Application Guide

Audio systems

Introduction

Your partner for audio systems

At NXP we offer a wide portfolio of advanced solutions for audio systems. Each one is built on our deep understanding of what designers and manufacturers need, and what's required to go to market.

We provide an extensive portfolio of standard products, and support peripherals functions, such as advanced audio and HDMI interfaces. We also can deliver application-specific solutions for reception, drawing on a complete range of radio-receiver ICs.

We use next generation packaging to save space, lower costs, and improve content security, and we reduce energy consumption 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.
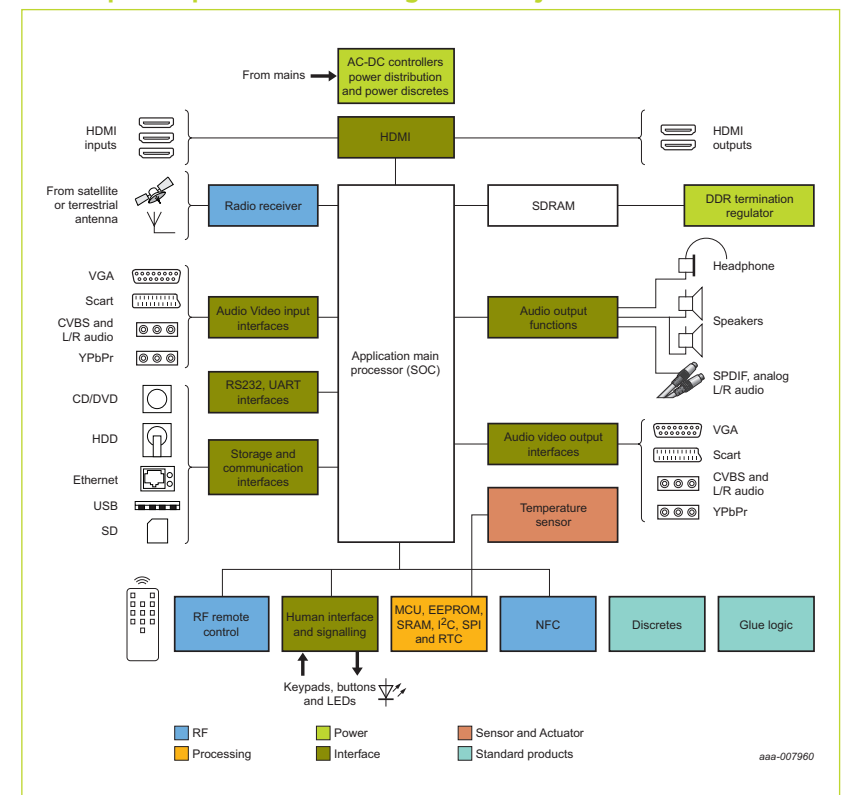
Our company is known for innovation and the ability to introduce new technologies that set the standard for performance, efficiency, and size. Our new chip-scale-package (CSP) devices, for example, have an exceptionally compact footprint yet achieve a new benchmark in mechanical robustness.

We support our customers with a cost-efficient supply chain, and an enterprise-wide commitment to the highest standards of security, quality, and reliability. We also help our customers prepare for the future, by working with them to implement new features - such as NFC for easy pairing with mobile phones and tablets - that will drive growth. In short, our customers have the confidence that comes from working with a world-class partner.

There's more.

This application guide is an introduction to our Audio systems portfolio. 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 http://www.nxp.com/applications/consumer/Audio-and-home-theater-systems.html

NXP improves performance throughout the system

aaa-007960

Contents

1. Power efficiency

Every system needs to use power efficiently, but when audio devices need to be able to have anywhere, anytime connectivity, for Internet radio, or music streaming, it can be hard to shut down the system when it's not actively being used. The challenge is to design a power distribution system that operates very efficiently in all modes, from fully active to deep sleep.

At NXP, we specialize in saving power, and build on decades of expertise in portable and battery-powered systems. Our GreenChip™ family, now in its third generation, delivers best-in-class efficiency for power supplies.

Our AC/DC controllers cover the full power range, from the 5 W required by small audio dock stations to the 150 W and above required by home theater system amplifiers. Our AC/DC controllers also deliver high efficiency at low load, meaning they are extremely well suited to systems that need to maintain high efficiency in standby or deep-sleep mode. To lower power consumption in standby even further, we also offer standalone low-power controllers that can be associated with a high-power resonant topology.

Our load switches provide precise control of the different power domains in an audio system, and can be used to control the power line on a USB interface.

We round out our power portfolio with a family of precision shunt regulators, and a broad range of discretes that help optimize energy consumption throughout the system.

1. Power efficiency

1.1 Primary AC/DC controllers

<75 W flyback controller TEA1738 for primary control of low- to mid-power audio systems and Hi-Fi components

The TEA1738 supports high-end regulation schemes. For designs that need less sophisticated flyback control, the TEA1733 is recommended.
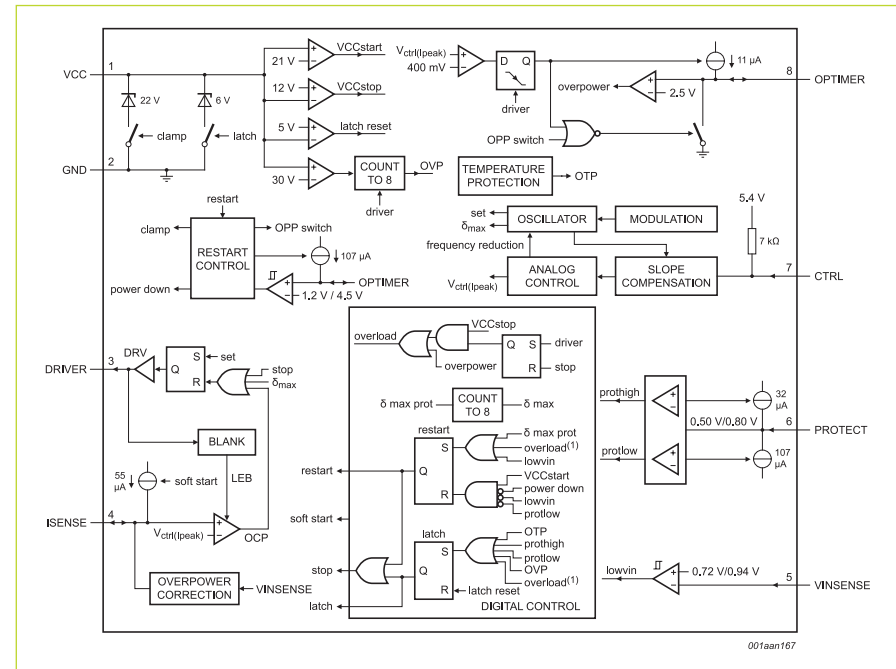
Features

▸ SMPS controller IC enabling low-cost applications
▸ Large input voltage range (12 to 30 V)
▸ Integrated OverVoltage Protection (OVP) on pin V_{cc}
▸ Very low supply current during start-up and restart (typically 10 μA)
▸ Low supply current during normal operation (typically 0.55 mA without load)
▸ Overpower or high/low line compensation
▸ Adjustable overpower time-out
▸ Adjustable overpower restart timer
▸ Fixed switching frequency with frequency jitter to reduce EMI
▸ Frequency reduction at medium power operation to maintain high efficiency
▸ Frequency reduction with fixed minimum peak current
▸ Frequency increase at peak power operation
▸ Slope compensation for CCM operation
▸ Low and adjustable OverCurrent Protection (OCP) trip level
▸ Adjustable soft-start operation
▸ Two protection inputs (e.g. for input UVP and OVP)
▸ IC overtemperature protection

TEA1738 selection table

Type	Safe restart protection	Latched protection	Low startup voltage (13.2 V typical)
TEA1738T	Yes	No	No
TEA1738FT	Yes	No	Yes
TEA1738LT	No	Yes	No

TEA1738T block diagram

001aan167

1. Power efficiency

75 to 150 W GreenChip III flyback and PFC controller TEA1751 for primary control of mid-power audio systems and Hi-Fi components

Features
▸ Integrated PFC and flyback controller
▸ Universal mains supply operation [70 to 276 V (AC)]
▸ NXP-patented dual-boost PFC with accurate maximum output voltage
▸ High level of integration, for very low external component count and cost-effective design
▸ On-chip start-up current source

PFC green features
▸ NXP-patented valley/zero voltage switching for minimum switching losses
▸ Frequency limitation to reduce switching losses
▸ PFC is switched off when a low load is detected at the flyback output

Flyback green features
▸ NXP-patented valley switching for minimum switching losses
▸ Frequency reduction with fixed minimum peak current at low power operation for high efficiency at low output power levels

Protection features
▸ Safe restart mode for system fault conditions
▸ NXP-patented continuous mode protection via demagnetization detection for both converters
▸ UnderVoltage Protection (UVP) (foldback during overload)
▸ OverVoltage Protection (OVP) for both converters (adjustable for flyback converter)

▸ Mains voltage independent OverPower Protection (OPP)
▸ Open control loop protection for both converters. The open loop protection on the flyback converter is latched on the TEA1751L and safe restart on the TEA1751
▸ IC overtemperature protection
▸ Low and adjustable OverCurrent Protection (OCP) trip level for both converters
▸ General purpose input for latched protection, e.g. to be used for system OverTemperature Protection (OTP)

Typical application configuration

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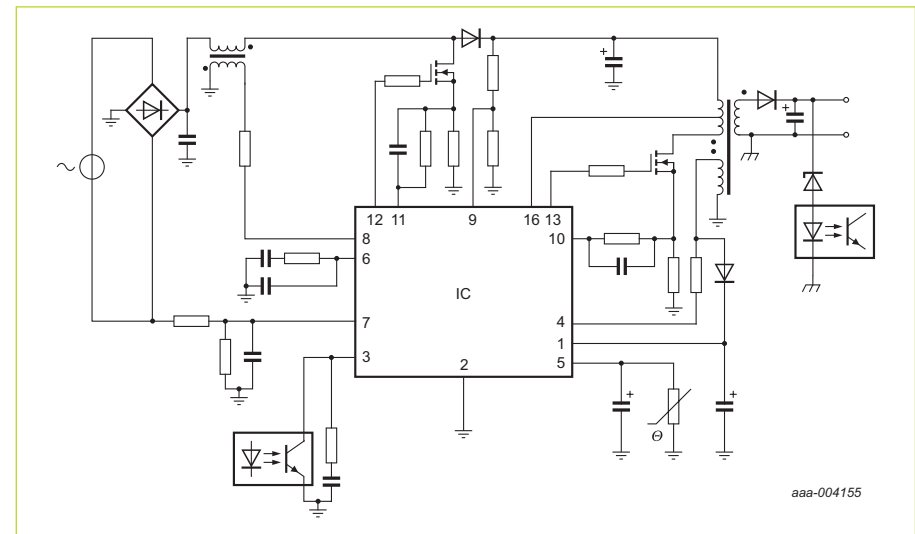
1. Power efficiency

Greenchip flyback and PFC controller TEA1755 for primary control of mid-power audio systems and Hi-Fi components up to 250 W

The TEA1755LT is the latest generation of green Switched Mode Power Supply (SMPS) controller ICs. The TEA1755LT combines a controller for Power Factor Correction (PFC) and a flyback controller. Its high level of integration enables cost-effective power supply design using a very low number of external components.

The PFC operates in Quasi-Resonant (QR) or Discontinuous Conduction Mode (DCM), with valley switching.

The specially built-in green functions provide high efficiency at all power levels. At high power levels the flyback operates in QR mode or DCM with valley detection. At medium power levels, the flyback controller switches to Frequency Reduction (FR) mode and limits the peak current to an adjustable minimum value. In low power mode, the PFC switches off to maintain high efficiency. At very low power levels, when the flyback switching frequency drops below 24 kHz, the flyback converter switches to burst mode. During the non-switching phase of burst mode, the internal IC supply current is minimized to further optimize efficiency. Valley switching is used in all operating modes.

These modes ensure high-efficiency at low power and good standby power performance while minimizing audible transformer noise.

A typical configuration of the TEA1755LT IC

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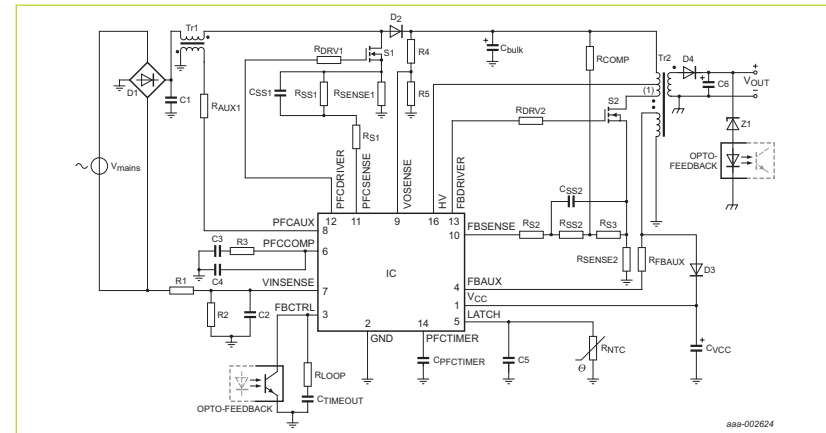
Features
▸ Integrated PFC and flyback controller
▸ Dual-boost PFC with accurate maximum output voltage
▸ Adjustable PFC switch off delay
▸ External PFC switch on and switch off override
▸ On-chip start-up current source
▸ Reduced IC supply current during burst mode enabling ErP lot 6
▸ Power-down functionality for very low standby power
▸ Valley/Zero-Voltage Switching for both flyback and PFC
▸ PFC switched off when a low-load is detected at the flyback output
▸ Frequency reduction with adjustable minimum peak current at low-power operation maintains high-efficiency at low output power levels
▸ Burst mode operation at very low-power levels for high-efficiency operation
▸ Continuous mode protection using demagnetization detection
▸ Accurate OverVoltage Protection (OVP) for both converters
▸ Mains voltage independent OverPower Protection (OPP)
▸ Open control loop protection for both converters
▸ General-purpose input for latched protection

1. Power efficiency

150 to 500 W main power supply resonant controller TEA1611 for primary control of high power audio systems and Hi-Fi components

Features

‣ Universal mains supply operation (70 to 276 V (AC))
‣ Integrated high-voltage level-shift function
‣ Integrated high-voltage bootstrap diode
‣ Low start-up current (green function)
‣ Adjustable non-overlap time
‣ Internal OverTemperature Protection (OTP)
‣ OverCurrent Protection (OCP) that activates a shut-down timer
‣ Soft-start timing pin
‣ Transconductance error amplifier for ultra high-ohmic regulation feedback
‣ Latched shut-down circuit for OverVoltage Protection (OVP)
‣ Adjustable minimum and maximum frequencies
‣ UnderVoltage LockOut (UVLO)
‣ Fault latch reset input
‣ Wide supply voltage range (max 20 V)

150 to 500 W HBC and PFC controller TEA1713 for primary control of high-power audio systems and Hi-Fi components

Features

‣ Adaptive non-overlap timing control
‣ Capacitive mode protection for HBC controller
‣ On-chip high-voltage start-up source
‣ Stand-alone operation or from external DC supply
‣ Extended wide supply voltage range (36 V)
‣ Boundary Condition Mode operation with on-time control
‣ Valley/zero voltage switching for min. switching losses
‣ Frequency limitation to reduce switching losses
‣ Accurate boost voltage regulation

TEA1611 basic configuration

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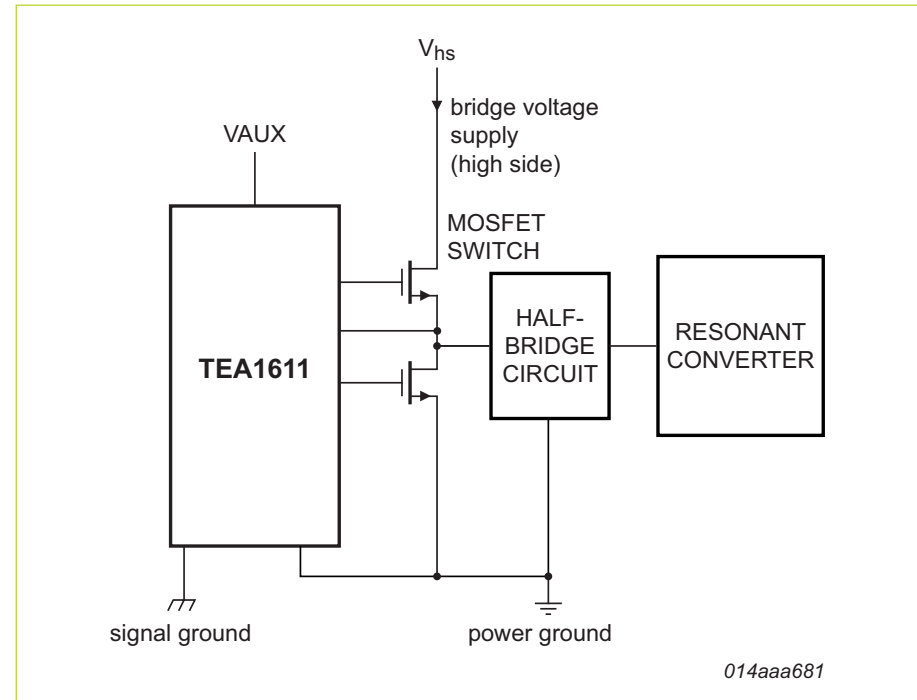
‣ Burst mode switching with soft-start and soft-stop
‣ Adaptive non-overlap timing (cycle-by-cycle)
‣ Burst mode switching to reduce low-load consumption
‣ Integrated high-voltage level shifter
‣ Adjustable min and max frequency (up to 500 kHz)

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1.2 Main power supply: secondary synchronous rectification ICs

Designed for switched-mode power supplies (SMPS), NXP's extremely efficient and highly integrated GreenChip ICs enable simple, cost-effective power supplies with very few external components.

