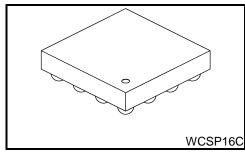
TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

# **TCK323G**

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

The TCK323G is 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 from 2.3 to 36V. Switch ON resistance is only 98 m $\Omega$  (typ.) at V<sub>IN</sub> = 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.

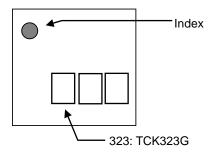


Weight: 3.9 mg (typ.)

#### **Feature**

- High output current: IOUT (DC) = 2 A, per channel
- Low ON resistance :  $R_{ON} = 98 \text{ m}\Omega$  (typ.) at  $V_{IN} = 4.5 \text{ V}$ , 1.0 A, per channel
- Wide input voltage operation: V<sub>IN</sub> = 2.3 to 36 V
- Over Voltage Lockout : 15.0 V (typ.)
- Under Voltage Lockout: 2.9V (typ.)
- Reverse current blocking per channel(SW OFF state)
- · Inrush current reducing circuit.
- · Auto selection mode
- Break Before Make
- Thermal Shutdown function
- Small package: 0.5 mm pitch WCSP16C (1.9 mm x 1.9 mm, t: 0.5mm(typ.)), PD = 1.65 W

#### Top marking



Start of commercial production 2015-01



#### Absolute Maximum Ratings (Ta = 25°C)

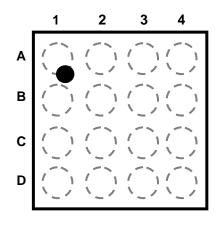
Characteristics	Symbol		Unit							
Input voltage	VINA, VINB	-0.3 to 40		-0.3 to 40		-0.3 to 40		-0.3 to 40		V
Control voltage	VCNT, VSEL		-0.3 to 6	V						
Output voltage	Vout		-0.3 to 18	V						
FLAG voltage	VFLAG	-0.3 to 6		V						
Output current	lout	DC	2.0	Δ.						
		Pulse	3.0 (Note 1)	Α						
Power dissipation	PD	1.65 (Note 2)		1.65 (Note 2)		W				
Operating temperature range	T <sub>opr</sub>	-40 to 85		−40 to 85		°C				
Junction temperature	Tj	150		150		°C				
Storage temperature	T <sub>stg</sub>	−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. (  $40~\text{mm} \times 40~\text{mm}$  , Cu 4 layer )

#### Pin Assignment (Top view/Bottom bump)



	1	2	3	4
Α	FLAG	V <sub>SEL</sub>	CNT	GND
В	V <sub>INA</sub>	V <sub>OUT</sub>	V <sub>OUT</sub>	V <sub>INB</sub>
С	V <sub>INA</sub>	V <sub>OUT</sub>	V <sub>OUT</sub>	V <sub>INB</sub>
D	V <sub>INA</sub>	V <sub>OUT</sub>	V <sub>OUT</sub>	V <sub>INB</sub>

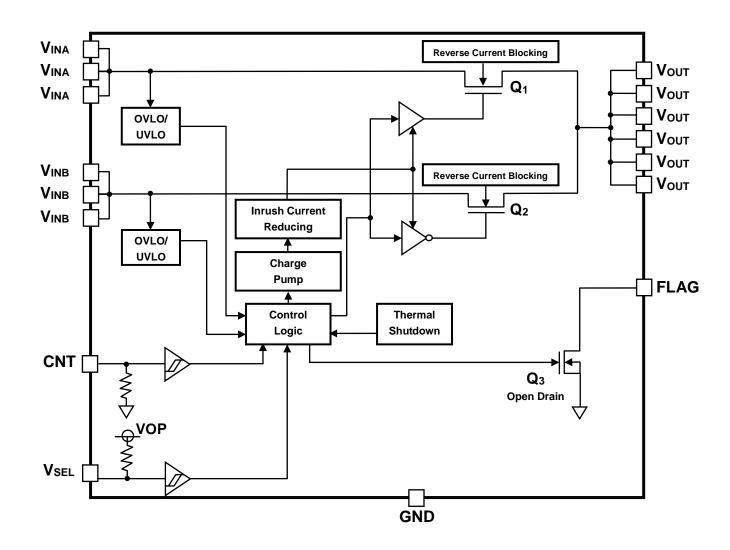
#### **Product list**

Part number	Over voltage lockout VINA	Over voltage lockout VINB	FLAG monitored in auto selection mode
TCK323G	15.0V (typ.)	15.0V (typ.)	Q2

