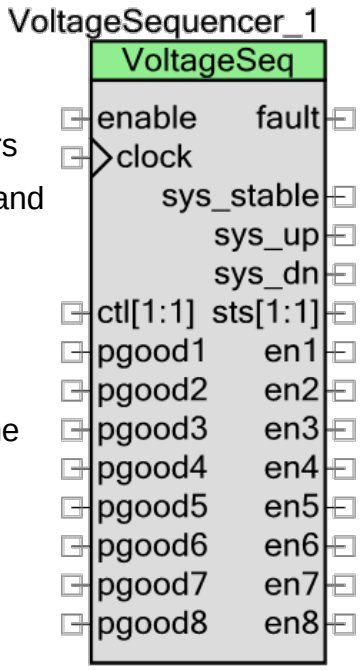
Voltage Sequencer

2.0



Features

- Supports sequencing and monitoring of up to 32 power converters
- Supports voltage regulator circuits with logic-level enable inputs and logic-level “power good” status outputs
- Capable of interacting with a variety of host communications interface including I^2C, SMBus or PMBus
- Autonomous (standalone) or host driven operation
- Sequence timing, order and dependencies can be entered into the customizer simplifying the usage model

General Description

The Voltage Sequencer component provides a simple way to define power-up and power-down sequencing of up to 32 power converters to meet system requirements. Sequence timing, order and dependencies can be entered into the customizer simplifying the usage model for the user. The component will automatically take care of sequencing without requiring any firmware development by the user.

When to Use an Voltage Sequencer

- The component can exist standalone in a PSoC Creator design project whereby it interacts solely with the external power converters. The Voltage Sequencer has control over the enable terminals of the power converters and monitors their power good (pgood) terminals to confirm their health.

- This component can co-exist and interoperate with the Power Monitor component whereby the Voltage Sequencer controls the enable terminals of the power converters and the Power Monitor component measures power converter output voltages and load currents to determine their health. In that case, there are internal pgood wire connections between the 2 components.

- This component can co-exist and interoperate with the Voltage Fault Detector component whereby the Voltage Sequencer controls the enable terminals of the power converters and the Voltage Fault Detector component checks power converter output voltages to

determine their health. In that case, there are internal pgood wire connections between the 2 components.

- This component can co-exist with the Power Monitor and the Voltage Fault Detector components simultaneously where the pgood outputs from those components are logically ANDed together to create a composite pgood signal that gets input to the Voltage Sequencer component.
- The component shall be capable of interacting with a variety of host communications interface including (but not limited to) I^2C, SMBus (System Management Bus) or PMBus (Power Management Bus).
- Multiple instantiations of this component are not allowed in a single design project. Independent sequencing of independent groups of power converters can be supported with a single component instantiation.

Input/Output Connections

This section describes the various input and output connections for the Voltage Sequencer component. An asterisk (*) in the list of I/Os indicates that the I/O may be hidden on the symbol under the conditions listed in the description of that I/O.

Enable – Input

Global enable pin that can optionally be used to initiate a power up sequence or a power down sequence**.**

Clock – Input

Timing source used by the component.

System Stable – Output

Active high signal is asserted when system has been up for a user-defined amount of time.

System Up – Output

Active high signal is asserted when all power converters are in the ON state and are within normal operating conditions.

System Down – Output

Active high signal is asserted when all power converters are in the OFF state.

Warning – Output *

Active high signal is asserted when one or more power converters did not shut down within the **TOFF_MAX_WARN_LIMIT** time period. Displays if you deselect checkbox under the **Disable TOFF_MAX warnings** parameter.

Fault – Output

Active high signal is asserted when a fault condition on one or more power converters. It must be avoided to connect this terminal to an interrupt component since the component has a buried ISR that needs to respond to faults as soon as possible. The intended usage model for this terminal is driving other logic or pins.

Sequencer Control Inputs – Input *

General purpose inputs with user defined polarity that may be used to gate power-up sequencing state changes, to force partial or complete power-down sequencing or both. Displays if you set nonzero value under **the Number of control inputs** parameter.

Sequencer Status Outputs – Output *

General purpose outputs with user defined polarity that can be asserted and de-asserted at any point throughout the sequencing process to notify external components of the sequencer's progress. Displays if you set nonzero value under **the Number of status outputs** parameter.

Power Converter Enables – Output

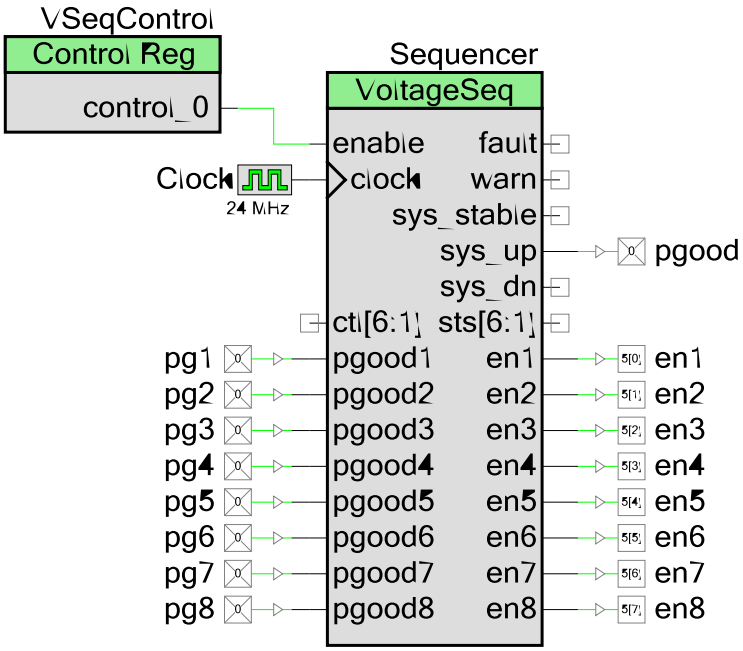
Power converter enable outputs. When asserted, these outputs are intended to enable the selected power converter to begin regulating power to its output.

Power Converter Power Goods – Input

Power converter power good status inputs. These signals may come directly from the power converter status output pins or be derived inside PSoC from ADC monitoring of power converter voltage outputs (e.g. **PowerMonitor** component) or OV/UV window comparator range detection (e.g. **VoltageFaultDetector** component).

Schematic Macro Information

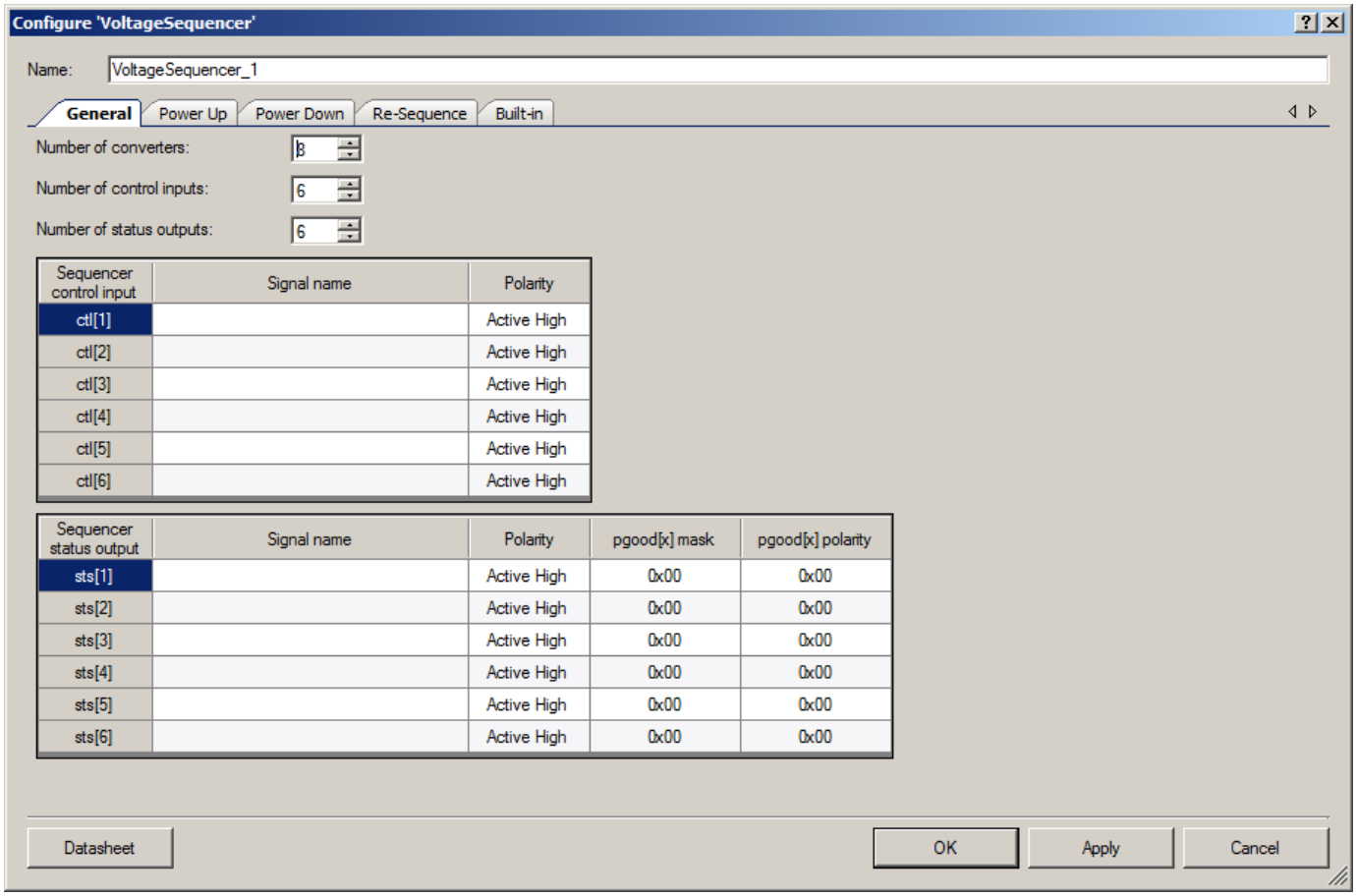
The default Voltage Sequencer in the Component catalog is a schematic macro using Voltage Sequencer with default settings. It is connected with Control Register, Clock source and I/O pins.



