INTEGRATED 730V SI MOSFET FLY-BACK ICS POWER THE FUTURE AUXILIARY POWER SUPPLY SOLUTIONS

Saving time, space, cost, and boost system performance:
The BM2P06xMF fly-back ICs provide an advanced solution for auxiliary power supply up to 45W without an external heatsink in a single package.

By Rony Karim, Application Marketing Manager, ROHM Semiconductor

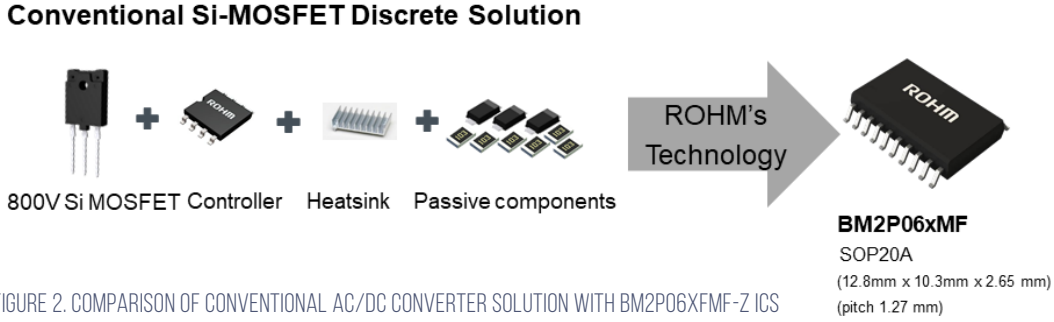


FIGURE 2. COMPARISON OF CONVENTIONAL AC/DC CONVERTER SOLUTION WITH BM2P06XFMF-Z ICS

ROHM's BM2P06xMF IC series integrates a 730V Si MOSFET and a PWM controller in one package. By using these fly-back ICs, designers can achieve up to 45W output power without any additional heatsink, discharge resistor – without the need of a step-down power supply. They help designers to shorten design time, simplify the circuitry, reduce cost and increase reliability by offering an integrated design. These ICs are the best-in-class products and the right fit for industrial (auxiliary) power supplies or switch mode power supplies (SMPS), including industrial drives, home appliances, consumer products and server applications. ROHM has also developed an evaluation board, the BM2P060MF-EVK-001 to support power engineers to design a power supply unit.

BM2P06xMF-Z
SOP20A Package
(12.8mm × 10.3mm × 2.65mm)

FIGURE 1. BM2P06X-FMF-Z FLY-BACK ICS' DIMENSIONS

Auxiliary power supply is an essential and vital part of industrial inverters to deliver different levels of DC voltages for gate drivers and for control units. A proper selection of AC/DC devices will save design time, development and production cost and will reduce system complexity. The newly released BM2P06xMF-Z ICs offers integrated 730V Si MOSFET and target single phase 85 to 264V AC systems to benefit the designers by simplifying auxiliary power supply and SMPS design. The conventional discrete device-based solutions increase the risk of failure and the complexity of the design circuit.

Benefits of ROHM's solution vs. conventional ICs

AC/DC converters for industrial and consumer applications must not only support 85 to 264V AC to accommodate different AC voltages around the world, but they also comply with international standards such as Energy Star and the IEC 62368 safety standard. It is also important for AC/DC converter ICs to be surface mountable to reduce costs. High loss DMOSFETs and planar MOSFETs are still widely used in AC/DC converter ICs, making it difficult to provide high output power in a surface mount package. A conventional discrete MOSFET-based solution also requires additional passive components and heatsink which is costly and require additional space and time.

