TND340/D

AMIS−49200 Fieldbus MAU Reference Board

Physical Layer Conformance Testing FF−830 Test Results

ON Semiconductor®

http://onsemi.com

TECHNICAL NOTE

Scope

This document contains the relevant results of the FOUNDATION® Fieldbus Physical Layer Conformance testing performed on the AMIS−49200 Fieldbus MAU Reference Board (Rev 1.0). For a detailed explanation of each test describing its purpose and set-up refer to FF−830.

Definitions, Acronyms and Abbreviations

DUT – Device Under Test
FIC – Field Interface Card
ICS – Implementation Conformance Statement
MAU – Medium Attachment Unit
MDS – Medium Dependent Sublayer
PN – Probe Node
PR – Probe Response

Device Set-up

All tests were run at room temperature.

Device: AMIS−49200 FF Reference Board

Test Equipment Used:

- Tektronix THS730A 2-channel Isolated Oscilloscope
- KEPCO − Variable Power Supply, all tests run at 24 V unless otherwise stated
- Discrete Board for Non-Fieldbus Power Supply with Two Terminators
  - L = 5 mH, 18 AWG, 1.3 Ω Air Core Inductor (Jantzen)
  - RL = 50 Ω ±1%
  - Two Terminators Each Consisting of:
    - R = 50 Ω ±1 Ω (Qty = 2)
    - C = 2 μF 400 V Crosscap (Qty = 2) (Jantzen)
- Fieldbus Message Source Device
- HP33120A – Arbitrary Waveform Generator
- Waveform Generation Interface – a custom Fieldbus physical interface circuit card functions as the interface between the arbitrary waveform generator and the Fieldbus test network

NOTES: The FF−830 specification (from Fieldbus Foundation) is not available from ON Semiconductor to customers. Please contact the Fieldbus Foundation at www.fieldbus.org to obtain the latest test specifications.

Custom testing services are not provided by ON Semiconductor.

TEST SUMMARY

Table 1. TEST SUMMARY

Test ID #	Test	Test Notes	Test Status
1.1	Valid ID of DUT	See Annex E of FF−830	(Note 1)
1.2	Static Conformance Review		(Note 1)
1.3	ICS Self-consistency		(Note 1)
1.4	Consistency between DUT and ICS		(Note 1)
2.1	Signal and Power Connections		(Note 1)
2.2	Receive Signal Polarity		(Note 1)
2.3	Transmitted Signal Polarity		(Note 1)
3.1	Output Amplitude		Pass
3.2	Output Amplitude with One Terminator		(Note 1)
3.3	Signal Bias		Pass
3.4	Output Signal Distortion		Pass
4.1	Bit Rate		(Note 1)
4.2	Bit Time		(Note 1)
4.3	Rise and Fall Times		Pass
4.4	Slew Rate		Pass
4.5	Jitter		(Note 1)
4.6	Transmit Enable Time		(Note 1)
4.7	Quiescent DVC Output		(Note 1)
5.1	Maximum Rate of Current Change		(Note 1)
5.2	Maximum Current		(Note 1)
6.1	Receiver Sensitivity		Pass
6.2	Receiver Noise Rejection		Pass
7.1	Operating Voltage		(Note 1)
7.2	Withstand Voltage		(Note 1)
7.3	Ripple Sensitivity		(Note 1)
8.1	Common Mode Broadband Interference		(Note 1)
8.2	Common Mode Power Frequency		(Note 1)
9.1	Input Impedance		Pass
9.2	Unbalanced Capacitance		(Note 1)

1. Accuracy of test requires entire node electronics to be present, including the host microprocessor and associated memory, Fieldbus link controller and associated support circuitry. Test is to be performed by customer.

Test results for room temperature on tests run indicate the physical layer DOES conform to all specifications put forth by the Fieldbus Foundation.

TEST RESULTS

Test Group 1 – Static Conformance Review

These tests are not applicable. Tests to be performed by customer.

Test Group 2 – Basic Interconnection Tests

These tests are not applicable. Tests to be performed by customer.

Test Group 3 – Transmit Levels

Test ID's: 3.1 Output Amplitude, 3.3 Signal Bias, and 3.4 Output Signal Distortion

Test Results: PASS

Tests were set-up per diagram in "Test Group 3" of FF−830.

