HART® Field Device Specification:

Kurz Instruments, Inc. MFT B-Series

Document 360209-AQ, rev. A

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1. INTRODUCTION

1.1 Scope

This document describes the function, performance, and operating procedures for the Kurz Instruments, Inc. Model MFT B-Series with HART protocol. The HART version uses the same mass flow measurement methodology as the MFT B-Series; therefore, this manual describes only the functions unique to the HART communication interface. The Kurz Instruments, Inc. Thermal Mass Flow Transmitter, Model MFT B-Series complies with HART Protocol Revision 7.0.

This document specifies all the device specific features and documents HART Protocol implementation details (e.g., the Engineering Unit Codes supported). The functionality of this Field Device is described sufficiently to allow its proper application in a process and its complete support in HART capable Host Applications.

1.2 Purpose

This specification is designed to compliment other documentation (e.g., the *MFT B-Series Installation Manual*) by providing a complete, unambiguous description of this Field Device from a HART Communication perspective

1.3 Who should use this document?

The specification is designed to be a technical reference for HART capable Host Application Developers, System Integrators and knowledgeable End Users. It also provides functional specifications (e.g., commands, enumerations and performance requirements) used during Field Device development, maintenance and testing. This document assumes the reader is familiar with HART Protocol requirements and terminology.

1.4 Abbreviations and definitions

ADC	Analog to Digital Converter
CPU	Central Processing Unit (of microprocessor)
DAC	Digital to Analog Converter
EEPROM	Electrically-Erasable Read-Only Memory

1.5 References

HART Smart Communications Protocol Specification. HCF_SPEC-12. Available from the HCF.

MFT-B Installation Manual, Document 360209-A. Available from Kurz Instruments, Inc.

2. DEVICE IDENTIFICATION

Manufacturer Name:	Kurz Instruments, Inc.	**Model Name(s):**	MFT B-Series: 454FTB, 504FTB, 534FTB, KBAR 2000B
Manufacture ID Code:	24623 (0x602F)	**Device Type Code:**	57559 (0xE0D7)
HART Protocol Revision	7.0	**Device Revision:**	1
Number of Device Variables	6		
Physical Layers Supported	FSK		
Physical Device Category	Transmitter, Non-DC-isolated Bus Device		

3. PRODUCT OVERVIEW

The MFT B-Series Mass Flow Transmitter (MFTB) is an insertion or inline flow transmitter that uses thermal convection to measure mass flow.

The MFT B-Series comes standard with one 4 to 20mA output channel. Additional options that can be purchased on the Flow Transmitters are two solid state relay outputs, two digital inputs, and one 4-20mA input.

4. PRODUCT INTERFACES

4.1 Process Interface

4.1.1 Sensor Input Channels

The MFT B-Series can be optionally configured with one 4-20mA input and/or up to two digital inputs. Details about these optional input channels and their functions can be found in the MFT B-Series User Guides.

4.2 Host interface

4.2.1 Analog Output Channel

A two-wire optically isolated 4-20 mA current loop is connected on two terminals marked "AO1+" and "AO1-". Refer to the Installation Manual for connection details. HART Communication is supported on this loop.

This is the only analog output on the MFT B-Series, HART flow transmitter. This analog output can be configured to output the measured process Flow Rate , Average Velocity or Temperature. The process Flow and Velocity are linearized and scaled according to a configured range that can be entered through the HART interface. This output can be configured to correspond to the Primary Variable.

Device malfunction can be indicated by down-scale or up-scale current (NAMUR NE 43 compliant). The direction is selectable by the user as LOW OUTPUT or HIGH OUTPUT. This setting is not configurable through the HART interface but can be configured using the meter's local keypad. Refer to the MFTB User Guide for details. Current values are shown in the table below.

	Direction	Values (mA)
Device malfunction indication	Down: less than	3.6
	Up: greater than	21.0

4.2.2 Discrete Outputs

The MFT B-Series can be configured with up to two optically isolated solid state relays. DO1 can be configured to energize when any alarm or fault event occurs. If the Air Purge Sensor Cleaning System is installed, DO2 is used to energize a solenoid valve for periodic or on-demand cleaning of the sensor. The Air Purge Sensor Cleaning can be setup and controlled through the HART interface.

