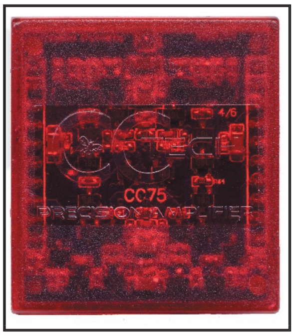

CC75

Precision Full Balanced LEF - Single Ended Class A Universal Amplifier

Features

- Full Differential Operation (4-pole)
- LEF Class-A Output Stage
- Wide Range of Application
- Integrated Offset Servo Control
- Integrated Voltage Regulator
- Selectable Gain 0...about 5000
- Unity Zero Gain Stable
- Configurable Internal Filter
- Configurable Frequency Compensation
- Configurable Feedback Ratio
- Very Low Dynamic Distortion
- Low Noise
- Target Offset Adjustment
- Ease To Use

Applications

- Very High Performance Audio Circuitry
- DAC Output Amplifier
- ADC Input Amplifier
- Active Filters
- Single Ended To Differential Converter
- Transformerless Microphone Amplifier
- Differential Receivers
- Precision Instrumentation
- *Current Injection®* Amplifiers
- Differential *Current Injection®*
- Differential Integrators

Description

The CC75 universal Amplifier defines a new quality standard for analog signal amplifiers and provides a wide range of applications. The unique LEF-Technology neutralizes the Vce and the Ic distortions naturally, so that a signal correction by negative feedback is normally not required any more. Especially audio equipment takes a lot of sonic benefit of CC75's unique circuitry. However, an operation with negative feedback is possible as well. The fully balanced design allows a cross loop feedback with 2 balanced loops. The open loop gain and frequency response is user adjustable in a wide range. Thus the feedback ratio is free to choose by the user. The free adjustable characteristic of CC75 in feedback loop operation and the balance between precision and speed, allows a wide field of engineers the use of CC75 in their own way. The voltage amplifier is a multiple cascoded folded single ended amplifier. This means: just one voltage amplifier stage receives a signal on any DC level and outputs at GND (or user adjustable offset level). There is no active complementary transistor pair sharing a signal. Due to the single ended amplifier topology CC75 operates always in "Class A".

CC75 has balanced inputs and outputs and is therefore a 4-pole amplifier. The open loop gain is adjustable by just one external resistor at the "Gain" pins. Without any resistor CC75 provides a gain of 0 - practically about more than -90dB. Therefore it is easy to use the gain pins for a filter pole.

The C-pins are for filter purposes and for setting the gain/maximum voltage/noise relation. Adding a capacitor to GND causes a low pass filter inside of CC75. This filter can be used for frequency compensation in closed loop operation. A resistor connected to these pins reduces the gain, the noise and the maximum output voltage. The C-pins allow a lossless volume control as well.

The "Offset" pins allow to trim the offset to zero or even any other required output voltage - e.g. 2.5 V for ADC converter inputs. The offset can be externally adjusted for both differential outputs separately. CC75 has an internal offset servo circuit and provides a stable offset even without negative feedback.

CC75 as well includes an internal voltage regulator, which makes external designs easier. The internal regulator is designed for best dynamic performance rather than the smallest tolerance. The active regulating frequency range is wider than the available signal range of CC75 and therefore dynamically stable.

All external pins are easy to use and allow even unexperienced users to build excellent amplifiers for various applications.

Pin Description

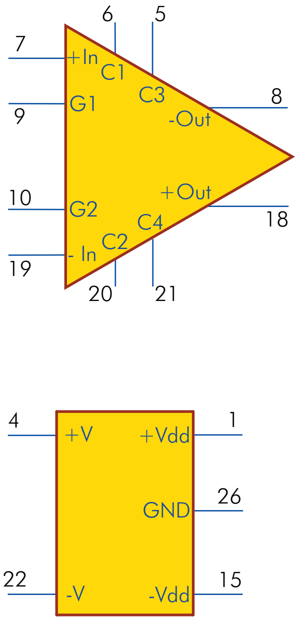

Fig. 1

1. Internal Positive Voltage +Vdd
2. NC
3. NC
4. Positive Supply Voltage. Range from 18 V...25 V unregulated.
5. Virtual ground -Out voltage amp
6. Voltage amp configuration pin
7. Non inverted input
8. Inverted output
9. Gain configuration 1; inverted CI-input
10. Gain configuration 2; non inverted CI-input

