

# **SQFlash SD Card Datasheet**

***(SQF-ISDx1-xG-21x)***

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**Revision History**

| Rev. | Date      | History  |
|------|-----------|--|
| 0.1  | 2014/7/1  | 1. 1 <sup>st</sup> draft                       |
| 0.2  | 2015/7/1  | 1. Update to 15nm MLC                          |
| 0.3  | 2016/3/10 | 1. Add ultra MLC and wear leveling information |
| 0.4  | 2016/3/15 | 1. Add TBW information                         |
|      |           |  |
|      |           |  |
|      |           |  |

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## 1. Overview

The Industrial SD Card (ISD) of the SQFlash is fully compliant to the specification released by SD Card Association. The Command List supports [Part 1 Physical Layer Specification Ver3.1 Final] definitions. Card Capacity of Non-secure Area, Secure Area Supports [Part 3 Security Specification Ver3.0 Final] Specifications.

The SQF-ISD is based on 9-pin interface, designed to operate at a maximum operating frequency of 100MHz. It can alternate communication protocol between the SD mode and SPI mode. It performs data error detection and correction with very low power consumption. Current capacity would be offered from 4GB to 64GB; it's possible to reach 2TB in the future with ex-FAT, which is called SDXC (Extended Capacity SD Memory Card).

The SQF-ISD is specifically made for any rigorous environments where devices need to be operated at extended temperature, and strong data integrity and reliability are demanded. Such environments include both industrial and automotive applications. The SQF-ISD is the best choice for exceptional reliability, excellent performance and wide compatibility.

## 2. Standard Features

- Support SD system specification version 2.0 and 3.0. and compliant with UHS-I
- Card Capacity of Non-secure Area, Secure Area Supports [Part 3 Security Specification Ver3.0 Final] Specifications
- Support SD SPI mode
- Designed for read-only and read/write cards.
- The Command List supports [Part 1 Physical Layer Specification Ver3.01 Final] definitions
- Copyrights Protection Mechanism - Complies with highest security of SDMI standard
- CPRM (Content Protection for Recordable Media) of SD Card supported
- Support up to 72bits BCH ECC circuits to protect data communication.
- Global Wear Leveling support
  - SQFlash provides advanced Wear Leveling algorithm, which can efficiently spread out the flash usage through the whole flash media area. Moreover, by implementing both dynamic and static Wear Leveling algorithms, the life expectancy of the NAND Flash is greatly improved.
- Card removal during read operation will never harm the content
- Password Protection of cards (option)
- Write Protect feature using mechanical switch
- Built-in write protection features (permanent and temporary)
- High transmission speed
- +4KV/-4KV ESD protection in contact pads
- Dimensions: 32mm (L) x 24mm (W) x 2.1mm (H)
- Operating voltage range : 2.7-3.6V

### 3. Additional Features

#### ■ Capacities

- SLC type : 128MB , 256MB , 512MB , 1GB , 2GB , 4GB , 8GB , 16GB , 32GB
- Ultra MLC type : 4GB , 8GB , 16GB , 32GB , 64GB
- MLC type : 8GB , 16GB , 32GB , 64GB , 128GB

#### ■ Flash type

- SLC : 32nm for 1G / 2G, the rest are 24nm
- MLC : 15nm

#### ■ Performance (MB per sec)

- Max. Read / Write: 90 / 45

#### ■ Temperature Ranges

- Commercial Temperature
  - 0°C to 70°C
- Industrial Temperature
  - -40°C to 85°C

#### ■ Mechanical Specification

- Shock : 1,500G, Peak / 0.5ms
- Vibration : 5G, Peak / 10~2000Hz
- Drop Test: 1.5m free fall
- Torque Test: 0.15N-m or +/-2.5deg
- Switch Cycles Test: Slide 0.4N to 5N

#### ■ Humidity

- Operating Humidity : 5% ~ 93%
- Non-Operating Humidity : 5% ~ 93%

#### ■ NAND flash Data Retention

- 10 years

■ **Endurance**

JEDEC defined an endurance rating TBW (TeraByte Written), following by the equation below, for indicating the number of terabytes a flash drive can be written which is a measurement of flash drive's expected lifespan, represents the amount of data written to the device.

$$TBW = [(NAND\ Endurance) \times (Flash\ Drive\ Capacity)] / WAF$$

- **NAND Endurance:** Program / Erase cycle of a NAND flash.
  - SLC: 60,000 cycles
  - Ultra MLC: 20,000 cycles
  - MLC: 3,000 cycles
- **Flash Drive Capacity:** Physical capacity in total of a Flash Drive.
- **WAF:** Write Amplification Factor (WAF), as the equation shown below, is a numerical value representing the ratio between the amount of data that a flash drive controller needs to write and the amount of data that the host's flash controller writes. A better WAF, which is near to 1, guarantees better endurance and lower frequency of data written to flash memory.

$$WAF = (Lifetime\ write\ to\ flash) / (Lifetime\ write\ to\ host)$$

The TBW rating for a flash drive shall be derived for and verified under the following workload conditions,

- Sequential Write (copy file into card)
- P/E cycles incurred: erase count after writing – erase count before writing

➤ **SQFlash SD Card TBW**

|        | WAF     | TBW  |           |     |
|--------|---------|------|-----------|-----|
|        |         | SLC  | Ultra MLC | MLC |
| 1 GB   | 1.02441 | 57   | --        | --  |
| 2 GB   | 1.02564 | 114  | --        | --  |
| 4 GB   | 1.03013 | 227  | 75        | --  |
| 8 GB   | 1.03226 | 454  | 151       | 22  |
| 16 GB  | 1.03226 | 908  | 302       | 45  |
| 32 GB  | 1.03060 | 1819 | 606       | 90  |
| 64 GB  | TBD     | --   | TBD       | TBD |
| 128 GB | TBD     | --   | --        | TBD |

