MIC2875/6 Evaluation Board

4.8A I_{SW}, Synchronous Boost Regulator with Bi-Directional Load Disconnect

General Description

The MIC2875/6 evaluation board is a compact and highly-efficient 2MHz synchronous boost regulator with a 4.8A switch. It features a bi-directional load disconnect function which prevents any leakage current between the input and output when the device is disabled.

The MIC2875/6 operates in bypass mode automatically when the input voltage is greater than the target output voltage. At light loads, the boost converter goes to PFM mode to improve the efficiency. The part also features an integrated anti-ringing switch to minimize EMI.

The MIC2875 is designed to operate with a minimum switching frequency of 45kHz from no load to full load to minimize switching artifacts in the audio band.

Datasheets and support documentation are available on Micrel's web site at: www.micrel.com.

Requirements

The MIC2875/6 evaluation board requires a bench input power source that is adjustable from 2.5V to 5.5V and is able to deliver greater than 4.5A at 2.5V.

Precautions

The evaluation board does not have reverse polarity protection. Applying a negative voltage across the VIN terminal to the ground (GND) terminal can damage the device. It should not exceed 5.5V on the input.

Input power leads should be kept as short as possible to minimize the inductance. VIN measurements should be made at the VIN and GND terminals, to ensure that the voltage drop on the input power leads are not included.

Getting Started

1. **Connect an external supply to the VIN terminals.**

   Apply the desired input voltage to the VIN (J1) and GND (J2) terminals of the evaluation board, paying careful attention to polarity and supply range (2.5V to 5.5V). An ammeter can be placed between the power supply and the input terminal of the evaluation board. Ensure that the supply voltage is monitored at the VIN (J1) terminal, as the ammeter and/or power-lead resistance can reduce the voltage supplied to the input.

2. **Connect a load to VOUT and GND terminals.**

   The load connected between VOUT (J3) and GND (J4) terminals of the evaluation board can be either passive (resistive) or active (electronic load). In case of electronic load, keep the load disabled until the MIC2875/6 has been powered up.
   An ammeter may be placed between the load and the output terminal. Ensure the output voltage is monitored across the VOUT (J3) and GND (J4) terminals.

3. **Enable/Disable the MIC2875/6.**

   The MIC2875/6 evaluation board has an enable (EN) pin (J8).The MIC2875/6 is in standby mode when the EN pin is asserted high. Setting the jumper at JP1 connects the EN pin to VIN through a 10kΩ pull-up resistor. If this pin is driven low, the IC is shut down. This pin has an internal pull-down resistor and can be left open.

4. **Power Good (/PG).**

   A power good (/PG) test pin (J5) is provided to monitor the power good function. It is an open drain active low output power good output. Setting the jumper at JP2 connects the /PG pin to VIN through a 1MΩ pull-up resistor. This pin is asserted low when the output is above the power good threshold.

Ordering Information

Part Number	Description
MIC2875-AYMT EV	MIC2875 Adjustable Output
MIC2875-5.0YMT EV	MIC2875-5.0V Fixed Output
MIC2876-AYMT EV	MIC2876 Adjustable Output
MIC2876-5.0YMT EV	MIC2876-5.0V Fixed Output

