



Signal conditioning

TSV6xx series



www.BDTIC.com/ST

Sensors, MCUs and ST op-amps

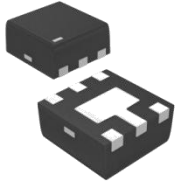
- ST is #1 in MEMS sensors
- ST's STM32 family is a top-selling ARM Cortex-M MCU series
- Leader in industry-standard op-amps, ST is enlarging its portfolio towards higher performance amplifiers focusing on low power, high precision and tiny packages

ST op-amps enhance the signal chain



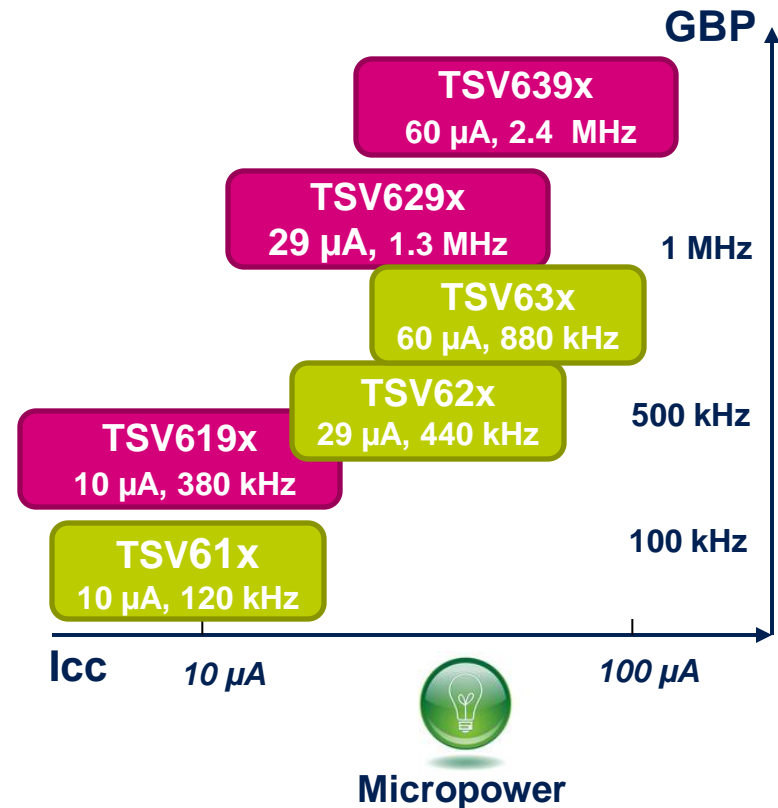
ST op-amps provide the perfect fit between our sensors and microcontrollers

TSV6x series: micropower op-amps



Zero trade-offs and easy-to-design micropower op-amps, ideal for small signal conditioning

- Ultra low supply voltage: V_{CC} min 1.5 V
- Standby current: I_{CC} 5 nA typ
- Micropower and high merit factor
- Lower offset with $V_{IO} = 500 \mu V$
- Low input bias current: $i_{lib} = 1 \text{ pA}$
- Space saving DFN8 2 x 2 mm for dual
- Higher ESD protection: 4 kV



TSV6x series: main parameters

Parameters	TSV61x TSV619x	TSV62x TSV629x	TSV63x TSV639x
Ultra-low V_{CC}	1.5 to 5.5 V		
Tiny packages	DFN6/8-SC70-5/6, SOT23-5/6/8, MSO8/10, SO-8, TSSOP14/16		
Low V_{IO}	1 mV max	Down to 500 μV max TSV6xA	
I_{stby} typ	-	5 nA	
I_{CC} typ, μ A	10	29	60
GBP typ, kHz	120/450	420/1300	880/2500
Temperature range	-40 to +85 °C	-40 to +125 °C	
Design robustness	-	EMI hardened (dual and quad)	
	High ESD tolerance (\geq 4 kV HBM)		

