



Gowin USB Type-C PD 协议硬件和软件设计 参考手册

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版本信息

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1 关于本手册

1.1 手册内容

Gowin USB Type-C PD 协议硬件和软件设计参考手册主要描述了 USB Type-C Power Delivery 协议架构组成、通信流程、基于 Gowin 平台软硬件设计流程和方法、软件用户接口及软硬件参考设计。主要用于帮助用户快速了解 Gowin USB Type-C PD 的产品特性、特点及使用方法。

1.2 适用产品

本手册中描述的信息适用于以下产品：

1. GW2A 系列 FPGA 产品
2. GW2AR 系列 FPGA 产品

1.3 相关文档

通过登录高云半导体网站 www.gowinsemi.com.cn 可以下载、查看以下相关文档：

1. GW2A 系列 FPGA 产品数据手册
2. GW2AR 系列 FPGA 产品数据手册
3. Gowin 云源软件用户指南

1.4 术语、缩略语

表 1-1 中列出了本手册中出现的相关术语、缩略语及相关释义。

表 1-1 术语、缩略语

术语、缩略语	全称	含义
USB	Universal Serial Bus	通用串行总线
PD	Power Delivery	供电协议
BMC	Bi-Phase Mark Coding	双相标记编码
SOP	Start Of Packet	起始包
CRC	Cyclic Redundancy Check	循环冗余校验