Evaluation Board Description

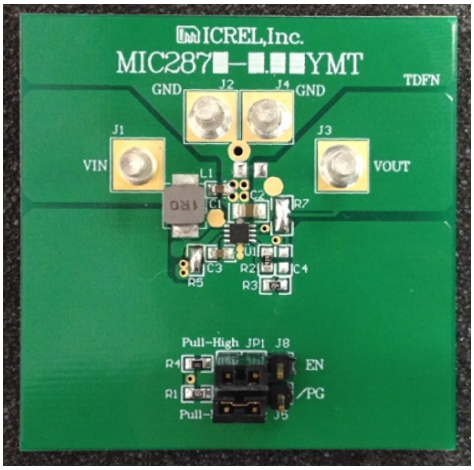


Figure 1. MIC2875-AYMT Evaluation Board

Bi-Directional Output Disconnect

The power stage of the MIC2875/6 consists of a NMOS transistor as the main switch and a PMOS transistor as the synchronous rectifier. A control circuit turns off the back gate diode of the PMOS to isolate the output from the input supply when the chip is disabled (V_{EN} = 0V). An "always on" maximum supply selector switches the cathode of the backgate diode to either the IN or the OUT, whichever pin has a higher voltage. As a result, the output of the MIC2875/6 is bi-directionally isolated form the input as long as the device is disabled. The maximum supply selector and hence the output disconnect function requires only 0.3V at the IN pin to operate.

Minimum Switching Frequency (MIC2875 Only)

When the MIC2875 enters the pulse-skipping mode for more than 20µs, an internal control circuitry forces the PMOS to turn on briefly to discharge VOUT to VIN through the inductor. When the inductor current reaches a predetermined threshold, the PMOS is turned off and the NMOS is turned on so that the inductor current can decrease gradually. Once the inductor current reaches zero, the NMOS is eventually turned off. The above cycle repeats if there is no switching activity for another 20µs, effectively maintaining a minimum switching frequency of 45kHz. The frequency control circuit is disabled when VOUT is less than or within 200mV of VIN. This minimum switching frequency feature is advantageous for applications that are sensitive to low frequency EMI such as audio systems.

Integrated Anti-Ringing Switch

The MIC2875/6 includes an anti-ringing switch that eliminates the ringing on the SW node of a conventional boost converter operating in the discontinuous conduction mode (DCM). At the end of a switching cycle during DCM operation, both the NMOS and PMOS are turned off. The anti-ringing switch in the MIC2875/6 clamps the SW pin voltage to IN to dissipate the remaining energy stored in the inductor and the parasitic elements of the power switches.

Automatic Bypass Mode (when $V_{IN} > V_{OUT}$)

The MIC2875/6 automatically operates in bypass mode when the input voltage is higher than the target output voltage. In bypass mode, the NMOS is turned off while the PMOS is fully turned on to provide a very low impedance path from IN to OUT.

Soft-Start

The MIC2875/6 integrates an internal soft-start circuit to limit the inrush current during start-up. When the device is enabled, the PMOS is turned on slowly to charge the output capacitor to a voltage close to the input voltage. Then, the device begins boost switching cycles to gradually charge up the output voltage to the target VOUT.

Output Voltage Programming

The MIC2875/6 has an adjustable version that allows the output voltage to be set by an external resistor divider R2 and R3. The typical feedback voltage is 900mV and the recommended maximum and minimum output voltage is 5.5V and 3.2V respectively. The current through the resistor divider should be significantly larger than the current into the FB pin (0.01µA typical). It is recommended that the total resistance of R2 + R3 should be approximately 1MΩ. The appropriate R2 and R3 values for the desired output voltage are calculated by:

$$R2 = R3 \times \left(\frac{V_{OUT}}{0.9V} - 1 \right) \quad \text{Eq. 1}$$

Safe Operating Area (SOA)

The safe operating area (SOA) curves represent the boundary of the maximum safe operating current and maximum safe operating junction temperature.

