

The STUSB4500 software programming guide

Introduction

This software guide is a non-exhaustive document aimed at clarifying a good practice when the customized STUSB4500 software is being written.



Figure 1. STEVAL-ISC005V1

Table 1. Minimal configuration

1 x NUCLEO-F072RB	STM32 Nucleo-64 development board with ARM Cortex M0
1 x STEVAL-ISC005V1	STUSB4500 evaluation board
STSW-STUSB003	Software library including STUSB4500 hardware abstraction layers, drivers and code example
IAR 8.x	C code compiler



1 How to?

1.1 How USB PD negotiation works

- At connection, a source connects to a sink @ 5 V (Type-C), therefore first of all, the STUSB4500 advertises itself as a USB Type-C SINK.
- 2. Then, a USB PD capable source advertises its power budget (SRC_PDOj) to the STUSB4500.
- 3. The sink (STUSB4500) is responsible for:
 - a. evaluating the SRC_PDOj according to application needs (stored in STUSB4500 SNK_PDOi) thanks to an internal algorithm
 - b. sending a request (voltage, current) to the SOURCE if any of the SRC_PDOj is compatible with any SNK_PDOi (power MATCH). In case of failure, the negotiation ends with a USB PD mismatch.
- 4. The SOURCE is responsible for:
 - a. accepting or declining the request (RDO) sent by the STUSB4500.
 - b. if accepted, implementing the voltage and current transition from current profile to the new power profile (within 275 ms after "accept")
 - c. notifying the SINK about the transition to new power profile is completed (PS_READY)

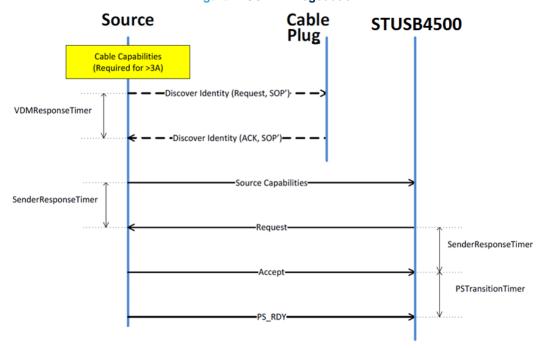


Figure 2. USB PD negotiation

1.2 How to initialize the STUSB4500 properly

In order to properly initialize the STUSB4500 for software operations, it is recommended to:

- 1. Clear all interrupts by reading (I²C multi-read command for instance) all 10 registers from address 0x0D to 0x16
- 2. Configure interrupt mask register (@0x0C) according to application requirements (recommended list of alerts to be unmasked: CONNECTION STATUS, MONITORING STATUS, PRT STATUS)

For further details, see the STSW-STUSB003 function: usb_pd_init

1.3 How to send a USB PD software reset

In order to send a USB PD "SOFT_RESET_MESSAGE" command, the following sequence must be done:

1. WRITE 0x0D (SOFT_RESET) in the TX_HEADER_LOW register (@0x51)

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2. WRITE 0x26 (SEND_COMMAND) in the PD_COMMAND_CTRL register (@ 0x1A) For further details, see STSW-STUSB003 function **Send_Soft_reset_Message**

1.4 How to fill the PDO registers

The STUSB4500 supports up to 3 fixed supply PDO. As per USB PD standard, a SINK PDO is composed 32 bits that must be filled according to figure below.

PDO1, PDO2 and PDO3 from the STUSB4500 can be changed by software by accessing respectively the registers 0x85-0x88, 0x89-0x8C and 0x8D-0x90. Each PDO is composed of a word of 4 bytes. Please note PDO1 must be fixed 5 V according to USB PD standard.

Bits	Description
B3130	Fixed supply
B29	Dual-role power
B28	Higher capability
B27	Unconstrained power
B26	USB communication capable
B25	Dual-role data
	Fast role swap required USB-Type-C current:
	- 00b: fast swap not supported (default)
B2423	- 01b: default USB power
	- 10b: 1.5 A@5 V
	- 11b: 3.0 A@5 V
B2220	Reserved-Shall be set to zero
B1910	Voltage in 50 mV units
B90	Operational current in 10 mA units

Table 2. Fixed supply PDO-sink

Filling the PDO register only does not force new PDO contract negotiation. Please check Section 1.5 How to force the STUSB4500 to re-negotiate with the SOURCE.

For further details, see STSW-STUSB003 function: Update_PDO

1.5 How to force the STUSB4500 to re-negotiate with the SOURCE

As per USB PD standard, a new contract negotiation must occur when a SOFT_RESET_MESSAGE is sent (by either the SOURCE or the SINK).

Therefore, once the PDO registers have been updated by software, sending a SOFT_RESET_MESSAGE to the SOURCE a new USB PD negotiation starts, by taking into account the new STUSB4500 PDO values (please check Section 1.3 How to send a USB PD software reset).

1.6 How to force VBUS to 5 V

An easy way to force the STUSB4500 to negotiate 5 V is to set the number of active PDO to 1 (cf register 0x70: DPM_PDO_NUMB register) followed by a SOFT_RESET_MESSAGE (please check Section 1.3 How to send a USB PD software reset).

For further details, see STSW-STUSB003 functions: Negotiate_5V, Update_Valid_PDO_Number

1.7 How to read USB-C connection STATUS

By accessing the 2 registers below:

- PORT_STATUS_1 (@0x0E)
- CC STATUS (@0x11)

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It is possible to report the following information to the application processor:

- 1. the plug orientation (CC pin attached to CC1 or CC2)
- the USB-C source current (R_p resistor value)

Note:

At the connection, the STUSB4500 connects first in USB-C mode before negotiating any USB PD contract. In order to know the final connection status (USB-C or USB PD explicit contract), it is recommended to wait 500 ms after ATTACH event.

For further details, see STSW-STUSB003 function: Print_Type_C_Only_Status

1.8 How to read USB PD STATUS

By accessing the 4 registers below:

- RDO_REG_STATUS_0 (@0x91)
- RDO_REG_STATUS_1 (@0x92)
- RDO REG STATUS 2 (@0x93)
- RDO REG STATUS 3 (@0x94)

it is possible to report to the application processor some information:

- if the STUSB4500 is attached in USB-C mode (object position = 000b) or in USB PD contract (object position different from 000b)
- the PDO index from the SOURCE that has been requested by the STUSB4500 internal algorithm (if object position is different from 000b)
- and various information as per USB PD standard definition (see table below)

Bits Description **B31** Reserved-Shall be set to zero B30....28 Object position (000b is Reserved and Shall Not be used) B27 GiveBack flag = 0 **B26** Capability mismatch B25 USB communications capable **B24** No USB suspend B23 Unchunked extended messages supported B22....20 Reserved-Shall be set to zero B19...10 Operating current in 10 mA units B9 0 Maximum operating current 10 mA units

Table 3. Fixed request data object RDO

For further details, see STSW-STUSB003 function: Print_RDO;

1.9 How to access to the PDO from the SOURCE

As a normal process from the USB-PD negotiation (see Section 1.1 How USB PD negotiation works), the SOURCE initiates a USB PD contract negotiation by sharing its POWER profile (SRC_PDO) with the STUSB4500.

