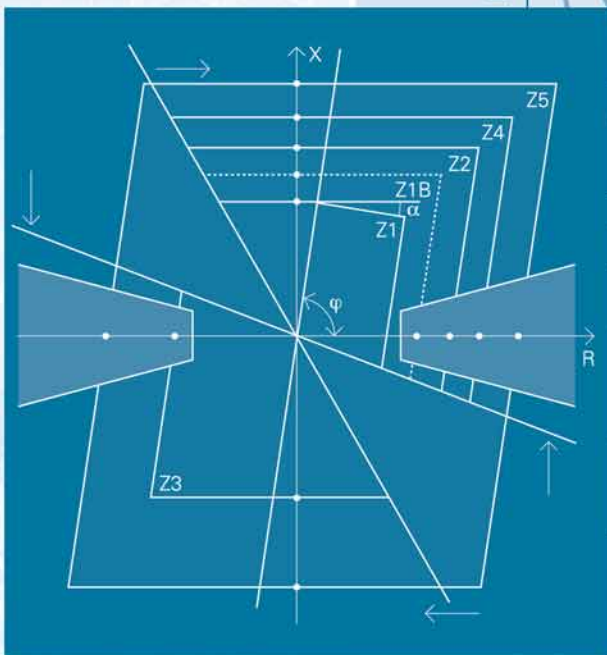
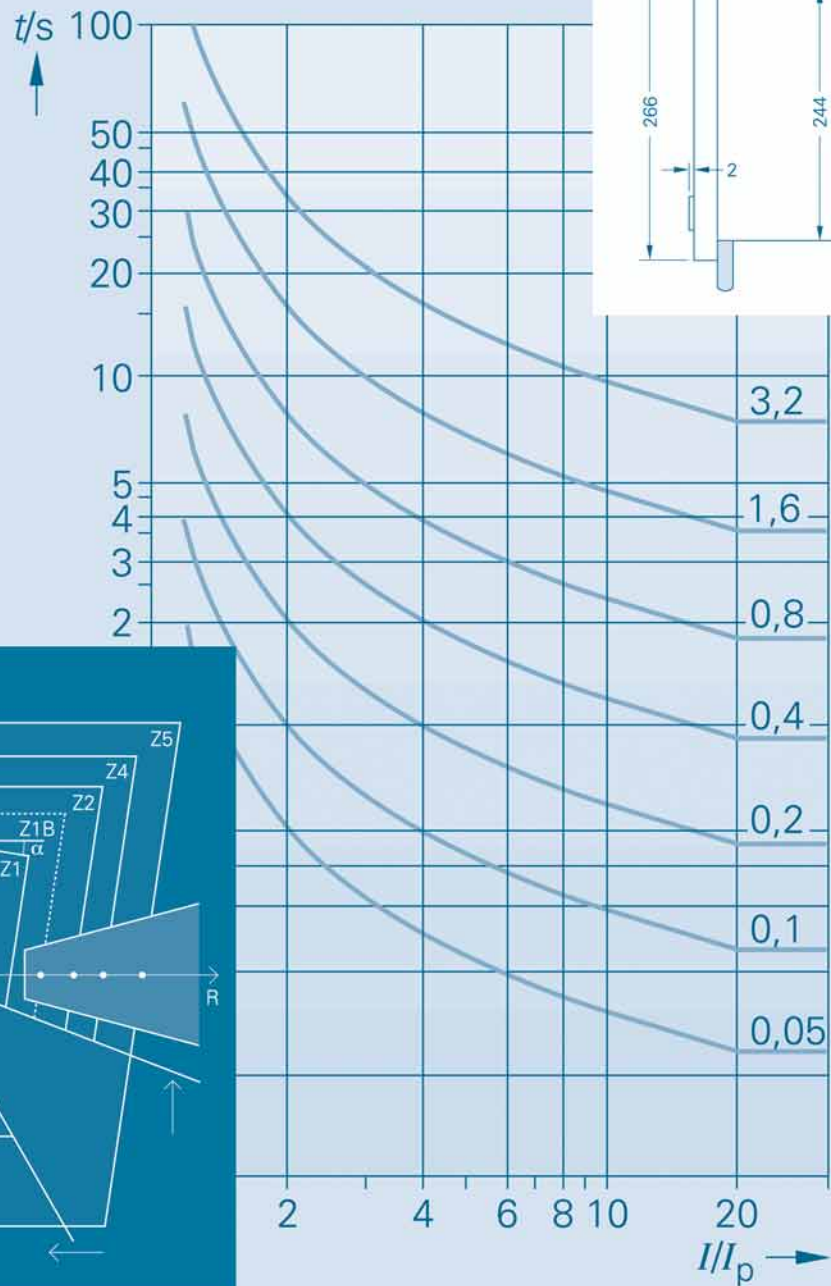
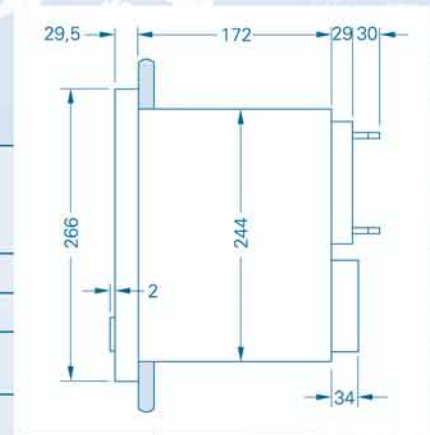


# Appendix

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Relay Characteristics	15/2
Dimension Drawings	15/7
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Order No. Index	15/26
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## Relay characteristics

## Inverse-time characteristics of TOC relays

Fig.	IEC 60255-3				ANSI/IEEE							
	Normal inverse	Very inverse	Extremely inverse	Long inverse	Inverse	Short inverse	Long inverse	Definite inverse	Moderately inverse	Very inverse	Extremely inverse	
Relay	15/1	15/2	15/3	15/4	15/5	15/6	15/7	15/8	15/9	15/11	15/13	
7SD5	■	■	■	■	■	■	■	■	■	■	■	
7SD610	■	■	■	■	■	■	■	■	■	■	■	
7SJ450*-***00-0	■	■	■									
7SJ450*-***00-1									■	■	■	
7SJ460*-***00-0	■	■	■									
7SJ460*-***00-1									■	■	■	
7SJ600	■	■	■	■	■	■	■	■	■	■	■	
7SJ602	■	■	■	■	■	■	■	■	■	■	■	
7SJ61	■	■	■	■	■	■	■	■	■	■	■	
7SJ62	■	■	■	■	■	■	■	■	■	■	■	
7SJ63	■	■	■	■	■	■	■	■	■	■	■	
7SJ64	■	■	■	■	■	■	■	■	■	■	■	
7UM61	■	■	■		■			■	■	■	■	
7UM62	■	■	■		■			■	■	■	■	
7UT612	■	■	■	■	■	■	■	■	■	■	■	
7UT613	■	■	■	■	■	■	■	■	■	■	■	
7UT63	■	■	■	■	■	■	■	■	■	■	■	

Relay characteristics

Inverse-time overcurrent protection characteristics according to IEC 60255 and BS142.

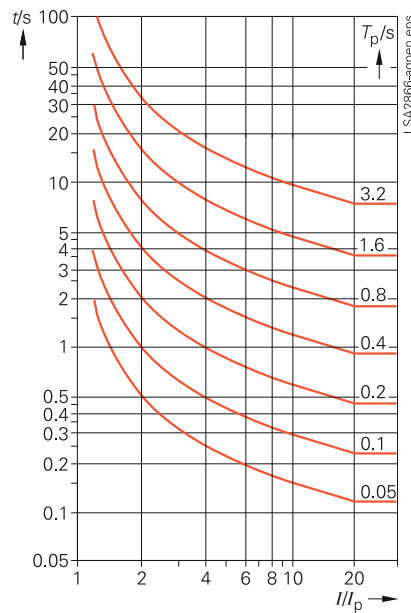


Fig. 15/1  
Inverse

$$t = \frac{0.14}{(I/I_p)^{0.02} - 1} \cdot T_p$$

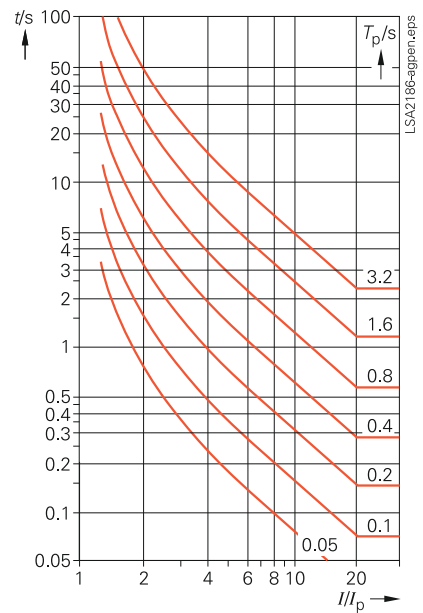


Fig. 15/2  
Very inverse

$$t = \frac{13.5}{(I/I_p) - 1} \cdot T_p$$

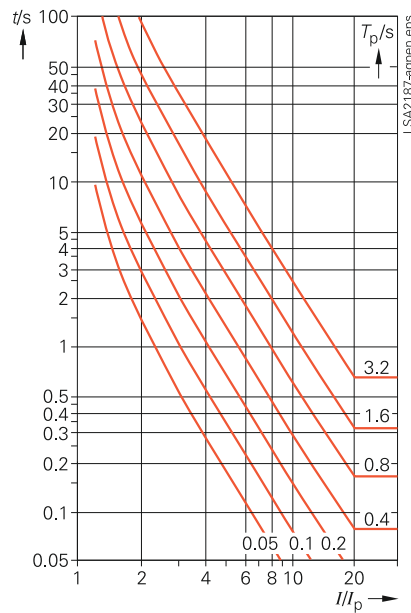


Fig. 15/3  
Extremely inverse

$$t = \frac{80}{(I/I_p)^2 - 1} \cdot T_p$$

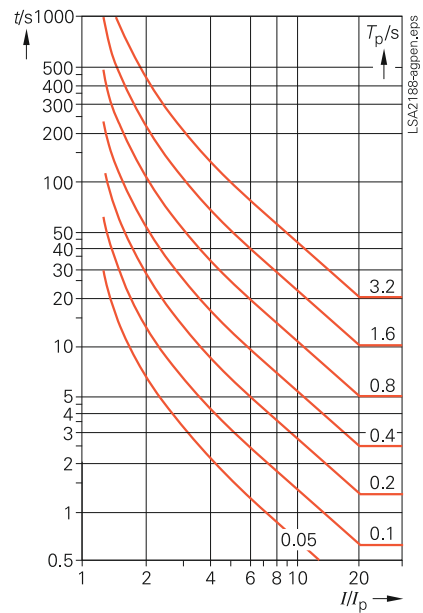


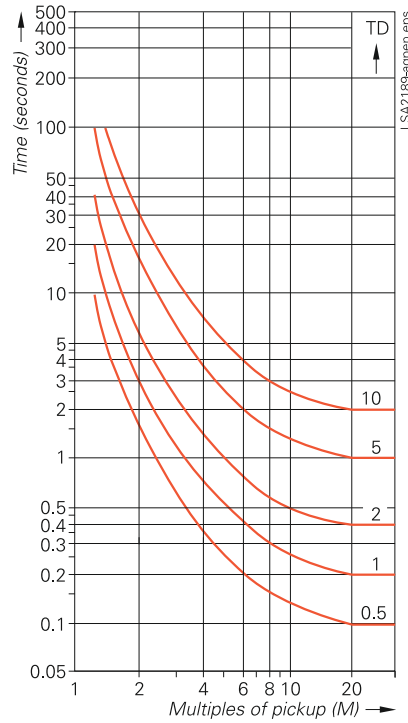
Fig. 15/4  
Long inverse

$$t = \frac{120}{(I/I_p) - 1} \cdot T_p$$

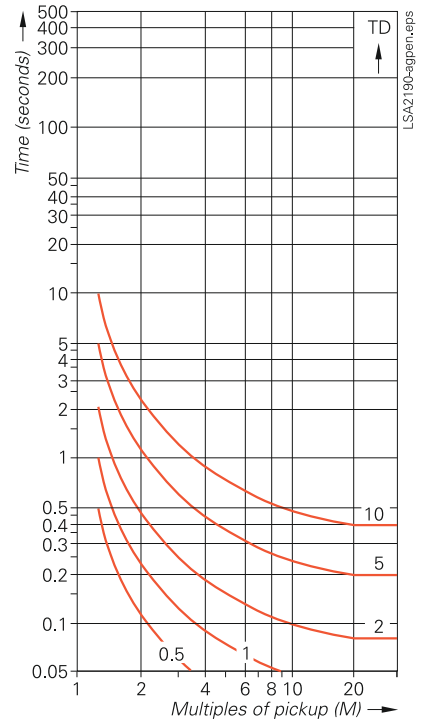
- $I$  = current
- $t$  = tripping time
- $I_p$  = pickup setting
- $T_p$  = time multiplier setting

