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**Quality Assurance and Device Registration**

**Conformance Test Report** **February 2, 2018**

For the:

**Corporation Name** **L-mag Device Type** **0xE2A6**

Prepared for:

**Corporation Name**

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By

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**Release Date:** **February 2, 2018**

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# Executive Summary

On November 29, 2017, the HART Test Lab at CQC in Beijing, China received the Corporation Name Lmag electromagnetic flowmeter for registration as per CQC *Quality Assurance and Device Registration Procedure*. (FCG PD20012).

This report summarizes testing and compliance assessment of the Corporation Name L-mag electromagnetic flowmeter (Expanded Device Type Code 0xE2A6; Device Revision  0x01; Software Revision 0x01, Hardware Revision 0x01).

The HART Test Lab at CQC performed 124 tests during the course of assessing the L-mag, and CQC analyzed the data produced.

Based on this testing and analysis, the L-mag complies with the HART Communication Protocol Requirements.

The  Corporation Name L-mag submitted for registration is a non-burst mode external-powered field device that supports HART Protocol Revisior  7.

# INTRODUCTION

## Contact Information

Name:

Company:

Address:

Email:

Phone:

## DUT Identification

Manufacturer Name: Corporation Name

Model Name(s): L-mag

Manufacture ID Code (HEX): 0x601E

Expanded Device Type Code (HEX): 0xE2A6

Device ID (HEX): 0x000002

Device Profile (HEX): 0x01

Device Revision: 0x01

Hardware Revision: 0x01

Software Revision: 0x01

HART Protocol Revision: 7

Burst Mode Support: No

Physical Layers Supported: FSK

FSK Physical Device Category: 4-wire high-impedance transmitter

## Scope

This report summarizes the testing and compliance assessment of the Corporation Name L-mag electromagnetic flowmeter (Expanded Device Type Code 0xE2A6; Device Revision 0x01).

As per the requirements in CQC *Quality Assurance and Device Registration Procedure* (FCG

PD20012), the registration package supplied by Corporation Name was reviewed and audited (see Section 2).

The  L-mag is a wired device and the following tests were performed:

* **Token-Passing Data-Link** **Layer** –slave tests (Data-Link Layer Services: non-burst mode)
* **Application Layer Universal Commands** – via wired FSK interface tests
* **Application Layer Common Practice Commands** – via wired FSK interface tests, both mandatory and optional commands

The test equipment used during testing is listed in Subsection 1.8. Upon completion of the testing the data and results were assessed for compliance. The results are discussed in Section 3 and Summarized in the Annexes. Conclusions, based on the testing and assessments, are provided in Section 4.

## Overview

The Device Under Test (DUT) is a Corporation Name L-mag electromagnetic flowmeter (Expanded Device Type Code 0xE2A6; Device Revision 0x01). The DUT is a 4-wire high-impedance transmitter as per the *FSK Physical Layer Specification* (HCF\_SPEC-54, FCG TS20054 Revision 9.1). As such, the DUT must be tested per CQC *Quality Assurance and Device Registration Procedure* (FCG PD20012).

The DUT includes an FSK interface that supports current-loop (4-20mA) output as well as HART signaling. Access to the FSK interface is via a wiring terminal on the device.

On November 29, 2017, the HART Test Lab at CQC in Beijing, China received the DUT and testing commenced shortly thereafter. Issues were found and an updated device was received and began testing on 3 January, 2018.

This report refers to the DUT with Expanded Device Type Code 0xE2A6, Device Revision 0x01, Software Revision 0x01, and Hardware Revision 0x01.

## Confidentiality

This report is provided for the exclusive use of the Product's Manufacturer. The Manufacturer is authorized to distribute this report only internally and only in its entirety. Any other distribution requires the express written permission of CQC and the Product's Manufacturer.

## References

The following documents provided the basis for conformance testing.

**The HART Communication Protocol Specifications**

The following HART Communication Protocol Specification was the basis for conformance testing:

*HART Communication Protocol Specification*. HCF\_SPEC-13, FCG TS20013. Revision 7.6

**The HART Communication Protocol Test Specifications**

The following HART Communication Protocol Test Specifications were used during conformance testing:

*Slave Token-Passing Data Link Layer Test Specification*, HCF\_TEST-1, FCG TT20001. Revision 3.1

*FSK Physical Layer Test Specification*, HCF\_TEST-2. Revision 2.2

*Slave Universal Command Test Specification*, HCF\_TEST-3, FCG TT20005. Revision 4.1

*Slave Common Practice Command Test Specification*, HCF\_TEST-4, FCG TT20004. Revision 5.0

