Quality Assurance and Device Registration

Conformance Test Report

May 21, 2019

For the:

AMETEK Drexelbrook Radar DRx400/DRx500

Device Type 0x4EEA

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Executive Summary

On March 22, 2019, FieldComm Group received the AMETEK Drexelbrook Radar DRx400/DRx500 level meter for registration as per FieldComm Group *Quality Assurance and Device Registration Procedure*. (HCF_PROC-12).

This report summarizes testing and compliance assessment of the AMETEK Drexelbrook Radar DRx400/DRx500 level meter (Expanded Device Type Code 0x4EEA; Device Revision 0x01; Software Revision 0x00, Hardware Revision 0x01). The Radar DRx400/DRx500 is a private label version of the Krohne OPTIWAVE x400/x500 (Device Type 0x45B9).

FieldComm Group performed 98 tests during the course of assessing the Radar DRx400/DRx500 and analyzed the data produced.

Based on this testing and analysis, the Radar DRx400/DRx500 complies with the HART Communication Protocol Requirements.

The AMETEK Drexelbrook Radar DRx400/DRx500 submitted for registration is a burst mode 2-wire loop power field device that supports HART Protocol Revision 7.

1. INTRODUCTION

1.1 Contact Information

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1.2 DUT Identification

Manufacturer Name:	AMETEK Drexelbrook
Model Name(s):	Radar DRx400/DRx500
Manufacture ID Code (HEX):	0x004E
Expanded Device Type Code (HEX):	0x4EEA
Device ID (HEX):	0x051D96
Device Profile (HEX):	0x01
Device Revision:	0x01
Hardware Revision:	0x01
Software Revision:	0x00
HART Protocol Revision:	7
Burst Mode Support:	Yes
Physical Layers Supported:	FSK
FSK Physical Device Category:	2-wire high-impedance transmitter

1.3 Scope

This report summarizes the testing and compliance assessment of the AMETEK Drexelbrook Radar DRx400/DRx500 level meter (Expanded Device Type Code 0x4EEA; Device Revision 0x01).

As per the requirements in FieldComm Group *Quality Assurance and Device Registration Procedure* (HCF_PROC-12), the registration package supplied by AMETEK Drexelbrook was reviewed and audited (see Section 2).

The Radar DRx400/DRx500 is a wired device and the following tests were performed:

- **Physical Layer** – wired FSK interface
- **Token-Passing Data-Link Layer** –slave tests (Data-Link Layer Services: 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.

1.4 Overview

The Device Under Test (DUT) is an AMETEK Drexelbrook Radar DRx400/DRx500 level meter (Expanded Device Type Code 0x4EEA; Device Revision 0x01). The DUT is a 2-wire high-impedance transmitter as per the *FSK Physical Layer Specification* (HCF_SPEC-54). As such, the DUT must be tested per FieldComm Group *Quality Assurance and Device Registration Procedure* (HCF_PROC-12).

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 March 22, 2019, FieldComm Group received the DUT at FieldComm Group Austin offices and testing commenced shortly thereafter.

This report refers to the DUT with Expanded Device Type Code 0x4EEA, Device Revision 0x01, Software Revision 0x00, and Hardware Revision 0x01.

1.5 Limitation of Liability

This report summarizes the audits, testing and analysis used to assess the product's compliance with HART Communication Protocol requirements. The product's qualification for registration is solely based on (1) the applicable revision of the HART Communication Protocol Specifications; (2) the latest Standard Test Specifications and (3) the latest Standard Test Tools available from FieldComm Group at the time of this report's release. THIS REPORT DOES NOT IMPLY THAT FIELDCOMM GROUP PRODUCT REGISTRATION IS OR EVER HAS BEEN A CERTIFICATION PROGRAM. REGISTRATION DOES NOT CERTIFY THAT THE PRODUCT COMPLIES WITH ALL HART COMMUNICATION PROTOCOL REQUIREMENTS.

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THE FINDINGS DISCLOSED IN THIS REPORT ARE RELEVANT ONLY TO THE SAMPLE PROVIDED FOR TEST BY CLIENT.

