

TISP61089 Gated Protector Series

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Description

These '61089 parts are all dual forward-conducting buffered p-gate thyristor (SCR) overvoltage protectors. They are designed to protect monolithic SLICs (Subscriber Line Interface Circuits) against overvoltages on the telephone line caused by lightning, a.c. power contact and induction. The '61089 limits voltages that exceed the SLIC supply rail voltage. The '61089 parameters are specified to allow equipment compliance with Telcordia (formerly Bellcore) GR-1089-CORE and ITU-T recommendations K.20, K.21 and K.45.

The SLIC line driver section is typically powered from 0 V (ground) and a negative (battery) voltage. The protector gate is connected to this negative supply. This references the protection (clipping) voltage to the negative supply voltage. The protection voltage will then track the negative supply voltage and the overvoltage stress on the SLIC is minimized.

Positive overvoltages are clipped to ground by diode forward conduction. Negative overvoltages are initially clipped close to the SLIC negative supply rail value. If sufficient current is available from the overvoltage, then the protector SCR will switch into a low voltage on-state condition. As the overvoltage subsides the high holding current of '61089 SCR helps prevent d.c. latchup.

The '61089 is intended to be used with a series resistance of at least 25 Ω and a suitable overcurrent function for Telcordia compliance. Power fault conditions require a series overcurrent element which either interrupts or reduces the circuit current before the '61089 current rating is exceeded. For equipment compliant to ITU-T recommendations K.20 or K.21 or K.45 only, the series resistor value is set by the coordination requirements. For coordination with a 400 V limit GDT, a minimum series resistor value of 10 Ω is recommended.

The '61089 buffered gate design reduces the loading on the SLIC supply during overvoltages caused by power cross and induction. The regular pin-out for surface mount and through-hole packages is a feed through configuration. Connection to the SLIC is made via the '61089, Ring through pins 4 - 5 and Tip through pins 1 - 8. A non-feed-through surface mount (D) package is available. This shunt (SD) version pin-out does not make duplicate connections to pin 5 and pin 8 which increases package creepage distance from ground of the other connections from about 0.7 mm to over 3 mm. High voltage ringing SLICs, with battery voltages below -100 V and down to -155 V, can be protected by the TISP61089B device. Details of this device are in the TISP61089B data sheet.

Absolute Maximum Ratings, -40 °C $\leq$ T_J $\leq$ 85 °C (Unless Otherwise Noted)

Rating	Symbol	Value	Unit
Repetitive peak off-state voltage, V _{GK} = 0	61089 '61089A V _{DRM}	-100 -120	V
Repetitive peak gate-cathode voltage, V _{KA} = 0	61089 '61089A V _{GKRM}	-85 -120	V
Non-repetitive peak on-state pulse current (see Notes 1 and 2) 10/1000 μ s (Telcordia (Bellcore) GR-1089-CORE, Issue 2, February 1999, Section 4) 5/320 μ s (ITU-T K.20, K.21 & K.45, K.44 open-circuit voltage wave shape 10/700 μ s) 1.2/50 μ s (Telcordia (Bellcore) GR-1089-CORE, Issue 2, February 1999, Section 4) 2/10 μ s (Telcordia (Bellcore) GR-1089-CORE, Issue 2, February 1999, Section 4)	I _{PSSM}	30 40 100 120	A
Non-repetitive peak on-state current, V _{GG} = -75 V, 50 Hz to 60 Hz (see Notes 1 and 2) 0.1 s 1 s 5 s 300 s 900 s	I _{TSM}	11 4.8 2.7 0.95 0.93	A
Non-repetitive peak gate current, 1/2 μ s pulse, cathodes commoned (see Notes 1 and 2)	I _{GSM}	+40	A
Operating free-air temperature range	T _A	-40 to +85	°C
Junction temperature	T _J	-40 to +150	°C
Storage temperature range	T _{stg}	-40 to +150	°C

NOTES: 1. Initially the protector must be in thermal equilibrium with -40 °C $\leq$ T_J $\leq$ 85 °C. The surge may be repeated after the device returns to its initial conditions. Gate voltage ranges are -20 V to -75 V for the '61089 and -20 V to -100 V for the '61089A.

2. The rated current values may be applied either to the Ring to Ground or to the Tip to Ground terminal pairs. Additionally, both terminal pairs may have their rated current values applied simultaneously (in this case the Ground terminal current will be twice the rated current value of an individual terminal pair). Above 85 °C, derate linearly to zero at 150 °C lead temperature.

