



Discrete Power MOSFETs

IXYS A Littelfuse Technology

 **Littelfuse®**
Expertise Applied | Answers Delivered

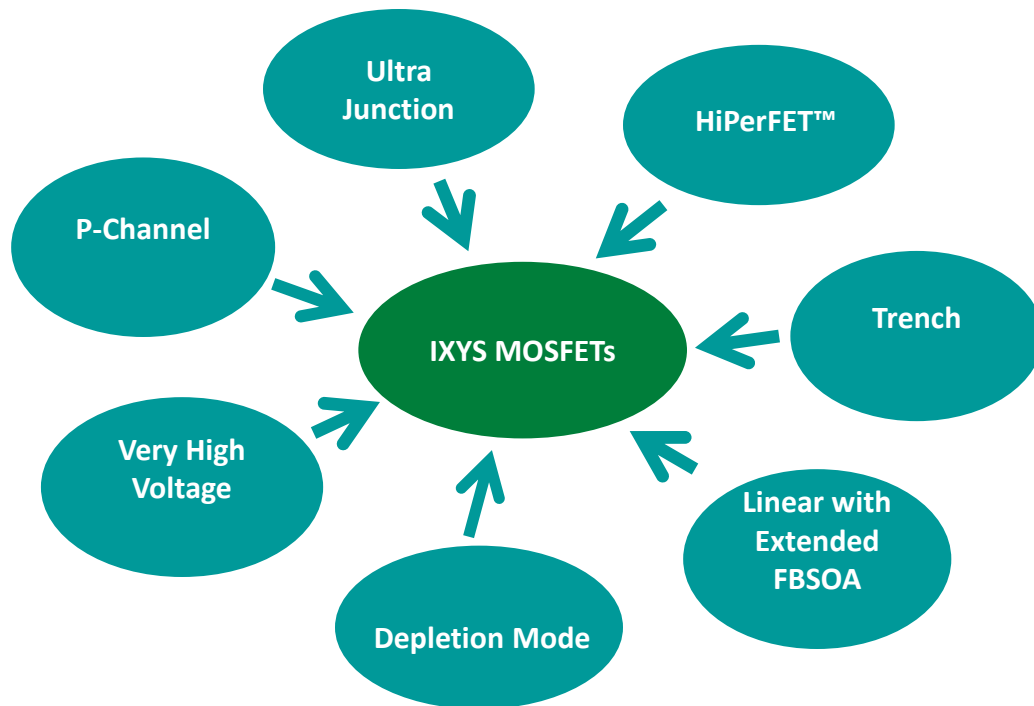
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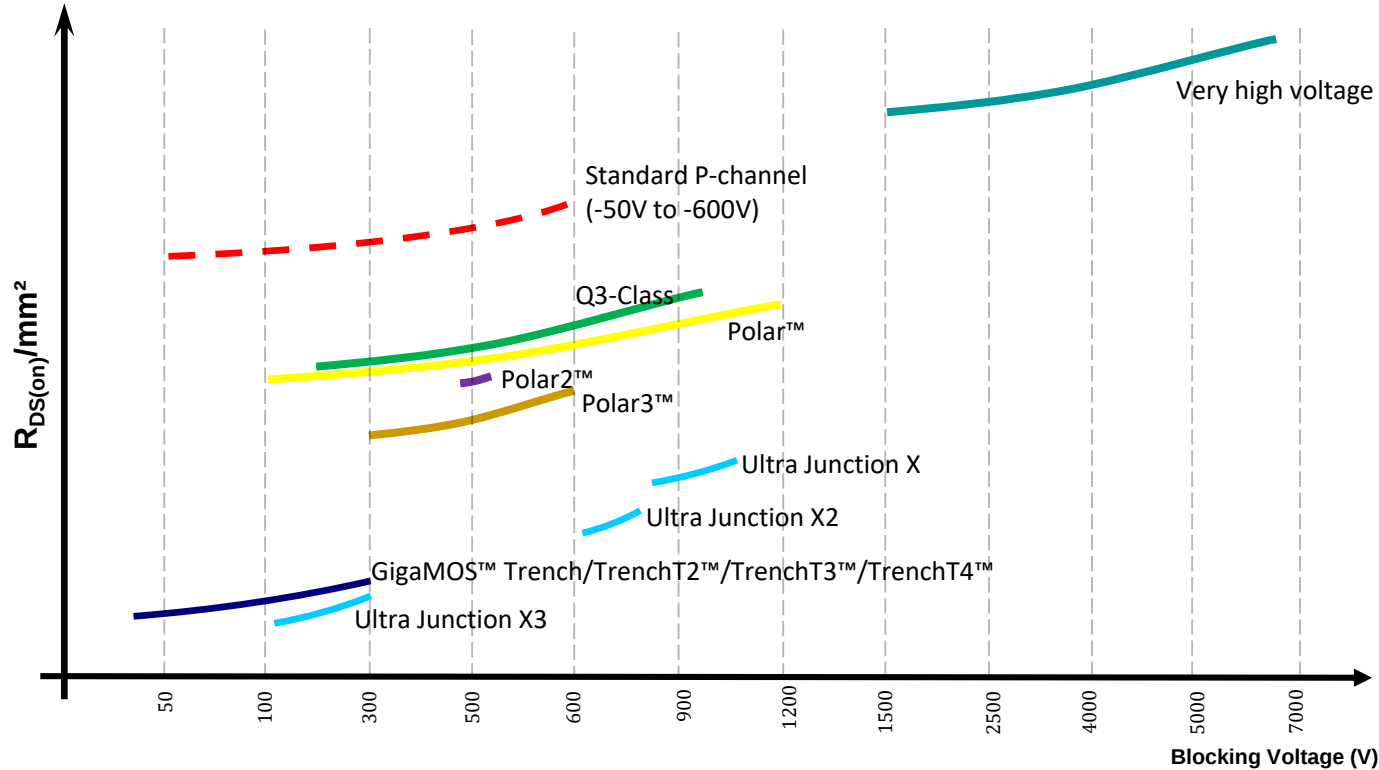
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I. IXYS Power MOSFETs

