



**FTF 2016**  
TECHNOLOGY FORUM

# USB TYPE-C OVERVIEW

## ECOSYSTEM & ADOPTION

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FTF-DES-N1908  
MAY 16, 2016 (2:00PM)

PUBLIC USE



# AGENGA

- USB Type-C and USB PD Introduction
- USB Type-C Eco-System & Early adopters
- NXP Type-C Solution



# USB TYPE-C & PD INTRODUCTION

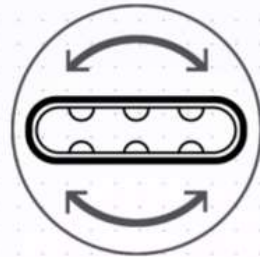
# USB Type-C & Power Delivery Introduction

24 pins



Type-C

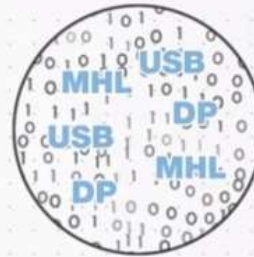
WITH **NEW FEATURES** INCLUDING:



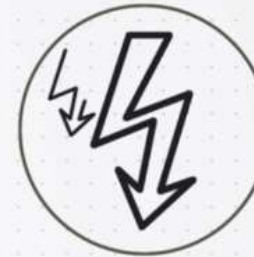
**REVERSIBLE  
AND  
ROBUST  
CONNECTOR**



UP TO  
**100W**  
OF POWER



UP TO  
**10 Gigabits**  
OF DATA AND  
VIDEO OVER  
THE SAME LINE



COMMUNICATING  
DEVICES CAN REQUEST  
**DIFFERENT VOLTAGE**  
LEVELS OF POWER

# USB Type-C & Power Delivery Introduction

## USB Type-C (Rev 1.2)

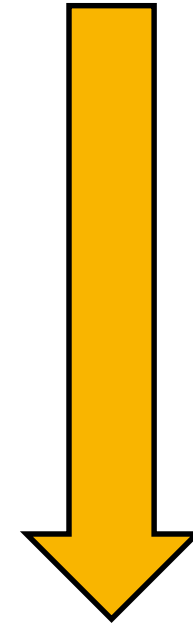
- Mechanical connector, plug and cable spec
- Polarity detection, DFP/UFP/DRP role detection

## USB Power Delivery (PD 3.0) Standard

- Protocol to negotiate higher voltage (>5V) & current over CC line
- Protocol to swap power role and data role
- Protocol to negotiate other functions (VDM) over the connector

## USB Type-C Alternate Mode Standard

- How to negotiate DisplayPort over USB Type-C
- How to negotiate Thunderbolt over USB Type-C
- How to negotiate MHL video data over
- How to authenticate for security over USB Type-C



Simpler  
Implementation  
\$

More Complex  
Implementation  
\$\$\$

System Designer can choose to implement partial or all features based on their requirement

# USB Type-C & Power Delivery Introduction

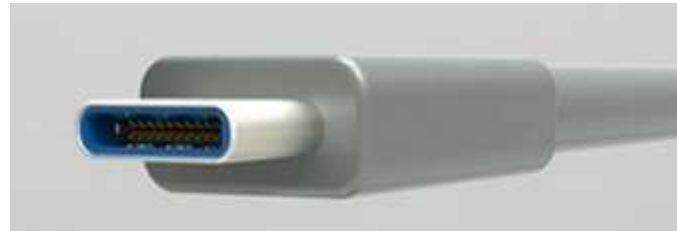
Receptacle



24 pins

- 1 CC1
- 1 CC2
- 2 SBU1/SBU2
- 4 VBUS
- 4 GND
- 8 Signal (4 DIFF Pair)
- 4 Signal (USB 2.0)

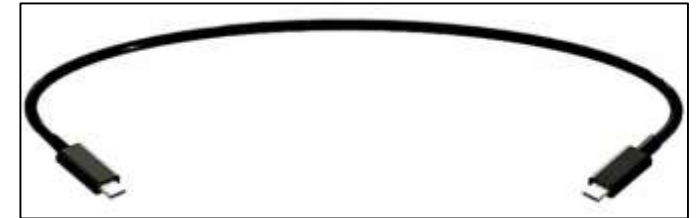
Plug



22 pins

- 1 CC
- 1 VCONN
- 2 SBU1/SBU2
- 4 VBUS
- 4 GND
- 8 Signal (4 DIFF Pair)
- 2 Signal (USB 2.0)

