Description of the MaxComm data protocol for communication with SolarMax products using the MaxComm interface

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Protocol description

1.1 Structure

The protocol is structured as follows:

STX	Src-Add	FS	Dest-Add	FS	Length	FRS	Port	US	Data	FRS	Crc	ETX or ETB
FRAME							DATA			FRAME		

	Meaning	**Character / value**	**ASCII value (dec)**
STX	Start of Text; indicates the start of a data packet	{	123
ETX	End of Text; indicates the end of a data packet if no further packets associated with this transmission follow	}	125
ETB	End of Text Block; indicates the end of a data packet if further packets associated with this transmission follow	)	41
FRS	Frame Separator; indicates start / end of frame data	|	124
US	Union Separator; separator between unions	:	58
FS	Field Separator; separator for fields within a union	;	59
Src-Add	Address of the sending device	00 ... FF	
Dest-Add	Address of the target device	00 ... FF	
Length	Length of all characters of the data packet	00 ... FF	
Crc	Sum of the ASCII values of all characters from the address up to and including the FRS, before the Crc	0000 ... FFFF	
Port	Port number for determining the target or the origin of the user data	0 ... FFFF	
Data	User data, see description below		

The transfer rate is 19,200 bps. The protocol is 8 data bits, no parity, 1 stop bit (8N1).

The maximum length of a data packet is 255 bytes. If the volume of data exceeds the length of a packet, several packets will be generated, each ending with ETB. The devices listed in Section 3.4 can send (but not receive) multiple packets.

All numeric values are encoded as ASCII characters in hexadecimal form.

A data packet ending with ETX never has a US or FS before the FRS.

`Src-Address`, `Dest-Address` and `Length` are always two ASCII characters long, `Crc` is always four ASCII characters long.

1.2 Timing

The MaxComm communication protocol is based on the master-slave principle. The SolarMax devices do not send data spontaneously, but only in response to queries from the master. Only one device at a time may be polled. The next device can only be polled once a response has been received from the previously polled device or the response timeout has elapsed.

The maximum response time depends on the number of queried values:

- typical response time: 300 ms

- maximum response time (timeout): 3000 ms

1.3 Addressing

The `Src-Add` field contains the device address of the data packet source. The `Dest-Add` field contains the address of the device for which the data packet is intended. There are several predefined addresses which cannot be assigned to SolarMax devices.

Address (dec)	Designation	Description
0	Broadcast	The **Broadcast** address can only occur as a destination address. All devices connected to the bus respond to it. It may **only be used for point-point connections**.
250	Network master	The address of the network master (MaxComm Basic, MaxWeb).
251	Host	The address of an alternative network master that is connected in addition to the network master.[1)]
252	MaxDisplay	Reserved address for large displays with the MaxDisplay interface.
253	reserved	-
254	reserved	-
255	Uninitialized	Default value for non-configured network nodes

[1)] In each case the system must ensure that only one query at a time is sent to a device, see Section 1.2.

The address range of the MaxComm protocol is 0 (0x00) to 255 (0xFF). Each address may only occur once in the network. For SolarMax devices, addresses between 1 and 249 can be used. In respect of SolarMax devices, the network address is set either via their display or a DIP switch.

1.4 Port number

The port number can be used to determine the destination or source of user data. Different ports are available, depending on the network node type:

Port number (dec)	Meaning
100	User data
200	Setting / command
1000	Messages from the interface

1.5 Messages from the interface

If data cannot be interpreted by the network node, the device returns a message with port number 1000. The following messages are possible:

Key	Meaning
IPR	Invalid Protocol: Error in checksum or length / transmission error
IPN	Invalid Port Number: The selected port is not served

Example:

Host sends: `{FB;2A;<Length>|1F4:TYP|<Crc>}`

Network node responds: `{2A;FB;<Length>|3E8:IPN|<Crc>}`

The network nodes do not detect any error messages from the host.

1.6 Messages from devices

If data cannot be interpreted by the device, either because the device doesn't support the key, or the key is not applicable at this moment, the device will send back a message with a missing key or a key without value.

1.6.1 Key not supported

If the device does not support the key, it will send back a message with the key missing.

Example:

Host sends: `{FB;2A;<Length>|1F4:TYP|<Crc>}`

Device responds: `{2A;FB;<Length>|1F4:|<Crc>}`

1.6.2 Key not applicable

If the device generally supports the key, but due to specific settings the key can not be applied at this moment, the device will simply send back the key without any value.

