TECHNICAL NOTE – TN001

TBD62783 Performance

1 Introduction

Performance tests of TBD62783AFWG transistor array. These arrays are used on the PiIO-xxx-H series of products. They are octal high side DMOS transistor switches with a per channel max current of 0.5A.

This document covers various aspects of the device which will be usful for the application design engineer:

- Switching performance
- Thermal considerations
- Output protection schemes

Note - Toshiba also have an applications PDF not for this device which you also may wish to refer to.

2 Thermal tests

A digital load is used to determine the maximum current spread over all channels on required to create different changes in temperature. The device max temperature is stated as 85 degrees centigrade. The P-SOP Packaged device was the one tested, the device has no built in thermal shutdown so the operating conditions need to be checked where high currents are being drawn.

2.1 4 channels on

4 of the inputs are set high, the supply voltage is set to 12 and 24V. The load is adjusted to make the device temperature change by a prescribed amount.

Delta T (Centigrade)	50	60	70
Max total current through device at: 12V Field voltage	1.3 A	1.4 A	1.5 A
24V Field Voltage	1.24 A	1.35 A	1.45 A

2.2 8 channels on

8 of the inputs are set high, the supply voltage is set to 12 and 24V. The load is adjusted to make the device temperature change by a prescribed amount.

Delta T (Centigrade)	50	60	70
Max total current through device at: 12V Field voltage	1.8 A	2.05 A	2.1 A
24V Field Voltage	1.75 A	2 A	2.05 A

2.3 Per channel simplification

The above can be re-stated, assuming 25 degree ambient as:

