns
Rise Time	t_r	I_C = 10 A, V_{CE} = 400 V	—	100	—	
Turn-Off Delay Time	$t_{d(off)}$	V_{GE} = 15 V	—	0.4	—	μs
Fall Time	t_f	$R_{G(on)}$ = 50 Ω, $R_{G(off)}$ = 100 Ω	—	2.5	—	
Turn-Off Delay Time	$t_{d(off)}$	Inductive Load, T_J = 125°C	—	0.8	1.2	μs
Fall Time	t_f	L = 45 μH, I_C = 10 A	—	0.8	1.0	
Equivalent Fall Time	$t_{f(eq)}$	$V_{CE(clamp)}$ = 400 V, V_{GE} = 15 V	—	0.6	0.8	
Turn-Off Switching Losses	E_f	$R_{G(on)}$ = 50 Ω, $R_{G(off)}$ = 100 Ω	—	1.6	2.0	mJ
PILOT CHARACTERISTICS[2] [3] [4]						
Pilot - Emitter Kelvin Voltage	V_{PEK}	V_{GE} = 15 Vdc, R_P = 2 KΩ				
I_C = 5 A			—	1.25	—	V
I_C = 10 A			1.4	1.67	1.8	
I_C = 20 A			—	2.06	—	

[1] Applies for 3.3°C per watt maximum thermal resistance, case-to-ambient.
[2] Pulse test: Pulse widths ≤ 300 μs, duty cycle ≤ 2%.
[3] Refer to Fig. 10.
[4] When Not in Use Connect E_P to Emitter.

GSI510, IGT5E10CS

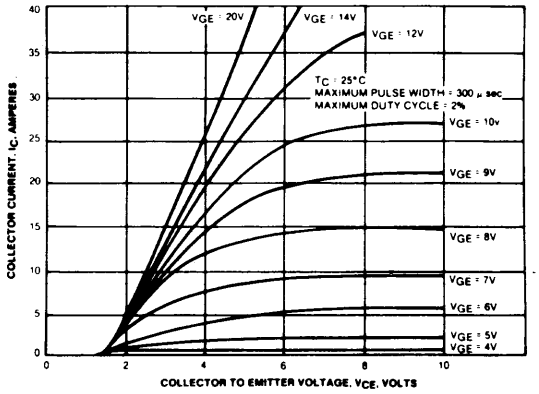


Fig. 1 - Typical output characteristics.

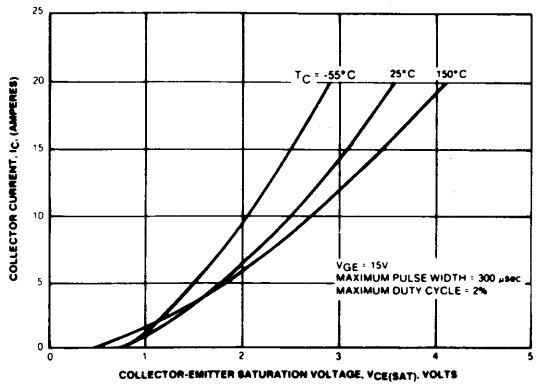


Fig. 2 - Typical collector-emitter saturation voltage.

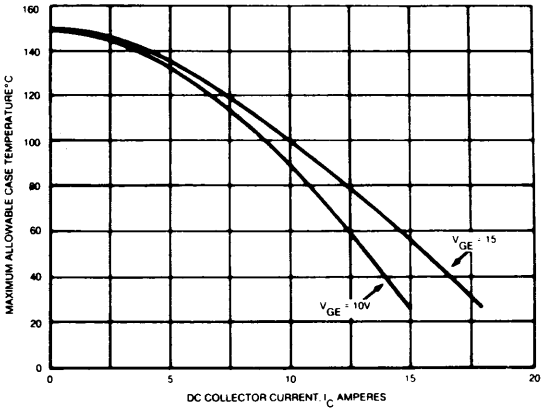


Fig. 3 - Maximum allowable case temperature vs. DC collector current.

