

Description

This voltage controlled Solidtron™ (VCS) discharge switch utilizes an n-type MOS-Controlled Thyristor mounted in a five leaded TO-247 plastic package.

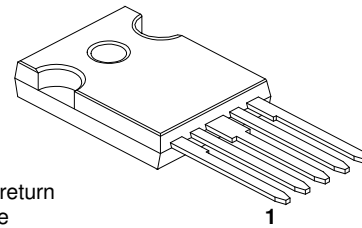
The VCS features the high peak current capability and low On-state voltage drop common to SCR thyristors combined with extremely high di/dt capability. This semiconductor is intended for the control of high power circuits with the use of very small amounts of input energy and is ideally suited for capacitor discharge applications.

The industry standard TO-247 package allows for integration of the Solidtron using automated insertion equipment.

Features

- 1400V Peak Off-State Voltage
- 32A Continuous Rating
- 4kA Surge Current Capability
- >100kA/uSec di/dt Capability
- <100nSec Turn-On Delay
- Low On-State Voltage
- MOS Gated Control
- Low Inductance Package

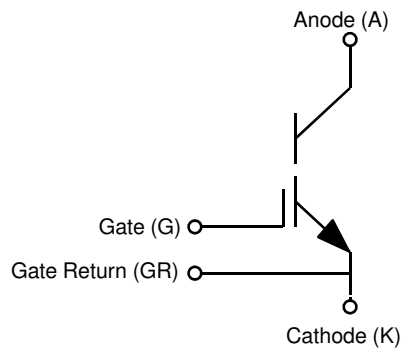
Package Size - 4



- Pin 1 : Gate
- Pin 2 : Gate return
- Pin 3 : Anode
- Pin 4 : Cathode
- Pin 5 : Cathode

5 Lead TO-247

Schematic Symbol



Absolute Maximum Ratings

	SYMBOL	VALUE	UNITS
Peak Off-State Voltage	V _{DRM}	1400	V
Peak Reverse Voltage	V _{RPM}	-5	V
Off-State Rate of Change of Voltage Immunity	dv/dt	5000	V/uSec
Continuous Anode Current at 110°C	I _{A110}	32	A
Repetitive Peak Anode Current (Pulse Width=1uSec)	I _{ASM}	4000	A
Rate of Change of Current	di/dt	150	kA/uSec
Continuous Gate-Cathode Voltage	V _{GKS}	+/-20	V
Peak Gate-Cathode Voltage	V _{GKM}	+/-25	V
Minimum Negative Gate-Cathode Voltage Required for Garanteed Off-State	V _{GK(OFF-MIN)}	-5	V
Maximum Junction Temperature	T _{JM}	150	°C
Maximum Soldering Temperature (Installation)		260	°C

This **SILICON POWER** product is protected by one or more of the following U.S. Patents:

5,521,436	5,446,316	5,105,536	5,209,390	4,958,211	5,206,186	4,857,983	5,082,795	4,644,637
5,585,310	5,557,656	5,777,346	5,139,972	5,111,268	5,757,036	4,888,627	4,980,741	4,374,389
5,248,901	5,564,226	5,446,316	5,103,290	5,260,590	5,777,346	4,912,541	4,941,026	4,750,666
5,366,932	5,517,058	5,577,656	5,028,987	5,350,935	5,995,349	5,424,563	4,927,772	4,429,011
5,497,013	4,814,283	5,473,193	5,304,847	5,640,300	4,801,985	5,399,892	4,739,387	5,293,070
5,532,635	5,135,890	5,166,773	5,569,957	5,184,206	4,476,671	5,468,668	4,648,174	

