Learning Outcomes (LO) of

Certified PROFIBUS PA Engineer
CPPAE

SU4 Training Center

Version 1.3
June 2011

Order No: 4.732

Prepared by the PROFIBUS Working Group SU4 Training Center

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In this specification the following key words (in **bold** text) will be used:

may: indicates flexibility of choice with no implied preference.

should: indicates flexibility of choice with a strongly preferred implementation.

shall: indicates a mandatory requirement. Designers **shall** implement such mandatory requirements to ensure interoperability and to claim conformance with this specification.

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Content

Revision Log

Identification	Version	Originator	Date	Change Note / History / Reason
xxx-YY-nnnn	1.1	Ad-hoc-WG	13May05	Initial version
	1.2	Michael Ulrich	15.Sept08	Update of Chapter: 3.5/3.6/3.8/6 Document overtaken in to new template.
	1.x	Michael Ulrich	15.Sept.10	
	1.3	Michael Ulrich	30.May.11	Update of Chapter: 1/2/3.3/3.6/3.8/3.10/4/6

PROFIBUS Learning Outcomes, Order No: XXX

Course Title:	**Certified PROFIBUS PA Engineer**
Course Code:	**CPPAE**
Course Duration:	**Minimum of 2.5 Days (including 0.5 day for examination)**
Grading Type:	**Normal**
Credits:	**x CPD/CPH/PDH (Continuous Professional Development/Hours, Professional Development Hours)**
Prerequisite:	**Industrial Industrial Automation and Electro technical background. Certified PROFIBUS Engineer course✶**

✶ *Depending on the course content, sequence and duration of the Certified PROFIBUS PA Engineer training, the prerequisites can be different.*
In any case, the learning outcomes is the same.

Version 1.2
September 2008

Developed by the Working Group “Training” (WG 9) within the Technical Committee for “Test and Certification” (TC1).

This Learning Outcome is one of a series of several courses:

5.11 Certified PROFIBUS Engineer
5.12 Certified PROFIBUS Installer
5.13 Certified PROFIBUS-PA Engineer
5.21 Certified PROFINET Engineer
5.22 Certified PROFINET Installer

1 Aims & Objectives

The objectives of this course are to provide both hands on and theoretical training program on PROFIBUS PA. The course will provide an opportunity for the participant to acquire the required skills to design, set-up, operate, diagnose and troubleshoot PA networks.
Depending on the course prerequisites, the content, sequence and duration of the PA Engineer training can be different but must be a minimum of 2.5 days. In any case, the learning outcomes are the same.

2 Learning Outcomes

On successful completion of this course students will be able to:	**Assessment Mode**
Explain the terminology associated with PROFIBUS PA and main parts of DP✶	Theory Exam
Wire & Configure a PROFIBUS DP/PA Network with profile PA devices	Practical Exam
Given a set of network specification, design a PROFIBUS PA network	Theory Exam
Given bus monitor traces and raw telegrams from a PROFIBUS DP/PA network, identify the network faults.	Theory Exam/ Practical Exam
Given a GSD file for a PROFIBUS PA device, identify its limitation and suitability for a given application	Theory Exam
Given a faulty PROFIBUS DP/PA network, use bus monitor and Oscilloscope to identify and troubleshoot the network	Practical Exam
Know the difference between EDDL- and FDT/DTM-based engineering tools and be able to modify parameters and check diagnostic of a PA device by using one of either type of tool.	Theory Exam/ Practical Exam

✶These topics could also be covered by the certified engineer course

3 Syllabus

3.1 Instructors

The instructors have to pass the final examination but it is not absolutely necessary to join the course. The instructors have to be listed at PI. Every instructor may have its own slide set based on a English example. Only the final test is unified.

3.2 PROFIBUS Structure

- ☐ What is behind PROFIBUS organization and how is it organized✶
- ☐ Market position of PROFIBUS PA and future

3.3 Bus physics & Wiring

- ☐ Cable specification
- ☐ Cable types
- ☐ Segment/network
- ☐ Shielding/grounding concept
- ☐ Cable distances
- ☐ DP/PA Termination✶
- ☐ Drop/spur/stub length
- ☐ PA network calculation, design and configuration
- ☐ Ex application examples for PA (High power trunk concept(Fieldbarrier), FISCO segment coupler concept
- ☐ Introduction to DART technology