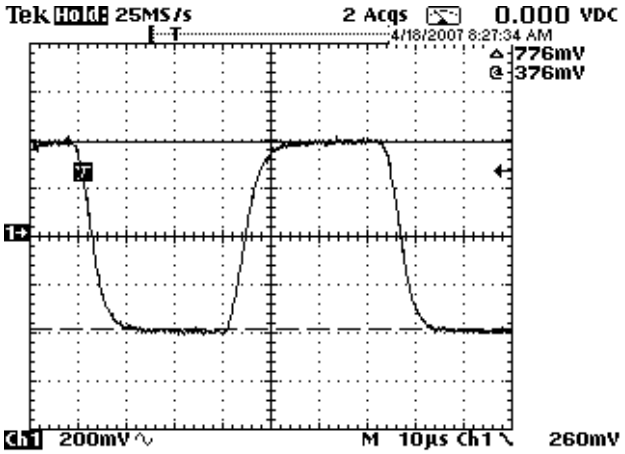

Figure 1. Power Supply = 24 V

Table 2. TEST CASE 3.1

Test Case 3.1 Output Amplitude Clause 223.1a			
		Power Supply = 24 V	
Step	Action-Behavior	Measured or Calculated Data (mV)	Verdict
3.1.2	Transmit PN and Capture DUT Response		
3.1.3	Measure Maximum Positive Peak Level of Response Waveform	380	
	Measure Minimum Positive Trough Level of Response Waveform	372	
	Calculate Positive Mid-voltage ('mid-voltage peak to trough')	376	
3.1.4	Measure Maximum Negative Peak Level of Response Waveform	−408	
	Measure Minimum Negative Trough Level of Response Waveform	−392	
	Calculate Negative Mid-voltage ('mid-voltage peak to trough')	−400	
3.1.5	Calculate Output Amplitude from Negative to Positive Mid-voltage	776	
	If Amplitude is between 0.75 V and 1.0 V Peak-to-peak Pass, otherwise Fail		Pass
3.3.5	Calculate | Positive Mid-voltage | − | Negative Mid-voltage |	24	
	If Absolute Difference Does Not Exceed ±50mV Peak Pass, otherwise Fail		Pass
	Calculate 10% of Peak-to-peak	77.6	
	Calculate 10% Point	−322.4	
	Calculate 90% Point	298.4	
	Set Cursors to 10% and 90% Points on the Waveform for Reference		
3.4.3	Check Each Response Waveform Rise from 10−90% Peak-to-peak		
	If No Negative Going Transitions in 10−90% pk-pk Range Pass, otherwise Fail		Pass
3.4.4	Check Each Response Waveform Fall from 90−10% Peak-to-peak		
	If No Positive Going Transitions in 90−10% pk-pk Range Pass, otherwise Fail		Pass
3.4.5	Check Each Response Waveform Region above 90% Peak-to-peak		
	If No Variation ≥ ±10% pk-pk Including All Distortions Pass, otherwise Fail		Pass
3.4.6	Check Each Response Waveform Region below 10% Peak-to-peak		
	If No Variation ≥ ±10% pk-pk Test Including All Distortions Pass, otherwise Fail		Pass

Test ID: 3.2 Output Amplitude One Trunk Terminator Removed

This test is not applicable. Test to be performed by customer.

Test Group 4 – Transmit Timing and Quiescent Output

Test ID's: 4.1 Bit Rate, 4.2 Bit Time

These tests are not applicable. Tests to be performed by customer.

Test ID's: 4.3 Rise and Fall Times, 4.4 Slew Rate

Test Results: PASS

1. Test ID 4.3 Rise and Fall Times:

$$\text{Positive mid–voltage} = \frac{\text{Positive Peak} - \text{Positive Trough}}{2} + \text{Positive Trough}$$

$$\text{Positive mid–voltage} = \frac{380\ \text{mV} - 372\ \text{mV}}{2} + 372\ \text{mV} = 376\ \text{mV}$$

$$\text{Negative mid–voltage} = \frac{\text{Negative Peak} - \text{Negative Trough}}{2} + \text{Negative Trough}$$

$$\text{Negative mid–voltage} = \frac{-408\ \text{mV} - (-392\ \text{mV})}{2} - 392\ \text{mV} = -400\ \text{mV}$$

Peak-to-peak voltage = |Positive mid-voltage| + + |Negative mid-voltage|

Peak-to-peak voltage = |376 mV| + |–400 mV| = 776 mV

10 % of peak-to-peak = 0.1 × 776 mV = 77.6 mV

10 % point = negative mid-voltage + 10% of peak-to-peak = = –400 mV + 77.6 mV = –322.4 mV

90 % point = positive mid-voltage – 10% of peak-to-peak = = 376 mV – 77.6 mV = 298.4 mV

