DDB104R3
EVB User Guide

Quick Start Guide:

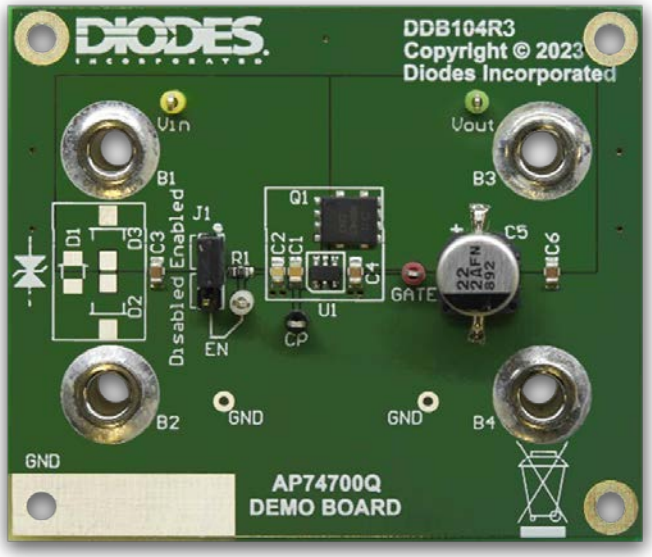


Figure 1: DDB104R3 Demo Board

Pin	Description
B1	Voltage Input Banana Plug Socket
B3	Voltage Output Banana Plug Socket
B2, B4	GROUND 0V Banana Plug Socket
Vin, Vout, GND1, GND2	Power rail test points
CP	Charge pump test point
J1	Enable pin selection header
EN	Enable pin test point
GATE	MOSFET gate test point

Table 1: DDB104R3 Pin Legend

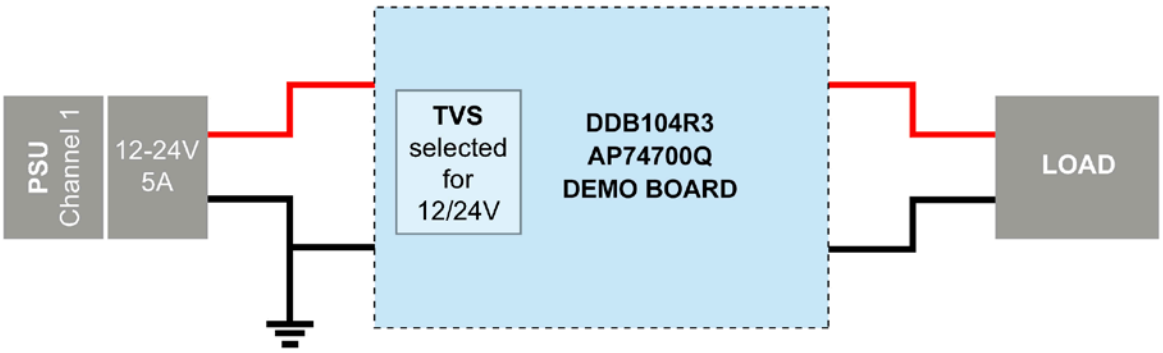


Figure 2: DDB104R3 Test Setup

1. Ensure correct TVS device is used for testing.
2. Set channel 1 of PSU to 12V or 24V, depending on the TVS device selected, and the current limit to 5A.
3. Connect B3 and B4 to the load using banana plugs.
4. Set the jumper to Enabled on the J1 header.
5. Connect B1 to channel 1 of the PSU.
6. Connect B2 to the ground of the PSU.
7. Attach oscilloscope probe to Vin, Vout, and Gate test points, and a current probe between Vout and the load.

