

DIN EN 61800-7-202

ICS 29.160.30; 29.200

Ersatz für
DIN EN 61800-7-202:2008-11
Siehe Anwendungsbeginn

**Elektrische Leistungsantriebssysteme mit einstellbarer Drehzahl –
Teil 7-202: Generisches Interface und Nutzung von Profilen für
Leistungsantriebssysteme (PDS) –
Spezifikation von Profil-Typ 2
(IEC 61800-7-202:2015);
Englische Fassung EN 61800-7-202:2016**

Adjustable speed electrical power drive systems –
Part 7-202: Generic interface and use of profiles for power drive systems –
Profile type 2 specification
(IEC 61800-7-202:2015);
English version EN 61800-7-202:2016

Entraînements électriques de puissance à vitesse variable –
Partie 7-202: Interface générique et utilisation de profils pour les entraînements
électriques de puissance –
Spécification de profil de type 2
(IEC 61800-7-202:2015);
Version anglaise EN 61800-7-202:2016

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DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE

Anwendungsbeginn

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

Für DIN EN 61800-7-202:2008-11 besteht eine Übergangsfrist bis 2018-12-25.

Nationales Vorwort

Vorausgegangener Norm-Entwurf: E DIN EN 61800-7-202:2015-02.

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.

Die enthaltene IEC-Publikation wurde vom SC 22G „Adjustable speed electric drive systems incorporating semiconductor power converters“ erarbeitet.

Das IEC-Komitee hat entschieden, dass der Inhalt dieser Publikation bis zu dem Datum (stability date) unverändert bleiben soll, das auf der IEC-Website unter „<http://webstore.iec.ch>“ zu dieser Publikation angegeben ist. Zu diesem Zeitpunkt wird entsprechend der Entscheidung des Komitees die Publikation

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

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Der Zusammenhang der zitierten Dokumente mit den entsprechenden Deutschen Dokumenten 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 Anwender der vorliegenden Norm der englischen Sprache als Fachsprache bedienen, wird die Englische Fassung der EN 61800-7-202 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.

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 61800-7-202:2008-11 wurden folgende Änderungen vorgenommen:

- a) Überarbeitung der Spezifikationen für das Antriebsprofil und die Antriebsachse;
- b) redaktionelle Überarbeitung des gesamten Dokuments.

Frühere Ausgaben

DIN EN 61800-7-202: 2008-11

Nationaler Anhang NA (informativ)

Auszugsweise Übersetzung^{N1)}

1 Anwendungsbereich

Dieser Teil der IEC 61800 beschreibt den Profil-Typ 2 (CIP Motion™) für Leistungsantriebssysteme (PDS). Profil-Typ 2 kann auf verschiedene Technologien für Kommunikationsnetzwerke abgebildet werden.

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 und Abkürzungen.

3.1.1

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]

3.1.2

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]

3.1.3

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 z. B. das Referenzieren, wider.

[QUELLE: IEC 61800-7-1:2015, 3.3.1.2]

3.1.4

Attribut

(en: attribute)

Eigenschaft oder Charakteristik einer Funktionseinheit

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

^{N1)} Nationale Fußnote: Die Nummerierung aus IEC 61800-7-202:2015-11 wurde beibehalten.

3.1.5

Achse

(en: axis)

logisches Element in einem Automatisierungssystem (z. B. ein Bewegungssteuerungssystem), das eine bestimmte Form der Bewegung darstellt

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

[QUELLE: IEC 61800-7-1:2015, 3.2.4]

3.1.6

Busregler

(en: bus regulator)

jede Methode zur Begrenzung des Anstiegs des Gleichspannungspegels des Busses, die bei einer Abbremsung des Motors angewendet wird

3.1.7

CIP Motion™¹⁵⁾

(en: CIP Motion™)

Erweiterungen der CIP-Dienste und des CIP-Protokolls zur Unterstützung der Bewegungssteuerung über CIP-Netzwerke

[QUELLE: IEC 61800-7-1:2015, 3.3.3.1]

3.1.8

CIP Motion™-Steuerung

(en: CIP Motion™ controller)

CIP-konforme Steuerung, die ein Bewegungssteuerungs-Achsenobjekt enthält und über eine CIP-Motion-E/A-Verbindung mit einem CIP-Motion-Gerät kommunizieren kann

Anmerkung 1 zum Begriff: Die Beschreibung des Bewegungssteuerungs-Achsenobjektes gehört nicht zum Anwendungsbereich von IEC 61800-7.

[QUELLE: IEC 61800-7-1:2015, 3.3.3.2]

3.1.9

CIP Motion™-Gerät

(en: CIP Motion™ device)

CIP-konformes Gerät, das eine oder mehrere Instanzen eines Bewegungsgeräte-Achsenobjektes enthält und über eine CIP-Motion-E/A-Verbindung mit einer CIP-Motion-Steuerung kommunizieren kann

BEISPIEL: Ein CIP-Motion-Antrieb ist ein Sonderfall eines CIP-Motion-Geräts.

[QUELLE: IEC 61800-7-1:2015, 3.3.3.3]

3.1.10

CIP Motion™-Antriebsprofil

(en: CIP Motion™ drive profile)

Zusammenstellung von Objekten, die zur Implementierung eines CIP-Motion-Antriebsgeräts verwendet werden, welches das Bewegungsgeräte-Achsenobjekt sowie standardmäßige Unterstützungsobjekte wie das Identitätsobjekt und das Zeitsynchronisationsobjekt umfasst

Anmerkung 1 zum Begriff: Der dem CIP-Motion-Antriebsprofil zugeordnete Gerätetyp ist 25_{hex}.

¹⁵⁾ CIP Motion™ und CIP Sync™ sind Marken der ODVA, Inc. Diese Information ist zum Nutzen der Anwender dieser Internationalen Norm enthalten, stellt aber keine Bevorzugung des Inhabers der Marke oder seiner Produkte durch die IEC dar. Für die Konformität mit diesem Profil ist die Nutzung der Marke CIP Motion™ oder CIP Sync™ nicht erforderlich. Die Nutzung der Marke CIP Motion™ oder CIP Sync™ bedarf der Genehmigung der ODVA, Inc.

3.1.11**CIP Motion™-E/A-Verbindung****CIP Motion™-Verbindung**

(en: CIP Motion™ I/O Connection; CIP Motion™ Connection)

periodische, bidirektionale CIP-Verbindung der Klasse 1 zwischen einer Steuerung und einem Antrieb, die als Teil der CIP-Motion-Spezifikation festgelegt ist

[QUELLE: IEC 61800-7-1:2015, 3.3.3.4]

3.1.12**CIP Sync™¹⁵⁾**

(en: CIP Sync™)

Erweiterungen der CIP-Dienste und des CIP-Protokolls zur Einkapselung der Zeitsynchronisationsfunktionalität nach IEC 61588:2009 über ein CIP-Netzwerk

Anmerkung 1 zum Begriff: Siehe Zeitsynchronisationsobjekt (en: Time Sync Object) in IEC 61158-5-2 und IEC 61158-6-2).

[QUELLE: IEC 61800-7-1:2015, 3.3.3.5]

3.1.13**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]

3.1.14**geschlossener Regelkreis**

(en: closed loop)

Methoden zur Regelung, bei denen ein bestimmtes Rückführsignal zum Antrieb der tatsächlichen Dynamik des Motors verwendet wird, um die vorgegebene Dynamik durch einen Servo-Vorgang abzugleichen

Anmerkung 1 zum Begriff: In den meisten Fällen gibt es ein tatsächliches Rückführgerät, welches dieses Signal bereitstellt; in einigen Fällen jedoch wird das Signal von der Motoransteuerung (d. h. einer sensorlosen Operation) abgeleitet.

3.1.15**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]

3.1.16**Leiten**

(en: control)

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

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

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3.1.17

Steuergerät

(en: control device)

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]

3.1.18

Stromrichter

(en: converter)

Gerät, das üblicherweise eingehenden Wechselstrom in ausgehenden Gleichstrom umformt

Anmerkung 1 zum Begriff: Ein Stromrichter wird gemeinhin auch als Stromversorgung des Antriebs bezeichnet. Im Zusammenhang mit einem Antriebssystem ist der Stromrichter für die Umformung einer Eingangsgröße aus dem Wechselstromnetz in einen Gleichstrombus verantwortlich.

3.1.19

zyklischer Datenblock

(en: Cyclic Data Block)

Echtzeitdatenblock mit hoher Priorität, der über eine CIP-Motion-Verbindung periodisch übertragen wird

3.1.20

Datentyp

(en: data type)

Menge von Werten mit einer Menge zulässiger Operationen

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

3.1.21

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]

3.1.22

Gerät

Feldgerät

(en: device; field device)

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

[QUELLE: IEC 61800-7-1:2015, 3.2.10]

3.1.23

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]

3.1.24

Antrieb

(en: drive)

Gerät, das zur Steuerung der Dynamik eines Motors vorgesehen ist

3.1.25**Ereignisdatenblock**

(en: Event Data Block)

Echtzeitdatenblock mit mittlerer Priorität, der über eine CIP-Motion-Verbindung nur dann übertragen wird, wenn ein festgelegtes Ereignis auftritt

Anmerkung 1 zum Begriff: Übergänge bei Registrierung und Markierungseinträgen sind typische Antriebsereignisse.

