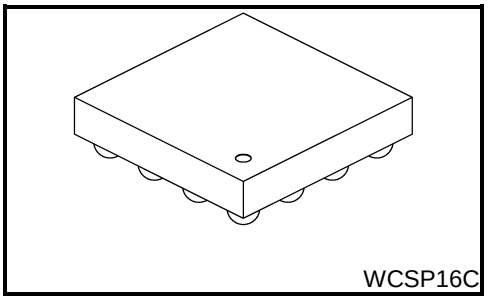
TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

TCK321G, TCK322G

36 V, Dual Inputs – Single Output Power Multiplexer IC with Over Voltage Protection

The TCK321G and TCK322G are 36 V high input voltage Dual Inputs-Single Output multiplexer load switch ICs. It has Over Voltage Protection featuring low switch ON resistance, high output current and wide input voltage operation. Switch ON resistance is only 98 mΩ at 4.5 V, - 1.0 A load conditions. And these feature a slew rate control driver, thermal shutdown and flag function. Also it can block reverse current if switch turned off. Output current is available up to 2.0 A per channel. Thus this is suitable for power management selector such as Battery Charge application.

This device is available in 0.5 mm pitch small package WCSP16C (1.9 mm x 1.9 mm, t**:** 0.5 mm (typ.)).Thus this devices is ideal for portable applications that require high-density board assembly such as mobile phone.

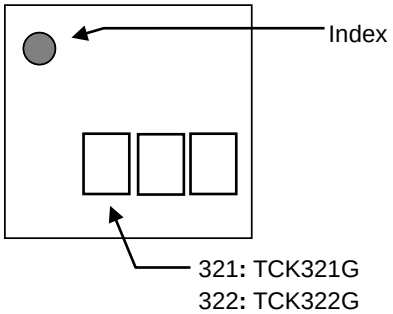


Weight **:** 3.9 mg (typ.)

Feature

- High output current**:** I_{OUT} (DC) = 2 A, per channel
- Low ON resistance **:** R_{ON} = 98 mΩ (typ.) at V_{IN} = 4.5 V, - 1.0 A, per channel
- Wide input voltage operation**:** V_{IN} = 2.3 to 36 V
- Over Voltage Lockout **:** 12.0 V, 15.0 V (typ.)
- Under Voltage Lockout**:** 2.9 V (typ.)
- Reverse current blocking per channel(SW OFF state)
- Inrush current reducing circuit.
- Auto selection mode
- Manual selection mode
- Break Before Make switch
- Thermal Shutdown function
- Small package**:** 0.5 mm pitch WCSP16C (1.9 mm x 1.9 mm, t**:** 0.5 mm (typ.)), PD = 1.65 W

Top marking



Start of commercial production
2015-10

Absolute Maximum Ratings (Ta = 25°C)

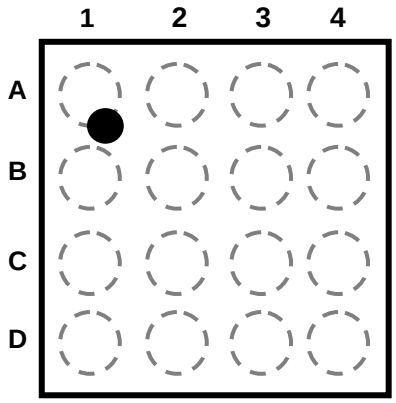
Characteristics	Symbol	Rating			Unit
Input voltage	V_{INA}, V_{INB}	-0.3 to 40			V
Control voltage	V_{CNT}, V_{SEL}	-0.3 to 6			V
Output voltage	V_{OUT}	-0.3 to 18			V
FLAG voltage	V_{FLAG}	-0.3 to 6			V
Output current	I_{OUT}	DC	2.0		A
		Pulse	3.0	(Note 1)	
Power dissipation	P_D	1.65		(Note 2)	W
Operating temperature range	T_{opr}	−40 to 85			°C
Junction temperature	Tj	150			°C
Storage temperature	T_{stg}	−55 to 150			°C

Note**:** Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings. Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note1**:** 1 ms pulse, 1% duty cycle

Note2**:** Rating at mounting on a board**:** FR4 board. (40 mm × 40 mm × 1.6 mm, Cu 4 layer)

Pin Assignment (Top view/Bottom bump)



