Master Digital Physical Device Behaviors

Attributes	Definition
See physical device template (Device.wb3) for attributes	
Behaviors	
Access Control ( )	
Function Name	The identification of the specific function under review.
Inputs	
Input Description	The input signals including the electrical and encoding characteristics and maximum and minimum values.
Process	
Validate Access	The provisions required to prevent unauthorized operation or modification of the system or system parameters.
Change Access Criteria	The provisions required to prevent unauthorized changes to access criteria.
Initialization / Reset Mode	The condition that the function assumes upon startup or energization - both initially and after reset.
Outputs	
Output Description	The output signals to remotely indicate system and maintenance function status , including electrical and encoding characteristics and max. and min. values.
Actuate ( )	
Function Name	The identification of the function under review.
Inputs	
Actuator Type	The description of how the actuator performs its function (e.g., mechanical relay, solid-state current interrupter)
Possible States	The description of the possible switch states (e.g., trip, not-tripped, bypassed)
Process	
Type of state change	The form of transition between states (e.g, make before break, break before make)
Required state transitions	A description of which states must be reachable from each state
Performance	
Response Time	The time required after an abrupt change input until the output comes to rest a its new value
Outputs	
Trip Outputs	The output signals or commands to be provided by the device
Local Displays	The displays provided on the device to indicate the status of the actuation function.
Remote Outputs	The output signals to remotely indicate the status and results of the actuate function, including electrical and encoding characteristics and max. and min. values.
Calibrate ( )	Functions to allow removal of the capability of a channel to perform a protective action due to a requirement for replacement, repair, test, or calibration.
Inputs	
Manual Controls	Manual inputs to the functions. Typically the controls to initiate and remove bypass.
Process	
Determine Error	The description of the method to be used to determine measurement error.
Adjust	The description of the method to be used to adjust measurement error.
Outputs	
Displays	The display the measurement for use in calibration.
Channel Operational Bypass ( ) - For each operational bypass function the following constraints should be considered	
Function Name	The identification of the specific function under review.
Process	
Bypass Algorithm	The logical or mathematical description of the conditions under which division operational bypass is to occur.
Setpoint Algorithm	The algorithm that is used to calculate the bypass permissive setpoint (often setpoint = constant)
Performance	
Precision	The degree of exactness or discrimination with which a quantity is stated; for example a precision of 2 vs. 5 decimal places.
Response Time	The time required after an abrupt change input until the output comes to rest a its new value
Update Rate	The time required to obtain a collection of data
Channel Trip ( ) - For each trip function the following constraints should be considered	

Function Name	The identification of the specific function under review.
Process	
Trip Algorithm	The logical or mathematical description of the conditions under which trip is to occur.
Setpoint Algorithm	The algorithm that is used to calculate the setpoint (often setpoint = constant)
Performance	
Precision	The degree of exactness or discrimination with which a quantity is stated; for example a precision of 2 vs. 5 decimal places.
Response Time	The time required after an abrupt change input until the output comes to rest a its new value
Update Rate	The time required to obtain a collection of data
Digital Output ( ) -- For each output function the following constraints should be considered	
Function Name	The identification of the specific function under review.
Process	
Communications Protocol	The set of rules required of a functional unit to achieve communications with other elements of the system.
Initialization / Reset Mode	The condition that the function assumes upon startup or energization - both initially and after reset.
Outputs	
Output Description	The output signals to be produced in electrical and encoding characteristics of the output signal including maximum and minimum values.
Communications Protocol	The set of rules required of a functional unit to achieve communications with other elements of the system.
Performance	
Precision	The degree of exactness or discrimination with which a quantity is stated; for example a precision of 2 vs. 5 decimal places.
Response Time	The time required after an abrupt change input until the output comes to rest a its new value
Update Rate	The time required to obtain a collection of data
Display ( ) -- For each display function the following constraints should be considered	
Function Name	The identification of the specific function under review.
Process	
Display Algorithm	The function that describes the relationship between input conditions and the display. Typically a simple function such as "if bypass then display bypass."
Initialization / Reset Mode	The condition that the function assumes upon startup or energization - both initially and after reset.
Outputs	
Display Outputs	The description of the information to be displayed including formats, graphics, and navigation functions.
Performance	
Uncertainty	The allowable about by which the channel output is in doubt. Typically includes accuracy, environment effects, drift, etc.
Response Time	The time required after an abrupt change input until the output comes to rest a its new value
Update Rate	The time required to obtain a collection of data
Division Operational Bypass ( ) - For each operational bypass function the following constraints should be considered	
Function Name	The identification of the specific function under review.
Process	
Bypass Algorithm	The logical or mathematical description of the conditions under which division operational bypass is to occur.
Performance	
Response Time	The time required after an abrupt change input until the output comes to rest a its new value
Update Rate	The time required to obtain a collection of data
Division Trip ( ) - For each trip function the following constraints should be considered	
Function Name	The identification of the specific function under review.
Process	
Trip Algorithm	The logical or mathematical description of the conditions under which trip is to occur.
Performance	
Response Time	The time required after an abrupt change input until the output comes to rest a its new value
Update Rate	The time required to obtain a collection of data
Maintain ( )	
Function Name	The identification of the specific function under review.
Inputs	