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 <sub>SEL</sub>	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 <sub>INA</sub> ,V <sub>INB</sub>	Input. Each has Over Voltage Lock Out (OVLO) and Under Voltage Lock Out function (UVLO).
B2,C2,D2 B3,C3,D3	V <sub>out</sub>	Output.

# **Operation Logic Table**

		CNT Low	CNT High		
V <sub>SEL</sub> Low	V <sub>INA</sub> Q <sub>1</sub>	OFF	OFF		
	V <sub>INB</sub> Q <sub>2</sub>	OFF	ON		
	FLAG Q₃	OFF	ON (When V <sub>INA</sub> or V <sub>INB</sub> is out of regular voltage )		
	Reverse current block	Q <sub>1</sub> Active / Q <sub>2</sub> Active	Q <sub>1</sub> Active / Q <sub>2</sub> Inactive		
V <sub>SEL</sub> High	V <sub>INA</sub> Q <sub>1</sub>	Auto selection mode	ON		
	V <sub>INB</sub> Q <sub>2</sub>	Supplied V <sub>INA</sub> ;	OFF		
	FLAG Q₃	$Q_1$ ON, $Q_2$ and $Q_3$ OFF  Supplied $V_{INB}$ ;	ON (When V <sub>INA</sub> or V <sub>INB</sub> is out of regular voltage)		
	Reverse current block	$Q_2$ and $Q_3$ ON, $Q_1$ OFF Supplied $V_{INA}$ and $V_{INB}$ ; $Q_1$ ON, $Q_2$ and $Q_3$ OFF	Q₁ Inactive / Q₂ Active		



## DC Characteristics (Ta = -40 to 85°C)

Observatoristics	Company of	Test Condition	Ta = 25°C			Ta = −40 to 85°C		Unit
Characteristics	Symbol		Min	Тур.	Max	Min	Max	Unit
Input voltage	VIN	_	2.3	_	36	2.3	36	V
V <sub>SEL</sub> , CNT High-level input voltage	VIH	V <sub>INA</sub> , V <sub>INB</sub> = 2.3 to 36 V	1.6	_	_	1.6	_	V
V <sub>SEL</sub> , CNT Low-level input voltage	VIL	V <sub>INA</sub> , V <sub>INB</sub> = 2.3 to 36 V	_	_	0.4	_	0.4	V
Over voltage lock out (OVLO) rising threshold	V <sub>OVL_RI</sub>	_	_	15.0	_	13.4	16.6	٧
Over voltage lock out (OVLO) falling threshold	Vovl_fa	_	_	Vovl_ri - 0.5	_	_	_	٧
Under voltage lock out (UVLO) rising threshold	V <sub>UVL_RI</sub>	_	_	2.9	_	2.3	3.5	٧
Under voltage lock out (UVLO) falling threshold	Vuvl_fa	_	_	V <sub>UVL_RI</sub> - 0.3	_	_	_	V
Quiescent current (Switch ON state)	I <sub>Q(ON)</sub>	Q1 or Q2 = ON mode, IOUT = 0 mA , VIN=5.0V	_	140	_	_	200	μА
Quiescent current (Switch OFF state)	I <sub>Q(OFF)</sub>	CNT and V <sub>SEL</sub> : Low, V <sub>INA or</sub> V <sub>INB</sub> = 5.0 V, V <sub>OUT</sub> = 0 V	_	60	_	_	90	μА
Switch OFF state current	loff	CNT and V <sub>SEL</sub> = Low, V <sub>IN</sub> = Open, V <sub>OUT</sub> = 5 V	_	0.1	_	_	1	μА
Reverse blocking current	I <sub>RB</sub>	CNT and V <sub>SEL</sub> : Low, V <sub>IN</sub> = 0 V, V <sub>OUT</sub> = 5.0 V	_	0.1	_	_	10	μА
On resistance	Ron	IOUT = -1.0 A, V <sub>IN</sub> = 4.5 V	_	98	_	_	170	mΩ
FLAG Leak current	ILEAK	V <sub>IO</sub> = 5.0 V	_	_	2	_	2	μА
FLAG Output low voltage	VoL	I <sub>SINK</sub> = 1 mA, V <sub>IO</sub> = 5.0 V	_	_	0.4	_	0.4	V
V <sub>SEL</sub> , CNT Pull up resistance	Rvc	_	_	500	_	_	_	kΩ

