

INTERNATIONAL STANDARD

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

(<https://standards.iteh.ai>)

Document Preview

IEC 61158-5-10:2007

<https://standards.iteh.ai/catalog/standards/iec/36911a2f-3e14-4374-844a-cd544031d5b0/iec-61158-5-10-2007>

Withhold



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2007 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.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: 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 corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

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 It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

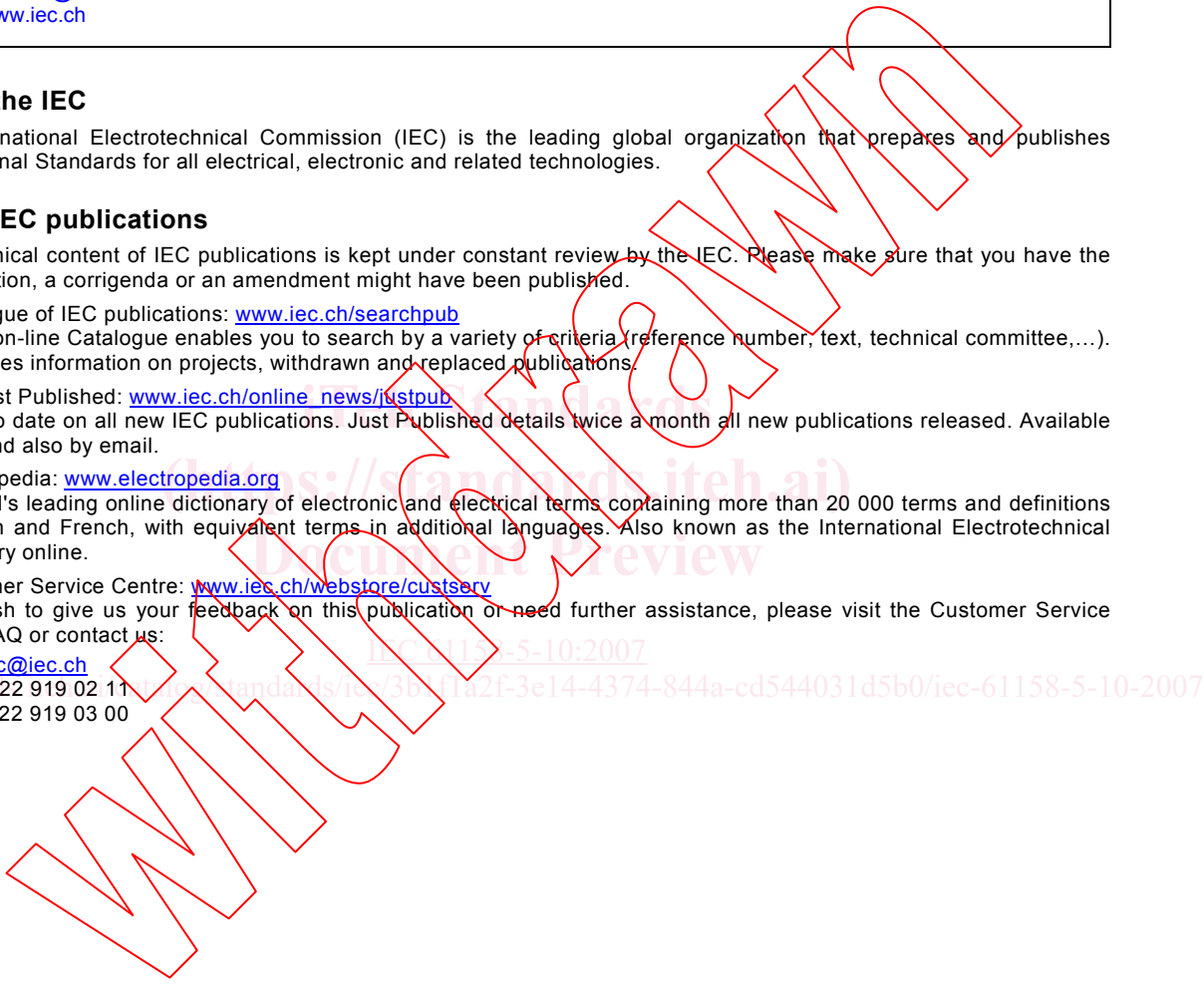
- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch

Tel.: +41 22 919 02 11

Fax: +41 22 919 03 00



INTERNATIONAL STANDARD

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

(<https://standards.iteh.ai>)
Document Preview

IEC 61158-5-10:2007

<https://standards.iteh.ai/en/standards/iec/3611a2f-3e14-4374-844a-cd544031d5b0/iec-61158-5-10-2007>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE **XH**

CONTENTS

FOREWORD.....	16
INTRODUCTION.....	18
1 Scope.....	19
1.1 Overview.....	19
1.2 Specifications.....	20
1.3 Conformance.....	20
2 Normative references.....	20
3 Terms, definitions, abbreviations, symbols and conventions.....	22
3.1 Referenced terms and definitions.....	22
3.2 Additional terms and definitions for distributed automation.....	23
3.3 Additional terms and definitions for decentralized periphery.....	25
3.4 Additional terms and definitions for media redundancy.....	33
3.5 Abbreviations and symbols.....	34
3.6 Additional abbreviations and symbols for distributed automation.....	35
3.7 Additional abbreviations and symbols for decentralized periphery.....	35
3.8 Additional abbreviations and symbols for media redundancy.....	36
3.9 Conventions.....	36
4 Concepts.....	39
5 Data type ASE.....	39
5.1 General.....	39
5.2 Formal definition of data type objects.....	42
5.3 FAL defined data types.....	43
5.4 Data type ASE service specification.....	86
6 Communication model for common services.....	86
6.1 Concepts.....	86
6.2 ASE data types.....	86
6.3 ASEs.....	87
7 Communication model for distributed automation.....	184
7.1 Concepts.....	184
7.2 ASE data types.....	191
7.3 ASEs.....	195
7.4 ARs.....	412
7.5 Summary of FAL classes.....	416
7.6 Summary of FAL services.....	417
8 Communication model for decentralized periphery.....	420
8.1 Concepts.....	420
8.2 ASE data types.....	436
8.3 ASEs.....	436
8.4 Behavior of an IO device.....	671
8.5 Behavior of an IO controller.....	737
8.6 Application characteristics.....	744

Annex A (informative) Device instances	746
Annex B (informative) Components of an Ethernet interface	748
Annex C (informative) Scheme of MAC address assignment	752
Annex D (informative) Collection of objects	753
Annex E (informative) Measurement of the fast startup time	754
Bibliography	755
Figure 1 – Data type class hierarchy example	40
Figure 2 – NetworkTime date relation	63
Figure 3 – UTF-8 coding of four different characters	67
Figure 4 – PTCP applications	100
Figure 5 – Clock drift measurement	110
Figure 6 – Multiple synchronization	110
Figure 7 –MRP stack	112
Figure 8 – Ring topology with one manager and clients	123
Figure 9 – MRM in an open ring	123
Figure 10 – More than one MRM in the ring	125
Figure 11 – Media redundancy diagnosis dependencies	126
Figure 12 – Locating the destination for redundant RT frames	165
Figure 13 – Example of periods at a local port	172
Figure 14 – FAL ASEs communication architecture	187
Figure 15 – Runtime object model	188
Figure 16 – Relationship between engineering and runtime	189
Figure 17 – Navigation in the runtime object model	190
Figure 18 – Operating state block diagram	229
Figure 19 – Device status model for the common diagnosis	230
Figure 20 – ACCO ASE structure	261
Figure 21 – Productive operation of data connections	262
Figure 22 – Quality code transfer – standard behavior	274
Figure 23 – Startup of a connection	275
Figure 24 – Quality code with communication fault	275
Figure 25 – Quality code when an connection is cleared	276
Figure 26 – Quality code when an connection is deactivated	276
Figure 27 – Quality code during the transfer of "incorrect" connection data	277
Figure 28 – Quality code for provider in "CBAReady" state	278
Figure 29 – Quality code when clearing an object from the provider	278
Figure 30 – Quality code when a connection is forced	279
Figure 31 – Quality code at QoS violation	279
Figure 32 – Push mode	286
Figure 33 – Pull mode overview	287

