TOSHIBA

Single-Phase Step Voltage Regulator

ADVANTAGES OF TOSHIBA SINGLE-PHASE STEP VOLTAGE REGULATORS (SVR)

RELIABILITY BUILT BY HISTORY

Quality and reliability proven by utilities, energy cooperatives and industries in Brazil and worldwide.

COMPLIANCE WITH STANDARD REQUIREMENTS:

Proven through independent laboratory test reports:

* IEEE ANSI C57-15
* IEC 60076-21
* NBR 11809.

HIGH WITHSTANDING WITH SUPERIOR PERFORMANCE PROVEN THROUGH LONG LIFE TIME AND ENERGY EFFICIENCY

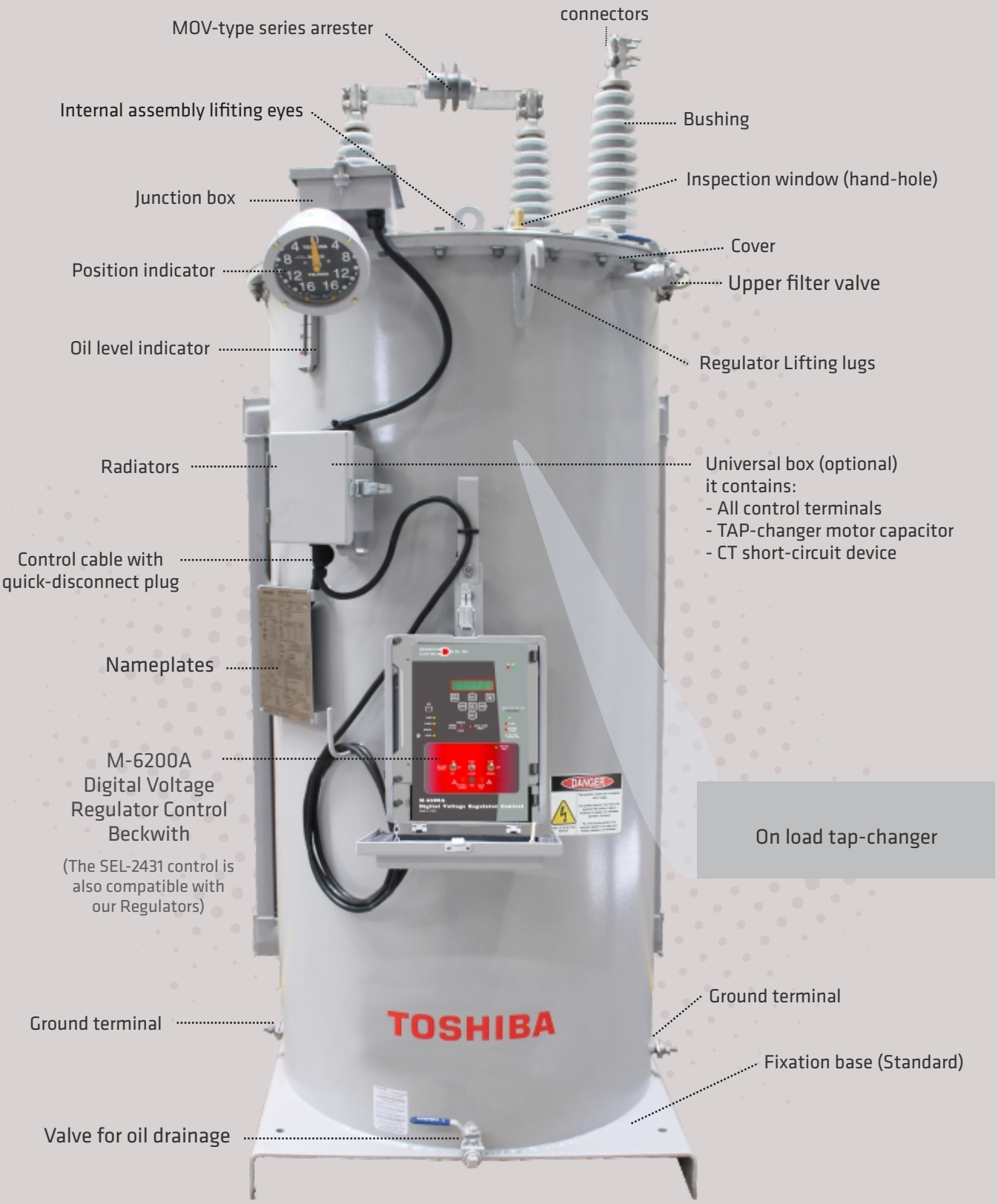
ROBUSTNESS ASSOCIATED WITH THE ON LOAD TAP CHANGER

