

SECURE INTERFACE & POWER SOLUTIONS

2017Q2



EXTERNAL USE



SECURE CONNECTIONS
FOR A SMARTER WORLD

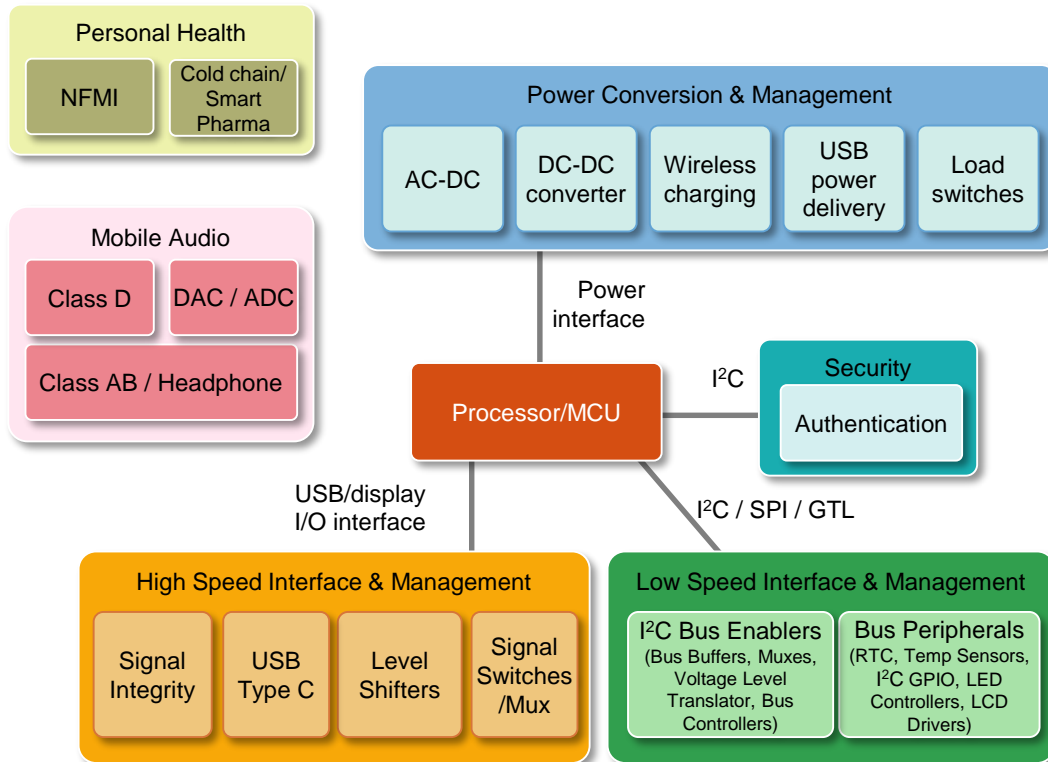
Secure Interfaces and Power (SIP) Fast Facts

1726	Orderable part numbers in BL-SIP (~90% registrable)
38	Different product categories across interface & power portfolio, including automotive market segment.
~\$5B	BL-SIP SAM – a huge market !
24,000+	Worldwide end customers across broad set of applications
~50%	BL-SIP business is broad market
120	# of new BL-SIP products released since 2015

Win 5 – 10 devices/project at every customer with \$3+ BOM cost



Secure Interfaces & Power Portfolio



***50+ functions are automotive qualified**

Portfolio categories		# of devices*
Power Conversion & Management	AC-DC	60+
	DC-DC converter	6
	Wireless charging	7
	USB power delivery	5+
	Load switches	20+
High Speed Interface & Management	Signal Integrity	6
	USB Type-C	5
	Level Shifters	12+
	Signal Switches/Mux	20+
Low Speed Interface & Management	I ² C Bus Enablers (Bus Buffers, Muxes, Voltage Level Translators, Bus Controllers, protocol bridges)	70+
	Bus Peripherals (RTC, Temp Sensors, I ² C GPIO, LED Controllers, LCD Drivers)	160+
Authentication	Authenticator for Anti-counterfeit	2
Personal Health	NFMI	3
	Cold Chain/Smart Pharma	2
Mobile Audio	Class AB / Headphone	2
	Class D / Smart Amplifier	13
	DAC / ADC	3

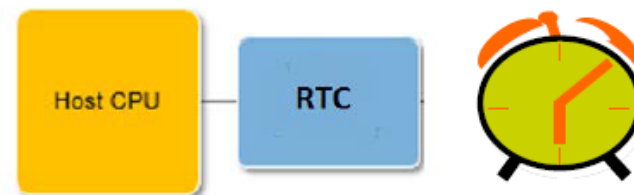
Low Speed Interface & Management

- ✓ RTC
- ✓ Voltage Level Translators
- ✓ Multiplexer / Switch
- ✓ Stepper Motor Driver
- ✓ Capacitive Sensors
- ✓ LCD Driver
- ✓ I2C Temperature Sensors
- ✓ GPIO Expander
- ✓ LED Controller
- ✓ Voltage Comparators
- ✓ I2C Bus Buffers

Real time clocks

What is a Real time clock?

Real time clock is an integrated circuit clock used in electronic systems to keep an accurate track of time.



Discovery questions

- Does your system processor has an integrated Real time clock?
 - If yes, do you need higher accuracy?
 - If yes, do you need a lower power external RTC?
- Do you need an external stand-alone RTC with battery management and alarm features?
- Do you need to support time-stamp/tamper detect functionality?

Key customer careabouts:

- Accuracy
- Power consumption
- Package
- Cost
- Interface – I2C/SPI



Standalone RTC Highlights

RTC Families:

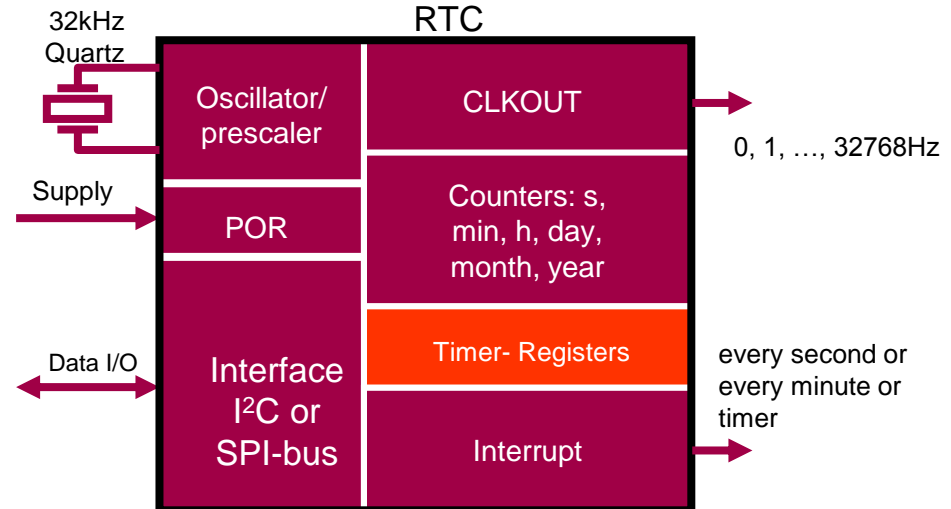
- | | | |
|----------------------------------|---------------------------------------|-----------------------------------------------------------|
| • Low Power RTC Family | PCF8523, PCF2123 | Ultra-low power, I ² C or SPI Interface |
| • Low Cost, Low Power RTC Family | PCF85063, PCF85063A, PCF85063B | Low power, I ² C or SPI Interface |
| | PCF85263A | Low power, time-stamp & battery switchover |
| | PCF85363A | Low power, 64-Byte RAM |
| • Accurate RTC Family | PCF2127(A)T/2, PCF2129(A)T/2 | Highly accurate RTC, I ² C and SPI Interface |
| • Automotive RTC Family | PCA8565, PCA21125, PCA85063A | High temp. up to 125°C, I ² C or SPI Interface |
| • Accurate/Automotive RTC Family | PCA2129T/Q900/2 | Highly accurate and AEC-Q100 compliant |

Key Features:

- Time keeping
- Low power; <100nA I_{CC} (PCF2123)
- Large voltage range; 1.5V to 5.5V
- Clock from seconds to 99 years
- Programmable Timer
- Frequency output
- Small packages (TSSOP8, HVSON10, etc)

Value Proposition:

- For highly accurate time-keeping, choose NXP RTCs with as low as **±3ppm** accuracy
- For long battery life, chose NXP RTCs with the industry's lowest current consumption of less than **100nA**
- For rugged environment applications, there is no way around NXP RTCs with extended temperature range up to **125°C** and **AEC-Q100 automotive compliant qualification**



Key RTC Products



	Type	Interface	Package	Status	Key features
Tiny	PCF8563	I ² C-Bus	SO8, TSSOP8, HVSON8	Production	Industry standard
	PCF85063 PCF85063A	I ² C-Bus	HWSO8, SO8 HXSON10	Production	Tiny footprint, best cost (<i>PCF85063A with alarm</i>)
	PCF85063B	SPI Bus	HXSON10	Production	Tiny footprint, best cost, alarm
Latest Generation	PCF85263A PCF85363A	I ² C-Bus	SO8, TSSOP8/10 HXSON10	Production	Two alarms, watchdog, electronic tuning, battery management, time stamp (<i>PCF85363A features also 64byte of RAM</i>)
	PCF85263B PCF85363B	SPI-Bus	SO8, TSSOP10, HXSON10	Development	Two alarms, watchdog, electronic tuning, battery management, time stamp (<i>PCF85363B features also 64byte of RAM</i>)
Lowest Power	PCF2123	SPI Bus	TSSOP14, HVQFN16	Production	Lowest power (100nA), electronic tuning
	PCF8523	I ² C-Bus	SO8, TSSOP14 HVSON8,	Production	Low power (100nA), electronic tuning Battery management
Precise	PCF2129A, PCF2127A	I ² C-Bus/ SPI Bus	SO20	Production	High accuracy ±3ppm, -25°...+65°C Battery management, Time stamp, metal can quartz (<i>PCF2127A features also 512byte RAM</i>)
	PCF2129 PCF2127	I ² C-Bus/ SPI Bus	SO16	Production	High accuracy ±3ppm, -40°...+85°C Battery management, Time stamp, ceramic quartz (<i>PCF2127 features also 512byte RAM</i>)
Automotive	PCA8565	I ² C-Bus	TSSOP8, HVSON10*	Production	Robustness: up to 125°C
	PCA85063A	I ² C-Bus	TSSOP8	Production	
	PCA21125	SPI Bus	TSSOP14	Production	Robustness: up to 125°C
	PCA2129	I ² C-Bus/ SPI Bus	SO16	Production	High accuracy ±3ppm, Battery management, Time stamp, ceramic quartz for automotive

* HVSON10 package variant is not automotive grade

RTC Selector Guide




RTC Portfolio	PCF8563	PCF85063A/B	PCF85263	PCF85363	PCF8523	PCF2123	PCF2127	PCF2129	PCA21125
Time	✓	✓	✓	✓	✓	✓	✓	✓	✓
Alarm	✓	✓	✓ 2x	✓ 2x	✓	✓	✓	✓	✓
Timer/ Watch dog	✓	✓	✓	✓	✓	✓	✓	✓	✓
Interrupt	✓	✓	✓ 2x	✓ 2x	✓ 2x	✓	✓	✓	✓
Stop Watch			✓	✓					
Time stamp			✓ 3x	✓ 3x			✓	✓	
Time stamp/ Tamper input			✓	✓			✓	✓	
Battery backup			✓	✓	✓		✓	✓	
Tuning register		✓	✓	✓	✓	✓	✓	✓	
Temperature compensation							✓	✓	
Factory calibration							✓	✓	
Quartz crystal							✓	✓	
RAM integrated				✓			✓		
High Temperature	PCA8565	PCA85063							✓
AEC-Q100 Automotive	PCA8565	PCA85063						PCA2129	✓
Interface									



Comparison: NXP Accurate Real Time Clocks

Key Features:

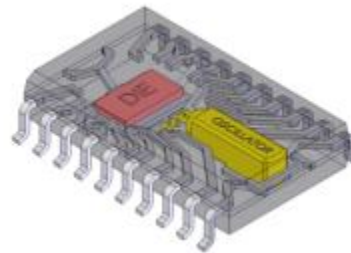
- The aRTC comprises a Real Time Clock (RTC) and a temperature compensated quartz oscillator (TCXO).
- The quartz crystal is integrated in the package.
- No need for further tuning over time; Just set the clock time once.
- The type names are quite similar, but the differences are highlighted bold characters.

Type number	PCF21 27 AT/2	PCF21 29 AT/2	PCF21 27 T/2	PCF21 29 T/2	PCA2129T/Q900/2
Version	Industrial	Industrial	Industrial	Industrial	Automotive
Grade	General Quality spec GQS	General Quality spec GQS	General Quality spec GQS	General Quality spec GQS	AEC-Q100 Grade 3
Package	SO20	SO20	SO16 drop-in compliant to SO20	SO16 drop-in compliant to SO20	SO16
Frequency accuracy	+/- 5ppm -15°C...+60°C +/-10ppm -25...-15, 60..65°C	+/- 5ppm -15°C...+60°C +/-10ppm -25...-15, 60..65°C	+/- 8ppm -30°C...+80°C +/-15ppm <-30°C, >80°C	+/- 8ppm -30°C...+80°C +/-15ppm <-30°C, >80°C	+/- 8ppm -30°C...+80°C +/-15ppm <-30°C, >80°C
Construction	Metal can quartz	Metal can quartz	Ceramic quartz	Ceramic quartz	Ceramic quartz
Silicon foundry Assembly fab Wafer and final test	TSMC Taiwan APB Bangkok Thailand APB Bangkok Thailand	TSMC Taiwan APB Bangkok Thailand APB Bangkok Thailand	TSMC Taiwan APB Bangkok Thailand APB Bangkok Thailand	TSMC Taiwan APB Bangkok Thailand APB Bangkok Thailand	TSMC Taiwan APB Bangkok Thailand APB Bangkok Thailand
Release status	Released mass production	Released mass production	Released mass production	Released mass production	Released mass production
	2129 + 512 Byte RAM count down timer reset output pin		2129 + 512 Byte RAM count down timer reset output pin		

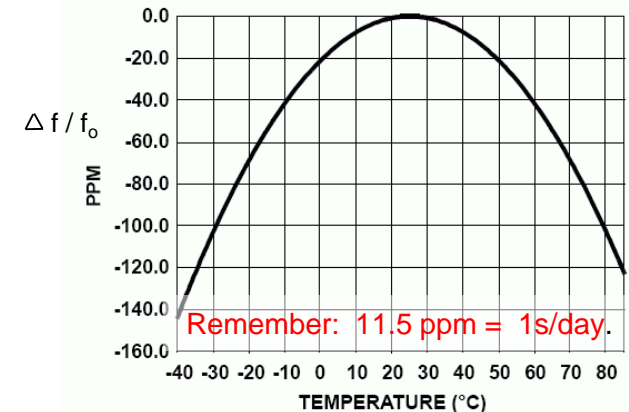
PCF2127A / 29A: Low-Power Accurate Real Time Clock (aRTC)

Features and Benefits

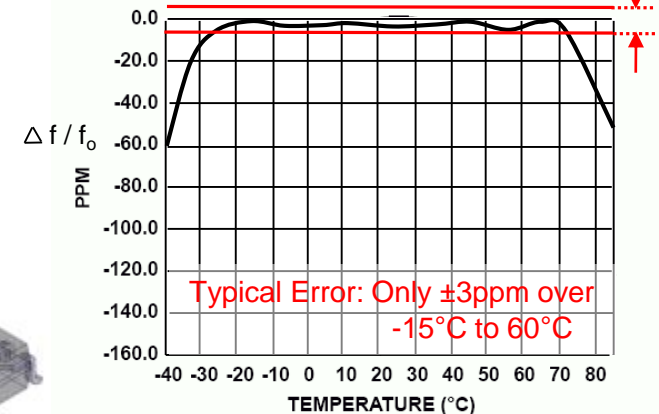
- ▶ High accuracy ($\pm 3\text{ppm}$; typ.) for accurate time reference
- ▶ Ultra-low power consumption enables long battery life
 - $\sim 500\text{nA}$ @ $V_{\text{DD}}=2.0\text{V}$ and $T_{\text{amb}}=25^\circ\text{C}$
- ▶ Integrated quartz crystal requires no external quartz
- ▶ Integrated TCXO with temperature compensation circuit requires no external temperature sensor and no temperature dependent tuning
- ▶ Battery backup and switchover functionality ensures reference timekeeping during power down
- ▶ Factory calibrated and ready at very first power up
- ▶ No external capacitors required and no re-calibration required to compensate for aging
- ▶ Integrated 512-byte RAM (PCF2127A) for retaining critical data during power down
- ▶ SPI and I²C Interface
- ▶ SO20 Package
- ▶ **AEC Q100 Compliant (PCA2129T/Q900)**



Standard RTC (Non-Compensated)



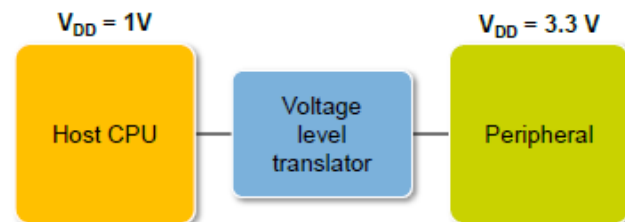
Accurate RTC (Compensated)



Voltage level translators

What is a voltage level translator?

This is a device used for changing the signal voltage level from one to another. Processors typically run on lower voltages compared to peripherals. Hence, there is always some requirement for voltage level translation around processors.



Discovery questions

- Do you have multiple I/O voltage or voltage rails in your system?
- How many different voltages do you need to convert and what voltage do you need to convert?
- Do you need to isolate system peripherals or multiple loads on the bus? (If so, promote the “Active” level translators)

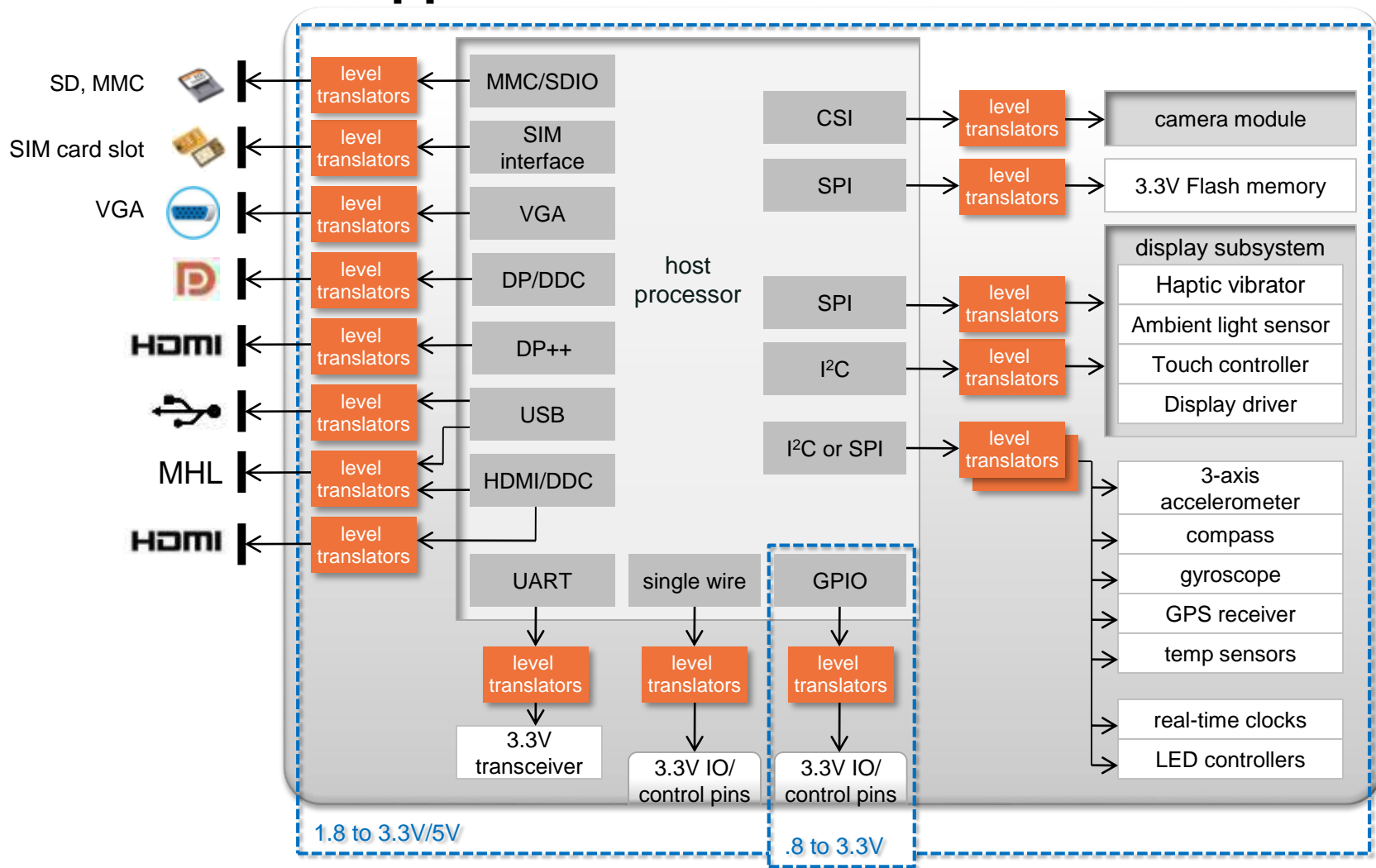
Key customer careabouts:

- No. of channels
- Package
- Voltage support
- I/O design – open drain, push-pull
- Direction sensing option





Wide Selection of Voltage Level Translators For Different Applications





Voltage-Level Translator Overview

PCA Family

Features:

- Single and Dual supply
- Capacitive isolation
- High noise margin

Applications

- I2C buffering
- Long cable
- Hot-swap

NVT Family

Features:

- Dual supply
- Bidirectional
- Auto-sensing
- Passive
- External pull-ups required
- 1-10 bits wide

Applications

- Control interfaces

NTB Family

Features:

- Dual supply
- Auto-sensing
- Isolates capacitance
- Push-pull outputs
- Low output drive

Applications

- Control interfaces with active drive

GTL Family

Features:

- Supports 'GTL' logic
- Dual supply
- Auto sensing
- GTL to LVTTTL level translation

Applications

- Supports GTL levels on micro-processors

NTS/NTSX Family

Features:

- Dual supply
- Bidirectional
- Passive
- Open Drain
- Integrated Pull up resistors
- NTSX family has high sink current capability

Applications

- Control Interfaces



Level Translators with Capacitance Isolation (“Active”)

PCA Family

► Why used?

- Voltage level shifting between host processor’s I²C-bus and peripheral devices when there is a mismatch of supply voltages
- Used when additional drive is needed or to isolate two sections of the bus loading

► Where used?

- Digital logic level translation between host processor and slave device where **capacitance isolation and speed of >3MHz (up to 30MHz) is required**

SPEED	OUTPUT DRIVE	V RANGE	LEVEL TRANS	TECHNOLOGY	FUNCTION / USE	PACKAGE	PART#
Fm	A: 1 mA B: 6 mA 09A: 100 µA 09A: 6mA/30 mA	A: 1.0 to (V _{CCB} -1V) B: 3.0 to 5.5V	2 V _{dd} / 5V tolerant	A side (LV)	Works with any I ² C slave	SO8, TSSOP8, XQFN8	PCA9509
		A: 0.8 to 1.5V B: 2.3 to 5.5V				TSSOP8, XQFN8	PCA9509A PCA9509P
	6 mA	A: 1.0 to V _{CCB} -1.5V B: 3.0 to 5.5V	2 V _{dd} / 5V tolerant	static offset	Ideal for 1.0V master controlling 3.3V slave or vice-versa	TSSOP20, HVQFN24	PCA9519
	6 mA	2.3 to 3.6V	5V tolerant	offset on both sides	Extension of the I ² C-bus by buffering	SO8, TSSOP8 (MSOP8), HWSON8	PCA9515A
	6 mA (A&B)	A: 0.9 to 5.5V B: 2.7 to 5.5V	yes	B side (HV)	I ² C-bus buffering to I ² C device	S08, MSOP8 , HWSON	PCA9517A
Fm+	13 mA (A&B)	A: 0.8 to 5.5V B: 2.2 to 5.5V	yes	B side (HV)	I ² C-bus buffering to I ² C device	TSSOP8, HWSON8	PCA9617A



Passive Level Translators

NVT Family

- ▶ NVT family: lowest standby current (5 μ A)
 - Bidirectional, no directional pin required
 - Widest supply range: from 1 to 5V
 - Fast propagation delay
 - I²C and DDC compliant
 - Lock-up-free operation for isolation when EN=LOW
 - No offset
 - Voltage translation with supplies from different domains
- ▶ Extremely thin, small pkgs available

BIT(S)	SPEED	OUTPUT DRIVE	V RANGE	FUNCTION	BUS/USE	PACKAGE	PART#
1	< 33 MHz	open-drain with 50pF capacitance & 197-Ω pull-up	1.0 to 5.0V		general purpose, I ² C, SMbus, I ² S, SPI, digital RGB	TSSOP8, XSON8U, XSON6	NVT2001
2				alt source PCA9306			NVT2002
3				<1.5 nsec max propagation delay		TSSOP10/16, HXSON12, DHVQFN16, HVQFN16	NVT2003
6							NVT2006
8				alt source GTL2003, control signals		DHVQFN20/24, TSSOP20/24, HVQFN24	NVT2008
10							NVT2010
2	6 mA (A&B)	A: 0.9 to 5.5V B: 2.7 to 5.5V	B side (HV)	I ² C, I ² S, SMbus		SO8, TSSOP8, VSSOP8, XQFN8, XSON8, XSON8U	PCA9306



Level Translators – NTB Family

3-State and Auto-Direction Sensing

- ▶ Auto-direction sensing
- ▶ Wide operating voltage range
- ▶ Dual-supply, translating transceiver
- ▶ Suitable for 3-state and push-pull applications
- ▶ Capacitance isolation
- ▶ Not recommended for open-drain applications (use NTS family instead)

CH	V RANGE	OUTPUT DRIVE	BW	DESCRIPTION	OUTPUT ENABLE	PACKAGE	PART#
1	1.2V - 3.6V to 1.65 - 5.5V	-20 μ A	25 MHz	3-state or push pull	Active High	SC-88, TSOP6, XSON6	NTB0101
1					Active Low	SC-88	NTB0101A
2					Active High	TSSOP8, XSON8, XSON8U	NTB0102
4					Active High	XQFN12, DHVQFN14, WCSP12	NTB0104

GTL Value Proposition

► Where used?

