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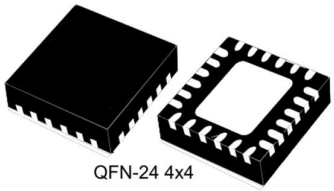
TECHNICAL NOTE

STUSB4500 NVM registers
Description and generic access

WLCSP-25 2.6x2.6



QFN-24 4x4

Related products

- STUSB4500
  Standalone USB PD sink controller with short-to-VBUS protections
- STEVAL-ISC005V1
  Evaluation board for the STUSB4500 USB Power Delivery controller
- • STREF-SCS001V1
  Fast and easy migration from DC barrel to Type-C

Scope

- Summary of STUSB4500 NVM operation
- NVM organization
- I2C access description for NVM Read and Write
- “C” code example
- Full NVM Mapping
- Practical example with STSW-STUSB002 GUI software import and export

Content

1 NVM Principle

1.1 IC Startup

The STUSB4500 is a USB power delivery controller that addresses sink devices.
It is a full autonomous and auto-run device that implements a proprietary algorithm to allow the negotiation of a power delivery contract with a source without MCU support. PDO profiles and other parameters are configured in an integrated non-volatile memory (NVM).

When the device starts, NVM content is loaded into registers, and parameters are used by the algorithms and state machines.

Device behaviour can be customised by changing some values in NVM. A specific procedure based on I2C accesses allows the read, erase and write of NVM.
Parameters are described in STUSB4500 datasheet, and NVM mapping is described in this document.

Thus, to avoid side effects, it is strongly recommended to use ST provided tools such as STSW-STUSB002 GUI software to modify the parameters.

1.2 NVM Organization

Memory is organized into 5 banks of 64bits
Each bank can be addressed individually.
For any operation, the whole content of the bank (all the 64bits) will be affected.

Memory map : Addresses

Bank	Address							
0	0xC0	0xC1	0xC2	0xC3	0xC4	0xC5	0xC6	0xC7
1	0xC8	0xC9	0xCA	0xCB	0xCC	0xCD	0xCE	0xCF
2	0xD0	0xD1	0xD2	0xD3	0xD4	0xD5	0xD6	0xD7
3	0xD8	0xD9	0xDA	0xDB	0xDC	0xDD	0xDE	0xDF
4	0xE0	0xE1	0xE2	0xE3	0xE4	0xE5	0xE6	0xE7

Memory map : Data

Bank	Data							
0	Data_C0	Data_C1	Data_C2	Data_C3	Data_C4	Data_C5	Data_C6	Data_C7
1	Data_C8	Data_C9	Data_CA	Data_CB	Data_CC	Data_CD	Data_CE	Data_CF
2	Data_D0	Data_D1	Data_D2	Data_D3	Data_D4	Data_D5	Data_D6	Data_D7
3	Data_D8	Data_D9	Data_DA	Data_DB	Data_DC	Data_DD	Data_DE	Data_DF
4	Data_E0	Data_E1	Data_E2	Data_E3	Data_E4	Data_E5	Data_E6	Data_E7

Memory map : Default Values

Bank	Data							
0	0x00	0x00	0xB0	0xAA	0x00	0x45	0x00	0x00
1	0x10	0x40	0x9C	0x1C	0xFF	0x01	0x3C	0xDF
2	0x02	0x40	0x0F	0x00	0x32	0x00	0xFC	0xF1
3	0x00	0x19	0x56	0xAF	0xF5	0x35	0x5F	0x00
4	0x00	0x4B	0x90	0x21	0x43	0x00	0x40	0xFB

1.3 NVM map full list

Bank 0

Addr	Content
0xC0	RESERVED : VENDOR_ID_LOW = 0x00
0xC1	RESERVED : VENDOR_ID_HIGH = 0x00
0xC2	RESERVED : PRODUCT_ID_LOW = 0xB0
0xC3	RESERVED : PRODUCT_ID_HIGH = 0xAA
0xC4	RESERVED : BCD_DEVICE_ID_LOW = 0x00
0xC5	RESERVED : BCD_DEVICE_ID_LOW = 0x45
0xC6	RESERVED : PORT_ROLE_CTRL = 0x00
0xC7	RESERVED : DEVICE_POWER_ROLE_CTRL = 0x00

Bank 1

Addr	Content			
0xC8	RESERVED : 0b00		GPIO_CFG[1:0]	RESERVED : 0x0
0xC9	0	1	VBUS_DCHG_MASK	RESERVED : 0b00000
0xCA	DISCHARGE_TIME_TO_0V[3:0]			VBUS_DISCH_TIME_TO_PDO[3:0]
0xCB	RESERVED : 0x1C			
0xCC	RESERVED : 0xFF			
0xCD	RESERVED : 0x01			
0xCE	RESERVED : 0x3C			
0xCF	RESERVED : 0xDF			

Bank 2

Addr	Content
0xD0	RESERVED : 0x02
0xD1	RESERVED : 0x40
0xD2	RESERVED : 0x0F
0xD3	RESERVED : 0x00
0xD4	RESERVED : 0x32
0xD5	RESERVED : 0x00
0xD6	RESERVED : 0xFC
0xD7	RESERVED : 0xF1

Bank 3

Addr	Content			
0xD8	RESERVED : 0x00			
0xD9	RESERVED : 0x19			
0xDA	LUT_SNK_PDO1_I[3:0]	SNK_ UNCONS_ POWER	DPM_SNK_ PDO_NUMB[1:0]	USB_ COMM_ CAPABLE
0xDB	SNK_HL1[3:0]	SNK_LL1[3:0]		
0xDC	SNK_LL2[3:0]	LUT_SNK_PDO2_I[3:0]		
0xDD	LUT_SNK_PDO3_I[3:0]	SNK_HL2[3:0]		
0xDE	SNK_HL3[3:0]	SNK_LL3[3:0]		
0xDF	RESERVED : SNK_PDO_FILL_0xDF = 0x00			

Bank 4

Addr	Content				
0xE0	SNK_PDO_ FLEX1_V[1:0]	RESERVED : 0b000000			
0xE1	SNK_PDO_FLEX1_V[9:2]				
0xE2	SNK_PDO_FLEX2_V[7:0]				
0xE3	SNK_PDO_FLEX_I[5:0]				SNK_PDO_ FLEX2_V[9:8]
0xE4	0	POWER_OK_ CFG[1:0]	0	SNK_PDO_FLEX_I[9:6]	
0xE5	RESERVED : SPARE = 0x00				
0xE6	RESERVED : 0b010		REQ_ SRC_ CURRENT	RESERVED : 0x0	
0xE7	RESERVED : ALERT_STATUS_1_MASK = 0xFB				

2 I2C NVM Access

NVM access is done through STUSB4500 I2C read and write commands to specific registers.

2.1 NVM registers

2.1.1 Control registers :

Registers list

Addr	Content
0x95	FTP_KEY
0x96	FTP_CTRL_0
0x97	FTP_CTRL_1

FTP_KEY

Bit	7	6	5	4	3	2	1	0
Content	FTP_KEY							

Address: 0x95
Default: 0x00
Description: FTP_KEY register

[7:0]	FTP_KEY: Customer FTP access Key

FTP_CTRL_0

Bit	7	6	5	4	3	2	1	0
Content	FTP_CUST_PWR	FTP_CUST_RST_N	RESERVED	FTP_CUST_REQ	RESERVED	FTP_CUST_SECT		

Address: 0x96
Default: 0x40
Description: FTP_CTRL_0 register

[7]	FTP_CUST_PWR: Not used
[6]	FTP_CUST_RST_N: NVM macro-cell reset in customer mode (Active Low) 0: Active reset 1: No reset
[5]	RESERVED = 0
[4]	FTP_CUST_REQ: Access request to NVM in customer mode
[3]	RESERVED = 0
[2:1]	FTP_CUST_SECT: 000: Sector 0 accessed 001: Sector 1 accessed 010: Sector 2 accessed 011: Sector 3 accessed 100: Sector 4 accessed others: Not allowed in customer mode (In this case sector 0 accessed)

FTP_CTRL_1

Bit	7	6	5	4	3	2	1	0
Content	FTP_CUST_SER					FTP_CUST_OPCODE		

Address: 0x97
Default: 0x00
Description: FTP_CTRL_1 register

[7:3]	FTP_CUST_SER: NVM sector input in customer mode 00000: (NO_SECTOR) No sector selected xxxx1: Sector 0 selected xxx1x: Sector 1 selected xx1xx: Sector 2 selected x1xxx: Sector 3 selected 1xxxx: Sector 4 selected
[2:0]	FTP_CUST_OPCODE: NVM operation in customer mode 000: Read memory array 001: Shift In Data on Program Load Register 010: Shift In Data on Sector Erase Register 011: Shift Out Data on Program Load Register 100: Shift Out Data on sector Erase Register 101: Erase memory array 110: Program word into EEPROM 111: Soft Program array

2.1.2 Data registers :

NVM Data Read / Write registers

Addr	Content
0x53	NVM data : LSB
0x54	NVM data
0x55	NVM data
0x56	NVM data
0x57	NVM data
0x58	NVM data
0x59	NVM data
0x5A	NVM data : MSB

2.2 NVM READ procedure

2.2.1 Procedure

The following operations shall be done for NVM read:

2.2.1.1 *NVM Accessibility*

Before any operation, the customer access key must be written in the FTP_KEY register. This write gives the access to the FTP_CTRL_0 and FTP_CTRL_1 registers.

- Unlock NVM by writing password in FTP_KEY register :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x95, data = 0x47

2.2.1.2 *NVM Power-up / Reset Sequence*

After STUSB4500 start-up sequence, the NVM is powered off.
Before any customer operation, the NVM must be powered on and reset pulse must be applied by the following sequence:

- Put NVM internal controller and NVM in operational conditions : write FTP_CUST_RST_N at ‘1’ in FTP_CTRL_0 register :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x40

- Reset NVM internal controller and NVM : write FTP_CUST_RST_N at ‘0’ in FTP_CTRL_0 register :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x00
- A temporization upper than 2 us must be observed before the following write.
- Put NVM internal controller and NVM in operational conditions : write FTP_CUST_RST_N at ‘1’ in FTP_CTRL_0 register :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x40

2.2.1.3 *NVM Customer Sector0 Read*

- Set Read Sector Opcode (0b000) in FTP_CTRL_1 register :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x00
- Load Opcode : set FTP_CUST_REQ = ‘1’ and FTP_CUST_SECT = 0b000 in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
- Wait for command execution : 1ms
- Read NVM Data (8 bytes) at starting address 0x53
  - (Less Significant Byte)
    Data_C0 : I2C Read : dev_addr = 0x28, reg_addr = 0x53
  - Data_C1 : I2C Read : dev_addr = 0x28, reg_addr = 0x54
  - Data_C2 : I2C Read : dev_addr = 0x28, reg_addr = 0x55
  - Data_C3 : I2C Read : dev_addr = 0x28, reg_addr = 0x56
  - Data_C4 : I2C Read : dev_addr = 0x28, reg_addr = 0x57
  - Data_C5 : I2C Read : dev_addr = 0x28, reg_addr = 0x58
  - Data_C6 : I2C Read : dev_addr = 0x28, reg_addr = 0x59
  - (Most Significant Byte)
    Data_C7 : I2C Read : dev_addr = 0x28, reg_addr = 0x5A

