SIPROTEC

Additional Information for users of the IEC 60870-5-103
Communication Interface in SIPROTEC Protection Relays

Revision Date: 01. Sept. 2005
Edited by:
M. Zaherdoust PTD EA 13
Tel. ++49 911 433 8463
e-mail: marko.zaherdoust@siemens.com

Content

This document is available in English only. For the use in conjunction with German versions of the relays and with German relay manuals, the German terms are added in *[italic letters]*.

General

The IEC 60870-5-103 defines an open communication interface for the communication with protection relays. Details of this communication protocol are described in the standard document:

IEC 60870-5-103 document
English version Telecontrol equipment and systems – Transmission Protocols – Companion Standard for the informative interface of protection equipment ISBN 2-8318-4159-3 (order code) IEC Central Office Geneva, Switzerland
German version Fernwirkeinrichtungen und –systeme Anwendungsbezogene Norm für die Informationsschnittstelle von Schutzeinrichtungen Beuth Verlag GmbH, 10772 Berlin Fax ++49 (0)30 2601-1268

The intention of this application guide is to give additional information for the integration of SIPROTEC relays into monitoring or control systems using the IEC-interface. This paper has to be used in conjunction with the standard and with the relay manuals.

The IEC-Interface in SIPROTEC Relays

The IEC 60870-5-103 describes methods of information exchange. It is based on explicitly specified APPLICATION SERVICE DATA UNITS (ASDUs) and application procedures for transmission of ‘standardized’ messages . These ‘standardized’ messages (compatible part) do not include all possible protection functions and all possible messages of these protection functions. For this reason, relays may offer more information than explicitly defined in the standard. For these cases the ‘private ranges’ are defined in the standard and have to be used for compatibility reasons. Specific information about the amount of information available in the different relay types can be found in the relay manuals.

On the other hand, a protection device may support only a subset of the messages and procedures specified in the standard. The use of predefined messages and application procedures is mandatory, if applicable.

The “compatibility level” of Siemens protection equipment is based on the companion standard ‘2’ without the use of generic services.

The term VDEW/ZVEI or VDEW is sometimes used in the manuals as a synonym of IEC60870-5-103. The history of the IEC-standard is based on a VDEW/ZVEI recommendation.

In this paper, several classes of SIPROTEC relays are referenced:
- SIPROTEC 4 relays: 7SJ61/2/3, 7SA522, 7SD52, 7SA6, 7UM6, 7SS52
- V3 relays: 7SA51,7SJ51, 7UT51, 7SD51, 7SD50, 7UM51.
- 7SJ600-based relays: 7SJ600/2, 7SD600, 7RW600, 7SV600

These classes have different scopes of functions on the communication port and are explained when necessary.

Amount of information

The amount of information the relays offer is listed in the relay manuals. The manuals contain tables with all information available in monitoring direction. For SIPROTEC 4 relays, the tables indicate
- the status (CG indicates that a message is transmitted if the information comes and if it goes; C indicates that a message is transmitted with coming information only)
- type and information number
- general interrogation (GI indicates that the actual status of the information is transmitted, if a general interrogation is initiated via the IEC interface.

The type of the ASDU used for the transmission of the information is not always explicitly given in the tables (now listed in the newest manuals). It can however be derived from the following table:

Annunciations Type of information	ASDU (DU) Type identification
Operational messages	1
Measured values	3 or 9 (details see chapter “Measured values”)
Fault messages	2
Fault messages with value	4

Table T1

(The type identification of ASDU is listed in IEC-Standard chapter 7.2.1 table 3)

Informations in the table of the manuals of version V3 relays indicate:

manual	Standard
VDEW/ZVEI	IEC60870-5-103
CA [KM]	Compatible information number as defined in IEC Standard, chapter 7.2.5.2 tables 8 to 17
GI [GA]	Messages whitch will transmitted via a “general interrogation of annunciation” with DU 1 or DU 2
BT [MM]	Annunciation will be transmitted as a tag such as defined in “transmission of disturbance data”.
Type	Function type as defined in IEC Standard, chapter 7.2.5.1 Compatible range Private range
Inf	Information number as defined in IEC Standard, chapter 7.2.5.2
CG [KG]	CG indicates that a message is transmitted if the information comes (C) and if it goes (G)

