PRODUCT/PROCESS
CHANGE NOTIFICATION

PCN AMS/20/12117

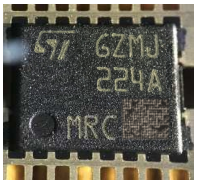
Analog, MEMS & Sensors (AMS)

New material set in ST Bouskoura for General Purpose Analog products in TSSOP14 packages

WHAT:

Progressing on the activities related to quality continuous improvement, ST is glad to announce a new material set for General Purpose Analog products in TSSOP14 package produced in ST Bouskoura.
The goal of this PCN is to qualify new material set as described below and to move to brand new equipments replacing obsolete machines.
This new set of material was developed to improve our product robustness.

Please find more information related to material change in the table here below

Material	Current process	Modified process	Comment
Diffusion location	ST Ang Mo Kio (Singapore)/ UMC / ST Agrate	ST Ang Mo Kio (Singapore)/ UMC / ST Agrate	No change
Assembly location	ST Bouskoura	ST Bouskoura	No change
Molding compound	Sumitomo G630AY	Sumitomo G700KC	Move from low cost molding compound to high reliability compound
Die attach	Ablestick 8601-S25	Ablestick 8601-S25	No change
Leadframe	Copper preplated NiPdAgAu standard density	Copper preplated NiPdAu standard density	Reducing risk of discoloration sporadically encountered
Wire	Copper 1 mil	Copper 1 mil	No change
Equipment	20 years old equipments DA ASM AD889 WB ASM Eaggle 60	Latest generation of equipment DA ASM 832i WB KnS Connex ELA	To reduce risk of sporadic excursion Traceability thanks to 2D code on leadframe
Traceability	Assy lot	2D code allowing single die traceability	TSSOP14  **TO be implemented end Q4/2020**

WHY:
This material change will contribute to ST's continuous quality product improvement and ensure a consistent assembly process through all the TSSOP production lines.

HOW:
The qualification program consists mainly of comparative electrical characterization and reliability tests.

You will find here after the qualification test plan which summarizes the various test methods and conditions that ST uses for this qualification program.

WHEN:
The new material set will be implemented in Q2/2020 in Bouskoura.

Marking and traceability:

Unless otherwise stated by customer's specific requirement, the traceability of the parts assembled with the new material set will be ensured by new internal sales type, date code and lot number.

The changes here reported will not affect the electrical, dimensional and thermal parameters keeping unchanged all the information reported on the relevant datasheets.

There is -as well- no change in the packing process or in the standard delivery quantities.
Shipments may start earlier with the customer's written agreement.

Reliability Qualification plan

New Halogen free material set for TSSOP in ST Bouskoura

General Information	
Product Line	*0124, 0339, 0924, V994, UY43*
Product Description	Quad op amp bipolar, Quad comparator bipolar, quad op amp, biCMOS quad op amp, micropower quad CMOS voltage comparator
P/N	*LM2902PT, LM2901PT, TS924IPT, TSV994IPT, TSX339IPT*
Product Group	*AMS*
Product division	*General Purpose Analog &RF*
Package	*TSSOP14*
Silicon Process technology	*Bipolar, , HF2CMOS, HF5CMOS, HVG8A*

Locations	
Wafer fab	*ST Singapore UMC, ST Agrate*
Assembly plant	*ST Bouskoura (Morocco)*
Reliability Lab	*ST Grenoble, ST Bouskoura*

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1 APPLICABLE AND REFERENCE DOCUMENTS

Document reference	Short description
AEC-Q100	Stress test qualification for automotive grade integrated circuits
AEC-Q101	Stress test qualification for automotive grade discrete semiconductors
JESD47	Stress-Test-Driven Qualification of Integrated Circuits
AEC Q006	Qualification requirements for components using copper (cu) wire interconnections

2 GLOSSARY

DUT	Device Under Test
PCB	Printed Circuit Board
SS	Sample Size

3 RELIABILITY EVALUATION OVERVIEW

3.1 Objectives

To qualify a new material set for products in TSSOP14 package produced in ST Bouskoura

3.2 Conclusion

Qualification Plan requirements have to be fulfilled without issue. It is stressed that reliability tests have to show that the devices behave correctly against environmental tests (no failure). Moreover, the stability of electrical parameters during the accelerated tests have to demonstrate the ruggedness of the products and safe operation, which is consequently expected during their lifetime.