Number of channels on	**Max current per channel (A)**
1	.5
2	.5

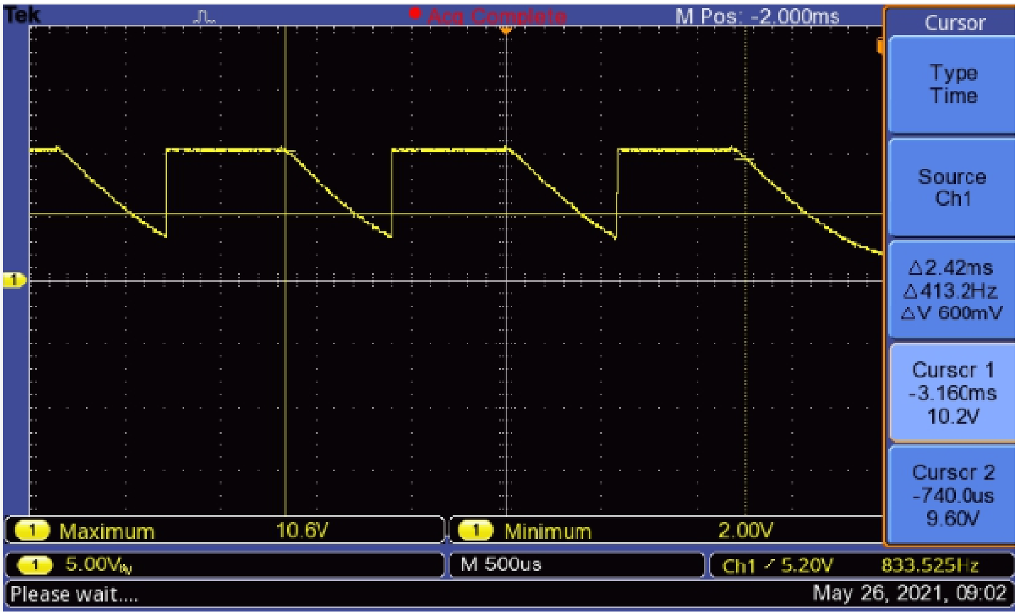
4	.33
8	.25

3 Switching speed tests

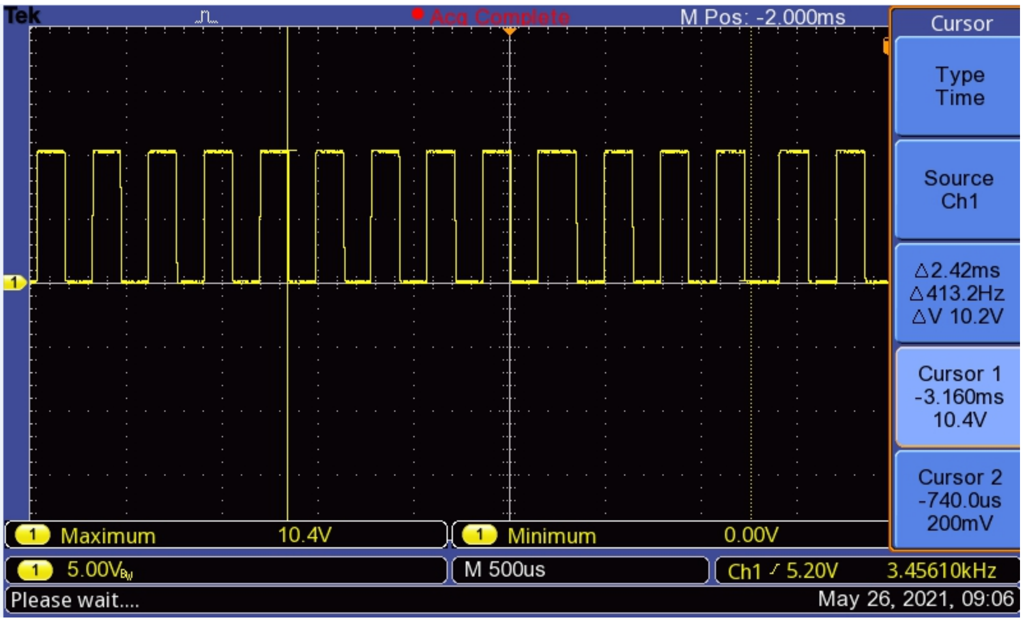
Switching performance is tested up to 10KHz using the GPIOzero PWM function.

3.1 Tests with no load

In the following we can see the turn off time at 12V @ 10Khz is too slow. This is measuring at the output terminals with no load.



Adding a 1KR Load however solved this issue, it should be noted therefore for fast switching performance the outputs should be loaded.



4 Overload protection

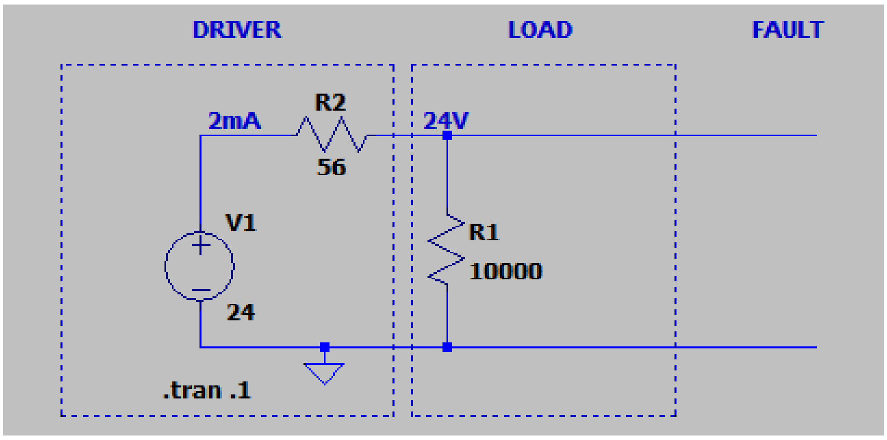
Since the transistor array has no short circuit protection, the following methods are discussed should short circuit / overload protection be a requirement. Generally, you'd want current limiting if:

