Application Note

AN_551

FT4232HP/FT2232HP/FT232HP Configuration Guide

Version 1.1

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Configuration guide for FT4232HP, FT2232HP, and FT232HP

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1 Introduction

The FT4232HP/FT2232HP/FT232HP are high speed USB devices with Type-C power delivery features. Within the power delivery functionality there are multiple configurable options available, and this document describes all the configurable options. The configuration options covered in this document only cover the power delivery configuration. For USB configurations, please refer to AN 124 User Guide For FTDI FT_Prog Utility.

1.1 Overview

This document describes each configurable option and the configurable values of each parameter in the EEPROM of the FT4232HP/FT2232HP/FT232HP. The EEPROM is external, and it is needed only if the design needs a custom configuration. If the default configuration is sufficient then there is no need to have an external EEPROM. For default values, please refer to the sections below.

1.2 Glossary of Terms

SI. No.	Term	Description
1	Sink / Consumer	When the device is consuming power from the host port, the device is said to be in "Sink" mode or device is said to be a "consumer".
2	Source / Provider	When the device is supplying power to the host, then the device is operating in "Source" mode. The device can change the role from Sink to Source if the device is self-powered and power role swap is enabled in the configuration.
3	Power Role Swap	The process of changing the role is called role swap. The device has the capability to switch the role from Sink to Source if the device is self-powered.

2 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. Default settings do not support PR SWAP. However, if the device is self-powered, then PR SWAP can be supported by modifying the configurations.	0 – Disabled.	0 – Disabled. 1 – Enabled.
Sink Accept PR Swap	Option to accept PR SWAP when FT4232HP /FT2232HP/FT232HP 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.
vConn Swap	Option to enable vConn swap support.	0 – Reject	0 – Reject 1 – Accept
External MCU	This is to switch over to external MCU mode.	0 – Internal MCU.	0 – Internal MCU. 1 – External MCU.
PD Auto Clock	Auto clock enable / disable. Auto clock feature is explained in section 2.4.	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
GPIO Count	PD Source uses GPIOs to control the power supplies. This option indicates how many GPIOs are used for power supply control.	0	0 – 3
GPIO Number1	GPIO number for power supply control. GPIO can also be used as an ISET in case of sink only configuration.	'NA'	Following options are available as a dropdown list in FT_PROG. Values 0 – 3, A Text 'NA'. Select the appropriate GPIO value for this

Parameter	Description	Default value	Configurable values
			option. And if this field is unused, then select 'NA'.
GPIO Number2	GPIO number for power supply control. GPIO can also be used as an ISET in case of sink only configuration.	'NA'	Following options are available as a dropdown list in FT_PROG. Values 0 – 3, A Text 'NA'. Select the appropriate GPIO value for this option. And if this field is unused, then select 'NA'.
GPIO Number3	GPIO number for power supply control. GPIO can also be used as an ISET in case of sink only configuration.	'NA'	Following options are available as a dropdown list in FT_PROG. Values 0 – 3, A Text 'NA'. Select the appropriate GPIO value for this option. And if this field is unused, then select 'NA'.
GPIO Number4	GPIO number for power supply control. GPIO can also be used as an ISET in case of sink only configuration.	'NA'	Following options are available as a dropdown list in FT_PROG. Values 0 – 3, A Text 'NA'. Select the appropriate GPIO value for this option. And if this field is unused, then select 'NA'.
PD Load Enable	GPIO number configured with load enable switch for PD	2	Following options are available as a dropdown list in FT_PROG. Values 0 – 3, A Text 'NA'. Select the appropriate GPIO value for this option. And if this field is unused, then select 'NA'.