Relay characteristics

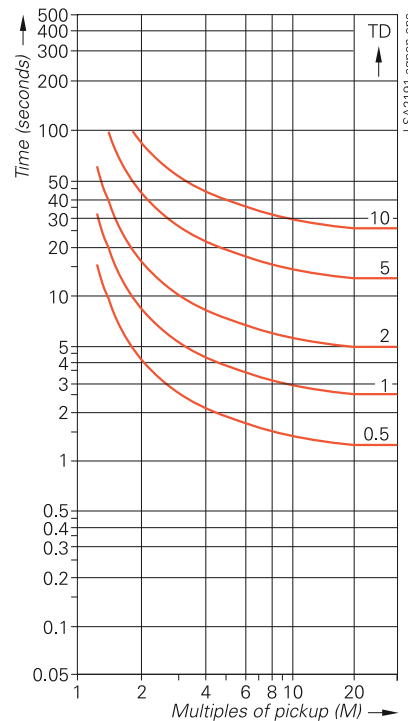
Inverse-time overcurrent protection characteristics according to ANSI (IEEE) C37.112



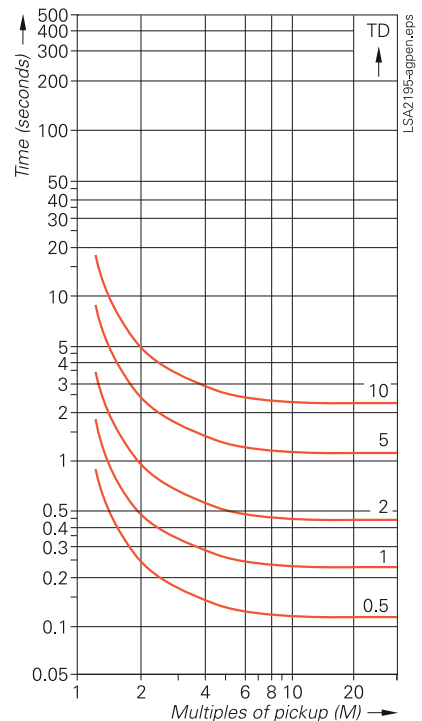
**Fig. 15/5**  
Inverse  $t = \left( \frac{8.9341}{M^{2.0938} - 1} + 0.17966 \right) \cdot TD$



**Fig. 15/6**  
Short inverse  $t = \left( \frac{0.2663}{M^{1.2969} - 1} + 0.03393 \right) \cdot TD$



**Fig. 15/7**  
Long inverse  $t = \left( \frac{5.6143}{M - 1} + 2.18592 \right) \cdot TD$

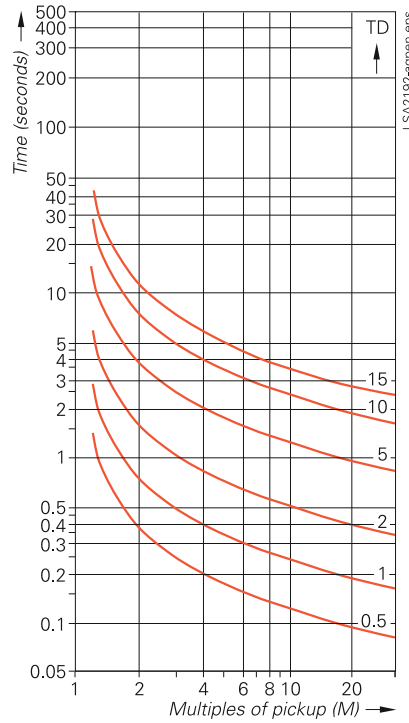


**Fig. 15/8**  
Definite inverse  $t = \left( \frac{0.4797}{M^{1.5625} - 1} + 0.21359 \right) \cdot TD$

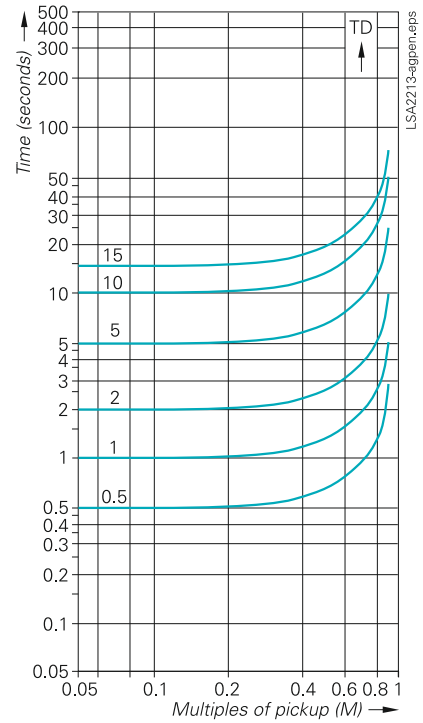
$t$  = tripping time in seconds  
 $M$  = current in multiples of pickup setting ( $I/I_p$ ) range 0.1 to 4  
 $TD$  = time dial

Relay characteristics

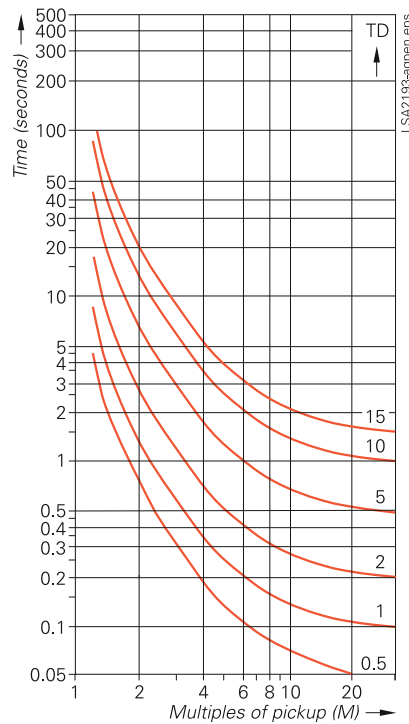
Inverse-time overcurrent protection characteristics according to ANSI (IEEE) C37.112



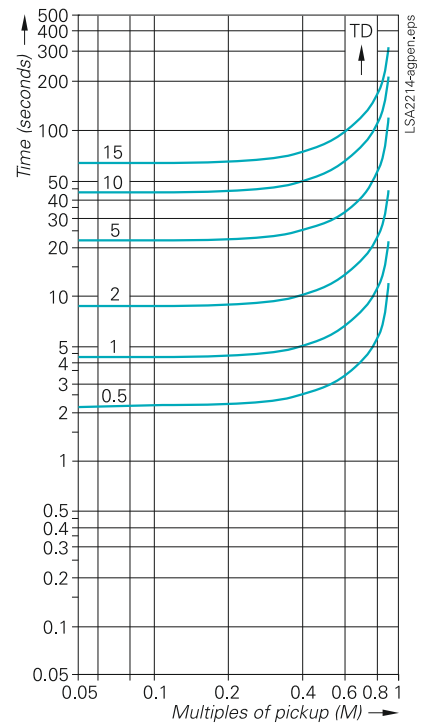
**Fig. 15/9**  
Moderately inverse  
$$t = \left( \frac{0.0103}{M^{0.02} - 1} + 0.0228 \right) \cdot TD$$



**Fig. 15/10**  
Reset moderately inverse  
$$t_{\text{reset}} = \frac{0.97 \cdot TD}{M^2 - 1}$$



**Fig. 15/11**  
Very inverse  
$$t = \left( \frac{3.922}{M^2 - 1} + 0.0982 \right) \cdot TD$$



**Fig. 15/12**  
Reset very inverse  
$$t_{\text{reset}} = \frac{4.32 \cdot TD}{M^2 - 1}$$

$t$  = tripping time in seconds  
 $M$  = current in multiples of pickup setting ( $I/I_p$ ) range 0.1 to 4  
 $TD$  = time dial

Relay characteristics

Inverse-time overcurrent protection characteristics according to ANSI (IEEE) C37.112

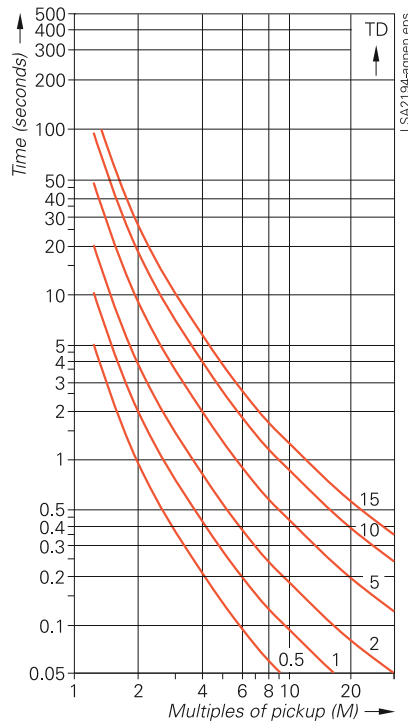


Fig. 15/13 Extremely inverse

$$t = \left( \frac{5.64}{M^2 - 1} + 0.0243 \right) \cdot TD$$

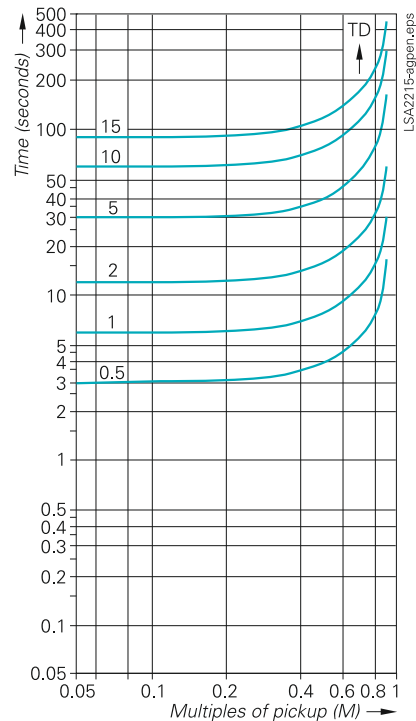


Fig. 15/14 Reset extremely inverse

$$t_{reset} = \frac{5.82 \cdot TD}{M^2 - 1}$$

$t$  = tripping time in seconds

$M$  = current in multiples of pickup setting ( $I/I_p$ ) range 0.1 to 4

$TD$  = time dial

Pinout of communication port

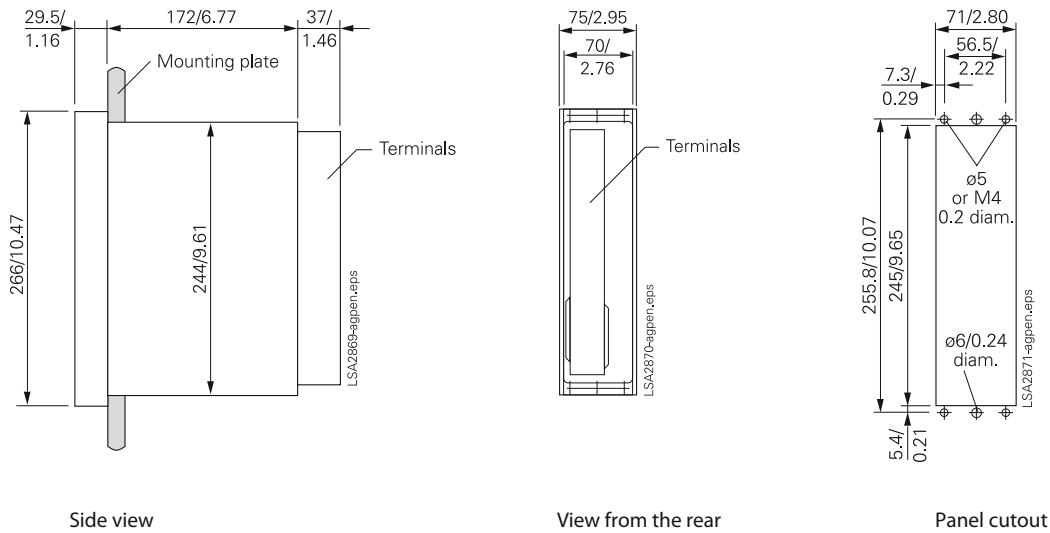
Pin no.	PC interface at front	Port A: Time synchronisation		Port B: System interface			Port C/D Rear service interface or protection data interface	
		RS232 IEC 60870-5-103	RS485 IEC 60870-5-103	RS485 PROFIBUS-FMS Slave, PROFIBUS-DP Slave	RS485 MODBUS, DNP 3.0	RS232	RS485	
1								
1	–	P24 input 24 V	Shield (with shield ends electrically connected)					
2	R x D	P5 input 5 V	R x D	–	–	–	R x D	–
3	T x D	common return	T x D	A/A' (Rx/D/TxD-N)	B/B' (Rx/D/TxD-P)	A	T x D	A
4	–	–	–	–	CNTR-A (TTL)	RTS (TTL level)	–	–
5	GND	Shield	GND	C/C' (GND)	C/C' (GND)	GND1	GND	C (GND)
6	–	–	–	–	+ 5 V voltage supply (max. Load < 100 mA)	VCC1	–	–
7	RTS	P12 input 12 V	RTS	–*)	–*)	–	RTS	(RTS RS232 used)
8	CTS	–	CTS	B/B' (Rx/D/TxD-P)	A/A' (Rx/D/TxD-N)	B	CTS	B
9	–	Shield	–	–	–	–	–	–

