# 32-bit RISC Microcontroller
# Reference Manual

# Voltage Detection Circuit (LVD-D2)

## Revision 1.0

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Toshiba Electronic Devices & Storage Corporation

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# Preface

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## Conventions

- Numeric formats follow the rules as shown below:
  Hexadecimal: 0xABC
  Decimal: 123 or 0d123 - Only when it needs to be explicitly shown that they are decimal numbers.
  Binary: 0b111 - It is possible to omit the "0b" when the number of bits can be distinctly understood from a sentence.
- "_N" is added to the end of signal names to indicate low active signals.
- It is called "assert" that a signal moves to its active level, "deassert" to its inactive level.
- When two or more signal names are referred, they are described like as [m:n].
  Example: S[3:0] shows four signal names S3, S2, S1 and S0 together.
- The characters surrounded by ***[ ]*** defines the register.
  Example: ***[ABCD]***
- "N" substitutes suffix number of two or more same kind of registers, fields, and bit names.
  Example: ***[XYZ1]***, ***[XYZ2]***, ***[XYZ3]*** → ***[XYZn]***
- "x" substitutes suffix number or character of units and channels in the register list.
- In case of unit, "x" means A, B, and C, ...
  Example: ***[ADACR0]***, ***[ADBCR0]***, ***[ADCCR0]*** → ***[ADxCR0]***
- In case of channel, "x" means 0, 1, and 2, ...
  Example: ***[T32A0RUNA]***, ***[T32A1RUNA]***, ***[T32A2RUNA]*** → ***[T32AxRUNA]***
- The bit range of a register is written like as [m: n].
  Example: Bit[3: 0] expresses the range of bit 3 to 0.
- The configuration value of a register is expressed by either the hexadecimal number or the binary number.
  Example: ***[ABCD]***<EFG> = 0x01 (hexadecimal), ***[XYZn]***<VW> = 1 (binary)
- Word and byte represent the following bit length.
  Byte: 8 bits
  Half word: 16 bits
  Word: 32 bits
  Double word: 64 bits
- Properties of each bit in a register are expressed as follows:
  R: Read only
  W: Write only
  R/W: Read and write are possible.
- Unless otherwise specified, register access supports only word access.
- The register defined as "Reserved" must not be rewritten. Moreover, do not use the read value.
- The value read from the bit having default value of "-" is unknown.
- When a register containing both of writable bits and read-only bits is written, read-only bits should be written with their default value, In the cases that default is "-", follow the definition of each register.
- Reserved bits of the write-only register should be written with their default value. In the cases that default is "-", follow the definition of each register.
- Do not use read-modified-write processing to the register of a definition which is different by writing and read out.

## Terms and Abbreviations

Some of abbreviations used in this document are as follows:

| | |
|---|---|
| LVD | Voltage Detection Circuit |

# 1. Outlines

The main functions of a voltage detecting circuit (LVD) are as follows.

| Function classification | Function | Functional description | Remarks |
|---|---|---|---|
| Supply voltage detection function | Reset | Reset is output when DVDD5 is setting detection voltage or less. | Either reset or interrupt is selected. |
| | Interrupt | Interrupt is output when DVDD5 is setting detection voltage or less. | |
| | Monitor | Output of LVD can be monitored. | - |
| | Detection/release voltage selection | Detection/release voltage can be selected. | - |

