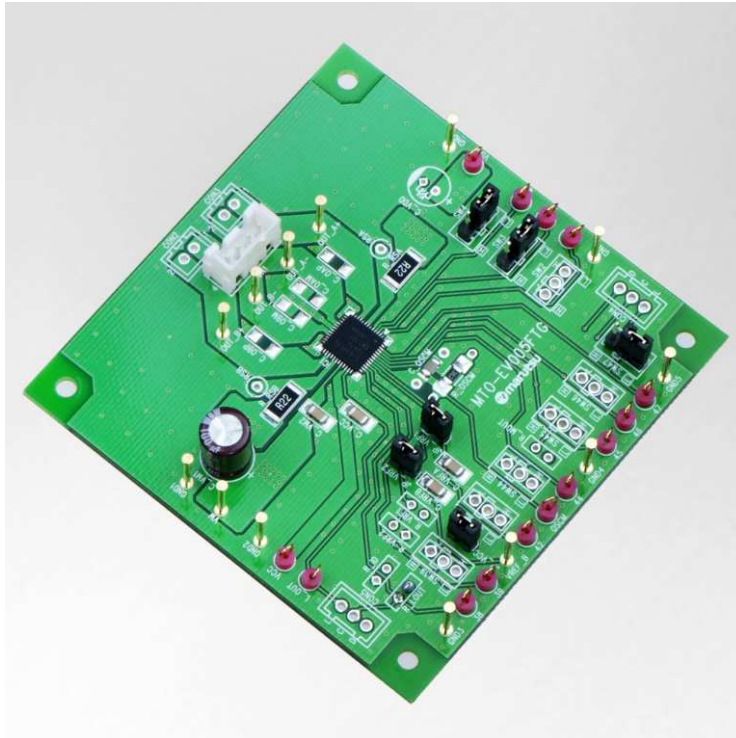# Instruction Manual for
Evaluation Board of TB67S103AFTG

12th Sep. 2018

Rev.1.0

Product Outline

The TB67S103AFTG is PWM chopper type 2-phase bipolar stepping motor driver IC.
3-wire serial interface system and clock-in control system are used in combination.
The operations of this IC is set by 3-wire serial interface and the motor rotation is
controlled by clock-in control system. And the ID function is available. By setting IDs,
up to 4 of TB67S103AFTG can be controlled independently.
By adopting Bi-CD process, maximum Output withstand voltage of 50 V and
maximum Output current of 4.0A as absolute maximum ratings are realized.
Owing to this evaluation board, it is possible to try each excitation operation of
2 phase, 1-2 phase, W1-2 phase, 2W1-2 phase, 4W1-2 phase, 8W1-2 phase
with PWM constant current drive.

In addition, Toshiba's new advanced technology of ADMD (Advanced Dynamic Mixed
Decay) is equipped in this IC. By monitoring current decay situation inside the IC
and optimizing choice of Fast Decay and Slow Decay automatically, ADMD provides
improved current followability at higher speed rotation than the conventional system,
ADMD realizes motor control with high efficiency/low noise at high speed rotation.

【Note】

In using this device, please be careful about the thermal condition sufficiently.
And for detailed operations such as control input, please refer to the datasheet
and the application notes by accessing to the following URL.
https://toshiba.semicon-storage.com/ap-en/product/linear/motordriver/detail.TB67S103AFTG.html

Further, use of this evaluation board is strictly limited to the purpose of evaluating
and learning the motor control. Please do not ship it to market.

Basic Notes in use of this evaluation board

Power Supply Voltage and Operating Range

 In using the TB67S103AFTG, the voltage should be applied to the VM and VREF pins.
 The absolute maximum rating of VM (Power supply voltage for motor) is 50V,
but operating range of the power supply is 10 to 47V.
 The absolute maximum rating of Vref (Reference Voltage for setting motor current) is 5V,
but operating range of this voltage is 0 to 3.6V.

