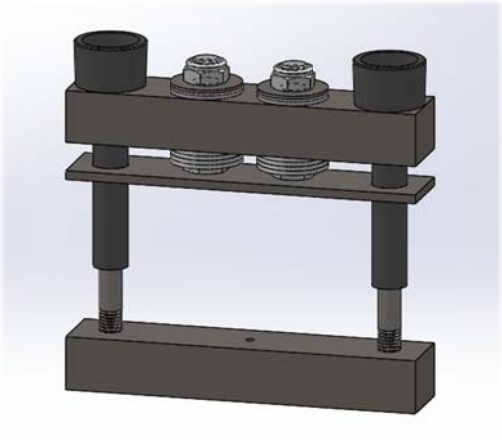
Application Note

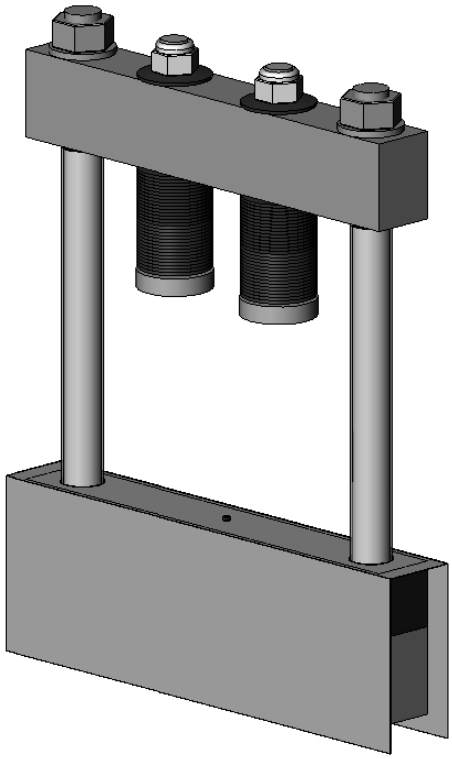
Recommended clamps for capsule semiconductors and full mounting instructions

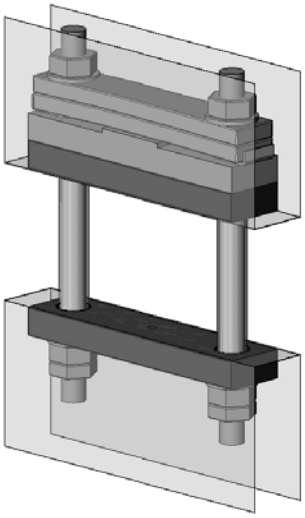
Nov 13 – Issue 1

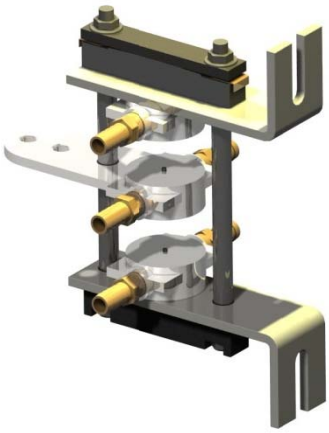
This application note details the recommended clamping parts and mounting procedure for use with IXYS UK Westcode Ltd's range of high power capsule semiconductors

Proper clamping is essential to the performance and lifetime of IXYS UK's capsule semiconductors. Insufficient clamping can cause incorrect operation of the semiconductor being used and premature failure of the device. Using the clamping parts referenced overleaf and adhering to the advised mounting procedures in this application note will guarantee safe and reliable operation of the semiconductors selected for your application.









