

# TI 929L-1600-30

## Integrated Gate-Commutated Thyristor

### Properties

- Full reverse voltage
- Low on-state losses
- Snubberless
- Suitable for inverters, drives and traction applications
- High reliability

### Key Parameters

$V_{DRM}, V_{RRM}$	=	3 000	V
$I_{TGQM}$	=	1 600	A
$I_{TAVm}$	=	868	A
$I_{TSM}$	=	14 000	A
$V_{TO}$	=	2.098	V
$r_T$	=	0.538	mΩ

### Types

	$V_{DRM}, V_{RRM}$
TI 929L-1600-30	3 000 V
TI 929L-1600-25	2 500 V
TI 929L-1600-20	2 000 V

### Mechanical Data (see Fig. 6)

$F_m$	Mounting force	17 ± 3 kN
$m$	Weight	1.70 kg
$D_s$	Surface creepage distance	33 mm
$D_a$	Air strike distance	11 mm
$D_p$	Pole-piece diameter	63 mm
$l$	Length	286 mm
$h$	Height	59 mm
$w$	Width	150 mm



Fig. 1 Case

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<b>Maximum Ratings</b>			<b>Maximum Limits</b>	<b>Unit</b>
$V_{DRM}$ $V_{RRM}$	<b>Repetitive peak off-state and peak reverse voltage</b> <i><math>T_j = -40 \div 125 \text{ }^\circ\text{C}</math>, Gate unit energized</i>	TI 929L-1600-30 TI 929L-1600-25 TI 929L-1600-20	3 000 2 500 2 000	V
$V_{Dclink}$	<b>Permanent DC voltage for <math>\lambda = 100</math> FIT failure rate</b> <i>Gate unit energized</i>	TI 929L-1600-30 TI 929L-1600-25 TI 929L-1600-20	1 800 1 500 1 200	V
$I_{TRMS}$	<b>RMS on-state current</b> <i><math>T_c = 70 \text{ }^\circ\text{C}</math>, half sine waveform, <math>f = 50 \text{ Hz}</math></i>		1 363	A
$I_{TAVm}$	<b>Average on-state current</b> <i><math>T_c = 70 \text{ }^\circ\text{C}</math>, half sine waveform, <math>f = 50 \text{ Hz}</math></i>		868	A
$I_{TSM}$	<b>Peak non-repetitive surge</b> <i>half sine pulse, <math>t_p = 10 \text{ ms}</math>, <math>V_R = 0 \text{ V}</math></i>		14 000	A
$I^2t$	<b>Limiting load integral</b> <i>half sine pulse, <math>t_p = 10 \text{ ms}</math>, <math>V_R = 0 \text{ V}</math></i>		980 000	A <sup>2</sup> s
$T_{jmin} - T_{jmax}$	<b>Junction operating temperature range</b>		-40 $\div$ 115	$^\circ\text{C}$
$T_{stgmin} - T_{stgmax}$	<b>Storage temperature range</b>		-40 $\div$ 80	$^\circ\text{C}$

Unless otherwise specified  $T_j = 115 \text{ }^\circ\text{C}$

Characteristics		Value			Unit
		min.	typ.	max.	
$V_{TM}$	Maximum peak on-state voltage $I_{TM} = 1\,600\text{ A}$ , CS - ON			3.000	V
$V_{TO}$	Threshold voltage			2.098	V
$r_T$	Slope resistance $I_{T1} = 1\,362\text{ A}$ , $I_{T2} = 4\,086\text{ A}$			0.538	m $\Omega$
$I_{DM}$	Peak off-state current $V_D = V_{DRM}$ , Gate unit energized			150	mA
$I_{RM}$	Peak reverse current $V_R = V_{RRM}$ , Gate unit energized			150	mA

