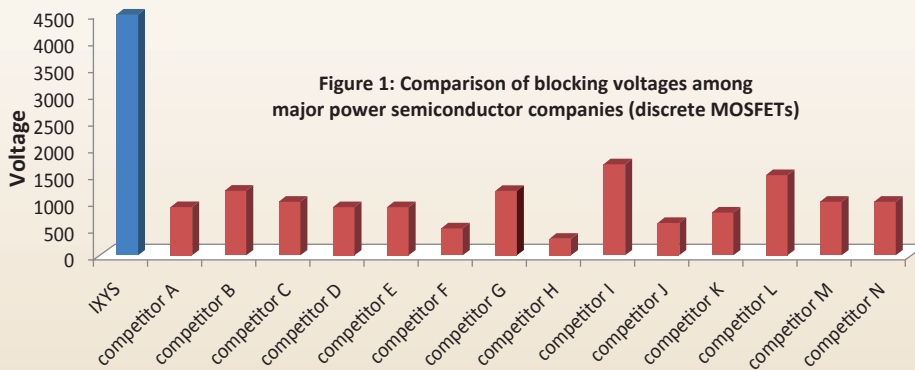




## IXYS Power MOSFETs, Modules, and Gate Drivers (From 75V to 4500V)

### IXYS Power MOSFET Technologies

IXYS Corporation (NASDAQ: IXYS) possesses unique Power MOSFET technologies and boasts the largest possible selection of power semiconductor product lines in the industry. In addition to conventional power devices, IXYS' portfolios include, among others, linear and depletion mode Power MOSFETs. Moreover, when it comes to very high-voltage, high-power discrete MOSFETs, IXYS stands head and shoulders above competition as can be seen from Figure 1 below. Plus, power modules with various configurations (half-bridge, full-bridge, six-pack, buck, and boost) are available. IXYS Integrated Circuits Division also offers gate drivers for discrete MOSFETs as well as for modules. More often than not customers can rely on IXYS for a complete power semiconductor solution.



### Proprietary Packaging Technologies

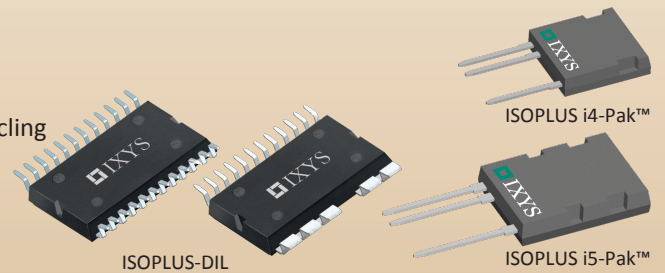
At high voltage and power levels, it is critical that heat dissipated in the power system be removed efficiently, and the characteristics of the package are as important as the chip itself and could become a limiting factor. Among many of proprietary packaging technologies IXYS has developed to deal with the issue include ISOPLUS™ and High-Voltage packages.

#### ISOPLUS™ Packages

- ISOPLUS i4-Pak™
- ISOPLUS i5-Pak™
- ISOPLUS-DIL™

#### Features

- Low thermal resistance
- Increase power and temperature cycling
- High reliability
- Reduced EMI
- 3, 4, 5 lead configurations available

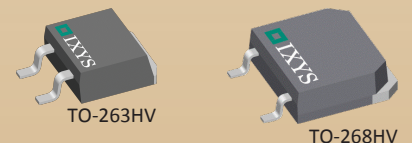


#### High Voltage Packages

- TO-263HV
- TO-268HV
- TO-247HV (coming soon)
- TO-264HV (coming soon)