Example:

Host sends: `{FB;2A;<Length>|1F4:TYP|<Crc>}`

Device responds: `{2A;FB;<Length>|1F4:TYP|<Crc>}`

2 Data query

2.1 Query format

In order to retrieve data, a list containing the keys for the required values must be sent to the network node. A port number of 100 (0x64) is used for user data. Example:

`{FB;2A;<Length>|64:TYP;SWV;UDC|<Crc>}`

returns the values for TYPE (type), SWV (software version) and UDC (DC voltage) in the following form:

`{2A;FB;<Length>|64:TYP=7D0;SWV=28;UDC=180|<Crc>}`

Undefined keys are ignored in the response.

The requested data will only be transferred once.

No spaces may be used between a key and the preceding FS or the following FS.

The keys are case-sensitive.

2.2 Network variable

The transmitted user data are formatted based on standardised network variables. Each data key is assigned a network variable containing information about the formatting of the data key value. The following network variables are currently defined:

Name of network variable	Unit	Size	Offset / zero point	Resolution per digit	Minimum value	Maximum value
Voltage_1	V	16 bit	0	0.001	0	65.5350
Voltage_2	V	16 bit	0	0.1	0	6553.5000
Current_positive_1	A	16 bit	0	0.0001	0	6.5535
Current_positive_2	A	16 bit	0	0.01	0	655.3500
Current_rectified_1	A	16 bit	32767	0.0001	-3.2767	3.2768
Power	W	32 bit	0	0.5	0	1073741823.0000
Energy_1	kWh	32 bit	0	0.1	0	214748364.7000
Energy_2	kWh	32 bit	0	1	0	2147483647.0000
Temperature_positive	°C	16 bit	0	1	0	65535.0000
Temperature	°C	16 bit	32767	1	-32767	32768.0000
Hours	h	16 bit	0	1	0	23.0000
Minutes	min	16 bit	0	1	0	59.0000
Year	a	16 bit	0	1	0	99.0000
Month	m	16 bit	0	1	0	12.0000
Day	d	16 bit	0	1	0	31.0000
Microseconds	us	16 bit	0	1	0	65535.0000
Register	-	16 bit	0	1	0	65535.0000
Network address	-	16 bit	0	1	0	255.0000
Without_unit_1	-	32 bit	0	1	0	2147483647.0000
Without_unit_2	-	16 bit	0	1	0	65535.0000
Percent	%	16 bit	0	1	0	100.0000
Solar radiation	W/m2	16 bit	0	1	0	1500.0000
Solar energy	kWh/m2	32 bit	0	0.1	0	214748364.7000
DATE	-	YYYY,MM,DD	-	-	-	-
TIME	-	HH,MM,SS	-	-	-	-
unformatted	-	1...32 ASCII characters	-	-	-	-

2.3 Type identification

The TYPE key provides a value for identifying the device type associated with a network node. The following values are currently defined:

Device type	TYP (dec)	Device type	TYP (dec)	Device type	TYP (dec)
SolarMax 1440TS-SV MT	20812	SolarMax 20HT2	20255	SolarMax 3600SP	11025
SolarMax 1080TS-SV MT	20809	SolarMax 18MT3 A	20254	SolarMax 3000SP	11020
SolarMax 720TS-SV MT	20806	SolarMax 15MT3 A	20252	SolarMax 2500SP	11015
SolarMax 360TS-SV MT	20803	SolarMax 12MT2 A	20250	SolarMax 2000SP	11010
SolarMax 1440TS-SV ST	20712	SolarMax 18MT3 SV	20240	SolarMax 1500SP	11005
SolarMax 1080TS-SV ST	20709	SolarMax 8MT2	20215	SolarMax 1000SP	11000
SolarMax 720TS-SV ST	20706	SolarMax 15MT2	20213	MaxCount	10300
SolarMax 360TS-SV ST	20703	SolarMax 13MT2	20211	MaxMeteo plus2T	10210
SolarMax 360TS-SV	20700	SolarMax 10MT2	20210	MaxMeteo	10200