Component Parameters

Drag a Voltage Sequencer component onto your design and double click it to open the Configure dialog. This dialog has three tabs to guide you through the process of setting up the Voltage Sequencer component.

General Tab



Number of converters

Number of power converters to sequence. Range=1-32. (Default=8).

Number of control inputs

Number of general purpose control inputs. Range=0-6. (Default=1).

Number of status outputs

Number of general purpose status outputs. Range=0-6. (Default=1).

ctl[x] Signal name

Text field, 16 characters. Annotation purposes only. By default this field is empty and no value is required. Grayed out depending on Number of control inputs parameter.

ctl[x] Polarity

Options=Active High or Active Low. Grayed out depending on Number of control inputs parameter. (Default = Active High).

sts[x] Signal name

Text field, 16 characters. Annotation purposes only. By default this field is empty and no value is required. Grayed out depending on Number of status outputs parameter.

sts[x] Polarity

Options=Active High or Active Low. Grayed out depending on Number of status outputs parameter. (Default = Active High).

pgood[x] mask

Hexadecimal encoding of which pgood[x] signals participate in the logic equation for the sts[x] output where bit 0 corresponds to pgood[1] and bit 31 corresponds to pgood[32]. The encoding value will display 2, 4, 6 or 8 hex digits depending on the Number of converters parameter. The encoding for each bit is as follows:

1=pgood[x] participates

0=pgood[x] does not participate

Hexadecimal encoding can be entered manually, or helper form can be used to select the participating pgood[x] signals from the array.

Grayed out depending on NumStsOutputs parameter.

(Default = 0)

The associated sts[x] is the logical AND of the pgood[x] status of the selected power converters.

pgood[x] polarity

Hexadecimal encoding of the polarity of the pgood[x] signal that will be used in the logic equation for the sts[x] output. Bit 0 corresponds to pgood[1] and bit 31 corresponds to pgood[32]. The encoding value will display 2, 4, 6 or 8 hex digits depending on the Number of converters parameter. The encoding for each bit is as follows:

1=use the true pgood[x] in the logic equation

0=use the inverted pgood[x] in the logic equation

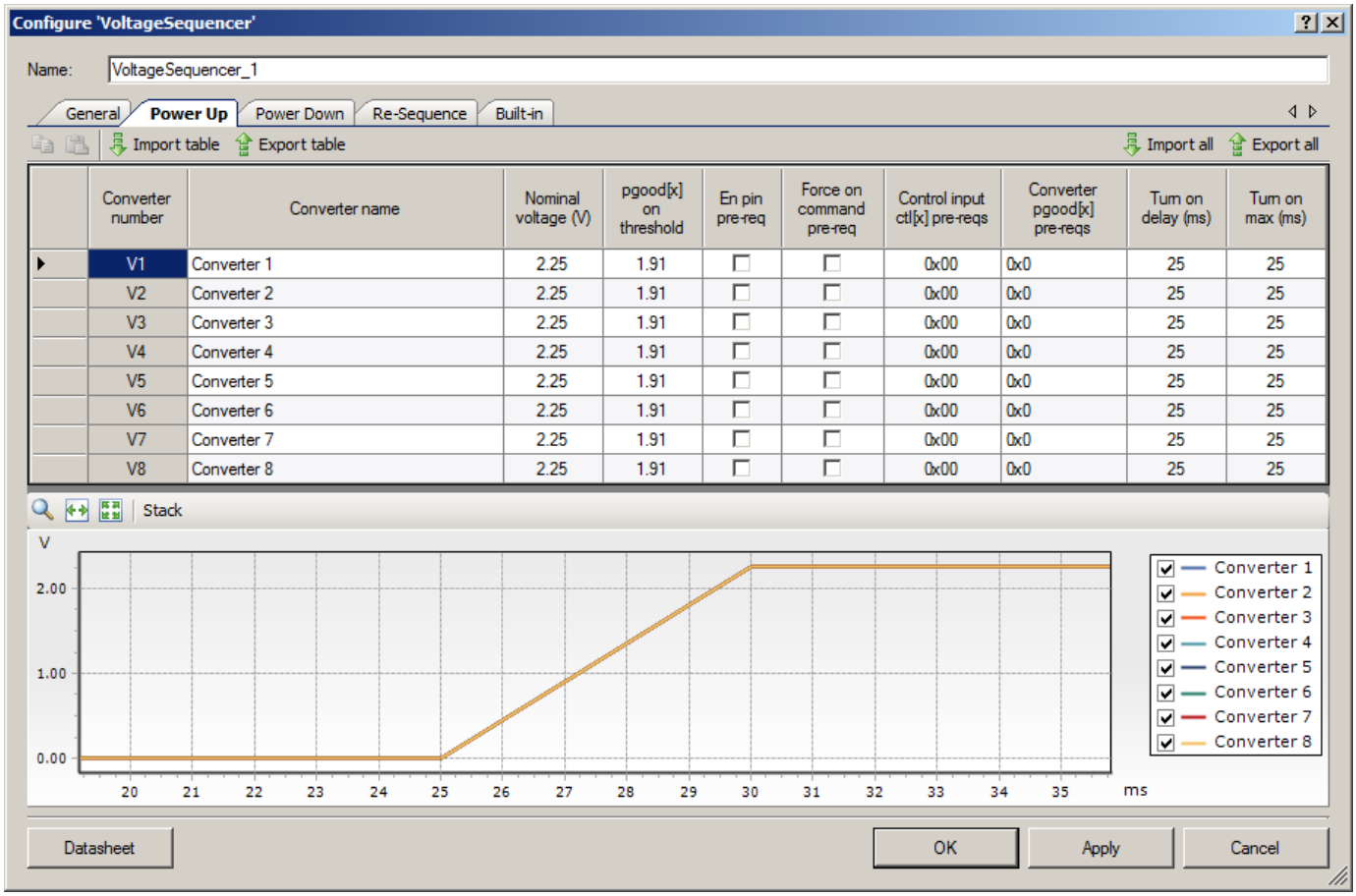
Hexadecimal encoding can be entered manually, or helper form can be used to select the participating pgood[x] signals from the array.

Grayed out depending on Number of status outputs parameter.

(Default = 0)

The associated sts[x] is the logical AND of the pgood[x] status of the selected power converters.

Power Up Tab



Converter name

Text field, 16 characters. Annotation purposes only. By default this field is empty and no value is required.

Nominal Voltage (V)

Nominal converter output voltage. Annotation purposes only. Range=0.01–65.54.

pgood[x] on threshold

Minimum converter output voltage required to be considered good during power up sequencing. Range=0.01–65.54. Must be <= VNom[x].

En pin pre-req

When true, the associated state machine's reset state is OFF. If ForceOnCmd[x] is also true, then the state machine waits for the enable pin to toggle from low to high –or– must wait for a host initiated command in order to transition to the PEND_ON state. If ForceOnCmd[x] is false,

then the state machine only needs to wait for enable pin to toggle from low to high. Options = True or False. (Default = False).

Force on command pre-req

When true, the associated state machine's reset state is OFF. If enPin[x]is also true, then the state machine waits for the enable pin to toggle from low to high –or–waits for a host initiated command in order to transition to the PEND_ON state. If enPin[x] is false, then the state machine only needs to wait for enable pin to toggle from low to high. Options = True or False. (Default = False).

Control input ctl[x] pre-reqs

Bitmask representing the ctl[x] inputs that will be pre-requisites for the associated power converter. The number of columns displayed in this section depends on the Number of control inputs parameter from the General Tab. Bit=1 -> ctl[x] input is a pre-requisite. Bit=0 -> ctl[x] input is not a pre-requisite. (Default = 0).

Converter pgood[x] pre-reqs

Bitmask representing the pgood[x] inputs that will be pre-requisites for the associated power converter Bit=1 -> pgood[x] input is a pre-requisite. Bit=0 -> pgood[x] input is not a pre-requisite. (Default = 0).

