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Siehe Anwendungsbeginn

Elektrische Leistungsantriebssysteme mit einstellbarer Drehzahl – Teil 7-304: Generisches Interface und Nutzung von Profilen für Leistungsantriebssysteme (PDS) – Abbildung von Profil-Typ 4 auf Netzwerktechnologien (IEC 61800-7-304:2015); Englische Fassung EN 61800-7-304:2016

Adjustable speed electrical power drive systems –
Part 7-304: Generic interface and use of profiles for power drive systems –
Mapping of profile type 4 to network technologies
(IEC 61800-7-304:2015);
English version EN 61800-7-304:2016

Entraînements électriques de puissance à vitesse variable –
Partie 7-304: Interface générique et utilisation de profils pour les entraînements électriques de puissance –
Mise en correspondance du profil de type 4 avec les technologies de réseaux
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Anwendungsbeginn

Anwendungsbeginn für die von CENELEC am 2015-12-25 angenommene Europäische Norm als DIN-Norm ist 2016-11-01.

Für DIN EN 61800-7-304:2008-11 besteht eine Übergangsfrist bis 2018-12-25.

Nationales Vorwort

Vorausgegangener Norm-Entwurf: E DIN EN 61800-7-304:2015-02.

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.

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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 Anwender der vorliegenden Norm der englischen Sprache als Fachsprache bedienen, wird die Englische Fassung der EN 61800-7-304 veröffentlicht. Zu deren Abschnitt 1, der den Anwendungsbereich festlegt, und Abschnitt 3, der die Begriffe festlegt, wurde eine Übersetzung angefertigt und als Nationaler Anhang NA der vorliegenden Norm hinzugefügt. Für einige der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Diese Norm steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

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Änderungen

Gegenüber DIN EN 61800-7-304:2008-11 wurden folgende Änderungen vorgenommen:

a) Aktualisierung der Abbildungsspezifikation;

b) redaktionelle Überarbeitung des gesamten Dokuments.

Frühere Ausgaben

DIN EN 61491: 1999-11
DIN EN 61800-7-304: 2008-11

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Nationaler Anhang NA
(informativ)

Auszugsweise Übersetzung[N1)]

1 Anwendungsbereich

Dieser Teil der IEC 61800 beschreibt die Abbildung des in IEC 61800-7-204 festgelegten Profil-Typs 4 (SERCOS) auf verschiedene Netzwerktechnologien.

– SERCOS I/II, siehe Abschnitt 5;
– SERCOS III, siehe Abschnitt 6;
– EtherCAT, siehe Abschnitt 7.

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

3 Begriffe und Abkürzungen

3.1 Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

3.1.1
Bestätigungstelegramm
(en: acknowledge telegram)
AT
Telegramm, in das jeder Slave seine Daten einfügt

Anmerkung 1 zum Begriff: Die englische Abkürzung AT wird auch in der französischen Sprachfassung benutzt.

3.1.2
Algorithmus
(en: algorithm)
vollständig bestimmte endliche Folge von Operationen, nach denen die Werte der Ausgangsdaten aus den Werten der Eingangsdaten berechnet werden können

[QUELLE: IEC 61800-7-1:2015, 3.2.1]

3.1.3
Anwendung
(en: application)
funktionales Element der Software, spezifisch für die Problemlösung bei industriellen Prozessen mit Messen und Regeln

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

[QUELLE: IEC 61800-7-1:2015, 3.2.2]

N1) Nationale Fußnote: Die Nummerierung aus IEC 61800-7-304:2015-11 wurde beibehalten.

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3.1.4
Attribut
(en: attribute)
Eigenschaft oder Charakteristik einer Funktionseinheit

[QUELLE: IEC 61800-7-1:2015, 3.2.3]

3.1.5
Klasse
(en: class)
Beschreibung einer Menge von Objekten, die dieselben Attribute, Operationen, Methoden, Beziehungen und dieselbe Semantik haben

[QUELLE: IEC 61800-7-1:2015, 3.2.5]

3.1.6
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.

[QUELLE: IEC 61800-7-1:2015, 3.3.1.3]

3.1.7
Kommunikationszyklus
(en: communication cycle)
Ansammlung aller Telegramme zwischen zwei Master-Synchronisationstelegrammen

3.1.8
Leiten
(en: control)
zweckmäßige Maßnahmen an oder in einem Prozess, um vorgegebene Ziele zu erreichen

[QUELLE: IEC 61800-7-1:2015, 3.2.6]

3.1.9
Steuergerät
Leiteinheit
(en: control device, control unit)
Baueinheit, die – innerhalb eines Moduls/einer Baugruppe oder eines Geräts – ein Anwendungsprogramm zur Steuerung des PDS enthält

[QUELLE: IEC 61800-7-1:2015, 3.2.7]

3.1.10
Steuerwort
(en: control word)
zwei benachbarte Bytes im Master-Datentelegramm, die Befehle für das adressierte PDS enthalten

[QUELLE: IEC 61800-7-1:2015, 3.3.5.4, modifiziert – Das Wort „Antrieb“ wurde durch die Abkürzung „PDS“ ersetzt.]

