

ELECTRICAL MEASURING TRANSDUCERS

TRIAD

Multifunction

**Digital
processing**

**Configurable
analogue outputs**

**0.2 accuracy class
4 kV insulation**



Profitable : lower price per function, and reduced set up costs.

3-in-1 : TRIAD replaces one, two or three conventional transducers.

Reliable : the MNA 10 ASIC guarantees no need for periodic calibration, even after environmental disturbances.

Compliance with EMC standards : the answer to the new Utilities and Industries specifications.

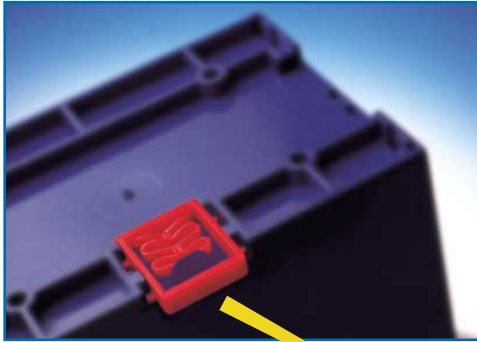
Configurable : drastically reduces inventory, ease of set up, saving on maintenance.



TRIAD ...

... An answer to all AC electrical parameters conversion requirements on a single-phase or three-phase power grid.

... Modularity, to create sets of two or three transducers in a single housing.

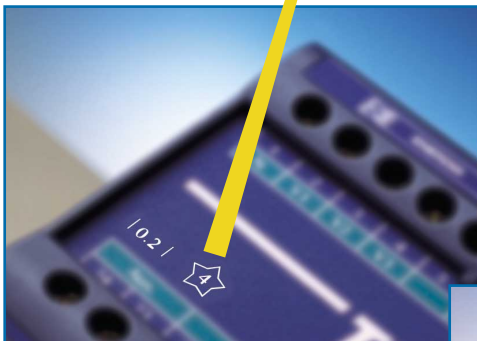
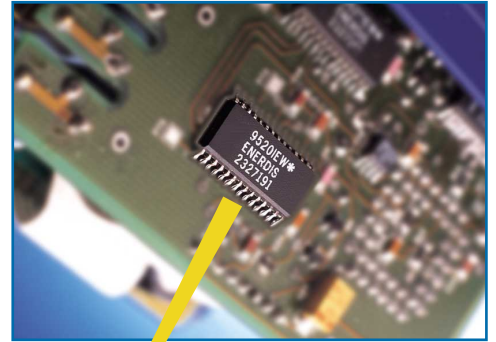


Ergonomics

Easy mounting
– on a DIN rail
– on panel

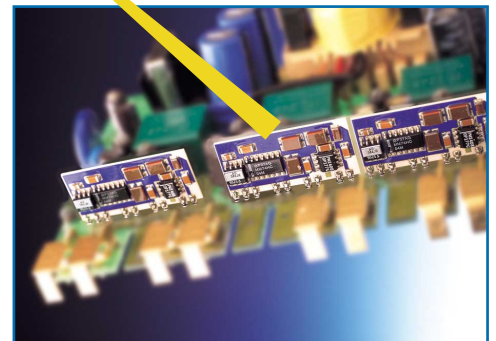
Accuracy / Reliability / Stability

Class 0.2 digital measurement core, based on the MNA 10 ASIC, developed specifically by ENERDIS for the TRIAD range



Standardisation

Compliance with international standards
– IEC 60688
– 89/336/EEC
(electromagnetic compatibility/EMC)
– 73/23/EEC (low voltage directive)



Multifunction / Economy

Three functions can be brought together in the same housing.



Accessibility / Security

– wide terminals (M6 6 mm²),
– excellent insulation (4 kV)

ENERDIS, experience and innovation in measuring transducers

- **For more than twenty years**, our transducers have earned themselves a **solid reputation for quality, accuracy, and reliability** in utilities sub-stations, LV/MV transformer cells, and monitoring/control panels... over the world.
- Through its close contacts with engineers in the electrical and industrial sectors, **ENERDIS remains constantly involved in research aimed at optimizing measuring transducers**. This knowledge of the applications and performance requirements for running electrical installations has led ENERDIS to design **the first range of digital-processing transducers, which include the following features: accuracy class 0.2%, 4kV insulation, multiple functions, and configurability**.
- **In developing an ASIC which incorporates all its know-how and the benefit of its experience**, ENERDIS has equipped the new *TRIAD* range of transducers with an **accurate and reliable measuring core**, a natural extension of the reputation for quality and performance which has always marked the success of its measuring devices..
- **The TRIAD range comes in 60mm or 120mm wide boxes, and can convert all AC electrical parameters in low level signals (4-20mA, 0-10V...).**

General features	Customer benefits
Multifunction	
TRIAD replaces 1, 2 or 3 conventional transducers	<ul style="list-style-type: none"> • Economy <ul style="list-style-type: none"> - price per function - installation costs - number of measuring transformers
Digital technology	
Measurement processing is entirely handled by the MNA 10 ASIC from ENERDIS	<ul style="list-style-type: none"> • Operation in harsh environment (temperature, humidity, disturbances...) • No need for periodic calibration • Compliance with EMC standards
Accuracy and insulation	
0.2 accuracy class according to IEC 60688 4kV insulation between inputs circuits, auxiliary supply and outputs circuits	<ul style="list-style-type: none"> • Installation safety • Compliance with international standards specified by industries and utilities
Switch mode auxiliary supply	
2 universal power units - from 80 to 230Vac and from 110 to 325Vdc - from 24 to 109Vdc and from 17 to 80Vac	<ul style="list-style-type: none"> • Adaptation to any auxiliary supply with only two models
Configuration	
Configuration by software	<ul style="list-style-type: none"> • Off-the-shelf availability • Ease of set up • Save on inventory and maintenance costs • Reconfigurable as site requirements change