Power Supply Sequence

 In applying power supplies and shutting those down, no special procedures is required,
because the TB67S103AFTG incorporates a error detection circuit of power-on reset (POR).
 The threshold voltage of POR is designed as VM=8.0V±1.0V.
 However, under unstable state of VM as raising and falling, it is recommended to
turn off the motor operation.
 Please start operation of motor by input signals after the power supplies become stable state.

Motor Current (Output Current)

 Motor current should not exceed the specified Output Current (3.0A or less).
 Also, please note that the maximum current may be limited due to usage conditions
(ambient temperature, heat issue, step resolution setting, etc.).
 Please set to the optimum value after thermal circulation and actual evaluation under
operating environment .

Control Input

 Before applying Power supplies, it is recommended that Input signals (SCLK, SDATA, SSET,
CLK, ENABLE, RESET) are set to Low level. But even if the logic signal is inputted when VM
voltage is not applied, electromotive force does not generate.

Explanation of Each Abnormality Detection Circuit

TSD (Thermal Shut Down)

 When the junction temperature (Tj) of this chip exceeds 160°C(typ.),a internal detection circuit stars operation and all outputs are turned off. And a dead time is set inside this IC in order to avoid malfunction caused by switching etc..
 In the operating state of TSD, IC stays stop mode.
 After TSD operation, TSD can be canceled by turning the power supply on again or inputting the serial data after setting standby mode (BANK0<D2:D0>=[0,0,0]).

 The TSD functions when the IC abnormally heats up. So that please avoid utilizing this function actively.

ISD (Over Current Detection)

When any of current which flows in output transistors exceeds 4.9A(typ.), a internal detection circuit stars operation and turns off all output transistors. And a dead time is set inside this IC in order to avoid malfunction caused by switching etc..
 In the operating state of ISD, IC stays stop mode.
 After ISD operation, ISD can be canceled by turning the power supply on again or resetting the serial input after setting standby mode (BANK0<D2:D0>=[0,0,0]).
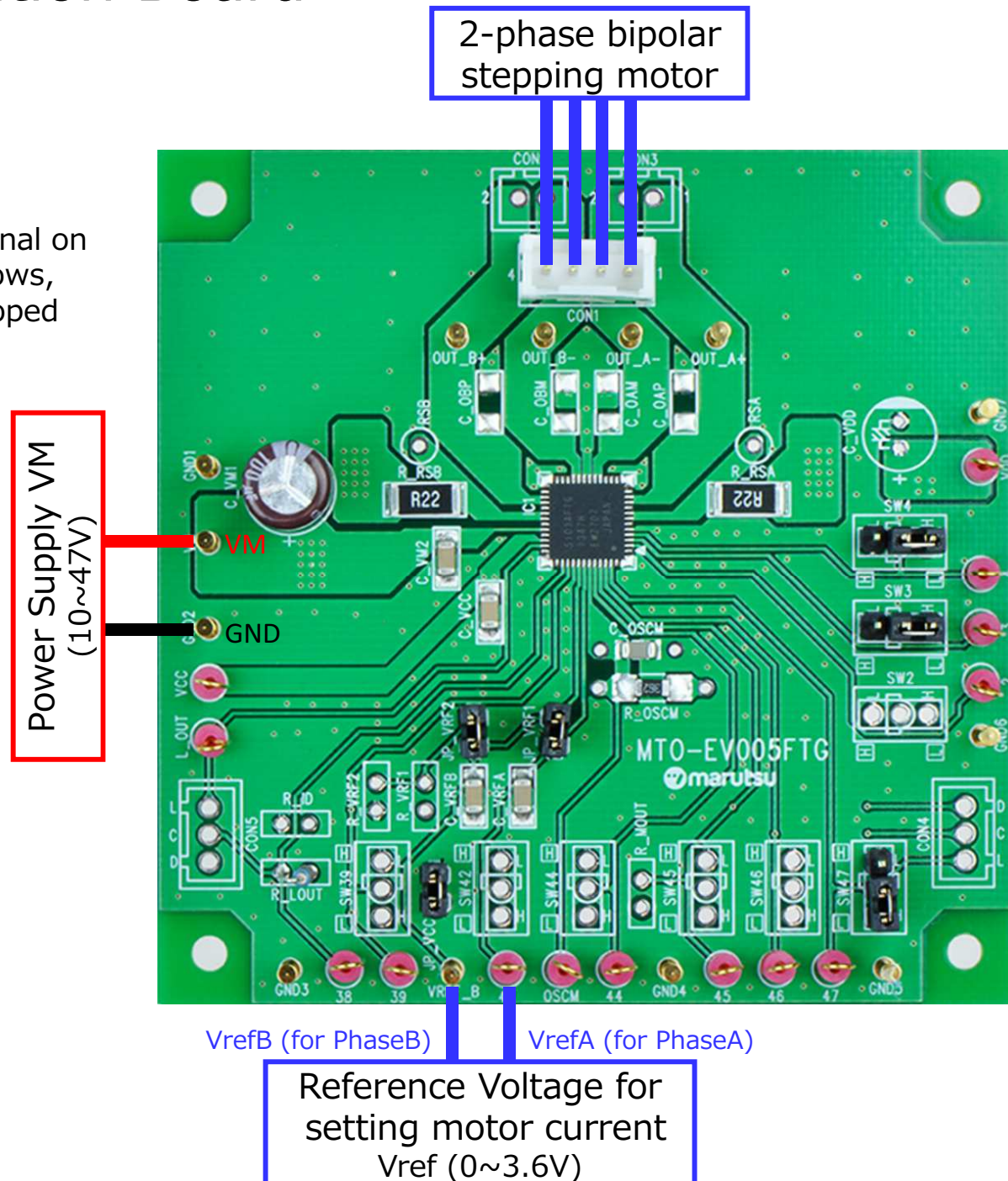
 ＊Those above values in each detection circuit are not guaranteed but reference ones.