#### 4. Pin Assignment and Block Diagram

SD memory Card Pad Assignment

| pin | SD Mode                |                       |                                 | SPI Mode |                  |                        |
|-----|------------------------|-----------------------|---------------------------------|----------|------------------|------------------------|
|     | Name                   | Type <sup>(1)</sup>   | Description                     | Name     | Type             | Description            |
| 1   | CD/DAT3 <sup>(2)</sup> | I/O/PP <sup>(3)</sup> | Card Detect/<br>Data Line[bit3] | CS       | I <sup>(3)</sup> | Chip Select (net true) |
| 2   | CMD                    | PP                    | Command/Response                | DI       | I                | Data In                |
| 3   | V <sub>SS1</sub>       | S                     | Supply voltage ground           | VSS      | S                | Supply voltage ground  |
| 4   | V <sub>DD</sub>        | S                     | Supply voltage                  | VDD      | S                | Supply voltage         |
| 5   | CLK                    | I                     | Clock                           | SCLK     | I                | Clock                  |
| 6   | V <sub>SS2</sub>       | S                     | Supply voltage ground           | VSS2     | S                | Supply voltage ground  |
| 7   | DAT0                   | I/O/PP                | Data Line[bit0]                 | DO       | O/PP             | Data Out               |
| 8   | DAT1                   | I/O/PP                | Data Line[bit1]                 | RSV      |                  |                        |
| 9   | DAT2                   | I/O/PP                | Data Line[bit2]                 | RSV      |                  |                        |

- (1) S: power supply, I:input; O:output using push-pull drivers; PP:I/O using push-pull drivers
- (2) The extended DAT lines (DAT1-DAT3) are input on power up. They start to operate as DAT lines after SET\_BUS\_WIDTH command. The Host shall keep its own DAT1-DAT3 lines in input mode, as well, while they are not used. It is defined so, in order to keep compatibility to MultiMedia Cards.
- (3) At power up this line has a 50KOhm pull up enabled in the card. This resistor serves two functions Card detection and Mode Selection. For Mode Selection, the host can drive the line high or let it be pulled high to select SD mode. If the host wants to select SPI mode it should drive the line low. For Card detection, the host detects that the line is pulled high. This pull-up should be disconnected by the user, during regular data transfer, with SET\_CLR\_CARD\_DETECT (ACMD42) command.

| Name | Width  | Description   |
|------|--------|---|
| CID  | 128bit | Card identification number; card individual number for identification. <b>Mandatory</b>   |
| RCA  | 16bit  | Relative card address; local system address of a card, dynamically suggested by the card and approved by the host during initialization. <b>Mandatory</b> |
| DSR  | 16bit  | Driver Stage Register; to configure the card's output drivers. <b>Optional</b>  |
| CSD  | 128bit | Card Specific Data; information about the card operation conditions. <b>Mandatory</b>   |
| SCR  | 64bit  | SD Configuration Register; information about the SD Memory Card's Special Features capabilities. <b>Mandatory</b>   |
| OCR  | 32bit  | Operation condition registers. <b>Mandatory</b>   |
| SSR  | 512bit | SD Status; information about the card proprietary features. <b>Mandatory</b>  |
| OCR  | 32bit  | Card Status; information about the card status. <b>Mandatory</b>  |



## 5. Power Consumption

Table list as below is the power consumption of ISD card with different type of flash memory.

| Capacity | Flash Structure   | Read (mA) | Write (mA) | Idle (uA) |
|----------|---|-----------|------------|-----------|
| 64GB     | 32GB x 2, COB (Wide Temp.)<br>8GB x 8, SIP (Std. Temp.) | 200       | 200        | 250       |

(1) Data transfer mode is single channel.

(2) Power Consumption may differ according to flash configuration, SDR configuration, or platform.

## 6. DC Characters

### 6.1 BUS Operating Conditions for 3.3V Signaling

- Threshold level for High Voltage Range

| Parameter           | Symbol   | Min                  | Max                  | Unit | Remarks                  |
|---------------------|----------|----------------------|----------------------|------|--------------------------|
| Supply voltage      | $V_{DD}$ | 2.7                  | 3.6                  | V    |                          |
| Output High Voltage | VOH      | $0.75 \cdot V_{DD}$  |                      | V    | IOH=-100uA $V_{DD}$ Min. |
| Output Low Voltage  | VOL      |                      | $0.125 \cdot V_{DD}$ | V    | IOL = 100uA $V_{DD}$ min |
| Input High Voltage  | VIH      | $0.625 \cdot V_{DD}$ | $V_{DD} + 0.3$       | V    |                          |
| Input Low Voltage   | VIL      | $V_{SS} - 0.3$       | $0.25 \cdot V_{DD}$  | V    |                          |
| Power up time       |          |                      | 250                  | ms   | From 0v to $V_{DD}$ min. |

- Peak Voltage and Leakage Current

| Parameter                 | Symbol | Min  | Max            | Unit | Remarks |
|---------------------------|--------|------|----------------|------|---------|
| Peak voltage on all lines |        | -0.3 | $V_{DD} + 0.3$ | V    |         |
| <b>All Inputs</b>         |        |      |                |      |         |
| Input Leakage Current     |        | -10  | 10             | uA   |         |
| <b>All Outputs</b>        |        |      |                |      |         |
| Output Leakage Current    |        | -10  | 10             | uA   |         |

- Threshold Level for 1.8V Signaling

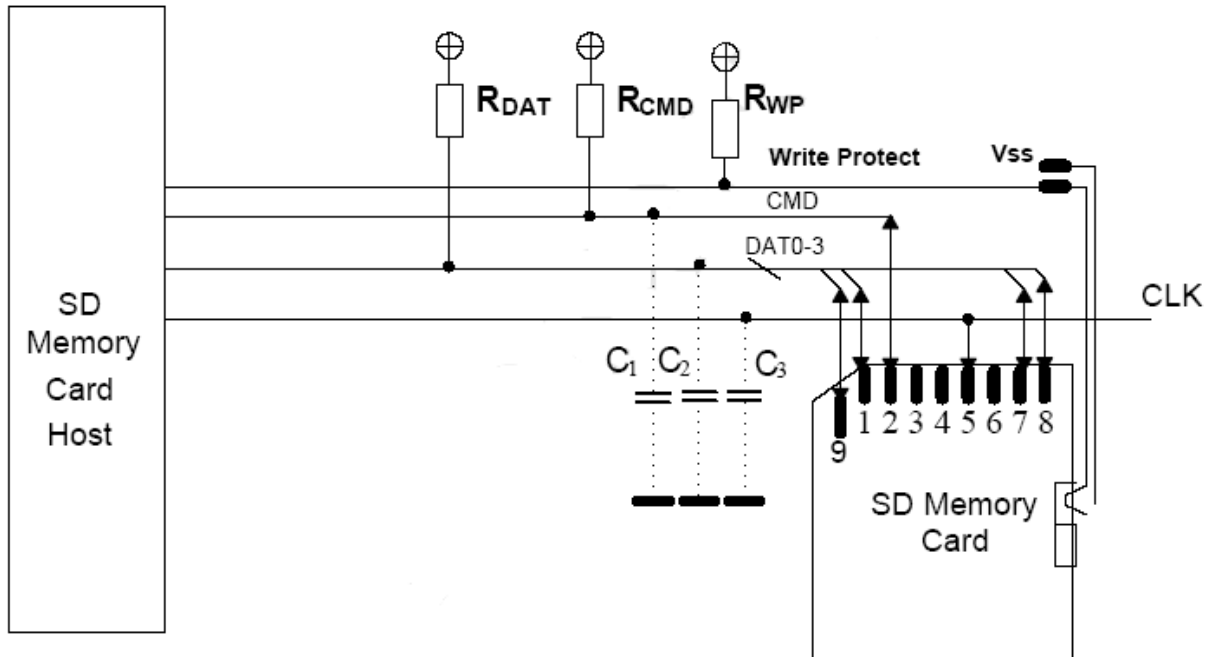
| Parameter           | Symbol     | Min            | Max  | Unit | Condition             |
|---------------------|------------|----------------|------|------|-----------------------|
| Supply Voltage      | $V_{DD}$   | 2.7            | 3.6  | V    |                       |
| Regulator Voltage   | $V_{DDIO}$ | 1.7            | 1.95 | V    | Generated by $V_{DD}$ |
| Output High Voltage | VOH        | 1.4            | -    | V    | IOH = -2mA            |
| Output Low Voltage  | VOL        |                | 0.45 | V    | IOL = 2mA             |
| Input High Voltage  | VIH        | 1.27           | 2.00 | V    |                       |
| Input Low Voltage   | VIL        | $V_{SS} - 0.3$ | 0.58 | V    |                       |

