Amtron Technology, Inc.

Industrial USB 3.0 Flash Drive

UA Series

Product Datasheet

Revision History

Revision	Description	Date
1.0	Initial release	2016-Jan-14
1.1	Update capacity	2016-May-28
1.2	Update performance	2016-Jul-02
1.3	Change part number prefix from UFD to UFD3	2018-Jun-01

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1. INTRODUCTION

1.1. Description

Amtron industrial grade UA series USB 3.0 flash drive (UFD3) is compatible with USB 1.1 / USB 2.0 / USB 3.0 specifications. In addition to being a removable and bootable flash disk, it can also be configured as a fixed drive for system recovery.

UA Series USB 3.0 flash drives are available in 128MB to 64GB (SLC NAND flash); 2GB to 256GB (pSLC NAND flash); 4GB to 512GB (MLC NAND flash) capacities.

1.2. Product Features

- **Capacity**
  - SLC: 128MB to 64GB
  - pSLC: 2GB to 256GB
  - MLC: 4GB to 512GB
- **Interface**
  - Super Speed up to 5Gbit/sec for USB 3.0
  - High speed up to 480Mbits/sec for USB 2.0
  - Full speed up to 12Mbits/sec for USB 1.1
- **Flash Interface**
  - Flash Type: SLC, pSLC, and MLC
- **Performance**
  - SLC Read/Write: up to 170 /120 MB/s
  - pSLC Read/Write: up to 140 /95 MB/s
  - MLC Read/Write: up to 190 /140 MB/s
- **Power Consumption**[1]
  - Read mode: 170 mA
  - Write mode: 170 mA
  - Idle mode: 40 mA
  - Standby: 2.5mA
- **Advanced Flash Management**
  - Bad Block Management
  - SMART
  - Wear Leveling
  - ECC
- **MTBF:**
  - 3,000,000 hours (SLC)
  - 2,500,000 hours (pSLC)
  - 2,000,000 hours (MLC)
- **Temperature Range**
  - Operation (Standard): 0°C ~ 70°C
  - Operation (Wide): -40°C ~ 85°C
  - Storage: -40°C ~ 85°C
- **Dynamics**
  - Vibration: 20G
  - Shock: 1500G
- **Compliant**
  - RoHS
  - CE & FCC
- **Other**
  - Metal housing
  - Disk usage status LED indicator

Notes:

1. Please see Section 4.2 Power Consumption for details.

1.3. Flash Management

1.3.1. Error Correction Code (ECC)

Flash memory cells deteriorate with use, which might generate random bit errors in the stored data. By applying the BCH ECC algorithm, the drive can detect and correct errors that occurred during the read process, ensuring that data have been read correctly and protecting data from corruption.

1.3.2. Wear Leveling

NAND flash devices can only undergo a limited number of program/erase cycles, and in most cases, the flash media are not used evenly. If certain areas are updated more frequently than others, then the lifetime of the device would be reduced significantly. To address this problem, wear leveling technique is applied to extend the lifespan of NAND flash by evenly distributing write and erase cycles across the media. The Amtron UA Series USB Drives utilize advanced dynamic and static wear leveling algorithms that efficiently spreads out the flash usage, thus greatly improving the life expectancy of the NAND flash.

1.3.3. Bad Block Management

Bad blocks are flash memory blocks that contain one or more invalid bits, which undermine their reliability. Blocks identified and marked as bad by the factory are referred to as “initial bad blocks”, and bad blocks that are developed during the lifespan of the flash are named “later bad blocks”. Amtron implements an efficient bad block management algorithm to detect and manage both the “initial” and “later” bad blocks. This prevents data from being stored in these locations, thereby improving data reliability.

