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## **HART Field Device Test Report**

HCF\_FRM-156. FCG FR20156. Rev. 6.0b

31 July 2020

### **INSTRUCTIONS**

This Test Report and all the fields it contains shall be completed for each Field Device registration submission (test campaign). In addition, some tests require additional data to be recorded (e.g., listing the Device Variables found during testing, oscilloscope captures). This data must be attached to the Test Report.

This Test Report provides a record of the testing; will satisfy most Quality Assurance Audits and provides sufficient detail to allow the test results to be reproduced. This Test Report must be included with the registration of the manufacturer's Field Device with FieldComm Group.

### **1. TEST OPERATOR**

Name	_____	Company	_____
Title	_____	Address	_____
Tel. No.	_____		_____
FAX No.	_____		_____
EMail	_____		_____

### **2. CERTIFICATION**

I hereby affirm that all data provided in this Test Report is accurate and complete.

Signature	_____	Date	_____
Name	_____		
Title	_____		

### **3. TEST DEVICE IDENTIFICATION**

Manufacturer Name:	_____	Model Name(s):	_____
Manufacture ID Code:	(      Hex )	Device Type Code:	(      Hex )
Device ID	Hex		
HART Protocol Revision	_____	Device Revision:	_____
Hardware Revision	_____	Software Revision:	_____
Revision Release Date	_____		
Physical Layers Supported	_____	Notes:	_____
Physical Device Category	_____		_____



#### 4. SLAVE TOKEN-PASSING DATA-LINK LAYER TEST DATA<sup>1</sup>

**Table 1. Slave Token-Passing Data-Link Layer Test Data**

Test	Result
DLL001 FSK Preamble Check	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL002 Delimiter Check	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> With Frame Exp.
DLL003 Frame Expansion Check	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> With Frame Exp.
DLL004 Short Frame Check	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL005 Master Address Bit Check	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL006 Burst Mode Bit Check	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL007 Long Frame Address Check	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL009 Incorrect Byte Count Check	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL010 Vertical Parity Check	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL011 Framing Error Check	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL012 Check Byte Test	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL013 FSK Gap Receive Timeout Test	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL014 Long Message Test	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL015 Start Of Message In Data Field Check	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL016 Preamble Check For BACK Frames	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
DLL017 Preamble Check For ACK Frames	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL018 Gap Errors in ACK Frames Check	<input type="checkbox"/> Pass <input type="checkbox"/> Fail Device Variables (List)
DLL019 Gap Check For BACK Frames	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
DLL020 Dribble Byte Check For ACK Frames	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL021 Dribble Byte Test For BACK Frames	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
DLL022 Test Host Address Bit For BACK Frames	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
DLL023 Test Burst Mode Bit Of Burst-Mode Slave Frames	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
DLL024 Test Slave Responds Within STO	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL025 Burst Hold During Master Preamble	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
DLL026 Test Burst Response Time After a DUT ACK	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable <input type="checkbox"/> Long Response Time
DLL027 Test Response Time Between Consecutive Bursts	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable <input type="checkbox"/> Long Response Time
DLL028 BACK Timing with STXs Errors	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable <input type="checkbox"/> Long Response Time

<sup>1</sup> Per Slave Token-Passing Data Link Layer Test Specification Rev 4.0



Test	Result
DLL029 Burst Mode Timeout On Other Slave	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable <input type="checkbox"/> Long Response Time
DLL030 Burst After Response From Other Slave	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable <input type="checkbox"/> Long Response Time
DLL032 Read Unique Identifier	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> >5 Request Preambles Suggested
DLL033 Write Polling Address	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL034 Read Unique Identifier with Tag (Command 11)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL035 Write Number Of Response Preambles	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
DLL038 Read Unique Identifier with Tag (Command 21)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL039 Slave Time-Out Stress Test	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Long Preamble Sequence Detected Total Non-Responses=
DLL040 Unique Address Test	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL041 Framing Successive Messages	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
DLL042 Command Number Expansion	<input type="checkbox"/> Pass <input type="checkbox"/> Fail    Not Applicable



## 5. PHYSICAL LAYER TEST DATA<sup>2</sup>

Device designed to meet *FSK Physical Layer Specification*<sup>3</sup>: ☐ 7.2 ☐ 8.0 ☐ 8.1 ☐ 9.1

Physical Device Type: ☐ Current Input ☐ Current Output  
☐ Voltage Input ☐ Voltage Output  
☐ Secondary ☐ Transmitter  
☐ Actuator ☐ Non-DC Isolated Bus Device  
☐ DC Isolated Bus Device

Impedance Type: ☐ High Impedance ☐ Low Impedance

Does this product require any special configuration settings or installation techniques for the device to pass all the physical layer tests? If so, these must be included in the product's user documentation.