## AC Characteristics (Ta = 25°C)

Characteristics Symbol Test Condition (Figure 1, 2, 3, 4)		Min	Тур.	Max	Unit	
Hold time	tHD	$V_{UVL}$ < $V_{IN}(5V)$ < $V_{OVL}$ , $R_L$ = 50 $\Omega$ Initial start up $V_{OUT}$ off state to charge-pump on state	_	15	_	ms
VOUT OVP off time	tovp	$\begin{aligned} &V_{\text{IN}} > V_{\text{OVLO\_RI}} \text{ , } V_{\text{IN}} \text{ rising} = 2V/\mu\text{s}, \\ &R_{\text{L}} = 50 \ \Omega \text{ , } V_{\text{OUT}} \text{ to } 80\% \text{ of } V_{\text{OVLO\_RI}} \end{aligned}$	_	3	_	μS
V <sub>OUT</sub> off time	tOFF	$\label{eq:VUVL} $$ V_{UVL} < V_{IN} (5V) < V_{OVL}, \ R_L = 50 \ \Omega \ , $$ CNT low to high to V_{OUT} to 80\% of V_{IN} $$$	_	0.5	_	μS
Vout rise time	t <sub>r</sub>	$V_{IN}$ = 5.0 $V$ , $R_L$ = 50 $\Omega$ , $C_L$ = 1.0 $\mu F$	_	2	_	ms
V <sub>OUT</sub> fall time	t <sub>f</sub>	$V_{IN}$ = 5.0V , $R_L$ = 50 $\Omega$ , $C_L$ = 1.0 $\mu F$	_	0.12	_	ms
V <sub>IN</sub> selection delay time	tSEL	$V_{IN}$ = 5.0V , $R_L$ = 50 $\Omega$ ,	_	0.5	_	μS
Break Before Make time	tBBM	$V_{IN}$ = 5.0 $V$ , $R_L$ = 50 $\Omega$ ,	-	15	_	ms