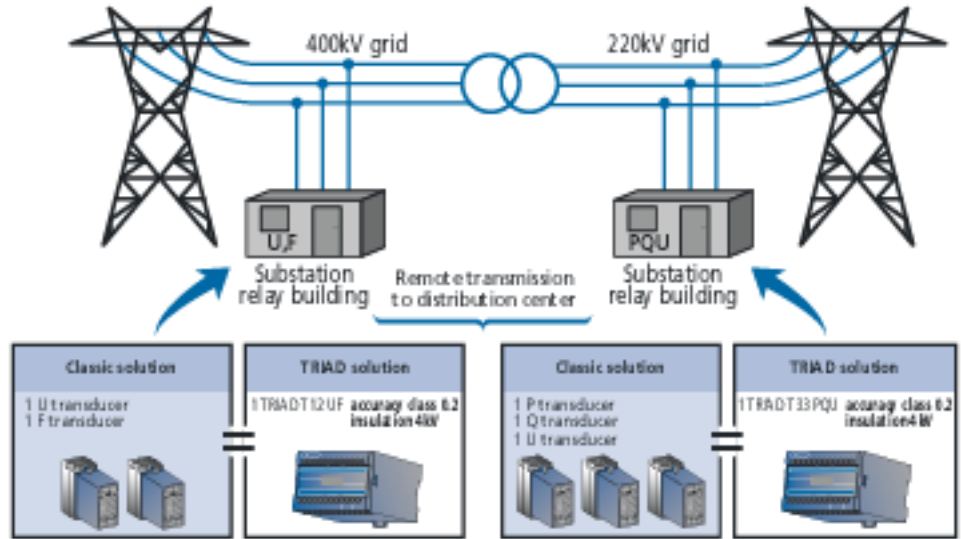
Summary			
	page		page
Applications	4	Operational specifications	8
Product range	5	Mechanical specifications	9
Functionalities	5	Connection diagrams	10 and 11
Transfer curves	5	Order form	12
How to define a TRIAD transducer	6	Additional products	13
Selection tables	7		

TRIAD : What will change in your installations

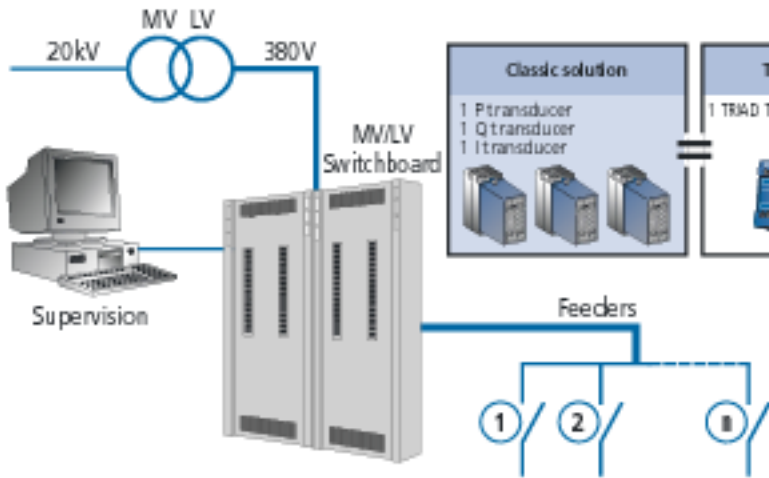
Some applications...

Electrical utility

Transducers are used in substations (e.g., 400 kV/220 kV) for remote transmission of electrical parameters (U, F, P, Q...) to the regional distribution center, to allow monitoring of electrical energy distribution and transport.



TRIAD reduces the number of conventional transducers from 5 to 2



Medium-voltage switchboard

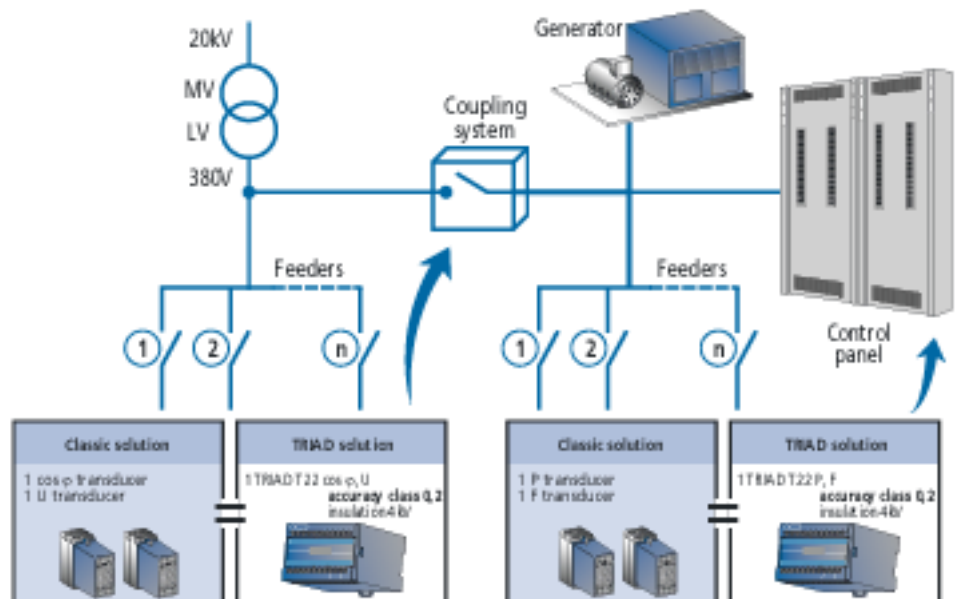
Transducers are present in the medium-voltage supply switchboard to transmit to a remote user measurements of electrical parameters (P, Q, I) required to supervise the medium-voltage grid.

TRIAD reduces the number of conventional transducers from 3 to 1

Energy co-generation


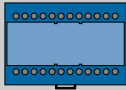
In the regulating cabinet, the transducers convert the instantaneous active power and frequency produced by the generator and transmit them to a PLC which drives the system

In the coupling box, the transducers transmit power factor ($\cos \varphi$) and voltage to a PLC, to synchronise the energy produced by the generator with the one of the grid.



TRIAD reduces the number of conventional transducers from 4 to 2

TRIAD : Product range

Power grids - Connections	Configurable		Type	Case	Auxiliary supply
Single phase	no	Current Voltage	TSPI TSPU		Self-powered
Single phase or balanced three-phase, 3/4-wire	yes	1 function 2 functions 3 functions	T11 T12 T13		2 universal power units 45 to 65 Hz 80 to 230 Vac (or 110 to 325 Vdc) or 24 to 109 Vdc (or 17 to 80 Vac)
Unbalanced three-phase, 3/4-wire	yes	1 function 2 functions 3 functions	T21 T22 T23		
Unbalanced three-phase, 4-wire	yes	1 function 2 functions 3 functions	T31 T32 T33		

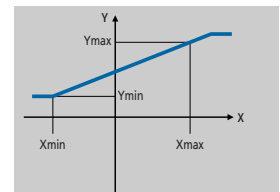
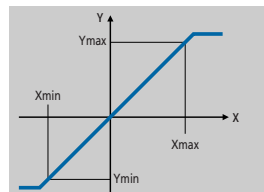
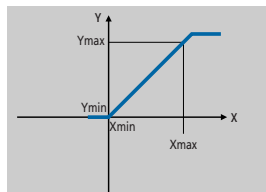
TRIAD : Functionalities