2.2.1.4 *NVM Customer Sector1 Read*

- Set Read Sector Opcode (0b000) in FTP_CTRL_1 register :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x00
- Load Opcode : set FTP_CUST_REQ = ‘1’ and FTP_CUST_SECT = 0b001 in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x51
- Wait for command execution : 1ms
- Read NVM Data (8 bytes) at starting address 0x53
  - (Less Significant Byte)
    Data_C8 : I2C Read : dev_addr = 0x28, reg_addr = 0x53
  - Data_C9 : I2C Read : dev_addr = 0x28, reg_addr = 0x54
  - Data_CA : I2C Read : dev_addr = 0x28, reg_addr = 0x55
  - Data_CB : I2C Read : dev_addr = 0x28, reg_addr = 0x56
  - Data_CC : I2C Read : dev_addr = 0x28, reg_addr = 0x57
  - Data_CD : I2C Read : dev_addr = 0x28, reg_addr = 0x58
  - Data_CE : I2C Read : dev_addr = 0x28, reg_addr = 0x59
  - (Most Significant Byte)
    Data_CF : I2C Read : dev_addr = 0x28, reg_addr = 0x5A

2.2.1.5 *NVM Customer Sector2 Read*

- Set Read Sector Opcode (0b000) in FTP_CTRL_1 register :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x00
- Load Opcode : set FTP_CUST_REQ = ‘1’ and FTP_CUST_SECT = 0b010 in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x52
- Wait for command execution : 1ms
- Read NVM Data (8 bytes) at starting address 0x53
  - (Less Significant Byte)
    Data_D0 : I2C Read : dev_addr = 0x28, reg_addr = 0x53
  - Data_D1 : I2C Read : dev_addr = 0x28, reg_addr = 0x54
  - Data_D2 : I2C Read : dev_addr = 0x28, reg_addr = 0x55
  - Data_D3 : I2C Read : dev_addr = 0x28, reg_addr = 0x56
  - Data_D4 : I2C Read : dev_addr = 0x28, reg_addr = 0x57
  - Data_D5 : I2C Read : dev_addr = 0x28, reg_addr = 0x58
  - Data_D6 : I2C Read : dev_addr = 0x28, reg_addr = 0x59
  - (Most Significant Byte)
    Data_D7 : I2C Read : dev_addr = 0x28, reg_addr = 0x5A

2.2.1.6 *NVM Customer Sector3 Read*

- Set Read Sector Opcode (0b000) in FTP_CTRL_1 register :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x00
- Load Opcode : set FTP_CUST_REQ = '1' and FTP_CUST_SECT = 0b011 in register FTP_CTRL_0 :
- I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x53
- Wait for command execution : 1ms
- Read NVM Data (8 bytes) at starting address 0x53
  - (Less Significant Byte)
    Data_D8 : I2C Read : dev_addr = 0x28, reg_addr = 0x53
  - Data_D9 : I2C Read : dev_addr = 0x28, reg_addr = 0x54
  - Data_DA : I2C Read : dev_addr = 0x28, reg_addr = 0x55
  - Data_DB : I2C Read : dev_addr = 0x28, reg_addr = 0x56
  - Data_DC : I2C Read : dev_addr = 0x28, reg_addr = 0x57
  - Data_DD : I2C Read : dev_addr = 0x28, reg_addr = 0x58
  - Data_DE : I2C Read : dev_addr = 0x28, reg_addr = 0x59
  - (Most Significant Byte)
    Data_DF : I2C Read : dev_addr = 0x28, reg_addr = 0x5A

2.2.1.7 *NVM Customer Sector4 Read*

- Set Read Sector Opcode (0b000) in FTP_CTRL_1 register :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x00
- Load Opcode : set FTP_CUST_REQ = '1' and FTP_CUST_SECT = 0b100 in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x54
- Wait for command execution : 1ms
- Read NVM Data (8 bytes) at starting address 0x53
  - (Less Significant Byte)
    Data_E0 : I2C Read : dev_addr = 0x28, reg_addr = 0x53
  - Data_E1 : I2C Read : dev_addr = 0x28, reg_addr = 0x54
  - Data_E2 : I2C Read : dev_addr = 0x28, reg_addr = 0x55
  - Data_E3 : I2C Read : dev_addr = 0x28, reg_addr = 0x56
  - Data_E4 : I2C Read : dev_addr = 0x28, reg_addr = 0x57
  - Data_E5 : I2C Read : dev_addr = 0x28, reg_addr = 0x58
  - Data_E6 : I2C Read : dev_addr = 0x28, reg_addr = 0x59
  - (Most Significant Byte)
    Data_E7 : I2C Read : dev_addr = 0x28, reg_addr = 0x5A

2.2.1.8 *Exit Test mode*

- Clear FTP_CTRL registers
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96,
    data = 0x40, 0x00
- Clear FTP_KEY register
  - I2C Write : dev_addr = 0x28, reg_addr = 0x95, data = 0x00

2.2.2 Pseudo Code example for full memory read

```
I2C Write : dev_addr = 0x28, reg_addr = 0x95, data = 0x47
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x40
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x00
Wait for command execution : 1ms
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x40
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x00
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
Wait for command execution : 1ms
[Data_C0..Data_C7] : 8 Bytes I2C Read : dev_addr = 0x28, reg_addr = 0x53
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x51
Wait for command execution : 1ms
[Data_C8..Data_CF] : 8 Bytes I2C Read : dev_addr = 0x28, reg_addr = 0x53
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x52
Wait for command execution : 1ms
[Data_D0..Data_D7] : 8 Bytes I2C Read : dev_addr = 0x28, reg_addr = 0x53
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x53
```

```
Wait for command execution : 1ms
[Data_D8..Data_DF] : 8 Bytes I2C Read : dev_addr = 0x28, reg_addr = 0x53
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x54
Wait for command execution : 1ms
[Data_E0..Data_E7] : 8 Bytes I2C Read : dev_addr = 0x28, reg_addr = 0x53
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x40, 0x00
I2C Write : dev_addr = 0x28, reg_addr = 0x95, data = 0x00
```

2.3 NVM WRITE procedure

2.3.1 Procedure

The following operations shall be done for NVM write :

2.3.1.1 *NVM Accessibility*

Before any operation, the customer access key must be written in the FTP_KEY register. This write gives the access to the FTP_CTRL_0 and FTP_CTRL_1 registers.

- Unlock NVM by writing password in FTP_KEY register
  - I2C Write : dev_addr = 0x28, reg_addr = 0x95, data = 0x47

2.3.1.2 *NVM Power-up Sequence*

After STUSB4500 start-up sequence, the NVM is powered off.
Before any customer operation, the NVM must be powered on and reset pulse must be applied by the following sequence:

- Load 0x00 to data register
  - I2C Write : dev_addr = 0x28, reg_addr = 0x53, data = 0x00
- Put NVM internal controller and NVM in operational conditions : write FTP_CUST_PWR and FTP_CUST_RST_N at ‘1’ in FTP_CTRL_0 register :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x40
- Reset NVM internal controller and NVM : write FTP_CUST_RST_N at ‘0’ in FTP_CTRL_0 register :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x00
- A temporization upper than 2 us must be observed before the following write.
- Put NVM internal controller and NVM in operational conditions : write FTP_CUST_RST_N at ‘1’ in FTP_CTRL_0 register :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x40

2.3.1.3 *NVM Customer Full Erase*

- Set “Shift In Data on Sector Erase Register” Opcode for all sectors : FTP_CUST_SER = 0b11111 and FTP_CUST_OPCODE = 0b010 in register FTP_CTRL_1
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0xFA
- Load Opcode : set FTP_CUST_REQ = ‘1’ in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
- Wait for command execution : 1ms
- Set “Soft Program array” : FTP_CUST_OPCODE = 0b111
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x07
- Load Opcode : set FTP_CUST_REQ = ‘1’ in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
- Wait for EP (Memory Erase time) : 5ms
- Set “Erase memory array” Opcode : FTP_CUST_OPCODE = 0b101
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x05
- Load Opcode : set FTP_CUST_REQ = ‘1’ in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
- Wait for EP (Memory Erase time) : 5ms

2.3.1.4 *NVM Customer Sector0 Write*

- Load NVM Data Sector 0 (8 bytes) at starting address 0x53
  - I2C Write : dev_addr = 0x28, reg_addr = 0x53,
    data = Data_C0, Data_C1, Data_C2, Data_C3, Data_C4, Data_C5, Data_C6, Data_C7
- Set “Shift In Data on Program Load Register” Opcode : FTP_CUST_OPCODE = 0b001
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x01
- Load Opcode : set FTP_CUST_REQ = ‘1’ in register FTP_CTRL_0 :

- I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
- Wait for command execution : 1ms
- Set “Program word into EEPROM” Opcode : FTP_CUST_OPCODE = 0b110
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x06
- Load Opcode with sector value : set FTP_CUST_REQ = ‘1’ and FTP_CUST_SECT = ‘000’ in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
- Wait for PP (Word Program time) : 2ms

2.3.1.5 *NVM Customer Sector1 Write*

- Load NVM Data Sector 1 (8 bytes) at starting address 0x53
  - I2C Write : dev_addr = 0x28, reg_addr = 0x53,
    data = Data_C8, Data_C9, Data_CA, Data_CB, Data_CC, Data_CD, Data_CE, Data_CF
- Set “Shift In Data on Program Load Register” Opcode : FTP_CUST_OPCODE = 0b001
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x01
- Load Opcode : set FTP_CUST_REQ = ‘1’ in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
- Wait for command execution : 1ms
- Set “Program word into EEPROM” Opcode : FTP_CUST_OPCODE = 0b110
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x06
- Load Opcode with sector value : set FTP_CUST_REQ = ‘1’ and FTP_CUST_SECT = ‘001’ in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x51
- Wait for PP (Word Program time) : 2ms

2.3.1.6 *NVM Customer Sector2 Write*

- Load NVM Data Sector 2 (8 bytes) at starting address 0x53
  - I2C Write : dev_addr = 0x28, reg_addr = 0x53,
    data = Data_D0, Data_D1, Data_D2, Data_D3, Data_D4, Data_D5, Data_D6, Data_D7
- Set “Shift In Data on Program Load Register” Opcode : FTP_CUST_OPCODE = 0b001
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x01
- Load Opcode : set FTP_CUST_REQ = ‘1’ in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
- Wait for command execution : 1ms
- Set “Program word into EEPROM” Opcode : FTP_CUST_OPCODE = 0b110
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x06
- Load Opcode with sector value : set FTP_CUST_REQ = ‘1’ and FTP_CUST_SECT = ‘010’ in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x52
- Wait for PP (Word Program time) : 2ms

2.3.1.7 *NVM Customer Sector3 Write*

- Load NVM Data Sector 3 (8 bytes) at starting address 0x53
  - I2C Write : dev_addr = 0x28, reg_addr = 0x53,
    data = Data_D8, Data_D9, Data_DA, Data_DB, Data_DC, Data_DD, Data_DE, Data_DF
- Set “Shift In Data on Program Load Register” Opcode : FTP_CUST_OPCODE = 0b001
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x01
- Load Opcode : set FTP_CUST_REQ = ‘1’ in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
- Wait for command execution : 1ms
- Set “Program word into EEPROM” Opcode : FTP_CUST_OPCODE = 0b110
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x06
- Load Opcode with sector value : set FTP_CUST_REQ = ‘1’ and FTP_CUST_SECT = ‘011’ in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x53
- Wait for PP (Word Program time) : 2ms

