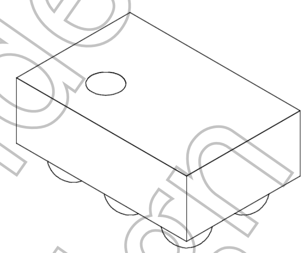
TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

TCK101G, TCK102G

1A Load Switch IC with Slew Rate Control Driver

The TCK101G and TCK102G are load switch ICs for power management with slew rate control driver featuring wide input voltage operation from 1.1 to 5.5 V. Switch ON resistance is only 55 mΩ typical at 3.3 V, 500 mA load condition and these feature a slew rate control driver and thermal shutdown. TCK101G has output auto-discharge function. Maximum Output current type is available up to 1 .0A (DC).

This device is available in 0.4 mm pitch ultra small package WCSP6B (0.8 mm x 1.2 mm, t: 0.64 mm (max)). Thus this device is ideal for portable applications that require high-density board assembly such as cellular phone.



WCSP6B

Weight: 1 mg (typ.)

Feature

- Wide input voltage operation: V_{IN} = 1.1 to 5.5 V
- Low ON resistance :
  R_{ON} = 50 mΩ (typ.) at V_{IN} = 5.0 V, 500 mA
  R_{ON} = 55 mΩ (typ.) at V_{IN} = 3.3 V, 500 mA
  R_{ON} = 75 mΩ (typ.) at V_{IN} = 1.8 V, 500 mA
  R_{ON} = 120 mΩ (typ.) at V_{IN} = 1.2 V, 500 mA
- Low Quiescent Current: I_Q = 8 μA (typ.) at V_{IN} = V_{CT} = 5.5 V, I_{OUT} = 0 mA
- Low standby current: $I_{Q(OFF)}$ = 0.07 μA (typ.) at OFF state
- Inrush current reduction circuit
- Thermal Shutdown function
- Auto-discharge (TCK101G)
- Pull down connection between CONTROL and GND
- Ultra small package : WCSP6B (0.8mm x 1.2mm, t: 0.64mm(max))

Start of commercial production
2012-08

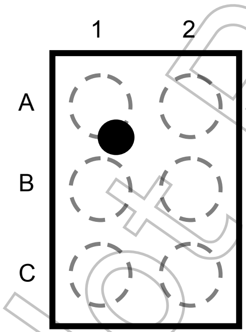
Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating		Unit
Input voltage	V_{IN}	-0.3 to 6.0		V
Control voltage	V_{CT}	-0.3 to 6.0		V
Output voltage	V_{OUT}	-0.3 to V_{IN} +0.3		V
Output current	I_{OUT}	DC	1.0	A
Power dissipation	P_D	800 (Note 1)		mW
Operating temperature range	T_{opr}	−40 to 85		°C
Junction temeperature	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 and the operating ranges. 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).

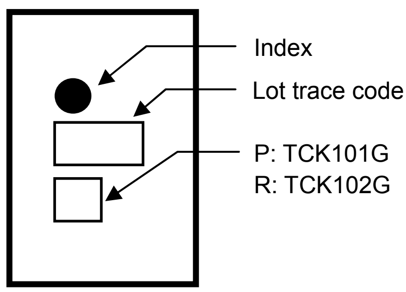
Note1: Rating at mounting on a board
(Glass epoxy board dimension : 40mm x 40mm, both sides of board
Metal pattern ratio : a surface approximately 50%, the reverse side approximately 50%
Through hole: diameter 0.5mm x 28)

Pin Assignment(Top view)