Connection of Evaluation Board

Corresponding table of Silk name and Signal name

Please note that the names of silk and signal on this board are different each other as follows, because this board is designed and developed as a unfired one for H-Bridge series.

Silk name	Signal name
L_OUT	NC
38	LO
39	ID
VREFB	VrefB
42	VrefA
OSCM	OSCM
44	SCLK
45	SO
46	SDATA
47	SSET
2	CLK
3	ENABLE
4	RESET

2-phase bipolar stepping motor

Power Supply VM (10~47V)

VM

GND

VrefB (for PhaseB)

VrefA (for PhaseA)

Reference Voltage for setting motor current
Vref (0~3.6V)

MTO-EV005FTG

Setting Motor Current

The TB67S103AFTG conducts motor operation by PWM constant current control which is based on the frequency of the OSCM oscillation circuit. The maximum current value (set Motor current value) can be determined by a sense resistor (RRS) and the reference voltage (Vref).

Formula of setting Motor Current Value

$$Iout(max) = Vref(gain) \times \frac{Vref(V)}{R_{RS}(\Omega)}$$

Vref(gain): damping ratio of Vref is 1/5.0(typ.)
This board is set to RRS=0.22Ω

By using the jumper of JP_VRF1, Vref of A and B channel are unified, and both can be set from the VrefA pin.

And it is also possible to generate a Vref voltage from the built-in regulator of VCC voltage by mounting resistors in R_VRF 1 and R_VRF2, and shorting JP_VRF2 on this board.