4 DEVICE CHARACTERISTICS

4.1 Device description

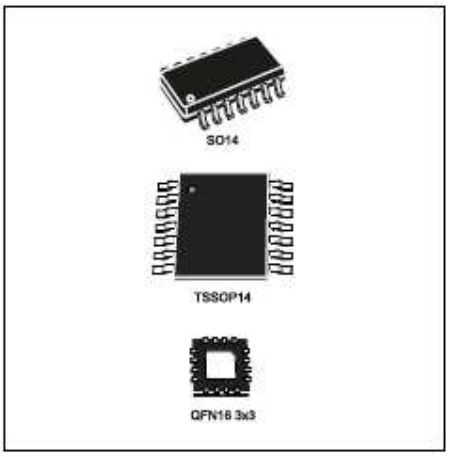
LM2902YPT

life.augmented

LM2902

Low-power quad operational amplifiers

Datasheet - production data



Description

This circuit consists of four independent, high-gain operational amplifiers (op amps) which employ internal frequency compensation and are specifically designed for automotive and industrial control systems.

The device operates from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low-power supply current drain is independent from the power supply voltage magnitude.

Features

- Wide gain bandwidth: 1.3 MHz
- Input common-mode voltage range includes negative rail
- Large voltage gain: 100 dB
- Supply current per amplifier: 375 µA
- Low input bias current: 20 nA
- Low input offset current: 2 nA
- Wide power supply range:
  - Single supply: 3 V to 30 V
  - Dual supplies: ± 1.5 V to ± 15 V

LM2901YPT,

LM2901

Low-power quad voltage comparator

Features

- Wide single supply voltage range or dual supplies for all devices: +2 V to +36 V or ±1 V to ±18 V
- Very low supply current (1.1 mA) independent of supply voltage (1.4 mW/comparator at +5 V)
- Low input bias current: 25 nA typ.
- Low input offset current: ±5 nA typ.
- Input common-mode voltage range includes negative rail
- Low output saturation voltage: 250 mV typ. (I_O = 4 mA)
- Differential input voltage range equal to the supply voltage
- TTL, DTL, ECL, MOS, CMOS compatible outputs

N
DIP14
(Plastic package)

D
SO-14
(Plastic micropackage)

P
TSSOP14
(Thin shrink small outline package)

Q4
QFN16 3x3
(Plastic micropackage)

Description

This device consists of four independent precision voltage comparators, which are designed specifically to operate from a single supply over a wide range of voltages. Operation from split power supplies is also possible.

These comparators also have a unique characteristic in that the input common-mode voltage range includes the negative rail even though operated from a single power supply voltage.

TS924IYPT

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TS924, TS924A

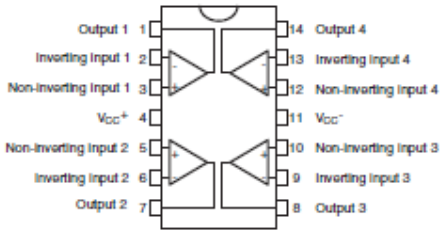
Rail-to-rail output current quad operational amplifier

Datasheet - production data

D
SO14
(plastic micropackage)

P
TSSOP14
(thin shrink small outline package)

Pin connections (top view)



Features

- Rail-to-rail input and output
- Low noise: 9 nV/√Hz
- Low distortion
- High output current: 80 mA (able to drive 32 Ω loads)
- High-speed: 4 MHz, 1.3 V/µs
- Operating range from 2.7 V to 12 V
- Low input offset voltage: 900 µV max. (TS924A)
- ESD internal protection: 3 kV
- Latch-up immunity
- Macromodel included in this specification

Related products

- See the TS921 device for the single version and the TS922 device for the dual version
- See the TSX56x series for smaller packages

Applications

- Headphone amplifiers
- Piezoelectric speaker drivers
- Sound cards
- MPEG boards, multimedia systems
- Line drivers, buffers
- Cordless telephones and portable communication equipment
- Instrumentation with low noise as key factor

Description

The TS924 and TS924A devices are rail-to-rail quad BiCMOS operational amplifiers optimized and fully specified for 3 V and 5 V operation.

