TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

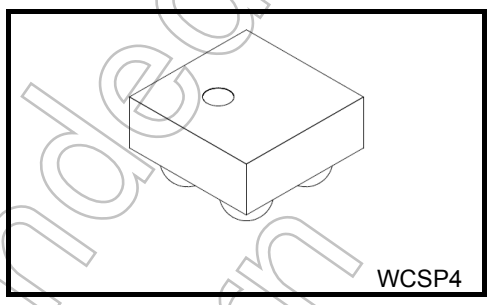
TCK106G, TCK107G, TCK108G

1.0 A Load Switch IC with Slew Rate Control Driver in Ultra Small Package

The TCK106G, TCK107G and TCK108G are load switch ICs for a general power management with slew rate control driver, featuring low switch ON resistance and wide input voltage operation from 1.1 to 5.5 V.

Switch ON resistance is only 49 mΩ typical at 5.0 V, 500 mA condition and output current is available on 1.0 A. TCK107G and TCK108G feature output auto-discharge function.

These devices are available in 0.4 mm pitch ultra small package WCSP4 (0.79 mm x 0.79 mm, t: 0.5 mm) .Thus this devices is ideal for portable applications that require high-density board assembly such as cellular phone.

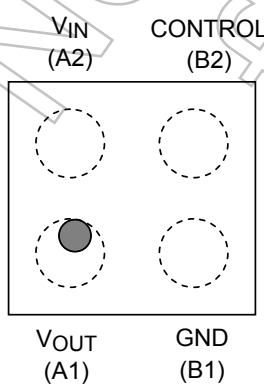


Weight: 0.7 mg (typ.)

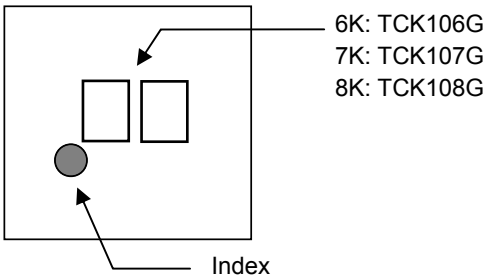
Feature

- Wide input voltage operation: V_{IN} = 1.1 to 5.5 V
- High output current: I_{OUT} = 1.0 A
- Low ON resistance :
  R_{ON} = 49 mΩ (typ.) at V_{IN} = 5.0 V, 500 mA
  R_{ON} = 57 mΩ (typ.) at V_{IN} = 3.3 V, 500 mA
  R_{ON} = 83 mΩ (typ.) at V_{IN} = 1.8 V, 500 mA
  R_{ON} = 143 mΩ (typ.) at V_{IN} = 1.2 V, 200 mA
  R_{ON} = 176 mΩ (typ.) at V_{IN} = 1.1 V, 200 mA
- Built in Slew rate control driver
- Built in Auto-discharge (TCK107G and TCK108G)
- Active High and Pull down connection between CONTROL and GND (TCK106G and TCK107G)
- Active Low (TCK108G)
- Ultra small package : WCSP4 (0.79 mm x 0.79 mm, t: 0.5 mm)

Pin Assignment(Top view)