1.6 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 FieldComm Group and the Product's Manufacturer.

1.7 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. Revision 7.5

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. Revision 3.0

FSK Physical Layer Test Specification, HCF_TEST-2. Revision 2.2

Slave Universal Command Test Specification, HCF_TEST-3. Revision 4.0

Slave Common Practice Command Test Specification, HCF_TEST-4. Revision 4.0

Device Registration Procedures

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

HCF Quality Assurance and Device Registration Procedure. HCF_PROC-12. Revision 2.3

Standard Forms

The following forms were used to summarize test results:

Slave Token-Passing Data-Link Test Summary. HCF_FRM-156.1. Revision 3.0

FSK Physical Layer Test Data Sheets. HCF_FRM-156.2. Revision 2.2

Slave Universal Command Test Summary. HCF_FRM-156.3. Revision 4.0

Slave Common Practice Command Test Summary. HCF_FRM-156.4. Revision 4.0

1.8 Test Equipment

The following equipment was used to perform the Conformance Test:

Physical Layer Test Kit. HCF_KIT-116. Revision 1.0

HART Test System. HCF_KIT-192. Revision 3.2

WaveTek Function Generator Model# FG3B. SN 707089

Kepco Model# BOP-50-2M SN 146556

Mactek RS-232 to HART Interface. SN 101923

Mactek RS-232 to HART Interface. SN 118196

National Instruments Scope Card Model# 5122. SN P10196230

IET Resistance Decade Box Model# RS-200. SN 02020914

IET Capacitance Decade Box Model# CS-300. SN 12089911

Fluke Multimeter Model# 77III. SN 77990287

HCF Analog Filter Model# HCF_TOOL-32. SN 0144

HCF Digital Filter Model# HCF_TOOL-31. SN 0184

1.9 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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2. REVIEW OF REGISTRATION PACKAGE

2.1 Registration 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	
Token-Passing Data-Link Test Summary. HCF_FRM-156.1	Yes	
FSK Physical Layer Test Data Sheets. HCF_FRM-156.2	Yes	
Slave Universal Command Test Summary. HCF_FRM-156.3	Yes	
Slave Common Practice Command Test Summary. HCF_FRM-156.4	Yes	
The product specification including device specific details as per *Field Device Specification Guide* (HCF_LIT-18)	Yes	Document: OPTIWAVE_x400x500_sys_HART_Field_Device_Specification_01.pdf
TP BA*.OUT (Token-Passing Data-Link) files	Yes	
TP DLL039a.qa.log and DLL039b.qa.log files	Yes	
TP UAL*.qa.log (Universal Command) files	Yes	
TP CAL*.qa.log (Common Practice Command) files	Yes	
Sample of device	Yes	
Purchase order for testing and registration fee	Yes	
Other supplied by manufacturer	Yes	Document: Manufacturer Declaration.pdf

2.2 Audit of manufacturer's test reports and data

2.2.1 FSK Physical Layer

The AMETEK Drexelbrook submittal of the FSK Physical Layer Test data (HCF_FRM-156.2) indicates the device passed all tests as a 2-wire high-impedance transmitter. The scope captures and measurement data are presented as required. The submitted results were consistent with FieldComm Group results.

2.2.2 Token-Passing Data-Link

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

2.2.3 Universal Command Application Layer

The submitted FSK results from AMETEK Drexelbrook indicated the device passed all Universal tests as a level meter.

2.2.4 Common Practice Command Application Layer

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

3. INDEPENDENT TESTING BY FIELDCOMM GROUP

As per *HCF Quality Assurance and Device Registration Procedure* (HCF_PROC-12), all devices submitted for registration shall be independently tested by FieldComm Group. This Section summarizes the testing performed by FieldComm Group and the resulting findings.