3.1.11
Zykluszeit
(en: cycle time)
Zeitspanne zwischen zwei aufeinanderfolgenden zyklisch auftretenden Ereignissen

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3.1.12
zyklische Kommunikation
(en: cyclic communication)
periodischer Austausch von Telegrammen

3.1.13
zyklische Daten
(en: cyclic data)
Teil der Nachricht, deren Bedeutung sich während einer zyklischen Operation der Schnittstelle nicht ändert

3.1.14
zyklischer Betrieb
(en: cyclic operation)
Geräte im Kommunikationsnetzwerk werden nacheinander zu feststehenden, konstanten Zeitintervallen adressiert und abgefragt

3.1.15
Datenaustausch
(en: data exchange)
bedarfsabhängige, nicht zyklische Übertragung von Informationen, nachdem vom Master eine Anforderung gesendet wurde (Dienstkanal)

[QUELLE: IEC 61800-7-1:2015, 3.3.5.7]

3.1.16
Datentyp
(en: data type)
Menge von Werten mit einer Menge zulässiger Operationen

[QUELLE: IEC 61800-7-1:2015, 3.2.8]

3.1.17
Gerät
Feldgerät
(en: device; field device)
<Funktionsbausteine> vernetzte unabhängige physische Einheit eines industriellen Automatisierungssystems, die fähig ist, spezifische Funktionen in einem speziellen Kontext auszuführen, und die durch ihre Schnittstellen abgegrenzt ist

[QUELLE: IEC 61800-7-1:2015, 3.2.9]

3.1.18
Geräteprofil
(en: device profile)
Darstellung eines Geräts bezüglich seiner Parameter, Parametergruppen und seines Verhaltens gemäß eines Gerätemodells, das die Daten und das Verhalten des Geräts beschreibt, wie es durch ein Netzwerk gesehen wird, unabhängig von einer bestimmten Netzwerktechnologie

[QUELLE: IEC 61800-7-1:2015, 3.2.11]

3.1.19
Lichtwellenleiter-Kabel
(en: fibre optic cable)
Übertragungsmedium für die serielle Datenübertragung optischer Signale

3.1.20
funktionales Element
(en: functional element)
Einheit von Software oder von Software, die mit Hardware kombiniert ist, fähig, eine festgelegte Funktion eines Geräts zu erfüllen

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

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

[QUELLE: IEC 61800-7-1:2015, 3.2.13]

3.1.21
Identifikationsnummer
IDN
(en: identification number)
Kennzeichnung von Betriebsdaten, unter der ein Datenblock mit seinem Attribut, seinem Namen, seiner Einheit, seinen minimalen und maximalen Eingabewerten und den Daten aufbewahrt wird

Anmerkung 1 zum Begriff: Die englische Abkürzung IDN wird auch in der französischen Sprachfassung benutzt.

3.1.22
Eingangsdaten
(en: input data)
Daten, die von einer externen Quelle in ein Gerät, eine Ressource oder ein funktionales Element übertragen werden

[QUELLE: IEC 61800-7-1:2015, 3.2.14]

3.1.23
Schnittstelle
(en: interface)
Grenze zwischen zwei Einheiten, die durch funktionale Merkmale, Signalkenngrößen oder andere Merkmale als geeignet festgelegt ist

[QUELLE: IEC 61800-7-1:2015, 3.2.15]

3.1.24
Linie
(en: line)
Netzwerktopologie, bei der das Übertragungsmedium von Station zu Station in Form einer Linie geführt wird

Anmerkung 1 zum Begriff: Die Informationen werden in einer Richtung vom Master bis zum letzten Slave in der Linie übertragen und fließen anschließend in umgekehrter Richtung über alle Slaves zum Master zurück (CP16/3, CP12).

3.1.25
Master
(en: master)
Knoten, der den anderen Knoten das Recht zur Übertragung zuweist

3.1.26
Master-Datentelegramm
MDT
(en: Master Data Telegram)
Telegramm, in das der Master seine Daten einfügt

Anmerkung 1 zum Begriff: Die englische Abkürzung MDT wird auch in der französischen Sprachfassung benutzt.

3.1.27
Master-Synchronisationstelegramm
MST
(en: Master Synchronisation Telegram)
Telegramm oder Teil eines Telegrammes, in das der Master ein Zeitsynchronisationssignal einfügt

Anmerkung 1 zum Begriff: Die englische Abkürzung MST wird auch in der französischen Sprachfassung benutzt.