- ☐ Yes, all special configuration and installation requirements are included in product's user documentation.  
☐ No

Does your company plan to publish Rx and Cx impedance values in your end user product manual?

- ☐ Yes ☐ No plans on inclusion in manual

100% pass of tests for HART Compliance is required. The following test summary must be included in submission of test results.

**Table 2. Physical Layer Test Data**

Test	Result
Waveshape	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Carrier Start Timing	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Carrier Stop Timing	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Carrier Decay Timing	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Carrier Start Transient	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Carrier Stop Transient	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Output Noise During Silence	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Analog Rate of Change	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
Receive Impedance Measurement	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
High Impedance: Rx = _____ Cx= _____	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
Low Impedance: Rx = _____ Cx= _____ Delta Z = _____	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A <input type="checkbox"/> Pass <input type="checkbox"/> Fail
Secondary: Zm = _____	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
Send Impedance	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
Noise Sensitivity	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Carrier Detect Level	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Carrier Detect Start / Stop	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

<sup>2</sup> Per *FSK Physical Layer Test Specification* Rev 2.2

<sup>3</sup> Devices complying with HART 6 or later must meet requirements of *FSK Physical Layer Specification* Rev 9.1



## 5.1 Waveshape

Test description can be found in Section 13.1 of *FSK Physical Layer Test Specification*.

Insert Oscilloscope Picture Here

**Figure 1. Transmit waveform @ 1200 Hz**

**Table 3. 1200Hz Waveform Test Data**

Test	Result
Measured Frequency: _____ Hz (1188-1212 Hz)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Measured Amplitude: _____ mVpp (400-800 mVpp; Lo Z) (400-600 mVpp; Hi Z)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
Measured Value of Current Sense Resistor: _____ $\Omega$	
Waveform Rise Time Characteristics: _____ (75 - 200 $\mu$ s)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Waveform Fall Time Characteristics: _____ (75 - 200 $\mu$ s)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail



Insert Oscilloscope Picture Here

**Figure 2. Transmit waveform @ 2200 Hz**

**Table 4. 2200Hz Waveform Test Data**

Test	Result
Measured Frequency: _____ Hz (2178-2222 Hz)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Measured Amplitude: _____ mVpp (400-800 mVpp; Lo Z) (400-600 mVpp; Hi Z)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A <input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
Measured Value of Current Sense Resistor: _____ $\Omega$	
Waveform Rise Time Characteristics: _____ (75 - 200 $\mu$ s)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Waveform Fall Time Characteristics: _____ (75 - 200 $\mu$ s)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail



## 5.2 Carrier Start/Stop/Decay

Test description can be found in Section 13.2 of *FSK Physical Layer Test Specification*.

Insert Oscilloscope Picture Here

**Figure 3. Carrier Start Waveform**

**Table 5. Carrier Start Time**

Test	Result
Measure Carrier Start Time: _____ ( $< 5$ bit times, 4.2 ms)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail



Insert Oscilloscope Picture Here

**Figure 4. Carrier Stop/Decay Waveform**

**Table 6. Carrier Stop/Decay Times**

Test	Result
Measure Stop Time: _____ (< 3 bit times, 2.5 ms)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Measure Decay Time: _____ (< 6 bit times, 5.0 ms)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail





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### 5.3 Carrier Start/Stop Transient

Test description can be found in Section 13.3 of *FSK Physical Layer Test Specification*.