Figure 34 – Detailed sequence chart of the pull mode 288

Figure 35 – QoS and ORPC communication channel..... 289

Figure 36 – QoS Violation within Pull Mode..... 290

Figure 37 – Monitoring the providers heartbeat 291

Figure 38 – State machine RemoteAcco 293

Figure 39 – State machine RemoteAccoProvider..... 293

Figure 40 – State machine RemoteAccoProvider_{ORPC} 294

Figure 41 – State machine AR_{ORPC} – Provider 294

Figure 42 – State machine GetConnectionData – Provider 295

Figure 43 – State machine ProviderConnection..... 295

Figure 44 – State machine ProvConnActivation..... 296

Figure 45 – State machine WorkerORPC 296

Figure 46 – Communication stack of distributed automation devices..... 297

Figure 47 – Application relations between devices 298

Figure 48 – Communication relations 298

Figure 49 – RT communication channel 300

Figure 50 – Interaction between provider and consumer 302

Figure 51 – State machine AR_{SRT} – Consumer 304

Figure 52 – State machine AR_{SRT} – Provider 304

Figure 53 – State machine AccoDataCR – Consumer 305

Figure 54 – State machine AccoDataCR – Provider 306

Figure 55 – RT frame layout..... 307

Figure 56 – Establishing an AccoDataCR..... 308

Figure 57 – Flowchart of the copy cycle for local connections 309

Figure 58 – State machine connect attempt 313

Figure 59 – Productive operation of data connections (ORPC channel)..... 320

Figure 60 – Productive operation of data connections (RT channel)..... 321

Figure 61 – Productive operation of data connections (Local channel) 321

Figure 62 – Data flow for cyclic RT 322

Figure 63 – Failure of the provider in productive operation (ORPC push mode)..... 324

Figure 64 – Failure of the provider in productive operation (ORPC pull mode) 325

Figure 65 – Scenario 1: Provider failure in productive operation (RT)..... 326

Figure 66 – Scenario 2: Recovery from provider failure in productive operation (RT)..... 327

Figure 67 – Failure of the consumer (push mode) 327

Figure 68 – Failure of the consumer (pull mode) 328

Figure 69 – Failure of the consumer..... 329

Figure 70 – Failure of the provider when setting up connections 331

Figure 71 – Information levels..... 332

Figure 72 – ACCO ASE status model for the common diagnosis 332

Figure 73 – ACCO ASE status model for the detailed diagnosis 333

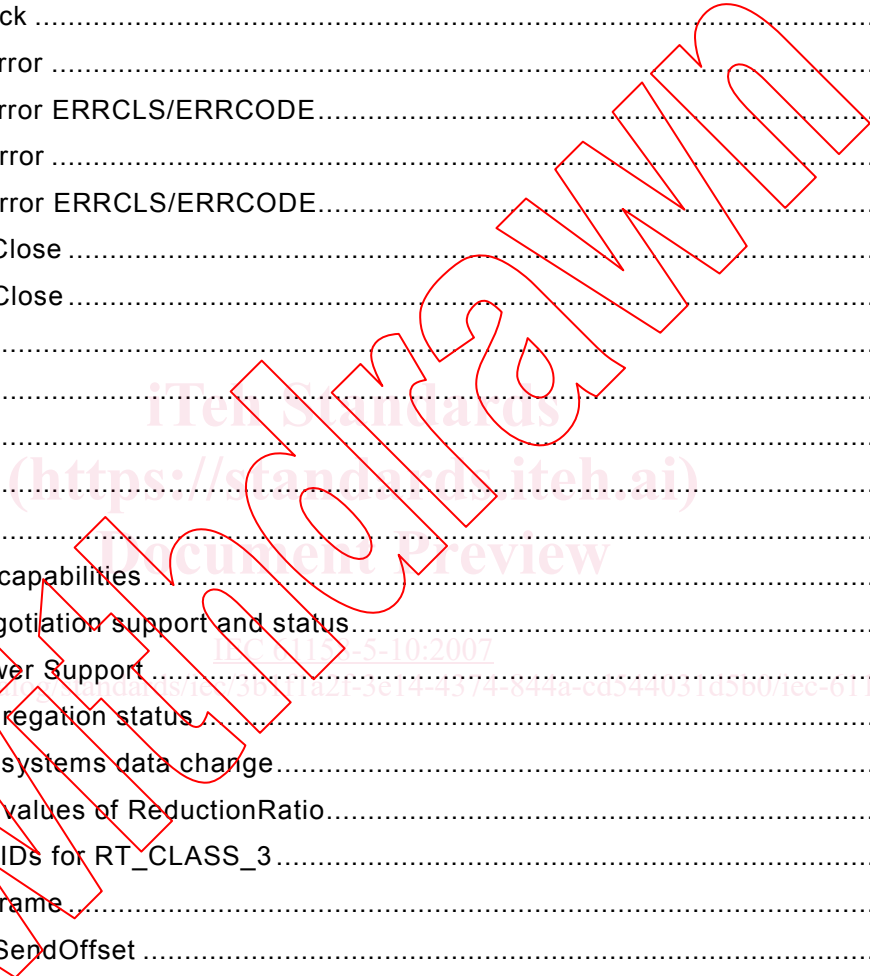
Figure 74 – Structure of the transmitted connection data 375