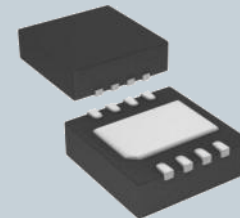
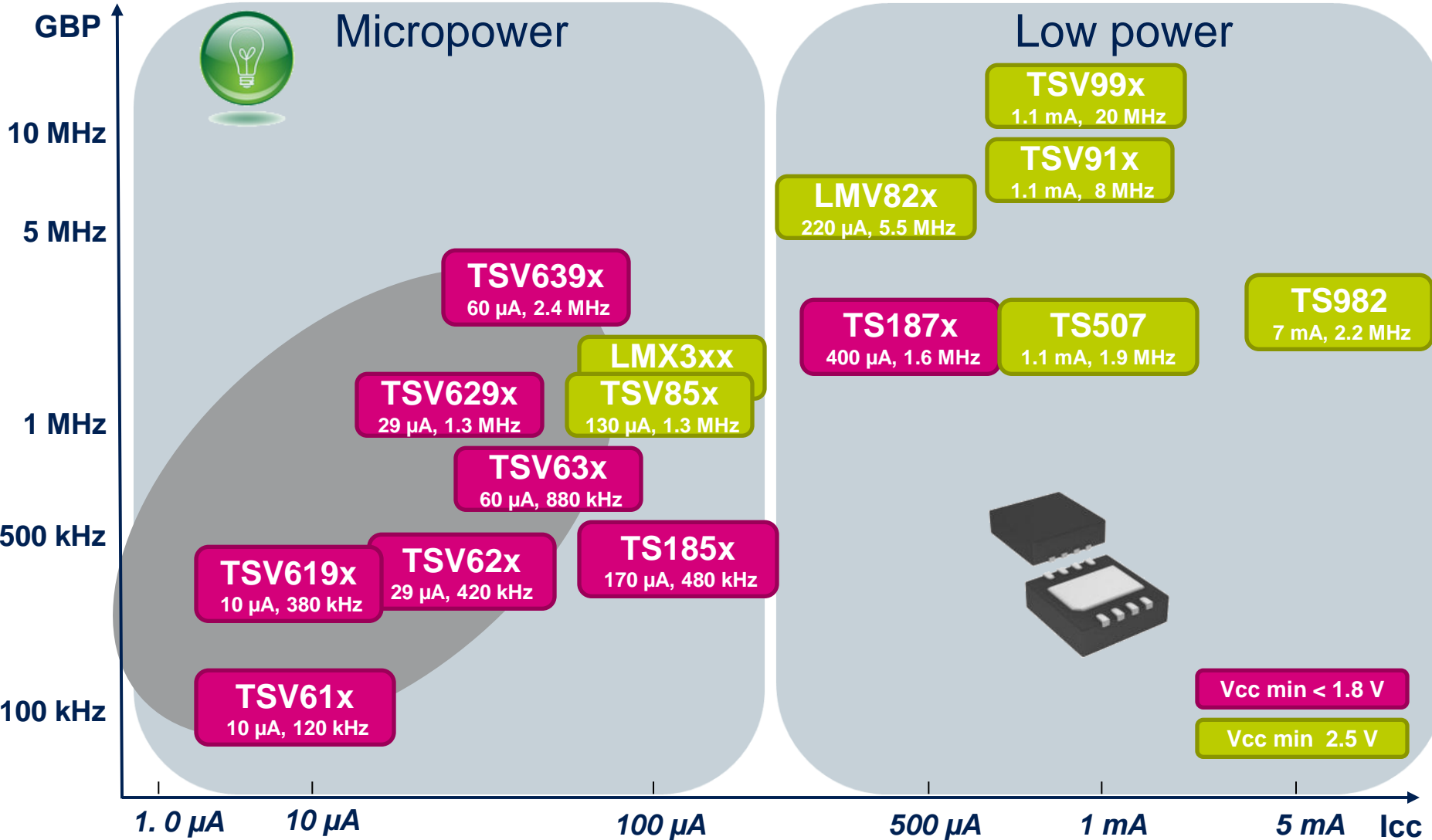
TSV6x series combines micropower features
with zero trade-offs in performance

ST op-amps portfolio: low-voltage (max 6 V)