**High-power GreenChip family TEA175x(L) and GreenChip SR family TEA176x & TEA179x**

Features
▸ Wide supply voltage range (8.5 to 38 V)
▸ High level of integration, resulting in very low external
   component count
▸ Wide opto output voltage range (3.5 to 38 V)
▸ High driver output voltage of 10 V to drive all MOSFET brands to
   the lowest R_{DSon}
▸ Accurate internal voltage reference for voltage control (TEA176x)

1.3 Standby power supply

The TEA172x family of HV start-up flyback controllers with integrated MOSFET are highly integrated devices which enable low no-load power consumption below 10 mW, reduce component count for a cost-effective application design, provide advanced control modes that deliver exceptional efficiency, and include many protections.

Application example for TEA1761T

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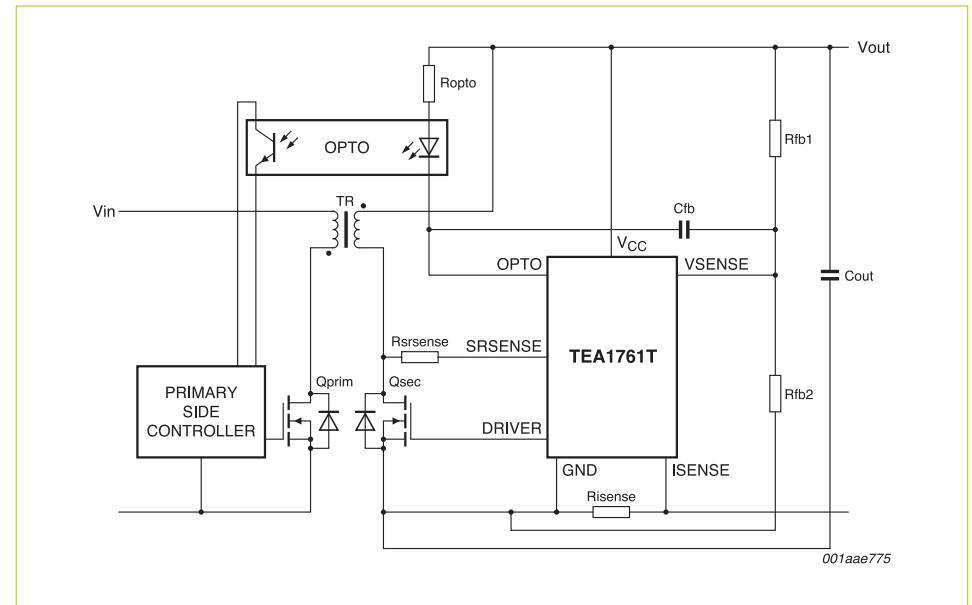
Type number	No load power	Switching frequency	CV/CC Regulation	Burst frequency	Transient Response	Package
TEA1721AT	<10 mW	51.5 kHz	5% / 10% +Lp	420 Hz	>4.3 V USB (2 x 680 µF)	SO-7
TEA1721BT	<15 mW	51.5 kHz	5% / 10% +Lp	885 Hz	>4.3 V USB (2 x 470 µF)	SO-7
TEA1721DT	<20 mW	51.5 kHz	5% / 10% +Lp	1260 Hz	>4.3 V USB (1 x 680 µF)	SO-7
TEA1721FT	<25 mW	51.5 kHz	5% / 10% +Lp	1850 Hz	+/- 5% (2 x 820 µF)	SO-7
TEA1723AT	<20 mW	51.5 kHz	5% / 10% +Lp	420 Hz	>4.3 V USB (2 x 680 µF)	SO-7
TEA1723BT	<30 mW	51.5 kHz	5% / 10% +Lp	885 Hz	>4.3 V USB (2 x 470 µF)	SO-7
TEA1723DT	<40 mW	51.5 kHz	5% / 10% +Lp	1260 Hz	>4.3 V USB (1 x 680 µF)	SO-7
TEA1723FT	<50 mW	51.5 kHz	5% / 10% +Lp	1850 Hz	+/- 5% (2 x 820 µF)	SO-7

1. Power efficiency

1.4 Shunt regulators

TL431 adjustable precision shunt regulator family
Three-terminal shunt regulator family with an output voltage range
between Vref and 36 V, to be set by two external resistors.

▸ The TL431xDBZR types feature an enhanced stability area with a very low
   load capacity requirement.
▸ The TL431xFDT types offer an enhanced stability area and a higher
   ElectroMagnetic Interference (EMI) ruggedness, for example, for Switch
   Mode Power Supply (SMPS) applications.
▸ The TL431xSDT types are designed for standard requirements and linear
   applications.

Key features
▸ Programmable output voltage up to 36 V
▸ Three different reference voltage tolerances:
   ▸ Standard grade: 2%
   ▸ A-Grade: 1%
   ▸ B-Grade: 0.5%
▸ Typical temperature drift: 6 mV (in a range of 0 °C up to 70 °C)
▸ Low output noise
▸ Typical output impedance: 0.2 Ω
▸ Sink current capability: 1 to 100 mA
▸ AEC-Q100 qualified (grade 1)

1. Power efficiency

1.5 Load switches

NXP's feature rich logic controlled high side load switches manage the distribution of power in application sub-systems to significantly reduce total power dissipation. Available in extremely small CSP packages and with a continuous current as low as 500 mA and as high as 3 A, NXP's range of load switches are suitable for multiple space constrained applications. Load switches are ideal for use in portable systems to extend battery life and optimize charging cycles.

Key features
- Wide input voltage range of 1.1 V to 20 V for design flexibility
- Low R_{ON} of 20 mΩ (typ.) for low loss across the switch
- Overvoltage tolerant threshold control logic eliminates external level shifters

- Integrated resistor to discharge load capacitance, when switch is disabled
- Reverse voltage protection
- Low power off leakage current for extended battery life
- Under voltage lock out ensures switch remains disabled when a voltage less than the operating range is applied
- Over temperature shutdown prevents any damage to switch and downstream peripherals

Type number	Description	V_{CC} (V)	Logic switching levels	R_{ON} (mΩ)	I_{SW} (A)	t_{ON} (ms)	R_{dch}	Power dissipation considerations	T_{amb} (Cel)
NX3P1107UK	Logic controlled high-side power switch	0.9 - 3.6	low threshold	34	1.5	0.15		Very low	-40 - 85
NX3P1108UK	Logic controlled high-side power switch	0.9 - 3.6	low threshold	34	1.5	0.15	Y	Very low	-40 - 85

1. Power efficiency

1.6 Discretes

The power consumption of audio products and other consumer appliances is progressively going down, because of new efficiency requirements and new power conservation regulations. This trend, among other factors, enables the usage of our new medium power Schottky diodes in the AC/DC 12 V rail.

▸ Our medium power Schottky diodes in SOD123W and SOD128 packages are used as freewheeling diodes on the secondary side, with an operating range of 30 to 60 V and 1 to 5 A. Recommended products include PMEG6030EP and PMEG4050EP.
▸ Our TL431xxFDT series offer enhanced EMI ruggedness, an outstanding step response, and stability area for all SMPS applications.

Schottky diodes		Zener diodes		Analog ICs	
PMEG4030ER	SOD123W	BZX84J-SERIES	SOD323F	TL431xxFDT	SOT23
PMEG4050EP	SOD128	BZX84-SERIES	SOT23		
PMEG6030EP	SOD128				

2. On-board connectivity

Depending on the SOC architecture, features and interface choices, the connection to an additional DSP or peripheral ICs is sometimes complex: it may not be possible to connect directly the IO interfaces of the ICs if, for example, the voltage levels they accept on their data interfaces do not match. NXP has a very large portfolio of devices that can be used to solve these issues, including passive, active, mono- and bi-directional level shifters, as well as buffers.

Low power passive level translators from the NVT2xxx, PCA9306, AUP, AVC, LVC, NTB/NTS and even the GTL families can be used for I^2C, I^2S, SPI, digital RGB Bidirectional Level Shift, while offering low standby power. Capacitance isolation devices in the PCA95xx family can perform I^2C & SMBus bidirectional Level Shift while offering the best noise margin. Active GTL devices (GTL2xxx, GTL16xx families) are the de-facto standard for use with Intel™ processors and support GTL to LVTTL bidirectional level shift.

If the control bus interfaces don't match, NXP's portfolio of I^2C/SPI/ parallel bus bridges can resolve the issue.

2.1 Low-power/ passive voltage translators

For new designs, NVT parts are recommended.

Key features
‣ Very low standby current (5 uA)
‣ Very wide supply range (from 1 to 5 V)
‣ Bidirectional without the need for a direction pin
‣ I^2C and DDC compliant
‣ Lock-up free operation for isolation when EN=LOW

# CH	NEW	OLD	USAGE
1	NVT2001	-	CLOCK
2	NVT2002	GTL2002	I^2C, I^2S, SMBUS
	PCA9306		
3	NVT2003	-	I^2C, SERVER
4	NVT2004	-	SPI
6	NVT2006	-	I^2C + SPI
8	NVT2008	GTL2003	DIGITAL RGB
10	NVT2010	GTL2010	DATA BUS
22	-	GTL2000	ADDRESS + DATA

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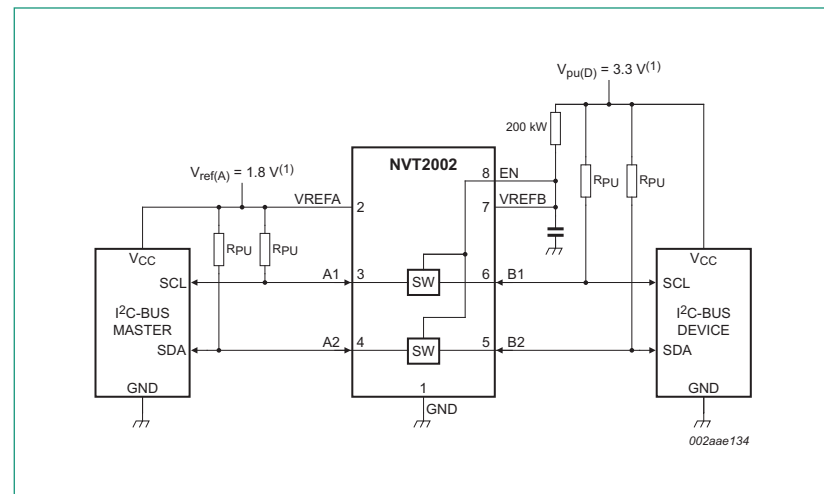
2. On-board connectivity

2.2 High performance voltage translators

NXP provides high performance voltage translators in multiple configurations to meet specific application needs and ease the design effort. The latest NTB/NTS series offers auto-sense direction and a wide operating voltage range.

NXP's voltage translators are available in a wide variety of leadless packages to meet today's stringent board-space constraints and reliability requirements.

Four main families let you address all level shifting needs:
▸ AUP: 0.8 – 3.6 V operating range, bidirectional.
▸ AVC: 0.8 – 3.6 V operating range, bidirectional.
▸ LVC: 1.2 – 5.5 V operating range, bidirectional.
▸ NTB/NTS: 1.65 – 5.5 V operating range, auto-sense direction.

NXP Voltage Translators

Type	Device type	$V_{CC(A)}$ (V)	$V_{CC(B)}$ (V)	Rate (Mbps)
1-bit	74AUP1T45	1.1 - 3.6	1.1 - 3.6	-
	74AVC(H)1T45	0.8 - 3.6	0.8 - 3.6	500
	74LVC(H)1T45	1.2 - 5.5	1.2 - 5.5	420
	74AUP1T34	1.1 - 3.6	1.1 - 3.6	-
	NTB0101	1.2 - 3.6	1.65 - 5.5	80
	NTS0101	1.65 - 3.6	2.3 - 5.5	50
2-bit	74AVC(H)2T45	0.8 - 3.6	0.8 - 3.6	500
	74LVC(H)2T45	1.2 - 5.5	1.2 - 5.5	420
	NTB0102	1.2 - 3.6	1.65 - 5.5	80
	NTS0102	1.65 - 3.6	2.3 - 5.5	50
4-bit	74AVC(H)4T245	0.8 - 3.6	0.8 - 3.6	380
	NTB0104	1.2 - 3.6	1.65 - 5.5	80
	NTS0104	1.65 - 3.6	2.3 - 5.5	50

Type	Device type	$V_{CC(A)}$ (V)	$V_{CC(B)}$ (V)	Rate (Mbps)
8-bit	74AVC(H)8T245	0.8 - 3.6	0.8 - 3.6	380
	74LVC(H)8T245	1.2 - 5.5	1.2 - 5.5	420
	74LVC4245A	1.5 - 5.5	1.5 - 3.6	300
16-bit	74AVC(H)16T245	0.8 - 3.6	0.8 - 3.6	380
	74ALVC164245	1.5 - 3.6	1.5 - 5.5	-
20-bit	74AVC(H)20T245	0.8 - 3.6	0.8 - 3.6	380

Suffix	GW	GM	GF	GT	GM	GD	GU
	SOT353	SOT886	SOT891	SOT833	SOT902	SOT996	SOT1174
	5-pin	6-pin	6-pin	8-pin	8-pin	8-pin	12-pin
Width (mm)	2.10	1.00	1.00	1.00	1.60	3.00	1.70
Length (mm)	2.00	1.45	1.00	1.95	1.60	2.00	2.0
Pitch (mm)	0.65	0.50	0.35	0.50	0.50	0.50	0.40

Suffix	UK	PW	BQ	BQ	DGG
	WLCSP12	SOT403	SOT763	SOT815	SOT362
	12-pin	16-pin	16-pin	24-pin	48-pin
Width (mm)	1.2	4.40	2.50	3.50	6.10
Length (mm)	1.6	5.00	3.50	5.50	12.50
Pitch (mm)	0.4	0.65	0.50	0.50	0.50

2. On-board connectivity

2.3 Active voltage translator buffers

These I²C level shifters provide digital logic level translation between a host processor and a slave device. This is an important part of voltage level shifting, since the host processor's I²C voltage continues to go down while the voltages used by peripheral devices remain unchanged. NXP is a market leader in I²C level translators and has a very large selection of active and passive level shifters to accommodate lowest processor voltage (<0.8 V) and highest peripheral voltage (>5.5 V).

