

Performance operational amplifiers and comparators



June 2006

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ECOPACK components

97% of products are already converted to RoHS. Ecopack is the name given to lead-free devices and lead-free packages from **STMicroelectronics**.

Lead-free devices are described inside an internal specification defining:

- **Their characteristics: lead-free connection coatings, solderability and identification features**
- **Their reliability, such as soldering resistance, reliability performances, whiskers risk prevention**

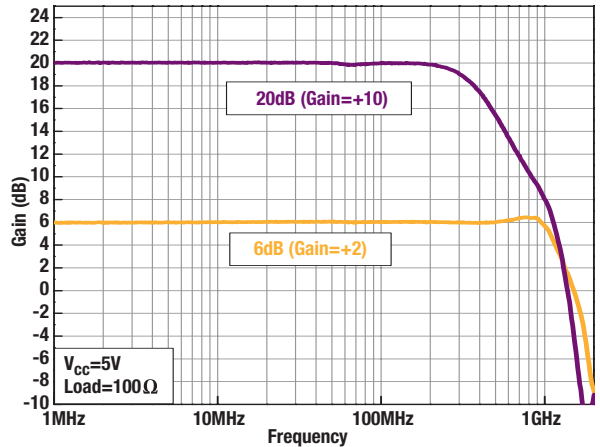
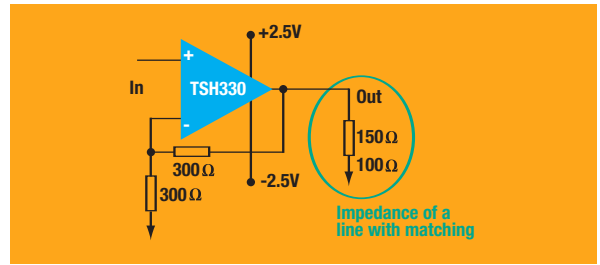
This specification is available for ST customers upon request. Ecopack components follow the RoHS directive including its exemptions (high-temperature solder for inner packages soldering and FritSealing glass).

STMicroelectronics is continuously working to develop and assess new lead-free technologies to allow full lead-free assembly devices with at least the same level of reliability as today's packages.

TSH330: Amplifier breaks 1GHz barrier (1.5GHz in unity gain)

Features

- High speed
 - Small signal bandwidth: 1.1GHz (Gain=2)
 - Slew rate: 1800V/ μ s
- Voltage noise: 1.3nV/ \sqrt Hz
- Low consumption
 - Quiescent current: 16mA
- Distortion
 - $F_{in}=10\text{MHz}$, $V_{out}=2\text{V}_{p-p}$, load=100 Ω
 - SFDR= -78dBc
 - $F_{in}=20\text{MHz}$, $V_{out}=1\text{V}_{p-p}$, load=100 Ω
 - SFDR= -73dBc
- Supply voltage:
 - +/-2.5V or 0/+5V



Applications

- High speed scopes
- Network analysers
- Spectrum analysers

- High-end video

Cross-reference

Part number	B_w (MHz)	I_{cc} (mA)	Load (Ω)	Noise (nV/ \sqrt Hz)	SR (V/ μ s)	Supply max. (V)	Feedback	Pin-to-pin compatible
TSH330	1500	16	100	1.3	1800	5	CFA	
THS4271	1400*	22*	100	3*	1000*	15	VFA	Yes
OPA640	1300*	22*	100	2, 9*	350*	10	VFA	Yes
CLC449	1100*	12	100	2, 2*	2500	12	VFA	Yes
AD8009	700*	14	100	1, 9*	5500	12	CFA	Yes
EL5191	1000*	9	100	5, 4*	4000	11	CFA	Yes
MAX4223	1000*	6	100	2*	1100*	11	CFA	Yes
THS4211	1000*	19*	100	7*	970*	15	VFA	Yes

* Superior TSH330 parameter

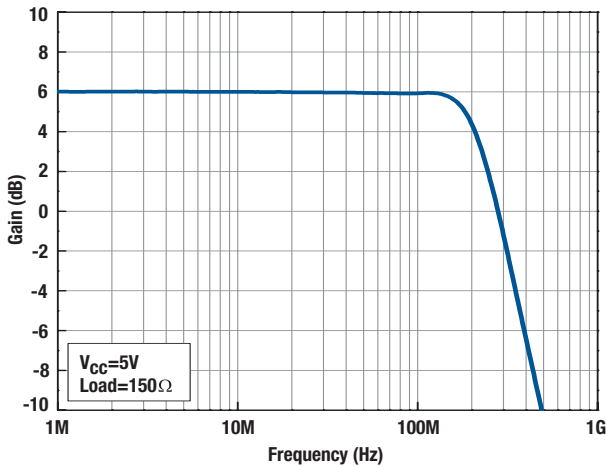
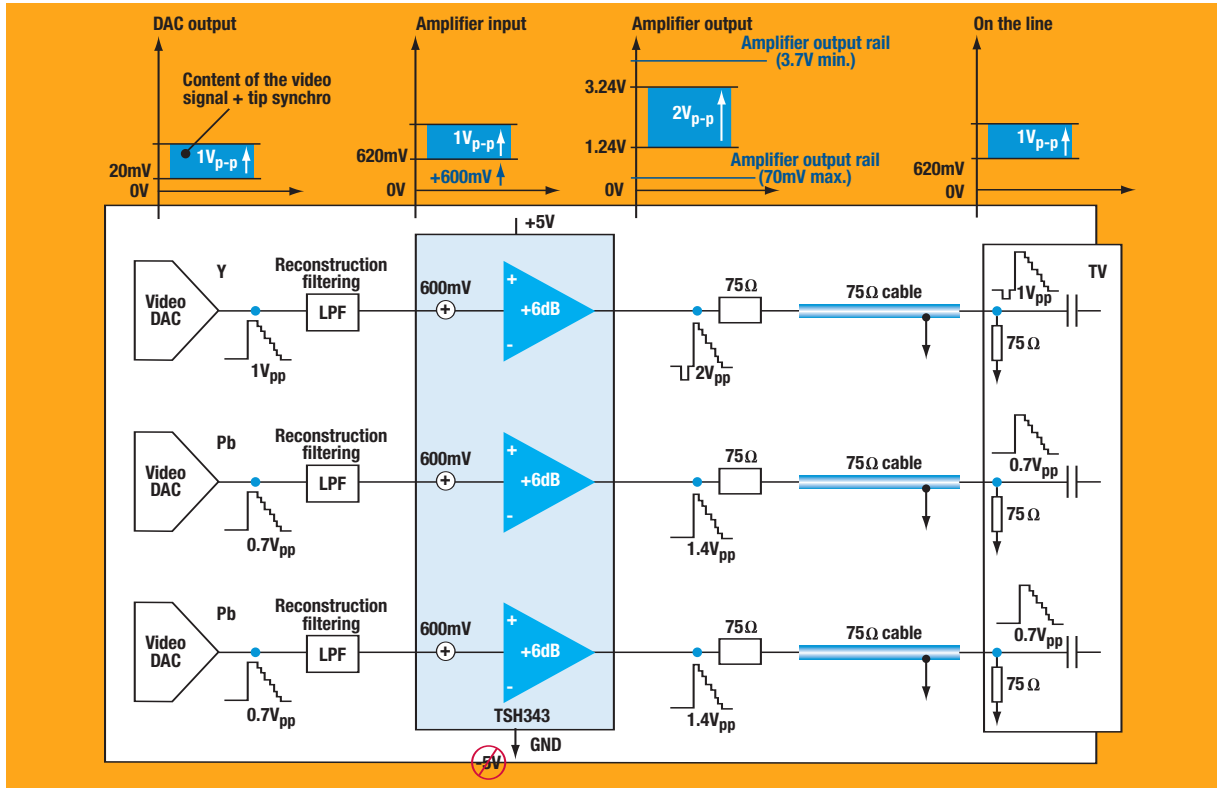
The cross is possible if the power supply of the op-amp in the application is 5V. The cross doesn't mean "second source", it must be considered in each case with requirements of the application

