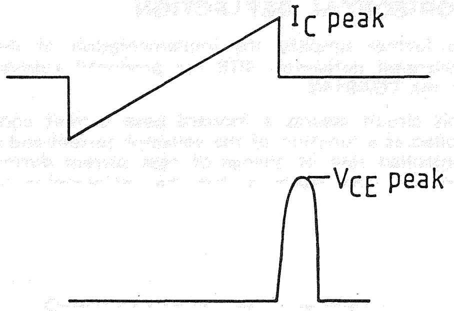
POWER TRANSISTOR DEVELOPMENTS FOR COLOUR CRT DEFLECTION

Typical 90° colour CRT deflection requires a current of 3A peak and a flyback voltage of 950V appears across the control transistor.

Fig. 1



12 years ago the typical requirements were a collector current of 4A or more and peak voltages were 1300V. The BU208 was developed to suit this application.

More recently these devices have been available in plastic packages, as the BU508. The only other technological advance has been the integration of the freewheel diode into the device, as BU208D/BU508D. Unfortunately these devices, or similar types, all suffer from relatively slow switching times, the storage times being 6 to 10μs and current fall time 500ns to 1μs.

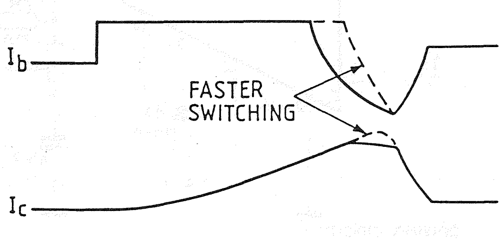
These slow switching characteristics have two inconveniences. Firstly in the fast growing high definition computer monitor application the storage time becomes a real limitation on system performance. This same limitation will apply to any future high definition broadcast TV systems. Secondly the slow fall time means a significant power dissipation as V_{CE} is increasing while IC is still not zero. As well as wasting power the temperature rise degrades reliability of all the components in the system. As the rest of the system dissipates less and less with advances in integration the power lost in the deflection transistor becomes more and more significant.

Another advance has been the use of switching power supplies which mean that the voltage applied to the deflection stage is closely regulated. Hence the peak flyback voltage is no longer subject to large variations.

TURN-OFF OF A HIGH VOLTAGE POWER TRANSISTOR

A high voltage power transistors storage time can be decreased by increasing the base extraction current and increasing the rate of change of base current.

Fig. 2



Regrettably this reduction in storage time may lead to a phenomena of current tailing;

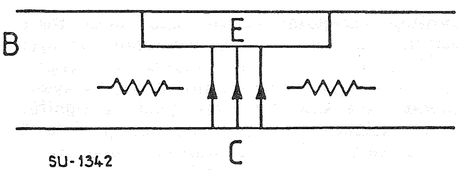
Fig. 3

SU-1341

during which the collector voltage can reach hundreds of volts, resulting in a high dissipation.

This 'tailing' is caused by crowding of the collector current in the centre of the emitter finger during turn off. This phenomena is due to the lateral base resistance and the effect of the electric field when the collector voltage increases.

Fig. 4



To avoid current tailing one solution often adopted is a small series inductance in the base circuit, (10μH typical), which enables a high peak extraction current to be achieved but with a controlled di/dt. But still the best switching that can be achieved is a t_s of around 4μs and t_f 300ns, and there the state of the art has stood still for several years. The requirement for a high voltage transistor in the switching power supply and the availability and price, together with ruggedness in fault conditions, of the BU208 family has resulted in their use in increasing numbers.

A NEW POWER TRANSISTOR FAMILY FOR CRT DEFLECTION

The demand in the computer and industrial markets for more efficient and smaller switching power supplies has resulted in the development of faster switching bipolar power diveces such as the SGS FASTSWITCH transistors.

Until now the voltage breakdown has been limited to 1000V. With the availability of 1200V minimum breakdown devices storage times of 1 to 2μs and 100 to 150ns fall times can be achieved in 90° deflection circuits.

