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

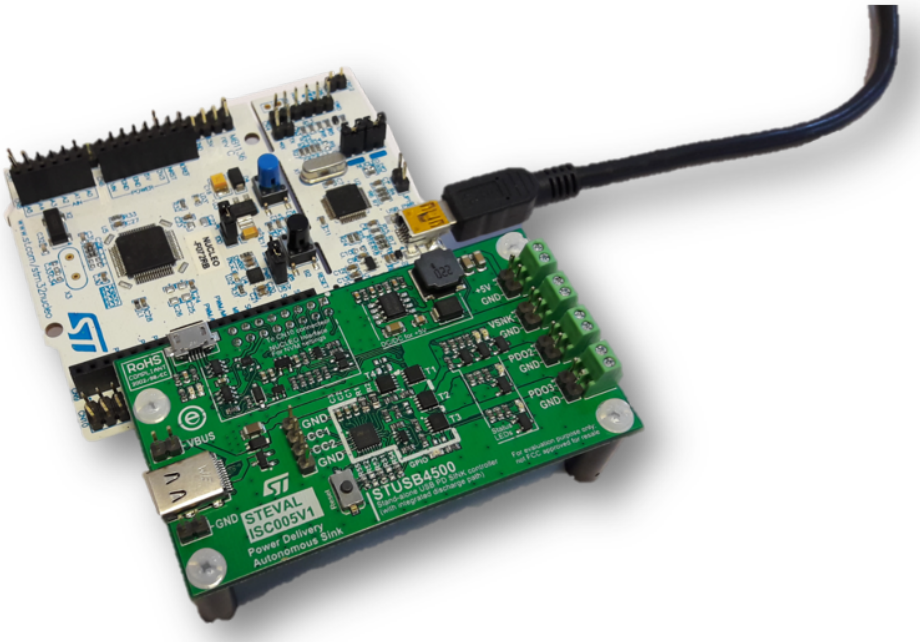


Table 1. Minimal configuration

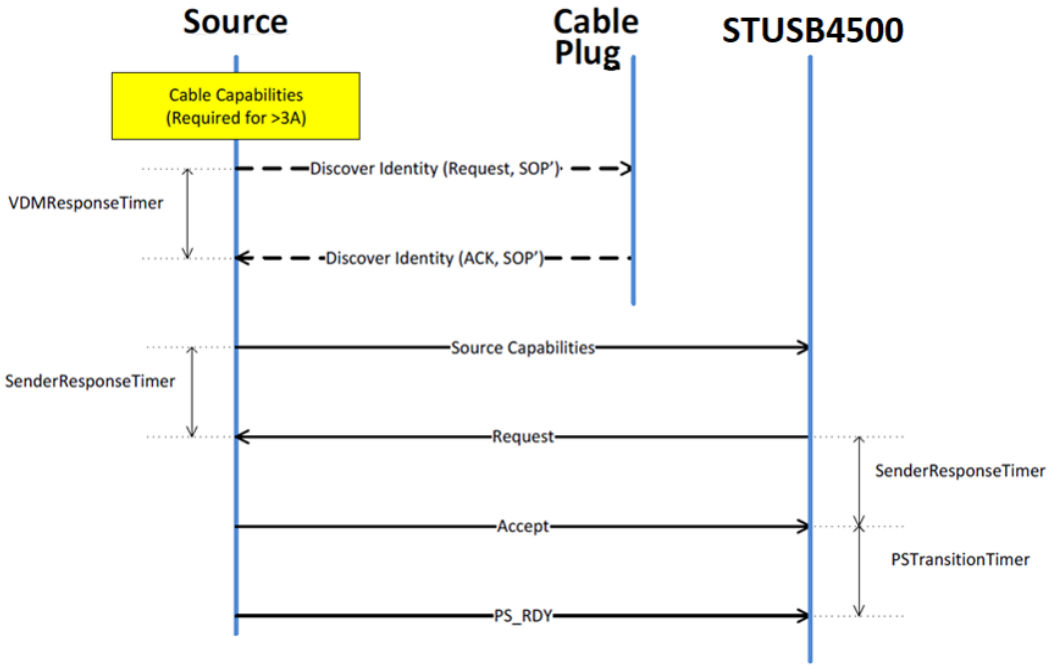
1 x NUCLEO-F072RB	STM32 Nucleo-64 development board with ARM Cortex M0
1 x STEVAL-ISC005V1	STUSB4500 evaluation board
STSW-STUSB003	Software library including STUSB4500 hardware abstraction layers, drivers and code example
IAR 8.x	C code compiler

