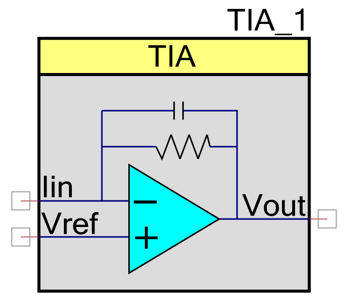
Trans-Impedance Amplifier (TIA)

1.50



Features

- Selectable conversion gain
- Selectable corner frequency
- Compensated for capacitive input sources
- Adjustable power settings
- Settable input reference voltage

General Description

The Trans-Impedance Amplifier (TIA) component provides an opamp-based current to voltage conversion amplifier with resistive gain and user-selected bandwidth. It is derived from the SC/CT block.

The TIA is used to convert an external current to a voltage. Typical applications include the measurement of sensors with current outputs such as photo-diodes. The conversion gain of the TIA is expressed in ohms, with the available range between 20 K and 1.0 Megohms. Current output sensors, such as photo-diodes often have substantial output capacitance. This requires shunt feedback capacitance in the TIA in order to guarantee stability. The TIA has a programmable feedback capacitor to meet this need and provide bandwidth limiting to reduce broadband noise.

Input/Output Connections

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

Iin – Analog

The Iin is the input signal terminal. The Iin is the sum of currents from the global inputs, which may include signals from a current output DAC.

Note This terminal name is `Iin` (capital `i`) **not** `lin` (lowercase `l`).

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Vref – Analog

Vref is the input terminal for a reference signal. The reference may be an internal reference, internal VDAC value, or external signal.

Vout – Analog

Vout is the output signal terminal. Vout is determined by the following equation, where Rfb is resistive feedback:

$$Vout = Vref - Iin * Rfb \qquad \textbf{Equation 1}$$

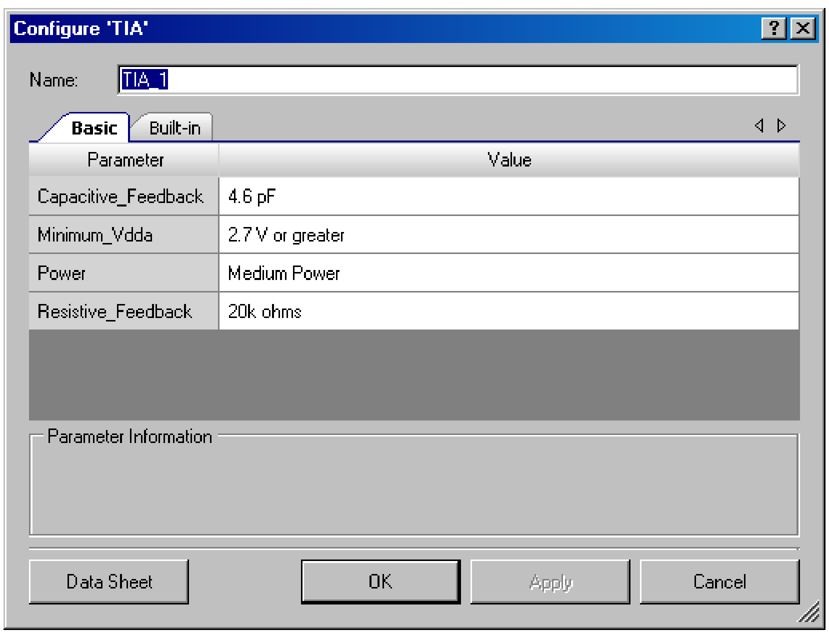
Positive (from source) currents result in output voltage, which is negative with respect to Vref.

Negative (into source) currents result in output voltage, which is positive with respect to Vref.

Parameters and Setup

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

Figure 1: Configure TIA Dialog



Capacitive Feedback

This sets the capacitive feedback for the TIA. The capacitive feedback can be set to None, 1.3 pF, 3.3 pF, or 4.6 pF (default). The -3 dB frequency for the TIA is calculated from the product of the values of resistive and capacitive feedback components.