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3.1.28
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 61800-7-1:2015, 3.2.17]

3.1.29
nicht zyklische Übertragung
(en: non-cyclic transmission)
nicht periodischer Austausch von Daten auf Anforderung des Masters

3.1.30
Betriebszyklus
(en: operating cycle)
Dauer des Regelkreises innerhalb des PDS oder der Steuereinheit

3.1.31
Betriebsart
(en: operating mode)
Kennzeichnung von Art und Umfang, wie der Mensch als Bediener in eine Leiteinrichtung eingreift

[QUELLE: IEC 61800-7-1:2015, 3.2.18]

3.1.32
Ausgabedaten
(en: Output Data)
Daten, die von einem Gerät, einer Ressource oder einem funktionalen Element kommen und von diesem/dieser zu externen Systemen übertragen werden

[QUELLE: IEC 61800-7-1:2015, 3.2.19]

3.1.33
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: Ein Parameter ist typischerweise durch einen Parameternamen, einen Datentyp und eine Zugriffsrichtung gekennzeichnet.

[QUELLE: IEC 61800-7-1:2015, 3.2.20]

3.1.34
PDS enable
(en: PDS enable)
Befehl zum Schließen der (des) Rückführkreise(s)

3.1.35
PDS on
(en: PDS on)
Befehl zum Aktivieren der Leistungsstufe

3.1.36
Profil
(en: profile)
Darstellung einer PDS-Schnittstelle bezüglich ihrer Parameter, Parametergruppen und ihres Verhaltens nach einem Kommunikationsprofil und einem Geräteprofil

[QUELLE: IEC 61800-7-1:2015, 3.2.21, modifiziert – Anmerkung 1 zum Begriff wurde gestrichen.]

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3.1.37
Protokoll
(en: protocol)
Vereinbarung über die Datenformate, Zeitabfolgen und die Fehlerkorrektur im Datenaustausch von Kommunikationssystemen

3.1.38
Ring
Ringstruktur
(en: ring; ring structure)
Netzwerktopologie, bei der das Übertragungsmedium von Station zu Station in Form eines Ringes geführt wird

Anmerkung 1 zum Begriff: Die Informationen werden nur in einer Richtung (CP16/1, CP16/2) oder in beiden Richtungen (CP16/3) übertragen.

3.1.39
Slave
(en: slave)
Knoten, dem das Recht zur Übertragung durch den Master zugewiesen wird

3.1.40
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 Elements des PDS wiedergibt

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

3.1.41
Statuswort
(en: status word)
zwei aufeinanderfolgende Bytes im PDS-Telegramm, die Statusinformationen enthalten

3.1.42
Telegramm
Nachricht
(en: telegram; message)
Datensatz

3.1.43
Topologie
(en: topology)
physische Netzwerkarchitektur in Bezug auf die Verbindung zwischen den Stationen des Kommunikationssystems

3.1.44
Übertragungsmedium
(en: transmission medium)
Sammelbegriff für die tatsächliche Form der physischen Verbindung zwischen den Stationen eines Kommunikationsnetzwerkes

Anmerkung 1 zum Begriff: Es können z. B. Lichtwellenleiter-Kabel verwendet werden.

3.1.45
Typ
(en: type)
Hardware- oder Software-Element, das die gemeinsamen Attribute festlegt, die von allen Instanzen des Typs gemeinsam genutzt werden

[QUELLE: IEC 61800-7-1:2015, 3.2.23]

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3.2 Abkürzungen

ADR	Adresse eines PDS. Die PDS-Adresse ist ADR [1 ≤ ADR ≤ 511]
AT	Bestätigungstelegramm (en: acknowledge telegram)
C1D	Diagnoseklasse 1 (en: class 1 diagnostic)
C2D	Diagnoseklasse 2 (en: class 2 diagnostic)
C3D	Diagnoseklasse 3 (en: class 3 diagnostic)
IDN	Identifikationsnummer (en: identification number)
I/O	Eingang/Ausgang (en: input/output)
K	Anzahl der Datensätze im MDT (siehe auch M)
k	Zeitabfolge der Datensätze im MDT, gekennzeichnet als k = 1 gegenüber K
M	Anzahl der PDS in einem einzigen Netzwerk (siehe auch K)
m	Zeitabfolge der ATs, gekennzeichnet als m = 1 gegenüber M
MDT	Master-Datentelegramm
MST	Master-Synchronisationstelegramm
NC	numerische Steuerung (auch Steuereinheit oder Regler)
PDS	Leistungsantriebssystem (en: power drive system)
SPS	speicherprogrammierbare Steuerung ohne einen Befehlssatz zur Bewegungssteuerung (en: PLC; programmable logic controller)
RT	Echtzeit (en: real-time)
SERCOS	serielles Echtzeitkommunikationssystem (en: SErial Real time COmmunication System)
t_3	Zeit, nach der der Befehlswert gültig ist
t_4	Zeitpunkt der Erfassung von Rückführwerten
t_5	maximale Verarbeitungszeit des Produzenten
t_{11}	maximale Aktivierungszeit des Konsumenten
t_{MTSG}	Verarbeitungszeit des Befehlswertes
t_{Ncyc}	Zykluszeit der Steuereinheit
t_{Pcyc}	Zykluszeit des Produzenten
t_{Rcyc}	Zykluszeit des PDS-Regelkreises
t_{Scyc}	Kommunikationszykluszeit
UC	vereinheitlichte Kommunikation (en: unified communication)