## Dimension drawings • Reference table

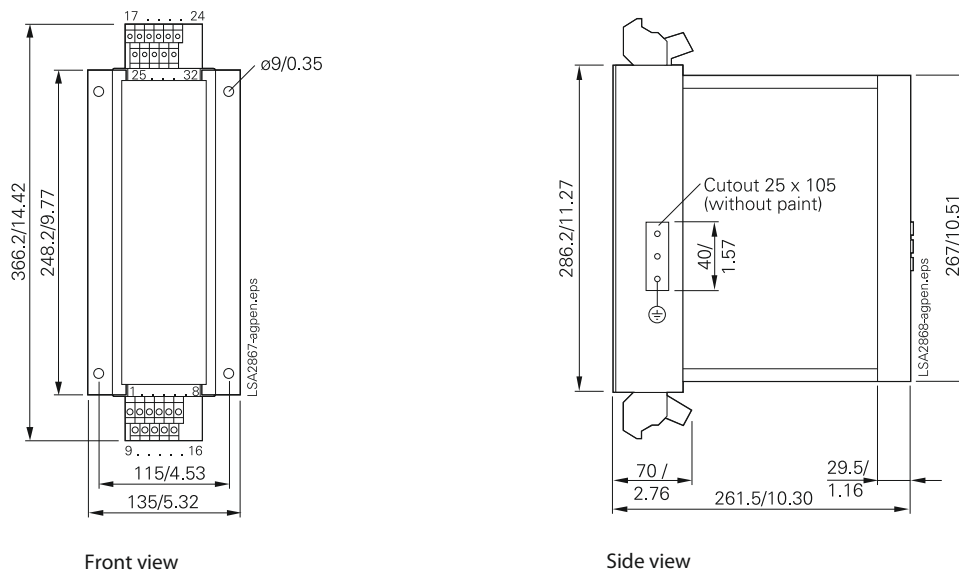
Relay	Flush/cubicle-mounting version		Surface-mounting version		Detached HMI	
	Page	Fig.	Page	Fig.	Page	Fig.
4AM4	-	-	15/24	15/57	-	-
4AM5	-	-	15/24	15/55, 15/56	-	-
6MD61	15/16	15/28	-	-	-	-
6MD63	15/12, 15/14	15/24, 15/26	15/14, 15/15	15/27	15/16	15/28
6MD66	15/14	15/26	15/15	15/27	15/16	15/28
7PA22	15/21	15/39, 15/41	15/21, 15/22	15/39, 15/47	-	-
7PA23	15/21, 15/22	15/40, 15/42	15/21, 15/22	15/40, 15/48	-	-
7PA26	15/23	15/49, 15/50	15/22	15/47	-	-
7PA27	15/22	15/43, 15/46	-	-	-	-
7PA30	15/21, 15/22	15/41, 15/42, 15/44, 15/45	15/22	15/44, 15/45, 15/47, 15/48	-	-
7RV16	15/21	15/37	15/21	15/37	-	-
7RW600	15/8	15/15	15/8, 15/9	15/16, 15/17	-	-
7SA522	15/12, 15/14	15/24, 15/26	15/15	15/27	-	-
7SA61	15/11, 15/12, 15/13, 15/14	15/22, 15/24, 15/25, 15/26	15/11, 15/15	15/23, 15/27	-	-
7SA63	15/11, 15/12, 15/14	15/22, 15/24, 15/26	15/11, 15/15	15/23, 15/27	-	-
7SA64	-	-	-	-	15/16	15/28
7SD5	15/12, 15/14	15/24, 15/26	15/15	15/27	-	-
7SD600	15/8	15/15	15/8, 15/9	15/16, 15/17	-	-
7SD610	15/11	15/22	15/11	15/23	-	-
7SJ45	15/9	15/18	15/9	15/19	-	-
7SJ46	15/9	15/18	15/9	15/19	-	-
7SJ600	15/8	15/15	15/8, 15/9	15/16, 15/17	-	-
7SJ602	15/10	15/20	15/10	15/21	-	-
7SJ61	15/11	15/22	15/11	15/23	-	-
7SJ62	15/11	15/22	15/11	15/23	-	-
7SJ63	15/12, 15/14	15/24, 15/26	15/15	15/27	15/16	15/28
7SJ64	15/11, 15/12, 15/14	15/22, 15/24, 15/26	15/11, 15/15	15/23, 15/27	15/16	15/28
7SN600	15/8	15/15	15/8, 15/9	15/16, 15/17	-	-
7SS522 central unit	15/18	15/32	15/18	15/32	-	-
7SS523 bay unit	15/17	15/29	15/17	15/30	-	-
7SS525	15/18	15/31	-	-	-	-
7SS60	15/8, 15/20	15/15, 15/36	-	-	-	-
7SV600	15/8	15/15	15/8, 15/9	15/16, 15/17	-	-
7TS16	15/22	15/45	15/23	15/45, 15/47	-	-
7UM61	15/11, 15/12	15/22, 15/24	15/11, 15/15	15/23, 15/27	-	-
7UM62	15/12, 15/14	15/24, 15/26	15/15	15/27	-	-
7UT6	15/11, 15/12, 15/14	15/22, 15/24, 15/26	15/11, 15/15	15/23, 15/27	-	-
7VE61	15/11	15/22	15/11	15/23	-	-
7VE63	15/12	15/24	15/15	15/27	-	-
7VK610/7VK611	15/11, 15/12	15/22, 15/24	15/11, 15/15	15/23, 15/27	-	-
7XR9	-	-	15/23	15/52, 15/53, 15/54	-	-
7XV5450	15/19	15/34	15/19	15/34	-	-
7XV5461	-	-	15/19	15/34	-	-
7XV5550	15/19	15/33	15/19	15/33	-	-
7XV5650/51/52/53/55	15/19, 15/21	15/33, 15/38	15/19, 15/21	15/33, 15/38	-	-
7XV5662	-	-	15/19, 15/21	15/34, 15/38	-	-
7XV5673	-	-	15/23	15/51	-	-
7XV75	15/20	15/35	-	-	-	-

Dimension drawings in mm / inch

Dimension drawings for 1/6 x 19" housing (7XP20)



**Fig. 15/15**  
Housing for panel flush mounting/  
cubicle mounting, terminals at rear (1/6 x 19")

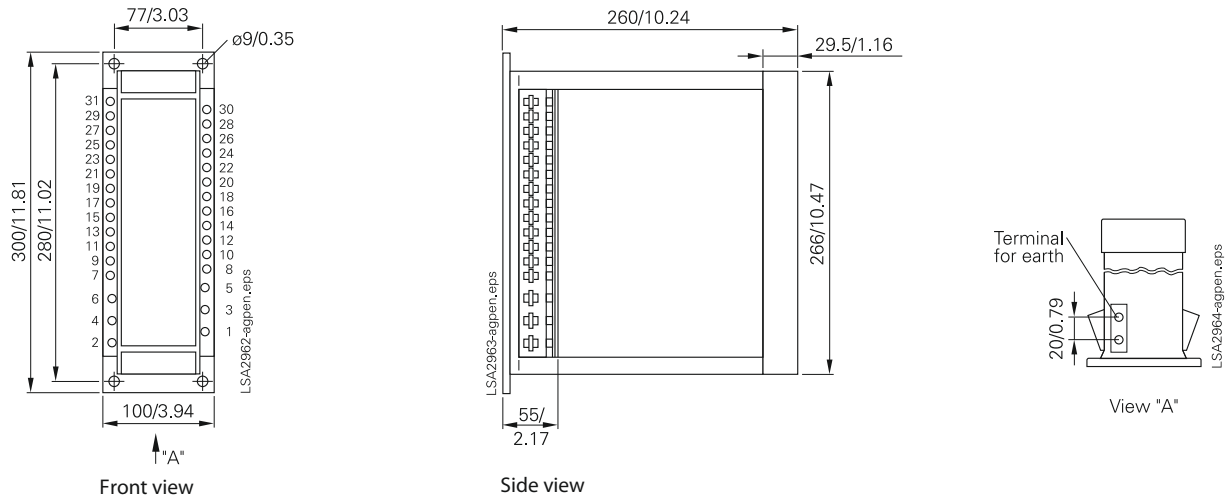


**Fig. 15/16**  
Housing for surface mounting,  
terminals at top and bottom (1/6 x 19")



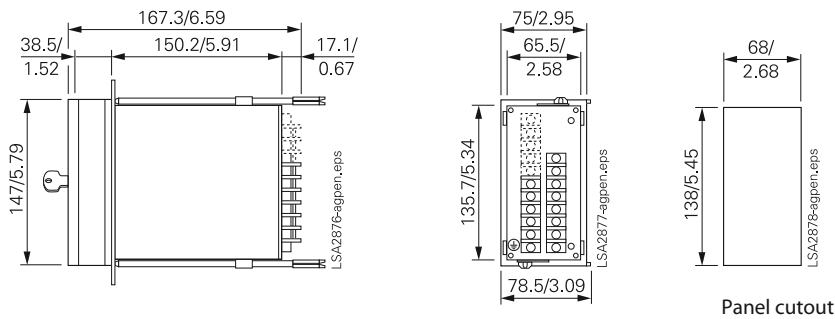
Dimension drawings in mm / inch

Dimension drawings for 1/6 x 19" housing (7XP20)

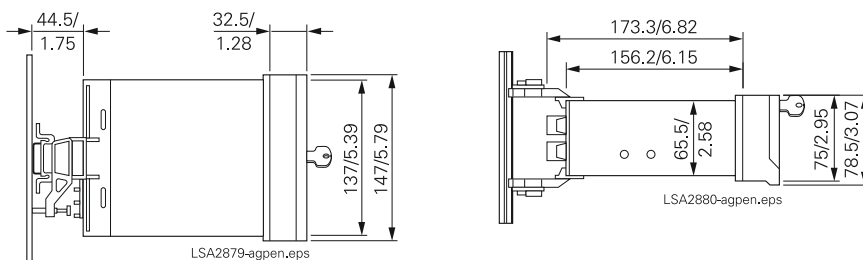


**Fig. 15/17**  
Housing for panel surface mounting,  
terminals on the side (1/6 x 19")

Dimension drawings for SIPROTEC easy



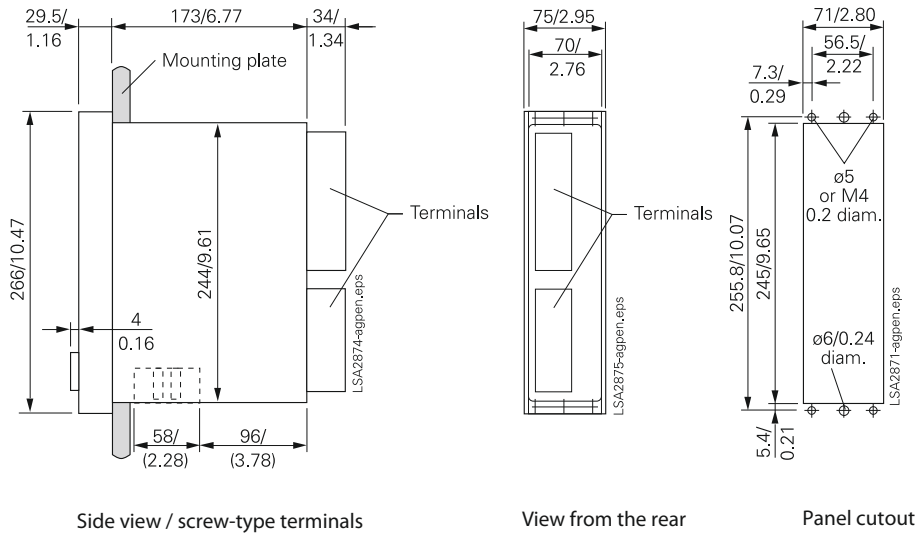
**Fig. 15/18**  
7SJ45, 7SJ46 housing for panel flush mounting



