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Entwurf

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 22G/275/CDV:2014); Englische Fassung FprEN 61800-7-304:2014

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 22G/275/CDV:2014);
English version FprEN 61800-7-304:2014

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
(CEI 22G/275/CDV:2014);
Version anglaise FprEN 61800-7-304:2014

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2015-01-30 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 Patentrechte, die sie kennen, mitzuteilen und unterstützende Dokumentationen zur Verfügung zu stellen.

Gesamtumfang 91 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE

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Nationales Vorwort

Die Englische Fassung des europäischen Dokuments FprEN 61800-7-304:2014 „Elektrische Leistungs antriebssysteme mit einstellbarer Drehzahl – Teil 7-304: Generisches Interface und Nutzung von Profilen für Leistungsantriebssysteme (PDS) – Abbildung von Profil-Typ 4 auf Netzwerktechnologien“ (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/275/CDV:2014 „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“ unverändert in den Entwurf FprEN 61800-7-304:2014 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 61800-7-304 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.

Es wird auf die Möglichkeit hingewiesen, dass einige Elemente dieses Dokuments Patentrechte berühren können. ISO [und/oder] IEC sind nicht dafür verantwortlich, einige oder alle diesbezüglichen Patentrechte zu identifizieren.

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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 61800-7-304:2008-11 wurden folgende Änderungen vorgenommen:

a) Aktualisierung der Abbildungsspezifikation;

b) 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 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.

3 Begriffe und Abkürzungen

3.1 Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

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

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: IEV 351-21-37]

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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
Attribut
(en: attribute)
Eigenschaft oder Charakteristik einer Einheit

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

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

[Quelle: ISO/IEC 19501, modifiziert]

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.

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: IEV 351-21-29]

3.1.9
Steuergerät
(en: control device)
physikalische Einheit, die – innerhalb eines Moduls/einer Baugruppe oder eines Gerätes – ein Anwendungsprogramm zur Steuerung des PDS enthält

3.1.10
Steuereinheit
(en: control unit)
Steuergerät

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3.1.11
Steuerwort
(en: control word)
zwei benachbarte Bytes im Master-Datentelegramm, die Befehle für das adressierte PDS enthalten

3.1.12
Zykluszeit
(en: cycle time)
Zeitspanne zwischen zwei aufeinanderfolgenden zyklisch auftretenden Ereignissen

3.1.13
zyklische Kommunikation
(en: cyclic communication)
periodischer Austausch von Telegrammen

3.1.14
zyklische Daten
(en: cyclic data)
Teil des Telegramms, dessen Bedeutung sich während einer zyklischen Operation der Schnittstelle nicht ändert

3.1.15
zyklische Operation
(en: cyclic operation)
Geräte im Kommunikationsnetzwerk werden nacheinander zu feststehenden, konstanten Zeitintervallen adressiert und abgefragt

3.1.16
Datenaustausch
(en: data exchange)
bedarfsabhängige, nicht zyklische Übertragung von Informationen, nachdem eine Anforderung durch den Master gesendet wurde (Dienstkanal)

3.1.17
Datentyp
(en: data type)
Menge von Werten mit einer Menge zulässiger Operationen

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

3.1.18
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, 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]

3.1.19
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

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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]

3.1.20
Lichtwellenleiter-Kabel
(en: fibre optic cable)
Übertragungsmedium für die serielle Datenübertragung optischer Signale

3.1.21
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]

3.1.22
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

3.1.23
Eingangsdaten
(en: input data)
Daten, die von einer externen Quelle in ein Gerät, eine Ressource oder ein funktionales Element übertragen werden

[Quelle: IEC/TR 62390:2005, 3.1.14]

3.1.24
Schnittstelle
(en: interface)
Grenze zwischen zwei Einheiten, die durch funktionale Merkmale, Signal-Eigenschaften oder andere geeignete charakteristische Merkmale festgelegt ist

[Quelle: IEV 351-21-35, modifiziert]

3.1.25
Linie
(en: line)
Netzwerktopologie, bei der das Übertragungsmedium von Station zu Station in Form einer Linie weitergeleitet wird. Die Informationen werden in einer Richtung vom Master zum letzten Slave der Linie übertragen und strömen anschließend in umgekehrter Reihenfolge über alle Slaves zum Master zurück

(CP16/3, CP12)

3.1.26
Master
(en: master)
Knoten, der den anderen Knoten das Recht zur Übertragung zuweist

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3.1.27
Master-Datentelegramm
MDT
(en: Master Data Telegram)
Telegramm, in das der Master seine Daten einfügt