Input Description	The input signals including the electrical and encoding characteristics and maximum and minimum values.
Communications Protocol	The set of rules required of a functional unit to achieve communications with other elements of the system.
Process	
Maintenance Process	The types of maintenance activities that are allowed.
Initialization / Reset Mode	The condition that the function assumes upon startup or energization - both initially and after reset.
Outputs	
Output Description	The output signals to be produced in electrical and encoding characteristics of the output signal including maximum and minimum values.
Communications Protocol	The set of rules required of a functional unit to achieve communications with other elements of the system.
Maintenance Bypass ( ) -- For each bypass function the following constraints should be considered	
Function Name	The identification of the specific function under review.
Inputs	
Manual Controls	The operator controls over maintenance bypass
Process	
Bypass algorithms	The relationship between input and the bypass/unbypass conditions. Typically a function of the manual bypass control and the status of redundant channels.
Initialization / Reset Mode	The condition that the function assumes upon startup or energization - both initially and after reset.
Outputs	
Trip Outputs	The condition the normal outputs assume during bypass.
Local Displays	The displays provided on the device to indicate the status and results of the bypass function.
Remote Outputs	The output signals to remotely indicate the status and results of the bypass, including electrical and encoding characteristics and max. and min. values.
Measure ( )	The initiation of a signal for the purpose of accomplishing a safety function.
Function Name	The identification of the function under review.
Inputs	
Parameter	The parameters or set of parameters to be measured
Span	The difference between the maximum and minimum values to be measured.
Rate of Change	The magnitude of change per unit time that the system must accommodate for a specified signal
Frequency Content	The signal bandwidth that must be maintained in the measurement
Process	
Convert input to electrical signal	The function describing the conversion between the process input and the electrical output.
Sensor Type	The physical principle used to perform the sense function (e.g., capacitance diaphragm, force balance, strain gauge, RTD)
Outputs	
Outputs	The output signals or commands to be provided by the system
Performance	
Uncertainty	The allowable about by which the channel output is in doubt. Typically includes accuracy, environment effects, drift, etc.
Response Time	The time required after an abrupt change input until the output comes to rest a its new value
Bandwidth	The range of frequencies within which the sensor performance meets other specification requirements.
Receive Analog Inputs ( ) -- For each input function the following constraints should be considered	
Function Name	The identification of the specific function under review.
Inputs	
Input Description	The input signals including the electrical and encoding characteristics and maximum and minimum values.
Process	
Data Validation	The methods used to authenticate data.
Performance	
Precision	The degree of exactness or discrimination with which a quantity is stated; for example a precision of 2 vs. 5 decimal places.
Update Rate	The time required to obtain a collection of data
Receive Binary Inputs ( ) -- For each input function the following constraints should be considered	
Function Name	The identification of the specific function under review.
Inputs	
Input Description	The electrical and encoding characteristics of the input signal including maximum and minimum values.