Micropower

Low power



V_{cc} min < 1.8 V
 V_{cc} min 2.5 V

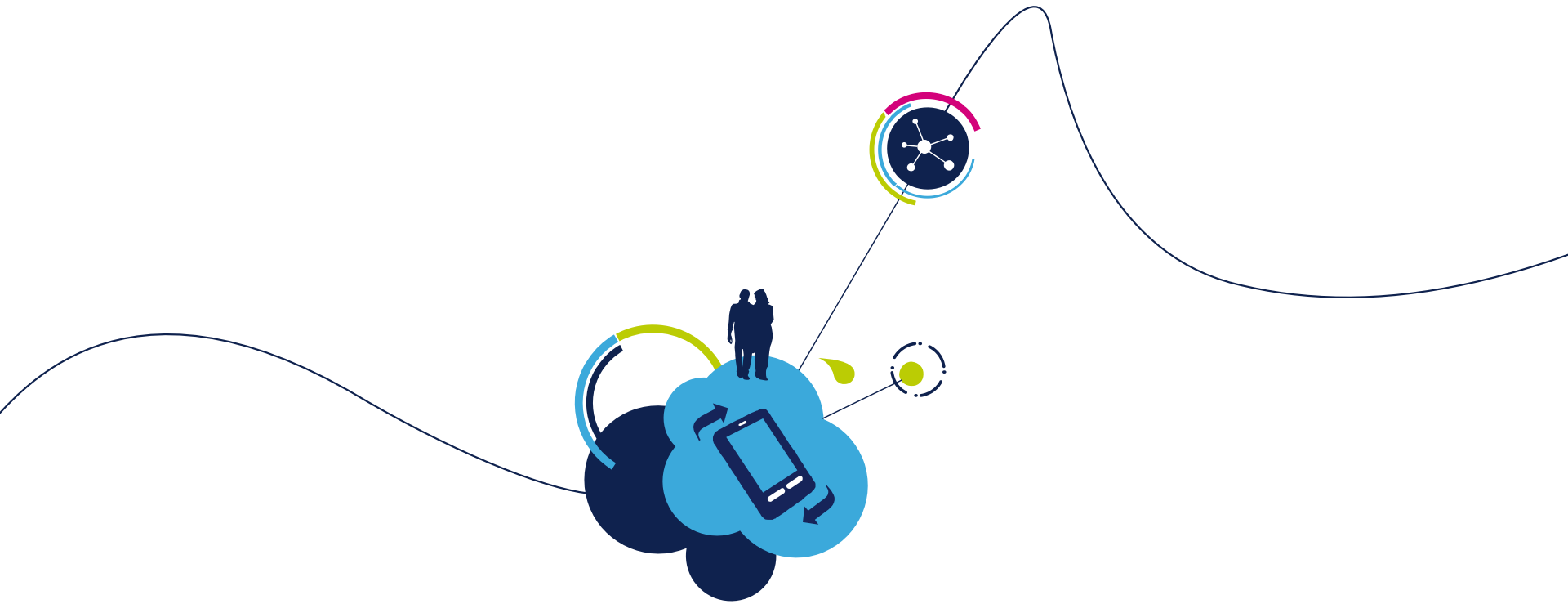
TSV6x product table

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Product	# channels	Supply voltage (V)		V_{IO} max (mV)	I_{ib} max (pA)	I_{cc} max (μ A)	GBP typ (MHz)	Slew rate typ (V/ μ s)	Stability gain	Standby
		min	max							
TSV611/2	1,2	1.5	5.5	4/0.8	10	15	0.12	0.034	≥ 1	No
TSV620/3/5	1,2,4	1.5	5.5	4/0.8	10	36	0.42	0.14	≥ 1	Yes
TSV621/2/4	1,2,4	1.5	5.5	4/0.8	10	36	0.42	0.14	≥ 1	No
TSV6191/2	1,2	1.5	5.5	4/0.8	10	15	0.45	0.07	≥ 10	No
TSV630/3/5	1,2,4	1.5	5.5	3/0.5/0.8	10	69	0.88	0.34	≥ 1	Yes
TSV631/2/4	1,2,4	1.5	5.5	3/0.5/0.8	10	69	0.88	0.34	≥ 1	No
TSV6290/3/5	1,2,4	1.5	5.5	4/0.8	10	36	1.3	0.35	≥ 4	Yes
TSV6291/2/4	1,2,4	1.5	5.5	4/0.8	10	36	1.3	0.35	≥ 4	No
TSV6390/3/5	1,2,4	1.5	5.5	3/0.5/0.8	10	69	2.5	0.7	≥ 4	Yes
TSV6391/2/4	1,2,4	1.5	5.5	3/0.5/0.8	10	69	2.5	0.7	≥ 4	No

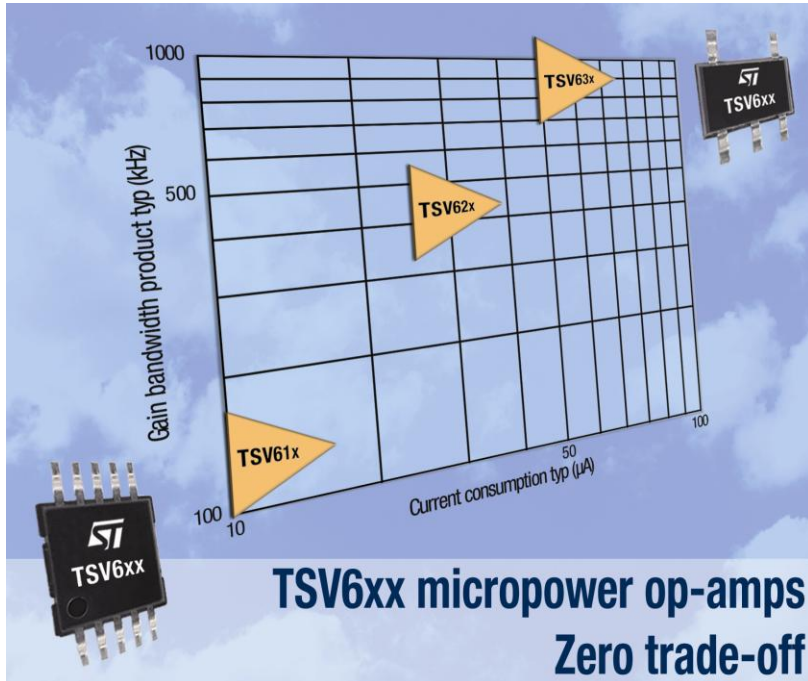
Main advantages of TSV6x

	ST offering	Competition
Parameter	TSV6 series	Various competitors
V_{OS} max (μV)	500/800 μV	4 mV range
I_q max (μA)	Smaller dispersion I _{CC} max – I _{CC} min	
Operating voltage range (V)	1.5 to 5.5	1.8 to 5.5
Shutdown pin	Yes (option)	Most competitors do not have standby
ESD performance	4 kV HBM	2 kV HBM
Package	DFN and QFN	Traditional



