

Press-pack IGBT's

Devices, assemblies & supporting products

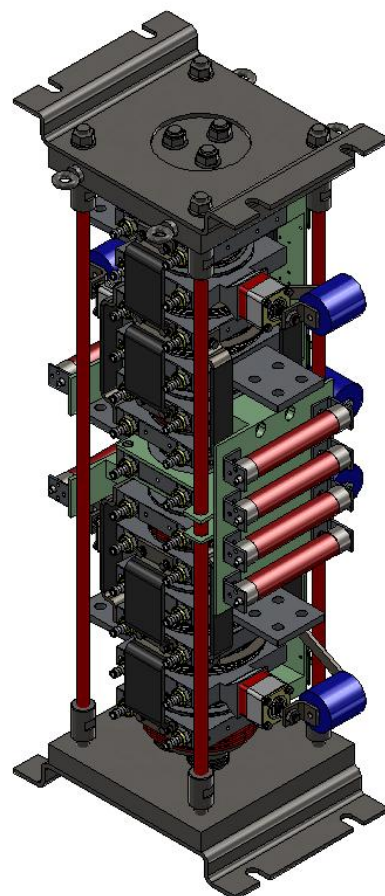
IUK-TSM-2014-003

Issue 2, Feb 2015

With a track record spanning more than 15 years as a leading innovator in press-pack IGBT technology, IXYS UK is proud to offer their range of 2.5kV, 4.5kV and new 6.5kV devices featuring the latest generation chipsets offering improved SOA.

In addition to the range of press-pack IGBT capsules, IXYS UK can also offer standard and custom design IGBT assemblies including the new 10kV, 6.6kV and 3.3kV 3-level inverter phase legs.

To support these products, IXYS UK can supply IGBT gate drives specifically designed to work with the press-pack IGBT's and a range of clamps, coolers and ancillary components.



Applications



- Medium voltage drives
 - Marine drives
 - Traction
 - Wind power converters
 - Industrial
- Energy utilities
 - STATCOM
 - FACTS
 - Active VAr controllers
 - Renewable generation



Image courtesy of CKD Elektrotechnika

Press-pack IGBT's

IXYS UK's press-pack IGBT's utilise an enhanced planar cell technology, delivering comparable $V_{CE(sat)}$ to modern trench designs whilst retaining the superior RBSOA, SCSOA performance and easy driving characteristics of traditional planar technology. When combined with IXYS UK's proven hermetic press-pack technology, these devices re-define the state-of-the-art for high power switching devices.

Available in a range of packages with electrode diameters of up to 132mm, IXYS UK can offer both reverse conducting and asymmetric blocking types available.

Improved diode chips complement the IGBT and offer breakthrough levels of performance and a choice of diode to IGBT ratio enables full utilisation of the IGBT in reverse conducting applications.

IXYS UK's new generation HP-sonic monolithic diodes complement the 2.5kV and 4.5kV asymmetric IGBT range and also support such applications as multi-level diode clamped converters. New multi-chip 6.5kV diodes are now available to support the new 6.5kV asymmetric IGBT's

Press-pack IGBT's are now gaining significant market share in the high performance medium voltage drive sector in the 2MW to 30MW and beyond range. They offer all the benefits of conventional IGBT's and more, over alternative bipolar technology while maintaining the high reliability levels associated with press-pack devices in these systems.

| Part No. | V_{CES} V | I_C A | $V_{CE(sat)}$ $I_C=I_C$ V | Reverse Conducting | Diode V_F $I_F=I_C$ V | T_{JMAX} °C | Outline |
|------------|----------------|------------|---------------------------------|-----------------------|-------------------------------|------------------|---------|
| T0360ND25A | 2500 | 360 | 3.07 | Y | 2.25 | 125 | W40 |
| T0500ND25E | 2500 | 500 | 3.06 | N | N/A | 125 | W40 |
| T0570VD25G | 2500 | 570 | 3.06 | Y | 2.01 | 125 | W67 |
| T0850VD25E | 2500 | 850 | 3.04 | N | N/A | 125 | W67 |
| T1200TD25A | 2500 | 1200 | 3.15 | Y | 2.50 | 125 | W41 |
| T1500TD25E | 2500 | 1500 | 3.06 | N | N/A | 125 | W41 |
| T2250AD25E | 2500 | 2250 | 3.03 | N | N/A | 125 | W71 |

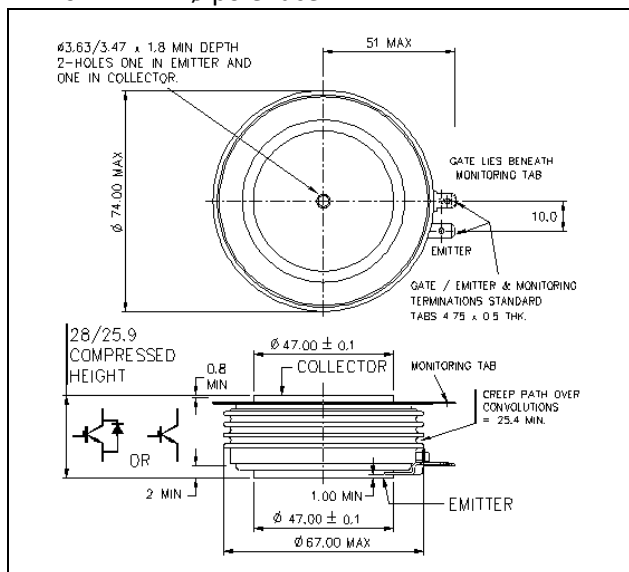
| | | | | | | | |
|------------|------|------|-----|---|------|-----|-----|
| T0160NB45A | 4500 | 160 | 3.4 | Y | 3.75 | 125 | W40 |
| T0240NB45E | 4500 | 240 | 3.8 | N | N/A | 125 | W40 |
| T0340VB45G | 4500 | 340 | 3.5 | Y | 3.45 | 125 | W67 |
| T0510VB45E | 4500 | 510 | 3.6 | N | N/A | 125 | W67 |
| T0600TB45A | 4500 | 600 | 3.7 | Y | 3.9 | 125 | W41 |
| T0800TB45E | 4500 | 800 | 3.5 | N | N/A | 125 | W41 |
| T0800EB45G | 4500 | 800 | 3.6 | Y | 3.5 | 125 | W44 |
| T0900EB45A | 4500 | 900 | 3.8 | Y | 3.9 | 125 | W44 |
| T1200EB45E | 4500 | 1200 | 3.6 | N | N/A | 125 | W44 |
| T1600GB45G | 4500 | 1600 | 3.5 | Y | 3.45 | 125 | W45 |
| T1800GB45A | 4500 | 1800 | 3.6 | Y | 3.9 | 125 | W45 |
| T2400GB45E | 4500 | 2400 | 3.6 | N | N/A | 125 | W45 |

