

DIN EN 61800-7-203

ICS 29.200; 29.160.30

Einsprüche bis 2015-04-06
Vorgesehen als Ersatz für
DIN EN 61800-7-203:2008-11**Entwurf**

**Elektrische Leistungsantriebssysteme mit einstellbarer Drehzahl –
Teil 7-203: Generisches Interface und Nutzung von Profilen für
Leistungsantriebssysteme (PDS) – Spezifikation von Profil-Typ 3
(IEC 22G/270/CDV:2014);
Englische Fassung FprEN 61800-7-203:2014**

Adjustable speed electrical power drive systems –
Part 7-203: Generic interface and use of profiles for power drive systems – Profile type 3
specification

(IEC 22G/270/CDV:2014);

English version FprEN 61800-7-203:2014

Entraînements électriques de puissance à vitesse variable –

Partie 7-203: Interface générique et utilisation de profils pour les entraînements électriques
de puissance – Spécification du profil de type 3

(CEI 22G/270/CDV:2014);

Version anglaise FprEN 61800-7-203:2014

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2015-02-06 wird der Öffentlichkeit zur Prüfung und
Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses
Entwurfes besonders zu vereinbaren.

Stellungnahmen werden erbeten

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- oder in Papierform an die DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE, Stresemannallee 15, 60596 Frankfurt am Main.

Die Empfänger dieses Norm-Entwurfs werden gebeten, mit ihren Kommentaren jegliche relevanten
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Gesamtumfang 190 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE

Nationales Vorwort

Die Englische Fassung des europäischen Dokuments FprEN 61800-7-203:2014 „Elektrische Leistungsantriebssysteme mit einstellbarer Drehzahl – Teil 7-203: Generisches Interface und Nutzung von Profilen für Leistungsantriebssysteme (PDS) – Spezifikation von Profil-Typ 3“ (Entwurf in der Umfrage) ist unverändert in diesen Norm-Entwurf übernommen worden.

Die Internationale Elektrotechnische Kommission (IEC) und das Europäische Komitee für Elektrotechnische Normung (CENELEC) haben vereinbart, dass ein auf IEC-Ebene erarbeiteter Entwurf für eine Internationale Norm zeitgleich (parallel) bei IEC und CENELEC zur Umfrage (CDV-Stadium) und Abstimmung als FDIS (en: Final Draft International Standard) bzw. Schluss-Entwurf für eine Europäische Norm gestellt wird, um eine Beschleunigung und Straffung der Normungsarbeit zu erreichen. Dem entsprechend ist das internationale Dokument IEC 22G/270/CDV:2014 „Adjustable speed electrical power drive systems – Part 7-203: Generic interface and use of profiles for power drive systems – Profile type 3 specification“ unverändert in den Entwurf FprEN 61800-7-203:2014 übernommen worden.

Das internationale Dokument wurde vom SC 22G „Adjustable speed electric drive systems incorporating semiconductor power converters“ der Internationalen Elektrotechnischen Kommission (IEC) erarbeitet.

Bei der Abstimmung zu dem Europäischen Schluss-Entwurf bei CENELEC und dem Internationalen Schluss-Entwurf bei IEC [Final Draft International Standard (FDIS)] sind jeweils nur „JA/NEIN“-Entscheidungen möglich, wobei „NEIN“-Entscheidungen fundiert begründet werden müssen. Dokumente, die bei CENELEC als Europäische Norm angenommen und ratifiziert werden, sind unverändert als Deutsche Normen zu übernehmen.

Für dieses Dokument ist das nationale Arbeitsgremium K 226 „Ausrüstung von Starkstromgeräten und -anlagen mit elektronischen Betriebsmitteln“ der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE (www.dke.de) zuständig.

Für den Fall einer undatierten Verweisung im normativen Text (Verweisung auf eine Norm ohne Angabe des Ausgabedatums und ohne Hinweis auf eine Abschnittsnummer, eine Tabelle, ein Bild usw.) bezieht sich die Verweisung auf die jeweils neueste gültige Ausgabe der in Bezug genommenen Norm.

Für den Fall einer datierten Verweisung im normativen Text bezieht sich die Verweisung immer auf die in Bezug genommene Ausgabe der Norm.

Der Zusammenhang der zitierten Normen mit den entsprechenden Deutschen Normen ergibt sich, soweit ein Zusammenhang besteht, grundsätzlich über die Nummer der entsprechenden IEC-Publikation. Beispiel: IEC 60068 ist als EN 60068 als Europäische Norm durch CENELEC übernommen und als DIN EN 60068 ins Deutsche Normenwerk aufgenommen.

Das Präsidium des DIN hat mit Präsidialbeschluss 1/2004 festgelegt, dass DIN-Normen, deren Inhalt sich auf internationale Arbeitsergebnisse der Informationsverarbeitung gründet, unter bestimmten Bedingungen allein in englischer Sprache veröffentlicht werden dürfen. Diese Bedingungen sind für die vorliegende Norm erfüllt.

Da sich die Benutzer des vorliegenden Normentwurfs der englischen Sprache als Fachsprache bedienen, wird die englische Fassung der FprEN 61800-7-203 veröffentlicht. Zu deren Abschnitt 1, der den Anwendungsbereich festlegt, und deren Abschnitt 3, der die Begriffe festlegt, wurde eine Übersetzung angefertigt und als informativer Nationaler Anhang NA des vorliegenden Normentwurfs hinzugefügt. Für viele der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Dieser Normentwurf steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

Es ist vorgesehen, auch bei der entsprechenden zukünftigen Deutschen Norm auf die deutsche Sprachfassung zu verzichten und diese in der englischsprachigen Fassung zu veröffentlichen.

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Das Original-Dokument enthält Bilder in Farbe, die in der Papierversion in einer Graustufen-Darstellung wiedergegeben werden. Elektronische Versionen dieses Dokuments enthalten die Bilder in der originalen Farbdarstellung.

Änderungen

Gegenüber DIN EN 61800-7-203:2008-11 wurden folgende Änderungen vorgenommen:

- a) Geringfügige Anpassungen innerhalb des Base Mode Parameter Access-Mechanismus;
- b) geringfügige Aktualisierungen und Vereinfachungen der Festlegungen für den Zustandsautomaten (en: state machine) für Anwendungsklasse 3;
- c) redaktionelle Überarbeitung des gesamten Dokumentes.

Nationaler Anhang NA (informativ)

Die deutschen Übersetzungen haben Empfehlungscharakter und können nur die ungefähre Begrifflichkeit in Deutsch wiedergeben. Unter Experten wird empfohlen, ausschließlich die englischen Fachbegriffe zu verwenden, um die Gefahr von Missverständnissen zu reduzieren.

1 Anwendungsbereich

IEC 61800-7 beschreibt Profile für Leistungsantriebssysteme (en: Power Drive Systems, PDS) und ihre Abbildung auf bestehende Kommunikationssysteme unter Verwendung eines generischen Schnittstellenmodells.

Es ist nicht Zweck der in diesem Teil der IEC 61800-7 beschriebenen Funktionen, funktionale Sicherheit zu gewährleisten. Dies erfordert zusätzliche Maßnahmen nach den maßgeblichen Normen, Vereinbarungen und Gesetzen.

Dieser Teil der IEC 61800-7 beschreibt den Profil-Typ 3 für Leistungsantriebssysteme (PDS). Profil-Typ 3 kann auf verschiedene Technologien für Kommunikationsnetzwerke abgebildet werden.

3 Begriffe und Abkürzungen

3.1 Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

3.1.1

Istwert

(en: actual value)

Wert einer variablen Größe zu einem gegebenen Zeitpunkt

[QUELLE: IEV 351-21-02]

Anmerkung 1 zum Begriff: Istwerte oder Ist-Größen werden in diesem Teil der Reihe IEC 61800-7 als Eingangsdaten des Programms zur Steuerung der Anwendung verwendet, um Rückführgrößen oder andere Prozessgrößen des PDS zu überwachen.

3.1.2

Algorithmus

(en: **algorithm**)

vollständig bestimmte endliche Folge von Anweisungen, nach denen die Werte der Ausgangsgrößen aus den Werten der Eingangsgrößen berechnet werden können

[QUELLE: IEC 351-21-37]

3.1.3

Anwendung

(en: **application**)

funktionales Element der Software, spezifisch für die Problemlösung beim Messen und Steuern in industriellen Prozessen

Anmerkung 1 zum Begriff: Eine Anwendung kann über Ressourcen verteilt sein und kann mit anderen Anwendungen kommunizieren.

[QUELLE: IEC/TR 62390:2005, 3.1.2, modifiziert]

3.1.4

Anwendungsmodus

(en: **application mode**)

Art der Anwendung, die von einem PDS angefordert werden kann

Anmerkung 1 zum Begriff: Die verschiedenen Anwendungsmodi spiegeln den Regelkreis für die Regelung des Drehmoments, der Geschwindigkeit, der Position oder andere Anwendungen, wie Referenzieren, wider.

3.1.5

Attribut

(en: **attribute**)

Eigenschaft oder Charakteristik einer Einheit

[QUELLE: IEC/TR 62390:2005, 3.1.3]

3.1.6

Achse

(en: **axis**)

logisches Element eines Bewegungssteuerungssystems, das eine bestimmte Form der Bewegung darstellt

Anmerkung 1 zum Begriff: Achsen können rotatorisch oder linear, physikalisch oder virtuell, gesteuert oder nur beobachtet sein.

Anmerkung 2 zum Begriff: Eine physikalische Achse kann eine oder mehrere der folgenden Komponenten einschließen: einen Bewegungssensor, eine Bewegungssteuerungsstruktur, einen Leistungsverstärker und einen Bewegungsaktor.

3.1.7

Klasse

(en: **class**)

Beschreibung einer Menge von Objekten, die dieselben Attribute, Operationen, Methoden, Beziehungen und Bedeutungen haben

[QUELLE: ISO/IEC 19501, modifiziert]

3.1.8

taktzyklussynchrone Anwendung

(en: **clock cycle synchronous application**)

Synchronisation der Abtast- und Zykluszeiten in der Regelungssoftware in digitalen Antriebs- und Steuerungssystemen

3.1.9

Befehle

(en: **commands**)

Menge an Befehlen von dem Programm zur Steuerung der Anwendung an das PDS, um das Verhalten des PDS oder der funktionalen Elemente des PDS zu steuern

Anmerkung 1 zum Begriff: Das Verhalten wird durch Zustände oder Betriebsarten wiedergegeben.

Anmerkung 2 zum Begriff: Die verschiedenen Befehle können jeweils durch ein Bit dargestellt werden.

3.1.8

Leiten

(en: **control**)

zweckmäßige Maßnahmen an oder in einem Prozess, um vorgegebene Ziele zu erreichen

[QUELLE: IEC 351-21-29]

3.1.10

Steuergerät

(en: **control device**)

physikalische Einheit, die – innerhalb eines Moduls/einer Baugruppe oder eines Gerätes – ein Anwendungsprogramm zur Steuerung des PDS enthält

3.1.11

Datentyp

(en: **data type**)

Menge von Werten mit einer Menge zulässiger Operationen

[QUELLE: ISO/IEC 2382-15:1999, 15.04.01, modifiziert]

3.1.12

Gerät

(en: **device**)

Feldgerät

vernetzte unabhängige physikalische Einheit eines industriellen Automatisierungssystems, die fähig ist, spezifische Funktionen in einem bestimmten Kontext auszuführen und die durch ihre Schnittstellen begrenzt ist

[QUELLE: IEC 61499-1:2005, 3.30, modifiziert]

Einheit, die Steuerungs- und Regelfunktionen sowie Aktor- und/oder Sensorfunktionen ausführt und Schnittstellen zu anderen derartigen Einheiten innerhalb eines Automatisierungssystems hat

[QUELLE: ISO 15745-1:2003, 3.11]

3.1.13

Geräteprofil

(en: **device profile**)

Darstellung eines Gerätes bezüglich seiner Parameter, seiner Parametergruppen und seines Verhaltens nach einem Gerätemodell, das die Daten und das Verhalten des Gerätes beschreibt, wie es durch ein Netzwerk gesehen wird

Anmerkung 1 zum Begriff: Dies ist eine Definition aus IEC/TS 61915, die durch das Hinzufügen der funktionalen Gerätestruktur erweitert ist.

[QUELLE: IEC/TR 62390:2005, 3.1.9, modifiziert]

3.1.14

E/A-Daten des OD

(en: **DO IO Data**)

Sammlung aller Eingangs- und Ausgangsdaten (zyklische Übertragung) eines Antriebsobjekts (Antriebsachse)

3.1.15**Antriebsobjekt****(en: Drive Object)**

funktionales Element einer Antriebseinheit

3.1.16**Kommunikation zwischen Antrieben****(en: Drive to Drive communication)**

(zyklische) Kommunikation zwischen Antrieben aus der Sicht des Nutzers

3.1.17**Antriebseinheit****(en: Drive Unit)**

logisches Gerät, das alle funktionalen Elemente bezogen auf eine zentrale Verarbeitungseinheit umfasst

3.1.18**funktionales Element****(en: functional element)**

Einheit von Software oder von Software, die mit Hardware kombiniert ist, fähig, eine festgelegte Funktion eines Gerätes zu erfüllen

Anmerkung 1 zum Begriff: Ein funktionales Element hat eine Schnittstelle zu anderen funktionalen Elementen und Funktionen.

Anmerkung 2 zum Begriff: Ein funktionales Element kann aus einem oder mehreren Funktionsbausteinen, Objekten oder Parameterlisten erstellt werden.