Description:

The DDB104R3 Demo Board showcases the AP74700Q, which is an automotive-compliant ideal diode MOSFET controller. When used with an appropriate external N-channel power MOSFET, it provides a low-loss 20mV forward voltage drop rectification in unidirectional power paths and reverse voltage protection. It supports a wide input operation range from 3.2V to 65V, allowing control of many popular DC rail voltages such as 12V, 24V, or higher automotive battery systems. The 3.2V input voltage support is suitable for severe cold crank systems. The AP74700Q can withstand and protect loads from reverse voltages down to -65V. Its internal gate driver quickly turns off the MOSFET during a reverse current event and ensures there is no DC reverse current flow. The fast reverse current blocking response makes the device suitable for systems with output voltage holdup requirements during ISO7637-2 pulse testing, as well as power failure and input micro-short conditions. The high 65V voltage rating of the AP74700Q simplifies system design for automotive ISO7637-2 protection.

The DDB104R3 Demo Board is designed to allow two types of MOSFET packages to be used for testing: the 3x3mm PowerDI®3333 and the 5x6mm PowerDI5060 packages. The footprint of Q1, shown in Figure 3, has a small groove in the drain pad which ensures that if a PowerDI3333 MOSFET is used, it does not skew to one side due to the solder's surface tension, thus making it easier to solder.

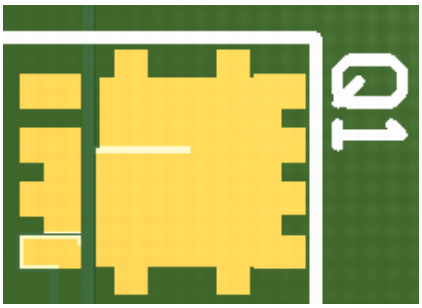


Figure 3: Q1 MOSFET Footprint

MOSFET Selection Table

Based on the design requirements, preferred MOSFET ratings are:

- 60V $V_{DS(MAX)}$ and ±20V $V_{GS(MAX)}$
- $R_{DS(ON)}$ @$I_{Load(Nominal)}$: (20mV / $I_{Load(Nominal)}$) ≤ $R_{DS(ON)}$
- MOSFET gate threshold voltage V_{TH}: 2V maximum

According to the criteria mentioned above, the following table presents some MOSFETs recommended for use with the AP74700Q depending on the load current:

Part Number	V_{DS} (V)	$R_{DS(ON)}$ @V_{GS}=10V (mΩ)	$I_{Load(Nominal)}$ (A)*	Package
DMTH6016LFVWQ	60	16	1.25 to 5	PowerDI3333-8 (SWP) (Type UX)
DMTH69M8LFVWQ		9.5	2 to 15	PowerDI3333-8 (SWP) (Type UX)
DMT6007LFGQ		6	3.5 to 15	PowerDI3333-8
DMTH6004SPSQ		3.1	6.5 to 30	PowerDI5060-8
DMTH61M5SPSWQ		1.5	15 to 45	PowerDI5060-8 (SWP) (Standard)
DMTH4014LFVWQ	40	13.7	1.5 to 10	PowerDI3333-8
DMTH47M2LFVWQ		8.9	2.25 to 15	PowerDI3333-8 (SWP) (Type UX)
DMTH47M2LPSWQ		7.3	2.75 to 20	PowerDI5060-8
DMTH43M8LFGQ**		3	6 to 25	PowerDI3333-8
DMTH41M8SPSQ		1.8	11.5 to 40	PowerDI5060-8
DMTH41M2SPSQ		1.2	17 to 50	PowerDI5060-8

Table 2: MOSFET Selection Table

*Note that the MOSFET's load current limit for ambient temperature applications is closer to the higher value. For high-temperature applications, it is closer to the lower value.

**The default MOSFET used on this board is the DMTH43M8LFGQ.

Description (continued):

The thermal images in Figure ***4*** show the AP74700Q driving a DMTH43M8LFGQ (PowerDI3333) and a DMTH61M5LPSQ (PowerDI5060) at 20A load current at an ambient temperature of T_A=25°C.

