



# Application guide

Portable devices and mobile handsets  
Enhancing the user experience, simplifying the design



# Introduction

## Your partner for portable devices and mobile handsets

NXP Semiconductors is a recognized leader in portable and mobile applications. We offer a comprehensive portfolio of best-in-class solutions and have long-standing partnerships with every major handset maker in the industry.

Our customers rely on us for innovation, whether it's application-specific solutions for peripheral functions that enhance the user experience – like advanced audio, secure services (NFC), or tailored software – or simply the most extensive portfolio of standard products.

We use next-generation packaging to save space in compact designs, and we extend battery life with low-power technologies that dramatically increase efficiency. We design for ruggedness, supplying devices that stand up to intensive use, and we deliver the high integration needed to simplify development, lower BOM and production costs, and reduce time-to-market.

We consistently introduce new technologies that set the standard for performance, efficiency, and size. Our new chip-scale package (CSP) devices, for example, have an exceptionally compact footprint yet achieve a new benchmark in mechanical robustness.

We also offer security and reliability, with a cost-efficient supply chain and an enterprise-wide commitment to the highest standards of quality. In short, our customers have the confidence that comes from working with a world-class partner.

### **There's more.**

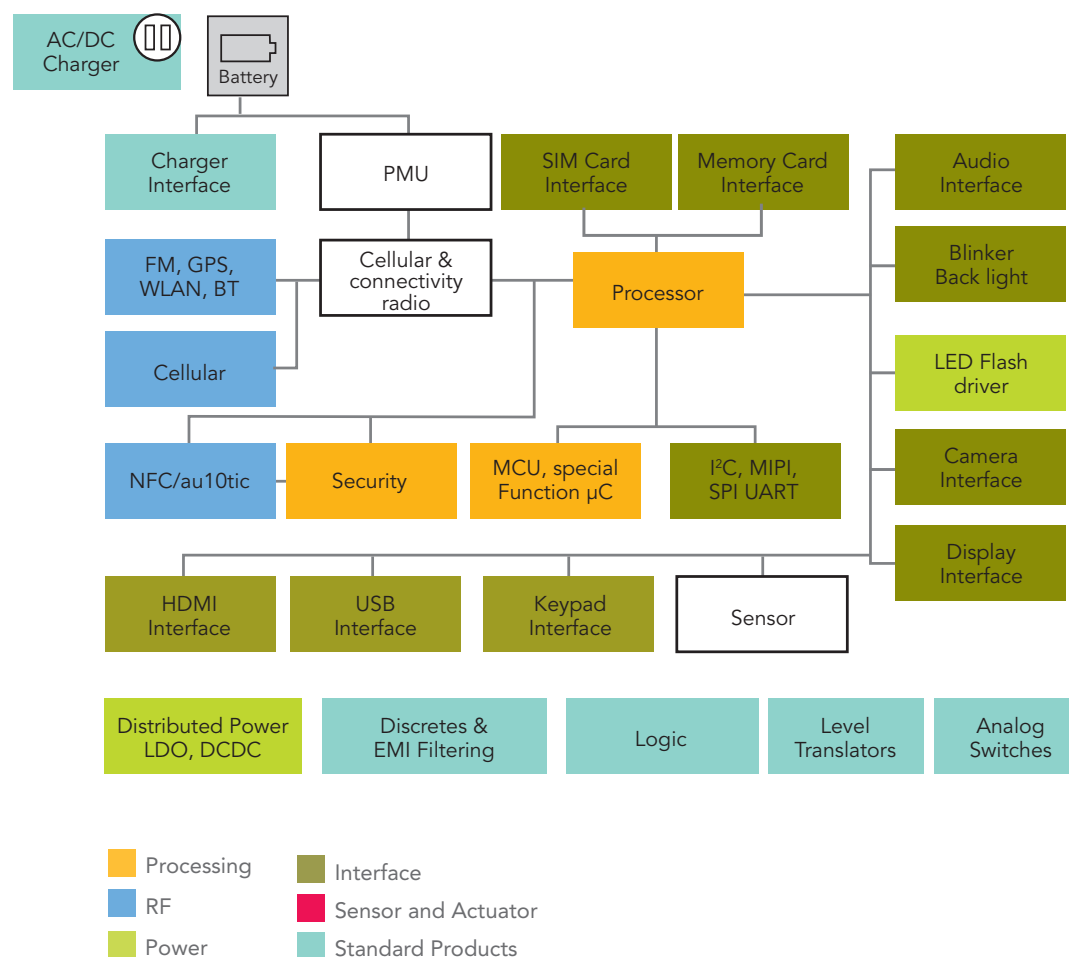
This application guide provides an introduction to our portfolio for portable devices. It highlights many of the forward-thinking solutions we have available, but it's only the beginning. To learn more, please visit our dedicated application page at [www.nxp.com/applications/portable/cellular\\_phone\\_mms](http://www.nxp.com/applications/portable/cellular_phone_mms)

# Introduction

## System diagram for generic portable application

NXP offers a wide range of application-specific peripheral solutions for portable devices and mobile handsets. These solutions serve to support the move toward:

- ▶ Enhanced user experiences
- ▶ Connectivity everywhere
- ▶ Secure transactions
- ▶ Enhanced services
- ▶ Mobilized multimedia
- ▶ Enhanced audio quality
- ▶ Standardized technology interfaces



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# 1. Audio solutions

NXP is committed to higher performance, shorter design cycles, and lower overall cost.

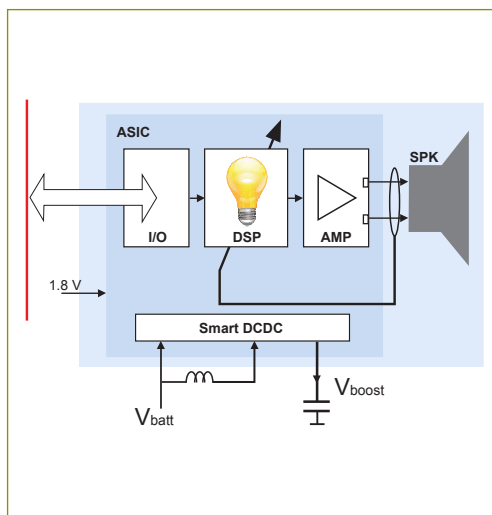
Our application knowledge builds on decades of technical leadership to deliver pure, uncolored sound performance. Our power-efficient amplifier techniques extend battery life, are compatible with digital audio interfaces, and support our speaker portfolio with maximum loudness in a minimum form factor. Our advanced EMI filters and ESD protection solutions enable undistorted audio signals and robust audio interfaces.

To extend performance even further, we offer LifeVibes™ for Mobile, a suite of tailored audio software solutions that let designers optimize the end-user's audio experience.

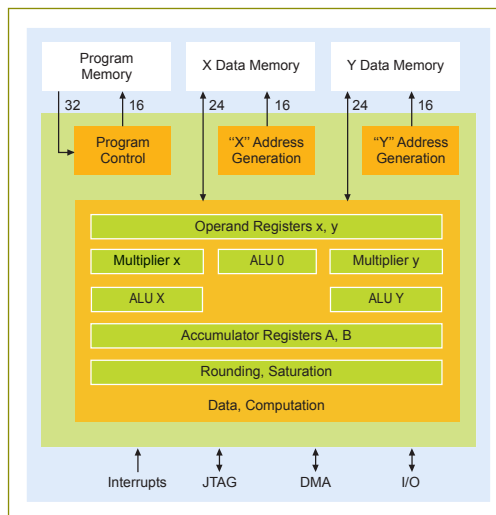
## NXP audio advantages

- ▶ NXP's power-efficient audio amplifier techniques extend battery life and are compatible with upcoming digital audio interfaces
- ▶ Low-power CoolFlux DSP is optimized for audio with an extensive range of audio algorithms
- ▶ Our LifeVibes audio software enhances the user experience with functions such as VoiceClarity, ConcertSound, and Horn Removal
- ▶ Our advanced EMI filter and ESD protection solutions enable undistorted audio signals in combination with very robust audio interfaces
- ▶ NXP's analog switch portfolio supports multiple sources sharing the limited number of analog interfaces in mobile devices

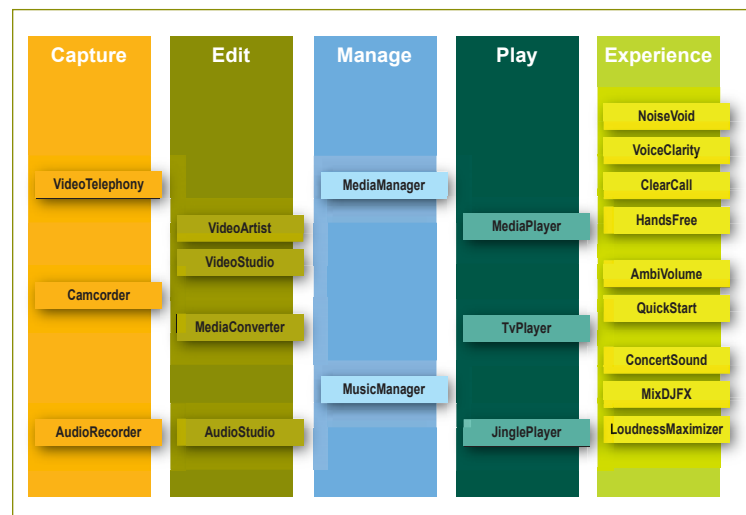
## Advanced Class-D audio amplifier



## Basic DSP structure




## LifeVibes MxMedia catalog index



# 1. Audio solutions

## Highlights of the NXP audio portfolio

	Analog input	Digital input	Headphone
	<b>SA58670ABS</b> 2 x 2.1 W @ 5 V, 4 $\Omega$ Stereo audio amplifier <a href="#">i</a>	<b>TFA9879</b> 2.5 W @ 5 V, 4 $\Omega$ I <sup>2</sup> S, PCM input/equalizer/DRC <a href="#">i</a>	<b>TDA1308AUK</b> Class-AB headphone driver <a href="#">i</a>
	<b>SA58671UK</b> 2 x 1.2 W @ 5 V, 8 $\Omega$ Stereo audio amplifier <a href="#">i</a>	<b>TFA9881</b> 2.7 W @ 5 V, 4 $\Omega$ (1% THD) PDM bus, simple control <a href="#">i</a>	<b>SA5863UK</b> Class-G headphone driver <a href="#">i</a>
	<b>SA58672UK and TK</b> 3 W @ 5.5 V, 4 $\Omega$ Mono audio amplifier <a href="#">i</a>	<b>TFA9882</b> 2.7 W @ 5 V, 4 $\Omega$ (1% THD) I <sup>2</sup> S bus, simple control <a href="#">i</a>	

# 1. Audio solutions

## 1.1 Digital-in Class-D amplifiers

By using a digital interface, our audio amplifiers simplify the audio architecture, enable easy interfacing, and lower system cost. They eliminate the need for a digital-to-analog converter (DAC) in the host processor, and the PDM/I<sup>2</sup>S format guarantees an ultra-small IC footprint. The digital interface reduces RF susceptibility, in the device and the system overall, and lowers sensitivity to input-clock jitter. Also, because the digital interface eliminates the problems that can arise from DC offsets due to leakage currents in analog designs, there's no need for couple capacitors or safeguard speakers.

### **I<sup>2</sup>S-input Class-D**

- ▶ 1-direction data (+ control tokens) via 3 wires
- ▶ 2 channels
- ▶ Sample based, no complex modulation
- ▶ Stable up to 0 dB full scale, with no artifacts at clipping
- ▶ Signal at 1 Fs can be easily signal processed
  - Volume control, EQ, DRC, etc

### **PDM-input Class-D**

- ▶ 1-direction data (+ control tokens) via 2 wires
- ▶ 2 channels
- ▶ Less distortion from "wrong" bits
- ▶ Simple digital-to-analog conversion (saves power)
- ▶ L/R by means of clock phase

### **Benefits of digital interface**

- ▶ Highly immune to RF interference
  - No pick-up of GSM or other disturbing signals
- ▶ No need for digital-to-analog converter in host processor
  - For dual audio channels, digital interface requires fewer pins
  - Achieving good analog performance is difficult with host processors built using advanced CMOS technology
- ▶ No DC offset at the output due to input leakage currents
- ▶ Easy layout
  - Digital interface traces are less sensitive to noise pick-up on the PCB
  - Amplifier can be placed close to speaker
  - Fewer components required (no input couple capacitors)

# 1. Audio solutions

## 2.7 W PDM input Class-D amplifiers TFA9881 & TFA9882

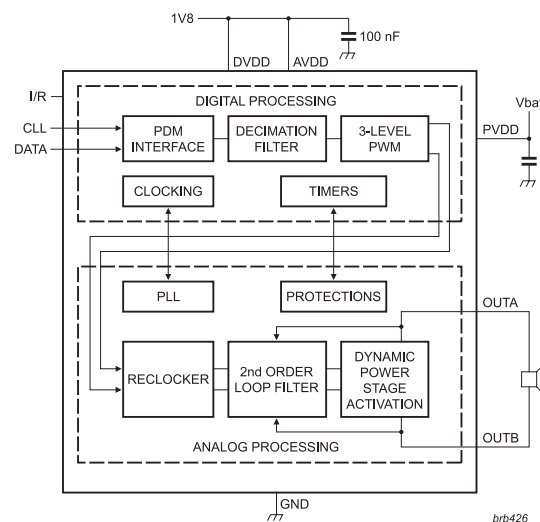
These compact amplifiers include either a PDM input (TFA9881) or an I<sup>2</sup>S input (TFA9882) as the interface for audio and control settings. Audio starts automatically when the clock associated with the data stream is on. For maximum power saving, the amplifier enters a power-down mode as soon as the clock for the data stream is stopped.

### Features

- ▶ Single power supply: 2.3 to 5.5 V
- ▶ Output power
  - 1.4 W into 4  $\Omega$  at 1% THD; 3.6 V
  - 2.7 W into 4  $\Omega$  at 1% THD; 5 V
- ▶ Dynamic Power Stage Activation (DPSA) technology for very low quiescent power (6.5 mW)
- ▶ Fully automatic power-down mode for maximum power savings
- ▶ PDM stream for audio and IC control
  - PDM clock range 2 to 6.144 MHz
  - Standby and mute by PDM signal
  - 4 gain settings and slope control by PDM
  - Standby, mute, and on
- ▶ ESD on output pins to support HV flash ESD discharge (IEC 61000-4-2 10 kV)
- ▶ Left/right selection by control pin
- ▶ Low  $R_{DS(on)}$  ( $\sim 0.1 \Omega$ ) for high efficiency
- ▶ WLCSP9 package (1.3 x 1.3 mm) with 0.4 mm pitch

### Benefits

- ▶ Simple architecture with small size and minimized number of connections
- ▶ Smallest solution available with benchmark performance for THD, noise, and idle current
- ▶ Less distortion with 'wrong' bits
- ▶ Simple D/A conversion (power saving)



### Read more on the links below

- ▶ TFA9881 product page
- ▶ TFA9881 leaflet

### Application video





# 1. Audio solutions

## 2.5 W I<sup>2</sup>S input mono Class-D amplifier TFA9879HN

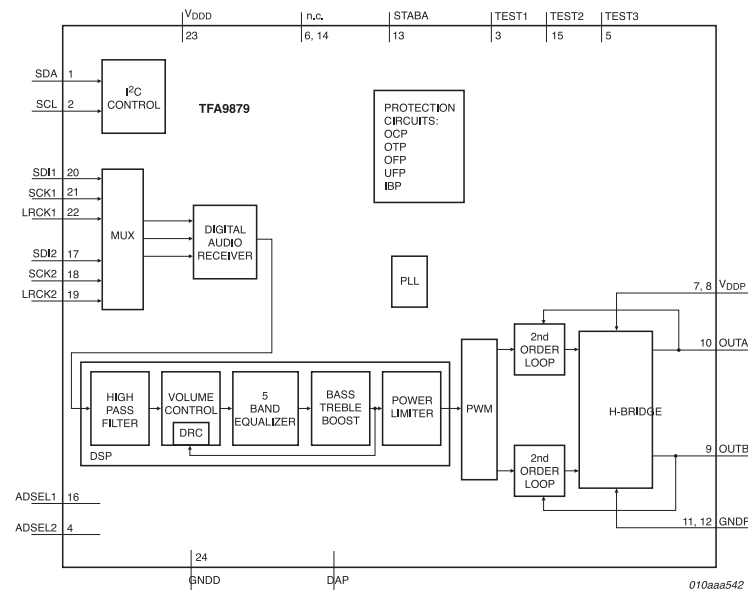
Equipped with sound-processing features like a DRC and an equalizer, this Class-D audio amplifier comes with two digital audio inputs, so the audio amplifier can be connected to the baseband and the multimedia IC.