| | | | | | | | |
|------------|------|------|------|---|------|-----|------|
| T0258HF65G | 6500 | 258 | 4.80 | Y | 3.45 | 125 | W95 |
| T0385HF65E | 6500 | 385 | 4.80 | N | N/A | 125 | W95 |
| T0600AF65G | 6500 | 600 | 4.80 | Y | 3.45 | 125 | W98 |
| T0900AF65E | 6500 | 900 | 4.80 | N | N/A | 125 | W98 |
| T0900DF65A | 6500 | 900 | 4.80 | Y | 3.40 | 125 | W96 |
| T1290BF65A | 6500 | 1290 | 4.80 | Y | 3.60 | 125 | W103 |
| T1375DF65E | 6500 | 1375 | 4.80 | N | N/A | 125 | W96 |
| T1890BF65E | 6500 | 1890 | 4.80 | N | N/A | 125 | W103 |

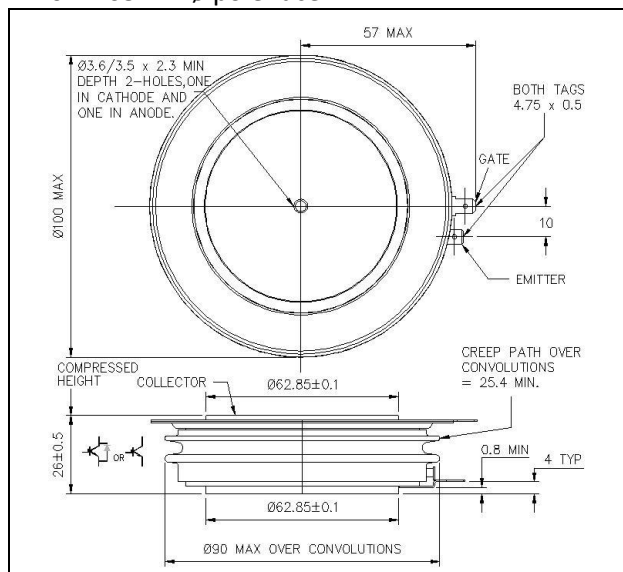
Features and benefits

- Bondless construction for improved reliability
- Hermetic devices suitable for all cooling options including direct liquid immersion
- Explosion and rupture resistant (at more than 10 times the energy of a similarly rated module)
- High thermal cycling resistance
- Double side cooling
- Mechanically compatible with GTO thyristors, allowing