Unless otherwise specified  $T_j = 115\text{ }^\circ\text{C}$

### Turn-on switching


Maximum rated values		Value	Unit
$(di_T/dt)_{cr}$	Critical rate of rise of on-state current	1 000	A/ $\mu\text{s}$
Conditions: $T_j = 90\text{ }^\circ\text{C}$ , $I_T = 1400\text{ A}$ , $f = 0\div 1000\text{ Hz}$			
Characteristic values		Value	Unit
$I_{Tm}$	Peak on-state current	1 600	A
$t_{don}$	Turn-on delay time	$\leq 3.5$	$\mu\text{s}$
$t_r$	Rise on-time	$\leq 1.2$	$\mu\text{s}$
$E_{on}$	Turn-on energy per pulse	$\leq 0.85$	J
Conditions: $T_j = 90\text{ }^\circ\text{C}$ , $L_{CL} = 0.2\text{ }\mu\text{H}$ , $L_i = 2\text{ }\mu\text{H}$ , $R_s = 12\text{ }\Omega$ , $V_{LC} = 0,6 V_{DRM}$ (Fig. 8)			

### Turn-off switching

Maximum rated values		Value	Unit
$I_{TGQM}$	Max. controllable turn-off current	1 400	A
$t_{doff}$	Turn-off delay time	$\leq 3.5$	$\mu\text{s}$
$t_f$	Fall time	$\leq 0.5$	$\mu\text{s}$
$E_{off}$	Turn-off energy per pulse	$\leq 4.0$	J
Conditions: $T_j = 90\text{ }^\circ\text{C}$ , $C_{CL} = 10\text{ }\mu\text{F}$ , $L_{CL} = 0.2\text{ }\mu\text{H}$ , $L_i = 2\text{ }\mu\text{H}$ , $R_s = 12\text{ }\Omega$ , $V_{LC} = 0,6 V_{DRM}$ (Fig. 8)			

Thermal Parameters		Value	Unit
$R_{thjc}$	Thermal resistance junction to case double side cooling	18.4	K/kW
$R_{thch}$	Thermal resistance case to heatsink, double side cooling	6.0	K/kW

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**Transient Thermal Impedance**

**Analytical function for transient thermal impedance**

$$Z_{thjc} = \sum_{i=1}^4 R_i (1 - \exp(-t / \tau_i))$$

Conditions:  
 $F_m = 17 \pm 3$  kN, Double side cooled

<i>i</i>	1	2	3	4
$R_i$ (K/kW)	10.03	7.35	0.80	0.22
$\tau_i$ (s)	0.7140	0.1491	0.0109	0.0019

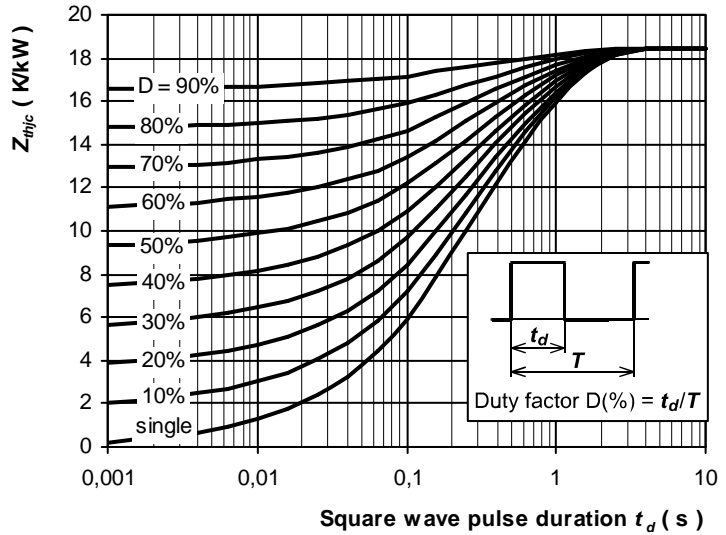


Fig. 2 Transient thermal impedance junction to case (Double side cooled)