4.3 Local Interfaces, Jumpers And Switches

4.3.1 Local Controls And Displays

The MFT B-Series has a local 2x16 LCD display and 20-key keypad. This allows the user to view/change parameters that are not accessible through the HART interface. Refer to the MFTB User Guide for details regarding the onboard menu system.

5. DEVICE VARIABLES

The following Table lists the MFTB Device Variables available through the HART interface.

Device Variable Number	Name	Description	Units	HART Class Code
0, 246	PV	Primary Variable (Usually Flow Rate)	SCFM, SCFH, PPM, PPH, SLPM, SCMH, KGM, KGH, SFPM, SMPS	72

1, 247	SV	Secondary Variable (usually Average Velocity)	SCFM, SCFH, PPM, PPH, SLPM, SCMH, KGM, KGH, SFPM, SMPS	67
2, 248	TV	Process Temperature	degF, degC	64
3, 249	QV	Totalized Flow Rate	Cubic Ft, Pounds, Liters, Cubic Meter, Kilograms, Feet, Meter	71
244	Percent Range	Output % FS	None	72
245	Loop Current	Analog Out mA	mA	72

6. DYNAMIC VARIABLES

The following Table lists the Dynamic Variables that are implemented.

	Description	Units
PV	Flow Rate or Average Velocity	SCFM, SCFH, PPM, PPH, SLPM, SCMH, KGM, KGH, SFPM, SMPS
SV	Flow Rate or Average Velocity	SCFM, SCFH, PPM, PPH, SLPM, SCMH, KGM, KGH, SFPM, SMPS
TV	Temperature of the process gas	degC, degF
QV	Totalized Flow	Cubic Ft, Pounds, Liters, Cubic Meter, Kilograms, Feet, Meter

PV is mapped to either Flow Rate or Average Velocity depending on the selection of PV units. SV is mapped to Flow Rate or Average Velocity depending on which value is mapped to PV (ie if PV is mapped to Flow Rate, SV will be mapped to Average Velocity; if PV is mapped to Average Velocity, SV will be mapped to Flow Rate).

7. STATUS INFORMATION

7.1 Device Status

The Field Device Status byte that is contained in the second data byte of the device's response to any HART command provides the following bit definitions for the current operating status of the MFT B-Series Flow Transmitter.

Bit Mask	Definition	Conditions to set bit
0x80 (bit 7)	Device Malfunction	Any FaultIndex bit except bits 7, 28-31
0x40 (bit 6)	Configuration Changed	Any parameter change
0x20 (bit 5)	Cold Start	Whenever a power cycle/reboot occurs on the MFTB
0x10 (bit 4)	More Status Available	Set when any bits in the following status bytes are set: Device Specific Status 0 Device Specific Status 1 Device Specific Status 2 Device Specific Status 3 Device Specific Status 4 Device Specific Status 5 Extended Device Status Standardized Status 0
0x08 (bit 3)	Loop Current Fixed	OperationStatus bit 1, Device Specific Status 5, bits 0, 1, 2, 3, 4
0x04 (bit 2)	Loop Current Saturated	OperationStatus bit 3
0x02 (bit 1)	Non-Primary Variable Out of Limits	FaultIndex bits 0-16
0x01 (bit 0)	Primary Variable Out of Limits	FaultIndex bit 7

When the Bit #4 "More Status Available" or Bit #7 "Device Malfunction" bits are set, the HOST should send Command 48 – Read Additional Device Status to determine the exact nature of the status indication (See Section 7.3)

See Section 11 for bitwise definition of MFTB FaultIndex and OperationStatus.

