Application Note

AN_448

FT4233HP_FT2233HP_FT233HP Configuration Guide

Version 1.3

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Configuration guide for FT4233HP, FT2233HP and FT233HP.

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1 Introduction

The FT4233HP, FT2233HP, and FT233HP are high-speed USB devices with two Type-C ports that include power delivery features. The power delivery functionality offers multiple configurable options, which are described in this document. However, it's important to note that this document only covers power delivery configuration options. For USB configurations please refer to AN_124 User Guide for FTDI FT_PROG Utility.

1.1 Overview

This document provides a description of each configurable option and the corresponding configurable values for each parameter in the EEPROM of the FT4233HP/FT2233HP/FT233HP. The EEPROM is an external component and is only necessary if a custom configuration is required for the design. If the default configuration is suitable, then an EEPROM is not needed. For default values, please refer to the sections below.

1.2 Glossary of Terms

S/N	Term	Description
1	Port 1	The port that has data communication capability and USB enumeration when connected to a host port is referred to as "Port 1" in this document.
2	Port 2 / Charging Port	The second port is referred to as either "Port 2" or "Charging Port" in this document.
3	Sink / Consumer	When the device is drawing power from the host port, it is referred to as being in "Sink" mode or functioning as a "consumer". The device will be in Sink mode when there is no charger connected to the charging port.
4	Source / Provider	When the device supplies power to the host, it is operating in "Source" mode. The device can change from Sink to Source when a charger is attached to the charging port.
5	Pass-through	In pass-through mode, the device will copy the charger power profile and use it as its own source capability on port 1. For example, if the charger attached to the charging port has 20V, 15V, and 5V profiles, then the device will also report 20V, 15V, and 5V on its port 1.
6	Power Role Swap	The process of changing the role is called a role swap. The device can switch the role from Sink to Source if the device is self-powered or when a PD charger is connected to the charging port.

2 Hardware Control Overview

The following image displays a section of the hardware schematic, highlighting various hardware controls such as PS_EN, PD1_LOAD_EN, PD2_LOAD_EN, and other GPIO controls. The following sections explain how to configure these controls using the configuration tool.
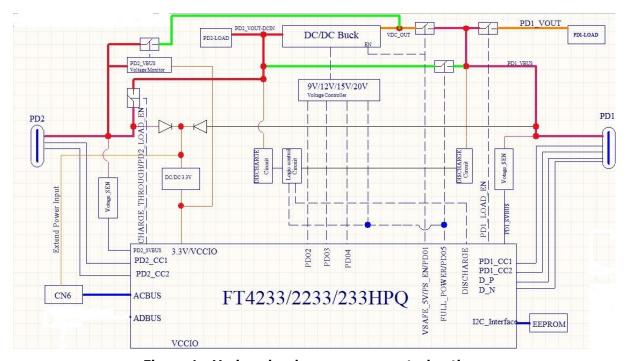

Figure 1 - Various hardware power control options

- **VSAFE_5V / PS_EN / PDO01** – This control enables the 5V power supply.

  PDO2 / PDO3 / PDO4 – These pins correspond to the power supply for their respective Power Delivery Objects (Source PDOs).

- **FULL_POWER / PDO5** – Corresponding to PDO5 or Full power pin in case of pass-through mode. In pass-through mode, the full power pin allows the input power to be passed through to the PD1 port. And PD1 port will be sourcing power.

  Discharge – This pin controls the discharge of VBUS, which safely discharges the bus voltage when necessary.

- **PD1_Load** – This control enables the load switch for **PD1**, allowing power to flow through the first Power Delivery port.

- **PD2_Load / CHARGE_THROUGH** – Similarly, this control enables the load switch for **PD2**, managing power flow through the second Power Delivery port. This pin is also used as charge through in pass-through mode.

  The Load Enable (PD1_Load / PD2_Load) function can drive a status LED or control the load switch circuit used to route VBUS power to the customer's hardware.

3 Configuration Parameters

256 bytes in the configuration EEPROM are reserved for configuration options. **Table 1** gives the information for all the configurable options.