TSH343/TSH344: Triple high-definition video drivers

Features

- 5V single supply
- Large bandwidth:
 - TSH343: 280MHz (features an internal DC shift)
 - TSH344: 340MHz
- Internal gain of 6dB
- No DC input coupling capacitor required
- Low harmonic distortion
- Specified on 100Ω and 150Ω loads
- SO8 package

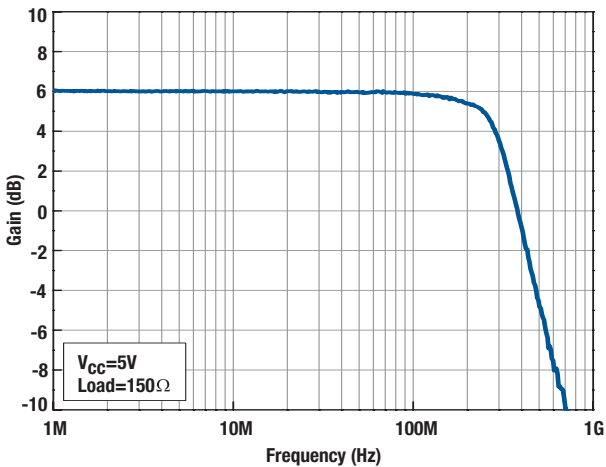
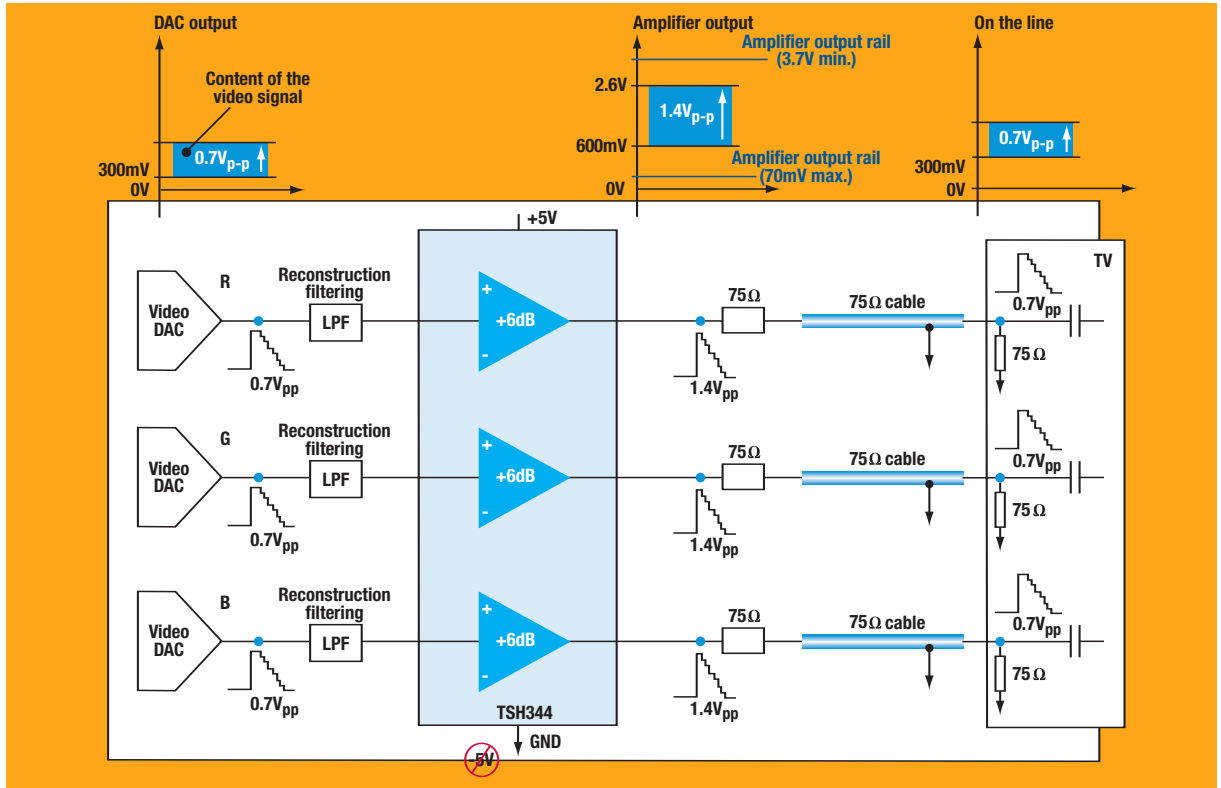
TSH343: Triple video driver for driving YPbPr signals on 75Ω lines in single supply



Applications

- High-end video systems
- High Definition TV (HDTV)
- Broadcast and graphic video
- Multimedia products