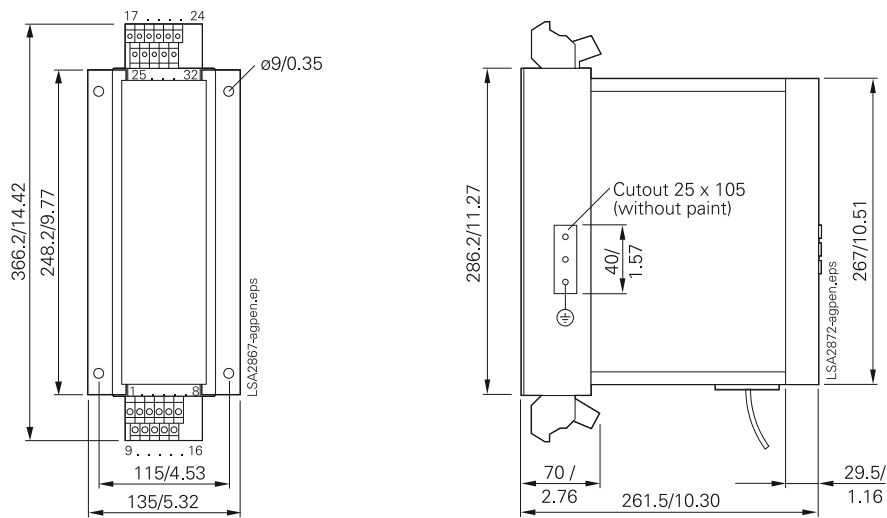
**Fig. 15/19**  
7SJ45, 7SJ46 housing for rail mounting

Dimension drawings in mm / inch

Dimension drawings for SIPROTEC 7SJ602



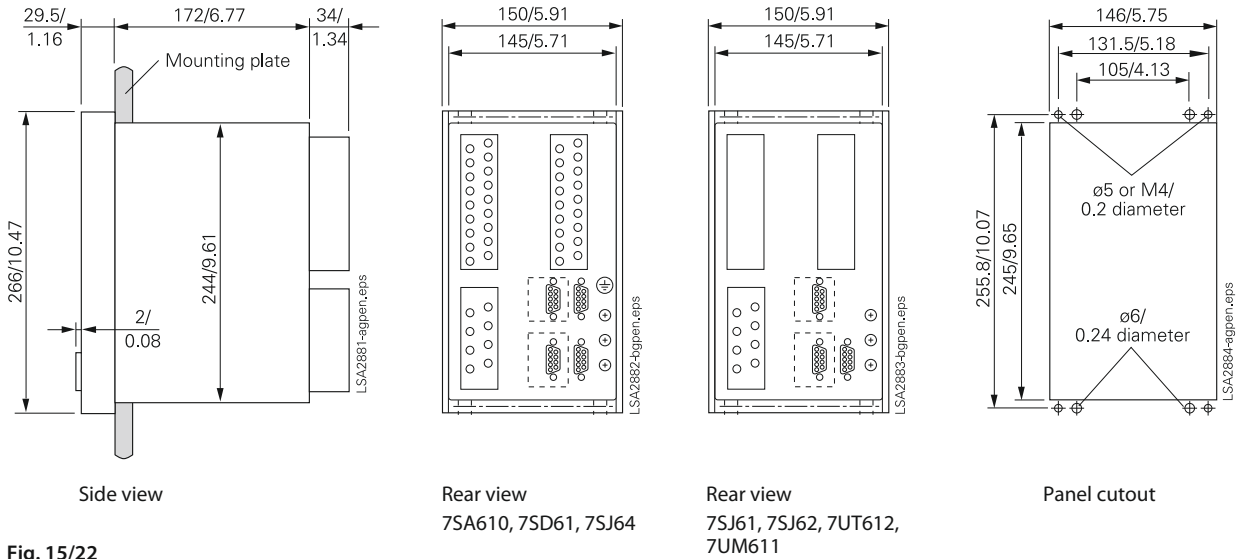
**Fig. 15/20**  
7SJ602 with 7XP20 housing  
for panel flush mounting/cubicle mounting,  
terminals at rear



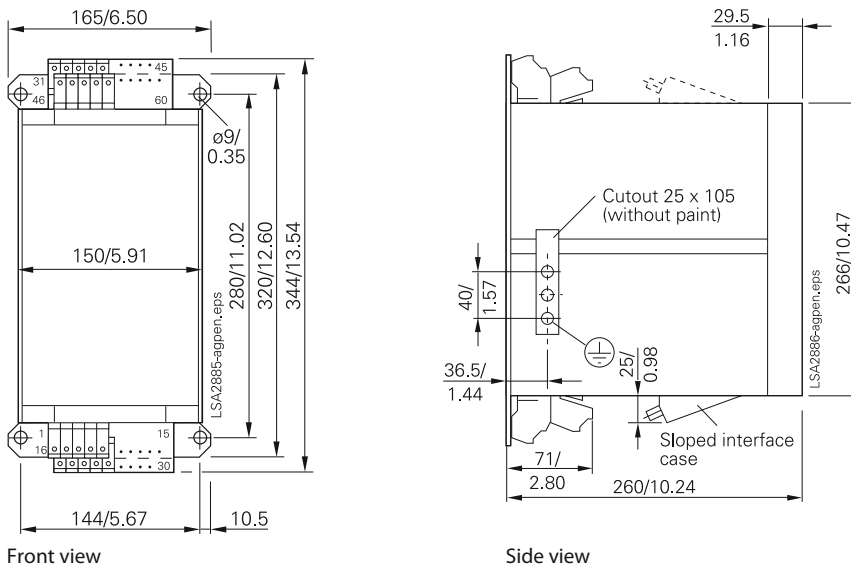
**Fig. 15/21**  
7SJ602 with 7XP20 housing  
for surface mounting,  
terminals at top and bottom

Dimension drawings in mm / inch

Dimension drawings for SIPROTEC 4  
1/3 x 19" housing (7XP20)



**Fig. 15/22**  
Housing for panel flush mounting/  
cubicle mounting (1/3 x 19")



**Fig. 15/23**  
1/3 x 19" surface-mounting housing,  
terminals at top and bottom

Dimension drawings in mm / inch

Dimension drawings for SIPROTEC 4  
1/2 x 19" flush-mounting housings (7XP20)

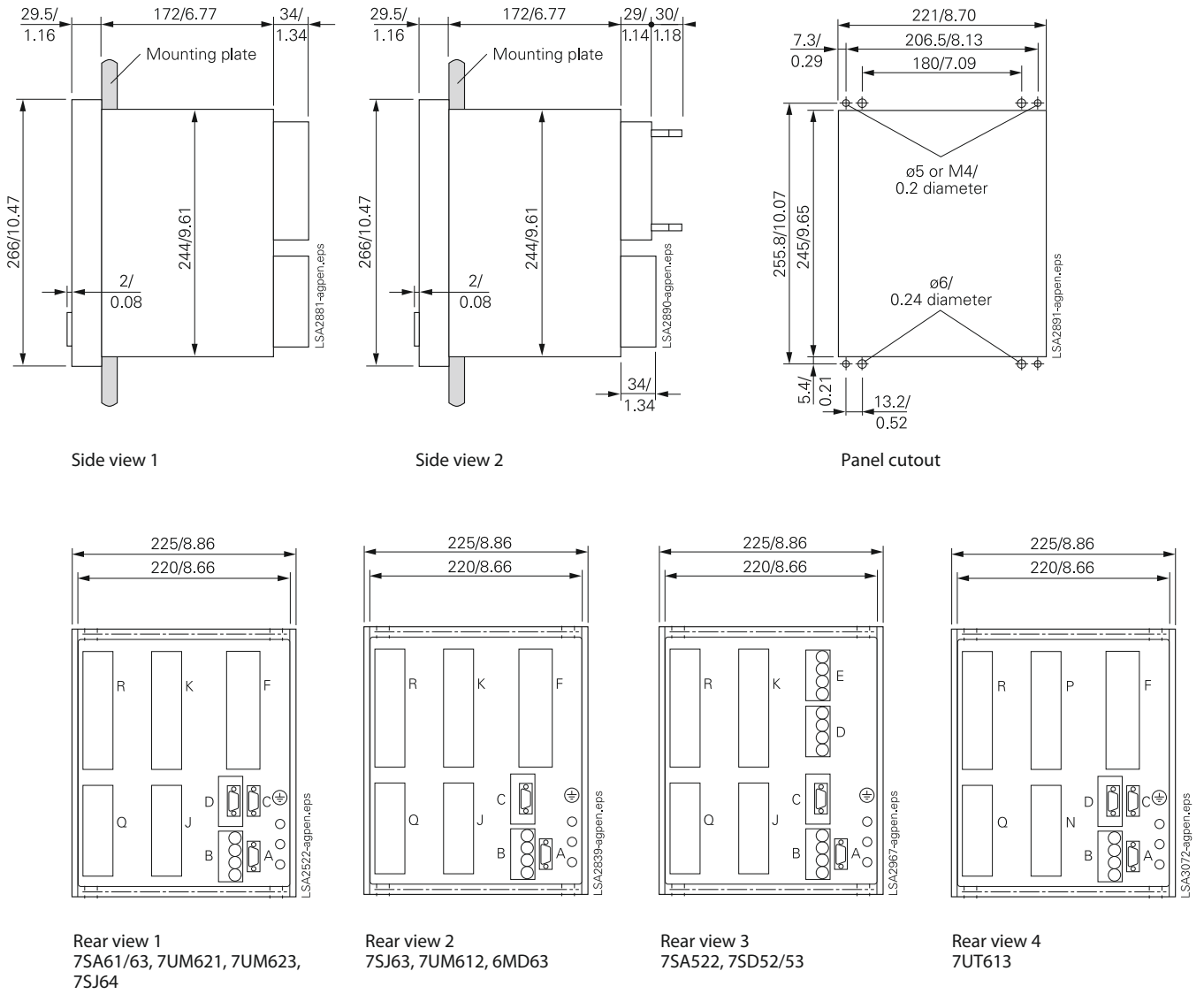


Fig. 15/24  
1/2 x 19" flush-mounting housing

## Dimension drawings in mm / inch

Dimension drawings for SIPROTEC 4  
2/3 x 19" flush-mounting housings (7XP20)

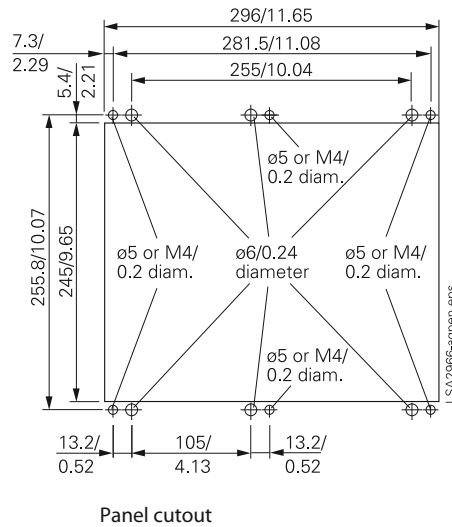
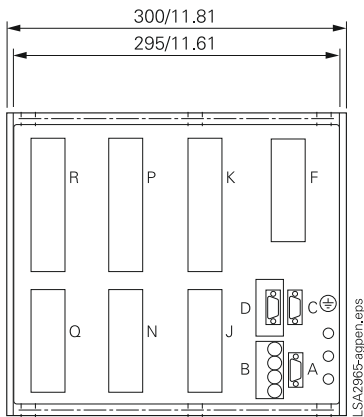
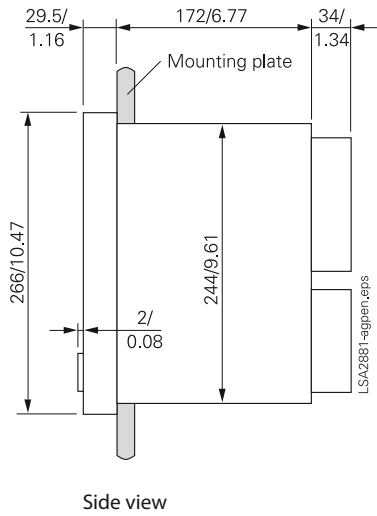
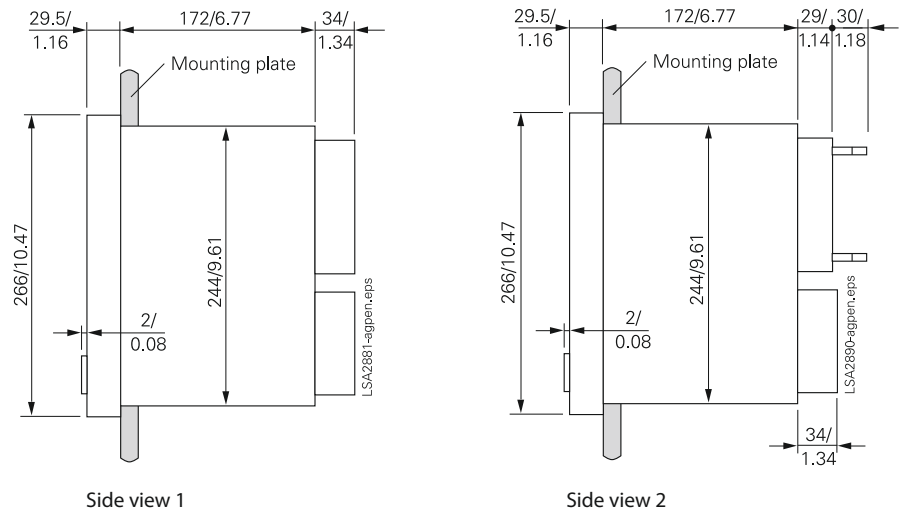


