PRODUCT/PROCESS
CHANGE NOTIFICATION

PCN AMS/20/12302

Analog, MEMS & Sensors (AMS)

New material set in ST Bouskoura for General Purpose Analog products in TSSOP8 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 TSSOP8 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 will 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 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	 **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 Q3/2020 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	*0158, 0393, 0922 , 1022, 3702*
Product Description	Low power Dual op amp bipolar, Low power Dual comparator bipolar, Rail to rail Dual op amp, biCMOS, Current sense amplifier
P/N	*LM2904PT, LM2903PT, TS922IPT, TSC1021IPT, TS3702IPT*
Product Group	*AMS*
Product division	*General Purpose Analog &RF*
Package	*TSSOP8*
Silicon Process technology	*Bipolar, , HF2CMOS, BCD3S, HC1PA*

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

TABLE OF CONTENTS

1 APPLICABLE AND REFERENCE DOCUMENTS

Document reference	Short description
JESD47	Stress-Test-Driven Qualification of Integrated Circuits

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 TSSOP8 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

LM2904PT

life.augmented

LM2904, LM2904A
LM2904W, LM2904AW
Datasheet

Low-power dual operational amplifier

Features

- Frequency compensation implemented internally
- Large DC voltage gain: 100 dB
- Wide bandwidth (unity gain): 1.1 MHz (temperature compensated)
- Very low supply current/amplifier, essentially independent of supply voltage
- Low input bias current: 20 nA (temperature compensated)
- Low input offset current: 2 nA
- Input common-mode voltage range includes negative rail
- Differential input voltage range equal to the power supply voltage
- Large output voltage swing 0 V to [(V_{CC} +) -1.5 V]

Description

This circuit consists of two independent, high gain operational amplifiers (op amps) that have frequency compensation implemented internally. They are designed specifically for automotive and industrial control systems. The circuit operates from a single power supply over a wide range of voltages. The low power supply drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, DC gain blocks and all the conventional op amp circuits which can now be more easily implemented in single power supply systems. For example, these circuits can be directly supplied from the standard 5 V which is used in logic systems and easily provides the required electronic interfaces without requiring any additional power supply.

In linear mode, the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from a single power supply.

Maturity status link		
	Enhanced V_{IO}	Enhanced ESD
LM2904		
LM2904A	✓	
LM2904W		✓
LM2904AW	✓	✓

Related products	
TSB572	Dual op-amps for low-power consumption (380 µA with 2.5 MHz GBP)
LM2902 LM2902W	Quad op-amps version
LM2904WH LM2904AH	High temperature version (150 °C)

LM2903PT,

life.augmented

LM2903

Low-power dual voltage comparator

Datasheet - production data

D
SO8
(plastic micropackage)

S
MiniSO8
(plastic micropackage)

P
TSSOP8
(thin shrink small outline package)

DFN8 2x2 mm
(plastic micropackage)

Related products

- See the LM2903W for similar devices with higher ESD performances
- See the LM2903H for similar devices with operating temperature up to 150 °C

Description

This device consists of two independent low-power voltage comparators designed specifically to operate from a single supply over a wide range of voltages. Operation from split power supplies is also possible.

In addition, the device has a unique characteristic in that the input common-mode voltage range includes the negative rail even though operated from a single power supply voltage.

Features

- Wide single supply voltage range or dual supplies +2 V to +36 V or ±1 V to ±18 V
- Very low supply current (0.4 mA) independent of supply voltage (1 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
- Automotive qualification

TS922IPT

life.augmented

TS922, TS922A

Datasheet

Rail-to-rail, high output current, dual operational amplifier

Flip-chip with backcoating

SO8

TSSOP8

Product status link
TS922 and TS922A

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 V/µs
- Operating from 2.7 to 12 V
- Low input offset voltage: 900 µV max. (TS922A)
- ESD internal protection: 2 kV
- Latch-up immunity

Applications

- Line drivers and actuator drivers
- Portable speakers
- Instrumentation with low noise as key factor
- Multimedia systems and portable equipments

Description

The TS922 and the TS922A devices are rail-to-rail dual BiCMOS operational amplifiers optimized and fully specified for 3 V and 5 V operations. These devices have high output currents which allow low-load impedances to be driven.

Very low noise, low distortion, low offset, and a high output current capability make these devices an excellent choice for high quality, low voltage, or battery operated audio systems.

