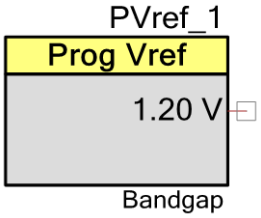
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PSoC 4 Programmable Voltage Reference (PVref_P4)

1.0



Features

- Reference is based on either Bandgap or Vdda
- Each instantiation may be a different value
- Adjustable by 1/16 steps between Vss and Bandgap or Vdda
- Up to four individual references
- References may be changed during runtime

General Description

The PSoC 4 Programmable Voltage Reference (PVref_P4) Component provides an adjustable stable reference voltage for the analog resources in your design. Each Component provides a voltage reference that is based on either Vdda or the Bandgap voltage in 1/16 increments. This reference may be connected to any high impedance input such as the input to an opamp or comparator and cannot be routed to a GPIO unless it is buffered with an opamp.

When to Use a PVref_P4

Use the Programmable Reference any time a stable know voltage is required for comparison, such as with comparators, VDACs, and ADCs.

Input/Output Connections

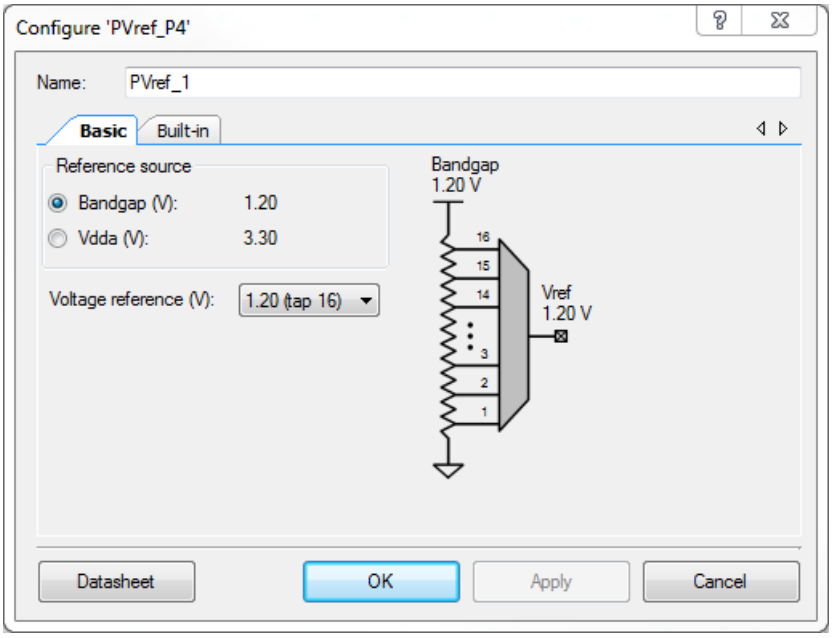
This section describes the various input and output connections for the PVref_P4 Component. An asterisk (*) in the following list indicates that it may not be shown on the Component symbol for the conditions listed in the description of that I/O.

Terminal Name	I/O Type	Description
Vout	Analog Output	Reference Voltage Output.

Component Parameters

Drag a PVref_P4 Component onto your design and double click it to open the Configure dialog. This dialog has the following tabs with different parameters.

Basic Tab



Parameter Name	Description
Reference Source	This option selects the reference source to be based on either the internal bandgap voltage or the Vdda supply. The default is bandgap voltage.
Output Voltage	This parameter is used to select the desired output voltage from the voltage divider. Default is the full reference source (16/16*Vref).

Application Programming Interface

API functions allow configuration of the component using the CPU.

By default, PSoC Creator assigns the instance name **PVref_P4** to the first instance of a component in a given design. You can rename it 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 **PVref_P4** .

Modules

- General APIs
  General APIs are used for run-time configuration of the component during active power mode.
- Power Management APIs
  Power management APIs perform the necessary configurations to the components to prepare it for entering low power modes.

General APIs

General APIs are used for run-time configuration of the component during active power mode.

These include, initializing, starting, stopping, reading from registers and writing to registers.

