

TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

TCK2291xG

2A Load Switch IC with True Reverse Current Blocking

The TCK2291xG series is Load Switch ICs for power management with True Reverse Current Blocking and Thermal Shutdown function featuring low switch on resistance, ultra low quiescent current, high output current and wide input voltage operation from 1.1 to 5.5 V. Switch ON resistance is only 31 m Ω at 5.0 V, -0.15 A load conditions and output current is available on 2.0 A. And these feature a slew rate control driver and output auto-discharge function.

This device is available in 0.4 mm pitch ultra small package WCSP6E (0.8 mm \times 1.2 mm, t: 0.55 mm). Thus this devices is ideal for portable applications that require high-density board assembly such as cellular phone.

Feature

- True Reverse Current Blocking
- Thermal Shutdown function
- Output auto-discharge (Option)
- Under voltage lockout
- Low ON resistance :

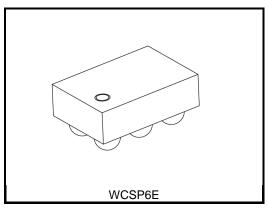
 $R_{ON} = 31 \text{ m}\Omega$ (typ.) at $V_{IN} = 5.0 \text{ V}$, $I_{OUT} = -0.15 \text{ A}$

 R_{ON} = 40 m Ω (typ.) at V_{IN} = 3.3 V, I_{OUT} = -0.15 A

 $R_{ON} = 70 \text{ m}\Omega$ (typ.) at $V_{IN} = 1.8 \text{ V}$, $I_{OUT} = -0.15 \text{ A}$

 $R_{ON} = 141 \text{ m}\Omega$ (typ.) at $V_{IN} = 1.2 \text{ V}$, $I_{OUT} = -0.15 \text{ A}$

- Low Quiescent Current: IQ = 11 μA (typ.) at IOUT = 0 mA
- Low standby current: I_{Q(OFF)} = 0.6 μA (typ.) at OFF state
- Inrush current reduction circuitt
- Pull down connection between Control and GND(Option)
- Ultra small package: WCSP6E (0.8 mm x 1.2 mm, t: 0.55 mm)



Weight: 1 mg (typ.)

Start of commercial production 2016-06



Function Table

Part number	Function								
	True Reverse current blocking	Output auto-discharge	Under voltage lock out	Thermal shut down	Control pin polarity	Control pin pull down connection	Device Marking		
TCK22910G	Built in	N/A	Built in	Built in	Active Low	-	4S		
TCK22911G	Built in	Built in	Built in	Built in	Active Low	-	3S		
TCK22912G	Built in	N/A	Built in	Built in	Active High	Built in	2\$		
TCK22913G	Built in	Built in	Built in	Built in	Active High	Built in	1S		



Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol		Rating	Unit		
Input voltage	VIN		-0.3 to 6.0			
Control voltage	VcT		-0.3 to 6.0			
Output voltage	Vout	OUT -0.3 to 6.0		V		
Output current	Іоит	DC	2.0	A		
		Pulse	3.0 (Note1)	А		
Power dissipation	PD		800 (Note 2)			
Operating temperature range T _{opr}			°C			
Junction temeperature	Tj		°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: 100 µs pulse, 2% duty cycle

Note2: Rating at mounting on a board

Glass epoxy board dimension: 40mm x 40mm (both sides of board), t=1.6mm

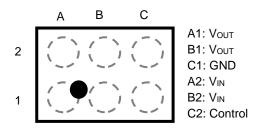
Metal pattern ratio: a surface approximately 50%, the reverse side approximately 50%

Through hole: diameter 0.5mm x 28)

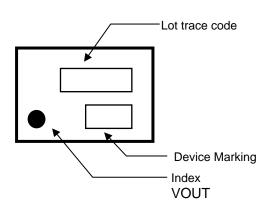
Operating conditions

Characteristics	Symbol	Condition	Min	Max	Unit
Input voltage	VIN	_	1.1	5.5	V
Output voltage	Vout	_	_	VIN	V
Output current	lout	1.8 V ≤ V _{IN}	_	2.0	Α
Control High level innut valtage	V	1.2V < V _{IN} ≤ 5.5 V	1.0	V _{IN}	V
Control High-level input voltage	VIH	1.1V ≤V _{IN} ≤1.2 V	0.9	_	V
Control Low-level input voltage	VIL	_	_	0.4	V

