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IXYS SEMICONDUCTOR GMBH E72873
Edisonstrasse 15
68623 Lampertheim, GERMANY

Electrically Isolated Semiconductor Device, Model(s) GBO25-12NO1, GBO25-16NO1

Power Switching Semi-Conductors, "ISOPLUS-247 package", Model(s) C, D, I or M followed by additional numbers and letters, followed by HI, HJ, HQ or HR.

Power Switching Semi-Conductors, "ISOPLUS-247 package", Model(s) CS or DS followed by up to 10 numbers and letters, followed by R.

Power Switching Semi-Conductors, "ISOPLUS-i4", Model(s) C, D, I or M followed by two letters, followed by additional numbers and letters, followed by FB, FC, FD or FE.

Power switching semi-conductors, "ISOPLUS-i4", Model(s) CS#

Power Switching Semi-Conductors, "ISOPLUS-i4", Model(s) CS, DH, DS followed by up to 15 numbers and letters, followed by F or F1.

Power switching semi-conductors, "ISOPLUS-i4", Model(s) DS#, DSE#, FBE#, FBO#, FBS#, FCC#, FCD#, FDC#, FDD#, FDI#, FDM#, FEE#, FID#, FII#, FIO#, FMD#, FMK#, FMM#, FRR#, FSS#, FUE#, FUO#, FUS#, IXBF#, IXDF#, IXEF#, IXFF#, IXGF#, IXKF#, IXLF#, IXSF#, IXUF#

Power Switching Semi-Conductors, "ISOPLUS220 package", Model(s) C, D, I or M followed by additional numbers and letters, followed by PI or PJ.

Power Switching Semi-Conductors, "ISOPLUS220 package", Model(s) CS, DS or DG followed by numbers and letters, followed by C.

Power switching semi-conductors, Model(s) 40370-32*

Power Switching Semi-Conductors, Model(s) C, D, I or M followed by two letters, followed by additional numbers and letters, followed by NA.

Power Switching Semi-Conductors, Model(s) C, D, I, and M followed by numbers and/or letters, followed by GU, GV, GW, GX, GY or GZ.

Power Switching Semi-Conductors, Model(s) C, D, I, and M followed by numbers and/or letters, followed by LA, LB, LC, or LD.

Power Switching Semi-Conductors, Model(s) CS followed by additional letters and/or numbers, followed by M.

Power Switching Semi-Conductors, Model(s) D followed by additional letters and/or numbers, followed by M.

Power Switching Semi-Conductors, Model(s) D, C, M or I followed by additional letters and/or numbers, followed by PN or PM.

Power Switching Semi-Conductors, Model(s) DS followed by additional letters and/or numbers, followed by M.

Power switching semi-conductors, Model(s) DSEI....P, DSEK....P

Power Switching Semi-Conductors, Model(s) GUO followed by numbers, followed by "-", followed by numbers, followed by NO1.

Power Switching Semi-Conductors, Model(s) ISOPLUS-264 Models C, D, I or M, followed by two letters, followed by additional numbers and letters, followed by KI, KJ, KK, KL, KM, KN ,KO, KP, KQ, KR, KS, KT, KU, KV. Models IXBL, IXFL, IXTL or LKK, followed by additional numbers and letters

Power Switching Semi-Conductors, Model(s) IX (single phase) followed by two numbers, followed by MB, followed by three numbers.

Power Switching Semi-Conductors, Model(s) IX (three phase) followed by two numbers, followed by MT, followed by three numbers.

Power Switching Semi-Conductors, Model(s) IX followed by additional letters and/or numbers, followed by M.

Power Switching Semi-Conductors, Model(s) M followed by two letters, followed by additional numbers and letters, followed by JA, JB, JC, JD or JE.

Power Switching Semi-Conductors, Model(s) MC and M followed by two letters, followed by additional numbers or letters, followed by VB or VC.

Power Switching Semi-Conductors, Model(s) MC, MD, MI or MM followed by two letters, followed by additional numbers and letters, followed by ED, EH, SF, or SH.

Power Switching Semi-Conductors, Model(s) MC, MD, MI or MM followed by two letters, followed by additional numbers and letters, followed by ML or MH.

Power Switching Semi-Conductors, Model(s) MC, MD, MI or MM followed by two letters, followed by additional numbers and letters, followed by TA, TB, TC, TD, TE, TF, or TG.

Power Switching Semi-Conductors, Model(s) MC, MD, MI or MM followed by two letters, followed by additional numbers and letters, followed by VA.

Power Switching Semi-Conductors, Model(s) MC, MD, MI or MM followed by two letters, followed by additional numbers and letters, followed by YA, YB, YC, YD, YE,YF, YI, YJ, YK or YL.

Power Switching Semi-Conductors, Model(s) MC, MD, MI, and MM followed by 8 to 10 alphanumeric characters, followed by MI.

Power Switching Semi-Conductors, Model(s) MC, MD, MI, and MM followed by 8 to 10 alphanumeric characters, followed by SA.

Power Switching Semi-Conductors, Model(s) MC, MD, MI, and MM followed by 8 to 11 alphanumeric characters, followed by CA, CB, CC, CD, CE, CF, CG, CH.

Power Switching Semi-Conductors, Model(s) MC, MD, MI, or MM followed by two letters, followed by additional numbers and letters, followed by KA, KB, KC, KD or KE.

Power Switching Semi-Conductors, Model(s) MC, MD, MI, or MM followed by two letters, followed by additional numbers or letters, ending with VH.

Power Switching Semi-Conductors, Model(s) MCC, MCD, MCK, MDC, or MDD followed by 120 through 200.*

Power Switching Semi-Conductors, Model(s) MCC, MCD, MDA, MDC, or MDD followed by numbers between 19 and 100.*

Power Switching Semi-Conductors, Model(s) MCC, MCD, MDC, or MDD followed by 170 through 350.*

Power switching semi-conductors, Model(s) MCC165*, MCC220*, MCC250*, MCC310*, MCD165*, MCD220*, MCD250*, MCD310*

Power switching semi-conductors, Model(s) MCO or MDO, followed by 400 through 650.*

Power switching semi-conductors, Model(s) MDC165*, MDC220*, MDC250*, MDC310*, MDD165*, MDD220*, MDD250*, MDD310*

Power Switching Semi-Conductors, Model(s) MDI followed by 90 through 1550*

Power switching semi-conductors, Model(s) MDI, MID or MII, followed by 20 through 150.*

Power Switching Semi-Conductors, Model(s) MEA, MEE, MEK, MPK or MEO followed by numbers between 50 and 240.*

Power Switching Semi-Conductors, Model(s) MEA, MEE, MEK, or MEO followed by 150 through 600.*

Power Switching Semi-Conductors, Model(s) MID followed by 90 through 1550*

Power Switching Semi-Conductors, Model(s) MIE followed by 90 through 1550*

Power Switching Semi-Conductors, Model(s) MII followed by 90 through 1550*

Power Switching Semi-Conductors, Model(s) MIO followed by 90 through 1550*

Power switching semi-conductors, Model(s) MIO, VIO or VMO, followed by 200 through 1200.*

Power switching semi-conductors, Model(s) MLO 100*, MLO 36*, MLO 50*, MLO 75*, MLO....7, MMO 36*, MMO 50*, MMO 75*

Power Switching Semi-Conductors, Model(s) MMO, MCO, MCD followed by additional numbers, followed by io1 or io6.

Power switching semi-conductors, Model(s) MMO....7

Power Switching Semi-Conductors, Model(s) MUBW, MWI or MKI followed by additional numbers and/or letters, followed by 7or 8, may be followed by T.

Power Switching Semi-Conductors, Model(s) MUBW, MWI, or MKI followed by additional numbers and /or letters, followed by 6K.

Power Switching Semi-Conductors, Model(s) MWI followed by additional numbers and/or letters, followed by 9.

Power Switching Semi-Conductors, Model(s) MWI followed by additional numbers and/or letters, followed by A5, DL1, iol, io2, ioX, NO1, NO2, or NOX, may be followed by T

Power Switching Semi-Conductors, Model(s) VBBW followed by additional numbers and/or letters, followed by A5, DL1, iol, io2, ioX, NO1, NO2, or NOX, may be followed by T

Power switching semi-conductors, Model(s) VBE*, VBE.. .NO7

Power Switching Semi-Conductors, Model(s) VBEF followed by additional numbers and/or letters, followed by A5, DL1, iol, io2, ioX, NO1, NO2, or NOX, may be followed by T

Power Switching Semi-Conductors, Model(s) VBH followed by additional numbers and/or letters, followed by A5, DL1, iol, io2, ioX, NO1, NO2, or NOX, may be followed by T

Power switching semi-conductors, Model(s) VBO or VUO, followed by 10 through 125.*

Power switching semi-conductors, Model(s) VBO or VUO, followed by 50 through 100.*

Power switching semi-conductors, Model(s) VBO...7, VBO...NO7, VBO13*, VBO14*, VBO15*, VBO16*, VBO17*, VBO18*, VBO19*, VBO20*, VBO21*, VBO22*, VBO23*, VBO24*, VBO25*, VBO26*, VBO27*, VBO28*, VBO29*, VBO30*, VBO31*, VBO32*, VBO33*, VBO34*, VBO35*, VBO36*, VCA....7, VCC....7, VCD....7, VCK....7, VCO....7

Power Switching Semi-Conductors, Model(s) VDD may be followed by 15, 24, 25, 33, or 36, followed by 05, 12, 14, 16, 500, 1200, 1400, or 1600, may be followed by G02, E, N01, N, PH *