Functions

- void PVref_P4_Init(void)
- void PVref_P4_Enable(void)
- void PVref_P4_Start(void)
- void PVref_P4_Stop(void)
- void PVref_P4_SetTap(uint32 dividerTap)
- void PVref_P4_SetVRefSrc(uint32 reference)

Function Documentation

void PVref_P4_Init (void)

Initialize/Restore the default Voltage Reference configuration as defined in the customizer. If the reference is set to Vdda, it will enable all Vdda-based references.

Side Effects

If the reference is Vdda-based, the function will enable all Vdda-based references because they share the same resistor tree.

void PVref_P4_Enable (void)

Enables the Voltage Reference.

void PVref_P4_Start (void)

Initializes all parameters required to setup the component as defined in the customizer. If the reference is set to Vdda, it will enable all Vdda based references.

Global Variables

PVref_P4_initVar - This variable is used to indicate the initial configuration of this component. The variable is initialized to zero and set to 1 the first time PVref_P4_Start() is called. This allows the component initialization without re-initialization in all subsequent calls to the PVref_P4_Start() routine.

Side Effects

If the reference is Vdda-based, the function will enable all Vdda-based references because they share the same resistor tree.

void PVref_P4_Stop (void)

Disables the Voltage Reference.

void PVref_P4_SetTap (uint32 *dividerTap*)

Selects which of the equally spaced resistor divider taps will be used for the reference. The output will range in 1/16th steps between Vref/16 to Vref.

Parameters:

dividerTap	One of the 16-tap voltage dividers to select a voltage between 1/16 of the reference source to the full reference source in steps of 1/16. • 1 : 1/16 Vref • ... : ... • 16 : Vref

void PVref_P4_SetVRefSrc (uint32 *reference*)

Selects whether the reference at the top of the resistor divider is based on the bandgap or Vdda.

Parameters:

reference	The reference source. • PVref_P4_BANDGAP_REFERENCE : Bandgap reference • PVref_P4_VDDA_REFERENCE : Vdda reference

Side Effects

If the reference is based on Vdda, it will affect all Vdda-based references because they share the same resistor tree.

Power Management APIs

Power management APIs perform the necessary configurations to the components to prepare it for entering low power modes.

These APIs must be used if the intent is to put the chip to sleep, then to continue the component operation when it comes back to active power mode.

Functions

- void PVref_P4_Sleep(void)
- void PVref_P4_Wakeup(void)

Function Documentation

void PVref_P4_Sleep (void)

Prepares the component to enter Sleep mode. If the reference is based on Vdda, the function will open the switch at the bottom of the resistor tree to eliminate the current flow through the resistor. If the reference is based on the bandgap, this function will do nothing.

Side Effects

If the reference is based on Vdda, it will affect all Vdda-based references because they share the same resistor tree.

void PVref_P4_Wakeup (void)

Restores the component after exiting Sleep mode. By calling this function for any Vdda-based reference, the function will enable all Vdda-based references because they all are based on the same resistor divider. For bandgap-based references, nothing will happen.

Side Effects

If the reference is based on Vdda, it will affect all Vdda-based references because they share the same resistor tree.

Global Variables

Global variables used in the component.

The following global variables are used in the component.

Variables

- uint8 **PVref_P4_initVar**

PVref_P4_backup_struct Struct Reference

Data Fields

- uint8 **enableState**

Code Examples and Application Notes

This section lists the projects that demonstrate the use of the Component.

Code Examples

PSoC Creator provides access to code examples in the Code Example 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 "Code Example" topic in the PSoC Creator Help for more information.

There are also numerous code examples that include schematics and example code available online at the Cypress Code Examples web page. Examples that use this Component include:

- CE203972 - Comparator with Programmable Voltage Reference

Application Notes

Cypress provides a number of application notes describing how PSoC can be integrated into your design. You can access the Cypress Application Notes search web page at www.cypress.com/appnotes.

API Memory Usage

Shows the Flash, SRAM and stack usage of the Component.

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 an 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.