1 How to?

1.1 How USB PD negotiation works

1. 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)
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.

Table 2. Fixed supply PDO-sink

Bits	Description
B31...30	Fixed supply
B29	Dual-role power
B28	Higher capability
B27	Unconstrained power
B26	USB communication capable
B25	Dual-role data
B24..23	Fast role swap required USB-Type-C current: - 00b: fast swap not supported (default) - 01b: default USB power - 10b: 1.5 A@5 V - 11b: 3.0 A@5 V
B22..20	**Reserved-Shall** be set to zero
B19...10	Voltage in 50 mV units
B9...0	Operational current in 10 mA units

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)

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

1. the plug orientation (CC pin attached to CC1 or CC2)
2. 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)

Table 3. Fixed request data object RDO

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

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**

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).

2 Register map

Table 4. **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 0x19	Reserved	Reserved
0x1A	PD_COMMAND_CTRL	PD_COMMAND_CTRL register
0x1B to 0x1F	reserved	reserved
0x20	MONITORING_CTRL_0	MONITORING_CTRL_0 register
0x21	Reserved	Reserved
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

Offset	Register name	Description
0x2E	reserved	reserved
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 0x6F	Reserved	reserved
0x70	DPM_PDO_NUMB	DPM_PDO_NUMB register
0x71 to	reserved	reserved

Offset	Register name	Description
0x84		
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

3 Register description

3.1 BCD_TYPEC_REV_LOW register

7	6	5	4	3	2	1	0
BCD_TYPEC_REV_7_0							
R							

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

7	6	5	4	3	2	1	0
BCD_USBPD_REV_15_8							
R							

Address: STUSB_BLOCKBaseAddress + 0x09
Type: R
Reset: 0x20

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

3.3 BCD_USBPD_REV_LOW register

7	6	5	4	3	2	1	0
BCD_USBPD_REV_7_0							
R							

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

7	6	5	4	3	2	1	0
BCD_USBPD_REV_15_8							
R							

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

7	6	5	4	3	2	1	0
DEVICE_CAPAB_HIGH							
R							

Address: STUSB_BLOCKBaseAddress + 0x0A
Type: R
Reset: 0x00

[7:0]	**DEVICE_CAPAB_HIGH**: Not used

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
[1]	**PRT_STATUS_AL**
[0]	reserved

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

Address: STUSB_BLOCKBaseAddress + 0x0D
Type: R
Reset: 0x00

[0]	**ATTACH_TRANS**: 0: No transition detected in attached states 1: Transition detected in attached state

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

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

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 (Overvoltage condition)
[4]	**VBUS_LOW_STATUS**: VBUS_LOW status updated during VBUS_READY transition from HIGH to LOW 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**

3.11 TYPEC_MONITORING_STATUS_1 register

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

Address: STUSB_BLOCKBaseAddress + 0x10
Type: R
Reset: 0x00

[3]	**VBUS_READY**: 0: (NO_VBUS_READY) VBUS disconnected (Unpowered or vSafe0V) 1: (VBUS_READY) VBUS connected (vSafe5V or negotiated power level)
[2]	**VBUS_VSAFE0V**: 0: (NO_VSAFE0V) VBUS is higher than 0.8 V 1: (VSAFE0V) VBUS is lower than 0.8 V
[1]	**VBUS_VALID_SNK**: 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**