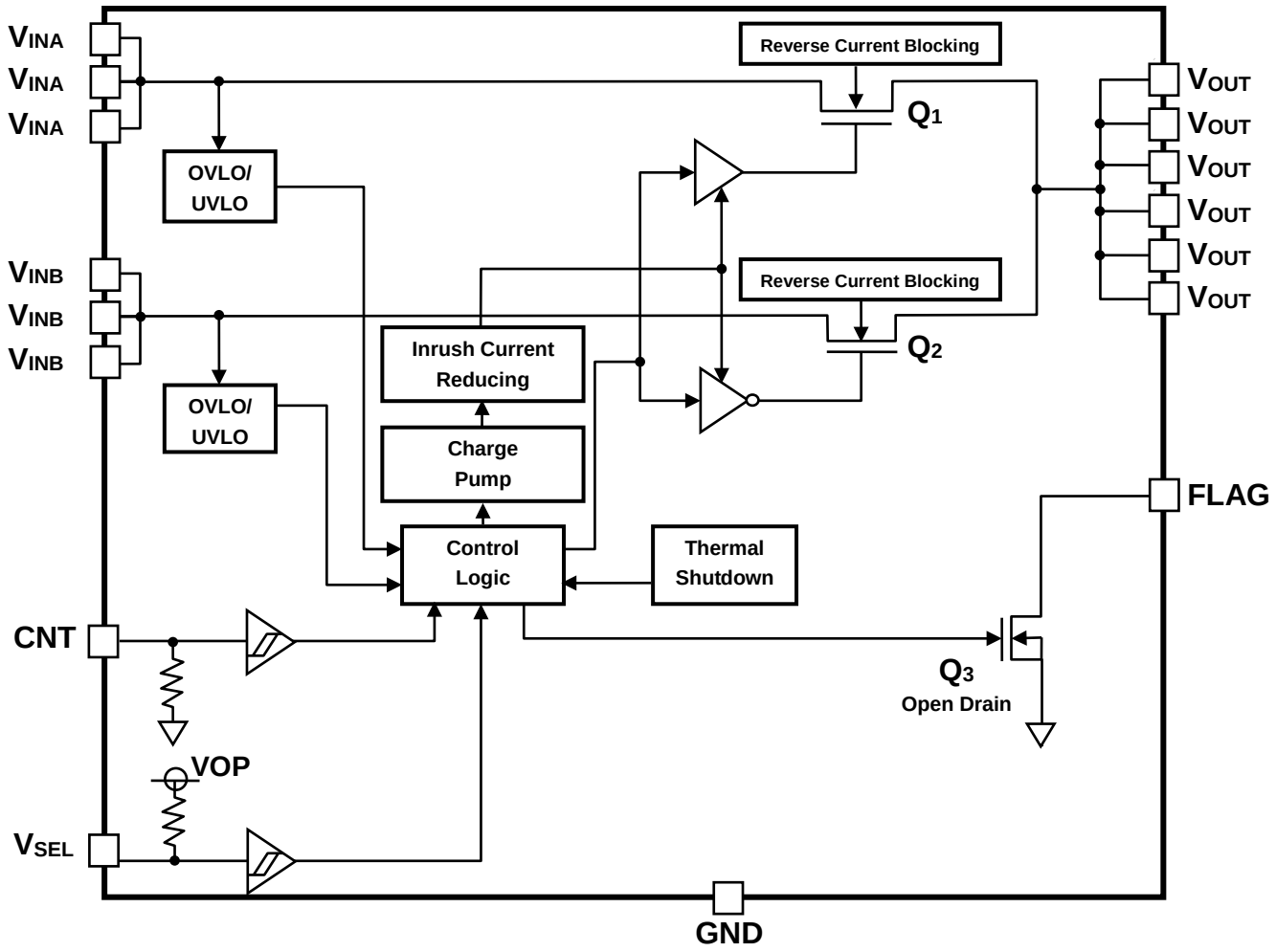
	1	2	3	4
A	FLAG	V_{SEL}	CNT	GND
B	V_{INA}	V_{OUT}	V_{OUT}	V_{INB}
C	V_{INA}	V_{OUT}	V_{OUT}	V_{INB}
D	V_{INA}	V_{OUT}	V_{OUT}	V_{INB}

Product list

Part number	Over voltage lockout VINA	Over voltage lockout VINB	FLAG monitored in auto selection mode
TCK321G	12.0 V (typ.)	12.0 V (typ.)	Q1
TCK322G	15.0 V (typ.)	15.0 V (typ.)	Q1

Please ask your local retailer about the devices with other OVLO, logic and functions.

Block Diagram



PIN Description

PIN	Name	Description
A1	FLAG	Open drain acknowledge signal output.
A2	V_{SEL}	Input selector function. It is internally connected to VOP(Pull up).
A3	CNT	Mode control function. It is internally connected to GND(Pull down)
A4	GND	Ground
B1,C1,D1 B4,C4,D4	V_{INA} ,V_{INB}	Input. Each has Over Voltage Lock Out (OVLO) and Under Voltage Lock Out function (UVLO).
B2,C2,D2 B3,C3,D3	V_{OUT}	Output.

Operation Logic Table

		CNT Low	CNT High
V_{SEL} Low	V_{INA} Q_1	OFF	OFF
	V_{INB} Q_2	OFF	ON
	FLAG Q_3	OFF	ON (When V_{INA} or V_{INB} is out of regular voltage)
	Reverse current block	Q_1 Active / Q_2 Active	Q_1 Active / Q_2 Inactive
V_{SEL} High	V_{INA} Q_1	Auto selection mode Supplied V_{INA}; Q_1 and Q_3 ON, Q_2 OFF Supplied V_{INB}; Q_2 ON, Q_1 and Q_3 OFF Supplied V_{INA} and V_{INB}; Q_1 and Q_3 ON, Q_2 OFF	ON
	V_{INB} Q_2		OFF
	FLAG Q_3		ON (When V_{INA} or V_{INB} is out of regular voltage)
	Reverse current block		Q_1 Inactive / Q_2 Active