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

TSC1021IPT

life.augmented

TSC1021

High-side current sense amplifier

Datasheet - production data

TSSOP8

Related products

- See TSC103 for higher common-mode operating range (2.9 V to 70 V)

Applications

- Automotive current monitoring
- Notebook computers
- Server power supplies
- Telecom equipment
- Industrial SMPS
- Current sharing
- LED current measurement

Features

- Wide common-mode operating range independent of supply: 2.8 V to 30 V
- Wide common-mode survival range: -32 V to 60 V (reversed battery and load-dump conditions)
- Maximum input offset voltage:
  - ±1.5 mV for T_{amb} = 25 °C
  - ±2.3 mV for -40 °C < T_{amb} < 125 °C
- Maximum total output voltage error:
  - ±1.5 % for T_{amb} = 25 °C
  - ±2.5 % for -40 °C < T_{amb} < 125 °C
- Maximum variation over temperature:
  - dV_{os}/dT = 8 µV/°C
  - dV_{out}/dT = 100 ppm/°C
- Low current consumption: I_{CC} max = 300 µA
- -40 °C to 125 °C operating temperature range
- Internally fixed gain: 20 V/V, 50 V/V
- EMI filtering

Description

The TSC1021 measures a small differential voltage on a high-side shunt resistor and translates it into a ground-referenced output voltage.

The TSC1021 has been specifically designed for automotive conditions: load-dump protection up to 60 V, reverse-battery protection up to -32 V, ESD protection up to 4 kV and internal filtering for EMI performance.

Input common-mode and power supply voltages are independent: the common-mode voltage can range from 2.8 to 30 V in operating conditions and up to 60 V in absolute maximum ratings while the TSC1021 can be supplied by a 5 V independent supply line.

The TSC1021 is housed in a tiny TSSOP8 package and integrates a buffer that provides low impedance output to ease interfacing and avoid accuracy losses. The overall device current consumption is lower than 300 µA.

TSX3702IPT

TS3702

Micropower dual CMOS voltage comparators

Features

- Push-pull CMOS output (no external pull-up resistor required)
- Extremely low supply current: 9µA typ / comparator
- Wide single supply range: 2.7V to 16V or dual supplies (±1.35V to ±8V)
- Extremely low input bias current: 1pA typ
- Extremely low input offset currents: 1pA typ
- Input common-mode voltage range includes GND
- High input impedance: $10^{12}\Omega$ typ
- Fast response time: 2µs typ for 5mV overdrive
- Pin-to-pin and functionally compatible with bipolar LM393

Description

The TS3702 is a micropower CMOS dual voltage comparator with extremely low consumption of 9µA typ / comparator (20 times less than bipolar LM393). The push-pull CMOS output stage allows power and space saving by eliminating the external pull-up resistor required by usual open-collector output comparators.

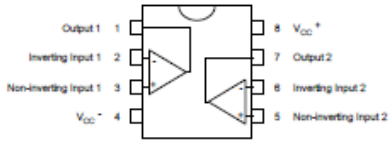
Thus response times remain similar to the LM393.

N
DIP8
(Plastic package)

D
SO8
(Plastic micropackage)

P
TSSOP8
(Thin shrink small outline package)

Pin connections
(Top view)



4.2 Construction note

	P/N *LM2904PT*	P/N *LM2903PT*	P/N TS922IPT	P/N TSC1021IAIPT	P/N TS3702IPT
Wafer/Die fab. information					
Wafer fab manufacturing location	ST Singapore	ST Singapore	ST Singapore	ST Singapore	ST Singapore
Technology	Bipolar	Bipolar	HF2CMOS	BCD3S	HC1PA
Die finishing back side	RAW SILICON	RAW SILICON	RAW SILICON	RAW SILICON	RAW SILICON
Die size (microns)	1070x1010µm²	950x870µm²	1720x1190µm²	1280x1750µm²	1366x1136µm²
Bond pad metallization layers	AlSiCu	AlSiCu	AlSiCu	AlSiCu	AlSi
Passivation type	Nitride	Nitride	P-VAPOX/NITRIDE	USG-PSG-SiON-PIX	HDP/TEOS/SiN/Polyimide
Wafer Testing (EWS) information					
Electrical testing manufacturing location	ST Singapore	ST Singapore	ST Singapore	ST Singapore	ST Singapore
Assembly information					
Assembly site	ST Bouskoura	ST Bouskoura	ST Bouskoura	ST Bouskoura	ST Bouskoura
Package description	TSSOP8	TSSOP8	TSSOP8	TSSOP8	TSSOP8
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

5 TESTS PLAN SUMMARY

5.1 Test vehicle

Lot #	Process/ Package	Product Line	Comments
1	Bipolar/TSSOP8	0158	
2	Bipolar/TSSOP8	0393	
3	HF2CMOS/TSSOP8	0922	
4	BCD3S/TSSOP8	1022	
5	HC1PA/TSSOP8	3702	