It is possible to access these power profiles at the beginning of the power negotiation by reading the RX_Buffer after confirmation from PRT_STATUS register. This dynamic register flags each incoming message.

When an incoming message is reported, its content is temporarily stored in the RX buffers (from 0x31 to 0x4E).

As each incoming message overrides the former message, it is important to quickly store in application processor memory the STUSB4500 RX buffer content (header + data object) in order to catch the SOURCE power profiles.

For further details, see STSW-STUSB003 functions: ALARM_MANAGEMENT, Print_PDO_FROM_SRC

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1.10 How to access the STUSB4500 policy engine state

In order to understand what is the current state of the USB PD negotiation, it is possible to monitor in real time the STUSB4500 policy engine FSM. Please refer to PE_FSM register (@0x29) or check **Get_Device_STATUS** function from the STSW-STUSB003 library.

1.11 How to manage alerts

The STUSB4500 uses 4 alert status bits.

See ALERT_STATUS_1 register (0x0B):

- [bit 7] reserved
- [bit 6] PORT_STATUS_AL
- [bit 5] TYPEC_MONITORING_STATUS_AL
- [bit 4] CC_HW_FAULT_STATUS_AL
- [bit 3] reserved
- [bit 2] reserved
- [bit 1] PRT_STATUS_AL
- [bit 0] reserved

The 4 bits from the ALERT_STATUS_1 register are always active by default. Each of them can trigger an external interrupt through the ALERT pin (falling edge) if the corresponding Mask register ALERT_STATUS_1_MASK (0x0C) is cleared.

When an alert is triggered, clearing an event is performed by reading the associated STATUS registers. Active bits are marked as RC (read clear) in the register description tables:

Table 4. Register description

Alert bit (from register 0x0B)	Associated read clear register
[bit 6] - PORT_STATUS_AL	0x0D: PORT_STATUS_0
[bit 5] - TYPEC_MONITORING_STATUS_AL	0x0F: TYPEC_MONITORING_STATUS_0
[bit 4] - CC_HW_FAULT_STATUS_AL	0x12: CC_HW_FAULT_STATUS_0
[bit 1] - PRT_STATUS_AL	0x16: PRT_STATUS

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2 Register map

Table 5. Register map

Offset	Register name	Description
0x06	BCD_TYPEC_REV_LOW	BCD_TYPEC_REV_LOW register
0x07	BCD_TYPEC_REV_HIGH	BCD_TYPEC_REV_HIGH register
0x08	BCD_USBPD_REV_LOW	BCD_USBPD_REV_LOW register
0x09	BCD_USBPD_REV_HIGH	BCD_USBPD_REV_HIGH register
0x0A	DEVICE_CAPAB_HIGH	DEVICE_CAPAB_HIGH register
0x0B	ALERT_STATUS_1	ALERT_STATUS_1 register
0x0C	ALERT_STATUS_1_MASK	ALERT_STATUS_1_MASK register
0x0D	PORT_STATUS_0	PORT_STATUS_0 register
0x0E	PORT_STATUS_1	PORT_STATUS_1 register
0x0F	TYPEC_MONITORING_STATUS_0	TYPEC_MONITORING_STATUS_0 register
0x10	TYPEC_MONITORING_STATUS_1	TYPEC_MONITORING_STATUS_1 register
0x11	CC_STATUS	CC_STATUS register
0x12	CC_HW_FAULT_STATUS_0	CC_HW_FAULT_STATUS_0 register
0x13	CC_HW_FAULT_STATUS_1	CC_HW_FAULT_STATUS_1 register
0x14	PD_TYPEC_STATUS	PD_TYPEC_STATUS register
0x15	TYPEC_STATUS	TYPEC_STATUS register
0x16	PRT_STATUS	PRT_STATUS register
0x17		
to	Reserved	Reserved
0x19		
0x1A	PD_COMMAND_CTRL	PD_COMMAND_CTRL register
0x1B		
to	reserved	reserved
0x1F	MONITORING OTEN	MONITORING OTRI A
0x20	MONITORING_CTRL_0	MONITORING_CTRL_0 register
0x21	Reserved	Reserved MONITORING OTBL Quaritate
0x22	MONITORING_CTRL_2	MONITORING_CTRL_2 register
0x23	RESET_CTRL	RESET_CTRL register
0x24	Reserved	Reserved
0x25	VBUS_DISCHARGE_TIME_CTRL	VBUS_DISCHARGE_TIME_CTRL register
0x26	VBUS_DISCHARGE_CTRL	VBUS_DISCHARGE_CTRL register
0x27	VBUS_CTRL	VBUS_CTRL register
0x28	reserved	Reserved
0x29	PE_FSM	PE_FSM register
0x2B	reserved	reserved
0x2C	reserved	reserved
0x2D	GPIO_SW_GPIO	GPIO_SW_GPIO register
0x2E	reserved	reserved

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Offset	Register name	Description
0x2F	Device_ID	Device_ID register
0x30	reserved	reserved
0x31	RX_HEADER_LOW	RX_HEADER_LOW register
0x32	RX_HEADER_HIGH	RX_HEADER_HIGH register
0x33	RX_DATA_OBJ1_0	RX_DATA_OBJ1_0 register
0x34	RX_DATA_OBJ1_1	RX_DATA_OBJ1_1 register
0x35	RX_DATA_OBJ1_2	RX_DATA_OBJ1_2 register
0x36	RX_DATA_OBJ1_3	RX_DATA_OBJ1_3 register
0x37	RX_DATA_OBJ2_0	RX_DATA_OBJ2_0 register
0x38	RX_DATA_OBJ2_1	RX_DATA_OBJ2_1 register
0x39	RX_DATA_OBJ2_2	RX_DATA_OBJ2_2 register
0x3A	RX_DATA_OBJ2_3	RX_DATA_OBJ2_3 register
0x3B	RX_DATA_OBJ3_0	RX_DATA_OBJ3_0 register
0x3C	RX_DATA_OBJ3_1	RX_DATA_OBJ3_1 register
0x3D	RX_DATA_OBJ3_2	RX_DATA_OBJ3_2 register
0x3E	RX_DATA_OBJ3_3	RX_DATA_OBJ3_3 register
0x3F	RX_DATA_OBJ4_0	RX_DATA_OBJ4_0 register
0x40	RX_DATA_OBJ4_1	RX_DATA_OBJ4_1 register
0x41	RX_DATA_OBJ4_2	RX_DATA_OBJ4_2 register
0x42	RX_DATA_OBJ4_3	RX_DATA_OBJ4_3 register
0x43	RX_DATA_OBJ5_0	RX_DATA_OBJ5_0 register
0x44	RX_DATA_OBJ5_1	RX_DATA_OBJ5_1 register
0x45	RX_DATA_OBJ5_2	RX_DATA_OBJ5_2 register
0x46	RX_DATA_OBJ5_3	RX_DATA_OBJ5_3 register
0x47	RX_DATA_OBJ6_0	RX_DATA_OBJ6_0 register
0x48	RX_DATA_OBJ6_1	RX_DATA_OBJ6_1 register
0x49	RX_DATA_OBJ6_2	RX_DATA_OBJ6_2 register
0x4A	RX_DATA_OBJ6_3	RX_DATA_OBJ6_3 register
0x4B	RX_DATA_OBJ7_0	RX_DATA_OBJ7_0 register
0x4C	RX_DATA_OBJ7_1	RX_DATA_OBJ7_1 register
0x4D	RX_DATA_OBJ7_2	RX_DATA_OBJ7_2 register
0x4E	RX_DATA_OBJ7_3	RX_DATA_OBJ7_3 register
0x51	TX_HEADER_LOW	TX_HEADER_LOW register
0x52	TX_HEADER_HIGH	TX_HEADER_HIGH register
0x53		
to	Reserved	reserved
0x6F		
0x70	DPM_PDO_NUMB	DPM_PDO_NUMB register
0x71		
to	reserved	reserved
0x84		