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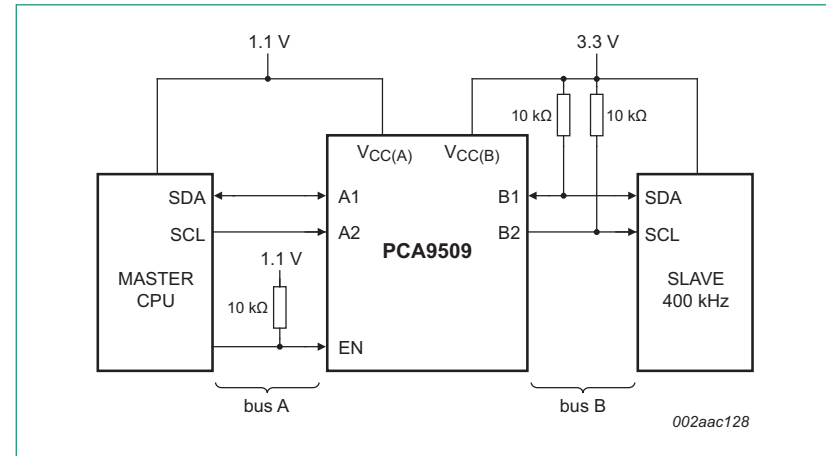
NXP Level Shifter Portfolio

Device	Description	Normal I/O	Static Level Offset I/O	Accelerator	Idle Stop Detect for Hotswap	Interrupt	ESD (HBM)
PCA9507	2.7 to 5.5 V Level Shifter	A side	B side	× (A side)			5 KV
PCA9508	0.9 to 5.5 V Level Shifter with Offset Free Hot-Swap	A side	B side		×		6 KV
PCA9509/A/P	0.8 to 5.5 V Level Shifter	B side	A side				2 KV
PCA9515A	3.3 / 5.0 V I²C-Bus Repeater		A & B sides				2 KV
PCA9516A	5-Channel I²C Bus Hub		A & B sides				2 KV
PCA9517A	0.9 to 5.5 V Level Shifter	A side	B side				5 KV
PCA9518A	5-Channel I²C Bus Hub Expander		A & B sides				2 KV
PCA9519	1.1 to 5.5 V Quad Level Shifter	B side	A side				2 KV
PCA9527	3.0 to 5.5 V Level Shifter	A side	B side	× (A side)		×	8 KV

2. On-board connectivity

2.4 I^{2}C/SPI/UART protocol bridges

To help overcome the limitations of various interfaces between the host bus and its peripherals, NXP offers a wide portfolio of next-generation I^{2}C/SPI/UART bridges that make it easier to manage on-board communication.

These bridges enable greater design flexibility by linking legacy and new systems and vice versa, thus allowing system designers to retain their original design investment and reduce time-to-market.

I^{2}C/SPI-to-UART Bridges

Part	UART	FIFO	SPI	GPIO
SC16IS740	1	64	4 Mbps	-
SC16IS750	1	64	4 Mbps	8
SC16IS752	2	64	15 Mbps	8
SC16IS760	1	64	15 Mbps	8
SC16IS762	2	64	15 Mbps	8

UART-to-I^{2}C Bridges

Part	UART	I^{2}C	GPIO	CLK
SC18IM700	460.8 kbps	400 kHz	8	Int

I^{2}C-to-SPI Bridges

Part	SPI	I^{2}C	GPIO	CLK
SC18IS602B	1.8 Mbps	400 kHz	4	Int

SPI-to-I^{2}C Bridges

Part	SPI	I^{2}C	GPIO	CLK
SC18IS600	1 Mbps	400 kHz	4	Int

2. On-board connectivity

2.5 UARTs

UARTs manage the data transfer between processor and communication channel, check communication errors, and relieve the processor from the task of managing communication errors. NXP is an established supplier of UARTs, and has a long history of leadership in industrial formats.

SC16C85xxS: New 1.8 – 3.3 V UARTs
Features
▸ Single- and dual-channel UART
▸ Intel/Motorola™ and VLIO interface
▸ Sleep mode / low-power mode
▸ Programmable sampling rates up to 20 Mbps
▸ 128 bytes Tx / Rx FIFOs
▸ Automatic RS485
▸ IrDA version 1.0
▸ Independent UART Tx and Rx enable/disable
▸ Ultra small: TFBGA package

Part Number	CH	Host Interface	VCC	TFBGA (3.5 x 3.5)	HVQFN (5 x 5)	LQFP (7 x 7)
SC16C850SL	1	Intel / Motorola	1.8 V	√	√	TBD
SC16C850SV	1	VLIO	1.8 V	TBD	√	
SC16C852SL	2	Intel / Motorola	1.8 V	√	√	√
SC16C852SV	2	VLIO	1.8 V	√	√	TBD

3. Compatibility with legacy interfaces

With the rising popularity of digital data interfaces, and the pressure to optimize package pincount, SOC manufacturers tend to limit the number of analog audio and video interfaces and, as a result, limit the system designer's ability to customize the system. We give designers the chance to add back some of the flexibility, at an optimized cost, with a full range of high-performance audio and video bandwidth switches in standard, small-footprint packages.

Also, since SOCs that use denser CMOS processes may not be compatible with legacy audio/video interfaces or may not include sensitive analog functions like ADCs and DACs, we offer a full range of helpful functions, including audio DACs, codecs, level shifters, and buffers.
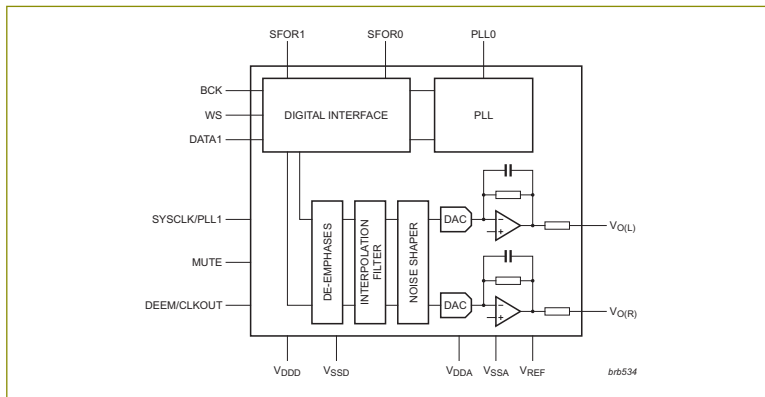
3. Compatibility with legacy interfaces

3.1 Audio digital-to-analog converters (DACs) and codecs

We offer a wide range of stereo DACs with serial inputs. The UDA133x series uses the I^2S interface, and audio codecs such as UDA1338H are also available.

Audio DAC series UDA133x

Type	Supply	PLL	Volume control	Control	Data formats	Package
UDA1330ATS	2.7 to 5.5 V		Digital logarithm	I^2C / L3 / Static	I^2S, LSB, or MSB justified; 16, 18, 20, 24 bit; 1 F_s	SSOP16
UDA1334ATS	2.4 to 3.6 V	•		Static	I^2S, LSB justified; 16, 18, 20, 24 bit; 1 F_s	SSOP16
UDA1334BTS	2.4 to 3.6 V			Static		SSOP16

UDA1334ATS block diagram

brb534

Compatibility with legacy interfaces

Audio codec UDA1338H

The multichannel configuration makes the device eminently suitable for use in digital audio equipment which incorporates surround feature, such as multichannel home audio-video application.

Features and benefits

General

▸ 2.7 V to 3.6 V power supply
▸ 5 V tolerant digital inputs
▸ 24-bit data path
▸ Selectable control: via L3-bus or I²C-bus microcontroller interface
▸ Supports sample frequency ranges for:
  - Audio ADC: fs = 16 to 100 kHz
  - Voice ADC: fs = 7 to 50 kHz
  - Audio DAC: fs = 16 to 200 kHz
▸ Separate power control for ADC and DAC
▸ ADC plus integrated high-pass filter to cancel DC offset
▸ Integrated digital filter plus DAC
▸ Slave mode only applications
▸ Easy application

Multiple format data interface

▸ Audio interface supports standard I²S-bus, MSB-justified, LSB-justified and two multichannel formats
▸ Voice interface supports I²S-bus and mono channel formats

Digital sound processing

▸ Control via L3-bus or I²C-bus:
▸ Channel independent digital logarithmic volume
▸ Digital de-emphasis for fs = 32, 44.1, 48, or 96 kHz
▸ Soft or quick mute
▸ Output signal polarity control

Advanced audio configuration

▸ Inputs:
  - Four single-ended audio inputs (2 × stereo) with programmable gain amplifiers
  - One single-ended voice input
▸ Outputs:
  - Six differential audio outputs (3 × stereo)
  - DSD mode to support stereo DSD playback
  - High linearity, wide dynamic range and low distortion
  - DAC digital filter with selectable sharp or soft roll-off

UDA1338 block diagram
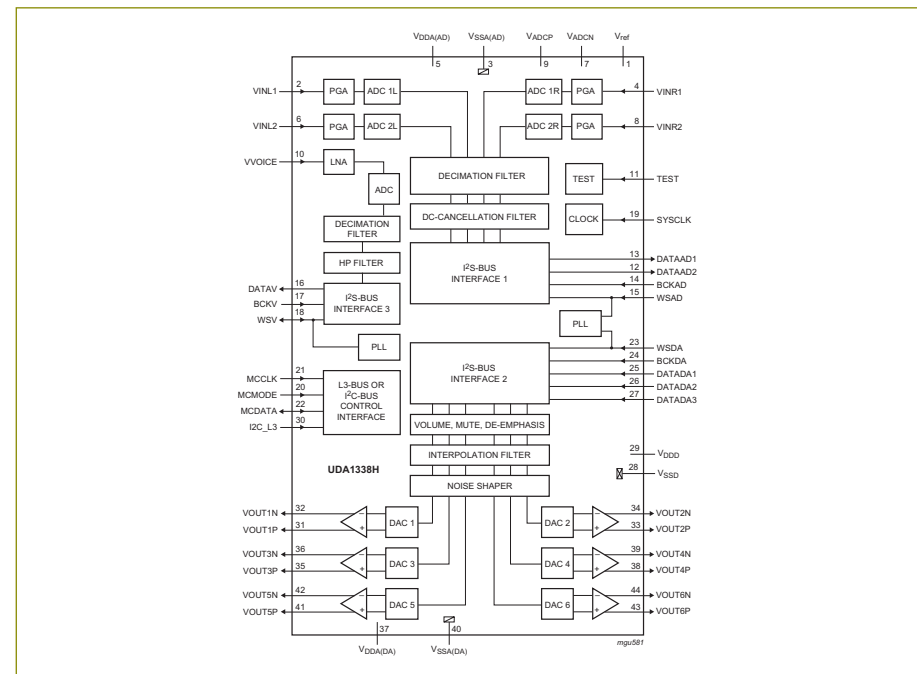
3. Compatibility with legacy interfaces

3.2 Auto-Direction Sensing Level Shifter/Translator

The NTB/S0102 and NTB/S0104 are dual-supply translating transceivers with auto-direction sensing, enabling bidirectional voltage level translation.
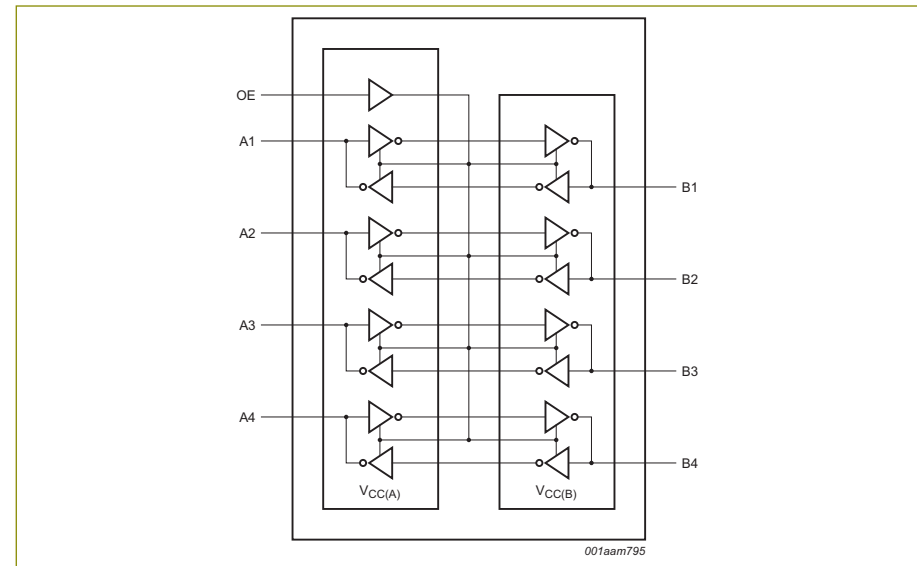
The NTB/S0102 is a two-bit translator featuring two data input-output ports, one output enable, and two supply pins. It is suitable for translating between any low-voltage nodes (1.2, 1.5, 1.8, 2.5, or 3.3 V and 5.0 V), and is available in TSSOP8, XSON8, XSON8U, and XQFN10 packages.

The NTB/S0104 is a four-bit translator featuring four data input-output ports, one output enable, and two supply pins. It is suitable for translating between any low-voltage nodes (1.2, 1.5, 1.8, 2.5, or 3.3 V and 5.0 V), and is available in WCSP12 (1.2 x 1.6 x 0.56, 0.4 mm pitch), XQFN12 (1.7 x 2.0 x 0.5, 0.4 mm pitch), and DHVQFN14 (2.5 x 3.0 x 0.85 mm, 0.5 mm pitch).

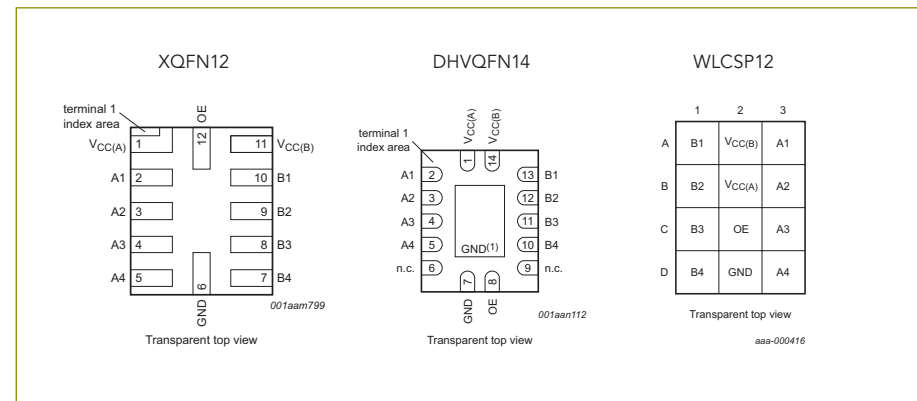### Features
▸ Operates at VccA = 1.2 - 3.6 V and VccB = 1.65 - 5.5 V supply
▸ Inputs up to 5.5 V
▸ Partial power-down mode
▸ High impedance off state
▸ Auto-direction sensing

NTB/S0104 functional diagram

001aam795

NTB/S0104 package options

XQFN12   DHVQFN14   WLCSP12

001aam799   001aan112   aaa-000416

Transparent top view

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3. Compatibility with legacy interfaces

3.3 Audio, video, and data switches

NXP provides high-performance analog switches in all common configurations, tailored to answer specific application needs and ease design effort.

