elster
Instromet

Ultrasonic Flow Meter

Series 6

Manual
Modbus Protocol

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Contents

1 General Information

1.1 Introduction

This document describes the serial communication protocol for measured data for the following Series 6 ultrasonic flow meters from Elster:

- CheckSonic Series 6
- Q.Sonic Series 6
- CheckSonic^{vx}
- Q.Sonic^{atom}
- Q.Sonic^{plus}
- Q.Sonic^{max}

Information is passed in messages between the ultrasonic flow meter and a master device. A message is a data packet conforming to certain rules. The information may be measured data, a command or a response to a command. Commands are passed from a master device to the ultrasonic flow meter, measured data and commands responses are passed from the ultrasonic flow meter to the master device.

The Series 6 Ultrasonic Flow Meters from Elster are equipped with two serial ports that can be independently configured as RS232 or RS485. On these ports the ModBus data protocol shall be implemented to allow existing equipment such as flow computers and supervisory systems to read measured data from the meter.

In addition, an alternative protocol is available where the registers are limited to 16 bits. For more information on the alternative protocol, ⇨ refer to Chapter 7 - Alternative ‘16-bits’ List (p.25)

Please note: This booklet only contains information regarding the Modbus Protocol. For a complete list of references about your ultrasonic flow meter or its corresponding hardware or software, please refer to ⇨ Appendix I – References at the end of this manual, or visit **http://www.docuthek.com/**.

1.2 Text Labelling

This manual employs consistent visual cues and standard text formats to help you easily locate and interpret information. This information will help you quickly identify relevant content.

1.2.1 Presentation of Safety and Risk Instructions

Safety Instructions

Safety instructions include notes and information which if disregarded may lead to functions not working correctly or not working at all. Safety instructions are described below:

Safety instruction (optional)

Safety instruction text

Tips and Recommendations

Tips include notes and information that make it easier for the user. Tips are described below:

Heading (optional)

Hint text

1.2.2 Paragraph Formats

Example

Multi-row examples are marked by two continuous blue lines and the keyword “Example”.

1.2.3 Character Formats

Example	Use
⇨ See Chapter 4.2 Abstract Data Types (p.12)	References to additional information are marked with an arrow. If the arrow refers to information within the document, these references are formatted as hyperlinks in blue font. You can go directly to the corresponding section by clicking on the blue text.
www.docuthek.com	links (Hyperlink)
A and ***B***	**Bold** and *Italicized* letters are used to make important words clearly stand out from the rest of the text.
Absolute temperature / Reserved for future use	Narrow, Italicized font refers to items which are reserved for future use.
`readme.txt`	All the alphabetical strings which depict sheer ASCII character strings such as identifier for physical quantities, directory or file names.

Table 1: Character Formats

1.2.4 Acronyms

The following is a list of commonly used acronyms throughout this document.

MSB	Most Significant Bit
LSB	Least Significant Bit
OSI Model	Open Systems Interconnection Model
RTU	Remote Terminal Unit
DCE	Data-Circuit Terminating Equipment
DTE	Data Terminal Equipment
UFM	Ultrasonic Flow Meter

2 OSI Layer 1: The Hardware Layer

2.1 Introduction

The physical layer concerns both the physical and electrical interface between the user equipment and the network terminating equipment. It provides the link layer with a means of transmitting a serial bit stream between the two correspondent systems.

The ultrasonic flow meters from Elster are fitted with a serial interface software configurable as RS-485 or RS-232.

2.2 RS-485 Hardware Connections

The RS-485 electrical standard is used on a shielded twisted pair data link. The RS-485 terminals are called ***A*** and ***B***. The following rules apply when connecting an ultrasonic flow meter to external equipment:

- RS-485 devices should be connected "1:1" (or "straight through"). This means that the SPU terminal ***A*** is connected to the external equipment's terminal ***A***, and the SPU terminal ***B*** is connected to the external equipment's terminal ***B***.

2.3 RS-232C Hardware Connections

- Equipment configured as Data Circuit-terminating Equipment (DCE) transmits data on pin 2, and receives data on pin 3.
- Equipment configured as Data Terminal Equipment (DTE) transmits data on pin 3, and receives data on pin 2.
- A standard "1:1" (or "straight through") serial cable must be used when interfacing DCE with DTE.
- A "null modem" serial cable must be used when interfacing DTE to DTE (or DCE to DCE).

