

Quick Start Guide:



Figure 1: DDB106R1 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: DDB106R1 Pin Legend

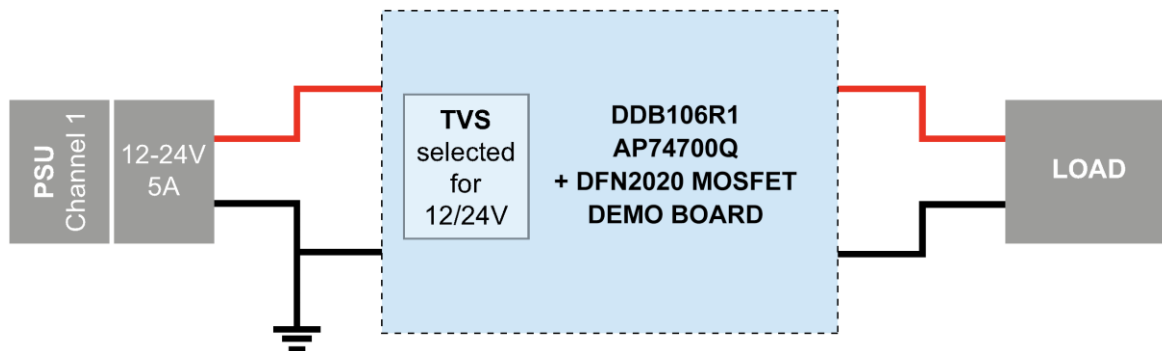


Figure 2: DDB106R1 Test Setup

1. Ensure correct TVS device is used for the testing.
2. Set channel 1 of PSU to 12V or 24V, depending on the TVS device selected, and current limit to 5A.
3. Connect B3 and B4 to a 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 DDB106R1 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 it 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 designs for automotive ISO7637-2 protection.

The DDB106R1 Demo Board is designed to allow testing of the AP74700Q with a 2x2mm MOSFET in the U-DFN2020-6 package, which provides a compact layout, as seen in Figure 3. Due to the pinout of the U-DFN2020-6 package, the gate pin of the AP74700Q must be routed through vias to the other side of the MOSFET to reach its gate pin.

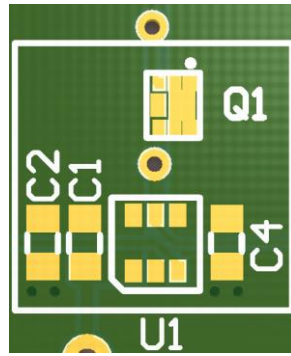


Figure 3: Q1 MOSFET footprint and connection to AP74700Q

MOSFET Selection Table

Based on the design requirements, preferred MOSFET ratings are:

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

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

Part Number	V_{DS} (V)	$R_{DS(ON)} @ V_{GS}=10V$ (m Ω)	$I_{Load(Nominal)}$ (A)*	Package
DMT3020LFDFQ	30	17	1.175 to 6	U-DFN2020-6 (Type F)
DMN3016LFDFQ		12	1.66 to 7	U-DFN2020-6 (Type F)
DMT3006LFDFQ		7	2.85 to 10	U-DFN2020-6 (Type F)
DMN4020LFDEQ	40	21	0.95 to 6	U-DFN2020-6 (Type E)
DMTH4008LFDFWQ**		11.5	1.73 to 9	U-DFN2020-6 (SWP) (Type F)
DMTH6016LFDFWQ	60	18	1.1 to 7	U-DFN2020-6 (SWP) (Type F)

Table 2: MOSFET Selection Table

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

**The default MOSFET used on this board is the DMTH4008LFDFWQ.

Description (continued):

The thermal image in Figure 4 shows the AP74700Q driving a DMTH4008LDFWQ at 5A load current at an ambient temperature of $T_A=25^\circ\text{C}$.

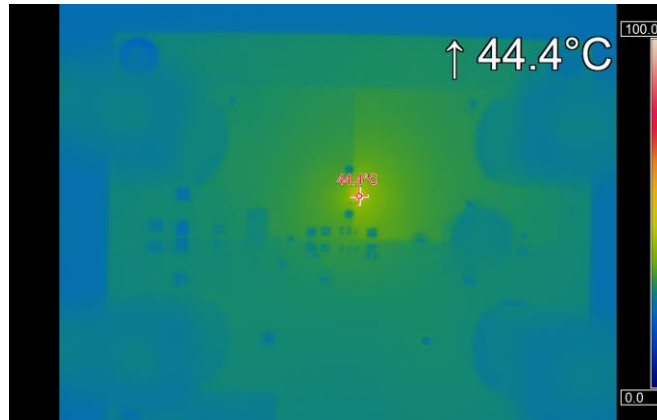


Figure 4: Thermal image of DMTH4008LDFWQ at 5A load current

The DDB106R1 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 DDB106R1 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.