	TSPI	TSPU	Basic functions			Advanced functions			
	I (RMS) self-powered	U or V (RMS) self-powered	I (True RMS)	U or V (True RMS)	F	S	P	Q	Cos φ Power factor
Input									
Nominal value	In : 1 or 5A	Vn : 100/√3, 110/√3, 120/√3 or 230V Un : 100, 110, 120, 230 or 400V	In : 1 or 5A	Vn : 100/√3, 110/√3 or 230V Un : 100, 110, 230 or 400V ①	Fn : 50 or 60Hz	In : 1 or 5A Vn : 100/√3, 110/√3 or 230V Un : 100, 110, 230 or 400V ①			
Measuring range (X)	0...100% In	0...100% Vn or 0...100% Un	0...Xmax with 0.5 In < Xmax < 1.3 In	0...Xmax with 0.5 Vn < Xmax < 1.2Vn	X1 ... X2 with Fn - 5 Hz ≤ X1 ≤ Fn - 1 Hz Fn + 1 Hz ≤ X2 ≤ Fn + 5 Hz [accuracy 0.2% X2]	0...Xmax or Xmin...Xmax with 0.7 Sn ≤ Xmax ≤ 1.3 Sn Sn = Un x In (single phase) Sn = Un x In x √3 (3-wire) Sn = Vn x In x 3 (4-wire) ②			0.5 Cap...1...0.5 Ind 0.8 Cap...1...0.2 Ind [other values, please consult us]
Output			Configurable as per the following transfer curves : 0...Ymax or Ymin...Ymax with -20 mA ≤ Ymax ≤ +20 mA and Ymax - Ymin ≥ 5mA or -10V ≤ Ymax ≤ +10V and Ymax - Ymin ≥ 2.5V						
Output range (Y)	0...10mA or 0...20mAdc	0...10 or 0...20mAdc ; 0...5 or 0...10Vdc							
Load resistance			current output: ≤ 15 V/Ymax		voltage output: ≥ 1 kΩ				
Overflow	max. value: 1.1 Ymax (Ymax = current or voltage output)								
Response time	< 100 ms	< 200 ms	< 350 ms						
Accuracy	Cl. 0.2 : from 10 to 100%In and from 50 to 100% Un or Vn		Class 0.2 (± 0.2% of the input range)						

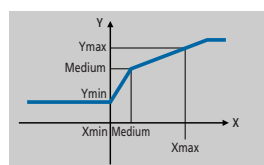
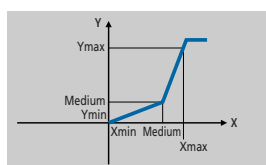
① other nominal values adjustable from 50 to 480V ② measuring range adjustable within the indicated limits class 0.5 for 0.4Sn ≤ Xmax ≤ 0.7Sn

TRIAD : Transfer curves

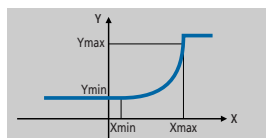
Linear transfer curves
with adjustable zero offset



Two-slope
transfer curves



Quadratic
transfer curves



How to select the right TRIAD transducer for your application⁽¹⁾ ?

(See order form on page 12)

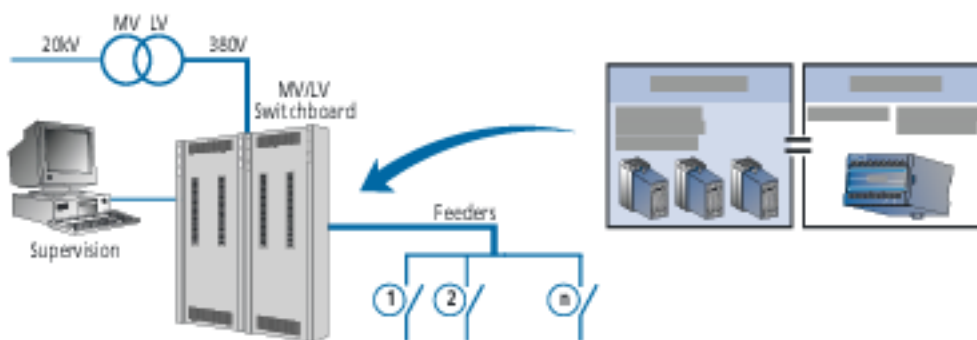
1

Determine:

- The type of power grid
e.g.: Three-phase balanced 3-wire
- The types of measurements you wish to perform among: I (current), U (voltage), F (frequency), P (active power), Q (reactive power), S (apparent power) and $\cos \varphi$ (power factor)
e.g.: P, Q and I

2

Select the best arrangement of functions in the two- or three-output housings, according to the layout of your measuring points with the opposite tables.



3

Indicate the inputs / outputs parameters of your transducer

- Measuring transformers ratios (the secondary of your transformers corresponds to the transducer current and voltage inputs).
e.g.: 750A/1A current transformer => 1A current inputs
20000V/110V voltage transformer => 110V voltage inputs
- Measuring range for each function
e.g.: TRIAD transducer 3 phases T32
Function # 1: Total active power (Pt) 0...30MW
Function # 2: Total reactive power (Qt) -20...0...20Mvar
- Transfer curve and output range for each function
e.g.: linear output 0...20mA

4

Specify

- The type of auxiliary supply available in your installation
e.g.: 230Vac
- The nominal operating frequency
e.g.: 60Hz

⁽¹⁾ For self powered transducers, refer to page 8

TRIAD : The selection tables⁽¹⁾

In the following tables, you will find for each kind of power grid, the TRIAD transducer and its connection diagram which allow the conversion of 1, 2 or 3 electrical parameters (functions). All connection diagrams are listed in pages 10 and 11.