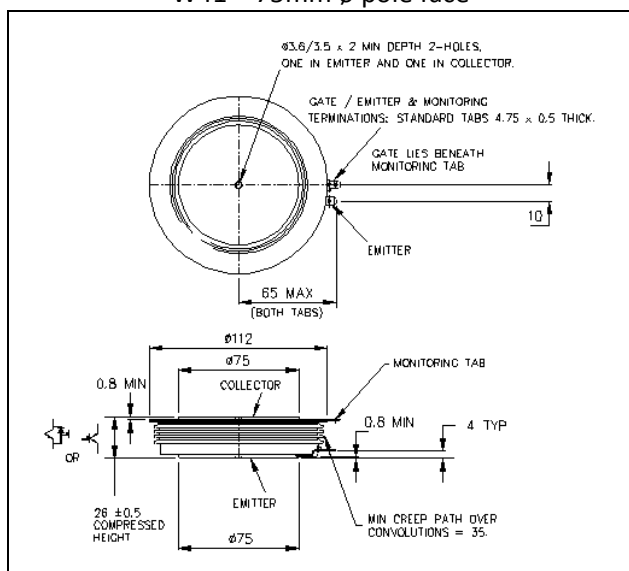
W40 – 47mm \varnothing pole face



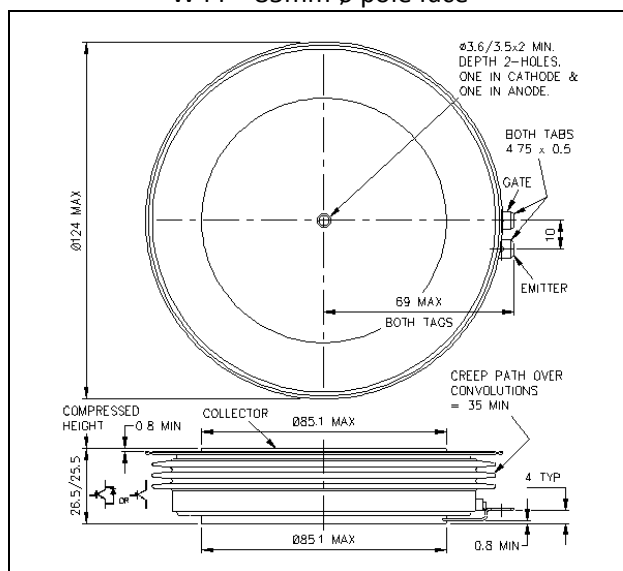
W67 – 63mm \varnothing pole face



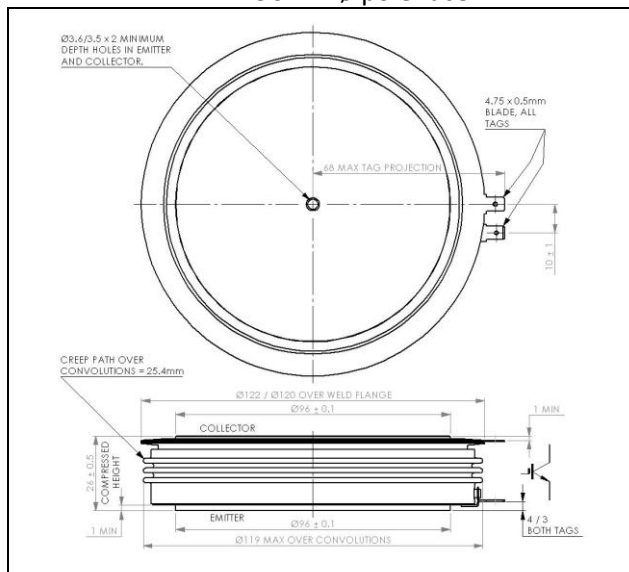
W41 – 75mm \varnothing pole face



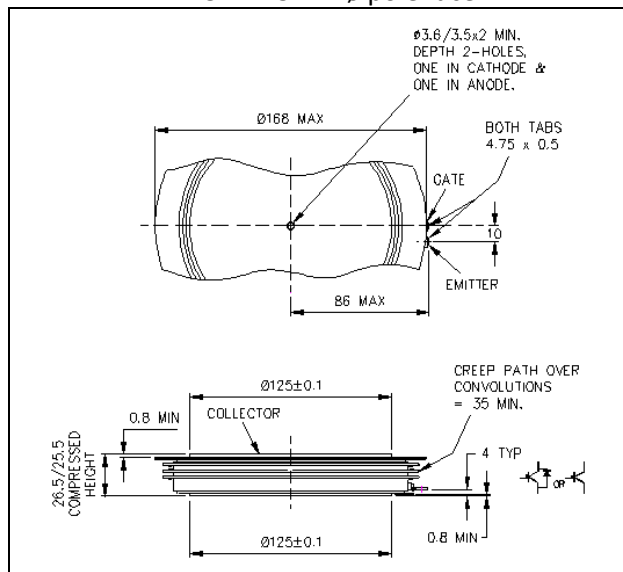
W44 – 85mm \varnothing pole face



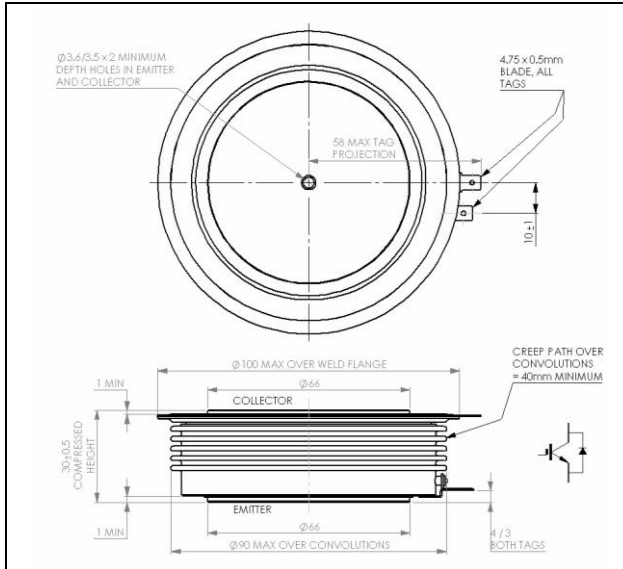
W71 – 96mm \varnothing pole face



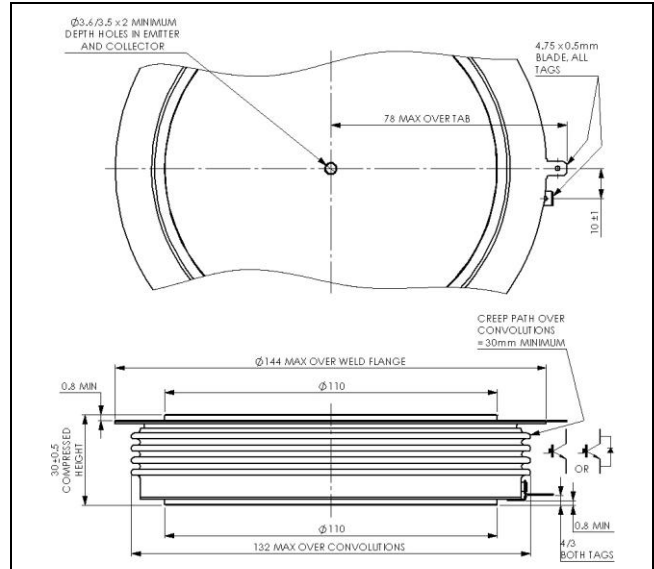
W45 – 125mm \varnothing pole face



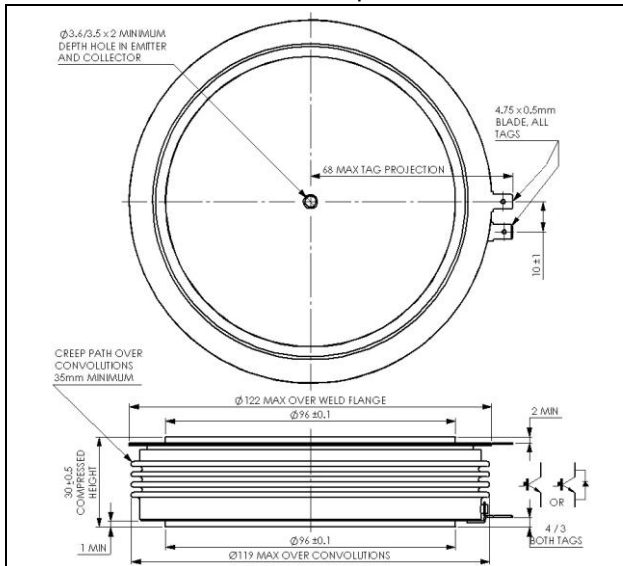
W95 – 66mm \varnothing pole face



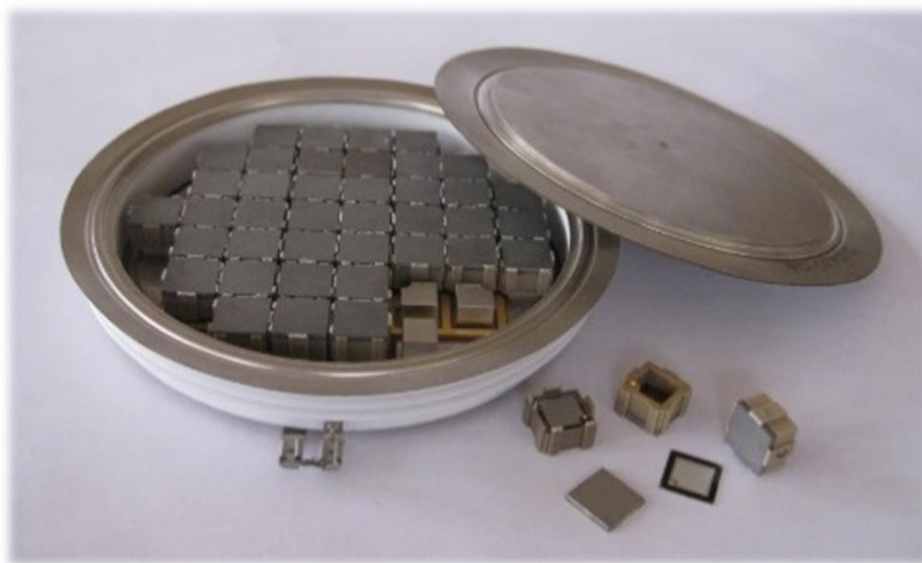
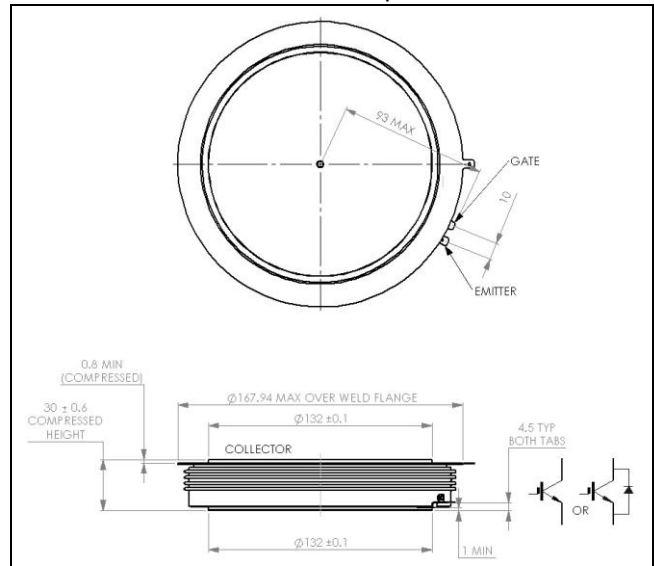
W96 – 110mm \varnothing pole face



W98 - 96mm \varnothing pole face



W103 - 132mm \varnothing pole face



New generation high-power sonic fast recovery diodes

Improved safe operating area (SOA) and reverse recovery characteristics for our 2.5kV, 4.5kV HP-sonic monolithic diode range complements our new asymmetric IGBT range and also supports such applications as multi-level diode clamped converters. Also available are a new range of multi-chip 6.5kV diodes suitable for the new 6.5kV asymmetric IGBT's.

These diodes incorporate a unique manufacturing process and lifetime control to offer a class leading trade-off between conduction and switching losses. The wide SOA makes them ideal as freewheeling diodes for snubberless IGBT and IGCT applications.

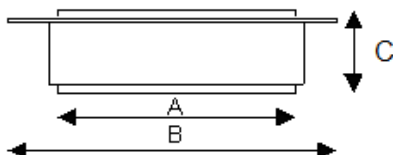
Features

- Robust dynamic characteristics – $di/dt > 4000A/\mu s$
- Up to 150°C operating junction temperature
- Soft fast recovery – no snap off
- Low recovery losses, low forward voltage drop
- Snubberless operation

Applications

- Anti-parallel diodes of IGBT's and IGCT's
- Clamp and snubber diodes
- Any application which requires a fast low loss diode
- Ideally suited for:
 - Traction
 - Medium voltage drives
 - Renewables
 - Induction heating
 - Pulsed power applications

