

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74VCXR162245FT**LOW-VOLTAGE 16-BIT BUS TRANSCEIVER
WITH 3.6V TOLERANT INPUTS AND OUTPUTS**

The TC74VCXR162245FT is a high performance CMOS 16-bit BUS TRANSCEIVER. Designed for use in 1.8, 2.5 or 3.3 Volt systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

It is also designed with over voltage tolerant inputs and outputs up to 3.6V.

This 16bit bus transceiver is controlled by direction control (DIR) inputs and output enable (\overline{OE}) inputs which are common to each byte. It can be used as two 8-bit transceivers or one 16-bit transceiver. The direction of data transmission is determined by the level of the DIR inputs. The \overline{OE} inputs can be used to disable the device so that the busses are effectively isolated.

The $26\text{-}\Omega$ series resistor helps reducing output overshoot and undershoot without external resistor.

All inputs are equipped with protection circuits against static discharge.

FEATURES

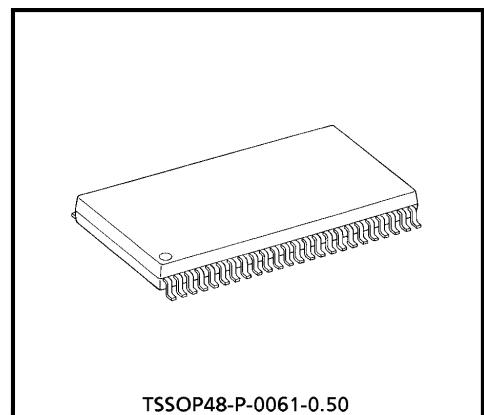
- 26- Ω Series Resistors on all Outputs.
- Low Voltage Operation : $V_{CC} = 1.8 \sim 3.6V$
- High Speed Operation : $t_{pd} = 3.4\text{ns}$ (max.) at $V_{CC} = 3.0 \sim 3.6V$
 : $t_{pd} = 4.3\text{ns}$ (max.) at $V_{CC} = 2.3 \sim 2.7V$
 : $t_{pd} = 5.7\text{ns}$ (max.) at $V_{CC} = 1.8V$
- 3.6V Tolerant inputs and outputs.
- Output Current : $I_{OH}/I_{OL} = \pm 12\text{mA}$ (min.) at $V_{CC} = 3.0V$
 : $I_{OH}/I_{OL} = \pm 8\text{mA}$ (min.) at $V_{CC} = 2.3V$
 : $I_{OH}/I_{OL} = \pm 4\text{mA}$ (min.) at $V_{CC} = 1.8V$
- Latch-up Performance : $\pm 300\text{mA}$
- ESD Performance : Human Body Model $> \pm 2000V$
 : Machine Model $> \pm 200V$
- Package : TSSOP (Thin Shrink Small Outline Package)
- Bidirectional interface between 2.5V and 3.3V signals.
- Power Down Protection is provided on all inputs and outputs
- Supports live insertion / withdrawal (Note 3)

Note 1) Do not apply a signal to any bus terminal when it is in the output mode. Damage may result.

- 2) All floating (high impedance) bus terminal must have their input level fixed by means of pull up or pull down resistors.
- 3) To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

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TSSOP48-P-0061-0.50

Weight : 0.25g (Typ.)

PIN CONNECTION

1DIR	1	1	48	1OE
1B1	2	47	1A1	
1B2	3	46	1A2	
GND	4	45	GND	
1B3	5	44	1A3	
1B4	6	43	1A4	
VCC	7	42	VCC	
1B5	8	41	1A5	
IB6	9	40	1A6	
GND	10	39	GND	
1B7	11	38	1A7	
1B8	12	37	1A8	
2B1	13	36	2A1	
2B2	14	35	2A2	
GND	15	34	GND	
2B3	16	33	2A3	
2B4	17	32	2A4	
VCC	18	31	VCC	
2B5	19	30	2A5	
2B6	20	29	2A6	
GND	21	28	GND	
2B7	22	27	2A7	
2B8	23	26	2A8	
2DIR	24	25	2OE	