The subsequent dramatic reduction in dissipated power enables savings in heatsinking, and reliability to be improved. These improvements can be achieved in both the deflection stage and switching power supply.

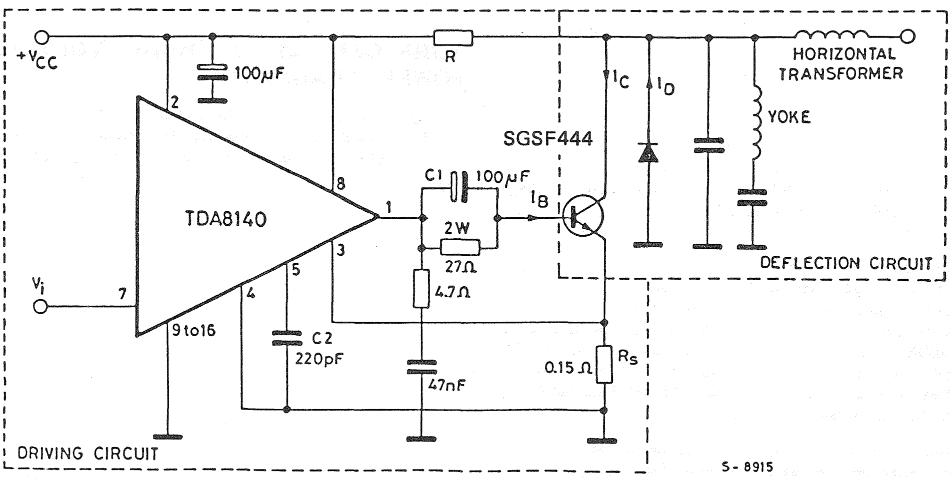
The introduction of a completely isolated package the ISOWATT218, makes the mounting on the minimal heatsinks now required easy and trouble free.

A DRIVER INTEGRATED CIRCUIT FOR HORIZONTAL DEFLECTION

To further simplify the implementation of the horizontal deflection SGS has produced a driver IC, the TDA8140.

This circuit assures a forward base current controlled as a function of the collector current and a controlled rate of change of base current during turn-off. The result is that the performance of

Fig. 5 - Optimum horizontal deflection circuit.



the power transistor is not critically dependant or transistor parameters or component tolerances.

The I_{B1} base current charges up C1 during the on periods and this creates the negative bias used during turn-off.

The I_{B1} after an initial period is controlled in proportion to the emitter current sensed by R_S. The turn-on is delayed by about 4µs during which time C2 is discharged. A sync. detector included in the device prevents turn on of the power transistor while the collector voltage is > 0.

When the input to the TDA8140 goes high I_{B1} ceases and I_{B2} starts to extract charge from the power transistor. The value of I_{B2} is maintained proportional to the voltage across C2 which being charged via a constant current source is a linear ramp.

In a normal small screen TV application with the TDA8140 and a SGSF444 the total storage time, including the TDA8140, was 3 to 3.5µs with a fall time of about 250ns. In this case the circuit as shown in fig. 5.

In free air in the laboratory the power transistor was only slightly warm even when operating without any heatsink. Operation at higher line rates or with a high ambient temperature would require some heatsinking.

A further advantage is that with a minimum gain of 6 at 3A the I_{B1} can be limited to 0.5A peak hence reducing dissipation in the driver integrated circuit. As the total stored charge to be removed by I_{B2} is much lower for the SGSF444 than a BU508 the losses in the driver are further reduced.

CONCLUSION

For many applications transistors with 1200V rating can be used with adequate safety margin. The SGSF444 is ideal for small screen 90° deflection, working with I_C around 3A. The SGSF464 is a larger device for operation at currents around 5A, a lower current device SGSF424 will also be available. The availability of these fast switching devices in the easy to mount ISOWATT218 package, for example SGSIF444, offers further improvements in overall cost and reliability.