Cable

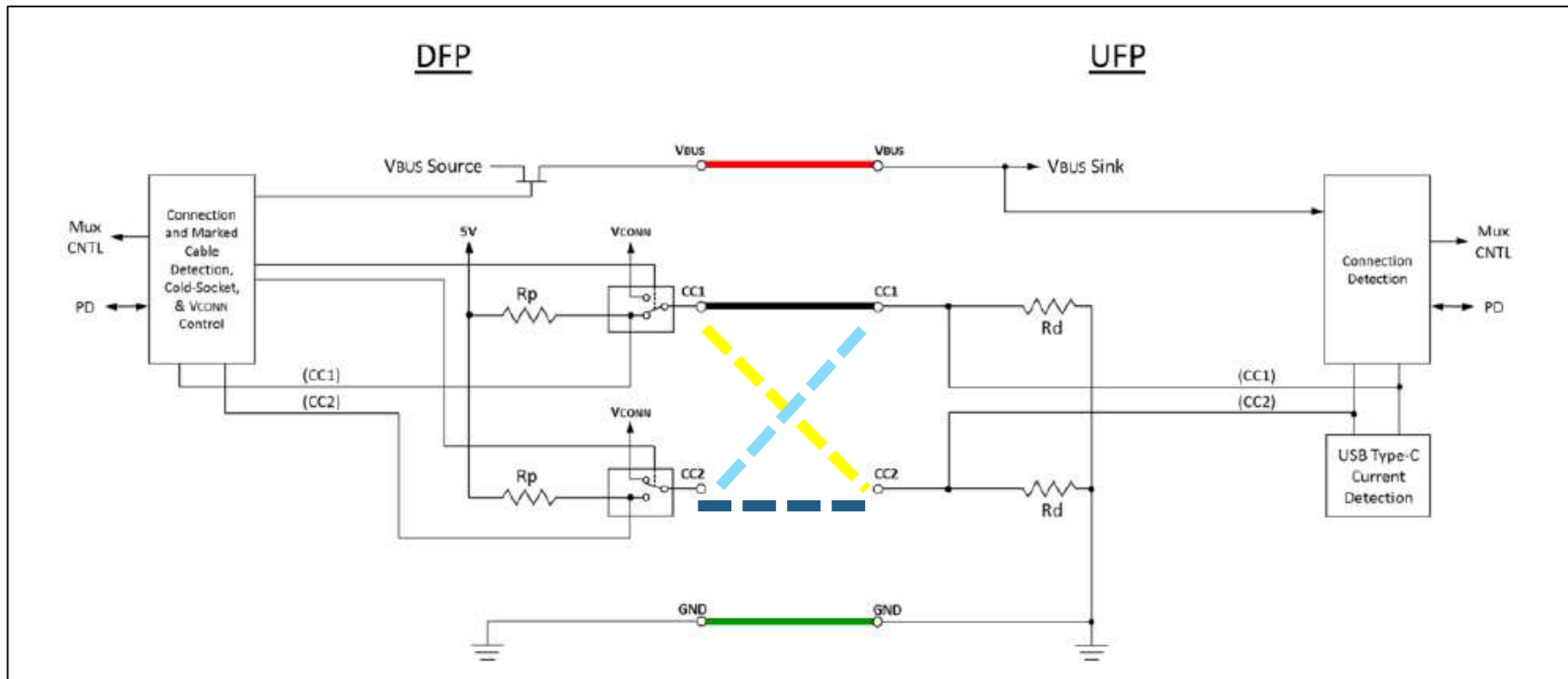


Cable Ref	USB Version	Cable Length	Current Rating
<a href="#">CC2-3</a>	<a href="#">USB 2.0</a>	≤ 4 m	3 A
<a href="#">CC2-5</a>			5 A
<a href="#">CC3G1-3</a>	<a href="#">USB 3.1 Gen1</a>	≤ 2 m	3 A
<a href="#">CC3G1-5</a>			5 A
<a href="#">CC3G2-3</a>	<a href="#">USB 3.1 Gen2</a>	≤ 1 m	3 A
<a href="#">CC3G2-5</a>			5 A