Insert Oscilloscope Picture Here

**Figure 5. Carrier Start Transient Waveform**



Insert Oscilloscope Picture Here

**Figure 6. Carrier Stop Transient Waveform**

**Table 7. Peak Carrier Start/Stop Transient Data**

DC average output of test filter: \_\_\_\_\_

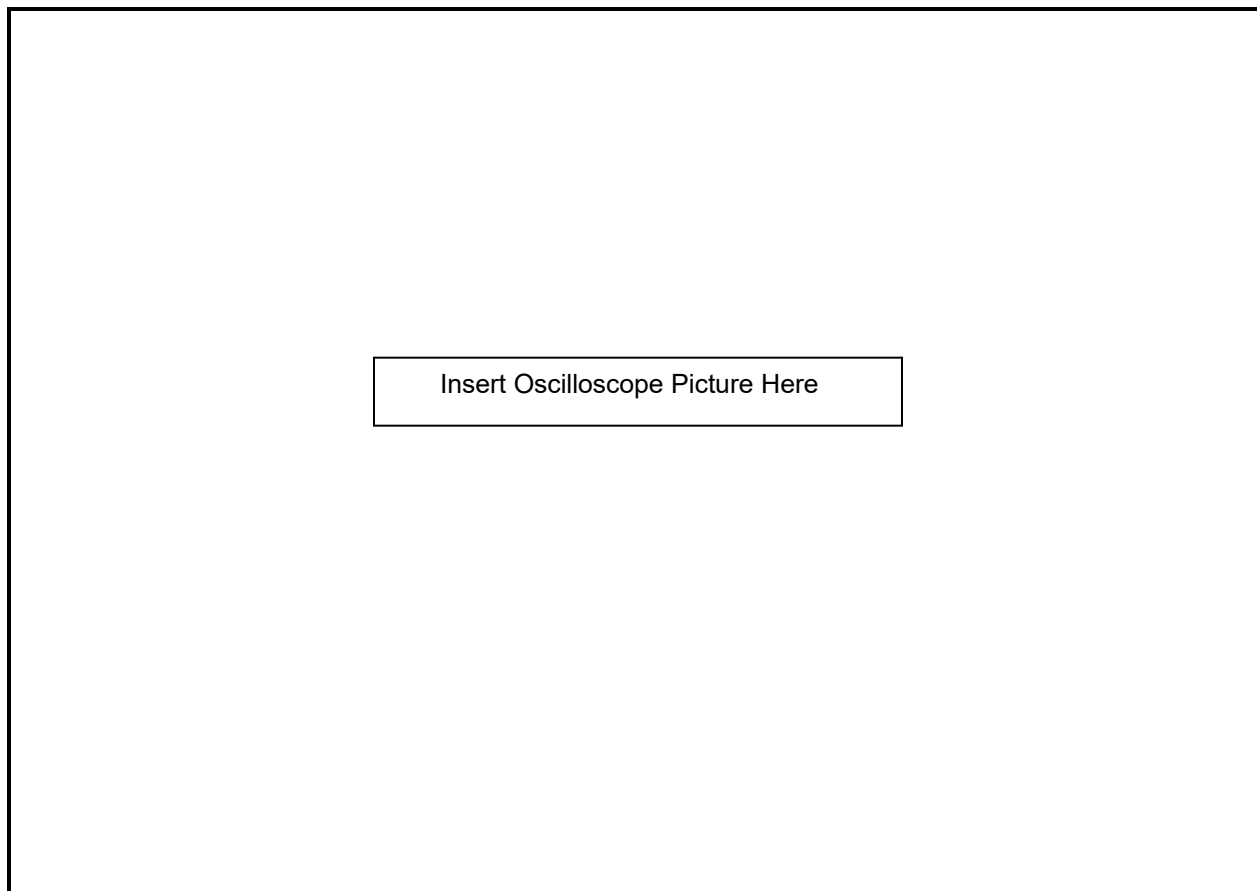
Test	Result
Carrier Start Peak Analog Filter Output: _____ (100mV max <sup>4</sup> )	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Carrier Stop Peak Analog Filter Output: _____ (100mV max <sup>4</sup> )	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

<sup>4</sup> The 100 mV Peak test criteria includes the filter gain of 10



## 5.4 Output Noise During Silence

Test description can be found in Section 13.4 of *FSK Physical Layer Test Specification*. The noise test is performed with an oscilloscope and a DVM. Oscilloscope picture (no filtering allowed with oscilloscope) of noise is required for the broadband test only.