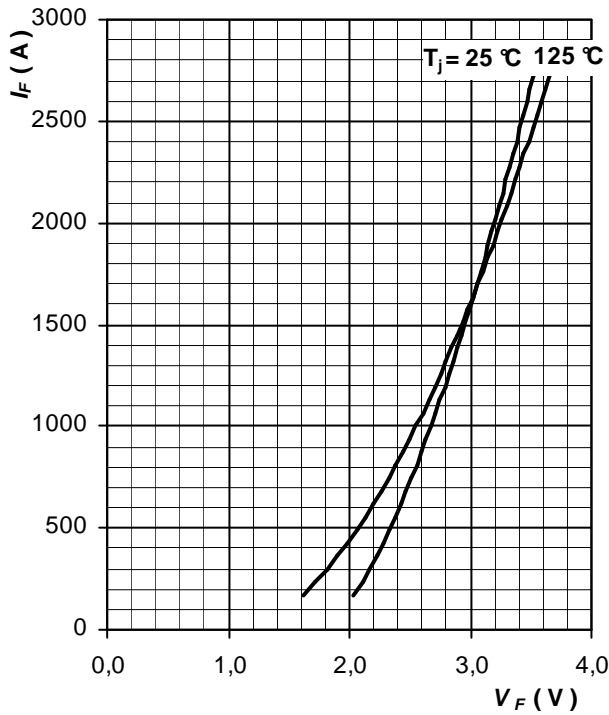


Fig. 3 Maximum instantaneous on-state characteristics

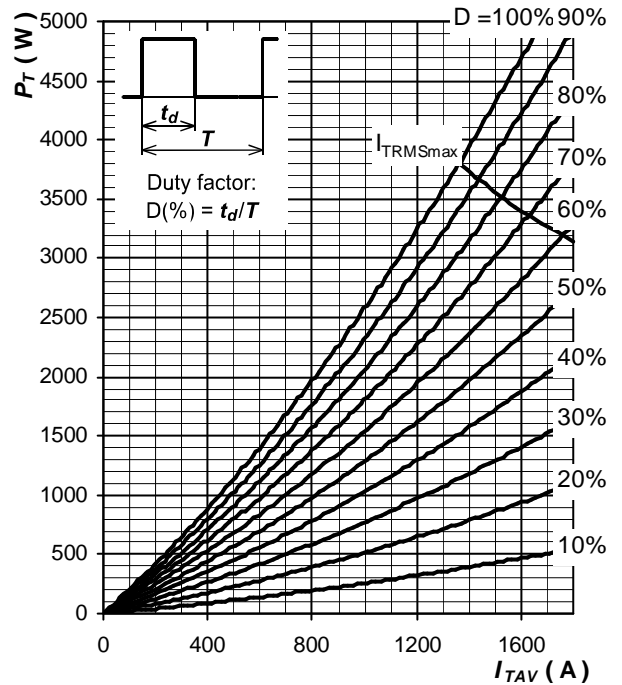


Fig. 4 Power losses vs. rectangular pulse current

<b>Gate unit</b>		<b>Value</b>	<b>Unit</b>
$V_{GIN}$	Gate unit voltage	- 20	V
$P_{max}$	Gate unit power consumption <sup>1)</sup>	80	W
$I_{Gmax}$	Max. power current	4	A
$P_{on CS}$	Control Signal optical input power (B1)	> -20	dBm
$P_{off CS}$	Control Signal optical noise power (B1)	< -45	dBm
$P_{on SF}$	Status Feedback optical output power(B2)	> -20	dBm
$P_{off SF}$	Status Feedback optical noise power (B2)	< -50	dBm
$t_{onmin}$	Minimal on time	5 ± 20%	µs
$t_{offmin}$	Minimal off time	6 ± 20%	µs
$t_{GLITCH}$	Pulse width threshold	< 0.75	µs
$f_{max}$	Frequency	1 000	Hz
$t_{fd}$	Delay time of on gate current	2.0	µs
$t_{rd}$	Delay time of off gate current	2.0	µs
$D_{max}$	Maximum duty	100	%
$T_{wmin} - T_{wmax}$	Operating temperature range <sup>2)</sup> ( Fig. 5 )	-20 ÷ 70	°C
$T_{stgmin} - T_{stgmax}$	Storage temperature range	-40 ÷ 80	°C
<b>X1</b>	Gate part power connector (see Fig.6 )	BU95-02 Hartman	-
<b>CS - B1</b>	LWL receiver for command signal	HFBR-2524 Agilent	-
<b>SF - B2</b>	LWL transmitter for status feedback	HFBR-1528 Agilent	-