3.1.26**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.

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]

3.1.27**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]

3.1.28**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]

3.1.29**Wechselrichter**

(en: inverter)

Gerät, das üblicherweise eingehenden Gleichstrom in ausgehenden Wechselstrom umformt

Anmerkung 1 zum Begriff: Ein Wechselrichter wird gemeinhin auch als Antriebsverstärker bezeichnet. Im Zusammenhang mit einem Antriebssystem ist der Wechselrichter für die Steuerung des Energieflusses vom Gleichstrombus zu einem Wechselstrommotor verantwortlich.

3.1.30**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]

3.1.31**Bewegung**

(en: motion)

jeder Aspekt der Dynamik einer Achse

Anmerkung 1 zum Begriff: Im Kontext dieses Teils der IEC 61800-7 ist dies nicht auf Servo-Antriebe begrenzt, sondern umfasst alle Formen der antriebsbasierten Motorsteuerung.

[QUELLE: IEC 61800-7-1:2015, 3.3.3.8]

3.1.32

Bewegungssteuerungs-Achsenobjekt

(en: Motion Control Axis Object)

Objekt, das die Attribute, die Dienste und das Verhalten einer reglerbasierten Achse entsprechend der CIP-Motion-Spezifikation festlegt

3.1.33

Bewegungsgeräte-Achsenobjekt

(en: Motion Device Axis Object)

Objekt, das die Attribute, die Dienste und das Verhalten einer bewegungsgerätebasierten Achse entsprechend der CIP-Motion-Spezifikation festlegt

Anmerkung 1 zum Begriff: Dieses Objekt umfasst Kommunikation, Gerätesteuerung und grundlegende funktionale Elemente des Antriebs, wie in IEC 61800-7 definiert.

[QUELLE: IEC 61800-7-1:2015, 3.3.3.9]

3.1.34

offener Regelkreis

(en: open loop)

Methoden zur Regelung, bei denen keine Rückführung angewendet wird, um die tatsächliche Dynamik des Motors zwingend an die vorgegebene Dynamik anzugleichen

BEISPIEL: Beispiele für offene Regelkreise sind Schrittantriebe und Frequenzumrichter-Antriebe.

3.1.35

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]

3.1.36

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]

3.1.37

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]

3.1.38

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.]

3.1.39

Lesen

Abrufen

(en: read; get)

Operation, die den Empfang eines Attributwertes aus der Sicht der Steuerseite der Schnittstelle einschließt

3.1.40**Registrierung**

(en: registration)

schnelle Protokollierung der Position der Bewegungsachse, die durch ein Ereignis ausgelöst wird

3.1.41**Dienstdatenblock**

(en: Service Data Block)

Echtzeitdatenblock mit niedriger Priorität in Verbindung mit einer Dienstinricht von der Steuerung, der über eine CIP-Motion-Verbindung periodisch übertragen wird

Anmerkung 1 zum Begriff: Dienstdaten schließen Dienstanforderungsnachrichten ein, um auf Attribute von Bewegungsgeräte-Achsenobjekten zuzugreifen oder verschiedene Antriebsdiagnosen durchzuführen.

3.1.42**Sollwert**

(en: set-point)

Wert oder Variable, der/die als Ausgabedaten von dem Programm zur Steuerung der Anwendung verwendet wird, um das PDS zu steuern

Anmerkung 1 zum Begriff: Der zum Antrieb gesendete Wert wird zur direkten Steuerung bestimmter Aspekte der Motordynamik genutzt und beinhaltet Lage, Geschwindigkeit, Beschleunigung und Drehmoment (ist aber nicht darauf beschränkt).

[QUELLE: IEC 61800-7-1:2015, 3.3.1.5, modifiziert – Anmerkung 1 zum Begriff wurde ergänzt.]

3.1.43**Parallelregler**

(en: shunt regulator)

spezielle Regelungsmethode, bei der der Gleichstrombus über einen Verlustleistungswiderstand geschaltet wird, um die generatorische Energie eines bremsenden Motors abzuleiten

3.1.44**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.

[QUELLE: IEC 61800-7-1:2015, 3.3.1.6]

3.1.45**synchronisiert**

(en: synchronized)

Zustand, in dem der Wert der lokalen Uhr des Antriebs mit der Master-Uhr der verteilten Systemzeit synchronisiert ist

Anmerkung 1 zum Begriff: Im synchronisierten Zustand können die Antriebsgeräte und Steuergeräte Zeitstempel in Verbindung mit CIP-Motion-Verbindungsdaten verwenden.

[QUELLE: IEC 61800-7-1:2015, 3.3.3.11]

3.1.46**Systemzeit**

(en: System Time)

absoluter Zeitwert, wie in der CIP-Sync-Spezifikation festgelegt, im Kontext eines verteilten Zeitsystems, in dem alle Geräte über lokale Uhren verfügen, die mit einer gemeinsamen Master-Uhr synchronisiert werden

Anmerkung 1 zum Begriff: Im Zusammenhang mit CIP-Motion entspricht die Systemzeit einem ganzzahligen 64-Bit-Wert in Nanosekunden mit einem Wert von 0 entsprechend dem Datum 1970-01-01.

[QUELLE: IEC 61800-7-1:2015, 3.3.3.12]

3.1.47

thermisches Modell

(en: thermal model)

jeder Algorithmus, der das thermische Verhalten des entsprechenden Geräts während des Betriebs zu modellieren versucht

3.1.48

Zeitabstand

(en: time offset)

Abstandswert der Systemzeit in Verbindung mit den CIP-Motion-Verbindungsdaten, der dem Quellgerät zugeordnet ist

Anmerkung 1 zum Begriff: Der Systemzeitabstand entspricht einem 64-Bit-Abstandswert, welcher der lokalen Uhr des Geräts hinzugefügt wird, um die Systemzeit für dieses Gerät zu erzeugen.

3.1.49

Zeitstempel

(en: time stamp)

Stempelwert der Systemzeit in Verbindung mit den CIP-Motion-Verbindungsdaten, der den absoluten Zeitpunkt der Erfassung der zugehörigen Daten übermittelt oder auch zur Festlegung der Anwendung der zugehörigen Daten verwendet werden kann

Anmerkung 1 zum Begriff: CIP-Zeitstempel gelten immer im Kontext eines verteilten Zeitsystems, in dem alle Knoten im CIP-Steuernetzwerk über Uhren verfügen, die mit einer Master-Uhrenquelle über CIP-Sync synchronisiert werden.

[QUELLE: IEC 61800-7-1:2015, 3.3.3.13]

3.1.50

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]

3.1.51

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 61800-7-1:2015, 3.2.25]

3.1.52

Frequenzumrichter-Antrieb

(en: variable frequency drive)

VFD

Klasse von Antriebsprodukten, die die Geschwindigkeit eines Motors, üblicherweise eines Induktionsmotors, über eine proportionale Beziehung zwischen der Antriebsausgangsspannung und der vorgegebenen Ausgangsfrequenz regeln

Anmerkung 1 zum Begriff: Frequenzumrichter-Antriebe werden deshalb mitunter als U/f-Antriebe bezeichnet.

Anmerkung 2 zum Begriff: Die englische Abkürzung VFD wird auch in der französischen Sprachfassung benutzt.

3.1.53

Vektorantrieb

(en: vector drive)

Klasse von Antriebsprodukten, die die Dynamik eines Motors über einen geschlossenen Regelkreis regeln, wobei (unter anderem) sowohl Drehmoment- als auch Fluss-Vektor-Komponenten des Statorstroms des Motors in Bezug auf den Fluss-Vektor des Rotors geregelt werden

3.1.54**Schreiben**

Festlegen

(en: write; set)

Operation, die die Festlegung eines Attributes auf einen bestimmten Wert aus der Sicht der Steuerseite der Schnittstelle einschließt

3.2 Abkürzungen

Ack	Bestätigen (en: acknowledge)
Act	Ist (en: actual)
Blk	Block
CIP™ ¹⁶⁾	Common Industrial Protocol (siehe IEC 61158 Type 2, IEC 61784-1 und IEC 61784-2 Communication Profile Family 2)
Cmd	Befehl (en: command)
Cyc	zyklisch (en: cyclic)
HMI	Mensch-Maschine-Schnittstelle (en: human machine interface)
ID	Kennzeichner (en: identifier)
impl.	Implementierung (en: implementation)
I/O	Eingang/Ausgang (en: Input/Output)
Opt.	optional
PDS	Leistungsantriebssystem (en: power drive system)
Req.	erforderlich (en: required)
RMS	Effektivwert (en: root mean square)
r/min	Umdrehungen je Minute (en: revolutions per minute)
Sync'd	synchronisiert (en: synchronized)
TCP	Transmission Control Protocol (siehe IETF RFC 793)
UDP	User Datagram Protocol (siehe IETF RFC 768)
VFD	Frequenzumrichter-Antrieb (en: variable frequency drive)

¹⁶⁾ CIP™ ist eine Marke der ODVA, Inc. Diese Information ist zum Nutzen der Anwender dieser Internationalen Norm enthalten, stellt aber keine Bevorzugung des Inhabers der Marke oder seiner Produkte durch die IEC dar. Für die Konformität mit diesem Profil ist die Nutzung der Marke CIP™ nicht erforderlich. Die Nutzung der Marke CIP™ bedarf der Genehmigung der ODVA, Inc.

