SSS725•SSS741•SSS747

High-Performance Operational Amplifiers

Functional Description

The SSS series are high-performance operational amplifiers designed for systems demanding extremely high accuracy. Superior DC and AC characteristics of low input offset voltage, low input offset current, low input bias current and high large signal voltage gain provide performance comparable to discrete or hybrid modules. The SSS series are functionally, electrically and pin-for-pin equivalent to the PMI SSS series.

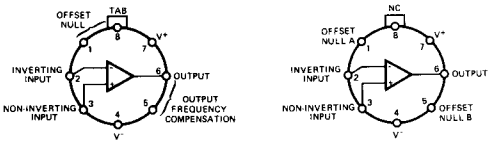
Distinctive Characteristics

- Superior DC and AC characteristics V_{OS}, I_{OS}, A_{VO}, I_B, CMRR, PSRR
- 100% reliability assurance testing in compliance with MIL-STD-883

CONNECTION DIAGRAMS

Top View

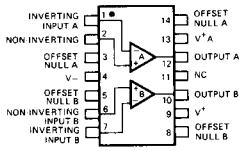
SSS725 / SSS741 — Metal Cans



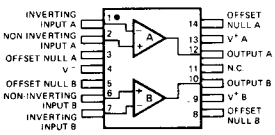
Notes:
(1) All leads through. No pins connected to case on SSS725.
(2) Pin 4 connected to case on SSS741.

LIC-746

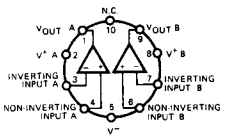
SSS747 — Dual-In-Line



SSS747 — Flat Package



SSS747 — Metal Can

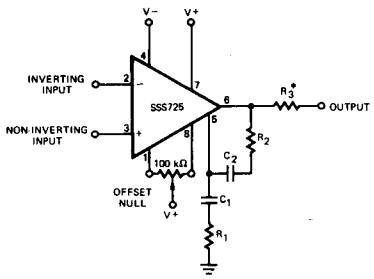


Notes:
(1) On Metal Can, pin 5 is connected to case.
(2) On DIP, pin 4 is connected to bottom of package.
(3) On Flat Package, pin 4 is connected to bottom of package.

LIC-747

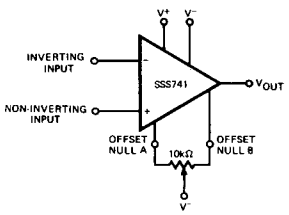
FUNCTIONAL DIAGRAMS

SSS725



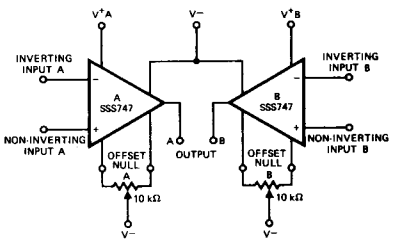
LIC-748

SSS741



LIC-749

SSS747



LIC-750

ORDERING INFORMATION

Order Number	Package Type	Temperature Range
SSS725J	Metal Can	−55°C - +125°C
SSS725BJ	Metal Can	−25°C - +85°C
SSS725EJ	Metal Can	0°C - +70°C
SSS741J	Metal Can	−55°C - +125°C
SSS741CJ	Metal Can	0°C - +70°C
SSS747K	Metal Can	−55°C - +125°C
SSS747Y	Hermetic DIP	−55°C - +125°C
SSS747M	Flat Pak	−55°C - +125°C
SSS747CK	Metal Can	0°C - +70°C
SSS747CY	Hermetic DIP	0°C - +70°C

SSS725 FREQUENCY

Compensation Component Values

A_{VCL}	R_1 (Ω)	C_1 (nF)	R_2 (Ω)	C_2 (nF)
1000	470	1.0	—	—
100	47	10	—	—
10	27	50	270	1.5
1	10	50	39	20

*Use R_3 = 51 Ω when the amplifier is operated with capacitive loads.