| Part No. | V_{RRM} | I_{FAV} $T_K=55^\circ C$ | I_{FSM} 10ms ½ sine $V_R \leq 60\% V_{RRM}$ | I^2t $V_R \leq 60\% V_{RRM}$ | V_{T0} | r_T | T_{JM} | R_{thJK} 180° Sine | Dimension mm | | |
|---------------|-----------|-------------------------------|---|-----------------------------------|----------|-------|----------|----------------------------|-----------------|-----|--------------------|
| | V | A | A | A ² s | V | mΩ | °C | K/W | A | B | C |
| | | | | | | | | | | | |
| E0170YC40-45C | 4000-4500 | 210 | 1390 | 9.67×10^3 | 2.580 | 7.170 | 150 | 0.073 | 25 | 42 | 26 |
| E0280YH20-25C | 2000-2500 | 350 | 2330 | 27.1×10^3 | 1.410 | 2.600 | 150 | 0.073 | 25 | 42 | 26 |
| E0330MF65F | 6500 | 277 | 3070 | 47.1×10^3 | 1.890 | 5.800 | 125 | 0.043 | 50 | 75 | 30 |
| E0460QC40-45C | 4000-4500 | 532 | 5750 | 165×10^3 | 2.150 | 3.040 | 150 | 0.029 | 38 | 60 | 26 |
| E0660N#40-45C | 4000-4500 | 765 | 7318 | 268×10^3 | 2.000 | 2.236 | 150 | 0.020 | 47 | 74 | NC – 26 NH – 14 |
| E0770HF65F | 6500 | 632 | 7060 | 249×10^3 | 1.890 | 2.358 | 125 | 0.019 | 66 | 100 | 30 |
| E0800QC20-25C | 2000-2500 | 960 | 10700 | 575×10^3 | 1.410 | 0.839 | 150 | 0.029 | 38 | 60 | 26 |
| E1000TF65F | 6500 | 915 | 10400 | 537×10^3 | 2.291 | 1.185 | 125 | 0.015 | 75 | 112 | 30 |
| E1200NC20-25C | 2000-2500 | 1338 | 13300 | 884×10^3 | 1.305 | 0.678 | 150 | 0.020 | 47 | 74 | 26 |
| E1300VF40-45C | 4000-4500 | 1350 | 14000 | 1.08×10^6 | 2.310 | 0.930 | 150 | 0.013 | 63 | 100 | 26 |
| E1375EF65F# | 6500 | 1125 | 13400 | 898×10^3 | 1.890 | 1.423 | 125 | 0.011 | 85 | 124 | 30 |
| E1500N#36-48P | 3600-4800 | 1280 | 17050 | 1.45×10^6 | 1.417 | 0.656 | 140 | 0.019 | 47 | 74 | NC – 26 NH – 14 |
| E2060FF65F | 6500 | 1690 | 22100 | 2.44×10^6 | 1.890 | 0.951 | 125 | 0.007 | 100 | 144 | 30 |
| E2250VF20-25C | 2000-2500 | 2426 | 25200 | 3.17×10^6 | 1.510 | 0.250 | 150 | 0.013 | 63 | 100 | 26 |
| E2400TC40-45C | 4000-4500 | 2233 | 25600 | 3.29×10^6 | 2.060 | 0.590 | 150 | 0.008 | 75 | 112 | 26 |
| E4000TC20-25C | 2000-2500 | 4080 | 50000 | 12.5×10^6 | 1.406 | 0.149 | 150 | 0.008 | 75 | 112 | 26 |