[QUELLE: IEC/TR 62390:2005, 3.1.12]

3.1.19**Eingangsdaten****(en: Input Data)**

Daten, die zyklisch vom Gerät an den Regler zu senden sind

3.1.20**Schnittstelle****(en: interface)**

Grenze zwischen zwei Einheiten, die durch funktionale Merkmale, Signal-Eigenschaften oder andere geeignete charakteristische Merkmale festgelegt ist

[QUELLE: IEC 351-21-35, modifiziert]

3.1.21**E/A-Daten****(en: IO Data)**

Eingangs- und Ausgangsdaten eines Gerätes

3.1.22**isochroner Modus****(en: Isochronous Mode)**

Dienst des Kommunikationssystems für die Taktzyklussynchronisation, der einen konstanten Bus(zeit)zyklus mit einem Taktzyklussignal am Anfang des Zyklus erzeugt

3.1.23**Modell****(en: model)**

mathematische oder physikalische Darstellung eines Systems oder Prozesses, die das System oder den Prozess aufgrund bekannter Gesetzmäßigkeiten, einer Identifikation oder getroffener Annahmen genügend genau abbildet

[QUELLE: IEC 351-21-36]

3.1.24

Betriebsart

(en: **operating mode**)

Kennzeichnung von Art und Umfang, wie der Mensch als Bediener in eine Leiteinrichtung eingreift

[QUELLE: IEC 351-31-01]

3.1.25

Ausgangsdaten

(en: **Output Data**)

Daten, die zyklisch vom Regler an das Gerät zu senden sind

3.1.26

Parameter

(en: **parameter**)

Datenelement, das Geräteinformationen darstellt, die aus einem Gerät gelesen oder in ein Gerät geschrieben werden können; z. B. durch ein Netzwerk oder ein lokales Bediengerät

Anmerkung 1 zum Begriff: Aus IEC/TS 61915, angepasst.

Anmerkung 2 zum Begriff: Ein Parameter ist typischerweise durch einen Parameternamen, einen Datentyp und eine Zugriffsrichtung gekennzeichnet.

[QUELLE: IEC/TR 62390:2005, 3.1.22, modifiziert]

3.1.27

Prozessdaten

(en: **Process data**)

Daten in Verbindung mit dem Regelungs- bzw. Steuerungsprozess, z. B. Verstärkungsfaktor und Zustandsvariablen, typischerweise auf Parameter abgebildet

3.1.28

Profil

(en: **profile**)

Darstellung einer PDS-Schnittstelle hinsichtlich ihrer Parameter, Parametergruppierung und ihres Verhaltens nach einem Kommunikations- und einem Geräteprofil

3.1.29

Sollwert

(en: **setpoint**)

Wert oder Variable, der/die als Ausgangsdatenwert bzw. -variable von dem Programm zur Steuerung der Anwendung verwendet wird, um das PDS zu steuern

3.1.30

Zustand

(en: **status**)

Menge an Informationen von dem PDS an das Programm zur Steuerung der Anwendung, die den Zustand oder die Betriebsart des PDS oder eines funktionalen Elementes des PDS wiedergibt

Anmerkung 1 zum Begriff: Die verschiedenen Zustandsinformationen können jeweils mit einem Bit kodiert werden.

3.1.31

technologische Funktionen

(en: **technological functions**)

geschlossene Regelkreise und Ablaufsteuerungen für die Automatisierung von anwendungsspezifischen Prozessen

3.1.32**Typ****(en: type)**

Hardware- oder Software-Element, das die gemeinsamen Attribute festlegt, die von allen Instanzen des Typs gemeinsam genutzt werden

[QUELLE: IEC/TR 62390:2005, 3.1.25]

3.1.33**Anwendungsfall****(en: use case)**

Festlegung der Klasse einer Folge von Aktionen, einschließlich Varianten, die ein System (oder eine andere Einheit) durchführen kann, wobei sie mit Aktoren des Systems zusammenwirken

[QUELLE: IEC/TR 62390:2005, 3.1.26]

3.1.34**Variable****(en: variable)**

Software-Einheit, die jeweils verschiedene Werte zu einer Zeit annehmen kann

Anmerkung 1 zum Begriff: Die Werte sowohl einer Variablen als auch eines Parameters sind üblicherweise auf einen bestimmten Datentyp festgelegt.

[QUELLE: IEC/TR 62390:2005, 3.1.27]

3.2 Abkürzungen

AC	PROFIdrive-Anwendungsklasse (en: Application Class)
BERO	Näherungsschalter (en: Proximity Switch)
CO	Kommunikationsobjekt (en: Communication Object)
CR	Kommunikationsbeziehung (en: Communication Relationship)
C-LS	Lebenszeichen des Reglers (en: Controller's Sign-Of-Life)
DO	Antriebsobjekt (en: Drive Object)
DO-LS	Lebenszeichen des Antriebsobjekts (en: Drive Object Sign-Of-Life)
DP	dezentrale (verteilte) Peripherie (en: Decentralized (distributed) Periphery)
DSC	Dynamic Servo Control
DU	Antriebseinheit (en: Drive Unit)
DX	Datenaustausch (en: Data_Exchange)
f	Frequenz (en: frequency)
GSD	Gerätestammdaten-Datei (Gerätebeschreibung, Eingabe für ein Bus-Konfigurationstool) (en: Device Data File)
HMI	Mensch-Maschine-Schnittstelle (en: Human Machine Interface)
ID	Kennzeichner
IO Data	E/A-Daten; zyklisch übertragen (en: IO Data)

I/O	Eingang/Ausgang (en: Input/Output)
KV	Verstärkungsfaktor des geschlossenen Positionsregelkreises
KPC	Verstärkungsfaktor des geschlossenen Positionsregelkreises
LS	Lebenszeichen (en: Sign-Of-Life)
LSB	niedrigstwertiges Bit (en: Least Significant Bit)
MSB	höchstwertiges Bit (en: Most Significant Bit)
M CR	Multicast-CR
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der Chemischen Industrie
NC	Numerische Steuerung (en: Numerical Control System) mit einem numerischen Steuerbefehlssatz
Pxxx	Parameter (gekennzeichnet durch Nummer xxx)
PAP	Parameterzugangspunkt (en: Parameter Access Point)
PBE	Parameterbeschreibung (en: Parameter description)
P-Device	Peripheriegerät (PROFIdrive Base Model) (en: Peripheral Device)
PDS	Leistungsantriebssystem (en: Power Drive System)
PI	PROFIBUS International
SPS	speicherprogrammierbare Steuerung ohne einen Befehlssatz zur Bewegungssteuerung
PLL	Phasenregelkreis (en: Phase Locked Loop)
PNO	PROFIBUS Nutzerorganisation
PNU	Parameternummer (en: Parameter Number)
PROFIBUS	Process Field Bus
PROFINET	Process Field Bus
PWE	Parameterwert
RFG	Hochlaufgeber (en: Ramp Function Generator)
RMS	Effektivwert (wahrer Effektivwert) (en: Root Mean Square)
SN	Vorzeichen (en: Sign)
STW	Steuerwort (en: Control Word)
Ta	Abtastzeit
TDC	Datenzykluszeit (en: Data-Cycle-Time)
TDX	Datenaustauschzeit (en: Data_Exchange-Time)

TM	Masterzeit
TCAC	Zykluszeit der Steueranwendung (en: Controller_Application_Cycle-Time)
TCLS	Zeit für Lebenszeichen des Reglers (en: Contoller_Life_Sign-Time)
TO	Ausgangszeit (en: Output-Time)
TPC	Abtastzeit des Positionsreglers (en: Position Controller Sampling Time))
TSC	Abtastzeit des Drehzahlreglers (en: Speed Controller Sampling Time)
TDLS	Zeit für Lebenszeichen des DO (en: DO_Life_Sign-Time)
VIK	Verband der Industriellen Energie- und Kraftwirtschaft
xerr	Abweichung des geschlossenen Regelkreissystems
ZSW	Statuswort (en: Status Word)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

**Part 7-203: Generic interface and use of profiles for
power drive systems – Profile type 3 specification**

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- International Standard IEC 61800-7-203 has been prepared by subcommittee SC 22G: Adjustable speed electric drive systems incorporating semiconductor power converters, of IEC technical committee TC 22: Power electronic systems and equipment.
- This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.
- The main changes with respect to the previous edition are listed below.
- Minor updates in the Base Mode Parameter Access mechanism.
 - Minor updates and simplification in the application class 3 state machine definition
 - Editorial adjustments in relation with the new version of the IEC Directive Part 2.

54 The text of this standard is based on the following documents:

FDIS	Report on voting
22G/XX/FDIS	22G/XX/RVD

55
56 Full information on the voting for the approval of this standard can be found in the report on
57 voting indicated in the above table.

58 This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

59 A list of all parts of the IEC 61800 series, under the general title *Adjustable speed electrical*
60 *power drive systems*, can be found on the IEC website.

61 The committee has decided that the contents of this publication will remain unchanged until
62 the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data
63 related to the specific publication. At this date, the publication will be

- 64 • reconfirmed;
65 • withdrawn;
66 • replaced by a revised edition, or
67 • amended.

68

69 The National Committees are requested to note that for this publication the stability date
70 is 2019.

71 THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE
72 DELETED AT THE PUBLICATION STAGE.

73

74 **IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it**
75 **contains colours which are considered to be useful for the correct understanding of its**
76 **contents. Users should therefore print this document using a colour printer.**

77

INTRODUCTION

78 **0.1 General**

79 The IEC 61800 series is intended to provide a common set of specifications for adjustable
80 speed electrical power drive systems.

81 IEC 61800-7 describes a generic interface between control systems and power drive systems.
82 This interface can be embedded in the control system. The control system itself can also be
83 located in the drive (sometimes known as "smart drive" or "intelligent drive").

84 A variety of physical interfaces is available (analogue and digital inputs and outputs, serial
85 and parallel interfaces, fieldbuses and networks). Profiles based on specific physical
86 interfaces are already defined for some application areas (e.g. motion control) and some
87 device classes (e.g. standard drives, positioner). The implementations of the associated
88 drivers and application programmers interfaces are proprietary and vary widely.

89 IEC 61800-7 defines a set of common drive control functions, parameters, and state machines
90 or description of sequences of operation to be mapped to the profiles.

91 IEC 61800-7 provides a way to access functions and data of a drive that is independent of the
92 used drive profile and communication interface. The objective is a common drive model with
93 generic functions and objects suitable to be mapped on different communication interfaces.
94 This makes it possible to provide common implementations of motion control (or velocity
95 control or drive control applications) in controllers without any specific knowledge of the drive
96 implementation.

97 There are several reasons to define a generic interface:

98 **For a drive device manufacturer**

- 99 – Less effort to support system integrators
- 100 – Less effort to describe drive functions because of common terminology
- 101 – The selection of drives does not depend on availability of specific support

102 **For a control device manufacturer**

- 103 – No influence of bus technology
- 104 – Easy device integration
- 105 – Independent of a drive supplier

106 **For a system integrator (builds modules, machines, plants etc.)**

- 107 – Less integration effort for devices
- 108 – Only one understandable way of modeling
- 109 – Independent of bus technology

110 Much effort is needed to design a motion control application with several different drives and
111 a specific control system. The tasks to implement the system software and to understand the
112 functional description of the individual components may exhaust the project resources. In
113 some cases, the drives do not share the same physical interface. Some control devices just
114 support a single interface which will not be supported by a specific drive. On the other hand,
115 the functions and data structures are specified with incompatibilities. It is up to the systems
116 integrator to write interfaces to the application software to handle that which should not be his
117 responsibility.

118 Some applications need device exchangeability or integration of new devices in an existing
119 configuration. They are faced with different incompatible solutions. The efforts to adopt a
120 solution to a drive profile and to manufacturer specific extensions may be unacceptable. This
121 will reduce the degree of freedom to select a device best suited for this application to the
122 selection of the unit which will be available for a specific physical interface and supported by
123 the controller.

124 IEC 61800-7-1 is divided into a generic part and several annexes as shown in Figure 1. The
125 drive profile types for CiA® 402¹, CIP Motion^{TM2}, PROFIdrive³ and SERCOS®⁴ are mapped
126 to the generic interface in the corresponding annex. The annexes have been submitted by
127 open international network or fieldbus organizations which are responsible for the content of
128 the related annex and use of the related trade marks.

129 This part of IEC 61800-7 specifies the profile type 3 (PROFIdrive).

130 The profile types 1, 2 and 4 are specified in IEC 61800-7-201, IEC 61800-7-202 and
131 IEC 61800-7-204.

132 IEC 61800-7-301, IEC 61800-7-302, IEC 61800-7-303 and IEC 61800-7-304 specify how the
133 profile types 1, 2, 3 and 4 are mapped to different network technologies (such as CANopen®⁵,
134 CC-Link IE® Field Network⁶, EPA^{TM7}, EtherCAT®⁸, Ethernet Powerlink^{TM9}, DeviceNet^{TM10},
135 ControlNet^{TM11}, EtherNet/IP^{TM12}, PROFIBUS¹³, PROFINET¹⁴ and SERCOS®).