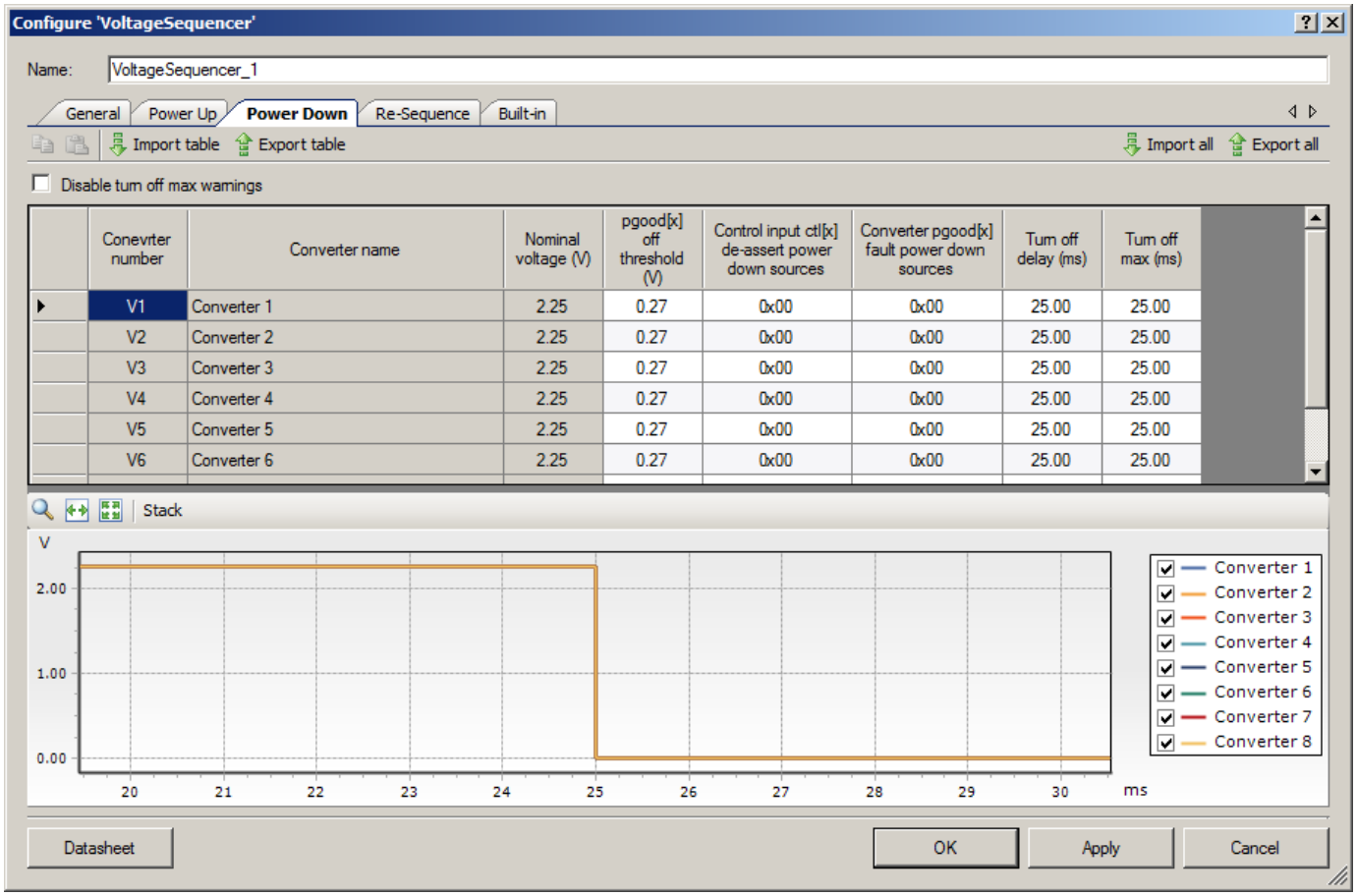
Turn on delay (ms)

Turn on delay. Units are ms. Step size is 0.25 ms. Range=0–65535 (0-16.384 s).(Default = 25).

Turn on max (ms)

Turn on max delay. Units are ms. Step size is 0.25 ms. Range=0–65535 (0-16.384 s). (Default = 25).

Power Down Tab



Disable turn off max warnings

Allows globally enable or disable warnings caused by TOFF_MAX_WARN_LIMIT timeouts

Options = Checked or un-checked. Disabling this option removes the warn terminal from the symbol (Default = Un-Checked).

Converter name

Text field, 16 characters. Annotation purposes only. Display brought forward from the Power Up tab.

Nominal voltage (V)

Nominal converter output voltage. Annotation purposes only. Display brought forward from the Power Up tab.

pgood[x] off threshold (V)

The voltage level that the power converter output must drop to in order to be considered powered-off. Range=0.00–65.54. Must be <= VNom[x].

Control input ctl[x] de-assert power down sources

Bitmask representing the list of ctl[x] inputs that can generate a fault condition. Any of the checked ctl[x] inputs will generate a fault condition when de-asserted for the associated power converter. The number of columns displayed in this section depends on the Number of control inputs parameter from the General Tab. Bit=1 -> ctl[x] input can generate a fault. Bit=0 -> ctl[x] input cannot generate a fault. (Default = 0).

Converter pgood[x] fault power down sources

Bitmask representing the list of pgood[x] inputs that can generate a fault condition. Any of the checked pgood[x] inputs will generate a fault condition when de-asserted for the associated power converter. Bit=1 -> pgood[x] input can generate a fault. Bit=0 -> pgood[x] input cannot generate a fault. (Default = each power converter has its own pgood[x] checked).

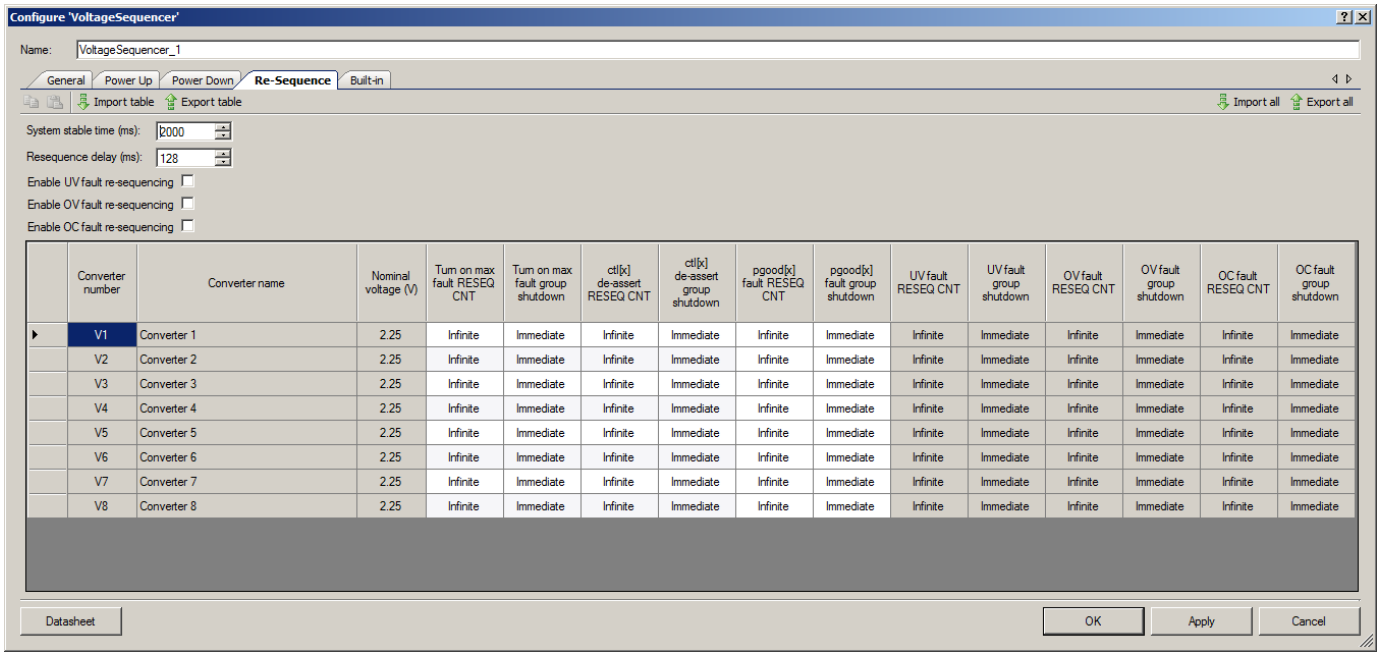
Turn off delay (ms)

Turn off delay. Units are ms. Step size is 0.25 ms. Range=0–65535 (0-16.384 s). Set to 0 for immediate shutdown. (Default = 25).

Turn off max (ms)

Turn off max delay. Units are ms. Step size is 0.25 ms. Range=0–65535 (0-16.384 s). (Default = 25).

Re-Sequence Tab



System stable time (ms)

Number of ms that all power converters must remain in the ON state before the system is considered “stable”. 16-bit value, 8 ms resolution, 0-524 sec range. (Default = 2 sec).

Resequence delay (ms)

Global re-sequence delay for all power converter state machines. Units are steps of 8 ms. Range=0-65535 (0-534.28 sec). (Default = 128).

Enable UV fault re-sequencing

Enabling this option gives ability to enter re-sequence count and slave shutdown parameters. If checked, PGReseqCnt[x] and PGSlaveResp[x] columns become grayed out as the UVReseqCnt[x] and UVSlaveResp[x] parameters override those parameters. If unchecked, UVReseqCnt[x] and UVSlaveResp[x] parameters are grayed out. Options=Checked, Unchecked. (Default = Unchecked).

Enable OV fault re-sequencing

Enabling this option gives ability to enter re-sequence count and slave shutdown parameters. If checked, PGReseqCnt[x] and PGSlaveResp[x] columns become grayed out as the OVReseqCont[x] and OVSlaveResp[x] parameters override those parameters. If unchecked, OVReseqCont[x] and OVSlaveResp[x] parameters are grayed out. Options=Checked, Unchecked. (Default = Unchecked).

Enable OC fault re-sequencing

Enabling this option gives ability to enter re-sequence count and slave shutdown parameters. If checked, PGReseqCnt[x] and PGSlaveResp[x] columns become grayed out as the OCReseqCnt[x] and OCSlaveResp[x] parameters override those parameters. If unchecked, OCReseqCnt[x] and OCSlaveResp[x] parameters are grayed out. Options=Checked, Unchecked. (Default = Unchecked).

Converter name

Text field, 16 characters. Annotation purposes only. Display brought forward from the Power Up tab.

Nominal voltage (V)

Nominal converter output voltage. Annotation purposes only. Display brought forward from the Power Up tab.

Turn on max fault RESEQ CNT

TON_MAX fault re-sequence count for the associated power converter. Options=None, 1-30, Infinite. (Default = Infinite)

Turn on max fault group shutdown

TON_MAX fault slave shutdown response pulldown box. Options=Soft, Immediate. When “Soft” is chosen, the power down delay time for each slave is determined by the ToffDelay[x] parameter set for that slave in the Power Down tab. (Default = Immediate).

ctl[x] de-assert RESEQ CNT

Ctl[x] fault re-sequence count for the associated power converter. Options=None, 1-30, Infinite. (Default = Infinite).

ctl[x] de-assert group shutdown

Ctl[x] fault slave shutdown response. Options=Soft, Immediate. (Default = Immediate).

pgood[x] de-assert RESEQ CNT

pgood[x] fault re-sequence count for the associated power converter. Options=None, 1-30, Infinite. (Default = Infinite).

pgood[x] de-assert group shutdown

pgood[x] fault slave shutdown response pulldown box. Options=Soft, Immediate. (Default = Immediate).