Parameter	Description	Default value	Configurable values
Sink Request Power Role Swap	Sink will initiate a PR SWAP request only if this option is set.	1 – Enabled.	0 – Disabled. 1 – Enabled.
Sink Accept PR Swap	Option to accept PR SWAP when FT4233HP /FT2233HP/FT233HP is a sink. If this option is not set, PR_SWAP request from a source will be rejected	0 – Reject.	0 – Reject. 1 – Accept.
Source Request PR SWAP	When the device is a Source, this option is used to decide whether to swap back to sink when it sees a port2 disconnect event.	0 – Disabled.	0 – Disabled. 1 – Enabled.
Source Accept PR SWAP	When the device is a source, a PR_SWAP request from sink can be accepted or rejected based on this option.	0 – Reject.	0 – Reject. 1 – Accept.
Pass-Through	This is applicable only for the design with 2 type C port. Port2 is a charging port and when pass-through is enabled, the profile used in port2 will be passed on to port1.	1 – Enabled.	0 – Disabled. 1 – Enabled.
External MCU	This is to switch over to external MCU mode.	0 – Internal MCU.	0 – Internal MCU. 1 – External MCU.
PD2 Enable	Enable or disable PD2 (Port2).	1 – Enabled.	0 – Disabled. 1 – Enabled.
PD1 Auto Clock	Auto clock enable / disable. Auto clock feature is explained in section 4.5.	0 – Disabled.	0 – Disabled. 1 – Enabled.
PD2 Auto Clock	Auto clock enable / disable.	0 – Disabled.	0 – Disabled. 1 - Enabled.
Use EFUSE	This option indicates whether to use trim values from EFUSE or not. Keep this enabled always. Configurable option is provided for characterization purpose only.	1 – Use EFUSE.	0 – Do not use EFUSE TRIM. 1 – Use EFUSE TRIM

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Parameter	Description	Default value	Configurable values
FRS	Fast Role Swap	'FRS DISABLED'	'FRS DISABLED' 'Default USB Power' '1.5A@5V' '3A@5V'
FRS Threshold	Voltage drop threshold to trigger the FRS	4680	4680 4368 4056
EXTEND_ISET	Not used by default. In a Sink-only configuration, more pins can be used as ISETS. By enabling this option, it will give more ISETs to choose from.	0	0 – Extended ISET not used. 1 – Extended ISET used.
ISET_PD2	By default, the ISET is applied only for the PD1 (port1) profile. If this bit is set, then all the ISET will be on Port2 (PD2).	0	0 – ISET is applied on PD1. 1 - ISET is applied on PD2.
ISET_ENABLED	bit to enable / disable ISET feature/	1	0 – Disable the ISET feature. All the above ISET fields will be ignored. 1 – ISET Enabled.
GPIO 0	Configuration option for GPIO 0.	'VSAFE_5V'	Please refer to tables Table 3,Table 4 and Table 5 for the available configuration options for each GPIO. If this field is unused, then select 'NA'.
GPIO 1	Configuration option for GPIO 1	'N/A'	Please refer to tables Table 3,Table 4 and Table 5 for the available configuration options for each GPIO. If this field is unused, then select 'NA'.
GPIO 2	Configuration option for GPIO 2	'PD1_LOAD_EN'	Please refer to tables Table 3,Table 4 and Table 5 for the available configuration options for each GPIO. If this field is unused, then select 'NA'.
GPIO 3	Configuration option for GPIO 3	'FULL_POWER'	Please refer to tables Table 3,Table 4 and Table 5 for the

