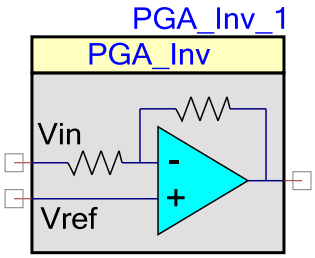
Inverting Programmable Gain Amplifier (PGA_Inv)

1.10

Features

- Gain steps from -1 to -49
- High input impedance
- Adjustable power settings



General Description

The Inverting Programmable Gain Amplifier (PGA_Inv) component implements an OpAmp-based inverting amplifier with user-programmable gain. This amplifier has high input impedance, wide bandwidth.

When to use a PGA_Inv

The PGA_Inv is used anytime a signal does not have sufficient amplitude and the signal needs to be inverted. A PGA_Inv may be placed in front of a comparator, ADC, or mixer to increase the signal amplitude. Another use for the PGA_Inv is to provide a high input impedance to the next stage. Components constructed of switched cap blocks may have a lower than desired input impedance, or input impedance that is a function of the switch frequency. In either case, the PGA_Inv can be used as a unity gain amplifier to buffer the input and drive the next stage.

Input/Output Connections

This section describes the various input and output connections for the PGA_Inv. 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.

Vin – Analog

Vin is the input signal terminal.

Vout – Analog

Vout is the output voltage signal terminal. Vout is a function of (Vin - Vref) times the Gain:

*Vout = Vref + (Vin-Vref) * Gain* where Gain is a negative value

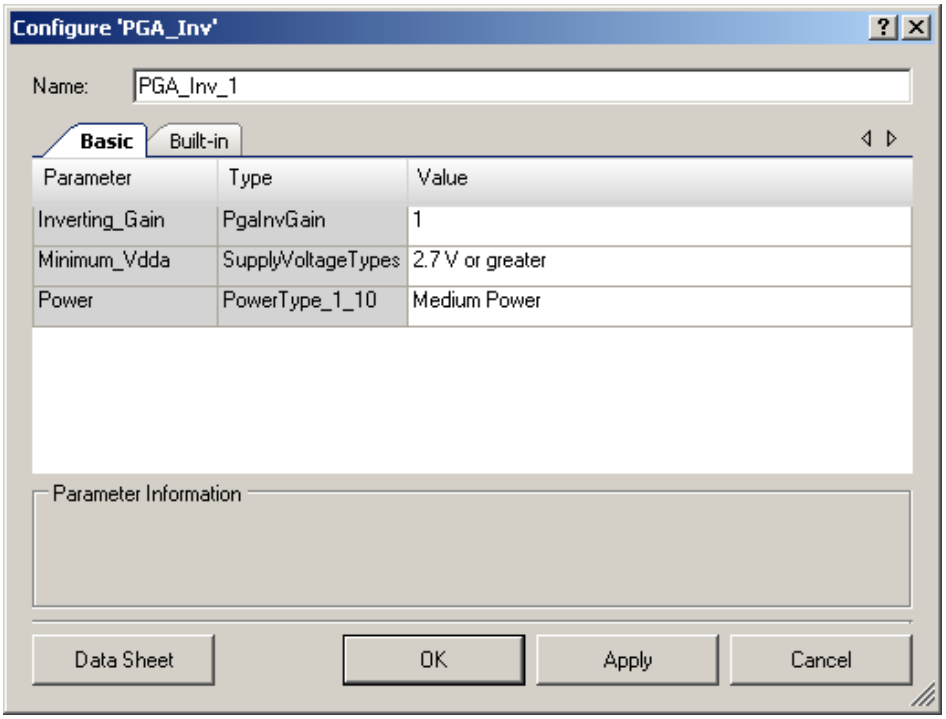
Vref – Analog

Vref is the input terminal for a reference signal.

Parameters and Setup

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

Figure 1 Configure PGA_Inv Dialog



Inverting_Gain

This parameter is used to set the default gain of the amplifier. You may select settings between -1 and -49 with this parameter, and allowable inverting gains provided are: 1 (default), 3, 7, 15, 22, 23, 24, 31, 47, and 49. The may also be set at runtime with the SetGain() API.

Power

This sets the initial drive power of the PGA_Inv. The power determines the speed with which the PGA_Inv reacts to changes in the input signal. There are four power settings; Minimum, Low, Medium (default), and High. A Low Power setting results in the slowest response time and a High Power setting results in the fastest response time. The PGA_Inv power can be set at runtime using the SetPower() API.

Placement

There are no placement specific options.

Resources

The PGA_Inv uses one SC/CT 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 "PGA_Inv_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 "PGA_Inv".

