HIGH FREQUENCIES DAMPER DIODES

B. RIVET

INTRODUCTION

The trend in new monitors is for ever increasing switching frequencies of the horizontal deflection stage : 64kHz ---> 110kHz.

SGS THOMSON has developed new 1500V Damper diodes (DTV64D-DTV82D-DTV110D) using a new silicon structure and a suitable lifetime reduction process both optimized in order to reduce the peak forward voltage (V_{FP}) .

For high switching frequencies, the key parameters optimization of the damper diodes becomes more and more critical. This application note describes these key parameters and the associated power losses.

KEY PARAMETERS OF THE DAMPER DIODE

The key parameters of a damper diode are the peak forward voltage (V_{FP}), the forward voltage (V_F) and the recovery time (trr).

Reverse recovery time : trr

The table in fig.1 gives the maximum reverse recovery time for the three high frequency damper diodes.

	trr max I_F =1A - d_{IF}/dt =50 A/µs V_R = 30V - Tj = 25°C
DTV64D	135 ns
DTV82D	125 ns
DTV110D	115 ns

Fig.1: Maximum reverse recovery time of DTV64D, DTV82D and DTV110D.

The application note "CHOICE OF DAMPER DIODE FOR A HORIZONTAL DEFLECTION" explains in detail the very particular mechanism of the switching OFF losses (Poff) in the damper diode. The maximum value of trr has been chosen to be sure that the switching OFF losses in the damper diode will be negligible.

Voltage drop : V_F

This parameter fixes the value of the conduction losses (Pcond) in the diode. This losses can be estimated by :

$$Pcond = Vto\,\frac{Ip}{2}\,\delta = Rd\,\frac{Ip^2}{3}\,\delta$$

Where :

- Ip : peak current in the diode
- δ : duty cycle of the conduction time
- Vto : Threshold voltage of the damper diode
- Rd : dynamical resistance of the damper diode