1.5 技术支持与反馈

高云半导体提供全方位技术支持，在使用过程中如有任何疑问或建议，可直接与公司联系：

网址：www.gowinsemi.com.cn

E-mail：support@gowinsemi.com

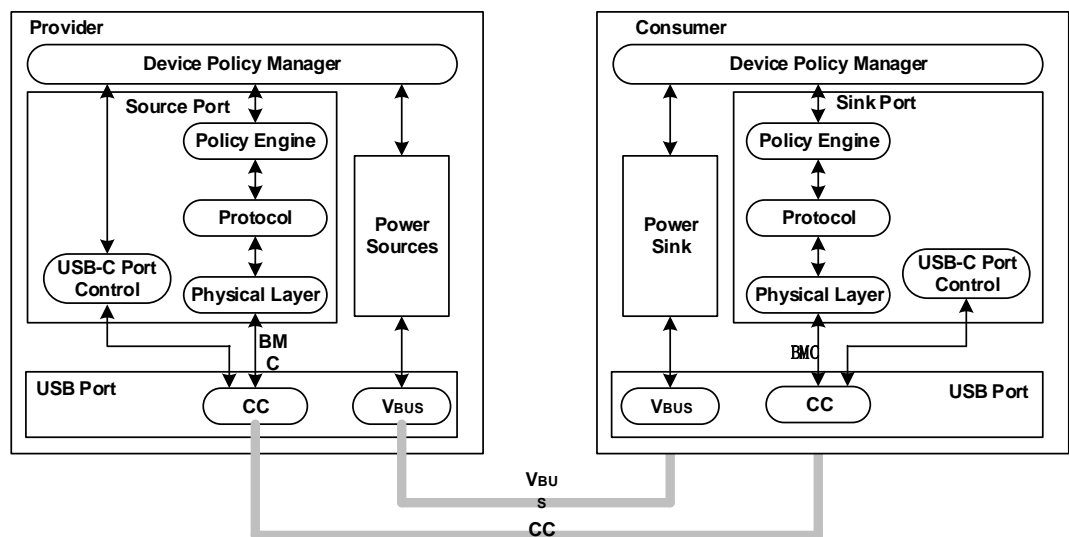
Tel: +86 755 8262 0391

2 USB Type-C PD 协议

2.1 USB Type-C PD 协议架构

USB Type-C Power Delivery 协议架构，如图 2-1 所示。

图 2-1 USB Type-C PD 协议架构



USB Type-C Power Delivery 协议分为：

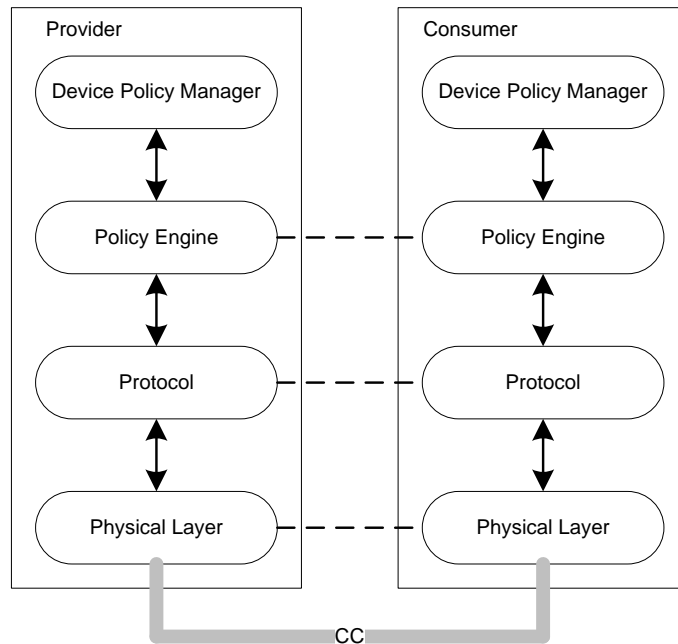
- Provider 发送端
 - Consumer 接收端
- Provider 和 Consumer 分别由以下组成：
- Device Policy Manager
 - Policy Engine
 - Protocol Layer
 - Physical Layer

Provider 和 Consumer 通过 CC 端口数据通信，通过 V_{BUS} 端口供电。

2.2 USB Type-C PD 协议通信流程

USB Type-C Power Delivery 协议数据通信流程，如图 2-2 所示。

图 2-2 USB Type-C PD 协议数据通信流程



Consumer 接收端插上 USB Type-C 设备后，Provider 发送端完成以下流程：

- 检测 Consumer 接收端是否有 USB Type-C 设备插入
- 检测 USB Type-C 接口正反面插入方向
- 初始化供电检测，建立数据通信关系
- V_{BUS} 端口电流检测
- USB Type-C PD 协议通信

2.3 USB Type-C PD 协议

2.3.1 Policy Engine

Policy Engine 层构建通信流程，如表 2-1 所示。

表 2-1 Message Sequence

Message Sequence
Power Negotiation
Reclaiming Power with GotoMin Message
Soft Reset
Hard Reset
Power Role Swap
Fast Role Swap
Data Role Swap
Vconn Swap
Additional Capabilities, Status and Information
Security
Firmware Update

Message Sequence
Structured VDM
Built in Self-Test (BIST)

2.3.2 Protocol layer

Protocol layer 包括三种消息类型：

- Control Message
- Data Message
- Extended Message

Control Message

Control Message 包括的消息类型，如表 2-2 所示。

表 2-2 Control Message 类型

Bits	Message Type
00001	GoodCRC
00010	GotoMin
00011	Accept
00100	Reject
00101	Ping
00110	PS_RDY
00111	Get_Source_Cap
01000	Get_Sink_Cap
01001	DR_Swap
01010	PR_Swap
01011	VCONN_Swap
01100	Wait
01101	Soft_Reset
10000	Not_Supported
10001	Get_Source_Cap_Extended
10010	Get_Status
10011	FP_Swap
10100	Get_PPS_Status
10101	Get_Country_Codes

Data Message

Data Message 包括的消息类型，如表 2-3 所示。

表 2-3 Data Message 类型

Bits	Type
00001	Source_Capabilities
00010	Request
00011	BIST
00100	Sink_Capabilities
00101	Battery_Status