2.3.1.8 *NVM Customer Sector4 Write*

- Load NVM Data Sector 4 (8 bytes) at starting address 0x53

- I2C Write : dev_addr = 0x28, reg_addr = 0x53,
  data = Data_E0, Data_E1, Data_E2, Data_E3, Data_E4, Data_E5, Data_E6, Data_E7
- Set “Shift In Data on Program Load Register” Opcode : FTP_CUST_OPCODE = 0b001
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x01
- Load Opcode : set FTP_CUST_REQ = ‘1’ in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
- Wait for command execution : 1ms
- Set “Program word into EEPROM” Opcode : FTP_CUST_OPCODE = 0b110
  - I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x06
- Load Opcode with sector value : set FTP_CUST_REQ = ‘1’ and FTP_CUST_SECT = ‘100’ in register FTP_CTRL_0 :
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x54
- Wait for PP (Word Program time) : 2ms

2.3.1.9 *Exit Test mode*

- Clear FTP_CTRL registers
  - I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x40, 0x00
- Clear FTP_KEY register
  - I2C Write : dev_addr = 0x28, reg_addr = 0x95, data = 0x00

2.3.2 Pseudo Code example for full memory Write

```
I2C Write : dev_addr = 0x28, reg_addr = 0x95, data = 0x47
I2C Write : dev_addr = 0x28, reg_addr = 0x53, data = 0x00
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x40
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x00
Wait for command execution : 1ms
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x40
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0xFA
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
Wait for command execution : 1ms
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x07
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
Wait for EP (Memory Erase time) : 5ms
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x05
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
Wait for EP (Memory Erase time) : 5ms
I2C Write : dev_addr = 0x28, reg_addr = 0x53, data = [Data_C0..Data_C7]
Wait for command execution : 1ms
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x01
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
Wait for command execution : 1ms
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x06
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
Wait for PP (Word Program time) : 2ms
I2C Write : dev_addr = 0x28, reg_addr = 0x53, data = [Data_C8..Data_CF]
Wait for command execution : 1ms
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x01
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
Wait for command execution : 1ms
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x06
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x51
Wait for PP (Word Program time) : 2ms
I2C Write : dev_addr = 0x28, reg_addr = 0x53, data = [Data_D0..Data_D7]
Wait for command execution : 1ms
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x01
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
Wait for command execution : 1ms
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x06
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x52
```

```
Wait for PP (Word Program time) : 2ms
I2C Write : dev_addr = 0x28, reg_addr = 0x53, data = [Data_D8..Data_DF]
Wait for command execution : 1ms
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x01
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
Wait for command execution : 1ms
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x06
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x53
Wait for PP (Word Program time) : 2ms
I2C Write : dev_addr = 0x28, reg_addr = 0x53, data = [Data_E0..Data_E7]
Wait for command execution : 1ms
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x01
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x50
Wait for command execution : 1ms
I2C Write : dev_addr = 0x28, reg_addr = 0x97, data = 0x06
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x54
Wait for PP (Word Program time) : 2ms
I2C Write : dev_addr = 0x28, reg_addr = 0x96, data = 0x40, 0x00
I2C Write : dev_addr = 0x28, reg_addr = 0x95, data = 0x00
```

3 “C” code example

3.1 I2C API functions

```
HAL_StatusTypeDef I2C_Read_USB_PD(uint8_t Port, uint16_t Address ,uint8_t *DataR ,uint16_t Length);
/* I2C Read for STUSB4500
    Device address : DevADDR defined by STUSB4500 IC, ADDR0 and ADDR1 pins
        (default : 0x28 in 7 bits format)
    uint16_t Address : Register address RegADDR
    uint8_t *DataR : data pointer
    uint16_t Length : number of data to read */

HAL_StatusTypeDef I2C_Write_USB_PD(uint8_t Port, uint16_t Address ,uint8_t *DataW ,uint16_t Length);
/* I2C Write for STUSB4500
    Device address : DevADDR defined by STUSB4500 IC, ADDR0 and ADDR1 pins
        (default : 0x28 in 7 bits format)
    uint16_t Address : Register address RegADDR
    uint8_t *DataW : data pointer
    uint16_t Length : number of data to write */
```

3.2 Header & definition

```
/*NVM Flasher Registers Definition */
#define FTP_CUST_PASSWORD_REG   0x95
#define FTP_CUST_PASSWORD       0x47
#define FTP_CTRL_0              0x96
#define FTP_CUST_PWR            0x80
#define FTP_CUST_RST_N          0x40
#define FTP_CUST_REQ            0x10
#define FTP_CUST_SECT           0x07
#define FTP_CTRL_1              0x97
#define FTP_CUST_SER            0xF8
#define FTP_CUST_OPCODE         0x07
#define RW_BUFFER               0x53

/*"000" then No Operation
"001" then Read
"010" and FTP_ADR[2:0]="000" then Shift-In Write Bit Data (0x20-0x28). (to be done before
Programming)
"010" and FTP_ADR[2:0]="001" then Shift-In Erase Sector Data (0x20). (to be done before Erasing)
"011" and FTP_ADR[2:0]="000" then Shift-Out Read Bit Data (0x20-0x28). (to be done after Reading)
"011" and FTP_ADR[2:0]="001" then Shift-Out Erase Sector Data (0x20). (to be done after Erasing)
"100" then Verify (to be done after Programming)
"101" then Erase
"110" then Program
"111" then Soft Programming (to be done after Erasing)*/
#define READ                0x00
#define WRITE_PL            0x01
#define WRITE_SER           0x02
#define READ_PL             0x03
#define READ_SER            0x04
#define ERASE_SECTOR        0x05
#define PROG_SECTOR         0x06
#define SOFT_PROG_SECTOR    0x07
#define SECTOR_0            0x01
#define SECTOR_1            0x02
#define SECTOR_2            0x04
#define SECTOR_3            0x08
#define SECTOR_4            0x10
```

3.1 nvm_flash

```
uint8_t nvm_flash(uint8_t Port)
{
    if (CUST_EnterWriteMode(0, SECTOR_0 |SECTOR_1 |SECTOR_2 |SECTOR_3 | SECTOR_4 ) != 0 ) return 1;

    if (CUST_WriteSector(0,0,Sector0) != 0 ) return 1;
    if (CUST_WriteSector(0,1,Sector1) != 0 ) return 1;
    if (CUST_WriteSector(0,2,Sector2) != 0 ) return 1;
    if (CUST_WriteSector(0,3,Sector3) != 0 ) return 1;
    if (CUST_WriteSector(0,4,Sector4) != 0 ) return 1;

    if (CUST_ExitTestMode(0) != 0 ) return 1;

    return 0;
}
```

3.2 EnterReadMode

```
uint8_t CUST_EnterReadMode(uint8_t Port)
{
    unsigned char Buffer[10];

    /* Set Password*/
    Buffer[0]=FTP_CUST_PASSWORD;
    if ( I2C_Write_USB_PD(Port,FTP_CUST_PASSWORD_REG,Buffer,1) != HAL_OK ) return 1;

    /* Set RST_N bit */
    Buffer[0]= FTP_CUST_RST_N ;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;

    /* Reset NVM */
    Buffer[0]=0;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;

    /* Set RST_N bit */
    Buffer[0]= FTP_CUST_RST_N ;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;

    return 0 ;
}
```

3.3 ReadSector

```
uint8_t CUST_ReadSector(uint8_t Port,char SectorNum, unsigned char *SectorData)
{
    unsigned char Buffer[10];

    /* Set Read Sectors Opcode */
    Buffer[0]= (READ & FTP_CUST_OPCODE);
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_1,Buffer,1) != HAL_OK ) return 1;

    /* Load Read Sectors Opcode */
    Buffer[0]= (SectorNum & FTP_CUST_SECT) | FTP_CUST_RST_N | FTP_CUST_REQ;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;

    /* Wait for execution */
    do
    {
        if ( I2C_Read_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;
    }
    while(Buffer[0] & FTP_CUST_REQ);

    /* Sectors Data are available in RW-BUFFER @ 0x53 */
    I2C_Read_USB_PD(Port,RW_BUFFER,&SectorData[0],8);
}
```

3.4 EnterWriteMode

```
uint8_t CUST_EnterWriteMode(uint8_t Port,unsigned char ErasedSector)
{
    unsigned char Buffer[10];

    /* Set Password*/
    Buffer[0]=FTP_CUST_PASSWORD;
    if ( I2C_Write_USB_PD(Port,FTP_CUST_PASSWORD_REG,Buffer,1) != HAL_OK ) return 1;

    /* this register must be NULL for Partial Erase feature */
    Buffer[0]= 0;
    if ( I2C_Write_USB_PD(Port,RW_BUFFER,Buffer,1) != HAL_OK ) return 1;

    /* Set RST_N bit */
    Buffer[0]= FTP_CUST_RST_N ;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;

    /* Reset NVM */
    Buffer[0]=0;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;

    /* Set RST_N bit */
    Buffer[0]= FTP_CUST_RST_N;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;

    /* Load 0xF1 to FTP_CUST_SER to erase all sectors of FTP and Set Write SER Opcode */
    Buffer[0]=((ErasedSector << 3) & FTP_CUST_SER) | ( WRITE_SER & FTP_CUST_OPCODE);
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_1,Buffer,1) != HAL_OK ) return 1;

    /* Load Write SER Opcode */
    Buffer[0]= FTP_CUST_RST_N | FTP_CUST_REQ ;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;

    /* Wait for execution */do
    {
        if ( I2C_Read_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;
    }
    while(Buffer[0] & FTP_CUST_REQ);

    /* Set Soft Prog Opcode */
    Buffer[0]=  SOFT_PROG_SECTOR & FTP_CUST_OPCODE ;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_1,Buffer,1) != HAL_OK ) return 1;

    /* Load Soft Prog Opcode */
    Buffer[0]= FTP_CUST_RST_N | FTP_CUST_REQ ;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;

    /* Wait for execution */
    do
    {
        if ( I2C_Read_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;
    }
    while(Buffer[0] & FTP_CUST_REQ);

    /* Set Erase Sectors Opcode */
    Buffer[0]= ERASE_SECTOR & FTP_CUST_OPCODE ;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_1,Buffer,1) != HAL_OK ) return 1;

    /* Load Erase Sectors Opcode */
    Buffer[0]= FTP_CUST_RST_N | FTP_CUST_REQ ;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;

    /* Wait for execution */
    do
    {
        if ( I2C_Read_USB_PD(Port,FT_CTRL_0,Buffer,1) != HAL_OK ) return 1;
    }
```

```
    while(Buffer[0] & FTP_CUST_REQ);

    return 0;
}
```

3.5 WriteSector

```
uint8_t CUST_WriteSector(uint8_t Port,char SectorNum, unsigned char *SectorData)
{
    unsigned char Buffer[10];

    /* Write Sectors Data in RW-BUFFER @ 0x53 */
    I2C_Write_USB_PD(Port,RW_BUFFER,SectorData,8);

    /*Set Write to PL Opcode*/
    Buffer[0]= (WRITE_PL & FTP_CUST_OPCODE);
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_1,Buffer,1) != HAL_OK ) return 1;

    /* Load Write to PL Sectors Opcode */
    Buffer[0]= FTP_CUST_RST_N | FTP_CUST_REQ;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;

    /* Wait for execution */
    do
    {
        if ( I2C_Read_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;
    }
    while(Buffer[0] & FTP_CUST_REQ) ;

    /*Set Prog Sectors Opcode*/
    Buffer[0]= (PROG_SECTOR & FTP_CUST_OPCODE);
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_1,Buffer,1) != HAL_OK ) return 1;

    /* Load Prog Sectors Opcode */
    Buffer[0]=(SectorNum & FTP_CUST_SECT) |FTP_CUST_RST_N | FTP_CUST_REQ;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;

    /* Wait for execution */
    do
    {
        if ( I2C_Read_USB_PD(Port,FTP_CTRL_0,Buffer,1) != HAL_OK ) return 1;
    }
    while(Buffer[0] & FTP_CUST_REQ) ;
    return 0;
}
```

3.6 ExitTestMode

```
uint8_t CUST_ExitTestMode(uint8_t Port)
{
    unsigned char Buffer[10];

    /* clear registers */
    Buffer[0]= FTP_CUST_RST_N; Buffer[1]=0x00;
    if ( I2C_Write_USB_PD(Port,FTP_CTRL_0,Buffer,2) != HAL_OK ) return 1;

    /* Clear Password */
    Buffer[0]=0x00;
    if ( I2C_Write_USB_PD(Port,FTP_CUST_PASSWORD_REG,Buffer,1) != HAL_OK ) return 1;

    return 0 ;
}
```

4 NVM Map

4.1 NVM Map customization through STSW-STUSB002 GUI

Thanks to STSW-STUSB002 GUI software, parameters can be modified to configure STUSB4500 without studying the full map.
GUI can read and write STUSB4500 device through NUCLEO-F072RB interface board for evaluation, configuration validation and quick prototyping.
GUI can also interpret and generate text format files of NVM map.