Pin Assignment(Top view)

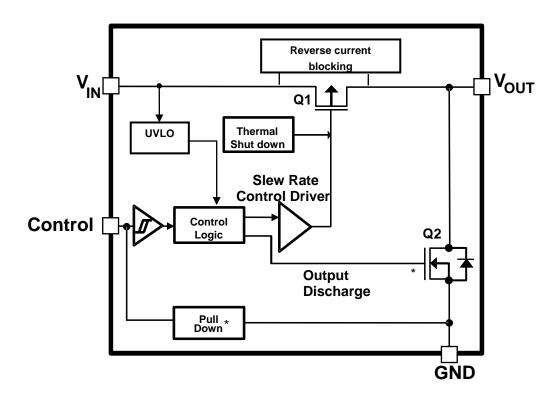


Top marking





Block Diagram



*:Option

Operation logic table

		TCK22910G	TCK22911G	TCK22912G	TCK22913G
	Output Q ₁	OFF	OFF	ON	ON
Control	Discharge Q ₂	_	ON	_	OFF
"High"	Reverse current blocking	Active	Active	Active	Active
	Output Q ₁	ON	ON	OFF	OFF
Control	Discharge Q ₂	_	OFF	_	ON
"Low"	Reverse current blocking	Active	Active	Active	Active



Electrical Characteristics

DC Characteristics (Ta = -40 to 85°C)

21		T	. 0		Ta = 25°C			Ta = -40 to 85°C	
Characteristics	Symbol	Test	Condition	Min	Тур.	Max	Min	Max	Unit
Quiescent current (ON state)	lo	IOUT = 0 mA	VIN = 1.1 V		9	_	_	_	μА
Quiescent current (ON state)	IQ	1001 = 0 IIIA	VIN = 5.5 V	-	11	_	_	20	μА
Quiescent current (OFF state)	IQ(OFF)	V _{IN} = 5.5 V, V _O (Note 3)	UT = OPEN,	_	0.6	_	_	2.5	μА
Switch leakage current(OFF state)	ISD(OFF)	VOUT = GND, current through from VIN to VOUT. (Note 4)	V _{IN} = V _{CT} = 5.5 V	_	20	_	_	2000	nA
Reverse blocking current	I _{RB}	V _{OUT} = 5.0 V, V _{IN} = 0 V, RCB active		_	0.01	_	_	2	μА
Reverse blocking voltage threshold	VRB	Vout – Vin		_	35	_	_	_	mV
Reverse blocking release voltage threshold	V _{RBR}	Vout – Vin		_	-15	_	_	_	mV
Under Voltage Lock Out (UVLO) rising threshold	Vuvl_ri	_		_	0.82	_	_	1.1	٧
Under Voltage Lock Out (UVLO) falling threshold	V _U VL_FA	_		_	0.77	_	_	_	٧
			V _{IN} = 5.0 V	-	31	_	_	85	
			V _{IN} = 3.3 V	_	40	_	_	95	
On resistance	Ron	I _{OUT} = -0.1 A	V _{IN} = 1.8 V	_	70	_	_	140	mΩ
			V _{IN} = 1.2 V	1	141	_	_	_	
			V _{IN} = 1.1 V	-	179	_	_	_	
Output discharge on resistance	R _{SD}	— (Note 5)		_	100	_	_	-	Ω

Note 3 : Except $I_{SD(OFF)}$ OFF-state switch current

Note 4 : Only applies to the TCK22910G and TCK22912G Note 5 : Only applies to the TCK22911G and TCK22913G



AC Characteristics (Ta = 25°C)

$V_{IN} = 5.0 V, TCK22910G$

Characteristics	Symbol	Test Condition(Figure 2)	Min	Тур.	Max	Unit
V _{OUT} rise time	t _r	V_{IN} = 5.0 V , R_L = 500 Ω , C_L =0.1 μF ,	_	1.4	_	ms
V _{OUT} fall time	t _f	V_{IN} = 5.0 V , R_L = 500 Ω , C_L =0.1 μF ,	_	120	_	μS
Turn on delay	ton	V_{IN} = 5.0 V , R_L = 500 Ω , C_L =0.1 μF ,	_	800	_	μS
Turn off delay	toff	V_{IN} = 5.0 V , R_L = 500 Ω , C_L =0.1 μF ,	_	5	_	μS