3 OSI Layer 2: The Link Layer

3.1 Introduction

The link layer builds on the physical connection and provides a reliable information transfer facility.

3.2 General Characteristics

A serial data link is used with the following specifications:

- Transmission mode: asynchronous, half duplex (RS-485) or full duplex (RS-232C)
- Transmission rate - instrument type dependent:
    - Programmable: 300 – 115200.
    - Normal values are: 4800 bps, 9600 bps (default), 19200 bps or 38400 bps
- Start bits: 1
- Data bits: 8 (LSbit first)
- Stop bits: 1
- Parity - instrument type dependent: none (default), or even.

3.3 Message Format

Frame synchronization can be maintained in the Remote Terminal Unit (RTU) transmission mode only by simulating a synchronous message. The receiving device monitors the elapsed time between receipt of characters. If 3½ times elapse without a new character or completion of frame, then the device flushes the frame and assumes that the next byte received will be an address. Please see Figure 3-1.

T3.5	Address	Function	Data	Checksum	T3.5
	8 bits	8 bits	N x 8 bits	16 bits	

Figure 3-1: RTU Message frame format

Description of the message fields:

- The ***T3.5*** field represents the time-out limit (3½ character times) that provides frame synchronization.
- The ***Address*** field immediately follows the beginning of the frame and consists of 8 bits (1byte). These bits indicate the user assigned address of the slave device that is to receive the message sent by the attached master. Each slave will respond to a query that contains its address. When the slave sends a response, the slave address informs the master which slave is communicating. Valid addresses range from 1 to 247. Broadcast messages – which have address 0 – are not supported by Elster ultrasonic flow meters.
- The ***Function*** code field tells the addressed device which function to perform. As a standard, Elster Series 6 ultrasonic flow meters use only code 3. Herewith the current value of one or more registers is obtained.
- The high order bit in the function code field is set by the slave device to indicate abnormal responses being transmitted to the master device. ⇨ See Chapter 3.4 Exception Responses (p.11) for a description of exception responses. This bit remains 0 if the message is a query or a normal response message.
- The ***Data*** field contains information needed by the addressed device to perform the specific function or it contains data collected by the device in response to a query or limits. For example, the function code tells the slave to read a holding register and the data field is needed to indicate which register to start at and how many to read.
- The ***Checksum*** field consists of 16 bits (2 bytes) which contain the CRC-16 checksum of the message. This field allows the master and slave devices to check the message for errors in the transmission. Sometimes, because of electrical noise or other interference, a message may be changed slightly while it is on its way from one unit to another. The error checking assures that the slave or master does not react to messages that have changed during transmission. This increases the safety and the efficiency of the communication system.

3.4 Exception Responses

The high order bit of the function code field is set by the slave device to indicate that an abnormal response is being transmitted to the master device.

Operation errors are those involving illegal data in a message or difficulty in communicating. These errors result in an exception response. The exception response codes are listed in Table 2.

Code	Name	Meaning
01	Illegal Function	The message function received is not an allowable action for the device
02	Illegal Data Address	The address referenced in the data field is not an allowable address for the device

Table 2: Supported Error Codes

When a slave device detects one of these errors, it sends a response message to the master consisting of a slave address, function code, error code and error check fields, see Figure 3-2.

T3.5	Address	Function	Exception	Checksum	T3.5
	8 bits	8 bits	8 bits	16 bits	

Figure 3-2: Exception response message frame format

3.5 Bits and Bytes

Bits and bytes are handled according to the following rules:

- Bits are numbered 0 through 7; bit 0 is the least significant bit (LSB), bit 7 is the most significant bit (MSB). The decimal value of bit N is 2N.
- The bits of a byte are transmitted in ascending order: LSbit first; MSbit last.

4 OSI Layer 6: The Presentation Layer

4.1 Introduction

The presentation layer is concerned with the representation (syntax) of the data during transfer between two correspondent application layer protocol entities.

The presentation layer maps the application layer's abstract data types to the link layer's data units (bytes).

4.2 Abstract Data Types

The presentation layer recognises the following abstract data types:

- ***Short Word***: Two bytes (16 bits) containing an integer number between 0 and 65535. Byte order: MSB first, LSB last.

- ***Long Word***: Four bytes (32 bits) containing an integer number between 0 and + 4294967295. Byte order: MSB first, LSB last.

Tip!