### Features

- ▶ Single power supply: 2.5 to 5.5 V
- ▶ Output power (THD=10%)
  - 2.5 W @ 4 Ω, 5 V supply
  - 1.29 W @ 8 Ω, 5 V supply
  - 0.7 W @ 8 Ω, 3.7 V supply
- ▶ 2x I<sup>2</sup>S audio inputs
- ▶ Integrated micro DSP with 5-band equalizer, dynamic range control, bass and treble control (-18 to +18 dB), and digital volume control
- ▶ PLL for automatic clock regeneration
- ▶ No output filter required
- ▶ Diagnostic features (by I<sup>2</sup>C readout)
- ▶ Compact HVQFN24 (4.0 x 4.0 x 0.85 mm) package

### Benefits

- ▶ Full digital Class-D with feedback for high PSRR and good audio performance
- ▶ Fixed gain for high PSRR
- ▶ High RF immunity suppression, easier application combined with lower noise levels
- ▶ Reduced BOM costs due to high level of integration
- ▶ Integrated parametric equalizer for speaker curve compensation (software calculation tool to optimize the EQ parameters)



Read more on the link below

▶ TFA9879HN product page

Application video



# 1. Audio solutions

## 1.2 Class-G headphone amplifier

### 2 x 25 mW Class-G stereo headphone amplifier SA58635

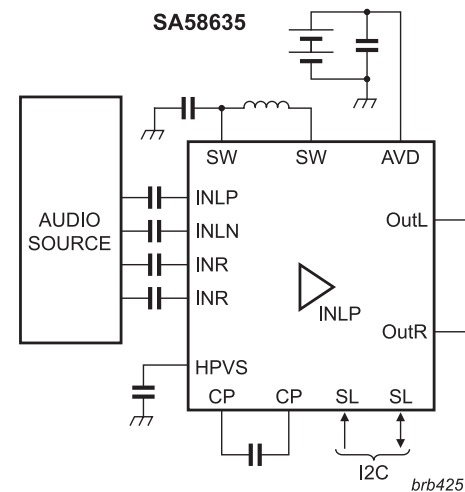
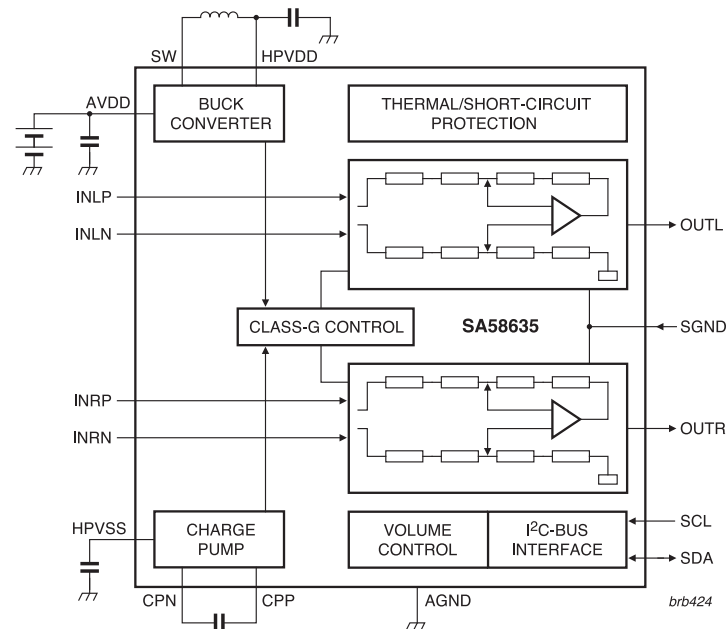
This power-efficient Class-G headphone amplifier delivers excellent S/N performance in an ultra-small package.

#### Features

- ▶ Easy mechanical integration due to rectangular shape
- ▶ 80% efficiency employing Class-G dynamic power management design
- ▶ Operating voltage: 0.9 to 1.7 V
- ▶ S/N performance: 100 dB
- ▶ Thermal and short-circuit protection circuitry
- ▶ Pop & click suppression circuitry
- ▶ I<sup>2</sup>C-bus interface and control for volume control (32 steps), mute, and operation selection mode
- ▶ Available in WLCSP16 (2 x 2 mm) or HVQFN20 (4 x 4 mm) package

#### Benefits

- ▶ Long battery life
- ▶ Excellent audio quality
- ▶ Low EMI to enable combinations with FM radio
- ▶ No need for headphone coupling capacitors



# 1. Audio solutions

## 1.3 Low-ohmic switches

### Low-ohmic switches NX3 series

These best-in-class low-ohmic switches are an excellent choice for audio and mixed-signal applications in small, portable devices. They feature low switching threshold levels, so they're ideal for interfacing with audio ICs, ASICs, and other circuits requiring switching level translation. The combination of low ON resistance and low  $R_{ON}$  flatness greatly reduces switched signal attenuation and distortion. Low power consumption makes the NX3 family especially well suited for portable applications. The ultra-compact MicroPak™ packages greatly improve placement and routing, so the switches are easier to place in applications where board space and headroom are at a premium.

### Features

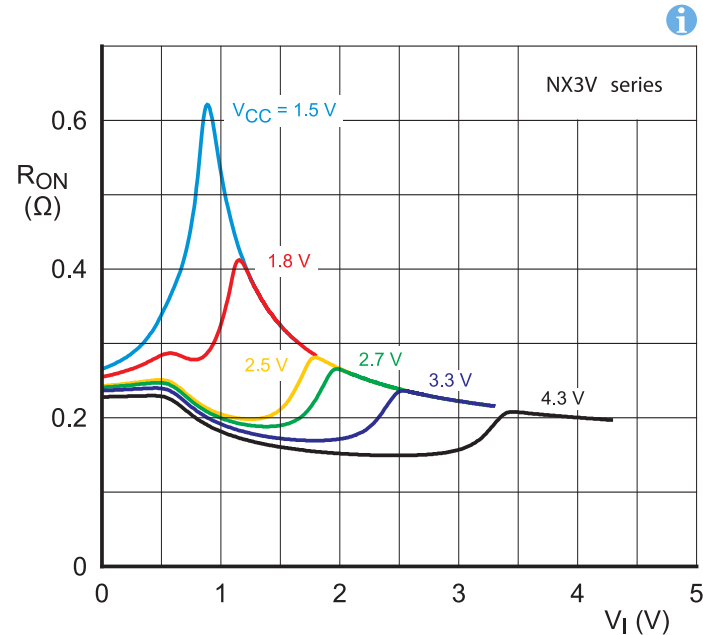
- ▶ Low  $R_{ON}$  (L series =  $0.75\ \Omega$ , V series =  $0.45\ \Omega$ )
- ▶  $R_{ON}$  flatness ( $0.1\ \Omega$  typ)
- ▶ Wide supply range (1.4 to 4.3 V)
- ▶ High current handling (up to 350 mA continuous)
- ▶ Low leakage ( $<50\ \text{nA}$  at  $85\ ^\circ\text{C}$ )
- ▶ Break-before-make switching
- ▶ Overvoltage-tolerant control inputs
- ▶ Low-threshold input variants
- ▶ Excellent ESD performance (7.5 kV HBM)
- ▶ Fully specified ( $-40$  to  $+85$  and  $-40$  to  $+125\ ^\circ\text{C}$ )
- ▶ Pb-free, RoHS, and Dark Green compliant
- ▶ PicoGate and MicroPak packages

### Benefits

- ▶ Reduced signal attenuation and distortion
- ▶ Longer battery life
- ▶ Lower chip count
- ▶ Easier placement in tight layouts

### Read more on the links below

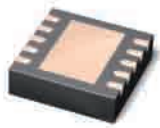
- ▶ Low-ohmic switch leaflet
- ▶ Low-ohmic switch products



# 1. Audio solutions

## Dual low-ohmic SPDT analog switches NX3L4684 & NX3L2267

These advanced switches provide two low-ohmic single-pole, double-throw (SPDT) analog switches suitable for use as an analog or digital multiplexer/demultiplexer. The two devices provide similar functionality, but with different pinouts.



### Features

- ▶ Wide supply voltage range: 1.4 to 4.3 V
- ▶ Very low ON resistance ( $0.3 \Omega$  at  $V_{cc} = 2.3 \text{ V}$ )
- ▶ Break-before-make switching
- ▶ High noise immunity
- ▶ Low switching threshold at control input
- ▶ -3 dB frequency of 20 MHz
- ▶ Very small, 10-pin leadless packages

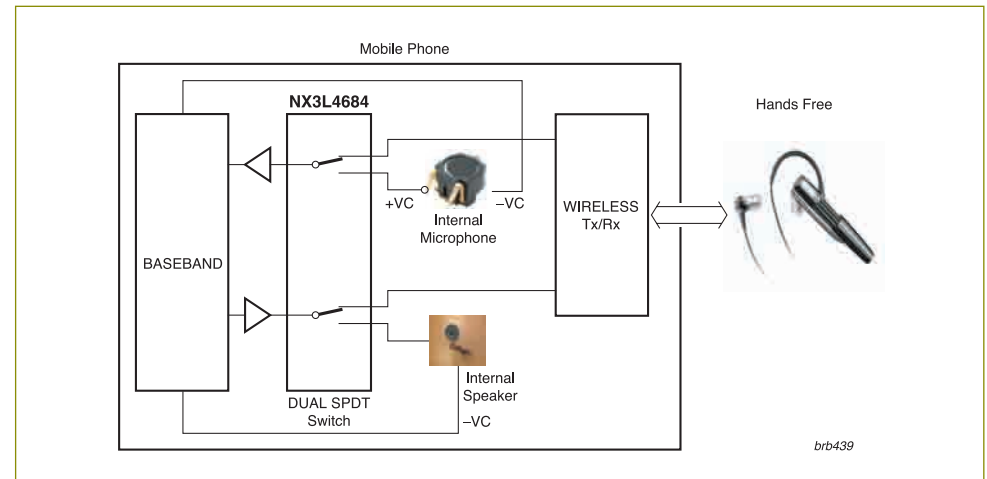
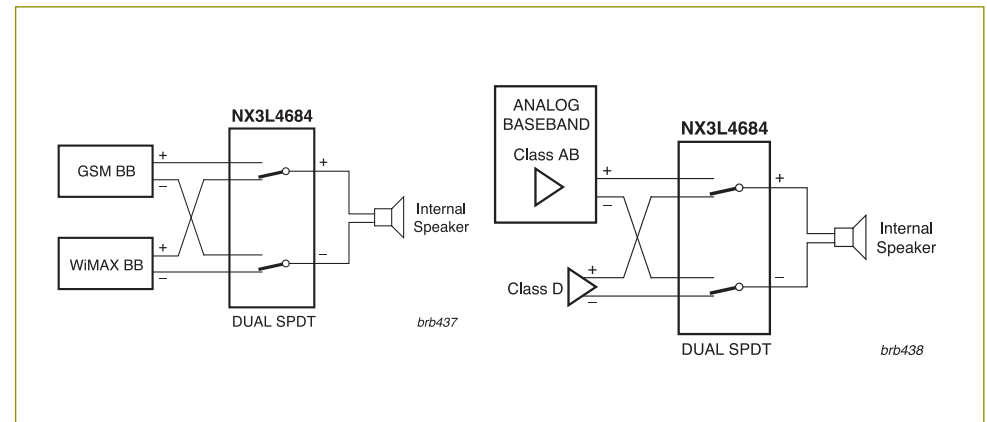
### Benefits

- ▶ Superior performance
- ▶ Smaller layouts

### Read more on the links below

- ▶ [NX3L4684 data sheet](#)
- ▶ [NX3L2267 data sheet](#)

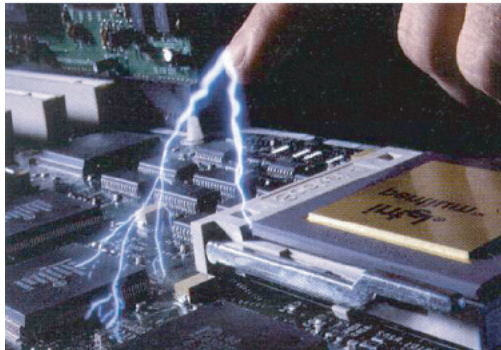
## Application examples



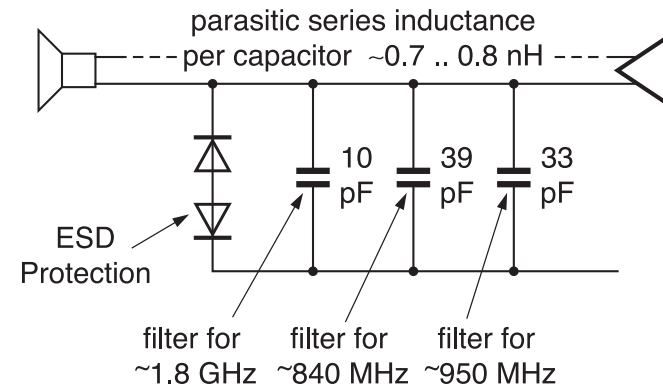
# 1. Audio solutions

## 1.4 Audio-specific EMI filters and ESD protection

These highly integrated, optimized devices use coil-based EMI filters for speaker and receiver interfaces and are designed for use with 2G, 2.5G, and 3G frequencies. They use NXP's high-K technology to integrate coupling capacitors, deliver excellent EMI suppression with a broad filter response, and offer robust ESD protection with very low clamping voltage.



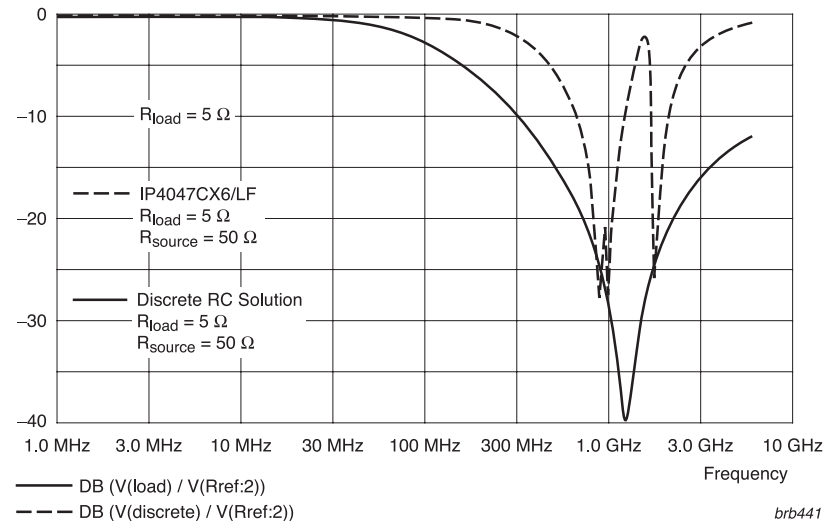
brb461



Discrete Solution

brb440

Filter response: discrete (solid line) versus integrated EMI filter (dotted line)



brb441

# 1. Audio solutions

## EMI filters for analog audio interfaces

The analog audio interfaces in most portable devices use differential signals. The filtering requirements for these signals can vary according to maximum allowed series resistance, maximum capacitance, and maximum operating voltage. NXP's EMI filters include high R-channel C-R-C filters for microphones, multi-ohm R-channel C-R-C filters for receivers and headphones, and sub-one-ohm R-channel C-L-C filters for handsfree and speakerphone applications. All have pre-defined filter performance (independent of component resonance frequencies), and, compared to discrete solutions, depend very little on PCB layout.

## Features

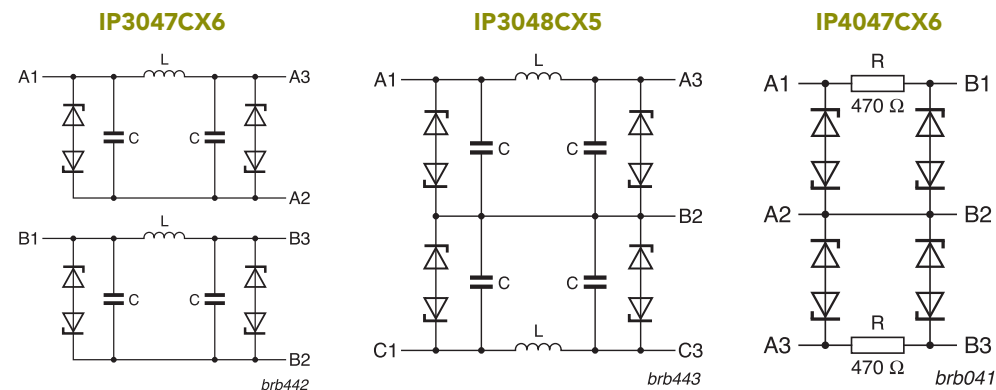
- ▶ Integrated dual-channel LC or RC filter
- ▶ Predefined filter performance simplifies design-in
- ▶ ESD protection of  $\pm 15$  kV IEC 61000-4-2
- ▶ Wafer-level chip-scale package (0.4 or 0.5 mm pitch)
- ▶ Pb-free and RoHS-compliant

## Benefits

- ▶ Support for all three use cases (microphone, receiver/headphone, handsfree/speakerphone)
- ▶ Robust ESD protection with very low clamping voltage
- ▶ No demodulated RF noise in the audio channel
- ▶ Small footprint yields optimized designs

## Read more on the links below

- ▶ NXP Mobile Usage brochure
- ▶ IP3047CX6 product page
- ▶ IP3048CX5 product page



## Selection guide for audio EMI filters

Type name [+ /LF]	Channel small signal equivalents		Loudspeaker		Microphone		Integrated biasing resistors
	$R_{\text{channel}}$ ( $L_{\text{channel}}$ )	$C_{\text{channel}}$	$\leq 8 \Omega$	$\geq 8 \Omega$	Single-ended	Differential	
IP4027CX20/LF	10 $\Omega$ , 100 $\Omega$	225 pF, 75 pF		x		x	1.1 k $\Omega$ pull-up/down
IP4047CX6/LF	0.95 $\Omega$	2x 140 pF	x				-
IP4048CX5/LF	10 $\Omega$	2x 100 pF		x			-
IP4049CX5/LF	68 $\Omega$	2x 47 pF			x	x	-
IP4055CX6/LF	470 $\Omega$	35 pF			x	x	-
IP4355CX6/LF	470 $\Omega$	<20 pF			x	x	-
IP4363CX10/LF	15 $\Omega$ , 95 $\Omega$	65 pF, 33 pF		x	x		2 k $\Omega$ pull-up/down
IP5002CX8/LF	2.2 $\Omega$ , 4.4 $\Omega$	65 nF, + 1 nF			Single-ended to quasi-differential		-
IP3047CX6	0.25 $\Omega$ (3 nH)	280 pF	x				-
IP3048CX5	0.25 $\Omega$ (3 nH)	280 pF	x				-

# 1. Audio solutions

## Audio-specific ESD solutions

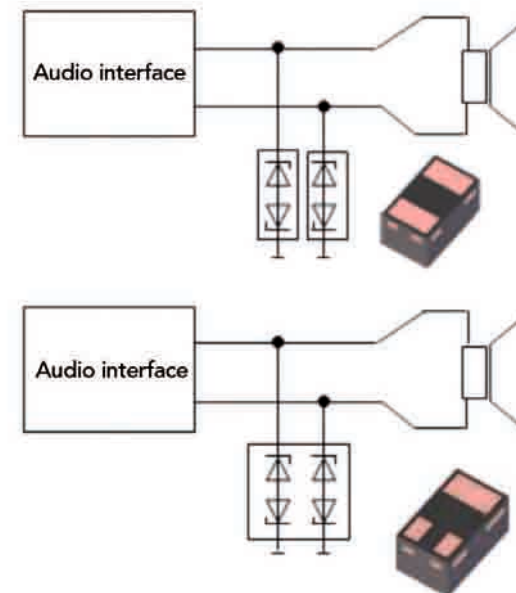
NXP's standalone ESD solutions are robust, flexible devices with low clamping voltages. They're available in a number of space-saving package formats.