Power Switching Semi-Conductors, Model(s) VDI followed by 90 through 1550*

Power switching semi-conductors, Model(s) VDI....P1, VDI100*, VDI25*, VDI50*, VDI75*, VEE*, VGO....7, VH013*, VH014*, VH015*, VH016*, VH017*, VH018*, VH019*, VH020*, VH021*, VH022*, VH023*, VH024*, VH025*, VH026*, VH027*, VH028*, VH029*, VH030*, VH031*, VH032*, VH033*, VH034*, VH035*, VH036*, VHF*, VHF....7, VHF13*, VHF14*, VHF15*, VHF16*, VHF17*, VHF18*, VHF19*, VHF20*, VHF21*, VHF22*, VHF23*, VHF24*, VHF25*, VHF26*, VHF27*, VHF28*, VHF29*, VHF30*, VHF31*, VHF32*, VHF33*, VHF34*, VHF35*, VHF36*, VHFD*, VHM...7, VHO....7

Power Switching Semi-Conductors, Model(s) VID followed by 90 through 1550*

Power Switching Semi-Conductors, Model(s) VID may be followed by 15, 24, 25, 33, or 36, followed by 05, 12, 14, 16, 500, 1200, 1400, or 1600, may be followed by G02, E, N01, N, PH *

Power switching semi-conductors, Model(s) VID....P1, VID100*, VID25*, VID50*, VID75*

Power Switching Semi-Conductors, Model(s) VIE followed by 90 through 1550*

Power Switching Semi-Conductors, Model(s) VII followed by 90 through 1550*

Power switching semi-conductors, Model(s) VII....7, VII....P1, VII100*, VII25*, VII50*, VII75*, VIO....P1, VK013*, VK014*, VK015*, VK016*, VK017*, VK018*, VK019*, VK020*, VK021*, VK022*, VK023*, VK024*, VK025*, VK026*, VK027*, VK028*, VK029*, VK030*, VK031*, VK032*, VK033*, VK034*, VK035*, VK036*, VKI....7, VKI....P1, VKM...7, VKO....7

Power Switching Semi-Conductors, Model(s) VMD may be followed by 15, 24, 25, 33, or 36, followed by 05, 12, 14, 16, 500, 1200, 1400, or 1600, may be followed by G02, E, N01, N, PH *

Power Switching Semi-Conductors, Model(s) VMH may be followed by 15, 24, 25, 33, or 36, followed by 05, 12, 14, 16, 500, 1200, 1400, or 1600, may be followed by G02, E, N01, N, PH *

Power Switching Semi-Conductors, Model(s) VMK, VMM, or VMO followed by numbers between 25 and 250.*

Power Switching Semi-Conductors, Model(s) VMM followed by 90 through 1550*

Power Switching Semi-Conductors, Model(s) VMM may be followed by 15, 24, 25, 33, or 36, followed by 05, 12, 14, 16, 500, 1200, 1400, or 1600, may be followed by G02, E, N01, N, PH *

Power switching semi-conductors, Model(s) VMO....P1, VTO....7

Power Switching Semi-Conductors, Model(s) VUB followed by additional numbers and/or letters, followed by A5, DL1, iol, io2, ioX, NO1, NO2, or NOX, may be followed by T

Power switching semi-conductors, Model(s) VUB*

Power Switching Semi-Conductors, Model(s) VUB, VUO, or VVZB followed by additional numbers and/or letters, followed by NO1, NOX or ioX, may be followed by T.

Power switching semi-conductors, Model(s) VUB...P1, VUB...PO1, VUBM....P1

Power Switching Semi-Conductors, Model(s) VUBW followed by additional numbers and/or letters, followed by A5, DL1, iol, io2, ioX, NO1, NO2, or NOX, may be followed by T

Power switching semi-conductors, Model(s) VUC*

Power Switching Semi-Conductors, Model(s) VUC15 may be followed by 15, 24, 25, 33, or 36, followed by 05, 12, 14, 16, 500, 1200, 1400, or 1600, may be followed by G02, E, N01, N, PH *

Power Switching Semi-Conductors, Model(s) VUC25 may be followed by 15, 24, 25, 33, or 36, followed by 05, 12, 14, 16, 500, 1200, 1400, or 1600, may be followed by G02, E, N01, N, PH *

Power Switching Semi-Conductors, Model(s) VUC36 may be followed by 15, 24, 25, 33, or 36, followed by 05, 12, 14, 16, 500, 1200, 1400, or 1600, may be followed by G02, E, N01, N, PH *

Power switching semi-conductors, Model(s) VUCB*, VUE*, VUE.. .NO7, VUI*, VUI....N7

Power Switching Semi-Conductors, Model(s) VUM followed by additional numbers and/or letters, followed by A5, DL1, iol, io2, ioX, NO1, NO2, or NOX, may be followed by T

Power switching semi-conductors, Model(s) VUM*, VUM.....N7

Power Switching Semi-Conductors, Model(s) VUM24 may be followed by 15, 24, 25, 33, or 36, followed by 05, 12, 14, 16, 500, 1200, 1400, or 1600, may be followed by G02, E, N01, N, PH *

Power Switching Semi-Conductors, Model(s) VUM33 may be followed by 15, 24, 25, 33, or 36, followed by 05, 12, 14, 16, 500, 1200, 1400, or 1600, may be followed by G02, E, N01, N, PH *

Power Switching Semi-Conductors, Model(s) VUO followed by additional numbers and/or letters, followed by A5, DL1, iol, io2, ioX, NO1, NO2, or NOX, may be followed by T

Power switching semi-conductors, Model(s) VUO*, VUO...7, VUO...NO7, VUO30*, VUO50*, VUO60*

Power Switching Semi-Conductors, Model(s) VVBW followed by additional numbers and/or letters, followed by A5, DL1, iol, io2, ioX, NO1, NO2, or NOX, may be followed by T

Power switching semi-conductors, Model(s) VVY*, VVY12*, VVY24*, VVY40*

Power Switching Semi-Conductors, Model(s) VVZ followed by additional numbers and/or letters, followed by A5, DL1, iol, io2, ioX, NO1, NO2, or NOX, may be followed by T

Power switching semi-conductors, Model(s) VVZ*, VVZ....7, VVZ12*, VVZ24*, VVZ40*

Power Switching Semi-Conductors, Model(s) VVZB followed by additional numbers and/or letters, followed by A5, DL1, iol, io2, ioX, NO1, NO2, or NOX, may be followed by T

Power switching semi-conductors, Model(s) VW2X*, VW3....7, VWI....P1

Power Switching Semi-Conductors, Model(s) VWM followed by additional numbers and/or letters, followed by A5, DL1, iol, io2, ioX, NO1, NO2, or NOX, may be followed by T

Power switching semi-conductors, Model(s) VWM....7

Power Switching Semi-Conductors, Model(s) VWO followed by additional numbers and/or letters, followed by A5, DL1, iol, io2, ioX, NO1, NO2, or NOX, may be followed by T

Power switching semi-conductors, Model(s) VWO....7, VZI....P1

Power switching semi-conductors, package SOT-227B, miniBloc, Model(s) DH1X*, DH2X*, DSEI*, DSEP*, DSI*, DSS*, IXDN*, IXEN*, IXFN*, IXGN*, IXKN*, IXLN*, IXSN*, IXTN*, IXUN*, VBE*, VBO*, VBS*

Semi-conductor diodes, thyristors, IGBTs or MOSFETS, "ISOPLUS-247 package", Model(s) IXDR%, IXER%, IXFR%, IXKR%

Semi-conductor diodes, thyristors, IGBTs or MOSFETS, "ISOPLUS220 package", Model(s) IXKC*

- Followed by up to 15 numbers and letters.

% - Followed by up to 10 numbers and letters.

* - May be followed by additional numbers or letters.

Marking: Company name or trademark IXYS, and model designation.

Last Updated on 2017-12-08

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IXYS CORP E153432
1590 BUCKEYE DR
MILPITAS, CA 95035-7418 USA

Power Switching Semi-Conductors, Model(s) CS followed by additional letters and/or numbers, followed by M.

Power Switching Semi-Conductors, Model(s) D followed by additional letters and/or numbers, followed by M.

Power Switching Semi-Conductors, Model(s) D, C, M or I followed by additional letters and/or numbers, followed by PN or PM.

Power Switching Semi-Conductors, Model(s) DS followed by additional letters and/or numbers, followed by M.

Power Switching Semi-Conductors, Model(s) IX followed by additional letters and/or numbers, followed by M.

Power Switching Semi-Conductors, Model(s) IX followed by an upper case letter, followed by N, followed by any number 01 through 99999, followed by additional numbers and letters.

Semi-conductor diodes, thyristors, IGBT or MOSFETS, ISO247 package, Model(s) IX J Series IX, followed by one letter B, C, D, E, F, G, H, K, L, S, T, U, X, or Y, followed by J, may be followed by 01-09, 1R1-1R9, 1-9, 10-99, or 100-999 may be followed by N or P, may be followed by 01-10, 1-99 or 100-800, may be followed by up to six alpha-numeric characters.

Semi-conductor diodes, thyristors, IGBT or MOSFETS, ISOPLUS I4-PAC package, Model(s) IX F Series IX, followed by one letter B, C, D, E, F, G, H, K, L, S, T, U, X, or Y, followed by F, may be followed by 01-09, 1R1-1R9, 1-9, 10-99, or 100-999 may be followed by N or P, may be followed by 01-10, 1-99 or 100-800, may be followed by up to six alpha-numeric characters.