The NX family of switches offers very low on resistance and is available in a wide variety of leadless packages to meet today's stringent board space constraints and reliability requirements.

The NX3L/NX3V series is for audio and applications requiring a low on resistance (Ron = 0.5-1.0 Ω, bandwidth <60 MHz).

The NX3DV series is for mid- to high-frequency signals, such as analog or digital video, including MIPI CSI and DSI (Ron = 2-10 Ω, bandwidth = 200-500 MHz), as well as USB 2.0 and MHL (Ron = 2-10 Ω, bandwidth >720 MHz).

The NX3L family supports a wide operating voltage range, best-in-class on resistance/capacitance combinations, -90 dB isolation and crosstalk for superior signal integrity, and low current consumption for higher power savings. These devices also include a built-in level shifter option, operate over the automotive operating temperature range, and are available in small-footprint packages (Picogate, MicroPak, ThinQFN).

NX3DV and NX5DV data/video switches

Type number	Description	Configuration	V_{CC} (V)	R_{ON} (Ω)	$R_{ON(FLAT)}$ (Ω)	$f_{(-3dB)}$ (MHz)	THD (%)	Xtalk (dB)	Tamb (°C)	Package type	Package drawing
NX3DV221GM	USB2.0 switch with enable	DPDT-Z	2.3 - 3.6	7	0.7	1000	N/A	-40	-40~85	XQFN10	SOT1049-2
NX3DV2567GU	four-pole. double-throw switch	4PDT	1.4 - 4.3	10.5		330	N/A	-60	-40~125	XQFN16	SOT1161-1
NX3DV2567HR	four-pole. double-throw switch	4PDT	1.4 - 4.3	10.5		330	N/A	-60	-40~125	HXQFN16	SOT1039-2
NX3DV3899GU	dual double-pole. double-throw with low threshold inputs	DPDT	1.4 - 4.3	4.2	1	200	0.01	-90	-40~125	XQFN16	SOT1161-1
NX3DV3899HR	dual double-pole. double-throw with low threshold inputs	DPDT	1.4 - 4.3	4.2	1	200	0.01	-90	-40~125	HXQFN16	SOT1039-1
NX3DV42GM	USB2.0 double pole. double throw	DPDT	3.0 - 4.3	6.5		950	N/A	-30	-40~85	XQFN10	SOT1049-3
NX3DV42GU	USB2.0 double pole. double throw	DPDT	3.0 - 4.3	6.5		950	N/A	-30	-40~85	XQFN10	SOT1160-1
NX3DV642GU	3-lane high-speed MIPI compatible switch	6PDT-Z	2.65 - 4.3	9.5		950	N/A	-55	-40~85	XQFN24	SOT1310-1
NX5DV330BQ	four-pole. double-throw switch	4PDT-Z	4.0 - 5.5	7		400	N/A	-63	-40~85	DHVQFN16	SOT763-1
NX5DV330D	four-pole. double-throw switch	4PDT-Z	4.0 - 5.5	7		400	N/A	-63	-40~85	SO16	SOT109-1
NX5DV330DS	four-pole. double-throw switch	4PDT-Z	4.0 - 5.5	7		400	N/A	-63	-40~85	SSOP16	SOT519-1
NX5DV330PW	four-pole. double-throw switch	4PDT-Z	4.0 - 5.5	7		400	N/A	-63	-40~85	TSSOP16	SOT403-1
NX5DV4885EHF	dual supply 1 of 2 VGA switch		2.0 - 5.5	4	0.5	600	N/A	-50	-40~85	HVQFN24	SOT616-3
NX5DV713EHF	dual supply 1 of 2 VGA switch		2.0 - 5.5	4	0.5	600	N/A	-50	-40~85	HWQFN32	SOT1180-1
NX5DV713HF	dual supply 1 of 2 VGA switch		2.0 - 5.5	4	0.5	600	N/A	-50	-40~85	HWQFN32	SOT1180-1
NX5DV715HF	dual supply 1 of 2 VGA switch		2.0 - 5.5	4	0.5	600	N/A	-50	-40~85	HWQFN32	SOT1180-1

3. Compatibility with legacy interfaces

NX3L and NX3V low-ohmic analog switches (to be continued)

Type number	Description	Configuration	V_{CC} (V)	R_{ON} (Ω)	$R_{ON(FLAT)}$ (Ω)	$f_{(-3dB)}$ (MHz)	THD (%)	Xtalk (dB)	Tamb (°C)	Package type	Package drawing
NX3L1G3157GM	single-pole. double-throw	SPDT-Z	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON6	SOT886
NX3L1G3157GW	single-pole. double-throw	SPDT-Z	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	TSSOP6	SOT363
NX3L1G384GM	single-pole. single-throw	SPST-NC	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON6	SOT886
NX3L1G384GW	single-pole. single-throw	SPST-NC	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	TSSOP5	SOT353
NX3L1G53GD	single-pole. double-throw	SPDT-Z	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON8	SOT996-2
NX3L1G53GM	single-pole. double-throw	SPDT-Z	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XQFN8	SOT902-1
NX3L1G53GT	single-pole. double-throw	SPDT-Z	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON8	SOT833-1
NX3L1G66GM	single-pole. single-throw	SPST-NO	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON6	SOT886
NX3L1G66GW	single-pole. single-throw	SPST-NO	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	TSSOP5	SOT353
NX3L1T3157GM	single-pole. double-throw with low threshold inputs	SPDT	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON6	SOT886
NX3L1T3157GW	single-pole. double-throw with low threshold inputs	SPDT	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	TSSOP6	SOT363
NX3L1T384GM	single-pole. single-throw with low threshold inputs	SPST-NC	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON6	SOT886
NX3L1T384GW	single-pole. single-throw with low threshold inputs	SPST-NC	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	TSSOP5	SOT353
NX3L1T5157GM	single-pole. double-throw with low threshold inputs	SPDT	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON6	SOT886
NX3L1T53GD	single-pole. double-throw with low threshold inputs	SPDT-Z	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON8	SOT996-2
NX3L1T53GM	single-pole. double-throw with low threshold inputs	SPDT-Z	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XQFN8	SOT902-1
NX3L1T53GT	single-pole. double-throw with low threshold inputs	SPDT-Z	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON8	SOT833-1
NX3L1T66GM	single-pole. single-throw	SPST-NO	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON6	SOT886
NX3L1T66GW	single-pole. single-throw	SPST-NO	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	TSSOP5	SOT353
NX3L2267GM	dual single-pole double-throw with low threshold inputs	SPDT	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XQFN10	SOT1049-3
NX3L2267GU	dual single-pole double-throw with low threshold inputs	SPDT	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XQFN10	SOT1160-1
NX3L2267SGU	dual single-pole double-throw with low threshold inputs	SPDT	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XQFN10	SOT1160-1
NX3L2467GU	dual double-pole. double-throw with low threshold inputs	DPDT	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XQFN16	SOT1161-1
NX3L2467HR	dual double-pole. double-throw with low threshold inputs	DPDT	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	HXQFN16	SOT1039-1
NX3L2467PW	dual double-pole. double-throw with low threshold inputs	DPDT	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	TSSOP16	SOT403-1
NX3L2G384GD	dual single-pole. single-throw	SPST-NC	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON8	SOT996-2
NX3L2G384GM	dual single-pole. single-throw	SPST-NC	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XQFN8	SOT902-1
NX3L2G384GT	dual single-pole. single-throw	SPST-NC	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON8	SOT833-1
NX3L2G66GD	dual single-pole. single-throw	SPST-NO	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON8	SOT996-2

3. Compatibility with legacy interfaces

NX3L and NX3V low-ohmic analog switches

Type number	Description	Configuration	V_{CC} (V)	R_{ON} (Ω)	$R_{ON(FLAT)}$ (Ω)	$f_{(-3dB)}$ (MHz)	THD (%)	Xtalk (dB)	Tamb (°C)	Package type	Package drawing
NX3L2G66GM	dual single-pole. single-throw	SPST-NO	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XQFN8	SOT902-1
NX3L2G66GT	dual single-pole. single-throw	SPST-NO	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON8	SOT833-1
NX3L2T384GD	dual single-pole. single-throw with low threshold inputs	SPST-NC	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON8	SOT996-2
NX3L2T384GM	dual single-pole. single-throw with low threshold inputs	SPST-NC	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XQFN8	SOT902-1
NX3L2T384GT	dual single-pole. single-throw with low threshold inputs	SPST-NC	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON8	SOT833-1
NX3L2T66GD	dual single-pole. single-throw with low threshold inputs	SPST-NO	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON8	SOT996-2
NX3L2T66GM	dual single-pole. single-throw with low threshold inputs	SPST-NO	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XQFN8	SOT902-1
NX3L2T66GT	dual single-pole. single-throw with low threshold inputs	SPST-NO	1.4 - 4.3	0.75	0.3	60	0.02	-90	-40~125	XSON8	SOT833-1
NX3L4051HR	single-pole. octal-throw	SP8T-Z	1.4 - 4.3	0.75	0.3	15	0.02	-90	-40~125	HXQFN16	SOT1039-1
NX3L4051PW	single-pole. octal-throw	SP8T-Z	1.4 - 4.3	0.75	0.3	15	0.02	-90	-40~125	TSSOP16	SOT403-1
NX3L4053HR	triple single-pole. double-throw	SPDT-Z	1.4 - 4.3	0.8	0.3	60	0.02	-90	-40~125	HXQFN16	SOT1039-1
NX3L4053PW	triple single-pole. double-throw	SPDT-Z	1.4 - 4.3	0.8	0.3	60	0.02	-90	-40~125	TSSOP16	SOT403-1
NX3L4357GM	single-pole. triple-throw with low threshold inputs	SP3T-Z	1.4 - 4.3	0.75	0.35	30	0.02	-90	-40~125	XQFN10	SOT1049-2
NX3L4684GM	dual single-pole double-throw with low threshold inputs	SPDT	1.4 - 4.3	0.8	0.3	25	0.02	-90	-40~125	XQFN10	SOT1049-3
NX3L4684TK	dual single-pole double-throw with low threshold inputs	SPDT	1.4 - 4.3	0.8	0.3	25	0.02	-90	-40~125	HVSON10	SOT650-2
NX3V1G384GM	single-pole. single-throw	SPST-NC	1.4 - 4.3	0.45	0.2	25	0.01	-90	-40~125	XSON6	SOT886
NX3V1G384GW	single-pole. single-throw	SPST-NC	1.4 - 4.3	0.45	0.2	25	0.01	-90	-40~125	TSSOP5	SOT353
NX3V1G66GM	single-pole. single-throw	SPST-NO	1.4 - 4.3	0.45	0.2	25	0.01	-90	-40~125	XSON6	SOT886
NX3V1G66GW	single-pole. single-throw	SPST-NO	1.4 - 4.3	0.45	0.2	25	0.01	-90	-40~125	TSSOP5	SOT353
NX3V1T384GM	single-pole. single-throw with low threshold inputs	SPST-NC	1.4 - 4.3	0.45	0.2	25	0.01	-90	-40~125	XSON6	SOT886
NX3V1T384GW	single-pole. single-throw with low threshold inputs	SPST-NC	1.4 - 4.3	0.45	0.2	25	0.01	-90	-40~125	TSSOP5	SOT353
NX3V1T66GM	single-pole. single-throw	SPST-NO	1.4 - 4.3	0.45	0.2	25	0.01	-90	-40~125	XSON6	SOT886
NX3V1T66GW	single-pole. single-throw	SPST-NO	1.4 - 4.3	0.45	0.2	25	0.01	-90	-40~125	TSSOP5	SOT353

4. The need to support faster digital interfaces

The increased use of digital data transport and storage formats has led to the expanding use of digital connections between consumer audio and/or video devices. HDMI and USB are now commonplace in consumer systems, and eSATA, DisplayPort, and USB 3.0 are beginning to migrate into the consumer space, too.

High-speed interfaces bring with them a number of issues that make board layout more difficult, such as the need to preserve signal quality throughout the system, from the SOC to the connector. Also, GHz-class interfaces often need to meet industry specifications, so compliance with technology standards can be another concern.

NXP has long experience with high data rates -- up to 10 GHz and beyond -- and works closely with the standards that govern their use. We use that knowledge to improve performance and ease system design.

For example, we offer HDMI switches and combinations of ESD protection and signal buffers, as well as USB 3.0 redrivers which, when used close to a system connector, help preserve the signal at the connector, thus easing the constraints of board layout. For SOCs that implement DisplayPort, instead of HDMI, we have a full family of DP-to-HDMI level shifters. And, for those who need to emulate a legacy VGA output, we have a DisplayPort-to-VGA bridge.

4.1 High-speed data switches

High-speed USB 3.0, PCI-e, DisplayPort, and SATA switches CBTL0xxxx

NXP supplies an extensive family of high-speed data switches, suitable for data rates of 5 Gbps or higher, as specified by USB 3.0, PCI-e, SATA, and DisplayPort.

Differential multi-channel 2:1 high-speed multiplexer/demultiplexer switches

| Type number	Number of differential channels	Signal switching speed	V_{DD} operating range	Package	Standard data rate supported
CBTL02042	2	5 Gb/s	3.3 V ±10%	DHVQFN20	PCIe Gen 2, DisplayPort 1.1a, USB 3.0, SATA 3 Gb/s
CBTL04082	4	5 Gb/s	3.3 V ±10%	HVQFN42	PCIe Gen 2, DisplayPort 1.1a, USB 3.0, SATA 3 Gb/s
CBTU04082	4	5 Gb/s	1.8 V ±10%	HVQFN42	PCIe Gen 2, DisplayPort 1.1a, USB 3.0, SATA 3 Gb/s
CBTL02043	2	8 Gb/s	3.3 V ±10%	DHVQFN20	PCIe Gen 3, DisplayPort 1.2, USB 3.0, SATA 6 Gb/s
CBTL04083	4	8 Gb/s	3.3 V ±10%	HVQFN42	PCIe Gen 3, DisplayPort 1.2, USB 3.0, SATA 6 Gb/s
CBTU04083	4	8 Gb/s	1.8 V ±10%	HVQFN42	PCIe Gen 3, DisplayPort 1.2, USB 3.0, SATA 6 Gb/s

The need to support faster digital interfaces

4.2 DisplayPort switch

Our data buses for DisplayPort 1.2 support data rates up to 5.4 Gbps.