### Single-channel ESD solutions

Type	Channels	Cline (pF)	BV	Package	Size (L x B x H) mm
PESD5V0S1BL	1	35	5	SOD882	1.06 x 0.6 x 0.5
PESD5V0U1BL	1	2.9	5	SOD882	1.06 x 0.6 x 0.5
IP4302CX2/LF	1	10	16	CSP	0.76 x 0.76 x 0.61
PESD5V0V1BL/BLD	1	11	5	SOD882	1.0 x 0.6 x 0.5
				SOD882D	1.0 x 0.6 x 0.37
PESD5V0S1BSF	1	35	5.5	SOD962	0.6 x 0.3 x 0.3
PESD5V0L1BSF	1	12	5.5	SOD962	0.6 x 0.3 x 0.3
PESD5V0V1BSF	1	3.5	5.5	SOD962	0.6 x 0.3 x 0.3

### Dual-channel ESD solutions

Type	Channels	Cline (pF)	BV	Package	Size (L x B x H) mm
IP4303CX4/LF	2	10	16	CSP	0.76 x 0.76 x 0.61
PESD5V0U2BM	2	2.9	5	SOT883	1.0 x 0.6 x 0.5



# 1. Audio solutions

## 1.5 LifeVibes for Mobile software

### LifeVibes for Mobile software

NXP's LifeVibes software solutions for mobile devices deliver a vibrant, easy-to-enjoy multimedia experience. Available in tailored packages for audio and voice applications, they help developers create portable products that offer more fun, more features, and considerably more quality and clarity of music, video, and voice. Optimized for different mobile device segments and platforms, LifeVibes software is used in over 700 million mobile devices, making it the market leader in mobile multimedia software. The list below includes just a few examples. For our complete portfolio, which includes NoiseVoid, VoiceClarity, ClearCall, VideoTelephony, and more, go to [www.software.nxp.com](http://www.software.nxp.com)

### Sound Expedience 3.0

- ▶ Best-in-class rich and natural audio experience for headphone and speakers
- ▶ Full multi-channel surround sound
- ▶ Plug-and-Play extension of the Android Audio Effects

### Voice Experience

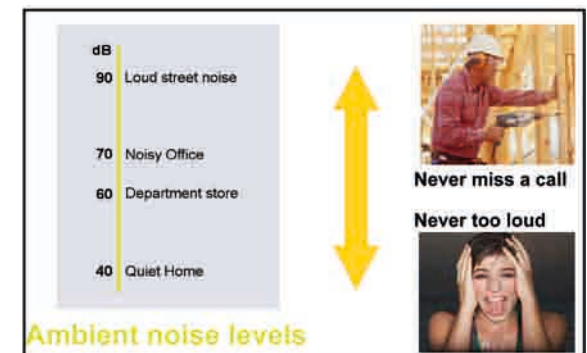
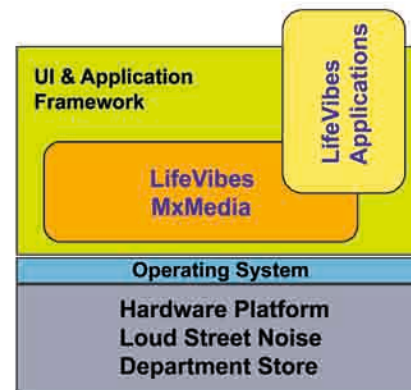
- ▶ Crystal-clear speech, with support for HD Voice
- ▶ Echo cancellation & noise reduction
- ▶ Voice enhancements on application processor
- ▶ Pre-integrated on common Android processor
- ▶ VoiceClarity for maximum speaker volume

### AmbiVolume 1.0

- ▶ Automatically adjusts ringtone volume to environment noise
- ▶ Adaptation is continuous
- ▶ Loudness maximizer (optional)

### Read more

- ▶ [www.software.nxp.com](http://www.software.nxp.com)





## 2. Distributed power

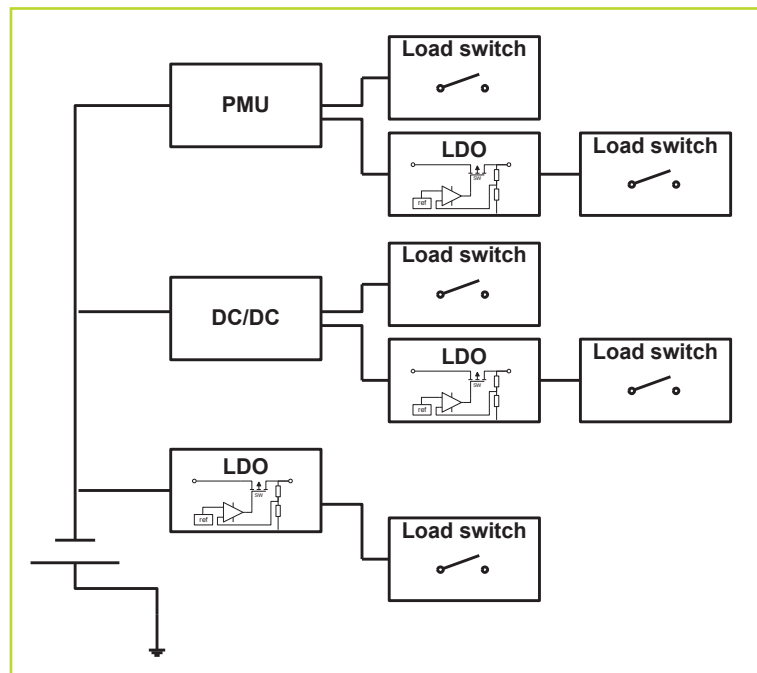
In portable devices, the supply voltage can vary depending on the battery's charge level. For mobile phones, the typical range is from about 2.7 to around 4.7 volts. However, the system's ICs need to have a stable (and often lower) supply voltage. Even though most appliances have a central Power Management Unit (PMU), the PMU may not be able to offer all the required voltages or currents at once, so additional devices are needed to expand the available source nodes. Various boundary conditions, such as required voltage drop, average and peak current, noise, PSRR, thermal budget, and cost, can influence the choice of support device.

If, for example, the required voltage source has enough current delivery capabilities, a load switch may be sufficient for controlling the supply. On the other hand, with functions that consume a lower current or have a short active cycle time, a Low Drop Out (LDO) function may offer a more cost-efficient solution.

High-current and low-voltage supplies typically use DC/DC converters to maximize efficiency and minimize heat generation. For very low-noise applications, an LDO is often used to regulate the DC/DC converter output voltage and reduce ripple on the supply.

Also, some charger inputs use a load switch rated with a higher voltage to isolate the charger input from the battery and protect the charging circuit from overvoltage conditions.

Typical use cases of DC/DC converters, LDOs, and load switches



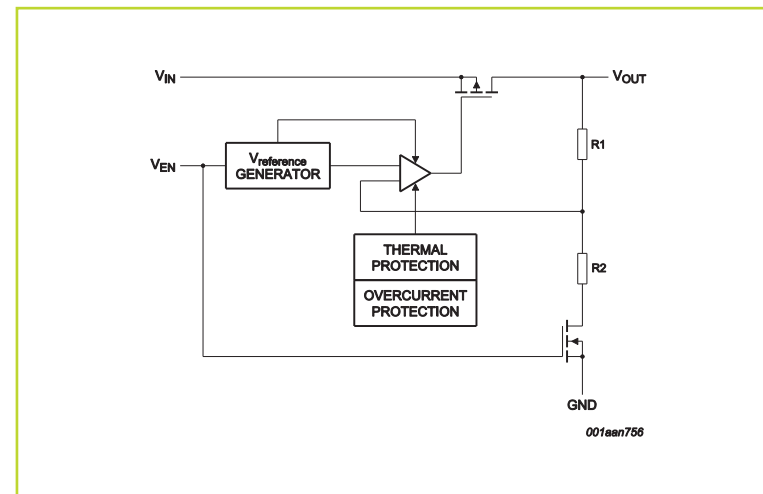
## 2. Distributed power

### 2.1 Low Drop Out (LDO) regulators

In the portable market, especially in the area of smartphones and tablets, the pressure to innovate quickly means designers often have to add new features to an existing platform. LDOs are a simple way to provide newly added devices with power from the battery or a pre-regulated voltage. Our LDOs offer the lowest dropout in a CSP or leadless package that measures only 0.76 x 0.76 mm. Our high PSRR device family is also available in a tiny leadless package, measuring just 1 x 1 mm.

#### Features

- ▶ Operating input voltage from 2.3 to 5.5 V
- ▶ Output voltage from 1.2 to 3.6 V
- ▶ 2% accuracy
- ▶ Low quiescent current in shut-down mode
- ▶ Turn-on time  $\leq 200 \mu\text{s}$
- ▶ Available low- and high-ohmic output states when disabled
- ▶ Integrated high-level ESD protection



Read more on the link below

- ▶ [Low dropout regulators product page](#)

Type (package)	$V_{IN}$ (V)	$V_{OUT}$ (V)	$\Delta V_0$	PSRR@ 1 kHz, 1 mA	$V_{do}$ drop out voltage	$I_{OUT DC}$ (mA)	$P_D$ (mW)	Output noise ( $\mu V_{rms}$ )
LD6806CX4/xxP (or H) (WLCSP4)	2.3 to 5.5	1.2, 1.3 1.4, 1.6 1.8, 2.0 2.2, 2.3 2.5, 2.8 2.9, 3.0 3.3, 3.6	2%	55 dB	60 mV @ 200 mA	200	650	30
LD6806F/xxP (or H) (SOT886/XSON)							450	
LD6806TD/xxP (or H) (SOT753)							700	
LD6805K/xxP (or H) (HUSON4)				75 dB	250 mV @ 150 mA	150	160	40



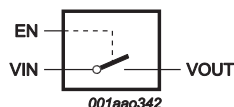
# 2. Distributed power

## 2.2 Load switches with logic control

Load switches are a cost-effective way to control individual supplies in designs that use a power supply with sufficient current budget available. Unlike LDOs, these load switches have no noticeable quiescent current. The high-side load switches in chipscale (CSP) packaging offer integrated level translators and can be ordered with a floating or discharge switch output for off time. The CSP package measures 0.76 x 0.76 mm and has a footprint compatible with the NXP LD6806CX4 LDO, for easy upgrades to the power supply scheme.

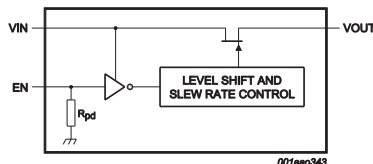
### Features

- ▶ Operating input voltage from 1.1 to 3.6 V
- ▶  $R_{DSon}$  95 mΩ at 1.8 V only
- ▶ High current capability  $I_{maxDC}$  500 mA
- ▶ 1.2 logic control level at 3.6 V supply
- ▶ Low quiescent current in shut-down mode
- ▶ Floating output when disabled (NX3P191)
- ▶ Integrated 280 Ω discharge resistor (NX3P190)
- ▶ Integrated higher-level ESD protection



### Read more on the links below

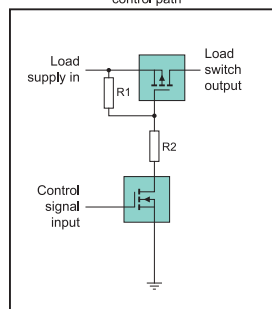
- ▶ NX3P190 product page
- ▶ NX3P191 product page
- ▶ Load switches application page



## 2.3 Standard load switches

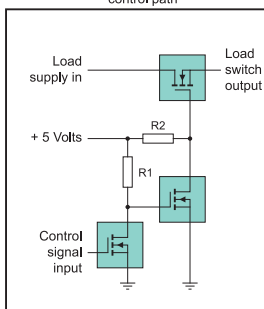
For supplies working with higher currents and/or higher voltages, we offer various P- and N-channel FETs, as well as bipolar devices, that can be used to control the charge current and to protect the charger interface from overvoltage and overcurrent conditions. These devices support voltage ranges above 30 V, and can handle currents in the range of several Amperes.

Load Switch with a P-channel FET in the load path and an N-channel FET in the control path



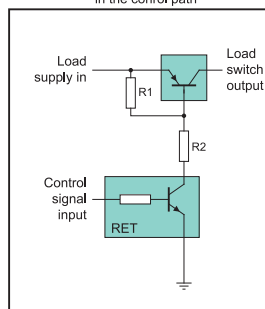
Use case:  
Load supply voltage >  $V_{GSmin}$

Load Switch with an N-channel FET in the load path and a dual N-channel FET in the control path



Use case:  
Load supply voltage +  $V_{GSmin}$  < +5 V

Load Switch with a low  $V_{CEsat}$  transistor in the load path and a Resistor-Equipped Transistor in the control path



Use case:  
Load supply voltage > Load supply current/ $h_{FE}$  \*  $R_2$  + 0.8 V

### Read more on the link below

- ▶ Load switches application page

## 2. Distributed power

### 2.4 Charger interfaces

We make charging more reliable and more efficient, with advanced ESD protection solutions and TVS diodes that protect the charging ICs, and low  $V_{CEsat}$  (BISS) transistors that guard against power losses. All these options are optimized for portable performance, and are available in small, space-saving packages.

#### ESD/TVS diodes for power line protection IP4085CX4/LF, IP4385CX4/LF, IP4386CX4/LF, IP4387CX4/LF

These robust ESD/TVS diodes, housed in CSP packages, protect the charger interface of a PMU from transients. They also protect against wrong polarity connections. IP4085CX4/LF offers surge immunity according IEC 61000-4-5 (8/20  $\mu$ s) up to 60 A. Its reverse clamping voltage is less than 20 V at a current of 1 A.

#### ESD/TVS and integrated melting fuse IP4389CX4

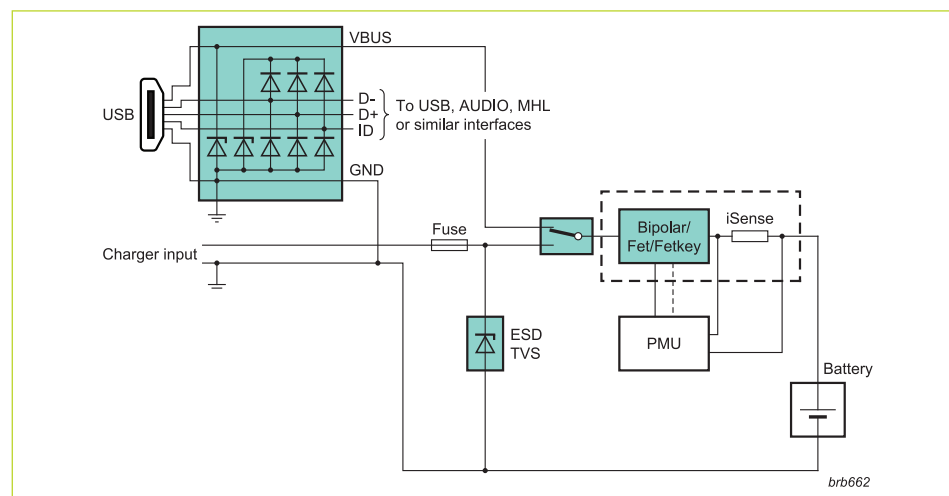
This novel device, designed specially for charger inputs, is a TVS diode with an integrated melting fuse. It protects against overvoltage, reverse-polarity, and overcurrent conditions. The fuse is rated 2 A DC with just 35 m $\Omega$  of series resistance. The component measures only 0.76 x 0.76 x 0.61 mm.

	$V_{BR}$	$C_{JO}$	Pitch (mm)
IP4085CX4/LF	16 V	160 pF	0.5
IP4385CX4/LF	7 V	450 pF	0.4
IP4386CX4/LF	16 V	160 pF	0.4
IP4387CX4/LF	10 V	290 pF	0.4
IP4389CX4/LF	14 V	220 pF	0.4

#### Read more on the links below

- ▶ IP4085CX4, IP4385CX4, IP4386CX4 and IP4387CX4 product page
- ▶ IP4389CX4 data sheet
- ▶ Charging interface application page

#### Charger input protection



PESD12VS1UL PESD15VS1UL PESD24VS1UL	PESD12VS1UB PESD15VS1UB PESD24VS1UB	IP4085CX4	IP4385CX4 IP4386CX4 IP4387CX4
SOD882 1.0 ´ 0.6 ´ 0.5 mm	SOD523 1.2 ´ 0.8 ´ 0.6 mm	CSP 0.5 mm pitch 0.91 ´ 0.91 ´ 0.65 mm	CSP 0.4 mm pitch 0.76 ´ 0.76 ´ 0.61 mm

brb462

## 2. Distributed power

### BISS transistors for the charger interface

With lower saturation voltages than any previous generation, NXP's ultra-low  $V_{CEsat}$  (BISS) transistors are a perfect fit for the charging interface.