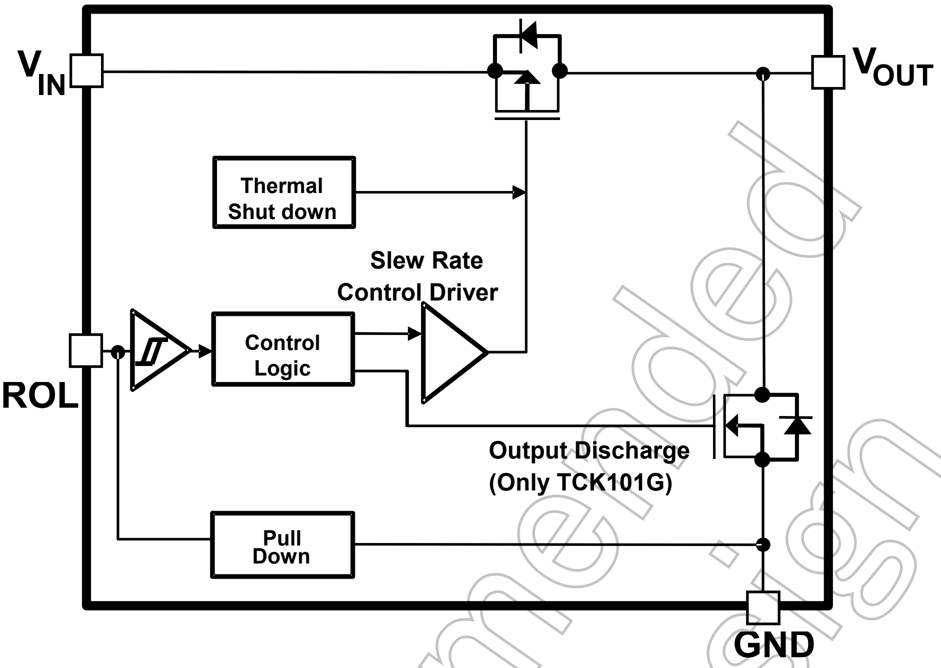


A1: V_{OUT}
B1: V_{OUT}
C1: GND
A2: V_{IN}
B2: V_{IN}
C2: CONTROL

Top marking



Block Diagram



Function Table

Part number	Function		
	Thermal Shutdown	Output auto-discharge	Control pin connection
TCK101G	Bulit in	Bulit in	Pull down
TCK102G	Bulit in		Pull down

Electrical Characteristics

DC Characteristics (Ta = -40 to 85°C)

Characteristics	Symbol	Test Condition		Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = –40 to 85°C Min	Ta = –40 to 85°C Max	Unit
Input voltage	V_{IN}	—		1.1	—	5.5	1.1	5.5	V
CONTROL High-level input voltage	V_{IH}	1.2 V < V_{IN} ≤ 5.5 V		1.0	—	—	1.0	—	V
		1.1 V ≤ V_{IN} ≤ 1.2 V		0.9	—	—	0.9	—	
CONTROL Low-level input voltage	V_{IL}	V_{IN} = 1.1 to 5.5 V		—	—	0.4	—	0.4	V
Quiescent current (ON state)	I_Q	I_{OUT} = 0 mA, V_{IN} = V_{CT} = 5.5 V		—	8	—	—	20	μA
Standby current (OFF state)	$I_{Q(OFF)}$	V_{IN} = 5.5 V, V_{CT} = 0 V, V_{OUT} = OPEN (Note 2)		—	0.07	—	—	1	μA
OFF-state switch current	$I_{SD(OFF)}$	V_{CT} = 0 V, V_{OUT} = GND	V_{IN} = 5.0 V	—	10	—	—	1000 (Note3)	nA
			V_{IN} = 3.3 V	—	2	—	—	1000	
			V_{IN} = 1.8 V	—	1	—	—	1000	
			V_{IN} = 1.2 V	—	1	—	—	1000	
On resistance	R_{ON}	I_{OUT} = 500 mA	V_{IN} = 5.0 V	—	50	—	—	70	mΩ
			V_{IN} = 3.3 V	—	55	—	—	75	
			V_{IN} = 1.8 V	—	75	—	—	100	
			V_{IN} = 1.2 V	—	120	—	—	180	
			V_{IN} = 1.1 V	—	155	—	—	—	
Discharge on resistance	R_{SD}	— (TCK101G)		—	100	—	—	—	Ω

Note 2 : Except OFF-state switch current

Note 3 : Ta = 65 ℃

AC Characteristics (Ta = 25°C)

V_{IN} = 1.2 V

Characteristics	Symbol	Test Condition(Figure 1)		Min	Typ.	Max	Unit
V_{OUT} rise time	t_r	R_L = 500 Ω , C_L = 0.1 μF		—	370	—	μs
V_{OUT} fall time	t_f	R_L = 500 Ω , C_L = 0.1 μF	TCK101G	—	25	—	μs
			TCK102G	—	95	—	
Turn on delay	t_{ON}	R_L = 500 Ω , C_L = 0.1 μF		—	390	—	μs
Turn off delay	t_{OFF}	R_L = 500 Ω , C_L = 0.1 μF		—	8	—	μs

