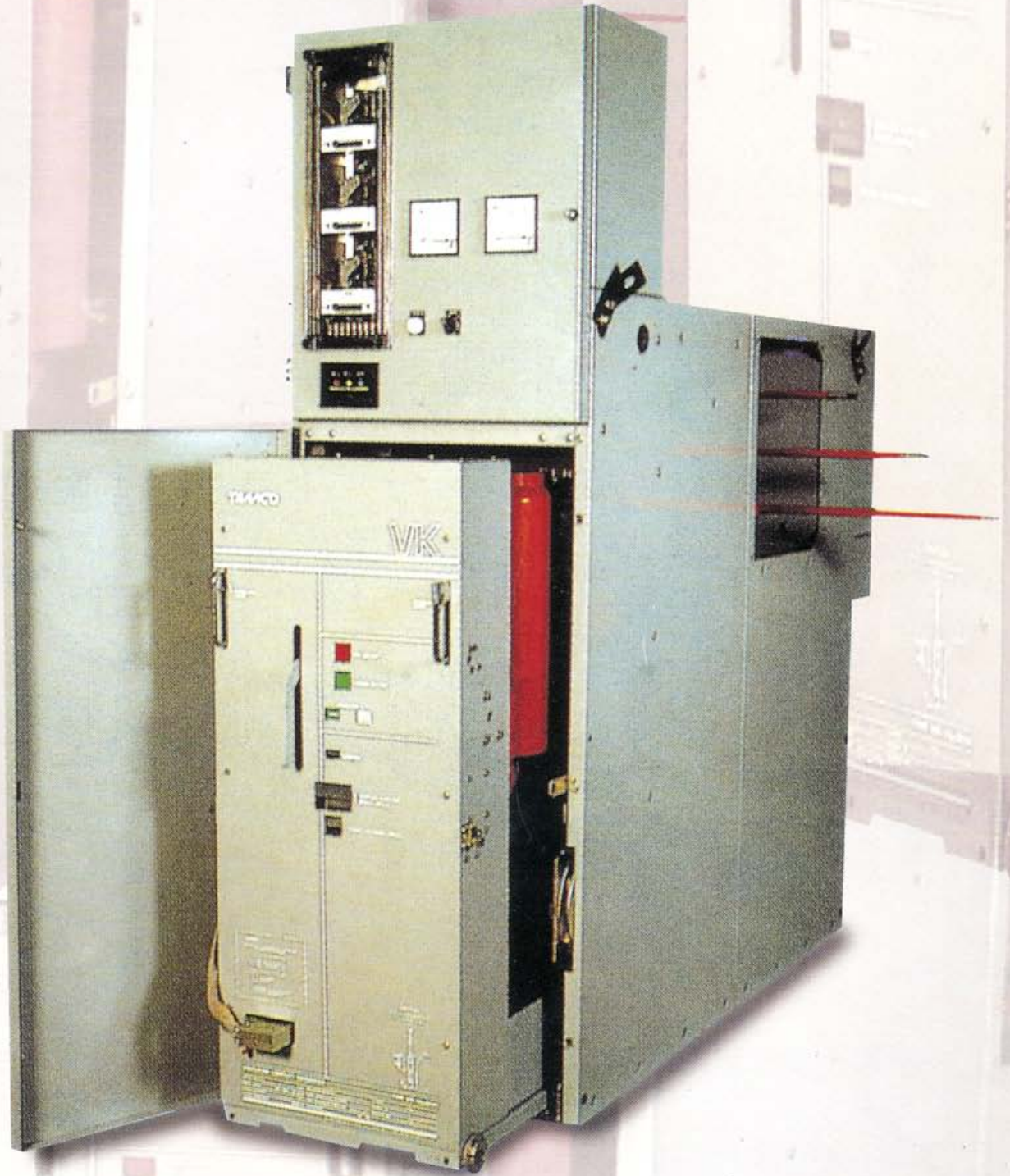


TAMCO MIDDLE EAST



VHIH
VHID

VACUUM
METALCLAD
SWITCHGEAR

REPORT OF PERFORMANCE

CLIENT Tamco Cutler-Hammer SDN Berhad,
Petaling Jaya, Malaysia
MANUFACTURER Tamco Middle East Limited,
Dubai, United Arab Emirates
APPARATUS Metal-enclosed switchgear and controlgear assembly
DESIGNATION Assembly: VHH
Vacuum circuit-breakers: VK-10J25H (630 A) / VK-10M25H (1250 A)
Earthing switch: EX5W 10-25
SERIAL No. Vacuum circuit-breakers: U/940478 (630 A) / U/940428 (1250 A)

RATINGS ASSIGNED BY THE MANUFACTURER

| | | |
|------------------------------|------------|------------|
| Voltage | 12 | kV |
| Current | 630 / 1250 | A |
| Frequency | 50 | Hz |
| Short-time withstand current | 25 kA | during 3 s |
| Peak withstand current | 63 | kA |
| TRV | | |
| Rest-pole-to-clear factor | 1.5 | |

The tests have been carried out strictly in accordance with IEC 298 (STC).
The apparatus has complied with the relevant requirements.

Date of tests 17th March 1998

The performance of the apparatus tested and the observations made during the tests have been recorded in the tables with test results and the oscillograms.