4.1.1 STSW-STUSB002 GUI file format

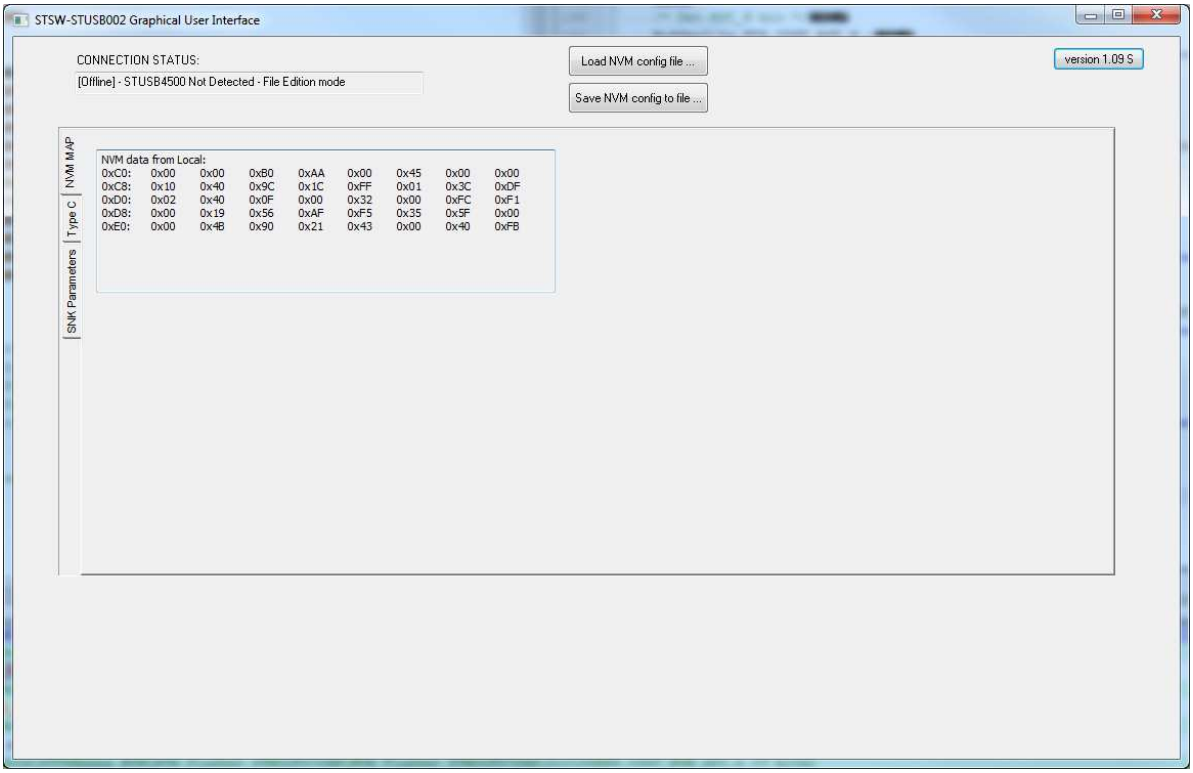
```
0xC0:→Data_C0→Data_C1→Data_C2→Data_C3→Data_C4→Data_C5→Data_C6→Data_C7→CR LF
0xC8:→Data_C8→Data_C9→Data_CA→Data_CB→Data_CC→Data_CD→Data_CE→Data_CF→CR LF
0xD0:→Data_C0→Data_C1→Data_C2→Data_C3→Data_C4→Data_C5→Data_C6→Data_C7→CR LF
0xD8:→Data_C8→Data_C9→Data_CA→Data_CB→Data_CC→Data_CD→Data_CE→Data_CF→CR LF
0xE0:→Data_E0→Data_E1→Data_E2→Data_E3→Data_E4→Data_E5→Data_E6→Data_E7→CR LF
CR LF
```

Symbols note :
→ : ASCII code 0x09 TAB (horizontal tab)
CR : ASCII code 0x0D CR (carriage return)
LF : ASCII code 0x0A LF (NL line feed, new line)

4.1.2 STUSB4500 NVM default content (GUI file format)

```
0xC0:  0x00  0x00  0xB0  0xAA  0x00  0x45  0x00  0x00
0xC8:  0x10  0x40  0x9C  0x1C  0xFF  0x01  0x3C  0xDF
0xD0:  0x02  0x40  0x0F  0x00  0x32  0x00  0xFC  0xF1
0xD8:  0x00  0x19  0x56  0xAF  0xF5  0x35  0x5F  0x00
0xE0:  0x00  0x4B  0x90  0x21  0x43  0x00  0x40  0xFB
```

4.1.1 NVM file interface with STSW-STUSB002 GUI



NVM mapping, read from I2C command and in the right file format, can be loaded into STSW-STUSB002 GUI with the “Load NVM config file …” button.

Then the parameters can be displayed and modified in the other tabs (“SNK Parameters”, “TypeC”)

The “NVM MAP” tab reflects the modified parameters, and then the configuration can be exported with the “Save NVM config to file …” button.

The exported file contains the NVM Map that can bed flashed with I2C commands previously described.

4.2 NVM Map Detailed Content

VENDOR_ID_LOW

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x00							

Address: 0xC0
Default: 0x00
Description: VENDOR_ID_LOW

[7:0]	RESERVED : VENDOR_ID_LOW = 0x00

VENDOR_ID_HIGH

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x00							

Address: 0xC1
Default: 0x00
Description: VENDOR_ID_HIGH

[7:0]	RESERVED : VENDOR_ID_HIGH = 0x00

PRODUCT_ID_ LOW

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0xB0							

Address: 0xC2
Default: 0xB0
Description: PRODUCT_ID_LOW

[7:0]	RESERVED : PRODUCT_ID_LOW = 0xB0

PRODUCT_ID_ HIGH

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0xAA							

Address: 0xC3
Default: 0xAA
Description: PRODUCT_ID_HIGH

[7:0]	RESERVED : PRODUCT_ID_HIGH = 0xAA

BCD_DEVICE_ID_LOW

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x00							

Address: 0xC4
Default: 0x00
Description: BCD_DEVICE_ID_LOW

[7:0]	RESERVED : BCD_DEVICE_ID_LOW = 0x00

BCD_DEVICE_ID_HIGH

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x45							

Address: 0xC5
Default: 0x45
Description: BCD_DEVICE_ID_HIGH

[7:0]	RESERVED : BCD_DEVICE_ID_LOW = 0x45

PORT_ROLE_CTRL

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x00							

Address: 0xC6
Default: 0x00
Description: PORT_ROLE_CTRL

[7:0]	RESERVED : PORT_ROLE_CTRL = 0x00

DEVICE_POWER_ROLE_CTRL

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x00							

Address: 0xC7
Default: 0x00
Description: DEVICE_POWER_ROLE_CTRL

[7:0]	RESERVED : DEVICE_POWER_ROLE_CTRL = 0x00

GPIO_CTRL

Bit	7	6	5	4	3	2	1	0
Content	0	0	GPIO_CFG[1:0]		0	0	0	0

Address: 0xC8
Default: 0x10
Description: GPIO_CTRL

[7:6]	RESERVED : 0b00
[5:4]	GPIO_CFG[1:0]
[3:0]	RESERVED : 0x0

ANALOG_CTRL

Bit	7	6	5	4	3	2	1	0
Content	0	1	VBUS_ DCHG_ MASK	0	0	0	0	0

Address: 0xC9
Default: 0x40
Description: ANALOG_CTRL

[7]	RESERVED : 0b0
[6]	RESERVED : 0b1
[5]	VBUS_DCHG_MASK
[4:0]	RESERVED : 0b00000

DISCHARGE_TIME_CTRL

Bit	7	6	5	4	3	2	1	0
Content	DISCHARGE_TIME_TO_0V[3:0]				VBUS_DISCH_TIME_TO_PDO[3:0]			

Address: 0xCA
Default: 0x9C
Description: DISCHARGE_TIME_CTRL

[7:4]	DISCHARGE_TIME_TO_0V[3:0]
[3:0]	VBUS_DISCH_TIME_TO_PDO[3:0]

RESERVED_0xCB

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x1C							

Address: 0xCB
Default: 0x1C
Description: RESERVED

[7:0]	RESERVED : 0x1C

RESERVED_0xCC

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0xF0							

Address: 0xCC
Default: 0xF0
Description: RESERVED

[7:0]	RESERVED : 0xFF

RESERVED_0xCD

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x01							

Address: 0xCD
Default: 0x01
Description: RESERVED

[7:0]	RESERVED : 0x01

RESERVED_0xCE

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x00							

Address: 0xCE
Default: 0x00
Description: RESERVED

[7:0]	RESERVED : 0x3C

RESERVED_0xCF

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0xDF							

Address: 0xCF
Default: 0xDF
Description: RESERVED

[7:0]	RESERVED : 0xDF

RESERVED_0xD0

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x02							

Address: 0xD0
Default: 0x02
Description: RESERVED

[7:0]	RESERVED : 0x02

RESERVED_0xD1

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x40							

Address: 0xD1
Default: 0x40
Description: RESERVED

[7:0]	RESERVED : 0x40

RESERVED_0xD2

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x0F							

Address: 0xD2
Default: 0x0F
Description: RESERVED

[7:0]	RESERVED : 0x0F

RESERVED_0xD3

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x00							

Address: 0xD3
Default: 0x00
Description: RESERVED

[7:0]	RESERVED : 0x00

RESERVED_0xD4

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x32							

Address: 0xD4
Default: 0x32
Description: RESERVED

[7:0]	RESERVED : 0x32

RESERVED_0xD5

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x00							

Address: 0xD5
Default: 0x00
Description: RESERVED

[7:0]	RESERVED : 0x00

RESERVED_0xD6

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0xFC							

Address: 0xD6
Default: 0xFC
Description: RESERVED

[7:0]	RESERVED : 0xFC

RESERVED_0xD7

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0xF1							

Address: 0xD7
Default: 0xF1
Description: RESERVED

[7:0]	RESERVED : 0xF1

RESERVED_0xD8

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x00							

Address: 0xD8
Default: 0x00
Description: RESERVED

[7:0]	RESERVED : 0x00

RESERVED_0xD9

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x19							

Address: 0xD9
Default: 0x19
Description: RESERVED

[7:0]	RESERVED : 0x19

SNK_PDO_FILL_0xDA

Bit	7	6	5	4	3	2	1	0
Content	LUT_SNK_PDO1_I[3:0]				SNK_ UNCONS_ POWER	DPM_SNK_ PDO_NUMB[1:0]		USB_ COMM_ CAPABLE

Address: 0xDA
Default: 0x56
Description: SNK_PDO_FILL, part 1 of 11

[7:4]	LUT_SNK_PDO1_I[3:0]
[3]	SNK_UNCONS_POWER
[2:1]	DPM_SNK_PDO_NUMB[1:0]
[0]	USB_COMM_CAPABLE

SNK_PDO_FILL_0xDB

Bit	7	6	5	4	3	2	1	0
Content	SNK_HL1[3:0]				SNK_LL1[3:0]			