Process	
Data Validation	The methods used to authenticate data.
Performance	
Precision	The degree of exactness or discrimination with which a quantity is stated; for example a precision of 2 vs. 5 decimal places.
Update Rate	The time required to obtain a collection of data
Receive Digital Inputs ( ) -- For each input fun	The initiation of a signal for the purpose of accomplishing a safety function.
Function Name	The identification of the specific function under review.
Inputs	
Input Description	The input signals including the electrical and encoding characteristics and maximum and minimum values.
Process	
Communications Protocol	The set of rules required of a functional unit to achieve communications with other elements of the system.
Data Validation	The methods used to authenticate data.
Performance	
Precision	The degree of exactness or discrimination with which a quantity is stated; for example a precision of 2 vs. 5 decimal places.
Update Rate	The time required to obtain a collection of data
Test ( ) -- For each test function the following constraints should be considered	
Function Name	The identification of the specific function under review.
Inputs	
Manual Controls	The operator controls over test performance
Process	
Test Process	The description of the testing to be performed including sequencing, and scheduling.
Initialization / Reset Mode	The condition that the function assumes upon startup or energization - both initially and after reset.
Outputs	
Functional Outputs	The condition the normal outputs assume during testing.
Local Displays	The displays provided on the device to indicate the status and results of the test function.
Remote Outputs	The output signals to remotely indicate the status and results of the test function, including electrical and encoding characteristics and max. and min. values.
Performance	
Uncertainty	The allowable about by which the test results are in doubt. Typically includes accuracy, environment effects, drift, etc.
Test Completion Time	The time allowed for test performance, particularly automatic test performance.
Test Frequency	The frequency at which testing is repeated.
Test ( )	
Inputs	
Manual Controls	The operator controls over test performance
Process	
Test Process	The description of the testing to be performed including sequencing, and scheduling.
Outputs	
Functional Outputs	The condition the normal outputs assume during testing.
Local Displays	The displays provided on the device to indicate the status and results of the test function.
Remote Outputs	The output signals to remotely indicate the status and results of the test function, including electrical and encoding characteristics and max. and min. values.
Functional Test ( )	
Inputs	
Manual Controls	Manual inputs to the functions. Typically the controls to initiate bypass.
Process	
Test Process	The description of the tests to be performed including pass / fail criteria.
Outputs	
Action on Test Failure	The automatic actions, e.g. trip or bypass (if any) taken upon test failure.
Displays	The displays of test results or test status.

Master Digital Physical Device Behaviors

Attributes	Typical Source of Constraints	Typical Location of Constraints	Comments
See physical device template (Device.wb3) for attributes			
Behaviors			
Access Control ( )			
Function Name	Security Analysis	Protection System Specification	
Inputs			
Input Description	Integrity strategies	Protection System Specification	
Process			
Validate Access	Integrity strategies	Protection System Specification	
Change Access Criteria	Integrity strategies	Protection System Specification	
Initialization / Reset Mode	Defined safe state	Protection System Specification	
Outputs			
Output Description	Integrity strategies	Protection System Specification	
Actuate ( )			
Function Name	Accident analysis assumptions	Protection System Specification	
Inputs			
Switch Type	Task Analysis	Protection System Specification	
Possible States	Task Analysis	Protection System Specification	
Process			
Type of state change	Design decision	Protection System Specification	
Required state transitions	Accident analysis assumptions	Protection System Specification	
Performance			
Response Time	Accident analysis assumptions	Protection System Specification	
Outputs			
Trip Outputs	Interface requirements	Protection System Specification	
Local Displays	Task Analysis	Protection System Specification	
Remote Outputs	Task Analysis	Protection System Specification	
Calibrate ( )			Often the calibrate function will not be part of the sensor.
Inputs			
Test Inputs	Design Decision	Protection System Specification	
Process			
Determine Error	Maintenance Task Analysis	Protection System Specification	
Adjust	Maintenance Task Analysis	Protection System Specification	
Outputs			
Displays	Maintenance Task Analysis	Protection System Specification	
Channel Operational Bypass ( ) - For each operational bypass function the following constraints should be considered			
Function Name	Assumed safety functions	Protection System Specification	
Process			
Bypass Algorithm	Assumed safety functions	Protection System Specification	
Setpoint Algorithm	Assumed safety functions	Protection System Specification	
Performance			
Precision	System uncertainty requirements	Setpoint Analysis	
Response Time	Function delay time assumption	Protection System Specification	
Update Rate	System bandwidth & response time	Protection System Specification, Setpoint Analysis	
Channel Trip ( ) - For each trip function the following constraints should be considered			
Function Name	Assumed safety functions	Protection System Specification	
Process			
Trip Algorithm	Assumed safety functions	Setpoint Analysis, Protection System Specification	