- Input Leakage Current for 1.8V Signaling

| Parameter             | Symbol | Min | Max | Unit | Remarks                       |
|-----------------------|--------|-----|-----|------|-------------------------------|
| Input Leakage Current |        | -2  | 2   | uA   | DAT3 pull-up is disconnected. |

6.2 BUS Operating Conditions for 3.3V Signaling

- BUS Circuitry Diagram:

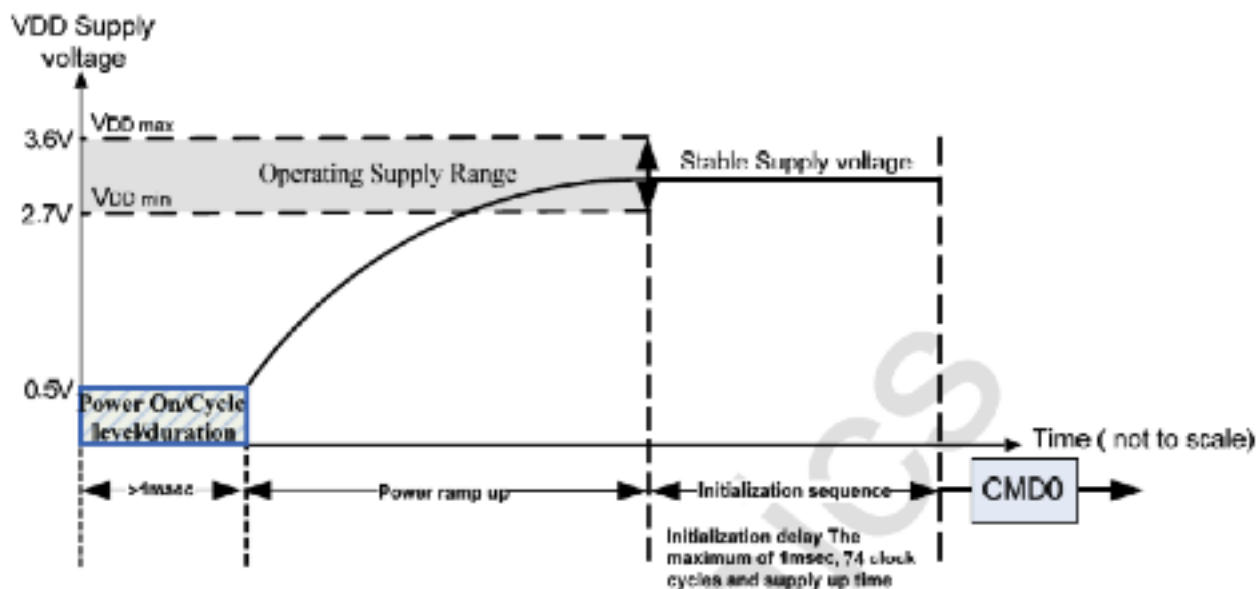


- BUS Operating Conditions – Signal Line’s Load  
Total bus cpapcitanse =  $CHOST + CBUS + N \cdot CCARD$

| Parameter                                   | Symbol                 | Min | Max | Unit       | Remark                                     |
|---|------------------------|-----|-----|------------|--|
| Pull-up resistance                          | $R_{CMD}$<br>$R_{DAT}$ | 10  | 100 | k $\Omega$ | to prevent bus floating                    |
| Total bus capacitance for each signal line  | $C_L$                  |     | 40  | pF         | 1 card $CHOST+CBUS$ shall not exceed 30 pF |
| Capacitance of the card for each signal pin | $C_{CARD}$             |     | 10  | pF         |  |
| Maximum signal line inductance              |                        |     | 16  | nH         |  |
| Pull-up resistance inside card (pin1)       | $R_{DAT3}$             | 10  | 90  | k $\Omega$ | May be used for card detection             |
| Caocapcity Connected to Power Line          | $C_C$                  |     | 5   | uF         | To prevent inrush current                  |

### 6.3 Power Up Time

- Host needs to keep power line level less than 0.5V and more than 1ms before power ramp up.



#### Power On or Power Cycle

Followings are requirements for Power on and Power cycle to assure a reliable SD Card hard reset.

- (1) Voltage level shall be below 0.5V
- (2) Duration shall be at least 1ms.