Bits	Type
00110	Alert
00111	Get_Country_Info
01111	Vendor_Defined

Extended Message

Extended Message 包括的消息类型，如表 2-4 所示。

表 2-4 Extended Message 类型

Bits	Type
00001	Source_Capabilities_Extended
00010	Status
00011	Get_Battery_Cap
00100	Get_Battery_Status
00101	Battery_Capabilities
00110	Get_Manufacturer_Info
00111	Manufacturer_Info
01000	Security_Request
01001	Security_Response
01010	Firmware_Update_Request
01011	Firmware_Update_Response
01100	PPS_Status
01101	Country_Info
01110	Country_Codes

2.3.3 Physical Layer

Physical Layer 数据包格式，如图 2-3 所示。

图 2-3 Message Packe

Preamble (training for receive)	SOP*(Start of Packet)	Message Header	Byte 0...n	CRC	EOP(End of Packet)
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Physical Layer 数据包包括：

- Preamble
- SOP*，数据包起始符
- Message Header，消息头信息
- 消息数据信息
- CRC 校验
- EOP，数据包结束符

SOP

SOP 包括的类型，如表 2-5 所示。

表 2-5 SOP 类型

Type	K-code number	K-code
SOP	1	Sync-1
	2	Sync-1
	3	Sync-1
	4	Sync-2

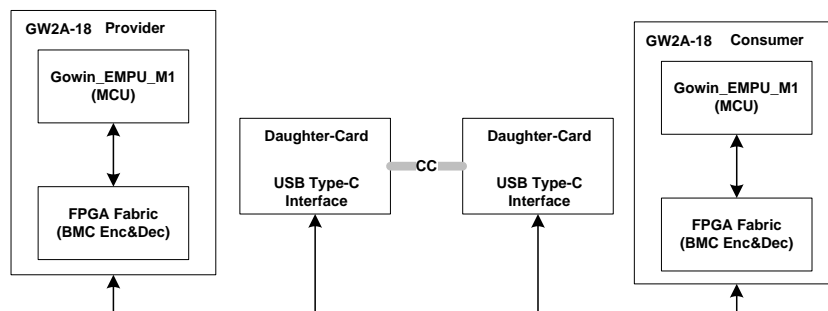
Type	K-code number	K-code
SOP'	1	Sync-1
	2	Sync-1
	3	Sync-3
	4	Sync-3
SOP''	1	Sync-1
	2	Sync-3
	3	Sync-1
	4	Sync-3
SOP''_Debug	1	Sync-1
	2	RST-2
	3	Sync-3
	4	Sync-2
SOP'_Debug	1	Sync-1
	2	RST-2
	3	RST-2
	4	Sync-3
Cable Reset	1	RST-1
	2	Sync-1
	3	RST-1
	4	Sync-3
Hard Reset	1	RST-1
	2	RST-1
	3	RST-1
	4	RST-2