THIS REPORT CONSISTS OF:

| | |
|------------------------------|-------------------------|
| Sheets | 7 |
| Circuit diagrams | 1 |
| Electromagnetic oscillograms | 3 |
| Photographs | 3 |
| Test reports | 7 |
| Technical drawing | 1 (M021000-HT1 95-1095) |
| Summary sheet | B7CE |

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KEMA Nederland B.V.
[Signature]
H.W. Kemper
Arnhem, 5th July 1998

MATERIAL DATA

Switchgear panel

| | |
|--------------------------------|---|
| Manufacturer | Tamco Middle East Ltd., Dubai, United Arab Emirates |
| Type | VHH |
| Job no. | ENQ 98334 |
| Drawing no. | 98334-J1 |
| Rated voltage | 11 kV |
| Busbar current rating | 1250 A |
| Busbar size | 10x75 mm |
| Short-time current rating (3s) | 25 kA |
| Date of manufacture | December 1998 |
| Sampling procedure | by the manufacturer |

Circuit-breaker unit

| | |
|----------------------------------|---|
| Manufacturer | Tamco Middle East Ltd., Dubai, United Arab Emirates |
| Type | VK 10M25H |
| Serial no. | U/98 2226 |
| Rated voltage | 12 kV |
| Rated current | 630 A |
| Rated frequency | 50/60 Hz |
| Rated insulation level - impulse | 95 kV _p |
| - 1 min a.c. | 38 kV |
| Short-time current rating (3 s) | 25 kA |
| Short-circuit breaking current | 25 kA |
| Short-circuit making current | 63 kA _p |
| Rated operation sequence | O-0.3s-CO-3 min-CO |
| Rated voltage closing coil | 100/110 V d.c. |
| Rated voltage trip coil | 100/110 V d.c. |
| Rated voltage motor supply | 100/110 V d.c. |
| Weight | 130 kg |
| Year of manufacture | 1998 |
| Sampling procedure | by the manufacturer |

Drawings

Manufacturer's drawings of the switchgear are represented in appendix A pages 1-17.

REFERENCE TO OTHER REPORTS

No. 99-1060 Lightning impulse voltage test on panel type VHH with circuit-breaker type VK 10J25H

MATERIAL DATA

Switchgear panel

| | |
|--------------------------------|---|
| Manufacturer | Tamco Middle East Ltd., Dubai, United Arab Emirates |
| Type | VHH |
| Job no. | ENQ 98334 |
| Drawing no. | 98334-J1 |
| Rated voltage | 11 kV |
| Busbar current rating | 1250 A |
| Busbar size | 10x75 mm |
| Short-time current rating (3s) | 25 kA |
| Date of manufacture | December 1998 |
| Sampling procedure | by the manufacturer |

Circuit-breaker unit

| | |
|----------------------------------|---|
| Manufacturer | Tamco Middle East Ltd., Dubai, United Arab Emirates |
| Type | VK 10J25H |
| Serial no. | U/98 2220 |
| Rated voltage | 12 kV |
| Rated current | 630 A |
| Rated frequency | 50/60 Hz |
| Rated insulation level - impulse | 95 kV _p |
| - 1 min a.c. | 38 kV |
| Short-time current rating (3 s) | 25 kA |
| Short-circuit breaking current | 25 kA |
| Short-circuit making current | 63 kA _p |
| Rated operation sequence | O-0.3s-CO-3 min-CO |
| Rated voltage closing coil | 100/110 V d.c. |
| Rated voltage trip coil | 100/110 V d.c. |
| Rated voltage motor supply | 100/110 V d.c. |
| Weight | 90 kg |
| Year of manufacture | 1998 |
| Sampling procedure | by the manufacturer |

Drawings

Manufacturer's drawings of the switchgear are represented in appendix A pages 1-17.

REFERENCE TO OTHER REPORTS

No. 99-1159 Lightning impulse voltage test on panel type VHH with circuit-breaker type VK 10M25H

Tamco Middle East started to manufacture medium voltage vacuum switchgear in 1994 under licence from Tamco Corporate Holdings Malaysia. Through extensive R&D Tamco has expanded its range of 12kV indoor metalclad switchgear to cover:

- ✓ *Up to 12kV Rated Voltage*
- ✓ *75 or 95kVp Impulse Withstand Voltage*
- ✓ *Up to 3150A Normal Current*
- ✓ *20, 25, 31.5 or 40kA, 3Seconds, Short-Circuit Current*

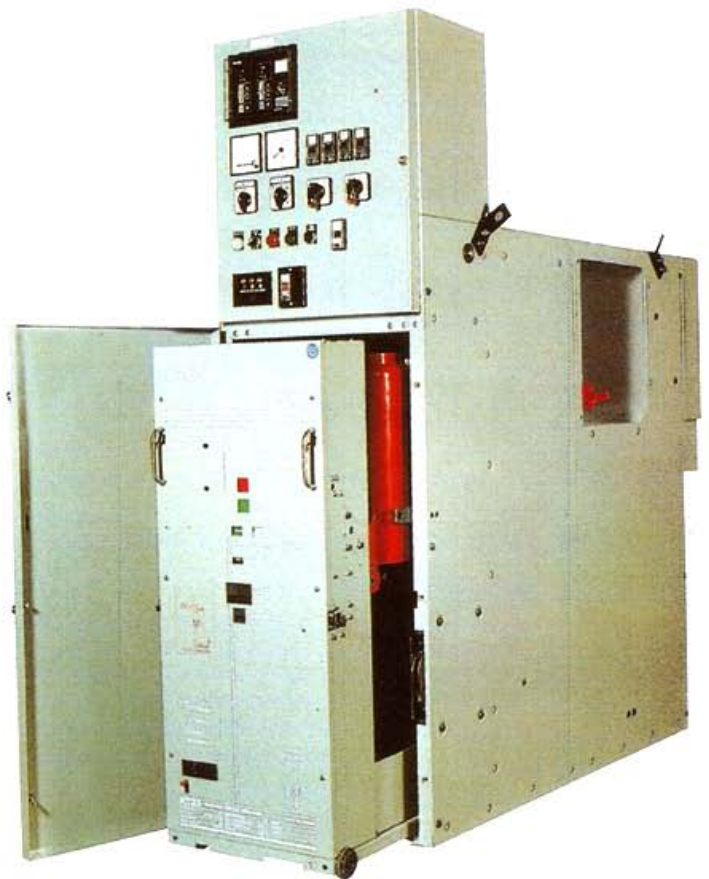
The switchgear is designed and tested to IEC 298 and IEC 56 and the designs have been short-circuit proven at the independent laboratories of KEMA or ASTA.