Figure 75 – Example of communication between controlling devices and field devices	421
Figure 76 – Example of communication between an engineering station and several controlling and field devices	421
Figure 77 – Example of communication between field devices and a server station.....	422
Figure 78 – Example of communication between field devices	422
Figure 79 – Structural units of one arbitrary API of an IO device (general)	424
Figure 80 – Example 1 structural units for interfaces and ports within API 0.....	425
Figure 81 – Example 2 structural units for interfaces and ports within API 0.....	426
Figure 82 – Overview of application processes	428
Figure 83 – IO device with APs, slots and subslots	429
Figure 84 – Application Process with application objects (APOs)	432
Figure 85 – Access to a remote APO	433
Figure 86 – Access to a remote APO for provider/consumer association	434
Figure 87 – Example of one AR with two AREPs	435
Figure 88 – Relation of a record data object to one real object.....	437
Figure 89 – Relation of a record data object to two real objects	438
Figure 90 – Overview IO ASE service interactions	448
Figure 91 – Example of a resource model at the alarm source	525
Figure 92 – General isochronous application model (example).....	560
Figure 93 – ASE relations in an IO device operating in isochronous mode	566
Figure 94 – State machine relations in an IO device operating in isochronous mode	566
Figure 95 – SyncCtl state diagram	570
Figure 96 – Output state diagram.....	572
Figure 97 – Input state diagram	577
Figure 98 – Assignment of communication relationship to application relationship	650
Figure 99 – Implicit application relationship.....	653
Figure 100 – Example IO application relationship (one-to-one)	655
Figure 101 – Example IO application relationship one-to-many	656
Figure 102 – Overview ASE state machines for IO device	672
Figure 103 – State diagram application startup IO device.....	673
Figure 104 – State diagram startup manager IO device.....	681
Figure 105 – State diagram IRT port state IO device (standard).....	684
Figure 106 – State diagram IRT port state IO device (optimized).....	696
Figure 107 – State diagram neighborhood check.....	703
Figure 108 – State diagram PD parameter check IO device	712
Figure 109 – State diagram for a submodule	722
Figure 110 – State diagram IO controller during startup	738
Figure 111 – State diagram startup manager IO controller	741
Figure 112 – Example of network topology including slower wireless segments	745
Figure 113 – Example of media redundancy including wireless segments	745
Figure A.1 – Instance model	746

Figure B.1 – Scheme of an Ethernet interface	748
Figure B.2 – Scheme of an Ethernet interface with bridging ability	749
Figure B.3 – Scheme of an Ethernet interface with optical ports	750
Figure B.4 – Scheme of an Ethernet interface with bridging ability using radio communication	751
Figure B.5 – Scheme of an Ethernet interface with radio communication	751
Figure C.1 – Scheme of MAC address assignment	752
Figure D.1 – Example for an intersection of IO device, slot, and AR	753
Figure E-1 – Measurement of the fast startup time	754
Table 1 – PERSISTDEF	46
Table 2 – VARTYPE	47
Table 3 – ITEMQUALITYDEF	47
Table 4 – STATEDEF	51
Table 5 – GROUPEXCEPTIONDEF	51
Table 6 – ACCESSRIGHTSDEF	51
Table 7 – HRESULT	52
Table 8 – N2 value range	56
Table 9 – N2 octets	56
Table 10 – N4 value range	57
Table 11 – N4 octets	57
Table 12 – X2 value range	58
Table 13 – X2 octets	58
Table 14 – X4 value range	58
Table 15 – X4 octets	58
Table 16 – Unipolar2.16 value range	59
Table 17 – Unipolar2.16 octets	59
Table 18 – E2 value range	59
Table 19 – E2 octets	59
Table 20 – C4 value range	60
Table 21 – V2 octets	60
Table 22 – L2 octets	60
Table 23 – UUID for decentralized peripherals	61
Table 24 – UUID for distributed automation	62
Table 25 – NetworkTime values	63
Table 26 – NetworkTime octets	63
Table 27 – T2 values	64
Table 28 – T4 values	64
Table 29 – D2 values	65
Table 30 – R2 values	65
Table 31 – UNICODEString values	66