Setpoint Algorithm	Assumed safety functions	Setpoint Analysis, Protection System Specification	
Performance			
Precision	System uncertainty requirements	Setpoint Analysis	
Response Time	Function delay time assumption	Setpoint Analysis, Protection System Specification	
Update Rate	System bandwidth & response time	Protection System Specification, Setpoint Analysis	
Digital Output ( ) -- For each output function the following constraints should be considered			
Function Name	Assumed safety functions	Protection System Specification	
Process			
Communications Protocol	Error rates & determinism requirements	Protection System Specification	
Initialization / Reset Mode	Defined safe state	Protection System Specification	
Outputs			
Output Description	Noise immunity & failure mode requirements	Protection System Specification	
Communications Protocol	Error rates & determinism requirements	Protection System Specification	
Performance			
Precision	System uncertainty requirements	Setpoint Analysis	
Response Time	Function delay time assumption	Protection System Specification	
Update Rate	System bandwidth & response time	Protection System Specification, Setpoint Analysis	
Display ( ) -- For each display function the following constraints should be considered			
Function Name	Operator task analysis	Protection System Specification	
Process			
Display Algorithm	Operator task analysis	Protection System Specification	
Initialization / Reset Mode	Operator task analysis	Protection System Specification	
Outputs			
Display Outputs	Operator task analysis, Human factors standards	Protection System Specification	
Performance			
Uncertainty	Operator task analysis	Protection System Specification	
Response Time	Operator task analysis, Human factors standards	Protection System Specification	
Update Rate	Operator task analysis, Human factors standards	Protection System Specification	
Division Operational Bypass ( ) - For each operational bypass function the following constraints should be considered			
Function Name	Assumed safety functions	Protection System Specification	
Process			
Bypass Algorithm	Assumed safety functions	Protection System Specification	
Performance			
Response Time	Function delay time assumption	Protection System Specification	
Update Rate	System bandwidth & response time	Protection System Specification, Setpoint Analysis	
Division Trip ( ) - For each trip function the following constraints should be considered			
Function Name	Assumed safety functions	Protection System Specification	
Process			
Trip Algorithm	Assumed safety functions	Protection System Specification	
Performance			
Response Time	Function delay time assumption	Protection System Specification	
Update Rate	System bandwidth & response time	Protection System Specification, Setpoint Analysis	
Maintain ( )			
Function Name	Maintenance task analysis	Protection System Specification	
Inputs			
Input Description	Maintenance task analysis	Protection System Specification	
Communications Protocol	Error rates & determinism requirements	Protection System Specification	
Process			
Maintenance Process	Maintenance task analysis	Protection System Specification	
Initialization / Reset Mode	Maintenance task analysis	Protection System Specification	