(TOP VIEW)

TRUTH TABLE

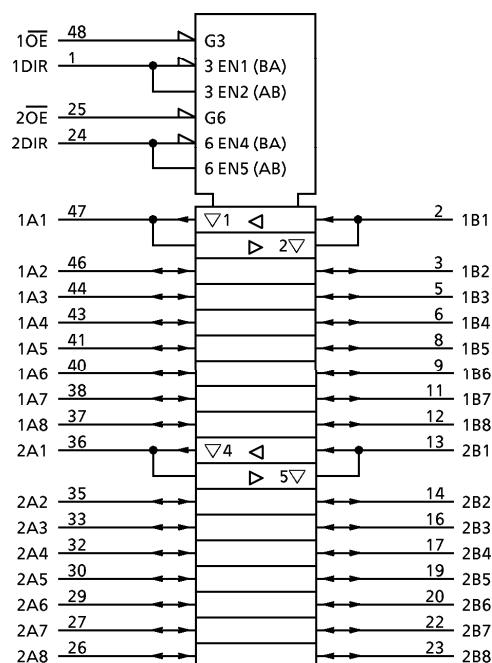
INPUT		FUNCTION		OUTPUT
1OE	1DIR	BUS 1A1-1A8	BUS 1B1-1B8	
L	L	OUTPUT	INPUT	A = B
L	H	INPUT	OUTPUT	B = A
H	X	High Impedance		Z

INPUT		FUNCTION		OUTPUT
2OE	2DIR	BUS 2A1-2A8	BUS 2B1-2B8	
L	L	OUTPUT	INPUT	A = B
L	H	INPUT	OUTPUT	B = A
H	X	High Impedance		Z

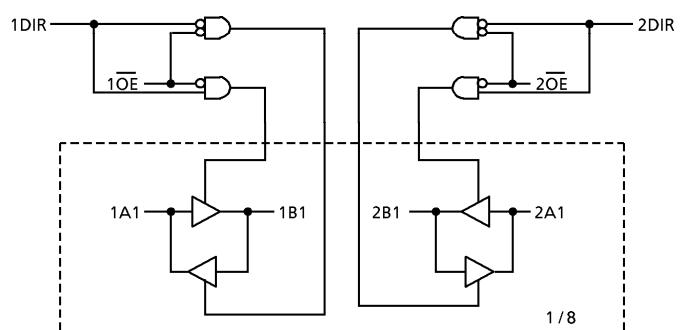
X : Don't Care

Z : High impedance

IEC LOGIC SYMBOL



SYSTEM DIAGRAM



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MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{CC}	-0.5~4.6	V
DC Input Voltage (DIR, \overline{OE})	V_{IN}	-0.5~4.6	V
DC Bus I/O Voltage	$V_{I/O}$	-0.5~4.6 (Note 1)	V
		-0.5~ V_{CC} +0.5 (Note 2)	
Input Diode Current	I_{IK}	-50	mA
Output Diode Current	I_{OK}	± 50 (Note 3)	mA
DC Output Current	I_{OUT}	± 50	mA
Power Dissipation	P_D	400	mW
DC V_{CC} / Ground Current Per Supply Pin	I_{CC}/I_{GND}	± 100	mA
Storage Temperature	T_{stg}	-65~150	°C

(Note 1) Off-State

(Note 2) High or Low State. I_{OUT} absolute maximum rating must be observed.(Note 3) $V_{OUT} < GND$, $V_{OUT} > V_{CC}$ **RECOMMENDED OPERATING RANGE**