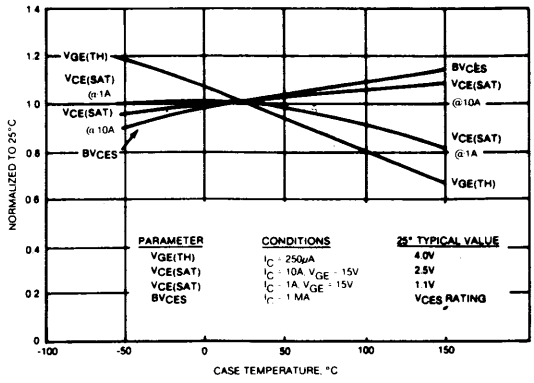


Fig. 4 - Typical temperature dependence of parameters.

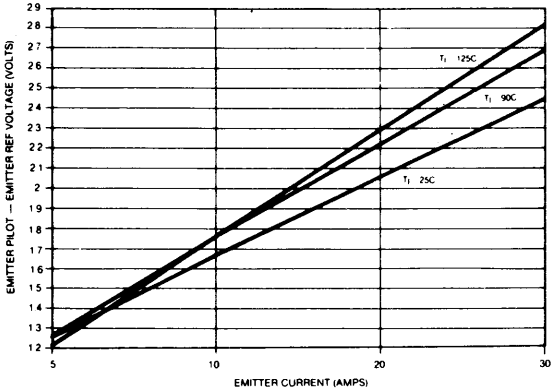


Fig. 5A - Typical emitter pilot characteristics 2 Kohm pilot resistor.

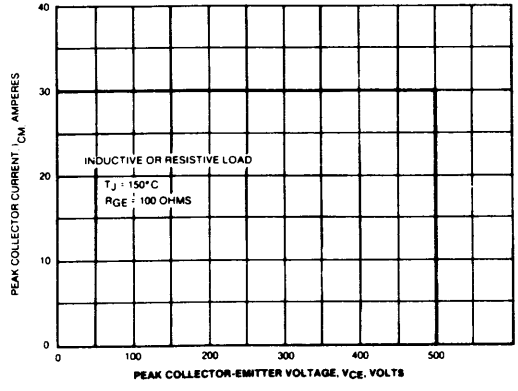


Fig. 5B - Turn-off safe operating area.

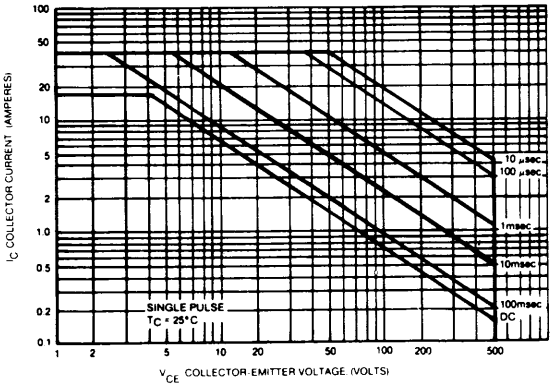


Fig. 6 - Turn-on safe operating area.

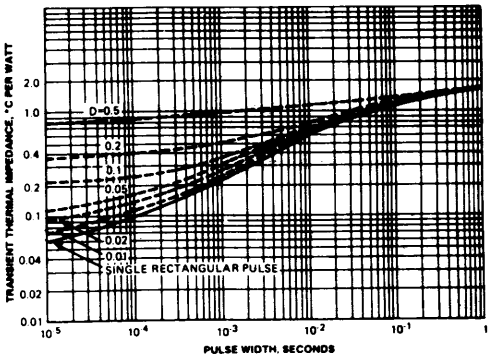


Fig. 7 - Maximum transient thermal impedance.

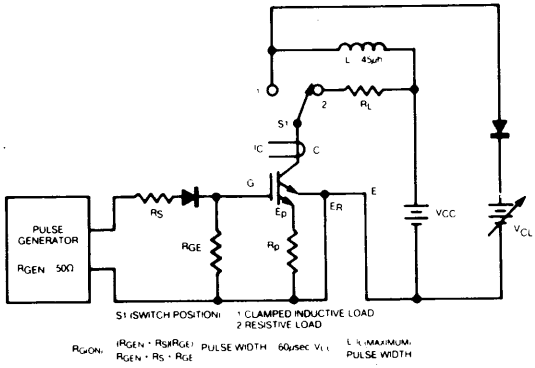


Fig. 8 - Basic switching test circuit.