MAXIMUM RATINGS HIGH PERFORMANCE INSTRUMENTATION OP AMP

	SSS725
Supply Voltage	±22V
Internal Power Dissipation (Note 1) Metal Can (TO-99)	500mW
Differential Input Voltage	±5V
Input Voltage (Note 2)	±22V
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	
SSS725	−55°C to +125°C
SSS725B	−25°C to +85°C
SSS725E	0°C to +70°C
Lead Temperature (Soldering, 60 sec.)	300°C
Output Short-Circuit Duration	Indefinite

ELECTRICAL CHARACTERISTICS

(V_S = ±15V, T_A = 25°C Unless Otherwise Noted)

Symbol	Parameter	Condition	SSS725/725E Min.	SSS725/725E Max.	SSS725B Min.	SSS725B Max.	Units
V_{os}	Input Offset Voltage (Without external trim)	$R_s \leq 20k\Omega$		0.5		0.75	mV
I_{os}	Input Offset Current			5.0		5.0	nA
I_B	Input Bias Current			80		80	nA
e_n	Input Noise Voltage (Note 3)	f_O = 10Hz f_O = 100Hz f_O = 1kHz		15.0 9.0 7.5		15.0 9.0 7.5	nV/√Hz nV/√Hz nV/√Hz
i_n	Input Noise Current (Note 3)	f_O = 10Hz f_O = 100Hz f_O = 1kHz		1.2 0.6 0.25		1.2 0.6 0.25	pA/√Hz pA/√Hz pA/√Hz
R_{in}	Input Resistance		0.7		0.7		MΩ
A_{vo}	Large Signal Voltage Gain	$R_L \geq 2k\Omega$ V_O = ±10V	1,000,000		1,000,000		
V_{om}	Maximum Output Voltage Swing	$R_L \geq 10k\Omega$ $R_L \geq 2k\Omega$ $R_L \geq 1k\Omega$	±12.5 ±12.0 ±11.0		±12.5 ±12.0 ±11.0		V V V
CMVR	Input Voltage Range		±13.5		±13.5		V
CMRR	Common Mode Rejection Ratio	$R_S \leq 20k\Omega$	120		110		dB
PSRR	Power Supply Rejection Ratio	$R_S \leq 20k\Omega$		5.0		5.0	μV/V
P_d	Power Consumption			120		120	mW
A_{vo}	Large Signal Voltage Gain	$R_L \geq 500\Omega$ V_O = ±0.5V V_S = ±3V	100,000		100,000		
P_d	Power Consumption	V_S = ±3V		6		6	mW

The Following Specifications Apply Over The Operating Temperature Range

Symbol	Parameter	Condition	SSS725 Min.	SSS725 Max.	SSS725E Min.	SSS725E Max.	SSS725B Min.	SSS725B Max.	Units
V_{os}	Input Offset Voltage (Without external trim)	$R_S \leq 20k\Omega$		0.7		0.6		1.0	mV
	Average Input Offset Voltage Drift (Without external trim) (Note 4)	R_S = 50Ω		2.0		2.0 (Note 3)		2.8 (Note 3)	μV/°C
	Average Input Offset Voltage Drift (With external trim) (Note 4)	R_S = 50Ω		1.0		0.6		1.0 (Note 3)	μV/°C
I_{os}	Input Offset Current	T_A MAX. T_A MIN.		4.0 18.0		5.0 7.0		5.0 14.0	nA nA
	Average Input Offset Current Drift			90		40 (Note 3)		90 (Note 3)	pA/°C
I_B	Input Bias Current	T_A MAX. T_A MIN.		70 180		80 100		80 150	nA nA
CMRR	Common Mode Rejection Ratio	$R_S \leq 20k\Omega$	110		115		106		dB
PSRR	Power Supply Rejection Ratio	$R_S \leq 20k\Omega$		8.0		7.0		8.0	μV/V
A_{vo}	Large Signal Voltage Gain	V_O = ±10V; T_A MAX. $R_L \geq 2k\Omega$; T_A MIN.	1,000,000 500,000		1,000,000 800,000		1,000,000 500,000		
V_{om}	Maximum Output Voltage Swing	$R_L \geq 2k\Omega$	±12.0		±12.0		±12.0		V

Notes 1. Derate at 6.8mW/°C for operation at ambient temperatures above 75°C.
2. For supply voltages less than ±22V, the absolute maximum input voltage is equal to the supply voltage.
3. Parameter is not 100% tested. 90% of all units meet these specifications.
4. Thermoelectric voltages generated by dissimilar metals at the contacts to the input terminals can prevent the realization of the performance indicated if both sides of the contacts are not kept at approximately the same temperature. Therefore, the device ambient temperature should not be altered without simultaneously changing the contact temperature.