– Leerseite –

English Version

Adjustable speed electrical power drive systems -
Part 7-202: Generic interface and use of profiles for power drive
systems - Profile type 2 specification
(IEC 61800-7-202:2015)

Entraînements électriques de puissance à vitesse variable -
Partie 7-202: Interface générique et utilisation de profils
pour les entraînements électriques de puissance -
Spécification de profil de type 2
(IEC 61800-7-202:2015)

Elektrische Leistungsantriebssysteme mit einstellbarer
Drehzahl - Teil 7-202: Generisches Interface und Nutzung
von Profilen für Leistungsantriebssysteme (PDS) -
Spezifikation von Profil-Typ 2
(IEC 61800-7-202:2015)

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.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

The text of document 22G/308/FDIS, future edition 2 of IEC 61800-7-202, 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 61800-7-202:2016.

The following dates are fixed:

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

This document supersedes EN 61800-7-202:2008.

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 61800-7-202:2015 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 61131-3	NOTE	Harmonized as EN 61131-3.
IEC 61158 Series	NOTE	Harmonized as EN 61158 Series.
IEC 61158-2:2014	NOTE	Harmonized as EN 61158-2:2014 (not modified).
IEC 61158-3-2:2014	NOTE	Harmonized as EN 61158-3-2:2014 (not modified).
IEC 61499-1:2005	NOTE	Harmonized as EN 61499-1:2005 ¹⁾ (not modified).
IEC 61784-1:2014	NOTE	Harmonized as EN 61784-1:2014 (not modified).
IEC 61784-2:2014	NOTE	Harmonized as EN 61784-2:2014 (not modified).
IEC 61800 Series	NOTE	Harmonized as EN 61800 Series.
IEC 61800-7 Series	NOTE	Harmonized as EN 61800-7 Series.
IEC 61800-7-201	NOTE	Harmonized as EN 61800-7-201.
IEC 61800-7-203	NOTE	Harmonized as EN 61800-7-203.
IEC 61800-7-204	NOTE	Harmonized as EN 61800-7-204.
IEC 61800-7-301	NOTE	Harmonized as EN 61800-7-301.
IEC 61800-7-302	NOTE	Harmonized as EN 61800-7-302.
IEC 61800-7-303	NOTE	Harmonized as EN 61800-7-303.
IEC 61800-7-304	NOTE	Harmonized as EN 61800-7-304.
IEC 62026-3	NOTE	Harmonized as EN 62026-3.

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

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INTRODUCTION

0.1 General

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.

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 profiles types for CiA® 402¹, CIP Motion™², PROFIdrive³ 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 trademarks.

This part of IEC 61800-7 specifies the profile type 2 (CIP Motion™).

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

-
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IEC 61800-7-301, IEC 61800-7-302, IEC 61800-7-303 and IEC 61800-7-304 specify how the profile types 1, 2, 3 and 4 are mapped to different network technologies (such as CANopen®⁵, CC-Link IE® Field Network⁶, EPA™⁷, EtherCAT®⁸, Ethernet Powerlink™⁹, DeviceNet™¹⁰, ControlNet™¹¹, EtherNet/IP™¹², PROFIBUS¹³, PROFINET¹⁴ and SERCOS®).

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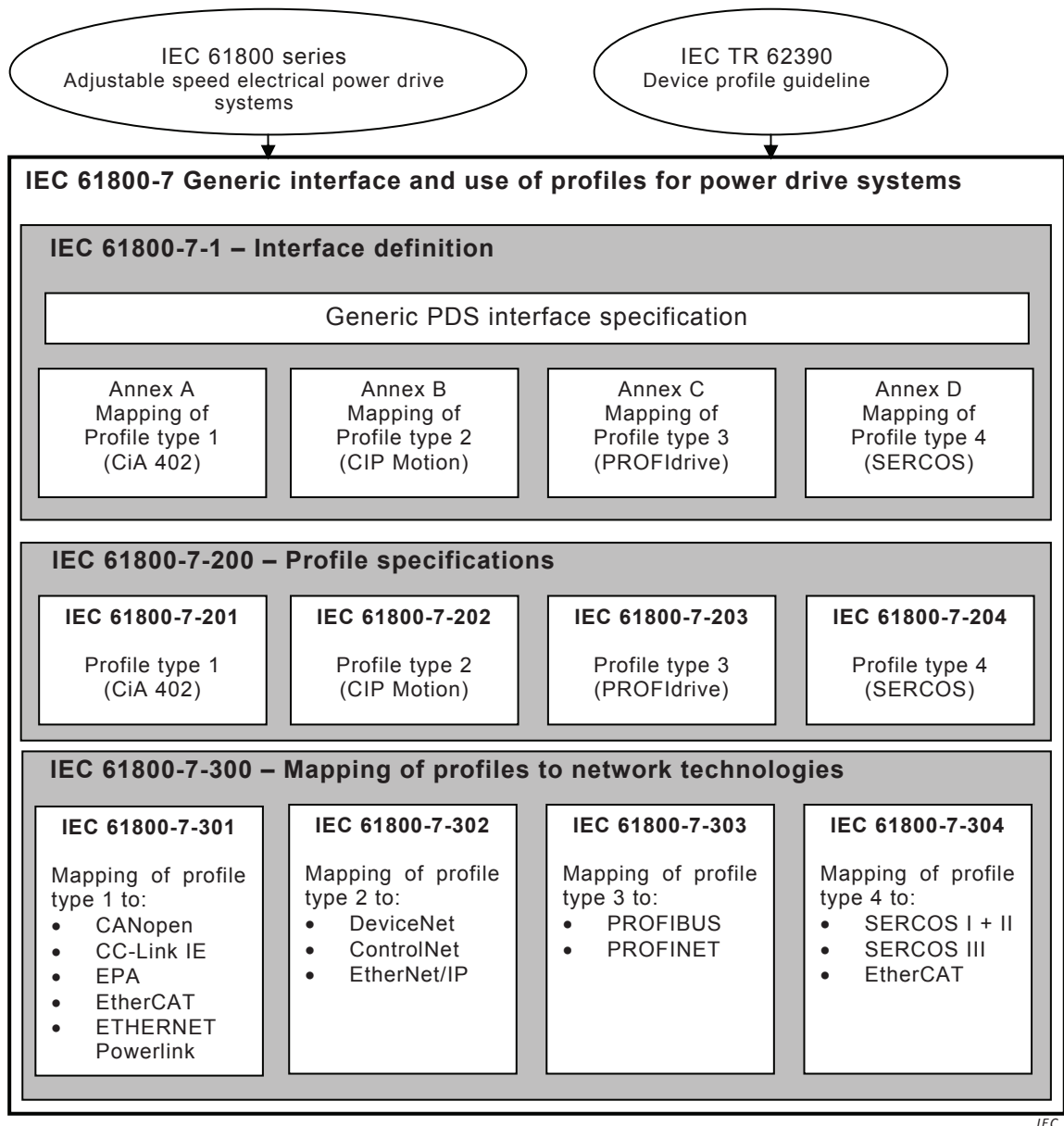


Figure 1 – Structure of IEC 61800-7

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. This patent is held by its inventors under license to ODVA, Inc:

Publication / Application serial number	Holder	Title
US 7,983,769 EP 1659465	[ODVA]	Time stamped motion control network protocol that enables balanced single cycle timing and utilization of dynamic data structures

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[ODVA]	ODVA, Inc. 2370 East Stadium Boulevard #1000 Ann Arbor, Michigan 48104 USA Attention: Office of the Executive Director email: odva@odva.org
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ADJUSTABLE SPEED ELECTRICAL POWER DRIVE SYSTEMS –

Part 7-202: Generic interface and use of profiles for power drive systems – Profile type 2 specification

1 Scope

This part of IEC 61800 specifies profile type 2 (CIP Motion™) for Power Drive Systems (PDS). Profile type 2 can be mapped onto different communication network technologies.

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 60204-1, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 61158-4-2:2014, *Industrial communication networks – Fieldbus specifications – Part 4-2: Data-link layer protocol specification – Type 2 elements*

IEC 61158-5-2:2014, *Industrial communication networks – Fieldbus specifications – Part 5-2: Application layer service definition – Type 2 elements*

IEC 61158-6-2:2014, *Industrial communication networks – Fieldbus specifications – Part 6-2: Application layer protocol specification – Type 2 elements*

IEC 61588:2009, *Precision clock synchronization protocol for networked measurement and control systems*

IEC 61800-7-1:2015, *Adjustable speed electrical power drive systems – Part 7-1: Generic interface and use of profiles for power drive systems – Interface definition*

IEEE Std 112-2004, *IEEE Standard Test Procedure for Polyphase Induction Motors and Generators*

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

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]

3.1.2 **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]

3.1.3 **application mode**

type of application that can be requested from a PDS

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

[SOURCE: IEC 61800-7-1:2015, 3.3.1.2]

3.1.4 **attribute**

property or characteristic of an entity

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

3.1.5 **axis**

logical element inside an automation system (e.g. a motion control system) that represents some form of movement

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

[SOURCE: IEC 61800-7-1:2015, 3.2.4]

3.1.6 **bus regulator**

any method used to limit the rise in DC bus voltage level that occurs when decelerating a motor

3.1.7 **CIP Motion™¹⁵**

extensions to the CIP services and protocol to support motion control over CIP networks

[SOURCE: IEC 61800-7-1:2015, 3.3.3.1]

3.1.8 **CIP Motion™ controller**

CIP compliant controller containing a Motion Control Axis Object that can interface to a CIP Motion device via a CIP Motion I/O Connection

Note 1 to entry: A description of the Motion Control Axis Object is beyond the scope of IEC 61800-7.