**Figure 7. Unfiltered Broadband Output Noise Waveform**

**Table 8. Output Noise During Silence Data**

Test	Result
Broadband noise without a filter: Output Noise = _____ mV RMS (138 mV RMS Max.)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
In-band (500Hz-10 kHz) noise using HART Digital Test Filter: Output Noise = _____ mV RMS (22 mV RMS Max. <sup>5</sup> )	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A <sup>6</sup>

☐ No filter was used<sup>6</sup>

<sup>5</sup> The 22 mV RMS test criteria includes the filter gain of 10

<sup>6</sup> In-band noise test is not required when broadband noise (no filter is used) is less than 2.2 mV RMS.



## 5.5 Analog Rate of Change

Test description can be found in Section 13.5 of *FSK Physical Layer Test Specification*.

Insert Oscilloscope Picture Here

**Figure 8. Analog Signaling Waveform**

**Table 9. Analog Rate of Change Data**

Test device's A/D sampling rate: \_\_\_\_\_ Hz

Test device's worst case sensor range-down: \_\_\_\_\_

Test device's damping setting (minimum setting if applicable): \_\_\_\_\_

Test	Result
Analog signaling filtered signal magnitude: _____ mVpp (150 mVp max. <sup>7</sup> )	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
Communication errors during analog signaling (100 communication attempts): _____/ 100 (0/100 required for a PASS)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

<sup>7</sup> The 150 mVp test criteria includes the filter gain of 10



## 5.6 Receive Impedance

Test description can be found in Section 13.6 of *FSK Physical Layer Test Specification*.

### 5.6.1 High Impedance and Low Impedance Devices

Table 10. Test Data for High & Low Impedance Devices

Case connect to (+) terminal				Case connect to (-) terminal			
Frequency	V <sub>a</sub>	V <sub>b</sub>	Z <sub>m</sub> <sup>8</sup>	Frequency	V <sub>a</sub>	V <sub>b</sub>	Z <sub>m</sub> <sup>8</sup>
200 Hz <sup>9</sup>				200 Hz <sup>9</sup>			
500 Hz				500 Hz			
950 Hz				950 Hz			
1.6 kHz				1.6 kHz			
2.5 kHz				2.5 kHz			
5 kHz				5 kHz			
10 kHz				10 kHz			
20 kHz <sup>10</sup>				20 kHz <sup>10</sup>			
50 kHz <sup>10</sup>				50 kHz <sup>10</sup>			

Impedance shall be calculated over the Normal Frequency Band. Data is recorded outside the Normal Frequency Band to calculate the variance of impedance for low impedance devices as well as providing additional data points when graphically determining the values for R<sub>x</sub> and C<sub>x</sub> for high impedance devices.

Is device ground-referenced? ☐ No

☐ Yes; Nature of ground reference: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

<sup>8</sup>  $Z_m = V_b R / V_a$  Where R=5000 Ω for a High Impedance Device or 250 Ω for a Low Impedance Device

<sup>9</sup> Outside the HART Extended Frequency Band for high impedance devices.

<sup>10</sup> Outside the HART Extended Frequency Band for low impedance devices.