V_{IN} = 3.3 V

Characteristics	Symbol	Test Condition(Figure 1)		Min	Typ.	Max	Unit
V_{OUT} rise time	t_r	R_L = 500 Ω , C_L = 0.1 μF		—	170	—	μs
V_{OUT} fall time	t_f	R_L = 500 Ω , C_L = 0.1 μF	TCK101G	—	45	—	μs
			TCK102G	—	100	—	
Turn on delay	t_{ON}	R_L = 500 Ω , C_L = 0.1 μF		—	135	—	μs
Turn off delay	t_{OFF}	R_L = 500 Ω , C_L = 0.1 μF		—	10	—	μs

AC Waveform

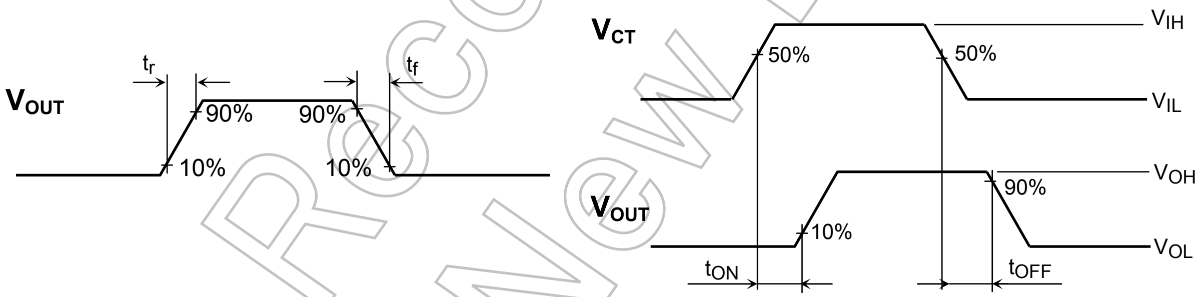
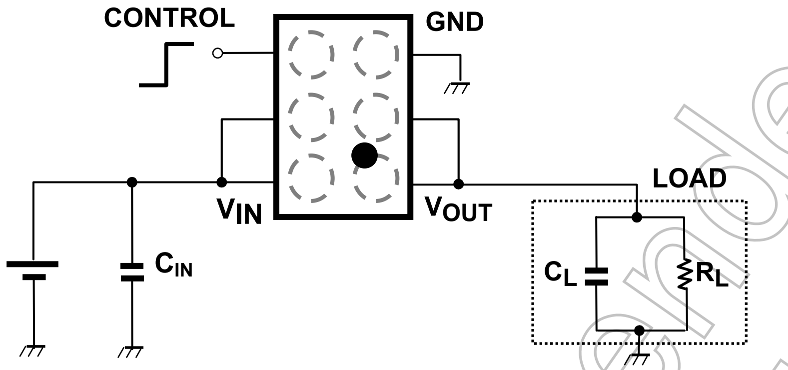


Figure 1 t_r, t_f, t_{ON}, t_{OFF} Waveforms

Application Note

1. Application circuit example (top view)

The figure below shows the recommended configuration for TCK101G and TCK102G.



Control Voltage	Output Voltage
HIGH	ON
LOW	OFF
OPEN	OFF

1) Input capacitor C_{IN}

An input capacitor (C_{IN}) is not necessary for the guaranteed operation of TCK101G and TCK102G. However, it is recommended to use input capacitors to reduce voltage drop due to sharp changes in output current and also for improved stability of the power supply. When used, place C_{IN} as close to V_{IN} pin to improve stability of the power supply. Also, due to the C_{IN} selected, $V_{IN} < V_{OUT}$ may occur, causing a reverse current to flow through the body diode of the pass-through p-ch MOSFET of the load switch IC. In this case, a higher value for C_{IN} as compared to C_L is recommended.

2) Output capacitor

An output capacitor (C_{OUT}) is not necessary for the guaranteed operation of TCK101G and TCK102G. However, there is a possibility of overshoot or undershoot caused by output load transient response, board layout and parasitic components of load switch IC. In this case, an output capacitor with C_{OUT} more than 0.1μF us recommended.