# Timing chart Manual selection mode

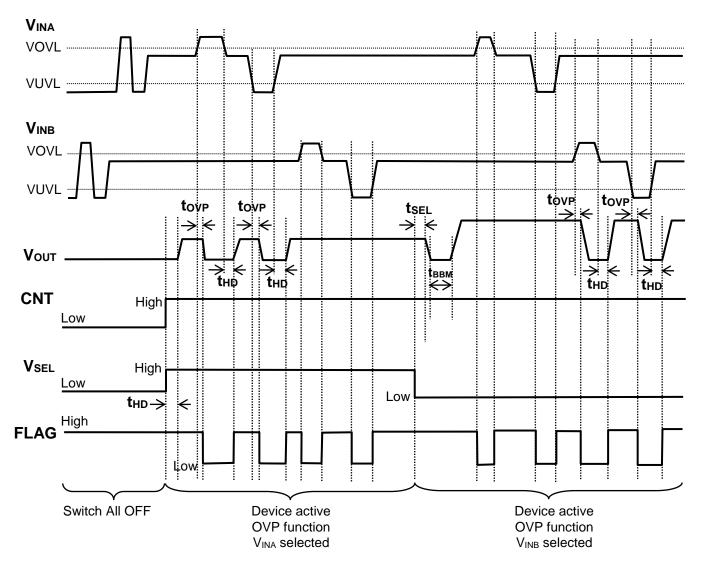


Fig.1 thd, tovp, tsel

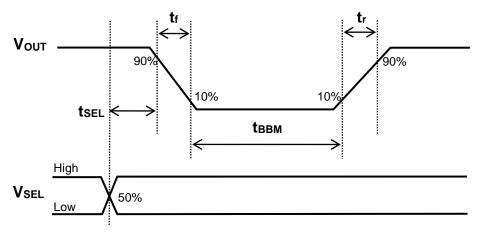


Fig.2 tr, tf, tbbm

# Timing chart Auto selection mode

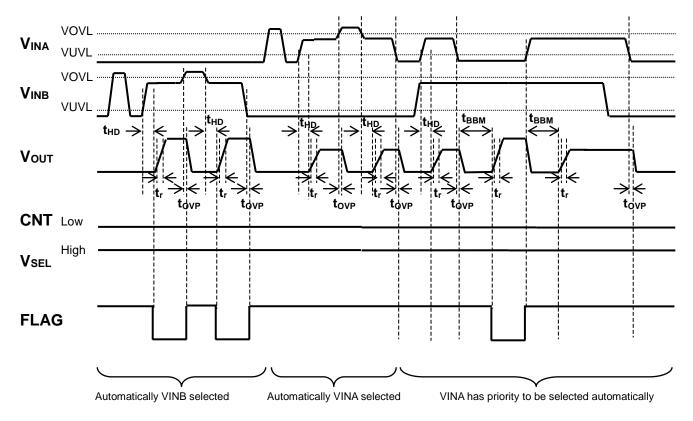
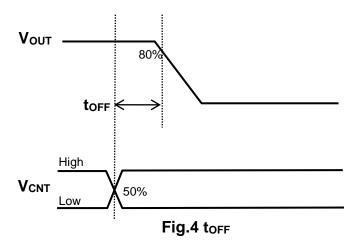
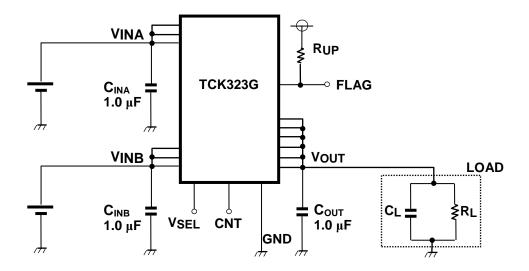


Fig.3 thd, tovp



#### **Application Note**

#### 1. Application circuit example



#### 1) Input and Output capacitor

An input capacitor ( $C_{IN}$ ) and an output capacitor ( $C_{OUT}$ ) are necessary for the stable operation of TCK323G. 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  $1.0\mu F$  as close to  $V_{IN}$  pin to improve stability of the power supply.

#### 2) Control pin

Control pins for TCK323G is 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.

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#### 4. Power Dissipation

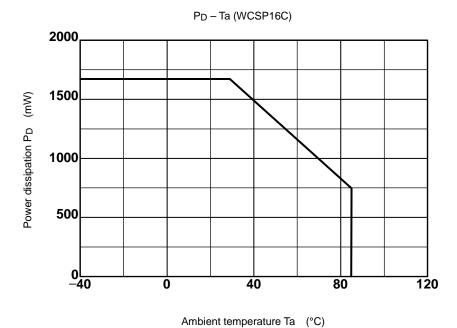
Board-mounted power dissipation ratings for TCK323G are available in the Absolute Maximum Ratings table

Power dissipation is measured on the board condition shown below.