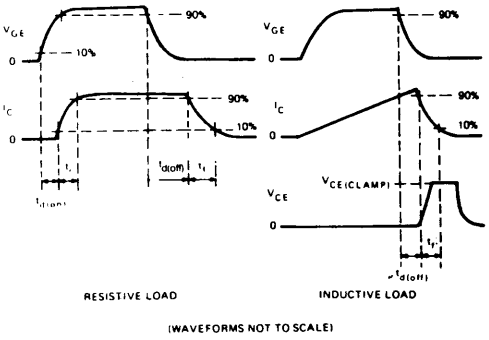


Fig. 9 - Switching waveforms.

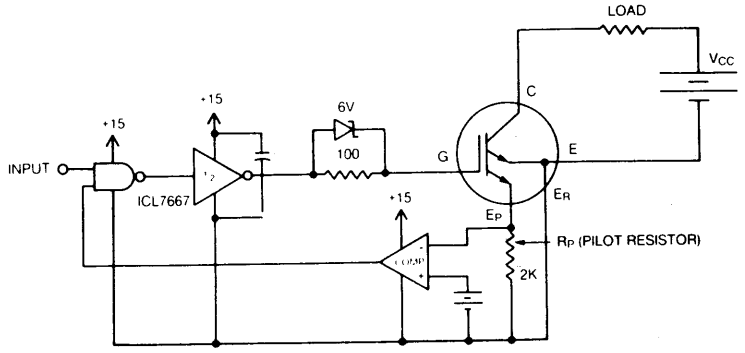


Fig. 10 - Typical circuit utilizing the emitter pilot for overcurrent protection

GSI525, IGT7E20CS

File Number **2327**

Current Sensing IGT™ Transistors

Insulated Gate Bipolar Transistors

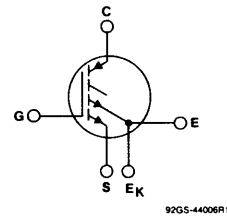
25 A, 500 V

$r_{DS}(on)$ = 0.105 Ω

Features:

- *Low $V_{CE}(sat)$ - 1.8 V typ. @ 25 A*
- *Ultra-fast turn-on - 150 ns typical*
- *Polysilicon MOS gate - voltage controlled turn on/off*
- *High current handling - 25 A @ 85° C case*
- *Current sensing pilot*

TERMINAL DIAGRAM



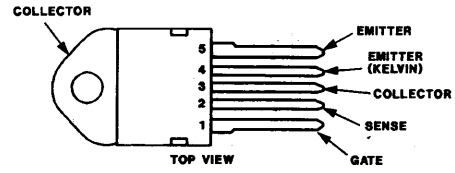
92GS-44006R1

N-CHANNEL ENHANCEMENT MODE

The GSI525 and/or IGT7E20CS IGT™ Transistor (Insulated-Gate Bipolar Transistor) is a MOS-Gated power-switching device combining the best features of power MOSFETs and bipolar transistors with current sensing pilots. The result is a device that has the high input impedance of MOSFETs and the low on-state conduction losses of bipolar transistors. The gate characteristics of the IGT™ Transistor are similar to power MOSFETs but its equivalent $r_{ds}(on)$ drain resistance is ten times lower and varies only moderately between 25°C and 150°C, thus offering extended power handling capability.

The IGT™ Transistor is ideal for many high voltage switching applications up to 5 kHz where low conduction losses are essential; ac and dc motor controls, power supplies and drivers for solenoids, relays, and contactors.

TERMINAL DESIGNATION



TO-218 (5 LEAD)

MAXIMUM RATINGS

COLLECTOR-EMITTER VOLTAGE (V_{GE} = 0 V)	V_{CES}	500	V
COLLECTOR-GATE VOLTAGE (R_{GE} = 1 MΩ)	V_{CGR}	500	V
CONTINUOUS DRAIN CURRENT	I_C		
At T_C = 85°C		25	A
PULSED COLLECTOR CURRENT	I_{CM}*	80	A
GATE-EMITTER VOLTAGE	V_{GE}	±20	V
TOTAL POWER DISSIPATION	P_D		
At T_C = 25°C		125	W
Derate Above 25°C		1	W/°C
OPERATING AND STORAGE JUNCTION TEMPERATURE RANGE	T_J, T_{stg}	-40 to +150	°C
THERMAL RESISTANCE, JUNCTION TO CASE	$R_{\theta JC}$	1	°C/W
MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES	T_L		
1/8 inch from case for 5 seconds		260	°C

*Repetitive Rating: Pulse width limited by maximum junction temperature. Gate control turn-off not allowed above 50 amperes.