Address: 0xDB
Default: 0xAF
Description: SNK_PDO_FILL, part 2 of 11

[7:4]	SNK_HL1[3:0]
[3:0]	SNK_LL1[3:0]

SNK_PDO_FILL_0xDC

Bit	7	6	5	4	3	2	1	0
Content	SNK_LL2[3:0]				LUT_SNK_PDO2_I[3:0]			

Address: 0xDC
Default: 0xF5
Description: SNK_PDO_FILL, part 3 of 11

[7:4]	SNK_LL2[3:0]
[3:0]	LUT_SNK_PDO2_I[3:0]

SNK_PDO_FILL_0xDD

Bit	7	6	5	4	3	2	1	0
Content	LUT_SNK_PDO3_I[3:0]				SNK_HL2[3:0]			

Address: 0xDD
Default: 0x35
Description: SNK_PDO_FILL, part 4 of 11

[7:4]	LUT_SNK_PDO3_I[3:0]
[3:0]	SNK_HL2[3:0]

SNK_PDO_FILL_0xDE

Bit	7	6	5	4	3	2	1	0
Content	SNK_HL3[3:0]				SNK_LL3[3:0]			

Address: 0xDE
Default: 0x5F
Description: SNK_PDO_FILL, part 5 of 11

[7:4]	SNK_HL3[3:0]
[3:0]	SNK_LL3[3:0]

SNK_PDO_FILL_0xDF

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x00							

Address: 0xDF
Default: 0x00
Description: SNK_PDO_FILL, part 6 of 11

[7:0]	RESERVED : SNK_PDO_FILL_0xDF = 0x00

SNK_PDO_FILL_0xE0

Bit	7	6	5	4	3	2	1	0
Content	SNK_PDO_ FLEX1_V[1:0]		RESERVED : 0b000000					

Address: 0xE0
Default: 0x00
Description: SNK_PDO_FILL, part 7 of 11

[7:6]	SNK_PDO_FLEX1_V[1:0]
[5:0]	RESERVED : 0b000000

SNK_PDO_FILL_0xE1

Bit	7	6	5	4	3	2	1	0
Content	SNK_PDO_FLEX1_V[9:2]							

Address: 0xE1
Default: 0x4B
Description: SNK_PDO_FILL, part 8 of 11

[7:0]	SNK_PDO_FLEX1_V[9:2]

SNK_PDO_FILL_0xE2

Bit	7	6	5	4	3	2	1	0
Content	SNK_PDO_FLEX2_V[7:0]							

Address: 0xE2
Default: 0x90
Description: SNK_PDO_FILL, part 9 of 11

[7:0]	SNK_PDO_FLEX2_V[7:0]

SNK_PDO_FILL_0xE3

Bit	7	6	5	4	3	2	1	0
Content	SNK_PDO_FLEX_I[5:0]						SNK_PDO_ FLEX2_V[9:8]	

Address: 0xE3
Default: 0x21
Description: SNK_PDO_FILL, part 10 of 11

[7:2]	SNK_PDO_FLEX_I[5:0]
[1:0]	SNK_PDO_FLEX2_V[9:8]

SNK_PDO_FILL_0xE4

Bit	7	6	5	4	3	2	1	0
Content	0	POWER_OK_ CFG[1:0]		0	SNK_PDO_FLEX_I[9:6]			

Address: 0xE4
Default: 0x43
Description: SNK_PDO_FILL, part 11 of 11

[7]	RESERVED : 0b0
[6:5]	POWER_OK_CFG[1:0]
[4]	RESERVED : 0b0
[3:0]	SNK_PDO_FLEX_I[9:6]

SPARE

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0x00							

Address: 0xE5
Default: 0x00
Description: SPARE

[7:0]	RESERVED : SPARE = 0x00

VBUS_CTRL

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0b010			REQ_ SRC_ CURRENT	RESERVED : 0x0			

Address: 0xE6
Default: 0x40
Description: VBUS_CTRL

[7:5]	RESERVED : 0b010
[4]	REQ_SRC_CURRENT
[3:0]	RESERVED : 0x0

ALERT_STATUS_1_MASK

Bit	7	6	5	4	3	2	1	0
Content	RESERVED : 0xFB							

Address: 0xE7
Default: 0xFB
Description: ALERT_STATUS_1_MASK

[7:0]	RESERVED : ALERT_STATUS_1_MASK = 0xFB

5 Example

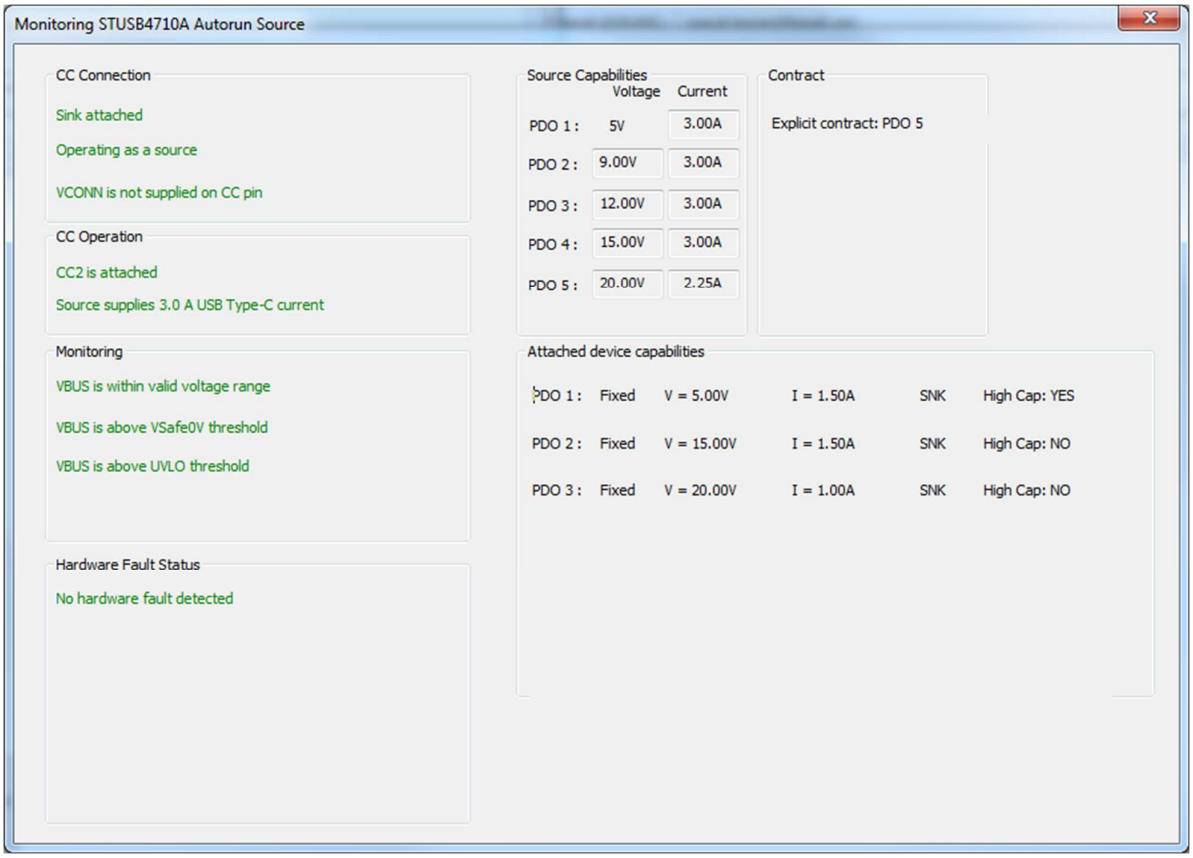
5.1 Using an Aardvark for I2C & GUI

In this example, the following procedure will be described:

- Check default configuration
- Read STUSB4500 NVM map using Aardvark tool & Batch file
- Extract the NVM content
- Change parameters with STSW-STUSB002 GUI
  - Load NVM configuration
  - Modify parameters
  - Save NVM configuration
- Check modified parameters
- Insert NVM content into Aardvark Batch file
- Write STUSB4500 NVM
- Re-Read STUSB4500 NVM map
- Check new configuration

5.1.1 Check default configuration

Connect a TypeC / Power delivery SRC to STUSB4500 and check SNK profiles.
For example, with STUSB4710A Evaluation board (STEVAL-ISC004V1) and associated Software



STUSB4710A_-_STUSB4500_capas_Default

5.1.2 Read STUSB4500 NVM map

5.1.2.1 *Read batch*

```
<aardvark>
    <configure i2c="1"/>
    <i2c_bitrate khz="400"/>
    <i2c_write addr="0x28" radix="16"> 95 47 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 40 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 00 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 96 40 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 97 00 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 50 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 53 </i2c_write>
    <i2c_read addr="0x28" count="8"/>
    <i2c_write addr="0x28" radix="16"> 96 51 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 53 </i2c_write>
    <i2c_read addr="0x28" count="8"/>
    <i2c_write addr="0x28" radix="16"> 96 52 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 53 </i2c_write>
    <i2c_read addr="0x28" count="8"/>
    <i2c_write addr="0x28" radix="16"> 96 53 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 53 </i2c_write>
    <i2c_read addr="0x28" count="8"/>
    <i2c_write addr="0x28" radix="16"> 96 54 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 53 </i2c_write>
    <i2c_read addr="0x28" count="8"/>
    <i2c_write addr="0x28" radix="16"> 96 40 00 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 95 00 </i2c_write>
</aardvark>
```