#### Features

- ▶ Reduced saturation voltage  $V_{CEsat}$
- ▶ Improved collector current capabilities
- ▶ High current gain HFE
- ▶ Small package

#### Benefits

- ▶ Safer charging
- ▶ Small footprint

#### Read more on the links below

- ▶ Low  $V_{CEsat}$  (BISS) transistors brochure
- ▶ Application note

TVS diodes in CSP						
Product	BV	ESD protection	Channel small signal equivalents		Package B x L x H (mm)	Package
			$P_{D,tot}$	$C_{channel}$		
IP4085CX4	14 V	15 KV	1.1 W	240 pF	0.91 x 0.91 x 0.65	CSP 0.5 mm
IP4385CX4	7 V	15 KV	0.75 W	240 pF	0.76 x 0.76 x 0.65	CSP 0.4 mm
IP4386CX4	14 V	15 KV	0.75 W	240 pF	0.76 x 0.76 x 0.65	CSP 0.4 mm
IP4387CX4	10 V	15 KV	0.75 W	240 pF	0.76 x 0.76 x 0.65	CSP 0.4 mm
IP4389CX4	14 V	30 kV, +2 A fuse	0.75 W	160 pF	0.76 x 0.76 x 0.50	CSP 0.4 mm

Protection diodes				
Product	BV	ESD protection	$C_{line}$	Package
PESD12VS1UL	12 V	30 KV	38 PF	SOD882
PESD15VS1UL	15 V	30 KV	32 PF	SOD882
PESD24VS1UL	24 V	30 KV	23 PF	SOD882

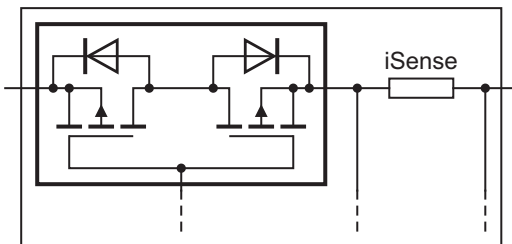
  

Load switches		
Product	Description	Package
PMTD	Dual N-channel series MOSFET	SOT666
PMZ	Single N-channel series MOSFET	SOT883
PMV65XP	Single P-channel series MOSFET	SOT23

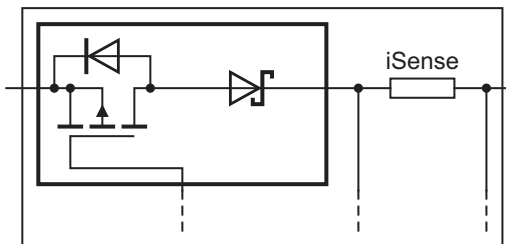
  

BISS		
Product	Description	Package
PBSS304PX	BISS	SOT89
PBSS4520	BISS	SOT1061
PBSS5630PA	BISS	SOT1061
PBSS4520	BISS	SOT1061

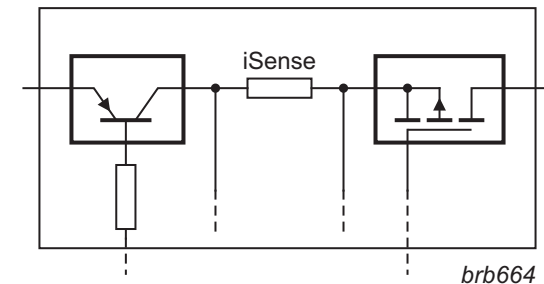
Over voltage and back-drive protection



Over voltage and back-drive protection



Linear charging



# 3. Display and camera interfaces

Our next-generation EMI filters and ESD protection devices support a broad range of user interfaces and protect all the relevant frequencies for 2G, 3G, LTE, WLAN, and Bluetooth. Available as cost-efficient RC filters or optimized LC filters for interfaces with high clock rates, these products deliver superior filter performance and robust ESD protection at the lowest clamping voltages, and are housed in space-saving leadless and CSP packages.

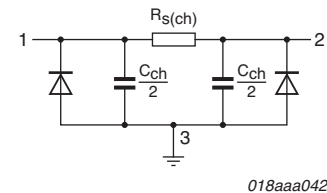
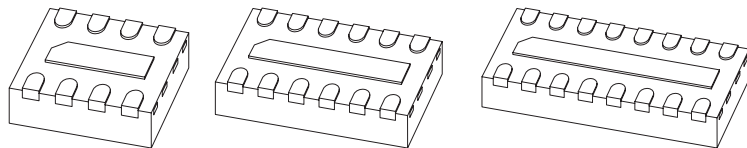
## EMI filter and ESD protection devices PEMI series

This RC filter family offers 35 RC combinations based on five resistor and seven capacitor values. Each combination is available in six different packages with one, two, four, six, or eight channels. The HXSON packages have a reduced width (only 1.2 mm typ) and a maximum height of 0.5 mm, and are available with four, six, or eight channels.

Available values:

Channel resistance: 20, 45, 65, 100 and 200  $\Omega$

Channel capacitance: 15, 19, 23, 28, 32, 36, 40 pF (@ 0V<sub>DC</sub>)



## Features

- ▶ Up to 30 dB insertion loss at mobile-phone frequencies of 800 MHz to 3 GHz
- ▶ High ESD protection up to  $\pm 25$  kV, far exceeding IEC 61000-4-2, level 4
- ▶ Low ESD clamping voltage
- ▶ Available in 1-, 2-, 4-, 6-, or 8-channel formats
- ▶ 35 different RC filters per package for easy performance optimization
- ▶ Ultra-thin dark green leadless package in 0.4 mm pitch

## Benefits

- ▶ Solutions for all use cases
- ▶ Robust ESD protection with very low clamping voltage
- ▶ No demodulated RF noise in the audio channel
- ▶ Optimized designs due to small footprint

## Read more on the links below

- ▶ PEMI EMI filter and ESD protection family
- ▶ NXP Mobile Usage brochure

# 3. Display and camera interfaces

## RC-based EMI filters IP433x family in WLCSP packages

Ideal for use in applications requiring the utmost in miniaturization, these RC low-pass filter arrays are housed in WLCSP packages that measure only 1.96 x 1.61 mm (typ). They provide filtering of undesired RF signals in the 800 to 3,000 MHz frequency band.

### Features

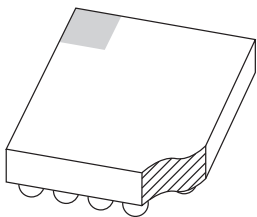
- ▶ Integrated 7- or 10-channel RC filter network
- ▶ 70  $\Omega$  series resistance; 25 pF (typ) capacitance per line
- ▶ High ESD protection exceeding IEC 61000-4-2, level 4
- ▶ WLCSP package with 0.4 mm pitch

### Benefits

- ▶ Significantly reduced board space
- ▶ Easy routing

### Read more on the links below

- ▶ IP4337CX18LF product page
- ▶ IP4338CX24LF product page



## LC-based EMI filters IP32xx family for use with high clock rates

In designs that use high data-rate interfaces, a broad pass band and a very steep roll are required to achieve the maximum attenuation at unwanted frequencies in the RF transmitter transceiver range. These EMI filters, optimized for use with high-resolution images and color LCD applications in wireless handsets, are 4-, 6-, and 8-channel LC low-pass filter arrays that filter unwanted RF signals in the range of 800 MHz to 6 GHz. They integrate up to eight inductors and 16 diodes in a 0.4 mm pitch 8-, 12-, or 16-pin MicroPak lead-free plastic package. The package is QFN-compatible and has a height of only 0.5 mm.

### Features

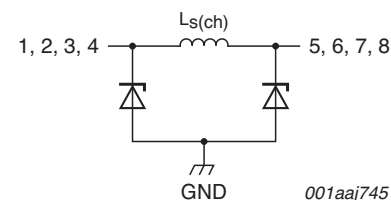
- ▶ Integrated 4-, 6-, or 8-channel LC filter network
- ▶ High ESD protection exceeding IEC 61000-4-2, level 4 and in accordance with MIL-STD-883
- ▶ QFN-type plastic package with 0.4 mm pitch

### Benefits

- ▶ Faster roll-off
- ▶ Low ESD clamping voltages
- ▶ Small form factors

### Read more on the link below

- ▶ IP3253/54CZ8/CZ12/CZ16 product page



001aaj745

# 3. Display and camera interfaces

## LC-based EMI filters IP333x family in WLCSP packages

Similar to the IP4337x family of RC-based EMI filters, these LC-based filters provide filtering of undesired RF signals in the 800 to 3,000 MHz frequency band. They are housed in WLCSP packages that measure only 2.06 x 1.66 mm (typ).

### Features

- ▶ Integrated 7- or 10-channel LC filter network
- ▶ 125  $\Omega$  series resistance; 25 pF (typ) capacitance per line
- ▶ High ESD protection exceeding IEC 61000-4-2, level 4
- ▶ WLCSP package with 0.4 mm pitch

### Benefits

- ▶ Significantly reduced board space
- ▶ Easy routing

### Read more on the links below

- ▶ IP3337CX18 product page
- ▶ IP3338CX24 product page

## LC-based EMI filters IP3348 family for MIPI interface

Similar to the IP32xx family, these LC-based EMI filters integrate a 2-, 4-, 6-, or 8-channel LC filter network and are designed for use with the Mobile Industry Processor Interface (MIPI). They require low serial channel resistance in combination with a matching pass band bandwidth and a maximum attenuation of unwanted frequencies between 470 MHz (Mobile TV) and 6 GHz.



### Features

- ▶ Integrated 2-, 4-, 6-, and 8-channel LC filter network
- ▶ High ESD protection exceeding IEC 61000-4-2, level 4
- ▶ WLCSP package

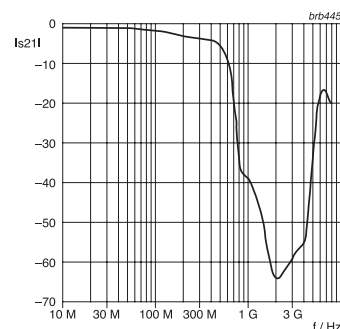
### Benefits

- ▶ Optimized for serial MIPI interfaces
- ▶ Suppression of disturbances in mobile TV frequencies

### Read more on the link below

- ▶ IP425xCZ8-4/CZ12-6/CZ16-8 IP4256CZ3-M/CZ5-W/CZ6-F leaflet

### Measurement example of fast roll-off and superior filtering



Type name	Channel small signal equivalents			-3 dB frequency (insertion loss)	Remark
	$L_{\text{channel}}$	$R_{\text{channel}} (L_{\text{channel}})$	$C_{\text{channel}}$		
IP3053Cxy	35 nH	100 $\Omega$	30 pF	150 MHz	2-, 4-, 6-, or 8-channel CLC-type EMI filter/ESD protection, 0.4 mm pitch same footprint as IP3088Cxy
IP3088Cxy	40 nH	18 $\Omega$	42 pF	175 MHz	2-, 4-, 6-, or 8-channel CLC-type EMI filter/ESD protection, 0.4 mm pitch same footprint as IP3053Cxy
IP3348Cxy	15 nH	10 $\Omega$	30 pF	350 MHz	2-, 4-, 6-, or 8-channel CLC-type EMI filter/ESD protection, 0.4 mm pitch
IP3337CX18/LF	60 nH	125 $\Omega$	25 pF	180 MHz	7-channel CLC-type EMI filter/ESD protection, 0.4 mm pitch same footprint as IP4337CX18/LF
IP3338CX24/LF	60 nH	125 $\Omega$	25 pF	180 MHz	10-channel CLC-type EMI filter/ESD protection, 0.4 mm pitch same footprint as IP4338CX24/LF and IP3328CX24/LF and IP3328CX24

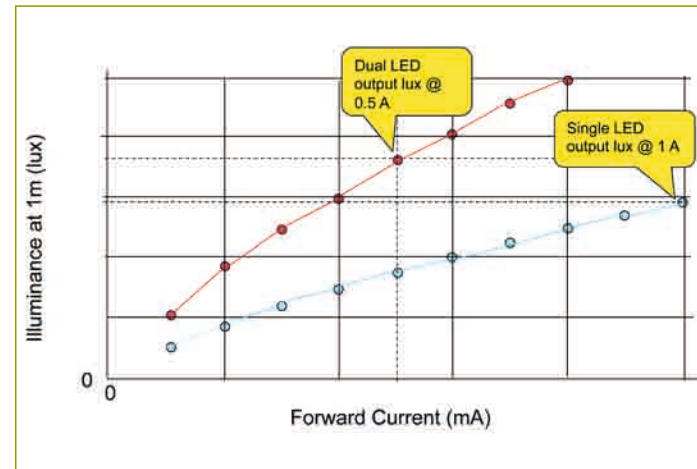
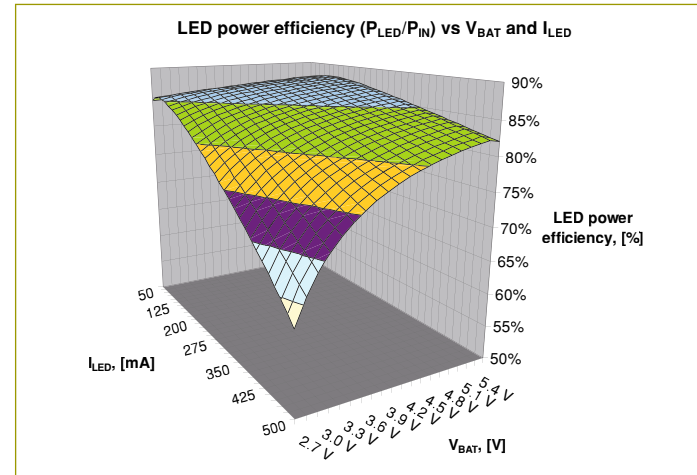


## 4. Lighting and blinking

Enhance the user experience with high-performance camera flash products and small, energy-efficient controllers for LED lighting and blinking.

Our camera flash products use current-mode DC/DC conversion and can drive one or two LEDs in series. In flash mode, they drive up to 500 mA, and in torch mode, which is used with movies or videos, they drive up to 200 mA. Driving two LEDs in series ensures the boost converter operates in boost mode, for 30% higher efficiency than with a single LED.

For LED lighting and blinking, our solutions offer energy-efficient ways to control power, message, and status indicators, or just add some fun.



# 4. Lighting and blinking

## 4.1 Camera flash products

### Asynchronous boost converter for single/dual high-power LED SSL3250A

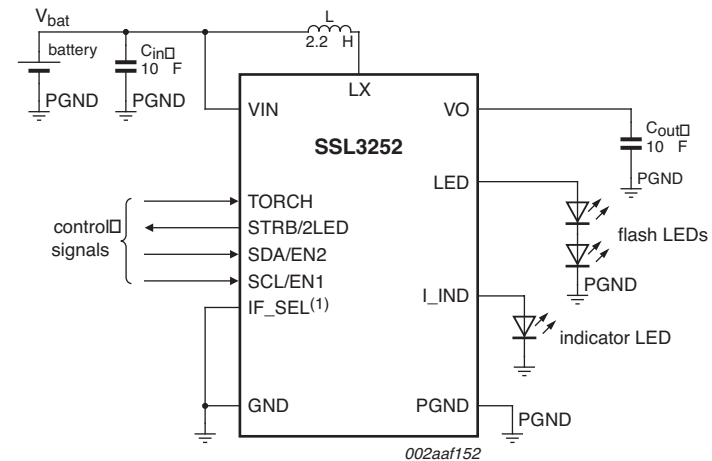
Ideal for driving up to two high-brightness LEDs, the efficient SSL3252A is an I<sup>2</sup>C-programmable high-side asynchronous boost converter that uses a minimum of external components and delivers efficiency above 85%. The device supports Flash mode, Assist light mode, Torch mode, and Indicator mode.

#### Features

- ▶ High-side current source for main and indicator LEDs
- ▶ Wide input voltage ranging from 2.5 to 5.5 V
- ▶ High efficiency of over 85% at optimum output current
- ▶ Switching frequency of 2 MHz
- ▶ Internally timed flash operation up to 850 ms
- ▶ I<sup>2</sup>C-programmable up to 400 kHz
- ▶ Strobe signal to avoid I<sup>2</sup>C latency for the flash
- ▶ Direct enable signals for standalone operation
- ▶ Forward voltage sensing to allow single/dual LED detection
- ▶ Separate indicator LED output of 2.5 to 10 mA
- ▶ Integrated protection circuits for enhanced system reliability (OTP, UVLO, OVP, short, broken coil)
- ▶ Low device shut-down current of less than 1  $\mu$ A
- ▶ Small WLCSP12 package with 500  $\mu$ m bump pitch

#### Benefits

- ▶ Dual LED mode enables high efficiency
- ▶ Robust due to built-in protection
- ▶ Torch mode for videos



#### Read more on the links below

- ▶ SSL3250A/SSL3252 leaflet
- ▶ Photo flash LED driver application note
- ▶ SSL3252 product page

# 4. Lighting and blinking

## Ultra-low $V_{CEsat}$ (BISS) transistors PBSS 4220V PBSS2515M

Housed in medium-power SOT666 and SOT883 packages, these new BISS (Breakthrough In Small Signal) transistors feature lower saturation voltages than any previous BISS transistor generation.

### Features

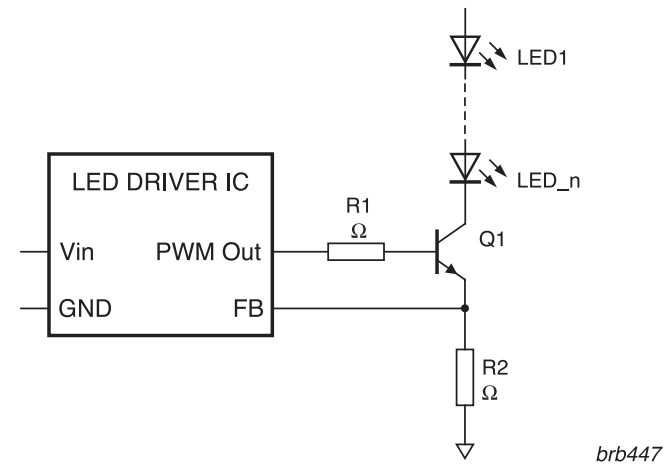
- ▶ Reduced saturation voltage,  $V_{CEsat}$
- ▶ Improved collector current capabilities
- ▶ High current gain HFE
- ▶ Low turn-on voltage compared to MOSFET
- ▶ Ultra-small SOT883 package (1.0 x 0.6 x 0.5 mm)
- ▶ Small SOT666 package (1.6 x 1.2, 0.55 mm)

### Benefits

- ▶ High circuit efficiency
- ▶ Low energy consumption
- ▶ Reduced heat generation
- ▶ Enables smaller products

### Read more on the link below

- ▶ High voltage low  $V_{CEsat}$  (BISS) transistors product page



# 4. Lighting and blinking

## 4.2 LED blinkers and dimmers

### LED controller PCA9632

The PCA9632 is a 4-bit LED driver, controlled by the I<sup>2</sup>C-bus, that is optimized for red/green/blue/amber (RGBA) color-mixing applications.

#### Features

- ▶ Multifunction: LED on, off, bright, dim, or blinking
- ▶ Blink rate: 40 ms to 10.73 s
- ▶ Four 8-bit PWMs for individual LED brightness control
- ▶ One 6-bit PWM for group dimming
- ▶ Fixed I<sup>2</sup>C-bus address (C4h), no pins
- ▶ Programmable via I<sup>2</sup>C-bus, 400 kHz
- ▶ Low standby current (<1  $\mu$ A)
- ▶ Push-pull output current: 25 mA sink, 10 mA source
- ▶ Voltage range: 2.3 to 5.5 V

#### Benefits

- ▶ Single-chip solution to drive up to 4 LEDs for superior color-mixing effect (RGBA)
- ▶ Extended battery life with low power consumption
- ▶ Offloads CPU from blinking operation

#### Read more on the link below

- ▶ PCA9632 product page

### One-wire single LED driver PCA9901

The PCA9901 is a 20 mA current source for a single LED that allows standalone blinking of a predefined pattern, so it offloads the microcontroller and saves battery power.

