Dual 500mA/50MHz Current Feedback Amplifier

July 1999

FEATURES

- **500mA Output Drive Current**
- **50MHz Bandwidth, $A_V = 2$, $R_L = 25\Omega$**
- **900V/µs Slew Rate, $A_V = 2$, $R_L = 25\Omega$**
- High Input Impedance, 10MΩ
- Wide Supply Range, ±5V to ±15V
- Enhanced θ_{JA} SO-20 Package
- Shutdown Mode
- Adjustable Supply Current
- Stable with C_L = 10,000pF

APPLICATIONS

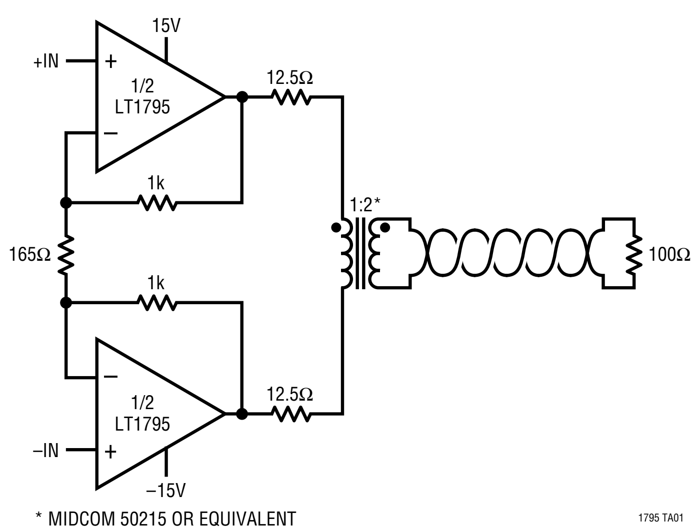
- **ADSL Drivers**
- Buffers
- Test Equipment Amplifiers
- Video Amplifiers
- Cable Drivers

DESCRIPTION

The LT®1795 is a dual current feedback amplifier with high output current and excellent large signal characteristics. The combination of high slew rate, 500mA output drive and ±15V operation enables the device to deliver significant power at frequencies in the 1MHz to 2MHz range. Short-circuit protection and thermal shutdown insure the device's ruggedness. The LT1795 is stable with large capacitive loads and can easily supply the large currents required by the capacitive loading. A shutdown feature switches the device into a high impedance, low current mode, reducing power dissipation when the device is not in use. For lower bandwidth applications, the supply current can be reduced with a single external resistor.

TYPICAL APPLICATION

Central Office ADSL Line Driver



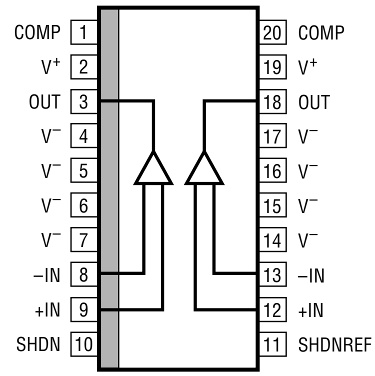
ABSOLUTE MAXIMUM RATINGS

(Note 1)

Supply Voltage .... ±18V
Input Current .... ±15mA
Output Short-Circuit Duration (Note 2) .... Indefinite
Operating Temperature Range .... –40°C to 85°C
Specified Temperature Range (Note 3) ... –40°C to 85°C
Junction Temperature .... 150°C
Storage Temperature Range .... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) .... 300°C

PACKAGE/ORDER INFORMATION

TOP VIEW



S PACKAGE
20-LEAD PLASTIC SW

θ_{JA} = 40°C/W (Note 4)

ORDER PART NUMBER
LT1795CSW LT1795ISW

Consult factory for Military grade parts.

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full specified temperature range, otherwise specifications are at T_A = 25°C. V_{CM} = 0V, ±5V ≤ V_S ≤ ±15V, pulse tested, V_{SHDN} = 2.5V, $V_{SHDNREF}$ = 0V unless otherwise noted. (Note 3)

