

# THYRISTOR CONTROLLED RECTIFIERS

EFFICIENT-**REC-T**



# EFFICIENT

## POWER CONVERSION

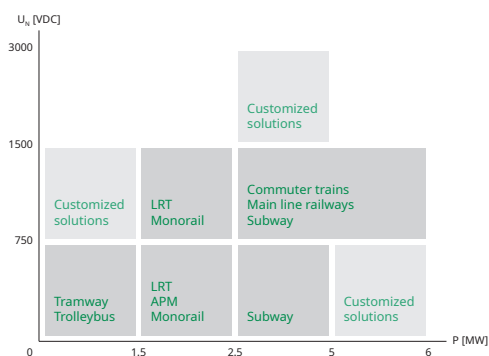


Using experience accumulated over more than 50 years working in the field of traction power substations, Sécheron has designed the EFFICIENT product category from the ground up to cover all the customer needs for DC supplies.

All EFFICIENT products are built specifically to comply with the most stringent requirements of usability, maintainability and durability in traction power application environments, maximizing the return of investment for our customers. These reliable and field-proven building blocks are also the basis for custom applications upon specific requests.

## GENERAL INFORMATION

### APPLICATIONS



Thanks to its complete range of rated voltages, Sécheron is able to cover all types of traction networks.

Sécheron's REC-T rectifier products incorporate decades of experience in traction rectifiers, making these controlled rectifiers for DC traction power supply and industrial applications a reliable long-term investment.

The design of the rectifiers is based on optimally sized and field-proven thyristors, offering particularly high performances and reliability. Thyristor press-pack technology also provides high overload capacity, allowing for natural air-cooled and low maintenance solutions.

The rectifier design is adapted to find the best compromise between high power factor, low harmonic distortion and required output power.

The REC-T rectifiers are designed in accordance with customer specifications and International, European or American standards.

## MAIN BENEFITS

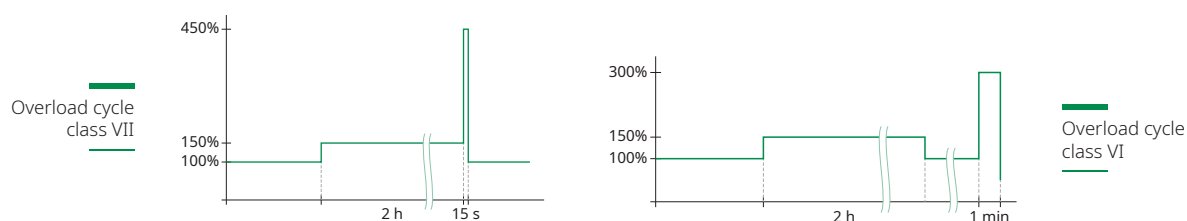
- ✓ Regulation of the voltage of the line in order to compensate for voltage drops, can potentially increase the distance between traction substations reducing the total quantity of installed assets
- ✓ Compact and robust design
- ✓ Adaptability: power connection from either the top or the bottom of the cubicle
- ✓ Ease of access for easy maintenance of components
- ✓ Natural air cooling (optional forced air)
- ✓ High efficiency
- ✓ Safe and reliable

# MAIN CHARACTERISTICS

	Unit	Values		
		750 V	1 500 V	3 000 V
<b>Standard rectifier range</b>				
Rated DC voltage	[V]	750	1 500	3 000
Rated power	[MW]	0.5 - 2	1 - 3	4
Maximum power	[MW]	Up to 9	Up to 9	Up to 12
Power frequency withstand voltage	[kV]	4.6	9.2	14
Overload	-	Class VI & Class VII per IEC 62590 (EN 50328) Extra heavy traction service per IEEE 1653.2		
AC frequency	[Hz]	50/60		
Efficiency	[%]	> 97.5		
Power factor	-	1 (with optional filter) <sup>(1)</sup>		
THDi	[%]	< 5 (with optional filter) <sup>(1)</sup>		
Cooling	-	Natural air		
Temperature range	[°C]	-5 / +40 (without derating)		
Maximum altitude	[m]	< 1 000 (without derating)		
Protection degree	-	Up to IP32		
Noise level	[dB]	< 65		

<sup>(1)</sup>Note: In thyristor converters, the power factor and THDi are determined by the transformer's parameters.