Function	Description
void PGA_Inv_Start(void)	Start the PGA_Inv
void PGA_Inv_Stop(void)	Power down PGA_Inv.
void PGA_Inv_SetGain(uint8 gain)	Sets gain to pre-defined constants.
void PGA_Inv_SetPower(uint8 power)	Set drive power to one of four settings.

void PGA_Inv_Start(void)

Description: Turns on the Analog Buffer and sets the power level.

Parameters: None

Return Value: None

Side Effects: None

void PGA_Inv_Stop(void)

Description: Turn off PGA_Inv and enable its lowest power state.

Parameters: None

Return Value: None

Side Effects: None. Does not affect power or gain settings.

void PGA_Inv_SetGain(uint8 gain)

Description: Set gain of amplifier between -1 and -49. The table below shows the valid gain settings.

Parameters: Uint8 gain: Set the gain to a specific value. See table below for valid gain settings.

Gain Setting	Notes
PGA_Inv_GAIN_01	Gain = -1
PGA_Inv_GAIN_03	Gain = -3
PGA_Inv_GAIN_07	Gain = -7
PGA_Inv_GAIN_15	Gain = -15
PGA_Inv_GAIN_22	Gain = -22
PGA_Inv_GAIN_23	Gain = -23
PGA_Inv_GAIN_24	Gain = -24
PGA_Inv_GAIN_31	Gain = -31
PGA_Inv_GAIN_47	Gain = -47
PGA_Inv_GAIN_49	Gain = -49

Return Value: None

Side Effects: None

void PGA_Inv_SetPower(uint8 power)

Description: Sets the drive power to one of four settings; minimum, low, medium, or high.

Parameters: (uint8) power: Sets the power level to one of three settings, low, medium, or high.

Power Setting	Notes
PGA_Inv_MINPOWER	Minimum active power and slowest reaction time.
PGA_Inv_LOWPOWER	Low power and speed.
PGA_Inv_MEDPOWER	Medium power and speed.
PGA_Inv_HIGHPOWER	Highest active power and fastest reaction time.

Return Value: None

Side Effects: None

Sample Firmware Source Code

The following is a C language example demonstrating the basic functionality of the PGA_Inv component. This example assumes the component has been placed in a design with the default name "PGA_Inv_1."

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

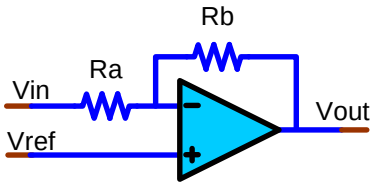
```
#include <device.h>

void main()
{
    PGA_Inv_1_Start();
    PGA_Inv_1_SetGain(PGA_Inv_1_GAIN_24);
    PGA_Inv_1_SetPower(PGA_Inv_1_MEDPOWER);
}
```

Functional Description

The PGA_Inv is constructed from a generic SC/CT block. The gain is selected by adjusting two resistors, Ra and Rb. (See Figure 2). Ra may be set to either 20K or 40K ohms. Rb may be set between 20K and 1000K ohms, to generate the possible gain values selectable in either the parameter dialog or the SetGain function. You are not required to select the resistance values, but instead the parameter dialog and SetGain function select the proper resistor values for the selected gain.

Figure 2 PGA_Inv Schematic



DC and AC Electrical Characteristics

The following values are indicative of expected performance and based on initial characterization data. Unless otherwise specified in the tables below, all T_A = 25°C, V_{dd} = 5.0V, Power HIGH, Op-Amp bias LOW, output referenced to Analog Ground = V_{ssa} .

5.0V/3.3V DC Electrical Characteristics

Parameter	Typical	Min	Max	Units	Conditions and Notes
Gain Deviation from Nominal					
G = -1				%	
G = -3				%	
G = -7				%	
G = -15				%	
G = -22				%	
G = -23				%	
G = -24				%	
G = -31				%	
G = -47				%	
G = -49				%	
Input					
Input Offset Voltage				mV	
Input Voltage Range				V	
Leakage				nA	
Input Capacitance				pF	
Output Swing				V	
PSRR				dB	
Operating Current					
Minimum Power				uA	
Low Power				uA	
Medium Power				uA	
High Power				uA	

5.0V/3.3V AC Electrical Characteristics

Parameter	Typical	Min	Max	Units	Conditions and Notes
AC Electrical Characteristics					
Slew Rate (20% to 80%)					
Minimum Power				V/uS	
Low Power				V/uS	
Medium Power				V/uS	
High Power				V/uS	
Settling Time					
Minimum Power				uS	
Low Power				uS	
Medium Power				uS	
High Power				uS	
Noise					
Minimum Power				nV/√Hz	
Low Power				nV/√Hz	
Medium Power				nV/√Hz	
High Power				nV/√Hz	

Note More specifications at other voltages and graphs will be added after characterization.