Expected life time of 20 to 25 years free of maintenance
*Based to real loading and regulation of distribution line.

CUTTING EDGE ELECTRONIC CONTROL AND EASY OPERATION

EQUIPMENT MANUFACTURED IN BRAZIL WITH WORLDWIDE TECHNICAL ASSISTANCE.

SINGLE-PHASE STEP VOLTAGE REGULATORS COMPONENTS



Devices and accessories available:

1- Pressure-Relief device (included in the regulators).

2- Pole-Mounting Bracket (units up to 288kVA not shown)

3 - Tank and radiators can be in carbon or stainless steel according to customers's requirements.

4 - Carbon steel tank and radiators can have painting treatment or galvanized according to customer's requirements

TECHNICAL PERFORMANCE AND DIFFERENTIALS

Great performance on Short-circuit test

Impedance variation	
IEEE ANSI C57.15/2009; IEC 60076-21:2011 NBR 11809/1991	**Toshiba**
Maximum: 22,5%	*Maximum*: 12%
	our usual value <=8%

Excitation current variation	
IEEE ANSI C57.15/2009; IEC 60076-21:2011 NBR 11809/1991	**Toshiba**
Maximum: 25%	*Maximum*: 5%
	our usual value <=3%

Long lifetime of the active part

Power factor of the insulation material	
our ensured value	*Maximum*: 1,0%
our usual value	0,5%

Note: Lower power factor value contributes for a longer lifetime

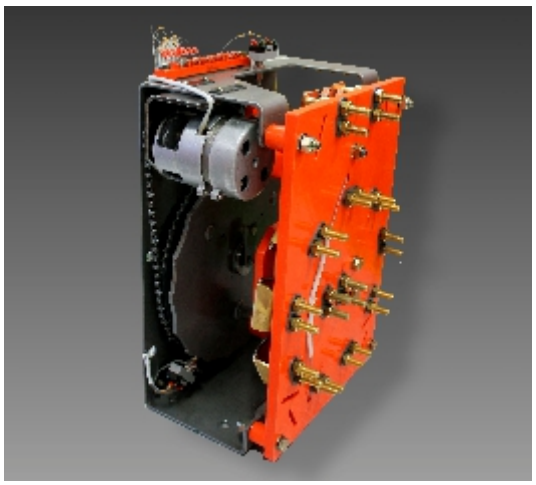
High precision on the tap position indication

Special sensors developed by Toshiba

1 - Great reliability on the dynamic performance of the decisions taken by the electronic control for the correct voltage regulation on the distribution line.

2 - In the event of maintenance, fast replacement of the electronic control without the necessity to bring the tap changer to the neutral position, while the regulators is on.

Under request, the regulator can be designed to withstand 40 times its nominal current.

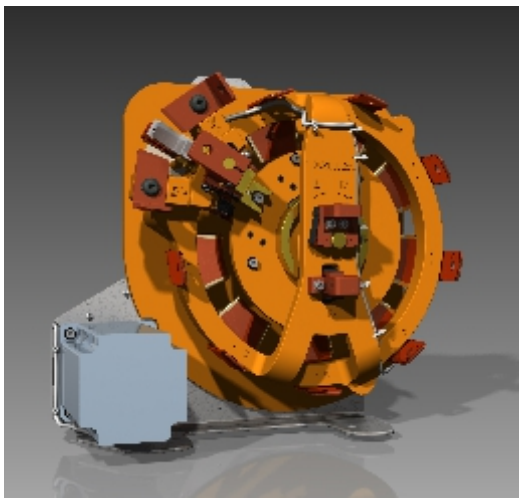


CR-3

- Mechanism action through Spring Drive
- Operation time for each position : 4s
- Operation time from neutral to maximum position: 64s
- Current capacity up to 668 A.