IGBT Gate Drives

The C044BG400 IGBT Gate Driver is a low power consumption driver with on board VCE desaturation detection for high reliability application. The driver features a fibre-optic communication interface for drive, status and switching feedback signals. A fully supervised DC/DC converter with EMI filtering, low coupling capacitance and high partial discharge level is integrated into the board. The high voltage collector sense and gate interface are implemented on a separate card to allow close coupling to the IGBT. A range of pre-configured boards is available to complement IXYS UK's range of press-pack IGBTs – other applications on request.



| Part No. | IGBT Type |
|---------------|------------|
| C0044BG400SBK | T0160NB45A |
| C0044BG400SBL | T0240NB45E |
| C0044BG400SBQ | T0340VB45G |
| C0044BG400SBA | T0360ND25A |
| C0044BG400SBB | T0500ND25E |
| C0044BG400SBE | T0510VB45E |
| C0044BG400SBF | T0570VD25G |
| C0044BG400SBM | T0600TB45A |
| C0044BG400SBG | T0800EB45G |
| C0044BG400SBN | T0800TB45E |
| C0044BG400SBH | T0850VD25E |
| C0044BG400SBP | T0900EB45A |
| C0044BG400SBR | T1200EB45E |
| C0044BG400SBC | T1200TD25A |
| C0044BG400SBD | T1500TD25E |
| C0044BG400SBJ | T1600GB45G |
| C0044BG400SBS | T1800GB45A |
| C0044BG400SBV | T2250AD25E |
| C0044BG400SBT | T2400GB45E |

Features and benefits

- High reliability topology
- Designed for ultra-low power consumption
- Built in DC/DC converter with soft start
- Integrated input filter for low EMI
- Separate low impedance path for parasitic EMI currents
- PD-voltage levels available up to 11kV on request
- Low impedance from gate to emitter at start-up and power fail
- Monitoring of all secondary supply voltages
- Monitoring of IGBT switching status (V_{CE} de-sat condition)
- Soft switch-off at V_{CE} de-sat fault condition
- Fibre-optic links for switching commands and status control
- Low light protection for input signal
- Short-pulse suppression, configurable
- Balanced propagation delay time
- Gate current up to 44A
- Optional gate speed-up capacitors

6.5kV gate drives in development
Please contact IXYS UK for more information

Press-pack IGBT 3-level inverters

A range of 3-level topology assemblies using press-pack IGBT technology have been developed to serve applications at the highest end of the power market.

3 separate designs are available, a totally independent 3.3kV system, a 6.6kV system and a 10kV system. The 6.6kV and 10kV systems are based on the combination of 2 IGBT stacks and 1 diode stack. Each system benefits from direct water cooling to provide highly effective heat dissipation away from the devices and pre-loaded disc spring clamping to evenly distribute the applied force across the entire surface area of the device.

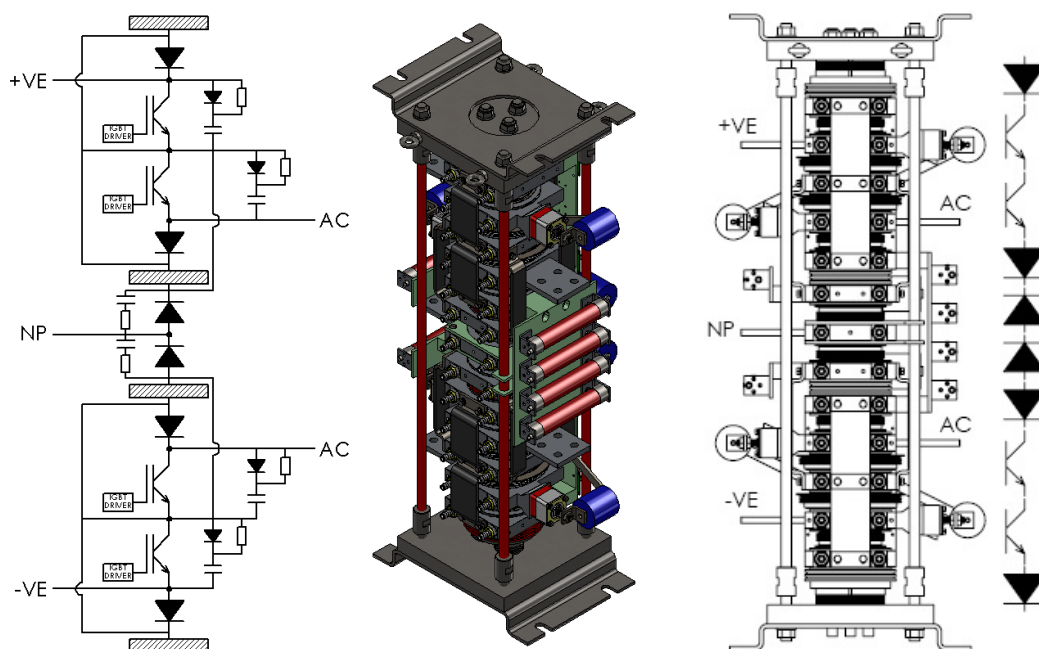
Also designed into each system is an integrated snubber circuit design and an isolated clamping rod system to limit the occurrence of eddy currents within the unit.