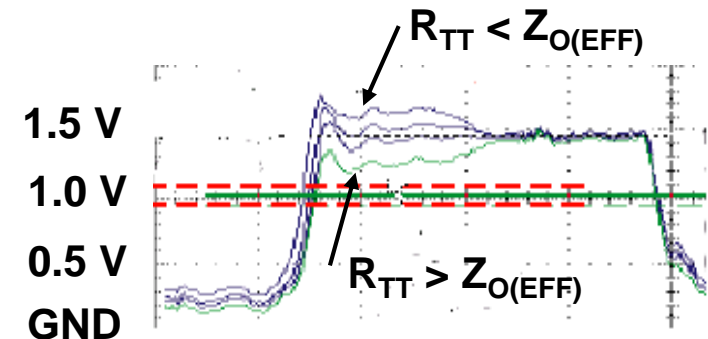
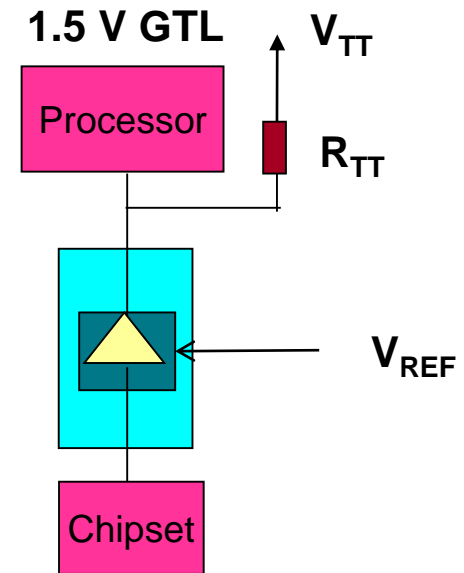
- Signal voltage conversion between low voltage processor and LVTTTL device

► Why **G**unning **T**ransceiver **L**ogic (GTL)?

- Largest selection of GTL devices available
- Provide level transition between GTL I/O and LVTTTL I/O
- Low voltage open drain interface with externally supplied V_{REF} threshold voltage with $\pm 0.05V$ V_{IL} & V_{IL} range and R_{TT} sized to match trace impedance to minimize reflections.

► Why Dedicated GTL Processor to Chipset Interface?

- Work with Intel on new device functionality that is required with their processors
- Integrated control logic using GTL and LVTTTL input line levels
- Enable pin to disable signals
- Saves board space and component count



$$Z_o = 50 \text{ Ohm}$$



GTL Active Translation Device Status

Device	Function
GTL2005	4-bit GTL to LVTTL
GTL2006	13-bit Xeon translator
GTL2007	12-bit Xeon translator with power good
GTL2008	12-bit Xeon translator with power good & Hi Z outputs
GTL2012	2-bit GTL to LVTTL
GTL2014	4-bit GTL to LVTTL
GTL2018	8-bit GTL to LVTTL
GTL2034	4-bit GTL to GTL
GTL2107	12-bit Xeon translator with power good & Hi Z outputs



Level Translators – NTS Family

Open Drain and Auto Direction Sensing

► Features

- Operating voltage range: 1.65 - 3.6V to 2.3 - 5.5V
- Low power consumption: 30 μ A max I_{CC}
- Uni or bi-directional, auto-sensing
- 1-, 2- and 4-bit in multiple small packages
- Push pull and open drain drivers: UART, GPIO, I²C, SMBus, etc.
- No external components required
- Suspend mode; partial power down with IOFF
- Standby mode
- Operating temp range: -40 to 125°C

BITS	V RANGE	OUTPUT DRIVE	BW	DESCRIPTION	PACKAGE	PART#
1	1.65 - 3.6V to 2.3 - 5.5V	-20 μ A/1 mA	25 MHz	open drain	XSON6	NTS0101
2					TSSOP8, XSON8, XQFN8	NTS0102
3					XQFN10	NTS0103
4					TSSOP14, XQFN12, WLCSP12, DHVQFN14	NTS0104
2	1.65 - 5.5V	-20 μ A/6 mA	25 MHz	open drain	XQFN8	NTSX2102

Multiplexers & Switches Value Proposition

Why used?

- Address conflict resolution if two devices with same address need to be on the same bus
- Voltage level translation to allow devices with different voltage supplies to operate on the same I²C-bus
- Broadcast communication to identically addressed slaves

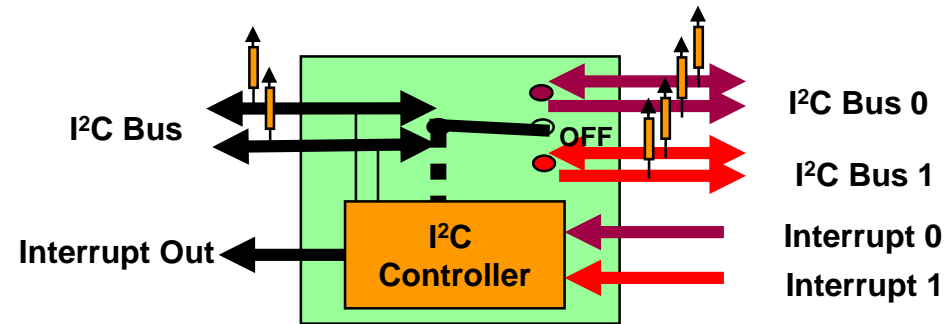
Where used?

- Notebooks, desktop, server, telecom, power suppliers, and anywhere that requires the I²C-bus to be split

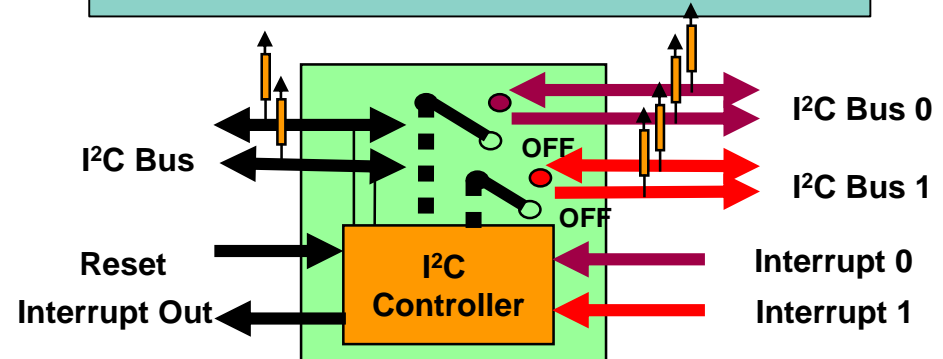
Differences between Multiplexers & Switches?

- A mux can select only one channel at a time, while a switch can select one or more channels at a time.

Application Note AN262



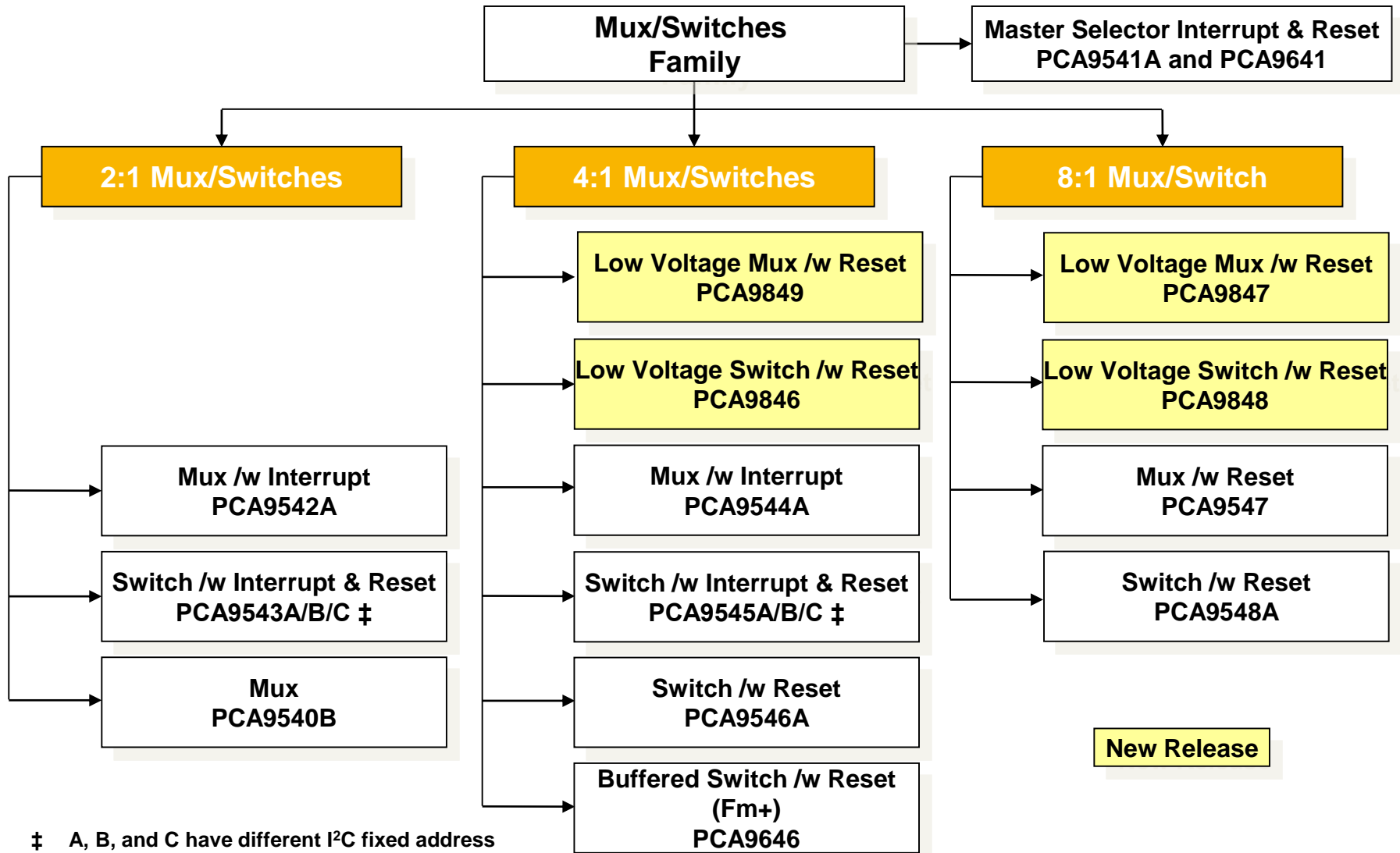
Multiplexer
Can only select one downstream channel at a time



Switch
Can select one or more downstream channels at a time.
Multiple channels are selected in broadcast mode.



Multiplexer / Switch Family



Stepper Motor Controller Value Proposition

► Why used?

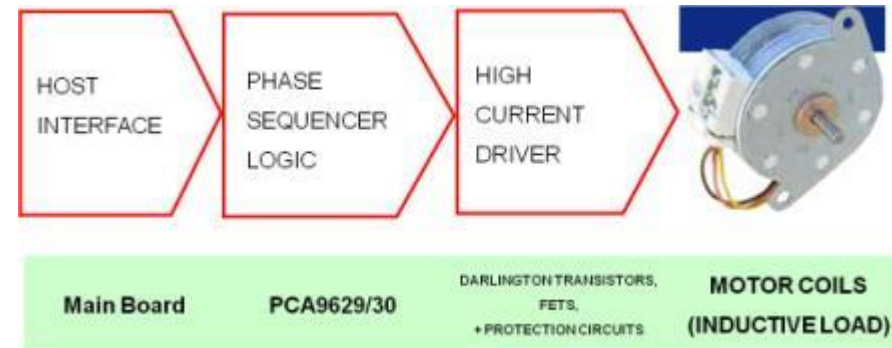
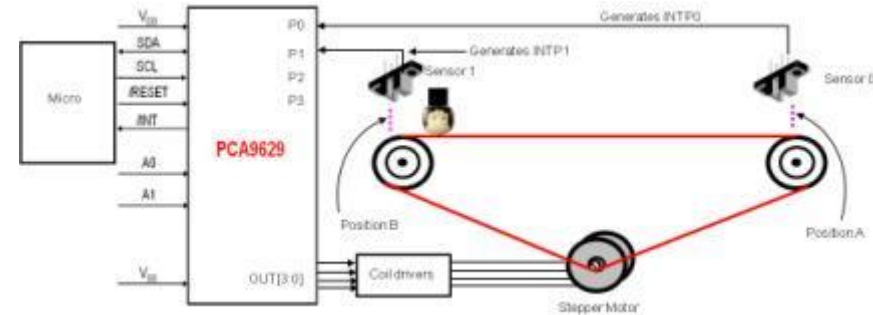
- Offload CPU/Microcontroller from driving control signals to the motor driver

► Where Used?

- HVAC Compressors and blowers
- Industrial motors
- Variable-speed fans and pumps
- Premium e-bikes
- Laundry machines
- Medical pumps and blowers
- Toys

► Why NXP Stepper Motor Controller?

- Supports different commands (start, stop, ramp-up, ramp-down, direction control, etc.).
- Interfaces with different stepper motors as drivers are external.
- Easy integration in the system with I²C interface.



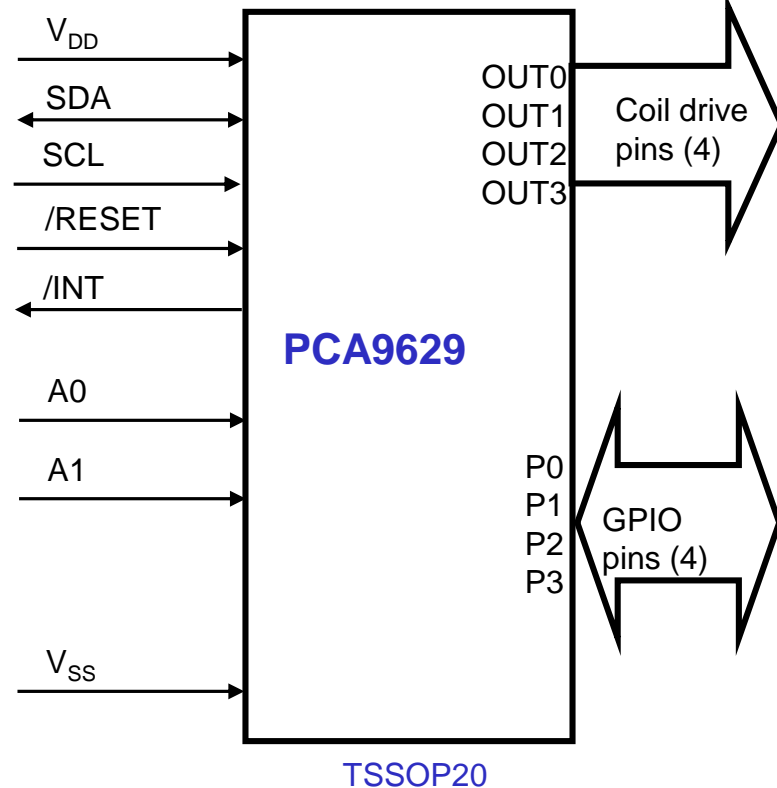
PCA9629 1-Channel Stepper Motor Controller

Features

- ▶ Provide drive signals for driving a single stepping motor:
 - One, Half and Two Phase Drive Control
 - Start, stop, ramp-up/ramp-down and direction control of stepper motors
 - Programmable steps per rotation allows use of many models of stepper motors
 - Programmable step pulse width to control speed of motor
 - Balanced push-pull outputs: Drives 1000 pF loads with 15 ns rise and fall times
- ▶ Interrupt linked extra steps, direction reversal and stop control
- ▶ Four GPIOs programmable as inputs or push-pull outputs (25 mA) to sense optical interrupter for motor home position or drive solenoid/LEDs, respectively
- ▶ Stand alone operation: Off loads microcontroller
- ▶ Hardware RESET to recover from bus stuck condition

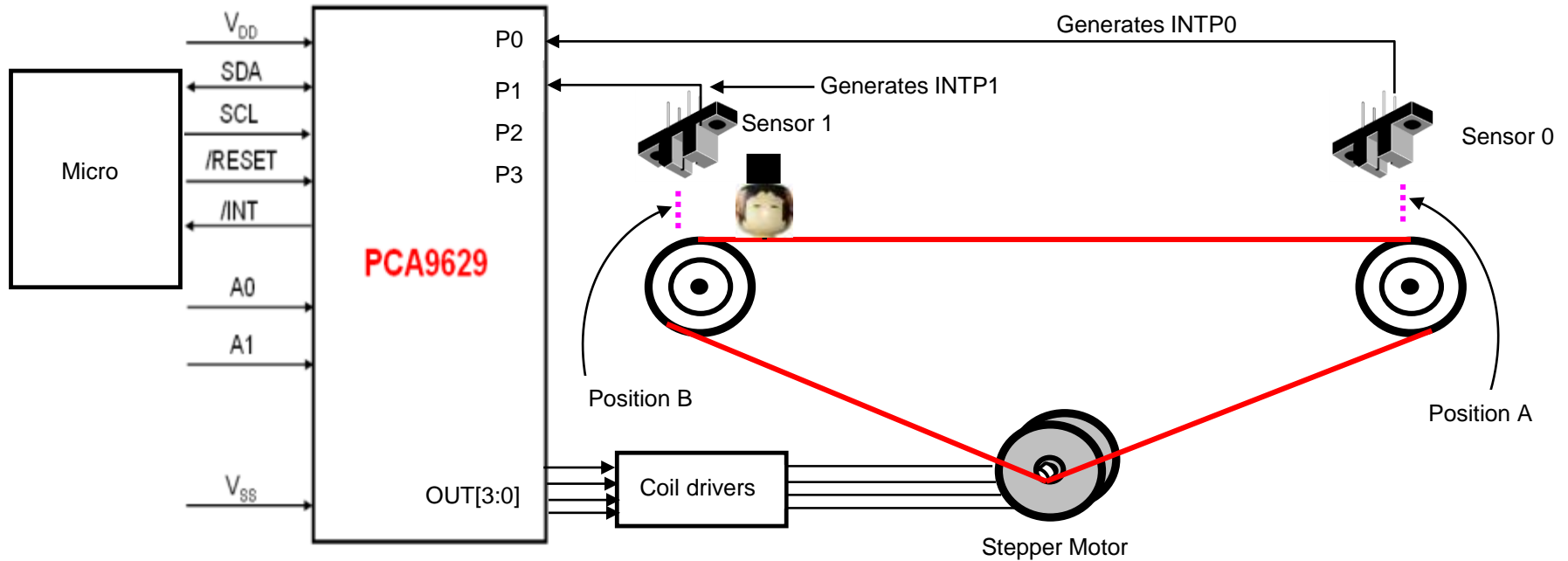
Potential applications

- ▶ White Goods
- ▶ Robotics & Toys
- ▶ Gaming & Vending Machines
- ▶ Security & Surveillance Camera

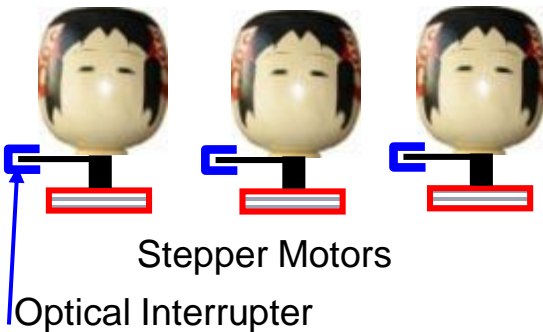




Stepper Motor Controller Typical Application



Doll Head Control



Wall-e-remote-control-robot



Open / Shut Doors



Capacitive Sensors Value Proposition



► Why used?

- No contact required (no actual pressing on touch area)
- Works even when wearing gloves
- Works in dirty environment (self-calibrating)
- Works together with any event that generates a pre-defined change in capacitance

► Where used?

- Switches in medical environment
- Switches for use in explosive environment
- Sanitary applications like in public rest rooms
- Mobile applications to detect proximity to the head
- Keypads

► Why NXP?

- Products are very sensitive, highly configurable and consumes low power

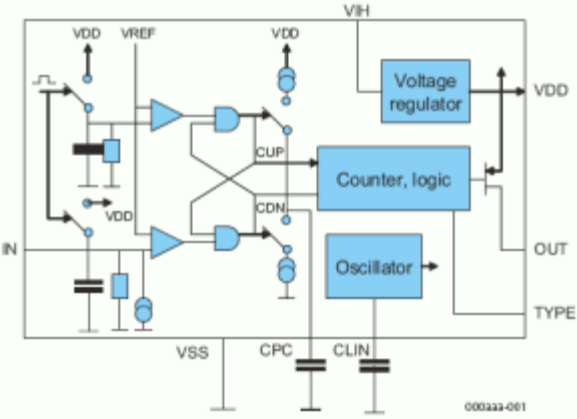
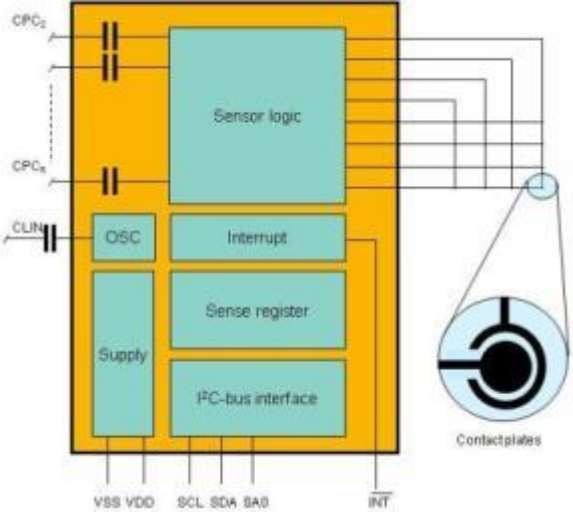
When in the hand,
display is ON



When on the ear,
display is OFF



Capacitive Sensor Portfolio

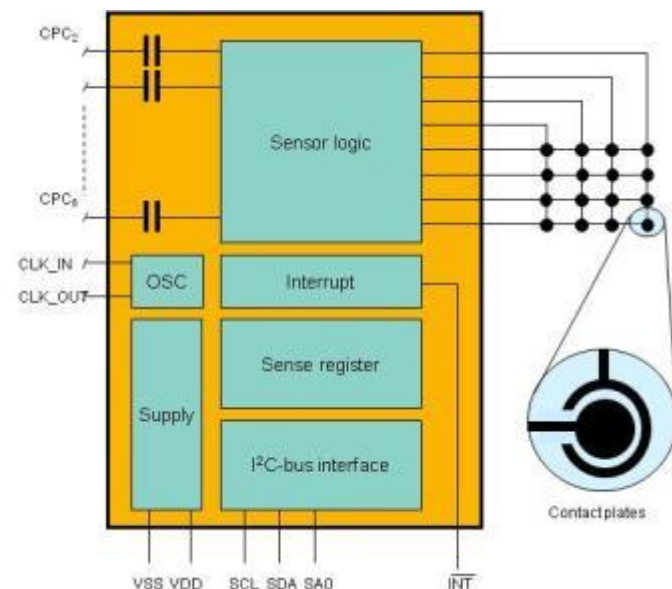
Single Channel	Eight Channel
 <p>000222-061</p>	
<p>PCF8883</p> <ul style="list-style-type: none"> • One input one output • Does not require a microcontroller • Available in two packages <ul style="list-style-type: none"> • PCF8883T (SOIC8) • PCF8883US (WLCSP8) 	<p>PCA8885 and PCF8885</p> <ul style="list-style-type: none"> • 8-Channels • Requires a microcontroller • May be configured for up to 28 sensors • With two devices, user may enable up to 80 sensors • Available as both industrial and automotive versions in TSSOP28 • Industrial version also available in SOIC28 package. QFN 28-pin package under consideration.