Table T2

In V3 manuals a “p” in the column “function type” of the annunciation tables indicates a compatible information according to the protection type (equal to device parameter 7208 function type).

p means:

protection device	function type
7UTx	176
7SAx	128
7SDx	192
7SJx , 7SS52	160

SIPROTEC 4 relays and V3 relays offer a large amount of information on the IEC interface. This amount of information can however be controlled by the user:

- For V3 relays the user can select via parameter 7221 SYS INTERF whether compatible information only shall be available (setting “VDEW COMPATIBLE”) or whether all information (compatible and private range) shall be transmitted. Please check, that this parameter is set to “VDEW EXTENDED” if you want to use manufacturer specific information additionally.
- For SIPROTEC 4 relays, the user may choose for every individual information whether it is available on the serial interface or not. This is done in the matrix of DIGSI 4. Furthermore, you can define additional (user-defined) signals generated by the relay and offer them on the IEC interface. In this case you have to define a function type, an information number and the Data Unit (1 or 2). The Data Unit has to be selected according to the definition in table T1. All other additional definitions will be done automatically in DIGSI 4.

Additional annunciations in the private range are realized as compatible annunciations. Only the function types and information numbers are different.

Relays based on 7SJ600 technology (7SJ602, 7RW600, 7SD600, 7SV600) offer a limited amount of information and have no general interrogation function. For more information see annex.

Disturbance Data

The transmission of the disturbance data (sampled values) is done according to the IEC-standard. If available in the protection equipment, disturbance recording information includes:

- analogue values, digitally coded as currents I_{L1}, I_{L2}, I_{L3}, I_N,
- voltages V_{L1}, V_{L2}, V_{L3}, V_{EN};
- other quantities (e.g. secondary winding currents of transformers, differential currents)
- binary values (indications), recorded as tags, for example start/pick-up and trip indications.

A printout of a fault record from a particular relay using DIGSI indicates the curves available in the relay type under consideration. For machine protection relays (7UM51x) the fault record either can show instantaneous or true r.m.s. values. When true r.m.s. values are drawn, the fault record has a recording time up to 60sec.

The Data Units used for disturbance data are listed in IEC-Standard chapter 7.2.1, table 3, Type Identification of ASDU (approx. Data Unit 20-30)

Bellow listed you find NOCs (number of channel), which are included in the disturbance data units (see also chapter 7.2.6.10 IEC-Standard) for transmission.

Channel Number	Description
1	Fault Recording Channel for iL1 in A (compatible only with Fct. 128)
2	Fault Recording Channel for iL2 in A (compatible only with Fct. 128)
3	Fault Recording Channel for iL3 in A (compatible only with Fct. 128)
4	Fault Recording Channel for iE in A (compatible only with Fct. 128)
5	Fault Recording Channel for uL1 in V (compatible only with Fct. 128)
6	Fault Recording Channel for uL2 in V (compatible only with Fct. 128)
7	Fault Recording Channel for uL3 in V (compatible only with Fct. 128)
8	Fault Recording Channel for uen in V (compatible only with Fct. 128)
64	Fault Recording Channel for IPL Parallel Line in A
65	Fault Recording Channel for IPL1 primary in A (Feeder-, Busbar-,Transformer-Differential Protection)
66	Fault Recording Channel for IPL2 primary in A (Feeder-, Busbar-,Transformer-Differential Protection)
67	Fault Recording Channel for IPL3 primary in A (Feeder-, Busbar-,Transformer-Differential Protection)
68	Fault Recording Channel for IPo primary in A (Feeder-, Busbar-,Transformer-Differential Protection)
69	Fault Recording Channel for ISL1 secondary in A (Feeder-, Busbar-,Transformer-Differential Protection)
70	Fault Recording Channel for ISL2 secondary in A (Feeder-, Busbar-,Transformer-Differential Protection)
71	Fault Recording Channel for ISL3 secondary in A (Feeder-, Busbar-,Transformer-Differential Protection)
72	Fault Recording Channel for ISo secondary in A (Feeder-, Busbar-,Transformer-Differential Protection)
73	Fault Recording Channel for ITL1 tertiary in A (Feeder-, Busbar-,Transformer-Differential Protection)
74	Fault Recording Channel for ITL2 tertiary in A (Feeder-, Busbar-,Transformer-Differential Protection)
75	Fault Recording Channel for ITL3 tertiary in A (Feeder-, Busbar-,Transformer-Differential Protection)
76	Fault Recording Channel for ITo tertiary in A (Feeder-, Busbar-,Transformer-Differential Protection)
77	Fault Recording Channel for IDL1 Differential Current in A
78	Fault Recording Channel for IDL2 Differential Current in A
79	Fault Recording Channel for IDL3 Differential Current in A
80	Fault Recording Channel for ISTL1 Stabilising Current in A
81	Fault Recording Channel for ISTL2 Stabilising Current in A
82	Fault Recording Channel for ISTL3 Stabilising Current in A