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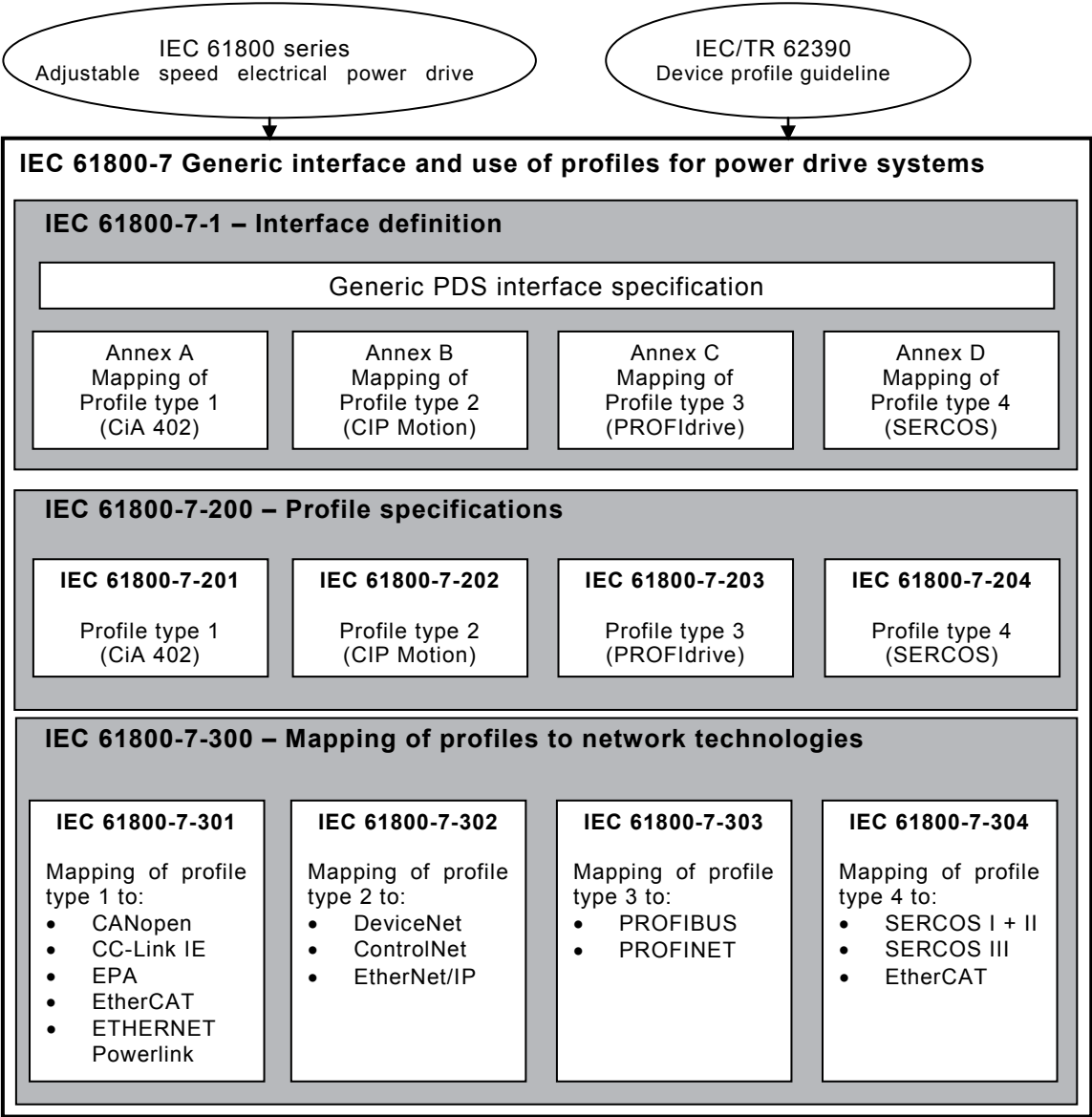


Figure 1 – Structure of IEC 61800-7

¹³ PROFIBUS is a trade name of PROFIBUS & PROFINET International. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by IEC of the trade name holder or any of its products. Compliance to this profile does not require use of the trade name PROFIBUS. Use of the trade name PROFIBUS requires permission of PROFIBUS & PROFINET International.

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0.2 Patent declaration

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning the following:

Publication/ Application serial number	Holder	Title	Derwent accession Number	Derwent publication
EP844542	[SI]	Numerical control method and control structure for controlling of movement of objects whereby speed control is effected at a higher rate than position control	1998-274369	EP844542-A1 27.05.1998; DE59603496-G 02.12.1999; EP844542-B1 27.10.1999

The IEC takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured the IEC that he is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with IEC. Information may be obtained from:

[SI]	Siemens AG Corporate Intellectual Property Licensing & Transactions Otto-Hahn-Ring 6 81730 Munich Germany
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ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –**Part 7-203: Generic interface and use
of profiles for power drive systems –
Profile type 3 specification****1 Scope**

IEC 61800-7 specifies profiles for Power Drive Systems (PDS) and their mapping to existing communication systems by use of a generic interface model.

The functions specified in this part of IEC 61800-7 are not intended to ensure functional safety. This requires additional measures according to the relevant standards, agreements and laws.

This part of IEC 61800-7 specifies profile type 3 for Power Drive Systems (PDS). Profile type 3 can be mapped onto different communication network technologies.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61158-5-3:2014¹⁵, *Industrial communication networks – Fieldbus specifications – Part 5-3: Application layer service definition – Type 3 elements*

IEC 61158-5-10:2014¹⁵, *Industrial communication networks – Fieldbus specifications – Part 5-10: Application layer service definition – Type 10 elements*

IEC 61158-6-3:2014¹⁵, *Industrial communication networks – Fieldbus specifications – Part 6-3: Application layer protocol specification – Type 3 elements*

IEC 61158-6-10:2014¹⁵, *Industrial communication networks – Fieldbus specifications – Part 6-10: Application layer protocol specification – Type 10 elements*

IEC 61800-7 (all parts), *Adjustable speed electrical power drive systems – Generic interface and use of profiles for power drive systems*

IEC 61800-7-1, *Adjustable speed electrical power drive systems – Part 7-1: Generic interface and use of profiles for power drive systems – Interface definition*

IEC 61800-7-303, *Adjustable speed electrical power drive systems – Part 7-303: Generic interface and use of profiles for power drive systems – Mapping of profile type 3 to network technologies*

¹⁵ To be published.

193 3 Terms, definitions and abbreviated terms

194 3.1 Terms and definitions

195 For the purposes of this document, the following terms and definitions apply.

196 3.1.1

197 **actual value**

198 value of a variable at a given instant

199 [SOURCE: IEC 351-21-02]

200 Note 1 to entry: Actual value or actual variable are used in this part of the IEC 61800-7 series as input data of the
201 application control program to monitor feedback variables or other process variables of the PDS.

202 3.1.2

203 **algorithm**

204 completely determined finite sequence of operations by which the values of the output data
205 can be calculated from the values of the input data

206 [SOURCE: IEC 351-21-37]

207 3.1.3

208 **application**

209 software functional element specific to the solution of a problem in industrial-process
210 measurement and control

211 Note 1 to entry: An application may be distributed among resources, and may communicate with other applications.

212 [SOURCE: IEC/TR 62390:2005, 3.1.2, modified]

213 3.1.4

214 **application mode**

215 type of application that can be requested from a PDS

216 Note 1 to entry: The different application modes reflect the control loop for torque control, velocity control, position
217 control or other applications like homing.

218 3.1.5

219 **attribute**

220 property or characteristic of an entity

221 [SOURCE: IEC/TR 62390:2005, 3.1.3]

222 3.1.6

223 **axis**

224 logical element of a motion control system that exhibits some form of movement

225 Note 1 to entry: Axes can be rotary or linear, physical or virtual, controlled or simply observed.

226 Note 2 to entry: A physical *axis* may include one or more of the following components: a motion sensor, a motion
227 control structure, a power amplifier, and a motion actuator.

228 3.1.7

229 **class**

230 description of a set of objects that share the same attributes, operations, methods,
231 relationships, and semantics

232 [SOURCE: ISO/IEC 19501, modified]

233 3.1.8

234 **clock cycle synchronous application**

235 synchronization of sampling and cycle times in the closed-loop control software in digital
236 drives and control systems

237 3.1.9

238 **commands**

239 set of commands from the application control program to the PDS to control the behaviour of
240 the PDS or functional elements of the PDS

241 Note 1 to entry: The behaviour is reflected by states or operating modes.

242 Note 2 to entry: The different commands may be represented by one bit each.

243 **3.1.8**244 **control**

245 purposeful action on or in a process to meet specified objectives

246 [SOURCE: IEC 351-21-29]

247 **3.1.10**248 **control device**249 physical unit that contains – in a module/subassembly or device – an application program to
250 control the PDS251 **3.1.11**252 **data type**

253 set of values together with a set of permitted operations

254 [SOURCE: ISO/IEC 2382-15:1999, 15.04.01, modified]

255 **3.1.12**256 **device**

257 field device

258 networked independent physical entity of an industrial automation system capable of
259 performing specified functions in a particular context and delimited by its interfaces

260 [SOURCE: IEC 61499-1:2005, 3.30, modified]

261 entity that performs control, actuating and/or sensing functions and interfaces to other such
262 entities within an automation system

263 [SOURCE: ISO 15745-1:2003, 3.11]

264 **3.1.13**265 **device profile**266 representation of a device in terms of its parameters, parameter assemblies and behaviour
267 according to a device model that describes the device's data and behaviour as viewed
268 through a network269 Note 1 to entry: This is a definition from IEC/TS 61915 which is extended by the addition of the device functional
270 structure.

271 [SOURCE: IEC/TR 62390:2005, 3.19, modified]

272 **3.1.14**273 **DO IO Data**

274 collection of all Input Data and Output Data (cyclic transmission) of a Drive Object (drive axis)

275 **3.1.15**276 **Drive Object**

277 functional element of a Drive Unit

278 **3.1.16**279 **Drive to Drive communication**

280 communication (cyclic) between drives from the user's perspective

281 **3.1.17**282 **Drive Unit**

283 logical device which comprises all functional elements related to one central processing unit

284 **3.1.18**285 **functional element**286 entity of software or software combined with hardware, capable of accomplishing a specified
287 function of a device

288 Note 1 to entry: A functional element has an interface, associations to other functional elements and functions.

289 Note 2 to entry: A functional element can be made out of function block(s), object(s) or parameter list(s).

290 [SOURCE: IEC/TR 62390:2005, 3.1.12]

- 291 **3.1.19**
292 **Input Data**
293 data to be sent cyclically from the device to the controller
- 294 **3.1.20**
295 **interface**
296 shared boundary between two entities defined by functional characteristics, signal
297 characteristics, or other characteristics as appropriate
298 [SOURCE: IEC 351-21-35, modified]
- 299 **3.1.21**
300 **IO Data**
301 Input Data and Output Data of a device
- 302 **3.1.22**
303 **Isochronous Mode**
304 communication system service for clock cycle synchronism which generates a constant
305 (timing) bus cycle with a clock cycle signal at the start of the cycle
- 306 **3.1.23**
307 **model**
308 mathematical or physical representation of a system or a process, based with sufficient
309 precision upon known laws, identification or specified suppositions
310 [SOURCE: IEC 351-21-36]
- 311 **3.1.24**
312 **operating mode**
313 characterisation of the way and the extent to which the human operator intervenes in the
314 control equipment
315 [SOURCE: IEC 351-31-01]
- 316 **3.1.25**
317 **Output Data**
318 data to be sent cyclically from the controller to the device
- 319 **3.1.26**
320 **parameter**
321 data element that represents device information that can be read from or written to a device,
322 for example through the network or a local HMI
323 Note 1 to entry: Adapted from IEC/TS 61915.
324 Note 2 to entry: A parameter is typically characterized by a parameter name, data type and access direction.
325 [SOURCE: IEC/TR 62390:2005, 3.1.22, modified]
- 326 **3.1.27**
327 **Process data**
328 data related to the control process, for example gain factor and state variables, typically
329 mapped to parameters
- 330 **3.1.28**
331 **profile**
332 representation of a PDS interface in terms of its parameters, parameter assemblies and
333 behaviour according to a communication profile and a device profile
- 334 **3.1.29**
335 **setpoint**
336 value or variable used as Output Data of the application control program to control the PDS
- 337 **3.1.30**
338 **status**
339 set of information from the PDS to the application control program reflecting the state or mode
340 of the PDS or a functional element of the PDS
341 Note 1 to entry: The different status information may be coded with one bit each.

- 342 **3.1.31**
343 **technological functions**
344 closed-loop controls and sequence controls for automation of application-specific processes
- 345 **3.1.32**
346 **type**
347 hardware or software element which specifies the common attributes shared by all instances
348 of the type
- 349 [SOURCE: IEC/TR 62390:2005, 3.1.25]
- 350 **3.1.33**
351 **use case**
352 class specification of a sequence of actions, including variants, that a system (or other entity)
353 can perform, interacting with actors of the system
- 354 [SOURCE: IEC/TR 62390:2005, 3.1.26]
- 355 **3.1.34**
356 **variable**
357 software entity that may take different values, one at a time
- 358 Note 1 to entry: The values of a variable as well as of a parameter are usually restricted to a certain data type.
- 359 [SOURCE: IEC/TR 62390:2005, 3.1.27]
- 360

361 **3.2 Abbreviated terms**

362	AC	PROFIdrive Application Class
363	BERO	Proximity Switch
364	CO	Communication Object
365	CR	Communication Relationship
366	C-LS	Controller's Sign-Of-Life
367	DO	Drive Object
368	DO-LS	Drive Object Sign-Of-Life
369	DP	Decentralised (distributed) Periphery
370	DSC	Dynamic Servo Control
371	DU	Drive Unit
372	DX	Data_Exchange
373	f	frequency
374	GSD	Device Data File (device description, input for a bus configuring tool)
375	HMI	Human Machine Interface
376	ID	Identifier
377	IO Data	IO Data; is transmitted cyclically
378	I/O	Input/Output
379	K_V	Position closed loop control gain factor
380	k_{PC}	Position closed loop control gain factor
381	LS	Sign-Of-Life
382	LSB	Least Significant Bit
383	MSB	Most Significant Bit
384	M CR	Multicast CR
385	NAMUR	Standards Working Group for Instrumentation and Control in the Chemical Industry
386		
387	NC	Numerical control system with a numeric control command set
388	Pxxx	Parameter (identified by number xxx)
389	PAP	Parameter Access Point
390	PBE	Parameter description
391	P-Device	Peripheral Device (PROFIdrive Base Model)
392	PDS	Power Drive System
393	PI	PROFIBUS international
394	PLC	Programmable Logic Controller without a Motion Control command set
395	PLL	Phase Locked Loop (phase control loop)

396	PNO	PROFIBUS User Organization
397	PNU	Parameter Number
398	PROFIBUS	Process Field Bus
399	PROFINET	Process Field Bus
400	PWE	Parameter value
401	RFG	Ramp Function Generator
402	RMS	Root Mean Square value (true Root Mean Square value)
403	SN	Sign
404	STW	Control Word
405	T_a	Sampling time
406	T_{DC}	Data-Cycle-Time
407	T_{DX}	Data_Exchange-Time
408	T_M	Master-Time
409	T_{CAC}	Controller_Application_Cycle-Time
410	T_{CLS}	Contoller_Life_Sign-Time
411	T_O	Output-Time
412	T_{PC}	Position Controller Sampling Time
413	T_{SC}	Speed Controller Sampling Time
414	T_{DLS}	DO_Life_Sign-Time
415	VIK	Association of the Industrial Customers and Industrial Power Producers
416	x_{err}	Closed loop control system deviation
417	ZSW	Status Word

418

419 4 General

420 4.1 Background

421 The PROFIdrive profile was generated by the PROFIBUS user organization PROFIBUS
 422 international (PI). It defines a unified device behaviour and access technique to the drive
 423 data.