3.12 CC_STATUS register

7	6	5	4	3	2	1	0
RESERVED		LOOKING_4_CONNECTION	CONNECT_RESULT	CC2_STATE		CC1_STATE	
R		R	R	R		R	

Address: STUSB_BLOCKBaseAddress + 0x11
Type: R
Reset: 0x00

[5]	**LOOKING_4_CONNECTION:** 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
[4]	**CONNECT_RESULT**: 0: Reserved. 1: (PRESENT_RD) The device is presenting Rd. When when TYPE-C FSM is in the following states: Attached.SNK, DebugAccessory.SNK
[3:2]	**CC2_STATE: (available when CONNECT_result =1)** 00: Reserved 01: SNK.Default (Above minimum vRd-Connect) 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)
[1:0]	**CC1_STATE: (available when CONNECT_result =1)** 00: Reserved 01: SNK.Default (Above minimum vRd-Connect) 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)

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

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

[7]	**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)
[6]	**VPU_VALID:** 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)
[4]	**VBUS_DISCH_FAULT:** 0: (NO_FAULT) No VBUS discharge issue 1: (FAULT) VBUS discharge issue has occurred
[3]	reserved
[2]	reserved
[1]	reserved
[0]	reserved

3.15 PD_TYPEC_STATUS register

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

Address: STUSB_BLOCKBaseAddress + 0x14
Type: R
Reset: 0x00

[3:0]	**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 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)

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

[7]	**REVERSE**: Connection orientation, indicates CC pin used for PD communication 0: (STRAIGHT_CC1) CC1 is attached 1: (TWISTED_CC2) CC2 is attached
[6]	**reserved**
[5]	**reserved**
[4:0]	**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 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

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**
[2]	**PRL_MSG_RECEIVED**: 0: (NO_MSG_RECEIVED) Cleared by I²C master 1: (MSG_RECEIVED) Interrupt for protocol layer message received
[1]	**reserved**
[0]	**PRL_HW_RST_RECEIVED**: 0: (NO_HW_RST) Cleared by I²C 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]	**SEND_COMMAND:** 0x26

3.19 MONITORING_CTRL_0 register

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

Address: STUSB_BLOCKBaseAddress + 0x20
Type: R/W
Reset: 0x10

[7:4]	**reserved**
[3]	**VBUS_SNK_DISC_THRESHOLD**: VBUS threshold for TYPE-C state machine de-connection 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_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

[0]	**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

3.23 VBUS_DISCHARGE_CTRL register

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

Address: STUSB_BLOCKBaseAddress + 0x26
Type: R/W
Reset: 0x00 (initialized by NVM)

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

3.24 VBUS_CTRL register

7	6	5	4	3	2	1	0
RESERVED						SINK_VBUS_EN	RESERVED
R						R	R

Address: STUSB_BLOCKBaseAddress + 0x27
Type: R
Reset: 0x00

[1]	**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**

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

[7:0]	**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) 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)

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

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

3.27 Device_ID register

7	6	5	4	3	2	1	0
Device_ID_7_0							
R							

Address: STUSB_BLOCKBaseAddress + 0x2F
Type: R/W
Reset: 0x25

[7:0]	**Device_ID_7_0**

3.28 RX_HEADER_LOW register

7	6	5	4	3	2	1	0
RX_HEADER_7_0							
R							

Address: STUSB_BLOCKBaseAddress + 0x31
Type: R
Reset: 0x00

[7:0]	**RX_HEADER_7_0**

3.29 RX_HEADER_HIGH register

7	6	5	4	3	2	1	0
RX_HEADER_15_8							
R							

Address: STUSB_BLOCKBaseAddress + 0x32
Type: R
Reset: 0x00

[7:0]	**RX_HEADER_15_8**

3.30 RX_DATA_OBJ1_0 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ1_0							
R							

Address: STUSB_BLOCKBaseAddress + 0x33
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ1_0**