Tamco Middle East operates an ISO 9002 quality system registered with Lloyds Register Quality Assurance.

Tamco vacuum switchgear has proven its reliability and suitability for service under severe climatic conditions where the switchgear has been supplied to power utilities and industrial/commercial users in all 5 continents of the world.

This brochure is divided into 2 parts:

- Type VHIH single-busbar switchgear
- Type VHID double-busbar switchgear



- ✓ *Metalclad, fully compartmentalised*
- ✓ *Horizontal isolation, horizontal drawout*
- ✓ *Fully rated fault-make earthing switching*
- ✓ *Interlocked for safety*
- ✓ *Internal arc-fault proven*
- ✓ *Earthquake proven*
- ✓ *Passed climatic aging tests*
- ✓ *Simple installation*
- ✓ *Readily extensible*
- ✓ *Minimal maintenance*

VHIH

Single busbar
Metalclad Switchgear



Cubicle

Made of high grade pickled-&-oiled mild steel sheets, cut and folded on numerically controlled machines, the cubicle parts are painted by an advanced automated chain conveyer Electro-static Epoxy-Powder Spray Painting Line which provides optimum protection against corrosion and weathering.

The paint work is tested to withstand 1000 hours in a 5% salt spray, in accordance with Japanese standard JIS-2-2371.

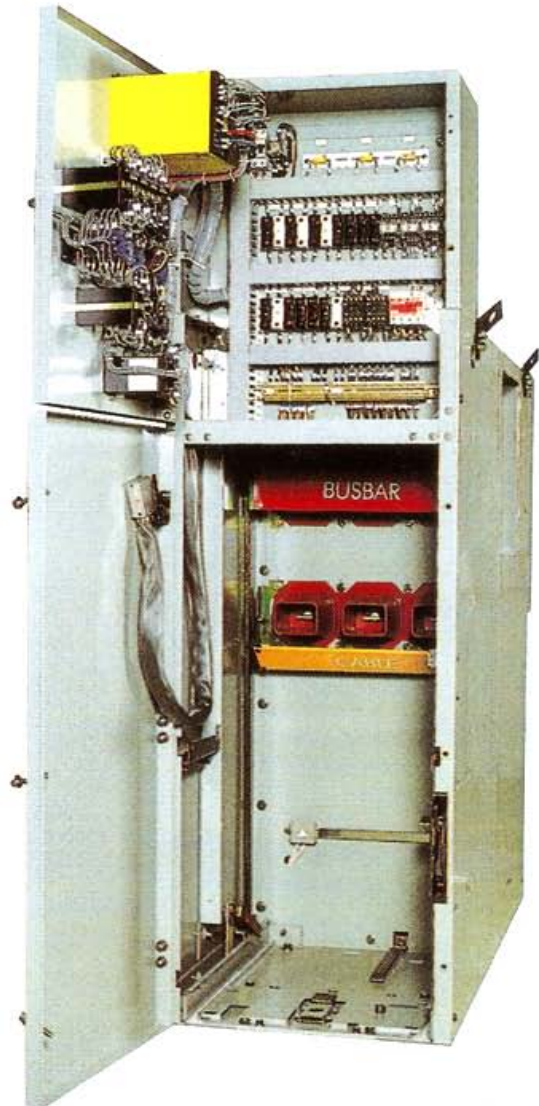
The cubicle parts are riveted/bolted together to form a rigid enclosure with fully segregated busbar compartment, circuit compartment, VCB compartment, and low voltage compartment. The construction complies fully with the requirements of a metalclad enclosure as defined in IEC 298.

Standard ingress protection is IP3X as per IEC 144. Higher IP ratings are available on request.

To prove its suitability for service in severe climatic conditions, the switchgear has been subjected to climatic aging tests according to IEC 932, and proven to Design Class 2 (the highest class).

The switchgear has been designed and tested to ensure the safety of the operator in the event of an internal arc-fault. Arc vents are provided in the busbar, circuit and VCB compartments .

The switchgear has also been successfully tested to withstand seismic forces of 5 - 7 on the Richter scale, in accordance with IEC 68-2-59 and IEC 68-3-3.



Other key design features are:

Busbars - Although classified as air-insulated, the busbars are covered with solid insulation throughout their length including the joints, to enhance insulation security.

Shutters - Automatic metal shutters are provided to close off access to live parts when the VCB is isolated or withdrawn. The shutters can be padlocked independently.

Front door - The VCB compartment is fitted with a padlockable front door which not only provides a flush frontage to the switchboard line-up, but also upholds the integrity of the ingress protection (IP) rating even the VCB is isolated or withdrawn.

Height of live parts - No live parts are located less than 300mm above floor level. This feature provides an added measure of security in case the switchgear is installed in a low lying area.

Cabling space - The cable termination height is more than 750mm above floor level, and generous space is provided for terminating the power cable. This feature is much appreciated by cable jointers and operating personnel.

Current Transformers

Ring type CTs are mounted on earthed condenser bushings. This mounting arrangement offers a high degree of flexibility. Wound primary CTs can also be accommodated.



Busbar



Cable Compartment

Potential Transformers

PTs are mounted on the rear of the cubicle, usually in the upper part of the circuit compartment. The PTs are fuse protected on both primary and secondary sides.

3 mounting options are offered: *fixed*, *isolatable* (preferred) and *drawout*. The isolatable design offers the advantages of isolation without having to put up with the inconvenience of a conventional drawout PT.

Earthing Switch

Circuit earthing is effected by a fault-make earthing switch interlocked with the VCB. The switch is tested to make and carry the rated short-circuit current for 3 seconds, in accordance with IEC 129. Earthing by means of an integral earthing switch is proven to be safe, simple and reliable.