#### Features

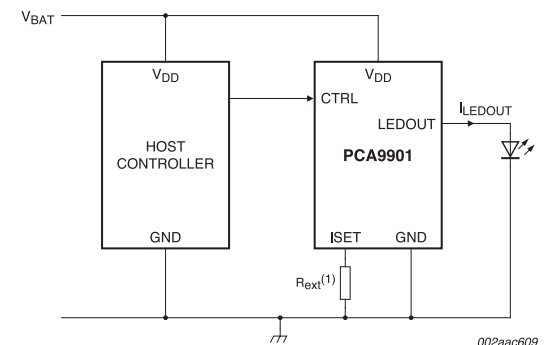
- ▶ 1-bit constant current LED control
- ▶ Standalone blinking capability after “learning” the sequence
- ▶ Simple one-wire interface
- ▶ Wake-up, standby, and reset modes
- ▶  $V_{CC} = 2.1$  to 5.5 V
- ▶  $I_{max} = 2.0$  mA (current in the LED set by external resistor)
- ▶ Ideal for low-power applications:  $I_{cc} < 250 \mu$ A,  $I_{standby} < 1 \mu$ A
- ▶ XSON8 (3 x 2 x 0.5 mm) and WLCSP6 (1 x 1.2 x 0.6 mm) packages

#### Benefits

- ▶ Frees up CPU for other tasks
- ▶ Very low power consumption compared to microcontroller solution
- ▶ Minimal PCB routing with single-wire control

#### Read more on the link below

- ▶ PCA9901 product page



# 5. Memory card interfaces

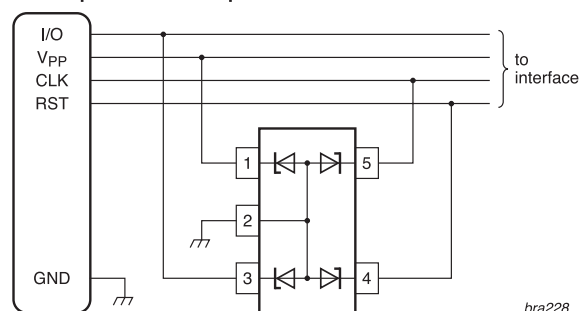
Covering all the most popular interface formats, including SIM cards, SD cards, and T-Flash, our highly integrated memory card interfaces are best-in-class conditioning solutions that reduce board space, shorten design cycles, and lower the bill of materials. They deliver advanced ESD protection and EMI filtering while adding extra features that increase design flexibility.

## 5.1 SIM card interfaces

### ESD protection family PESD5V0x4Ux

These unidirectional quadruple ESD protection diode arrays are housed in small surface-mounted device (SMD) plastic packages and are designed to protect up to four signal lines from the damage caused by ESD and other transients.

#### Mobile phone SIM card protection



#### Read more on the link below

- ▶ PESD5V0S4UF product page

### Interface protection and EMI filtering ICs, IP4064CX8/LF, IP4364CX8/LF, IP4264CX8-20, IP4264CZ8-40

With three digital lines and additional protection for the supply rail, these devices provide all the necessary components for complete EMI filtering and ESD protection in SIM cards.

#### Features

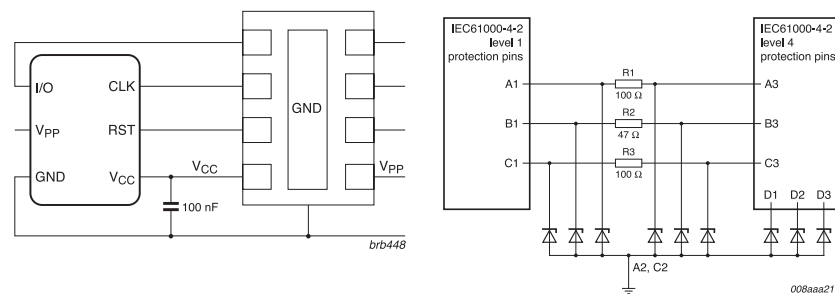
- ▶ 3-channel SIM card interface integrated RC-filter array
- ▶ Integrated 100  $\Omega$ /100  $\Omega$ /47  $\Omega$  series channel resistors
- ▶ Downstream ESD protection up to  $\pm 15$  kV (contact), exceeding IEC 61000-4-2, level 4
- ▶ Available in leadless and wafer-level chip-scale packages with 0.5 or 0.4 mm pitch

#### Benefits

- ▶ Ultra-robust ESD protection with low clamping voltage
- ▶ Suppression of all 2G and 3G mobile phone frequencies
- ▶ Simplified design due to ultra-small footprint

#### Read more on the links below

- ▶ SIM card interface application page
- ▶ SIM card EMI filtering and ESD protection using integrated discretes application note
- ▶ SD(HC)-memory card and MMC interface conditioning application note



# 5. Memory card interfaces

## SIM card protection with three USB connection pins IP4365CX11

Similar to the IP4044CX8 and its related product types, the IP4365CX11 offers exceptional EMI filtering and ESD protection while adding three connector pins for use with USB.

### Features

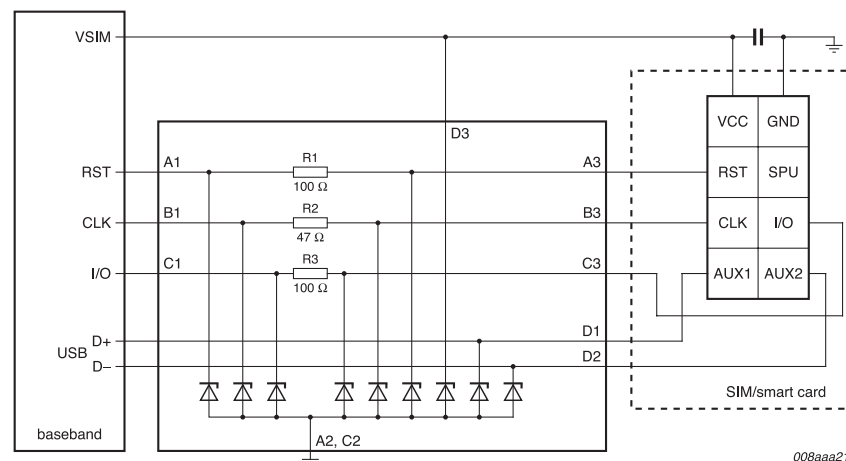
- ▶ 3-channel SIM card interface integrated RC-filter array
- ▶ Three additional protection diodes for internal USB connection protection
- ▶ Integrated 100  $\Omega$ /100  $\Omega$ /47  $\Omega$  series channel resistors integrated
- ▶ Downstream ESD protection up to  $\pm 15$  kV (contact), exceeding IEC 61000-4-2, level 4
- ▶ Wafer-level chip-scale package with 0.4 mm pitch

### Benefits

- ▶ Ultra-robust ESD protection with low clamping voltage
- ▶ Suppression of all 2G and 3G mobile phone frequencies
- ▶ Simplified design due to ultra-small footprint

### Read more on the links below

- ▶ SIM card interface application page
- ▶ SIM card EMI filtering and ESD protection using integrated discretes application note
- ▶ SD(HC)-memory card and MMC interface conditioning application note



Product	Cline	Pitch	Package	Size
IP4044CX8	35 pF	0.5 mm	CSP	1.41 x 1.41
IP4064CX8	<20 pF	0.5 mm	CSP	1.41 x 1.41
IP4364CX8	<20 pF	0.4 mm	CSP	1.16 x 1.16
IP4365CX11	<10 pF	0.4 mm	CSP	1.16 x 1.56
IP4366CX8	<10 pF	0.4 mm	CSP	1.16 x 1.16
IP4264CZ8	10 pF / 40 pF	0.4 mm	Plastic	1.35 x 1.75

# 5. Memory card interfaces

## 3 + 1 pole DT switch NX3DV2567 with analog supply switch path

The NX3DV2567 is a four-pole double-throw analog switch (4PDT) with one channel optimized to switch supplies in dual-SIM and other applications.

## Dual DPDT switch NX3L2467 for SIM Card switching applications

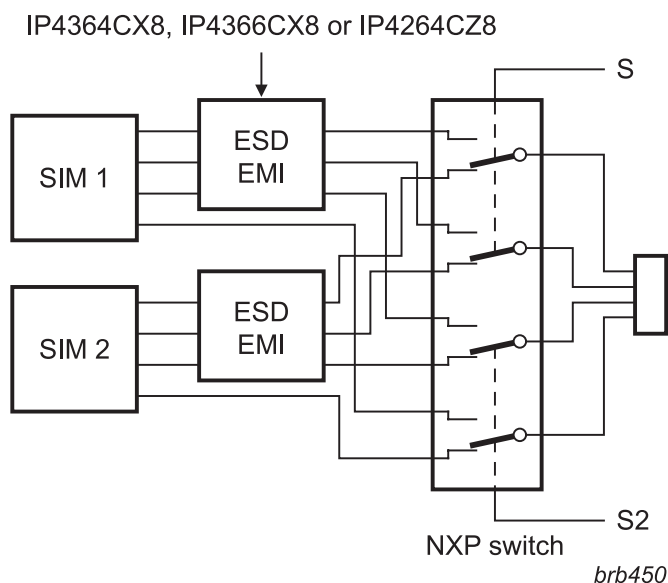
This is a dual, low-ohmic double-pole, double throw (DPDT) analog switch suitable for use as an analog or digital multiplexer/demultiplexer.

### Features

- ▶ Wide supply voltage range: 1.4 to 4.3 V
- ▶ Very low ON resistance (peak)
- ▶ Break-before-make switching
- ▶ High noise immunity
- ▶ CMOS low-power consumption
- ▶ Latch-up performance exceeds 100 mA per JESD 78 Class II Level A
- ▶ 1.8 V control logic at  $V_{CC}$  is 3.6 V
- ▶ Control input accepts voltages above supply voltage
- ▶ Very low supply current, even when input is below  $V_{CC}$
- ▶ High current handling capability
- ▶ Tiny leadless XQFN16 package (1.8 x 2.6 x 0.5 mm)

### Benefits

- ▶ Small form factor
- ▶ Compatible with 1.8 V chipsets



### Read more on the links below

- ▶ NX3DV2567 product page
- ▶ NX3L2467 data sheet
- ▶ SIM card EMI filtering and ESD protection using integrated discretes application note
- ▶ SD(HC)-memory card and MMC interface conditioning application note

# 5. Memory card interfaces

## 5.2 SD card and T-Flash interfaces

### Integrated level shifter IP4853CX24 with PSU, EMI filter, and ESD protection

Optimized for the SD Card and T-Flash interfaces, this device contains bidirectional push-pull drivers for clock speeds up to 50 or 60 MHz. It is ideal of use with a low-voltage processor that interfaces to a memory card requiring voltages of 2.9 V and above. An integrated LDO delivers 2.9 V for the memory card from a battery voltage of up to 5 V. The low-voltage side can operate between 1.62 and 1.9 V while the high-voltage side works at between 2.5 and 3.5 V.

#### Features

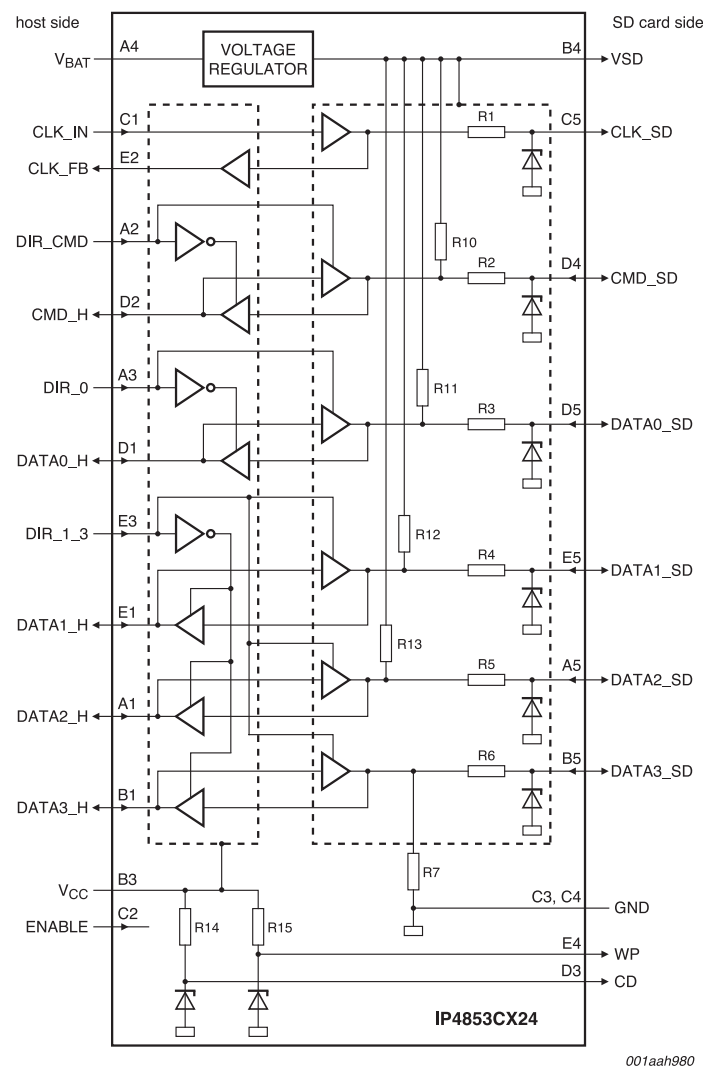
- ▶ High-speed, active level shifter between 1.8 and 2.9 V
- ▶ EMI-filter
- ▶ IEC 61000-4-2, level 4 compliant ESD-protection
- ▶ Memory card supply (2.9 V LDO) from battery
- ▶ 0.4 mm pitch device with a package size of just 2.01 x 2.01 mm

#### Benefits

- ▶ Design flexibility due to very small footprint
- ▶ Lower BOM, greater cost efficiency

#### Read more on the links below

- ▶ IP4853CX24 product page
- ▶ SD(HC)-memory card and MMC interface conditioning application note
- ▶ SIM card EMI filtering and ESD protection using integrated discretes application note





# 5.

## SDIO ESD protection and EMI filter IP4357CX17

This small (1.1 x 2.4 mm) EMI filter and ESD protection device supports all SD, MicroSD, and TransFlash (T-Flash) cards with clock speeds up to 50 MHz (including UHS-I, DDR50 mode). It integrates a high-ohmic pull-up resistor for card detect switches and protects against ESD discharges up to 15 kV contact (IEC 61000-4-2) by using a superior dual stage clamping structure.

## Features

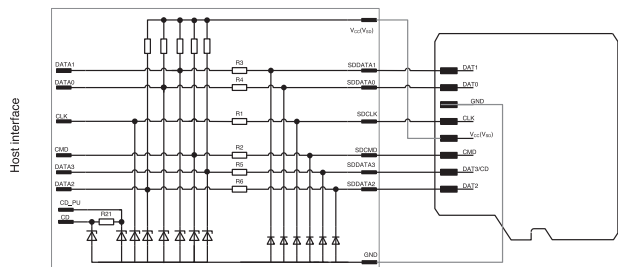
- ▶ 5 channels with integrated EMI/RF-filter and pull-up resistors
- ▶ 1 channel with integrated EMI/RF-filter (CLK) only
- ▶ IEC 61000-4-2, level 4 compliant , 15 kV contact & air discharge input protection
- ▶ WLCSP package (1.1 x 2.4 mm with 0.4 mm pitch)
- ▶ Pb-free and RoHS-compliant

## Benefits

- ▶ Smaller board size due to high integration
- ▶ Reduced BOM, higher cost efficiency

**Read more on the links below**

- ▶ Memory card interface application page
- ▶ Ultra low capacitance ESD protection diodes leaflet



## ESD protection and EMI filter ICs IP4350CX24/LF & IP4352CX24/LF with 9 channels

Similar to the IP4052CX20/LF, these ICs contain nine channels protected by rail-to-rail diodes at the card holder interface side and are housed in wafer-level chip-scale packages with a 0.4 mm pitch. The IP4350CX24/LF can be used with MultiMediaCards and integrates all the required pull-up and pull-down resistors. It is optimized for use with the SD-Card level shifter IP4852CX25/LF.

**Read more on the link below**

- Ultra low capacitance ESD protection diodes leaflet

	IP4357CX17	IP4350CX24/LF	IP4352CX24/LF	IP4252CZxx-TT1
No of lines	6	6 + 3	6 + 3	6 or 8
$R_{line}$	40 $\Omega$	15 $\Omega$	40 $\Omega$	25 $\Omega$
$R_{pull}$	12.5 k $\Omega$ , 50 k $\Omega$	4.7 k $\Omega$ , 50 k $\Omega$	15 k $\Omega$ , 50 k $\Omega$	-
$C_{line}$ ( $V_{bias} = 0$ V)	<20	<9	<20	-
Package size	1.1 x 2.4 mm	1.95 x 2.11 mm	2.01 x 2.02 mm	1.35 x 2.5 (6ch)

## ESD protection and EMI filter ICs IP4252CZxx

These C-R-C EMI filters and ESD protection devices are available in 4-, 6-, and 8-pin leadless packages with 0.4 mm pitch. The Rline is 40  $\Omega$  and the Cline, at Vbias equals 2.5 V, is 12 pF.