Table 32 – UTF-8 character encoding scheme	67
Table 33 – OctetString2+Unsigned8 octets	78
Table 34 – Float32+Unsigned8 octets	79
Table 35 – Unsigned8+Unsigned8 octets	79
Table 36 – Data Types for Value in a VARIANT	82
Table 37 – Unsigned16_S octets	83
Table 38 – Unsigned16_S meaning	83
Table 39 – Integer16_S octets	84
Table 40 – Integer16_S meaning	84
Table 41 – Unsigned8_S octets	84
Table 42 – Unsigned8_S meaning	84
Table 43 – OctetString_S octets	85
Table 44 – OctetString_S status bits	85
Table 45 – F message trailer with 4 octets	85
Table 46 – F message trailer with 5 octets	86
Table 47 – Get	92
Table 48 – Set	94
Table 49 – Identify	97
Table 50 – Hello	98
Table 51 – Clock stratum	102
Table 52 – Start bridge	104
Table 53 – Start slave	105
Table 54 – Start master	106
Table 55 – Stop bridge	107
Table 56 – Stop slave	107
Table 57 – Stop master	108
Table 58 – State change	109
Table 59 – Start MRM	117
Table 60 – Stop MRM	119
Table 61 – Change state	119
Table 62 – Start MRC	120
Table 63 – Stop MRC	121
Table 64 – Neighborhood changed	122
Table 65 – MRP network/connection parameters	127
Table 66 – MRM parameters	127
Table 67 – MRC parameters	127
Table 68 – Set prov data	128
Table 69 – Set prov status	129
Table 70 – PPM activate	130
Table 71 – Close	131
Table 72 – Start	131

Table 73 – Error.....	132
Table 74 – Get cons data.....	132
Table 75 – Get cons status.....	133
Table 76 – Set redRole.....	133
Table 77 – CPM activate.....	134
Table 78 – APMS activate.....	138
Table 79 – APMR activate.....	139
Table 80 – APMS A data.....	140
Table 81 – APMR A data.....	141
Table 82 – APMR ack.....	141
Table 83 – APMS error.....	142
Table 84 – APMS error ERRCLS/ERRCODE.....	142
Table 85 – APMR error.....	143
Table 86 – APMR error ERRCLS/ERRCODE.....	143
Table 87 – APMS_Close.....	143
Table 88 – APMR_Close.....	144
Table 89 – Connect.....	145
Table 90 – Release.....	146
Table 91 – Read.....	147
Table 92 – Write.....	148
Table 93 – Control.....	149
Table 94 – System capabilities.....	154
Table 95 – Auto negotiation support and status.....	155
Table 96 – MDI Power Support.....	156
Table 97 – Link aggregation status.....	156
Table 98 – Remote systems data change.....	159
Table 99 – Allowed values of ReductionRatio.....	162
Table 100 – Frame IDs for RT_CLASS_3.....	163
Table 101 – Sync Frame.....	163
Table 102 – FrameSendOffset.....	163
Table 103 – Tx Port Entry.....	164
Table 104 – Port state change.....	167
Table 105 – Set port state.....	167
Table 106 – Flush filtering data base.....	167
Table 107 – IFW IRT Schedule Add.....	168
Table 108 – IFW IRT Schedule Remove.....	168
Table 109 – IFW Schedule.....	169
Table 110 – MAU type change.....	173
Table 111 – Set MAU type.....	174
Table 112 – IP Multicast address.....	176
Table 113 – Set ARP cache.....	176



ITeK Standards

(<https://standards.iteh.ai>)