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Recommended Operating Conditions

Component		Min	Typ	Max	Unit
C_G	Gate decoupling capacitor	100	220		nF
R_S	Series resistor for GR-1089-CORE first-level surge survival	25			Ω
	Series resistor for GR-1089-CORE first-level and second-level surge survival	40			Ω
	Series resistor for GR-1089-CORE intra-building port surge survival	8			Ω
	Series resistor for K.20, K.21 and K.45 coordination with a 400 V primary protector	10			Ω

Electrical Characteristics, $T_J = 25^\circ\text{C}$ (Unless Otherwise Noted)

Parameter	Test Conditions	Min	Typ	Max	Unit
I_D Off-state current	$V_D = V_{DRM}$, $V_{GK} = 0$ $T_J = 25^\circ\text{C}$			-5	μA
	$T_J = 85^\circ\text{C}$			-50	μA
$V_{(BO)}$ Breakover voltage	2/10 μs , $I_{PP} = -56\text{ A}$, $R_S = 45\ \Omega$, $V_{GG} = -48\text{ V}$, $C_G = 220\text{ nF}$ 2/10 μs , $I_{PP} = -100\text{ A}$, $R_S = 50\ \Omega$, $V_{GG} = -48\text{ V}$, $C_G = 220\text{ nF}$ 1.2/50 μs , $I_{PP} = -53\text{ A}$, $R_S = 47\ \Omega$, $V_{GG} = -48\text{ V}$, $C_G = 220\text{ nF}$ 1.2/50 μs , $I_{PP} = -96\text{ A}$, $R_S = 52\ \Omega$, $V_{GG} = -48\text{ V}$, $C_G = 220\text{ nF}$		-57 -60 -60 -64		V
$V_{GK(BO)}$ Gate-cathode impulse breakover voltage	2/10 μs , $I_{PP} = -56\text{ A}$, $R_S = 45\ \Omega$, $V_{GG} = -48\text{ V}$, $C_G = 220\text{ nF}$ 2/10 μs , $I_{PP} = -100\text{ A}$, $R_S = 50\ \Omega$, $V_{GG} = -48\text{ V}$, $C_G = 220\text{ nF}$ 1.2/50 μs , $I_{PP} = -53\text{ A}$, $R_S = 47\ \Omega$, $V_{GG} = -48\text{ V}$, $C_G = 220\text{ nF}$ 1.2/50 μs , $I_{PP} = -96\text{ A}$, $R_S = 52\ \Omega$, $V_{GG} = -48\text{ V}$, $C_G = 220\text{ nF}$		9 12 12 16		V
V_F Forward voltage	$I_F = 5\text{ A}$, $t_w = 200\ \mu\text{s}$			3	V
V_{FRM} Peak forward recovery voltage	2/10 μs , $I_{PP} = 56\text{ A}$, $R_S = 45\ \Omega$, $V_{GG} = -48\text{ V}$, $C_G = 220\text{ nF}$ 2/10 μs , $I_{PP} = 100\text{ A}$, $R_S = 50\ \Omega$, $V_{GG} = -48\text{ V}$, $C_G = 220\text{ nF}$ 1.2/50 μs , $I_{PP} = 53\text{ A}$, $R_S = 47\ \Omega$, $V_{GG} = -48\text{ V}$, $C_G = 220\text{ nF}$ 1.2/50 μs , $I_{PP} = 96\text{ A}$, $R_S = 52\ \Omega$, $V_{GG} = -48\text{ V}$, $C_G = 220\text{ nF}$		6 8 8 12		V
I_H Holding current	$I_T = -1\text{ A}$, $di/dt = 1\text{ A/ms}$, $V_{GG} = -48\text{ V}$	-150			mA
I_{GKS} Gate reverse current	$V_{GG} = V_{GK} = V_{GKRM}$, $V_{KA} = 0$ $T_J = 25^\circ\text{C}$			-5	μA
	$T_J = 85^\circ\text{C}$			-50	μA
I_{GT} Gate trigger current	$I_T = -3\text{ A}$, $t_{p(g)} \geq 20\ \mu\text{s}$, $V_{GG} = -48\text{ V}$			5	mA
V_{GT} Gate-cathode trigger voltage	$I_T = -3\text{ A}$, $t_{p(g)} \geq 20\ \mu\text{s}$, $V_{GG} = -48\text{ V}$			2.5	V
Q_{GS} Gate switching charge	1.2/50 μs , $I_{PP} = -53\text{ A}$, $R_S = 47\ \Omega$, $V_{GG} = -48\text{ V}$, $C_G = 220\text{ nF}$		0.1		μC
C_{KA} Cathode-anode off-state capacitance	$f = 1\text{ MHz}$, $V_d = 1\text{ V}$, $I_G = 0$, (see Note 3) $V_D = -3\text{ V}$			100	pF
	$V_D = -48\text{ V}$			50	pF