### Read more on the links below

- ▶ SD(HC)-memory card and MMC interface conditioning application note
- ▶ SIM card EMI filtering and ESD protection using integrated discretes application note
- ▶ Ultra low capacitance ESD protection diodes leaflet
- ▶ IP4251\_52\_53\_54-TTL product page

# 5. Memory card interfaces

Product name	Device type	Additional features	No. of filter channels	Package type [+ size]
Memory card interface, ESD protection & EMI filter devices with integrated biasing (pull-up/down) resistors, ESD protection level of >15 kV contact, far exceeding the IEC 61000-4-2, level 4 (8 kV contact, 15 kV air)				
IP4051CX11/LF	Passive, ESD protection & EMI filter		4	CSP, 0.5 mm pitch [1.96 x 2.54 mm]
IP4351CX11/LF	Passive, ESD protection & EMI filter		4	CSP, 0.4 mm pitch [2.01 x 2.02 mm]
IP4357CX17	Passive, ESD protection & EMI filter	Includes CD	6 (+1)	CSP, 0.4 mm pitch [1.1 x 2.4 mm]
IP4060CX16/LF	Passive, ESD protection & EMI filter		6	CSP, 0.5 mm pitch [2.01 x 2.02 mm]
IP4350CX24/LF	Passive, ESD protection & EMI filter	Includes WP&CD	6 (+5)	CSP, 0.4 mm pitch [2.01 x 2.02 mm]
IP4352CX24/LF	Passive, ESD protection & EMI filter	Includes WP&CD	6 (+5)	CSP, 0.4 mm pitch [2.01 x 2.02 mm]
Memory card interface, ESD protection & EMI filter devices, ESD protection level according IEC 61000-4-2, level 4 (8 kV contact, 15 kV air discharge)				
IP4252CZ8-4	Passive, ESD protection & EMI filter		4	DFN, 0.4 mm pitch [1.35 x 1.7 mm]
IP4252CZ12-6	Passive, ESD protection & EMI filter		6	DFN, 0.4 mm pitch [1.35 x 2.5 mm]
IP4252CZ12-8	Passive, ESD protection & EMI filter		8	DFN, 0.4 mm pitch [1.35 x 3.3 mm]
Bi-directional memory card interface voltage translator device, IC level ESD protection according IEC 61340-3-1, HBM, 2 kV 15 kV air discharge)				
IP4852CX25/LF	Active, 1.8 ↔ 2.9 V voltage translator	Voltage translators	6	CSP, 0.4 mm pitch [2.01 x 2.01 mm]
LDO, voltage translators, ESD protection & EMI filter & biasing resistors including WP&CD, integrated ESD protection level according IEC 61000-4-2, level 4				
IP4853CX24/LF	Active, 1.8 ↔ 2.9 V voltage translator	LDO	6 (+3)	CSP, 0.4 mm pitch [2.01 x 2.01 mm]

# 6. High-speed data interfaces

## 6.1 HDMI

NXP is a founding member of the HDMI consortium and actively supports the use of HDMI in mobile applications. Our portfolio includes a full range of HDMI transceivers, HDMI interface conditioning components, and advanced ESD protection diodes.

Our Authorized Test Center in Caen, France offers HDMI compliance measurements, and our development teams can assist with the more challenging aspects of HDMI design, including HDCP keys.

### HDMI transmitter TDA19989

This compact, low-power HDMI 1.4 transmitter has 3 x 8-bit RGB or YCbCr video inputs and offers support for CEC. It is backward compatible with DVI 1.0 and can be connected to any DVI 1.0 or HDMI sink.

### Features

- ▶ Complies with industry standards
  - HDMI1.4
  - DVI1.0
  - EIA/CEA-861B
  - HDCP 1.3 (optional)
- ▶ Supports CEC with embedded clock generation
- ▶ Advanced video interface
  - Up to 150 MHz pixel clock
  - RGB4:4:4 or YCbCr4:4:4 (24 bits)
  - YCbCr4:2:2 semi-planar (12 bits)
  - YCbCr4:2:2 ITU656 (up to 12 bits)
  - Embedded or separate syncs
  - Configurable pin mapping

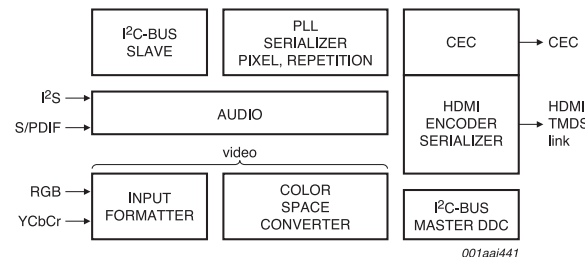
- ▶ High maximum resolution
  - 1080p/60 Hz for TV
  - 1600x1200/60 Hz for computer UXGA60
  - 720p/1080i in ITU656
- ▶ Low power consumption
  - 720p: 55 mW
  - 1080p: 120 mW
  - Standby with I<sup>2</sup>C on: 130 µW
- ▶ Video processing capabilities
- ▶ Audio interface: I<sup>2</sup>S /SPDIF audio input
- ▶ Control interfaces
  - I<sup>2</sup>C
  - Interrupt pin for HDMI core and CEC
  - Receiver detection: Hot Plug Detect, RxSense
  - Small BGA package (4.5 x 4.5 mm)

### Benefits

- ▶ Simpler design
- ▶ Proven solution

### Read more on the links below

- ▶ [HDMI transmitters product page](#)
- ▶ [HDMI interface application page](#)



# 6. High-speed data interfaces

## Advanced ESD protection and interface conditioning ICs IP4285CZ9-TBB and IP4221CZ6

These devices include high-level ESD protection diodes for the TMDS signal lines. All TMDS intra-pairs are protected by a special diode configuration offering a low line capacitance of only 0.8 pF.

### Features

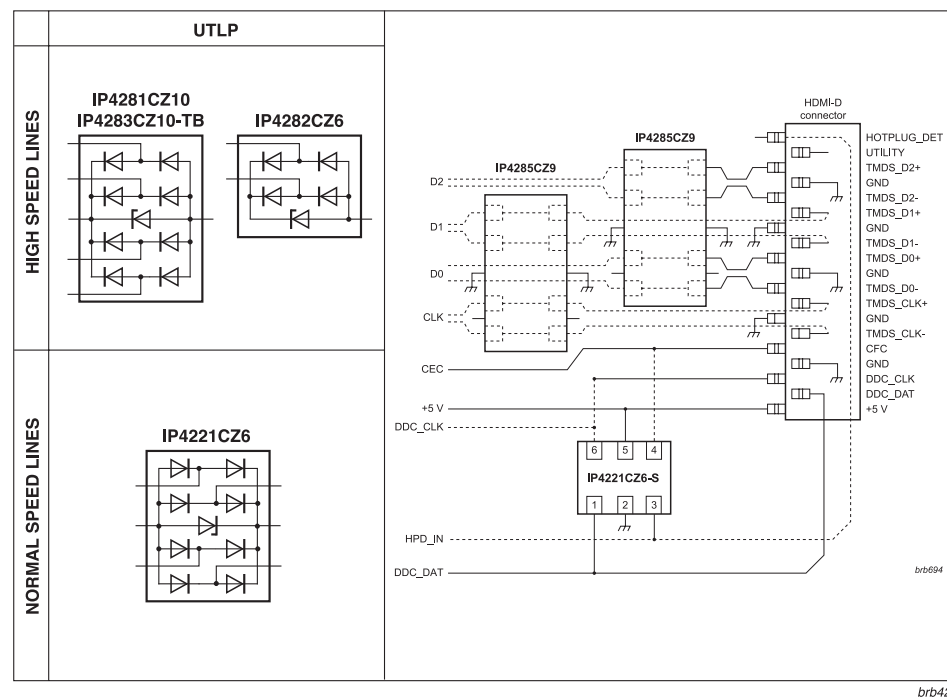
- ▶ ESD protection of  $\pm 12$  kV according to IEC 61000-4-2, level 4 for all TMDS lines
- ▶ Design-friendly "flow-through" signal routing
- ▶ Matched 0.4 mm trace spacing
- ▶ TMDS lines with  $\leq 0.05$  pF matching capacitance between TMDS pairs
- ▶ Line capacitance of only 0.8 pF for each channel - IP4285CZ9
- ▶ 4-channel, Ultra-Thin Leadless Package

### Benefits

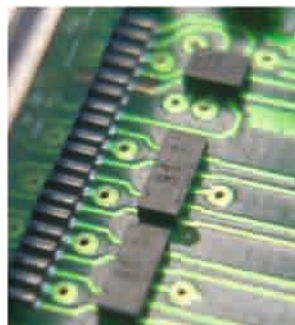
- ▶ System ESD protection for USB 2.0, HDMI 1.3 and 1.4, DisplayPort, eSATA, and LVDS
- ▶ Optimized layout and routing

### Read more on the links below

- ▶ IP4221CZ6-S product page
- ▶ HDMI interface application page



### Optimized layout for HDMI C connector



# 6. High-speed data interfaces

## Advanced ESD protection ICs IP4309CX9 and IP4310CX8 in WLCSP packages

These devices, housed in WLCSP packages with 0.4 mm pitch, cover the full HDMI interface with ESD protection on all pins, biasing of DDC lines, and hotplug. The IP4309CX9 has low-capacitance ESD protection diodes in a 4 x 2 configuration, while the IP4310CX8 covers the lower-speed communication interface.

### Features

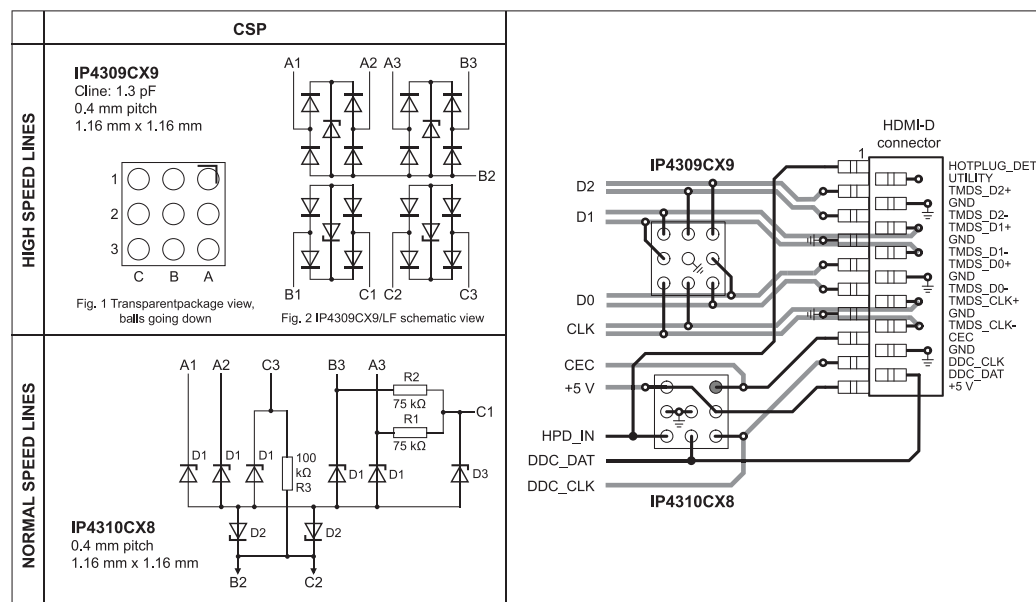
- ▶ ESD protection of  $\pm 15$  kV according to IEC 61000-4-2, level 4 for all TMDS lines
- ▶ TMDS lines with  $\leq 0.05$  pF matching capacitance between TMDS pairs
- ▶ Line capacitance of only 1.3 pF for each channel
- ▶ Chip-scale package (1.16 x 1.16 x 0.61 mm)

### Benefits

- ▶ HDMI 1.3a compliant
- ▶ Small footprint

### Read more on the links below

- ▶ NXP Mobile Usage brochure
- ▶ HDMI interface application page



brb430

# 6. High-speed data interfaces

## ESD protection, DDC/CEC buffering, and Hot Plug module IP4791CZ12

The IP4791CZ12 is an optimized and highly integrated HDMI interface protection and conditioning solution in a small leadless package. It supports HDMI type C and D connectors and contains DDC buffering, CEC buffered level shifting and pull-up current sources, Hot Plus detect, and  $\pm 8$  kV ESD protection for all signals.

### Features

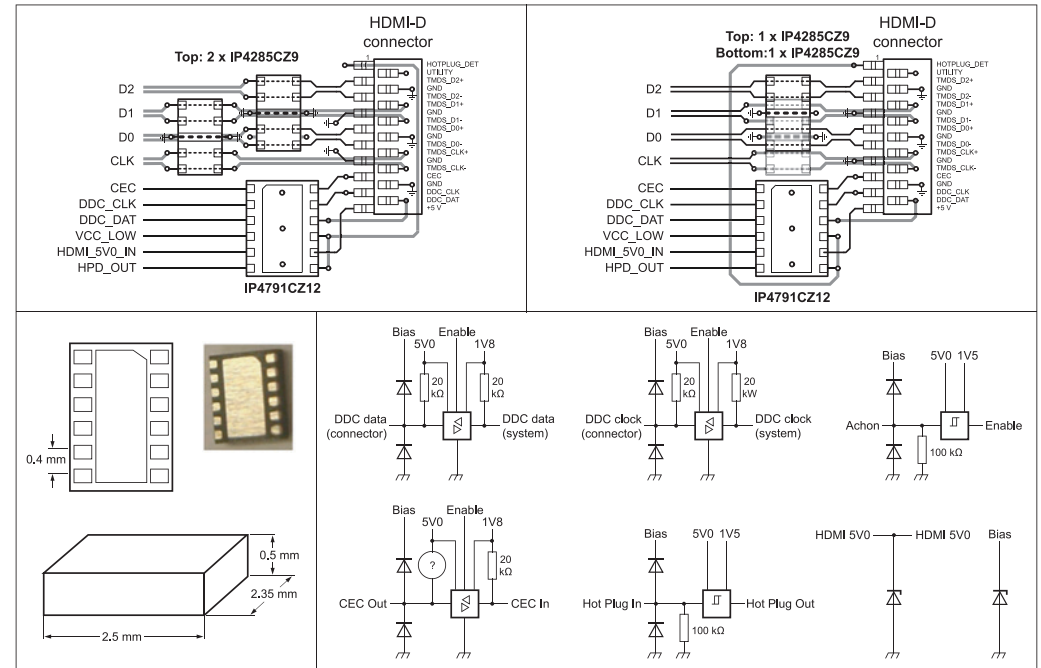
- ▶ ESD protection of  $\pm 12$  kV according to IEC 61000-4-2 for all TMDS lines
- ▶ ESD protection of  $\pm 8$  kV according to IEC 61000-4-2 for all control lines
- ▶ CEC buffered level shifting
- ▶ DDC buffer
- ▶ CEC pull up resistors
- ▶ Hot Plug detect
- ▶ Ultra-small leadless packages with 0.4 mm pitch enable simple, straight PCB routing

### Benefits

- ▶ HDMI 1.4 compliant
- ▶ No need for separate level shifter
- ▶ Small footprint
- ▶ Compatible with HDMI type C and D connectors

### Read more on the links below

- ▶ IP4791CZ12 product page
- ▶ HDMI interface application page



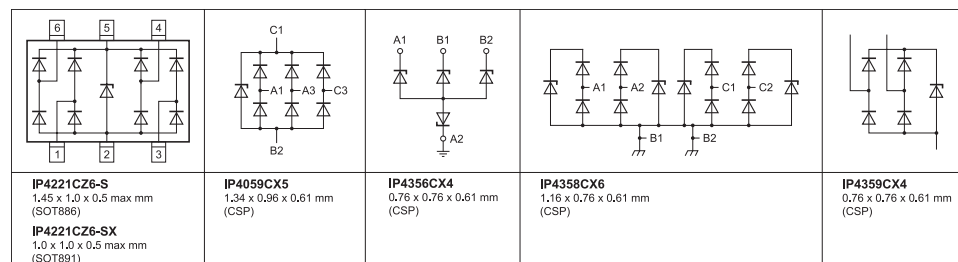
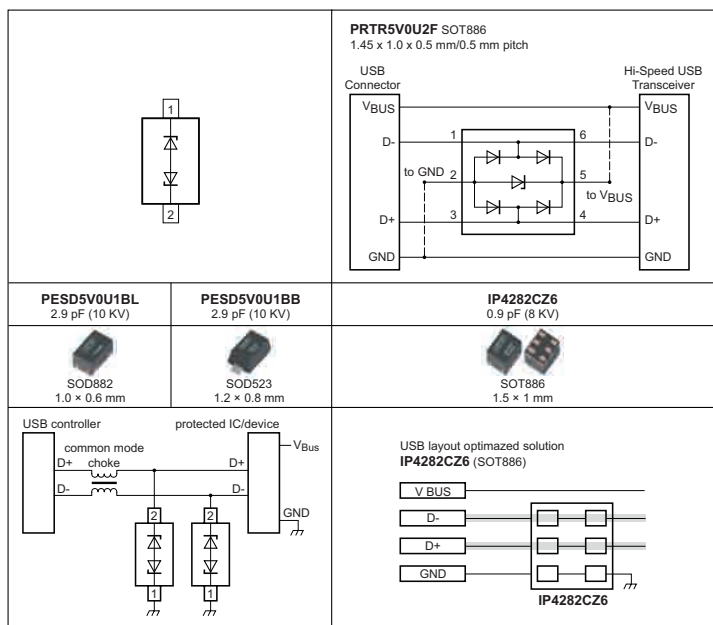
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# 6. High-speed data interfaces

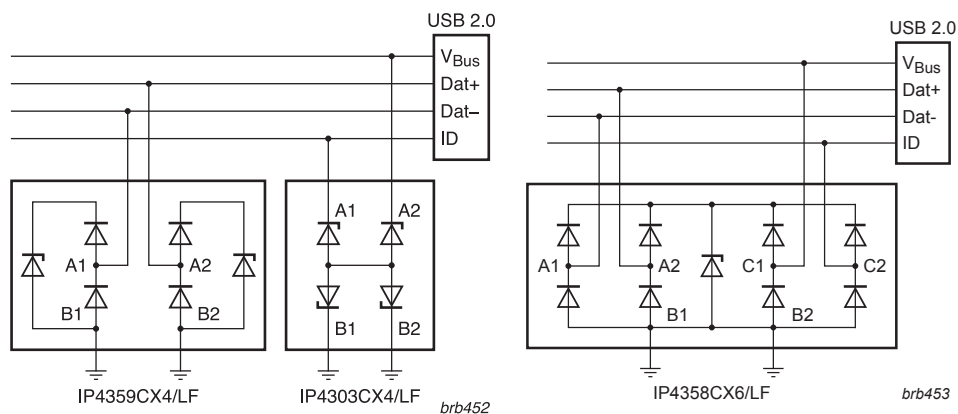
## 6.2 High-Speed USB

We support the USB 2.0 High Speed (HS) standard, which requires very low line capacitance, especially for protection devices, and allows no series resistors in the data lines. Available in CSP, leadless, or plastic packages, these highly integrated solutions deliver high robustness with 8 kV IEC 61000-4-2 ESD protection, and are easy to route.

