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IL DESIGN DEI CONVERTITORI AUSILIARI È INDICATO NEL DOCUMENTO ANESSO

ALLEGATO 1: Design and calculation document APS Trenitalia_IT

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Revisione: 0
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AX.02.V4.0008

AX.02.0G.0010.00 APS1

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(IVIESCA)

Design and calculation document

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1. ISSUE CONTROL AND DISTRIBUTION

ISSUE CONTROL

ISSUE	REASON	DATE
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DT-00096

Progettazione e calcolo dell'APS 660kVA
per l'upgrade delle Locomotive E402A di Trenitalia

DESCRIZIONE TECNICA	DT-00096	**Edizione**	0	**Data**	2015.07.14
ESEGUITO E CONTROLLATO	Cecilia de la Viesca S.	**APPROVATO**	Carlos de la Viesca E.M.		

TABELLA DELLE EDIZIONI E MODIFICHE

Edizione	Data	Descrizione della modifica	Modificato da	Controllato da	Approvato da
0	2015.07.14	Prima edizione	CeVS	CVEM	CVEM

INDICE

1 Obiettivo

L'APS è progettato in base alla nostra specifica tecnica numero ET-00129_V13.
L'APS si alimenta da 2 linee stabilizzate dopo il chopper elevatore del sistema di trazione della Locomotiva.
La tensione nominale di queste linee è $4kV_{dc}$ con un range da 3.6kV a 4.2kV.

Le tensioni di uscita richieste sono $600V_{dc}$ e $410V_{ac}$/60Hz (un autotrasformatore esterno aumenta la tensione ai $450V_{ac}$ richiesti dai carichi della locomotiva).

La potenza richiesta a 410V/60Hz è 260kVA/230kW. Il carico richiesto a $600V_{dc}$ è 400kW oltre a quello richiesto dall'inverter.

L'APS è formato da 2 parti completamente indipendenti, che condividono solamente l'involucro meccanico:

- Il convertitore DC/DC, $4kV_{dc}/600V_{dc}$ e 640kW, e;
- l'inverter DC/AC $600V_{dc}/410V_{ac}$.

Hanno circuito di alimentazione indipendente, controlli indipendenti e sistema di ventilazione indipendente.

Ci sono 2 sistemi APS sulla locomotiva, elettricamente identici, ma l'involucro meccanico è simmetrico, dato che l'accesso e la bocca di entrata e la bocca di uscita dell'aria di ventilazione sono simmetrici. I sottogruppi sono gli stessi in entrambi gli APS.

Il calcolo del sistema è stato fatto simulando il sistema con PSIM e tenendo in considerazione tutti i valori rilevanti ottenuti.

2 Calcolo e simulazione del Convertitore DC/DC

Lo schema elettrico semplificato è il seguente:

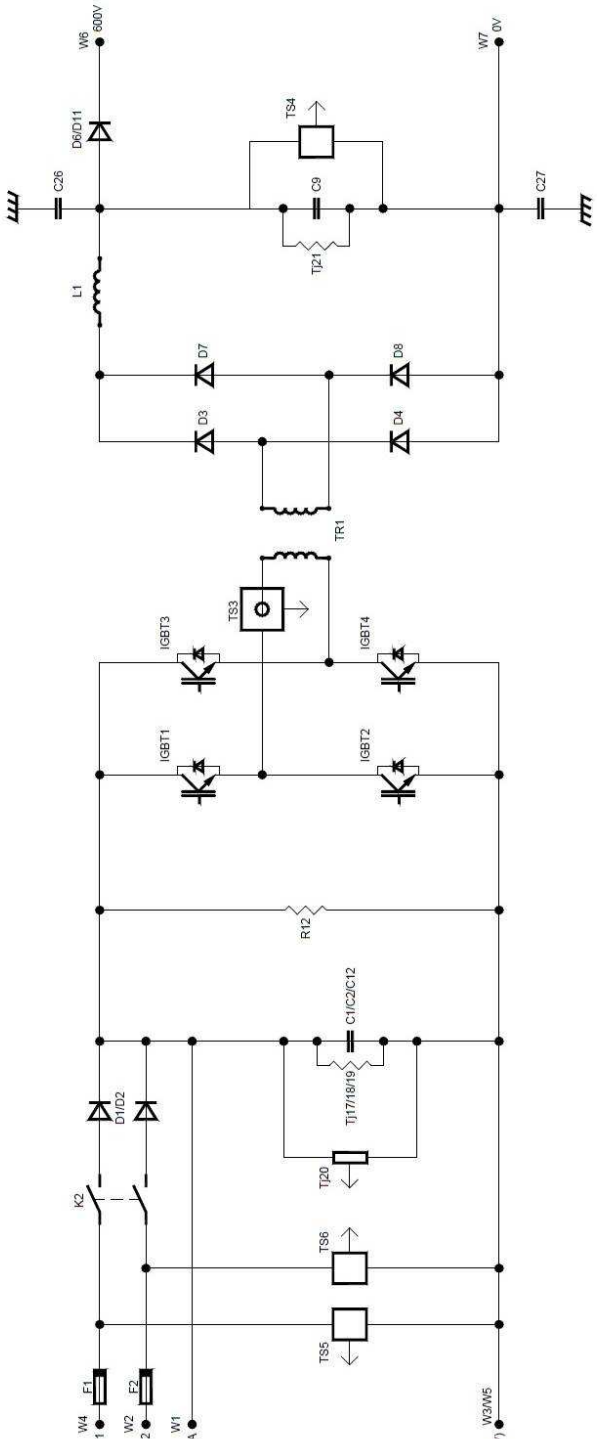


Figura 1: Schema elettrico semplificato del Convertitore DC/DC

- Gli ingressi +HV1 e +HV2 sono collegati a ogni chopper elevatore di trazione;
- I fusibili F1 e F2 vengono usati per prevenire danni nel cablaggio in caso di corto circuito nello stadio di entrata;
- K2 è un contattore bipolare che rimarrà normalmente chiuso e che si aprirà solo in caso di guasto permanente del convertitore;
- D1 e D2 sono dei diodi di disaccoppiamento per prelevare l'energia dal convertitore elevatore di trazione che eroga una tensione più elevata, sono diodi veloci e possono operare commutando con il ripple dei convertitori elevatori di trazione;
- C1, C2 e C12 vengono usati solo per mantenere bassa la sovratensione di commutazione, non è un filtro di ingresso
- IGBT1, IGBT2, IGBT3 e IGBT4 sono comandati in PWM al fine di regolare la tensione di uscita;
- TR1 adatta il livello della tensione dall'ingresso all'uscita; funziona a 300Hz, il rapporto di tensione è 3600V/600V, la potenza nominale è di 640kW;
- D3, D4, D7 e D8 raddrizzano la tensione di uscita del trasformatore e L1 e C9 filtrano questa forma d'onda;
- D6 e D11 permettono di creare una linea treno a $600V_{dc}$ collegando 2 convertitori DC/DC in parallelo; e,
- C26 e C27 sono condensatori per la soppressione di EMI.

2.1 Dimensionamento dei fusibili F1 e F2

La condizione peggiore si verifica quando è presente solo un convertitore elevatore di trazione per alimentare l'APS e la tensione di rete è al suo valore minimo (3600V):

$$I = \frac{Output\_Power}{(Converter\_Efficiency \times Minimum\_Voltage)} = \frac{640kW}{(0.97 \times 3600V)} = 183A$$

Il fusibile selezionato è il SIBA SBQ-DC2 280A aR4200/S9020026280. Vedasi datasheet allegato.

Tenendo in considerazione la temperatura interna dell'armadio di 70ºC, il fusibile da 280A sopporterà i 216A in modo permanente, vi è ancora margine per il normale esercizio.

2.2 Dimensionamento del K2

È stato selezionato un contattore bipolare per 4,2kV della SCHALTBAU e da 400A per polo, il CT1230/04V24ET-01. Vedasi datasheet allegato. Il contattore non si aprirà né chiuderà mai in presenza di potenza; funge da sezionatore.

2.3 Dimensionamento di D1/D2

Ogni diodo di ingresso è formato da due diodi 4.5kV in serie, in modo da poter sopportare il doppio della tensione nominale massima (4.2kV).

I diodi selezionati hanno rigidità dielettrica verso l'involucro di 10.2kV_{rms} 50Hz 1min.

I diodi sono DYNEX DFM800XXM45-TS001. Vedasi datasheet allegato. Il totale è di 2 moduli, 4 diodi. La serie è fatta con un diodo di ogni modulo, per trasmettere il calore generato al dissipatore. Ci sono snubber per livellare la tensione nei diodi.

La caduta di tensione di ogni diodo a 183A è di 1.53V, quindi la potenza massima dissipata di ogni diodo è di 280W.

È stato calcolato che la temperatura della giunzione a una temperatura ambiente di 50ºC è di 86.7ºC, molto più bassa rispetto ai consentiti 125ºC. Vedasi calcolo del dissipatore allegato.

2.4 Dimensionamento di C1/C2/C12

I condensatori di ingresso vengono usati solamente per limitare le sovratensioni di commutazione sul ponte convertitore dopo aver bloccato gli IGBT.

I condensatori selezionati sono 3 unità in parallelo di ICAR LNK-P4B-20-500, ognuno da 20µF 5kVdc e sovratensioni 10kV. Ogni condensatore è dotato di un resistore locale montato su una scheda con un valore resistivo di 8MΩ. I resistori sono per HV.

È inoltre presente una resistenza di scarica di valore molto più basso nel dissipatore del convertitore.

Le condizioni di esercizio peggiori, sia per la tensione che per la corrente, si verificano in esercizio a pieno carico e 4.2$kV_{dc.}$

Le forme d'onda di tensione e corrente sono:

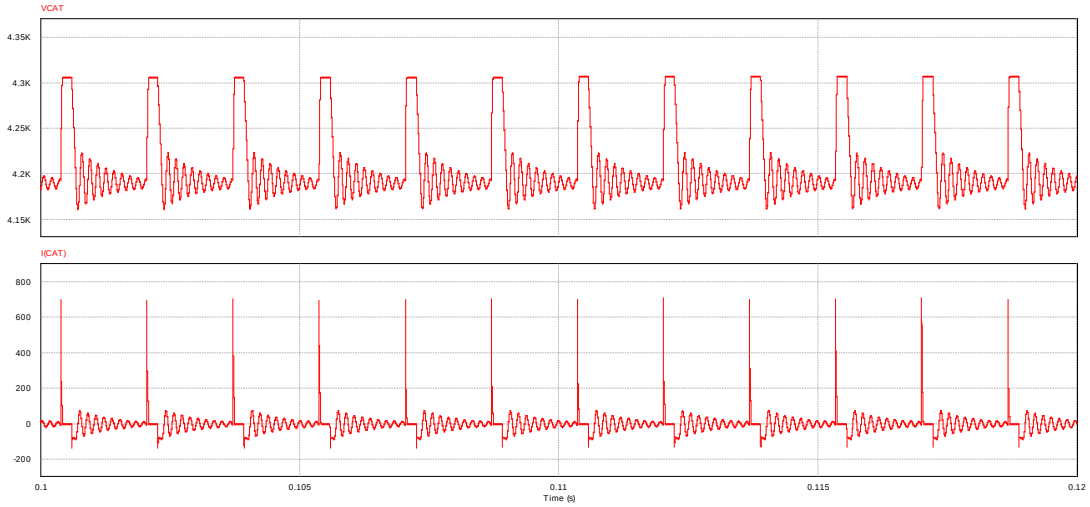


Figura 2: Forme d'onda di tensione e corrente di C1/C2/C12

La corrente rms totale che passa attraverso i condensatori è pari a 47.6A ottenuta dalla simulazione.

Questa corrente genera dissipazione di energia nel condensatore $4.5m\Omega \times (47.6A/3)^2 = 1.13W$ che produce una $\Delta\theta = 1.13W \times 2.75^{o}C/W = 3.1^{o}C$.

Dato che si considera che la temperatura massima dell'armadio è pari a 70ºC, la temperatura massima del punto caldo sarà di 73.1ºC.

2.5 Dimensionamento di IGBT1, IGBT2, IGBT3 e IGBT4

Gli elementi selezionati sono ABB 5SNA0400J650100. Vedasi datasheet allegato.

Gli IGBT selezionati hanno rigidità dielettrica verso l'involucro di 10.2kV$_{rms}$ 50Hz 1min.

Le condizioni di esercizio peggiori si verificano con la tensione di ingresso massima e la carica massima.

Le forme d'onda di tensione e corrente sono

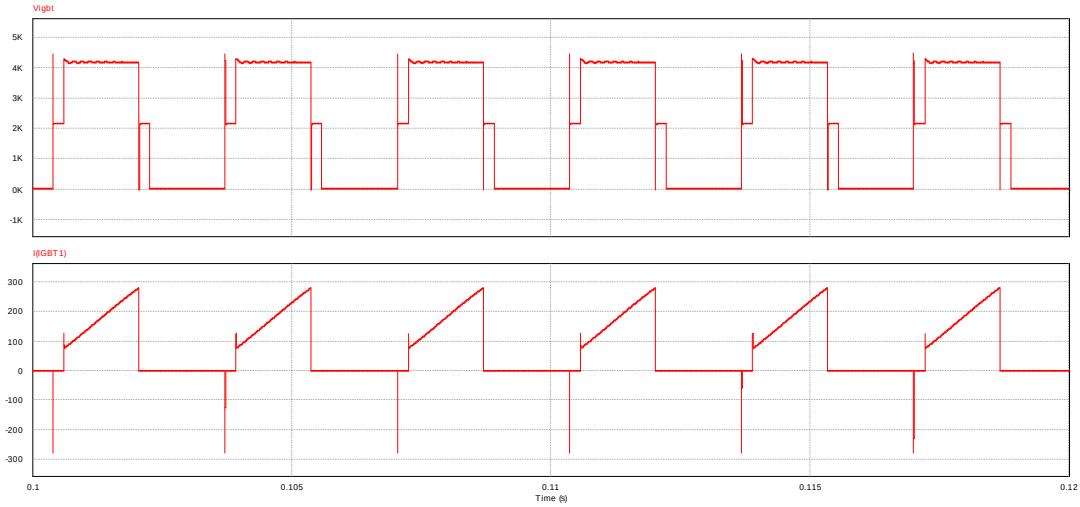


Figura 3: Forme d'onda di tensione e corrente di IGBT1, IGBT2, IGBT3 e IGBT4

Da queste curve si ottiene:

I_{IGBT} media	81A
I_{IGBT} rms	127A
I_{IGBT} picco	280A
V_{IGBT} picco	4460V

Con questi valori e una frequenza di commutazione di 300Hz si ottiene:

Perdite di conduzione	311W
Perdite di switch-off	543W
Perdite di switch-on	Trascurabili
Perdite totali	***853W***

La temperatura raggiunta dalla giunzione è di 112.3ºC, a temperatura ambiente massima e l'aria riscaldata dal precedente dissipatore. In questo dissipatore è inoltre presente una resistenza di scarica da 150kΩ /250W referenza VISHAY RPS0250DH150K00JBZA4 e uno snubber locale. Vedasi calcolo del dissipatore allegato.

2.6 Dimensionamento del Trasformatore

Il trasformatore TR1 funzionerà a 300Hz, la tensione di ingresso sarà a onda quadra 3600V, per tensioni più elevate ci sarà un'onda rettangolare, ma la tensione media raddrizzata applicata al primario sarà praticamente costante.

Con 4.2kV la tensione e corrente del primario e del secondario saranno:

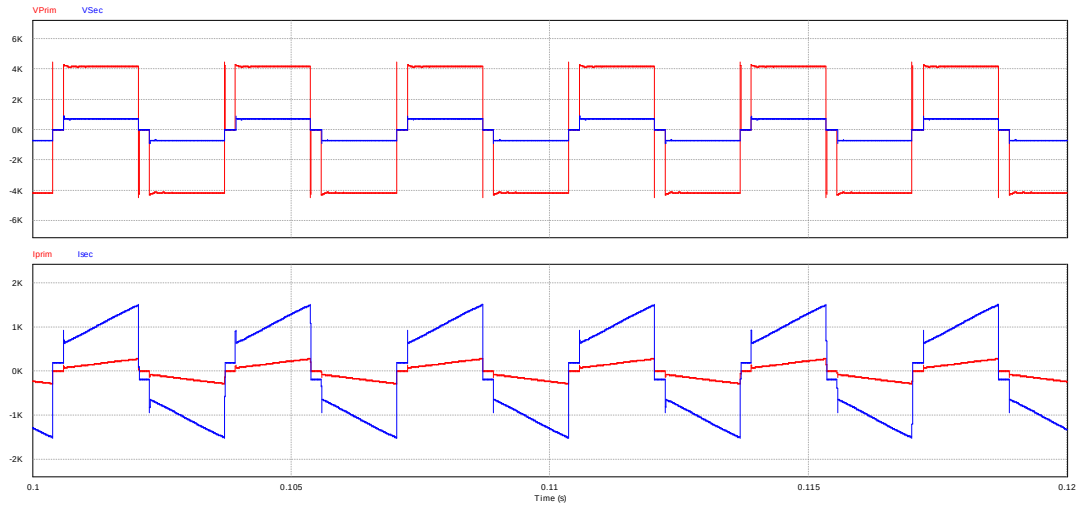


Figura 4: Tensione di ingresso 4.2kV – forme d'onda di tensione e corrente del primario e secondario del trasformatore

Con 3.6kV la tensione e corrente del primario e del secondario saranno:

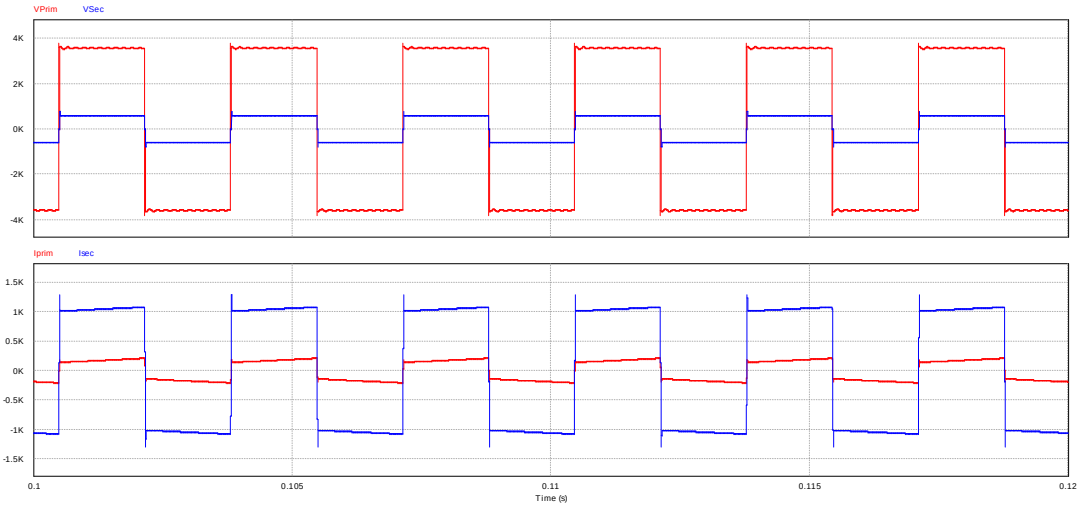


Figura 5:Tensione di ingresso 3.6kV – forme d'onda di tensione e corrente del primario e secondario del trasformatore

Per quanto riguarda il trasformatore, vengono considerati i seguenti valori:

- ✓ Tensione primaria : 3600V 300Hz Onda quadra
- ✓ Corrente primaria : 180A_{rms} Onda quadra
- ✓ Tensione secondaria : 600V Onda quadra
- ✓ Corrente secondaria : 1070A_{rms} Onda quadra
- ✓ Rigidità dielettrica da primario a secondario e intelaiatura 9.5kV_{rms} 50Hz 1min
- ✓ Rigidità dielettrica da secondario a primario e intelaiatura 2.5kV_{rms} 50Hz 1min
- ✓ Raffreddamento forzato a 2m/s a 70ºC
- ✓ Classe H
- ✓ Δθ massima : 110ºC

2.7 Dimensionamento di D3, D4, D7 e D8

Gli elementi selezionati sono Dynex DFM1200FXS12-A000. Vedasi datasheet allegato. Questi moduli sono 2×1200A 1200V. Per ogni ramo di diodi usiamo un modulo completo con i 2 diodi in parallelo.

Le condizioni di esercizio peggiori si verificano con la tensione di ingresso massima e il carico massimo.

Le forme d'onda di tensione e corrente sono

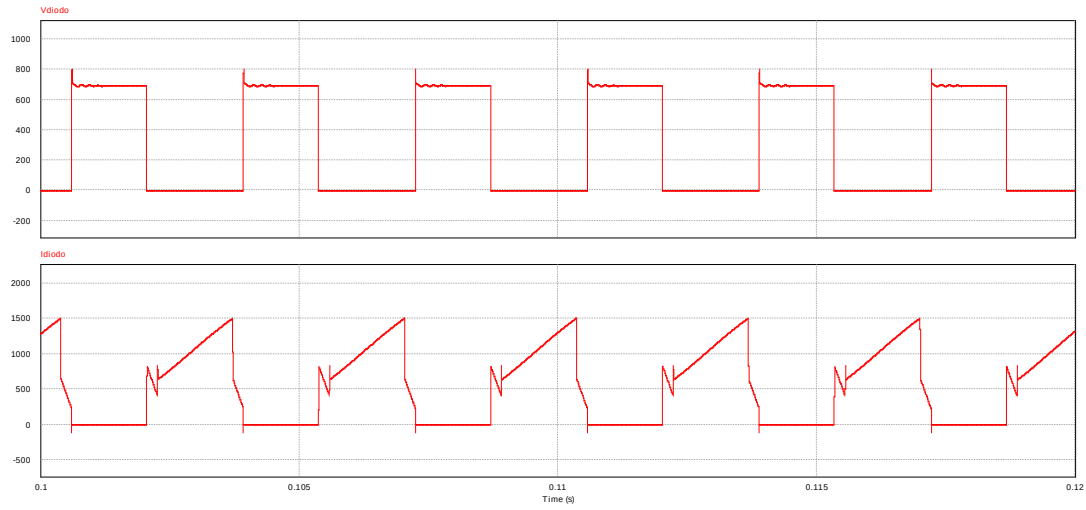


Figura 6: Forme d'onda di tensione e corrente di D3, D4, D7 e D8

Da queste curve si ottiene:

I_{DIODE} media	537A
I_{DIODE} rms	756A
I_{DIODE} picco	1501A
V_{DIODE} picco	850V

Con questi valori e una frequenza di commutazione di 300Hz si ottiene:

Perdite di conduzione	735W
Perdite di commutazione	Trascurabili nei diodi
Perdite totali dei diodi	***735W***

È presente un limitatore di sovratensione composto da un diodo veloce, un condensatore 32uF e da resistenze di scarica per far fronte alle sovratensioni di commutazione del diodo dovute al tempo di recupero dello stesso. Nelle condizioni peggiori, queste resistenze dissipano 110W ciascuna; in totale ci sono 10 resistenze in parallelo. 6 di queste resistenze sono posizionate in questo dissipatore e 4 nel dissipatore del diodo di uscita.

La temperatura raggiunta dalla giunzione è di 104.7ºC, a temperatura ambiente massima e l'aria riscaldata dal precedente dissipatore. Vedasi calcolo del dissipatore allegato.

2.8 Dimensionamento dell'induttore di uscita L1 e del condensatore C9

L'induttore funziona a 600Hz; la tensione di ingresso sarà un'onda rettangolare (impulsi), con un valore medio di $600V_{dc}$.

La condizione di esercizio peggiore per l'induttore è a $4200V_{dc}$ e carico massimo. Il valore scelto per l'induttanza è 150µH.

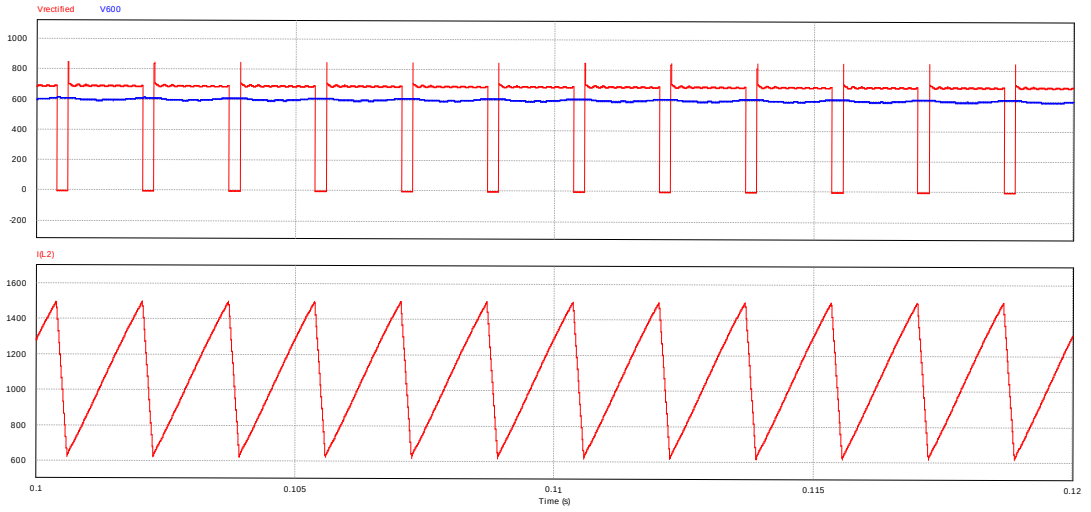


Figura 7: Forme d'onda tensione e corrente dell'induttore

Per quanto riguarda l'induttore, vengono considerati i seguenti valori:

- ✓ Corrente RMS : 1100A_{rms}
- ✓ Corrente DC : 1070A_{dc}
- ✓ Correnti armoniche : 224A_{rms}@600Hz+98A_{rms}@1200Hz+56A_{rms}@1800Hz
- ✓ Corrente di picco : 1500A_p
- ✓ Rigidità dielettrica verso l'intelaiatura : 2.5kVrms 50Hz 1min
- ✓ Raffreddamento forzato 2m/s a 70ºC
- ✓ Classe H
- ✓ Δθ massima : 110ºC

Il condensatore C9 avrà la corrente di ripple che passa attraverso l'induttore L1 ovvero:

$$224A_{rms}@\ 600Hz + 98A_{rms}@1200Hz + 56A_{rms}\ @1800Hz = 250A_{rms}$$

Il condensatore selezionato è di ICAR LNK-P5X-5000-90, ognuno da 5mF 900 V_{dc}

Questa corrente genera dissipazione di energia nel condensatore di $18m\Omega \times 250^2 = 11.2W$ che produce una $\Delta\theta = 11.2W \times 1.15^oC/W = 13^oC$. Dato che la temperatura massima dell'armadio nella parte inferiore dello stesso sarà inferiore a 60ºC, la temperatura massima del punto caldo sarà di 73ºC.

Ci sarà comunque almeno un convertitore e un inverter in funzionamento, quindi questa corrente verrà suddivisa come minimo in 2 condensatori, perciò la temperatura del punto caldo sarà molto più bassa.

Il condensatore è dotato di un resistore locale montato su scheda con un valore resistivo di 660kΩ.

2.9 Dimensionamento di D6/D11

Ogni diodo di uscita è formato da due diodi 1200A/2.2kV in parallelo. I diodi selezionati sono SEMIKRON SKKE1200/22H4. Vedasi datasheet allegato. Il totale è di 2 moduli, 2 diodi. Il collegamento in parallelo è fatto per trasmettere il calore generato al dissipatore. Ci sono snubber per proteggere i diodi in caso di distacco del carico.

La corrente in questa linea è di 1070A; la caduta di tensione per i 2 diodi in parallelo è di 0.767V quindi la potenza totale è pari a 821W.

Per il calcolo del dissipatore è stato preso in considerazione una ripartizione della corrente di 2/3-1/3 (554W / 267W). Sono incluse anche 4 resistenze da 100W che fanno parte del raddrizzatore limitatore.

È stato calcolato che la temperatura della giunzione a una temperatura ambiente di 50ºC è di 103ºC, molto più bassa rispetto ai consentiti 125ºC. Vedasi calcolo del dissipatore allegato.

2.10 Dimensionamento del sistema di ventilazione

Il convertitore DC/DC viene raffreddato ad aria forzata. Il ventilatore selezionato è Ziehl Abegg referenza RH28M-PDK.3I.1R. Vedasi datasheet allegato.

Il canale dell'aria include, nel seguente ordine:

1. Modulo del diodo di ingresso D1/D2;
2. Modulo convertitore IGBT1, IGBT2, IGBT3, IGBT4;
3. Modulo raddrizzatore D3, D4, D7, D8;
4. Modulo del diodo MT D6 e D11 ;
5. Trasformatore TR1;
6. Induttore L1.

Prendendo in considerazione la caduta di pressione di tutti i moduli e l'uscita dell'aria (griglia di aerazione della locomotiva), è stato calcolato un flusso d'aria di 1630m^3/h e una pressione statica di 849Pa. Con questi valori sono stati realizzati tutti i calcoli termici del dissipatore.

3 Calcolo e simulazione dell’inverter DC/AC

Lo schema elettrico semplificato è il seguente:

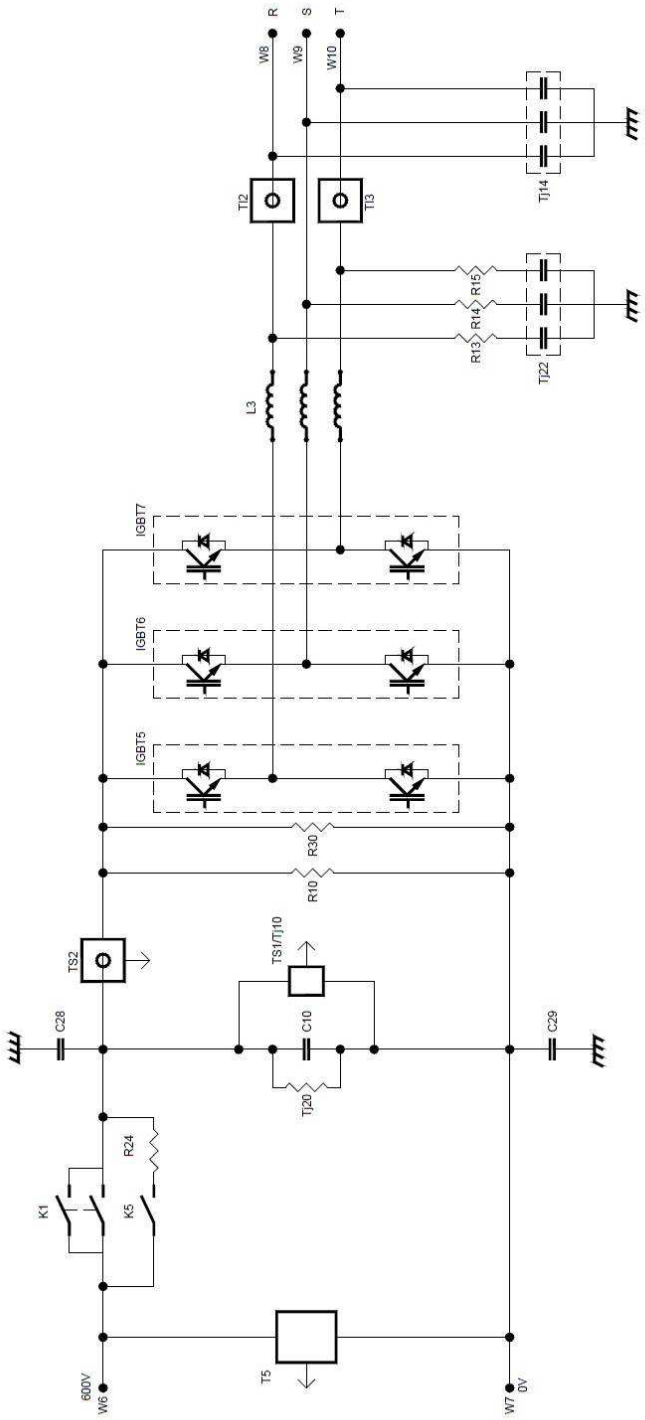


Figura 8: Schema elettrico semplificato dell’inverter DC/AC

- L'ingresso W6 (600V) è collegato alla linea $600V_{dc}$, formata dai 2 convertitori DC/DC in parallelo. Il collegamento in parallelo dei 2 convertitori DC/DC è fatto attraverso 2 contattori unipolari esterni (Uscita 600V) in modo da riconfigurare la generazione di tensione nei diversi scenari;
- Il contattore K1 è il contattore di ingresso principale dell'inverter. È destinato a essere utilizzato come sezionatore. Il K5 è il contattore di precarica che normalmente sarà aperto e verrà chiuso solo per realizzare la precarica del condensatore di ingresso;
- C10 è il condensatore di filtro di ingresso;
- IGBT5, IGBT6 e IGBT7 formano il ponte dell'inverter trifase;
- L3, R13, R14, R15 e i condensatori inclusi nel Tj22 formano un filtro dissipatore che riduce il dV/dt; e,
- C28, C29 e i condensatori inclusi nel Tj14 sono condensatori per la soppressione di EMI.

3.1 Dimensionamento di K1, K5, R24 e C10

Come K1 si utilizza un contattore bipolare con i 2 poli in parallelo, è stato selezionato progettato il LTC002502SA*0 di MICROELETTRICA da 1kV 500A. Vedasi datasheet allegato. Il contattore non si aprirà né chiuderà mai con l'alimentazione in funzionamento; funzionerà come un sezionatore.

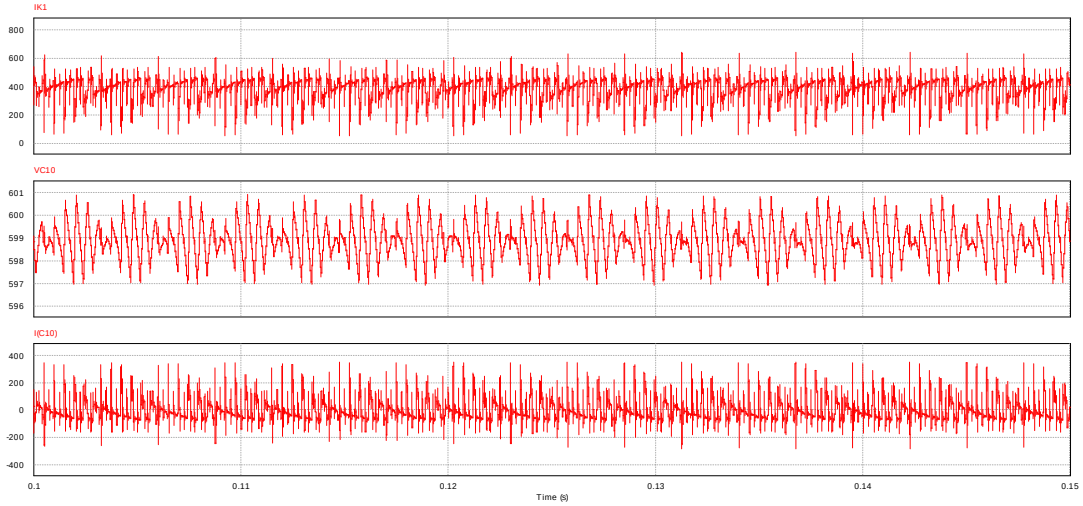


Figura 9:Forma d'onda di corrente attraverso il contattore K1 e forme d'onda di tensione e corrente attraverso il condensatore C10

La corrente che passa attraverso il contattore è $\frac{230kW}{(0.97\times 600V)} = 395A$

Per la precarica, viene usato come K5 un relè sotto vuoto unipolare di TYCO referenza LEV100A4ANG ($100A_{dc}$ - $900V_{dc}$). Vedasi datasheet allegato.

Per la precarica viene usata una resistenza 2200Ω/250W. La resistenza selezionata è VISHAY RPS250DL-2k2-10%. Vedasi datasheet allegato.

Il C10 è stato selezionato in modo da sopportare il ripple di corrente generato dall'inverter.

Il condensatore C10 avrà corrente di ripple generata dall'inverter pari a $84A_{rms}$ come da simulazione.

Il condensatore selezionato è il LNK-P5X-5000-90 di ICAR, ognuno da 5mF $900V_{dc.}$.Vedasi datasheet allegato.

Questa corrente genera dissipazione di energia nel condensatore $18m\Omega \times 84^2 = 1.27W$ che produce una $\Delta\theta = 1.27W \times 1.15^{o}C/W = 1.46^{o}C$. Dato che la temperatura massima dell'armadio nella parte inferiore dello stesso sarà inferiore a 60ºC, la temperatura massima del punto caldo sarà di 62ºC.

Il condensatore è dotato di un resistore locale montato su scheda con un valore resistivo di 660kΩ.

3.2 Dimensionamento degli IGBT5, IGBT6 e IGBT7

L'inverter trifase funziona con modulazione ad onda sinusoidale per ottenere un'uscita variabile di tensione e frequenza. Il sistema di modulazione ha iniezione di terza armonica (o modulazioni a due rami) in modo da ridurre il numero di commutazioni. La tensione di uscita fondamentale è 410V/60Hz, o livelli proporzionali a frequenze più basse.

L'uscita dell'inverter è 260kVA/230kW (410V, 366A, pf 0.885).

I moduli IGTB selezionati sono 900A/1200V referenza FUJI 2MBI900VXA-120P-50. Vedasi datasheet allegato.

Per il calcolo delle perdite, viene usato il simulatore FUJI:

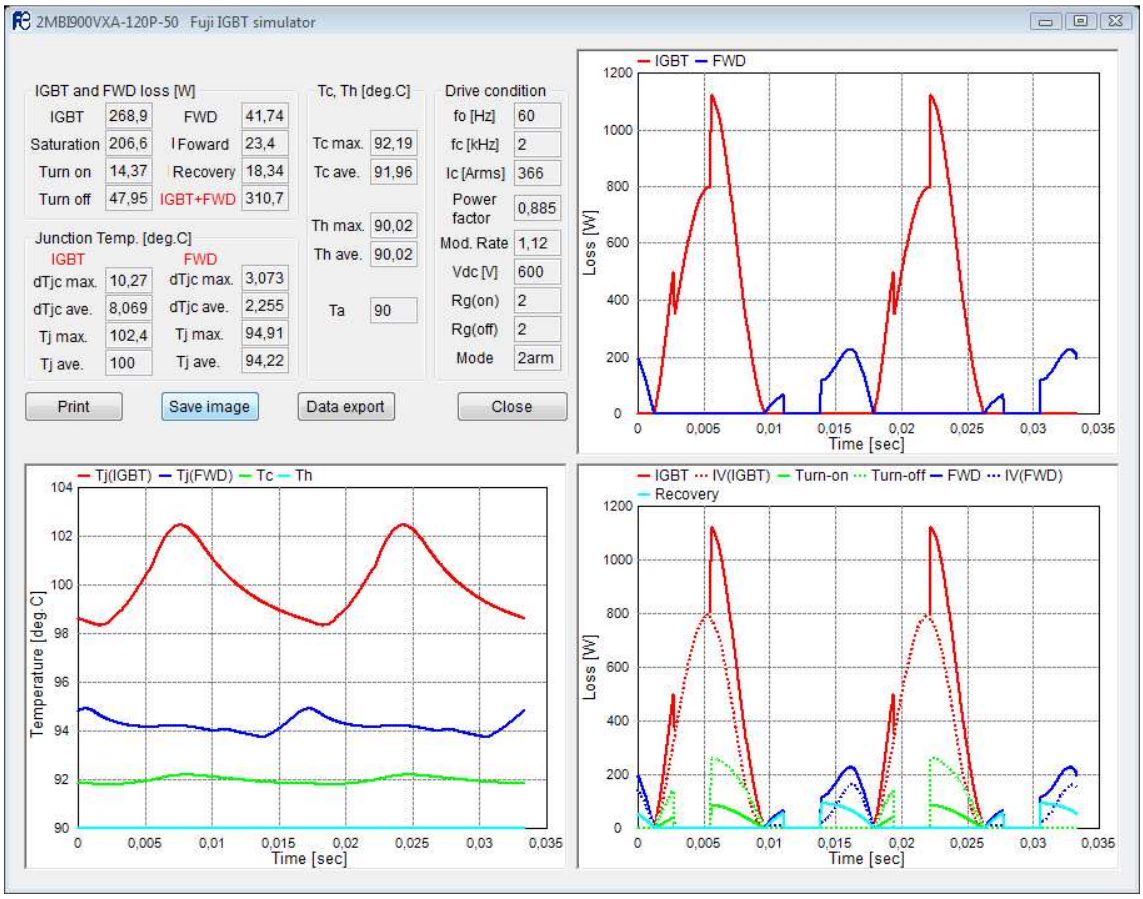


Figura 10: Calcolo delle perdite

Da questo calcolo si evidenzia che le perdite in ogni modulo sono $2 \times 310.7W = 621W$ a 60Hz / 410V.

Si calcolano anche le perdite a frequenze più basse, 20Hz/137V:

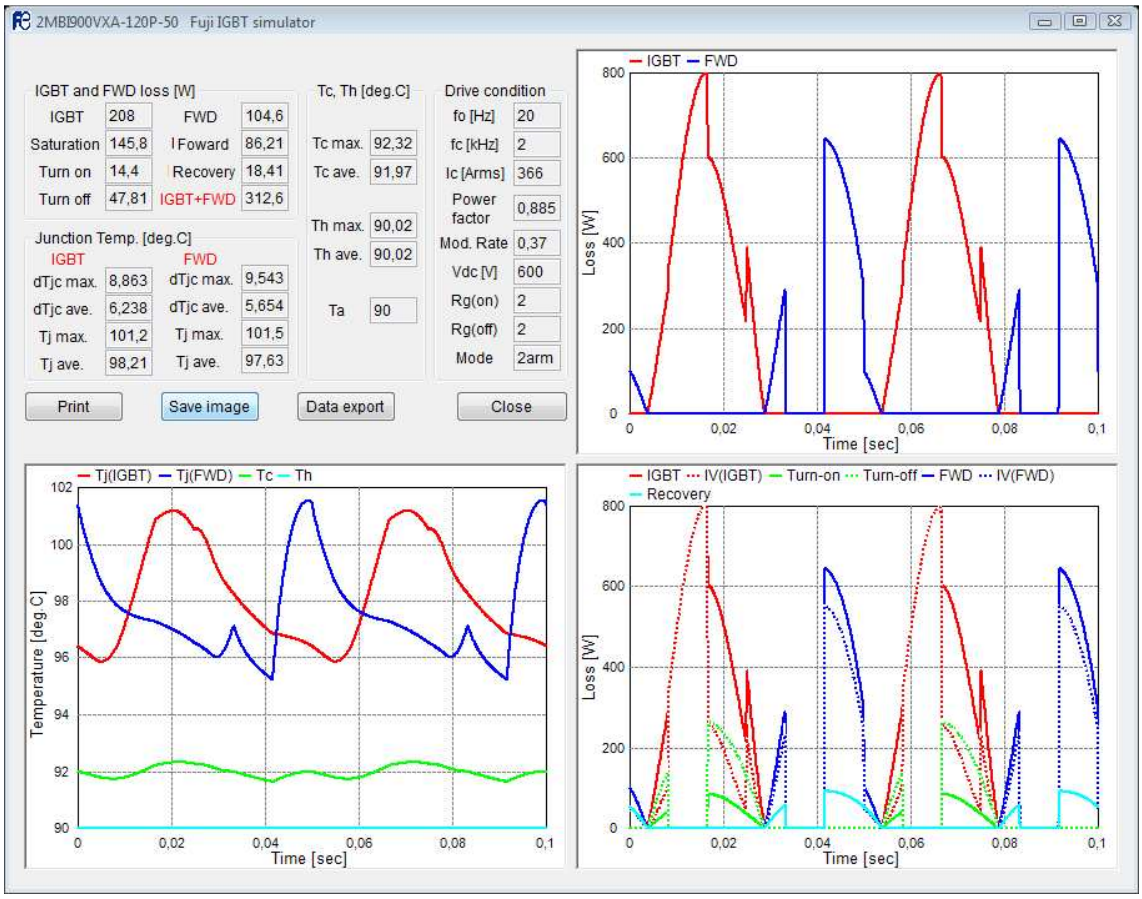


Figura 11: Calcolo delle perdite a 20Hz/137V

Da questo calcolo si evidenzia che le perdite in ogni modulo sono a 20Hz/137V.

Nel dissipatore ci sono 2 resistori di scarica per il C10, ognuno da 75kΩ/50W e ciascuno dissipa 4.8W, trascurati nei calcoli termici a causa del loro basso valore.

Si è aggiunto un margine e calcolato il dissipatore per 740W per modulo. Vedasi calcolo del dissipatore allegato.

La temperatura massima della giunzione ottenuta è nel range dei 102ºC mentre gli IGBT possono funzionare a 150ºC

Durante il sovraccarico di 400kVA/230kW 60Hz, il dissipatore non si surriscalda a causa della sua inerzia termica, ma la temperatura della giunzione dell'IGBT aumenta.

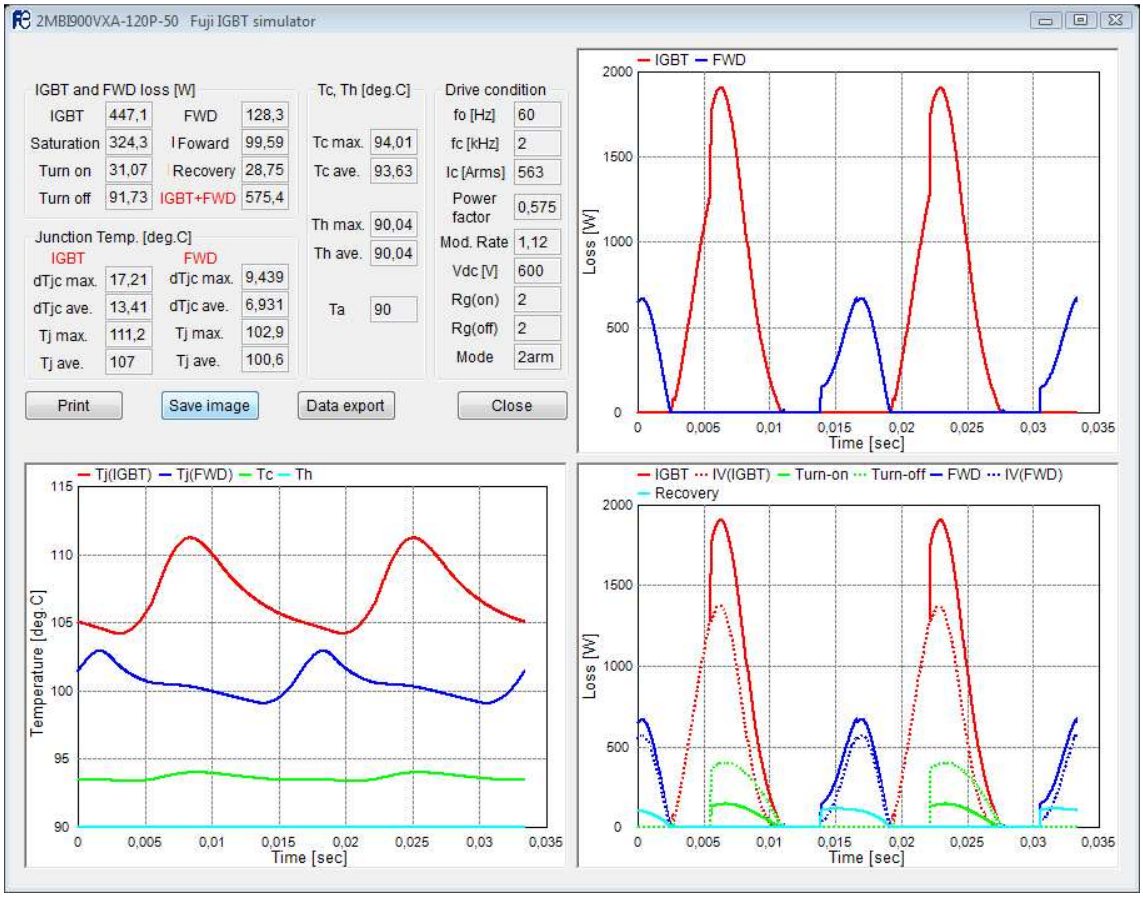


Figura 12:Calcolo delle perdite durante il sovraccarico

La temperatura massima della giunzione ottenuta è nel range dei 112ºC mentre gli IGBT possono funzionare a 150ºC.

3.3 Dimensionamento del filtro AC e RF (L3, R13, R14 and R15)

Questo modulo è dedicato a ridurre il dV/dt in uscita a 1000V/µs. L'induttore è formato da 3 barre di rame che passano attraverso nuclei di polvere di ferro, ed il valore dell'induttore è 800nH. La resistenza e i condensatori riducono il dV/dt. Le resistenze sono montate su un dissipatore, a causa della frequenza di modulazione di 2kHz la dissipazione di energia in ogni resistenza è pari a 300W, il resistore selezionato è VISHAY LPS0600L 2R20 K B. Vedasi datasheet allegato.

Vedasi calcolo termico del dissipatore allegato.

3.4 Dimensionamento del sistema di ventilazione

L'inverter DC/AC viene raffreddato ad aria forzata. Il ventilatore selezionato è Ziehl Abegg referenza RH22M-2DK.1E.1R. Vedasi datasheet allegato.

Il canale d'aria include, nel seguente ordine:

1. Modulo Inverter;
2. Filtro AC e RF;
3. Trasformatore TR1 (parte del convertitore DC/DC); e,
4. Induttore L1 (parte del convertitore DC/DC).

Prendendo in considerazione la caduta di pressione di tutti i moduli e l'uscita dell'aria (griglia di aerazione della locomotiva), è stato calcolato un flusso d'aria di 716m^3/h e una pressione statica di 598Pa. Con questi valori sono stati realizzati tutti i calcoli termici del dissipatore.

ALLEGATO 1

CALCOLI TERMICI DEL DISSIPATORE

HV DIODES D1/D2

R-Tools 3D Heatsink Thermal Modeling

R-Tools Simulation - Design Output Summary

User: Cecilia de la Viesca (cecilia.viesca@ingenieriaviesca.com)
Project: DIODOS-TI660KVA
Simulation Date: 2015-05-12 11:21:39

Thermal Design Details

Heatsink type: Swaged fin
Part number: Fabfin: FF300T16A35AS69A
Weight: 8.18056 kg
Heatsink dimensions: 300.0 mm wide x 300.0 mm long x 84.0 mm high
Material: Aluminum
Finish: A

Environment

Ambient Temperature: 50.0 C
Altitude: 0.0 m

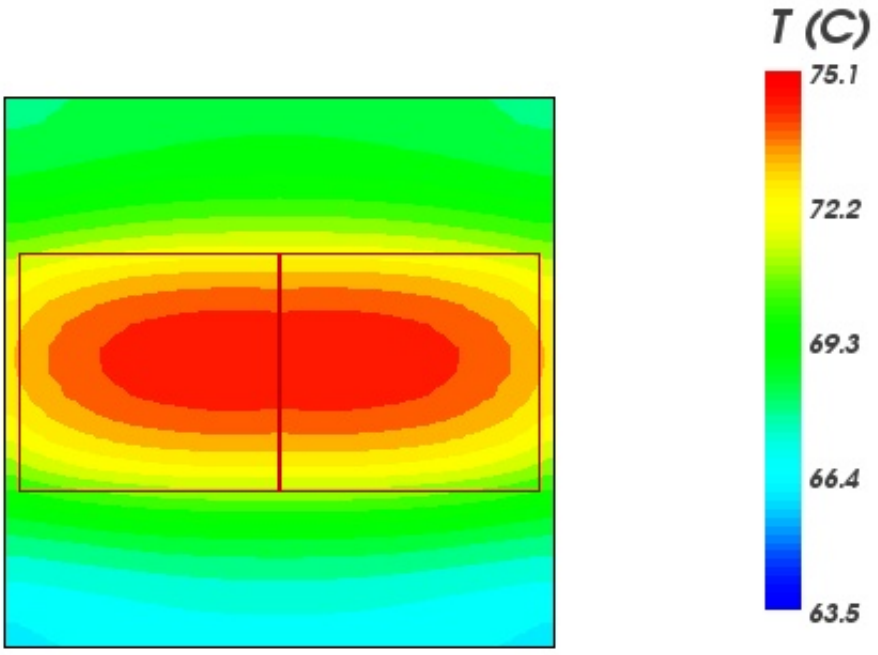
Thermal Design Details

			Temperature			
Source Names	**%sc**	**Power**	**Tsink-avg**	**Tsink-max**	**Tcase**	**Tjunction**
			C	C	C	C
D2	20.2%	290.0 W	73.7	75.1	75.1	86.7
D1	20.2%	290.0 W	73.7	75.1	75.1	86.7

Hydraulic Design Details

Type of Flow: Fixed flow rate (push)
Fluid: Air
Flow velocity: 2.5 m/s
Total Pressure Drop: 14.662 Pa
Exit Temperature: 57.9 C

Baseplate Temperature Profile



Download Qfin4 project file

CONVERTER BRIDGE
IGBT1 ,IGBT2, IGBT3, IGBT4

R-Tools 3D Heatsink Thermal Modeling

R-Tools Simulation - Design Output Summary

User: Cecilia de la Viesca (cecilia.viesca@ingenieriaviesca.com)
Project: 630kVA-Inv (15 Dec 2014, FabFin)
Simulation Date: 2015-05-13 05:41:17

Thermal Design Details

Heatsink type: Swaged fin
Part number: Fabfin: AF400T17A90AF117A
Weight: 25.9068 kg
Heatsink dimensions: 500.0 mm wide x 400.0 mm long x 133.0 mm high
Material: Aluminum
Finish: A

Environment

Ambient Temperature: 51.0 C
Altitude: 0.0 m

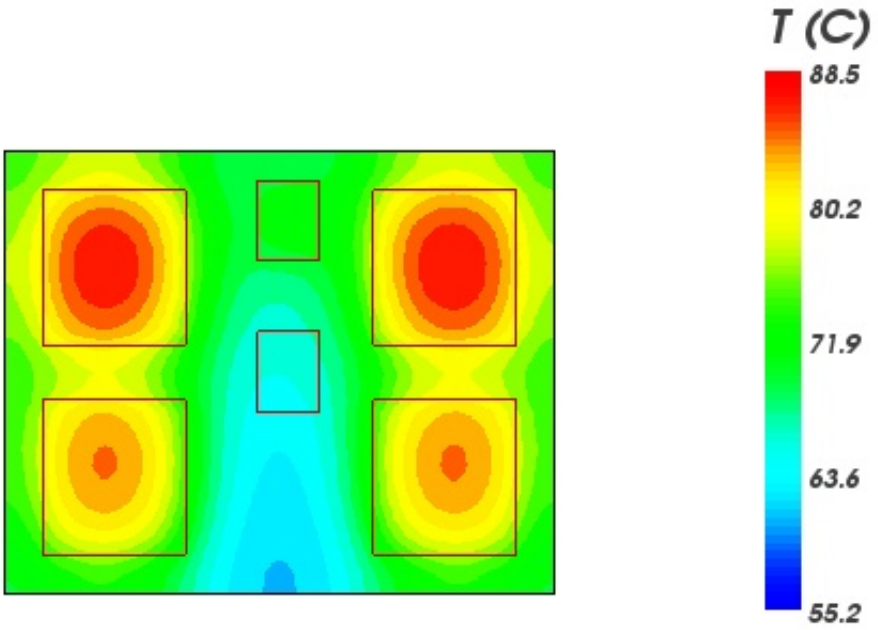
Thermal Design Details

			Temperature			
Source Names	**%sc**	**Power**	**Tsink-avg**	**Tsink-max**	**Tcase**	**Tjunction**
			C	C	C	C
R1	2.0%	117.0 W	71.5	72.4	72.4	100.9
IGBT1	9.1%	853.0 W	80.8	85.3	85.3	109.2
IGBT4	9.1%	853.0 W	80.8	85.4	85.4	109.2
IGBT3	9.1%	853.0 W	83.8	88.5	88.5	112.4
IGBT2	9.1%	853.0 W	83.6	88.4	88.4	112.3
R2	2.0%	18.0 W	66.2	68.0	68.0	72.4

Hydraulic Design Details

Type of Flow: Fixed flow rate (push)
Fluid: Air
Flow velocity: 5.6 m/s
Total Pressure Drop: 106.553 Pa
Exit Temperature: 59.5 C

Baseplate Temperature Profile



Download Qfin4 project file

600V RECTIFIER
D3, D4, D7, D8

R-Tools 3D Heatsink Thermal Modeling

R-Tools Simulation - Design Output Summary

User: Cecilia de la Viesca (cecilia.viesca@ingenieriaviesca.com)
Project: 630kVA-Rect
Simulation Date: 2015-05-14 04:03:49

Thermal Design Details

Heatsink type: Swaged fin
Part number: Fabfin: AF400T17A90AF117A
Weight: 25.9068 kg
Heatsink dimensions: 500.0 mm wide x 400.0 mm long x 133.0 mm high
Material: Aluminum
Finish: A

Environment

Ambient Temperature: 59.5 C
Altitude: 0.0 m

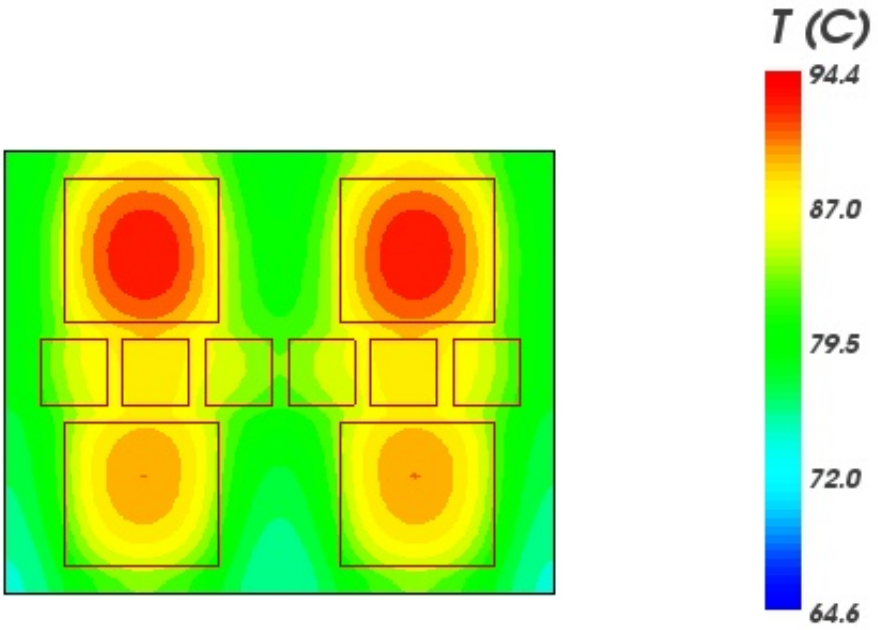
Thermal Design Details

			Temperature			
Source Names	**%sc**	**Power**	**Tsink-avg**	**Tsink-max**	**Tcase**	**Tjunction**
			C	C	C	C
MOD2	9.0%	735.0 W	90.9	94.4	94.4	104.7
R4	1.8%	110.0 W	85.2	86.9	86.9	113.8
MOD4	9.0%	735.0 W	87.8	91.4	91.4	101.6
R3	1.8%	110.0 W	85.1	86.9	86.9	113.7
MOD1	9.0%	735.0 W	87.8	91.3	91.3	101.6
R2	1.8%	110.0 W	88.8	89.7	89.7	116.5
R6	1.8%	110.0 W	85.4	87.9	87.9	114.8
R1	1.8%	110.0 W	85.4	88.0	88.0	114.8
R5	1.8%	110.0 W	88.8	89.7	89.7	116.5
MOD3	9.0%	735.0 W	90.9	94.4	94.4	104.7

Hydraulic Design Details

Type of Flow: Fixed flow rate (push)
Fluid: Air
Flow velocity: 5.6 m/s
Total Pressure Drop: 102.574 Pa
Exit Temperature: 68.3 C

Baseplate Temperature Profile



Download Qfin4 project file

600V DIODES
D6/D11

R-Tools 3D Heatsink Thermal Modeling

R-Tools Simulation - Design Output Summary

User: Cecilia de la Viesca (cecilia.viesca@ingenieriaviesca.com)
Project: TI-DIODO SALIDA (bis)
Simulation Date: 2015-05-19 09:32:22

Thermal Design Details

Heatsink type: Swaged fin
Part number: Fabfin: AF180T17A90AF117A
Weight: 11.6581 kg
Heatsink dimensions: 500.0 mm wide x 180.0 mm long x 133.0 mm high
Material: Aluminum
Finish: A

Environment

Ambient Temperature: 68.3 C
Altitude: 0.0 m

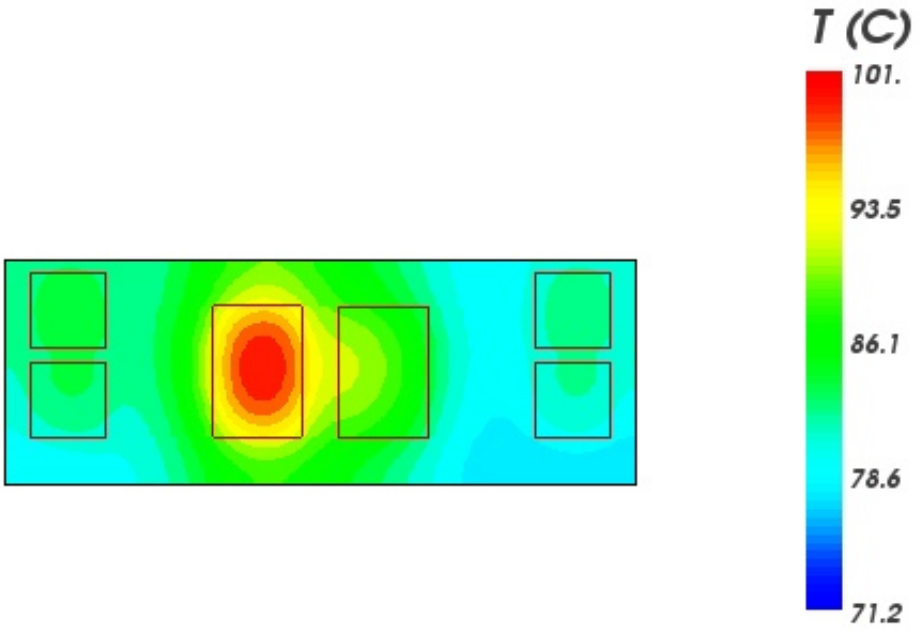
Thermal Design Details

			Temperature			
Source Names	**%sc**	**Power**	**Tsink-avg**	**Tsink-max**	**Tcase**	**Tjunction**
			C	C	C	C
D1	8.1%	554.0 W	97.1	101.0	101.0	135.3
R4	4.0%	100.0 W	82.5	83.2	83.2	107.6
R1	4.0%	100.0 W	82.8	84.1	84.1	108.5
R3	4.0%	100.0 W	81.2	82.5	82.5	106.9
R2	4.0%	100.0 W	84.2	84.8	84.8	109.2
D2	8.1%	267.0 W	88.6	92.1	92.1	108.7

Hydraulic Design Details

Type of Flow: Fixed flow rate (push)
Fluid: Air
Flow velocity: 5.6 m/s
Total Pressure Drop: 56.646 Pa
Exit Temperature: 71.4 C

Baseplate Temperature Profile



Download Qfin4 project file

INVERTER

R-Tools 3D Heatsink Thermal Modeling

R-Tools Simulation - Design Output Summary

User: Cecilia de la Viesca (cecilia.viesca@ingenieriaviesca.com)
Project: TI-Inversor
Simulation Date: 2015-05-21 10:39:02

Thermal Design Details

Heatsink type: Swaged fin
Part number: Fabfin: AF250T17A72AF117A
Weight: 12.9534 kg
Heatsink dimensions: 400.0 mm wide x 250.0 mm long x 133.0 mm high
Material: Aluminum
Finish: A

Environment

Ambient Temperature: 50.0 C
Altitude: 0.0 m

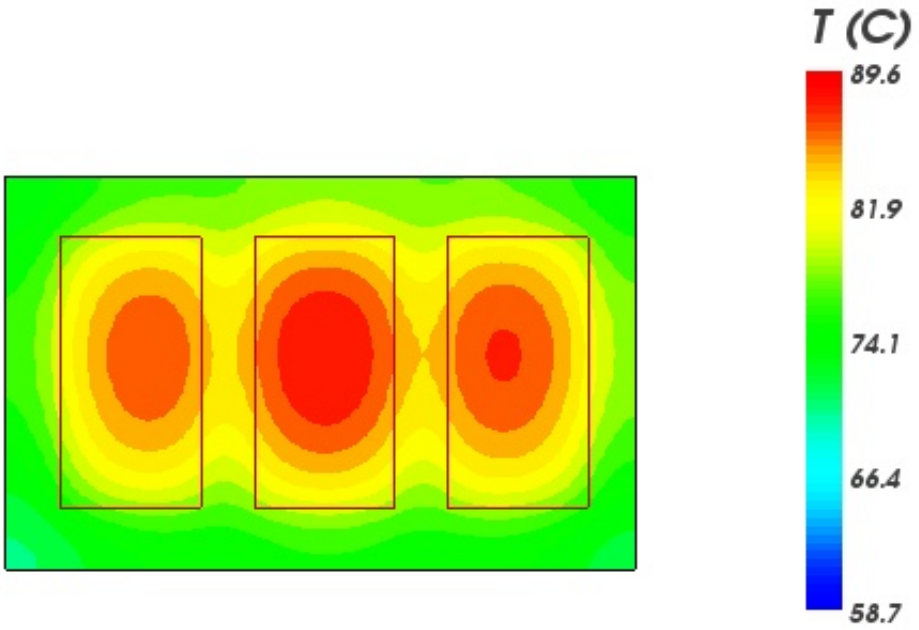
Thermal Design Details

			Temperature			
Source Names	**%sc**	**Power**	**Tsink-avg**	**Tsink-max**	**Tcase**	**Tjunction**
			C	C	C	C
IGBT1	15.3%	740.0 W	83.9	87.7	87.7	97.1
IGBT2	15.3%	740.0 W	86.2	89.6	89.6	99.0
IGBT3	15.3%	740.0 W	84.6	88.2	88.2	97.7

Hydraulic Design Details

Type of Flow: Fixed flow rate (push)
Fluid: Air
Flow velocity: 4.0 m/s
Total Pressure Drop: 39.813 Pa
Exit Temperature: 59.3 C

Baseplate Temperature Profile



Download Qfin4 project file

DV/DT RESISTORS
R13, R14, R15

R-Tools 3D Heatsink Thermal Modeling

R-Tools Simulation - Design Output Summary

User: Cecilia de la Viesca (cecilia.viesca@ingenieriaviesca.com)
Project: TI-Mod_R
Simulation Date: 2015-05-21 10:59:55

Thermal Design Details

Heatsink type: Swaged fin
Part number: Fabfin: AF180T17A45AF117A
Weight: 5.82904 kg
Heatsink dimensions: 250.0 mm wide x 180.0 mm long x 133.0 mm high
Material: Aluminum
Finish: A

Environment

Ambient Temperature: 59.3 C
Altitude: 0.0 m

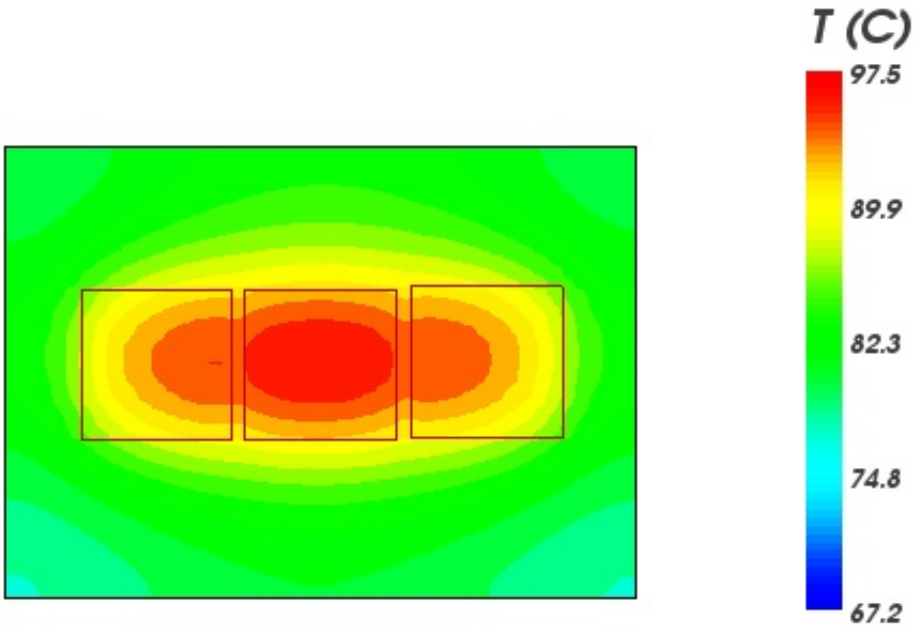
Thermal Design Details

			Temperature			
Source Names	**%sc**	**Power**	**Tsink-avg**	**Tsink-max**	**Tcase**	**Tjunction**
			C	C	C	C
R3	8.0%	300.0 W	92.2	95.8	95.8	136.6
R1	8.0%	300.0 W	92.0	96.0	96.0	136.8
R2	8.0%	300.0 W	95.0	97.5	97.5	138.3

Hydraulic Design Details

Type of Flow: Fixed flow rate (push)
Fluid: Air
Flow velocity: 4.0 m/s
Total Pressure Drop: 32.029 Pa
Exit Temperature: 65.5 C

Baseplate Temperature Profile



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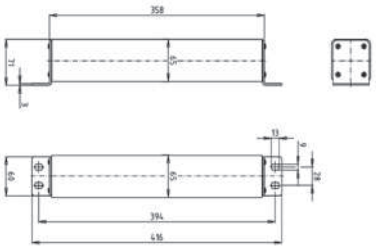
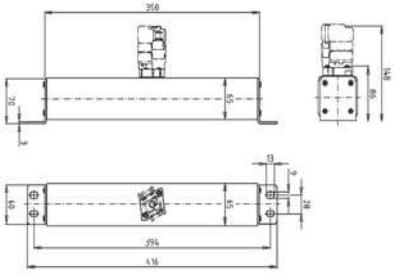
ALLEGATO 2

DATASHEET DEL CONVERTITORE

DC 4200 V SQB-DC 2



90 200 25



90 200 26

Verpackungseinheit / Packing unit: 1 Stück / 1 pieces

Betriebsklasse / Class	
aR	IEC 60 077-5 UIC 550

Bemessungs-spannung Rated Voltage	Artikel Nr. Article No	Größe Size	Bemessungsstrom Rated Current
V			A
DC 3600	90 200 25 90 200 26*	SQB-DC 2	100-315

Bemessungsausschaltvermögen / Rated breaking capacity 30 kA DC 4200 V (L/R=15ms)
Prüfausschaltspannung / Breaking test voltage DC 4200 V

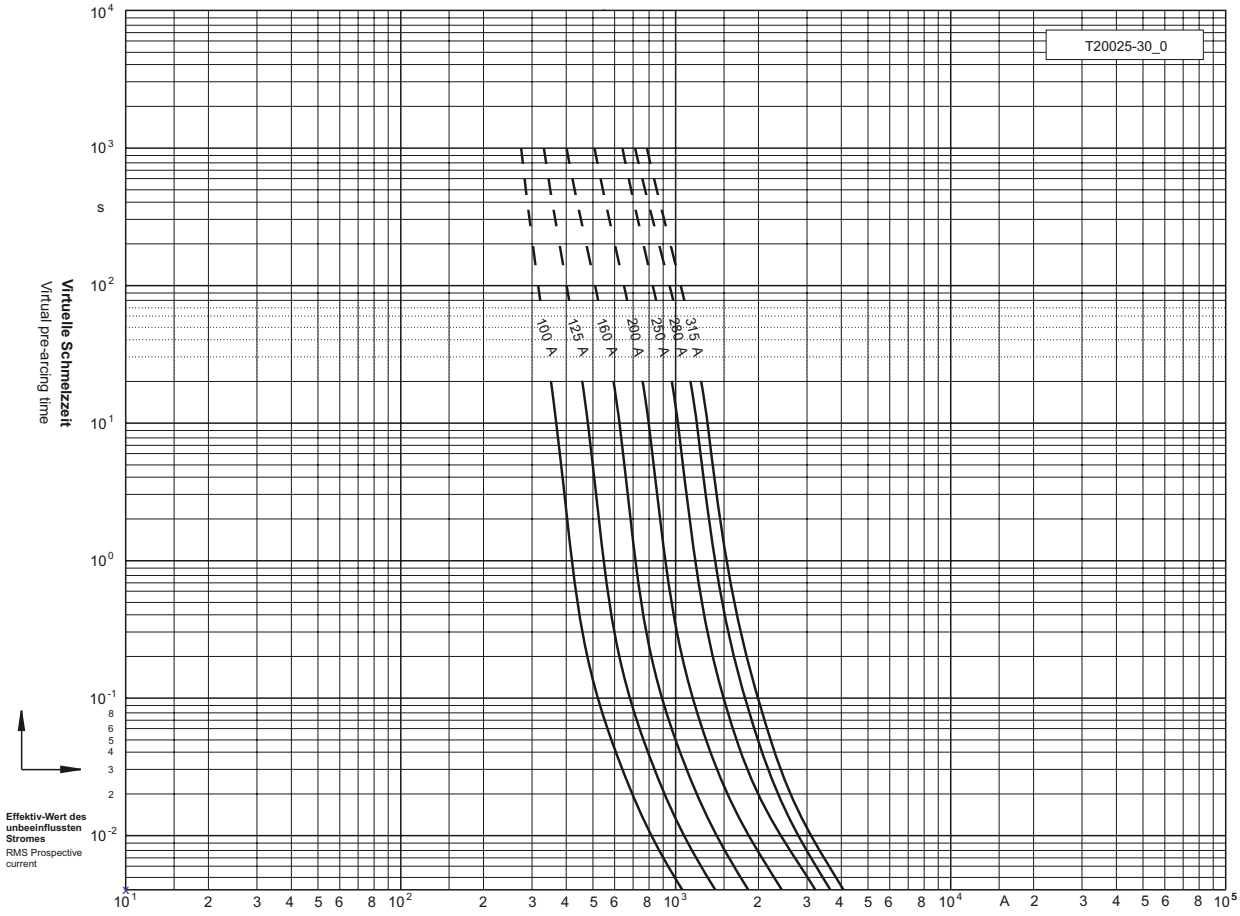
Bemessungsstrom Rated Current	Artikel Nr. Article No.		Gewicht Weight	Schmelzintegral Pre-Arcing-I^2t-Value	Ausschaltintegral Total I^2t-Value	Leistungsabgabe Power Loss
					@ DC 4200 V L/R=15ms	
A			kg / 1	A^2s	A^2s	W
100	90 200 25.100	90 200 26.100	3,60/3,92	2.300	19.000	75
125	90 200 25.125	90 200 26.125	3,60/3,92	4.000	33.500	90
160	90 200 25.160	90 200 26.160	3,60/3,92	6.600	55.300	120
200	90 200 25.200	90 200 26.200	3,60/3,92	11.800	98.000	145
250	90 200 25.250	90 200 26.250	3,60/3,92	21.000	175.000	165
280	90 200 25.280	90 200 26.280	3,60/3,92	27.000	221.000	205
315	90 200 25.315	90 200 26.315	3,60/3,92	33.000	273.000	220

* Anbaumöglichkeit eines Meldeschalters
suitable for switch fitting

Applikationskoeffizienten / Application coefficients (Weiterführende Informationen siehe Seite 13 / for more information see page 13)					
a	A2	B1 max.	B2	Cf3	
130	0,55	1,25	0,6	0,8	

DC 4200 V SQB-DC 2

Zeit/Strom-Kennlinien
Time-current characteristics



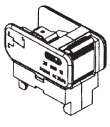
B-Switch for MS-Adapter Mounting

B-Switch — Rated Voltage AC 250 V — For Fuse-links with Adapter / For Micro Switch Fitting

Insulating Voltage up to [V]	Part No. Standard	Part No. Low Level	Change-over Circuits	Weight [g]	Pack
1 300	28 003 10	28 004 10	1	25	10
1 300	28 003 20	28 004 20	2	32	10
2 400	28 003 11	28 004 11	1	25	10
2 400	28 003 21	28 004 21	2	32	10
5 000	28 003 12	28 004 12	1	25	10
5 000	28 003 22	28 004 22	2	32	10

Type	Part No.	Insulating Voltage [V]	Interupting Rating: min. Load Requirements AC / DC [V_{ohmsch}]	[mA]	max. Data AC / DC [V]	[A]
standard	28 003 10 / 28 003 20	1 300	5	50	AC 250	12
	28 003 11 / 28 003 21	2 400	30	10		
	28 003 12 / 28 003 22	5 000	100	5	DC 35	10

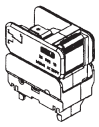
Type	Part No.	Insulating Voltage [V]	Interupting Rating: min. Load Requirements AC / DC [V_{ohmsch}]	[mA]	max. Data [V]	[A]
low level	28 004 10 / 28 004 20	1,300	do not use below		AC 250	10
	28 004 11 / 28 004 21	2,400	5	1		
	28 004 12 / 28 004 22	5,000			DC 35	1



up to 1,300 V

Standard Part No. 28 003 10 / 20

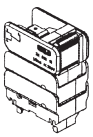
Low Level Part No. 28 004 10 / 20



up to 2,400 V

Standard Part No. 28 003 11 / 21

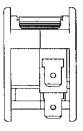
Low Level Part No. 28 004 11 / 21



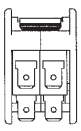
up to 5,000 V

Standard Part No. 28 003 12 / 22

Low Level Part No. 28 004 12 / 22



1 Change-over circuit
2 contact terminals
6,3 x 0,8 mm



2 Change-over circuit
2x2 contact terminals
6,3 x 0,8 mm

SCHALTBAU

Connect · Contact · Control

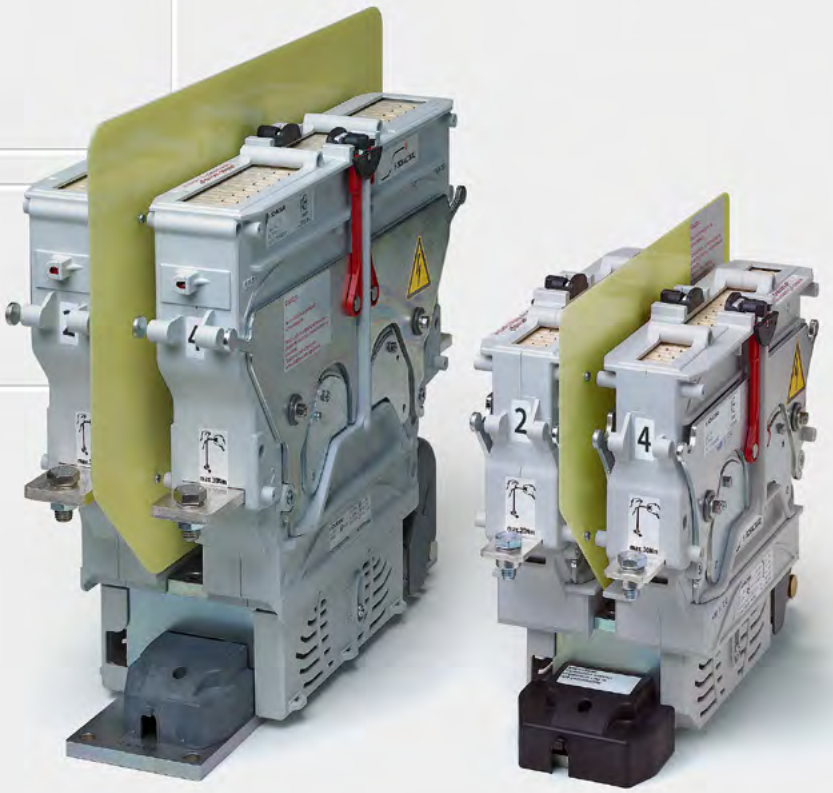
3

Contactors

CT1215/04, CT1230/04
CT1215/08, CT1230/08

Double pole
power contactors
for AC and DC

Catalogue **C21**.*en*



CT1215/04, CT1230/04, CT1215/08, CT1230/08 Double pole power contactors for AC and DC

CT Series – revolutionary method of arc quenching for both DC and AC

With the new double pole CT series contactors Schaltbau expands its product line of state-of-the-art power contactors. The outstanding technical feature is the innovative combination of electromagnetic and permanent-magnetic blowout technology for electric arc control. The successful combination of these two principles greatly improves both switching functionality and reliability and forms a practical and economically impressive device concept.