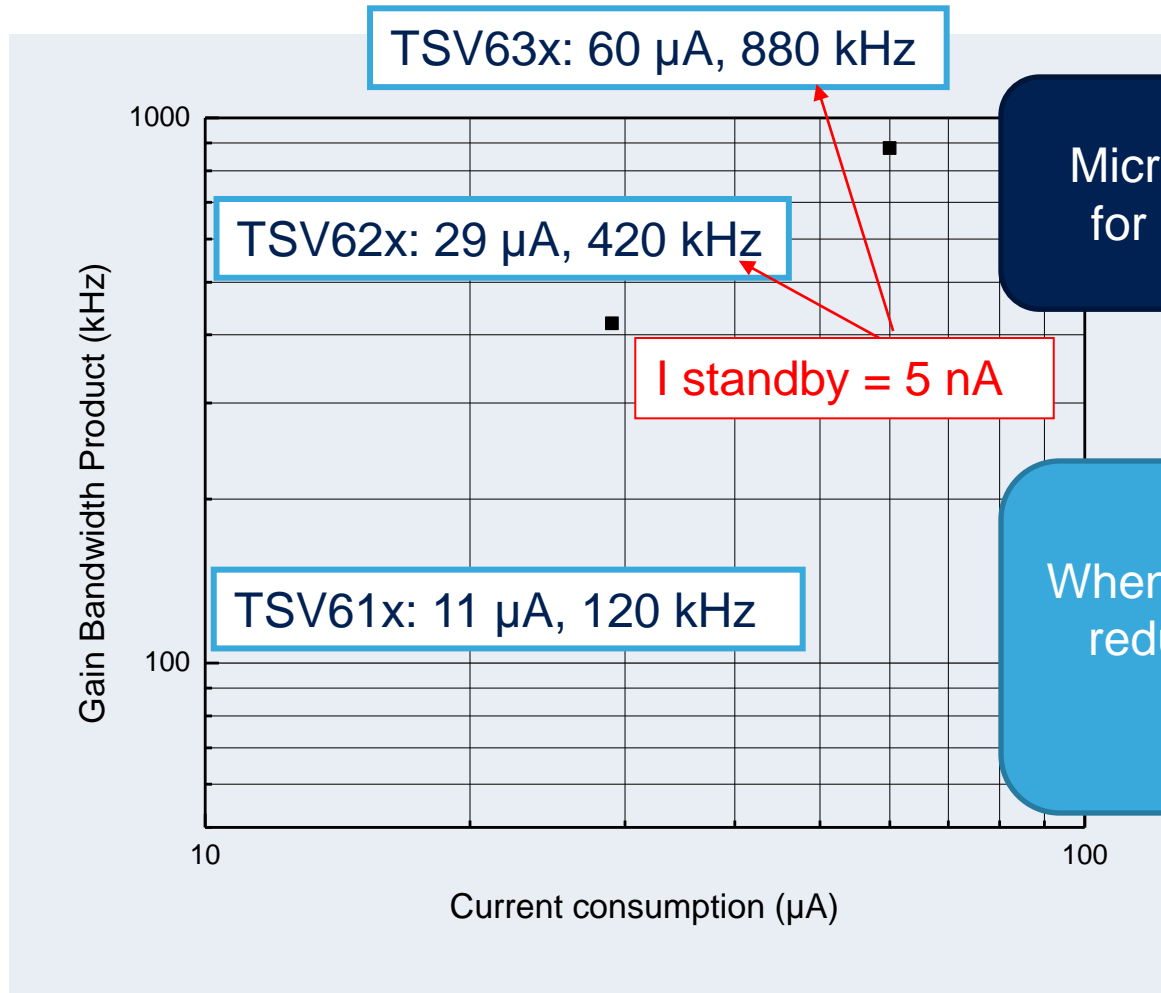
Technical overview of TSV6x series

New micropower op-amps TSV6xx series



Perfect for power-conscious applications
Zero trade-offs in performance

TSV6xx micropower features



Micropower consumption ideal for battery-powered systems

When not in use, consumption is reduced to 5 nA, which limits battery discharge

Zero trade-offs in supply voltage range

- TSV6x series operate from 5.5 V down to 1.5 V
- When battery is discharged or close to end of life, its supply voltage drops below 1.8 V, but the TSV6x still continues operating

Extended battery lifetime
Environmentally friendly

Zero trade-offs in dynamic range

- Rail-to-rail input
 - Input common mode voltage extends to 100 mV beyond power rails

- Rail-to-rail output
 - Output voltage can go up to 35 mV max from rails

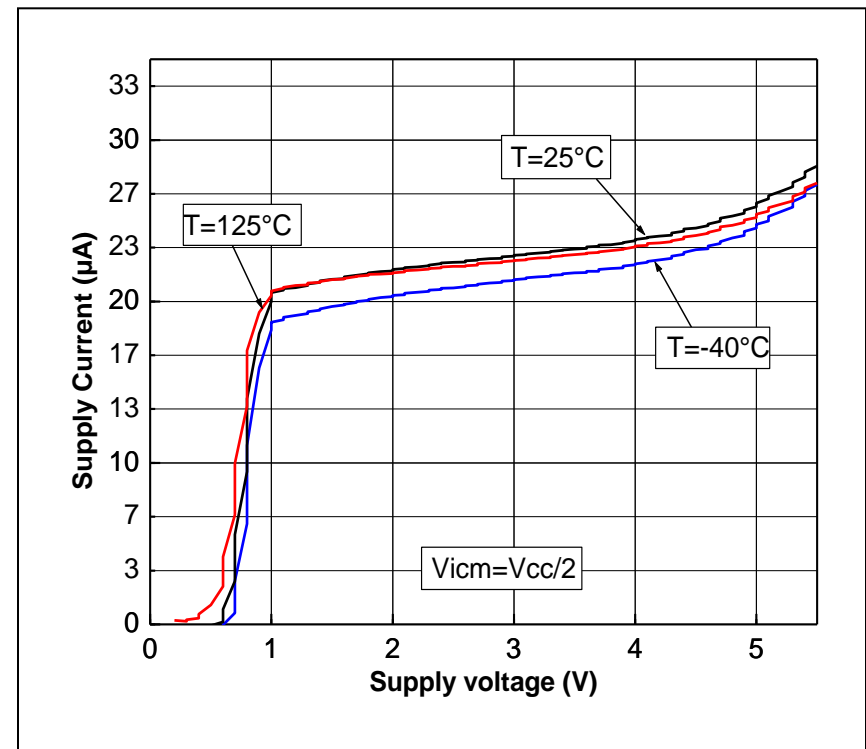
Dynamic range optimization mandatory for ultra-low supply voltage operation

Zero trade-offs in consumption variation

- Good behavior versus supply voltage
- Good behavior versus temperature

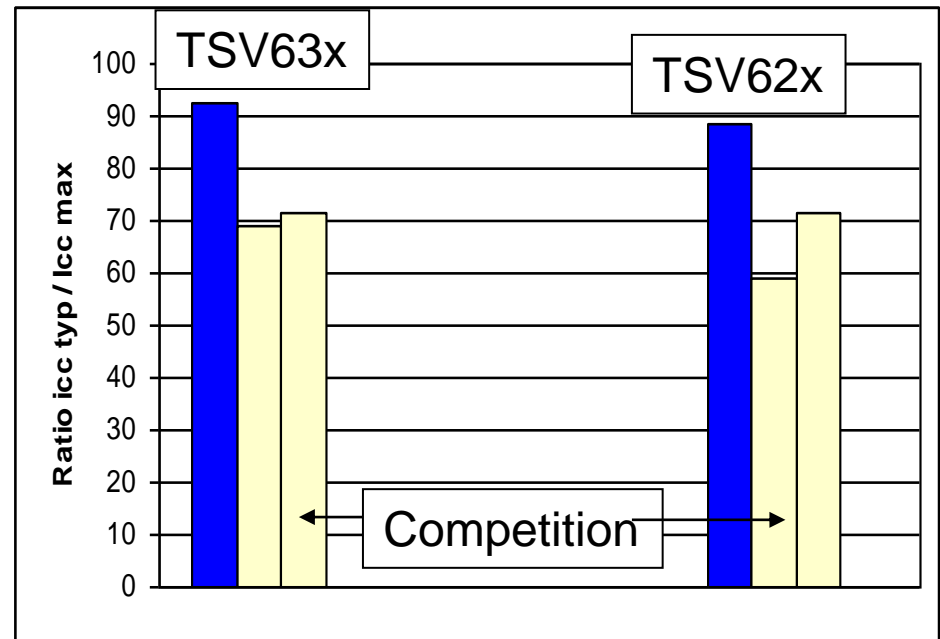
Performances not affected by battery discharge or temperature variations