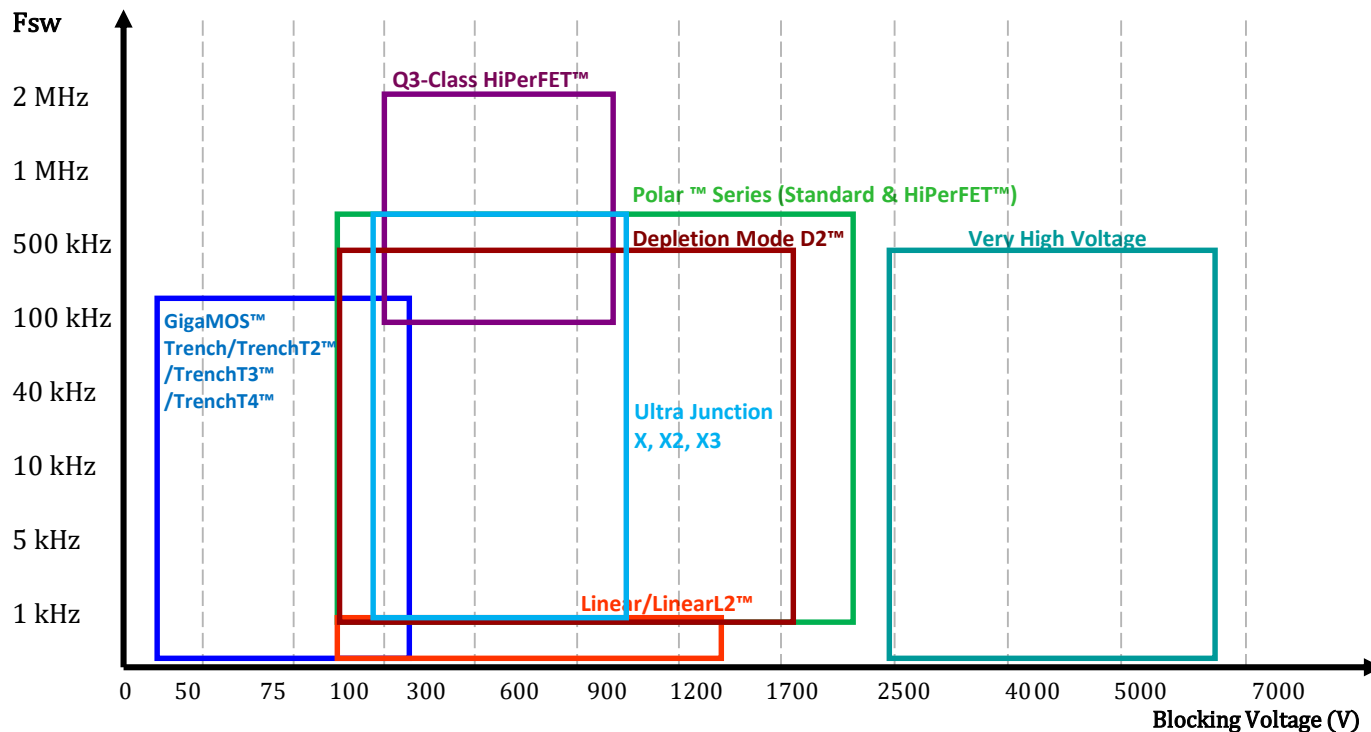


On-Resistance $R_{DS(on)}$ vs. Blocking Voltage



MOSFET Switching Frequency vs Blocking Voltage

Discrete MOSFETs



II. Power MOSFET Product Portfolio

Product Family/Technology	Voltage V_{DSS}	Current at 25°C I_{D25}	On-resistance $R_{DS(on)}$ (max)
N-Channels			
Ultra Junction X	850V – 1000V	3.5A – 110A	33mΩ – 2.5Ω
Ultra Junction X2	650V – 700V	2A – 170A	13mΩ – 2.3Ω
Ultra Junction X3	150V – 300V	30A – 400A	2.5mΩ – 66mΩ
Polar™, Polar2™, Polar3™	100V – 1200V	2.1A – 300A	5.5mΩ – 3.3Ω
Q3-class	200V – 1100V	10A – 100A	40mΩ – 1.2Ω
GigaMOS™ Trench, TrenchT2™	40V – 300V	12A – 600A	1mΩ – 85mΩ
TrenchT3™, TrenchT4™	36V – 60V	220A – 660A	0.85mΩ – 4mΩ
Linear with Extended FBSOAs	75V – 1500V	2A – 240A	7mΩ – 15Ω
Depletion mode	100V – 1700V	0.1A – 16A	64mΩ – 80Ω
Standard (high voltage, very high voltage)	100V – 4700V	0.1A – 200A	7.5mΩ – 625Ω

Power MOSFET Product Portfolio

Product Family/Technology	Voltage V_{DSS}	Current at 25°C I_{D25}	On-resistance $R_{DS(on)}$ (max)
P-Channels			
TrenchP™	-50V to -200V	-10A to -210A	7.5mΩ – 0.35Ω
PolarP™	-100V to -600V	-10A to -170A	14mΩ – 1Ω
Standard	-85V to -600V	-8A to -50A	55mΩ – 1.2Ω

IXYS MOSFET Advantages and Applications

Product Family	Features/Advantages	Applications
Ultra Junction (X, X2, X3 Classes)	▪ Lowest $R_{DS(on)}$ and gate charge ▪ Fast soft recovery body diodes ▪ dv/dt ruggedness ▪ Superior avalanche capability ▪ Highest power densities	▪ Battery chargers for electric and hybrid vehicles ▪ High-efficiency power supplies ▪ DC-DC converters ▪ High-power switching audio amplifiers ▪ Synchronous rectification
Polar3™ and Q3-Class	▪ Low $R_{DS(on)}$ and gate charge ▪ High avalanche energy rating ▪ Low thermal resistance ▪ Dynamic dv/dt ratings ▪ Simple drive requirements ▪ High-speed switching	▪ Switched-mode and resonant mode power supplies ▪ Lamp ballasts ▪ Welding machines ▪ Medical equipment ▪ Robotics and servo control ▪ Solar inverters