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	T_A = 25°C			±3	±13	mV
			●		±4.5	±17	mV
	Input Offset Voltage Matching	T_A = 25°C			±1	±3.5	mV
			●		±1.5	±5.0	mV
	Input Offset Voltage Drift		●		10		µV/°C
I_{IN}^+	Noninverting Input Current	T_A = 25°C			±2	±5	µA
			●		±8	±20	µA
	Noninverting Input Current Matching	T_A = 25°C			±0.5	±2	µA
			●		±1.5	±7	µA
I_{IN}^-	Inverting Input Current	T_A = 25°C			±10	±70	µA
			●		±20	±100	µA
	Inverting Input Current Matching	T_A = 25°C			±10	±30	µA
			●		±20	±50	µA
e_n	Input Noise Voltage Density	f = 10kHz, R_F =1k, R_G = 10Ω, R_S = 0Ω			3.6		nV/√Hz
$+i_n$	Input Noise Current Density	f = 10kHz, R_F =1k, R_G = 10Ω, R_S = 10kΩ			2		pA/√Hz
$-i_n$	Input Noise Current Density	f = 10kHz, R_F =1k, R_G = 10Ω, R_S = 10kΩ			30		pA/√Hz
R_{IN}^+	Input Resistance	V_{IN} = ±12V, V_S = ±15V	●	1.5	10		MΩ
		V = ±2V, V_S = ±5V	●	0.5	5		MΩ
C_{IN}^+	Input Capacitance	V_{IN} = ±15V			2		pF
	Input Voltage Range (Note 5)	V_S = ±15V	●	±12	±13.5		V
		V_S = ±5V	●	±2	±3.5		V
CMRR	Common Mode Rejection Ratio	V_S = ±15V, V_{CM} = ±12V	●	55	62		dB
		V_S = ±5V, V_{CM} = ±2V	●	50	60		dB
	Inverting Input Current Common Mode Rejection	V_S = ±15V, V_{CM} = ±12V	●		1	10	µA/V
		V_S = ±5V, V_{CM} = ±2V	●		1	10	µA/V

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full specified temperature range, otherwise specifications are at T_A = 25°C. V_{CM} = 0V, ±5V ≤ V_S ≤ ±15V, pulse tested, V_{SHDN} = 2.5V, $V_{SHDNREF}$ = 0V unless otherwise noted. (Note 3)

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
PSRR	Power Supply Rejection Ratio	V_S = ±5V to ±15V	●	60	77		dB
	Noninverting Input Current Power Supply Rejection	V_S = ±5V to ±15V	●		30	500	nA/V
	Inverting Input Current Power Supply Rejection	V_S = ±5V to ±15V	●		1	5	µA/V
A_V	Large-Signal Voltage Gain	V_S = ±15V, V_{OUT} = ±10V, R_L = 25Ω V_S = ±5V, V_{OUT} = ±2V, R_L = 12Ω	● ●	55 55	68 68		dB dB
R_{OL}	Transresistance, $\Delta V_{OUT}/\Delta I_{IN}^-$	V_S = ±15V, V_{OUT} = ±10V, R_L = 25Ω V_S = ±5V, V_{OUT} = ±2V, R_L = 12Ω	● ●	75 75	200 200		kΩ kΩ
V_{OUT}	Maximum Output Voltage Swing	V_S = ±15V, R_L = 25Ω, T_A = 25°C	 ●	±11.5 ±10.0	±12.5 ±11.5		V V
		V_S = ±5V, R_L = 12Ω, T_A = 25°C	 ●	±2.5 ±2.0	±3 ±3		V V
I_{OUT}	Maximum Output Current	V_S = ±15V, R_L = 1Ω	●	0.5	1	2	A
I_S	Supply Current Per Amplifier	V_S = ±15V, V_{SHDN} = 2.5V, T_A = 25°C	 ●		29	34 42	mA mA
	Supply Current Per Amplifier, R_{SHDN} = 51k, (Note 6)	V_S = ±15V, T_A = 25°C	 ●		15	20 25	mA mA
	Positive Supply Current, Shutdown	V_S = ±15V, V_{SHDN} = 0.4V	●		1	200	µA
	Output Leakage Current, Shutdown	V_S = ±15V, V_{SHDN} = 0.4V, T_A = 25°C			1	10	µA
	Channel Separation	V_S = ±15V, V_{OUT} = ±10V, R_L = 25Ω, T_A = 25°C		80	110		dB
SR	Slew Rate (Note 7)	A_V = 4, R_L = 400Ω, T_A = 25°C		400	900		V/µs
SR	Slew Rate	A_V = 4, R_L = 25Ω, T_A = 25°C			900		V/µs
BW	Small-Signal BW	A_V = 2, V_S = ±15V, Peaking ≤ 1.5dB R_F = R_G = 910Ω, R_L = 100Ω			65		MHz
BW	Small-Signal BW	A_V = 2, V_S = ±15V, Peaking ≤ 1.5dB R_F = R_G = 820Ω, R_L = 25Ω			50		MHz

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: Applies to short-circuits to ground only. A short-circuit between the output and either supply may permanently damage the part when operated on supplies greater than ±10V.