5.1.2.1 *Default Read results*

```
Export Time: 2019-05-07 16:18:01
Port 0
Adapter HW_Version: 3.00 FW_Version: 3.51

"Time","Module","Read/Write","Master/Slave","Features","Bitrate","Address","Length","Data"
"2019-05-07 16:17:59.644","","","","","","","","Configure: I2C=1 SPI=1 GPIO=0"
"2019-05-07 16:17:59.644","","","","","","","","Power Control Disabled"
"2019-05-07 16:17:59.644","I2C","","","","","","","I2C Pullups Disabled"
"2019-05-07 16:17:59.648","I2C","","","","","","","I2C Bitrate Set to: 400"
"2019-05-07 16:17:59.651","I2C","W","M","---","400","0x28","2","95 47"
"2019-05-07 16:17:59.653","I2C","W","M","---","400","0x28","2","96 40"
"2019-05-07 16:17:59.655","I2C","W","M","---","400","0x28","2","96 00"
"2019-05-07 16:17:59.657","I2C","W","M","---","400","0x28","2","96 40"
"2019-05-07 16:17:59.661","I2C","W","M","---","400","0x28","2","97 00"
"2019-05-07 16:17:59.664","I2C","W","M","---","400","0x28","2","96 50"
"2019-05-07 16:17:59.674","I2C","W","M","---","400","0x28","1","53"
"2019-05-07 16:17:59.684","I2C","R","M","---","400","0x28","8","00 00 B0 AA 00 45 00 00"
"2019-05-07 16:17:59.688","I2C","W","M","---","400","0x28","2","96 51"
"2019-05-07 16:17:59.706","I2C","W","M","---","400","0x28","1","53"
"2019-05-07 16:17:59.710","I2C","R","M","---","400","0x28","8","10 40 9C 1C FF 01 3C DF"
"2019-05-07 16:17:59.713","I2C","W","M","---","400","0x28","2","96 52"
"2019-05-07 16:17:59.726","I2C","W","M","---","400","0x28","1","53"
"2019-05-07 16:17:59.730","I2C","R","M","---","400","0x28","8","02 40 0F 00 32 00 FC F1"
"2019-05-07 16:17:59.734","I2C","W","M","---","400","0x28","2","96 53"
"2019-05-07 16:17:59.752","I2C","W","M","---","400","0x28","1","53"
"2019-05-07 16:17:59.756","I2C","R","M","---","400","0x28","8","00 19 56 AF F5 35 5F 00"
"2019-05-07 16:17:59.760","I2C","W","M","---","400","0x28","2","96 54"
```

```
"2019-05-07 16:17:59.769","I2C","W","M","---","400","0x28","1","53"
"2019-05-07 16:17:59.776","I2C","R","M","---","400","0x28","8","00 4B 90 21 43 00 40 FB"
"2019-05-07 16:17:59.779","I2C","W","M","---","400","0x28","3","96 40 00"
"2019-05-07 16:17:59.782","I2C","W","M","---","400","0x28","2","95 00"
```

5.1.3 Extracting the NVM content

5.1.3.1 *Read results*

```
"2019-05-07 16:17:59.684","I2C","R","M","---","400","0x28","8","00 00 B0 AA 00 45 00 00"
"2019-05-07 16:17:59.710","I2C","R","M","---","400","0x28","8","10 40 9C 1C FF 01 3C DF"
"2019-05-07 16:17:59.730","I2C","R","M","---","400","0x28","8","02 40 0F 00 32 00 FC F1"
"2019-05-07 16:17:59.756","I2C","R","M","---","400","0x28","8","00 19 56 AF F5 35 5F 00"
"2019-05-07 16:17:59.776","I2C","R","M","---","400","0x28","8","00 4B 90 21 43 00 40 FB"
```

5.1.3.2 *Extract data*

```
00 00 B0 AA 00 45 00 00
10 40 9C 1C FF 01 3C DF
02 40 0F 00 32 00 FC F1
00 19 56 AF F5 35 5F 00
00 4B 90 21 43 00 40 FB
```

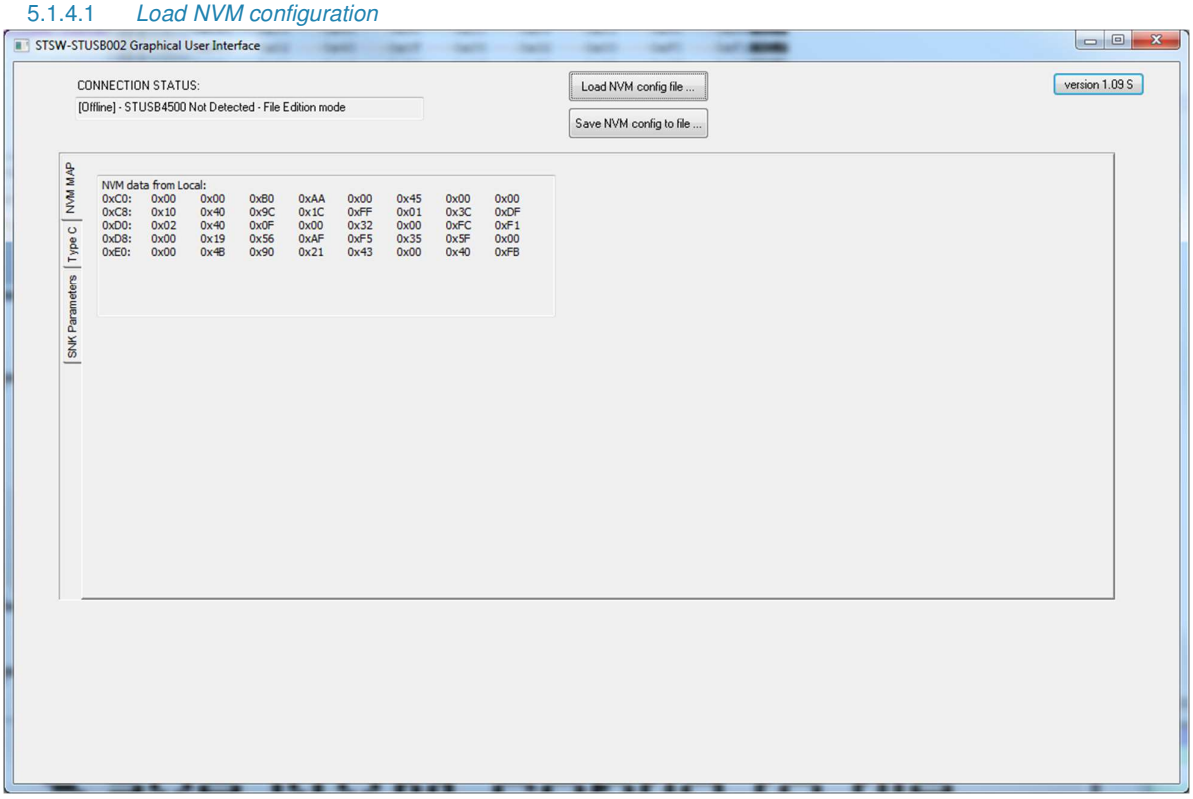
5.1.3.2.1 Convert to GUI File format

```
0xC0:  0x00  0x00  0xB0  0xAA  0x00  0x45  0x00  0x00
0xC8:  0x10  0x40  0x9C  0x1C  0xFF  0x01  0x3C  0xDF
0xD0:  0x02  0x40  0x0F  0x00  0x32  0x00  0xFC  0xF1
0xD8:  0x00  0x19  0x56  0xAF  0xF5  0x35  0x5F  0x00
0xE0:  0x00  0x4B  0x90  0x21  0x43  0x00  0x40  0xFB
```

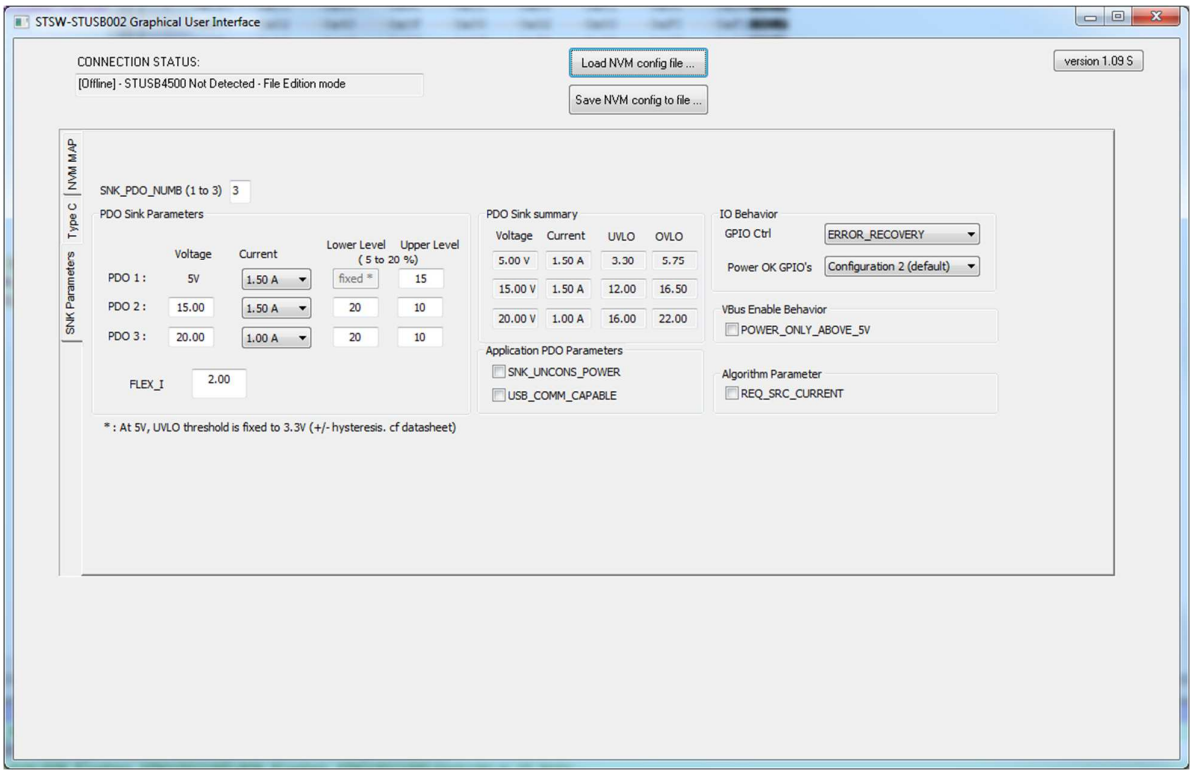
Save this configuration to a file, for example `STUSB4500_Default.txt`

5.1.4 Change parameters with STSW-STUSB002 GUI

5.1.4.1 *Load NVM configuration*



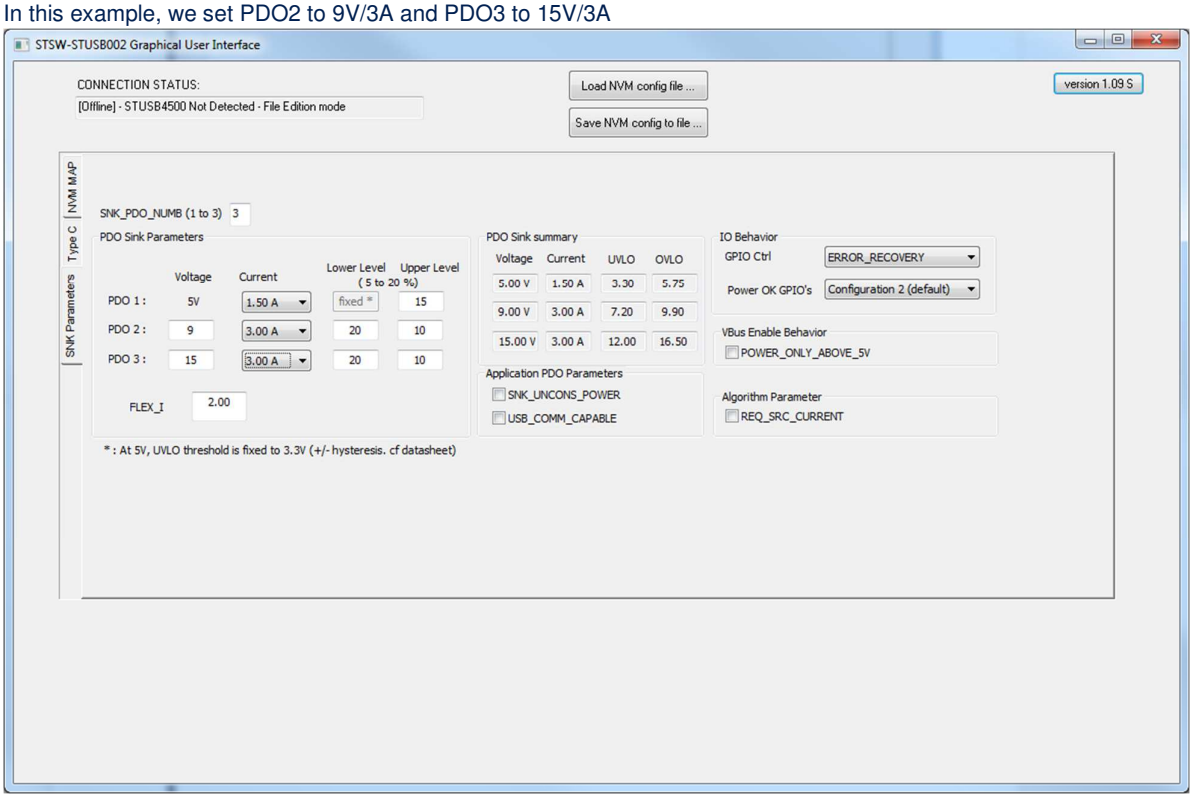
STSW-STUSB002_-_STUSB4500_NVM_Map_Load_After_Aardvark_Read