Trench (GigaMOS™ Trench, TrenchT2™, TrenchT3™, TrenchT4™)	▪ Ultra low on-resistance $R_{DS(on)}$ ▪ High current handling capability ▪ Avalanche capability ▪ 175° operating temperature ▪ Fast body diodes	▪ High-current switching power supplies ▪ Cordless home appliances and power tools ▪ Electric forklifts ▪ Unmanned aerial vehicles (UAV) ▪ Primary-side switches ▪ Class-D audio amplifiers

IXYS MOSFET Advantages and Applications

Product Family	Features/Advantages	Applications
LinearL2™ with extended Forward Bias Safe Operating Area (FBSOA)	▪ High power in linear mode operation ▪ Guaranteed FBSOA at 75°C ▪ Avalanche rated ▪ Low static drain-to-source on resistance	▪ Current sources ▪ Circuit breakers ▪ Linear regulators ▪ Soft-start applications ▪ Programmable loads
Depletion Mode D2™	▪ 'Normally-On' operation ▪ Low $R_{DS(on)}$ ▪ Linear mode tolerant ▪ Useable body diode ▪ Fast switching	▪ Current regulation ▪ Solid-state relays ▪ Level shifting ▪ Active loads ▪ Start-up circuits
High Voltage and Very High Voltage	▪ High blocking voltage ▪ Proprietary high-voltage ISOPLUS™ packages ▪ Up to 4500V electrical isolation (DCB) ▪ UL 94 V-0 Flammability qualified (molding epoxies)	▪ Capacitor discharge circuits ▪ High-voltage power supplies ▪ Pulse circuits ▪ Laser and X-ray generation systems ▪ Energy tapping applications from the power grid

IXYS MOSFET Advantages and Applications

Product Family	Features/Advantages	Applications
P-Channels (TrenchP™ and PolarP™)	▪ Fast intrinsic diode ▪ Dynamic dv/dt rated ▪ Avalanche rated ▪ Rugged PolarP™ process ▪ Extended FBSOA ▪ Low gate charge and $R_{DS(on)}$	▪ Load switches ▪ High-side switches ▪ DC-DC converters ▪ Current regulators ▪ Automatic test equipment