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Elektrische Leistungsantriebssysteme mit einstellbarer Drehzahl - Teil 7-304: Generisches Interface und Nutzung von Profilen für Leistungsantriebssysteme (PDS) - Abbildung von Profil-Typ 4 auf Netzwerktechnologien
(IEC 61800-7-304:2015)

This European Standard was approved by CENELEC on 2015-12-25. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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European foreword

The text of document 22G/314/FDIS, future edition 2 of IEC 61800-7-304, prepared by SC 22G “Adjustable speed electric drive systems incorporating semiconductor power converters” of IEC/TC 22 “Power electronic systems and equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61800-7-304:2016.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2016-09-25
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2018-12-25

This document supersedes EN 61800-7-304:2008.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61800-7-304:2015 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61158:2014 Series	NOTE	Harmonized as EN 61158:2014 Series.
IEC 61499-1:2005	NOTE	Harmonized as EN 61499-1:2005 [1)] (not modified).
IEC 61800 Series	NOTE	Harmonized as EN 61800 Series.
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IEC 61800-7-303	NOTE	Harmonized as EN 61800-7-303.

[1)] Superseded by EN 61499-1:2013 (IEC 61499-1:2012).

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INTRODUCTION

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

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

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

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

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

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

There are several reasons to define a generic interface:

For a drive device manufacturer

– less effort to support system integrators;
– less effort to describe drive functions because of common terminology;
– the selection of drives does not depend on availability of specific support;

For a control device manufacturer

– no influence of bus technology;
– easy device integration;
– independent of a drive supplier;

For a system integrator

– less integration effort for devices;
– only one understandable way of modeling;
– independent of bus technology.

Much effort is needed to design a motion control application with several different drives and a specific control system. The tasks to implement the system software and to understand the functional description of the individual components may exhaust the project resources. In some cases, the drives do not share the same physical interface. Some control devices just support a single interface which will not be supported by a specific drive. On the other hand, the functions and data structures are often specified with incompatibilities. This requires the system integrator to write special interfaces for the application software and this should not be his responsibility.

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

IEC 61800-7-1 is divided into a generic part and several annexes as shown in Figure 1. The drive profile types for CiA® 402[1], CIP Motion™[2], PROFIdrive[3] and SERCOS®[4] are mapped to the generic interface in the corresponding annex. The annexes have been submitted by open international network or fieldbus organizations which are responsible for the content of the related annex and use of the related trade marks.

The different profile types 1, 2, 3 and 4 are specified in IEC 61800-7-201, IEC 61800-7-202, IEC 61800-7-203 and IEC 61800-7-204.

This part of IEC 61800-7 specifies how the profile type 4 (SERCOS®) is mapped to the network technologies SERCOS® and EtherCAT®[5].

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1 CiA® 402 is a registered trade mark of CAN in Automation e.V. (CiA). This information is given for the convenience of users of this International Standard and does not constitute an endorsement by IEC of the trade mark holder or any of its products. Compliance to this profile does not require use of the registered trade mark CiA® 402. Use of the registered trade mark CiA® 402 requires permission of CAN in Automation e.V. (CiA).

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IEC 61800-7-301, IEC 61800-7-302 and IEC 61800-7-303 specify how the profile types 1, 2 and 3 are mapped to different network technologies (such as CANopen®[6], CC-Link IE® Field Network[7], EPA™[8], EtherCAT®, Ethernet Powerlink™[9], DeviceNet™[10], ControlNet™[11], EtherNet/IP™[12], PROFIBUS[13] and PROFINET[14]).