Parameter	Description	Default value	Configurable values
Discharge Pin	GPIO to enable the discharge circuit	'NA'	(Should not be same as any of the GPIO Number1 to Number4 value). Following options are available as a dropdown list in FT_PROG. Values 0 – 3, A Text 'NA'. Select the appropriate GPIO value for this option. And if this field is unused, then select 'NA'.
Discharge Enable BM	GPIO bitmap to enable the discharge circuit	1 – drive high	Following options are available in the dropdown list of FT_PROG. Drive Low Drive Hi Input Mode. Don't Care.
Discharge Disable BM	GPIO bitmap to disable the discharge circuit	0 – drive low	Following options are available in the dropdown list of FT_PROG. Drive Low Drive Hi Input Mode. Don't Care.
CC Indication	Option to indicate CC Orientation through a GPIO	Not Selected in Default Configuration	(Should not be same as any of the GPIO Number1 to Number7 value). Following options are available as a dropdown list in FT_PROG. Values 0 – 3, A Text 'NA'. Select the appropriate GPIO value for this option. And if this field is unused, then select 'NA'.
ISET1	GPIO Number. State of the GPIO is used to indicate which sink profile is used. ISET1 is to indicate the case non-PD TYPEC_1.5A attachment.	1	Any GPIO number based on the board design can be used. Any GPIO value 0 – 3 can be used as long as these pins

Parameter	Description	Default value	Configurable values
			are not used for any other purpose. If the PCB design supports PD Source, then do not use the pins reserved for source as ISET.
ISET2	GPIO Number. State of the GPIO is used to indicate which sink profile is used. ISET2 is to indicate the case non-PD TYPEC_3A attachment.	3	Any GPIO number based on the board design can be used. Any GPIO value 0 – 3 can be used as long as these pins are not used for any other purpose. If the PCB design supports PD Source, then do not use the pins reserved for source as ISET.
ISET3	GPIO Number. State of the GPIO is used to indicate which sink profile is used. ISET3 is to indicate PD profile 1 (5V3A).	3	Any GPIO number based on the board design can be used. Any GPIO value 0 – 3 can be used as long as these pins are not used for any other purpose. If the PCB design supports PD Source, then do not use the pins reserved for source as ISET.
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_BM_PDO1(vSafe5v)	There are two cases for 5V. They are typically the same however, in case there is a difference, this option is for PDO_1. 1. 5V after PD contract negotiation. 2. vSafe5V during PR_SWAP before negotiating high power. In case the GPIO mapping for these two are not same, then please use the mapping for case 2 using the vSafe5V	'Don't Care'	For each GPIO, following options are available as a dropdown list in FT_PROG. Drive High Drive Low. Input Mode. Don't Care.

Parameter	Description	Default value	Configurable values
	option (another option available).		
GPIO_BM_PDO2	GPIO Bitmap for PDO2	'Don't Care'	Drive High Drive Low Input Mode. Don't Care.
GPIO_BM_PDO3	GPIO Bitmap for PDO3	'Don't Care'	Drive High Drive Low. Input Mode. Don't Care.
GPIO_BM_PDO4	GPIO Bitmap for PDO4	'Don't Care'	Drive High Drive Low. Input Mode. Don't Care.
vSet0V	Settings to set 0V (Turn off all supplies)	'Don't Care'	Drive High Drive Low Don't Care.
vSafe5V	vSafe5V – used in case vSafe5V is not same as the 5V at PDO1. (can be different power – as vSafe5V is before negotiation)	'Don't Care'	Drive High Drive Low Don't Care.
Sink PDO1	Voltage and current profile for PDO1. Typically, PDO1 is vSafe5.	Voltage in 1mv Unit – 5000 (5v). Current in 1ma Unit – 3000 (3A)	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 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.