Parameter	Description	Default value	Configurable values
			available configuration options for each GPIO. If this field is unused, then select 'NA'.
GPIO 4	Configuration option for GPIO 4	'CHARGE_THROUGH'	Please refer to tables Table 3,Table 4 and Table 5 for the available configuration options for each GPIO. If this field is unused, then select 'NA'.
GPIO 5	Configuration option for GPIO 5	'DISCHARGE'	Please refer to tables Table 3,Table 4 and Table 5 for the available configuration options for each GPIO. If this field is unused, then select 'NA'.
GPIO 6	Configuration option for GPIO 6	'ISET3'	Please refer to tables Table 3,Table 4 and Table 5 for the available configuration options for each GPIO. If this field is unused, then select 'NA'.
GPIO 7	Configuration option for GPIO 7	'N/A'	Please refer to tables Table 3,Table 4 and Table 5 for the available configuration options for each GPIO. If this field is unused, then select 'NA'.
Sink PDO1	Voltage and current profile for PDO1. Typically, PDO1 is vSafe5.	Voltage in 1mV Unit – 5000 (5V). And in 50mV Steps. Current in 1mA Unit – 3000 (3A), 10mA Steps.	Voltage – 5000 (5V) Current – (0-5000) (0-5A)
Sink PDO2	Voltage and current profile for PDO2.	0	0 Means this profile is not used. User is allowed to configure the profile to any valid voltage / current value without conflicting. A valid profile is a unique profile (Same voltage profile as

Parameter	Description	Default value	Configurable values
			another PDO not allowed – Also the profiles should be in the descending order of voltage).
Sink PDO3	Voltage and current profile for PDO3.	0	Same as above.
Sink PDO4	Voltage and current profile for PDO4.	0	Same as above.
Sink PDO5	Voltage and current profile for PDO5.	0	Same as above.
Sink PDO6	Voltage and current profile for PDO6.	0	Same as above.
Sink PDO7	Voltage and current profile for PDO7.	0	Same as above.
Source PDO1	Voltage and current profile for PDO1. Typically, PDO1 is vSafe5.	Voltage in 1mV Unit – 5000 (5V). And in 50mV Steps. Current in 1mA Unit – 3000 (3A), 10mA Steps.	Voltage – 5000 (5V) Current – (0-5000) (0-5A)
Source PDO2	As default setting is pass-through, the values populated for these PDOs are based on charger capabilities.

However, these fields can be populated with proper PDO settings if pass through is disabled. | Pass-through | |
Source PDO3		Pass-through	
Source PDO4		Pass-through	
Source PDO5		Pass-through	
Source PDO6		Pass-through	
Source PDO7		Pass-through	
Sink2 PDO1	Voltage and current profile for PDO1. Typically, PDO1 is vSafe5.	Voltage in 1mV Unit – 5000 (5V). And in 50mV Steps. Current in 1mA Unit – 3000 (3A), 10mA Steps	Voltage – 100 (5V) Current – (0-500) (0-5A)
Sink2 PDO2	Pass-through	Pass-through	
Sink2 PDO3		Pass-through	
Sin2 PDO4		Pass-through	
Sink2 PDO5		Pass-through	
Sink2 PDO6		Pass-through	
Sink2 PDO7		Pass-through	

Parameter	Description	Default value	Configurable values
I2C Address	Used for External MCU.	32 (0x20)	Any Valid address.
Power Reserved for OWN use	Power reserved for own use. When Pass-through option is on, instead of doing a real pass through, some power can be reserved for the internal power consumption. So this field takes an input in milli-watts and source capabilities will be advertised with updated current after taking the internal power consumption into account.	Power reserved in milli-watts (mW) 2500	Min – 0. Max – 65535 (65watts).
TRIM1	Do not use this in Production. Set to 0. Used for characterization only.	0	
TRIM2	Do not use this in Production. Set to 0. Used for characterization only.	0	
External DC	This option indicates the device is self-powered and has a fixed External power supply. If the device is externally powered, then power role swap can be supported. Use this option to indicate externally powered device.	UNCHECK	CHECKBOX

Table 1 - Configuration Parameters

4   Configuration Descriptions

4.1 Power Role Swap Options

There are four configurable options for power role swaps:

1. Sink Request Power Role (PR) Swap:

When enabled, the sink initiates a power role swap request. It uses the connection status of Port 2 to determine whether to initiate a power role swap. Port 2 must be connected to a PD charger with a valid PD contract negotiated for the swap to occur. If this option is not enabled, Port 1 will remain as a sink even if Port 2 has a valid PD contract.