3.1.28
Master-Synchronisationstelegramm
MST
(en: Master Synchronisation Telegram)
Telegramm, das vom Master übertragen wird, welcher ein Zeitsynchronisationssignal an den (die) Slave(s) in einem einzelnen Netzwerk sendet

3.1.29
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: IEV 351-21-36]

3.1.30
nicht zyklische Übertragung
(en: non-cyclic transmission)
nicht periodischer Austausch von Daten auf Anforderung des Masters

3.1.31
Betriebszyklus
(en: operating cycle)
Dauer des Regelkreises innerhalb des PDS oder der Steuereinheit

3.1.32
Betriebsart
(en: operating mode)
Kennzeichnung von Art und Umfang, wie der Mensch als Bediener in eine Leiteinrichtung eingreift

[Quelle: IEV 351-31-01]

3.1.33
Ausgangsdaten
(en: output data)
Daten, die von einem Gerät, einer Ressource oder einem funktionalen Element in externe Systeme übertragen werden

[Quelle: IEC/TR 62390:2005, 3.1.21]

3.1.34
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]

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3.1.35
PDS enable
(en: PDS enable)
Befehl zum Schließen der (des) Rückführkreise(s)

3.1.36
PDS on
(en: PDS on)
Befehl zum Aktivieren der Leistungsstufe

3.1.37
Profil
(en: profile)
Darstellung einer PDS-Schnittstelle hinsichtlich ihrer Parameter, Parametergruppierung und ihres Verhaltens nach einem Kommunikations- und einem Geräteprofil

3.1.38
Protokoll
(en: protocol)
Vereinbarung über die Datenformate, Zeitabfolgen und die Fehlerkorrektur im Datenaustausch von Kommunikationssystemen

3.1.39
Ring, Ringstruktur
(en: ring, ring structure)
Netzwerktopologie, bei der das Übertragungsmedium von Station zu Station in Form eines Rings weitergeleitet wird. Die Informationen werden nur in einer Richtung (CP16/1, CP16/2) oder in beiden Richtungen (CP16/3) übertragen

3.1.40
Slave
(en: slave)
Knoten, dem das Recht zur Übertragung durch den Master zugewiesen wird

3.1.41
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.

3.1.42
Statuswort
(en: status word)
zwei aufeinanderfolgende Bytes im PDS-Telegramm, die Statusinformationen enthalten

3.1.43
Telegramm
(en: telegram)
Datensatz

3.1.44
Topologie
(en: topology)
physikalische Netzwerkarchitektur in Bezug auf die Verbindung zwischen den Stationen des Kommunikationssystems

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3.1.45
Übertragungsmedium
(en: transmission medium)
Sammelbegriff für die tatsächliche Form der physikalischen Verbindung zwischen den Stationen eines Kommunikationsnetzwerks

Anmerkung 1 zum Begriff: Zum Beispiel: Lichtwellenleiter-Kabel.

3.1.46
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]

3.2 Abkürzungen

ADR	Adresse eines Telegramms. 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)
PLC	speicherprogrammierbare Steuerung ohne einen Befehlssatz zur Bewegungssteuerung (en: Programmable Logic Controller)
RT	Echtzeit (en: Real-time)
SERCOS	SErial Real time COmmunication System
t_3	Zeit, nach der der Befehlswert gültig ist
t_4	Zeitpunkt der Erfassung von Rückführwerten

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t_5	Maximale Verarbeitungszeit des Produzenten
t_{11}	Maximale Aktivierungszeit des Konsumenten
t_{MTSG}	Verarbeitungszeit des Befehlswerts
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)
ADR	Adresse eines PDS

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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International Standard IEC 61800-7-304 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.

- Update of mapping specification
- Editorial adjustments in relation with the new version of the IEC Directive Part 2.

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

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

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

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

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

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

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

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

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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 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.

Some applications need device exchangeability or integration of new devices in an existing configuration. They are faced with different incompatible solutions. The efforts to adopt 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.

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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].