However, please note that if more current than the built-in regulator's ability is drawn, VCC regulation may not be maintained. So that please be careful that total of voltage dividing resistors does not become less than 10kΩ.
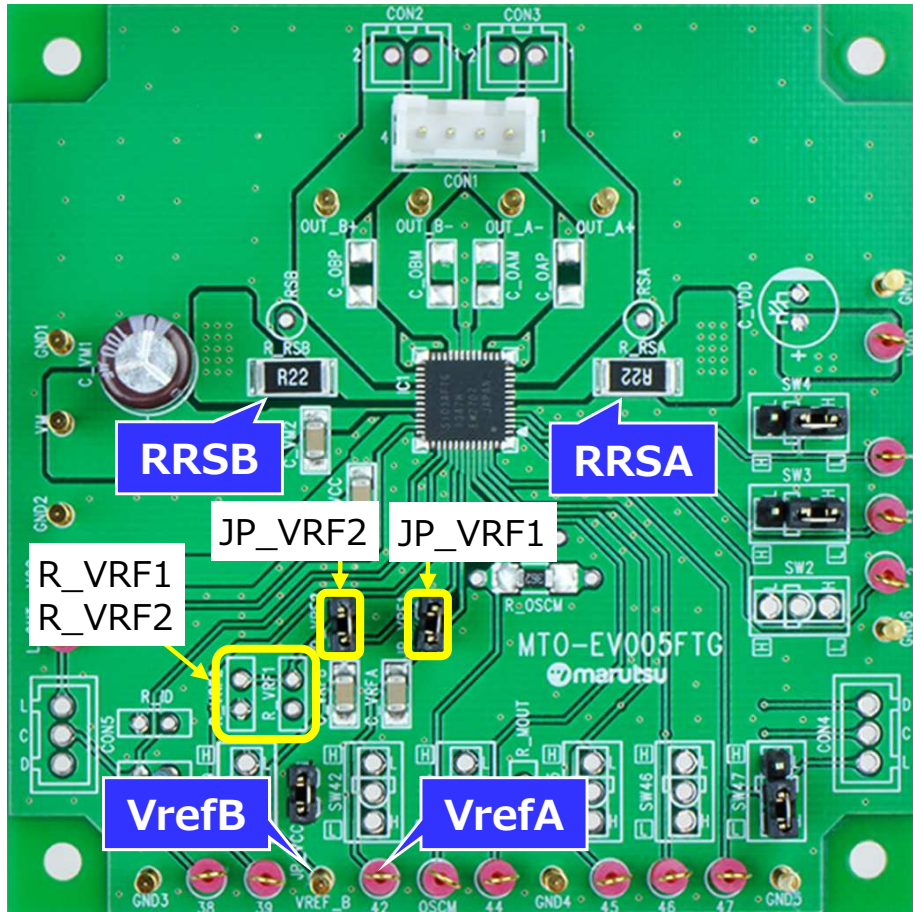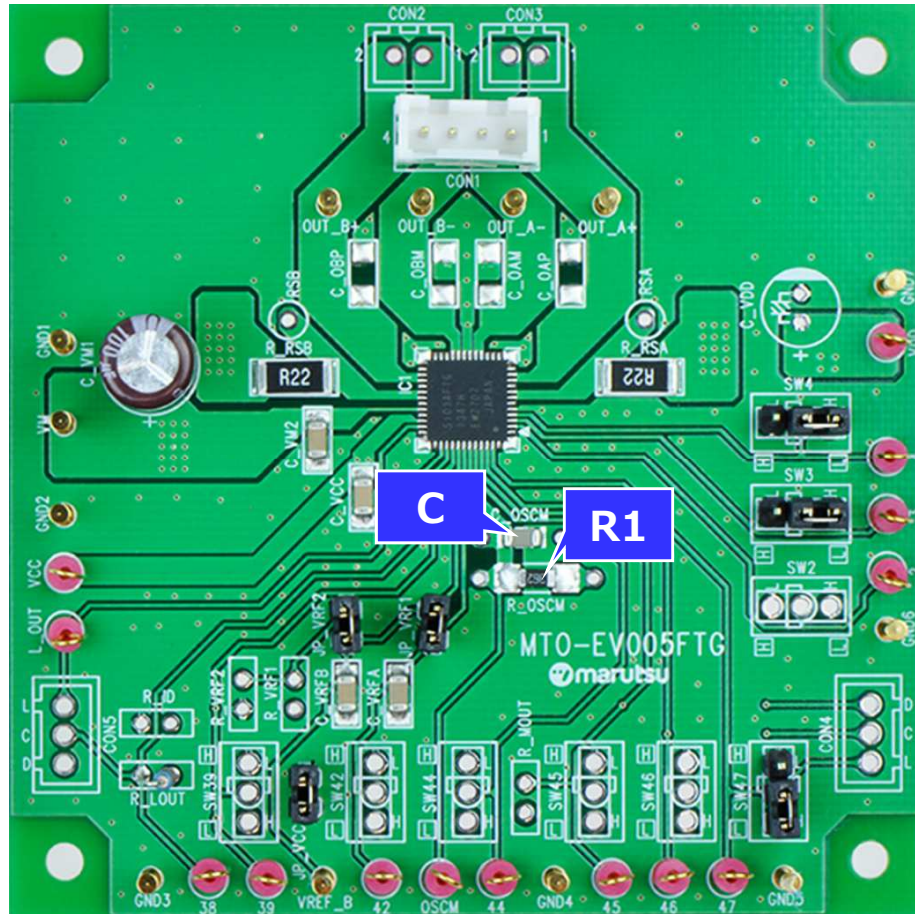
Waveform of Motor Current
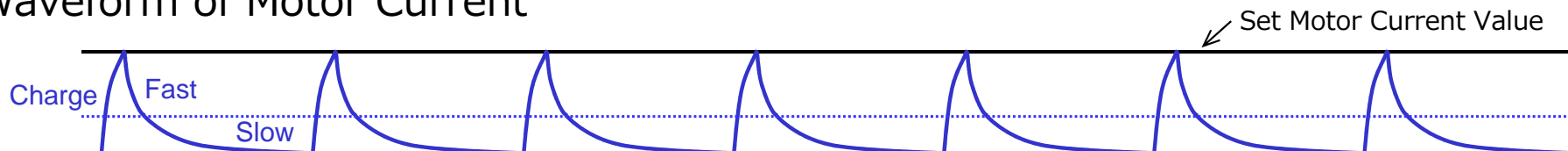
Setting Evaluation Board :2
Setting the Chopping Frequency for constant current PWM control