CR-10

- Mechanism action through Spring Drive
- Operation time for each position : 4s
- Operation time from neutral to maximum position: 64s
- Current capacity up to 1200 A.



CR-20

- New generation of high speed tap-changers
- Direct motor drive action of the mechanism
- Operation time for each position: 0,35s
- Operation time from neutral to maximum position: 5,6s
- Current capacity up to 668 A.

Notes:

- *Each device is designed for a specific range of current and voltage applications.*
- *Toshiba tap-changers meet IEEE, IEC and NBR standards for mechanical, thermal and dielectric requirements.*

Controls compatible with Toshiba Voltage Regulators.

SEL-2431

Voltage Regulator Control

The SEL-2431 Voltage Regulator Control is compatible with most 32-step, single-phase voltage regulators. Use various hinge and wiring kits to easily upgrade existing controls without removing the regulator from service. Quickly integrate the SEL-2431 into Ethernet or serial communications networks using fiber or copper options.

M-6200A

Digital Voltage Regulator Control - Beckwith

Digital Regulator Control for Toshiba Single Phase Voltage Regulator.

- Maximum Communication Options For Wired or Wireless Networks;
- Standard RS-232 or RS-485;
- Optional ST or V-Pin Serial Fiber Optic Port;
- Embedded Bluetooth, Class 1 (v2.0), 1Mbps, 128 bit encryption, up to 1/2 mile transmission;
- Supports DNP3.0, MODBUS and Cooper 2179 Protocols;
- DNP mapping templates to match SCADA historical databases;
- Time sync via DNP3.0 Set Time Command;
- Sequence of Events (SOE) Recording Of Events – Stores 129 events, mSec time-stamped with Graphic Logic Initiate from critical operational factors;
- FULL DNP implementation – Including DNP File Transfer, multi-addressing, unsolicited response, source address validation;
- TRUE Ethernet – Full 10/100Mbps auto-negotiable concurrent multi-session and multi-protocol support;
- DNP+Ethernet – Send/receive DNP configuration files using DNP File Transfer Protocol;
- DNP+Ethernet – Device Discovery using TapTalk;
- SCADA HeartBeat – Integrity check of communications media and/or Master. Fully programmable;
- Manual HeartBeat Timer;
- Quick (10 -15 second) Uploading of Configurations, Settings, Firmware Upgrades;
- Assists in locating harmonics adversely affecting customer processes;
- Helps mitigation measures to determine corrective filter design and location;
- CBEMA Event Recording and Reporting;
- Oscillography Capture – Selectable 16, 32, or 64 samples per cycle. Captures sags, swells, CBEMA events and sub-synchronous transients;
- Cyber Security – Comprehensive cyber security tools to implement NERC CIP requirements, including IPsec and Radius server security;
- Data Logging Continuous Recording – Data stored in non-volatile memory requiring no battery backup;
- Harmonics Detection, Recording, Protection and Suppression;
- Downloading of Event Reports, Oscillography;
- No need for battery to back up clock;
- Smart Flash SD Card Slot;
- Supports Control Cloning.

TVC (Toshiba Voltage Control)

TVC-SP (Single-Phase)

Description: Standard
Arrangement: One control for each regulator
Regulation: Traditional - Each regulator with its control.
* Optional: Three-phase Regulation
(Master - Slave; Master - follower ; and positions difference management among regulators).

TVC-MP (Multi-Phase)

Description: Single Command Control
Arrangement: One control in each regulator + interconnexion via optic fiber
Regulation: Single (per phase) + Three-phase (Master - Slave; Master - follower; and positions difference management among regulators).

TVC-MPi (Multi-Phase Integrated)

Description: Three-Phase Control
Arrangement: One control for each regulators bank
Regulation: Single (per phase) +
Three-phase (Master - Slave; Master - follower; and positions difference management among regulators).

HOW TO SPECIFY A REGULATOR

How to specify regulators to feed a total load of 1.5 MVA, fed through a transformer of 69 kV / 13.8 kV .