Parameter	Description	Default value	Configurable values
Source PDO1	Voltage and current profile for PDO1. Typically, PDO1 is vSafe5. Default Setting does not have source capability.	Voltage in 1mv Unit – 5000 (5v). And in 50mV Steps. Current in 1ma Unit – 300 (3A), 10mA Steps.	Voltage – 5000 (5V) Current – (0-5000) (0-5A)
Source PDO2	Default Setting does not have source capability.	Voltage in 50mv Unit – 0. Current in 10ma Unit – 0	
Source PDO3	Default Setting does not have source capability.	Voltage in 50mv Unit – 0. Current in 10ma Unit – 0	
Source PDO4	Default Setting does not have source capability.	Voltage in 50mv Unit – 0. Current in 10ma Unit – 0	
Sender Response Timer	tSenderResponse timer in the PD Spec Rev3.0.	27ms (all the timer values are in milli-seconds)	Any Value within Spec.
Hard Reset Timer	tPSHardReset timer in the PD Spec Rev3.0.	30ms	Any Value within Spec.
Source Capability Timer	tTypeCSendSourceCap timer in the PD Spec Rev3.0.	190ms	Any Value within Spec.
Discover Identity Timer	tDiscoverIdentity timer in the PD Spec Rev3.0.	45ms	Any Value within Spec.
Source Recover Timer	tSrcRecover timer in the PD Spec Rev3.0.	750ms	Any Value within Spec.
Transition Timer	tPSTransition timer in the PD Spec Rev3.0.	500ms	Any Value within Spec.
Source off timer	tPSSourceOff timer in the PD Spec Rev3.0.	890ms	Any Value within Spec.
No Response Timer	tNoResponse timer in the PD Spec Rev3.0.	4000ms	Any Value within Spec.
Sink Wait Capability Timer	tTypeCSinkWaitCap timer in the PD Spec Rev3.0.	465ms	Any Value within Spec.
Sink Activity Timer	tSinkActivity timer in the PD Spec. However, this timer is not used as it is not required in type-c 1.2+.	135ms	Any Value within Spec.
Sink Request Timer	tSinkRequest timer in the PD Spec.	110ms	Any Value within Spec.
Discharge Timer	Internal timer used to keep the discharge circuit on. During PR_SWAP and also during Source Voltage transition, discharge circuit	100ms	Any value based on the discharge circuit design.

Parameter	Description	Default value	Configurable values
	will be turned on for the duration mentioned in this timer.		
Chunk not supported timer	tChunkingNotSupported timer in the PD Spec Rev 3.0.	40ms	Any Value within Spec.
I2C Address	Used for external MCU.	32 (0x20)	Any Valid address.
TRIM1	Do not use this in production. Set to 0.	0	
TRIM2	Do not use this in Production. Set to 0.	0	
External DC	This option indicates the device is self-powered and has a fixed External power supply. FT4232HP/FT2232HP/FT232HP does not support power role swap in its default settings as role swap feature needs a power supply. So, 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

2.1 Power Role Swap Options

There are four different combinations for power role swap. And these are the four configurable options available.

- Sink Request Power Role (PR) Swap

  When this option is set, sink initiates a power role swap request if the device is self-powered. The "External DC" option indicates if the device is self-powered.

- Sink Accept PR Swap

  In case the device receives a PR_SWAP request from the source, 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 supply.

- Source Request PR SWAP

  This option is not applicable to single port devices.

- Source Accept PR SWAP

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

2.2 vConn Swap

When this option is set, the device will do a vConn Swap every time it changes the power role.

2.3 External MCU

By default, Internal MCU will be active. If the design is using an external MCU instead of FT4232HP internal MCU, the customer needs to indicate this through a bit in the configuration. Select the "External MCU" Option to enable external MCU. Once this bit is set, the internal MCU won't be active.

If the design does not have an EEPROM and still needs an External MCU, then both GPIO_0 and GPIO_1 of FT4232HP can be pulled high to achieve this. This has the same behavior as setting the External MCU bit.

2.4 PD Auto Clock

To aid in power saving, the clock can be turned off to the PD device when there is no activity. With auto clock option enabled, the clock will turn on whenever there is any activity to the PD device and will turn off after the activity.

2.5 Use EFUSE

The PD device has an internal EFUSE block, and its size is 64bits. This EFUSE is programmed during the IC characterization time, and it is one time programmable. The value programmed in this block is used by the software to program bandgap voltage, pull up current, pull down resistance etc. "Use EFUSE" option is enabled by default. Software uses the EFUSE value only if this option is enabled. For debugging purpose this option can be disabled but not recommended to disable it for production.