SolarMax 4TP	20653	SolarMax 15MT3	20208	SolarMax 6000C	6010
SolarMax 5TP2	20652	SolarMax 13MT3	20206	SolarMax 6000E	6000
SolarMax 6TP2	20651	SolarMax 10MT	20202	SolarMax 4200C	4200
SolarMax 7TP2	20650	SolarMax 20S	20100	SolarMax 4000C	4010
SolarMax 5000P	20640	SolarMax 35S	20110	SolarMax 4000	4001
SolarMax 4600P	20635	SolarMax 6000S	20040	SolarMax 4000E	4000
SolarMax 4000P	20630	SolarMax 4200S	20030	SolarMax 3000C	3010
SolarMax 3000P	20620	SolarMax 3000S	20020	SolarMax 3000E	3001
SolarMax 2000P	20610	SolarMax 2000S	20010	SolarMax 3000	3000
SolarMax 1320TS-SV MT	20512	SolarMax 60SHT-S	11120	SolarMax 2000C	2010
SolarMax 990TS-SV MT	20509	SolarMax 50SHT-S	11115	SolarMax 2000E	2001
SolarMax 660TS-SV MT	20506	SolarMax 60SHT	11110	SolarMax 2000	2000
SolarMax 330TS-SV MT	20503	SolarMax 50SHT	11105	SolarMax 330C-SV	330
SolarMax 1320TS-SV ST	20412	SolarMax 30SHT	11100	SolarMax 300C	300
SolarMax 990TS-SV ST	20409	SolarMax 28SHT	11095	SolarMax 125	126
SolarMax 660TS-SV ST	20406	SolarMax 25SHT	11090	SolarMax 100	101
SolarMax 330TS-SV ST	20403	SolarMax 22SHT	11085	SolarMax 100C	100
SolarMax 300TS MT	20318	SolarMax 20SHT	11080	SolarMax 80C	80
SolarMax 300TS ST	20316	SolarMax 17SHT	11075	SolarMax 60	61
SolarMax 100TS	20314	SolarMax 15SMT	11070	SolarMax 50C	50
SolarMax 80TS	20312	SolarMax 13SMT	11065	SolarMax 45	46
SolarMax 50TS	20310	SolarMax 10SMT	11060	SolarMax 40	41
SolarMax 32HT2	20266	SolarMax 8SMT	11055	SolarMax 35C	35
SolarMax 32HT4	20262	SolarMax 6SMT	11050	SolarMax 30	31
SolarMax 30HT4	20260	SolarMax 6000SP	11045	SolarMax 30C	30
SolarMax 25HT4	20258	SolarMax 5000SP	11040	SolarMax 25C	25
SolarMax 25HT2	20257	SolarMax 4600SP	11035	SolarMax 20	21
SolarMax 20HT4	20256	SolarMax 4000SP	11030	SolarMax 20C	20

2.4 Available data

Depending on the device type, different data can be polled:

			SolarMax Inverters	MaxMeteo	MaxCount
Value / meaning	**Key**	**Network variable**			
AC output	PAC	Power	✓		
Operating hours	KHR	without_unit_1	✓		
Date (new inverters)	DATE	Date	✓		
Date year (old inverters)	DYR	Year	✓	✓	✓
Date month (old inverters)	DMT	Month	✓	✓	✓
Date day (old inverters)	DDY	Day	✓	✓	✓
Energy year	KYR	Energy_2	✓		
Energy month	KMT	Energy_2	✓		
Energy day	KDY	Energy_1	✓		
Energy total	KT0	Energy_2	✓		
Pulse counter 1 year	I1Y	Energy_1			✓
Pulse counter 1 power	I1P	Power			✓
Pulse counter 1 scaling	I1S	without_unit_2			✓
Pulse counter 1 day	I1D	Energy_1			✓
Pulse counter 1 total	I1T	Energy_1			✓
Pulse counter 2 year	I2Y	Energy_1			✓
Pulse counter 2 power	I2P	Power			✓
Pulse counter 2 scaling	I2S	without_unit_2			✓
Pulse counter 2 day	I2D	Energy_1			✓
Pulse counter 2 total	I2T	Energy_1			✓
Installed capacity	PIN	Power	✓		
Mains cycle duration	TNP	Microsecond	✓		
Network address	ADR	Network address	✓	✓	
Relative output	PRL	Percent	✓		