MAXIMUM RATINGS — HIGH-PERFORMANCE FREQUENCY COMPENSATED OP AMP — SSS741/741C

Supply Voltage	
SSS741	±22V
SSS741C	±18V
Internal Power Dissipation (Note 1)	500mW
Differential Input Voltage	±30V
Voltage between Offset Null and V^-	±0.5V
Input Voltage (Note 2)	±15V
Output Short-Circuit Duration (Note 3)	Indefinite
Operating Temperature Range	
SSS741	−55°C to +125°C
SSS741C	0°C to +70°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 60 sec.)	300°C

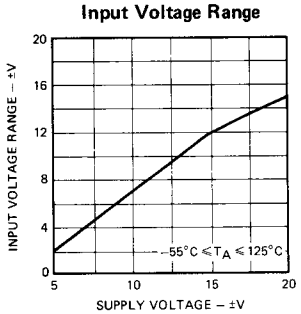
ELECTRICAL CHARACTERISTICS (T_A = 25°C) (Note 4)

Symbol	Parameter	Conditions	SSS741 Min.	SSS741 Max.	SSS741C Min.	SSS741C Max.	Units
V_{os}	Input Offset Voltage	$R_s \leq 50k\Omega$		2.0		5.0	mV
I_{os}	Input Offset Current			5.0		20	nA
I_B	Input Bias Current			50		100	nA
R_{in}	Input Resistance		2.0		1.0		MΩ
A_{vo}	Large-Signal Voltage Gain	$V_s = \pm15V$, $R_L \geq 2k\Omega$ $V_{out} = \pm10V$	100		50		V/mV
V_{om}	Output Voltage Swing	$V_s = \pm15V$, $R_L \geq 10k\Omega$ $R_L \geq 2k\Omega$	±12 ±10		±12 ±10		V V
CMVR	Input Voltage Range	$V_s = \pm15V$ $V_s = \pm20V$	±12 ±15		±12		V
CMRR	Common Mode Rejection Ratio	$R_s \leq 50k\Omega$	80		70		dB
PSRR	Power Supply Rejection Ratio	$R_s \leq 50k\Omega$		100		150	μV/V
P_d	Power Consumption	$V_s \leq \pm15V$		85		85	mW
The Following Specifications Apply Over the Operating Temperature Range							
V_{os}	Input Offset Voltage	$R_s \leq 50k\Omega$		3.0		6.0	mV
I_{os}	Input Offset Current			10		50	nA
I_B	Input Bias Current			100		200	nA
A_{vo}	Large-Signal Voltage Gain	$V_s = \pm15V$, $R_L \geq 2k\Omega$ $V_{out} = \pm10V$	25		25		V/mV
V_{om}	Output Voltage Swing	$V_s = \pm15V$, $R_L \geq 10k\Omega$ $R_L \geq 2k\Omega$	±12 ±10		±12 ±10		V V
CMVR	Input Voltage Range	$V_s = \pm20V$	±15				V
CMRR	Common Mode Rejection Ratio	$R_s \leq 50k\Omega$	80		70		dB
PSRR	Power Supply Rejection Ratio	$R_s \leq 50k\Omega$		100		150	μV/V

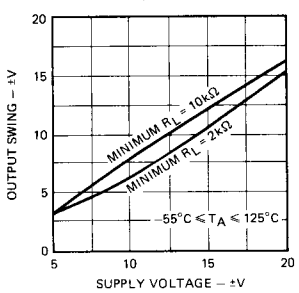
Notes 1. Derate metal can package at 6.8 mW/°C for operation at ambient temperatures above 75°C.
2. For supply voltages less than ±15V, the maximum input voltage is equal to the supply voltage.
3. Short circuit may be to ground or either supply. Rating applies to +125°C case temperature or +75°C ambient temperature.
4. The SSS741 specifications apply for $\pm5V \leq V_s \leq \pm20V$. The SSS741C specifications apply for $V_s = \pm15V$.

GUARANTEED PERFORMANCE

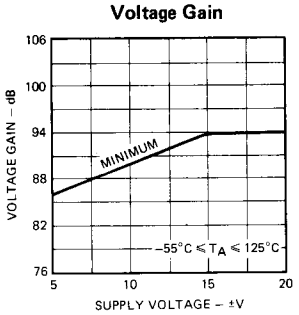
Input Voltage Range



Output Swing



Voltage Gain



LIC-751

MAXIMUM RATINGS HIGH-PERFORMANCE DUAL FREQUENCY COMPENSATED OP AMP SSS747/747C

Supply Voltage	
SSS747	±22V
SSS747C	±18V
Internal Power Dissipation (Note 1)	
DIP, Metal Can	800mW
Flat Package	500mW
Differential Input Voltage	±30V
Voltage between Offset Null and V^-	±0.5V
Input Voltage (Note 2)	±15V
Output Short-Circuit Duration (Note 3)	Indefinite
Operating Temperature Range	
SSS747	−55°C to +125°C
SSS747C	0°C to +70°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 60 sec.)	300°C