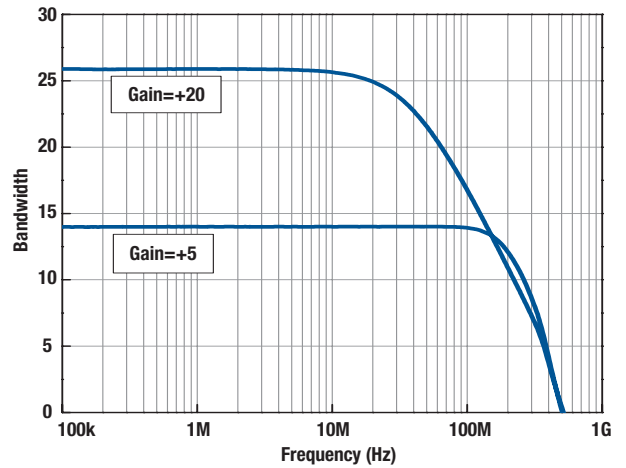
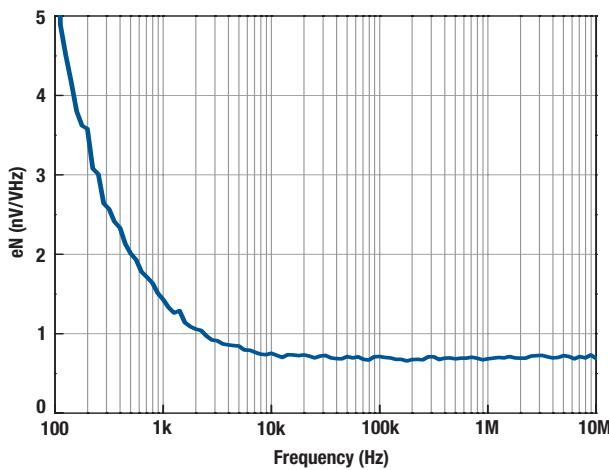
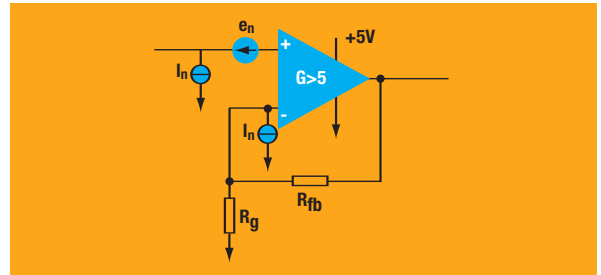
TSH344 Triple video driver for driving RGB signals on 75Ω lines in single supply



TSH300: Ultra low noise amplifier for industrial and medical instrumentation (0.65nV/ $\sqrt{\text{Hz}}$; 200MHz bandwidth)

Features

- $B_w=200\text{MHz}$ (gain=5)
- $I_{cc}=15\text{mA}$
- $e_n=0.65\text{nV}/\sqrt{\text{Hz}}$
- Stable for gains ≥ 5
- $I_n=3.3\text{pA}/\sqrt{\text{Hz}}$
- VFA

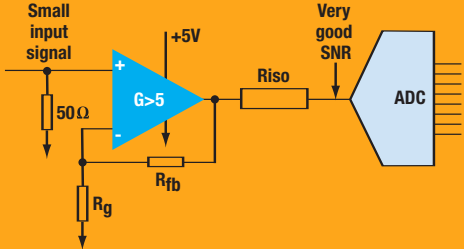


Cross-reference

Part number	v-noise (nV/ $\sqrt{\text{Hz}}$) typ./max	i-noise (pA/ $\sqrt{\text{Hz}}$) typ./max.	Gain stable >	B_w (MHz)	SR (V/ μs)	I_{cc} (mA)	Supply (V) min./max.	Rail-to-rail	Feedback	Standby	Pin-to-pin compatible
TSH300	0.65/0.77	3.3/5.5	5	270	220	14.4	4.5/5.5	No	VFA	No	
MAX4107	0.75	2.5	5	350	500	15	10/12	No	CFA	No	Yes
EL2125	0.83	2.4	10	175	225	10.8	5/30	No	VFA	No	Yes
OPA847	0.85/0.92	2.5/3.5	12	600	950	18.1	10/12	No	VFA	Yes	Yes ¹
LMH6624	0.92	2.3	10	180	360	11.4	5/12	No	VFA	No	Yes
OPA687	0.95/1.1	2.5/3.2	12	600	900	18.5	10/12	No	VFA	Yes	Yes ¹
LT6200	0.95/2.3	3.5	1	165	180	20	2.5/12.6	Yes	VFA	Yes	Yes ¹
CLC425	1.05/1.25	1.6/2.5	5	90	350	15	10/14	No	VFA	No	Yes

¹ Except stand-by pin.

Applications



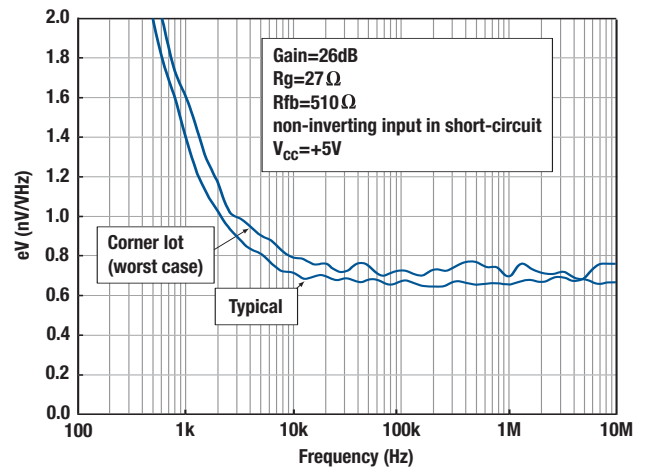
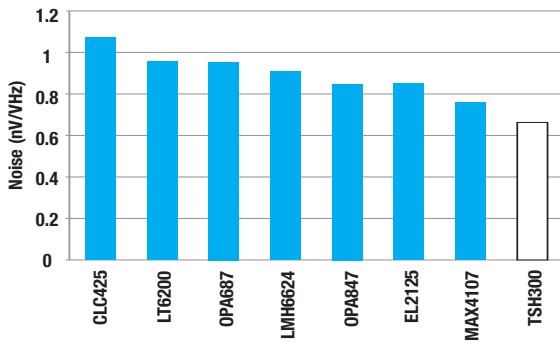
- Output noise level for a gain of +20:
 - ($R_{fb}=510\Omega$, $R_g=27W$)
- On a band of 10kHz – 1MHz: $20.5\mu V_{rms}$
 - SNR>90dB on $1V_{pp}$
- On a band of 10kHz – 5MHz: $45.8\mu V_{rms}$
 - SNR>85dB on $1V_{pp}$