3.31 RX_DATA_OBJ1_1 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ1_1							
R							

Address: STUSB_BLOCKBaseAddress + 0x34
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ1_1**

3.32 RX_DATA_OBJ1_2 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ1_2							
R							

Address: STUSB_BLOCKBaseAddress + 0x35
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ1_2**

3.33 RX_DATA_OBJ1_3 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ1_3							
R							

Address: STUSB_BLOCKBaseAddress + 0x36
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ1_3**

3.34 RX_DATA_OBJ2_0 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ2_0							
R							

Address: STUSB_BLOCKBaseAddress + 0x37
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ2_0**

3.35 RX_DATA_OBJ2_1 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ2_1							
R							

Address: STUSB_BLOCKBaseAddress + 0x38
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ2_1**

3.36 RX_DATA_OBJ2_2 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ2_2							
R							

Address: STUSB_BLOCKBaseAddress + 0x39
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ2_2**

3.37 RX_DATA_OBJ2_3 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ2_3							
R							

Address: STUSB_BLOCKBaseAddress + 0x3A
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ2_3**

3.38 RX_DATA_OBJ3_0 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ3_0							
R							

Address: STUSB_BLOCKBaseAddress + 0x3B
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ3_0**

3.39 RX_DATA_OBJ3_1 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ3_1							
R							

Address: STUSB_BLOCKBaseAddress + 0x3C
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ3_1**

3.40 RX_DATA_OBJ3_2 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ3_2							
R							

Address: STUSB_BLOCKBaseAddress + 0x3D
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ3_2**

3.41 RX_DATA_OBJ3_3 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ3_3							
R							

Address: STUSB_BLOCKBaseAddress + 0x3E
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ3_3**

3.42 RX_DATA_OBJ4_0 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ4_0							
R							

Address: STUSB_BLOCKBaseAddress + 0x3F
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ4_0**

3.43 RX_DATA_OBJ4_1 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ4_1							
R							

Address: STUSB_BLOCKBaseAddress + 0x40
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ4_1**

3.44 RX_DATA_OBJ4_2 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ4_2							
R							

Address: STUSB_BLOCKBaseAddress + 0x41
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ4_2**

3.45 RX_DATA_OBJ4_3 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ4_3							
R							

Address: STUSB_BLOCKBaseAddress + 0x42
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ4_3**

3.46 RX_DATA_OBJ5_0 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ5_0							
R							

Address: STUSB_BLOCKBaseAddress + 0x43
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ5_0**

3.47 RX_DATA_OBJ5_1 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ5_1							
R							

Address: STUSB_BLOCKBaseAddress + 0x44
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ5_1**

3.48 RX_DATA_OBJ5_2 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ5_2							
R							

Address: STUSB_BLOCKBaseAddress + 0x45
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ5_2**

3.49 RX_DATA_OBJ5_3 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ5_3							
R							

Address: STUSB_BLOCKBaseAddress + 0x46
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ5_3**

3.50 RX_DATA_OBJ6_0 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ6_0							
R							

Address: STUSB_BLOCKBaseAddress + 0x47
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ6_0**

3.51 RX_DATA_OBJ6_1 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ6_1							
R							

Address: STUSB_BLOCKBaseAddress + 0x48
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ6_1**

3.52 RX_DATA_OBJ6_2 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ6_2							
R							

Address: STUSB_BLOCKBaseAddress + 0x49
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ6_2**

3.53 RX_DATA_OBJ6_3 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ6_3							
R							

Address: STUSB_BLOCKBaseAddress + 0x4A
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ6_3**

3.54 RX_DATA_OBJ7_0 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ7_0							
R							

Address: STUSB_BLOCKBaseAddress + 0x4B
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ7_0**

3.55 RX_DATA_OBJ7_1 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ7_1							
R							

Address: STUSB_BLOCKBaseAddress + 0x4C
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ7_1**

3.56 RX_DATA_OBJ7_2 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ7_2							
R							

Address: STUSB_BLOCKBaseAddress + 0x4D
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ7_2**