# 2. Configuration

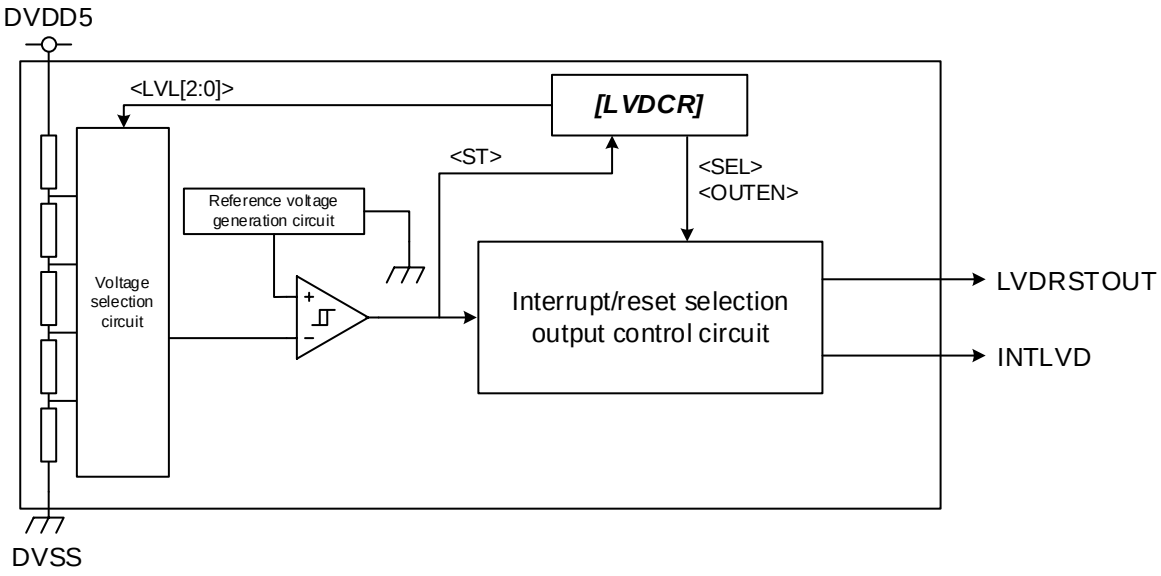


**Figure 2.1 Block Diagram of LVD**

**Table 2.1 List of Signals**

| No | Symbol | Signal name | I/O | Related reference manual |
|---|---|---|---|---|
| 1 | DVDD5 | Power supply pin for detection | Input | Datasheet |
| 2 | LVDRSTOUT | LVD reset | Output | Clock Control and Operation Mode |
| 3 | INTLVD | LVD interrupt | Output | Exception |

# 3. Details of Function and Operation

The voltage detection circuit supervises the voltage of DVDD5.

The reference voltage which occurs in the reference voltage generation circuit is compared with the output voltage of voltage selection circuit which selects the detection voltage made from DVDD5.

According to a comparison result, the interrupt/reset selection output control circuit outputs reset or interrupt.

And a comparison result can be monitored.

## 3.1. Detection Operation

When the DVDD5 is a detection voltage or less, an output of voltage detection circuit becomes "High". It keeps "High" until the DVDD5 exceeds a release voltage.

When the DVDD5 is a release voltage or more, an output of voltage detection circuit becomes "Low". It keeps "Low" until the DVDD5 becomes below a detection voltage.

The $t_{VDDT1}$ and $t_{VDDT2}$ are required as the time from detection and release timing until an output of voltage detection circuit changes.

And $t_{LVDPW}$ is defined as the pulse width that is required to detect.

For their details, refer to "Electrical Characteristics" in a datasheet.