1.3.4. Pseudo SLC

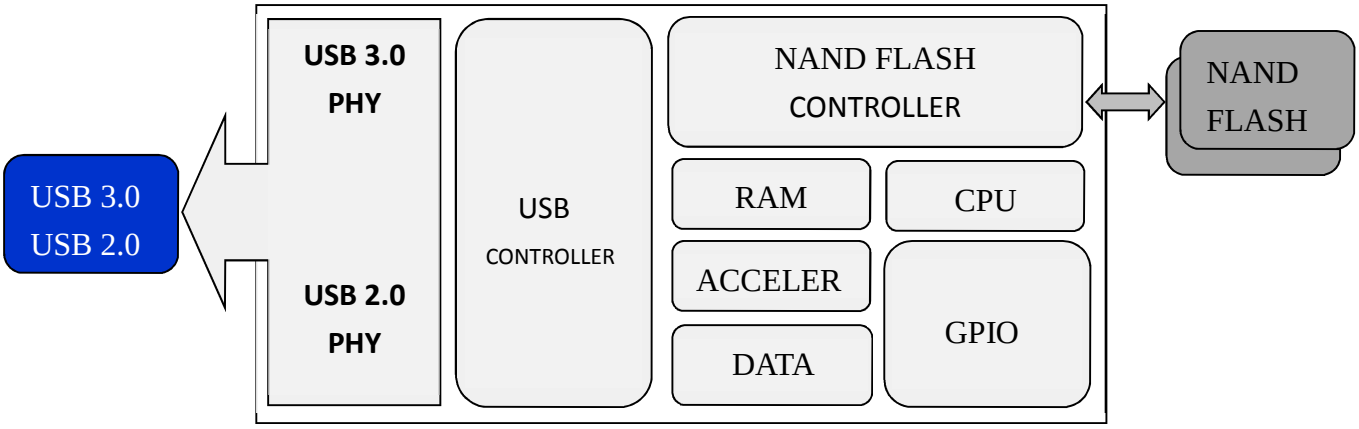
Pseudo SLC can be considered an extended version of the MLC. While MLC contains both fast and slow pages, pseudo SLC only applies fast pages for programming. The concept of pseudo SLC is demonstrated in the two tables below. The first and second bits of a memory cell represent a fast and slow page respectively, as shown in the left table. Since only fast pages are programmed when applying pseudo SLC, only the bits highlighted in red are used, as shown in the right table. As a result, since only fast pages are programmed, pseudo SLC provides better performance and endurance than MLC. Its performance approaches that of the SLC while remaining at a lower cost.

MLC Flash	
1st bit (fast)	2nd bit (slow)
1	1
1	0
0	1
0	0

→

Pseudo SLC	
1st bit (fast)	2nd bit (slow)
1	1
1	0
0	1
0	0

1.3.5. Block Diagram



Block Diagram

2. PRODUCT SPECIFICATIONS

- **Compatible with USB specification revision 1.1, 2.0 and 3.0.**
- **Capacity available:**
  - SLC: 128MB to 64GB
  - MLC: 4GB to 512GB
  - pSLC: 2GB to 256GB
- **Supports Windows 2000 SP4 and Windows XP *without* device driver.**
- **Supports Windows Vista, Windows 7 and Windows 8 *without* device driver.**
- **Supports Linux Kernel ver 2.4.0 or above *without* device driver. (USB 1.1 speed)**
- **Supports Linux Kernel ver 2.4.10 or above *without* device driver. (USB 2.0 speed)**
- **Durable solid-state storage – data retention up to 10 years.**
- **No external power is required - DC 4.5V ~ 5.5V from USB port.**
- **Transfer rate for USB interface:**
  - Super Speed up to 5Gbit/sec for USB 3.0
  - High speed up to 480Mbits/sec for USB 2.0
  - Full speed up to 12Mbits/sec for USB 1.1
- **Low Power consumption.**
- **Performance (MB/s)**
  - SLC

Capacity	Flash Structure	Sequential	
		Read (MB/s)	Write (MB/s)
128MB	TSB TSOP SLC 24nm 1Gb*1	30	5
256MB	TSB TSOP SLC 24nm 2Gb*1	30	10
512MB	TSB TSOP SLC 24nm 4GB*1	30	20
1GB	TSB TSOP SLC 32nm 8Gb*1	30	20
2GB	TSB TSOP SLC 32nm 16Gb*1	30	20
4GB	TSB TSOP SLC 24nm 32Gb*1	30	25
8GB	TSB BGA132 SLC 24nm 64Gb*1	170	80
16GB	TSB BGA132 SLC 24nm 128Gb*1	170	120
32GB	TSB BGA132 SLC 24nm 256Gb*1	170	120

Notes:

1. The table above is for reference only. Performance may vary from flash configuration, DDR configuration, and platform.
2. Samples are made of Toshiba SLC NAND Flash.
3. The performance is obtained from CrystalDiskMark 5.0.2 x64 (C) (1000 MB).