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	1.8~3.6	V
		1.2~3.6 (Note 4)	
Input Voltage (DIR, \overline{OE})	V_{IN}	-0.3~3.6	V
Bus I/O Voltage	$V_{I/O}$	0~3.6 (Note 5)	V
		0~ V_{CC} (Note 6)	
Output Current	I_{OH}/I_{OL}	± 12 (Note 7)	mA
		± 8 (Note 8)	
		± 4 (Note 9)	
Operating Temperature	T_{opr}	-40~85	°C
Input Rise And Fall Time	dt/dv	0~10 (Note 10)	ns/V

(Note 4) Data Retention Only

(Note 5) Off-State

(Note 6) High or Low State

(Note 7) $V_{CC} = 3.0 \sim 3.6V$ (Note 8) $V_{CC} = 2.3 \sim 2.7V$ (Note 9) $V_{CC} = 1.8V$ (Note 10) $V_{IN} = 0.8 \sim 2.0V$, $V_{CC} = 3.0V$

ELECTRICAL CHARACTERISTICSDC characteristics ($T_a = -40\sim85^\circ C$, $2.7V < V_{CC} \leq 3.6V$)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	MIN.	MAX.	UNIT	
Input Voltage	"H" Level	V_{IH}				2.7~3.6	2.0	—	
	"L" Level	V_{IL}				2.7~3.6	—	0.8	
Output Voltage	"H" Level	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100\mu A$	2.7~3.6	$V_{CC} - 0.2$	—	V	
				$I_{OH} = -6mA$	2.7	2.2	—		
				$I_{OH} = -8mA$	3.0	2.4	—		
				$I_{OH} = -12mA$	3.0	2.2	—		
	"L" Level	V_{OL}		$I_{OL} = 100\mu A$	2.7~3.6	—	0.2		
				$I_{OL} = 6mA$	2.7	—	0.4		
				$I_{OL} = 8mA$	3.0	—	0.55		
				$I_{OL} = 12mA$	3.0	—	0.8		
Input Leakage Current	I_{IN}	$V_{IN} = 0\sim 3.6V$		2.7~3.6	—	± 5.0	μA		
3-State Output Off-State Current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0\sim 3.6V$		2.7~3.6	—	± 10.0	μA		
Power Off Leakage Current	I_{OFF}	$V_{IN}, V_{OUT} = 0\sim 3.6V$		0	—	10.0	μA		
Quiescent Supply Current	I_{CC}	$V_{IN} = V_{CC}$ or GND $V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6V$		2.7~3.6	—	20.0	μA		
Increase In I_{CC} Per Input	ΔI_{CC}	$V_{IH} = V_{CC} - 0.6V$		2.7~3.6	—	750			

ELECTRICAL CHARACTERISTICSDC characteristics ($T_a = -40\sim85^\circ C$, $2.3V \leq V_{CC} \leq 2.7V$)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	MIN.	MAX.	UNIT	
Input Voltage	"H" Level	V_{IH}			2.3~2.7	1.6	—	V	
	"L" Level	V_{IL}			2.3~2.7	—	0.7		
Output Voltage	"H" Level	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100\mu A$	2.3~2.7	$V_{CC} - 0.2$	—	V	
				$I_{OH} = -4mA$	2.3	2.0	—		
				$I_{OH} = -6mA$	2.3	1.8	—		
				$I_{OH} = -8mA$	2.3	1.7	—		
	"L" Level	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 100\mu A$	2.3~2.7	—	0.2	V	
				$I_{OL} = 6mA$	2.3	—	0.4		
				$I_{OL} = 8mA$	2.3	—	0.6		
Input Leakage Current	I_{IN}	$V_{IN} = 0\sim 3.6V$		2.3~2.7	—	± 5.0	μA		
3-State Output Off-State Current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL}		2.3~2.7	—	± 10.0	μA		
Power Off Leakage Current	I_{OFF}	$V_{IN}, V_{OUT} = 0\sim 3.6V$		0	—	10.0	μA		
Quiescent Supply Current		I_{CC}	$V_{IN} = V_{CC}$ or GND	2.3~2.7	—	20.0	μA		
			$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6V_{CC}$	2.3~2.7	—	± 20.0			