11\. / 12. / 13. / 14. Not existing due to compatibility with other models

15. Internal Negative Voltage -Vdd
16. Offset adjustment +Out
17. Offset adjustment -Out
18. Non inverted output
19. Inverted input
20. Virtual ground +Out voltage amp
21. Voltage amp configuration pin
22. Negative Supply Voltage. Range from -18 V...-25 V unregulated.
23. NC
24. NC
25. Not existing due to compatibility with other models
26. GND
27. Not existing due to compatibility with other models

Pin Orientation

Top View

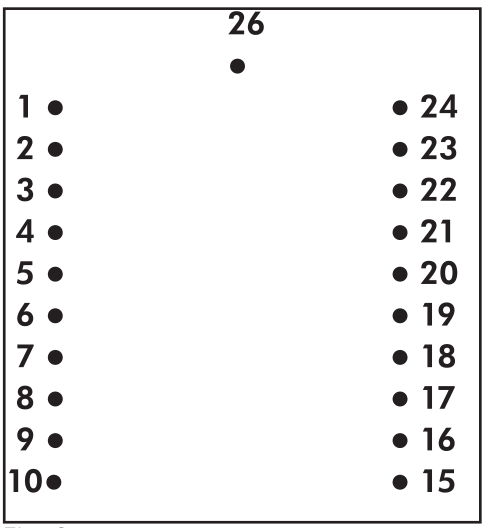

Fig. 2

Mechanical Dimension

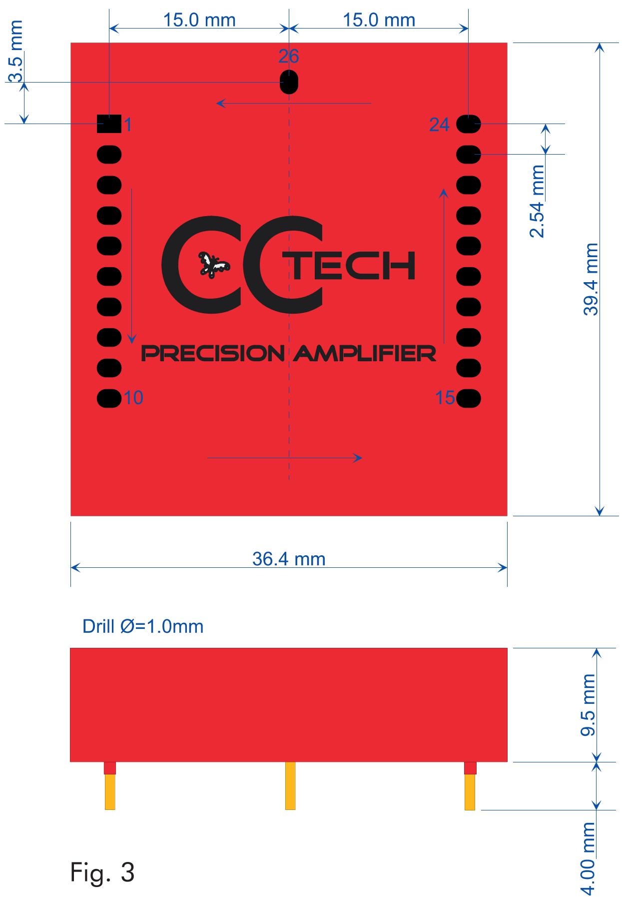

Fig. 3

Basic Applications - Non Feedback Use

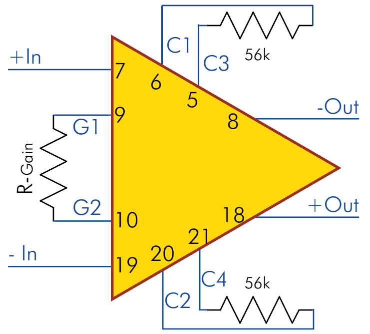

Fig. 4

Fig. 4 • Balanced Sources

This is the basic use of CC75 as a differential Amplifier. This circuit requires a balanced input signal and provides a balanced output signal. To set a gain higher than 0, a resistor must be applied between the gain pins. The resulting gain is G=96000/Rgain - means: a 10kΩ gain resistor would result in a gain of 9.4=19.4dB. The maximum gain of about 800 is set by shorting G1 and G2. Unity gain requires a resistor of 96kΩ.
For output noise sensitive applications it is suggested to add two resistors with lower value than 56kΩ to the C-pins (recommended: about 22 to 33kΩ). The maximum gain is reduced, however for all applications requiring a gain of less than 100 this circuit is recommended.
For higher gain requirements the resistors at the C-pins can be increased, or even C-pins can be left open. Due to internal 330kΩ the gain can be increased to about 5000.

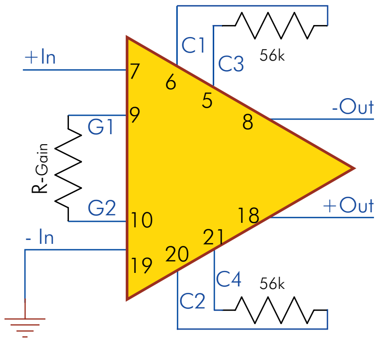

Fig. 5

Fig. 5 • Unbalanced Sources

This is the basic use of CC75 as a differential Amplifier for unbalanced input signals. However, this circuit provides a balanced output signal. The gain calculation is related to the balanced output. This means that e.g. a gain of 2 for an input voltage of 1V would result in 1V output voltage on +out and inverted on -out. The differential summary is 2V.