III. Latest Discrete MOSFET Product Lines

- 200V Ultra Junction X3-Class HiPerFET™ MOSFETs
- 250V Ultra Junction X3-Class HiPerFET™ MOSFETs
- 300V Ultra Junction X3-Class HiPerFET™ MOSFETs

- 650V Ultra Junction X2-Class MOSFETs
- 650V Ultra Junction X2-Class HiPerFET™ MOSFETs
- 850V Ultra Junction X-Class HiPerFET™ MOSFETs
- 1000V Ultra Junction X-Class HiPerFET™ MOSFETs

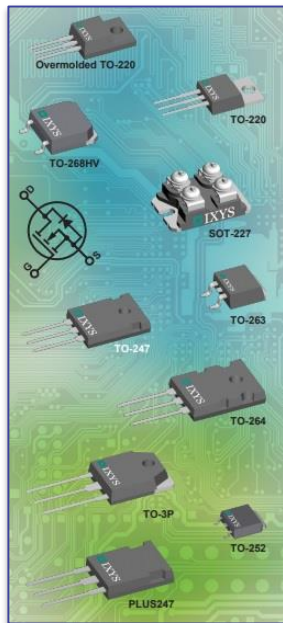
- 40V High-Current TrenchT4™ MOSFETs
- 60V TrenchT3™ HiPerFET™ MOSFETs

- 4500V MOSFETs

200V Ultra Junction X3-Class HiPerFET™ Power MOSFETs

(36A – 300A)

With low-noise fast recovery body diodes and lowest on-resistances



FEATURES

- Lowest on-resistances $R_{DS(on)}$ (3.5mΩ in SOT-227, 4mΩ in TO-264)
- Ultra-low gate charges Q_g
- Low-noise fast recovery body diodes
- Superior dv/dt performance
- Avalanche capable
- International standard packages

ADVANTAGES

- Low conduction and switching losses
- High power density
- Reduced number of snubbers required
- Easy to design in

APPLICATIONS

- Battery chargers for light electric vehicles (LEVs), motor control (48V-110V systems), synchronous rectification, power solid-state relays

Part number example:

IXFP72N20X3

“X3” denotes Ultra Junction X3-Class

“F” denotes HiPerFET™ (fast body diode)

IXFA36N20X3

IXFH90N20X3

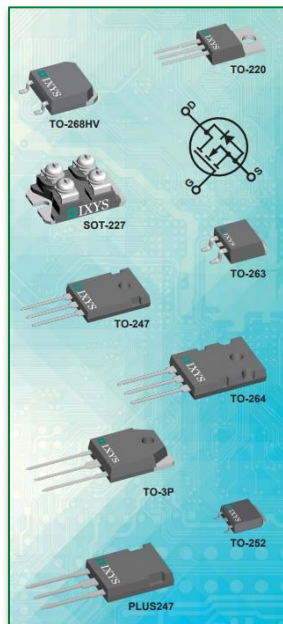
IXFN220N20X3

IXFX300N20X3

250V Ultra Junction X3-Class HiPerFET™ Power MOSFETs

(30A – 240A)

Offering best-in-class on-state resistance and gate charge Figure of Merit



FEATURES

- Lowest on-resistance $R_{DS(on)}$ and gate charge Q_g (5mΩ in TO-264, 4.5mΩ in SOT-227)
- Fast soft recovery body diodes
- dv/dt ruggedness
- Superior avalanche capability
- International standard packages

ADVANTAGES

- High efficiency
- High power density
- Improved system reliability
- Easy to design in

APPLICATIONS

- Flyback converters for telecom power supplies, half-bridge Class-D audio amplifiers, synchronous rectification

Part number example:

IXFA30N25X3

“X3” denotes Ultra Junction X3-Class

“F” denotes HiPerFET™ (fast body diode)

IXFP60N25X3

IXFH120N25X3

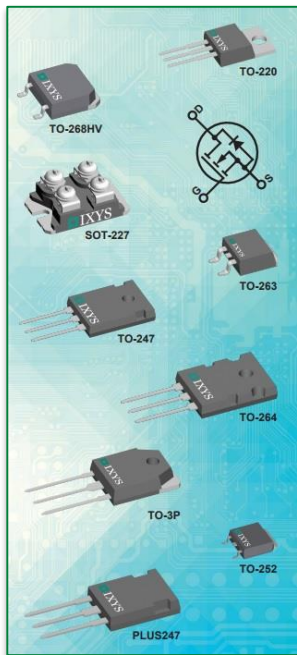
IXFT170N25X3HV

IXFN240N25X3

300V Ultra Junction X3-Class HiPerFET™ Power MOSFETs

(26A – 210A)

Featuring benchmark Figure of Merit (on-resistance x gat charge)