3.1 FSK Physical Layer

FieldComm Group conducted the FSK Physical Layer tests on the FSK-based interface port of the AMETEK Drexelbrook Radar DRx400/DRx500 level meter. The testing followed the procedures specified in the *FSK Physical Layer Test Specification* (HCF_TEST-2) to assess compliance with the *FSK Physical Layer Specification* (HCF_SPEC-54). The Radar DRx400/DRx500 was tested as a 2-wire high-impedance transmitter.

FieldComm Group conducted all 10 specified FSK Physical Layer tests. The DUT passed all tests.

3.2 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). FieldComm Group performed 46 Token-Passing Data Link Layer tests using HART Test System (HCF_KIT-192). All communications were recorded using HSniffer (HCF_TOOL-004) 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 Radar DRx400/DRx500 is a burst mode transmitter. The results are summarized in Annex A2 and the DUT passed all applicable tests.

3.3 Universal Command Application Layer

FieldComm Group executed all 16 Universal Command Application Layer tests using the HART Test System (HCF_KIT-192) 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.

3.4 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) provides standard test specifications for many common practice commands.

FieldComm Group executed all of the test automation available for the Common Practice Application Layer tests using the HART Test System (HCF_KIT-192) 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, 38, 42, 50, 51, 55, 60, 61, 62, 63, 64, 65, 66, 67, 68, 79, 103, 104, 105, 107, 108, and 109.

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

The DUT supports Device Specific Commands 150, 151, 156, 157, 158, 159, 164, 180, 181, 182, 188, 190, 191, 196, 197, 198, 199, 200, 201, 204, 210, 211, 216, 217, 222, 223, 224, 225, 230, 231, 232, and 233.

The AMETEK Drexelbrook Radar DRx400/DRx500 level meter (Expanded Device Type Code 0x4EEA, Device Revision 0x01) meets all the requirements for registration based on FieldComm Group *Quality Assurance and Device Registration Procedure* (HCF_PROC-12). Testing and analysis of the Radar DRx400/DRx500 demonstrated the product compliance with the HART Communication Protocol Requirements.

The AMETEK Drexelbrook Radar DRx400/DRx500 submitted for registration supports HART Protocol Revision 7 as a burst mode 2-wire loop power level meter.

TEST SUMMARIES

A1. FSK Physical Layer

The following table summarizes the FSK Physical Layer test results of the FSK port of the DUT. The device was tested as 2-wire loop power level meter.

DUT Identification

Manufacturer Name: AMETEK Drexelbrook

Model Name(s): Radar DRx400/DRx500

Manufacture ID Code(HEX): 0x004E

Expanded Device Type code : 0x4EEA

Device ID (HEX): 0x051D96

Test Result Summary

Test	Description	Result
13.1	Wave shape	**Pass**
13.2	Carrier Start / Stop	**Pass**
	Carrier Decay Timing	**Pass**
13.3	Carrier Start / Stop Transient	**Pass**
13.4	Output Noise During Silence	**Pass**
13.5	Analog Rate of Change	**Pass**
13.6	Receive Impedance Measurement	**Pass**
	Rx = 300K ohms, Cx = 10 nF	
13.7	Send Impedance	**NA**
13.8	Noise Sensitivity	**Pass**
13.9	Carrier Detect Level	**Pass**
	Carrier Detect Start / Stop	**Pass**

A2. Token-Passing Data-Link Layer

The Token-Passing Data-Link Layer tests were performed via the FSK interface.