Busbar earthing is effected by a busbar earthing switch usually mounted at the bus-section panel.

Low Voltage Compartment

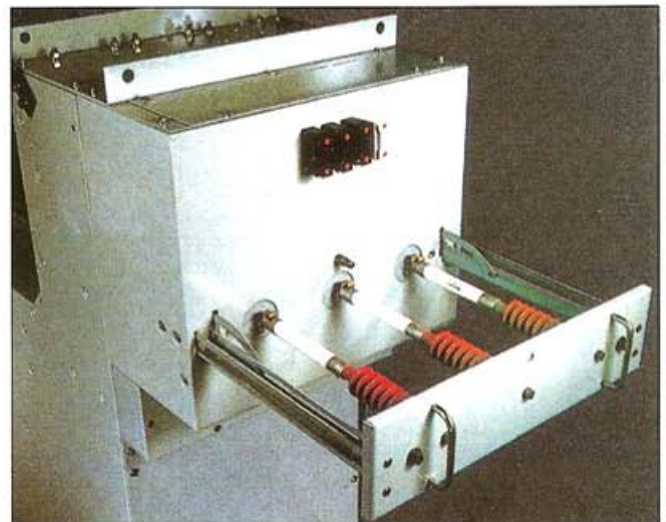
Relays, instruments and pilot devices are mounted in the low voltage compartment at the front of the cubicle. The standard 1.926m height provides ample space for normal distribution applications, but an additional chamber can be mounted on top, if necessary, for more complex protection and control schemes.

Safety Interlocks

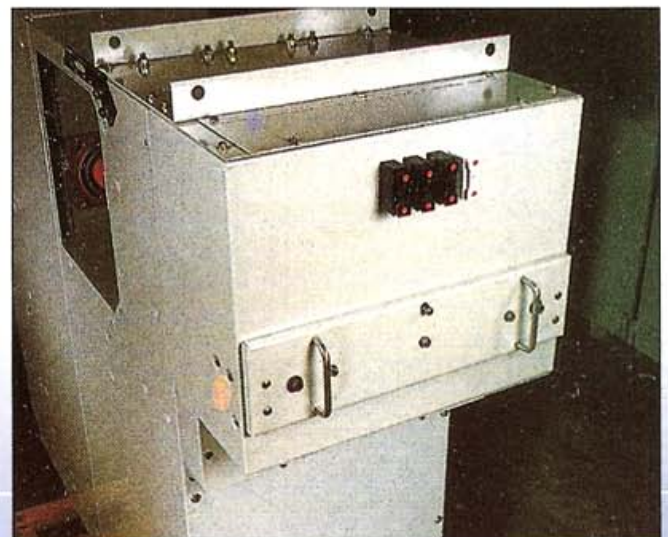
Operator safety is paramount in the design of the switchgear. Robust mechanical interlocks are provided to ensure:

- VCB cannot be engaged or withdrawn unless it is in the open position.
- VCB cannot be operated unless it is in the engaged or isolated position (not in between).
- Earthing switch cannot be closed when the VCB is engaged.
- VCB cannot be engaged when the earthing switch is closed.

Optional key interlocks are provided to meet specific operational requirements.



Isolation PT - disconnected



Isolation PT - connected

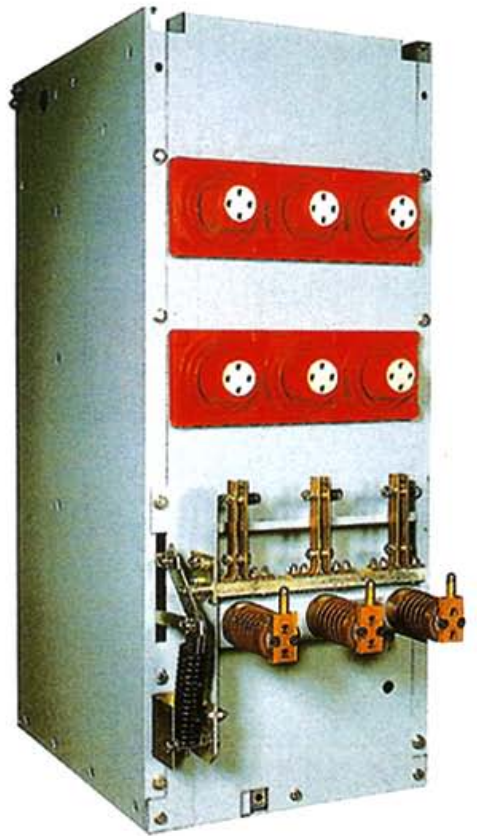
Vacuum Circuit Breaker

At the heart of the switchgear is the vacuum circuit breaker (VCB). The circuit breaker is truck mounted, and adopts the proven horizontal isolation/horizontal drawout principle.

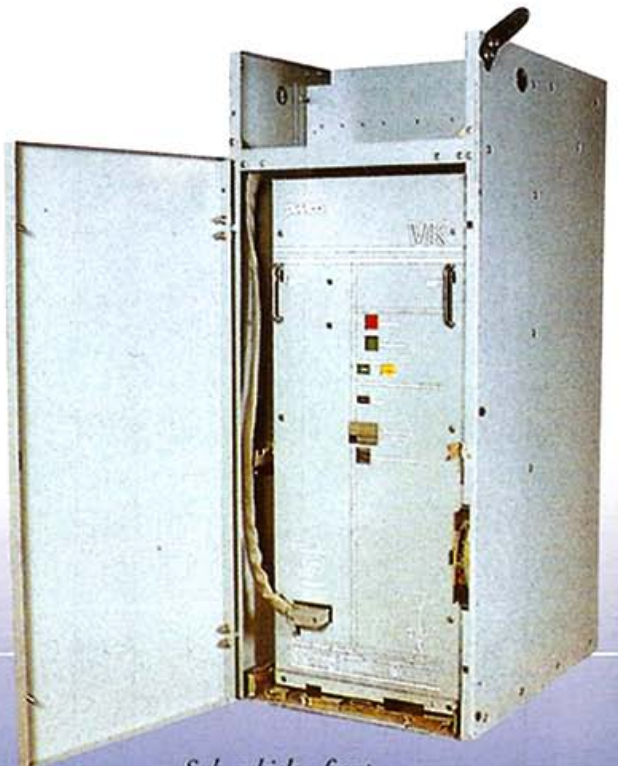
Vacuum interrupters - Tamco designs and manufactures VCB's using vacuum interrupters from different sources to meet the diverse needs of the market. The preferred interrupter suppliers are Toshiba of Japan and Cutler Hammer (formerly Westinghouse) of USA.