Performance Characteristics $T_J=25^\circ\text{C}$ unless otherwise specified			Measurements			
Parameters	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Anode to Cathode Breakdown Voltage	$V_{(BR)}$	$V_{GK}=-5, I_A=1\text{mA}$	1400			V
Anode-Cathode Off-State Current	i_D	$V_{GE}=5\text{V}, V_{AK}=1200\text{V}$	$T_C=25^\circ\text{C}$	<10	100	μA
			$T_C=150^\circ\text{C}$	250	1000	μA
Gate-Cathode Turn-On Threshold Voltage	$V_{GK(TH)}$	$V_{AK}=V_{GK}, I_{AK}=1\text{mA}$		0.7		V
Gate-Cathode Leakage Current	$I_{GK(IKG)}$	$V_{GK}=\pm 20\text{V}$			500	nA
Anode-Cathode On-State Voltage	V_T	$I_T=32\text{A}, V_{GK}=+5\text{V}$ (See Figures 1,2 & 3)	$T_C=25^\circ\text{C}$	1.5	2.0	V
			$T_C=150^\circ\text{C}$	1.3	1.5	V
Input Capacitance	C_{ISS}			6		nF
Turn-on Delay Time	$t_{D(ON)}$	0.2 μF Capacitor Discharge		50	100	nS
Rate of Change of Current	di/dt	$T_J=25^\circ\text{C}, V_{GK}= -5\text{V to } +5\text{V}$		75		kA/ μSec
Peak Anode Current	I_P	$V_{AK}=800\text{V}, R_G=4.7\Omega$		3500		A
Discharge Event Energy	E_{DIS}	$L_S=7\text{nH}$ (See Figures 4,5 & 6)		32		mJ
Turn-on Delay Time	$t_{D(ON)}$	0.2 μF Capacitor Discharge		50	100	nS
Rate of Change of Current	di/dt	$T_J=150^\circ\text{C}, V_{GK}= -5\text{V to } +5\text{V}$		110		kA/ μSec
Peak Anode Current	I_P	$V_{AK}=1200\text{V}, R_G=4.7\Omega$	4000			A
Discharge Event Energy	E_{DIS}	$L_S=7\text{nH}$ (See Figures 4,5 & 6)		70		mJ
Junction to Case Thermal Resistance	$R_{\theta JC}$	Anode (bottom) side cooled (Note 1.)		0.08		$^\circ\text{C/W}$

Typical Performance Curves (unless otherwise specified)

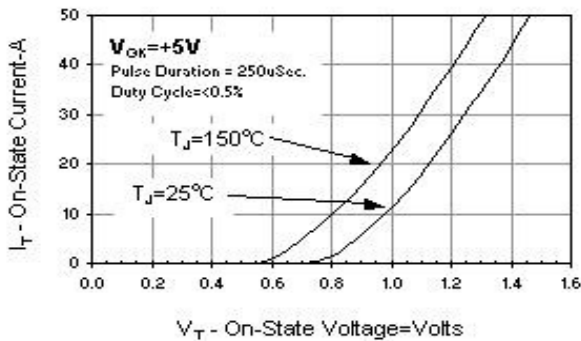


Figure 1. On-State Characteristics

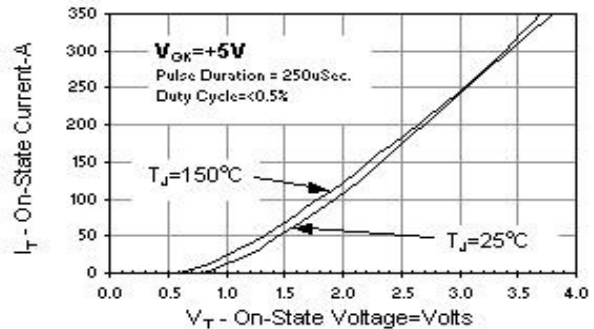


Figure 2. On-State Characteristics

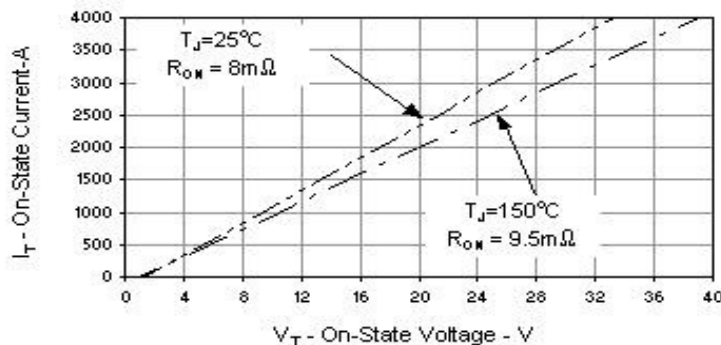


Figure 3. Predicted High Current On-State Characteristics

Typical Performance Curves (Continued)