Note 1: Powered with recommended supply unit SU 929A

Note 2: Recommended temperature: ≤ 60°C

<b>Visual feedback (see Fig.6 )</b>		<b>Color</b>
<b>Power</b>	„Light“ when power supply is OK	green
<b>Fault</b>	„Light“ when GCT not redy / Failure	red
<b>Gate ON</b>	„Light“ when gate current is flowing	yelow

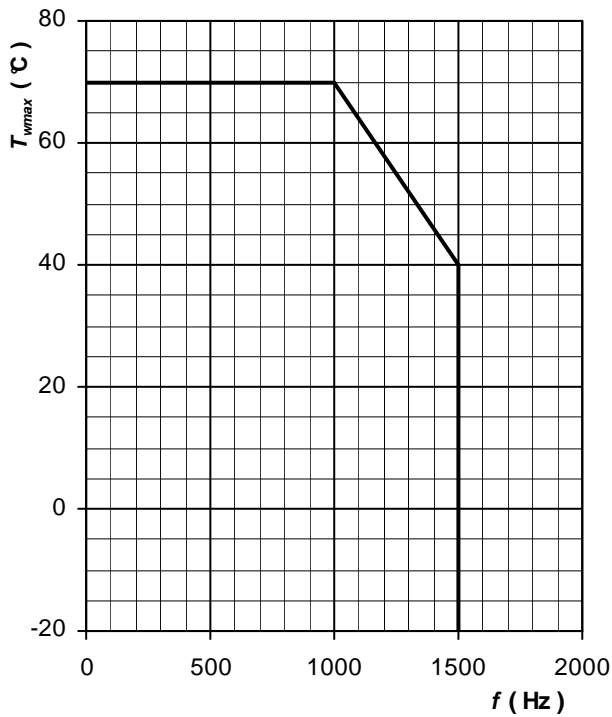


Fig. 5 Gate drive part operating temperature area

<b>Supply unit (recommended type)</b>		<b>Value</b>	<b>Unit</b>
<b>V<sub>c</sub></b>	DC power supply – SU 929A-24 or SU 929B - SU 929A-48	18 + 36 36 + 60	V
<b>P</b>	Power consumption (cut-off limit)	90	W
<b>V<sub>out1</sub></b>	Output supply voltage	-20	V
<b>T<sub>wmin</sub> - T<sub>wmax</sub></b>	Operating temperature range <sup>2)</sup>	-20 to +70	°C
<b>V<sub>is</sub>/1min</b>	Insulation strength (SU 929A / SU 929B)	5.0 / 10.5	[kV]
<b>m</b>	Weight (SU 929A / SU 929B)	1 135 / 1 650	g