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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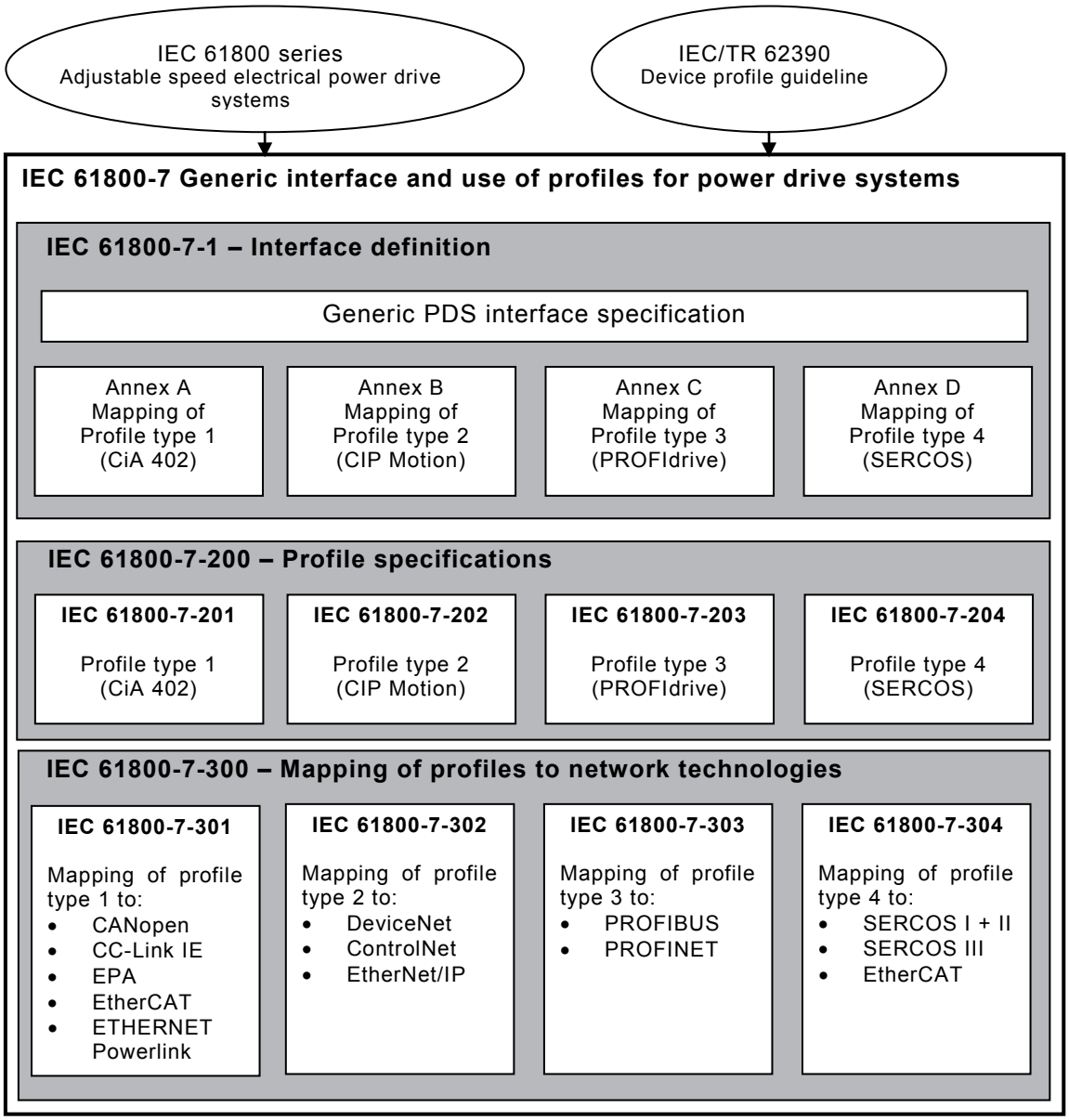

Figure 1 – Structure of IEC 61800-7

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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

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 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.

2 Normative references

The following referenced documents are indispensable for the application of this document. 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 61158-6-16, *Industrial communication networks – Fieldbus specifications – Part 6-16: Application layer protocol specification – 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 (all parts), *Adjustable speed electrical power drive systems – Generic interface and use of profiles for power drive systems*

IEC 61800-7-204, *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 8802-3:2000, *Information technology -Telecommunications and information exchange between systems - Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

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3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

3.1.1
Acknowledge Telegram
AT
telegram, in which each slave inserts its data

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: IEV 351-21-37]

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/TR 62390:2005, 3.1.2, modified]

3.1.4
attribute
property or characteristic of an entity

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

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

[Source: ISO/IEC 19501, modified]

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

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

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

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

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

[Source: IEV 351-21-29]

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

3.1.10
control unit
control device

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3.1.11
control word
two adjacent bytes inside the master data telegram containing commands for the addressed PDS

3.1.12
cycle time
time span between two consecutive cyclically recurring events

3.1.13
cyclic communication
the periodic exchange of telegrams

3.1.14
cyclic data
the part of the telegram which does not change its meaning during cyclic operation of the interface