# USB Type-C & Power Delivery Introduction

## USB Type-C CC = Communication Channel

- Polarity & DRP/UFP/DFP detection



# USB Type-C & Power Delivery Introduction

USB Power Delivery : Communication Protocol over CC @ 300KHz



Type-C Cable



*Tablet (Example of Power Delivery communication)*

*Q1 : What voltage you can provide me for charging? (SRC\_CAP)*

*Q2 : I like to select 9V for charging (RDO)*

*A3: Okay, I can charge you at 9V (Power Role Swap)*

*Q4: I like to receive DisplayPort graphic instead USB 3.0 data through Type-C connector (DP Alternative Mode)*

*Notebook Computer (Example of Power Delivery Communication)*

*A1: I can provide you 5V, 9V, 12V, 20V (PDO)*

*A2: Okay. I am providing 9V on the VBUS (PS\_RDY)*

*Q3: (1 hour later). I am running of battery, can you charge me back? (Power Role Swap)*

*A4: Okay, I am switching the DisplayPort signal to the Type-C Connector*



# USB Type-C Interface Benefits

## Size

- Smaller connector designed to fit all form factors

## Ease of use

- User friendly
- Independent of plug orientation and cable direction

## Future Scalability

- Designed to support future upgrades in the spec – higher speeds

## Extends USB family

- Legacy USB devices supported. C to A cable.

## Last connector

- Enables one connector platform
- Supports power, video and data over single connector



# USB TYPE-C ECOSYSTEM



# Ecosystem Illustration

NXP offers USB Type-C solutions in

- Systems
- Cable and dongle adaptors
- AC/DC power adaptors



# Ecosystem Illustration (I)

NXP offers USB Type-C solutions in

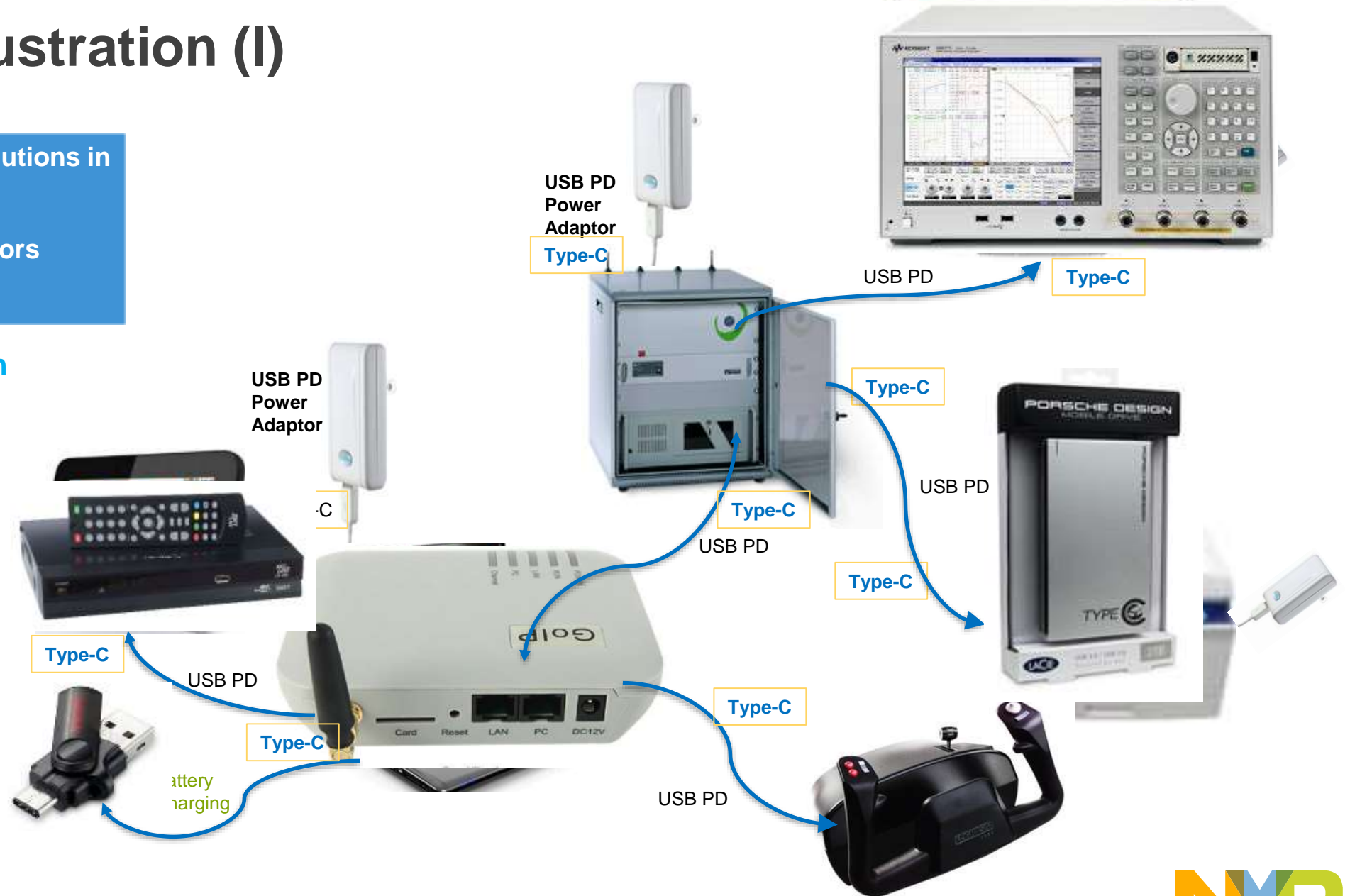
- Systems
- Cable and dongle adaptors
- AC/DC power adaptors