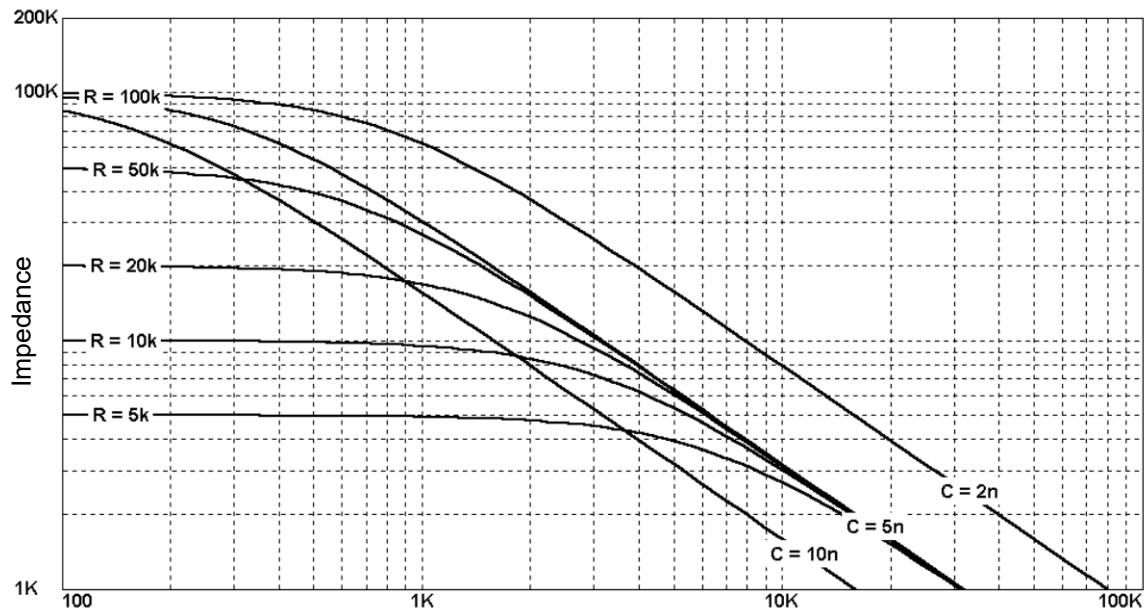


Figure 9. High Impedance Magnitude Graph

Table 11. Test Data for High Impedance Devices

1. Published  $R_x$  and  $C_x$  estimated from Impedance Magnitude data:

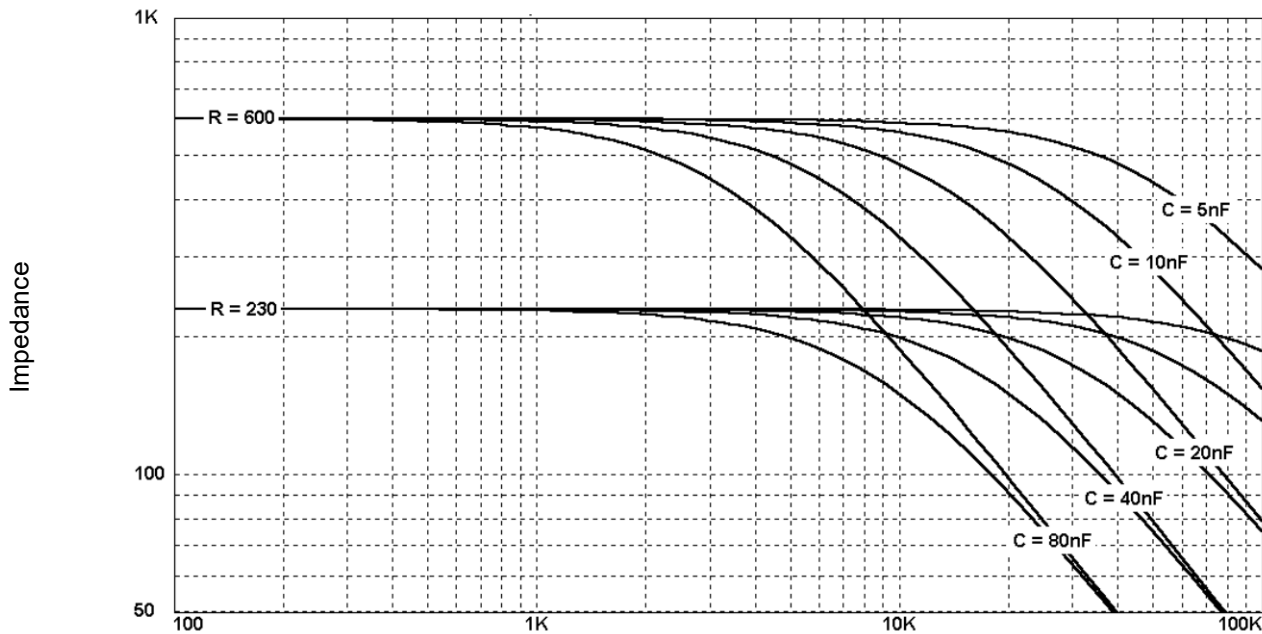
$R_x$ : \_\_\_\_\_  $\Omega$  ☐  $C_x$ : \_\_\_\_\_ pF