The CT contactor concept is flexible and can be adapted to suit the needs of the customer. Due to its technical characteristics, its economical advantages, its compactness and versatility, the CT power contactor series is simply predestined for use in industrial and railway applications alike. The contactors are especially suited for use in locomotives, cranes, and converters of wind turbines and PV installations, but also in mining.

Features

- Compact, rugged innovative design
- Rated operating voltage 1,500 V or 3,000 V
- Double-break contacts, (normally open)
- 1, 2*1, and 3*2 pole versions
- Easy inspection and replacement of main contact tips as well as arc chute
- Drive system with coil tolerance according to railway standards
- Functional insulation for main circuit
- Basic insulation between main circuit and protective earth
- Reinforced insulation between main circuit and control circuit / auxiliary circuit

Applications

Double pole CT Series contactors comprise a number of various design versions catering to a wide range of uses, such as:

- **Main contactor for:**
  Traction converters and inverters for auxiliary equipment
- **Contactor for:**
  Field circuits of motors, conventional resistor based traction units (retrofit), starter and compressor motors, and heating circuits

Ordering code

Series CT, 2 pole

Example: **CT1230/04 H 110ET-00**

Series

CT11	1 pole NO contactor *1
CT12	2 pole NO contactor
CT13	3 pole NO contactor *2

Main contacts: Nominal voltage

15	U_n = 1,500 V
30	U_n = 3,000 V

Main contacts: Conventional thermal current

04	I_{th} = 400 A*4.1
06	I_{th} = 600 A*3/*4.2
08	I_{th} = 800 A*4.2
11	I_{th} = 1,100 A*3/*4.2
15	I_{th} = 1,500 A*3/*4.1/*5

Mounting position

H	horizontal (lock bar yellow)
V	vertical (lock bar red)

Coil voltage

24 / 36 / 48 / 72 / 110 V DC

Auxiliary contacts

1x S870*6.2 (a1) 1x S870*6.2 (b_0) 2x S826*6.1/*6.3	M3 screw-type terminals	00
1x S870*6.2 (a1) 1x S870*6.2 (b_0)	M3 screw-type terminals	01
2x S826*6.3	Flat tabs 6.3 x 0.8	
4x S826*6.3	M3 screw-type terminals	02
4x S826*6.3	Flat tabs 6.3 x 0.8	03

Surge suppression/type of coil

Suppressor diode / standard coil *4.3	T
Double coil controller (DCC) / double coil *4.4	CM

Coil tolerance

-30 % … +25 %	E

Note:
Presented in this catalogue are only stock items which can be supplied in short delivery time.
For some variants minimum quantities apply. Please do not hesitate to ask for the conditions.

Special variant:
If you need a special variant of the contactor, please do not hesitate to contact us. Maybe the type of contactor you are looking for is among our many **special designs**. *If not, we can also supply* **customized** *designs. In this case, however, minimum order quantities apply.*

**1 See catalogue C20*
**2 Special design, upon request*
**3 Series in development*
**4.1 Suppressor diode / standard coil*
**4.2 Double coil controller (DCC), integrated / double coil*
**4.3 For main contacts I_{th} = 400 A*
**4.4 For main contacts I_{th} > 400 A*
**5 Single pole version: 2x main contacts I_{th} = 800 A, parallel connected*
**6.1 Aux. contact, blowout version*
**6.2 Aux. contact: snap-action switch S826, see also catalogue D26*
**6.3 Aux. contact: snap-action switch S870, see also catalogue D70*

SCHALTBAU

Specifications Double pole power contactors for AC and DC — Series CT, 2 pole

Series	CT1215/04	CT1230/04	CT1215/08	CT1230/08
Type of voltage	DC (bidirectional), AC (f < 60 Hz)		DC (bidirectional), AC (f < 60 Hz)	
Main contacts, number of, configuration	2x NO		2x NO	
Nominal voltage U_n	1,500 V	3,000 V	1,500 V	3,000 V
Rated operating voltage U_e	1,800 V	3,600 V	1,800 V	3,600 V
Rated insulation voltage U_{Nm}	3,000 V	4,800 V	3,000 V	4,800 V
Rated impulse withstand voltage U_{Ni}	15 kV	25 kV	15 kV	25 kV
Pollution degree / Overvoltage category	PD3 / OV3	PD3 / OV3	PD3 / OV3	PD3 / OV3
Switching surge overvoltage				
U_e = 1,800 V	<9 kV	---	<9 kV	---
U_e = 3,600 V	---	< 15 kV	---	< 15 kV
Conventional thermal current $_{th}$	400 A *1	400 A *1	800 A	800 A
Component category (IEC 60077-2)	A2	A2	A2	A2
Short-circuit making capacity	2.5 kA (new contacts) / 5 kA (used contacts)		3.5 kA (new contacts) / 8 kA (used contacts)*2	
Rated operating current I_e (2 poles connected in series, at operational frequency C2)				
DC, U_e = 1,200 V (T2 = 15 ms)				
DC, U_e = 1,800 V (T2 = 15 ms)	450 A		800 A	
DC, U_e = 3,600 V (T2 = 15 ms)	---	350 A (extrapolated value)	---	800 A
Rated operating current I_e (per pole, at operational frequency C2)				
DC, U_e = 1,200 V (T2 = 15 ms)				
DC, U_e = 1,800 V (T2 = 15 ms)	300 A		450 A	---
DC, U_e = 3,600 V (T2 = 15 ms)	---	200 A	---	320 A
Breaking capacity (2 poles connected in series, T2 = 15 ms)				
DC, U_e = 1,200 V	1,400 A		2,000 A	---
DC, U_e = 1,800 V	800 A	1,200 A	1,400 A	2,000 A
DC, U_e = 3,600 V	---	750 A	---	1,200 A *3
Breaking capacity (2 poles connected in series, T2 = 1 ms)				
DC, U_e = 1,200 V	2,600 A		4,200 A	---
DC, U_e = 1,800 V	1,800 A	upon request	3,000 A	3,400 A
DC, U_e = 3,600 V	---	upon request	---	2,300 A *3
Breaking capacity (per pole, cosφ = 0.8)				
AC, U_e = 1,200 V (f = 16,7 / 50 Hz)	1,000 A / 700 A		1,900 A / 1.400 A	--- / ---
AC, U_e = 1,800 V (f = 16,7 / 50 Hz)	800 A / 500 A	1,600 A / 900 A	1,500 A / 1.000 A	2,300 A / 1,500 A
AC, U_e = 3,600 V (f = 16,7 / 50 Hz)	--- / ---	900 A / 500 A	--- / ---	1,300 A / 900 A
Breaking capacity (per pole, cosφ = 1)				
AC, U_e = 1,200 V (f = 16.7 / 50 Hz)	1,300 A / 1,000 A		2,200 A / 1,600 A	--- / ---
AC, U_e = 1,800 V (f = 16.7 / 50 Hz)	1,000 A / 700 A	2,100 A / 1,200 A	1,900 A / 1,200 A	2,900 A / 1,700 A
AC, U_e = 3,600 V (f = 16.7 / 50 Hz)	--- / ---	1,300 A / 800 A	--- / ---	1,600 A / 1,300 A
Rated short-time withstand current I_{cw} (T < 100 ms)	5 kA	5 kA	8 kA*2	8 kA*2
Critical current range	None	None	None	None
Main contacts				
Contact material	$AgSnO_2$		$AgSnO_2$	
Terminals	M10		M12	
Torque	20 Nm max.		30 Nm max.	
Auxiliary contacts				
Number and type	1x S870 (a_1), 1x S870 (b_0), 2x S826 or 4x S826) *4		1x S870 (a_1), 1x S870 (b_0), 2x S826 or 4x S826) *4	
Contact material	Silver		Silver	
S826 switching capacity (T = 5 ms)	16 A at 24 V DC; 13.5 A at 80 V DC; 7 A at 110 V DC		16 A at 24 V DC; 13.5 A at 80 V DC; 7 A at 110 V DC	
Terminals	Screws M3 / Flat tabs 6.3 x 0.8 mm		Screws M3 / Flat tabs 6.3 x 0.8 mm	
Magnetic drive				
Pollution degree / overvoltage category	PD3 / OV2		PD3 / OV2	
Coil voltage U_s	24 / 36 / 48 / 72 / 110 V DC		24 / 36 / 48 / 72 / 110 V DC	
Coil tolerance	-30 % ... +25 % U_s		-30 % ... +25 % U_s	
Coil power consumption at U_s and T_a = 20 °C	cold coil: 70 W / warm coil: 50 W		pull-in (1s max.): 280 W max. / hold: 27 W	
Pull-in time, typical at T_a = 20 °C	85 ms		> 100 ms	
Drop-off voltage, typical at T_a = 20 °C	> 0.08 x U_s		> 0.08 x U_s	
Drop-off time, typical at T_a = 20 °C	50 ms		> 100 ms	
Switching frequency at T_a = 20 °C and 1.25 U_s	4 operations/minute		4 operations/minute max.	
Type of coil	Standard coil		Double coil	
Surge suppression	Suppressor diode		Double coil controller with integrated suppressor diode	
Coil terminal	Cage clamp		Cage clamp	
Ingress protection rating (IP code)	IP00		IP00	
Mechanical endurance	> 2 million operating cycles		> 2 million operating cycles	
Vibration / Shock (EN 61373)	Category 1, Class B		Category 1, Class B	
Mounting position	horizontal / vertical		horizontal / vertical *5	
Ambient conditions				
Operating temperature / storage temperature	-40 °C … +70 °C / -40 °C … +85 °C		-40 °C … +70 °C / -40 °C … +85 °C	
Altitude	< 2,000 m above sea level		< 2,000 m above sea level	
Humidity (EN 50125-1)	< 75 % yearly average		< 75 % yearly average	
Weight	18 kg	22 kg	30 kg	35 kg

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*1 With frequent switching under load the conv. thermal current I_{th} must be limited to 350 A.

*2 Preliminary values

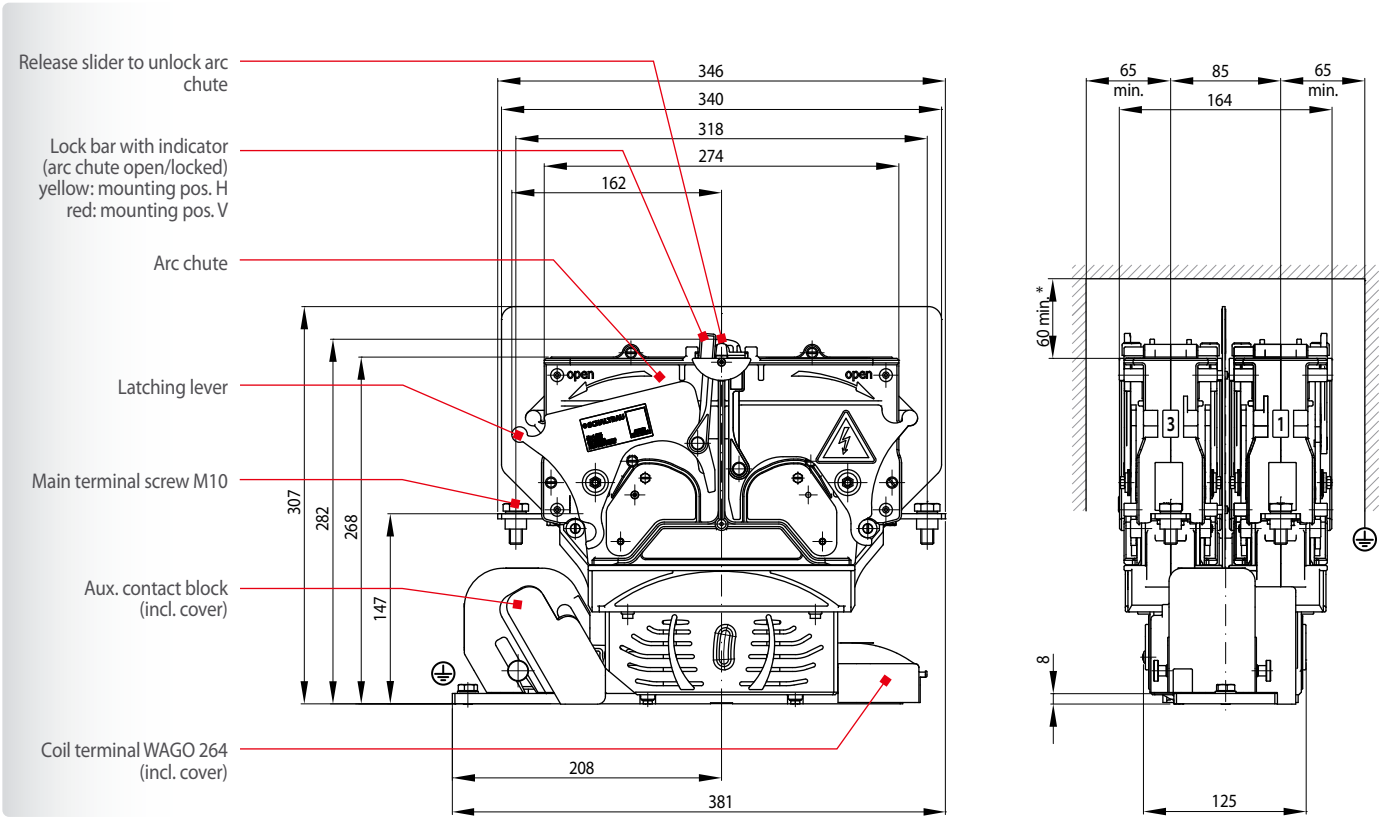
*3 »Observe dimensioning instructions for C1230/08 Series on page 6

*4 a1 and b0 according to IEC60077

*5 For frequent load switching use contactors for vertical mounting (red lock bars).

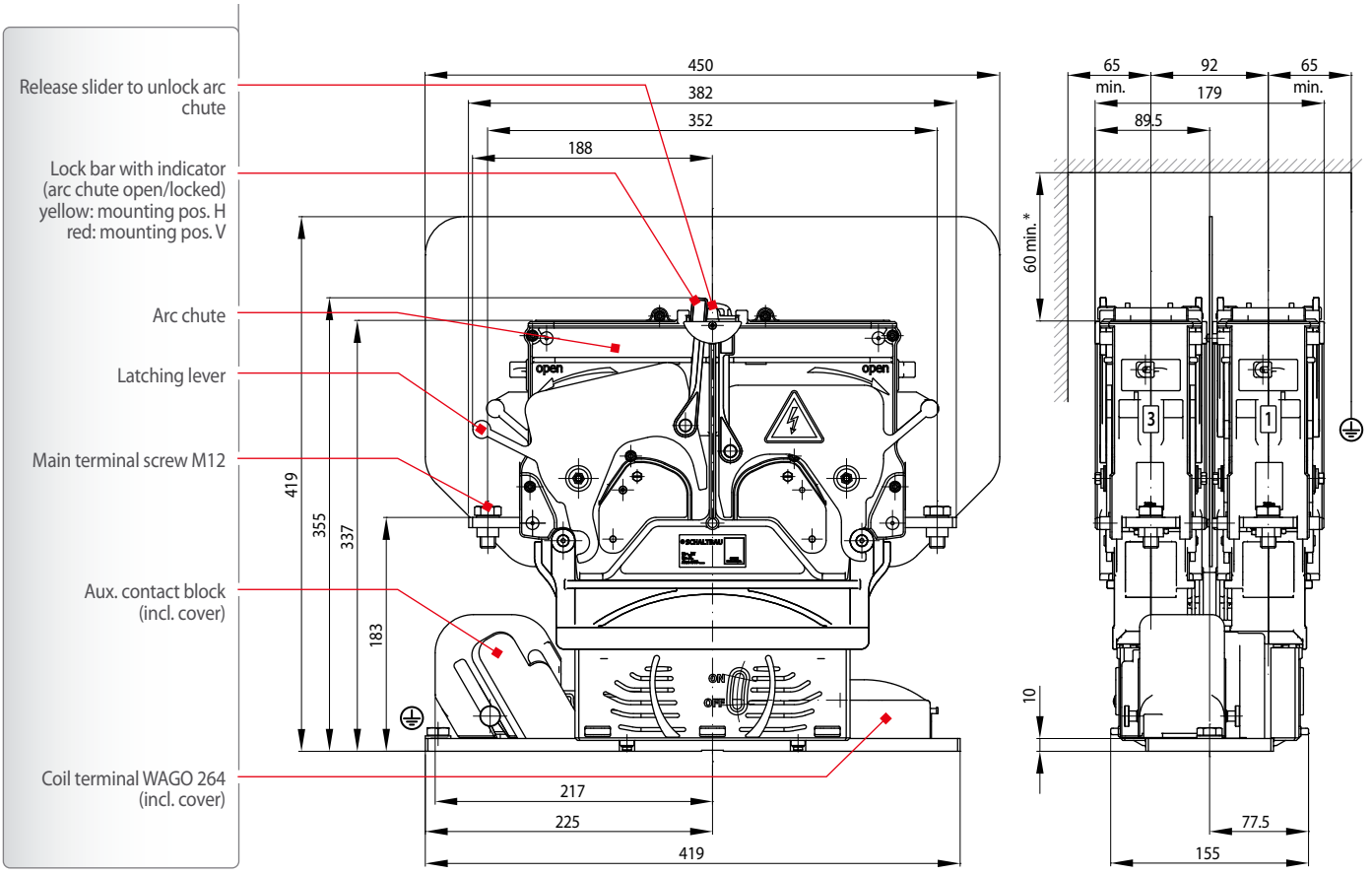
CT1215/04 Dimension diagram double pole NO contactor for 1,500 V / 400 A

Series CT, 2 pole



CT1215/08 Dimension diagram double pole NO contactor for 1,500 V / 800 A

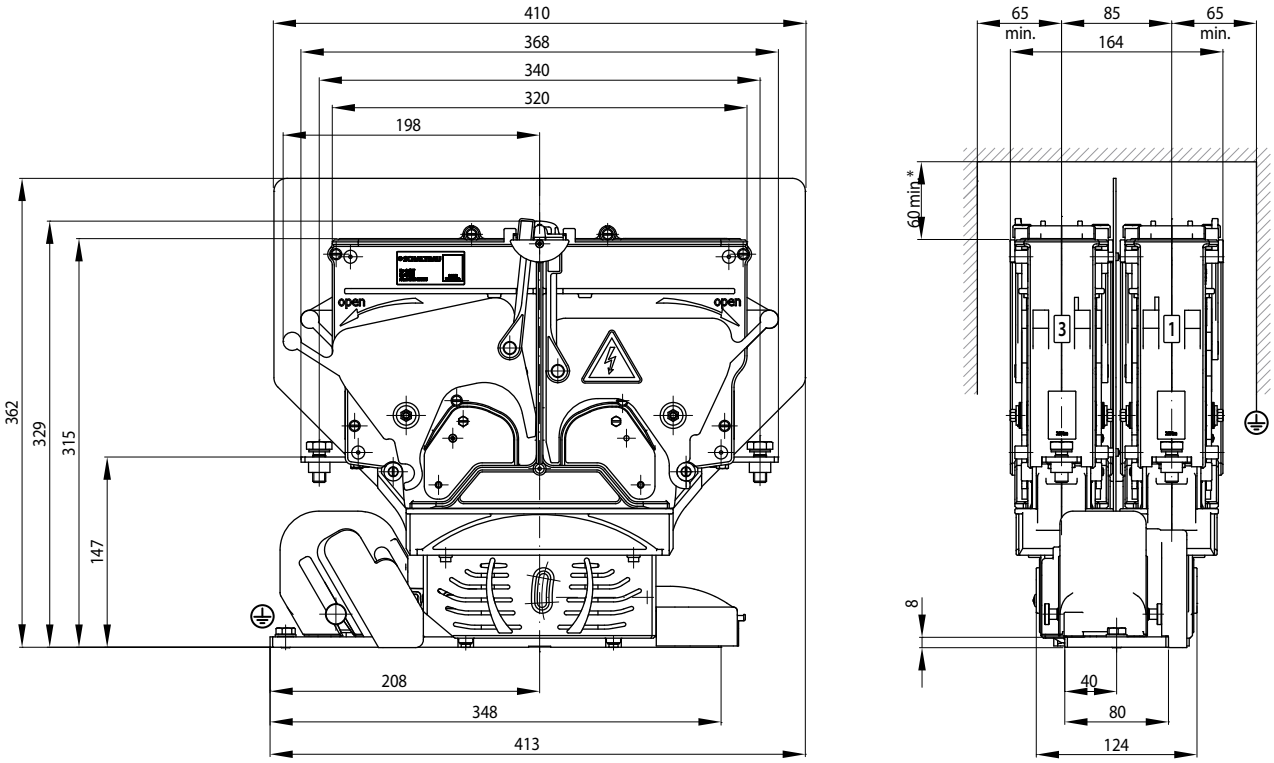
Series CT, 2 pole



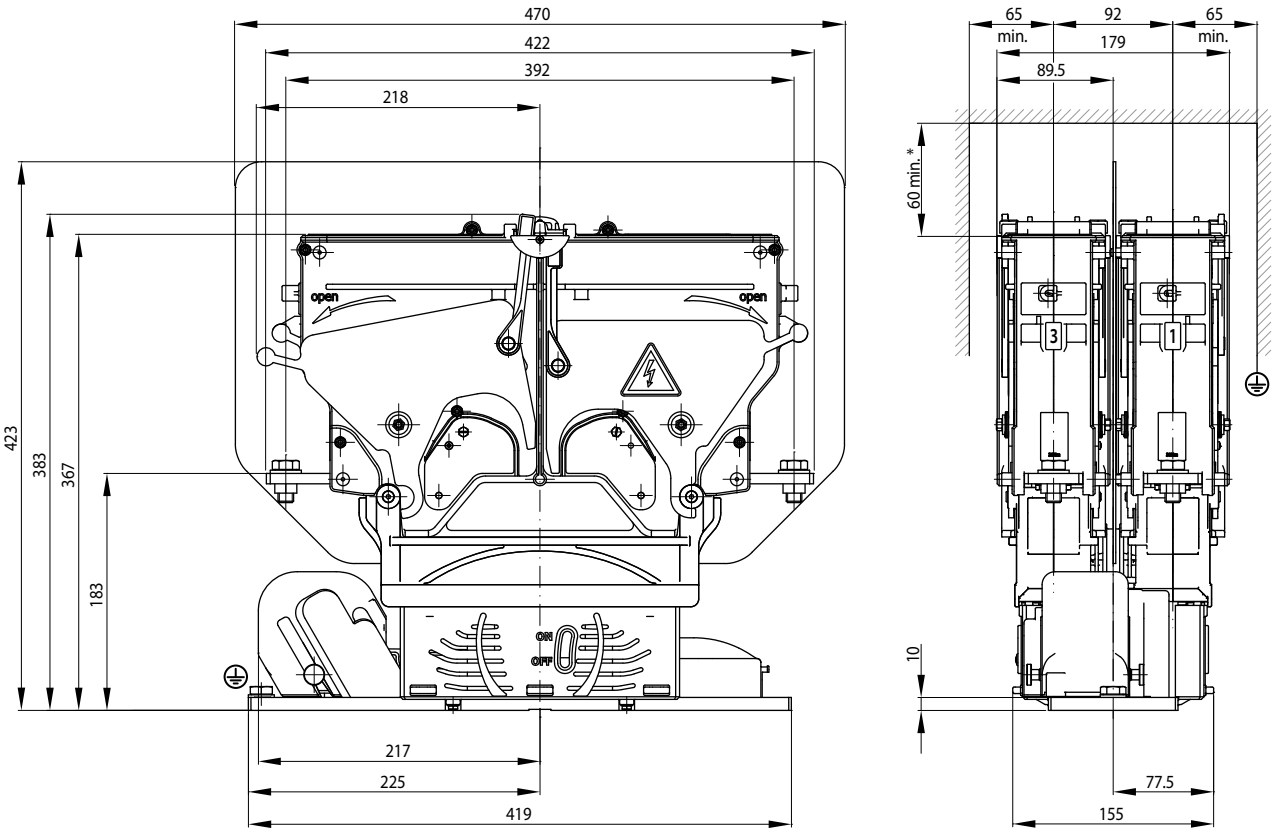
⚠ **** Minimum clearance:***
Interrupting at maximum capacity could require larger clearance!
Feel free to contact us, we will be happy to assist you with dimensioning.

Dimensions in mm

CT1230/04 Dimension diagram double pole NO contactor for 3,000 V / 400 A — Series CT, 2 pole



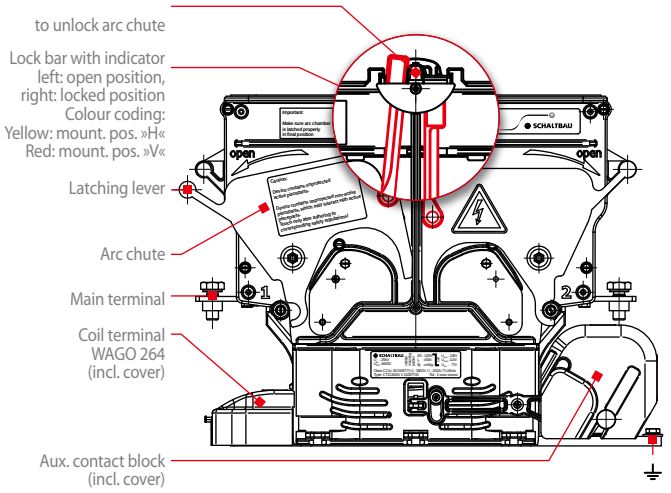
CT1230/08 Dimension diagram double pole NO contactor for 3,000 V / 800 A — Series CT, 2 pole



⚠ **** Minimum clearance:***
Interrupting at maximum capacity could require larger clearance!
Feel free to contact us, we will be happy to assist you with dimensioning.

Dimensions in mm

Mounting instructions



Start up

Before initial start up make sure that:

- the arc chute is mounted properly and the lock bars are locked in position
- the protective covers are mounted properly
- the contactor is earthed (PE terminal on mounting plate)

Removal of arc chute

1. Push both release sliders in the direction indicated by the arrow and hold them in this position.
2. Move all four levers for unlocking the arc chute in the direction indicated by the arrow.
3. The arc chute incorporating the stationary main contacts can now be lifted from the contactor.

Mounting the arc chute

1. Mount the arc chute onto the magnetic drive. Note: The arc chute has keys on one side to fit into slots on the corresponding side of the contactor. So you cannot mount it the wrong way round.
2. Move all four levers for unlocking the arc chute into the original position.
3. Check: The arc chute is locked properly, if all four lock bars click into place and cannot be opened without pushing the release slider.

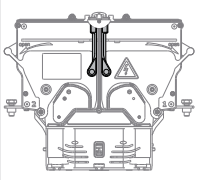
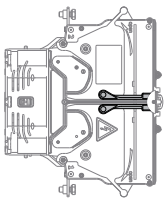
Removal of protective covers

- Protective cover auxiliary switches: Dismount arc chute first, then loosen knurled head screws and remove protective cover.
- Protective cover coil terminals: Unscrew cover and take it off.

Mounting of protective covers

- Protective cover auxiliary switches: Position protective cover and screw in both knurled head screws. Then mount arc chute.
- Protective cover coil terminals: Introduce protective cover into the groove of the coil drive and locate in position. Then tighten screws.

Mounting positions

Mounting position	»H« horizontal	»V« vertical
Lock bars, colour	YELLOW	RED
Mounting position Please observe the mounting position as shown on the nameplate	»H« horizontal 	»V« vertical 

Dimensioning instructions

- Do you need some help? For selecting the contactor that suits your application best do not hesitate to ask our advice.
- For dimensioning CT12xx/xx Series contactors please observe the following instructions:
  1. For connection of the main contacts Schaltbau recommends the use of busbars with the following dimensioning:
     - Conv. thermal current I_{th} = 400 A: 60 x 5 mm
     - Conv. thermal current I_{th} = 800 A: 80 x 8 mm
  2. Observe clearance of live parts to arc chute! Refer to dimension drawings on page 4 and 5 for data.
  3. CT1230/08: For frequent load switching use contactors for vertical mounting (red lock bars).
  4. For nominal voltages $U_n \geq$ 3,000 V DC ask for our special design CT1230/08 ... 200.

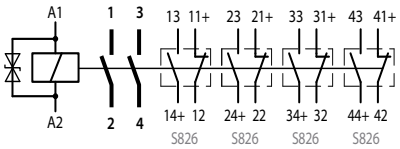
Surge suppression

- **CT12xx/04 Series with main contacts designed for I_{th}=400 A:**
  Surge suppression/coil type »T«: Standard coil with suppressor diode. The use of a suppressor diode for limiting transient overvoltages occurring on opening of the coil is optimally attuned to the contactor's switching behaviour. The existing opening characteristic must not be negatively influenced by parallel connection with an external diode.
- **CT12xx/08 Series with main contacts designed for I_{th}=800 A:**
  Surge suppression/coil type »CM«: Double coil with integrated double coil controller (DCC module).
  Observe correct polarity of coil terminals. Do not add any extra suppressor diodes to the configuration.

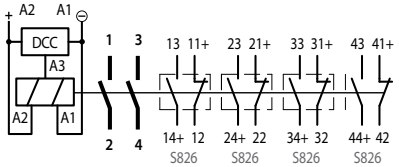
Circuit diagrams

- **Versions to industry standard**

2x NO I_{th} = 400 A,
Standard coil ,
Aux. contacts 4 x S826

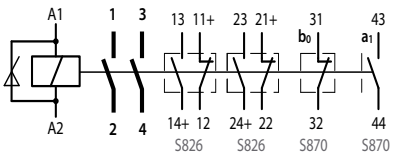


2x NO I_{th} = 800 A,
Double coil with
double coil controller,
Aux. contacts 4 x S826

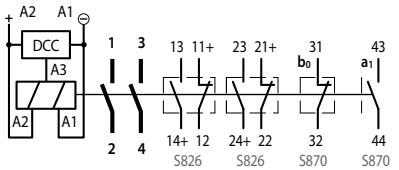


- **Versions to railway standard IEC 60077**

2x NO I_{th} = 400 A,
Standard coil,
Aux. contacts (IEC 60077)
2 x S826, 1 x S870$_{(b0)}$,
1 x S870$_{(a1)}$



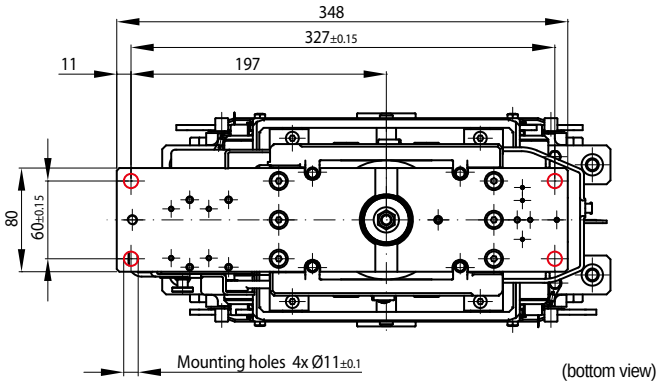
2x NO I_{th} = 800 A,
Double coil with
double coil controller,
Aux. contacts (IEC 60077)
2 x S826, 1 x S870$_{(b0)}$,
1 x S870$_{(a1)}$



Mounting holes

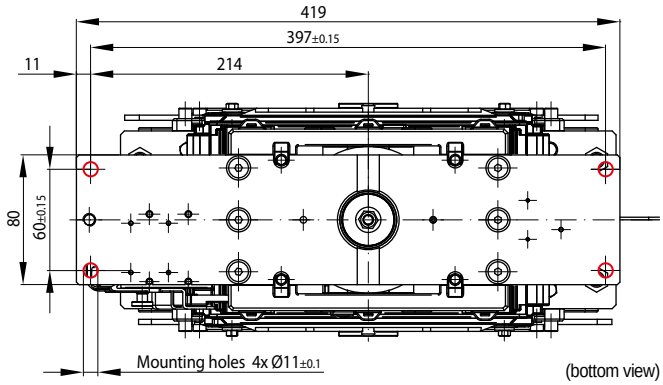
Series CT, 2 pole

- **Double pole NO contactor, CT1215/04, CT1230/04 Series**



(bottom view)

- **Double pole NO contactor CT1215/08, CT1230/08 Series**



(bottom view)

Spare parts

Series CT, 2 pole

Items	Spare part, description	Ordering code CT1215/04	CT1230/04	CT1215/08	CT1230/08
1	Set of two stationary contacts	MC CT1015/04	MC CT1030/04	MC CT1015/08	MC CT1030/08
1	Contact bridge with mounted contact holder, mounting position »H« horizontal	CBH CT1215/04	CBH CT1230/04	CBH CT1215/08	CBH CT1230/08
1	Contact bridge with mounted contact holder, mounting position »V« vertical	CBV CT1215/04	CBV CT1230/04	CBV CT1215/08	CBV CT1230/08
1	Protective cover coil terminals	CC CT1030/04		CC CT1030/08	
1	Protective cover aux. switches	CA CT1030/04		CA CT1030/08	
1	Snap-action switch (SPDT)	S826 a L			
1	Contact block of 2x S870 (momentary switches a1, b0)	AS S870			

Maintenance instructions

For detailed maintenance, safety and mounting instructions please refer to our operating manuals C21/04-M.en and C21/08-M.en!

- CT12xx/xx Series contactors are maintenance free with normal use.
- Make regular inspections once or twice a year. So when installing the contactor, make sure that there is enough space to remove and replace the arc chute with ease and that the main contacts become accessible for inspection.
- Frequent switching or switching under high load may lead to increased wear of the main contacts. In this case replacement of the main contacts may become necessary. The design of the CT contactor series allows for easy replacement of the main contacts. For detailed information please refer to our manuals C21/04-M.en and C21/08-M.en respectively.

Safety instructions

- The switching device meets the requirements of basic insulation. Make sure the plate onto which the drive of the contactor is mounted is earthed in a vibration resistant way.
- Do not use contactor without properly mounted arc chute.
- The contactor has unprotected live parts and carries a label that warns of the hazard. This caution must be observed and the label must not be removed in any way.
- The required clearance of live parts to ground and other parts of the contactor is to be observed as well as the safety regulations of the applicable standards.
- Switching at maximum breaking capacity might require larger clearance! Do not hesitate to ask our advice for dimensioning.
- Do not use contactor without protective covers (for coil terminals and auxiliary switches).
- Coil suppression for reducing surges when the coil is switched off is optimally attuned to the contactor's switching behaviour. The existing opening characteristic must not be negatively influenced by parallel connection with an external diode.
- Improper handling of the contactor, e.g. when hitting the floor with some impact, can result in breakage, visible cracks and deformation.

Standards

- **IEC 60077:** Railway applications – Electric equipment for rolling stock
- **EN 50124-1:** Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment
- **IEC 61373:** Railway applications - Rolling stock equipment - Shock and vibration tests

Defective parts must be replaced immediately!

Dimensions in mm

Schaltbau GmbH

For detailed information on our products and services visit our website – or give us a call!

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e-Mail contact@schaltbau.de

with compliments:

RoHS 2011/65/EC

Schaltbau GmbH manufactures in compliance with RoHS.

IRIS Certification

The production facilities of Schaltbau GmbH have been IRIS certified since 2008.

Schaltbau GmbH ISO 14001 certified since 2002

Certified to DIN EN ISO 14001 since 2002. For the most recent certificate visit our website.

Schaltbau GmbH ISO 9001 certified since 1994

Certified to DIN EN ISO 9001 since 1994. For the most recent certificate visit our website.

Electrical Components and Systems for Railway Engineering and Industrial Applications

Connectors

- Connectors manufactured to industry standards
- Connectors to suit the special requirements of communications engineering (MIL connectors)
- Charging connectors for battery-powered machines and systems
- Connectors for railway engineering, including UIC connectors
- Special connectors to suit customer requirements

Snap-action switches

- Snap-action switches with positive opening operation
- Snap-action switches with self-cleaning contacts
- Enabling switches
- Special switches to suit customer requirements

Contactors

- Single and multi-pole DC contactors
- High-voltage AC/DC contactors
- Contactors for battery powered vehicles and power supplies
- Contactors for railway applications
- Terminal bolts and fuse holders
- DC emergency disconnect switches
- Special contactors to suit customer requirements

Electrics for rolling stock

- Equipment for driver's cab
- Equipment for passenger use
- High-voltage switchgear
- High-voltage heaters
- High-voltage roof equipment
- Equipment for electric brakes
- Design and engineering of train electrics to customer requirements

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SCHALTBAU

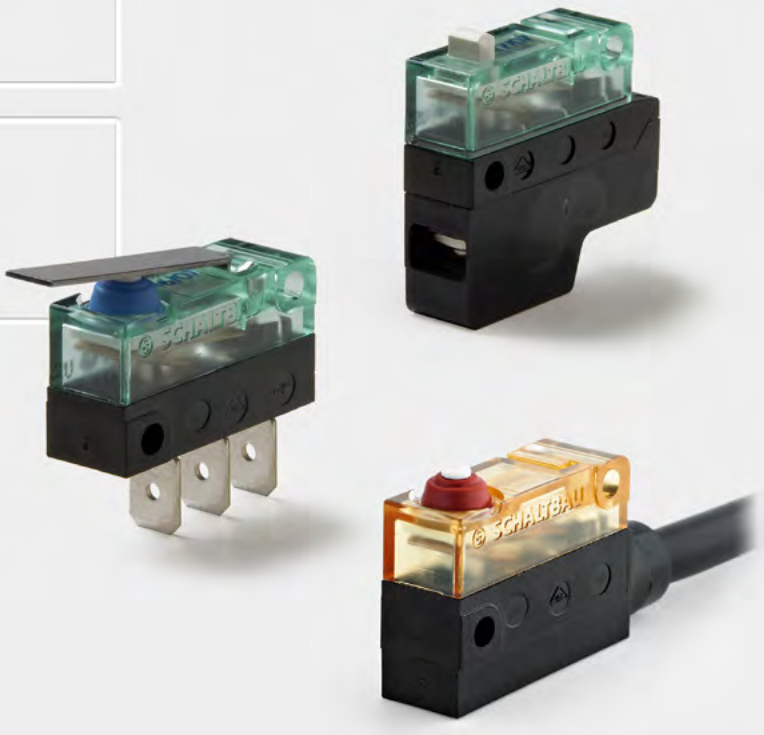
Connect · Contact · Control

2

S870, S970 Series

Snap-action switches
Positive opening operation
Self-cleaning contacts

Catalogue D70.en



Snap-action switches S870/S970 Series

Single break SPDT switches with positive opening operation and wiping contacts

S870/S970 Series snap-action switches feature positive opening operation, which guarantees that even contacts which have become welded together due to a short-circuit will open reliably.

Wiping contacts protected against dust, humidity and contaminants ensure high reliability even with small contact loads. Versions with gold contacts are especially suited for switching low voltages and small currents.

A defined as well as repeatable switching action is possible thanks to the snap mechanism whose switching speed is virtually independent of the actuation speed. That is why snap-action switches are preferred in applications with slow actuation speeds , where they are used, for instance, as motor switches, position switches, or gear limit switches.

Features

Series S870/S970

Variants for extreme conditions: Ruggedized housing made from polyetherimide (PEI). Designed for use in harsh environments. Improved resistance to extremes of temperature, chemicals and impact.

IP Rating: Degrees of protection against dust, humidity, contaminants, or access to hazardous parts to IEC 60529: Contacts: IP40, IP60 or IP67 / Terminals: IP00, IP20 or IP67

Positive opening operation: Reliable breaking of both circuits even if the contacts have become welded together (in compliance with IEC 60947-5-1, Annex K).

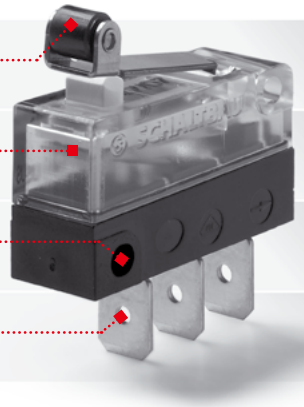
Self-cleaning contacts: Continuous low contact resistance ensures high contact reliability over the entire design life of the switch.

Single break contacts: Changeover switch, also available as NC or NO versions with leads or cable connection. Compact design.

Contact material: Silver or gold

Design and function

Series S870/S970



- **Actuator**
  - Standard: Push button
  - Actuator styles: roller lever, plain lever or simulated roller lever
- **Contact area**
  - Microswitch with SPDT, NC or NO contacts
  - Positive opening operation and wiping contacts
  - Contact material: Silver or gold
- **Mounting**
  - Ganging (side mount)
- **Terminals**
  - Flat tabs / solder lugs / PCB
  - M3 screws with saddle clamp
  - Factory-potted cable or leads

S970 Better

Resistance to
- temperature
- chemicals
- impact

Variants for extreme conditions

Schaltbau has developed special variants for use in harsh environments. The S970 Series has a ruggedized housing made from polyetherimide (PEI) that stands for improved resistance to:

- temperatures from -55 °C to +150 °C*
- chemicals (e.g. acids and alkalis)
- impact (PEI 50% more resistant than PC)

The amber, transparent switches are ideally suited for applications where impact forces are high and/or frequent as well as for use in products that are exposed to strong chemicals or extremes of temperature.

The S9xx Series switches have the same design, dimensions and technical features as the switches of the standard S8xx series, allowing for easy replacement and upgrade from a standard switch without additional implementation effort.

Applications

S970 switches are typically used with systems and components that require a high degree of safety and reliability, such as

- Limit switches for machine, door and plant control systems
- Control switches for the driver's desk of rail vehicles or crane consoles
- Switching elements for automation
- Safety limit switches for control systems and plant controls

** Dependent on version*

Specifications subject to alterations!

Ordering code

Series S870/S970

Example: **S870 W1D1a**

Series

S870	S870 Series, standard
S970	S970 Series, with improved resistance to temperature, chemicals and impact

Contact configuration

W	SPDT
O	SPST-NC *1
S	SPST-NO *1

Ingress protection rating

	Contacts	Terminals
1	IP40	IP00 (IP20*2)
2	IP60	IP00
3	IP67	IP67

Terminals

A	Screw-type
B	Leads, opposite actuator side, length = 500 mm
D	Flat tabs, 6.3 x 0.8 mm
F	PCB, 180°
G	Solder lugs
L	Cable, opposite actuator side, length = 500 mm

Contact material

1	Silver
4	Gold

Actuator

Push button (standard)	a
Plain lever, short	k
Plain lever, long	l
Plain lever, medium	m
Roller lever, long	r
Roller lever, short	t
Simulated roller lever, medium	u
Simulated roller lever, long	v

Note:

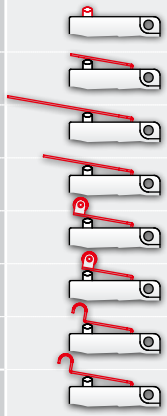
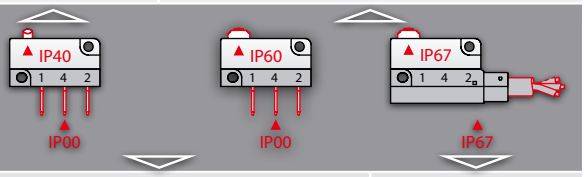
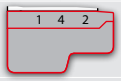
This product catalogue comprises only stock items. For some variants minimum quantities apply. Please ask for conditions.

Special variants:

If you need a special variant of the switch, please do not hesitate to contact us. Maybe the type of switch you are looking for is among our many special designs. If not, we can also supply customized designs. In this case minimum quantities apply.

*1 Only for versions with connected leads or cable

*2 Only for versions with screw-type terminals

Parameter	Identification	Version (sealed to)		
IP rating: contacts / terminals		IP40/00	IP60/00	IP67/67
Actuator styles				
▶ Push button (standard)	a			
▶ Plain lever, short	k			
▶ Plain lever, long	l			
▶ Plain lever, medium	m			
▶ Roller lever, long	r			
▶ Roller lever, short	t			
▶ Simulated roller lever, medium	u			
▶ Simulated roller lever, long	v			
▶ Series ▶ Contacts ▶ Ingress protection rating (IP code) ▶ Contact material	S870 / S970 W / O / S 1 / 2 / 3 1 / 4			
Terminals				
▶ M3 screws with saddle clamp	A			---
▶ Leads, opposite actuator side, length 500 mm	B	---		
▶ Flat tabs 6.3 x 0.8	D			---
▶ PCB terminals, 180°	F			---
▶ Solder lugs	G			---
▶ Cable, opposite acutator side, length 500 mm	L	---		

SCHALTBAU

S870 / S970

S870 W1D1 a / S970 W1D1 a
Sealed to IP40/IP00
Push button (standard)
Flat tabs 6.3x0.8

S870 W2D1 a / S970 W2D1 a
Sealed to IP60/IP00
Push button (standard)
Flat tabs 6.3x0.8

S870 W1F1 k / S970 W1F1 k
Sealed to IP40/IP00
Plain lever, short
PCB terminals 180°

S870 W1G1 u / S970 W1G1 u
Sealed to IP40/IP00
Simulated roller lever, medium
Solder lugs

S870 W3B1 r / S970 W3B1 r
Sealed to IP67/IP67
Roller lever, long
Leads

S870 W3L1 a / S970 W3L1 a
Sealed to IP67/IP67
Push button (standard)
Cable

S870 W1A1 t / S970 W1A1 t
Sealed to IP40/IP20
Roller lever, short
Screw-type terminals

Specifications

Series S870/S970

S870 / S970 Series IP Rating: Contacts / Terminals ▶	Standard	IP40/IP00 + IP40/IP20	IP60/IP00	IP67/IP67
Contact configuration	IEC 60947	1x SPDT, Form C, single break contacts, 3 terminals / 1x SPST-NC, Form B single break contacts, 2 terminals / 1x SPST-NO, Form A, single break contacts, 2 terminals		
Conventional thermal current I_{th}	IEC 60947	10 A at T = 85° C		
	UL 508	10 A at T = 85° C		
Rated insulation voltage U_i	IEC 60947	250 V		
	UL 508	300 V		
Pollution degree	IEC 60947	PD3		
	UL 508	S870: PD3 / S970: PD2		
Rated impulse withstand voltage U_{imp}	IEC 60947	4 kV		
Overvoltage category	IEC 60947	OV3		
Utilization category for silver contacts *1	IEC 60947	AC-15: 230 V AC / 1.5 A DC-13: 60 V DC / 0.5 A		
	UL 508*3	AC 240 V / 1.5 A DC 60 V / 0.5 A		
Contact gap, typical	IEC 60947	1x 1.2 mm		
Contact force, typical	IEC 60947	0.3 N		
Contact resistance, typical, no leads connected	IEC 60947	100 mΩ		
Positive opening force *2	IEC 60947	20 N		
Actuator travel for positive opening operation	IEC 60947	see page 6, 7		
Maximum actuator travel *2	IEC 60947	3.0 mm		
Actuation speed	IEC 60947	1.0 m/s max. 0.1 mm/s min.		
Vibration resistance, 10 … 500 Hz all directions (without aux. actuator at 10 µs max. opening time)	IEC 60068-2-6	50 g		
Shock resistance (without aux. actuator at 10 µs max. opening time)	IEC 60068-2-27	70 g, half sinus		
Short-circuit protection for silver contacts *1	IEC 60269-2	10 A gG		
Switching frequency, max.	IEC 60947	300 operations/minute		
Actuation force *2	IEC 60947	2.4 N max.	3.0 N max.	3.0 N max.
Release force *2	IEC 60947	0.5 N min.	0.5 N min.	0.5 N min.
Ingress protection rating (IP code) Contacts	IEC 60529	IP40	IP60	IP67
Terminals Screw-type	IEC 60529	IP20	---	---
Flat tabs	IEC 60529	IP00	IP00	---
PCB / Solder lugs	IEC 60529	IP00	IP00	---
Leads / Cable	IEC 60529	---	---	IP67
Mechanical endurance	IEC 60947	10 million cycles, min.	5 million cycles, min.	5 million cycles, min.
Ambient temperature Flat tabs / PCB / Solder lugs S870	IEC 60947	-40 °C … +85 °C	-40 °C … +85 °C	---
S970		-55 °C … +150 °C	-55 °C … +150 °C	---
Leads *4 S870/S970		---	---	-20 °C … +85 °C
Cable *4 S870/S970		---	---	-30 °C … +85 °C
Material Contacts	---	silver (Ag90Ni10) or gold (AuNi3Ag26)		
Terminals	---	brass, silver or gold plated		
Seal *5	---	S870: silicon, blue / S970: silicon, red		
Housing, upper part	---	S870: PC, light green, transparent / S970: PEI, amber, transparent		
Housing, lower part	---	S870: PC, black / S970: PEI, black		
Cable / Leads *4	UL/CSA	Insulation: PVC / leads: AWG 18		
Mounting position	---	any		
Weight, no leads connected	---	approx. 7 g, no aux. actuator / cable / leads		
Approvals	---			

SCHALTBAU

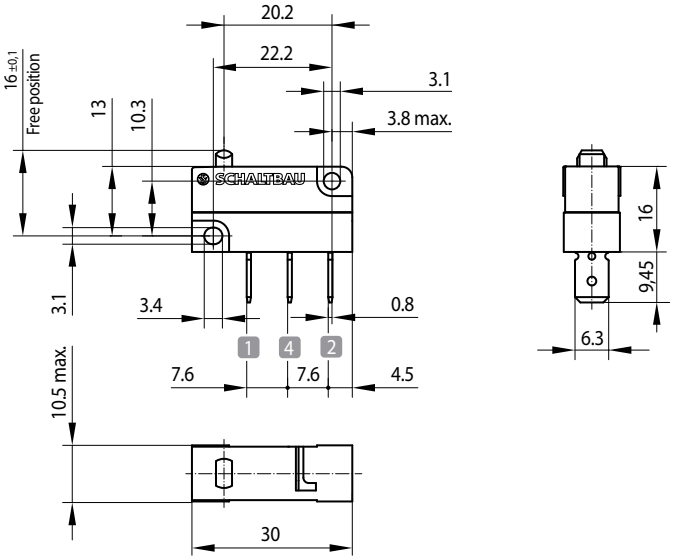
*1 Data for gold contacts upon request *2 Measured next to push button *3 General Purpose
*4 Others upon request *5 Only versions sealed to IP60/IP00 and IP67/IP67

Specifications are subject to alteration without prior notice

Note:
Data valid for new switches under laboratory conditions and at room temperature, unless otherwise mentioned.

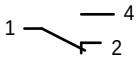
Dimension and circuit diagrams

- **Dimensions S870 W1D1a / S970 W1D1a**



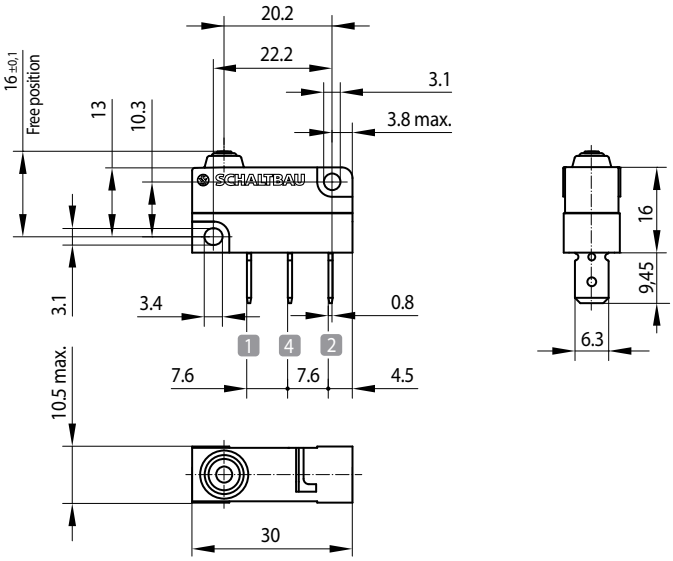
Circuit diagram

SPDT:



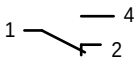
S870 W1D1a / S970 W1D1a	
S870 W1D1a	SPDT
S870 W1D1a	Contacts IP40 Terminals IP00
S870 W1D1a	Flat tabs 6.3x0.8 mm
S870 W1D1a	Contact material silver
S870 W1D1a	Push button (standard)
S970 W1D1a	SPDT
S970 W1D1a	Contacts IP40 Terminals IP00
S970 W1D1a	Flat tabs 6.3x0.8 mm
S970 W1D1a	Contact material silver
S970 W1D1a	Push button (standard)

- **Dimensions S870 W2D1 a / S970 W2D1 a**



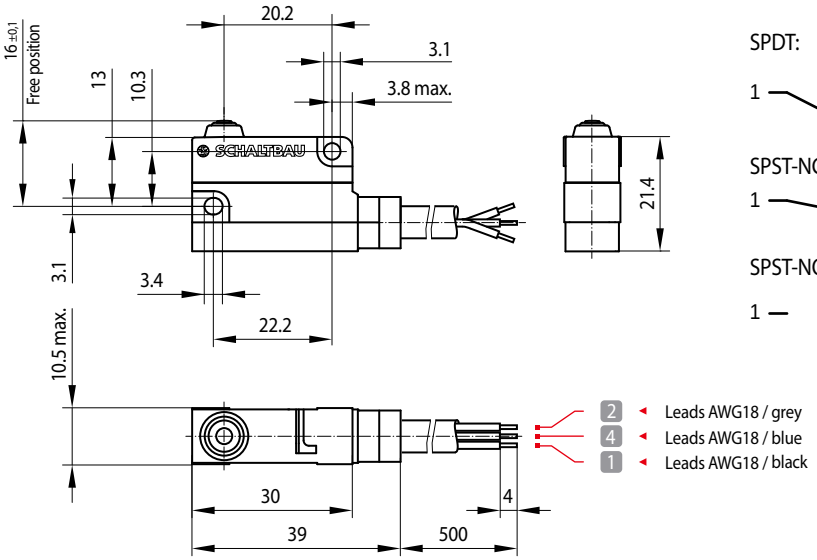
Circuit diagram

SPDT:



S870 W2D1a / S970 W2D1a	
S870 W2D1a	SPDT
S870 W2D1a	Contacts IP60 Terminals IP00
S870 W2D1a	Flat tabs 6.3x0.8 mm
S870 W2D1a	Contact material silver
S870 W2D1a	Push button (standard)
S970 W2D1a	SPDT
S970 W2D1a	Contacts IP60 Terminals IP00
S970 W2D1a	Flat tabs 6.3x0.8 mm
S970 W2D1a	Contact material silver
S970 W2D1a	Push button (standard)

- **Dimensions S870 W3L1 a / S970 W3L1 a**



Circuit diagram

SPDT:

SPST-NC:

SPST-NO:

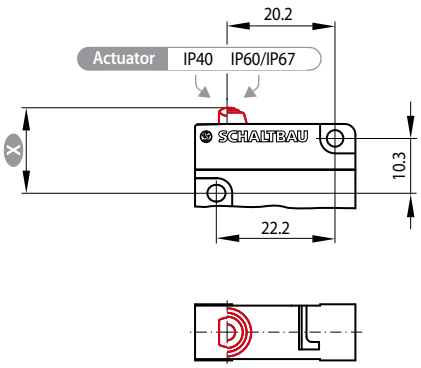
S870 W3L1a / S970 W3L1a	
S870 W3L1a	SPDT
S870 W3L1a	Contacts IP67 Terminals IP67
S870 W3L1a	Cable, length 500 mm
S870 W3L1a	Contact material silver
S870 W3L1a	Push button (standard)
S970 W3L1a	SPDT
S970 W3L1a	Contacts IP67 Terminals IP67
S970 W3L1a	Cable, length 500 mm
S970 W3L1a	Contact material silver
S970 W3L1a	Push button (standard)

Specifications are subject to alteration without prior notice / Dimensions in mm

Actuator styles, actuator positions

Series S870/S970

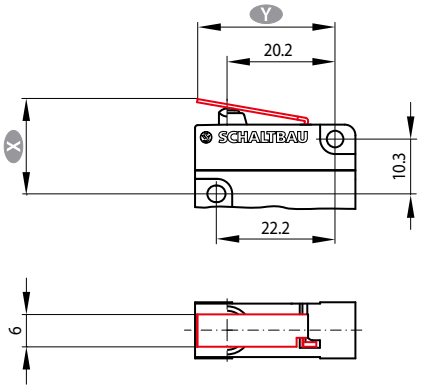
- **Push button (standard)** Actuator style **a**



Actuator position	Push button (standard) a Dimension X in mm
Free position	16.0 ± 0.1
Operating position	14.8 ± 0.2
Release position	15.1 ± 0.2
Total positive opening travel	13.3
Total travel position	13.0
Movement differential *(between operating and release position)*	0.3 *(typical)*

Note: *To ensure the proper working of the positive opening operation it is necessary to depress the plunger to the point of total positive opening travel. However, it must not be pushed beyond total travel position.*
Data is valid for new switches.

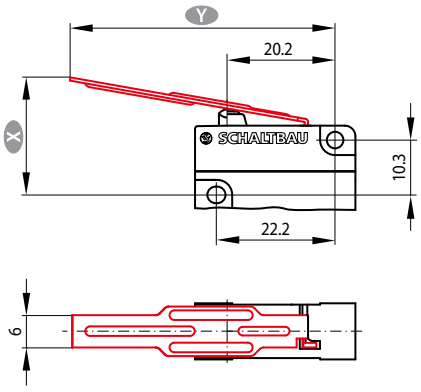
- **Plain lever, short** Actuator style **k**



Actuator position	Plain lever k Dimension X in mm
Lever length Y	25.7
Free position	17.5 ± 0.2
Operating position	15.9 ± 0.3
Release position	16.2 ± 0.3
Total positive opening travel	13.7
Total travel position	13.4
Movement differential *(between operating and release position)*	0.3 *(typical)*

Note: *To ensure the proper working of the positive opening operation it is necessary to depress the plunger to the point of total positive opening travel. However, it must not be pushed beyond total travel position.*
Data is valid for new switches.

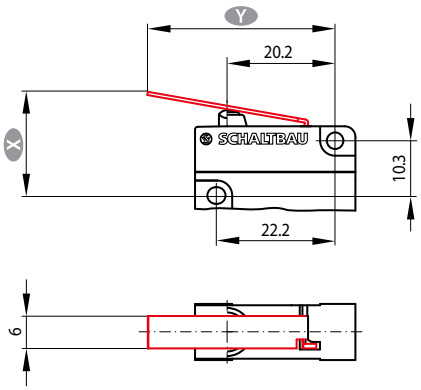
- **Plain lever, long** Actuator style **l**



Actuator position	Plain lever l Dimension X in mm
Lever length Y	49.2
Free position	21.4 ± 0.3
Operating position	18.0 ± 0.4
Release position	18.8 ± 0.4
Total positive opening travel	13.2
Total travel position	12.9
Movement differential *(between operating and release position)*	0.8 *(typical)*

Note: *To ensure the proper working of the positive opening operation it is necessary to depress the plunger to the point of total positive opening travel. However, it must not be pushed beyond total travel position.*
Data is valid for new switches.

- **Plain lever, medium** Actuator style **m**

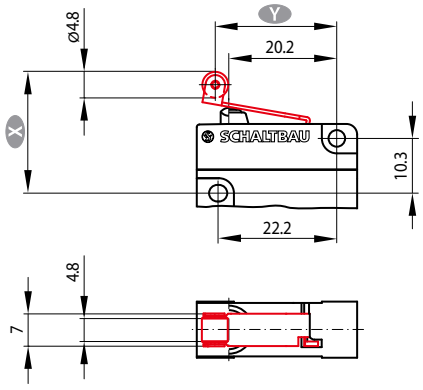


Actuator position	Plain lever m Dimension X in mm
Lever length Y	34.9
Free position	19.0 ± 0.25
Operating position	16.7 ± 0.35
Release position	17.3 ± 0.35
Total positive opening travel	13.5
Total travel position	13.2
Movement differential *(between operating and release position)*	0.6 *(typical)*

Note: *To ensure the proper working of the positive opening operation it is necessary to depress the plunger to the point of total positive opening travel. However, it must not be pushed beyond total travel position.*
Data is valid for new switches.

Actuator styles, actuator positions (continued)

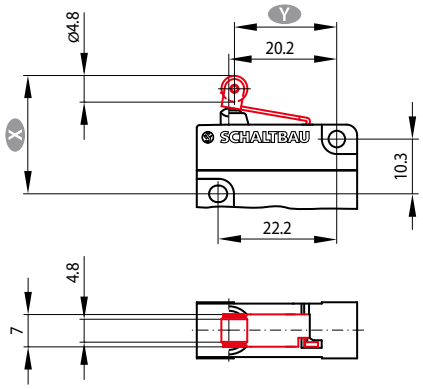
- **Roller lever, long** Actuator style **r**



Actuator position	Roller lever r Dimension X in mm
Lever length Y	22.6
Free position	22.4 ± 0.3
Operating position	21.1 ± 0.4
Release position	21.4 ± 0.4
Total positive opening travel	19.3
Total travel position	19.0
Movement differential *(between operating and release position)*	0.3 *(typical)*

Note: *To ensure the proper working of the positive opening operation it is necessary to depress the plunger to the point of total positive opening travel. However, it must not be pushed beyond total travel position. Data is valid for new switches.*

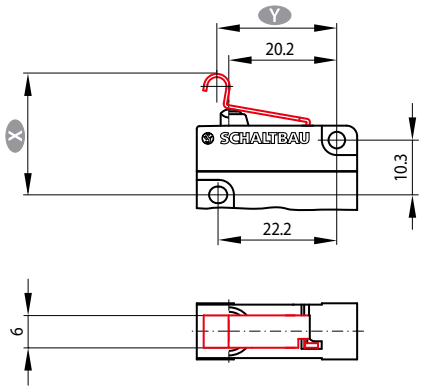
- **Roller lever, short** Actuator style **t**



Actuator position	Roller lever t Dimension X in mm
Lever length Y	19.1
Free position	21.9 ± 0.3
Operating position	20.7 ± 0.4
Release position	21.0 ± 0.4
Total positive opening travel	19.3
Total travel position	19.0
Movement differential *(between operating and release position)*	0.3 *(typical)*

Note: *To ensure the proper working of the positive opening operation it is necessary to depress the plunger to the point of total positive opening travel. However, it must not be pushed beyond total travel position. Data is valid for new switches.*

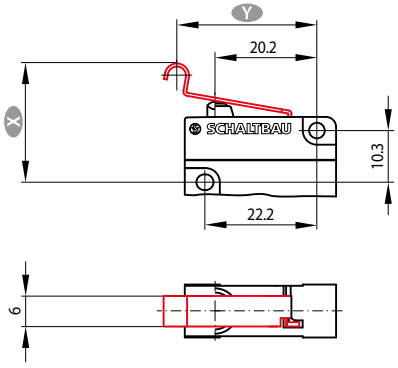
- **Simulated roller lever, medium** Actuator style **u**



Actuator position	Simulated roller lever u Dimension X in mm
Lever length Y	22.6
Free position	22.4 ± 0.3
Operating position	21.1 ± 0.4
Release position	21.4 ± 0.4
Total positive opening travel	19.3
Total travel position	19.0
Movement differential *(between operating and release position)*	0.3 *(typical)*

Note: *To ensure the proper working of the positive opening operation it is necessary to depress the plunger to the point of total positive opening travel. However, it must not be pushed beyond total travel position. Data is valid for new switches.*

- **Simulated roller lever, long** Actuator style **v**



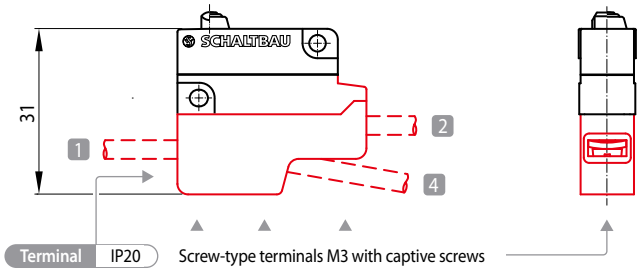
Actuator position	Simulated roller lever v Dimension X in mm
Lever length Y	27.6
Free position	23.3 ± 0.3
Operating position	21.5 ± 0.4
Release position	22.0 ± 0.4
Total positive opening travel	19.2
Total travel position	18.8
Movement differential *(between operating and release position)*	0.3 *(typical)*

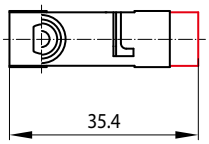
Note: *To ensure the proper working of the positive opening operation it is necessary to depress the plunger to the point of total positive opening travel. However, it must not be pushed beyond total travel position. Data is valid for new switches.*

Terminals

Series S870/S970

- **M3 screws** terminal style **A**

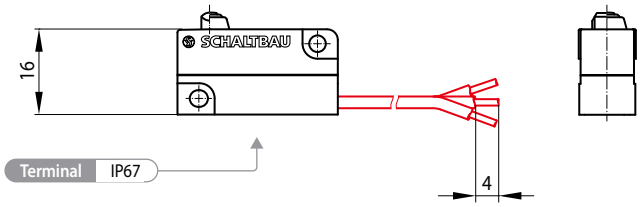


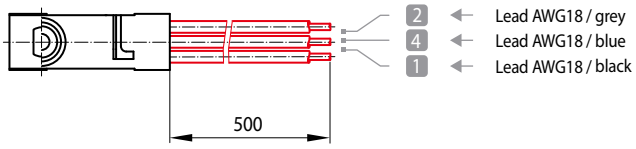


Note:

- *Single and multiple-wire conductors with wire gauges AWG 20 ... 15 (0.5 mm² ... 1.5 mm²) can be clamped with or without wire end ferrules.*
- *2 conductors max. with same wire gauge can be clamped per terminal*
- *Tightening torque of terminal screws should be 1 Nm max.*

- **Leads, on side opposite actuator** terminal style **B**



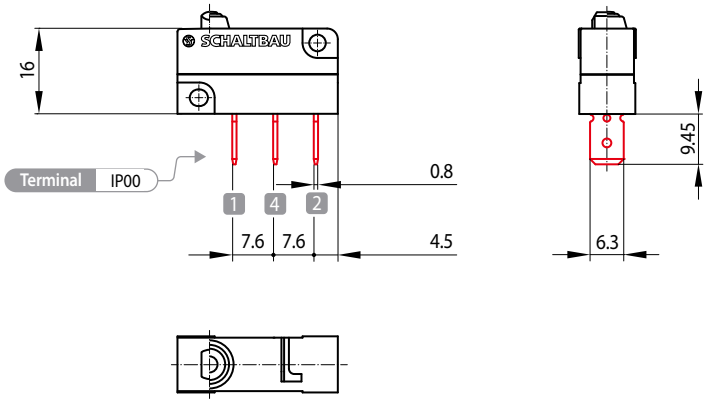


Note:

Contact configuration:

Lead			
2 */ grey*	•	•	
4 */ blue*	•	•	•
1 */ black*	•		•

- **Flat tabs, straight** terminal style **D**

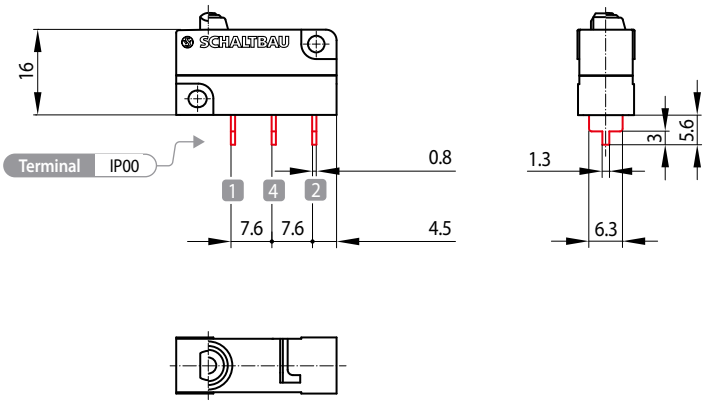


Note:

- *Flat tabs 6.3 x 0.8 mm*

Terminals (continued)

- **PCB terminals, straight** terminal style **F**



Note:

Hand soldering:

- *Soldering apparatus: Hand-held soldering iron*
- *Solder: Flux-filled solder wire, leadfree*
- *Temperature/duration: 400 °C; 5 s max. **

Selective soldering:

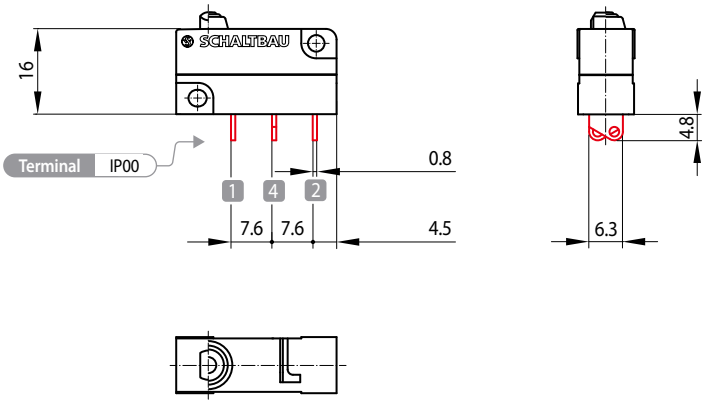
- *Soldering apparatus : Selective soldering station*
- *Solder: Leadfree solder for selective and wave soldering*
- *Temperature/duration: 300 °C; 2,5 s; 3 mm wave distance; Flux time 1 s*

Wave soldering:

- *Soldering apparatus : Wave soldering station, 1 wave (Wörthmann wave)*
- *Solder: Leadfree solder for selective and wave soldering*
- *Temperature/duration: 260 °C; 5 s; 66 mm wave distance; conveyor speed 0.8 m/min*
  Preheating approx. 113 s at 110 ... 145 °C (typical)

* *PCB; 1.6 mm; through-contacted*

- **Solder lugs, straight** terminal style **G**

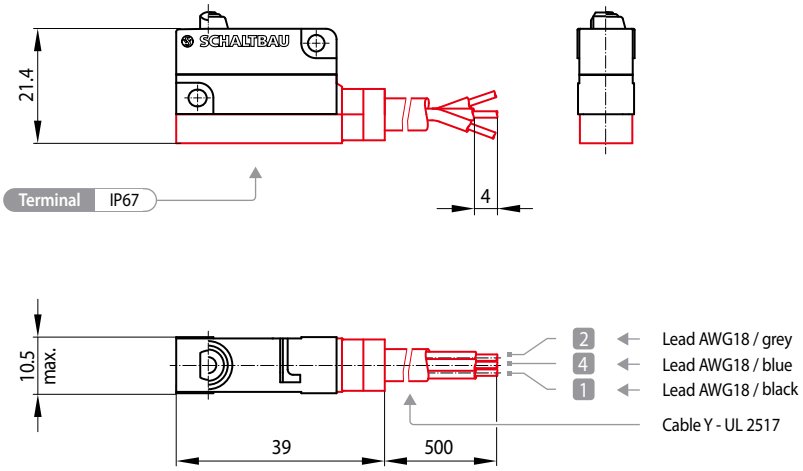


Note:

Hand soldering:

- *Soldering apparatus: Hand-held soldering iron*
- *Solder: Flux-filled solder wire, leadfree*
- *Temperature/duration: 400 °C; 5 s max., pre-tinned leads*

- **Cable, on side opposite actuator** terminal style **L**



Note:

Contact configuration:

Lead			
2 */ grey*	•	•	
4 */ blue*	•	•	•
1 */ black*	•		•

Mounting

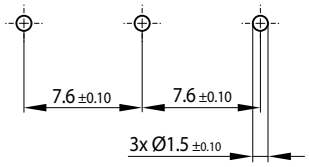
Series S870/S970

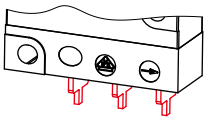
Ganging (side mount)

- through the two transversal holes in the body of the switch by means of a collar screw or threaded bolt .
  Tightening torque 0.7 Nm max.
- Alternatively, DUO-Clips or retaining rings can be used.

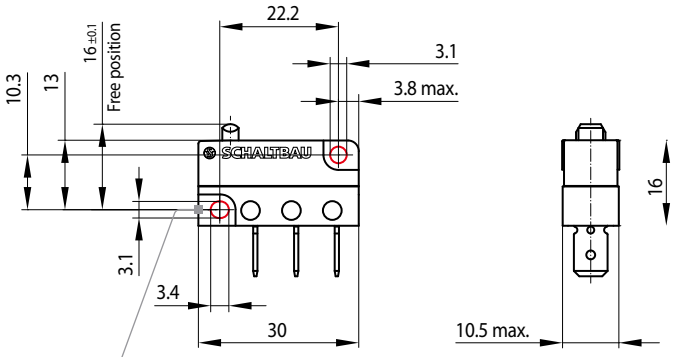
Mounting on PCB (only S870 Wx F xx / S970 Wx F xx)

- Holes for PCB terminals, straight





S870 / S970
PCB terminals, straight



2xM3 collar screw/threaded bolt including washer,
Tightening torque 0.7 Nm max.

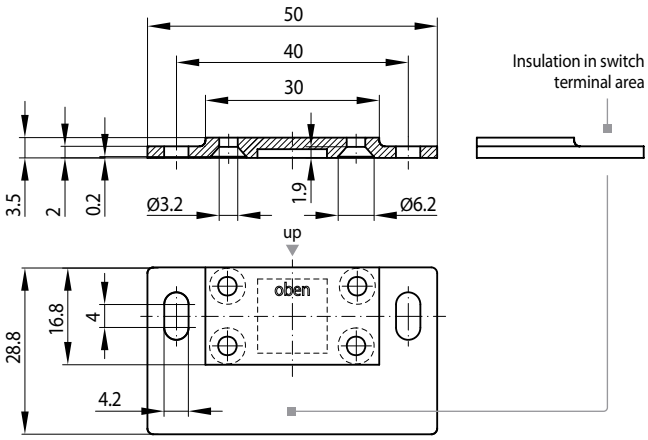
Mounting Mounting plates

Series S870/S970

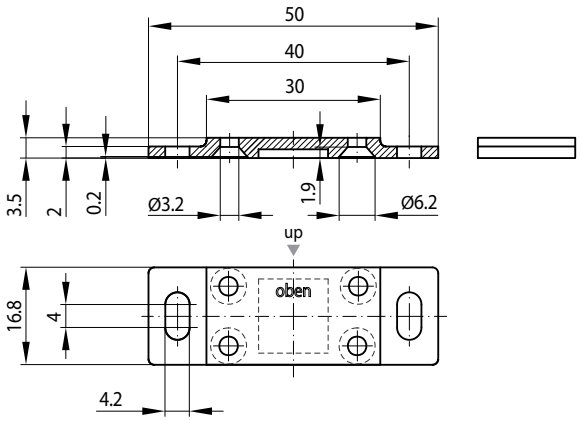
For mounting the switches on uninsulated surfaces use mounting plates with the following features:

- Suitable for side mounting of the switch on the left and on the right
- Material: polyamide PA66, flammability rating UL 94V-0

Long mounting plate, ordering code: MP g



Short mounting plate, ordering code: MP k

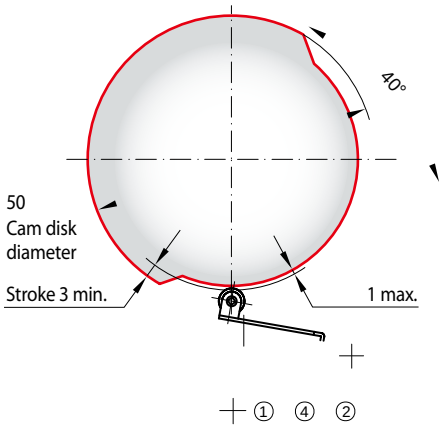


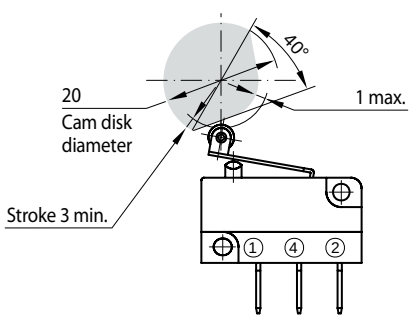
Mounting When to use a roller lever

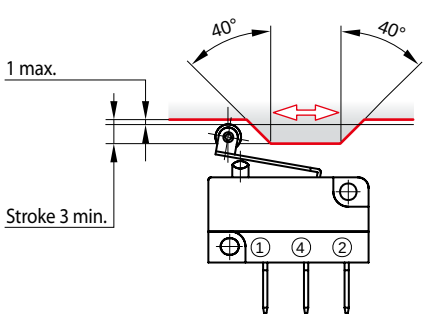
Series S870/S970

Snap-action switches are designed for actuation with and without a roller lever.
A roller lever, however, is required if the direction of actuation deviates more than ±15° from the plunger axis.

Cam disk, diameter 50 mm	Cam disk, diameter 20 mm	Linear cam







Mounting and safety instructions, environmental conditions

Series S870/S970

Mounting instructions:

- Snap-action switches should be mounted by qualified professional staff only.
- Observe the required clearance and creepage distances. This is also applicable for connected wires.
- It is necessary to use insulating plates when ganging or mounting switches on uninsulated surfaces.
- The switches can be mounted in any orientation.
- When mounting the switches make sure to use 2 fastening elements (e.g. screws).
- Only use adequate fastening elements such as cylinder head or collar screws and DUO-clips, including washers. The value for maximum tightening torque must not be exceeded.
- The actuator should not be pre-tensioned when in the free position. When actuated the actuator should travel beyond the operating position for at least 50% of the predefined overtravel, all the way to the total travel position.
- Avoid tilting the screw when mounting to prevent mechanical tension on the housing.
- To ensure the proper function of the positive opening operation it is necessary to depress the plunger to the end of the positive opening travel.
- To prevent mechanical destruction of the switch, make sure that actuation of the switch does not exceed the specified total travel position. Do not use the switch as a mechanical end stop.
- High-impact actuation of the switch can have a negative effect on its mechanical life.
- When securing stripped wire ends in the terminal clamp, make sure the wire insulation is flush with the clamp.
- Prevent a transfer of forces to the switch terminals, and ensure that connected leads have a functioning strain relief.

Non-permissible environmental conditions:

- Cleaning agents, adhesives, solvents, or screw-retaining varnish must be compatible with polycarbonate (S870) and polyetherimide (S970) respectively. Never use chemicals not compatible with polycarbonate for S870 Series switches or not compatible with polyetherimide for S970 Series snap-action switches.
- Using such chemicals can result in cracks, deformation, breakage and dissolution of the housing or complete destruction of the respective switch.
- Switches sealed to IP 67 are immersion protected. That means there is no ingress of water in a harmful quantity when a new switch (which is not operated) is immersed in water (1 m depth) for 30 minutes. This degree of protection cannot be warranted, however, when chemicals not compatible with polycarbonate are used for S870 Series switches or not compatible with polyetherimide for S970 Series switches.

Standards

- **IEC 60947-1:** Low-voltage switchgear and controlgear, Part 1: General rules
- **IEC 60947-5-1, Annex K:** Special requirements for control switches with direct opening action
- **UL508:** Industrial control equipment
- **IEC 60529:** Degrees of protection provided by enclosures (IP Code)
- **UL 94V-0:** Flammability Standard
- **DIN 41636-6:** Sensitive switches for communication technology; dimensions, type A
- **DIN EN ISO 13849-1:** Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
- **IEC 60068-2-6:** Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)
- **IEC 60068-2-27:** Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock

Safety instructions

Series S870/S970

- In case of moisture of any kind or impact of aggressive substances, chemicals, solvents or acids appropriate protective measures must be taken by the user in accordance with IEC 60364-4-41:2005, modified (Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock). One such measure is the limitation of the voltage range.
- Be sure to make regular visual inspections.
- Improper handling of the switch, e.g. when hitting the floor with some impact, can result in breakage, visible cracks and deformation.