Fig. 15/25  
2/3 x 19" flush-mounting housing for 7SA613

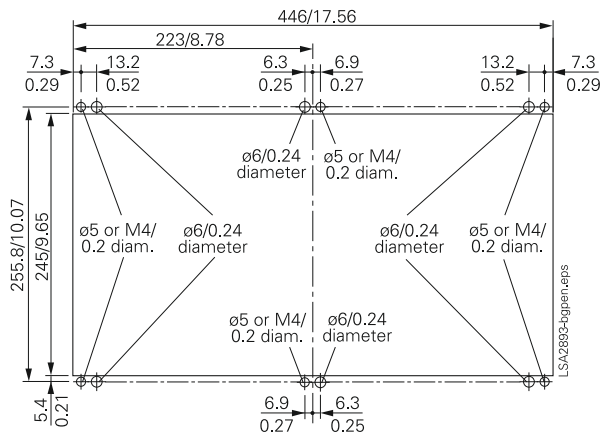
Dimension drawings in mm / inch

Dimension drawings for SIPROTEC 4  
1/1 x 19" flush-mounting housings (7XP20)

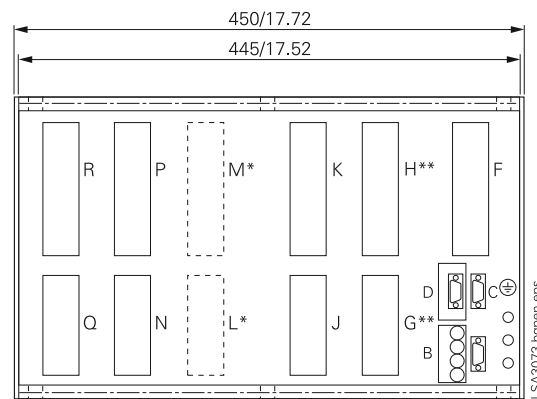


Side view 1

Side view 2

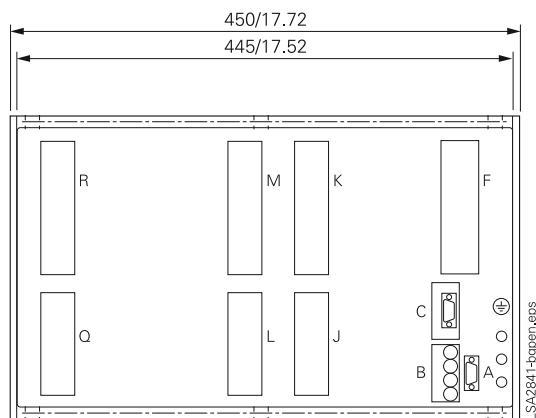


Panel cutout

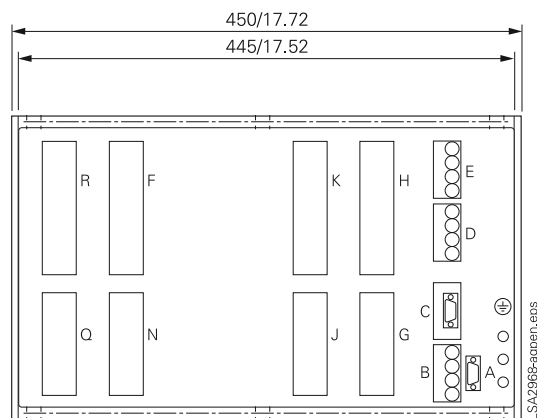


\* Terminals M and L additionally for 7UT635 and 7SJ647 only  
\*\* Terminals H and G not for 7SJ645 and 7SJ647

Rear view 1  
7SA6, 7UM622, 7SJ64, 7UT633, 7UT635



Rear view 2  
7SJ63, 6MD63

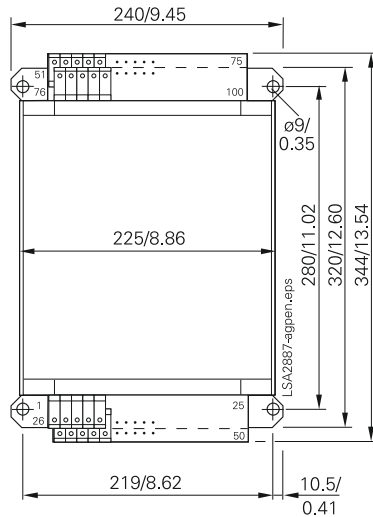


Rear view 3  
7SA522, 7SD52/53

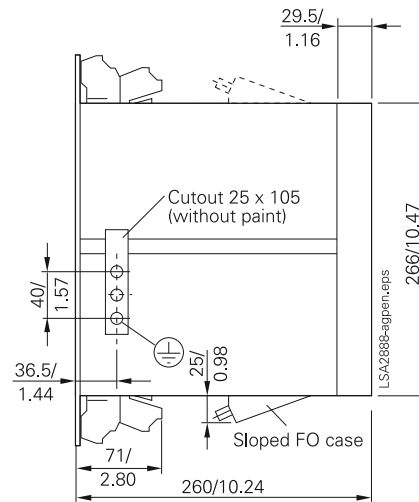
Fig. 15/26  
in 1/1 x 19" flush-mounting housing

## Dimension drawings in mm / inch

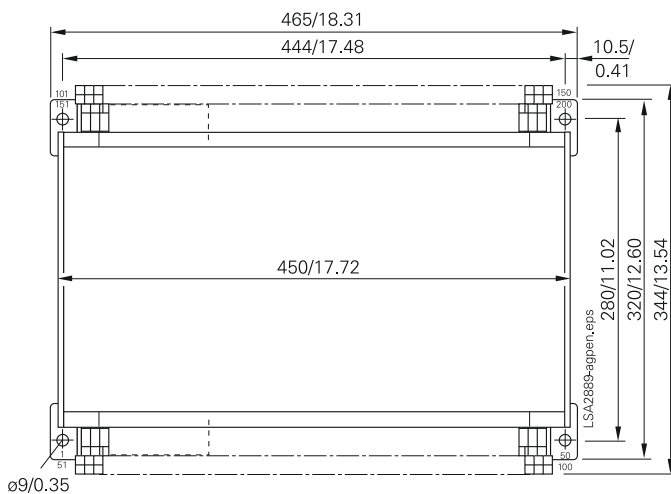
Dimension drawings for SIPROTEC 4  
1/2 and 1/1 x 19" surface-mounting housings  
(7XP20)



Front view  
1/2 x 19" surface-mounting,  
terminals at top and bottom  
housing 7XP20



Side view

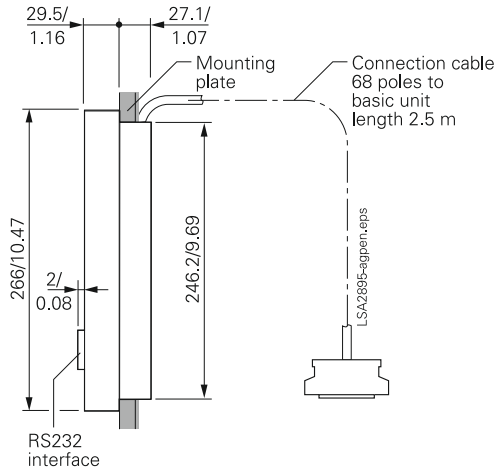


Front view  
1/1 x 19" surface-mounting housing 7XP20  
(without sloped FO case)

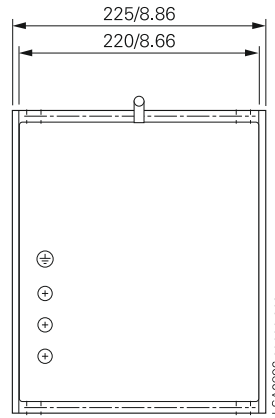
Fig. 15/27  
1/2 and 1/1 x 19" surface-mounting housing

Dimension drawings in mm / inch

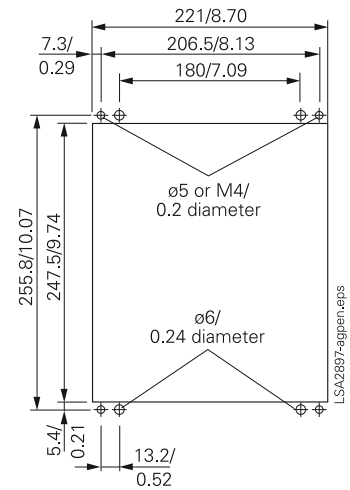
Dimension drawings for SIPROTEC 4  
1/2 and 1/1 x 19" housings  
with detached operator panel



Detached operator panel (side view)



Rear view



Panel cutout

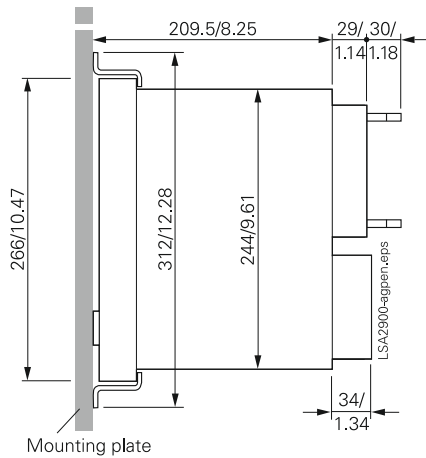
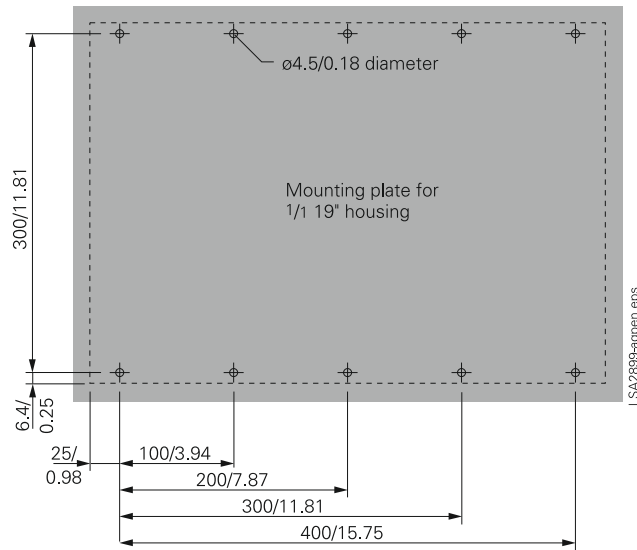
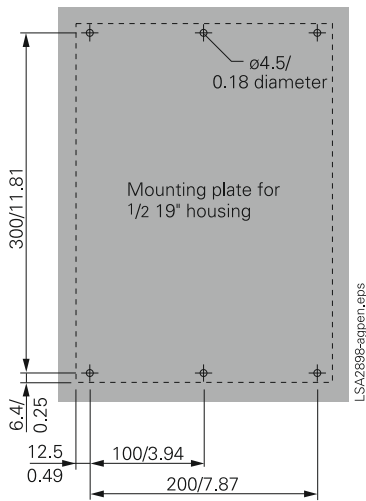
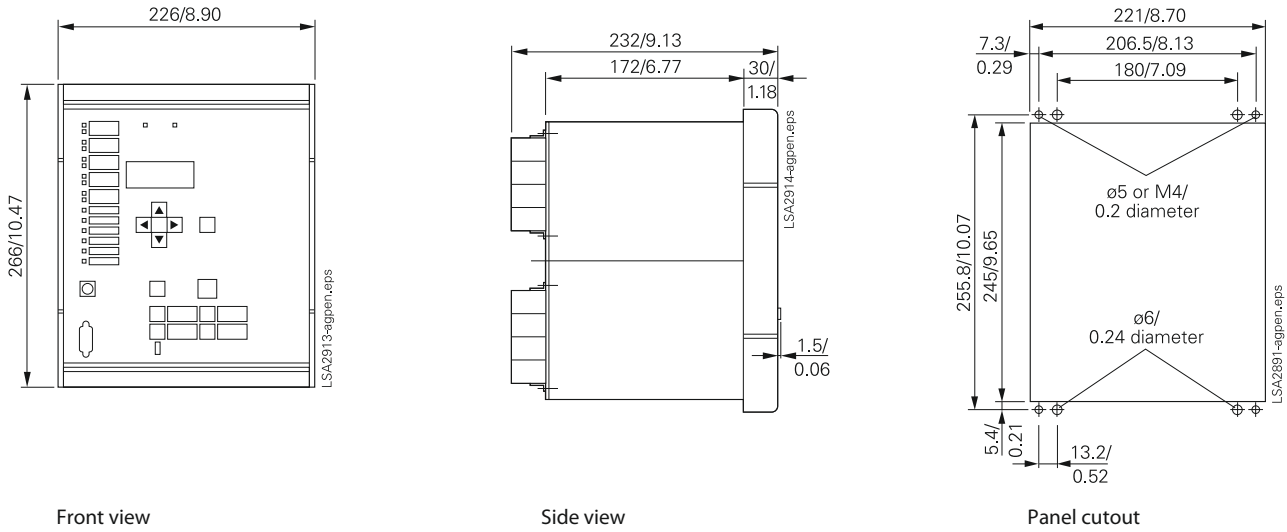