Features and benefits

- Direct water cooled for effective heat dissipation
- Pre-loaded clamping to evenly distribute the applied force
- Isolated clamping rod system
- Integrated snubber circuit
- Single unit mechanical configuration: Short inductance paths for relative size of unit to avoid high stray inductance
- Advanced optically fired gate trigger circuits

3.3kV system – Complete phase leg

| | |
|-----------------------------|------------|
| Power Rating (MW) | 8 |
| Nominal Line Current (Amps) | 1600 |
| No. of IGBT's | 4 |
| No. of Diodes | 6 |
| No. of Coolers | 13 |
| Required IGBT Type | T2400GB45E |
| Required Diode Type | E2400TC45C |

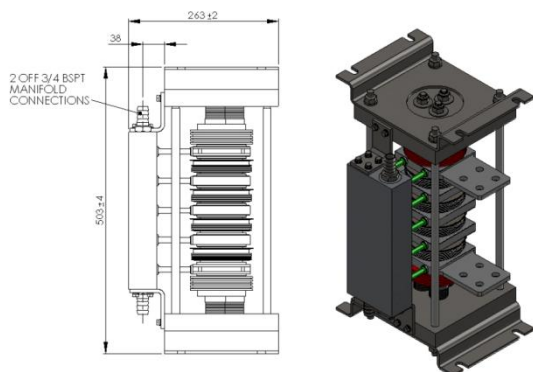


XA1600GV45WT

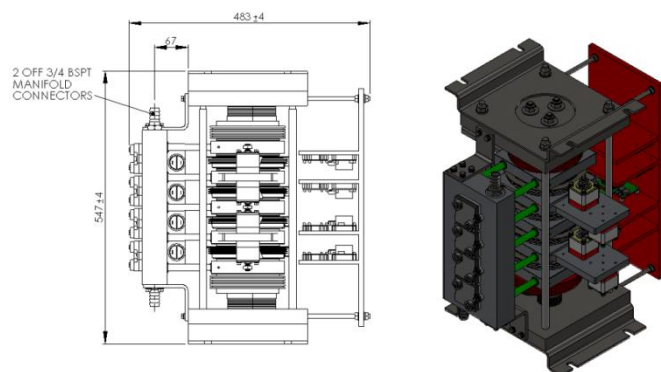
6.6kV system

Phase leg requirement – 2 × IGBT stack & 1 × diode stack

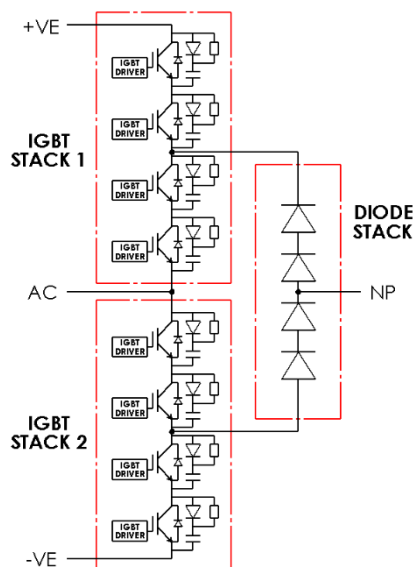
| | |
|-----------------------------|------------|
| Power Rating (MW) | 12 |
| Nominal Line Current (Amps) | 1000 |
| No. of IGBT's | 4 |
| No. of Diodes | 4 |
| No. of Coolers | 5 |
| Required IGBT Type | T1600GB45G |
| Required Diode Type | E2400TC45C |



Diode stack: XA1000TV45WE/B



IGBT stack: XA1000GV45WT/B

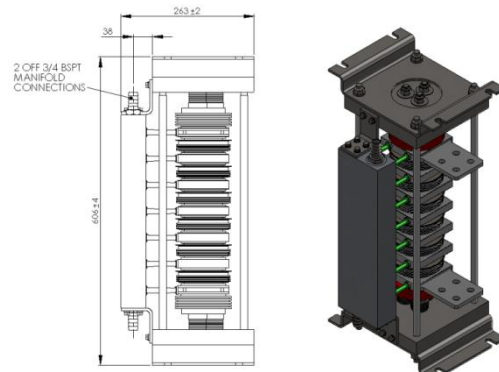


Phase leg schematic

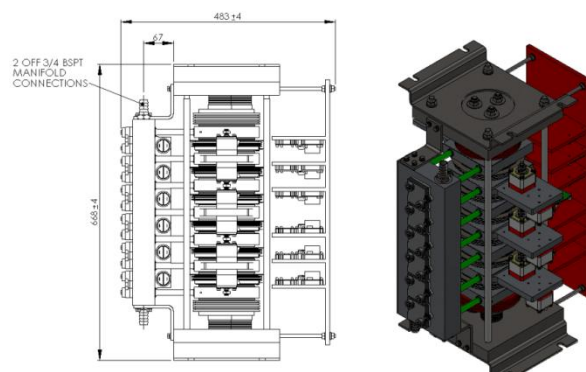
10kV system

Phase leg requirement – 2 × IGBT stack & 1 × diode stack

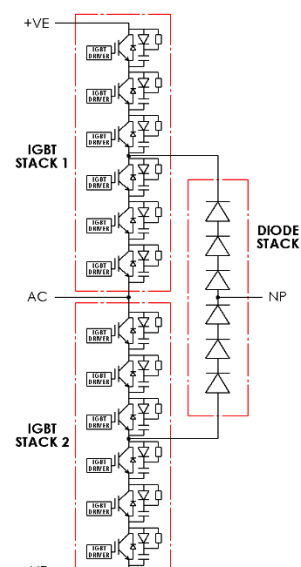
| | |
|-----------------------------|------------|
| Power Rating (MW) | 16 |
| Nominal Line Current (Amps) | 1000 |
| No. of IGBT's | 6 |
| No. of Diodes | 6 |
| No. of Coolers | 7 |
| Required IGBT Type | T1600GB45G |
| Required Diode Type | E2400TC45C |



Diode stack: XA1000TV45WE/A



IGBT stack: XA1000GV45WT/A



Phase leg schematic

New – DC Link Capacitors

The E50 PK16 capacitor can be universally used for the assembly of low inductance DC buffer circuits and DC filters; with its high energy density it can replace banks of series-connected electrolytic capacitors as well as large film capacitors in rectangular cases.