◆ pSLC

Capacity	Flash Structure	Sequential	
		Read (MB/s)	Write (MB/s)
2GB	TSOP pSLC 15nm 32Gb * 1	70	18
4GB	TSOP pSLC 15nm 64Gb * 1	70	15
8GB	TSOP pSLC 15nm 128Gb * 1	60	30
16GB	BGA132 pSLC 15nm 256Gb * 1	140	45
32GB	BGA132 pSLC 15nm 512Gb * 1	140	95
64GB	BGA132 pSLC 15nm 1024Gb *1	140	95
128GB	BGA132 pSLC 15nm 1024Gb *2	143	68

Notes:

1 The table above is for reference only. Performance may vary from flash configuration, DDR configuration, and platform.

2 The performance is obtained from CrystalDiskMark 5.0.2 x64 (C) (1000 MB).

◆ MLC

Capacity	Flash Structure	Sequential	
		Read (MB/s)	Write (MB/s)
4GB	TSOP MLC 15nm 32Gb * 1	95	7
8GB	TSOP MLC 15nm 64Gb * 1	95	20
16GB	TSOP MLC 15nm 128Gb * 1	95	25
32GB	BGA132 MLC 15nm 256Gb * 1	190	45
64GB	BGA132 MLC 15nm 512Gb * 1	190	95
128GB	BGA132 MLC 15nm 1024Gb *1	190	95
256GB	BGA132 MLC 15nm 1024Gb *2	193	148
512GB	BGA132 MLC 15nm 2048Gb *2	192	146

Notes:

1 The table above is for reference only . Performance may vary from flash configuration, DDR configuration, and platform.

2 The performance is obtained from CrystalDiskMark 5.0.2 x64 (C) (1000 MB).

3. ENVIRONMENTAL SPECIFICATIONS

3.1. Environmental Conditions

3.1.1. Temperature and Humidity

- Temperature:
  - Storage: -40°C to 85°C
  - Operational (Standard grade): 0°C to 70°C
  - Operational (Wide grade): -40°C to 85°C
- Humidity:
  - Standard grade: RH 90% under 40°C (operational)
  - Wide grade: RH 95% under 55°C (operational)

■ **High Temperature Test Condition**

	Temperature	Humidity	Test Time
Operation (Standard)	70°C	0% RH	72 hours
Operation (Wide)	85°C	0% RH	72 hours
Storage (Standard)	85°C	0% RH	72 hours
Storage (Wide)	85°C	0% RH	168 hours

Result: No abnormality is detected.

■ **Low Temperature Test Condition**

	Temperature	Humidity	Test Time
Operation (Standard)	0°C	0% RH	24 hours
Operation (Wide)	-40°C	0% RH	72 hours
Storage (Standard)	-25°C	0% RH	24 hours
Storage (Wide)	-40°C	0% RH	168 hours

Result: No abnormality is detected.

■ **High Humidity Test Condition**

	Temperature	Humidity	Test Time
Operation (Standard)	40°C	95% RH	4 hours
Operation (Wide)	55°C	95% RH	24 hours
Storage (Standard)	40°C	95% RH	48 hours
Storage (Wide)	55°C	95% RH	96 hours

Result: No abnormality is detected.

■ **Temperature Cycle Test**

	Temperature	Test Time	Cycle
Operation (Standard)	0°C	30 min	10 cycles
	70°C	30 min	
Operation (Wide)	-40°C	30 min	20 cycles
	85°C	30 min	
Storage (Standard)	0°C	30 min	10 cycles
	70°C	30 min	
Storage (Wide)	-40°C	30 min	50 cycles
	85°C	30 min	

Result: No abnormality is detected.

3.1.2. Shock

■ **Shock Specification**

	Acceleration Force	Half Sin Pulse Duration	Number of Shocks
Non-operational	1500G	0.5ms	6 faces, 5 times each

Result: No abnormality is detected when power on.

3.1.3. Vibration

■ **Vibration Specification**

	Condition		Vibration Orientation
	Frequency/Displacement	Frequency/Acceleration	
Non-operational	20Hz~80Hz/1.52mm	80Hz~2000Hz/20G	X, Y, Z axis/60 min for each

Result: No abnormality is detected when power on.

3.1.4. Drop

■ **Drop Specification**

	Height of Drop	Number of Drop
Non-operational	110cm free fall	6 face of each unit,

Result: No abnormality is detected when power on.