Top marking



Start of commercial production
2013-02

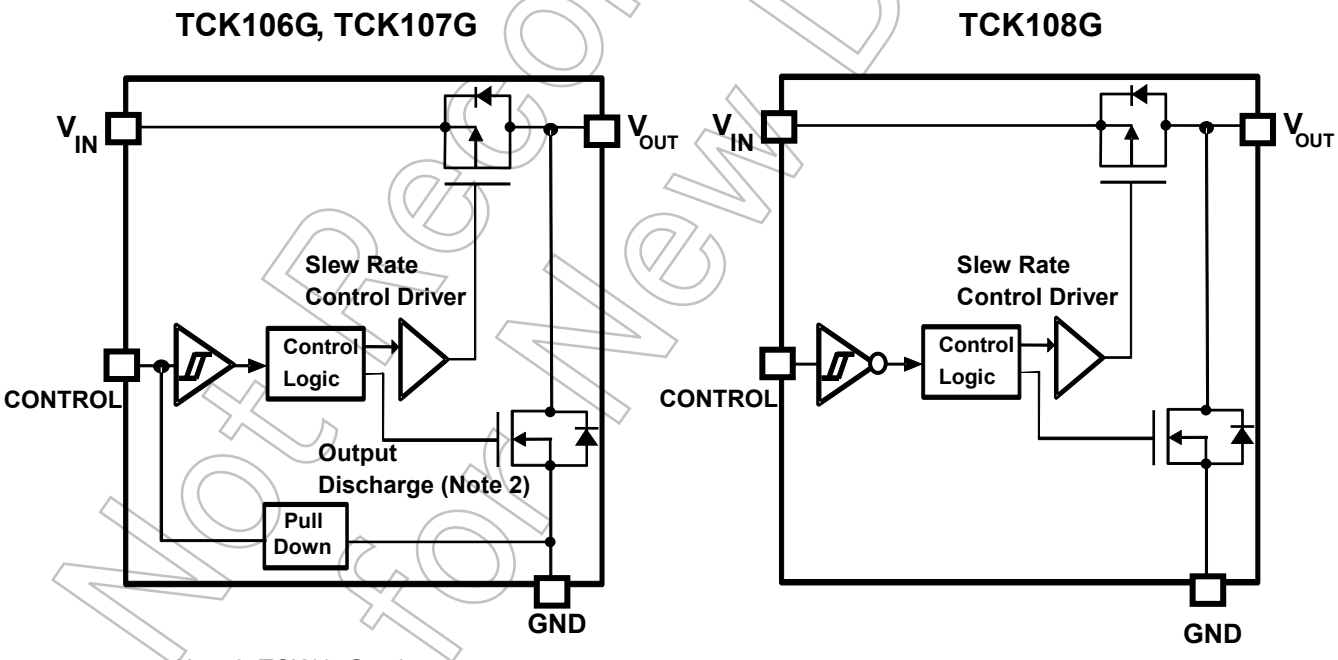
Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating		Unit
Input voltage	V_{IN}	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)

Block Diagram



Note 2: TCK107G only

Electrical Characteristics

DC Characteristics (Ta = -40 to 85°C)

Characteristics	Symbol	Test Condition		Min	Typ.	Max	Unit
Input voltage	V_{IN}	—		1.1	—	5.5	V
CONTROL High-level input voltage	V_{IH}	V_{IN} = 1.1 to 5.5 V		0.9	—	—	V
CONTROL Low-level input voltage	V_{IL}	V_{IN} = 1.1 to 5.5 V		—	—	0.4	V
Quiescent current (ON state)	I_Q	V_{IN} = V_{CT} = 5.5 V, I_{OUT} = 0 mA	TCK106G TCK107G	—	80	200	nA
		V_{IN} = 5.5 V, V_{CT} = 0 V, I_{OUT} = 0 mA	TCK108G				
Standby current (OFF state)	$I_{Q(OFF)}$	V_{IN} = 5.5 V, V_{CT} = 0 V, V_{OUT} = OPEN (Note 3)	TCK106G TCK107G	—	50	135	nA
		V_{IN} = V_{CT} = 5.5 V, V_{OUT} = OPEN (Note 3)	TCK108G				
OFF-state switch current	$I_{SD(OFF)}$	V_{IN} = 5.5 V, V_{CT} = 0 V, V_{OUT} = GND	TCK106G TCK107G	—	14	1000	nA
		V_{IN} = V_{CT} = 5.5 V, V_{OUT} = GND	TCK108G				
On resistance	R_{ON}	V_{IN} = 5.0 V, I_{OUT} = -0.5 A		—	49	73	mΩ
		V_{IN} = 3.3 V, I_{OUT} = -0.5 A		—	57	84	
		V_{IN} = 1.8 V, I_{OUT} = -0.5 A		—	83	123	
		V_{IN} = 1.2 V, I_{OUT} = -0.2 A		—	143	225	
		V_{IN} = 1.1 V, I_{OUT} = -0.2 A		—	176	—	
Discharge on resistance	R_{SD}	— (TCK107G and TCK108G)		—	100	—	Ω

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

AC Characteristics (Ta = 25°C)