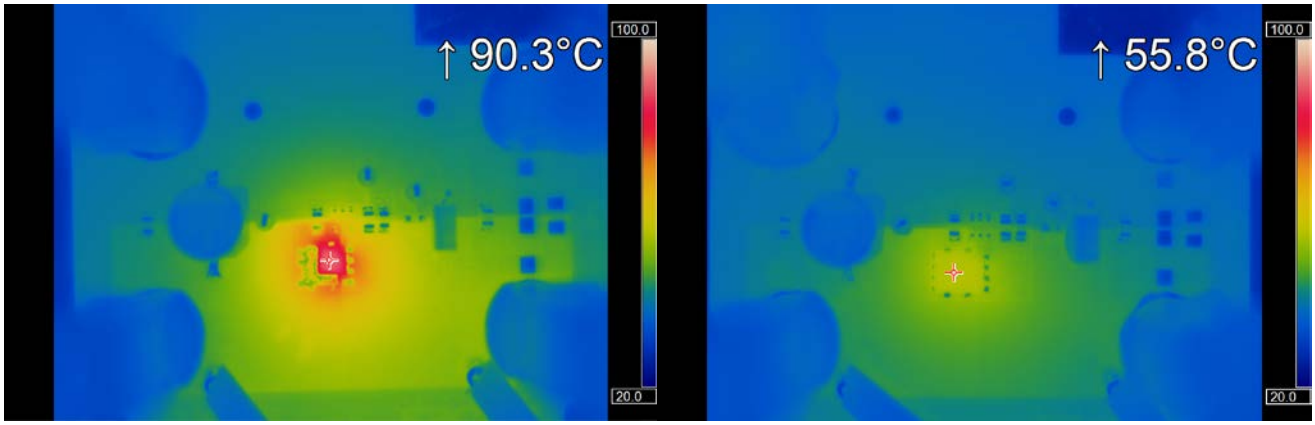
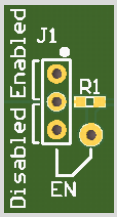


Figure 4: Thermal Image of DMTH43M8LFGQ (Left) and DMTH61M5LPSQ (Right) at 20A Load Current

The DDB104R3 Demo Board comes with 4mm banana plug sockets to make it easier to use. Connections to these points can be made using 4mm banana plugs, or by soldering wires to them. Banana-plug sockets B1 and B2 are the inputs of the DDB104R3 Demo Board. Banana-plug sockets B3 and B4 are the outputs of the Demo Board. A load must be connected across the outputs of the demo board for it to work optimally.

Table ***3*** below describes the behavior of the AP74700Q when the jumper on the J1 header is set in different positions.