3.1.5. Bending

■ **Bending Specification**

	Force	Action
Non-operational	≥ 50N	Hold 1min/5times

Result: No abnormality is detected when power on.

3.1.6. Torque

■ **Torque Specification**

	Force	Action
Non-operational	0.5 N-m or ±5 deg	Hold 30s/5times

Result: No abnormality is detected when power on.

3.1.7. Electrostatic Discharge (ESD)

■ **Contact ESD Specification**

Device	Capacity	Temperature	Relative Humidity	+/- 12KV	Result
UFD3	256GB	24.0°C	49% (RH)	No degradation of performance or loss of function.	PASS

3.2. Certification

- RoHS
- CE / FCC

4. ELECTRICAL SPECIFICATIONS

4.1. Absolute Maximum Ratings

Item	Symbol	Parameter	MIN	MAX	Unit
1	VCC5A	5V Power	-0.6	+9.0	V
2	VCC3IO	IO Power	-0.6	+7.5	V
3	AVCC33	Phy 3.3V Power	-0.6	+7.5	V
4	VCCK	AON Core Power	-0.6	+5.5	V
5	Ta	Operating Temperature (Commercial)	0	+70	℃
6	Tst	Storage Temperature	-25	+85	℃

4.2. Power Consumption

4.2.1. SLC

Capacity	Power Consumption (mA)			
	Read	Write	Idle	Standby
128MB	80	90	25	2.5
256MB	85	95	25	2.5
512MB	85	95	25	2.5
1GB	85	95	25	2.5
2GB	90	100	25	2.5
4GB	90	100	30	2.5
8GB	100	120	30	2.5
16GB	100	120	30	2.5
32GB	100	120	30	2.5

Notes:

1. Samples are made of Toshiba SLC NAND Flash.
2. Power Consumption may vary from flash configuration, DDR configuration, or platform.

4.2.2. pSLC

Capacity	Power Consumption (mA)			
	Read	Write	Idle	Standby
2GB	90	95	35	2.5
4GB	90	120	35	2.5
8GB	130	150	35	2.5
16GB	130	150	35	2.5
32GB	130	150	35	2.5
64GB	150	160	40	2.5
128GB	170	160	40	2.5

Notes:

1. Samples are made of Toshiba pSLC NAND Flash.
2. Power consumption may vary from flash configuration, DDR configuration, or platform.

4.2.3. MLC

Capacity	Power Consumption (mA)			
	Read	Write	Idle	Standby
4GB	80	75	30	2.5
8GB	80	75	30	2.5
16GB	130	150	35	2.5
32GB	130	150	35	2.5
64GB	150	160	35	2.5
128GB	170	160	35	2.5
256GB	170	160	40	2.5
512GB	170	170	40	2.5

Notes:

1. Samples are made of Toshiba MLC NAND Flash..
2. Power consumption may vary from flash configuration, DDR configuration, or platform.

4.3. DC Characteristic

Symbol	Parameter	Conditions	MIN	TYP	MAX	Unit
VCCK	Core Power Supply	Core Area	0.99	1.1	1.21	V
VCC3IO	Power Supply	1.8V I/O	1.62	1.8	1.98	V
		3.3V I/O	3.0	3.3	3.6	V
Temp	Junction Temperature		0	25	115	℃
V_{IL}	Schmitt Trigger	VCC3IO = 3.3V	0.35 * VCC3IO			V
	CMOS Trigger		0.5 * VCC3IO			
	Two Trigger		0.45 * VCC3IO			
V_{IH}	Schmitt Trigger		0.65 * VCC3IO			V
	CMOS Trigger		0.5 * VCC3IO			
	Two Trigger		0.55 * VCC3IO			
V_{IL}	Schmitt Trigger	VCC3IO = 1.8V	0.41 * VCC3IO			V
	CMOS Trigger		0.53 * VCC3IO			
	Two Trigger		0.5 * VCC3IO			
V_{IH}	Schmitt Trigger		0.69 * VCC3IO			V
	CMOS Trigger		0.53 * VCC3IO			
	Two Trigger		0.56 * VCC3IO			
V_{OL}	Output Low voltage	|Iol| = 2 ~ 16 mA			0.4	V
V_{OH}	Output High voltage	|Ioh| = 2 ~ 16 mA	VCC3IO- 0.4			V
Rpu	Input Pull-Up Resistance	PU=high, PD=low	40	50	190	KΩ
Rpd	Input Pull-Down Resistance	PU=high, PD=low	40		190	KΩ
Iin	Input Leakage Current	Vin = VCC3I or 0			10	μA
Ioz	Tri-state Output Leakage Current		-10	±1	10	μA