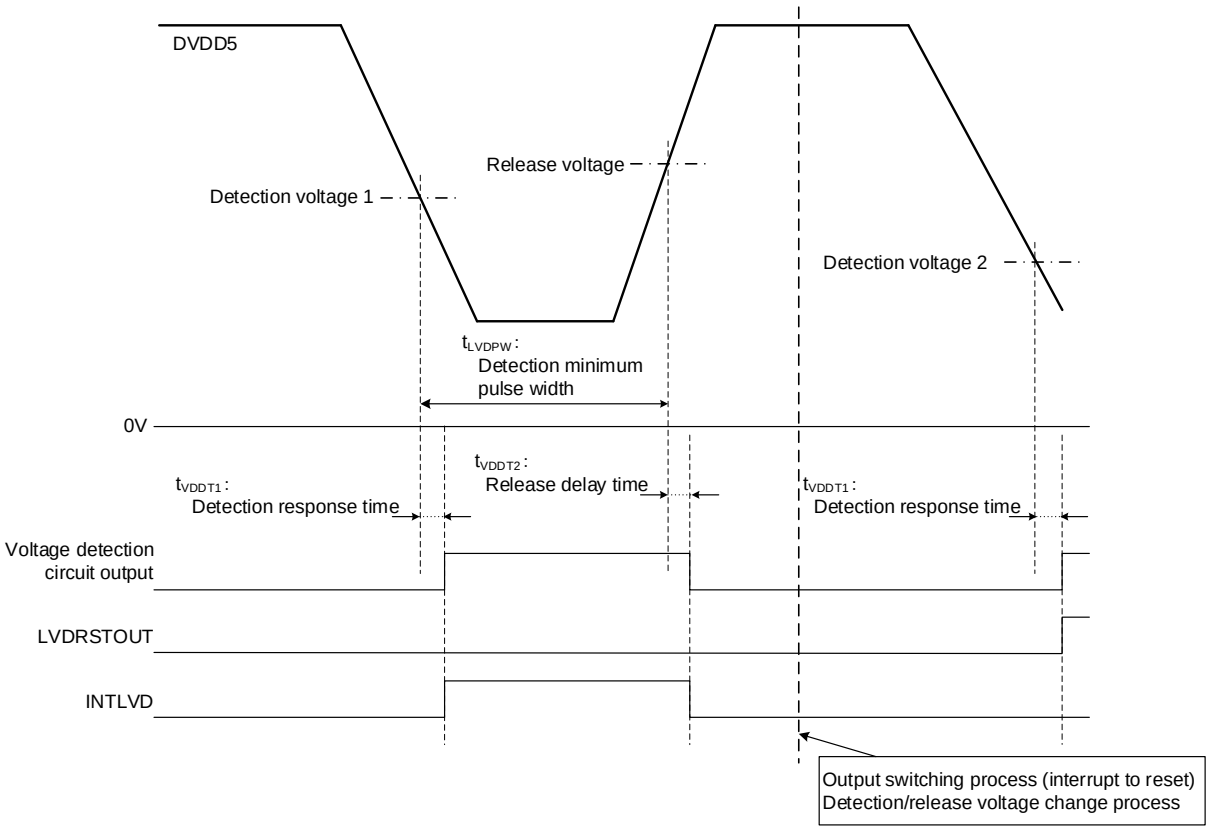


**Figure 3.1 Detection Operation**

## 3.2. Settings

The voltage detection circuit is initialized to enable detection operation and to output reset after turning on of a power supply.

A detection/release voltage is selected by ***[LVDCR]***<LVL[2:0]>.
To enable the voltage detection operation, set ***[LVDCR]***<EN> to "1".
The output of voltage detection circuit can be monitored by reading ***[LVDCR]***<ST>. And it can be output as reset or interrupt. Either reset or interrupt can be output by ***[LVDCR]***<SEL>.
The selected signal is output when ***[LVDCR]***<OUTEN> is set to "1".

The procedures of register settings are shown below.

### 3.2.1. Selection of Detection/release Voltage and Voltage Detection Circuit's Output

The procedure to select a detection/release voltage and voltage detection circuit's output is shown below.

When only detection/release voltage is selected, step (4) is not required.
When only voltage detection circuit's output is selected, step (2) and (3) are not required.

(1) Set ***[LVDCR]***<OUTEN> to "0".
(2) Set ***[LVDCR]***<LVL[2:0]>.
(3) Wait 100μs or more.
(4) Set ***[LVDCR]***<SEL>.
(5) Set ***[LVDCR]***<OUTEN> to "1".

### 3.2.2. Change Operation from Enable to Disable

Execute below procedure to disable detection operation.

(1) Set ***[LVDCR]***<OUTEN> to "0".
(2) Set ***[LVDCR]***<EN> to "0".

### 3.2.3. Change Operation from Disable to Enable

Execute below procedure to enable detection operation.

(1) Set ***[LVDCR]***<OUTEN> to "0".
(2) Set ***[LVDCR]***<EN> to "1".
(3) Wait 1ms or more.
(4) Set ***[LVDCR]***<OUTEN> to "1".

# 4. Registers

## 4.1. Register List

Control registers and their addresses are as follows.

| Peripheral function | | Channel/Unit | Base address |
|---|---|---|---|
| | | | TYPE1 |
| Voltage Detection Circuit | LVD | - | 0x4003EC00 |

| Register name | | Address (Base+) |
|---|---|---|
| LVD Control Register | ***[LVDCR]*** | 0x0000 |

Note: Byte access is required for the register of LVD. It cannot be bit band accessed.

## 4.2. Details of Register

### 4.2.1. *[LVDCR]* (LVD Control Register)

| Bit | Bit symbol | After reset | Type | Function |
|---|---|---|---|---|
| 7 | ST | 0 | R | Voltage detection circuit's output monitor (Note 1)<br>0: DVDD5 is release voltage or more.<br>1: DVDD5 is detection voltage or less. |
| 6:4 | LVL[2:0] | (Note 2) | R/W | Detection/release voltage selection (Note 3)<br><br>Detection voltage / Release voltage<br>000: 2.65V / 2.7V<br>001: 2.7V / 2.75V<br>010: 2.8V / 2.85V<br>011: 2.9V / 2.95V<br>100: 4.0V / 4.05V<br>101: 4.2V / 4.25V<br>110: 4.4V / 4.45V<br>111: 4.6V / 4.65V |
| 3 | - | 0 | R | Read as "0". |
| 2 | SEL | 0 | R/W | Voltage detection circuit's output selection<br>0:Reset<br>1: Interrupt |
| 1 | OUTEN | 1 | R/W | Voltage detection circuit's output control<br>0: Output disabled<br>1: Output enabled |
| 0 | EN | 1 | R/W | Detection operation control<br>0: Detection disabled<br>1: Detection enabled |

Note 1: Perform multiple readings and verify that the values are the same.

Note 2: Regarding an initial value after reset, refer to the reference manual "Product Information".

Note 3: Regarding the detection/release voltage which can be set, refer to "Electrical Characteristics" in a datasheet.

# 5. Revision History

**Table 5.1 Revision History**

| Revision | Date | Description |
|---|---|---|
| 1.0 | 2024-04-12 | - First release |

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