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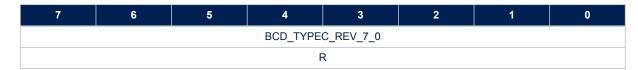
Offset	Register name	Description
0x85	DPM_SNK_PDO1_0	DPM_SNK_PDO1_0 register
0x86	DPM_SNK_PDO1_1	DPM_SNK_PDO1_1 register
0x87	DPM_SNK_PDO1_2	DPM_SNK_PDO1_2 register
0x88	DPM_SNK_PDO1_3	DPM_SNK_PDO1_3 register
0x89	DPM_SNK_PDO2_0	DPM_SNK_PDO2_0 register
0x8A	DPM_SNK_PDO2_1	DPM_SNK_PDO2_1 register
0x8B	DPM_SNK_PDO2_2	DPM_SNK_PDO2_2 register
0x8C	DPM_SNK_PDO2_3	DPM_SNK_PDO2_3 register
0x8D	DPM_SNK_PDO3_0	DPM_SNK_PDO3_0 register
0x8E	DPM_SNK_PDO3_1	DPM_SNK_PDO3_1 register
0x8F	DPM_SNK_PDO3_2	DPM_SNK_PDO3_2 register
0x90	DPM_SNK_PDO3_3	DPM_SNK_PDO3_3 register
0x91	RDO_REG_STATUS_0	RDO_REG_STATUS_0 register
0x92	RDO_REG_STATUS_1	RDO_REG_STATUS_1 register
0x93	RDO_REG_STATUS_2	RDO_REG_STATUS_2 register
0x94	RDO_REG_STATUS_3	RDO_REG_STATUS_3 register

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3 Register description

3.1 BCD_TYPEC_REV_LOW register

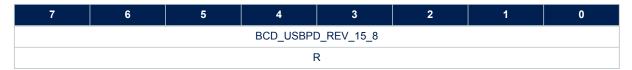


Address: STUSB_BLOCKBaseAddress + 0x06

Type: R Reset: 0x12

[7:0] **BCD_TYPEC_REV_7_0**: Defined Type-C release supported by the device

3.2 BCD_USPD_REV_HIGH register



Address: STUSB_BLOCKBaseAddress + 0x09

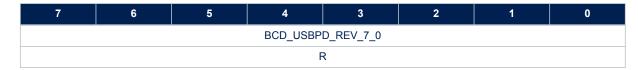
Type: R Reset: 0x20

[7:0] BCD_USBPD_REV_15_8: Defined Power Delivery release supported by the device

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3.3 BCD_USBPD_REV_LOW register

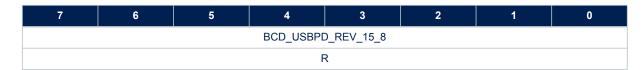


Address: STUSB_BLOCKBaseAddress + 0x08

Type: R Reset: 0x11

[7:0] | BCD_USBPD_REV_7_0: Defined Power Delivery release supported by the device

3.4 BCD_USPD_REV_HIGH register

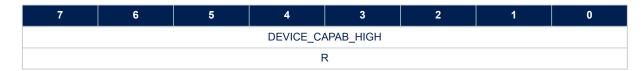


Address: STUSB_BLOCKBaseAddress + 0x09

Type: R Reset: 0x20

[7:0] **BCD_USBPD_REV_15_8**: Defined Power Delivery release supported by the device

3.5 DEVICE_CAPAB_HIGH register



Address: STUSB_BLOCKBaseAddress + 0x0A

Type: R Reset: 0x00

[7:0] DEVICE_CAPAB_HIGH: Not used

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3.6 ALERT_STATUS_1 register

7	6	5	4	3	2	1	0
reserved	PORT_STATUS_AL	TYPEC_MONITORING_STATUS_AL	CC_HW_FAULT_STATUS_AL	PD_TYPEC_STATUS_AL	reserved	PRT_STATUS_AL	reserved
R	R	R	R	R	R	R	R

Address: STUSB_BLOCKBaseAddress + 0x0B

Type: R Reset: 0x00

[7]	reserved
[6]	PORT_STATUS_AL
[5]	TYPEC_MONITORING_STATUS_AL
[4]	CC_HW_FAULT_STATUS_AL
[3]	reserved
[2]	reserved
[1]	PRT_STATUS_AL
[0]	reserved

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3.7 ALERT_STATUS_1_MASK register

7	6	5	4	3	2	1	0
reserved	PORT_STATUS_AL_MASK	TYPEC_MONITORING_STATUS_MASK	CC_FAULT_STATUS_AL_MASK	reserved	reserved	PRT_STATUS_AL_MASK	reserved
R/W	R/W	R/W	R/W	R/W	R	R/W	R/W

Address: STUSB_BLOCKBaseAddress + 0x0C

Type: R/W

Reset: 0xFB (initialized by NVM)

[7]	reserved
	PORT_STATUS_AL_MASK
[6]	0: (UNMASKED) Interrupt unmasked
	1: (MASKED) Interrupt masked
	TYPEC_MONITORING_STATUS_MASK
[5]	0: (UNMASKED) Interrupt unmasked
	1: (MASKED) Interrupt masked
	CC_FAULT_STATUS_AL_MASK
[4]	0: (UNMASKED) Interrupt unmasked
	1: (MASKED) Interrupt masked
[3]	reserved
[2]	reserved
	PRT_STATUS_AL_MASK:
[1]	0: (UNMASKED) Interrupt unmasked
	1: (MASKED) Interrupt masked
[0]	reserved