#### Power Supply Ramp Up

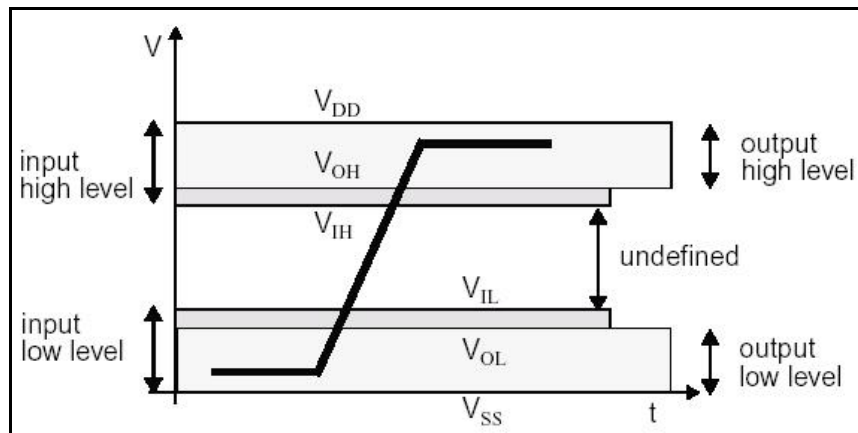
The power ramp up time is defined from 0.5V threshold level up to the operating supply voltage which is stable between VDD(min.) and VDD(max.) and host can supply SDCLK. Followings are recommendation of Power ramp up:

- (1) Voltage of power ramp up should be monotonic as much as possible.
- (2) The minimum ramp up time should be 0.1ms.
- (3) The maximum ramp up time should be 35ms for 2.7-3.6V power supply.

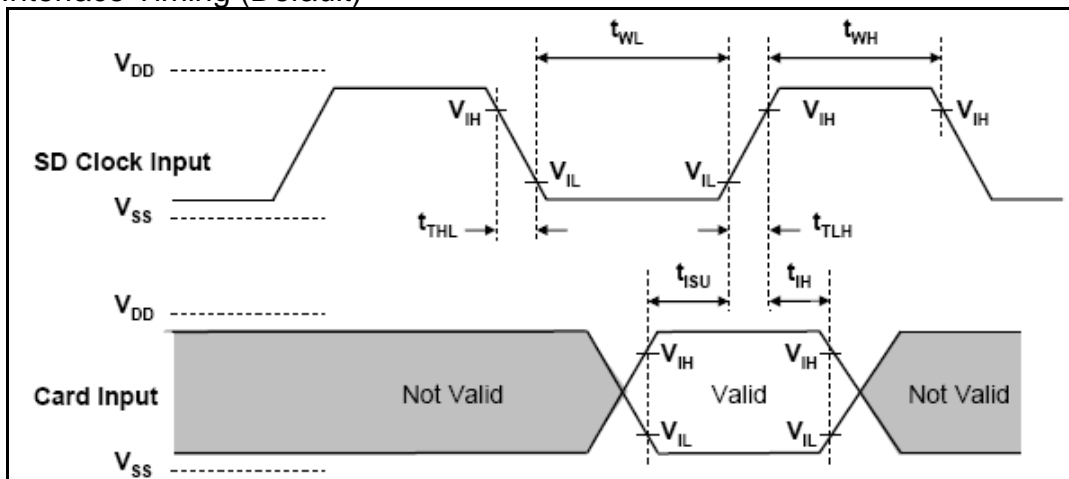
#### Power Down and Power Cycle

- When the host shuts down the power, the card VDD shall be lowered to less than 0.5Volt for a minimum period of 1ms. During power down, DAT, CMD, and CLK should be disconnected or driven to logical 0 by the host to avoid a situation that the operating current is drawn through the signal lines.
- If the host needs to change the operating voltage, a power cycle is required. Power cycle means the power is turned off and supplied again. Power cycle is also needed for accessing cards that are already in Inactive State. To create a power cycle the host shall follow the power down description before power up the card (i.e. the card VDD shall be once lowered to less than 0.5Volt for a minimum period of 1ms).

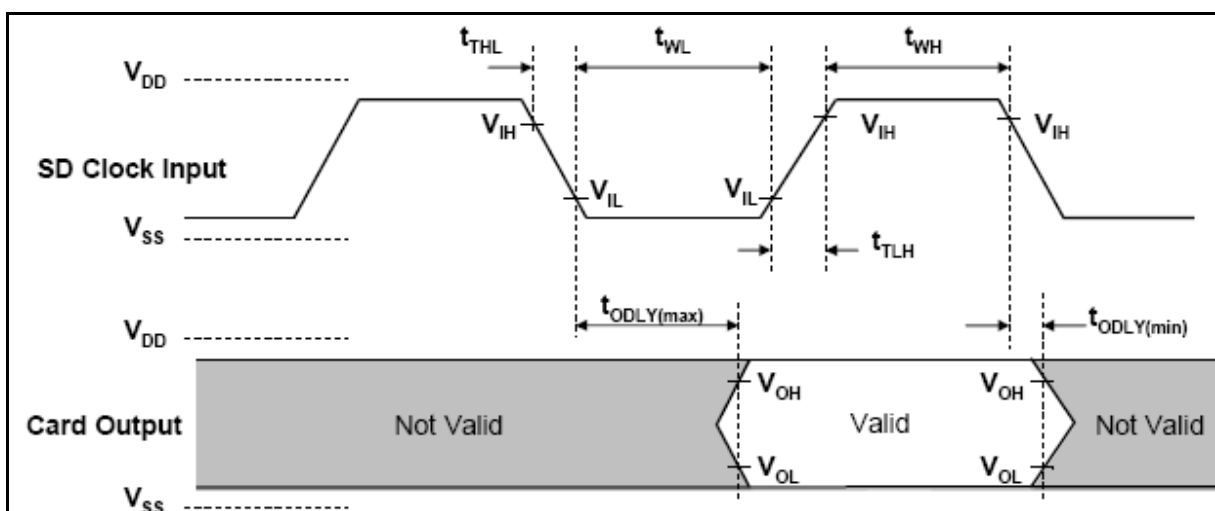
**7. AC Characters**



**7.1 SD Interface Timing (Default)**



Card Input Timing (Default Speed Card)