Document Review

61158-5-10:2007

<https://standards.iteh.ai/catalog/standards/sist/61158-5-10-2007>

Table 114 – Enterprise number	179
Table 115 – Vendor OUI	179
Table 116 – IRT schedule sdd.....	180
Table 117 – IRT schedule remove.....	181
Table 118 – Schedule	181
Table 119 – N data	182
Table 120 – A data.....	183
Table 121 – C data	184
Table 122 – Connectable data types	192
Table 123 – Supported data types according to the Base Object Version.....	193
Table 124 – Usage of character sets.....	195
Table 125 – QueryInterface (Unknown interface)	197
Table 126 – AddRef (Unknown interface).....	198
Table 127 – Release (Unknown interface).....	199
Table 128 – GetTypeInfoCount (Dispatch interface).....	200
Table 129 – GetTypeInfo (Dispatch interface)	201
Table 130 – GetIDsOfNames (Dispatch interface).....	202
Table 131 – Invoke (Dispatch interface).....	203
Table 132 – CRC table for the PDev stamp calculation (hexadecimal values).....	208
Table 133 – get_Producer (Physical device interface).....	209
Table 134 – get_Product (Physical device interface).....	210
Table 135 – get_SerialNo (Physical device interface).....	211
Table 136 – get_ProductionDate (Physical device interface).....	212
Table 137 – Revision (Physical device interface)	213
Table 138 – get_LogicalDevice (Physical device interface)	214
Table 139 – Type (Physical device interface).....	215
Table 140 – PROFinetRevision (Physical device interface).....	216
Table 141 – get_PDevStamp (Physical device interface).....	217
Table 142 – get_Count (Browse interface)	218
Table 143 – BrowseItems (Browse interface)	219
Table 144 – get_Count2 (Browse interface)	220
Table 145 – BrowseItems2 (Browse interface)	222
Table 146 – Save (Persist interface)	223
Table 147 – Save2 (Persist interface)	224
Table 148 – get_Name (Logical device interface).....	230
Table 149 – get_Producer (Logical device interface).....	231
Table 150 – get_Product (Logical device interface).....	232
Table 151 – get_SerialNo (Logical device interface).....	233
Table 152 – get_ProductionDate (Logical device interface).....	234
Table 153 – Revision (Logical device interface)	235
Table 154 – get_ACCO (Logical device interface).....	236

Table 155 – get_RTAuto (Logical device interface)	237
Table 156 – PROFinetRevision (Logical device interface)	238
Table 157 – ComponentInfo (Logical device interface)	239
Table 158 – get_State (State interface).....	240
Table 159 – Activate (State interface)	242
Table 160 – Deactivate (State interface)	243
Table 161 – Reset (State interface).....	244
Table 162 – AdviseState (State interface)	245
Table 163 – UnadviseState (State interface)	246
Table 164 – get_Time (Time interface).....	247
Table 165 – put_Time (Time interface).....	248
Table 166 – get_Count (Browse interface)	249
Table 167 – BrowseItems (Browse interface)	250
Table 168 – get_Count2 (Browse interface)	251
Table 169 – BrowseItems2 (Browse interface)	253
Table 170 – GroupError (Group error interface)	254
Table 171 – AdviseGroupError (Group Error interface).....	256
Table 172 – UnadviseGroupError (Group Error interface).....	257
Table 173 – PingFactor values.....	259
Table 174 – QoS subtypes in the ORPC communication channel	268
Table 175 – QoS subtypes in the RT communication channel	269
Table 176 – QoS Types and Values	269
Table 177 – Epsilon value for connectable data types	271
Table 178 – Quality Codes.....	273
Table 179 – Quality code priority table	281
Table 180 – Maximum ORPC substitute value apply time.....	291
Table 181 – Maximum GetConnectionData hold time	292
Table 182 – Usage of RT Variants	299
Table 183 – Mapping QoS Value to RT cycle time.....	300
Table 184 – Maximum RT Substitute Value Apply Time	301
Table 185 – Time Intervals and Timeouts.....	323
Table 186 – Error codes for the ACCO ASE detailed diagnosis	334
Table 187 – AddConnections (ACCO management interface).....	336
Table 188 – RemoveConnections (ACCO management interface)	337
Table 189 – ClearConnections (ACCO management interface)	339
Table 190 – SetActivationState (ACCO management interface)	340
Table 191 – GetInfo (ACCO management interface)	341
Table 192 – GetIDs (ACCO management interface)	342
Table 193 – GetConnections (ACCO management interface)	343
Table 194 – ReviseQoS (ACCO management interface).....	345
Table 195 – get_PingFactor (ACCO management interface)	346