DUT Identification

Manufacturer Name: AMETEK Drexelbrook

Model Name(s): Radar DRx400/DRx500

Manufacture ID Code(HEX): 0x004E

Expanded Device Type code : 0x4EEA

Device ID (HEX): 0x051D96

Test Result Summary

Test title	Result	Deposition	Comments
DLL001a: FSK Preamble Check-More Preamble Bytes Than Requested	**Pass**		
DLL001b: FSK Preamble Check-From 5 up to Number Requested Preamble Bytes	**Pass**		
DLL001c: FSK Preamble Check-0 or 1 Preamble Bytes	**Pass**		
DLL001d: FSK Preamble Check-Non 0xFF in Last Two Preamble Bytes	**Pass**		
DLL001e: FSK Preamble Check-Non 0xFF Followed By Two 0xFF Bytes	**Pass**		
DLL001f: FSK Preamble Check-Preamble Sequences with Non 0xFF Values	**Pass**		
DLL002: Delimiter Check	**Pass**		
DLL003: Frame Expansion Check	**Pass**		
DLL004: Short Frame Check	**Pass**		
DLL005: Master Address Bit Check	**Pass**		
DLL006: Burst Mode Bit Check	**Pass**		
DLL007: Long Frame Address Check	**Pass**		
DLL009: Incorrect Byte Count Check	**Pass**		
DLL010: Vertical Parity Check	**Pass**		
DLL011: Framing Error Check	**Pass**		
DLL012: Check Byte Test	**Pass**		
DLL013: FSK Gap Receive Timeout Test	**Pass**		
DLL014: Long Message Test	**Pass**		
DLL015: Start Of Message In Data Field Check	**Pass**		
DLL016: Preamble Check For BACK Frames	**Pass**		

DLL017: Preamble Check For ACK Frames	**Pass**		
DLL018: Gap Errors in ACK Frames Check	**Pass**		See CR #5076[1]
DLL019: Gap Check For BACK Frames	**Pass**		
DLL020: Dribble Byte Check For ACK Frames	**Pass**		
DLL021: Dribble Byte Test For BACK Frames	**Pass**		
DLL022: Test Host Address Bit For BACK Frames	**Pass**		
DLL023: Test Burst Mode Bit Of Burst-Mode Slave Frames	**Pass**		
DLL024a: Test Slave Responds Within STO-Verify STO for Selected Universal Commands	**Pass**		
DLL024b: Test Slave Responds Within STO-Verify STO for All Commands	**Pass**		
DLL024c: Test Slave Responds Within STO-Verify STO for Extended Command Numbers	**Pass**		
DLL025: Burst Hold During Master Preamble	**Pass**		
DLL026: Test Burst Response Time After a DUT ACK	**Pass**		
DLL027: Test Response Time Between Consecutive Bursts	**Pass**		
DLL028: BACK Timing with STXs Errors	**Pass**		
DLL029: Burst Mode Timeout On Other Slave	**Pass**		
DLL030: Burst After Response From Other Slave	**Pass**		
DLL032: Read Unique Identifier (Command 0)	**Pass**		
DLL033a: Write Polling Address (Command 6)-Test All Polling Addresses	**Pass**		
DLL033b: Write Polling Address (Command 6)-Test Invalid Data Fields	**Pass**		
DLL033c: Write Polling Address (Command 6)-Test Loop Current Signaling	**Pass**		
DLL034: Read Unique Identifier with Tag (Command 11)	**Pass**		
DLL035: Write Number Of Response Preambles (Command 59)	**Pass**		

[1] **CR#5076** Working Group decision in November 2014 rendered Update Failure deprecated. Response Code 0x08 "Update Failure" is now ignored and treated same as 0x00 "Success".

DLL036a: Write Burst Mode Command Number (Command 108)-Verify Mandatory Burst Commands	**Pass**		See CR #5523[1]
DLL036b: Write Burst Mode Command Number (Command 108)-BACK Changes Command Response In Burst Mode	**Pass**		
DLL036c: Write Burst Mode Command Number (Command 108)-Support for 16-Bit Burst Command Numbers	**Pass**		
DLL036d: Write Burst Mode Command Number (Command 108)-Support for Multiple Burst Messages	**Pass**		
DLL037a: Burst Mode Control (Command 109)-Enable/Disable Burst Mode	**Pass**		
DLL037b: Burst Mode Control (Command 109)-Verify Burst mode through power cycles, self-test, reset	**Pass**		
DLL037c: Burst Mode Control (Command 109)-Verify Supported Burst Mode Control Codes	**Pass**		
DLL037d: Burst Mode Control (Command 109)-Support for Multiple Burst Messages	**Pass**		
DLL038: Read Unique Identifier With Long Tag (Command 21)	**Pass**		
DLL039a: Slave Time-Out Stress Test-Verify Cyclical Data Access	**Pass**		
DLL039b: Slave Time-Out Stress Test-Verify Write Commands	**Pass**		
DLL040: Unique Address Test	**Pass**		
DLL041: Framing Successive Messages	**Pass**		
DLL042: Command Number Expansion	**Pass**		
DLL043a: Write Burst Device Variables-Basic Command 107 Support	**Pass**		
DLL043b: Write Burst Device Variables-Command 107 Support Across Burst Messages	**Pass**		
DLL044a: Support for Multiple Burst Messages-Verify support for at least 3 Burst Messages	**Pass**		
DLL044b: Support for Multiple Burst Messages-Verify on-the-fly burst configuration changes	**Pass**		