PCF8885: 4x4 Channel Proximity Switch



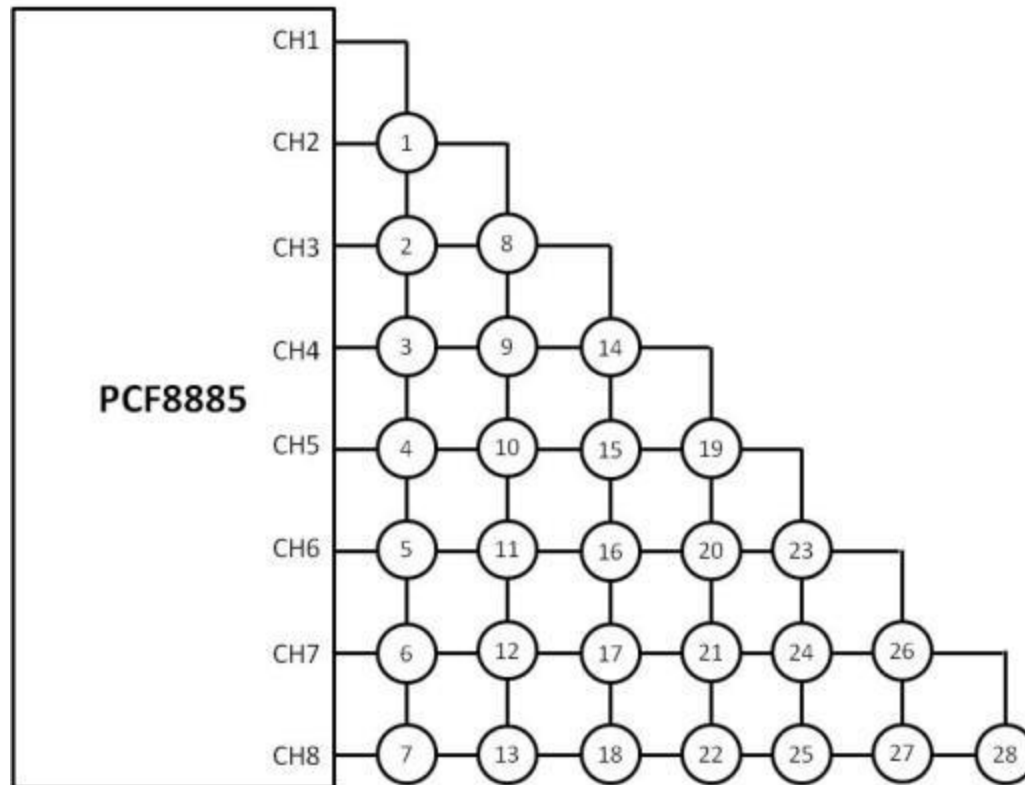
Key Features:

- Based on the PCF8883 algorithm
- Fm+ I²C-bus (1MHz) interface
- Supply voltage range: $2.5V < V_{DD} < 5.5V$
- Input capacitance range: 10pF to 40pF
- Adjustable scanning frequency
- Channel masking feature
- Fast start-up mode
- One sub-address enables 2 devices per bus
- Sleep mode activated via I²C bus or sleep input
- Three sensing modes: 1-key, 2-keys and N-keys
- Two events handling modes; direct and latching modes
- **AEC-Q100 Qualified for Automotive Applications**



Eight-Channel Capacitive Touch Sensor	
PCF8885T/1	SOIC28; 7.5mm body width
PCF8885TS/1	TSSOP28; 4.4mm body width
PCF8885TL	QFN28; 5mm x 5mm (Under Consideration)

PCF8885: Single Device with up to 28-Sensors



Inputs							
	b7	b6	b5	b4	b3	b2	b1 b0
1	0	0	0	0	0	0	1 1
2	0	0	0	0	0	1	0 1
3	0	0	0	0	1	0	0 1
4	0	0	0	1	0	0	0 1
5	0	0	1	0	0	0	0 1
6	0	1	0	0	0	0	0 1
7	1	0	0	0	0	0	0 1
8	0	0	0	0	0	1	1 0
9	0	0	0	0	1	0	1 0
10	0	0	0	1	0	0	1 0
11	0	0	1	0	0	0	1 0
12	0	1	0	0	0	0	1 0
13	1	0	0	0	0	0	1 0
14	0	0	0	0	1	1	0 0
15	0	0	0	1	0	1	0 0
16	0	0	1	0	0	1	0 0
17	0	1	0	0	0	1	0 0
18	1	0	0	0	0	1	0 0
19	0	0	0	1	1	0	0 0
20	0	0	1	0	1	0	0 0
21	0	1	0	0	1	0	0 0
22	1	0	0	0	1	0	0 0
23	0	0	1	1	0	0	0 0
24	0	1	0	1	0	0	0 0
25	1	0	0	1	0	0	0 0
26	0	1	1	0	0	0	0 0
27	1	0	1	0	0	0	0 0
28	1	1	0	0	0	0	0 0

- ▶ Sensors 1 to 28 are each connected to two channels
 - ▶ Sensor 1 is connected to CH1 & CH2
 - ▶ Sensor 2 is connected to CH1 & CH3
 - ▶ Sensor 8 is connected to CH2 & CH3
- ▶ Total of 28 Sensors
- ▶ Device should be used in the 2-key mode
- ▶ After reading the SENS register, from the two bits set, the user can infer which sensor is touched.

What are LCD Drivers?

► Why used?

- To display any kind of information as...
 - 7-segment
 - Starburst
 - Character
 - Graphics

► Where used?

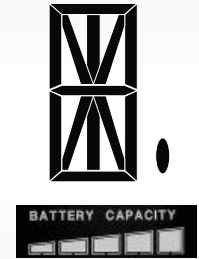
- Automotive
 - Instrument Clusters, climate controls, car radios
- Industrial
 - E-meter, industrial control, point of sales
- White Goods
 - Washing machines, dish washer, refrigerators
- Consumer
 - Portable/handheld devices

► Why NXP LCD Drivers?

- Wide range of segment outputs
- Wide power supply range for Vdd and VLCD
- On-chip RAM with auto incremental addressing
- On-chip oscillator
- On-chip LCD bias voltage generation
- Low power consumption
- No external components
- Automotive qualification (*selected parts*)

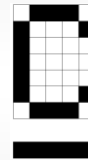
Segment Driver

- Wide-range of segment count to allow single chip solutions in most cases
→ 60 x 4, 80 x 4, 160 x 4, 60 x 8, ...



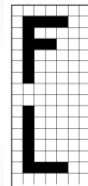
Character Driver

- Separate icon row for versatile usage

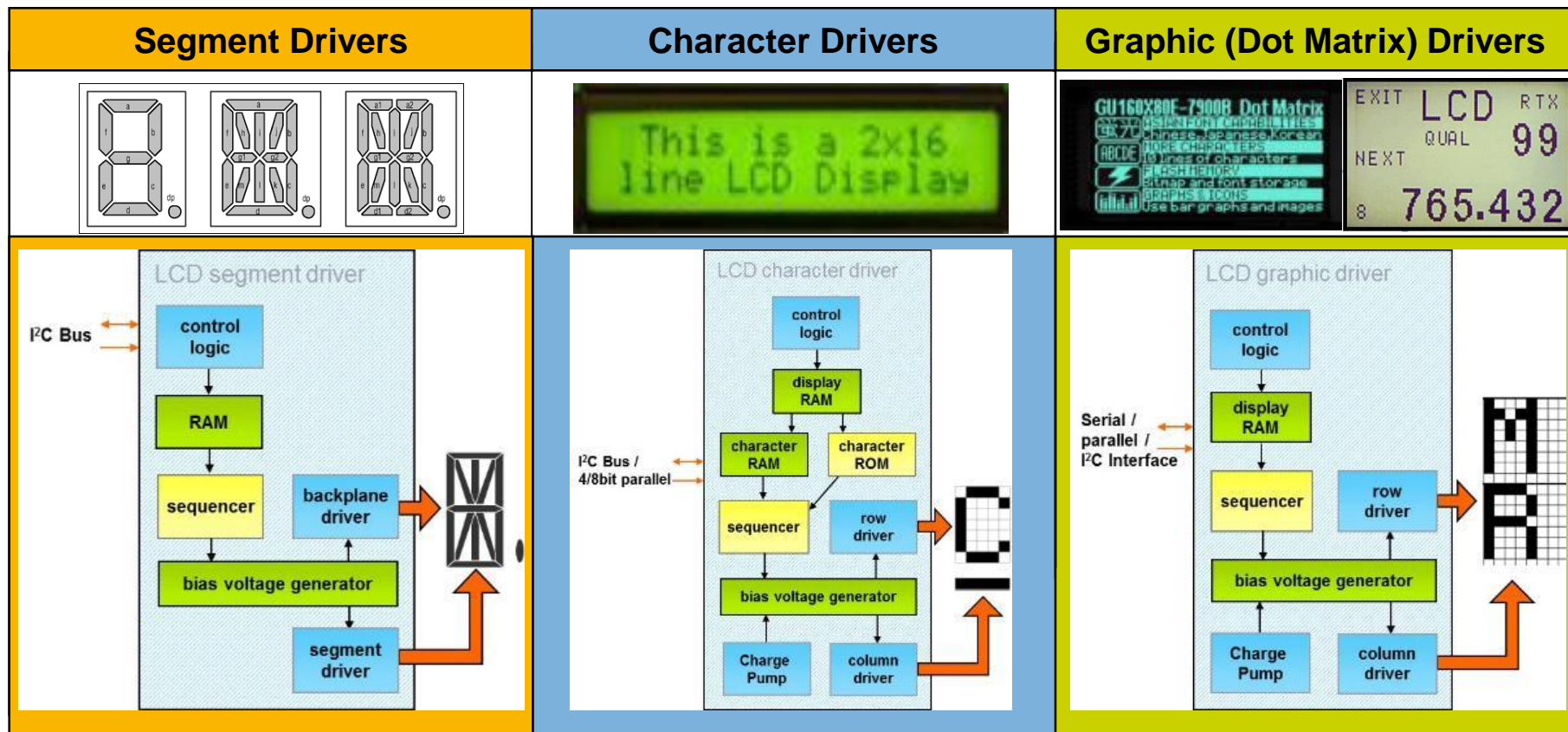


Graphic Drivers

- Niche resolutions that are not common in the market
→ 34 x 128, 80 x 128



What are LCD Drivers?



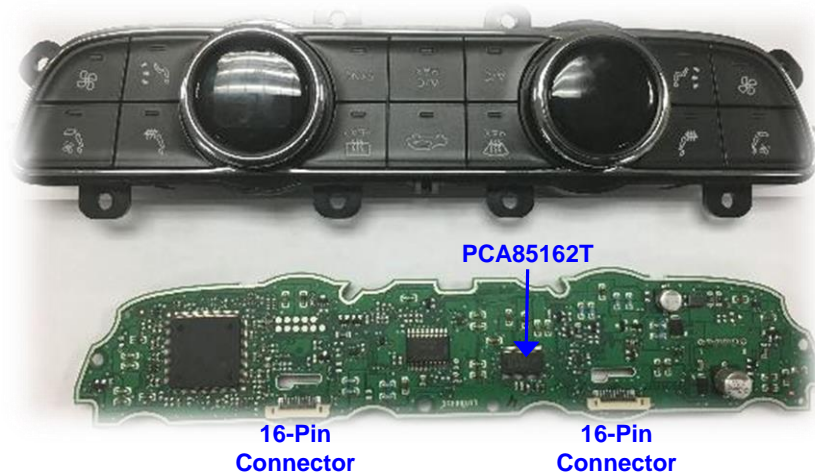
LCD Drivers: Key Products





Segment Drivers		Character Drivers	Graphic (Dot Matrix) Drivers
<ul style="list-style-type: none"> • PCA8561 4 x 18 Segments • PCF8566 4 x 24 Segments • PCx85162 4 x 32 Segments • PCA85262 4 x 32 Segments • PCx8551 4 x 36 Segments • PCx85176 4 x 40 Segments • PCA85276 4 x 40 Segments • PCx8553 4 x 40 Segments • PCA8546 4 x 44 Segments • PCA8547 4 x 44 Segments • PCx85134 4 x 60 Segments • PCA8543 4 x 60 Segments • PCx8536 8 x 40 Segs + 6PWM • PCF8545 8 x 40 Segments • PCx8537 8 x 44 Segments • PCA9620 8 x 60 Segments 	P a c k a g e d	<ul style="list-style-type: none"> • PCF2116 4-Line x 12-Character or 2-Line x 24-Character COG • PCF2119 2-Line x 16-Character PCF21219 Plus 160 icons COG • PCx2117 2-Line x 20-Character Plus 200 icons COG 	<ul style="list-style-type: none"> • PCx8539 18 x 100 (COG) Small Graphic Driver • PCF8531 34 x 128 (COG) Small 4-x-20 Text Characters Full Graphics • PCF8811 80 x 128 (COG) Large Universal Display • PCF8578 8 x 32 (stand-alone) Up to 40,960 dots when combined with 32 PCF8579 VSO56, LQFP64, TQFP64
<ul style="list-style-type: none"> • PCx8576D,E 4 x 40 Segments • PCA8576F 4 x 40 Segments • PCx85133 4 x 80 Segments • PCA85233 4 x 80 Segments • PCA8530 4x102 Segments • PCx85132 4 x 160 Segments • PCA85232 4 x 160 Segments • PCx8538 9 x 102 Segments 			

x = A (Automotive) & F (Industrial)

PCA8561: 4x18 Cased Segments Driver



Target Applications	Target Customers
HVAC Controllers 	BHTC Calsonic kansei Methode TRW
Instrument Clusters 	Denso Calsonic Kansei Continental Magneti Marelli NSI Yazaki Visteon

Various LCD Driver Demo Boards

PCA9620 evaluation board OM13500



PCA8537 evaluation board OM13500A



PCA8538 evaluation board OM13501



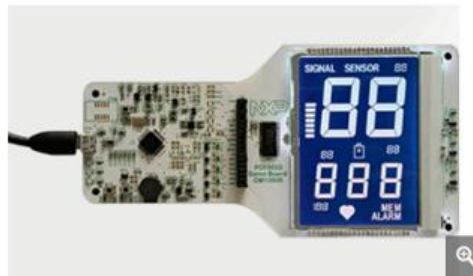
NXP OM13502: PCA2117 demo board



NXP OM13503: PCA8539 demo board



OM13506: demoboard for PCF8553DDT

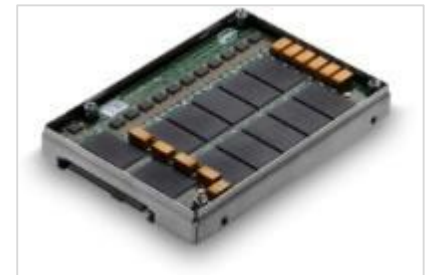
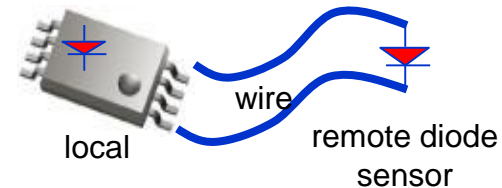


OM11052 has LCD PCF8636



I²C Temperature Sensors

- ▶ Determine temperature and set window for interrupt, alarm, fan control, shutdown, etc.
- ▶ Applications
 - Industrial, medical, server, workstation and storage motherboards, enterprise SSD and hybrid drives
 - power supplies, DIMM modules
- ▶ Large selection of commonly used local and local/remote thermal sensors
 - Wide range of packages
 - Continuous innovation with lower voltage, smaller package and higher accuracy





I²C Temperature Sensor Portfolio

V RANGE	ACCURACY (LOCAL)	ACCURACY (REMOTE)	SMBus TIMEOUT	TEMP RES.	ADC RES.	SUPPLY CURRENT	NOTES	PACKAGE	PART#
2.8 to 5.5V	±2 °C		YES	0.125	11-bit	operating: 300 µA standby: 1 µA	industry standard,	SO8, SSOP8, XSON8U, HWSON8 (metal pad)	LM75B
2.7 to 5.5V	±1 °C		YES	0.125	11-bit	operating: 200 µA standby: 1 µA		SO8, MSOP8, HWSON8, SOT23-6 (TSOP6)	PCT2075
1.7 to 3.6V			YES	0.125	11-bit	operating: 400 µA standby: 5 µA	low voltage	HWSON8	SE98A
3.0 to 3.6V			YES	0.125	11-bit	operating: 400 µA standby: 3 µA	DDR3, 2K EEPROM	HWSON8	SE97B
1.65 to 1.95V	±1.0°C typ. (-40 to +125 °C) ± 0.5°C typ. (0 to +85 °C)		YES	0.0625	12-bit	operating: 30µA standby: 1 µA	TMP102 replacement, 1.8V	WLCSP6	PCT2202
3V to 5.5V	±2 °C	±3 °C †		1.0	8-bit	operating: 70 µA standby: 3 µA		QSOP16	NE1617A
3.0V to 3.6V	±2 °C	±1 °C †		0.125	11-bit	operating: 500 µA standby: 10 µA		SO8, TSSOP8, HVSON8	SA56004

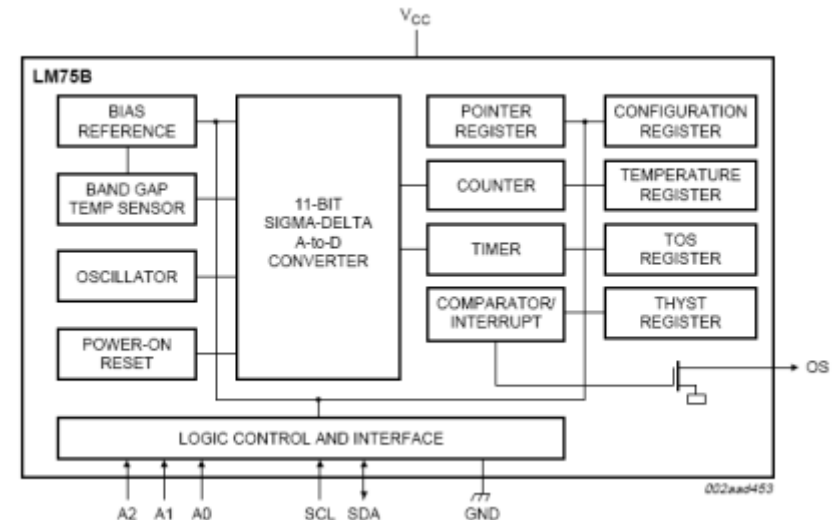
† The NE1617A and SA56004 can also be connected to an external diode for remote temperature sensing.

LM75B

Local Digital Temp. Sensor & Thermal Watchdog

Features

- ▶ Pin-for-pin replacement for industry standard LM75 and LM75A
- ▶ I²C-bus interface - 8 devices on the same bus
- ▶ Power supply range from 2.8 V to 5.5 V
- ▶ Temperatures range from -55 °C to +125 °C
- ▶ Frequency range 20 Hz to 400 kHz with bus fault time-out to prevent hanging up the bus
- ▶ 11-bit ADC - temperature resolution of 0.125 °C
- ▶ Temperature accuracy of:
 - ± 2 °C from -25 °C to +100 °C
 - ± 3 °C from -55 °C to +125 °C
- ▶ Programmable temperature threshold and hysteresis set points
- ▶ Max supply current of 1.0 μ A in shutdown mode
- ▶ Stand-alone operation as thermostat at power-up
- ▶ ESD protection exceeds 4500 V HBM per JESD22-A114, 450 V MM per JESD22-A115 and 2000 V CDM per JESD22-C101
- ▶ Small 8-pin package types: SO8 and TSSOP8



Type number	Topside mark	Package		Version
		Name	Description	
LM75BD	LM75BD	SO8	plastic small outline package; 8 leads; body width 3.9 mm	SOT98-1
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; UTLT based; body 3 × 2 × 0.5 mm	SOT996-2
LM75BTP	M75	HWSON8	plastic thermal enhanced very very thin small outline package; no leads; 8 terminals, 2 × 3 × 0.8 mm	SOT1069-2

PCT2075: Digital Temp. Sensors & Thermal Watchdog



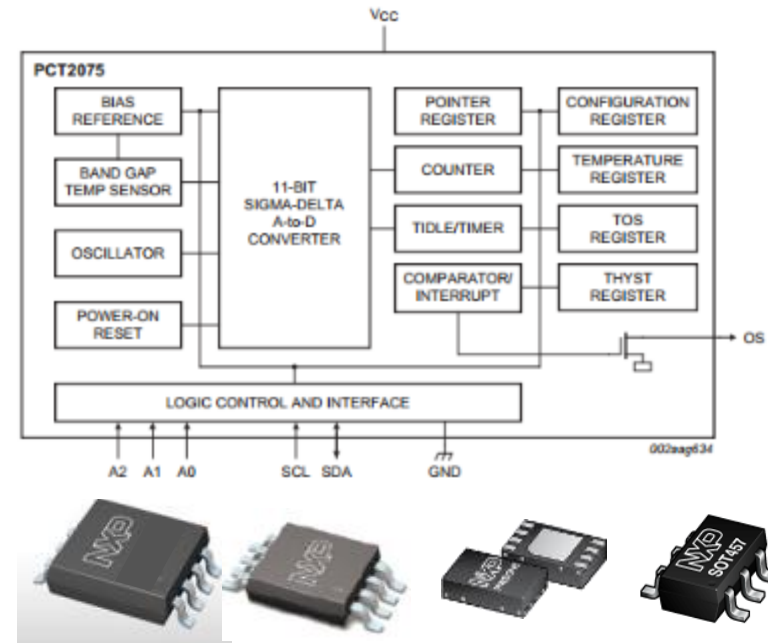
FEATURES

- **Fm+ I²C-bus (1MHz)** with SMBus timeout
- Power supply range - **2.7 V** to 5.5 V
- Temperatures range - **-55 °C** to **+125 °C**
- Programmable temperature threshold and hysteresis set points allows customer-defined default Tos & Thyst set points
- **T_{idle}** programmable adjustment for **temperature sampling**. Allows reduction in power consumption
- Stand-alone operation as thermostat at power-up
- **Expanded I²C address range with 3 state pins (27 @ 8-pin and 3 @ 6-pin)** address latched at power up
- 8-pin package types: SO8, TSSOP8, HWSON8
- 6-pin package types: SOT23-6 (TSOP6)

PCT2075: 11-Bit ADC

±1 °C (max.) from -25 °C to +100 °C

±2 °C (max.) from -55 °C to +125 °C



Package	SO8	TSSOP8	HWSON8	TSOP6 SOT23-6
SOT #	SOT96-1	SOT505-1	SOT1069-2	SOT457
Pitch (mm)	1.27	0.65	0.5	0.95
Width (mm)	3.90	3.0	2.0	3.0
Length (mm)	3.90	5.0	3.0	1.5
Height (mm)	1.75	1.1	0.8	1.1

GPIO Expanders Value Proposition



► Why used?

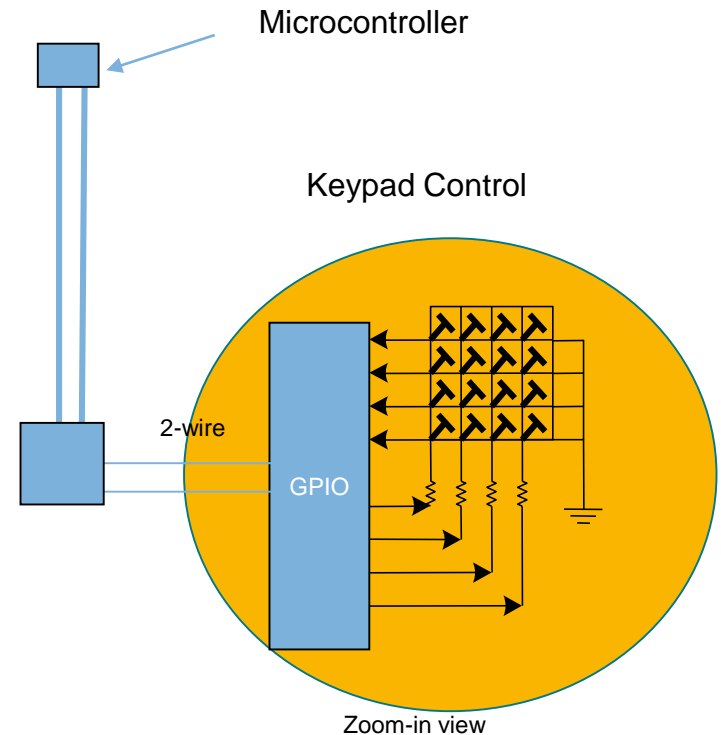
- Easily adds I/O via I²C-bus
- Additional inputs for keypad, switch, signal monitoring and fan control
- Additional outputs for LED control, ACPI power switch, relay, timers and sensor.