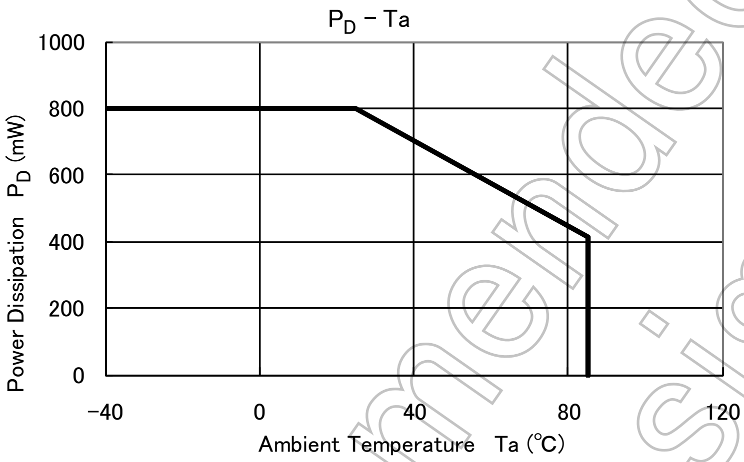
3) Control pin

A control pins for TCK101G and TCK102G are both Active High, which controls both the pass-through p-ch MOSFET and the discharge n-ch MOSFET (only for TCK101G), operated by the control voltage and Schmitt trigger. When the control voltage level is High, p-ch MOSFET is ON state and n-ch MOSFET is OFF state. When control voltage level is Low, and the state of the MOSFETs is reversed. Also, pull down resistance equivalent to a few MΩ is connected between CONTROL and GND, thus the load switch IC is in OFF state even when CONTROL pin is OPEN. In addition, CONTROL pin has a tolerant function such that it can be used even if the control voltage is higher than the input voltage.

2. 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=1.8mm
Metal pattern ratio: a surface approximately 50%, the reverse side approximately 50%
Through hole: diameter 0.5mm x 28

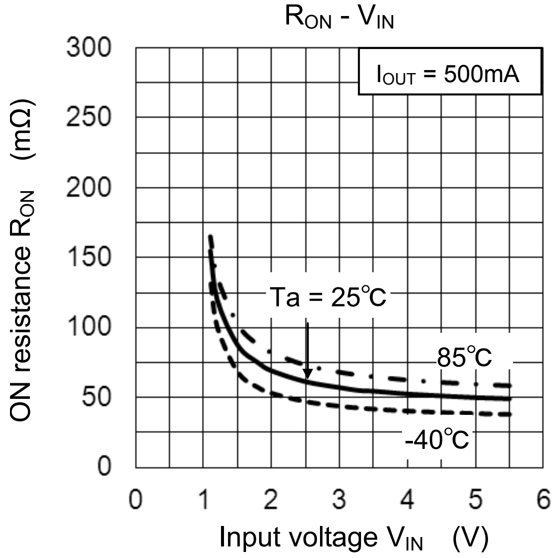


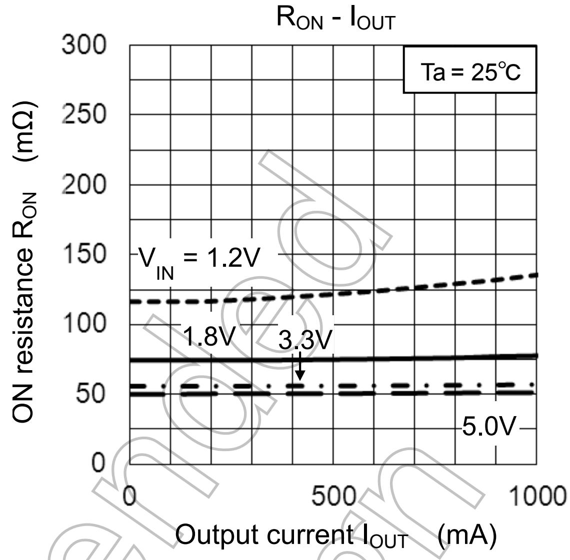
Please allow sufficient margin when designing a board pattern to fit the expected power dissipation. Also take into consideration the ambient temperature, input voltage, output current etc and applying the appropriate derating for allowable power dissipation during operation.