83	Fault Recording Channel for IM1 Summation Current Local Station in A
84	Fault Recording Channel for IM2 Summation Current Remote Station in A
85	Fault Recording Channel for IM3 Summation Current 2nd Remote Station in A
86	Fault Recording Channel for ID Differential Current in A
87	Fault Recording Channel for IST Stab.-Summation Current Local Station in A
88	Fault Recording Channel for IL1g Remote Station in A (Line Differential Protection)
89	Fault Recording Channel for IL2g Remote Station in A (Line Differential Protection)
90	Fault Recording Channel for IL3g Remote Station in A (Line Differential Protection)
91	Fault Recording Channel for Iog Remote Station in A (Line Differential Protection)
92	Fault Recording Channel for IMit Current Positive Sequence in A
93	Fault Recording Channel for UMit Voltage Positive Sequence in V
94	Fault Recording Channel for PHI Phase Angle in degrees
95	Fault Recording Channel for IGegen Negative Sequence Current in %
96	Fault Recording Channel for R Fault Resistance in Ohm
97	Fault Recording Channel for X Fault Reactance in Ohm
98	Fault Recording Channel for P/SN Active Power related to Apparent Power in %
99	Fault Recording Channel for Q/SN Reactive Power related to Apparent Power in %
100	Fault Recording Channel for I0 Current with sensitive Current Transformer in A
101	Fault Recording Channel for U2 Voltage for Synchro-Check in V
102	Fault Recording Channel for U1 Voltage for Synchro-Check in V
103	Fault Recording Channel for IA Current in A
104	Fault Recording Channel for IB Current in A
105	Fault Recording Channel for UL12 in V
106	Fault Recording Channel for UL23 in V
107	Fault Recording Channel for UL31 in V
108	Fault Recording Channel for Sampling Period (dt) in ms (variable Sampling Frequency)
110	Fault Recording Channel for Transformer-Starpoint Current in A (7SA513)
111	Fault Recording Channel for Excitation Voltage in V (Machine Protection)
112	Fault Recording Channel for IL1 eff. in A (Machine Protection)
113	Fault Recording Channel for IL2 eff. in A (Machine Protection)
114	Fault Recording Channel for IL3 eff. in A (Machine Protection)
115	Fault Recording Channel for IE eff. in A (Machine Protection)
116	Fault Recording Channel for the Phase Angle, no Dimension (Machine Protection)