► Where used?

- Computing (Servers, RAID Systems, etc.)
- Industrial Controls
- Medical Equipment
- Cell Phones
- Gaming Machines
- Test and Measurement Instrumentations

► Why NXP GPIOs?

- Largest selection of 4, 8, 16 and 40-bit GPIO in Quasi-bidirectional and Push-pull outputs with Interrupt and/or reset in a wide range of packages
- Invented the I²C-bus. Continuously developing newer devices with added features to support different applications.



I/O Expanders with Flexible Output Structures

Quasi-Output Structure:

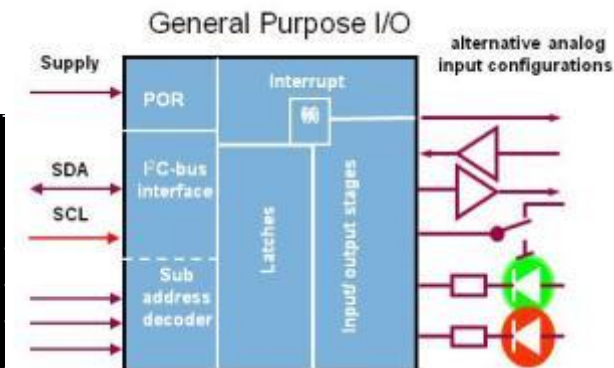
- Strong PMOS transistor is turned on only during the LH transition and turned off during static drive
- Weak pull-up current source (100µA) at the output
- Used in low-power applications where the 100-µA drive is sufficient to bias the inputs of CMOS devices
- May be reconfigured as an input or output without the need of a port configuration register

# of Outputs	Interrupt	Reset	Interrupt & Reset	2Kbit EEPROM	Interrupt and 2Kbit EEPROM
8	PCF8574/74A, PCA8574/74A, PCA9674/74A	PCA9670	PCA9672	PCA9500/58	PCA9501
16	PCF8575/75C, PCA9675	PCA9671	PCA9673	-	-

Totem-Pole Output Structure:

- Upper PMOS transistor is turned on during LH transition and static high drive. Up to 10mA (or 25mA) of high drive
- Some devices have weak pull-up resistors at the output
- Used in applications requiring high drive for heavy loads
- Extra command byte needed to switch an I/O pin between input and output

# of Outputs	None	Reset	Interrupt	Interrupt and Reset
4	PCA9536			PCA9537
8		PCA9557	PCA9534/54/54A	PCA9538, PCA9502, PCA9574
16	-	-	PCA9535/35C/55	PCA9539/39R, PCA9575
40	-	-		PCA9505/06, PCA9698





I²C GPIOs

Totem-Pole Output Structure

BITS	V RANGE	BW	RESET	INT	I/O PULL-UP	NOTES	PART#
4	2.3 to 5.5V	400 kHz	NO	NO			PCA9536
			YES	YES			PCA9537
8	2.5 to 3.6V	400 kHz	YES	YES		SPI & I ² C	PCA9502
	2.3 to 5.5V			YES			PCA9534
	2.3 to 5.5V		YES	YES		Open Drain Interrupt output	PCA9538
	2.3 to 5.5V			YES	100 K Ω	Use PCA9554A for alternate I ² C address	PCA9554/A
	2.3 to 5.5V		YES				PCA9557
	1.1 to 3.6V		YES	maskable	prog. PU / PD or bus hold	low voltage, 2 supplies for level trans. selectable open drain	PCA9574
16	2.3 to 5.5V	400 kHz	NO	YES			PCA9535
	2.3 to 5.5V		YES	YES			PCA9539
	2.3 to 5.5V					"R" version resets I ² C-bus state machine	PCA9539R
	2.3 to 5.5V			YES	100 K Ω		PCA9555
	1.1 to 3.6V		YES	maskable	prog. PU / PD or bus hold	Active low, low voltage, 3 supplies for level trans., selectable open drain	PCA9575
40	2.3 to 5.5V	400 kHz	YES	YES	100 K Ω	Output enable	PCA9505
			YES	YES		Output enable	PCA9506
	2.3 to 5.5V	1 MHz	YES	YES		Output enable, selectable open drain	PCA9698

LOW VOLTAGE

8	1.65 to 5.5V	400 kHz	YES	YES		Low standby current: 1.5 μ A typ at 5V supply; 1.0 μ A typ at 3.3V supply	PCA9538A
				YES	100 K Ω	Use PCA9554C for alternate I ² C address	PCA9554B/C
			YES	YES		Standby current: 3 μ A max dual V _{CC}	PCA6408A
16	1.65 to 5.5V	400 kHz	NO	YES		Low standby current: 1.5 μ A typ at 5V supply; 1.0 μ A typ at 3.3V supply	PCA9535A
			YES	YES			PCA9539A
			YES	100 K Ω			PCA9555A
			YES	YES		Dual V _{CC} ; low standby current: 1.5 μ A typ at 5V supply; 1.0 μ A typ at 3.3V supply	PCA6416A





I²C GPIOs

Quasi Output Structure

BITS	V RANGE	BW	RESET	INT	I/O PULL-UP [1]	NOTES	PART#
8	2.5 to 6.0V	100 kHz	NO	YES	weak PU		PCF8574/A
	2.3 to 5.5V	400 kHz	NO	YES	weak PU		PCA8574/A
	2.2 to 3.6V	400 kHz	NO	NO	weak PU	2 Kb EEPROM	PCA9500
		400 kHz	NO	YES	weak PU	2 Kb EEPROM	PCA9501
	2.3 to 5.5V	1 MHz	YES	NO	weak PU		PCA9670
		1 MHz	YES	YES	weak PU		PCA9672
		1 MHz	NO	YES	weak PU		PCA9674/A
16	4.5 to 5.5V	400 kHz	NO	YES	weak PU		PCF8575
	2.3 to 5.5V	400 kHz	NO	YES	weak PU		PCA8575
	2.3 to 5.5V	1 MHz	YES	NO	weak PU		PCA9671
		1 MHz	YES	YES	weak PU		PCA9673
		1 MHz	NO	YES	weak PU		PCA9675

Note [1]: The Quasi-outputs have a strong pull-up (transistor) to V_{DD} to allow fast rising edges into heavy loaded outputs. The devices with weak pull-ups have a 100- μ A current source to V_{DD} .



I²C GPIOs

Open Drain Output

- ▶ No upper PMOS transistor
- ▶ Prevent current leakage through protection diode

BITS	V RANGE	BANDWIDTH	RESET	INTERRUPT	I/O Pull-Up	NOTES	PART(S)
8	3.0 to 3.6V	400 kHz	NO	NO	weak PU	2 Kb EEPROM, with 5-bit mux, 1-bit latch DIP SWITCH	PCA9558
16	2.3 to 5.5V	400 kHz	NO	YES			PCA9535C
	4.5 to 5.5V		NO	YES			PCF8575C



PCALxxxx GPIO Family with Agile I/O

- ▶ Operates Down to 1.65V and Up to 5.5V
- ▶ Easy migration: drop in replacement for existing PCA95XX GPIOs
- ▶ Features input latch, /INT mask and other new Agile IO features

	BITS	V RANGE	BW	RESET	INT	I/O PULL-UP	NOTES	PACKAGE	PART#
	8	1.65 to 5.5V	400 kHz	YES	YES	programmable	single V _{CC}	HVQFN16, TSSOP16	PCAL9554B PCAL9554C
				YES	YES	programmable	single V _{CC}	HVQFN16, TSSOP16	PCAL9538A
				YES	YES	programmable	dual V _{CC}	HVQFN16, TSSOP16, XQFN16, XFBGA16	PCAL6408A
	16	1.65 to 5.5V	400 kHz		YES	programmable	single V _{CC} & advanced IO	HWQFN24, TSSOP24	PCAL9555A
					YES	programmable	single V _{CC} & advanced IO	HWQFN24, TSSOP24	PCAL9535A
				YES	YES	programmable	single V _{CC} & advanced IO	HWQFN24, TSSOP24	PCAL9539A
				YES	YES	programmable	Voltage Level Translation	TSSOP24, HWQFN24, 24-pin BGA (XFBGA, VFBGA & UFBGA)	PCAL6416A
NEW	24	0.8 to 3.6V	1 MHz	YES	YES	programmable	Additional Agile I/O features	QFN32, TSSOP32, UFBGA32	PCAL6524

LED Controllers Value Proposition



- ▶ **Why used?**
 - Offloads CPU from blinking operation
- ▶ **Where used?**
 - Equipment status indicator and control (Blinkers)
 - Keypad and LCD backlighting (Dimmers)
 - Color mixing and brightness control (Dimmers)
- ▶ **Why NXP LED Controller?**
 - Large selection of LED Controllers in a wide range of packages
 - Minimized supply voltage ripple with programmable LED outputs phase shifting
 - Thermally enhanced HTSSOP package



Mood Lighting



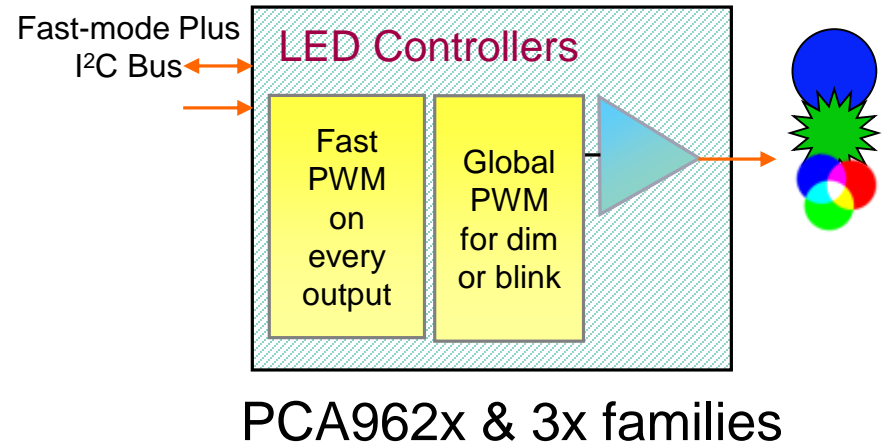
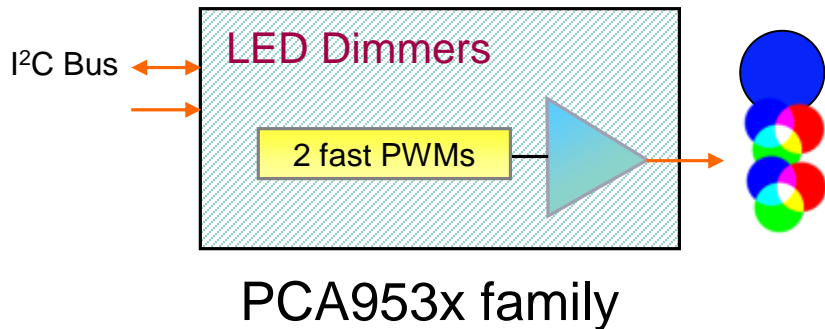
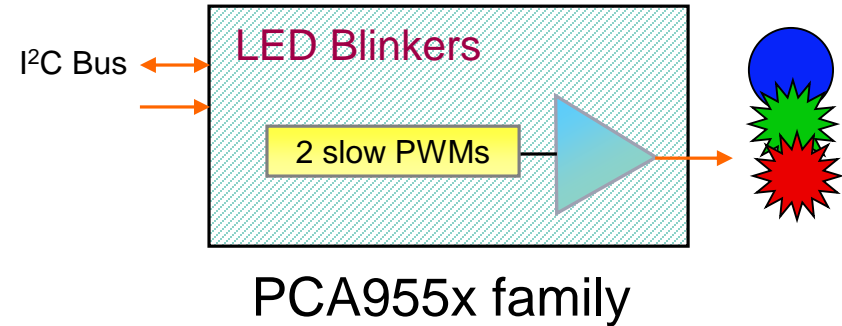
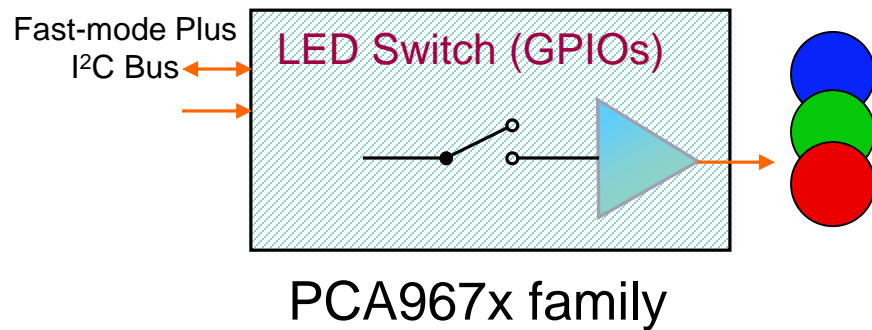
LCD Backlighting





I²C LED Switch, Blinkers, Dimmers and Controllers

Product overview



LED Controller Portfolio



Voltage-Source LED Controllers

Number of Outputs	LED Blinkers (25mA / 5V)	LED Dimmers (25mA / 5V)	Color Mixing LED Controllers (25mA / 5V)	Color Mixing LED Controllers (100mA / 40V)
2	PCA9550	PCA9530		
4	PCA9553	PCA9533	PCA9632 ^[1] PCA9633	
8	PCA9551	PCA9531	PCA9634	PCA9624
16	PCA9552	PCA9532	PCA9635 ^[3] PCA9685 ^{[2] [3]}	PCA9622
24				PCA9626

[1] Low power version of PCA9633

[2] The PCA9685 has 12-bit PWM while the PCA9635 has 8-bit PWM

[3] AEC-Q100 qualified

Current-Source LED Controllers

Device	# of Outputs	F _{OSC}	Output Current	Active-Low /OE	Interface
PCA9952 ^[2]	16	8MHz	5mA ~ 57mA	Yes	Fm+ I ² C; 8 Addresses
PCA9955 ^[2]	16	8MHz	5mA ~ 57mA		Fm+ I ² C; 16 Addresses
PCA9955B ^[2]	16	8MHz	225µA ~ 57mA	Yes	Fm+ I ² C; 125 Addresses
PCA9745B ^[2]	16	8MHz	225µA ~ 57mA	Yes	Serial-Shift; No Address
PCA9755B ^[1]	16	8MHz	225µA ~ 57mA	Yes	SPI; 25 Addresses
PCA9956B	24	8MHz	225µA ~ 57mA	Yes	Fm+ I ² C; 125 Addresses

[1] In development

[2] AEC-Q100 Qualified



Voltage Comparators

- ▶ Low-power, rail-to-rail I/O
- ▶ No phase inversion with overdriven input signals.
- ▶ Excellent noise rejection for high signal integrity
- ▶ Very low supply current ($I_{CC} < 6 \mu A$)
- ▶ Low start up voltage: 1.3 to 5.5 V
- ▶ Leading MicroPak and PicoGate packages

Applications

- ▶ Portable media players
- ▶ Consumer/wearable devices
- ▶ Set top boxes
- ▶ Navigation devices
- ▶ LCD displays
- ▶ Notebook and tablet PC
- ▶ Cellular handsets

V _{CC} (min – max)	CURRENT (TYP)	PROP DELAY	INPUT OFFSET V	OPERATING TEMP	OUTPUT	# COMPARATORS	PACKAGE	PART#	
1.3 to 5.5V	drive: 68 mA supply: 5 μA	0.5 ms	0.5 mV	-40 to 85°C	push pull	2	SOT972, SOT902	NCX2220	
					open drain			NCX2222	
	drive: 68 mA supply: 6 μA				push pull	1	SOT886, SOT353	NCX2200	
					open drain			NCX2202	

I²C-Bus Buffer Family



Repeaters

PCA9509 Processor to SMBus SO	PCA9515/15A/16A SO
PCA9509A Processor to SMBus SO	PCA9518A 5-Channel Hub Expander SO
PCA9509P Processor to SMBus SO	PCA9519 4 x PCA9509 SO
PCA9517A 0.9 – to 5.5V SO	PCA9646 30-mA Drive; 1:4-Channel NO
PCA9617A 0.8 to 5.5V SO	
PCA9507 RTA for HDMI SO	
PCA9527 PCA9507 + ½ PCA9517 SO	

Hot-Swap Buffers

PCA9508 Active Level Shifter SO
PCA9510A No Accelerator IO
PCA9511A 0.6-V Threshold IO
PCA9512A/12B Active Level Shifter IO
PCA9513A 92-μA Current Source IO
PCA9514A 0.8-V Threshold IO

Extenders (Long Cable) (Long Cable Drivers)

P82B96 [1] SO
P82B715 No Static Offset AM
PCA9600/9601 1-MHz Speed SO
PCA9614/15 2-CH Differential Driver SO
PCA9616 3-CH Differential Driver SO

- NO** = No Offset
- SO** = Static Offset
- IO** = Incremental Offset
- AM** = Amplifier

[1] P82B96 is widely used for opto-isolation applications

Blue → 1 MHz system

I²C-Bus Repeaters

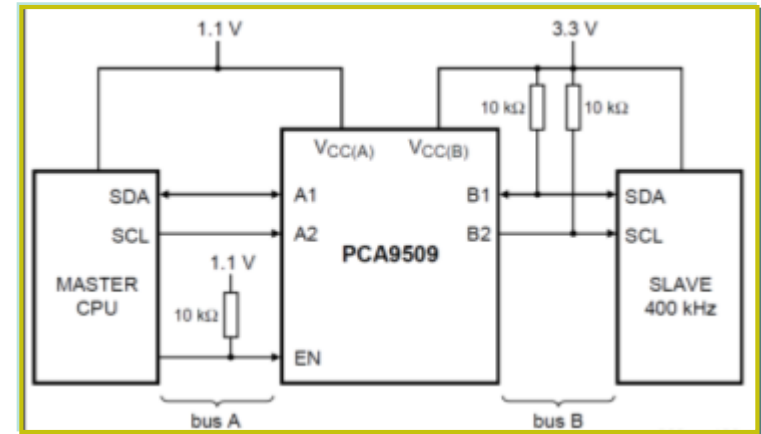
Why used?

- Voltage level shifting between host processor's I²C-bus and peripheral devices when there is a mismatch of supply voltages
- Used when additional drive is needed or to isolate two sections of the bus loading

Where used?

- Digital logic level translation between host processor and slave device where **capacitance isolation and speed of >3MHz (up to 30MHz) is required**

NXP Level Shifter Portfolio



Device	Description	Normal I/O	Static Level Offset I/O	Idle Stop Detect for Hotswap	ESD (HBM)
PCA9508	0.9V-to-5.5V Level Shifter with Offset Free Hot-Swap	A Side	B Side	×	6KV
PCA9509	1.0V-to-5.5V Level Shifter	B Side	A Side		2KV
PCA9509A	0.8V-to-5.5V Level Shifter	B side	A Side		2KV
PCA9515A	3.3V / 5.0V I ² C-Bus Repeater		A & B Sides		2KV
PCA9516A	5-Channel I ² C Bus Hub		A & B Sides		2KV
PCA9517A	0.9V-to-5.5V Level Shifter	A Side	B Side		5KV
PCA9617A	0.8V-to-5.5V Level Shifter	A Side	B Side		5KV
PCA9518A	5-Channel I ² C Bus Hub Expander		A & B Sides		2KV
PCA9519	1.1V-to-5.5V Quad Level Shifter	B Side	A Side		2KV

Hot-Swappable Buffers

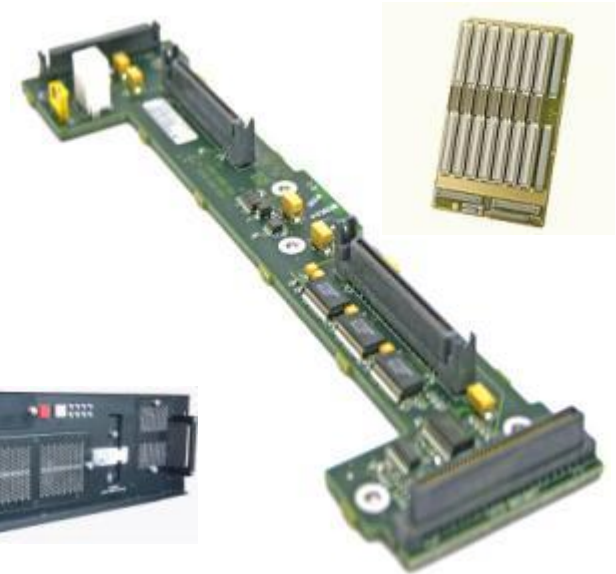


► Why used?

- During hot-swapping, glitches on the SCL and SDA lines may cause data corruption on the I²C-bus. The NXP hot-swappable buffers will prevent any data corruption in these applications.

► Where used?

- Applications requiring I/O card insertion into a live system
- Multipoint Backplanes Cards
- VME
- cPCI
- AdvancedTCA Cards



► NXP Hot-Swappable Buffer Portfolio

Device	Accelerator	1-V Precharge	Ready OD Output and Low I _{CC} Disable	Dual-V _{CC} for Level Translation	92-μA Current Source	ESD (HBM)
PCA9508				x		6KV
PCA9510A		x (Input Side Only)	x			2KV
PCA9511A	0.6V	x	x			2KV
PCA9512A	0.6V (with Disable Pin)	x		x		2KV
PCA9513A	0.8V		x		x (Input Side Only)	2KV
PCA9514A	0.8V		x			2KV

Long-Distance Bus Buffers



► Why used?

- Drives the I²C-bus signals over a long-distance cable and through inter-connects
- Re-drive the SCL and SDA signals into loads exceeding the maximum specified 400-pF bus capacitance

► Where used?

- Between card interconnects (does not support voltage level translation)
- In noisy environment with compressors, pumps, relays, EMI, etc.
- To eliminate the need for multiple costly bus controllers
- AdvancedTCA
- Opto-Couplers Interface

► NXP Long-Distance I²C-Bus Buffer Portfolio

Device	V _{CC}	F _{MAX}	Max Cable-Side Load	Cable Length	Capacitance Isolation	Interrupt	Signal Levels	ESD (HBM)
P82B715	3.0V – 12.5V	100kHz	3,000pF	50m			Single-ended	2.5KV
P82B96	2.0V – 15.0V	400kHz	4,000pF	20m	x		Single-ended	3.5KV
PCA9600/01	2.5V – 15.0V	1MHz	4,000pF	20m	x		Single-ended	4.5KV
PCA9614/15	3.0V – 5.5V	1MHz		100ft	x		Differential	4.0KV
PCA9616	3.0V – 5.5V	1MHz		100ft	x	x	Differential	4.0KV



High Speed Interface & Management

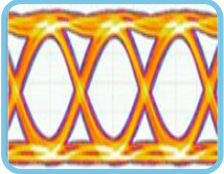
- ✓ USB Type-C solution
- ✓ Analog Switches
- ✓ Load Switches

USB Type-C Connector

- ▶ USB Type-C is a new Connector Standard billed as the 'Last Connector', that will allow multi-function signaling (e.g. USB, Display Port, etc.) to pass over a small form factor, compact, high reliability connector. Signaling for 5Gbps USB3 signals to future anticipated 20Gbps will all be available over the same connector.
- ▶ NXP's value proposition in this emerging market is that we provide a broad portfolio of best-in-class solutions for:
 - USB-Power Delivery
 - X-Bar Switches
 - Microcontrollers
 - Authentication
 - AC/DC adapter components
 - Load Switches
- ▶ This will enable NXP to realize our vision of seamless connectivity of Data, Video, Security and Power over a single Connector
- ▶ On the following pages, there is a brief explanation of the USB Type-C connector.



Vision – Seamless Connectivity of Data, Video, Power and Security Over Single Connector



High Speed Signal Transmission

- Signal transmission at ultra high speed supports growing data and video content
- USB has good potential to lead among the technologies and become the majority / standard connector.