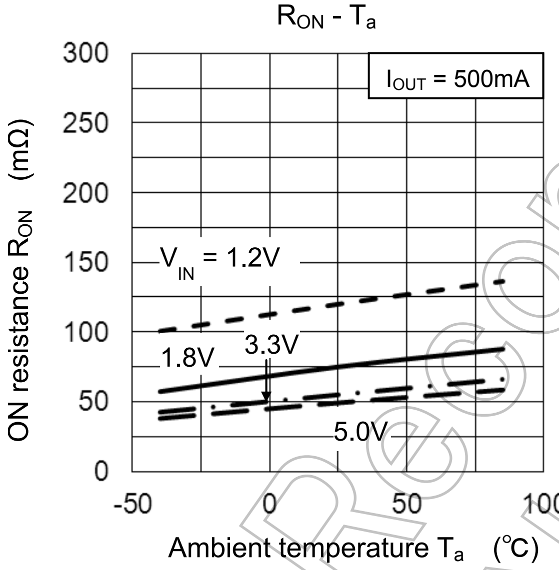
3. Thermal shut down function

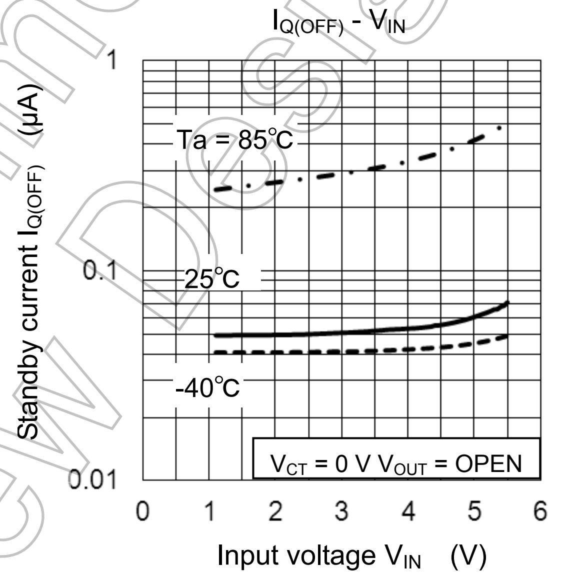
Thermal shutdown function is designed in these products, but these does not assure for the suppression of uprising device operation. In use of these products, please read through and understand dissipation idea for absolute maximum ratings from the above mention or our 'Semiconductor Reliability Handbook'.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

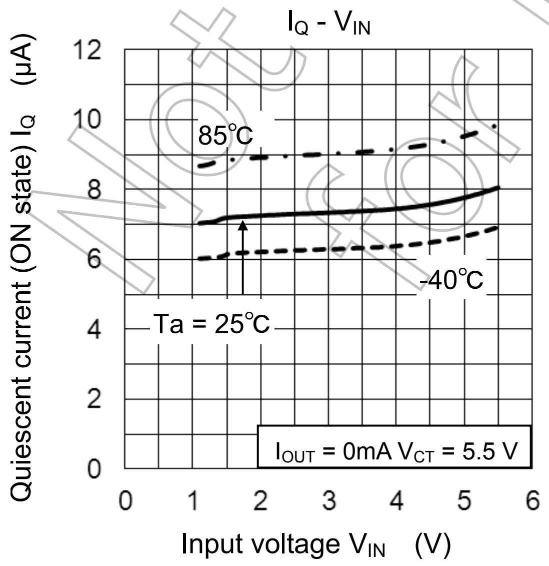
TCK101G, TCK102G Representative Characteristics