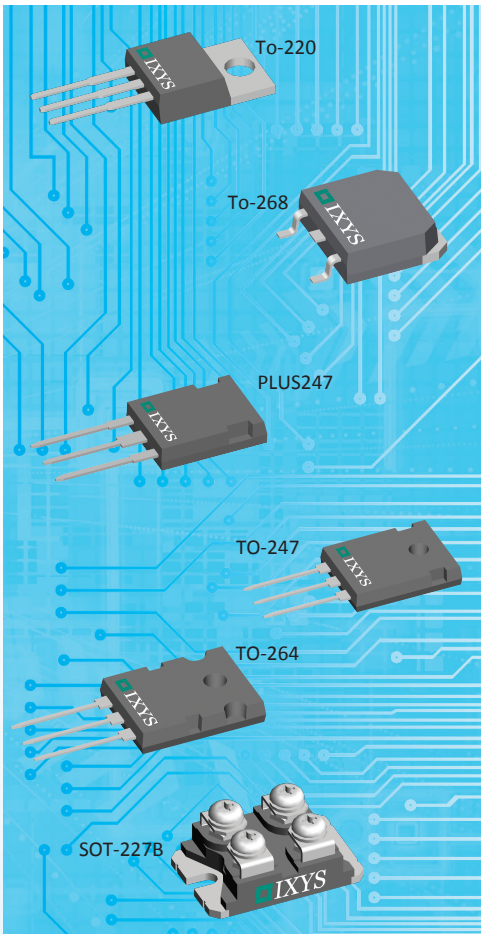
#### Features

- Increased creepage distance between leads
- Arc-prevention in high voltage applications
- Electrically isolated tab for heat sinking
- Excellent thermal performance
- Best-in-class power and temperature cycling

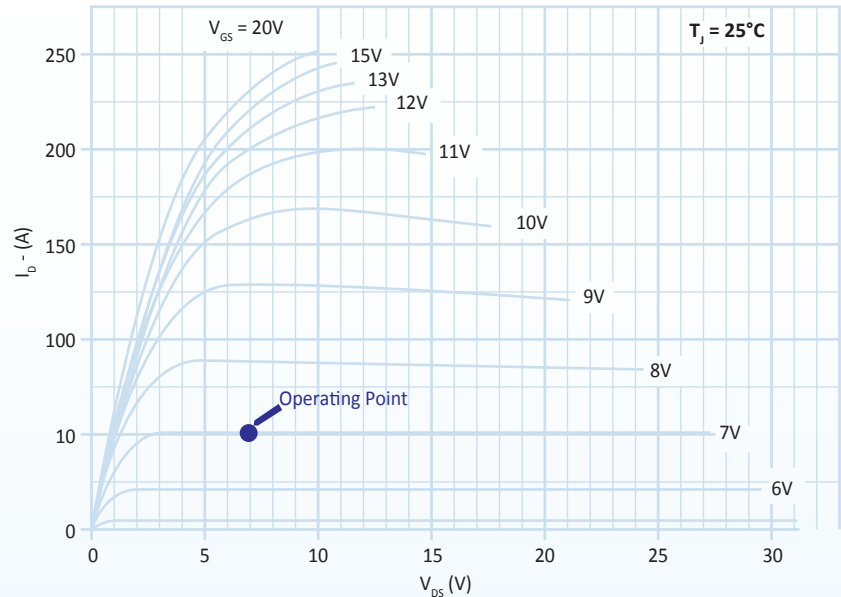


# 75V-600V LinearL2™ Power MOSFETs with Extended FBSOAs

Designed for high-power linear-mode applications



Tailored specifically for applications requiring Power MOSFETs to operate in their current saturation regions, these unique devices feature low thermal resistances, high power density, and extended Forward Bias Safe Operating Areas (FBSOA).



Extended Output Characteristics: IXTA80N075L2

## Extended Forward Bias Safe Operating Areas (FBSOA)

When Power MOSFETs are utilized in linear-mode operation, as opposed to their conventional switch-mode one, they are required to endure substantially high thermal and electrical stresses due to the simultaneous occurrence of high drain voltages and currents; these extreme stresses can cause typical devices to fail.

IXYS LinearL2™ Power MOSFETs have been designed to address these kinds of device failures – the FBSOAs are “extended” when the positive feedback of electro-thermal instability is suppressed, giving rise to larger “operating windows.” The FBSOAs are guaranteed at 75°C. The  $R_{DS(on)}$  of the MOSFET is not that relevant in these kinds of linear-mode high-power dissipation applications. The figure above demonstrates a possible operating point for the IXTA80N075L2.