Network Instrumentation

Storage Set Top Box

Gateway

USB-Key Gaming



# Publically Released USB Type-C Products



- Apple 12"MacBoook
- Google Chrome Book Pixel
- Dell Latitude 7000
- HP Spectra 13
- Asus Transformer book
- Lenovo Yoga 900
- Acer Aspire



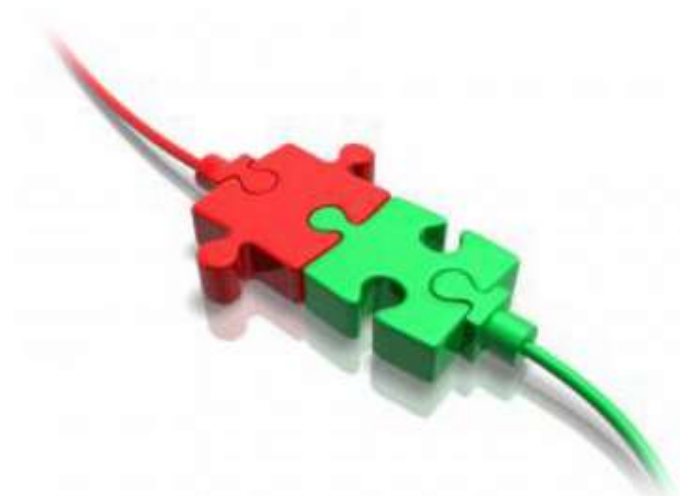
- Google Nexus
- LG G5
- Microsoft Lumia 900
- XiaoMi Mi5
- Huawei P9
- LeTV Superphone
- One plus 2



- Acer H7
- ASUS MB169C+
- Lenovo *ThinkVision X1*

# Compliance Testing & Interoperability

- Since the Type-C cable can covers many function, it is important to comply to the latest USB PD specification
- PD Compliance failure creates the following problems:
  - Not able to interoperate with other systems using USB Type-C connector
  - Not able to collect USB PD certification and logo.
    - Amazon.com announce not to carry any non-compliant Type-C cables
  - Cause damage to other systems.
- How to meet PD compliance?
  - Good design practice
  - Pretest using PD protocol test equipment. (e.g. Ellisys 350)
  - 3rd party certification lab (GRL)



# NXP PRODUCT OFFERING & SOLUTION



# NXP USB Type-C Website

NXP > Interface and Connectivity > Wired Connectivity > USB Type-C > USB-Type-C System

## USB-Type-C System

A long-time leader in USB systems and member of the USB-IF, NXP helped define the Type-C specification. This gives our engineers a keen understanding of Type-C implementations such as this USB subsystem, complemented by a solutions portfolio fully equipped to support every aspect of Type-C design.