[1] **CR#5523** Allow RC8 to CMD108 since test system does not know prior configuration. See also CR#4348.

DLL045: Smart Data Publishing	**Fail**	**Pass**	1011 Command 9 Average Update Period (4.52) seconds is not within 10 percent of the Update Period (4.00) seconds. See CR #4269[1]

[1] **CR#4269** Requesting allowance for multiple BACKs in the average calculation of the CMD9 BACK (0 to 4 seconds). Test case is considered passed.

A3. Universal Command Application Layer

The Universal Command Application Layer tests were performed via the FSK interface. The following tables summarize the test results from performing the Universal Command Application Layer tests.

DUT Identification

Manufacturer Name: AMETEK Drexelbrook

Model Name(s): Radar DRx400/DRx500

Manufacture ID Code(HEX): 0x004E

Expanded Device Type code : 0x4EEA

Device ID (HEX): 0x051D96

Test Result Summary

Test title	Result	Deposition	Comments
UAL000: Confirm All Universal Commands Supported	**Pass**		
UAL001: Read Dynamic Variables(Commands 1, 2, and 3)	**Pass**		Number of Dynamic Variables = 4
UAL005: Write Message	**Pass**		
UAL006: Write Tag Descriptor and Date	**Pass**		
UAL007: Verify Command 14 and 15 Response	**Pass**		
UAL008: Write Final Assembly Number	**Pass**		
UAL009: Verify Write Protect	**Pass**		
UAL010: Verify Cold Start Bit	**Pass**		
UAL011a: Read Device Variables (Command 9)- Checking for Supported Device Variables	**Pass**		
UAL011b: Read Device Variables (Command 9)-Checking for Supported Device Variables	**Pass**		
UAL012: Read Dynamic Variable Classification	**Pass**		
UAL013: Write Long Tag	**Pass**		
UAL038a: Reset Configuration Changed Flag- Without Configuration Changed Counter	**Pass**		
UAL038b: Reset Configuration Changed Flag-With Configuration Changed Counter	**Pass**		
UAL048a: Read Additional Device Status-Basic checking of Command 48	**Pass**		
UAL048b: Read Additional Device Status-Clearing the "More Status Available" bit	**Pass**		

A4. Common Practice Command Application Layer

The Common Practice Command Application Layer tests were performed via the FSK interface. The following tables summarize the test results from performing the Common Practice Command Application Layer tests.