7.2 Extended Device Status

The Extended Device Status byte contained in byte 6 of command 48 Response Data Byte contains the following bitwise status information:

Bit Mask	Definition	Conditions to set bit
0x80 (bit 7)	Undefined	NA
0x40 (bit 6)	Undefined	NA
0x20 (bit 5)	Undefined	NA
0x10 (bit 4)	Undefined	NA
0x08 (bit 3)	Undefined	NA
0x04 (bit 2)	Critical Power Failure	Not Used by MFTB
0x02 (bit 1)	Device Variable Alert	FaultIndex bits 7, 28-31
0x01 (bit 0)	Maintenance Required	Any FaultIndex bit excluding bits 7, 28-31

7.3 Additional Device Status (Command #48)

Command #48 returns 9 bytes of additional device status data for the field device. This command should be sent whenever Bit #4 (More Status Available) or Bit #7 (Device Malfunction) is set in the Device Status byte to determine the exact nature of the alert, warning, alarm, or malfunction.

The following bitwise status indications are provided in the Additional Device Status response:

Byte	Bit	Meaning
Byte 0 Device Specific Status 0 MFTB FaultIndex Byte 0	0	RP resistance above high limit
	1	RP resistance below low limit
	2	RTC resistance above high limit
	3	RTC resistance below low limit
	4	Wire Resistance above high limit
	5	Sensor RPS lead open circuit
	6	High sensor or wire leakage current. S-GND below 100K ohms
	7	Flow rate above design limit
Byte 1 Device Specific Status 1 MFTB FaultIndex Byte 1	0-1	Undefined
	2	ADC failed to convert data
	3	Sensor control stop responding
	4	Sensor control crowbar engaged
	5	Sensor type does not match config
	6	Abnormal sensor node voltages
	7	Unable to write new config file
Byte 2 Device Specific Status 2 MFTB FaultIndex Byte 2	0	Sensor type does not match board
	1-7	Undefined
Byte 3 Device Specific Status 3 MFTB FaultIndex Byte 3	0-3	Undefined
	4	HART Warning: Subsystem Fail
	5	Sensor leak warning S-GND below 100K ohms
	6	Power was applied (momentary)
	7	Change made to configuration (momentary)
Byte 4 Device Specific Status 4	0	Device in Diagnostic Mode MFTB SensorTestFlag is set
	1	Fixed current output
	2	Fault Event in MFTB – ie any bit in FaultIndex is set except POWER_ON and CONFIG_CHANGE
	3	Analog output is saturated

	4	MFTB Alarm 1
	5	MFTB Alarm 2
	6-7	Undefined
Byte 5 Device Specific Status 5	0	Zero Drift Test in progress
	1	Mid-span Drift Test in progress
	2	Full-span Drift Test in progress
	3	Drift Check Cycle All Tests
	4	Purge Start Flag
	5-7	Undefined
Byte 6 Extended Device Status See Section 7.2	0	Maintenance Required
	1	Device Variable Alert
	2-7	Undefined
Byte 7 Device Operating Mode	NOT USED by MFTB	Undefined
Byte 8 Standardized Status 0	NOT USED by MFTB	Undefined

"Undefined" bits are always set to 0.

The bits in the FaultIndex are set or cleared by the self-test executed at power up, or following a reset or self-test command. They are also set by any error/failure detected during continuous self-testing while the flow meter is operational.

8. UNIVERSAL COMMANDS

All Universal Commands are implemented as specified in the HART Universal Command Specification – HCF_SPEC-127, including Command 38 – Reset Configuration Changed Flag and Command 48 – Read Additional Device Status.

Command #3 – Read Dynamic Variables and Loop Current, returns PV, SV, TV (Temperature), QV (Totalized Flow) for a total of 24 bytes of response data.

Command #9 – Read Device Variables with Status; the following Device Variable Codes are applicable – 00=PV, 01=SV, 02=TV, 03=QV.

9. COMMON-PRACTICE COMMANDS

9.1 Supported Commands

The following common-practice commands are implemented:

34 Write PV Damping Value

35 Write PV Range Values

36 Set PV Upper Range Value

37 Set PV Lower Range Value

40 Enter/Exit Fixed Current Mode

41 Perform Device Self-Test

42 Perform Master Reset

44 Write PV Units

45 Trim AO1 DAC Zero

46 Trim AO1 DAC Span

9.2 Burst Mode

This Field Device does not support Burst Mode.

9.3 Catch Device Variable

This Field Device does not support Catch Device Variable.