⚠ **Defective parts must be replaced immediately!**

Schaltbau GmbH

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Certified to DIN EN ISO 9001 since 1994. For the most recent certificate visit our website.

Electrical Components and Systems for Railway Engineering and Industrial Applications

Connectors

- Connectors manufactured to industry standards
- Connectors to suit the special requirements of communications engineering (MIL connectors)
- Charging connectors for battery-powered machines and systems
- Connectors for railway engineering, including UIC connectors
- Special connectors to suit customer requirements

Snap-action switches

- Snap-action switches with positive opening operation
- Snap-action switches with self-cleaning contacts
- Enabling switches
- Special switches to suit customer requirements

Contactors

- Single and multi-pole DC contactors
- High-voltage AC/DC contactors
- Contactors for battery powered vehicles and power supplies
- Contactors for railway applications
- Terminal bolts and fuse holders
- DC emergency disconnect switches
- Special contactors to suit customer requirements

Electrics for rolling stock

- Equipment for driver's cab
- Equipment for passenger use
- High-voltage switchgear
- High-voltage heaters
- High-voltage roof equipment
- Equipment for electric brakes
- Design and engineering of train electrics to customer requirements

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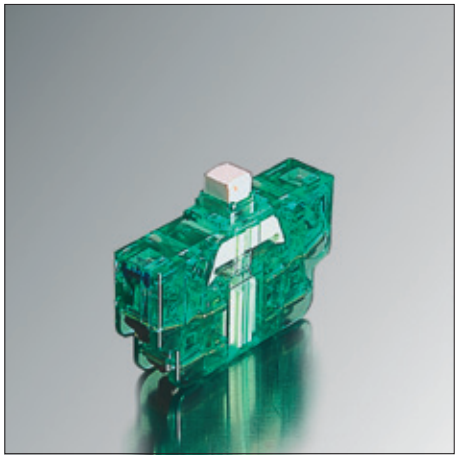
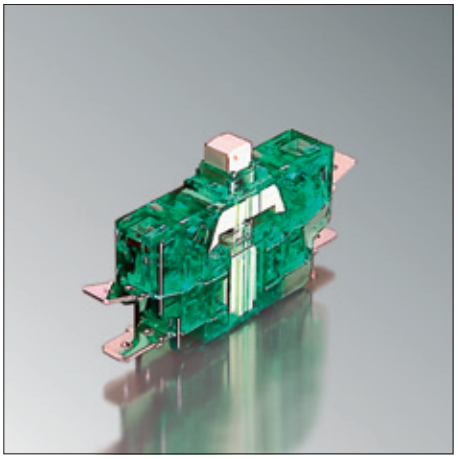
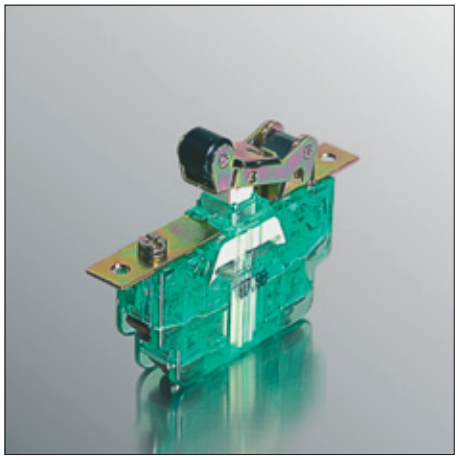
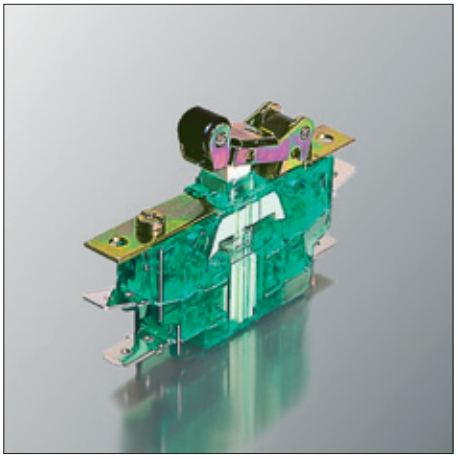
Connect · Contact · Control

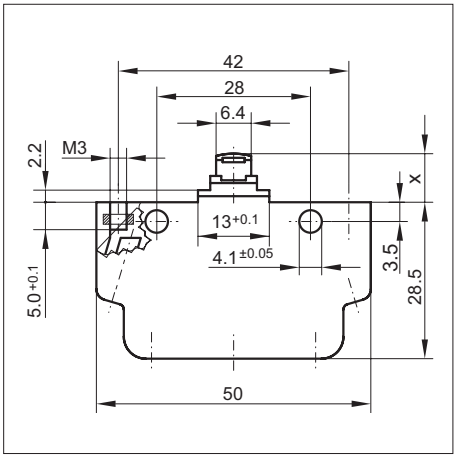
Snap-action switches with positive opening operation and self-cleaning double-break contacts
Sealed to IP40
S826 Series

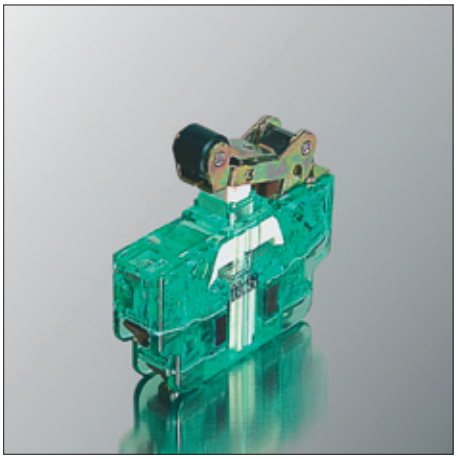












D 26.*en*

S826 Series snap-action switches

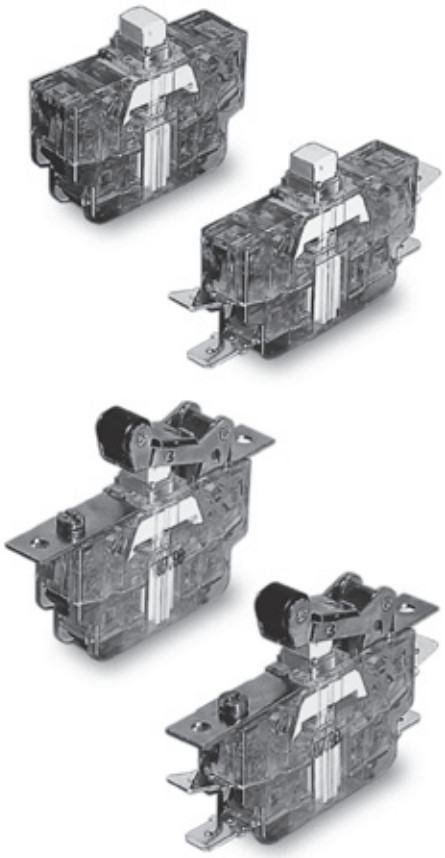
Features

- Transparent green housing allows for eaysy inspection of contact condition and internal mechanism
- Practical terminals and accessories:
  - Flat quick-connect terminals according to DIN 46247-3
  - Screw-type terminals
  - Auxiliary actuators
  - Protective cover
- Enhanced DC breaking capacity thanks to magnetic blowout
- Contacts
  - hard silver contacts for high breaking capacity
  - gold-plated contacts with low contact resistance for switching low currents and voltages

Standards

- Performance according to IEC 60947-5-1, VDE 0660 part 200
- Positive opening operation. Mechanical form-locking feature according to IEC 60947-5-1 annex K, VDE 0660 part 200 annex K
- Protection degree IP40 according to IEC 60529, VDE 0470 part 1, DIN 40050-9
- Fire retardant according to UL 94V-0
- Dimensions according to DIN 41636-6, type F
- Flat quick-connect terminals according to DIN 46247-3

Specifications



Specification*1	
Conventional thermal current I_{th}	10 A
Rated insulation voltage U_i	400 V
Pollution degree	3
Rated impulse withstand voltage U_{imp}	4 kV
Overvoltage category	III
Contact material	Hard silver (AgCu3), Gold alloy (AuAg26Ni3)
Contact gap, typical	2 x 0.85 mm
Contact force, typical	0.40 N
Contact resistance, typical, without leads connected	100 mΩ
Utilization category (for hard silver contacts)*2	AC 15 230 VAC / 1.0 A DC 13 110 VDC / 0.5 A
Positive opening force*3	20 N
Actuator travel for positive opening	see page 8
Maximum actuator travel*3	3.2 mm
Actuating speed	1 m/s max. 0.5 mm/s min.
Vibration resistance (EN 60068-2-6) 10 ... 500 Hz all directions (at 10 µs maximum opening time)	10 g
Shock resistance (EN 60068-2-27) (at 10 µs maximum opening time)	30 g
Short-circuit protection	6 A gG (IEC 60269-2)
Max. frequency of operation	465 cycles / minute
Actuating force	see page 8
Release force	see page 8
Mechanical endurance	10 million cycles min.
Operating temperature range	-40°C ... +85°C
Weight per switch, without wires	20 ... 40 g according to type
Approvals	

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*1 Valid for new switches *2 Gold upon request *3 measured next to actuator

Design characteristics

The positive opening operation of S826 Series snap-action switches guarantees the forced disconnection of contacts even when stuck or welded due to overload currents, or in the unlikely event of a failure of the snap-action mechanism. S826 Series switches are, therefore, especially suited for safety-related applications.

A characteristic feature of the switch is the rapid motion of its contact bridge induced by the force of a pretensioned spring to the effect that the speed at which the moving contact member transfers from one position to another is essentially independent of the actuator speed. This allows the handling of high electric loads at low actuating speeds with a switch of compact design that will fit in the most confined spaces.

The wiping, double-break contacts ensure high reliability even at low electric loads. Switches with gold contacts are particularly suitable for low currents and voltages. Since the contact bridges of S826 Series switches are galvanically isolated, two separate load circuits with independent voltage levels can be controlled simultaneously.

Applications

- Limit switch for use on machine, door and plant controls
- Auxiliary switch in e.g. cam switches and control devices
- Electromechanical switching element for automation tasks with separate electric loads
- Sensor for NC, PLC and computer controls
- Safety limit switch in control panels and electrical installations
- Assemblies subject to high shock and vibration

Ordering code

Example: **S826 b 10 / 20 / 40 L**

Series / Contact type

S826	SPDT-DB (form Z circuitry)

Auxiliary actuator options:

a	roller lever with mounting brackets
as	roller lever and mounting brackets with slotted holes
b	pushbutton
c	mounting brackets
cs	mounting brackets with slotted holes
d	roller lever with angled mounting brackets
e	roller lever only

Contact material:

No number	hard silver (AgCu3)
10	gold alloy (AuAg26Ni3)

Terminals:

No number	screw with saddle clamp
20	flat quick-connect terminals 6.3 x 0.8 mm
30	screw with spring washer

Actuating and Release Forces:

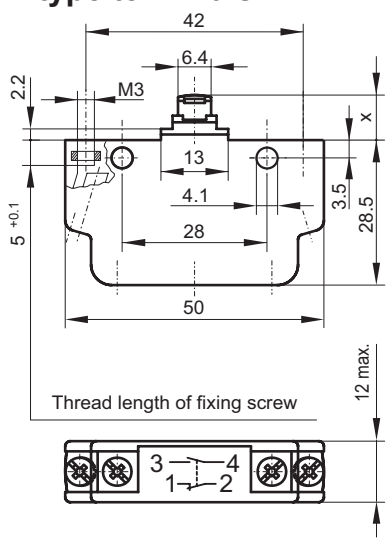
No number	standard (3.3 N max. / 0.2 N min.)
40	stronger reset coil spring (5.5 N max. / 2.9 N min.)

Accessories:

No number	no magnetic blowout
L	standard magnetic blowout

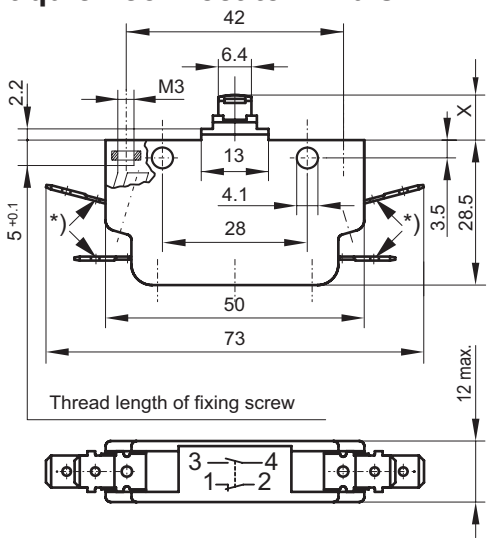
Dimensions

Screw-type terminals



Design with retainer ring and saddle clamps

Flat quick-connect terminals

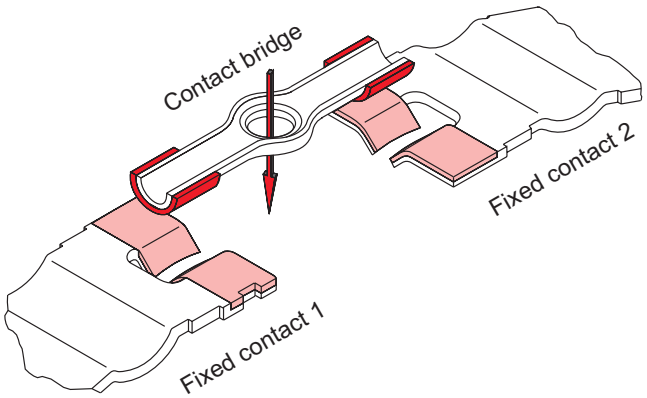


*) terminals can be angled by 90° max. if required

Dimensions in mm

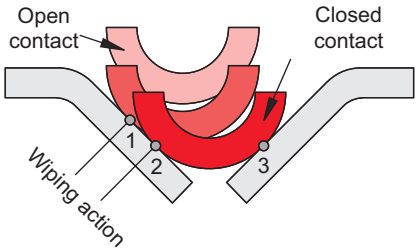
Wiping double-break contacts

Contact Arrangement



Self-cleaning of contacts

Being loosely supported by the plunger inside the switch, the contact bridge initially meets the V-shaped fixed contacts at one point only (1) when making contact, before it is straightened between them by the coaxial pressure of the snap spring. The contact bridge slides thereby against the fixed contacts from position 1 to position 2 and thus creates a defined friction.

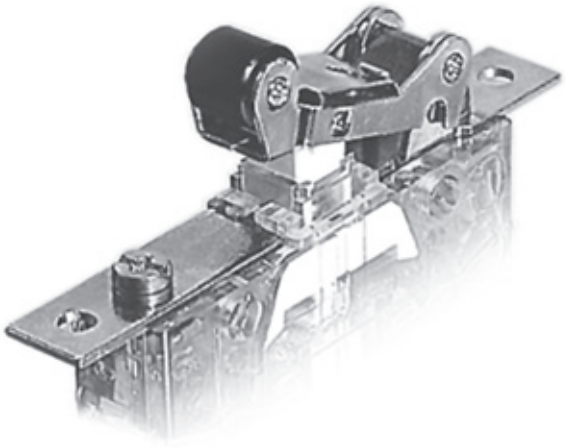


During each operation this wiping action results in self-cleaning of the contacts on one side. In total travel position contact is closed on either side of the V-shaped fixed contact (at 2 and 3). The wiping action helps clean the contacts of contamination and keeps contact resistance low.

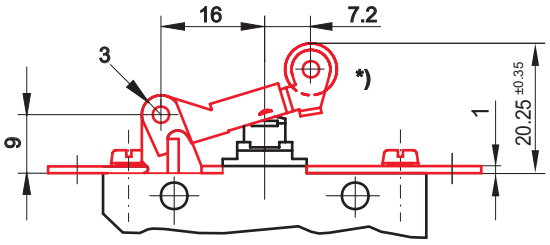
Accessories

Auxiliary actuators

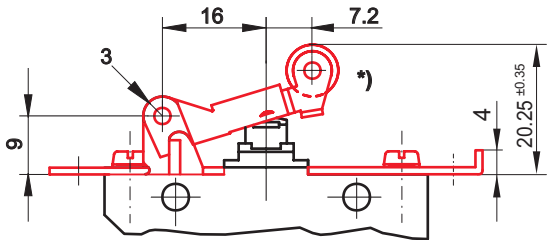
- **Field of application**
  - if direction of actuation deviates more than ±15° from the perpendicular line
  - if transverse actuators such as cam disks, switch rods or push rods are to be applied
  - if maximum actuating speed of transverse actuator ≤1.0 m/s.
- **Roller lever characteristics**
  - The roller itself is manufactured from wear-resistant and smooth-running thermoplastic
  - Integral part of ordered switch type (see "Ordering code", p. 3)



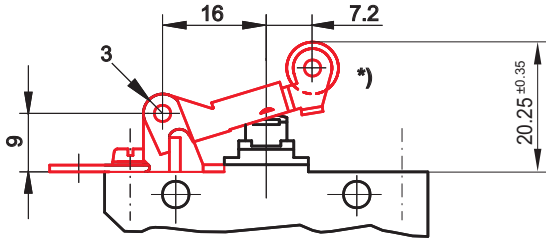
Auxiliary actuator options



Type a



Type d



Type e

*) Roller diameter: 8.0
Roller width: 6.8

For other dimensions please refer to "Notes on project planning", p. 8 and 9.

Dimensions in mm

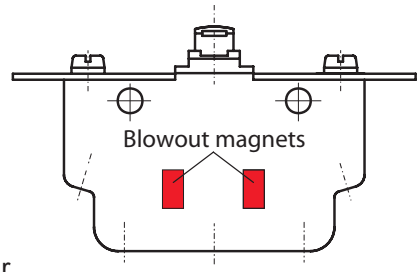
Magnetic blowout

● Mode of action

To increase the breaking capacity and the permissible breaking current under DC loads, integral magnetic blow-outs are available. Permanent magnets create a field across the switching contacts, forcing the arc out of the contact area.

The blowout magnets are mounted in the cut-outs of the contact area, the effect being independent of the terminal polarity.

The switches can be ganged together, maintaining the normal pitch of 12.5 mm.



● Maximum breaking capacity

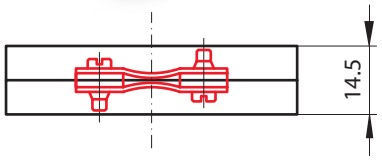
The maximum breaking capacity values are based on 20 operations at which value the arc is still quenched. In determining the electrical rating and operating life of a switch its maximum breaking capacity is reflected. However increased numbers of operations apply (see p. 6).

S286 Series - Maximum breaking capacity

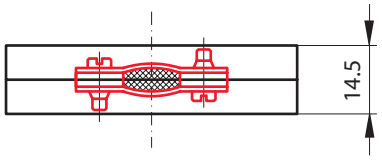
	Switching voltage (U)	24 V DC		80 V DC		110 V DC		220 V DC	
	Blowout	no	yes	no	yes	no	yes	no	yes
Time constant L/R	5 ms	>16A	>16A	6.5A	13.5A	4A	7A	0.6A	0.8A
	10 ms	>16A	>16A	5.5A	12A	3A	5.5A	0.4A	0.6A
	20 ms	15A	>16A	4A	9A	1.7A	4A	0.3A	0.5A
	30 ms	12A	>16A	2.5A	7A	1A	3A	0.2A	0.4A
	40 ms	10A	>16A	1.5A	5A	0.6A	2A	---	---
	50 ms	8A	>16A	1.2A	4A	0.4A	1.5A	---	---

Protective housing / cover

● Protective Housing SK-100 complete with strain relief



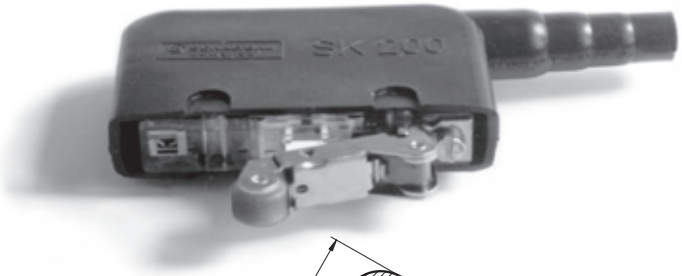
Clamp for cables, 5 ... 8 mm in diameter
Minimum retention force: 80 N

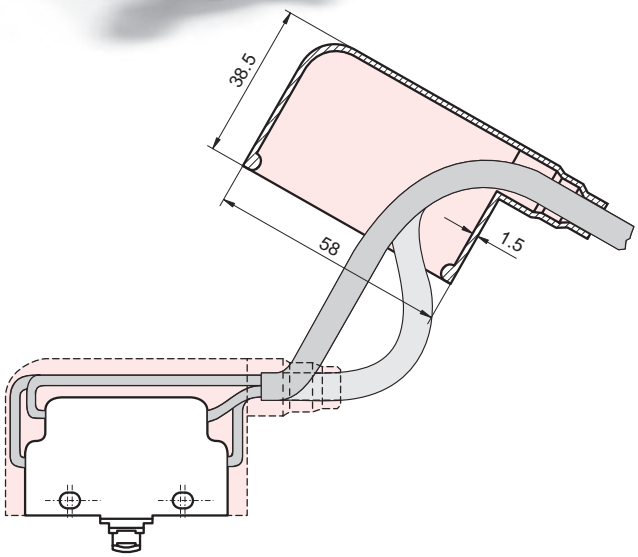


Clamp for cables, 8 ... 10.9 mm in diameter
Minimum retention force: 80 N

- Half shells made of impact resistant fiber glass reinforced PC
- Suitable for switches with screw-type terminals
- Terminals protected against direct contact (IP40)
- Rear strain relief, retention force > 80 N for cable diameter 5 to 8 mm or 8 to 10.9 mm

● Flexible Protective Cover SK-200





- Protective cover made of permanently flexible soft PVC
- Suitable for switches with screw-type terminals
- Finger protected screw terminals (IP40: protection against direct contact)
- Lateral cable outlet with stepped sleeve for supporting outer cable jackets ranging from 6.9 up to 10.9 mm in diameter

Dimensions in mm

Electrical rating and operating life

Electrical life

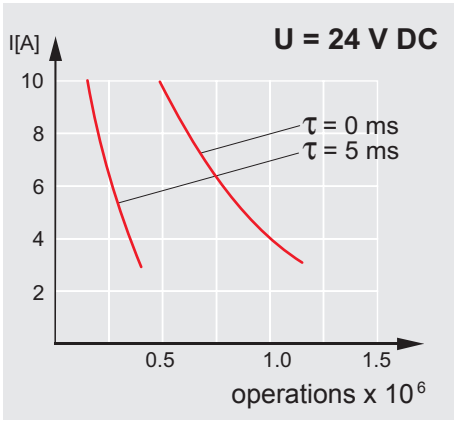
is a measure of contact life depending on external conditions such as:

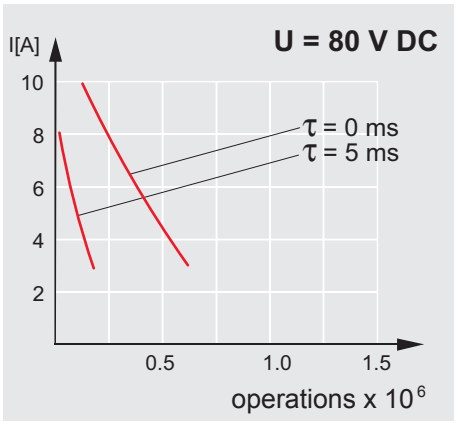
- rated voltage and rated current
- type of load (inductive / capacitive / resistive)
- frequency of operation (operations / minute)
- arc quenching characteristics / capacity (especially in DC applications)
- pollution, e.g. dust, harmful substances, noxious gases and vapours

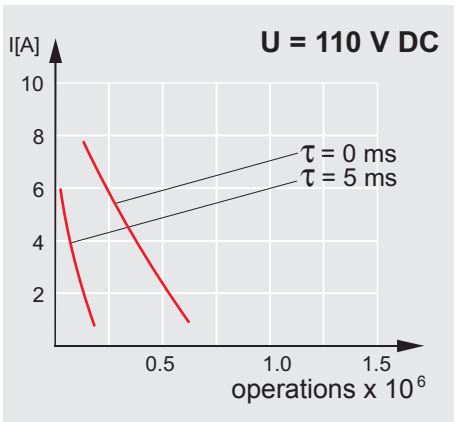
Note:

These curves are based on the results of electrical life tests carried out under laboratory conditions. The values shown in the diagrams are representative.
We reserve the right to make technical alterations without prior notice.

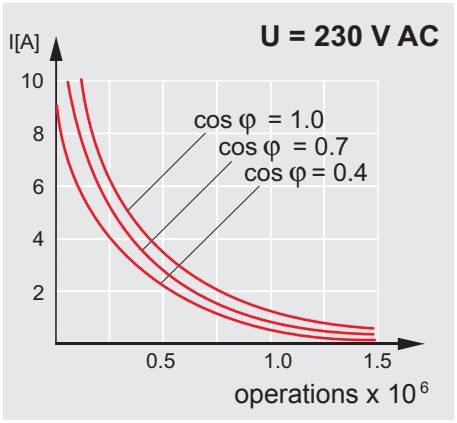
DC electrical rating

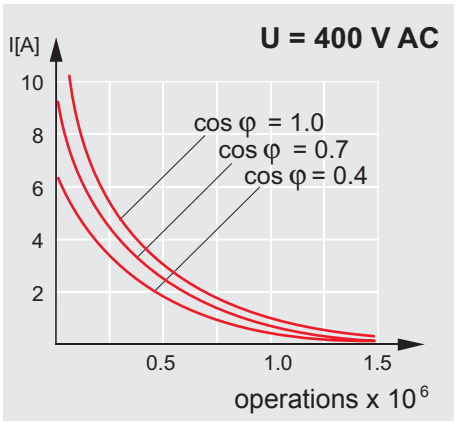






AC electrical rating





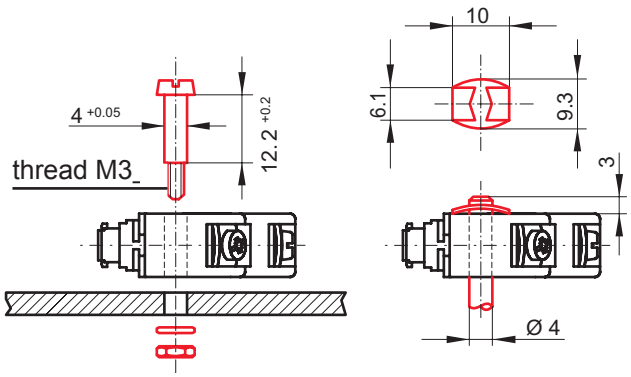
Notes on project planning

● Mechanical Fastening

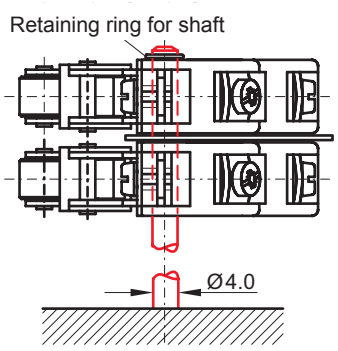
- Ganging or lateral mounting through the two transversal bore-holes with 4 mm screws or bolts (tightening torque 1.3 Nm max.).
  Alternatively, DUO-Clips or retaining rings can be used.

- Manner of fastening:

Bolts	DUO-Clips
Cylinder head bolts, thread length 10 mm BS-ZK	
Hexagonal head bolts, thread length 10 mm BS-SK	DC-800 to put on bolts BS-ZK



- Front mounting of S826 switches:
  - with auxiliary actuator type a, c, d by way of the mounting brackets that come with the roller lever
  - with standard pushbutton (type b) by nut retainers inserted in the housing of the switch
- During mechanical mounting please make sure to have 2 fixing points.
- In order to safeguard clearance and creepage distances it is necessary to use insulating plates when ganging S826 switches with screw-type or flat quick-connect terminals or when mounting them on uninsulated surfaces .



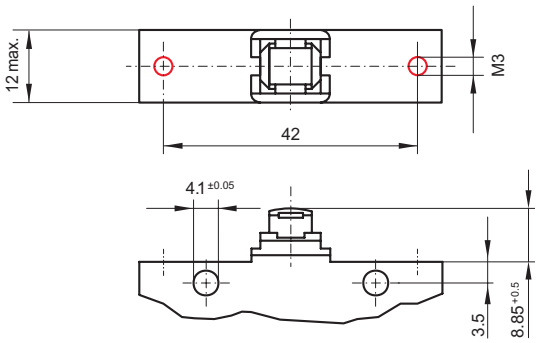
12.0 mm normal pitch
14.5 mm pitch
with protective housing / cover (SK-100 / SK-200)
12.5 mm pitch
with insulation plate 0.5 mm

Mounting on bolts with groove and retaining ring

● Auxiliary actuator type b (pushbutton)

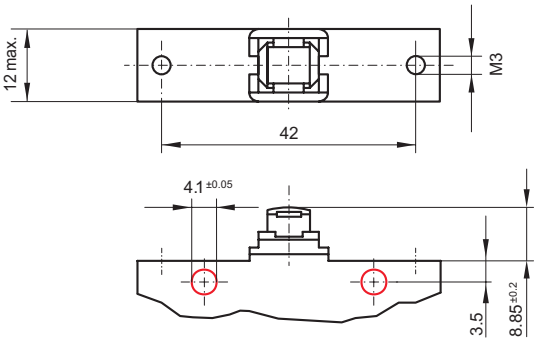
• Front mounting

(tightening torque 0.7 Nm max.)

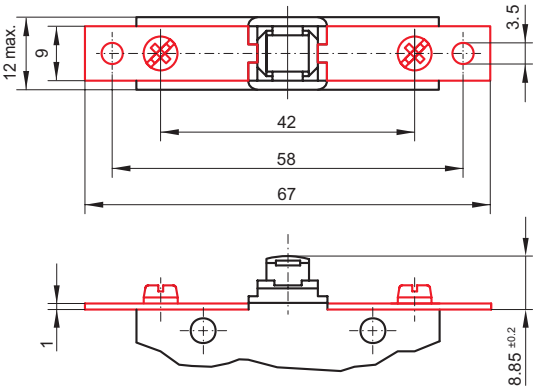


• Lateral mounting / ganging

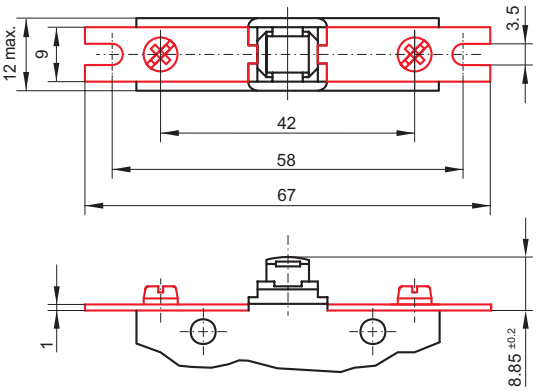
(tightening torque 1.3 Nm max.)



● Auxiliary actuator type a, c, d



● Auxiliary actuator type as, cs



Dimensions in mm

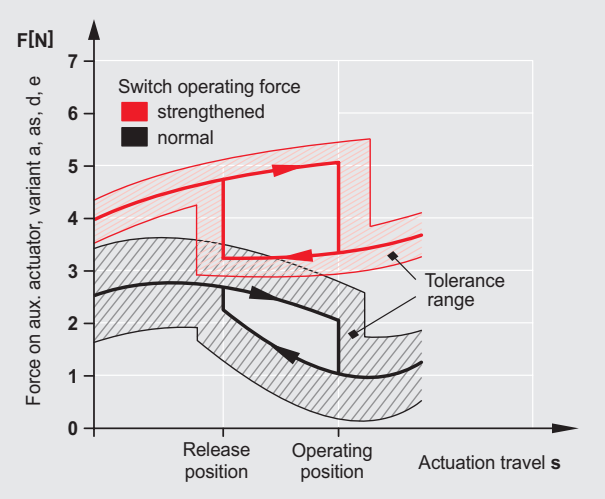
Notes on project planning

Actuating force / Release force

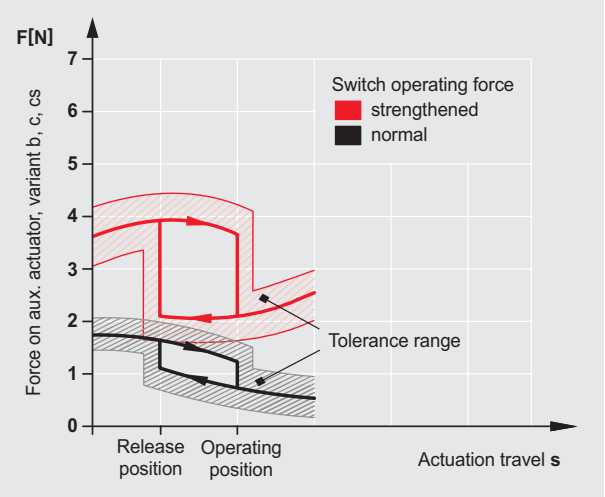
In some applications the mechanism actuating the snap-action switch may be found wanting a somewhat stronger release force.

In these cases snap-action switches with a strengthened reset spring are being used.

Snap-action switch	Maximum actuating force		Minimum release force	
Type	normal	strengthened	normal	strengthened
S826 b S826 c S826 cs	3.6 N	5.5 N	0.2 N	2.9 N
S826 a S826 as S826 d S826 e	2.1 N	4.4 N	0.15 N	1.6 N



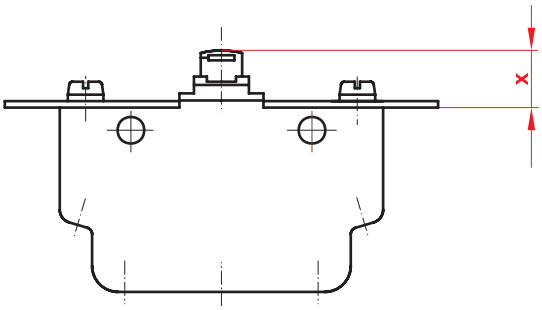
Force / travel diagram of actuator (pushbutton), style S826 b, S826 c, S826 cs



Force / travel diagram of auxiliary actuator, style S826 a, S826 as, S826 d, S826 e

Actuator travel

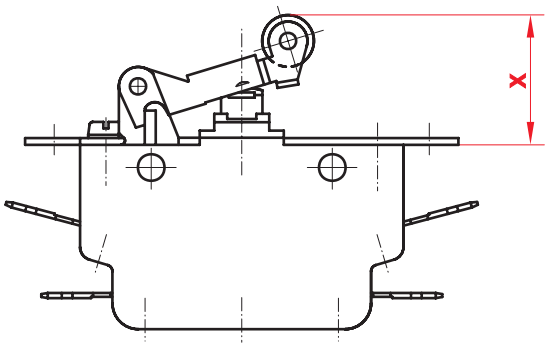
Pushbutton



Dimension x (mm)	Actuator position
8.85 ±0.20	Free position
6.60 ±0.35	Operating position
5.85	Total travel position for positive opening operation
5.65	Total travel position
7.80 ±0.35	Release position

The differential movement between operating and release position is 1.2 mm (typical).

Actuator with roller lever



Dimension x (mm)	Actuator position
20.25 ±0.35	Free position
16.60 ±0.50	Operating position
13.60	Total travel position for positive opening operation
13.30	Total travel position
18.40 ±0.50	Release position

The differential movement between operating and release position is 2.2 mm (typical).

Note: The stated dimensions of actuator positions apply to all corresponding actuator styles.

Dimensions in mm

Notes on project planning

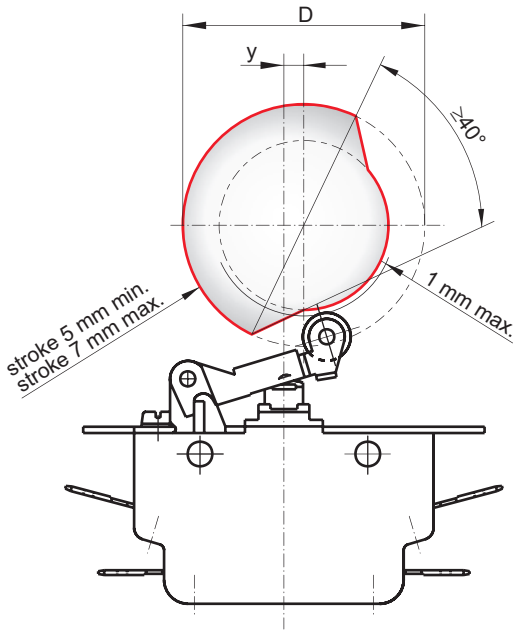
Snap-action switches are designed for actuation with and without roller lever.

A roller lever is required if direction of actuation deviates more than ±15° from the perpendicular line or actuating is carried out by means of transverse actuators such as cam disks, switch rods or push rods.

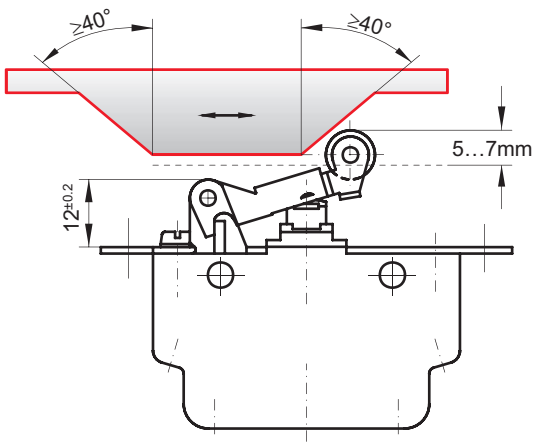
To ensure the proper working of the positive opening operation it is necessary to depress the plunger to the point of total positive opening travel. However, it must not be squeezed byond total travel position, since that may cause mechanical destruction (see "Actuator travel", p. 8).

Switch with roller lever actuated by cam disk

Disk diameter D (mm)	Distance y (mm)
40	3.6
60	0
100 max.	0



Switch with roller lever actuated by trigger cam



Dimensions in mm

Screw-type terminals

- Single- and multiple-wire conductors with wire gauges AWG 18 ... 13 (0.75 ... 2.5 mm²) can be clamped without wire end ferrules. If ferrule is used the maximum wire gauge is AWG 15 (1.5 mm²).
- 2 conductors max. with same wire gauge can be clamped per terminal
- Wire insulation must be flush with the clamping unit
- Tightening torque of terminal screws should be 0.5 Nm min. and 0.7 Nm max.
- Wire end ferrules according to DIN 46228.

Flat quick-connect terminals

- Flat tabs (6.3 x 0.8 mm) according to DIN 46247, sheet 3, preferably with insulated cable sleeves.
- After mounting the switch and making wiring connections, the insulation distance between ground and each terminal should be confirmed as sufficient.
- The flat quick-connect terminals are provided with a forming point where the flat tab can be angled by < 90°, if necessary.

Note: Make sure that strain-relief of the connected cable works.

Circuit diagram

- **Actuator (pushbutton)**
- **Auxiliary actuator (roller lever)**

SPDT-DB
(Form Z circuitry)

Degree of protection

The contacts of S826 Series switches are sealed to IP40, and the terminals to IP00.

However terminals of switches used with protective housing SK-100 and protectice cap SK-200 respectively are finger protected to IP40.

Instruction: Cleaning agents, adhesives, solvents, or screw-retaining varnish must be compatible with polycarbonate. Never use chemicals not compatible with polycarbonate.

RoHS 2002/95/EC

Schaltbau GmbH manufactures in compliance with RoHS. The LV Series connectors are RoHS compliant.

ISO 14001:2005 BUREAU VERITAS Certification

Schaltbau GmbH has an environment management system that has been certified since 2002.

ISO 9001:2000 BUREAU VERITAS Certification

Schaltbau GmbH has a quality management system that has been certified since 1994.

Electrical Components and Systems for Railway Engineering and Industrial Applications

Connectors	• Connectors manufactured to industry standards • Connectors to suit the special requirements of communications engineering (MIL connectors) • Charging connectors for battery-powered machines and systems • Connectors for railway engineering, including UIC connectors • Special connectors to suit customer requirements
Snap-action switches	• Snap-action switches with positive opening operation • Snap-action switches with self-cleaning contacts • Enabling switches • Special switches to suit customer requirements
Contactors	• Single and multi-pole DC contactors • High-voltage AC/DC contactors • Contactors for battery powered vehicles and power supplies • Contactors for railway applications • Terminal bolts and fuse holders • DC emergency stop switches • Special contactors to suit customer requirements
Electrics for rolling stock	• Equipment for driver‘s cab • Equipment for passenger use • High-voltage switchgear • High-voltage heaters • High-voltage roof equipment • Equipment for electric brakes • Design and engineering of train electrics to customer requirements

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Issued 12-2010

Summary Type Test Report
Contactors CT1130/04 and CT1230/04
1-1756-yyyyyy

For the completeness of the test documents and the compliance with the targets in this test report	Name	Department	Date	Signature
Project Management:	R. Junck	vi	2010-08-16	
Engineering:	G. Rinser	ek	19.7.2010	
Quality Management:	Dr. B. Lampert	Q/U	2010-07-16	
Product Management:	A. Rudolph	vpb	2010.07.26	(For Mr. Rudolph)

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0. Definitions

Contactors series CT1030 fulfil the requirements of **EN60077-1** and **EN60077-2**.

EN60077-1: Railway applications – Electrical equipment for rolling stock – Part 1: General service conditions and general rules
EN60077-2: Railway applications – Electrical equipment for rolling stock – Part 2: Electrotechnical components – General rules

Additional general standards

EN50124-1: Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment
EN50125-1: Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock

General climatic conditions

Designation	Class	Value/Range	Schaltbau Data Sheet
Altitude	A1	< 1,400 m	< 2,000 m
Temperature	T1 (5K2 according to EN60721-3-5)	Internal location (3): -25 °C … +70 °C	-40 °C … +70 °C
Reference temperature T_r		+25 °C	
Ambient temperature T_a	Internal location (T_r + 30 K)	+55 °C	
Humidity	Yearly average	< 75% relative humidity	

General definitions:

Main circuit	U_n	Nominal voltage
	U_e	Rated operating voltage
Magnetic drive	U_s	Control supply voltage

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Main technical data

Series	**CT1030/04**
Kind of current	DC (bidirectional) AC (f ≤ 60 Hz)
Main contacts (number, configuration)	1x, 2x, 3x SPST-NO
Nominal voltage U_n	3,000 V
Rated operating voltage U_e	3,600 V
Rated insulation voltage U_{Nm} (U_i)	4,800 V
Rated impulse withstand voltage U_{Ni} (U_{imp})	25 kV
Pollution degree / Overvoltage category	PD3 / OV3
Conventional free air thermal current I_{th}	400 A
Component category	A2
Main contacts Contact material Terminals	 $AgSnO_2$ M10
Magnetic drive Rated control supply voltage U_s Operating range of U_s	 24 / 36 / 72 / 110 V DC 0.7 … 1.25 x U_s
Degree of protection (IEC 60529)	IP00
Vibrations and shock (EN61373)	Category 1, class B
Mounting position	Vertical / horizontal
Temperature Operating temperature Storage temperature Altitude Humidity (EN 50125-1)	 -40 °C … +70 °C -40 °C … +85 °C < 2,000 m above sea level < 75% relative humidity, yearly average

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I. General performance characteristics

1.1 Operating limits

Purpose	The purpose of this test is to verify the function of the contactors			
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V			
Test conditions	Horizontal and vertical mounting position			
Standard	EN60077-2: 9.3.3.1 (EN60077-1: 8.2.1.5)			
1.1.1	**Pull-in voltage**			
Standard	-			
Test description	Test pull-in voltage; 5 operations; T_a = 20 °C			
Criteria	U_s: = 58 V			
	CT1030/04:			Passed
1.1.2	**Operating limits**			
Standard	EN60077-2: 8.2.1 c1			
Test description	Test pull-in voltage; 20 operations; T_a = 70 °C (after 1h with U_s: = 110 V and T_a = 70 °C)			
Criteria	$U_{s\,min}$: = 77 V; $U_{s\,max}$: = 138 V			
	CT1030/04:			Passed
1.1.3	**Operating limits**			
Standard	EN60077-2: 8.2.1 c2			
Test description	Test pull-in voltage; 20 operations; T_a = 70 °C (after 1h with U_s: = 126.5 V and T_a = 70 °C)			
Criteria	$U_{s\,min}$: = 88 V; $U_{s\,max}$: = 138 V			
	CT1030/04:			Passed

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1.1.4	**Voltage fluctuations**			
Standard	EN60077-1: 8.2.1.5			
Test description	20 voltage fluctuation cycles from $U_{s\ min}$ to $U_{s\ max}$; $T_{out\ of\ range}$ < 0.1 s; T_a = 20 °C			
Criteria	$U_{s\ min}$: = 66 V; $U_{s\ max}$: = 154 V, no variation of function			
	CT1030/04:			Passed
1.1.5	**Voltage fluctuations**			
Standard	EN60077-1: 8.2.1.5			
Test description	20 voltage fluctuation cycles, $T_{out\ of\ range}$ < 1 s; T_a = 20 °C, no damage			
Criteria	$U_{s\ max}$: = 154 V			
	CT1030/04:			Passed
1.1.6	**Simultaneous occurrence voltage/temperature**			
Standard	EN60077-1: 8.2.1.1			
Test description	Test pull-in voltage; 20 operations, 0.3 s; T_a = -40 °C			
Criteria	$U_{s\ min}$: = 77 V; $U_{s\ max}$: = 138 V			
	CT1030/04:			Passed
1.1.7	**Drop-off voltage**			
Standard	-			
Test description	Test drop-off voltage; 5 operations; T_a = 20 °C			
Criteria	U_s: > 11 V (10% of nominal coil voltage)			
	CT1030/04:	Actual value:	> 10 V	Accepted
1.1.8	**Pull-in voltage**			
Standard	-			
Test description	Test pull-in voltage; 5 operations; T_a = 20 °C (Confirmation of 1.1.1)			
Criteria	U_s: = 58 V			
	CT1030/04:			Passed

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1.1.9	**Closing time**			
Standard	-			
Test description	Test closing time; 5 operations; T_a = 20 °C; U_s = 110 V			
Criteria	-			
	CT1030/04:	t = 120 ms		Tested
1.1.10	**Time constant of magnetic drive**			
Standard	-			
Test description	Measure time constant of the coil			
Criteria	-			
	CT1130/04:	t = __ ms		Not tested
	CT1230/04:	t = __ ms		
	CT1315/04:	t = __ ms		
1.1.11	**Opening time**			
Standard	-			
Test description	Test opening time; 5 operations; T_a = 20 °C; U_s = 110 V			
Criteria	-			
	CT1030/04:	t = 60 ms		Tested

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1.2 Temperature rise

Purpose	The purpose of this test is to verify the temperature rise of the main contacts	
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V	
Test conditions	Horizontal, vertical	
1.2.1	**Contact warming main contacts (new contacts)**	
Standard	EN60077-2: 9.3.3.2 (EN60077-1: 8.2.2)	
Test description	T_a = RT (+10 °C … +40 °C); U_s = 126.5 V I_{th} = 400 A; type of current = DC; terminal cross section: 60 x 5 mm; connection length: 2x0.5 m; torque = 15 Nm; Test until stable condition is reached (max 8 h) Test point for contact warming: Middle of the contact bridge Test point for terminal warming: End of fixed contact close to cable lug	
Criteria	Δθ <= 40 K (main terminals) Δθ <= 70 K (contact bridge) (massive silver contacts)	

	CT1130/04:	Terminals:	< 30 K	Bridge:	< 58 K	Passed
	CT1230/04:	Terminals:	< 36 K	Bridge:	< 55 K	

1.2.2	**Coil warming (new contacts)**				
Standard	EN60077-1: 9.3.2.6				
Test description	Refer to 1.2.1				
Criteria	Δθ ≤ 100 K (Class F)				
		Values			
	CT1130/04:	$R_{1\,20}$ = 214.9 Ω	$P_{1\,20}$ = 74.5 W	$P_{2\,20}$ = 53.0 W	Passed
	CT1230/04:	$R_{1\,20}$ = 114.4 Ω	$P_{1\,20}$ = 139.9 W	$P_{2\,20}$ = 105.0 W	

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1.3 Dielectric properties

Purpose	The purpose of this test is to verify the insulation coordination			
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V			
1.3.1	**Clearance and creepage distances, main circuit**			
Standard	EN50124-1: Appendix A			
			CT1030/04	
	Overvoltage category/Pollution degree		OV3/PD3	
	U_{Nm} (U_i)		4,8 kV	
Criteria	U_{Ni} (table A2, for functional/basic insulation) (U_{imp})		25 kV	
	U_{Ni} (table A2, for reinforced insulation) (U_{imp})		40 kV	
	Clearance (table A3) Main terminal – Main terminal (functional insulation) Main terminal – earth (basic insulation) (*) Main terminal – control circuit (reinforced insulation) (*) Main terminal – auxiliary circuit (reinforced insulation) (*)		 ≥ 32 mm ≥ 32 mm ≥ 60 mm ≥ 60 mm	Passed
	Creepage (table A7, CTI = 600)			
	Main terminal – Main terminal (functional insulation) Main terminal – earth (basic insulation) (*) Main terminal – control circuit (reinforced insulation) (*) Main terminal – auxiliary circuit (reinforced insulation) (*)		≥ 60 mm ≥ 60 mm ≥ 120 mm ≥ 120 mm	
1.3.2	**Clearance and creepage distances, control/auxiliary circuit**			
Standard	EN50124-1: Appendix A			
	Overvoltage category/Pollution degree		OV2/PD3	
	U_{Nm} (U_i)		150 V	
Criteria	U_{Ni} (table A1, for functional/basic insulation) (U_{imp})		1.5 kV	
	Clearance (table A3) Control/auxiliary circuit – earth (basic insulation)		≥ 0.8 mm	Passed
	Creepage (table A6, CTI = 600) Control/auxiliary circuit – earth (basic insulation)		≥ 2.0 mm	

(*) Tested with main contacts open and closed

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1.3.3	**Dielectric strength**			
Purpose	The purpose of this test is the alternative verification of the clearance of the contactors for functional insulation			
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V			
Test description	Apply test voltage between main terminals: Reference: EN50124-1, table A.8			
Criteria	No flash over		**CT1030/04**	
	Test voltage		13.3 kV (50 Hz), 1 min	
	Main terminal – Main terminal			
	CT1030/04:			Passed

1.3.4	**Partial discharge**			
Purpose	The purpose of this test is to verify the long term stability of the insulating materials			
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V			
Test description	Apply test voltage between main terminals and ground: Reference: VDE 0110-20			
			CT1030/04	
Criteria	Inception voltage		> 5.4 kV	
	Extinction voltage		> 4.3 kV	
	CT1030/04:			Passed

1.4 Operational performance capability

Purpose	The purpose of this test is to verify the operational performance, component category A2					
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V					
Test conditions	Horizontal, vertical					
1.4.1	**Operational performance capability DC**					
Standard	EN60077-2: 9.3.3.4					
Test description	U = U_e; I = I_e; T = 15 ms; T_a = 20 °C; U_s = 110 V					
Criteria	Operational frequency: C2					
	CT1030/04: I_e = 200 A	Cycles: 5	Without current: 40,000	With current: 400	Sum: 200,000/2,000	Passed
1.4.2	**Operational performance capability AC 16.7 Hz**					
Standard	EN60077-2: 9.3.3.4					
Test description	U = U_e; I = I_e; f = 16.7 Hz, cosφ = 0.8; T_a = 20 °C; U_s = 110 V					
Criteria	Operational frequency: C2					
	CT1030/04: I_e = 350 A	Cycles: 5	Without current: 40,000	With current: 400	Sum: 200,000/2,000	Passed

1.4.3	**Operational performance capability AC 50 Hz**					
Standard	EN60077-2: 9.3.3.4					
Test description	U = U_e; I = I_e; f = 50 Hz; cosφ = 0.8; T_a = 20 °C; U_s = 110 V					
Criteria	Operational frequency: C2					
	CT1030/04: I_e = 280 A	Cycles: 5	Without current: 40,000	With current: 400	Sum: 200,000/2,000	Passed

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1.4.4	**Verification of dielectric withstand**				
Purpose	The purpose of this test is to verify the dielectric strength after the test of the operational performance				
Standard	EN60077-2: 9.3.3.5 (EN60077-1, 9.3.3.3 and table 4)				
Test description	U = 75% of ((2 x U_{Nm}) + 2,000 V); 1 min				
Criteria	No flash over				
				CT1030/04	
	Main circuit – Main circuit			8.7 kV	
	Main circuit – Earth			8.7 kV	
	Main circuit – Control/Aux circuit			8.7 kV	
	Control/ Aux circuit - Earth			1.5 kV	
	CT1030/04:				Passed

1.4.5	**Verification of temperature rise**					
Purpose	The purpose of this test is to verify the contact warming after the test of the operational performance					
Standard	EN60077-2: 9.3.3.6 (see 1.2.1)					
Test description	Refer to 1.2.1					
Criteria	Δθ <= 40 K (main terminals) (or 20 K more than in 1.2.1) Δθ <= 70 K (contact bridge) (massive silver contacts) (or 20 K more than in 1.2.1)					
	CT1030/04:	Terminals:	< 32 K	Bridge:	< 70 K	Passed/ Accepted
	CT1230/04:	Terminals:	< 62 K	Bridge:	< 102 K	

Remark to 1.4.5: *** For 2 and 3 pole contactors with heavy load switchings the conventional thermal currents must be derated to I_{th} = 350 A**

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II. Ability to withstand vibration and shock

2.1 Vibration and shock

Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V					
Test conditions	Horizontal, vertical					
2.1.1	**Vibration test**					
Purpose	The purpose of this test is to verify the ability to withstand vibrations					
Standard	EN61373, category 1, class B (EN60077-2, 9.3.4.1)					
Test description	U_s = 110 V; harmonic sweep; random test 5 hours per axis (4 hours contacts closed, 1 hour contacts open)					
Criteria	Opening of main contacts: < 1 ms; opening of auxiliary contacts: < 0.1 ms (for closed contacts)					
	CT1030/04:					Passed

2.1.2	**Shock test**					
Purpose	The purpose of this test is to verify the ability to withstand shock					
Standard	EN61373, category 1, class B (EN60077-2, 9.3.4.2)					
Test description	U_s = 110 V; 2 x 3 shocks per axis (contacts closed)					
Criteria	Opening of main contacts: < 1 ms; opening of auxiliary contacts: < 0.1 ms (for closed contacts)					
	CT1030/04:					Passed

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2.1.3	**Verification of mechanical operation**			
Purpose	The purpose of this test is to verify the mechanical operation after testing vibration and shock			
Standard	EN60077-2: 9.3.4.3			
Test description	Refer to Routine Test Procedure			
Criteria	Pull-in voltage, drop-off voltage: Within limits, no significant change in reference to routine test			
	CT1030/04:			Passed

2.1.4	**Verification of dielectric withstand**				
Purpose	The purpose of this test is to verify the dielectric strength after testing vibration and shock				
Standard	EN60077-2: 9.3.4.4				
Test description	U = 75% of ((2 x U_{Nm}) + 2,000 V); 1 min				
Criteria	No flash over				
				CT1030/04	
	Main circuit – Main circuit			8.7 kV	
	Main circuit – Earth			8.7 kV	
	Main circuit – Control/Aux circuit			8.7 kV	
	Control/ Aux circuit - Earth			1.5 kV	
	CT1030/04:				Passed

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III. Critical currents

3.1 Searching for critical currents

Purpose	The purpose of this test is to search for critical currents which cannot be switched off safely					
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V					
Test conditions	Horizontal, vertical					
3.1.1	**Critical currents DC**					
Standard	EN60077-2: 9.3.5					
Test description	T_a = RT; U_s = 110 V U = U_e; T3 = 40 ms (for 1,500 V) ; T3 = 30 ms (for 3,000 V)					
Criteria	Search from I = 0 A to I = I_e					
	CT1030/04:		Critical current range:	None		Passed

IV. Climatic conditions

4.1. Temperature

Purpose	The purpose of this test is to verify the environmental stability of the contactors	
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V	
4.1.1	**Temperature tests**	
Test description	Environment tests according to EN60068	
Test description	Tests A: Cold (EN60068-2-1): -40 °C, 16 h (test of storage temperature)	
Test description	Tests B: Dry heat (EN60068-2-2): +85 °C, 16 h (test of storage temperature)	
Test description	Test Db: Damp heat (EN60068-2-30): +25 °C … +55 °C, humidity 95%, 24 h, 6 cycles	
	CT1030/04:	Passed
4.1.2	**Verification of mechanical operation**	
Purpose	The purpose of this test is to verify the function of the contactors after **each** of the environmental tests	
Test conditions	Refer to Routine Test Procedure	
Criteria:	Pull-in voltage, drop-off voltage: Within limits, no significant change in reference to routine test	
	CT1030/04:	Passed

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4.1.3	**Verification of dielectric withstand**				
Purpose	The purpose of this test is to verify the dielectric strength after the environmental tests				
Standard	EN 60077-2: 9.3.4.4				
Test description	U = 75% of ((2 x U_{Nm}) + 2,000 V)); 1 min				
Criteria	No flash over				
				CT1030/04	
	Main circuit – Main circuit			8.7 kV	
	Main circuit – Earth			8.7 kV	
	Main circuit – Control/Aux circuit			8.7 kV	
	Control/ Aux circuit - Earth			1.5 kV	
	CT1030/04:				Passed

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4.2 Salt mist

Purpose	The purpose of this test is to verify the ability to withstand climatic conditions without deviations					
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V					
4.2.1	**Salt mist test**					
Standard	Test Ka: Salt mist (EN60068-2-11):					
Test description	96 h					
	CT1030/04:					Passed
4.2.2	**Verification of mechanical operation**					
Purpose	The purpose of this test is to verify the function of the contactors after the salt mist test					
Test conditions	20 operations, T_a = 20 °C; U_s = 126.5 V Visual inspection concerning excessive corrosion					
Criteria:	No deviation of function; no excessive corrosion; all screws can be opened					
	CT1030/04:					Passed

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V. Other tests

5.1 Electromagnetic compatibility (EMC)

Purpose	The purpose of this test is to test the electromagnetic compatibility of the contactor			
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V			
Test conditions	T_a = RT; U_s = 110 V; Coil with power saving circuit			
Standard	EN60077-2: 9.3.7			
Test description	Perform all tests according to EN50121-3-2 (IEC52236-3-2)			
Criteria	Compliance with the limits; no unwanted switch-on or switch-off operations			
	CT1030/04:			n.a.

5.2 Acoustic noise emission

	Not applicable	n.a.

5.3 Short-time withstand current

Purpose	The purpose of this test is to test the ability to withstand a very high current for a short time			
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V			
Test conditions	T_a = RT; U_s = 110 V			
Standard	EN60077-2: 9.3.7			
Test description	Apply the test current: I = 6 kA, t < 100 ms [preferably < 20 ms] (contacts are closed prior to testing)			
Criteria	No welding of main contacts			
	CT1030/04:			Passed

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5.4 Short-circuit making current

Purpose	The purpose of this test is to test the making capacity onto a capacitive load or a short circuit			
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V			
Test conditions	T_a = RT; U_s = 110 V			
Standard	EN60077-2: 9.3.7			
Test description	Close the test current: I = 3.5 kA (new contacts) I = 5 kA (used contacts), 100 ms [preferably < 20 ms] (contacts are open prior to testing)			
Criteria	No welding of main contacts			
	CT1030/04:			Passed

5.5 Breaking capacity

Purpose	The purpose of this test is to test the breaking capacity					
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V					
Test conditions	T_a = RT; U_s = 110 V					
Test description	DC: T < 1 ms; T = 15 ms; AC: cosφ = 1; cosφ = 0.8					
Criteria	No standing arc					
	CT1030/04:	**DC** 1,200 V 1,800 V 3,600 V	Value: 2,000 A 1,600 A 800 A	T < 1 ms	Value: 900 A 700 A 400 A	T = 15 ms
	CT1030/04:	**16.7 Hz AC** 1,200 V 1,800 V 3,600 V	Value: 2,500 A 2,100 A 1,300 A	cosφ = 1	Value: 2,000 A 1,600 A 900 A	cosφ = 0.8
	CT1030/04:	**50 Hz AC** 1,200 V 1,800 V 3,600 V	Value: 1,500 A 1,200 A 800 A	cosφ = 1	Value: 1,200 A 900 A 500 A	cosφ = 0.8

5.6 Switching overvoltages

Purpose	The purpose of this test is determine the switching overvoltages for DC					
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V					
Test conditions	Refer to 1.4 and 3.1					
Standard	EN 60077-2: 8.2.7					
Test description	During testing of 1.4 and 3.1 switching voltages shall not exceed the limit U_{peak}					
Criteria	$U_{peak} < 3x\ U_{Nm}$					
	CT1030/04:				$U_{ov} < 14.4$ kV *	Passed

5.7 Auxiliary contacts

Purpose	The purpose of this test is to test the correct function of the auxiliary contacts and the indication circuits a1 and b0				
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V				
Test conditions	T_a = RT; U_s = 110 V				
Test description	Activate and deactivate contactor				
Criteria	Correct changeover of auxiliary contacts and indication circuits between the final positions of the contactor				
	CT1030/04:				Passed

VI. Additional tests

6.1 Mechanical durability

Purpose	The purpose of this test is to test the mechanical durability			
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V			
6.1.1	**Mechanical durability test**			
Test description	T_a = 90 °C; U_s = 138 V; T_{on} = 0.5 s; T_{off} = 0.5 s; 1,000,000 operations			
	T_a = -40 °C; U_s = 77 V; T_{on} = 0.5 s; T_{off} = 15 s; 100 operations			
	T_a = -40 °C; U_s = 138 V; T_{on} = 0.5 s; T_{off} = 15 s; 1,000 operations			
	T_a = RT; U_s = 126.5 V; T_{on} = 0.5 s; T_{off} = 0.5 s; 1,000,000 operations			
	Recording of: Number of operations (coil actuation, main contacts, auxiliary contacts)			
	CT1030/04:			Passed

6.1.2	**Verification of mechanical operation**			
Purpose	The purpose of this test is to verify the mechanical operation after testing of the mechanical endurance			
Test description	Refer to Routine Test Procedure			
Criteria	Pull-in voltage, drop-off voltage: Within limits, no significant change in reference to routine test. No significant difference in the number of operations (coil actuation, main contacts, auxiliary contacts)			
	CT1030/04:			Passed

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6.1.3	**Verification of dielectric withstand**				
Purpose	The purpose of this test is to verify the dielectric strength after testing the mechanical endurance				
Standard	EN60077-2: 9.3.4.4				
Test description	U = 75% of ((2 x U_{Nm}) + 2,000 V); 1 min				
Criteria	No flash over				
				CT1030/04	
	Main circuit – Main circuit			8.7 kV	
	Main circuit – Earth			8.7 kV	
	Main circuit – Control/Aux circuit			8.7 kV	
	Control/ Aux circuit - Earth			1.5 kV	
	CT1030/04:				Passed

6.1.4	**Verification of wear**			
Purpose	The purpose of this test is to verify the function of the contactors after the mechanical endurance test			
Test conditions	Open contactors and inspect all parts for wear or damage			
Criteria	No excessive wear, no damage			
	CT1030/04:			Passed

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VII. Verification of documents

7.1 Visual inspection

Purpose	The purpose of this test is to check the assembly of the contactors			
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V			
Test description	Checking the correct assembly of the contactors in accordance with the drawings. Reference: Dimensioned drawing			
	CT1030/04:			Passed

7.2 Dimensions/Weight

Purpose	The purpose of this test is to check the dimensions and the weight of the contactors			
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V			
Test description	Checking all dimensions and the weight (separate FAI report) Reference: Dimensioned drawing			
	CT1130/04: < 13 kg			Passed
	CT1230/04: < 27 kg			

7.3 Torques

Purpose	The purpose of this test is to check the torques of the mounting and main contact screws			
Test object	Contactors CT1130/04, CT1230/04; coil voltage 110 V			
Test description	Apply test torque to all screws Reference: Dimensioned drawing			
	Main terminals: 15 Nm (Test torque = 20 Nm)			
	Mounting: n.a.			
Criteria	No breaking, no damage			
	CT1030/04:			Passed

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Section: Development, Test laboratory

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Our ref.:
Phone:
Fax:
e-Mail:
Date: 18.12.2014

Contactor CT 1130/04 and CT1230/04 for customer Ingenieria Viesca

TO WHOM IT MAY CONCERN

We herewith conform that for SCHALTBAU contactors CT1130/04 V 24ET-xx and CT1230/04 V 24ET-xx are suitable for follows application:

- Double pole (1 x CT1230 or 2 x CT1130 without mechanical fixing)
- Vertical mounting position
- Coil voltage 24V dc (- 30% ... +25%)
- Load: 4.200 V dc / 180A
- Type of Load: capacitive load , 0,5 Ω , 20µF
- Current peak of 8-9kA for < 1ms

Best Regards
Schaltbau GmbH

i.V. d. L

Lorenz Neuwieser
Vice President
Business Unit Contactors

i.V. Schwanke

Carsten Schwanke
Productmanager Contactors

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Our ref.:
Phone:
Fax:
e-Mail:
Date: 04.02.2015

Contactor CT 1130/04 and CT1230/04 for customer Ingenieria Viesca

TO WHOM IT MAY CONCERN

We hereby confirm that SCHALTBAU contactors CT1130/04 V 24ET-xx and CT1230/04 V 24ET-xx are suitable for the follow application:

- Double pole (1 x CT1230 or 2 x CT1130 without mechanical fixing)
- Vertical mounting position
- Coil voltage 24V dc (- 30% ... +25%)
- Load: 4.200 V dc / 180A
- Type of Load: capacitive load , 60µF
- Current peak of 10kA for < 1ms

Best Regards
Schaltbau GmbH

i.V.

Lorenz Neuwieser
Vice President
Business Unit Contactors

i.V.

Carsten Schwanke
Productmanager Contactors

DFM800XXM45-TS001

Fast Recovery Diode Module

Replaces DS6096-1

DS6096-2 October 2013 (LN31066)

FEATURES

- 10.2kV Isolation Package
- Low Reverse Recovery Charge
- High Switching Speed
- Low Forward Volt Drop
- Isolated AlSiC Base With AlN Substrates
- Dual Diodes Can Be Paralleled For 1600A Rating

APPLICATIONS

- Chopper Diodes
- Boost and Buck Converters
- Free-wheel Circuits
- Snubber Circuit
- Resonant Converters
- Induction Heating
- Multi-level Switch Inverters

The DFM800XXM45-TS001 is a dual 4500V, fast recovery diode (FRD) module. Designed for low power loss, the module is suitable for a variety of high voltage applications in motor drives and power conversion.

Fast switching times and low reverse recovery losses allow high frequency operation, making the device suitable for the latest drive designs employing PWM and high frequency switching.

The module incorporates an electrically isolated base plate and low inductance construction enabling circuit designers to optimise circuit layouts and utilise grounded heat sinks for safety.

ORDERING INFORMATION

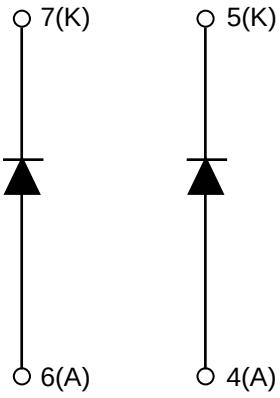
Order As:

DFM800XXM45-TS001

Note: When ordering, please use the complete part number

KEY PARAMETERS

V_{RRM}		**4500V**
V_F	**(typ)**	**2.8V**
I_F	**(max)**	**800A**
I_{FM}	**(max)**	**1600A**



External connection required for a single 1600A diode

Fig. 1 Circuit configuration

Outline type code: X

(See Fig. 7 for further information)

Fig. 2 Package

ABSOLUTE MAXIMUM RATINGS

Stresses above those listed under 'Absolute Maximum Ratings' may cause permanent damage to the device. In extreme conditions, as with all semiconductors, this may include potentially hazardous rupture of the package. Appropriate safety precautions should always be followed. Exposure to Absolute Maximum Ratings may affect device reliability.

T_{case} = 25°C unless stated otherwise

Symbol	Parameter	Test Conditions	Max.	Units
V_{RRM}	Repetitive peak reverse voltage	T_j = 125°C	4500	V
I_F	Forward current (per arm)	DC, T_{case} = 65°C	800	A
I_{FM}	Max. forward current	T_{case} = 115°C, t_p = 1ms	1600	A
I^2t	I^2t value fuse current rating	V_R = 0, t_p = 10ms, T_j = 125°C	300	kA^2s
P_{max}	Max. power dissipation	T_{case} = 25°C, T_j = 125°C	4160	W
V_{isol}	Isolation voltage – per module	Commoned terminals to base plate. AC RMS, 1 min, 50Hz	10.2	kV
Q_{PD}	Partial discharge – per module	IEC1287, V_1 = 6900V, V_2 = 5100V, 50Hz RMS	10	pC

THERMAL AND MECHANICAL RATINGS

Internal insulation material: AlN

Baseplate material: AlSiC

Creepage distance: 56mm

Clearance: 26mm

CTI (Comparative Tracking Index): > 600

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Units
$R_{th(j-c)}$	Thermal resistance (per arm)	Continuous dissipation – junction to case	-	-	24	°C/kW
$R_{th(c-h)}$	Thermal resistance – case to heatsink (per module)	Mounting torque 5Nm (with mounting grease)	-	-	8	°C/kW
T_j	Junction temperature		-40	-	125	°C
T_{stg}	Storage temperature range		-40	-	125	°C
	Screw Torque	Mounting – M6	-	-	5	Nm
		Electrical connections – M8	-	-	10	Nm

STATIC ELECTRICAL CHARACTERISTICS – PER ARM

T_{case} = 25°C unless stated otherwise.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
I_{RM}	Peak reverse current	V_R = 4500V, T_j = 125°C			60	mA
V_F	Forward voltage	I_F = 800A		2.8		V
		I_F = 800A, T_j = 125°C		3.2		V
L_M	Inductance	-		40		nH

DYNAMIC ELECTRICAL CHARACTERISTICS – PER ARM

T_{case} = 25°C unless stated otherwise (when used with DIM800XSM45-TS001)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Units
Q_{rr}	Reverse recovery charge	I_F = 800A V_R =2800V dI_F/dt = 2000/µs		880		µC
I_{rr}	Peak reverse recovery current			680		A
E_{rec}	Reverse recovery energy			1480		mJ

T_{case} = 125°C unless stated otherwise (when used with DIM800XSM45-TS001)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Units
Q_{rr}	Reverse recovery charge	I_F = 800A V_R = 2800V dI_F/dt = 2000A/µs		1450		µC
I_{rr}	Peak reverse recovery current			750		A
E_{rec}	Reverse recovery energy			2500		mJ

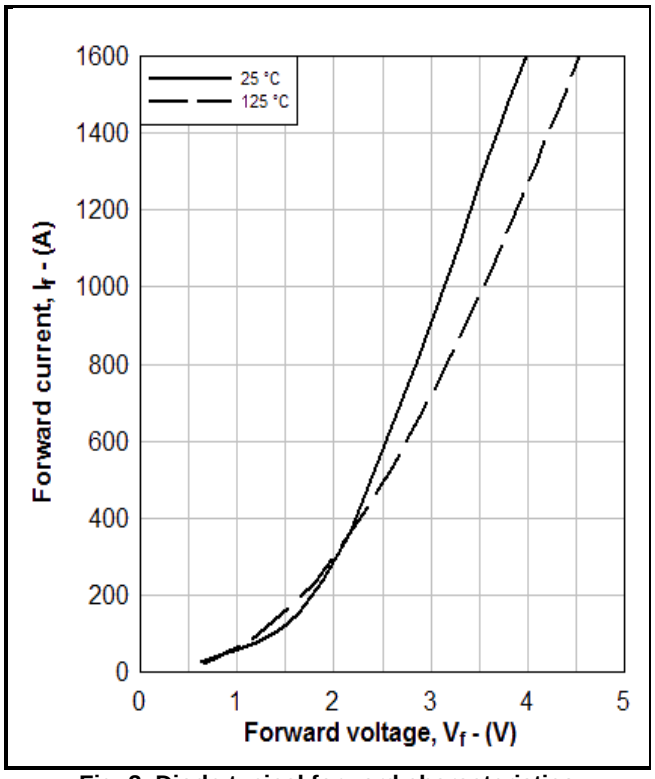


Fig. 3 Diode typical forward characteristics

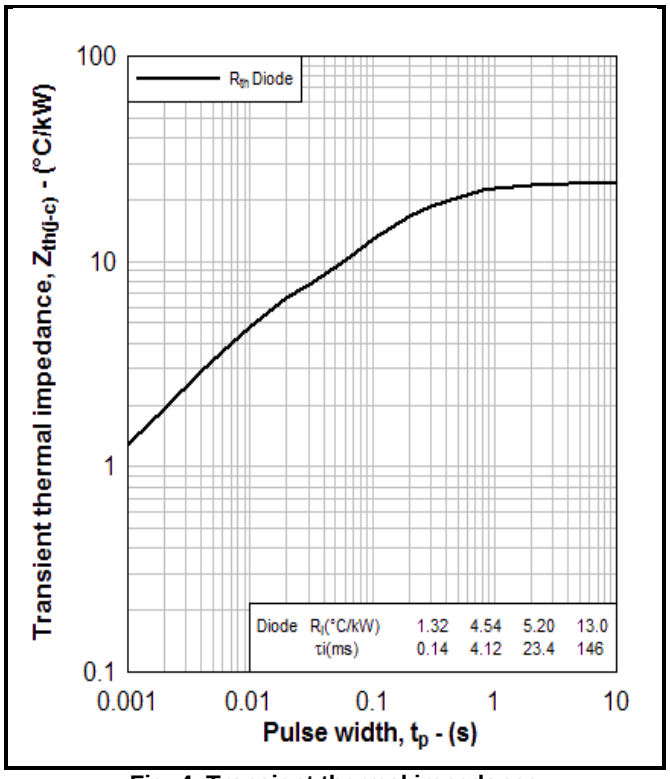


Fig. 4 Transient thermal impedance

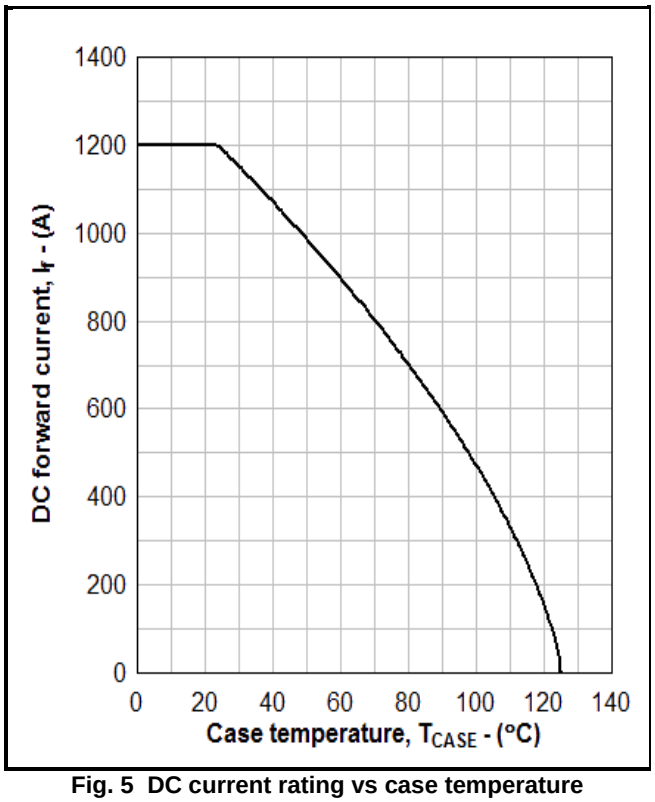


Fig. 5 DC current rating vs case temperature

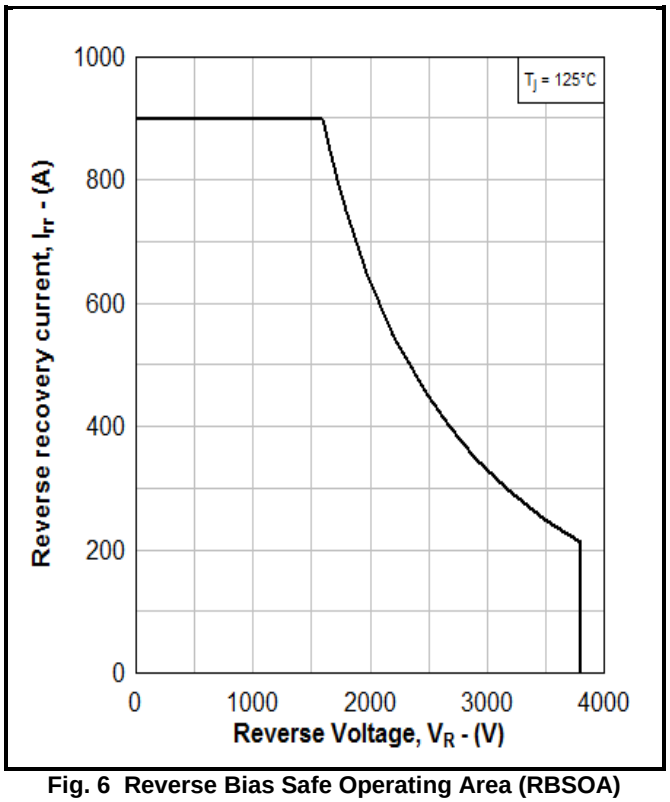
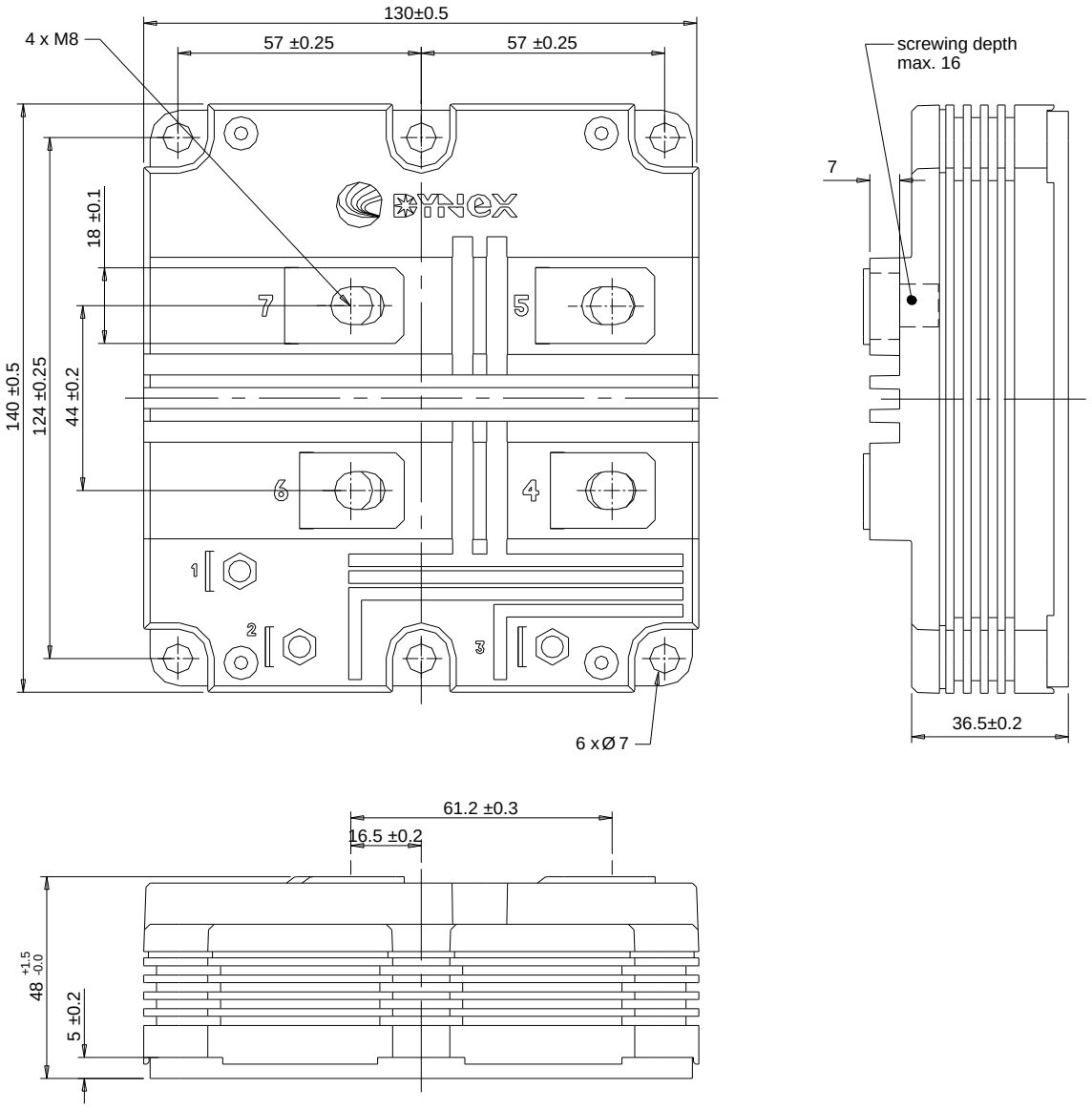


Fig. 6 Reverse Bias Safe Operating Area (RBSOA)

PACKAGE DETAILS

For further package information, please visit our website or contact Customer Services.
All dimensions in mm, unless stated otherwise.
DO NOT SCALE.