424 For the user, this means that engineering costs are reduced when planning and implementing
 425 plants and systems, as the various drives respond the same way to control instructions.

426 The programming costs are significantly reduced by using standardised program blocks in the
 427 open-loop and closed-loop control systems for controlling the drive. For drive manufacturers,
 428 as a result of the profile definition, development costs are reduced and the implementation of
 429 non-proprietary standardised interface improves the chances of being successful in the
 430 market.

431 The mapping to the generic interface is given in IEC 61800-7-1, Annex C.



4.2 Requirements

Today, variable-speed electric drives from basic AC drive converters up to high-dynamic performance servo controllers are being increasingly connected to higher-level open-loop and closed-loop control systems in automated plants and systems via digital interfaces.

In today's systems, the speed interface is mostly common. The speed setpoint is entered from a higher-level automation system which controls the drive. Generally, the speed actual value is signalled back to the automation system to monitor the drive.

In order that the digital field bus interface in distributed automation concepts may also be used in the area of motion control with several drive axes, today's standard field busses shall be expanded by specific features. This involves fulfilling the following requirements:

Clock cycle synchronism: If a central motion controller is being used which handles the interpolation and closed-loop position control, the control loop shall be closed via the bus. The speed setpoint is transferred to the drive in the setpoint direction. In the actual value direction, the drive provides a position actual value. In order to implement sufficiently high loop gains to fulfil the required dynamic performance, the delays shall be minimal and it is especially important that they be absolutely constant. If the motion control task requires the coordination of several axes, the position actual values shall be acquired precisely at the same time and evaluated in synchronism in the motion controller. Furthermore, the setpoints shall take effect precisely at the same time in the axes. The actual value acquisition, transfer and setpoint activation are in clock cycle synchronism with the closed-loop position controller.

Drive-to-Drive communication: State-of-the-art automation solutions with digital Drive Units also use distributed concepts where the open-loop and closed-loop control tasks, which were previously implemented centrally, are shifted into intelligent drives. Examples are single-axis-positioning drives or drives with integrated software for winding functions or synchronous operating applications.

If automation functions are to be decentralised and distributed, then data shall be directly transferred between the drives, which, for example for an electronic shaft, shall be realised with precise angular synchronism and also with clock cycle synchronism.

Acyclic communication: The acyclic communication services are requested to transfer parameter requests for operator control and monitoring of drives in parallel to the cyclic data exchange.

With modern automation profiles, it is a strong requirement that state of the art communication systems be supported.

4.3 Goals of the PROFIdrive Profile

To protect investments in engineering tools, automation program libraries and training of staff, it is important to have a stable generic application profile functionality which migrates to future enhanced field bus systems by keeping its application platform interface stable.

5 Data types

5.1 Data types overview

Profile-specific data types corresponding to the particular drive requirements are defined. The profile-specific data types are individually defined in 5.3. The standard types are defined in IEC 61158-5-10. An overview of all of the permissible data types (standard data types and profile-specific data types) is given in Table 1 and Table 2.

It is strongly recommended to use standard and profile specific data types out of Table 1 and Table 2 for all drive device parameters. In addition, because of compatibility to older systems, all Controller and Device implementations also shall support the basic data types Byte, Word, Double word as defined in Table 31. For further information about handling of data types in the PROFIdrive Base Mode Parameter Access see 6.2.3.6.

5.2 Standard data types

Table 1 shows references of data types used in this profile and the related definitions.

482

Table 1 – Standard data types

Data types used in Profile PROFIdrive	Reference to definition	Data type numeric identifier
Boolean	Boolean (see IEC 61158-5-10)	1
Integer8	Integer8 (see IEC 61158-5-10)	2
Integer16	Integer16 (see IEC 61158-5-10)	3
Integer32	Integer32 (see IEC 61158-5-10)	4
Integer64	Integer64 (see IEC 61158-5-10)	55
Unsigned8	Unsigned8 (see IEC 61158-5-10)	5
Unsigned16	Unsigned16 (see IEC 61158-5-10)	6
Unsigned32	Unsigned32 (see IEC 61158-5-10)	7
Unsigned64	Unsigned64 (see IEC 61158-5-10)	56
FloatingPoint	Float32 (see IEC 61158-5-10)	8
FloatingPoint64	Float64 (see IEC 61158-5-10)	15
VisibleString	VisibleString (see IEC 61158-5-10)	9
OctetString	OctetString (see IEC 61158-5-10)	10
UNICODEString	UNICODEString (see IEC 61158-5-10)	39
TimeOfDay (with date indication)	TimeOfDay (see IEC 61158-5-10)	12
TimeDifference (do not use) ^a	TimeDifference (see IEC 61158-5-10)	13
Date	Date (see IEC 61158-5-10)	50
TimeOfDay without date indication	TimeOfDay (see IEC 61158-5-10)	52
TimeDifference with date indication	TimeDifference (see IEC 61158-5-10)	53
TimeDifference without date indication	TimeDifference (see IEC 61158-5-10)	54
^a Data type TimeDifference shall not be used for new device implementations. For device implementation use data types TimeDifference with date indication and TimeDifference without date indication instead. For compatibility reasons all three data types of TimeDifference shall be supported by a controller implementation.		

483

484 5.3 Profile-specific data types

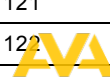
485 5.3.1 General

486 All profile-specific data types (see Table 2) may be implemented in the drive (optional data
487 types).

488

Table 2 – Profile specific data types

Data types used in Profile PROFIdrive	Reference to definition	Data type numeric identifier
N2 Normalised value (16 bit)	5.3.2, Table 3 and Table 4	113
N4 Normalised value (32 bit)	5.3.2, Table 3 and Table 4	114
V2 Bit sequence	5.3.6 and Table 10	115
L2 Nibble	5.3.7 and Table 11	116
R2 Reciprocal time constant	5.3.10 and Table 14	117
T2 Time constant (16 bit)	5.3.8 and Table 12	118
T4 Time constant (32 bit)	5.3.8 and Table 12	119
D2 Time constant	5.3.9 and Table 13	120
E2 Fixed point value (16 bit)	5.3.4, Table 7 and Table 8	121
C4 Fixed point value (32 bit)	5.3.5 and Table 9	122
X2 Normalised value, variable (16 bit)	5.3.3, Table 5 and Table 6	123



Data types used in Profile PROFIdrive	Reference to definition	Data type numeric identifier
X4 Normalised value, variable (32 bit)	5.3.3, Table 5 and Table 6	124

It is strongly recommended to use the profile specific data types for optimum matching to the application. For compatibility to older drive applications with none of the profile-specific data types:

- Instead of N2, N4 or X2, X4 use Integer16, Integer32 with optional normalisation.

5.3.2 Normalised value: N2, N4

Meaning

Linear normalised value. 0 % corresponds to 0 (0x0), 100 % corresponds to 2^{14} (0x4000) for N2 or 2^{30} (0x40000000) for N4.

Table 3 – N2, N4-Range of values

Coding	Data type	Range of values	Resolution	Length
113	N2	$-200 \% \leq i \leq (200 \cdot 2^{-14}) \%$	$2^{-14} = 0,0061 \%$	2 Octet
114	N4	$-200 \% \leq i \leq (200 \cdot 2^{-30}) \%$	$2^{-30} = 9,3 \times 10^{-8} \%$	4 Octet

Coding

- Representation in twos complement, the MSB (Most Significant Bit) is the bit after the sign bit (SN) of the first octet.
- SN = 0: positive numbers including zero
- SN = 1: negative numbers

Table 4 – N2, N4-Coding

Octet	Bit							
	8	7	6	5	4	3	2	1
1	SN	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}
2	2^{-7}	2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}
3	2^{-15}	2^{-16}	2^{-17}	2^{-18}	2^{-19}	2^{-20}	2^{-21}	2^{-22}
4	2^{-23}	2^{-24}	2^{-25}	2^{-26}	2^{-27}	2^{-28}	2^{-29}	2^{-30}

5.3.3 Normalised value (variable normalisation): X2, X4

Meaning

Linear normalised value. 0 % corresponds to 0 (0x0), 100 % corresponds to 2^X . The structure is the same as for data types N2 and N4, but the normalisation (100 %) does not automatically refer to bit 14 or bit 30 respectively, but is variable. The normalisation bit is coded in the parameter description element "DO IO Data normalisation" (refer to 6.2.1.3).

Table 5 – X2, X4-Range of values

Coding	Data type	Range of values	Resolution	Length
123	X2 (e.g. with $x = 12$)	$-800 \% \leq i \leq (800 \cdot 2^{-12}) \%$	2^{-12}	2 Octet
124	X4 (e.g. with $x = 28$)	$-800 \% \leq i \leq (800 \cdot 2^{-28}) \%$	2^{-28}	4 Octet

Coding

- Twos complement representation, the MSB (Most Significant Bit) is the bit after the sign bit (SN) of the first octet.
- SN = 0: positive numbers including zero.

- SN = 1: negative numbers.

Table 6 – X2, X4-Coding (example x=12/28)

Octet	Bit							
	8	7	6	5	4	3	2	1
1	SN	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}
2	2^{-5}	2^{-6}	2^{-7}	2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}
3	2^{-13}	2^{-14}	2^{-15}	2^{-16}	2^{-17}	2^{-18}	2^{-19}	2^{-20}
4	2^{-21}	2^{-22}	2^{-23}	2^{-24}	2^{-25}	2^{-26}	2^{-27}	2^{-28}

5.3.4 Fixed point value: E2

Meaning

Linear fixed-point value with seven binary places after the decimal point. 0 corresponds to 0 (0x0), 128 corresponds to 2^{14} (0x4000).

Table 7 – E2-Range of values

Coding	Data type	Range of values	Resolution	Length
121	E2	$-256+2^{-7} \leq i \leq 256-2^{-7}$	$2^{-7} = 0,007\ 812\ 5$	2 Octet

Coding

- Twos complement representation, the MSB (Most Significant Bit) is the bit after the sign bit (SN) of the first octet.
- SN = 0: positive numbers including zero.
- SN = 1: negative numbers.

Table 8 – E2-Coding

Octet	Bit							
	8	7	6	5	4	3	2	1
1	SN	2^7	2^6	2^5	2^4	2^3	2^2	2^1
2	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}

5.3.5 Fixed point value: C4

Meaning

Linear fixed point value with four decimal places. 0 corresponds to 0 (0x0), 0,0001 corresponds to 2^0 (0x0000 0001).

Table 9 – C4-Range of values

Coding	Data type	Range of values	Resolution	Length
122	C4	$-214\ 748,364\ 8 \leq i \leq 214\ 748,364\ 7$	$10^{-4} = 0,000\ 1$	4 Octet

Coding

As by Integer32, weighting of the bits has been reduced by a factor of 10 000.

5.3.6 Bit sequence: V2

Meaning

Bit sequence to control and represent application functions. 16 Boolean variables are combined in two octets. (Coding: 115)

Table 10 – V2-Coding

Octet	Bit
-------	-----



	8	7	6	5	4	3	2	1
1	15	14	13	12	11	10	9	8
2	7	6	5	4	3	2	1	0

5.3.7 Nibble: L2**Meaning**

Four associated bits form a nibble. Four nibbles are represented in two octets.

The definition of the nibble is not specified. (Coding: 116)

Table 11 – L2-Coding

Octet	Bit							
	8	7	6	5	4	3	2	1
1	Nibble 3				Nibble 2			
2	Nibble 1				Nibble 0			

Comment regarding time parameters

The value of time parameters of types D2, T2, T4, R2 always refer to the specified constant sampling time T_a . The associated sampling time (value of profile parameter 962) is required in order to interpret the internal value.

5.3.8 Time constant: T2, T4**Meaning**

Time data as a multiple of constant sampling time T_a .

Table 12 – T2, T4-Range of values

Coding	Data type	Range of values	Resolution	Length
118	T2	$0 \leq i \leq 32\,767 \times T_a$	T_a	2 Octet
119	T4	$0 \leq i \leq 4\,294\,967\,295 \times T_a$	T_a	4 Octet

Interpreted value = Internal value $\times T_a$

Coding of internal value

- T2: As by Unsigned16 with a restricted Range of values $0 \leq x \leq 32\,767$. When interpreted, internal values outside this range are set to 0.
- T4: As by Unsigned 32.

5.3.9 Time constant: D2**Meaning**

Time data as a fraction of the constant sampling time T_a .

Table 13 – D2-Range of values

Coding	Data type	Range of values	Resolution	Length
120	D2	$0 \leq i \leq (2-2^{-14}) \times T_a$	$2^{-14} \times T_a$	2 Octet

Interpreted value = Internal value $\times T_a/16\,384$

Coding of internal value

As by Unsigned16 with a restricted Range of values $0 \leq x \leq 32\,767$. When interpreted, internal values outside this range are set to 0.