### Portfolio overview



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[Click here for pre-selection](#)

**Read more on the link below**

► USB and (e)SATA ESD products

# 7. Level translators

Next-generation process technologies usually offer smaller geometries and, along with the smaller footprint, lower maximum supply and I/O voltages. But legacy products, such as external interfaces and memory cards, are often slower to change and, as a result, can use a higher specified voltage. Level translators provide a convenient way to bridge the gap.

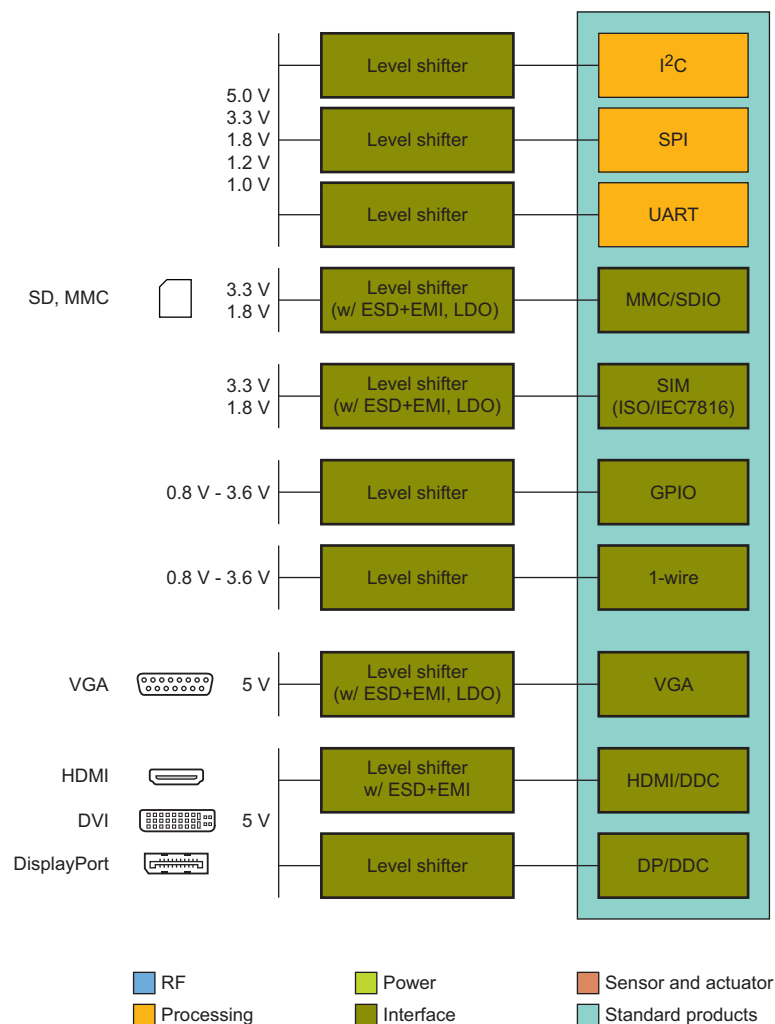
NXP offers a comprehensive portfolio of level translators optimized for the various interfaces used in portable applications. These range from 1-wire protocol to a 50 Mbyte/s SD memory card interface.

Devices with externally accessible interface contacts often require additional, high-level ESD protection and EMI filtering. For these devices, level translators with uni- or bidirectional drivers with direction control or auto sensing are recommended. The device interface will dictate the specific features required.

[Read more on the link below](#)

► [Voltage translators application page](#)

## Standard level translators



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# 7. Level translators

## 7.1 I<sup>2</sup>C level translators

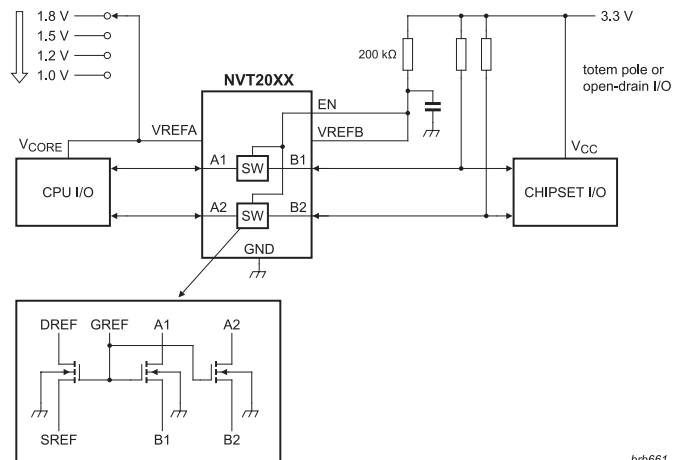
NXP offers one of the most comprehensive portfolios of I<sup>2</sup>C, UART, and SPI-related products. Functions include the following:

- ▶ 1/2/4-bit level translators
- ▶ 4/8/16-bit GPIO expanders
- ▶ LED blinker
- ▶ High-speed UARTs (with IR driver capabilities)

Depending on the requirements of the I<sup>2</sup>C bus load, different implementations of I<sup>2</sup>C level translators (NVT or NTS type) with automatic direction sensing are available in very small leadless packages. The PCA9509 is an auto direction sensing repeater (buffered) I<sup>2</sup>C translator.

[Read more on the link below](#)

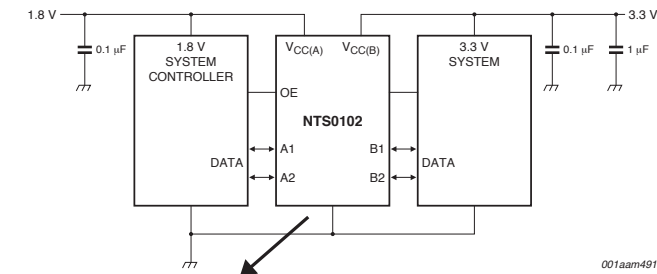
- ▶ NVT2001/02 product page



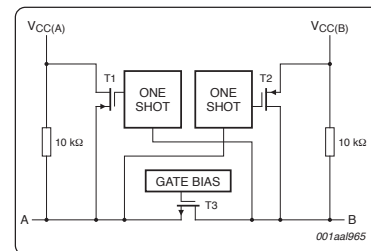
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[Read more on the links below](#)

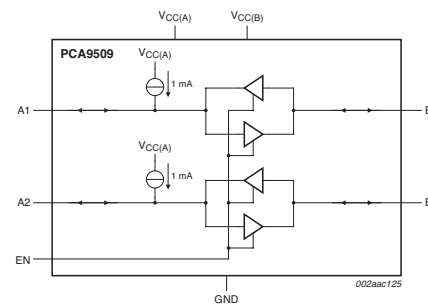
- ▶ NTS0102 product page
- ▶ NTS0104 product page
- ▶ PCA9509 product page



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# 7. Level translators

## 7.2 Level shifters for voltage translation

We offer an extensive range of level shifters for use as voltage translators. All are optimized for low power consumption and small footprint.

### Features

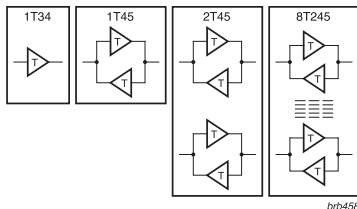
- ▶ Wide operating voltage (0.8 to 3.6 V)
- ▶ High speed (2 ns typical)
- ▶ High current capability (up to 50 mA)
- ▶ Overvoltage ( $>V_{CC}$ ) tolerant inputs and outputs
- ▶ Lowest power consumption
- ▶ Live insertion
- ▶ Bus hold
- ▶ Standby/suspend mode
- ▶ TTL-compatible inputs
- ▶ Configurable logic functions
- ▶ Pb-free, RoHS- and Dark Green-compliant
- ▶ PicoGate and MicroPak packages

### Benefits

- ▶ Reduced power consumption
- ▶ Smaller designs

### Read more on the link below

- ▶ [Level shifters/translators product page](#)



### Standard level translators

Width	Device type	$V_{CC(A)}$ (V)	$V_{CC(B)}$ (V)	$t_{PD}$ (ns)	Rate (Mb/s)
1-bit	74AUP1T45	1.1-3.6	1.1-3.6	4.3	250
	74AVC(H)1T45	0.8-3.6	0.8-3.6	2.1	500
	74LVC(H)1T45	1.2-5.5	1.2-5.5	2.5	420
2-bit	74AVC(H)2T45	0.8-3.6	0.8-3.6	2.1	500
	74LVC(H)2T4	1.2-5.5	1.2-5.5	2.5	420
	NTB0102	1.2-3.6	1.65-5.5	3.8	80
	NTS0102	1.65-3.6	2.3-5.5	4.4	50
4-bit	74AVC(H)4T45	0.8-3.6	0.8-3.6	2.1	500
	NTB0104	1.2-3.6	1.65-5.5	3.8	80
	NTS0104	1.65-3.6	2.3-5.5	4.4	50
8-bit	74AVC(H)8T245	0.8-3.6	0.8-3.6	2.1	500
	74LVC(H)8T245	1.2-5.5	1.2-5.5	3.5	420
	74LVC4245	1.5-5.5	1.5-3.6	3.4	300

Suffix	GW	GM	GF	GT	GM	GD	BQ	BQ
	SOT353	SOT886	SOT891	SOT833	SOT902	SOT996	SOT763	SOT815
	5-pin	6-pin	6-pin	8-pin	8-pin	8-pin	16-pin	24-pin
Width (mm)	2.10	1.00	1.00	1.00	1.60	3.00	2.50	3.50
Length (mm)	2.00	1.45	1.00	1.95	1.60	2.00	3.50	5.50
Pitch (mm)	0.65	0.50	0.35	0.50	0.50	0.50	0.50	0.50

# 8. Keypad and joystick interfaces

We have all the ingredients for best-in-class keypad and joystick interfaces, from GPIO expanders and tailored ESD/EMI filters to one of the widest portfolios of microcontrollers on the market.

## GPIO expanders

These expanders provide a simple way of adding extra GPIO while keeping interconnections to a minimum.

### Features

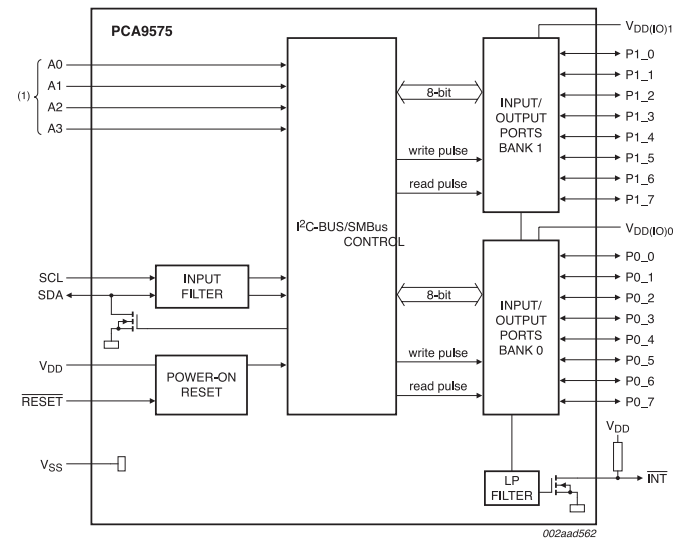
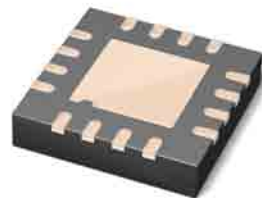
- ▶ 8/16 inputs/outputs
  - True bidirectional I/O
  - Push-pull outputs/open drain
  - Bus keeper feature for inputs
  - Programmable pull-up/pull-down
- ▶ Input voltage range: 1.1 to 3.6 V
- ▶ I/O voltage range: 1.1 to 3.6 V
- ▶ Up to 16 different slave addresses
- ▶ Bit maskable input interrupts
- ▶ Hardware/software reset
- ▶ Low standby current <1 uA
- ▶ 16- and 24-pin HVQFN packages

### Benefits

- ▶ Fast, easy expansion of GPIO
- ▶ Minimize interconnections

### Read more on the links below

- ▶ PCA9574 product page
- ▶ PCA9575 product page
- ▶ GPIO for mobile:
  - NXP web pre-selection



### Other GPIO expanders

Type	Bits	interrupt	V <sub>cc</sub>	Description
PCA9574	8	x	1.1 V – 3.6 V	8-bit I <sup>2</sup> C-bus and SMBus, level translating, low-voltage GPIO with reset and interrupt
PCA9575	16	x	1.1 V – 3.6 V	8-bit I <sup>2</sup> C-bus and SMBus, level translating, low-voltage GPIO with reset and interrupt
PCA9535	16	x	2.3 V – 5.5 V	16-bit I <sup>2</sup> C-bus and SMBus, low-power I/O port with interrupt
PCA9536	4	-	2.3 V – 5.5 V	4-bit I <sup>2</sup> C-bus and SMBus, low-power I/O port
PCA9537	4	x	2.3 V – 5.5 V	4-bit I <sup>2</sup> C-bus and SMBus, low-power I/O port with interrupt
PCA9553	4	-	2.3 V – 5.5 V	4-bit LED driver with programmable blink rates

# 8. Keypad and joystick interfaces

## 8/16/32-bit microcontrollers

From the smallest 8-bit 80C51 to the highest performing 32-bit ARM microcontrollers, we drive the industry as an innovation leader with our highly-integrated and cost-effective products. Our options include enhanced 80C51, ARM7, ARM9, and even ARM Cortex-M architectures.

### Read more on the links below

- ▶ Web page
- ▶ Selection guide

## ESD protection and EMI filters for keypads and joysticks

These highly integrated devices provide broad suppression of unwanted 2G and 3G RF signals, offer extremely low ESD clamping voltage, and deliver ESD protection exceeding EC 61000-4-2 level 4, with 15 kV contact and at least 15 kV air discharge input protection.

### Read more on the link below

- ▶ NXP Mobile Usage brochure

Type	Package	Pitch	Number of lines	C typ (0 V)	R channel
IP4032CX25/LF	CSP	0.5	10	40 pF	80 Ω
IP4033CX25/LF	CSP	0.5	10	40 pF	80 Ω
IP4035CX24/LF	CSP	0.5	10	50 pF	1 kΩ
IP4337CX18/LF	CSP	0.4	7	25 pF	70 Ω
IP4338CX24/LF	CSP	0.4	10	25 pF	70 Ω
IP4041CX25/LF	CSP	0.5	10	50 pF	200 Ω
IP4053CX15/LF	CSP	0.5	6	60 pF	100 Ω
IP4153CX15/LF	CSP	0.5	6	30 pF	100 Ω
IP4353CX15/LF	CSP	0.4	6	60 pF	100 Ω
IP4054CX15/LF	CSP	0.5	4+4	60 pF	100 Ω
IP4088CX20/LF	CSP	0.5	8	50 pF	100 Ω
IP4253CZ8	plastic	0.4	4	45 pF	200 Ω
IP4253CZ12	plastic	0.4	6	45 pF	200 Ω
IP4253CZ16	plastic	0.4	8	45 pF	200 Ω
IP4256CZ3-M	plastic	0.65	1	45 pF	100 Ω
IP4256CZ5-W	plastic	0.5	2	45 pF	100 Ω
IP4256CZ6-F	plastic	0.5	2	45 pF	100 Ω
IP4055CX6	CSP	0.5	2	35 pF	470 Ω
IP4355CX6	CSP	0.4	2	25 pF	470 Ω

### Read more on the links below

- ▶ IP4035CX24 product page
- ▶ IP4337CX18 product page
- ▶ IP4338CX24 product page
- ▶ IP4041CX25 product page
- ▶ IP4251CZyy product page
- ▶ IP4252CZyy product page
- ▶ IP4253CZyy product page
- ▶ IP4254CZyy product page
- ▶ IP4256CZ3-(X) product page

# 9. RF interfaces

## GPS LNA BGU7005

Housed in an extremely small SOT886 package, this Low Noise Amplifier (LNA) requires only one external matching inductor and one external decoupling capacitor. It adapts itself to the changing environment in response to the presence of different radio systems in the cellular handset. At low jamming power levels, it delivers 16.5 dB gain at a noise figure of 0.9 dB. During high jamming power levels, resulting, for example, from a cellular transmit burst, it temporarily increases its bias current to improve sensitivity.

### Features

- ▶ Low-noise, high-gain MMIC
- ▶ Input and output DC decoupled
- ▶ Noise figure (NF) = 0.9 dB at 1.575 GHz
- ▶ High 1 dB compression point of -11 dBm
- ▶ Supply voltage: 1.5 to 2.85 V

### Benefits

- ▶ Fully integrated solution with the lowest external BOM
- ▶ Simplified design (only 2 external components needed)
- ▶ Supports 1.8 V operation with long battery life
- ▶ Very high compression point, with excellent handling of mobile Tx jammers
- ▶ Unrivalled immunity to jammers due to Adaptive Bias™
- ▶ 40% size and 10% cost reduction on PCB due to highest level of integration
- ▶ 20% faster time to first fix in urban canyons / indoor environments

## FM radio LNA BGU7003(/W)

FM radios that integrate the antenna into the mobile device can use one of these LNAs to compensate for losses in antenna sensitivity

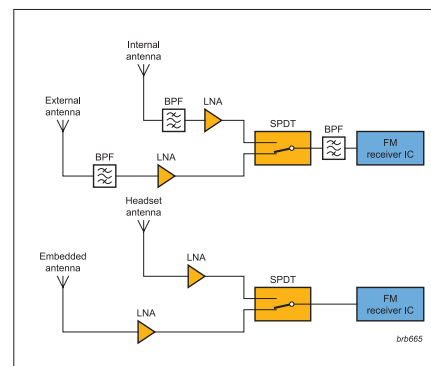
resulting from impedance mismatches. Housed in extremely small packages (SOT891 or SOT886), both deliver a gain of 23 dB with a noise figure of just 0.6 dB. They require only one external matching inductor and one external decoupling capacitor.

### Benefits

- ▶ Family of products offers flexibility in gain and linearity
- ▶ Lowest external component count
- ▶ Broad voltage range: 1.5 to 5.0 V

### Read more on the links below

- ▶ BGU7003 product page
- ▶ BGU7005 product page



### Application video



## Varicap diodes for TV-on-mobile

These small devices play a big role in tuning mechanisms. They deliver excellent linearity and matching, offer very low series resistance, have high capacitance ratios, and meet the requirements of tight capacitance specifications.