$V_{IN} = 5.0 V, TCK22911G$

Characteristics	Symbol	Test Condition(Figure 2)	Min	Тур.	Max	Unit
V _{OUT} rise time	t _r	V_{IN} = 5.0 V , R_L = 500 Ω , C_L =0.1 μF ,	_	1.4	_	ms
V _{OUT} fall time	t _f	V_{IN} = 5.0 V , R_L = 500 Ω , C_L =0.1 μF ,	_	60	_	μS
Turn on delay	ton	V_{IN} = 5.0 V , R_L = 500 Ω , C_L =0.1 μF ,	_	800	_	μS
Turn off delay	tOFF	$V_{\text{IN}}\text{=}~5.0~\text{V}$, RL = 500 Ω , CL=0.1 $\mu\text{F},$	_	5	_	μS

$V_{IN} = 5.0 V, TCK22912G$

Characteristics	Symbol	Test Condition(Figure 1)	Min	Тур.	Max	Unit
V _{OUT} rise time	t _r	V_{IN} = 5.0 V , R_L = 500 Ω , C_L =0.1 μF ,	_	1.4	_	ms
V _{OUT} fall time	t _f	V_{IN} = 5.0 V , R_L = 500 Ω , C_L =0.1 μF ,	_	120	_	μS
Turn on delay	ton	V_{IN} = 5.0 V , R_L = 500 Ω , C_L =0.1 μF ,	_	800	_	μS
Turn off delay	toff	$V_{\mbox{\footnotesize{IN}}}\mbox{=}5.0~\mbox{V}$, $R_{\mbox{\footnotesize{L}}}\mbox{=}500~\Omega$, $C_{\mbox{\footnotesize{L}}}\mbox{=}0.1~\mu\mbox{F},$	_	10	_	μS

V_{IN} = 5.0 V, TCK22913G

Characteristics	Symbol	Test Condition(Figure 1)	Min	Тур.	Max	Unit
VOUT rise time	tr	$V_{\text{IN}}\text{=}~5.0~\text{V}$, RL = 500 Ω , CL=0.1 $\mu\text{F},$	_	1.4	_	ms
Vout fall time	tf	$V_{\text{IN}\text{=}}$ 5.0 V , RL = 500 Ω , CL=0.1 $\mu\text{F},$	_	60	_	μS
Turn on delay	ton	$V_{\text{IN}\text{=}}$ 5.0 V , RL = 500 Ω , CL=0.1 $\mu\text{F},$	_	800	_	μS
Turn off delay	toff	$V_{\text{IN=}}$ 5.0 V , RL = 500 Ω , CL=0.1 $\mu\text{F},$	-	10	_	μS



AC Waveform

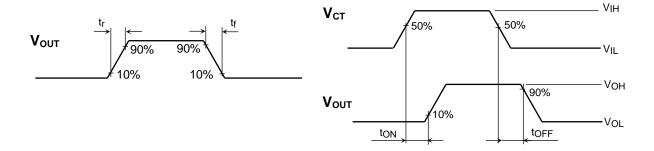


Figure 1 t_r, t_f, t_{ON}, t_{OFF} Waveforms(Active High)

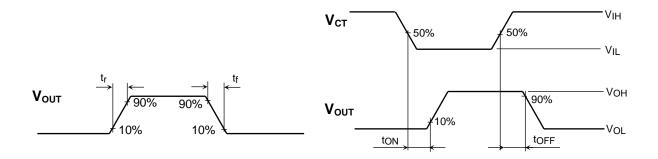


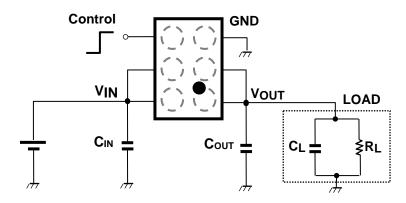
Figure 2 t_r, t_f, t_{ON}, t_{OFF} Waveforms(Active Low)



Application Note

1. Application circuit example (top view)

The figure below shows the recommended configuration for TCK2291xG.