579 **5.3.10 Reciprocal time constant: R2**580 **Meaning**581 Time data as a reciprocal multiple of a constant sampling time T_a .582 **Table 14 – R2-Range of values**

Coding	Data type	Range of values	Resolution	Length
117	R2	$1 \times T_a \leq i \leq 16\,384 \times T_a$	T_a	2 Octet

583

584 Interpreted value = $16\,384 \times T_a$ / internal value585 **Coding of internal value**586 As by Unsigned16 with a limited Range of values $1 \leq x \leq 16\,384$.

587 When interpreted, internal values outside this range are set to 16 384

588 **6 Specifications**589 **6.1 Integration of drives in automation systems**590 **6.1.1 General**

591 This clause specifies the abstract modelling and different variants for integration of
 592 PROFIdrive drive Axis in automation systems. This PROFIdrive model is generally
 593 independent of the Communication System used as network platform (PROFIBUS,
 594 PROFINET). Depending on the communication system, limitations to the general model and
 595 functionality may be possible.

596 **6.1.2 Base Model**597 **6.1.2.1 Communication Devices**

598 The PROFIdrive Base Model defines as basic elements the following three classes of devices:

599 **Controller**

600 The Controller is a controlling device which is associated with one or more drives (axes).
 601 Related to the automation system, the Controller is the host for the overall automation.

602 **P-Device**

603 The P-Device (peripheral device) is a field device and the host device for the drives (closed
 604 loop control, inverter). The P-Device typically is associated with one or more Controller
 605 devices.

606 **Supervisor**

607 The Supervisor typically is an engineering device which manages provisions of configuration
 608 data (parameter sets) and collections of diagnosis data from P-Devices and/or Controllers.

609 **6.1.2.2 Communication Relationship**

610 The PROFIdrive Base Model defines the following types of communication relationships
 611 between the Devices:

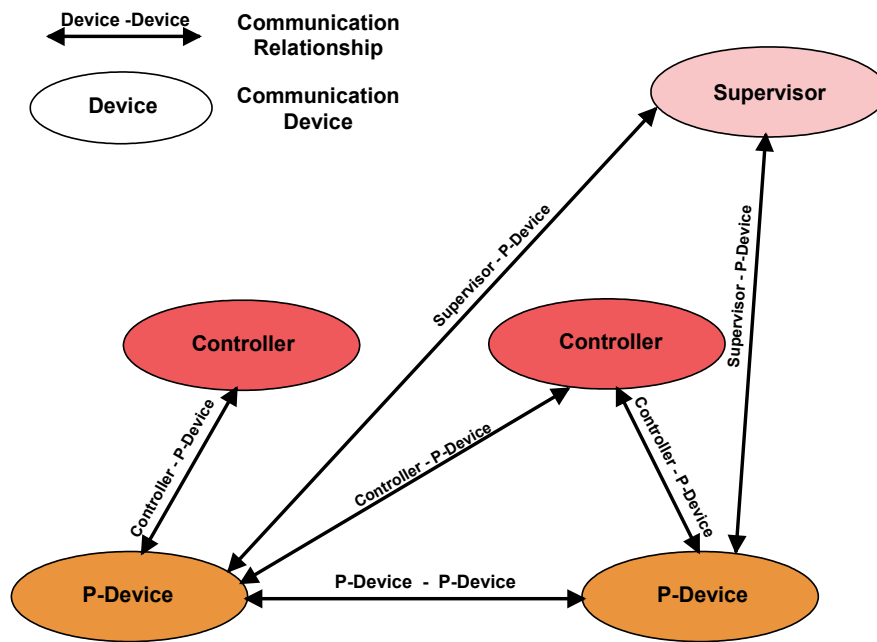


Figure 2 – PROFIdrive Devices and their relationship

Figure 2 shows the PROFIdrive Devices and the defined relationships between them in the context of the PROFIdrive Base Model.

6.1.2.3 Communication Network

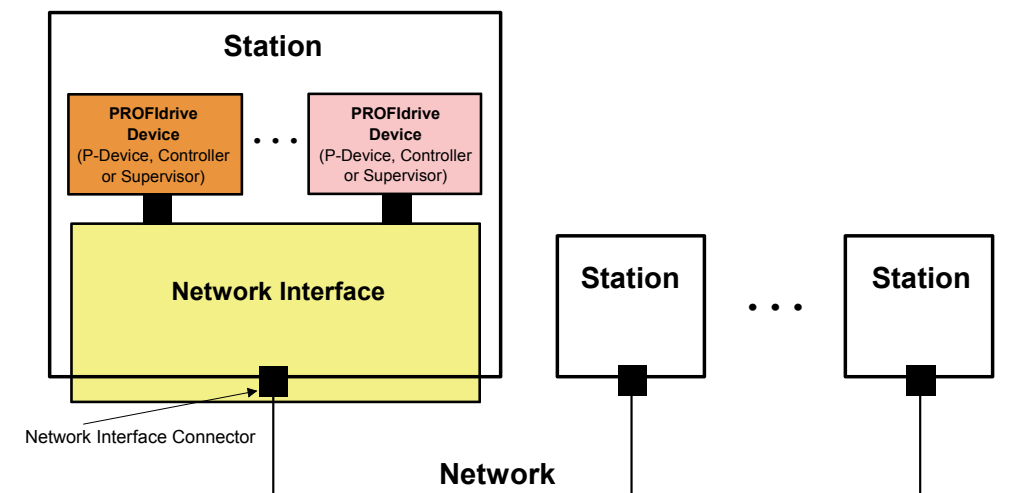


Figure 3 – General Communication Model of a PROFIdrive Automation System

Figure 3 shows the general architecture of the automation system and the location of the PROFIdrive Devices as components of the Station. The physical model generally consists of physical Stations embedded in a Communication Network system. Though every Station comprises a Network Interface Connector to physically connect the Station to the Network and a Network Interface functionality, which provides the Communication Service to the Devices.

Therefore the PROFIdrive Device is precisely defined by the following address information:

- Network,
- Station (Identifier for Station inside the Network),
- Device (Identifier for Device inside the Station).

6.1.2.4 Functional Object

The PROFIdrive Device consists of one or more Functional Objects. The Functional Objects are logical Objects which represent a special functionality inside the automation system. Figure 4 shows the general architecture of the PROFIdrive Device containing Functional Objects.

If the Device is of P-Device type, the Functional Objects inside the P-Device are of Drive Object type (see Figure 4). The typical functionality of the Drive Object is the drive functionality itself (motor, inverter stage, closed loop current and speed control, Input and output functionality). For example, one drive axis is related to a Drive Object.

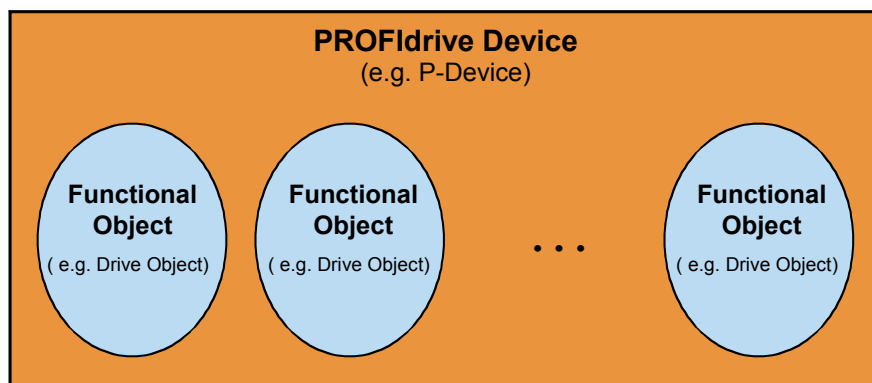


Figure 4 – The PROFIdrive Device (consists of one or several Functional Objects)

6.1.2.5 Object Model

Based on the Objects defined in the Base Model, the hierarchical order and dependencies between them are specified in the Object Model (see Figure 5).

Every Station consists of the Network Interface and one or more Devices. The Network Interface is related to the Network to which the Station is connected. The Devices are classified in three types, Controller, P-Device and Supervisor. If the Device is of P-Device type, the P-Device consists of one or more Drive Units (DU) which comprises one or more Drive Objects (DO). Clustering the Drive Objects in Drive Units (DU) may be used to define the affiliation of Drive Objects to one physical drive control unit (CPU) or physical cluster. The Drive Unit expresses definitely the area of validity of global parameters.

In addition, the “Communication Object” (CO), which has a relationship to the Network Interface and also to the Functional Object (e.g. Drive Object), is defined. The purpose of the Communication Object is to be a Communication System addressable communication end point, which may be associated to a Functional Object.

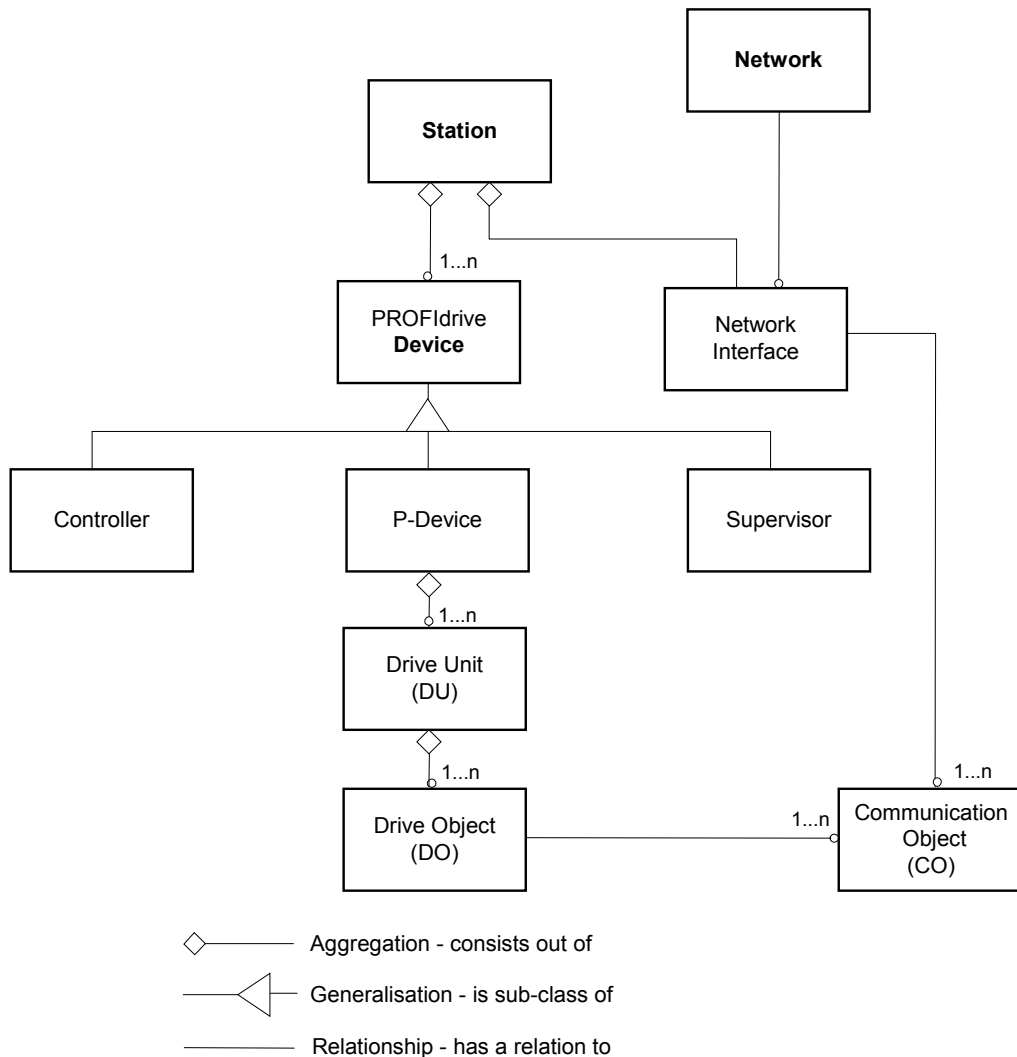


Figure 5 – Hierarchical order in the Object Model

6.1.2.6 Layer Model

Separation of the objects in the Base Model according to the aspects of application and communication leads to the Layer Model according to Figure 6. Here, the Application Layer only contains the functional aspects of the automation system, independent of the distribution of the functional elements among physical stations and devices. The distribution aspect is represented by the Communication Layer, which specifies the physical network components and the allocation of the Functional Objects to them.