Example: Three-phase balanced 3-wire → table ②
 P, Q and I measurements → 3 functions
 TRIAD transducer → T13
 Connection diagram → TD012

① Single-phase (1V/1I)

	Functions						
	I	V	F	Cos φ	P	Q	S
1 Function	◀ T11 (TD003) ▶						
		◀ T11 (TD004) ▶					
				◀ T11 (TD005) ▶			
2 Functions		◀ T12 (TD006) ▶					
				◀ T12 (TD007) ▶			
3 Functions				◀ T13 (TD007) ▶			

② Three-phase balanced 3/4-wire (1U/1I)

	Functions						
	I	V or U	F	Cos φ	P	Q	S
1 Function	◀ T11 (TD009) ▶						
		◀ T11 (TD008) ▶					
				◀ T11 (TD010) ▶			
2 Functions		◀ T12 (TD011) ▶					
				◀ T12 (TD012) ▶			
3 Functions				◀ T13 (TD012) ▶			

③ Three-phase unbalanced 3-wire (2U/2I)

	Functions						
	I	U	F	Cos φ	P	Q	S
1 Function		◀ T11 (TD008) ▶					
				◀ T21 2 elements, 2U/2I (TD015) ▶			
2 Functions		◀ T12 (TD011) ▶					
		◀ T22 (TD013) ▶					
				◀ T22 2 elements, 2U/2I (TD015) ▶			
3 Functions	◀ T33 (TD014) ▶						
		◀ T23 (TD013) ▶					
				◀ T23 2 elements, 2U/2I (TD015) ▶			

④ Three-phase unbalanced 4-wire (2U/3I or 3V/3I)

	Functions						
	I	V or U	F	Cos φ	P	Q	S
1 Function		◀ T11 (TD008) ▶					
				◀ T21 2 ^{1/2} elements, 2U/3I (TD016) ▶			
				◀ T31 3 elements, 3V/3I (TD018) ▶			
2 Functions		◀ T12 (TD011) ▶					
		◀ T22 (TD013) ▶					
				◀ T22 2 ^{1/2} elements, 2U/3I (TD016) ▶			
3 Functions	◀ T33 (TD014) ▶						
		◀ T23 (TD013) ▶					
		◀ T33 (TD017) ▶					
			◀ T33 3 elements, 3V/3I (TD018) ▶				

(1) For self powered transducers, refer to page 8

Operational specifications

Standards

Reference standard: IEC 688 (EN 60688, VDEN 60688, BS 60688...)
 Electromagnetic compatibility: 89/336/CEE
 Low voltage directive: 73/23/CEE

Accuracy

Accuracy class 0.2: according to IEC 688

Electrical performances

Inputs

	CURRENT	VOLTAGE
Nominal value	$1A \leq I_n \leq 5A$	$50V \leq U_n \leq 480V$
Frequency	45 ... 65Hz	
Burden	$\leq 0.5VA$	$\leq 0.5VA$
Maximum overloads	2In permanent 20In / 1s 40In / 0.5s	1.5Un permanent 2Un / 1s 4Un / 0.5s

Outputs

	CURRENT	VOLTAGE
Nominal value	from -20mA to 20mA	from -10V to 10V
Load	$\leq 15V / I_s (1)$	$\geq 1k\Omega$
Overflow	1.1 Is (1)	1.1 Us (1)
Residual ripple peak-to-peak	40µA	20mV

(1) Is = output current
 Us = output Voltage

Auxiliary supply

Two switch mode auxiliary supply versions (50/60Hz)
 (running from +10% to -15% of the extremes)
 - from 80 to 230Vac (or 110 to 325Vdc)
 - from 24 to 109Vdc (or 17 to 80Vac)
 Burden: 6VA

Sampling frequency

- 15.625kHz (312 samples per period in 50Hz)

Response time : $\leq 350ms$, according to IEC 60688

Insulation according to IEC 61010-1

- between inputs circuits, auxiliary supply and outputs circuits: 4kV, 50Hz, 1mn
 - output to output: 500V, 50Hz, 1mn

Housing

Self-extinguishing thermoplastic material UL94V0
 Enclosure according to IEC 529:

- IP 503 housing
- IP 203 front panel

Weight:

- 60mm x 81mm models: 320g
- 120mm x 81mm models: 700g

Connections

- Terminals allowing connection of single core 6mm² conductors and 4mm² multiple-core conductors, by moveable clamp and screw

Environment

Temperature according to IEC 60688:

- Operation: -10° ... +55°C
- Storage: -40° ... +70°C

Humidity according to IEC 60688:

- Operation: +55°C at 95% relative humidity

Electromagnetic compatibility (89/336/EEC) CE

- Immunity according to EN 50082-2
 - Withstanding impulse voltage according to EN 61000-4-5: 2kV (1,2/50µs)
 - Ring wave and damped oscillatory wave according to EN 61000-4-12: 1 kV
 - Fast transient burst according to EN 61000-4-4: 2 kV on the auxiliary supply unit; 2kV between inputs/outputs
 - Electrostatic discharge according to EN 61000-4-2: 8 kV air, 4 kV by contact
 - Electromagnetic field immunity according to EN 61000-4-3: 80MHz ... 1GHz, 10V/m
 - Power frequency magnetic field immunity test according to EN 61000-4-8: 30A/m at 50Hz
- Radiated and conducted emissions according to EN 50081-2

Mechanical strength according to IEC 61010-1

Vibration according to IEC 60068-2-6

Shock according to IEC 60068-2-27

Specific characteristic for self powered transducers

Self powered current transducers (TSPi)

Input1A or 5A
 Burden2VA
 Linear output0-10mA or 0-20mA
 Frequency.....50 or 60Hz
 Response time $\leq 100ms$

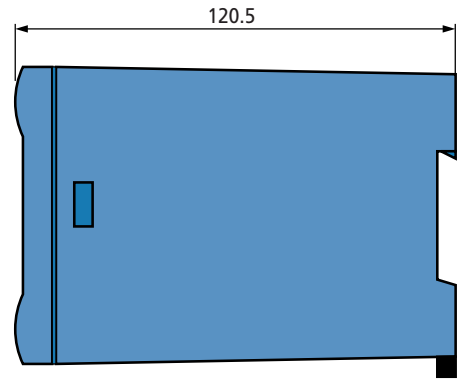
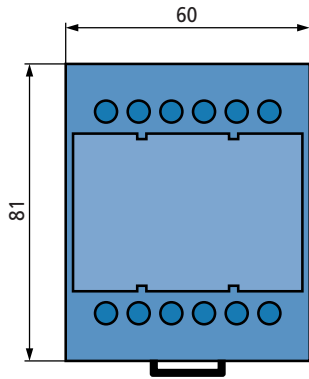
Self powered voltage transducers (TSPU)

Input57.7 - 63.5 - 69.3 - 100 - 110 - 120 - 230 or 400V
 Burden2VA
 Linear output0-5V or 0-10V or 0-10mA or 0-20mA
 Frequency.....50 or 60Hz
 Response time $\leq 200ms$

