Table of Contents

1 Introduction 1
1.1 Scope 1
1.2 References 1
1.3 Definitions 1
1.4 Acronyms and Abbreviations 3
2 Technical Overview 4
2.1 Key Features of the Function Block Application Architecture 4
2.1.1 Key Components 5
2.1.2 Key Operations 7
2.1.2.1 Function Block Definitions 7
2.1.2.2 Function Block Links 7
2.1.2.3 Alert Processing 7
2.1.2.4 Information Access 8
2.1.2.5 Coordination of Function Block Execution 9
2.1.2.6 Clock Synchronization 9
2.1.3 Open Interfaces 9
3 Function Block Application Process Architecture 10
3.1 External Interactions 11
3.1.1 Interactions With Configuration Applications 12
3.1.2 Interactions with Human Interface Applications 12
3.1.3 Interaction With Other Field Devices 13
3.1.4 Interactions for the Establishment of Function Block Links 13
3.1.5 Interactions for the establishment of FB Links 13
3.1.6 Support Services 13
3.2 Interactions Within a Device 13
3.2.1 Interactions with Other Function Block Applications 15
3.2.2 Interactions with System Management 15
3.2.3 Interactions with Other Device Applications 15
3.3 Function Block Application Structure 15
3.3.1 Device Resources 16
3.3.2 Block Object 17
3.3.2.1 Block Events 18
3.3.2.2 Block Parameters 18
3.3.3 Resource Block 22
3.3.4 Transducer Block 23
3.3.5 Function Block 24
3.3.6 Function Block Links 24
3.3.7 Alert Objects 25
3.3.8 View Object 25
3.3.9 Domain Objects 25
4 Formal Models 26
4.1 Resource Formal Model 26
4.1.1 Attributes: 26
4.1.2 Services: 27
4.1.3 Attribute Definitions: 27
4.1.3.1 RESOURCE Name 27
4.1.3.2 Vendor Name 27
4.1.3.3 Model Name 27
4.1.3.4 Revision 27
4.1.3.5 Logical Status 27
4.1.3.6 Physical Status 27
4.1.3.7 Object Dictionary 27
4.2 Directory Object Formal Model 28
4.2.1 Attributes: 28
4.2.2 Services: 28
4.2.3 Attribute Definitions: 28
4.2.3.1 DD Member Id 28
4.2.3.2 Index 28

4.2.3.3 Data Type 28
4.2.3.4 Sub-index 28
4.2.3.5 Data Length 29
4.2.3.6 Usage 29
4.2.3.7 Storage 29
4.2.3.8 List of Valid Values 29
4.2.3.9 Initial Value 29
4.2.3.10 Block DD Item Id 29
4.3 Formal Block Model 30
4.3.1 Attributes: 30
4.3.2 Services: 30
4.3.3 Attribute Definitions: 30
4.3.3.1 Block DD Member Id 30
4.3.3.2 Block Index 30
4.3.3.3 Data Type 30
4.3.3.4 Sub-index 31
4.3.3.5 Data Length 31
4.3.3.6 Usage 31
4.3.3.7 Storage 31
4.3.3.8 List of Parameters 31
4.3.3.9 List of Valid Values 32
4.3.3.10 Initial Value 32
4.3.3.11 DD Item Id 32
4.4 Resource Block Formal Model 32
4.4.1 Attributes: 32
4.4.2 Attribute Definitions: 32
4.4.2.1 List of Parameters 32
4.4.2.2 List of Valid Values 32
4.5 Transducer Block Formal Model 32
4.5.1 Attributes: 32
4.5.2 Attribute Definitions: 32
4.5.2.1 List of Parameters 32
4.5.2.2 List of Valid Values 32
4.6 Input Transducer Block Formal Model 32
4.7 Output Transducer Block Formal Model 33
4.8 Display Transducer Block Formal Model 33
4.9 Function Block Formal Model 33
4.9.1 Attributes: 33
4.9.2 Attribute Definitions: 33
4.9.2.1 Sub-index 33
4.9.2.2 List of Parameters 35
4.10 Input Function Block Formal Model 36
4.10.1 Attribute Definitions: 36
4.10.1.1 List of Parameters 36
4.11 Output Function Block Formal Model 36
4.11.1 Attribute Definitions: 36
4.11.1.1 List of Parameters 36
4.12 Calculation Function Block Formal Model 36
4.12.1 Attribute Definitions: 36
4.12.1.1 List of Parameters 36
4.13 Parameter Formal Model 37
4.13.1 Attributes: 37
4.13.2 Services: 37
4.13.3 Attribute Definitions: 37
4.13.3.1 Parameter DD Member Id 37
4.13.3.2 Parameter Index 37
4.13.3.3 Relative Index 37
4.13.3.4 Data Type 37
4.13.3.5 Sub-index 37
4.13.3.6 Data Length 37
4.13.3.7 Units 37
4.13.3.8 Usage 38