3.8 PORT_STATUS_0 register

7	6	5	4	3	2	1	0
			RESERVED				ATTACH_TRANS
			R				RC

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Address: STUSB_BLOCKBaseAddress + 0x0D

Type: R Reset: 0x00

ATTACH_TRANS:

[0] 0: No transition detected in attached states

1: Transition detected in attached state

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3.9 PORT_STATUS_1 register

7	6	5	4	3	2	1	0
ATTACHED_DEVICE		reserved	POWER_MODE	DATA_MODE	reserved	ATTACH	
R		R	R	R	R	R	

Address: STUSB_BLOCKBaseAddress + 0x0E

Type: R Reset: 0x00

	ATTACHED_DEVICE:						
	000: (NONE_ATT) No device connected						
	001: (SNK_ATT) Sink device connected						
[7:5]	010: reserved						
[7:5]	011: (DBG_ATT) Debug accessory device connected						
	100: reserved						
	101: reserved						
	Others: Do not use						
[4]	reserved						
	POWER_MODE:						
[3]	0: device is sinking power						
	1: reserved						
	DATA_MODE:						
[2]	0: UFP						
	1: reserved						
[1]	reserved						
	ATTACH:						
[0]	0: UNATTACHED						
	1: ATTACHED						

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3.10 TYPEC_MONITORING_STATUS_0 register

7	6	5	4	3	2	1	0
	RESERVED	VBUS_HIGH_STATUS	VBUS_LOW_STATUS	VBUS_READY_TRANS	VBUS_VSAFE0V_TRANS	VBUS_VALID_SNK_TRANS	RESERVED
	R	RC	RC	RC	RC	RC	R

Address: STUSB_BLOCKBaseAddress + 0x0F

Type: RC Reset: 0x0F

[5]	VBUS_HIGH_STATUS: VBUS_HIGH status updated during VBUS_READY transition from HIGH to LOW 0: (VBUS_HIGH_OK) VBUS below high threshold 1: (VBUS_HIGH_KO) VBUS above high threshold (Overveltage condition)
	1: (VBUS_HIGH_KO) VBUS above high threshold (Overvoltage condition) VBUS_LOW_STATUS: VBUS_LOW status updated during VBUS_READY transition from HIGH to LOW 2. (VBUS_HIGH_KO) VBUS_LOW STATUS.
[4]	0: (VBUS_LOW_OK) VBUS above low threshold 1: (VBUS_LOW_KO) VBUS below low threshold (Undervoltage condition)
[3]	VBUS_READY_TRANS: 0: (NO_TRANS) status cleared 1: (TRANS_DETECTED) Transition detected on VBUS_READY bit
[2]	VBUS_VSAFE0V_TRANS: 0: (NO_TRANS) status cleared 1: (TRANS_DETECTED) Transition detected on VBUS_VSAFE0V bit
[1]	VBUS_VALID_SNK_TRANS: 0: (NO_TRANS) status cleared 1: (TRANS_DETECTED) Transition detected on VBUS_VALID_SNK bit
[0]	reserved

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3.11 TYPEC_MONITORING_STATUS_1 register

7	6	5	4	3	2	1	0
	DESCEDAMEN			VBUS_READY	VBUS_VSAFE0V	VBUS_VALID_SNK	RESERVED
	F	₹		R	R	R	R

Address: STUSB_BLOCKBaseAddress + 0x10

Type: R Reset: 0x00

| VBUS_READY:
| [3] 0: (NO_VBUS_READY) VBUS disconnected (Unpowered or vSafe0V)
| 1: (VBUS_READY) VBUS connected (vSafe5V or negotiated power level)
| VBUS_VSAFE0V:
| [2] 0: (NO_VSAFE0V) VBUS is higher than 0.8 V
| 1: (VSAFE0V) VBUS is lower than 0.8 V
| VBUS_VALID_SNK:
| [1] 0: (NO_VBUS_VALID_SNK) VBUS is lower than 1.9 V or 3.5 V (depending of VBUS_SNK_DISC_THRESHOLD value)
| 1: (VBUS_VALID_SNK) VBUS is higher than 1.9 V or 3.5 V (depending of VBUS_SNK_DISC_THRESHOLD value)
| [0] reserved

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3.12 CC_STATUS register

7	6	5	4	3	2	1	0
	אר היא האיל האיל היא	LOOKING_4_CONNECTION	CONNECT_RESULT	STATE		HATO 500	<u></u>
R		R	R	F	₹	F	₹

Address: STUSB_BLOCKBaseAddress + 0x11

Type: R Reset: 0x00

	LOOKING_4_CONNECTION:
[5]	0: (NOT_LOOKING) The device is not actively looking for a connection. A transition from '1' to '0' indicates a potential connection has been found. When the device is in power-up sequence or when TYPE-C FSM is in the following states: Attached.SNK, DebugAccessory.SNK
	1: (LOOKING) The device is looking for a connection
	CONNECT_RESULT:
[4]	0: Reserved.
[11]	1: (PRESENT_RD) The device is presenting Rd. When when TYPE-C FSM is in the following states: Attached.SNK, DebugAccessory.SNK
	CC2_STATE: (available when CONNECT_result =1)
	00: Reserved
[3.3]	01: SNK.Default (Above minimum vRd-Connect)
[3:2]	10: SNK.Power1.5 (Above minimum vRd-Connect)
	11: SNK.Power3.0 (Above minimum vRd-Connect)
	This field returns 00b if (LOOKING_4_CONNECTION=1)
	CC1_STATE: (available when CONNECT_result =1)
	00: Reserved
[1:0]	01: SNK.Default (Above minimum vRd-Connect)
[1.0]	10: SNK.Power1.5 (Above minimum vRd-Connect)
	11: SNK.Power3.0 (Above minimum vRd-Connect)
	This field returns 00b if (LOOKING_4_CONNECTION=1)

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3.13 CC_HW_FAULT_STATUS_0 register

7	6	5	4	3	2	1	0
RESERVED	RESERVED	VPU_OVP_FAULT_TRANS	VPU_VALID_TRANS	RESERVED	RESERVED	RESERVED	RESERVED
R	R	RC	RC	RC	R	R	R

Address: STUSB_BLOCKBaseAddress + 0x12

Type: R Reset: 0x10

[7]	reserved
	VPU_OVP_FAULT_TRANS:
[5]	0: (NO_TRANS) Cleared
	1: (TRANS_DETECTED) Transition occurred on VPU_OVP_FAULT bit
	VPU_VALID_TRANS:
[4]	0: (NO_TRANS) Cleared
	1: (TRANS_DETECTED) Transition occurred on VPU_VALID bit
[3]	reserved
[2]	reserved
[1]	reserved
[0]	reserved

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3.14 CC_HW_FAULT_STATUS_1 register