High output current allows low load impedances to be driven.

The TS924 and TS924A devices exhibit a very low noise, low distortion, low offset, and high output current capability, making these devices an excellent choice for high-quality, low-voltage, and battery-operated audio systems.

The devices are stable for capacitive loads up to 500 pF.

TSV994IYPT

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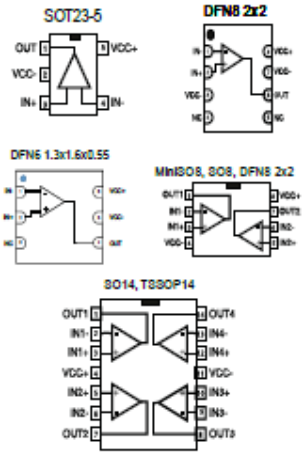
TSV991, TSV992, TSV994 TSV991A TSV992A, TSV994A

Datasheet

Rail-to-rail input/output 20 MHz GBP operational amplifiers

Pin connections
(top view)



Features

- Low input offset voltage: 1.5 mV max. (A grade)
- Rail-to-rail input and output
- Wide bandwidth 20 MHz
- Stable for gain ≥ 4 or ≤ -3
- Low power consumption: 820 µA typ.
- High output current: 35 mA
- Operating from 2.5 V to 5.5 V
- Low input bias current, 1 pA typ.
- ESD internal protection ≥ 5 kV

Applications

- Battery-powered applications
- Portable devices
- Signal conditioning and active filtering
- Medical instrumentation
- Automotive applications

Description

The TSV99x and TSV99xA family of single, dual, and quad operational amplifiers offers low voltage operation and rail-to-rail input and output. These devices feature an excellent speed/power consumption ratio, offering a 20 MHz gain-bandwidth, stable for gains above 4 (100 pF capacitive load), while consuming only 1.1 mA maximum at 5 V. They also feature an ultra-low input bias current. These characteristics make the TSV99x family ideal for sensor interfaces, battery-supplied and portable applications, as well as active filtering. These characteristics make the TSV99x, TSV99xA family ideal for sensor interfaces, battery-supplied and portable applications, as well as active filtering.

Product status link
TSV991, TSV992, TSV994, TSV991A, TSV992A, TSV994A

Related products	
See TSV911, TSV912, TSV914, TSV911A, TSV912A, TSV914A	For unity-gain stable amplifiers

TSX339IYPT

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TSX339

Datasheet

Micropower quad CMOS voltage comparators

Features

- Low supply current: 5 µA typ. per comparator
- Wide single supply range 2.7 V to 16 V or dual supplies (±1.35 V to ±8 V)
- Extremely low input bias current: 1 pA typ.
- Input common-mode voltage range includes ground
- Open drain output
- High input impedance: 10^{12} Ω typ
- Fast response time: 2 µs typ. for 5 mV overdrive
- ESD tolerance: 4 kV HBM, 200 V MM
- Pin-to-pin and functionally compatible to the quad CMOS TS339 comparators

Applications

- Automotive
- Industrial

Description

The TSX339 is a micropower CMOS quad voltage comparator, which exhibits a very low current consumption of 5 µA typical per comparator. This device was designed as the improvement of the TS339: it shows a lower current consumption, a better input offset voltage, and an enhanced ESD tolerance. The TSX339 is fully specified over a wide temperature range and is proposed in automotive grade for the TSSOP14 package. It is fully compatible with the TS339 CMOS comparator and is available with similar packages. The new tiny package, QFN16 3x3, is also proposed for the TSX339 thus allowing even more integration on applications.