Multi-Function USB Connector

- Smaller neat form factor design drives the connector to carry multiple signals for data and video
- Data, video and power over a single connector is becoming a requirement



Power Delivery

- Proprietary charging methods enable faster charging
- USB PD extends beyond USB BC to allow up to 100W charging, power support and role swap for system power optimization
- USB PD is specified to support USB connectors



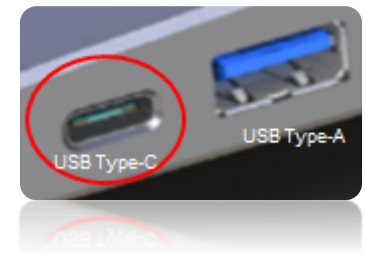
Security/Authentication

- Authentication can be used to verify that peripherals really belong to that specific OEM to enable secure connections, prevent counterfeiting and for safety concerns (e.g. Battery charging)

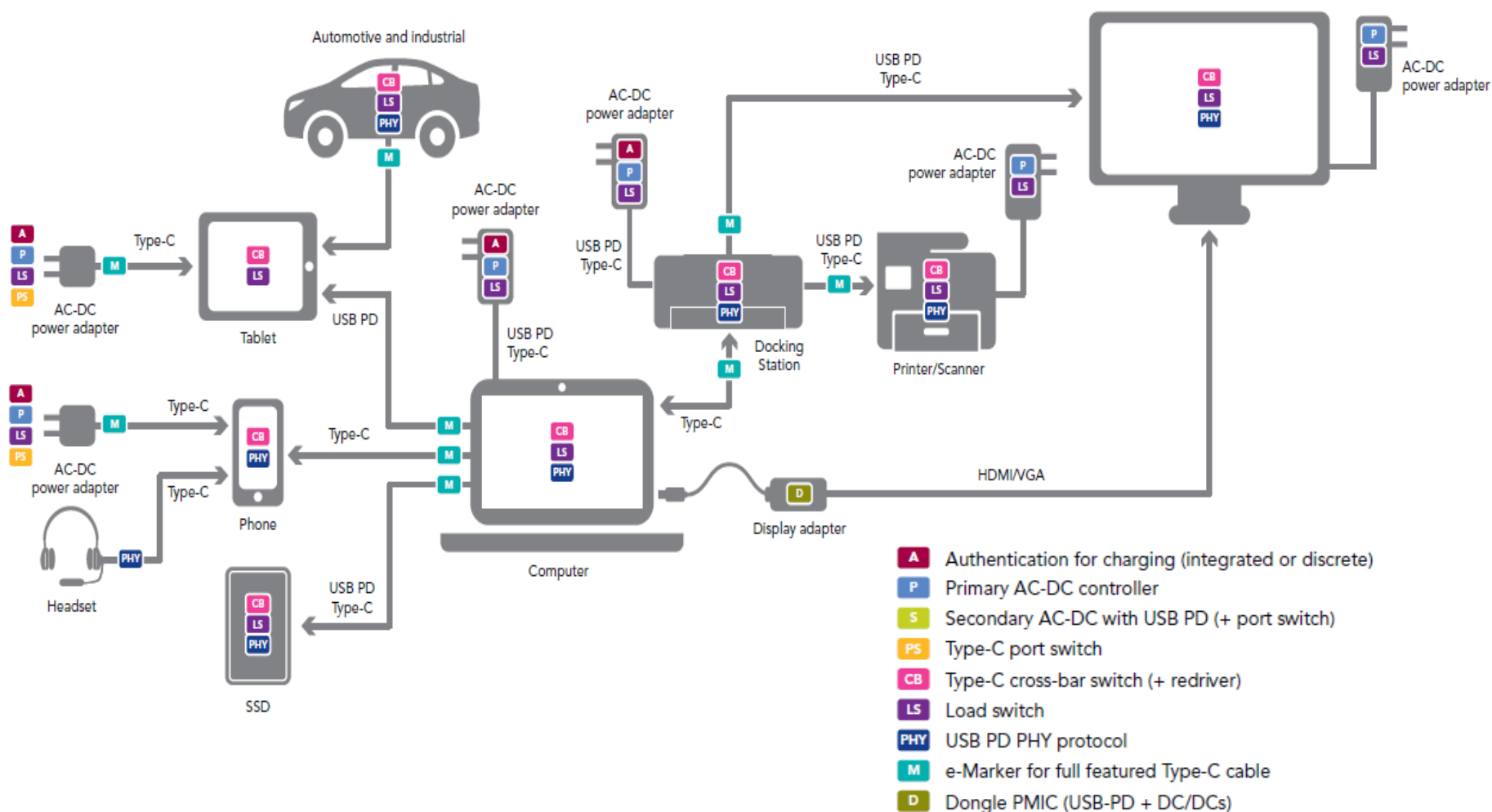
- **Smaller form factor allowing convergence of computing and mobile**



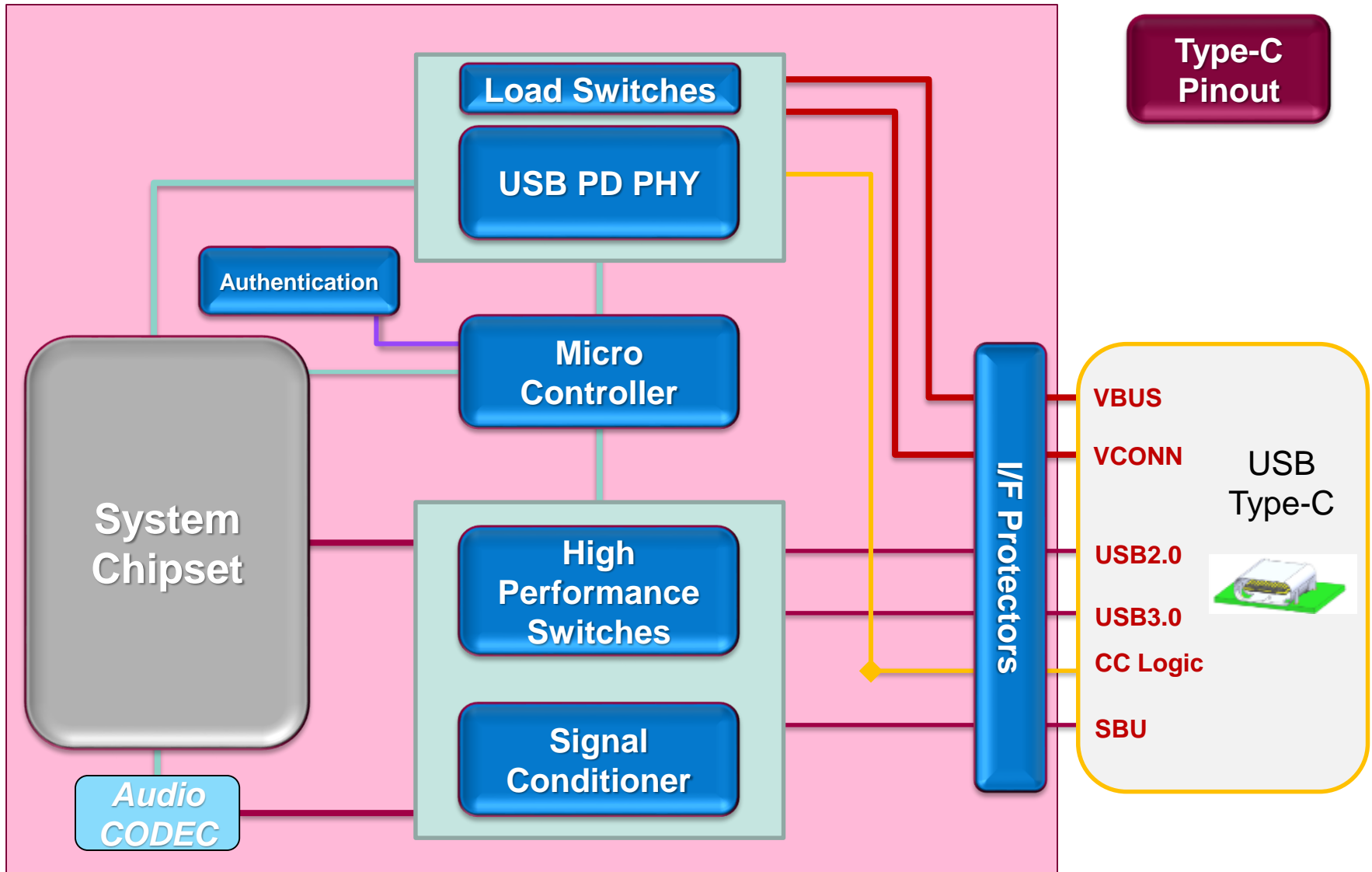
- **New USB Type-C Connector - Tiny, Robust, Flippable, High Speed and Default Power Delivery**



USB Type-C Ecosystem & Solutions



System Solution for USB Type-C Connector



USB Type-C Connector – Pinout and Alignment

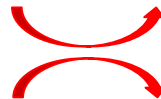


Receptacle (Front View)

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1-	VBUS	CC1	D+	D-	SBU1	VBUS	RX2-	RX2+	GND
GND	RX1+	RX1-	VBUS	SBU2	D-	D+	CC2	VBUS	TX2-	TX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
USB3.0				USB2.0				USB3.0			



Normal Plug



Reverse Plug



A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
GND	RX2+	RX2-	VBUS	SBU1	D-	D+	CC	VBUS	TX1-	TX1+	GND
GND	TX2+	TX2-	VBUS	VCONN			SBU2	VBUS	RX1-	RX1+	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12



CLICK
HERE

System
Solution

AC/DC
Adaptor

Type-C
Cable

Active
cable &
adaptor

USB Type-C Product Status Overview

Part Number	HIGH SPEED SIGNAL SWITCHES	Status
CBTL02043	Two differential channel 2:1 Mux-Demux switch	Production
CBTL04GP043	Dual channel 2x2 crosspoint switch	Production
CBTL08GP053	USB Type-C High performance Crossbar Switch	Production
CBTU02043	1.8v supply. Two differential channel 2:1 Mux-Demux switch	Sampling, Prod Oct '16

Part Number	ANALOG SWITCHES (sideband signal control)	Status
NX3L2T66	Dual SPST analog switch (0.5 ohm, 60 MHz)	Production
NX3DV3899	Dual DPDT analog switch (4.5 ohm, 200 MHz)	Production
NX5DV715	Dual DPDT analog switch (4.0 ohm, 500 MHz)	Production
NX3DV221, NX3DV42	Single DPDT analog switch (4.0 ohm, 950MHz)	Production

Part Number	USB REDRIVERS	Status
PTN36221A	Single channel USB3 Redriver	Production
PTN36241G	Dual channel USB3 Redriver, smaller package, low power for mobile	Production
PTN36001	Dual channel USB3 Redriver. Smaller package for computing.	Production
PTN36043	USB3.1 Active switch with redriver	Production

Part Number	USB PD-PHY and CC-LOGIC CONTROLLERS	Status
PTN5100/PTN5100D/ PTN5100A/PTN5100DA	Type-C PD PHY and Protocol IC (I2C or SPI option)	Production
PTN5150/50A/50H	Type-C CC Logic IC	Production



USB Type-C Product Status Overview (continued)

Part Number	USB LOAD SWITCHES	Status	
NX5P2190	2A load switch with OCP / OVP / OTP	Production	
NX20P5090	5A programmable OVP power switch	Production	
NX5P3090	3A adjustable current limit power switch	Production	
NX5P3190	3A adjustable current limit power switch with OTP and CC logic	Sampling now	MP – Q1 2017

Part Number	AC/DC CONVERTERS	Status	
TEA1836 / TEA1892	45W wall plug AC/DC converters	Production	
TEA1993	Gen II Synchronous Rectifier controller for multi-output voltage	Production	
TEA1936	Primary controller Flyback Quasi Resonant	Production	
TEA1903/TEA1905	Integrated USB PD secondary side controller (TEA1905 supports Quick charge (2.0 and 3.0) and 5V direct charging)	Sampling now	MP – Dec '16

Part Number	MICROCONTROLLERS	Status	
LPC1115	Low cost, low power microcontroller	Production	
LPC11U35	Low cost, low power microcontroller with integrated EEPROM and USB	Production	
LPC11E37/LPC11E36	Low cost, low power microcontroller with integrated EEPROM	Production	

Part Number	AUTHENTICATION	Status	
A7101	Tamper resistant, highly secure authentication solution for Type-C	Production	
A1006	Tamper resistant, highly secure authentication solution for Type-C	Sampling now	MP – Oct '16



Host Platform Feature and Component Selection

Smartphone

Tablet

Laptop

AIO

Motherboard

Data Signal



USB2 (OTG)
Only

USB3 &
USB2

DisplayPort
Over USB
Type-C

Thunderbolt
Over USB
Type-C

Description	Part number
NXP CC logic	PTN5150
NXP sideband mux	NX3DV221

Description	Part number
NXP CC logic	PTN5150
NXP USB active switch	PTN36043
NXP USB 3.1 passive switch	CBTL02043 CBTU02043
NXP sideband mux	NX3DV221

Description	Part number
NXP PD Controller	LPC1115
NXP PD PHY	PTN5100
NXP Data Switch for USB3.1 & DP	CBTL08GP053
NXP sideband mux	NX3DV221

Description	Part number
NXP PD Controller	LPC11E37
NXP PD PHY	PTN5100
NXP sideband mux	NX3DV221



CLICK
HERE

System
Solution

AC/DC
Adaptor

Type-C
Cable

Active
cable &
adaptor

Host Platform Feature and Component Selection

Smartphone

Tablet

Laptop

AIO

Motherboard

USB Power

Type-C Default
Power Delivery

15W (max)

Description	Part number
NXP CC logic	PTN5150
NXP Load Switch (5V)	NX5P3090

USB PD2.0 Power
Delivery

60W (max) - Cable
100W (max) - Connector

Description	Part number
NXP PD Controller	LPC1115
NXP PD PHY	PTN5100
NXP Load Switch (20V)	NX20P5090
NXP Load Switch (5V)	NX5P3090



CLICK
HERE

System
Solution

AC/DC
Adaptor

Type-C
Cable

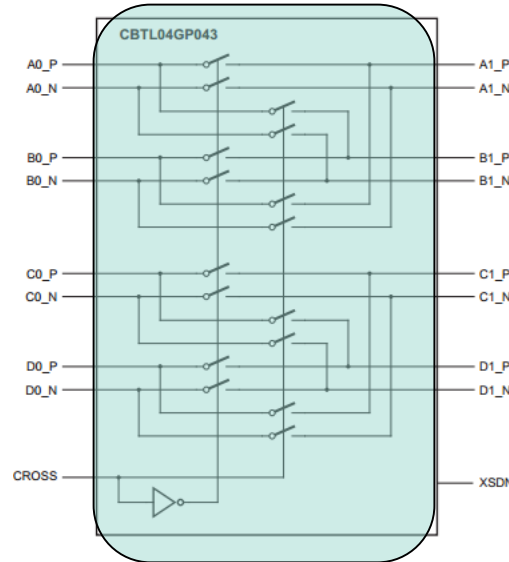
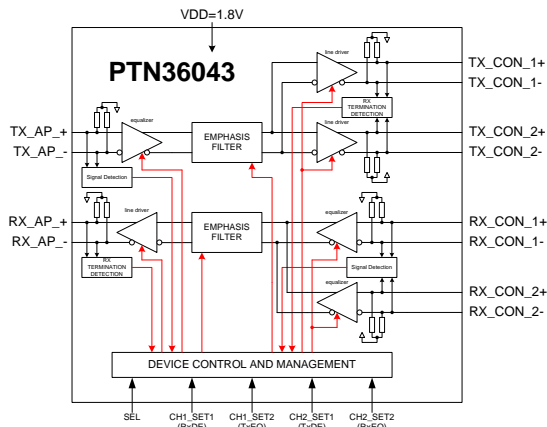
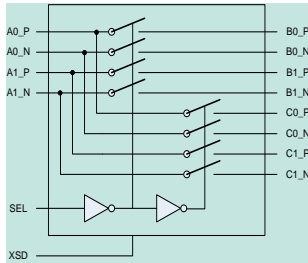
Active
cable &
adaptor

Switches Overview for USB Type-C Applications

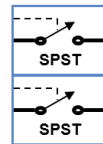
CBTU02043/PTN36043

CBTL04GP043/
NX3DV42/NX3DV221

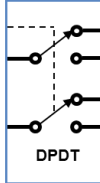
CBTL08GP053



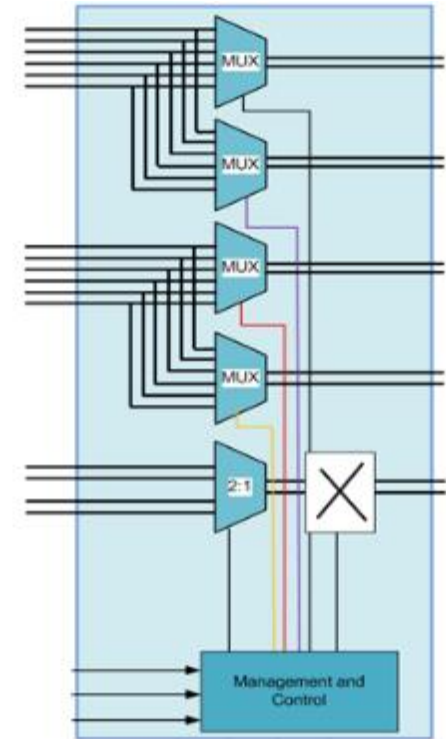
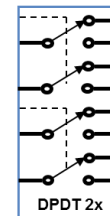
NX3L2T66



NX3DV42
NX3DV221



NX3DV3899



Mobile & Portable
Applications

Computing
Applications

Computing & Docking
Applications



System
Solution

AC/DC
Adaptor

Type-C
Cable

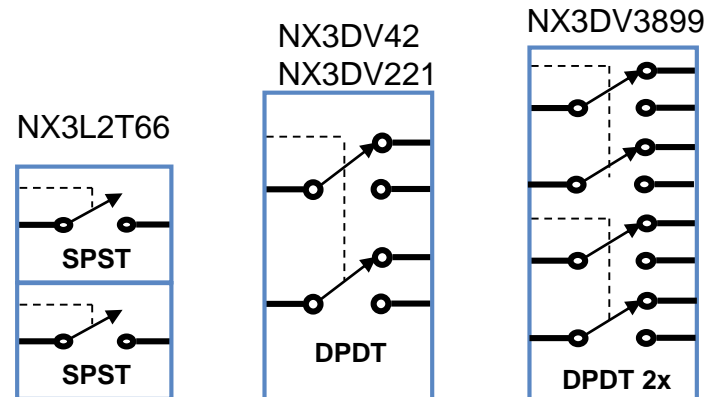
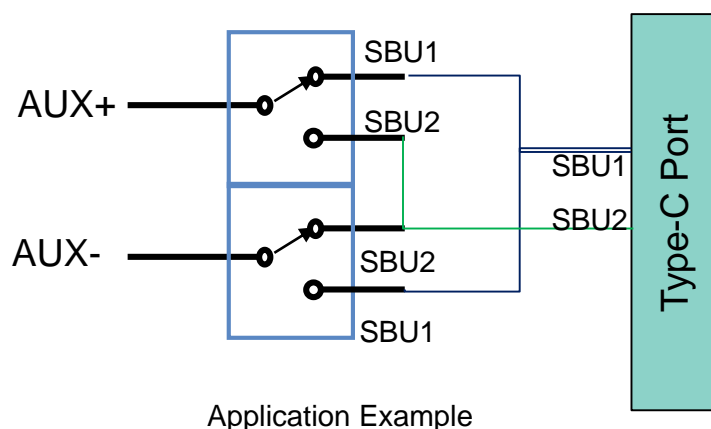
Active
cable &
adaptor

Analog Switches for Sideband Signal Control

Key Value:

- Wide operating voltage range
- Low on resistance/capacitance combination
- High isolation, low crosstalk for superior signal integrity
- Built in level shifter option for control pin
- Low current consumption for higher power savings
- Small footprint Picogate, MicroPak, ThinQFN.

Part number	Configuration	R _{on} (Ω)	f _{3dB} (MHz)	Package
NX3L2T66	Dual SPST	0.75	60	XSON8, XQFN8
NX3DV221	Single DPDT	4.0	1000	XQFN10, HVSON10
NX3DV42	Single DPDT	4.0	950	XQFN10
NX3DV3899	Dual DPDT	2.4	200	XQFN16, HXQFN16U



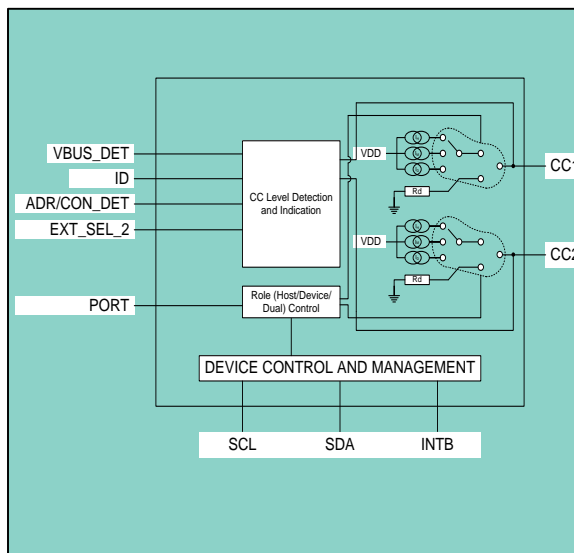
USB Type-C, PD and Logic Interface Product Status Overview

Products in Production	Product Description	Target Schedule
CBTL02043	Two differential channel 2:1 Mux-Demux switch For type-C USB3 port flip	In Production
CBTU02043	High bandwidth USB3.1 mux switch	Sampling now, Production Oct 2016
CBTL04GP043	Dual channel 2x2 crosspoint switch For USB3 and 2-lane DP port flip	In Production
NX3L2T66, NX3DV42, NX3DV221, NX3DV3899	Analog switches For type-C sideband signals	In Production
CBTL08GP053	USB Type-C High performance Crossbar Switch IC For USB3/2-lane DP or 4-lane DP support	In Production



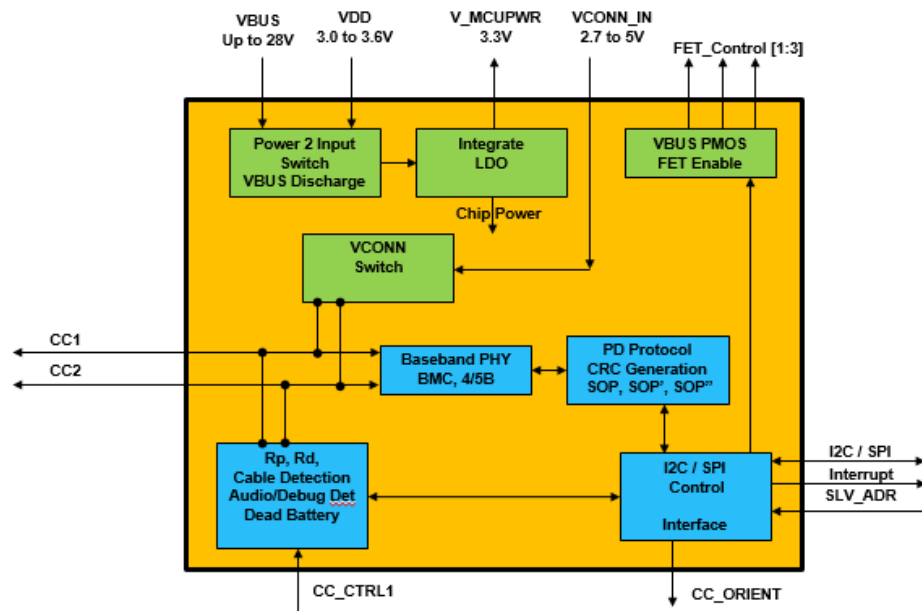
USB Type-C PD PHY and CC Logic Controller

PTN5150
CC Logic



Type-C CC logic,
Legacy USB,
OTG

PTN5100
PD PHY



Alternate Mode &
USB Power
Delivery



System
Solution

AC/DC
Adaptor

Type-C
Cable

Active
cable &
adaptor



NXP High Speed Analog Switches

General Purpose

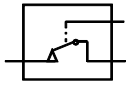
	BANDWIDTH	CHANNELS	SUPPLY VOLTAGE	INSERTION LOSS	CROSSTALK	OFF-ISOLATION	PART#
Gen 2	5 Gbps	4	1.8V	-2dB at 3 GHz	-23 dB at 3 GHz	-23 dB at 3 GHz	CBTU04082B
	5 Gbps	4	3.3V	-1.2dB at 2.5GHz	-30dB at 2.5GHz	-25dB at 2.5GHz	CBTL04082A/B
	5 Gbps	2	3.3V	-0.9dB at 2.5GHz	-30dB at 2.5GHz	-25dB at 2.5GHz	CBTL02042A/B
Gen 3	8 Gbps	4	1.8V	-2.8dB at 4 GHz	-30dB at 4GHz	-30dB at 4GHz	CBTU04083B
	8 Gbps	4	3.3V	-1.3dB at 4GHz	-29dB at 4GHz	-20dB at 4GHz	CBTL04083A/B
	8 Gbps	2	3.3V	-1.3dB at 4GHz	-35dB at 4GHz	-20dB at 4GHz	CBTL02043A/B
	10 Gbps	1	3.3V	-1.3dB at 4GHz	-35dB at 4GHz	-20dB at 4GHz	CBTL01023
	10Gbps	4	3.3V				CBTL04GP043
	12Gbps	2	1.8V / 3.3V	-1.4dB at 5GHz	-37dB at 5GHz	-20dB at 5GHz	CBTU02043