Nominal Weight: 1100g

Module Outline Type Code: X

Fig. 7 Module outline drawing

IMPORTANT INFORMATION:

This publication is provided for information only and not for resale.

The products and information in this publication are intended for use by appropriately trained technical personnel.

Due to the diversity of product applications, the information contained herein is provided as a general guide only and does not constitute any guarantee of suitability for use in a specific application. The user must evaluate the suitability of the product and the completeness of the product data for the application. The user is responsible for product selection and ensuring all safety and any warning requirements are met. Should additional product information be needed please contact Customer Service.

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The products are not intended for use in applications where a failure or malfunction may cause loss of life, injury or damage to property. The user must ensure that appropriate safety precautions are taken to prevent or mitigate the consequences of a product failure or malfunction.

The products must not be touched when operating because there is a danger of electrocution or severe burning. Always use protective safety equipment such as appropriate shields for the product and wear safety glasses. Even when disconnected any electric charge remaining in the product must be discharged and allowed to cool before safe handling using protective gloves.

Extended exposure to conditions outside the product ratings may affect reliability leading to premature product failure. Use outside the product ratings is likely to cause permanent damage to the product. In extreme conditions, as with all semiconductors, this may include potentially hazardous rupture, a large current to flow or high voltage arcing, resulting in fire or explosion. Appropriate application design and safety precautions should always be followed to protect persons and property.

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We annotate datasheets in the top right hand corner of the front page, to indicate product status if it is not yet fully approved for production. The annotations are as follows:-

Target Information:	This is the most tentative form of information and represents a very preliminary specification. No actual design work on the product has been started.
Preliminary Information:	The product design is complete and final characterisation for volume production is in progress. The datasheet represents the product as it is now understood but details may change.
No Annotation:	The product has been approved for production and unless otherwise notified by Dynex any product ordered will be supplied to the **current version of the data sheet prevailing at the time of our order acknowledgement.**

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T.S. N°:	1K 7361 REV.A
Date:	09.02.2015
Signature	MC
Approval:	DT DQ
Sheet	1 of 2

TECHNICAL SPECIFICATION

CAPACITOR FOR USE IN POWER ELECTRONIC CIRCUITS DC APPLICATIONS
Self-healing metallized dielectric capacitor, self-extinguish plastic casing and resin filled, dry. Unprotected.

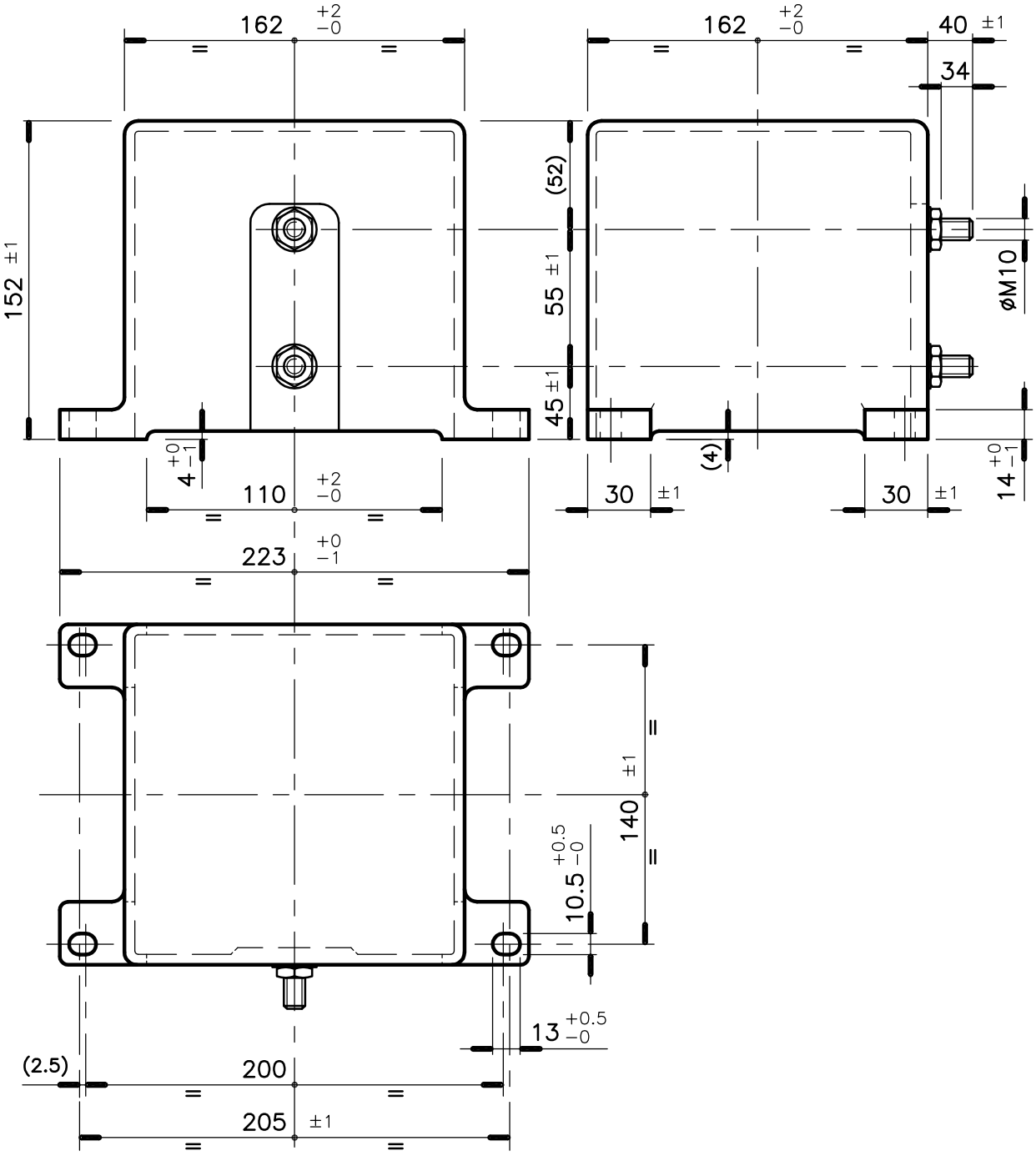
LNK-P4B-20-500

RATINGS, GENERAL CHARACTERIST.	:
Rated Capacitance Cn	20 µF
Capacitance tolerance	+10/-10 %
Rated D.C. Voltage Un	5.000 V
Peak voltage Us	10.000 V
Maximum r.m.s. current Imax	50 A
Repetitive peak current i	2.300 A
Surge peak current Is	4.600 A
Full Current Max Working Frequency	15 KHz
Series Resistance Rs [mOhm]	4,5
Self Inductance L	<30 nH
Tanδ (typical value)	0,0002 + 2*Pi*f*C*Rs
Temperat.coeff.of capacitance	- 260 ppm / °C
Thermal resist.natural cooling	2,75 °C/W
Thermal resist.forced cooling	2,2 °C/W
TEST DATA	:
DC Test between terminals, 10s	7.500 V
AC Test between terminals and case, 10s	8.000 V
ENVIROMENTAL CHARACTERISTICS	:
Climatic Category:	T min = - 25 °C T max = + 70 °C
Storage temperature:	Ts min = - 40 °C Ts max = + 85 °C
RELIABILITY	:
max expected number failures	-
per 10exp9 components hours	300 fit
Expected life (Ln)	100.000 h at 70°C hot spot
MECHANICAL CHARACTERISTICS	:
Case dimensions:	See drawing in sheet 2 of 2
Case material:	Self-extinguish plastic
Terminals:	See drawing in sheet 2 of 2
Terminals maximum torque:	20 Nm
Fixing maximum torque:	8 Nm
Approx weight:	5,2 Kg
Creepage distance:	47 mm
Clearance:	35 mm
Reference:	IEC 61071
	UL approved - file number E191589

ICAR S.P.A. V. ISONZO, 10 20052 MONZA (MI) ITALY

T.S. N° : 1K 7361
Rev. : A : 09.02.15
Signature : MC
Approval : DT DQ

TECHNICAL SPECIFICATION



MODEL : LNK—P4B—20—500

High Voltage Resistors
Product Overview

Metallux USA, Inc.

think sensors

05/2010 · US

Metallux USA, Inc.
Building C, Suite 4
3495 Winton Place
Rochester, NY 14623
Tel: +1-585-360-0054
http://www.metallux-usa.com/
info@metallux-usa.com

High Voltage Resistor - Product Overview

Type	Metallux type	Dimensions LxW inch /ØxL inch	Resistance-value Ohm	Tolerance %	TC ppm/° C	Nominal load W at 40°C	Supply voltage KVDC air (oil)	VCR typ. ppm/V
High voltage resistor								
HVR 967								
	967.3.25	1 x 0,15“	100 k – 4 G	1	from 50	1,0	8,0 (12)	‹ 2
	967.3.38	1,496 x 0,15“	100 k – 6 G	1	from 50	1,5	10 (15)	‹ 2
	967.5.13	0,5 x 0,196“	100 k – 10 G	0,25 – 1	from 50	1,0	5 (7,5)	‹ 2
	967.7.51	2,043 x 0,275“	500 k – 10 G	0,25 – 0,5	from 50	2,0	20 (30)	‹ 0,9
	967.8.26	1,023 x 0,314“	500 k – 10 G	0,25 – 0,5	from 50	2,0	10 (15)	‹ 2
	967.13.38	1,515 x 0,511“	500 k – 30 G	0,25 – 1	from 50	3,0	15 (30)	‹ 1
	967.15.51	2 x 0,59“	1 M – 50 G	0,25 – 1	from 50	4,5	30 (45)	‹ 1
	967.25.90	3,503 x 1“	10 M – 100 G	0,25 – 1	from 50	10,0	45 (70)	‹ 0,5
High volage resistor								
HVR 968								
	968.2	Ø 0,314 x 1,062“	1 M – 50 G	0,5 – 10	from 50	3,8	12 (15)	‹ 1,5
	968.3	Ø 0,314 x 1,456“	1 M – 50 G	0,5 – 10	from 50	5,0	18 (22)	‹ 0,80
	968.5	Ø 0,314 x 2,047“	1 M – 50 G	0,5 – 10	from 50	7,5	24 (30)	‹ 0,60
	968.7	Ø 0,314 x 3,07“	1 M – 50 G	0,5 – 10	from 50	10,0	36 (48)	‹ 0,30
	968.10	Ø 0,314 x 4,055“	1 M – 50 G	0,5 – 10	from 50	12,5	60 (72)	‹ 0,24
	96812	Ø 0,314 x 5,04“	1 M – 50 G	0,5 – 10	from 50	15,0	75 (90)	‹ 0,20
	968.15	Ø 0,314 x 6,023“	1 M – 50 G	0,5 – 10	from 50	17,0	90 (110)	‹ 0,16
High voltage resistor								
HVR 969								
	969.11	Ø 0,531 x 3,188“	2 M – 10 G	0,5 – 10	from 50	11,0	24 (32)	‹ 0,15
	969.23	Ø 0,531 x 6,141“	2 M – 10 G	0,5 – 11	from 50	23,0	48 (72)	‹ 0,15
	969.54	Ø 1,181 x 6,22“	2 M – 10 G	0,5 – 12	from 50	54,0	48 (72)	‹ 0,15
	969.71	Ø 1,181 x 8,188“	2 M – 10 G	0,5 – 13	from 50	71,0	64 (96)	‹ 0,15
	969.105	Ø 1,181 x 12,125“	2 M – 10 G	0,5 – 14	from 50	105,0	96 (148)	‹ 0,15
	Special features: Tolerance range 1 % to 20 %; TC from 50 ppm/°C, low inductiv, short term availability							
High precision resistor								
HPR 967								
	967.3.25	1 x 0,15“	200 k – 4 G	0,25	from 10	0,7	8 (12)	‹ 1
	967.3.38	1,496 x 0,15“	200 k – 6 G	0,25	from 10	1,0	10 (15)	‹ 1
	967.5.13	0,5 x 0,196“	1 M – 10 G	0,25	from 10	0,7	5 (7,5)	‹ 2
	967.7.51	2,043 x 0,275“	1 M – 10 G	0,1 – 1	from 10	1,4	20 (30)	‹ 0,3
	967.8.26	1,023 x 0,314“	1 M – 10 G	0,1 – 1	from 10	1,4	10 (15)	‹ 1
	967.13.38	1,515 x 0,511“	1 M – 30 G	0,1 – 1	from 10	2,0	15 (22)	‹ 0,4
	967.15.51	2 x 0,59“	1 M – 50 G	0,1 – 1	from 10	3,0	30 (45)	‹ 0,3
	967.25.90	3,503 x 1“	1 M – 100 G	0,1 – 5	from 10	8,0	45 (70)	‹ 0,15
High precision resistor								
HPR 968								
	968.2	Ø 0,314 x 1,062“	1 M – 50 G	0,1 – 1	from 10	2,6	12 (15)	‹ 0,75
	968.3	Ø 0,314 x 1,456“	1 M – 50 G	0,1 – 1	from 10	3,0	18 (22)	‹ 0,40
	968.5	Ø 0,314 x 2,047“	1 M – 50 G	0,1 – 1	from 10	5,0	24 (30)	‹ 0,30
	968.7	Ø 0,314 x 3,07“	1 M – 50 G	0,1 – 1	from 10	6,5	36 (48)	‹ 0,15
	968.10	Ø 0,314 x 4,055“	1 M – 50 G	0,1 – 1	from 10	8,0	60 (72)	‹ 0,12
	968.12	Ø 0,314 x 5,04“	1 M – 50 G	0,1 – 1	from 10	10,0	75 (90)	‹ 0,10
	968.15	Ø 0,314 x 6,023“	1 M – 50 G	0,1 – 1	from 10	12,0	90 (110)	‹ 0,08

High precision resistor
HPR 969

Metallux type	Dimensions LxW inch/ØxL inch	Resistance value Ohm	Tolerance %	TC ppm/° C	Nominal load W bei 40°C	Supply voltage KVDC air (oil)	VCR typ. ppm/V
969.11	Ø 0,531 x 3,188“	2 M – 10 G	0,1 – 0,5	from 10	7	24 (32)	‹ 0,1
969.23	Ø 0,531 x 6,141“	2 M – 10 G	0,1 – 0,5	from 10	15	48 (72)	‹ 0,1
969.54	Ø 1,181 x 6,22“	2 M – 10 G	0,1 – 0,5	from 10	36	48 (72)	‹ 0,1
969.71	Ø 1,181 x 8,188“	2 M – 10 G	0,1 – 0,5	from 10	54	64 (96)	‹ 0,1
969.105	Ø 1,181 x 12,125“	2 M – 10 G	0,1 – 0,5	from 10	75	96 (148)	‹ 0,1

Special features: high longterm stability through special design - high precision and low supply coefficient

High voltage impulse resistor
HVI 967

Metallux type	Dimensions LxW inch/ØxL inch	Resistance value Ohm	Tolerance %	TC ppm/° C	Nominal load W bei 40°C	Supply voltage KVDC air (oil)	VCR typ. ppm/V
967.5.13	0,5 x 0,196“	to 500 k	1 – 20	100	7J at 100 msec	5 (7,5)	
967.8.26	1,023 x 0,314“	to 500 k	1 – 20	100	15J at 100 msec	10 (15)	
967.15.51	2 x 0,59“	to 500 k	1 – 20	100	30J at 100 msec	30 (45)	

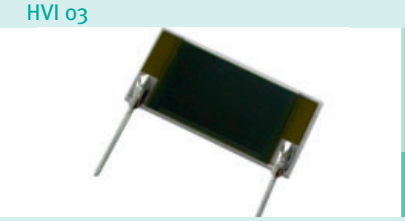
High voltage impulse resistor
HVI 968

Metallux type	Dimensions LxW inch/ØxL inch	Resistance value Ohm	Tolerance %	TC ppm/° C	Nominal load W bei 40°C	Supply voltage KVDC air (oil)	VCR typ. ppm/V
968.3	Ø 0,314 x 1,456“	to 500 k	1 – 20	100	35	12 (15)	
968.5	Ø 0,314 x 2,047“	to 500 k	1 – 20	100	50	24 (30)	
968.10	Ø 0,314 x 4,055“	to 500 k	1 – 20	100	100	60 (72)	

High voltage impulse resistor
HVI 969

Metallux type	Dimensions LxW inch/ØxL inch	Resistance value Ohm	Tolerance %	TC ppm/° C	Nominal load W bei 40°C	Supply voltage KVDC air (oil)	VCR typ. ppm/V
969.54	Ø 1,2 x 6,22“	to 500 k	1 – 20	100	1000	48 (72)	
969.71	Ø 1,2 x 8,188“	to 500 k	1 – 20	100	1800	64 (96)	
969.105	Ø 1,2 x 12,125“	to 500 k	1 – 20	100	3600 energy 100 msec 0,25 hz	96 (148)	

High voltage surge resistor
HVI 03



Metallux type	Dimensions LxW inch/ØxL inch	Resistance value Ohm	Tolerance %	TC ppm/° C	Nominal load W bei 40°C	Supply voltage KVDC air (oil)	VCR typ. ppm/V
03.1	0,354 x 0,216“	4 k – 100 k	2 – 20	100	0,5	1,2/50 to VDE 750 5 kV	
03.2	0,433 x 0,216“	3,5 k – 100 k	2 – 20	100	0,5		
03.3	0,511 x 0,216“	3,5 k – 100 k	2 – 20	100	0,8		
03.4	0,826 x 0,314“	700 R – 100 k	2 – 20	100	1,0		
03.5	0,826 x 0,413“	700 R – 100 k	2 – 20	100	1,5		
03.6	1,023 x 0,413	700 R – 100 k	2 – 20	100	2,0		

Special features: high impulse load - operating in air, potting compound or in oil - Ohm-values dependant of tolerance und TC

Type	Metallux type	Dimensions LxW inch/ØxL inch	Resistance values Ohm	Tolerance ratio %	TC ratio ppm/° C	Nominal load W at 40°C	Supply voltage KVDC air (oil)	VCR typ. ppm/V
High voltage divider **HVD 1000**								
	1000.2 1000.3 1000.4 1000,5	1,023 x 0,314“ 1,515 x 0,511“ 2,027 x 0,61 3,051 x 0,61“	1,5 M – 150 M 5 M – 500 M 10 M – 1,5 G 15 M – 2 G	to 0,1 to 0,1 to 0,1 to 0,1	10 – 50 10 – 50 10 – 50 10 – 50	0,5 1,2 1,8 2,4	8 (12) 15 (22) 24 (36) 32 (49)	‹ 1 ‹ 0,4 ‹ 0,3 ‹ 0,2
High voltage divider **HVD 2000**								
	2000.23 2000.105	Ø 0,531 x 6,141“ Ø 1,2 x 12,125“	10 M – 10 G 20 M – 20 G	to 0,1 to 0,1	10 – 50 10 – 50	10 50	60 (90) 90 (120)	‹ 0,1 ‹ 0,1
	Special features: high longterm stability - high accurancy of measurement							
Resistor network (high voltage) **Network**								
	3000	1,023 x 0,314“ 1,515 x 0,511“ 2 x 0,275“ 2 x 0,59“	100 k – 1 G 100 k – 1 G 100 k – 1 G 100 k – 1 G	to 0,1 to 0,1 to 0,1 to 0,1	10 – 50 10 – 50 10 – 50 10 – 50	1,0 1,4 2,0 3,0	10 20 15 30	‹ 1 ‹ 0,4 ‹ 0,3 ‹ 0,2

All resisitors available with specific cover for operation in air, compound or oil.

Metallux USA, Inc.
Building C, Suite 4
3495 Winton Place
Rochester, NY 14623
Tel: +1-585-360-0054
http://www.metallux-usa.com/
info@metallux-usa.com

V_{CE} = 6500 V
I_C = 400 A

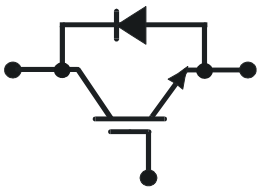


ABB HiPak™

IGBT Module

5SNA 0400J650100

Doc. No. 5SYA 1592-03 04-2012

- **AlSiC base-plate for high power cycling capability**
- **AlN substrate for low thermal resistance**
- **Recognized under UL1557, File E196689**

Maximum rated values [1]

Parameter		Conditions			
Collector-emitter voltage		V_{GE} = 0 V, T_{vj} ≥ 25 °C			
		V_{CC} = 4400 V, $V_{CEM\,CHIP}$ ≤ 6500 V V_{GE} ≤ 15 V, T_{vj} ≤ 125 °C			

[1] Maximum rated values indicate limits beyond which damage to the device may occur per IEC 60747
[2] For detailed mounting instructions refer to ABB Document No. 5SYA2039

IGBT characteristic values [3]

Parameter	Symbol	Conditions		min	typ	max	Unit
Collector (-emitter) breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0 V, I_C = 10 mA, T_{vj} = 25 °C		6500			V
Collector-emitter [4] saturation voltage	$V_{CE\ sat}$	I_C = 400 A, V_{GE} = 15 V	T_{vj} = 25 °C		4.2	4.8	V
			T_{vj} = 125 °C		5.4	5.9	V
Collector cut-off current	I_{CES}	V_{CE} = 6500 V, V_{GE} = 0 V	T_{vj} = 25 °C			8	mA
			T_{vj} = 125 °C		35	80	mA
Gate leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = ±20 V, T_{vj} = 125 °C		-500		500	nA
Gate-emitter threshold voltage	$V_{GE(TO)}$	I_C = 160 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		6	7.4	8	V
Gate charge	Q_{ge}	I_C = 400 A, V_{CE} = 3600 V, V_{GE} = -15 V .. 15 V			5.3		µC
Input capacitance	C_{ies}	V_{CE} = 25 V, V_{GE} = 0 V, f = 1 MHz, T_{vj} = 25 °C			95.3		nF
Output capacitance	C_{oes}				4.41		
Reverse transfer capacitance	C_{res}				0.85		
Turn-on delay time	$t_{d(on)}$	V_{CC} = 3600 V, I_C = 400 A, R_G = 5.6 Ω, V_{GE} = ±15 V, L_σ = 280 nH, inductive load	T_{vj} = 25 °C		700		ns
			T_{vj} = 125 °C		630		
Rise time	t_r		T_{vj} = 25 °C		250		ns
			T_{vj} = 125 °C		220		
Turn-off delay time	$t_{d(off)}$	V_{CC} = 3600 V, I_C = 400 A, R_G = 5.6 Ω, V_{GE} = ±15 V, L_σ = 280 nH, inductive load	T_{vj} = 25 °C		1410		ns
			T_{vj} = 125 °C		1700		
Fall time	t_f		T_{vj} = 25 °C		650		ns
			T_{vj} = 125 °C		980		
Turn-on switching energy	E_{on}	V_{CC} = 3600 V, I_C = 400 A, V_{GE} = ±15 V, R_G = 5.6 Ω, L_σ = 280 nH, inductive load	T_{vj} = 25 °C		2250		mJ
			T_{vj} = 125 °C		2800		
Turn-off switching energy	E_{off}	V_{CC} = 3600 V, I_C = 400 A, V_{GE} = ±15 V, R_G = 5.6 Ω, L_σ = 280 nH, inductive load	T_{vj} = 25 °C		1340		mJ
			T_{vj} = 125 °C		2120		
Short circuit current	I_{SC}	t_{psc} ≤ 10 µs, V_{GE} = 15 V, T_{vj} = 125 °C, V_{CC} = 4400 V, $V_{CEM\ CHIP}$ ≤ 6500 V			1800		A
Module stray inductance	$L_{\sigma\ CE}$				20		nH
Resistance, terminal-chip	$R_{CC'+EE'}$		T_C = 25 °C		0.1		mΩ
			T_C = 125 °C		0.15		

[3] Characteristic values according to IEC 60747 – 9
[4] Collector-emitter saturation voltage is given at chip level

Diode characteristic values [5]

Parameter	Symbol	Conditions		min	typ	max	Unit
Forward voltage [6]	V_F	I_F = 400 A	T_{vj} = 25 °C		3.2	3.8	V
			T_{vj} = 125 °C		3.4	4.0	
Reverse recovery current	I_{rr}	V_{CC} = 3600 V, I_F = 400 A, V_{GE} = ±15 V, R_G = 5.6 Ω, L_σ = 280 nH inductive load	T_{vj} = 25 °C		510		A
			T_{vj} = 125 °C		680		
Recovered charge	Q_{rr}		T_{vj} = 25 °C		450		µC
			T_{vj} = 125 °C		770		
Reverse recovery time	t_{rr}		T_{vj} = 25 °C		1840		ns
			T_{vj} = 125 °C		2120		
Reverse recovery energy	E_{rec}		T_{vj} = 25 °C		670		mJ
			T_{vj} = 125 °C		1380		

[5] Characteristic values according to IEC 60747 – 2
[6] Forward voltage is given at chip level

Package properties [7]

Parameter	Symbol	Conditions	min	typ	max	Unit
IGBT thermal resistance junction to case	$R_{th(j-c)IGBT}$				0.016	K/W
Diode thermal resistance junction to case	$R_{th(j-c)DIODE}$				0.032	K/W
IGBT thermal resistance case to heatsink [2]	$R_{th(c-s)IGBT}$	IGBT per switch, λ grease = 1W/m x K		0.012		K/W
Diode thermal resistance case to heatsink [7]	$R_{th(c-s)DIODE}$	Diode per switch, λ grease = 1W/m x K		0.024		K/W
Partial discharge extinction voltage	V_e	f = 50 Hz, Q_{PD} ≤ 10pC (acc. to IEC 61287)	5100			V
Comparative tracking index	CTI		≥ 600			

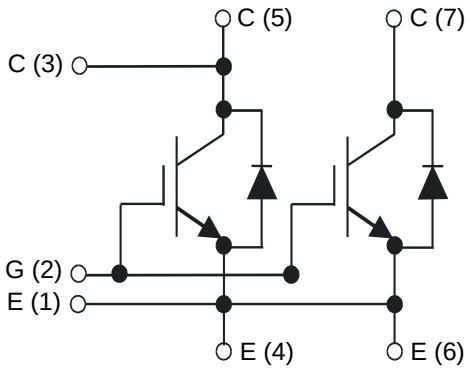
[2] For detailed mounting instructions refer to ABB Document No. 5SYA2039

Mechanical properties [7]

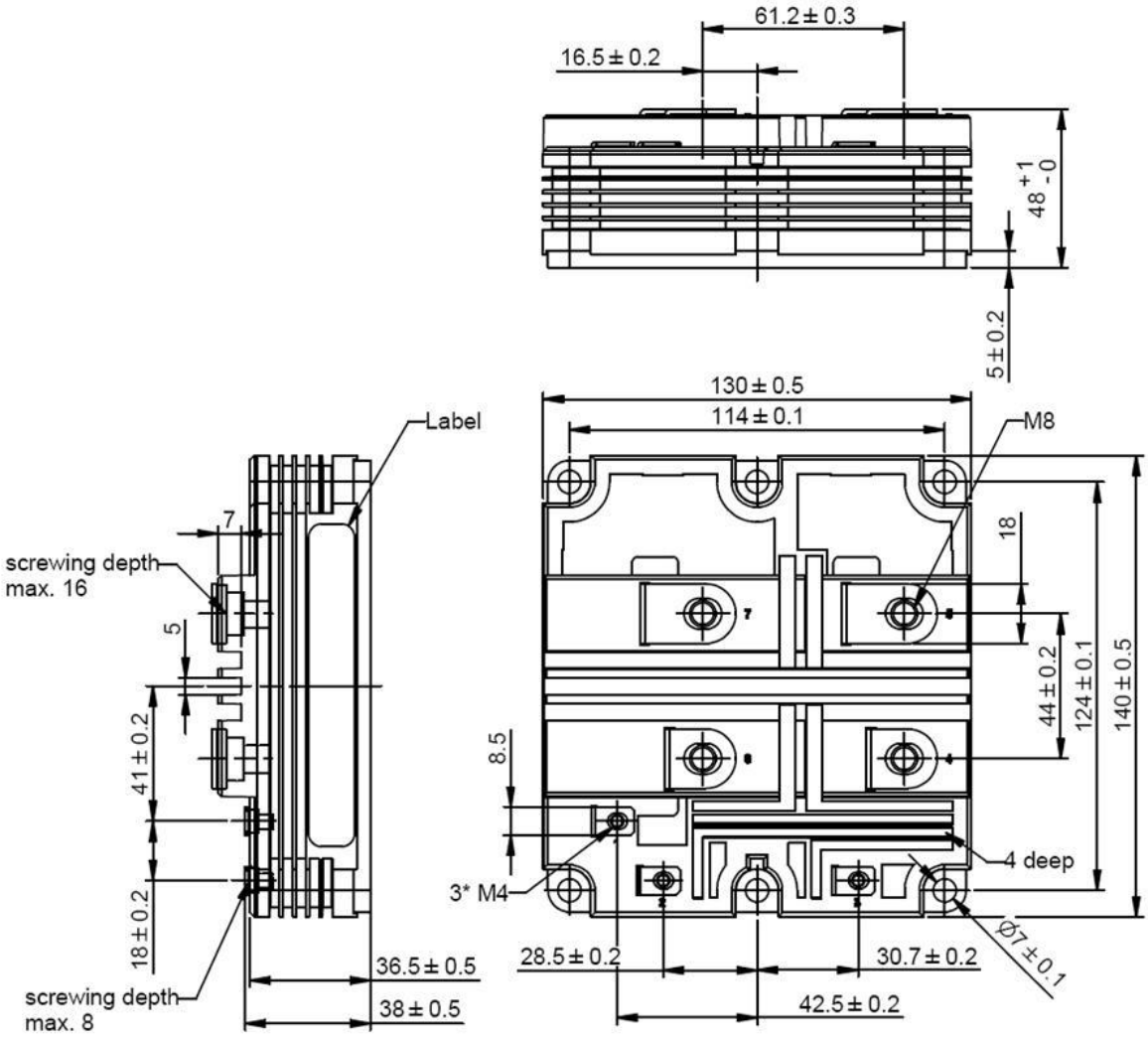
Parameter	Symbol	Conditions		min	typ	max	Unit
Dimensions	L x W x H	Typical , see outline drawing		130 x 140 x 48			mm
Clearance distance in air	d_a	according to IEC 60664-1 and EN 50124-1	Term. to base:	40			mm
			Term. to term:	26			
Surface creepage distance	d_s	according to IEC 60664-1 and EN 50124-1	Term. to base:	64			mm
			Term. to term:	56			
Mass	m				1150		g

[7] Package and mechanical properties according to IEC 60747 – 15

Electrical configuration



Outline drawing [2)]



Note: all dimensions are shown in mm

[2)] For detailed mounting instructions refer to ABB Document No. 5SYA2039

This is an electrostatic sensitive device, please observe the international standard IEC 60747-1, chap. IX.

This product has been designed and qualified for Industrial Level.

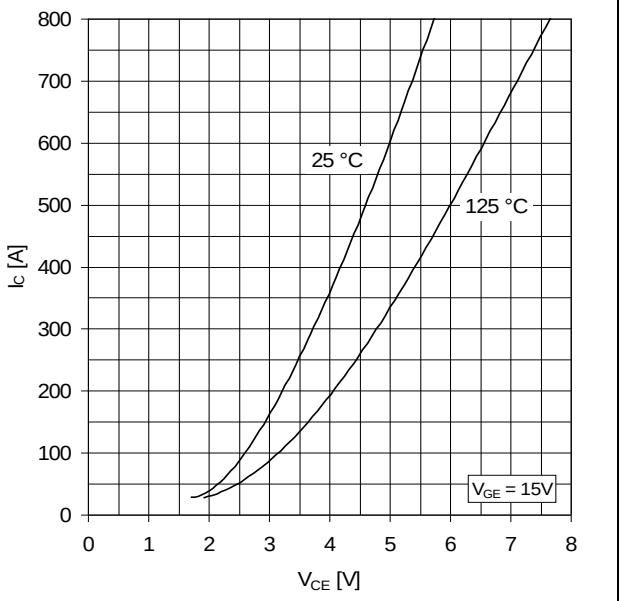


Fig. 1 Typical on-state characteristics, chip level

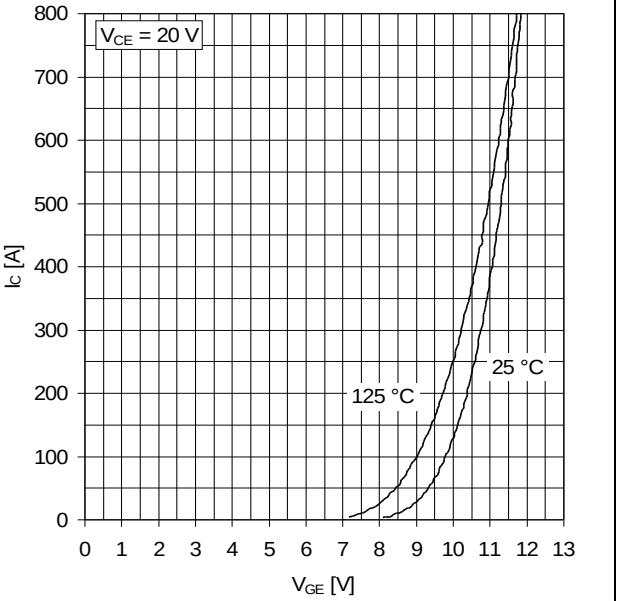


Fig. 2 Typical transfer characteristics, chip level

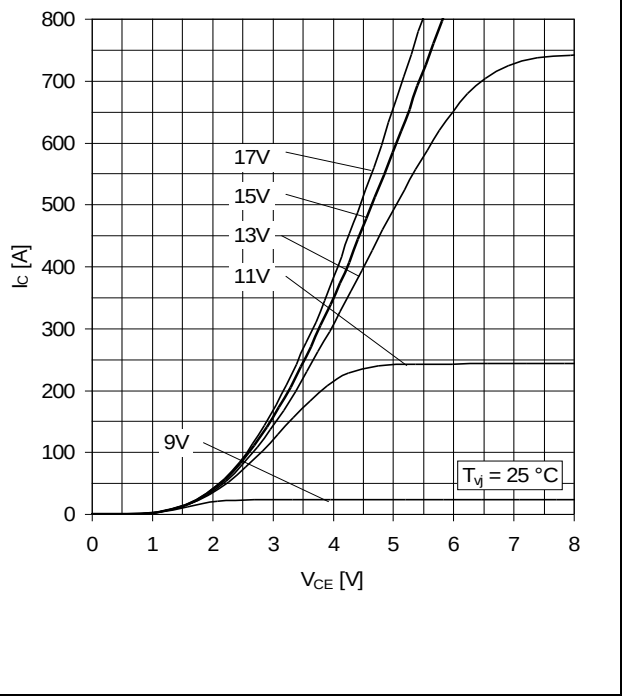


Fig. 3 Typical output characteristics, chip level

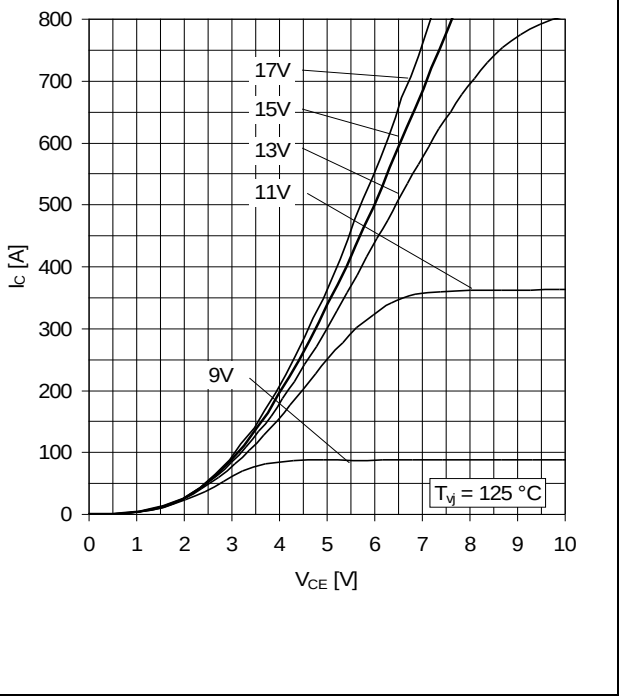


Fig. 4 Typical output characteristics, chip level

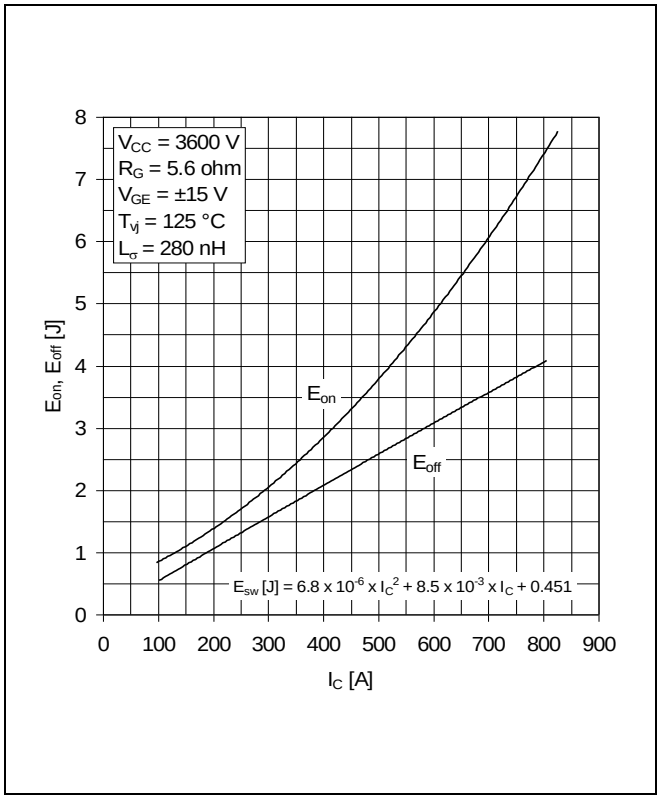


Fig. 5 Typical switching energies per pulse vs collector current

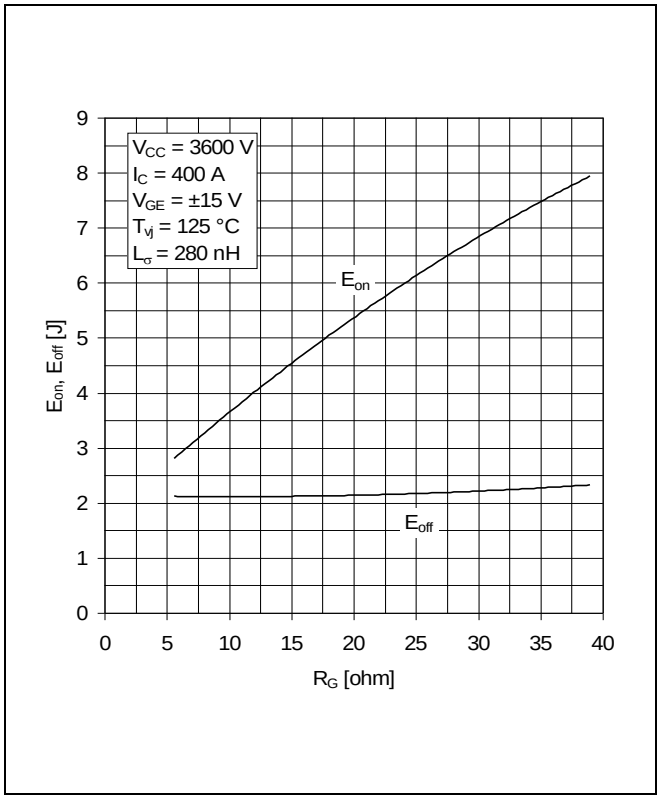


Fig. 6 Typical switching energies per pulse vs gate resistor

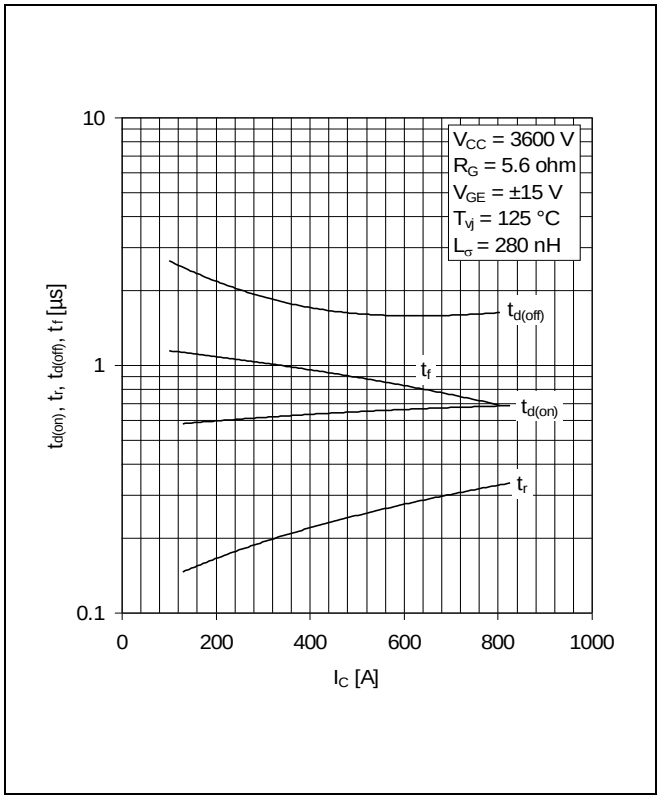


Fig. 7 Typical switching times vs collector current

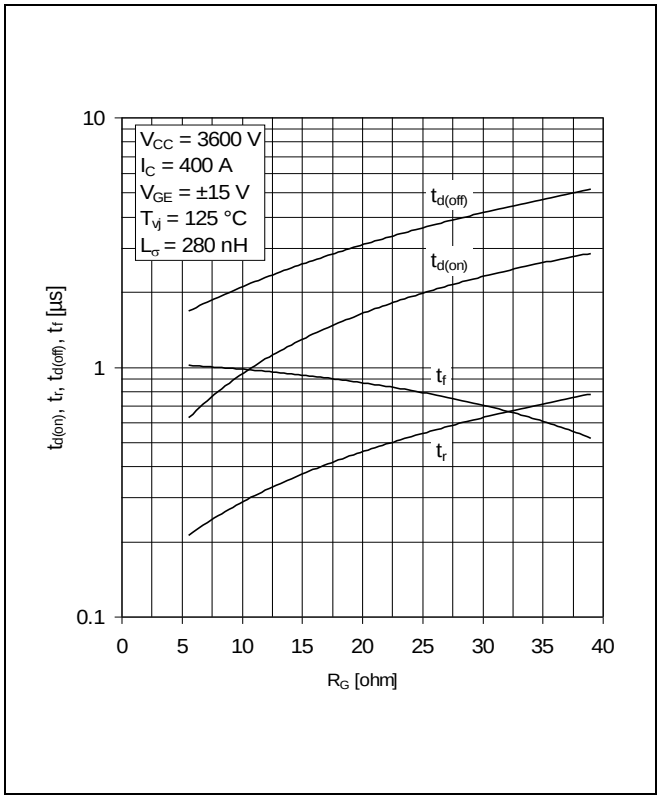


Fig. 8 Typical switching times vs gate resistor

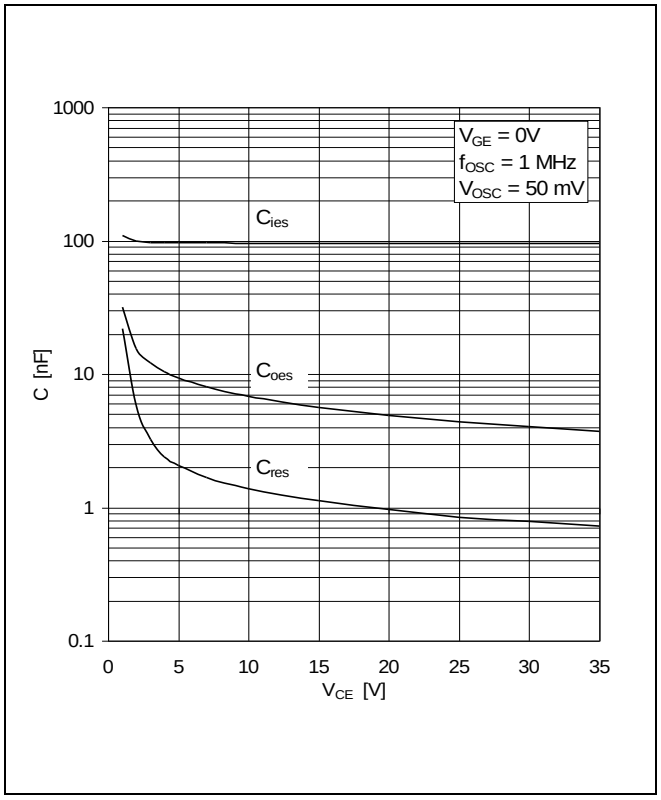


Fig. 9 Typical capacitances vs collector-emitter voltage

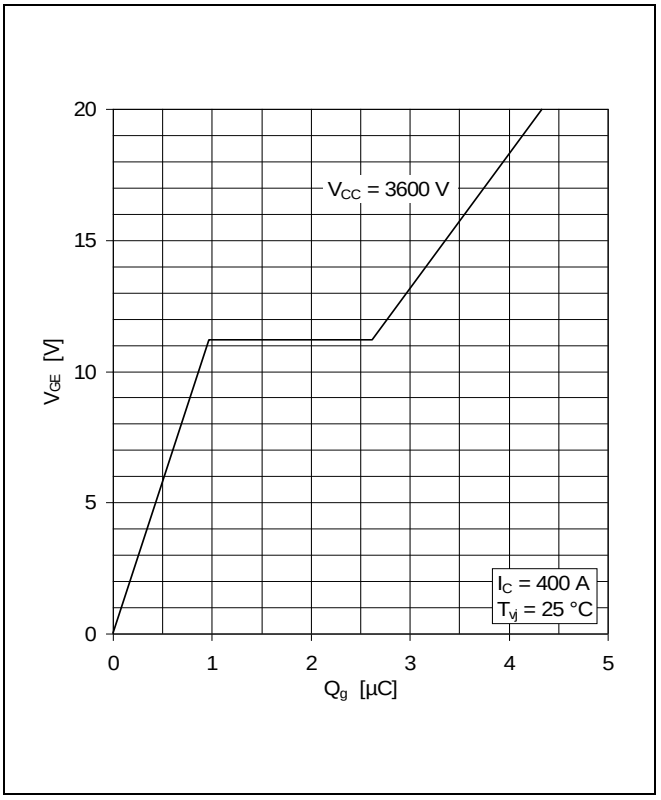


Fig. 10 Typical gate charge characteristics

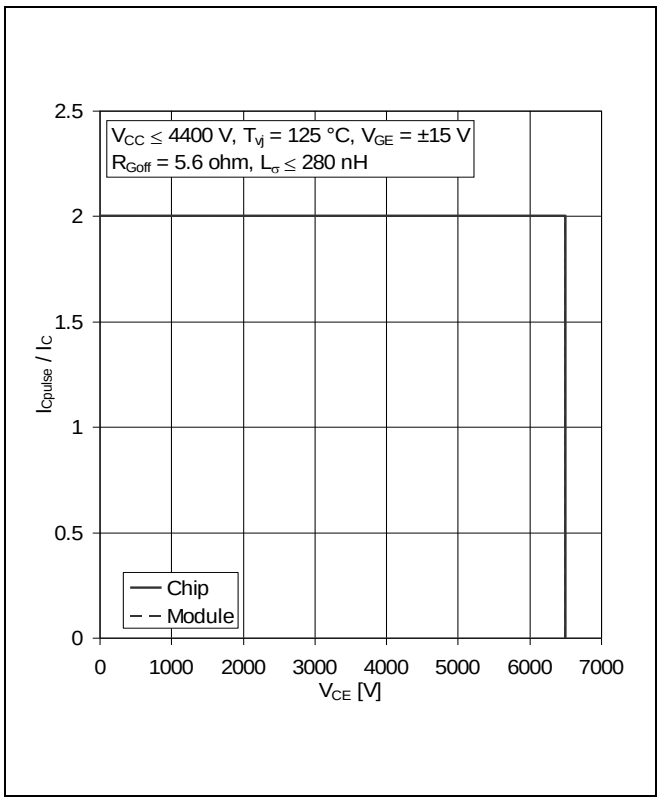


Fig. 11 Turn-off safe operating area (RBSOA)

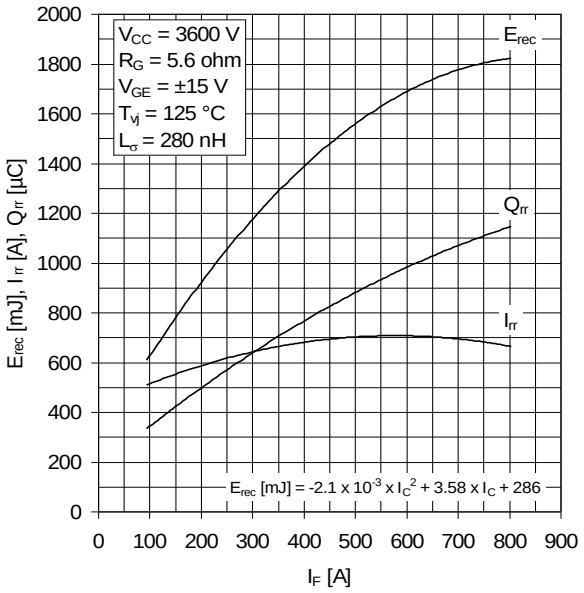


Fig. 12 Typical reverse recovery characteristics vs forward current

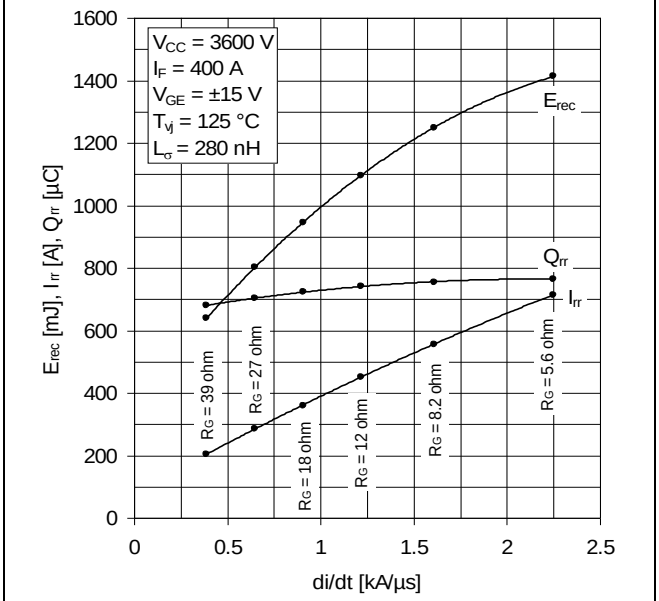


Fig. 13 Typical reverse recovery characteristics vs di/dt

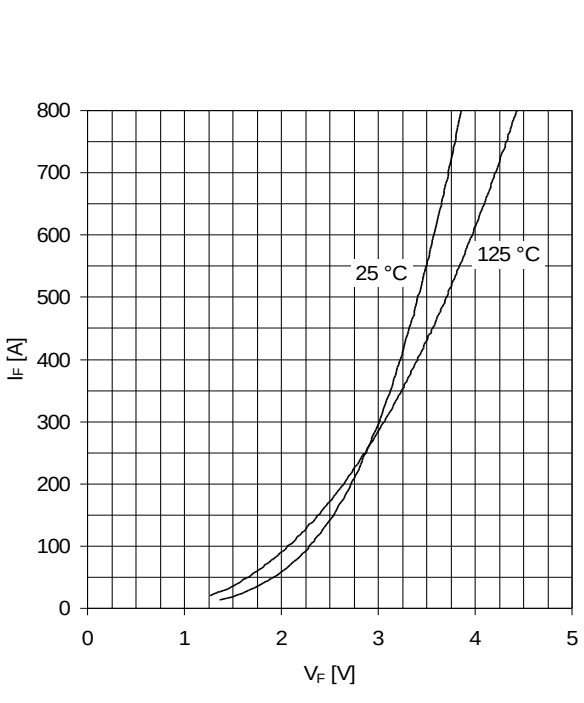


Fig. 14 Typical diode forward characteristics, chip level

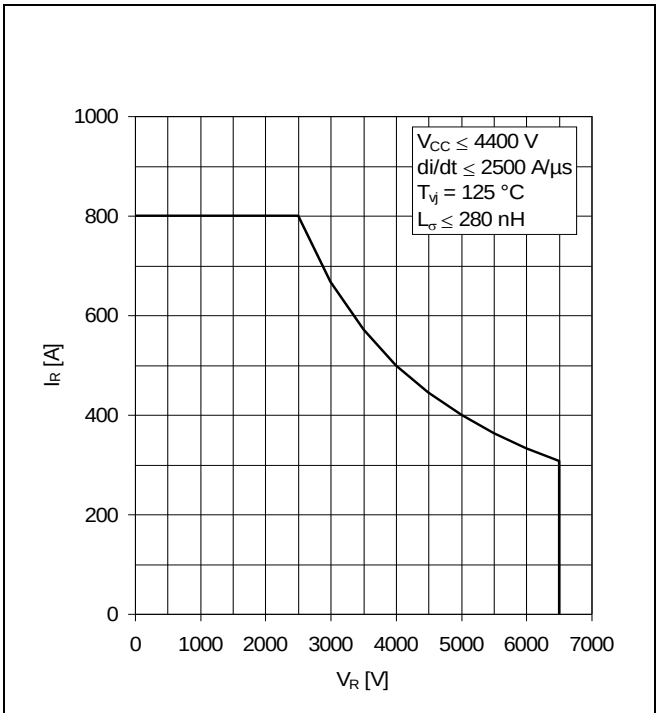


Fig. 15 Safe operating area diode (SOA)

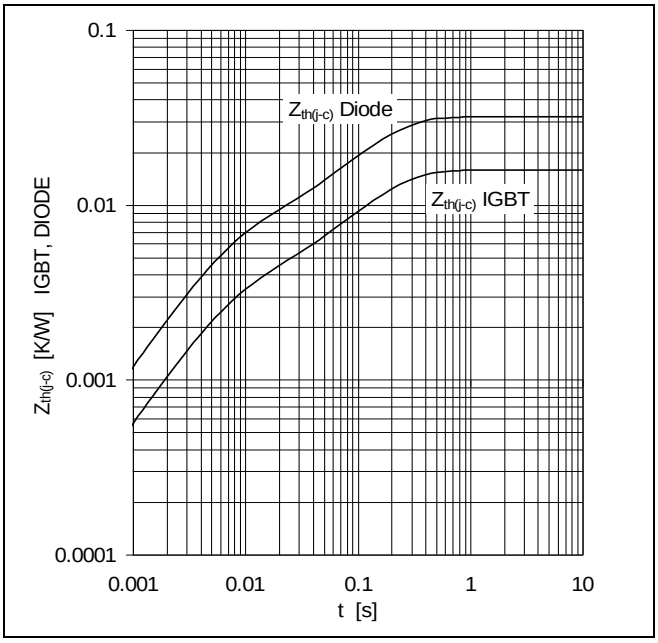


Fig. 16

$$Z_{th\,(j\text{-}c)}(t) = \sum_{i=1}^{n} R_i\,(1 - e^{-t/\tau_i})$$

IGBT						
	R_i(K/kW)	12.75	2.99			
	τ_i(ms)	151	5.84			
DIODE						
	R_i(K/kW)	25.5	6.3			
	τ_i(ms)	144	5.83			

For detailed information refer to:

- 5SYA 2042 Failure rates of HiPak modules due to cosmic rays
- 5SYA 2043 Load – cycle capability of HiPaks
- 5SYA 2045 Thermal runaway during blocking
- 5SYA 2058 Surge currents for IGBT diodes
- 5SZK 9120 Specification of environmental class for HiPak

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Internet www.abb.com/semiconductors

Doc. No. 5SYA 1592-03 04-2012

DFM1200FXS12-A000

Fast Recovery Diode Module

Replaces DS5645-1.1

DS5845-2 April 2010 (LN26743)

FEATURES

- Low Reverse Recovery Charge
- High Switching Speed
- Low Forward Volt Drop
- Isolated Cu Base with Al_2O_3 Substrates
- Dual Diodes can be paralleled for 2400A Rating
- Lead Free Construction

APPLICATIONS

- Chopper Diodes
- Boost and Buck Circuits
- Free-wheel Circuits
- Multi-level Switch Inverters

The DFM1200FXS12-A000 is a dual 1200V, fast recovery diode (FRD) module. Designed for low power loss, the module is suitable for a variety of high voltage applications in motor drives and power conversion.

Fast switching times and low reverse recovery losses allow high frequency operation, making the device suitable for the latest drive designs employing PWM and high frequency switching.

The module incorporates an electrically isolated base plate and low inductance construction enabling circuit designers to optimise circuit layouts and utilise grounded heat sinks for safety.

ORDERING INFORMATION

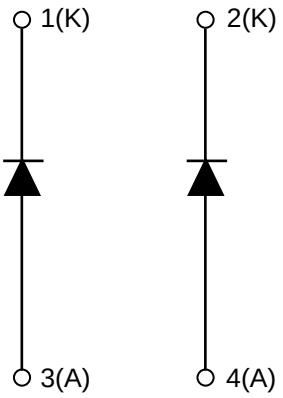
Order As:

DFM1200FXS12-A000

Note: When ordering, please use the complete part number

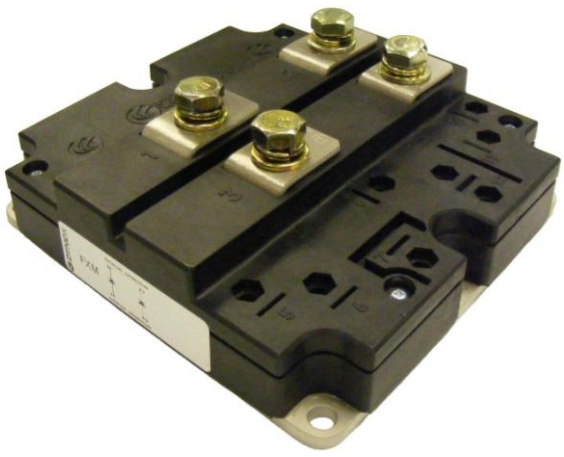
KEY PARAMETERS

V_{RRM}		**1200V**
V_F	**(typ)**	**1.9V**
I_F	**(max)**	**1200A**
I_{FM}	**(max)**	**2400A**



External connection required for a single 2400A diode

Fig. 1 Circuit configuration



Outline type code: F

(See Fig. 7 for further information)

Fig. 2 Package

ABSOLUTE MAXIMUM RATINGS

Stresses above those listed under 'Absolute Maximum Ratings' may cause permanent damage to the device. In extreme conditions, as with all semiconductors, this may include potentially hazardous rupture of the package. Appropriate safety precautions should always be followed. Exposure to Absolute Maximum Ratings may affect device reliability.

T_{case} = 25°C unless stated otherwise

Symbol	Parameter	Test Conditions	Max.	Units
V_{RRM}	Repetitive peak reverse voltage	T_j = 125°C	1200	V
I_F	Forward current (per arm)	DC, T_{case} = 75°C, T_j = 125°C	1200	A
I_{FM}	Max. forward current	T_{case} = 110°C, t_p = 1ms	2400	A
I^2t	I^2t value fuse current rating	V_R = 0, t_p = 10ms, T_j = 125°C	200	kA^2s
P_{max}	Max. transistor power dissipation	T_{case} = 25°C, T_j = 125°C	5000	W
V_{isol}	Isolation voltage – per module	Commoned terminals to base plate. AC RMS, 1 min, 50Hz	2500	V

THERMAL AND MECHANICAL RATINGS

Internal insulation material: Al_2O_3

Baseplate material: Cu

Creepage distance: 20mm

Clearance: 10mm

CTI (Comparative Tracking Index): 350

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Units
$R_{th(j-c)}$	Thermal resistance (per arm)	Continuous dissipation – junction to case	-	-	20	°C/kW
$R_{th(c-h)}$	Thermal resistance – case to heatsink (per module)	Mounting torque 5Nm (with mounting grease)	-	-	8	°C/kW
T_j	Junction temperature		-	-	125	°C
T_{stg}	Storage temperature range		-40	-	125	°C
	Screw Torque	Mounting – M6	-	-	5	Nm
		Electrical connections – M8	-	-	10	Nm

STATIC ELECTRICAL CHARACTERISTICS – PER ARM

T_{case} = 25°C unless stated otherwise.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
I_{RM}	Peak reverse current	V_R = 1200V, T_j = 125°C			30	mA
V_F	Forward voltage	I_F = 1200A		1.9	2.2	V
		I_F = 1200A, T_j = 125°C		2.1	2.4	V
L_M	Inductance			20		nH

STATIC ELECTRICAL CHARACTERISTICS

T_{case} = 25°C unless stated otherwise.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
L_M	Module inductance (externally connected in parallel)			15		nH

DYNAMIC ELECTRICAL CHARACTERISTICS – PER ARM

T_{case} = 25°C unless stated otherwise

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Units
Q_{rr}	Reverse recovery charge	I_F = 1200A V_R = 600V dI_F/dt = 9000A/µs		200		µC
I_{rr}	Peak reverse recovery current			800		A
E_{rec}	Reverse recovery energy			80		mJ

T_{case} = 125°C unless stated otherwise

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Units
Q_{rr}	Reverse recovery charge	I_F = 1200A V_R = 600V dI_F/dt = 8400A/µs		300		µC
I_{rr}	Peak reverse recovery current			920		A
E_{rec}	Reverse recovery energy			140		mJ

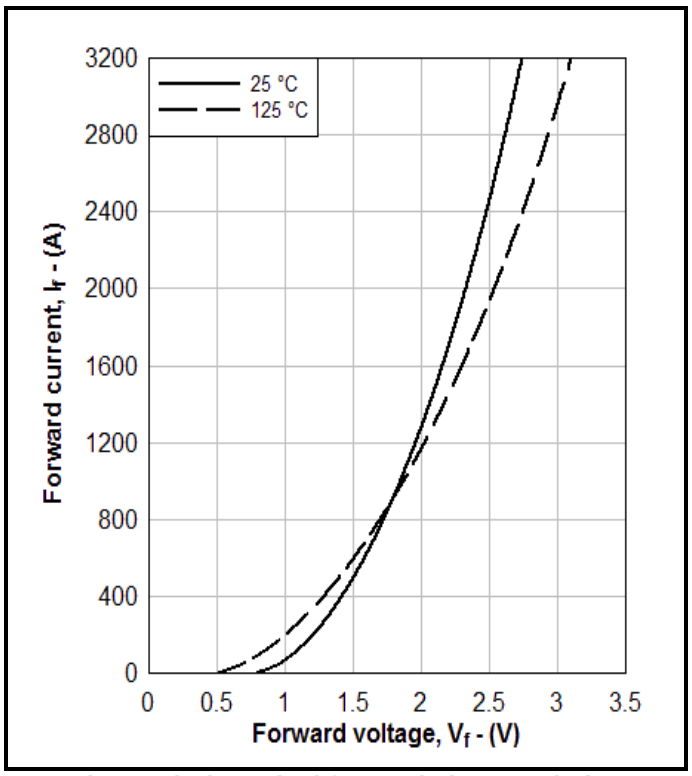


Fig. 3 Diode typical forward characteristics

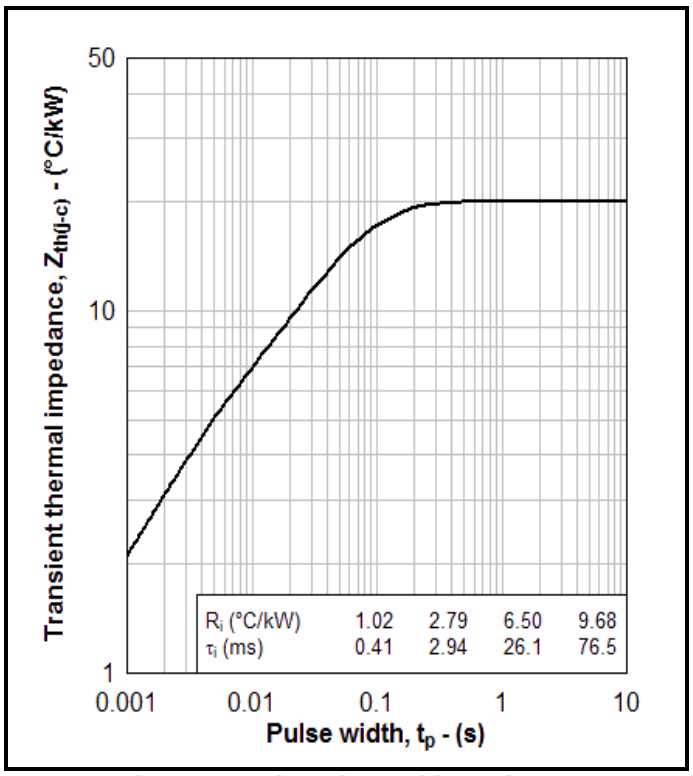


Fig. 4 Transient thermal impedance

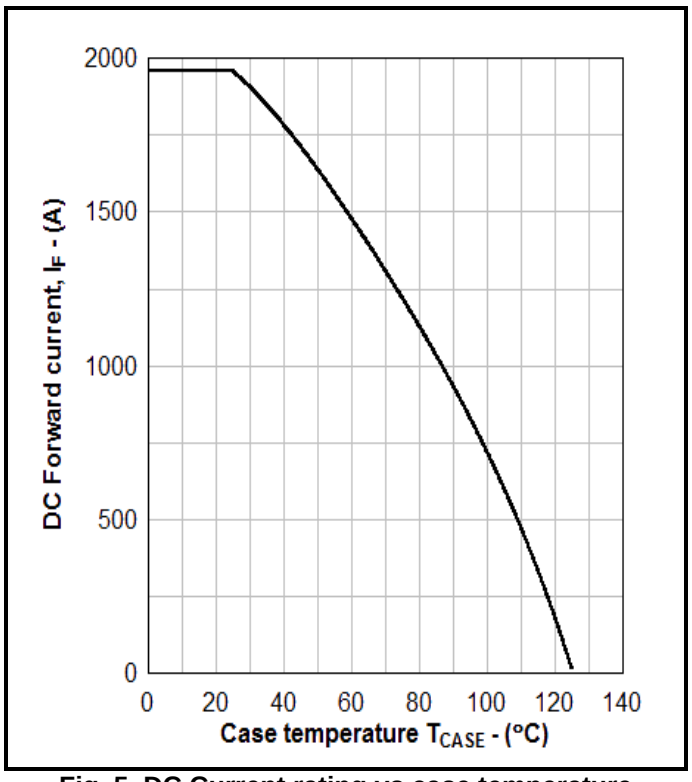


Fig. 5 DC Current rating vs case temperature

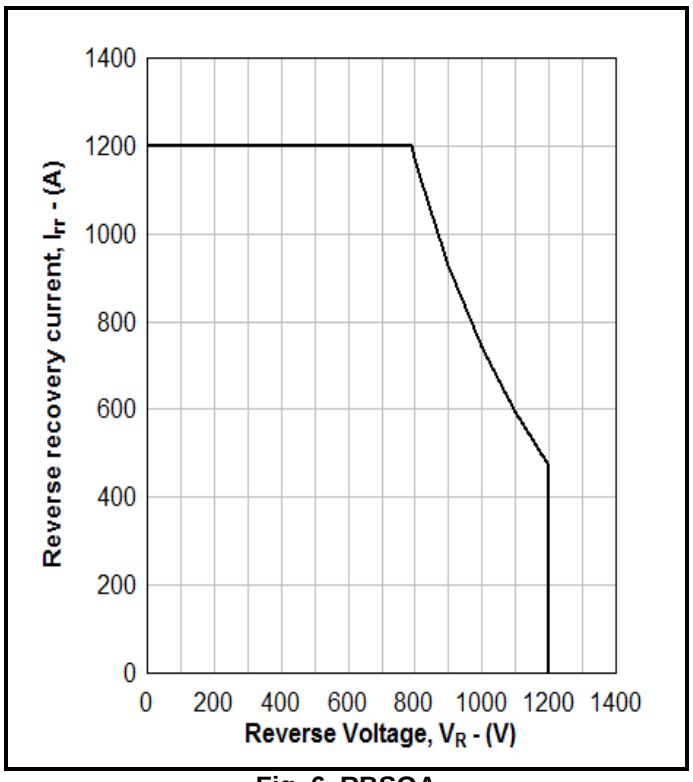
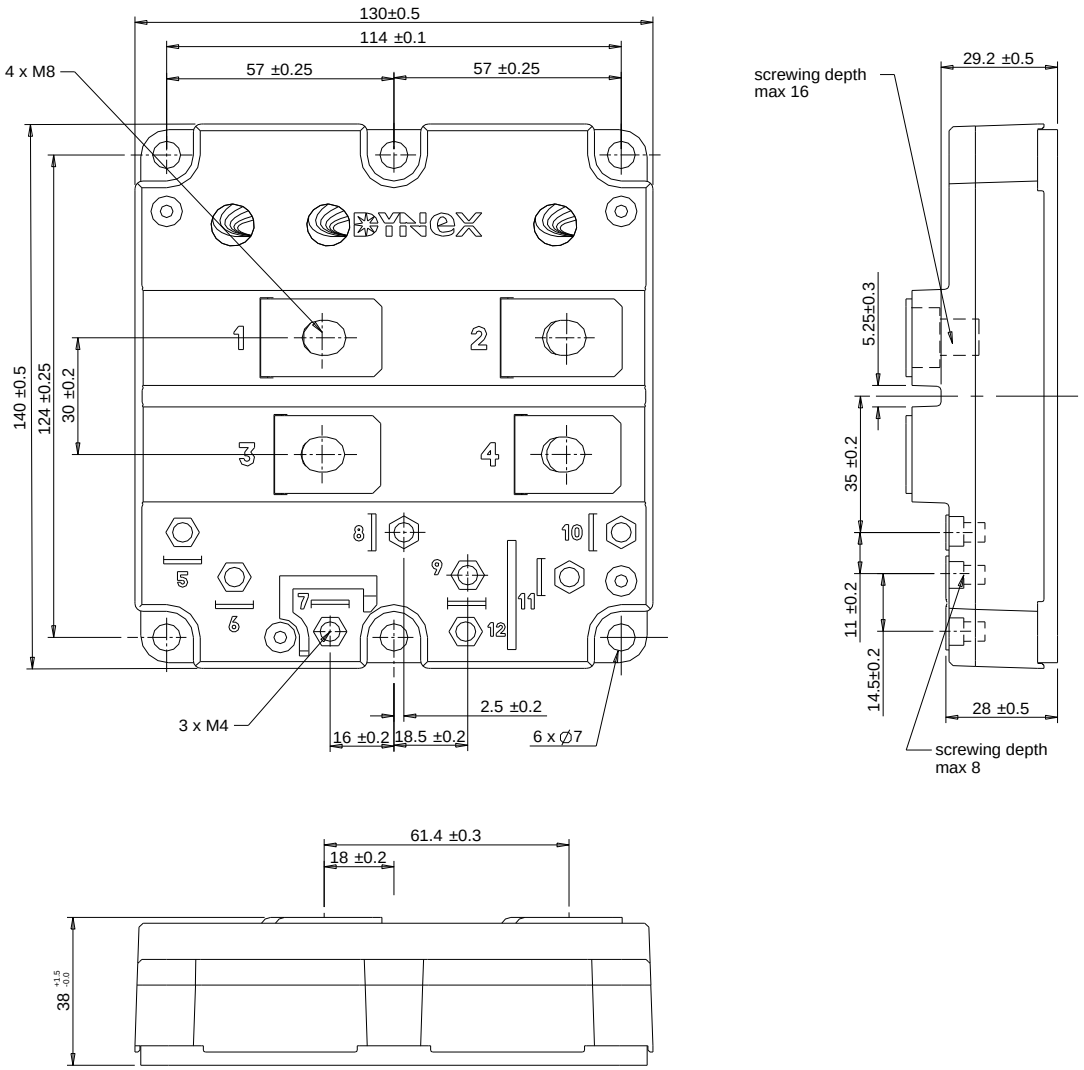


Fig. 6 RBSOA

PACKAGE DETAILS

For further package information, please visit our website or contact Customer Services.
All dimensions in mm, unless stated otherwise.
DO NOT SCALE.



Nominal Weight: 1450g

Module Outline Type Code: F

Fig. 7 Module outline drawing

HEADQUARTERS OPERATIONS

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email: power_solutions@dynexsemi.com

Datasheet Annotations: Dynex Semiconductor annotate datasheets in the top right hand corner of the front page, to indicate product status.

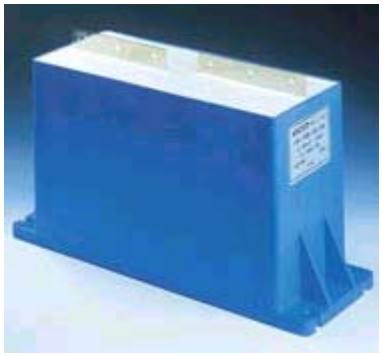
The annotations are as follows:-

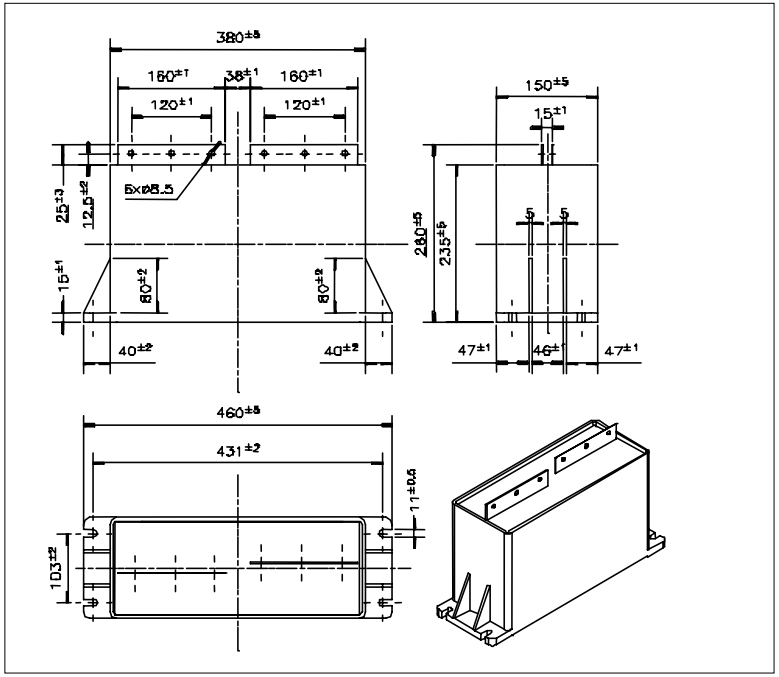
Target Information:	This is the most tentative form of information and represents a very preliminary specification. No actual work on the product has been started.
Preliminary Information:	The product is in design and development. The datasheet represents the product as it is understood but may change.
Advance Information:	The product design is complete and final characterisation for volume production is well in hand.
No Annotation:	The product parameters are fixed and the product is available to datasheet specification.

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P5X - … Series

High capacitance, low inductance connections





Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working Frequency**	Weight	Box qty
	C (µF)	Un (V)	Urms	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (m Ω)	Rthn (°C/W)	(kHz)	(kg)	(pcs)
LNK-P5X-8000-70	8000	700	200	1400	300	4	<30	0.14	1.15	20	18	1
LNK-P5X-5000-90	5000	900	250	1800	300	4	<30	0.18	1.15	20	18	1
LNK-P5X-4200-100	4200	1000	300	2000	250	4	<30	0.19	1.15	20	18	1
LNK-P5X-3500-110	3500	1100	350	2200	250	5	<30	0.21	1.15	20	18	1
LNK-P5X-2600-125	2600	1250	420	2500	250	7	<30	0.24	1.15	20	18	1
LNK-P5X-2000-145	2000	1450	420	2900	200	8	<30	0.28	1.15	20	18	1
LNK-P5X-1600-160	1600	1600	420	3200	200	10	<30	0.31	1.15	20	18	1
LNK-P5X-1300-180	1300	1800	450	3600	200	10	<30	0.34	1.15	20	18	1
LNK-P5X-1000-200	1000	2000	600	4000	250	25	<30	0.19	1.15	20	18	1
LNK-P5X-850-220	850	2200	700	4400	250	30	<30	0.21	1.15	20	18	1
LNK-P5X-650-250	650	2500	800	5000	250	30	<30	0.23	1.15	20	18	1
LNK-P5X-500-290	500	2900	850	5800	200	38	<30	0.27	1.15	20	18	1
LNK-P5X-400-320	400	3200	900	6400	200	40	<30	0.3	1.15	20	18	1
LNK-P5X-300-360	300	3600	950	7200	200	45	<30	0.36	1.15	20	18	1

** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

Issue 031027

LNK

METALLIZED POLYPROPYLENE D.C. LINK CAPACITORS

ICAR

Technology Looking Ahead

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

Replacement of Electrolytic Capacitors by Metallized Polypropylene Film Capacitors in DC Link application.

A typical industrial drive basically consist of two parts :

- An AC / DC section which convert the AC voltage of the industrial network at fixed frequency (50 ÷ 60 Hz) into a DC voltage.
- A DC / AC section that supply a motor at variable frequency.

These two parts are connected a DC bus (*Link circuit*) and capacitors are used in this section to filter the high frequency component (*DC Link Capacitors*) . The most important requirements for these capacitors are :

- the capability in withstanding high current at frequencies above 1000 Hz,
- the high energy density (*Joule / dm³*) .

Usually Electrolytic Capacitors are used up to a voltage around 2000 V . Beside the advantage of having a very large capacitance value per can the limits for Electrolytic capacitors are :

- The maximum working voltage across each capacitor which is around 450 ÷ 500 V
- The current , especially at high frequency , is limited by their high ESR (*Equivalent Series Resistance*) .

Consequently, in most of the cases , Electrolytic Capacitors have to be connected in series/parallel to form banks to reach the requested performances in terms of Voltage and Current.

Seen the above , in order to reduce the ripple current , the banks are often designed with a very large equivalent capacitance which is normally easy to get with electrolytics capacitors. In other words the equivalent capacitance of these banks can be much lower whenever the capacitors would be able to handle an higher current . Another important point to keep into account in assembling Electrolytic Capacitor banks is to pay attention at the connection in order to keep the inductance as low as possible.

In many cases it is possible to replace favourably Electrolytic Capacitors with Metallized film capacitors.

Under certain conditions the saving become evident already at 500 V and it is more and more important as well as the voltage increase.
As commented , there is no availability of Electrolytic Capacitors above 450 ÷ 500 V, on the opposite it is quite normal to manufacture Metallized Film Capacitors which can work at several thousands of Volts .
Moreover, since Metallized Film Capacitors can handle, with the same capacitance, much higher current than Electrolytic , it is possible , and also convenient, to reduce the total equivalent capacitance of the bank.