UV fault RESEQ CNT

UV fault re-sequence count for the associated power converter. Options=None, 1-30, Infinite. (Default = Infinite).

UV fault group shutdown

UV fault slave shutdown response. Options=Soft, Immediate. (Default = Immediate).

OV fault RESEQ CNT

OV fault re-sequence count for the associated power converter. Options=None, 1-30, Infinite. (Default = Infinite).

OV fault group shutdown

OV fault slave shutdown response. Options=Soft, Immediate. (Default = Immediate).

OC fault RESEQ CNT

OC fault re-sequence count for the associated power converter. Options=None, 1-30, Infinite. (Default = Infinite).

OC fault group shutdown

OC fault slave shutdown response. Options=Soft, Immediate. (Default = Immediate).

Application Programming Interface

Application Programming Interface (API) routines allow you to configure the component using software. The following table lists and describes the interface to each function. The subsequent sections cover each function in more detail.

By default, PSoC Creator assigns the instance name " VoltageSequencer_1" to the first instance of a component in a given design. You can rename the instance to any unique value that follows the syntactic rules for identifiers. The instance name becomes the prefix of every global function name, variable, and constant symbol. For readability, the instance name used in the following table is "Sequencer".

Function	Description
Sequencer_Start()	Enables the componeny and places all power converter state machines into the appropriate state.
Sequencer_Stop()	Disables the component.
Sequencer_Init()	Initializes the component.

Function	Description
Sequencer_Enable()	Enables the component.
Sequencer_SetCtlPolarity()	Sets the polarity of the selected general purpose sequencer control input.
Sequencer_GetCtlPolarity()	Returns the polarity of the selected general purpose sequencer control input.
Sequencer_SetStsPgoodMask()	Specifies which pgood[x] signals participate in the generation of the specified general purpose sequencer control output pins.
Sequencer_GetStsPgoodMask()	Returns which pgood[x] signals participate in the generation of the specified general purpose sequencer control output pin.
Sequencer_SetStsPgoodPolarity()	Configures the logic conditions that will cause the selected general purpose sequencer control output pins to be asserted.
Sequencer_GetStsPgoodPolarity()	Returns the polarity of the signals used in the AND expression for the selected general purpose sequencer control output.
Sequencer_SetPgoodOnThreshold()	Sets the power good voltage threshold for power on detection.
Sequencer_GetPgoodOnThreshold()	Returns the power good voltage threshold for power on detection.
Sequencer_SetEnPinPrereq()	Determines which power converter state machines have the enable pin as a power up pre-requisite.
Sequencer_GetEnPinPrereq()	Returns which power converter state machines have the enable pin as a power up pre-requisite.
Sequencer_SetOnCmdPrereq()	Determines which power converter state machines have a host initiated Forced On command as a power up prerequisite.
Sequencer_GetOnCmdPrereq()	Determines which power converter state machines have a host initiated Forced On command as a power up prerequisite.
Sequencer_SetPgoodPrereq()	Determines which pgood[x] pins are power up prerequisites for the selected power converter state machine.
Sequencer_GetPgoodPrereq()	Determines which pgood[x] pins are power up prerequisites for the selected power converter state machine.
Sequencer_SetTonDelay()	Sets the TON delay parameter for the selected power converter.
Sequencer_GetTonDelay()	Returns the TON delay parameter for the selected power converter.
Sequencer_SetTonMax()	Sets the TON_MAX parameter for the selected power converter.
Sequencer_GetTonMax()	Returns the TON_MAX parameter for the selected power converter.
Sequencer_SetPgoodOffThreshold()	Sets the power good voltage threshold for power off detection.
Sequencer_GetPgoodOffThreshold()	Returns the power good voltage threshold for power off detection.
Sequencer_SetCtlFaultSource()	Determines which ctl[x] pins will generate a fault condition for the selected power converter state machine when de-asserted.
Sequencer_GetCtlFaultSource()	Returns which ctl[x] pins will generate a fault condition for the selected power converter state machine when de-asserted.

Function	Description
Sequencer_SetPgoodFaultSource()	Determines which other pgood[x] pins will generate a fault condition for the selected power converter state machine when de-asserted.
Sequencer_GetPgoodFaultSource()	Returns which pgood[x] pins will generate a fault condition for the selected power converter state machine when de-asserted.
Sequencer_SetToffDelay()	Sets the TOFF delay parameter for the selected power converter.
Sequencer_GetToffDelay()	Returns the TOFF delay parameter for the selected power converter.
Sequencer_SetToffMax()	Sets the TOFF_MAX_DELAY parameter for the selected power converter.
Sequencer_GetToffMax()	Returns the TOFF_MAX_DELAY parameter for the selected power converter.
Sequencer_SetSysStableTime()	Sets the global TRESEQ_DELAY parameter for all power converter state machines.
Sequencer_GetSysStableTime()	Returns the global TRESEQ_DELAY parameter for all power converter state machines.
Sequencer_SetReseqDelay()	Sets the global TRESEQ_DELAY parameter for all power converter state machines.
Sequencer_GetReseqDelay()	Returns the global TRESEQ_DELAY parameter for all power converter state machines.
Sequencer_SetTonMaxReseqCnt()	Sets the re-sequence count for TON_MAX fault conditions.
Sequencer_GetTonMaxReseqCnt()	Returns the re-sequence count for TON_MAX fault conditions.
Sequencer_SetTonMaxFaultResp()	Sets the shutdown mode for fault slaves when a TON_MAX fault condition occurs on the selected master converter.
Sequencer_GetTonMaxFaultResp()	Returns the shutdown mode for fault slaves when a TON_MAX fault condition occurs on the selected master converter.
Sequencer_SetCtlReseqCnt()	Sets the re-sequence count for fault conditions due to de-asserted ctl[x] inputs.
Sequencer_GetCtlReseqCnt()	Returns the re-sequence count for fault conditions due to de-asserted ctl[x] inputs.
Sequencer_SetCtlFaultResp()	Sets the shutdown mode for power converters in response to fault conditions due to de-asserted ctl[x] inputs.
Sequencer_GetCtlFaultResp()	Returns the shutdown mode for power converters in response to fault conditions due to de-asserted ctl[x] inputs.
Sequencer_SetFaultReseqSrc()	Sets the power converter fault re-sequence sources.
Sequencer_GetFaultReseqSrc()	Returns the power converter fault re-sequence sources.
Sequencer_SetPgoodReseqCnt()	Sets the re-sequence count for fault conditions due to de-asserted pgood[x] inputs.

Function	Description
Sequencer_GetPgoodReseqCnt()	Returns the re-sequence count for fault conditions due to de-asserted pgood[x] inputs.
Sequencer_SetPgoodFaultResp()	Sets the shutdown mode for fault slaves for fault conditions due to de-asserted pgood[x] inputs.
Sequencer_GetPgoodFaultResp()	Returns the shutdown mode for fault slaves for fault conditions due to de-asserted pgood[x] inputs.
Sequencer_SetOvReseqCnt()	Sets the re-sequence count for over-voltage (OV) fault conditions.
Sequencer_GetOvReseqCnt()	Returns the re-sequence count for over-voltage (OV) fault conditions.
Sequencer_SetOvFaultResp()	Sets the shutdown mode for fault slaves due to overvoltage (OV) fault conditions.
Sequencer_GetOvFaultResp()	Returns the shutdown mode for fault slaves due to overvoltage (OV) fault conditions.
Sequencer_SetUvReseqCnt()	Sets the re-sequence count for under-voltage (UV) fault conditions.
Sequencer_GetUvReseqCnt()	Returns the re-sequence count for under-voltage (UV) fault conditions.
Sequencer_SetUvFaultResp()	Sets the shutdown mode for fault slaves due to undervoltage (UV) fault conditions.
Sequencer_GetUvFaultResp()	Returns the shutdown mode for fault slaves due to undervoltage (UV) fault conditions.
Sequencer_SetOcReseqCnt()	Sets the re-sequence count for over-current (OC) fault conditions.
Sequencer_GetOcReseqCnt()	Returns the re-sequence count for over-current (OC) fault conditions.
Sequencer_SetOcFaultResp()	Sets the shutdown mode for fault slaves due to overcurrent (OC) fault conditions.
Sequencer_GetOcFaultResp()	Returns the shutdown mode for fault slaves due to overcurrent (OC) fault conditions.
Sequencer_EnFaults()	Enables/disables assertion of the fault output signal.
Sequencer_SetFaultMask()	Sets which power converters have faults enabled.
Sequencer_GetFaultStatus()	Returns which power converters have fault detection enabled.
Sequencer_EnWarnings()	Enables/disables assertion of the warn output signal.
Sequencer_SetWarningMask()	Sets which power converters have warnings enabled.
Sequencer_GetWarningStatus()	Returns a bit mask containing TOFF_MAX_WARN warning status for all power converters.
Sequencer_GetState()	Returns the current state machine state for the selected power converter.
Sequencer_ForceOff()	Forces the selected power converter to power down either immediately or after the TOFF delay.

Function	Description
Sequencer_ForceAllOff()	Forces all power converters to power down either immediately or after their TOFF delays.
Sequencer_ForceOn()	Forces the selected power converter to power up.
Sequencer_ForceAllOn()	Forces all power converters to power up.