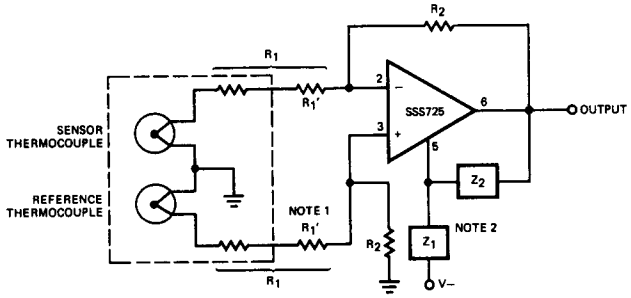
ELECTRICAL CHARACTERISTICS (T_A = 25°C) (Note 4)

Symbol	Parameter	Conditions	SSS747 Min.	SSS747 Max.	SSS747C Min.	SSS747C Max.	Units
V_{os}	Input Offset Voltage	$R_s \leq 50k\Omega$		2.0		5.0	mV
I_{os}	Input Offset Current			5.0		20	nA
I_B	Input Bias Current			50		100	nA
R_{in}	Input Resistance		2.0		1.0		MΩ
A_{vo}	Large Signal Voltage Gain	$R_L \geq 2k\Omega$, $V_s = \pm 15V$, $V_{out} = \pm 10V$	100		50		V/mV
V_{om}	Output Voltage Swing	$V_s = \pm 15V$, $R_L \geq 10k\Omega$ $R_L \geq 2k\Omega$	±12 ±10		±12 ±10		V V
CMVR	Input Voltage Range	$V_s = \pm 15V$ $V_s = \pm 20V$	 ±15		±12		V V
CMRR	Common Mode Rejection Ratio	$R_s < 50k\Omega$	80		70		dB
PSRR	Power Supply Rejection Ratio	$R_s < 50k\Omega$		100		150	μV/V
P_d	Power Dissipation	$V_s < \pm 15V$		85		85	mW
CS	Channel Separation		100				dB
The Following Specifications Apply Over The Operating Temperature Ranges							
V_{os}	Input Offset Voltage	$R_s < 50k\Omega$		3.0		6.0	mV
I_{os}	Input Offset Current			10		50	nA
I_B	Input Bias Current			100		150	nA
A_{vo}	Large Signal Voltage Gain	$V_s = \pm 15V$, $V_o = \pm 10V$, $R_L \geq 2k\Omega$	25		25		V/mV
V_{om}	Output Voltage Swing	$V_s = \pm 15V$, $R_L \geq 10k\Omega$ $R_L \geq 2k\Omega$	±12 ±10		±12 ±10		V V
CMVR	Input Voltage Range	$V_s = \pm 20V$	±15				V
CMRR	Common Mode Rejection Ratio	$R_s < 50k\Omega$	80		70		dB
PSRR	Power Supply Rejection Ratio	$R_s < 50k\Omega$		100		150	μV/V

Notes 1. Derate metal can package at 6.8 mW/°C for operation at ambient temperatures above 30°C, the dual-in-line package at 9 mW/°C for operation at ambient temperatures above 60°C, and the Flat package at 5.4 mW/°C for operation at ambient temperatures above 57°C.
2. For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.
3. Short circuit may be ground or either supply. Rating applies to 125°C case temperature or +60°C ambient temperature for each side.
4. The SSS747 specifications apply for $\pm 5V \leq V_s \leq \pm 20V$, unless otherwise noted. The SSS747C specifications apply for $\pm 5V \leq V_S \leq \pm 15V$, unless otherwise noted.

TYPICAL APPLICATIONS

Thermocouple Amplifier — SSS725

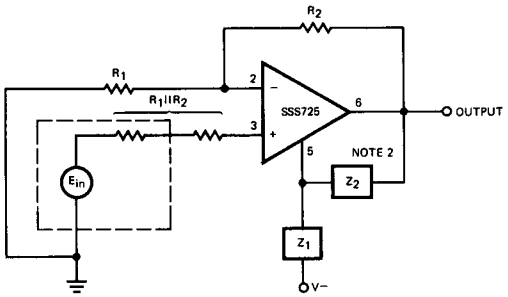


$$A_V = \frac{-R_2}{R_1 + \frac{R_1}{A_{VO}} + \frac{R_2}{A_{VO}}}$$

Notes:
(1) R_1' is adjusted so that the sum of R_1' and the thermocouple circuit resistance equals the correct value for R_1.
(2) See Frequency Compensation Circuit.