7	6	5	4	3	2	1	0
VPU_OVP_FAULT	VPU_VALID	RESERVED	VBUS_DISCH_FAULT	RESERVED	RESERVED	RESERVED	RESERVED
R	R	R	R	R	R	R	R

Address: STUSB_BLOCKBaseAddress + 0x13

Type: R Reset: 0x40

[0] reserved

VPU_OVP_FAULT: 0: (NO_FAULT) No overvoltage condition on CC pins when in pull-up mode (CC pins voltage is below overvoltage threshold of 6.0 V) 1: (FAULT) Overvoltage condition has occurred on CC pins when in pull-up mode (CC pins voltage is above overvoltage threshold of 6.0 V) VPU_VALID: [6] 0: (NO_VALID) CC pins pull-up voltage is below UVLO threshold of 2.8 V when in pull-up mode 1: (VALID) CC pins pull-up voltage is above UVLO threshold of 2.8 V when in pull-up mode (normal operating condition) VBUS_DISCH_FAULT: [4] 0: (NO_FAULT) No VBUS discharge issue 1: (FAULT) VBUS discharge issue has occurred [3] reserved [1] reserved

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3.15 PD_TYPEC_STATUS register

7	6	5	4	3	2	1	0	
	RESE	RVED		PD_TYPEC_HAND_CHECK				
	F	₹			R	С		

Address: STUSB_BLOCKBaseAddress + 0x14

Type: R Reset: 0x00

PD_TYPEC_HAND_CHECK: hand checking sent by Type C to Power Delivery to feedback requested action 0000: (CLEARED) cleared 0001: reserved 0010: reserved 0011: reserved 0100: reserved 0101: reserved 0110: reserved [3:0] 0111: reserved 1000: (PD_HARD_RESET_COMPLETE_ACK) 1001: reserved 1010: reserved 1011: reserved 1100: reserved 1101: reserved 1110: (PD_HARD_RESET_RECEIVED_ACK) 1111: (PD_HARD_RESET_SEND_ACK)

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3.16 TYPEC_STATUS register

7	6	5	4	3	2	1	0
REVERSE	RESERVED	RESERVED		TYPEC_FSM_STATE			
R	R	R			R		

Address: STUSB_BLOCKBaseAddress + 0x15

Type: R Reset: 0x00

	REVERSE: Connection orientation, indicates CC pin used for PD communication
[7]	0: (STRAIGHT_CC1) CC1 is attached
	1: (TWISTED_CC2) CC2 is attached
[6]	reserved
[5]	reserved
	TYPEC_FSM_STATE: Indicates Type-C FSM state
	00000: (UNATTACHED_SNK)
	00001: (ATTACHWAIT_SNK)
	00010: (ATTACHED_SNK)
	00011: (DEBUGACCESSORY_SNK)
	00100: Reserved
	00101: Reserved
	00110: Reserved
	00111: Reserved
	01000: Reserved
	01001: Reserved
	01010: Reserved
	01011: Reserved
[4:0]	01100: (TRY_SRC)
	01101: (UNATTACHED_ACCESSORY)
	01110: (ATTACHWAIT_ACCESSORY)
	01111: reserved
	10000: reserved
	10001: reserved
	10010: reserved
	10011: (TYPEC_ERRORRECOVERY)
	10100: Reserved
	10101: Reserved
	10110: Reserved
	10111: Reserved
	11000: Reserved
	11001: Reserved

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3.17 PRT_STATUS register

7	6	5	4	3	2	1	0
RESERVED	RESERVED	RESERVED	PRT_BIST_RECEIVED	RESERVED	PRL_MSG_RECEIVED	RESERVED	PRL_HW_RST_RECEIVED
R	R	R	RC	R	RC	R	RC

Address: STUSB_BLOCKBaseAddress + 0x16

Type: RC Reset: 0x00

[7:3]	reserved					
	PRL_MSG_RECEIVED:					
[2]	0: (NO_MSG_RECEIVED) Cleared by I ² C master					
	1: (MSG_RECEIVED) Interrupt for protocol layer message received					
[1]	reserved					
	PRL_HW_RST_RECEIVED:					
[0]	0: (NO_HW_RST) Cleared by I ² C master					
	1: (HW_RST_RECEIVED) Interrupt for a PD hardware reset request coming from RX					

3.18 PD_COMMAND_CTRL register

7	6	5	4	3	2	1	0
RESERVED	RESERVED	SEND_MESSAGE_COMMAND					
R	R			R	W		

Address: STUSB_BLOCKBaseAddress + 0x1A

Type: R/W Reset: 0x00

[5.0]	
15:01	SEND COMMAND: 0x26
[0.0]	OLIVE_COMMINATOR CALC

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3.19 MONITORING_CTRL_0 register

7	6	5	4	3	2	1	0
	מדייפרי	7 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		VBUS_SNK_DISC_THRESHOLD	RESERVED	RESERVED	RESERVED
	F	₹		R/W	R	R	R

Address: STUSB_BLOCKBaseAddress + 0x20

Type: R/W Reset: 0x10

[7:4]	reserved
	VBUS_SNK_DISC_THRESHOLD: VBUS threshold for TYPE-C state machine de-connection
[3]	0: (SNK_DISC_HIGH) Select a VBUS threshold at 3.5 V - Reset value
	1: (SNK_DISC_LOW) Select a VBUS threshold at 1.9 V
[2:0]	reserved

3.20 MONITORING_CTRL_2 register

7	6	5	4	3	2	1	0	
	VSHIFT	Г_HIGH		VSHIFT_LOW				
R/W					R/	W		

Address: STUSB_BLOCKBaseAddress + 0x22

Type: R/W Reset: 0xFF

[7:4]	VSHIFT_HIGH: shift register initialisation high level (set OVP level)
[3:0]	VSHIFT_LOW: shift register initialisation low level (set UVP level)

3.21 RESET_CTRL register

7	6	5	4	3	2	1	0		
RESERVED							RESET_SW_EN		
	R/W						R/W		

Address: STUSB_BLOCKBaseAddress + 0x23

Type: R/W Reset: 0x00

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RESET_SW_EN: Software reset

0: (SW_RESET_OFF) Software reset disabled
1: (SW_RESET_ON) Software reset enabled

3.22 VBUS_DISCHARGE_TIME_CTRL register

7	6	5	4	3	2	1	0	
	DISCHARGE_	TIME_TO_0V		DISCHARGE_TIME_TRANSITION				
R/W					R/	W		

Address: STUSB_BLOCKBaseAddress + 0x25

Type: R/W

Reset: 0x9C (initialized by NVM)

[7:4] DISCHARGE_TIME_TO_0V: Discharge time from any contract to 0 V. Standard default is 800 ms

[3:0] DISCHARGE_TIME_TRANSITION: Discharge time from any contract to next one. Standard default is 270 ms

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3.23 VBUS_DISCHARGE_CTRL register

7	6	5	4	3	2	1	0
VBUS_DISCHARGE_EN	RESERVED			DESEBVED			
R/W	R/W			F	?		