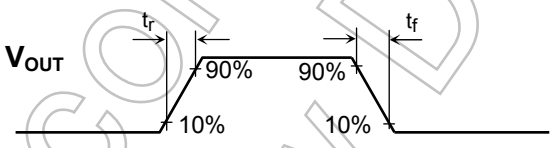
V_{IN} = 1.2 V

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		—	290	—	μs
V_{OUT} fall time	t_f	R_L = 500 Ω, C_L = 0.1 μF	TCK107G TCK108G	—	30	—	μs
			TCK106G	—	104	—	
Turn on delay	t_{ON}	R_L = 500 Ω, C_L = 0.1 μF		—	305	—	μs
Turn off delay	t_{OFF}	R_L = 500 Ω, C_L = 0.1 μF		—	5	—	μs

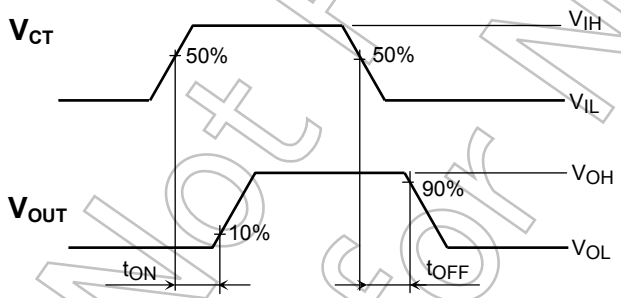
V_{IN} = 3.3 V

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		—	130	—	μs
V_{OUT} fall time	t_f	R_L = 500 Ω, C_L = 0.1 μF	TCK107G TCK108G	—	25	—	μs
			TCK106G	—	110	—	
Turn on delay	t_{ON}	R_L = 500 Ω, C_L = 0.1 μF		—	100	—	μs
Turn off delay	t_{OFF}	R_L = 500 Ω, C_L = 0.1 μF		—	10	—	μs

AC Waveform



TCK106G, TCK107G



TCK108G

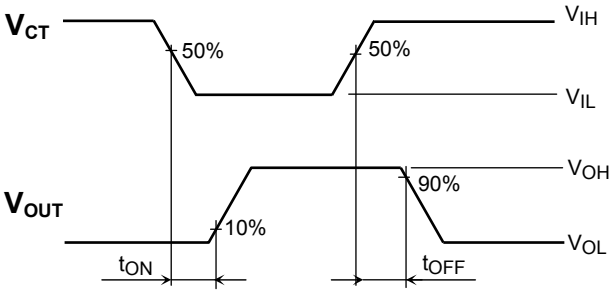
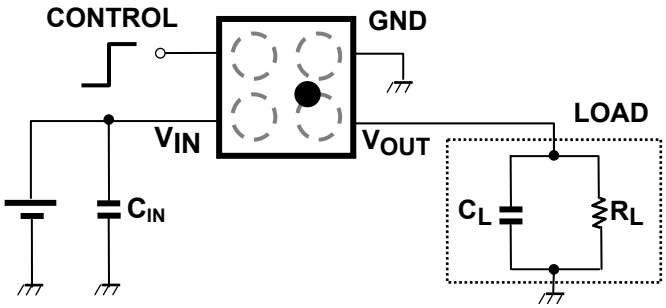


Figure 1 t_r, t_f, t_{ON}, t_{OFF} Waveforms

Application Note

1. Application circuit example (top view)

The figure below shows the recommended configuration for TCK106G, TCK107G and TCK108G.



Part number	Control voltage	IC Operation
TCK106G TCK107G	HIGH	ON
	LOW	OFF
	OPEN	OFF
TCK108G	HIGH	OFF
	LOW	ON

1) Input capacitor

An input capacitor (C_{IN}) is not necessary for the guaranteed operation of TCK106G, TCK107G and TCK108G. 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 TCK106G, TCK107G and TCK108G. 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.