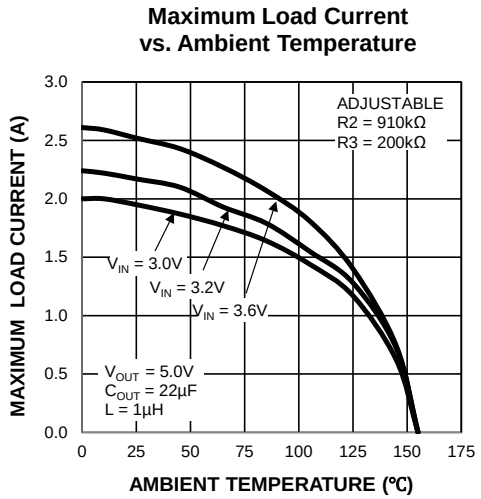
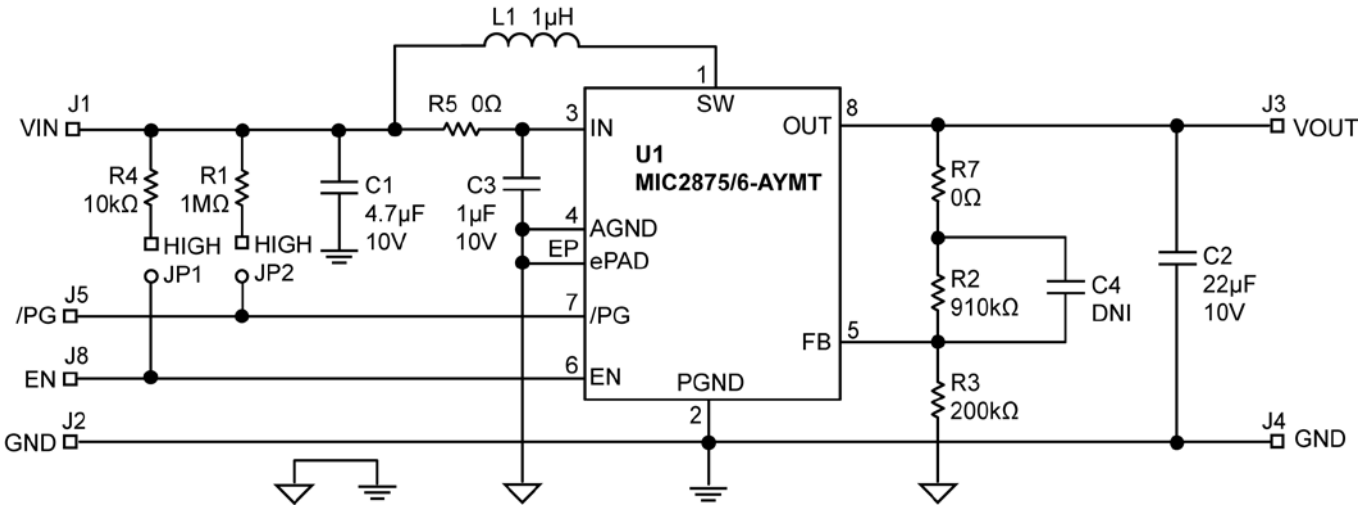


Figure 2. MIC2875/6 Safe Operating Area (SOA) Curves

Figure 2 illustrates the SOA for various V_{IN} mounted on the MIC2875/6 EVB from 0°C to +155°C.

Evaluation Board Schematics (MIC2875/6-AYMT)



MIC2875/6-AYMT (V_{IN} ≤ 5.0V)