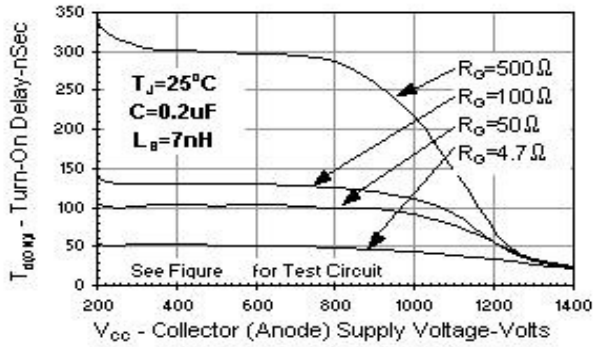


Figure 4. Turn-On Delay Characteristics
 $R_G=4.7\Omega - 500\Omega$, $T_J=25^\circ\text{C}$

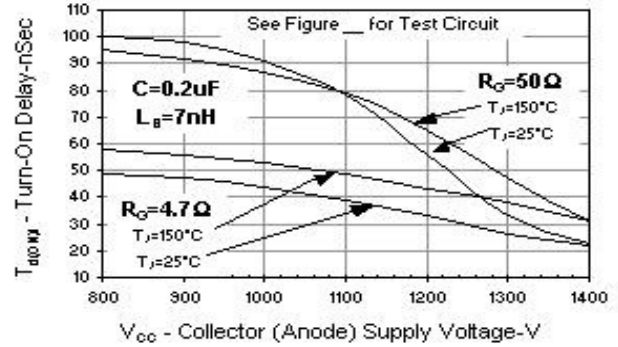


Figure 5. Turn-On Delay Characteristics
 $R_G=4.7\Omega \text{ \& } 50\Omega$, $T_J=25^\circ\text{C} \text{ \& } 150^\circ\text{C}$

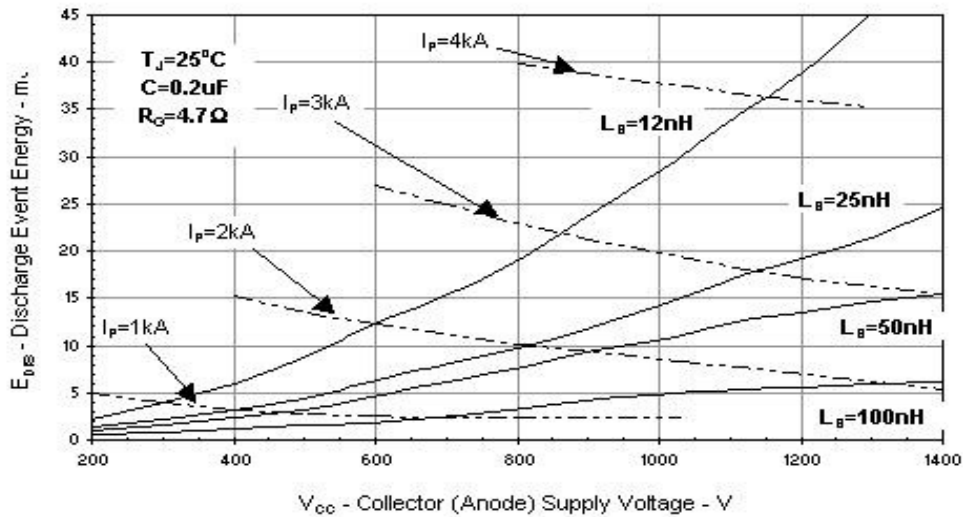
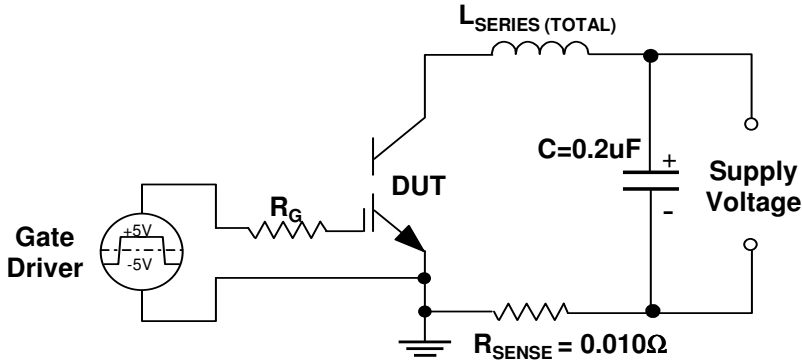