CBTL06DP213 high-performance DP 1.2 switch

▸ Very High Performance Bi-directional Switch for DP 1.2 (5.4 Gb/s)
  applications
▸ Supports
  ▸ 2:1 multiplexing/switching of four high-speed lanes of DP Main Link
  ▸ 4:1 multiplexing/switching of DP AUX channels / DDC signals
  ▸ 2:1 multiplexing/switching of DP HPD signal
  ▸ Two selection pins and one shutdown pin
▸ Excellent signal-integrity performance
  ▸ R_{ON} 14Ω
  ▸ -3 dB BW: 11 GHz
  ▸ Diff. return loss: -20 dB @ 100 MHz, -17 dB @ 1.35 GHz,
     -13 dB @ 2.7 GHz
  ▸ Diff. insertion loss: -0.9 dB @ 100 MHz, -1 dB @ 1.35 GHz,
      -1.3 dB @ 2.7 GHz
▸ 3.3 V supply voltage
▸ Low power consumption
▸ Active current consumption: 2 mA (typical)
▸ Shutdown current: 10 µA
▸ ESD 2 kV HBM, 500 V CDM
▸ TFBGA48 package (5 x 5 mm, 0.5 mm ball pitch)
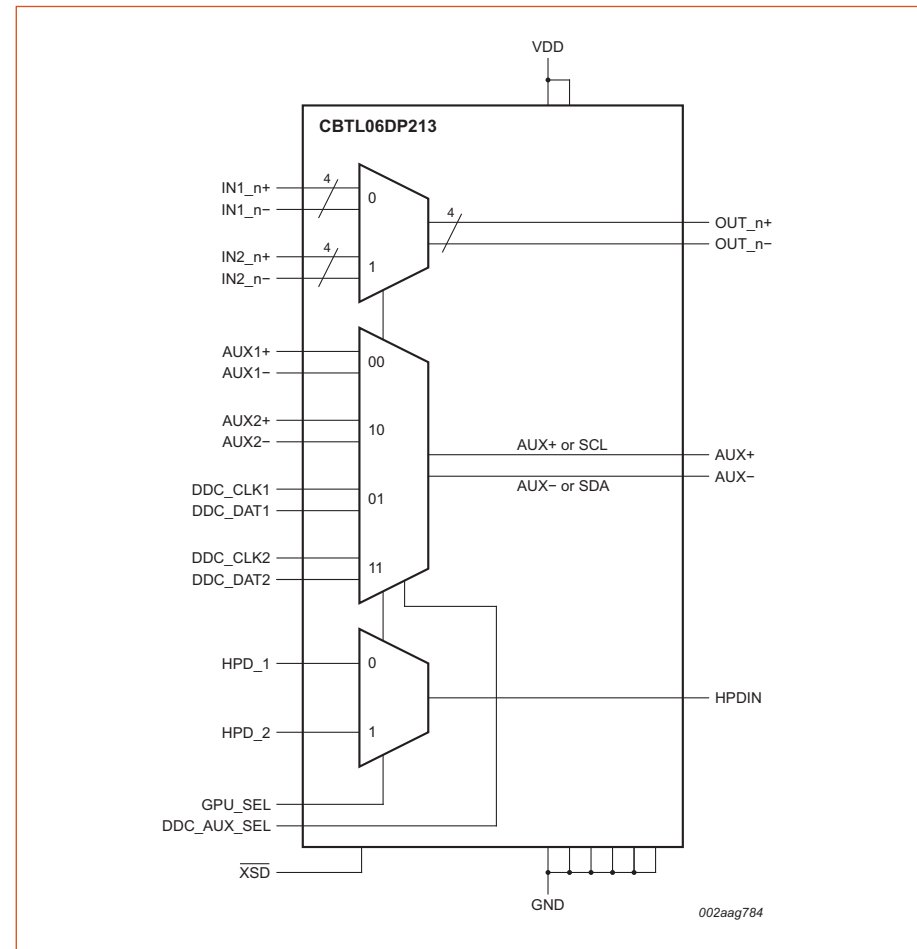
4. The need to support faster digital interfaces

4.3 DisplayPort-to-DVI/HDMI adapter

When working with a DisplayPort-only SOC that has support for Dual-Mode, use these devices to connect to HDMI output interfaces.

Portfolio overview

Part Number	DVI	HDMI
PTN3360A, PTN3360B Enhanced DisplayPort-DVI/HDMI level shifters (Follow-up versions of PTN3300A, PTN3300B)	x	x
PTN3361B Enhanced DisplayPort-DVI/HDMI level shifters with DDC buffer, feature optimized for dongle application (Follow-up version of PTN3301)	x	x
PTN3380B Enhanced DisplayPort-DVI/HDMI level shifter with 5V voltage regulator, cost and feature optimized for dongle application	x	
PTN3381B Enhanced DisplayPort-DVI/HDMI level shifter with DDC buffer and 5 V voltage regulator, cost and feature optimized for dongle application		x
PTN3381D Enhanced DisplayPort-DVI/HDMI level shifter with Deep Color Support, DDC buffer, and 5 V voltage regulator, cost and feature optimized for dongle application		x
PTN3360D Enhanced DisplayPort-HDMI level shifter with Deep Color Support for HDMI on the main board	x	x

The need to support faster digital interfaces

4.4 USB 2.0 switches

USB 2.0 switch NX3DV221

This switch, housed in an XQFN10U package, is a dual SPDT analog switch designed for use with USB 2.0 high-speed (480 Mbps) signals in applications with limited USB I/O. The wide bandwidth (1 GHz) allows signals to pass with minimal edge and phase distortion. The switch is bidirectional and offers little or no attenuation at the outputs. Designed for low bit-to-bit skew and high channel-to-channel noise isolation, it is ideally suited for use in any high-bandwidth application.

Features
- Operating supply: 2.3 to 3.6 V
- Switch inputs: up to 5.5 V
- Supply current I_{CC} <2 µA in low-power mode
- On resistance R_{ON} <7.0 Ω
- Typical CS(ON) = 6.0 pF
- High bandwidth f(-3 dB) = 1.0 GHz

NX3DV221 functional diagram
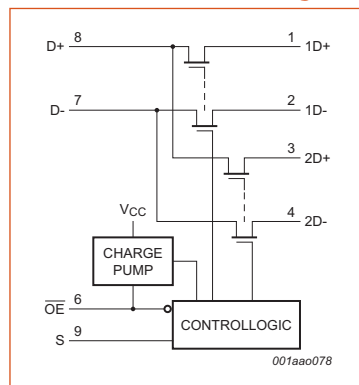
This switch also exists in a dual version (NX3DV42).

4.5 USB 3.0 redrivers

PTN36241B is a SuperSpeed USB 3.0 redriver IC that enhances signal quality by performing receive equalization on the deteriorated input signal followed by transmit de-emphasis maximizing system link performance. With its superior differential signal conditioning and enhancement capability, the device delivers significant flexibility and performance scaling for various systems with different PCB trace and cable channel conditions and still benefits from optimum power consumption.

PTN36241B is a dual-channel device that supports data signaling rate of 5 Gbit/s through each channel. PTN36241B has two channels: one channel is facing the USB host, and another channel is facing the USB peripheral or device. Each channel consists of a high-speed Transmit (Tx) differential lane and a high-speed Receive (Rx) differential lane.

PTN36241B has independent 5-level configuration pins for each channel to select receive equalization, transmit de-emphasis and output swing and these pins can be easily configured by board-strapping (for example, short, open, resistor). To support applications that require greater level of configurability, PTN36241B delivers intelligent multiplexing of I²C-bus interface onto 5-level configuration pins. By default, the device is configured with the board-strapped levels of configuration pins. When I²C-bus reads/writes are performed over these multiplexed pins, the device decodes I²C transactions and configures its internal functions appropriately.

PTN36241B has built-in advanced power management capability that enables significant power savings under various different USB 3.0 Low-power modes (U2/U3). It can detect LFPS signaling and link electrical conditions and can dynamically activate/de-activate internal circuitry and logic. The device performs these actions without host software intervention and conserves power.

PTN36241B will go through the compliance testing controlled by the internal state machine. No compliance pin is required.

PTN36241B is powered from 3.3 V supply and is available in HVQFN24 4 x 4 mm package with 0.5 mm pitch.

Features

High-speed channel processing

▸ Supports USB 3.0 specification (SuperSpeed only)

▸ Support of 2 channels

▸ Selectable receive equalization on each channel to recover from Inter Symbol Interference (ISI) and high-frequency losses, with provision to choose from five Equalization gain settings per channel

▸ Selectable transmit de-emphasis and output swing on each channel delivers pre-compensation suited to channel conditions

▸ Supports pin and I²C-bus programmable Input Signal Threshold setting to reliably work under different noise environments accommodating sensitivity needs

▸ Integrated termination resistors provide impedance matching on both transmit and receive sides

▸ Programmable termination resistor for receiver side

▸ Automatic receiver termination indication and detection

▸ Low active power: 330 mW / 100 mA (typical), V_{DD} = 3.3 V

▸ Power-saving states:
  ▸ 53 mW / 16 mA (typical) when in U2/U3 states
  ▸ 20 mW / 6 mA (typical) when no connection detected

▸ Excellent differential and common return loss performance

▸ 14 dB differential and 15 dB common-mode return loss for 10 MHz to 1250 MHz

▸ Flow-through pinout to ease PCB layout and minimize crosstalk effects

▸ Hot Plug capable

▸ Supports EasyCom that will go through the compliance testing controlled by the internal state machine

▸ Power supply: V_{DD} = 3.3 V ± 10%

▸ HVQFN24 4 × 4 mm package, 0.5 mm pitch; exposed center pad for thermal relief and electrical ground
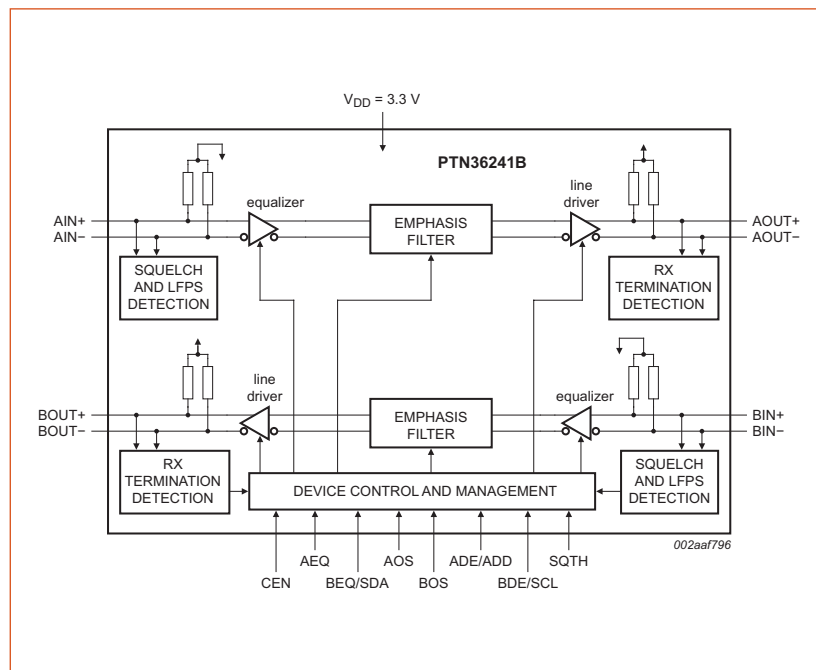
▸ ESD: 5 kV HBM, 1250 V CDM

▸ Operating temperature range 0 °C to 85 °C

Enhancements

▸ Intelligent I²C-bus multiplexing and 5-level logic configuration options (with patent-pending quinary pins) delivering ultimate flexibility

▸ I²C-bus interface:
  ▸ Standard-mode (100 kbit/s) or Fast-mode (400 kbit/s)
  ▸ 3.3 V tolerant

PTN36242L is a dual-port version of the USB 3.0 re-driver PTN36241B.

The need to support faster digital interfaces

4.6 HDMI receivers, transmitters, switches, and buffers

Our support for HDMI extends through a wide range of products, from transmitters and receivers to switches and ESD protection. Designers can leverage our extensive knowledge of system design, for fast development of high-definition applications.

Portfolio overview

Product family	Part number	Description	Features							Market			Mass Production
			Video	High Bit Rate Audio	HDCP	Video upscale	HDMI 1.4a			TV	STB AVR Blu-Ray Disk	Mobile & Low Power	
							3D	Adobe RGB	ARC				
HDMI transmitters	TDA9984	1080p upscaler transmitter	1080p 50/60 Hz 8b/color	x	x	x	x	x	x		x		x
	TDA19988(*)	Ultra low power, ultra small size, full 3D support	1080p 50/60 Hz 8b/color		x		x	x	x		x	x	x
HDMI switches	TDA19995	3:1 HDMI switch	1080p 50/60 Hz deep color	x	x		x	x	x	x	x		x
	TDA19997	4:1 HDMI switch	1080p 50/60 Hz deep color	x	x		x	x	x	x	x		x
	TDA19998	4:1 HDMI Fast switch F^3	1080p 50/60 Hz deep color	x	x		x	x	x	x	x		x
HDMI receivers	TDA19971(*)	1 input HDMI receiver, low power, small size	1080p 50/60 Hz deep color	x	x		x	x	x	x	x	x	x
	TDA19972(*)	2 inputs HDMI receiver, low power, small size	1080p 50/60 Hz deep color	x	x		x	x	x	x	x	x	x

(*)New product

5. Audio performance

In the consumer space, docking stations, sound bars, and other audio components are gauged by their perceived quality of audio rendition, especially the bass, and their ability to optimize sound effects found in movies.

Our Class-D audio amplifiers and audio-processing solutions build on our leadership in automotive entertainment, and maximize the effect of the small form-factor speaker systems in portable equipment. Also, our low-power CoolFlux DSPs are available with an extensive range of audio algorithms.

5.1 Audio amplifiers

These Class-D amplifiers drive the audio system's speaker.

Mid-power class-D amplifiers

Product	Description	Package
TDA8932BT/N2	2 x 15 W @22 V, 4 Ω	SO32
TDA8932BTW/N2	2 x 18 W @24 V, 4 Ω	HTSSOP32
TDA8933BTW	2 x 10 W @24 V, 8 Ω	HTSSOP32
TFA9810T	2 x 9 W @12 V, 8 Ω	SO32
TFA9815T	2 x 28 W @18 V, 8 Ω	SO32
	2 x 17.8 W @12 V, 4 Ω	

5.2 Audio system for high output power

To support the need for more channels per set (5.1/7.1), energy-saving eco modes, and sound-processing features, NXP offers a range of amplifiers, including the TDA8954 stereo amplifier with analog-in (2 x 265 W). A full listing appears on the next page.

5. Audio performance

Audio system for high output power

Product	Supply voltage	Output current	Efficiency	Po(SE) @ Max	Features
TDA8920C	±12.5 to ±32.5 V	> 9.2 A	4 Ω: 88% 6 Ω: 90% 8 Ω: 92%	125 W	▸ Same as TDA8950 ▸ Increased supply headroom (vs. TDA8920B) ▸ Clock divider makes external clock less critical on accuracy
TDA8922C	±12.5 to ±32.5 V	> 6 A	8 Ω: 88%	2 x 75 W	▸ Same as TDA8950 ▸ Increased supply voltage headroom (vs. TDA8922B)
TDA8950	±12.5 to ±40 V	> 9.2 A	4 Ω: 88%	2 x 140 W	▸ Pout = 2 x 140 W (4 Ω) ▸ Adaptive gate drive ▸ Thermal foldback (TFB) ▸ Clock divider makes external clock less critical on accuracy
TDA8953	±12.5 to ±42.5 V	> 12 A	3 Ω: 88% 4 Ω: 91% 6 Ω: 92%	2 x 210 W	▸ Same as TDA8950 with 66% increased Power area ▸ Reduced idle dissipation (dual Stabi) ▸ Higher efficiency ▸ Pop-noise tuning ▸ No clock detection ➡ power stage 3-state ▸ Selectable TFB
TDA8954	±12.5 to ±42.5 V	> 12 A	Same as TDA8953	2 x 210 W	▸ Same as TDA8953 with diagnostic ▸ 2-pin diagnostic ▸ Selectable TFB

5.3 Headphone amplifiers

For audio systems and components that include a headphone plug, we recommend the headphone amplifier TDA1308 and Class-G headphone driver SA58635.