Minimum_Vdda

This parameter is determined by the minimum analog supply voltage expected for the PSoC in the design. The parameter can be set to one of two values:

- 2.7 V or greater (default)
- Less than 2.7 V

For an analog supply voltage below 2.7 V, the amplifier makes use of an internal boost circuit. The component implementation uses an additional 10 MHz clock to drive the boost circuit for the amplifier block.

Power

This sets the initial drive power of the TIA. The power determines the speed with which the TIA reacts to changes in the input signal. There are four power settings; Minimum, Low, Medium (default), and High. Minimum Power setting results in the slowest response time and High Power the fastest. Minimum and Low Power settings have reduced drive currents and are not suitable for the lower values of feedback resistor.

Resistive Feedback

This sets the nominal resistive feedback for the TIA. The resistive feedback may be selected from the following set of allowed values (in ohms): 20k (default), 30k, 40k, 80k, 120k, 250k, 500k, and 1000k.

Placement

There are no placement specific options.

Resources

The TIA uses one SC/CT block. Typically, the Vref input is routed from a voltage reference, a VDAC output or an externally supplied reference on a GPIO.

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 "TIA_1" 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 "TIA".

Function	Description
void TIA_Init(void)	Initializes or restores default TIA configuration.
void TIA_Enable(void)	Enables the TIA.
void TIA_Start(void)	Power up the TIA.
void TIA_Stop(void)	Power down the TIA.
void TIA_SetPower(uint8 power)	Set drive power to one of four levels.
void TIA_SetResFB(uint8 res_feedback)	Set the resistive feedback to one of 8 values.
void TIA_SetCapFB(uint8 cap_feedback)	Set the capacitive feedback to one of 4 values.
void TIA_Sleep(void)	Stops and saves the user configurations.
void TIA_Wakeup(void)	Restores and enables the user configurations.
void TIA_SaveConfig(void)	Empty function. Provided for future usage.
void TIA_RestoreConfig(void)	Empty function. Provided for future usage.

Global Variables

Variable	Description
TIA_initVar	Indicates whether the TIA has been initialized. The variable is initialized to 0 and set to 1 the first time TIA_Start() is called. This allows the component to restart without reinitialization after the first call to the TIA_Start() routine. If reinitialization of the component is required, then the TIA_Init() function can be called before the TIA_Start() or TIA_Enable() function.

void TIA_Init(void)

Description: Initializes or restores default TIA configuration.

Parameters: None

Return Value: None

Side Effects: All registers will be reset to their initial values. This will re-initialize the component.

void TIA_Enable(void)

Description: Enables the TIA.

Parameters: None

Return Value: None

Side Effects: None

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void TIA_Start(void)

Description: Performs all of the required initialization for the component and enables power to the amplifier. The first time the routine is executed, the resistive and capacitive feedback and amplifier power are set based on the values provided during the configuration. When called to restart the TIA following a TIA_Stop() call, the current component parameter settings are retained.

Parameters: None

Return Value: None

Side Effects: None

void TIA_Stop(void)

Description: Turn off the TIA block.

Note This API is not recommended for use on PSoC 3 ES2 and PSoC 5 ES1 silicon. These devices have a defect that causes connections to several analog resources to be unreliable when not powered. The unreliability manifests itself in silent failures (e.g. unpredictably bad results from analog components) when the component utilizing that resource is stopped. It is recommended that all analog components in a design should be powered up (by calling the <INSTANCE_NAME>_Start() APIs) at all times. Do not call the <INSTANCE_NAME>_Stop() APIs.

Parameters: None

Return Value: None

Side Effects: Does not affect power, resistive or capacitive feedback settings

void TIA_SetPower(uint8 power)

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

Parameters: (uint8) power: See the following table for valid power settings.

Power Setting	Notes
TIA_MINPOWER	Minimum active power and slowest reaction time.
TIA_LOWPOWER	Low power and speed.
TIA_MEDPOWER	Medium power and speed.
TIA_HIGHPOWER	Highest active power and fastest reaction time.

Return Value: None

Side Effects: None

(void) TIA_SetResFB(uint8 res_feedback)

Description: Set the amplifier resistive feedback value.

Parameters: uint8 res_feedback: See table below for valid resistive feedback settings.