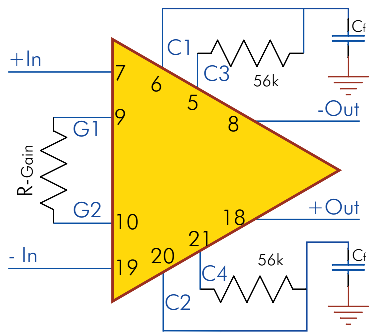

Fig. 6

Fig. 6 • Low Pass Filter

This circuit shows how to make a simple buffered low pass filter inside the CC75. The output impedance at the C-pins with external 56kΩ is about 48kΩ and therefore the filter is easy to calculate: $f_0=1/(2x\pi x48k\Omega xC_f)$. If the output impedance of the C-pins should be changed by a different resistor, the calculation impedance changes accordingly.

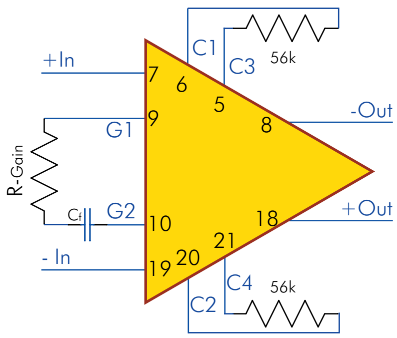

Fig. 7

Fig. 7 • High Pass Filter

This circuit shows a simple high pass filter inside the CC75. For low frequencies the gain decreases according to the resistor/capacitor relation. This filter calculation is as followed: $f_0=1/(2x\pi xR_{gain}xC_f)$. High pass and low pass filter can be combined and are decoupled.

Basic Applications - Non Feedback Use - Current Injection®

Description

Current Injection is another method of using CC75 as signal amplifier. The use of current injection looks a little like the use of an inverted OP-amp, but is basically different. Current injection requires no feedback. Due to the sophisticated CC75 internal voltage amplifier, the source current can be used to directly result in an output voltage. In current injection operation CC75's internal voltage amplifier currents are all static and the source current itself causes internal unbalanced currents which causes an output voltage. Dynamically this voltage amplifier is naturally excellent. The noise and the THD of CC75's input stage is avoided. Just the LEF output stage buffers the signal.
A disadvantage of current injection is a limited flexibility in use due to possible input impedance limitations. According to the required gain, the input impedance might be too low for some applications. Another limitation is the need for a balanced or earth free input source.