117	Fault Recording Channel for f-f_N in Hz (Machine Protection)
118	Fault Recording Channel for Phase-Phase-Voltage in V (Machine Protection)
119	Fault Recording Channel for Rotor Voltage in V (Machine Protection)
120	Fault Recording Channel for Earth Voltage in V (Machine Protection)
121	Fault Recording Channel for Rotor Current in mA (Machine Protection)
122	Fault Recording Channel for Phase-Phase-Voltage eff. in V (Machine Protection)
123	Fault Recording Channel for Earth Voltage eff. in V (Machine Protection)
124	Fault Recording Channel for Negative Sequence Current in per cent (Machine Protection)
125	Fault Recording Channel for Earth Current in mA (Machine Protection)
126	Fault Recording Channel for Earth Current eff. in A (Machine Protection)
127	Fault Recording Channel for Rotor Current in A (Machine Protection)
128	Fault Recording Channel for Winding Voltage in V (Machine Protection)
129	Fault Recording Channel for Rotor Voltage in V (Machine Protection)
130	Fault Recording Channel for Stator Current in A (Machine Protection)
131	Fault Recording Channel for Measured Voltage for Rotor Earth Fault Protection in V (Machine Protection)
132	Fault Recording Channel for maximum Phase-Phase-Voltage in V (Machine Protection)
133	Fault Recording Channel for Winding Voltage eff. in V (Machine Protection)
134	Fault Recording Channel for Stator Voltage eff. in V (Machine Protection)
135	Fault Recording Channel for Stator Current eff. in A (Machine Protection)
136	Fault Recording Channel for Stator Resistance in Ohm (Machine Protection)
137	Fault Recording Channel for max. Phase-Phase-Voltage eff. in V (Machine Protection)
138	Fault Recording Channel for Stator Voltage in V (Machine Protection)
139	Fault Recording Channel for Rotor Earth Fault Protection (Machine Protection)
140	Fault Recording Channel for Negative Sequence Current in A (Machine Protection)
141	Fault Recording Channel for (Railway System Protection)
142	Fault Recording Channel for (Railway System Protection)
143	Fault Recording Channel for Calculated Displacement Voltage (SSÜ)
144	Fault Recording Channel for Phase Current for Railway System Protection (Machine Protection)
145	Fault Recording Channel for Phase Voltage for Railway System Protection (Machine Protection)

Table T4

Breaker Control

The IEC 60870-5-103 has its main focus on protection equipment. For this reason, breaker control commands are not part of the standard. This limits the application of the standard for combined protection and control devices.

To overcome these limitations of the IEC standard, control functions have been implemented in all SIPROTEC 4 relays and in the 7SJ531 relay using the private range of data units and using the command transmission protocol from IEC 60870-5-5. The implementation was done according to the following paper issued by the VDEW: " Digitale Stationsleittechnik – Ergänzende Empfehlungen zur Anwendung in Verteilnetzstationen" , ISBN 3-8022-0555-3. The implementation uses function type 240 for breaker control.

If breaker control functions are used in the V3-device 7SJ531 the parameter 7221 has to be set to "VDEW EXTENDED".

Definitions in VDEW-Paper

The procedure to control breakers or other devices is the command transmission procedure and is defined as in the IEC standard 60870-5-5.

In addition to 'CAUSE OF TRANSMISSION 12' (remote operation with positive acknowledgement) the VDEW-Paper defines 'CAUSE OF TRANSMISSION 13' for remote operation with negative acknowledgement. This acknowledgement comes from the protection device, after a command was requested by the substation. The semantics of CAUSE OF TRANSMISSION are listed in the IEC-Standard, chapter 7.2.3. , table 5.

The double command and double-point information are extended:

command from substation				feedback from protection relay			
DCO	:=	UI2 [1..2] <0..3>		DPI	:=	UI2 [1..2] <0..3>	
with	<0>	:=	0 (not used)	with	<0>	:=	indeterminate
	<1>	:=	OFF		<1>	:=	OFF
	<2>	:=	ON		<2>	:=	ON
	<3>	:=	0 (not used)		<3>	:=	disturbed

The additional compatible messages from VDEW defined with function type and information number for breaker control are shown in the table T5.
Breaker control is offered in 7SJ531 (V3) and SIPROTEC 4 devices.
For SIPROTEC 4, the following table applies:

Commands	ASDU	CAUSE OF TRANSMISSION	Function Type	Information Number
Q0 ON/OFF	20	20	240	160
Q1 ON/OFF	20	20	240	161
Q2 ON/OFF	20	20	240	162
Q9 ON/OFF	20	20	240	163
Q8 ON/OFF	20	20	240	164
Annunciations				
Q0 ON/OFF	1	1,7,9,11,12,13*, 20,21	240	160
Q1 ON/OFF	1	1,7,9,11,12,13*, 20,21	240	161
Q2 ON/OFF	1	1,7,9,11,12,13*, 20,21	240	162
Q9 ON/OFF	1	1,7,9,11,12,13*, 20,21	240	163
Q8 ON/OFF	1	1,7,9,11,12,13*, 20,21	240	164

Table T5

* CAUSE OF TRANSMISSION 13 for VDEW definition is equal to 80 realized in 7SJ531. In some cases 80 is also used in SIPROTEC 4.

In the SIPROTEC 4 relays additional commands can also be defined (see DIGSI 4). These commands can be created in DIGSI 4 in the I/O matrix and have to be marshalled to the IEC-interface (see chapter “amount of information”).

The 7SJ531 V3 relay has only a subset of messages for the command function.

Commands	ASDU	CAUSE OF TRANSMISSION	Function Type	Information Number
Q0 ON/OFF	20	20	101	105
Annunciations				
Q0 ON/OFF	1	1,7,9,11,12, **80**, 20,21	101	105
Q1 ON/OFF	1	1,7,9,11	101	106
etc. see manual				

Table T6

The commands coming from the substation controller have ASDU 20. The protection device annunciations concerning breaker control have ASDU 1.
Please pay attention that the acknowledge from the device with cause of transmission positive (20) is only to confirm the processing of the command of the substation. An unsuccessful command function has as reaction from protection device cause of transmission 21. The end/result of processing a command is indicated by the spontaneous message of the protection device with the same function type and information number and with a cause of transmission 12 or 13 (80). The indication of end of processing is only necessary if the state of the device has changed (cause of transmission 12). If the state of the controlled device has not changed during the command monitoring time the spontaneous message “command monitoring time run out” shall be sent (cause of transmission 13 (80)).

Measured values

According to the compatible IEC standard, measured values (rms values of voltages, currents, ...) are transmitted using data unit 3 or 9. With data unit 3, only a small list of well defined measured values can be transmitted (max 4 values).

To optimize the performance of relays with many measured values, it was necessary to define function types and information numbers using data unit 9 in the private range. This data unit contains up to 16 measured values.

For V3 relays the following applies:

For the transmission of measured values, either the compatible range or the private range can be used. The use of both modes together is not possible. The mode can by parameterised via parameter 7222 “SYS MEASUR.”. If the parameter is set to “VDEW COMPATIBLE” the data unit 3 as defined in the standard will be used for the transmission of measured values for most relay types. Only the distance protection relays 7SA51 use data unit 9 in the compatible mode for the transmission of measured values. If the compatible mode for the transmission of measured values is used, the definitions in the standards are valid (ASDU 9 see IEC standard document chapter 7.3.1.8). The function types and information numbers for measured values given in the tables of the relay manuals are not applicable in this case.

The information tables in the relay manuals show the function type and information number which are used for the transmission of measured values with data unit 9 if the parameter 7222 is set to “VDEW EXTENDED”. The sequence of the values of the data unit 9 listed in the manual is in general according to the sequence used in data unit 9 for transmission. For more details see tables in the annex of this paper.

The same principle is valid for SIPROTEC 4 devices. Data unit 3 offers max. 4 values and in data unit 9 are listed up to 16 values.

The range of the values which can be transmitted is mostly 240% or 2.4 of the rated value. The value in data unit 9 has 13 bit (1 sign, 12 bit data). That means that +/- 4096 indicates +/- 240% of the measured value. Some special measured values (cos φ, Iea, Ier, ..) use other rated values.

7SJ600-based relays offer only a few amount of measured values. They are transmitted using data unit 3 in the compatible format. For more information see annex.

