APPLICATION NOTES

ASSEMBLING 125mm THYRISTORS
FOR
PULSE POWER APPLICATIONS

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1. BACKGROUND

1.1 *Defining Pulse Power Applications*

Pulse power involves the storage of energy until it is released at very high power levels. Dethlefsen [1] has bracketed the requirements for suitable solid state power switches as falling within the following envelope:

- blocking voltage, 5 to 60 kV
- peak current, 5 to 200 kA
- pulse widths, 0.1 to 1000 μs

Some of the applications encountered by the authors have di/dt requirement >1000A/μs requiring special considerations on device design and method of gating. Investigations are currently performed in the range of 500 to 1000μs pulse duration and up to 200 kA.

Broad descriptions of the potential market for Pulse Power Switches are given in publications of Dethlefsen [1] and Levy [2]. Most testing activity to date, however, has been to replace triggered spark gaps as closing switches in support of electric gun programs for the U.S. Army and magnet or laser charging circuits used in government laboratories.

1.2 *General Approach to Pulse Power Ratings*

A combination of surge current testing (Fig. 1) and an empirically based computer model [3] are used. The exact current waveform is used in both cases. It is verified based on test that thermal runaway (Fig.2 & Fig.3) does not occur by observing the V_T vs. time or the I_T vs. V_T loop. An internal examination of the device is made to ensure that the mating surfaces are not arcing or spitting as due to insufficient metallization or flatness.

Next, ΔT_J for the hottest portion next to the gate boundary is determined by computer model, considering the finite expansion rate of the turned-on region in combination with the gate geometry. Finally, life expectancy in terms of the number of shots is determined as in [4], that is:

$$\# \text{ shots} = (300 / \Delta T)^9 \quad \text{using } ^oC$$

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Special precautions for assembling mating parts needed to ensure predictable life expectancy for the SPT400 series 125mm thyristor under pulse duty.

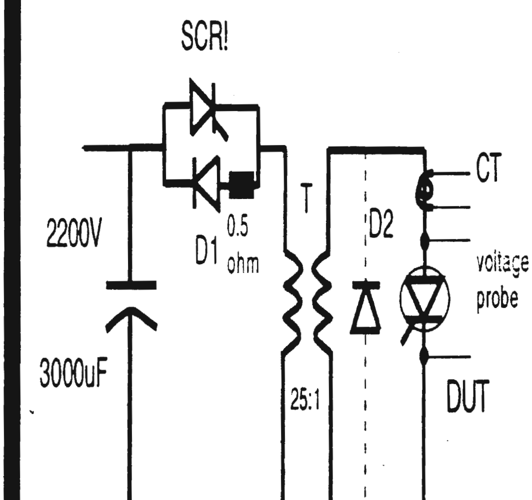


Fig.1 Type of laboratory circuit used to establish pulse power current ratings

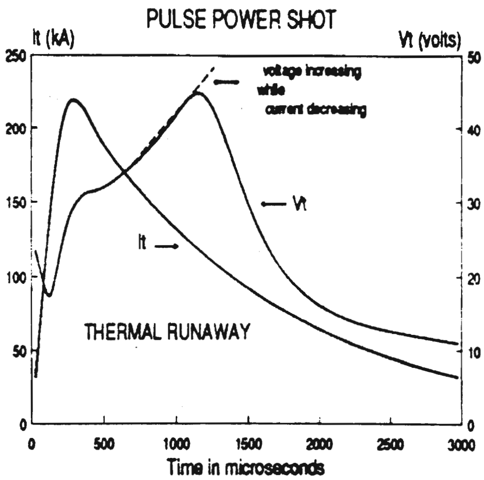


Fig.2 Representation of a pulse power shot showing evidence of thermal runaway. On-state voltage is increasing substantially while the current is decreasing.

