

---

**HART® Field Device Specification:**  
**DELTA CONTROLS CORPORATION**  
**MODEL 5XX REV 1.0**

Document 00-50035, rev. A

Initial release: 28 February 2021

Author: Ted Keys  
Delta Controls Corporation  
585 Fortson Street  
Shreveport, LA 71107  
USA



## TABLE OF CONTENTS

1. Introduction .....	5
1.1 Scope .....	5
1.2 Purpose .....	5
1.3 Who should use this document? .....	5
1.4 Abbreviations and definitions .....	5
1.5 References .....	5
2. Device Identification .....	6
3. Product Overview .....	6
4. Product Interfaces .....	6
4.1 Process Interface .....	6
4.1.1 Sensor Input Channels .....	6
4.2 Host interface .....	6
4.2.1 Analog Output: Process Level .....	6
4.3 Local Interfaces, Jumpers and Switches .....	7
4.3.1 Local Controls and Displays .....	7
4.3.2 Internal Jumpers and Switches .....	7
4.4 Device Variables .....	8
4.5 Dynamic Variables .....	8
5. Status Information .....	8
5.1 Device Status .....	8
5.2 Extended Device Status .....	10
5.3 Additional Device Status (Command #48) .....	11
6. Universal Commands .....	11
7. Common-Practice Commands .....	12
7.1 Supported Commands .....	12
7.2 Burst Mode .....	12
7.3 Catch Device Variable .....	13
8. Device-Specific Commands .....	13
8.1 Command #128: READ PARAMETER .....	13
8.2 Command #129: WRITE PARAMETER .....	14

- 8.3 Command #130: CALIBRATE TABLE VALUE .....**Error! Bookmark not defined.**
- 8.4 Command #131: WRITE CALIBRATION TABLE ENTRY**Error! Bookmark not defined.**
- 9. Tables ..... 16
  - 9.1 List of Device Parameters (see command 128 & 129) ..... 16
- 10. Performance..... 17
  - 10.1 Sampling Rates ..... 17
  - 10.2 Power-Up ..... 17
  - 10.3 Reset ..... 17
  - 10.4 Self-Test ..... 17
  - 10.5 Command Response Times ..... 17
  - 10.6 Busy and Delayed-Response ..... 18
  - 10.7 Long Messages ..... 18
  - 10.8 Non-Volatile Memory ..... 18
  - 10.9 Modes..... 18
  - 10.10 Write Protection ..... 18
  - 10.11 Damping ..... 18
- Annex A. Capability Checklist ..... 19
- Annex B. Default Configuration..... 20
- Annex C. Revision History..... 21

## 1. INTRODUCTION

### 1.1 Scope

The Delta Controls Corporation Level Transmitter, model 5XX, revision 1 complies with HART Protocol Revision 7.06. 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 complement other documentation (e.g., the *5xx 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

<b>DAC</b>	Digital to Analog Converter
<b>EEPROM</b>	Electrically-Erasable Read-Only Memory

### 1.5 References

*HART Smart Communications Protocol Specification*. HCF\_SPEC-12. Available from the HCF.

*500 Series Installation Manual*, Document 00-5XX03. Available from the Delta Controls Corporation.

## 2. DEVICE IDENTIFICATION

<b>Manufacturer Name:</b>	Delta Controls Corporation	<b>Model Name(s):</b>	5XX
<b>Manufacture ID Code:</b>	24842 (0x610A)	<b>Device Type Code:</b>	58553 (0xE4B9)
<b>HART Protocol Revision</b>	7.06	<b>Device Revision:</b>	1
<b>Number of Device Variables</b>	3		
<b>Physical Layers Supported</b>	FSK		
<b>Physical Device Category</b>	Transmitter, Non-DC-isolated Bus Device		

5XX refers to a series of pressure transmitters including models 551, 552, 562, 563, 565, 566, 571, 572, 591, and 592. Models 551, 565, 571, and 591 have electronics that are integrated into the sensor housing. Models 552, 562, 563, 566, 572, and 592 have remote electronics mounted in a PVC or Explosionproof housing. The model number is engraved on the body of integral units and on a nameplate on the housing of those units with remote electronics.

## 3. PRODUCT OVERVIEW

The 5XX is a simple two-wire loop-powered pressure transmitter with a 4-to-20mA output.

The device measures pressure and converts this to a level measurement.