Instrumentation



- Piezoelectric preamplifier for acoustic microscopy
- Transimpedance amplifier

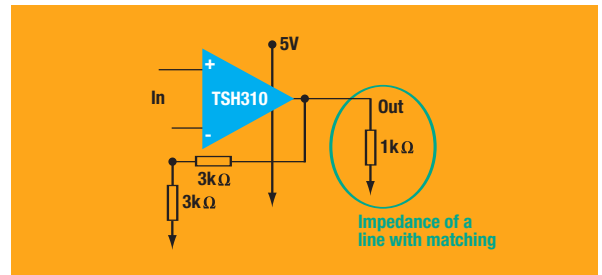
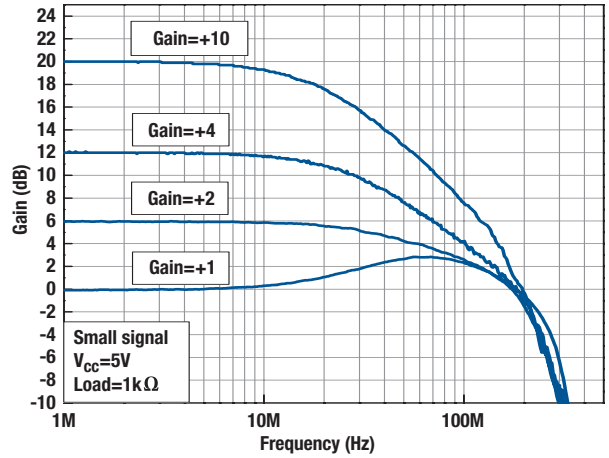
Sensor



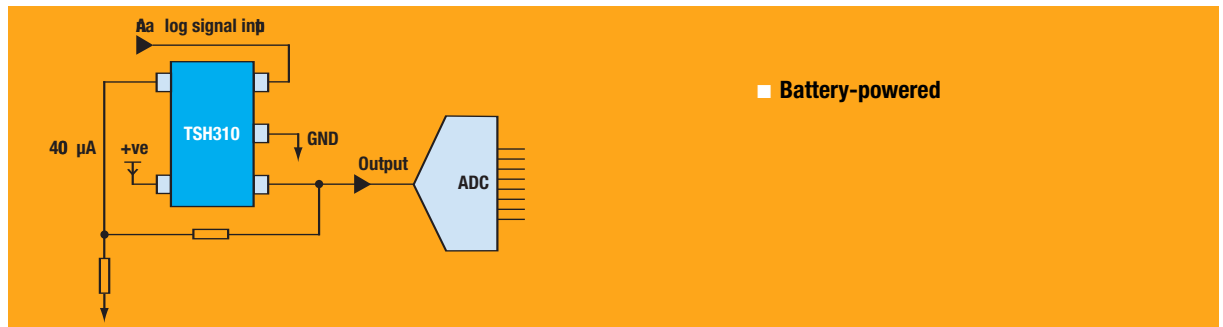
TSH310: Ultra low consumption – 130MHz bandwidth and only 400µA

Features

- 2mW ultra-low consumption (400µA at 5V)
- High speed
 - Small signal bandwidth: 120MHz (gain=2)
 - Slew rate: 115V/µs
- Voltage noise: 7.5nV/√Hz
- Distortion
 - $F_{in}=1\text{MHz}$, $V_{out}=2V_{p-p}$, load=1kΩ
 - SFDR= -87dBc
 - $F_{in}=10\text{MHz}$, $V_{out}=1V_{p-p}$, load=1kΩ
 - SFDR= -55dBc



Application



Cross-reference

Part number	B _w (MHz) gain=1	I _{cc} (mA)	Load (Ω)	Noise (nV/√Hz)	SR (V/µs)	Supply max. (V)	Feedback	Pin-to-pin compatible
TSH330	230	0.4	1000	7.5	115	5	CFA	
AD8005	270	0.4	1000	4	280	10	CFA	Yes
AD8031	80*	0.75*	1000	15*	30*	12	VFA	Yes
AD8038	350	1*	2000	8*	425	10	VFA	Yes
LMH6645	65*	0.7*	1000	17*	24*	12	VFA	Yes
THS4281	90*	1*	1000	12*	30*	10	VFA	Yes
MAX4180	245	1*	1000/150	2	450	10	CFA	No
MAX4181	270	1*	1000/150	2	320	10	CFA	No

* Superior TSH310 parameter

The cross-reference is applicable if the power supply of the op-amp in the application is 5V. The cross-reference doesn't imply "second source"; in each case, the application requirements should be considered.

TSH7x/TSH8x: High speed rail-to-rail op-amp family for standard video

TSH7x/TSH8x family – wide band, rail-to-rail, low power op-amp with standby function

Features

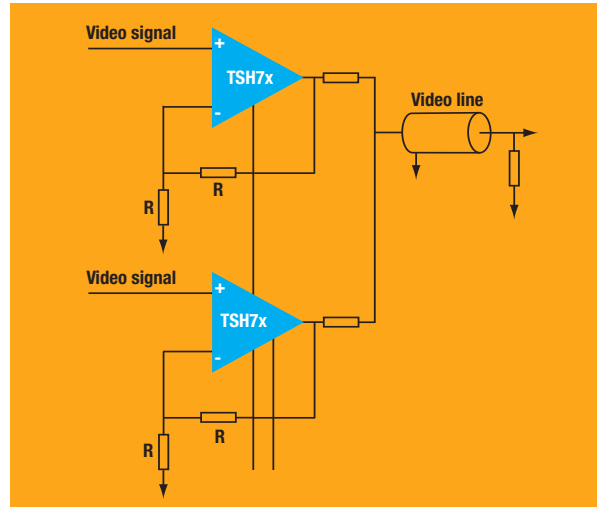
- 3V, 5V and ±5V power supplies
- Output rail-to-rail
- Gain bandwidth product: 70MHz
- High slew rate: 100V/μs
- Low distortion, THD of 0.1%
- Specified for 150Ω load
- Standby function (TSH71-TSH73-TSH75)
- TSH7x: 0 to 70°C, 3 to 12V
- TSH8x: -40 to 85°C, 5 to 12V

Applications

- Video line driver for DVD and Set-Top Box applications
- Video signal multiplexing (standby function)

Benefits

- Standard pin-out
- Automotive grade available



TSH7x competition

Part number	Analog Devices	Texas Instruments	National Semiconductor	Elantec	Maxim	Linear Technology
TSH70	AD8051		LM7131	EL2170 EL5144	MAX4012	
TSH71	AD8041	THS4031 THS4051 THS4081 OPA631 OPA634 OPA635	LM7131	EL2045 EL2250 EL2170 EL2245 EL5146		LT1363 LT1812 LT1190 LT1191 LT1195 LT1252
TSH72	AD8042 AD8052 AD8072	THS4032 THS4052 THS6082 OPA632 OPA2631 OPA2634		EL2245 EL2210 EL2211 EL2270 EL5244	MAX4016	LT1364 LT1813 LT1361 LT1253
TSH73	AD8044 AD8054			EL2450 EL2310	MAX4018	
TSH74	AD8044 AD8054			EL2410 EL2411 EL2445 EL2470 EL5444	MAX4020	LT1365 LT1362 LT1254