### FEATURES

- Designed for linear operation
- Guaranteed FBSOA at 75°C
- Avalanche rated
- International standard packages
- UL 94 V-0 Flammability qualified (molding epoxies)

### ADVANTAGES

- High power density
- Easy to mount
- Space savings

### APPLICATIONS

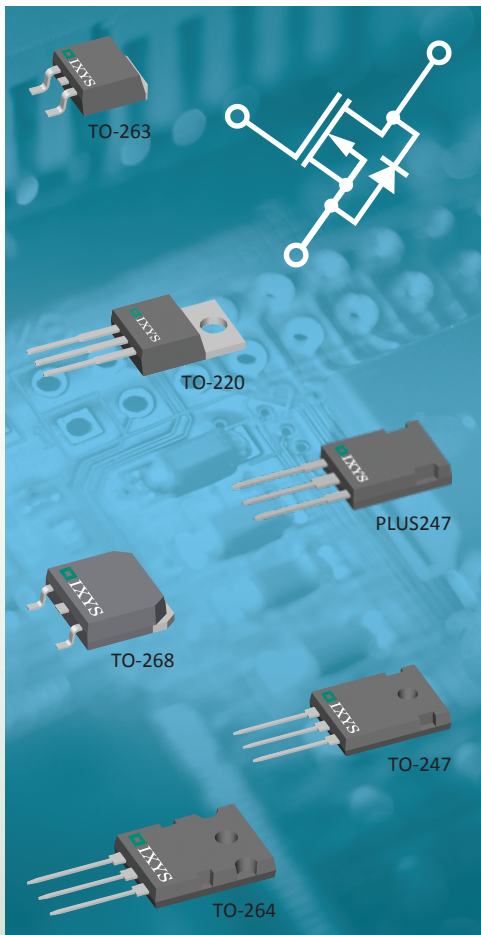
- Current regulators
- Fan controllers
- Linear amplifiers
- Programmable loads
- Soft start controls
- Solid state circuit breakers

## Partial Parts List (75V-600V, 15A-200A)

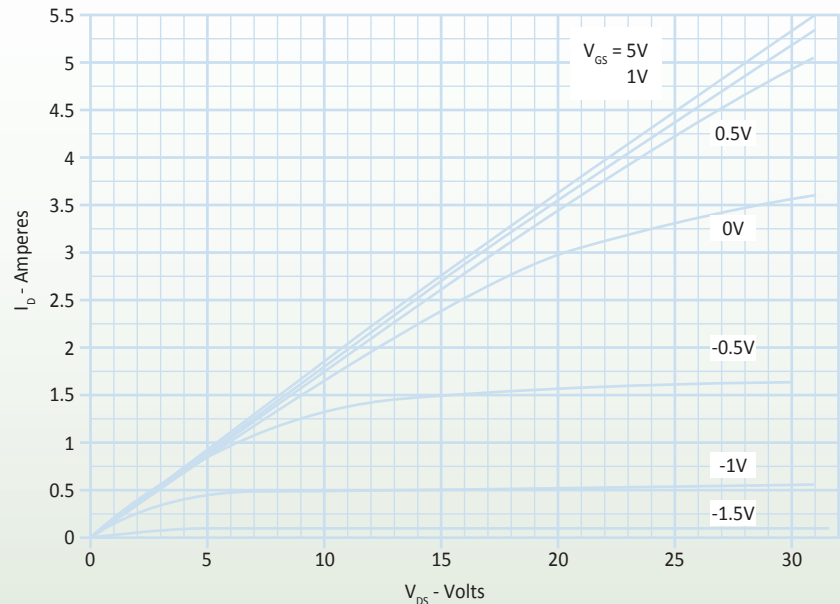
Part Number	$V_{DS}$ max (V)	$I_{D(Cont)}$ $T_c = 25^\circ C$ (A)	$R_{thJC}$ max (°C/W)	$R_{DS(on)}$ max $T_J = 25^\circ C$ ( $\Omega$ )	SOA Rating $T_c = 75^\circ C$	$Q_g$ typ (nC)	$P_D$ (W)	Package Style
IXTP80N075L2	75	80	0.35	0.24	$I_D = 3A$ at $V_{DS} = 75V$	103	357	TO-220
IXTK200N10L2	100	200	0.12	0.011	$I_D = 6.25A$ at $V_{DS} = 100V$	540	1040	TO-264
IXTT60N20L2	200	60	0.23	0.045	$I_D = 1.2A$ at $V_{DS} = 200V$	255	540	TO-268
IXTX90N25L2	250	90	0.13	0.033	$I_D = 2.3A$ at $V_{DS} = 250V$	640	960	PLUS247
IXTN60N50L2	500	53	0.17	0.1	$I_D = 0.9A$ at $V_{DS} = 400V$	610	735	SOT-227
IXTH30N60L2	600	30	0.23	0.24	$I_D = 0.6A$ at $V_{DS} = 480V$	335	540	TO-247