## 4. PRODUCT INTERFACES

### 4.1 Process Interface

#### 4.1.1 Sensor Input Channels

Model 5XX primary input channel is a millivolt-level signal from a pressure sensor. A second channel measures the pressure sensor bridge resistance and can be used to determine sensor temperature. On most units, the temperature channel is left uncalibrated and does not return meaningful temperature data. The bridge resistance value is also used to diagnose sensor wiring problems and sensor health.

### 4.2 Host interface

#### 4.2.1 Analog Output: Process Level

The two-wire 4-to-20mA current loop is connected on two terminals marked "Loop+" and "Loop-". Refer to the Installation Manual for connection details.

This is the only output from this transmitter, representing the level measurement, linearized and scaled according to the configured range of the instrument. This output corresponds to the Primary Variable. HART Communication is supported on this loop. This device has a CN number of 1.

A guaranteed linear over-range is provided. Device malfunction can be indicated by down-scale or up-scale current. The direction is selectable by the user; see Section 4.3 below. Current values are shown in the table below.

	Direction	Values (percent of range)	Values (mA or V)
<b>Linear over-range</b>	Down	-0.625%	3.9 mA
	Up	+105.0% ± 1.0%	21 mA
<b>Device malfunction indication</b>	Down: less than	-1.25%	3.8 mA
	Up: greater than	+112.5%	22.0 mA
<b>Maximum current</b>		+112.5%	22.0 mA
<b>Multi-Drop current draw</b>			4.0 mA
<b>Lift-off voltage</b>			12 V

## 4.3 Local Interfaces, Jumpers and Switches

### 4.3.1 Local Controls and Displays

Devices with remote electronics have a window providing visible access to an LCD display.

### 4.3.2 Internal Jumpers and Switches

On devices with remote electronics, four pushbuttons are provided to set up operating parameters without connection to an external controller. Detailed information is provided in the 5XX Operation Manual.

Variables

### 4.4 Device Variables

Variable	Meaning	Units	Unit Codes
DV0	PV	undefined	240
DV1	Pressure	Undefined	240
DV2	Temperature	DegC DegF	32,33

### 4.5 Dynamic Variables

Three Dynamic Variables are implemented.

	Meaning	Units
PV	Process Variable	undefined

## 5. STATUS INFORMATION

### 5.1 Device Status

BIT	Name	Meaning
0	0 Primary Variable out of limits	Set if the Device Variable mapped to PV is out of transducer limits. Range setting by Command 35 does not affect these limits.
1	Non PV out of limits	Set if any of the Device Variables not mapped to PV is out of limits. This bit is formed by OR-ing all out-of-limit informations of DV 0 to 5 except the one mapped to PV.
2	Loop Current Saturated	Set if the analog output 1 (channel 0) current is out of the linear overrange Limits.
3	Loop Current Fixed	Set if analog output 1 (channel 0) current no longer tracks the PV value. Use of any of commands 6, 40, 66 or 79 may cause the current to be fixed.
4	More Status Available	Set whenever any irregularity is detected. Use of Command 48 will read additional details.
5	Cold Start	Set after initial power up and after execution of Command 42. Bit is cleared for each Master individually after recognition of the first



		command.
6	Configuration Changed	Set when the Field Device configuration is modified. Each Master will clear this bit individually by use of Command 38.
7	Device Malfunction	Set if the Field Device's self-monitoring detected an abnormal condition of class Error. Warnings will not set this bit.

## 5.2 Extended Device Status

Bit	Name	Meaning
0	Maintenance Required	Device requires maintenance.
1	Device Variable Alert	Some device variable is in an alarm or warning state
2	unused	Bit not supported
3	Failure	Device variable invalid due to malfunction
4	Out of Spec	Condition detected that could affect accuracy (ie ambient temperature)
5	Function Check	Bit not supported
6	Unused	Undefined
7	Unused	Undefined

### 5.3 Additional Device Status (Command #48)

Command #48 returns 9 bytes of data, with the following status information:

Byte	Bit	Meaning	Class	Device Status Bits Set
0	DEVICE SPECIFIC STATUS			
	0	Sensor Error (usually broken sensor or wiring problem)	ERROR	4,7
	1	Not Defined		
	2	Not Defined		
	3	Not Defined		
	4	Not Defined		
	5	Not Defined		
	6	Not Defined		
	7	Not Defined		
1,2,3,4,5	Not Defined			
6	EXENDED DEVICE STATUS			
	0	Device requires maintenance.	WARNING	4
	1	Some device variable is in an alarm or warning state	WARNING	4
	2	Bit not supported		
	3	Bit not supported	ERROR	4,7
	4	Bit not supported	WARNING	4
	5	Bit not supported		
	6,7	Not Defined		
7	Not supported			
8	STANDARD STATUS			
	0,1,2	Bit(s) not supported		
	3	Watchdog reset occurred	WARNING	4
	4,5,6,7	Bit(s) not supported		

"Not Defined" bits are always set to 0.