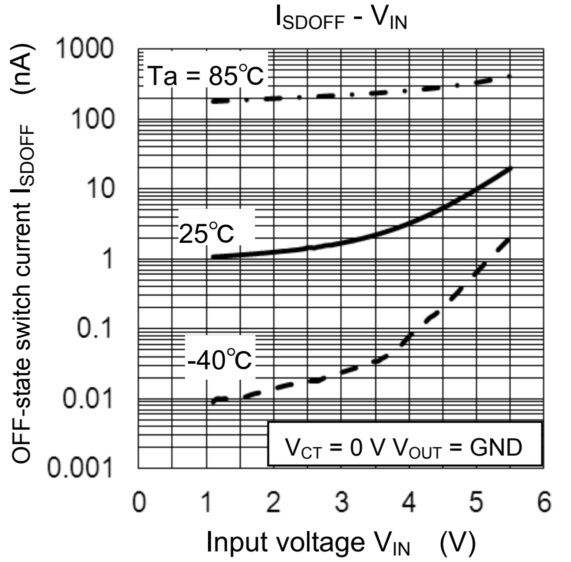


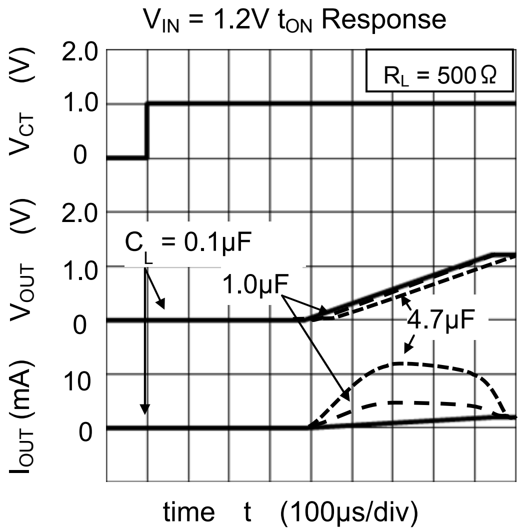


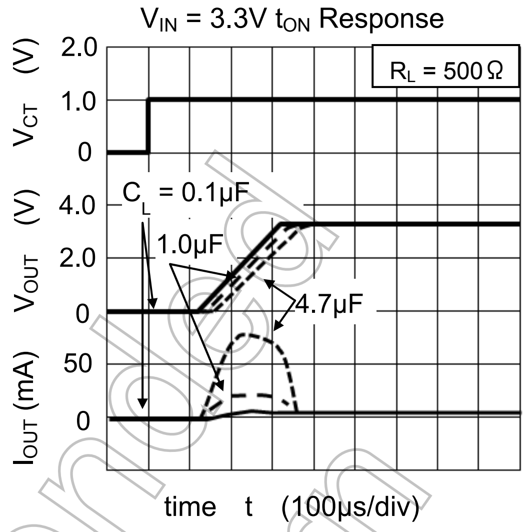


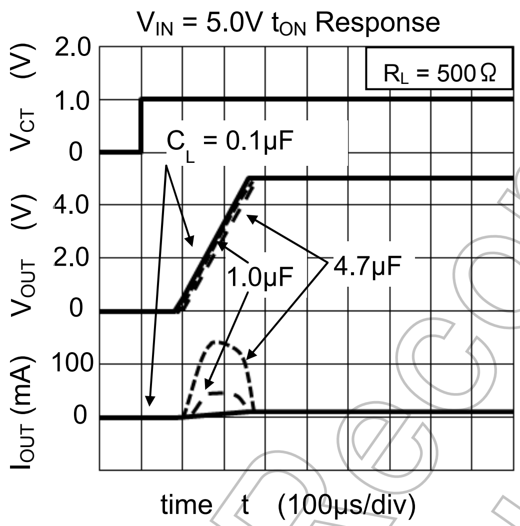




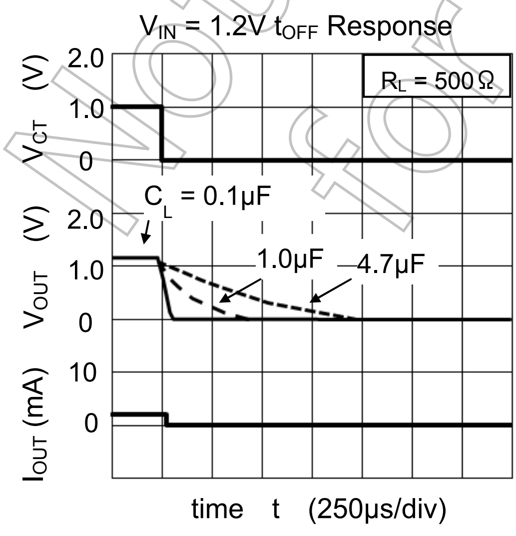


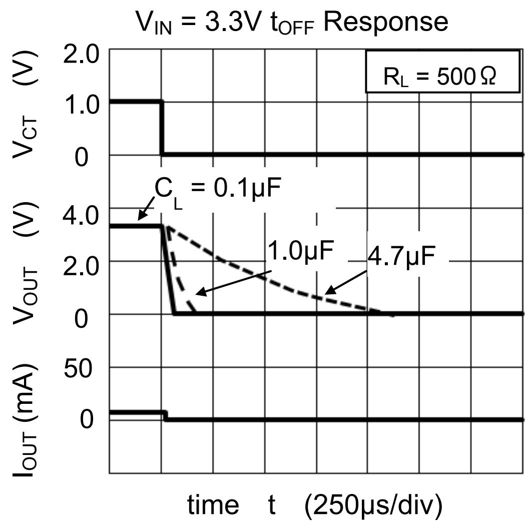