Gain Setting	Notes
TIA_RES_FEEDBACK_20K	Feedback resistor = 20k
TIA_RES_FEEDBACK_30K	Feedback resistor = 30k
TIA_RES_FEEDBACK_40K	Feedback resistor = 40k
TIA_RES_FEEDBACK_80K	Feedback resistor = 80k
TIA_RES_FEEDBACK_120K	Feedback resistor = 120k
TIA_RES_FEEDBACK_250K	Feedback resistor = 250k
TIA_RES_FEEDBACK_500K	Feedback resistor = 500k
TIA_RES_FEEDBACK_1000K	Feedback resistor = 1000k

Return Value: None

Side Effects: None

(void) TIA_SetCapFB(uint8 cap_feedback)

Description: Set the amplifier capacitive feedback value.

Parameters: uint8 cap_feedback: See table below for valid capacitive feedback settings.

Gain Setting	Notes
TIA_CAP_FEEDBACK_NONE	No capacitive feedback
TIA_CAP_FEEDBACK_1_3PF	Feedback capacitor = 1.3 pF
TIA_CAP_FEEDBACK_3_3PF	Feedback capacitor = 3.3 pF
TIA_CAP_FEEDBACK_4_6PF	Feedback capacitor = 4.6 pF

Return Value: None

Side Effects: None

void TIA_Sleep(void)

Description: Stops the component operation. Saves the configuration registers and the component enable state. Should be called just prior to entering sleep.

Parameters: None

Return Value: None

Side Effects: None

void TIA_Wakeup(void)

Description: Restores the component enable state and configuration registers. Should be called just after awaking from sleep.

Parameters: None

Return Value: None

Side Effects: None

void TIA_SaveConfig(void)

Description: Empty function. Provided for future usage.

Parameters: None

Return Value: None

Side Effects: None

void TIA_RestoreConfig(void)

Description: Empty function. Provided for future usage.

Parameters: None

Return Value: None

Side Effects: None

Sample Firmware Source Code

The following is a C language example demonstrating the basic functionality of the TIA component. This example assumes the component has been placed in a design with the default name "TIA_1."

Note If you renamed your component you must also edit the example code as appropriate to match the component name you specified; otherwise, this example code will not work.

If the TIA component will be used with the parameter settings configured during the project design phase, only a call to the associated TIA Start() routine is required to use this component.

```
#include <device.h>

void main()
{
    TIA_1_Start();
}
```

The remaining TIA component API routines can be used to change the component parameter settings at runtime.

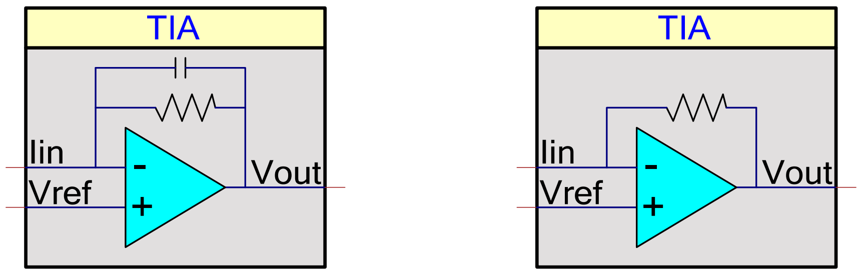
```
#include <device.h>

void main()
{
    TIA_1_Start();
    TIA_1_SetResFB(TIA_1_RES_FEEDBACK_250K);
    TIA_1_SetCapFB(TIA_1_CAP_FEEDBACK_4_6PF);
    TIA_1_SetPower(TIA_1_MEDPOWER);
}
```

Functional Description

The TIA is constructed from a generic SC/CT block. The topology is an opamp with a selectable feedback resistor from the output to the inverting input. Optionally a selectable feedback capacitor can also be connected between the output and the inverting input. See the following for TIA configurations.

Figure 2: TIA Configurations

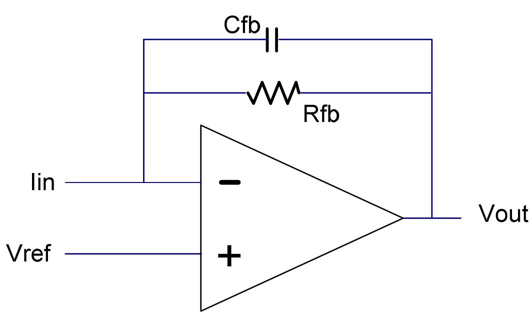


with Capacitive Feedback

without Capacitive Feedback

The output voltage is controlled by adjusting the Rfb feedback resistor. (See the following figure.) Rfb may be set to one of 8 values, between 20k and 1000k ohms, selectable in either the parameter dialog or the using the SetResFB() API function.

