

Profibus

Overview and analysis

Profibus originated in the European market and has become a worldwide standard because of its performance attributes. Profibus consists of several variations which are designed for use in special applications. The two Profibus versions most commonly used are Profibus-DP (Distributed Peripherals) and Profibus-PA (Process Automation).

Profibus-DP is recognized as a high performance bus network capable of transmitting thousands of I/O point information in less than a few milliseconds. For that reason it has been used extensively for fast response control applications such as turbine servos and variable speed drives.

Profibus-PA was developed to connect directly into Profibus-DP and may be used in intrinsically safe applications. DP uses the RS485 physical layer while PA uses the IEC 61158-2 physical layer designed primarily for process applications.

Profibus-DP features

- High speed data access capable of handling time critical functions.
- Networks up to 32 devices (up to 126 with repeaters) on a 4-wire network; (2 wires for signal and 2 wires for power).
- Trunk network may extend up to 4,000 feet (1220 meters) per segment.
- Dramatically cuts wiring costs and commissioning over conventional applications.
- Interfaces readily into newer control systems.
- Used extensively throughout Europe with support in North America.

Profibus-DP description

The DP version of Profibus uses the RS485 physical layer with its unique data link layer and a direct data link mapper connecting the data link layer directly to application functions.

Profibus uses a medium access control which includes token-passing for multi-master applications and the master slave interaction.

Networks may be multi-master, multi-master with slaves, or single-master with slaves. In a multi-master network the token is passed to each master in a predetermined time frame. The master with the token is active and communicates with other masters or accesses its assigned slaves.

Communication occurs on a peer-to-peer basis for data communication or on a multi-cast basis for control commands. Cyclic polling may also be used for data communication between the master and its designated slaves. DP also offers acyclic communication services for the parameterization, operation, monitoring, and alarm-handling of intelligent field devices. These acyclic services may be handled in parallel to data transfer with the master taking some additional time to carry out this function. Acyclic extended functions are optional.

Profibus-DP handles large amounts of I/O data at very high speeds. DP requires about 1 millisecond to handle 1024 I/O points over 32 devices at the 12Mbit/sec rate. This is possible due to the efficient mapping of the data from the data link layer directly to the user layer by means of the SRD service of the data link layer.

For configuration of DP devices a GSD file (Electronic device data sheet) is used which describes the characteristics of a device type in a precisely defined format. Vendors provide specific GSD files to users. The system simply reads the GSD file for each device and automatically configures the bus system using this information.

An EDD (Electronic Data Description) file, which is not vendor specific, is also used to describe each device. These files, also provided by vendors, are read by the engineering tools to simplify the Profibus systems configuration, commissioning, and maintenance.

Profibus-DP specifications					
Physical layer	RS-485				
Cabling	(1) shielded twisted pair for signal and (1) pair for 24 VDC supply				
Topology	Trunk with drops				
<u>Cable length</u>					
Baud rate (Kbits/sec)	93.75	187.5	500	1500	12000
Length (meters)	1200	1000	400	200	100
Number of devices	32 per segment; up to 126 with 4 repeaters				
Bus power	Must have auxiliary 24 VDC supply				
Transmission rate	9.6 K to 12 M bits/second				
Data access	Token sharing for multi-masters; peer-to-peer; multicast and cyclic polling for data transfer; acyclic for asset management				
Data transfer size	Up to 246 bytes of input & 246 bytes of output depending on device type.				
Device identity	Specific ID number for each device				
Error detection	HD4 CRC (Cyclic Redundancy Check)				
Support organization	Profibus users group www.profibus.com				

Profibus-PA description

Profibus-PA was designed as a substitute for HART and 4 to 20mA signal transmission in the process industries. It uses function blocks designed around process industry requirements and uses the IEC 61158-2 physical layer, making it compatible with intrinsic safety circuits. See figure 1.

Profibus-PA links to the control architecture via Profibus-DP with a segment coupler or link as shown. Segment couplers are signal converters that adapt the RS-485 signals to the 61158-2 signal level. They are transparent from the bus protocol point of view. If segment couplers are used, the baud rate on the DP (RS-485) segment must be restricted to 45 Kbits/sec. The segment coupler also injects power into the PA network for the segment instrumentation.

Links are independent slaves on the DP network which represent all devices connected to the 61158-2 segment. When PA segments are connected using links there is no limit to the baud rate on the DP segment which enables faster overall bus network performance.

The measured values and status of the PA devices are transmitted cyclically, with high priority between the DCS and the measuring transducers using the DP basic functions. This provides timely transfer of values into the control system. Asset management parameters are transmitted with low-priority, acyclic DP functions.

Profibus-PA specifications	
Physical layer	IEC 61158-2
Cabling	Shielded twisted pair
Topology	Trunk with branching
Cable length	1900 m (6200 ft)
Number of devices	32 (practical limit of 0.50 amp divided by current used/device)
Bus power	Up to 0.5 A per segment
Transmission rate	31.25 Kbits/second

Figure 1
Profibus PA