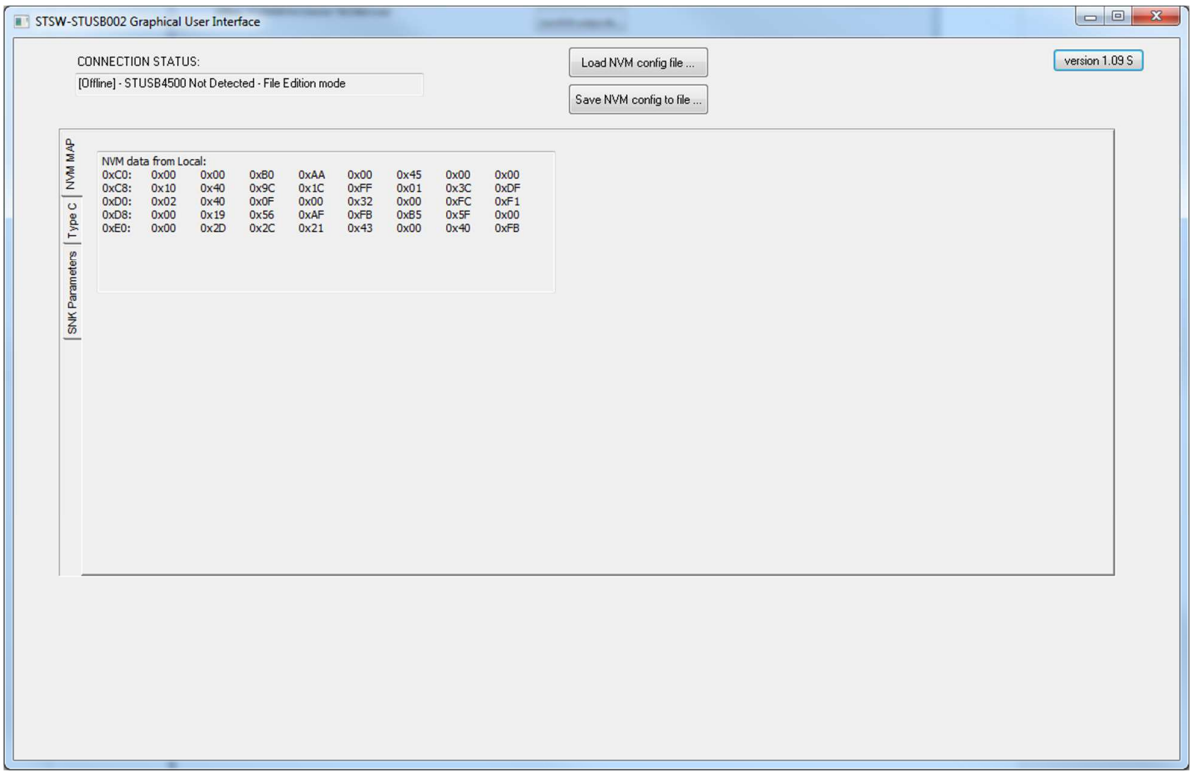
STSW-STUSB002_-_STUSB4500_SNK_Load_After_Aardvark_Read

5.1.4.2 *Modify parameters*

In this example, we set PDO2 to 9V/3A and PDO3 to 15V/3A



STSW-STUSB002_-_STUSB4500_SNK_Modification



STSW-STUSB002_-_STUSB4500_NVM_Map_Modification

5.1.4.3 *Save NVM configuration*

With the “Save NVM config to file …” button, export the modified NVM configuration to a file, for example STUSB4500_5V-1A5_9V-3A_15V-3A.txt

```
0xC0:  0x00   0x00   0xB0   0xAA   0x00   0x45   0x00   0x00
0xC8:  0x10   0x40   0x9C   0x1C   0xF0   0x01   0x00   0xDF
0xD0:  0x02   0x40   0x0F   0x00   0x32   0x00   0xFC   0xF1
0xD8:  0x00   0x19   0x56   0xAF   0xFB   0xB5   0x5F   0x00
0xE0:  0x00   0x2D   0x2C   0x21   0x43   0x00   0x40   0xFB
```

5.1.5 Check modified parameters

```
STUSB4500_Default.txt
0xC0:  0x00   0x00   0xB0   0xAA   0x00   0x45   0x00   0x00
0xC8:  0x10   0x40   0x9C   0x1C   0xFF   0x01   0x3C   0xDF
0xD0:  0x02   0x40   0x0F   0x00   0x32   0x00   0xFC   0xF1
0xD8:  0x00   0x19   0x56   0xAF   0xF5   0x35   0x5F   0x00
0xE0:  0x00   0x4B   0x90   0x21   0x43   0x00   0x40   0xFB

STUSB4500_5V-1A5_9V-3A_15V-3A.txt
0xC0:  0x00   0x00   0xB0   0xAA   0x00   0x45   0x00   0x00
0xC8:  0x10   0x40   0x9C   0x1C   0xF0   0x01   0x00   0xDF
0xD0:  0x02   0x40   0x0F   0x00   0x32   0x00   0xFC   0xF1
0xD8:  0x00   0x19   0x56   0xAF   0xFB   0xB5   0x5F   0x00
0xE0:  0x00   0x2D   0x2C   0x21   0x43   0x00   0x40   0xFB
```

Différences :

- Address 0xCC
  - STUSB4500_Default : `0xFF`
  - STUSB4500_5V-1A5_9V-3A_15V-3A : `0xF0`
  - Not taken into account : GUI side effect
- Address 0xCE
  - STUSB4500_Default : `0x3C`
  - STUSB4500_5V-1A5_9V-3A_15V-3A : `0x00`
  - Not taken into account : GUI side effect
- Address 0xDC 0xDD
  - STUSB4500_Default : `0xF5 0x35`
  - STUSB4500_5V-1A5_9V-3A_15V-3A : `0xFB 0xB5`
  - This corresponds to PDO currents modification
    - STUSB4500_Default : LUT_SNK_PDO2_I = 0b0101 =
    - STUSB4500_Default : LUT_SNK_PDO3_I = 0b0011 =
    - STUSB4500_5V-1A5_9V-3A_15V-3A : LUT_SNK_PDO2_I = 0b1011 =
    - STUSB4500_5V-1A5_9V-3A_15V-3A : LUT_SNK_PDO3_I = 0b1011 =
- Address 0xE0 to 0xE4
  - STUSB4500_Default : `0x00 0x4B 0x90 0x21 0x43`
  - STUSB4500_5V-1A5_9V-3A_15V-3A : `0x00 0x2D 0x2C 0x21 0x43`
  - This corresponds to PDO voltages modification
    - STUSB4500_Default :
      - SNK_PDO_ FLEX1_V[1:0] = 0b00
      - SNK_PDO_FLEX1_V[9:2] = 0x4B = 0b01001011
      - SNK_PDO_FLEX1_V = 0b0100101100 = 300 = 15V
    - STUSB4500_Default :
      - SNK_PDO_ FLEX2_V[7:0] =0x90 = 0b10010000
      - SNK_PDO_FLEX2_V[9:8] = 0b01
      - SNK_PDO_FLEX2_V = 0b0110010000 = 400 = 20V
    - STUSB4500_5V-1A5_9V-3A_15V-3A :
      - SNK_PDO_ FLEX1_V[1:0] = 0b00
      - SNK_PDO_FLEX1_V[9:2] = 0x2D = 0b00101101
      - SNK_PDO_FLEX1_V = 0b0010110100 = 180 = 9V
    - STUSB4500_5V-1A5_9V-3A_15V-3A:
      - SNK_PDO_ FLEX2_V[7:0] =0x2C = 0b00101100
      - SNK_PDO_FLEX2_V[9:8] = 0b01
      - SNK_PDO_FLEX2_V = 0b0100101100 = 300 = 15V

5.1.6 Insert NVM content into Aardvark Batch file

5.1.6.1 *Extract data*

```
00 00 B0 AA 00 45 00 00
10 40 9C 1C F0 01 00 DF
02 40 0F 00 32 00 FC F1
00 19 56 AF FB B5 5F 00
00 2D 2C 21 43 00 40 FB
```

5.1.6.1 *Write batch*

```
<aardvark>
    <configure i2c="1"/>
    <i2c_bitrate khz="400"/>
    <i2c_write addr="0x28" radix="16"> 95 47 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 53 00 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 40 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 00 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 96 40 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 97 FA </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 50 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 97 07 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 50 </i2c_write>
    <sleep ms="5"/>
    <i2c_write addr="0x28" radix="16"> 97 05 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 50 </i2c_write>
    <sleep ms="5"/>
    <i2c_write addr="0x28" radix="16"> 53 00 00 B0 AA 00 45 00 00 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 97 01 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 50 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 97 06 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 50 </i2c_write>
    <sleep ms="2"/>
    <i2c_write addr="0x28" radix="16"> 53 10 40 9C 1C F0 01 00 DF </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 97 01 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 50 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 97 06 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 51 </i2c_write>
    <sleep ms="2"/>
    <i2c_write addr="0x28" radix="16"> 53 02 40 0F 00 32 00 FC F1 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 97 01 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 50 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 97 06 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 52 </i2c_write>
    <sleep ms="2"/>
    <i2c_write addr="0x28" radix="16"> 53 00 19 56 AF FB B5 5F 00 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 97 01 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 50 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 97 06 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 53 </i2c_write>
    <sleep ms="2"/>
    <i2c_write addr="0x28" radix="16"> 53 00 2D 2C 21 43 00 40 FB </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 97 01 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 50 </i2c_write>
    <sleep ms="1"/>
    <i2c_write addr="0x28" radix="16"> 97 06 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 96 54 </i2c_write>
    <sleep ms="2"/>
    <i2c_write addr="0x28" radix="16"> 96 40 00 </i2c_write>
    <i2c_write addr="0x28" radix="16"> 95 47 </i2c_write>
</aardvark>
```