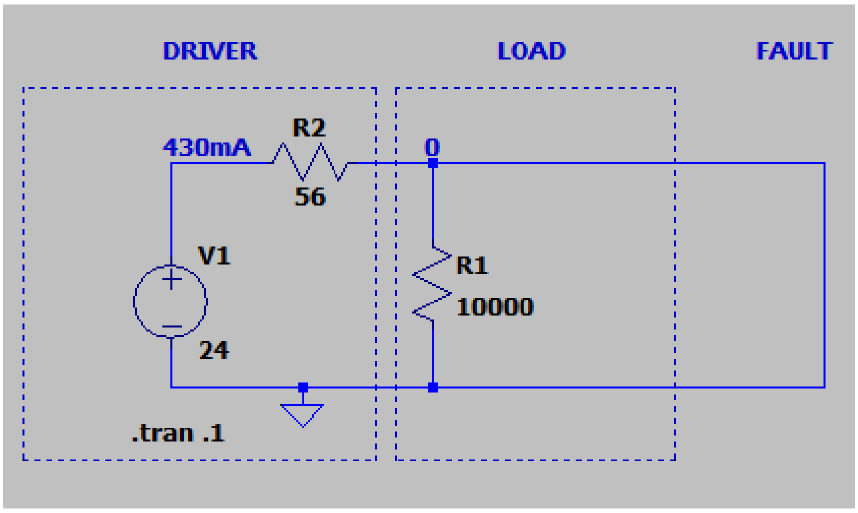
- Wires leaving primary enclosure and likely to be damaged
- Powering a device susceptible to failing short
- Anywhere else there is a risk of a short
- The field supply powers the PI and if it were shorted at the drive output a PI reset would occur and that is not desirable.

NOTE - Fuses and PTCs are not considered fast enough to protect semicondictors.

4.1 Low current

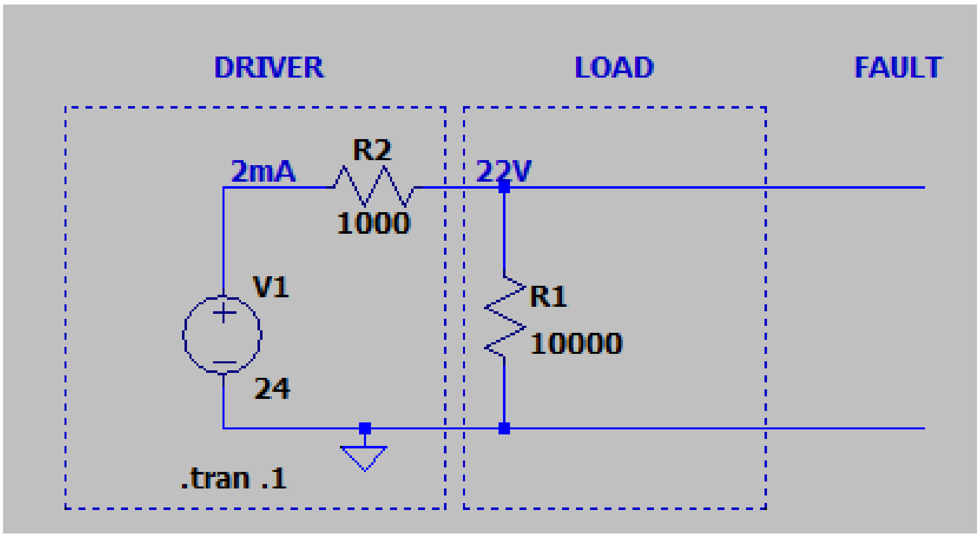
For low current demand a series resistor can protect the output by limiting the short circuit current.