✶These topics could also be covered by the certified engineer course

3.4 PROFIBUS general

- ☐ From analog to digital communication✶
- ☐ OSI model✶
- ☐ Comparison DP / PA
- ☐ PA related features
- ☐ Segmentation
- ☐ Addressing (hard/software)
- ☐ Master/slave✶
- ☐ Token passing✶
- ☐ Cyclic and acyclic communication
- ☐ FISCO concept
- ☐ PA profiles 3.0x
- ☐ Slot index list
- ☐ GSD technology✶
- ☐ EDD technology
- ☐ FDT/DTM technology
- ☐ Modular-compact slaves
- ☐ PA profile related data string (4byte value, one byte status) and (1byte value, one byte status)
- ☐ PA status interpretation
- ☐ Construction of PA diagnosis
- ☐ RS485 Basics, baud rates

PROFIBUS general cont.

- ☐ MBP Basics, baud rate
- ☐ Basic, fault current of field devices
- ☐ Qualities of Manchester Bus coded signal
- ☐ Qualities of RS485 signal✶

✶ These topics could also be covered by the certified engineer course

3.5 Network Components

- ☐ DP/PA Link from Siemens, qualities
- ☐ DP/PA couplers from P+F (SK1, SK2 and SK3), types and qualities (SK2 mention but no details, reason not sold any more)
- ☐ EX and non EX specific components
- ☐ Connectors DP/PA✶
- ☐ T-boxes with and without protection functionality (current limiter, over voltage protection etc.)
- ☐ Confectioned cables
- ☐ Two and four wire PA field devices,
- ☐ PA profile acting devices working on DP
- ☐ FISCO/Entity Field Barrier
- ☐ DP/PA over voltage protection✶
- ☐ Redundancy concepts of Physical Layer (MBP)

✶These topics could also be covered by the certified engineer course

3.6 Network Set-up

- ☐ Tool for creating specific GSD file for DP/PA Link
- ☐ Tool for converting GSD files for DP/PA coupler SK2, SK3
- ☐ Installation & wiring DP/PA segment
- ☐ Adjustment of bus parameters✶
- ☐ Read/Write data✶
- ☐ Watchdog timer✶
- ☐ Cyclic and acyclic communication✶
- ☐ How to connect acyclic tool on running bus segment
- ☐ DP/PA device integration examples in to different systems.
- ☐ Watchdog timer settings for PA side within SK3
- ☐ FDT/DTM Tool (FieldCare or any FDT/DTM based tool)
- ☐ EDDL Tool (PDM)

✶These topics could also be covered by the certified engineer course

3.7 Trouble Shooting using:

- ☐ Oscilloscope
- ☐ Multimeter
- ☐ Configuration tools
- ☐ Bus monitor
- ☐ Noise generator for physical signal simulation on segments

3.8 PROFIBUS Details DPV0 / DPV1

- ☐ MC1/MC2 functions✶
- ☐ GSD files✶
- ☐ Content of manufacture specific GSD files for PA devices
- ☐ PA Profile GSD files
- ☐ PROFIBUS PA Profile content of 3.00 – 3.02
- ☐ Condensed Status+Diag. messages
- ☐ Automatic Ident Nr. Adoption / MS0
- ☐ PA Profile EDD/ DTMs
- ☐ Service Access Points
- ☐ Start up sequence✶
- ☐ Parameterization telegram✶
- ☐ Configuration telegram✶
- ☐ Standard diagnosis according to PA profile, extended diagnostic
- ☐ Data exchange telegram✶
- ☐ DP Master state✶
- ☐ Global Control✶
- ☐ Data structure of DPV1

✶These topics could also be covered by the certified engineer course

3.9 Bus Monitor

- ☐ Description & use of bus monitor to capture telegrams✶
- ☐ Capture and interpretation telegrams on DP side✶
- ☐ Capture and interpretation telegrams on PA side
- ☐ Record filter✶
- ☐ View filter✶

Telegram capture like;✶

- ☐ Parameterization
- ☐ Configuration
- ☐ Diagnostics
- ☐ Data exchange
- ☐ Global control
- ☐ FDL status
- ☐ Token telegrams
- ☐ DP-V1 class 2 master

✶These topics could also be covered by the certified engineer course

3.10 Bus parameters & Cycle times

- ☐ Explanation of bus parameters(T_{sdr}, T_{idle}, ...)✶
- ☐ Calculation of PA bus cycle time for single master systems using P+F SK3 coupler.
- ☐ Calculation of PA bus cycle time for single master systems using SIEMENS DP/PA Link

