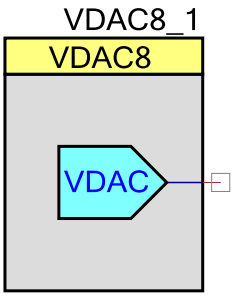
8-Bit Voltage Digital to Analog Converter (VDAC8)

1.20

Features

- Two ranges: 1.020V and 4.080V full scale
- Software or clock driven output strobe
- Data source may be CPU, DMA, or UDB
- Voltage output



General Description

The VDAC8 component is an 8-bit voltage output Digital to Analog Converter (DAC). It may be configured in a number of ways depending on your needs. The VDAC8 may be controlled by hardware, software or with a combination of both hardware and software.

When to use a VDAC8

Use the VDAC8 when you need a fixed or programmable voltage source.

Input/Output Connections

This section describes the various input and output connections for the VDAC8. An asterisk (*) in the list of I/O's states that the I/O may be hidden on the symbol under the conditions listed in the description of that I/O.

Vout – Analog

The Vout terminal is the connection to the DAC's voltage output. It may be routed to any analog compatible pin on the PSoC.

data[7:0] – Input *

This 8-bit wide data signal connects the VDAC8 directly to the DAC Bus. The DAC Bus may be driven by UDB based components, control registers, or routed directly from GPIO pins. This input is enabled by setting the "Data_Source" parameter to "DAC Bus". If the "CPU or DMA" option is selected instead, the bus connection will disappear from the component symbol.

Use the data[7:0] input when hardware is capable of setting the proper value without CPU intervention. When using this option, the strobe option should be set as "External" as well.

For many applications this input is not required, but instead the CPU or DMA will write a value directly to the data register. In firmware, use the SetRange() function or directly write a value to the VDAC8_1_Data register (assuming an instance name of “VDAC8_1”).

strobe – Input *

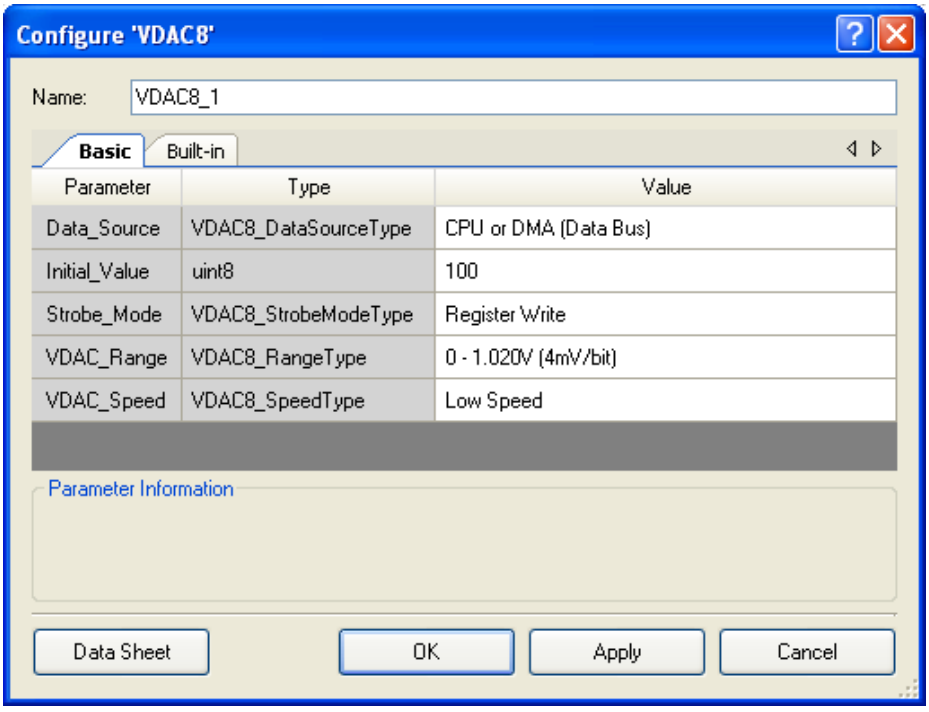
The strobe input is an optional signal input and is selected with the “Strobe_Mode” parameter. If Strobe_Mode is set to “External”, the pin will be visible and must be connected to a valid digital source. In this mode the data is transferred from the VDAC8 register to the DAC on the next positive edge of the strobe signal. If this parameter is set to “Register Write” the pin will disappear from the symbol and any write to the data registers will be immediately transferred to the DAC.