Device type	Device housing code	Drawing No.	Electrode diameter (mm)	Max capsule height (mm)	Recommended clamps	
W (Rectifier Diode)	YC	W2	25.1	15.1	XSK0500D#042Mxxx	XK0450D/S#056M
	YH	W3	25.1	26.6	XSK0500D#042Mxxx	XK0450D/S#056M
	WC	W1	19	14.4	XSK0500D#042Mxxx	
	LC	W4	34	27	XSK1500D#065Mxxx	XK1100DA076M
	NC	W5	47	27.7	XSK2200D#075Mxxx	XK2140SA076M
	MC	W54	50	26.3	XSK3000D#087xxx	XK3000SA116M
	VC	W6	63	33	XSK3000D#103xxx	XK3000SA116M
	VF	W43	62.85	26	XSK3000D#103xxx	XK3000SA116M
	QK	WD2	38	15	XSK2000DA076xxx	
	QR	WD7	38	14.5	XSK2000DA076xxx	
	ZC	W7	73.1	37.65	XSK3800DA112Mxxx	XSK4500D#112Mxxx
	ZD	W42	73.1	26	XSK3800DA112Mxxx	XSK4500D#112Mxxx
	HL	WD5	68	26	XSK3800DA116Mxxx	
	MK	WD3	50	15	XSK3000DA076xxx	
	TJ	W89	75	26	XK7000DA128ML	
	TE	W94	75	35	XK7000DA128ML	
	FC	W52	99.3	36.5	XK9000D/SA160M	
	FD	W59	99.3	26.5	XK9000D/SA160M	
M (Fast diodes)	YC	W2	25.1	15.1	XSK0500D#042Mxxx	XK0450D/S#056M
	YH	W3	25.1	26.6	XSK0500D#042Mxxx	XK0450D/S#056M
	WC	W1	19	14.4	XSK0500D#042Mxxx	
	LC	W4	34	27	XSK1500D#065Mxxx	XK1100DA076M
	NC	W5	47	27.7	XSK2200D#075Mxxx	XK2140SA076M
	ND	W37	47	21	XSK2200D#075Mxxx	XK2140SA076M
	VC	W6	63	33	XSK3000D#103xxx	XK3000SA116M
	VF	W43	62.85	26	XSK3000D#103xxx	XK3000SA116M
	ZC	W7	73.1	37.65	XSK3800DA112Mxxx	XSK4500D#112Mxxx
	ZD	W42	73.1	26	XSK3800DA112Mxxx	XSK4500D#112Mxxx
F (Extra-fast diodes)	YC	W2	25.1	15.1	XSK0500D#042Mxxx	XK0450D/S#056M
	YH	W3	25.1	26.6	XSK0500D#042Mxxx	XK0450D/S#056M
	WC	W1	19	14.4	XSK0500D#042Mxxx	
	LC	W4	34	27	XSK1500D#065Mxxx	XK1100DA076M
	NC	W5	47	27.7	XSK2200D#075Mxxx	XK2140SA076M
	NH	W47	47	14	XSK2200D#075Mxxx	XK2140SA076M
	ND	W37	47	21	XSK2200D#075Mxxx	XK2140SA076M
	VC	W6	63	33	XSK3000D#103xxx	XK3000SA116M
	VF	W43	62.85	26	XSK3000D#103xxx	XK3000SA116M
E (High power sonic FRD's)	YH	W3	25.1	26.6	XSK0500D#042Mxxx	XK0450D/S#056M
	QC	W68	38	26	XSK1500D#065Mxxx	XK1800D/S#076M
	NC	W5	47	27.7	XSK2200D#075Mxxx	XK2140SA076M
	NH	W47	47	14	XSK2200D#075Mxxx	XK2140SA076M
	VF	W43	62.85	26	XSK3000D#103xxx	XK3000SA116M
	TC	W28	75	26.6	XK7000DA128ML	
N (Phase control thyristors)	WC	W8	19	14.4	XSK0500D#042Mxxx	XK0450D/S#056M
	WN	W90	19	14	XK0550D/SA056M	
	YN	W91	25	14	XK1000D/SA076M	XK1100DA076M
	YS	W9	25.1	15.1	XK0550D/SA056M	XSK0900D#042Mxxx
	LC	W10	34	27	XSK1500D#065Mxxx	XK1100DA076M
	LN	W92	34	26	XSK1500D#065Mxxx	
	NC	W11	47	27.7	XSK2200D#075Mxxx	XK2140SA076M
	NG	W57	47	35.5	XSK2200D#075Mxxx	XK2140SA076M
	MC	W70	50	26.3	XK3000SA116ML	
	JK	WP1	32	14	XSK1500DA076xxx	
	HA	W79	66	26	XSK3800DA112Mxxx	
	HE	W80	66	35	XSK3800DA112Mxxx	
	VC	W12	63	33	XSK3000D#103xxx	XK3000SA116M
	VF	W62	62.85	27	XSK3000D#103xxx	XK3000SA116M
	QL	WP6	38	26.3	XK1800D/Sx076M	
	QK	WP2	38	14.5	XSK2000DA076xxx	
	ML	WP5	50	26.3	XK2700D/Sx076M	
	ZC	W13	73.1	37.65	XSK3800DA112Mxxx	XSK4500D#112Mxxx
	ZD	W46	73.1	26	XSK3800DA112Mxxx	XSK4500D#112Mxxx
	MK	WP3	50	14.5	XSK3000DA076xxx	
	TE	W82	75	35	XK7000DA128ML	
	TJ	W81	75	26	XK7000DA128ML	
	TC	W14	75	26.6	XK7000DA128ML	
	TD	W51	75	35	XK7000DA128ML	
	HK	WP4	68	14.5	XK4000D/SA116ML	XSK4000Dx103Mxxx
	FC	W15	99.3	36.5	XK9000D/SA160M	
	FD	W48	100	26	XK9000D/SA160M	