Example : With a DTV64D

Vto (typ.) = 0.89V

Rd (typ.) = 35mΩ

and Ip = 6A

δ = 0.45

We find

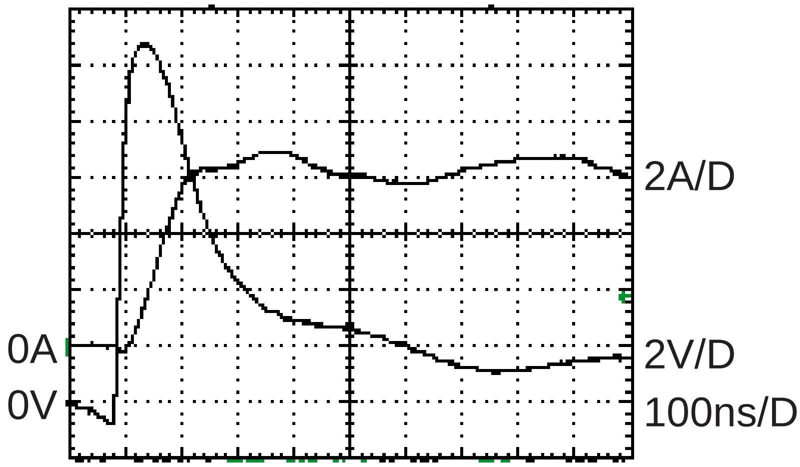
Pcond =1.4W

Peak forward voltage : V_{FP}

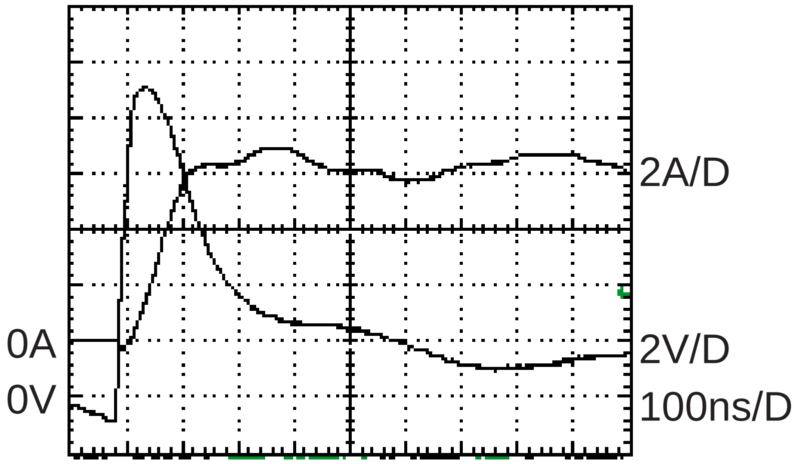
This parameter has to be as low as possible in order to reduce switching ON losses in the diode. The peak forward voltage depends mainly on the dIF/dt. (V_{FP} increases with dIF/dt). For this application the d_{IF}/dt is typically equal to 60A/µs.

Fig.2 shows the current and voltage across the diode when it turns on, in the following conditions : Ip = 6A d_{IF}/dt = 60A/µs Tj = 100°C with DTV64D, DTV82D and DTV110D.

DTV64D



DTV82D



DTV110D

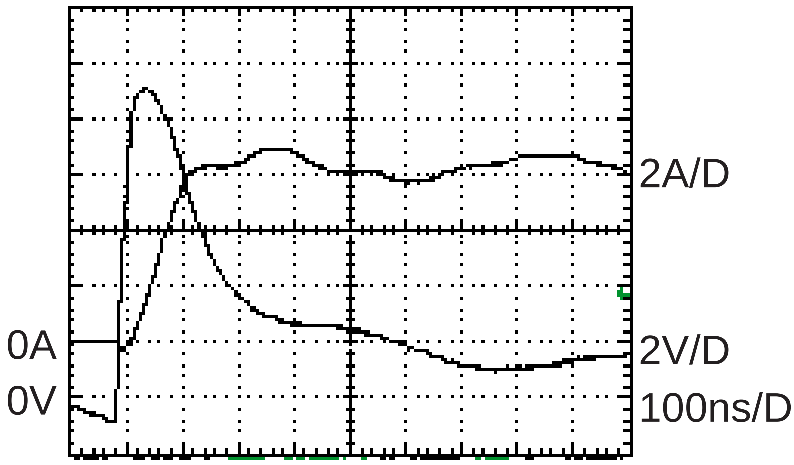


Fig. 2: Oscillograms of V_{FP} for DTV64D, DTV82D, DTV110D with I_p=6A d_{IF}/dt = 60A/µs Tj = 100°C

The corresponding energy can be calculated by :

$$W_{ON} = \int_{o}^{t_{FR}} v.\, i\, dt$$

by using this formula and the switching oscillogram of the DTV64D we find :

$$W_{ON} = 11.3\mu\ J$$

Switching ON losses are given by :

$$P_{ON} = Won\ x\ F$$

Example : With a DTV64D
Ip = 6A
dIF/dt = 60A/µs
Tj = 100°C
F = 64kHz

We have

$$W_{ON} = 11.3\mu\ J$$

and

$$\mathbf{P_{ON} = 0.73W}$$

Total losses in the damper diode : P_T

The reverse losses due to the leakage current are negligible and the switching OFF losses with ST damper diodes are also negligible.

So total losses in the damper diodes are the sum of the conduction losses and the switching ON losses :

$$P_T = P_{ON} + Pcond$$

Example : DTV64D
Ip = 6A
δ = 0.45
F = 64kHZ

PT = 2.1W

CONCLUSION

The new damper diodes have been optimized for horizontal deflection circuits working at high frequencies. A new technology has been developed to reduce the peak forward voltage as much as possible. The compromise between trr and VF has been chosen to be sure that switching OFF losses are negligible. SGS THOMSON offers high frequencies damper diodes DTV64D, DTV82D, DTV110D for operation typically at 64, 82 and 110kHz. Obviously each diode can be used for higher frequencies : for example a DTV82D can be used at 110kHz, in this case the total losses will be higher than with a DTV110D.