**Device Registration Procedures**

The following registration procedure was used during conformance testing and registration:

*HART Product Registration Procedure. FCG PD20012. Revision 2.4*

**Standard Forms**

The following forms were used to summarize test results:

*HART Field Device Test Report HCF\_FRM-156, FCG FR20156. Rev. 5.0*

## Test Equipment

The following equipment was used to perform the Conformance Test:

*Physical Layer Test Kit*. HCF\_KIT-116, FCG TK20116. Revision 1.0

*HART Test System*. HCF\_KIT-192, FCG TK20192. Revision 3

Agilent Function/Arbitrary Waveform Generator Model# 33250A. SN MY40031872

Kepco Model# BOP-50-2M. SN 158442

Mactek RS-232 to HART Interface. SN 118506

Mactek RS-232 to HART Interface. SN 111692

Yokogawa Digital Oscilloscope Model# DL9040. SN 91G419681

Resistance Decade Box Model# ZX17-1. SN /

HCF Analog Filter Model# HCF\_TOOL-32. SN 507

HCF Digital Filter Model# HCF\_TOOL-31. SN 562

## Definitions, Acronyms and Symbols

**1.9.1 Definitions**

All terms and phrases unique to HART or critical to understanding this report are defined in this section.

|  |  |
| --- | --- |
| **Application Layer** | Topmost layer in the Open System Interconnect (OSI) model. In the HART  Protocol this layer includes: the definitions of data types; revision rules; application procedures; and the HART Commands. |
| **Byte** | 8-bits, sometimes called an Octet. |
| **Data Link Layer** | Layer 2 in the OSI model. This layer is responsible for the error-free communication of data. The Data Link Layer defines the message structure, error detection strategy and bus arbitration rules. |
| **Device Variable** | A uniquely defined data item within a Field Device that is always associated with cyclical process information. A Device Variable's value varies in response to changes and variations in the process. |
| **Dynamic Variable** | The connection between the process and an analog channel. All HART field devices may contain Primary, Secondary, Tertiary, and Quaternary Variables that are mapped to the first 4 analog channels in a field device. |
| **Field Device** | Field Devices are connected to the Process and their Device Variables vary as process conditions change. |
| **Interoperability** | Interoperability is the ability for like devices from different manufacturers to work together in a system and be substituted one for another without loss of functionality at the host system level. |
| **Logical Link Control** | Logical Link Control (LLC) is the higher of the two data link layer sub-layers defined in the OSI Model. The LLC sub-layer handles error control, flow control, framing, and addressing. |
| **Long Tag** | A 32 character ISO Latin-1 string used to identify the field device. See Tag. |
| **Medium Access Control** | A sub-layer found with the OSI Data-Link Layer (OSI Layer 2) used for arbitrating access to the communication channel. |
| **Packet** | A generic reference to the set of data communicated across a network |
| **Physical Layer** | Layer 1 in the OSI model. The Physical Layer is responsible for transmission of the raw bit stream and defines the mechanical and electrical connections and signaling parameters for devices. |
| **Request Data Bytes** | The sub-field returned in the Data field that contains the Application Layer message data being transmitted from the Master to the Slave. |
| **Response Data Bytes** | The sub-field returned in the Data field that contains the Application Layer  message data being transmitted from the Slave to the Master. The first byte in the HART Data Field that is not a Response Code, Communication Status, Device Status or Extended Command Number. |
| **Transaction** | A complete, atomic cycle of Data-Link activity. A transaction consists of (a) a single DLPDU transmission from a source device, or (b) two DLPDUs: one from the Data-Link source followed by a second, link-level acknowledgement DLPDU from the destination. |
| **Unique Identifier** | The concatenation of the Device Type and Device ID used in constructing the long frame address (see the Data Link Layer Specification). These data, when combined, uniquely identify a specific field device. No two devices ever manufactured may have the same combination of these data. |

**1.9.2 Acronyms and Symbols**

All Symbols and Abbreviations used in this report are listed in this section.

APDU Application Protocol Data Unit

DPDU Data-link Protocol Data Unit

DUT Device Under Test

HCF HART Communication Foundation

STO Slave Time-Out

SOM Start Of Message

**1.9.3 Test Result Definitions**

All test results used in this report are listed in this section

**Passed**: The device is conformant.

**Not Applicable**: The test case does not apply to this device.

**Failed**: The device is not conformant.

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# REVIEW OF CONFORMANCE TEST PACKAGE

## Conformance Test Package Contents

The manufacturer supplied registration package was reviewed. A summary of the supplied versus required materials is shown in Table 1.