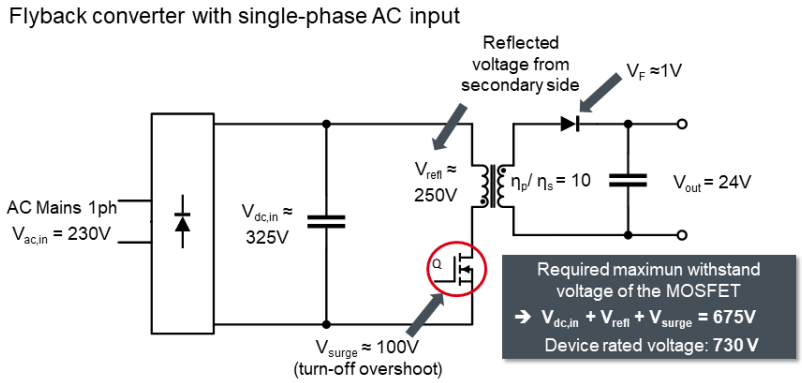


FIGURE 3. ESTIMATION OF DEVICE VOLTAGE AND PRODUCT SELECTION

To solve these issues, the surface mount and high output power capable AC/DC device BM2P06xMF-Z fly-back ICs are designed in an SOP20A surface mount device package, measuring 12.8 x 10.3 x 2.65mm. (Figure 1).

They are equipped with an original low-loss SJ (super junction) MOSFET with optimised PWM control circuitry – facilitating the development of 85 to 264V AC/DC converters. The surface mount package supports automatic board mounting to reduce factory mounting cost.

By offering integrated solution in one package, BM2P06xMF-Z ICs eliminate passive components and heatsink (Figure 2), saving space, design time and system cost. They also reduce the risk of device failure and increase the reliability of the system. Removing the discharge resistor and the low standby power control technology ensure extremely low standby power consumption which increases the performance and efficiency of the power supply system.

Supply voltages up to 60V (VCC) are also supported by these ICs which eliminate the need for an external step-down power supply circuit for further cost saving.

Auxiliary power supply design

Figure 3 shows a simplified circuitry of an AC/DC fly-back converter with a supply voltage ($V_{ac,in}$) of 230V AC which means the DC link voltage ($V_{dc,in}$) is 325V and the reflection voltage (V_{refl}) of transformer is 250V - considering 10:1 transformer turn ratio. The turn-off over-shoot voltage (V_{surge}) of the MOSFET is considered 100V. To select the right MOSFET for the power supply design, the breakdown voltage of the MOSFET must be higher than the accumulation of Vdc,in , Vrefl. and Vsurge voltage.

Figure 3 explains the estimation of breakdown voltage of the MOSFET. The accumulation of voltages ($V_{dc,in} + V_{refl.} + V_{surge}$) is 675V. Consequently, a MOSFET which rated voltage is >675V is required for this