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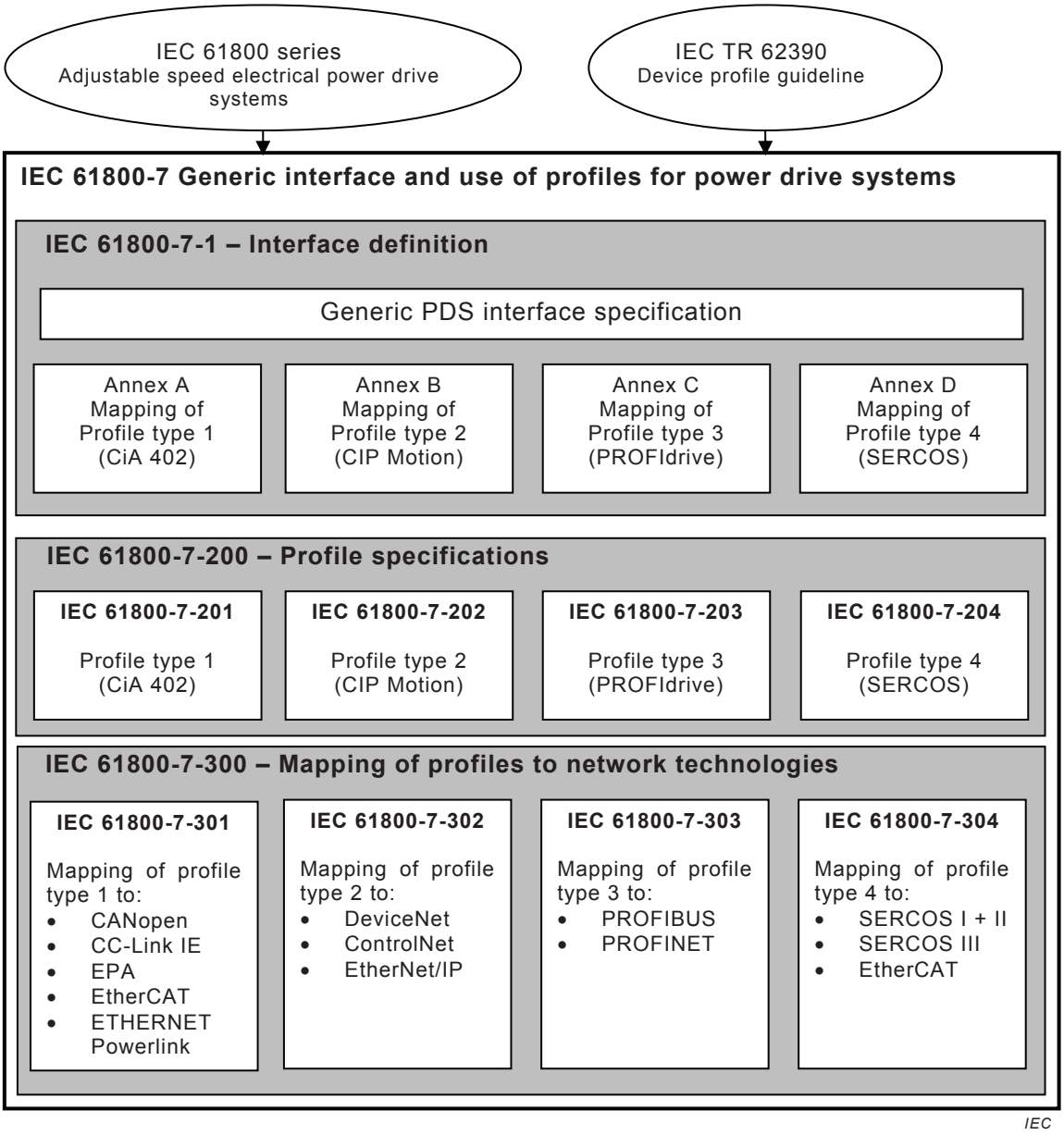

Figure 1 – Structure of IEC 61800-7

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ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

Part 7-304: Generic interface and use of profiles for power drive systems – Mapping of profile type 4 to network technologies

1 Scope

This part of IEC 61800 specifies the mapping of the profile type 4 (SERCOS) specified in IEC 61800-7-204 onto different network technologies.

– SERCOS I / II, see Clause 5,
– SERCOS III, see Clause 6,
– EtherCAT, see Clause 7.

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.

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 61158-2, *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*

IEC 61158-4-16, *Industrial communication networks – Fieldbus specifications – Part 4-16: Data-link layer protocol specification – Type 16 elements*

IEC 61158-5-16, *Industrial communication networks – Fieldbus specifications – Part 5-16: Application layer service definition – Type 16 elements*

IEC 61491:2002, *Electrical equipment of industrial machines – Serial data link for real-time communication between controls and drives*

IEC 61784-1, *Industrial communication networks – Profiles – Part 1: Fieldbus profiles*

IEC 61784-2, *Industrial communication networks – Profiles – Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3*

IEC 61800-7-204:2015, *Adjustable speed electrical power drive systems – Part 7-204: Generic interface and use of profiles for power drive systems – Profile type 4 specification*

ISO/IEC/IEEE 8802-3:2014, *Standard for Ethernet*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

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3.1.1
acknowledge telegram
AT
telegram, in which each slave inserts its data

Note 1 to entry: The English abbreviation AT is also used in French.