Here are the main reasons to choice a Metallized Film Capacitors :

- Much higher current per capacitance (A/µF) i.e. possibility of using a lower capacitance bank.
- Higher voltage per element i.e. there is no need of series connection.
- Higher capability to wistand to overvoltages , up to 2 times the rated voltage.
- More than 10 years lifetime in the temperature range -25 ÷ +70 ºC .
- Non polar dielectric.

Beside the above mentioned advantages typical of all the Metallized Film Capacitors ***ICAR,*** exploiting the 50 years experience in capacitor manufacturing , has developed this new range of DC Link capacitors **LNK series** with further advantages.

- By using a new metallizing process (patented) on polypropylene film ***ICAR*** can offer capacitors which size is less than one half if compared with the traditionally Metallized capacitors .
- The use of polypropylene make the dielectric losses extremely low at any frequency ,(i.e. very low ESR) this make this kind of capacitor extremely valid at the very high frequency typical of the last generation of IGBT inverters.

LNK construction consist of a completely dry resin filled capacitor, plastic casing , self extinguish. No more leakage problems, no more dangerous electrolytes.

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK SERIES ICAR CAPACITORS

General Technical Characteristics

Environmental:

Operating temperature:

ϑ_{min} : - 25°C ϑ_{max} : + 70°C

Storage temperature

ϑ_{min} : - 40°C ϑ_{max} : + 85°C

Ratings:

Capacitance tolerance: ± 10%

Useful life (at 70°C hot-spot): 100000 hrs.

Reliability: 300 FIT.

Casing:

Self extinguishing, low smoke plastic material.

Filler / impregnant:

Self extinguishing resin.

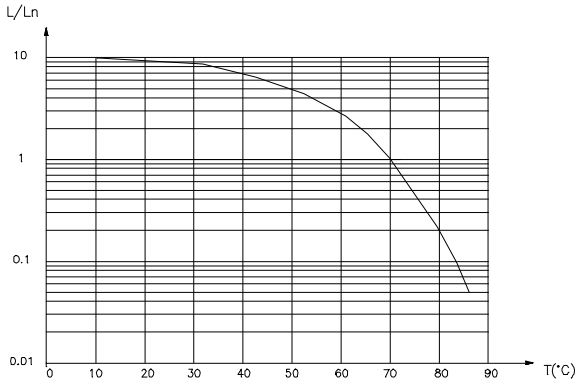
Standard of reference:

IEC 61071 – 60068 - 61881

With the new LNK series a new level of safety for the DC capacitors has been reached:

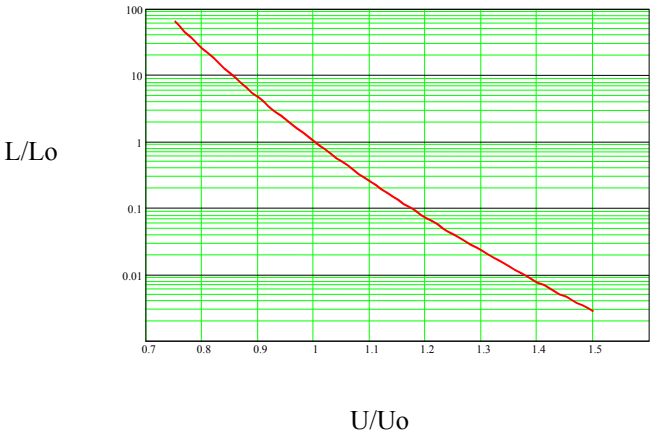
- ***Active safety:*** When the capacitor is stressed within the specifications, Icar patented metalization is designed to bring capacitor to an open circuit at the end of life.
- ***Passive safety:*** In case of failure the gas generated in not trapped in a sealed aluminium case but has a safe way out given by breaking of the casting resin. The risk of explosion is then dramatically reduced.
- ***Fire prevention:*** Casting resin and case material are flame retardant

Expected life versus hot spot temperature at rated voltage



Ln = expected life with hot spot temperature of 70°C
L = expected life with hot spot temperature T

Useful life versus voltage



Ln = expected life at rated voltage Un
L = expected life at U

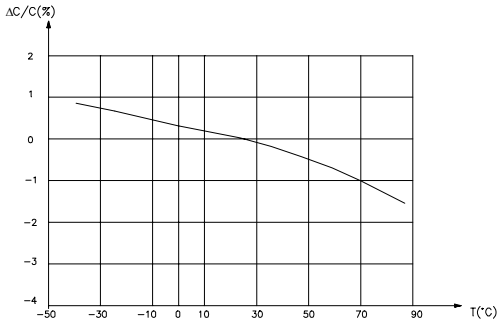
LNK SERIES

METALLIZED POLYPROPYLENE D.C. LINK CAPACITORS

Replacing Electrolitycs Capacitors by Metallized Polypropylene Film Capacitors.

- **No series connections for higher Voltage (Up to 4000 Vdc).**
- **Extremely low losses even at very high frequencies.**
- **Higher ripple current.**
- **Plastic case**
- **Lower E.S.R.**
- **Dry , environmental friendly construction.**

Capacitance variation versus temperature



Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

SELECTING THE CORRECT CAPACITOR

VOLTAGE

The first check should be done on the working voltage: The surge voltage U_S, the rated voltages U_N and U_{rms} should be not higher than the operating values.
Also the sum of the ripple and the dc component of the voltage should not be beyond the rated voltage U_N.
Although it is possible to work above the rated voltage, this will mean a reduction of the expected life; this can be evaluated through the correspondent graph.

CURRENT LIMITATION

The I_{rms} current must not exceed the maximum current I_{max}. The current must also be compatible with the maximum power that can be dissipated.
The I_{mxx} values in the schedules was been calculated supposing irrelevant the dielectric losses (Q" tan δ_0)and they correspond with a difference of temperature ($\theta_n - \theta_0$)of about 20°C. As a consequence, to have an expected life of 100.000 at the maximum current, the ambient temperature has not to exceed of 50°C.
If not the expected life will be calculated again using the graph on the following page.
The thermal check, here indicated, will be done in any case.
In case of forced air cooling the thermal resistance will be reduced of 30%.

THERMAL CHECK

First of all the power due to the internal losses of the capacitor should be calculated.
These power losses consist of the dielectric losses and series losses ($R_S * I^2_{rms}$) i.e. those due to the resistance of the armatures and the connections.
The total power can be calculated as follows:
$P = Q \tan \delta_0 + R_S I^2_{rms}$
It is now possible to calculate the hot spot temperature as:
$\vartheta_h = R_{th} * P + \vartheta_0$.
The expected life for these capacitors is actually calculated with the assumption the hot spot temperature is 70°C. In these conditions, at rated voltage the expected life is calculated as 100000 hours, with a failure rate of 300 FIT.
Using the enclosed graphs and other data here given the designer can calculate the expected life of the in the actual working conditions.

WARNING

This thermal check supposes that only the heat generated into the capacitor is transmitted to the environment through the case surface. Eventual localised overheating (poor connections, hot components in the nearby etc.) would then likely bring the capacitor to a dramatic reduction of the expected life.

DEFINITIONS

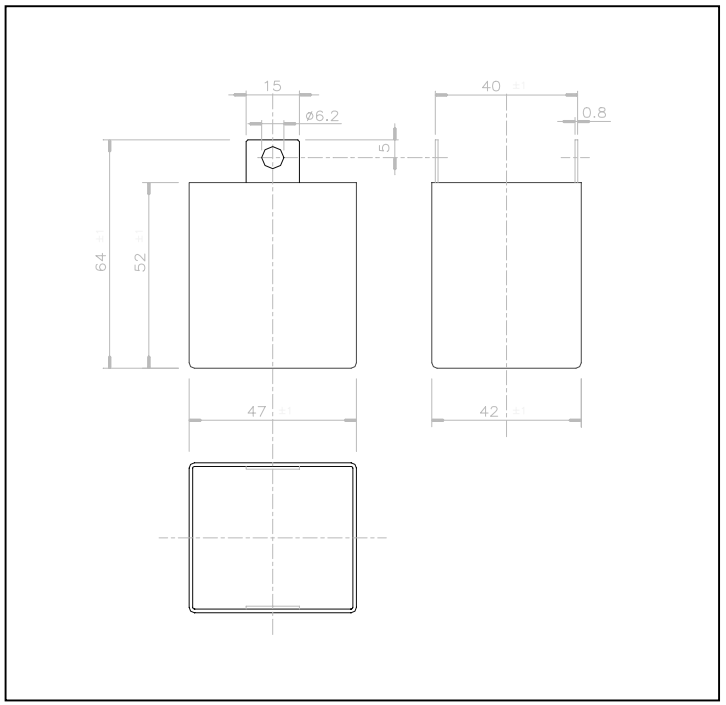
C_N	Rated Capacitance.
U_N	Rated (repetitive peak) voltage.
U_{rms}	Rated rms. voltage.
U_S	Surge (not repetitive) peak voltage.
I_{max}	Maximum rms. current value for continuous operation.
Q	Reactive power = $2 * \pi * F * C * U^2$rms
F	Fundamental frequency.
R_S	Series resistance i.e. the resistance responsible for the current heat losses ($I^2 R_S$) in the capacitor.
ESR	Equivalent Series Resistance defined as $ESR = R_S + \tan \delta_0 / 2*\pi*f*C$
tan δ_0	Dielectric dissipation factor. It can be considered as constant in the normal working frequency range. Typical value for polypropylene is $2*10^{-4}$.
tan δ	Dissipation factor calculated as: $\tan \delta_0 + 2*\pi*C*F*R_S$.
dv/dt	Maximum slope of the voltage waveshape.
I_{PK}	Peak current $I_{PK} = C * dv/dt$.
P	Total power dissipated in the capacitor.
R_{th}	Thermal resistance between the hot-spot in the winding and the environment (natural cooling), so that: $P = (\vartheta_h - \vartheta_0) / R_{th}$
ϑ_h	Hottest point in the capacitor winding.
ϑ_0	Operating ambient temperature. It is the air temperature measured under steady conditions, measured at 0,1 m from capacitor case.
L_0	Expected life at rated voltage U_0 and hot-spot temperature of 70°C
L	Expected life at the actual working conditions, obtained from the enclosed graph.
L_S	Self inductance of the capacitor. It is due to the internal connections, terminals, winding characteristics and physical dimensions.

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P1X - … Series

Very low inductance, small size.



Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Paek Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working frequency**	Weight	Box quantity
	C (µF)	Un (V)	Urms (V)	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (m W)	Rthn (°C/W)	(kHz)	(kg)	(pcs)
LNK-P1X –45-70	45	700	200	1400	40	50	10	1.40	8	50	0.15	100
LNK-P1X –30-90	30	900	250	1800	35	70	10	1.70	8	50	0.15	100
LNK-P1X –25-100	25	1000	300	2000	35	100	10	1.80	8	50	0.15	100
LNK-P1X –22-110	22	1100	350	2200	35	85	10	1.90	8	50	0.15	100
LNK-P1X –16-125	16	1250	400	2500	25	100	10	2.28	8	50	0.15	100
LNK-P1X –10-145	10	1450	400	2900	20	110	10	3.00	8	50	0.15	100
LNK-P1X –7.5-180	7.5	1800	450	3600	15	140	10	3.25	8	50	0.15	100

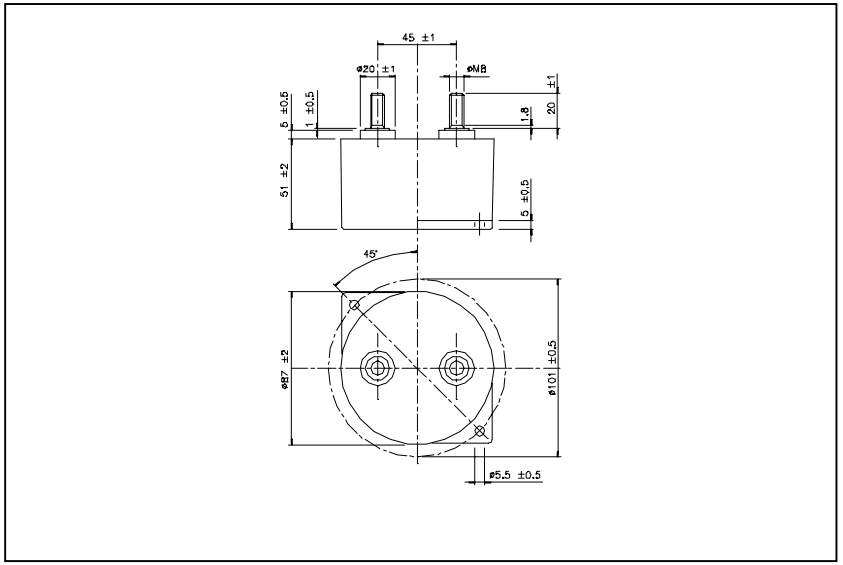
**In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P2X - … Series

High current for heatsink mounting



Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working Frequency**	Tightening Torque	Weight	Box qty
	C (µF)	Un (V)	Urms (V)	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (m W)	Rthn (°C/W)	(kHz)	(Nm)	(kg)	(pcs)
LNK-P2X-150-70	150	700	200	1400	100	55	<30	0.4	5	20	10	0.5	16
LNK-P2X-100-90	100	900	250	1800	80	70	<30	0.55	5	20	10	0.5	16
LNK-P2X-80-100	80	1000	300	2000	80	75	<30	0.6	5	20	10	0.5	16
LNK-P2X-70-110	70	1100	350	2200	80	80	<30	0.65	5	20	10	0.5	16
LNK-P2X-50-125	50	1250	400	2500	80	95	<30	0.75	5	20	10	0.5	16
LNK-P2X-40-145	40	1450	400	2900	80	110	<30	0.8	5	20	10	0.5	16
LNK-P2X-25-180	25	1800	450	3600	60	140	<30	1	5	20	10	0.5	16

* Thermal resistance is calculated with the capacitor installed on a heatsink through an heat conductive paste, In case this is not be done thermal resistance should be considered as the double so that the current rating should be consequently reduced.

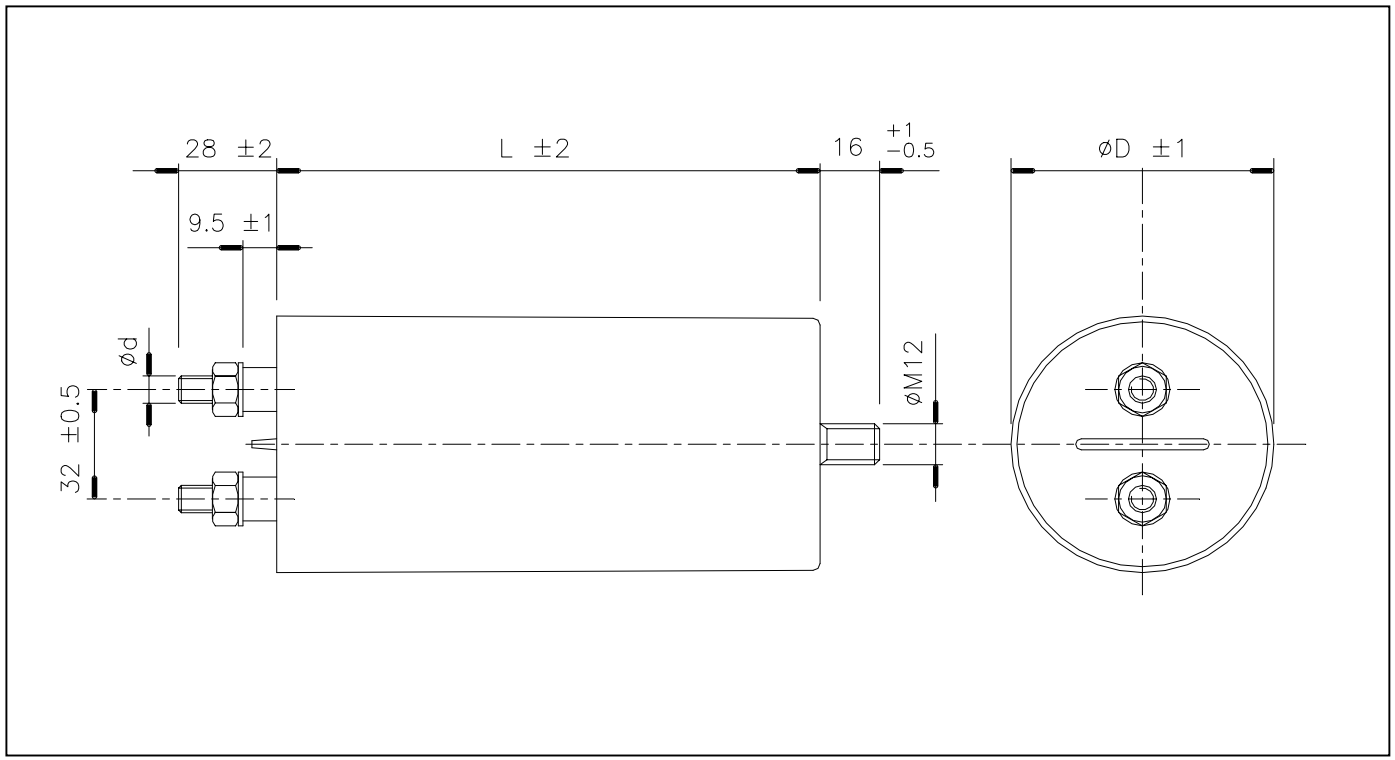
** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P3X - … Series

For an easier replacement of electrolytic capacitors



Issue 031027

LNK – P3X - … Series

For an easier replacement of electrolytic capacitors

Model	Capacitance	Reted DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working Frequency**	Tightening Torque	Weight	d	D	L	Box qty
	C (µF)	Un (V)	Urms (V)	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (mΩ)	Rthn (°C/W)	(kHz)	(Nm)	(kg)	(mm)	(mm)	(mm)	(pcs)
LNK-P3X-200-70	200	700	200	1400	30	20	80	3.9	5.7	5	6	0.5	M6	60	140	36
LNK-P3X-400-70	400	700	200	1400	40	20	90	2.7	4.5	5	6	0.9	M6	75	155	16
LNK-P3X-750-70	750	700	200	1400	55	20	90	1.6	4.00	5	10	1.4	M8	100	155	9
LNK-P3X-140-90	140	900	250	1800	30	20	80	4.0	6.04	5	6	0.5	M6	60	140	36
LNK-P3X-250-90	250	900	250	1800	40	20	90	2.03	5.04	5	6	0.9	M6	75	155	16
LNK-P3X-500-90	500	900	250	1800	55	20	90	1.09	3.07	5	10	1.4	M8	100	155	9
LNK-P3X-120-100	120	1000	300	2000	30	20	80	4.02	6.03	5	6	0.5	M6	60	140	36
LNK-P3X-200-100	200	1000	300	2000	40	20	90	3.03	5.05	5	6	0.9	M6	75	155	16
LNK-P3X-400-100	400	1000	300	2000	55	20	90	2.00	3.07	5	10	1.4	M8	100	155	9
LNK-P3X-100-110	100	1100	350	2200	30	20	80	4.07	6.04	5	6	0.5	M6	60	140	36
LNK-P3X-190-110	190	1100	350	2200	40	20	90	3.03	5.01	5	6	0.9	M6	75	155	16
LNK-P3X-350-110	350	1100	350	2200	55	20	90	2.02	3.07	5	10	1.4	M8	100	155	9
LNK-P3X-75-125	75	1250	400	2500	30	30	80	5.04	6.03	5	6	0.5	M6	60	140	39
LNK-P3X-140-125	140	1250	400	2500	40	20	90	3.08	5.01	5	6	0.9	M6	75	155	16
LNK-P3X-250-125	250	1250	400	2500	55	20	90	2.05	3.07	5	10	1.4	M8	100	155	9
LNK-P3X-50-145	50	1450	400	2900	25	30	80	7.0	6.07	5	6	0.5	M6	60	140	36
LNK-P3X-100-145	100	1450	400	2900	30	30	90	4.06	5.03	5	6	0.9	M6	75	155	16
LNK-P3X-200-145	200	1450	400	2900	55	30	90	2.07	3.07	5	10	1.4	M8	100	155	9
LNK-P3X-33-180	33	1800	450	3600	20	40	80	8.05	6.06	5	6	0.5	M6	60	140	36
LNK-P3X-66-180	66	1800	450	3600	30	30	90	5.06	5.00	5	6	0.9	M6	75	155	16
LNK-P3X-125-180	125	1800	450	3600	45	30	90	3.03	3.07	5	10	1.4	M8	100	155	9

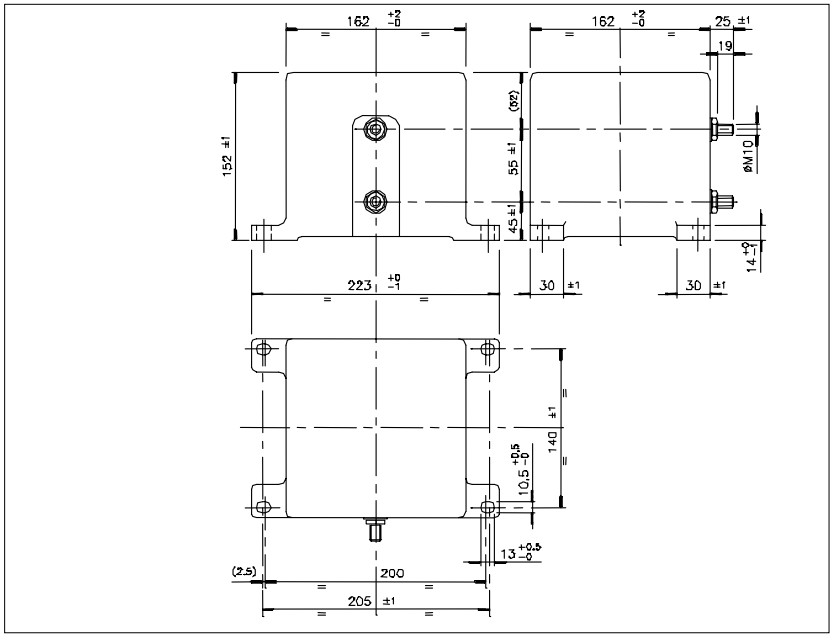
** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P4X - … Series

Sturdy construction for heavy duty



Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working Frequency**	Tightening Torque	Weight	Box qty
	C (µF)	Un (V)	Urms (V)	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (mΩ)	Rthn (°C/W)	(kHz)	(Nm)	(kg)	(pcs)
LNK-P4X-2000-70	2000	700	200	1400	120	3	<30	0.5	2	20	20	5	4
LNK-P4X-1300-90	1300	900	250	1800	120	6	<30	0.6	2	20	20	5	4
LNK-P4X-900-110	900	1100	350	2200	120	10	<30	0.7	2	20	20	5	4
LNK-P4X-650-125	650	1250	400	2500	120	25	<30	0.8	2	20	20	5	4
LNK-P4X-500-145	500	1450	400	2900	100	30	<30	0.9	2	20	20	5	4
LNK-P4X-350-180	350	1800	450	3600	100	35	<30	1.1	2	20	20	5	4
LNK-P4X-220-220	220	2200	700	4400	120	85	<30	0.7	2	20	20	5	4
LNK-P4X-55-400	55	4000	1000	8000	60	150	<30	2.85	2	20	20	5	4
LNK-P4X-20-500	20	5000	1250	10000	50	280	<30	4.5	2	20	20	5	4

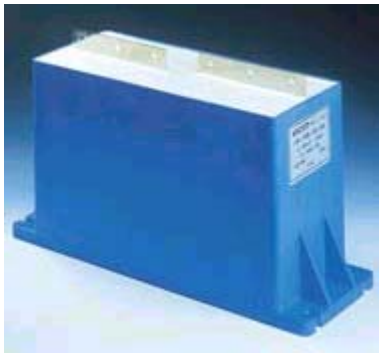
** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

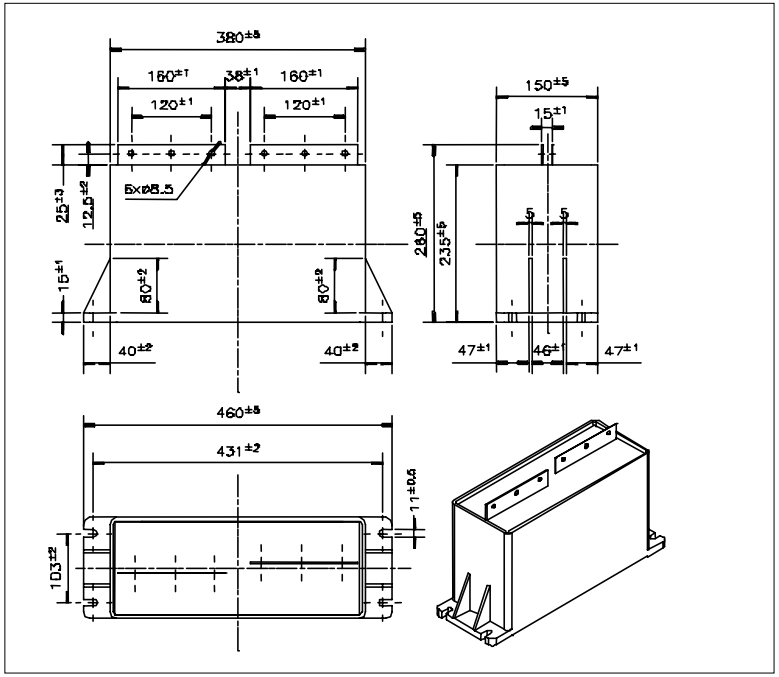
Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P5X - … Series

High capacitance, low inductance connections





Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working Frequency**	Weight	Box qty
	C (µF)	Un (V)	Urms	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (m Ω)	Rthn (°C/W)	(kHz)	(kg)	(pcs)
LNK-P5X-8000-70	8000	700	200	1400	300	4	<30	0.14	1.15	20	18	1
LNK-P5X-5000-90	5000	900	250	1800	300	4	<30	0.18	1.15	20	18	1
LNK-P5X-4200-100	4200	1000	300	2000	250	4	<30	0.19	1.15	20	18	1
LNK-P5X-3500-110	3500	1100	350	2200	250	5	<30	0.21	1.15	20	18	1
LNK-P5X-2600-125	2600	1250	420	2500	250	7	<30	0.24	1.15	20	18	1
LNK-P5X-2000-145	2000	1450	420	2900	200	8	<30	0.28	1.15	20	18	1
LNK-P5X-1600-160	1600	1600	420	3200	200	10	<30	0.31	1.15	20	18	1
LNK-P5X-1300-180	1300	1800	450	3600	200	10	<30	0.34	1.15	20	18	1
LNK-P5X-1000-200	1000	2000	600	4000	250	25	<30	0.19	1.15	20	18	1
LNK-P5X-850-220	850	2200	700	4400	250	30	<30	0.21	1.15	20	18	1
LNK-P5X-650-250	650	2500	800	5000	250	30	<30	0.23	1.15	20	18	1
LNK-P5X-500-290	500	2900	850	5800	200	38	<30	0.27	1.15	20	18	1
LNK-P5X-400-320	400	3200	900	6400	200	40	<30	0.3	1.15	20	18	1
LNK-P5X-300-360	300	3600	950	7200	200	45	<30	0.36	1.15	20	18	1

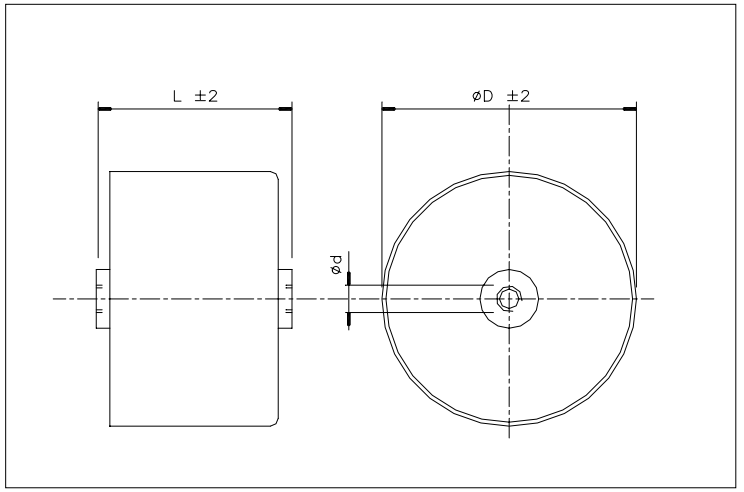
** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P6X - … Series

Axial, very low inductance



Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working Frequency**	Tightening Torque	Weight	d	D	L	Box qty
	C (µF)	Un (V)	Urms (V)	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (mΩ)	Rthn (°C/W)	(kHz)	(Nm)	(kg)	(mm)	(mm)	(mm)	(pcs)
LNK-P6X-90-70	90	700	200	1400	80	30	10	0.7	3.5	30	6	0.27	M6	70	59	25
LNK-P6X-125-70	125	700	200	1400	80	30	10	0.5	3	30	10	0.41	M8	80	62	16
LNK-P6X-150-70	150	700	200	1400	80	30	10	0.4	2.5	30	10	0.47	M8	90	62	16
LNK-P6X-50-90	50	900	250	1700	50	30	10	1	3.5	30	6	0.27	M6	70	59	25
LNK-P6X-75-90	75	900	250	1700	70	30	10	0.7	3	30	10	0.41	M8	80	62	16
LNK-P6X-100-90	100	900	250	1700	80	30	10	0.5	2.5	30	10	0.47	M8	90	62	16
LNK-P6X-33-110	33	1100	350	2200	45	40	10	1.3	3.5	30	6	0.27	M6	70	59	25
LNK-P6X-50-110	50	1100	350	2200	55	40	10	0.9	3	30	10	0.41	M8	80	62	16
LNK-P6X-66-110	66	1100	350	2200	75	40	10	0.6	2.5	30	10	0.47	M8	90	62	16
LNK-P6X-30-125	30	1250	400	2500	30	50	10	1.6	3.5	30	6	0.27	M6	70	59	25
LNK-P6X-40-125	40	1250	400	2500	40	50	10	1.1	3	30	10	0.41	M8	80	62	16
LNK-P6X-50-125	50	1250	400	2500	50	50	10	0.8	2.5	30	10	0.47	M8	90	62	16
LNK-P6X-20-145	20	1450	400	2900	40	110	10	1.6	3.5	30	6	0.27	M6	70	59	25
LNK-P6X-30-145	30	1450	400	2900	50	110	10	1.1	3	30	10	0.41	M8	80	62	16
LNK-P6X-40-145	40	1450	400	2900	65	110	10	0.8	2.5	30	10	0.47	M8	90	62	16
LNK-P6X-15-180	15	1800	450	3600	40	130	10	1.7	3.5	30	6	0.27	M6	70	59	25
LNK-P6X-20-180	20	1800	450	3600	50	130	10	1.3	3	30	10	0.41	M8	80	62	16
LNK-P6X-25-180	25	1800	450	3600	60	130	10	1	2.5	30	10	0.47	M8	90	62	16

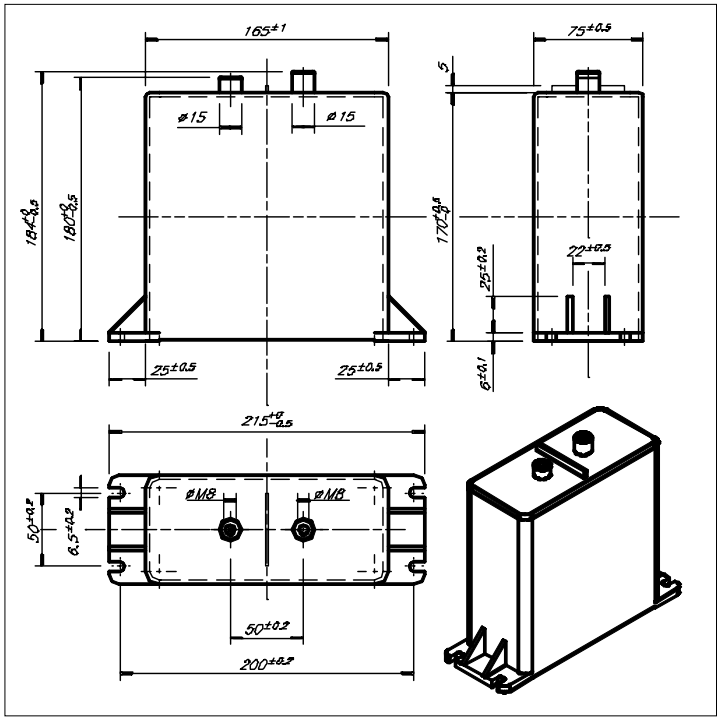
** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P7X - … Series

High current, low inductance, for busbars connections



Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with Natural cooling	Full current Max Working Frequency**	Tightening Torque	Weight	Box qty
	C (µF)	Un (V)	Urms (V)	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (mΩ)	Rthn (°C/W)	(kHz)	(Nm)	(kg)	(pcs)
LNK-P7X-1200-70	1200	700	200	1400	180	10	30	0.22	2.02	20	12	2.9	8
LNK-P7X-750-90	750	900	250	1800	155	10	30	0.28	2.02	20	12	2.9	8
LNK-P7X-600-100	600	1000	300	2000	150	13	30	0.32	2.02	20	12	2.9	8
LNK-P7X-500-110	500	1100	350	2200	145	14	30	0.35	2.02	20	12	2.9	8
LNK-P7X-400-125	400	1250	400	2500	140	17	30	0.38	2.02	20	12	2.9	8
LNK-P7X-300-145	300	1450	400	2900	130	19	30	0.44	2.02	20	12	2.9	8
LNK-P7X-200-180	200	1800	450	3600	120	24	30	0.53	2.02	20	12	2.9	8

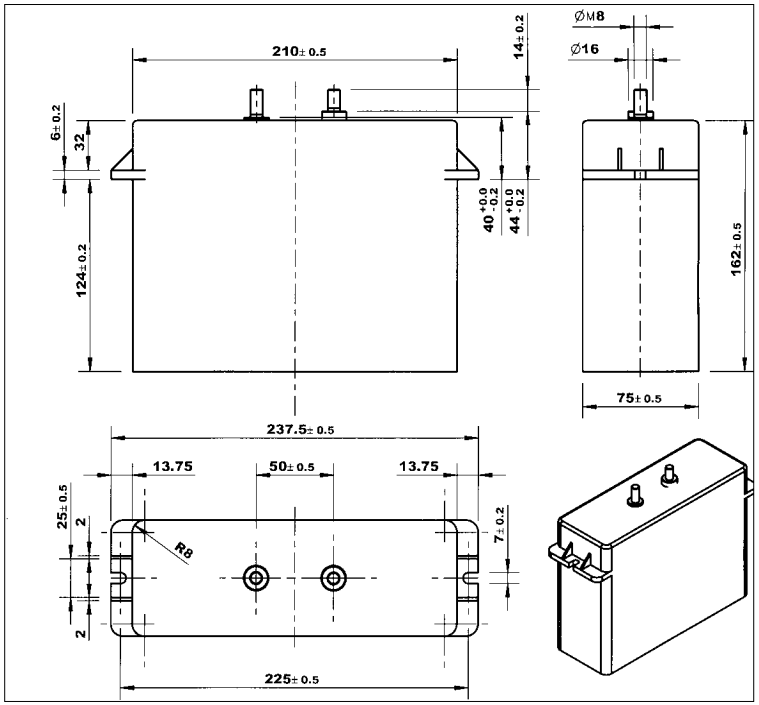
** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P8X - … Series

Sturdy construction for busbars connections



Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with Natural cooling	Full current Max Working Frequency**	Tightening Torque	Weight	Box qty
	C (µF)	Un (V)	Urms (V)	Us (V)	(A)	(V / µs)	L (nH)	Rs (mΩ)	Rthn (C/W)	(KHz)	(Nm)	(kg)	(pcs)
LNK-P8X-1500-70	1500	700	200	1400	180	10	30	0.22	1.8	20	12	3.6	6
LNK-P8X-850-90	850	900	250	1800	155	12	30	0.27	1.8	20	12	3.6	6
LNK-P8X-700-100	700	1000	300	2000	150	13	30	0.30	1.8	20	12	3.6	6
LNK-P8X-600-110	600	1100	350	2200	145	14	30	0.31	1.8	20	12	3.6	6
LNK-P8X-430-125	430	1250	400	2500	140	17	30	0.36	1.8	20	12	3.6	6
LNK-P8X-330-145	330	1450	400	2900	130	19	30	0.40	1.8	20	12	3.6	6
LNK-P8X-200-180	200	1800	450	3600	120	24	30	0.51	1.8	20	12	3.6	6

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

WARNING

DO NOT MISAPPLY CAPACITORS FOR POWER ELECTRONICS

Icar spa is not responsible for any kind of possible damages to persons or things, derived from the improper installation and application of Power Electronics capacitors.

Most common misapplication forms:

- Ripple current beyond specification or not according with the maximum power that can be dissipated.
- Surge or working voltage beyond specified value.
- Hot spot or storage temperature beyond the specified limits or not according with the maximum power that can be dissipated.
- Incorrect mounting or wrong installation
  - installation nearby hot components or heat sources
  - not suitable connections (not adequate cable or busbars cross section)
  - nuts and washers material, shape or size not suitable for the application
  - tightening torque not according to the specification
- Unusual service conditions as :
  - mechanical shock and vibrations,
  - corrosive or abrasive conductive parts in cooling air,
  - oil or water vapour or corrosive substances,
  - explosive gas or dust,
  - radioactivity,
  - excessive and fast variations of ambient conditions,
  - service areas higher than 2000 m above sea level.

Periodic check of the connection conditions and tightening torque is strongly recommended.

In case of doubt in choice or in performances of the capacitors Icar technical service **MUST** be contacted.

Personal Safety :

Electrical or mechanical misapplication of Power Electronics Capacitors may become hazardous. Personal injury or property damage may result from disruption of the capacitor and consequent expulsion of melted material.
Before using the capacitors in any application, please read carefully the technical information contained in this catalogue.
The energy stored in a capacitor may become lethal**,** to prevent any chance of shock the capacitor should be discharged before handling.
Special attention must be taken to make sure the capacitors are correctly used for each application and that warnings and instructions are followed

ICAR PRODUCTS

ICAR provides a first class service in the following products:

- **Power Electronics Capacitors;**
- **Metallized polypropylene film capacitors for lighting and motor running;**
- **Power factor correction capacitors low and high voltage;**
- **Automatic power factor correction banks with harmonics filtering;**
- **Coupling capacitors and Capacitive Voltage Transformers (CVT);**
- **Energy storage and pulse capacitors ;**
- **RFI / EMI Filters.**

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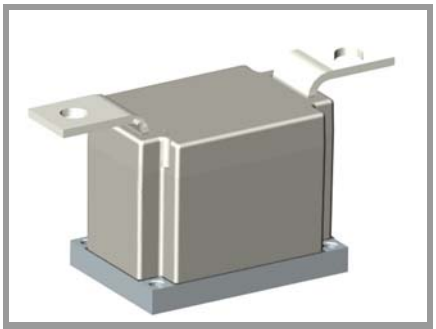
SKKE 1200/22 H4



SEMIPACK® 6

Rectifier Diode Modules

SKKE 1200/22 H4

Features

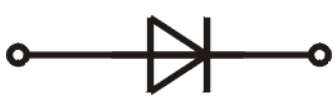
- Precisious metal pressure contacts for high reliability
- UL recognized, file no. E 63 532

Typical Applications*

- Rectifiers

Absolute Maximum Ratings				
Symbol	**Conditions**		**Values**	**Unit**
Recitifier Diode				
I_{FAV}	sin. 180°	T_c = 85 °C	1376	A
		T_c = 100 °C	1180	A
I_{FSM}	10 ms	T_j = 25 °C	45000	A
		T_j = 160 °C	40000	A
i^2t	10 ms	T_j = 25 °C	10125000	A^2s
		T_j = 160 °C	8000000	A^2s
V_{RSM}			2200	V
V_{RRM}			2200	V
T_j			-40 ... 160	°C
Module				
T_{stg}			-40 ... 125	°C
V_{isol}	a.c.; 50 Hz; r.m.s.	1 min	4000	V
		1 s	4800	V

Characteristics						
Symbol	**Conditions**		**min.**	**typ.**	**max.**	**Unit**
Diode						
V_F	T_j = 25 °C, I_F = 3000 A				1.40	V
$V_{(TO)}$	T_j = 160 °C				0.72	V
r_T	T_j = 160 °C				0.19	mΩ
I_{RD}	T_j = 160 °C, V_{RD} = V_{RRM}				60	mA
$R_{th(j-c)}$	cont.	per chip			0.0385	K/W
		per module			0.0385	K/W
$R_{th(j-c)}$	sin. 180°	per chip			0.04	K/W
		per module			0.04	K/W
Module						
$R_{th(c-s)}$	chip				0.01	K/W
	module				0.01	K/W
M_s	to heatsink M6		5.1		6.9	Nm
M_t	to terminal M12		15.3		20.7	Nm
a					5 * 9,81	m/s^2
w				2150		g



SKKE

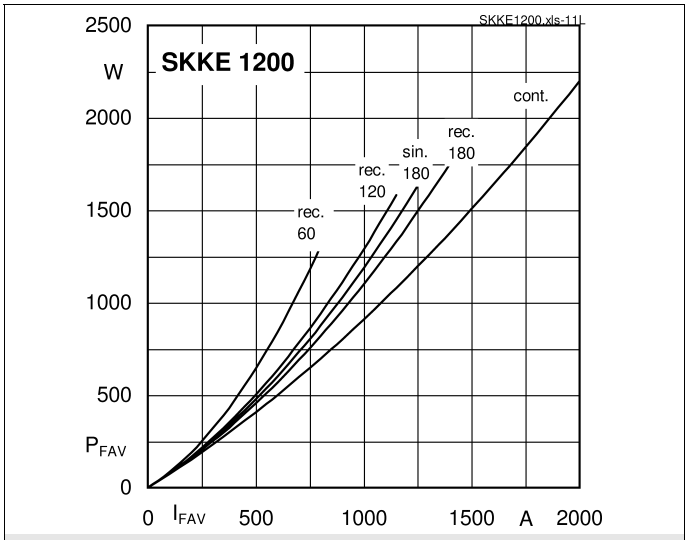


Fig. 11L: Power dissipation per diode vs. forward current

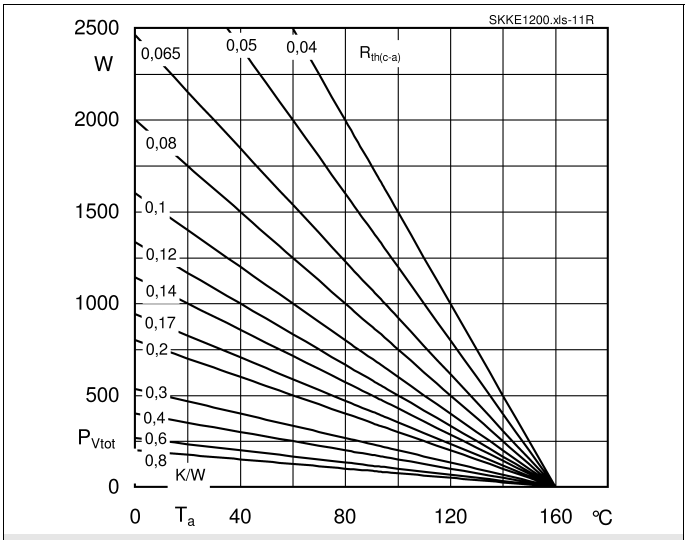


Fig. 11R: Power dissipation per diode vs. ambient temperature

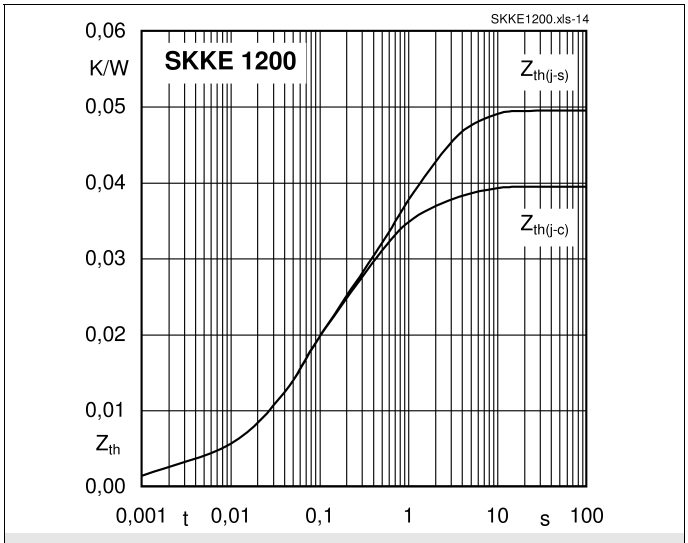


Fig. 14: Transient thermal impedance vs. time

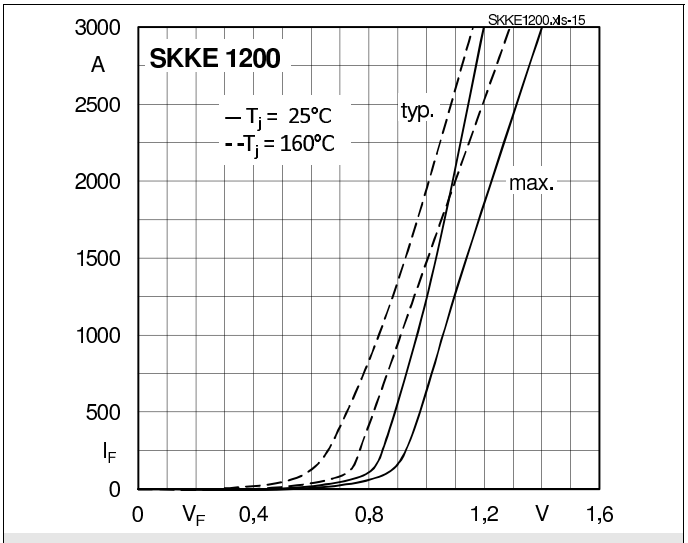


Fig. 15: Forward characteristics

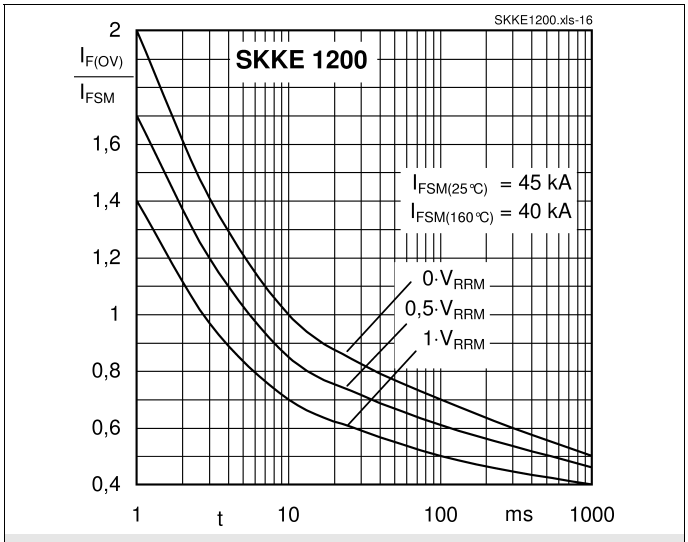
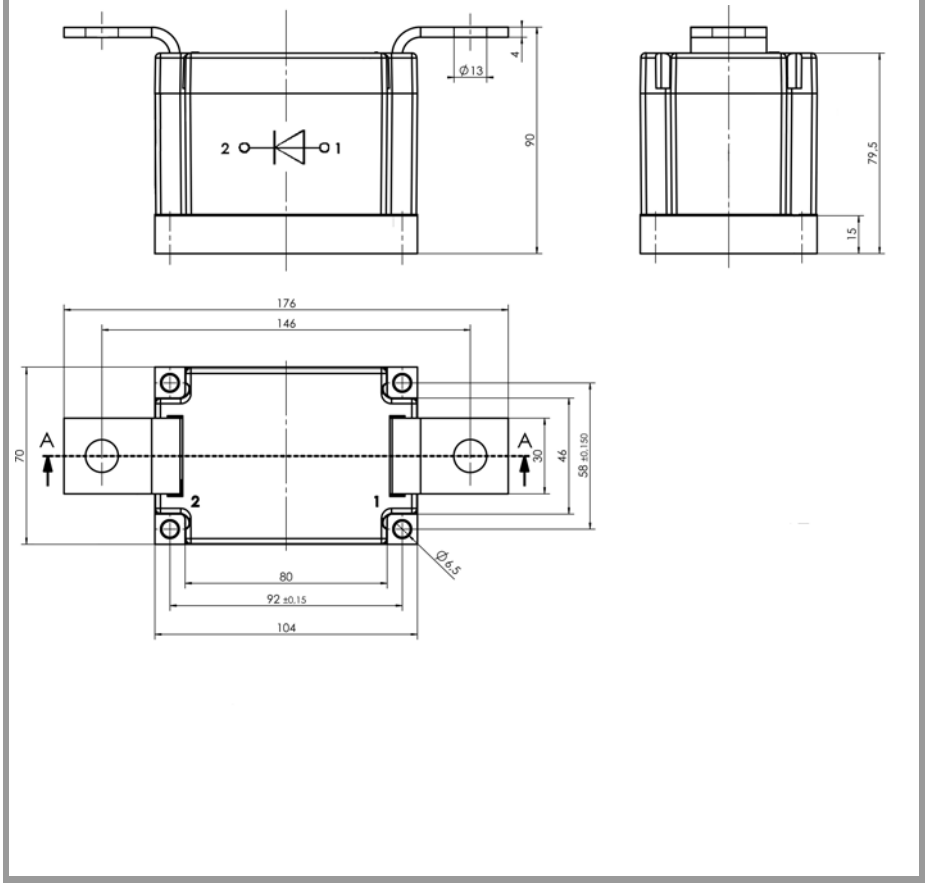


Fig. 16: Surge overload current vs. time

SKKE 1200/22 H4



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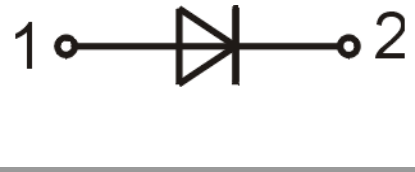


SKKE

This is an electrostatic discharge sensitive device (ESDS), international standard IEC 60747-1, Chapter IX

* The specifications of our components may not be considered as an assurance of component characteristics. Components have to be tested for the respective application. Adjustments may be necessary. The use of SEMIKRON products in life support appliances and systems is subject to prior specification and written approval by SEMIKRON. We therefore strongly recommend prior consultation of our staff.

Film Capacitors

Metallized Polypropylene Film Capacitors (MKP)

Series/Type: **B32656S**
Date: December 2012

Typical applications
- IGBT
- Snubbering

Climatic
- Max. operating temperature: 110 °C
- Climatic category (IEC 60068-1): 55/100/56

Construction
- Dielectric: polypropylene (PP)
- Wound capacitor technology with internal series connection
- Plastic case (UL 94 V-0)
- Epoxy resin sealing (UL 94 V-0)

Features
- High pulse strength and high contact reliability
- Very low inductance
- RoHS-compatible
- Halogen-free capacitors available on request

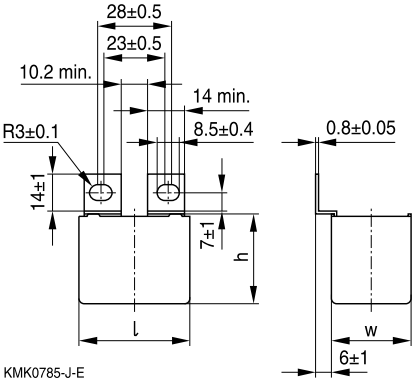
Terminals
- Strap terminals, tinned copper or brass (max. torque 10 Nm)

Marking
Manufacturer's logo, ordering code, style (MKP)
rated capacitance (coded), cap. tolerance (code letter),
rated DC voltage, date of manufacture (coded)

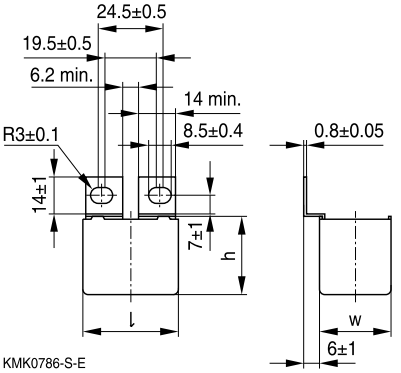
Delivery mode
Bulk (untaped)

Dimensional drawings

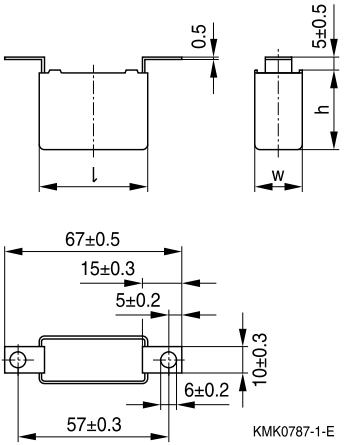
T1 (code no. 561)



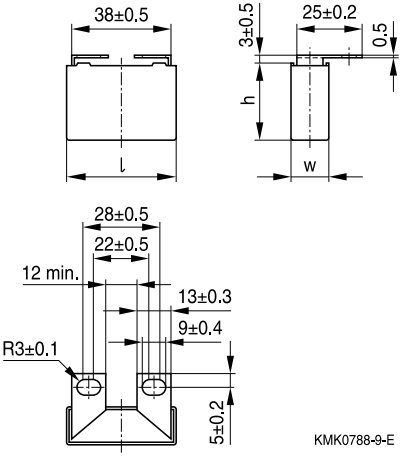
T2 (code no. 562)



T3 (code no. 563)

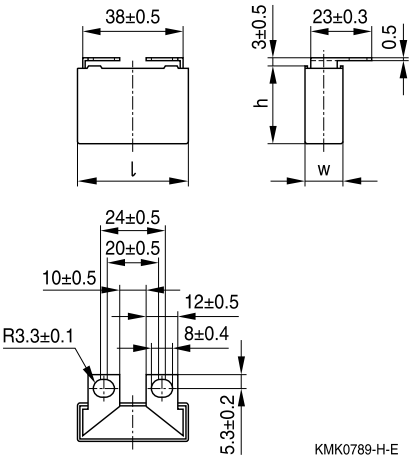


T4 (code no. 564)

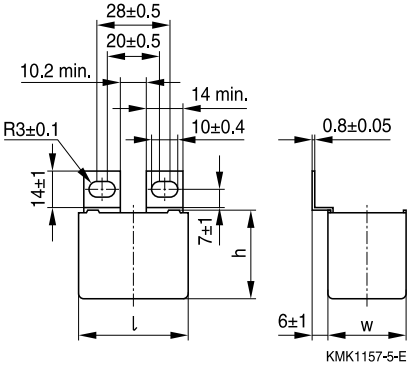


Dimensional drawings (continued)

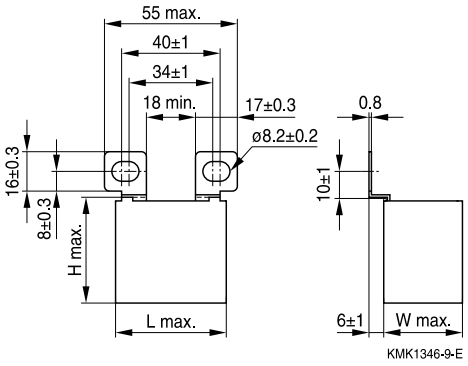
T5 (code no. 565)

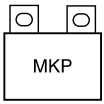


T6 (code no. 566)



T7 (code no. 577)





Overview of available types

Type	B32656S				
V_R (V DC)	850	1000	1250	1600	2000
V_{RMS} (V AC)	450	480	500	750	800
C_R (nF)					
47					
68					
100					
120					
150					
220					
270					
330					
390					
470					
560					
680					
820					
1000					
1200					
1500					
1800					
2200					
2700					
3300					

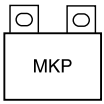
Electrical specifications, ordering codes and packing units

V_R V DC	V_{RMS} f≤1kHz V AC	C_R nF	Max. dimensions w × h × l mm	I_{RMS} 100 kHz A	ESR 100 kHz mΩ	Ordering code (composition see below)	Ter-minal	pcs./ MOQ
850	450	220	12.0 × 22.5 × 42.0	5	10.0	B32656S8224+563	T3	224
		220	12.0 × 22.5 × 42.0	5	10.0	B32656S8224+564	T4	384
		270	12.0 × 22.5 × 42.0	6	9.0	B32656S8274+563	T3	224
		270	12.0 × 22.5 × 42.0	6	9.0	B32656S8274+564	T4	384
		330	12.0 × 22.5 × 42.0	6	9.0	B32656S8334+563	T3	224
		330	12.0 × 22.5 × 42.0	6	9.0	B32656S8334+564	T4	384
		390	12.0 × 22.5 × 42.0	7	8.0	B32656S8394+563	T3	224
		390	12.0 × 22.5 × 42.0	7	8.0	B32656S8394+564	T4	384
		470	12.0 × 22.5 × 42.0	8	8.0	B32656S8474+563	T3	224
		470	12.0 × 22.5 × 42.0	8	8.0	B32656S8474+564	T4	384
		560	14.0 × 25.0 × 42.0	8	7.0	B32656S8564+563	T3	168
		560	14.0 × 25.0 × 42.0	8	7.0	B32656S8564+564	T4	288
		560	14.0 × 25.0 × 42.0	8	7.0	B32656S8564+565	T5	288
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+561	T1	192
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+562	T2	192
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+563	T3	144
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+564	T4	192
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+565	T5	192
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+566	T6	192
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+577	T7	180
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+561	T1	192
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+562	T2	192
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+563	T3	144
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+564	T4	192
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+565	T5	192
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+566	T6	192
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+577	T7	180

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%



Electrical specifications, ordering codes and packing units

V_R V DC	V_{RMS} f≤1kHz V AC	C_R nF	Max. dimensions w × h × l mm	I_{RMS} 100 kHz A	ESR 100 kHz mΩ	Ordering code (composition see below)	Ter-minal	pcs./ MOQ
850	450	1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+561	T1	168
		1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+562	T2	168
		1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+563	T3	144
		1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+564	T4	128
		1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+565	T5	128
		1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+566	T6	168
		1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+577	T7	156
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+561	T1	168
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+562	T2	168
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+563	T3	144
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+564	T4	128
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+565	T5	128
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+566	T6	168
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+577	T7	156
		1500	31.0 × 26.5 × 43.6	13	5.0	B32656S8155+561	T1	128
		1500	31.0 × 26.5 × 43.6	13	5.0	B32656S8155+562	T2	128
		1500	31.0 × 26.5 × 43.6	13	5.0	B32656S8155+563	T3	72
		1500	31.0 × 26.5 × 43.6	13	5.0	B32656S8155+566	T6	128
		1500	31.0 × 26.5 × 43.6	13	5.0	B32656S8155+577	T7	84
		1800	28.0 × 37.0 × 42.0	15	4.5	B32656S8185+561	T1	108
		1800	28.0 × 37.0 × 42.0	15	4.5	B32656S8185+562	T2	108
		1800	28.0 × 37.0 × 42.0	15	4.5	B32656S8185+563	T3	96
		1800	28.0 × 37.0 × 42.0	15	4.5	B32656S8185+566	T6	108
		1800	28.0 × 37.0 × 42.0	15	4.5	B32656S8185+577	T7	96
		2200	30.0 × 45.0 × 42.0	17	3.5	B32656S8225+561	T1	48
		2200	30.0 × 45.0 × 42.0	17	3.5	B32656S8225+562	T2	48
		2200	30.0 × 45.0 × 42.0	17	3.5	B32656S8225+563	T3	96
		2200	30.0 × 45.0 × 42.0	17	3.5	B32656S8225+566	T6	48
		2200	30.0 × 45.0 × 42.0	17	3.5	B32656S8225+577	T7	96

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%

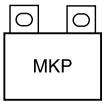
Electrical specifications, ordering codes and packing units

V_R V DC	V_{RMS} f≤1kHz V AC	C_R nF	Max. dimensions w × h × l mm	I_{RMS} 100 kHz A	ESR 100 kHz mΩ	Ordering code (composition see below)	Ter-minal	pcs./ MOQ
850	450	2700	30.0 × 45.0 × 42.0	20	3.0	B32656S8275+561	T1	48
		2700	30.0 × 45.0 × 42.0	20	3.0	B32656S8275+562	T2	48
		2700	30.0 × 45.0 × 42.0	20	3.0	B32656S8275+563	T3	96
		2700	30.0 × 45.0 × 42.0	20	3.0	B32656S8275+566	T6	48
		2700	30.0 × 45.0 × 42.0	20	3.0	B32656S8275+577	T7	96
		3300	33.0 × 48.0 × 43.0	23	2.5	B32656S8335+561	T1	84
		3300	33.0 × 48.0 × 43.0	23	2.5	B32656S8335+562	T2	84
		3300	33.0 × 48.0 × 43.0	23	2.5	B32656S8335+563	T3	64
		3300	33.0 × 48.0 × 43.0	23	2.5	B32656S8335+566	T6	84
		3300	33.0 × 48.0 × 43.0	23	2.5	B32656S8335+577	T7	84
1000	480	220	12.0 × 22.5 × 42.0	6	10.0	B32656S0224+563	T3	224
		220	12.0 × 22.5 × 42.0	6	10.0	B32656S0224+564	T4	384
		270	12.0 × 22.5 × 42.0	7	9.0	B32656S0274+563	T3	224
		270	12.0 × 22.5 × 42.0	7	9.0	B32656S0274+564	T4	384
		330	14.0 × 25.0 × 42.0	7	9.0	B32656S0334+563	T3	168
		330	14.0 × 25.0 × 42.0	7	9.0	B32656S0334+564	T4	288
		330	14.0 × 25.0 × 42.0	7	9.0	B32656S0334+565	T5	288
		390	14.0 × 25.0 × 42.0	8	8.0	B32656S0394+563	T3	168
		390	14.0 × 25.0 × 42.0	8	8.0	B32656S0394+564	T4	288
		390	14.0 × 25.0 × 42.0	8	8.0	B32656S0394+565	T5	288
		470	14.0 × 25.0 × 42.0	9	8.0	B32656S0474+563	T3	168
		470	14.0 × 25.0 × 42.0	9	8.0	B32656S0474+564	T4	288
		470	14.0 × 25.0 × 42.0	9	8.0	B32656S0474+565	T5	288
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+561	T1	192
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+562	T2	192
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+563	T3	144
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+564	T4	192
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+565	T5	192
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+566	T6	192
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+577	T7	180

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%



Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
1000	480	680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+561	T1	192
		680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+562	T2	192
		680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+563	T3	144
		680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+564	T4	192
		680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+565	T5	192
		680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+566	T6	192
		680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+577	T7	180
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+561	T1	168
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+562	T2	168
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+563	T3	144
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+564	T4	128
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+565	T5	128
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+566	T6	168
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+577	T7	156
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+561	T1	96
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+562	T2	96
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+563	T3	104
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+564	T4	96
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+565	T5	96
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+566	T6	96
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+577	T7	144
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+561	T1	96
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+562	T2	96
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+563	T3	104
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+564	T4	96
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+565	T5	96
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+566	T6	96
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+577	T7	144

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%

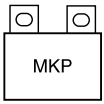
Electrical specifications, ordering codes and packing units

V_R V DC	V_{RMS} f≤1kHz V AC	C_R nF	Max. dimensions w × h × l mm	I_{RMS} 100 kHz A	ESR 100 kHz mΩ	Ordering code (composition see below)	Ter-minal	pcs./ MOQ
1000	480	1500	30.0 × 45.0 × 42.0	15	5.0	B32656S0155+561	T1	48
		1500	30.0 × 45.0 × 42.0	15	5.0	B32656S0155+562	T2	48
		1500	30.0 × 45.0 × 42.0	15	5.0	B32656S0155+563	T3	96
		1500	30.0 × 45.0 × 42.0	15	5.0	B32656S0155+566	T6	48
		1500	30.0 × 45.0 × 42.0	15	5.0	B32656S0155+577	T7	96
		1800	30.0 × 45.0 × 42.0	16	4.5	B32656S0185+561	T1	48
		1800	30.0 × 45.0 × 42.0	16	4.5	B32656S0185+562	T2	48
		1800	30.0 × 45.0 × 42.0	16	4.5	B32656S0185+563	T3	96
		1800	30.0 × 45.0 × 42.0	16	4.5	B32656S0185+566	T6	48
		1800	30.0 × 45.0 × 42.0	16	4.5	B32656S0185+577	T7	96
		2200	30.0 × 45.0 × 42.0	19	3.5	B32656S0225+561	T1	48
		2200	30.0 × 45.0 × 42.0	19	3.5	B32656S0225+562	T2	48
		2200	30.0 × 45.0 × 42.0	19	3.5	B32656S0225+563	T3	96
		2200	30.0 × 45.0 × 42.0	19	3.5	B32656S0225+566	T6	48
		2200	30.0 × 45.0 × 42.0	19	3.5	B32656S0225+577	T7	96
		2700	33.0 × 48.0 × 43.0	23	2.5	B32656S0275+561	T1	84
		2700	33.0 × 48.0 × 43.0	23	2.5	B32656S0275+562	T2	84
		2700	33.0 × 48.0 × 43.0	23	2.5	B32656S0275+563	T3	64
		2700	33.0 × 48.0 × 43.0	23	2.5	B32656S0275+566	T6	84
		2700	33.0 × 48.0 × 43.0	23	2.5	B32656S0275+577	T7	84
1250	500	120	12.0 × 22.5 × 42.0	5	15.0	B32656S7124+563	T3	224
		120	12.0 × 22.5 × 42.0	5	15.0	B32656S7124+564	T4	384
		150	12.0 × 22.5 × 42.0	6	15.0	B32656S7154+563	T3	224
		150	12.0 × 22.5 × 42.0	6	15.0	B32656S7154+564	T4	384
		220	14.0 × 25.0 × 42.0	8	10.0	B32656S7224+563	T3	168
		220	14.0 × 25.0 × 42.0	8	10.0	B32656S7224+564	T4	288
		220	14.0 × 25.0 × 42.0	8	10.0	B32656S7224+565	T5	288
		270	14.0 × 25.0 × 42.0	8	9.0	B32656S7274+563	T3	168
		270	14.0 × 25.0 × 42.0	8	9.0	B32656S7274+564	T4	288
		270	14.0 × 25.0 × 42.0	8	9.0	B32656S7274+565	T5	288

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%



Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
1250	500	330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+561	T1	192
		330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+562	T2	192
		330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+563	T3	144
		330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+564	T4	192
		330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+565	T5	192
		330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+566	T6	192
		330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+577	T7	180
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+561	T1	168
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+562	T2	168
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+563	T3	144
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+564	T4	128
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+565	T5	128
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+566	T6	168
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+577	T7	156
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+561	T1	168
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+562	T2	168
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+563	T3	144
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+564	T4	128
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+565	T5	128
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+566	T6	168
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+577	T7	156
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+561	T1	96
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+562	T2	96
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+563	T3	104
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+564	T4	96
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+565	T5	96
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+566	T6	96
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+577	T7	144

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%

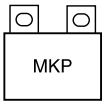
Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
1250	500	680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+561	T1	96
		680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+562	T2	96
		680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+563	T3	104
		680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+564	T4	96
		680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+565	T5	96
		680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+566	T6	96
		680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+577	T7	144
		820	28.0 × 37.0 × 42.0	13	6.0	B32656S7824+561	T1	108
		820	28.0 × 37.0 × 42.0	13	6.0	B32656S7824+562	T2	108
		820	28.0 × 37.0 × 42.0	13	6.0	B32656S7824+563	T3	72
		820	28.0 × 37.0 × 42.0	13	6.0	B32656S7824+566	T6	108
		820	28.0 × 37.0 × 42.0	13	6.0	B32656S7824+577	T7	96
		1000	28.0 × 37.0 × 42.0	15	6.0	B32656S7105+561	T1	108
		1000	28.0 × 37.0 × 42.0	15	6.0	B32656S7105+562	T2	108
		1000	28.0 × 37.0 × 42.0	15	6.0	B32656S7105+563	T3	72
		1000	28.0 × 37.0 × 42.0	15	6.0	B32656S7105+566	T6	108
		1000	28.0 × 37.0 × 42.0	15	6.0	B32656S7105+577	T7	96
		1200	30.0 × 45.0 × 42.0	16	5.0	B32656S7125+561	T1	48
		1200	30.0 × 45.0 × 42.0	16	5.0	B32656S7125+562	T2	48
		1200	30.0 × 45.0 × 42.0	16	5.0	B32656S7125+563	T3	72
		1200	30.0 × 45.0 × 42.0	16	5.0	B32656S7125+566	T6	48
		1200	30.0 × 45.0 × 42.0	16	5.0	B32656S7125+577	T7	96
		1500	30.0 × 45.0 × 42.0	18	4.0	B32656S7155+561	T1	48
		1500	30.0 × 45.0 × 42.0	18	4.0	B32656S7155+562	T2	48
		1500	30.0 × 45.0 × 42.0	18	4.0	B32656S7155+563	T3	72
		1500	30.0 × 45.0 × 42.0	18	4.0	B32656S7155+566	T6	48
		1500	30.0 × 45.0 × 42.0	18	4.0	B32656S7155+577	T7	96
		1800	33.0 × 48.0 × 43.0	22	3.0	B32656S7185+561	T1	84
		1800	33.0 × 48.0 × 43.0	22	3.0	B32656S7185+562	T2	84
		1800	33.0 × 48.0 × 43.0	22	3.0	B32656S7185+563	T3	64
		1800	33.0 × 48.0 × 43.0	22	3.0	B32656S7185+566	T6	84
		1800	33.0 × 48.0 × 43.0	22	3.0	B32656S7185+577	T7	84

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%



Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
1600	750	68	12.0 × 22.5 × 42.0	5	25.0	B32656S1683+563	T3	224
		68	12.0 × 22.5 × 42.0	5	25.0	B32656S1683+564	T4	384
		100	12.0 × 22.5 × 42.0	6	20.0	B32656S1104+563	T3	224
		100	12.0 × 22.5 × 42.0	6	20.0	B32656S1104+564	T4	384
		120	14.0 × 25.0 × 42.0	6	15.0	B32656S1124+563	T3	168
		120	14.0 × 25.0 × 42.0	6	15.0	B32656S1124+564	T4	288
		120	14.0 × 25.0 × 42.0	6	15.0	B32656S1124+565	T5	288
		150	14.0 × 25.0 × 42.0	7	15.0	B32656S1154+563	T3	168
		150	14.0 × 25.0 × 42.0	7	15.0	B32656S1154+564	T4	288
		150	14.0 × 25.0 × 42.0	7	15.0	B32656S1154+565	T5	288
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+561	T1	192
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+562	T2	192
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+563	T3	144
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+564	T4	192
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+565	T5	192
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+566	T6	192
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+577	T7	180
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+561	T1	168
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+562	T2	168
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+563	T3	144
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+564	T4	128
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+565	T5	128
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+566	T6	168
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+577	T7	156
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+561	T1	96
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+562	T2	96
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+563	T3	104
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+564	T4	96
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+565	T5	96
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+566	T6	96
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+577	T7	144

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%

Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
1600	750	390	28.0 × 37.0 × 42.0	13	8.0	B32656S1394+561	T1	108
		390	28.0 × 37.0 × 42.0	13	8.0	B32656S1394+562	T2	108
		390	28.0 × 37.0 × 42.0	13	8.0	B32656S1394+563	T3	72
		390	28.0 × 37.0 × 42.0	13	8.0	B32656S1394+566	T6	108
		390	28.0 × 37.0 × 42.0	13	8.0	B32656S1394+577	T7	96
		470	28.0 × 37.0 × 42.0	14	8.0	B32656S1474+561	T1	108
		470	28.0 × 37.0 × 42.0	14	8.0	B32656S1474+562	T2	108
		470	28.0 × 37.0 × 42.0	14	8.0	B32656S1474+563	T3	72
		470	28.0 × 37.0 × 42.0	14	8.0	B32656S1474+566	T6	108
		470	28.0 × 37.0 × 42.0	14	8.0	B32656S1474+577	T7	96
		560	30.0 × 45.0 × 42.0	15	7.0	B32656S1564+561	T1	48
		560	30.0 × 45.0 × 42.0	15	7.0	B32656S1564+562	T2	48
		560	30.0 × 45.0 × 42.0	15	7.0	B32656S1564+563	T3	72
		560	30.0 × 45.0 × 42.0	15	7.0	B32656S1564+566	T6	48
		560	30.0 × 45.0 × 42.0	15	7.0	B32656S1564+577	T7	96
		680	30.0 × 45.0 × 42.0	17	6.0	B32656S1684+561	T1	48
		680	30.0 × 45.0 × 42.0	17	6.0	B32656S1684+562	T2	48
		680	30.0 × 45.0 × 42.0	17	6.0	B32656S1684+563	T3	72
		680	30.0 × 45.0 × 42.0	17	6.0	B32656S1684+566	T6	48
		680	30.0 × 45.0 × 42.0	17	6.0	B32656S1684+577	T7	96
		820	33.0 × 48.0 × 43.0	20	4.5	B32656S1824+561	T1	84
		820	33.0 × 48.0 × 43.0	20	4.5	B32656S1824+562	T2	84
		820	33.0 × 48.0 × 43.0	20	4.5	B32656S1824+563	T3	64
		820	33.0 × 48.0 × 43.0	20	4.5	B32656S1824+566	T6	84
		820	33.0 × 48.0 × 43.0	20	4.5	B32656S1824+577	T7	84

MOQ = Minimum Order Quantity, consisting of 4 packing units.
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Composition of ordering code

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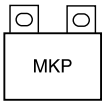
K = ±10%
J = ±5%



Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
2000	800	47	12.0 × 22.5 × 42.0	5	35.0	B32656S2473+563	T3	224
		47	12.0 × 22.5 × 42.0	5	35.0	B32656S2473+564	T4	384
		68	14.0 × 25.0 × 42.0	6	25.0	B32656S2683+563	T3	192
		68	14.0 × 25.0 × 42.0	6	25.0	B32656S2683+564	T4	288
		68	14.0 × 25.0 × 42.0	6	25.0	B32656S2683+565	T5	288
		100	14.0 × 25.0 × 42.0	7	20.0	B32656S2104+563	T3	192
		100	14.0 × 25.0 × 42.0	7	20.0	B32656S2104+564	T4	288
		100	14.0 × 25.0 × 42.0	7	20.0	B32656S2104+565	T5	288
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+561	T1	192
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+562	T2	192
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+563	T3	144
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+564	T4	192
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+565	T5	192
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+566	T6	192
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+577	T7	180
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+561	T1	168
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+562	T2	168
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+563	T3	160
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+564	T4	192
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+565	T5	192
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+566	T6	168
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+577	T7	156
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+561	T1	96
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+562	T2	96
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+563	T3	104
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+564	T4	96
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+565	T5	96
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+566	T6	96
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+577	T7	144

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%

Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
2000	800	270	28.0 × 37.0 × 42.0	13	9.0	B32656S2274+561	T1	108
		270	28.0 × 37.0 × 42.0	13	9.0	B32656S2274+562	T2	108
		270	28.0 × 37.0 × 42.0	13	9.0	B32656S2274+563	T3	72
		270	28.0 × 37.0 × 42.0	13	9.0	B32656S2274+566	T6	108
		270	28.0 × 37.0 × 42.0	13	9.0	B32656S2274+577	T7	96
		330	28.0 × 37.0 × 42.0	14	9.0	B32656S2334+561	T1	108
		330	28.0 × 37.0 × 42.0	14	9.0	B32656S2334+562	T2	108
		330	28.0 × 37.0 × 42.0	14	9.0	B32656S2334+563	T3	72
		330	28.0 × 37.0 × 42.0	14	9.0	B32656S2334+566	T6	108
		330	28.0 × 37.0 × 42.0	14	9.0	B32656S2334+577	T7	96
		390	30.0 × 45.0 × 42.0	15	8.0	B32656S2394+561	T1	48
		390	30.0 × 45.0 × 42.0	15	8.0	B32656S2394+562	T2	48
		390	30.0 × 45.0 × 42.0	15	8.0	B32656S2394+563	T3	72
		390	30.0 × 45.0 × 42.0	15	8.0	B32656S2394+566	T6	48
		390	30.0 × 45.0 × 42.0	15	8.0	B32656S2394+577	T7	96
		470	30.0 × 45.0 × 42.0	17	8.0	B32656S2474+561	T1	48
		470	30.0 × 45.0 × 42.0	17	8.0	B32656S2474+562	T2	48
		470	30.0 × 45.0 × 42.0	17	8.0	B32656S2474+563	T3	72
		470	30.0 × 45.0 × 42.0	17	8.0	B32656S2474+566	T6	48
		470	30.0 × 45.0 × 42.0	17	8.0	B32656S2474+577	T7	96
		560	33.0 × 48.0 × 43.0	20	6.5	B32656S2564+561	T1	84
		560	33.0 × 48.0 × 43.0	20	6.5	B32656S2564+562	T2	84
		560	33.0 × 48.0 × 43.0	20	6.5	B32656S2564+563	T3	64
		560	33.0 × 48.0 × 43.0	20	6.5	B32656S2564+566	T6	84
		560	33.0 × 48.0 × 43.0	20	6.5	B32656S2564+577	T7	84

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%

Technical data

Operating temperature range	Max. operating temperature $T_{op,max}$		+110 °C	
	Upper category temperature T_{max}		+100 °C	
	Lower category temperature T_{min}		−55 °C	
	Rated temperature T_R		+85 °C	
Dissipation factor tan δ (in 10^{-3})	at	$C_R \leq 0.1$ µF	0.1 µF$<C_R \leq$1 µF	$C_R >$1 µF
at 20 °C	1 kHz	–	0.5	0.5
(upper limit values)	10 kHz	–	0.8	1.5
	100 kHz	5.0	–	–
Insulation resistance R_{ins}	$C_R \leq$ 0.33 µF	$C_R >$ 0.33 µF		
or time constant $\tau = C_R \cdot R_{ins}$	100 GΩ	30000 s		
at 20 °C, rel. humidity ≤ 65%				
(minimum as-delivered values)				
DC test voltage	1.6 · V_R, 2 s			
Category voltage V_C	T_A (°C)	DC voltage derating	AC voltage derating	
(continuous operation with V_{DC}	$T_A \leq 85$	$V_C = V_R$	$V_{C,RMS} = V_{RMS}$	
or V_{AC} at f ≤ 1 kHz)	$85<T_A \leq 100$	$V_C = V_R \cdot (165-T_A)/80$	$V_{C,RMS}=V_{RMS} \cdot (165-T_A)/80$	
Operating voltage V_{op} for	T_A (°C)	DC voltage (max. hours)	AC voltage (max. hours)	
short operating periods	$T_A \leq 85$	$V_{op} = 1.25 \cdot V_C$ (2000 h)	$V_{op} = 1.0 \cdot V_{C,RMS}$ (2000 h)	
(V_{DC} or V_{AC} at f ≤ 1 kHz)	$85<T_A \leq 100$	$V_{op} = 1.25 \cdot V_C$ (1000 h)	$V_{op} = 1.0 \cdot V_{C,RMS}$ (1000 h)	
Damp heat test	56 days/40 °C/93% relative humidity			
Limit values after damp	Capacitance change $\lvert\Delta C/C\rvert$		≤ 3%	
heat test	Dissipation factor change Δ tan δ		≤ 0.5 · 10^{-3} (at 1 kHz)	
			≤ 1.0 · 10^{-3} (at 10 kHz)	
	Insulation resistance R_{ins}		≥ 50% of minimum	
	or time constant $\tau = C_R \cdot R_{ins}$		as-delivered values	
Reliability:				
Failure rate λ	1 fit (≤ 1 · 10^{-9}/h) at 0.5 · V_R, 40 °C			
Service life t_{SL}	200 000 h at 1.0 · V_R, 85 °C			
	For conversion to other operating conditions and temperatures, refer to chapter "Quality, 2 Reliability".			
Failure criteria:				
Total failure	Short circuit or open circuit			
Failure due to variation	Capacitance change $\lvert\Delta C/C\rvert$		> 10%	
of parameters	Dissipation factor tan δ		> 4 · upper limit value	
	Insulation resistance R_{ins}		< 1500 MΩ ($C_R \leq$0.33 µF)	
	or time constant $\tau = C_R \cdot R_{ins}$		< 500 s ($C_R >$0.33 µF)	

Pulse handling capability

"dV/dt" represents the maximum permissible voltage change per unit of time for non-sinusoidal voltages, expressed in V/µs.