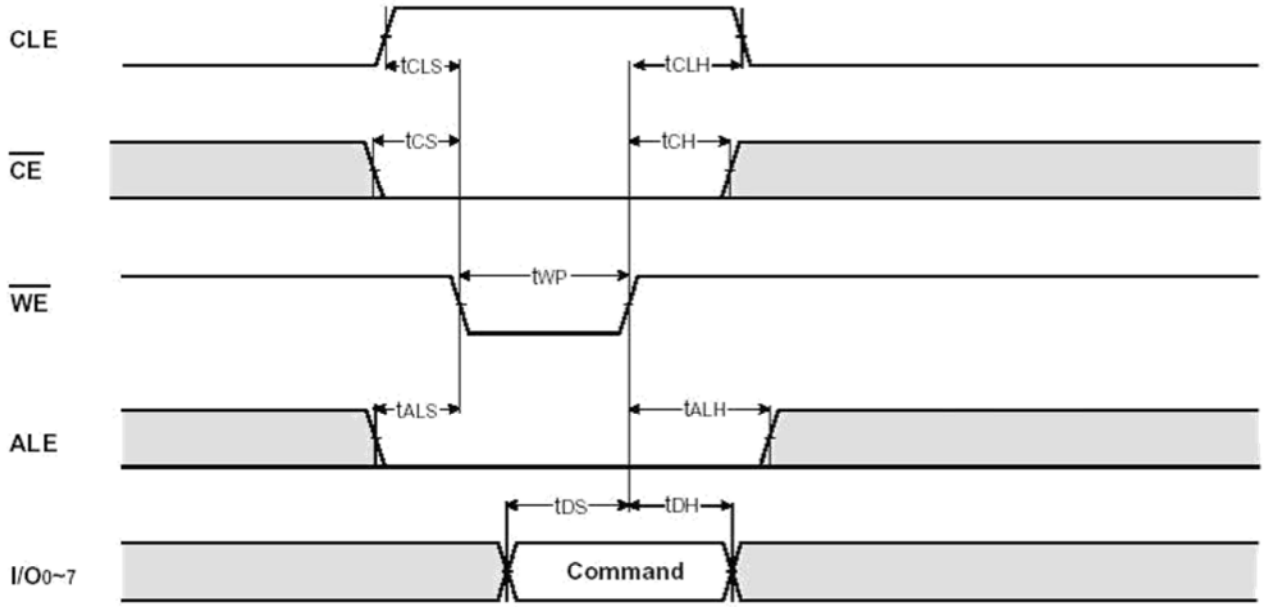
4.4. AC Characteristic

4.4.1. Flash Memory Interface Timing

Information below is for reference and example use only. For the actual timing, please refer to the related flash spec.