1) Input and Output capacitor

An input capacitor (C_{IN}) and an output capacitor (C_{OUT}) are necessary for the stable operation of TCK2291xG. 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

The Control pin for TCK2291xG controls state of the switch, operated by the control voltage and Schmitt trigger. Also, pull down resistance equivalent to a few $M\Omega$ is connected between Control and GND, thus the load switch IC is in OFF state even when Control pin is OPEN. (except TCK22910G and TCK22911G). A control pins for TCK22910G and TCK22911G is Active low. Products that Control pin is an open connection, please use be sure to fix the potential of the Control pin to High or Low.

2. Thermal shutdown function

This device has a built-in Thermal shutdown circuit. If the junction temperature goes beyond 170°C (Typ.), thermal shutdown circuit operates and turns off power switch. When the junction temperature decreases lower than 150°C, the power switch is turned on due to hysteresis. This operation is repeated as long as the junction temperature continues increasing.

3. True reverse current blocking

This device has built-in True reverse current blocking circuit (TRCB) to block reverse current from VOUT to VIN regardless of output MOSFET ON/OFF condition. (Full-Time Reverse Current Protection)

4. Under-voltage Lockout

This device has a built-in Under-voltage Lockout Circuit to turn off switch if VIN drops below UVLO. This circuit has hysteresis and UVLO is released when VIN exceeds threshold.

5. Instructions and directions for use

This device has a built-in several functions, 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.



6. Power Dissipation

Power dissipation is measured on the board condition shown below.

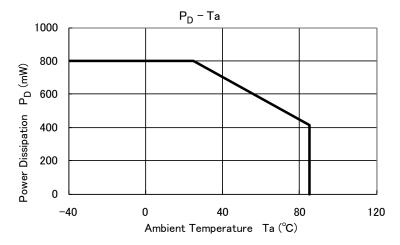
[The Board Condition]

Board material: Glass epoxy (FR4)

Board dimension: 40mm x 40mm (both sides of board), t=1.6mm

Metal pattern ratio: a surface approximately 50%, the reverse side approximately 50%

Through hole: diameter 0.5mm x 28

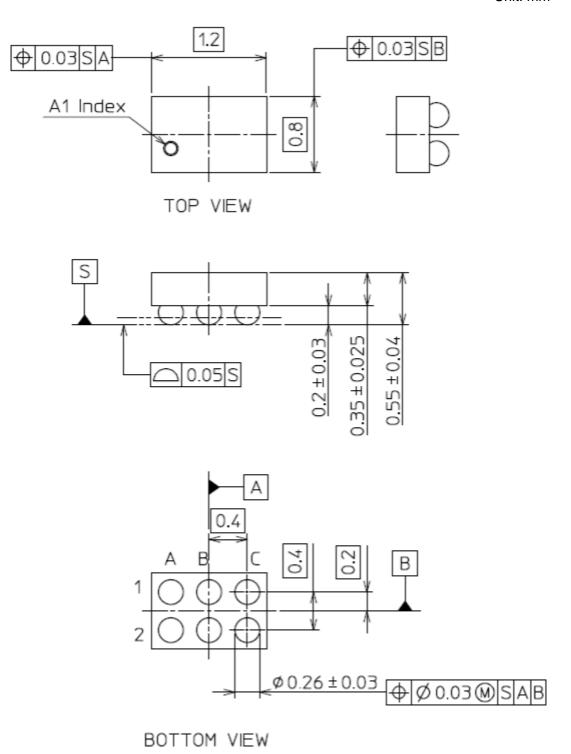


Please allow sufficient margin when designing a board pattern to fit the expected power dissipation. Also take into consideration the ambient temperature, input voltage, output current etc and applying the appropriate derating for allowable power dissipation during operation.



Package dimension

Unit: mm

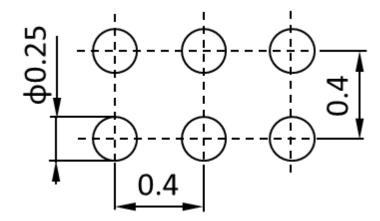


Weight: 1 mg (typ.)



Land pattern dimensions (for reference only)

Unit: mm





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Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

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Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А