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[SOURCE: IEC 61800-7-1:2015, 3.3.3.2]

3.1.9

CIP Motion™ device

CIP compliant device containing one or more Motion Device Axis Object instances that can communicate to a CIP Motion controller via a CIP Motion I/O Connection

EXAMPLE: A CIP Motion drive is a particular case of a CIP Motion device.

[SOURCE: IEC 61800-7-1:2015, 3.3.3.3]

3.1.10

CIP Motion™ drive profile

collection of objects used to implement a CIP Motion drive device that includes the Motion Device Axis Object, as well as standard support objects like the Identity Object and the Time Sync Object

Note 1 to entry: The Device Type assigned to the CIP Motion drive profile is 25_{hex}.

3.1.11

CIP Motion™ I/O Connection

CIP Motion™ Connection

periodic bi-directional, class 1, CIP connection between a controller and a drive that is defined as part of the CIP Motion specification

[SOURCE: IEC 61800-7-1:2015, 3.3.3.4]

3.1.12

CIP Sync™¹⁵

extensions to the CIP services and protocol to encapsulate IEC 61588:2009 time synchronization functionality over a CIP Network

Note 1 to entry: See Time Sync Object in IEC 61158-5-2 and IEC 61158-6-2.

[SOURCE: IEC 61800-7-1:2015, 3.3.3.5]

3.1.13

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]

3.1.14

closed loop

methods of control where there is a feedback signal of some kind that is used to drive the actual dynamics of the motor to match the commanded dynamics by servo action

Note 1 to entry: In most cases, there is a literal feedback device to provide this signal, but in some cases, the signal is derived from the motor excitation (i.e. sensorless operation).

3.1.15

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

3.1.16

control

purposeful action on or in a process to meet specified objectives

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

3.1.17

control device

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

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

3.1.18

converter

device that generally converts AC input to DC output

Note 1 to entry: A converter is also commonly called the Drive Power Supply. In the context of a drive system, the converter is responsible for converting AC main input into DC bus power.

3.1.19

Cyclic Data Block

high priority real-time data block that is transferred by a CIP Motion Connection on a periodic basis

3.1.20

data type

set of values together with a set of permitted operations

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

3.1.21

device

field device

<function blocks> 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 61800-7-1:2015, 3.2.9]

3.1.22

device

field device

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

[SOURCE: IEC 61800-7-1:2015, 3.2.10]

3.1.23

device profile

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

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

3.1.24

drive

device designed to control the dynamics of a motor

3.1.25

Event Data Block

medium priority real-time data block that is transferred by a CIP Motion Connection only after a specified event occurs

Note 1 to entry: Registration and marker input transitions are typical drive events.

3.1.26

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

3.1.27

input data

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

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

3.1.28

interface

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

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

3.1.29

inverter

device that generally converts DC input to AC output

Note 1 to entry: An inverter is also commonly called the Drive Amplifier. In the context of a drive system, the inverter is responsible for controlling the application of DC bus power to an AC motor.

3.1.30

model

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

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

3.1.31

motion

any aspect of the dynamics of an axis

Note 1 to entry: In the context of this part of IEC 61800-7, it is not limited to servo drives but encompasses all forms of drive based motor control.

[SOURCE: IEC 61800-7-1:2015, 3.3.3.8]

3.1.32

Motion Control Axis Object

object that defines the attributes, services, and behavior of a controller based axis according to the CIP Motion specification

3.1.33

Motion Device Axis Object

object that defines the attributes, services, and behavior of a motion device based axis according to the CIP Motion specification

Note 1 to entry: This object includes Communications, Device control, and Basic drive FE elements as defined in IEC 61800-7.

[SOURCE: IEC 61800-7-1:2015, 3.3.3.9]

3.1.34

open loop

methods of control where there is no application of feedback to force the actual motor dynamics to match the commanded dynamics

EXAMPLE Examples of open loop control are stepper drives and variable frequency drives.

3.1.35

operating mode

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

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

3.1.36

output data

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

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

3.1.37

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]

3.1.38

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]

3.1.39

read

get

operation that involves the retrieving of an attribute value from the perspective of the controller side of the interface

3.1.40

registration

high speed record of motion axis position triggered by an event

3.1.41

Service Data Block

lower priority real-time data block associated with a service message from the controller that is transferred by a CIP Motion Connection on a periodic basis

Note 1 to entry: Service data includes service request messages to access Motion Device Axis Object attributes or perform various drive diagnostics.

3.1.42

set-point

value or variable used as output data of the application control program to control the PDS

Note 1 to entry: The value sent to the drive is used to directly control some aspect of the motor dynamics, which includes (but is not limited to) position, velocity, acceleration, and torque.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.5, modified – Note 1 to entry is added]

3.1.43

shunt regulator

specific bus regulator method that switches the DC bus across a power dissipating resistor to dissipate the regenerative power of a decelerating motor

3.1.44

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.

[SOURCE: IEC 61800-7-1:2015, 3.3.1.6]

3.1.45

synchronized

condition where the local clock value on the drive is locked onto the master clock of the distributed System Time

Note 1 to entry: When synchronized, the drive and controller devices may utilise time stamps associated with CIP Motion Connection data.

[SOURCE: IEC 61800-7-1:2015, 3.3.3.11]

3.1.46

System Time

absolute time value as defined in the CIP Sync specification in the context of a distributed time system where all devices have a local clock that is synchronized with a common master clock

Note 1 to entry: In the context of CIP Motion, System Time is a 64-bit integer value in units of nanoseconds with a value of 0 corresponding to the date 1970-01-01.

[SOURCE: IEC 61800-7-1:2015, 3.3.3.12]

3.1.47

thermal model

any algorithm that attempts to model the thermal behavior of the associated device during operation

3.1.48

time offset

System Time offset value associated with the CIP Motion Connection data that is associated with source device

Note 1 to entry: The System Time offset is a 64-bit offset value that is added to a device's local clock to generate System Time for that device

3.1.49

time stamp

System Time stamp value associated with the CIP Motion Connection data that conveys the absolute time when the associated data was captured, or that can also be used to determine when the associated data shall be applied

Note 1 to entry: CIP time stamps are always in the context of a distributed time system where all nodes on the CIP control network have clocks that are synchronized with a master clock source using CIP Sync.

[SOURCE: IEC 61800-7-1:2015, 3.3.3.13]

3.1.50

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]

3.1.51

variable

software entity that may take different values, one at a time

Note 1 to entry: The values of a variable as well as of a parameter are usually restricted to a certain data type.

[SOURCE: IEC 61800-7-1:2015, 3.2.25]

3.1.52

variable frequency drive

VFD

class of drive products that seek to control the speed of a motor, typically an induction motor, through a proportional relationship between drive output voltage and commanded output frequency

Note 1 to entry: Variable frequency drives are therefore sometimes referred to as a Volts/Hertz drives.

Note 2 to entry: The English abbreviation VFD is also used in French.

3.1.53

vector drive

class of drive products that seek to control the dynamics of a motor via closed loop control which includes, but is not limited to, closed loop control of both torque and flux vector components of motor stator current relative to the rotor flux vector

3.1.54

write

set

operation that involves the setting of an attribute to a specified value from the perspective of the controller side of the interface

3.2 Abbreviated terms

Ack acknowledge

Act	actual
Blk	block
CIP™ ¹⁶	Common Industrial Protocol (see IEC 61158 Type 2, IEC 61784-1 and IEC 61784-2 Communication Profile Family 2)
Cmd	command
Cyc	cyclic
HMI	human machine interface
ID	identifier
impl.	implementation
I/O	Input/Output
Opt.	optional
PDS	power drive system
Req.	required
RMS	root mean square
r/min	revolutions per minute
Sync'd	synchronized
TCP	Transmission Control Protocol (see IETF RFC 793)
UDP	User Datagram Protocol (see IETF RFC 768)
VFD	variable frequency drive

4 Overview

4.1 General

CIP Motion devices control, monitor or support the motion of one or more moving component of a machine. Machine motion is typically generated by rotary or linear motion actuators, i.e.: motors, and monitored by feedback devices. Each motor is typically driven by a power structure and a motion control algorithm that comprise a CIP Motion Drive Device Type.