The trend in interrupter design is to continuously reduce the vacuum envelope size and enhance short-circuit capability at the same time. Tamco's VCB designs are continuously reviewed and upgraded to keep up with the latest development in vacuum technology.

Mechanisms - One significant advantage VCB's have over other switching media is the comparatively low mechanical energy levels required to open or close a VCB. This translates to a relatively simple and light weight operating mechanism which can be manufactured to close tolerances, and which will perform consistently throughout the circuit breaker's life-span without the need for periodic adjustments.



Sub-cubicle - back



Sub-cubicle - front

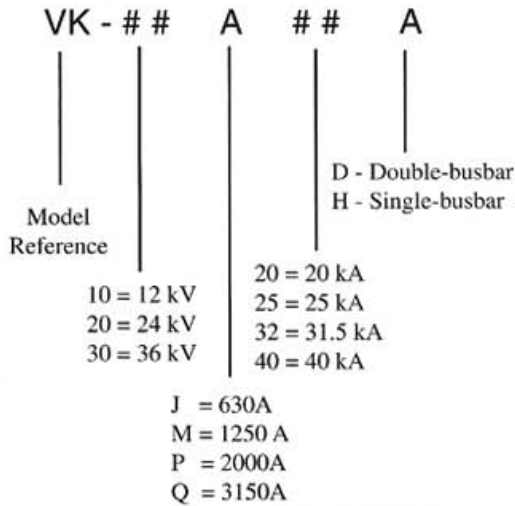
2 options of operating mechanisms are offered:

- Hand charged spring, stored energy mechanism with manual and/or electrical release;
- Motor charged spring, stored energy mechanism with manual and electrical release.

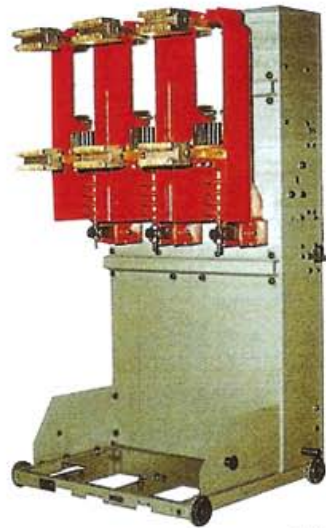
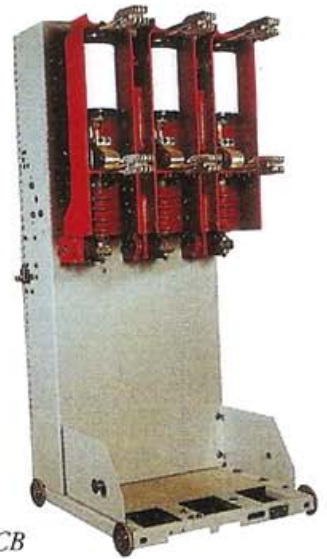
Standard control voltages are 30V and 110V DC.

Maintenance - The VCB requires minimal maintenance. Its design life-span is 20 years or 10,000 operations.

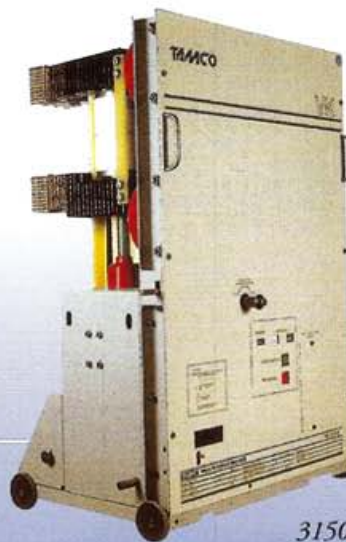
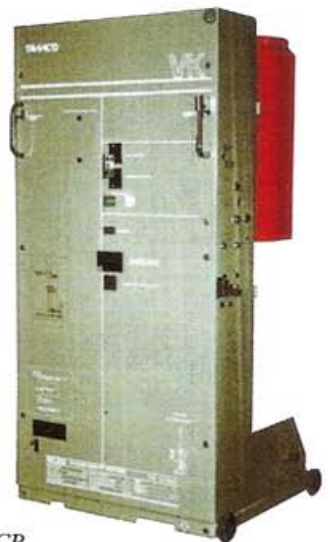
Nomenclature - The model numbers of Tamco VCBs observe the following nomenclature:



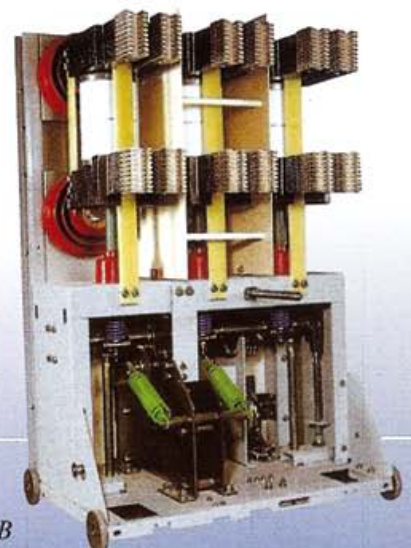
630/1250A VCB



2000A VCB



3150A VCB



Product range - The current range of Tamco 12 kV Single-busbar VCB is described in the following table.