DC Characteristics (Ta = -40 to 85°C)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = −40 to 85°C		Unit
			Min	Typ.	Max	Min	Max	
Input voltage	V_{IN}	—	2.3	—	36	2.3	36	V
V_{SEL}, CNT High-level input voltage	V_{IH}	V_{INA}, V_{INB} = 2.3 to 36 V	1.6	—	—	1.6	—	V
V_{SEL}, CNT Low-level input voltage	V_{IL}	V_{INA}, V_{INB} = 2.3 to 36 V	—	—	0.4	—	0.4	V
Over voltage lock out (OVLO) rising threshold	V_{OVL_RI}	TCK321G	—	12.0	—	10.5	13.5	V
		TCK322G	—	15.0	—	13.4	16.6	
Over voltage lock out (OVLO) falling threshold	V_{OVL_FA}	—	—	V_{OVL_RI} - 0.5	—	—	—	V
Under voltage lock out (UVLO) rising threshold	V_{UVL_RI}	—	—	2.9	—	2.3	3.5	V
Under voltage lock out (UVLO) falling threshold	V_{UVL_FA}	—	—	V_{UVL_RI} - 0.3	—	—	—	V
Quiescent current (Switch ON state)	$I_{Q(ON)}$	Q1 or Q2 = ON mode, I_{OUT} = 0 mA , VIN=5.0 V	—	140	—	—	200	μA
Quiescent current (Switch OFF state)	$I_{Q(OFF)}$	CNT and V_{SEL}: Low, $V_{INA\ or}$ V_{INB} = 5.0 V, V_{OUT} = 0 V	—	60	—	—	90	μA
Switch OFF state current	I_{OFF}	CNT and V_{SEL}: Low, V_{IN} = Open, V_{OUT} = 5 V	—	0.1	—	—	1	μA
Reverse blocking current	I_{RB}	CNT and V_{SEL}: Low, V_{IN} = 0 V, V_{OUT} = 5.0 V	—	0.1	—	—	10	μA
On resistance	R_{ON}	I_{OUT} = -1.0 A, V_{IN} = 4.5 V	—	98	—	—	170	mΩ
FLAG Leak current	I_{LEAK}	V_{IO} = 5.0 V	—	—	2	—	2	μA
FLAG Output low voltage	V_{OL}	I_{SINK} = 1 mA, V_{IO} = 5.0 V	—	—	0.4	—	0.4	V
V_{SEL} , CNT Pull up resistance	R_{VC}	—	—	500	—	—	—	kΩ

AC Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition (Figure 1, 2, 3, 4)	Min	Typ.	Max	Unit
Hold time	t_{HD}	V_{UVL} < V_{IN}(5 V) < V_{OVL}, R_L = 50 Ω Initial start up V_{OUT} off state to charge-pump on state	—	15	—	ms
V_{OUT} OVP off time	t_{OVP}	V_{IN} > V_{OVLO_RI} , V_{IN} rising = 2 V/μs, R_L = 50 Ω , V_{OUT} to 80% of V_{OVLO_RI}	—	3	—	μs
V_{OUT} off time	t_{OFF}	V_{UVL} < V_{IN} (5 V) < V_{OVL}, R_L = 50 Ω , CNT low to high to V_{OUT} to 80% of V_{IN}	—	0.5	—	μs
V_{OUT} rise time	t_r	V_{IN}= 5.0 V , R_L = 50 Ω , C_L= 1.0 uF	—	2	—	ms
V_{OUT} fall time	t_f	V_{IN}= 5.0 V , R_L = 50 Ω , C_L= 1.0 uF	—	0.12	—	ms
V_{IN} selection delay time	t_{SEL}	V_{IN}= 5.0 V , R_L = 50 Ω ,	—	0.5	—	μs
Break Before Make time	t_{BBM}	V_{IN}= 5.0 V , R_L = 50 Ω ,	—	15	—	ms