# 100V-1700V Depletion-Mode D2™ Power MOSFETs

For zero-power “Normally-On” load-switch designs



As opposed to the enhancement-mode MOSFETs, these depletion-mode devices operate in a ‘normally-on’ mode, requiring zero turn-on voltage at the gate terminal. With blocking voltages up to 1700V and low drain-to-source resistances they provide simplified control and reduced power dissipation in systems that are continuously “on” (emergency or burglar alarms, for instance).



Output characteristics – IXTH2N170D2

## “Normally-On” operation

The drain current of a depletion-mode Power MOSFET flows when its gate terminal is at zero volt, and hence the name ‘normally-on.’ A negative bias voltage is required to turn the device off, reducing the current to micro amperes. These devices, therefore, need only simple biasing schemes. And with a high enough drain-to-source voltage, they behave almost like ideal current sources, exhibiting very high output impedances. The combination of these two characteristics makes them excellent for current regulator applications, in particular. The IXTH2N170D2, for instance, exhibits such qualities, as shown in the figure above.

### FEATURES

- ‘Normally-On’ operation
- Linear mode tolerant
- Low  $R_{DS(on)}$
- Useable body diode
- Internal standard packages
- UL 94 V-0 Flammability qualified (molding epoxies)

### ADVANTAGES

- Simplified control
- Easy to mount
- Space savings
- High power density

### APPLICATIONS

- Audio amplifiers
- Start-up circuits
- Protection circuits
- Ramp generators
- Current regulators
- Active loads

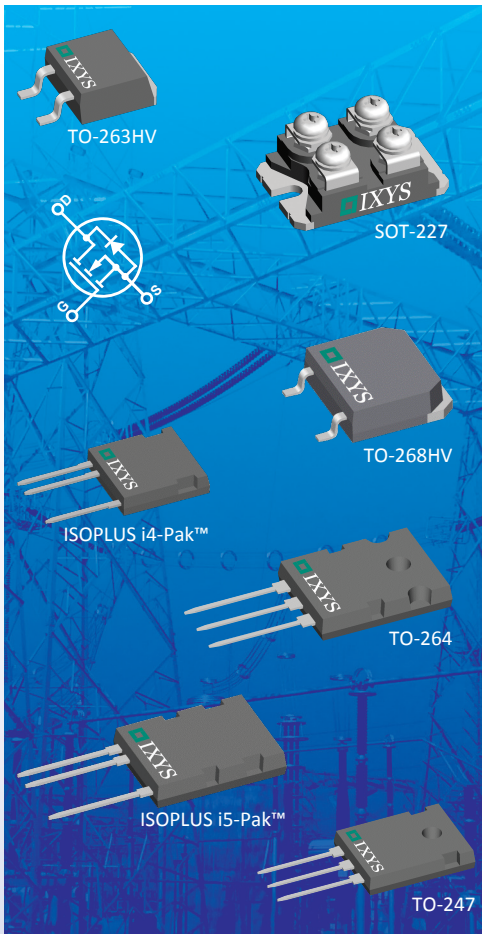
## Partial Parts List (100V-1700V, 800mA-16A)

