Fieldbus Testing with Online Physical Layer Diagnostics

Technical White Paper

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Abstract

Installation and wiring work for today's fieldbus installations in process automation, FOUNDATION Fieldbus H1 and PROFIBUS PA, currently requires tedious manual and typically incomplete methods for checkout and validation. New online advanced physical layer diagnostic systems automate construction and pre-commission test and report generation, up to the point of loop checkout. Fully automated fieldbus test methodology realizes better installation quality and time savings.

This paper describes a newly revised, significantly shortened and vastly simplified test procedure applicable to fieldbus systems. Additional guidelines for troubleshooting that is described herein will further enhance commissioning and testing work. A case study compares the new working procedure to existing technologies and procedures and shows the savings potential, which expresses itself in a reduction in commissioning time.

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Quality Information from a Quality Supplier

This technical white paper utilizes Pepperl+Fuchs' expertise and knowledge to provide a clear insight into the many new technological and application issues you may face with a fieldbus installation. It corresponds to our way of working and thinking: combining state-of-the-art technologies with years of research and innovation to simplify planning, installation and commissioning, operation, and plant upkeep.

If the content of this paper sparks comments or questions, we invite you to contact your Pepperl+Fuchs office or representative to get in touch with our experts. We are glad to share our expertise with you for your business success.

Our promise is to simplify your work processes with fieldbus: You can stay focused on your day-to-day business with a reliable Field-Connex® fieldbus infrastructure. It ensures the connection between DCS and instruments, fully digital with explosion protection for any hazardous area. We are driven to provide innovation with proven reliability for process automation practitioners:

- FieldConnex is robust, reliable, and the first choice of many well-known end users worldwide.
- Advanced physical layer diagnostics reach down to spurs, accessories, and instruments; interpret data, and provide detailed fault analysis. Water ingress and worn-out surge protectors are identified without manual inspection.
- The high-power trunk concept allows long cable runs and high device counts and is now an industry standard. DART Fieldbus makes the high-power trunk intrinsically safe.

Content

Table 1 lists abbreviations in this document.

Table 1: Abbreviations

Abbreviation	Definition
ADM	Advanced diagnostic module
APLD	Advanced physical layer diagnostics
ATE	Automated test engine
CAPEX	Capital expenditure
FDH-1	Fieldbus diagnostic handheld
RC	Resistance capacitance

1 Introduction

Many of the major projects are using digital fieldbus technology as the preferred platform for control and instrumentation. Most of the lessons learned from the early projects have been implemented successfully in technology, products and working procedures for the current projects. Testing the installation as described in working guidelines, published previously by the Fieldbus Foundation and PROFIBUS International [1], is manual, labor intensive and requires specialist knowledge.

With the introduction of online advanced physical layer diagnostic (APLD) equipment, fully automated network testing and reporting reduces the time and cost for commissioning and plant upkeep. This technology optimizes the test process and report generation. At the same time APLD helps establish the optimal fieldbus installation quality and thus a highly available automation system. The new APLD equipment needs a revised, yet vastly simplified construction and commissioning procedure, requiring minimal technical expertise.

Advanced physical layer diagnostics enable high-speed automated construction as well as commissioning testing with automated test report generation and documentation. APLD provide the ‘handover’ of a system that will have been fully checked to a highly detailed technical level. This is impossible to achieve with methods of manual inspection, thus assuring uncompromised segment quality and system availability for the end customer and plant operator.

This paper addresses two audiences: For practitioners, it provides insight into contemporary fieldbus commissioning and maintenance procedures (chapters 2 and 0). Step by step instructions assist in optimizing working procedures. Decision makers are presented with arguments and a case study (chapter 4) that show how CAPEX and OPEX savings that are realized with these procedures. Chapter 5 summarizes the facts.

2 Testing and commissioning procedures

This chapter describes testing procedures and improvements that are achieved in the past years. Testing installations with 4…20 mA interfacing is well-known in practice and thus not described in detail. Table 2 provides a comparison of basic testing attributes as they apply to testing the fieldbus installation. This chapter describes how automated testing utilizing APLD significantly reduces commissioning, testing and troubleshooting effort in comparison to manual inspection. Savings are even more dramatic in comparison to 4…20 mA infrastructures. At the same time the test quality is improved.

2.1 Manual inspection

AG-181 is the working guideline created by fieldbus users and issued by the Fieldbus Foundation [2]. The versions up to 3.0 (01/2009) detail manual procedures for installing and commissioning fieldbus segments. Manual inspection requires handling of diverse pieces of equipment such as:

1. Digital multi-meter for current, voltage and resistance
2. Advanced capacitance meter capable of independent RC measurement
3. Digital storage oscilloscope
4. Handheld fieldbus signal generator and data analyzer
5. Screwdriver for connect and disconnect of devices and wiring interfaces
6. Set of paper test sheets and pens for manual documentation

The manual inspection prescribes to first run a check on the segment cable and then connect each instrument in sequence and check as shown in Figure 1. Each instrument must be disconnected to repeat this procedure for the next instrument.