 © Fieldbus Foundation 1994-2012

4.13.3.9 Storage 38
4.13.3.10 List of Valid Values 38
4.13.3.11 Initial Value 38
4.13.3.12 Parameter DD Item Id 38
4.14 Output Parameter Formal Model 38
4.14.1 Attributes: 38
4.14.2 Services: 38
4.14.3 Attribute Definitions: 38
4.14.3.1 Sub-index 38
4.15 Status (Formal Model) 39
4.15.1.1 Forward Path 39
4.15.1.2 Cascade Control 39
4.15.1.3 Status of Input and Calculation Blocks 39
4.15.1.4 Propagation 39
4.15.2 Status Attribution Definition 40
4.15.2.1 List of Valid Values 40
4.16 Primary Output Parameter Formal Model [OUT, OUT_D] 41
4.16.1 Attributes: 41
4.16.2 Attribute Definitions: 41
4.16.2.1 Sub-index 41
4.17 Input Parameter Formal Model 42
4.17.1 Attributes: 42
4.17.2 Attribute Definitions: 42
4.17.2.1 Sub-index 42
4.18 Primary Input Parameter Formal Model [IN, IN_D] 43
4.18.1 Attributes: 43
4.19 Cascade Input Parameter Formal Model [CAS_IN, CAS_IN_D] 43
4.19.1 Attributes: 43
4.20 Fault State Clear Latch Formal Model [CLEAR_LATCH_D] 43
4.21 Contained Parameter Formal Model 43
4.21.1 Attributes: 43
4.22 Static Revision Parameter Formal Model [ST_REV] 43
4.22.1 Attributes: 44
4.23 Tag Description Parameter Formal Model [TAG_DESC] 44
4.23.1 Attributes: 44
4.24 Strategy Parameter Formal Model [STRATEGY] 44
4.24.1 Attributes: 44
4.25 Alert Key Parameter Formal Model [ALERT_KEY] 44
4.25.1 Attributes: 44
4.26 Mode Parameter Formal Model [MODE_BLK] 45
4.26.1 Attributes: 45
4.26.2 Attribute Definitions: 45
4.26.2.1 Sub-index 45
4.27 Block Error Parameter Formal Model [BLOCK_ERR] 49
4.27.1 Attributes: 49
4.27.2 Attribute Definitions: 49
4.27.2.1 List of Valid Values 49
4.28 Setpoint Parameter Formal Model [SP, SP_D] 49
4.28.1 Attributes: 50
4.28.2 Attribute Definitions: 50
4.28.2.1 Sub-index 50
4.29 Process Variable Parameter Formal Model [PV, PV_D] 51
4.29.1 Attributes: 51
4.29.2 Attribute Definitions: 51
4.29.2.1 Sub-index 51
4.30 Scaling Parameter Formal Model [*_SCALE] 52
4.30.1 Attributes: 52
4.30.2 Attribute Definitions: 52
4.30.2.1 Sub-index 52
4.31 Channel Parameter Formal Model [CHANNEL] 52
4.31.1 Attributes: 53
4.32 Alarm Summary Parameter Formal Model 53