Metering

Metering values (e.g. kWh) are not defined in the IEC standard and there are no compatible data units available which are suitable for the transmission of metered values. Some SIPROTEC 4 relays offer the possibility to transmit metered values via the IEC interface. For this reason, the private data unit 205 has been defined for the transmission of metered values. The relay manuals give detailed information about the amount of information which is available together with the function types and information numbers. Only one metering value per data unit is transmitted.
The structure of this data unit is:

	Byte-Description		decimal	hex
	Start Sequence 1		104	0x68
	Length		16	0x10
	Length		16	0x10
	Start Sequence 1		104	0x68
1	Control Sequence 00x0 1000		40/8	0x28/0x08
2	Address Field			
3	Type Identification		205	0x04
4	Variable Structure Qualifier		129	0x81
5	Cause of transmission		1 or 7	0x01 or 0x07
6	Device Address			
7	Function Type	See annex		
8	Information Number	See annex		
9		Info Element 15		
10				
11				
12				
13	ms	Time		
14				
15	min			
16	h			
	Checksum			
	Stop Sequences		22	0x16

Info Element 15

	8	7	6	5	4	3	2	1
Byte 1	2^7		Me-tered	Value				2^0
Byte 2	2^{15}		Me-tered	Value				2^8
Byte 3	2^{23}		Me-tered	Value				2^{16}
Byte 4	Irrele-vant	Internal Error	Irrele-vant	Sign	2^{27}	Me-tered	Value	2^{24}

In SIPROTEC 4 data unit 205 is sent spontaneously, in 7SJ531 the values are sent on request. To activate the transmission of data unit 205 in 7SJ531 the master system has to send the following telegram.

	Byte-Description		deci-mal	hex
	Start Sequence 1		104	0x68
	Length		14	0x0E
	Length		14	0x0E
	Start Sequence 1		104	0x68
1	Control Sequence 01x0 0100		100/ 68	0x64/ 0x44
2	Address Field		255	0xFF
3	Type Identification		255	0xFF
4	*Variable Structure Qualifier*		110	0x6E
5	*Cause of transmission*		0	0x00
6	*Device Address*		255	0xFF
7	*Function Type*		74	0x48
8	*Information Number*		64	0x40
9		Irrelevant		
....				
14		Irrelevant		
	Checksum			
	Stop Sequences		22	0x16

IEC communication with 7SS52

The digital busbar and breaker failure protection 7SS52 consists of a central unit and up to 48 bay units. The central unit as well as the bay units are able to provide the control center (LSA) with datas to transfer.

In practise you only need to connect the central unit to LSA system. The bay units which are connected to the central unit by fiber-optic cables will also send their information via the interface of the central unit to LSA system.

In the manual 7SS52 in chapter appendix A is an overview of the annunciations to the control center. In the appendix A is also explained the procedure to get the information, which one of the device units has sent datas to the control center. Function type 195 to 206 is reserved for the bay units. Each function type has up to 252 information numbers.

E.g. for the first bay unit is reserved :
Function type 195, information number with the range of 1-63,

second bay unit :
Function type 195, information number with the range of 64-126,

third bay unit:
Function type 195, information number with the range of 127 -189,

forth bay unit:
Function type 195, information number with the range of 190-252,

fifth bay unit:
Function type 196, information number with the range of 1-63,

and so on.

Time synchronization

V3 and V4 relays:
The following amount of data is transmitted for time synchronisation: Milliseconds, Minutes, Invalid-bit, Hours, Summer time-bit, Day of month, Day of week, Months, Years
For time representation, the day of the week is not supported. According to the IEC standard, it is set to zero. Generally, we recommend a time synchronisation in intervals of 1 min to 10 min. V3 and V4 relays will set the “time invalid-bit” if the time synchronisation intervals are longer than 15 min. A time synchronisation in intervals shorter than 1min will not increase the accuracy of the clock.