The capacitance in a DC buffer circuit must be sufficiently sized to both handle and smoothen the occurring ripple currents. The traditional use of series/parallel-connected electrolytic capacitors offered large capacitance at seeming low cost, however the low cost per microfarad is countered by very low current strength, the high sensitivity to voltage and current surges, as well as high risk of field failures resulting in high maintenance cost. Advanced know-how in special capacitor film coating and many years of practical experience in designing and manufacturing capacitors have allowed the design of the E50 PK16 range with high current density. With fivefold the current strength of conventional electrolytic capacitors, it is not necessary to reproduce the same capacitance in film technology. Instead, the user now gets a superior technical solution within the same – or even less – space.

Thanks to its compact cylindrical aluminium (NT) or plastic (N4) can design these capacitors are ideal for both electrical and mechanical requirements of high-speed IGBT converters. Its robust terminals and the robust fixing stud allow for very simple and reliable mounting that unites lowest inductance and highest current strength. The particularly large creepage and clearance distances make this design suitable for a wide range of operating voltages. As a result, existing standard converter concepts can easily be adapted to new applications without having to change the principal construction and to re-approve the entire system. The capacitors listed below have been designed specifically to match the requirements of IXYS UK's press-pack IGBT range in most inverter/converter applications.

Features and benefits

- Superior voltage and current strength
- Dramatic increase in operational life
- Drastic reduction of failures
- Minimisation of power dissipation losses
- Substantial reduction of self-inductance and series resistance
- More exact manufacturing tolerances
- Elimination of sharing resistors



New – DC Link Capacitors

| Part No. | V _{DC} | Capacitance | Series resistance R _S | Maximum current I _{MAX} | Inductance L _e | Diameter | Length | Design |
|----------------|-----------------|-------------|-------------------------------------|-------------------------------------|------------------------------|----------|--------|--------|
| | V | μF | Ω | A | nH | mm | mm | |
| E50.N15-254N5W | 1300 | 250 | 4.20 | 60 | 40 | 85 | 155 | N5 |
| E50.N15-304NTW | 1300 | 300 | 3.70 | 60 | 40 | 85 | 155 | NT |
| E50.R16-554NTW | 1300 | 545 | 2.30 | 80 | 40 | 116 | 165 | NT |
| E50.N25-564NTW | 1300 | 560 | 2.30 | 60 | 60 | 85 | 252 | NT |
| E50.R23-824NTW | 1300 | 820 | 1.70 | 100 | 50 | 116 | 230 | NT |
| E50.R29-115NTW | 1300 | 1090 | 1.40 | 100 | 60 | 116 | 295 | NT |
| E50.R34-145NTW | 1300 | 1370 | 1.10 | 100 | 70 | 116 | 345 | NT |
| E50.S29-165NTW | 1300 | 1560 | 1.10 | 120 | 70 | 136 | 295 | NT |
| E50.S34-205NTW | 1300 | 1950 | 0.69 | 120 | 70 | 136 | 345 | NT |

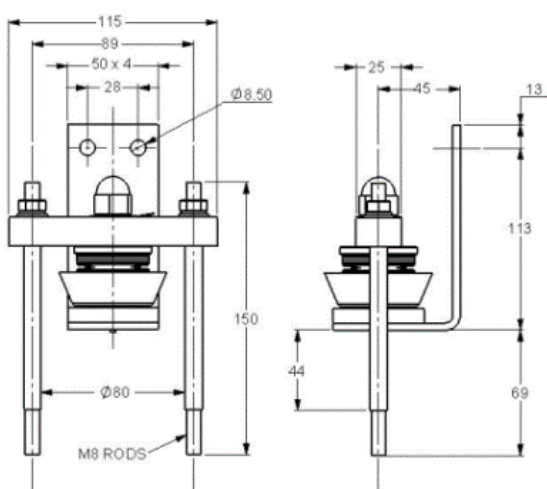
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|----------------|------|-----|------|-----|----|-----|-----|----|
| E50.N15-603NTW | 2800 | 60 | 1.3 | 50 | 40 | 85 | 155 | NT |
| E50.N23-104NTW | 2800 | 100 | 1.70 | 60 | 60 | 85 | 232 | NT |
| E50.R16-114NTW | 2800 | 110 | 0.66 | 80 | 40 | 116 | 165 | NT |
| E50.R23-174NTW | 2800 | 165 | 0.63 | 100 | 50 | 116 | 230 | NT |
| E50.R29-224NTW | 2800 | 220 | 0.62 | 100 | 60 | 116 | 295 | NT |
| E50.R34-284NTW | 2800 | 275 | 0.85 | 100 | 70 | 116 | 345 | NT |
| E50.S29-314NTW | 2800 | 310 | 0.61 | 120 | 70 | 136 | 295 | NT |
| E50.S34-394NTW | 2800 | 390 | 0.76 | 120 | 70 | 136 | 345 | NT |

| | | | | | | | | |
|----------------|------|------|------|-----|----|-----|-----|----|
| E50.N15-293NTW | 3600 | 29 | 1.40 | 50 | 40 | 85 | 155 | NT |
| E50.N23-503NTW | 3600 | 50 | 1.90 | 60 | 60 | 85 | 232 | NT |
| E50.R16-573NTW | 3600 | 57 | 0.67 | 80 | 40 | 116 | 165 | NT |
| E50.R23-863NTW | 3600 | 85.5 | 0.65 | 100 | 50 | 116 | 230 | NT |
| E50.R29-114NTW | 3600 | 114 | 0.68 | 100 | 60 | 116 | 295 | NT |
| E50.R34-144NTW | 3600 | 142 | 0.88 | 100 | 70 | 116 | 345 | NT |
| E50.S29-164NTW | 3600 | 160 | 0.63 | 120 | 70 | 136 | 295 | NT |