## Load cycle



# STANDARDS

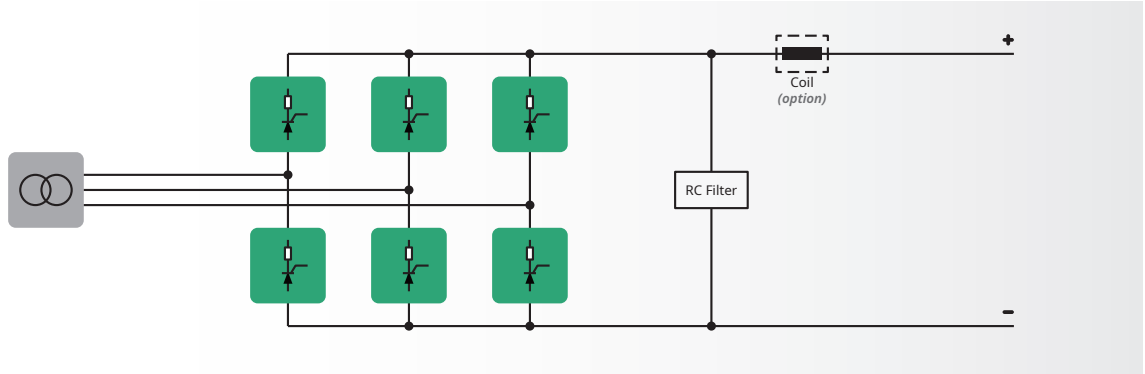
Our rectifiers are fully compliant and type tested according to the following standards:

- **IEC 62497 (EN 50124)** | Railway applications – Insulation coordination
- **IEC 60146 (EN 60146)** | Semiconductor convertors – General requirements and line commutated convertors
- **IEC 62590 (EN 50328)** | Railway applications – Fixed installations – Electronic power converters for substations
- **IEC 60850 (EN 50163)** | Railway applications – Supply voltages of traction systems
- **IEC 62236 (EN 50121)** | Railway applications – Electromagnetic compatibility
- **IEC 60076 (EN 60076)** | Power transformers
- **IEEE P1653.5** | Recommended Practice for Controlled Rectifiers for Traction Power Substation Applications
- **IEEE 519** | Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

# CONNECTIONS

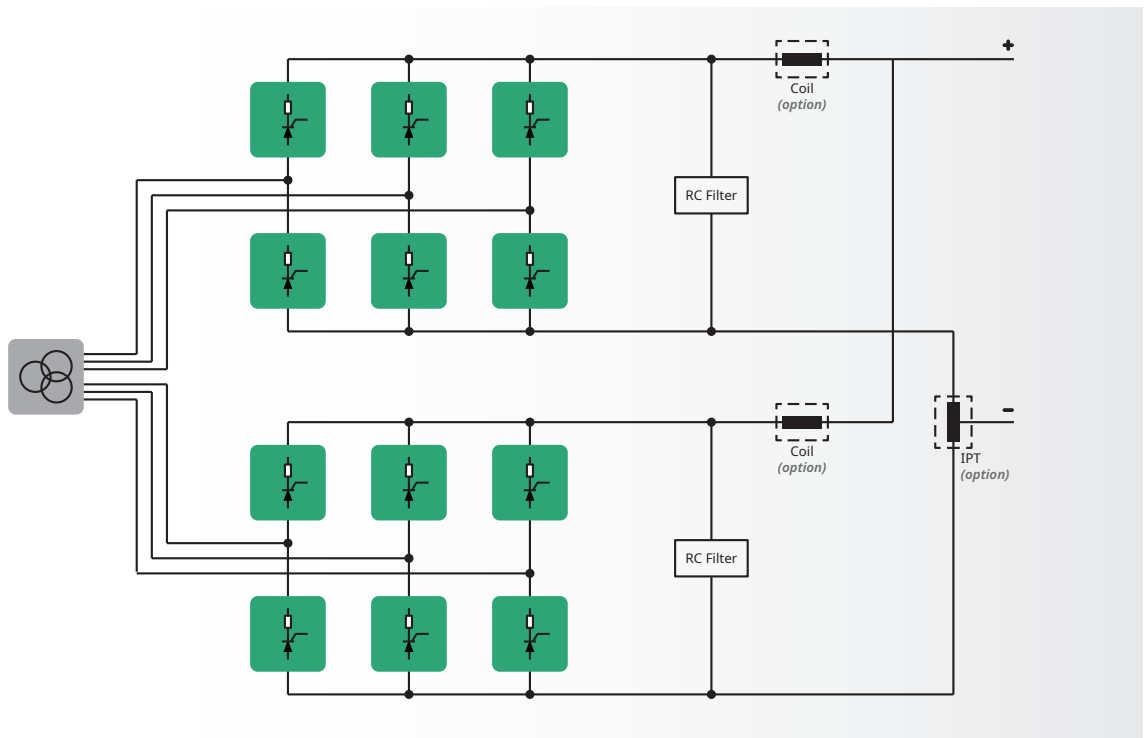
## 6-pulse - Up to 1 500 VDC

- Connection n°8 according to IEC 60146-1-2



## 12-pulse, with or without IPT - Up to 1 500 VDC

- Connection n°9 according to IEC 60146-1-2

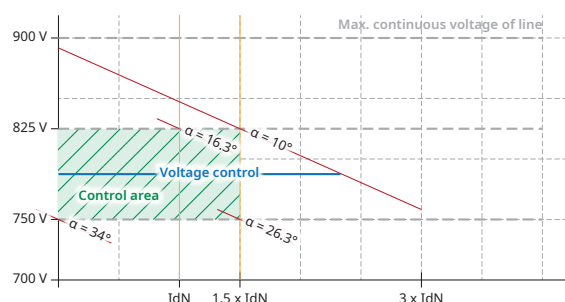


## NP+1 rectifiers with fuses (on demand)

Composed of several parallel thyristors on each branch, the faulty thyristor will be isolated from the circuit by melting the associated fuse allowing the rectifier to continue its operation.

