

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Industrial communication networks – Profiles –
Part 3-13: Functional safety fieldbuses – Additional specifications for CPF 13**

**Réseaux de communication industriels – Profils –
Partie 3-13: Bus de terrain de sécurité fonctionnelle – Spécifications
supplémentaires pour CPF 13**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2021 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC online collection - oc.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC online collection - oc.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Industrial communication networks – Profiles –
Part 3-13: Functional safety fieldbuses – Additional specifications for CPF 13**

**Réseaux de communication industriels – Profils –
Partie 3-13: Bus de terrain de sécurité fonctionnelle – Spécifications
supplémentaires pour CPF 13**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 25.040.40; 35.100.05

ISBN 978-2-8322-9759-9

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD	14
0 Introduction	16
0.1 General.....	16
0.2 Patent declaration.....	18
1 Scope.....	19
2 Normative references	19
3 Terms, definitions, symbols, abbreviated terms and conventions	20
3.1 Terms and definitions.....	20
3.1.1 Common terms and definitions.....	20
3.1.2 CPF 13: Additional terms and definitions	25
3.2 Symbols and abbreviated terms	27
3.2.1 Common symbols and abbreviated terms.....	27
3.2.2 CPF 13: Additional symbols and abbreviated terms	27
3.3 Conventions.....	28
3.3.1 Hexadecimal values.....	28
3.3.2 Binary values.....	28
3.3.3 Wildcard digits.....	28
3.3.4 Diagrams	29
4 Overview of FSCP 13/1 (openSAFETY™).....	29
4.1 Functional Safety Communication Profile 13/1	29
4.2 Technical overview	29
5 General	30
5.1 External documents providing specifications for the profile	30
5.2 Safety functional requirements.....	30
5.3 Safety measures	31
5.4 Safety communication layer structure.....	32
5.5 Relationships with FAL (and DLL, PhL)	34
5.5.1 General	34
5.5.2 Data types	34
6 Safety communication layer services	34
6.1 Modelling	34
6.1.1 Reference model	34
6.1.2 Communication model	35
6.1.3 Device roles and topology.....	36
6.2 Life cycle model.....	40
6.2.1 General	40
6.2.2 Concept, planning and implementation	40
6.2.3 Commissioning	41
6.2.4 Operation terms.....	43
6.2.5 Maintenance terms	44
6.3 Non safety communication layer	44
6.3.1 General	44
6.3.2 Requirements for data transport	44
6.3.3 Domain protection and separation	48
7 Safety communication layer protocol	48

7.1	Safety PDU format	48
7.1.1	Structure of Safety PDUs	48
7.1.2	Address field (ADR)	53
7.1.3	PDU identification field (ID)	53
7.1.4	Length field (LE)	55
7.1.5	Consecutive Time field (CT)	55
7.1.6	Payload data field (DB0 to DBn)	55
7.1.7	Cyclic Redundancy Check field (CRC-8 / CRC-16).....	55
7.1.8	Time Request Address field (TADR)	56
7.1.9	Time Request Distinctive Number field (TR)	56
7.1.10	UDID of SCM coding (UDID of SCM)	56
7.2	Safety Process Data Object (SPDO)	57
7.2.1	General	57
7.2.2	SPDO telegram types	57
7.2.3	Data Only telegram.....	57
7.2.4	Data with Time Request telegram	58
7.2.5	Data with Time Response telegram	59
7.3	Safety Service Data Object (SSDO)	60
7.3.1	General	60
7.3.2	SSDO telegram types	60
7.3.3	SSDO services and protocols	61
7.3.4	SSDO Download Initiate	62
7.3.5	SSDO Download Segment	64
7.3.6	SSDO Download Initiate with Preload	64
7.3.7	SSDO Download Segment with Preload.....	66
7.3.8	SSDO Upload Initiate.....	67
7.3.9	SSDO Upload Segment	68
7.3.10	SSDO Upload Initiate with Preload	69
7.3.11	SSDO Upload Segment with Preload	70
7.3.12	SSDO Abort.....	71
7.3.13	SSDO Preload	73
7.4	Safety Network Management (SNMT)	74
7.4.1	General	74
7.4.2	SNMT telegram types	74
7.4.3	SNMT services and protocols	75
7.5	Safety Object dictionary (SOD)	89
7.5.1	General	89
7.5.2	Object dictionary entry definition.....	89
7.5.3	Data type entry specification.....	94
7.5.4	Object description.....	96
7.6	Safety related PDO mapping.....	141
7.6.1	General	141
7.6.2	Transmit SPDOs.....	142
7.6.3	Receive SPDOs.....	142
7.6.4	SPDO mapping parameter	142
7.6.5	SPDO mapping example.....	143
7.6.6	SDPO Feature Set.....	145
7.6.7	SPDO error handling	146
7.7	State and sequence diagrams	146