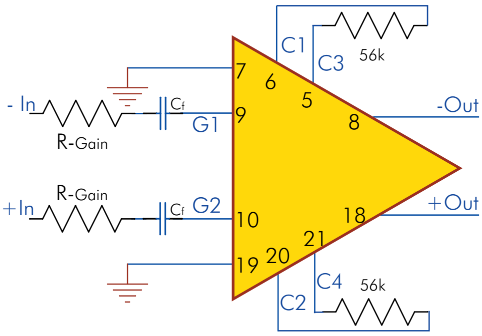

Fig. 8

Fig. 8 • Current Injection For Balanced Sources

This is the basic circuit of CC75 in current injection use. The source signal current is directly injected to CC75's internal amplifier stages through a resistor. The G1/G2 input impedance is very low, so that the input impedance just depends on R-Gain. The gain calculation is very easy: G=48000/R-Gain. If e.g. a preamplifier requires a gain of about 4, R-gain would be 12kΩ, which is also the input impedance. The source impedance at the CC75 inputs is 0 for this example and therefore the input noise is very low. To avoid DC offset currents a coupling capacitor is added. This capacitor could be avoided by trimming the G1/G2 voltage to the source potential.

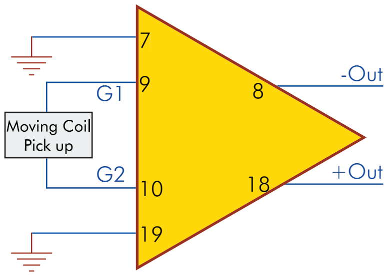

Fig. 9

Fig. 9 • Current Injection For Earth Free Sources

For earth free sources, e.g. a phono MC pick up, current injection is the ideal way of achieving low noise, low THD and excellent dynamic performance. In this circuit the low source impedance of the MC pick up would cause a high gain inside CC75. For other earth free sources with higher voltage the gain can be set by a series resistor.
The current injection operation is also best for professional audio application using transformer coupled lines.

Volume Control

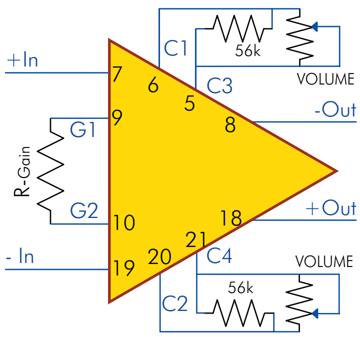

Fig. 10

Fig. 10 • Volume Control

For volume control it is suggested to add a stereo potentiometer to the C-pins. The maximum gain for a 47kΩ potentiometer is then calculated: G=47kΩ/Rgain. By reducing the potentiometer's resistance the input signal and also noise and THD are reduced accordingly. This means: When turning down volume to 0, only the noise of the LEF output stage can be recognized.

Offset Voltage Setting

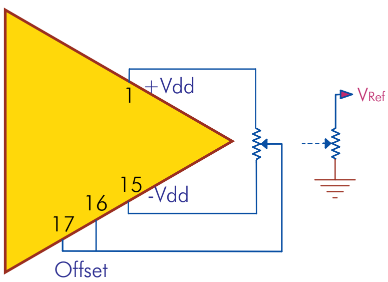

Fig. 11

Fig. 11 • Offset Pins

CC75's Pin 16 and 17 normally remain unused. Internally the offset reference voltage is set to GND. However, in some applications it might be necessary to choose a different target offset voltage. This can be done by a simple voltage source. Stable voltage can be obtainde from the internal stabilized Voltages at Pin 1 (+Vdd) and Pin 15 (-Vdd), or from a stable external Voltage (Vref). Any voltage at the offset pins will be the output DC-offset voltage.
The impedance of the offset pins is about 1kΩ to GND.

Absolute Maximum Ratings

	Min	Norm	Max.
Power supply voltage	18V	19V	25V
Supply Current		13mA	60mA
Output current in LEF operation			5mA
Continuous output current			50mA
Gain resistor range	0		∞
C-pin resistor range *)	0		∞
Current injection			400μA
Target offset range	-3V	0V	+3V