Semi-conductor diodes, thyristors, IGBT or MOSFETS, ISOPLUS SMPD package, Model(s) IXM2001 IX, followed by one letter B, C, D, E, F, G, H, K, L, S, T, U, X, or Y, followed by L, may be followed by 01-09, 1R1-1R9, 1-9, 10-99, or 100-999 may be followed by N or P, may be followed by 01-10, 1-99 or 100-800, may be followed by up to six alpha-numeric characters.

Semi-conductor diodes, thyristors, IGBT or MOSFETS, ISOPLUS SMPD package, Model(s) MDIX4X30N65B3 IX, followed by one letter B, C, D, E, F, G, H, K, L, S, T, U, X, or Y, followed by L, may be followed by 01-09, 1R1-1R9, 1-9, 10-99, or 100-999 may be followed by N or P, may be followed by 01-10, 1-99 or 100-800, may be followed by up to six alpha-numeric characters.

Semi-conductor diodes, thyristors, IGBT or MOSFETS, ISOPLUS SMPD package, Model(s) MMIX IX, followed by one letter B, C, D, E, F, G, H, K, L, S, T, U, X, or Y, followed by L, may be followed by 01-09, 1R1-1R9, 1-9, 10-99, or 100-999 may be followed by N or P, may be followed by 01-10, 1-99 or 100-800, may be followed by up to six alpha-numeric characters.

Semi-conductor diodes, thyristors, IGBT or MOSFETS, ISOPLUS SMPD package, Model(s) MMIX1992 IX, followed by one letter B, C, D, E, F, G, H, K, L, S, T, U, X, or Y, followed by L, may be followed by 01-09, 1R1-1R9, 1-9, 10-99, or 100-999 may be followed by N or P, may be followed by 01-10, 1-99 or 100-800, may be followed by up to six alpha-numeric characters.

Semi-conductor diodes, thyristors, IGBT or MOSFETS, ISOPLUS220 package, Model(s) IX followed by one letter B, C, D, E, F, G, H, K, L, S, T, U, X, or Y, followed by C, may be followed by 01-09, 1R1-1R9, 1-9, 10-99, or 100-999 may be followed by N or P, may be followed by 01-10, 1-99 or 100-800, may be followed by up to six alpha-numeric characters.

Semi-conductor diodes, thyristors, IGBT or MOSFETS, ISOPLUS264 package, Model(s) IX L Series IX, followed by one letter B, C, D, E, F, G, H, K, L, S, T, U, X, or Y, followed by L, may be followed by 01-09, 1R1-1R9, 1-9, 10-99, or 100-999 may be followed by N or P, may be followed by 01-10, 1-99 or 100-800, may be followed by up to six alpha-numeric characters.

Semi-conductor diodes, thyristors, IGBT or MOSFETS, SSMPD package, Model(s) MMJX MMJX, followed by 1, 2, 3, followed by B, C, D, E, F, G, H, K, L, S, T, U, X, or Y, followed by number 1-999, followed by N or P, followed by number 1-800, may be followed by up to 6 alpha-numeric characters.

Semi-conductor diodes, thyristors, or MOSFETS, 247 hole-less package, Model(s) DSE (a), IXBR (a), IXGR (a), IXLR (a), IXSR (a), IXTR (a)

Semi-conductor diodes, thyristors, or MOSFETS, ISOPLUS247 package, Model(s) IX followed by one letter B, C, D, E, F, G, H, K, L, S, T, U, X, or Y, followed by R, may be followed by 01-09, 1R1-1R9, 1-9, 10-99, or 100-999 may be followed by N or P, may be followed by 01-10, 1-99 or 100-800, may be followed by up to six alpha-numeric characters.

(a) - Followed by up to 10 numbers and letters.

Marking: Company name and model designation.

Last Updated on 2018-08-29

Handling and Mounting Littelfuse miniBLOC - SOT227B

Objectives

This application note discusses mounting and handling for Littelfuse power semiconductors in SOT227B package, the miniBLOC, as depicted in Figure 1. Information is provided focusing on special precautions to be considered during mounting.

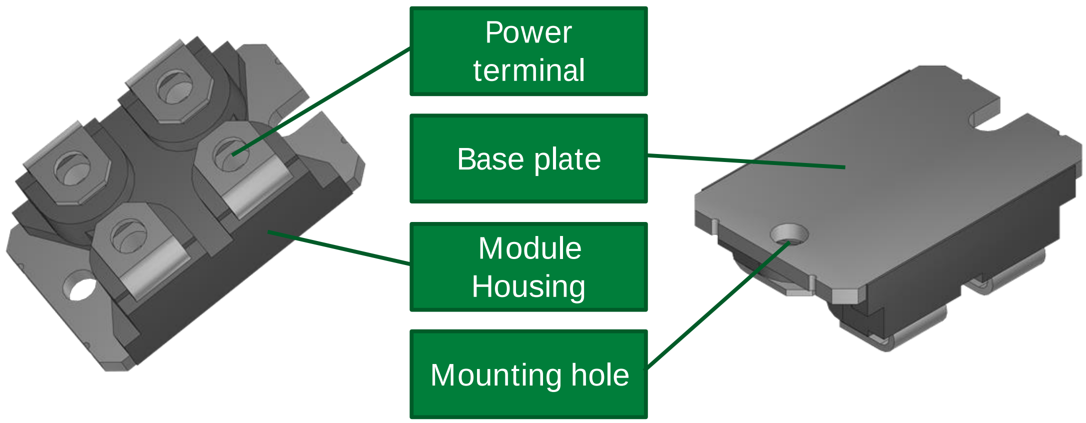


Figure 1: Littelfuse miniBLOC, in SOT227B

Applications

- Industrial motor drives
- PV inverters
- UPS systems
- DC-DC converters
- Commercial vehicles

Target Audience

This document is intended for potential adopters of power semiconductors who want to determine the appropriate mounting and cooling solution to ensure proper package mounting and thermal performance.

Contact Information

For more information on the topic of mounting this kind of device, contact the Littelfuse Power Semiconductor team of product and applications experts:

- PowerSemiSupport@Littelfuse.com

Table of Contents

List of Figures

1. Introduction

The miniBLOC is the intermediate link between discrete power devices like the TO-263 and power semiconductor modules like Littelfuse Y-series. Though it features a DCB-substrate to carry the dies, the molded housing structure characterizes it to be a discrete component rather than a power module. The internal DCB substrate inherently offers electrical insulation, allowing for mounting of several miniBLOCs to the same heat sink without additional means of isolation. The base plate in turn acts as large-area interface between the semiconductor and a heat sink.

The package provides features beneficial for power electronic applications. These include:

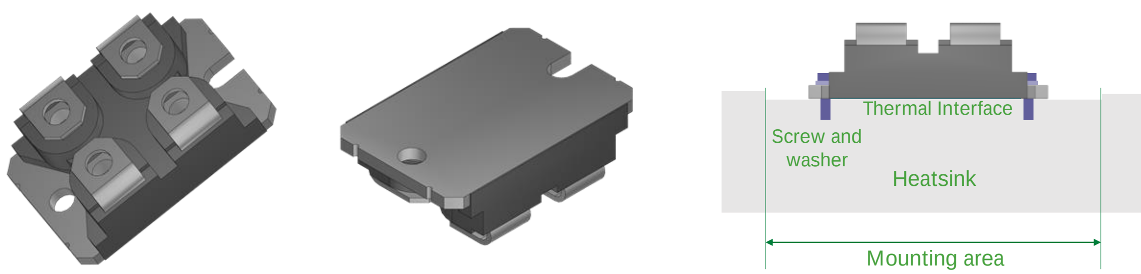
- High electric insulation strength
- High thermal performance
- Current ratings to support applications up to hundreds of kilowatts
- Internal construction is designed to reduce stray inductance and parasitic capacitances, leading to improved EMI-performance

With the four terminals, the miniBLOC is available in a variety of technologies including IGBT, thyristor , Si- and SiC- diode and MOSFET in voltage classes from 40 to 2500 V and current ratings up to 600A.

There are a few miniBLOCs, such as the DSEC 240-04A and the DSEC 240-06A, that feature a non-isolated construction and an electrically active base plate. These are diode devices, designed for special purposes. Despite the slightly different internal construction, the recommendations made in this application note are valid for these types as well.

2. Recommended Heat Sink Assembly

Semiconductor power devices are designed to be mounted onto a heat sink, most often using screws. A layer of Thermal Interface Material (TIM) is needed to ensure a high thermal conductivity from the dice to the heatsink. After the application of thermal interface material is completed, the component can be mounted to a heatsink by mounting screws. An example of a SOT227B assembly is sketched in Figure 2.



(a) Power device, top-view (b) Power device, bottom-view (c) Mounted to the Heat Sink

Figure 2. Mounting the miniBLOC to a Heat Sink

2.1. Heat Sink Preparation

When the package is mounted, the base plate becomes the crucial surface for thermal management. A heatsink needs to be mounted for heat dissipation, as depicted in Figure 2. There are dedicated mounting holes in the package; the proper set of dimensions for the drill-hole-pattern is given in the correlating datasheet.

To ensure a low value of thermal resistance, the contact surface of the heat sink must be flat, even, and clean. For the mounting area, the surface quality must achieve or exceed the values given in Figure 3.