Note 3: The LT1795C is guaranteed to meet specified performance from 0°C to 70°C and is designed, characterized and expected to meet these extended temperature limits, but is not tested at –40°C and 85°C. The LT1795I is guaranteed to meet the extended temperature limits.

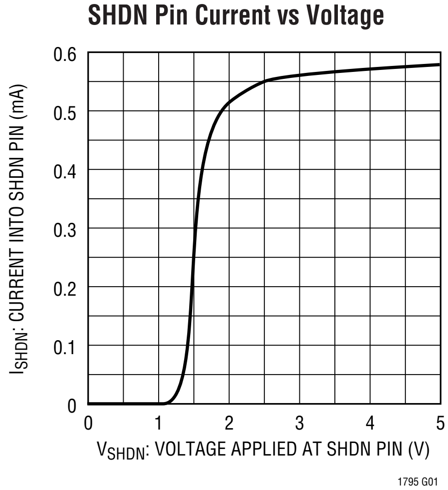
Note 4: Thermal resistance varies depending upon the amount of PC board metal attached to the device. If the maximum dissipation of the package is exceeded, the device will go into thermal shutdown protection.

Note 5: Guaranteed by the CMRR tests.

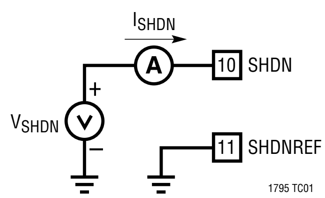
Note 6: R_{SHDN} is connected between the SHDN pin and V^+.

Note 7: Slew rate is measured at ±5V on a ±10V output signal while operating on ±15V supplies with R_F = 1k, R_G = 333Ω (A_V = +4) and R_L = 400Ω.

TYPICAL PERFORMANCE CHARACTERISTICS



TEST CIRCUIT (SHDN Pin Current)



APPLICATIONS INFORMATION

The LT1795 is a dual current feedback amplifier with high output current drive capability. The amplifier is designed to drive low impedance loads such as twisted-pair transmission lines with excellent linearity.

SHUTDOWN/CURRENT SET

If the shutdown/current set feature is not used, connect SHDN to V^+ and SHDNREF to ground.

The SHDN and SHDNREF pins control the biasing of the two amplifiers. The pins can be used to either turn off the amplifiers completely, reducing the quiescent current to less then 200μA, or to control the quiescent current in normal operation.

When $V_{SHDN} = V_{SHDNREF}$, the device is shut down. The device will interface directly with 3V or 5V CMOS logic when SHDNREF is grounded and the control signal is applied to the SHDN pin. Switching time between the active and shutdown states is about 1.5μs.

Figures 1 to 4 illustrate how the SHDN and SHDNREF pins can be used to reduce the amplifier quiescent current. In both cases, an external resistor is used to set the current. The two approaches are equivalent, however the required resistor values are different. The quiescent current will be approximately 120 times the current in the SHDN pin. The voltage across the resistor in these conditions is $V^+ – 1.5V$. For example, a 50k resistor between V^+ and SHDN will set the quiescent current to 33mA with $V_S = ±15V$. If ON/OFF control is desired in addition to reduced quiescent current, then the circuits in Figures 5 to 7 can be employed.

APPLICATIONS INFORMATION

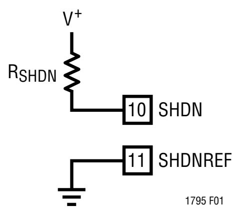


Figure 1. R_{SHDN} Connected Between V^+ and SHDN (Pin 10); SHDNREF (Pin 11) = GND. See Figure 2

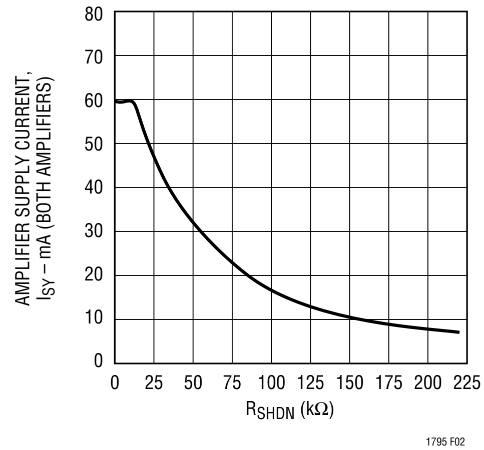


Figure 2. LT1795 Amplifier Supply Current vs R_{SHDN}. T_A = 25°C, V_S = ±15V, R_{SHDN} Connected Between V^+ and SHDN, SHDNREF = GND (See Figure 1)