3.1.2
algorithm
completely determined finite sequence of operations by which the values of the output data can be calculated from the values of the input data

[SOURCE: IEC 61800-7-1:2015, 3.2.1]

3.1.3
application
software functional element specific to the solution of a problem in industrial-process measurement and control

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

[SOURCE: IEC 61800-7-1:2015, 3.2.2]

3.1.4
attribute
property or characteristic of an entity

[SOURCE: IEC 61800-7-1:2015, 3.2.3]

3.1.5
class
description of a set of objects that share the same attributes, operations, methods, relationships, and semantics

[SOURCE: IEC 61800-7-1:2015, 3.2.5]

3.1.6
commands
set of commands from the application control program to the PDS to control the behavior of the PDS or functional elements of the PDS

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

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

[SOURCE: 61800-7-1:2015, 3.3.1.3]

3.1.7
communication cycle
accumulation of all telegrams between two master synchronization telegrams

3.1.8
control
purposeful action on or in a process to meet specified objectives

[SOURCE: 61800-7-1:2015, 3.2.6]

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3.1.9
control device
control unit
physical unit that contains – in a module/subassembly or device – an application program to control the PDS

[SOURCE: 61800-7-1:2015, 3.2.7]

3.1.10
control word
two adjacent bytes inside the master data telegram containing commands for the addressed PDS

[SOURCE: IEC 61800-7-1:2015, 3.3.5.4, modified — The word "drive" is replaced by the word "PDS".]

3.1.11
cycle time
time span between two consecutive cyclically recurring events

3.1.12
cyclic communication
periodic exchange of telegrams

3.1.13
cyclic data
part of the message which does not change its meaning during cyclic operation of the interface

3.1.14
cyclic operation
devices in the communication network are addressed and queried one after the other at fixed, constant time intervals

3.1.15
data exchange
demand dependent, non cyclic transmission of information after request was sent by the master (service channel)

[SOURCE: 61800-7-1:2015, 3.3.5.7]

3.1.16
data type
set of values together with a set of permitted operations

[SOURCE: 61800-7-1:2015, 3.2.8]

3.1.17
device
field device
networked independent physical entity of an industrial automation system capable of performing specified functions in a particular context and delimited by its interfaces

[SOURCE: 61800-7-1:2015, 3.2.9]

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3.1.18
device profile
representation of a device in terms of its parameters, parameter assemblies and behavior according to a device model that describes the device's data and behavior as viewed through a network, independent from any network technology

[SOURCE: 61800-7-1:2015, 3.2.11]

3.1.19
fibre optic cable
transmission medium for serial data transmission of optical signals

3.1.20
functional element
entity of software or software combined with hardware, capable of accomplishing a specified function of a device

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

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

[SOURCE: 61800-7-1:2015, 3.2.13]

3.1.21
identification number
IDN
designation of operating data under which a data block is preserved with its attribute, name, unit, minimum and maximum input values, and the data

Note 1 to entry: The English abbreviation IDN is also used in French.

3.1.22
input data
data transferred from an external source into a device, resource or functional element

[SOURCE: 61800-7-1:2015, 3.2.14]

3.1.23
interface
shared boundary between two entities defined by functional characteristics, signal characteristics, or other characteristics as appropriate

[SOURCE: 61800-7-1:2015, 3.2.15]

3.1.24
line
network topology in which the transmission medium is routed from station to station in the form of a line

Note 1 to entry: The information is transmitted in one direction from the master down to the last slave in the line, and then flows back to the master via all the slaves in the reverse order (CP16/3, CP12).

3.1.25
master
node, which assigns the other nodes the right to transmit

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3.1.26
master data telegram
MDT
telegram, in which the master inserts its data

Note 1 to entry: The English abbreviation MDT is also used in French.

3.1.27
master synchronization telegram
MST
telegram, or part of a telegram, in which the master inserts a time synchronization signal

Note 1 to entry: The English abbreviation MST is also used in French.

3.1.28
model
mathematical or physical representation of a system or a process, based with sufficient precision upon known laws, identification or specified suppositions

[SOURCE: 61800-7-1:2015, 3.2.17]

3.1.29
non-cyclic transmission
non-periodic exchange of data at the request of the master

3.1.30
operating cycle
period of the control loop within the PDS or the control unit

3.1.31
operating mode
characterization of the way and the extent to which the human operator intervenes in the control equipment

[SOURCE: 61800-7-1:2015, 3.2.18]

3.1.32
output data
data originating in a device, resource or functional element and transferred from them to external systems

[SOURCE: 61800-7-1:2015, 3.2.19]

3.1.33
parameter
data element that represents device information that can be read from or written to a device, for example through the network or a local HMI

Note 1 to entry: A parameter is typically characterized by a parameter name, data type and access direction.

[SOURCE: IEC 61800-7-1:2015, 3.2.20]

3.1.34
PDS enable
command to close the feedback loop(s)

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3.1.35
PDS on
command that the power stage can be activated

3.1.36
profile
representation of a PDS interface in terms of its parameters, parameter assemblies and behavior according to a communication profile and a device profile

[SOURCE: IEC 61800-7-1:2015, 3.2.21, modified – Note 1 to entry is deleted.]

3.1.37
protocol
convention about the data formats, time sequences, and error correction in the data exchange of communication systems

3.1.38
ring
ring structure
network topology in which the transmission medium is routed from station to station in the form of a ring.