7.7.1	Safety Process Data Object (SPDO)	146
7.7.2	Time synchronization and validation	150
7.7.3	Safety Service Data Object (SSDO)	160
7.7.4	SOD access	162
7.7.5	Safety Network Management Object (SNMT)	171
7.7.6	SN power up	173
7.7.7	SN power down	180
7.7.8	SN recovery after Restart / Error	180
7.7.9	SCM power up	180
7.7.10	Address verification	183
7.7.11	Commissioning mode	185
7.7.12	Handle single UDID mismatch	185
7.7.13	Activate SN	189
7.7.14	Device exchange	190
8	Safety communication layer management	190
8.1	General	190
8.2	Configuration of a Safety Domain	191
8.3	Parameter check mechanism	191
9	System requirements	191
9.1	Indicators and switches	191
9.2	Installation guidelines	192
9.3	Safety function response time	192
9.4	Duration of demands	193
9.5	Constraints for calculation of system characteristics	193
9.5.1	General	193
9.5.2	Number of sinks limit	193
9.5.3	Message rate limit	193
9.5.4	Message payload limit	193
9.5.5	Bit error rate considerations	194
9.5.6	Residual error rate	194
9.6	Maintenance	195
9.6.1	Diagnostic information	195
9.6.2	Replacement of safety related devices	195
9.6.3	Modification	196
9.6.4	Machine part changing	196
9.6.5	Firmware update of safety related nodes	196
9.6.6	Machine check due to service interval	196
9.7	Safety manual	196
10	Assessment	196
10.1	General	196
10.2	CP 13/1 assessment	197
10.3	FSCP 13/1 conformance test	197
10.4	Approval of functional safety by competent assessment body	197
Annex A (informative) Additional information for functional safety communication profiles of CPF 13		198
A.1	Hash function calculation	198
A.2	Void	201
Annex B (informative) Information for assessment of the functional safety communication profiles of CPF 13		202

Bibliography.....	203
Figure 1 – Relationships of IEC 61784-3 with other standards (machinery)	16
Figure 2 – Relationships of IEC 61784-3 with other standards (process).....	17
Figure 3 – Producer consumer example.....	30
Figure 4 – Client server example	30
Figure 5 – Communication layer structure.....	33
Figure 6 – Safety communication channel.....	34
Figure 7 – Characteristic producer / consumer communication.....	35
Figure 8 – Extended producer / consumer communication	36
Figure 9 – Client Server communication.....	36
Figure 10 – Topology overview	37
Figure 11 – Safety Domain protection (example).....	38
Figure 12 – Safety Domain separation (example).....	39
Figure 13 – Data flow example.....	43
Figure 14 – Communication model.....	45
Figure 15 – SPDO transport.....	46
Figure 16 – SSDO transport.....	47
Figure 17 – Diagnostic data representation.....	48
Figure 18 – Safety PDUs inside a CP 13/1 PDU.....	49
Figure 19 – Basic Safety PDU for $n = 0 - 8$ octet payload data	49
Figure 20 – Basic Safety PDU from 9 octet payload data	49
Figure 21 – Slim Safety PDU for $n = 0 - 8$ octet payload data	50
Figure 22 – Slim Safety PDU from 9 octet payload data	51
Figure 23 – Safety PDU with 40 bit counter for $n = 0 - 8$ octet payload data	52
Figure 24 – Safety PDU with 40 bit counter from 9 octet payload data	52
Figure 25 – SPDO_Data_Only telegram.....	58
Figure 26 – SPDO_Data_with_Time_Request telegram	58
Figure 27 – SPDO_Data_with_Time_Response telegram.....	59
Figure 28 – SSDO download protocols.....	62
Figure 29 – SSDO upload protocols	62
Figure 30 – SSDO Download Initiate protocol	63
Figure 31 – SSDO Download Segment protocol	64
Figure 32 – SSDO Download Initiate protocol with Preload	65
Figure 33 – SSDO Download Segment protocol with Preload	66
Figure 34 – SSDO Upload Initiate protocol.....	67
Figure 35 – SSDO Upload Segment protocol	68
Figure 36 – SSDO Upload Initiate protocol with Preload	69
Figure 37 – SSDO Upload Segment protocol with Preload	71
Figure 38 – SSDO Abort protocol.....	72
Figure 39 – UDID Request / Response protocol.....	75
Figure 40 – SADR Assignment protocol	76
Figure 41 – Reset Node Guarding Time protocol.....	77