Figure 3: TIA Schematic



The DC output level can be adjusted by adding current to the Iin terminal. Positive current (into the terminal) pushes the output negative; negative current (pulling current from the terminal) pushes the output positive. The source of the current may be an internal DAC.

The amplifier bandwidth is determined by the interaction between the feedback resistor Rfb and the selection of the capacitor in parallel with Rfb. The capacitive feedback value Cfb can be set to one of four values in either the parameter dialog or by using the SetCapFB() API function.

The -3 dB frequency for the amplifier is:

$$Freq - 3dB = 1/(2\pi R_{fb} C_{fb} \qquad \textbf{Equation 2}$$

The following table shows the minimum capacitive feedback values that can be used with each power setting and still guarantee TIA circuit stability.

Power Setting	Minimum Capacitive Feedback	Units	Conditions and Notes
Minimum Power		pF	
Low Power		pF	
Medium Power		pF	
High Power		pF	

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 $T_A = 25^{\circ}C$, $V_{dda} = 5.0V$, Power HIGH, Op-Amp bias LOW, output referenced to 1.024V.

Note Characteristic data table will be updated following silicon characterization.

5.0 V/3.3 V DC Electrical Characteristics

Parameter	Description	Conditions	Min	Typ	Max	Units
Rconv20	20 kΩ		14	20	28	kΩ
Rconv30	30 kΩ		21	30	42	kΩ
Rconv40	40 kΩ		28	40	56	kΩ
Rconv80	80 kΩ		56	80	112	kΩ
Rconv120	120 kΩ		84	120	168	kΩ
Rconv250	250 kΩ		175	250	350	kΩ
Rconv500	500 kΩ		350	500	700	kΩ
Rconv1000	1000 kΩ		700	1000	1400	kΩ
TCRconv	Temp coefficient conversion resistance	Rconv=120k	na	tbc	tbc	ppm/deg C
Vos	Input Offset Voltage	Vdda=3.3 V, 25 C, P=Min	na	tbc	tbc	mV
		Vdda=3.3 V, 25 C, P=Low	na	tbc	tbc	mV
		Vdda=3.3 V, 25 C, P=Med	na	tbc	tbc	mV
		Vdda=3.3 V, 25 C, P=High	na	tbc	tbc	mV

PRELIMINARY

Parameter	Description	Conditions	Min	Typ	Max	Units
TCVos	Temp coefficient Input Offset Voltage	P=Min	na	tbc	tbc	uV/deg C (abs value)
		P=Low	na	tbc	tbc	uV/deg C (abs value)
		P=Med	na	tbc	tbc	uV/deg C (abs value)
		P=High	na	tbc	tbc	uV/deg C (abs value)
Rin	Input resistance	Reference input	na	10	na	Meg ohms
Cin	Input capacitance	Reference input (routing dependent)	na	tbc	tbc	pF
PSRR	Power supply rejection ratio	Iin=0	tbc	tbc		dB
Idda	Operating current	Vdda=1.71 V, P=Min		tbc	tbc	uA
		Vdda=5.0 V, P=High		tbc	tbc	

Figures

Histogram offset voltage 100 parts, 4 per part T=25C, P=High X axis mV Y axis % in bins	**Voffset vs temperature,** Vdda=5.0V, P=High X axis: temp -40 to 85 C Y axis Voffset 1 max 2 typ 3 min
	Conversion Gain vs Temp, Vdda=5.0V, P=high X axis temp -40 to 85 C Y axis mean % deviation from nominal 1 R=20 k 2 R=30 k 3 R=40k 4 R=80k 5 R=120k 6 R=250k 7 R=500k 8 R=1.0 Meg
Operating current vs voltage, P=min, Iin=0 X axis Vdda, 1.7, 2.7, 3.3, 5.0 Y axis Op current uA 1 max at worst temp 2 typ at 25C	**Operating current vs voltage, P=low, Iin=0** X axis Vdda, 1.7, 2.7, 3.3, 5.0 Y axis Op current uA 1 max at worst temp 2 typ at 25C