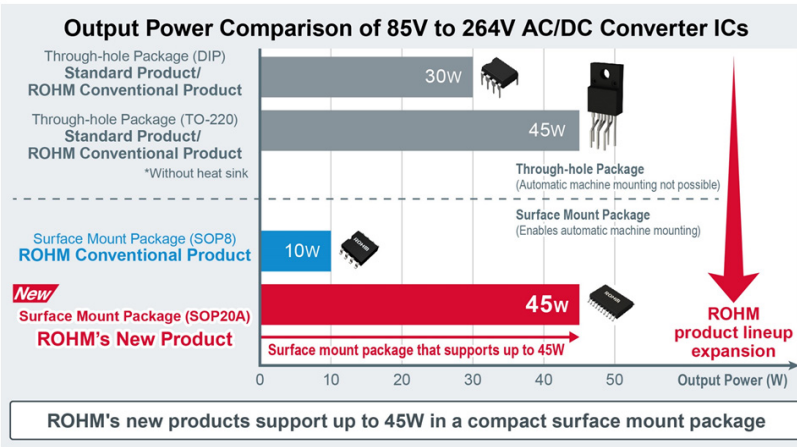


FIGURE 4. OUTPUT POWER COMPARISON OF DIFFERENT PACKAGES

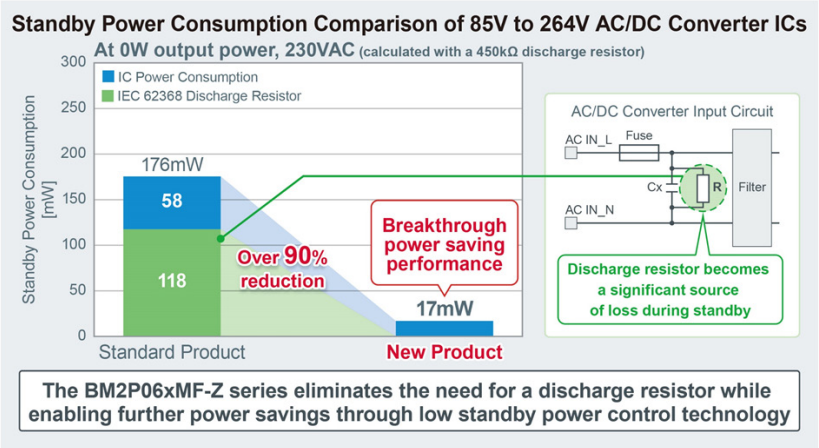


FIGURE 5. STANDBY POWER CONSUMPTION COMPARISON

auxiliary power supply circuit design. The MOSFET rated voltage or breakdown voltage of BM2P06xFMF-Z ICs is 730V which is higher than the sum of these three voltages. BM2P06xFMF-Z ICs have sufficient breakdown voltage to support single phase AC input voltage.

BM2P06xFMF-Z ICs have a built in 730V Si MOSFET and a PWM controller allowing 25 to ~65kHz switching frequency. The ICs could operate at max 150°C junction temperature.

Product Name	Package	MOSFET ON Resistance (typ.)	MOSFET Breakdown Voltage (Max.)
BM2P060MF-Z	SOP20A	0.7 Ω	730V
BM2P061MF-Z		1.0 Ω	
BM2P063MF-Z		3.0 Ω	

TABLE 1

They support from 11 to 60V supply voltage. They have overload protection, x-cap discharge function and brownout function. The ICs are available in three R_{ds_on} values (see Table 1).

Key features

There are plenty of features integrated and can be realised from BM2P06xFMF-Z ICs in a SOP20A package. Some key features are mentioned below.

Cost reduction

The 45W SMD package significantly reduces factory mounting costs. They integrate a low loss (low R_{ds_on}) 730V SJ MOSFET along with both startup and optimised control circuits in a compact, high heat dissipation SMD SOP20A package. In addition to compatibility with input voltages from 85 to 264V AC, the surface mount package supports high output power up to 45W (24V x 1.875A=45W), which has been difficult to achieve in the past. Figure 4 compares output powers from standard through hole packages and the maximum achievable output power from BM2P06xFMF-Z ICs.

Reduced power consumption

BM2P06xFMF-Z ICs reduce standby power consumption by 90% or more over standard products. The BM2P06xMF-Z series uses a control circuit (x-capacitor discharge function) that leverages ROHM's high voltage process and analogue design technologies to meet the safety requirements of IEC 62368 even without a discharge resistor (Figure 5). By eliminating discharge resistor and optimising the control of the switching frequency, BM2P06xFMF-Z ICs consume standby power of only 17mW (at 0W output, 230V AC) which reduce the standby power consumption by more than 90% form standard products.

The ICs also introduce a noise reduction mode that suppresses noise from the isolation transformer components. This mode can be turned off to decrease standby power or can be turned on. It is also possible to adjust if there is a concern about isolated transformer component noise or a need to minimise the workload for counter measures.