TSV62x



Zero trade-offs in parameter dispersion

- TSV62x and TSV63x quiescent current is internally adjusted to reduce I_{CC} spread



Better control of quiescent current provides better control of GBP
Poor control of GBP may lead to lower stability or lower bandwidth
and could lead to application issues

Zero trade-offs in merit factor

- Better bandwidth to current consumption ratio

	I _{cc} (μ A) Max (5 V)	GBP (kHz) Typ	Slew rate (V/ μ s) Min	Slew rate (V/ μ s) Max
TSV61x	15	120		0.034
TSV62x	36	420	0.11	0.14
TSV63x	70	880	0.25	0.34

Ideal for all applications for which current consumption is crucial, such as battery-powered devices or security equipment

Zero trade-offs in precision

- Input offset voltage internally adjusted
 - TSV6xx: down to 500 μV max

Reduced offset error ($G_{\text{DC}} * V_{\text{io}}$) for precision-demanding applications

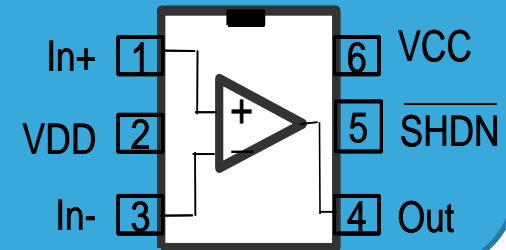
- CMOS input
 - Low input bias current:
1 pA typ, 10 pA max

Reduced error due to bias current
($I_{\text{ib}} * R_{\text{f}}$)

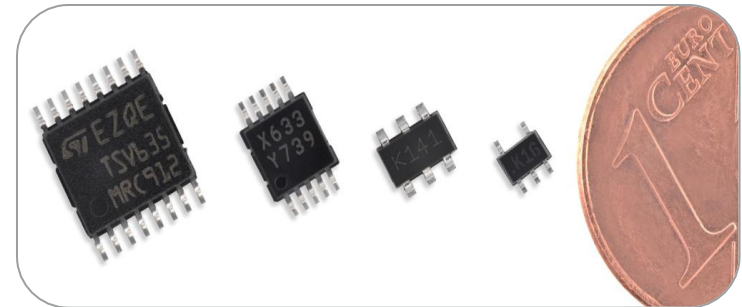
Ideal for applications requiring precision

Zero trade-offs in size

- TSV6xx op-amps offered in a large choice of micro-packages
 - Single: SC70-5/6, SOT23-5/6
 - Dual: DFN, SOT23-8, MSO-8/10, SO-8
 - Quad: QFN, TSSOP14/16



Micro-packages are ideal for board space saving



Zero trade-offs in design robustness

- Good EMI rejection ratio

Conditions for TSV62x, TSV63x	EMIRR typ dB
$V_{RF} = 100 \text{ mV}_{RMS}$ $f = 400 \text{ MHz}$	61
$V_{RF} = 100 \text{ mV}_{RMS}$ $f = 900 \text{ MHz}$	85
$V_{RF} = 100 \text{ mV}_{RMS}$ $f = 1800 \text{ MHz}$	92
$V_{RF} = 100 \text{ mV}_{RMS}$ $f = 2400 \text{ MHz}$	83

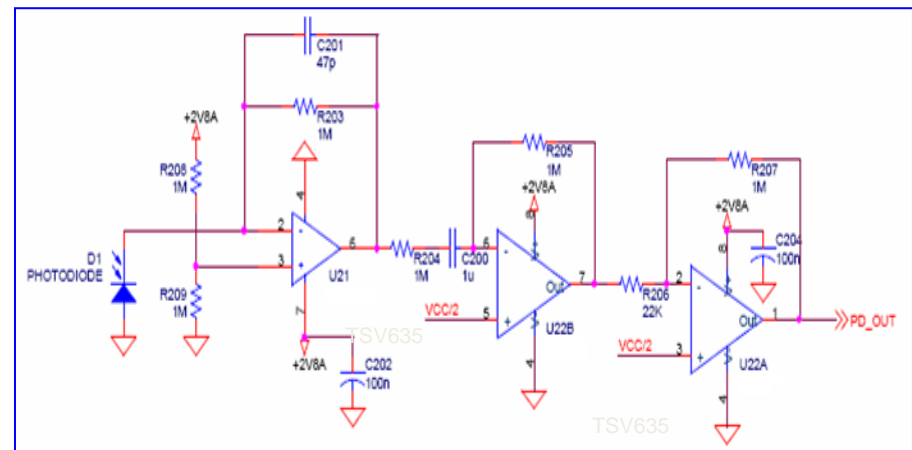
- High tolerance to ESD: $\geq 4\text{kV}$ HBM

- Main parameters guaranteed over extended temperature range for TSV62x and TSV63x: -40 to $+125$ °C