In PWM control of the TB67S103AFTG, the internal oscillation frequency (fOSCM) and the chopping frequency (fchop) can be adjusted according to the constant of the external components those are connected to the OSCM pin. In general, f_{chop} is recommended to set in the frequency range of 50kHz to 100kHz.
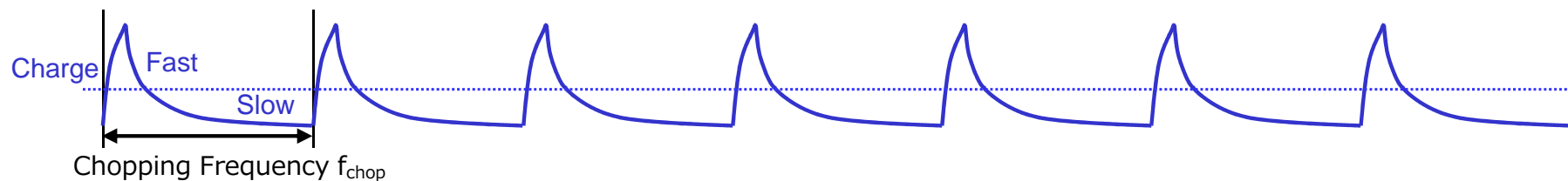
Formula of Chopping Frequency

$$f_{OSCM} = 1 / [0.56 \times \{C \times (R1+500)\}]$$
$$f_{chop} = f_{OSCM} / 16$$