Product status link
TSX339

Related products	
See TSX3704	for push-pull output

4.2 Construction note

	P/N *LM2902YPT*	P/N *LM2901YPT*	P/N TS924IYPT	P/N TSV994IYPT	P/N TSX339IYPT
Wafer/Die fab. information					
Wafer fab manufacturing location	ST Singapore	ST Singapore	ST Singapore	UMC Taiwan	ST Agrate
Technology	Bipolar	Bipolar	HF2CMOS	HF5CMOS	HVG8A
Die finishing back side	RAW SILICON	RAW SILICON	RAW SILICON	RAW SILICON	RAW SILICON
Die size (microns)	1420x1360	1370x1270	1980x2450	1770X1160	1830X1440
Bond pad metallization layers	AlSiCu	AlSiCu	AlSiCu	AlCu	AlCu
Passivation type	Nitride	Nitride	P-VAPOX/NITRIDE	PSG + NITRIDE	HDP/TEOS/SiN/Polyimide
Wafer Testing (EWS) information					
Electrical testing manufacturing location	ST Singapore	ST Singapore	ST Singapore	ST Singapore	ST Singapore
Tester	ASL1K	ASL1K	ASL1K	ASL1K	ASL1K
Assembly information					
Assembly site	ST Bouskoura	ST Bouskoura	ST Bouskoura	ST Bouskoura	ST Bouskoura
Package description	TSSOP14	TSSOP14	TSSOP14	TSSOP14	TSSOP14
Molding compound	EME G700KC	EME G700KC	EME G700KC	EME G700KC	EME G700KC
Frame material	Cu	Cu	Cu	Cu	Cu
Die attach process	Epoxy Glue	Epoxy Glue	Epoxy Glue	Epoxy Glue	Epoxy Glue
Die attach material	8601S-25	8601S-25	8601S-25	8601S-25	8601S-25
Wire bonding process	Thermosonic ball bonding	Thermosonic ball bonding	Thermosonic ball bonding	Thermosonic ball bonding	Thermosonic ball bonding
Wires bonding materials/diameters	Cu 1 mil	Cu 1 mil	Cu 1 mil	Cu 1 mil	Cu 1 mil
Lead finishing process	electroplating	electroplating	electroplating	electroplating	electroplating
Lead finishing/bump solder material	NiPdAu	NiPdAu	NiPdAu	NiPdAu	NiPdAu
Final testing information					
Testing location	ST Bouskoura	ST Bouskoura	ST Bouskoura	ST Bouskoura	ST Bouskoura
Tester	ASL1K	ASL1K	ASL1K	ASL1K	ASL1K

5 TESTS PLAN SUMMARY

5.1 Test vehicle

Lot #	Process/ Package	Product Line	Comments
1	Bipolar/TSSOP14	0124	
2	Bipolar/TSSOP14	0339	
3	HF2CMOS/TSSOP14	0924	
4	HF5CMOS/TSSOP14	V994	
5	HVG8A/TSSOP14	UY43	CZ9510KURL, CZ9510KURN

5.2 Test plan and results summary

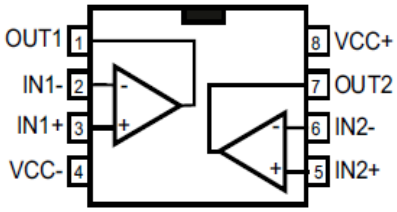
Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS					Note
						Lot 1 0124	Lot 2 0339	Lot3 0924	Lot 4 V994	Lot5 UY43	
HTB/ HTOL	N	JESD22 A-108	Ta = 150°C or 125°C, BIAS		168 H	77	77	77		77	
					1000 H	77	77	77		77	
HTSL	N	JESD22 A-103	Ta = 150°C		168 H	50	50	50	2x0/50	2x0/50	
					500 H	50	50	50	2x0/50	2x0/50	
					1000 H	50	50	50	50	50	
PC		JESD22 A-113	Drying 24 H @ 125°C Store 168 H @ Ta=85°C Rh=85% Over Reflow @ Tpeak=260°C 3 times		Final	Below sample + 22units	Below sample + 22units	Below sample + 22units	PASS	PASS	
AC	Y	JESD22 A-102	Pa=2Atm / Ta=121°C		96 H	77	77	77	0/77	0/77	
TC	Y	JESD22 A-104	Ta = -65°C to 150°C		100 cy	77	77	77	2x0/77	2x0/77	
					200 cy	77	77	77	2x0/77	2x0/77	
					500 cy	77	77	77	2x0/77	2x0/77	
					1000cy	77	77	77	2x77	2x77	
THB	Y	JESD22 A-101	Ta = 85°C, RH = 85%, BIAS		168 H	77	77	77	77	77	
					500 H	77	77	77	77	77	
					1000 H	77	77	77	77	77	
Other Tests											
ESD	N	AEC Q101-001, 002 and 005	CDM								
						3	3	3	3	3	