These events are automatically detected, recorded and transmitted to the operator for maintenance.

# CONTROL MODES



Example of output characteristic for a thyristor controlled rectifier 750 V

## Dynamic voltage control

The firing angle is regulated at any time to maintain the DC output voltage at a defined level. The voltage regulation compensates for the inductive and resistive voltage drops over the whole load range.

## Diode mode

The firing angle is fixed and the voltage-current characteristic of the rectifier follows one of a non-controlled diode rectifier.

# PROTECTIONS

## OVERVOLTAGE PROTECTION

### Internal overvoltage

During turn-off, the load current of the thyristor does not stop flowing immediately but continues briefly in reverse direction as reverse recovery current. This peak reverse recovery current causes a voltage peak which is eliminated by an individual snubber circuit mounted in parallel with each thyristor.

### External overvoltage

Essentially due to lightning strikes, AC circuit breaker operation or short-circuits, external overvoltage can occur. The rectifier is equipped on the DC side with a RC filter capable of absorbing significant surges. A surge arrester can optionally be installed directly between the output terminals of the rectifier.

## SHORT-CIRCUIT PROTECTION

All REC-T controlled rectifiers are designed to withstand external short circuits without damage on the AC or the DC side thanks to circuit breakers.

## OTHER PROTECTIONS

### Enclosure frame leakage

The rectifier enclosure is isolated from the floor and connected to the station's ground via the frame leakage current sensor.

### Over-temperature

Over-temperature detection devices are provided with the equipment to avoid failures due to an abnormal increase of temperature.

### Control source failure

The system monitors the health of the auxiliary control power source.

### Over-current

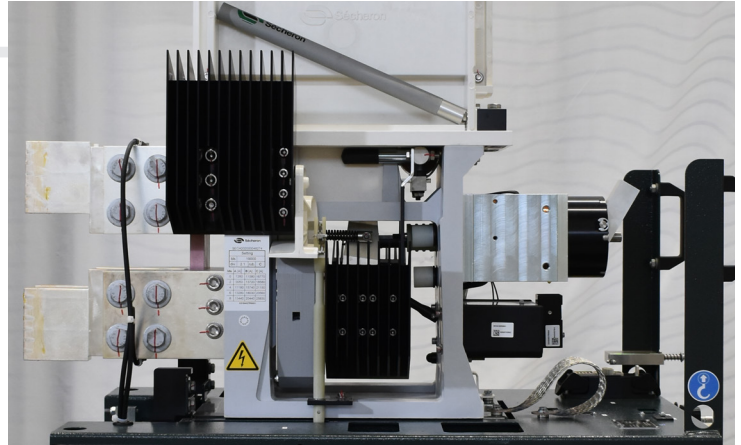
Rectifier over-current causes tripping of the AC circuit breaker and of the rectifier DC HSCB.

# OPTIMIZED INVESTMENT

Sécheron provides engineering support to ensure an optimized investment in fixed installation assets based on customer specifications.

## Protection & reliability

Based on Sécheron's ample experience, the protective devices present in the rectifier and the complete substation are carefully coordinated to ensure optimal protection. Breakers and other protective devices are configured to ensure safety and to preserve the acquired assets.



## Remote control monitoring & diagnostics

The rectifier includes a SEPCOS system, allowing connection to all types of communication bus and protocols.

## Reduced maintenance

The high thermal inertia means that forced air cooling is not required thanks to thyristor presspack technology, reducing maintenance requirements.



# TRANSFORMER-RECTIFIER GROUP

Based on strong experience, Sécheron provides an engineering and consulting support services for transformers according to standards IEC 62695 (EN 50329) and IEEE 1653.1:

- Technical specification
- Monitoring during manufacturing process with the supplier
- Assistance during factory acceptance tests
- Assistance during combined tests of the complete transformer-rectifier group



To ensure the compatibility of rectifier and transformer, Sécheron is able to provide the complete transformer-rectifier group.

## RELATED PRODUCTS

### REV

#### REVERSIBLE CONTROLLED CONVERTERS

Sécheron's REC-T controlled rectifiers can be customized further by integrating an energy recovery solution in the form of an INV-I inverter, obtaining a fully controlled, reversible substation.

Please check the REV brochure for further details about the complete reversible converter product range.



Refer to **Brochure REV** • SG847024BEN



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