Note 2: Recommended temperature: ≤ 60°C

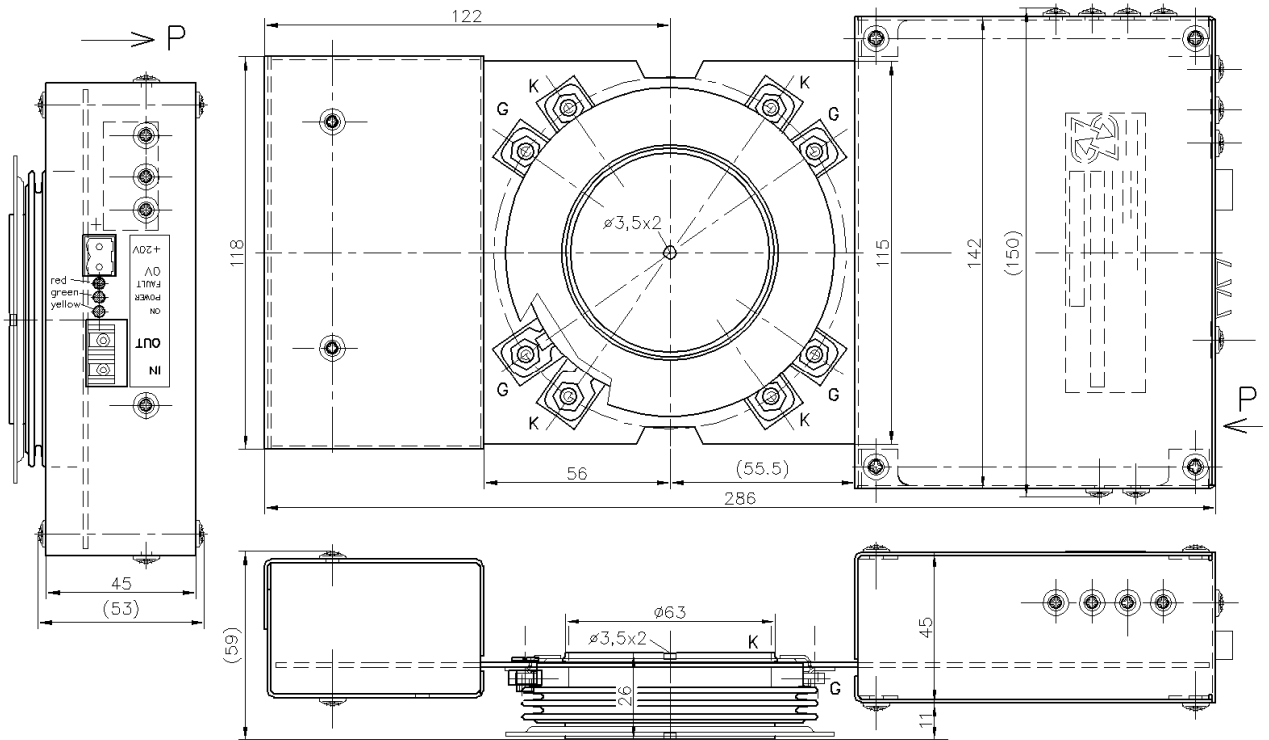


Fig. 6 Device gate part drawing

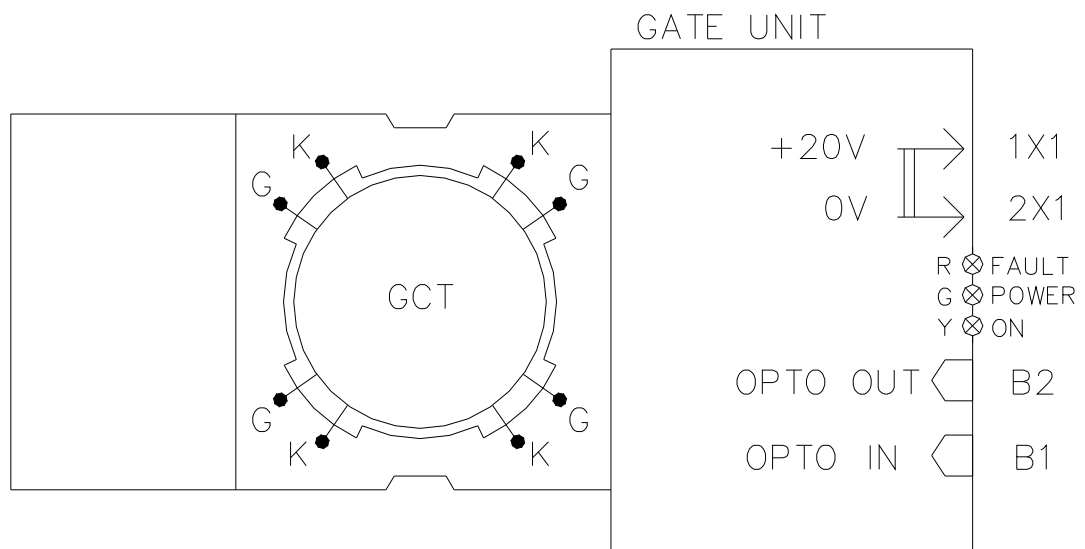