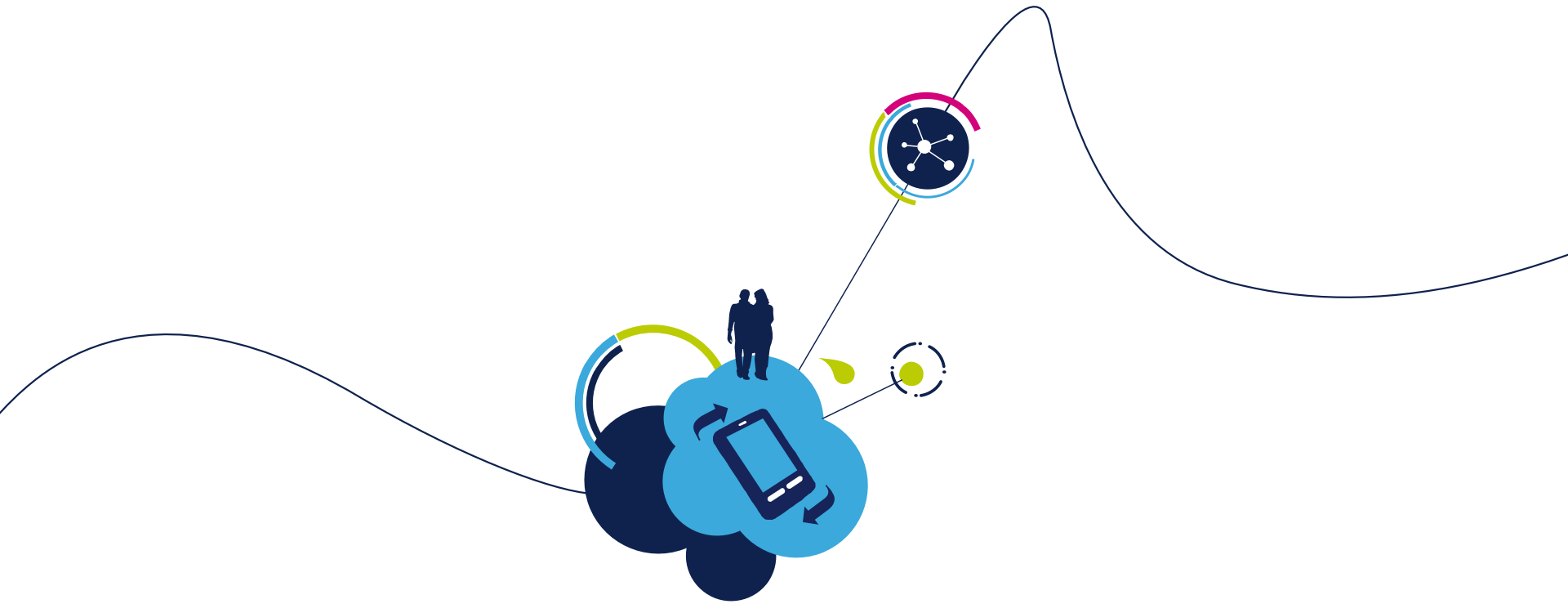
Robust design, high reliability

- Battery-powered and portable applications:
 - Glucose meters, instrumentation, consumer devices
- Low-side current sensing
- Security, alarms, smoke detectors
- Signal conditioning, filtering

Signal conditioning: example



TSV635



Application examples

Key parameters

Minimum supply voltage

Low power consumption

Small package

ST solution

V_{CC} min
1.5 V

$I_{CC} < 70 \mu A$
Shutdown mode
(< 60 nA)

Mini SO-8
Mini SO-10

Customer advantage


Battery powered applications

Longer battery life

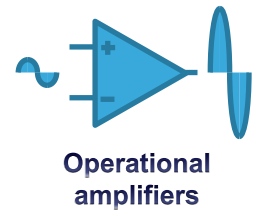
Reduced form factor



Chemical sensor
signal conditioning



TSV632IST
TSV633IST





Signal conditioning

Key parameters

Minimum supply voltage

Low power consumption

Small package

ST solution

$V_{CC\ min}$
1.5 V

$I_{CC} < 70\ \mu A$
Shutdown mode
($< 60\ nA$)