NOTES: 3. These capacitance measurements employ a three terminal capacitance bridge incorporating a guard circuit. The unmeasured device terminals are a.c. connected to the guard terminal of the bridge.

Thermal Characteristics

Parameter	Test Conditions	Min	Typ	Max	Unit
$R_{\theta JA}$ Junction to free air thermal resistance	$T_A = 25^\circ\text{C}$, EIA/JESD51-3 PCB, EIA/JESD51-2 environment, $P_{TOT} = 1.7\text{ W}$ D Package			120	$^\circ\text{C/W}$

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Parameter Measurement Information

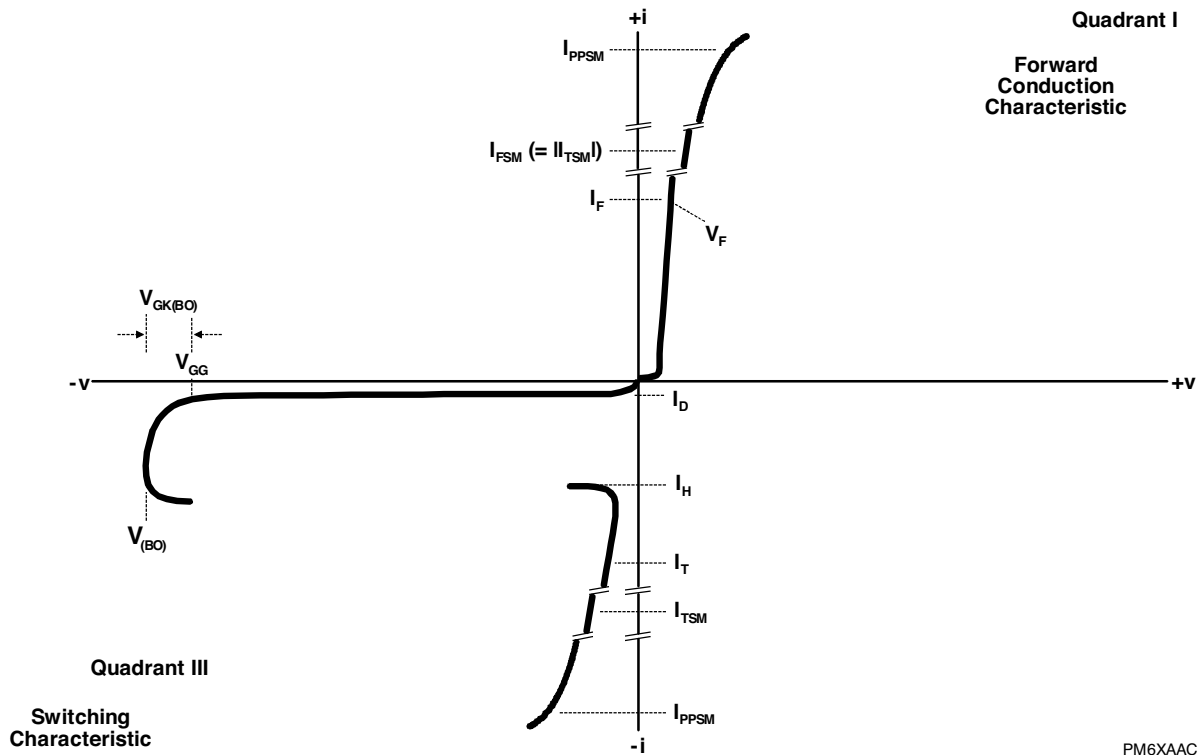


Figure 1. Voltage-Current Characteristic
 Unless Otherwise Noted, All Voltages are Referenced to the Anode