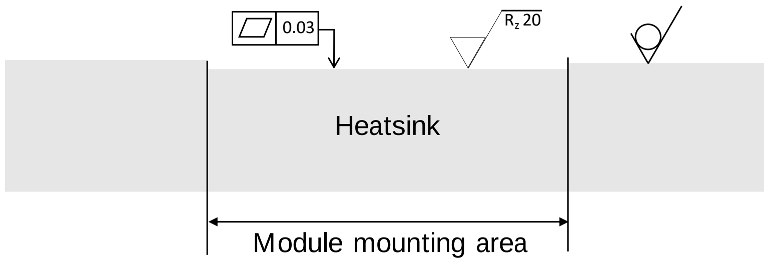


Figure 3. **Heat Sink's Surface Requirements to Mount** Power Modules

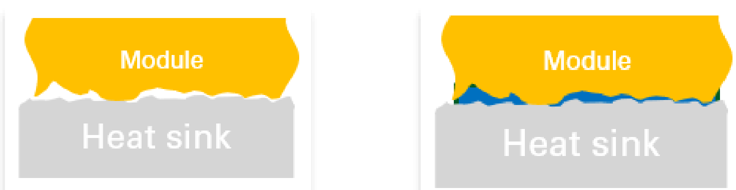
Prior to mounting, cleaning all surfaces with a suitable cleaning agent is advised.

2.2. Use of Thermal Interface Materials

The use of Thermal Interface Materials (TIM) is mandatory to achieve a suitable contact between the device's base and the heat sink surface. It reduces the thermal resistance case-to-heatsink, R_{thch}. Thermal interface materials are available as thermal pad and thermal grease or compound. Unlike the discrete packages where the copper cooling pad is usually electrically active, packages with solid metal base plates internally feature a DCB structure which uses a layer of ceramic as electrical isolation. With up to 4500 V isolation voltage, the packages provide the option to use electrically non-isolated thermal interface materials. It is not recommended to use an interface material with isolation such as silicone-pads sometimes used for discrete packaged devices. These materials inherently exhibit a higher thermal resistance compared to thermal greases or conductive thermal pads.

The thermal interface materials should be applied evenly to the device base plate or the heat sink surface. Ideally, screen printing is used to achieve accurate and reproduceable results. A screen thickness of 100µm with a fill-factor of 70-80% and a regular pattern of honeycomb-shaped openings has proven to be a reasonable approach.

As no electrical isolation is required from the TIM layer, it is recommended to have a very thin layer of TIM so that the material just fills the gaps and voids between the device's copper pad and the heatsink, as seen in Figure 4.



(a) Without TIM, air gaps remain

(b) With TIM, the gaps are filled, contact area increases, and thermal resistance is reduced

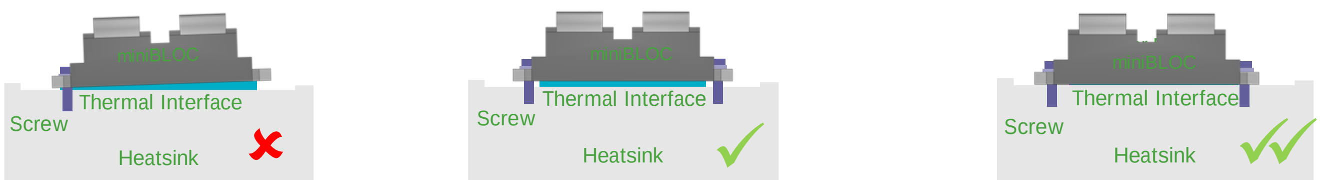
Figure 4. Improving Thermal Transfer by using Thermal Interface Material (TIM)

If a solid thermal pad is considered, softer materials with high thermal conductivity are preferred to better fill the gaps. The thermal pad should be as thin as possible to provide the lowest thermal resistance. The mounting mechanism using screws provides proper pressure on the thermal interface material to ensure a low value of thermal resistance. A procedure to create a proper stencil and set up a basic stencil-printing equipment is described in detail in the application note *Basics of Stencil Generation to Apply Thermal Grease to Power Semiconductors*, which can be downloaded from the Littelfuse website.

2.3. Detailed Mounting Procedure

Mounting the module by screws inherently achieves mounting forces in a range of kilonewton. Though the base plate is highly resistant to pressure, the internal DCB-structure is very sensitive towards bending. Therefore, careful handling and step-by-step tightening of the screws is mandatory to achieve the desired pressure distribution and prevent bending the internal DCB.
Besides the mounting forces, an even distribution of thermal interface material is important. Uneven distribution, particularly with higher amount of material in the center of the module, may also lead to high local forces that could damage the DCB inside the power module.
Using solid sheets as thermal interface material is not a recommended solution as these typically remain too thick and limit the module's thermal performance. Additionally, they may lead to further issues during mounting.

Figure 5(a) illustrates that the module lifts on one side in case the first screw is bolted down too much and Figure 5(b) and Figure 5(c) show a two-step sequence to prevent this from happening.



(a) To be prevented: Bolting down one side may tilt the module which leads to bending	(b) Recommended: Loosely bolt down all screws to the point **where the screw's head touches the washer**	(c) In a further step, tighten the screws to their final torque using a precise torque wrench

Figure 5: Bolting down the screw – Incorrect and Correct Method

The tightening procedure is summarized in Table 1.

Table 1: Mounting Sequence to mount SOT227B

Package Type	Screw Diameter	Step 1	Step 2	Step 3	Step 4
SOT227B	4 mm	Bolt down both screws, so that the screws' heads get the washers to contact the base pate	Apply 0.5 Nm to both screws	Wait for the assembly to settle. Settling time depends on the TIM in use and varies from 5-10 minutes	Apply no more than 1.5 Nm to both screws

In case imperial screws are preferred for mounting, a screw 8-36 is the closest replacement for M4. The mounting torque needs to be limited to not exceed 11.5 lb-in

3. Further Mechanical Aspects

Besides the data and procedures to mount power electronic components, influences that arise from mechanical parts and physics need detailed attention. Some details that appear to be of minor impact can lead to unexpected effects with highly detrimental consequences.

3.1. Metric Thread, Imperial Thread, Self-tapping Screws

The recommended material for mounting the module to the heat sink is a metric screw with spring-washer and captivated washer as described by ISO 10644. Zinc- or nickel-plated steel screws with a property class 6.8 or higher, as depicted in Figure 6, are recommended.

Figure 6: Phillips-style Screws and Captivated Washers acc. to ISO 10644

Using screws with imperial scale is an option too. However, due to the different diameters and thread's pitch, the ratio between turning angle, torque, and resulting mounting forces also changes. Purely translating newton meter (Nm) into pound inches (lb-in) might result in misleading values. Individual verification of the result is advised to verify proper pressure and pressure distribution is achieved.

In case self-tapping screws like those described in DIN7504-K and ISO15480 are preferred, dedicated tests are needed to correlate torque, turning angle, and mounting force. As the torque mainly depends on the drill-hole's diameter and the heat sink material, no general recommendation can be made. Using washers and spring-washers in combination with self-tapping screws is advised.

3.2. Mounting the Electronics and DC-link Components

Power modules are robust regarding pressure applied, but highly sensitive towards pulling forces. Pulling forces can be a consequence of dynamic influences like shock and vibration but as well result from the combination of materials used in the construction and their tolerances.
A mechanical assembly must ensure that the resulting forces to the terminals remain directed as pictured in Figure 7.

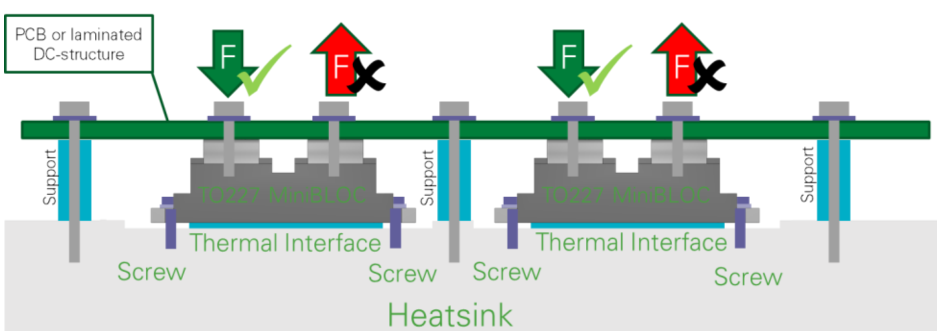


Figure 7: Module assembly with Power-Terminals attached

A total force of up to 100N applying pressure to the module is tolerable while no pulling force may remain after mounting is complete. To achieve this, properly dimensioned supports must be installed. These prevent static forces as well as dynamic events from reaching the terminals. Including all tolerances, the supports' length needs to remain below the height of the module in use.
Larger components like DC-link capacitors, output terminals, or heavy current sensors require additional support. In case of vibration, undampened oscillating masses may inject destructive forces into the power component.

To mount the DC-link-structure to the modules, either as PCB or laminated copper plates, 4 suitable screws are delivered with each miniBLOC, a tube with 10 devices contains 40 screws. In case a different type of screw is desired, the screws mandatorily need to comply with the information given in the data sheet. The maximum length of the screws depends on the thickness of the structure mounted on top of the modules. Caution is advised as too long screws can damage the housing, enter electrically sensitive areas, and cause severe damage.

As the nuts embedded in the modules feature metric threads, the use of screws according to imperial scale is not an option for mounting the power terminals. The nuts are held in place by the housing. Applying too high torque can lead to damage of the housing and in turn to loss of function.

The terminal screws can support a maximum torque of 1.1 Nm or 9 lb-in. Especially in combination with oils used to prevent corrosion, the friction during mounting can change massively, leading to a distortion in the ratio of torque and turning angle. The same applies when using adhesive-based thread lockers.