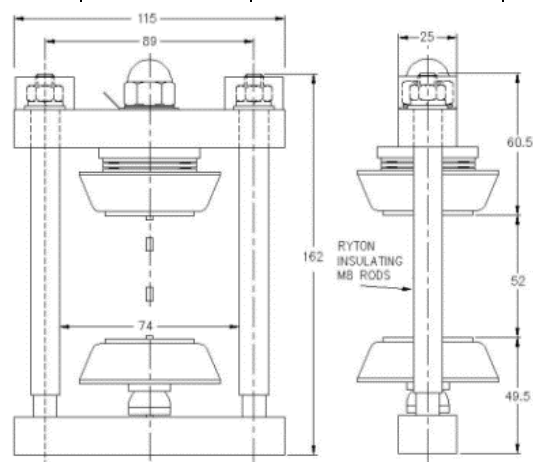


Recommended clamps for capsule IGBT's

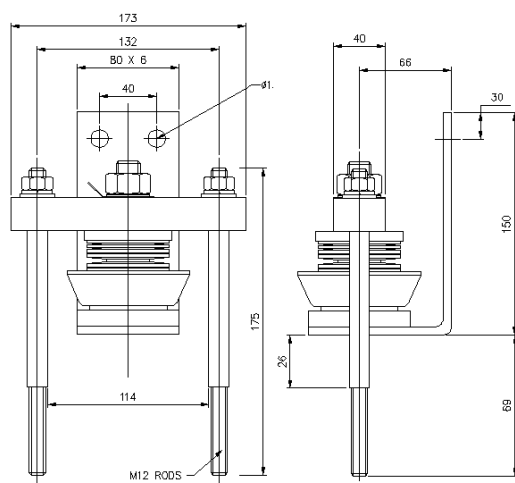
| Device type | Device housing code | Electrode diameter (mm) | Max capsule height (mm) | Recommended clamps |
|-----------------|---------------------|-------------------------|-------------------------|--------------------|
| Press-pack IGBT | NB/ND | 47 | 28 | XK1000D/SA074M |
| | VB/VB | 62.85 | 26 | XK3060D/SA140ML |
| | TB/TD | 75 | 26 | XK2000D/SA114M |
| | AB/AD | 96 | 26 | XK3060D/SA140ML |
| | EB | 85.1 | 26.5 | XK3060D/SA140ML |
| | GB | 125 | 26.5 | XK6120D/SA180ML |



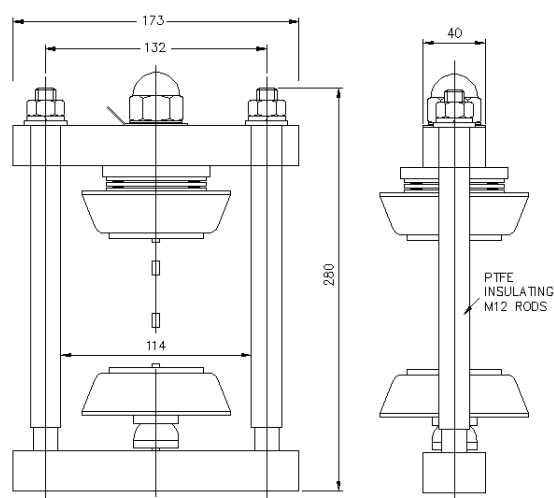
XK1000DA074M



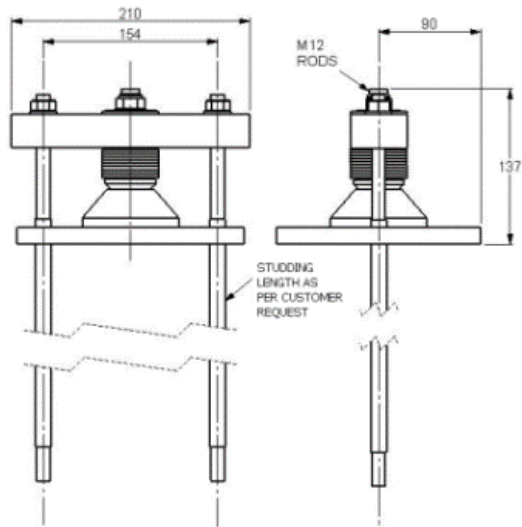
XK1000SA074M



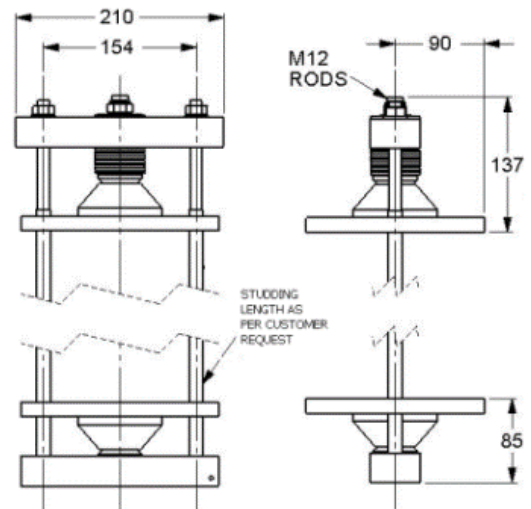
XK2000DA114M



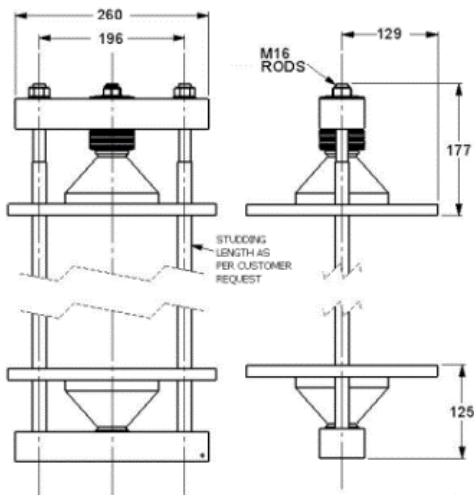
XK2000SA114M



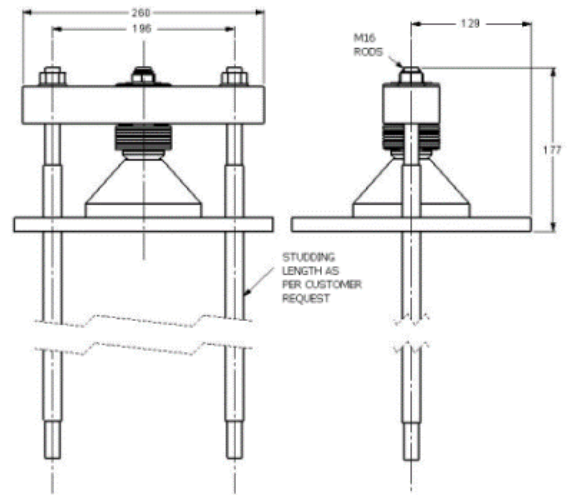
XK3060DA140ML



XK3060SA140ML



XK6120DA180ML



XK6120SA180ML



FM26085

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