2. Sink Accept PR Swap:

If the device is receiving a PR_SWAP request from the source, the sink can either reject it or accept it based on this option. This option should be set only if the device is externally powered through a DC power or through Port 2.

3. Source Request PR SWAP:

The device, initially a sink, can only become a source through PR_SWAP. Once the PR_SWAP is successful, the device switches to source. If this option is set, the device can go back to sink if it detects a disconnect on Port 2. However, there is no guarantee that the device can successfully go back to sink, as it may lose power and undergo a power cycle.

4. Source Accept PR SWAP:

Similar to the above case, the device (source) can go back to sink if the current sink requests a PR_SWAP. Whether to accept the request or not is based on this option.

4.2 Pass-Through

When this option is set, the PD Source capabilities of the charger connected to Port2 will be passed to Port1 and the same profile will appear on Port 1.

4.3 External MCU

The device comes with a default Type-C and PD state machine. If the features provided by this internal state machine do not meet the customer's requirements, the customer has the option to implement their own state machines and additional features using the I2C slave interface available on the Customer MCU.

When using such solution, this "External MCU" option should be set if there is an EEPROM available. If no EEPROM, then GPIO_0, GPIO_1 can be pulled high to indicate the same.

4.4 PD2 Enable

If the second port is not required in the design, it can be disabled to reduce the power consumption.

4.5 PD1 Auto Clock / PD2 Auto Clock

To save power, the clock can be turned off for both PD1 and PD2 when there is no activity. With the auto clock option enabled, the clock will be automatically turned on whenever there is an activity and then turned off after the activity ends.

4.6 Use EFUSE

The trimming process utilizes trim values stored in the EFUSE. When this option is set to 0, the trim values are not retrieved from EFUSE, and instead, the TRIM1/TRIM2 values from EEPROM are used.

4.7 FRS

This option allows you to enable or disable Fast Role Swap (FRS). The device can quickly switch from a source to a sink. When this option is enabled, the device can switch back to the sink without causing a disconnection on the USB interface.

4.8 FRS Threshold

This option takes the threshold voltage for the FRS. The default is 4680mV. When the voltage drops below this level triggers an FRS.

4.9 ISET

The ISET pins indicate the available power profiles. By default, there are three options: ISET1, ISET2, and ISET3. However, enabling the EXTEND_ISET option will make more ISET pins available. The table below shows the ISET options.

ISET Pin	Meaning	Remarks
ISET1	TYPE-C 5V 1P5A Profile	Optional.
ISET2	TYPE-C 5V 3A Profile	Optional.
ISET3	PDO1 Profile	Typically, 5V3A profile. If 5V3A, then ISET2 can be left unassigned so that FT_Prog will internally make ISET2 same as ISET3.
ISET4	PDO2 Profile	Available in Sink-only use case when the EXTEND_ISET option is set in the configuration.
ISET5	PDO3 Profile	Available in Sink-only use case when the EXTEND_ISET option is set in the configuration.
ISET6	PDO4 Profile	Available in Sink-only use case when the EXTEND_ISET option is set in the configuration.
ISET7	PDO5 Profile	Available in Sink-only use case when the EXTEND_ISET option is set in the configuration.
ISET8	PDO6 Profile	Available in Sink-only use case when the EXTEND_ISET option is set in the configuration.
ISET9	PDO7 Profile	Available in Sink-only use case when the EXTEND_ISET option is set in the configuration.

Table 2 - ISET Options

4.10 EXTEND_ISET

When the device is in sink-only mode, more GPIO pins are available for use as ISET. As seen in the figure below, more ISET pins are in the GPIO dropdown list.
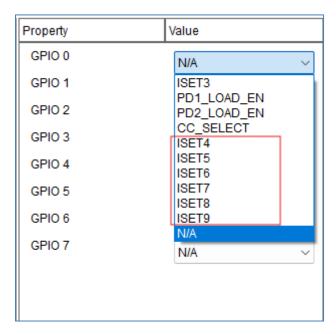

Figure 2 - GPIO Dropdown shows more ISET options when EXTEND_ISET is enabled

4.11 ISET_PD2

By default, the ISET pins indicate the port1 (PD1) profile selection. However, this behavior can be changed to indicate the profile for port2 by selecting ISET_PD2. The ISET pin indication will be based on the PD2 profile.