Fig. 7 Schema of input-output connection

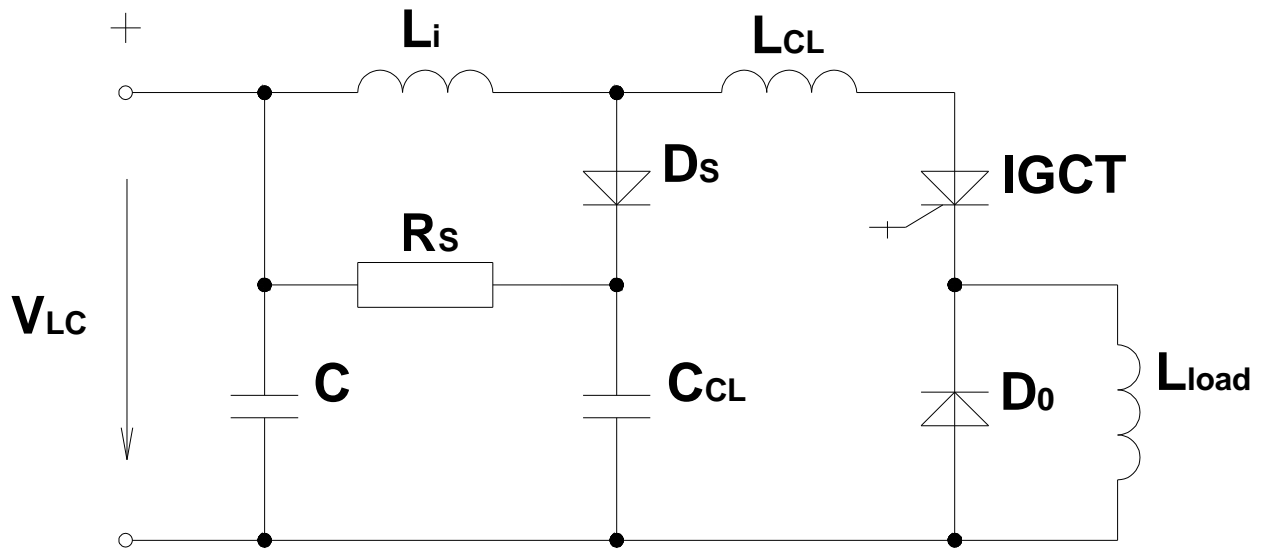


Fig.8 Test circuit.

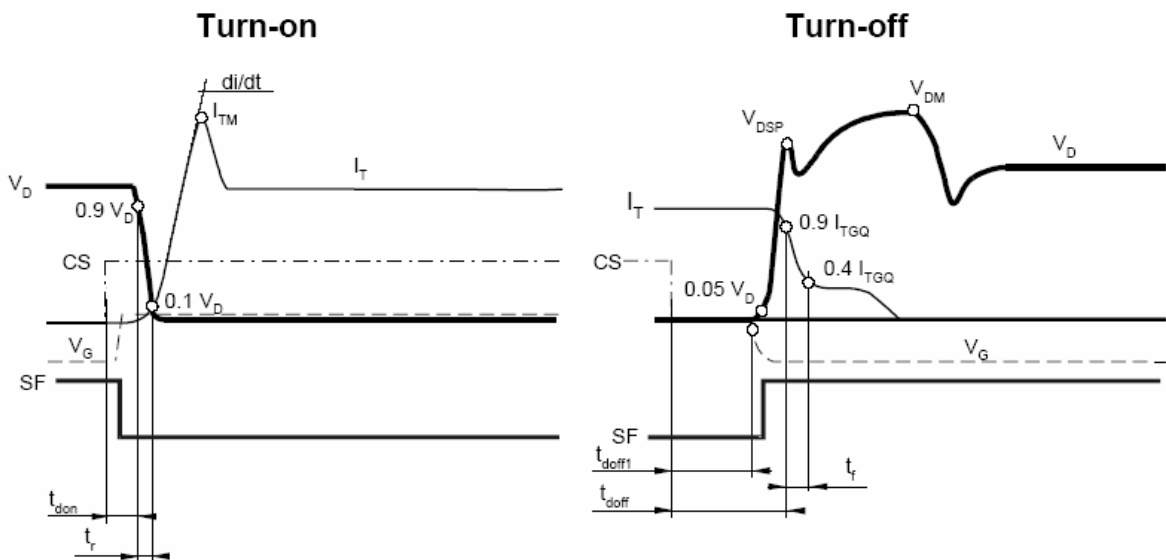


Fig. 9 Turn-on and turn-off waveform diagram