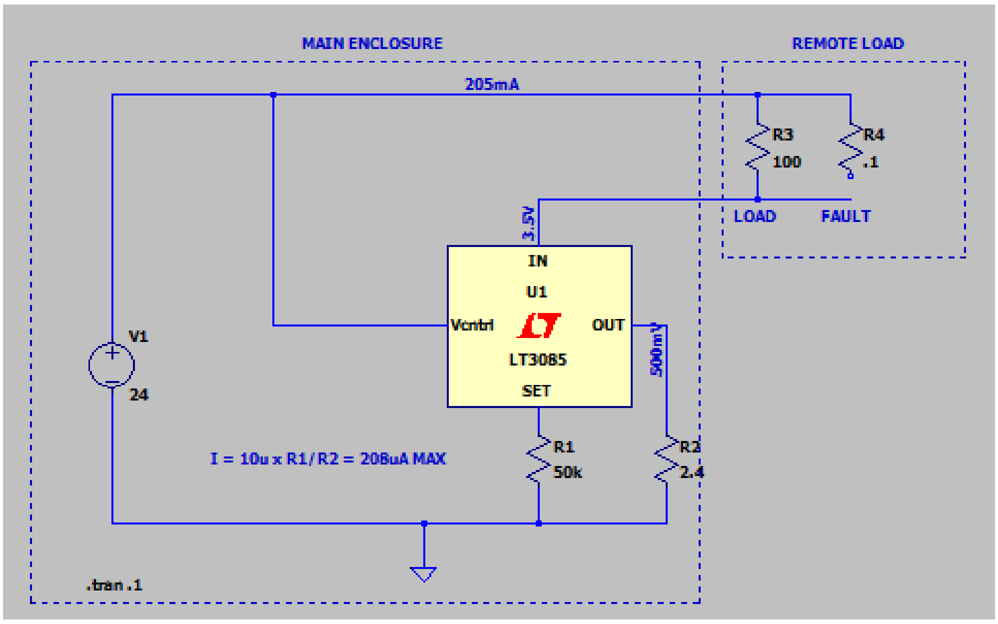
This can work well for loads with a high input impedance. In the above example though R2 dissipates 10W under fault conditions - this can be reduced by either increasing the series resistor or using a PTC to protect the resistor from overload. A resettable fuse would need a trip current well below 430mA (in this example) to automatically shut down the output quickly when the faut occurs.

Alternatively, you can increase the current limit resistor, in the below example only 0.5W/24mA is dissipated in fault conditions so you no longer need the PTC, however the volt drop in normal operation is increased.