Class-AB stereo headphone driver TDA1308

Features
▶ Wide temperature range
▶ No switch ON/OFF clicks
▶ Excellent power supply ripple rejection
▶ Low power consumption
▶ Short-circuit resistant
▶ High performance
▶ High signal-to-noise ratio
▶ High slew rate
▶ Low distortion
▶ Large output voltage swing

TDA1308 block diagram

mka779
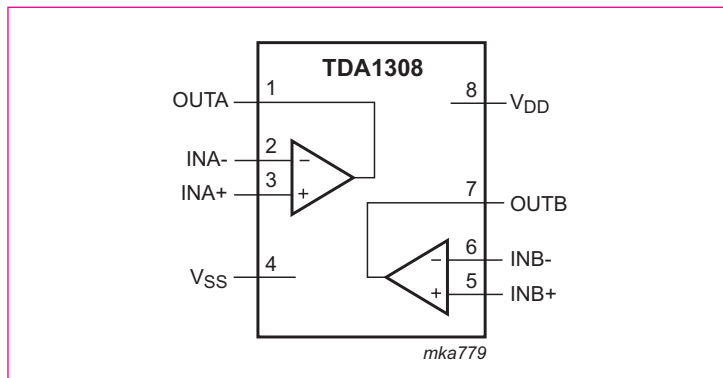
Class-G headphone driver SA58635

Features
▶ High efficiency with dynamic power management
▶ I^{2}C interface and control
  - Volume control (32-step taper audio)
  - Software shutdown
  - Independent channel mute and enable
▶ Low supply current: 1.5 mA typ (battery friendly)
▶ S/N performance of 100 dB
▶ Integrated charge pump, buck converter
▶ Thermal and short-circuit protection circuitry
▶ Pop-and-click suppression circuitry
▶ 16-bump WL-CSP (1.7 x 1.7 x 0.4 mm)

Typical application of SA58635

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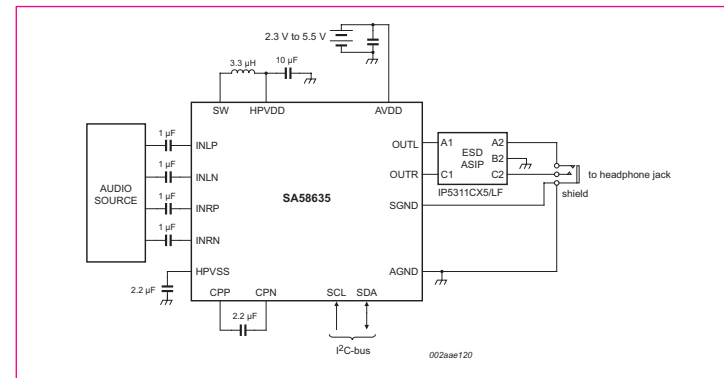
5. Audio performance

5.4 Audio system with adaptive sound maximizer and speaker protection

TFA9887 overview

The TFA9887 is an audio system consisting of a high efficiency class-D audio amplifier, an embedded DSP with a sophisticated speaker-boost and protection algorithm and an intelligent DC-to-DC converter. It can safely deliver 2.65 W (RMS; THD = 1 %) output power into a 4 Ω speaker that is nominally only rated for 0.5 W. The integrated intelligent DC-to-DC converter allows the system to deliver this power from a battery voltage of 3.6 V. The audio input interface is I²S and the control settings are communicated via an I²C-bus interface.

The TFA9887 guarantees safe speaker operation under all operating conditions. It maximizes acoustic output while ensuring diaphragm displacement and voice coil temperature do not exceed rated limits. The processing is capable of providing a significant improvement in sound volume and quality, while also ensuring reliable operation. This function is based on an adaptive model that operates in all loudspeaker environments (e.g. free air, closed box or vented box). Furthermore, advanced signal processing ensures the quality of the audio signal is always optimized.

Adaptive DC-to-DC conversion boosts the supply voltage only when necessary (when the output signal level is high). This maximizes the output power of the class-D audio amplifier while limiting quiescent power consumption. The TFA9887 also adapts the amplifier gain to limit battery current when the battery voltage is low.

The device features low RF susceptibility because it has a digital input interface that is insensitive to clock jitter. The second order closed loop architecture used in a class-D audio amplifier provides excellent audio performance and high supply voltage ripple rejection.

The TFA9887 is available in a 29-bump WLCSP (Wafer Level Chip-Size Package) with a 400 μm pitch.

Features
‣ Sophisticated speaker-boost and protection algorithm that maximizes speaker performance while protecting the speaker:
  ‣ Fully embedded software, no additional license fee or porting required.
  ‣ Total integrated solution that includes DSP, amplifier, DC-to-DC, sensing and more.
‣ Adaptive excursion control - guarantees that the speaker membrane excursion never exceeds its rated limit
‣ Real-time temperature protection - direct measurement ensures that voice coil temperature never exceeds its rated limit
‣ Environmentally aware - automatically adapts speaker parameters to acoustic and thermal changes including compensation for speaker-box leakage
‣ Output power: 2.65 W (RMS) into 4 Ω at 3.6 V supply voltage (THD = 1%)
‣ Clip avoidance - DSP algorithm prevents clipping even with sagging supply voltage
‣ Bandwidth extension option to increase low frequency response
‣ Intelligent DC-to-DC converter maximizes audio headroom from any supply level and limits current consumption at low battery voltages
‣ Compatible with standard Acoustic Echo Cancellers (AECs)
‣ High efficiency and low-power dissipation
‣ Wide supply voltage range (fully operational from 2.5 to 5.5 V)
‣ Two I²S inputs to support two audio sources
‣ I²C-bus control interface (400 kHz)
‣ Dedicated speech mode with speech activity detector
‣ Speaker current and voltage monitoring (via the I²S-bus) for Acoustic Echo Cancellation (AEC) at the host
‣ Fully short-circuit proof across the load and to the supply lines
‣ Sample frequencies from 8 to 48 kHz supported
‣ 3 bit clock/word select ratios supported (32x, 48x, 64x)
‣ Option to route I²S input direct to I²S output to allow a second I²S output slave device to be used in combination with the TFA9887
‣ TDM interface supported
‣ Volume control
‣ Low RF susceptibility
‣ Input clock jitter insensitive interface
‣ Thermally protected
‣ 'Pop noise' free at all mode transitions

6. Being part of a connected home

Audio components need to connect to the external world, so they can receive information from broadcast radio or the Internet. They also need to connect to other equipment in, for example, a home-entertainment system, to allow control from a universal remote control or smartphone, or to distribute audio content.

NXP is a recognized leader in solutions for in-car entertainment and offers a full range of FM radio receivers, sound/fader devices, and CD/audio processor ICs. We also offer RF transistors for use in LNAs, to improve the performance of WiFi connectivity, and have fully integrated Zigbee/RF4CE transceivers that make it easy to add RF control functions to an audio system. As a leader in NFC, we have solutions that make it easy to pair audio components with tablets, smartphones, and other consumer devices.

We have dedicated interfaces for wired connectivity to smartphones, and we support development of MFi audio accessories. (see www.nxp.com/applications/consumer/MFi-audioaccessories.html)

6.1 Low IF analog radio tuner TEF66xx family

Features
- AM / FM tuner with low IF conversion
- PLL synthesizer with integrated VCO
- Integrated AM LNA with AGC and RF selectivity
- Stereo decoder with output for interfacing with external analog or digital audio processor
- Advanced weak signal processing (soft mute, stereo blend, high cut control)
- AM / FM noise blanker (TEF6601+TEF662x: FM only)
- Integrated FM LNA with AGC
- Fast software development due to integrated radio functions and easy interface
- Very good AM / FM strong signal behavior
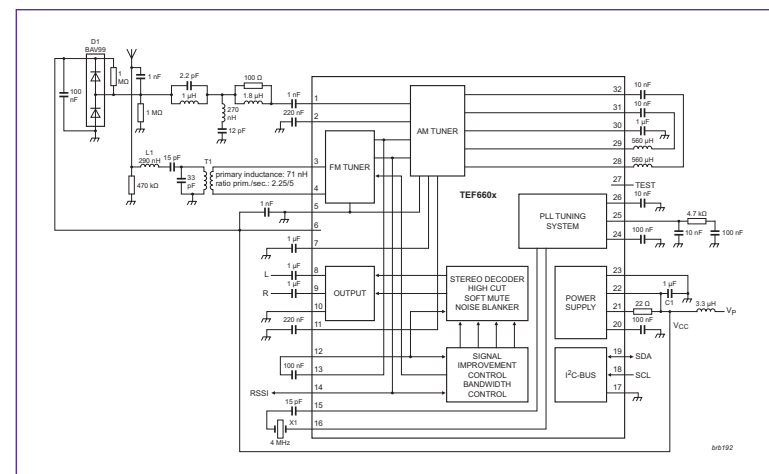
Being part of a connected home

TEF66xx family overview

Type number		TEF6601	TEF6606	TEF6607	TEF6613	TEF6614	TEF6616	TEF6617	TEF6621	TEF6623	TEF6624
System	Supply	8.5 V	8.5 V	8.5 V	8.5 V	8.5 V	8.5 V	8.5 V	8.5 V	8.5 V	8.5 V
	Output	L/R, MPX	L/R, MPX	L/R, MPX	MPX, RDS	L/R, MPX, RDS	L/R, MPX, RDS	L/R, MPX, RDS	L/R, MPX	L/R, MPX, RDS	L/R, MPX, RDS
	IF filter	-	PACS	PACS	PACS	PACS	PACS	PACS	-	PACS	PACS
RD(B)S	Demodulator/ Decoder	-/-	-/-	-/-	✔ / ✔	✔ /-	✔ / ✔	✔ / ✔	-/-	✔ /-	✔ /-
FM	Japan / EU / US bands	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
	OIRT	-	✔	✔	✔	✔	✔	✔	-	✔	✔
	Stereo Decoder	✔	✔	✔	-	✔	✔	✔	✔	✔	✔
	Noise Blanker	-	✔	✔	-	✔	✔	✔	-	-	-
	Weak Signal Processing	✔	✔	✔	-	✔	✔	✔	✔	✔	✔
AM	LW	✔	✔	✔	-	✔	✔	✔	✔	-	✔
	MW	✔	✔	✔	-	✔	✔	✔	✔	-	✔
	SW	-	✔	✔	-	✔	✔	✔	-	-	-
	Noise Blanker	-	✔	✔	-	✔	✔	✔	-	-	-
	Weak Signal Processing	✔	✔	✔	-	✔	✔	✔	✔	-	✔
	Enhanced Static Selectivity	-	-	✔	-	-	-	✔	-	-	-
General	Package	SO32	SO32	SO32	SO32	SO32	SO32	SO32	SO32	SO32	SO32
	AEC-Q100	✔	✔	✔	✔	✔	✔	✔	-	-	-
	T_{amb}	-40 to 85 °C	-40 to 85 °C	-40 to 85 °C	-40 to 85 C	-40 to 85 °C	-40 to 85 °C	-40 to 85 °C	-20 to 85 °C	-20 to 85 °C	-20 to 85 °C
	Product release	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available

Being part of a connected home

6.2 Sound fader control circuit TEA6320

Features

▸ Source selector for four stereo and one mono inputs
▸ Interface for noise reduction circuits
▸ Interface for external equalizer
▸ Volume, balance, and fader control
▸ Special loudness characteristic automatically controlled in combination with volume setting
▸ Bass and treble control
▸ Mute control at audio signal zero crossing
▸ Fast mute control via I²C-bus
▸ Fast mute control via pin
▸ I²C-bus control for all functions
▸ Power supply with internal power-on reset
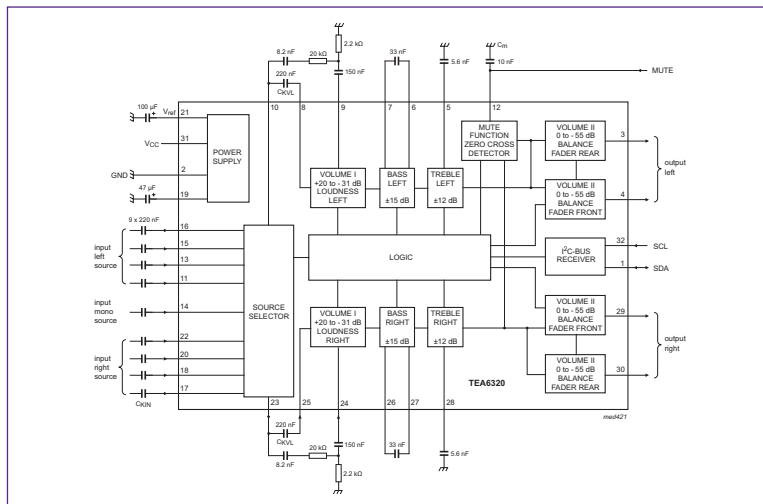
6.3 One-chip CD audio device with integrated MP3/WMA decoder

The SAF784x is a single-chip solution CD audio decoder with on-chip MP3 and WMA decoding, digital servo, audio DAC, sample-rate converter, preamplifier, laser driver, and integrated ARM7TDMI-S microprocessor. The device contains all of the required ROM and RAM, including an internal re-programmable Flash ROM, and is targeted at low-cost compressed audio CD applications. The design is a one-chip CD audio decoder IC, with additions to allow low-cost system implementation of MP3 and WMA decoding. It also includes Aux_L, Aux_R analog inputs.

6. Being part of a connected home

6.4 JN516x wireless microcontroller

The JN516x series is a range of ultra low power, high performance wireless microcontrollers supporting JenNet-IP, ZigBee PRO or RF4CE networking stacks to facilitate the development of Home Automation, Smart Energy, Light Link and Remote control applications. They feature an enhanced 32- bit RISC processor with embedded Flash and EEPROM memory, offering high coding efficiency through variable width instructions, a multi-stage instruction pipeline and low power operation with programmable clock speeds. They also include a 2.4 GHz IEEE802.15.4 compliant transceiver and a comprehensive mix of analogue and digital peripherals. Three memory configurations are available to suit different applications. The best in class operating current of 15 mA, with a 0.6 µA sleep timer mode, gives excellent battery life allowing operation direct from a coin cell.

The peripherals support a wide range of applications. They include a 2-wire I²C, and SPI ports which can operate as either master or slave, a four channel ADC with a battery sensor and a temperature sensor. It can support a large switch matrix of up to 100 elements, or alternatively a 20 key capacitive touch pad.

Features

‣ Single chip device to run stack and application
‣ Very low current solution for long battery life – over 10 years
‣ Supports multiple network stacks
‣ Highly featured 32-bit RISC CPU for high performance and low power
‣ System BOM is low in component count and cost
‣ Flexible sensor interfacing options

Radio
‣ 2.4 GHz IEEE802.15.4 compliant
‣ 128-bit AES security processor
‣ MAC accelerator with packet formatting, CRCs, address check, auto-acks, timers
‣ Integrated ultra low power sleep oscillator - 0.6 µA
‣ 2.0 V to 3.6 V battery operation
‣ Deep sleep current 0.12 µA (Wake-up from IO)
‣ < $0.15 external component cost
‣ RX current 17 mA , TX 15 mA
‣ Receiver sensitivity -95 dBm
‣ Transmit power 2.5 dBm
‣ Time of Flight engine for ranging
‣ Antenna Diversity (Auto RX)

6. Being part of a connected home

Microcontroller

‣ 32-bit RISC CPU, 1 to 32 MHz clock speed
‣ Variable instruction width for high coding efficiency
‣ Multi-stage instruction pipeline
‣ JN5161: 64kB/8kB/4kB (Flash/RAM/EEPROM)
‣ JN5164: 160kB/32kB/4kB (Flash/RAM/EEPROM)
‣ JN5168: 256kB/32kB/4kB (Flash/RAM/EEPROM)
‣ Data EEPROM with guaranteed 100k write operations
‣ RF4CE, JenNet-IP, ZigBee SE and ZigBee Light Link stacks
‣ 2-wire I²C compatible serial interface. Can operate as either master or slave
‣ 5 x PWM (4x timer & 1 timer/counter)
‣ 2 low power sleep counters
‣ 2 x UART
‣ SPI Master & Slave port, 3 selects
‣ Supply voltage monitor with 8 programmable thresholds
‣ 4-input 10-bit ADC, comparator
‣ Battery and temperature sensors
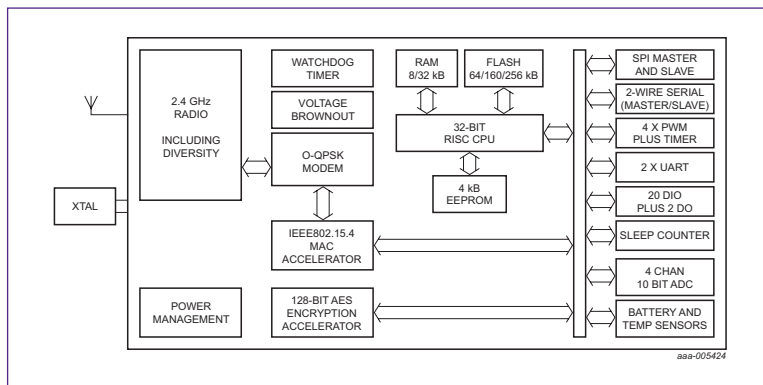
‣ Watchdog & Brown Out Reset
‣ Up to 20 Digital IO Pins (DIO)
‣ Infra-red remote control transmitter
‣ Temperature range -40 to +125 °C
‣ Package 6 x 6 mm 40-lead
‣ Lead-free and RoHS compliant

6.5 Solutions for easy pairing via NFC

NFC Forum compliant NTAG ICs are the ideal choice for mass market deployment of NFC proximity marketing and electronics pairing applications.