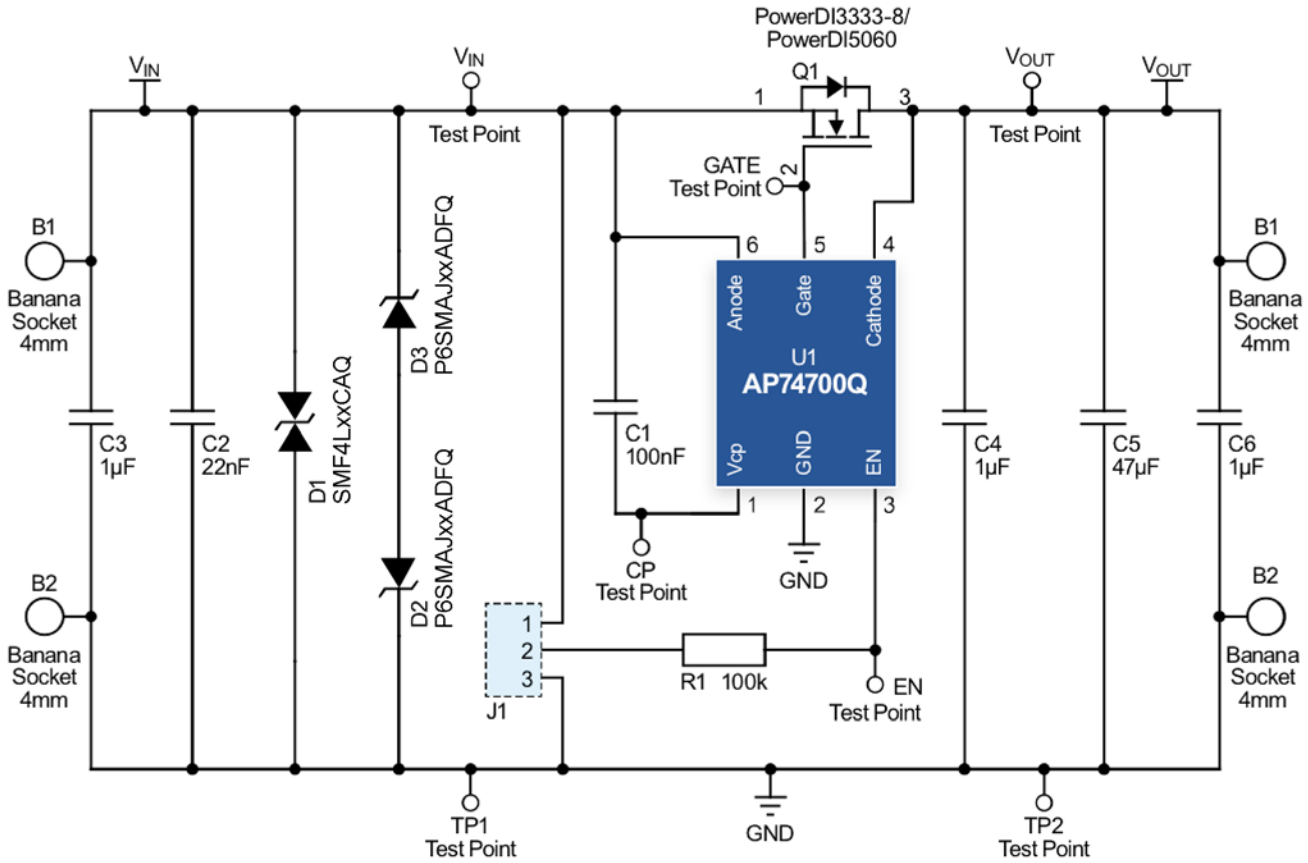


J1 Jumper Position	Behaviour of the AP74700Q
ENABLED	Normal operation. The AP74700Q regulates the MOSFET's gate voltage to minimize forward conduction losses
DISABLED	The AP74700Q is in shutdown mode. The forward current flow through the external MOSFET is uninterrupted but is conducted through the MOSFET's body diode.
Not Connected	Same as DISABLED

Table 3: J1 Header Jumper Position Functionality

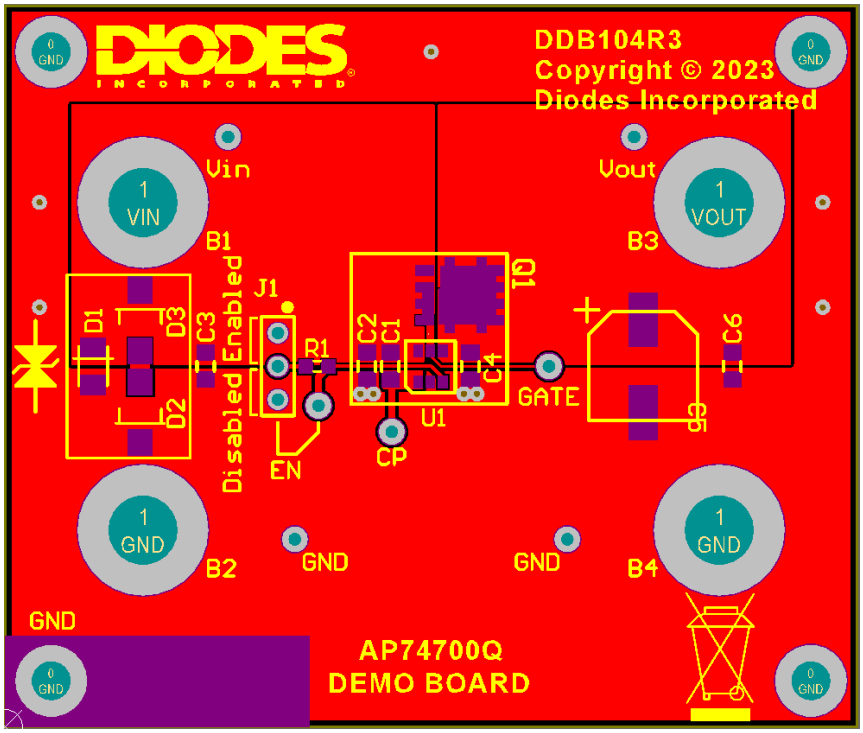
The board has the option to add TVS protection devices on the input side to protect against voltage spikes that might occur in an automotive environment. The recommended TVS devices to use on the DDB104R3 are either a single SMF bidirectional TVS, which comes in a DO-219AA package with almost half the size of an SMA TVS and the same power rating; or two P6SMA unidirectional TVSs, which come in the D-FLAT package with the same size as an SMA but with power rating of an SMB. The TVS devices are not included as default, and, if used, must be selected according to the voltage range the AP74700Q is tested at.