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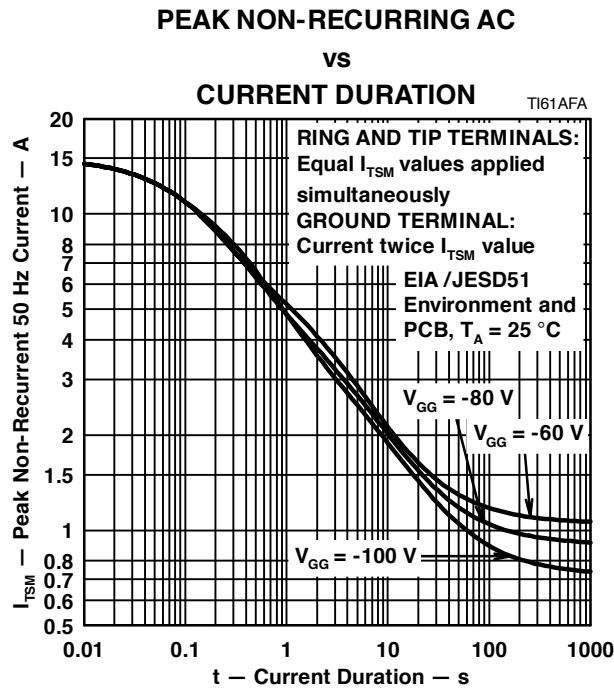


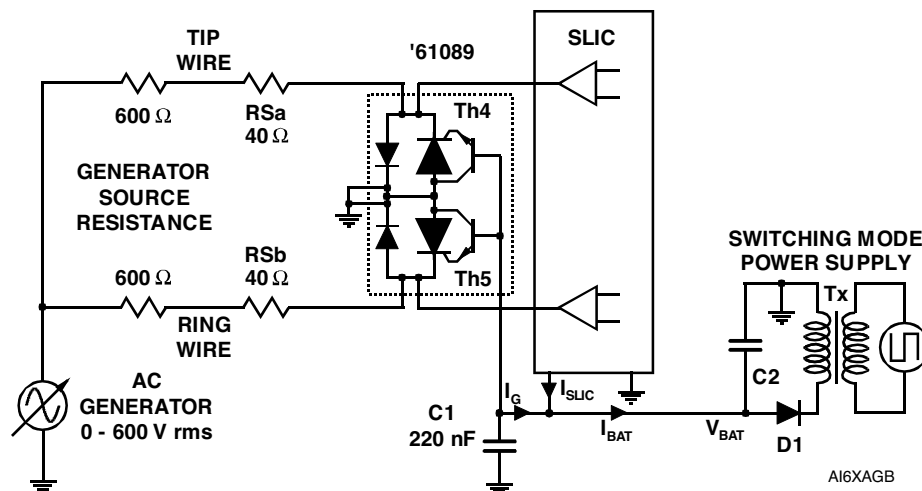
Figure 2. Non-repetitive Peak On-State Current against Duration
(Gate Voltage Ranges are -20 V to -75 V for the '61089 and -20 V to -100 V for the '61089A)

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Gated Protectors

Purpose of Gated Protectors

SLICs have become more sophisticated. To minimize power consumption, some designs automatically adjust the supply voltage, V_{BAT} , to a value that is just sufficient to drive the required line current. For short lines the supply voltage would be set low, but for long lines, a higher supply voltage would be generated to drive sufficient line current. The optimum protection for this type of SLIC would be given by a protection voltage which tracks the SLIC supply voltage. This can be achieved by connecting the protection thyristor gate to the SLIC supply, Figure 3. This gated (programmable) protection arrangement minimizes the voltage stress on the SLIC, no matter what value of supply voltage.



Operation of Gated Protectors

Application Circuit

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APPLICATIONS INFORMATION

Application Circuit (Continued)

protector. The TISP7xxxF3 protector has the same protection voltage for any terminal pair. This protector is used when the ring generator configuration may be ground or battery-backed. For dedicated ground-backed ringing generators, the TISP3xxxF3 gives better protection as its inter-conductor protection voltage is twice the conductor to ground value.

Relay contacts 3a and 3b connect the line conductors to the SLIC via the '61089 protector. The protector gate reference voltage comes from the SLIC negative supply (V_{BAT}). A 220 nF gate capacitor sources the high gate current pulses caused by fast rising impulses.