2. Typical multidrop current \_\_\_\_\_ mA; ☐ N/A<sup>11</sup>,

3. Non-Powered Measurements:  $R_{tg}(+) =$  \_\_\_\_\_;  $C_{tg}(+) =$  \_\_\_\_\_

☐ N/A  $R_{tg}(-) =$  \_\_\_\_\_;  $C_{tg}(-) =$  \_\_\_\_\_

<sup>11</sup> Device does not support multidrop. Devices complying with HART 6 or later must support multidrop



**Figure 10. Low Impedance Magnitude Graph**

**Table 12. Test Data for Low Impedance Devices**

1. Minimum Receive Impedance,  $Z_{in}$ , from Figure 10 (500 -10,000 Hz): \_\_\_\_\_  $\Omega$
2. ☐ Maximum Receive Impedance,  $Z_{in}$ , from Figure 10 (500 -10,000 Hz): \_\_\_\_\_  $\Omega$
3. Maximum Impedance/ Minimum Impedance = \_\_\_\_\_ (spec = +/- 3 dB; i.e. <2)

☐ Pass ☐ Fail ☐ N/A

4. Minimum Receive Impedance,  $Z_{in}$ , from Figure 10 (950 -2500 Hz): \_\_\_\_\_  $\Omega$
5. Maximum Receive Impedance,  $Z_{in}$ , from Figure 10 (950 -2500 Hz): \_\_\_\_\_  $\Omega$

230  $\Omega$  <  $Z_{in}$  < 600  $\Omega$  ☐ Pass ☐ Fail

6. Published  $R_x$  and  $C_x$  estimated from Impedance Magnitude data:

$R_x$ : \_\_\_\_\_  $\Omega$ ;  $C_x$ : \_\_\_\_\_ pF

7. Non-Powered Measurements:  $R_{tg}(+) =$  \_\_\_\_\_;  $C_{tg}(+) =$  \_\_\_\_\_

☐ N/A  $R_{tg}(-) =$  \_\_\_\_\_;  $C_{tg}(-) =$  \_\_\_\_\_



## 5.6.2 Secondary Devices

**Table 13. Test Data for (Powered) Secondary Devices**

Powered - Normal Polarity				Powered - Reverse Polarity			
Frequency	V <sub>a</sub>	V <sub>b</sub>	Z <sub>m</sub> <sup>8</sup>	Frequency	V <sub>a</sub>	V <sub>b</sub>	Z <sub>m</sub> <sup>8</sup>
950 Hz				950 Hz			
1.6 kHz				1.6 kHz			
2.5 kHz				2.5 kHz			

**Table 14. Test Data for (Un-Powered) Secondary Devices**

Device Off - Normal Polarity				Device Off - Reverse Polarity			
Frequency	V <sub>a</sub>	V <sub>b</sub>	Z <sub>m</sub> <sup>8</sup>	Frequency	V <sub>a</sub>	V <sub>b</sub>	Z <sub>m</sub> <sup>8</sup>
950 Hz				950 Hz			
1.6 kHz				1.6 kHz			
2.5 kHz				2.5 kHz			

**Table 15. Test Data for High Impedance Devices**

1. Minimum Receive Impedance, Z<sub>m</sub>, all configurations, 950 Hz - 2.5 kHz: \_\_\_\_\_ Ω

☐ Pass ☐ Fail (specification > 5 kΩ)

2. Non-Powered Measurements:

R<sub>tg</sub> (+) = \_\_\_\_\_; C<sub>tg</sub> (+) = \_\_\_\_\_

☐ N/A

R<sub>tg</sub> (-) = \_\_\_\_\_; C<sub>tg</sub> (-) = \_\_\_\_\_





## 5.7 Send Impedance – Low Impedance and Secondary Devices

The calculated send impedance as outlined in Section 13.7.4 of *FSK Physical Layer Test Specification* (using the 1.2 and 2.2 kHz data)