✶These topics could also be covered by the certified engineer course

4 Text Books

- ☐ Popp.M.," The new rapid way to PROFIBUS DP", PNO, No 4.072, 2003
- ☐ Ch. Diedrich/Th.Bangemann, PROFIBUS PA, Instrumentation Technology fort he Process Industry
- ☐ PROFIBUS Profile Guidelines
- ☐ PROFIBUS Installation and commissioning guideline from PI
- ☐ Mitchell, Ron, "PROFIBUS A Pocket Quide", ISA Publication, ISBN 1-55617-862-x
- ☐ Powell, James & Vandeline, Henry, "On the road with the process fieldbus; An introduction to PROFIBUS for process aoutomation". SIEMENS publication, ISBN 978-0-9782495-1-9

5 Training Equipment

The typical training equipment is given as a guide. Each PCC can decide on the configuration of the equipment so long as the syllabus for the course is covered and the learning outcomes achievable.

Example set-up:
Each training kit can consist of a MC1 PLC with modular and compact slaves. Laptop or PC can be used as both a programming unit and as MC2. Two, max. 3 candidates per training kit.

6 Typical Practical Work

- ☐ Installation and wiring of DP/PA segment using DP/PA Link or DP/PA Coupler
- ☐ Setting device addresses hard / software
- ☐ Creating live list with monitoring tools (bus scan) ✶
- ☐ GSD integration in master class 1 (MC1) systems
- ☐ EDD / DTM integration in master class 2 (MC2) systems
- ☐ Configuration of PA slaves in MC1 systems
- ☐ Setting bus parameters✶
- ☐ Read/write cyclic data to slaves✶
- ☐ Replacing devices different manufacture (manufacture specific GSD files)✶
- ☐ Replacing devices different manufacture same type of device type (Profile GSD files)
- ☐ Replacing devices, same manufacturer, different version (show automatic Ident. Version adoption functionality)
- ☐ Setting up cyclic communication with any available master (PLC or PC) (useful to show the bytes handling, bytes interpretation)✶
- ☐ Read /write acyclic data to slaves with parameterization tools like EDD, FDT/DTM technology
- ☐ Interpretation of status and diagnosis on manipulated segments✶
- ☐ Reading out ext. diagnosis in system configuration tool✶
- ☐ Capture and interpretation DP protocol using bus analyzer on manipulate segments, connected on RS485 as well on MBP physic

- ☐ Commissioning PA segment which was manipulated before, faults like;

Wiring faults:

- ☐ On PA segment shield and Communication wire swapped
- ☐ More than 2 terminations on PA segment
- ☐ DP cable connected on the wrong outlet of the plug✶
- ☐ DP A/B swapped on Link or coupler input
- ☐ Shortcut behind field barrier spur
- ☐ Noise on segment (using noise generator)✶

Configuration faults:

- ☐ Wrong GSD file in Master system implemented (ID number mismatch)✶
- ☐ Field device acting in profile mode/manufacture specific mode
- ☐ Double address✶
- ☐ Device address on 126 (no cyclic data exchange possible)✶
- ☐ Wrong module on selected slot (in master system)
- ☐ Scaling in transducer not equal AI (PV on display different than PV on bus)
- ☐ Field device locked by a other master✶
- ☐ Watchdog time to short✶
- ☐ Configured device missing on segment*

✶These topics could also be covered by the certified engineer course

7 Assessment Scheme

The assessment is a combination of practical and theory examinations. Candidates must pass both components to pass the course. A candidate must score 70% in each component to pass the course.

Practical Test (Duration 2 hours)

Using the training faults such as cable break, double address, faulty configuration, wrong GDS file, etc. is generated and candidate is asked to diagnose the problems using the available tools, and troubleshoot to recover the system to normal working condition. With help of a Master system, the segment must be set to cyclic communication and to read out specific PV from field devices. At the running segment, an acyclic tool must be connected, to create a live list.

Theory Test: (Duration 2 Hours)

The candidate will be examined on the following topics:
Basic knowledge (30%)
Transmission technology & wiring (20%)
Trouble shooting & commissioning (15%)
Design techniques (15%)

The exam questions to be picked from a central database of questions, this database is set up and administered by PI. Each question in the database is given a weight in percentage. Each PCC should select appropriate number of questions from each section to achieve the breakdown given above

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