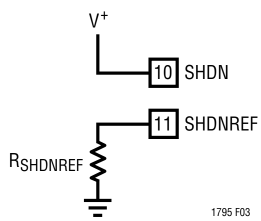


Figure 3. $R_{SHDNREF}$ Connected Between SHDNREF (Pin 11) and GND; SHDN (Pin 10) = V^+. See Figure 4

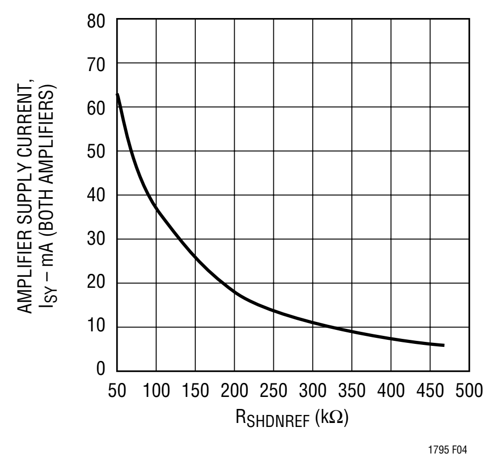


Figure 4. LT1795 Amplifier Supply Current vs $R_{SHDNREF}$. T_A = 25°C, V_S = ±15V, $R_{SHDNREF}$ Connected Between SHDNREF and GND, SHDN = V^+ (See Figure 3)

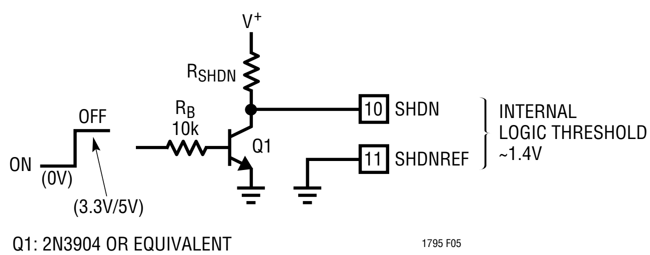


Figure 5. Setting Amplifier Supply Current Level with ON/OFF Control, Version 1

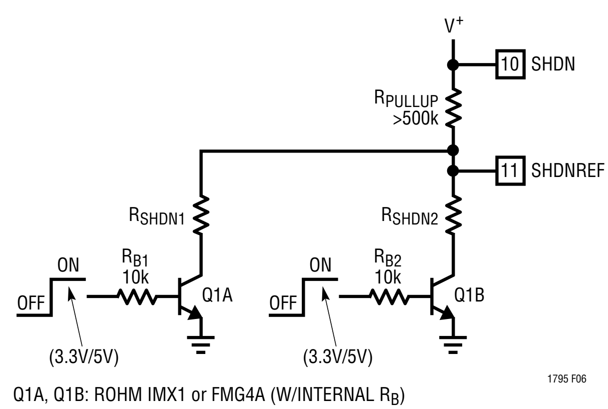


Figure 6. Setting Multiple Amplifier Supply Current Levels with ON/OFF Control, Version 2

APPLICATIONS INFORMATION

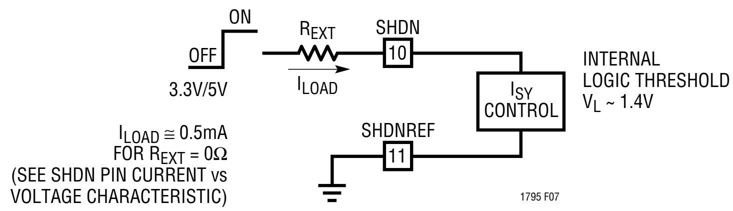


Figure 7. Setting Amplifier Supply Current Level with ON/OFF Control, Version 3

THERMAL CONSIDERATIONS

The LT1795 contains a thermal shutdown feature that protects against excessive internal (junction) temperature. If the junction temperature of the device exceeds the protection threshold, the device will begin cycling between normal operation and an off state. The cycling is not harmful to the part. The thermal cycling occurs at a slow rate, typically 10ms to several seconds, which depends on the power dissipation and the thermal time constants of the package and heat sinking. Raising the ambient temperature until the device begins thermal shutdown gives a good indication of how much margin there is in the thermal design.