Figure 42 – SN set to Pre-Operational protocol.....	79
Figure 43 – SN set to Operational protocol	80
Figure 44 – SN Acknowledge protocol.....	82
Figure 45 – SN set to stop protocol.....	83
Figure 46 – SCM set to Operational protocol.....	83
Figure 47 – Node Guarding protocol	84
Figure 48 – Additional SADR Assignment protocol.....	85
Figure 49 – UDID of SCM Assignment protocol.....	87
Figure 50 – Init CT value assignment protocol	88
Figure 51 – SPDO mapping example	143
Figure 52 – State diagram TxSPDO	146
Figure 53 – SPDO communication producer.....	147
Figure 54 – State diagram RxSPDO.....	148
Figure 55 – SPDO communication consumer	148
Figure 56 – State diagram process data.....	149
Figure 57 – Time synchronization and validation.....	150
Figure 58 – Time synchronization detail.....	151
Figure 59 – Calculation of propagation delay	153
Figure 60 – Time validation, propagation delay explanation limits	153
Figure 61 – Time synchronization on a nonsafe network	155
Figure 62 – Explanation of time synchronization	155
Figure 63 – Time synchronization failure.....	156
Figure 64 – State diagram time synchronization producer	157
Figure 65 – State diagram time synchronization consumer.....	158
Figure 66 – State diagram SSDO client.....	160
Figure 67 – State diagram SSDO server	161
Figure 68 – Expedited SOD access.....	162
Figure 69 – State diagram segmented SOD download access client	163
Figure 70 – Segmented SOD download access.....	164
Figure 71 – State diagram segmented SOD download access server	165
Figure 72 – State diagram SOD preload download access client.....	167
Figure 73 – SOD preload download access.....	168
Figure 74 – State diagram SOD preload download access server	170
Figure 75 – State diagram SNMT master	172
Figure 76 – State diagram SNMT slave.....	173
Figure 77 – State diagram SN power up.....	174
Figure 78 – State diagram SN Pre-Operational	176
Figure 79 – State diagram SN additional paramters	178
Figure 80 – State diagram SN Operational.....	179
Figure 81 – Life Guarding telegram.....	180
Figure 82 – State diagram SCM power up.....	181
Figure 83 – State diagram SCM Operational	182
Figure 84 – State diagram SCM address verification.....	184