"k_0" represents the maximum permissible pulse characteristic of the waveform applied to the capacitor, expressed in $V^2/\mu s$.

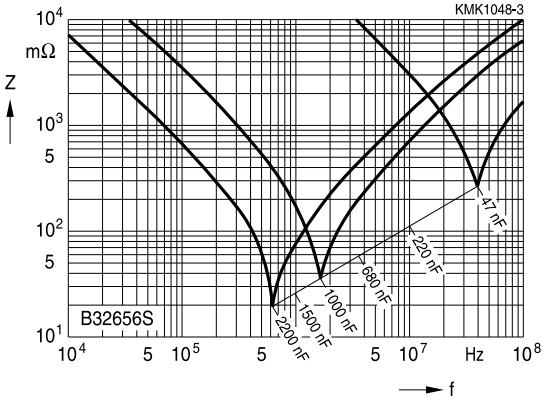
Note:
The values of dV/dt and k_0 provided below must not be exceeded in order to avoid damaging the capacitor.

dV/dt and k_0 values

V_R (V DC)	V_{RMS} (V AC)	dV/dt in V/µs	k_0 in $V^2/\mu s$
850	450	400	680 000
1000	480	450	900 000
1250	500	500	1 250 000
1600	750	600	1 920 000
2000	800	700	2 800 000

Impedance Z versus frequency f

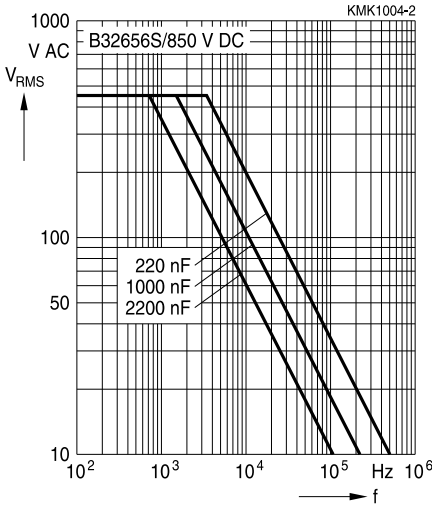
(typical values)



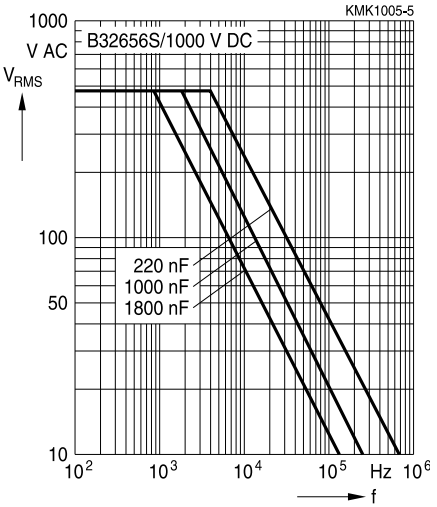
Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 90$ °C)

For T_A >90 °C, please refer to "General technical information", section 3.2.3.

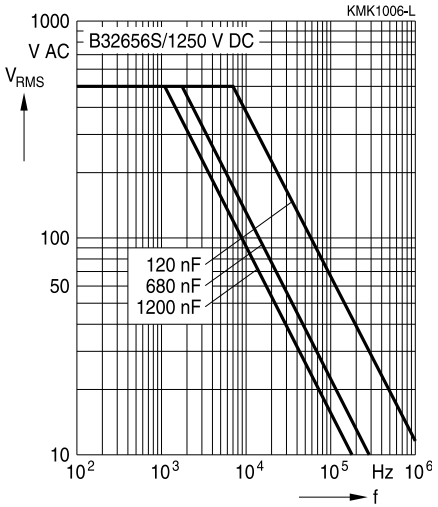
850 V DC/450 V AC



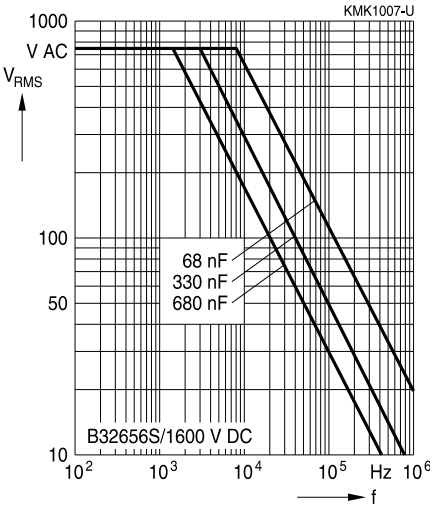
1000 V DC/480 V AC



1250 V DC/500 V AC



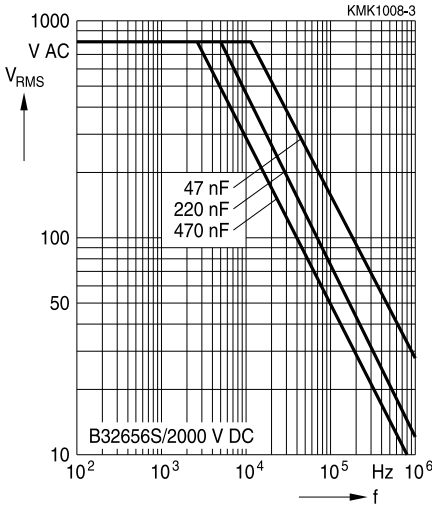
1600 V DC/750 V AC



Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 90$ °C)

For T_A >90 °C, please refer to "General technical information", section 3.2.3.

2000 V DC/800 V AC



Mounting guidelines

1 Soldering

1.1 Solderability of leads

The solderability of terminal leads is tested to IEC 60068-2-20, test Ta, method 1.

Before a solderability test is carried out, terminals are subjected to accelerated ageing (to IEC 60068-2-2, test Ba: 4 h exposure to dry heat at 155 °C). Since the ageing temperature is far higher than the upper category temperature of the capacitors, the terminal wires should be cut off from the capacitor before the ageing procedure to prevent the solderability being impaired by the products of any capacitor decomposition that might occur.

Solder bath temperature	235 ±5 °C
Soldering time	2.0 ±0.5 s
Immersion depth	2.0 +0/−0.5 mm from capacitor body or seating plane
Evaluation criteria: Visual inspection	 Wetting of wire surface by new solder ≥90%, free-flowing solder

1.2 Resistance to soldering heat

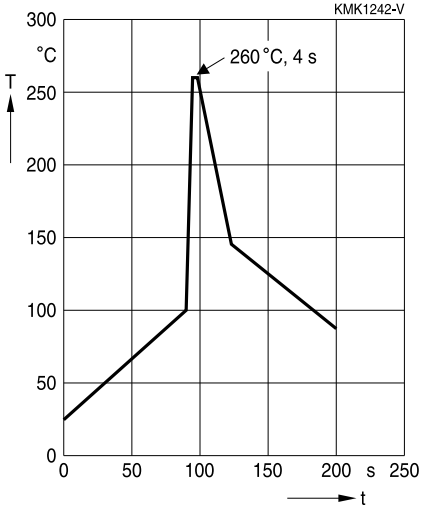
Resistance to soldering heat is tested to IEC 60068-2-20, test Tb, method 1A.
Conditions:

Series		Solder bath temperature	Soldering time
MKT	boxed (except 2.5 × 6.5 × 7.2 mm) coated uncoated (lead spacing > 10 mm)	260 ±5 °C	10 ±1 s
MFP MKP	 (lead spacing > 7.5 mm)		
MKT	boxed (case 2.5 × 6.5 × 7.2 mm)		5 ±1 s
MKP MKT	(lead spacing ≤ 7.5 mm) uncoated (lead spacing ≤ 10 mm) insulated (B32559)		< 4 s recommended soldering profile for MKT uncoated (lead spacing ≤ 10 mm) and insulated (B32559)

MKP

B32656S

Snubber (wound)



Immersion depth	2.0 +0/−0.5 mm from capacitor body or seating plane
Shield	Heat-absorbing board, (1.5 ±0.5) mm thick, between capacitor body and liquid solder
Evaluation criteria:	
Visual inspection	No visible damage
$\Delta C/C_0$	2% for MKT/MKP/MFP 5% for EMI suppression capacitors
tan δ	As specified in sectional specification

1.3 General notes on soldering

Permissible heat exposure loads on film capacitors are primarily characterized by the upper category temperature T_{max}. Long exposure to temperatures above this type-related temperature limit can lead to changes in the plastic dielectric and thus change irreversibly a capacitor's electrical characteristics. For short exposures (as in practical soldering processes) the heat load (and thus the possible effects on a capacitor) will also depend on other factors like:

- Pre-heating temperature and time
- Forced cooling immediately after soldering
- Terminal characteristics:
  diameter, length, thermal resistance, special configurations (e.g. crimping)
- Height of capacitor above solder bath
- Shadowing by neighboring components
- Additional heating due to heat dissipation by neighboring components
- Use of solder-resist coatings

The overheating associated with some of these factors can usually be reduced by suitable countermeasures. For example, if a pre-heating step cannot be avoided, an additional or reinforced cooling process may possibly have to be included.

EPCOS recommends the following conditions:

- Pre-heating with a maximum temperature of 110 °C
- Temperature inside the capacitor should not exceed the following limits:
  - MKP/MFP 110 °C
  - MKT 160 °C
- When SMD components are used together with leaded ones, the leaded film capacitors should not pass into the SMD adhesive curing oven. The leaded components should be assembled after the SMD curing step.
- Leaded film capacitors are not suitable for reflow soldering.

Uncoated capacitors

For uncoated MKT capacitors with lead spacings ≤10 mm (B32560/B32561) the following measures are recommended:

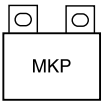
- pre-heating to not more than 110 °C in the preheater phase
- rapid cooling after soldering

Cautions and warnings

- Do not exceed the upper category temperature (UCT).
- Do not apply any mechanical stress to the capacitor terminals.
- Avoid any compressive, tensile or flexural stress.
- Do not move the capacitor after it has been soldered to the PC board.
- Do not pick up the PC board by the soldered capacitor.
- Do not place the capacitor on a PC board whose PTH hole spacing differs from the specified lead spacing.
- Do not exceed the specified time or temperature limits during soldering.
- Avoid external energy inputs, such as fire or electricity.
- Avoid overload of the capacitors.

The table below summarizes the safety instructions that must always be observed. A detailed description can be found in the relevant sections of the chapters "General technical information" and "Mounting guidelines".

Topic	Safety information	Reference chapter "General technical information"
Storage conditions	Make sure that capacitors are stored within the specified range of time, temperature and humidity conditions.	4.5 "Storage conditions"
Flammability	Avoid external energy, such as fire or electricity (passive flammability), avoid overload of the capacitors (active flammability) and consider the flammability of materials.	5.3 "Flammability"
Resistance to vibration	Do not exceed the tested ability to withstand vibration. The capacitors are tested to IEC 60068-2-6. EPCOS offers film capacitors specially designed for operation under more severe vibration regimes such as those found in automotive applications. Consult our catalog "Film Capacitors for Automotive Electronics".	5.2 "Resistance to vibration"



Topic	Safety information	Reference chapter "Mounting guidelines"
Soldering	Do not exceed the specified time or temperature limits during soldering.	1 "Soldering"
Cleaning	Use only suitable solvents for cleaning capacitors.	2 "Cleaning"
Embedding of capacitors in finished assemblies	When embedding finished circuit assemblies in plastic resins, chemical and thermal influences must be taken into account. Caution: Consult us first, if you also wish to embed other uncoated component types!	3 "Embedding of capacitors in finished assemblies"

Symbols and terms

Symbol	English	German
α	Heat transfer coefficient	Wärmeübergangszahl
α_C	Temperature coefficient of capacitance	Temperaturkoeffizient der Kapazität
A	Capacitor surface area	Kondensatoroberfläche
β_C	Humidity coefficient of capacitance	Feuchtekoeffizient der Kapazität
C	Capacitance	Kapazität
C_R	Rated capacitance	Nennkapazität
ΔC	Absolute capacitance change	Absolute Kapazitätsänderung
$\Delta C/C$	Relative capacitance change (relative deviation of actual value)	Relative Kapazitätsänderung (relative Abweichung vom Ist-Wert)
$\Delta C/C_R$	Capacitance tolerance (relative deviation from rated capacitance)	Kapazitätstoleranz (relative Abweichung vom Nennwert)
dt	Time differential	Differentielle Zeit
Δt	Time interval	Zeitintervall
ΔT	Absolute temperature change (self-heating)	Absolute Temperaturänderung (Selbsterwärmung)
$\Delta \tan \delta$	Absolute change of dissipation factor	Absolute Änderung des Verlustfaktors
ΔV	Absolute voltage change	Absolute Spannungsänderung
dV/dt	Time differential of voltage function (rate of voltage rise)	Differentielle Spannungsänderung (Spannungsflankensteilheit)
$\Delta V/\Delta t$	Voltage change per time interval	Spannungsänderung pro Zeitintervall
E	Activation energy for diffusion	Aktivierungsenergie zur Diffusion
ESL	Self-inductance	Eigeninduktivität
ESR	Equivalent series resistance	Ersatz-Serienwiderstand
f	Frequency	Frequenz
f_1	Frequency limit for reducing permissible AC voltage due to thermal limits	Grenzfrequenz für thermisch bedingte Reduzierung der zulässigen Wechselspannung
f_2	Frequency limit for reducing permissible AC voltage due to current limit	Grenzfrequenz für strombedingte Reduzierung der zulässigen Wechselspannung
f_r	Resonant frequency	Resonanzfrequenz
F_D	Thermal acceleration factor for diffusion	Therm. Beschleunigungsfaktor zur Diffusion
F_T	Derating factor	Deratingfaktor
i	Current (peak)	Stromspitze
I_C	Category current (max. continuous current)	Kategoriestrom (max. Dauerstrom)

Symbol	English	German
I_{RMS}	(Sinusoidal) alternating current, root-mean-square value	(Sinusförmiger) Wechselstrom
i_z	Capacitance drift	Inkonstanz der Kapazität
k_0	Pulse characteristic	Impulskennwert
L_S	Series inductance	Serieninduktivität
λ	Failure rate	Ausfallrate
λ_0	Constant failure rate during useful service life	Konstante Ausfallrate in der Nutzungsphase
λ_{test}	Failure rate, determined by tests	Experimentell ermittelte Ausfallrate
P_{diss}	Dissipated power	Abgegebene Verlustleistung
P_{gen}	Generated power	Erzeugte Verlustleistung
Q	Heat energy	Wärmeenergie
ρ	Density of water vapor in air	Dichte von Wasserdampf in Luft
R	Universal molar constant for gases	Allg. Molarkonstante für Gas
R	Ohmic resistance of discharge circuit	Ohmscher Widerstand des Entladekreises
R_i	Internal resistance	Innenwiderstand
R_{ins}	Insulation resistance	Isolationswiderstand
R_P	Parallel resistance	Parallelwiderstand
R_S	Series resistance	Serienwiderstand
S	severity (humidity test)	Schärfegrad (Feuchtetest)
t	Time	Zeit
T	Temperature	Temperatur
τ	Time constant	Zeitkonstante
tan δ	Dissipation factor	Verlustfaktor
tan δ_D	Dielectric component of dissipation factor	Dielektrischer Anteil des Verlustfaktors
tan δ_P	Parallel component of dissipation factor	Parallelanteil des Verlfustfaktors
tan δ_S	Series component of dissipation factor	Serienanteil des Verlustfaktors
T_A	Ambient temperature	Umgebungstemperatur
T_{max}	Upper category temperature	Obere Kategorietemperatur
T_{min}	Lower category temperature	Untere Kategorietemperatur
t_{OL}	Operating life at operating temperature and voltage	Betriebszeit bei Betriebstemperatur und -spannung
T_{op}	Operating temperature	Beriebstemperatur
T_R	Rated temperature	Nenntemperatur
T_{ref}	Reference temperature	Referenztemperatur
t_{SL}	Reference service life	Referenz-Lebensdauer
V_{AC}	AC voltage	Wechselspannung

Symbol	English	German
V_C	Category voltage	Kategoriespannung
$V_{C,RMS}$	Category AC voltage	(Sinusförmige) Kategorie-Wechselspannung
V_{CD}	Corona-discharge onset voltage	Teilentlade-Einsatzspannung
V_{ch}	Charging voltage	Ladespannung
V_{DC}	DC voltage	Gleichspannung
V_{FB}	Fly-back capacitor voltage	Spannung (Flyback)
V_i	Input voltage	Eingangsspannung
V_o	Output voltage	Ausgangssspannung
V_{op}	Operating voltage	Betriebsspannung
V_p	Peak pulse voltage	Impuls-Spitzenspannung
V_{pp}	Peak-to-peak voltage Impedance	Spannungshub
V_R	Rated voltage	Nennspannung
$\hat{v}_R$	Amplitude of rated AC voltage	Amplitude der Nenn-Wechselspannung
V_{RMS}	(Sinusoidal) alternating voltage, root-mean-square value	(Sinusförmige) Wechselspannung
V_{SC}	S-correction voltage	Spannung bei Anwendung "S-correction"
V_{sn}	Snubber capacitor voltage	Spannung bei Anwendung "Beschaltung"
Z	Impedance	Scheinwiderstand
e	Lead spacing	Rastermaß

Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or lifesaving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet (www.epcos.com/material). Should you have any more detailed questions, please contact our sales offices.
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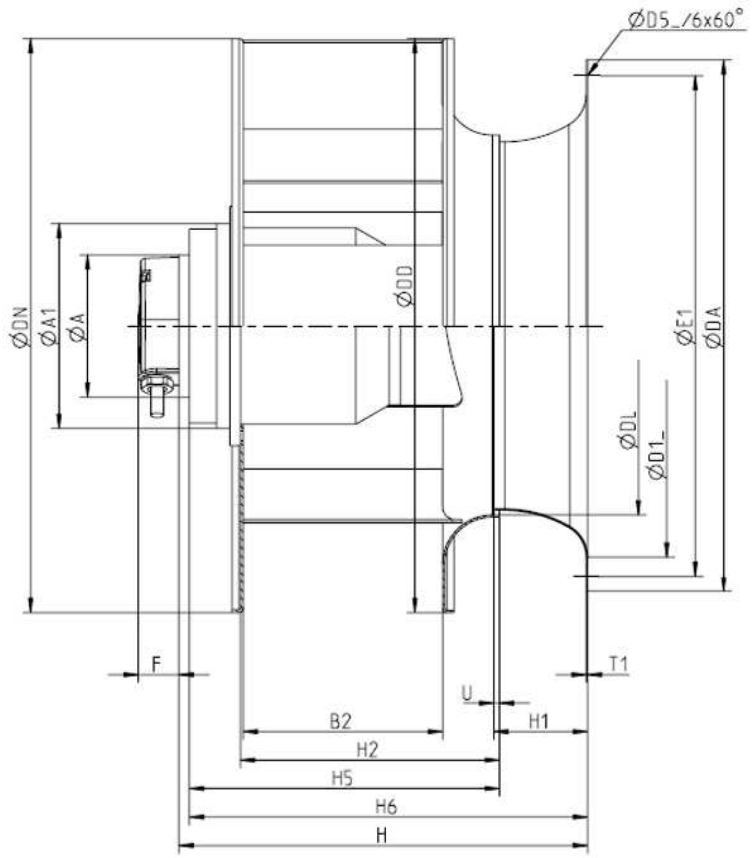
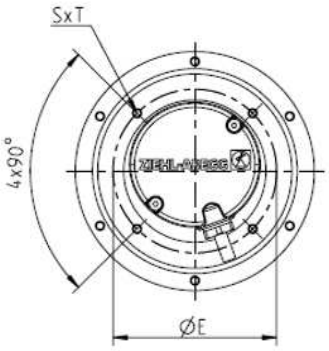
Ziehl-Abegg Iberica S.Specifications Parts (Order Confirmation) 585 08.05.2015
javier

Part-no.	Description
162850	RH28M-PDK.3I.1R

Single inlet impeller with backward curved blades.
Type: RH28M-PDK.3I.1R
3~ 400V ±10% D/Y 50Hz P1 0,57/0,47kW
1,15/0,75A DI=35% 2860/2560rpm COSY 0,73 70°C
3~ 400V ±10% D/Y 60Hz P1 0,90/0,70kW
1,45/1,1A DI=35% 3320/2620rpm COSY 0,89 55°C
3~ 460V ±10% D/Y 60Hz P1 0,93/0,8kW
1,4/1,05A DI=40% 3390/2920rpm COSY 0,84 55°C
IP54 THCL 155
Conceived for application in railways and roads.
Supply cable side 155cm.
Connection diagram: 1360-108XA Sandwich label
Rating plate: 1x fixed.
Fitting position H/Vo.
Motor protection: thermal contact
Special impregnation HV.
Balancing quality G 2,5
Painting motor: 1 coat paint RAL 7032 (pebble grey).
Material impeller: aluminium,
Painting impeller: unpainted
All attaching parts secured with Loctite.
With additional cable gland to fix the ground strip or
the screening from customer`s side.
ball bearing with long-time lubrication.

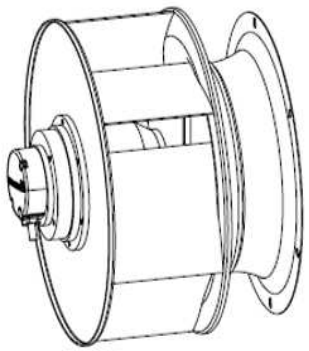


ohne Lüfterrad und Düse dargestellt



Masse und Darstellung ohne Befestigungsteile
elektrischer Anschluss vereinfacht dargestellt

TYP	MOTOR	A	A1	B2	DA	DD	DN	DL	D1_	D5_	E	E1	F	H	H1	H2	H5	H6	SXT	T1	U	ohne Düse kg MLR_MASSE	mit Dü kg GES_MAS
RH28M-__K.31.1_	MK092-70	100.0	144.0	101.5	265.0	284.0	280.0	187.5	234.6	7.0	115.0	250.0	-	216.8	43.0	133.0	169.3	209.3	M6x14	1.0	3.0	9.1	9.5



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Darstellung schematisch gezeichnet - Änderungen vorbehalten
schematical drawn image - subject to modifications

Benennung title: RH22-56M / AC / MK077-MK115 / Aluminium-Lüfterr

Index index	Änderung revision	Datum date	Name name
1	L-05	15.06.2011	hut
erstellt drawn		10.08.2006	fz
geprüft checked		16.06.2011	Hbe

Maße in mm dimensions in mm

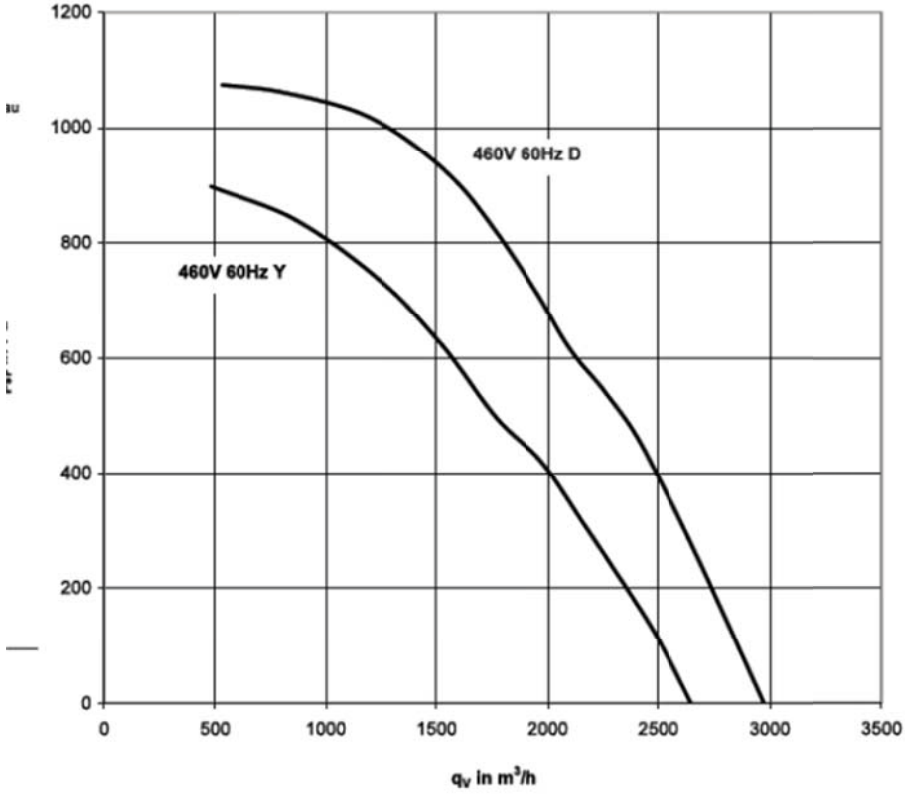
Zeichnungsnummer drawing number: L-AL-3181/1

162850 RH28M-PDK.3I.1R

Single inlet impeller with backward curved blades.
Type: RH28M-PDK.3I.1R
3~ 400V ±10% D/Y 50Hz 0,57/0,47kW
1,15/0,75A DI=35% 2860/2560rpm COSY 0,73 70°C
3~ 400V ±10% D/Y 60Hz 0,90/0,70kW
1,45/1,1A DI=35% 3320/2620rpm COSY 0,89 55°C
3~ 460V ±10% D/Y 60Hz P1 0,93/0,80kW
1,4/1,05A DI=40% 3390/2920rpm COSY 0,84 55°C
IP54 THCL 155
ErP conform 2013
N=58,0
statA=44,8%
Suitable for railways and roads.
Supply cable side 155cm.
Connection diagram: 1360-108XA
Rating plate: 1x fixed.
Fitting position H/Vo.
Motor protection: thermal contact
Special impregnation HV.
Balancing quality G 2,5
Motor: 1 coat paint RAL 7032 (pebble grey).
Impeller made of aluminium unpainted
All attaching parts secured with Loctite.
With additional cable gland to fix the ground strip or the screening from customer`s side.
ball bearing with long-time lubrication.

Valores de arranque:

RH28M-PDK.3I.1R (162850)
400V 50Hz D = 7,0A
400V 50Hz Y = 2,4A
400V 60Hz D = 7,0A
400V 60Hz Y = 2,2A
460V 60Hz D = 8,0A
460V 60Hz Y = 2,6A



ZIEHL-ABEGG SE
Heinz-Ziehl-Straße
74653 Künzelsau
Tel.: +49 (7940) 16 - 0
http://www.ziehl-abegg.de

RH28M-PDK.3I.1R

Beschreibung / Description

RH28M-PDK.3I.1R
3~ 400V ±10% D/Y 50Hz P1 0,57/0,47kW
1,15/0,75A DI=35% 2860/2560/MIN COSY 0,73 70°C
3~ 400V ±10% D/Y 60Hz P1 0,90/0,70kW
1,45/1,1A DI=35% 3320/2620/MIN COSY 0,89 55°C
3~ 460V ±10% D/Y 60Hz P1 0,93/0,8kW
1,4/1,05A DI=40% 3390/2920/MIN COSY 0,84 55°C
IP54 THCL 155

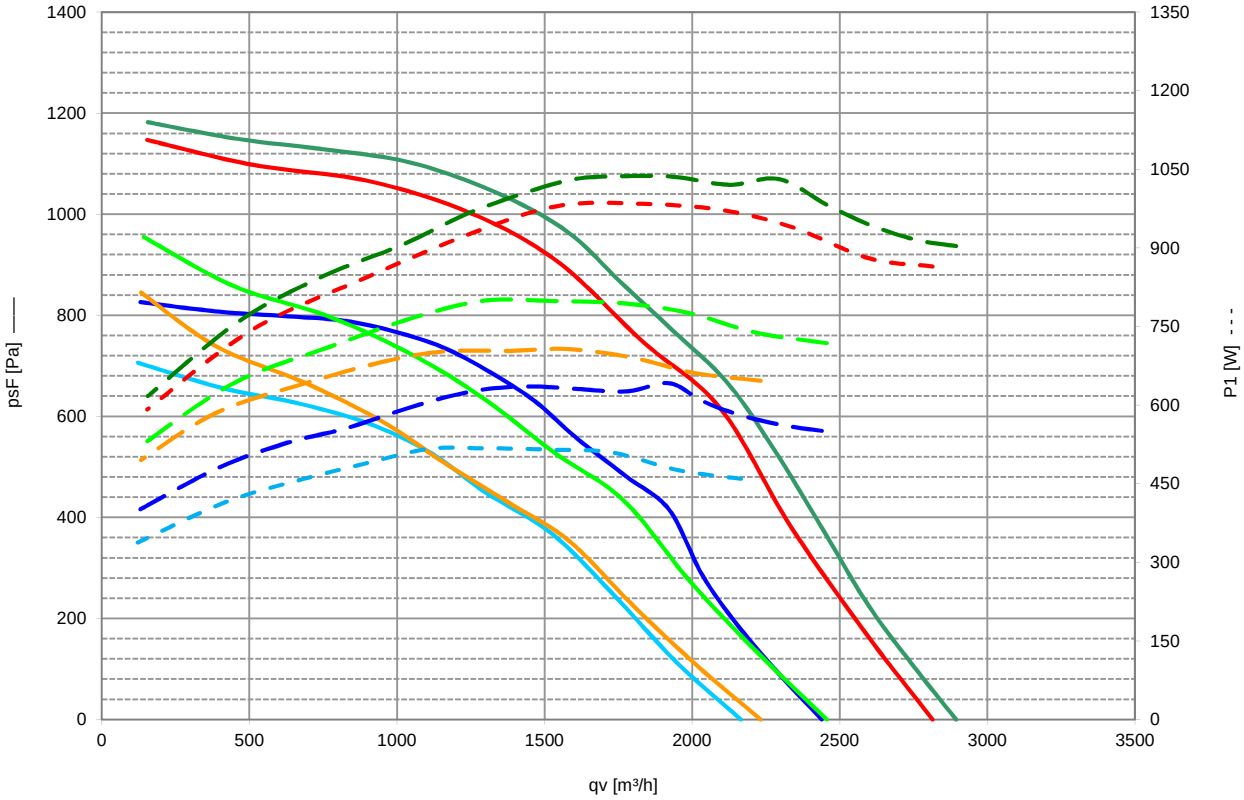
Messaufbau / Assembling:
Ventilator montiert in Einlaufdüse ohne Berührschutzgitter.
Fan measured in inlet bell mouth without guard grille.

Legende / Legend

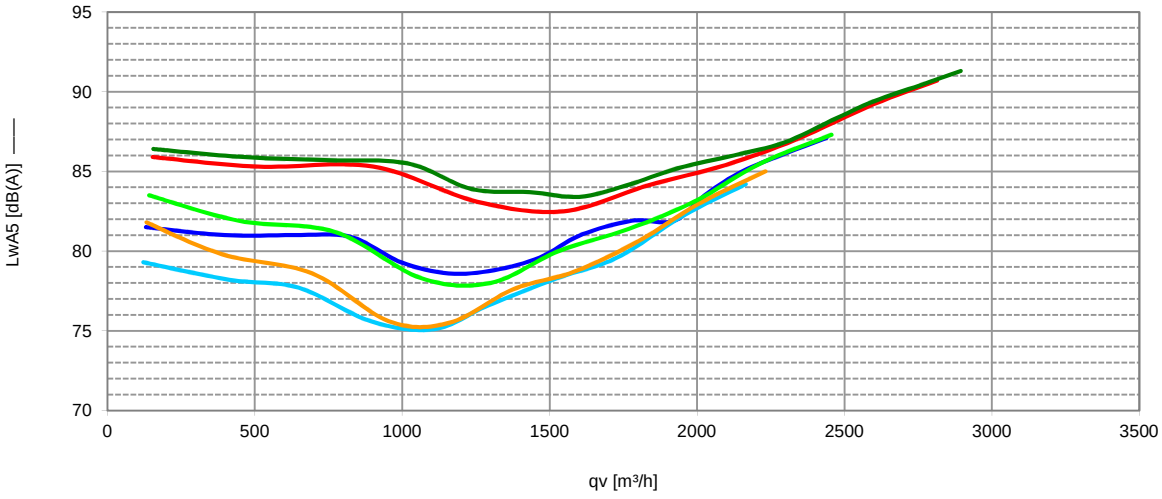
- A) 3~ 400V 50Hz D [ID 94318]
- B) 3~ 400V 50Hz Y [ID 94318]
- C) 3~ 400V 60Hz D [ID 94319]
- D) 3~ 400V 60Hz Y [ID 94319]
- E) 3~ 460V 60Hz D [ID 94319]
- F) 3~ 460V 60Hz Y [ID 94319]

Gemessen mit üblichen Toleranzen / Measured with normal tolerances

1. Diagramm / Chart : Volumenstrom - Druckerhöhung - elektr. Leistungsaufnahme / Airflow - Pressure - Electr. Power Input



2. Diagramm / Chart : Volumenstrom - Akustik / Airflow - Acoustics



162419

Los datos acústicos LWA medidos a 460V 60Hz ~3 para estos ventiladores.

162850
DP1: approx. 84dBA- 1630m3/h at 849Pa
DP2: approx. 85dBA- 1834m3/ at 761Pa

ALLEGATO 3

DATASHEET DELL'INVERTER

LTC line

Applications
Auxiliary converter input
Filter pre-charging
Electromagnetic brakes
Heating/Air conditioning systems
Line contactor

The LTC Series contactors, thanks to their excellent balance between dimensions, performances and robustness, are suitable for all those applications on-board which demand a small, smart device. Their design encourages applications where high operating frequencies and small available spaces are important requirements.
Like all Microelettrica Scientifica contactors, the LTC Series are based on a standard concept, but a very high level of customization can be achieved by replacing a few key components.
Normally open and normally closed poles can be fitted, as well as mechanical latching.
The breaking circuit is equipped with permanent magnets to work efficiently both with high and low currents.
The DC control coil operates without economy resistor within a wide working range.
A "varistor" cuts off the peak voltage when the coil is deenergized.
More than 20000 LTC contactors are delivered worldwide each year for the most demanding projects and applications.

General Characteristics

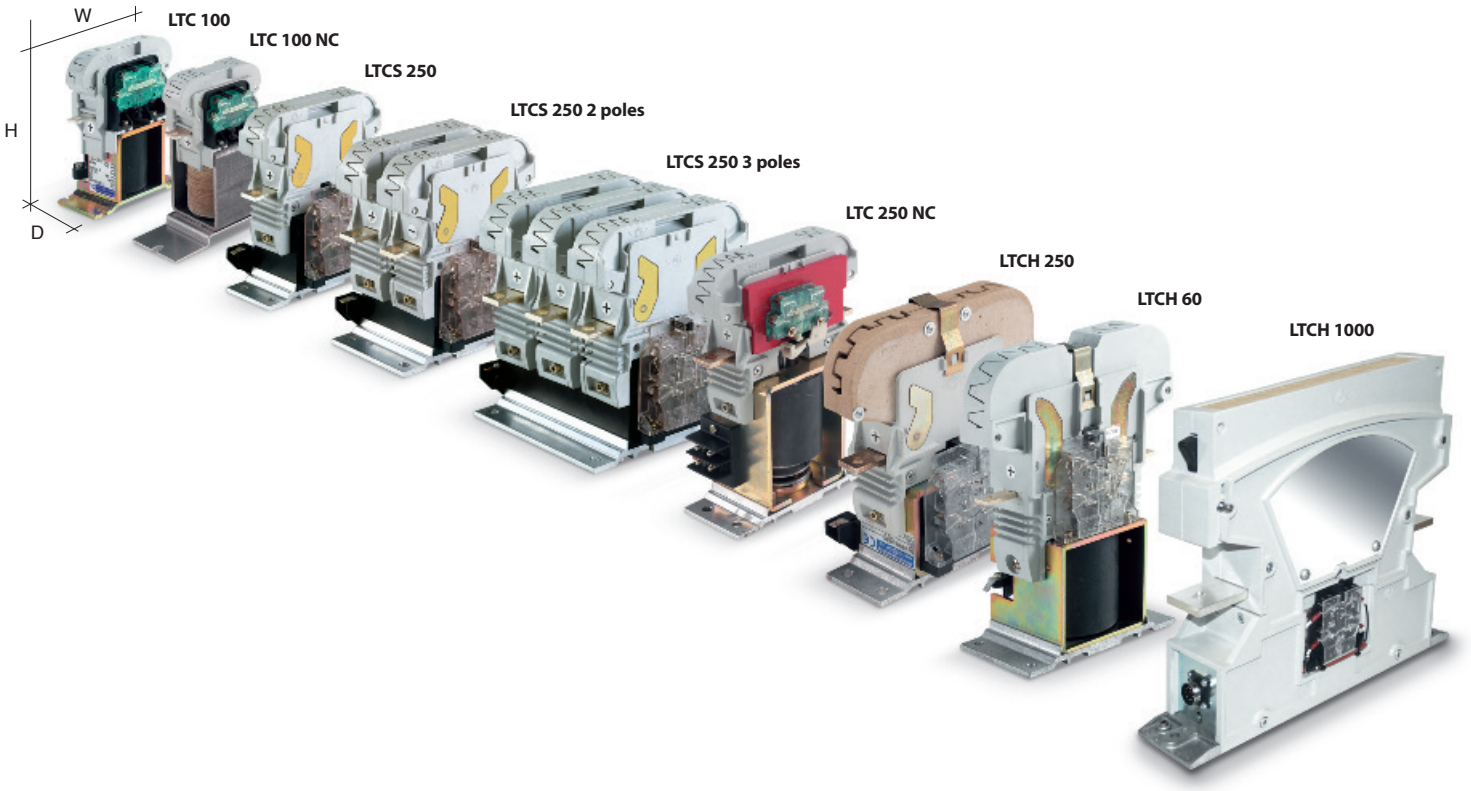
- The modern and compact heavy duty line, up to 4000$V_{DC/AC}$ application, up to 1000A/pole
- On-board and stationary applications
- 1-2-3 and 4 pole configuration available, NO and NC poles, permanent magnets or indirect arc blow outs
- Flexible control and auxiliary contacts options, customization available

Auxiliary contact blocks type SL11

- Normally mounted on LTHS and LTC contactors
- Made in self extinguishing Latamid polyamide, guarantee high electrical and mechanical performances as well as very low temperature resistance
- Double interrupting, self cleaning, solid silver contacts
- On request special execution with gold plate contacts

Switches

Contactors: LTC line



Type	Umax [$V_{AC/DC}$]	Ith [A]	W [mm]	H [mm]	D1/D2/D3 [mm] (1/2/3 poles)
LTC 100	1000	100	106	127.5	63
LTC 100 2 poles	1000	100/200	120	127	93
LTC 100 NC	1000	100	106	155	60
LTCS 250	2000	250	140	156.5	86
LTCS 250 2 poles	2000	250/500	140	156.5	109.2
LTCS 250 3 poles	2000	250	140	156.5	165.5
LTC 250 NC	2000	250	140	196	78
LTCH 250	2000	250	154	176	86
LTCH 60	4000	60	168	221	88
LTCH 60 2 poles	4000	60/120	168	221	125
LTCH 1000	2000	1000	385	300	93

KNORR-BREMSE

Microelettrica Scientifica

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Tel.: +39 02 575731 Fax: +39 02 57510940 - sales.contactors@microelettrica.com
www.microelettrica.com

LTC002502SA*0

Type	LTCS 250 or LTCH 250
Number of Poles	2 NO
Mounting Position	Horizontal - Vertical [1]
Control Voltage Rating [V_{dc}]	12 ÷ 220
Auxiliary Contact Blocks	Max 4 x (1 NO + 1 NC or 2 NO)
Block Type	SL
Arc chute Material	Polyester Resin - Ceramic
Contact Tips Material	S6

[1] To be specified in order phase.

Description

Contactor with double interruption in air, electromagnetic control by full power coil. Single state functioning.
Reference standard IEC 60077.

Electrical Characteristics				
Rated Operational Voltage [V_{ac}/V_{dc}]	1800			
Max Operational Voltage [V_{ac}/V_{dc}]	2000			
Rated Insulation Voltage [V]	2000			
	Series Connected		Parallel Connected	
Arc chute Type	Polyester Resin	Ceramic	Polyester Resin	Ceramic
Conventional Free Air Thermal Current [A] at 75°C [2]	–	–	400	400
DC-Rated Operational Current (τ=15ms) [A]				
1800V	–	–	–	–
900V	–	–	80	125
DC-Maximum Breaking Capacity (τ=15ms) [A]				
1800V	–	–	–	–
900V	–	–	165	200
AC-Maximum Breaking Capacity (cosϕ=0,8; 50Hz) [A]				
1800V	–	–	–	–
900V	–	–	260	320
Short Circuit Withstand Capacity for 5ms [kA]	–	–	8	8
Critical Current Range [A]	–	–	DC reverse current	DC reverse current
Fault Making Capacity [kA]	–	–	4.8	4.8
Component Category / Operational Frequency Class	A2 / C3			
Blow Out Circuit Type	Permanent Magnet			

[2] Device cabled according IEC 60947

Minimum Clearances
from metal parts [mm]
X = 120; Y = 120 ; Z =30

HORIZONTAL
MOUNTING [3]

VERTICAL
MOUNTING [3]

[3] **OTHER MOUNTING POSITIONS NOT ALLOWED**

Microelettrica

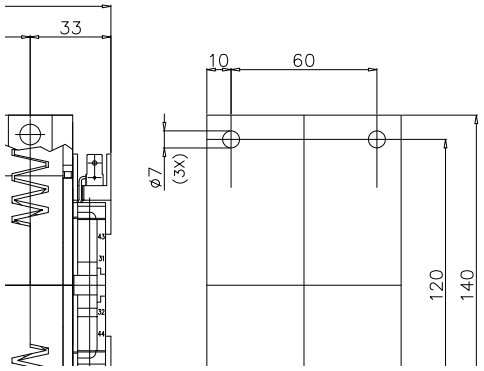
Mechanical Characteristics	
Mechanical Endurance (cycles)	$2x10^6$
Shock and Vibrations (IEC61373)	Cat.1 - Class B
Weight [kg]	3.5

Control Circuit	
Control Voltage Range	$0.7U_c \div 1.25U_c$
Power Consumption (U_c and T = 20°C) at Pick Up - when Holding [W]	35 - 35
Mechanical Operation Time (U_c and T = 20°C) when Closing - Opening [ms]	55 - 25
Time Constant (L/R) at Pick Up - when Holding [ms]	25 - 85
Electrical Connections	Fast-On 6.35x0.8mm

Auxiliary Contacts	
Tips material	Solid Silver (Gold plating opt)
Rated Operational Voltage [V_{ac} / V_{dc}]	250
Rated Current [A]	10
Minimum Switching Current at $16V_{dc}$ [mA] [4]	20
Electrical Connections	Fast-On 6.35x0.8mm - Screw M4

Environmental Conditions	
Stock Temperature Range	-50°C ÷ +85°C
Operational Temperature Range	-40°C ÷ +75°C
Pollution Degree - Overvoltage Category (EN 50124-1)	PD3 / OV3
Max Altitude without Performance Derating [m]	1500

[4] In clean and dry conditions



Rev.05 12/2014

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Tel. +39 02 575731 - Fax +39 02 57510940 - E-Mail: info@microelettrica.com

Introducing

KILOVAC LEV100 Series 900 Vdc Contactor

with 1 form X contacts rated 100A continuous

Tyco Electronics

Our commitment. Your advantage.

Tyco Electronics
Our commitment. Your advantage.

KILOVAC LEV100 Series 900 Vdc Contactor

PART NUMBERING

Typical Part Number | **LEV100** | **A** | **4** | **A** | **N** | **G**

Series:
LEV100 = 100A Contactor

Contact Arrangement:
A = 1 Form X (SPST-NO-DM)

Coil Voltage:
4 = 12VDC 5 = 24VDC 6 = 48VDC

Coil Wire Length:
A = 15 inches [.4M]

Coil Termination:
N = None – Stripped Wires

Mounting and Power Terminals:
G = Bottom Mount (2 x #8); M5 x 10 H = Side Mount (2 x #8); M5 x 10

NOTE: All part numbers are RoHS compliant.
Specifications are subject to change without notice.

PRODUCT OFFERING

- Bottom Mount Models

3-1618389-7	LEV100A4ANG	12Vdc coil	15”[.4m] leads
9-1618389-8	LEV100A5ANG	24Vdc coil	15”[.4m] leads
3-1618391-7	LEV100A6ANG	48Vdc coil	15”[.4m] leads

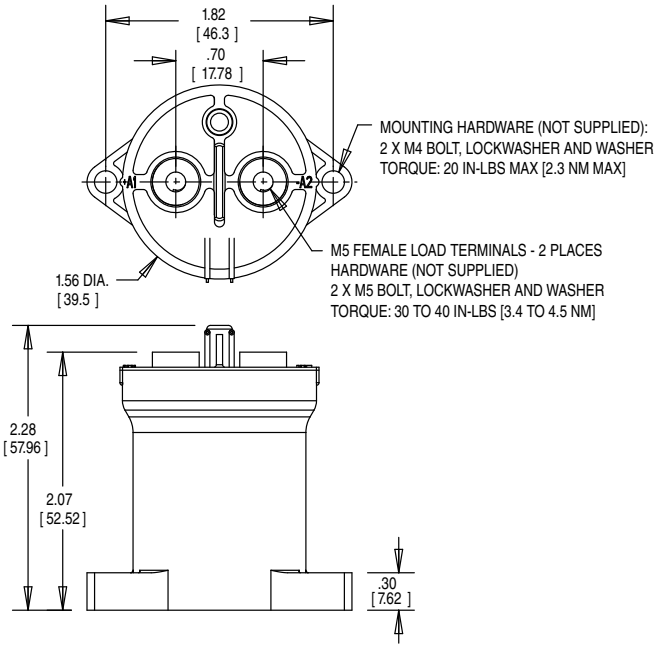
- Side Mount Models

4-1618391-0	LEV100A4ANH	12Vdc coil	15”[.4m] leads
4-1618391-1	LEV100A5ANH	24Vdc coil	15”[.4m] leads
4-1618391-2	LEV100A6ANH	48Vdc coil	15”[.4m] leads

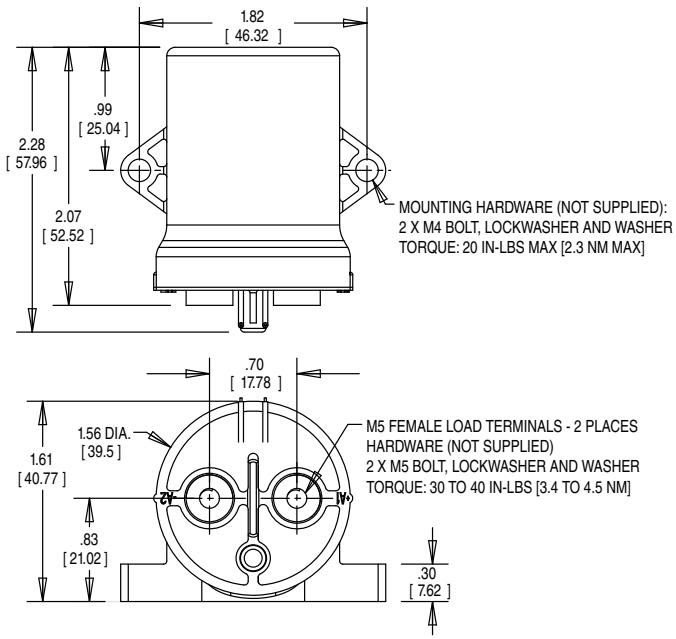
KILOVAC LEV100 Series 900 Vdc Contactor

PERFORMANCE DATA

Bottom Mount



Side Mount



KILOVAC LEV100 Series 900 Vdc Contactor

Tyco Electronics
Our commitment. Your advantage.

KEY FEATURES

Hermetically sealed — intrinsically safe. Operates in explosive/harsh environments without oxidation or contamination of contacts, including long periods of non-operation

8kV isolation between open contacts permits use for high voltage isolation and carry

12, 24 and 48 Vdc coils

Designed and built in accordance to AIAG QS9000

RoHS Ready

DESCRIPTION

Lowest cost, 900 Vdc 100 amp, hermetically sealed DC contactor in the industry

Compact package available in side- or bottom-mount configurations, not position sensitive

APPLICATIONS

Power/motor control circuit isolation, circuit protection and safety in industrial machinery

Automotive battery switching and backup

MECHANICAL

Compact epoxy-sealed resin enclosure occupies only about 4 in^3 (65.5 cm^3)

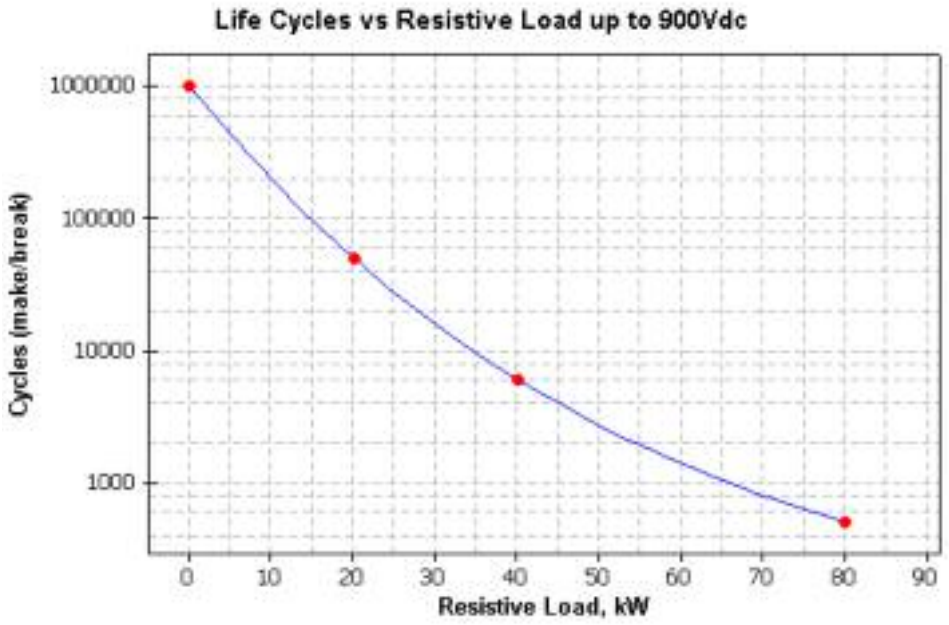
Robust integral mounting plate on either bottom or side of enclosure accepts two M4 screws

Inert gas filled contact chamber

Flying leads for coil connections

Load terminals threaded for M5 bolts (not included)

LOAD LIFE VS. RESISTIVE POWER SWITCHING



PERFORMANCE DATA

Physical Data	
Contact Arrangement: Main Contacts	SPST-NO-DM (1 Form X)
Dimensions	See drawings on page 4
Weight	6.7 oz (190g)

Contact Data	
Contact Arrangement: Main Contacts	SPST-NO-DM (1 Form X)
Voltage Rating: Main Contacts Switching (max)	900VDC
Current Rating: Main Contacts Switching	
Continuous (Note 1)	100A
Short Term -- 3 Minutes (Note 2)	200A
Hot Switching Performance (Polarity sensitive)	
50A make/break @ +400Vdc	50,000 cycles
100A make/break @ +400Vdc	6,000 cycles
100A make/break @ -400Vdc	1,000 cycles
200A make/break @ +400Vdc	500 cycles
1,000A break only @ +400Vdc	25 cycles
600A make only	25 cycles
Maximum Short Circuit Current (1/2 cycle, 60 Hz) (through closed contacts)	1,250A
Dielectric Withstand Voltage (Note 3)	
Between Open Contacts	5,600Vrms/8,000Vdc
Contacts to Coil	2,000Vrms/4,000Vdc
Insulation Resistance, Terminal to Terminal / Terminals to Coil	
When New	100 megohms, min. @ 500Vdc
At End of Life	50 megohms, min. @ 500Vdc
Mechanical Life	1 million cycles

Coil Operating Voltage (valid over temperature range)			
Nominal Voltage	12Vdc	24Vdc	48Vdc
Maximum Voltage	16Vdc	28Vdc	52Vdc
Pick Up Voltage (20°C)	8Vdc	16Vdc	33Vdc
Drop Out Voltage (20°C)	1.2Vdc	2.4Vdc	4.8Vdc
Coil Current (nominal at 20°C, 12vdc)	461mA	250mA	122mA
Coil Power			
Nominal @ Vnom, +20°C	5.5W	6.0W	6.0W
Pickup (close)			
Voltage Max.@85 ° C	9.6Vdc	19.2Vdc	38.4Vdc
Coil Resistance			
Nominal @ +20°C ± 5% (ohms)	26	96	392

Operate & Release Time	
Operate Time Max.	25ms
Operate Bounce Max.	5ms
Release Time	10ms

Environmental Data	
Shock, 11ms 1/2 sine (operating)	20G peak
Sine Vibration, 20G peak	55-2,000 Hz.
Operating Temperature Range	-40°C to +85°C
Noise Emission (at 100 mm distance)	70dB(a)

Notes

Note 1: 8.4 mm^2 conductor. Current rating depends upon conductor size. Keep terminals below 175°C max continuous.

Note 2: 3 minutes at +40°C ambient with 8.4 mm^2 (#8 AWG) conductor.

Note 3: 2,000Vrms minimum under all conditions, until end of life.

FOR MORE INFORMATION

Technical Support

Internet:	www.tycoelectronics.com
E-mail:	newproducts@tycoelectronics.com
USA:	1-800-522-6752
Canada:	1-905-470-4425
Mexico:	1-800-733-8926
C. America:	52-55-1106-0803
South America:	55-11-2103-6000
Hong Kong:	852-2735-1628
Japan:	81-44-844-8013
UK:	44-208-420-8341

Tyco Electronics Corporation
Harrisburg, PA

relays.tycoelectronics.com/kilovac

6-1773450-9 — 5M — A&D/CGX — 04-08

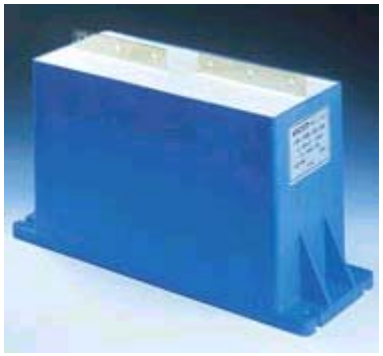
Tyco Electronics

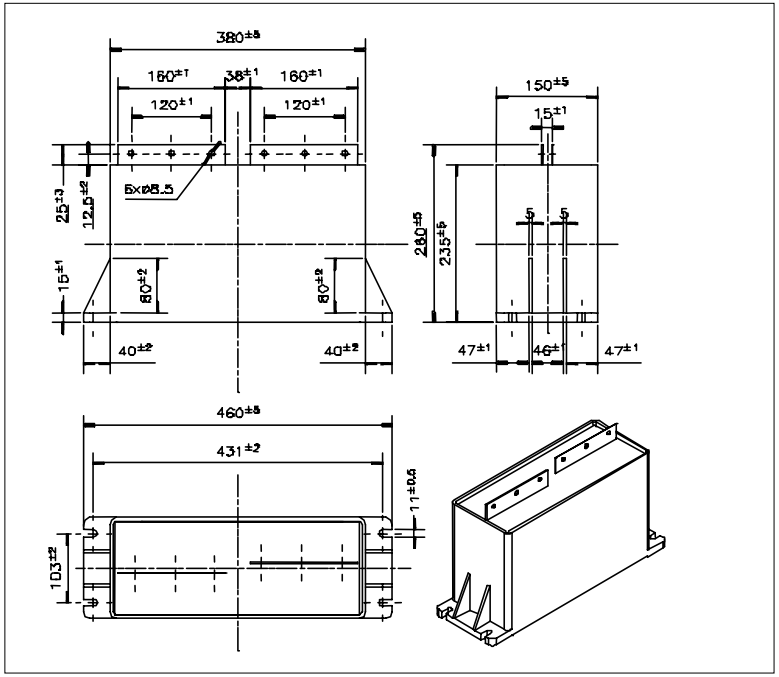
Our commitment. Your advantage.

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P5X - … Series

High capacitance, low inductance connections





Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working Frequency**	Weight	Box qty
	C (µF)	Un (V)	Urms	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (m Ω)	Rthn (°C/W)	(kHz)	(kg)	(pcs)
LNK-P5X-8000-70	8000	700	200	1400	300	4	<30	0.14	1.15	20	18	1
LNK-P5X-5000-90	5000	900	250	1800	300	4	<30	0.18	1.15	20	18	1
LNK-P5X-4200-100	4200	1000	300	2000	250	4	<30	0.19	1.15	20	18	1
LNK-P5X-3500-110	3500	1100	350	2200	250	5	<30	0.21	1.15	20	18	1
LNK-P5X-2600-125	2600	1250	420	2500	250	7	<30	0.24	1.15	20	18	1
LNK-P5X-2000-145	2000	1450	420	2900	200	8	<30	0.28	1.15	20	18	1
LNK-P5X-1600-160	1600	1600	420	3200	200	10	<30	0.31	1.15	20	18	1
LNK-P5X-1300-180	1300	1800	450	3600	200	10	<30	0.34	1.15	20	18	1
LNK-P5X-1000-200	1000	2000	600	4000	250	25	<30	0.19	1.15	20	18	1
LNK-P5X-850-220	850	2200	700	4400	250	30	<30	0.21	1.15	20	18	1
LNK-P5X-650-250	650	2500	800	5000	250	30	<30	0.23	1.15	20	18	1
LNK-P5X-500-290	500	2900	850	5800	200	38	<30	0.27	1.15	20	18	1
LNK-P5X-400-320	400	3200	900	6400	200	40	<30	0.3	1.15	20	18	1
LNK-P5X-300-360	300	3600	950	7200	200	45	<30	0.36	1.15	20	18	1

** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

Issue 031027

LNK

METALLIZED POLYPROPYLENE D.C. LINK CAPACITORS

ICAR

Technology Looking Ahead

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

Replacement of Electrolytic Capacitors by Metallized Polypropylene Film Capacitors in DC Link application.

A typical industrial drive basically consist of two parts :

- An AC / DC section which convert the AC voltage of the industrial network at fixed frequency (50 ÷ 60 Hz) into a DC voltage.
- A DC / AC section that supply a motor at variable frequency.

These two parts are connected a DC bus (*Link circuit*) and capacitors are used in this section to filter the high frequency component (*DC Link Capacitors*) . The most important requirements for these capacitors are :

- the capability in withstanding high current at frequencies above 1000 Hz,
- the high energy density (*Joule / dm³*) .

Usually Electrolytic Capacitors are used up to a voltage around 2000 V . Beside the advantage of having a very large capacitance value per can the limits for Electrolytic capacitors are :

- The maximum working voltage across each capacitor which is around 450 ÷ 500 V
- The current , especially at high frequency , is limited by their high ESR (*Equivalent Series Resistance*) .

Consequently, in most of the cases , Electrolytic Capacitors have to be connected in series/parallel to form banks to reach the requested performances in terms of Voltage and Current.

Seen the above , in order to reduce the ripple current , the banks are often designed with a very large equivalent capacitance which is normally easy to get with electrolytics capacitors. In other words the equivalent capacitance of these banks can be much lower whenever the capacitors would be able to handle an higher current . Another important point to keep into account in assembling Electrolytic Capacitor banks is to pay attention at the connection in order to keep the inductance as low as possible.

In many cases it is possible to replace favourably Electrolytic Capacitors with Metallized film capacitors.

Under certain conditions the saving become evident already at 500 V and it is more and more important as well as the voltage increase.
As commented , there is no availability of Electrolytic Capacitors above 450 ÷ 500 V, on the opposite it is quite normal to manufacture Metallized Film Capacitors which can work at several thousands of Volts .
Moreover, since Metallized Film Capacitors can handle, with the same capacitance, much higher current than Electrolytic , it is possible , and also convenient, to reduce the total equivalent capacitance of the bank.

Here are the main reasons to choice a Metallized Film Capacitors :

- Much higher current per capacitance (A/µF) i.e. possibility of using a lower capacitance bank.
- Higher voltage per element i.e. there is no need of series connection.
- Higher capability to wistand to overvoltages , up to 2 times the rated voltage.
- More than 10 years lifetime in the temperature range -25 ÷ +70 ºC .
- Non polar dielectric.

Beside the above mentioned advantages typical of all the Metallized Film Capacitors ***ICAR,*** exploiting the 50 years experience in capacitor manufacturing , has developed this new range of DC Link capacitors **LNK series** with further advantages.

- By using a new metallizing process (patented) on polypropylene film ***ICAR*** can offer capacitors which size is less than one half if compared with the traditionally Metallized capacitors .
- The use of polypropylene make the dielectric losses extremely low at any frequency ,(i.e. very low ESR) this make this kind of capacitor extremely valid at the very high frequency typical of the last generation of IGBT inverters.

LNK construction consist of a completely dry resin filled capacitor, plastic casing , self extinguish. No more leakage problems, no more dangerous electrolytes.

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK SERIES ICAR CAPACITORS

General Technical Characteristics

Environmental:

Operating temperature:

ϑ_{min} : - 25°C ϑ_{max} : + 70°C

Storage temperature

ϑ_{min} : - 40°C ϑ_{max} : + 85°C

Ratings:

Capacitance tolerance: ± 10%

Useful life (at 70°C hot-spot): 100000 hrs.

Reliability: 300 FIT.

Casing:

Self extinguishing, low smoke plastic material.

Filler / impregnant:

Self extinguishing resin.

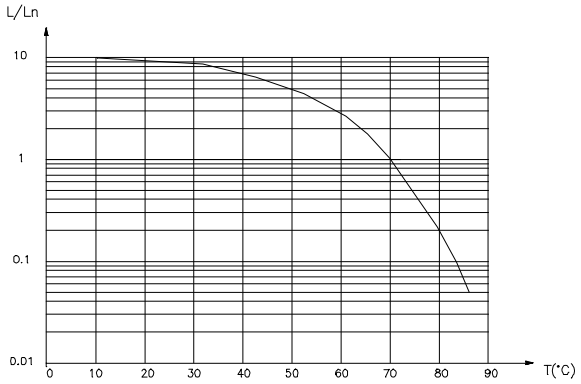
Standard of reference:

IEC 61071 – 60068 - 61881

With the new LNK series a new level of safety for the DC capacitors has been reached:

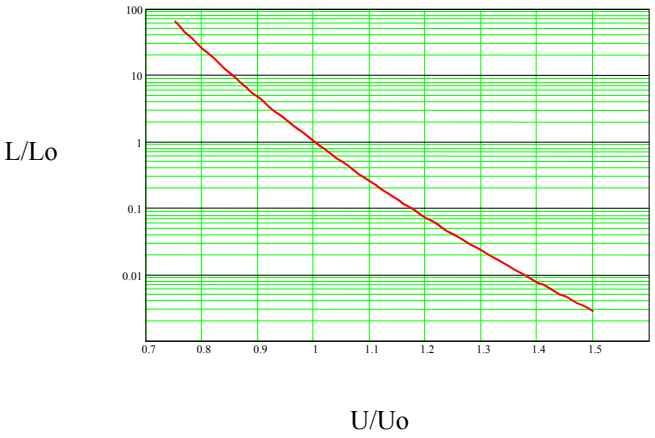
- ***Active safety:*** When the capacitor is stressed within the specifications, Icar patented metalization is designed to bring capacitor to an open circuit at the end of life.
- ***Passive safety:*** In case of failure the gas generated in not trapped in a sealed aluminium case but has a safe way out given by breaking of the casting resin. The risk of explosion is then dramatically reduced.
- ***Fire prevention:*** Casting resin and case material are flame retardant

Expected life versus hot spot temperature at rated voltage



Ln = expected life with hot spot temperature of 70°C
L = expected life with hot spot temperature T

Useful life versus voltage



Ln = expected life at rated voltage Un
L = expected life at U

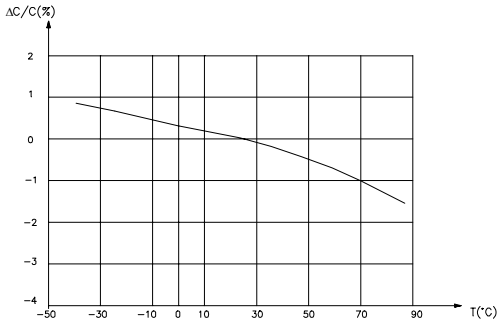
LNK SERIES

METALLIZED POLYPROPYLENE D.C. LINK CAPACITORS

Replacing Electrolitycs Capacitors by Metallized Polypropylene Film Capacitors.

- **No series connections for higher Voltage (Up to 4000 Vdc).**
- **Extremely low losses even at very high frequencies.**
- **Higher ripple current.**
- **Plastic case**
- **Lower E.S.R.**
- **Dry , environmental friendly construction.**

Capacitance variation versus temperature



Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

SELECTING THE CORRECT CAPACITOR

VOLTAGE

The first check should be done on the working voltage: The surge voltage U_S, the rated voltages U_N and U_{rms} should be not higher than the operating values.
Also the sum of the ripple and the dc component of the voltage should not be beyond the rated voltage U_N.
Although it is possible to work above the rated voltage, this will mean a reduction of the expected life; this can be evaluated through the correspondent graph.

CURRENT LIMITATION

The I_{rms} current must not exceed the maximum current I_{max}. The current must also be compatible with the maximum power that can be dissipated.
The I_{mxx} values in the schedules was been calculated supposing irrelevant the dielectric losses (Q" tan δ_0)and they correspond with a difference of temperature ($\theta_n - \theta_0$)of about 20°C. As a consequence, to have an expected life of 100.000 at the maximum current, the ambient temperature has not to exceed of 50°C.
If not the expected life will be calculated again using the graph on the following page.
The thermal check, here indicated, will be done in any case.
In case of forced air cooling the thermal resistance will be reduced of 30%.

THERMAL CHECK

First of all the power due to the internal losses of the capacitor should be calculated.
These power losses consist of the dielectric losses and series losses ($R_S * I^2_{rms}$) i.e. those due to the resistance of the armatures and the connections.
The total power can be calculated as follows:
$P = Q \tan \delta_0 + R_S I^2_{rms}$
It is now possible to calculate the hot spot temperature as:
$\vartheta_h = R_{th} * P + \vartheta_0$.
The expected life for these capacitors is actually calculated with the assumption the hot spot temperature is 70°C. In these conditions, at rated voltage the expected life is calculated as 100000 hours, with a failure rate of 300 FIT.
Using the enclosed graphs and other data here given the designer can calculate the expected life of the in the actual working conditions.

WARNING

This thermal check supposes that only the heat generated into the capacitor is transmitted to the environment through the case surface. Eventual localised overheating (poor connections, hot components in the nearby etc.) would then likely bring the capacitor to a dramatic reduction of the expected life.

DEFINITIONS

C_N	Rated Capacitance.
U_N	Rated (repetitive peak) voltage.
U_{rms}	Rated rms. voltage.
U_S	Surge (not repetitive) peak voltage.
I_{max}	Maximum rms. current value for continuous operation.
Q	Reactive power = $2 * \pi * F * C * U^2$rms
F	Fundamental frequency.
R_S	Series resistance i.e. the resistance responsible for the current heat losses ($I^2 R_S$) in the capacitor.
ESR	Equivalent Series Resistance defined as $ESR = R_S + \tan \delta_0 / 2*\pi*f*C$
tan δ_0	Dielectric dissipation factor. It can be considered as constant in the normal working frequency range. Typical value for polypropylene is $2*10^{-4}$.
tan δ	Dissipation factor calculated as: $\tan \delta_0 + 2*\pi*C*F*R_S$.
dv/dt	Maximum slope of the voltage waveshape.
I_{PK}	Peak current $I_{PK} = C * dv/dt$.
P	Total power dissipated in the capacitor.
R_{th}	Thermal resistance between the hot-spot in the winding and the environment (natural cooling), so that: $P = (\vartheta_h - \vartheta_0) / R_{th}$
ϑ_h	Hottest point in the capacitor winding.
ϑ_0	Operating ambient temperature. It is the air temperature measured under steady conditions, measured at 0,1 m from capacitor case.
L_0	Expected life at rated voltage U_0 and hot-spot temperature of 70°C
L	Expected life at the actual working conditions, obtained from the enclosed graph.
L_S	Self inductance of the capacitor. It is due to the internal connections, terminals, winding characteristics and physical dimensions.

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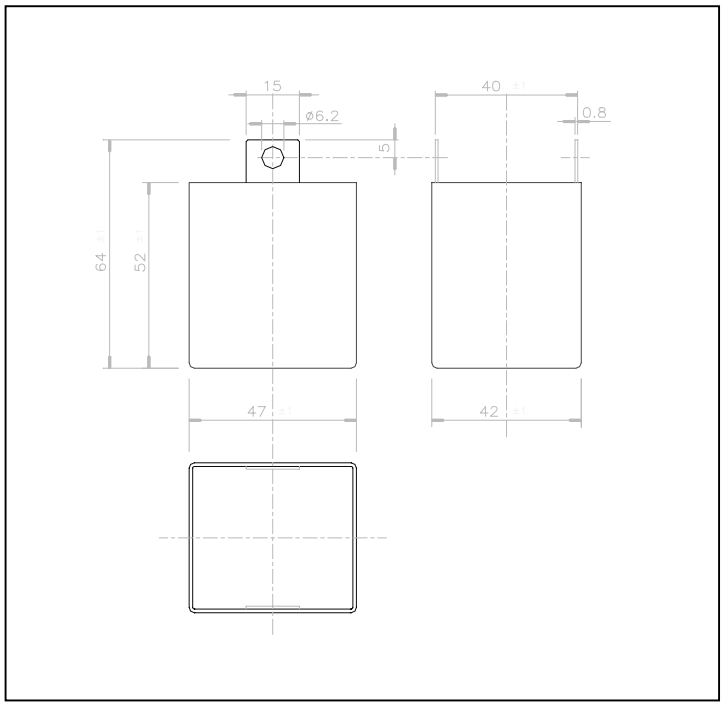
LNK – P1X - … Series

Very low inductance, small size.



Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Paek Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working frequency**	Weight	Box quantity
	C (µF)	Un (V)	Urms (V)	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (m W)	Rthn (°C/W)	(kHz)	(kg)	(pcs)
LNK-P1X –45-70	45	700	200	1400	40	50	10	1.40	8	50	0.15	100
LNK-P1X –30-90	30	900	250	1800	35	70	10	1.70	8	50	0.15	100
LNK-P1X –25-100	25	1000	300	2000	35	100	10	1.80	8	50	0.15	100
LNK-P1X –22-110	22	1100	350	2200	35	85	10	1.90	8	50	0.15	100
LNK-P1X –16-125	16	1250	400	2500	25	100	10	2.28	8	50	0.15	100
LNK-P1X –10-145	10	1450	400	2900	20	110	10	3.00	8	50	0.15	100
LNK-P1X –7.5-180	7.5	1800	450	3600	15	140	10	3.25	8	50	0.15	100

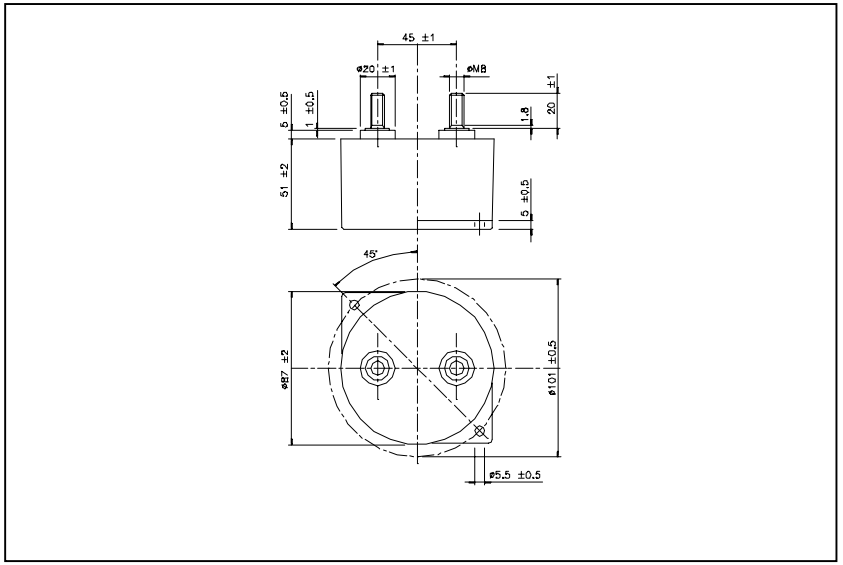
**In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P2X - … Series

High current for heatsink mounting



Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working Frequency**	Tightening Torque	Weight	Box qty
	C (µF)	Un (V)	Urms (V)	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (m W)	Rthn (°C/W)	(kHz)	(Nm)	(kg)	(pcs)
LNK-P2X-150-70	150	700	200	1400	100	55	<30	0.4	5	20	10	0.5	16
LNK-P2X-100-90	100	900	250	1800	80	70	<30	0.55	5	20	10	0.5	16
LNK-P2X-80-100	80	1000	300	2000	80	75	<30	0.6	5	20	10	0.5	16
LNK-P2X-70-110	70	1100	350	2200	80	80	<30	0.65	5	20	10	0.5	16
LNK-P2X-50-125	50	1250	400	2500	80	95	<30	0.75	5	20	10	0.5	16
LNK-P2X-40-145	40	1450	400	2900	80	110	<30	0.8	5	20	10	0.5	16
LNK-P2X-25-180	25	1800	450	3600	60	140	<30	1	5	20	10	0.5	16

* Thermal resistance is calculated with the capacitor installed on a heatsink through an heat conductive paste, In case this is not be done thermal resistance should be considered as the double so that the current rating should be consequently reduced.

** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

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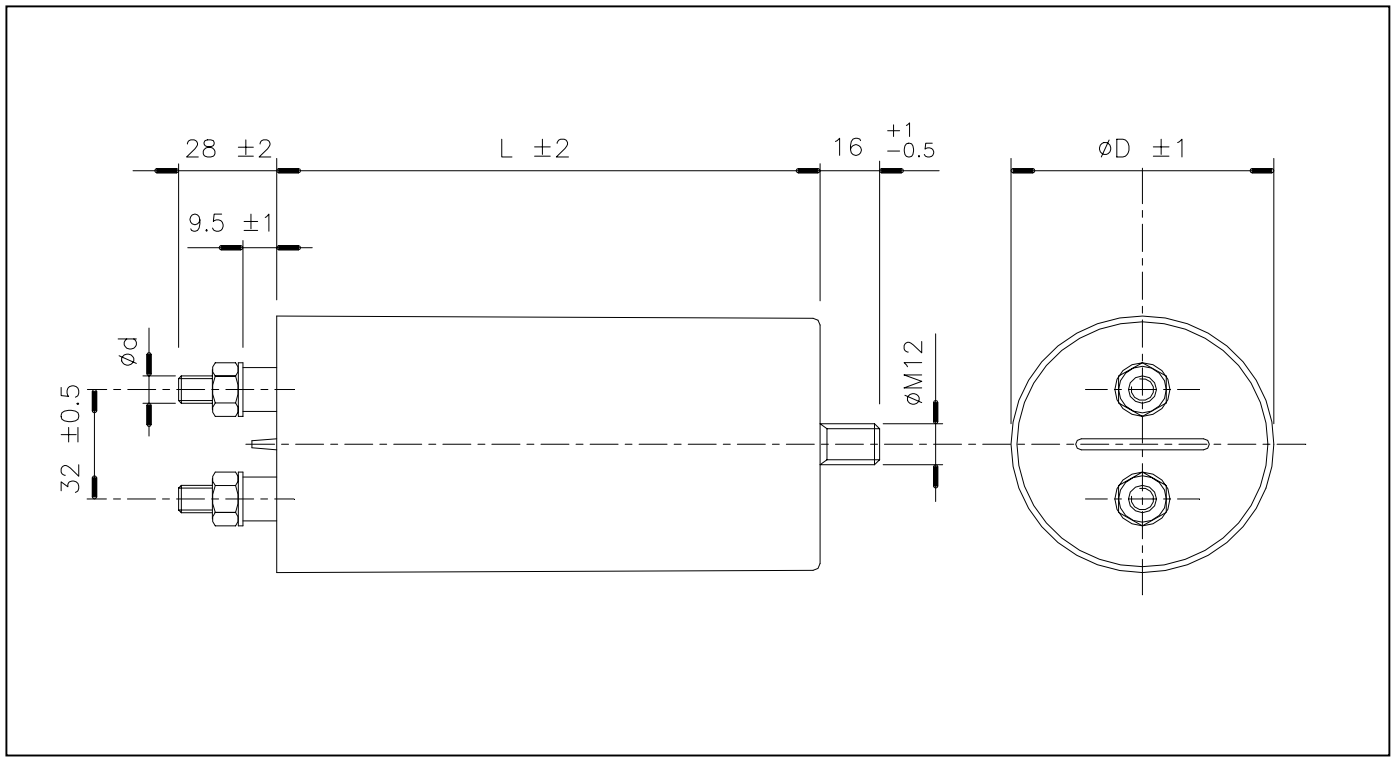
Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P3X - … Series

For an easier replacement of electrolytic capacitors



Issue 031027

LNK – P3X - … Series

For an easier replacement of electrolytic capacitors

Model	Capacitance	Reted DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working Frequency**	Tightening Torque	Weight	d	D	L	Box qty
	C (µF)	Un (V)	Urms (V)	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (mΩ)	Rthn (°C/W)	(kHz)	(Nm)	(kg)	(mm)	(mm)	(mm)	(pcs)
LNK-P3X-200-70	200	700	200	1400	30	20	80	3.9	5.7	5	6	0.5	M6	60	140	36
LNK-P3X-400-70	400	700	200	1400	40	20	90	2.7	4.5	5	6	0.9	M6	75	155	16
LNK-P3X-750-70	750	700	200	1400	55	20	90	1.6	4.00	5	10	1.4	M8	100	155	9
LNK-P3X-140-90	140	900	250	1800	30	20	80	4.0	6.04	5	6	0.5	M6	60	140	36
LNK-P3X-250-90	250	900	250	1800	40	20	90	2.03	5.04	5	6	0.9	M6	75	155	16
LNK-P3X-500-90	500	900	250	1800	55	20	90	1.09	3.07	5	10	1.4	M8	100	155	9
LNK-P3X-120-100	120	1000	300	2000	30	20	80	4.02	6.03	5	6	0.5	M6	60	140	36
LNK-P3X-200-100	200	1000	300	2000	40	20	90	3.03	5.05	5	6	0.9	M6	75	155	16
LNK-P3X-400-100	400	1000	300	2000	55	20	90	2.00	3.07	5	10	1.4	M8	100	155	9
LNK-P3X-100-110	100	1100	350	2200	30	20	80	4.07	6.04	5	6	0.5	M6	60	140	36
LNK-P3X-190-110	190	1100	350	2200	40	20	90	3.03	5.01	5	6	0.9	M6	75	155	16
LNK-P3X-350-110	350	1100	350	2200	55	20	90	2.02	3.07	5	10	1.4	M8	100	155	9
LNK-P3X-75-125	75	1250	400	2500	30	30	80	5.04	6.03	5	6	0.5	M6	60	140	39
LNK-P3X-140-125	140	1250	400	2500	40	20	90	3.08	5.01	5	6	0.9	M6	75	155	16
LNK-P3X-250-125	250	1250	400	2500	55	20	90	2.05	3.07	5	10	1.4	M8	100	155	9
LNK-P3X-50-145	50	1450	400	2900	25	30	80	7.0	6.07	5	6	0.5	M6	60	140	36
LNK-P3X-100-145	100	1450	400	2900	30	30	90	4.06	5.03	5	6	0.9	M6	75	155	16
LNK-P3X-200-145	200	1450	400	2900	55	30	90	2.07	3.07	5	10	1.4	M8	100	155	9
LNK-P3X-33-180	33	1800	450	3600	20	40	80	8.05	6.06	5	6	0.5	M6	60	140	36
LNK-P3X-66-180	66	1800	450	3600	30	30	90	5.06	5.00	5	6	0.9	M6	75	155	16
LNK-P3X-125-180	125	1800	450	3600	45	30	90	3.03	3.07	5	10	1.4	M8	100	155	9

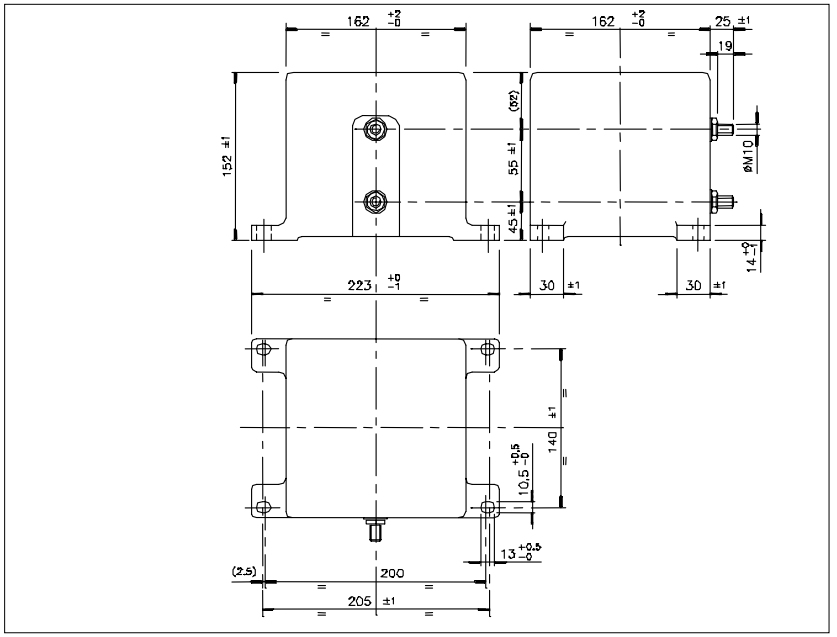
** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P4X - … Series

Sturdy construction for heavy duty



Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working Frequency**	Tightening Torque	Weight	Box qty
	C (µF)	Un (V)	Urms (V)	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (mΩ)	Rthn (°C/W)	(kHz)	(Nm)	(kg)	(pcs)
LNK-P4X-2000-70	2000	700	200	1400	120	3	<30	0.5	2	20	20	5	4
LNK-P4X-1300-90	1300	900	250	1800	120	6	<30	0.6	2	20	20	5	4
LNK-P4X-900-110	900	1100	350	2200	120	10	<30	0.7	2	20	20	5	4
LNK-P4X-650-125	650	1250	400	2500	120	25	<30	0.8	2	20	20	5	4
LNK-P4X-500-145	500	1450	400	2900	100	30	<30	0.9	2	20	20	5	4
LNK-P4X-350-180	350	1800	450	3600	100	35	<30	1.1	2	20	20	5	4
LNK-P4X-220-220	220	2200	700	4400	120	85	<30	0.7	2	20	20	5	4
LNK-P4X-55-400	55	4000	1000	8000	60	150	<30	2.85	2	20	20	5	4
LNK-P4X-20-500	20	5000	1250	10000	50	280	<30	4.5	2	20	20	5	4

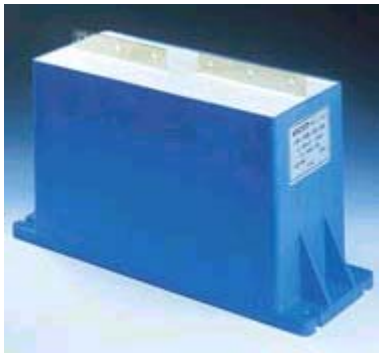
** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

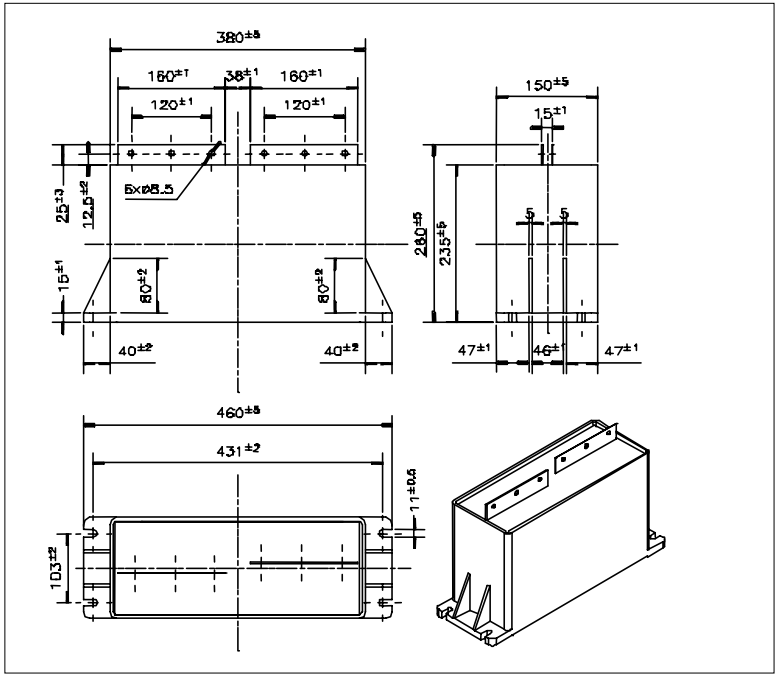
Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P5X - … Series

High capacitance, low inductance connections





Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working Frequency**	Weight	Box qty
	C (µF)	Un (V)	Urms	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (m Ω)	Rthn (°C/W)	(kHz)	(kg)	(pcs)
LNK-P5X-8000-70	8000	700	200	1400	300	4	<30	0.14	1.15	20	18	1
LNK-P5X-5000-90	5000	900	250	1800	300	4	<30	0.18	1.15	20	18	1
LNK-P5X-4200-100	4200	1000	300	2000	250	4	<30	0.19	1.15	20	18	1
LNK-P5X-3500-110	3500	1100	350	2200	250	5	<30	0.21	1.15	20	18	1
LNK-P5X-2600-125	2600	1250	420	2500	250	7	<30	0.24	1.15	20	18	1
LNK-P5X-2000-145	2000	1450	420	2900	200	8	<30	0.28	1.15	20	18	1
LNK-P5X-1600-160	1600	1600	420	3200	200	10	<30	0.31	1.15	20	18	1
LNK-P5X-1300-180	1300	1800	450	3600	200	10	<30	0.34	1.15	20	18	1
LNK-P5X-1000-200	1000	2000	600	4000	250	25	<30	0.19	1.15	20	18	1
LNK-P5X-850-220	850	2200	700	4400	250	30	<30	0.21	1.15	20	18	1
LNK-P5X-650-250	650	2500	800	5000	250	30	<30	0.23	1.15	20	18	1
LNK-P5X-500-290	500	2900	850	5800	200	38	<30	0.27	1.15	20	18	1
LNK-P5X-400-320	400	3200	900	6400	200	40	<30	0.3	1.15	20	18	1
LNK-P5X-300-360	300	3600	950	7200	200	45	<30	0.36	1.15	20	18	1

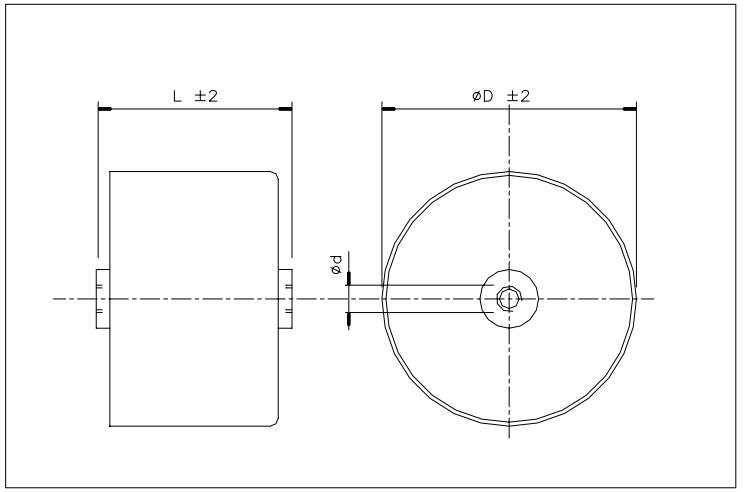
** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P6X - … Series

Axial, very low inductance



Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with natural cooling	Full current Max Working Frequency**	Tightening Torque	Weight	d	D	L	Box qty
	C (µF)	Un (V)	Urms (V)	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (mΩ)	Rthn (°C/W)	(kHz)	(Nm)	(kg)	(mm)	(mm)	(mm)	(pcs)
LNK-P6X-90-70	90	700	200	1400	80	30	10	0.7	3.5	30	6	0.27	M6	70	59	25
LNK-P6X-125-70	125	700	200	1400	80	30	10	0.5	3	30	10	0.41	M8	80	62	16
LNK-P6X-150-70	150	700	200	1400	80	30	10	0.4	2.5	30	10	0.47	M8	90	62	16
LNK-P6X-50-90	50	900	250	1700	50	30	10	1	3.5	30	6	0.27	M6	70	59	25
LNK-P6X-75-90	75	900	250	1700	70	30	10	0.7	3	30	10	0.41	M8	80	62	16
LNK-P6X-100-90	100	900	250	1700	80	30	10	0.5	2.5	30	10	0.47	M8	90	62	16
LNK-P6X-33-110	33	1100	350	2200	45	40	10	1.3	3.5	30	6	0.27	M6	70	59	25
LNK-P6X-50-110	50	1100	350	2200	55	40	10	0.9	3	30	10	0.41	M8	80	62	16
LNK-P6X-66-110	66	1100	350	2200	75	40	10	0.6	2.5	30	10	0.47	M8	90	62	16
LNK-P6X-30-125	30	1250	400	2500	30	50	10	1.6	3.5	30	6	0.27	M6	70	59	25
LNK-P6X-40-125	40	1250	400	2500	40	50	10	1.1	3	30	10	0.41	M8	80	62	16
LNK-P6X-50-125	50	1250	400	2500	50	50	10	0.8	2.5	30	10	0.47	M8	90	62	16
LNK-P6X-20-145	20	1450	400	2900	40	110	10	1.6	3.5	30	6	0.27	M6	70	59	25
LNK-P6X-30-145	30	1450	400	2900	50	110	10	1.1	3	30	10	0.41	M8	80	62	16
LNK-P6X-40-145	40	1450	400	2900	65	110	10	0.8	2.5	30	10	0.47	M8	90	62	16
LNK-P6X-15-180	15	1800	450	3600	40	130	10	1.7	3.5	30	6	0.27	M6	70	59	25
LNK-P6X-20-180	20	1800	450	3600	50	130	10	1.3	3	30	10	0.41	M8	80	62	16
LNK-P6X-25-180	25	1800	450	3600	60	130	10	1	2.5	30	10	0.47	M8	90	62	16

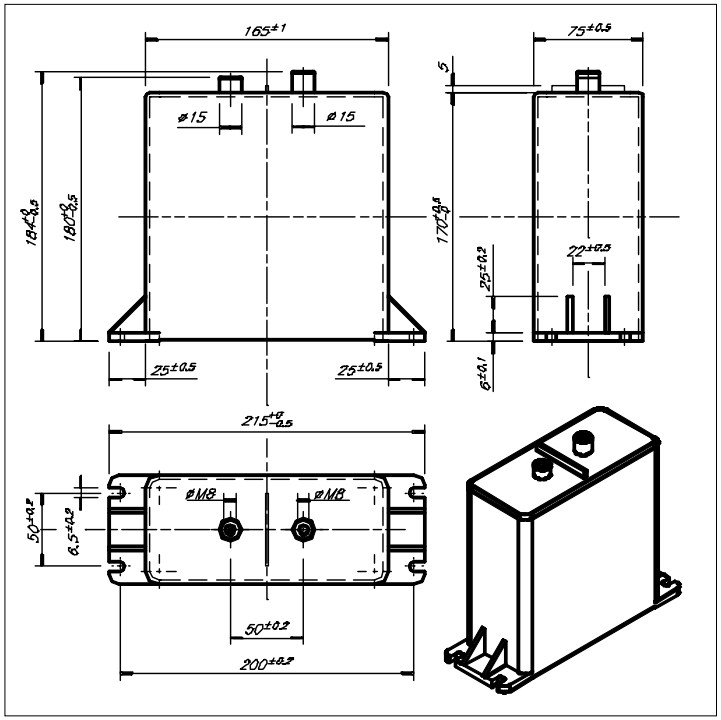
** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P7X - … Series

High current, low inductance, for busbars connections



Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with Natural cooling	Full current Max Working Frequency**	Tightening Torque	Weight	Box qty
	C (µF)	Un (V)	Urms (V)	Us (V)	Imax (A)	(V / µs)	L (nH)	Rs (mΩ)	Rthn (°C/W)	(kHz)	(Nm)	(kg)	(pcs)
LNK-P7X-1200-70	1200	700	200	1400	180	10	30	0.22	2.02	20	12	2.9	8
LNK-P7X-750-90	750	900	250	1800	155	10	30	0.28	2.02	20	12	2.9	8
LNK-P7X-600-100	600	1000	300	2000	150	13	30	0.32	2.02	20	12	2.9	8
LNK-P7X-500-110	500	1100	350	2200	145	14	30	0.35	2.02	20	12	2.9	8
LNK-P7X-400-125	400	1250	400	2500	140	17	30	0.38	2.02	20	12	2.9	8
LNK-P7X-300-145	300	1450	400	2900	130	19	30	0.44	2.02	20	12	2.9	8
LNK-P7X-200-180	200	1800	450	3600	120	24	30	0.53	2.02	20	12	2.9	8

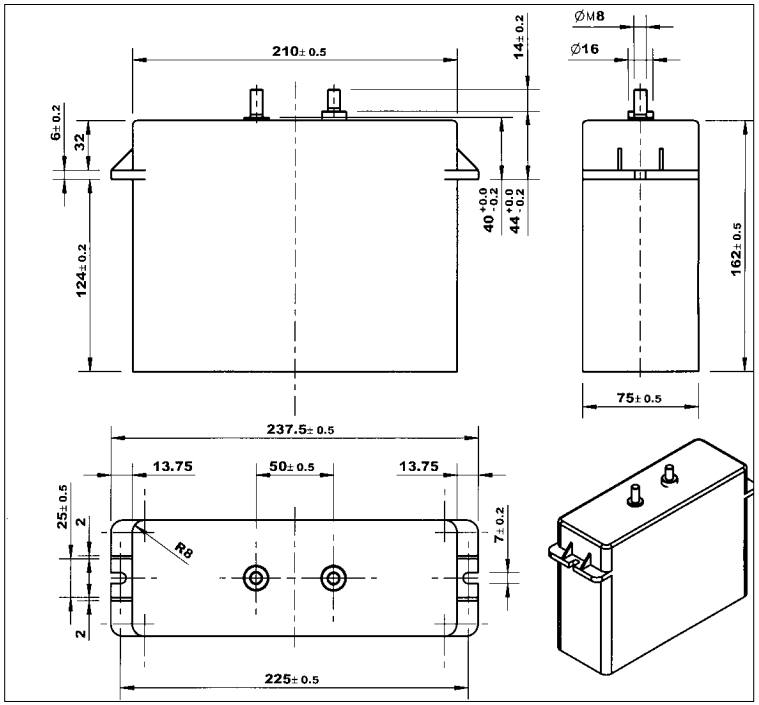
** In case of doubt regarding maximum working frequency, please contact Icar Tech. Dept. for de-rating according to current spectrum

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

LNK – P8X - … Series

Sturdy construction for busbars connections



Model	Capacitance	Rated DC Voltage	Rated AC Voltage	Peak Voltage	Max rms Current	dv / dt	Self Inductance	Series Resistance	Thermal Resistance with Natural cooling	Full current Max Working Frequency**	Tightening Torque	Weight	Box qty
	C (µF)	Un (V)	Urms (V)	Us (V)	(A)	(V / µs)	L (nH)	Rs (mΩ)	Rthn (C/W)	(KHz)	(Nm)	(kg)	(pcs)
LNK-P8X-1500-70	1500	700	200	1400	180	10	30	0.22	1.8	20	12	3.6	6
LNK-P8X-850-90	850	900	250	1800	155	12	30	0.27	1.8	20	12	3.6	6
LNK-P8X-700-100	700	1000	300	2000	150	13	30	0.30	1.8	20	12	3.6	6
LNK-P8X-600-110	600	1100	350	2200	145	14	30	0.31	1.8	20	12	3.6	6
LNK-P8X-430-125	430	1250	400	2500	140	17	30	0.36	1.8	20	12	3.6	6
LNK-P8X-330-145	330	1450	400	2900	130	19	30	0.40	1.8	20	12	3.6	6
LNK-P8X-200-180	200	1800	450	3600	120	24	30	0.51	1.8	20	12	3.6	6

Issue 031027

Via Isonzo 10, 20052 Monza (Mi) Italy

WARNING

DO NOT MISAPPLY CAPACITORS FOR POWER ELECTRONICS

Icar spa is not responsible for any kind of possible damages to persons or things, derived from the improper installation and application of Power Electronics capacitors.

Most common misapplication forms:

- Ripple current beyond specification or not according with the maximum power that can be dissipated.
- Surge or working voltage beyond specified value.
- Hot spot or storage temperature beyond the specified limits or not according with the maximum power that can be dissipated.
- Incorrect mounting or wrong installation
  - installation nearby hot components or heat sources
  - not suitable connections (not adequate cable or busbars cross section)
  - nuts and washers material, shape or size not suitable for the application
  - tightening torque not according to the specification
- Unusual service conditions as :
  - mechanical shock and vibrations,
  - corrosive or abrasive conductive parts in cooling air,
  - oil or water vapour or corrosive substances,
  - explosive gas or dust,
  - radioactivity,
  - excessive and fast variations of ambient conditions,
  - service areas higher than 2000 m above sea level.

Periodic check of the connection conditions and tightening torque is strongly recommended.

In case of doubt in choice or in performances of the capacitors Icar technical service **MUST** be contacted.

Personal Safety :

Electrical or mechanical misapplication of Power Electronics Capacitors may become hazardous. Personal injury or property damage may result from disruption of the capacitor and consequent expulsion of melted material.
Before using the capacitors in any application, please read carefully the technical information contained in this catalogue.
The energy stored in a capacitor may become lethal**,** to prevent any chance of shock the capacitor should be discharged before handling.
Special attention must be taken to make sure the capacitors are correctly used for each application and that warnings and instructions are followed

ICAR PRODUCTS

ICAR provides a first class service in the following products:

- **Power Electronics Capacitors;**
- **Metallized polypropylene film capacitors for lighting and motor running;**
- **Power factor correction capacitors low and high voltage;**
- **Automatic power factor correction banks with harmonics filtering;**
- **Coupling capacitors and Capacitive Voltage Transformers (CVT);**
- **Energy storage and pulse capacitors ;**
- **RFI / EMI Filters.**

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www.icar.com sales@icar.com

Film Capacitors

Metallized Polypropylene Film Capacitors (MKP)

Series/Type: **B32656S**
Date: December 2012

Typical applications
- IGBT
- Snubbering

Climatic
- Max. operating temperature: 110 °C
- Climatic category (IEC 60068-1): 55/100/56

Construction
- Dielectric: polypropylene (PP)
- Wound capacitor technology with internal series connection
- Plastic case (UL 94 V-0)
- Epoxy resin sealing (UL 94 V-0)

Features
- High pulse strength and high contact reliability
- Very low inductance
- RoHS-compatible
- Halogen-free capacitors available on request

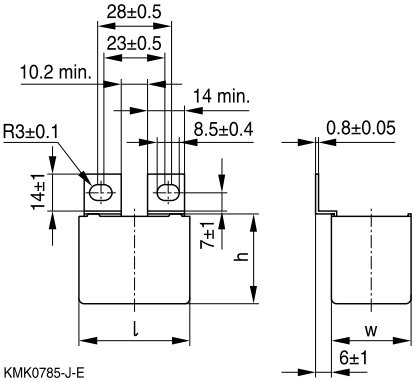
Terminals
- Strap terminals, tinned copper or brass (max. torque 10 Nm)

Marking
Manufacturer's logo, ordering code, style (MKP)
rated capacitance (coded), cap. tolerance (code letter),
rated DC voltage, date of manufacture (coded)

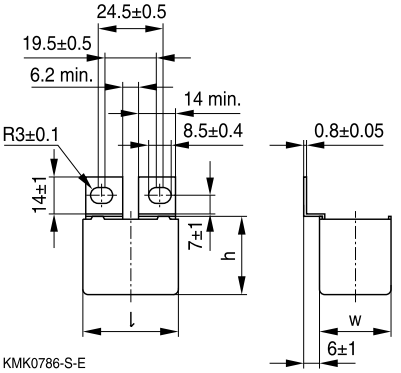
Delivery mode
Bulk (untaped)

Dimensional drawings

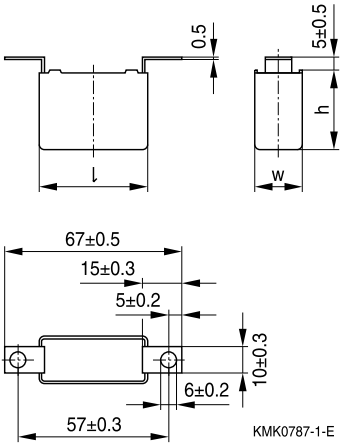
T1 (code no. 561)



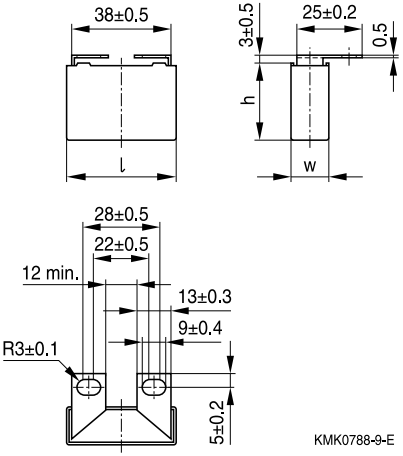
T2 (code no. 562)



T3 (code no. 563)

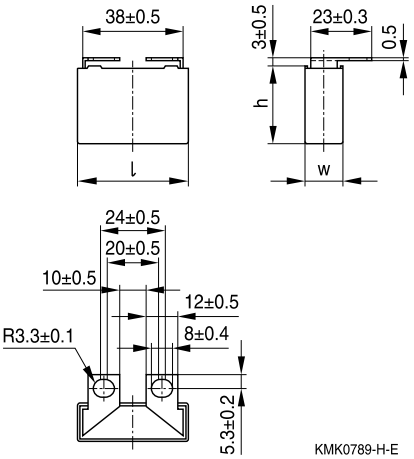


T4 (code no. 564)

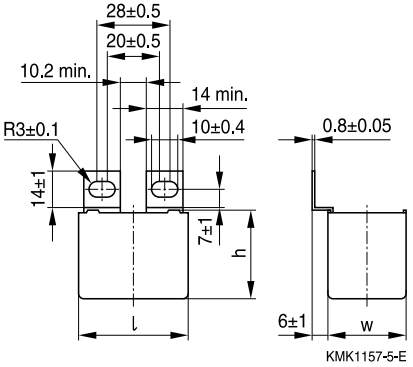


Dimensional drawings (continued)

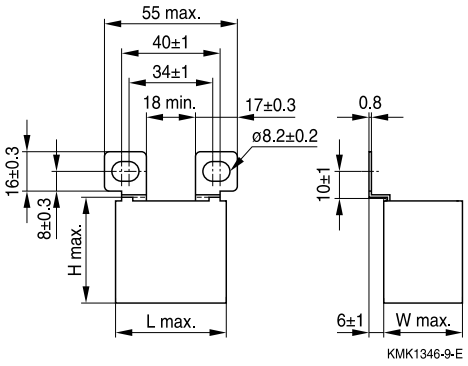
T5 (code no. 565)

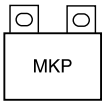


T6 (code no. 566)



T7 (code no. 577)





Overview of available types

Type	B32656S				
V_R (V DC)	850	1000	1250	1600	2000
V_{RMS} (V AC)	450	480	500	750	800
C_R (nF)					
47					
68					
100					
120					
150					
220					
270					
330					
390					
470					
560					
680					
820					
1000					
1200					
1500					
1800					
2200					
2700					
3300					

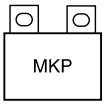
Electrical specifications, ordering codes and packing units

V_R V DC	V_{RMS} f≤1kHz V AC	C_R nF	Max. dimensions w × h × l mm	I_{RMS} 100 kHz A	ESR 100 kHz mΩ	Ordering code (composition see below)	Ter-minal	pcs./ MOQ
850	450	220	12.0 × 22.5 × 42.0	5	10.0	B32656S8224+563	T3	224
		220	12.0 × 22.5 × 42.0	5	10.0	B32656S8224+564	T4	384
		270	12.0 × 22.5 × 42.0	6	9.0	B32656S8274+563	T3	224
		270	12.0 × 22.5 × 42.0	6	9.0	B32656S8274+564	T4	384
		330	12.0 × 22.5 × 42.0	6	9.0	B32656S8334+563	T3	224
		330	12.0 × 22.5 × 42.0	6	9.0	B32656S8334+564	T4	384
		390	12.0 × 22.5 × 42.0	7	8.0	B32656S8394+563	T3	224
		390	12.0 × 22.5 × 42.0	7	8.0	B32656S8394+564	T4	384
		470	12.0 × 22.5 × 42.0	8	8.0	B32656S8474+563	T3	224
		470	12.0 × 22.5 × 42.0	8	8.0	B32656S8474+564	T4	384
		560	14.0 × 25.0 × 42.0	8	7.0	B32656S8564+563	T3	168
		560	14.0 × 25.0 × 42.0	8	7.0	B32656S8564+564	T4	288
		560	14.0 × 25.0 × 42.0	8	7.0	B32656S8564+565	T5	288
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+561	T1	192
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+562	T2	192
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+563	T3	144
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+564	T4	192
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+565	T5	192
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+566	T6	192
		680	16.0 × 28.5 × 42.0	9	6.0	B32656S8684+577	T7	180
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+561	T1	192
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+562	T2	192
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+563	T3	144
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+564	T4	192
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+565	T5	192
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+566	T6	192
		820	16.0 × 28.5 × 42.0	10	6.0	B32656S8824+577	T7	180

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%



Electrical specifications, ordering codes and packing units

V_R V DC	V_{RMS} f≤1kHz V AC	C_R nF	Max. dimensions w × h × l mm	I_{RMS} 100 kHz A	ESR 100 kHz mΩ	Ordering code (composition see below)	Ter-minal	pcs./ MOQ
850	450	1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+561	T1	168
		1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+562	T2	168
		1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+563	T3	144
		1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+564	T4	128
		1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+565	T5	128
		1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+566	T6	168
		1000	18.0 × 32.5 × 42.0	11	6.0	B32656S8105+577	T7	156
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+561	T1	168
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+562	T2	168
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+563	T3	144
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+564	T4	128
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+565	T5	128
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+566	T6	168
		1200	18.0 × 32.5 × 42.0	11	5.0	B32656S8125+577	T7	156
		1500	31.0 × 26.5 × 43.6	13	5.0	B32656S8155+561	T1	128
		1500	31.0 × 26.5 × 43.6	13	5.0	B32656S8155+562	T2	128
		1500	31.0 × 26.5 × 43.6	13	5.0	B32656S8155+563	T3	72
		1500	31.0 × 26.5 × 43.6	13	5.0	B32656S8155+566	T6	128
		1500	31.0 × 26.5 × 43.6	13	5.0	B32656S8155+577	T7	84
		1800	28.0 × 37.0 × 42.0	15	4.5	B32656S8185+561	T1	108
		1800	28.0 × 37.0 × 42.0	15	4.5	B32656S8185+562	T2	108
		1800	28.0 × 37.0 × 42.0	15	4.5	B32656S8185+563	T3	96
		1800	28.0 × 37.0 × 42.0	15	4.5	B32656S8185+566	T6	108
		1800	28.0 × 37.0 × 42.0	15	4.5	B32656S8185+577	T7	96
		2200	30.0 × 45.0 × 42.0	17	3.5	B32656S8225+561	T1	48
		2200	30.0 × 45.0 × 42.0	17	3.5	B32656S8225+562	T2	48
		2200	30.0 × 45.0 × 42.0	17	3.5	B32656S8225+563	T3	96
		2200	30.0 × 45.0 × 42.0	17	3.5	B32656S8225+566	T6	48
		2200	30.0 × 45.0 × 42.0	17	3.5	B32656S8225+577	T7	96

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%

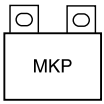
Electrical specifications, ordering codes and packing units

V_R V DC	V_{RMS} f≤1kHz V AC	C_R nF	Max. dimensions w × h × l mm	I_{RMS} 100 kHz A	ESR 100 kHz mΩ	Ordering code (composition see below)	Ter-minal	pcs./ MOQ
850	450	2700	30.0 × 45.0 × 42.0	20	3.0	B32656S8275+561	T1	48
		2700	30.0 × 45.0 × 42.0	20	3.0	B32656S8275+562	T2	48
		2700	30.0 × 45.0 × 42.0	20	3.0	B32656S8275+563	T3	96
		2700	30.0 × 45.0 × 42.0	20	3.0	B32656S8275+566	T6	48
		2700	30.0 × 45.0 × 42.0	20	3.0	B32656S8275+577	T7	96
		3300	33.0 × 48.0 × 43.0	23	2.5	B32656S8335+561	T1	84
		3300	33.0 × 48.0 × 43.0	23	2.5	B32656S8335+562	T2	84
		3300	33.0 × 48.0 × 43.0	23	2.5	B32656S8335+563	T3	64
		3300	33.0 × 48.0 × 43.0	23	2.5	B32656S8335+566	T6	84
		3300	33.0 × 48.0 × 43.0	23	2.5	B32656S8335+577	T7	84
1000	480	220	12.0 × 22.5 × 42.0	6	10.0	B32656S0224+563	T3	224
		220	12.0 × 22.5 × 42.0	6	10.0	B32656S0224+564	T4	384
		270	12.0 × 22.5 × 42.0	7	9.0	B32656S0274+563	T3	224
		270	12.0 × 22.5 × 42.0	7	9.0	B32656S0274+564	T4	384
		330	14.0 × 25.0 × 42.0	7	9.0	B32656S0334+563	T3	168
		330	14.0 × 25.0 × 42.0	7	9.0	B32656S0334+564	T4	288
		330	14.0 × 25.0 × 42.0	7	9.0	B32656S0334+565	T5	288
		390	14.0 × 25.0 × 42.0	8	8.0	B32656S0394+563	T3	168
		390	14.0 × 25.0 × 42.0	8	8.0	B32656S0394+564	T4	288
		390	14.0 × 25.0 × 42.0	8	8.0	B32656S0394+565	T5	288
		470	14.0 × 25.0 × 42.0	9	8.0	B32656S0474+563	T3	168
		470	14.0 × 25.0 × 42.0	9	8.0	B32656S0474+564	T4	288
		470	14.0 × 25.0 × 42.0	9	8.0	B32656S0474+565	T5	288
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+561	T1	192
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+562	T2	192
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+563	T3	144
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+564	T4	192
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+565	T5	192
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+566	T6	192
		560	16.0 × 28.5 × 42.0	9	7.0	B32656S0564+577	T7	180

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%



Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
1000	480	680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+561	T1	192
		680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+562	T2	192
		680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+563	T3	144
		680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+564	T4	192
		680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+565	T5	192
		680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+566	T6	192
		680	16.0 × 28.5 × 42.0	10	6.0	B32656S0684+577	T7	180
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+561	T1	168
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+562	T2	168
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+563	T3	144
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+564	T4	128
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+565	T5	128
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+566	T6	168
		820	18.0 × 32.5 × 42.0	11	6.0	B32656S0824+577	T7	156
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+561	T1	96
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+562	T2	96
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+563	T3	104
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+564	T4	96
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+565	T5	96
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+566	T6	96
		1000	20.0 × 39.5 × 42.0	12	6.0	B32656S0105+577	T7	144
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+561	T1	96
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+562	T2	96
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+563	T3	104
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+564	T4	96
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+565	T5	96
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+566	T6	96
		1200	20.0 × 39.5 × 42.0	13	5.0	B32656S0125+577	T7	144

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%

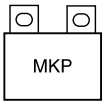
Electrical specifications, ordering codes and packing units

V_R V DC	V_{RMS} f≤1kHz V AC	C_R nF	Max. dimensions w × h × l mm	I_{RMS} 100 kHz A	ESR 100 kHz mΩ	Ordering code (composition see below)	Ter-minal	pcs./ MOQ
1000	480	1500	30.0 × 45.0 × 42.0	15	5.0	B32656S0155+561	T1	48
		1500	30.0 × 45.0 × 42.0	15	5.0	B32656S0155+562	T2	48
		1500	30.0 × 45.0 × 42.0	15	5.0	B32656S0155+563	T3	96
		1500	30.0 × 45.0 × 42.0	15	5.0	B32656S0155+566	T6	48
		1500	30.0 × 45.0 × 42.0	15	5.0	B32656S0155+577	T7	96
		1800	30.0 × 45.0 × 42.0	16	4.5	B32656S0185+561	T1	48
		1800	30.0 × 45.0 × 42.0	16	4.5	B32656S0185+562	T2	48
		1800	30.0 × 45.0 × 42.0	16	4.5	B32656S0185+563	T3	96
		1800	30.0 × 45.0 × 42.0	16	4.5	B32656S0185+566	T6	48
		1800	30.0 × 45.0 × 42.0	16	4.5	B32656S0185+577	T7	96
		2200	30.0 × 45.0 × 42.0	19	3.5	B32656S0225+561	T1	48
		2200	30.0 × 45.0 × 42.0	19	3.5	B32656S0225+562	T2	48
		2200	30.0 × 45.0 × 42.0	19	3.5	B32656S0225+563	T3	96
		2200	30.0 × 45.0 × 42.0	19	3.5	B32656S0225+566	T6	48
		2200	30.0 × 45.0 × 42.0	19	3.5	B32656S0225+577	T7	96
		2700	33.0 × 48.0 × 43.0	23	2.5	B32656S0275+561	T1	84
		2700	33.0 × 48.0 × 43.0	23	2.5	B32656S0275+562	T2	84
		2700	33.0 × 48.0 × 43.0	23	2.5	B32656S0275+563	T3	64
		2700	33.0 × 48.0 × 43.0	23	2.5	B32656S0275+566	T6	84
		2700	33.0 × 48.0 × 43.0	23	2.5	B32656S0275+577	T7	84
1250	500	120	12.0 × 22.5 × 42.0	5	15.0	B32656S7124+563	T3	224
		120	12.0 × 22.5 × 42.0	5	15.0	B32656S7124+564	T4	384
		150	12.0 × 22.5 × 42.0	6	15.0	B32656S7154+563	T3	224
		150	12.0 × 22.5 × 42.0	6	15.0	B32656S7154+564	T4	384
		220	14.0 × 25.0 × 42.0	8	10.0	B32656S7224+563	T3	168
		220	14.0 × 25.0 × 42.0	8	10.0	B32656S7224+564	T4	288
		220	14.0 × 25.0 × 42.0	8	10.0	B32656S7224+565	T5	288
		270	14.0 × 25.0 × 42.0	8	9.0	B32656S7274+563	T3	168
		270	14.0 × 25.0 × 42.0	8	9.0	B32656S7274+564	T4	288
		270	14.0 × 25.0 × 42.0	8	9.0	B32656S7274+565	T5	288

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%



Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
1250	500	330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+561	T1	192
		330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+562	T2	192
		330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+563	T3	144
		330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+564	T4	192
		330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+565	T5	192
		330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+566	T6	192
		330	16.0 × 28.5 × 42.0	8	9.0	B32656S7334+577	T7	180
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+561	T1	168
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+562	T2	168
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+563	T3	144
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+564	T4	128
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+565	T5	128
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+566	T6	168
		390	18.0 × 32.5 × 42.0	9	8.0	B32656S7394+577	T7	156
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+561	T1	168
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+562	T2	168
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+563	T3	144
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+564	T4	128
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+565	T5	128
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+566	T6	168
		470	18.0 × 32.5 × 42.0	9	8.0	B32656S7474+577	T7	156
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+561	T1	96
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+562	T2	96
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+563	T3	104
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+564	T4	96
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+565	T5	96
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+566	T6	96
		560	20.0 × 39.5 × 42.0	10	7.0	B32656S7564+577	T7	144

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%

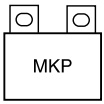
Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
1250	500	680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+561	T1	96
		680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+562	T2	96
		680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+563	T3	104
		680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+564	T4	96
		680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+565	T5	96
		680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+566	T6	96
		680	20.0 × 39.5 × 42.0	12	6.0	B32656S7684+577	T7	144
		820	28.0 × 37.0 × 42.0	13	6.0	B32656S7824+561	T1	108
		820	28.0 × 37.0 × 42.0	13	6.0	B32656S7824+562	T2	108
		820	28.0 × 37.0 × 42.0	13	6.0	B32656S7824+563	T3	72
		820	28.0 × 37.0 × 42.0	13	6.0	B32656S7824+566	T6	108
		820	28.0 × 37.0 × 42.0	13	6.0	B32656S7824+577	T7	96
		1000	28.0 × 37.0 × 42.0	15	6.0	B32656S7105+561	T1	108
		1000	28.0 × 37.0 × 42.0	15	6.0	B32656S7105+562	T2	108
		1000	28.0 × 37.0 × 42.0	15	6.0	B32656S7105+563	T3	72
		1000	28.0 × 37.0 × 42.0	15	6.0	B32656S7105+566	T6	108
		1000	28.0 × 37.0 × 42.0	15	6.0	B32656S7105+577	T7	96
		1200	30.0 × 45.0 × 42.0	16	5.0	B32656S7125+561	T1	48
		1200	30.0 × 45.0 × 42.0	16	5.0	B32656S7125+562	T2	48
		1200	30.0 × 45.0 × 42.0	16	5.0	B32656S7125+563	T3	72
		1200	30.0 × 45.0 × 42.0	16	5.0	B32656S7125+566	T6	48
		1200	30.0 × 45.0 × 42.0	16	5.0	B32656S7125+577	T7	96
		1500	30.0 × 45.0 × 42.0	18	4.0	B32656S7155+561	T1	48
		1500	30.0 × 45.0 × 42.0	18	4.0	B32656S7155+562	T2	48
		1500	30.0 × 45.0 × 42.0	18	4.0	B32656S7155+563	T3	72
		1500	30.0 × 45.0 × 42.0	18	4.0	B32656S7155+566	T6	48
		1500	30.0 × 45.0 × 42.0	18	4.0	B32656S7155+577	T7	96
		1800	33.0 × 48.0 × 43.0	22	3.0	B32656S7185+561	T1	84
		1800	33.0 × 48.0 × 43.0	22	3.0	B32656S7185+562	T2	84
		1800	33.0 × 48.0 × 43.0	22	3.0	B32656S7185+563	T3	64
		1800	33.0 × 48.0 × 43.0	22	3.0	B32656S7185+566	T6	84
		1800	33.0 × 48.0 × 43.0	22	3.0	B32656S7185+577	T7	84

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%



Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
1600	750	68	12.0 × 22.5 × 42.0	5	25.0	B32656S1683+563	T3	224
		68	12.0 × 22.5 × 42.0	5	25.0	B32656S1683+564	T4	384
		100	12.0 × 22.5 × 42.0	6	20.0	B32656S1104+563	T3	224
		100	12.0 × 22.5 × 42.0	6	20.0	B32656S1104+564	T4	384
		120	14.0 × 25.0 × 42.0	6	15.0	B32656S1124+563	T3	168
		120	14.0 × 25.0 × 42.0	6	15.0	B32656S1124+564	T4	288
		120	14.0 × 25.0 × 42.0	6	15.0	B32656S1124+565	T5	288
		150	14.0 × 25.0 × 42.0	7	15.0	B32656S1154+563	T3	168
		150	14.0 × 25.0 × 42.0	7	15.0	B32656S1154+564	T4	288
		150	14.0 × 25.0 × 42.0	7	15.0	B32656S1154+565	T5	288
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+561	T1	192
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+562	T2	192
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+563	T3	144
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+564	T4	192
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+565	T5	192
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+566	T6	192
		220	16.0 × 28.5 × 42.0	9	10.0	B32656S1224+577	T7	180
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+561	T1	168
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+562	T2	168
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+563	T3	144
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+564	T4	128
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+565	T5	128
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+566	T6	168
		270	18.0 × 32.5 × 42.0	10	9.0	B32656S1274+577	T7	156
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+561	T1	96
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+562	T2	96
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+563	T3	104
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+564	T4	96
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+565	T5	96
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+566	T6	96
		330	20.0 × 39.5 × 42.0	12	9.0	B32656S1334+577	T7	144

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%

Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
1600	750	390	28.0 × 37.0 × 42.0	13	8.0	B32656S1394+561	T1	108
		390	28.0 × 37.0 × 42.0	13	8.0	B32656S1394+562	T2	108
		390	28.0 × 37.0 × 42.0	13	8.0	B32656S1394+563	T3	72
		390	28.0 × 37.0 × 42.0	13	8.0	B32656S1394+566	T6	108
		390	28.0 × 37.0 × 42.0	13	8.0	B32656S1394+577	T7	96
		470	28.0 × 37.0 × 42.0	14	8.0	B32656S1474+561	T1	108
		470	28.0 × 37.0 × 42.0	14	8.0	B32656S1474+562	T2	108
		470	28.0 × 37.0 × 42.0	14	8.0	B32656S1474+563	T3	72
		470	28.0 × 37.0 × 42.0	14	8.0	B32656S1474+566	T6	108
		470	28.0 × 37.0 × 42.0	14	8.0	B32656S1474+577	T7	96
		560	30.0 × 45.0 × 42.0	15	7.0	B32656S1564+561	T1	48
		560	30.0 × 45.0 × 42.0	15	7.0	B32656S1564+562	T2	48
		560	30.0 × 45.0 × 42.0	15	7.0	B32656S1564+563	T3	72
		560	30.0 × 45.0 × 42.0	15	7.0	B32656S1564+566	T6	48
		560	30.0 × 45.0 × 42.0	15	7.0	B32656S1564+577	T7	96
		680	30.0 × 45.0 × 42.0	17	6.0	B32656S1684+561	T1	48
		680	30.0 × 45.0 × 42.0	17	6.0	B32656S1684+562	T2	48
		680	30.0 × 45.0 × 42.0	17	6.0	B32656S1684+563	T3	72
		680	30.0 × 45.0 × 42.0	17	6.0	B32656S1684+566	T6	48
		680	30.0 × 45.0 × 42.0	17	6.0	B32656S1684+577	T7	96
		820	33.0 × 48.0 × 43.0	20	4.5	B32656S1824+561	T1	84
		820	33.0 × 48.0 × 43.0	20	4.5	B32656S1824+562	T2	84
		820	33.0 × 48.0 × 43.0	20	4.5	B32656S1824+563	T3	64
		820	33.0 × 48.0 × 43.0	20	4.5	B32656S1824+566	T6	84
		820	33.0 × 48.0 × 43.0	20	4.5	B32656S1824+577	T7	84

MOQ = Minimum Order Quantity, consisting of 4 packing units.
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Composition of ordering code

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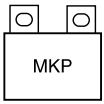
K = ±10%
J = ±5%



Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
2000	800	47	12.0 × 22.5 × 42.0	5	35.0	B32656S2473+563	T3	224
		47	12.0 × 22.5 × 42.0	5	35.0	B32656S2473+564	T4	384
		68	14.0 × 25.0 × 42.0	6	25.0	B32656S2683+563	T3	192
		68	14.0 × 25.0 × 42.0	6	25.0	B32656S2683+564	T4	288
		68	14.0 × 25.0 × 42.0	6	25.0	B32656S2683+565	T5	288
		100	14.0 × 25.0 × 42.0	7	20.0	B32656S2104+563	T3	192
		100	14.0 × 25.0 × 42.0	7	20.0	B32656S2104+564	T4	288
		100	14.0 × 25.0 × 42.0	7	20.0	B32656S2104+565	T5	288
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+561	T1	192
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+562	T2	192
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+563	T3	144
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+564	T4	192
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+565	T5	192
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+566	T6	192
		120	16.0 × 28.5 × 42.0	7	15.0	B32656S2124+577	T7	180
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+561	T1	168
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+562	T2	168
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+563	T3	160
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+564	T4	192
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+565	T5	192
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+566	T6	168
		150	18.0 × 32.5 × 42.0	9	15.0	B32656S2154+577	T7	156
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+561	T1	96
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+562	T2	96
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+563	T3	104
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+564	T4	96
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+565	T5	96
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+566	T6	96
		220	20.0 × 39.5 × 42.0	12	10.0	B32656S2224+577	T7	144

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%

Electrical specifications, ordering codes and packing units

V_R	V_{RMS} f≤1kHz	C_R	Max. dimensions w × h × l	I_{RMS} 100 kHz	ESR 100 kHz	Ordering code (composition see	Ter-	pcs./
V DC	V AC	nF	mm	A	mΩ	below)	minal	MOQ
2000	800	270	28.0 × 37.0 × 42.0	13	9.0	B32656S2274+561	T1	108
		270	28.0 × 37.0 × 42.0	13	9.0	B32656S2274+562	T2	108
		270	28.0 × 37.0 × 42.0	13	9.0	B32656S2274+563	T3	72
		270	28.0 × 37.0 × 42.0	13	9.0	B32656S2274+566	T6	108
		270	28.0 × 37.0 × 42.0	13	9.0	B32656S2274+577	T7	96
		330	28.0 × 37.0 × 42.0	14	9.0	B32656S2334+561	T1	108
		330	28.0 × 37.0 × 42.0	14	9.0	B32656S2334+562	T2	108
		330	28.0 × 37.0 × 42.0	14	9.0	B32656S2334+563	T3	72
		330	28.0 × 37.0 × 42.0	14	9.0	B32656S2334+566	T6	108
		330	28.0 × 37.0 × 42.0	14	9.0	B32656S2334+577	T7	96
		390	30.0 × 45.0 × 42.0	15	8.0	B32656S2394+561	T1	48
		390	30.0 × 45.0 × 42.0	15	8.0	B32656S2394+562	T2	48
		390	30.0 × 45.0 × 42.0	15	8.0	B32656S2394+563	T3	72
		390	30.0 × 45.0 × 42.0	15	8.0	B32656S2394+566	T6	48
		390	30.0 × 45.0 × 42.0	15	8.0	B32656S2394+577	T7	96
		470	30.0 × 45.0 × 42.0	17	8.0	B32656S2474+561	T1	48
		470	30.0 × 45.0 × 42.0	17	8.0	B32656S2474+562	T2	48
		470	30.0 × 45.0 × 42.0	17	8.0	B32656S2474+563	T3	72
		470	30.0 × 45.0 × 42.0	17	8.0	B32656S2474+566	T6	48
		470	30.0 × 45.0 × 42.0	17	8.0	B32656S2474+577	T7	96
		560	33.0 × 48.0 × 43.0	20	6.5	B32656S2564+561	T1	84
		560	33.0 × 48.0 × 43.0	20	6.5	B32656S2564+562	T2	84
		560	33.0 × 48.0 × 43.0	20	6.5	B32656S2564+563	T3	64
		560	33.0 × 48.0 × 43.0	20	6.5	B32656S2564+566	T6	84
		560	33.0 × 48.0 × 43.0	20	6.5	B32656S2564+577	T7	84

MOQ = Minimum Order Quantity, consisting of 4 packing units.
Further E series and intermediate capacitance values on request.

Composition of ordering code

+ = Capacitance tolerance code:
K = ±10%
J = ±5%

Technical data

Operating temperature range	Max. operating temperature $T_{op,max}$		+110 °C	
	Upper category temperature T_{max}		+100 °C	
	Lower category temperature T_{min}		−55 °C	
	Rated temperature T_R		+85 °C	
Dissipation factor tan δ (in 10^{-3})	at	$C_R \leq 0.1$ µF	0.1 µF$<C_R \leq$1 µF	$C_R >$1 µF
at 20 °C	1 kHz	–	0.5	0.5
(upper limit values)	10 kHz	–	0.8	1.5
	100 kHz	5.0	–	–
Insulation resistance R_{ins}	$C_R \leq$ 0.33 µF	$C_R >$ 0.33 µF		
or time constant $\tau = C_R \cdot R_{ins}$	100 GΩ	30000 s		
at 20 °C, rel. humidity ≤ 65%				
(minimum as-delivered values)				
DC test voltage	1.6 · V_R, 2 s			
Category voltage V_C	T_A (°C)	DC voltage derating	AC voltage derating	
(continuous operation with V_{DC}	$T_A \leq 85$	$V_C = V_R$	$V_{C,RMS} = V_{RMS}$	
or V_{AC} at f ≤ 1 kHz)	$85<T_A \leq 100$	$V_C = V_R \cdot (165-T_A)/80$	$V_{C,RMS}=V_{RMS} \cdot (165-T_A)/80$	
Operating voltage V_{op} for	T_A (°C)	DC voltage (max. hours)	AC voltage (max. hours)	
short operating periods	$T_A \leq 85$	$V_{op} = 1.25 \cdot V_C$ (2000 h)	$V_{op} = 1.0 \cdot V_{C,RMS}$ (2000 h)	
(V_{DC} or V_{AC} at f ≤ 1 kHz)	$85<T_A \leq 100$	$V_{op} = 1.25 \cdot V_C$ (1000 h)	$V_{op} = 1.0 \cdot V_{C,RMS}$ (1000 h)	
Damp heat test	56 days/40 °C/93% relative humidity			
Limit values after damp	Capacitance change $\lvert\Delta C/C\rvert$		≤ 3%	
heat test	Dissipation factor change Δ tan δ		≤ 0.5 · 10^{-3} (at 1 kHz)	
			≤ 1.0 · 10^{-3} (at 10 kHz)	
	Insulation resistance R_{ins}		≥ 50% of minimum	
	or time constant $\tau = C_R \cdot R_{ins}$		as-delivered values	
Reliability:				
Failure rate λ	1 fit (≤ 1 · 10^{-9}/h) at 0.5 · V_R, 40 °C			
Service life t_{SL}	200 000 h at 1.0 · V_R, 85 °C			
	For conversion to other operating conditions and temperatures, refer to chapter "Quality, 2 Reliability".			
Failure criteria:				
Total failure	Short circuit or open circuit			
Failure due to variation	Capacitance change $\lvert\Delta C/C\rvert$		> 10%	
of parameters	Dissipation factor tan δ		> 4 · upper limit value	
	Insulation resistance R_{ins}		< 1500 MΩ ($C_R \leq$0.33 µF)	
	or time constant $\tau = C_R \cdot R_{ins}$		< 500 s ($C_R >$0.33 µF)	

Pulse handling capability

"dV/dt" represents the maximum permissible voltage change per unit of time for non-sinusoidal voltages, expressed in V/µs.

"k_0" represents the maximum permissible pulse characteristic of the waveform applied to the capacitor, expressed in $V^2/\mu s$.

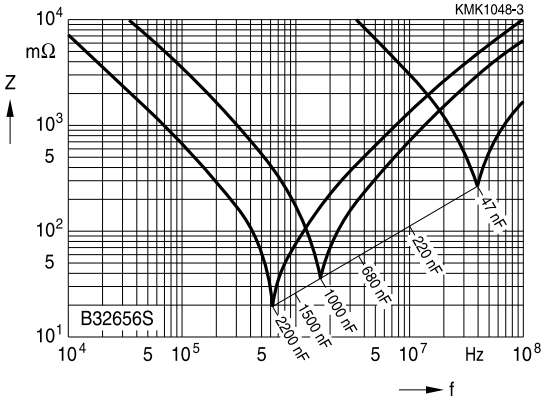
Note:
The values of dV/dt and k_0 provided below must not be exceeded in order to avoid damaging the capacitor.

dV/dt and k_0 values

V_R (V DC)	V_{RMS} (V AC)	dV/dt in V/µs	k_0 in $V^2/\mu s$
850	450	400	680 000
1000	480	450	900 000
1250	500	500	1 250 000
1600	750	600	1 920 000
2000	800	700	2 800 000

Impedance Z versus frequency f

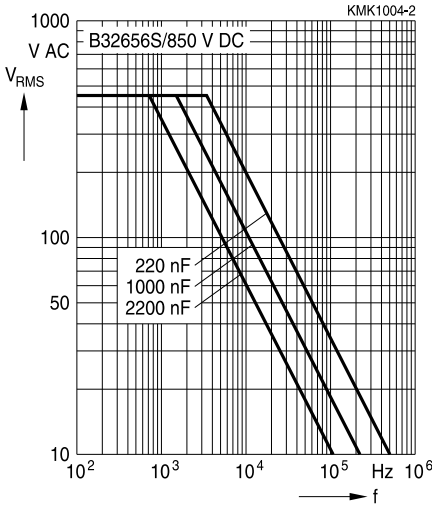
(typical values)



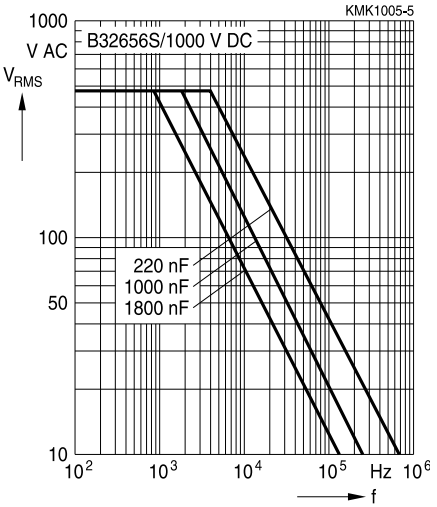
Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 90$ °C)

For T_A >90 °C, please refer to "General technical information", section 3.2.3.

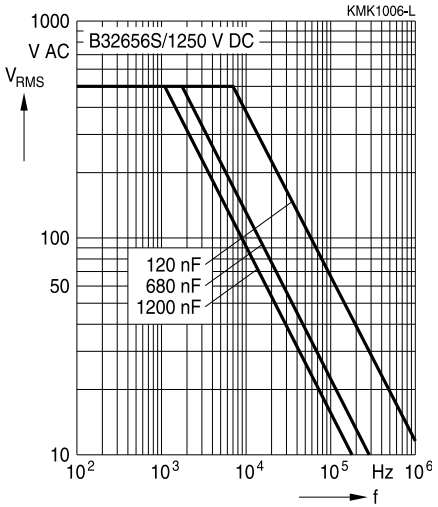
850 V DC/450 V AC



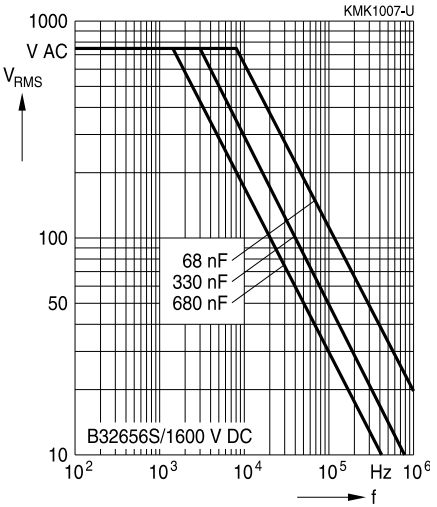
1000 V DC/480 V AC



1250 V DC/500 V AC



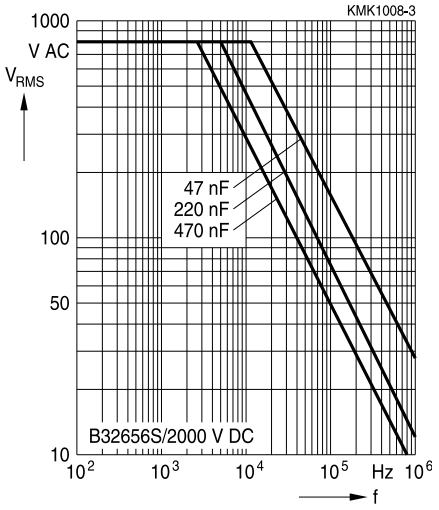
1600 V DC/750 V AC



Permissible AC voltage V_{RMS} versus frequency f (for sinusoidal waveforms, $T_A \leq 90$ °C)

For T_A >90 °C, please refer to "General technical information", section 3.2.3.

2000 V DC/800 V AC



Mounting guidelines

1 Soldering

1.1 Solderability of leads

The solderability of terminal leads is tested to IEC 60068-2-20, test Ta, method 1.

Before a solderability test is carried out, terminals are subjected to accelerated ageing (to IEC 60068-2-2, test Ba: 4 h exposure to dry heat at 155 °C). Since the ageing temperature is far higher than the upper category temperature of the capacitors, the terminal wires should be cut off from the capacitor before the ageing procedure to prevent the solderability being impaired by the products of any capacitor decomposition that might occur.

Solder bath temperature	235 ±5 °C
Soldering time	2.0 ±0.5 s
Immersion depth	2.0 +0/−0.5 mm from capacitor body or seating plane
Evaluation criteria: Visual inspection	 Wetting of wire surface by new solder ≥90%, free-flowing solder

1.2 Resistance to soldering heat

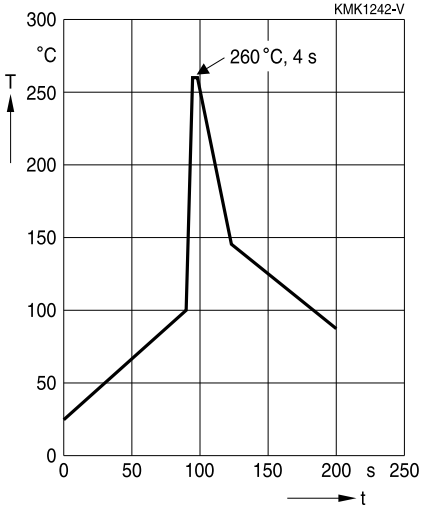
Resistance to soldering heat is tested to IEC 60068-2-20, test Tb, method 1A.
Conditions:

Series		Solder bath temperature	Soldering time
MKT	boxed (except 2.5 × 6.5 × 7.2 mm) coated uncoated (lead spacing > 10 mm)	260 ±5 °C	10 ±1 s
MFP MKP	 (lead spacing > 7.5 mm)		
MKT	boxed (case 2.5 × 6.5 × 7.2 mm)		5 ±1 s
MKP MKT	(lead spacing ≤ 7.5 mm) uncoated (lead spacing ≤ 10 mm) insulated (B32559)		< 4 s recommended soldering profile for MKT uncoated (lead spacing ≤ 10 mm) and insulated (B32559)

MKP

B32656S

Snubber (wound)



Immersion depth	2.0 +0/−0.5 mm from capacitor body or seating plane
Shield	Heat-absorbing board, (1.5 ±0.5) mm thick, between capacitor body and liquid solder
Evaluation criteria:	
Visual inspection	No visible damage
$\Delta C/C_0$	2% for MKT/MKP/MFP 5% for EMI suppression capacitors
tan δ	As specified in sectional specification

1.3 General notes on soldering

Permissible heat exposure loads on film capacitors are primarily characterized by the upper category temperature T_{max}. Long exposure to temperatures above this type-related temperature limit can lead to changes in the plastic dielectric and thus change irreversibly a capacitor's electrical characteristics. For short exposures (as in practical soldering processes) the heat load (and thus the possible effects on a capacitor) will also depend on other factors like:

- Pre-heating temperature and time
- Forced cooling immediately after soldering
- Terminal characteristics:
  diameter, length, thermal resistance, special configurations (e.g. crimping)
- Height of capacitor above solder bath
- Shadowing by neighboring components
- Additional heating due to heat dissipation by neighboring components
- Use of solder-resist coatings

The overheating associated with some of these factors can usually be reduced by suitable countermeasures. For example, if a pre-heating step cannot be avoided, an additional or reinforced cooling process may possibly have to be included.

EPCOS recommends the following conditions:

- Pre-heating with a maximum temperature of 110 °C
- Temperature inside the capacitor should not exceed the following limits:
  - MKP/MFP 110 °C
  - MKT 160 °C
- When SMD components are used together with leaded ones, the leaded film capacitors should not pass into the SMD adhesive curing oven. The leaded components should be assembled after the SMD curing step.
- Leaded film capacitors are not suitable for reflow soldering.

Uncoated capacitors

For uncoated MKT capacitors with lead spacings ≤10 mm (B32560/B32561) the following measures are recommended:

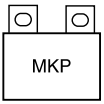
- pre-heating to not more than 110 °C in the preheater phase
- rapid cooling after soldering

Cautions and warnings

- Do not exceed the upper category temperature (UCT).
- Do not apply any mechanical stress to the capacitor terminals.
- Avoid any compressive, tensile or flexural stress.
- Do not move the capacitor after it has been soldered to the PC board.
- Do not pick up the PC board by the soldered capacitor.
- Do not place the capacitor on a PC board whose PTH hole spacing differs from the specified lead spacing.
- Do not exceed the specified time or temperature limits during soldering.
- Avoid external energy inputs, such as fire or electricity.
- Avoid overload of the capacitors.

The table below summarizes the safety instructions that must always be observed. A detailed description can be found in the relevant sections of the chapters "General technical information" and "Mounting guidelines".

Topic	Safety information	Reference chapter "General technical information"
Storage conditions	Make sure that capacitors are stored within the specified range of time, temperature and humidity conditions.	4.5 "Storage conditions"
Flammability	Avoid external energy, such as fire or electricity (passive flammability), avoid overload of the capacitors (active flammability) and consider the flammability of materials.	5.3 "Flammability"
Resistance to vibration	Do not exceed the tested ability to withstand vibration. The capacitors are tested to IEC 60068-2-6. EPCOS offers film capacitors specially designed for operation under more severe vibration regimes such as those found in automotive applications. Consult our catalog "Film Capacitors for Automotive Electronics".	5.2 "Resistance to vibration"



Topic	Safety information	Reference chapter "Mounting guidelines"
Soldering	Do not exceed the specified time or temperature limits during soldering.	1 "Soldering"
Cleaning	Use only suitable solvents for cleaning capacitors.	2 "Cleaning"
Embedding of capacitors in finished assemblies	When embedding finished circuit assemblies in plastic resins, chemical and thermal influences must be taken into account. Caution: Consult us first, if you also wish to embed other uncoated component types!	3 "Embedding of capacitors in finished assemblies"

Symbols and terms

Symbol	English	German
α	Heat transfer coefficient	Wärmeübergangszahl
α_C	Temperature coefficient of capacitance	Temperaturkoeffizient der Kapazität
A	Capacitor surface area	Kondensatoroberfläche
β_C	Humidity coefficient of capacitance	Feuchtekoeffizient der Kapazität
C	Capacitance	Kapazität
C_R	Rated capacitance	Nennkapazität
ΔC	Absolute capacitance change	Absolute Kapazitätsänderung
$\Delta C/C$	Relative capacitance change (relative deviation of actual value)	Relative Kapazitätsänderung (relative Abweichung vom Ist-Wert)
$\Delta C/C_R$	Capacitance tolerance (relative deviation from rated capacitance)	Kapazitätstoleranz (relative Abweichung vom Nennwert)
dt	Time differential	Differentielle Zeit
Δt	Time interval	Zeitintervall
ΔT	Absolute temperature change (self-heating)	Absolute Temperaturänderung (Selbsterwärmung)
$\Delta \tan \delta$	Absolute change of dissipation factor	Absolute Änderung des Verlustfaktors
ΔV	Absolute voltage change	Absolute Spannungsänderung
dV/dt	Time differential of voltage function (rate of voltage rise)	Differentielle Spannungsänderung (Spannungsflankensteilheit)
$\Delta V/\Delta t$	Voltage change per time interval	Spannungsänderung pro Zeitintervall
E	Activation energy for diffusion	Aktivierungsenergie zur Diffusion
ESL	Self-inductance	Eigeninduktivität
ESR	Equivalent series resistance	Ersatz-Serienwiderstand
f	Frequency	Frequenz
f_1	Frequency limit for reducing permissible AC voltage due to thermal limits	Grenzfrequenz für thermisch bedingte Reduzierung der zulässigen Wechselspannung
f_2	Frequency limit for reducing permissible AC voltage due to current limit	Grenzfrequenz für strombedingte Reduzierung der zulässigen Wechselspannung
f_r	Resonant frequency	Resonanzfrequenz
F_D	Thermal acceleration factor for diffusion	Therm. Beschleunigungsfaktor zur Diffusion
F_T	Derating factor	Deratingfaktor
i	Current (peak)	Stromspitze
I_C	Category current (max. continuous current)	Kategoriestrom (max. Dauerstrom)

Symbol	English	German
I_{RMS}	(Sinusoidal) alternating current, root-mean-square value	(Sinusförmiger) Wechselstrom
i_z	Capacitance drift	Inkonstanz der Kapazität
k_0	Pulse characteristic	Impulskennwert
L_S	Series inductance	Serieninduktivität
λ	Failure rate	Ausfallrate
λ_0	Constant failure rate during useful service life	Konstante Ausfallrate in der Nutzungsphase
λ_{test}	Failure rate, determined by tests	Experimentell ermittelte Ausfallrate
P_{diss}	Dissipated power	Abgegebene Verlustleistung
P_{gen}	Generated power	Erzeugte Verlustleistung
Q	Heat energy	Wärmeenergie
ρ	Density of water vapor in air	Dichte von Wasserdampf in Luft
R	Universal molar constant for gases	Allg. Molarkonstante für Gas
R	Ohmic resistance of discharge circuit	Ohmscher Widerstand des Entladekreises
R_i	Internal resistance	Innenwiderstand
R_{ins}	Insulation resistance	Isolationswiderstand
R_P	Parallel resistance	Parallelwiderstand
R_S	Series resistance	Serienwiderstand
S	severity (humidity test)	Schärfegrad (Feuchtetest)
t	Time	Zeit
T	Temperature	Temperatur
τ	Time constant	Zeitkonstante
tan δ	Dissipation factor	Verlustfaktor
tan δ_D	Dielectric component of dissipation factor	Dielektrischer Anteil des Verlustfaktors
tan δ_P	Parallel component of dissipation factor	Parallelanteil des Verlfustfaktors
tan δ_S	Series component of dissipation factor	Serienanteil des Verlustfaktors
T_A	Ambient temperature	Umgebungstemperatur
T_{max}	Upper category temperature	Obere Kategorietemperatur
T_{min}	Lower category temperature	Untere Kategorietemperatur
t_{OL}	Operating life at operating temperature and voltage	Betriebszeit bei Betriebstemperatur und -spannung
T_{op}	Operating temperature	Beriebstemperatur
T_R	Rated temperature	Nenntemperatur
T_{ref}	Reference temperature	Referenztemperatur
t_{SL}	Reference service life	Referenz-Lebensdauer
V_{AC}	AC voltage	Wechselspannung

Symbol	English	German
V_C	Category voltage	Kategoriespannung
$V_{C,RMS}$	Category AC voltage	(Sinusförmige) Kategorie-Wechselspannung
V_{CD}	Corona-discharge onset voltage	Teilentlade-Einsatzspannung
V_{ch}	Charging voltage	Ladespannung
V_{DC}	DC voltage	Gleichspannung
V_{FB}	Fly-back capacitor voltage	Spannung (Flyback)
V_i	Input voltage	Eingangsspannung
V_o	Output voltage	Ausgangssspannung
V_{op}	Operating voltage	Betriebsspannung
V_p	Peak pulse voltage	Impuls-Spitzenspannung
V_{pp}	Peak-to-peak voltage Impedance	Spannungshub
V_R	Rated voltage	Nennspannung
$\hat{v}_R$	Amplitude of rated AC voltage	Amplitude der Nenn-Wechselspannung
V_{RMS}	(Sinusoidal) alternating voltage, root-mean-square value	(Sinusförmige) Wechselspannung
V_{SC}	S-correction voltage	Spannung bei Anwendung "S-correction"
V_{sn}	Snubber capacitor voltage	Spannung bei Anwendung "Beschaltung"
Z	Impedance	Scheinwiderstand
e	Lead spacing	Rastermaß

Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or lifesaving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
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SPECIFICATION

(900A/1200V-IGBT Module)

Device Name : IGBT Module
(RoHS compliant product)

Type Name : 2MBI900VXA-120P-50

Spec. No. : MS5F7567

	DATE	NAME	APPROVAL
DRAWN	25-Jun-10	S.Yoshiwatari	O.Ikawa
CHECKED	25-Jun-10	H.kakiki	
CHECKED	14-Jul-10	K.Ohshika	

Fuji Electric Co., Ltd.

DWG No. **MS5F7567**

a
b

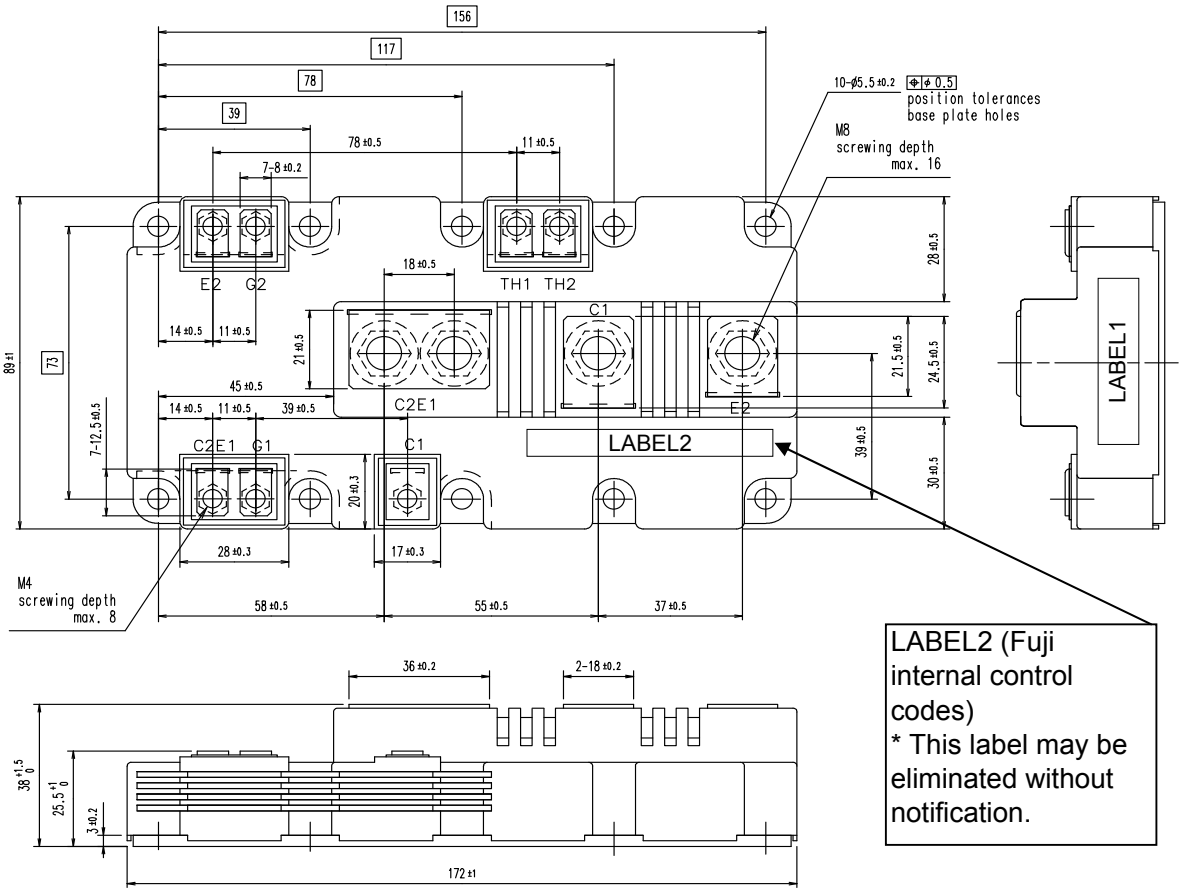
Revised Records

Date	Class-ification	Ind.	Content	Applied date	Drawn	Checked	Checked	Approved
25-Jun.-'10	enactment	-	-	Issued date	S.Yoshiwatari	H.Kakiki	K.Ohshika	O.Ikawa
28-Jun-'11	revised	a	Revised outline drawing, Qg curve, Rth(j-c) curve Added Internal Rg, weight, FWDSOA	28-Jun-'11	H.Ichikawa	S.Miyashita	K.Ohshika	O.Ikawa
31-Aug-'11	revised	b	Revised outline drawing(p3)	31-Aug-'11	H.Ichikawa	S.Miyashita	K.Ohshika	O.Ikawa

Type Name: 2MBI900VXA-120P-50 (RoHS compliant products)

*** V series soft switching chip set .**

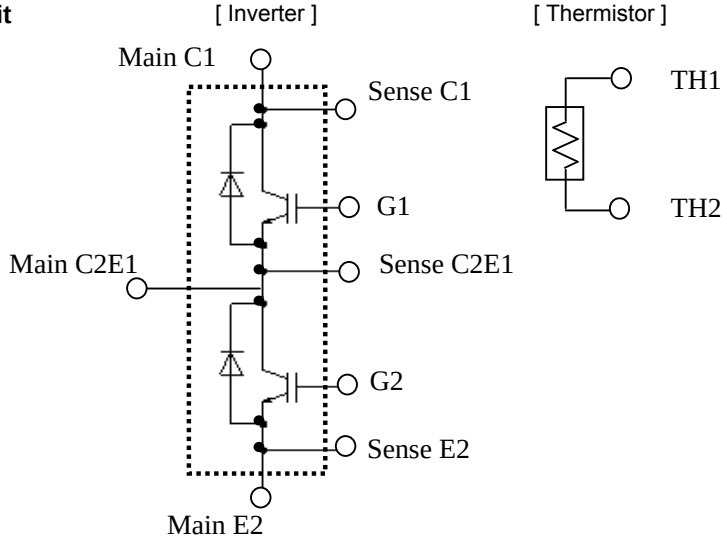
1. Outline Drawing (Unit : mm)(b)



LABEL2 (Fuji internal control codes)
* This label may be eliminated without notification.

Weight:850g(typ.)(a)

2. Equivalent Circuit



3. Maximum Ratings (at Tc= 25°C unless otherwise specified)

Items		Symbols	Conditions		Maximum Ratings	Units
Inverter	Collector-Emitter voltage	Vces			1200	V
	Gate-Emitter voltage	Vges			±20	V
	Collector current	Ic	Continuous	Tc= 25°C	1200	A
				Tc=100°C	900	
		Ic pulse	1ms		1800	
		-Ic			900	
		-Ic pulse	1ms		1800	
	Collector power dissipation	Pc	1 device		5100	W
Junction temperature		Tj			175	°C
Operating junction temperature (under switching conditions)		Tjop			150	
Case temperature		Tc			150	
Storage temperature		Tstg			-40 ~ +150	
Isolation voltage	between terminal and copper base (*1)	Viso	AC: 1min.		4000	VAC
	between thermistor and others (*2)					
Screw Torque *3	Mounting	-	M5		6.0	N m
	Main Terminals	-	M8		10.0	
	Sense Terminals	-	M4		2.1	

(*1) All terminals should be connected together during the test.

(*2) Two thermistor terminals should be connected together,
other terminals should be connected together and shorted to base plate during the test.

(*3) Recommendable Value : Mounting 3.0 ~ 6.0 Nm (M5)
Recommendable Value : Main Terminals 8.0 ~ 10.0 Nm (M8)
Recommendable Value : Sense Terminals 1.8 ~ 2.1 Nm (M4)

4. Electrical characteristics (at Tj= 25°C unless otherwise specified)

NOTICE:

The external gate resistance (Rg) shown below is one of our recommended value for the purpose of minimum switching loss. However the optimum Rg depends on circuit configuration and/or environment.
We recommend that the Rg has to be carefully chosen based on consideration if IGBT module matches design criteria, for example, switching loss, EMC/EMI, spike voltage, surge current and no unexpected oscillation and so on.

	Items	Symbols	Conditions		Characteristics min.	Characteristics typ.	Characteristics max.	Units	
Inverter	Zero gate voltage Collector current	Ices	Vge=0V, Vce=1200V		-	-	8.0	mA	
	Gate-Emitter leakage current	Iges	Vce=0V, Vge=±20V		-	-	1600	nA	
	Gate-Emitter threshold voltage	Vge(th)	Vce=20V, Ic=900mA		6.0	6.5	7.0	V	
	Collector-Emitter saturation voltage	Vce(sat) (terminal) *1	Vge=15V, Ic=900A	Tj=25°C	-	1.75	2.20	V	
				Tj=125°C	-	2.10	-		
				Tj=150°C	-	2.15	-		
		Vce(sat) (chip)		Tj=25°C	-	1.65	2.10		
				Tj=125°C	-	2.00	-		
				Tj=150°C	-	2.05	-		
	Internal gate resistance	Rg(int)	-		-	1.19	-	Ω	(a)
	Input capacitance	Cies	Vce=10V, Vge=0V, *f*=1MHz		-	83	-	nF	
	Turn-on time	ton	Vcc=600V, Ic=900A, Vge=±15V, Rg=1.6Ω,Ls=70nH		-	1000	-	nsec	
		tr			-	400	-		
		tr(i)			-	150	-		
	Turn-off time	toff			-	1200	-		
		tf			-	150	-		
	Forward on voltage	Vf (terminal) *1	Vge=0V, If=900A	Tj=25°C	-	1.90	2.35	V	
				Tj=125°C	-	2.05	-		
				Tj=150°C	-	2.00	-		
		Vf (chip)		Tj=25°C	-	1.80	2.25		
				Tj=125°C	-	1.95	-		
				Tj=150°C	-	1.90	-		
	Reverse recovery time	trr	If=900A		-	200	-	nsec	
Thermistor	Resistance	R	T=25°C		-	5000	-	Ω	
			T=100°C		465	495	520		
	B value	B	T=25/50°C		3305	3375	3450	K	

*1 Please refer to section 14 , there is definition of on-state voltage at terminal .

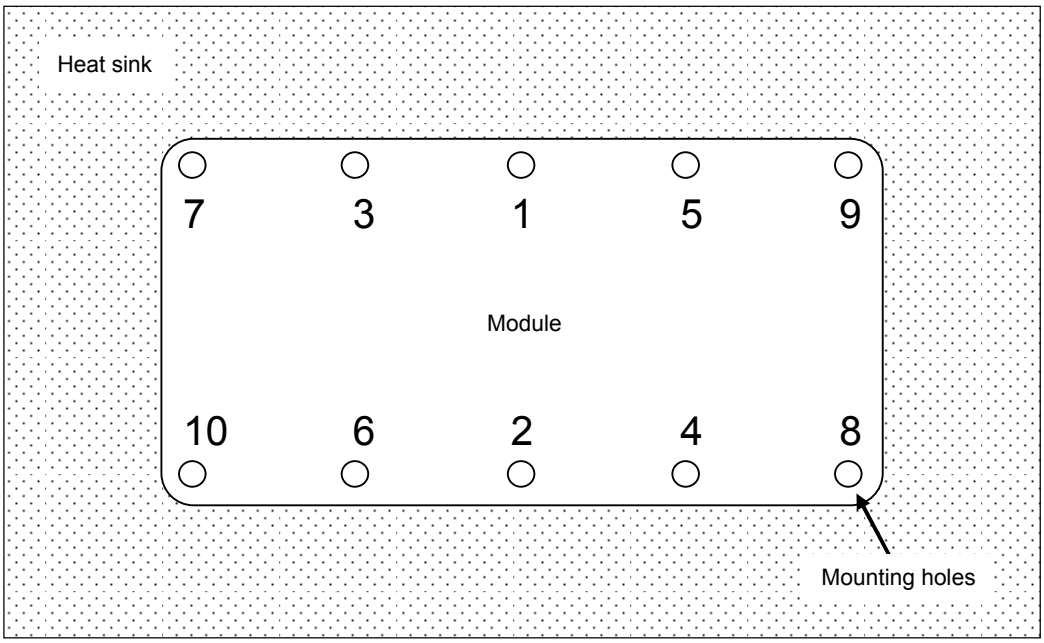
5. Thermal resistance characteristics

Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Thermal resistance(1device)	Rth(j-c)	Inverter IGBT	-	-	0.030	°C/W
		Inverter FWD	-	-	0.054	
Contact thermal resistance (1device) (*1)	Rth(c-f)	with Thermal Compound	-	0.00625	-	

(*1) This is the value which is defined mounting on the additional cooling fin with thermal compound.