This board is set to 100kHz by mounting C=270pF and R1=3.6kΩ.
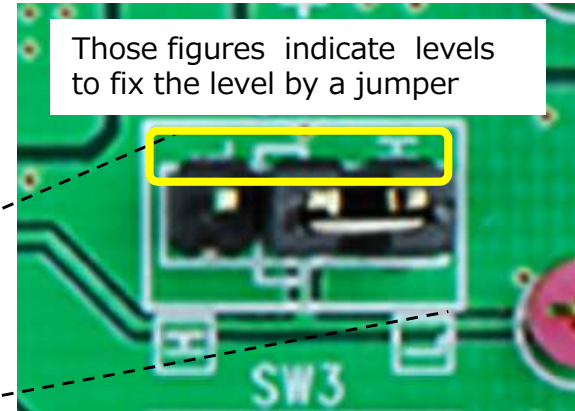
Waveform of Motor Current

Charge Fast

Slow

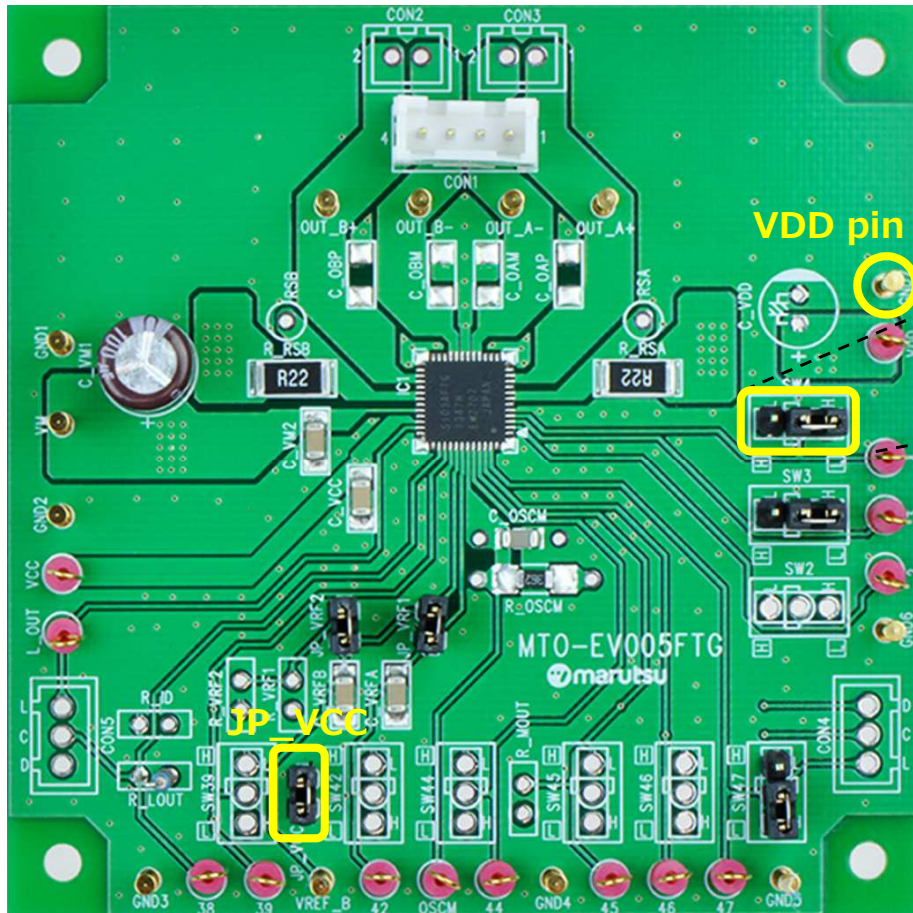Chopping Frequency f_{chop}

Setting Evaluation Board :3
Setting for Motor Operation

【Enlarged view of the jumper section】

Those figures indicate levels to fix the level by a jumper

VDD pin

JP_VCC

SW3

On this evaluation board, jumpers as shown in the picture above are provided for setting operation of TB67S103AFTG

When selecting functions by using jumpers, please short the JP_VCC, or supply high level from the VDD pin.

The characters surrounded by white square frame close to the jumpers show the Level (H/L). Please change the position of jumpers in accordance with the function setting to be used.

Further when inputting signals from the outside, please remove the short pins.

Circuit of Evaluation Board