Timing chart

Manual selection mode

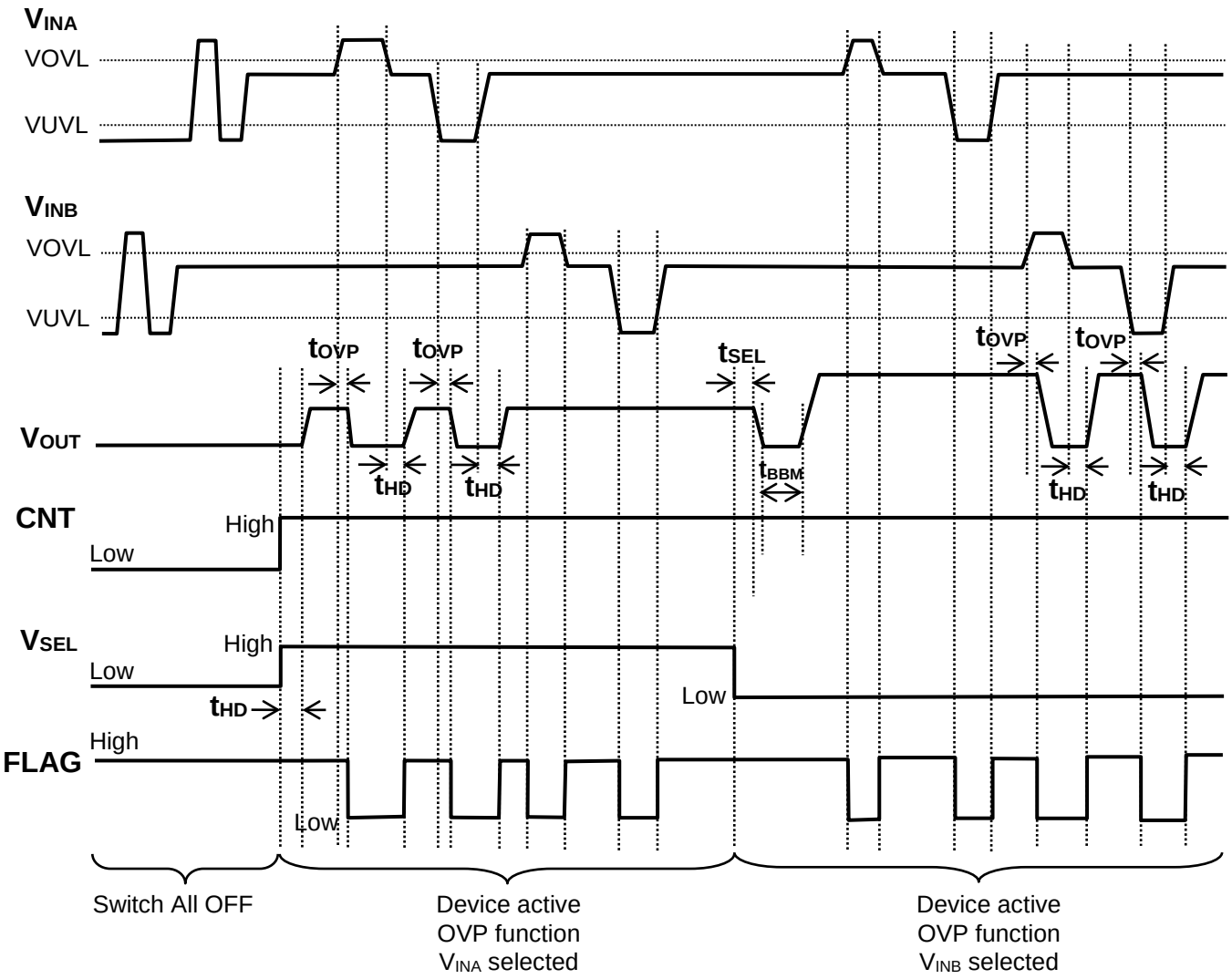


Fig.1 t_{HD}, t_{OVP}, t_{SEL}

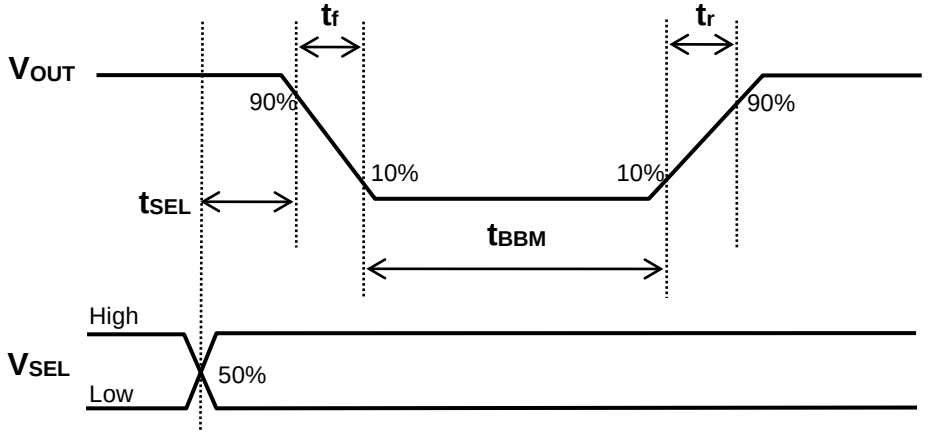


Fig.2 t_r, t_f, t_{BBM}

Timing chart

Auto selection mode

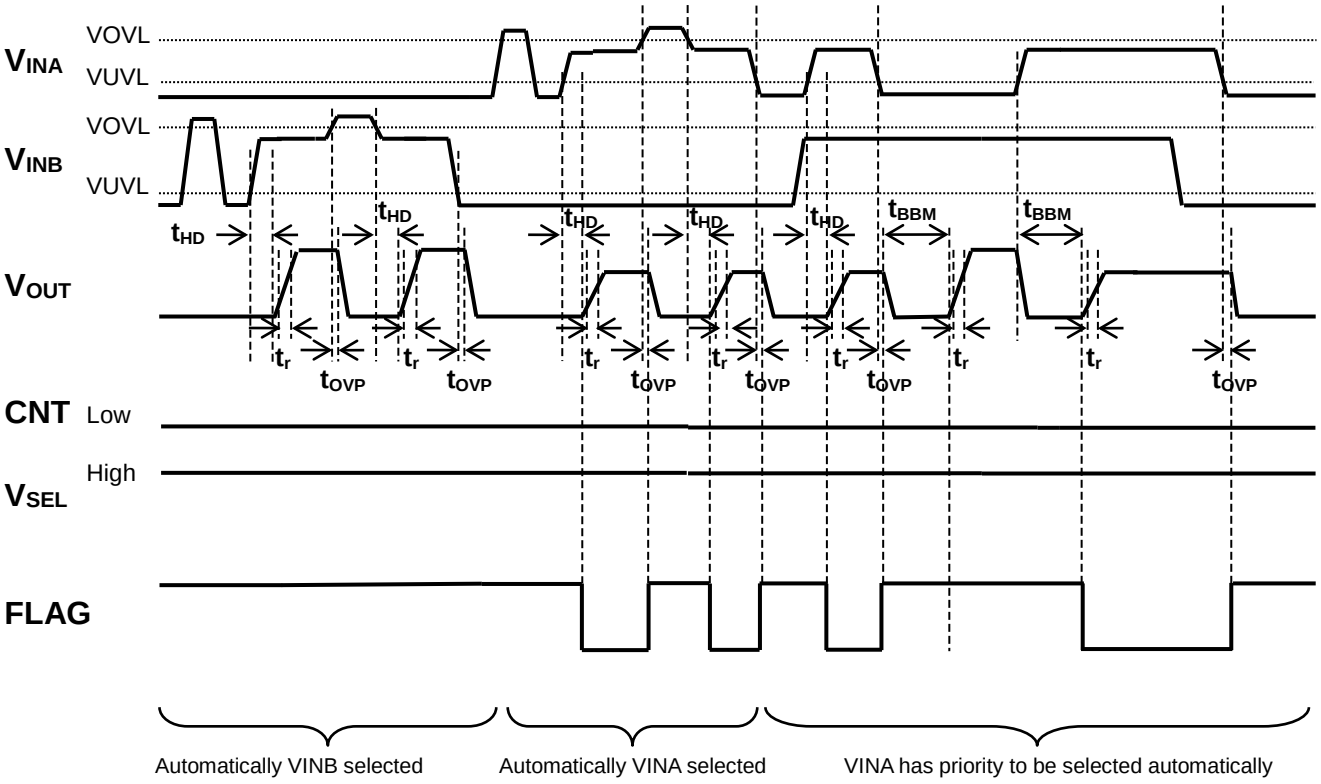


Fig.3 t_{HD}, t_{OVP}

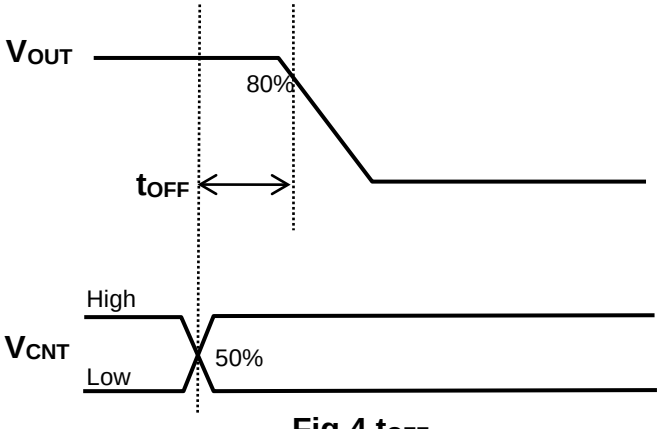
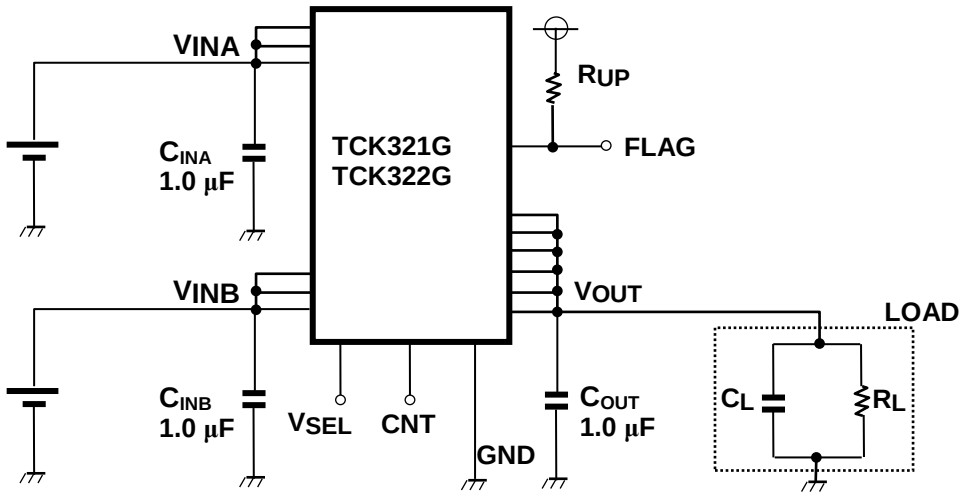


Fig.4 t_{OFF}

Application Note

1. Application circuit example (top view)



1) Input and Output capacitor

An input capacitor (C_{IN}) and an output capacitor (C_{OUT}) are necessary for the stable operation of TCK321G and TCK322G. And it is effective to reduce voltage overshoot or undershoot due to sharp changes in output current and also for improved stability of the power supply. When used, place C_{IN} and C_{OUT} more than 1.0 μF as close to V_{IN} pin to improve stability of the power supply.