Global Variables

Variable	Description
Sequencer_initVar	Indicates whether the Voltage Sequencer has been initialised.
Sequencer_ctlPolarity	Polarity of the general purpose control inputs.
Sequencer_ctlFaultSourceList[]	Defines which ctl[x] pins will generate a fault condition for each converter.
Sequencer_stsPgoodMaskList[]	Defines which pgood[x] pins are used to generate each sts[x] output.
Sequencer_stsPgoodPolarityList[]	Defines the logic conditions for generation of each sts[x] output.
Sequencer_stsLogicList[]	Defines sts[x] mask list based on pgood[x] mask and polarity.
Sequencer_pgoodOnThresholdList[]	Defines power good voltage threshold for power on detection.
Sequencer_enPinPrereqMask	Defines which converter have the enable pin as a power up pre-requisite.
Sequencer_onCmdPrereqMask	Defines which converter have a host initiated Forced On command as a power up pre-requisite.
Sequencer_ctlPrereqList[]	Defines which ctl[x] pins are power up pre-requisites for each converter.
Sequencer_pgoodPrereqList[]	Defines which pgood[x] pins are power up pre-requisites for each converter.
Sequencer_tonDelayList[]	Defines TON_DELAY parameter for each power converter.
Sequencer_tonMaxDelayList[]	Defines TON_MAX_DELAY parameter for each power converter.
Sequencer_pgoodOffThresholdList[]	Defines power good voltage threshold for power off detection.
Sequencer_pgoodFaultSourceList[]	Defines which pgood[x] pins will generate a fault condition for each converter.
Sequencer_toffDelayList[]	Defines TOFF_DELAY parameter for each power converter.
Sequencer_toffMaxDelayList[]	Defines TOFF_MAX_DELAY parameter for each power converter.
Sequencer_sysStableTime	System Stable Time parameter.
Sequencer_globalReseqDelay	Global TRESEQ_DELAY parameter.
Sequencer_tonMaxReseqCntList[]	Defines the re-sequence count for TON_MAX fault conditions.
Sequencer_tonMaxFaultRespMode	Defines the shutdown mode for fault slaves when a TON_MAX fault occurs.
Sequencer_ctlReseqCntList[]	Defines the re-sequence count for fault conditions due to de-asserted ctl[x] inputs.

Variable	Description
Sequencer_ctlFaultRespMode	Defines the shutdown mode for the converters in response to fault conditions due to de-asserted ctl[x] inputs.
Sequencer_faultReseqSrcList[]	Defines the power converter fault re-sequence sources.
Sequencer_pgoodReseqCntList[]	Defines the re-sequence count for fault conditions due to de-asserted pgood[x] inputs.
Sequencer_pgoodFaultRespMode	Defines the shutdown mode for fault slaves in response to fault conditions due to de-asserted pgood[x] inputs.
Sequencer_ovReseqCntList[]	Defines the re-sequence count for OV fault conditions.
Sequencer_ovFaultRespMode	Defines the shutdown mode for fault slaves due to OV fault conditions.
Sequencer_uvReseqCntList[]	Defines the re-sequence count for UV fault conditions.
Sequencer_uvFaultRespMode	Defines the shutdown mode for fault slaves due to UV fault conditions.
Sequencer_ocReseqCntList[]	Defines the re-sequence count for OC fault conditions.
Sequencer_ocFaultRespMode	Defines the shutdown mode for fault slaves due to OC fault conditions.
Sequencer_faultEnable	Enable/disable assertion of the fault output signal.
Sequencer_faultMask	Defines which power converters have faults enabled.
Sequencer_warnEnable	Enable/disable assertion of the warn output signal.

void Sequencer_Start(void)

Description: Enables the component and places all power converter state machines into the appropriate state (OFF or PEND_ON). Calls the Init() API if the component has not been initialized before. Calls the Enable() API.

Parameters: None

Return Value: None

Side Effects: None

void Sequencer_Stop (void)

Description: Disables the component

Parameters: None

Return Value: None

Side Effects: All output terminals are de-asserted

void Sequencer_Init(void)

Description: Initializes the component. Parameter settings are initialized based on parameters entered into the customizer.

Parameters: None

Return Value: None

Side Effects: None

void Sequencer_Enable(void)

Description: Enables the component.

Parameters: None

Return Value: None

Side Effects: None

void Sequencer_SetCtlPolarity(uint8 ctlNum, uint8 ctlPolarity)

Description: Sets the polarity of the selected general purpose sequencer control input (ctl[x])

Parameters: uint8 ctlNum
Specifies the control pin number
Valid range: 1-6

uint8 ctlPolarity
Specifies the polarity of the control pin
Options: 1=active high, 0=active low

Return Value: None

Side Effects: None

uint8 Sequencer_GetCtlPolarity(uint8 ctlNum)

Description: Returns the polarity of the selected general purpose sequencer control input (ctl[x])

Parameters: uint8 ctlNum
Specifies the control pin number

Valid range: 1-6

Return Value: uint8 ctlPolarity
Specifies the polarity of the control pin
Options: 1=active high, 0=active low

Side Effects: None

void Sequencer_SetStsPgoodMask(uint8 stsNum, uint32 stsPgoodMask)

Description: Specifies which pgood[x] signals participate in the generation of the specified general purpose sequencer control output pins (sts[x])

Parameters: uint8 stsNum
Specifies the status pin number
Valid range: 1-6

uint32 stsPgoodMask

Bit Field	Status Pgood Mask
0	1=Sts output depends on pgood[1]
1	1=Sts output depends on pgood[2]
…	…
31	1=Sts output depends on pgood[32]

Return Value: None

Side Effects: None

uint32 Sequencer_GetStsPgoodMask(uint8 stsNum)

Description: Returns which pgood[x] signals participate in the generation of the specified general purpose sequencer control output pins (sts[x])

Parameters: uint8 stsNum
Specifies the status pin number
Valid range: 1-6

Return Value: uint32 stsPgoodMask

Bit Field	Status Pgood Mask
0	1=Sts output depends on pgood[1]
1	1=Sts output depends on pgood[2]

…	…
31	1=Sts output depends on pgood[32]

Side Effects: None

void Sequencer_SetStsPgoodPolarity(uint8 stsNum, uint32 pgoodPolarity)

Description: Configures the logic conditions that will cause the selected general purpose sequencer control output pins (sts[x]) to be asserted

Parameters: uint8 stsNum
Specifies the status pin number
Valid range: 1-6

uint32 stsPgoodPolarity
Specifies the polarity of the pgood[x] signal required to assert the specified sts[x] signal

Bit Field	Status Polarity
0	0=pgood[1] must be low, 1=pgood[1] must be high
1	0=pgood[2] must be low, 1=pgood[2] must be high
…	…
31	0=pgood[32] must be low, 1=pgood[32] must be high

Return Value: None

Side Effects: None

uint32 Sequencer_GetStsPgoodPolarity(uint8 stsNum)

Description: Returns the polarity of the **pgood[x]** signals used in the AND expression for the selected general purpose sequencer control output (sts[x]).

Parameters: uint8 stsNum
Specifies the status pin number
Valid range: 1-6

Return Value: uint32 stsPgoodPolarity
Specifies the polarity of the pgood[x] signal required to assert the specified sts[x] signal

Bit Field	Status Polarity
0	0=pgood[1] must be low, 1=pgood[1] must be high

1	0=pgood[2] must be low, 1=pgood[2] must be high
…	…
31	0=pgood[32] must be low, 1=pgood[32] must be high

Side Effects: None

void Sequencer_SetPgoodOnThreshold(uint8 converterNum, uint16 onThreshold)

Description: Sets the power good voltage threshold for power on detection

Parameters: uint8 ctlNum
Specifies the converter number
Valid range: 1-32

uint16 onThreshold
Specifies the power good power on threshold in mV
Valid range: 0-65535

Return Value: None

Side Effects: None

uint16 Sequencer_GetPgoodOnThreshold(uint8 converterNum)

Description: Returns the power good voltage threshold for power on detection

Parameters: uint8 ctlNum
Specifies the converter number
Valid range: 1-32

Return Value: uint16 onThreshold
Specifies the power good power on threshold in mV
Valid range: 0-65535

Side Effects: None

void Sequencer_SetEnPinPrereq(uint32 converterMask)

Description: Determines which power converter state machines have the enable pin as a power up pre-requisite

Parameters: uint32 converterMask

Bit Field	Converter Mask
0	1=power converter 1 has the enable signal as a sequencing pre-requisite
1	1=power converter 2 has the enable signal as a sequencing pre-requisite
…	…
31	1=power converter 32 has the enable signal as a sequencing pre-requisite

Return Value: None

Side Effects: None

uint32 Sequencer_GetEnPinPrereq(void)

Description: Returns which power converter state machines have the enable pin as a power up pre-requisite

Parameters: None

Return Value: uint32 converterMask

Bit Field	Converter Mask
0	1=power converter 1 has the enable signal as a sequencing pre-requisite
1	1=power converter 2 has the enable signal as a sequencing pre-requisite
…	…
31	1=power converter 32 has the enable signal as a sequencing pre-requisite

Side Effects: None

void Sequencer_SetOnCmdPrereq(uint32 converterMask)

Description: Determines which power converter state machines have a host initiated Forced On command as a power up pre-requisite

Parameters: uint32 converterMask

Bit Field	Converter Mask
0	1=power converter 1 has Forced On command as a sequencing pre-requisite
1	1=power converter 2 has Forced On command as a sequencing pre-requisite

…	…
31	1=power converter 32 has Forced On command as a sequencing pre-requisite

Return Value: None

Side Effects: None

uint32 Sequencer_GetOnCmdPrereq(void)

Description: Returns which power converter state machines have a host initiated Forced On command as a power up pre-requisite

Parameters: None

Return Value: uint32 converterMask

Bit Field	Converter Mask
0	1=power converter 1 has Forced On command as a sequencing pre-requisite
1	1=power converter 2 has Forced On command as a sequencing pre-requisite
…	…
31	1=power converter 32 has Forced On command as a sequencing pre-requisite

Side Effects: None

void Sequencer_SetPgoodPrereq(uint8 converterNum, uint32 pgoodMask)

Description: Determines which pgood[x] pins are power up pre-requisites for the selected power converter state machine

Parameters: uint8 converterNum
Specifies the power converter state machine number
Valid range: 1-32

uint32 pgoodMask
Specifies which pgood[x] pins are power up pre-requisites for the selected power converter