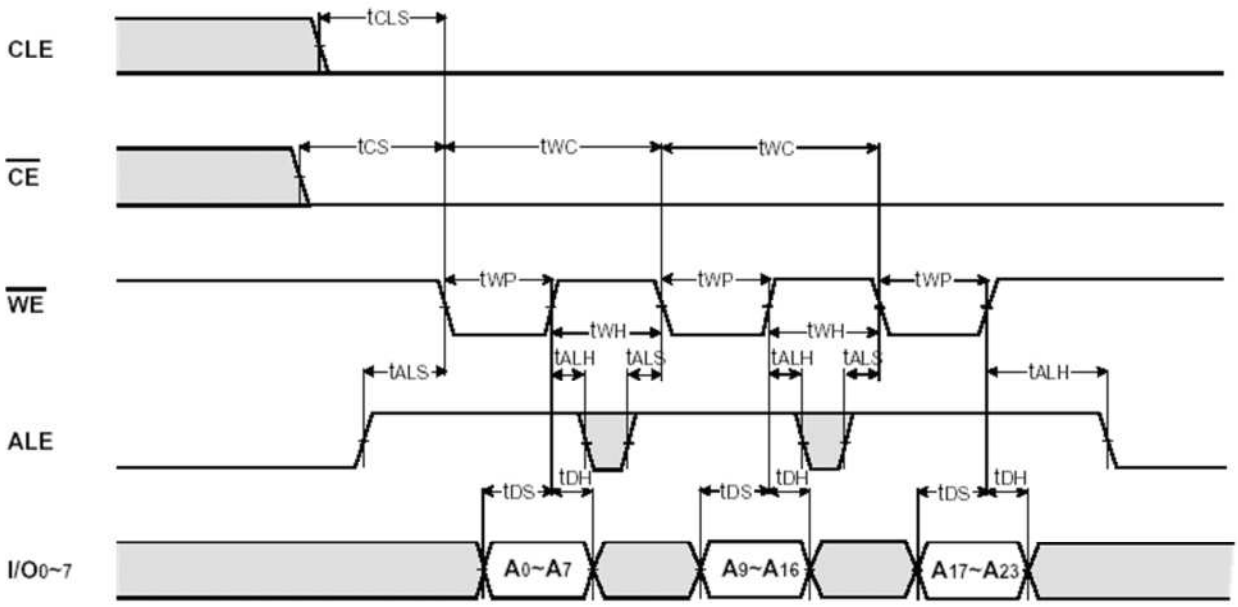
Parameter	Symbol	Min	Max	Unit
CLE Set-up Time	t_{CLS}	0	-	ns
CLE Hold Time	t_{CLH}	10	-	ns
CE Setup Time	t_{CS}	0	-	ns
CE Hold Time	t_{CH}	10	-	ns
WE Pulse Width	t_{WP}	25	-	ns
ALE Setup Time	t_{ALS}	0	-	ns
ALE Hold Time	t_{ALH}	10	-	ns
Data Setup Time	t_{DS}	20	-	ns
Data Hold Time	t_{DH}	10	-	ns
Write Cycle Time	t_{WC}	45	-	ns
WE High Hold Time	t_{WH}	15	-	ns
Read Cycle Time	t_{RC}	50	-	ns
/RE Pulse Width	t_{RP}	25	-	ns
/RE High Hold Time	t_{REH}	15	-	ns
Ready to /RE Low	t_{RR}	60	-	ns