4.33 Write Lock Parameter Formal Model [WRITE_LOCK] 54
4.33.1 Attributes: 54
4.34 FD Active Parameter Formal Model 55
4.34.1 Attribute Definitions: 55
4.34.2 Field Diagnostics Reporting Overview 55
4.35 Alarm Parameter Formal Model 57
4.35.1 Attributes: 58
4.36 Event Update Parameter Formal Model 59
4.36.1 Attributes: 59
4.37 Alert Priority 60
4.38 Simulate Parameter Formal Model [SIMULATE, SIMULATE_D] 61
4.38.1 Attributes: 61
4.38.2 Attribute Definitions: 61
4.39 Field Diagnostics Simulate Formal Model 61
4.40 DD Resource Parameter Formal Model [DD_RESOURCE] 62
4.40.1 Attributes: 62
4.40.1.1 List of Valid Values 62
4.41 Stale Data Timer [STALE_DATA_T] 63
4.41.1 Attributes: 63
4.41.1.1 List of Valid Values 63
4.42 Test Parameter Formal Model [TEST_RW] 63
4.42.1 Attributes: 63
4.42.2 Attribute Definitions: 63
4.42.2.1 Sub-index 63
4.43 Resource State Parameter Formal Model [RS_STATE] 64
4.43.1 Attributes: 64
4.43.2 Attribute Definitions: 64
4.43.2.1 List of Valid Values 64
4.44 SIF_ Error Parameter Formal Model [SIF_ERR] 66
4.44.1 Attributes: 66
4.44.2 Attribute Definitions: 66
4.44.2.1 List of Valid Values: 66
4.45 Function Block Link Object Formal Model 66
4.45.1 Attributes: 67
4.45.2 Services: 67
4.45.3 Attribute Definitions: 67
4.45.3.1 DD Member Id 67
4.45.3.2 Index 67
4.45.3.3 Data Type 67
4.45.3.4 Sub-index 67
4.45.3.5 Units 68
4.45.3.6 Usage 68
4.45.3.7 Storage 68
4.45.3.8 List of Valid Values 68
4.45.3.9 Association between Function Block Parameters 68
4.46 SIS Link Object Formal Model 70
4.46.1 Attributes: 71
4.46.2 Services: 71
4.46.3 Attribute Definitions 71
4.46.3.1 DD Member Id 71
4.46.3.2 Index 71
4.46.3.3 Data Type 71
4.46.3.4 Sub-index 71
4.46.3.5 Units 72
4.46.3.6 Usage 72
4.46.3.7 Storage 72
4.46.3.8 List of Valid Values 72
4.46.3.9 Association between Function Block Parameters 73
4.47 Alert Object Formal Model 74
4.47.1 Alert Object Class Definition 74
4.47.2 Alert Reporting Overview 76
4.47.3 Simple and Multi-bit Alarm Parameters 77