Gaps between bytes

According to the IEC-standard, gaps between individual bytes of a telegram are not allowed. The relays accept gaps of less than 3 bytes in telegrams without rejecting them. If longer gaps are expected in the communication to the relays, parameters are available to increase the tolerable length of the gaps.

Light on / light off

According to the IEC-standard “light on” has to be used for optical fibre links if no data transmission is running. We recommend however to use “light off” for Siemens equipment. This reduces degradation of the optical elements. If any starcouplers are used in the optical links, the setting “light off” is required. The “light on” recommendation gives no additional security for the data link. An outage of a device or of a communication link will be detected anyhow by the central unit as soon as a device does not answer any request.

In V3 relays, light on/light off can be changed by jumpers. The changing procedure is described in the relay manuals. In SIPROTEC 4 relays, this can by set by DIGSI4 (settings→serial ports→ rear port→idle state of fiber optic connection).

Please make sure, that all equipment used in your installation has the same setting for light on/light off!

Additional remarks

In order to react on unforeseen dead-locks on the communication link, the protection devices have a time-out monitoring function. After a defined period in which the device is not addressed /requested by the central unit, a timer runs out. Then the relay requires a new initializing procedure at the communication port before it answers on any requests.

The following table gives information about this time and possibilities to change it:

Type	Timer setting	Possibility to change the timer
7SJ600 V2.12 and lower	15sec	no
7SJ600 V2.13 and higher	10min	no
V3 relays	15sec	special parameter 7233 (Siemens codeword)
SIPROTEC 4 relays	no	

Table T7

Generally we recommend to poll every relay in intervals of less than 10sec in order to guarantee actual information in the monitoring system.

Annex

Measured values of 7SA511 V3.x

	Reference	Range of value [%]	VDEW compatible	VDEW extended
IL1[%]	100% = 1706	1,7 - 240	X	X
IL2[%]	100% = 1706	1,7 - 240	X	X
IL3[%]	100% = 1706	1,7 - 240	X	X
UL1E[%]	100% = 1706	1,7 - 240	X	X
UL2E[%]	100% = 1706	1,7 - 240	X	X
UL3E[%]	100% = 1706	1,7 - 240	X	X
UL12[%]	100% = 1706	1,7 - 240		X
UL23[%]	100% = 1706	1,7 - 240		X
UL31[%]	100% = 1706	1,7 - 240		X
P[%]	100% = 1706	1,7 - 240	X	X
Q[%]	100% = 1706	1,7 - 240	X	X
f[%]	100% = 1706	94 - 106	X	X
Iea [mA]	100mA= 170	No limit		X
Ier [mA]	100mA = 170	No limit		X

Metering values of 7SJ531

Information number with function type 133	meaning
51	Positive active energy (WP)
52	Positive reactive energy (WQ)
53	Negative active energy (WP)
54	Negative reactive energy (WQ)

Metering values of 7SJ63

Information number with function type 133	meaning
51	Positive active energy (WP)
52	Positive reactive energy (WQ)
53	Negative active energy (WP)
54	Negative reactive energy (WQ)
55	Impulse counter active energy (WQimp)
56	Impulse counter reactive energy (WQimp)

Measured values of V3 relays

7SA511			7SA513	
Measured values	VDEW compatible ASDU 9	VDEW extended	VDEW compatible ASDU 9	VDEW extended
1	IL1[%]	IL1[%]	IL1[%]	IL1[%]
2	IL2[%]	IL2[%]	IL2[%]	IL2[%]
3	IL3[%]	IL3[%]	IL3[%]	IL3[%]
4	UL1E[%]	UL1E[%]	UL1E[%]	UL1E[%]
5	UL2E[%]	UL2E[%]	UL2E[%]	UL2E[%]
6	UL3E[%]	UL3E[%]	UL3E[%]	UL3E[%]
7	P[%]	P[%]	P[%]	P[%]
8	Q[%]	Q[%]	Q[%]	Q[%]
9	f[%]	f[%]	f[%]	f[%]
10		UL12[%]		UL12[%]
11		UL23[%]		UL23[%]
12		UL31[%]		UL31[%]
13		Iea[mA]		
14		Ier[mA]		
15				
16				