Device type	Device housing code	Drawing No.	Electrode diameter (mm)	Max capsule height (mm)	Recommended clamps	
K (Medium voltage thyristors)	LC	W10	34	27	XSK1500D#065Mxxx	XK1100DA076M
	LG	W56	34	35.5	XSK1500D#065Mxxx	XK1100DA076M
	QA	W75	38	26	XK1800D/Sx076M	
	QE	W76	38	35	XK1800D/Sx076M	
	NC	W11	47	27.7	XSK2200D#075Mxxx	XK2140SA076M
	NG	W57	47	35.5	XSK2200D#075Mxxx	XK2140SA076M
	MA	W77	50	26	XK2700D/Sx076M	XSK3000D#087Mxxx
	ME	W78	50	35	XK2700D/Sx076M	XSK3000D#087Mxxx
	VC	W12	63	33	XSK3000D#103xxx	XK3000SA116M
	VF	W62	62.85	27	XSK3000D#103xxx	XK3000SA116M
	ZC	W13	73.1	37.65	XSK3800DA112Mxxx	XSK4500D#112Mxxx
	ZD	W46	73.1	26	XSK3800DA112Mxxx	XSK4500D#112Mxxx
	TC	W14	75	26.6	XK7000DA128ML	
	TD	W51	75	35	XK7000DA128ML	
	FC	W15	99.3	36.5	XK9000D/SA160M	
	FD	W48	100	26	XK9000D/SA160M	
	EC	W55	85.1	26.5	XK7000DA128ML	
P (Fast turn-off thyristors)	WC	W8	19	14.4	XSK0500D#042Mxxx	XK0450D/S#056M
	YS	W9	25.1	15.1	XK0550D/SA056M	XSK0900D#042Mxxx
	LC	W10	34	27	XSK1500D#065Mxxx	XK1100DA076M
R (Distributed gate thyristors)	YS	W9	25.1	15.1	XK0550D/SA056M	XSK0900D#042Mxxx
	LC	W10	34	27	XSK1500D#065Mxxx	XK1100DA076M
	NC	W11	47	27.7	XSK2200D#075Mxxx	XK2140SA076M
	MC	W70	50	26.3	XK3000SA116ML	
	ZC	W13	73.1	26	XSK3800DA112Mxxx	XSK4500D#112Mxxx
	ZD	W46	75	26.6	XSK3800DA112Mxxx	XSK4500D#112Mxxx
	TC	W14	75	26.6	XK7000DA128ML	
	TD	W51	75	35	XK7000DA128ML	
	EC	W55	85.1	26.5	XK7000DA128ML	
	FC	W15	99.3	36.5	XK9000D/SA160M	
	FD	W48	100	26	XK9000D/SA160M	
A (symmetric thyristors)	YC	W58	25.1	15.1	XK0550D/SA056M	XSK0900D#042Mxxx
	NC	W11	47	27.7	XSK2200D#075Mxxx	XK2140SA076M
Y (Pulse Thyristors)	KC	W34	29.5	16.5	XK055D/SA056M	
	NC	W36	47	28	XSK2200D#075Mxxx	XK2100S/SA076ML
G (GTO thyristor)	NC	W36	47	28	XK2100S/SA076ML	XSK2200D#075Mxxx
	QC	W35	38	26	XSK1500D#065Mxxx	
	HF	W85	66	26	XK2500D/SA116ML	XSK2200D#103Mxxx
	TF	W86	75	26	XK3500D/SA116ML	XSK3800D#112Mxxx
	EC	W33	85	26.5	XK4000SA116ML	
H (GTO thyristor)	KC	W34	29.5	16.5	XK0550D/SA056M	
	NC	W36	47	28	XK2100S/SA076ML	XSK2200D#075Mxxx
S (GTO thyristor)	YC	W93	25.1	16.5	XK0550D/SA056M	
	KC	W34	29.5	16.5	XK0550D/SA056M	
	NC	W36	47	28	XK2100S/SA076ML	XSK2200D#075Mxxx
T (IGBT)	NB	W40	47	28	XK1000D/SA074M	
	VB	W67	62.85	26	XK3060D/SA140ML	
	TB	W41	75	26	XK2000D/SA114M	
	AB	W71	96	26	XK3060D/SA140ML	
	EB	W44	85.1	26.5	XK3060D/SA140ML	
	GB	W45	125	26.5	XK6120D/SA180ML	