MiniSO-10

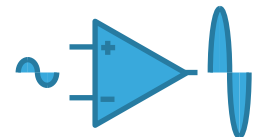
Customer advantage

Battery powered applications

Longer battery life

Reduced form factor

TSV633IST

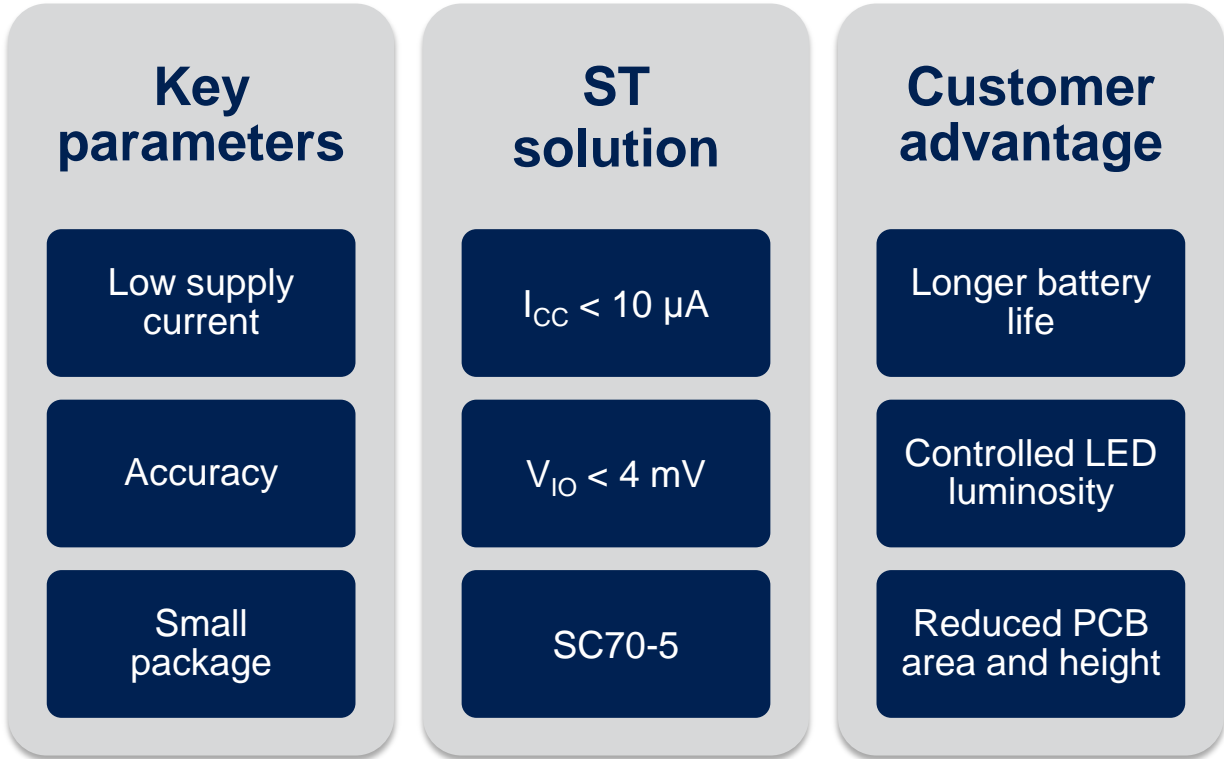


Operational amplifiers

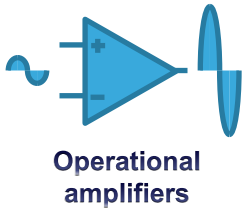
LED light for e-readers



LED current measurement



TSV611ICT



Operational amplifiers

Optical image stabilization

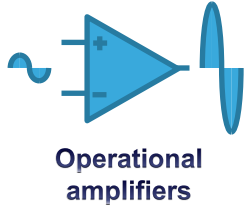


Hall sensor feedback loop

Key parameters	ST solution	Customer advantage
Wide bandwidth	GBP 1 MHz	Fast correction
Low supply current	$I_{CC} < 60 \mu A$	Longer battery life
Small package	DFN8 2 x 2	Reduced PCB area



TSV632IQ2T



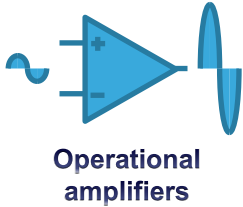
Handheld device sensor conditioning



Sensor signal conditioning

Key parameters	ST solution	Customer advantage
Minimum supply voltage	$V_{CC\ min} = 1.5\ V$	Battery powered applications
Low power consumption	$I_{CC} < 60\ \mu A$	Longer battery life
Small package	SC70-5	Reduced form factor