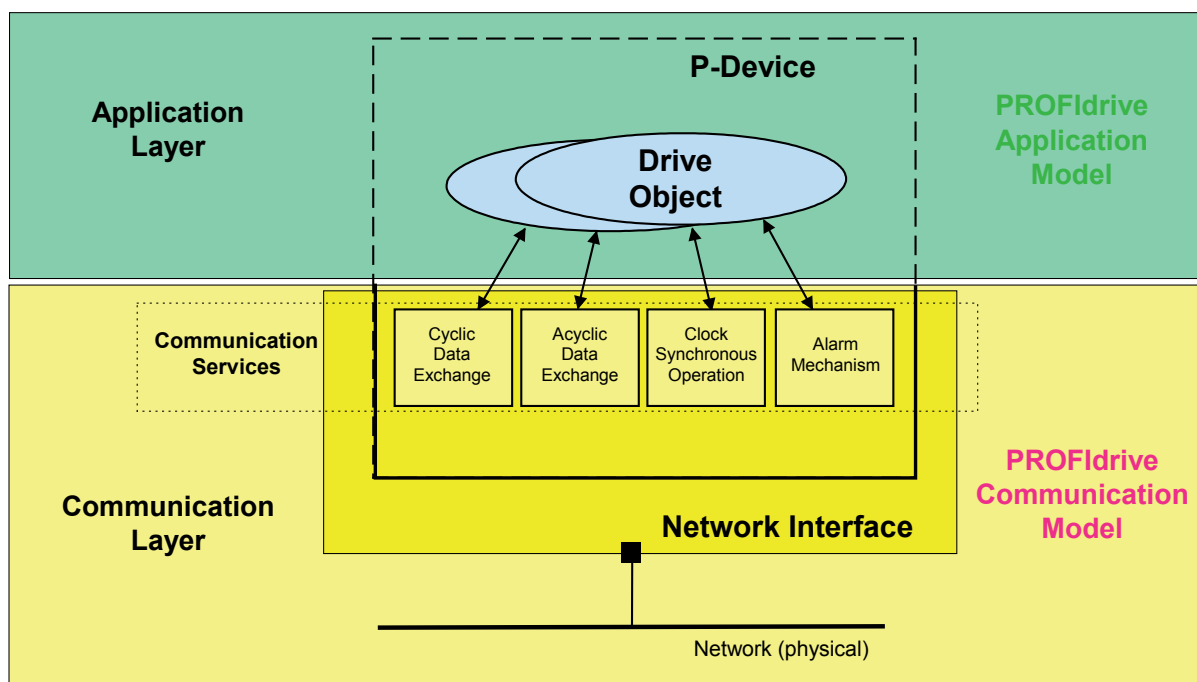


Figure 6 – PROFIdrive Base Model contains the “Application Layer” and “Communication Layer”

6.1.2.7 Communication Services

6.1.2.7.1 General

The PROFIdrive Base Model defines the following Communication Services. The Communication Services are provided from the Device and are used from the Functional Object.

The representation of data shall be in big-endian format.

6.1.2.7.2 Cyclic Data Exchange

Cyclic communication means the simple transfer of IO data of predefined size in a reserved time slot. With cyclic communication, the IO data that is critical with respect to time is exchanged between the controller and device or between devices. Typical such data contains setpoint values and actual values, control- and status information. The Cyclic Data Exchange service is assigned to the “Controller – P-Device” and the “P-Device – P-Device” relationship. A Cyclic Data Exchange channel is related to a Communication Object at its end points.

6.1.2.7.3 Acyclic Data Exchange

Compared to cyclic communication, data is exchanged acyclically only if necessary. Via acyclic communication, non time critical data is transferred, for example the download of firmware or parameter data. The Acyclic Data Exchange service is assigned to the “Controller – P-Device” and the “Supervisor – P-Device” relationship. An Acyclic Data Exchange channel is related to a Communication Object at its end points.

6.1.2.7.4 Alarm Mechanism

With the Alarm Mechanism service, alarm information and exception situations are signalled to the controlling device in a real time manner. The service works demand-oriented to keep the exception status image of the Functional Object in the Controller up to date. With this service, the controller is able to respond on an occurring event in the drive as fast as possible without polling the drive status information permanently. The Alarm Mechanism service is assigned to the “Controller – P-Device” relationship.

6.1.2.7.5 Clock Synchronous Operation

The Clock Synchronous Operation service guaranties that tasks on different communication Devices or Functional Objects start at the same time with minimum (specified) jitter (e.g. the sampling and output processes). This service also implies, that dedicated cyclic data packages are definitely transmitted until a certain moment in the communication cycle.

For drive technology, clock cycle synchronous communication is the basis for drive synchronisation. Not only message interchange on the bus system is implemented in an isochronous time base, but also the internal control algorithms - such as closed loop speed and current controllers in the drive, or the controller in the higher level automation system - are synchronised (see Figure 7).

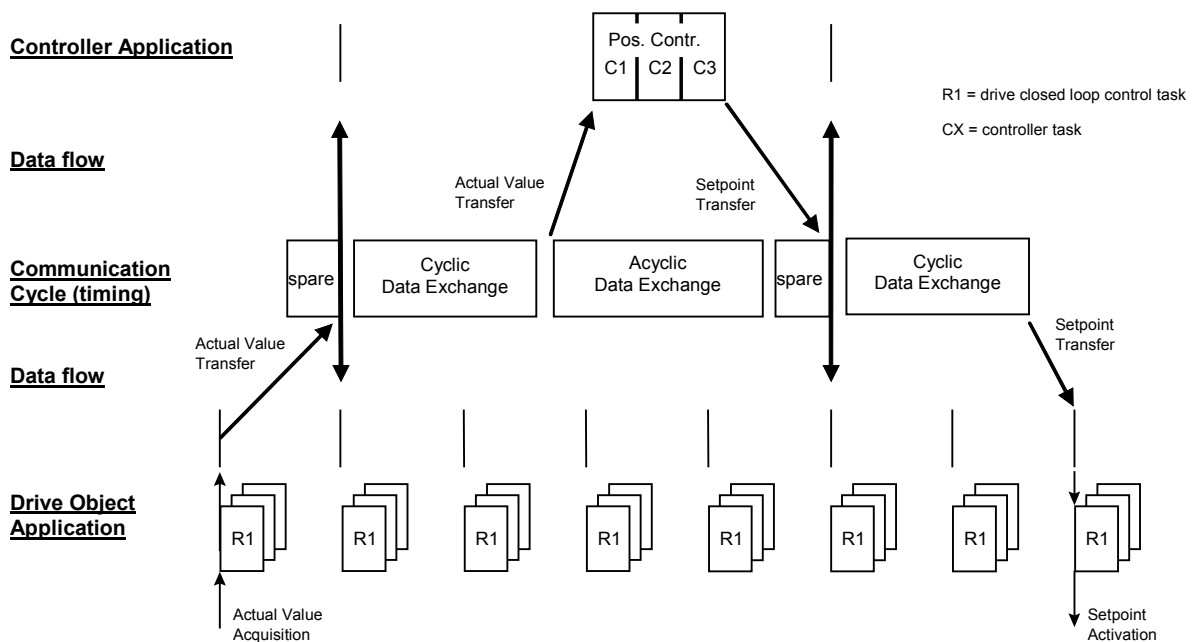


Figure 7 – Typical use case for Clock Synchronous Operation

The general model for the Clock Synchronous Operation service is defined according to Figure 8. The model is based on local clocks which are related to every Device supporting the Clock Synchronous Operation service. These local clocks are synchronised to one dedicated Master Clock. After the Clock Synchronous Operation mechanism is started, all Slave Clocks are synchronous to the Master Clock with a defined maximum Jitter of 1 μ s. The mechanism of start up and synchronisation of the Slave Clocks to the Master Clock are related to the Communication System (part of the Communication Layer).

713 The Device which comprises the Master Clock is defined as Clock Master. According to the
714 application, application tasks may be triggered by the Slave Clock of the Device. For example
715 concerning an axis controller, the sampling of input values and the output of the motor current
716 are triggered out of the Slave Clock and are therefore synchronous to all other processes
717 related to the Clock Master.

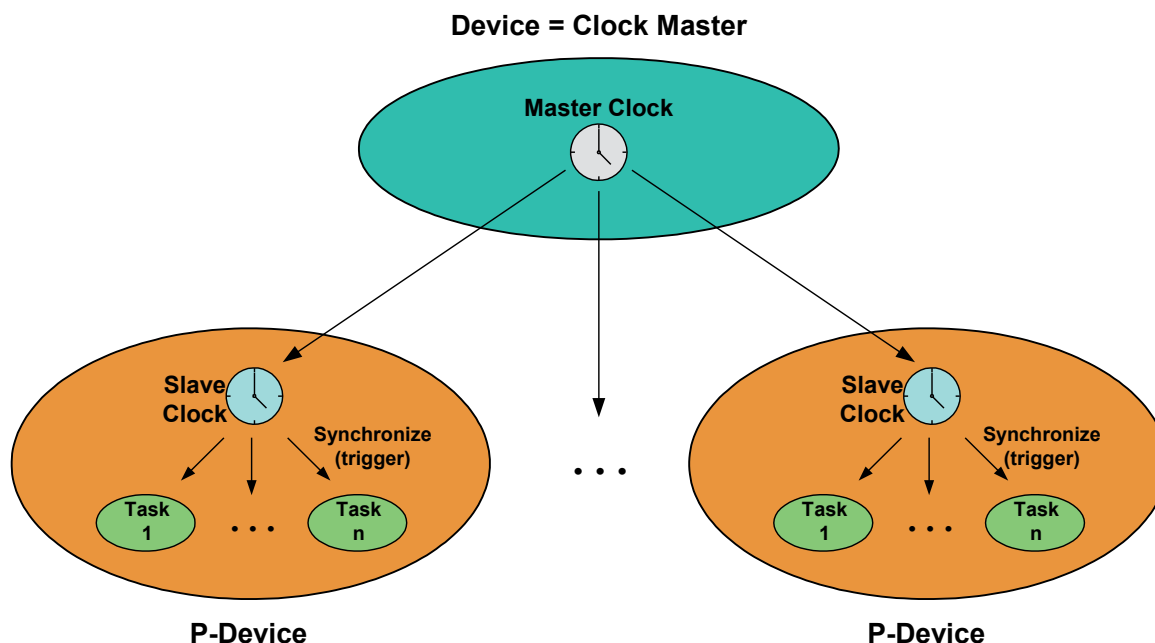


Figure 8 – General Model for Clock Synchronous Operation

6.1.2.7.6 Base Model State Machine

For the Base Model (see Figure 9) the following states, related to the communication and application run up process, are defined:

Offline

There is generally no Communication Service working.

Preparation

In this state, the Acyclic Data Exchange service and the Alarm Mechanism is working. This means that configuration information may be passed from the Controller to the Drive Unit and that Parameter Access is possible. In addition, alarms will be forwarded. There may be no Cyclic Data Exchange service or the transmitted Data is not valid. The Communication System tries to synchronise all Slave Clocks to the Clock Master.

Synchronisation

In this state, the Acyclic Data Exchange, the Cyclic Data Exchange and the Alarm Mechanism are working and the transmitted cyclic data is valid. The application processes try to synchronise their tasks to each other (synchronise to the local Slave Clock and synchronise the data streams via the cyclic communication channels).

Operation

In this state, the application processes are also synchronised and the whole application is ready to operate (productive work).

If, in one of these states, exceptions occur which cause the system to lose one or more of the characteristics related to the actual state, the related Devices will be forced to go back to a corresponding predecessor state, in order to proceed to switch forward to the next higher level again, if possible and allowed.

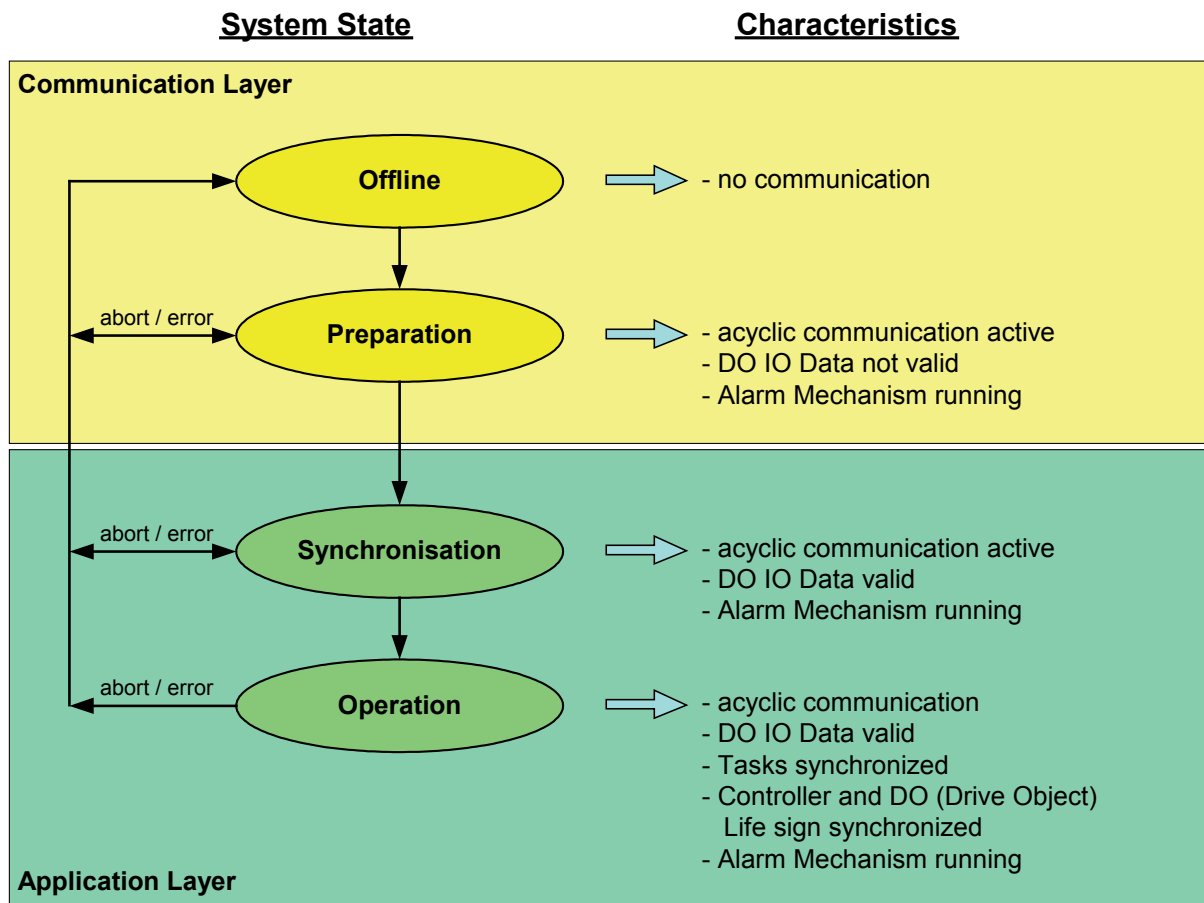


Figure 9 – Base Model State Machine

6.1.3 Drive Model

6.1.3.1 General

Based on the P-Device device type, defined in the Base Model previously, this subclause defines the architecture of the P-Device in more detail.