ELECTRICAL CHARACTERISTICSDC characteristics ($T_a = -40 \sim 85^\circ\text{C}$, $1.8V \leq V_{CC} < 2.3V$)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	MIN.	MAX.	UNIT	
Input Voltage	"H" Level	V_{IH}				1.8~2.3	$0.7 \times V_{CC}$	—	
	"L" Level	V_{IL}				1.8~2.3	—	$0.2 \times V_{CC}$	
Output Voltage	"H" Level	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100\mu\text{A}$	1.8	$V_{CC} - 0.2$	—	V	
	"L" Level	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 100\mu\text{A}$	1.8	1.4	—		
Input Leakage Current		I_{IN}	$V_{IN} = 0 \sim 3.6V$		1.8	—	± 5.0	μA	
3-State Output Off-State Current		I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0 \sim 3.6V$		1.8	—	± 10.0	μA	
Power Off Leakage Current		I_{OFF}	$V_{IN}, V_{OUT} = 0 \sim 3.6V$		0	—	10.0	μA	
Quiescent Supply Current		I_{CC}	$V_{IN} = V_{CC}$ or GND $V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6V$		1.8	—	20.0	μA	
					1.8	—	± 20.0		

AC characteristics ($T_a = -40 \sim 85^\circ\text{C}$, Input $t_r = t_f = 2.0\text{ns}$, $C_L = 30\text{pF}$, $R_L = 500\Omega$)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	MIN.	MAX.	UNIT	
Propagation Delay Time		t_{pLH} t_{pHL}	(Fig.1, 2)			1.8	1.5	5.7	
						2.5 ± 0.2	1.0	4.3	
						3.3 ± 0.3	0.8	3.4	
3-State Output Enable Time		t_{pZL} t_{pZH}	(Fig.1, 3)			1.8	1.5	7.6	
						2.5 ± 0.2	1.0	5.7	
						3.3 ± 0.3	0.8	4.2	
3-State Output Disable Time		t_{pLZ} t_{pHZ}	(Fig.1, 3)			1.8	1.5	5.7	
						2.5 ± 0.2	1.0	4.8	
						3.3 ± 0.3	0.8	4.1	
Output To Output Skew		t_{osLH} t_{osHL}	(Note 11)			1.8	—	0.5	
						2.5 ± 0.2	—	0.5	
						3.3 ± 0.3	—	0.5	

For $C_L = 50\text{pF}$, add approximately 300ps to the AC maximum specification.

(Note 11) Parameter guaranteed by design.
 $(t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|)$

Dynamic switching characteristics ($T_a = 25^\circ\text{C}$, Input $t_r = t_f = 2.0\text{ns}$, $C_L = 30\text{pF}$)

PARAMETER	SYMBOL	TEST CONDITION	$V_{CC} (\text{V})$	TYP.	UNIT
Quiet Output Maximum Dynamic V_{OL}	V_{OLP}	$V_{IH} = 1.8\text{V}, V_{IL} = 0\text{V}$ (Note 12)	1.8	0.15	V
		$V_{IH} = 2.5\text{V}, V_{IL} = 0\text{V}$ (Note 12)	2.5	0.25	
		$V_{IH} = 3.3\text{V}, V_{IL} = 0\text{V}$ (Note 12)	3.3	0.35	
Quiet Output Minimum Dynamic V_{OL}	V_{OLV}	$V_{IH} = 1.8\text{V}, V_{IL} = 0\text{V}$ (Note 12)	1.8	-0.15	V
		$V_{IH} = 2.5\text{V}, V_{IL} = 0\text{V}$ (Note 12)	2.5	-0.25	
		$V_{IH} = 3.3\text{V}, V_{IL} = 0\text{V}$ (Note 12)	3.3	-0.35	
Quiet Output Minimum Dynamic V_{OH}	V_{OHV}	$V_{IH} = 1.8\text{V}, V_{IL} = 0\text{V}$ (Note 12)	1.8	1.55	V
		$V_{IH} = 2.5\text{V}, V_{IL} = 0\text{V}$ (Note 12)	2.5	2.05	
		$V_{IH} = 3.3\text{V}, V_{IL} = 0\text{V}$ (Note 12)	3.3	2.65	

(Note 12) Parameter guaranteed by design.