3 Gowin USB Type-C PD 协议设计流程

3.1 硬件设计平台

Gowin USB Type-C PD 协议硬件设计平台，如图 3-1 所示。

图 3-1 Gowin USB Type-C PD 协议硬件设计平台



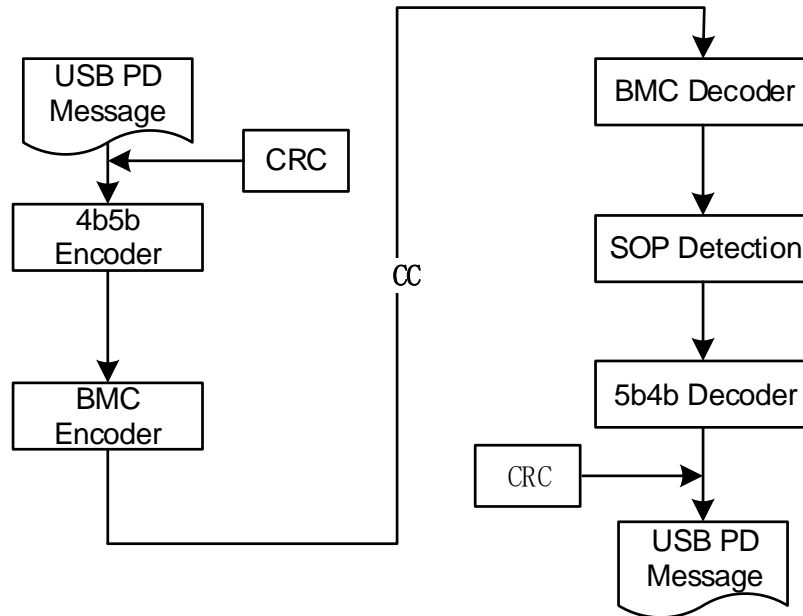
Gowin USB Type-C PD 协议硬件设计平台分为：

- Provider 发送端
 - Consumer 接收端
- Provider 和 Consumer 分别包括：
- GW2A-18 开发板
 - Gowin_EMPU_M1, MCU 软核
 - FPGA Fabric, BMC 编解码
 - Daughter Card 子板
 - USB Type-C 接口及接口电路

3.2 软件设计流程

Gowin USB Type-C PD 协议软件设计流程，如图 3-2 所示。

图 3-2 Gowin USB Type-C PD 协议软件设计流程



Gowin USB Type-C PD 协议软件设计流程包括：

- 生成 USB Type-C PD Message
- Provider 发送端 CRC 校验
- 4b5b 编码
- BMC 编码
- BMC 解码
- SOP 检测
- 5b4b 解码
- Consumer 接收端 CRC 校验
- 解析 USB Type-C PD Message

4 Gowin USB Type-C PD 协议设计实现

Gowin USB Type-C PD 协议设计实现包括：

- Gowin USB Type-C PD 协议硬件设计
- Gowin USB Type-C PD 协议软件设计

4.1 硬件设计

Gowin USB Type-C PD 协议硬件设计实现包括：

- Gowin_EMPU_M1，MCU 软核硬件设计
- BMC 编解码硬件设计

Gowin USB Type-C PD 协议设计发布包提供 Gowin USB Type-C PD 协议硬件设计实现。

4.2 软件设计

Gowin USB Type-C PD 协议软件设计实现包括：

- 生成 USB Type-C PD Message
- Provider 发送端 CRC 校验
- 4b5b 编码
- BMC 编码
- BMC 解码
- SOP 检测
- 5b4b 解码
- Consumer 接收端 CRC 校验
- 解析 USB Type-C PD Message

Gowin USB Type-C PD 协议设计发布包提供 Gowin USB Type-C PD 协议软件设计实现。

5 用户接口

5.1 Provider 用户接口

Provider 用户接口，如表 5-1 所示。

表 5-1 Provider 用户函数接口

Function	Description
type_c_power_negotiation_flow	Power Negotiation Provider is as transmitter and Consumer is as receiver
type_c_vdm_Consumer_flow	Structured VDM Provider is as transmitter and Consumer is as receiver
type_c_vdm_cable_flow	Structured VDM Provider is as transmitter and cable is as receiver
type_c_reclaim_power_flow	Reclaiming Power with GotoMin Message Provider is as transmitter and Consumer is as receiver
type_c_src_soft_reset_flow	Soft Reset Provider is as transmitter and Consumer is as receiver
type_c_src_hard_reset_flow	Hard Reset Provider is as transmitter and Consumer is as receiver
type_c_src_power_role_swap_flow	Power Role Swap Provider is as transmitter and Consumer is as receiver
type_c_src_data_role_swap_flow	Data Role Swap Provider is as transmitter and Consumer is as receiver
type_c_src_vconn_swap_flow	Vconn Swap Provider is as transmitter and Consumer is as receiver
type_c_src_alert_flow	Alert