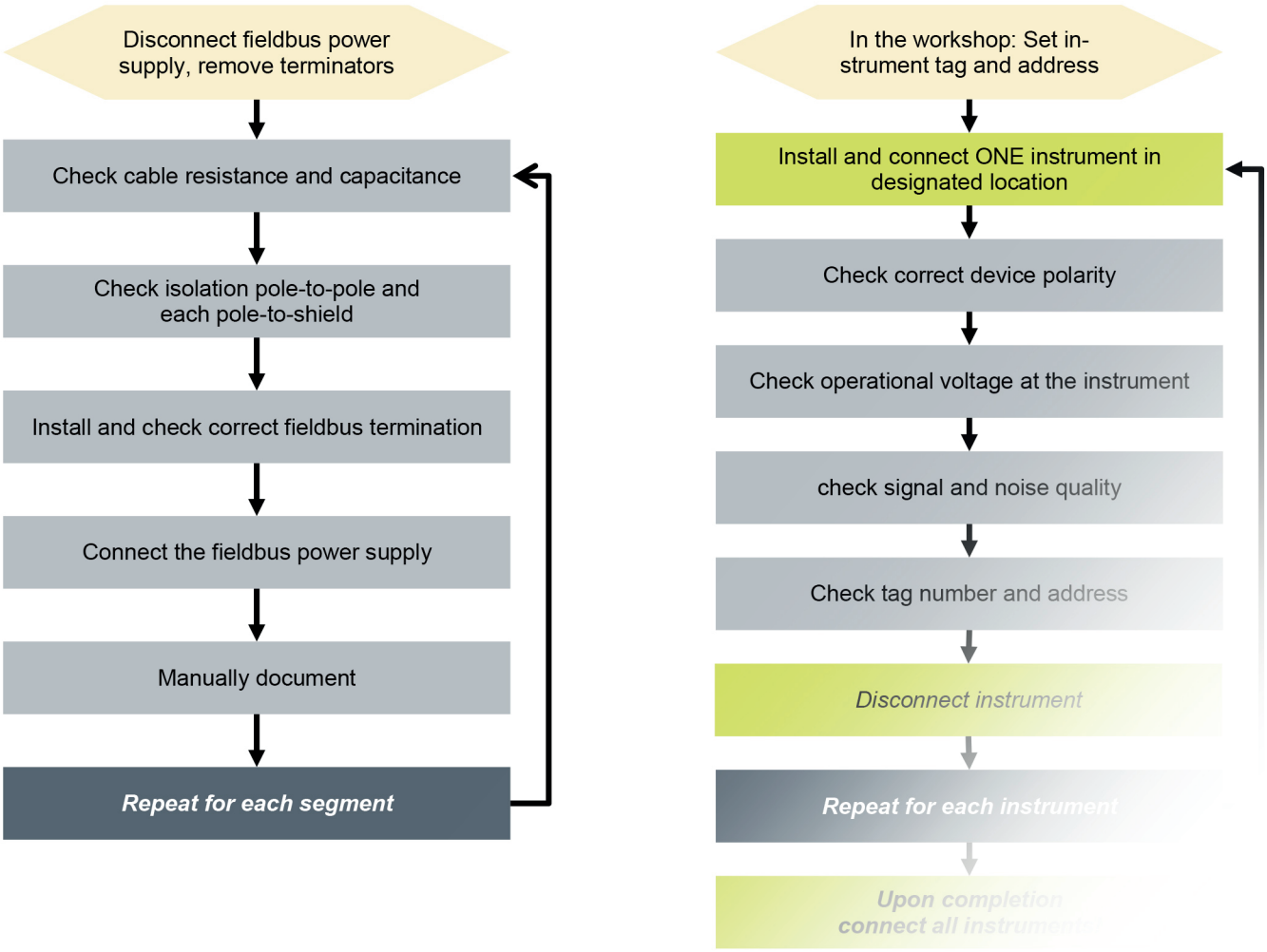

Figure 1: Manual constructional and electrical checks per segment and instrument

All documentation for constructional and instrument checks requires manual work. This procedure, though more efficient than classic cable checkout for 4…20 mA instrumentation, requires special preparations and has some disadvantages:

1. Special terminals or adaptors should be made available for connection of the various meter probes.
2. Many correctly installed terminals have no exposed conductors to clip test probes to. Therefore, 'eyelets' should be provided for testing, then removed after testing as they are exposed and not insulated. Alternatively, wires must be removed from the terminals and replaced after testing. This can give rise to potential failure issues if the terminals are not correctly reinstalled.
3. These tests demand far more expertise when compared to an equivalent 4...20 mA cable, and require a high level of measurement accuracy. Skilled engineers or technicians manually put together data from disparate devices to interpret the information. While oscilloscope data is extremely
4. Certain failure
5. Hand

This technical white paper provides you with a comprehensive insight into technology advances and applications for fieldbus commissioning.

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