6 ANNEXES

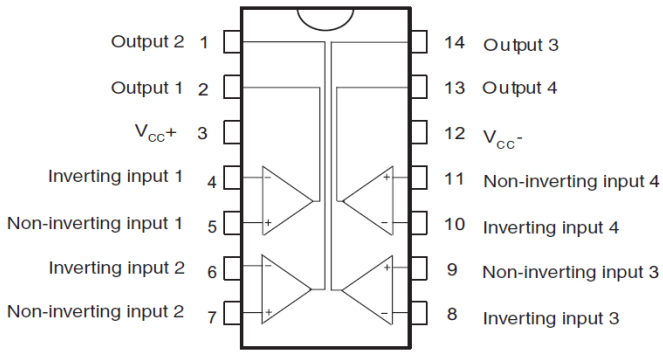
6.1 Device details

6.1.1 Pin connection

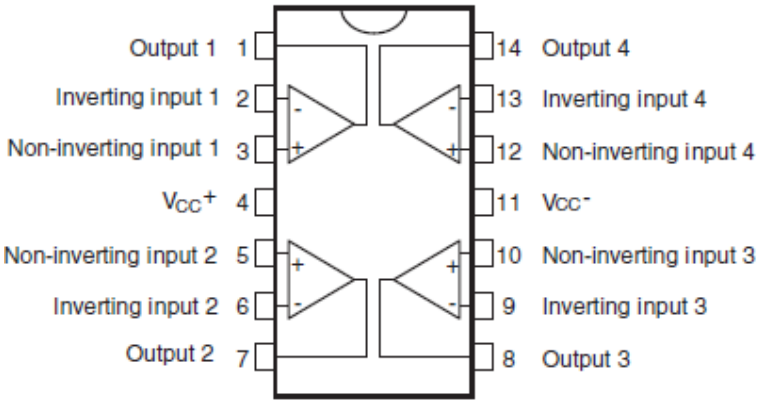
LM2903



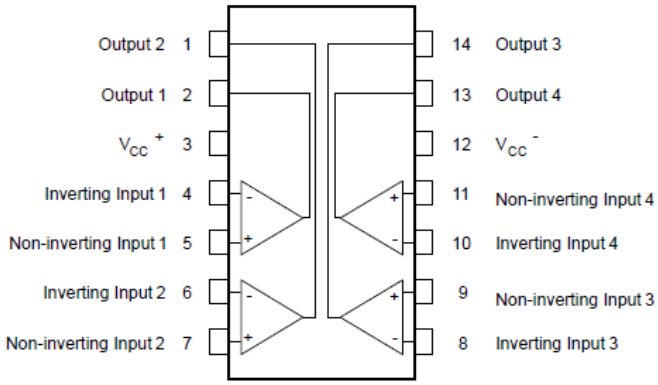
0339



0124, 0924, V994



UY43


Output 2 1
Output 1 2
V_{CC}^{+} 3
Inverting Input 1 4
Non-inverting Input 1 5
Inverting Input 2 6
Non-inverting Input 2 7
14 Output 3
13 Output 4
12 V_{CC}^{-}
11 Non-inverting Input 4
10 Inverting Input 4
9 Non-inverting Input 3
8 Inverting Input 3