Figure 85 – State diagram SCM handle single UDID mismatch	186
Figure 86 – State diagram SCM verify parameters	188
Figure 87 – State diagram activate SN	190
Figure 88 – Safety function response time	192
Figure 89 – Assessment flow of devices	197
Table 1 – Communication errors and detection measures (cyclic)	31
Table 2 – Communication errors and detection measures (acyclic)	32
Table 3 – Device roles	37
Table 4 – Basic Safety PDU format	50
Table 5 – Slim Safety PDU format	51
Table 6 – Safety PDU with 40 bit counter	53
Table 7 – PDU identification field (ID)	54
Table 8 – Used ID field combinations	54
Table 9 – Request / response identification	54
Table 10 – Type of CRC depending on LE	55
Table 11 – CRC polynoms for SPDUs	56
Table 12 – SPDO telegram types (ID field, bits 2, 3 and 4)	57
Table 13 – Fields of SPDO_Data_Only telegram	58
Table 14 – Fields of SPDO_Data_with_Time_Request telegram	59
Table 15 – Fields of SPDO_Data_with_Time_Response telegram	59
Table 16 – SSDO telegram types (ID field, bits 2, 3 and 4)	60
Table 17 – SOD Access Command (SACmd) – bit coding	61
Table 18 – Fields of Download Initiate SSDO_Service_Request telegram	63
Table 19 – Fields of Download Initiate SSDO_Service_Response telegram	63
Table 20 – Fields of Download Segment SSDO_Service_Request telegram	64
Table 21 – Fields of Download Segment SSDO_Service_Response telegram	64
Table 22 – Fields of Download Initiate SSDO_Service_Request telegram with Preload	65
Table 23 – Fields of Download Initiate SSDO_Service_Response telegram with Preload	65
Table 24 – Fields of Download Segment SSDO_Service_Request telegram with Preload	66
Table 25 – Fields of Download Segment SSDO_Service_Response telegram with Preload	67
Table 26 – Fields of Upload Initiate SSDO_Service_Request telegram	67
Table 27 – Fields of Upload Initiate SSDO_Service_Response telegram	68
Table 28 – Fields of Upload Segment SSDO_Service_Request telegram	69
Table 29 – Fields of Upload Segment SSDO_Service_Response telegram	69
Table 30 – Fields of Upload Initiate SSDO_Service_Request telegram with Preload	70
Table 31 – Fields of Upload Initiate SSDO_Service_Response telegram with Preload	70
Table 32 – Fields of Upload Segment SSDO_Service_Request telegram with Preload	71
Table 33 – Fields of Upload Segment SSDO_Service_Response telegram with Preload	71
Table 34 – Fields of SSDO Abort telegram	72
Table 35 – SSDO Abort codes	72
Table 36 – TR field usage for SSDO Preload	73
Table 37 – Bit fields inside TR field for SSDO Preload	74

Table 38 – SNMT telegram types (ID field, bits 2, 3 and 4)	74
Table 39 – Fields of SNMT_Request_UDID telegram	75
Table 40 – Fields of SNMT_Response_UDID telegram	76
Table 41 – Fields of SNMT_Assign_SADR telegram	77
Table 42 – Fields of SNMT_SADR_Assigned telegram.....	77
Table 43 – Fields of SNMT_SN_reset_guarding_SCM telegram	78
Table 44 – SNMT request telegram types	78
Table 45 – SNMT response telegram types.....	78
Table 46 – Fields of SNMT_SN_set_to_PRE_OP telegram	79
Table 47 – Fields of SNMT_SN_status_PRE_OP telegram	79
Table 48 – Fields of SNMT_SN_set_to_OP telegram	80
Table 49 – Fields of SNMT_SN_status_OP telegram	80
Table 50 – Fields of SNMT_SN_busy telegram	81
Table 51 – Fields of SNMT_SN_FAIL telegram	81
Table 52 – SNMT_SN_FAIL Error Group values.....	81
Table 53 – SNMT_SN_FAIL Error Code values	81
Table 54 – SNMT_SN_FAIL Error Code values in case of Error Group Code 5	82
Table 55 – Fields of SNMT_SN_ACK telegram	82
Table 56 – Fields of SNMT_SCM_set_to_STOP telegram	83
Table 57 – Fields of SNMT_SCM_set_to_OP telegram	84
Table 58 – Fields of SNMT_SCM_guard_SN telegram	84
Table 59 – Fields of SNMT_SN_status_OP/SNMT_SN_status_OP telegrams	85
Table 60 – Fields of SNMT_assign_additional_SADR telegram.....	86
Table 61 – Fields of SNMT_assigned_additional_SADR telegram	86
Table 62 – Fields of SNMT_assign_UDID_of_SCM telegram.....	87
Table 63 – Fields of SNMT_assigned_UDID_of_SCM telegram.....	87
Table 64 – Fields of SNMT_assign_Init_CT telegram.....	88
Table 65 – Fields of SNMT_assigned_Init_CT telegram	88
Table 66 – Object type definition.....	89
Table 67 – Access attributes for data objects.....	91
Table 68 – SPDO mapping attributes for data objects	91
Table 69 – Basic data type object definition example	91
Table 70 – Compound data type object definition example.....	92
Table 71 – Sub index interpretation	92
Table 72 – NumberOfEntries sub index specification	93
Table 73 – RECORD type object sub index specification.....	93
Table 74 – ARRAY type object sub index specification.....	94
Table 75 – StructureOfObject encoding	94
Table 76 – Object dictionary data types	95
Table 77 – 0021h Compound data type description example.....	96
Table 78 – 0021h Compound sub index descriptions example	96
Table 79 – Standard objects	97
Table 80 – Common communication objects	97