Operating current vs voltage, P=med, lin=0 X axis Vdda, 1.7, 2.7, 3.3, 5.0 Y axis Op current uA 1 max at worst temp 2 typ at 25C	**Operating current vs voltage, P=high lin=0** X axis Vdda, 1.7, 2.7, 3.3, 5.0 Y axis Op current uA 1 max at worst temp 2 typ at 25C
Operating current vs temp, P=min, lin=0 X axis Temp, -40 to +85C Y axis op current uA 1 Typ at 2.7V 2 Max at 2.7V 3 Typ at 5.5V 4 Max at 5.5V	**Operating current vs temp, P=low, lin=0** X axis Temp, -40 to +85C Y axis op current uA 1 Typ at 2.7V 2 Max at 2.7V 3 Typ at 5.5V 4 Max at 5.5V
Operating current vs temp, P=med, lin=0 X axis Temp, -40 to +85C Y axis op current uA 1 Typ at 2.7V 2 Max at 2.7V 3 Typ at 5.5V 4 Max at 5.5V	**Operating current vs temp, P=high, lin=0** X axis Temp, -40 to +85C Y axis op current uA 1 Typ at 2.7V 2 Max at 2.7V 3 Typ at 5.5V 4 Max at 5.5V
Output voltage vs load current, Vdda=2.7V, Rfb=120k, Vref=1.024V, P=min, lin adjusted for Vout=Vdd-0.050V at no load X axis output current uA Y axis output voltage 1 Vdd-Voh at -40 2 Vdd-Voh at 25 3 Vdd-Voh at 85 4 Vol at -40 5 Vol at 25 6 Vol at 85	**Output voltage vs load current, Vdda=2.7V Rfb=120k, Vref=1.024V, P=low, lin adjusted for Vout=Vdd-0.050V at no load** X axis output current uA Y axis output voltage 1 Vdd-Voh at -40 2 Vdd-Voh at 25 3 Vdd-Voh at 85 4 Vol at -40 5 Vol at 25 6 Vol at 85
Output voltage vs load current, Vdda=2.7V, Rfb=120k, Vref=1.024V, P=med, lin adjusted for Vout= Vdd-0.050V at no load X axis output current uA Y axis output voltage 1 Vdd-Voh at -40 2 Vdd-Voh at 25 3 Vdd-Voh at 85 4 Vol at -40 5 Vol at 25 6 Vol at 85	**Output voltage vs load current, Vdda=2.7V, Rfb=120k, Vref=1.024V, P=high, lin adjusted for Vout=Vdd-0.050V at no load** X axis output current uA Y axis output voltage 1 Vdd-Voh at -40 2 Vdd-Voh at 25 3 Vdd-Voh at 85 4 Vol at -40 5 Vol at 25 6 Vol at 85

Output voltage vs load current, Vdda=2.7V, Rfb=120k, Vref=1.024V, P=min, lin adjusted for Vout- Vdd-0.050V at no load X axis output current uA Y axis output voltage 1 Vdd-Voh at -40 2 Vdd-Voh at 25 3 Vdd-Voh at 85 4 Vol at -40 5 Vol at 25 6 Vol at 85	**Output voltage vs load current, Vdda=2.7V, Rfb=120k, Vref=1.024V, P=min, lin adjusted for Vout- Vdd-0.050V at no load** X axis output current uA Y axis output voltage 1 Vdd-Voh at -40 2 Vdd-Voh at 25 3 Vdd-Voh at 85 4 Vol at -40 5 Vol at 25 6 Vol at 85
Output voltage vs load current, Vdda=2.7V, Rfb=120k, Vref=1.024V, P=min, lin adjusted for Vout- Vdd-0.050V at no load X axis output current uA Y axis output voltage 1 Vdd-Voh at -40 2 Vdd-Voh at 25 3 Vdd-Voh at 85 4 Vol at -40 5 Vol at 25 6 Vol at 85	**Output voltage vs load current, Vdda=2.7V, Rfb=120k, Vref=1.024V, P=min, lin adjusted for Vout- Vdd-0.050V at no load** X axis output current uA Y axis output voltage 1 Vdd-Voh at -40 2 Vdd-Voh at 25 3 Vdd-Voh at 85 4 Vol at -40 5 Vol at 25 6 Vol at 85