Bit Field	Power Good Power Up Pre-Requisite Mask
0	1=pgood[1] must be asserted
1	1=pgood[2] must be asserted
…	…

31	1=pgood[32] must be asserted

Return Value: None

Side Effects: None

uint32 Sequencer_GetPgoodPrereq(uint8 converterNum)

Description: Determines which pgood[x] pins are power up pre-requisites for the selected power converter state machine

Parameters: uint8 converterNum
Specifies the power converter state machine number
Valid range: 1-32

Return Value: uint32 pgoodMask
Specifies which pgood[x] pins are power up pre-requisites for the selected power converter

Bit Field	Power Good Power Up Pre-Requisite Mask
0	1=pgood[1] must be asserted
1	1=pgood[2] must be asserted
…	…
31	1=pgood[32] must be asserted

Side Effects: None

void Sequencer_SetTonDelay(uint8 converterNum, uint16 tonDelay)

Description: Sets the **TON** delay parameter for the selected power converter. Defined as the time between a state machine's pre-requisites all becoming satisfied and the en[x] being asserted

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

uint16 tonDelay
units = 0.25 ms per LSB
Valid Range=0-65535 (0-16.384 s)

Return Value: None

Side Effects: None

uint16 Sequencer_GetTonDelay(uint8 converterNum)

Description: Returns the **TON** delay parameter for the selected power converter. Defined as the time between a state machine's pre-requisites all becoming satisfied and the en[x] being asserted

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

Return Value: uint16 tonDelay
units = 0.25 ms per LSB
Valid Range=0-65535 (0-16.384 s)

Side Effects: None

void Sequencer_SetTonMax(uint8 converterNum, uint16 tonMax)

Description: Sets the **TON_MAX** parameter for the selected power converter. Defined as the maximum time allowable between a power converter's en[x] being asserted and pgood[x] being asserted. Failure to do so generates a fault condition

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

uint16 tonMax
units = 0.25 ms per LSB
Valid Range=0-65535 (0-16.384 s)

Return Value: None

Side Effects: None

uint16 Sequencer_GetTonMax(uint8 converterNum)

Description: Returns the **TON_MAX** parameter for the selected power converter. Defined as the maximum time allowable between a power converter's en[x] being asserted and pgood[x] being asserted. Failure to do so generates a fault condition

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

Return Value: uint16 tonMax
units = 0.25 ms per LSB
Valid Range=0-65535 (0-16.384 s)

Side Effects: None

void Sequencer_SetPgoodOffThreshold(uint8 converterNum, uint16 onThreshold)

Description: Sets the power good voltage threshold for power off detection

Parameters: uint8 ctlNum
Specifies the converter number
Valid range: 1-32

uint16 offThreshold
Specifies the power good power off threshold in mV
Valid range: 0-65535

Return Value: None

Side Effects: None

uint16 Sequencer_GetPgoodOffThreshold(uint8 converterNum)

Description: Returns the power good voltage threshold for power off detection

Parameters: uint8 ctlNum
Specifies the converter number
Valid range: 1-32

Return Value: uint16 offThreshold
Specifies the power good power off threshold in mV
Valid range: 0-65535

Side Effects: None

void Sequencer_SetCtlFaultSource(uint8 converterNum, uint8 ctlPinMask)

Description: Determines which ctl[x] pins will generate a fault condition for the selected power converter state machine when de-asserted

Parameters: uint8 converterNum
Specifies the power converter state machine number
Valid range: 1-32

uint8 ctlPinMask
Specifies which ctl[x] pins can generate fault conditions

Bit Field	Control Pin Fault Mask
0	1=ctl[1] de-assertion will generate fault

1	1=ctl[2] de-assertion will generate fault
…	…
5	1=ctl[6] de-assertion will generate fault
7..6	Reserved. Set to zeroes

Return Value: None

Side Effects: None

uint8 Sequencer_GetCtlFaultSource(uint8 converterNum)

Description: Returns which ctl[x] pins will generate a fault condition for the selected power converter state machine when de-asserted

Parameters: uint8 converterNum
Specifies the power converter state machine number
Valid range: 1-32

Return Value: uint8 ctlPinMask
Specifies which ctl[x] pins can generate fault conditions

Bit Field	Control Pin Fault Mask
0	1=ctl[1] de-assertion will generate fault
1	1=ctl[2] de-assertion will generate fault
…	…
5	1=ctl[6] de-assertion will generate fault
7..6	Reserved. Set to zeroes

Side Effects: None

void Sequencer_SetPgoodFaultSource(uint8 converterNum, uint32 pgoodMask)

Description: Determines which other pgood[x] pins will generate a fault condition for the selected power converter state machine when de-asserted.

Note that the pgood[converterNum] pin is automatically a fault source for the selected power converter whether or not the corresponding bit in the pgoodMask is set or not.

Parameters: uint8 converterNum
Specifies the power converter state machine number
Valid range: 1-32

uint32 pgoodMask
Specifies which pgood[x] pins can generate fault conditions

Bit Field	Power Good Mask
0	1=pgood[1] de-assertion will generate fault
1	1=pgood[2] de-assertion will generate fault
…	…
31	1=pgood[32] de-assertion will generate fault

Return Value: None

Side Effects: None

uint32 Sequencer_GetPgoodFaultSource(uint8 converterNum)

Description: Returns which pgood[x] pins will generate a fault condition for the selected power converter state machine when de-asserted

Parameters: uint8 converterNum
Specifies the power converter state machine number
Valid range: 1-32

Return Value: uint32 pgoodMask
Specifies which pgood[x] pins can generate fault conditions

Bit Field	Power Good Mask
0	1=pgood[1] de-assertion will generate fault
1	1=pgood[2] de-assertion will generate fault
…	…
31	1=pgood[32] de-assertion will generate fault

Side Effects: None

void Sequencer_SetToffDelay(uint8 converterNum, uint16 toffDelay)

Description: Sets the TOFF delay parameter for the selected power converter. Defined as the time between making the decision to turn a power converter of and to actually de-asserting the en[x] pin

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

uint16 toffDelay
units = 0.25 ms per LSB
Valid Range=0-65535 (0-16.384 s)

Return Value: None

Side Effects: None

uint16 Sequencer_GetToffDelay(uint8 converterNum)

Description: Returns the TOFF delay parameter for the selected power converter. Defined as the time between making the decision to turn a power converter of and to actually de-asserting the en[x] pin

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

Return Value: uint16 toffDelay
units = 0.25 ms per LSB
Valid Range=0-65535 (0-16.384 s)

Side Effects: None

void Sequencer_SetToffMax(uint8 converterNum, uint16 toffMax)

Description: Sets the TOFF_MAX_DELAY parameter for the selected power converter. Defined as the maximum time allowable between a power converter's en[x] being de-asserted and power converter actually turning off. Failure to do so generates a warning condition

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

uint16 toffMax
units = 0.25 ms per LSB
Valid Range=0-65535 (0-16.384 s)

Return Value: None

Side Effects: None

uint16 Sequencer_GetToffMax(uint8 converterNum)

Description: Returns the TOFF_MAX_DELAY parameter for the selected power converter. Defined as the maximum time allowable between a power converter's en[x] being de-asserted and power converter actually turning off. Failure to do so generates a warning condition

Parameters: uint8 converterNum
Specifies the power converter number

Valid range: 1-32

Return Value: uint16 toffMax
units = 0.25 ms per LSB
Valid Range=0-65535 (0-16.384 s)

Side Effects: None

void Sequencer_SetSysStableTime(uint16 stableTime)

Description: Sets the global TRESEQ_DELAY parameter for all power converter state machines. Defined as the time between making the decision to re-sequence and beginning a new power up sequence

Parameters: uint16 stableTime
units = 8 ms per LSB
Valid Range=0-65535 (0-534.28 s)

Return Value: None

Side Effects: None

uint16 Sequencer_GetSysStableTime(void)

Description: Sets the global TRESEQ_DELAY parameter for all power converter state machines. Defined as the time between making the decision to re-sequence and beginning a new power up sequence

Parameters: None

Return Value: uint16 stableTime
units = 8 ms per LSB
Valid Range=0-65535 (0-534.28 s)

Side Effects: None

void Sequencer_SetReseqDelay(uint16 reseqDelay)

Description: Sets the global TRESEQ_DELAY parameter for all power converter state machines. Defined as the time between making the decision to re-sequence and beginning a new power up sequence

Parameters: uint16 reseqDelay
units = 8 ms per LSB
Valid Range=0-65535 (0-534.28 s)

Return Value: None

Side Effects: None

uint16 Sequencer_GetReseqDelay(void)

Description: Returns the global TRESEQ_DELAY parameter for all power converter state machines. Defined as the time between making the decision to re-sequence and beginning a new power up sequence

Parameters: None

Return Value: uint16 reseqDelay
units = 8 ms per LSB
Valid Range=0-65535 (0-534.28 s)

Side Effects: None

void Sequencer_SetTonMaxReseqCnt(uint8 converterNum, uint8 ReseqCnt)

Description: Sets the re-sequence count for TON_MAX fault conditions

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

uint8 reseqCnt
5 bit number
Options: 0=no re-sequencing, 31=infinite re-sequencing, 1-30=valid re-sequencing counts

Return Value: None

Side Effects: None

uint8 Sequencer_GetTonMaxReseqCnt(uint8 converterNum)

Description: Returns the re-sequence count for TON_MAX fault conditions

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

Return Value: uint8 reseqCnt
5 bit number
Options: 0=no re-sequencing, 31=infinite re-sequencing, 1-30=valid re-sequencing counts

Side Effects: None

void Sequencer_SetTonMaxFaultResp(uint8 converterNum, uint8 faultResponse)

Description: Sets the shutdown mode for fault slaves when a TON_MAX fault condition occurs on the selected master converter

Parameters: uint8 converterNum
Specifies the master power converter number
Valid range: 1-32

uint8 faultResponse
Specifies the shutdown mode for any slave power converters
Options: 0=immediate, 1=soft