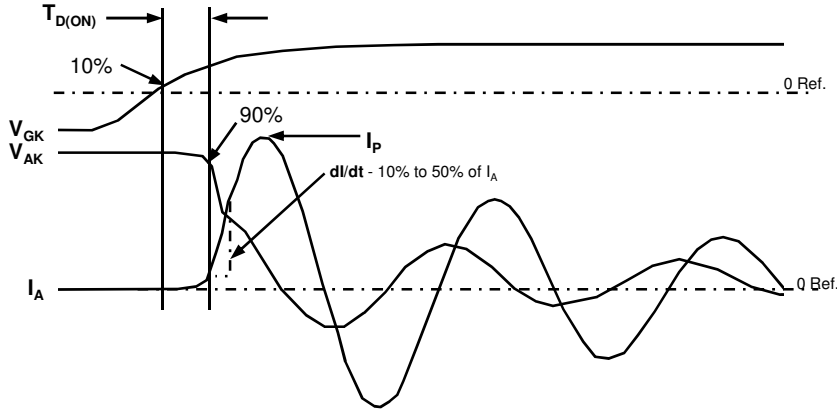
Figure 6. 0.2uF Discharge Pulse Performance Characteristics (See Figure 9.)

Test Circuit and Waveforms



- $L_{SERIES(TOTAL)}$ is calculated using $1 / (f 2\pi)^2 C$ where f = frequency of I_A (See Figure 10)
- R_{SENSE} is a calibrated Current Viewing Resistor (CVR)

Figure 9. 0.2uF Pulsed Discharge Circuit Schematic



- The waveform shown is representative of one produced using a very low inductance circuit (<10nH).
- V_{GK} is held positive until I_A oscillations have ended ($I_A=0$).

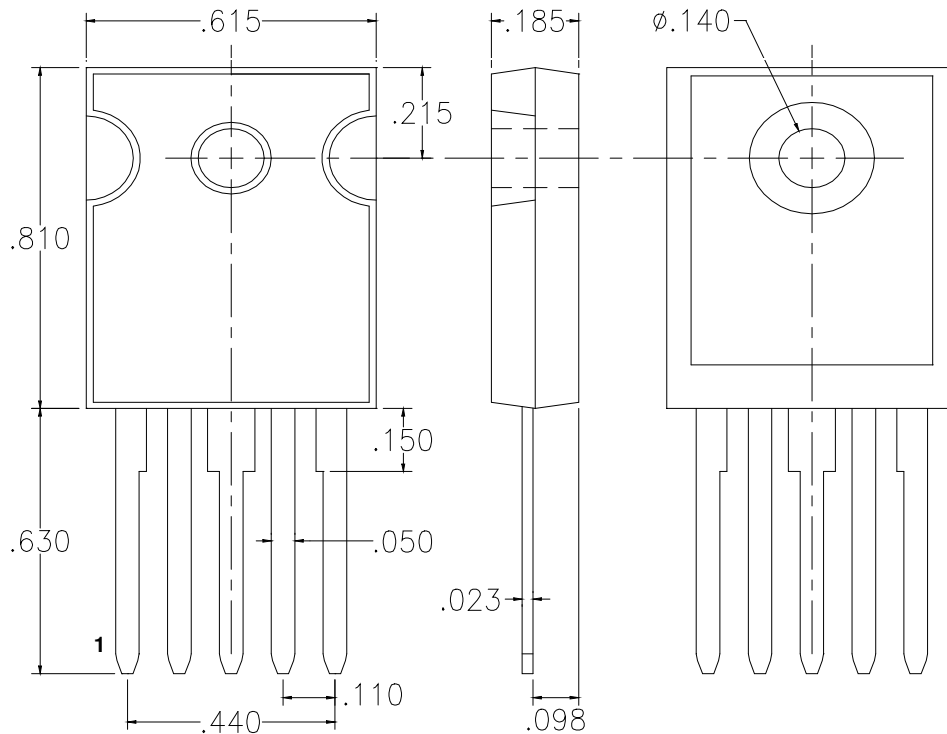
Figure 10. 0.2uF Pulsed Discharge Circuit Waveforms