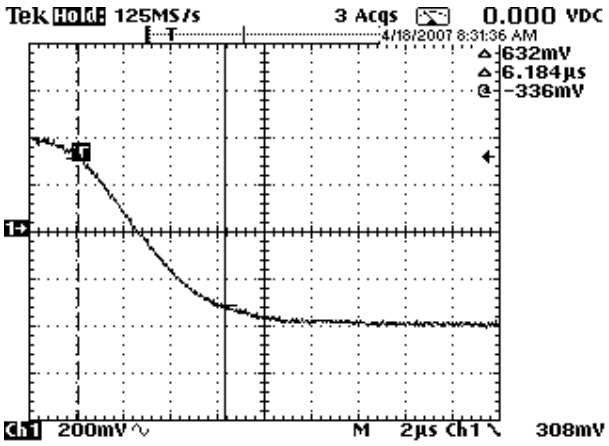

Figure 2. Fall Time 6.184 µs

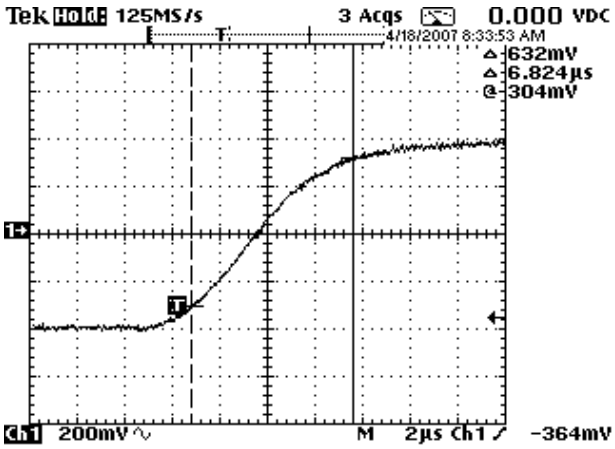

Figure 3. Rise Time 6.824 µs

Table 3. TEST CASE 4.3

Test Case 4.3 Rise and Fall Times Clause 22.3.3a		
Step	**Action-Behavior**	**Verdict**
4.3.1	Set-up for Group 4 with Supply Set for 24 V ±0.1 V D.C. at DUT	
4.3.2	Transmit PN and Capture DUT Response (or Use Response from 4.2)	
4.3.3	Measure Sample Response Waveform Fall from 90–10% Peak (it is Suggested to Use the Bit Cycle Selected for Test Case 4.2)	
	If Time Does Not Exceed 8 µs for 90–10% Peak-to-peak Pass, otherwise Fail	Pass
4.3.4	Measure Sample Response Waveform Rise from 90–10% Peak	
	If Time Does Not Exceed 8 µs for 10–90% Peak-to-peak Pass, otherwise Fail	Pass

2. Test ID 4.4 Slew Rate:

$$\text{Slew Rate} = \frac{\text{Volts}}{\text{Time}}; \qquad \text{Requirement}: \frac{\text{Volts}}{\text{Time}} \leqq \frac{0.2\ \text{V}}{1\ \mu\text{S}}$$

$$\frac{90\% - 10\%\ \text{Range}}{0.165\ \text{V}/\mu\text{S}}; \qquad \frac{10\% - 90\%\ \text{Range}}{0.150\ \text{V}/\mu\text{S}}$$

Table 4. TEST CASE 4.4

Test Case 4.4 Slew Rate Clause 22.3.3b		
Step	**Action-Behavior**	**Verdict**
4.4.1	Set-up for Group 4 with Supply Set for 24 V ±0.1 V D.C. at DUT	
4.4.2	Transmit PN and Capture DUT Response (or Use Response from 4.3)	
4.4.3	Measure Each Response Waveform Fall from 90−10% Peak-peak	
	Calculate Maximum Slew Rate between Each Pair of Sample Points	
	If Slew Rate ≤ 0.2 V per μs at any Point in Range 10% to 90% Pass, otherwise Fail	Pass
	Measure Each Response Waveform Rise from 10−90% Peak-peak	
	Calculate Maximum Slew Rate between Each Pair of Sample Points	
	If Slew Rate ≤ 0.2 V per μs at any Point in Range 10% to 90% Pass, otherwise Fail	Pass

Test ID's: 4.5 Jitter, 4.6 Transmit Enable Time, 4.7 Quiescent Transmitter Output

These tests are not applicable. Tests to be performed by customer.

Test Group 5 – Special Tests for Bus-powered Devices

These tests are not applicable. Tests to be performed by customer.