2) Control pin

Control pins for TCK321G and TCK322G are operated by the control voltage and Schmitt trigger. V_{SEL} pin has a tolerant function such that it can be used even if the control voltage is higher than the input voltage.

2. Reverse current blocking

Reverse current blocking(SW OFF state) function is designed in these products. This function is active at output n-ch MOSEFT turned off.

However these does not assure for the suppression of uprising device operation. In use of these products, please read through and understand dissipation idea for absolute maximum ratings from the above mention or our ‘Semiconductor Reliability Handbook’. Then use these products under absolute maximum ratings in any condition. Furthermore, Toshiba recommend inserting failsafe system into the design.

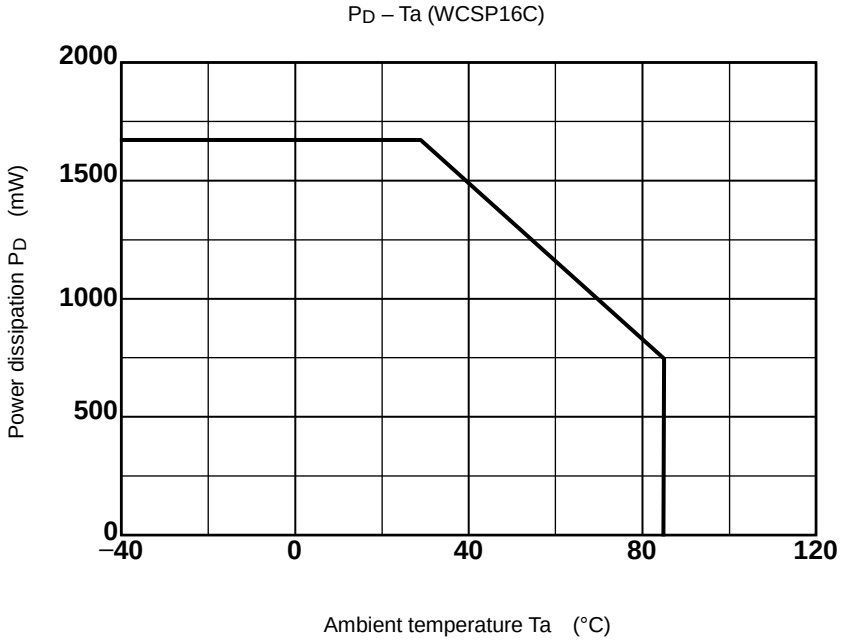
3. Thermal shut down function

Thermal shutdown function is designed in these products, but these does not assure for the suppression of uprising device operation. In use of these products, please read through and understand dissipation idea for absolute maximum ratings from the above mention or our ‘Semiconductor Reliability Handbook’. Then use these products under absolute maximum ratings in any condition. Furthermore, Toshiba recommend inserting failsafe system into the design.

4. Power Dissipation

Board-mounted power dissipation ratings for TCK321G and TCK322G are available in the Absolute Maximum Ratings table.
Power dissipation is measured on the board condition shown below.

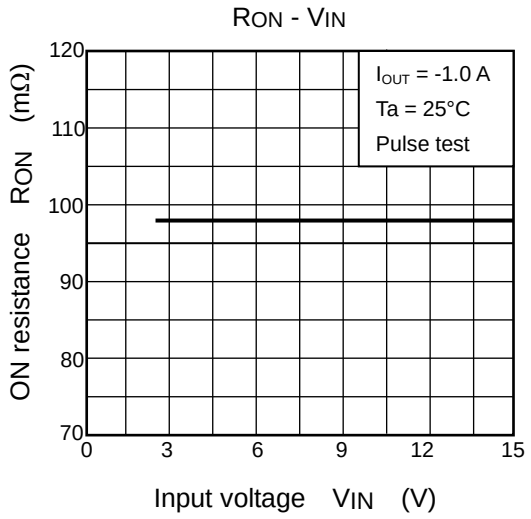
[The Board Condition]
Board material**:** Glass epoxy (FR4)
Board dimension**:** 40 mm x 40 mm (Cu 4 layer)

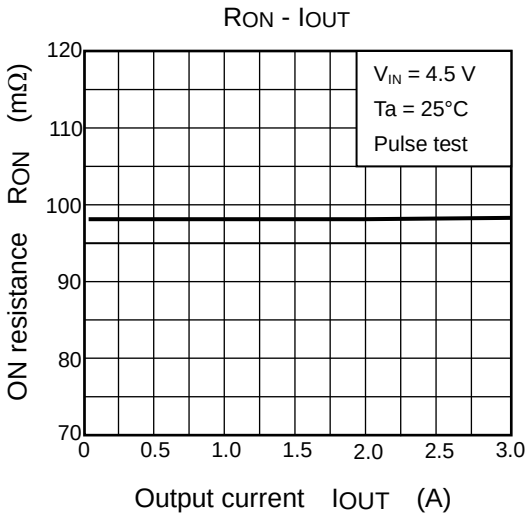


Please allow sufficient margin when designing a board pattern to fit the expected power dissipation. Also take into consideration the ambient temperature, input voltage, output current etc and applying the appropriate derating for allowable power dissipation during operation.

