1. **General description**

PTN5110 is a single-port TCPC compliant USB Power Delivery (PD) PHY IC that implements Type-C Configuration Channel (CC) interface and USB PD Physical layer functions to a Type-C Port Manager (TCPM) that handles PD Policy management. It is designed to comply with USB PD [1], Type-C [2] and TCPC [3] specifications. This IC is targeted primarily for use in system platforms (e.g. Notebook PCs, Desktop PCs, Chromebooks, Tablets, Convertibles, etc.). Other use cases may be feasible depending on the application architecture, e.g. docks, monitors, accessories, cable adapters, smartphones etc.

It can support various Type-C roles: Sink, Source, Sink with accessory support or DRP. It implements Type-C CC analog portion (i.e Rd/Rp/Ra detection, Rd/Rp indication) and PD Tx/Rx PHY and protocol state machines as per [3]. PTN5110 supports TCPM in system realization of the following PD roles:

1. Provider (P)
2. Provider/Consumer (P/C)
3. Consumer (C)
4. Consumer/Provider (C/P)

PTN5110 integrates VCONN load switch with programmable current limit, reverse leakage current blocking and Over Temperature Protection (OTP). It implements two enable control outputs for controlling load switches/FETs on VBUS source and/or sink power paths. It also implements VBUS voltage monitoring/measurement, VBUS Force discharge and Bleed discharge features as defined in [3].

PTN5110 provides the majority of relevant IO capability for the host processor/TCPM to easily control and manage the Type-C/PD interface via the TCPC interface:

- **VBUS Power path control of source and sink power rails (EN_SRC, EN_SNK1)**
- Up to four different slave addresses can be selected based on SLV_ADDR
- **ILIM_5V_VBUS** that allows TCPM to set two different current limits on VBUS 5 V Load switch.
- **FRS_EN** that allows for arming 5 V SRC load switch for Fast Role Swap (FRS) support
- **DBG_ACC** that can be used by host TCPM indicate Type-C debug accessory detection

PTN5110 offers tremendous flexibility to platform integrators by supporting a wide range of power supply input voltages. PTN5110 can operate on VBUS to support certain system use cases needing dead battery operation.
PTN5110 is available in HX2QFN16, 2.6 mm x 2.6 mm x 0.35 mm, 0.4 mm pitch.

**Remark:**
1. PTN5110 provides independently controllable pull-up resistor (Rp) implementations on CC1 and CC2 pins.
2. PTN5110 can detect/monitor voltage levels independently on each CC pin.

## 2. Features and benefits

### 2.1 USB PD and Type-C features

- Designed to comply with USB PD[1], USB Type-C [2] and TCPC [3] specifications
- Supports Type-C functionality as per [2][3]
  - Provides CC analog functions: Rp and Rd/GND dynamic indication and Rp/Rd/Ra dynamic detection, debouncing of CC pins, dynamic selection of different Rp/Rd values for CC1 and CC2 independently
  - Implements SNK role pull-down (Rd) behavior to handle dead battery/no power condition
  - Support for Type-C Debug Accessory detection and orientation detection (refer to Appendix of [2]) for Source and Sink Target Systems (TS). Indication of the result via dedicated pin (DBG_ACC) and status registers.
  - Plug orientation detection and indication via status register(s)
  - Supports integrated VCONN switch(es) delivering power to accessory
- Cooperatively work under TCPM control for Type-C Connection/Disconnection Detection, Power Delivery negotiation and contract(s), Alternate mode support, VDM exchanges and any custom functions
  - Implements TCPC functionality as per [3]
  - SOP* Configurable: Register programmable to generate and receive SOP, SOP’, SOP”-debug, SOP”-debug”
  - Supports Extended messaging and Chunking based packet transport
  - VBUS Bleed and Force discharge schemes are implemented as per [3]
  - Implements VCONN discharge on Hard Reset (TCPM Controlled)
  - Implements Fast Role Swap request detection (in 'initial sink' role) and indication (in 'initial source' role)
  - Supports VBUS source/sink power path control
  - Supports Seamless VBUS source voltage transitions among PD voltage rails (e.g. using Load switches - 5 V VBUS source switch - NX5P3290, High Voltage VBUS source switch):
    - For positive voltage transitions, PTN5110 implements make-before-break feature (turn on higher voltage rail first and turn off lower voltage rail after a time duration determined by summation of turn-on time and enable time of higher voltage rail load switch).
    - For negative voltage transitions, PTN5110 disables higher voltage rail load switch initially, performs force discharge and monitors VBUS voltage until stop threshold is reached and enables lower voltage rail load switch when VBUS voltage reaches equal to (or slightly less than) the programmed rail voltage in the TCPC I²C VBUS voltage Alarm register.
For a multi-port system implementation, PTN5110 allows for:
- TCPM initiated VBUS Sink path transitions from one Type-C port to another Type-C port using NXP High voltage sink switch (NX20P5090)
- Single VBUS Sink power path enabling under dead battery (when multiple Type-C ports can provide VBUS 5 V power)