6.1.3.2 P-Device

This profile of drive engineering defines a PROFIdrive Device of P-Device type according to Figure 10 as a P-Device containing exactly one or multiple Drive Units (DU). The P-Device may also contain other objects which are not Drive Units. See also Figure 5.

6.1.3.3 Drive Unit

This profile of drive engineering defines a PROFIdrive Drive Unit (DU) according to Figure 10 as part of a P-Device containing exactly one or multiple Drive Objects (DO). The unambiguous identification of a Drive Object within a Drive Unit is done by the Drive Object ID (DO-ID) which is assigned to every DO of a DU. The Drive Unit contains only Drive Objects. See also Figure 5.

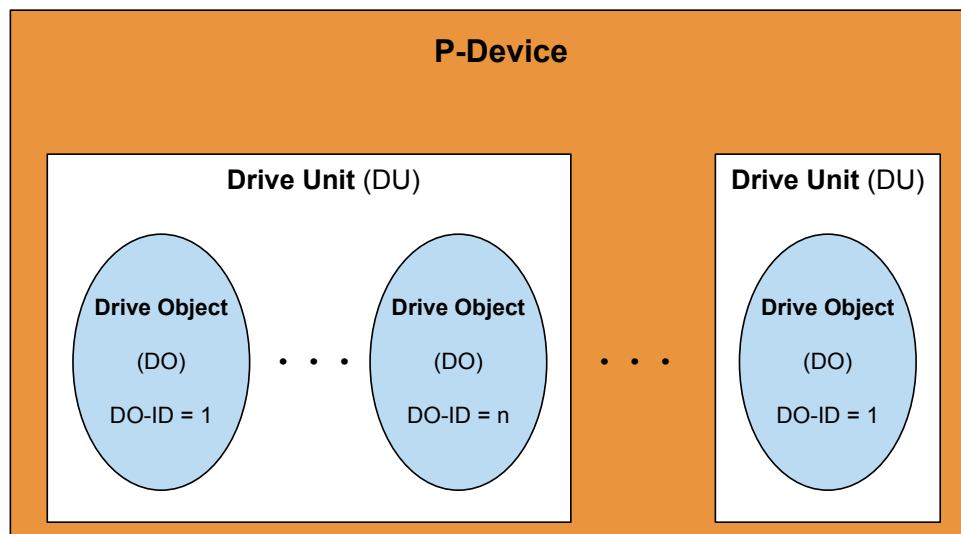


Figure 10 – General Drive Unit model

6.1.3.4 Drive Object

Figure 11 shows the general Drive Object (DO) architecture. The central element of the DO is the Process Control Task which is responsible for the automation functionality of the DO. Properties of the DO and the Process Control Task are represented and controlled by parameters. The parameters are administered in the Parameter Data Base. To access DO parameter, Acyclic Data Exchange service is used. For periodic transportation of setpoint values to the DO and actual values from the DO, the Cyclic Data Exchange service is used. If the DO is of Axis type (refer to 6.1.3.5), the DO comprises a General State Machine, which controls and represents the states of the Drive Process Control Task. Exceptions from the standard behaviour may occur in the Process Control Task or in the General State Machine. These exceptions may be signalled by the Alarm Mechanism to the controlling device.

The DO shall comprise as a minimum mandatory functionality:

- Parameters

The DO may comprise as an optional functionality:

- Process Control Task
- DO IO Data (setpoint value, actual values)
- General State Machine (for Axis type DO mandatory)
- Support for Alarm Mechanism

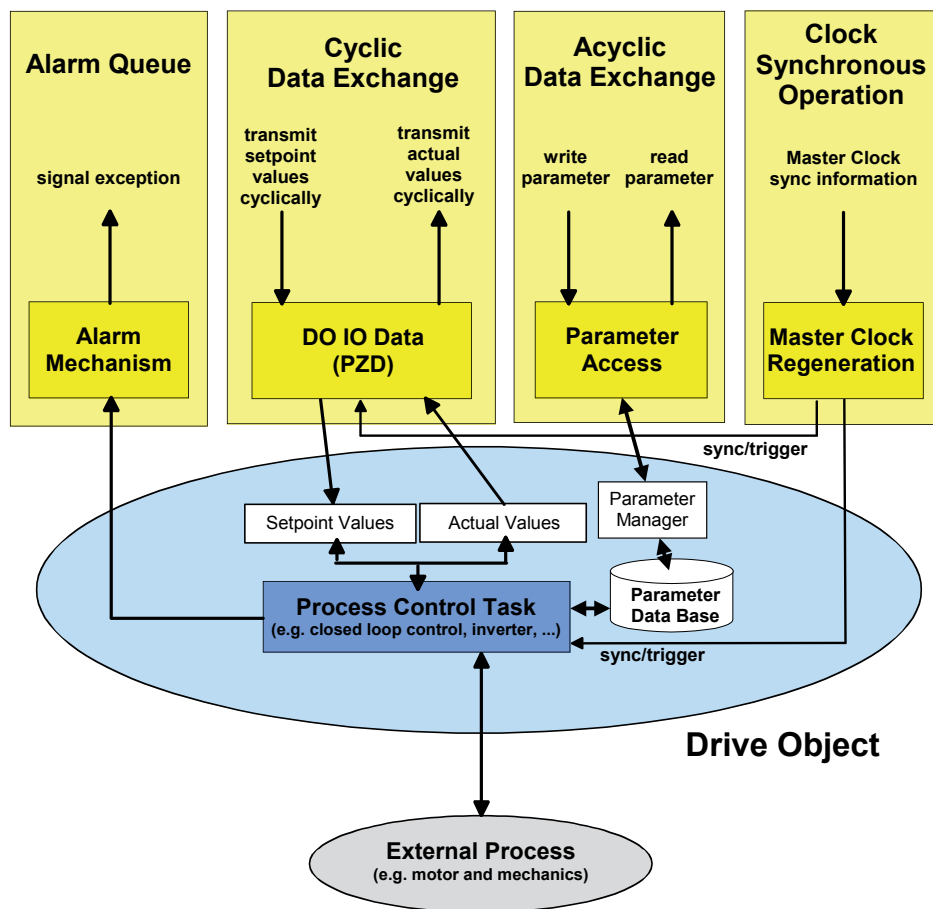


Figure 11 – General Drive Object architecture

6.1.3.5 Axis type Drive Object

The DOs may be of different type. One dedicated type, which is of general importance in this drive profile is the Axis type, which is typically related to a motor (Drive Axis) and is specified in detail in 6.3.

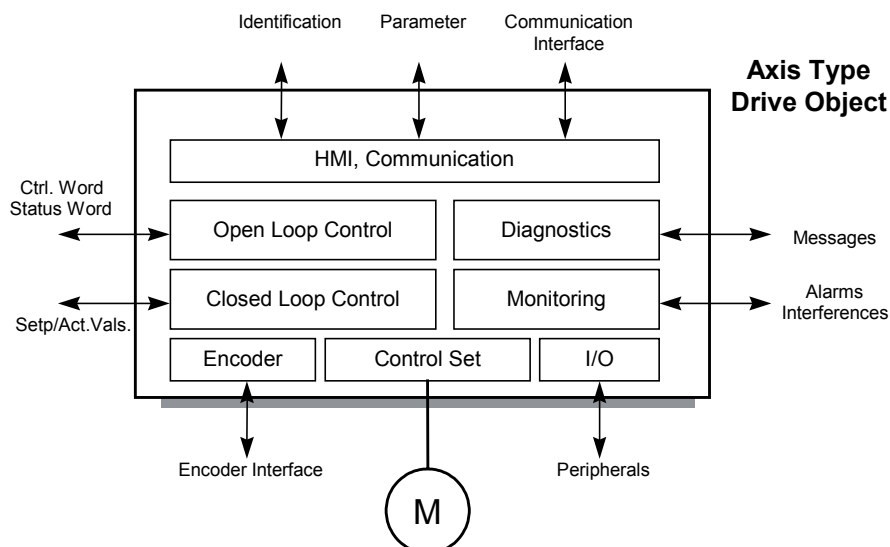


Figure 12 – Principle functional model of an Axis type Drive Object

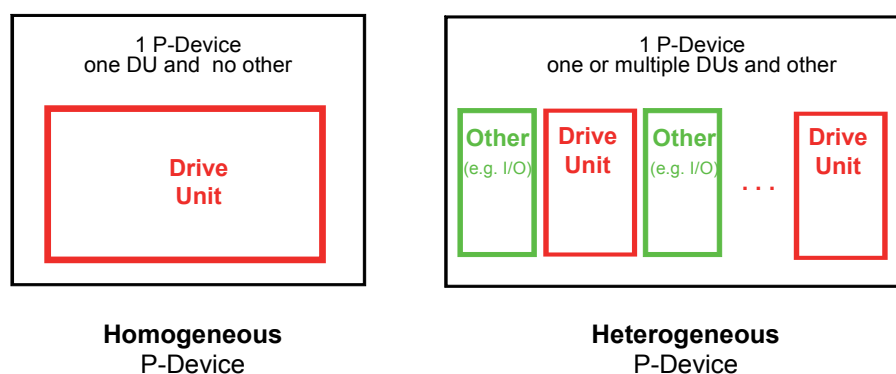
Figure 12 shows the principle functionality of an Axis type DO. The Axis DO consists of numerous function modules that work together internally, and therefore portray the intelligence of the Axis type DO.

790 The following logical objects are included in an Axis DO:

- 791 • Objects for DO identification
- 792 • Parameters for accessing information and settings of the individual function modules
- 793 • Objects for setting the communication interface (for example, PROFIdrive Interface)
- 794 • Objects for drive control (for example, control words and status words)
- 795 • Objects for setpoint processing (for example, setpoint values and actual values)
- 796 • Objects for diagnostics and monitoring (for example, messages, alarms, faults)
- 797 • Objects for integrated sensor interface(s)
- 798 • Objects for integrated peripheral functions (integrated I/O)

800 6.1.3.6 P-Device classification

801 Figure 13 shows the two classes of PROFIdrive P-Devices. While the Homogeneous type is a
 802 P-Device containing only one PROFIdrive Drive Unit (and nothing else), the Heterogeneous
 803 P-Device contains at least one PROFIdrive Drive Unit and other objects of this abstraction
 804 layer which are not specified within PROFIdrive (they may belong to other application
 805 profiles).

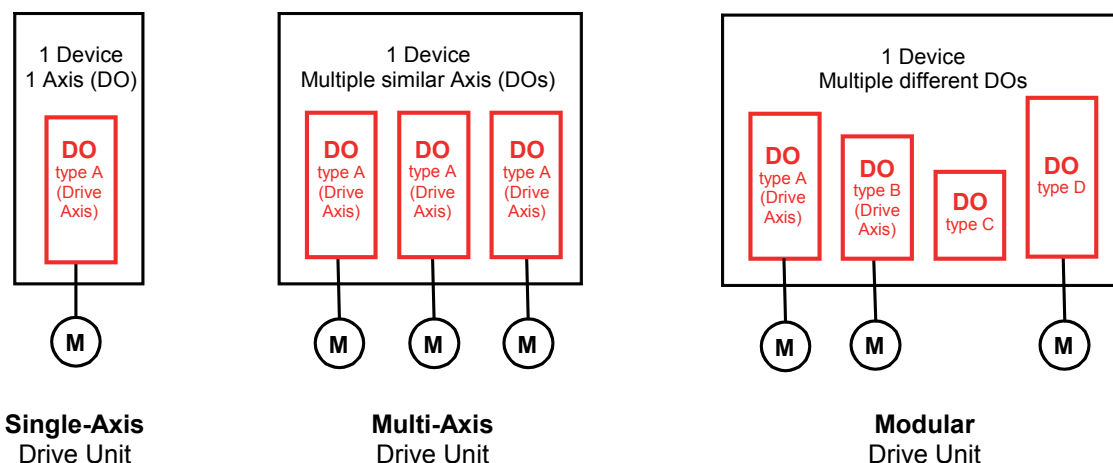


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807

Figure 13 – Classes of PROFIdrive P-Devices

808 6.1.3.7 Drive Unit classification

809 Figure 14 shows the three principle classes of PROFIdrive Drive Units. While the Single-Axis
 810 type is one physical device with only one Axis type DO, the Multi-Axis type consists of several
 811 similar Axis type DOs. The modular type provides the greatest flexibility and comprises one or
 812 more DOs, which may be of a different type.



813
814

Figure 14 – Classes of PROFIdrive Drive Units



6.1.4 P-Device communication model

Figure 15 shows the different communication channels which are available between the P-Device and the other Devices. The color shows the Communication Service related to this communication channel.

The Clock Synchronous Operation as well as DO IO Data transfer is available between P-Device and Controller and between P-Devices itself (Drive to Drive communication). Parameter Access to the P-Device is available from all other Controller and Supervisor Devices.