Drive functionality supported by the CIP Motion drive device profile can be applied to a variety of motor technologies, and can range from very simple “open loop” variable frequency drives to sophisticated “closed loop” vector controlled servo drives. In either case, motion is controlled via a command reference that can be configured for position control, velocity control, acceleration control, or current/torque control. The CIP Motion drive device profile also supports position, velocity and acceleration monitoring through multiple feedback, as does the CIP Motion encoder device profile.

All the attributes, services, and state behavior of a CIP Motion device are encapsulated in one or more Motion Device Axis Object instances. In addition to motion control and feedback monitoring functionality, the Motion Device Axis Object includes support for event monitoring, such position capture on a Registration event, and DC Bus management associated with a Power Converter. A CIP Motion device can manifest any combination of these functions to create various classes of CIP Motion compliant devices ranging from full featured servo drives, to CIP Motion Encoders, to standalone Power Converters, differentiated by the CIP Motion Device Type.

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This CIP Motion drive profile specification and the associated Motion Device Axis Object specification define the interface, the specific attributes, and command behaviors required to support motion control when connected to a CIP Motion compliant controller through a CIP network.

Of the applicable CIP Networks, EtherNet/IP™ is the network of choice for high performance, synchronized multi-axis control. Other CIP networks such as ControlNet™ and DeviceNet™ could be applied to lower performance non-synchronized motion device applications such as simple variable frequency drives, velocity loop drives, and indexing drives.

4.2 Control modes

4.2.1 General

The Motion Device Axis Object covers the behavior of various motion control system devices that includes feedback devices, drive devices, standalone converters and motion I/O devices. For drive devices, the Motion Device Axis Object covers a wide range of drive types from simple variable frequency (V/Hz) drives, to sophisticated position control servo drives, with or without integral converters. Indeed, many commercial drive products can be configured to operate in any one of these different motion control modes depending on the specific application requirements. The attributes of the Motion Device Axis Object are therefore organized to address this broad range of functionality and the framework for this organization is described in 4.2.

IEC 61800-7-1 and this part of the IEC 61800-7 series are organised around the general philosophy that position control is the highest form of dynamic control. That is, position control implies velocity control, and velocity control implies acceleration control. Acceleration is related to torque or force by the inertia or mass of the load, respectively, acceleration control implies torque control. And finally, since motor torque or force is generally related to motor current by a torque or force constant, respectively, torque control implies current control. The torque or force constant can be a function of the motor magnets as in a Permanent Magnet motor, or the induced flux of an Induction motor.

Since acceleration, torque/force, and current are generally related by a constant, these terms are sometimes used interchangeably in the industry. For example IEC 61800-7-1 refers to a torque control loop rather than a current control loop. This specification attempts to differentiate between these control properties where applicable. This is particularly useful when the relationship between them is not static, such as when inertia/mass changes with position or time, or when the torque/force constant changes due to temperature change or motor flux variation.

4.2.2 Control methods

Within this basic control paradigm, there is latitude for different control methods, both closed loop and open loop. By closed loop, it is generally implied that there is a feedback signal that is used to drive the actual dynamics of the motor to match the commanded dynamics by servo action. In most cases, there is a literal feedback device to provide this signal, and in some cases, the signal is derived from the motor excitation (i.e. sensorless/encoderless operation). By open loop, it is implied that there is no application of feedback to force the actual dynamics to match the commanded dynamics. While precision and performance are the hallmarks of closed loop control, simplicity and economy are the hallmarks of open loop control.

4.2.3 Control nomenclature

Finally, as evident in the description above, linear and rotary control applications can affect the control nomenclature. While rotary applications speak of torque and inertia, linear applications speak of force and mass. For the purposes of this part of the IEC 61800-7 series, when referring to rotary nomenclature, the defined behavior can generally be applied to linear applications by substituting the terms, force for torque and mass for inertia. With that understanding, Figure 2 to Figure 8 follow the IEC 61800-7-1 nomenclature using torque rather than force without loss of generality.

4.2.4 Position control

4.2.4.1 General concepts

In position control application mode, either the application control program (command execution function) or the motion planner (move trajectory control function) provide a set-point value to the CIP Motion device via the cyclic data connection. The position control method can be either open loop or closed loop.

4.2.4.2 Open loop position control

A device configured for open loop position control applies to a class of drive devices called stepper drives. This type of drive is illustrated in Figure 2.

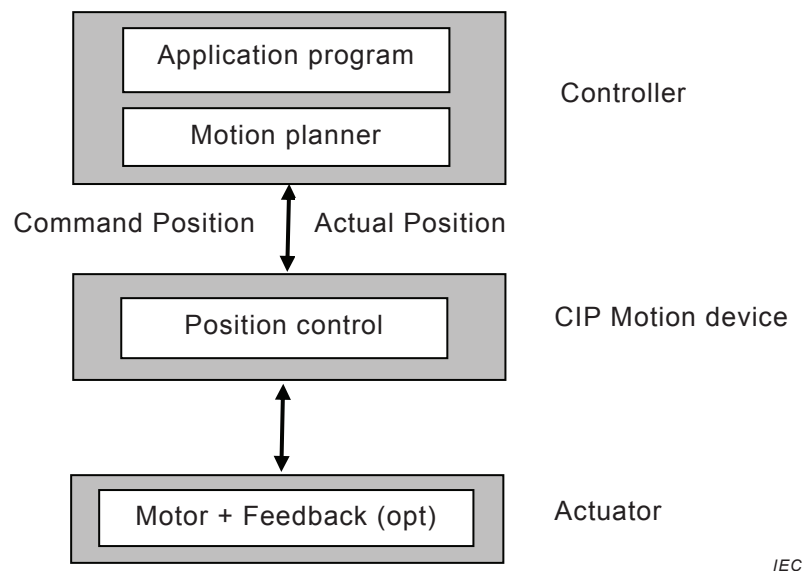


Figure 2 – Open loop position control

A feedback device for this configuration is optional. In the absence of a feedback device, actual position can be estimated by the drive and returned to the controller.

4.2.4.3 Closed loop position control

A motor control device configured for closed loop position control is traditionally referred to as position loop drive or position servo drive. A position servo drive implies an inner velocity and torque control loop as shown in Figure 3. The presence of the torque/current control loop sometimes results in this kind of drive being referred to as a vector drive.

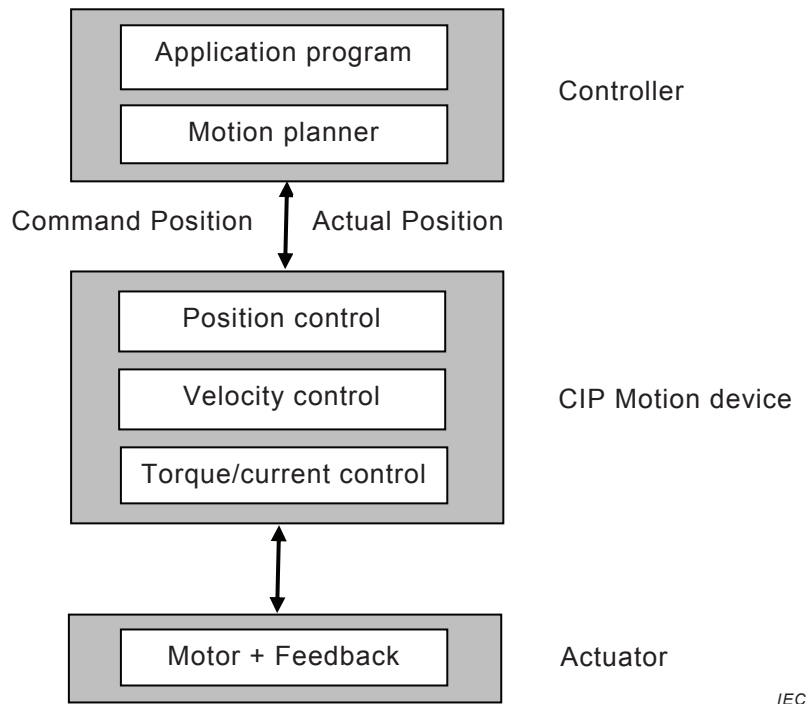


Figure 3 – Closed loop position control

A feedback device for this configuration is generally required to achieve good positioning accuracy. The feedback device may also be used to return Actual Velocity, and Actual Acceleration data to the controller via the cyclic data connection.

In addition to Command Position, the controller can pass Command Velocity and Command Acceleration for the purposes of forward control.

4.2.5 Velocity control

4.2.5.1 General concepts

In velocity control application mode, the application control program and motion planner provide a set-point value to the CIP Motion device via the cyclic data connection. The velocity control method can be either open loop or closed loop.

4.2.5.2 Open loop velocity control

A motor control device configured for open loop velocity control is traditionally referred to as variable frequency, or V/Hz, or VFD, drive. This type of drive is illustrated in Figure 4.

A feedback device for this configuration is optional. In the absence of a feedback device, actual velocity can be estimated by the drive and returned to the controller.