When handling sub-assemblies, supporting the whole setup to move it is recommended. Using the bus bar or the PCB as a handle includes a high risk of applying pulling forces and therefore needs to be prevented.

If a module is being replaced, ensure there is no contamination in the threaded hole; for example, thermal paste that has been solvent washed into the threads, as this may limit the screws' engagement resulting in false fastener tension and module clamping force.
In situations where blind holes are not required for maintaining corrosion or pressure sealing performance, threaded through holes can be used as these can be brushed, washed clean, and inspected easily.

3.3. Insulation Management

Two major parameters require to be considered when PCB-layouts and DC-link-components are designed:

- Clearance – the shortest possible distance between two points, and
- Creepage distance – the shortest path from one point to another point along an uninterrupted line on solid material

Particularly when using laminated bus bar structures, isolating the layers from each other remains an important task.

In high-voltage environments, arcing between different voltage levels must be prevented. Arcing takes place over air-gaps – clearance distances – so the voltage level expected in the final system defines the distance between pads and traces as well as between active areas and heat sinks or other grounded parts. Even if the clearance between two points is chosen to be high enough, the insulation strength can be reduced by conductive particles over a longer period. This depends on the degree of pollution, which relates to the ambient conditions the device is used in.

IEC60664-1 gives an insight about the relevant conditions that need to be considered to determine the creepage and clearance distances in a targeted design.

4. Conclusion

Littelfuse miniBLOC devices with their base plate and molded housing structure are mechanically robust components. Still, care needs to be taken to not bend the module during the mounting process and a mechanical arrangement must be designed to prevent pulling forces at the terminals. Applying thermal interface material by a well-controlled screen-printing process further helps to reduce unwanted mechanical stress to the device.

If these aspects are considered, mounting the devices can successfully be done by implementing established procedures and processes.

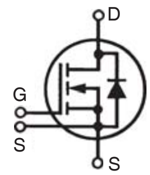
Revision History		
Version	Date	Changes
22.08a	August 2022	Initial version created for release

IXYS

Polar™ HiperFET™ Power MOSFET

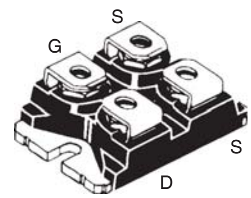
IXFN40N110P

V_{DSS} = 1100V
I_{D25} = 34A
$R_{DS(on)}$ ≤ 260mΩ
t_{rr} ≤ 300ns



N-Channel Enhancement Mode
Fast Intrinsic Rectifier

miniBLOC
E153432



G = Gate D = Drain
S = Source

Either Source Terminal S can be used as the Source Terminal or the Kelvin Source (Gate Return) Terminal.

Symbol	Test Conditions	Maximum Ratings	
V_{DSS}	T_J = 25°C to 150°C	1100	V
V_{DGR}	T_J = 25°C to 150°C, R_{GS} = 1MΩ	1100	V
V_{GSS}	Continuous	±30	V
V_{GSM}	Transient	±40	V
I_{D25}	T_C = 25°C	34	A
I_{DM}	T_C = 25°C, Pulse Width Limited by T_{JM}	100	A
I_A	T_C = 25°C	20	A
E_{AS}	T_C = 25°C	2	J
dv/dt	$I_S \le I_{DM}$, $V_{DD} \le V_{DSS}$, $T_J \le 150°C$	20	V/ns
P_D	T_C = 25°C	890	W
T_J		-55 ... +150	°C
T_{JM}		150	°C
T_{stg}		-55 ... +150	°C
V_{ISOL}	50/60 Hz, RMS, t = 1minute	2500	V~
	$I_{ISOL} \le$ 1mA, t = 1s	3000	V~
M_d	Mounting Torque for Base Plate	1.5/13	Nm/lb.in
	Terminal Connection Torque	1.3/11.5	Nm/lb.in
Weight		30	g

Features

- International Standard Package
- Low Intrinsic Gate Resistance
- miniBLOC with Aluminum Nitride Isolation
- Low Package Inductance
- Fast Intrinsic Rectifier
- Low $R_{DS(on)}$ and Q_G

Advantages

- High Power Density
- Easy to Mount
- Space Savings

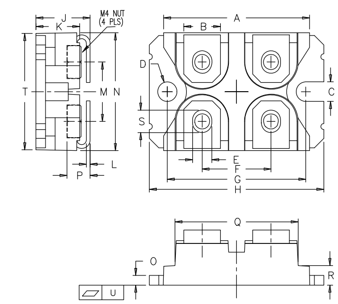
Applications

- DC-DC Converters
- Battery Chargers
- Switch-Mode and Resonant-Mode Power Supplies
- AC Motor Control
- High Speed Power Switching Appliccation

Symbol	Test Conditions (T_J = 25°C Unless Otherwise Specified)	Characteristic Values Min.	Typ.	Max.	
BV_{DSS}	V_{GS} = 0V, I_D = 3mA	1100			V
$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 1mA	3.5		6.5	V
I_{GSS}	V_{GS} = ±30V, V_{DS} = 0V			±300	nA
I_{DSS}	V_{DS} = V_{DSS}, V_{GS} = 0V			50	µA
	T_J = 125°C			3	mA
$R_{DS(on)}$	V_{GS} = 10V, I_D = 20A, Note 1			260	mΩ

Symbol	Test Conditions	Characteristic Values Min.	Typ.	Max.
(T_J = 25°C Unless Otherwise Specified)				
g_{fs}	V_{DS} = 20V, I_D = 20A, Note 1	20	32	S
C_{iss}	V_{GS} = 0V, V_{DS} = 25V, f = 1MHz		19	nF
C_{oss}			1070	pF
C_{rss}			46	pF
R_{Gi}	Gate Input Resistance		1.65	Ω
$t_{d(on)}$	**Resistive Switching Times**		53	ns
t_r	V_{GS} = 10V, V_{DS} = 0.5 • V_{DSS}, I_D = 20A		55	ns
$t_{d(off)}$	R_G = 1Ω (External)		110	ns
t_f			54	ns
$Q_{g(on)}$	V_{GS} = 10V, V_{DS} = 0.5 • V_{DSS}, I_D = 20A		310	nC
Q_{gs}			95	nC
Q_{gd}			142	nC
R_{thJC}				0.14 °C/W
R_{thCS}			0.05	°C/W

SOT-227B (IXFN) Outline



(M4 screws (4x) supplied)

SYM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	1.240	1.255	31.50	31.88
B	.307	.323	7.80	8.20
C	.161	.169	4.09	4.29
D	.161	.169	4.09	4.29
E	.161	.169	4.09	4.29
F	.587	.595	14.91	15.11
G	1.186	1.193	30.12	30.30
H	1.496	1.505	38.00	38.23
J	.460	.481	11.68	12.22
K	.351	.378	8.92	9.60
L	.030	.033	0.76	0.84
M	.496	.506	12.60	12.85
N	.990	1.001	25.15	25.42
O	.078	.084	1.98	2.13
P	.195	.235	4.95	5.97
Q	1.045	1.059	26.54	26.90
R	.155	.174	3.94	4.42
S	.186	.191	4.72	4.85
T	.968	.987	24.59	25.07
U	-.002	.004	-0.05	0.1

Source-Drain Diode

Symbol	Test Conditions	Characteristic Values Min.	Typ.	Max.
(T_J = 25°C Unless Otherwise Specified)				
I_S	V_{GS} = 0V			40 A
I_{SM}	Repetitive, Pulse Width Limited by T_{JM}			160 A
V_{SD}	I_F = I_S, V_{GS} = 0V, Note 1			1.5 V
t_{rr}	I_F = 20A, -di/dt = 100A/µs			300 ns
Q_{RM}	V_R = 100V, V_{GS} = 0V		2.2	µC
I_{RM}			16.0	A

Note 1. Pulse test, t ≤ 300µs, duty cycle, d ≤ 2%.