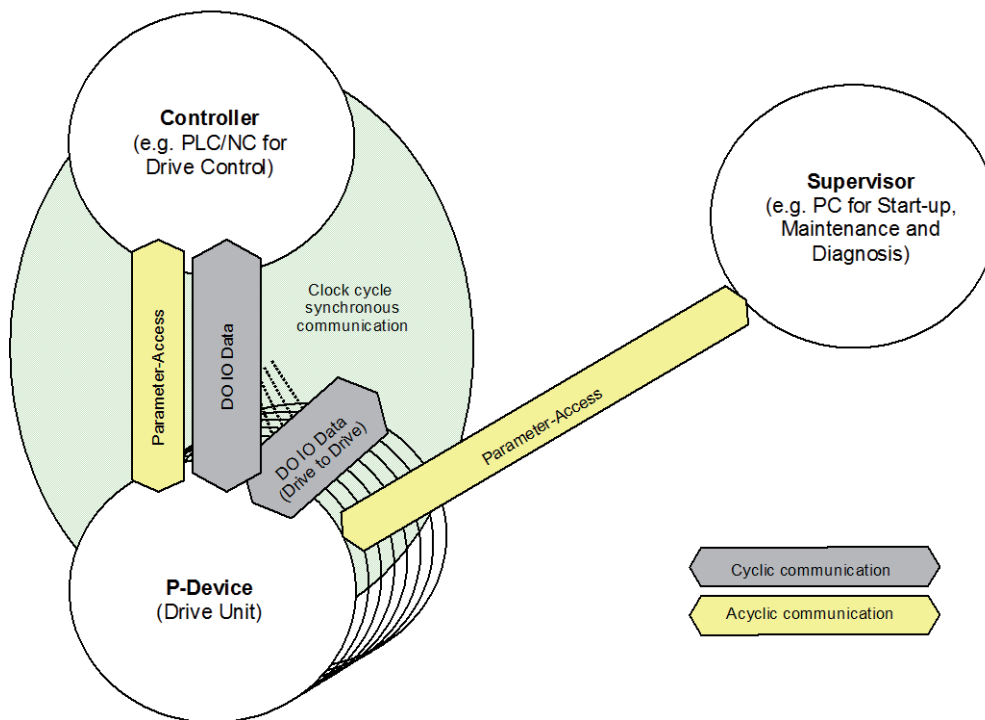


Figure 15 – Overview about the available Communication Services between the PROFIdrive Devices

6.1.5 Application Model and Application Classes

6.1.5.1 General

At present, drive applications are realised in multiple ways. Table 15 defines the different Application Classes where the drives are used. The Application Classes (AC) are typical examples from the entire spectrum of electrical drive engineering. The Application Classes include the functionality given by the application modes in IEC 61800-7-1.

The Application Model is part of the Application Layer and therefore only related to functional aspects (Functional Objects), independent on the distribution of Functional Objects among devices. Therefore the type of Application Class predefines the contents of the Functional Objects and the type of data (Information) to be transported between the Functional Objects (Interface).

Table 15 – Application Classes

No.	Application Class	Interface	Functions ^b
1	Standard Drive	n-setpoint, torque-setpoint, current-setpoint	Cyclic IO Data interface ^a
2	Standard drive with distributed technology controller (continuous process)	Technological setpoint-actual values (command variables)	Cyclic IO Data interface with Drive to Drive communication ^a
3	Single Axis positioning drive, with local Motion Control	pos-setpoint, run requests	Cyclic IO Data interface ^a
4	Motion Control with central interpolation and speed setpoint	n-setpoint	Cyclic IO Data interface, Clock Synchronous

No.	Application Class	Interface	Functions ^b
	interface Optional: DSC (Dynamic Servo Control)	x-actual additionally, for DSC: Δx (x_{err}), K_V (k_{PC})	Operation, DSC (refer to 6.3.5)
5	Motion Control with central interpolation and position setpoint interface	x-setpoint	Cyclic IO Data interface, Clock Synchronous Operation ^c
6	Motion control for clocked processes, or distributed angular synchronism	Command variables, motion instructions	Cyclic IO Data interface, Clock Synchronous Operation, Drive to Drive communication

NOTE The Application Classes described here are assigned Profile functions in 6.3.13, which a drive manufacturer shall implement if he wishes to be compliant with the particular Application Class.

^a The cyclic interface may also be operated clock-synchronously if, for example, it is a question of synchrony of the actions in the case of several drives.

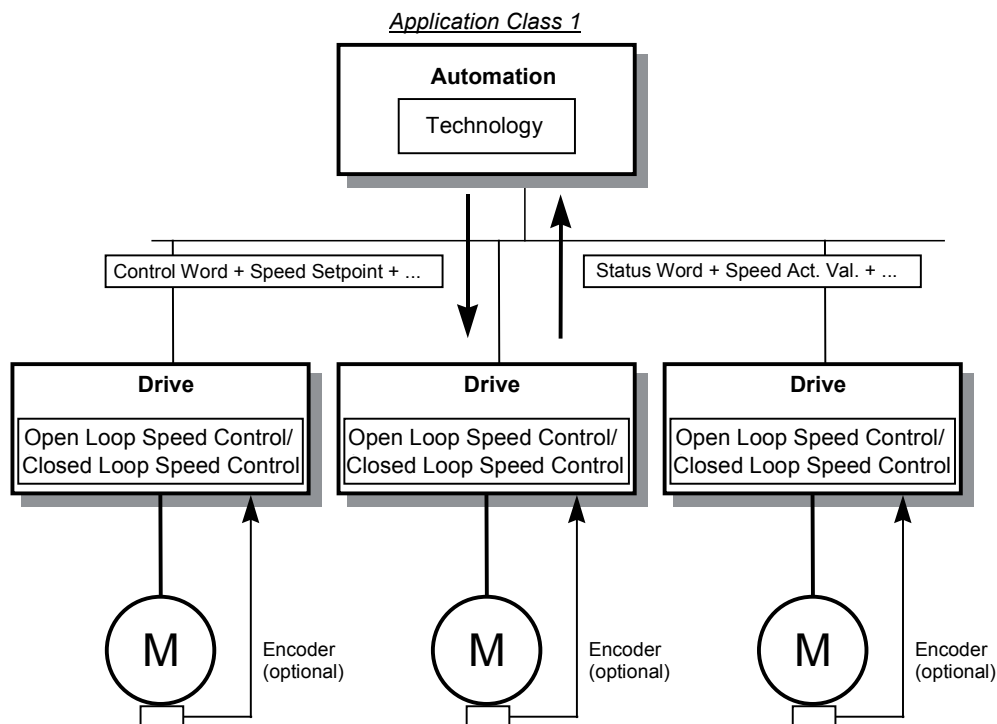
^b For all Application Classes: acyclic interface for parameters, diagnostics, identification.

^c This Application Class is not described in this edition of the Profile. The dynamic characteristics of Application Class 5 are reached with Application Class 4 with DSC.

838

839 6.1.5.2 AC 1: Standard Drive

840 In the simplest case, the drive is controlled via a primary setpoint (for example, speed
841 setpoint) (see Figure 16). The speed control is governed completely in the drive controller.
842 The PLC includes all technological functions for the automation process. The field bus is
843 merely the transmission medium between the automation system and the drive controller. The
844 Cyclic Data Exchange Communication Service is used. This type of application is used
845 primarily in the field of classical drive engineering (for example, conveyor systems). A PLC is
846 usually used as the automation system. Clock Synchronous Operation may be used, but is
847 typically not necessary for this Application Class.



848

849

Figure 16 – Application Class 1

6.1.5.3 AC 2: Standard drive with distributed technology controller

Application Class 2 represents a very flexible version for implementing drive applications (see Figure 17). In this version, the automation process is broken down into many small sub-processes.

The technology functions are no longer exclusively in the central PLC, but are also distributed in the Drives. The communication interface serves as the technology interface. The data that is exchanged via the bus system between the individual automation components and drive controllers may be individually defined. This variant assumes, however, that communication is guaranteed in all directions; that is, DO IO Data transfer should be possible also between Drive Objects (Axis). To realise applications like setpoint cascades, winders, and speed synchronism Clock Synchronous Operation should be possible. The technology functions are realised in the drive.

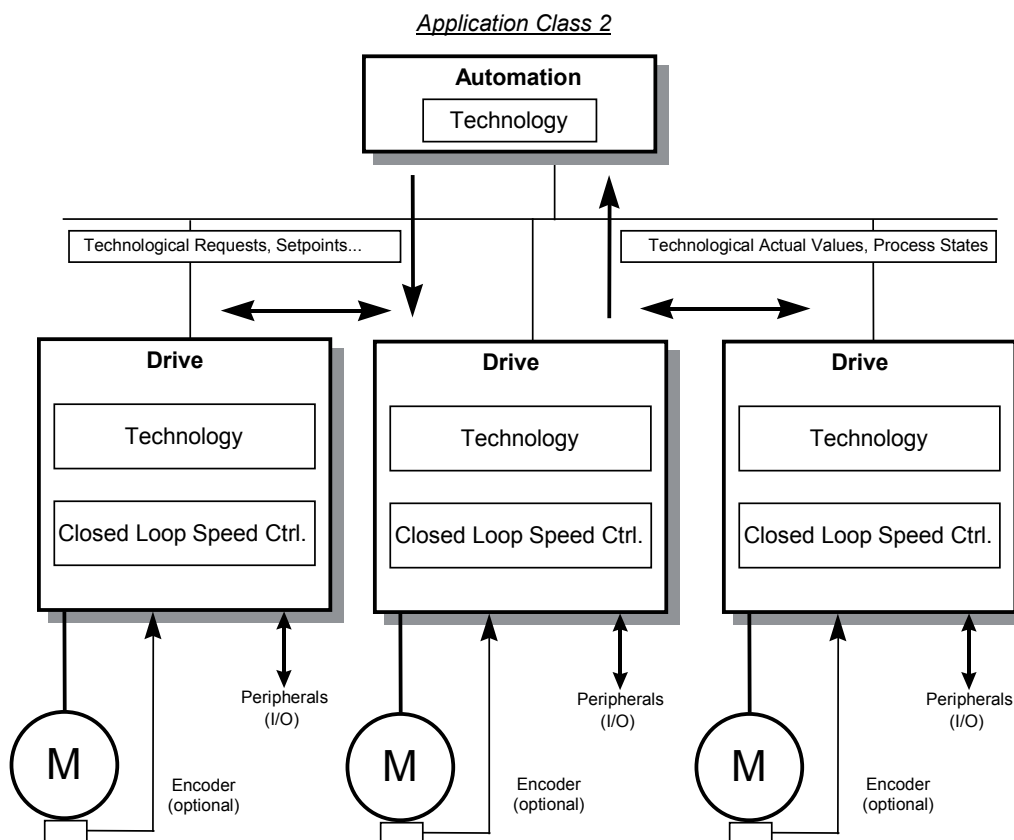


Figure 17 – Application Class 2

6.1.5.4 AC 3: Single Axis positioning drive with local Motion Control

In Application Class 3 (see Figure 18), only the technology functions for the automation process are still in the PLC. Positioning requests are stored in the Drive. A single positioning request is started via a command from the Controller (e.g. PLC). Interpolation and position control as well as speed control are implemented directly in the drive. Since in this variant, all time-critical control algorithms are hidden in the drive controller, Clock Synchronous Operation is only necessary if complex tracking for multiple axes shall be coordinated.

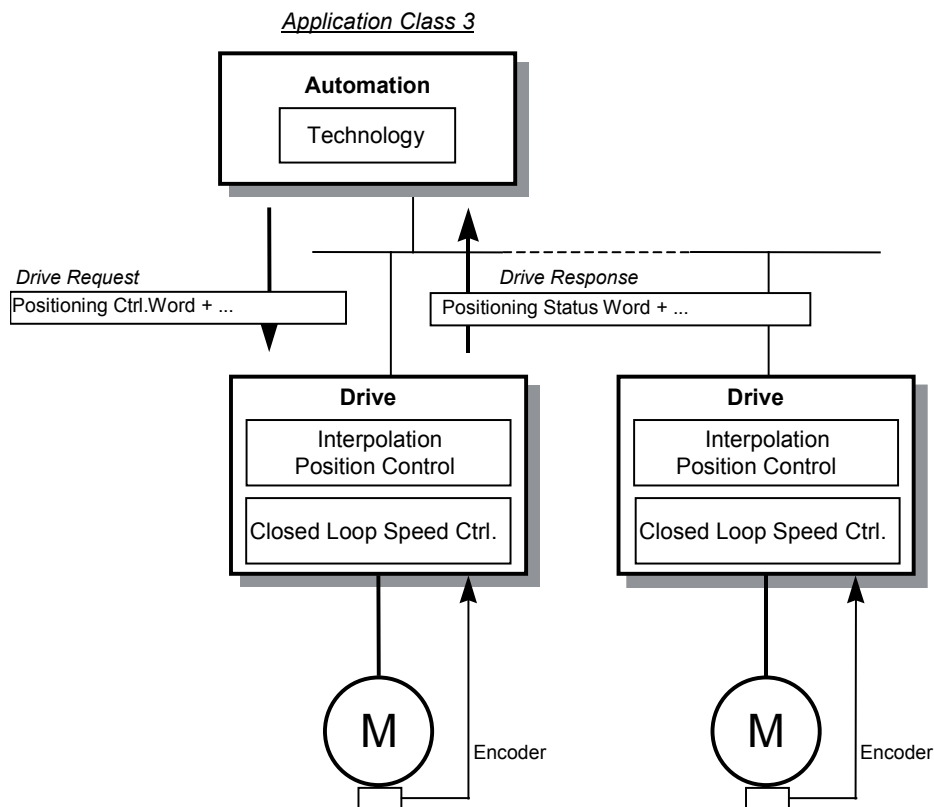


Figure 18 – Application Class 3

6.1.5.5 AC 4: Motion Control with central interpolation and speed setpoint interface

Application Class 4 (see Figure 19) shows the position closed loop control closed via the Communication System. Drives for manipulator and robotic applications often require a coordinated motion sequence of several drive systems. Motion control is primarily implemented via a central automation unit (NC). For each drive, these controllers calculate special setpoint profiles. By coordinating several drives (for example, for the XYZ axis), certain trajectories may be implemented. In addition to the required technology functions for the automation process, the automation system also includes the functions for interpolation and position control of the drive. Speed setpoint values and actual values as well as the position actual value are transferred via Cyclic Data Exchange. The drive controller essentially only includes the algorithms for closed loop speed control and actual position acquisition. Since the position is controlled via the bus system, Clock Synchronous Operation is necessary and shall be very precise. Additionally, the DSC-functionality may be used to increase the rigidity and dynamic response of the control loop.