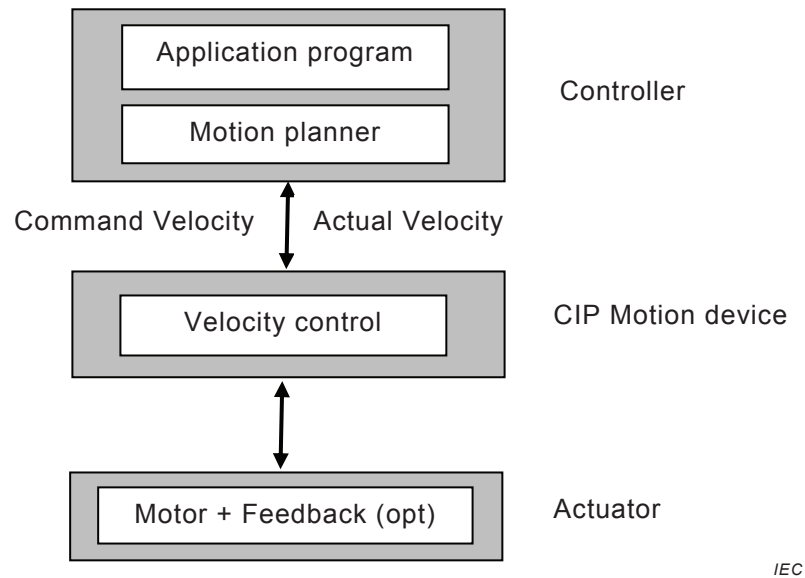


Figure 4 – Open loop velocity control

4.2.5.3 Closed loop velocity control

A motor control device configured for closed loop velocity control is traditionally referred to as velocity loop drive or velocity servo drive. A closed loop velocity control drive implies an inner torque/current control loop (see Figure 5) and therefore is sometimes referred to as a vector drive.

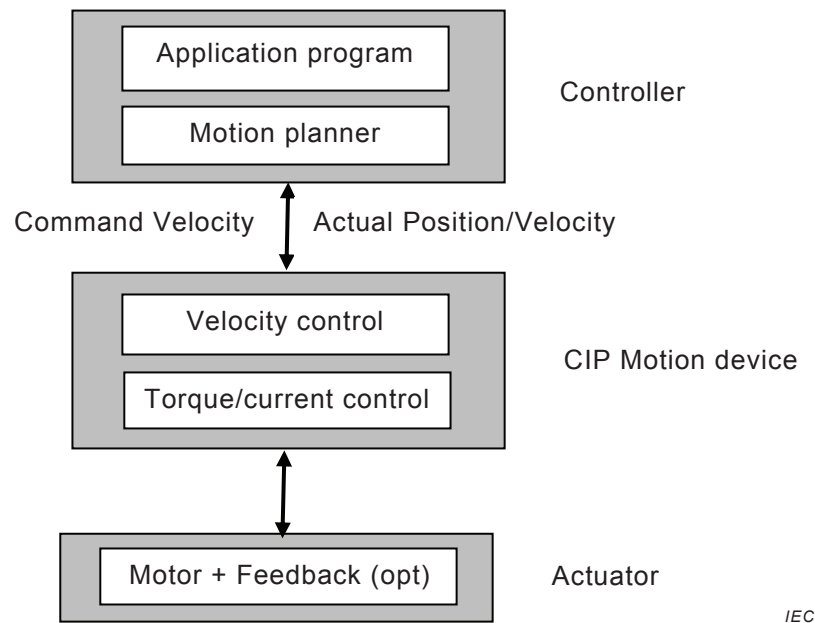


Figure 5 – Closed loop velocity control

A feedback device for the velocity loop drive configuration is optional. Tighter speed regulation is achieved when using a feedback device, particularly at low speed. When the feedback device is included, it may be used to return actual position, velocity, and acceleration data to the controller via the cyclic data connection. When the feedback device is not included, only estimated velocity can typically be returned to the controller.

In addition to Command Velocity, the controller can also pass Command Acceleration for the purposes of forward control.

4.2.6 Acceleration control

While neither a mainstream control mode in the industry, nor mentioned in IEC 61800-7-1, the acceleration control mode is included here to complete the dynamic progression from velocity control to torque control and because the Motion Device Axis Object can support an Acceleration Command, potentially derived from the controller's motion planner. In the acceleration control mode, the application control program and motion planner provide acceleration set-point values to the CIP Motion device via the cyclic data connection. The drive converts the acceleration set-point into a torque command using the estimated system inertia. Acceleration control works in concert with the inner torque/current control loop as shown in Figure 6.

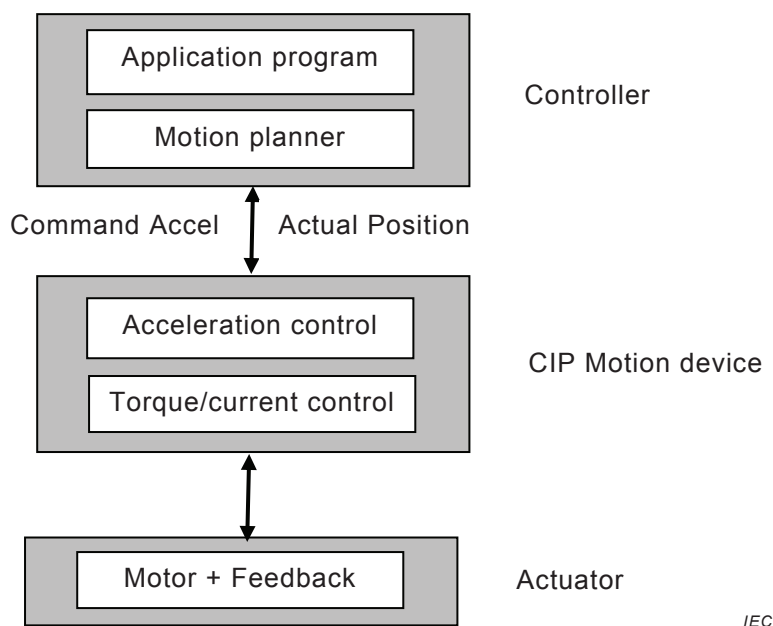


Figure 6 – Acceleration control

A feedback device for the acceleration control configuration is mandatory and may be used to return actual position, velocity, and acceleration data to the controller via the cyclic data connection.

4.2.7 Torque control

In torque control application mode, the application control program or the motion planner provide torque set-point values to the device via the cyclic data connection (see Figure 7). Because motor current and motor torque are generally related by a torque constant, K_t , torque control is often synonymous with current control.

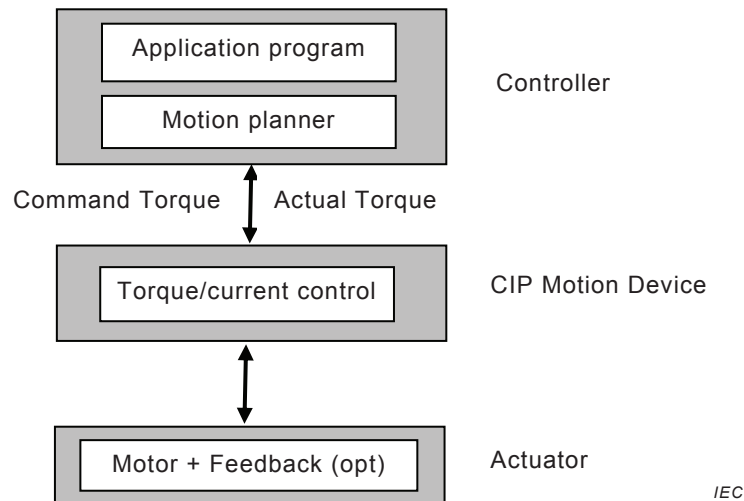


Figure 7 – Torque control

A position feedback device for this control mode is optional. If a feedback device is present, it may be used to return actual position, velocity, and acceleration data to the controller via the cyclic data connection.

4.2.8 No Control

The Motion Device Axis Object supports a “No Control” application mode where there is no dynamic motor control function. This mode is often used to support “feedback only” or “master feedback” functionality where a particular feedback channel in a CIP Motion drive device is serving as a master feedback source to the rest of the control system. This could also apply to integrated CIP Motion Encoder device types where the CIP Motion interface is applied directly to an Encoder.

In this “No Control” mode of operation, no set-point value is supplied to the CIP Motion device via the cyclic data connection, but actual position, velocity, and acceleration can be supplied by the device to the controller via the Cyclic Data Channel, if applicable. The No Control mode for Feedback Only functionality is illustrated in Figure 8.

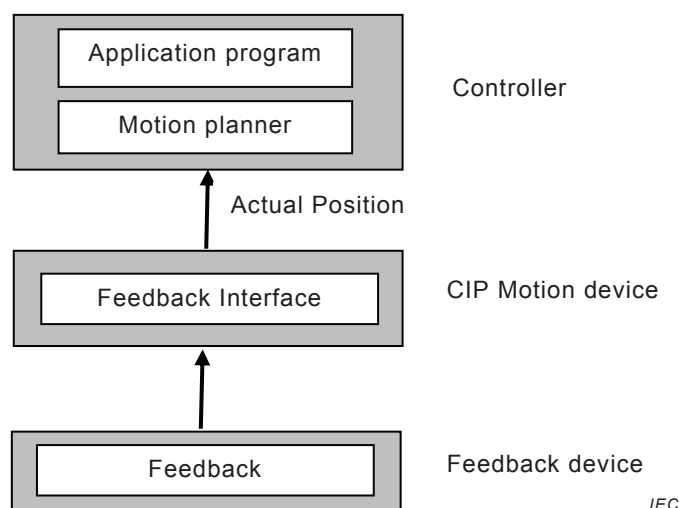


Figure 8 – No Control (Feedback Only)

No Control mode also applies to other CIP Motion device types, such as standalone Bus Power Converters and dedicated motion I/O device types. Since there is no feedback channel associated with these device types, no actual position is returned to the controller.