Part Number	$V_{DSS}$ max (V)	$I_D$ $T_c=25^\circ C$ (A)	$R_{DS(on)}$ $T_j=25^\circ C$ ( $\Omega$ )	$V_{GS(off)}$ max (V)	$C_{iss}$ typ (pF)	$R_{thJC}$ max ( $^\circ C/W$ )	$Q_g$ typ (nC)	$P_D$ (W)	Package Type
IXTH16N10D2	100	16	0.064	-4	5700	0.18	225	695	TO-247
IXTT16N20D2	200	16	0.08	-4	5500	0.18	208	695	TO-268
IXTP08N50D2	500	0.8	4.6	-4	312	2.08	12.7	60	TO-220
IXTT16N50D2	500	16	0.24	-4	5250	0.18	199	695	TO-268
IXTH10N100D2	1000	10	1.5	-4.5	5320	0.18	200	695	TO-247
IXTT2N170D2	1700	2	6.5	-4	3650	0.22	110	568	TO-268
IXTH2N170D2	1700	2	6.5	-4	3650	0.22	110	568	TO-247



# 2500V and 4500V Power MOSFETs

## Ideal for very high voltage power conversion applications



With breakdown voltage ratings of 2500V and 4500V, these N-channel devices are the highest voltage discrete Power MOSFETs available in the power semiconductor industry. The current ratings range from 200mA to 2A. They are specifically designed to address demanding, fast-switching power conversion applications requiring very high blocking voltages up to 4.5kV.

### Increased creepage distance

Housed in the proprietary high voltage versions of the international standard size packages, these devices have increased creepage distance between leads, preventing arcing encountered in high voltage applications; for instance, the creepage distance of the TO-263HV and TO-268HV has approximately increased 2 times to 4.28mm and 9.6mm, respectively.

### 4500V isolation (DCB) and excellent thermal performance

A ceramic isolation of up to 4.5kV is achieved with the Direct Copper Bond (DCB) substrate technology – an electrically isolated tab is provided for heat sinking. The DCB provides low thermal impedance and best-in-class power and temperature cycling capabilities. The ISOPLUS i4-Pak™ and ISOPLUS i5-Pak™ packages display these qualities.

### PCB space savings (elimination of multiple series-connected devices)

Thanks to the positive temperature coefficient of their on-state resistance, these very high voltage MOSFETs are ideally suited for parallel device operation, which provides cost-effective solutions compared to series-connected, lower-voltage MOSFET ones. This also results in reduction in the associated gate drive circuitry, further simplifying the design, saving PCB board space, and improving the reliability of the overall system.

### 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 saving (eliminates multiple series-connected devices)
- Easy mounting

### APPLICATIONS

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

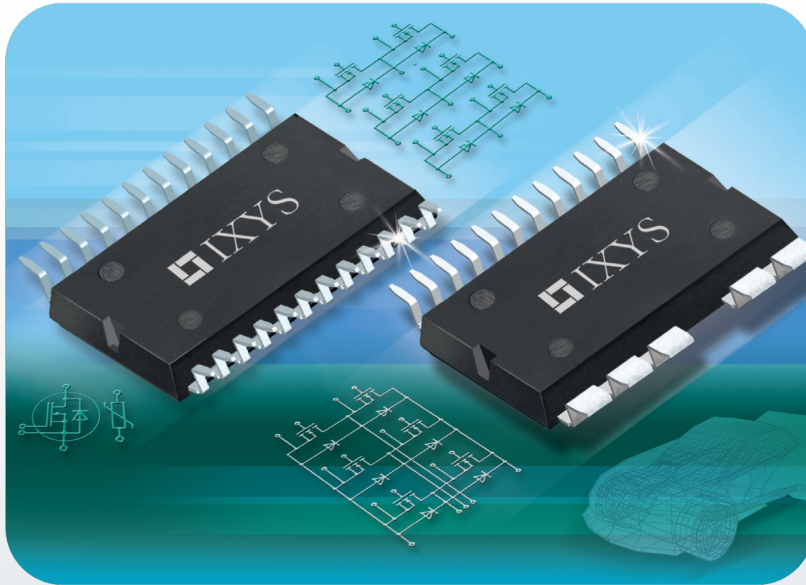
## Available Parts (2500V and 4500V, 200mA-5A)