Address: STUSB_BLOCKBaseAddress + 0x26

Type: R/W

Reset: 0x00 (initialized by NVM)

	VBUS_DISCHARGE_EN:
[7]	0: (DISABLE) Disable the forced assertion of VBUS discharge path
	1: (ENABLE) Force the assertion of VBUS discharge path
[6]	reserved

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3.24 VBUS_CTRL register

7	6	5	4	3	2	1	0
		DESERVED				SINK_VBUS_EN	RESERVED
		F	?			R	R

Address: STUSB_BLOCKBaseAddress + 0x27

Type: R Reset: 0x00

SINK_VBUS_EN

0: (VBUS_EN_SNK_FORCE_DIS) Disable the forced VBUS_EN_SNK pin assertion
1: (VBUS_EN_SNK_FORCE) Force the VBUS EN SNK pin assertion

[0] reserved

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3.25 PE_FSM register

7	6	5	4	3	2	1	0		
	PE_FSM_STATE								
R									

Address: STUSB_BLOCKBaseAddress + 0x29

Type: R Reset: 0x00

PE_FSM_STATE: Policy engine layer FSM state 00000000: (PE_INIT) 00000001: (PE_SOFT_RESET) 00000010: (PE_HARD_RESET) 00000011: (PE_SEND_SOFT_RESET) 00000100: (PE_C_BIST) 00010010: (PE_SNK_STARTUP) 00010011: (PE_SNK_DISCOVERY) 00010100: (PE_SNK_WAIT_FOR_CAPABILITIES) [7:0] 00010101: (PE_SNK_EVALUATE_CAPABILITIES) 00010110: (PE_SNK_SELECT_CAPABILITIES) 00010111: (PE_SNK_TRANSITION_SINK) 00011000: (PE_SNK_READY) 00011001: (PE_SNK_READY_SENDING) 00111010: (PE_HARD_RESET_SHUTDOWN) 00111011: (PE_HARD_RESET_RECOVERY) 01000000: (PE_ERRORRECOVERY)

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3.26 GPIO_SW_GPIO register

7	6	5	4	3	2	1	0
RESERVED						GPIO_SW_GPIO	
R						R/W	

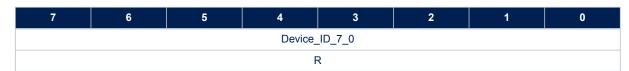
Address: STUSB_BLOCKBaseAddress + 0x2D

Type: R/W Reset: 0x00

GPIO_SW_GPIO: GPIO output value - Useful only when NVM parameter GPIO_CFG[1:0]=00b (refer to datasheet)

[0] 0: (DISABLE) GPIO value is Hi-Z 1: (ENABLE) GPIO value is 0b

3.27 Device_ID register

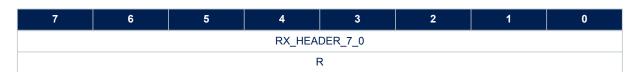


Address: STUSB_BLOCKBaseAddress + 0x2F

Type: R/W Reset: 0x25

[7:0] Device_ID_7_0

3.28 RX_HEADER_LOW register

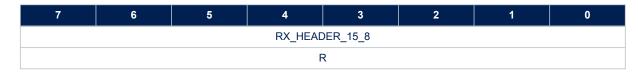


Address: STUSB_BLOCKBaseAddress + 0x31

Type: R Reset: 0x00

[7:0] **RX_HEADER_7_0**

3.29 RX_HEADER_HIGH register



Address: STUSB_BLOCKBaseAddress + 0x32

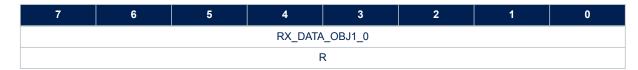
Type: R Reset: 0x00

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[7:0]	RX_HEADER_15_8	
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3.30 RX_DATA_OBJ1_0 register

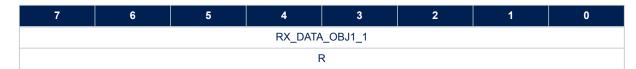


Address: STUSB_BLOCKBaseAddress + 0x33

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ1_0

3.31 RX_DATA_OBJ1_1 register

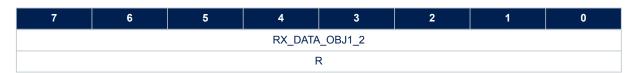


Address: STUSB_BLOCKBaseAddress + 0x34

Type: R Reset: 0x00

[7:0] **RX_DATA_OBJ1_1**

3.32 RX_DATA_OBJ1_2 register

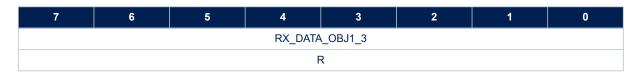


Address: STUSB_BLOCKBaseAddress + 0x35

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ1_2

3.33 RX_DATA_OBJ1_3 register



Address: STUSB_BLOCKBaseAddress + 0x36

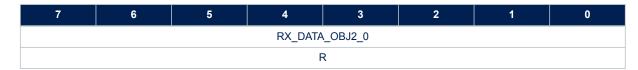
Type: R Reset: 0x00

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[7:0]

3.34 RX_DATA_OBJ2_0 register

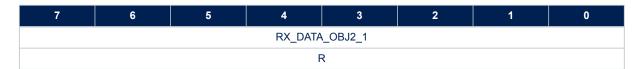


Address: STUSB_BLOCKBaseAddress + 0x37

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ2_0

3.35 RX_DATA_OBJ2_1 register

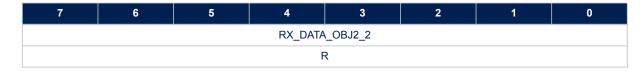


Address: STUSB_BLOCKBaseAddress + 0x38

Type: R Reset: 0x00

[7:0] **RX_DATA_OBJ2_1**

3.36 RX_DATA_OBJ2_2 register

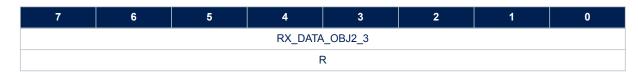


Address: STUSB_BLOCKBaseAddress + 0x39

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ2_2

3.37 RX_DATA_OBJ2_3 register



Address: STUSB_BLOCKBaseAddress + 0x3A

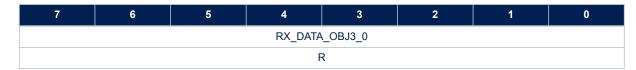
Type: R Reset: 0x00

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[7:0]	RX_DATA_OBJ2_3	
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3.38 RX_DATA_OBJ3_0 register