FEATURES

- Lowest on-resistance $R_{DS(on)}$ and gate charge Q_g (5.5mΩ in TO-264, 4.6mΩ in SOT-227)
- Fast recovery body diodes
- dv/dt and avalanche ruggedness
- International standard packages

ADVANTAGES

- Highest efficiency
- High power density
- Easy to design in

APPLICATIONS

- Solar micro-inverters, half-bridge Class-D audio amplifiers, brushed DC motor drivers

Part number example:

IXFP26N30X3

“X3” denotes Ultra Junction X3-Class

“F” denotes HiPerFET™ (fast body diode)

IXFA38N30X3

IXFH56N30X3

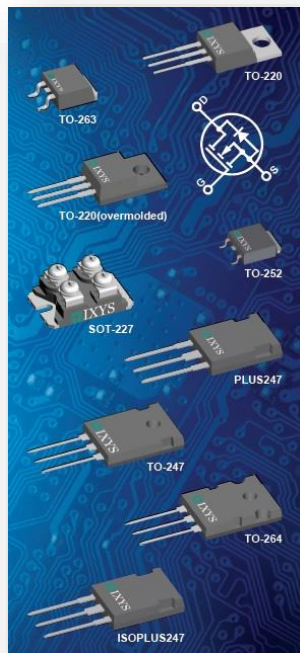
IXFT150N30X3HV

IXFN210N30X3

650V Ultra Junction X2-Class Power MOSFETs

(2A – 120A)

Ideal for Power Factor Correction (PFC) applications!



FEATURES

- Low $R_{DS(on)}$ and gate charge Q_g
- dv/dt ruggedness
- Avalanche capable
- Low package inductance
- International standard packages

ADVANTAGES

- High efficiency
- High power density
- Easy to mount
- Space savings

APPLICATIONS

- PFC circuits, resonant-mode power supplies, AC and DC motor drives, lighting control

Part number example:

IXTH34N65X2

“X2” denotes Ultra Junction X2-Class

IXTP2N65X2

IXTY4N65X2

IXTH12N65X2

IXTK120N65X2

650V Ultra Junction X2-Class HiPerFET™ Power MOSFETs

(5.6A – 170A)

With very soft recovery diodes

Optimized for soft-switching/resonant-mode power conversion applications



FEATURES

- Low $R_{DS(on)}$ and gate charge Q_g (13mΩ in SOT-227)
- Fast body diodes
- dv/dt ruggedness
- Avalanche rated
- Low package inductance
- International standard packages

ADVANTAGES

- Higher efficiency
- High power density
- Easy to mount
- Space savings

APPLICATIONS

- Resonant-mode power supplies, high intensity discharge lamp ballast, 3-level solar inverters, LED lighting

Part number example:

IXFH80N65X2

“X2” denotes Ultra Junction X2-Class

“F” denotes HiPerFET™ (fast body diode)

IXFA22N65X2

IXFP22N65X2

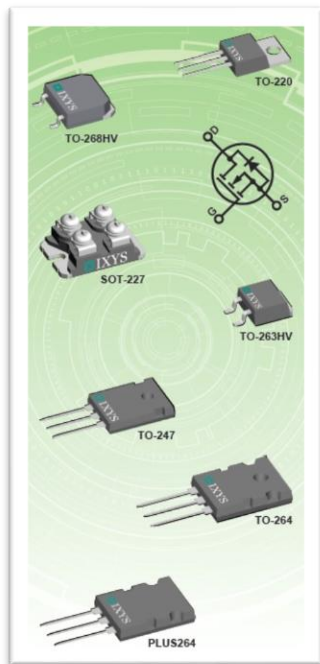
IXFN120N65X2

IXFK120N65X2

850V Ultra Junction X-Class HiPerFET™ Power MOSFETs

(3.5A – 110A)

Industry's lowest on-resistance Silicon devices
Enabling very high power density



FEATURES

- Ultra low on-resistance $R_{DS(on)}$ and gate charge Q_g (33mΩ in SOT-227)
- Fast body diodes
- dv/dt ruggedness
- Avalanche rated
- Low package inductance
- International standard packages

ADVANTAGES

- Higher efficiency
- High power density
- Easy to mount
- Space savings

APPLICATIONS

- Forward converters, flyback converters, solar inverters, robotics and servo control

Part number example:

IXFH20N85X

“X” denotes Ultra Junction X-Class

“F” denotes HiPerFET™ (fast body diode)

IXFH40N85X

IXFK50N85X

IXFB90N65X

IXFN110N85X

NEW!