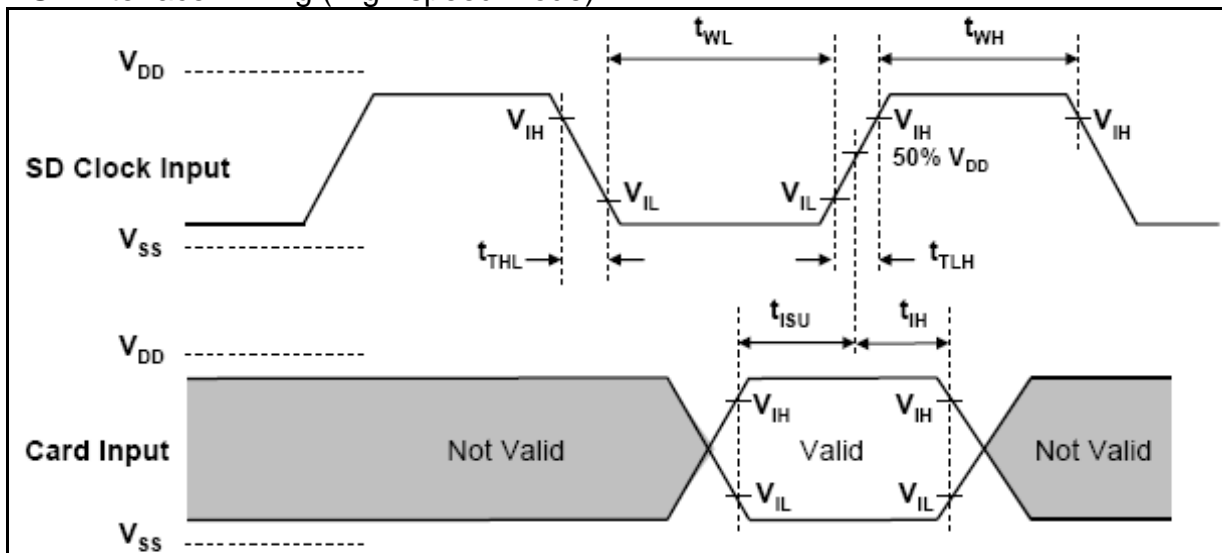


Card Output Timing (Default Speed Mode)

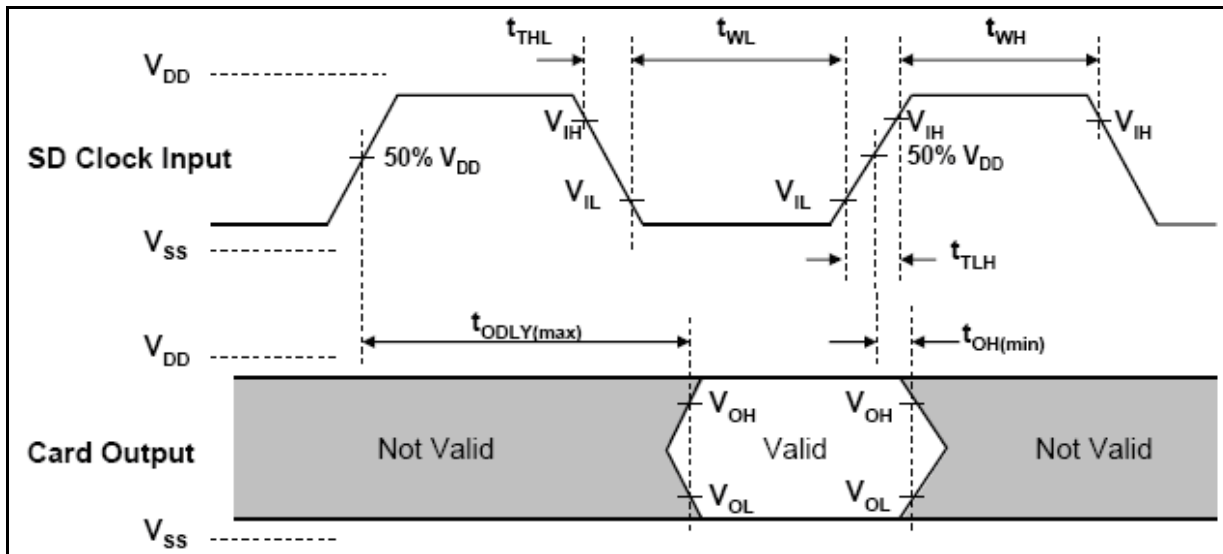
| Parameter   | Symbol            | Min                   | Max | Unit | Remark                             |
|---|-------------------|-----------------------|-----|------|------------------------------------|
| <b>Clock CLK (All values are referred to min(V<sub>IH</sub>) and max(V<sub>IL</sub>))</b> |                   |                       |     |      |                                    |
| Clock frequency Data Transfer Mode  | f <sub>PP</sub>   | 0                     | 25  | MHz  | C <sub>card</sub> ≤ 10 pF (1 card) |
| Clock frequency Identification Mode   | f <sub>OD</sub>   | 0 <sub>(1)</sub> /100 | 400 | kHz  | C <sub>card</sub> ≤ 10 pF (1 card) |
| Clock low time  | t <sub>WL</sub>   | 10                    |     | ns   | C <sub>card</sub> ≤ 10 pF (1 card) |
| Clock high time   | t <sub>WH</sub>   | 10                    |     | ns   | C <sub>card</sub> ≤ 10 pF (1 card) |
| Clock rise time   | t <sub>TLH</sub>  |                       | 10  | ns   | C <sub>card</sub> ≤ 10 pF (1 card) |
| Clock fall time   | t <sub>THL</sub>  |                       | 10  | ns   | C <sub>card</sub> ≤ 10 pF (1 card) |
| <b>Inputs CMD, DAT (referenced to CLK)</b>  |                   |                       |     |      |                                    |
| Input set-up time   | t <sub>ISU</sub>  | 5                     |     | ns   | C <sub>card</sub> ≤ 10 pF (1 card) |
| Input hold time   | t <sub>IH</sub>   | 5                     |     | ns   | C <sub>card</sub> ≤ 10 pF (1 card) |
| <b>Outputs CMD, DAT (referenced to CLK)</b>   |                   |                       |     |      |                                    |
| Output Delay time during Data Transfer Mode   | t <sub>ODLY</sub> | 0                     | 14  | ns   | C <sub>L</sub> ≤ 40 pF (1 card)    |
| Output Delay time during Identification Mode  | t <sub>ODLY</sub> | 0                     | 50  | ns   | C <sub>L</sub> ≤ 40 pF (1 card)    |

(1) 0Hz means to stop the clock. The given minimum frequency range is for cases where continuous clock is required.