TSV611ICT





Shock and rotational vibration sensor signal conditioning

Key parameters

Wide bandwidth

Low supply current

Small package

ST solution

GBP 1~8 MHz

I_{CC} 70~820 μA

SC70-5
SOT23-5

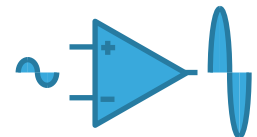
Customer advantage

Fast detection

Lower power consumption

Reduced PCB area

TSV631ICT
TSV911RILT



Operational amplifiers



Temperature control and proportional-integral regulator

Key parameters

Accuracy

Low supply current

Small package

ST solution

$V_{IO} < 800 \mu V$

$I_{CC} < 70 \mu A$

SOT23-8

Customer advantage

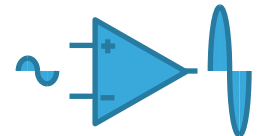
No production trimming

Reduced power consumption over lifetime

Reduced PCB area



TSV632AILT



Operational amplifiers



Electrochemical signal conditioning

Key parameters

Low input bias current

Accuracy

Low supply current

ST solution

CMOS input
 $I_{IB} < 10 \text{ pA}$

$V_{IO} < 800 \text{ } \mu\text{V}$

$I_{CC} < 30 \text{ } \mu\text{A}$

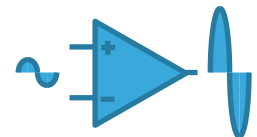
Customer advantage

Compatible with high-impedance sensor

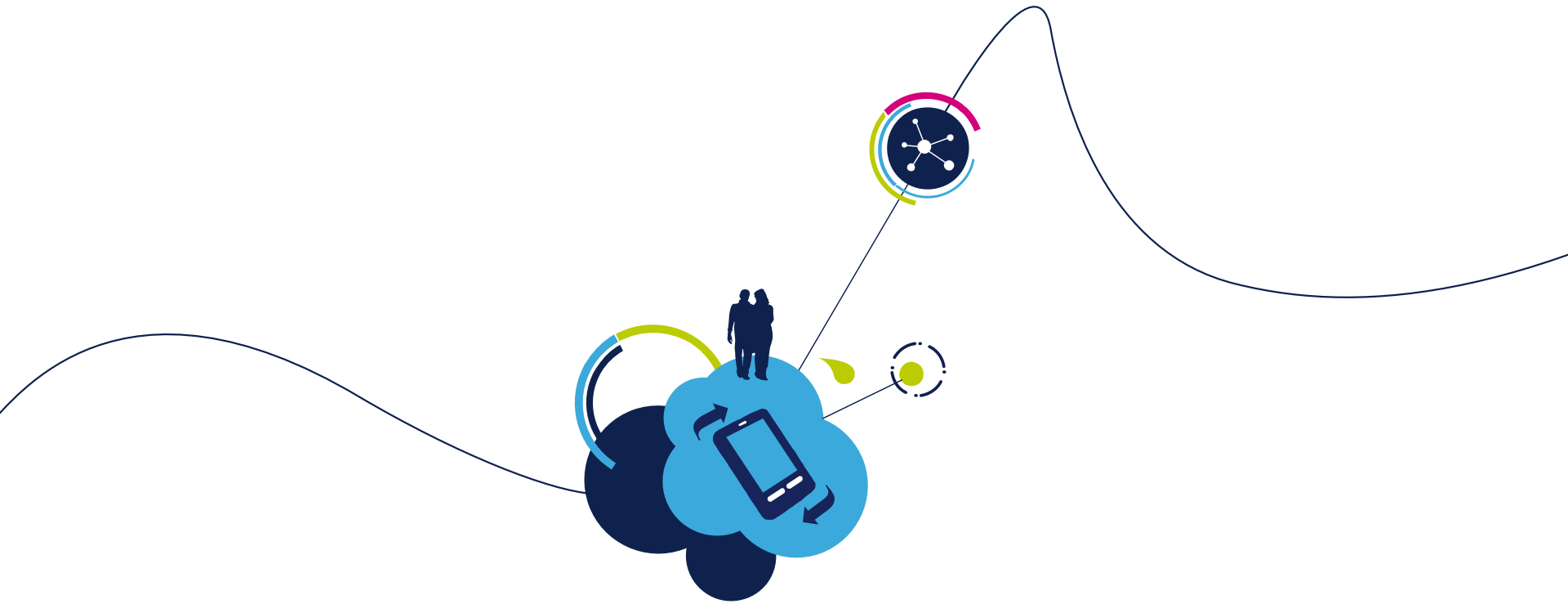
Accurate detection, no trimming

Energy saving over application lifetime

TSV622AIST



Operational amplifiers



And more...

Order code naming rules

T S V 6 2 9 1 A I Y C T

Series root name
TSV6: micropower
TSV8: low power
TSV5: high merit factor
TSZ1: zero drift

I_{CC} typ 25 °C
0: <10
1: <20
2: <40
3: <80
5: <150
6: <250
7: <400
8: <600
9: <850

None: standard device (unity gain stable)
9: higher GBW (stable for gain >5)

1: single
2: dual
4: quad
0: single with SHDN
3: dual with SHDN
5: quad with SHDN

None: standard device
A: enhanced V_{IO}

I: industrial temperature range: -40 to 125 °C
H: high temperature range: -40 to 150 °C

None: standard qualification
Y: automotive grade

Package
C: SC70
L: SOT23
Q: DFN/QFN
S: MiniSO
P: TSSOP
D: SO

Tape and reel



ST op-amp apps on Android market



ST op-amps – op-amp forum

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The screenshot shows a web browser window displaying the STMicroelectronics forum page for Amplifiers. The URL is <https://my.st.com/public/STe2ecomunities/analog/Lists/Amplifiers/AllItems.aspx>. The page features the STMicroelectronics logo and navigation links. A search bar is set to 'Analog'. The main content area is titled 'Amplifiers' and includes a sub-header 'OpAmps, Comperators, Current Sensing'. A notice states: 'This discussion board is dealing with ST OpAmp products. Please browse existing posts before you create a new discussion. **Note: This is a public forum, you should not post any confidential information here.** A complete **product overview, technical data and additional resources** (e.g. SPICE models) can be found on www.st.com, click [here](#).' Below the notice is a table of forum posts:

Subject	Created By	Posts	Last Updated	Last Updated By	Views	Helpful
How to select an Operational Amplifier?	boimond.anthony	2	11/22/2011 4:59 PM	boimond.anthony	48	
Glad to see new communication tool...	lang.qing yun	1	11/16/2011 10:01 AM	boimond.anthony	45	
good to see this new forum	mirmon.walter	0	9/16/2011 10:24 AM	mirmon.walter	58	

On the right side, there are 'My Forum Links' (Sign in to Forum, Communities Home, Code Of Conduct) and 'Browse Public Forums' (NOTE these forums are open to everybody!) with a list of categories: Analog, Amplifiers, Embedded Microprocessors, Microcontrollers, Online Tools, Power Conversion, and ST e2e Communities Support.

- The op-amps forum was recently created as part of the e2e initiative (engineers to engineers) launched by ST.
- This forum is a useful place to find or request information about op-amps.



Click on the following link to reach the forum:

<https://my.st.com/public/STe2ecomunities/analog/Lists/Amplifiers/AllItems.aspx>

Sign in to post a message

HiRel and standard product portfolio

		ST's differentiation	Key products
Comparator	<i>Standard</i>	Broad portfolio of general-purpose products Automotive quality	LM2901, LM2903 LM393, LM339
	<i>Low power</i>	From low to micropower High performance Battery friendly	LMV331, TS331 TS86x
	<i>High speed</i>	Excellent speed/power ratio Low voltage	TS3021, TS3011
Operational amplifier	<i>Standard</i>	Broad portfolio of general-purpose products Automotive quality, tiny packages	LM358, LM324, LM290x, LMV3x, LMV82x
	<i>Low power</i>	From low to micropower Extend battery life High accuracy and reliability	TSV6x, TSV85x
	<i>Precision</i>	$V_{io} < 100 \mu V$ (max.) Low noise	TSV7x, TSZ1x
	<i>Current sensing</i>	Wide supply-voltage range Highly rugged Low current consumption	TSC101, TSC102, TSC103
Battery monitoring		Easy-to-build and smallest gas gauge solution extended battery life	STC3100, STC3105

**Reliable
delivery with
high quality
level**

**ST's op-amps
and
comparators
are the glue
between
analog and
digital**

**ST's portfolio:
high-
performance
analog and
high-volume
capability**

**First choice
when it
comes to
performance:
check out our
new product
families**