4.12 ISET_ENABLED

All ISET-related fields are valid only when this field is enabled. Instead of modifying multiple ISET fields, this single enable/disable option helps manage the ISET feature.

4.13 GPIO 0 to GPIO 7

These are the 8 configurable GPIOs. Depending on the configuration options, such as sink-only device, pass-through, or non-pass-through (dual-role mode), these pins can be configured to use any of the options from the table below.

Sink-only Configuration	
Options	**Description**
ISET1	TypeC 5V 1P5A Profile
ISET2	TypeC 5V 3A Profile
ISET3	PDO1 Profile (5V3A)
PD1_LOAD_EN	PD1 Load Enable Pin

Sink-only Configuration	
Options	**Description**
PD2_LOAD_EN	PD2 Load Enable Pin
CC_SELECT	CC Selector Indicator
ISET4	PDO2 Profile
ISET5	PDO3 Profile
ISET6	PDO4 Profile
ISET7	PDO5 Profile
ISET8	PDO6 Profile
ISET9	PDO7 Profile

Table 3 - Options for Sink-only Configuration

Pass-Through	
Options	**Description**
ISET1	TypeC 5V 1P5A Profile
ISET2	TypeC 5V 3A Profile
ISET3	PDO1 Profile (5V3A)
PD1_LOAD_EN	PD1 Load Enable Pin
PD2_LOAD_EN	PD2 Load Enable Pin
DISCHARGE	Discharge Pin
CC_SELECT	CC Selector Indicator
VSAFE_5V	Internal 5V generator switch control
CHARGE_THROUGH	Charge through pin
FULL_POWER	Pin to enable full power. Refer to Figure 1 to understand the FULL_POWER path in the design.

Table 4 - Options for Pass-Through Configuration

Non-Pass Through	
Options	**Description**
ISET1	TypeC 5V 1P5A Profile
ISET2	TypeC 5V 3A Profile
ISET3	PDO1 Profile (5V3A)
PD1_LOAD_EN	PD1 Load Enable Pin
PD2_LOAD_EN	PD2 Load Enable Pin
DISCHARGE	Discharge Pin
CC_SELECT	CC Selector Indicator
PS_EN	Power Supply Enable Pin, also supplies 5V which is PDO1 Source Profile
P1	Source Pin for PDO2
P2	Source Pin for PDO3
P3	Source Pin for PDO4

Non-Pass Through	
Options	**Description**
P4	Source Pin for PDO5
P5	Source Pin for PDO6
P6	Source Pin for PDO7

Table 5 - Options for Non-Pass-Through / Dual Role Mode.

The figure below illustrates an example of GPIO configuration for pass-through mode. CHARGE_THROUGH and FULL_POWER options can be selected and assigned to GPIOs, as shown below.
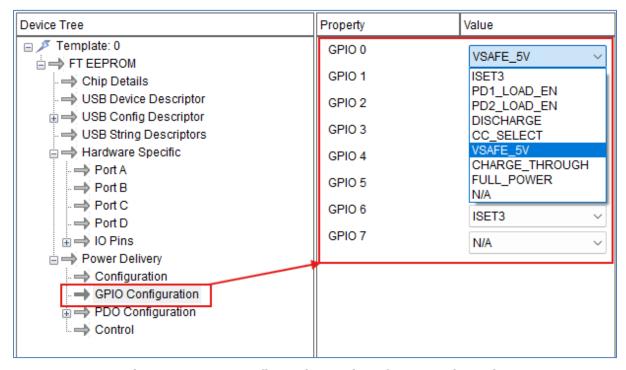

Figure 3 - GPIO Configuration options for Pass-Through

For non-pass-through cases, when the pass-through option in the configuration is unchecked, the GPIO Configuration will display different options. The screenshot below illustrates how it looks. These options can be utilized in dual role mode to support various source PDOs. These options are explained in Table 5 - Options for Non-Pass-Through / Dual Role Mode.