### 7.2 SD Interface Timing (High-speed Mode)



Card Input Timing (High Speed Card)



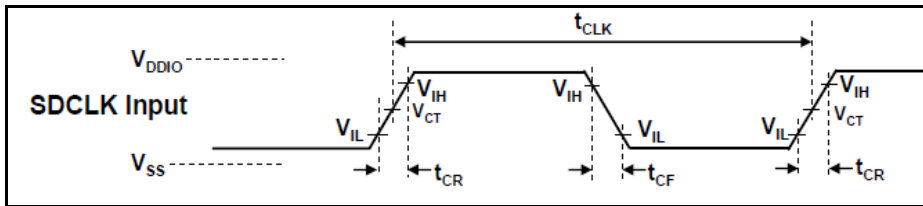
Card Output Timing (Default Speed Mode)

| Parameter   | Symbol            | Min | Max | Unit | Remark                             |
|---|-------------------|-----|-----|------|------------------------------------|
| <b>Clock CLK (All values are referred to min(V<sub>IH</sub>) and max(V<sub>IL</sub>))</b> |                   |     |     |      |                                    |
| Clock frequency Data Transfer Mode  | f <sub>PP</sub>   | 0   | 50  | MHz  | C <sub>card</sub> ≤ 10 pF (1 card) |
| Clock low time  | t <sub>WL</sub>   | 7   |     | ns   | C <sub>card</sub> ≤ 10 pF (1 card) |
| Clock high time   | t <sub>WH</sub>   | 7   |     | ns   | C <sub>card</sub> ≤ 10 pF (1 card) |
| Clock rise time   | t <sub>TLH</sub>  |     | 3   | ns   | C <sub>card</sub> ≤ 10 pF (1 card) |
| Clock fall time   | t <sub>THL</sub>  |     | 3   | ns   | C <sub>card</sub> ≤ 10 pF (1 card) |
| <b>Inputs CMD, DAT (referenced to CLK)</b>  |                   |     |     |      |                                    |
| Input set-up time   | t <sub>ISU</sub>  | 6   |     | ns   | C <sub>card</sub> ≤ 10 pF (1 card) |
| Input hold time   | t <sub>IH</sub>   | 2   |     | ns   | C <sub>card</sub> ≤ 10 pF (1 card) |
| <b>Outputs CMD, DAT (referenced to CLK)</b>   |                   |     |     |      |                                    |
| Output Delay time during Data Transfer Mode   | t <sub>ODLY</sub> |     | 14  | ns   | C <sub>L</sub> ≤ 40 pF (1 card)    |
| Output Hold time  | T <sub>OH</sub>   | 2.5 | 50  | ns   | C <sub>L</sub> ≤ 15 pF (1 card)    |
| Total System capacitance of each line <sup>1</sup>  | C <sub>L</sub>    |     | 40  | pF   | C <sub>L</sub> ≤ 15 pF (1 card)    |

(1) In order to satisfy severe timing, host shall drive only one card.

7.3 SD Interface timing (SDR12, SDR25 and SDR50 Modes)

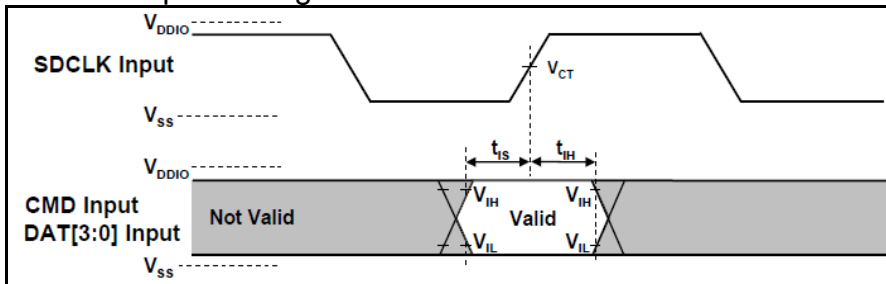
- Input:



| Symbol     | Min  | Max        | Unit | Remark  |
|------------|------|------------|------|---|
| tCLK       | 4.80 | 0          | ns   | 208MHz (Max.), Between rising edge, VCT= 0.975V |
| tCR, tCF   | -    | 0.2 * tCLK | ns   | tCR, tCF < 2.00ns (max.) at 100MHz, CCARD=10pF  |
| Clock Duty | 30   | 70         | %    |   |

Clock Signal Timing

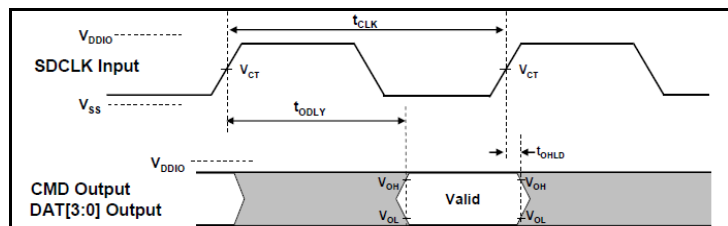
- SDR50 Input Timing:



| Symbol | Min  | Max | Unit | Remark                          |
|--------|------|-----|------|---------------------------------|
| tIS    | 3.00 | -   | ns   | $C_{CARD} = 10pF$ , VCT= 0.975V |
| tIH    | 0.80 | -   | ns   | $C_{CARD} = 5pF$ , VCT= 0.975V  |

Card Input Timing

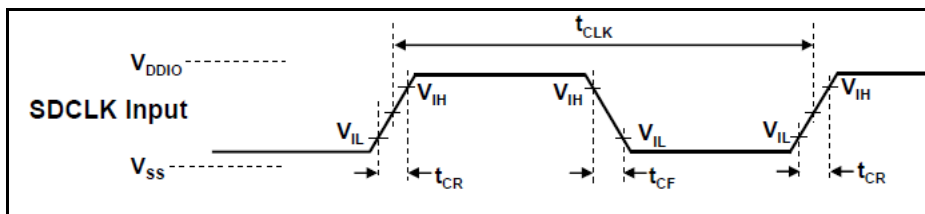
- Output:



| Symbol | Min | Max | Unit | Remark   |
|--------|-----|-----|------|--|
| tODLY  | -   | 7.5 | ns   | $t_{CLK} \geq 10.0ns$ , CL=30pF, using driver Type B, for SDR50            |
| tODLY  | -   | 14  | ns   | $t_{CLK} \geq 20.0ns$ , CL=40pF, using driver Type B, for SDR25 and SDR12, |
| TOH    | 1.5 | -   | ns   | Hold time at the tODLY (min.), CL=15pF                                     |