### 5.7.1 Secondary Device:

**Table 16. Test Data for Secondary Device Send Impedance<sup>12</sup>**

Test Load	Frequency	V1	V2	Zout
500 $\Omega$	1200 Hz		N/A	_____ $\Omega^*$
230 $\Omega$	1200 Hz	N/A		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
500 $\Omega$	2200 Hz		N/A	_____ $\Omega^*$
230 $\Omega$	2200 HZ	N/A		<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Secondary Receive Impedance, Zin: \_\_\_\_\_  $\Omega$  (from previous section)

### 5.7.2 Actuator Device

**Table 17. Test Data for Actuator Device Send Impedance<sup>12</sup>**

Test Load	Frequency	V1	V2	Zout
5 k $\Omega$	1200 Hz		N/A	_____ $\Omega^*$
1 k $\Omega$	1200 Hz	N/A		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
5 k $\Omega$	2200 Hz		N/A	_____ $\Omega^*$
1 k $\Omega$	2200 HZ	N/A		<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Low Impedance Receive Impedance, Zin: \_\_\_\_\_  $\Omega$  (from previous section)

### 5.7.3 Current Input Device

**Table 18. Test Data for Current Input Device Send Impedance<sup>12</sup>**

Test Load	Frequency	V1	V2	Zout
10 k $\Omega$	1200 Hz		N/A	_____ $\Omega^*$
1 k $\Omega$	1200 Hz	N/A		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
10 k $\Omega$	2200 Hz		N/A	_____ $\Omega^*$
1 k $\Omega$	2200 HZ	N/A		<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Current Input Receive Impedance, Zin: \_\_\_\_\_  $\Omega$  (from previous section)

<sup>12</sup> Test Criteria: (Send Zout x 0.80) < Receive Zin



## 5.8 Noise Sensitivity Tests

Test description can be found in Section 13.8 of *FSK Physical Layer Test Specification*.

**Table 19. Test Data for Noise Sensitivity**

Type of Interference	Frequency	Level	# of Errors (of 100 attempts)	Result <sup>13</sup>
In Band	1700 Hz	55 mVpp		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Out of Band	250 Hz	220 mVpp		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Out of Band	125 Hz	880 mVpp		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Out of Band	63 Hz	3.52 Vpp		<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Out of Band	29 Hz	16 Vpp <sup>14</sup>		<input type="checkbox"/> Pass <input type="checkbox"/> Fail

## 5.9 Carrier Detect Level

Test description can be found in Section 13.9 of *FSK Physical Layer Test Specification*.

**Table 20. Carrier Detect Test Data**

Parameter / Signaling Amplitude <sup>15</sup>	Result
Successful Error-Free Communications 120 mVpp	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Unsuccessful Communications 80 mVpp	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
Successful Error-Free Communications 120 mVpp	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

Value of Current Sense resistor: \_\_\_\_\_  $\Omega$

Type of HART Modem used: \_\_\_\_\_

### 5.9.1 Carrier Detect Start / Stop

**Table 21. Direct Measurement 16**

Start Time:	ms	(< 6 bit times, 5 ms)	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A
Stop Time:	ms	(< 6 bit times, 5 ms)	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input type="checkbox"/> N/A

**Table 22. Indirect Measurement**

Start - DUT responds to a message that has 3 preambles	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A
Time between end of carrier of Primary Master's request to end of carrier of slave's response: _____ ms (< 256.7 ms + response length)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> N/A

<sup>13</sup> No Allowable Errors

<sup>14</sup> A lower level of inject noise is allowable for Low Impedance Devices with integral current sense resistors

<sup>15</sup> If the 1200 and 2200 Hz signaling frequencies are of different amplitudes, the signaling level should be set using the signal of lesser amplitude

<sup>16</sup> Using the carrier detect signal in the DUT's modem



## 6. SLAVE UNIVERSAL COMMAND TEST DATA<sup>17</sup>

**Table 23. Slave Universal Command Test Data**

Test	Result
UAL000 Confirm All Universal Commands Supported	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
UAL001 Read Dynamic Variables (Commands 1, 2, and 3)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail Number of Dynamic Variables =
UAL005 Write Message	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
UAL006 Write Tag Descriptor and Date	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Invalid Date Detection Supported
UAL007 Verify Command 14 and 15 Response	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Sensor Limits Not Supported
UAL008 Write Final Assembly Number	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
UAL009 Verify Write Protect	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
UAL010 Verify Cold Start Bit	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Separate cold start bits not supported
UAL011 Read Device Variables (Command 9)	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Tested with Dynamic Variables
UAL012 Read Dynamic Variable Classification	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
UAL013 Write Long Tag	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
UAL038 Reset Configuration Changed Flag	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
UAL048 Read Additional Device Status	<input type="checkbox"/> Pass <input type="checkbox"/> Fail