Figure 4 - GPIO Options for Non-Pass-Through Mode

For a sink-only use case, the extended ISET option can select additional pins as ISET.
To put the device in sink-only mode, the power swap options should be disabled. The picture below shows the various options available in this use case.

Figure 5 - ISET Options

4.14 Sink PDO [1:7]

Option to select Voltage and Current Profile for Sink PDO1.

Corresponding to every PDO option, there is a field to input the voltage and a field to input the current in FT_PROG. Please input the voltage and current here for the PDO.

The lowest voltage profile should be PDO1 and the second lowest should be PDO2 and so on. Basically, the PDO profile should be in ascending order with respect to the voltage.

4.15 Source PDO [1:7]

Option to select Voltage and Current Profile for Source PDO1.

Corresponding to every PDO option, there is a field to input the voltage and a field to input the current in FT_PROG. Please input the voltage and current here for the PDO.

The lowest voltage profile should be PDO1 and the second lowest should be PDO2 and so on. Basically, the PDO profile should be in ascending order with respect to the voltage.

4.16 Sink2 PDO [1:7]

Option to select Voltage and Current Profile for Port2 Sink PDO1.

Corresponding to every PDO option, there is a field to input the voltage and a field to input the current in FT_PROG. Please input the voltage and current here for the PDO.

The lowest voltage profile should be PDO1 and the second lowest should be PDO2 and so on. Basically, the PDO profile should be in ascending order with respect to the voltage.

4.17 I2C Address

This is used for the case of an external MCU. The I2C address will default to 0x20 if this is not specified.

4.18 Power Reserved for OWN use

In pass-through mode, instead of passing through the actual charger profile to Port1, the device may reserve some power for its own power consumption.

This field is in milli-watts. Default value is 2500 (reserves 2.5watts – 5V500mA for internal use).

4.19 TRIM1

For Debug purpose only - Usually the TRIM values are taken from EFUSE. However, EFUSE can be overridden using this field.

4.20 TRIM2

For Debug purpose only - Usually the TRIM values are taken from EFUSE. However, EFUSE can be overridden using this field.

4.21 External DC

Even though the device has 2 Type-C ports, the device can still be externally powered through a DC power supply. In this case, Power Role Swap can be supported on Port1 without using any Port2 connections. This configuration option can be set to initiate a power role swap request to switch over the role to source. Also, Sink Request power role swap option should be set along with this.

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Distributor and Sales Representatives

Please visit the Sales Network page of the FTDI Web site for the contact details of our distributor(s) and sales representative(s) in your country.

Appendix A – References

Document References

AN_124 User Guide for FTDI FT_PROG Utility

FT_PROG

https://usb.org/sites/default/files/USB%20Power%20Delivery_1.zip

USB High Speed Series ICs

Acronyms and Abbreviations

Terms	Description
BM	Bit Map
BOS	Binary Object Store
GPIO	General Purpose Input Output
PD	Power Delivery
PDO	Power Delivery Object
PR SWAP	Power Role Swap.
USB	Universal Serial Bus
USB-IF	USB Implementers Forum

Appendix B – List of Tables & Figures

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Appendix C – Revision History

Document Title: AN_448 FT4233HP_FT2233HP_FT233HP Configuration Guide

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Product Page: USB High Speed Series ICs

Document Feedback: Send Feedback

Revision	Changes	Date
1.0	Initial Release.	30-04-2020
1.1	Updated release (Support for FT233HP).	12-08-2020
1.2	Removed Power Management Options Updated ISET section to reflect new ISET change for legacy cable Removed BOS descriptor related sections (USB Minor Versions EXT Capability, Min and Max Power) Added CC Indication option Added External DC option.	06-05-2021
1.3	Updates for improved user experience in FT_Prog. FT_Prog has been updated with a simpler GPIO configuration, and the document has been updated to reflect the same. Bitmap options and GPIO multiplexing have been removed. Added tables for various GPIO configurations. Added example screenshots of FT_Prog.	14-02-2025