When using the alternative '16-bits list', the Long Word is limited to 16 bits and 2 addresses are used for one register. ⇨ Please see Chapter 7 - Alternative '16-bits' List (p.25).

- ***Float:*** Four bytes containing a floating point number (IEEE-754). Byte order: MSB first, LSB last. The bytes can be viewed as 32 contiguous bits, which can be divided into fields as per Figure 4-1.

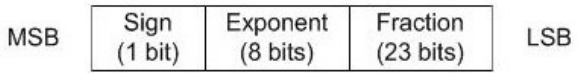

Figure 4-1: Abstract data type: Float

Where:

- ***Sign*** is a 1-bit field that contains the value **0** if the real value is positive; **1** if the real value is negative.
- ***Exponent*** is an 8-bit field that contains a value offset by 127; in other words, the actual exponent can be obtained from the exponent field by subtracting 127. An exponent field of all 0s or all 1s represents special cases. Otherwise, the real is called normalised.
- ***Fraction*** is a 23-bit field that contains the fractional part of the real value, represented in binary scientific notation. The most-significant digit of the fraction field is not actually represented, because by definition, this digit contains a value of 1 (unless the real number is 0 or denormalised).

Tip!

When using the alternative '16-bits list', the Float is limited to 16 bits and 2 addresses are used for one register. ⇨ Please see Chapter 7.3 Alternative '16-bits' Floating Point Registers (p.26).

- ***Double Float***: Eight bytes containing a floating point number (IEEE-754). Byte order: MSB first, LSB last. The bytes can be viewed as 64 contiguous bits, which can be divided into fields as per Figure 4-2:

W

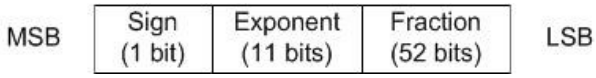

Figure 4-2: Abstract Data Type: Double

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- ***Sign*** is a 1-bit field that contains the value 0 if the real value is positive; 1 if the real value is negative.
- ***Exponent*** is an 11-bit field that contains a value offset by 127; in other words, the actual exponent can be

obtained from the exponent field by subtracting 127. An exponent field of all 0s or all 1s represents special cases. Otherwise, the real is called normalised.

- ***Fraction*** is a 52-bit field that contains the fractional part of the real value, represented in binary scientific notation. The most-significant digit of the fraction field is not actually represented, because by definition, this digit contains a value of 1 unless the real number is 0 or denormalised.

Tip!

When using the alternative '16-bits list', the Double Float is limited to 16 bits and 4 addresses are used for one register. ⇨ Please see Chapter 7.4 Alternative '16-bits' Double Float Registers (p.27)

5 OSI Layer 7: The Application Layer

5.1 Introduction

The application layer provides the user interface for data exchange with the ultrasonic flow meter.

5.2 Register Groups

The data types presented in Chapter 4 OSI Layer 6: The Presentation Layer (p.12) are assigned specific address ranges:

- **Short word** registers: n000… n199
- **Long word** registers: n200… n399
- **Floating point word** registers: n400… n599
- **Double float** registers: n600… n699 (only for the alternative 16-bits list, ⇨ See Chapter 7 - Alternative '16-bits' List (p.25)

Where n = 0 or 1;
higher values for n are available upon request, keeping in mind that the highest possible register is 65535.

5.2.1 Short Word Registers

Table 3 below lists the short word registers implemented in the Series 6 ultrasonic flow meters.

Address	Measured value	Units	Meaning
n000	InstrumentType	-	Flow meter identification code*
n001	NumPaths	-	Number of acoustic paths*
n002	SequenceNum LO	-	Measurement interval sequence number: 'Low-order' bytes
n003	SequenceNum HO	-	Measurement interval sequence number: 'High-order' bytes
n004	SampleRate	-	Number of acquired samples (elementary measurements)
n005…n012	ValidSamples: L1…L8	-	Number of valid samples of path 1…8
n013…n028	AgcLevel: Trd L1A….L8B	-	Gain required on the received pulses for proper measurement. Transducers: 1A, 1B, 2A, 2B,…, 8A, 8B
n029…n044	SNR: Trd L1A…L8B	-	Signal Noise Ratio (in dB) of transducer: 1A, 1B, 2A, 2B,…, 8A, 8B
Table continued on next page…			