7UM516		7UM11	7UM515	7UM12
Measured values	VDEW extended	VDEW extended	VDEW extended	VDEW extended
1	IL1[%]	IL1[%]	UL1E[%]	IL1[%]
2	IL2[%]	IL2[%]	UL2E[%]	IL2[%]
3	IL3[%]	IL3[%]	UL3E[%]	IL3[%]
4	UL1E[%]	UL1E[%]	U0	U0
5	UL2E[%]	UL2E[%]	Umit	FREQ.
6	UL3E[%]	UL3E[%]	UmaxLL	Imit[%]
7	U0	U0	U WIN	Igegen
8	FREQ.	FREQ.	FREQ.	COS PHI
9	Umit	Umit	U SES	P[%]
10	Imit[%]	Imit[%]	I SES	Q[%]
11	Igegen	Igegen	R SES	ULL
12	COS PHI	COS PHI	Igen	RE
13	R	P[%]	R LES	
14	X	Q[%]	U/f	
15	P[%]		U/f th.	
16	Q[%]			

7UT51		7SD502/3	7SD511/2
Measured values	VDEW extended	VDEW extended	VDEW extended
1	I1L1[%]	I1[%]	IL1[%]
2	I1L2[%]	I2[%]	IL2[%]
3	I1L3[%]	I3[%]	IL3[%]
4	I2L1[%]	ID[%]	IEa[%]
5	I2L2[%]	IS[%]	TL
6	I2L3[%]		
7	I3L1[%]		
8	I3L2[%]		
9	I3L3[%]		
10	IA[%]		
11	IB[%]		

7SJ511			7SJ512/512 (US without *)	
Measured values	VDEW compatible (DU 3)	VDEW extended	VDEW compatible (DU 3)	VDEW extended
1	IL2[%]	IL1[%]	IL2[%]	IL1[%]
2		IL2[%]	UL12[%]	IL2[%]
3		IL3[%]		IL3[%]
4		IE[%]		IE[%]
5		(x)		UL1E[%]
6		(x)		UL2E[%]
7		(x)		UL3E[%]
8		(x)		UE[%]
9		(x)		P[%]
10		(x)		Q[%]
11		(x)		S[%]
12		(x)		COS PHI
13		(x)		Iea[mA]*
14		(x)		Ier[mA]*
15				
16				

(x) like 7SJ512, but here invalid value

7SJ531		
Measured values	VDEW compatible (DU 3)	VDEW extended
1	IL2[%]	IL1[%]
2	UL12[%]	IL2[%]
3		IL3[%]
4		IE[%]
5		UL1E[%]
6		UL2E[%]
7		UL3E[%]
8		UL12[%]
9		UL23[%]
10		UL31[%]
11		P[%]
12		Q[%]
13		f[%]
14		COS PHI
15		IEEa[%]
16		IEEr[%]

7SA517	
Measured values	VDEW extended
1	Tltg[%]
2	f[%]
3	I[%]
4	U[%]

7SJ517	
Measured values	VDEW extended
1	f[%]
2	I1[%]
3	I2[%]

7RW600	
Measured values	VDEW extended
1	f
2	U
3	Ux

Annunciations 7SJ600 / 7RW600

7SJ600

FNr	content	BE	ST		KM	GA	MM	Typ	Info
501	General pick-up		KG		KM		MM	p	84
511	General trip		K		KM		MM	p	68
602	current L2 [%]	MW			KM			p	144

p=160

7RW600 V1.x

FNr	content	BE	ST		KM	GA	MM	Typ	Info
501	General pick-up		KG				MM	78	84
511	General trip		K				MM	78	68
937	Frequency in [Hz]	MW						78	138
968	Voltage at input V (bzw.U)	MW						78	138
969	Voltage at Vx (bzw. Ux)	MW						78	138

CA=KG (= kommend/gehend)
GI=GA (=Generalabfrage)
MW=Meßwert ; measured value