# System Definitions

## Status Variable Definitions

Status Variables are read-only values communicated to the host such as sensor readings or the clock value.

* Read-only communicated to the host
  + Sensor readings
  + Clock value
  + Status Variables can also include data that describes the equipment such as a list of the data collection events which are currently enabled for reporting.

Examples: Time since process start, coolant flow, coolant temp, current, voltage, etc.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| GEM ID | Human Readable  Name | Format[[1]](#endnote-2) | Units | Value  Range | Comments |
|  | System State | UByte |  | 0-4 | 0=Unknown  1=Initializing  2=Idle  3=Processing  4=Paused  5=Fault  6=Editing  7=Locked |
|  | Chiller State | UByte |  | 0-2 | 0=Unknown  1=Idle  2=Chilling |
|  | Process Count | ULong | Each | Full | Number of processes run since last reset |
|  | User Level | UByte | ms | 0-2 | 0=None  1=Operator  2=Engineer |
|  | Control State | UByte |  | 0-2 | 0=Unknown  1=Off  2=On |
|  | Selected Recipe | String |  |  | Selected recipe ID |
|  | Recipe List | String |  |  | Delineated string of current recipies |

## Data Variable Definitions

* Read Only Data items that can be gathered when an equipment event occurs. This data is only guaranteed to be valid in the context of the event. The value of this Data Variable is only valid in the context of the event. The value is transient and valid only at the time the event occurred so polling the value at a different time may have invalid or unexpected data.
* The Data Variables defined here will be used to define Event Reports that are sent as part of Event and Alarm notifications

Examples: Over current value, High coolant temp. value, Low Coolant flow value

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| GEM ID | Human Readable  Name | Formati | Units | Value  Range | Comments |
|  | Agitator Speed | UFloat | % | 0-100 | Speed of the agitator |
|  | Step ID | UShort |  | Full |  |
|  | Step Time | UInt | ms | Full |  |
|  | Process Time | UInt | ms | Full |  |
|  | Flow Rate High SP | UFloat | LPM | 0-100 |  |
|  | Flow Rate Low SP | UFloat | LPM | 0-100 |  |
|  | Flow Rate | UFloat | LPM | 0-100 | Flow rate of the fluid through the chiller |
|  | Conductivity | UFloat | mS | 0-200 | Conductivity of the fluid |
|  | Voltage Set Point | UFloat | VDC | 0-40 | Desired processing voltage |
|  | Voltage Feedback | UFloat | VDC | 0-40 | Measured processing voltage |
|  | Current Set Point | UFloat | ADC | 0-150 | Desired processing current |
|  | Current Feedback | UFloat | ADC | 0-150 | Measured processing current |
|  | Temperature SP | UFloat | °C | 0-100 | Temperature Set Point |
|  | Bath Temperature | Float | °C | 0-100 | Temperature of the fluid |
|  | Temperature Low SP | UFLoat | °C | 0-100 | Temp low setpoint |
|  | Temperature High SP | UFloat | °C | 0-100 | Temp high setpoint |
|  | Error Message | String |  |  |  |

## Equipment Constant Definitions

* Values that the host can change within limits specified by the equipment.
* Equipment Constant Values are specified to be only single values and not lists of values or arrays of values.

Examples: Process runtime, Over-current high limit value, Low Coolant flow limit value

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| GEM ID | Human Readable  Name | Formati | Units | Value  Range | Comments |
|  | Status Report Interval | UShort | ms | 100-60000  Default=1000 | Status report even interval time |
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## Collection Event Definitions

Collection events allow tracking of what the equipment is doing in real time.  A collection event is a notification. Its purpose is to notify the host when something of interest happens at the equipment. For example, collection events can report when material arrived, a consumable is running low, a hardware problem occurred, a camera inspected the material, the material is ready to be removed, a chamber reached the target vacuum pressure, processing completion, processing milestones, count cycles of activity, etc. The equipment can use the collection event feature to report when anything of interest happens.

|  |  |  |  |
| --- | --- | --- | --- |
| GEM ID | Human Readable  Name | Associated  Data[[2]](#endnote-3) | Comments |
|  | Process Status Changed | Process State  Selected Recipe |  |
|  | Recipe Changed | New Recipe File |  |
|  | Status Changed | All status data |  |
|  | Recipe List Changed | New Recipe List |  |
|  | Log In | User Level |  |
|  | Log Out/Shut Down | User Level=0 |  |
|  | Control State Changed | Control State |  |
|  | Process Completed | Selected Recipe  Process Count |  |
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## Alarm Definitions

An alarm is related to any abnormal situation on the equipment that may endanger people, equipment, or material being processed" [SEMI E30, 2]. GEM allows the host to be notified when alarm conditions are detected and cleared.

* Each alarm has two associated state model. ALARM SET (occurrence) and ALARM CLEAR (clearance)
* Each AlarmSet and AlarmClear has an associated Collection Event.