For surface mount devices, heat sinking is accomplished by using the heat spreading capabilities of the PC board and its copper traces. Power is dissipated from the package primarily through the V^- pins (4 to 7 and 14 to 17). These pins should have a good thermal connection to a copper plane, either by direct contact or by plated through holes. The copper plane may be an internal or external layer. The thermal resistance, junction-to-ambient will depend on the total copper area connected to these pins. For example, the thermal resistance of the LT1795 connected to a 2 × 2 inch, double sided 2 oz copper plane is 40°C/W.

CALCULATING JUNCTION TEMPERATURE

The junction temperature can be calculated from the equation:

$$T_J = (P_D)(\theta_{JA}) + T_A$$

where

T_J = Junction Temperature

T_A = Ambient Temperature

P_D = Device Dissipation

θ_{JA} = Thermal Resistance (Junction-to-Ambient)

Differential Input Signal Swing

The differential input swing is limited to about ±5V by an ESD protection device connected between the inputs. In normal operation, the differential voltage between the input pins is small, so this clamp has no effect. However, in the shutdown mode, the differential swing can be the same as the input swing. The clamp voltage will then set the maximum allowable input voltage.

POWER SUPPLY BYPASSING

To obtain the maximum output and the minimum distortion from the LT1795, the power supply rails should be well bypassed. For example, with the output stage supplying 0.5A current peaks into the load, a 1Ω power supply impedance will cause a droop of 0.5V, reducing the available output swing by that amount. Surface mount tantalum and ceramic capacitors make excellent low ESR bypass elements when placed close to the chip. For frequencies above 100kHz, use 1μF and 100nF ceramic capacitors. If significant power must be delivered below 100kHz, capacitive reactance becomes the limiting factor.

APPLICATIONS INFORMATION

Larger ceramic or tantalum capacitors, such as 4.7µF, are recommended in place of the 1µF unit mentioned above.

Inadequate bypassing is evidenced by reduced output swing and "distorted" clipping effects when the output is driven to the rails. If this is observed, check the supply pins of the device for ripple directly related to the output waveform. Significant supply modulation indicates poor bypassing.