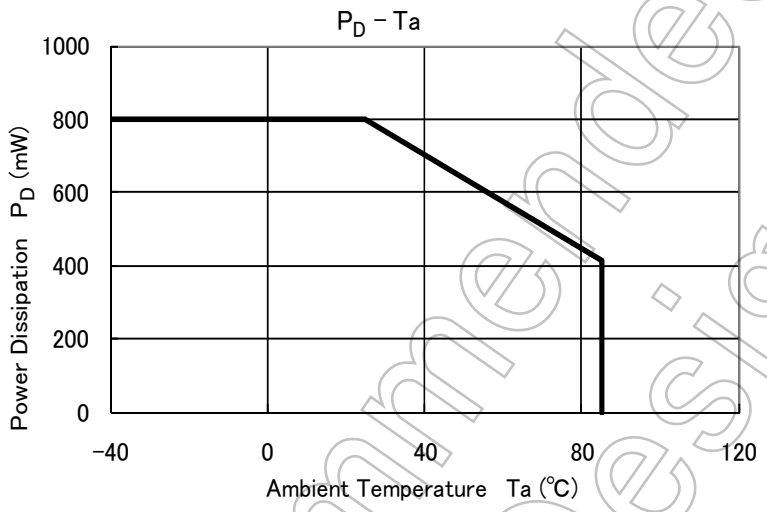
3) Control pin

A control pins for TCK106G and TCK107G are both Active High and TCK108G is Active Low. These controls both the pass-through p-ch MOSFET and the discharge n-ch MOSFET (except TCK106G), operated by the control voltage and Schmitt trigger. When the control voltage level is High (Low; TCK108G), p-ch MOSFET is ON state and n-ch MOSFET is OFF state. When control voltage level is Low (High; TCK108G), 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(except TCK108G). 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.

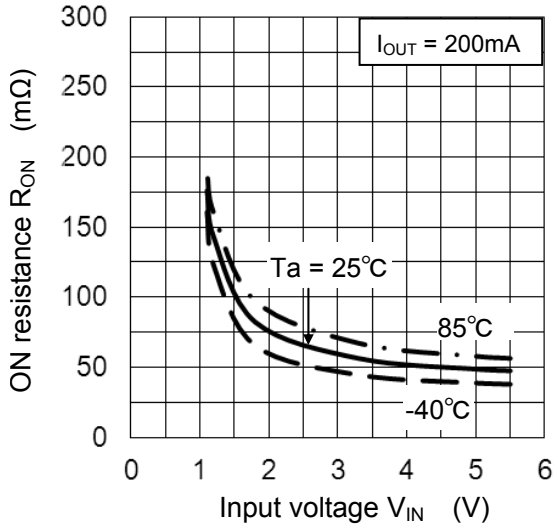
[The Board Condition]
Board material: Glass epoxy (FR4)
Board dimension: 40mm x 40mm (both sides of board), t=1.8mm
Metal pattern ratio: a surface approximately 50%, the reverse side approximately 50%
Through hole: diameter 0.5mm x 28



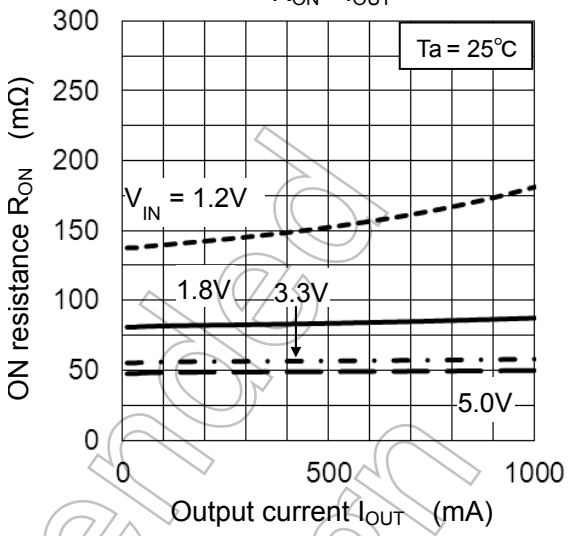
Please allow sufficient margin when designing a board pattern to fit the expected power dissipation. Also take into consideration the ambient temperature, input voltage, output current etc and applying the appropriate derating for allowable power dissipation during operation.