Substation Transformer

Secundary connection of the Transformer

- Grounded Wye
- Grounded Wye / Delta

Suitable Regulators Bank

Grounding Resistance of the Regulator Bank ≤ 20 Ω

Wye Connection	Closed Delta	Open Delta
Provided regulation: ±10%	Provided regulation: ±15%	Provided regulation: ±10%
3 regulators per bank	3 regulators per bank	2 regulators per bank
$I = \frac{1500\ kVA}{\sqrt{3} \times 13{,}8\ kV} = 62{,}8\ A$		$I = \frac{1500\ kVA}{\sqrt{3} \times 13{,}8\ kV} = 62{,}8\ A$
$Vn = \frac{13800}{\sqrt{3}} = 7967\ V$		$Vn = 13800\ V$
Regulator of 76,2 kVA, nominal voltage of 7,620 V and with additional voltage of 7,967 V. Nominal Current: 100 A	See table of preferred ratings in this catalog (pages 09, 10)	Regulator of 138 kVA, nominal voltage of 13,800 V. Nominal Current: 100 A

Application example in cubicles

PREFERRED RATINGS 60Hz STEP VOLTAGE REGULATORS

Rated Voltage	*Standard Available Voltages (1)*	*Rated kVA*	*Current Rating at +/-10%*	*Catalog Nº*
7620/13200Y 95/110kV BIL	7967 / 7620 / 7200 / 6930 / 6582	38,1	50	HCMR-60-7.62-50
		76,2	100	HCMR-60-7.62-100
		114,3	150	HCMR-60-7.62-150
		167	219	HCMR-60-7.62-219
		250	328	HCMR-60-7.62-328
		333	438	HCMR-60-7.62-438
		416	546	HCMR-60-7.62-546
		500	656	HCMR-60-7.62-656
		667	875	HCMR-60-7.62-875
		833	1093	HCMR-60-7.62-1.093
13800 95/110kV BIL	13800 / 13200 / 12600 / 12000 / 7967 /7620	69	50	HCMR-60-13.8-50
		138	100	HCMR-60-13.8-100
		207	150	HCMR-60-13.8-150
		276	200	HCMR-60-13.8-200
		414	300	HCMR-60-13.8-300
		552	400	HCMR-60-13.8-400
		667	483	HCMR-60-13.8-483
		833	604	HCMR-60-13.8-604
14400 / 24940Y 150kV BIL	14400 / 13800 / 13200 / 12000 / 7967/7620	72	50	HCMR-60-14.4-50
		144	100	HCMR-60-14.4-100
		288	200	HCMR-60-14.4-200
		333	231	HCMR-60-14.4-231
		432	300	HCMR-60-14.4-300
		576	400	HCMR-60-14.4-400
		667	463	HCMR-60-14.4-463
		833	578	HCMR-60-14.4-578
19920 / 34500Y 150kV BIL	19920 / 14400 / 13800 / 13200 / 7967 /7620	100	50	HCMR-60-19.92-50
		200	100	HCMR-60-19.92-100
		333	167	HCMR-60-19.92-167
		400	201	HCMR-60-19.92-201
		667	334	HCMR-60-19.92-334
		833	418	HCMR-60-19.92-418
23000 150kV BIL	23100 / 23000 / 19920 / 14400 / 13800 / 13200	230	100	HCMR-60-23-100
		469	200	HCMR-60-23-200
		690	300	HCMR-60-23-300
34500 200kV BIL	34500 / 33000 / 30000 / 19920 / 14400 / 13800	173	50	HCMR-60-34.5-50
		345	100	HCMR-60-34.5-100
		518	150	HCMR-60-34.5-150
		690	200	HCMR-60-34.5-200

(1) Standard voltage options will be shown as pinned on the nameplate

Notes:

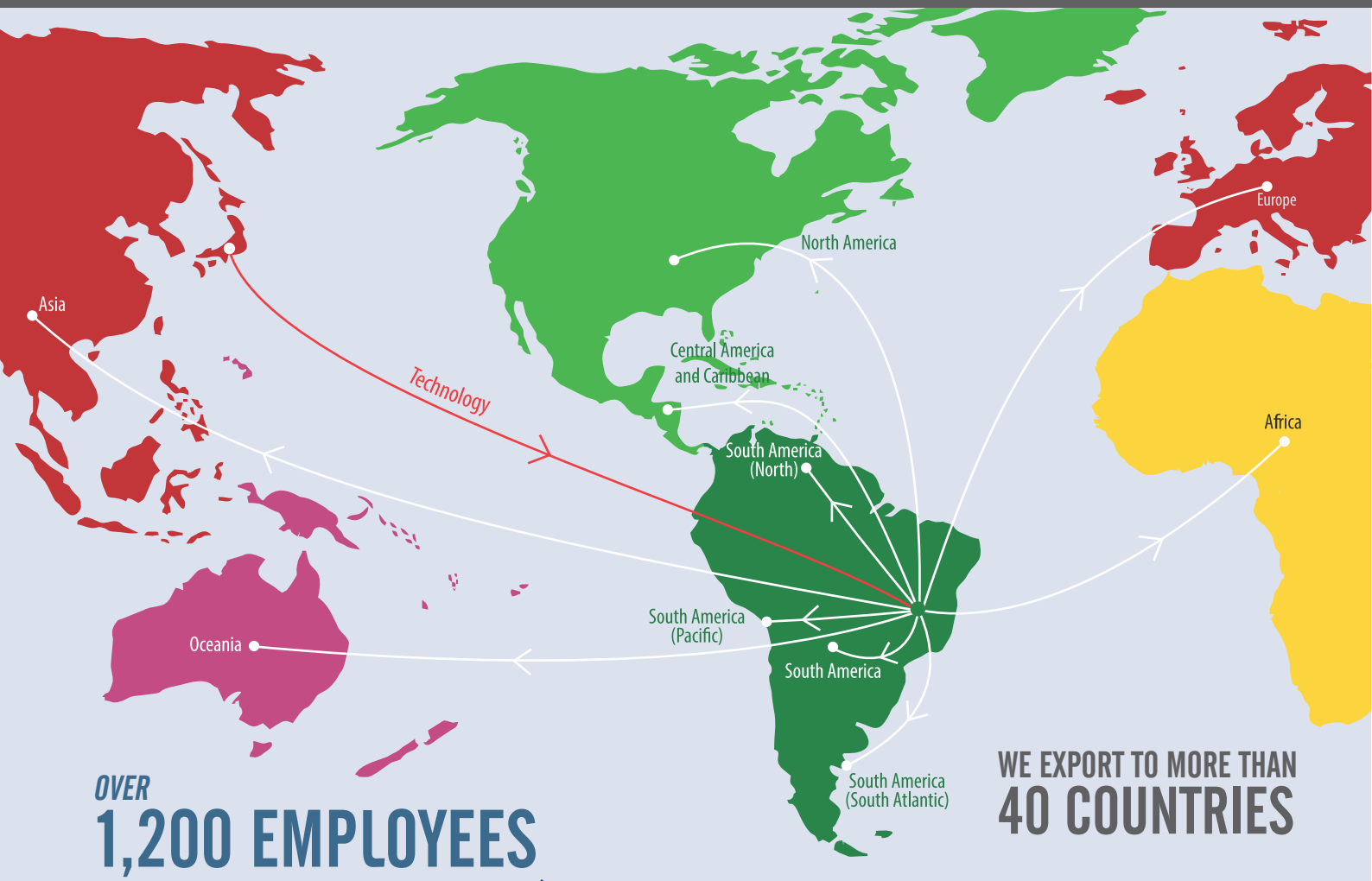
** Regulators are designed and constructed to withstand additional 12% increase to load current ratings and 65oC winding rise insulation.*

** Others voltage and current ratings can be availabe, for more information contact us.*

Supplementary continuous-current ratings	
Range of voltage regulation (%)	*Continuous - current rating (%)*
10	100
8.75	110
7.50	120
6.25	135
5.00	160

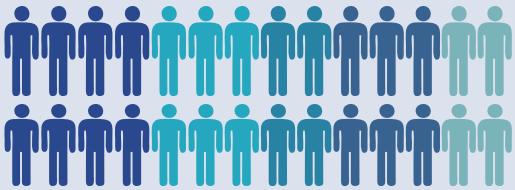
This table shall be applied up to 668 A rated current step voltage regulator.