Software version	SWV	without_unit_2	✓		
Solar energy year	RYR	Solar energy		✓	
Solar energy day	RDY	Solar energy		✓	
Solar energy total	RT0	Solar energy		✓	
Solar radiation	RAD	Solar radiation		✓	
Voltage DC	UDC	Voltage_2	✓		
Voltage phase 1	UL1	Voltage_2	✓		
Voltage phase 2	UL2	Voltage_2			
Voltage phase 3	UL3	Voltage_2			
Current DC	IDC	Current_positive_2	✓		
Current phase 1	IL1	Current_positive_2	✓		
Current phase 2	IL2	Current_positive_2			
Current phase 3	IL3	Current_positive_2			
Temperature power unit 1	TKK	Temperature_positive	✓		
Temperature power unit 2	TK2	Temperature_positive			
Temperature power unit 3	TK3	Temperature_positive			
Temperature solar cells	TSZ	Temperature		✓	
Type	TYP	without_unit_2	✓	✓	✓
Time (new Invertes)	TIME	Time	✓		
Time minute (old Inverters)	TMI	Minute	✓	✓	✓
Time hour (old Inverters)	THR	Hour	✓	✓	✓

The exact meanings of the individual values can be found in the instruction manual for the device in question.

2.5 Settings and commands

Settings and commands start with port number 200 (0xC8), followed by the command key and an optional parameter.

Example for setting the hour:

`{FB;2A;<Length>|C8:THR=10|<Crc>}` sets the hour to 16.

Settings and commands are acknowledged with Ok or Ko, depending on whether or not they were executed. The Ok or Ko messages are case-sensitive.

`{2A;FB;<Length>|C8:Ok|<Crc>} or {2A;FB;<Length>|C8:Ko|<Crc>}`

For commands with a parameter, a response in the form of Ok or Ko only indicates whether or not the command was detected and processed. It does not indicate acceptance of the transferred parameter. The set value should therefore be queried again.

The commands are case-sensitive. The = symbol may not be preceded or followed by any spaces.

Commands without a parameter are sent without the = symbol.

2.6 Available settings and commands

Depending on the device type, different settings can be made:

			SM 2000E... SM 6000C	SM 20C ... SM 300C	MaxMeteo	MaxCount
Value / meaning	**Key**	**Parameter Network variable**				
Set day	DDY=	Day	✓	✓	✓	✓
Set month	DMT=	Month	✓	✓	✓	✓
Set year	DYR=	Year	✓	✓	✓	✓
Set hour	THR=	Hour	✓	✓	✓	✓
Set minute	TMI=	Minute	✓	✓	✓	✓
Clear all energy counters	CLR	-	✓	✓		
Set energy day	KDY=	Energy_1	✓	✓		
Energy month	KMT=	Energy_2	✓	✓		
Energy year	KYR=	Energy_2	✓	✓		
Set energy total	KT0=	Energy_2	✓	✓		
Set operating hours	KHR=	without_unit_1	✓	✓		
Set installed capacity	PIN=	Power	✓	✓		
Pulse counter 1 day	I1D=	Energy_1				✓
Pulse counter 1 scaling	I1S=	without_unit_2				✓
Pulse counter 1 total	I1T=	Energy_1				✓
Pulse counter 1 year	I1Y=	Energy_1				✓
Pulse counter 2 day	I2D=	Energy_1				✓
Pulse counter 2 scaling	I2S=	without_unit_2				✓
Pulse counter 2 total	I2T=	Energy_1				✓
Pulse counter 2 year	I2Y=	Energy_1				✓
Solar energy day	RDY=	Solar energy			✓	
Solar energy total	RT0=	Solar energy			✓	
Solar energy year	RYR=	Solar energy			✓	

3 Controlling a MaxDisplay-compatible large display

The MaxComm protocol also includes the definition for the "MaxDisplay" interface, enabling control of MaxDisplay-compatible displays. The display data are sent to the display from the network master. The following values can be transmitted:

Value	Key	Network variable
AC output	PAC	Power
Energy day	KDY	Energy_1
Energy total	KT0	Energy_2
Energy year	KYR	Energy_2
Solar radiation	RAD	Solar radiation

A data packet for the display has the following structure:

```
{FA;FC;<Length>|64:PAC=1ABC;KDY=12A;KT0=13FB6;KYR=13FB6;RAD=1C2|<Crc>}
```

3.1 Display logic requirements

- The address of the display node (*Dest-Add*) may be programmed permanently to FC.
- The source address (*Src-Add*) is always the same / can be ignored.
- *Port* is a fixed value (see sample string).
- The network is also used by other data packets. The display must be able to filter out the packets addressed to it.

- New data are sent periodically to the display. The periodicity is not fixed, but depends on the data traffic and the number of network devices. It is never less than 5 s.
- The display must not send back a response.
- If a data packet is defective (*CRC* or *Length* incorrect, incomplete/defective data record), the old data must be retained in the display.
- The data packet for the display always ends with an ETX.