* see Table 4

<table>
<tr><th>Address</th><th>Measured value</th><th>Units</th><th>Meaning</th></tr>
<tr><td>n045</td><td>OperationalStatus</td><td>-</td><td>Operational Status of the Flow Meter:
<table><tr><th>Hex Value (Dec value)</th><th>Description</th></tr><tr><td>0x000 (0)</td><td>OK: Measurement data is reliable</td></tr><tr><td>0x001 (1)</td><td>Reduced Accuracy</td></tr><tr><td>0x002 (2)</td><td>Error – Non Fiscal: Specific paths in error resulting in non-fiscal measurement</td></tr><tr><td>0x004 (4)</td><td>Error – No Measurement: All paths in error</td></tr><tr><td>0x008 (8)</td><td>Error – Non fiscal high swirl: Potential accuracy issue due to high swirl & high velocity</td></tr><tr><td>0x010 (16)</td><td>Security: Security switch is open</td></tr></table></td></tr>
<tr><td>n046</td><td>Status2 (C/R-status)</td><td>-</td><td>(reserved for future use: Operational status of the optional inputs)</td></tr>
<tr><td>n047…n199</td><td>Undefined</td><td>-</td><td>Undefined registers always return zero ()</td></tr>
</table>

Table 3: Short Word Registers

The meter identification code with the corresponding number of paths are registered in Table 4:

Meter Name	Meter Identification Code	Number of Paths
CheckSonic Series 6	61	1
CheckSonic-2 Series 6	62	2
Q.Sonic-3 Series 6	63	3
Q.Sonic^{atom}	64	4
Q.Sonic-5 Series 6	65	5
Q.Sonic^{plus}	66	6
Q.Sonic^{max}	68	8
CheckSonic^{vx} 6P	70	6
CheckSonic^{vx} 3P	71	3

Table 4: Meter Identification

5.2.2 Long Word Registers

Table 5 lists the long word registers implemented in the Series 6 ultrasonic flow meters.

Address	Measured Value	Units	Meaning
n200…n207	Diabits: L1…L8	-	Reserved for diagnostic information of path 1…8*
n208	ForwardVolume	m^3	Accumulated actual volume 'forward': 8-digit counter
n209	ReverseVolume	m^3	Accumulated actual volume 'reverse': 8-digit counter
n210	ForwardAlarmVolume	m^3	Accumulated actual error volume 'forward': 8-digit counter
n211	ReverseAlarmVolume	m^3	Accumulated actual error volume 'reverse': 8-digit counter
n212	*Checksum1*	-	*Program (=firmware ROM) checksum*
n213	*Checksum2*	-	*Parameter set-up checksum*
n214…n399	Undefined	-	Undefined registers always return zero (0)

* see Table 6

Table 5: Long Word Registers

The Diagnostic bits (Diagbits) are reserved diagnostic information of each path. Detailed description can be found in Table 6:

Hex Value	Dec value	Short Description	Meaning
0x000	0	No error	No Error
0x001	1	No_Pulse_A	TA: received signal stat under threshold (signal too small)
0x002	2	Pulse_Clip_A	TA: crossing clip threshold (signal too big)
0x004	4	Criterion_A	TA: pulse ratios error
0x008	8	SNR_A	TA: Signal to Noise ratio too low
0x010	16	No_Pulse_B	TB: received signal stat under threshold (signal too small)
0x020	32	Pulse_Clip_B	TB: crossing clip threshold (signal too big)
0x040	64	Criterion_B	TB: pulse ratios error
0x080	128	SNR_B	TB: Signal to Noise ratio too low
0x100	256	VoS_range	Velocity of Sound out of range
0x200	512	VoG_range	Velocity of Gas out of range
0x400	1024	Ping_reject	Acceleration Error
0x800	2048	Performance_Low	Performance too low
0x1000	4096	Path Substitution	A per-path gas velocity value was calculated by substitution

Table continued on next page…

Hex Value	Dec value	Short Description	Meaning
0x2000	8192	WGF_VoS	VoS ratio or VoS standard deviation out of range
0x4000	16384	WGF_VoG	VoG ratio out of range
0x8000	32768	Std_dev_hi_A	TA: standard deviation exceeds threshold
0x10000	65636	Std_dev_hi_B	TB: standard deviation exceeds threshold
0x20000	131072	DSP_Error	Error (or inconsistency) in internal (DSP) parameters
0x40000	262144	Tracking Active	Seeking signal