Fig. 1. Output Characteristics @ $T_J = 25^oC$

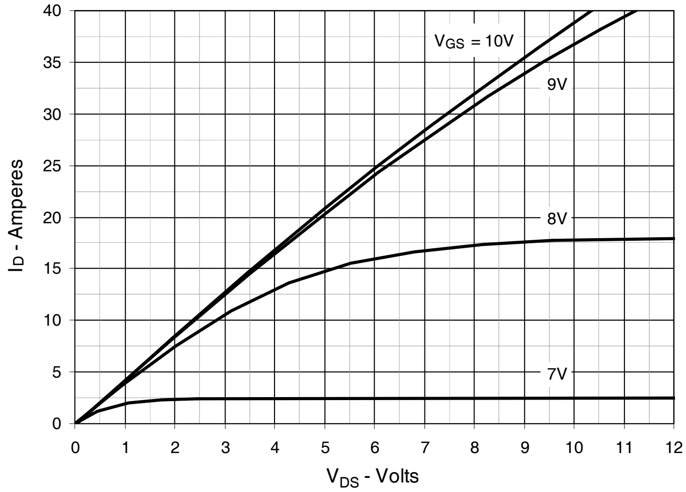


Fig. 2. Extended Output Characteristics @ $T_J = 25^oC$

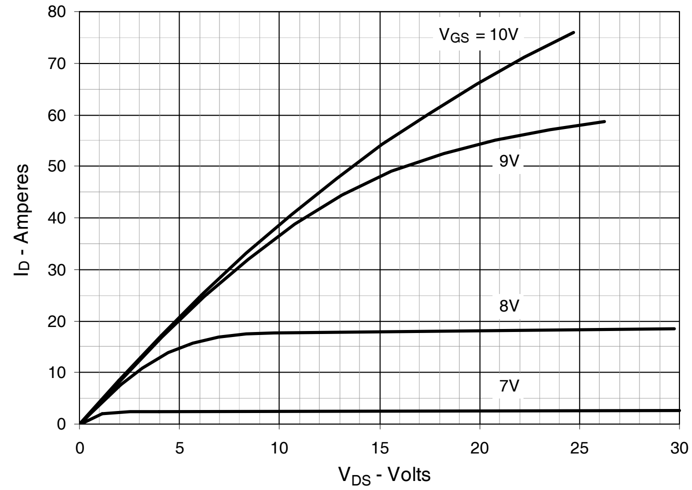


Fig. 3. Output Characteristics @ $T_J = 125^oC$

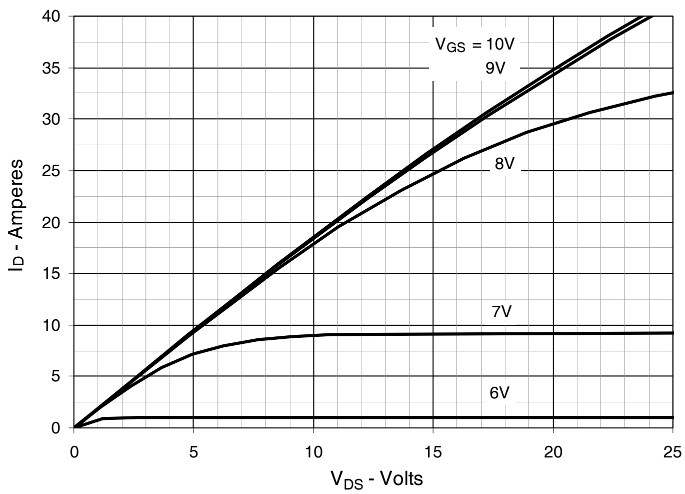


Fig. 4. $R_{DS(on)}$ Normalized to I_D = 20A Value vs. Junction Temperature

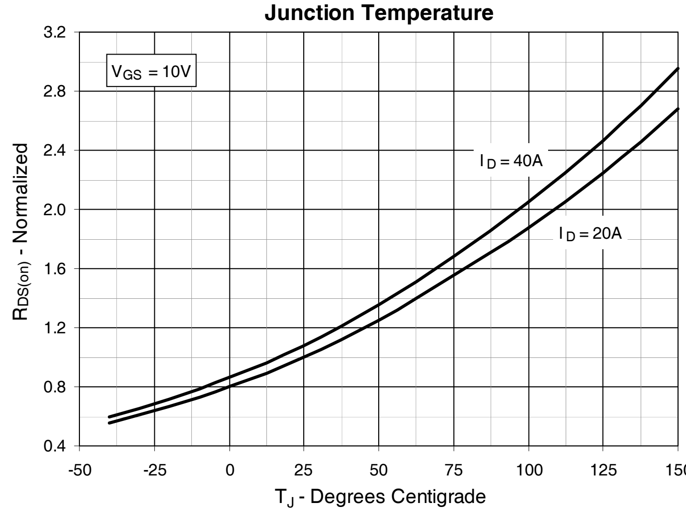


Fig. 5. $R_{DS(on)}$ Normalized to I_D = 20A Value vs. Drain Current

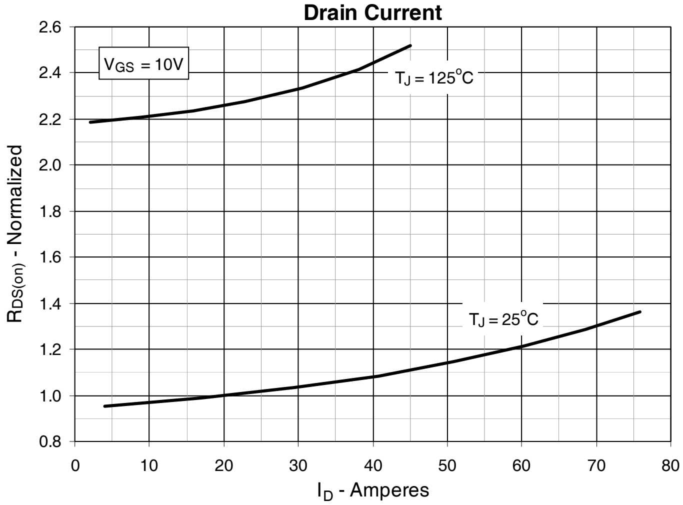
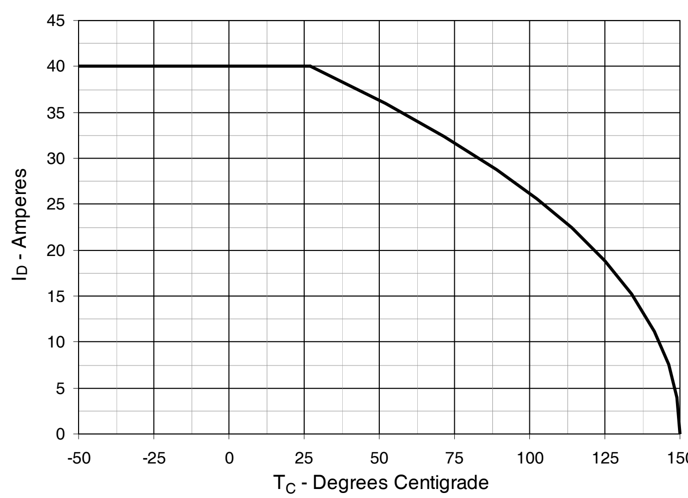
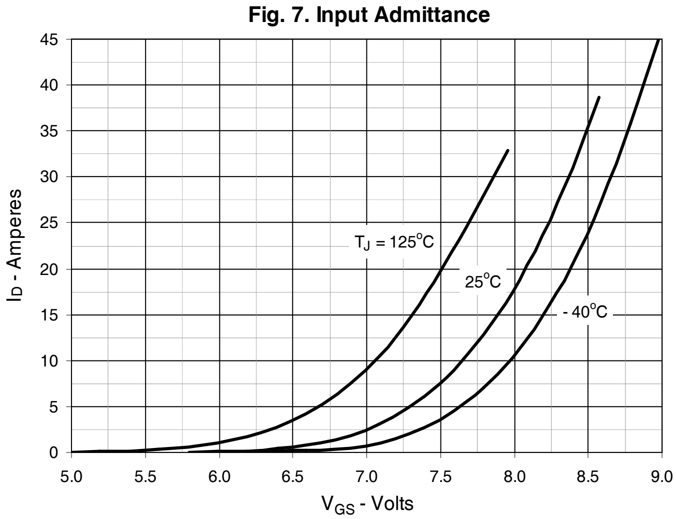
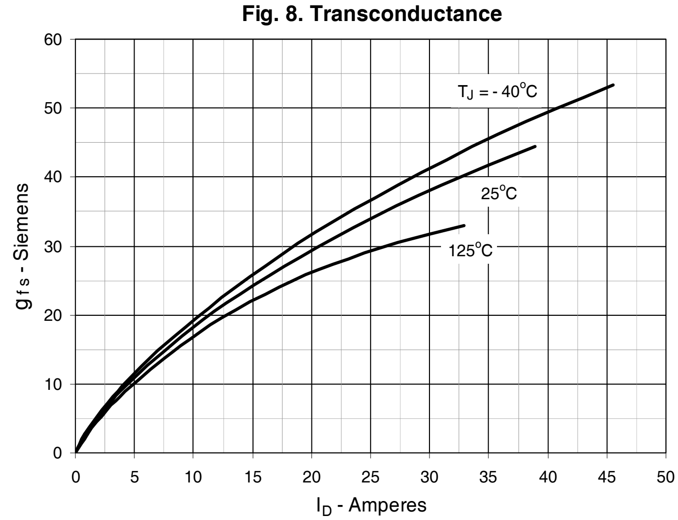
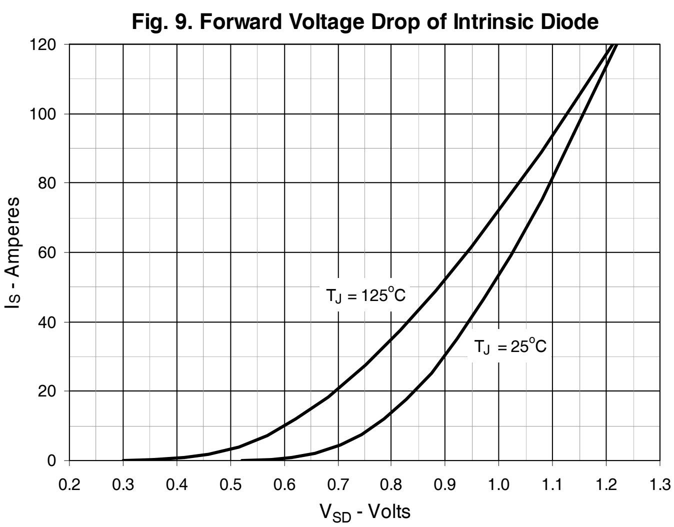