1000V Ultra Junction X-Class HiPerFET™ MOSFETs

(26A – 74A)

Optimized for soft-switching resonant mode power conversion applications

Features

- Ultra low on-resistance $R_{DS(on)}$ and gate charge Q_g
- Fast body diode
- Superior dv/dt performance
- Avalanche capability
- Available in international standard packages: TO-247, PLUS247, TO-268HV, SOT-227, TO-264, PLUS264

Advantages

- Higher efficiency
- Improved system reliability
- Easy to mount
- Space and cost savings

Applications

- Resonant mode power supplies
- AC and DC motor drives
- DC-DC converters
- Robotic and servo control
- Smart meters
- Renewable-energy inverters
- Welding inverters
- Battery chargers

Part number example:

IXFH26N100X

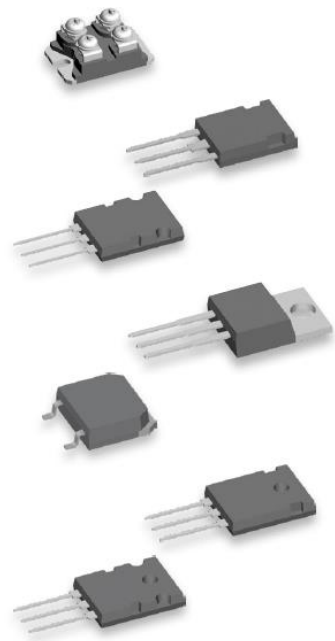
“X” denotes Ultra Junction X-Class

“F” denotes HiPerFET™ (fast body diode)

IXFT26N100X

IXFK32N100X

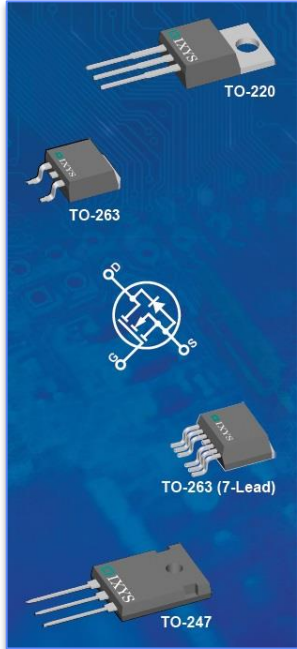
IXFN70N100X



40V High-Current TrenchT4™ Power MOSFETs

(230A – 660A)

Ideal for synchronous rectification applications



FEATURES

- Ultra low on-resistance $R_{DS(on)}$
- High-current handling capability
- Avalanche rated
- 175° C operating temperature
- International standard packages

ADVANTAGES

- High power density
- Easy to mount
- Space savings

APPLICATIONS

- Synchronous rectification, high-current switching power supplies, electric forklifts, cordless power tools, class-D audio amplifiers

Part number example:

IXTA340N04T4-7

“T4” denotes TrenchT4™ MOSFET technology

“7” denotes 7-lead package

IXTA230N04T4

IXTP270N04T4

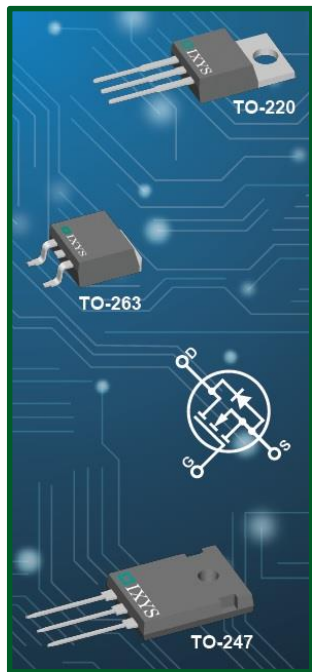
IXTT440N04T4HV

IXTN660N04T4

60V TrenchT3™ HiPerFET™ Power MOSFETs

(220A – 270A)

Ultra low on-resistance, rugged devices for industrial power conversion applications



FEATURES

- Ultra low on-resistance $R_{DS(on)}$
- High current handling capability
- Avalanche rated
- Fast body diode
- 175° C operating temperature
- International standard packages

ADVANTAGES

- High power density
- Easy to mount
- Space savings

APPLICATIONS

- Synchronous rectification, DC motor drive, solar micro-inverters

Part number example:

IXFA220N06T3

“T3” denotes 3rd generation Trench technology

“F” denotes HiPerFET™ (fast body diode)

IXFH220N06T3

IXFP220N06T3

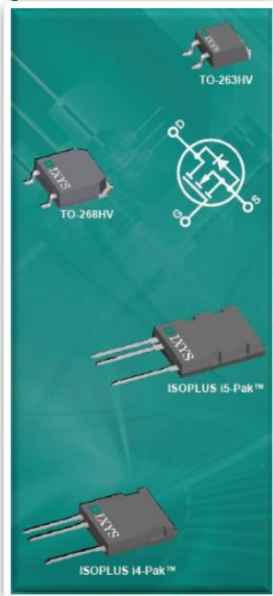
IXFH270N06T3

IXFA270N06T3

4500V Power MOSFETs

(200mA – 2A)

Ideal for very high voltage power conversion applications



FEATURES

- High blocking voltage
- Proprietary high-voltage ISOPLUS™ packages
- Up to 4500V electrical isolation (DCB)
- UL 94 V-0 Flammability qualified (molding epoxies)

