Dual Wide-Bandwidth Digitally Adjustable Current Amplifier (DACA)

**DACA FEATURES**

- Two Amplifiers Inside One Chip
- Fully-Differential inputs and outputs
- Digitally Controllable Current Gain (A\text{max} = 8)
- Wide Bandwidth (380MHz, A = 1)
- CMOS 0.35\textmu m Technology
- Low Supply Voltage (3.3 V or \pm 1.65V)
- Low Quiescent Current (6 mA per amplifier)
- 300\textmu A Output Current
- 44 PLCC Package

**APPLICATIONS**

- Low Current Controllable Amplifier
- Video/Broadcast Equipment
- Communications Equipment
- Current-mode Bus Driver
- High-Speed Data Acquisition
- Single-ended and Fully Differential Frequency Filters

**DESCRIPTION**

The DACA is a dual Current Amplifier designated for wide-bandwidth systems, current-mode buses and analog signal processing. Chip contains two independent Fully-Differential Amplifiers (A, B) which gains are controlled independently by two 3-bit digital buses with maximum gain 8 and step 1. DACA provides wide bandwidth. DACA is made in the CMOS 0.35\textmu m technology with only 3.3 V supply voltage and only 19.8 mW power consumption. Output current is linear up to 300 \mu A for all gains. Maximum input current in case of the lowest gain is therefore also 300 \mu A.

The DACA is internally formed by cascade of two Fully-Differential Adjustable Current Amplifier (FDA-CF) with balanced outputs, whose gains could be set independently. Gain is set by the sum of current that are connected to the output based on gain value. Input FDA-CF makes the difference between input currents with low input impedance.
PIN CONFIGURATION

Each of the two DACAs (A, B) has independent pinout as is obvious from the figure above. Number of pins of one DACA is 20. There are seven supply voltage pins, two VDD and five VSSs. Proper blocking of the supply voltage is required. Three-bit bus that provides control of current gain consists actually of two three-bit buses, marked by D1_G and D2_G group of pins. Corresponding bits of each bus have to be connected in order to obtain unity-round gain. Positive current input is marked as CI1, negative current input as CI2. Balanced outputs are marked as CO1 and CO2. D1VB and D2VB should be connected to +2 V with respect to VSS. For instance, basic connections of DACA A are illustrated in a figure bellow.
TYPICAL AC CHARACTERISTICS: \( V_S = \pm 1.65 \, V \)

At \( T_A = +25 \, ^\circ C \), \( I_{IN1_{MAX}} = -I_{IN2_{MAX}} = 40 \, \mu A \) and \( R_L = 500 \, \Omega \), unless otherwise noted.
CURRENT BUS AMPLIFIER

The DACA circuit was developed primarily for current mode applications. It provides adjustable current gain and can be used as single-ended or fully-differential circuit. The simplest application is the current-mode bus driver as shown in the following figure.

Current transfers are described by following equations

\[ I_{\text{OUT}+} = A (I_{\text{IN}+} - I_{\text{IN}-}) \]
\[ I_{\text{OUT}-} = A (I_{\text{IN}+} - I_{\text{IN}-}) \]
\[ I_{\text{DIFF}} = 2A (I_{\text{IN}+} - I_{\text{IN}-}) \]

where \( I_{\text{DIFF}} = I_{\text{OUT}+} - I_{\text{OUT}-} \). Differential gain is two times higher than single-ended. Therefore if differential signals are driven over the transmission line, obtainable gain is higher.

FULLY-DIFFERENTIAL BAND-PASS FILTER

DACA can be used as active element in filtering structures. Thanks to its adjustable gain, DACA can set some parameter of the final filter solution. As an example, band-pass filter with adjustable quality factor is provided. Structure contains also Dual-Output or Multiple-Output Current Followers those serve as current dividers.

Current transfer of this filter with adjustable quality factor is

\[
\frac{I_{\text{OUT}}}{I_{\text{IN}}} = \frac{2sC_2G_1A}{4s^2C_1C_2(2A+1)+2sC_2G_1+G_1G_2(2A+1)}
\]
PACKAGE INFORMATION

PLCC-44 Outline Dimensions

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