Note 1 to entry: The information is transmitted only in one direction (CP16/1, CP16/2) or in both directions (CP16/3)

3.1.39
slave
node, which is assigned the right to transmit by the master

3.1.40
status
set of information from the PDS to the application control program reflecting the state or mode of the PDS or a functional element of the PDS

Note 1 to entry: The different status information may be coded with one bit each.

3.1.41
status word
two adjacent bytes inside the PDS telegram containing status information

3.1.42
telegram
message
dataset

3.1.43
topology
physical network architecture with respect to the connection between the stations of the communication system

3.1.44
transmission medium
collective term for the real form of the physical connection between the stations of a communication network

Note 1 to entry: For instance, fibre optic cable can be used.

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3.1.45
type
hardware or software element which specifies the common attributes shared by all instances of the type

[SOURCE: IEC 61800-7-1:2015, 3.2.23]

3.2 Abbreviated terms

ADR	address of a PDS. PDS address is ADR [1 ≤ ADR≤ 511]
AT	acknowledge telegram
C1D	class 1 diagnostic
C2D	class 2 diagnostic
C3D	class 3 diagnostic
IDN	identification number
I/O	input/output
K	number of data records in the MDT (see also M)
k	time sequence of data records in the MDT, labelled as k= 1 to K
M	number of PDSs in one network (see also K)
m	time sequence of the ATs, labelled as m = 1 to M
MDT	master data telegram
MST	master sync telegram
NC	numerical control (also control unit or controller)
PDS	power drive system
PLC	programmable logic controller without a motion control command set
RT	real-time
SERCOS	SErial Real time COmmunication System
t_3	command value valid time
t_4	feedback acquisition capture point
t_5	maximum producer processing time
t_{11}	maximum consumer activation time
t_{MTSG}	command value processing time
t_{Ncyc}	control unit cycle time
t_{Pcyc}	producer cycle time
t_{Rcyc}	PDS control loop cycle time
t_{Scyc}	communication cycle time
UC	unified communication

4 General

This mapping defines among others the mapping to CP16/1 (SERCOS I), which has been previously specified in IEC 61491:2002 and it is incorporated in this standard as well as in the IEC 61158 and IEC 61784 communication standard families, while specifying the mapping of the SERCOS drive profile to the communication profiles CP16/2 (SERCOS II), CP16/3(SERCOS III) and CP12 (EtherCAT).

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In this part of IEC 61800-7, the mapping of the SERCOS drive profile (IEC 61800-7-204) to the CPF16 (SERCOS I, II and III) and CP12 (EtherCAT) communication profiles is described.

The SERCOS CP16/1 and CP16/2 interface use fibre optic transmission between control units and PDSs. As a result, interference is eliminated.

The SERCOS CP16/3 and EtherCAT CP12 use Ethernet data transmission instead. It may be realised either using 100BASE-TX (wire) or 100BASE-FX (fibre optic) depending upon the immunity performance needs.

5 Mapping to CP16/1 (SERCOS I) and CP16/2 (SERCOS II)

5.1 Reference to communication standards

CP16/1 and CP16/2 are specified in the IEC 61158 series and are referenced in IEC 61784-1. The detailed references are listed in IEC 61784-1, which shows also the differences between these two communication profiles.

5.2 Overview

Table 1 summarises the major features of CP16/1 and CP16/2.

Table 1 – CP16/1 and CP16/2 feature summary

Feature	CP16/1	CP16/2
Topology	Ring	Same as CP16/1
Data flow	From the master to the 1st slave, then to the next one, and so on until the last slave, then to the master (simplex communication between each participant)	Same as CP16/1
Communication medium	Fibre optic	Same as CP16/1
Transmission rate	2 Mbit/s or 4 Mbit/s	Same as CP16/1 In addition: 8 or 16 Mbit/s
Transmission rate setting	Manual setting (e.g. using a switch)	Same as CP16/1 In addition: Automatic baud rate recognition
Cycle time t_{Scyc}	62,5 µs, 125 µs, 250 µs, 500 µs, and up to 65 ms by steps of 250 µs.	Same as CP16/1
Number of slaves	Up to 254	Same as CP16/1
Device address ADR	$1 \leq ADR \leq 254$	Same as CP16/1
Synchronisation telegram	MST	Same as CP16/1
Slave telegrams	1 AT per PDS	Same as CP16/1
Master telegram	1 MDT	Same as CP16/1
Telegram order within a cycle	Compulsory: MST – ATs – MDT	Same as CP16/1
Non cyclic communication	Service channel (SVC): 2 bytes are reserved for each slave within AT and MDT	Same as CP16/1 In addition: It shall be possible to configure each slave for 4, 6, or 8 bytes within SVC

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Feature	CP16/1	CP16/2
Initialization	Automatic at power-up ($t_{Scyc} \geq 1$ ms) 4 intermediate communication phases (CP0 to CP3) before reaching normal operation (CP4)	Same as CP16/1
File transfer	Using the service channel	Same as CP16/1 In addition: Communication phases (CP5 and CP6) for file transfer

The exact number of PDSs which can be serviced per communication network depends on the cycle time, the selected data volume, and the transmission rate. The number of PDSs per control unit can also be expanded by using several networks. Table 2 shows some examples that are valid under normal operating conditions. The spare time is available for transmitting other data (e.g. communication with PLC-like I/Os) or as a safety margin to be used for later application developments.