TS507: High precision operational amplifier

Features

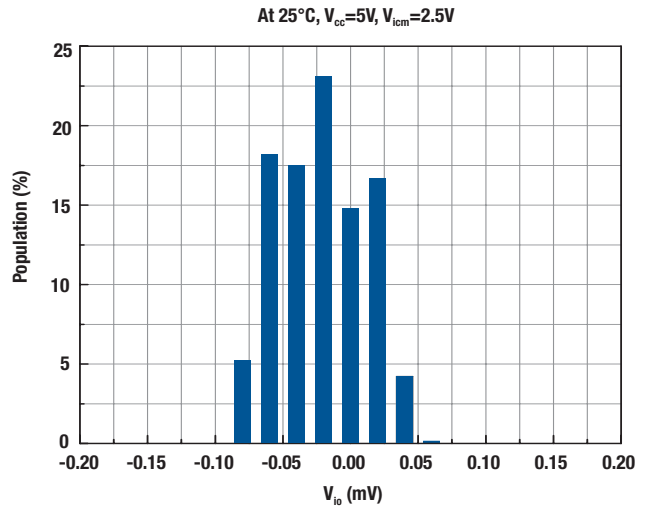
- High precision: 100 μ V offset voltage
- Precision ensured by patented package-level trimming techniques
- Rail-to-rail input/output
- High output current: 100mA
- Low noise: 12nV/ $\sqrt{\text{Hz}}$ at 1kHz
- 2.7 to 5.5V supply voltage

Applications

- Battery-powered systems, handheld devices
- Sensor signal conditioning
- Automotive applications
- Medical instrumentation
- Industrial instrumentation, factory automation

Benefits

- Low cost high precision device
- Automotive grade



TSV911/2/4 and TSV991/2/4: New rail-to-rail high GBP op-amps

Features

- CMOS inputs, rail-to-rail input/output
- 8.2MHz GBP for TSV911/2/4, unity gain stable
- 20MHz GBP for TSV991/2/4 stable with gain ≥ 5
- Low current consumption: 880 μ A typ
- Low supply voltage: 2.5 to 5.5V

Applications

- Signal conditioning, active filtering
- Automotive
- Battery-powered applications

Benefits

- Very low input bias current: 1pA typ
- Automotive grade

High speed op-amps

Part number	Description	Operating temp (°C)	Number of operators	Bandwidth		Type	Slew rate typ (V/μs)	Input noise (nV/√Hz)	I _{cc} typ. (mA)	Supply voltage		V _{io} max. (mV)	Rail-to-rail	
				Gain	(MHz)					Min. V	Max. V		In	Out
Large bandwidth														
TSH330	Low noise, very large bandwidth op-amp	-40 to 85	1	2	1100	CFA	1800	1.3	16.6	4.5	5.5	7		
TSH350	Low noise, very large bandwidth op-amp	-40 to 85	1	1	550	CFA	940	1.5	4.1	4.5	5.5	4		
TSH340	Video buffer, single supply, low input and output rail of 40mV/GND	-40 to 85	1	2	320		780	7	9.8	4.5	5.5		•	•
TSH341	Video op-amp, single supply, low input and output rail of 40mV/GND	-40 to 85	1	1	300	VFA	400	7	9.8	4.5	5.5	15	•	•
TSH343	Single supply triple video buffer for YPbPr signals (HD)	-40 to 85	1	2	250		740	25	13.7	4.5	5.5		•	•
TSH344	Single supply triple video buffer for RGB signals (HD)	-40 to 85	1	2	270		760	25	13.4	4.5	5.5		•	•
Ultra low noise														
TSH300	Ultra low noise high speed op-amp	-40 to 85	1	5	200	CFA	230	0.65	15	4.5	5.5	1.8		
Ultra low consumption														
TSH310	Ultra low consumption high speed op-amp	-40 to 85	1	1	120	CFA	115	7.5	0.4	4.5	5.5	6.5		
VGA														
TS652	Differential variable gain amplifier with standby mode	-40 to 85	Diff.	-9 +30	110 18		90	4.5	28	5	12	6		
Video drivers														
TSH340	Video buffer, single supply, low input and output rail of 40mV/GND	-40 to 85	1	2	320		780	7	9.8	4.5	5.5		•	•
TSH341	Video op-amp, single supply, low input and output rail of 40mV/GND	-40 to 85	1	1	300	VFA	400	7	9.8	4.5	5.5	15	•	•
TSH343	Single supply triple video buffer for YPbPr signals (HD)	-40 to 85	1	2	250		740	25	13.7	4.5	5.5		•	•
TSH344	Single supply triple video buffer for RGB signals (HD)	-40 to 85	1	2	270		760	25	13.4	4.5	5.5		•	•
TSH70/ 71/73/75	Rail-to-rail video op-amp with standby	0 to 70	1/3/5	1	100	VFA	100	8	7.2	3	12	10	•	•
TSH72/74	Rail-to-rail video op-amp	0 to 70	2/4	1	100	VFA	100	8	7.2	3	12	10	•	•
TSH80/81	Rail-to-rail video op-amp with standby	-40 to 85	1/2	1	100	VFA	100	8	8.2	4.5	12	10	•	•
TSH82	Rail-to-rail video op-amp	-40 to 85	2	1	100	VFA	100	8	8.2	4.5	12	10	•	•
TSH93	Video op-amp	-40 to 125	3	1	150	VFA	110	4.2	4.5	7	12	4		
TSH94/95	Video op-amp with standby	-40 to 125	3/4	1	150	VFA	110	4.2	4.5	7	12	4		
TSH110/ 112/114	Low noise, large bandwidth op-amp	-40 to 85	1/2/4	1	100	CFA	450	3	3	5	12	3		
TSH111/ 113	Low noise, large bandwidth op-amp with standby	-40 to 85	1/3	1	100	CFA	450	3	3	5	12	3		
TS615	Multi video line driver with standby (6 lines) and ADSL driver	-40 to 85	2	2	60	CFA	410	2.5	11.9	5	12	6	•	•
TS616	Multi video line driver (6 lines) and ADSL driver	-40 to 85	2	2	60	CFA	410	2.5	11.9	5	12	6	•	•
ADSL line drivers, high output current														
TS612	ADSL line driver with standby mode	-40 to 85	2	1	130	VFA	40	3	14	7	12	6		
TS613	ADSL line driver	-40 to 85	2	1	130	VFA	40	3	11	7	12	6		
TS615	Multi video line driver with standby (6 lines) and ADSL driver	-40 to 85	2	4	40	CFA	410	2.5	11.9	5	12	6	•	•
TS616	Multi video line driver (6 lines) and ADSL driver	-40 to 85	2	4	40	CFA	410	2.5	11.9	5	12	6	•	•