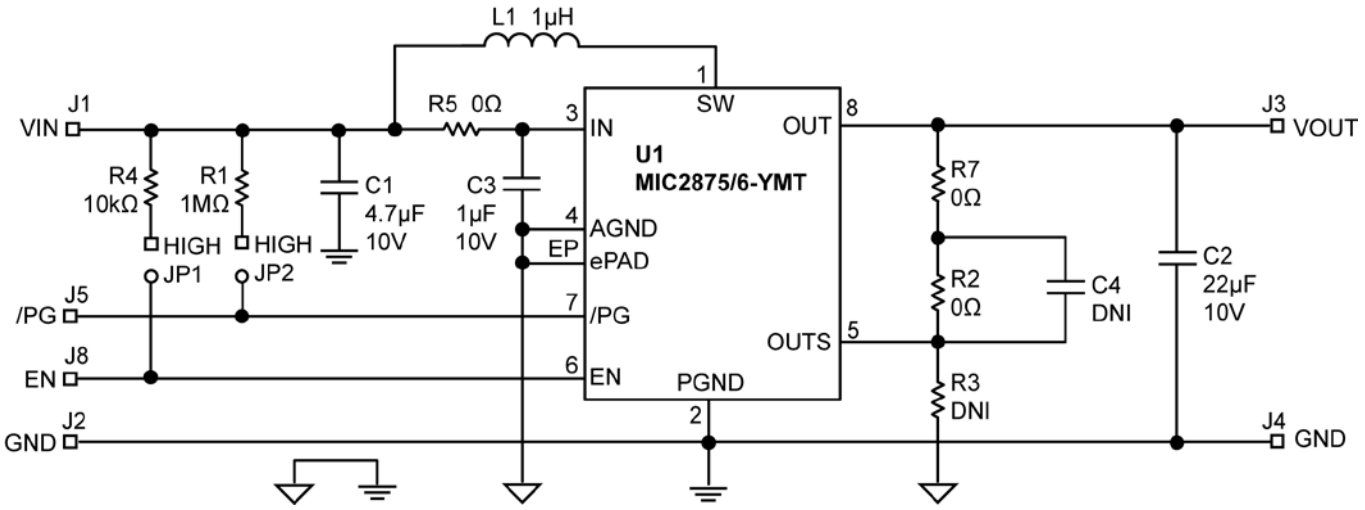
Bill of Materials

Item	Part Number	Manufacturer	Description	Qty.
C1	C1608X5R1A475K080AC	TDK[1]	Capacitor 4.7µF, 10V, 10%, X5R, 0603	1
C2	LMK212BJ226MG-T	Taiyo Yuden[2]	Capacitor 22µF, 10V, 20%, X5R, 0805 (V_{IN} ≤ 5.00V)	1
			Capacitor 22µF, 10V, 20%, X5R, 0805 (V_{IN} > 5.00V, in parallel)	3
C3	GRM188R61A105KA61J	Murata[3]	Capacitor 1µF, 10V, 10%, X5R, 0603	1
C4	–	–	Not Fitted, Size 0603	0
L1	PIMB042T-1R0MS-39	Cyntec[4]	Inductor 1µH, 4.5A, SMD, 4.2mm × 4.0mm × 1.8mm	1
R1	ERJ-3GEYJ105V	Panasonic[5]	Resistor 1MΩ, 5%, 0603	1
R2	1-1879417-8	TE[6]	Resistor 910kΩ, 0.1%, 0603	1
R3	ERA-3AEB204V	Panasonic	Resistor 200kΩ, 0.1%, 0603	1
R4	ERJ-3GEYJ103V	Panasonic	Resistor 10kΩ, 5%, 0603	1
R5, R7	CRCW0603000Z0EA	Vishay[7]	Resistor 0Ω, 0603	2
U1	**MIC2875-xYMT**	**Micrel, Inc.**[8]	**4.8A I_{SW}, Synchronous Boost Regulator with Bi-Directional Load Disconnect**	**1**
	MIC2876-xYMT			

Notes:

1. TDK: www.tdk.com.
2. Taiyo Yuden: www.t-yuden.com.
3. Murata: www.murata.com.
4. Cyntec: www.cyntec.com
5. Panasonic: www.panasonic.com.
6. TE: www.te.com.
7. Vishay: www.vishay.com.
8. **Micrel, Inc.: www.micrel.com.**

Evaluation Board Schematics (MIC2875/6-5.0YMT)



MIC2875/6-5.0YMT (V_{IN} ≤ 5.0V)