ADVANTAGES

- High power density
- Space savings (eliminates multiple series-connected devices)
- Easy mounting

APPLICATIONS

- Capacitor discharge circuits
- Pulse circuits
- Laser and X-ray generation systems
- High voltage relay disconnect circuits
- Energy tapping applications from the power grid

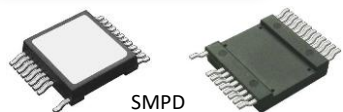
Part Numbers

IXTT02N450HV

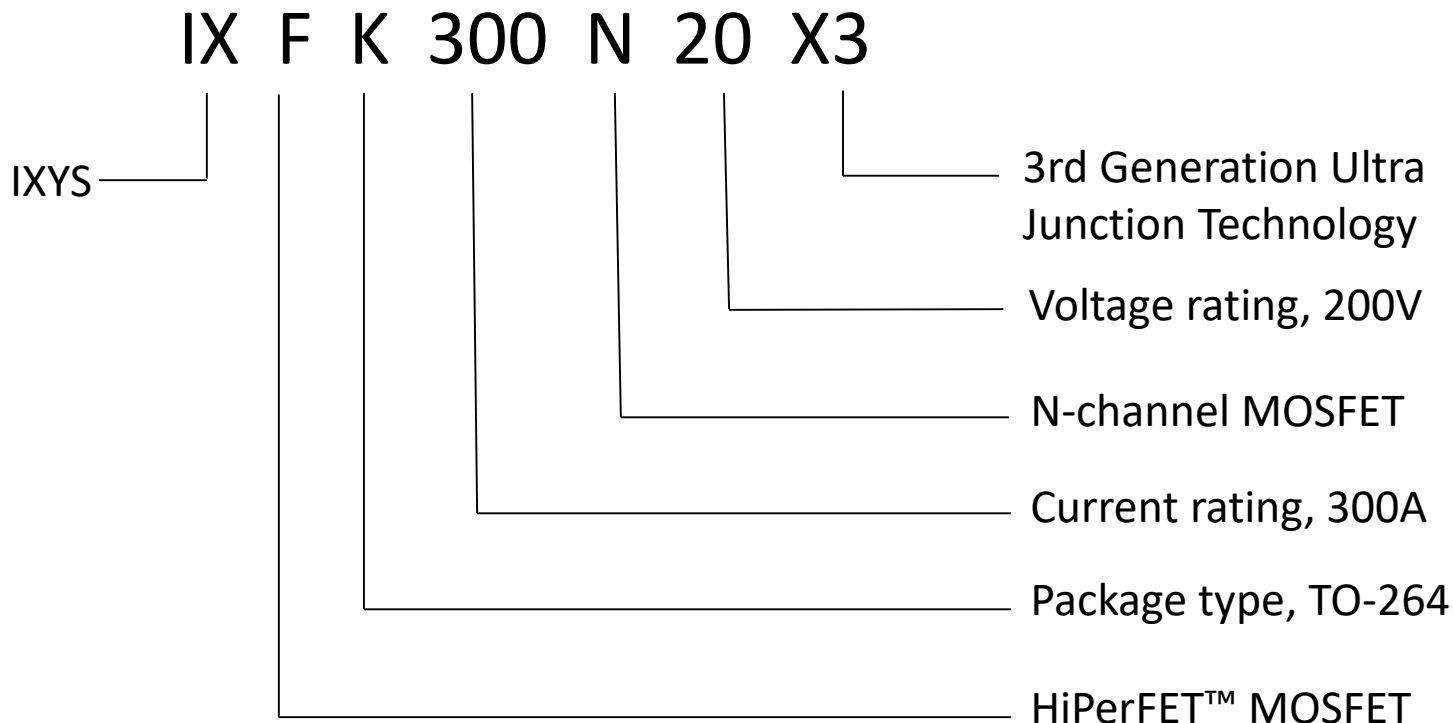
IXTF1N450

IXTH1N450HV

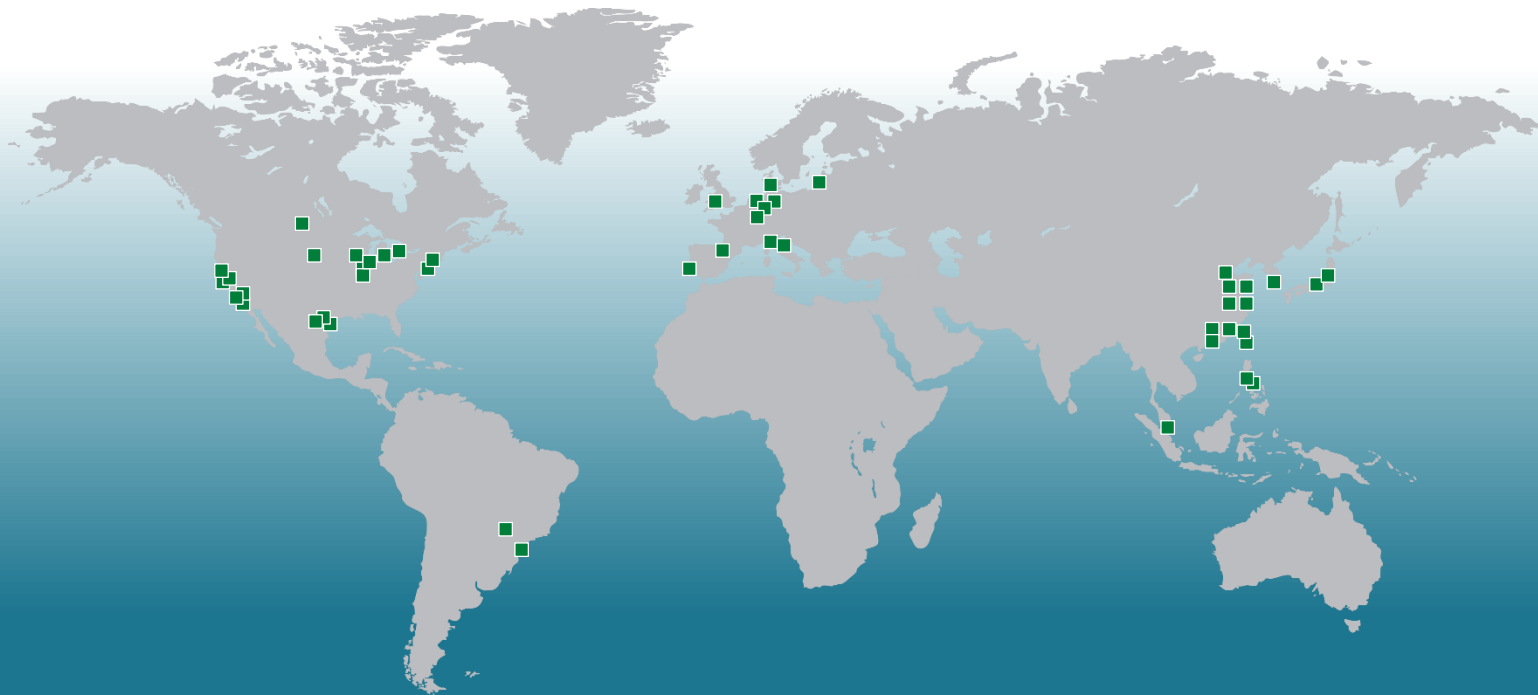
IXTL2N450



Nomenclature



Global Footprint – R&D, Manufacturing & Support



Global Footprint – R&D, Manufacturing & Support

Americas

Chicago, Illinois, USA (S)
Aliso Viejo, California, USA (RD, M)
Fremont, California, USA (RD, M)
Long Beach, California, USA (RD, M)
Milpitas, California, USA (RD, M)
Orange, California, USA (M)
Santa Clara, California, USA (M)
Champaign, Illinois, USA (RD)
Mount Prospect, Illinois, USA (RD)
Beverly, Massachusetts, USA (RD, M)
Boston, Massachusetts, USA (S, RD)
Troy, Michigan, USA (S)