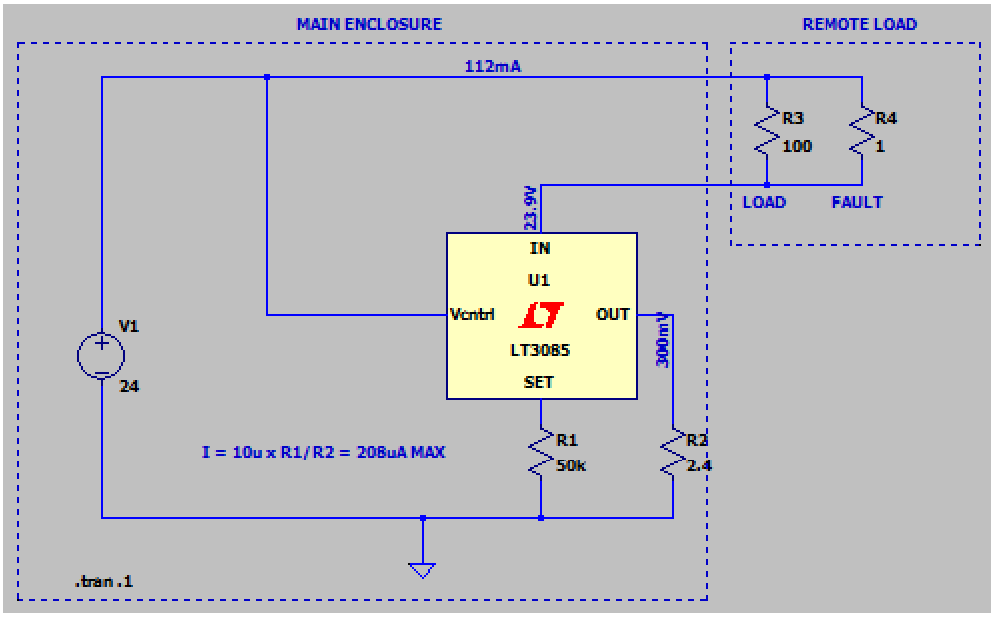


4.2 Medium current

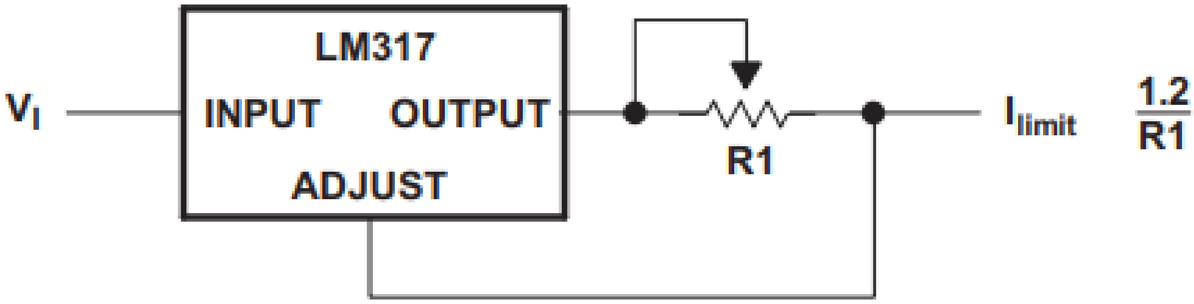
For loads of medium current i.e. < 200mA a linear regulator in current limit configuration can work well. Although you will have to pay attention to the power dissipation through the device, most regulators do have thermal shutdowns though. It may be difficult to add a PTC since there won't be much headroom above the to guarantee it trips. The LT3085 has a dropout voltage of 0.275V, which is subtracted off the maximum output voltage.



Then in fault configuration.

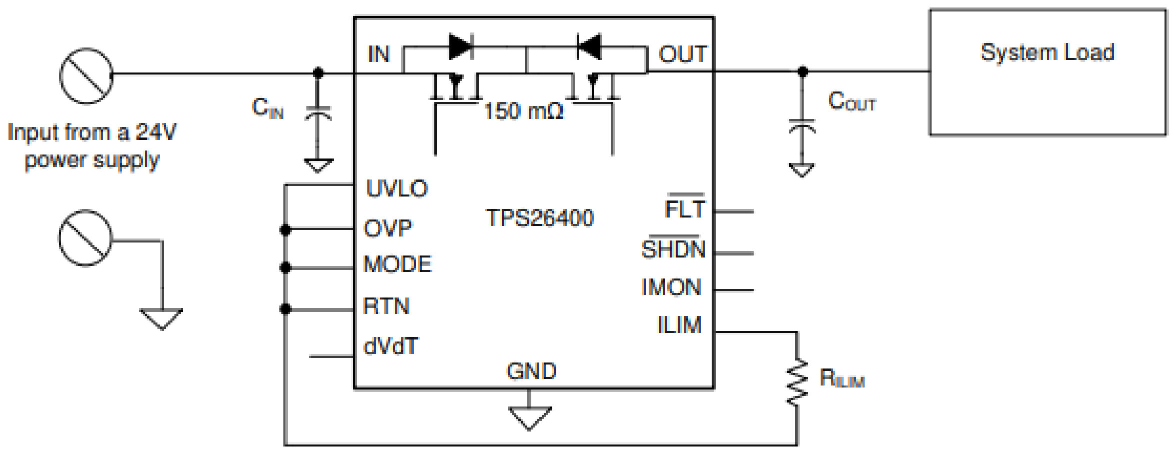


There are a variety of circuits to do this, you can also use discrete NPN transistors as well as using older regulators like the LM317 if you prefer the positive rail to be limited. Here R1 sets the maximum current. The dropout voltage for the LM317 is 1.5-2.5V however so you need to establish that would be acceptable to your design (as it's subtracted off the output voltage).



4.3 High current

Greater than 250mA effuses or other power management ICs are the best choice due to fast and reliable tripping as well as lower power dissipation. Here the Texas instruments TPS2640 42-V, 2-A effuse limits the max current using a programmable RLim resistor. Also there is no voltage lost across the device on normal operation with this solution, unlike the previous 2 discussed.


IN
OUT
System Load
C_{IN}
C_{OUT}
150 mΩ
Input from a 24V power supply
UVLO
OVP
MODE
RTN
dVdT
TPS26400
FLT
SHDN
IMON
ILIM
GND
R_{ILIM}