| Model | VK | 10J20H | 10M20H | 10J25H | 10M25H | 10P25H | 10M32H | 10P32H | 10P40H | 10Q40H |
|----------|--|----------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| R | Voltage (kV) | 12 | | | | | | | | |
| | Insulation Level: | | | | | | | | | |
| A | Impulse Withstand (kVp) | 75, 95 | | | | | | | | |
| | 1-min Power Freq (kV) | 28, 38 | | | | | | | | |
| T | Frequency (Hz) | 50 | | | | | | | | |
| | Normal Current (A) | 630 | 1250 | 630 | 1250 | 2000 | 1250 | 2000 | 2000 | 3150 |
| E | Short-circuit Breaking Current (kA) | 20 | | | 25 | | 31.5 | | 40 | |
| | Transient Recovery Voltage (kVp) | 20.6 | | | | | | | | |
| D | Short-circuit Making Current (kAp) | 50 | | | 63 | | 80 | | 100 | |
| | Operating Sequence | O-0.3 Sec.- CO - 3 Min- CO | | | | | | | | |
| | Duration of Short-circuit (S) | 3 | | | | | | | | |
| | Opening Time (mS) | 35 | | | | | | | | |
| | Break Time | < 3 Cycles | | | | | | | | |
| | Closing Time at No Load (mS) | 50 | | | | | | | | |
| | Closing Voltage (V DC) | 30, 110 | | | | | | | | |
| | Current (A) | 6.5, 3.5 | | | | | | | | |
| | Tripping Voltage (V DC) | 30, 110 | | | | | | | | |
| | Current (A) | 6.5, 3.5 | | | | | | | | |
| | Full Load Switching Life (no. of operations) | 10,000 | | | | | | | | |
| | Auxiliary Contacts | 3a + 3b | | | | | | | | |
| | Approx. Weight - VCB (kg) | 90 | 100 | 105 | 115 | 135 | 140 | 150 | 200 | 350 |

Cubicle Dimensions and Weights

| | | | | | | | | | |
|--|--------|-----|--------|-----|------|--|--------------|--|--------|
| Normal Current (A) | 630 | | 1250 | | 1250 | | 2000 | | 3150 |
| Short-circuit Current (kA) | 20, 25 | | 20, 25 | | 31.5 | | 25, 31.5, 40 | | 40 |
| Impulse Withstand (kVp) | 75, 95 | | 75, 95 | | 95 | | 75, 95 | | 75, 95 |
| Cubicle Width (mm) | 600 | 700 | 600 | 800 | 800 | | 800 | | 1000 |
| Depth (mm) | 1548 | | | | | | | | |
| Height (mm) | 1926 | | | | | | | | |
| Add, Width for Bus-section (mm) | 400 | | | | | | | | |
| Approx. Cubicle Weight without VCB and PT (kg) | 345 | | 360 | | 480 | | 480 | | 550 |
| Potential Transformers (kg) | 80 | | | | | | | | |

*Depth indicated is for a typical panel without PT, measured from front door to circuit compartment rear cover. Additional depth for isolatable PT is 288mm.

*for greater
operational
flexibility...*

VHID

Double-busbar
Metalclad Switchgear

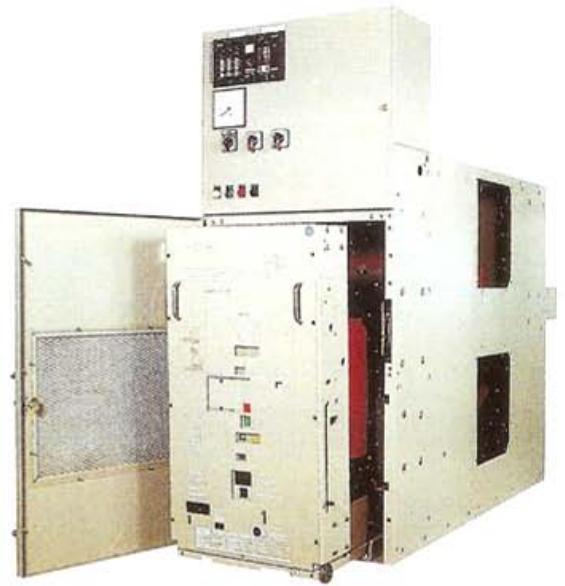


Almost all the winning features of the VHIH single-busbar design are retained in the VHID double-busbar version, which is in fact a natural extension of the single-busbar design.

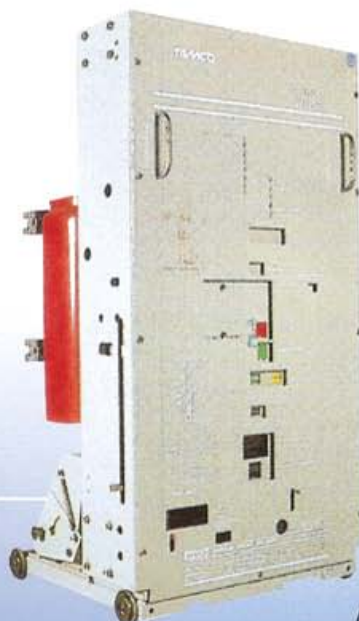
The cubicle has an additional busbar compartment. The "Main" and "Reserve" busbars are selected by lowering and raising the circuit breaker by means of a jackscrew built into the circuit breaker truck. This means of busbar selection is proven and offers the following advantages:

- Reliable error-free operation
- Minimum footprint
- Minimum height

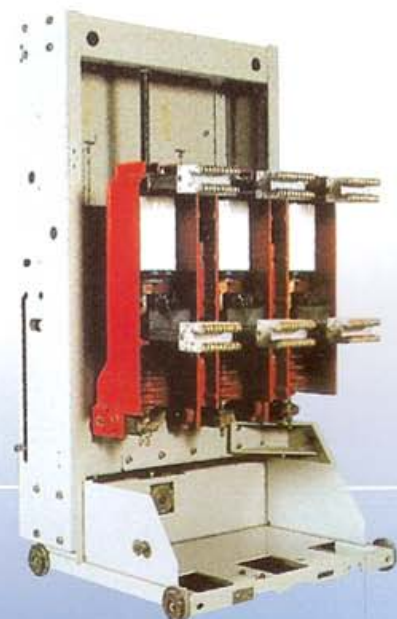
By utilising a large number of parts in common with the single busbar design, Tamco is able to offer double-busbar switchgear, with its attendant operational flexibility, at a very competitive price.