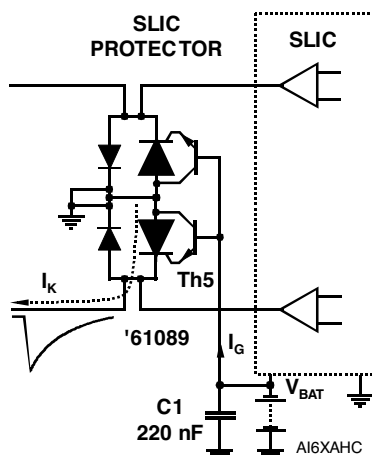


Figure 4. Negative Overvoltage Condition

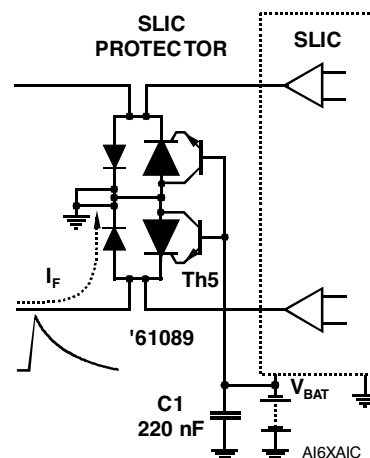


Figure 5. Positive Overvoltage Condition

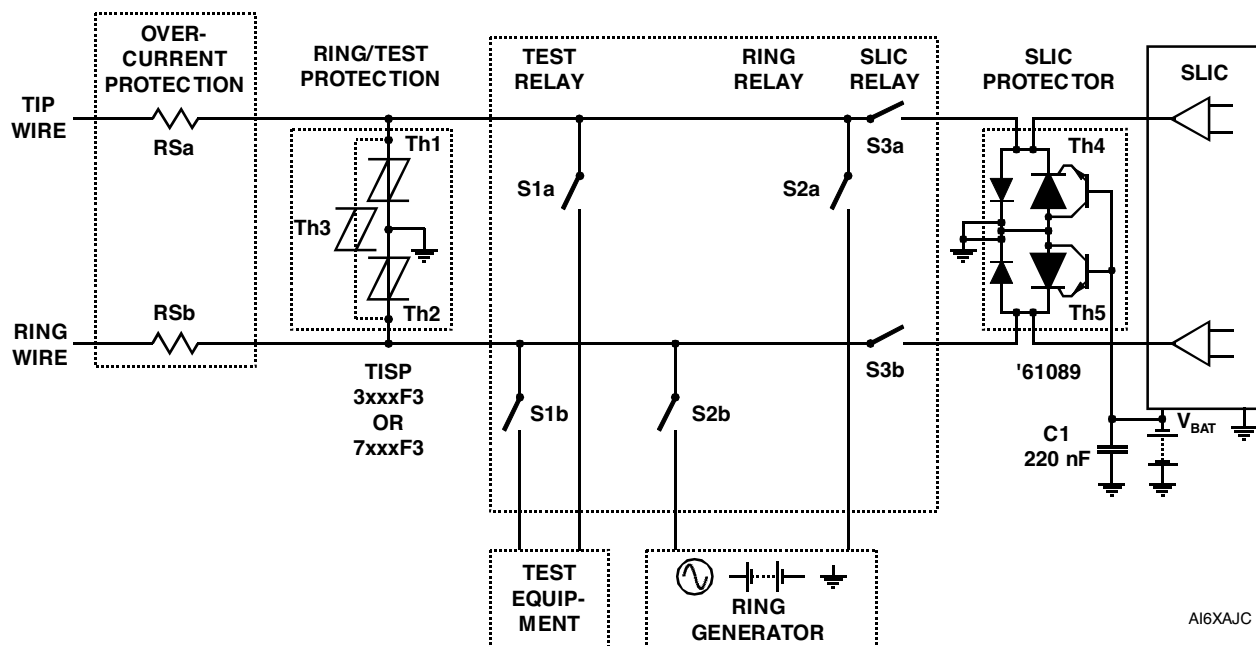


Figure 6. Typical Application Circuit

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MECHANICAL DATA

Device Symbolization Code

Devices will be coded as below.

Device	Symbolization Code
TISP61089DR-S	P61089
TISP61089SDR-S	61089S
TISP61089ADR-S	61089A
TISP61089ASDR-S	1089AS

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Asia-Pacific: Tel: +886-2 2562-4117 • Email: asiacus@bourns.com

Europe: Tel: +36 88 885 877 • Email: eurocus@bourns.com

The Americas: Tel: +1-951 781-5500 • Email: americus@bourns.com

www.bourns.com

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