Op-amps

Part number	Description	Operating temp (°C)	Number of operators	Input/output	Supply voltage		Supply current I _{CC} typ per amp (µA)	Input offset voltage V _{io} max (mV)	Input bias current I _b max (nA)	GBP typ (MHz)	Slew rate typ (V/µs)	Output current I _{out} typ (mA)	Noise 1kHz (nV/√Hz)	Package
					Min V	Max V								
Low voltage (<=2.7V)														
Precision (<=500µV)														
TS507*	High precision input/output rail-to-rail op-amp	-40 to 125	1	RR/RR	2.7	5.5	890	0.1	40	1.9	0.6	100	12	SO/SOT23
CMOS inputs, low power (<=1mA)														
TSV911/2/4*	CMOS inputs, low voltage	-40 to 125	1/2/4	RR/RR	2.5	5.5	880	4.5	0.05	8.2	4.9	30	25	SOT23-5, SO, MiniSO, TSSOP
TSV991/2/4*	CMOS inputs, high GBP	-40 to 125	1/2/4	RR/RR	2.5	5.5	880	4.5	0.05	20	11	30	25	SOT23-5, SO, MiniSO, TSSOP
TS912/4	Low power, wide supply voltage range	-40 to 125	2/4	RR/RR	2.7	16	200	10/5/2	0.15	0.8	0.4	40	30	DIP, SO
TS931/2/4	Micropower amplifier with CMOS inputs	-40 to 85	1/2/4	Single S-/RR	2.7	10	20	10/5/2	0.15	0.1	0.05	1.5	75	DIP, SO, TSSOP, SOT23
TS941/2/4	Ultra-micropower amplifier with CMOS inputs	-40 to 85	1/2/4	Single S-/RR	2.7	10	1.2	10/5/2	0.15	0.01	0.004	1.5		DIP, SO, TSSOP, SOT23
High output current														
TS1851/2/4	1.8V min. voltage supply, micropower	-40 to 125	1/2/4	RR/RR	1.8	6	120	3	50	0.48	0.2	40	40	DIP, SO, TSSOP, SOT23, MiniSO
TS1871/2/4	1.8V min. voltage supply, micropower	-40 to 125	1/2/4	RR/RR	1.8	6	400	3	125	1.6	0.54	65	27	DIP, SO, TSSOP, SOT23, MiniSO
TS921/2/4/5	Excellent audio performance, available in Flip-Chip	-40 to 125	1/2/4	RR/RR	2.7	12	1000	3/0.9	100	4	1.3	80	9	DIP, SO, TSSOP, Flip-Chip
TS951/2/4	Input and output rail-to-rail, low distortion (0.01%)	-40 to 125	1/2/4	RR/RR	2.7	12	900	6	100	3	1	22	25	DIP, SO, TSSOP, SOT23
TS982	200mA high output current dual operational amplifier	-40 to 125	2	RR/RR	2.5	5.5	5300	5	500	2	0.7	200	17	SO8 e-pad
Low noise														
TS921/2/4/5	Excellent audio performance, available in Flip-Chip	-40 to 125	1/2/4	RR/RR	2.7	12	1000	3/0.9	100	4	1.3	80	9	DIP, SO, TSSOP, Flip-Chip
TS461/2/4	TS321, LM324, LM358 replacement in low voltage applications	-20 to 70	1/2/4	STD/RR	2.7	10	2000	5	750	10	4	1.5	4	DIP, SO, TSSOP, SOT23, DFN8
TS971/2/4	High-performance, suitable for battery-powered applications	-40 to 125	1/2/4	STD/RR	2.7	10	2000	5	750	12	4	1.5	4	DIP, SO, TSSOP, SOT23, DFN8
High gain bandwidth product (≥5MHz)														
TSV911/2/4*	CMOS inputs, low voltage	-40 to 125	1/2/4	RR/RR	2.5	5.5	880	4.5	0.05	8.2	4.9	30	25	SOT23-5, SO, MiniSO, TSSOP
TSV991/2/4*	CMOS inputs, high GBP	-40 to 125	1/2/4	RR/RR	2.5	5.5	880	4.5	0.05	20	11	30	25	SOT23-5, SO, MiniSO, TSSOP
TS461/2/4	TS321, LM324, LM358 replacement in low voltage applications	-20 to 70	1/2/4	STD/RR	2.7	10	2000	5	750	10	4	1.5	4	DIP, SO, TSSOP, SOT23, DFN8
TS971/2/4	High-performance, suitable for battery-powered applications	-40 to 125	1/2/4	STD/RR	2.7	10	2000	5	750	12	4	1.5	4	DIP, SO, TSSOP, SOT23, DFN8
General purpose, low cost														
LMV321R/358/324	Low power input/output rail-to-rail op-amp	-40 to 125	1/2/4	RR/RR	2.5	6	120	3	125	1	0.3	29	40	SOT23-5, SO8, TSSOP8, SO14, TSSOP14
TSV321R/358/324	General purpose, input/output rail-to-rail op-amp	-40 to 125	1/2/4	RR/RR	2.5	6	400	3	125	1.4	0.6	65	30	SOT23-5, SO8, TSSOP8, SO14, TSSOP14, mini SO8

Part number	Description	Operating temp (°C)	Number of operators	Input/output	Supply voltage		Supply current I_{CC} typ per amp (μA)	Input offset voltage V_{IO} max (mV)	Input bias current I_b max (nA)	GBP typ (MHz)	Slew rate typ (V/μs)	Output current I_{out} typ (mA)	Noise 1kHz (nV/√Hz)	Package
					Min V	Max V								

Low power ($\leq 500\mu A$)

Micropower ($\leq 100\mu A$)														
TS941/2/4	Ultra-micropower amplifier with CMOS inputs	-40 to 85	1/2/4	Single S-/RR	2.7	10	1.2	10/5/2	0.15	0.01	0.004	1.5		DIP, SO, TSSOP, SOT23
TS931/2/4	Micropower amplifier with CMOS inputs	-40 to 85	1/2/4	Single S-/RR	2.7	10	20	10/5/2	0.15	0.1	0.05	1.5	75	DIP, SO, TSSOP, SOT23
High output current														
TS1851/2/4	1.8V min. voltage supply, micropower	-40 to 125	1/2/4	RR/RR	1.8	6	120	3	50	0.48	0.2	40	40	DIP, SO, TSSOP, SOT23, MiniSO
TS1871/2/4	1.8V min. voltage supply, micropower	-40 to 125	1/2/4	RR/RR	1.8	6	400	3	125	1.6	0.54	65	27	DIP, SO, TSSOP, SOT23, MiniSO
CMOS inputs														
TS912/4	Low power, wide supply voltage range	-40 to 125	2/4	RR/RR	2.7	16	200	10/5/2	0.15	0.8	0.4	40	30	DIP, SO
TS931/2/4	Micropower amplifier with CMOS inputs	-40 to 85	1/2/4	Single S-/RR	2.7	10	20	10/5/2	0.15	0.1	0.05	1.5	75	DIP, SO, TSSOP, SOT23
TS941/2/4	Ultra-micropower amplifier with CMOS inputs	-40 to 85	1/2/4	Single S-/RR	2.7	10	1.2	10/5/2	0.15	0.01	0.004	1.5		DIP, SO, TSSOP, SOT23
General purpose, low cost														
LMV321/R/358/324	Low power input/output rail-to-rail op-amp	-40 to 125	1/2/4	RR/RR	2.5	6	120	3	125	1	0.3	29	40	SOT23-5
TSV321/R/358/324	General purpose, input/output rail-to-rail op-amp	-40 to 125	1/2/4	RR/RR	2.5	6	400	3	125	1.4	0.6	65	30	SOT23-5