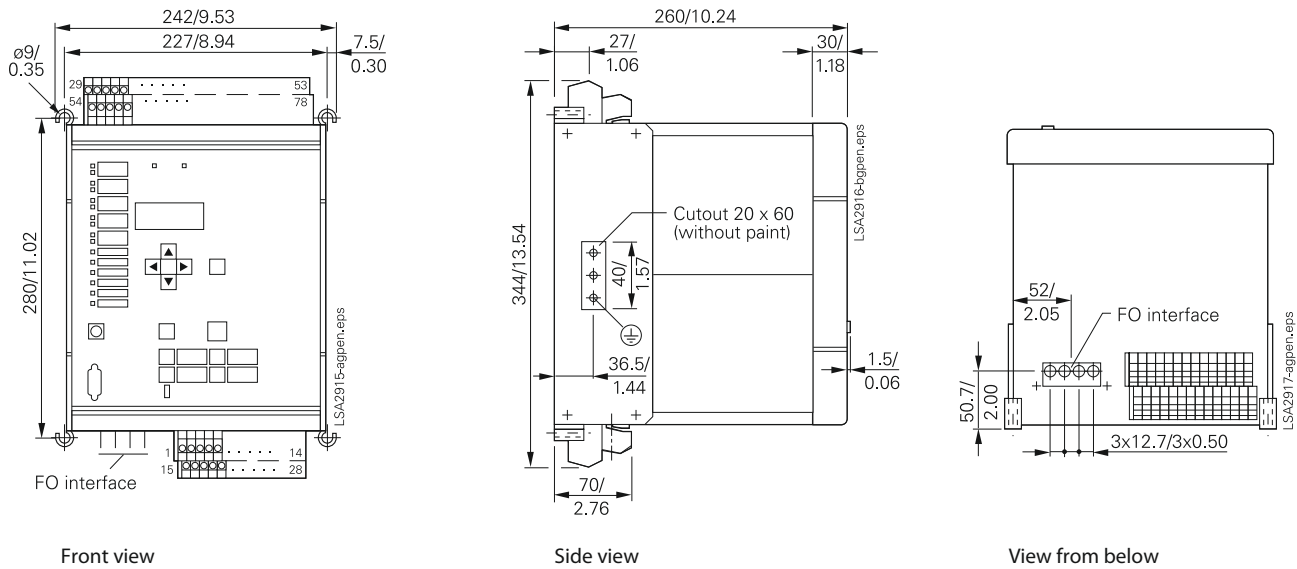
Fig. 15/28  
Housing with detached or no  
operator panel



Dimension drawings in mm / inch

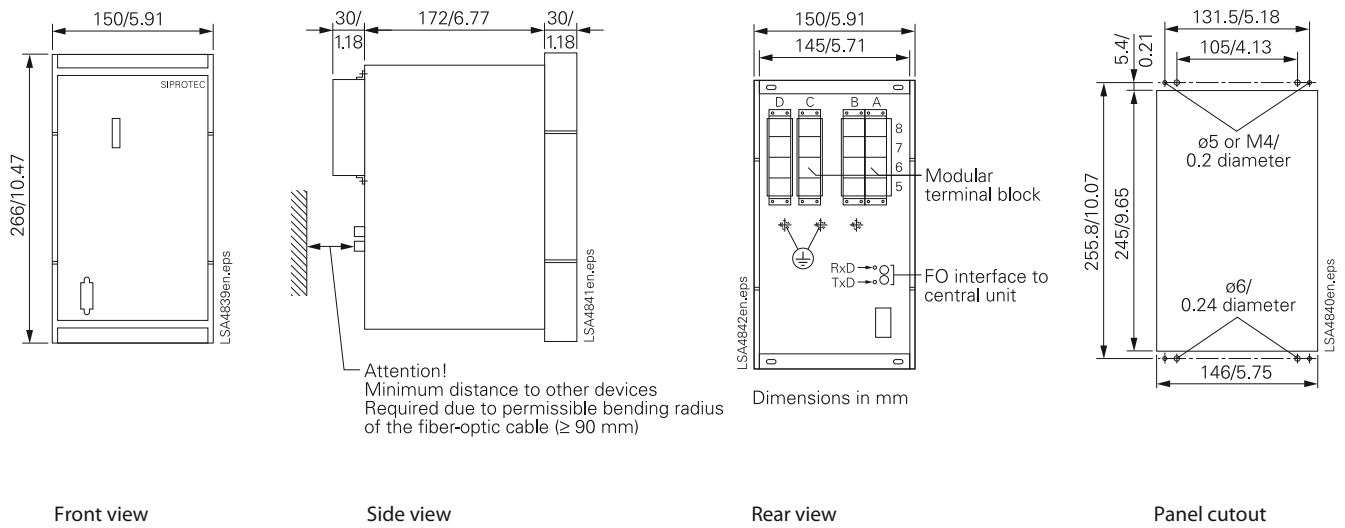


**Fig. 15/29**  
7SS523 bay unit in 7XP2040-2 housing  
for panel flush mounting/cubicle mounting

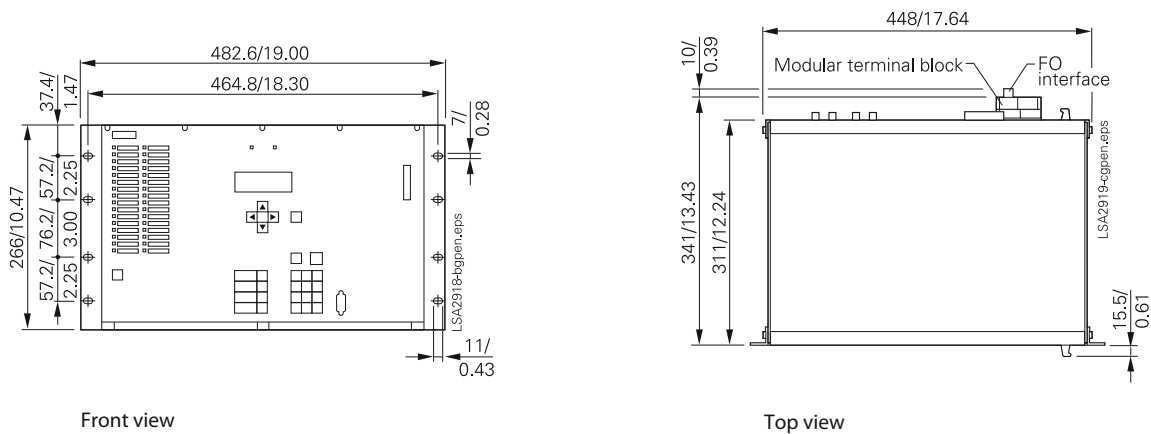


**Fig. 15/30**  
7SS523 bay unit in 7XP2040-1 housing for  
panel surface mounting

Dimension drawings in mm / inch

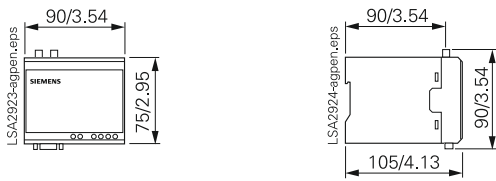


**Fig. 15/31**  
7SS525 busbar and breaker failure protection unit for panel flush mounting/cubicle mounting with housing for wall mounting