Examples: Low coolant Flow, No coolant flow, Coolant over temp. , Coolant under temp, Over Voltage, Under Voltage, Process Manually Aborted

|  |  |  |  |
| --- | --- | --- | --- |
| GEM ID | Human Readable  Name | Associated  Dataii | Comments |
|  | Out of temp range | Temperature Low/High SP  Bath Temperature |  |
|  | E-Stop |  | Only when control state is “off” |
|  | Internal Comms Error | Error Message | Error Message=”” on Clear |
|  | Other Error | Error Message | Error Message=”” on Clear |
|  | Flow Rate Low | Flow Rate Low SP  Flow Rate |  |
|  | Flow Rate High | Flow Rate High SP  Flow Rate |  |
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Application Data Sources

One Possible data source:

* frmInterface.bwMonitorRIO\_DoWork
  + calls clsBurlyticSystem.clsMonitorRIO in a 100ms loop to get updates from the RIO.
  + Can get a reference to this object passed to SECS/GEM thread?
  + Object will need new public methods defined to expose private data member below.

| Data Source | SECS/GEM Var | Type | New? | Done? |
| --- | --- | --- | --- | --- |
| clsTemperatureController.IsChillerOn | Chiller State | SV |  | Yes |
| TBD | Recipe List | SV |  | Yes |
| frmInterface.SelectedProcess.ID | Selected Recipe | SV |  | Yes |
| frmInterface.ProcessCount | Process Count | SV | Yes | Yes |
| frmInterface.SystemState | System State | SV |  | Yes |
| frmInterface.ProcessStopWatch.ElapsedMilliseconds | Process Time | SV |  | Yes |
| frmInterface.ControlIsOn | Control State | SV |  | Yes |
| frmInterface.UserLevel | User Level | SV |  | Yes |
|  |  |  |  |  |
| clsMonitorStatus.Temperature | Bath Temperature | DV |  | Yes |
| clsMonitorStatus.Conductivity | Conductivity | DV |  | Yes |
| clsMonitorStatus.Voltage | Voltage Feedback | DV |  | Yes |
| clsMonitorStatus.Current | Current Feedback | DV |  | Yes |
| clsMonitorStatus.FlowRate | Flow Rate | DV | Yes | Yes |
| clsMonitorStatus.VoltageSetPoint | Voltage Set point | DV |  | Yes |
| clsMonitorStatus.CurrentSetPoint | Current Set Point | DV |  | Yes |
| clsMonitorStatus.AgitatorSpeed | Agitator Speed | DV |  | Yes |
| clsTempContr.SetPoint | Temperature SP | DV |  | Yes |
| clsTempContr.SetPoint + clsTempContr.WarningRange | Temperature High SP | DV |  | Yes |
| clsTempContr.SetPoint + clsTempContr.WarningRange | Temperature Low SP | DV |  | Yes |
| frmInterface.UIException[[3]](#footnote-2) | Error Message | DV |  | Yes |
| Not implemented | Flow Rate High SP | DV |  | Yes |
| Not implemented | Flow Rate Low SP | DV |  | Yes |
| frmInterface.SelectedStepIndex | Step ID | DV |  | Yes |
| frmInterface.StepStopWatch.ElapsedMilliseconds | Step Time | DV |  | Yes |
|  |  |  |  |  |
| SECS/GEM Host (Default value = ?) | Status Report Interval | EC |  | Yes |
|  |  |  |  |  |
| frmInterface.RecipeChanged | Recipe Changed | CE |  | Yes |
| Auto generated every Status Report Interval | Status Changed | CE |  | Yes |
| Not Implemented | Control State Changed | CE |  | Yes |
|  | Process Status Changed | CE |  | Yes |
|  | Recipe List Changed | CE |  | Yes |
|  | Log In | CE |  | Yes |
|  | Log Out/Shut Down | CE |  | Yes |
|  | Process Completed | CE |  | Yes |
|  |  |  |  |  |
| objTemperatureController.SetPoint | Temp out of range | AE |  | Yes |
| Not implemented | E-Stop | AE |  | No |
| frmInterface.ExceptionOccurred | Other Error | AE |  | Yes |
|  | Internal Comm Error | AE |  | Yes |
| Calculate: Flow Rate < Flow Rate SP | Flow Rate Low | AE |  | No |
| Calculate: Flow Rate > Flow Rate SP | Flow Rate High | AE |  | No |

1. Format Notes:

   * Data formats can be simple (numeric, ASCII, Boolean) or complex (arrays, lists, structures). For example, numeric types can be I1, I2, I4, I8 (signed integer types of different byte length), U1, U2, U4, U8 (unsigned integer types) and F4 or F8 (floating point types).
   * List and array types contain multiple values in the data item. For example, image data would be formatted as a byte array.

   Structure types contain a specific type of data. For example, a variable may represent a slot map which contains carrier information as well as a list of slots and their wafer placement status. [↑](#endnote-ref-2)
2. List the specific data that can be reported with the Collection Event. Define all the equipment’s available. Define all of the equipment’s Status Variables in the Status Variable Table, Define, Define all of the equipment’s Equipment Constants in the Equipment Constant table. To be able to reference the variable back to the table it is defined in put a SV, EC notation after each listed variable. For example v1 – DV, v2 – DV, v3 – SV, v4 – SV, v5 – EC. [↑](#endnote-ref-3)
3. to parse out full message from inner exceptions. See frmInterface.ExceptionHandler for example [↑](#footnote-ref-2)