Part number definition

Product type	Average current rating	Device housing code		Voltage rating (V_{RRM} ÷ 100)	Fixed code dependent on device type
		Electrode diameter	Housing style		
W	**3128**	**V**	**C**	**30**	**0**

Device mounting instructions

Recommendations for interface properties

The interfaces to the device pole faces (either heatsink or busbar) must conduct both thermal and electrical energy from the device. It is important that these interfaces maintain a stable contact throughout the lifetime of the equipment to ensure reliable operation of the device. Both the surface geometry and finish are important factors to consider.

Surface roughness

The surface roughness is a measure of the microstructure of the surface and is expressed as a R_a value as per BS EN ISO 4287:1998+A1 2009. Prior to heatsink preparation a surface roughness, $R_a \leq 1.6\mu m$ for all contact surfaces is recommended.

Surface flatness

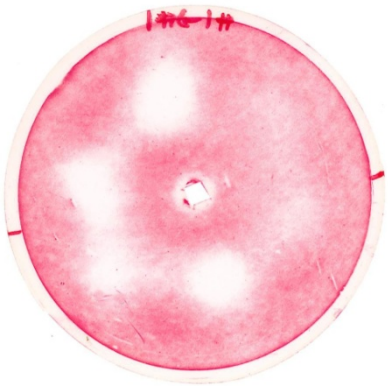
Flatness is a measure of the net variation of a surface defined by two parallel planes. A flatness of 30µm is required for thyristors, diodes and GTO's and 10µm for IGBT's for all interface surfaces within the clamping structure and clamp force range specified in the device data sheet.

Note 1: The flatness of an IGBT greater than that specified in the clamped condition may be seen prior to the device being clamped. This is due to differential thermal expansion of the housing components post manufacture and in no way reflects or impacts the device flatness once it is clamped to the nominal force.

Note 2: The stack components must only deflect elastically. A flatness greater than the maximum specified may result if plastic deformation of the contact surfaces (such as cooler collapse) occurs under loading.

IXYS UK recommends the use of Fuji Prescale film; see www.fujifilm-prescale.eu or a similar film product to confirm the pressure uniformity of the mechanical design of the assembly. The film is manufactured in a number of different pressure ranges and should be inserted between the device contact face and the cooler or heatsink. A good pressure distribution and a non-uniform pressure distribution are shown below.