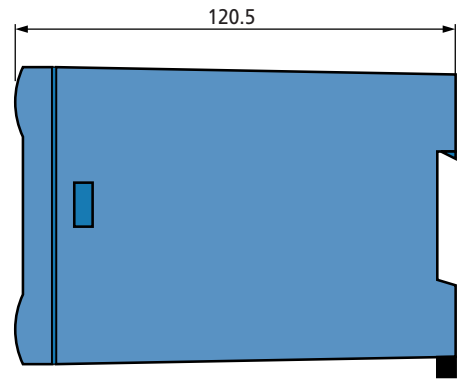
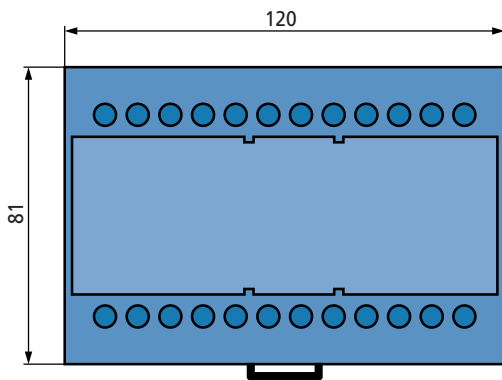
Mechanical specifications

Dimensions (mm)

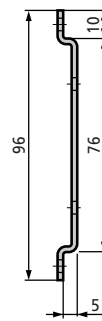
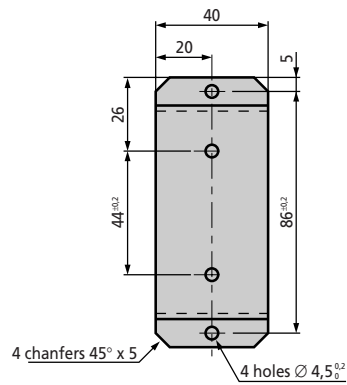
T11, TSPI and TSPU



T12, T13, T21, T22, T23, T31, T32 and T33

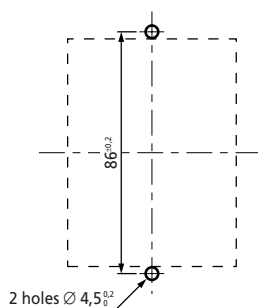


Panel mounting system (option)