For audio or periodic sampling applications, the same clock used to clock the data into the DAC could also be used to generate an interrupt. Each rising edge of the clock would transfer data to the DAC and cause an interrupt to get the next value loaded into the DAC register.

Parameters and Setup

Drag a VDAC8 component onto your design and double-click it to open the Configure dialog.

Figure 1 Configure VDAC8 Dialog



The VDAC8 component provides the following parameters.

Data_Source

This parameter selects the source of the data to be written into the DAC register. If the CPU (firmware) or the DMA will write data to the VDAC8, then select “CPU or DMA”. If data is written directly from the UDBs or UDB based component, then the “DAC Bus” should be selected. There is only one DAC Bus

Initial_Value

This is the initial value the VDAC8 will present after the Start() command is executed. The SetValue() function or a direct write to the DAC register will override the default value at anytime. Legal values are between 0 and 255 inclusive.

Strobe_Mode

This parameter selects whether the data is immediately written to the DAC as soon as the data is written into the VDAC8 data register. This mode is selected when the “Register Write” option is selected. When the “External” option is selected, a clock or signal from the UDBs controls when the data is written from the DAC register to the actual DAC.

VDAC_Range

This parameter allows you to set one of two voltage ranges as the default value. The range may be changed at any time during runtime with the SetRange() function.

Range	Lowest Value	Highest Value	Step Size
Range_1_Volt	0.0 mV	1.020 V	4 mV
Range_4_Volt	0.0 mV	4.080 V	16 mV

Output equations:

- 1 Volt range – Vout = (value/256) * 1.024 Volts
- 4 Volt range – Vout = (value/256) * 4.096 Volts

Note “value” is a number between 0 and 255.

VDAC_Speed

This parameter provides two settings: “Low Speed” and “High Speed”. In the “Low Speed” mode, the settling time is slower but consumes less operating current. In the “High Speed” mode, the voltage settles much faster, but at a cost of more operating current.

Resources

The VDAC8 uses one viDAC8 analog block.

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 "VDAC8_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 "VDAC8".

Function	Description
void VDAC8_Start(void)	Configures the VDAC8 with the default parameters with the give power.
void VDAC8_Stop(void)	Disables the VDAC8 and sets it to the lowest power state.
void VDAC8_SetSpeed(uint8 speed)	Set DAC speed.
void VDAC8_SetValue(uint8 value)	Sets value between 0 and 255 with the given range.
void VDAC8_SetRange(uint8 value)	Sets range to 1 or 4 volts.

void VDAC8_Start(void)

Description: The start function initializes the VDAC8 with the default values, and sets the power to the given level. A power level of 0, is the same as executing the stop function.

Parameters: None

Return Value: None

Side Effects: None

void VDAC8_Stop(void)

Description: Powers down VDAC8 to lowest power state and disables output.

Parameters: None

Return Value: None

Side Effects: None

void VDAC8_SetSpeed(uint8 speed)

Description: Set DAC speed.

Parameters: (uint8) speed: Sets DAC speed, see table below for valid parameters.

Option	Description
VDAC8_LOWSPEED	Low speed (low power)
VDAC8_HIGHSPEED	High speed (high power)

Return Value: None

Side Effects: None

void VDAC8_SetRange(uint8 range)

Description: Sets range to 1 or 4 volts.

Parameters: (uint8) range: Sets full scale range for VDAC8. See table below for ranges.