5.2 Test plan and results summary

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS					Note
						Lot 1 0158	Lot 2 0393	Lot3 0922	Lot 4 1022	Lot5 3702	
HTB/ HTOL	N	JESD22 A-108	Ta = 150°C or 125°C, BIAS		168 H	77	77	77	77	77	
					1000 H	77	77	77	77	77	
ELFR	N	JESD22 A-008	Ta = 125°C, BIAS			800		800	800	800	
HTSL	N	JESD22 A-103	Ta = 150°C		168 H	77	77	77	77	77	
					500 H	77	77	77	77	77	
					1000 H	77	77	77	77	77	
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	Below sample + 22units	Below sample + 22units	
AC	Y	JESD22 A-102	Pa=2Atm / Ta=121°C		96 H	77	77	77	77	77	
TC	Y	JESD22 A-104	Ta = -65°C to 150°C		100 cy	77	77	77	77	77	
					200 cy	77	77	77	77	77	
					500 cy	77	77	77	77	77	
					1000cy	77	77	77			
THB	Y	JESD22 A-101	Ta = 85°C, RH = 85%, BIAS		168 H	77		77	77	77	
					500 H	77		77	77	77	
					1000 H	77		77	77	77	
Other Tests											
ESD	N	AEC Q101-001, 002 and 005	CDM								
						3	3	3	3	3	
SD	N		After ageing 8h and 16h			X	X	X			
WBS	N		Wire bond Shear			X	X	X			
WBP	N		Wire bond Pull			X	X	X			
PD	N		Physical dimension			X	X	X			
ED	N		Electrical distribution			X	X	X			

This qualification is following the TSSOP14 PCN AMS/20/12117 on which we implemented the same changes. See below the results already available for TSSOP14

5.3 Test vehicle

Lot #	Process/ Package	Product Line	Comments
1	Bipolar/TSSOP14	0124	CZ01308ARQ CZ01302CRR
2	HF5CMOS/TSSOP14	V994	CZ9510KTRF CZ9510KTRG
3	HVG8A/TSSOP14	UY43	CZ9510KURL, CZ9510KURN

5.4 Test plan and results summary

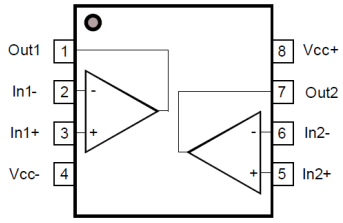
Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS					Note
						Lot 1 0124	Lot 4 V994	Lot5 UY43			
HTB/ HTOL	N	JESD22 A-108	Ta = 150°C or 125°C, BIAS		168 H	0/77	0/77	0/77			
					500 H	0/77	0/77	0/77			
					1000 H	0/77	0/77	0/77			
HTSL	N	JESD22 A-103	Ta = 150°C		168 H	0/50			2x0/50	2x0/50	
					500 H	0/50			2x0/50	2x0/50	
					1000 H	0/50			2x0/50	2x0/50	
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	PASS	PASS	PASS			
AC/ UHAST	Y	JESD22 A-102	Pa=2Atm / Ta=121°C		96 H	2x0/77	2x0/77	2x0/77			
TC	Y	JESD22 A-104	Ta = -65°C to 150°C		100 cy	0/77	2x0/77	2x0/77			
					500 cy	0/77	2x0/77	2x0/77			
					1000cy	0/77	2x0/77	2x77			
THB	Y	JESD22 A-101	Ta = 85°C, RH = 85%, BIAS		168 H	0/77	0/77	0/77			
					500 H	0/77	0/77	0/77			
					1000 H	70/7	0/77	0/77			

6 ANNEXES

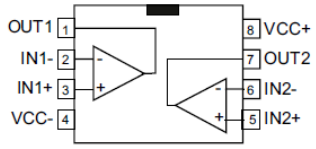
6.1 Device details

6.1.1 Pin connection

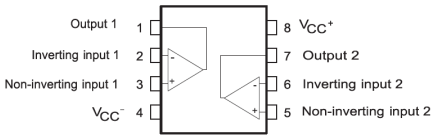
LM2904



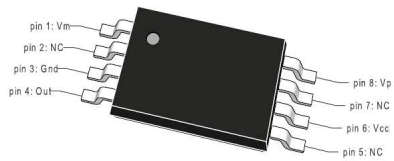
LM2903



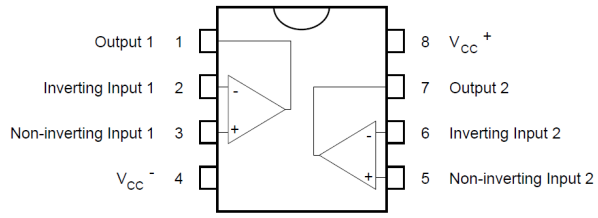
TS922



TSC1021



TS3702



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

	0158
Ball shear average (g)	38.2
Ball shear Min (g)	34.9
Ball shear Max (g)	40.4
Cpk	3.32
Failure mode	OK

Pull Test

	0158
Pull test average (g)	14.7
Pull Test Min (g)	11.4
Pull test Max (g)	16.3
Cpk	3.31
Failure mode	OK