Using Standard Power over Ethernet Controllers for High-Powered Devices

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1 Introduction

IEEE 802.3af specifies that powered devices (PDs) can draw no more than 15.4 W from the port. Losses in the power switch and dc-to-dc converter mean that the actual load will not get more than 13 W. Integrated power controllers like the TPS2384 are factory set to meet this requirement.

Any IEEE 802.3af power sourcing equipment (PSE) power controller can be used for higher power by adding a simple circuit to the port to increase available current. Figure 1 shows the TPS2384 integrated PSE connected to an Ethernet port, delivering 15.4 W.

The TPS2384 is capable of delivering 425 mA (I_{LIM}) to the port for a short amount of time, but if port current exceeds 375 mA (I_{CUT}) for more than 62 ms (T_{OVLD}), the TPS2384 will turn off the port.

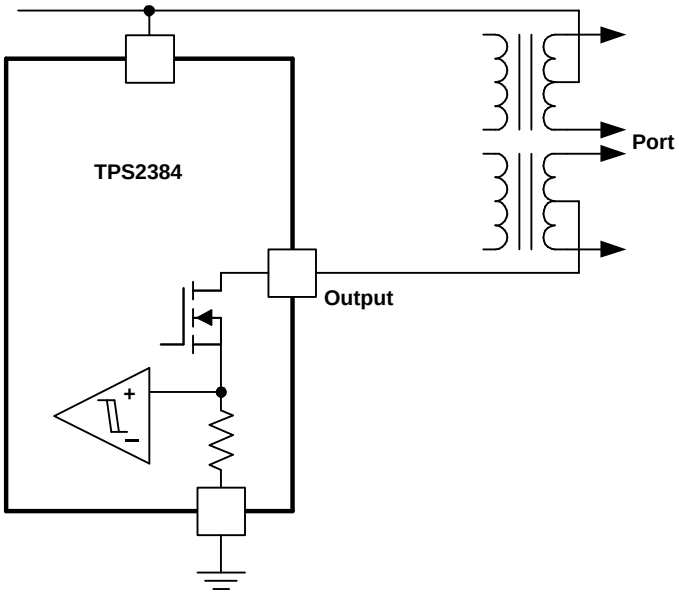

Figure 1. TPS2384 Delivering 15.4 W to an Ethernet Port

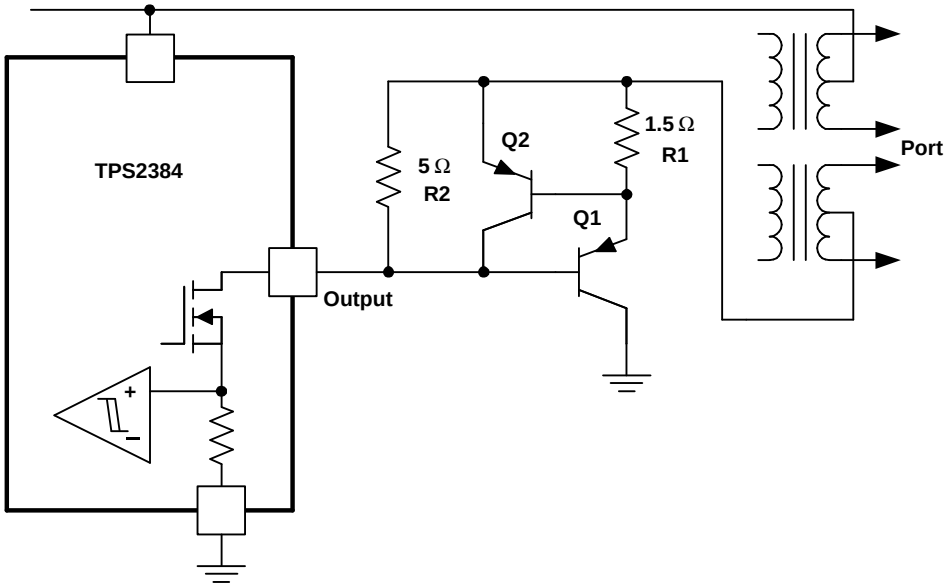

Figure 2. TPS2384 Modified to Deliver 30 W to an Ethernet Port

Using the modification shown in Figure 2, port power can be increased as high as desired. The maximum port power can be selected by changing R1.