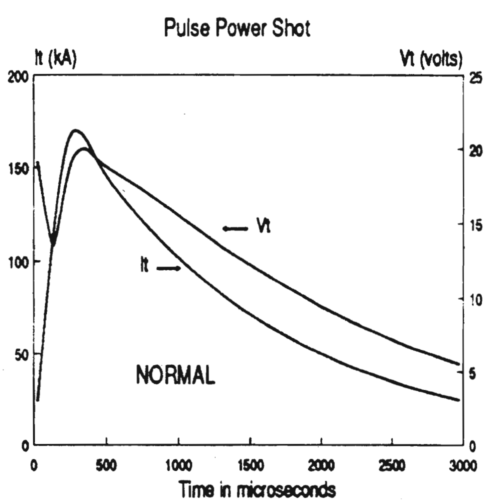
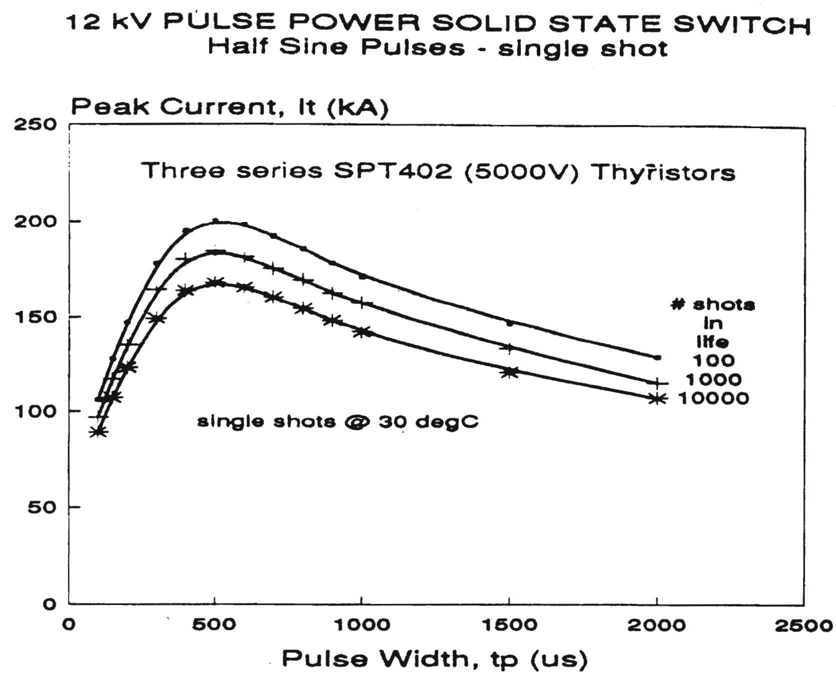


Fig. 3 Representation of a pulse power shot showing no evidence of thermal runaway. On-state voltage is decreasing normally as the current is decreasing.

An example of rating a 12 kV thyristor switch (using three 125mm SPT402 thyristors in series) is shown below. It is presented for half sine pulses at three levels of life expectancy. The pulse waveform will vary for specific cases, varying from job to job.

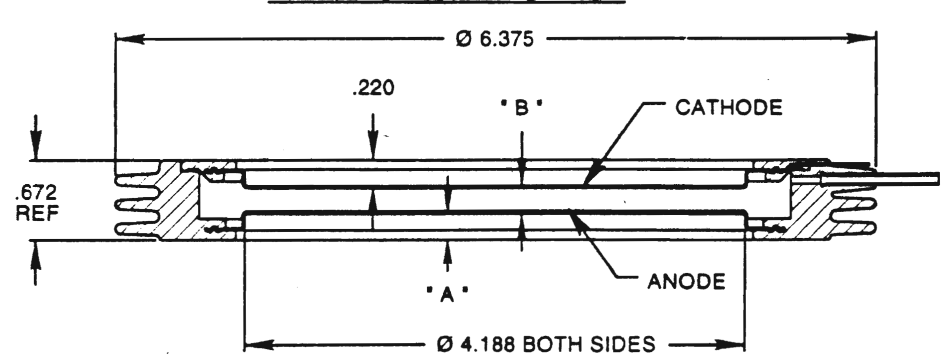


Overall descriptions and references to these procedures are given in *SPCO Application Notes* [5]. However, achieving this predicted performance and life expectancy is dependent on the attaining the required flatness and assembly of mating parts which is the subject of this application note.

1.3 *Design Concept for the SPT400 Series 125mm Thyristors*

Exploring emerging electrical power systems, military weapons, ship power propulsion & control and commercial ventures led to the development of a light weight low profile plastic disk package shown below:

LIGHT WEIGHT - LOW PROFILE
PLASTIC DISK PACKAGE



Dimension	**A**	.250 in	5000V designs
	B	.202	
	A	.220	2500V designs
	B	.232	

Weight: 18 oz Clamping force: 25000-30000 lb