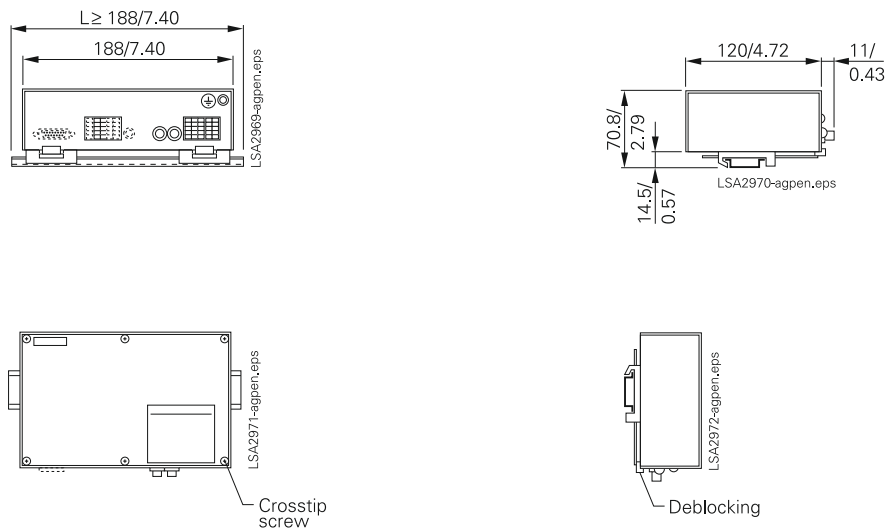


**Fig. 15/32**  
7SS522 central unit in SIPAC subrack

## Dimension drawings in mm / inch

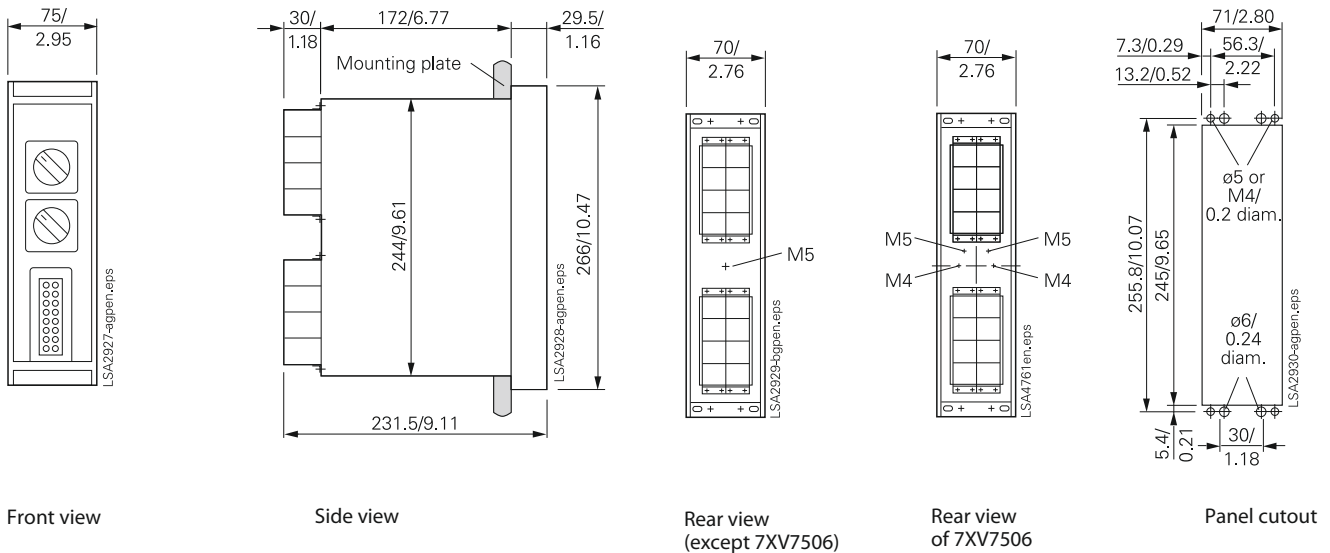


**Fig. 15/33**  
Converter devices for rail mounting

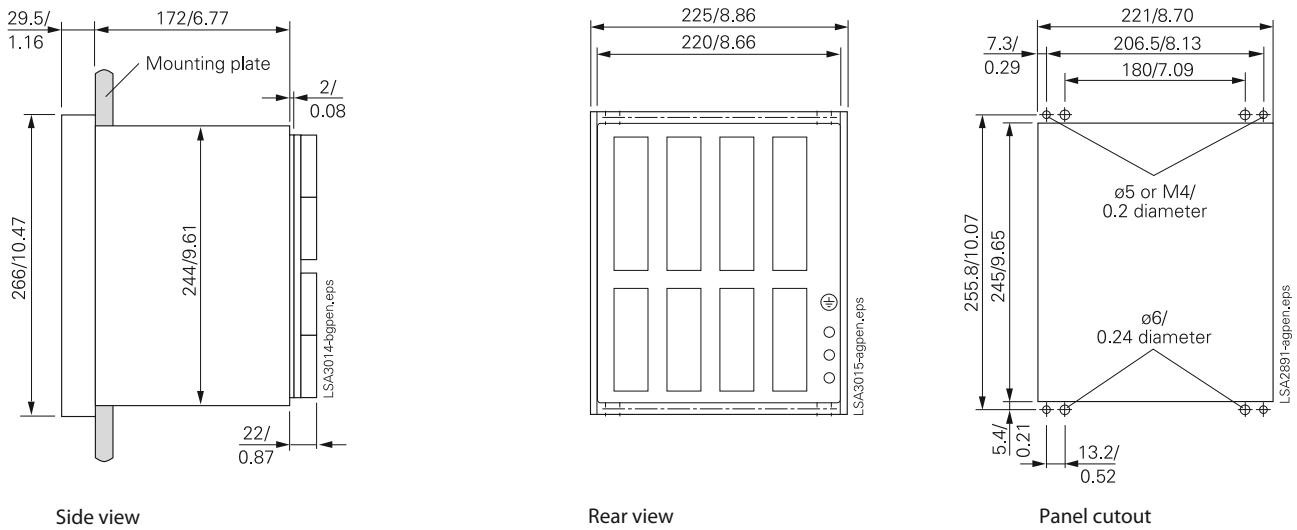


**Fig. 15/34**  
7XV5662 communication converter

Dimension drawings in mm / inch

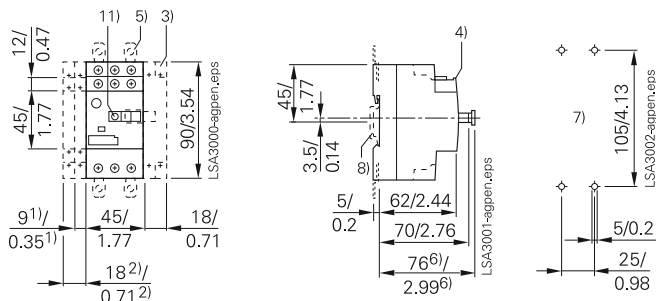


**Fig. 15/35**  
7XV75 with housing 7XP202-2  
(for panel flush mounting)



**Fig. 15/36**  
Housing 7XP204 of the peripheral modules (7SS60)  
for panel or cubicle flush mounting

Dimension drawings in mm / inch



7RV16 circuit-breaker  
Fig. 15/37

- 1) Auxiliary switch, 2-pole, located on the side.
- 2) Auxiliary switch, 4-pole, located on the side.
- 3) Auxiliary release.
- 4) Auxiliary switch transverse position.
- 5) Link for screw fixing.
- 6) Only with undervoltage release combined with leading auxiliary switch.
- 7) Drilling diagram.
- 8) Monitoring rail 35 mm, acc. to EN 50022.
- 11 Lockable in OFF position with padlock, bracket diameter 3.5 to 4.5 mm

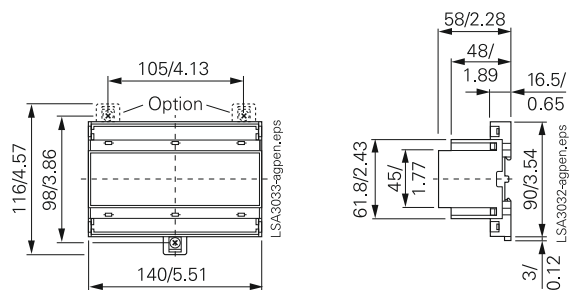


Fig. 15/38  
Resistance temperature detector (RTD-box)



Fig. 15/39  
7PA22 auxiliary relay

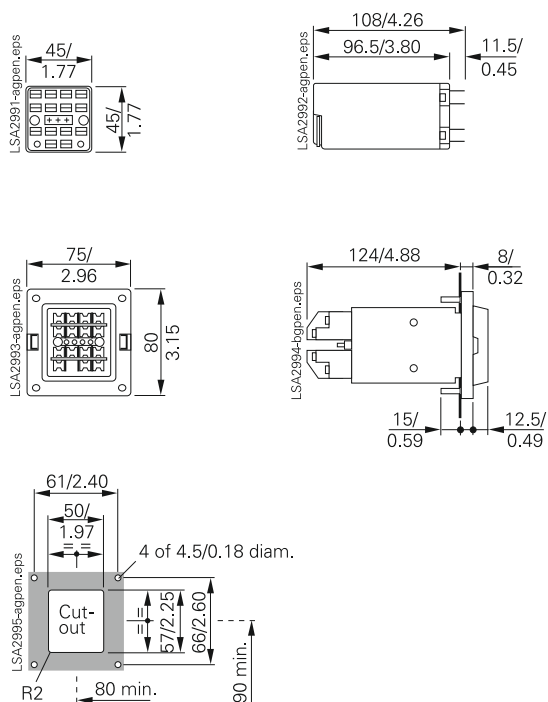


Fig. 15/40  
7PA23 auxiliary relay +  
flush mounting socket 7XP9011-1

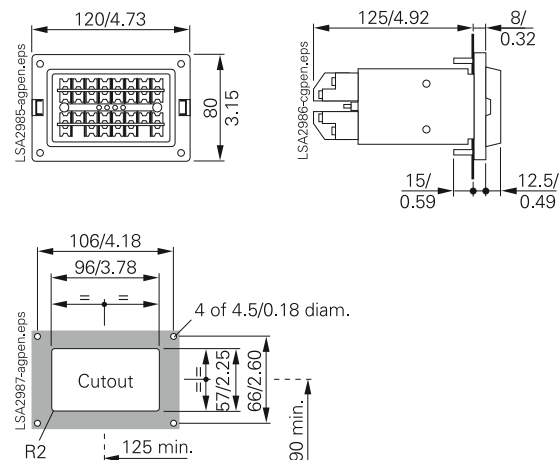
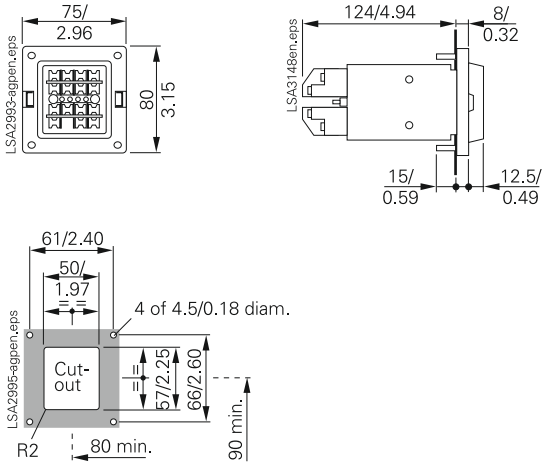
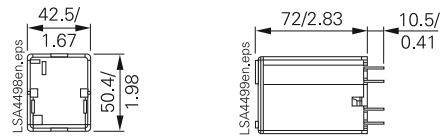


Fig. 15/41  
Flush mounting sockets 7XP9010-1, 7XP9010-2,  
7XP9010-4 for 7PA22 auxiliary relay  
7TS16 indication relay  
7PA30 three-phase trip circuit supervision

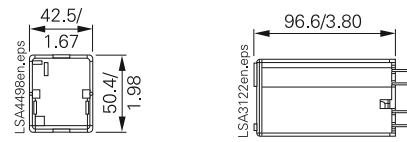
Dimension drawings in mm / inch



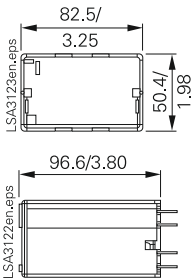
**Fig. 15/42**  
Flush mounting sockets 7XP9011-0, 7XP9011-1  
for 7PA23 auxiliary relay  
7PA30 trip single-phase circuit supervision



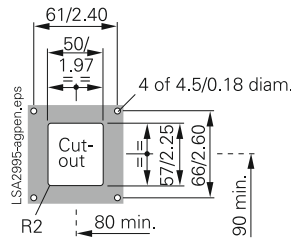
**Fig. 15/43**  
7PA27



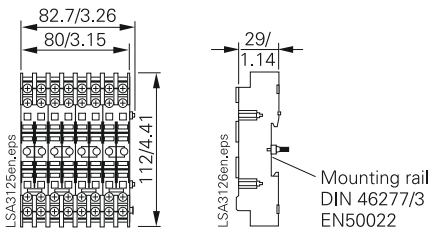
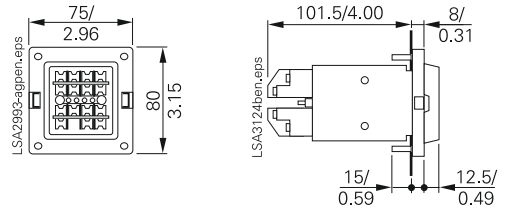
**Fig. 15/44**  
7PA30 single-phase



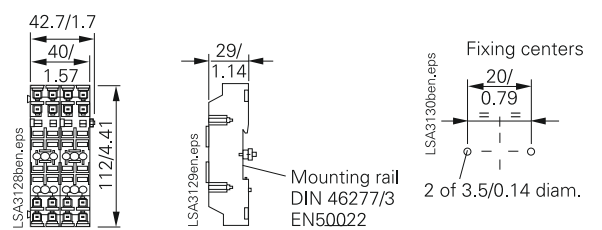
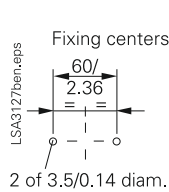
**Fig. 15/45**  
7TS16, 7PA30 three-phase



**Fig. 15/46**  
Flush mounting socket 7XP9011-2  
for 7PA27 auxiliary relay



**Fig. 15/47**  
Surface mounting socket 7XP9012  
7PA22, 7PA26 auxiliary relays  
7TS16 indication relay  
7PA30 three-phase trip circuit supervision



**Fig. 15/48**  
Surface mounting socket 7XP9013  
for 7PA23/27 auxiliary relay  
7PA30 single-phase trip circuit supervision