Application Notes

A1. Use of Gate Return

The VCS was designed for high di/dt applications. An independent cathode connection for use as "gate return" is provided on pin 2 to minimize the effects of rapidly changing Anode-Cathode current on the Gate control voltage, ($V=L \cdot di/dt$). It is therefore, critical that the user utilize the Gate Return as the point at which the gate driver reference (return) is attached to the VCS device.

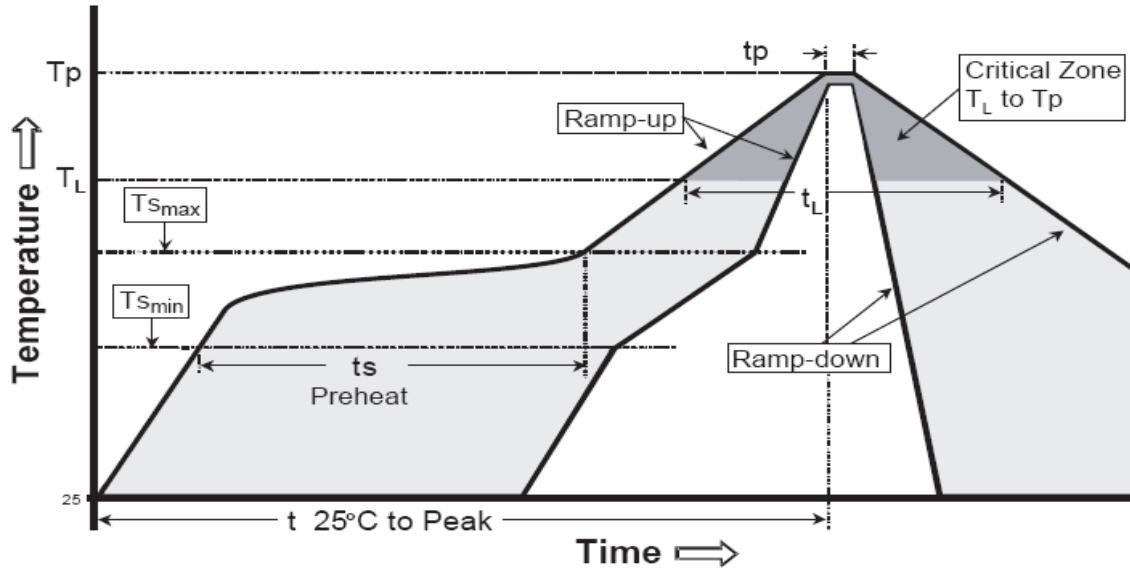
Packaging and Handling



Pin 1 : Gate
Pin 2 : Gate return
Pin 3 : Anode
Pin 4 : Cathode
Pin 5 : Cathode

As with all MOS gated devices, proper handling procedures must be observed to prevent electrostatic discharge which may result in permanent damage to the gate of the device

Recommended Reflow Profile:



IPC-020c-5-1

Profile Feature	Sn-Pb Eutectic Assembly
Average Ramp-Up Rate (T_{Smax} to T_p)	3 °C/second max.
Preheat - Temperature Min (T_{Smin}) - Temperature Max (T_{Smax}) - Time (t_{Smin} to t_{Smax})	100 °C 150 °C 60-120 seconds
Time maintained above: - Temperature (T_L) - Time (t_r)	183 °C 60-150 seconds
Peak/Classification Temperature (T_p)	225 + 0/-5 °C
Time within 5 °C of actual Peak Temperature (t_p)	10-30 seconds
Ramp-Down Rate	6 °C/second max.
Time 25 °C to Peak Temperature	6 minutes max.

Revision History

Rev	Date	EA #	Nature of Change
0	12-19-2007	04242009-NB-0010	Initial Issue