3.1.15
cyclic operation
devices in the communication network are addressed and queried one after the other at fixed, constant time intervals

3.1.16
data exchange
demand dependent, non cyclic transmission of information after a request was sent by the master (service channel)

3.1.17
data type
set of values together with a set of permitted operations

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

3.1.18
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: IEC 61499-1:2005, modified]

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

[Source: ISO 15745-1:2003]

3.1.19
device profile
representation of a device in terms of its parameters, parameter assemblies and behaviour according to a device model that describes the device's data and behaviour as viewed through a network

Note 1 to entry: This is a definition from IEC/TS 61915 which is extended by the addition of the device functional structure.

[Source: IEC/TR 62390:2005, 3.1.9, modified]

3.1.20
fibre optic cable
transmission medium for serial data transmission of optical signals

3.1.21
functional element
entity of software or software combined with hardware, capable of accomplishing a specified function of a device

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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: IEC/TR 62390:2005, 3.1.12]

3.1.22
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

3.1.23
input data
data transferred from an external source into a device, resource or functional element

[Source: IEC/TR 62390:2005, 3.1.14]

3.1.24
interface
shared boundary between two entities defined by functional characteristics, signal characteristics, or other characteristics as appropriate

[Source: IEV 351-21-35, modified]

3.1.25
line
network topology in which the transmission medium is routed from station to station in the form of a line. 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)

3.1.26
master
node, which assigns the other nodes the right to transmit

3.1.27
Master Data Telegram
MDT
telegram, in which the master inserts its data

3.1.28
Master Synchronisation Telegram
MST
telegram transmitted by the master, which sends a time synchronisation signal to the slave(s) in a single network

3.1.29
model
mathematical or physical representation of a system or a process, based with sufficient precision upon known laws, identification or specified suppositions

[Source: IEV 351-21-36]

3.1.30
non-cyclic transmission
non-periodic exchange of data at the request of the master

3.1.31
operating cycle
period of the control loop within the PDS or the control unit

3.1.32
operating mode
characterisation of the way and the extent to which the human operator intervenes in the control equipment

[Source: IEV 351-31-01]

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3.1.33
output data
data originating in a device, resource or functional element and transferred from them to external systems

[Source: IEC/TR 62390:2005, 3.1.21]

3.1.34
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: Adapted from IEC/TS 61915 .

Note 2 to entry: A parameter is typically characterized by a parameter name, data type and access direction.

[Source: IEC/TR 62390:2005, 3.1.22, modified]

3.1.35
PDS enable
command to close the feedback loop(s)

3.1.36
PDS on
command that the power stage can be activated

3.1.37
profile
representation of a PDS interface in terms of its parameters, parameter assemblies and behaviour according to a communication profile and a device profile

3.1.38
protocol
convention about the data formats, time sequences, and error correction in the data exchange of communication systems

3.1.39
ring, ring structure
network topology in which the transmission medium is routed from station to station in the form of a ring. The information is transmitted only in one direction (CP16/1, CP16/2) or in both directions (CP16/3)

3.1.40
slave
node, which is assigned the right to transmit by the master

3.1.41
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.

3.1.42
status word
two adjacent bytes inside the PDS telegram containing status information

3.1.43
telegram
dataset

3.1.44
topology
physical network architecture with respect to the connection between the stations of the communication system

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3.1.45
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.

3.1.46
type
hardware or software element which specifies the common attributes shared by all instances of the type

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

3.2 Abbreviated terms

ADR	Address of a telegram. 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
t3	Command value valid time
t4	Feedback acquisition capture point
t5	Maximum producer processing time
t11	Maximum consumer activation time
tMTSG	Command value processing time
tNcyc	Control unit cycle time
tPcyc	Producer cycle time
tRcyc	PDS control loop cycle time
tScyc	Communication cycle time
UC	Unified communication
ADR	Address of a PDS

4 General

This mapping defines among others the mapping to CP16/1 (SERCOS I), which has been previously specified in IEC 61491:2002. The IEC maintenance group has decided to incorporate it 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 standard family. The detailed references are listed in the corresponding part of 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 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
Initialisation	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

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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 initialisation, 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 synchronising all connected PDSs by way of cyclic data exchange for command and feedback values, including exact equidistant timing and synchronisation 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.

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.

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485 **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 [NOTE]	yes
NOTE With a CP16/2 master, CP16/1 slaves should be interoperable only at 2 or 4 Mbit/s.		

486

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

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

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

504 ### 5.3 Physical layer and topology

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

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

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