LIC-752

High Gain Non-Inverting Amplifier



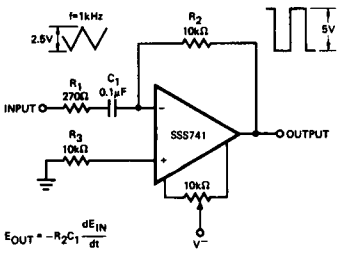
$$A_V = \frac{R_1 + R_2}{R_1 + \frac{R_1}{A_{VO}} + \frac{R_2}{A_{VO}}}$$

For ideal resistors and open loop gain greater than 10^6, in a +1000 gain configuration, the gain error will be less than 0.1% and input impedance will be greater than 700MΩ.

LIC-753

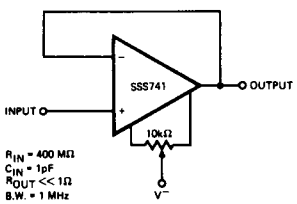
SSS741

Differentiator



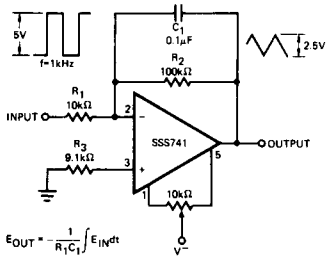
LIC-754

Unity Gain Voltage Follower



LIC-755

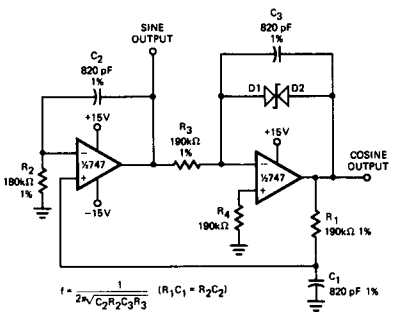
Integrator



LIC-756

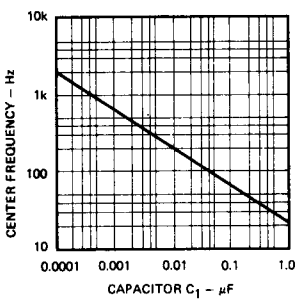
SSS747

Quadrature Oscillator



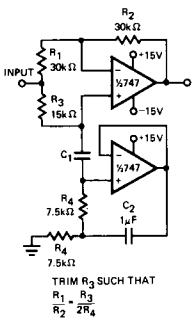
LIC-757

Notch Frequency as a Function of C_1



LIC-758

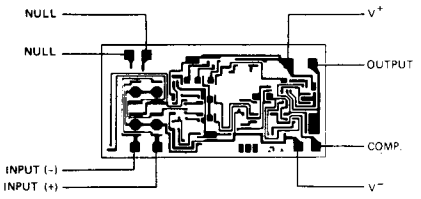
Notch Filter Using the 747 as a Gyrator



LIC-759

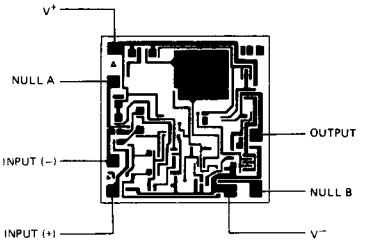
Metallization and Pad Layouts

SSS725



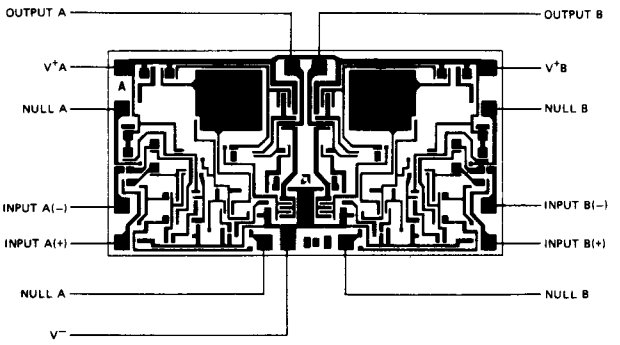
50 X 95 Mils

SSS741



56 X 56 Mils

SSS747



56 X 106 Mils