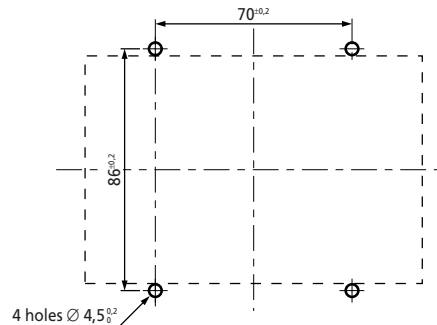


Panel drilling specifications

T11, TSPU and TSPI

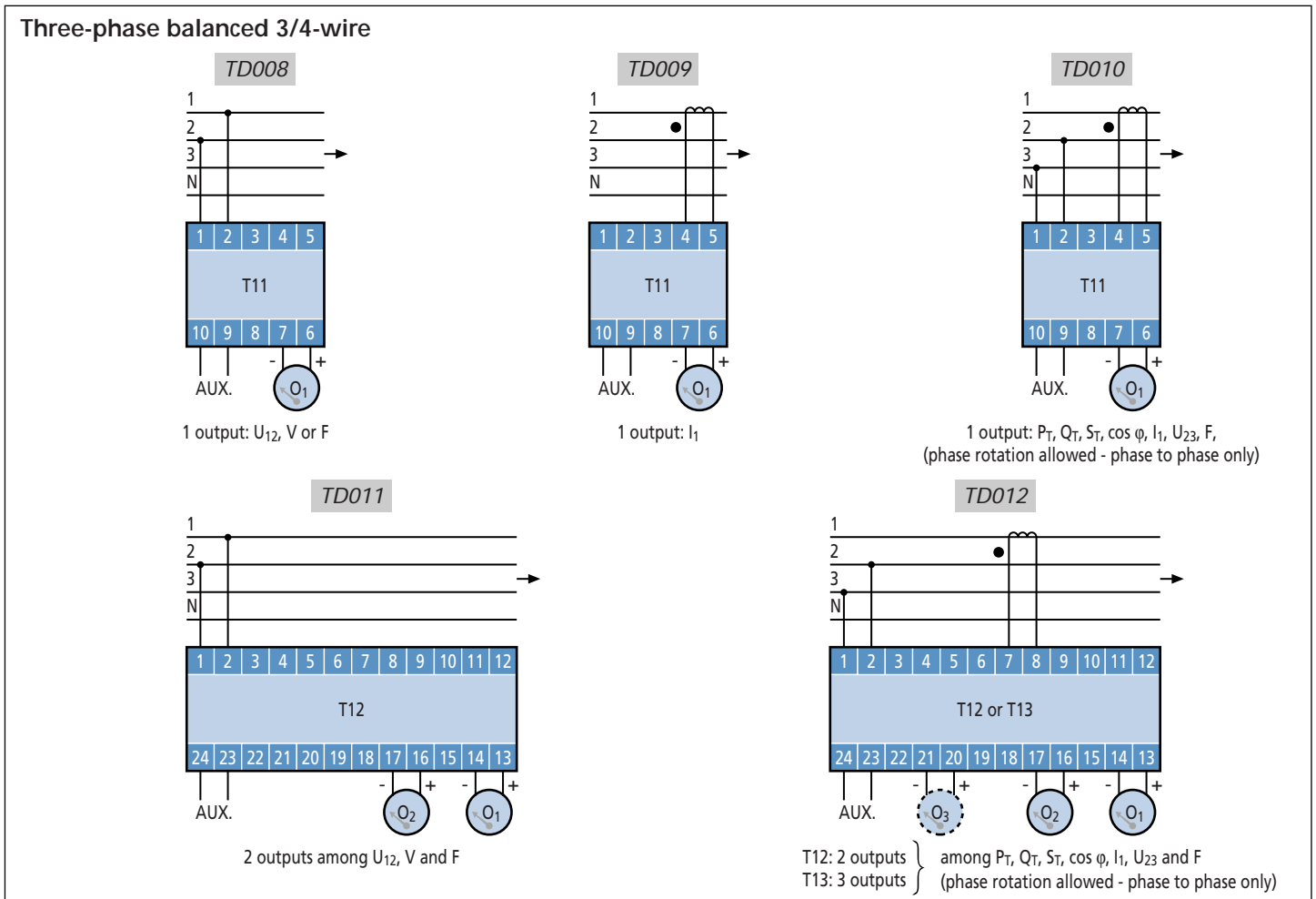
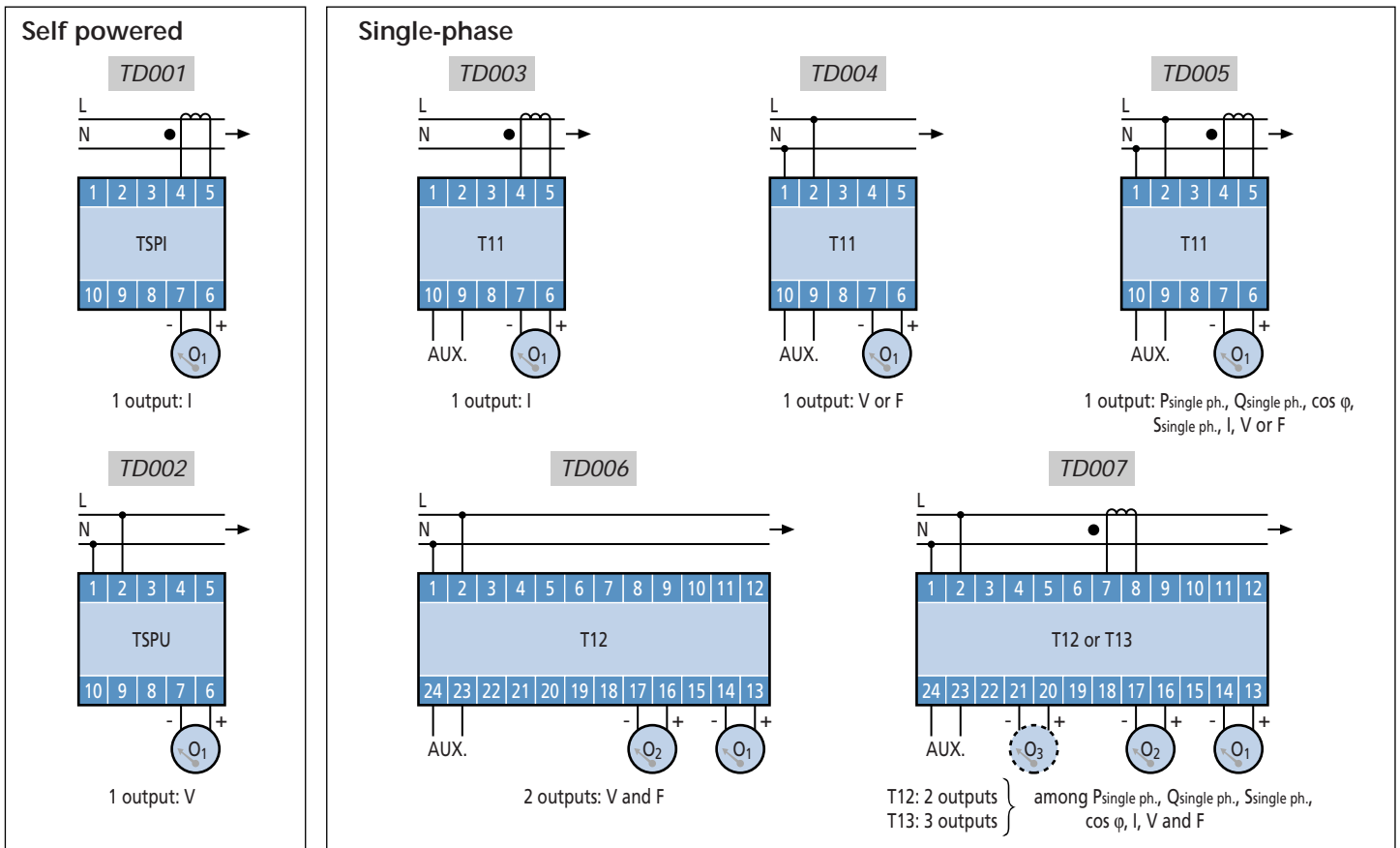


T21, T22, T23, T31, T32 and T33

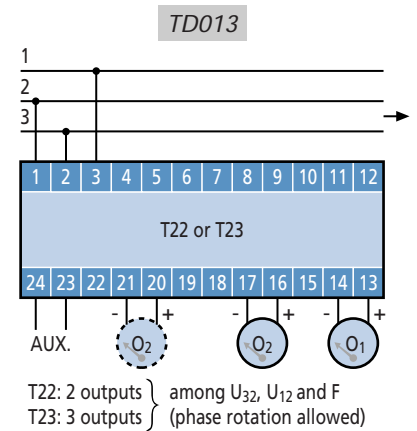
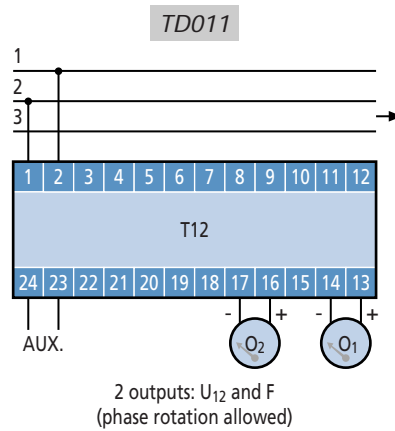
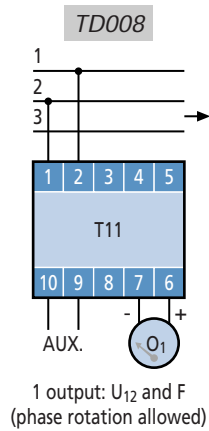