Table 196 – put_PingFactor (ACCO management interface)	347
Table 197 – get_CDBCcookie (ACCO management interface)	348
Table 198 – GetConsIDs (ACCO management interface)	349
Table 199 – GetConsConnections (ACCO management interface)	350
Table 200 – DiagConsConnections (ACCO management interface).....	351
Table 201 – GetProvIDs (ACCO management interface)	352
Table 202 – GetProvConnections (ACCO management interface)	354
Table 203 – GetDiagnosis (ACCO management interface)	355
Table 204 – Request.....	357
Table 205 – Connect (ACCO server interface)	364
Table 206 – Disconnect (ACCO server interface)	366
Table 207 – DisconnectMe (ACCO server interface)	367
Table 208 – SetActivation (ACCO server interface)	368
Table 209 – Ping (ACCO server interface)	369
Table 210 – Connect2 (ACCO server interface)	371
Table 211 – GetConnectionData (ACCO server interface)	373
Table 212 – OnDataChanged (ACCO callback interface).....	376
Table 213 – Version	376
Table 214 – Flags	377
Table 215 – Gnip (ACCO callback interface).....	378
Table 216 – ReadItems (ACCO sync interface)	379
Table 217 – WriteItems (ACCO sync interface)	381
Table 218 – WriteItemsQCD (ACCO sync interface).....	383
Table 219 – GroupError (Group Error interface)	384
Table 220 – AdviseGroupError (Group Error interface).....	385
Table 221 – UnadviseGroupError (Group Error interface).....	386
Table 222 – ConnectCR (ACCO server SRT interface).....	388
Table 223 – DisconnectCR (ACCO server SRT interface)	390
Table 224 – Connect (ACCO server SRT interface).....	391
Table 225 – Disconnect (ACCO server SRT interface)	392
Table 226 – DisconnectMe (ACCO server SRT interface).....	394
Table 227 – SetActivation (ACCO server SRT interface).....	395
Table 228 –Hresult values for access to properties of Custom RT-Auto objects	400
Table 229 – Hresult values for access to properties of the System RT-Auto object.....	401
Table 230 – Common hresult values on access to properties of RT-Auto objects	401
Table 231 – Quality code for access to properties of Custom RT-Auto objects	401
Table 232 – Quality code for access to properties of the System RT-Auto object	402
Table 233 – get_Name (RT-Auto interface)	402
Table 234 – Revision (RT-Auto interface).....	403
Table 235 – ComponentInfo (RT-Auto interface)	404
Table 236 – get_Count (Browse interface)	405

Table 237 – BrowseItems (Browse interface)	406
Table 238 – get_Count2 (Browse interface)	408
Table 239 – BrowseItems2 (Browse interface)	409
Table 240 – get_StateCollection (System properties interface)	411
Table 241 – get_StampCollection (System Properties interface)	412
Table 242 – CoCreateInstance.....	414
Table 243 – CoDisconnectObject	415
Table 244 – Call.....	415
Table 245 – Distributed automation FAL class summary	416
Table 246 – Assignment of the services to client and server	417
Table 247 – Requirements and features.....	420
Table 248 – Persistence behavior for record data objects	440
Table 249 – Read	441
Table 250 – Read query.....	443
Table 251 – Write	445
Table 252 – Set input.....	455
Table 253 – Set input IOCS	456
Table 254 – Get input	457
Table 255 – Get input IOCS	458
Table 256 – New input.....	459
Table 257 – Set input APDU data status.....	460
Table 258 – New input APDU data status.....	461
Table 259 – Read input data.....	462
Table 260 – Set output.....	464
Table 261 – Set output IOCS	465
Table 262 – Get output.....	466
Table 263 – Get output IOCS.....	467
Table 264 – New output	468
Table 265 – Set output APDU data status	469
Table 266 – New output APDU data status	470
Table 267 – Read output data.....	471
Table 268 – Read output substitute data	474
Table 269 – Write output substitute data	476
Table 270 – Read logbook	480
Table 271 – Logbook event.....	481
Table 272 – Dependencies within channel properties.....	485
Table 273 – Ext channel error type	488
Table 274 – Ext channel add value for accumulative info	489
Table 275 – Dependencies within channel properties for manufacturer specific diagnosis.....	490
Table 276 – Read device diagnosis.....	492