Based on ISO14443A technology, NTAG combines ease of integration, high RF sensitivity and anti-cloning features to provide benefits for the whole value chain up to the end consumer.
With the NTAG family, NXP is further expanding its NFC portfolio, already comprising NFC radio ICs, contactless reader / writers, embedded secure elements, contactless and dual interface smart cards (MIFARE and SmartMX), and authentication solutions.

Features

‣ ISO / IEC 14443A 2-3 compliant
‣ NFC Forum compliant
‣ Best-in-class RF performance
‣ Worldwide proven and reliable technology, together with worldwide support and third party equipment
‣ Unique identifier for each IC
‣ Re-programmable user memory from 48 bytes up to 32 kbytes with data retention up to 10 years
‣ Cloning protection
‣ Optional read-only locking function, crypto authentication
‣ Optional Field Detection pin

JN516x block diagram

aaa-005424

7. Expanding feature flexibility in cost-optimized platforms

Using an SOC or MCU with an optimized pin count may require the addition of external components to customize the interface, add features, or expand functionality. If, for example, a Cortex-M0 microcontroller is used for LED control and as an I/O hub, then add-on components might include GPIO expanders, LED blinkers, capacitive touch interfaces, LCD drivers, and EEPROMs. Along with a very large portfolio of ARM-based microcontrollers, NXP also offers a full selection of add-on components. For level shifters and bridges that connect the SOC or MCU to peripherals, see Section 2.

7.1 8/16/32-bit microcontrollers

We offer highly-integrated and cost-effective products, from the smallest 8-bit to the highest performing 32-bit ARM solutions.

The LPC111x family, based on Cortex-M0, is an excellent choice for standby microcontroller tasks. It can be used for power management, system and human interface monitoring (including remote control and keypad), signaling, LEDs, and more. The family delivers the outstanding performance of a 32-bit architecture, with best-in-class power consumption, and the optimized code footprint enables memory cost reduction.

The NXP approach lets designers work with a single ARM development environment to cover all their processing needs, from ARM7 and ARM9 to Cortex-M. Our portfolio also includes an industry-leading selection of enhanced 80C51.

Read more
Web page
www.nxp.com/techzones/microcontrollers-techzone/news.html

7.2 I²C GPIO expanders

Our GPIO expanders make it easy to increase the number of I/O using the I²C-bus. Add inputs for a keypad, a switch, signal monitoring, or fan control, or add outputs for LED control, an ACPI power switch, a relay, timers, or sensors.

Combat "feature creep" by increasing the number of I/O ports instead of adding a new microcontroller. Or, enable seamless migration to a newer microcontroller and still keep the same peripherals. Using expanders eliminates costly, congested PCBs, since a trace or wire isn't needed for each signal.

NXP offers an extremely wide selection. We have 4-, 8-, 16-, and 40-bit formats, support quasi-directional and push-pull outputs, and offer options with interrupts and/or resets — all in a wide range of packages.

# of Outputs	Interrupt	Reset	Interrupt & reset	2 kbit EEPROM	Interrupt & 2 kbit EEPROM
Quasi ouput (25 ma sink and 100 uA source)					
8	PCF8574/74A, PCA8574/74A, PCA9674/74A	PCA9670	PCA9672	PCA9500/58	PCA9501
16	PCF8575/75C, PCA9675	PCA9671	PCA9673	-	-

7.3 User-interface controls

In addition to IO expanders, NXP offers capacitive sensing devices for use with control buttons and keyboards.
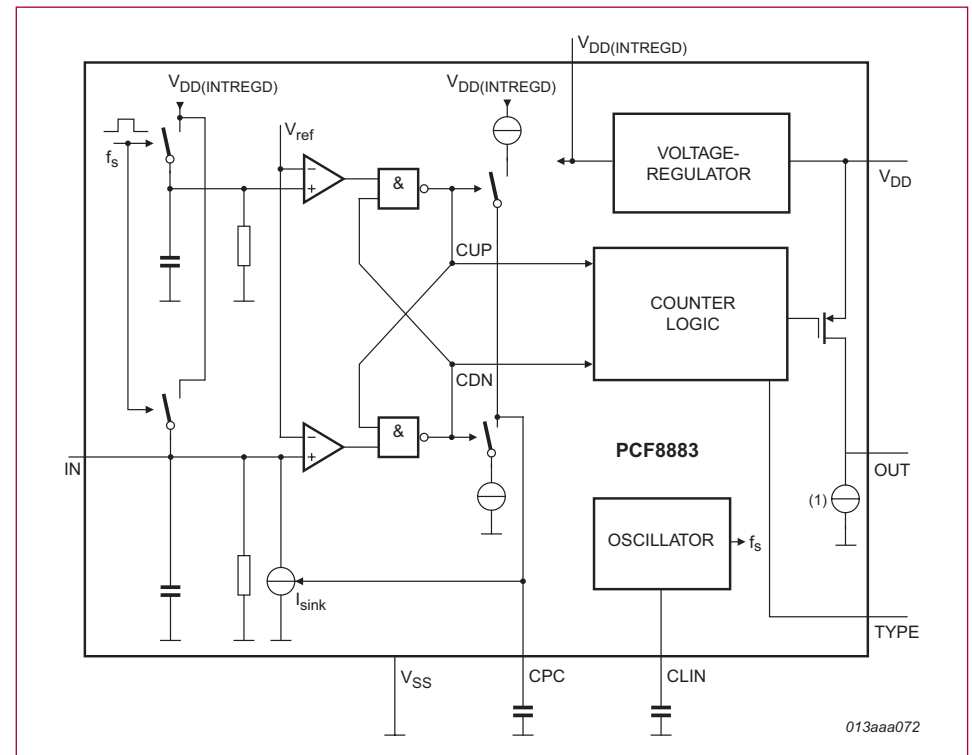
Capacitive proximity switch PCF8883T

This device supports innovative designs that use hermetically sealed keys on a keyboard or switches placed under glass.

Features

‣ Dynamic proximity switch
‣ Digital processing method
‣ Adjustable sensitivity, with very high limits
‣ Adjustable response time
‣ Wide input capacity range (10 to 60 pF)
‣ Automatic calibration
‣ Configurable output: push-button, toggle, pulse
‣ Wide voltage range (V_{DD} = 3 to 9 V)
‣ SOIC8 package (for larger volumes, other options are available on request)

PCF8883 block diagram

013aaa072

7. Expanding feature flexibility in cost-optimized platforms

Capacitive proximity switch PCA8885.

The integrated circuit PCA8885 is a capacitive 8-channel touch and proximity sensor that uses a patented (EDISEN) method to detect a change in capacitance on remote sensing plates. Changes in the static capacitances (as opposed to dynamic capacitance changes) are automatically compensated using continuous auto-calibration. Remote sensing plates (for example, conductive foils) can be connected to the IC using coaxial cable. The eight input channels operate independently of each other. There is also a built-in option for a matrix arrangement of the sensors: interrupt generation only when two channels are activated simultaneously, suppression of additional channel outputs when two channels are already active.

OM11057 evaluation board for PCA8885, PCF8885, and PCA8886
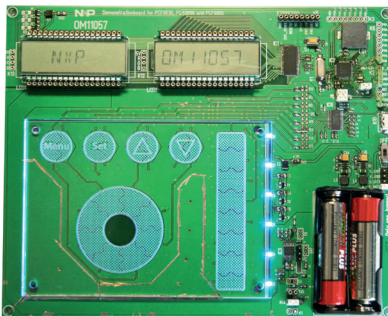
Features and benefits

‣ AEC-Q100 compliant for automotive applications
‣ Dynamic touch and proximity sensor with 8 sensor channels
‣ Support for matrix arrangement of sensors
‣ Sensing plates can be connected remotely
‣ Adjustable response time
‣ Adjustable sensitivity
  ‣ Continuous auto-calibration
  ‣ Digital processing method
  ‣ Can cope with up to 6 mm of acrylic glass
‣ Direct and latching switch modes
‣ I²C Fast-mode Plus (Fm+) compatible interface
  ‣ Two I²C-bus addresses
  ‣ Cascading of two ICs possible
  ‣ Interrupt signalling over I²C-bus
‣ Interrupt output
‣ Large voltage operating range (VDD = 2.5 to 5.5 V)
‣ Sleep mode (IDD< 100 nA)
‣ Low-power battery operation possible (IDD ~ 10 µA)
‣ Operating temperature range Tamb = -40 to +85 °C

7.4 LED controllers

Features

We also offer LED dimmers for use with the signalling LEDs found in most audio and home theater systems and Hi-Fi components design.

▸ Three LED driver states (on, off, flashing at a programmable rate)
▸ Two selectable, fully programmable blink rates (frequency and duty cycle) between 0.591 and 152 Hz (1.69 seconds and 6.58 milliseconds)
▸ 256 brightness steps
▸ I/O not used as LED drivers can be used as regular GPIO
▸ Internal oscillator requires no external components
▸ I^{2}C-bus interface is logic-compatible with SMBus
▸ Internal power-on reset

Type number	
PCA9530	2-bit I^{2}C LED dimmer, 2 HW selectable addresses
PCA9531	8-bit I^{2}C LED dimmer, 8 HW selectable addresses
PCA9532	16-bit I^{2}C LED dimmer, 8 HW selectable addresses
PCA9533	4-bit I^{2}C LED dimmer

For applications requiring a LED segments display, for example to indicate a sound track title, elapsed play time or sound rendering mode, the NPIC6C595 and NPIC6C596 power logic 8-bit shift registers with open drain outputs, are available.

PCA9530 block diagram

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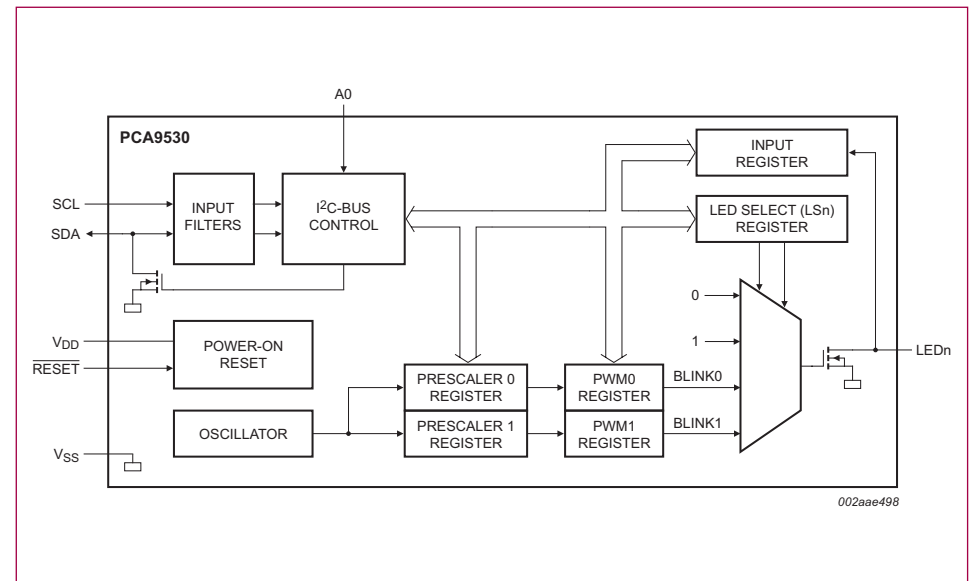
7. Expanding feature flexibility in cost-optimized platforms

7.5 LCD drivers

NXP's standalone LCD display drivers bring high reliability and low power consumption to a broad range of applications. They require few external components for operation, operate over a wide temperature range, support a wide range of supply voltages, and integrate vital interfaces. They are available in several different packages and delivery forms, to support various assembly technologies, and can be used in conjunction with an NXP RGB LED controller for LED backlighting.

NXP's portfolio includes segment, character, and graphic display drivers. NXP offers segment display drivers with the ability to drive large numbers of segments per device. That means more information can be displayed, at a lower cost. For automotive applications, NXP even has options that are AEC-Q100 compliant, ensuring reliable operation under the harshest conditions. NXP's character display drivers can be configured to drive almost any character set, including Japanese, and support a large number of icons. The graphic display drivers, for use with monochrome, dot-matrix LCDs, are available in two resolutions: 34 x 128, and 80 x 128.

Key features
▸ Standalone LCD controllers / drivers
▸ No external components required
▸ Low power consumption
▸ Wide temperature range
▸ Wide supply-voltage range
▸ Various interfaces, including I²C-bus, SPI, and parallel

▸ Suitable packages for different assembly technologies
- TSSOP, QFP, and surface-mount for standard assembly
- Bare die for chip-on-board (COB) modules
- Bumped die for chip-on-glass (COG) modules
- Bumped die for chip-on-flexfoil (COF)
▸ Add NXP RGB LED controller for LED backlighting in any color

The NXP I²C-bus LCD driver evaluation board (OM6290) demonstrates the features of NXP's LCD drivers. The board contains three displays, each controlled by an I²C-bus LCD driver. One member of every driver family is present, thus there is one segment driver, one character driver and one graphic driver on board. In addition, the segment display has a backlight driven by LED driver PCA9633. All drivers are controlled by an LPC2148 microcontroller.
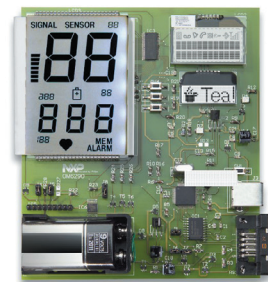
For more information log on to:
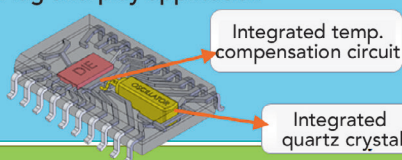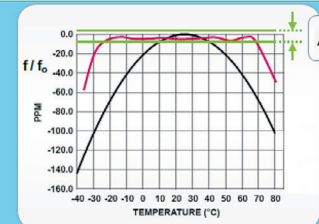http://www.standardics.nxp.com/support/boards/lcd.demo.board/

7.6 I²C real-time clocks (RTCs)

Our I²C portfolio includes high-accuracy RTCs that need no calibration, low-power RTCs that use less than 150 nA, and RTCs with an extended temperature range for reliable performance in the harshest conditions.