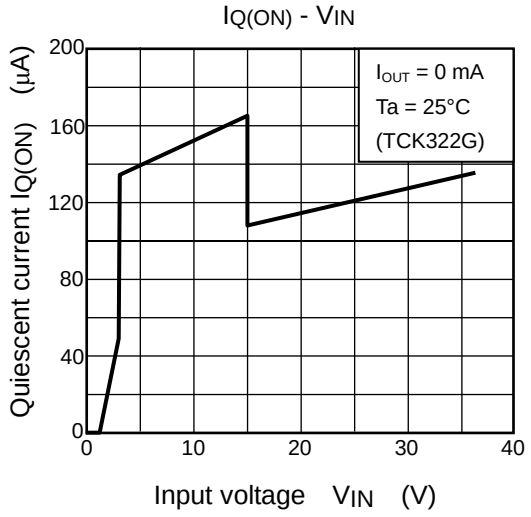
Representative Typical Characteristics

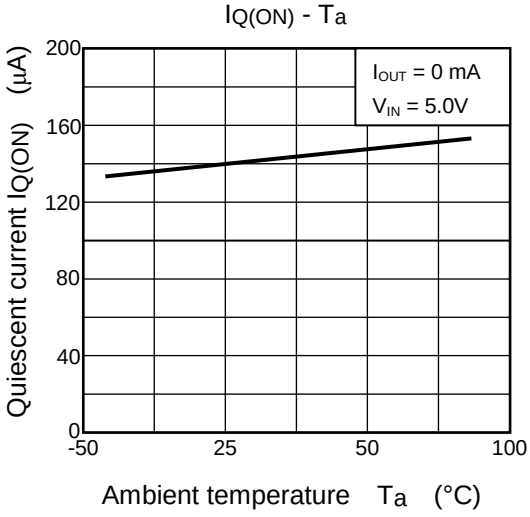
1) ON resistance

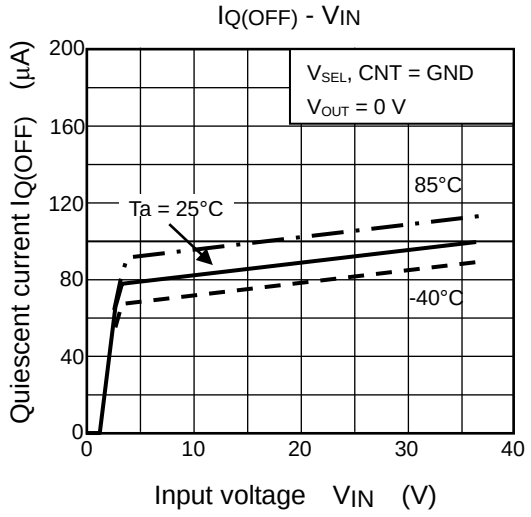


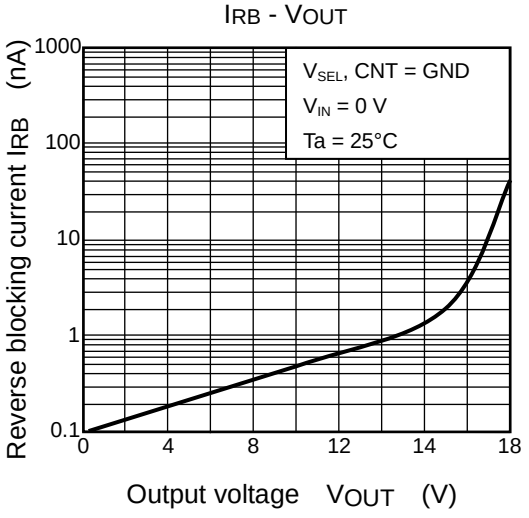


2) Quiescent current



