ENG-D00008

HART® Specification: Xgard Bright

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Echo Xue

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DETECTING GAS. SAVING LIVES.

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1. Introduction

1.1. Scope

The Xgard Bright complies with HART Protocol Revision 7.5. This document specifies all device specific features of the HART protocol implementation and should be used in conjunction with HART specification documents available from the HART Communication Foundation.

1.2. Purpose

This specification is designed to compliment other documentation (e.g., the *Xgard Bright 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
ROM	Read-Only Memory
RTD	Resistance Temperature Detector

1.5. References

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

Xgard Bright Installation Manual, Available from the Crowcon Detection Instruments.

2. Device Identification

Manufacturer Name:	Crowcon	Model Name(s):	Xgard Bright
Manufacture ID Code:	603 (EF Hex) 1	Device Type Code:	E39 (E6 Hex) 3
HART Protocol Revision	7	Device Revision:	1
Number of Device Variables	None		
Physical Layers Supported	FSK		
Physical Device Category	Transmitter, Non-DC-isolated Bus Device		

3. Product Overview

The Xgard Bright is a high-function fixed gas detector that can detect a wide variety of gases though different gas sensor. The Xgard Bright is compatible with any 4-20mA control system operating in either current source or sink mode. The addition of HART over 4-20 enhances the capabilities of the basic Xgard Bright.

4. Product Interfaces

4.1. Host interface

Analog Output: Gas Concentration

All electrical connection are made via the screw terminal block mounted on the terminal PCB in the enclosure base. The terminals are marked '+', 'Sig' and '-' and correct polarity should be observed when connecting the detector to control equipment.

This is the only output from this transmitter, representing the process gas concentration measurement, linearised and scaled according to the configured range of the instrument. This output corresponds to the Primary Variable. HART Communication is supported on this loop.

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; Current values are shown in the table below.

	Direction	Values (percent of range)	Values (mA or V)
Linear over-range	Down	-0.6% ± 0.1%	3.89 to 3.92 mA
	Up	+105.0% ± 1.0%	20.64 to 20.96 mA
	Down: less than	-1.0%	3.84 mA

Device malfunction indication	Up: greater than	+110.0%	21.60 mA
Maximum current		+112.5%	22.0 mA
Multi-Drop current draw			4.0 mA
Lift-off voltage			10.5 V

4.2. Local Interfaces, Jumpers And Switches

Local Controls And Displays

Xgard Bright operation display panel composed of OLED screen, three-color LED, two magnetic buttons. The OLED screen displays white color, when on. It has very high contrast can be clearly seen under sunlight. It is also has excellent low temperature feature, can work under minus 40℃.

5. Device Variables

This Field Device does not expose any Device Variables.

6. Dynamic Variables

One Dynamic Variables are implemented.

	Meaning	Units
PV	Gas level	%LEL, ppb, ppm, or %vol

7. Status Information

7.1. Device Status

The first two bytes in a field device HART message response correspond to the Response Code byte that indicates communications errors and the Field Device Status byte that gives the current operating status of the Xgard Bright. See the reference HCF_SPEC-99, Command Summary Specification for details.

7.2. 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	0	Initialising (instrument or sensor in power-on warm-up phase)	INFO	N/A
	1	Gas alarm 1	INFO	4
	2	Gas alarm 2	INFO	4
	3	Unused	INFO	N/A
	4	Unused	INFO	N/A
	5	Unused	INFO	N/A
	6	Unused	INFO	N/A
	7	Unused	INFO	N/A
1	0	Unused	INFO	N/A
	1	Unused	INFO	N/A
	2	Unused	INFO	N/A
	3	Unused	INFO	N/A
	4	Unused	INFO	N/A
	5	Unused	INFO	N/A
	6	Unused	INFO	N/A
	7	Unused	INFO	N/A
2	0	Unused	INFO	N/A
	1	Unused	INFO	N/A
	2	Unused	INFO	N/A
	3	Unused	INFO	N/A
	4	Unused	INFO	N/A
	5	Unused	INFO	N/A
	6	Unused	INFO	N/A
	7	Unused	INFO	N/A
3	0	Unused	INFO	N/A
	1	Unused	INFO	N/A
	2	Unused	INFO	N/A
	3	Unused	INFO	N/A
	4	Unused	INFO	N/A
	5	Unused	INFO	N/A
	6	Unused	INFO	N/A
	7	Unused	INFO	N/A
4	0	Unused	INFO	N/A
	1	Unused	INFO	N/A
	2	Unused	INFO	N/A
	3	Unused	INFO	N/A
	4	Unused	INFO	N/A
	5	Unused	INFO	N/A
	6	Unused	INFO	N/A
	7	Unused	INFO	N/A

5	0	Unused	INFO	N/A
	1	Unused	INFO	N/A
	2	Unused	INFO	N/A
	3	Unused	INFO	N/A
	4	Unused	INFO	N/A
	5	Unused	INFO	N/A
	6	Unused	INFO	N/A
	7	Unused	INFO	N/A

"Not used" bits are always set to 0.