5 Data types

5.1 Data type overview

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

Table 1 – Data types

Data types used in CIP Motion	Reference to definition
BOOL	Boolean (see 5.3.1.1.2 of IEC 61158-5-2:2014)
SINT	Integer8 (see 5.3.1.4.2.2 of IEC 61158-5-2:2014)
INT	Integer16 (see 5.3.1.4.2.4 of IEC 61158-5-2:2014)
DINT	Integer32 (see 5.3.1.4.2.6 of IEC 61158-5-2:2014)
LINT	Integer64 (see 5.3.1.4.2.8 of IEC 61158-5-2:2014)
USINT	Unsigned8 (see 5.3.1.4.3.2 of IEC 61158-5-2:2014)
UINT	Unsigned16 (see 5.3.1.4.3.4 of IEC 61158-5-2:2014)
UDINT	Unsigned32 (see 5.3.1.4.3.6 of IEC 61158-5-2:2014)
ULINT	Unsigned64 (see 5.3.1.4.3.8 of IEC 61158-5-2:2014)
REAL	Float32 (see 5.3.1.4.1.2 of IEC 61158-5-2:2014)
LREAL	Float64 (see 5.3.1.4.1.4 of IEC 61158-5-2:2014)
SWORD/BYTE	Bitstring8 (see 5.3.1.2.2 of IEC 61158-5-2:2014)
WORD	Bitstring16 (see 5.3.1.2.4 of IEC 61158-5-2:2014)
DWORD	Bitstring32 (see 5.3.1.2.6 of IEC 61158-5-2:2014)
LWORD	Bitstring64 (see 5.3.1.2.8 of IEC 61158-5-2:2014)

5.2 Conventions

Hexadecimal numbers in this part of the IEC 61800-7 series may be represented by nn_{hex} (if their exact data type is not defined) or $0xnn$, $0xn\text{nnn}$ (if their data type is specified).

6 CIP Motion drive profile

6.1 Object model

6.1.1 Object overview

The object model in Figure 9 represents a CIP Motion device.

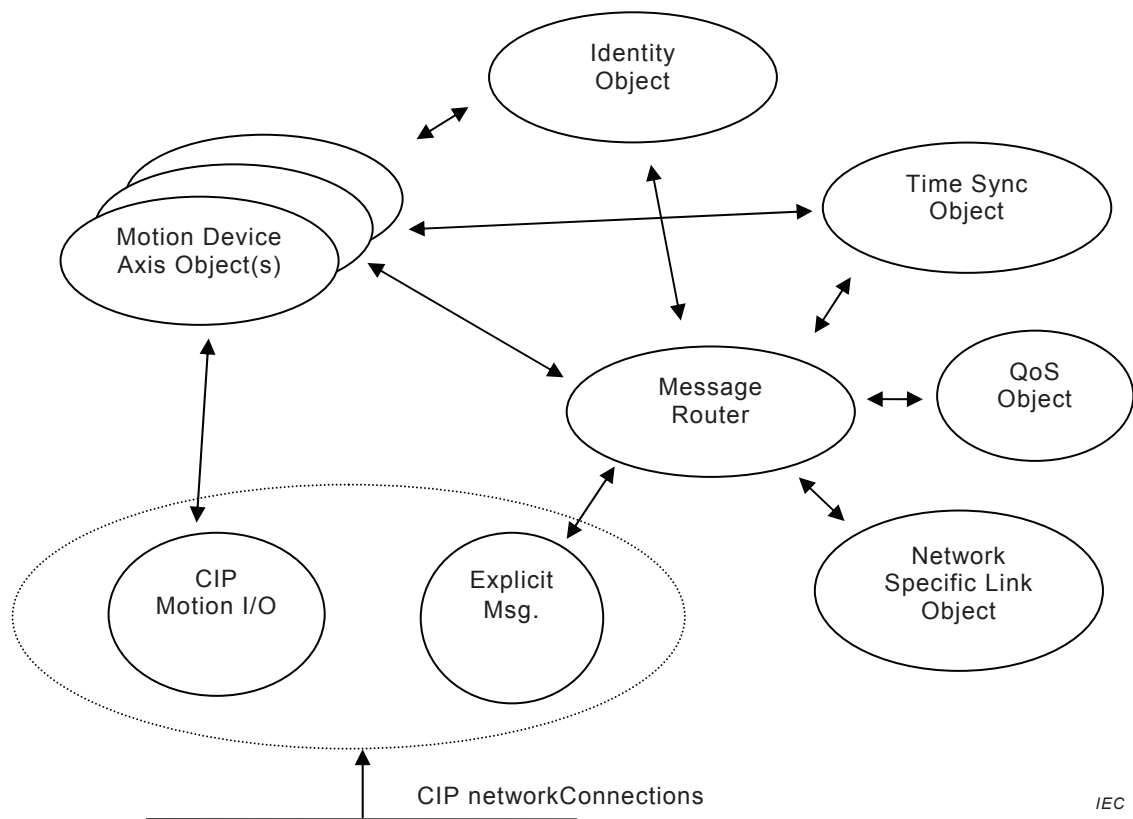


Figure 9 – Object Model for a CIP Motion device

Table 2 indicates:

- the object classes present in this device,
- whether or not the class is required,
- the number of instances present in each class.

Table 2 – Objects present in a CIP Motion device

Object class	Optional or required	Number of instances
CIP common required objects	Required	See IEC 61158-5-2 and IEC 61158-6-2
Motion Device Axis Object (0x42)	Required	1 per axis ^b
Time Sync Object (0x43)	Optional	1
QoS Object (0x48)	Conditional ^a	1
^a Required for EtherNet/IP		
^b An axis is an abstraction associated with a moving machine component, a converter power structure or a motion I/O device.		

Refer to IEC 61158-5-2, IEC 61158-6-2 and 6.4.6.1 for more details about these objects.

6.1.2 Object description

The object model in Figure 9 shows the main functional components of the CIP Motion device profile.

This object model also illustrates the use of multiple instances of a Motion Device Axis Object to implement a multi-axis motion device, such as a multi-axis drive. Each Motion Device Axis Object instance governs the behavior of the associated axis. In this device profile, the term “axis” is synonymous with a “Motion Device Axis Object instance”. The implemented content of the Motion Device Axis Object instances is dictated by the specific CIP Motion Device Type according to Table 3.

Table 3 – Motion Device Axis Object content by Device Type

Device type	Motion Device Axis Object content
CIP Motion Drive	Support for one or more of F, P, V, T Device Function Codes
CIP Motion Encoder	Support for E, but no support for F, P, V, T Device Function Codes
CIP Motion Converter	Support for B Device Function Code only
CIP Motion I/O	Support for I/O Device Function Code only

A single bi-directional I/O connection to the Motion Device Axis Object class instance provides a cyclic data path between the controller and each individual Motion Device Axis Object instance. This connection passes on a special data structure whose self-defining format can be used to transfer cyclic, event, and service related data.

An optional Time Sync Object is included in the object model to facilitate accurate time synchronization between CIP Motion controllers and drive devices for high performance motion control. For lower performance drives such as V/Hz (VFD) drives, or simple velocity servo drives, the Time Sync Object is not necessary for drive operation.

A CIP Motion I/O Connection is a standard, cyclic, bidirectional CIP I/O connection whose packets can vary in size, based on the formats outlined in 6.4.2.2.

6.2 How objects affect behavior

The objects for this device affect the device's behavior as shown in Table 4.

Table 4 – Object effect on behavior

Object class	Effect on behavior
CIP common required objects	See IEC 61158-5-2 and IEC 61158-6-2
Motion Device Axis Object	Provides dynamic control interface to drive, motor, and feedback components that comprise an axis.
Time Sync Object	Provide absolute time synchronization services between devices on the control network.
QoS Object	Provides configuration information associated with Ethernet QoS (Quality of Service) function.

6.3 Defining object interfaces

Objects supported for the CIP Motion device have the interfaces listed in Table 5.

Table 5 – Object interfaces

Object	Interface
CIP common required objects	See IEC 61158-5-2 and IEC 61158-6-2
Motion Device Axis Object	Message Router, CIP Motion I/O Connection, Time Sync Object, Identity Object
Time Sync Object	Message Router
QoS Object	Message Router

6.4 I/O connection messages

6.4.1 General

The CIP Motion device profile supports a Transport Class 1 point-to-point bi-directional I/O connection between the controller and the Motion Device Axis Object class: this I/O connection is specifically referred to as the CIP Motion I/O Connection.

The Motion Device Axis Object distributes the data in this connection to each instantiated Motion Device Axis Object instance.