Function	Description
	Provider is as transmitter and Consumer is as receiver
type_c_snk_capa_flow	Sink Capabilities Provider is as transmitter and Consumer is as receiver
type_c_src_battery_capa_flow	Battery Capabilities Provider is as transmitter and Consumer is as receiver
type_c_src_battery_status_flow	Battery Status Provider is as transmitter and Consumer is as receiver
type_c_src_manufacturer_info_flow	Manufacturer Information Provider is as transmitter and Consumer is as receiver
type_c_cable_plug_manufacturer_info_flow	Manufacturer Information Provider is as transmitter and cable is as receiver
type_c_src_country_code_flow	Country Codes Provider is as transmitter and Consumer is as receiver
type_c_cable_plug_country_code_flow	Country Codes Provider is as transmitter and cable is as receiver
type_c_src_country_info_flow	Country Information Provider is as transmitter and Consumer is as receiver
type_c_cable_plug_country_info_flow	Country Information Provider is as transmitter and cable is as receiver
type_c_src_security_flow	Security Provider is as transmitter and Consumer is as receiver
type_c_cable_plug_security_flow	Security Provider is as transmitter and cable is as receiver
type_c_src_fw_up_flow	Firmware Update Provider is as transmitter and Consumer is as receiver
type_c_cable_plug_fw_up_flow	Firmware Update Provider is as transmitter and cable is as receiver
type_c_Provider_respond_to_Consumer	Provider responds to Consumer's message Provider is as responder and Consumer is as receiver
cc_port_rx_GPIO_Config	Configs RX CC-Port' GPIO
ADC2_Config	Configs ADC2
cc_port_power_on_detection	Detects CC-Port voltage value

5.2 Consumer 用户接口

Consumer 用户接口，如表 5-2 所示。

表 5-2 Consumer 用户函数接口

Function	Description
type_c_snk_soft_reset_flow	Soft Reset Consumer is as transmitter and Provider is as receiver
type_c_snk_hard_reset_flow	Hard Reset Consumer is as transmitter and Provider is as receiver
type_c_snk_power_role_swap_flow	Power Role Swap Consumer is as transmitter and Provider is as receiver
type_c_fast_role_swap_flow	Fast Power Role Swap Consumer is as transmitter and Provider is as receiver
type_c_snk_data_role_swap_flow	Data Role Swap Consumer is as transmitter and Provider is as receiver
type_c_snk_vconn_swap_flow	Vconn Swap Consumer is as transmitter and Provider is as receiver
type_c_snk_alert_flow	Alert Consumer is as transmitter and Provider is as receiver
type_c_src_capa_flow	Source Capabilities Consumer is as transmitter and Provider is as receiver
type_c_src_capa_ext_flow	Source Capabilities Extended Consumer is as transmitter and Provider is as receiver
type_c_snk_battery_capa_flow	Battery Capabilities Consumer is as transmitter and Provider is as receiver
type_c_snk_battery_status_flow	Battery Status Consumer is as transmitter and Provider is as receiver
type_c_snk_manufacturer_info_flow	Manufacturer Information Consumer is as transmitter and Provider is as receiver
type_c_snk_country_code_flow	Country Codes Consumer is as transmitter and Provider is as receiver
type_c_snk_country_info_flow	Country Information Consumer is as transmitter and Provider is as receiver

Function	Description
type_c_snk_security_flow	Security Consumer is as transmitter and Provider is as receiver
type_c_snk_fw_up_flow	Firmware Update Consumer is as transmitter and Provider is as receiver
type_c_Consumer_respond_to_Provider	Consumer responds to Provider's message Consumer is as responder and Provider is as receiver
cc_port_rx_GPIO_Config	Configs RX CC-Port GPIO

6 参考设计

Gowin USB Type-C PD 协议设计发布包提供 Provider 和 Consumer 的硬件参考设计和软件参考设计。

硬件设计与软件设计编译、调试和下载方法参考 Gowin_EMPU_M1 的参考手册。