DUT Identification

Manufacturer Name: AMETEK Drexelbrook

Model Name(s): Radar DRx400/DRx500

Manufacture ID Code(HEX): 0x004E

Expanded Device Type code : 0x4EEA

Device ID (HEX): 0x051D96

Test Result Summary

Test title	Result	Deposition	Comments
CAL000: Checks for Common Practice Commands	**Pass**		
CAL001: Write Protect Test	**Pass**	**Not Applicable**	
CAL033: Read Device Variables	**Pass**		
CAL034: Write Primary Variable Damping Value	**Pass**		
CAL035: Write Primary Variable Range Values	**Pass**		
CAL036: Set Primary Variable Upper Range Value	**Pass (test aborted)**	**Not Applicable**	5000 Command 36 is not implemented
CAL037: Set Primary Variable Lower Range Value	**Pass (test aborted)**	**Not Applicable**	5000 Command 37 is not implemented
CAL040: Enter/Exit Fixed Current Mode	**Fail**		6588 (6566) Returned value 12.285007 is not within 5 percent of 4.250000 See CR #5442[1]
CAL041: Perform Self-Test	**Pass**		
CAL042: Perform Device Reset	**Pass**		
CAL043: Set Primary Variable Zero	**Pass (test aborted)**	**Not Applicable**	5000 Command 43 is not implemented
CAL044: Write Primary Variable Units	**Pass**		
CAL045: Trim Loop Current Zero	**Pass**		
CAL046: Trim Loop Current Gain	**Pass**		

[1] **CR#5442** DUT requires a few more milliseconds to read the change in actual current than the automated test case allows. Manual testing proved the DUT is conformant.

CAL047: Write Primary Variable Transfer Function	**Pass (test aborted)**	**Not Applicable**	5000 Command 47 is not implemented
CAL049: Write Primary Variable Transducer Serial Number	**Pass**		
CAL050: Read Dynamic Variable Assignments	**Pass**		
CAL051: Write Dynamic Variable Assignments	**Pass**		
CAL052: Set Device Variable Zero	**Pass (test aborted)**	**Not Applicable**	5000 Command 52 is not implemented
CAL053: Write Device Variable Units	**Pass**		
CAL054: Read Device Variable Information	**Pass**		
CAL055: Write Device Variable Damping Value	**Pass**		
CAL056: Write Device Variable Transducer Serial Number	**Pass (test aborted)**	**Not Applicable**	5000 Command 56 is not implemented
CAL071a: Lock Device- Basic Lock Testing	**Pass**		
CAL071b: Lock Device- Write Lock on TDMA Products	**Pass (test aborted)**	**Not Applicable**	5001 This test is only applicable to wireless devices.
CAL072: Squawk	**Pass (test aborted)**	**Not Applicable**	5002 Warning, Implementation of Command 72 is strongly recommended. This command is implemented by most Field Devices and widely used in Host Applications.
CAL073: Find Device	**Pass (test aborted)**	**Not Applicable**	5002 Command 73 not implemented
CAL074a: Verify I/O System Commands-Basic I/O and Sub-device Tests	**Pass (test aborted)**	**Not Applicable**	5125 Command 74 is not implemented.
CAL074b: Verify I/O System Commands-HART 7 I/O and Sub-device Testing	**Pass (test aborted)**	**Not Applicable**	5125 Command 74 is not implemented.
CAL074c: Verify I/O System Commands-Command 87 and 88 Testing	**Pass (test aborted)**	**Not Applicable**	5125 Command 74 is not implemented.
CAL074d: Verify I/O System Commands-I/O System and Sub-device Statistics	**Pass (test aborted)**	**Not Applicable**	5125 Command 74 is not implemented.

CAL078: Command Aggregation	**Pass[1]**	**Not Applicable**	
CAL079: Write Device variable	**Pass**	**Not Applicable**	
CAL080: Verify Device Variable Trim Commands	**Pass**	**Not Applicable**	
CAL091a: Trending- Basic Trending Operation	**Pass**	**Not Applicable**	
CAL091b: Trending-Basic Command 92 Testing	**Pass**	**Not Applicable**	
CAL091c: Trending-Support for multiple trends	**Pass**	**Not Applicable**	
CAL101: Subsystem Burst Mode	**Pass**	**Not Applicable**	
CAL115a: Event Notification-Basic Tests for all HART devices	**Pass**	**Not Applicable**	
CAL115b: Event Notification-Queuing of multiple events	**Pass**	**Not Applicable**	
CAL115c: Event Notification-Events and sub-devices	**Pass**	**Not Applicable**	
CAL512: Country Code	**Pass**	**Not Applicable**	

[1] FieldComm Group does not have standard test automation for CAL078, CAL079, CAL080, CAL091, CAL115, and CAL512. Consequently the test administrator used the Generic Device Description of the DD-IDE and manually monitored DUT Communication to confirm compliance with these test requirements.