Table 81 – Receive SPDO communication objects	97
Table 82 – Receive SPDO mapping objects	98
Table 83 – Transmit SPDO communication objects	98
Table 84 – User parameter (writeable at any time)	98
Table 85 – Transmit SPDO mapping objects	98
Table 86 – SADR DVI list	99
Table 87 – Additional SADR list	99
Table 88 – SADR UDID list	99
Table 89 – Additional parameter list	99
Table 90 – Object 1001h Error Register	100
Table 91 – Object 1001h Error Register value interpretation	100
Table 92 – Object 1002h Manufacturer status register	100
Table 93 – Object 1003h Pre defined error field	101
Table 94 – Object 1003h sub index 00h	101
Table 95 – Object 1003h sub index 01h	101
Table 96 – Object 1003h sub index 02h to FEh	102
Table 97 – Object 1003h Error statistics	102
Table 98 – Object 1004h sub index 00h	102
Table 99 – Object 1004h sub index 01h	103
Table 100 – Object 1004h sub index 02h	103
Table 101 – Object 1004h sub index 03h	103
Table 102 – Object 1004h sub index 04h	104
Table 103 – Object 1004h sub index 05h	104
Table 104 – Object 1004h sub index 06h	104
Table 105 – Object 1004h sub index 07h	105
Table 106 – Object 1004h sub index 08h	105
Table 107 – Object 1004h sub index 09h	105
Table 108 – Object 1004h sub index 0Ah	106
Table 109 – Object 1004h sub index 0Bh	106
Table 110 – Object 1004h sub index 0Ch	106
Table 111 – Object 1004h sub index 0Dh	107
Table 112 – Object 1004h sub index 0Eh	107
Table 113 – Object 100Ch Life Guarding	107
Table 114 – Object 100Ch sub index 00h	108
Table 115 – Object 100Ch sub index 01h	108
Table 116 – Object 100Ch sub index 02h	108
Table 117 – Object 100Dh Refresh Interval of Reset Guarding	109
Table 118 – Object 100Eh Number of Retries for Reset Guarding	109
Table 119 – Object 1018h Device Vendor Information	110
Table 120 – Object 1018h sub index 00h	110
Table 121 – Object 1018h sub index 01h	110
Table 122 – Object 1018h sub index 02h	111
Table 123 – Object 1018h sub index 03h	111