**Table 1. Summary of Materials Supplied with Registration Package.**

|  |  |  |
| --- | --- | --- |
| **Contents** | **Included** | **Comments** |
| Product Registration. HART Product Exhibit.xls  Properly completed | Yes  Yes |  |
| *HART Field Device Test Report HCF\_FRM-156, FCG FR20156* | Yes |  |
| The product specification including device specific details as per *Field Device Specification Guide* (HCF\_LIT-18) | Yes | Document : LMAGD001-lit18.doc |
| Sample of device | Yes |  |
| Purchase order for testing and registration fee | Yes |  |
| Other supplied by manufacturer | No |  |

## Audit of manufacturer's test reports and data

**2.2.1 Token-Passing Data-Link**

The submitted results from Corporation Name Corporation indicated the device passed all Token-Passing Data Link Layer tests as a non-burst mode slave field device.

**2.2.2 Universal Command Application Layer**

The submitted FSK results from Corporation Name Corporation indicated the device passed all Universal tests as an electromagnetic flowmeter.

**2.2.3 Common Practice Command Application Layer**

The  Corporation Name Corporation device completed all Common Practice Application Layer (CAL) test cases. The device does not support all Common Practice Commands.

# INDEPENDENT TESTING BY CQC

As per *CQC Quality Assurance and Device Registration Procedure* (FCG PD20012), all devices submitted for registration shall be independently tested by CQC. This Section summarizes the testing performed by CQC, and the resulting findings of CQC.

## Token-Passing Data-Link

Token-Passing Data-Link Layer tests were performed using the FSK interface of the DUT using HART Registered RS-232 to HART adapters (modems). CQC performed 63 Token-Passing Data Link Layer tests using HART Test System (HCF\_KIT-192, FCG TK20192). All communications were recorded using HSniffer (HCF\_TOOL-004, FCG TP20140) thus producing the binary .OUT files. These were, in turn analyzed using the Standard Token-Passing Data-Link Layer Compliance Assessors (post-processing HCF\_TOOL-086).

The L-mag is a non-burst mode transmitter. CQC review of the results are summarized in Annex A2 and the DUT passed all applicable tests.

## Universal Command Application Layer

CQC executed all 16 Universal Command Application Layer tests using the HART Test System (HCF\_KIT192, FCG TK20192) via the DUT's FSK Interface. All test message traffic was recorded in the .qa.log files associated with each test. The .qa.log files also contain descriptive information about the test and the device, as well as a pass-fail test disposition.

All tests were performed on the Token-Passing Data Link Layer using a HART Registered RS-232 to HART interface (modem) via a serial port. HSniffer was used in conjunction with the tests to visually monitor the message traffic. The results of the Universal Command Application Layer testing are summarized in Annex A3.

The DUT supports Universal Commands 0, 1, 2, 3, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 38, and 48.

The DUT passed all applicable Universal Command Application Layer tests.

## Common Practice Command Application Layer

Common Practice Command testing indicates that the DUT supports Common Practice Commands. The *Slave Common Practice Command Test Specification* (HCF\_TEST-004, FCG TT20004) provides standard test specifications for many common practice commands.

CQC executed all of the test automation available for the Common Practice Application Layer tests using the HART Test System (HCF\_KIT-192, FCG TS20192) via the DUT's FSK interface. All test message traffic was recorded in the .qa.log files associated with each test. The .qa.log files also contain descriptive information about the test and the device, as well as a pass-fail test disposition.

All tests were performed on the DUT’s FSK interface using a HART Registered RS-232 to HART interface (modem) via a serial port. HSniffer was used in conjunction with the tests to visually monitor the message traffic. The results of the Common Practice Command Application Layer testing are summarized in Annex A4.

The DUT supports Common Practice Commands 33, 34, 35 and 44.

All Common Practice Command Application Layer tests were run and concluded in a Pass result.

The DUT supports Device Specific Commands 128, 129, 130, 131, 132 and 133.

# CONCLUSIONS

The Corporation Name L-mag electromagnetic flowmeter (Expanded Device Type Code  0xE2A6, Device

Revision 0x01) meets all the requirements for registration based on CQC *Quality Assurance and Device Registration Procedure* (FCG PD20012). Testing and analysis of the L-mag demonstrated the product compliance with the HART Communication Protocol Requirements.

The Corporation Name L-mag submitted for registration supports HART Protocol Revision 7 as a nonburst mode external-powered electromagnetic flowmeter.

# TEST SUMMARIES

Test Class