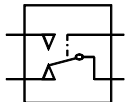
General Purpose Analog Switches

NX3 Family

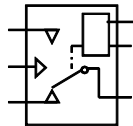
DESCRIPTION	BW	CH	R _{ON}	THD	XTALK	PART#
1x SPST	60 MHz	1	0.75 Ω	0.024	-90 dB	NX3L1G66
	25 MHz	1	0.45 Ω	0.01		NX3L1G/T384
2x SPST	25 MHz	2	0.75 Ω	0.024	-90 dB	NX3V1T384
			0.45 Ω	0.01		NX3L2G/T66/384
1x SPDT	60 MHz	1	0.75 Ω	0.024	-90 dB	NX3V2G/T66/384
						NX3L1G3157, 5157
						NX3L1T3157, 5157
						NX3L1G53
2x SPDT	20 MHz	2	0.8 Ω	0.01	-90 dB	NX3L1T53
	15 MHz		0.5 Ω	0.01		NX3L4684
	60 MHz		0.75 Ω	0.024		NX3L2267
2x DPDT or 4PDT	60 MHz	2	0.75 Ω	0.02	-90 dB	NX3L2467
	330 MHz		9.5 Ω	-	-60 dB	NX3DV2567
	200 MHz		4.5 Ω	0.01	-90 dB	NX3DV3899
2x DPDT + 1x 3PDT	500 MHz		4.0 Ω	-	-40 dB	NX5DV715
			9.0 Ω			
1x SP3T	30 MHz	1	0.75 Ω	0.02	-90 dB	NX3L4357
1x SP8T	15 MHz	1	0.75 Ω	0.02	-90 dB	NX3L4051
3x SPDT	60 MHz	3	0.8 Ω	0.02	-90 dB	NX3L4053



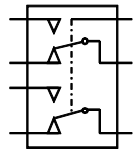
SPST



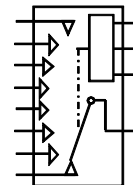
SPDT



SP3T



DPDT



SP8T



NXP High Speed Analog Switches

Application Specific

	BANDWIDTH	CHANNELS	INSERTION LOSS	CROSSTALK	OFF-ISOLATION	PART#
DisplayPort	11.1 GHz	6	-1.3dB @2.7GHz	-35dB @2.7GHz	-30dB @2.7GHz	CBTL06DP213
Thunderbolt	5.0 GHz	N/A	-0.5db @5MHz	-40db @5MHz	-75dB @5MHz	CBTL05023
	10.0 GHz	N/A				CBTL05024
HDMI	9.5GHz	6	-1.3dB @2.7GHz	-32dB @2.7GHz	-23dB @2.7GHz	CBTL06GP213
Memory	400-800 Mbps	11				CBTU4411
	2.5GHz, DDR3	14				CBTW28DD14
	DDR4	12				CBTV24DD12



NXP Signal Switches for VGA Video Applications

NX5DVxxx Family

DESCRIPTION	CHANNELS	R _{ON}	BANDWIDTH	XTALK		PART#
1:2, TTL-compatible	4	< 5.0 Ω	300 MHz	-63 dB	SO, SSOP, TSSOP, DQFN	NX5DV330
dual supply, 1:2	7	4 Ω	500 MHz	-50 dB	QFN24	NX5DV4885
dual supply, 1:2, SPDT	7	4 Ω	500 MHz	-44 dB	QFN32	NX5DV713/E
dual-supply, 1:2, SPDT	7	4/9 Ω	600 MHz	-40 dB	QFN32	NX5DV715



Analog Switches for MIPI CSI/DSI Applications

BW	CH	R _{ON}	XTALK	OFF-ISOLATION	DESCRIPTION	PACKAGE(S)	PART#
950 MHz	6	7.5 Ω	-30 dB	-30dB	Differential TPDT switch	XQFN24U	NX3DV642
950 MHz	2	5.8 Ω	-30 dB	-30dB	Differential SPDT switch	XQFN10U, XQFN10	NX3DV42
1 GHz	2	3.6 Ω	-40 dB	-38dB	Differential SPDT switch with charge pump, bidirectional	XQFN10U (SOT1049)	NX3DV221

NX3DV2567 – Dual SIM Card Data Switch



Description

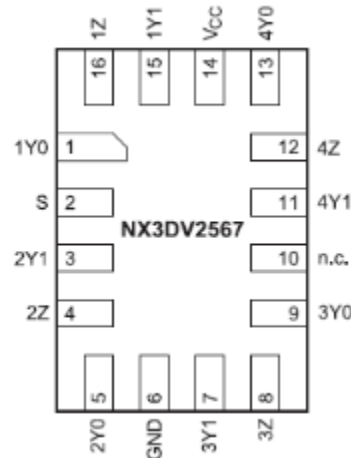
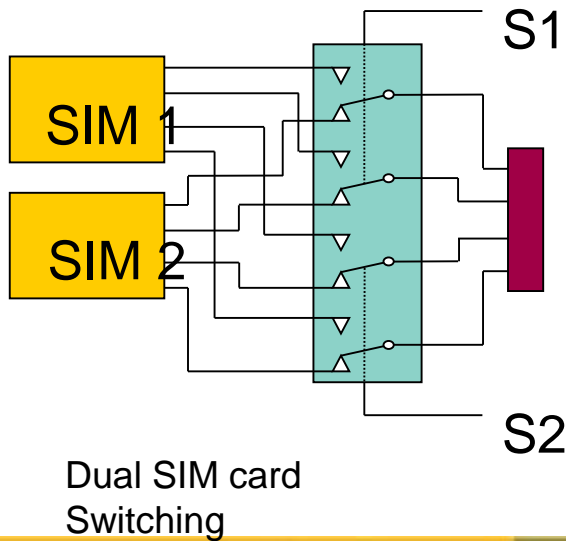
Dual low-ohmic DPDT switch designed for analog or digital multiplexer/demultiplexer. Optimized for switching WLAN-SIM data and control signals, it features low on capacitance of 10 pF to ensure high-speed data transfer. The supply switch path has a low ON resistance to ensure minimal voltage drop as well. This device is a perfect fit for dual SIM card switching applications.

Available in: XQFN116 (SOT1161) 1.8 x 2.6 x 0.5 mm, 0.4 mm pitch.
HXQFN16U (SOT1039) 3.0 x 3.0 x 0.5 mm, 0.5 mm pitch.

Replaces: FSA2567.

Applications

- Notebook and tablet PC
- Cellular handsets
- Portable media players
- Set top boxes

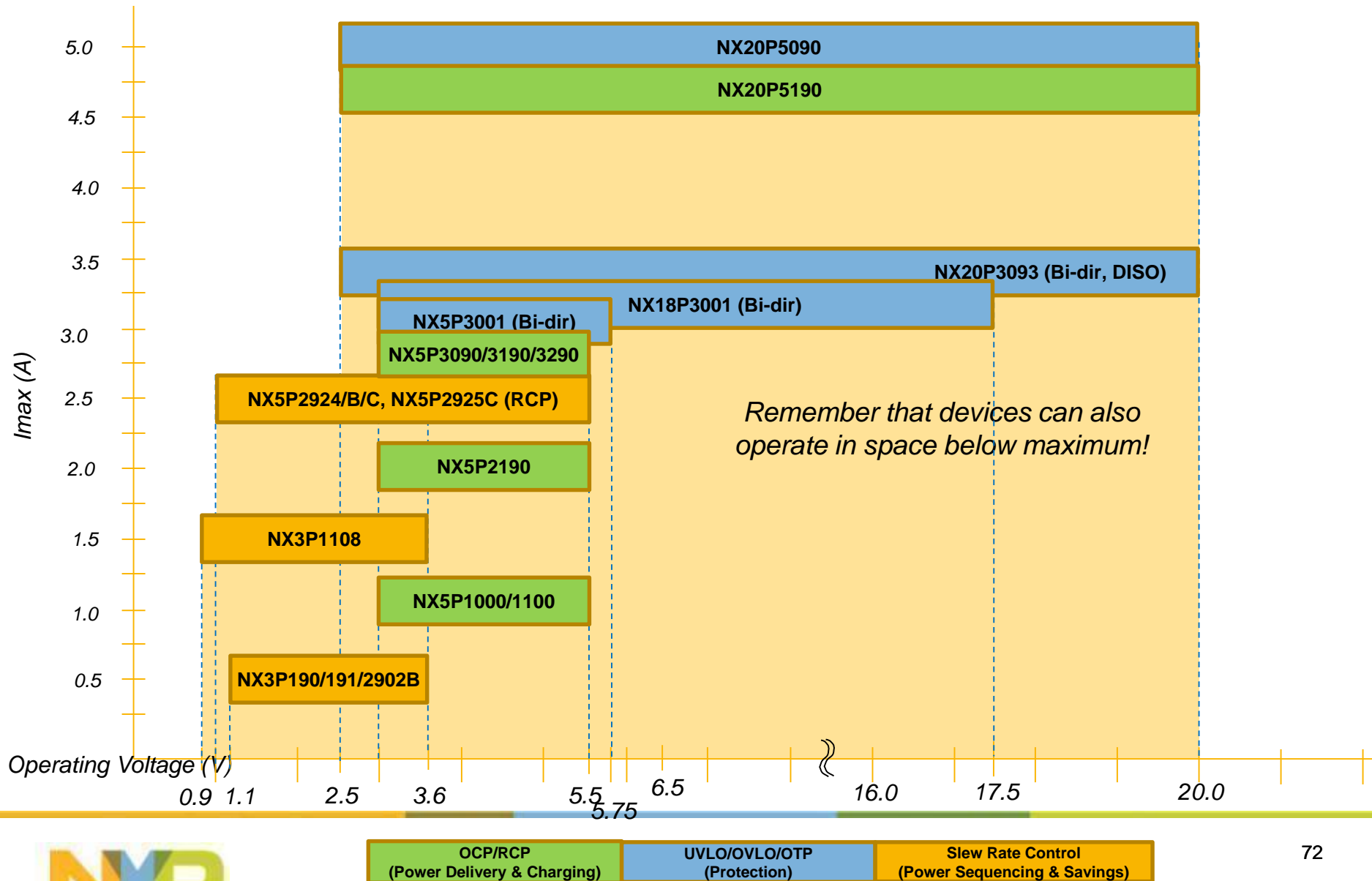


Features

- Operates at 1.4 – 4.3 V supply.
- Control inputs up to 4.3 V
- Dedicated supply source switch
- High Off isolation of -60dB
- On resistance $R_{ON} < 1.0 \Omega$
- Typical $C_{S(ON)}$ for data path = 16 pF
- High Bandwidth $f_{(-3dB)} = 330 \text{ MHz}$
- Low Cross Talk = -60dB

NXP Load Switch Family

For Power Sequencing, Power Savings, Power Delivery, Protection & Control





Load Switches Portfolio

For Power Sequencing, Power Savings, Power Delivery, Protection & Control

- ▶ **Ultra-low current consumption**
- ▶ **Low and flat on-resistance (R_{ON})**
- ▶ **Wide Supply Voltage Range**

Power Sequencing & Savings
Protection (OVP)
Power Delivery & Charging (OCP)

Device	V_{IN} (V)	R_{ON} TYP (m Ω)	$I_{QUIESCENT}$ TYP (nA)	I_{OUTPUT} MAX (A)	Slew Rate	R_{dch}	UVLO	OVP	OTP	OCP	RCP	Package
NX3P190	1.1 – 3.6	65	100	0.5	Y							WLCSP4
NX3P191	1.1 – 3.6	65	100	0.5	Y	Y						WLCSP4
NX3P2902B	1.1 – 3.6	65	10	0.5	Y	Y						WLCSP4
NX3P1108	0.9 – 3.6	35	100	1.5	Y	Y						WLCSP4
NX5P2924	0.9 – 5.5	14	500	2.5	Y	Y						WLCSP6
NX5P2925C	0.8 – 5.5	18	500	2.5	Y	Y					Y	WLCSP6
NX5P1000 †	3.0 – 5.5	60	200	1 (adj)	Y		Y	Y	Y	Y	Y	WLCSP12
NX5P1100 †‡	3.0 – 5.5	60	200	1 (adj)	Y		Y	Y	Y	Y	Y	WLCSP12
NX5P2190 †	3.0 – 5.5	60	200	2.0 (adj)	Y		Y	Y	Y	Y	Y	WLCSP9
NX5P3090 †	2.5 – 5.5	30	TBD	3.0 (adj)	Y	Y	Y	Y	Y	Y	Y	WLCSP12
NX5P3001 †	3.0 - 5.75	65	100	3.0	Y		Y	Y	Y			WLCSP12
NX18P3001 †	3.0 - 17.5	65	100	3.0	Y		Y	Y	Y			WLCSP12
NX20P5090 †	2.5 – 20	30	TBD	5.0	Y		Y	Y	Y			WLCSP15
NX5P3201C †	2.7 – 5.5 3.4 – 6.5	8 32	TBD	6.0 3.0	Y		Y	Y N	Y		Y N	WLCSP30

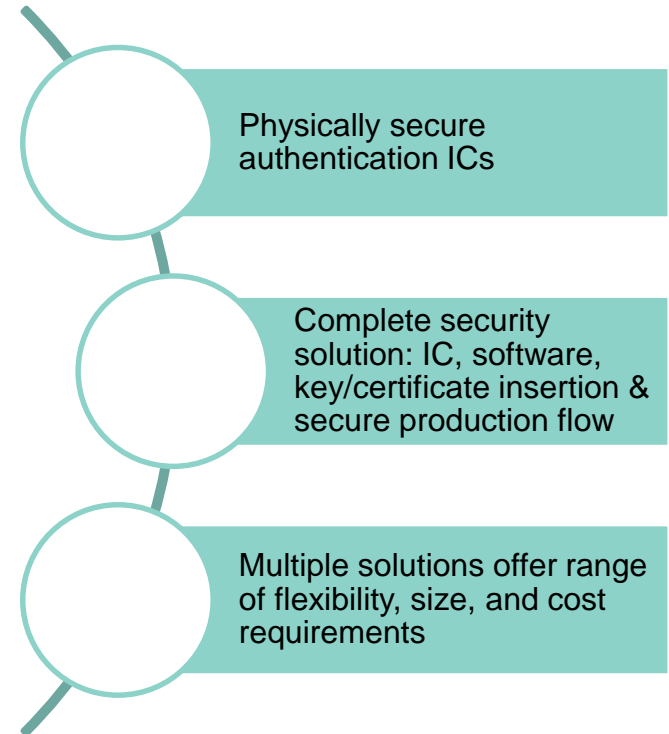
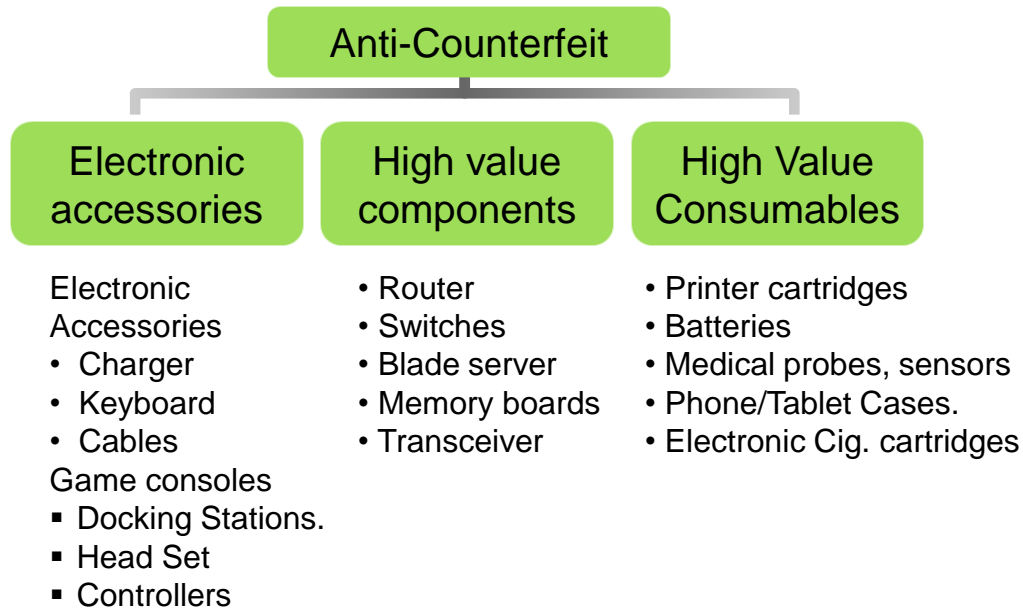
† 30V Tolerant for USB OTG 3.0

‡ 8ms OCP trigger delay



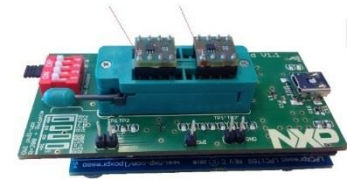
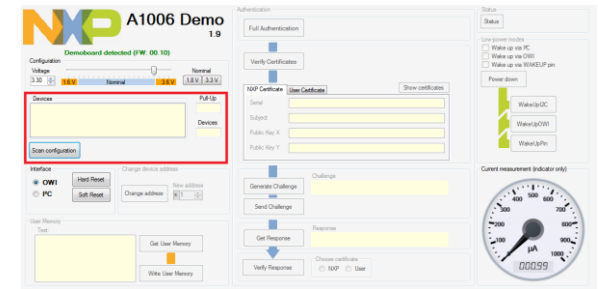
Authentication (Anti-Counterfeit)

Anti-counterfeit Protection



Tamper Resistant Authentication - A1006

- ▶ No security IC needed on host side because of public key authentication (PKI)
 - Authentication protocol based on ECDH (Elliptic Curve Diffie Hellman) with standardized NIST B-163 elliptic curve.
 - Digitally signed certificates contain public key corresponding to die-unique private key
- ▶ Industry leading advanced security features include: TRNG, active shielding, security sensors, many more
- ▶ 4 kbit EEPROM supports 2 certificates, system memory, and 1kbit for user needs
- ▶ Industry's lowest power (50uA typ, 500uA max)
 - Deep sleep power < 1 uA at 1.8V Vdd
- ▶ Industry's smallest footprint – as small as 1 mm² in WLCSP
 - Also available in HXSON6 2 x 2 mm package
- ▶ Flexible Interfaces: 400 kbps I2C or one wired interface
 - OWI bus powered (no external Vdd needed)
 - OWI interface rated 8kV IEC61000-4-2 ESD protection



NXP Value Proposition for A1006 Secure Authenticator

Best in class anti-counterfeiting/anti-hacking technology

- Strongest levels of market-proven and certified security
- End to end security includes common criteria certified production facilities and secure personalization/key insertion per chip

Lowest power, smallest footprint, high performance

- Solutions as small as 1mm²
- Power consumption as low as 500 uA full-on, 50 uA typ, < 1 uA deep sleep
- Full certificate validation plus ECC challenge-response in ~50 ms

Ease of system integration

- Bus-powered one wire interface
- 8kV IEC61000-4-2 contact ESD protection
- Demo board and host demo software available
- Applications support team includes security experts



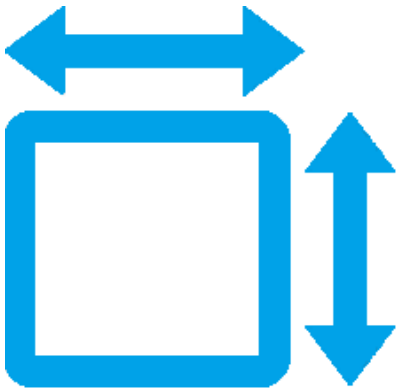
Personal Health

- ✓ NxH5104 4MBit EEPROM
- ✓ NFMI for Hearable
- ✓ NTAG SmartSensor

Introducing NxH5104 4MBit EEPROM



4MBit or 500kByte



2.8mm by 2.7mm



**Av. write current
at 0.7mA**



Write protection



COMPANY CONFIDENTIAL

PL PH, NxH5104 4MBit EEPROM

79

April 19, 2017

NxH5104 – ultra low power 4MBit SPI EEPROM

Features

Minimal footprint	4Mbit in 7.8mm² area (2.80mm by 2.74mm) WL-CSP package with 13 bumps , 400um pitch Highly integrated: 1 external cap
Supply direct from battery	With integrated Power Management Unit to support ZnAir, NiMH and Silver-Zink batteries, offering direct operation from 1.0 .. 2.0V supply
Ultra low power	Designed for minimal average and peak currents: <ul style="list-style-type: none">• Power-down < 5 uA• Average read current at .6 mA
Interfaces	128-byte and 256-byte page access via SPI <ul style="list-style-type: none">• Speed up to 10MHz
Auxiliary supply	Auxiliary supply with current limiting allows supplying e.g. a LED <ul style="list-style-type: none">• 2mA up to 3.2V
Reliable	Operating temperature -20 to 85 degrees >10 years data retention 500 000 program cycles



NxH2281/NxH2261/NXH2265: NFMI for hearables

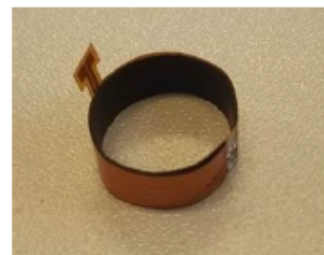
NxH2280: Initial NFMI offering for hearing and hearables

NxH2281: Increasing audio quality to the level of existing Bluetooth A2DP headsets

NxH2261: Same functionality as NxH2281 but standard package offering for CE products

Key delta features / benefits (NxH2280 → NxH2281/NxH2261)

Parameter	NxH2280	NxH2281	NxH2261
Increased audio quality			
• Codec	G.722	SBC	SBC
• Audio bandwidth	16 kHz	21 kHz	21 kHz
• THD+N	-40 dB	-67 dB	-67 dB
• SNR	-81 dB	-93 dB	-93 dB
• Power [mW] <i>*unidirectional streaming</i>	2.5 mW	3.6 mW*	3.6 mW*
Net data throughput [kbps]	220	220	220
Free CortexM0 programming memory	10 kB	15 kB	15 kB
Non-volatile memory [kbit]	512	512	512
Package			
• Pin compatible with NxH2280	Yes	Yes	No
• Bump diameter [um]	130	130	250
• UBM [um]	100	100	240
• Back side coating	No	No	Yes
• Underfill required	Yes	Yes	No
• Size [mm ²]	10.4	10.4	10.4
Status	R	CQS, R by 04/17	CQS, R by 04/17

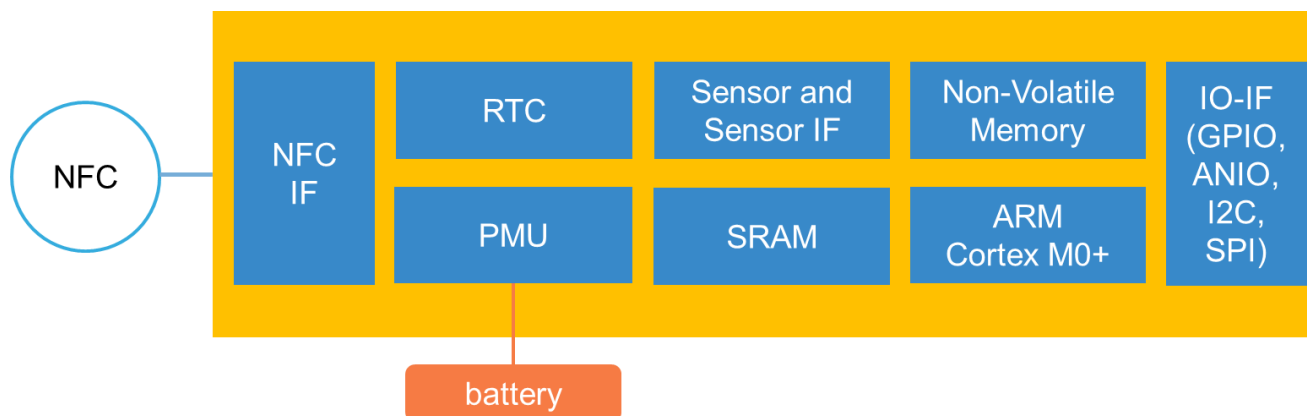


Remarks:

- ** audio streaming using G.722, fs=48 kHz still supported*
- ***NxH2265 product is under specification*