Part Number	V <sub>DSS</sub> (V)	I <sub>D(cont)</sub> TC = 25°C (A)	R <sub>DS(on)</sub> max. T <sub>J</sub> =25°C (Ω)	C <sub>iss</sub> typ. (pF)	Q <sub>g</sub> typ. (nC)	t <sub>rr</sub> typ. (μs)	R <sub>th(jc)</sub> max. (°C/W)	P <sub>D</sub> (W)	Package Style
IXTA02N250HV	2500	0.2	450	116	7.4	1.5	1.5	83	TO-263HV
IXTF1N250	2500	1	40	1660	41	2.5	1.13	110	ISOPLUS i4-Pak™
IXTH1N250	2500	1.5	40	1660	41	2.5	0.5	250	TO-247
IXTK5N250	2500	5	8.8	8560	200	1.2	0.13	960	TO-264
IXTN5N250	2500	5	8.8	8560	200	1.2	0.18	700	SOT-227
IXTA02N50HV	4500	0.2	750	256	10.4	1.6	1.1	113	TO-263HV
IXTF02N450	4500	0.2	750	256	10.4	1.6	1.6	78	ISOPLUS i4-Pak™
IXTT02N450HV	4500	0.2	750	256	10.4	1.6	1.1	113	TO-268HV
IXTF1N450	4500	0.9	85	1730	40	1.75	0.77	165	ISOPLUS i4-Pak™
IXTT1N450HV	4500	1	85	1730	40	1.75	0.24	520	TO-268HV
IXTL2N450	4500	2	23	6900	156	1.75	0.56	220	ISOPLUS i5-Pak™

# 75V-100V Six-Pack Trench MOSFET Modules in ISOPLUS-DIL™ Package

## Optimized for automotive applications

Housed in a proprietary compact dual-in-line package and constructed with IXYS' Trench Technology, these six-pack MOSFET modules are designed for automotive power switching applications. Capable of carrying current up to 265A and able to dissipate heat efficiently through the Direct Copper Bond (DCB) ceramic isolation, they are well suited for such designs as electric power steering, starter generator, fork lift drive, and propulsion drive systems.



### The ISOPLUS-DIL™ Package

This is a surface-mountable DCB isolated package available in two configurations: 1) 12 leads on one side and 300A power pins on the other 2) 12 leads on both sides. It is just 37.5mm long and 25mm wide and intended for high-current, low-voltage (less than 200V) applications. The ISOPLUS™ advantage also facilitates having multiple dice on the same single substrate – in addition to the six-pack topology, buck, boost, half-bridge, and full-bridge configurations are implementable.

### Direct Copper Bond (DCB) Isolation

A high-voltage ceramic isolation is achieved with the DCB substrate technology – an electrically isolated tab is provided for heat sinking. The DCB provides low thermal impedance and best-in-class power and temperature cycling capabilities.

#### FEATURES

- Low  $R_{DS(on)}$
- Optimized intrinsic diode
- ISOPLUS-DIL™ package offers
  - High level of integration
  - High current carrying capability
  - Auxiliary leads for control
  - DCB isolated ceramic base plate for optimal heat transfer
  - Space saving and weight reduction

#### ADVANTAGES

- High reliability
- Easy assembly
- Low EMI
- High efficiency

#### APPLICATIONS

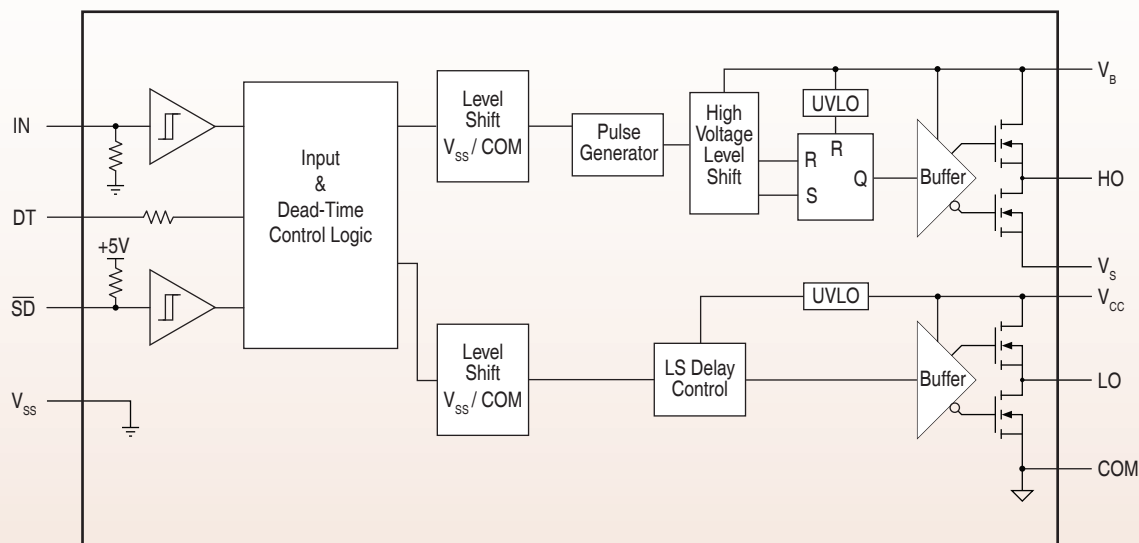
- Electric power steering
- Starter generator
- Water pumps
- Fork lift drives
- Active suspension
- Propulsion drive systems