## 6. UNIVERSAL COMMANDS

Command #3 returns PV for a total of 9 bytes of response data).

Sensor serial number is Not Defined, and returns 0.

## 7. COMMON-PRACTICE COMMANDS

### 7.1 Supported Commands

The following common-practice commands are implemented:

- 33 Read Device Variables
- 34 Write Damping Value
- 35 Write Range Values
- 40 Enter/Exit Fixed Current Mode
- 42 Perform Master Reset
- 45 Trim DAC Zero
- 46 Trim DAC Gain
- 48 Read Additional Device Status
- 54 Read Device Variable Information
- 59 Write Number of Response Preambles
- 72 Squawk (On units with remote electronics, causes outline rectangle on LCD for 2 seconds. On units with integral electronics, this command has no effect.)
- 100 Write Primary Variable Alarm Code
- 103 Write Burst Period
- 104 Write Burst Trigger
- 105 Read Burst Mode Configuration
- 107 Write Burst Device Variables
- 108 Write Burst Mode Command Number
- 109 Burst Mode Control

### 7.2 Burst Mode

This Field Device supports three Burst Messages.

The following commands can be represented in a Burst Message:

- 1 Read Primary Variable
- 2 Read Loop Current and Percent Of Range
- 3 Read Dynamic Variables and Loop Current
- 9 Read Device Variables with Status
- 33 Read Device Variables
- 48 Read Additional Device Status

### 7.3 Catch Device Variable

This Field Device does not support Catch Device Variable.

## 8. DEVICE-SPECIFIC COMMANDS

The following device-specific commands are implemented:

- 123 Restore/Write/Initialize Calibration Parameters
- 128 Read Parameter
- 129 Write Parameter

### 8.1 Command #123: SAVE/RESTORE FACTORY VALUES

#### Request Data Bytes

Byte	Format	Description
0	INT8	Memory Command: 4 – restore factory values 8 – save factory values 86 – restore initial power-on values

#### Response Data Bytes

Byte	Format	Description
0	INT8	Memory Command

### 8.2 Command #128: READ PARAMETER

Read a device parameter value

#### Request Data Bytes

Byte	Format	Description
0	Enum	Parameter to read (see section 10.1)

**Response Data Bytes**

Byte	Format	Description	
0	Enum	Parameter to read	
1	Enum	Datatype (See bytes 3-6)	
2	Enum	Units	
3	Byte	Value	Datatype = 0,6
3-4	Int[2] uint16	Value	Datatype = 2
3-6	Float	Value	Datatype = 3
3-6	Int[4] int32	Value	Datatype = 4

**Command-Specific Response Codes**

Code	Class	Description
0	Success	No Command-Specific Errors
2	Error	Invalid selection (of units)
5	Error	Too few data bytes

**8.3 Command #129: WRITE PARAMETER**

**Request Data Bytes**

Byte	Format	Description
0	Enum	Parameter to write (see section 9.1)
1	Byte	Byte value to write
1,2	Int[2] uint16	Integer value to write
1,2,3,4	Float	Float value to write
1,2,3,4	Int[4] int32	Float value to write

**Response Data Bytes**

Byte	Format	Description	
0	Enum	Parameter (see section 9.1)	
1	Enum	Datatype (See bytes 3-6)	
2	Enum	Units	
3	Byte	Value	Datatype = 0,6
3-4	Int[2] uint16		Datatype = 2
3-6	Float		Datatype = 3
3-6	Int[4] int32		Datatype = 4

**Command-Specific Response Codes**

<b>Code</b>	<b>Class</b>	<b>Description</b>
0	Success	No Command-Specific Errors
2	Error	Invalid selection (of units)
5	Error	Too few data bytes