Harris Semiconductor IGBT product is covered by one or more of the following U.S. patents:

4,364,073	4,417,385	4,430,792	4,443,931	4,466,176	4,532,534	4,567,641
4,587,713	4,618,872	4,620,211	4,631,564	4,639,754	4,639,762	4,641,162
4,644,637	4,682,195	4,684,413	4,717,679	4,794,432	4,801,986	4,803,533
4,809,045	4,810,665					

ELECTRICAL CHARACTERISTICS, T_C = 25° C Unless Otherwise Specified

CHARACTERISTIC		TEST CONDITIONS	LIMITS MIN.	LIMITS TYP.	LIMITS MAX.	UNITS
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage	BV_{CES}	V_{GE} = 0 V, I_C = 250 μA	500	—	—	V
Collector Cut-off Current	I_{CES}	V_{CE} = Max. Rating, V_{GE} = 0 V, T_C = 25° C	—	—	250	μA
		V_{CE} = Max. Rating x 0.8, V_{GE} = 0 V, T_C = 125° C(1)	—	—	4	mA
Gate-Emitter Leakage Current	I_{GES}	V_{GE} = ±20 V	—	—	±500	nA
ON CHARACTERISTICS(2)						
Gate Threshold Voltage	$V_{GE}(th)$	V_{CE} = V_{GE}, I_C = 500 μA, T_C = 25° C	2	4	5.5	V
		T_C = 150° C	—	2	—	
Collector-Emitter Saturation Voltage	$V_{CE}(sat)$	V_{GE} = 15 V, I_C = 25 A, T_C = 25° C	—	1.8	2.6	
		T_C = 150° C	—	1.9	—	
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{ies}	V_{GE} = 0 V, V_{CE} = 25 V, f = 1 MHz	—	2300	—	pF
Output Capacitance	C_{oes}		—	250	—	
Reverse Transfer Capacitance	C_{res}		—	35	—	
SWITCHING CHARACTERISTICS(2) (See Figs. 8 & 9)						
Turn-on Delay Time	$t_d(on)$	Resistive Load, T_J = 150° C, I_C = 25 A, V_{CE} = 400 V, V_{GE} = 15 V, $R_G(on)$ = 50 Ω, $R_G(off)$ = 50 Ω	—	100	—	ns
Rise Time	t_r		—	150	—	
Turn-off Delay Time	$t_d(off)$		—	0.6	—	μs
Fall Time	t_f		—	3	—	
Turn-off Delay Time	$t_d(off)$	Inductive Load, T_J = 150° C, L = 45 μH, I_C = 25 A, $V_{CE}(clamp)$ = 400 V, V_{GE} = 15 V, $R_G(on)$ = 50 Ω, $R_G(off)$ = 50 Ω	—	1.5	2.5	μs
Fall Time	t_f		—	1.2	1.6	
Turn-off Switching Losses	E_f		—	5	8	mJ
PILOT CHARACTERISTICS(2)(3)(4)						
Pilot - Emitter Kelvin Voltage	V_{PEK}	V_{GE} = 15 Vdc, R_P = 1 KΩ				
I_C = 20 A			1	1.3	1.6	V
I_C = 30 A			—	1.45	—	
I_C = 40 A			—	1.7	—	

(1) Applies for 3.3° C per watt maximum thermal resistance, case to ambient.

(2) Pulse test: Pulse widths ≤ 300 μs, duty cycle ≤ 2%.

(3) Refer to Fig. 5(a).

(4) When not in use connect P to Emitter.

GSI525, IGT7E20CS

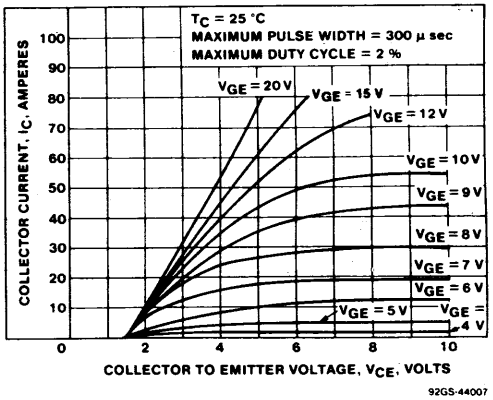


Fig. 1 - Typical output characteristics.