6.4.2 CIP Motion I/O Connection

6.4.2.1 Overview

The following subclause specifies the CIP Motion I/O Connection format that includes the Controller-to-Device (C-to-D) Connection and the Device-to-Controller (D-to-C) Connection for bi-directional data transfer between a CIP Motion controller and a CIP Motion device, as shown in Figure 10.

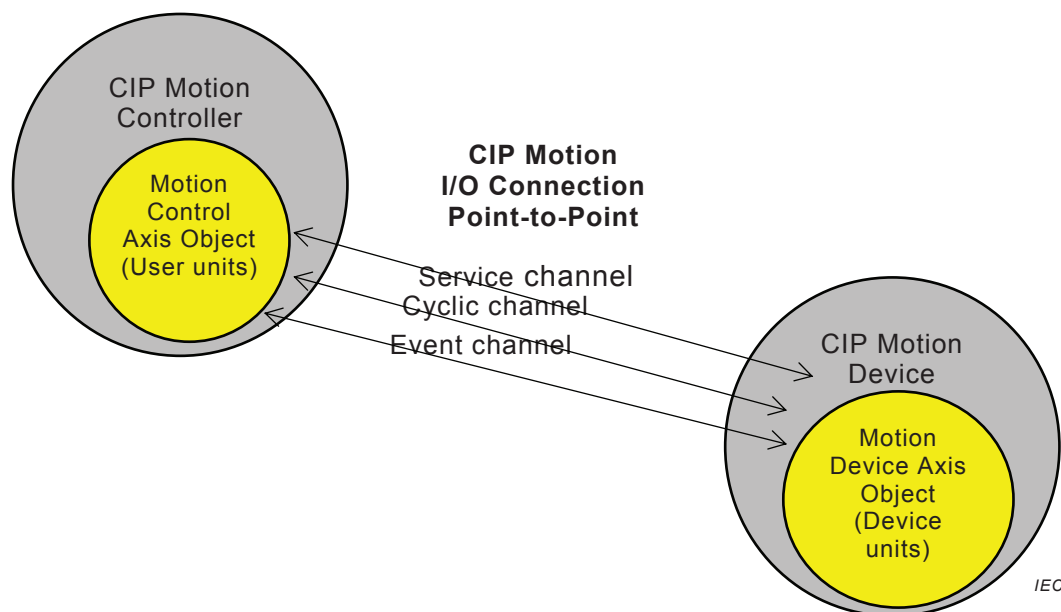


Figure 10 – CIP Motion I/O Connection model

6.4.2.2 CIP Motion I/O Connection structure

Both CIP Motion I/O Connection data structures (Controller-to-Device and Device-to-Controller) begin with a Connection Header followed by a Time Data Block that typically includes a 64-bit time stamp. The Time Data Block is then followed by one or more Instance Data Blocks for each axis supported by the device node.

The size and contents of the Time Data Block and Instance Data Blocks vary dynamically as determined by the associated headers. This ability to vary the contents of the data blocks from update to update allows the device and controller to only send data that has changed from the last update, dramatically reducing the overall size of the typical CIP Motion Connection packet.

Each Instance Data Block within the CIP Motion I/O Connection packet consists of three sets of data blocks associated with the cyclic, event, and service data channels. From the device's perspective, these three distinct data channels have different data processing priorities as illustrated in Figure 11.

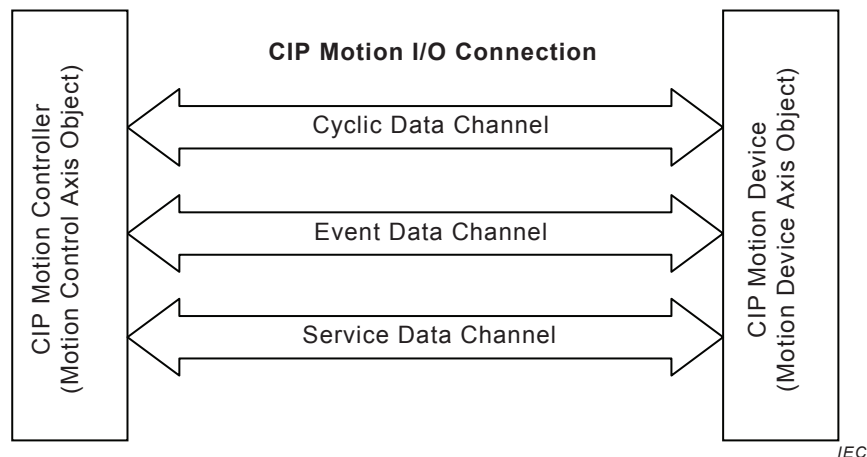


Figure 11 – CIP Motion I/O Connection channels

The specific functionality of these three data channels is as follows.

- **Cyclic Data Channel:** carries Cyclic Data Blocks that are sampled or calculated every Controller Update Period and synchronized with other nodes in the motion control system through use of distributed System Time. Cyclic data is high priority data that shall be immediately processed and applied to the device axis within one Device Update Period.
- **Event Data Channel:** carries event data associated with device event(s) (e.g. registration, homing, etc.) that have occurred within the last Controller Update Period. Event data is medium priority and shall be processed and applied within one Controller Update Period.
- **Service Data Channel:** carries data associated with service requests to read or write attribute values of the Motion Device Axis Object as part of on-line configuration and diagnostic functionality, as well as service requests to affect Motion Device Axis Object behavior as part of controller instruction execution. Service data has lowest priority and is typically buffered and processed as a background task. There is no guarantee that a service request will be processed within Controller Update Period.

Taken together, these three data channels provide a comprehensive controller to device data connection solution for industrial motion control.

6.4.2.3 I/O connection formats

An overview of the CIP Motion I/O Connection format is shown in Figure 12 and Figure 13.

Not shown in these format figures is the encapsulation associated with the Class 1 Transport that includes a Sequence Count. For a detailed description of the Class 1 Transport header refer to IEC 61158-5-2 and IEC 61158-6-2. Multi-octet data in the CIP I/O Connection data structure follows standard little-endian octet-addressing rule. In the figures, octet ordering reads left to right. The gray banners in the figures are section labels and are not part of the actual connection data structure. Unless otherwise stated, data structure elements defined as “reserved” or marked with a hyphen, “-”, shall be set to zero (0).

← 32-bit Word (octet 1 octet 2 octet 3 octet 4) →			
Controller-to-Device Connection format			
Connection Header			
Time Data Block			
Instance Data Blocks			
Connection Header and Time Data Block			
Connection Format	Format Revision	Update ID	Node Control
Instance Count	–	Last Received ID	Time Data Set
Controller Time Stamp			
Controller Time Offset			
Instance Data Block			
Instance Data Header			
Cyclic Data Block			
Cyclic Write Data Block			
Event Data Block			
Service Data Block			
Instance Data Header			
Instance Num	–	Instance Blk Size	Cyclic Blk Size
Cyc. Cmd Blk Size	Cyc. Write Blk Size	Event Blk Size	Service Blk Size
Cyclic Data Block			
Control Mode	Feedback Mode	Axis Control	Control Status
Command Data Set	Actual Data Set	Status Data Set	Command Control
Cyclic Data			
Cyclic Write Data Block			
Cyclic Write Blk ID	–	Cyclic Read Blk ID	–
Cyclic Write Data			
Event Data Block			
Event Checking Control			
Reg Data Set	Home Data Set	Watch Data Set	–
Registration Event Data			
Home Event Data			
Watch Event Data			
Event Ack. ID1	Event Ack. Status 1	Event Ack. ID2	Event Ack. Status 2
...			
Service Data Block			
Transaction ID	Service Code	–	–
Service Specific Request Data			

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Figure 12 – Controller-to-Device Connection format (Connection Point 2)

← 32-bit Word (octet 1 octet 2 octet 3 octet 4) →			
Device-to-Controller Connection format			
Connection Header			
Time Data Block			
Instance Data Blocks			
Connection Header and Time Data Block			
Connection Format	Format Revision	Update ID	Node Status
Instance Count	Node Fault/Alarm	Last Received ID	Time Data Set
Device Time Stamp			
Device Time Offset			
Lost Updates	Late Updates	–	
Timing Diagnostic Data			
Instance Data Block			
Instance Data Header			
Cyclic Data Block			
Cyclic Read Data Block			
Event Data Block			
Service Data Block			
Instance Data Header			
Instance Num	–	Instance Blk Size	Cyclic Blk Size
Cyc. Act. Blk Size	Cyc. Read Blk Size	Event Blk Size	Service Blk Size
Cyclic Data Block			
Control Mode	Feedback Mode	Axis Response	Response Status
–	Actual Data Set	Status Data Set	Axis State
Cyclic Data			
Cyclic Read Data Block			
Cyclic Write Blk ID	Cyclic Write Status	Cyclic Read Blk ID	Cyclic Read Status
Cyclic Read Data			
Event Data Block			
Event Checking Status			
Reg Data Ack	Home Data Ack	Watch Data Ack	–
Event ID	Event Status	Event Type	–
Event Position			
Event Time Stamp			
...			
Service Data Block			
Transaction ID	Service Code	General Status	Extended Status
Service Specific Response Data			

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Figure 13 – Device-to-Controller Connection format (Connection Point 2)