4.4.2. Command Latch Cycle



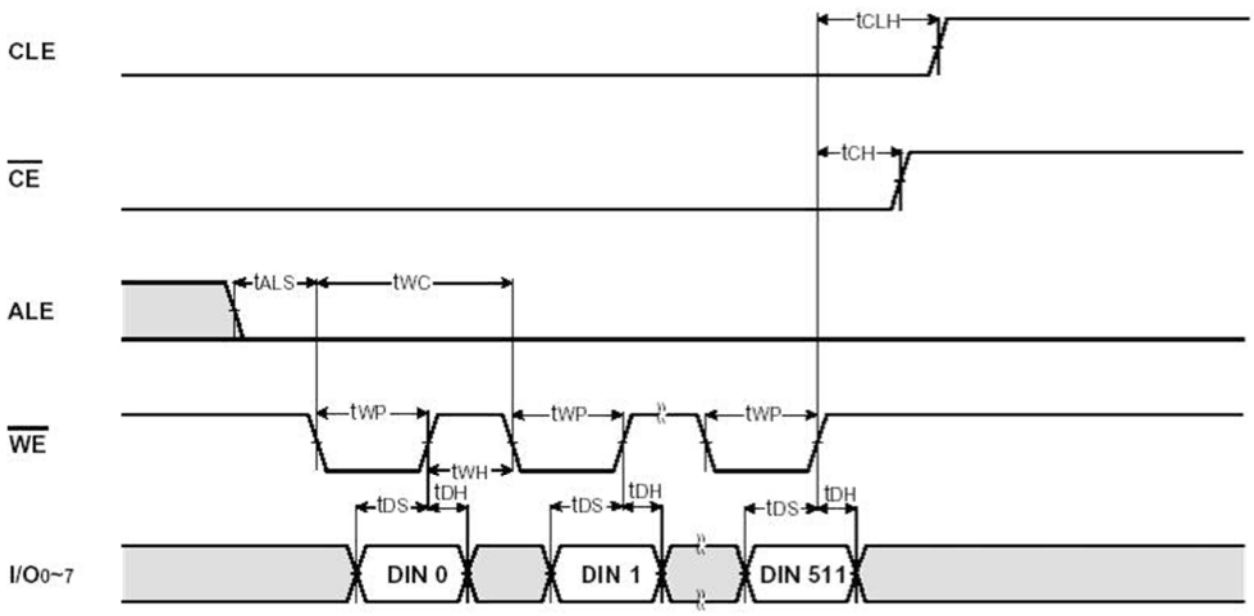
Command Latch Cycle

4.4.3. Address Latch Cycle



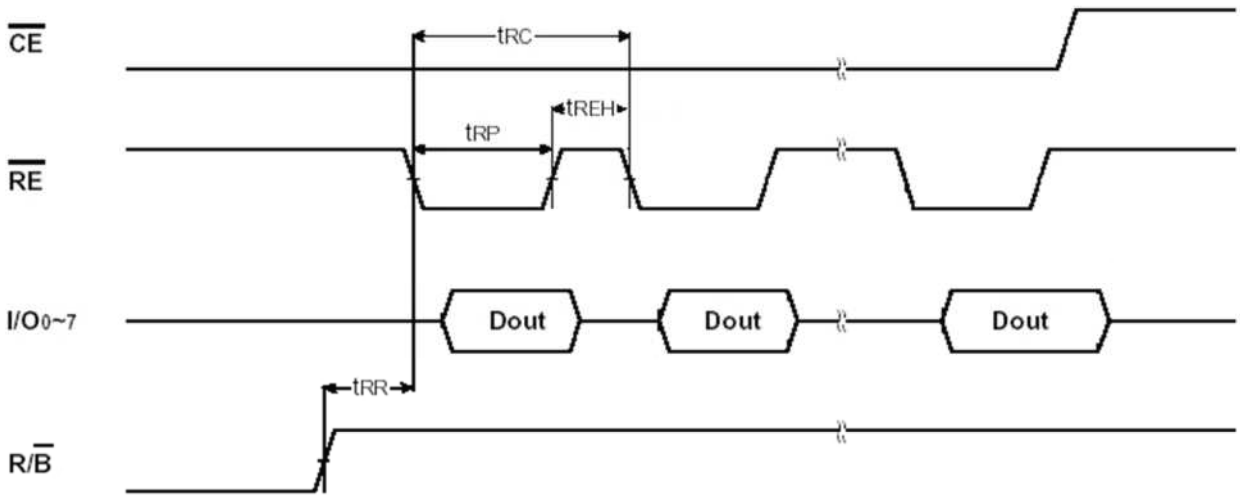
Address Latch Cycle

4.4.4. Input Data Latch Cycle



Input Data Latch Cycle

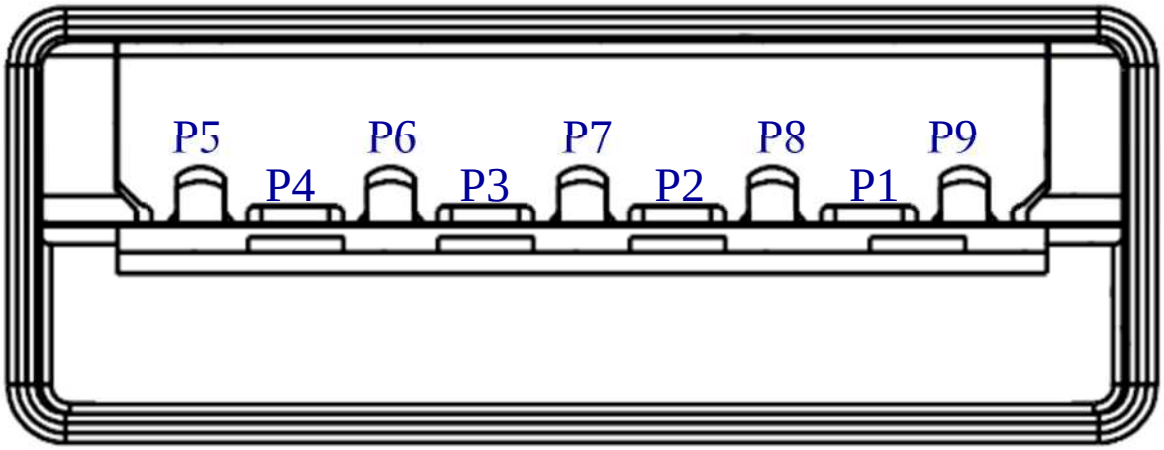
4.4.5. Sequential Out Cycle after Read (CLE=L, /WE=H, ALE=L)