10. DEVICE-SPECIFIC COMMANDS

The following device-specific commands are implemented:

128 Read Correction Factor Data

129 Write Correction Factor Data

130 Read Current Correction Factor

131 Read Flow Area

132 Write Flow Area

133 Read Last Cal Date

137 Read Purge Parameters

138 Write Purge Parameters

139 Start Purge Cycle

140 Read Zero-Mid-Span Drift Check Parameters

141 Write Zero-Mid-Span Drift Check Parameters

142 Read Zero-Mid-Span Drift Check Results

143 Start Zero-Mid-Span Drift Check Test

144 Read Diagnostic Data

145 Reset Totalizer

146 Read Standard Conditions

147 Write Standard Conditions

10.1 Command 128: Read Correction Factor Data

Reads the Field Calibration Correction Factor and the 8 set(s) of Variable Correction Factors (VCF) from the device. The VCF are data pairs that define a Reference Flow (or Velocity) and the Observed/Actual Flow (or Velocity). The number of valid VCF pairs - NCorrPts is included in the response data. This value defines the number of VCF sets that are currently used in the process data calculations.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	Correction Factor Unit Code (see Section 11.1)
1-4	Float	Field Calibration Correction Factor
5	Unsigned-8	Number of Variable Correction Factor Data Sets (configured for use)
6-9	Float	Data Point 1 - Reference Flow (or Velocity)
10-13	Float	Data Point 1 – Observed Flow (or Velocity)
14-17	Float	Data Point 2 – Reference Flow (or Velocity)
18-21	Float	Data Point 2 – Observed Flow (or Velocity)
22-25	Float	Data Point 3 – Reference Flow (or Velocity)
26-29	Float	Data Point 3 – Observed Flow (or Velocity)
30-33	Float	Data Point 4 – Reference Flow (or Velocity)
34-37	Float	Data Point 4 – Observed Flow (or Velocity)
38-41	Float	Data Point 5 – Reference Flow (or Velocity)
42-45	Float	Data Point 5 – Observed Flow (or Velocity)
46-49	Float	Data Point 6 – Reference Flow (or Velocity)
50-53	Float	Data Point 6 – Observed Flow (or Velocity)
54-57	Float	Data Point 7 – Reference Flow (or Velocity)
58-61	Float	Data Point 7 – Observed Flow (or Velocity)
62-65	Float	Data Point 8 – Reference Flow (or Velocity)
66-69	Float	Data Point 8 – Observed Flow (or Velocity)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors

10.2 Command 129: Write Correction Factor Data

Writes the Field Calibration Correction Factor and the 8 set(s) of Variable Correction Factors (VCF) from the device.

Request Data Bytes

Byte	Format	Description
0	Enum	Correction Factor Unit Code (see Section 11.1)
1-4	Float	Field Calibration Correction Factor
5	Unsigned-8	Number of Variable Correction Factor Data Sets (configured for use)
6-9	Float	Data Point 1 - Reference Flow (or Velocity)
10-13	Float	Data Point 1 – Observed Flow (or Velocity)
14-17	Float	Data Point 2 – Reference Flow (or Velocity)
18-21	Float	Data Point 2 – Observed Flow (or Velocity)
22-25	Float	Data Point 3 – Reference Flow (or Velocity)
26-29	Float	Data Point 3 – Observed Flow (or Velocity)
30-33	Float	Data Point 4 – Reference Flow (or Velocity)
34-37	Float	Data Point 4 – Observed Flow (or Velocity)
38-41	Float	Data Point 5 – Reference Flow (or Velocity)
42-45	Float	Data Point 5 – Observed Flow (or Velocity)
46-49	Float	Data Point 6 – Reference Flow (or Velocity)
50-53	Float	Data Point 6 – Observed Flow (or Velocity)
54-57	Float	Data Point 7 – Reference Flow (or Velocity)
58-61	Float	Data Point 7 – Observed Flow (or Velocity)
62-65	Float	Data Point 8 – Reference Flow (or Velocity)
66-69	Float	Data Point 8 – Observed Flow (or Velocity)