Connection diagrams

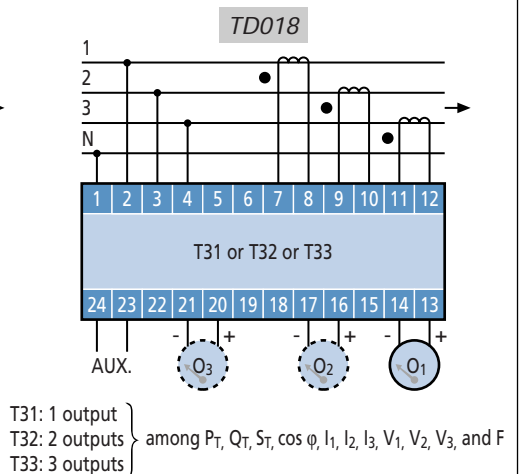
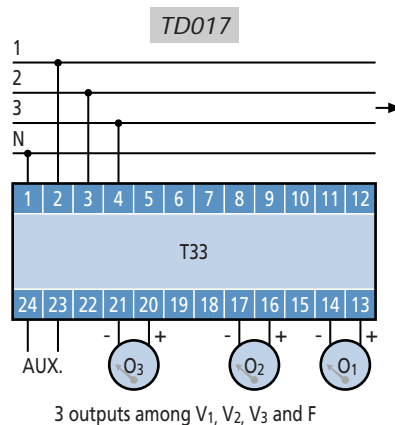
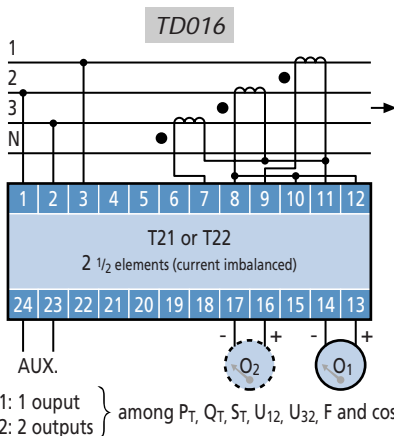
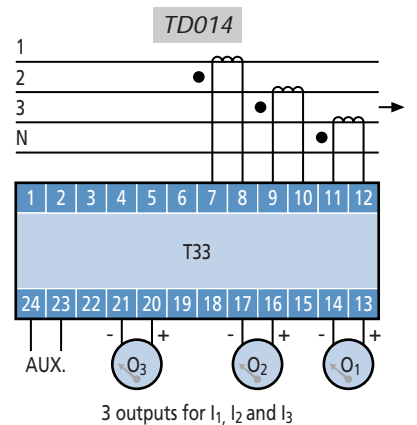
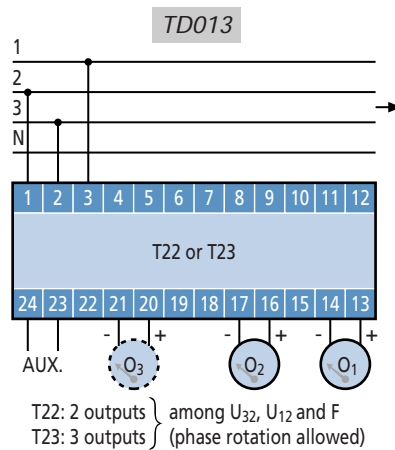
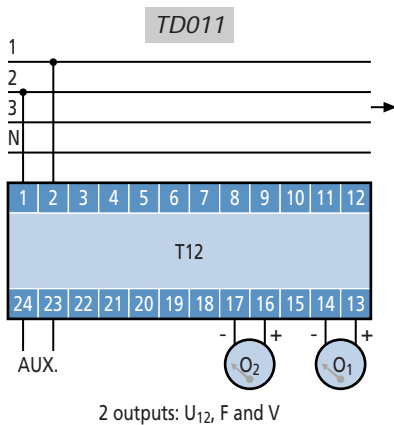
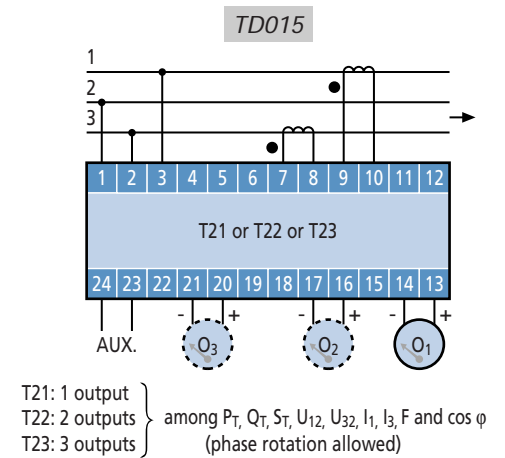
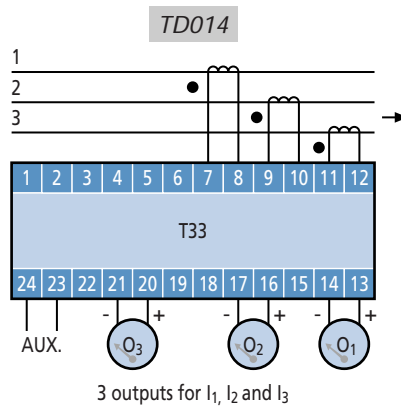
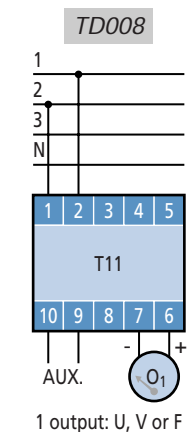
In order to select the right TRIAD transducer for your application, please refer to selection tables (page 7)



Three-phase unbalanced 3-wire



Three-phase unbalanced 4-wire



TRIAD range transducers: order form

Following the selection of the transducer in page 7, please copy, fill out and attach this form to your order.

1 Power grid

- | | |
|--|---|
| <input type="checkbox"/> Single-phase | <input type="checkbox"/> 3-phase unbalanced 3-wire (2 elements 2U, 2I) |
| <input type="checkbox"/> 3-phase balanced 3-wire | <input type="checkbox"/> 3-phase unbalanced 4-wire (2 ^{1/2} elements 2U, 3I) |
| <input type="checkbox"/> 3-phase balanced 4-wire | <input type="checkbox"/> 3-phase unbalanced 4-wire (3 elements 3V, 3I) |

2 Model

- | | | |
|------------------------------|------------------------------|------------------------------|
| 1 function | 2 functions | 3 functions |
| <input type="checkbox"/> T11 | <input type="checkbox"/> T12 | <input type="checkbox"/> T13 |
| <input type="checkbox"/> T21 | <input type="checkbox"/> T22 | <input type="checkbox"/> T23 |
| <input type="checkbox"/> T31 | <input type="checkbox"/> T32 | <input type="checkbox"/> T33 |

Connection diagrams

TD

3 Inputs

Current		Voltage	
<input type="checkbox"/> With current transformer Primary Secondary	or <input type="checkbox"/> Direct	<input type="checkbox"/> With voltage transformer Primary Secondary	or <input type="checkbox"/> Direct
<input type="text"/> / <input type="text"/> A	<input type="text"/> A	<input type="text"/> / <input type="text"/> V	<input type="text"/> V
		<input type="checkbox"/> Phase to phase	<input type="checkbox"/> Phase to neutral

1st output (function)