With this modification, lower port currents flow through R2. If the port current is larger than V_{BE}/R2 = 0.6 V/5 Ω= 120 mA, then the voltage drop on R2 will be high enough to allow Q1 to turn on and additional current will flow through Q1. This modification will current limit when the voltage drop on R1 reaches V_{BE} of Q2. At this point, the peak current in the port will be limited to the sum of the TPS2384 peak output current and the current through Q1. Likewise, the sustained current in the port will be limited to the TPS2384 sustained maximum current plus the current through Q1.

- I_{MAX} = I_{LIM} TPS2384 + V_{BE}/R1 = 425 mA + 0.6 V/1.5 Ω = 825 mA.
- I_{CUT} = I_{CUT} TPS2384 + V_{BE}/R1 = 375 mA + 0.6/1.5 Ω = 775 mA.

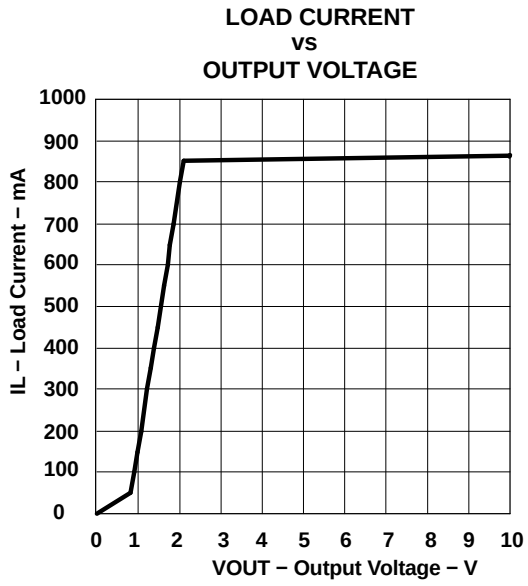

Figure 3. Performance of Current Booster with Values Shown in Figure 2

This same modification can be used with a powered device power controller such as the TPS2375, as shown in Figure 4.

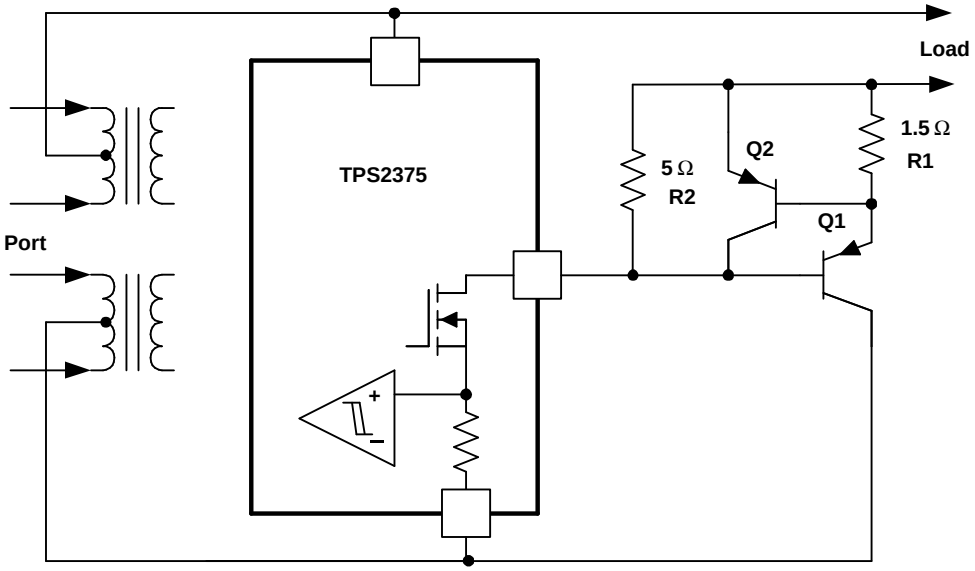

Figure 4. Increasing Available Current from an IEEE 802.3af Powered Device Controller

For Power-over-Ethernet use, Q1 must be a 100-V transistor capable of handling 600 mA and able to take port ESD stress, such as the BCP53. Current gain is not important. Q2 can be any low-voltage transistor but must be capable of 200-mA current. As shown, the current limit is increased by V_{BE}/R1, and V_{BE} has a negative temperature coefficient, so some decrease in current with increasing temperature is expected. Lab data with BCP53 transistors shows that this current varies 30 mA and -50 mA with a change in temperature from -40°C to 100°C.

When increasing port current above IEEE 802.3af levels, selection of transformers must also be considered. The wire in the transformer must be sized for higher dc current. Also, transformer imbalance creates a dc field in the core, so a better matched transformer or larger core will be required.

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