### Read more on the link below

- ▶ Varicap diodes product page

# 10. NFC and RFID

NFC, which stands for Near-Field Communication, is the critical technology needed to realize the promise of connecting physical and virtual environments. NFC provides a secure wireless two-way communication between a mobile phone and reception devices such as other mobile phones, payment terminals, and identification

readers. The smartphone market will soon adopt NFC as a new connectivity option, similar to the way GPS, Bluetooth, and WiFi were added to smartphones in the past. However, unlike the prior applications, NFC is much richer and not simply yet another new connectivity solution.

## Solutions for end-to-end mobile transactions and device authentication



# 10. NFC and RFID

## NFC and secure element PN65N

The PN65N combines the well-known PN544 NFC controller with a secure element. The higher level of integration saves board space, shortens development time, and lowers manufacturing cost. Furthermore, the device is footprint-compatible with the PN544, for seamless upgrades and component reduction without having to redesign an existing system.

## Second-generation NFC controller PN544

This high-quality, high-performance NFC controller enables a new range of contactless applications for improved on-the-go experiences. It complies with all released NFC and ETSI/SCP SWP and HCI standards, guarantees interoperability with the existing infrastructure, and provides a flexible, full-featured platform for meeting GSMA requirements in next-generation NFC-enabled devices and services. It offers fully host-controllable power states, delivers a small footprint, and supports multiple secure elements.

### Features

- ▶ Smallest package TFBGA64 (4.5 x 4.5 x 0.8 mm)
- ▶ High level of integration for greater flexibility
- ▶ Support for variety of RF protocols
- ▶ Integrated power management unit
- ▶ Battery Low mode and Power by the Field enabled to comply with deployed infrastructure when handset is off
- ▶ Integrated Frac-N PLL to save XTAL quartz

- ▶ Simultaneous multi cards management (ISO14443-A,B,B', MIFARE)
- ▶ Compliancy with Paypass and EMVCo polling loop
- ▶ Integrated self test to verify antenna matching circuit during production
- ▶ Up to 10 cm operating distance
- ▶ Optimized 80C51 core processor with embedded firmware
- ▶ RoHS-2006 compliant

### Benefits

- ▶ Support for all released NFC standards
- ▶ Guaranteed interoperability with existing infrastructure
- ▶ PN544 Single Wire Protocol (SWP) interface interoperability with major UICC/SIM suppliers
- ▶ Small footprint
- ▶ Shorter integration time due to qualified design-in support for antenna design & software
- ▶ Easy access to NFC technology
- ▶ Leverages NXP expertise and experience with major device manufacturers

### Read more on the links below

- ▶ PN544 leaflet
- ▶ NXP NFC website



# 11. Logic for portable applications

We are deeply committed to the logic market. To ensure that our portfolio remains leading-edge, we continually invest in new process and package technologies, as well as packaging facilities.

We offer advanced, ultra-low-power CMOS logic that's specially designed for portable applications. Our configurable logic gates simplify type approval and shorten design cycles, and our voltage translators make it easy to convert signal levels.

- ▶ Extremely low power consumption for extended battery life
- ▶ Wide range of single-, dual-, and triple-gate functions and configurable logic gates for board layout optimization, especially in advanced, low-power system designs

[Read more on the link below](#)

- ▶ 74AUP1G/2G/3Gxxx leaflet

## 11.1 Ultra-low-power CMOS logic

### Low-voltage, Si-gate CMOS AUP family for portable

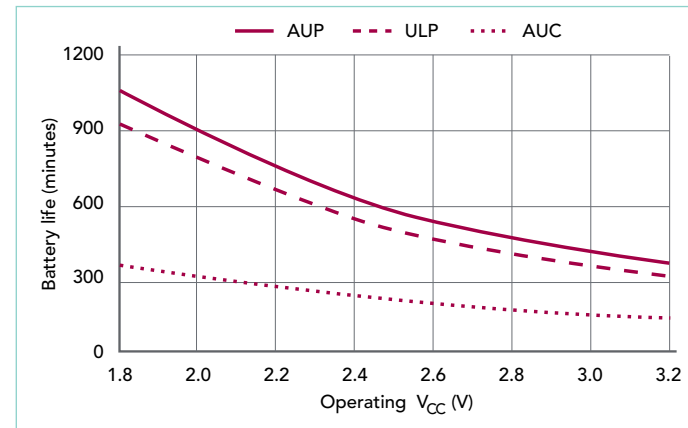
These products offer the industry's lowest dynamic power consumption in a logic device and are designed for use in high-performance, low-power applications.

#### Features

- ▶ 4 ns performance
- ▶ -4/4 mA static drive
- ▶ 0.9  $\mu$ A standby current
- ▶ Optimized for 1.8 V
- ▶ 3.6 V tolerant I/O
- ▶ PicoGate and MicroPak packages
- ▶ Multiple sources

#### Benefits

- ▶ Low propagation delay for advanced applications
- ▶ Wide operating voltage for mixed-voltage applications
- ▶ Schmitt-trigger action on all inputs for high noise immunity





# 11. Logic for portable applications

## 11.2 Configurable logic gates

### Multi-function AUP family for portable applications

For greater design flexibility and simpler inventory management, we offer configurable logic functions that let a single device perform many different operations. The 74AUP1T58, for example, provides low-power, low-voltage configurable logic gate functions. Its output state is determined by eight patterns of 3-bit input. The user can choose the logic functions AND, OR, NAND, NOR, XOR, inverter, or buffer. All inputs can be connected to  $V_{CC}$  or GND.

### Features

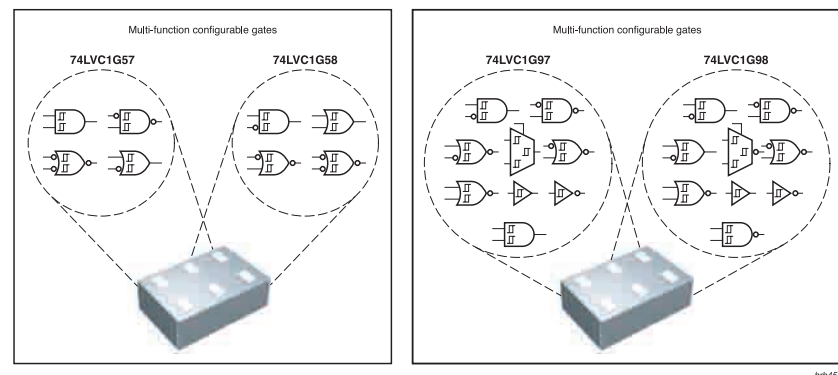
- ▶ Very low dynamic power dissipation (CPD)
- ▶ Wide  $V_{CC}$  from 0.8 to 3.6 V
- ▶ Schmitt-trigger inputs provide high noise immunity
- ▶ Superior ESD protection
- ▶ Wide operating temperature of -40 to +125 °C
- ▶  $T_{PD}$  of 3.2 ns and  $I_{OL}$  of 2.2 mA at 1.8 V  $V_{CC}$
- ▶ Available in single/dual gate functions
- ▶ PicoGate and MicroPak packaging

### Benefits

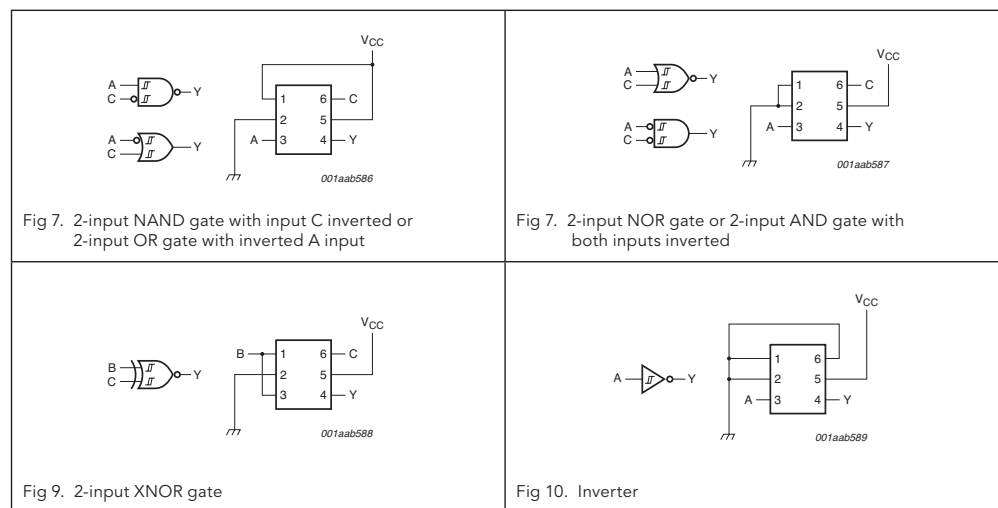
- ▶ Greater design flexibility
- ▶ Simpler inventory management

### Read more on the link below

- ▶ General-purpose logic solutions brochure



### Four of nine possible 74LVC1G57 configurations



### Read more on the link below

- ▶ 74LVC1G57 product page

# 11. Logic for portable applications

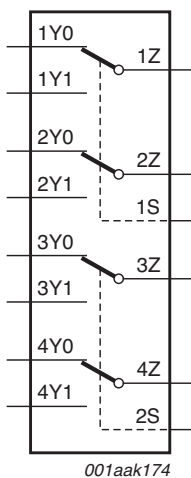
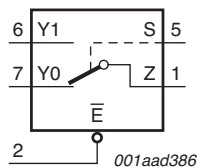
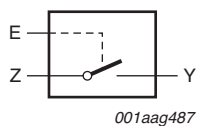
## 11.3 Logic-controlled analog switches

The NX3 series offers a wide variety of switch configurations, ranging from a single-channel SPST (single-pole, single-throw) to an SP8T (single-pole, eight-throw). The supported bandwidths range from 15 MHz at the low end to 330 MHz at the high end, for dual-channel USB 2.0 switching. All are suitable for use with analog and digital signals, such as USB, microphone, speaker, and so on.

### Features

- Supply voltage range of 1.4 to 4.3 V
- Leadless QFN package types
- Low THD due to low voltage dependence
- Pb-free and RoHS-compliant

[Click here for pre-selection](#)



Configuration	Device type	$R_{ON\ MAX}$ (@2.7 V) ( $\Omega$ )	$f_{-3dB}$ (MHz)	THD (%)	X-talk (dB)
1x SPST	NX3L1G66	0.75	60	0.024	-90
	NX3VT384	0.45	25	0.01	-90
2x SPST	NX3L2G66	0.75	60	0.024	-90
	NX3VT384	0.45	25	0.01	-90
1x SPDT	NX3L1G3157	0.75	60	0.024	-90
	NX3L1T3157	0.75	60	0.024	-90
	NX3L1G53	0.75	60	0.024	-90
	NX3L1T53	0.75	60	0.024	-90
2x SPDT	NX3L4684	0.8 0.5	60 25	0.01	-90
	NX3L2267	0.75	60	0.024	-90
2x DPDT or 4PDT	NX3L2467	0.75	60	0.02	-90
	NX3DV2567	9.5	330	-	-60
	NX3DV3899	4.5	200	0.01	-90
1x SPTT	NX3L4357	0.75	30	0.02	-90
1x SP8T	NX3L4051	0.75	15	0.02	-90
3x SPDT	NX3L4053	0.8	60	0.02	-90

# 12. Discretes for portable applications

Our comprehensive portfolio of ultra-small diodes and transistors enables high performance in increasingly small portable electronics. We safeguard sensitive ICs with advanced ESD protection diodes and EMI filters, and guarantee the lowest power losses in battery-driven systems with low-voltage-drop Schottky diodes and low  $V_{CEsat}$  (BISS) transistors. We also offer a full range of standard switching, Schottky, and Zener diodes, along with small-signal transistors, MOSFETs, and resistor-equipped transistors (RETs).

## Innovation in small packages






NXP's new SOD882D is the latest landmark in ultra-small leadless plastic packages. It is the industry's first to offer solderable side pads. The very small size of only 1.0 x 0.6 x 0.37 mm and superior mechanical stability are unmatched. For more details, please visit [www.nxp.com/package/SOD882D.html](http://www.nxp.com/package/SOD882D.html)

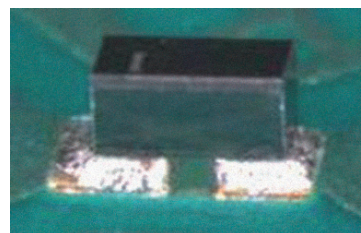


## Read more on the links below

- Pre-selection
- Portfolio overview
- Selection guide for ESD protection
- Selection guide for BISS transistors

## ESD protection diodes

Package	Size (mm)	Number of protected lines		$C_{oss}$ typ (pF)	$V_{RWM}$ (V)	ESD rating <sup>1)</sup> max (kV)	$I_{ES}$ @ $V_{RWM}$ max (mA) (V)		Configuration	Type
SOD962	0.6 x 0.3 x 0.3	2	1	35	5	30	0.0001	5		PESD5V0S1BSF
			1	12	5	30	0.0001	5		PESD5V0L1BSF
			1	3.5	5	15	0.0001	5		PESD5V0V1BSF
SOD882 SOD882D	1.0 x 0.6 x 0.5	1	1	35	5	30	0.1	5		PESD5V0S1BL(D)
				12	5	25	0.1	5		<b>PESD5V0V1BL(D)</b>
				2.9	5	10	0.1	5		PESD5V0U1BL
				0.9	5	9	0.1	5		PESD5V0X1BL
				0.4	5	8	0.1	5		<b>PESD5V0F1BL</b>
				150	5	30	1	5		PESD5V0S1UL(D)
		1	1	2	5	9	0.1	5		PESD5V0U1UL
				200	3.3	30	2	3.3		PESD3V3S1UL
				38	12	30	0.05	12		PESD12VS1UL
				0.95	5	8	1	5		5PESD5VX1ULD
		2	1	2.9	5	10	0.1	5		PESD5V0U2BM
				22	3.3	15	0.3	3.3		PESD3V3L2UM
SOT883 (SC-101)	1.0 x 0.6 x 0.5	2	1	16	5	15	0.025	5		PESD5V0L2UM



# 12. Discretes for portable applications

## Low $V_{CEsat}$ (BISS) transistors

Polarity	$V_{CE0}$ (V)	$I_C$ (A)	$I_{CM}$ (A)	$h_{FE}$ min/typ	@ $I_C$ (A)	@ $V_{CE}$ (V)	$R_{CEsat}$ typ (m $\Omega$ ) @ $I_C$ $I_C/I_B = 10$	$V_{CEsat}$ typ (mV) @ $I_C = 0.5$ A; $I_B = 0.05$ A	$V_{CEsat}$ max (mV)	@ $I_C$ (A)	@ $I_B$ (A)	Type	Package	Size (mm)	$P_{tot}$ (mW) <sup>1)</sup>
NPN	15	0.5	1.0	200/325	0.01	2	360	-	250	0.5	0.05	PBSS2515M	SOT883 (SC-101)	1.0 x 0.6 x 0.5	250
	40	0.5	1.0	200/550	0.01	2	380	-	250	0.5	0.05	PBSS2540M			
	20	2.0	4.0	220/410	0.5	2	140	70	350	2	0.2	PBSS4220V			
	40	1.0	3.0	300/-	0.5	5	150	70	440	2	0.2	PBSS4140V	SOT666	1.6 x 1.2 x 0.55	500
		2.0	3.0	300/400	0.5	5	150	70	400	2	0.2	PBSS4240V			
	60	1.0	2.0	200/400	0.5	5	200	110	250	1	0.1	PBSS4160V			
	15	0.5	1.0	200/425	0.01	2	300	200	250	0.5	0.05	PBSS2515E	SOT416 (SC-75)	1.6 x 0.8 x 0.77	250
PNP	40	0.5	1.0	200/350	0.01	2	380	200	250	0.5	0.05	PBSS2540E			
	15	0.5	1.0	200/260	0.01	2	300	150	250	0.5	0.05	PBSS3515M	SOT883 (SC-101)	1.0 x 0.6 x 0.5	250
	40	0.5	1.0	200/380	0.01	2	440	220	350	0.5	0.05	PBSS3540M			
	20	2.0	4.0	220/440	0.1	2	140	75	390	2	0.2	PBSS5220V			
	40	1.0	2.0	300/-	0.1	5	200	120	310	1	0.1	PBSS5140V	SOT666	1.6 x 1.2 x 0.55	500
		1.8	3.0	300/450	0.1	5	185	100	530	2	0.2	PBSS5240V			
	60	1.0	2.0	150/250	0.5	5	220	120	330	1	0.1	PBSS5160V			
2 x PNP	15	0.5	1.0	200/325	0.01	2	300	130	250	0.5	0.05	PBSS3515E	SOT416 (SC-75)	1.6 x 0.8 x 0.77	250
	40	0.5	1.0	200/380	0.01	2	440	230	350	0.5	0.05	PBSS3540E			
	15	0.5	1.0	200/-	0.01	2	300	170 <sup>2)</sup>	250	0.5	0.05	PBSS3515VS			
NPN/PNP	15	0.5	1.0	200/-	0.01	2	300	170 <sup>2)</sup>	250	0.5	0.05	PBSS2515VPN	SOT666	1.6 x 1.2 x 0.55	500
2 x NPN			1.0	200/-	0.01	2	300	170 <sup>2)</sup>	250	0.5	0.05	PBSS2515VS			

<sup>1)</sup> Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>

<sup>2)</sup> @  $I_C = 0.5$  A;  $I_B = 0.025$  A

Package outline	Pins	Package size (mm)
SOD882 /SOD882D 	2	1.0 x 0.6 x 0.5
SOD523 (SC-79) 	2	1.2 x 0.8 x 0.6
SOT883 (SC-101) 	3	1.0 x 0.6 x 0.5

# Additional resources

The listed web pages provide access to additional information about NXP and its product lines.

**Mobile devices application page**

<http://www.nxp.com/applications/portable-devices/cellular-mobile-phone-solution.html>



**Technical support (including application notes)**

<http://www.nxp.com/technical-support-portal.html>

**X-reference tool (search tool for NXP website, for use offline)**

<http://www.nxp.com/products/x-reference-offline-tool/>

**NXP Chinese website (simplified characters)**

[www.cn.nxp.com](http://www.cn.nxp.com)

**NXP Chinese website (traditional characters)**

[www.tw.nxp.com](http://www.tw.nxp.com)

**NXP Japanese website**

[www.jp.nxp.com](http://www.jp.nxp.com)



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