Measuring signal and measuring range (X)	Transfer curve	Output signal (Y)
<input type="checkbox"/> I <input type="checkbox"/> U <input type="checkbox"/> V <input type="checkbox"/> F <input type="checkbox"/> P <input type="checkbox"/> Q <input type="checkbox"/> S <input type="checkbox"/> Cos φ Min medium Max <input type="text"/> <input type="text"/> <input type="text"/> Unit ⁽¹⁾ <input type="text"/>	<input type="checkbox"/> Linear <input type="checkbox"/> 2 slopes <input type="checkbox"/> Quadratic	Min medium Max <input type="text"/> <input type="text"/> <input type="text"/> mA or <input type="text"/> <input type="text"/> <input type="text"/> V

2nd output (function)

Measuring signal and measuring range (X)	Transfer curve	Output signal (Y)
<input type="checkbox"/> I <input type="checkbox"/> U <input type="checkbox"/> V <input type="checkbox"/> F <input type="checkbox"/> P <input type="checkbox"/> Q <input type="checkbox"/> S <input type="checkbox"/> Cos φ Min medium Max <input type="text"/> <input type="text"/> <input type="text"/> Unit ⁽¹⁾ <input type="text"/>	<input type="checkbox"/> Linear <input type="checkbox"/> 2 slopes <input type="checkbox"/> Quadratic	Min medium Max <input type="text"/> <input type="text"/> <input type="text"/> mA or <input type="text"/> <input type="text"/> <input type="text"/> V

3rd output (function)

Measuring signal and measuring range (X)	Transfer curve	Output signal (Y)
<input type="checkbox"/> I <input type="checkbox"/> U <input type="checkbox"/> V <input type="checkbox"/> F <input type="checkbox"/> P <input type="checkbox"/> Q <input type="checkbox"/> S <input type="checkbox"/> Cos φ Min medium Max <input type="text"/> <input type="text"/> <input type="text"/> Unit ⁽¹⁾ <input type="text"/>	<input type="checkbox"/> Linear <input type="checkbox"/> 2 slopes <input type="checkbox"/> Quadratic	Min medium Max <input type="text"/> <input type="text"/> <input type="text"/> mA or <input type="text"/> <input type="text"/> <input type="text"/> V

4 Auxiliary supply

AC DC

Nominal frequency

50Hz 60Hz

Options

- | | | |
|--|---|--|
| <input type="checkbox"/> Panel mounting | <input type="checkbox"/> Conformity certificate | <input type="checkbox"/> Calibration certificate |
| <input type="checkbox"/> Tropicalisation | <input type="checkbox"/> Type test certificate | |
| Label language : | <input type="checkbox"/> English | <input type="checkbox"/> French <input type="checkbox"/> German <input type="checkbox"/> Spanish |

(1) Please mention the unit of the measuring range
example : W, kW or MW

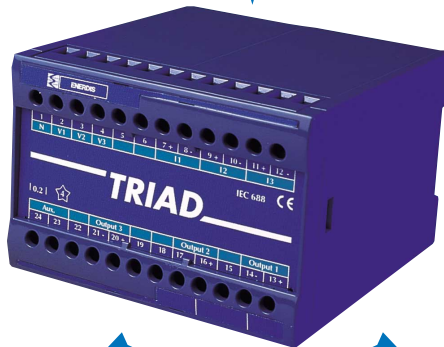
Some additional ENERDIS products



Current transformers



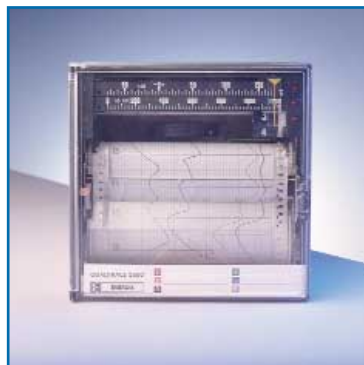
DC electrical parameter transducers



Rack-unit transducers



Analog meters



Recorders



Digital meters

Customer references ...

UTILITIES

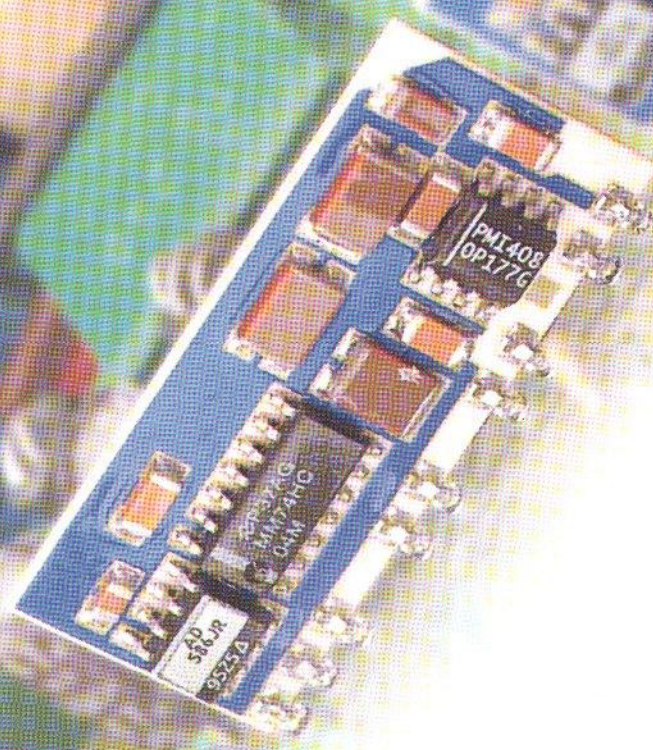
CIE (Ivory Coast)
EDF (France)
EDL (Lebanon)
EDP (Portugal)
EGAT (Thailand)
ELECTROLIMA (Peru)
ELES (Slovenia)
EWR (Saudi Arabia)
ITAIPU (Brazil)
Mew (Quatar)
NEK (Bulgaria)
ONE (Morocco)
PEA (Thailand)
PIN (Indonesia)
PGCI (India)
SONELGAZ (Algeria)
STEG (Tunisia) ...

INDUSTRIES

Anglo Alpha Ciment Works
Beghin Say Sugar refinery
Cairo Subway
Caterpillar
ELF
European Gas Turbine SA
Kanthan Ciment Works
New Sulzer Diesel
Paris Airport
Pechiney
Peugeot
RATP
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Usinor Sacilor
Wärtsilla SACM Diesel ...

CONTRACTORS

Ansaldo
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CEE Relays Ltd

87C Whitby Road, Slough, Berks, SL1 3DR (Registered Office)
Telephone: (01753) 576477 Fax: (01753) 825661
Website: www.ceerelays.co.uk