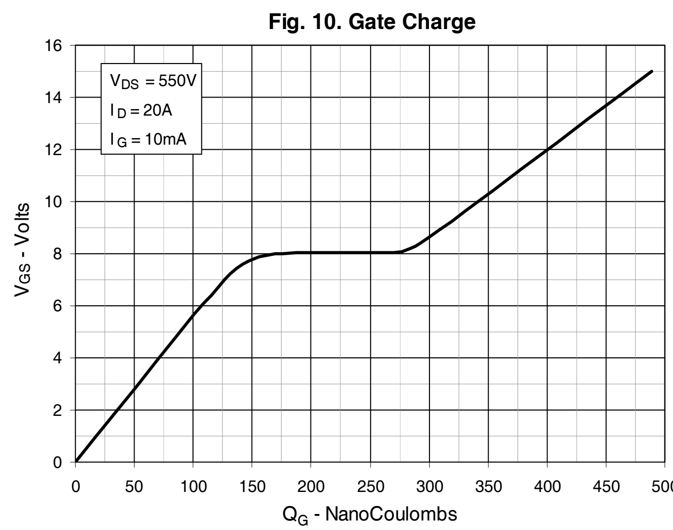
Fig. 6. Maximum Drain Current vs. Case Temperature

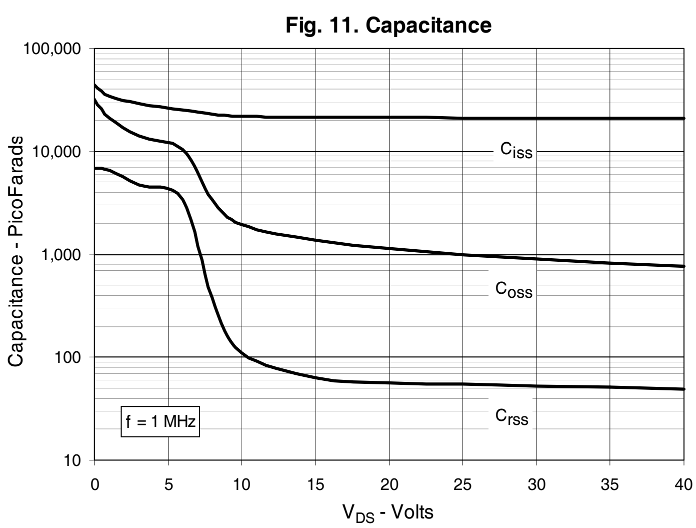


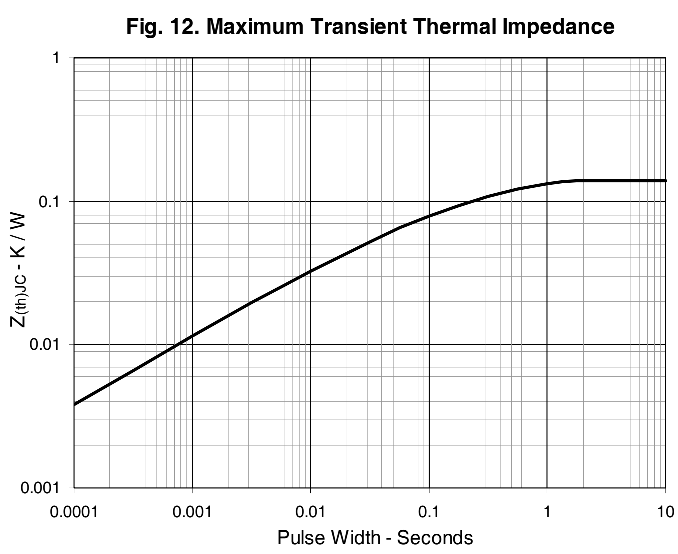




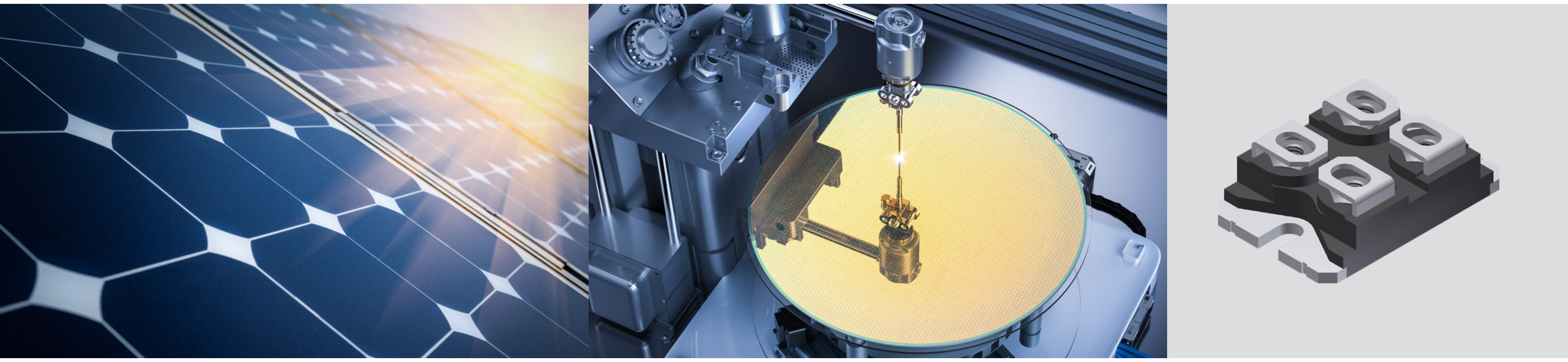








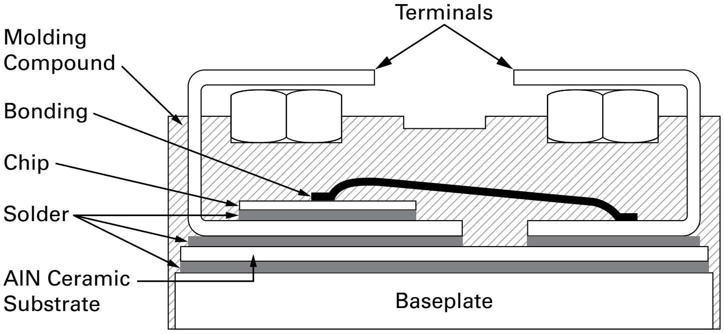
IXYS Reserves the Right to Change Limits, Test Conditions, and Dimensions.



Isolated **mini**ature power **BLOC**K (miniBLOC™) solution for Plasma Power Supplies

Littelfuse's isolated miniBLOC™ (SOT-227B) is a discrete miniature power BLOCK, conveniently bridging the power gap between inexpensive discrete packages and full-sized power modules. Littelfuse offers a wide range of Si and SiC miniBLOC™ MOSFET solutions catering to the design demands of plasma power supplies.

The miniBLOC™ solution offering fully isolated base plate, higher power densities, faster switching speeds, wide device choice, ease of application, and long-term reliability will serve as a key enabler, providing the right solution to development needs at different power levels.



Cross-section of SOT-227B (miniBLOC)

The **mini**ature power **BLOC**K Advantage

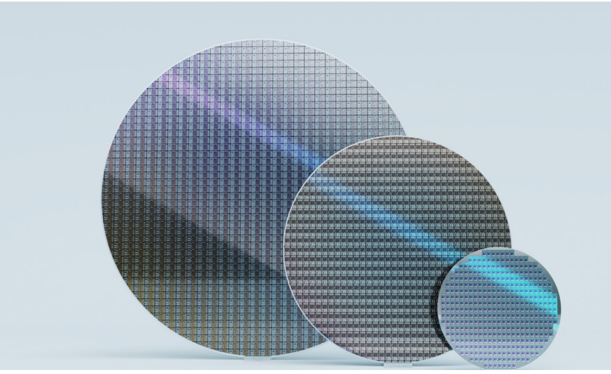
Features

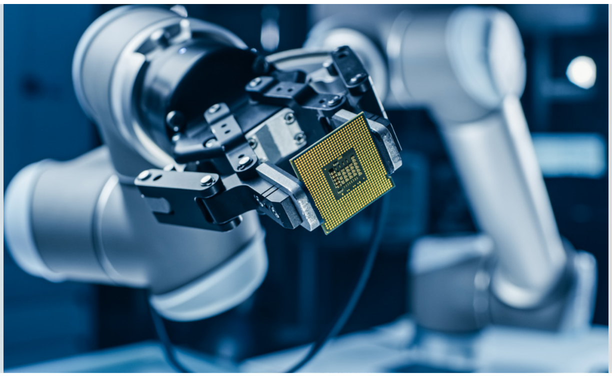
- Aluminum Nitride ceramic-based compact discrete package with electrically isolated baseplate
- Reduced overall junction-sink thermal impedance in comparison to non-isolated discretes
- Isolation up to 2.5 kV V_{RMS}/60 s or 3 kV V_{RMS}/1 s
- Extended creepage and clearance distances:
  - Terminal-terminal: clearance of up to 7 mm and creepage of up to 10.5 mm
  - Terminal-baseplate: clearance of up to 8.5 mm and creepage of up to 10.5 mm
- Discrete power block with high current-handling capability
- Low internal lead inductance < 5 nH
- Option for Kelvin-Source terminal
- Screw-mounted discrete package with four screwed terminal leads

Advantages

- Aluminum Nitride internal isolation increases power density, simplifies thermal design, improves reliability, and enables superior power cycling capability with cooler chip temperatures compared to non-isolated and conventionally isolated discretes
- Optimal for high-voltage design given the inherent isolation and extended creepage and clearance
- Reduced paralleling effort and decreased part count resulting in PCB space savings
- Higher safety overvoltage margin with reduced overvoltage stress at chip level due to lower package stray inductance
- Kelvin-Source terminal improves controllability, enabling faster switching speeds
- Rugged and stable mounting, ease of manufacturing and handling in assembly