PSoC 4 (GCC)

Configuration	PSoC Analog Coprocessor	
	Flash Bytes	SRAM Bytes
Default	232	2

Functional Description

The PVref_P4 Component provides an adjustable analog voltage reference in your design. You can instantiate several PVref_P4 Components on the schematic (particular number depends on the selected device resources and can be obtained from the device datasheet) and set the reference source to be either Vdda or the bandgap voltage. You may also select one tap of the 16-tap voltage divider to select a voltage between 1/16 of the reference source to the full reference source in steps of 1/16. The PVref_P4 Component output may be connected to any high impedance input such as the input to an opamp or comparator. To route Component output to a GPIO - it should be buffered with an opamp.

Note There are general predefined settings for the Programmable Reference Block, such as "Reference Source", "Voltage Reference Value", "Bandgap Gain", "Enable Vdda reference during Deep Sleep", which are located under the System Editor of the Design-Wide Resources file. For more details, refer to the PSoC Creator Help.

Note Changes to these settings will affect all PVref_P4 Component instances. The general settings in the System Editor can be tuned by System APIs as well. For more details refer, to System Reference Guide.

Note The actual value of the Vdda-based reference is dependable on real value of the Vdda voltage. The Vdda voltage is changeable and should be accurately treated to get precise reference.

Low Power Mode Behavior

The bandgap reference will be automatically disabled in deep sleep. In case of Vdda reference source to eliminate the current flow through the resistor it can be switched off by calling PVref_P4_Sleep() API. There is an option to leave Vdda reference enabled in deep sleep. To do this "Vdda reference active during deep sleep" option should be enabled in System tab at the Design Wide Resources window and PVref_P4_Sleep() API shouldn't be called prior to enter device into deep sleep mode.

Block Diagram and Configuration

A simplified diagram of the PVref_P4 hardware is shown in the Component customizer. The reference voltages are derived from a resistor string. There are 2 separate identical resistor strings. The resistor string is made up of 16 resistor legs each with a poly taps. The top of the first resistor string is connected to bandgap reference and the top of the second resistor is connected to Vdda reference. The bottom of the first resistor string is connected to Vssa and the bottom of the second resistor string is connected through a switch Vdda_enable to Vssa. Each resistor string has four 16:1 muxes. This 16:1 mux selects one of 16 voltages from the resistor string. The output reference voltages are not buffered and must be connected to only high impedance nets.

Industry Standards

Lists the industry standard compliance of the PVref_P4 Component.

MISRA Compliance

This section describes the MISRA-C:2004 compliance and deviations for the Component. There are two types of deviations defined:

- project deviations – deviations that are applicable for all PSoC Creator Components
- specific deviations – deviations that are applicable only for this Component

This section provides information on Component-specific deviations. Project deviations are described in the MISRA Compliance section of the *System Reference Guide* along with information on the MISRA compliance verification environment.

The PVref_P4 Component does not have any specific deviations.

Registers

Describes the UDB registers used in the PVref_P4 Component.

For fixed-function blocks, refer to the chip Technical Reference Manual (TRM) for more information about the registers.

Resources

The PVref_P4 Component uses the dedicated PRB (Programmable Reference Block) IP in the silicon.

DC and AC Electrical Characteristics

Specifications are valid for -40° C = T_A = 85° C and T_J = 100° C, except where noted.

Specifications are valid for 1.71 V to 5.5 V, except where noted.

DC Specifications

Parameter	Description	Conditions	Min	Typ	Max	Units
	Total resistor string resistance		-	86.45	-	*kOhms*

AC Specifications

Parameter	Description	Conditions	Min	Typ	Max	Units
Resistor divider ratio error	Deviation from 1/16 taps.		-	2.0	-	%
Bandgap resistor divider current	Bandgap divided by the resistance of the entire resistor divider string.		-	14	-	uA
Vdda resistor divider current	Vdda divided by the resistance of the entire resistor divider string.		-	64	-	uA

Component Changes

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

Version	Description of Changes	Reason for Changes / Impact
1.0.c	Updated AC Specifications data.	
1.0.b	Minor datasheet edits.	
1.0.a	Edited datasheet.	Final characterization data for PSoC 4000S, PSoC 4100S and PSoC Analog Coprocessor devices is not available at this time. Once the data is available, the Component datasheet will be updated on the Cypress web site.
1.0	Initial Component version.	

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