[The Board Condition]

Board material: Glass epoxy (FR4)

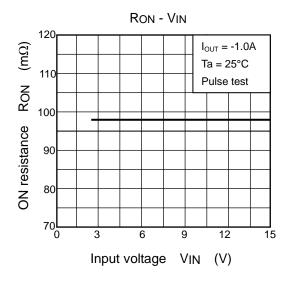
Board dimension: 40 mm x 40 mm (Cu 4 layer)

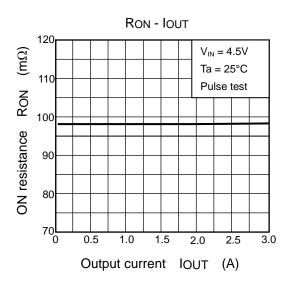


Please allow sufficient margin when designing a board pattern to fit the expected power dissipation. Also take into consideration the ambient temperature, input voltage, output current etc and applying the appropriate derating for allowable power dissipation during operation.

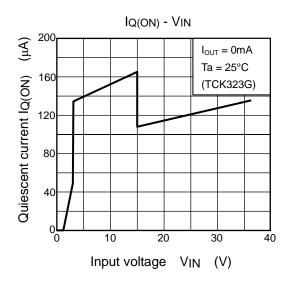
#### **Representative Typical Characteristics**

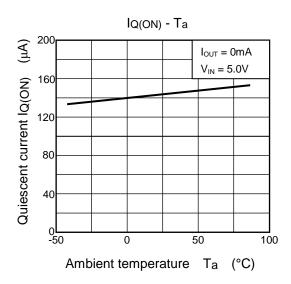
#### 1) ON resistance

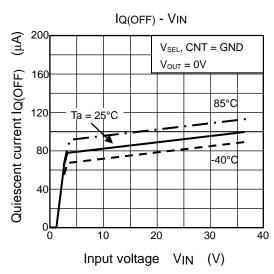


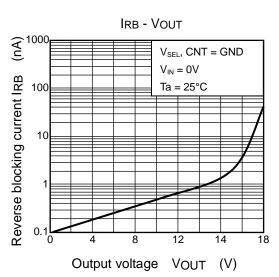


#### 2) Quiescent current



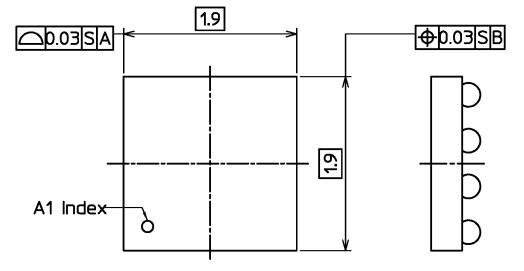


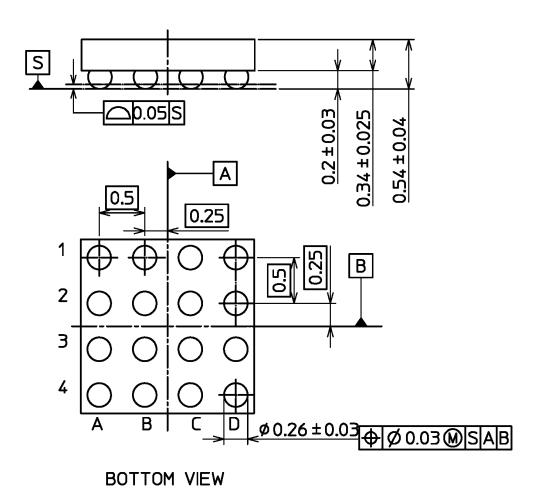




## **Package Dimensions**

WCSP16C Unit: mm

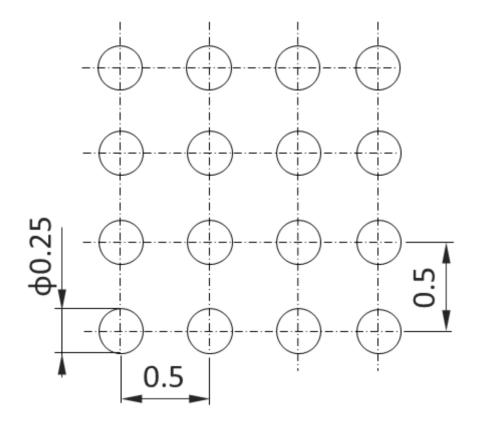




Weight: 3.9 mg (typ.)

Land pattern dimensions (for reference only)

Unit:mm



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