Rapid City, South Dakota, USA (S, RD, M)
Lake Mills, Wisconsin, USA (S, RD)
Manaus, Brazil (S)
São Paulo, Brazil (S)
Burlington, Canada (S)
Saskatoon, Canada (S, RD)
Matamoros, Mexico (M)
Muzquiz, Mexico (M)
Piedras Negras, Mexico (RD, M)

Europe

Bremen, Germany (S, RD)
Essen, Germany (S)
Lampertheim, Germany (RD, M)
Lauf, Germany (S)
Legnago, Italy (RD, M)
Ozegna, Italy (RD, M)
Kaunas, Lithuania (RD, M)
Amsterdam, Netherlands (S)
Deventer, Netherlands (S)
Leiden, Netherlands (S)
Charneca de Caparica, Portugal (M)
San Sebastian, Spain (RD)
Chippenhams, United Kingdom (RD, M)

Asia

Beijing, China (S)
Chu-Pei, Taiwan, China (RD)
Dongguan, China (RD, M)
Hong Kong, China (S)
Kunshan, China (RD, M)
Shanghai, China (S, RD, M)
Suzhou, China (S, RD, M)
Taipei, Taiwan, China (S)
Wuxi, China (RD, M)
Tokyo, Japan (S)
Tsukuba, Japan (RD, M)
Seoul, South Korea (S)
Lipa City, Philippines (RD, M)
Taguig City, Philippines (M)
Singapore (S)

S–International Sales
RD–Research & Development
M–Manufacturing