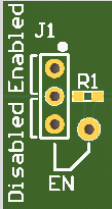
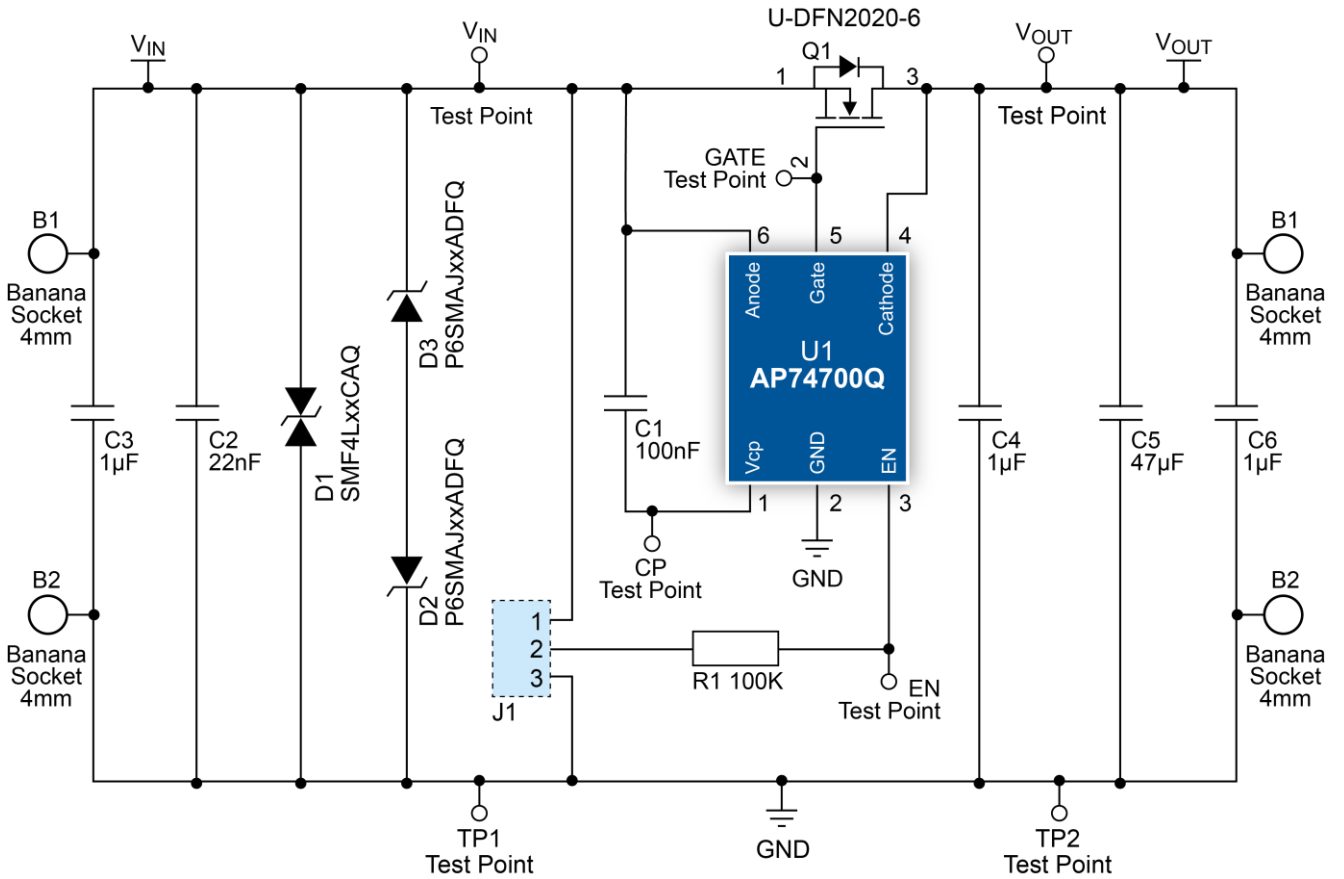
	J1 jumper position	Behaviour of the AP74700Q
	ENABLED	Normal operation. The AP74700Q regulates the MOSFET's gate voltage to minimize forward conduction losses
	DISABLED	The AP74700Q is in shutdown mode. The forward current flow through the external MOSFET is uninterrupted but is conducted through the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