Table 6: Diagnostic Bits

5.2.3 Floating Point Registers

Table 7 lists the floating point registers implemented in the Series 6 UFM:

Address	Measured value	Units	Meaning
n400	Speed of Sound	m/s	Speed of Sound (N-path average)
n401	Velocity of Gas	m/s	Velocity of Gas (N-path average)
n402	*Pressure*	*kPa*	*Absolute pressure / Reserved for future use*
n403	*Temperature*	*K*	*Absolute temperature / Reserved for future use*
n404	QLine	m^3/h	Volume flow at line conditions (= actual flow)
n405	*QBase*	*Nm^3/h*	*Volume flow at base/reference conditions (= corrected volume flow) / Reserved for future use*
n406…n413	Cpp: L1…L8	m/s	Speed of Sound per acoustic path (L1…L8)
n414…n421	Vpp: L1…L8	m/s	Velocity of Gas per acoustic path (L1…L8)
n422	*Tspare*	-	*Reserved for future use*
n423	Swirl Angle	Degrees	Swirl angle estimation from the swirl paths
n424	*Meter Factor*	*Pulse/ m^3/h*	*Meter factor / Reserved for future use*
n425…n599	Undefined	-	Undefined registers always return zero (0)

Table 7: Floating Point Register

6 Examples

Example 1

Read long word register #200 (SequenceNum) from device #1. The query and response data streams are shown below.

Query:

T3.5	Address	Function	Start Reg	# of Regs	Check sum	T3.5
	01	03	00 C8	00 01	05 F4	

Response:

T3.5	Address	Function	Byte Count	Register Contents	Check sum	T3.5
	01	03	04	00 00 04 07	B9 31	

Note(s):

Query and response data are shown as hexadecimal values
Returned register value: SequenceNum = 1031 (hex: 00 00 04 07)

Example 2

Read short word registers #4 through #7 (SampleRate, ValidSamples (L1), ValidSamples(L2), ValidSamples (L3)) from device #1. The query and response data streams are shown below.

Query:

T3.5	Address	Function	Start Reg	# of Regs	Check sum	T3.5
	01	03	00 04	00 04	05 C8	

Response:

T3.5	Address	Function	Byte Count	Register Contents	Check sum	T3.5
	01	03	08	00 0F 00 0E 00 0D 00 0C	92 D0	

Note(s):

- Query and response data are shown as hexadecimal values.
- Returned register values:
    - SampleRate = 15 (hex: 00 0F)
    - ValidSamples (L1)= 14 (hex: 00 0E)
    - ValidSamples (L2)= 13 (hex: 00 0D)
    - ValidSamples (L3)= 12 (hex: 00 0C)

Example 3

Read floating-point register #400 (Speed of Sound) from device #16. The query and response data streams are shown below.

Query:

T3.5	Address	Function	Start Reg	# of Regs	Check sum	T3.5
	16	03	01 90	00 01	86 FC	

Response:

T3.5	Address	Function	Byte Count	Register Contents	Check sum	T3.5
	16	03	04	43 D2 C0 00	78 8F	

Note(s):

- Query and response data are shown as hexadecimal values.
- Returned register values: SpeedOfSound = 421.5 (hex: 43 D2 C0 00)

7 Alternative ‘16-bits’ List

7.1 Alternative ‘16-bits’ Short Word Registers

Please see Table 3 (Short Word Registers). The alternative ’16-bits’ short word list is the same as the standard ModBus.

7.2 Alternative ‘16-bits’ Long Word Registers

Table 8 lists the Long word registers for the alternative ‘16-bits’ list. Each register uses 2 addresses.

Address	Measured Value	Units	Meaning
n200…n215	Diabits: L1…L8	-	Reserved for diagnostic information of path 1…8*
n216	ForwardVolume	m^3	Accumulated actual volume ‘forward’: 8-digit counter
n218	ReverseVolume	m^3	Accumulated actual volume ‘reverse’: 8-digit counter
n220	ForwardAlarmVolume	m^3	Accumulated actual error volume ‘forward’: 8-digit counter
n222	ReverseAlarmVolume	m^3	Accumulated actual error volume ‘reverse’: 8-digit counter
n224	*Checksum1*	-	*Program (=firmware ROM) checksum*
n226	*Checksum2*	-	*Parameter set-up checksum*
n228…n399	Undefined	-	Undefined registers always return zero (0)

* See Table 6 *Reserved for future use*

Table 8: Long Word Registers, alternative 16-bits list

7.3 Alternative ‘16-bits’ Floating Point Registers

Table 9 lists the floating point registers for the alternative ’16-bits’ list. Each register uses two addresses.