Dimension drawings in mm / inch



Fig. 15/49  
7PA26 auxiliary relay

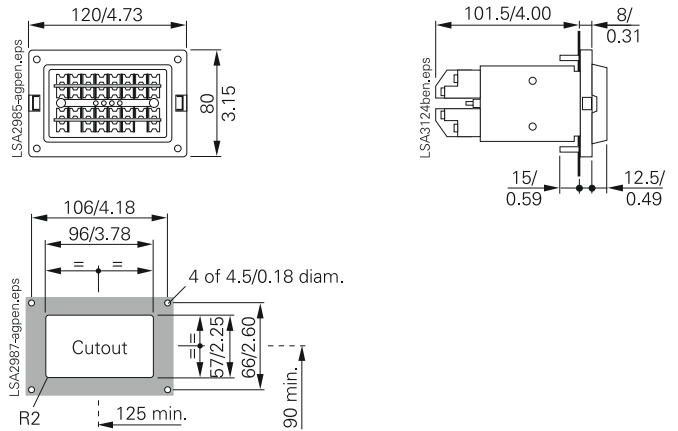


Fig. 15/50  
Flush-mounting socket 7XP9010-3 for 7PA26

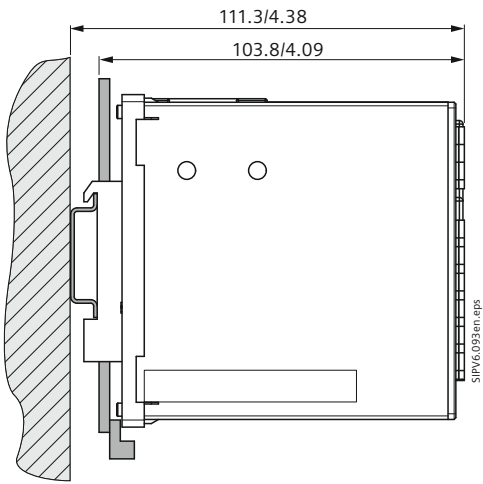


Fig. 15/51  
7XV5673 I/O-Unit

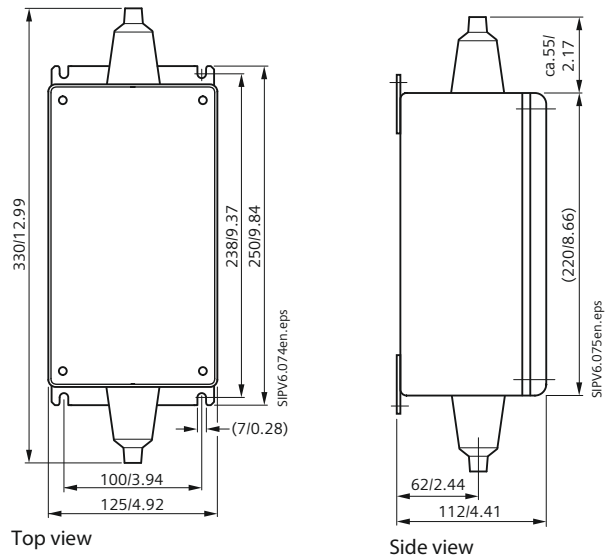


Fig. 15/52 7XR9513 isolating transformer

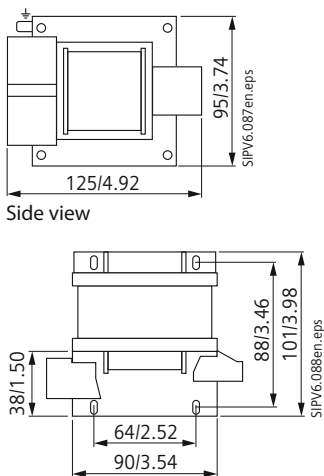


Fig. 15/53 7XR9515 isolating transformer

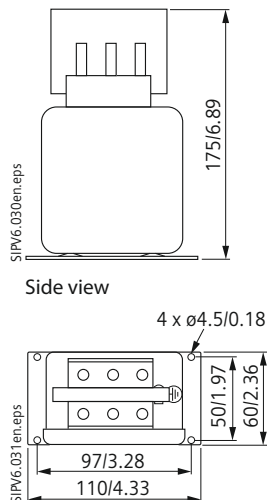
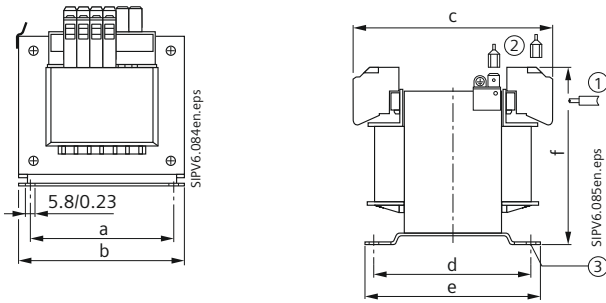


Fig. 15/54 7XR9516 isolating transformer

Dimension drawings in mm / inch



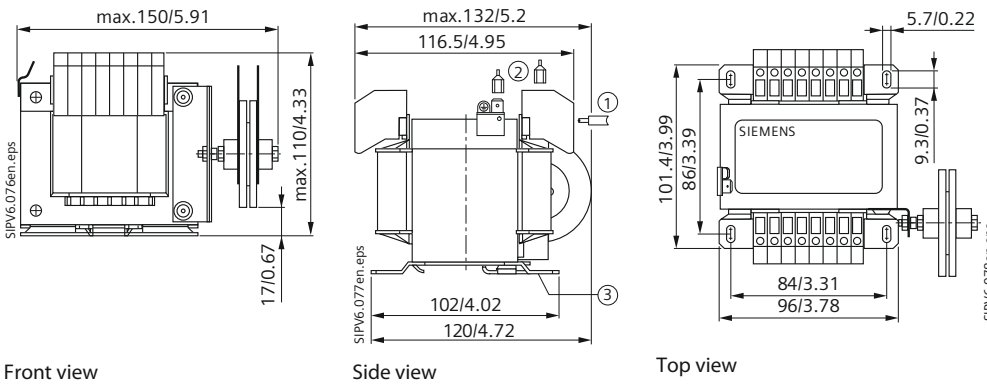
Front view

Side view

Type	a	b <sup>*)</sup>	c <sup>*)</sup>	d	e <sup>*)</sup>	f <sup>*)</sup>
<b>4AM5065</b>	84/	99/	106/	86.5/	104.5/	105/
<b>4AM5070</b>	3.31	3.90	4.17	3.4	4.11	4.13
<b>4AM5170</b>	84/	99/	120/	86.5/	104.5/	105/
	3.31	3.90	4.72	3.41	4.11	4.13
<b>4AM5272</b>	90/	123/	116/	85/	103/	123/
	3.54	4.84	4.57	3.35	4.06	4.84

<sup>\*)</sup> max. dimension

**Fig. 15/55**  
4AM50, 4AM5170, 4AM52 auxiliary current transformer without varistor



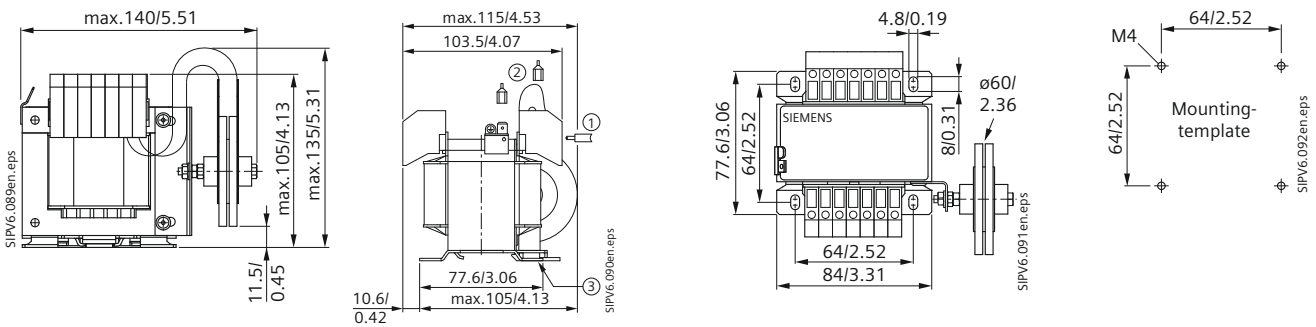
Front view

Side view

Top view

- Terminal 8WA9200 Siemens  
Cross-section:  
Single-wire 0.5 mm<sup>2</sup> to 6 mm<sup>2</sup>  
Fine-wire 0.5 mm<sup>2</sup> to 4 mm<sup>2</sup>  
Current rating: 21 A  
Number of terminals  
depending on design
- Flat connector  
DIN46244-A6.3-0.8
- Fixing ratchet for  
DIN rail mounting

**Fig. 15/56**  
4AM5120 auxiliary current transformer with varistor



Front view

Side view

Top view

**Fig. 15/57**  
4AM auxiliary current transformer



## Assignment for products

Products applied until now	Function	Recommended new products
7PA10	Auxiliary relay	7PA26/27
7PA20	Lockout relay	7PA22/23
7PA21	Trip circuit monitoring	7PA30
7RP72	Frequency relay	7RW600
7SD24	Line differential relay	7SD600
7SD510/511	Line differential relay via FO	7SD610
7SD512	Line differential relay via FO	7SD5
7SA500	Distance protection	7SA6, 7SA522
7SA501	Distance protection	7SA6, 7SA522
7SA502	Distance protection	7SA6, 7SA522
7SA510	Distance protection	7SA6, 7SA522
7SA511	Distance protection	7SA6, 7SA522
7SA513	Distance protection	7SA6, 7SA522
7SJ41	Overcurrent relay	7SJ45
7SJ50	Overcurrent relay	7SJ600/602/80
7SJ510	Overcurrent relay	7SJ61
7SJ511	Overcurrent relay	7SJ61
7SJ512	Overcurrent relay	7SJ62
7SJ531	Overcurrent relay	7SJ63
7SK52	Motor protection	7SK80 See SIP 3.01 SIPROTEC Compact Catalog E50001-K4403-A011-A1-7600
7SN71	Transient earth fault relay	7SN600
7UT512	Transformer differential relay	7UT612
7UT513	Transformer differential relay	7UT613/7UT63
7UM51	Machine protection	7UM61/62
7TS15	Annuciation relay	7TS16
7SS51	Busbar protection	7SS52
7SS13	Busbar protection	7SS60
7VH80/83, 7VH60	High-impedance diff. protection	7SR23 Reyrolle See <a href="http://www.siemens.com/siprotec">www.siemens.com/siprotec</a>
7SV50	BF relay	7SV600
7SV512	Breaker failure relay	7VK61
7VK512	Auto-reclosure und synchronism check relay	7VK61
7XV72	Test switch	7XV75
7XS50	DIGSI operating program	7XS54

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## Training

Equipment reliability and availability are essential for all owners and users. At the same time, maintenance costs need to be kept to a minimum. The liberalization of energy markets presents new challenges to all; maintaining and enhancing competitive strength are among today's most important business goals. Investment in technical plants and human resources enables these goals to be realized. Innovations in the technical field confront the users with the need of establishing, maintaining and extending their qualification and know-how. Our training programs are tailored to meet your specific needs. With our know-how, we can help you to keep ahead.

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Each course and the corresponding training documents are available in many languages. On the Internet at [www.siemens.com/power-academy](http://www.siemens.com/power-academy) you will find our complete training program with details of contents, dates, costs and contacts.

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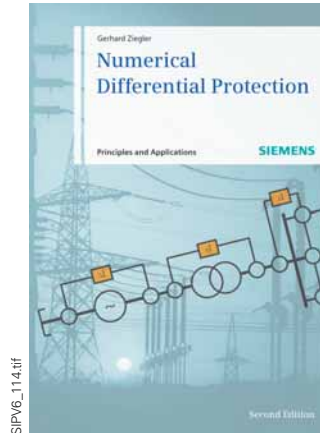
A foundation for your success:  
The Siemens Power Academy TD course catalog

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## Books and publications

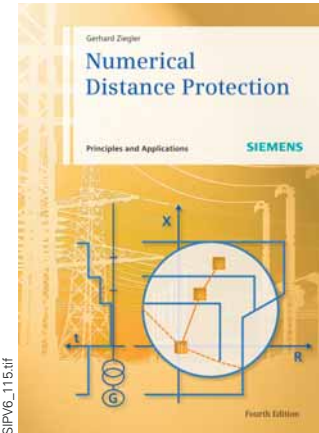
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A textbook and standard work in one, these books cover all topics, which have to be paid attention to for planning, designing, configuring and applying differential and distance protection systems. The books are aimed at students and engineers who wish to familiarize themselves with the subject of differential/distance substation protection, as well as the experienced user, entering the area of numerical differential/distance protection. Furthermore, they serve as a reference guide for solving application problems.



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On 76 pages the “Motor protection brochure” describes the principles of asynchronous and synchronous motors, gives an overview of relay protection functions for motors and details on protection of low-, medium- and high-power motors.

If you wish to know more about efficient energy automation in accordance with the IEC 61850 standard, then our “IEC 61850 brochure” is the right source to turn to.

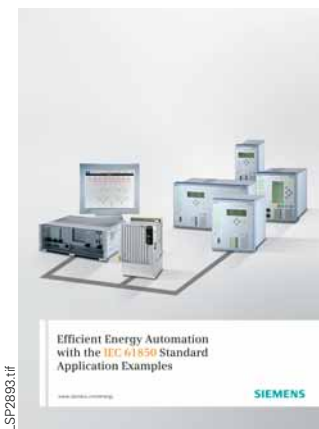
Topics covered comprise, among others, switchgear interlocking with IEC 61850 GOOSE, reverse interlocking, innovative solutions for substation control with IEC 61850.

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- SIPROTEC relay features
- SIPROTEC application hints
- Communication based on IEC 61850
- DIGSI Software operating program
- SIGRA Software evaluation of fault records

Computer-based interactive training:  
Study, practice, check your knowledge

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List of available multimedia CD ROMs/DVDs	
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This conformity has been proved by tests performed according to the Council Directive in accordance with the generic standards EN 61000-6-2 and EN 61000-6-4 (for EMC directive) and with the standard EN 60255-27 (for Low Voltage Directive) by Siemens AG.

The device is designed and manufactured for application in an industrial environment.

The product conforms with the international standard of IEC 60255 and the German standard VDE 0435.

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