Outputs			
Output Description	Maintenance task analysis	Protection System Specification	
Communications Protocol	Error rates & determinism requirements	Protection System Specification	
Maintenance Bypass ( ) -- For each bypass function the following constraints should be considered			
Function Name	Maintenance task analysis	Protection System Specification	
Inputs			
Manual Controls	Maintenance task analysis	Protection System Specification	
Process			
Bypass algorithms	Integrity strategies	Protection System Specification	
Initialization / Reset Mode	Defined safe state	Protection System Specification	
Outputs			
Trip Outputs	Defined safe state	Protection System Specification	
Local Displays	Maintenance task analysis	Protection System Specification	
Remote Outputs	Maintenance task analysis	Protection System Specification	
Measure ( )			
Function Name	Accident analysis assumptions	Protection System Specification	
Inputs			
Parameter	Accident analysis assumptions	Protection System Specification	
Span	Accident analysis results (bounds of accident and normal values)	Protection System Specification	
Rate of Change	Accident analysis results (measured from transient curves)	Protection System Specification	
Frequency Content	Accident analysis results (calculated from transient curves)	Protection System Specification	
Process			
Convert input to electrical signal	Accident analysis results (calculated from transient curves)	Protection System Specification	
Sensor Type	Accident analysis assumptions	Protection System Specification	Typically sensor type is not a safety constraint provided other constraints are met.
Outputs			
Outputs	Accident analysis assumptions	Protection System Specification	
Performance			
Uncertainty	Accident analysis assumptions	Protection System Specification	
Response Time	Accident analysis assumptions	Protection System Specification	
Bandwidth	Input Rate of Change and Frequency Content	Protection System Specification	
Receive Analog Inputs ( ) -- For each input function the following constraints should be considered			
Function Name	Assumed safety functions	Protection System Specification	
Inputs			
Input Description	Noise immunity & failure mode requirements	Protection System Specification	
Process			
Data Validation	Reliability Strategy	Protection System Specification	
Performance			
Precision	System uncertainty requirements	Setpoint Analysis	
Update Rate	System bandwidth & response time	Protection System Specification, Setpoint Analysis	
Receive Binary Inputs ( ) -- For each input function the following constraints should be considered			
Function Name	Assumed safety functions	Protection System Specification	
Inputs			
Input Description	Noise immunity & failure mode requirements	Protection System Specification	
Process			
Data Validation	Reliability Strategy	Protection System Specification	

Performance			
Precision	System uncertainty requirements	Setpoint Analysis	
Update Rate	System bandwidth & response time	Protection System Specification, Setpoint Analysis	
Receive Digital Inputs ( ) -- For each input function the following constraints should be considered			
Function Name	Assumed safety functions	Protection System Specification	
Inputs			
Input Description	Noise immunity & failure mode requirements	Protection System Specification	
Process			
Communications Protocol	Error rates & determinism requirements	Protection System Specification	
Data Validation	Reliability strategy	Protection System Specification	
Performance			
Precision	System uncertainty requirements	Setpoint Analysis	
Update Rate	System bandwidth & response time	Protection System Specification, Setpoint Analysis	
Test ( ) -- For each test function the following constraints should be considered			
Function Name	Integrity strategies	Protection System Specification	
Inputs			
Manual Controls	Integrity strategies	Protection System Specification	
Process			
Test Process	Integrity strategies	Protection System Specification	
Initialization / Reset Mode	Defined safe state	Protection System Specification	
Outputs			
Functional Outputs	Defined safe state	Protection System Specification	
Local Displays	Operator task analysis	Protection System Specification	
Remote Outputs	Operator task analysis	Protection System Specification	
Performance			
Uncertainty	Integrity strategies	Protection System Specification	
Test Completion Time	Allowed out-of service time	Protection System Specification	
Test Frequency	Reliability assumptions	Protection System Specification	
Test ( )			
Inputs			
Manual Controls	Maintenance Task Analysis	Protection System Specification	
Process			
Test Process	Integrity Strategies		
Outputs			
Functional Outputs	Maintenance Task Analysis	Protection System Specification	
Local Displays	Maintenance Task Analysis	Protection System Specification	
Remote Outputs	Task Analysis	Protection System Specification	
Functional Test ( )			Many sensors will not have a distinct functional test capability.
Inputs			
Manual Controls	Design Decision	Protection System Specification	
Process			
Test Process	Integrity Strategy	Protection System Specification	
Outputs			
Action on Test Failure	Tech Specs	Protection System Specification	
Displays	Maintenance Task Analysis	Protection System Specification	