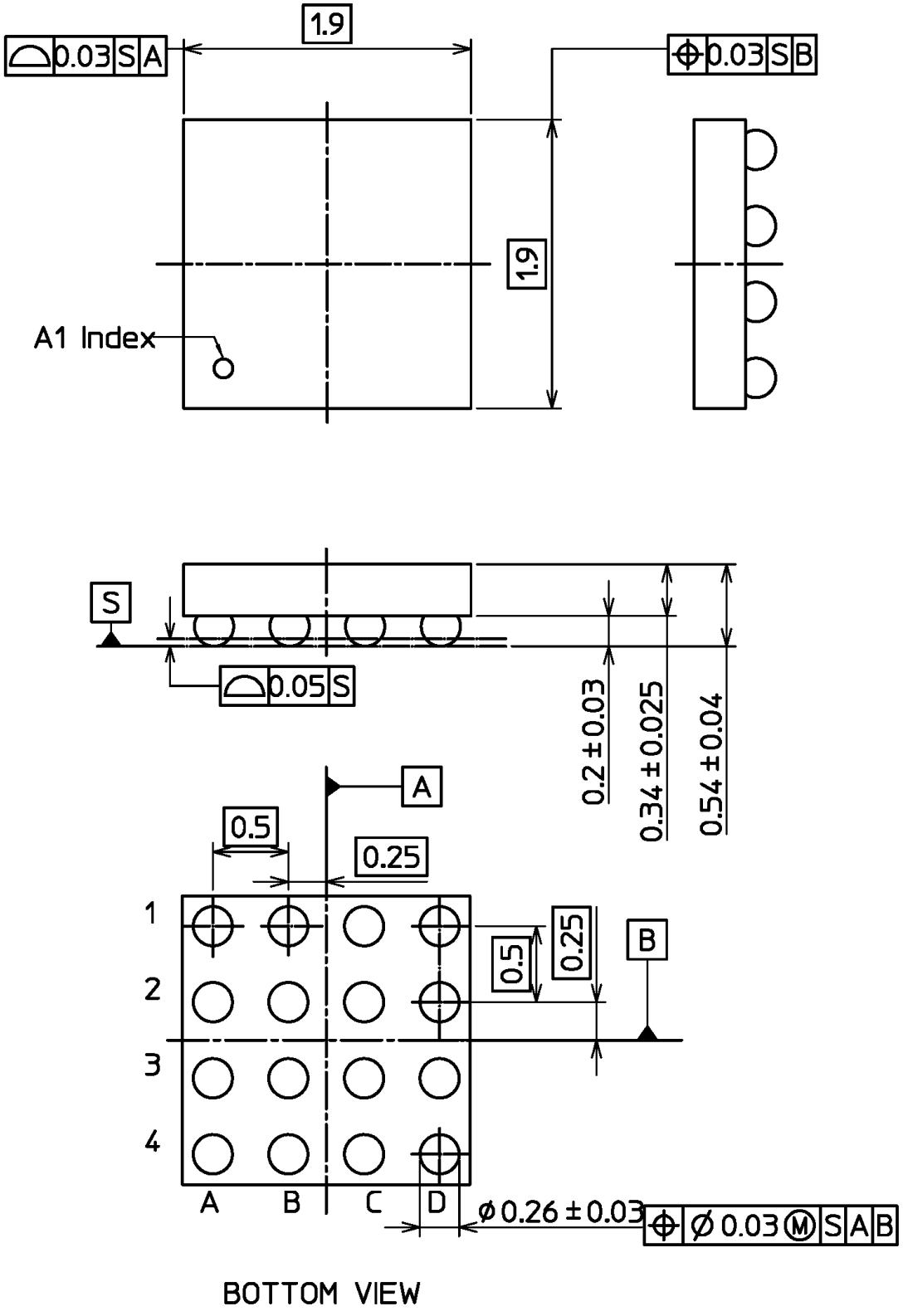






Package Dimensions

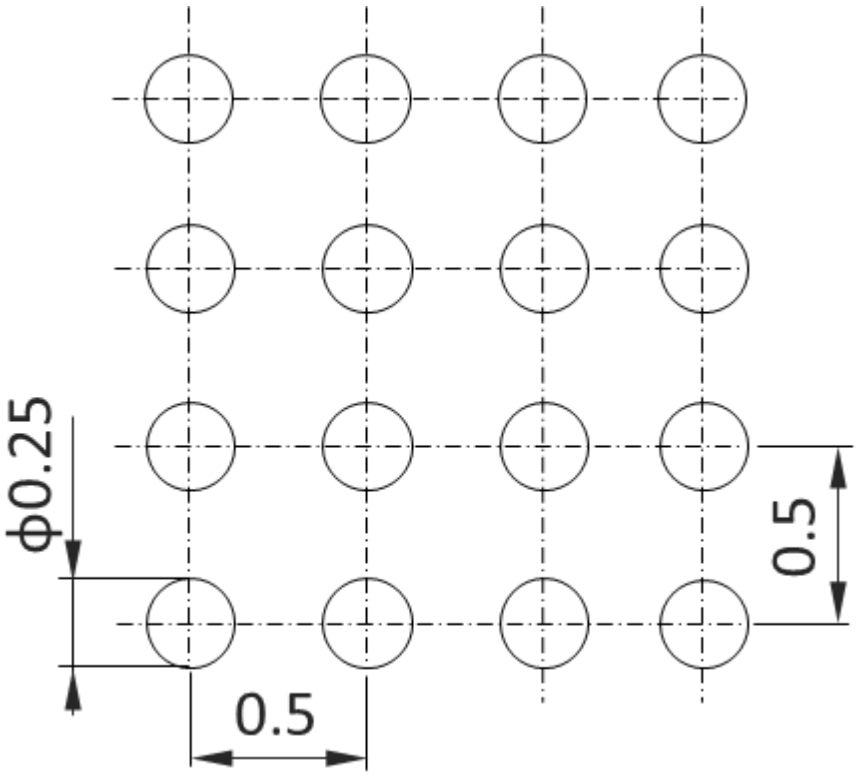
WCSP16C Unit: mm



Weight : 3.9 mg (typ.)

Land pattern dimensions (for reference only)

Unit: mm



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