Table 124 – Object 1018h sub index 04h	111
Table 125 – Object 1018h sub index 05h	112
Table 126 – Object 1018h sub index 06h	112
Table 127 – Object 1018h sub index 07h	112
Table 128 – Object 1018h sub index 08h	113
Table 129 – Object 1018h sub index 09h	113
Table 130 – Structure of Revision Number	113
Table 131 – Structure of parameter checksum domain	114
Table 132 – CRC polynom for parameter checksum	114
Table 133 – Structure of Stack Version	114
Table 134 – Object 1019h Unique Device ID	115
Table 135 – Object 101Ah Parameter Download	115
Table 136 – Format of Parameter Download	116
Table 137 – Format of additional parameter header	116
Table 138 – Object 101Bh SCM Parameters	116
Table 139 – Object 101Bh sub index 00h	117
Table 140 – Object 101Bh sub index 01h	117
Table 141 – Object 1200h Common Communication Parameter	117
Table 142 – Object 1200h sub index 00h	118
Table 143 – Object 1200h sub index 01h	118
Table 144 – Object 1200h sub index 02h	118
Table 145 – Object 1200h sub index 03h	119
Table 146 – Object 1200h sub index 04h	119
Table 147 – Object 1201h SSDO Communication Parameter	120
Table 148 – Object 1201h sub index 00h	120
Table 149 – Object 1201h sub index 01h	120
Table 150 – Object 1201h sub index 02h	121
Table 151 – Object 1202h SNMT Communication Parameter	121
Table 152 – Object 1202h sub index 00h	121
Table 153 – Object 1202h sub index 01h	122
Table 154 – Object 1202h sub index 02h	122
Table 155 – Object 1400h – 17FEh RxSPDO Communication Parameter	122
Table 156 – Object 1400h – 17FEh sub index 00h	123
Table 157 – Object 1400h – 17FEh sub index 01h	123
Table 158 – Object 1400h – 17FEh sub index 02h	123
Table 159 – Object 1400h – 17FEh sub index 03h	124
Table 160 – Object 1400h – 17FEh sub index 04h	124
Table 161 – Object 1400h – 17FEh sub index 05h	124
Table 162 – Object 1400h – 17FEh sub index 06h	125
Table 163 – Object 1400h – 17FEh sub index 07h	125
Table 164 – Object 1400h – 17FEh sub index 08h	125
Table 165 – Object 1400h – 17FEh sub index 09h	126
Table 166 – Object 1400h – 17FEh sub index 0Ah	126

Table 167 – Object 1400h – 17FEh sub index 0Bh.....	126
Table 168 – Object 1400h – 17FEh sub index 0Ch.....	127
Table 169 – Object 1800h – 1BFEh RxSPDO communication parameter.....	127
Table 170 – Object 1800h – 1BFEh sub index 00h.....	127
Table 171 – Object 1800h – 1BFEh sub index 01h.....	128
Table 172 – Object 1800h – 1BFEh sub index 02h – FEh.....	128
Table 173 – Object C00h – 1FFEh TxSPDO communication parameter.....	128
Table 174 – Object 1C00h – 1FFEh sub index 00h	129
Table 175 – Object 1C00h – 1FFEh sub index 01h	129
Table 176 – Object 1C00h – 1FFEh sub index 02h	129
Table 177 – Object 1C00h – 1FFEh sub index 03h	130
Table 178 – Object C000h – C3FEh TxSPDO mapping parameter	130
Table 179 – Object C000h – C3FEh sub index 00h	130
Table 180 – Object C000h – C3FEh sub index 01h	131
Table 181 – Object C000h – C3FEh sub index 02h – FEh.....	131
Table 182 – Object C400h – C7FEh SADR-DVI list.....	131
Table 183 – Object C400h – C7FEh sub index 00h	132
Table 184 – Object C400h – C7FEh sub index 01h	132
Table 185 – Object C400h – C7FEh sub index 02h	132
Table 186 – Object C400h – C7FEh sub index 03h	133
Table 187 – Object C400h – C7FEh sub index 04h	133
Table 188 – Object C400h – C4FEh sub index 05h	133
Table 189 – Object C400h – C7FEh sub index 06h	134
Table 190 – Object C400h – C7FEh sub index 07h	134
Table 191 – Object C400h – C7FEh sub index 08h	134
Table 192 – Object C400h – C7FEh sub index 09h	135
Table 193 – Object C400h – C7FEh sub index 0Ah.....	135
Table 194 – Object C400h – C7FEh sub index 0Bh.....	135
Table 195 – Object C400h – C7FEh sub index 0Ch.....	136
Table 196 – Bit field of optional features	136
Table 197 – Object C400h – C7FEh sub index 0Dh.....	136
Table 198 – Object C400h – C7FEh sub index 0Eh.....	136
Table 199 – Object C400h – C7FEh sub index 0Fh.....	137
Table 200 – Object C801h – CBFFh Additional SADR list	137
Table 201 – Object C801h – CBFFh sub index 00h.....	137
Table 202 – Object C801h – CBFFh sub index 01h.....	138
Table 203 – Object C801h – CBFFh sub index 02h.....	138
Table 204 – Object Additional SADR List Example.....	139
Table 205 – Object CC01h – CFFFh SADR-UDID list.....	139
Table 206 – Object CC01h – CFFFh sub index 00h.....	139
Table 207 – Object CC01h – CFFFh sub index 01h – FEh	140
Table 208 – SADR-UDID List Example.....	140
Table 209 – Object E400h – E7FEh SSCM additional parameter list	140