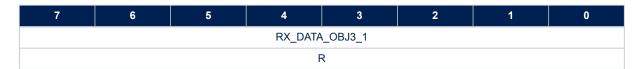


Address: STUSB_BLOCKBaseAddress + 0x3B

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ3_0

3.39 RX_DATA_OBJ3_1 register

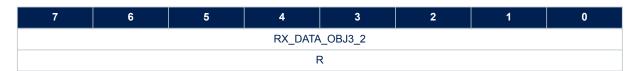


Address: STUSB_BLOCKBaseAddress + 0x3C

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ3_1

3.40 RX_DATA_OBJ3_2 register

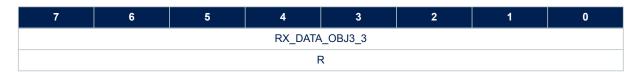


Address: STUSB_BLOCKBaseAddress + 0x3D

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ3_2

3.41 RX_DATA_OBJ3_3 register



Address: STUSB_BLOCKBaseAddress + 0x3E

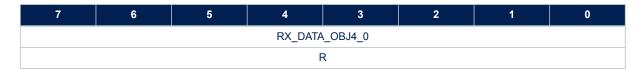
Type: R Reset: 0x00

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[7:0]	RX_DATA_OBJ3_3	
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3.42 RX_DATA_OBJ4_0 register

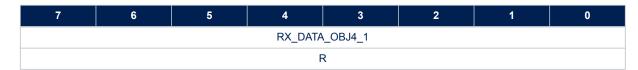


Address: STUSB_BLOCKBaseAddress + 0x3F

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ4_0

3.43 RX_DATA_OBJ4_1 register

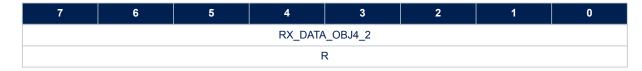


Address: STUSB_BLOCKBaseAddress + 0x40

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ4_1

3.44 RX_DATA_OBJ4_2 register

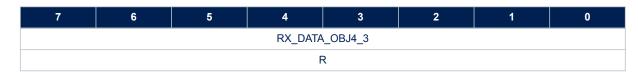


Address: STUSB_BLOCKBaseAddress + 0x41

Type: R Reset: 0x00

[7:0] **RX_DATA_OBJ4_2**

3.45 RX_DATA_OBJ4_3 register



Address: STUSB_BLOCKBaseAddress + 0x42

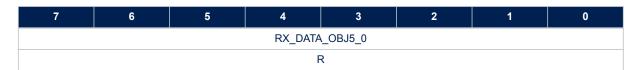
Type: R Reset: 0x00

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[7:0]

3.46 RX_DATA_OBJ5_0 register

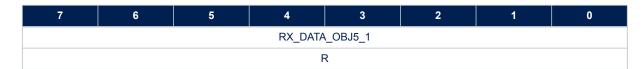


Address: STUSB_BLOCKBaseAddress + 0x43

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ5_0

3.47 RX_DATA_OBJ5_1 register

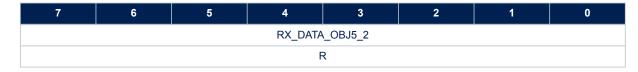


Address: STUSB_BLOCKBaseAddress + 0x44

Type: R Reset: 0x00

[7:0] **RX_DATA_OBJ5_1**

3.48 RX_DATA_OBJ5_2 register

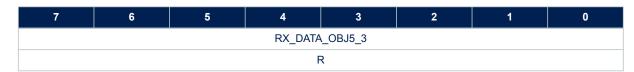


Address: STUSB_BLOCKBaseAddress + 0x45

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ5_2

3.49 RX_DATA_OBJ5_3 register



Address: STUSB_BLOCKBaseAddress + 0x46

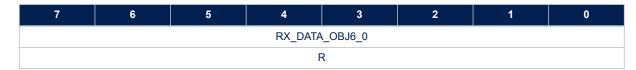
Type: R Reset: 0x00

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[7:0]	RX_DATA_OBJ5_3	
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3.50 RX_DATA_OBJ6_0 register

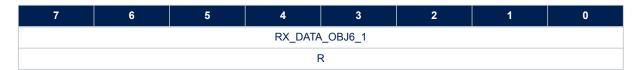


Address: STUSB_BLOCKBaseAddress + 0x47

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ6_0

3.51 RX_DATA_OBJ6_1 register

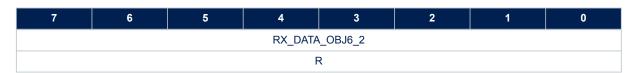


Address: STUSB_BLOCKBaseAddress + 0x48

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ6_1

3.52 RX_DATA_OBJ6_2 register

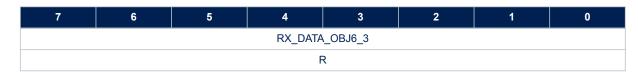


Address: STUSB_BLOCKBaseAddress + 0x49

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ6_2

3.53 RX_DATA_OBJ6_3 register



Address: STUSB_BLOCKBaseAddress + 0x4A

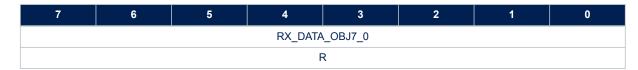
Type: R Reset: 0x00

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[7:0]	RX_DATA_OBJ6_3	
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3.54 RX_DATA_OBJ7_0 register

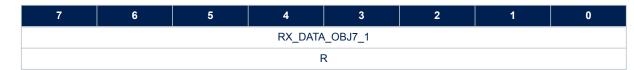


Address: STUSB_BLOCKBaseAddress + 0x4B

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ7_0

3.55 RX_DATA_OBJ7_1 register

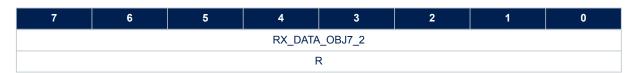


Address: STUSB_BLOCKBaseAddress + 0x4C

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ7_1

3.56 RX_DATA_OBJ7_2 register

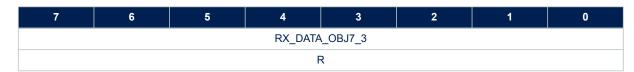


Address: STUSB_BLOCKBaseAddress + 0x4D

Type: R Reset: 0x00

[7:0] RX_DATA_OBJ7_2

3.57 RX_DATA_OBJ7_3 register



Address: STUSB_BLOCKBaseAddress + 0x4E

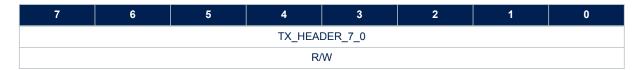
Type: R Reset: 0x00

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[7:0]	RX_DATA_OBJ7_3	
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3.58 TX_HEADER_LOW register

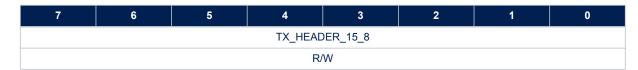


Address: STUSB_BLOCKBaseAddress + 0x51

Type: R/W Reset: 0x00

[7:0] TX_HEADER_7_0

3.59 TX_HEADER_HIGH register



Address: STUSB_BLOCKBaseAddress + 0x52

Type: R/W Reset: 0x00

[7:0] TX_HEADER_15_8

3.60 DPM_PDO_NUMB register

7	6	5	4	3	2	1	0
RESERVED					DPM_SNK_PDO_NUMB		
R						R/W	

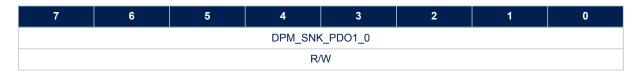
Address: STUSB_BLOCKBaseAddress + 0x70

Type: R/W

Reset: 0x03 (initialized by NVM)