Address	Measured value	Units	Meaning
n400	Speed of Sound	m/s	Speed of Sound (N-path average)
n402	Velocity of Gas	m/s	Velocity of Gas (N-path average)
n404	*Pressure*	*kPa*	*Absolute pressure / Reserved for future use*
n406	*Temperature*	*K*	*Absolute temperature / Reserved for future use*
n408	QLine	m^3/h	Volume flow at line conditions (= actual flow)
n410	*QBase*	*Nm^3/h*	*Volume flow at base/reference conditions (= corrected volume flow) / Reserved for future use*
n412…n426	Cpp: L1…L8	m/s	Speed of Sound per acoustic path (L1…L8)
n428…n442	Vpp: L1…L8	m/s	Velocity of Gas per acoustic path (L1…L8)
n444	*Tspare*	-	*Reserved for future use*
n446	Swirl Angle	Degrees	Swirl angle estimation from the swirl paths
n448	*Meter Factor*	*Pulse/ m^3/h*	*Meter factor*
n450…n599	Undefined	-	Undefined registers always return zero (0)

Table 9: Floating Point Register, alternative 16-bits list

7.4 Alternative ‘16-bits’ Double Float Registers

Table 10 lists the double float registers for the alternative ‘16-bits‘ list. Each register uses 4 addresses.

Address	Measured value	Units	Meaning
n600… n628	Transit time A to B: L1 … L8	s	The pulse transit time per acoustic path from transducer A to transducer B
n632… n660	Std Dev: Transit time A to B: L1 … L8	s	The standard deviation of the pulse transit time per acoustic path from transducer A to transducer B
n664… n692	Transit time B to A: L1 … L8	s	The pulse transit time per acoustic path from transducer B to transducer A
n696… n724	Std Dev: Transit time B to A: L1 … L8	s	The standard deviation of the pulse transit time per acoustic path from transducer B to transducer A
n728…n799	Undefined	-	Undefined registers always return zero (0)

Table 10: Double Float Registers, alternative 16-bits list

8 Index

Appendix I – References

All references listed below can be obtained from Elster. Additionally, most references are available online at: http://www.docuthek.com/.

[1] UFM Series 6 Q.Sonic^{plus} Operation and Maintenance Manual
SAP Ref.: 73023467
Doc. No.: 10000050188 (last valid revision)

[2] UFM Series 6 CheckSonic Operation and Maintenance Manual
SAP Ref.: 73023471
Doc. No.: 10000050192 (last valid revision)

[3] UFM Series 6 Q.Sonic^{max} Operation and Maintenance Manual
SAP Ref.: 73023477
Doc. No.: 10000051506 (last valid revision)

[4] UFM Series 6 Wiring Instructions
SAP Ref.: 73023470
Doc. No.: 10000050191 (last valid revision)

[5] UFM Series 6 Shipping and Storage Manual
SAP Ref.: 73023469
Doc. No.: 10000050190 (last valid revision)

[6] UFM Series 6 Safety Instructions
SAP Ref.: 73023465
Doc. No.: 10000050186 (last valid revision)

[7] UFM Series 6 Modbus Protocol
SAP Ref.: 73023466
Doc. No.: 10000050187 (last valid revision)

[8] UFM Series 6 Transducer Exchange at Atmospheric Conditions
SAP Ref.: 73023472
Doc. No.: 03.200.001.001/02/2 (last valid revision)

[9] Retraction Tool NG Transducers
SAP Ref.: 73023473
Doc. No.: 03.203.101.001.02/2 (last valid revision)

[10] UFM Series 6 Exchanging PCB boards in TIP
SAP Ref.: 73023474
Doc. No.: 03.303.101.000.02/2 (last valid revision)

[11] UFM Series 6 Exchanging Boards at the Rear Compartment of the SPU
SAP Ref.: 73023475
Doc. No.: 03.302.101.000.02/2 (last valid revision)

[12] External VDSL Range Extender User Manual
SAP Ref.: 73023483
Doc. No.: 10000050357 (last valid revision)

[13] UFM Series 6 SonicExplorer Software Application Manual
SAP Ref.: 73023308
Doc. No.: 10000050563 (last valid revision)