The diagram illustrates the internal components of a USB-Type-C system. On the left, a dark grey box represents the 'System chipset', which is connected to an 'Audio CODEC' block below it. To the right of the system chipset is an 'LPC MCU (PD Policy)' block. Above the MCU is an 'Authentication' block, and above that is a grey-bordered box containing 'Load switches' and 'USB PD PHY' blocks. Below the MCU is another grey-bordered box containing 'High performance switches' and 'Signal conditioners' blocks. To the right of these MCU-related blocks is a vertical blue box labeled 'I/F Protection and filtering'. On the far right is a grey box representing the 'USB Type-C' connector, with labels for 'VBUS', 'VCONN', 'CC', 'USB 3.x', 'USB 2.x', and 'SBU'. A small image of a USB Type-C connector is shown next to these labels. The ID 'aaa-018185' is printed at the bottom right of the diagram area.



# NXP Secure Interfaces & Power Solutions

Signal Management		Smart Power	Bus Enablers & Peripherals	
<b>SIGNAL SWITCHES</b> <ul style="list-style-type: none"> <li>• USB Type-C</li> <li>• Thunderbolt</li> <li>• PCIe</li> <li>• SATA, SAS</li> <li>• Memory Interfaces</li> <li>• USB</li> <li>• DisplayPort (DP)</li> <li>• HDMI</li> <li>• MHL</li> <li>• MIPI</li> <li>• CSI/DSI</li> <li>• VGA</li> <li>• Audio</li> </ul>	<b>ADAPTERS, BRIDGES &amp; UARTs</b> <ul style="list-style-type: none"> <li>• DP – VGA</li> <li>• DP – LVDS</li> <li>• Inter-bus Bridges (I<sup>2</sup>C, SPI &amp; UART)</li> <li>• UARTs</li> </ul>	<b>DISTRIBUTION &amp; PROTECTION</b> <ul style="list-style-type: none"> <li>• Load Switches</li> <li>• Surge Protection/e-Fuses</li> <li>• USB Power Switches</li> <li>• USB PD / Type-C</li> </ul>	<b>I<sup>2</sup>C-bus ENABLERS</b> <ul style="list-style-type: none"> <li>• Bus Buffers</li> <li>• Level Translators</li> <li>• Muxes &amp; Switches</li> <li>• Bus Controllers</li> </ul>	<b>OTHER BUSES(SPI, ETC.)</b> <ul style="list-style-type: none"> <li>• Bus Buffers</li> <li>• Level Translators</li> <li>• General Purpose I/Os (Expanders)</li> <li>• Real Time Clocks</li> <li>• LCD Display Drivers</li> </ul>
<b>GENERAL PURPOSE SWITCHES</b> <ul style="list-style-type: none"> <li>• Analog</li> </ul>	<b>VOLTAGE REFERENCE &amp; DETECTION</b> <ul style="list-style-type: none"> <li>• Voltage Comparators</li> </ul>	<b>CHARGING</b> <ul style="list-style-type: none"> <li>• Wireless Charging</li> <li>• Rapid Battery Charging</li> </ul>	<b>I<sup>2</sup>C-bus PERIPHERALS</b> <ul style="list-style-type: none"> <li>• General Purpose I/Os (Expanders)</li> <li>• Temperature Sensors</li> <li>• LED Controllers</li> <li>• Stepper Motor Controller</li> <li>• Real Time Clocks</li> <li>• LCD Display Drivers</li> <li>• Capacitive Touch Switches &amp; Proximity Sensors</li> </ul>	
<b>SIGNAL INTEGRITY</b> <ul style="list-style-type: none"> <li>• HDMI/DVI Level Shifters</li> <li>• USB 3.0 Redrivers</li> </ul>	<b>LEVEL TRANSLATION</b> <ul style="list-style-type: none"> <li>• GTL</li> <li>• General Purpose</li> </ul>	<b>POWER Management</b> <ul style="list-style-type: none"> <li>• Battery Management with PMIC</li> <li>• AC-to-DC Solutions</li> </ul>	<ul style="list-style-type: none"> <li>• EEPROMs &amp; DIP Switches</li> <li>• Data Converters</li> </ul>	
	<b>RF/IF</b> <ul style="list-style-type: none"> <li>• LNAs, Mixers, Switches</li> <li>• Transceivers</li> </ul>	<b>POWERLINE COMMUNICATION</b> <ul style="list-style-type: none"> <li>• Modems</li> </ul>		
	<ul style="list-style-type: none"> <li>• Security</li> <li>• Authentication</li> </ul>	<b>POWER Conversion</b> <ul style="list-style-type: none"> <li>• DC-DC, Buck/Boost</li> </ul>		





SECURE CONNECTIONS  
FOR A SMARTER WORLD

# ATTRIBUTION STATEMENT

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