Table 3: J1 header jumper position functionality

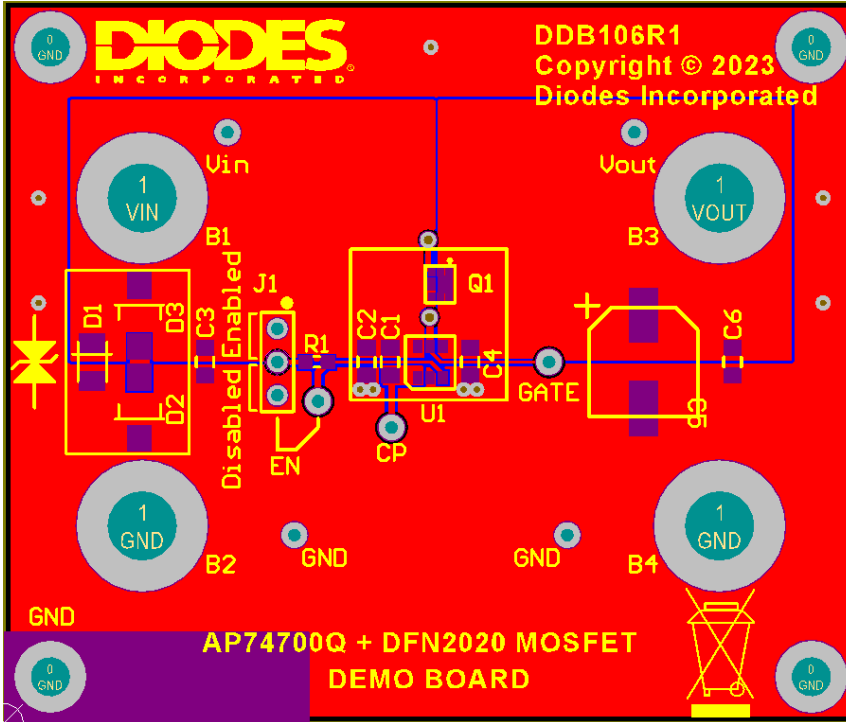
The board has the option to add TVS protection devices on the input side to protect against voltage spikes that might occur in an automotive environment. The recommended TVS devices to use on the DDB106R1 are either a single SMF bidirectional TVS, which comes in a DO-219AA package with almost half the 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 the 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.

Board Schematic:

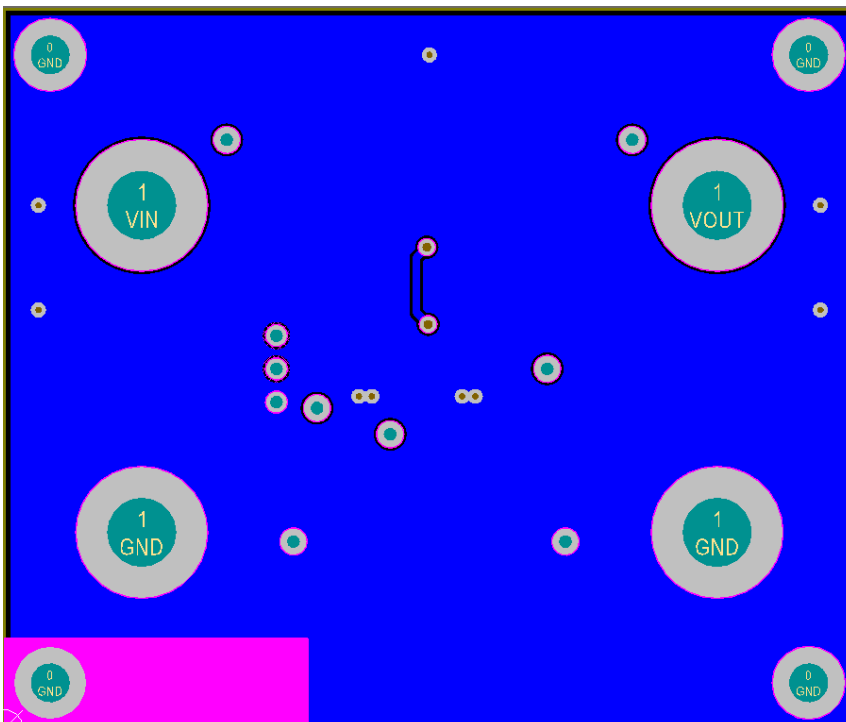


Board Layers (Top View):

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	1 μ F 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	47 μ F 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 (DMTH4008LDFDQ default)	U-DFN2020-6
1	D1	SMF4LxxCAQ*	DO-219AA
1	D2	P6SMAJxxADFDQ*	D-FLAT
1	D3	P6SMAJxxADFDQ*	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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