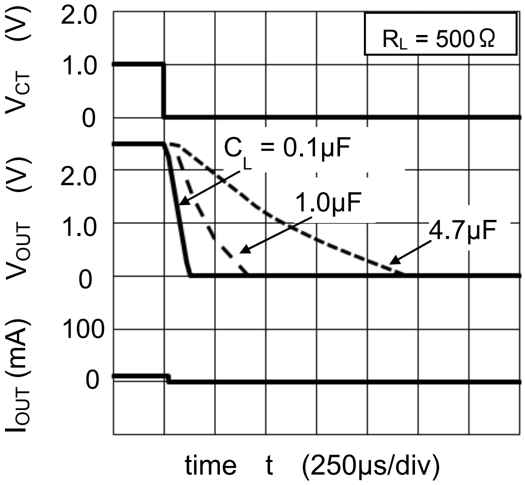


TCK101G t_{OFF} Response



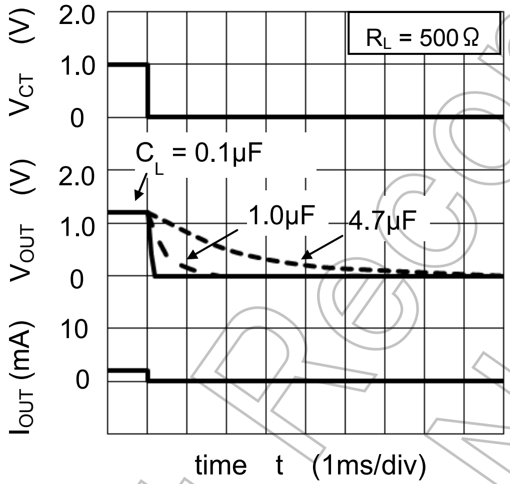


V_{IN} = 5.0V t_{OFF} Response

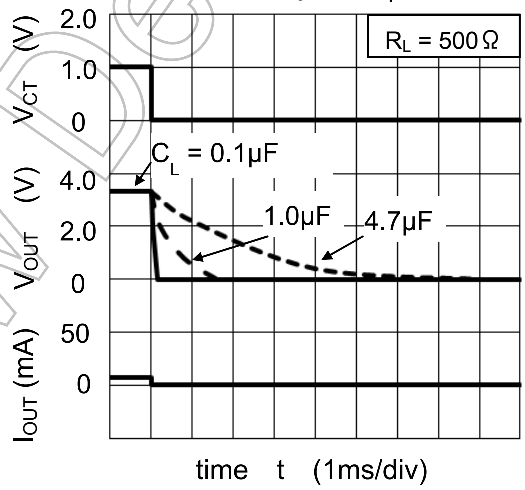


TCK102G t_{OFF} Response

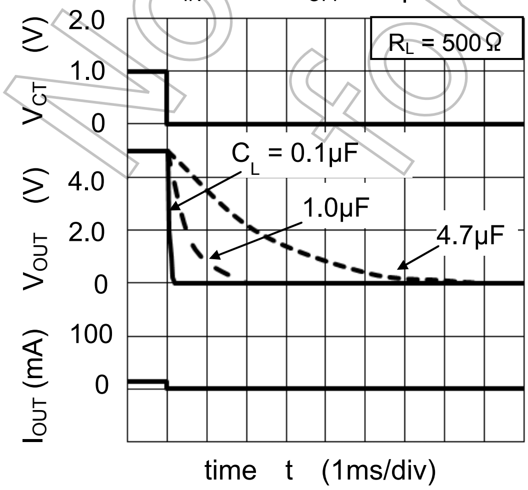