Table 210 – Object E400h – E7FEh sub index 00h	141
Table 211 – Object E400h – E7FEh sub index 01h – 10h.....	141
Table 212 – Structure of SPDO mapping entry.....	142
Table 213 – Mapping example table 1.....	143
Table 214 – Mapping example table 2.....	143
Table 215 – Mapping example table 3.....	144
Table 216 – Mapping example table 4.....	144
Table 217 – Mapping example table 5.....	144
Table 218 – Mapping example table 6.....	144
Table 219 – Mapping example table 7.....	145
Table 220 – SPDO telegram features (TR field, bits 2-7).....	145
Table 221 – SPDO communication producer item description	147
Table 222 – SPDO communication producer state description	147
Table 223 – SPDO communication consumer item description	148
Table 224 – SPDO communication consumer state description	149
Table 225 – SPDO communication consumer telegram validation item description.....	150
Table 226 – SPDO communication consumer telegram validation state description.....	150
Table 227 – Time synchronization item description	152
Table 228 – Time validation item description	154
Table 229 – Extended time synchronization item description.....	156
Table 230 – Time synchronization producer item description	157
Table 231 – Time synchronization producer state description	158
Table 232 – Time synchronization consumer item description	159
Table 233 – Time synchronization consumer state description	159
Table 234 – SSDO client item description	161
Table 235 – SSDO client state description	161
Table 236 – SSDO server state description.....	161
Table 237 – SOD access item description.....	162
Table 238 – Segmented SOD access client item description	164
Table 239 – Segmented SOD download access client state description	164
Table 240 – Segmented SOD access server item description.....	166
Table 241 – Segmented SOD access server state description.....	166
Table 242 – SOD preload download access client item description	168
Table 243 – SOD preload download access client state description	169
Table 244 – SOD preload download access server item description.....	171
Table 245 – SOD preload download access server state description.....	171
Table 246 – SNMT master item description.....	172
Table 247 – SNMT master state description.....	172
Table 248 – SNMT slave state description	173
Table 249 – SN power up state description	174
Table 250 – State and communication object relation	174
Table 251 – SN Pre-Operational state item description	177
Table 252 – SN Pre-Operational state description.....	177

Table 253 – SN additional parameter state description 179

Table 254 – SN Operational state item description..... 180

Table 255 – SN Operational state description 180

Table 256 – SCM power up state description 181

Table 257 – State and communication object relation 181

Table 258 – SCM Operational state item description 183

Table 259 – SCM Operational state description 183

Table 260 – Address verification item description 185

Table 261 – Address verification state description 185

Table 262 – SCM handle single UDID mismatch state description..... 187

Table 263 – SCM verify parameters state description 189

Table 264 – Activate SN state description..... 190

Table 265 – Residual error rate 194

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
PROFILES –****Part 3-13: Functional safety fieldbuses –
Additional specifications for CPF 13**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 61784-3-13 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This third edition cancels and replaces the second edition published in 2016. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- removal of block up-/download;
- addition of SSDO with preload;
- addition of SPDO feature sets;

- addition of SPDO with 40 bit counter;
- addition of SPDO dynamic SCT;
- addition of additional parameter sets;
- corrections and editorial improvements.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
65C/1083/FDIS	65C/1087/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts of the IEC 61784-3 series, published under the general title *Industrial communication networks – Profiles – Functional safety fieldbuses*, can be found on the IEC website.

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

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

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.