2.6 GPIO Count

By default, FT4232HP/FT2232HP/FT232HP does not support power role swap and source operation. However, if the device is self-powered then it is possible to do role swap. When the device is a source, it uses GPIOs to manage the power supplies. There can be multiple GPIOs to control multiple power sources (5V, 9V, 15V etc.). The total number of GPIOs used to control the power supplies should be defined in this field.

FT4232HP/FT2232HP/FT232HP has a total of 4 GPIO Pins. So, the valid value for this field is 0 to 3. When the FT4232HP/FT2232HP/FT232HP is configured as a sink only device, set this field to 0. Since the number of GPIOs available is only 4, maximum profiles can be supported are only 4.

2.7 GPIO Number1 – 4

This field represents the GPIO pins used for controlling the power supply. In case there are three GPIO pins used, then GPIO Number 1 to GPIO Number 3 will indicate those three pins.

2.8 PD Load Enable

GPIO Pin is used to enable the PD load.

2.9 Discharge Pin

This indicates the GPIO Pin used for enabling and disabling the discharge circuit.

2.10 Discharge Enable BM

A 2-bit bitmap indicates how to enable discharge circuit.

This can be one of the following values. FT_PROG gives these options as a dropdown list and hence the user does not need to know the bitmap.

- Drive High
- Drive Low
- Input Mode.
- Don't Care (This means, this pin is not used).

2.11 Discharge Disable BM

A 2-bit bitmap indicates how to disable discharge circuit.

This can be one of the following values. FT_PROG gives these options as a dropdown list and hence the user does not need to know the bitmap.

- Drive High
- Drive Low
- Input Mode.
- Don't Care (This means, this pin is not used).

2.12 ISET

There are three ISET options by default. ISET1, ISET2 and ISET3.

These pins are used to indicate the power profile being used when the device is a sink. Even though there are 3 ISET options by default, ISET feature for legacy cable has been disabled. That is, TYPE-C 1.5A (ISET1) and TYPE-C 3A (ISET2) feature has been disabled and hence only ISET3 (PD MODE) can be used.

These are the GPIO pins.

ISET1 – Type-C 1.5A Attached. (No PD) - Feature has been disabled currently.
ISET2 – Type-C 3A Attached – 5V3A. (No PD) - Feature has been disabled currently.
ISET3 – PD. 5V, 3A profile.

In case more than three ISETs are needed, it is possible to configure more than three if the device is used in sink only configuration. In sink only configuration, GPIOs reserved for source power supply control are not needed hence those pins can be used as ISETs.

To do this, set the option "EXTEND_ISET" (described in below sections).

2.13 ISET_ENABLED

All the ISET related fields are valid only if this field is enabled. Instead of changing multiple ISET fields, this single enable / disable option helps to enable / disable the ISET feature.

2.14 GPIO_BM_PDO1 (vSafe5v)

GPIO Bitmap to select Source PDO1. The bitmap indicates the combination of the GPIOs state used to get the selected profile.

For example, for PD01, GPIO0 – Drive Hi, GPIO1 – Drive Hi, GPIO2 – Don't Care (NA).

These options are available as a table in FT_PROG and the states of the GPIO as dropdown list.

2.15 GPIO_BM_PDO2

GPIO Bitmap to select Source PDO2. The bitmap indicates the combination of the GPIOs state used to get the selected profile.

For example, GPIO0– Drive Hi, GPIO1 – Drive Hi, GPIO2 – Don't Care (NA).

These options are available as a table in FT_PROG and the states of the GPIO as dropdown list.

2.16 GPIO_BM_PDO3

GPIO Bitmap to select Source PDO3. The bitmap indicates the combination of the GPIOs state used to get the selected profile.

For example, GPIO0 – Drive Hi, GPIO1 – Drive Hi, GPIO2 – Don't Care (NA).

These options are available as a table in FT_PROG and the states of the GPIO as dropdown list.

2.17 GPIO_BM_PDO4

GPIO Bitmap to select Source PDO4. The bitmap indicates the combination of the GPIOs state used to get the selected profile.