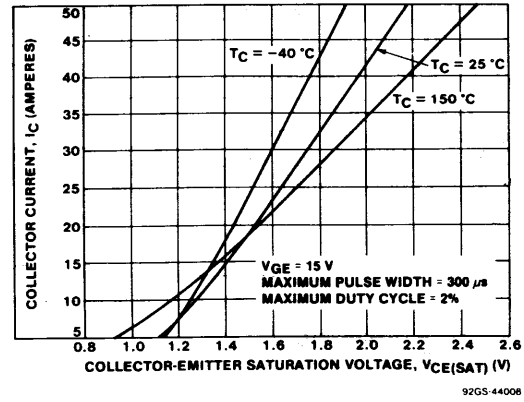


Fig. 2 - Typical collector-emitter saturation voltage

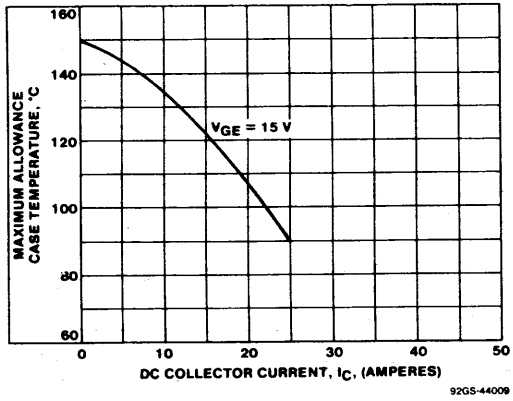


Fig. 3 - Maximum allowable dc collector current vs. case temperature.

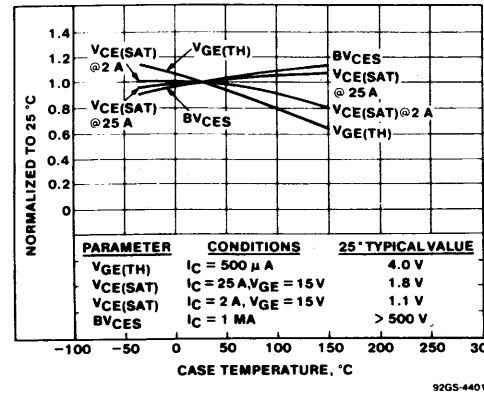


Fig. 4 - Typical temperature dependence of parameters.

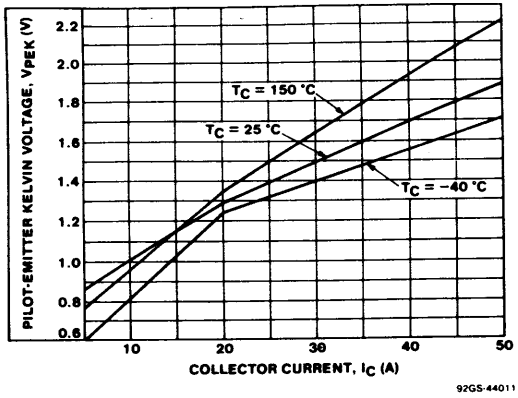


Fig. 5(a) - Typical emitter pilot characteristics - 1 KΩ pilot resistor.

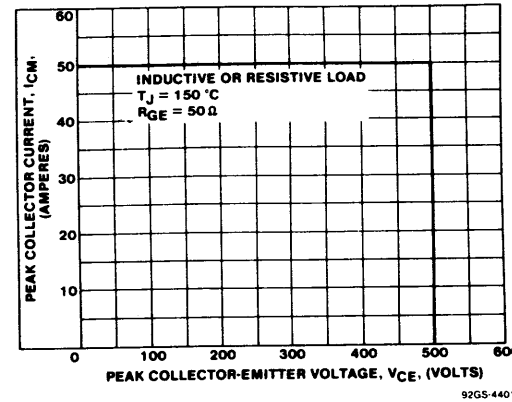


Fig. 5(b) - Turn-off safe operating area.