2.2 System protection features
- Back current protection on all pins when PTN5110 is unpowered
- CC pins are 6 V tolerant

2.3 General
- Provides two Power path enable controls: EN_SRC, EN_SNK1
- TCPM Host interface control and status update handled via I^2^C-bus interface.
  Supports I^2^C slave interface standard mode (100 kHz), Fast mode (400 kHz) and Fast mode plus (1 MHz)
- Up to four I^2^C device slave address options selectable via SLV_ADDR pin. This allows for multi-port implementation with PTN5110
- Supports register access: device configuration, control and status/interrupt interfacing through Slave I^2^C-bus conforming to [3]
- Power supply: VDD range (2.7 V to 5.5 V) and VBUS (4 V to 25 V)
  - Tolerant up to 28 V on VBUS (and operational up to maximum of 25 V on VBUS)
- Ambient operating temperature range –40 to 85 °C
- ESD 8 kV HBM, 1 kV CDM
- Package: HX2QFN16, 2.6 mm x 2.6 mm x 0.35 mm, 0.4 mm pitch

3. Applications
- PC platforms: Notebook PCs, Desktop PCs, Ultrabooks, Chromebooks
- Tablets, 2:1 Convertibles, Smartphones and Portable devices
- PC accessories/peripherals: Docking, Mobile Monitors, Multi-Function Monitors, Portable/External hard drives, Cable adaptors, Dongles and accessories, etc.
4. Ordering information

Table 1. Ordering information

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<tr>
<th>Type number</th>
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<th>Application</th>
<th>Package</th>
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<th>Version</th>
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<td>PTN5110HQ[1]</td>
<td>511</td>
<td>Notebook/portable</td>
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<td>SOT1883-1</td>
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<td>PTN5110DHQ[1]</td>
<td>51D</td>
<td>Docking</td>
<td>HX2QFN16</td>
<td>plastic, thermal enhanced super thin quad flat package; no leads; 16 terminals; body 2.6 x 2.6 x 0.35 mm</td>
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</tr>
<tr>
<td>PTN5110THQ[1]</td>
<td>51T</td>
<td>Desktop</td>
<td>HX2QFN16</td>
<td>plastic, thermal enhanced super thin quad flat package; no leads; 16 terminals; body 2.6 x 2.6 x 0.35 mm</td>
<td>SOT1883-1</td>
</tr>
</tbody>
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[1] Total height after printed-circuit board mounting ≤0.5 mm (maximum)

4.1 Ordering options

Table 2. Ordering options

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<th>Type number</th>
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<td>HX2QFN16</td>
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<td>4000</td>
<td>$T_{\text{amb}} = -40 , ^\circ\text{C} \text{ to } +85 , ^\circ\text{C}$</td>
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<tr>
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<td>PTN5110DHQZ</td>
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<td>PTN5110THQ</td>
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<td>HX2QFN16</td>
<td>REEL 7&quot; Q2/T3 *STANDARD MARK SMD</td>
<td>4000</td>
<td>$T_{\text{amb}} = -40 , ^\circ\text{C} \text{ to } +85 , ^\circ\text{C}$</td>
</tr>
</tbody>
</table>
5. Block diagram

Fig 1. Block diagram
6. References

[5] PTN5110 Application Programming guide; contact NXP for more information

Note: PTN5110 silicon has been tested with Ellisys USB PD Compliance Test suite version 3.1.6044. However, the official USB-IF compliance test program (for [1], [2]) and approved compliance test suite are not yet available.

7. Revision history

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<th>Change notice</th>
<th>Supersedes</th>
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8. Legal information

8.1 Data sheet status

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<tr>
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<td>This document contains data from the objective specification for product development.</td>
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<tr>
<td>Preliminary [short] data sheet</td>
<td>Qualification</td>
<td>This document contains data from the preliminary specification.</td>
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<tr>
<td>Product [short] data sheet</td>
<td>Production</td>
<td>This document contains the product specification.</td>
</tr>
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</table>

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term ‘short data sheet’ is explained in section “Definitions”.

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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