Master Digital Physical Device Behaviors

Attributes	Safety Constraint	Source	Actual Requirement	Source	Constraints Met?	Comments
See physical device template (Device.wb3) for attributes						
Behaviors						

Access Control ( )						
Function Name						
Inputs						
Input Description						
Process						
Validate Access						
Change Access Criteria						
Initialization / Reset Mode						
Outputs						
Output Description						
Actuate ( )						
Function Name						
Inputs						
Actuator Type						
Possible States						
Process						
Type of state change						
Required state transitions						
Performance						
Response Time						
Outputs						
Trip Outputs						
Local Displays						
Remote Outputs						
Calibrate ( )						
Inputs						
Test Inputs						
Process						
Determine Error						
Adjust						
Outputs						
Displays						
Channel Operational Bypass ( ) - For each operational bypass function the following constraints should be considered						
Function Name						
Process						
Bypass Algorithm						
Setpoint Algorithm						
Performance						
Precision						
Response Time						
Update Rate						
Channel Trip ( ) - For each trip function the following constraints should be considered						
Function Name						
Process						
Trip Algorithm						
Setpoint Algorithm						
Performance						
Precision						
Response Time						
Update Rate						

Digital Output ( ) -- For each output function the following constraints should be considered						
Function Name						
Process						
Communications Protocol						
Initialization / Reset Mode						
Outputs						
Output Description						
Communications Protocol						
Performance						
Precision						
Response Time						
Update Rate						
Display ( ) -- For each display function the following constraints should be considered						
Function Name						
Process						
Display Algorithm						
Initialization / Reset Mode						
Outputs						
Display Outputs						
Performance						
Uncertainty						
Response Time						
Update Rate						
Division Operational Bypass ( ) - For each operational bypass function the following constraints should be considered						
Function Name						
Process						
Bypass Algorithm						
Performance						
Response Time						
Update Rate						
Division Trip ( ) - For each trip function the following constraints should be considered						
Function Name						
Process						
Trip Algorithm						
Performance						
Response Time						
Update Rate						
Maintain ( )						
Function Name						
Inputs						
Input Description						
Communications Protocol						
Process						
Maintenance Process						
Initialization / Reset Mode						
Outputs						
Output Description						
Communications Protocol						
Maintenance Bypass ( ) -- For each bypass function the following constraints should be considered						
Function Name						

Inputs						
Input Description						
Process						
Bypass algorithms						
Initialization / Reset Mode						
Outputs						
Trip Outputs						
Local Displays						
Remote Outputs						
Measure ( )						
Function Name						
Inputs						
Parameter						
Span						
Rate of Change						
Frequency Content						
Process						
Convert input to electrical signal						
Sensor Type						
Outputs						
Outputs						
Performance						
Uncertainty						
Response Time						
Bandwidth						
Receive Analog Inputs ( ) -- For each input function the following constraints should be considered						
Function Name						
Inputs						
Input Description						
Process						
Data Validation						
Performance						
Precision						
Update Rate						
Receive Binary Inputs ( ) -- For each input function the following constraints should be considered						
Function Name						
Inputs						
Input Description						
Process						
Data Validation						
Performance						
Precision						
Update Rate						
Receive Digital Inputs ( ) -- For each input function the following constraints should be considered						
Function Name						
Inputs						
Input Description						
Process						
Communications Protocol						
Data Validation						

Performance						
Precision						
Update Rate						
Test ( ) -- For each test function the following constraints should be considered						
Function Name						
Inputs						
Manual Controls						
Process						
Test Process						
Initialization / Reset Mode						
Outputs						
Trip Outputs						
Local Displays						
Remote Outputs						
Performance						
Uncertainty						
Response Time						
Update Rate						
Test ( )						
Inputs						
Manual Controls						
Process						
Test Process						
Outputs						
Functional Outputs						
Local Displays						
Remote Outputs						
Functional Test ( )						
Inputs						
Manual Controls						
Process						
Test Process						
Outputs						
Action on Test Failure						
Displays						