Double-busbar cubicle



Double-busbar VCB



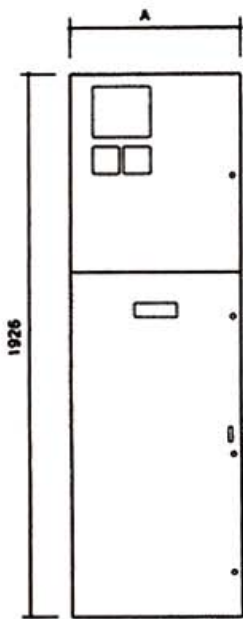
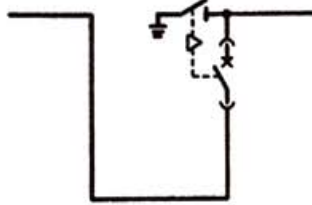
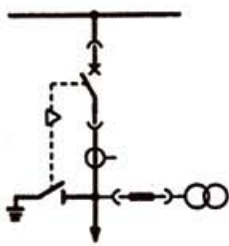
Product range - The current range of Tamco 12 kV double-busbar VCB is described in the following table.

| Model | VK | 10J20D | 10M20D | 10J25D | 10M25D | 10P25D |
|-------|--|----------------------------|--------|--------|--------|--------|
| R | Voltage (kV) | 12 | | | | |
| | Insulation Level: | | | | | |
| A | Impulse Withstand (kVp) | 75, 95 | | | | |
| | 1-min Power Freq (kV) | 28, 38 | | | | |
| T | Frequency (Hz) | 50 | | | | |
| | Normal Current (A) | 630 | 1250 | 630 | 1250 | 2000 |
| E | Short-circuit Breaking Current (kA) | 20 | | 25 | | |
| | Transient Recovery Voltage (kVp) | 20.6 | | | | |
| D | Short-circuit Making Current (kAp) | 50 | | | 63 | |
| | Operating Sequence | O-0.3 Sec.- CO - 3 Min- CO | | | | |
| | Duration of Short-circuit (S) | 3 | | | | |
| | Opening Time (mS) | 35 | | | | |
| | Break Time | < 3 Cycles | | | | |
| | Closing Time at No Load (mS) | 50 | | | | |
| | Closing Voltage (V DC) | 30, 110 | | | | |
| | Current (A) | 6.5, 3.5 | | | | |
| | Tripping Voltage (V DC) | 30, 110 | | | | |
| | Current (A) | 6.5, 3.5 | | | | |
| | Full Load Switching Life (no. of operations) | 10,000 | | | | |
| | Auxiliary Contacts | 3a + 3b | | | | |
| | Approx. Weight - VCB (kg) | 140 | 160 | 150 | 170 | 195 |

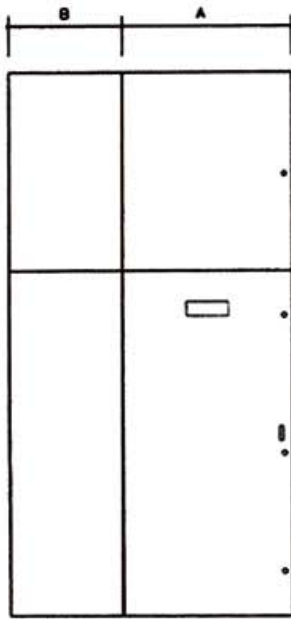
Cubicle Dimensions and Weights

| | | | |
|--|--------|--------|--------|
| Normal Current (A) | 630 | 1250 | 2000 |
| Short-circuit Current (kA) | 20, 25 | 20, 25 | 25 |
| Impulse Withstand (kVp) | 75, 95 | 75, 95 | 75, 95 |
| Cubicle Width (mm) | 600 | 600 | 800 |
| Depth (mm) | 1808 | | |
| Height (mm) | 1926 | | |
| Add. Width for Bus-section (mm) | 400 | | |
| Approx. Cubicle Weight without VCB and PT (kg) | 490 | 600 | 650 |
| Potential Transformers (kg) | 80 | | |

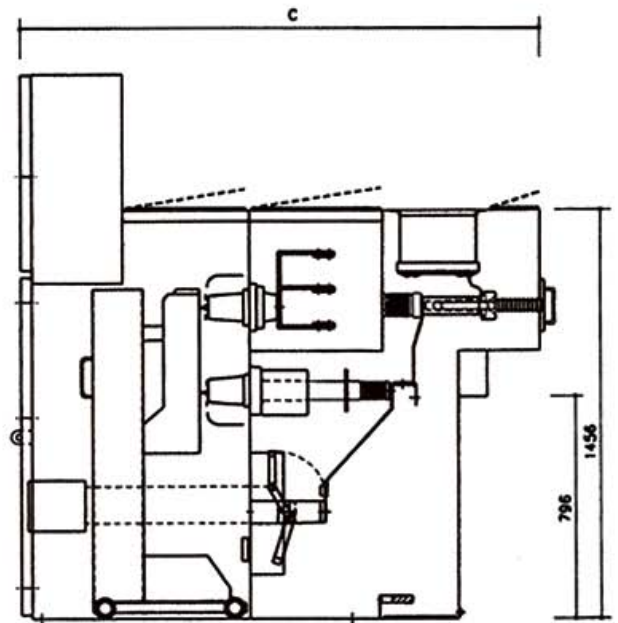
* Depth indicated is for a typical panel without PT, measured from front door to circuit compartment rear cover. Additional depth for isolatable PT is 288mm.