Precision ($\geq 500\mu V$)

High voltage														
OP07	Very low offset, bipolar op-amp	-40 to 105	1	STD/STD	6	30	5000	0.15		0.5	0.17	-	10	DIP, SO
TS512A/4A	A low noise and distortion (8nV/Hz and 0.03%)	-40 to 125	2/4	STD/STD	6	30	300	0.5	150	3	1.5	23/13	10	DIP, SO
Low voltage														
TS507*	High precision input/output rail-to-rail op-amp	-40 to 125	1	RR/RR	2.7	5.5	890	0.1	40	1.9	0.6	100	12	SO, SOT23

High voltage range

Low noise														
LM833	Very low noise and low distortion (0.002%)	-40 to 125	2	STD/STD	5	30	2000	5	1000	15	7	20	4.5	DIP, SO
MC33078/9	Very low noise and low distortion (0.002%)	-40 to 125	2/4	STD/STD	5	30	2000	2/2.5	750	15	7	29	4.5	DIP, SO
CMOS inputs														
TS271	Micropower, programmable op-amp	-40 to 125	1	STD/STD	3	16	15	10/5/2	1 typ	0.1/0.7/2.3		0.04/0.6/4.5	60	DIP, SO
TS272/4	Micropower, wide range of input offset voltage	-40 to 125	2/4	STD/STD	3	16	1500	10/5/2	1 typ	3.5	5.5	60	30	DIP, SO
TS27L2/4	Micropower, wide range of input offset voltage	-40 to 125	2/4	STD/STD	3	16	15	10/5/2	1 typ	0.1	0.04	60	68	DIP, SO
TS27M2/4	Micropower, wide range of input offset voltage	-40 to 125	2/4	STD/STD	3	16	200	10/5/2	1 typ	1	0.6	60	38	DIP, SO
TS912/4	Low power, wide supply voltage range	-40 to 125	2/4	RR/RR	2.7	16	200	10/5/2	0.15	0.8	0.4	40	30	DIP, SO

Op-amps

Part number	Description	Operating temp (°C)	Number of operators	Input/output	Supply voltage		Supply current I_{CC} typ per amp (μA)	Input offset voltage V_{IO} max (mV)	Input bias current I_b max (nA)	GBP typ (MHz)	Slew rate typ (V/μs)	Output current I_{out} typ (mA)	Noise 1kHz (nV/√Hz)	Package
					Min V	Max V								

High voltage range

High gain bandwidth product (≥ 5 MHz)														
TS971/2/4	High-performance, suitable for battery-powered applications	-40 to 125	1/2/4	STD/RR	2.7	10	2000	5	750	12	4	1.5	4	DIP, SO, TSSOP, SOT23, DFN8
Low input offset voltage														
TS522/4	Very low noise suitable for audio applications (4.5nV/Hz)	-40 to 125	2/4	STD/STD	5	30	2000	0.85	750	15	7	29		DIP, SO

High-temperature range (-40 to 150°C)

Voltage comparators														
LM2901H	High-temperature, low power quad voltage comparator	-40 to 150	4	STD/STD	2	36	275	7	250	N/A	N/A	16	N/A	SO/WAFER
LM2903H	High-temperature, low power dual voltage comparator	-40 to 150	2	STD/STD	2	36	200	7	250	N/A	N/A	16	N/A	SO/WAFER
Operational amplifiers														
LM2904WH	High-temperature, dual general-purpose op-amp	-40 to 150	2	STD/STD	3	30	350	7	150	1.1	0.6	40	40	SO/WAFER
TS922/AUT	High-temperature dual low noise rail-to-rail op-amp	-40 to 125	2	RR/RR	2.7	12	1000	3	100	4	1.3	80	9	SO/WAFER
LM2902H	High-temperature, low power quad op-amp	-40 to 150	4	STD/STD	3	30	350	7	150	1.1	0.6	40	40	SO/WAFER
TS924H*	High-temperature, dual low noise rail-to-rail op-amp	-40 to 150	4	RR/RR	2.7	12	1000	3	100	4	1.3	80	9	SO/WAFER

Comparators

Part numbers	General description	Number of operators	Technology	Supply current I_{CC} typ μA	Supply voltage V_{CC} max V	Input offset voltage V_{IO} max mV	Response time μs
Micropower							
TS339	Open drain – micropower	4	CMOS	9	16	5	1.5
TS3702	Push pull – micropower	2	CMOS	9	16	5	1.5
TS3704	Push pull – micropower	4	CMOS	9	16	5	1.2
TS393	Open drain – micropower	2	CMOS	10	16	5	1.5
TS7211	Rail-to-rail inputs, push pull output – micropower	1	BiCMOS	6	10	7	0.5
TS7221	Rail-to-rail inputs, open drain output – micropower	1	BiCMOS	6	10	7	0.5
TS861	Rail-to-rail inputs, push pull output – micropower	1	BiCMOS	6	10	7	0.5
TS862	Rail-to-rail inputs, push pull output – micropower	2	BiCMOS	6	10	7	0.5
TS864	Rail-to-rail inputs, push pull output – micropower	4	BiCMOS	6	10	7	0.5
General purpose							
LM2901	Open collector – low power	4	BIPOLAR	275	36	7	1.3
LM2903	Open collector – low power	2	BIPOLAR	200	36	7	1.3
LM311	Open emitter and collector	1	BIPOLAR	5000	36	7.5	0.2
LM319	High speed	2	BIPOLAR	8000	36	8	0.08
LM339	Open collector – low power	4	BIPOLAR	275	36	2	1.3
LM393	Open collector – low power	2	BIPOLAR	200	36	5	1.3
TS372	Open drain – low power	2	CMOS	150	16	10	0.6
TS374	Open drain – low power	4	CMOS	150	16	10	0.6
TS391	Open collector – low power	1	BIPOLAR	200	36	5	1.3