Return Value: None

Side Effects: None

uint8 Sequencer_GetTonMaxFaultResp(uint8 converterNum)

Description: Returns the shutdown mode for fault slaves when a TON_MAX fault condition occurs on the selected master converter

Parameters: uint8 converterNum
Specifies the master power converter number
Valid range: 1-32

Return Value: uint8 faultResponse
Specifies the shutdown mode for any slave power converters
Options: 0=immediate, 1=soft

Side Effects: None

void Sequencer_SetCtlReseqCnt(uint8 converterNum, uint8 reseqCnt)

Description: Sets the re-sequence count for fault conditions due to de-asserted ctl[x] inputs

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

uint8 reseqCnt
5 bit number
0=no re-sequencing, 31=infinite re-sequencing,
1-30=valid re-sequencing counts

Return Value: None

Side Effects: None

uint8 Sequencer_GetCtlReseqCnt(uint8 converterNum)

Description: Returns the re-sequence count for fault conditions due to de-asserted ctl[x] inputs

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

Return Value: uint8 reseqCnt
5 bit number
0=no re-sequencing, 31=infinite re-sequencing,
1-30=valid re-sequencing counts

Side Effects: None

void Sequencer_SetCtlFaultResp(uint8 converterNum, uint8 faultResponse)

Description: Sets the shutdown mode for power converters in response to fault conditions due to de-asserted ctl[x] inputs

Parameters: uint8 converterNum
Specifies the master power converter number
Valid range: 1-32

uint8 faultResponse
Specifies the shutdown mode for any slave power converters
Options: 0=immediate, 1=soft

Return Value: None

Side Effects: None

uint8 Sequencer_GetCtlFaultResp(uint8 converterNum)

Description: Returns the shutdown mode for power converters in response to fault conditions due to de-asserted ctl[x] inputs

Parameters: uint8 converterNum
Specifies the master power converter number
Valid range: 1-32

Return Value: uint8 faultResponse
Specifies the shutdown mode for any slave power converters
Options: 0=immediate, 1=soft

Side Effects: None

void Sequencer_SetFaultReseqSrc(uint8 converterNum, uint8 reseqSrc)

Description: Sets the power converter fault re-sequence sources

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

uint8 reseqSrc

Bit Field	Re-Sequence Source
0	1=OV fault source enabled
1	1=UV fault source enabled
2	1=OC fault source enabled
7:3	Reserved

Return Value: None

Side Effects: When reseqSrc is zero, power good (pgood) inputs become the fault re-sequence source.

uint8 Sequencer_GetFaultReseqSrc(uint8 converterNum)

Description: Returns the power converter fault re-sequence source

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

Return Value: uint8 reseqSrc

Bit Field	Re-Sequence Source
0	1=OV fault source enabled
1	1=UV fault source enabled
2	1=OC fault source enabled
7:3	Reserved

Side Effects: None

void Sequencer_SetPgoodReseqCnt(uint8 converterNum, uint8 reseqCnt)

Description: Sets the re-sequence count for fault conditions due to de-asserted pgood[x] inputs

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

uint8 reseqCnt
5 bit number
0=no re-sequencing, 31=infinite re-sequencing,
1-30=valid re-sequencing counts

Return Value: None

Side Effects: None

uint8 Sequencer_GetPgoodReseqCnt(uint8 converterNum)

Description: Returns the re-sequence count for fault conditions due to de-asserted pgood[x] inputs

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

Return Value: uint8 reseqCnt
5 bit number
0=no re-sequencing, 31=infinite re-sequencing,
1-30=valid re-sequencing counts

Side Effects: None

void Sequencer_SetPgoodFaultResp(uint8 converterNum, uint8 faultResponse)

Description: Sets the shutdown mode for fault slaves for fault conditions due to de-asserted pgood[x] inputs

Parameters: uint8 converterNum
Specifies the master power converter number
Valid range: 1-32

uint8 faultResponse
Specifies the shutdown mode for any slave power converters
Options: 0=immediate, 1=soft

Return Value: None

Side Effects: None

uint8 Sequencer_GetPgoodFaultResp(uint8 converterNum)

Description: Sets the shutdown mode for fault slaves for fault conditions due to de-asserted pgood[x] inputs

Parameters: uint8 converterNum
Specifies the master power converter number
Valid range: 1-32

Return Value: uint8 faultResponse
Specifies the shutdown mode for any slave power converters
Options: 0=immediate, 1=soft

Side Effects: None

void Sequencer_SetOvReseqCnt(uint8 converterNum, uint8 reseqCnt)

Description: Sets the re-sequence count for over-voltage (OV) fault conditions

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

uint8 reseqCnt
5 bit number
0=no re-sequencing, 31=infinite re-sequencing, 1-30=valid re-sequencing counts

Return Value: None

Side Effects: None

uint8 Sequencer_GetOvReseqCnt(uint8 converterNum)

Description: Sets the re-sequence count for over-voltage (OV) fault conditions

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

Return Value: uint8 reseqCnt
5 bit number
0=no re-sequencing, 31=infinite re-sequencing, 1-30=valid re-sequencing

counts

Side Effects: None

void Sequencer_SetOvFaultResp(uint8 converterNum, uint8 faultResponse)

Description: Sets the shutdown mode for fault slaves due to over-voltage (OV) fault conditions

Parameters: uint8 converterNum
Specifies the master power converter number
Valid range: 1-32

uint8 faultResponse
Specifies the shutdown mode for slave power converters
Options: 0=immediate, 1=soft

Return Value: None

Side Effects: None

uint8 Sequencer_GetOvFaultResp(uint8 converterNum)

Description: Returns the shutdown mode for fault slaves due to over-voltage (OV) fault conditions

Parameters: uint8 converterNum
Specifies the master power converter number
Valid range: 1-32

Return Value: uint8 faultResponse
Specifies the shutdown mode for slave power converters
Options: 0=immediate, 1=soft

Side Effects: None

void Sequencer_SetUvReseqCnt(uint8 converterNum, uint8 reseqCnt)

Description: Sets the re-sequence count for under-voltage (UV) fault conditions

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

uint8 reseqCnt
5 bit number
0=no re-sequencing, 31=infinite re-sequencing, 1-30=valid re-sequencing counts

Return Value: None

Side Effects: None

uint8 Sequencer_GetUvReseqCnt(uint8 converterNum)

Description: Returns the re-sequence count for under-voltage (UV) fault conditions

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

Return Value: uint8 reseqCnt
5 bit number
0=no re-sequencing, 31=infinite re-sequencing, 1-30=valid re-sequencing counts

Side Effects: None

void Sequencer_SetUvFaultResp(uint8 converterNum, uint8 faultResponse)

Description: Sets the shutdown mode for fault slaves due to under-voltage (UV) fault conditions

Parameters: uint8 converterNum
Specifies the master power converter number
Valid range: 1-32

uint8 faultResponse
Specifies the shutdown mode for any slave power converters
Options: 0=immediate, 1=soft

Return Value: None

Side Effects: None

uint8 Sequencer_GetUvFaultResp(uint8 converterNum)

Description: Returns the shutdown mode for fault slaves due to under-voltage (UV) fault conditions

Parameters: uint8 converterNum
Specifies the master power converter number
Valid range: 1-32

Return Value: uint8 faultResponse

Specifies the shutdown mode for any slave power converters
Options: 0=immediate, 1=soft

Side Effects: None

void Sequencer_SetOcReseqCnt(uint8 converterNum, uint8 reseqCnt)

Description: Sets the re-sequence count for over-current (OC) fault conditions

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

uint8 reseqCnt
5 bit number
0=no re-sequencing, 31=infinite re-sequencing, 1-30=valid re-sequencing counts

Return Value: None

Side Effects: None

uint8 Sequencer_GetOcReseqCnt(uint8 converterNum)

Description: Returns the re-sequence count for over-current (OC) fault conditions

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

Return Value: uint8 reseqCnt
5 bit number
0=no re-sequencing, 31=infinite re-sequencing, 1-30=valid re-sequencing counts

Side Effects: None

void Sequencer_SetOcFaultResp(uint8 converterNum, uint8 faultResponse)

Description: Sets the shutdown mode for fault slaves due to over-current (OC) fault conditions

Parameters: uint8 converterNum
Specifies the master power converter number
Valid range: 1-32

uint8 faultResponse

Specifies the shutdown mode for any slave power converters
Options: 0=immediate, 1=soft

Return Value: None

Side Effects: None

uint8 Sequencer_GetOcFaultResp(uint8 converterNum)

Description: Returns the shutdown mode for fault slaves due to over-current (OC) fault conditions

Parameters: uint8 converterNum
Specifies the master power converter number
Valid range: 1-32

Return Value: uint8 faultResponse
Specifies the shutdown mode for any slave power converters
Options: 0=immediate, 1=soft

Side Effects: None

void Sequencer_EnFaults(uint8 faultEnable)

Description: Enables/disables assertion of the fault output signal. Faults are still processed by the state machine and fault status is still available through the GetFaultStatus() API.

Parameters: uint8 faultEnable
Options: 0=disabled, 1=enabled
Enabled when the component is started

Return Value: None

Side Effects: None

void Sequencer_SetFaultMask(uint32 faultMask)

Description: Sets which power converters have faults enabled

Parameters: uint32 faultMask
All bits are set when the component is started

Bit Field	Fault Mask
0	1=enable fault detection for power converter 1
1	1= enable fault detection for power converter 2

…	…
31	1= enable fault detection for power converter 32

Return Value: None

Side Effects: None

uint32 Sequencer_GetFaultStatus(void)

Description: Set which power converters have fault detection enabled

Parameters: None

Return Value: uint32 faultStatus
Fault status of power converters

Bit Field	Fault Status
0	1=power converter 1 has/had a fault
1	1=power converter 2 has/had a fault
…	…
31	1=power converter 32 has/had a fault

Side Effects: Calling this API de-asserts the fault output pin

void Sequencer_EnWarnings(uint8 warnEnable)

Description: Enables/disables assertion of the warn output signal. Warning status is still available through the GetWarningStatus() API.