Capacitive characteristics ($T_a = 25^\circ\text{C}$)

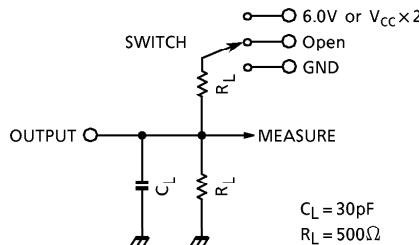
PARAMETER	SYMBOL	TEST CONDITION	$V_{CC} (\text{V})$	TYP.	UNIT
Input Capacitance	C_{IN}	DIR, OE	1.8, 2.5, 3.3	6	pF
Bus I/O Capacitance	$C_{I/O}$	An, Bn	1.8, 2.5, 3.3	7	pF
Power Dissipation Capacitance	C_{PD}	$f_{IN} = 10\text{MHz}$ (Note 13)	1.8, 2.5, 3.3	20	pF

(Note 13) C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

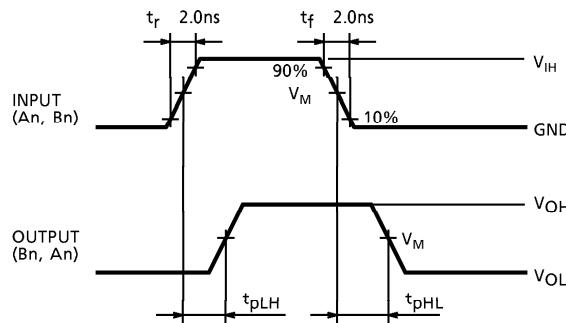
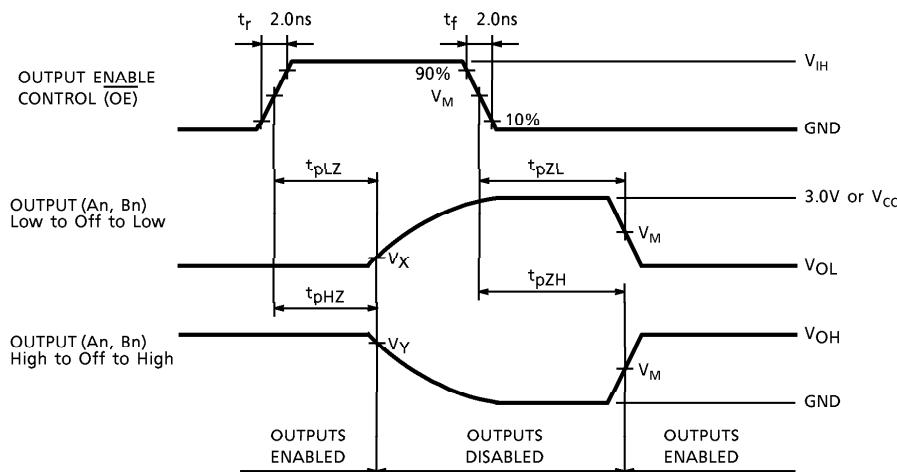
$$I_{CC (\text{opr.})} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 16 \text{ (per bit)}$$

Fig.1 Test circuit



PARAMETER	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PLZ}, t_{PZL}	6.0V @ $V_{CC} = 3.3 \pm 0.3\text{V}$ $V_{CC} \times 2$ @ $V_{CC} = 2.5 \pm 0.2\text{V}$ @ $V_{CC} = 1.8\text{V}$
t_{PHZ}, t_{PZH}	GND