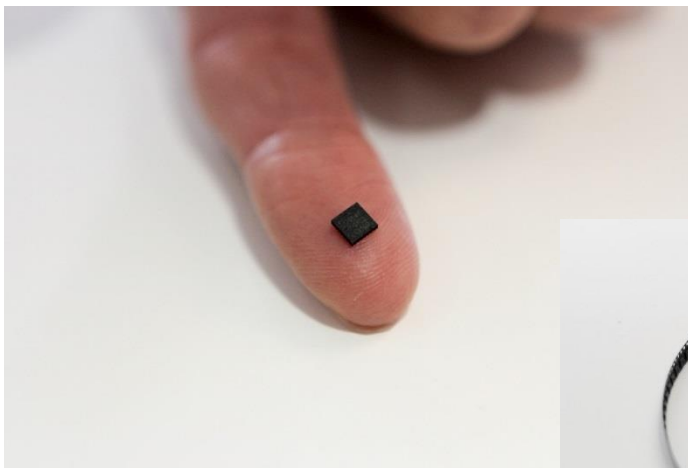
NTAG SmartSensor

- ▶ Single chip for creating **semi-passive sensing NFC solutions (tags)**
 - Semi-passive
 - Periodic sensing powered by battery
 - Passive communication over NFC when touching
 - Flexible and autonomous: open ARM Cortex M0+, large non-volatile memory
 - Easy to apply: just add a battery and an NFC antenna



Features

- ▶ ISO14443 NFC interface
 - Configuration and Communication
- ▶ Open Cortex M0+
 - Flexible solution
 - SDK based on LPCXpresso IDE
- ▶ Large non-volatile memory
 - Not visible from the NFC interface
- ▶ PMU
 - Powered via battery or passive over NFC
- ▶ IO interfaces
 - GPIO, ANIO, SWD, I2C, SPI
- ▶ Extendable with companion solutions:
 - UCODE-I2C, MEMS sensors
- ▶ Sensor and/or Sensor interfaces
 - Accurate and factory-calibrated temperature sensor: 0.3°C in the range 0..40°C and 0.5°C outside this range



	Sensors					Packages		
	digital IO	Temp	ADC	DAC	Current	HVQFN24	WLCSP25	BumpedDie
NHS3100	✓	✓				✓	✓	✓
NHS3152	✓	✓	✓	✓	✓	✓	✓	

Recommended sales prices



Reference Design

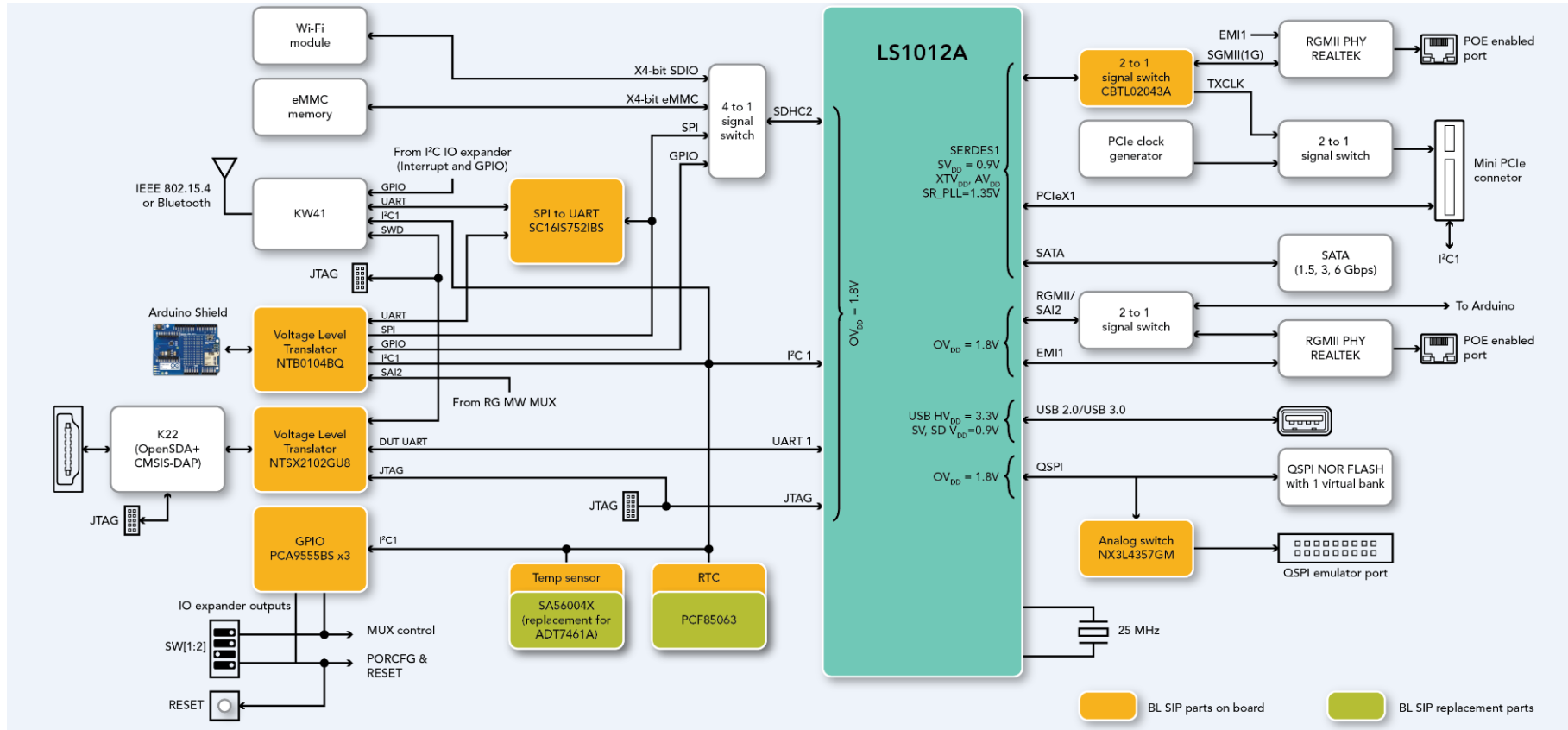
Target Interface & Power Devices by Application Segment

Applications	Leading Processor	Leading and Attach SIP Technology	SIP Hero parts
Servers	Intel X86 Processor Family	Attach: GTL translators, I2C translators, GPIO, Temp sensor	Attach: GTL2014, PCA9617A, PCAL6416A, PCT2075
Portable	Qualcomm MSM 89x series NXP i.MX6SL, i.MX6UL, i. MX7ULP series	Leading: USB type-C, Attach: Load Switches, GPIO, level translator	Leading: PTN5150A, Attach: NX3P2902B, NTS0102, PCA9570
White Goods	NXP Kinetis KVx , KEx Series	Attach: RTC, Level translator, LED controller, GPIO	PCF85063A, NTS0104, PCA9955B, PCAL6416A
SSD – Storage	Intel, LSI SanDisk, Seagate SSD Controller series	Attach: Analog Switches, Memory switches, Level Translators, GPIO, Load Switches, temp sensors	Attach: CBTU02043, CBTV24DD12, NTS0104, PCA6408A, NX5P2924, LM75BTP
Enterprise, Carriers.... Networking infrastructure (Base stations, Routers, Switches, Gateways, WLAN Access points, Firewall, WAN optimization)	NXP QorIQ P-series, T-series, LS-Series (LS2, LS1 families); NXP Kinetis KW Series	Attach: HS switches, memory switches, level translators, RTC, I2C temp sensor, Analog Switches	Attach: CBTL04083, CBTV24DD12, NTS0102, PCF85063A, PCT2075, NX3L4357
Infotainment: Multimedia System	NXP i.MX6, i.MX8	Leading: USB Type-C Attach: RTC, Signal switches, level translators	Leading: PTN5110, PTN5150A Attach: PCF85063A, CBTL04GP043, NTS0104
Building and Home Automation; Home Gateway	NXP Kinetis K64x, K81x series, QorIQ LS1 Series; LPC546xx, KW41 & KW35, CLRC663 Series	Attach: RTC, GPIO Expander, LCD Driver, Level translators	Attach: PCF85063A, PCAL6416A, PCF85176, NTS0104
IoT Gateway: Digital Networking	NXP QorIQ LS102x, LS104x series	Leading: USB Type-C Attach: HS switches, level translators, GPIO, I2C temp sensor, Analog switch	Attach: CBTU02043, NTS0102, PCA9555A, PCT2075, NX3L4684
IoT Home Automation	NXP LPC1700, LPC1500 Series LPC546xx, i.MX ULP, Kinetis KW2xD series	Attach: RTC, GPIO Expander, LCD Driver, Level translators	Attach: PCF85063A, PCAL6416A, PCF85176, NTS0104
IoT Home Energy Gateway	NXP LS102x, LS104x series, i.MX6, i.MX 7 series	Attach: Level Translators, signal switches, GPIO, RTC	Attach: NTB0104, CBTL02043A, PCA9555A, PCF85063A
ePOS	NXP i.MX6UL, i.MX7 S, D, i.MX8 Series NXP Kinetis KL81, K81 Series TDA8035 CT / PN5180 CL Series	Attach: Load switches, level translators, RTC	Attach: NX5P2190, NTS0102, PCF85063A
Medical: Blood Glucose Monitor	NXP MCP5125, + Kinetis KW/KL	Attach: RTC, Authentication, LCD Driver	Attach: PCF85063A, A1006, PCF85176
Video Surveillance	NXP ASC884xA and ASC885xA Series	Leading: USB Type-C Attach: Level translator, RTC, Active switch, temp sensor, Authentication	Leading: PTN5150A Attach: NTS0102, PCF85063A, PTN36043, PCT2075, A1006

Digital Networking cross-sell enabling Reference design/block diagrams



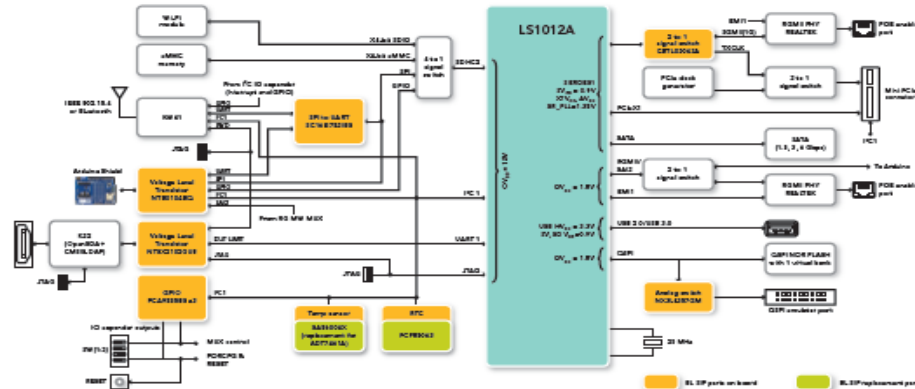
LS1012A Reference Design Block Diagram



LS1012A SOLUTIONS AROUND THE CORE QUICK REFERENCE



LS1012A Reference Design Block Diagram

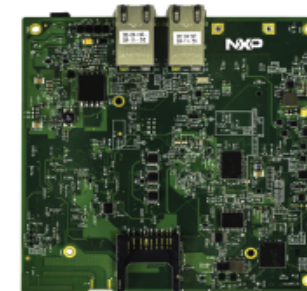


INTERFACE DISCOVERY QUESTIONS

- Does your LS1012A design need to accommodate multiple module options like Wi-Fi or eMMC memory etc.?
 - High speed switches will help optimize the use of the I/O from the DN Processor
- Does your design need UART interface?
 - SPI/I2C to UART bridge serves the purpose
- Does your design need voltage level translators to interface with different peripheral devices?
- Does your design need GPIO to extend the DN I/O capability?
- Does your design need temperature sensor with alerts capability?

LS1012A Reference Design with BL-SIP parts

BL-SIP Parts	Qty	Description	Key Features/ Differentiators
CRTL02043A	1	2 channel, 2:1 mux/demux Differential High speed switch	- Minimized switch impedance causing attenuation through the switch is negligible - Minimized channel-to-channel skew and crosstalk - Allows expansion of existing high-speed ports for extremely low power - Multiple sourced part
SC14IS752IBS	1	Dual UART with I2C-bus/ SPI interface	- Low operating and sleep current; additional programmable I/O pins - Very small HVQFN32 and TSSOP28 packages - Seamless protocol conversion from I2C-bus/SPI to RS-232/ RS-485 and is fully bidirectional
PCA9555B5	3	16 bit GPIO for PC-bus/ SMBus applications	- Higher drive capability, 5 V I/O tolerance, lower supply current, individual I/O configuration, and smaller packaging.
NTSX2102GU8H	1	Dual supply voltage level translator	- Wide supply voltage range of 1.65V to 5.5V translating between any of the voltage nodes (1.8V, 2.5V, 3.3V and 5.0V). - Preventing the damaging backflow current through the device when it is powered down - Latch-up performance exceeds 100 mA per JEDEC 78B Class II - Multiple package options
NX3L4357GM	1	Low-ohmic single-pole triple-throw analog switch	- Wide supply voltage range from 1.4 V to 4.3 V - Very low ON resistance -High noise immunity - Latch-up performance exceeds 100 mA per JEDEC 78B Class II Level A; Very low supply current, even when input is below V_{CC}
NTB0104BQ	1	4-bit, dual supply voltage level translator	- Bi-direction and auto sensing - Wide supply voltage range: $V_{CC}(A)$: 1.2 V to 3.6 V and $V_{CC}(B)$: 1.65 V to 5.5 V - Latch-up performance exceeds 100 mA per JEDEC 78B Class II. - Multiple package options
SA54004X (Equivalent pin compatible part on board)	1	Remote/local digital temperature sensor	- Over temperature alarms - SMBus time-out protocol - Multiple package options - Multiple sourced part



<http://bit.ly/LS1012ARefDesign>

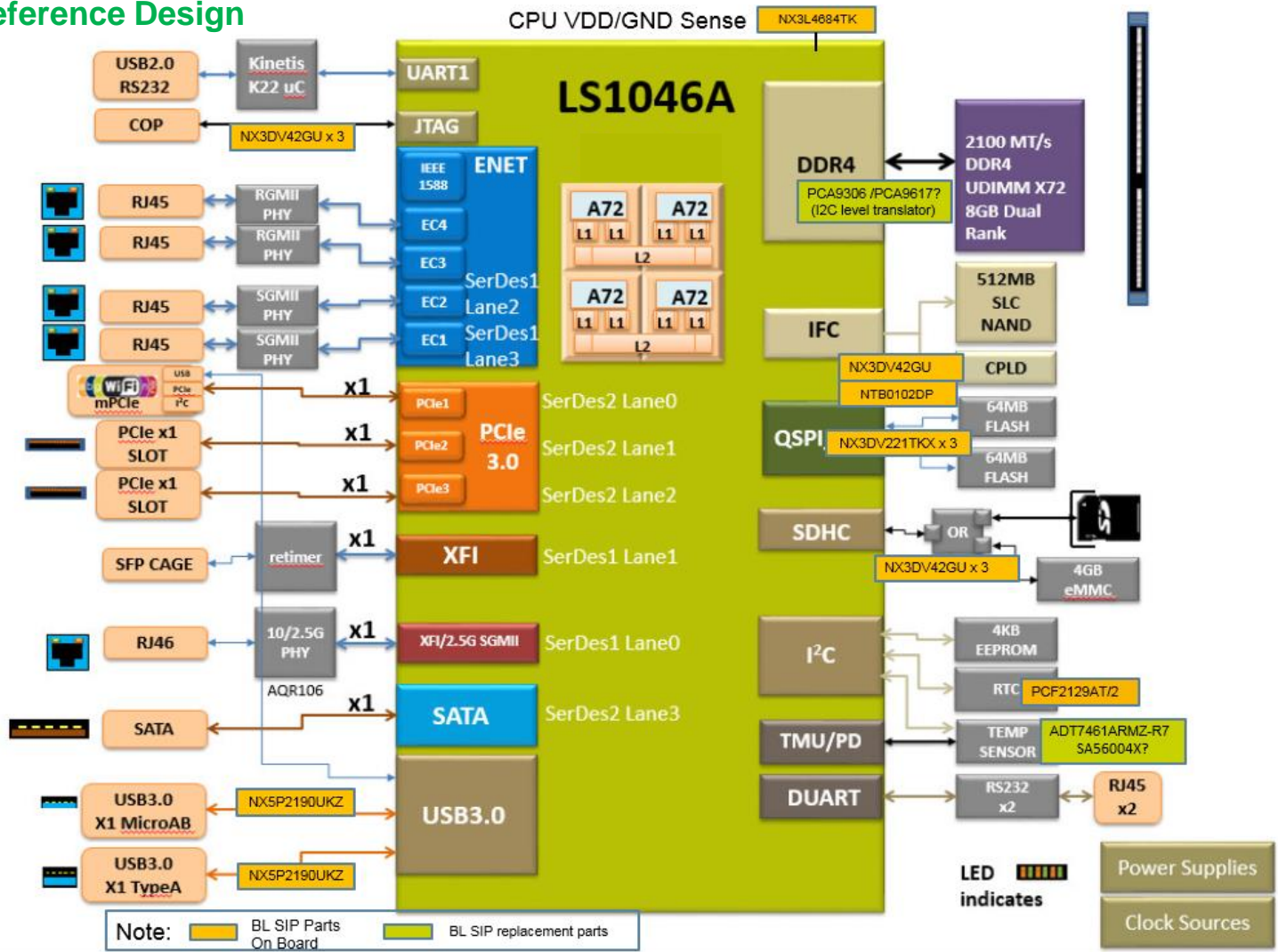
LS1012A Reference Design with BL-SIP Parts Key Features/Differentiators

BLSIP Parts	Quantity	Description	Key Features/ Differentiators
CBTL02043A	1	2 channel, 2 : 1 mux/demux Differential High speed switch	<ul style="list-style-type: none"> -Minimized switch impedance causing attenuation through the switch is negligible -Minimized channel-to-channel skew and crosstalk -Allows expansion of existing high-speed ports for extremely low power.
SC16IS752IBS	1	Dual UART with I2C-bus/SPI interface	<ul style="list-style-type: none"> -Low operating and sleep current; additional programmable I/O pins -Very small HVQFN32 and TSSOP28 packages, -Seamless protocol conversion from I2C-bus/SPI to RS-232/RS-485 and bidirectional
PCA9555BS	3	16 bit GPIO for I ² C-bus/SMBus	-Higher drive capability, 5 V I/O tolerance, lower supply current, individual I/O configuration
NTSX2102GU8H	1	Dual supply Voltage level translator	<ul style="list-style-type: none"> -Wide supply voltage range of 1.65V to 5.5V translating between 1.8V, 2.5V, 3.3V and 5.0V. -preventing the damaging backflow current through the device when it is powered down. -Latch-up performance exceeds 100 mA per JESD 78B Class II
NX3L4357GM	1	Low-ohmic single-pole triple-throw analog switch	<ul style="list-style-type: none"> -Wide supply voltage range from 1.4 V to 4.3 V; Low ON resistance -High noise immunity -Latch-up performance exceeds 100 mA per JESD 78B Class II Level A -Very low supply current, even when input is below VCC
NTB0104BQ	1	4-bit, dual supply Voltage level translator	<ul style="list-style-type: none"> -Bi-direction and auto sensing -Wide supply voltage range: VCC(A): 1.2 V to 3.6 V and VCC(B): 1.65 V to 5.5 V -Latch-up performance exceeds 100 mA per JESD 78B Class II.
SA56004X (Equivalent part on board)	1	Remote/local digital temperature sensor	<ul style="list-style-type: none"> -Over temperature alarms -SMBus time-out protocol

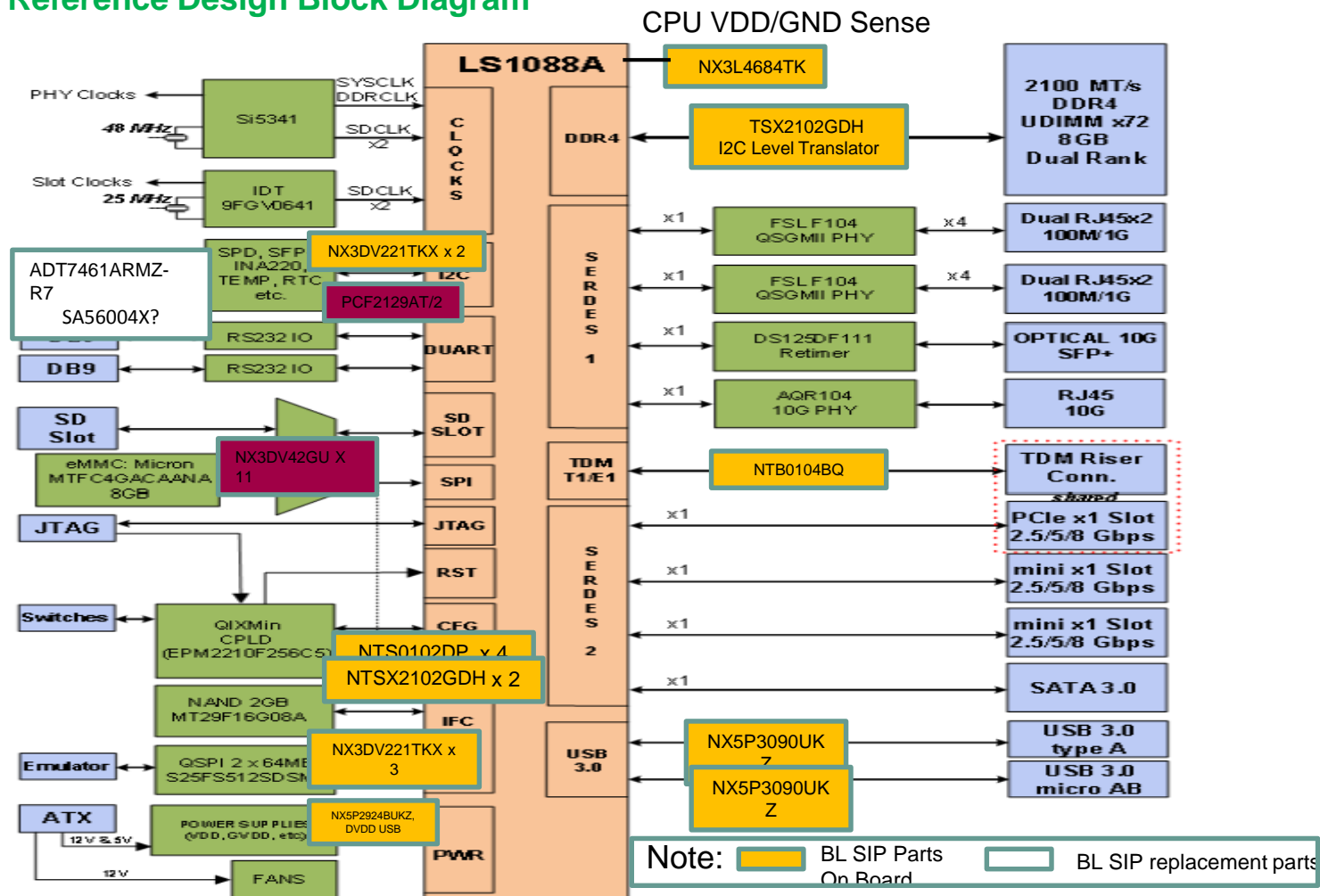
LS1012A –RDB board has 8 BL-SIP parts on the design files (schematic, layout, BOM)



LS1046A Reference Design



LS1088A Reference Design Block Diagram

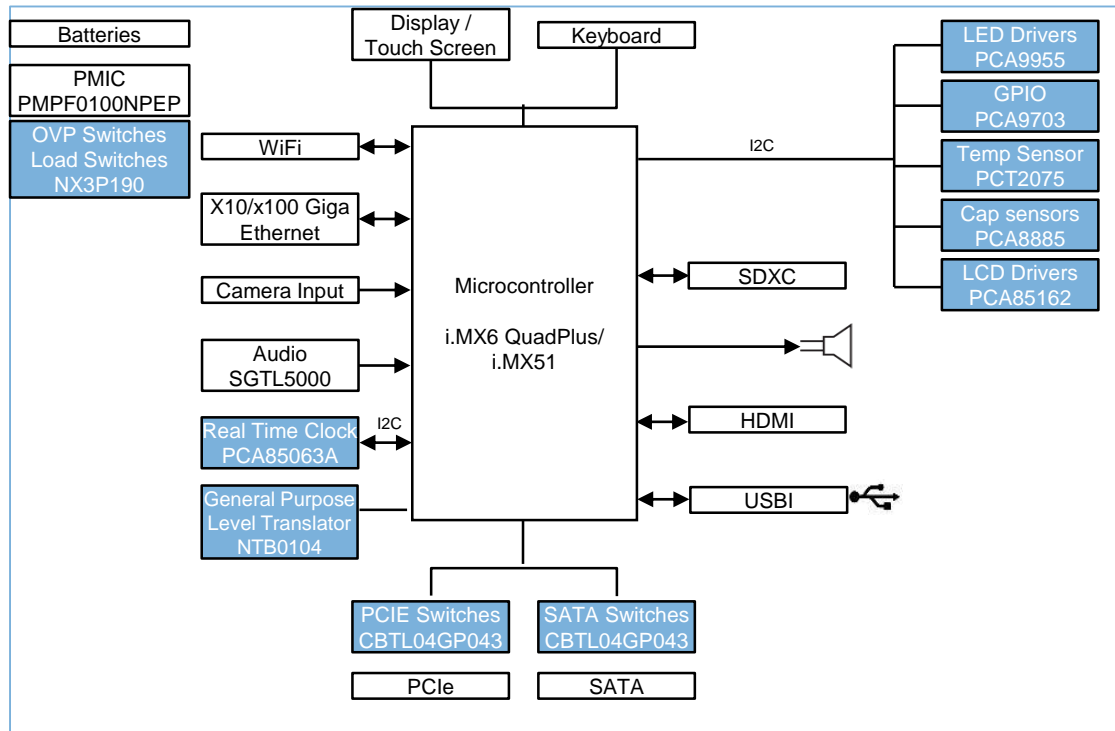


NXP Interface Solutions on Intel Reference Design

Purley EX Lightning Ridge 4S Reference Design

Intel Reference Design	PCA95456 Quad Bi-directional switch with Reset	PCA9535 16-bit GPIO w/ INT	PCA9617A 1MHz, 0.8V to 2.5 / 3.3 / 5 V translator	GTL2003 8-bit bidirectional low voltage translator	GTL2014 4-bit LVTTTL to GTL transceiver
Purley EX Lightning Ridge 4S Intel Doc # : CDI 553664	1	4	14	3	8
Purley EX Lightning Ridge Left PCIE RISER Intel Doc # : CDI#553666	1	1	1		
Purley EX Lightning Ridge Right PCIE RISER Intel Doc # : CDI 553667	1	1	1		