Parameters: uint8 warnEnable
Options: 0=disabled, 1=enabled

Enabled when the component is started

Return Value: None

Side Effects: None

void Sequencer_SetWarningMask(uint32 warnMask)

Description: Sets which power converters have warnings enabled

Parameters: uint32 warnMask
All bits are cleared when the component is started

Bit Field	Warning Mask
0	1=enable warnings for power converter 1

1	1= enable warnings for power converter 2
…	…
31	1= enable warnings for power converter 32

Return Value: None

Side Effects: None

uint32 Sequencer_GetWarningStatus(void)

Description: Returns a bit mask containing TOFF_MAX_WARN warning status for all power converters. Bits are sticky until cleared by calling this API.

Parameters: None

Return Value: uint32 warningStatus
Fault status of power converters

Bit Field	Warning Status
0	1=power converter 1 has/had a warning
1	1=power converter 2 has/had a warning
…	…
31	1=power converter 32 has/had a warning

Side Effects: Calling this API de-asserts the warn output pin

uint8 Sequencer_GetState(uint8 converterNum)

Description: Returns the current state machine state for the selected power converter.

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

Return Value: uint8 state
Power converter state machine state

Encoding	State
0	OFF
1	PEND_ON
2	TON_DELAY
3	TON_MAX
4	ON
5	TOFF_DELAY
6	TOFF_MAX

7	PEND_RESEQ
8	TRESEQ_DELAY
9..255	Undefined

Side Effects: None

void Sequencer_ForceOff(uint8 converterNum, uint8 powerOffMode)

Description: Forces the selected power converter to power down either immediately or after the TOFF delay

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

uint8 powerOffMode
Specifies the shutdown mode
Options: 0=immediate, 1=soft

Return Value: None

Side Effects: None

void Sequencer_ForceAllOff(uint8 powerOffMode)

Description: Forces all power converters to power down either immediately or after their TOFF delays

Parameters: uint8 powerOffMode
Specifies the shutdown mode
Options: 0=immediate, 1=soft

Return Value: None

Side Effects: None

void Sequencer_ForceOn(uint8 converterNum)

Description: Forces the selected power converter to power up

Parameters: uint8 converterNum
Specifies the power converter number
Valid range: 1-32

Return Value: None

Side Effects: If the selected power converter state machine was in the OFF state, this API call will cause the state machine to transition into the PEND_ON state

void Sequencer_ForceAllOn(void)

Description: Forces all power converter to power up

Parameters: None

Return Value: None

Side Effects: If any power converter state machines were in the OFF state, this API call will cause them to transition into the PEND_ON state

API Constants

Name	Description
NUMBER_OF_CONVERTERS	Number of converters to sequence
NUMBER_OF_CTL_INPUTS	Number of sequencer control inputs
NUMBER_OF_STS_OUTPUTS	Number of sequencer status outputs
INFINITE_RESEQUENCING	Fixed value = 31 (from PMBus specification)

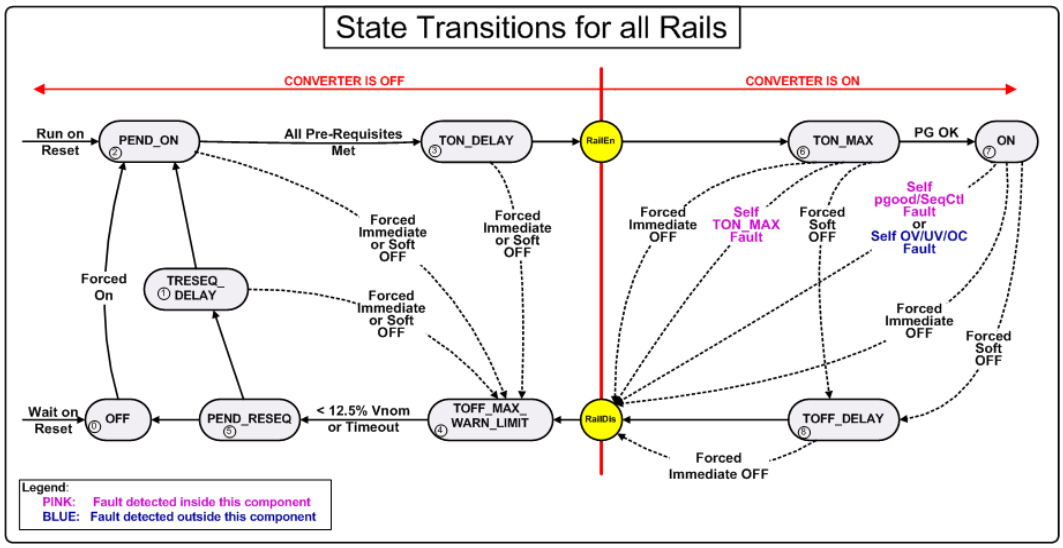
Sample Firmware Source Code

PSoC Creator provides numerous example projects that include schematics and example code in the Find Example Project dialog. For component-specific examples, open the dialog from the Component Catalog or an instance of the component in a schematic. For general examples, open the dialog from the Start Page or **File** menu. As needed, use the **Filter Options** in the dialog to narrow the list of projects available to select.

Refer to the “Find Example Project” topic in the PSoC Creator Help for more information.

Functional Description

To support complex event-based sequencing, management of each power converter is done through an independent firmware state machine that drives the enable output (en[x]) for the associated power converter. Each power converter has its own state machine. The state transition flow is shown in the diagram below.



At the start of time (after a power on reset for example), all state machines for all of the power converters begin in either the OFF state or the PEND_ON state under user control. The state machine for each power converter then transitions to a new state depending on how the user defines the sequencing conditions. Power converter fault conditions also drive the associated state machine to a new state as defined by the user. In the diagram above, the 2 identified fault response transitions (highlighted in pink and blue color) refer to faults that have occurred on this power converter. At any given point in time, any of the state machines can be in any one of the defined states.

State machine transitions for every power converter are always handled in the Sequencer State Machine ISR that gets invoked every 250 µs. When a power converter's state machine is in the ON state and a fault occurs, the Fault Handler ISR will be invoked. The Fault Handler ISR is responsible for time critical activities such as disabling the faulted power converter immediately. It also sets a fault flag that will be recognized the next time the Sequencer State Machine ISR is invoked. The Sequencer State Machine ISR will then take care of non-time critical fault handling activities such as state machine transitions.

In most real-world applications, power converters have a relationship to each other – they are not truly independent. This may occur when multiple power converters supply power to a single chip or a group of chips. In that case, when one power converter fails, the other power converters must be shutdown also. Another example is that there may be a hardware enforced relationship between two or more power converters. For example, the output of one power converter may be the power supply input of another power converter. In that case, when the primary power converter faults and will be shutdown, it is required to shut down the secondary power converter also because it will lose power anyway.

To support these use cases, fault conditions on one power converter state machine must be able to influence state transitions of the state machines for other power converters. To address this requirement, the concept of Fault Masters and Fault Slaves is introduced. If the user specifies that a fault on one power converter must force a shutdown on one or more operational power converters, then the faulted power converter is referred to as the Fault Master and the operational power converters that will be shutdown as a result are referred to as Fault Slaves.

The Fault Slaves can be configured to shutdown immediately (along with the Fault Master) or go through a soft shutdown with configurable delays. When there is a hardware enforced relationship between power converters, the Fault Slaves that draw power from the Fault Master must be set for immediate shutdown to ensure fault conditions are not generated on the Fault Slaves.

Registers

The VoltageSequencer has several control and status registers that are used by the firmware APIs to control operation and monitor status. None of these registers are accessible directly by user firmware.

Resources

The VoltageSequencer component is almost entirely firmware based. The component utilizes the following resources.

Configuration	Resource Type					
	Datapath Cells	Macrocells	Status Cells	Control Cells	DMA Channels	Interrupts
8 Converters	–	TBD	TBD	TBD	–	3
16 Converters	–	TBD	TBD	TBD	–	3
24 Converters	–	TBD	TBD	TBD	–	3
32 Converters	–	TBD	TBD	TBD	–	3

API Memory Usage

The component memory usage varies significantly, depending on the compiler, device, number of APIs used and component configuration. The following table provides the memory usage for all APIs available in the given component configuration.

The measurements have been done with associated compiler configured in Release mode with optimization set for Size. For a specific design the map file generated by the compiler can be analyzed to determine the memory usage.

Configuration	PSoC 3 (Keil_PK51)		PSoC 5 (GCC)		PSoC 5LP (GCC)	
	Flash Bytes	SRAM Bytes	Flash Bytes	SRAM Bytes	Flash Bytes	SRAM Bytes
8 Converters	TBD	TBD	TBD	TBD	TBD	TBD
16 Converters	TBD	TBD	TBD	TBD	TBD	TBD

24 Converters	TBD	TBD	TBD	TBD	TBD	TBD
32 Converters	TBD	TBD	TBD	TBD	TBD	TBD

DC and AC Electrical Characteristics

The following values are indicative of expected performance and based on initial characterization data.

DC and AC Characteristics

Parameter	Description	Min	Typ	Max	Unit
f_{CLOCK}	Clock frequency	TBD	TBD	TBD	MHz
f_{BUS_CLK}	Min Bus Clock Frequency				
	8 Converters	TBD	–	–	MHz
	16 Converters	TBD	–	–	MHz
	24 Converters	TBD	–	–	MHz
	32 Converters	TBD	–	–	MHz
$t_{TRANSITION}$	Sequencer state transition time	–	250	275	µs
t_{FAULT_RESP}	Fault response time	TBD	TBD	TBD	ns
t_{ON_DELAY}	Programmable power-on delay	TBD	TBD	TBD	ms
t_{OFF_DELAY}	Programmable power-off delay	TBD	TBD	TBD	ms

Component Changes

This section lists the major changes in the component from the previous version.

Version	Description of Changes	Reason for Changes / Impact
2.0		New datasheet