Example of good pressure distribution



Example of poor pressure distribution

Surface finish

In order to maintain a good electrical connection and avoid corrosion over time, IXYS UK recommends that all non-aluminium contact surfaces be nickel-plated. Chemical plating is preferable to electroplating in high reliability applications. Plating depth should be 4-6µm in accordance with that applied to the device.

Surface preparation prior to assembly

All contact surfaces should be clean and dry prior to assembly. If necessary all non-plated contact surfaces should be lightly abraded to remove oxide films with a rotary wire brush using a suitable contact grease to form a slurry or alternatively polished using 3M Scotchbright™ or a similar product. Note that the slurry produced by the abrasion should be left on the contact surface until the device is ready to be mounted (to prevent re-oxidation). The contact surfaces should then be cleaned using ethanol or similar solvent and a lint free cloth. Lint free gloves should be worn when handling prepared parts. A very thin film of suitable mounting grease, such as Jetlube SCX13 (IXYS UK part number XSGSCX13) should be applied to the device. When the device has been clamped to full load a small bead approximately 0.1mm in diameter should be squeezed out from between the contact surfaces.

Pictures of the surface preparation process are shown in appendix 1.

Mounting Force, F_M

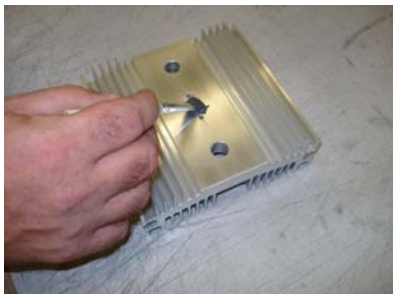
The mounting force, F_M is the recommended force to be applied for optimal device performance. The data sheet ratings are not guaranteed if the mounting force is lower than that specified in the data sheet. The thermal impedance and the on-state voltage drop will increase, and the short circuit current rating will decrease when the force is reduced below the rated value.

Too high a mounting force could reduce the load cycling capability. The mounting force must be uniformly applied across the whole area of the pole face, this is particularly important for press-pack IGBT's. Variations in contact pressure of more than 10% across the pole face are not permitted.

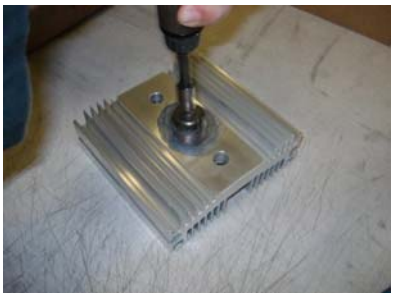
Appendix 1

Load the brush with a small amount of XSGSCX13 semiconductor mounting grease.

Apply the grease to the heatsink close to the spirol pin as shown.



An air operated rotary wire brush is used to abrade the paste onto the heatsink.



Note that the rotary wire brush must be replaced when the bristles are too short.

These bristles are of an acceptable length.

Leave the heatsink slurried with the thermal grease until the device is ready to be mounted.

The heatsink mounting surface should appear lightly abraded as shown.

Apply a small amount of thermal grease to a roller as shown.

Apply a small amount of thermal grease to the device anode and cathode contact surfaces.

Ensure that no debris or hairs are left on the contact surface.

The contact surface should have a thin film of grease applied to the surface as shown.

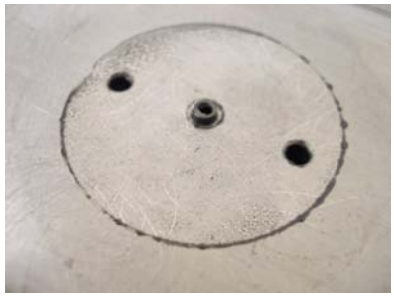
Place the device onto the heatsink.

Note that a small amount of grease should be squeezed out of the device/heatsink joint when the clamp is tightened. Excessive grease will cause a high volt drop across the joint and affect heat transfer.

The bead of grease should be no more than 0.1mm.

Heatsink after the device was removed to show the bead of thermal grease that has been squeezed out of the contact area when the pressure was applied.

Close up of the device mounting area after the device was removed.



Certificate FM26085

IXYS UK Westcode Ltd's BS EN ISO9001 quality system is registered by BSI

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