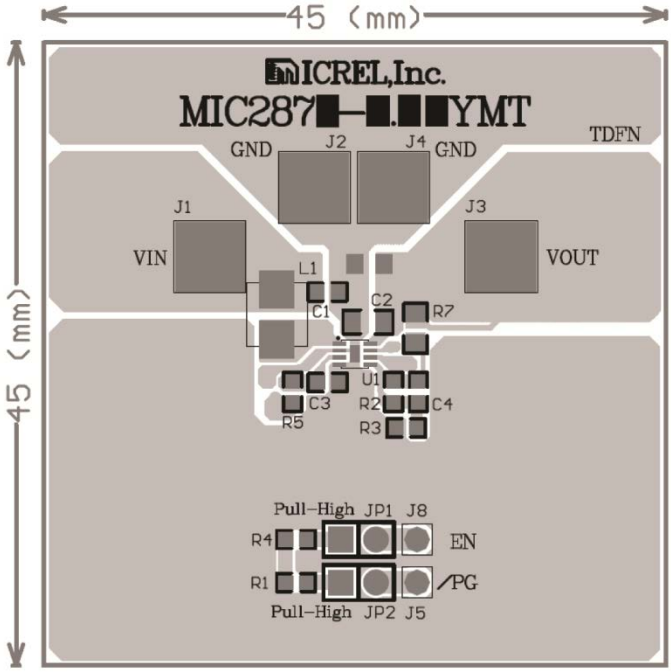
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C2	LMK212BJ226MG-T	Taiyo Yuden[10]	Capacitor 22µF, 10V, 20%, X5R, 0805 (V_{IN} ≤ 5.00V)	1
			Capacitor 22µF, 10V, 20%, X5R, 0805 (V_{IN} > 5.00V, in parallel)	3
C3	GRM188R61A105KA61J	Murata[11]	Capacitor 1µF, 10V, 10%, X5R, 0603	1
C4	–	–	Not Fitted, Size 0603	0
L1	PIMB042T-1R0MS-39	Cyntec[12]	Inductor 1µH, 4.5A, SMD, 4.2mm × 4.0mm × 1.8mm	1
R1	ERJ-3GEYJ105V	Panasonic[13]	Resistor 1MΩ, 5%, 0603	1
R2, R5, R7	CRCW0603000Z0EA	Vishay[14]	Resistor 0Ω, 0603	3
R3	–	–	Not Fitted, Size 0603	0
R4	ERJ-3GEYJ103V	Panasonic	Resistor 10kΩ, 5%, 0603	1
U1	**MIC2875-xYMT**	**Micrel, Inc.[15]**	**4.8A I_{SW}, Synchronous Boost Regulator with Bi-Directional Load Disconnect**	**1**
	MIC2876-xYMT			

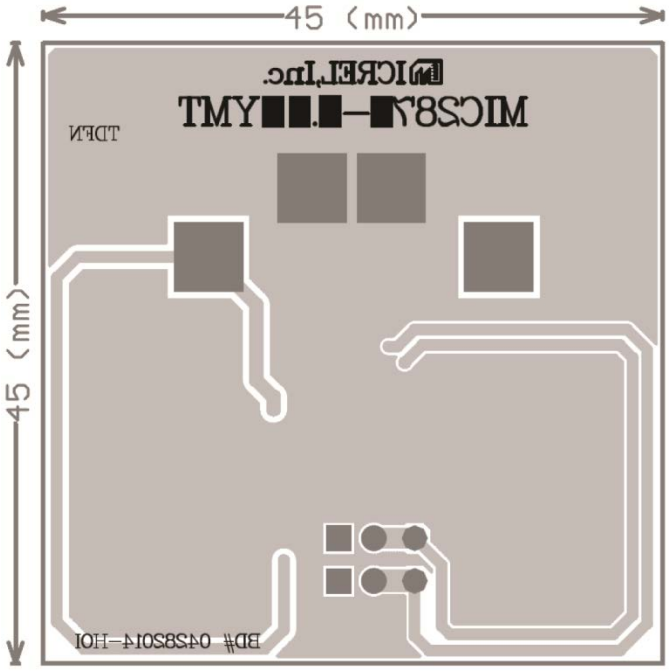
Notes:

9. TDK: www.tdk.com.
10. Taiyo Yuden: www.t-yuden.com.
11. Murata: www.murata.com.
12. Cyntec: www.cyntec.com.
13. Panasonic: www.panasonic.com.
14. Vishay: www.vishay.com.
15. **Micrel, Inc.: www.micrel.com.**

PCB Layout Recommendations



Top Layer



Bottom Layer

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