AC WAVEFORM

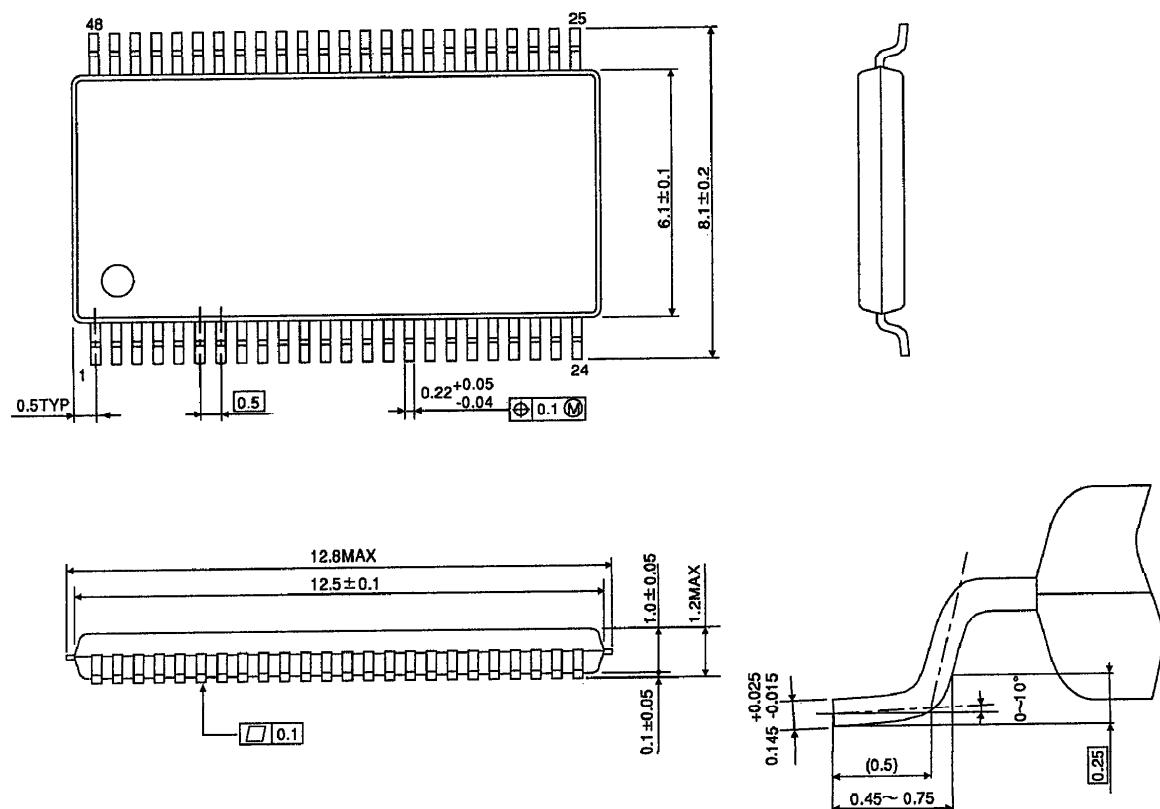
Fig.2 t_{PLH}, t_{PHL} Fig.3 $t_{PLZ}, t_{PHZ}, t_{PZL}, t_{PZH}$ 

SYMBOL	V_{CC}		
	$3.3 \pm 0.3\text{V}$	$2.5 \pm 0.2\text{V}$	1.8V
V_{IH}	2.7V	V_{CC}	V_{CC}
V_M	1.5V	$V_{CC} / 2$	$V_{CC} / 2$
V_X	$V_{OL} + 0.3\text{V}$	$V_{OL} + 0.15\text{V}$	$V_{OL} + 0.15\text{V}$
V_Y	$V_{OH} - 0.3\text{V}$	$V_{OH} - 0.15\text{V}$	$V_{OH} - 0.15\text{V}$

OUTLINE DRAWING

TSSOP48-P-0061-0.50

Unit : mm



Weight : 0.25g (Typ.)