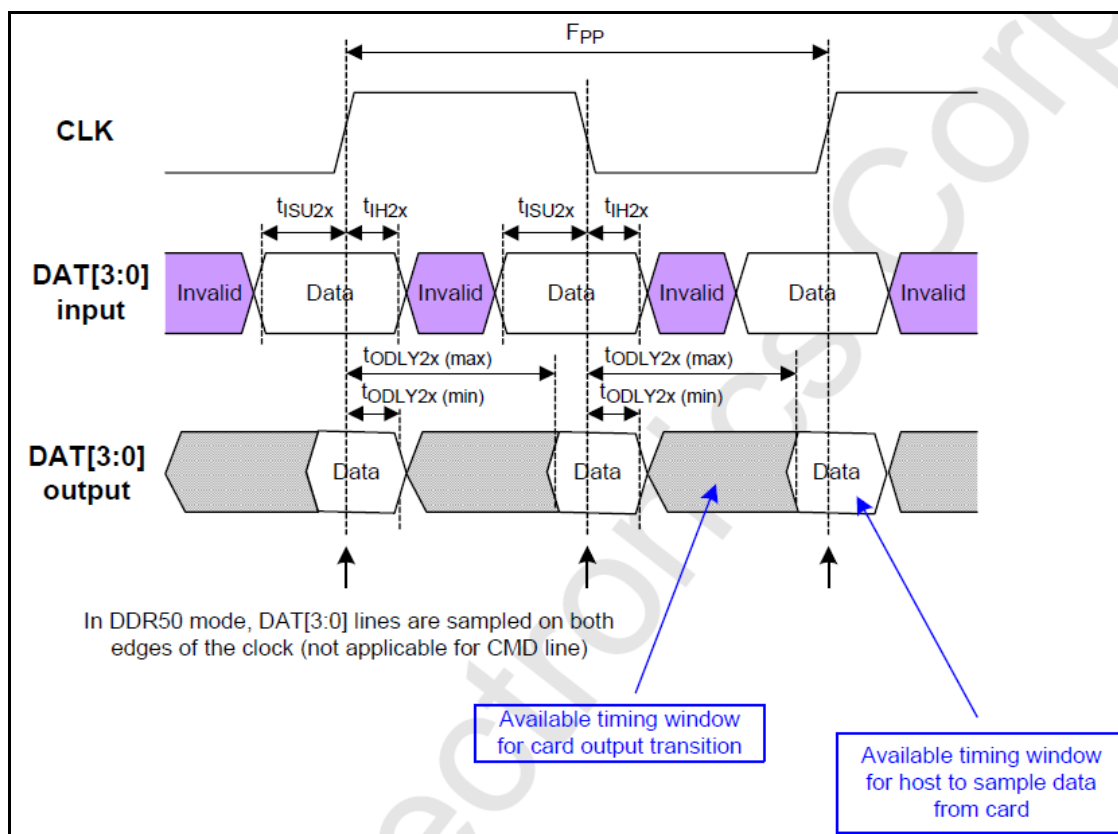
Output Timing of Fixed Data Window

7.4 SD Interface timing (DDR50 Modes)



| Symbol           | Min | Max             | Unit | Remark  |
|------------------|-----|-----------------|------|---|
| $t_{CLK}$        | 20  | -               | ns   | 50MHz (Max.), Between rising edge                                     |
| $t_{CR}, t_{CF}$ | -   | $0.2 * t_{CLK}$ | ns   | $t_{CR}, t_{CF} < 4.00\text{ns}$ (max.) at 50MHz, $CCARD=10\text{pF}$ |
| Clock Duty       | 45  | 55              | %    |   |