Increased reliability

BM2P06xFMF-Z ICs reduce the number of power supply circuit components lowering the

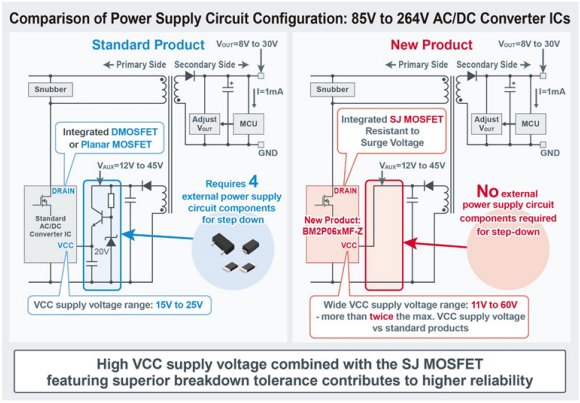


FIGURE 6. COMPARISON OF STANDARD PRODUCT AND BM2P06XFMF-Z ICS POWER SUPPLY CIRCUITS

FIGURE 7. THE BM2P060MF-EVK-001 EVALUATION BOARD

risk of power semiconductor failure and raising reliability.

Figure 6 compares the required components between standard product and the BM2P06xFMF-Z family. The new products support operation over a wide VCC voltage range from 11 to 60V. The maximum power supply voltage of BM2P06xFMF-Z ICs (60V) is twice that of standard products, providing superior reliability against external noise and surge voltages.

It is also possible to reduce the number of external step-down power supply circuit components (i.e., a Zener diode, resistor, capacitor, and transistor). The integrated SJ MOSFET resists the surge voltage to increase the avalanche (breakdown) tolerance more than 30x higher than DMOSFET or planar MOSFETs used in standard products.

Evaluation board and test results

ROHM offers an evaluation board BM2P060MF-EVK-001 with BM2P060FMF-Z , 0.70Ω IC.

Figure 8 demonstrates the test results of the evaluation board. The maximum output power is almost constant (>45W) and has less dependency with input voltage.

The thermal image (during operation) confirms that the junction temperature is beloe the limit. The junction temperature T_j is <90°C at Ta=25°C. If the ambient or case temperature (T_c) rises to 85°C the chip junction temperature would be 150°C which is under specification.

Conclusion

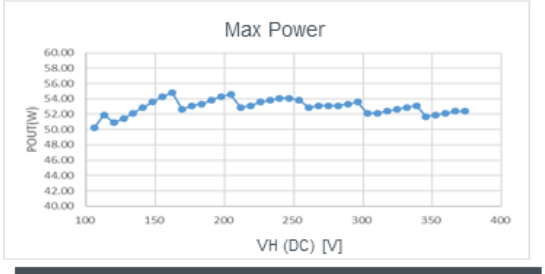
ROHM's BM2P06xMF-Z power ICs require no heatsink, no additional passive components and no additional controllers which saves design time, development and production cost and reduce system complexity. The power ICs are suitable for auxiliary power supply and for SMPS unit for 85 to ~264V AC supply, industrial equipment including inverters, AC servos, robotics and for consumer electronics such as home appliances, monitors, air conditioners and hairdryers.

ROHM at PCIM: Hall 9, booth 306

Power[W]	0	10	20	30	40	50
BM2P060MF-Z					30~45W	
BM2P061MF-Z				20~30W		
BM2P063MF-Z			10~25W			

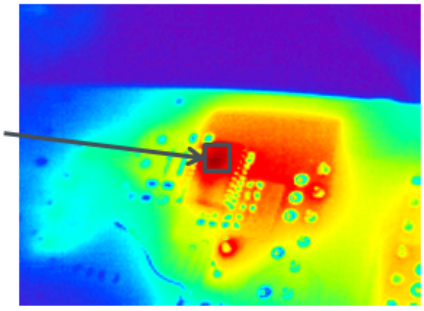
(SOP20A)

TABLE 2. THE ACHIEVABLE OUT POWER FROM BM2P06XFMF-Z ICS



Maximum power is almost constant and independent from input voltage

FIGURE 8. BM2P060MF-EVK-001 TEST RESULTS



Thermal Image of BM20P60MF-Z