Response Data Bytes

Byte	Format	Description
0	Enum	Correction Factor Unit Code (see Section 11.1)
1-4	Float	Field Calibration Correction Factor
5	Unsigned-8	Number of Variable Correction Factor Data Sets (configured for use)

6-9	Float	Data Point 1 - Reference Flow (or Velocity)
10-13	Float	Data Point 1 – Observed Flow (or Velocity)
14-17	Float	Data Point 2 – Reference Flow (or Velocity)
18-21	Float	Data Point 2 – Observed Flow (or Velocity)
22-25	Float	Data Point 3 – Reference Flow (or Velocity)
26-29	Float	Data Point 3 – Observed Flow (or Velocity)
30-33	Float	Data Point 4 – Reference Flow (or Velocity)
34-37	Float	Data Point 4 – Observed Flow (or Velocity)
38-41	Float	Data Point 5 – Reference Flow (or Velocity)
42-45	Float	Data Point 5 – Observed Flow (or Velocity)
46-49	Float	Data Point 6 – Reference Flow (or Velocity)
50-53	Float	Data Point 6 – Observed Flow (or Velocity)
54-57	Float	Data Point 7 – Reference Flow (or Velocity)
58-61	Float	Data Point 7 – Observed Flow (or Velocity)
62-65	Float	Data Point 8 – Reference Flow (or Velocity)
66-69	Float	Data Point 8 – Observed Flow (or Velocity)

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Parameter too large
4	Error	Parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-11		Undefined
12	Error	Invalid Units Code
13-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

10.3 Command 130: Read Current Correction Factor

Reads the Total Correction Factor from the device.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Float	Total Correction Factor

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors

10.4 Command 131: Read Flow Area

Read the Flow Area from the device.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Float	Flow Area
4	Enum	Flow Area Unit Code

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors

10.5 Command 132: Write Flow Area

Writes the Flow Area to the device.

Request Data Bytes

Byte	Format	Description
0-3	Float	Flow Area

Response Data Bytes

Byte	Format	Description
0-3	Float	Flow Area

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Parameter too large
4	Error	Parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-11		Undefined
12	Error	Invalid Units Code
13-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

10.6 Command 133: Read Last Cal Date

Reads the Last Calibration Date from the device. The device returns the Last Calibration Date as a date string in the form MM-DD-YYYY.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-17	Latin-1	Last Calibration Date

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors

10.7 Command 137: Read Purge Parameters

Reads the Purge Parameters from the device. The Purge parameters include the Purge Timer, Purge Assigned DO, Purge Width, Purge Hold Time, Purge Interval.

The Purge Timer sets the automatic purge feature ON or OFF. The state of the purge timer does not affect the ability to initiate a purge cycle using device specific command #139.

The Purge Assigned Digital Output (DO) is a fixed assignment and cannot be changed. It is always setup as DO2. The data is for informational purposes only.

The Purge Width is the time in milliseconds that the device will hold the purge solenoid open when a purge cycle is initiated.

The Purge Hold Time is the time to allow the sensor to recover following a purge. The Purge Hold Time entered is the total time for the entire purge cycle (e.g., a Hold Time of 2000 milliseconds with a Purge Time of 500 milliseconds means that the Purge Relay will be pulsed for 500 milliseconds, followed by an additional 1500 milliseconds of idle time to allow for sensor recovery).

The Purge Interval is used to set the frequency in minutes of the purge cycle when the Purge Timer is set to ON.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Purge Timer – 0 = OFF, 1 = ON
1	Unsigned-8	Assigned Digital Output for the Air Purge Sensor Cleaning System
2-3	Unsigned-16	Purge Width
4-5	Unsigned-16	Purge Hold Time
6-7	Unsigned-32	Purge Interval

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors

10.8 Command 138: Write Purge Parameters

Writes the Purge Parameters to the device. The Purge parameters include the Purge Switch, Purge Assigned DO, Purge Width, Purge Hold Time, Purge Interval. See Section 10.7 – Command 137 for parameter descriptions.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Purge Timer – 0 = OFF, 1 = ON
1	Unsigned-8	Assigned Digital Output for the Air Purge Sensor Cleaning System
2-3	Unsigned-16	Purge Width
4-5	Unsigned-16	Purge Hold Time
6-9	Unsigned-32	Purge Interval