For example, GPIO0 – Drive Hi, GPIO1 – Drive Hi, GPIO2 – Don't Care (NA).

These options are available as a table in FT_PROG and the states of the GPIO as dropdown list.

2.18 vSet0V

GPIO Bitmap to set 0V. The bitmap indicates the combination of the GPIOs state used to get the selected profile.

For example, GPIO0 – Drive Low, GPIO1 – Drive Low, GPIO2 – Don't Care (NA).

These options are available as a table in FT_PROG and the states of the GPIO as dropdown list.

2.19 vSafe5V

GPIO Bitmap to select vSafe5. This can be same as PDO1 too. The bitmap indicates the combination of the GPIOs state used to get the selected profile.

For example, GPIO0 – Drive Hi, GPIO1 – Drive Hi, GPIO2 – Don't Care (NA).

These options are available as a table in FT_PROG and the states of the GPIO as dropdown list.

2.20 Sink PDO [1:7]

Option to select Voltage and Current Profile for Sink PDO1.

Corresponding to every PDO option, there is a voltage dropdown box and a current dropdown box in FT_PROG. Please select the voltage and current from this list 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.

2.21 Source PDO [1:4]

Option to select Voltage and Current Profile for Source PDO1.

Corresponding to every PDO option, there is a voltage dropdown box and a current dropdown box in FT_PROG. Please select the voltage and current from this list 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.

2.22 Sender Response Timer

This option is to configure the *tSenderResponse* timer. Please refer to the PD spec for *tSenderResponse* timer details. Timer units are in milliseconds.

2.23 Hard Reset Timer

This option is to configure the *tPSHardReset* timer. Please refer to the PD spec for *tPSHardReset* timer details. Timer units are in milliseconds.

2.24 Source Capability Timer

This option is to configure *tTypeCSendSourceCap* timer. Please refer to PD Spec for more details on *tTypeCSendSourceCap* timer. Timer units are in milliseconds.

2.25 Discover Identity Timer

This option is to configure the *tDiscoverIdentity* timer. Please refer to the PD Spec for more details on *tDiscoverIdentity* timer. Timer units are in milliseconds.

2.26 Source Recover Timer

This option is to configure the *tSrcRecover* timer. Please refer to the PD Spec for more details on *tSrcRecover* timer. Timer units are in milliseconds.

2.27 Transition Timer

This option is to configure the *tPSTransition* timer. Please refer to the PD Spec for more details on *tPSTransition* timer. Timer units are in milliseconds.

2.28 Source off timer

This option is to configure the *tPSSourceOff* timer. Please refer to the PD Spec for more details on *tPSSourceOff* timer. Timer units are in milliseconds.

2.29 No Response Timer

This option is to configure the *tNoResponse* timer. Please refer to the PD Spec for more details on *tNoResponse*. Timer units are in milliseconds.

2.30 Sink Wait Capability Timer

This option is to configure the *tTypeCSinkWaitCap* timer. Please refer to the PD Spec for more details on *tTypeCSinkWaitCap* timer. Timer units are in milliseconds.

2.31 Sink Request Timer

This option is to configure the *tSinkRequest* timer. Please refer to the PD Spec for more details on *tSinkRequest* timer. Timer units are in milliseconds.

2.32 Discharge Timer

Internal timer used to keep the discharge circuit enabled. Discharge circuit will be enabled and kept enabled for the timer duration. Timer units are in milliseconds.

2.33 Chunk Not Supported Timer

This option is to configure the *tChunkingNotSupported* timer. Please refer to the PD Spec for more details on *tChunkingNotSupported* timer. Timer units are in milliseconds.

2.34 I2C Address

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

2.35 TRIM1

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

2.36 TRIM2

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

2.37 External DC

If the device is self-powered, then this option can be set to initiate a power role swap request to switch over the role to source. Sink Request power role swap option also should be set along with this to achieve 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

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

FT_PROG

AN 124 User Guide For FTDI FT_Prog Utility

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 and Figures

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Appendix C – Revision History

Document Title: AN_551 FT4232HP/FT2232HP/FT232HP Configuration Guide
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