Schematic Diagram:

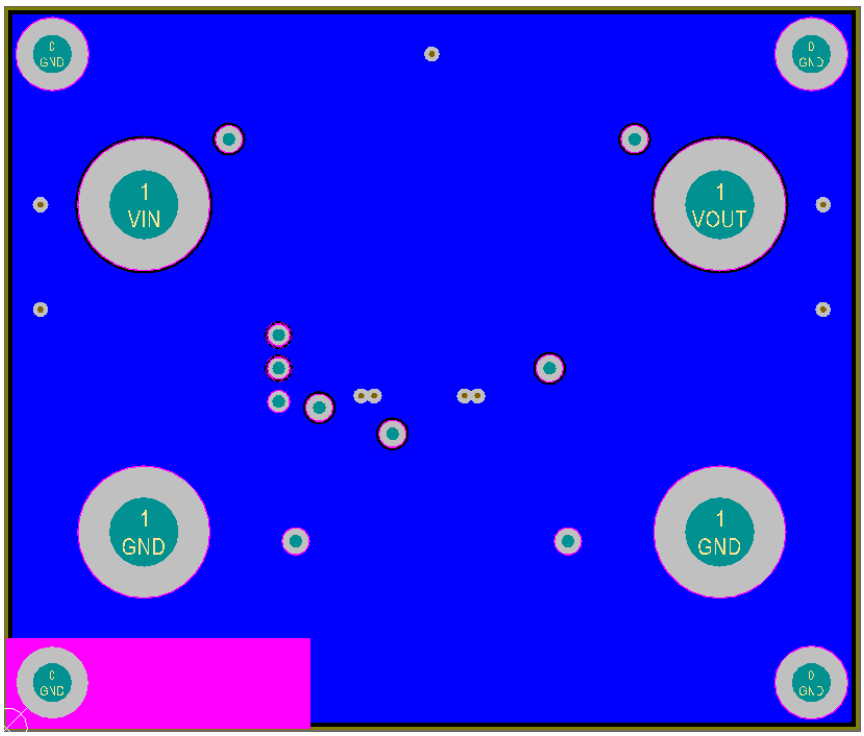


Board Layers (Top View Perspective):

Top layer:



Bottom layer:



Bill of Materials:

Qty.	Indents	Description	Footprint
4	B1, B2, B3, B4	Banana Socket 4mm	Banana socket
3	C3, C4, C6	1µF X7R 100V Ceramic SMD Capacitor	0805
1	C1	100nF X7R 100V Ceramic SMD Capacitor	0805
1	C2	22nF X7R 100V Ceramic SMD Capacitor	0805
1	C5	47µF 80V Electrolytic SMD Capacitor	Case D8
1	R1	100k SMD Resistor	0603
1	J1	3W Header	0.1” 3W
1	U1	AP74700Q	SOT26
1	Q1	MOSFET from selection Table ***2*** (DMTH43M8LFGQ default)	PowerDI5060-8/ PowerDI3333-8
1	D1	SMF4LxxCAQ	DO-219AA
1	D2	P6SMAJxxADFQ	D-FLAT
1	D3	P6SMAJxxADFQ	D-FLAT

*Note: these components are not fitted on the board and the user should fit the desired TVS device by themselves.

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