5.0V/3.3V AC Electrical Characteristics

Parameter	Description	Conditions	Min	Typ	Max	Units
GBW_L	-3dB Bandwidth, P=Low	Rconv=120k, Vdda=2.7 V, 25 C	tbc	tbc	na	MHz
GBW_H	-3dB Bandwidth, P=High	Rconv=120k, Vdda=5.0 V, 25 C	tbc	tbc	na	MHz
BW20	-3dB Bandwidth Rconv=20 kΩ	Cfb=0, P-high	1250	tbc	2000	kHz
BW30	-3dB Bandwidth Rconv=30 kΩ	Cfb=0, P-high	1000	tbc	1500	kHz
BW40	-3dB Bandwidth Rconv=40 kΩ	Cfb=0, P-high	800	tbc	1100	kHz
BW80	-3dB Bandwidth Rconv=80 kΩ	Cfb=0, P-high	450	tbc	660	kHz
BW120	-3dB Bandwidth Rconv=120 kΩ	Cfb=0, P-high	280	tbc	280	kHz
BW250	-3dB Bandwidth Rconv=250 kΩ	Cfb=0, P-high	130	tbc	180	kHz
BW500	-3dB Bandwidth Rconv=500 kΩ	Cfb=0, P-high	63	tbc	88	kHz

Parameter	Description	Conditions	Min	Typ	Max	Units
BW1000	-3dB Bandwidth Rconv=1000 kΩ	Cfb=0, P-high	31	tbc	42	kHz
SR_PMin	Slew Rate	20 - 80%, Rconv=120k, P=Min	tbc	tbc	na	V/us
SR_PLow		20 - 80%, Rconv=120k, P=Low	tbc	tbc	na	V/us
SR_PMed		20 - 80%, Rconv=120k, P=Med	tbc	tbc	na	V/us
SR_PHigh		20 - 80%, Rconv=120k, P=High	tbc	tbc	na	V/us
Tsettle_Pmin	Settling time to	1.0 V step to 0.1%, CLoad= 15 pF Vdda= 5.0 V, G=1, P=min	na	tbc	tbc	nsec
Tsettle_Plow		1.0 V step to 0.1%, CLoad= 15 pF Vdda= 5.0 V, G=1, P=low	na	tbc	tbc	nsec
Tsettle_Pmed		1.0 V step to 0.1%, CLoad= 15 pF Vdda= 5.0V, G=1, P=med	na	tbc	tbc	nsec
Tsettle_Phigh		1.0 V step to 0.1%, CLoad= 15 pF Vdda= 5.0 V, G=1, P=high	na	tbc	tbc	nsec
Vn_Pmin	Noise	Rconv=120k, f=10 kHz, P=min	na	tbc	na	nV/rtHz
Vn_Plow		Rconv=120k, f=10 kHz, P=Low	na	tbc	na	nV/rtHz
Vn_Pmed		Rconv=120k, f=10 kHz, P=Med	na	tbc	na	nV/rtHz
Vn_Phigh		Rconv=120k, f=10 kHz, P=High	na	tbc	na	nV/rtHz
CMRR		at 1.0 kHz, 1.0 V headroom, Rconv=120k, Iin=0	90	60		dB
PSRR		at 100 kHz, Vref=1.024 V Rconv=120k, Iin=0		69		

Figures

Typical Gain vs freq, 3.3V, P=min, Cfb=0	**Typical Gain vs freq, 3.3V, P=low, Cfb=0**
Iin=1.0V/Rfb X axis 10 kHz to 10 MHz Y axis Gain, dB 1 R=20 k 2 R=30 k 3 R=40k 4 R=80k 5 R=120k 6 R=250k 7 R=500k 8 R=1.0 Meg	Iin=1.0V/Rfb X axis 10 kHz to 10 MHz Y axis Gain, dB 1 R=20 k 2 R=30 k 3 R=40k 4 R=80k 5 R=120k 6 R=250k 7 R=500k 8 R=1.0 Meg