3.57 RX_DATA_OBJ7_3 register

7	6	5	4	3	2	1	0
RX_DATA_OBJ7_3							
R							

Address: STUSB_BLOCKBaseAddress + 0x4E
Type: R
Reset: 0x00

[7:0]	**RX_DATA_OBJ7_3**

3.58 TX_HEADER_LOW register

7	6	5	4	3	2	1	0
TX_HEADER_7_0							
R/W							

Address: STUSB_BLOCKBaseAddress + 0x51
Type: R/W
Reset: 0x00

[7:0]	TX_HEADER_7_0

3.59 TX_HEADER_HIGH register

7	6	5	4	3	2	1	0
TX_HEADER_15_8							
R/W							

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

7	6	5	4	3	2	1	0
DPM_SNK_PDO1_0							
R/W							

Address: STUSB_BLOCKBaseAddress + 0x85
Type: R/W
Reset: 0x64 (initialized by NVM)

[7:0]	**DPM_SNK_PDO1_0**

3.62 DPM_SNK_PDO1_1 register

7	6	5	4	3	2	1	0
DPM_SNK_PDO1_1							
R/W							

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

7	6	5	4	3	2	1	0
DPM_SNK_PDO1_2							
R/W							

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

7	6	5	4	3	2	1	0
DPM_SNK_PDO1_3							
R/W							

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

7	6	5	4	3	2	1	0
DPM_SNK_PDO2_0							
R/W							

Address: STUSB_BLOCKBaseAddress + 0x89
Type: R/W
Reset: 0x96 (initialized by NVM)

[7:0]	**DPM_SNK_PDO2_0**

3.66 DPM_SNK_PDO2_1 register

7	6	5	4	3	2	1	0
DPM_SNK_PDO2_1							
R/W							

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

7	6	5	4	3	2	1	0
DPM_SNK_PDO2_2							
R/W							

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

7	6	5	4	3	2	1	0
DPM_SNK_PDO2_3							
R/W							

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

7	6	5	4	3	2	1	0
DPM_SNK_PDO3_0							
R/W							

Address: STUSB_BLOCKBaseAddress + 0x8D
Type: R/W
Reset: 0x64 (initialized by NVM)

[7:0]	**DPM_SNK_PDO3_0**

3.70 DPM_SNK_PDO3_1 register

7	6	5	4	3	2	1	0
DPM_SNK_PDO3_1							
R/W							

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

7	6	5	4	3	2	1	0
DPM_SNK_PDO3_2							
R/W							

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

7	6	5	4	3	2	1	0
DPM_SNK_PDO3_3							
R/W							

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

7	6	5	4	3	2	1	0
RDO_REG_STATUS_0							
R/W							

Address: STUSB_BLOCKBaseAddress + 0x91
Type: R/W
Reset: 0x00

[7:0]	**RDO_REG_STATUS_0**

3.74 RDO_REG_STATUS_1 register

7	6	5	4	3	2	1	0
RDO_REG_STATUS_1							
R/W							

Address: STUSB_BLOCKBaseAddress + 0x92
Type: R/W
Reset: 0x00

[7:0]	**RDO_REG_STATUS_1**

3.75 RDO_REG_STATUS_2 register

7	6	5	4	3	2	1	0
RDO_REG_STATUS_2							
R/W							

Address: STUSB_BLOCKBaseAddress + 0x92
Type: R/W
Reset: 0x00

[7:0]	**RDO_REG_STATUS_2**

3.76 RDO_REG_STATUS_3 register

7	6	5	4	3	2	1	0
RDO_REG_STATUS_3							
R/W							

Address: STUSB_BLOCKBaseAddress + 0x94
Type: R/W
Reset: 0x00

[7:0]	**RDO_REG_STATUS_3**

Revision history

Table 5. **Document revision history**

Date	Version	Changes
16-Dec-2019	1	Initial release.

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