Sequential Out Cycle after Read (CLE=L, /WE=H, ALE=L)

5. INTERFACE

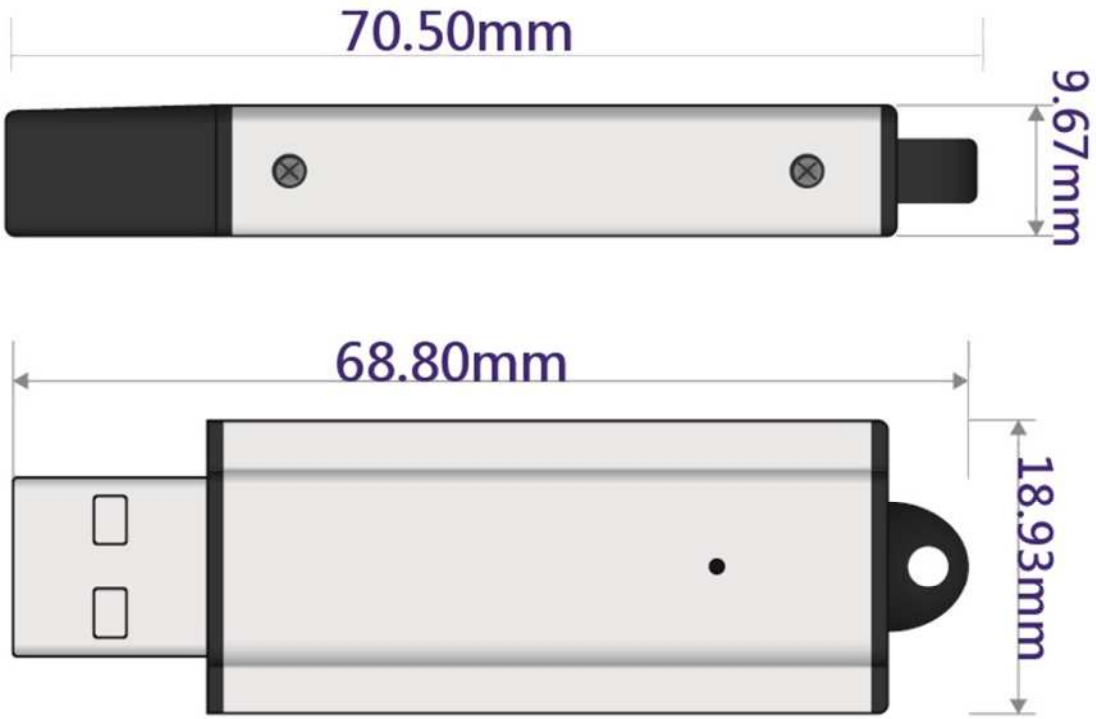
5.1. Pin Assignment and Descriptions



Pin Number	Type	Function
P1	V_{BUS}	Power
P2	D-	USB 2.0 differential pair
P3	D+	USB 2.0 differential pair
P4	GND	Ground
P5	StdA_SSRX-	SuperSpeed receiver differential pair
P6	StdA_SSRX+	SuperSpeed receiver differential pair
P7	GND_DRAIN	Ground
P8	StdA_SSTX-	SuperSpeed receiver differential pair
P9	StdA_SSTX+	SuperSpeed receiver differential pair
Shell	Shield	Connector Shell

6. PHYSICAL DIMENSION

Dimension:



7. PART NUMBER DECODER

UFD3- UA$X^1X^2X^3X^4X^5$ X^6 X^7

		X^1X^2 X^3X^4 X^5	X^6	X^7
UFD3	UA	128MB	C: SLC Standard (0ºC ~ +70ºC)	F: Fixed
		256MB	I: SLC Industrial (-40ºC ~ +85ºC)	R: Removable
		512MB	K: MLC Standard (0ºC ~ +70ºC)	
		001GB	M: MLC Industrial (-40ºC ~ +85ºC)	
		002GB	P: pSLC Standard (0ºC ~ +70ºC)	
		004GB	F: pSLC Industrial (-40ºC ~ +85ºC)	
		008GB		
		016GB		
		032GB		
		064GB		
		128GB		
		256GB		
		512GB		