6. Recommend way of module mounting to Heat sink Clamping

(1) Initial : 1/3 specified torque, sequence 1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 →10
(2) Final : Full specified torque ,sequence 1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 →10



7. Indication on module（モジュール表示）

Display on the module label
- Logo of production
- Type name : 2MBI900VXA-120P-50
- IC, VCES rating 900A 1200V
- Lot No. (5 digits)
- Place of manufacturing (code)
- Bar code

8. Applicable Category

This specification is applied to IGBT Module named 2MBI900VXA-120P-50 .
本納入仕様書はIGBTモジュール 2MBI900VXA-120P-50に適用する。

9. Storage and transportation notes（保管・運搬上の注意事項）

- The module should be stored at a standard temperature of 5 to 35°C and humidity of 45 to 75% .
  Be careful to solderability of the terminals if the module has passed over one year from manufacturing date, under the above storage condition.
  常温・常湿保存が望ましい。(5～35°C, 45～75%)
  本保存条件下で、製造から1年以上経過した場合は端子半田付け性に十分注意すること。

- Store modules in a place with few temperature changes in order to avoid condensation on the module surface.
  急激な温度変化のなきこと。(モジュール表面が結露しないこと)

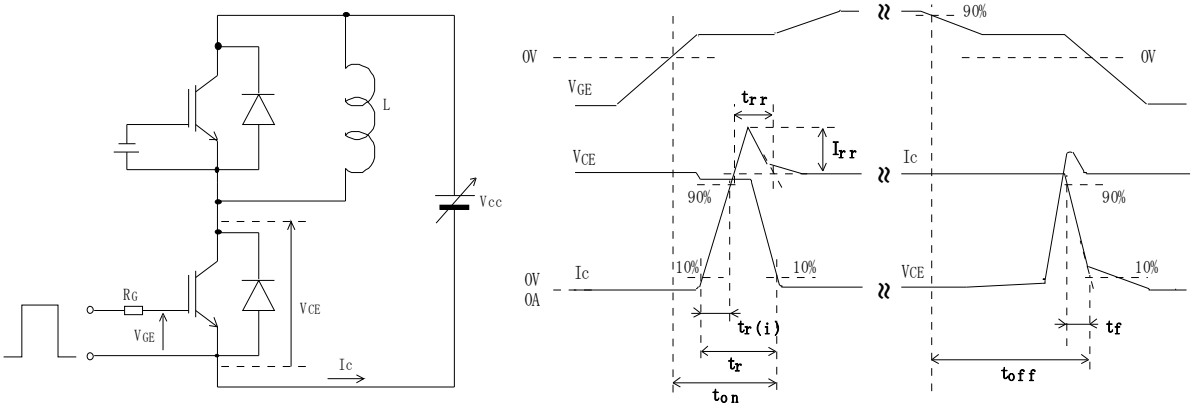
- Avoid exposure to corrosive gases and dust.
  腐食性ガスの発生場所、塵埃の多い場所は避けること。

- Avoid excessive external force on the module.
  製品に荷重がかからないように十分注意すること。

- Store modules with unprocessed terminals.
  モジュールの端子は未加工の状態で保管すること。

- Do not drop or otherwise shock the modules when transporting.
  製品の運搬時に衝撃を与えたり、落下させたりしないこと。

10. Definitions of switching time（スイッチング時間の定義）



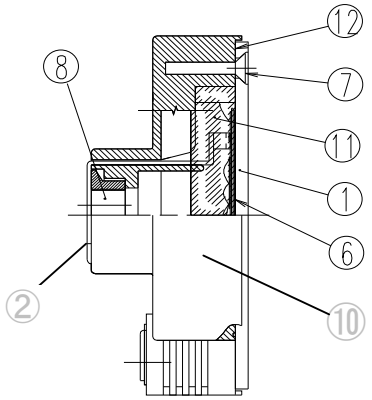
11. Packing and labeling（梱包仕様）

Display on the packing box
- Logo of production
- Type name
- Lot No
- Products quantity in a packing box

12. RoHS directive compliance（RoHS指令適用について）

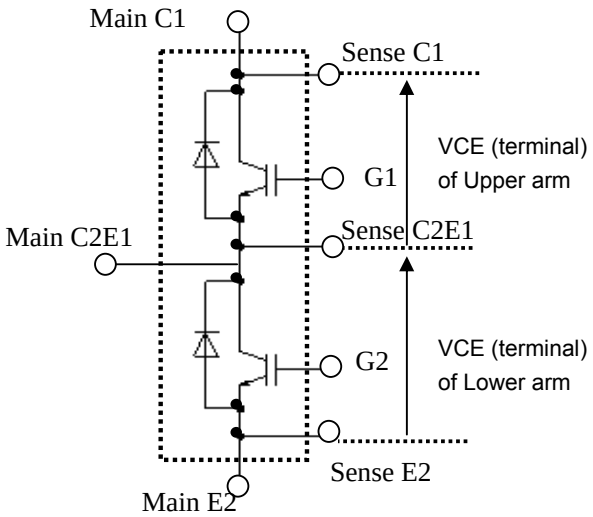
The document (MS5F6209) about RoHS that Fuji Electric issued is applied to this IGBT Module. The Japanese Edition(MS5F6212) is made into a reference grade.
本IGBTモジュールは富士電機が発行しているRoHSに関する資料MS5F6209を適用する。
日本語版(MS5F6212)は参考資料とする。

13. List of materials（材料リスト）



No.	Parts	Material (main)	Ref.
1	Base Plate	Cu	Ni plating
2	Terminal	Cu	Ni plating
3	FWD chip	Silicon	(Not drawn in above)
4	IGBT chip	Silicon	(Not drawn in above)
5	Wiring	Aluminum	(Not drawn in above)
6	Solder (Under chip) (Under Isolation substrate)	 Sn/Ag base Sn/Sb base	
7	Screw	Fe	
8	Nut	Fe	
9	Label	PET	(Not drawn in above)
10	Case	PPS resin	UL 94-V0
11	Silicone gel	Silicone resin	
12	Adhesive	Silicone resin	
13	Isolation substrate	Al2O3 + Cu	(Not drawn in above)
14	Resistance Chip	Silicon	(Not drawn in above)
15	Thermistor	Lead glass	(Not drawn in above)

14. Definition of on-state voltage at terminal and switching characteristics
（オン電圧端子値とスイッチング特性についての定義）



Fuji defined VCE value of terminal by using Sense C1 and Sense C2E1 for Upper arm and Sense C2E1 and Sense E2 for Lower arm .

Switching characteristics of VCE also is defined between Sense C1 and Sense C2E1 for Upper arm and Sense C2E1 and Sense E2 for Lower arm .

Please use these terminals whenever measure spike voltage and on-state voltage .

15. Reliability test results

Reliability Test Items

Test categories		Test items	Test methods and conditions	Reference norms EIAJ ED-4701 (Aug.-2001 edition)	Number of sample	Acceptance number
Mechanical Tests	1	Terminal Strength (Pull test)	Pull force : 20N (Control terminal) 40N (Main terminal) Test time : 10±1 sec.	Test Method 401 method Ⅰ	5	(0 : 1)
	2	Mounting Strength	Screw torque : 1.8 ~ 2.1 Nm (M4) 3.0 ~ 6.0 N·m (M5) 8.0 ~ 10.0 Nm（M8） Test time : 10±1 sec.	Test Method 402 method Ⅱ	5	(0 : 1)
	3	Vibration	Range of frequency : 10 ~ 500Hz Sweeping time : 15 min. Acceleration : 100m/s^2 Sweeping direction : Each X,Y,Z axis Test time : 6 hr. (2hr./direction)	Test Method 403 Reference 1 Condition code B	5	(0 : 1)
	4	Shock	Maximum accelerat : 5000m/s^2 Pulse width : 1.0msec. Direction : Each X,Y,Z axis Test time : 3 times/direction	Test Method 404 Condition code B	5	(0 : 1)
Environment Tests	1	High Temperature Storage	Storage temp. : 125 ± 5 °C Test duration : 1000hr.	Test Method 201	5	(0 : 1)
	2	Low Temperature Storage	Storage temp. : -40 ± 5 °C Test duration : 1000hr.	Test Method 202	5	(0 : 1)
	3	Temperature Humidity Storage	Storage temp. : 85 ± 2 °C Relative humidity : 85 ± 5% Test duration : 1000hr.	Test Method 103 Test code C	5	(0 : 1)
	4	Unsaturated Pressurized Vapor	Test temp. : 120 ± 2 °C Test humidity : 85 ± 5% Test duration : 96hr.	Test Method 103 Test code E	5	(0 : 1)
	5	Temperature Cycle	Low temp. -40 ± 5 °C Test temp. : High temp. 125 ± 5 °C RT 5 ~ 35 °C Dwell time : High ~ RT ~ Low ~ RT 1hr. 0.5hr. 1hr. 0.5hr. Number of cycles : 100 cycles	Test Method 105	5	(0 : 1)
	6	Thermal Shock	Test temp. : High temp. 100 $^{+0}_{-5}$ °C Used liquid : Water with ice and boiling water Dipping time : 5 min. par each temp. Transfer time : 10 sec. Number of cycles : 10 cycles	Test Method 307 method Ⅰ Condition code B	5	(0 : 1)

Reliability Test Items

Test categories		Test items	Test methods and conditions	Reference norms EIAJ ED-4701 (Aug.-2001 edition)	Number of sample	Acceptance number
Endurance Tests	1	High temperature Reverse Bias (for Collector - Emitter)	Test temp. : Tj = 150 ℃(-0 ℃/+5 ℃) Bias Voltage : VC = 0.8×VCES Bias Method : Applied DC voltage to C-E VGE = 0V Test duration : 1000hr.	Test Method 101	5	(0 : 1)
	2	High temperature Bias (for gate)	Test temp. : Tj = 150 ℃(-0 ℃/+5 ℃) Bias Voltage : VC = VGE = +20V or -20V Bias Method : Applied DC voltage to G-E VCE = 0V Test duration : 1000hr.	Test Method 101	5	(0 : 1)
	3	Temperature Humidity Bias	Test temp. : 85±2 ℃ Relative humidit : 85±5% Bias Voltage : VC = 0.8×VCES Bias Method : Applied DC voltage to C-E VGE = 0V Test duration : 1000hr.	Test Method 102 Condition code C	5	(0 : 1)
	4	Intermitted Operating Life (Power cycle) (for IGBT)	ON time : 2 sec. OFF time : 18 sec. Test temp. : 100±5 deg Tj ≦ 150 ℃, Ta=25±5 ℃ No. of cycles : 15000 cycles	Test Method 106	5	(0 : 1)

Failure Criteria

Item	Characteristic		Symbol	Failure criteria		Unit	Note
				Lower limit	Upper limit		
Electrical characteristic	Leakage current		ICES	-	USL×2	mA	
			±IGES	-	USL×2	μA	
	Gate threshold voltage		VGE(th)	LSL×0.8	USL×1.2	V	
	Saturation voltage		VCE(sat)	-	USL×1.2	V	
	Forward voltage		VF	-	USL×1.2	V	
	Thermal resistance	IGBT	Δ VGE or Δ VCE	-	USL×1.2	mV	
		FWD	Δ VF	-	USL×1.2	mV	
	Isolation voltage		Viso	Broken insulation		-	
Visual inspection	Visual inspection ┌ Peeling, Plating, └ and the others		-	The visual sample		-	

LSL : Lower specified limit.
USL : Upper specified limit.

Note :

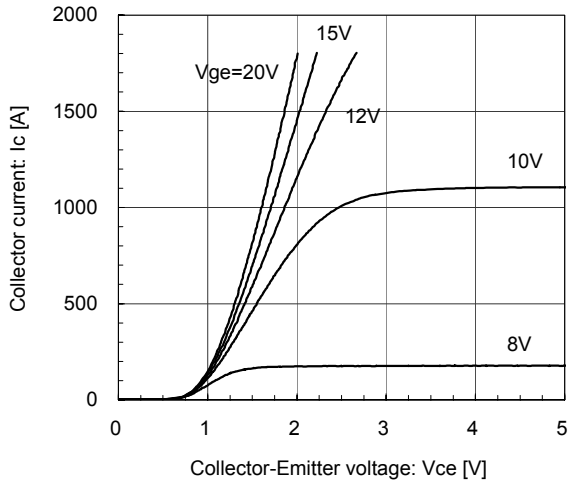
Each parameter measurement read-outs shall be made after stabilizing the components at room ambient for 2 hours minimum, 24 hours maximum after removal from the tests. And in case of the wetting tests, for example, moisture resistance tests, each component shall be made wipe or dry completely before the measurement.

Reliability Test Results

Test categories		Test items	Reference norms EIAJ ED-4701 (Aug.-2001 edition)	Number of test sample	Number of failure sample
Mechanical Tests	1	Terminal Strength (Pull test)	Test Method 401 Method Ⅰ	5	0
	2	Mounting Strength	Test Method 402 method Ⅱ	5	0
	3	Vibration	Test Method 403 Condition code B	5	0
	4	Shock	Test Method 404 Condition code B	5	0
Environment Tests	1	High Temperature Storage	Test Method 201	5	0
	2	Low Temperature Storage	Test Method 202	5	0
	3	Temperature Humidity Storage	Test Method 103 Test code C	5	0
	4	Unsaturated Pressurized Vapor	Test Method 103 Test code E	5	0
	5	Temperature Cycle	Test Method 105	5	0
	6	Thermal Shock	Test Method 307 method Ⅰ Condition code A	5	0
Endurance Tests	1	High temperature Reverse Bias	Test Method 101	5	0
	2	High temperature Bias (for gate)	Test Method 101	5	0
	3	Temperature Humidity Bias	Test Method 102 Condition code C	5	0
	4	Intermitted Operating Life (Power cycling) (for IGBT)	Test Method 106	5	0

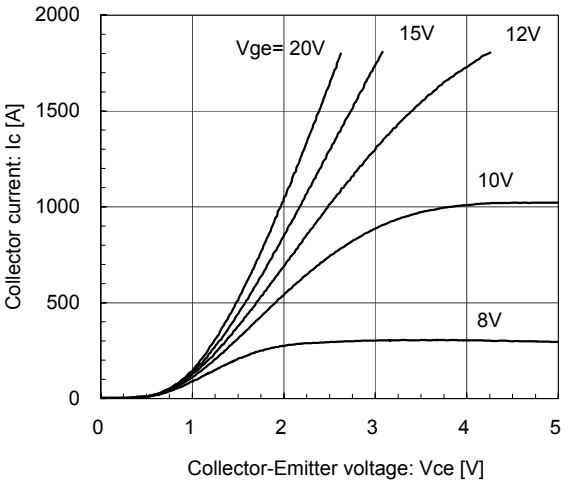
[INVERTER]

Collector current vs. Collector-Emitter voltage (typ.)
Tj= 25°C / chip



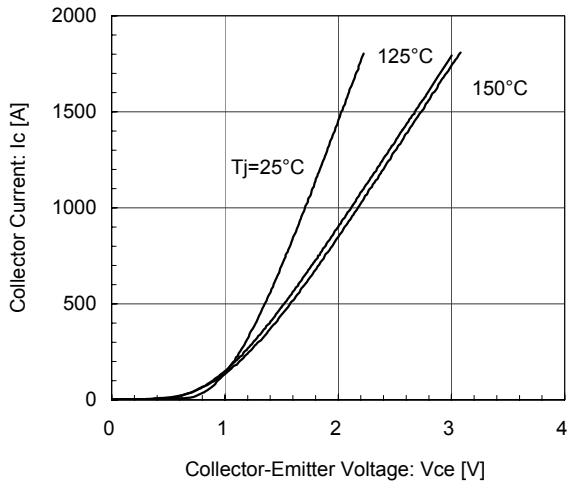
[INVERTER]

Collector current vs. Collector-Emitter voltage (typ.)
Tj= 150°C / chip



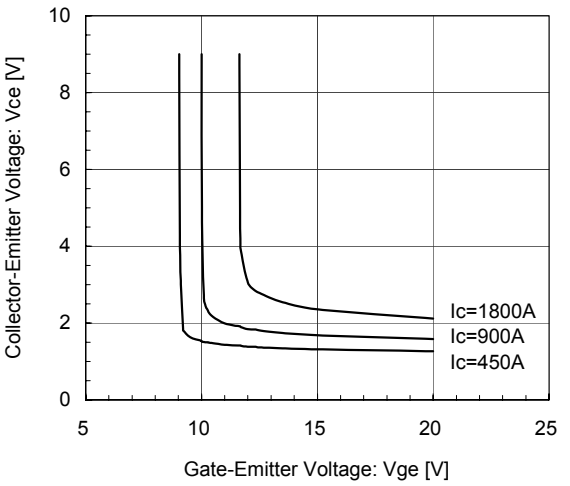
[INVERTER]

Collector current vs. Collector-Emitter voltage (typ.)
Vge= 15V / chip



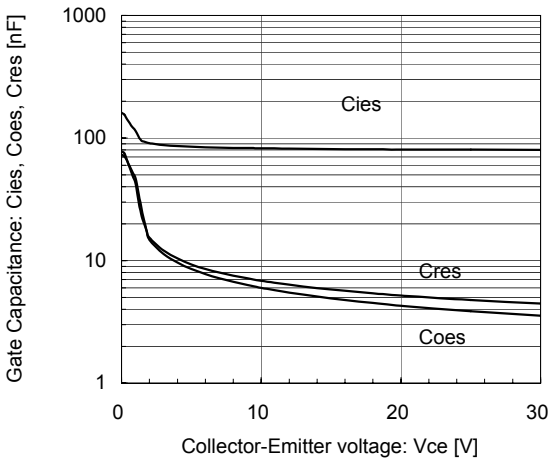
[INVERTER]

Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)
Tj= 25°C / chip



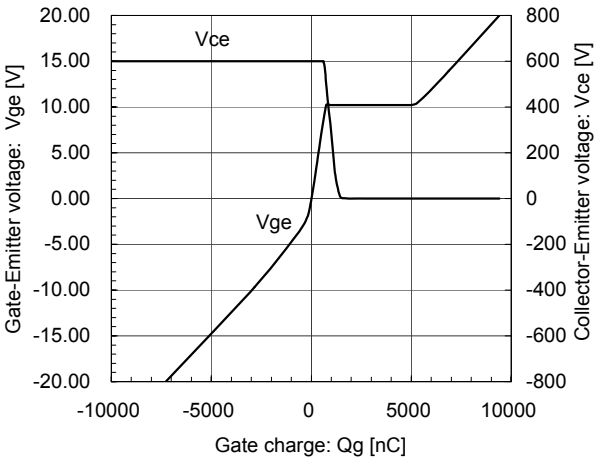
[INVERTER]

Gate Capacitance vs. Collector-Emitter Voltage (typ.)
Vge= 0V, f= 1MHz, Tj= 25°C



[INVERTER]

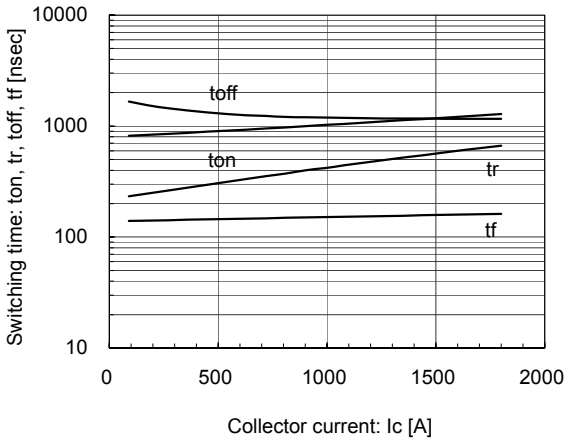
Dynamic Gate Charge (typ.)(a)
Vcc=600V, Ic=900A, Tj= 25°C



[INVERTER]

Switching time vs. Collector current (typ.)

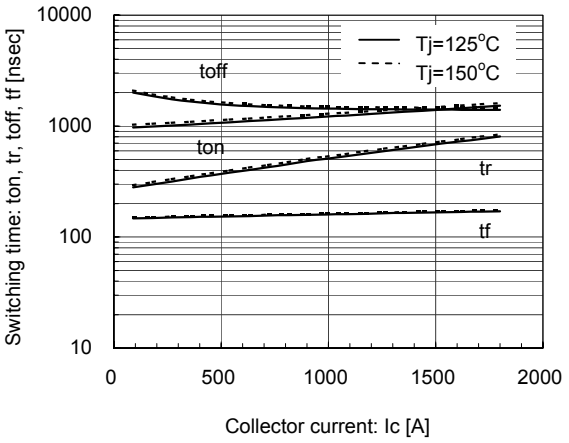
Vcc=600V, Vge=±15V, Rg=1.6Ω, Tj=25°C



[INVERTER]

Switching time vs. Collector current (typ.)

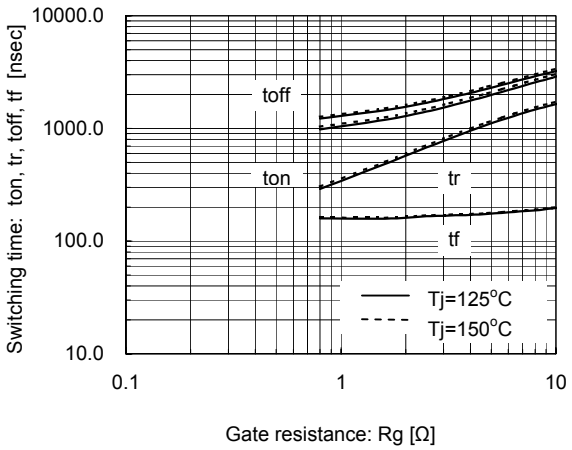
Vcc=600V, Vge=±15V, Rg=1.6Ω, Tj=125°C, 150°C



[INVERTER]

Switching time vs. Gate resistance (typ.)

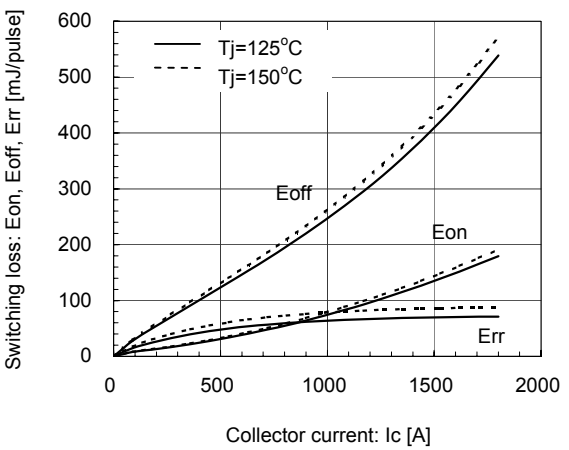
Vcc=600V, Ic=900A, Vge=±15V, Tj=125°C, 150°C



[INVERTER]

Switching loss vs. Collector current (typ.)

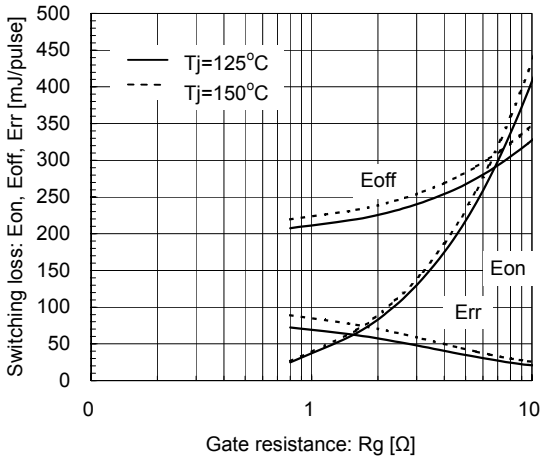
Vcc=600V, Vge=±15V, Rg=1.6Ω, Tj=125°C, 150°C



[INVERTER]

Switching loss vs. Gate resistance (typ.)

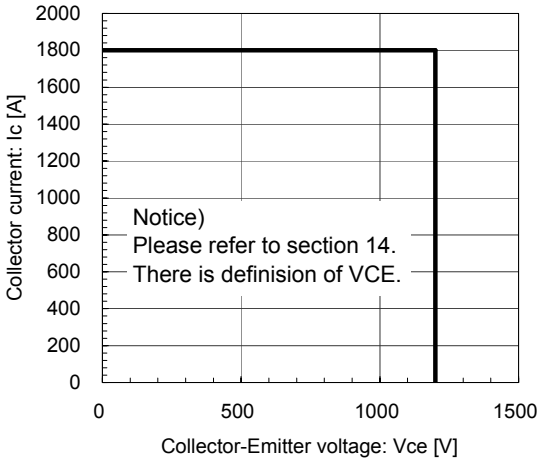
Vcc=600V, Ic=900A, Vge=±15V, Tj=125°C, 150°C



[INVERTER]

Reverse bias safe operating area (max.)

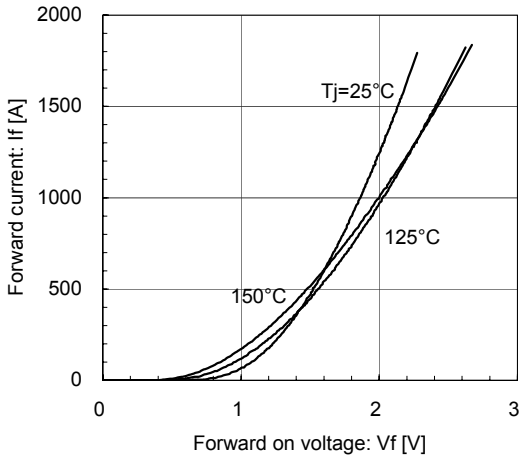
+Vge=15V, -Vge=15V, Rg=1.6Ω, Tj=150°C



[INVERTER]

Forward Current vs. Forward Voltage (typ.)

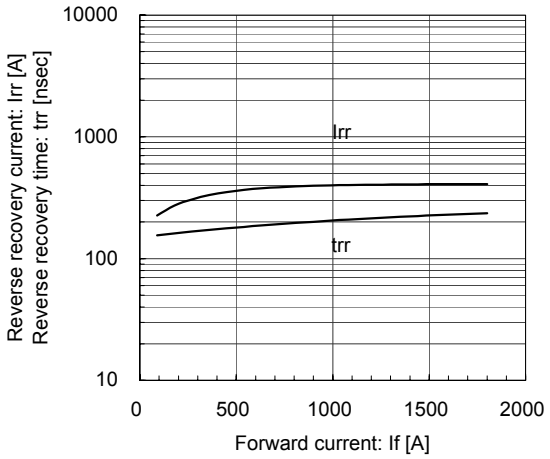
chip



[INVERTER]

Reverse Recovery Characteristics (typ.)

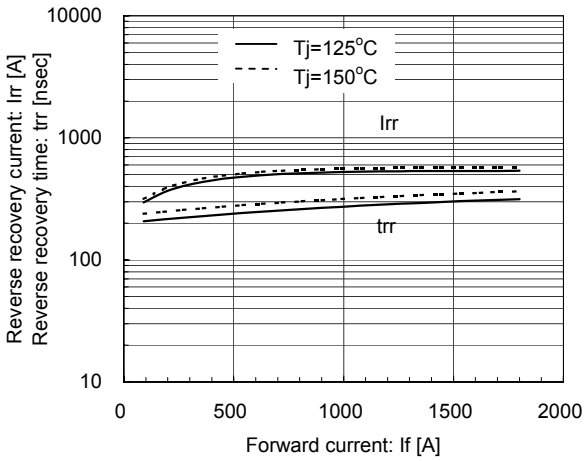
Vcc=600V, Vge=±15V, Rg=1.6Ω, Tj=25°C



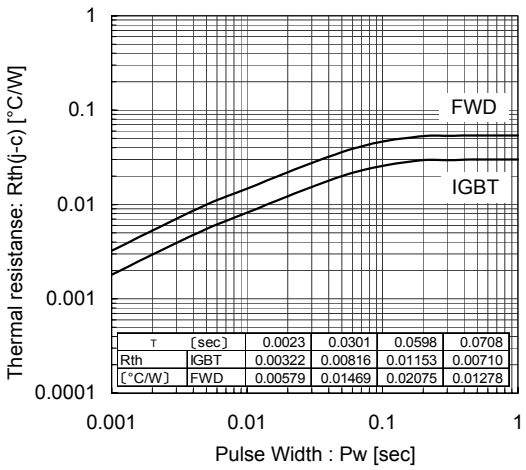
[INVERTER]

Reverse Recovery Characteristics (typ.)

Vcc=600V, Vge=±15V, Rg=1.6Ω, Tj=125°C, 150°C



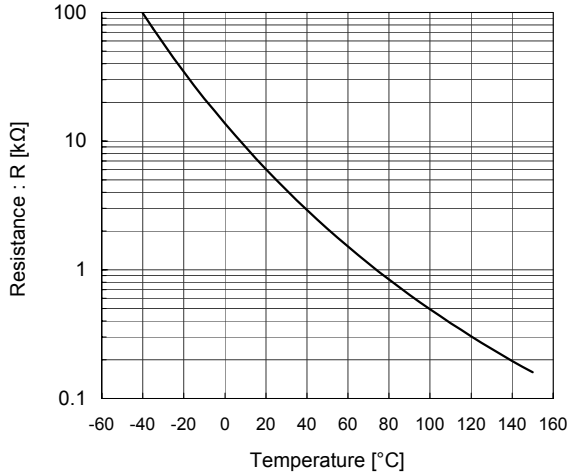
Transient Thermal Resistance (max.)(a)



T	[sec]	0.0023	0.0301	0.0598	0.0708
Rth	IGBT	0.00322	0.00816	0.01153	0.00710
[°C/W]	FWD	0.00579	0.01469	0.02075	0.01278

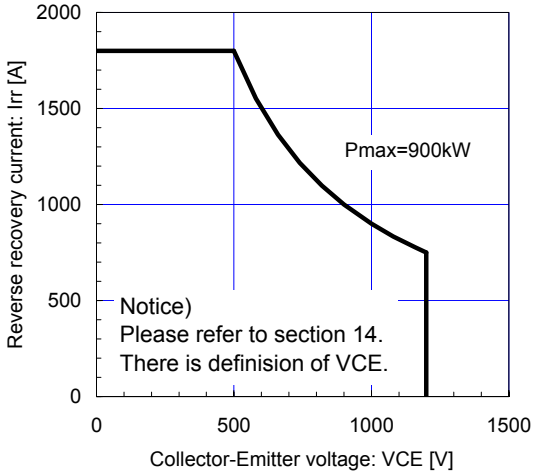
[THERMISTOR]

Temperature characteristic (typ.)



FWD safe operating area (max.)(a)

Tj=150°C



Warnings

- This product shall be used within its maximum rating (voltage, current, and temperature). This product may be broken in case of using beyond the maximum ratings.
  製品の最大定格（電圧，電流，温度等）の範囲内で御使用下さい。最大定格を超えて使用すると、素子が破壊する場合があります。

- Connect adequate fuse or protector of circuit between three-phase line and this product to prevent the equipment from causing secondary destruction, such as fire, its spreading, or explosion.
  万一の不慮の事故で素子が破壊した場合を考慮し、商用電源と本製品の間に適切な容量のヒューズ又はブレーカーを必ず付けて火災，爆発，延焼等の2次破壊を防いでください。

- Use this product after realizing enough working on environment and considering of product's reliability life. This product may be broken before target life of the system in case of using beyond the product's reliability life.
  製品の使用環境を十分に把握し、製品の信頼性寿命が満足できるか検討の上、本製品を適用して下さい。製品の信頼性寿命を超えて使用した場合、装置の目標寿命より前に素子が破壊する場合があります。

- If the product had been used in the environment with acid, organic matter, and corrosive gas (hydrogen sulfide, sulfurous acid gas), the product's performance and appearance can not be ensured easily.
  酸・有機物・腐食性ガス（硫化水素，亜硫酸ガス等）を含む環境下で使用された場合、製品機能・外観等の保証はできません。

- Use this product within the power cycle curve (Technical Rep.No. : MT5F12959). Power cycle capability is classified to delta-Tj mode which is stated as above and delta-Tc mode. Delta-Tc mode is due to rise and down of case temperature (Tc), and depends on cooling design of equipment which use this product. In application which has such frequent rise and down of Tc, well consideration of product life time is necessary.
  本製品は、パワーサイクル寿命カーブ以下で使用下さい(技術資料No.: MT5F12959)。パワーサイクル耐量にはこのΔTj による場合の他に、ΔTcによる場合があります。これはケース温度(Tc)の上昇下降による熱ストレスであり、本製品をご使用する際の放熱設計に依存します。ケース温度の上昇下降が頻繁に起こる場合は、製品寿命に十分留意してご使用下さい。

- Never add mechanical stress to deform the main or control terminal. The deformed terminal may cause poor contact problem.
  主端子及び制御端子に応力を与えて変形させないで下さい。 端子の変形により、接触不良などを引き起こす場合があります。

- Use this product with keeping the cooling fin's flatness and surface roughness in mounting area with in flatness 30um and surface roughness 10um . Also keep the tightening torque within the limits of this specification. Too large convex of cooling fin may cause isolation breakdown and this may lead to a critical accident. On the other hand, too large concave of cooling fin makes gap between this product and the fin bigger, then, thermal conductivity will be worse and over heat destruction may occur.
  冷却フィンは製品の取り付け範囲で平坦度を30um以下、表面の粗さは10um以下にして下さい。
  過大な凸反りがあったりすると本製品が絶縁破壊を起こし、重大事故に発展する場合があります。また、過大な凹反りやゆがみ等があると、本製品と冷却フィンの間に空隙が生じて放熱が悪くなり、熱破壊に繋がることがあります。

Warnings

- In case of mounting this product on cooling fin, use thermal compound to secure thermal conductivity. If the thermal compound amount was not enough or its applying method was not suitable, its spreading will not be enough, then, thermal conductivity will be worse and thermal run away destruction may occur.
  Confirm spreading state of the thermal compound when its applying to this product.
  (Spreading state of the thermal compound can be confirmed by removing this product after mounting.)
  素子を冷却フィンに取り付ける際には、熱伝導を確保するためのコンパウンド等をご使用ください。又、塗布量が不足したり、塗布方法が不適だったりすると、コンパウンドが十分に素子全体に広がらず、放熱悪化による熱破壊に繋がる事があります。
  コンパウンドを塗布する際には、製品全面にコンパウンドが広がっている事を確認してください。
  (実装した後に素子を取りはずすとコンパウンドの広がり具合を確認する事が出来ます。)

- It shall be confirmed that IGBT's operating locus of the turn-off voltage and current are within the RBSOA specification. This product may be broken if the locus is out of the RBSOA.
  ターンオフ電圧・電流の動作軌跡がRBSOA仕様内にあることを確認して下さい。RBSOAの範囲を超えて使用すると素子が破壊する可能性があります。

- If excessive static electricity is applied to the control terminals, the devices may be broken. Implement some countermeasures against static electricity.
  制御端子に過大な静電気が印加された場合、素子が破壊する場合があります。取り扱い時は静電気対策を実施して下さい。

- Never add the excessive mechanical stress to the main or control terminals when the product is applied to equipments. The module structure may be broken.
  素子を装置に実装する際に、主端子や制御端子に過大な応力を与えないで下さい。端子構造が破壊する可能性があります。

- In case of insufficient -VGE, erroneous turn-on of IGBT may occur. -VGE shall be set enough value to prevent this malfunction. (Recommended value : -VGE = -15V)
  逆バイアスゲート電圧-VGEが不足しますと誤点弧を起こす可能性があります。誤点弧を起こさない為に-VGEは十分な値で設定して下さい。(推奨値 : -VGE = -15V)

- In case of higher turn-on dv/dt of IGBT, erroneous turn-on of opposite arm IGBT may occur. Use this product in the most suitable drive conditions, such as +VGE, -VGE, RG, CGE to prevent the malfunction.
  ターンオン dv/dt が高いと対向アームのIGBTが誤点弧を起こす可能性があります。誤点弧を起こさない為の最適なドライブ条件(+VGE, -VGE, RG, CGE)でご使用下さい。

- This product may be broken by avalanche in case of VCE beyond maximum rating VCES is applied between C-E terminals. Use this product within its maximum voltage.
  VCESを超えた電圧が印加された場合、アバランシェを起こして素子破壊する場合があります。VCEは必ず最大定格の範囲内でご使用下さい。

Cautions

- Fuji Electric is constantly making every endeavor to improve the product quality and reliability. However, semiconductor products may rarely happen to fail or malfunction. To prevent accidents causing injury or death, damage to property like by fire, and other social damage resulted from a failure or malfunction of the Fuji Electric semiconductor products, take some measures to keep safety such as redundant design, spread-fire-preventive design, and malfunction-protective design.
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- The application examples described in this specification only explain typical ones that used the Fuji Electric products. This specification never ensure to enforce the industrial property and other rights, nor license the enforcement rights.
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- The product described in this specification is not designed nor made for being applied to the equipment or systems used under life-threatening situations. When you consider applying the product of this specification to particular used, such as vehicle-mounted units, shipboard equipment, aerospace equipment, medical devices, atomic control systems and submarine relaying equipment or systems, please apply after confirmation of this product to be satisfied about system construction and required reliability.
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If there is any unclear matter in this specification, please contact Fuji Electric Co., Ltd.

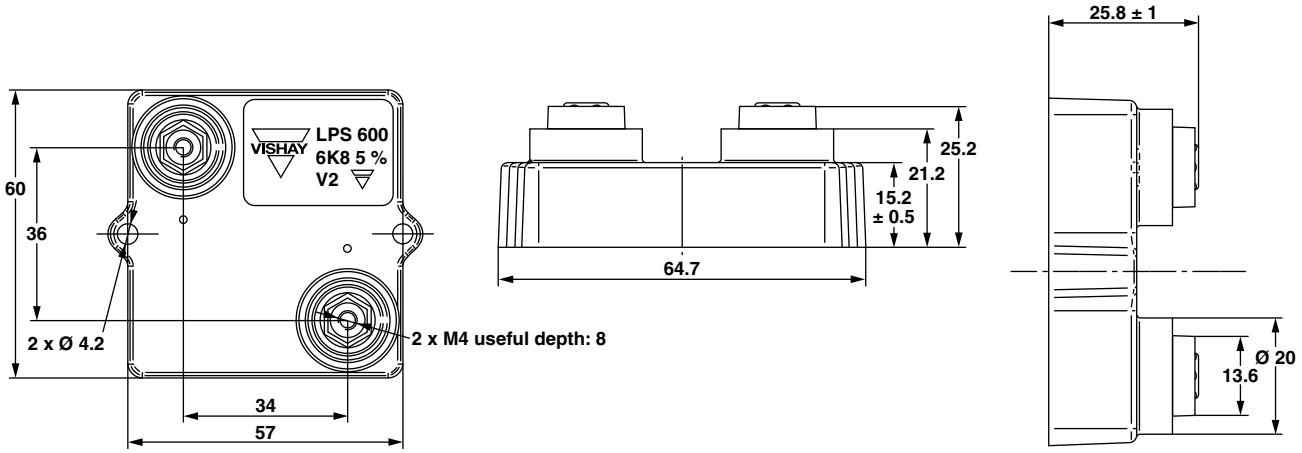
Power Resistor for Mounting onto a Heatsink Thick Film Technology

FEATURES

- 600 W at 85 °C bottom case temperature
- Wide resistance range: 0.3 Ω to 900 kΩ E24 series
- Non inductive
- Easy mounting
- Low thermal radiation of the case
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

DIMENSIONS in millimeters



Note

- Tolerances unless stated: ± 0.2 mm

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	RESISTANCE RANGE Ω	RATED POWER $P_{85\,°C}$ W	LIMITING ELEMENT VOLTAGE U_L V	TOLERANCE ± %	TEMPERATURE COEFFICIENT ± ppm/°C	CRITICAL RESISTANCE (Ω)
LPS 600	0.3 to 900K	600	5K	1, 2, 5, 10	150, 300, 500	41.66K

MECHANICAL SPECIFICATIONS

Mechanical Protection	Insulated case UL 94 V-0
Resistive Element	Thick film
Substrate	Alumina
End Connections	Screws M4
Tightening Torque Connections	2 Nm
Tightening Torque Heatsink	2 Nm
Maximum Torque	2.5 Nm
Weight	83 g ± 10 %

ENVIRONMENTAL SPECIFICATIONS

Temperature Range	- 55 °C to 155 °C
Climatic Category	55/155/56

TECHNICAL SPECIFICATIONS

Power Rating and Thermal Resistance	600 W at + 85 °C bottom case temperature $R_{TH\,(j-c)}$: 0.112 °C/W
Temperature Coefficient - 55 °C/155 °C IEC 60115-1 **Standard**	$R \leq 1\ \Omega$: ± 500 ppm/°C $1\ \Omega < R \leq 10\ \Omega$: ± 300 ppm/°C $10\ \Omega < R$: ± 150 ppm/°C
Dielectric Strength IEC 60115-1, 1 min, 10 mA max.	7 kV_{RMS} or 12 kV_{RMS}
Lightning test 1.2/50 µs IEC 61000-4-5	Until 12 kV
Insulation Resistance	≥ 10^4 MΩ
Inductance	≤ 0.1 µH
Partial Discharge (for LPS 600 D only)	≤ 100 pC/7 kV ≤ 10 pC/5 kV Other cases: Consult us

PERFORMANCE		
TESTS	**CONDITIONS**	**REQUIREMENTS**
Momentary Overload	IEC 60115-1 2 x P_r/10 s $U_{max.} \leq U_L$ = 5000 V	± (0.25 % + 0.05 Ω)
Rapid Temperature Change	IEC 60115-1/IEC 60068-2-14 Test Na 50 cycles - 55 °C to + 155 °C	± (0.5 % + 0.05 Ω)
Load Life	IEC 60115-1 1000 h (90/30) P_r at 85 °C	± (0.5 % + 0.05 Ω)
Humidity (Steady State)	IEC 60115-1 56 days RH 95 %/40 °C	± (0.5 % + 0.05 Ω)
Vibration	MIL STD 202 method 204 cond. D (10 *g*; 5/500 Hz)	± (0.25 % + 0.05 Ω)
Climatic Sequence	IEC 60115-1 (55/155/56)	± (1 % + 0.05 Ω)

RECOMMENDATIONS FOR MOUNTING ONTO A HEATSINK

- Surfaces in contact must be carefully cleaned.
- The heatsink must have an acceptable flatness: From 0.05 mm to 0.1 mm/100 mm.
- Roughness of the heatsink must be around 6.3 µm. In order to improve thermal conductivity, surfaces in contact (alumina, heatsink) should be coated with a silicone grease (type Bluesil Past 340 from BlueStar Silicones) or a thermal film (type Q Pad II) easier and faster to install than the grease.
- The fastening of the resistor to the heatsink is under pressure control of two screws tightened at 2 Nm for full power availability.

Tightening Torque on Heatsink	LPS 600
	2 Nm

- The following accessories are supplied with each product:
  - 2 screws CHC M4 x 25 class 8.8 and 2 M4 contact lock washers for heatsink mounting
  - 2 screws TH M4 x 6/6 and 2 M4 contact lock washers for connections

CHOICE OF THE HEATSINK

The user must choose the heatsink according to the working conditions of the component (power, room temperature). Maximum working temperature must not exceed 155 °C. The dissipated power is simply calculated by the following ratio:

$$P = \frac{\Delta T}{R_{TH\ (j\ -\ c)} + R_{TH\ (c\ -\ h)} + R_{TH\ (h\ -\ a)}}$$

P: Expressed in W

ΔT: Difference between maximum working temperature and room temperature

$R_{TH\ (j\ -\ c)}$: Thermal resistance value measured between resistive layer and outer side of the resistor. It is the thermal resistance of the component: (see specifications environmental paragraph).

$R_{TH\ (c\ -\ h)}$: Thermal resistance value measured between outer side of the resistor and upper side of the heatsink. This is the thermal resistance of the interface (grease, thermal pad), and the quality of the fastening device.

$R_{TH\ (h\ -\ a)}$: Thermal resistance of the heatsink.

Example:

$R_{TH\ (c\ -\ a)}$ for LPS 600 power dissipation 180 W at + 50 °C room temperature.

$\Delta T \leq 155\ °C - 50\ °C = 105\ °C$

$R_{TH\ (j\ -\ c)} + R_{TH\ (c\ -\ h)} + R_{TH\ (h\ -\ a)} = \frac{\Delta T}{P} = \frac{105}{180} = 0.58\ °C/W$

$R_{TH\ (j\ -\ c)} = 0.112\ °C/W$

$R_{TH\ (c\ -\ h)} + R_{TH\ (h\ -\ a)} = 0.58\ °C/W - 0.112\ °C/W = 0.468\ °C/W$

OVERLOADS

In any case the applied voltage must be lower than U_L = 5000 V.

Short time overload: 2 x P_r/10 s

Accidental overload: The values indicated on the following graph are applicable to resistors in air or mounted onto a heatsink.

ENERGY CURVE

POWER CURVE

MARKING

Series, style, ohmic value (in Ω), tolerance (in %), manufacturing date, Vishay Sfernice trademark.

POWER RATING

The temperature of the case should be maintained within the limits specified in the following figure.
To optimize the thermal conduction, contacting surfaces should be coated with silicone grease or thermal film, and heatsink mounting screws tightened to 2 Nm.

PACKAGING
Box of 15 units

ORDERING INFORMATION

LPS	600	100 kΩ	± 1 %	xxx	BO15	e
MODEL	STYLE	RESISTANCE VALUE	TOLERANCE	CUSTOM DESIGN	PACKAGING	LEAD (Pb)-FREE
			± 1 % ± 2 % ± 5 % ± 10 %	Optional on request: Special TCR, shape etc.		

GLOBAL PART NUMBER INFORMATION

L	P	S	0	6	0	0	H	4	7	R	0	J	B	

GLOBAL MODEL	DIELECTRIC	OHMIC VALUE	TOLERANCE	PACKAGING	SPECIAL
LPS 600	**L** = Dielectric strength 7 kV **H** = Dielectric strength 12 kV **D** = Partial discharge ≤ 100 pC/7 kV and ≤ 10 pC/5 kV	The first three digits are significant figures and the last digit specifies the number of zeros to follow. R designates decimal point. **48R7** = 48.7 Ω **47R0** = 47 Ω **1001** = 1 kΩ **4R70** = 4.7 Ω **R240** = 0.24 Ω	**F** = 1 % **G** = 2 % **J** = 5 % **K** = 10 %	**B** = Box 15 pieces	As applicable ZAx

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Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.

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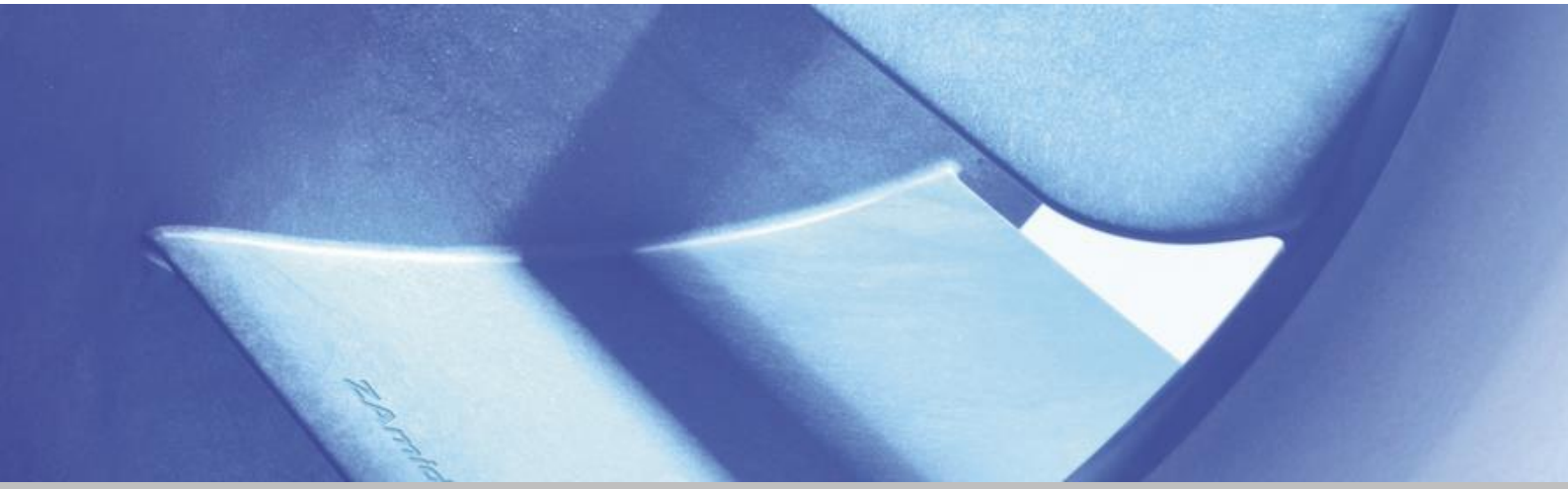
Part-no.	Description
153459	RH22M-2DK.1E.1R

Single inlet impeller with backward curved blades.
Type: RH22M-2DK.1E.1R
3~ 400V ±10% Y 50Hz P1 0,20kW
0,44A 2860rpm COSY 0,66
3~ 400V ±10% Y 60Hz P1 0,33kW
0,53A DI=25% 3260rpm COSY 0,90 70°C
3~ 460V ±10% Y 60Hz P1 0,34kW
0,51A DI=30% 3350rpm COSY 0,80 70°C
IP54Z THCL 155
Conceived for application in railways and roads.
Supply cable axial 205cm.
Connection diagram: 1360-159XA Sandwich label
Rating plate: 1x fixed.
Fitting position H/Vo.
Motor protection: thermal contact
Special impregnation HV.
Balancing quality G 6,3
Painting motor: 1 coat paint RAL 7032 (pebble grey).
Material impeller: aluminium,
Painting impeller: unpainted
Dust sealed design with felt sealing band.
With additional cable gland to fix the ground strip or
the screening from customer`s side.
ball bearing with long-time lubrication.
Bearing with nilos ring.

ES

Movement by Perfection



The Royal League in **ventilation**, control and drive technology

Product documentation

Type
RH22M-2DK.1E.1R

Article number
153459

ZIEHL-ABEGG

Product documentation

Customer
INGENIERIA VIESCA

Project
-

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Type
RH22M-2DK.1E.1R

Article number
153459

Contents

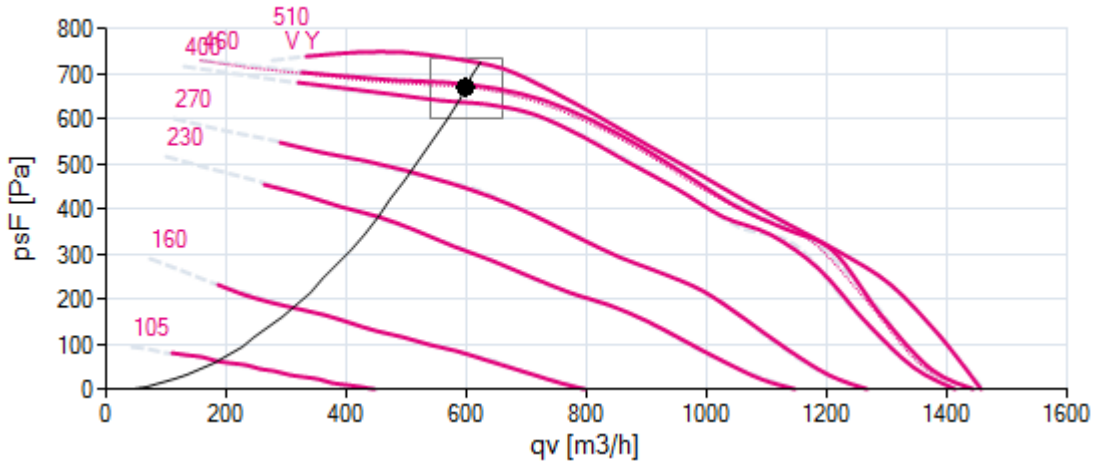
1. Product specification

Technical data

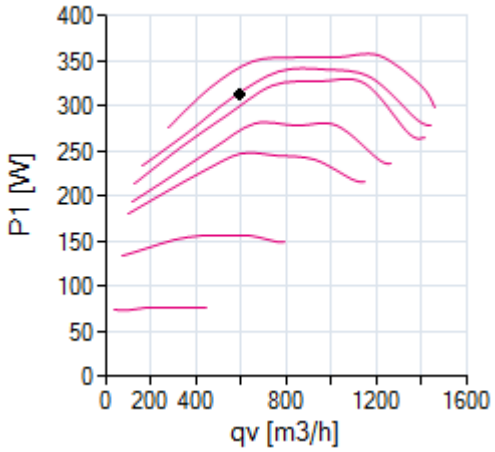
Article number	153459
Type	RH22M-2DK.1E.1R
Designation	Single inlet impeller with backward curved blades.
Rated values	3~400V ±10% Y 50Hz P_1 0.20kW 0.44A 2860/min COSY 0,66 3~400V ±10% Y 60Hz P_1 0.33kW 0.53A ΔI=25% 3260/min COSY 0,90 70°C 3~460V±10% Y 60Hz P_1 0.34kW 0.51A ΔI=30% 3350/min COSY 0,80 70°C
Electrical connection	Supply cable axial 4x 0,75mm2 x 205cm
Min. operating temperature [°C]	-40
Cable quality	Li4G4G-J
Painting motor	1 coat paint
Colour motor	RAL 7032 (pebble grey)
Material impeller	aluminium
Painting impeller	unpainted
Connection diagram	1360-159XA
Rating plate	1x fixed.
Installation position	H/Vo
Motor protection	thermal contact
Type of protection	IP54Z
Balancing quality	6,3
Quality of bearings	ball bearing with long-time lubrication
Special bearing	Bearing with nilos ring
Field of application	Conceived for application in railways and roads.
Characteristic rest2	Dust sealed design with sealing band.
Weight kg	4,10
ErP Data	Does not comply with the stipulations of the ErP regulations (not necessary for railway application)

2. Characteristic Curve

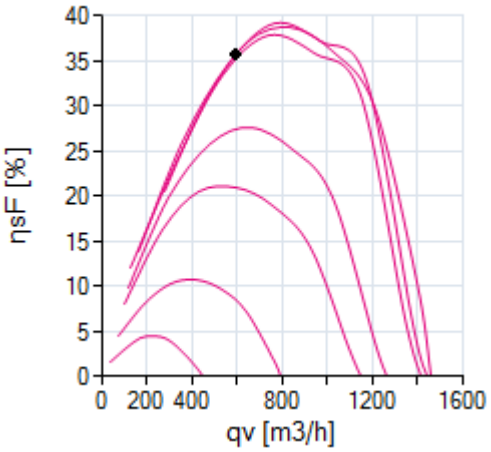
Air performance



Power input

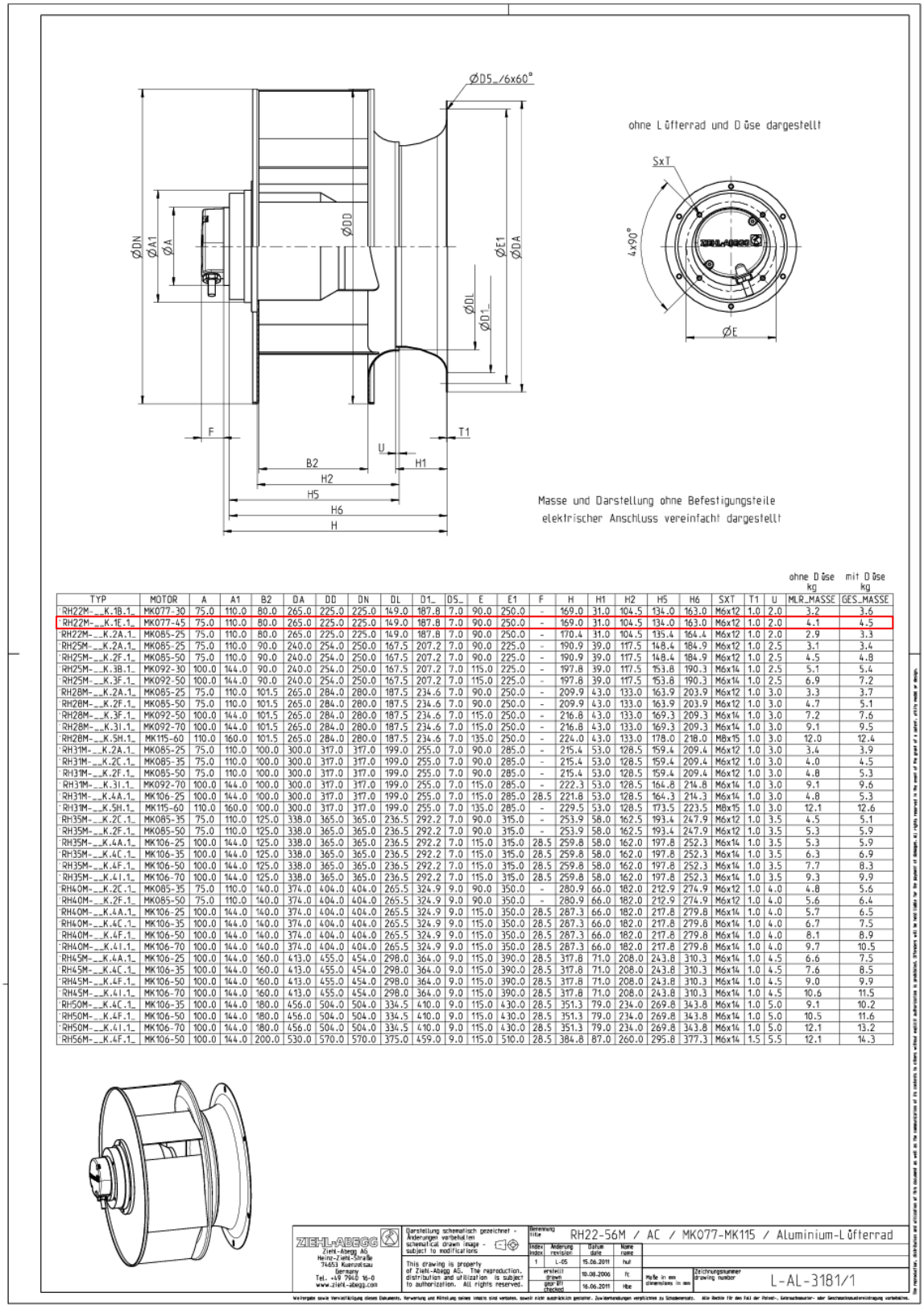


Efficiency



measured in standard nozzle in installation type A according to ISO 5801

3. Drawing



TYP	MOTOR	A	A1	B2	DA	DD	DN	DL	D1_	D5_	E	E1	F	H	H1	H2	H5	H6	SXT	T1	U	ohne Düse kg MLR_MASSE	mit Düse kg GES_MASSE
RH22M-__K.1B.1_	MK077-30	75.0	110.0	80.0	265.0	225.0	225.0	149.0	187.8	7.0	90.0	250.0	-	169.0	31.0	104.5	134.0	163.0	M6x12	1.0	2.0	3.2	3.6
RH22M-__K.1E.1_	MK077-45	75.0	110.0	80.0	265.0	225.0	225.0	149.0	187.8	7.0	90.0	250.0	-	169.0	31.0	104.5	134.0	163.0	M6x12	1.0	2.0	4.1	4.5
RH22M-__K.2A.1_	MK085-25	75.0	110.0	80.0	265.0	225.0	225.0	149.0	187.8	7.0	90.0	250.0	-	170.4	31.0	104.5	135.4	164.4	M6x12	1.0	2.0	2.9	3.3
RH25M-__K.2A.1_	MK085-25	75.0	110.0	90.0	240.0	254.0	250.0	167.5	207.2	7.0	90.0	225.0	-	190.9	39.0	117.5	148.4	184.9	M6x12	1.0	2.5	3.1	3.4
RH25M-__K.2F.1_	MK085-50	75.0	110.0	90.0	240.0	254.0	250.0	167.5	207.2	7.0	90.0	225.0	-	190.9	39.0	117.5	148.4	184.9	M6x12	1.0	2.5	4.5	4.8
RH25M-__K.3B.1_	MK092-30	100.0	144.0	90.0	240.0	254.0	250.0	167.5	207.2	7.0	115.0	225.0	-	197.8	39.0	117.5	153.8	190.3	M6x14	1.0	2.5	5.1	5.4
RH25M-__K.3F.1_	MK092-50	100.0	144.0	90.0	240.0	254.0	250.0	167.5	207.2	7.0	115.0	225.0	-	197.8	39.0	117.5	153.8	190.3	M6x14	1.0	2.5	6.9	7.2
RH28M-__K.2A.1_	MK085-25	75.0	110.0	101.5	265.0	284.0	280.0	187.5	234.6	7.0	90.0	250.0	-	209.9	43.0	133.0	163.9	203.9	M6x12	1.0	3.0	3.3	3.7
RH28M-__K.2F.1_	MK085-50	75.0	110.0	101.5	265.0	284.0	280.0	187.5	234.6	7.0	90.0	250.0	-	209.9	43.0	133.0	163.9	203.9	M6x12	1.0	3.0	4.7	5.1
RH28M-__K.3F.1_	MK092-50	100.0	144.0	101.5	265.0	284.0	280.0	187.5	234.6	7.0	115.0	250.0	-	216.8	43.0	133.0	169.3	209.3	M6x14	1.0	3.0	7.2	7.6
RH28M-__K.3I.1_	MK092-70	100.0	144.0	101.5	265.0	284.0	280.0	187.5	234.6	7.0	115.0	250.0	-	216.8	43.0	133.0	169.3	209.3	M6x14	1.0	3.0	9.1	9.5
RH28M-__K.5H.1_	MK115-60	110.0	160.0	101.5	265.0	284.0	280.0	187.5	234.6	7.0	135.0	250.0	-	224.0	43.0	133.0	178.0	218.0	M8x15	1.0	3.0	12.0	12.4
RH31M-__K.2A.1_	MK085-25	75.0	110.0	100.0	300.0	317.0	317.0	199.0	255.0	7.0	90.0	285.0	-	215.4	53.0	128.5	159.4	209.4	M6x12	1.0	3.0	3.4	3.9
RH31M-__K.2C.1_	MK085-35	75.0	110.0	100.0	300.0	317.0	317.0	199.0	255.0	7.0	90.0	285.0	-	215.4	53.0	128.5	159.4	209.4	M6x12	1.0	3.0	4.0	4.5
RH31M-__K.2F.1_	MK085-50	75.0	110.0	100.0	300.0	317.0	317.0	199.0	255.0	7.0	90.0	285.0	-	215.4	53.0	128.5	159.4	209.4	M6x12	1.0	3.0	4.8	5.3
RH31M-__K.3I.1_	MK092-70	100.0	144.0	100.0	300.0	317.0	317.0	199.0	255.0	7.0	115.0	285.0	-	222.3	53.0	128.5	164.8	214.8	M6x14	1.0	3.0	9.1	9.6
RH31M-__K.4A.1_	MK106-25	100.0	144.0	100.0	300.0	317.0	317.0	199.0	255.0	7.0	115.0	285.0	28.5	221.8	53.0	128.5	164.3	214.3	M6x14	1.0	3.0	4.8	5.3
RH31M-__K.5H.1_	MK115-60	110.0	160.0	100.0	300.0	317.0	317.0	199.0	255.0	7.0	135.0	285.0	-	229.5	53.0	128.5	173.5	223.5	M8x15	1.0	3.0	12.1	12.6
RH35M-__K.2C.1_	MK085-35	75.0	110.0	125.0	338.0	365.0	365.0	236.5	292.2	7.0	90.0	315.0	-	253.9	58.0	162.5	193.4	247.9	M6x12	1.0	3.5	4.5	5.1
RH35M-__K.2F.1_	MK085-50	75.0	110.0	125.0	338.0	365.0	365.0	236.5	292.2	7.0	90.0	315.0	-	253.9	58.0	162.5	193.4	247.9	M6x12	1.0	3.5	5.3	5.9
RH35M-__K.4A.1_	MK106-25	100.0	144.0	125.0	338.0	365.0	365.0	236.5	292.2	7.0	115.0	315.0	28.5	259.8	58.0	162.0	197.8	252.3	M6x14	1.0	3.5	5.3	5.9
RH35M-__K.4C.1_	MK106-35	100.0	144.0	125.0	338.0	365.0	365.0	236.5	292.2	7.0	115.0	315.0	28.5	259.8	58.0	162.0	197.8	252.3	M6x14	1.0	3.5	6.3	6.9
RH35M-__K.4F.1_	MK106-50	100.0	144.0	125.0	338.0	365.0	365.0	236.5	292.2	7.0	115.0	315.0	28.5	259.8	58.0	162.0	197.8	252.3	M6x14	1.0	3.5	7.7	8.3
RH35M-__K.4I.1_	MK106-70	100.0	144.0	125.0	338.0	365.0	365.0	236.5	292.2	7.0	115.0	315.0	28.5	259.8	58.0	162.0	197.8	252.3	M6x14	1.0	3.5	9.3	9.9
RH40M-__K.2C.1_	MK085-35	75.0	110.0	140.0	374.0	404.0	404.0	265.5	324.9	9.0	90.0	350.0	-	280.9	66.0	182.0	212.9	274.9	M6x12	1.0	4.0	4.8	5.6
RH40M-__K.2F.1_	MK085-50	75.0	110.0	140.0	374.0	404.0	404.0	265.5	324.9	9.0	90.0	350.0	-	280.9	66.0	182.0	212.9	274.9	M6x12	1.0	4.0	5.6	6.4
RH40M-__K.4A.1_	MK106-25	100.0	144.0	140.0	374.0	404.0	404.0	265.5	324.9	9.0	115.0	350.0	28.5	287.3	66.0	182.0	217.8	279.8	M6x14	1.0	4.0	5.7	6.5
RH40M-__K.4C.1_	MK106-35	100.0	144.0	140.0	374.0	404.0	404.0	265.5	324.9	9.0	115.0	350.0	28.5	287.3	66.0	182.0	217.8	279.8	M6x14	1.0	4.0	6.7	7.5
RH40M-__K.4F.1_	MK106-50	100.0	144.0	140.0	374.0	404.0	404.0	265.5	324.9	9.0	115.0	350.0	28.5	287.3	66.0	182.0	217.8	279.8	M6x14	1.0	4.0	8.1	8.9
RH40M-__K.4I.1_	MK106-70	100.0	144.0	140.0	374.0	404.0	404.0	265.5	324.9	9.0	115.0	350.0	28.5	287.3	66.0	182.0	217.8	279.8	M6x14	1.0	4.0	9.7	10.5
RH45M-__K.4A.1_	MK106-25	100.0	144.0	160.0	413.0	455.0	454.0	298.0	364.0	9.0	115.0	390.0	28.5	317.8	71.0	208.0	243.8	310.3	M6x14	1.0	4.5	6.6	7.5
RH45M-__K.4C.1_	MK106-35	100.0	144.0	160.0	413.0	455.0	454.0	298.0	364.0	9.0	115.0	390.0	28.5	317.8	71.0	208.0	243.8	310.3	M6x14	1.0	4.5	7.6	8.5
RH45M-__K.4F.1_	MK106-50	100.0	144.0	160.0	413.0	455.0	454.0	298.0	364.0	9.0	115.0	390.0	28.5	317.8	71.0	208.0	243.8	310.3	M6x14	1.0	4.5	9.0	9.9
RH45M-__K.4I.1_	MK106-70	100.0	144.0	160.0	413.0	455.0	454.0	298.0	364.0	9.0	115.0	390.0	28.5	317.8	71.0	208.0	243.8	310.3	M6x14	1.0	4.5	10.6	11.5
RH50M-__K.4C.1_	MK106-35	100.0	144.0	180.0	456.0	504.0	504.0	334.5	410.0	9.0	115.0	430.0	28.5	351.3	79.0	234.0	269.8	343.8	M6x14	1.0	5.0	9.1	10.2
RH50M-__K.4F.1_	MK106-50	100.0	144.0	180.0	456.0	504.0	504.0	334.5	410.0	9.0	115.0	430.0	28.5	351.3	79.0	234.0	269.8	343.8	M6x14	1.0	5.0	10.5	11.6
RH50M-__K.4I.1_	MK106-70	100.0	144.0	180.0	456.0	504.0	504.0	334.5	410.0	9.0	115.0	430.0	28.5	351.3	79.0	234.0	269.8	343.8	M6x14	1.0	5.0	12.1	13.2
RH56M-__K.4F.1_	MK106-50	100.0	144.0	200.0	530.0	570.0	570.0	375.0	459.0	9.0	115.0	510.0	28.5	384.8	87.0	260.0	295.8	377.3	M6x14	1.5	5.5	12.1	14.3

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Darstellung schematisch gezeichnet - Änderungen vorbehalten
schematic drawn image - subject to modifications

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Benennung / title: RH22-56M / AC / MK077-MK115 / Aluminium-Lüfterrad

Index / Index	Änderung / revision	Datum / date	Name / name
1	L-05	15.06.2011	hut
erstellt / drawn		10.08.2006	fc
gepr. BT / checked		16.06.2011	Hbe

Maße in mm / dimensions in mm

Zeichnungsnummer / drawing number: L-AL-3181/1

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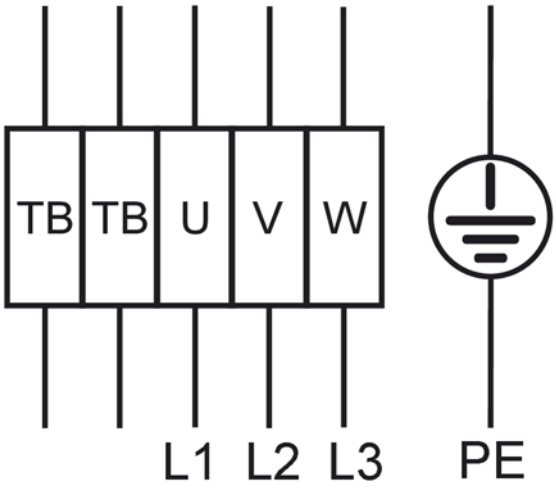
Dimensions in mm

Shown drawing is just to show the dimensions of the fan.

4. Connection diagram

Connection diagram	**1360-159XA**	
Description	3~ motor, 1 speed with thermostatic switch (if built in).	
Cable colours	U	brown
	V	blue or grey
	W	black
	TB	white



5. EU-Declaration of conformity

EC-Declaration of conformity

0029311-GB

as defined by the EC Low Voltage Directive 2006/95/EC, the EMC guideline 2004/108/EC, as well as ErP guideline 2009/125/EG.

The type of machinery:

- External rotor motor MK.., MW..
- Axial fan FA.., FB.., FC.., FE.., FF.., FS.., FT.., FH.., FL.., FN.., VR.., VN.., ZC.., ZF.., ZN..
- Centrifugal fan RA.., RD.., RE.., RF.., RG.., RH.., RK.., RM.., RR.., RZ.., GR.., ER..

Motor type:

- Asynchronous internal or external rotor motor with integrated frequency inverter for EDP system
- Electronically commutated internal or external rotor motor with integrated EC controller for EDP system

is developed, designed and manufactured in accordance with the EC Directives 2006/95/EC, 2004/108/EC and 2009/125/EC, on the own responsibility of

ZIEHL-ABEGG SE
Heinz-Ziehl-Strasse
D-74653 Kuenzelsau

The following standards are applied:

EN 60034-1:2010+Cor.:2010, EN 60204-1:2006, EN 60529:1991 + A1:2000, EN 61000-6-4:2007, EN 61000-6-2:2005

Compliance with the ErP Directive 2009/125/EC does not refer to external rotor motors MK.., MW..

Compliance with the EMC Directive 2004/108/EEC only applies to this product if it is connected according to the operating instructions. If this product is integrated in a system or complemented and operated with other components (e.g., switching and control equipment), the manufacturer of or company operating the overall plant is responsible for compliance with the EMC Directive 2004/108/EEC.

The complete technical documentation is available.

22.11.2013

Dr. W. Angelis - Technical Director Air Movement Division

i.V. W. Angelis

ZA92-GB-12/13 Index 003

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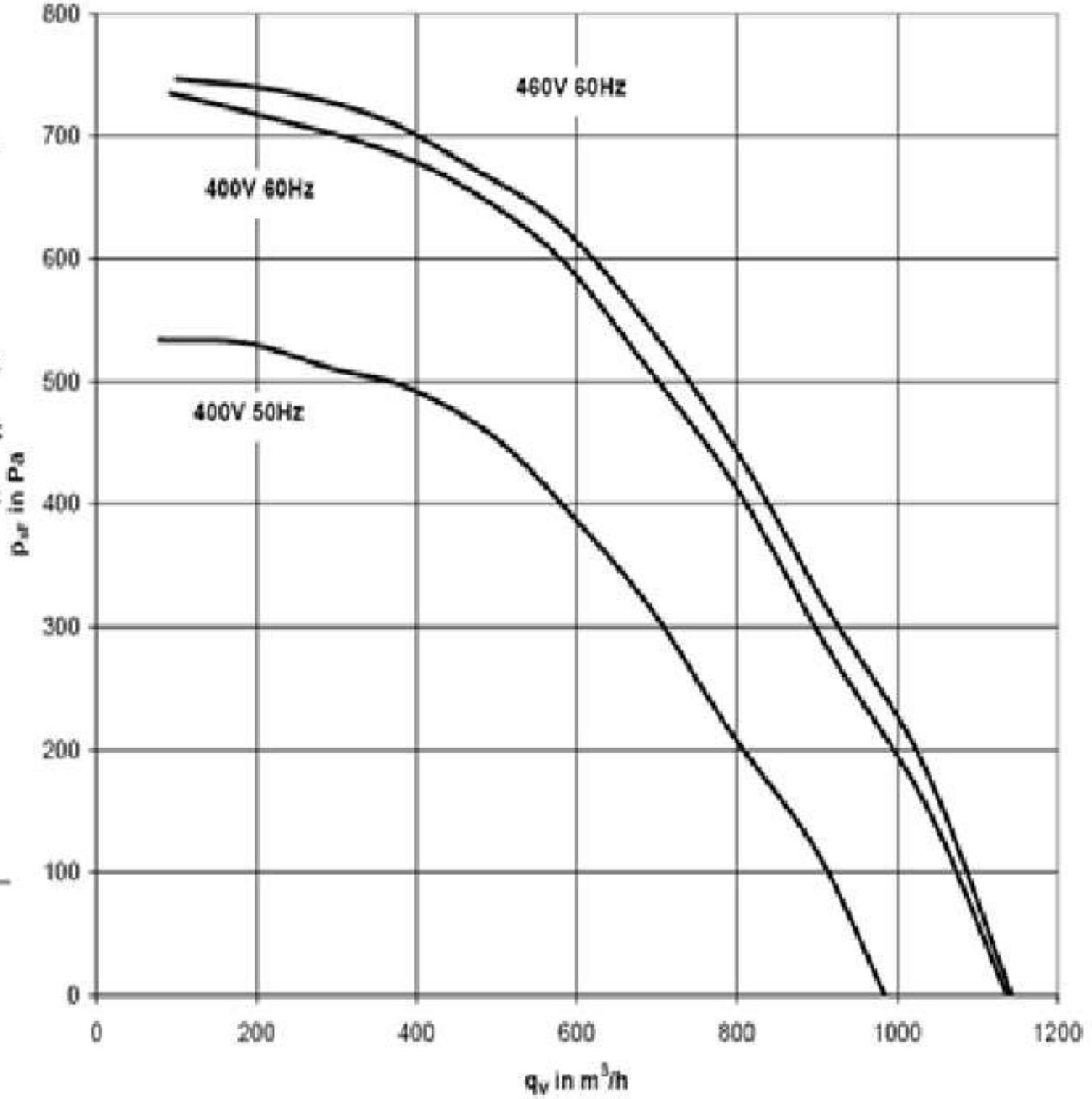
RH22M-2DK.1E.2R (AN 135413)

3~230/400V ±10% D/Y 50Hz P1 0,16kW
0,69/0,40A ΔI=10% 2890/min cosφ 0,58 70°C
3~230/400V ±10% D/Y 60Hz P1 0,26kW
0,78/0,45A DI=20% 3310/min cosφ 0,86 70°C
3~265/460V ±10% D/Y 60Hz P1 0,28kW
0,78/0,45A ΔI=20% 3380/min cosφ 0,78 70°C
IP44 THCL 155



Los datos acústicos LWA medidos a 460V 60Hz ~3 para estos ventiladores.
153459
DP1: approx. 80dBA- 716m3/h at 598Pa
DP2: approx. 82dBA- 956m3/ at 456Pa

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RH22M-2DK.1E.1R

Beschreibung / Description

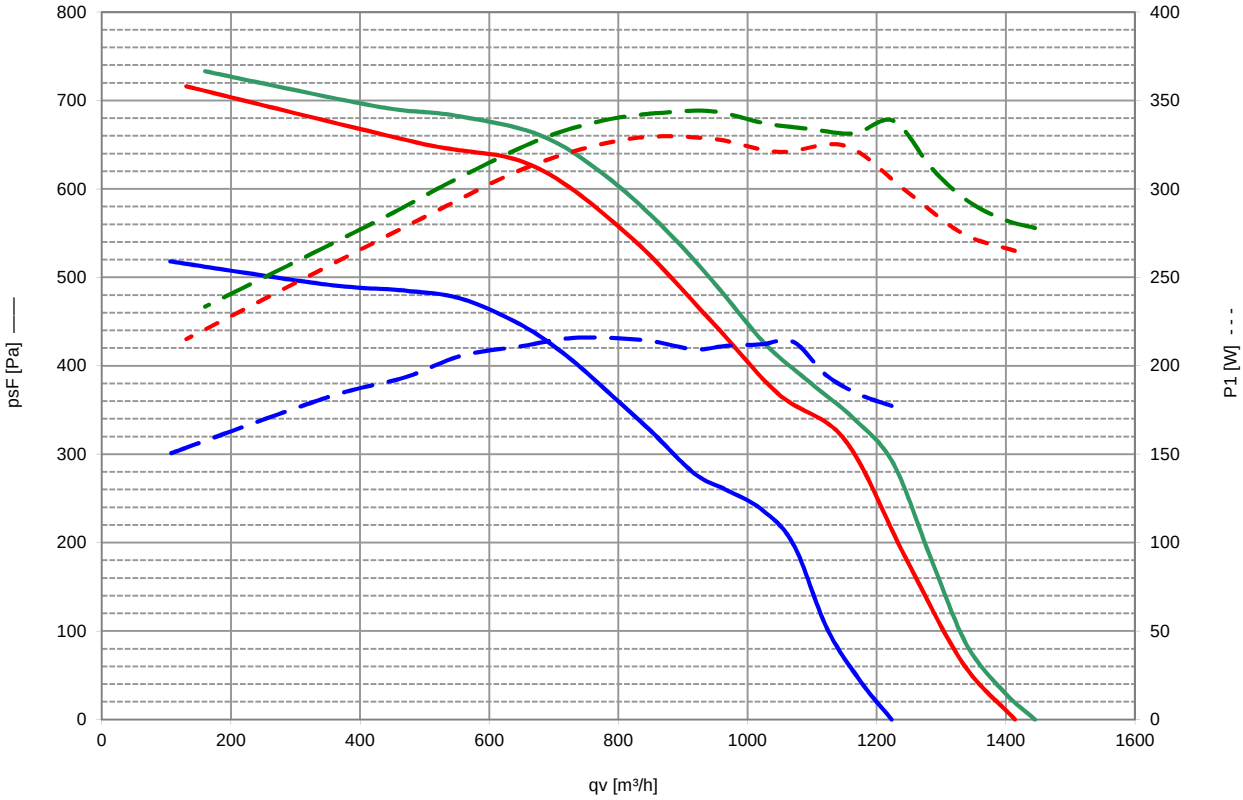
RH22M-2DK.1E.1R
3~ 400V ±10% Y 50Hz P1 0,20kW
0,44A 2860/MIN COSY 0,66
3~ 400V ±10% Y 60Hz P1 0,33kW
0,53A DI=25% 3260/MIN COSY 0,90 70°C
3~ 460V ±10% Y 60Hz P1 0,34kW
0,51A DI=30% 3350/MIN COSY 0,80 70°C
IP54Z THCL 155

Messaufbau / Assembling:
Ventilator montiert in Einlaufdüse ohne Berührschutzgitter.
Fan measured in inlet bell mouth without guard grille.

Legende / Legend

A) 3~ 400V 50Hz D [ID]
C) 3~ 400V 60Hz D [ID]
E) 3~ 460V 60Hz D [ID]
Gemessen mit üblichen Toleranzen / Measured with normal tolerances

1. Diagramm / Chart : Volumenstrom - Druckerhöhung - elektr. Leistungsaufnahme / Airflow - Pressure - Electr. Power Input



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