Option	Description
VDAC8_RANGE_1V	Set full scale range of 1.020 V
VDAC8_RANGE_4V	Set full scale range of 4.080 V

Return Value: None

Side Effects: None

void VDAC8_SetValue(uint8 value)

Description: Sets value to output on VDAC8. Valid values are between 0 and 255.

Parameters: (uint8) value: Value between 0 and 255. A value of 0 is the lowest (zero) and a value of 255 is the full scale value. The full scale value is dependent on the range which is selectable with the SetRange API.

Return Value: None

Side Effects: None

Sample Firmware Source Code

The following is a C language example demonstrating the basic functionality of the VDAC8 component. This example assumes the component has been placed in a design with the default name "VDAC8_1."

Note If you rename your component you must also edit the example code as appropriate to match the component name you specify.

```
#include <device.h>

void main()
{
    VDAC8_1_Start();                      // Enable VDAC8
    VDAC8_1_SetRange(VDAC8_1_RANGE_1V);   // Set full scale range to 1.024V
    VDAC8_1_SetValue(100);                // Set value to 400 mV
}
```

Registers

The functions provided support most of the common runtime functions required for most applications. The following register references provide brief descriptions for the advanced user. The VDAC8_Data register may be used to write data directly to the DAC without using the API. This may be useful for either the CPU or DMA.

VDAC8_CR0

Bits	7	6	5	4	3	2	1	0
Value	RSVD			mode	Range[1:0]		hs	RSVD

- mode: Sets DAC to either voltage or current mode.
- range[1:0]: DAC range settings.
- hs: Use to set data speed.

VDAC8_CR1

Bits	7	6	5	4	3	2	1	0
Value	RSVD		mx_data	reset_udb_en	mx_idir	idirbit	Mx_ioff	ioffbit

- mx_data: Select data source.
- reset_udb_en: DAC reset enable.
- mx_idir: Mux selection for DAC current direction control.
- idirbit: Register source for DAC current direction.

- mx_off: Mux selection for DAC current off control.
- ioffbit: Register source for DAC current off

VDAC8_DATA

Bits	7	6	5	4	3	2	1	0
Value	Data[7:0]							

- Data[7:0]: DAC data register.

DC and AC Electrical Characteristics

DC Characteristics

Parameter	Description	Conditions	Min	Typ	Max	Units
Range (FS)	VDAC_Range: 0 - 1.020V (4mV/bit)	=255/256*Vref Vdd >2.7V	-	1.02		Volt
Range (FS)	VDAC_Range: 0 - 4.080V (16mV/bit)	=255/256*4*Vref Vdd > 4.75V	-	4.08		Volt
Gain Error	Gain Error		-	0.2	0.6	%FSR
Offset	Offset	Output code = 0	-	0.25	1	LSB
Rout	Output resistance					
	High	Vout = 4V	-	16	-	kΩ
	Low	Vout = 1V	-	4	-	kΩ
Vout	Output voltage range					
	High	Code = 255, Vdda > 5V	-	4	-	V
	Low	Code = 255	-	1	-	V
INL	Integral non linearity	CL=15 pF	-	-	±1.6	LSB
DNL	Differential non linearity	CL=15 pF	-	-	±1	LSB
Ezs	Zero scale error		-	-	±1	LSB
Eg	Gain error		-	-	0.6	%
VDAC_ICC	DAC current low speed mode	Code = 0	-	-	100	µA
VDAC_ICC	DAC current high speed mode	Code = 0	-	-	400	µA

AC Characteristics

Parameter	Description	Conditions	Min	Typ	Max	Units
Fdac	Update rate	1V mode	-	-	1	Msps
	Update rate	4V mode			250	Ksps
Tsettle	Settling time to 0.5LSB	Full scale transition, CL = 15 pF				
	High	Vout = 4V	-	-	4000	ns
	Low	Vout = 1V	-	-	1000	ns