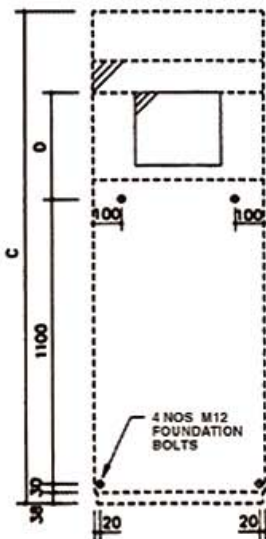
FRONT VIEW



FRONT VIEW



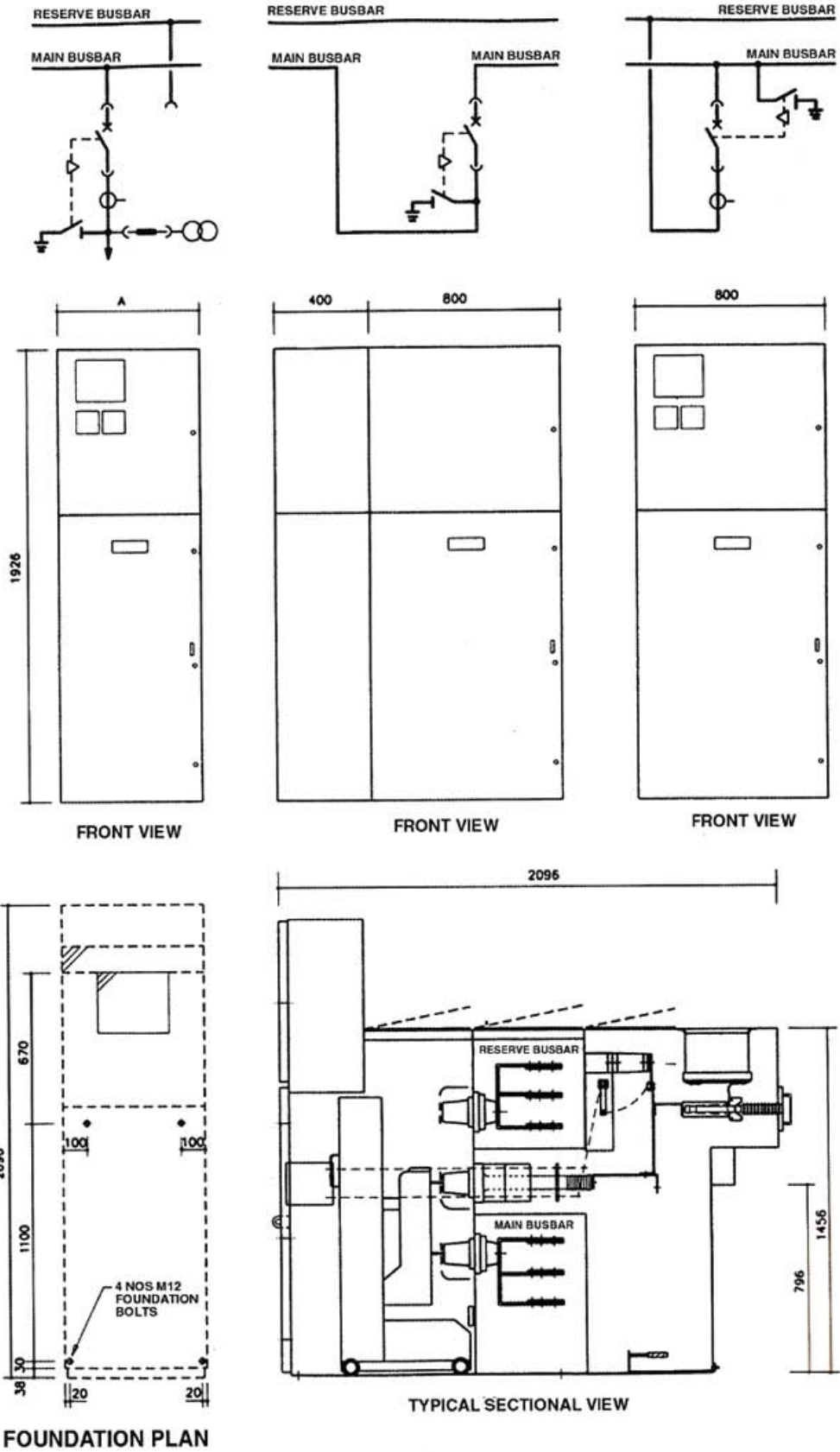
TYPICAL SECTIONAL VIEW



FOUNDATION PLAN

**VHIH (Single-busbar)
TYPICAL LAYOUTS**

| NORMAL CURRENT | 630A | 1250A | 2000A | 3150A |
|----------------|------|-------|-------|-------|
| DIM. A (mm) | 600 | 600 | 800 | 1000 |
| DIM. B (mm) | - | 400 | 400 | 600 |
| DIM. C (mm) | 1836 | 1836 | 2096 | 2191 |
| DIM. D (mm) | 380 | 380 | 640 | 675 |



**VHD (Double-busbar)
TYPICAL LAYOUTS**

| NORMAL CURRENT | 630A | 1250A | 2000A |
|----------------|------|-------|-------|
| DIM. A (mm) | 600 | 600 | 800 |

This information contained herein is correct at the time of going to press but as the product and its manufacturing processes are being developed continuously, this information is subject to change without notice, and the company cannot be held liable for any alleged misrepresentation howsoever arising.

TAMCO MIDDLE
EAST

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