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Purge Timer – 0 = OFF, 1 = ON
1	Unsigned-8	Assigned Digital Output for the Air Purge Sensor Cleaning System
2-3	Unsigned-16	Purge Width
4-5	Unsigned-16	Purge Hold Time
6-9	Unsigned-32	Purge Interval

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Parameter too large
4	Error	Parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-11		Undefined
12	Error	Invalid Units Code
13-15		Undefined
16	Error	Access Restricted

Code	Class	Description
17-31		Undefined
32	Error	Busy
33-127		Undefined

10.9 Command 139: Start Purge Cycle

Sends a request to the device to start a Purge Cycle. The device must be configured with the Air Purge Cleaning System and digital output #2 (DO2) must be assigned to this function.

NOTE: The device does not check if the Purge is configured when this command is received; it will always respond with success even if the Purge is not configured.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
None		

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors

10.10 Command 140: Read Zero-Mid-Span Drift Check Parameters

Reads the Zero-Mid-Span Drift Check parameters from the device. The Drift Check parameters include the ON/OFF status of the Auto Drift Check, the Time Interval of the Auto Drift Check, and for each of the Drift Check Tests the % of FS drive voltage and test duration.

The Auto Drift Check Timer configures the internal timer in the device to initiate the Drift Check Tests at a specified interval when it is set to ON. The Drift Check Timer has no effect on triggering the Drift Check Tests using device specific command #143 (ie the user can initiate a Drift Check Test using command #143 if the Drift Check Timer is OFF).

The Drift Check Time Interval defines the periodic interval, in hours that the Drift Check Tests will be initiated by the internal timer.

The % of FS drive voltage and test duration defines the amplitude of the output signal and duration that the output signal is applied for each Drift Check Test. The amplitude is given as a % of full scale of the independent voltage source which is 3.3V. For example, if 10.0% is entered for the % of FS for the Zero Drift Check Test, then 0.33V (10% of 3.3V) will be applied to the 4-20mA output for the Drift Check at Zero.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Auto Drift Check ON/OFF – 0=OFF, 1=ON
1-2	Unsigned-16	Auto Drift Check Time Interval
3-6	Float	Zero Drift Check % Full Scale
7-8	Unsigned-16	Zero Drift Check Duration
9-12	Float	Mid Drift Check % Full Scale
13-14	Unsigned-16	Mid Drift Check Duration
15-18	Float	Span Drift Check Full Scale
19-20	Unsigned-16	Span Drift Check Duration

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors

10.11 Command 141: Write Zero-Mid-Span Drift Check Parameters

Writes the Zero-Mid-Span Drift Check parameters from the device. The Drift Check parameters include the ON/OFF status of the Auto Drift Check, the Time Interval of the Auto Drift Check, and for each of the Drift Check Tests the % of FS drive voltage and test duration. See Section 10.10 for detailed description of the Drift Check Parameters.

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Auto Drift Check ON/OFF – 0=OFF, 1=ON
1-2	Unsigned-16	Auto Drift Check Time Interval
3-6	Float	Zero Drift Check % Full Scale
7-8	Unsigned-16	Zero Drift Check Duration
9-12	Float	Mid Drift Check % Full Scale
13-14	Unsigned-16	Mid Drift Check Duration
15-18	Float	Span Drift Check Full Scale
19-20	Unsigned-16	Span Drift Check Duration

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Auto Drift Check ON/OFF – 0=OFF, 1=ON
1-2	Unsigned-16	Auto Drift Check Time Interval
3-6	Float	Zero Drift Check % Full Scale
7-8	Unsigned-16	Zero Drift Check Duration
9-12	Float	Mid Drift Check % Full Scale
13-14	Unsigned-16	Mid Drift Check Duration
15-18	Float	Span Drift Check Full Scale
19-20	Unsigned-16	Span Drift Check Duration

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Parameter too large
4	Error	Parameter too small
5	Error	Too few data bytes received

Code	Class	Description
6		Undefined
7	Error	In Write Protect Mode
8-11		Undefined
12	Error	Invalid Units Code
13-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