Accurate RTCs	
PCF2127A	±3ppm (typ) over -20 to +70 °C, calibrated at V_{dd} = 3.3 V, I²C & SPI, RAM
PCF2129A	±3ppm (typ) over -20 to +70 °C, calibrated at V_{dd} = 3.3 V, I²C & SPI, cost-optimized

Low-power RTCs	
PCF8593	Low power, 1/100 s resolution
PCF8583	Low power, 240 scratch-pad RAM
PCF8563	Very low power (250 nA)
PCF2123	Extremely low power (as low as 100 nA), SPI, electronic frequency tuning register

RTCs with extended temperature range	
PCA8565	Low power, extended temp range to 125 °C, I²C
PCA2125	Extended temp range to 125 °C, SPI

Highly accurate family, as low as ± 3 ppm accurancy:
▸ No (re-)calibration needed
▸ Plug-and-play application

Integrated temp. compensation circuit

Integrated quartz crystal

Accurate RTC

Low-power family: extremely low operating power (<150 nA)
▸ Supports long battery life

NXP:
PCF2123 (w. SPI)   0.12 uA
PCF8563 (w. I2C)   0.25 uA

Extended temperature family: temperature range up to 125° C:
▸ Under harshest conditions
▸ AEC-Q100 compliant tested for automotive

Expanding feature flexibility in cost-optimized platforms

7.7 I²C design tools and tech support

As a leading provider of I²C solutions, we have one of the largest portfolios in the industry, with hundreds of options for all kinds of applications. We support all our I²C product families with an extensive array of development tools, application notes, sample designs, and discussion forums.

I²C demo board I2C2005-1
This kit is an easy-to-use tool for experimentation and training. It includes I²C-bus I/O ports, temperature sensors, LED drivers, and real-time clocks. It employs a USB interface to connect to a Windows PC or laptop and for power. To place an order, go to www.demoboard.com or visit eTools.

7.8 Memory termination regulator

DDR memory termination regulator NE578xx
Designed for appliances using DDR-type SDRAM, these devices include a standby mode and deliver enhanced efficiency.

Features
▸ Fast transient response time
▸ Over-temperature and over-current protection
▸ High bandwidth drivers minimize requirement for output hold-up filter capacitors
▸ Internal divider maintains termination voltage at 1/2 memory supply voltage

7.9 EEPROMs

Our EEPROMs support read/write access via I²C and are available in DIP, SO, and TSSOP packages. The wide operating voltage range (2.5 to 5.0 V) minimizes inventory requirements, and the high reliability ratings (1,000,000 read and write cycles; 10-year data retention) ensure system longevity.

PCA24S08A 1024 X 8 CMOS security EEPROM with access protection
The PCA24S08A functions as a dual access EEPROM with a wired serial port used to access the memory. Access permissions are set from the serial interface side to isolate blocks of memory from improper access.

Features
▸ Compatible with a 24C08 serial EEPROM
▸ Programmable read/write protection
▸ Lock/unlock function
▸ 8 k bits organized as 8 blocks of 128 bytes
▸ 16-byte page write, 10 ms write time
▸ Operating temperature range - 40 to +85 °C
▸ Operating supply voltage range of 2.5 to 3.6 V
▸ Packages: SO8 and TSSOP8

7.10 DIP switches

The PCA8550/PCA95xx family of I²C-controlled DIP switches is available in a wide range of packages. These devices help save space and component count, and are easier to change than physical DIP switches.

# 8. Higher customer satisfaction thanks to enhanced system reliability

Consumers are keenly aware of design and place high value on certain features. Smaller audio components are high on the list of consumer wants, but power dissipation can be a problem in small footprints. Temperature monitoring plays an important role in managing power dissipation, and NXP offers a range of local and distant solutions for tracking temperature.

Another consumer must-have is the ability to support multiple cable formats, including sensitive high-speed data links like HDMI and USB. Connection and disconnection operations have to be seamless, without degradation of performance or interruptions in functionality, because these kinds of issues can lead to expensive customer-service calls. NXP offers a full range of ESD and surge protections, as well as EMI filters, to safeguard all the signal I/O interfaces in an audio system.

8.1 I^{2}C temperature sensors

These devices can be used, in power supplies and on the main processing boards of home theaters systems and Hi-Fi audio components, to determine the temperature or window for an action such as an interrupt, an alarm, fan control, or shut-down. We offer a large selection of commonly used sensors, in a wide array of package types.
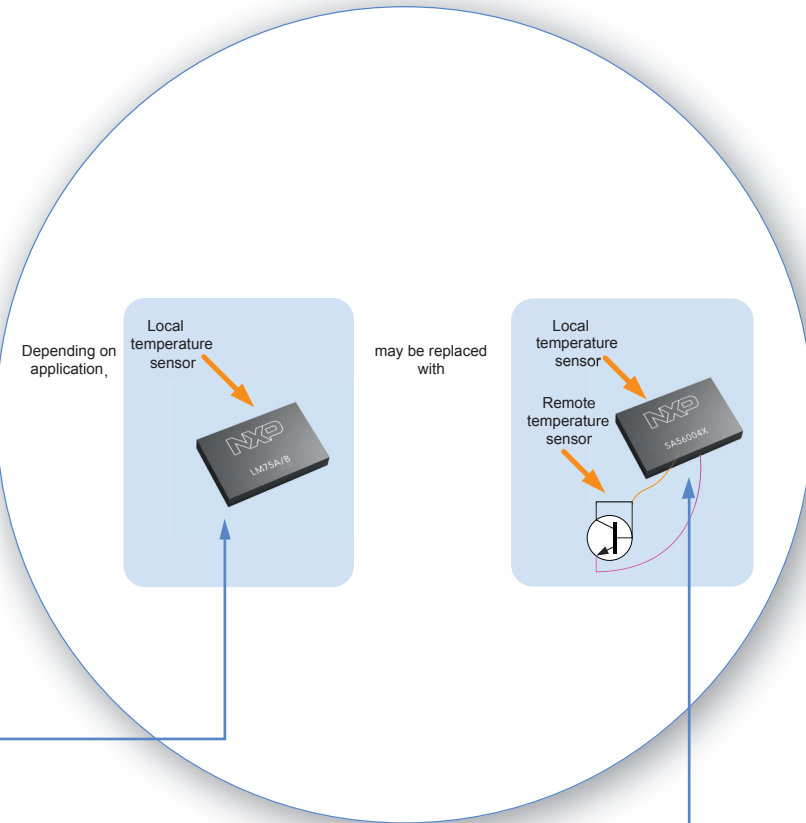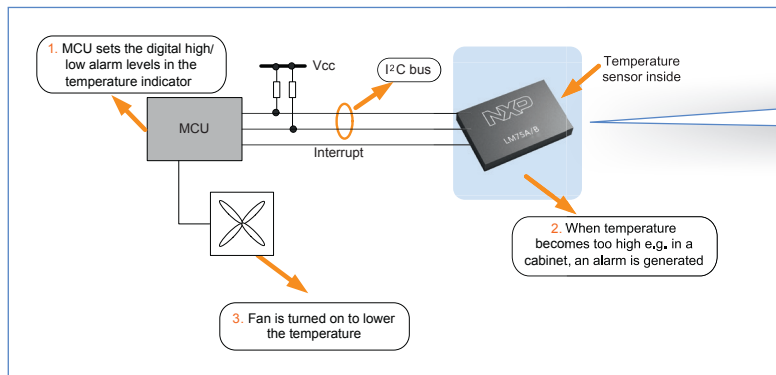
Local sensors	
LM75B	±2 °C local thermal Watchdog, -55 to +125 °C
PCT2075	± ½ °C local temperature sensor, -55 to +125 °C
SE95	±1 °C local thermal Watchdog, -55 to +125 °C
SE97	±1 °C local thermal Watchdog, 2 kbit EEPROM, -20 to +125 °C

Local and remote sensors	
NE1617A	±2 to ±3 °C (0 to +125 °C)
SA56004X	±2 to ±1 °C with alarms, -40 to +125 °C

8. Higher customer satisfaction through enhanced system reliability

Local digital temperature sensor and thermal Watchdog timer LM75B

This highly integrated device provides advanced performance in a cost-effective format and is available in a package that measures only 2 x 3 mm.

Features

▸ Pin-for-pin replacement for industry-standard LM75 and LM75A
▸ I²C-bus interface: up to 8 devices on the same bus
▸ Power supply range from 2.8 to 5.5 V
▸ Temperature range from -55 to +125 °C
▸ Frequency range from 20 Hz to 400 kHz with bus fault time-out to prevent hanging up the bus
▸ 11-bit ADC with temperature resolution of 0.125 °C
▸ Temperature accuracy of
   - ±2 °C from -25 to +100 °C
   - ±3 °C from -55 to +125 °C
▸ Programmable temperature threshold and hysteresis set points
▸ Max supply current of 1.0 µA in shutdown mode
▸ Standalone operation as thermostat at power-up
▸ ESD protection exceeds 4500 V HBM per JESD22-A114, and 2000 V CDM per JESD22-C101
▸ Small 8-pin package types: SO8, TSSOP8, XSON8U, and HWSON8

Type number	Topside mark	Package		
		Name	Description	Version
LM75BD	LM75BD	SO8	Plastic small outline package; 8 leads; body width 3.9 mm	SOT96-1
LM75BDP	LM75B	TSSOP8	Plastic thin shrink small outline package; 8 leads; body width 3 mm	SOT505-1
LM75BGD	75B	XSON8U	Plastic extremely thin small outline package; no leads; 8 terminals; UTLP based; body 3 x 2 x 0.5 mm	SOT996-2
LM75BTP	M75	HWSON8	Plastic thermal enhanced very very thin small outline package; no leads; 2 x 3 x 0.8 mm	SOT1169-2

8.2 Audio, video, and data ESD protections

With our portfolio, you can protect analog and digital audio and video, as well as specific high-speed data paths and other data interfaces. Depending on your system requirements, board layout, or connector pinning, choose a standalone solution or a protection array.

| Interface	Type number	Comments
HDMI, MHL	IP4294CZ10-TBR (TMDS lines) IP4285CZ6-TY (CEC, DDC, hot plug)	Ultra-low clamping, SOT1176, 0.5 pF Low clamping, SOT363, 0.8 pF
SCART YPbPr	PESD5V0L2BT PESD5V0L5UY	2 lines, bidirectional in SOT23, 75 pF 5 lines, bidirectional in SOT363, 19 pF
VGA, S-Video, analog Audio	PESD5V0L2BT PESD5V0U5BV	2 lines, bidirectional, SOT23, 75 pF 5 lines, bidirectional, SOT666, 3.5 pF
USB2.0	IP4220CZ6 PRTR5V0U2AX PESD5V0X1UAB	4 lines in SOT457, 1 pF 2 lines in SOT143B, 1.8 pF Single line in SOD523, 1.55 pF
Memory cards	IP4220CZ6	4 lines, unidirectional, SOT457, 1 pF
Ethernet	IP4238CZ10 IP4220CZ6	Surge protection, 30 kV, 25A 8/20, SOT1197, 3 pF 4 lines ESD protection, SOT457, 1 pF
general I/O	PESD5V0V1BB	Single line, bidirectional, 30 kV, SOD523, 11 pF

8.3 HDMI integrated buffers and ESD protections

By combining ESD protection with buffering, our HDMI solutions let you optimize component count.

Part Number	Features
IP4776CZ38	8 kV ESD IEC DDC level shifting Hot Plug back drive CEC back drive
IP4786CZ32	Contains all the components for a functional HDMI port, with impedance matched TMDS lines, DDC & CEC buffering, 500 mA current limiting and Hot Plug module, HDMI 1.4 HEAC support. Transmission Line Clamping (TLC) technology allows TDR measurements with reduced capacitive dip and enables a high protection level with excellent clamping performance.
IP4787CZ32	8 kV ESD IEC; DDC and CEC buffering; Hot Plug back drive; Standby mode; reduced external component count; HVQFN32

8.4 ESD protection and EMI filtering for SD Card and other low/medium-speed interfaces

Our integrated ESD protection devices, which include EMI filtering, are well suited for use with multi-channel interfaces such as SD/SDHC, medium-speed interfaces such as LCD displays, and low-speed interfaces such as keyboards. To protect an SD card connector, for example, use the IP4253, which is available with 4, 6, or 8 channels, or the IP4254. For memory-card interfaces, we recommend the PESD5V0L4UG or the PESD5V0V4UW.

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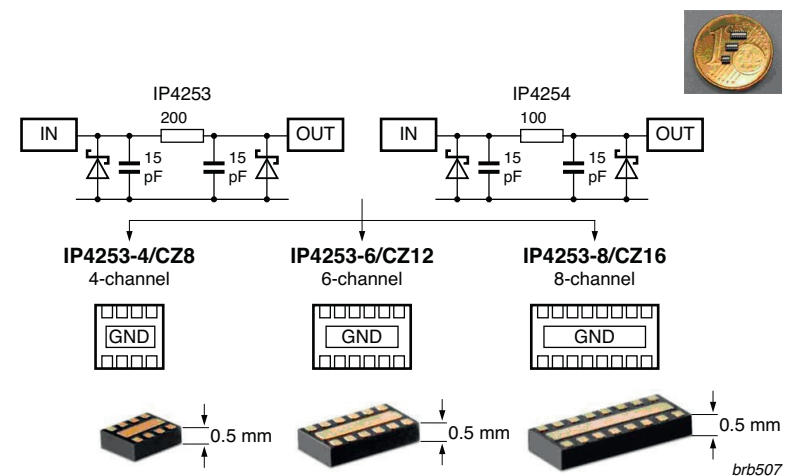
9. Securing the supply chain

The consumer market moves quickly, and that means designers and manufacturers have to move just as quickly to introduce new products and ramp production. Partnering with a world-class supplier can give you a head start in meeting that challenge.

With NXP as your partner, you have access to one of the broadest portfolios in the industry, covering logic, discrete solutions for power, and general-purpose devices. All are housed in footprint-optimized packages and deliver optimized cost/performance ratios.

9.1 Logic functions

We offer a wide range of logic functions in state-of-the-art packages. Our portfolio includes the industry-leading HC/T and LVC families, our new AUP family, plus translator and bus functions.

Packages include the ultra-compact DQFN, HVQFN, MicroPak XSON, and PicoGate. The PicoGate format is especially useful for adding functions with minimal PCB rework or expansion. There are two versions of DQFN: one with accessible pads, for easy signal probes during system validation, test, and production, and one without access to signals, to prevent probes, for use in applications with higher security requirements.

9.2 Discrete solutions for Power

Since integrated circuits typically use a lower core supply voltage than interfaces and memory devices, most boards require a number of different supply voltages. Our power solutions include a variety of devices, including medium-power Schottky diodes, bipolar transistors, and MOSFETs, to help create efficient, cost-effective linear regulators and DC/DC converters.

▸ The PBSS4041PZ can be used as a linear PNP regulator to generate 2.5 and 1.5 V analog supplies. It delivers excellent gain up to 15 A ICM while supporting 5.7 A of continuous current.
▸ Supporting 1.2 or 1.8 V, the PMEG2005EH, PMEG4010EH, and PMEG4030ER are excellent options for the freewheeling Schottky diodes commonly used in DC/DC conversion.
▸ The BSP030, a 10 A, N-channel MOSFET in an SOT233 package, can be used as an external MOSFET for synchronous rectification.
▸ The TL431xxSDT series of shunt regulators, along with the BC847, a general-purpose transistor, are recommended for low-power, discrete linear voltage regulators.

9.3 Special functions and general-purpose devices

To complement function-specific solutions, such as USB, and audio interface devices, we offer general-purpose discrete devices that are well suited for use on the main processing board.

▸ For audio muting, there is the low-noise low V_{CEsat} (BISS) transistor PBSS2515E, which is housed in an ultra-small SOT416 package, and the PBSS4140T, housed in the cost-efficient, high-volume SOT23 package.

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