All bits used in this transmitter indicate device or sensor failure, and therefore also set bit 7 and bit 4 of the Device Status byte.

8. Universal Commands

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

9. Common-Practice Commands

9.1. Supported Commands

This Field Device does not support Common Practice Commands.

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

10.1. Command #129 Zero Gas Reading

This command is similar to the Common Practice Command #43 (not implemented). It zeroes the gas (Primary Variable) reading in the absence of target gas. Normally this will be clean air; O2 (oxygen) and CO2 (carbon dioxide) sensors must be purged with N2 (nitrogen).

If the response code 8 is returned from this command then the Zero Gas Reading command should be repeated (poll status) until a status other than 8 is returned indicating the result of the zero operation.

10.2. Request Data Bytes

Byte	Format	Description
0	Integer	0 = Poll zero operation status 1 = Request zero operation

10.3. Response Data Bytes

Byte	Format	Description
0-1	Integer	Percentage of required operation time completed

10.4. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid selection
3-4		Undefined
5	Error	Too few bytes received
6-7		Undefined
8	Warning	Operation in progress
9-127		Undefined

10.5. Command #130 Calibrate Gas Reading

Calibrate the gas (Primary Variable~) so it reads the given calibration level with the gas level applied.This command issued to calibrate the Xgard Bright.

If the response code 8 is returned from this command then the Calibrate Gas Reading command should be repeated (poll calibration status) until a status other than 8 is returned indicating the result of the calibration operation.

Request Data Bytes

Byte	Format	Description
0	Integer	0 = Poll calibration operation status 1 = Request calibration operation
1-4	Float	Calibration level, in %LEL (ignored if requesting poll status or cross cal. has been set)

Response Data Bytes

Byte	Format	Description
0-1	Integer	Percentage of required operation time completed

Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1		Undefined
2	Error	Invalid selection
3-4		Undefined
5	Error	Too few bytes received
6-7		Undefined
8	Warning	Operation in progress
9-127		Undefined

11. Performance

11.1. Sampling Rates

Typical sampling rates are shown in the following table.

Primary Gas concentration sensor sample	10 per second
PV digital value calculation	2 per second
Analog output update	1 per second

11.2. Power-Up

On power up, the transmitter goes through a self-test procedure, which takes approximately 2 seconds. During this period, the device will not respond to HART commands, and the analog output is set at 3.0mA.

When the self-test is satisfactorily completed, and the first measurement has been made, the PV values are set, and the analog output moves to a value representing the measurement.

Fixed-current mode is cancelled by power loss.

11.3. Reset

The reset procedure is executed at power up

11.4. Self-Test

The self-test procedure is executed at power up,The self-test includes:

- microprocessor
- Ram
- Program rom
- Configuration storage eeprom
- Analog-to-digital converter

- Digital-to-analog converter
- Gas sensor.

This self-test takes about 2 seconds. During self-test following power-up or reset, the analog output is set to 3.0mA and the device will not respond to HART commands.

11.5. Command Response Times

Minimum	5ms
Typical	8ms
Maximum	100ms *

11.6. Busy and Delayed-Response

The transmitter may respond with "busy" status if a further command is received while self-test is underway.

Delayed-response is not used.

11.7. Long Messages

The largest data field used is in the response to Command 21: 34 bytes including the two status bytes.

11.8. 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.

11.9. Modes

Fixed current mode is not implemented.

11.10. Write Protection

Write-protection is not provided.

12. Capability Checklist

Manufacturer, model and revision	Crowcon Xgard Bright v1
Device type	Transmitter
HART revision	7.0
Device Description available	Yes
Number and type of sensors	1
Number and type of actuators	0
Number and type of host side signals	1: 4 - 20mA analog
Number of Device Variables	0

Number of Dynamic Variables	1
Mappable Dynamic Variables?	No
Number of common-practice commands	0
Number of device-specific commands	2
Bits of additional device status	3
Alternative operating modes?	No
Burst mode?	No
Write-protection?	No

13. Default Configuration

Parameter	Default value
Lower Range Value	0
Upper Range Value	100
PV Units	%LEL
Sensor type	pellistor
Number of wires	3
Number of response preambles	5

13. Revision History

1.0 Initialize release