6.2 Tests Description

Test name	Description	Purpose
Die Oriented		
HTOL High Temperature Operating Life **HTB** High Temperature Bias	The device is stressed in static or dynamic configuration, approaching the operative max. absolute ratings in terms of junction temperature and bias condition.	To determine the effects of bias conditions and temperature on solid state devices over time. It simulates the devices' operating condition in an accelerated way. The typical failure modes are related to, silicon degradation, wire-bonds degradation, oxide faults.
HTRB High Temperature Reverse Bias **HTFB / HTGB** High Temperature Forward (Gate) Bias	The device is stressed in static configuration, trying to satisfy as much as possible the following conditions: low power dissipation; max. supply voltage compatible with diffusion process and internal circuitry limitations;	To determine the effects of bias conditions and temperature on solid state devices over time. It simulates the devices' operating condition in an accelerated way. To maximize the electrical field across either reverse-biased junctions or dielectric layers, in order to investigate the failure modes linked to mobile contamination, oxide ageing, layout sensitivity to surface effects.
HTSL High Temperature Storage Life	The device is stored in unbiased condition at the max. temperature allowed by the package materials, sometimes higher than the max. operative temperature.	To investigate the failure mechanisms activated by high temperature, typically wire-bonds solder joint ageing, data retention faults, metal stress-voiding.
ELFR Early Life Failure Rate	The device is stressed in biased conditions at the max junction temperature.	To evaluate the defects inducing failure in early life.
Package Oriented		
PC Preconditioning	The device is submitted to a typical temperature profile used for surface mounting devices, after a controlled moisture absorption.	As stand-alone test: to investigate the moisture sensitivity level. As preconditioning before other reliability tests: to verify that the surface mounting stress does not impact on the subsequent reliability performance. The typical failure modes are "pop corn" effect and delamination.
AC Auto Clave (Pressure Pot)	The device is stored in saturated steam, at fixed and controlled conditions of pressure and temperature.	To investigate corrosion phenomena affecting die or package materials, related to chemical contamination and package hermeticity.
TC Temperature Cycling	The device is submitted to cycled temperature excursions, between a hot and a cold chamber in air atmosphere.	To investigate failure modes related to the thermo-mechanical stress induced by the different thermal expansion of the materials interacting in the die-package system. Typical failure modes are linked to metal displacement, dielectric cracking, molding compound delamination, wire-bonds failure, die-attach layer degradation.

Test name	Description	Purpose
TF / IOL Thermal Fatigue / Intermittent Operating Life	The device is submitted to cycled temperature excursions generated by power cycles (ON/OFF) at T ambient.	To investigate failure modes related to the thermo-mechanical stress induced by the different thermal expansion of the materials interacting in the die-package system. Typical failure modes are linked to metal displacement, dielectric cracking, molding compound delamination, wire-bonds failure, die-attach layer degradation.
THB Temperature Humidity Bias	The device is biased in static configuration minimizing its internal power dissipation, and stored at controlled conditions of ambient temperature and relative humidity.	To evaluate the package moisture resistance with electrical field applied, both electrolytic and galvanic corrosion are put in evidence.
Other		
ESD Electro Static Discharge	The device is submitted to a high voltage peak on all his pins simulating ESD stress according to different simulation models. CBM: Charged Device Model HBM: Human Body Model MM: Machine Model	To classify the device according to his susceptibility to damage or degradation by exposure to electrostatic discharge.
LU Latch-Up	The device is submitted to a direct current forced/sunk into the input/output pins. Removing the direct current no change in the supply current must be observed.	To verify the presence of bulk parasitic effect inducing latch-up.

ANNEX 1 Preliminar results

Bonding Strength a T0

Bond shear test

	UY43	V994	E125
Ball shear average (g)	44.2	41.1	42.6
Ball shear Min (g)	40.7	39	40.2
Ball shear Max (g)	47.7	43.4	45.8
Cpk	2.06	4.54	3.12
Failure mode	OK	OK	OK

Pull Test

	UY43	V994	E125
Pull test average (g)	12.3	13.2	11.7
Pull Test Min (g)	10.1	10.7	9.4
Pull test Max (g)	14.8	14.9	13.8
Cpk	2.16	2.74	2.24
Failure mode	OK	OK	OK