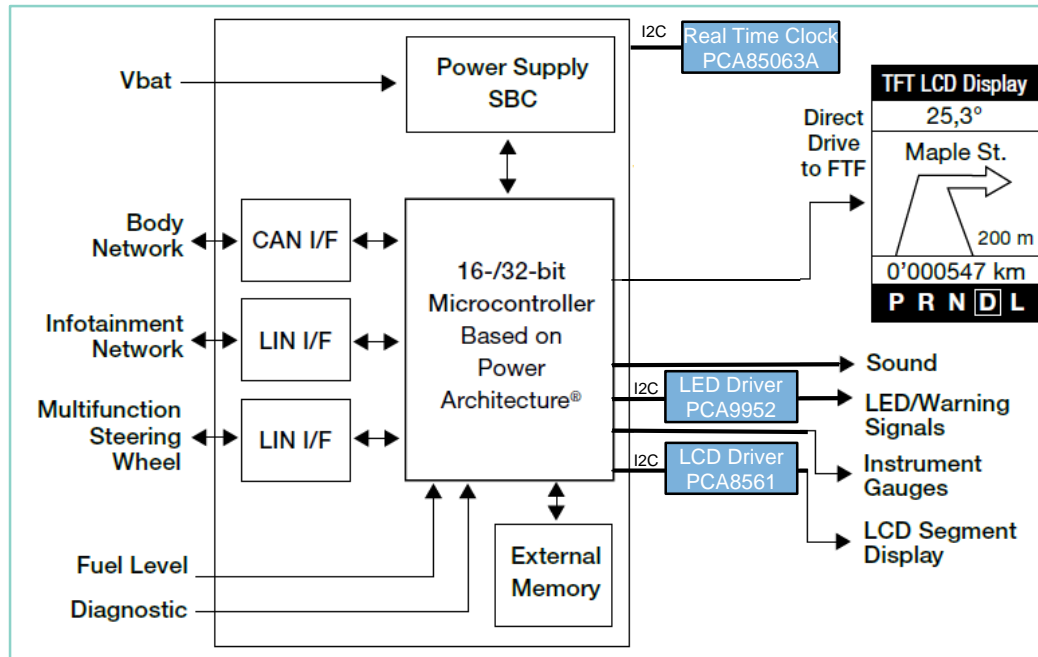
Application: Automotive Infotainment Unit



Products	Automotive Application Parts
Load Switches *	NX3P190
Real Time Clock (I2C)	PCA85063A
	PCA2129T
Signal Switches *	CBTL04GP043
LED Drivers (I2C/SPI)	PCA9955BTW/Q900
	PCA9635PW/Q900
GPIO Expanders (I2C)	PCA9703PW/Q900
	PCA9554PW/Q900
Temperature sensors * (I2C)	PCT2075
	LM75B
Capacitive sensors (I2C)	PCA8885TS/Q900/1
	PCA8886TS/Q900/1
LCD Drivers (I2C/SPI)	PCA85162T/Q900/1
	PCA85133U/2DA/Q1
General Purpose Level Translator	NTB0104BQ-Q100
	NTS0104PW-Q100

* Parts are not automotive qualified yet

Application: Automotive Instrument Cluster



Products	Automotive Qualified Parts
Real Time Clock (I2C)	PCA85063A
	PCA2129T
LED Driver (I2C)	PCA9952
	PCA9955
LCD Driver (I2C/SPI)	PCA8561
	PCA9620

SIP Automotive Hero Parts			
Product Family	Orderable Part #	Part Description	Key features and Differentiator
Voltage level Translator	NTB0104BQ-Q100	4-bit, dual supply Voltage level translator	<ul style="list-style-type: none"> • Bi-direction and auto sensing • Wide supply voltage VCC(A): 1.2 V to 3.6 V and VCC(B): 1.65 V to 5.5 V • Latch-up performance exceeds 100 mA per JESD 78B Class II
	NTS0104PW-Q100	4-bit, dual supply bidirectional translating transceiver with auto direction sensing	<ul style="list-style-type: none"> • VCC(A): 1.65 V to 3.6 V and VCC(B): 2.3 V to 5.5 V • IOFF circuitry provides partial Power-down mode operation • Inputs accept voltages up to 5.5 V
	NTB0102DP-Q100	2-bit, dual supply Voltage level translator	<ul style="list-style-type: none"> • Bi-direction and auto sensing • Wide supply voltage VCC(A): 1.2 V to 3.6 V and VCC(B): 1.65 V to 5.5 V • Latch-up performance exceeds 100 mA per JESD 78B Class II.
Analog Switch	NX3L1G3157GW-Q100	1x SPDT	<ul style="list-style-type: none"> • RON 0.75 (W) 0.75 • f -3dB 60 (MHz) • THD 0.024 (%) • X-talk -90 (dB)
	NX3L1G66GW-Q100	1x SPST	<ul style="list-style-type: none"> • RON 1.6 ohms (typical) at VCC = 1.4 V to 0.5 ohms (typical) at VCC = 4.3V • High noise immunity • High current handling :350 mA continuous current under 3.3 V supply
Capacitive Sensor	PCA8885TS/Q900/1	Dynamic touch and proximity 8 channel sensor	<ul style="list-style-type: none"> • Adjustable response time; Adjustable sensitivity • Continuous auto-calibration; Digital processing • Can cope with up to 6 mm of acrylic glass • Large voltage operating range (VDD = 2.5 V to 5.5V) • Sleep mode (IDD < 100 nA) • Low-power battery operation possible (IDD ~ 10 A)
	PCA8886TS/Q900/1	Dynamic proximity switch	<ul style="list-style-type: none"> • Digital processing • Automatic calibration; Adjustable sensitivity- can be made very high • Adjustable response time • Wide input capacitance range (10 pF to 60 pF) • Output configurable as push-button, toggle, or pulse • Wide voltage operating range (VDD = 3 V to 9 V) • Designed for battery powered applications (IDD = 6 A, typical)
GPIO Expander	PCA9703PW/Q900	16-channel	<ul style="list-style-type: none"> • SPI • Up to 18 V Tolerant
	PCA9554PW/Q900	8-channel	<ul style="list-style-type: none"> • I2C • Interrupt • TSSOP16
LCD Driver	PCA85162T/Q900/1	32 x 4 LCD driver for low multiplex rates	<ul style="list-style-type: none"> • Single chip LCD controller and driver • Wide logic LCD supply range: From 2.5 V for low-threshold LCDs; Up to 8.0 V for guest-host LCDs and high-threshold twisted nematic LCDs • 4 x 32(36) • TSSOP48
	PCA9620H/Q900/1	60 x 8 LCD high-drive segment driver	<ul style="list-style-type: none"> • peripheral device interfacing to almost any Liquid Crystal Display (LCD)1 with low multiplex rates • 480-bit RAM for display data storage • Selectable backplane drive configuration: static, 2, 4, 6, or 8 backplane multiplexing Programmable internal charge pump for on-chip LCD up to 3x VDD2

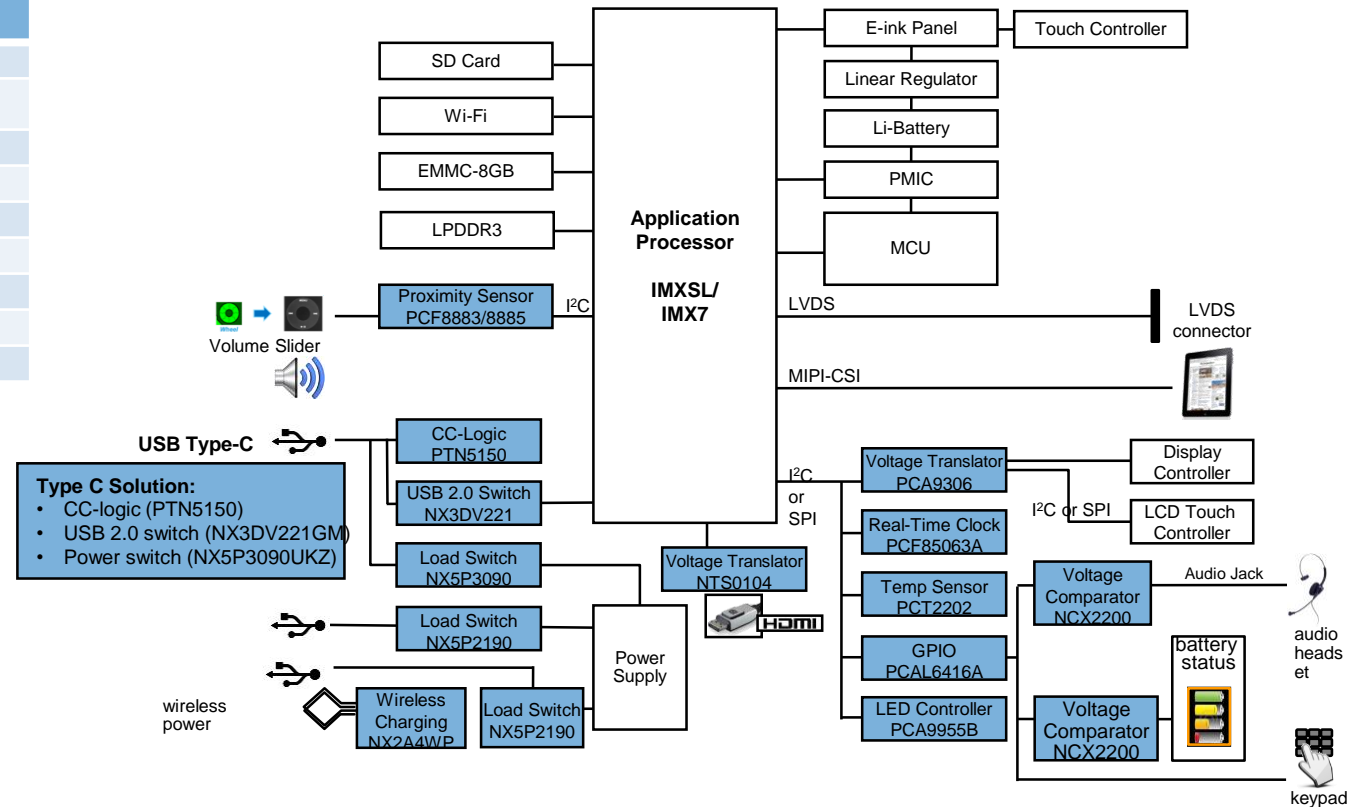


SIP Automotive Hero Parts			
Product Family	Orderable Part #	Part Description	Key features and Differentiator
LED Driver	PCA9955BTW/Q900	16-Channel; Constant Current	<ul style="list-style-type: none"> • VDD 40V • IDD 57mA • 1 MHZ Fm+ • 8-bit indiv/global;RGB – Mixer
	PCA9635PW/Q900	16-Channel; Voltage Source	<ul style="list-style-type: none"> • VDD 5V • IDD 25mA • 1 MHZ Fm+ • 8-bit indiv/global;RGB – Mixer
	PCA9745BTW/Q900	16-Channel; Constant Current	<ul style="list-style-type: none"> • VDD 40V • IDD 57mA • SPI Daisy Chain • 8-bit indiv/global;RGB – Mixer
Real Time Clock	PCA8565TS/1	Real time clock/calendar	<ul style="list-style-type: none"> • I2C, 400kHz • -40 °C to +125°C • TSSOP8
	PCA21125T/Q900/1	SPI-bus Real-Time Clock and calendar	<ul style="list-style-type: none"> • SPI, 6MHz • -40 °C to +125°C • TSSOP14
	PCA85063ATT/A	Tiny Real-Time Clock/calendar with alarm function and I ² C-bus	<ul style="list-style-type: none"> • I2C, 400kHz • -40 °C to +105°C • Low power • Tiny footprint TSSOP8
	PCA2129T/Q900/2	Accurate RTC with integrated quartz crystal	<ul style="list-style-type: none"> • I2C, 400kHz; SPI, 6.5MHz • -40 °C to +85°C • High accuracy ±3ppm typ. • SO161
UART	SC16IS740IPW/Q900	Single full-duplex UART	<ul style="list-style-type: none"> • Slave I2C-bus/SPI interface to a single-channel high performance UART. up to 5 Mbit/s • Selectable I2C-bus or SPI 3.3 V or 2.5 V operation; 64 bytes FIFO (transmitter and receiver)
	SC16C850IBS/Q900	Single-channel high performance UART	<ul style="list-style-type: none"> • Up to 5 Mbit/s • 3.3 V or 2.5 V operation; 128 bytes FIFO (transmitter and receiver) • High resolution clock prescaler with granularity of 1/ 16 to allow non-standard UART clock usage. • Automatic software (Xon/Xoff) and hardware (RTS/CTS or DTR/DSR) flow control



i.MX + BL-SIP: e-Reader

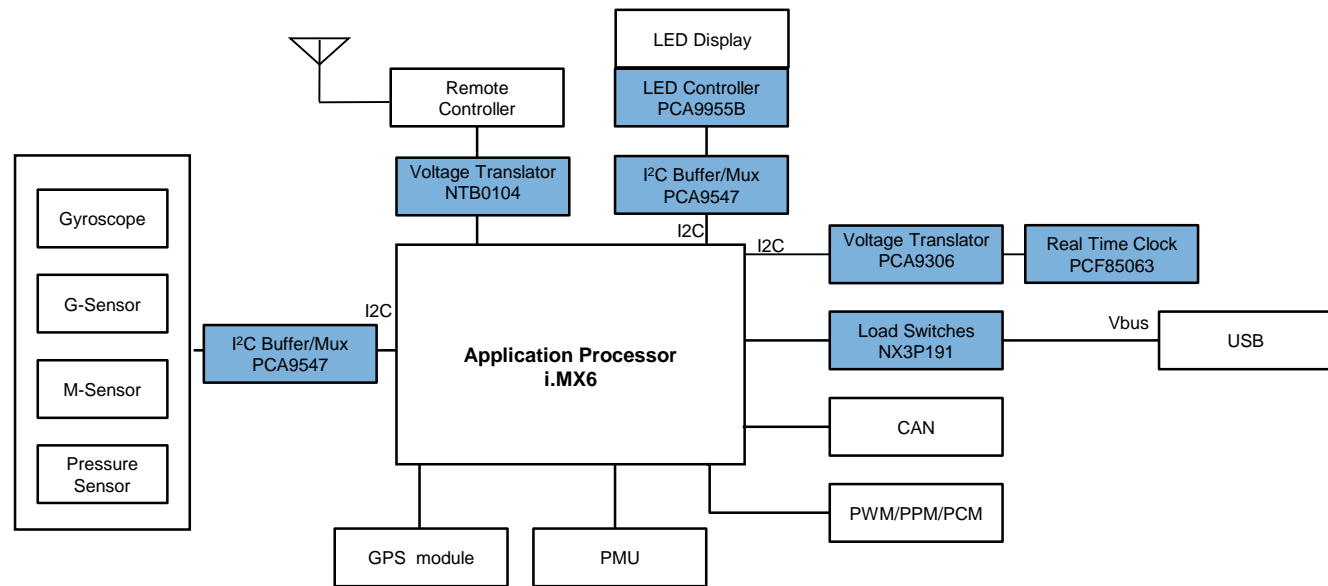
BL-SIP Portfolio Categories	Part # (x quantity)
Voltage Translator	NTX0104, PCA9306
Load Switches	NX5P3090 (x2), NX5P2190 (x2)
GPIO Expanders	PCAL6416A
CC-logic	PTN5150 (x2)
Proximity Sensor	PCF8883/8885
USB 2.0 Switch	NX3DV221GM (x2)
Voltage Comparator	NCX2200 (x2)
Temp Sensor	PCT2202
Wireless Charging	NX2A4WP (Opportunistic)



i.MX + BL SIP: Drone

BL-SIP Opp.

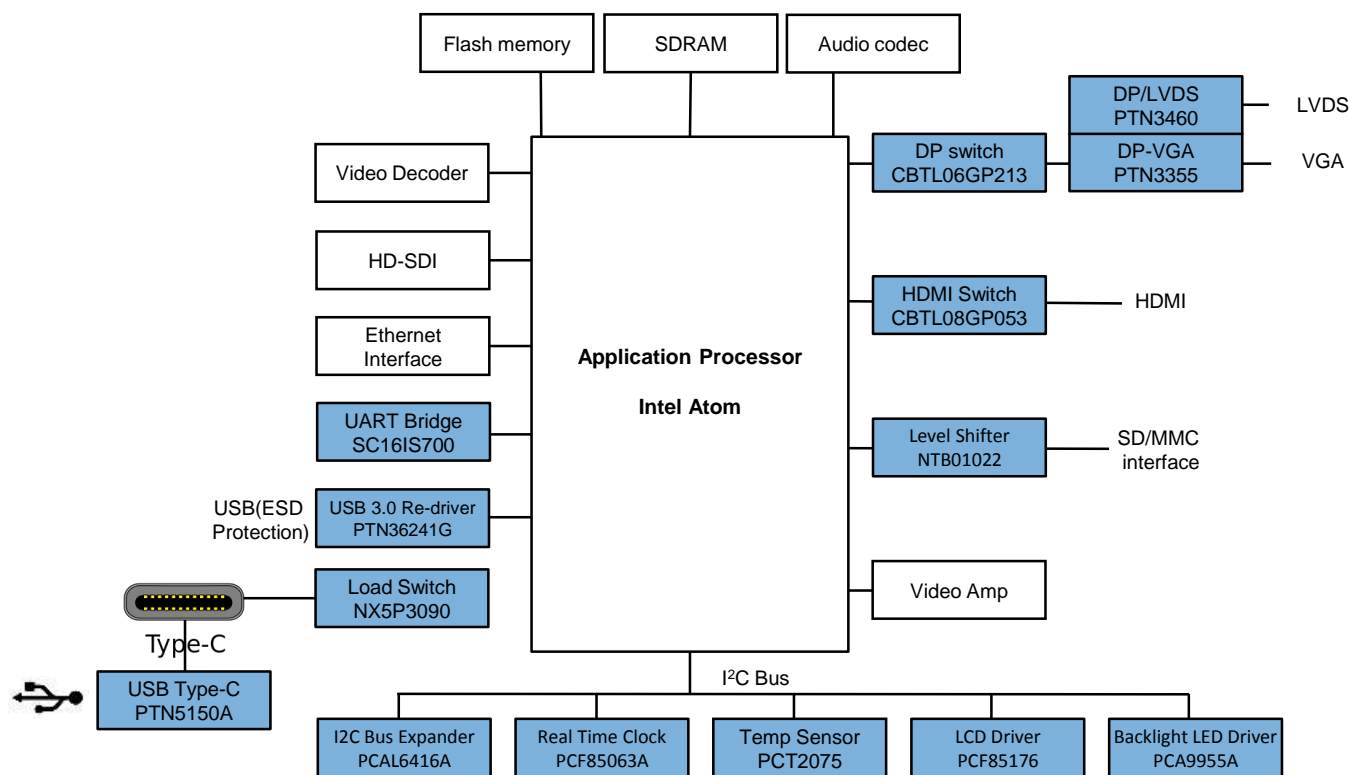
- Voltage Translator, NTB0104, PCA9306
- I2C Buffer/Mux, PCA9547
- Real Time Clock, PCF85063
- LED Controller, PCA9955B
- Load Switches, NX3P191



Intel Atom + BL SIP: Video Surveillance

BL-SIP Opp.

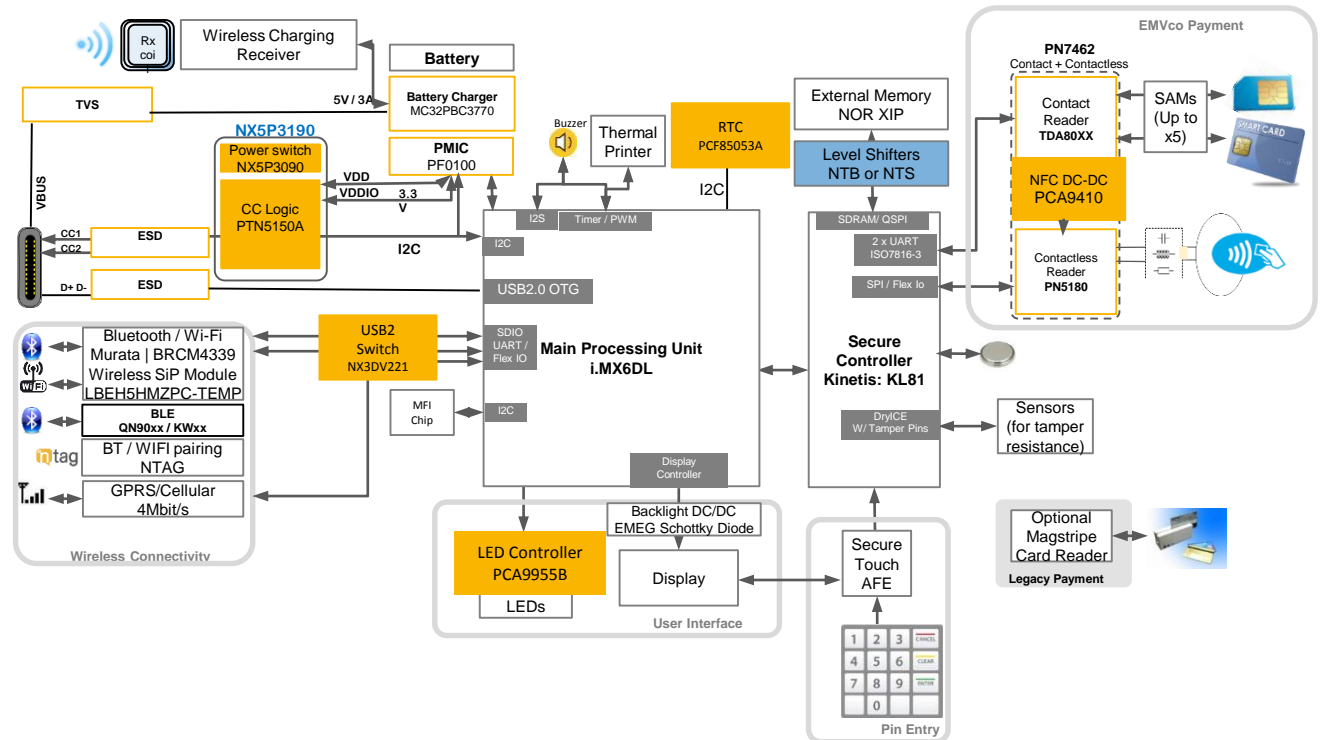
- USB Type-C, PTN5150A
- USB 3.0 Re-driver, PTN36241G
- Load Switch, NX5P3090
- I2C Bus Expander, PCAL6416A
- Real Time Clock, PCF85063A
- Temperature Sensor, PCT2075
- LCD Driver, PCF85176
- Backlight LED Driver, PCA9955A
- UART Bridge, SC16IS700
- DP switch, CBTL06GP213
- DP/LVDS, PTN3460
- DP-VGA, PTN3355
- HDMI Switch, CBTL08GP053
- Level Shifter, NTB01022



SIP with i.MX & Kinetis: Point-of-Sale System

SI&P Opportunity

- Real Time Clock, PCF85063A
- Type-C DFP controller, NX5P3190 or discrete versions:
 - Type-C CC-Logic, PTN5150A
 - Type-C Load Switch, NX5P3090
- LED Controller, PCA9955B
- DC-DC boost, PCA9410
- USB2 switch, NX3DV221
- Level Shifters, NTBxxx or NTSxxx



► April 2017



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FOR A SMARTER WORLD