 © Fieldbus Foundation 1994-2012

4.47.4 Alert Reporting Model 78
4.47.4.1 Detection of Alarms and Event Updates 78
4.47.4.2 Queuing Alarm and Event Updates 79
4.47.4.3 Dequeuing and Sending Alerts 80
4.47.4.4 Receiving Confirmations 81
4.47.4.5 Confirmation Timeouts 81
4.47.4.6 Receiving Acknowledgements 81
4.47.5 Alert State Machine 82
4.47.5.1 Alert State Diagram 82
4.47.5.2 Alert State Machine States 83
4.47.5.3 Alert State Machine Flags 84
4.47.5.4 Alert Value Mapping 84
4.47.5.5 Alert State Machine Reporting State 85
4.47.5.6 Alert State Machine Events 85
4.47.5.7 Alert State Machine Functions 86
4.47.5.8 Next State Transitions 87
4.47.5.9 Alert State Table 87
4.47.6 Alert Analog Formal Model 89
4.47.7 Alert Discrete Formal Model 89
4.47.8 Alert Update Formal Model 89
4.48 Alert Field Diagnostics Formal Model 90
4.49 View Object Formal Model 91
4.49.1 Attributes: 91
4.49.2 Services: 91
4.50 VIEW_1 Formal Model 91
4.50.1 Attributes: 91
4.51 VIEW_2 Formal Model 91
4.51.1 Attributes: 91
4.52 VIEW_3 Formal Model 91
4.52.1 Attributes: 91
4.53 VIEW_4 Formal Model 91
4.53.1 Attributes: 91
4.54 Domain Object Formal Model 92
4.54.1 Attributes: 92
4.54.2 Services: 92
4.54.3 Attribute Definitions: 92
4.54.3.1 DD Member Id 92
4.54.3.2 Index 92
4.54.3.3 Data Type 92
4.54.3.4 Max Octets 92
4.54.3.5 Domain State 92
4.54.3.6 Upload State 92
4.54.3.7 Counter 92
4.54.3.8 Usage 92
4.54.3.9 Storage 93
4.54.3.10 DD Item Id 93
5 Services 94
5.1 Overview 94
5.1.1 Interaction With FMS 94
5.1.1.1 FB_Read 95
5.1.1.2 FB_Write 95
5.1.1.3 FB_Tag 95
5.1.2 Other Interactions 95
5.2 Function Block Services and Protocol 95
5.3 Service Description 96
5.3.1 FB_Read 96
5.3.1.2 State Table 97
5.3.1.3 FB_Read Sequences 98
5.3.2 FB_Write 98
5.3.2.2 State Table 100
5.3.2.3 FB_Write Sequences 100
5.3.2.4 FB_Alert_Notify 101

5.3.2.5 State Table 101
5.3.2.6 FB_Alert_Ack 103
5.3.2.7 State Table 103
5.3.3 FB_Tag 105
5.3.3.2 State Table 106
5.3.3.3 FB_Tag Sequences 107
6 Function Block Mapping 108
6.1 Function Block Application Model 108
6.2 Data Types and Data Structures 108
6.3 Use of Object Extension 110
6.4 Definition 110
6.4.1 Attribute: Extension 110
6.4.1.1 Usage 110
6.4.1.2 Member Id 110
6.4.1.3 Item Id 110
6.5 OD Directory Object 111
6.5.1 Definition 112
6.5.1.1 Header 112
6.5.1.2 Composite List Directory Entries 112
6.5.1.3 Composite Directory Entries for Composite Lists 113
6.6 Block Definition 113
6.6.1.1 Block Object 113
6.6.1.2 Parameter Objects 113
6.6.2 Resource Block 113
6.6.3 Function Block 113
6.6.4 Transducer Block 113
6.7 Link Objects 113
6.8 Alert Object 114
6.9 View Objects 114
6.10 Domain Objects 114
6.11 SIS Link Object 114
7 Data Structure Definitions 115
7.1 Block Structure 115
7.2 Value & Status - Floating Point Structure 115
7.3 Value & Status - Discrete Structure 115
7.4 Value & Status - Bitstring Structure 116
7.5 Scaling Structure 116
7.6 Mode Structure 116
7.6.1 Access Permissions 117
7.6.2 Alarm Float Structure 117
7.6.3 Alarm Discrete Structure 117
7.6.4 Event Update Structure 118
7.6.5 Alarm Summary Structure 118
7.6.6 Alert Analog Structure 118
7.6.7 Alert Discrete Structure 119
7.6.8 Alert Update Structure 119
7.7 FB Link Structure 119
7.8 Simulate - Floating Point Structure 120
7.9 Simulate - Discrete Structure 120
7.10 Test Structure 120
7.11 Alarm Field Diagnostics Structure 121
7.12 Alert Field Diagnostics Structure 121
7.13 Field Diagnostics Simulate Structure 122
7.14 SIS Link Object 122
8 Specification Conformance 123

 © Fieldbus Foundation 1994-2012