10.12 Command 142: Read Zero-Mid-Span Drift Check Results

Reads the Zero-Mid-Span Drift Check results of the last Drift Check Test run. The Drift Check Results include the VCal Input and the corresponding output of the ADC during the Drift Check Test as well as the % Difference between these two values.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Float	VCal Input used for the Zero Drift Check Test
4-7	Float	VCal Output for the Zero Drift Check Test
8-11	Float	Percent Difference between VCal In and VCal Out for the Zero Drift Check Test
12-15	Float	VCal Input used for the MidSpan Drift Check Test
16-19	Float	VCal Output for the MidSpan Drift Check Test
20-23	Float	Percent Difference between VCal In and VCal Out for the MidSpan Drift Check Test
24-27	Float	VCal Input used for the FullSpan Drift Check Test
28-31	Float	VCal Output for the FullSpan Drift Check Test
32-35	Float	Percent Difference between VCal In and VCal Out for the FullSpan Drift Check Test

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors

10.13 Command 143: Start Zero-Mid-Span Drift Check Test

Sends a command to start a Zero-Mid-Span Drift Check Test. The command includes a Drift Check Command Code specifier that defines which Drift Check Test to run. The valid values are:

0x01 – Zero Drift Check Test
0x02 – Mid-Span Drift Check Test
0x04 – Full-Span Drift Check Test
0x08 – Run All Drift Check Tests

Note: The device does not check if an invalid command code is sent

Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Drift Check Command Code

Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Drift Check Command Code

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors

10.14 Command 144: Read Diagnostic Data

Reads the Diagnostic Data from the device. The Diagnostic Data includes input voltages, sensor outputs, sensor control data.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0-3	Float	VPs
4-7	Float	VIph
8-11	Float	VRtch
12-15	Float	VRtcl
16-19	Float	VLeakSense
20-23	Float	VExtIn
24-27	Float	VTemp
28-31	Float	VCal
32-35	Float	Irp
36-39	Float	Prp
40-43	Float	Rp
44-47	Float	Rtc
48-51	Float	Resistance of the Sensor Wire
52-55	Float	Sensor Leakage Resistance
56-59	Float	Electronics Temperature
60-63	Unsigned-32	Device Run Time counter
64-67	Float	VLl

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors

10.15 Command 145: Reset Totalizer

Sends a command to the device to reset the Flow Totalizer Accumulator. The value of the Flow Totalizer is mapped to the QV dynamic variable.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
None		

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors

10.16 Command 146: Read Standard Conditions

Reads the Standard Temperature and Pressure parameters from the device.

Request Data Bytes

Byte	Format	Description
None		

Response Data Bytes

Byte	Format	Description
0	Enum	Standard Temperature Unit Code
1	Enum	Standard Pressure Unit Code
2-5	Float	Standard Temperature Value
6-9	Float	Standard Pressure Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors

10.17 Command 147: Write Standard Conditions

Writes the Standard Temperature and Pressure parameters to the device.

Request Data Bytes

Byte	Format	Description
0	Enum	Standard Temperature Unit Code
1	Enum	Standard Pressure Unit Code
2-5	Float	Standard Temperature Value
6-9	Float	Standard Pressure Value

Response Data Bytes

Byte	Format	Description
0	Enum	Standard Temperature Unit Code
1	Enum	Standard Pressure Unit Code
2-5	Float	Standard Temperature Value
6-9	Float	Standard Pressure Value

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-2		Undefined
3	Error	Parameter too large
4	Error	Parameter too small
5	Error	Too few data bytes received
6		Undefined
7	Error	In Write Protect Mode
8-11		Undefined
12	Error	Invalid Units Code
13-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

11. TABLES

11.1 MFTB FaultIndex bit definition

Bit	Definition
0	RP resistance above high limit
1	RP resistance below low limit
2	RTC resistance above high limit
3	RTC resistance below low limit
4	Wire Resistance above high limit
5	Sensor RPS lead open circuit
6	High sensor or wire leakage current. S-GND below 100k ohms
7	Flow rate above design limit
8	Undefined
9	Undefined
10	ADC failed to convert data
11	Sensor control stop responding
12	Sensor control crowbar engaged
13	Sensor type does not match config
14	Abnormal sensor node voltages
15	Unable to write new config file
16	Sensor type does not match board
17-27	Undefined
28	HART Warning: Subsystem Fail
29	Sensor leak warning S-GND below 100k ohms
30	Power was applied (momentary)
31	Change made to the configuration (momentary)