Typical Gain vs freq, 3.3V, P=med, Cfb=0 Iin=1.0V/Rfb X axis 10 kHz to 10 MHz Y axis Gain, dB 1 R=20 k 2 R=30 k 3 R=40k 4 R=80k 5 R=120k 6 R=250k 7 R=500k 8 R=1.0 Meg	**Typical Gain vs freq, 3.3V, P=high, Cfb=0** Iin=1.0V/Rfb X axis 10 kHz to 10 MHz Y axis Gain, dB 1 R=20 k 2 R=30 k 3 R=40k 4 R=80k 5 R=120k 6 R=250k 7 R=500k 8 R=1.0 Meg
Typical Gain vs freq, 3.3V, P=high, Cfb=1.3pF Iin=1.0V/Rfb X axis 10 kHz to 10 MHz Y axis Gain, dB 1 R=20 k 2 R=30 k 3 R=40k 4 R=80k 5 R=120k 6 R=250k 7 R=500k 8 R=1.0 Meg	**Typical Gain vs freq, 3.3V, P=high, Cfb=3.3pF** Iin=1.0V/Rfb X axis 10 kHz to 10 MHz Y axis Gain, dB 1 R=20 k 2 R=30 k 3 R=40k 4 R=80k 5 R=120k 6 R=250k 7 R=500k 8 R=1.0 Meg
Typical Gain vs freq, 3.3V, P=high, Cfb=4.6 pF, Iin=1.0V/Rfb X axis 10 kHz to 10 MHz Y axis Gain, dB 1 R=20 k 2 R=30 k 3 R=40k 4 R=80k 5 R=120k 6 R=250k 7 R=500k 8 R=1.0 Meg	**-3dB BW (Typ, max) vs Vdda** Rfb=120k X axis Vdda 1,7, 2.7, 3.3, 5.0 Y axis BW kHz 1 P=min, typ 2 P=min, min 3 P=low, typ 4 P=low, min 5 P=med, typ 6 P=med, min 7 P=high, typ 8 P=high, min
-3dB BW (Typ) vs Temp, P=min X axis Temp deg C Y axis -3dB BW kHz 1 R=20 k 2 R=30 k 3 R=40k 4 R=80k 5 R=120k 6 R=250k 7 R=500k 8 R=1.0 Meg	**-3dB BW (Typ) vs Temp, P=low** X axis Temp deg C Y axis -3dB BW kHz 1 R=20 k 2 R=30 k 3 R=40k 4 R=80k 5 R=120k 6 R=250k 7 R=500k 8 R=1.0 Meg

-3dB BW (Typ) vs Temp, P=med X axis Temp deg C Y axis -3dB BW kHz 1 R=20 k 2 R=30 k 3 R=40k 4 R=80k 5 R=120k 6 R=250k 7 R=500k 8 R=1.0 Meg	**-3dB BW (Typ) vs Temp, P=high** X axis Temp deg C Y axis -3dB BW kHz 1 R=20 k 2 R=30 k 3 R=40k 4 R=80k 5 R=120k 6 R=250k 7 R=500k 8 R=1.0 Meg
Voltage noise, Vdda = 5.0V, P=high Xaxis freq kHz .01 to 1000 kHz Yaxis voltage noise nV/rtHz	**PSRR vs freq, Vdda = 5.0V, P=high** X axis freq 100 Hz to 1.0 MHz Y axis dB

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

Component Changes

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

Version	Description of Changes	Reason for Changes / Impact
1.50	Added Sleep/Wakeup and Init/Enable APIs.	To support low power modes, as well as to provide common interfaces to separate control of initialization and enabling of most components.
	TIA parameter Pull-down values are reordered in the ascending order.	The TIA parameter pull-down values are not in ascending order. The 80kOhm comes after 1000k Ohm. Reordered the values accordingly.
	Changed the minus symbol to be the same length as horizontal stroke in the '+' character.	Updated the minus symbol to meet the industry standard.
	Updated a conditional statement to properly enable the charge pump clock for PSoC 3 ES3 silicon and PSoC 5 ES2 silicon or later.	The charge pump clock was not being enabled properly and therefore SC blocks were not working.