[7:3]	reserved
[2:0]	DPM_SNK_PDO_NUMB

3.61 DPM_SNK_PDO1_0 register



Address: STUSB_BLOCKBaseAddress + 0x85

Type: R/W

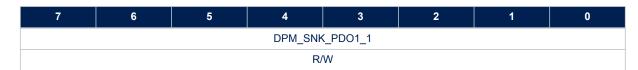
Reset: 0x64 (initialized by NVM)

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[7:0]	DPM_SNK_PDO1_0

3.62 DPM_SNK_PDO1_1 register



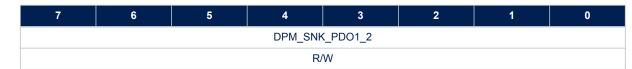
Address: STUSB_BLOCKBaseAddress + 0x86

Type: R/W

Reset: 0x90 (initialized by NVM)

[7:0] **DPM_SNK_PDO1_1**

3.63 DPM_SNK_PDO1_2 register



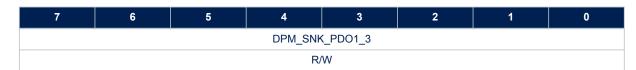
Address: STUSB_BLOCKBaseAddress + 0x87

Type: R/W

Reset: 0x01 (initialized by NVM)

[7:0] DPM_SNK_PDO1_2

3.64 DPM_SNK_PDO1_3 register



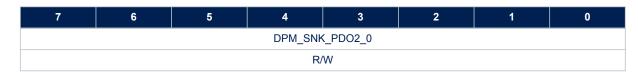
Address: STUSB_BLOCKBaseAddress + 0x88

Type: R/W

Reset: 0x04 (initialized by NVM)

[7:0] DPM_SNK_PDO1_3

3.65 DPM SNK PDO2 0 register



Address: STUSB_BLOCKBaseAddress + 0x89

Type: R/W

Reset: 0x96 (initialized by NVM)

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[7:0]	DPM_SNK_PDO2_0
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3.66 DPM_SNK_PDO2_1 register



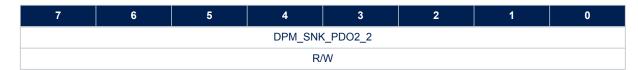
Address: STUSB_BLOCKBaseAddress + 0x8A

Type: R/W

Reset: 0xB0 (initialized by NVM)

[7:0] DPM_SNK_PDO2_1

3.67 DPM_SNK_PDO2_2 register



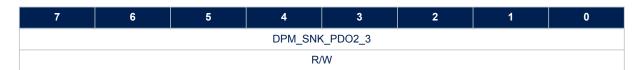
Address: STUSB_BLOCKBaseAddress + 0x8B

Type: R/W

Reset: 0x04 (initialized by NVM)

[7:0] DPM_SNK_PDO2_2

3.68 DPM_SNK_PDO2_3 register



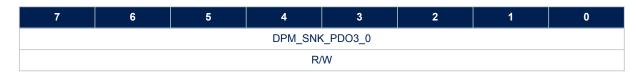
Address: STUSB_BLOCKBaseAddress + 0x8C

Type: R/W

Reset: 0x00 (initialized by NVM)

[7:0] DPM_SNK_PDO2_3

3.69 DPM SNK PDO3 0 register



Address: STUSB_BLOCKBaseAddress + 0x8D

Type: R/W

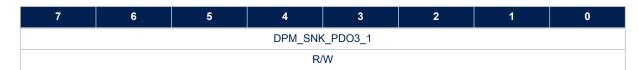
Reset: 0x64 (initialized by NVM)

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[7:0]	DPM_SNK_PDO3_0

3.70 DPM_SNK_PDO3_1 register



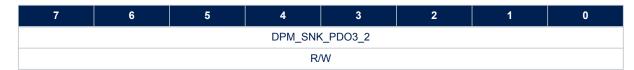
Address: STUSB_BLOCKBaseAddress + 0x8E

Type: R/W

Reset: 0x40 (initialized by NVM)

[7:0] DPM_SNK_PDO3_1

3.71 DPM_SNK_PDO3_2 register



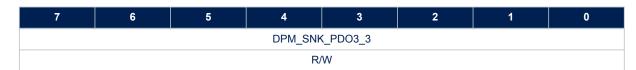
Address: STUSB_BLOCKBaseAddress + 0x8F

Type: R/W

Reset: 0x06 (initialized by NVM)

[7:0] DPM_SNK_PDO3_2

3.72 DPM_SNK_PDO3_3 register



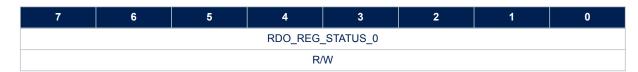
Address: STUSB_BLOCKBaseAddress + 0x90

Type: R/W

Reset: 0x00 (initialized by NVM)

[7:0] DPM_SNK_PDO3_3

3.73 RDO_REG_STATUS_0 register



Address: STUSB_BLOCKBaseAddress + 0x91

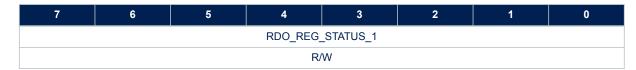
Type: R/W Reset: 0x00

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[7:0] RDO_REG_STATUS_0

3.74 RDO_REG_STATUS_1 register

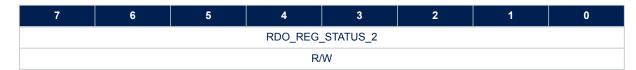


Address: STUSB_BLOCKBaseAddress + 0x92

Type: R/W Reset: 0x00

[7:0] RDO_REG_STATUS_1

3.75 RDO_REG_STATUS_2 register

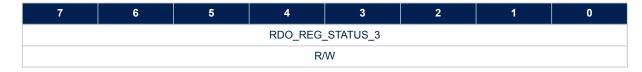


Address: STUSB_BLOCKBaseAddress + 0x92

Type: R/W Reset: 0x00

[7:0] RDO_REG_STATUS_2

3.76 RDO_REG_STATUS_3 register



Address: STUSB_BLOCKBaseAddress + 0x94

Type: R/W Reset: 0x00

[7:0] RDO_REG_STATUS_3

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Revision history

Table 6. Document revision history

Date	Version	Changes
16-Dec-2019	1	Initial release.
14-Dec-2020	2	Updated Section 1.10 How to access the STUSB4500 policy engine state.
23-Jan-2023	3	Added new Section 1.11 How to manage alerts. Updated Section 3.6 .

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