5.1.6.1 *Write results*

```
Export Time: 2019-05-07 17:03:06
Port 0
Adapter HW_Version: 3.00 FW_Version: 3.51

"Time","Module","Read/Write","Master/Slave","Features","Bitrate","Address","Length","Data"
"2019-05-07 17:03:04.957","","","","","","","","Configure: I2C=1 SPI=1 GPIO=0"
"2019-05-07 17:03:04.957","","","","","","","","Power Control Disabled"
"2019-05-07 17:03:04.959","I2C","","","","","","","I2C Pullups Disabled"
"2019-05-07 17:03:04.963","I2C","","","","","","","I2C Bitrate Set to: 400"
"2019-05-07 17:03:04.966","I2C","W","M","---","400","0x28","2","95 47"
"2019-05-07 17:03:04.967","I2C","W","M","---","400","0x28","2","53 00"
"2019-05-07 17:03:04.970","I2C","W","M","---","400","0x28","2","96 40"
"2019-05-07 17:03:04.973","I2C","W","M","---","400","0x28","2","96 00"
"2019-05-07 17:03:04.994","I2C","W","M","---","400","0x28","2","96 40"
"2019-05-07 17:03:05.000","I2C","W","M","---","400","0x28","2","97 FA"
"2019-05-07 17:03:05.002","I2C","W","M","---","400","0x28","2","96 50"
"2019-05-07 17:03:05.020","I2C","W","M","---","400","0x28","2","97 07"
"2019-05-07 17:03:05.029","I2C","W","M","---","400","0x28","2","96 50"
"2019-05-07 17:03:05.055","I2C","W","M","---","400","0x28","2","97 05"
"2019-05-07 17:03:05.059","I2C","W","M","---","400","0x28","2","96 50"
"2019-05-07 17:03:05.068","I2C","W","M","---","400","0x28","9","53 00 00 B0 AA 00 45 00 00"
"2019-05-07 17:03:05.082","I2C","W","M","---","400","0x28","2","97 01"
"2019-05-07 17:03:05.085","I2C","W","M","---","400","0x28","2","96 50"
"2019-05-07 17:03:05.098","I2C","W","M","---","400","0x28","2","97 06"
"2019-05-07 17:03:05.105","I2C","W","M","---","400","0x28","2","96 50"
"2019-05-07 17:03:05.117","I2C","W","M","---","400","0x28","9","53 10 40 9C 1C F0 01 00 DF"
"2019-05-07 17:03:05.131","I2C","W","M","---","400","0x28","2","97 01"
"2019-05-07 17:03:05.135","I2C","W","M","---","400","0x28","2","96 50"
"2019-05-07 17:03:05.145","I2C","W","M","---","400","0x28","2","97 06"
"2019-05-07 17:03:05.150","I2C","W","M","---","400","0x28","2","96 51"
"2019-05-07 17:03:05.161","I2C","W","M","---","400","0x28","9","53 02 40 0F 00 32 00 FC F1"
"2019-05-07 17:03:05.176","I2C","W","M","---","400","0x28","2","97 01"
"2019-05-07 17:03:05.180","I2C","W","M","---","400","0x28","2","96 50"
"2019-05-07 17:03:05.194","I2C","W","M","---","400","0x28","2","97 06"
"2019-05-07 17:03:05.198","I2C","W","M","---","400","0x28","2","96 52"
"2019-05-07 17:03:05.207","I2C","W","M","---","400","0x28","9","53 00 19 56 AF FB B5 5F 00"
"2019-05-07 17:03:05.223","I2C","W","M","---","400","0x28","2","97 01"
"2019-05-07 17:03:05.230","I2C","W","M","---","400","0x28","2","96 50"
"2019-05-07 17:03:05.240","I2C","W","M","---","400","0x28","2","97 06"
"2019-05-07 17:03:05.246","I2C","W","M","---","400","0x28","2","96 53"
"2019-05-07 17:03:05.253","I2C","W","M","---","400","0x28","9","53 00 2D 2C 21 43 00 40 FB"
"2019-05-07 17:03:05.273","I2C","W","M","---","400","0x28","2","97 01"
"2019-05-07 17:03:05.278","I2C","W","M","---","400","0x28","2","96 50"
"2019-05-07 17:03:05.286","I2C","W","M","---","400","0x28","2","97 06"
"2019-05-07 17:03:05.290","I2C","W","M","---","400","0x28","2","96 54"
"2019-05-07 17:03:05.305","I2C","W","M","---","400","0x28","3","96 40 00"
"2019-05-07 17:03:05.311","I2C","W","M","---","400","0x28","2","95 47"
```

5.1.7 Re-Read STUSB4500 NVM map

Run the same read batch as first step.

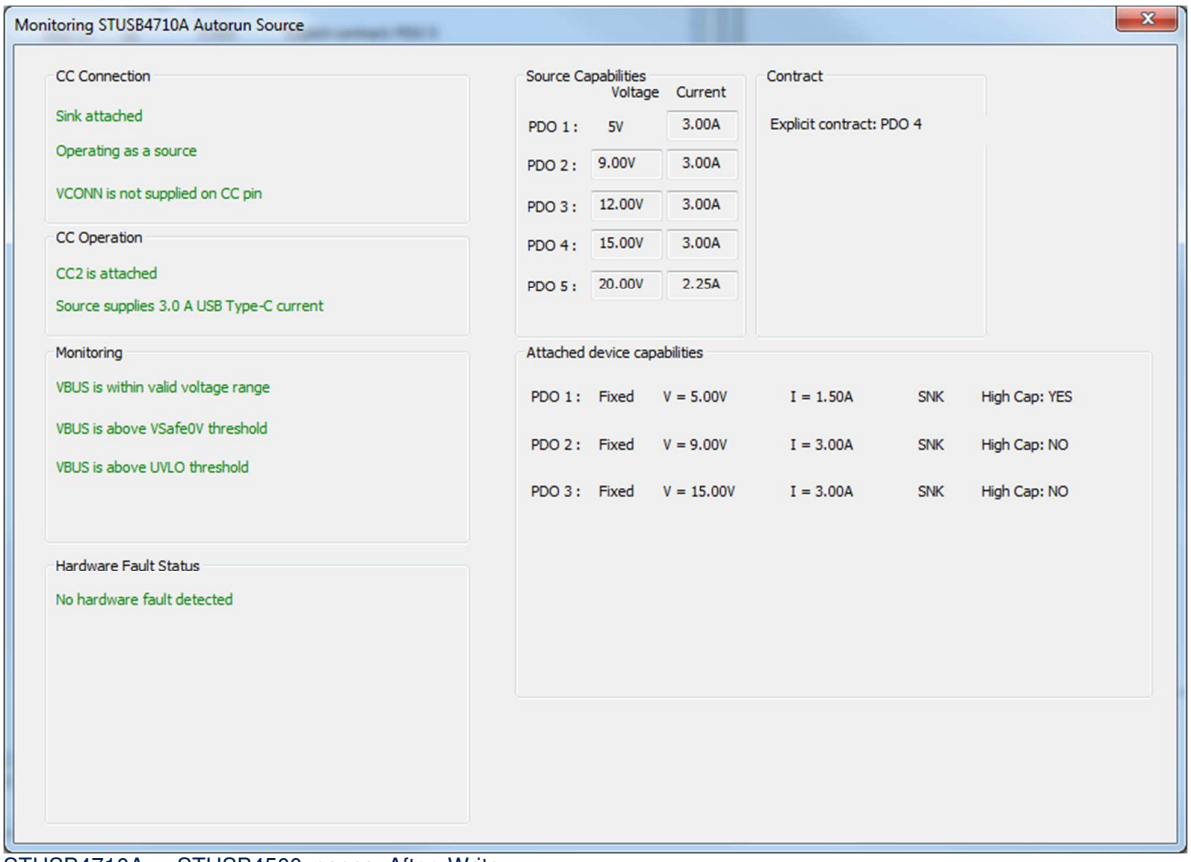
5.1.7.1 *Read results*

```
Export Time: 2019-05-09 11:43:42
Port 0
Adapter HW_Version: 3.00 FW_Version: 3.51

"Time","Module","Read/Write","Master/Slave","Features","Bitrate","Address","Length","Data"
"2019-05-09 11:43:40.588","","","","","","","","Configure: I2C=1 SPI=1 GPIO=0"
"2019-05-09 11:43:40.588","","","","","","","","Power Control Disabled"
"2019-05-09 11:43:40.591","I2C","","","","","","","I2C Pullups Disabled"
"2019-05-09 11:43:40.595","I2C","","","","","","","I2C Bitrate Set to: 400"
"2019-05-09 11:43:40.598","I2C","W","M","---","400","0x28","2","95 47"
"2019-05-09 11:43:40.599","I2C","W","M","---","400","0x28","2","96 40"
"2019-05-09 11:43:40.601","I2C","W","M","---","400","0x28","2","96 00"
"2019-05-09 11:43:40.621","I2C","W","M","---","400","0x28","2","96 40"
"2019-05-09 11:43:40.624","I2C","W","M","---","400","0x28","2","97 00"
"2019-05-09 11:43:40.625","I2C","W","M","---","400","0x28","2","96 50"
"2019-05-09 11:43:40.634","I2C","W","M","---","400","0x28","1","53"
"2019-05-09 11:43:40.644","I2C","R","M","---","400","0x28","8","00 00 B0 AA 00 45 00 00"
"2019-05-09 11:43:40.648","I2C","W","M","---","400","0x28","2","96 51"
"2019-05-09 11:43:40.671","I2C","W","M","---","400","0x28","1","53"
"2019-05-09 11:43:40.674","I2C","R","M","---","400","0x28","8","10 40 9C 1C F0 01 00 DF"
"2019-05-09 11:43:40.677","I2C","W","M","---","400","0x28","2","96 52"
"2019-05-09 11:43:40.694","I2C","W","M","---","400","0x28","1","53"
"2019-05-09 11:43:40.700","I2C","R","M","---","400","0x28","8","02 40 0F 00 32 00 FC F1"
"2019-05-09 11:43:40.703","I2C","W","M","---","400","0x28","2","96 53"
"2019-05-09 11:43:40.714","I2C","W","M","---","400","0x28","1","53"
"2019-05-09 11:43:40.720","I2C","R","M","---","400","0x28","8","00 19 56 AF FB B5 5F 00"
"2019-05-09 11:43:40.723","I2C","W","M","---","400","0x28","2","96 54"
"2019-05-09 11:43:40.746","I2C","W","M","---","400","0x28","1","53"
"2019-05-09 11:43:40.750","I2C","R","M","---","400","0x28","8","00 2D 2C 21 43 00 40 FB"
"2019-05-09 11:43:40.753","I2C","W","M","---","400","0x28","3","96 40 00"
"2019-05-09 11:43:40.756","I2C","W","M","---","400","0x28","2","95 00"
```

5.1.7.1 *Read results comparison*

```
"2019-05-07 16:17:59.684","I2C","R","M","---","400","0x28","8","00 00 B0 AA 00 45 00 00"
"2019-05-07 16:17:59.710","I2C","R","M","---","400","0x28","8","10 40 9C 1C FF 01 3C DF"
"2019-05-07 16:17:59.730","I2C","R","M","---","400","0x28","8","02 40 0F 00 32 00 FC F1"
"2019-05-07 16:17:59.756","I2C","R","M","---","400","0x28","8","00 19 56 AF F5 35 5F 00"
"2019-05-07 16:17:59.776","I2C","R","M","---","400","0x28","8","00 4B 90 21 43 00 40 FB"

"2019-05-09 11:43:40.644","I2C","R","M","---","400","0x28","8","00 00 B0 AA 00 45 00 00"
"2019-05-09 11:43:40.674","I2C","R","M","---","400","0x28","8","10 40 9C 1C F0 01 00 DF"
"2019-05-09 11:43:40.700","I2C","R","M","---","400","0x28","8","02 40 0F 00 32 00 FC F1"
"2019-05-09 11:43:40.720","I2C","R","M","---","400","0x28","8","00 19 56 AF FB B5 5F 00"
"2019-05-09 11:43:40.750","I2C","R","M","---","400","0x28","8","00 2D 2C 21 43 00 40 FB"
```

5.1.8 Check new configuration



STUSB4710A_-_STUSB4500_capas_After_Write