Clock Signal Timing

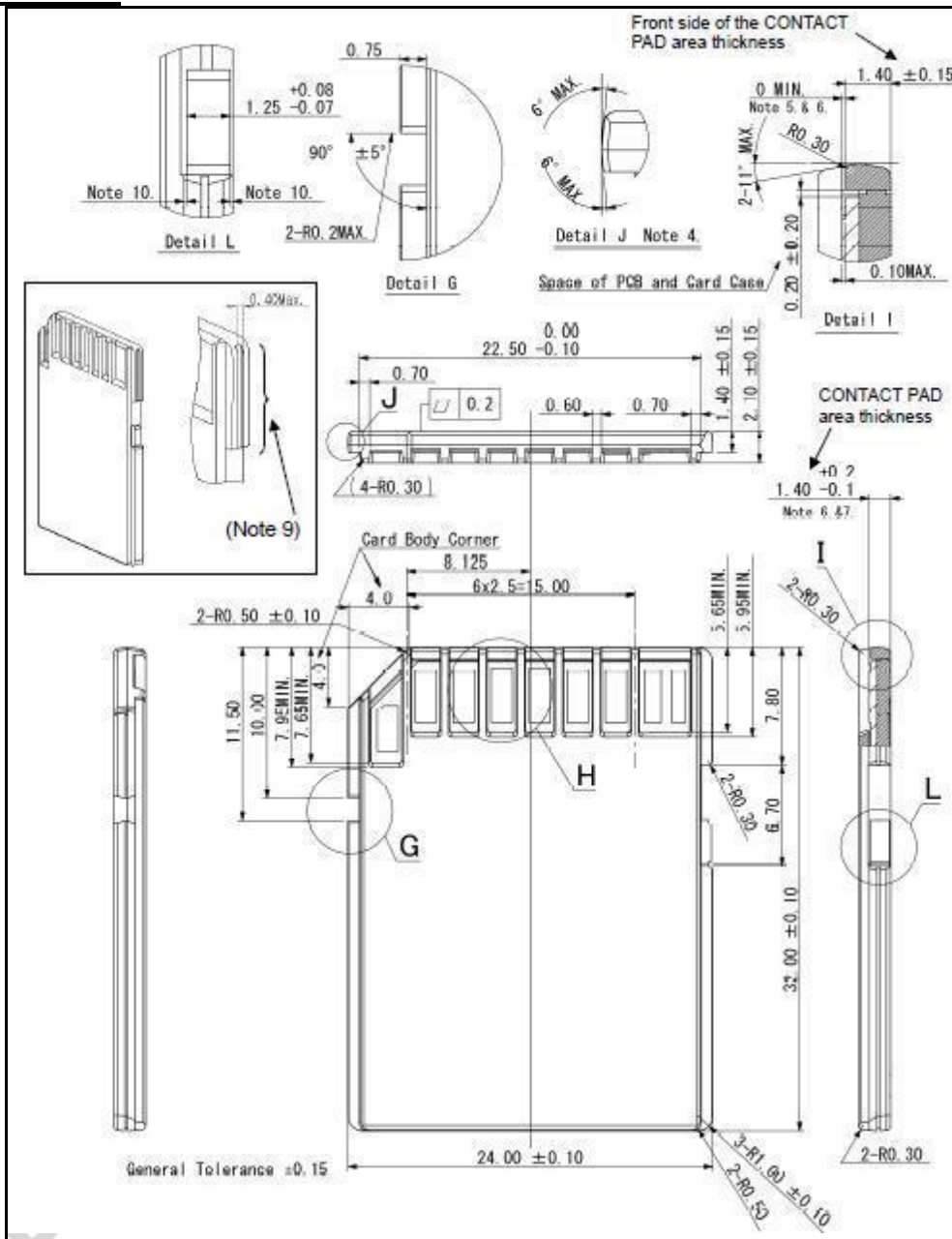


Timing Diagram DAT Inputs / Outputs Referenced to CLK in DDR50 Mode



| Parameter  | Symbol       | Min | Max  | Unit | Remark                            |
|--|--------------|-----|------|------|-----------------------------------|
| <b>Input CMD (referenced to CLK rising edge)</b>               |              |     |      |      |                                   |
| Input set-up time  | $t_{ISU}$    | 6   | -    | ns   | $C_{card} \leq 10$ pF<br>(1 card) |
| Input hold time  | $t_{IH}$     | 0.8 | -    | ns   | $C_{card} \leq 10$ pF<br>(1 card) |
| <b>Output CMD (referenced to CLK rising edge)</b>              |              |     |      |      |                                   |
| Output Delay time during Data Transfer Mode                    | $t_{ODLY}$   |     | 13.7 | ns   | $C_{card} \leq 30$ pF<br>(1 card) |
| Output Hold time   | $t_{OH}$     | 1.5 | -    | ns   | $C_{card} \leq 10$ pF<br>(1 card) |
| <b>Inputs DAT (referenced to CLK rising and falling edges)</b> |              |     |      |      |                                   |
| Input set-up time  | $t_{ISU2X}$  | 3   | -    | ns   | $C_{card} \leq 10$ pF<br>(1 card) |
| Input hold time  | $t_{IH2X}$   | 0.8 | -    | ns   | $C_{card} \leq 10$ pF<br>(1 card) |
| <b>Outputs CMD, DAT (referenced to CLK)</b>                    |              |     |      |      |                                   |
| Output Delay time during Data Transfer Mode                    | $t_{ODLY2X}$ | -   | 7.0  | ns   | $C_L \leq 25$ pF<br>(1 card)      |
| Output Hold time   | $t_{OH2X}$   | 1.5 | -    | ns   | $C_L \geq 15$ pF<br>(1 card)      |

**8. Dimensions**



**Dimensions of A SD Card (Bottom View, DIN)**

**Appendix: Part Number Table**
**SLC**

| Product                         | Advantech PN       |
|---------------------------------|--------------------|
| SQF I-SD C6 SLC 128M (0~70°C)   | SQF-ISDS1-128M-21C |
| SQF I-SD C6 SLC 256M (0~70°C)   | SQF-ISDS1-256M-21C |
| SQF I-SD C6 SLC 512M (0~70°C)   | SQF-ISDS1-512M-21C |
| SQF I-SD C6 SLC 1G (0~70°C)     | SQF-ISDS1-1G-21C   |
| SQF I-SD C6 SLC 2G (0~70°C)     | SQF-ISDS1-2G-21C   |
| SQF I-SD C6 SLC 4G (0~70°C)     | SQF-ISDS1-4G-21C   |
| SQF I-SD C10 SLC 8G (0~70°C)    | SQF-ISDS1-8G-21C   |
| SQF I-SD C10 SLC 16G (0~70°C)   | SQF-ISDS1-16G-21C  |
| SQF I-SD C10 SLC 32G (0~70°C)   | SQF-ISDS1-32G-21C  |
| SQF I-SD C6 SLC 128M (-40~85°C) | SQF-ISDS1-128M-21E |
| SQF I-SD C6 SLC 256M (-40~85°C) | SQF-ISDS1-256M-21E |
| SQF I-SD C6 SLC 512M (-40~85°C) | SQF-ISDS1-512M-21E |
| SQF I-SD C6 SLC 1G (-40~85°C)   | SQF-ISDS1-1G-21E   |
| SQF I-SD C6 SLC 2G (-40~85°C)   | SQF-ISDS1-2G-21E   |
| SQF I-SD C6 SLC 4G (-40~85°C)   | SQF-ISDS1-4G-21E   |
| SQF I-SD C10 SLC 8G (-40~85°C)  | SQF-ISDS1-8G-21E   |
| SQF I-SD C10 SLC 16G (-40~85°C) | SQF-ISDS1-16G-21E  |
| SQF I-SD C10 SLC 32G (-40~85°C) | SQF-ISDS1-32G-21E  |

**Ultra MLC**

| Product                            | Advantech PN      |
|------------------------------------|-------------------|
| SQF I-SD UHS-I UMLC 4G (0~70°C)    | SQF-ISDU1-4G-21C  |
| SQF I-SD UHS-I UMLC 8G (0~70°C)    | SQF-ISDU1-8G-21C  |
| SQF I-SD UHS-I UMLC 16G (0~70°C)   | SQF-ISDU1-16G-21C |
| SQF I-SD UHS-I UMLC 32G (0~70°C)   | SQF-ISDU1-32G-21C |
| SQF I-SD UHS-I UMLC 64G (0~70°C)   | SQF-ISDU1-64G-21C |
| SQF I-SD UHS-I UMLC 4G (-40~85°C)  | SQF-ISDU1-4G-21E  |
| SQF I-SD UHS-I UMLC 8G (-40~85°C)  | SQF-ISDU1-8G-21E  |
| SQF I-SD UHS-I UMLC 16G (-40~85°C) | SQF-ISDU1-16G-21E |
| SQF I-SD UHS-I UMLC 32G (-40~85°C) | SQF-ISDU1-32G-21E |
| SQF I-SD UHS-I UMLC 64G (-40~85°C) | SQF-ISDU1-64G-21E |

MLC

| Product                            | Advantech PN       |
|------------------------------------|--------------------|
| SQF I-SD UHS-I MLC 8G (0~70°C)     | SQF-ISDM1-8G-21C   |
| SQF I-SD UHS-I MLC 16G (0~70°C)    | SQF-ISDM1-16G-21C  |
| SQF I-SD UHS-I MLC 32G (0~70°C)    | SQF-ISDM1-32G-21C  |
| SQF I-SD UHS-I MLC 64G (0~70°C)    | SQF-ISDM1-64G-21C  |
| SQF I-SD UHS-I MLC 128G (0~70°C)   | SQF-ISDM1-128G-21C |
| SQF I-SD UHS-I MLC 8G (-40~85°C)   | SQF-ISDM1-8G-21E   |
| SQF I-SD UHS-I MLC 16G (-40~85°C)  | SQF-ISDM1-16G-21E  |
| SQF I-SD UHS-I MLC 32G (-40~85°C)  | SQF-ISDM1-32G-21E  |
| SQF I-SD UHS-I MLC 64G (-40~85°C)  | SQF-ISDM1-64G-21E  |
| SQF I-SD UHS-I MLC 128G (-40~85°C) | SQF-ISDM1-128G-21E |

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели,  
кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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