## Available Parts

Part Number	$V_{DS\ max}$ (V)	$I_{D25}$ $T_c = 25^\circ C$ A	$I_{D90}$ $T_c = 90^\circ C$ A	$R_{DS(on)\ typ.}$ $T_c = 25^\circ C$ m $\Omega$	$C_{iss}$ typ nF	$Q_g$ typ nC	$R_{thjc}$ K/W
MTI 200WX75GD	75	265	200	1.1	10.8	155	0.85
MTI 85W100GC	100	110	83	3.2	6.3	90	1.45
MTI 145WX100GD	100	190	145	1.7	11	155	0.85

# 600V High Voltage Half-Bridge Gate Driver (IX21844)

The IX21844 is a high voltage IC that can drive high speed MOSFETs and IGBTs that operate up to +600V. The IX21844 is configured with dependent high-side and low side referenced output channels which can source 1.4A and sink 1.8A. The floating high-side channel can drive an N-channel power MOSFET or IGBT 600V from the common reference. Manufactured on IXYS Integrated Circuits Division's proprietary high-voltage BCDMOS on SOI (silicon on isolator) process, the IX21844 is extremely robust and virtually immune to negative transients. The UVLO circuit prevents the turn-on of the MOSFET or IGBT until there is sufficient  $V_{BS}$  or  $V_{CC}$  supply voltage. A programmable dead-time can be set between 400ns and 5us to insure that both the high-side and low-side power MOSFET or IGBT are not enabled at the same time. Propagation delays are matched for use in high frequency applications. The IX21844 is available in 14-pin DIP and 14-pin SOIC (narrow body) packages. The 14-pin SOIC (narrow body) package is also available in tape & reel.



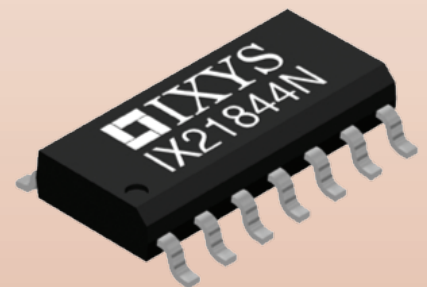
IX21844 Functional Block Diagram

## FEATURES

- Floating Channel for Bootstrap Operation to +600V with an Absolute Maximum Rating of +700V
- Programmable Dead-Time
- Outputs Can Source 1.4A and Sink 1.8A
- Gate Drive Supply Range From 10V to 20V
- Tolerant to Negative Voltage Transients: dV/dt Immune
- 3.3V and 5V Logic Compatible
- UndervoltageLockout for Both High-side and Low-Side Outputs
- Matched Propagation Delays

## APPLICATIONS

- Switch Mode Power Supply
- Motor Driver Inverter
- DC/DC Converter
- Uninterruptible Power Supplies (UPS)



## Driver Characteristics

Parameter	Rating	Units
$V_{\text{OFFSET}}$	600	V
$I_{O \text{ +/- (Source/Sink)}}$	1.4 / 1.8	A
$V_{\text{BIAS}}$	10-20	V

## Ordering Information

Part	Description
IX21844G	14-Pin DIP (25/Tube)
IX21844N	14-Pin SOIC (Narrow Body) (50/Tube)
IX21844NTR	14-Pin SOIC (Narrow Body) (2000/Reel)