SINCE 1968 MANUFACTURING HIGH QUALITY EQUIPMENT IN BRAZIL.



WE EXPORT TO MORE THAN
40 COUNTRIES

OVER
1,200 EMPLOYEES



of which, more than

150
ENGINEERS
AND SPECIALIZED TECHNICIANS

OVER
50,000
STEP VOLTAGE REGULATORS MANUFACTURED

MANUFACTURING CAPACITY:
- CURRENT RATING UP TO 1200A
- RATED VOLTAGE UP TO 34,5KV

OVER
4,000
POWER TRANSFORMERS AND SHUNT REACTORS MANUFACTURED.

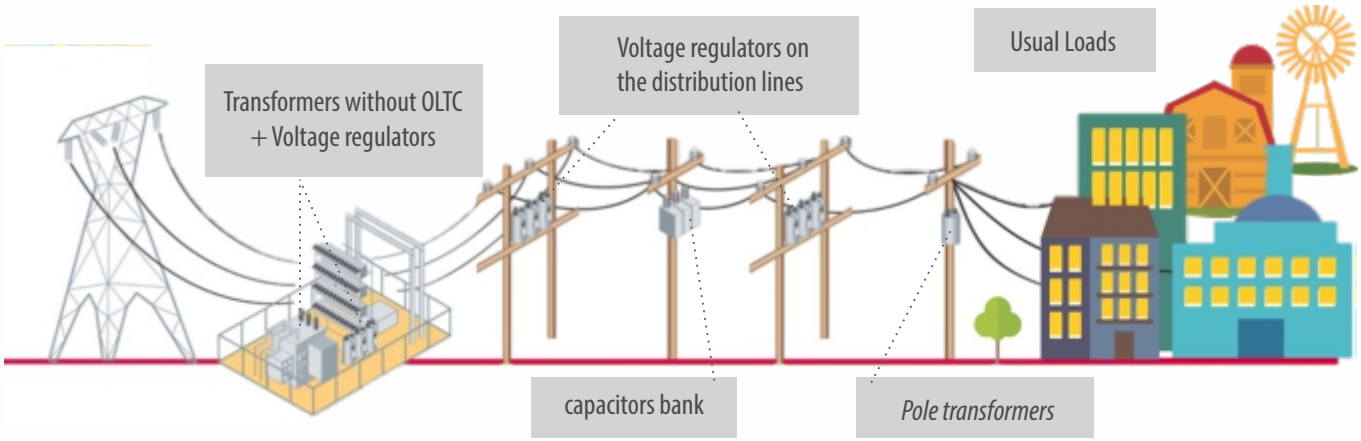
MANUFACTURING CAPACITY UP TO:
1,000 MVA - 800 KV

TSEA energia manufactures TOSHIBA brand equipment in Brazil

Betim Factory - Brazil

Contagem Factory - Brazil

Usual applications for single-phase voltage regulators



Technical and economic advantages of the Single-phase voltage regulators:
Prompt improvement of the voltage level in the distribution lines, avoiding the necessity of redistributing the loads on the phases, cable changes or construction of new substations.
Reduction of the energy interruption rate (protections action) due to inappropriate voltage level
improvement of the utilities gains due to the continuous supply of energy
Proper behavior of the loads , for example: motors, generators, irrigation systems, robots, electronic, loads, illumination, radars, panels, etc…
Better quality and reliability on the utility service
Improvement of the voltage level results on better load power factor and reduction of the energy cost.

Usual application of the Voltage regulators
- long electricity distribution lines
- towns or neighborhoods far from the big cities
- Industries with necessity of voltage regulation
- Rural areas
- during the progress of big constructions, like: Energy generation facilities, Airports, stadiums, etc…

Technical assistance:

Supervision service of installation, start up, trainings and spare parts / + 55 (31) 3329-6554 - falecom@tseaenergia.com.br

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