Table 2 – Number of PDSs per network (examples)

Communication profile	Transmission rate	Cycle time	Data record to each PDS	Data record from each PDS	Number of PDSs	Data rate (service channel) per PDS	Spare time
CP16/1 and 16/2	2 Mbit/s	2 ms	32 byte	32 byte	8	8 kbit/s (2 bytes)	390 µs
CP16/1 and 16/2	4 Mbit/s	1 ms	32 byte	32 byte	8	16 kbit/s (2 bytes)	125 µs
CP 16/2	8 Mbit/s	1 ms	36 byte	36 byte	15	32 kbit/s (4 bytes)	208 µs
CP 16/2	16 Mbit/s	500 µs	36 byte	36 byte	14	128 kbit/s (8 bytes)	113 µs
CP 16/2	16 Mbit/s	2 ms	16 byte	16 byte	112	8 kbit/s (2 bytes)	330 µs

IEC 61800-7-204 standardises the formats and scaling factors for operation data exchange between control units and PDS devices. During initialization, the operation of the interface is configured according to the performance characteristics of the control unit and the PDSs. Therefore, the velocity and/or position control is implemented by either the PDS or the control unit.

The control unit is capable of synchronizing all connected PDSs by way of cyclic data exchange for command and feedback values, including exact equidistant timing and synchronization of gated measurements and command values. Communication cycle times may be selected between 62,5 µs, 125 µs, 250 µs or any integer multiple of 250 µs.

In addition, the control panel of the control unit can be used to display and input PDS-specific data, parameters and diagnostic information which are available via an asynchronous service channel and standardised data records.

Command and feedback values in short or long words can be transmitted between the control unit and each PDS in both directions. Optional data (e.g. parameters, diagnostic texts) are transmitted in segments during every cycle. This data can be requested individually by the control unit. Errors in command and feedback values are corrected automatically through cyclic communication. The last valid command and feedback values are used until the next cycle. Two consecutive erroneous transmissions will cause the PDSs to halt.

With the SERCOS interface, a control unit may serve one or several networks, depending on the requirements. One example is shown in Figure 2.

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The connection of the control unit on a network is called a master. This master shall direct and control any communication within one network.

A slave is the connection between one or more PDSs and the network, or between an I/O station and the network. As shown in Figure 2, a group of PDSs such as several PDSs and I/Os may be clustered and tied into the network through a single connection depending on application. Individual participants shall be connected to each other via transmission segments that shall meet the requirements of CP16/1 (SERCOS I) or CP16/2 (SERCOS II).

The information exchanged in such a network depends greatly on the distribution of tasks between the control unit, the PDSs and I/O stations. Direct exchange of information takes place between the control unit on one side, the PDSs and I/O stations on the other side.

Interoperability between the communication profiles shall be as shown in Table 3.

Table 3 – Communication Profile Interoperability within a network

Master	Slave complying to CP16/1	Slave complying to CP16/2
CP16/1	Yes	Yes
CP16/2	Yes [a]	Yes
[a] With a CP16/2 master, CP16/1 slaves are interoperable only at 2 Mbit/s or 4 Mbit/s.		

The CP16/1 and CP16/2 interfaces shall allow for synchronization during cyclic data transmission as required by the SERCOS profile (see IEC 61800-7-204). It means that the operating cycle of the control unit can be synchronized with the communication cycle and operating cycle of the PDS so that beats between individual cycles can be prevented and the dead times in the control loops can be reduced to a minimum. It also implies that new command signals become active concurrently in all PDSs and that all PDSs take measurements at the same time, so that they can be sent back to the control unit as feedback values. This requires that the transmission cycles be strictly equidistant.

The data in the control loops need to be precise and punctual. Untimely data are of no value. When a transmission error is discovered, the communication cycle continues and the old data or an estimated value may be used for one communication cycle. To repeat the transmission with old data (for the purpose of correcting the error) is meaningless, since during the next communication cycle (e.g. 1 ms later), new command data will be transmitted. In the event of repeated transmission errors, a predetermined reaction, such as halting the system, shall ensue.

The non-cyclic transmission mode does not fulfil strict real-time requirements. The correctness of the data is acknowledged or is secured by repeating the transmission.

5.3 Physical layer and topology

The SERCOS CP16/1 (SERCOS I) and CP16/2 (SERCOS II) interface shall use fibre optic transmission between control units and PDSs, as specified in IEC 61158-2.

Communication topology shall be a ring, as shown in Figure 2.

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