Littelfuse®
Expertise Applied | Answers Delivered





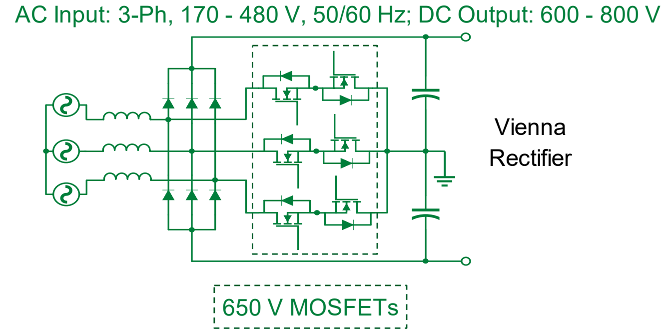
High Current (> 50 A), 650 V Ultra Junction X2-Class MOSFETs in miniBLOC™

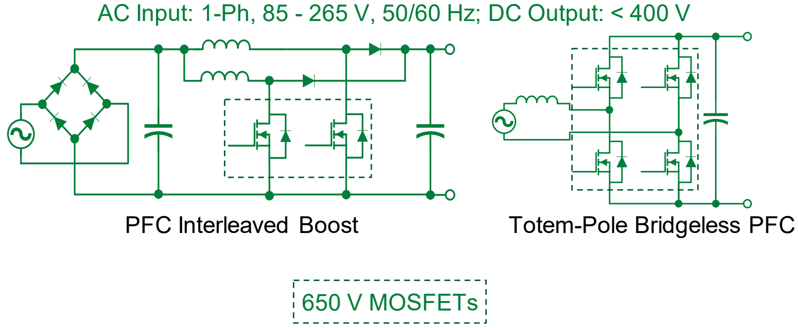
$R_{DS(on),max}$ [mΩ]	I_{D25} [A]	miniBLOC™
13	170	IXFN170N65X2 ●
17	145	IXFN150N65X2 ●
24	108	IXFN120N65X2 ●
30	78	IXFN100N65X2 ●
30	76	IXTN102N65X2 ●

- ● HiPerFET™ (fast-body diode)
- ● Standard body diode

The 650 V X2-Class Ultra Junction MOSFETs in miniBLOC™ package from Littelfuse exhibit some of the highest current ratings, lowest on-state resistances $R_{DS(on)}$, low gate charge Q_g, and superior dv/dt performance. Their superior avalanche capability further enhances device ruggedness in critical applications. Additionally, the HiPerFET™ devices with fast soft-recovery body diode have reduced switching losses and a better electromagnetic interference (EMI) behavior.

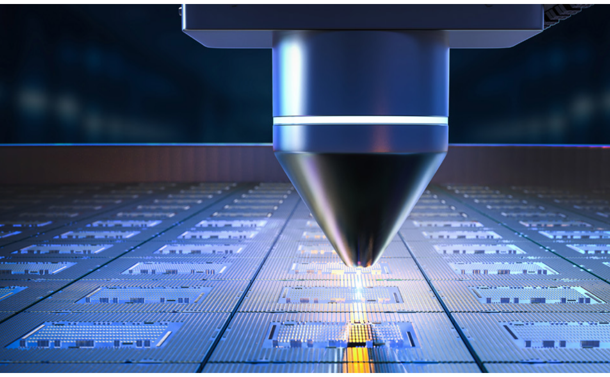
These benefits of the 650 V Ultra Junction X2-Class MOSFETs in combination with the advantages offered by the miniBLOC™ package make them a preferred choice for plasma power supplies.

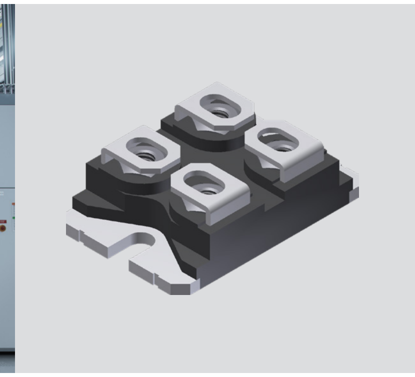




Scan this QR code to access the Littelfuse webpage on Ultra Junction X2-Class MOSFETs

Littelfuse®
Expertise Applied | Answers Delivered





900–1200 V Polar™ HiPerFET™ in miniBLOC™

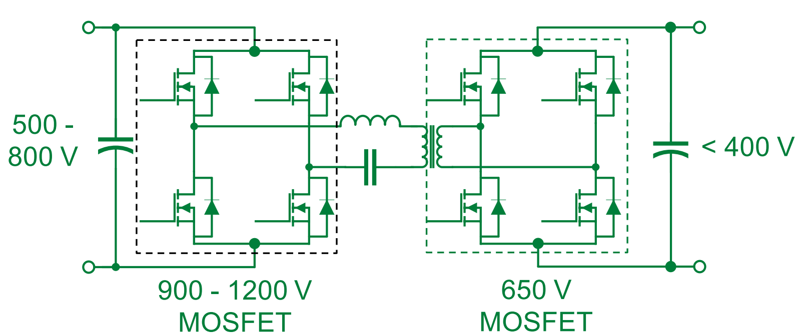
$R_{DS(on),max}$ [Ω]	I_{D25} [A]	V_{DSS} [V]	miniBLOC™ 
0.145	56	900	IXFN56N90P
0.160	43	900	IXFN52N90P
0.230	33	900	IXFN40N90P
0.21	38	1000	IXFN38N100P
0.22	37	1000	IXFN44N100P
0.32	27	1000	IXFN32N100P
0.39	23	1000	IXFN26N100P
0.26	34	1100	IXFN40N110P
0.31	32	1200	IXFN32N120P
0.35	30	1200	IXFN30N120P
0.46	23	1200	IXFN26N120P
0.57	20	1200	IXFN20N120P

Littelfuse 900–1200 V Polar™ HiPerFET™ devices are tailored to provide designers with a rugged device solution that offers the best advantage in performance and cost in high frequency applications.

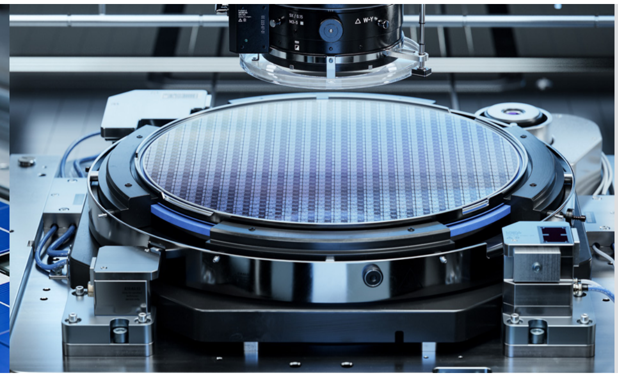
These devices incorporate the Polar technology platform to achieve low on-state resistances $R_{DS(on)}$ which improves conduction behavior. The low gate charge Q_g and fast body diode results in more efficient switching at all frequencies. The dv/dt and avalanche capabilities of these devices provide additional safeguards against overvoltage transients.

The benefits of the Polar™ HiPerFET™ devices, in addition to the advantages offered by the miniBLOC™ package, make them the best solution for plasma power supplies.

DC/DC LLC Converter



Scan this QR code to access the Littelfuse webpage on Polar HiPerFET™ devices


1200 V SiC MOSFETs in miniBLOC™ with Kelvin-Source

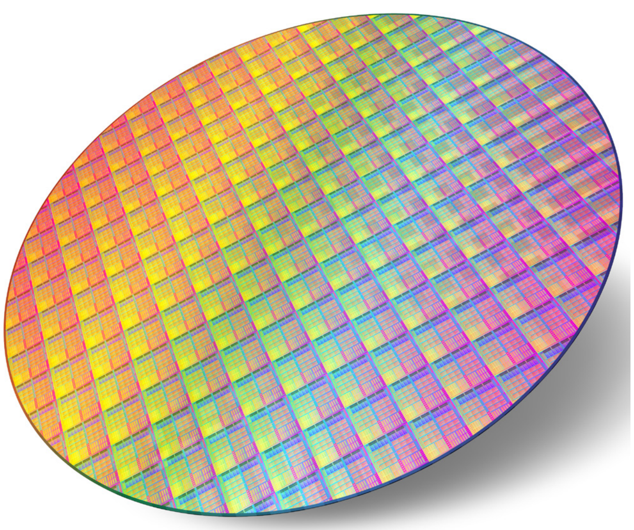
$R_{DS(on),max}$ [mΩ]	I_{D25} [A]	V_{DSS} [V]	miniBLOC™ w/ Kelvin-Source 
10	130	900	IXFN130N90SK
21	75	1200	IXFN75N120SK
32	55	1200	IXFN55N120SK
75	30	1200	IXFN30N120SK

Note: Preliminary datasheet and engineering samples available for the SiC MOSFETs in the table above

Littelfuse 1200 V SiC MOSFETs featuring low $R_{DS(on)}$ and low device capacitances, offer the highest efficiency for reduced cooling effort. The excellent conduction and switching behavior combined with higher frequency operation improves power density in the application.

The SiC MOSFETs in miniBLOC™ featuring a Kelvin-Source connection offer superior immunity to parasitic turn-on/turn-off events, thereby maximizing the high-speed switching performance of the MOSFET.

These advantages of SiC MOSFETs combined with the benefits offered by the miniBLOC™ package make them a preferred choice in Plasma Power Supplies.



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