Test Group 6 – Receive Characteristics Plus Transmit Disable Time

Test ID's 6.1 Receive Sensitivity, 6.2 Receiver Noise Rejection

Test Results: PASS

1. Test ID 6.1 Receive Sensitivity:

- Trigger on the Response from DUT
- Established Communication with the Device
- Reduced the Amplitude of the Waveform Generator until it is at 155 mVpp
- Verified that Communication Remained Intact for Several Minutes and RXA Remains Active

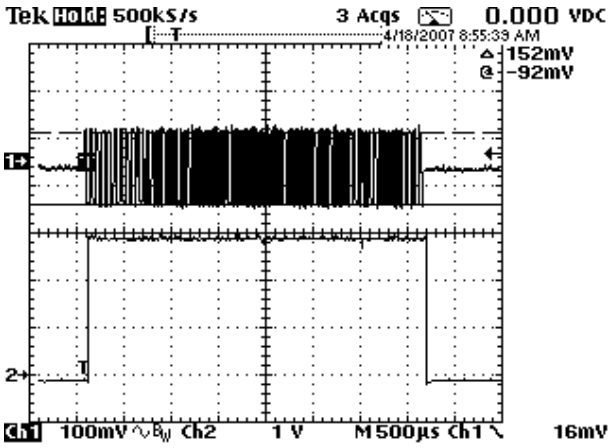

Figure 4. Channel 1 is PN in at 155 mV, Channel 2 is RXA Going Active

Table 5. TEST CASE 6.1

Test Case 6.1 Receiver Sensitivity Part of Clause 22.4.2		
Step	**Action-Behavior**	**Verdict**
6.1.1	Set-up for Group 6, Supply Set for 24 V ±0.1 V D.C. at DUT	
6.1.2	Set Waveform Generator for 155 mV ±5 mV pk-pk at DUT	
6.1.3	Transmit PN, Capture Response from DUT and Examine	
	PR Length	
	Preamble	
	Start Delimiter	
	End Delimiter	
	Frame Control	
	If Valid PR as Defined for Test Group 2 Pass, otherwise Fail	Pass

2. Test ID 6.2 Receiver Noise Rejection:

- Trigger on the RxA Pin
- Established Communication with the Device
- Reduced the Amplitude of the Waveform Generator until it is at 70 mVpp
- Verified that Communication Fails and RxA Remains Inactive

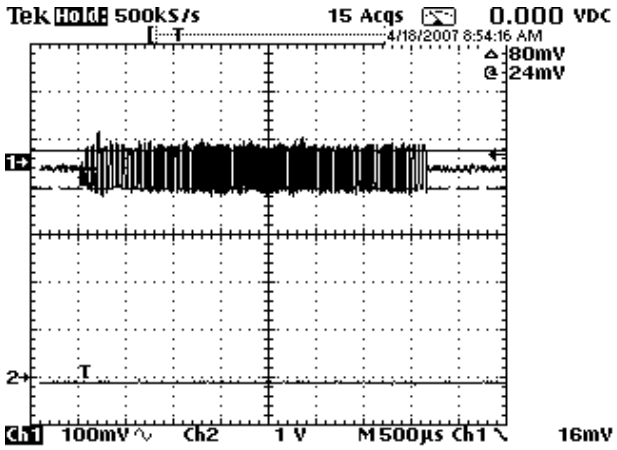

Figure 5. Channel 1 is PN in at 70 mV Channel 2 is RXA Staying Active

Table 6. TEST CASE 6.2

Test Case 6.2 Receiver Noise Rejection Part of Clause 22.4.2		
Step	**Action-Behavior**	**Verdict**
6.2.1	Set-up for Group 6, Supply Set for 24 V ±0.1 V D.C. at DUT	
6.2.2	Set Waveform Generator for 70 mV ±5 mV pk-pk at DUT	
6.2.3	Transmit PN, Capture Response from DUT	
	If No Response, neither Valid nor Invalid Waveform, Pass	Pass

Test Group 7 – Network Power Distribution

These tests are not applicable. Tests to be performed by customer.

Test Group 8 – Interference Sensitivity

These tests are not applicable. Tests to be performed by customer.

Test Group 9 – Input Circuit Parameter Measurement

Test ID 9.1 Input Impedance

Test Results: PASS

- Set-up according to Annex B for Bus-powered Devices
- Spec. Impedance ≥ 3 kΩ DUT
- Results: Powered but Idle at 9 V

Table 7. RESULTS

Supply (V)	Frequency in (kHz)	Vz (Vp-p)	Rs (Ω)	Vrs (mVp-p)	Z = (Rs/Vrs) * Vz (Ω)
9	7.8	0.3535	100.4	0.733	48419
9	15.625	0.3542	100.4	0.766	46425
9	31.25	0.3533	100.4	1.707	20780
9	39	0.3537	100.4	2.151	16509

Test ID 9.2 Unbalanced Capacitance

This test is not applicable. Test to be performed by customer.

REFERENCES

[1] FF−830 Fieldbus Foundation Specification 31.25 kbit/s Physical Layer Conformance Test – Rev. 1.50

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
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