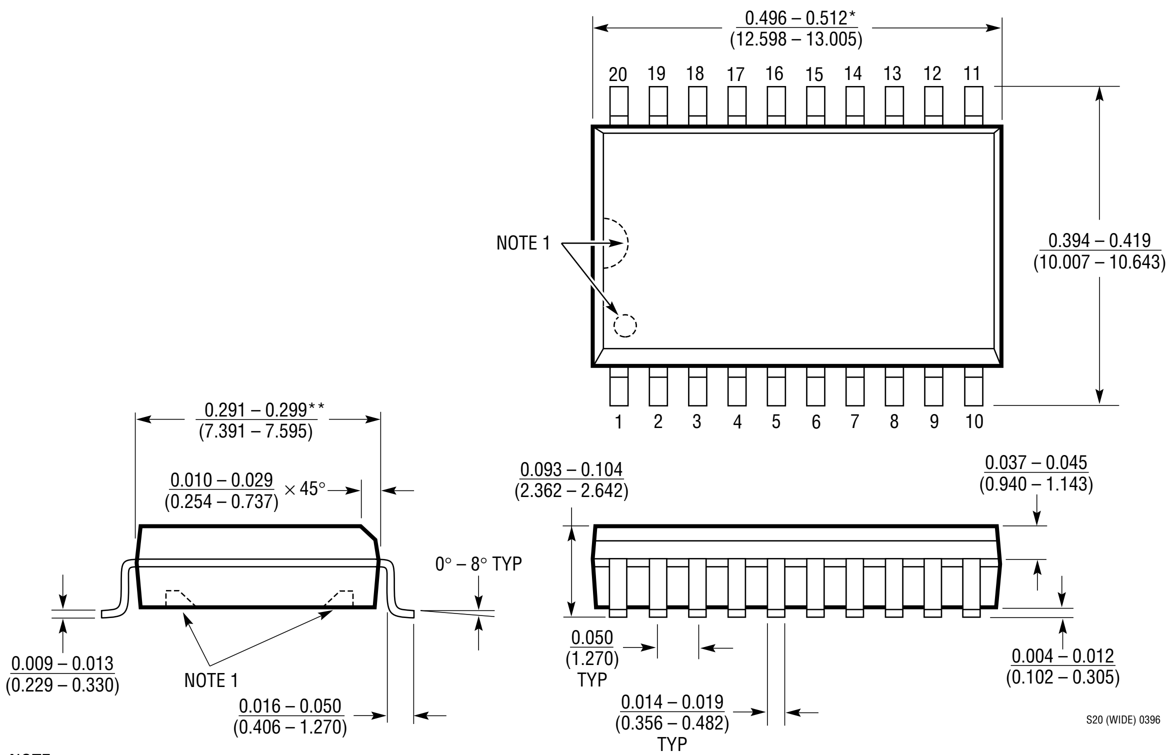
Capacitance on the Inverting Input

Current feedback amplifiers require resistive feedback from the output to the inverting input for stable operation. Take care to minimize the stray capacitance between the output and the inverting input. Capacitance on the inverting input to ground will cause peaking in the frequency response (and overshoot in the transient response), but it does not degrade the stability of the amplifier.

PACKAGE DESCRIPTION

Dimensions in inches (millimeters) unless otherwise noted.

SW Package
20-Lead Plastic Small Outline (Wide 0.300)
(LTC DWG # 05-08-1620)

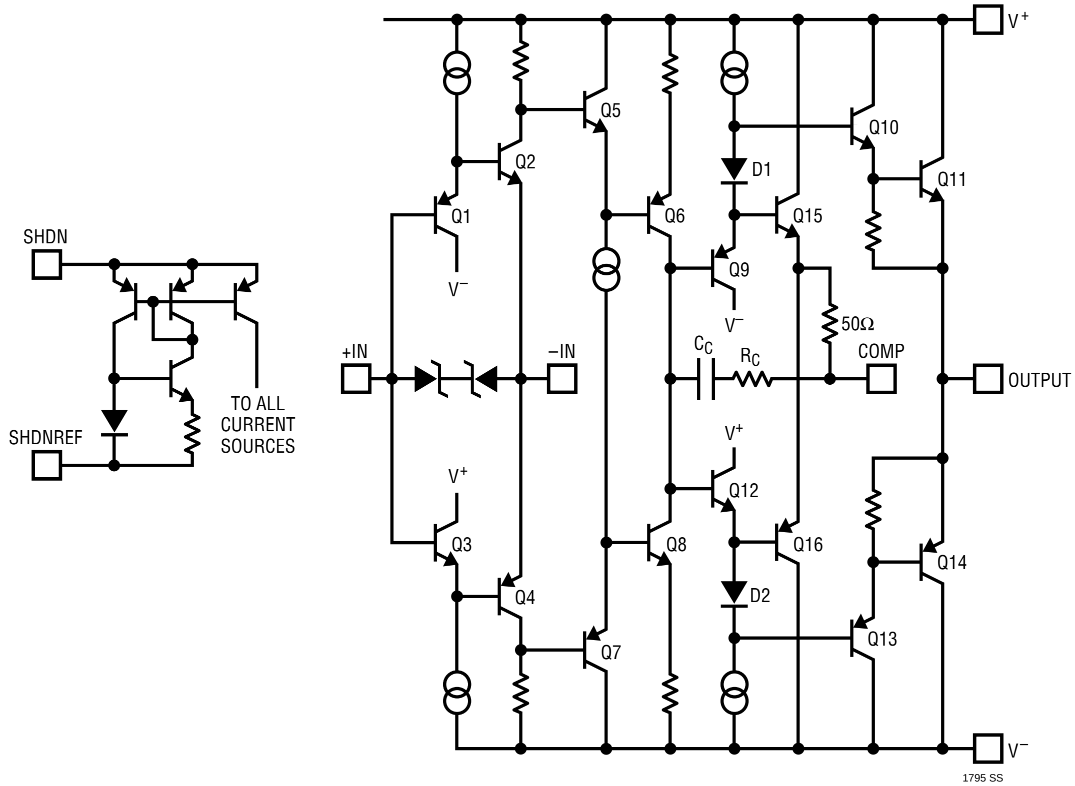


NOTE:
1. PIN 1 IDENT, NOTCH ON TOP AND CAVITIES ON THE BOTTOM OF PACKAGES ARE THE MANUFACTURING OPTIONS. THE PART MAY BE SUPPLIED WITH OR WITHOUT ANY OF THE OPTIONS

*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

**DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

SIMPLIFIED SCHEMATIC



RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1497	Dual 125mA, 50MHz Current Feedback Amplifier	900V/μs Slew Rate
LT1207	Dual 250mA, 60MHz Current Feedback Amplifier	Shutdown/Current Set Function

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