<sup>17</sup> Per *Slave Universal Command Test Specification* Rev 4.1



## 7. SLAVE COMMON PRACTICE COMMAND TEST DATA<sup>18</sup>

**Table 24. Slave Common Practice Command Test Data**

Test	Result
CAL000 Checks for Common Practice Commands	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Recommended Commands (List) _____
CAL001 Write Protect Test	<input type="checkbox"/> Pass <input type="checkbox"/> Fail
CAL033 Read Device Variables	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Device Variables (List) _____
CAL034 Write Primary Variable Damping Value	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL035 Write Primary Variable Range Values PV Units Code Unaffected By Command 35	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable <input type="checkbox"/> Pass <input type="checkbox"/> Fail
CAL036 Set Primary Variable Upper Range Value	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL037 Set Primary Variable Lower Range Value	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL040 Enter/Exit Fixed Current Mode	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL041 Perform Self Test	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL042 Perform Device Reset	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL043 Set Primary Variable Zero	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL044 Write Primary Variable Units	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Valid PV Units Codes (List): _____ _____
CAL045 Trim Loop Current Zero	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL046 Trim Loop Current Gain	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL047 Write Primary Variable Transfer Function	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Supported Transfer Functions (List): _____
CAL049 Write Primary Variable Transducer Serial Number	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL050 Read Dynamic Variable Assignments	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL051 Write Dynamic Variable Assignments	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Device Variables Assignable to PV (List): _____ Device Variables Assignable to SV (List): _____ Device Variables Assignable to TV (List): _____ Device Variables Assignable to QV (List): _____

<sup>18</sup> Per *Slave Common Practice Command Test Specification* Rev 6.0



Test	Result
CAL052 Set Device Variable Zero	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
	<input type="checkbox"/> Device Variables Supported (List) _____
CAL053 Write Device Variable Units	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable <input type="checkbox"/> For each Device Variable the Unit Codes it supports must be attached
CAL054 Read Device Variable Information	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL055 Write Device Variable Damping Value	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL056 Write Device Variable Transducer Serial Number	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL060 Read Analog Channel And Percent Of Range	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Analog Channels supported (List) _____
CAL062 Read Analog Channels	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Analog Channels supported (List) _____
CAL063 Read Analog Channel Information	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Analog Channels supported (List) _____
CAL064 Write Analog Channel Additional Damping Value	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Analog Channels supported (List) _____
CAL065 Write Analog Channel Range Values	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Analog Channels supported (List) _____
CAL066 Enter/Exit Fixed Analog Channel Mode	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Analog Channels supported (List) _____
CAL067 Trim Analog Channel Zero	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Analog Channels supported (List) _____
CAL068 Trim Analog Channel Gain	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Analog Channels supported (List) _____
CAL069 Write Analog Channel Transfer Function	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Analog Channels supported (List) _____
CAL070 Read Analog Channel Endpoint Values	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable Analog Channels supported (List): _____
CAL071 Lock Device	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL072 Squawk	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL073 Find Device	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL074 Verify I/O System Commands	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable



Test	Result
CAL078 Command Aggregation	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL079 Write Device Variable	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL080 Verify Device Variable Trim Commands	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL091 Trending	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL101 Subsystem Burst Mode	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL103 Support for Multiple Burst Messages	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL104 Smart Data Publishing	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL107 Write Burst Device Variables	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL108 Write Burst Mode Command Number	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL109 Burst Mode Control	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL115 Event Notification	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL512 Country Code	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL518 Location Description	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL520 Process Unit Tag	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL523 Read Condensed Status Mapping Array	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL524 Manipulating Condensed Status Map	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable
CAL526 Status Simulation	<input type="checkbox"/> Pass <input type="checkbox"/> Fail <input type="checkbox"/> Not Applicable