11.2 MFTB OperationStatus bit definition

Bit	Definition	Conditions to set bit
0 (0x01)	Device in diagnostic mode	SensorTestFlag is set
1 (0x02)	Device in current loop mode	HART.LoopCurrentMode & 0x80 || cHartCurrentControlFlag == 1
2 (0x04)	Device Fault	Any bit in FaultIndex is set except POWER_ON (Bit#30) or CONFIG_CHANGE (Bit #31)

3 (0x08)	4-20mA output is saturated	4-20mA signal is set to Low/High saturation value

12. PERFORMANCE

12.1 Sampling Rates

See MFT B-Series Brochure for sampling rate specs.

12.2 Power-Up

On power up, the MFT B-Series goes through a self-test procedure (see section 12.4), which takes approximately 2 seconds. Actual restart times can vary, the MFT B-Series Operation Manual provides details on the parameters that can affect the flow meter device restart/power up time. During this period, the device will not respond to HART commands, and the analog output is set at the NE-43 alarm (< 3.6 mA or > 21.0 mA) . When the self-test is satisfactorily completed, an additional delay of 20 seconds is required before a response to any HART command is guaranteed.

12.3 Reset

Command 42 ("Device Reset") causes the device to reset its microprocessor. The resulting restart is identical to the normal power up sequence. (See Section 12.2.)

12.4 Self-Test

The MFT B-Series does not support Command 41 – Self Test. The MFT B-Series performs periodic self tests as part of its normal operational task. Any errors or faults determined during the periodic self tests are recorded in the Device Specific Status bytes provided in the response to Command 48 ("Read Additional Device Status"). The self test procedure is also executed at power up, following Command 42 ("Device Reset"). For more details about the Built-in Diagnostic capabilities see the MFT B-Series User Manual.

12.5 Command Response Times

Minimum	20ms
Typical	50ms
Maximum	100ms

12.6 Busy and Delayed-Response

Delayed-response is not used.

12.7 Long Messages

The largest data field used is in the response to Command 128 – Read Correction Factor Data and Command 129 – Write Correction Factor Data. The number of bytes in the response data field for these commands is 70 bytes.

12.8 Non-Volatile Memory

EEPROM is used to hold the device's configuration parameters. New data is written to this memory immediately on execution of a write command.

12.9 Modes

Fixed current mode is implemented, using Command 40. This mode is cleared by power loss or reset.

12.10 Write Protection

The device does not have a write-protection function.

12.11 Damping

Damping is standard, affecting only the PV and the loop current signal.

ANNEX A. CAPABILITY CHECKLIST

Manufacturer, model and revision	Kurz Instruments Inc., MFT B-Series 2.0, rev. 1
Device type	Flow Transmitter
HART revision	7.0
Device Description available	Yes
Number and type of sensors	1 thermal anemometer, flow and temperature.
Number and type of actuators	none
Number and type of host side signals	1: 4 - 20mA analog
Number of Device Variables	6
Number of Dynamic Variables	6 – PV, SV, TV, QV, Percent Range, Loop Current
Mappable Dynamic Variables?	NO (The dynamic variables PV and SV are indirectly mappable when PV units are changed; TV and QV are fixed to represent temperature and totalized flow)
Number of common-practice commands	10
Number of device-specific commands	17
Bits of additional device status	
Alternative operating modes	No
Burst mode	No
Write-protection	No

ANNEX B. DEFAULT CONFIGURATION

Parameter	Default value
Lower Range Value	0
Upper Range Value	100000
PV Units	SCFM
Damping time constant	0.5 second
Fault-indication jumper	None
Write-protect jumper	None
Number of response preambles	5

ANNEX C. REVISION HISTORY

A1. Rev 1.0

Initial Release – June 28, 2010.