## 9. TABLES

### 9.1 List of Device Parameters (see command 128 & 129)

Parameter	Description	Format	
6	PRESSURE UNITS	ENUM	6 - psi 7 - bar 8 - millibar 10 - kg / sq cm 11 - pascals 12 - kilopascals
7	LENGTH UNITS	ENUM	44 - feet 45 - meters 47 - inches 48 - centimeters 49 - millimeters
8	VOLUME UNITS	ENUM	40 - gallons 41 - liters 43 - cubic meters 111 - cubic yards 112 - cubic feet 113 - cubic inches
9	MASS UNITS	ENUM	61 - kilogram 63 - pound
10	PROCESS VARIABLE UNITS	ENUM	Any Pressure, Length, Volume, or Mass units above
11	SPECIFIC GRAVITY	FLOAT	
12	TANK AREA	FLOAT	
13	OFFSET DISTANCE	FLOAT	
18	DAMPING	FLOAT	
21	SENSCALP1	FLOAT	In current Pressure Units
22	SENSCALP2	FLOAT	In current Pressure Units
23	BRIDGEKOHM	FLOAT	
25	SENSOR RANGE	ENUM	
26	SENSITIVITY	FLOAT	
27	ZEROMV	FLOAT	
28	MAINSFREQ	ENUM	50 - 50 Hz 60 - 60 Hz
29	PRESSURE RAW	INTEGER	
30	PRESSURE Mv	FLOAT	
31	BRIDGE RAW	INTEGER	
32	BRIDGEMV	FLOAT	
33	SENSCALMV1	FLOAT	



Parameter	Description	Format	
34	SENSCALMV2	FLOAT	
35	LSL	FLOAT	
36	USL	FLOAT	
37	ICAL	FLOAT	
38	TEMPERATURE	FLOAT	
39	TEMPERATURE UNITS	ENUM	32 – degrees Celsius 33 – degrees Fahrenheit
40	Z0	FLOAT	
41	Z1	FLOAT	

## 10. PERFORMANCE

### 10.1 Sampling Rates

Typical sampling rates are shown in the following table.

Units with integral electronics	3 per second
Units with remote electronics	1 per second

### 10.2 Power-Up

On power up, the transmitter goes through an initialization procedure, which takes approximately 2 seconds. During this period, the device will not respond to HART commands, and the analog output is set at 4.0mA.

Fixed-current mode is cancelled by power loss.

### 10.3 Reset

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

### 10.4 Self-Test

Continuous self-testing is part of the normal device operation.

### 10.5 Command Response Times

Minimum	20ms
Typical	50ms
Maximum	100ms *

## **10.6 Busy and Delayed-Response**

The transmitter does not respond with Delayed Response. Changing units (command 44) may cause subsequent commands to respond with BUSY for a few seconds.

## **10.7 Long Messages**

The largest data field used is in the response to Command 9: 66 bytes including the two status bytes.

## **10.8 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.

## **10.9 Modes**

Fixed current mode is implemented, using Command 40. This mode is cleared by power loss or reset. Another method to affect the loop current is Command 6 with Loop Current Mode parameter set to disabled. This mode setting is not affected by power cycle or reset but has to be changed by execution of Command 6 with Loop Current Mode parameter set to enabled.

## **10.10 Write Protection**

This Field Device does not support write-protection. A hardware switch or jumper cannot be accessed during operation in explosion hazard areas.

## **10.11 Damping**

The damping function has a first order low pass characteristic affecting only the PV and the loop current signal. The device accepts values from 0 to 60 seconds.

## **ANNEX A. CAPABILITY CHECKLIST**

Manufacturer, model and revision	Delta Controls Corporation model 5XX Rev 3
Device type	Transmitter
HART revision	7.06
Device Description available	Yes
Number and type of sensors	1 pressure sensor
Number and type of actuators	0
Number and type of host side signals	1: 4 - 20mA analog
Number of Device Variables	3
Number of Dynamic Variables	1
Mappable Dynamic Variables?	No
Number of common-practice commands	20
Number of device-specific commands	4
Bits of additional device status	8
Alternative operating modes?	No
Burst mode?	Yes
Write-protection?	No

## **ANNEX B.    DEFAULT CONFIGURATION**

<b>Parameter</b>	<b>Default value</b>
Lower Range Value	0
Upper Range Value	100
Damping time constant	4 second
Polling Address	0
Number of response preambles	5

## **ANNEX C. REVISION HISTORY**

### **A1. Changes from Rev 1.0 to Rev 2.0**

Support was added for HART 7.