Operational amplifiers and comparators cross-reference selector

Part number	Direct replacement	Similar
Analog Devices		
AD8041	TSH71-81	
AD8042	TSH72-82	
AD8051	TSH70-81	
AD8052	TSH72-82	
AD8054	TSH74	
AD822	TS922	
AD824	TS924	
OP213		TS952
OP186	TS941	
OP279	TS922	
OP281	TS942	
OP284	TS922	
OP292	TS922	
OP293		TS932
OP295	TS1852	
OP450		TS922
OP491		TS914
OP492	TS924	
OP495	TS934	
AD820		TS921
AD8531		TS921
AD8532		TS922
AD8534		TS924
AD8541		TS1851
AD8542		TS1852
AD8544		TS1854
AD8594		TS925
OP113	TS951	
OP181		TS941
OP183		TS951
OP193		TS931
OP196		TS931
OP213		TS952
OP250		TS922
OP283		TS952
OP284	TS922	
OP291		TS912
OP293		TS932
OP296		TS932
OP413		TS954
OP450		TS922
OP481		TS944
OP484	TS924	
OP491		TS914
OP493		TS934
OP496		TS934
SSM2135		TS948
Fairchild		
LMV321		LMV321
LMV324		LMV324
LMV358		LMV358
Harris		
ICL7612	TS912	
ICL7621		TS912
ICL7641		TS914

* Future products

Part number	Direct replacement	Similar
Intersil		
EL2211	TSH72-82	
EL2411	TSH74	
EL5144	TSH70-80	
EL5146	TSH71-81	
EL5244	TSH72-82	
EL5444	TSH74	
EL2311		TSH73
Linear Technology		
LT1367		TS914
LT1495		TS942
LT1495		TS942
LT1496		TS944
LT1638		TS1872
LT1639		TS1874
Maxim		
LMX321	LMV321	
LMX324	LMV324	
LMX358	LMV358	
ICL7612	TS912	
MAX4040	TS931	
MAX4041	TS931	
MAX4042	TS932	
MAX4044	TS934	
MAX406	TS941	
MAX407	TS942	
MAX4122	TS951	
MAX4124	TSV991*	
MAX4126	TS922	
MAX4128	TSV992*	
MAX4129	TS924	
MAX4129	TS942	
MAX4162	TS931	
MAX4163	TS932	
MAX4164	TS934	
MAX4165	TS1871	
MAX4167	TS922	
MAX4169	TS924	
MAX418	TS944	
MAX4231	TSV911*	
MAX4232	TSV912*	
MAX4234	TSV914*	
MAX4236B	TS507*	
MAX4240	TS931	
MAX4242	TS932	
MAX4244	TS934	
MAX4250	TS1851	
MAX4250	TS1871	
MAX4250	TS951	
MAX4252	TS1872	
MAX4254	TS1874	
MAX4255	TSV991*	
MAX4257	TSV992*	
MAX4326	TS922	
MAX4329	TS924	
MAX4389	TSH70-80	

Operational amplifiers and comparators cross-reference selector

Part number	Direct replacement	Similar
Maxim		
MAX4390	TSH70-80	
MAX4392	TSH72-82	
MAX4394	TSH73	
MAX4395	TSH74	
MAX4396	TSH75	
MAX4400	TS1871	
MAX4491	TSV911*	
MAX4492	TSV912*	
MAX473	TS971	
MAX474	TS972	
MAX475	TS974	
MAX492	TS1852	
MAX494	TS1854	
MAX495	TS1851	
ICL7621		TS912
IC7641		TS914
MAX4322		TS1871
MAX985		TS861
Micrel		
MIC7211	TS7211	
Microchip		
MCP602		TS912
MCP604		TS914
Mitsubishi		
M5216	TS922	
Motorola		
MC33502	TS1852	
MC33201		TS921
MC33202		TS922
MC33204		TS924
MC33207		TS925
National Semiconductor		
LMC6041	TS931	
LMC6042	TS932	
LMC6044	TS934	
LMC6082	TS912	
LMC6084	TS914	
LMC6434	TS934	
LMC6442	TS942	
LMC6462	TS932	
LMC6582	TS1872	
LMC6584	TS1874	
LMC660	TS914	
LMC662	TS912	
LMC7211	TS7211	
LMH6642	TSH70-80	
LMH6643	TSH72-82	
LMH6644	TSH74	
LMV321	LMV321	
LMV324	LMV324	
LMV358	LMV358	
LMV822	TS922	
LMV824	TS924	
LMV924	TS1874	

Part number	Direct replacement	Similar
National Semiconductor		
LPV321	TS931	
LPV324	TS934	
LPV358	TS932	
LM7131A	TSH70-80	
LM7301		TS951
LMC6032		TS912
LMC6034		TS914
LMC6035		TS912
LMC6036		TS914
LMC6482		TS912
LMC6484		TS914
LMC6492		TS912
LMC6494		TS914
LMC7101		TS951
LMC7111		TS931
LMV821		TS1871
NJRC		
NJM2100		TS462
NJM2106		TS951
NJM2107		TS462
NJM2107F		TS951
NJU7082		TS922
Philips		
NE5234		TS914
Rohm		
BA4510	TS462	
Texas Instruments		
LMV321	LMV321	
LMV324	LMV324	
LMV358	LMV358	
OPA2237	TS922	
OPA2241	TS932	
OPA2342	TS912	
OPA241	TS931	
OPA4237	TS924	
OPA4241	TS934	
OPA4342	TS914	
OPA631-32	TSH70-80	
OPA634-35	TSH70-80	
	TSH71-81	
	TSH72-82	
TLC2252	TS932	
TLC2254	TS934	
TLC2872	TS922	
TLV2361	TS971	
TLC2202		TS922
TLC2262		TS922
TLC2264		TS924
TLC2272		TS922
TLC2274		TS924
TLV2231		TS951
TLV2252		TS932
TLV2254		TS934
TLV2262		TS1852
TLV2264		TS1854

Operational amplifiers and comparators cross-reference selector

Part number	Direct replacement	Similar
Texas Instruments		
TLV2422		TS932
TLV2432		TS912
TLV2442		TS912
TLV2711		TS931
TLV2721		TS1851
TLV2731		TS951
TLV3432		TS1852
TOKO		
TK17021M	TS972	
TK17031M	TS952	

Part number	Direct replacement	Similar
Toshiba		
TA75S51	TS932	
TA75S58F	TS951	
TA75S58FU	TS952	
TC75S01F	TS951	
TC75W51FU	TS922	
TC75W54FU	TS922	
TA75S51F		TS931
TC75S56F		TS861
TC75S57F		TS861
TC75S58F		TS861
TC75S59F		TS861

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