V_{IN} = 1.2V t_{OFF} Response



V_{IN} = 3.3V t_{OFF} Response

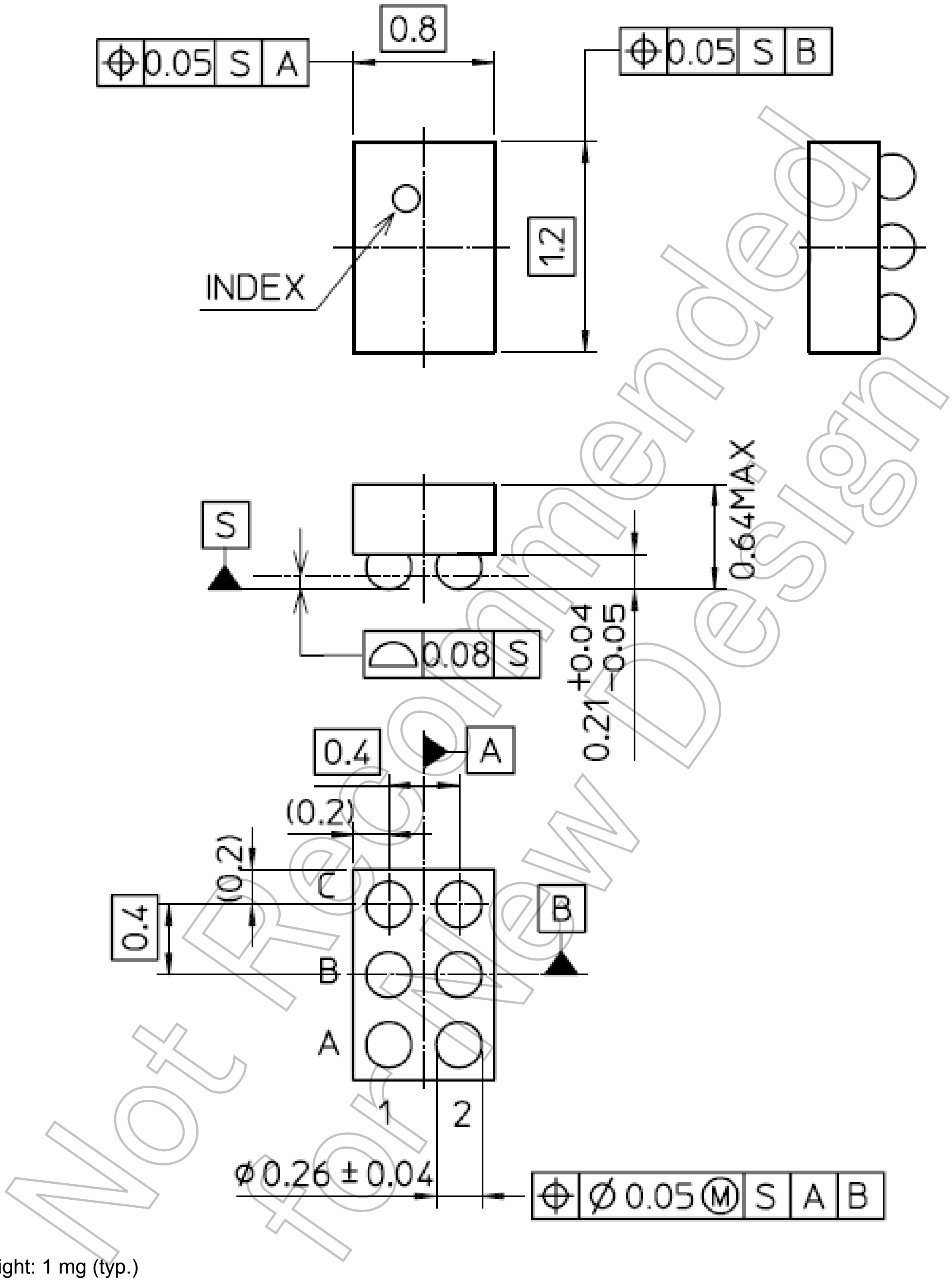


V_{IN} = 5.0V t_{OFF} Response



Package dimension

Unit: mm



Weight: 1 mg (typ.)

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