Representative Common Characteristics

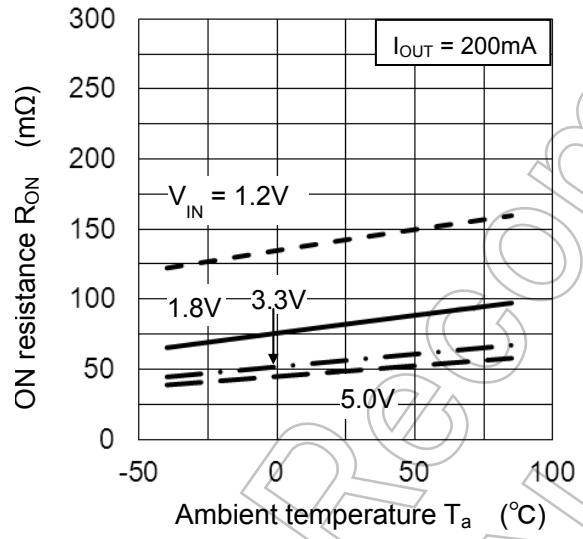
R_{ON} - V_{IN}



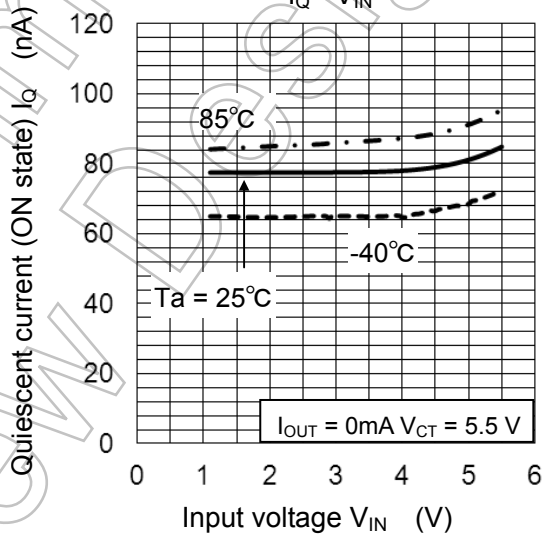
R_{ON} - I_{OUT}



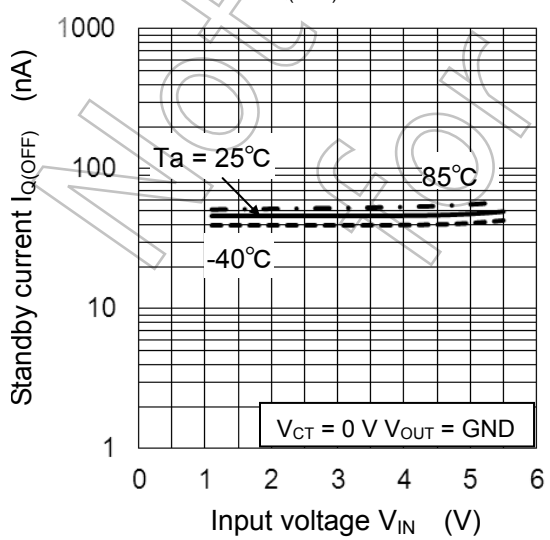
R_{ON} - T_a



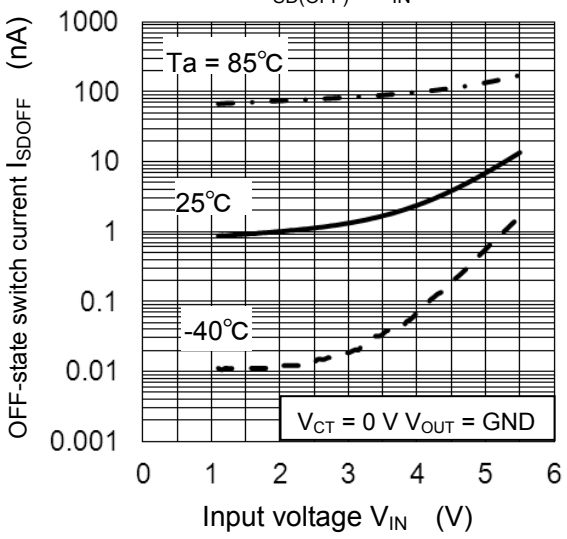
I_Q - V_{IN}



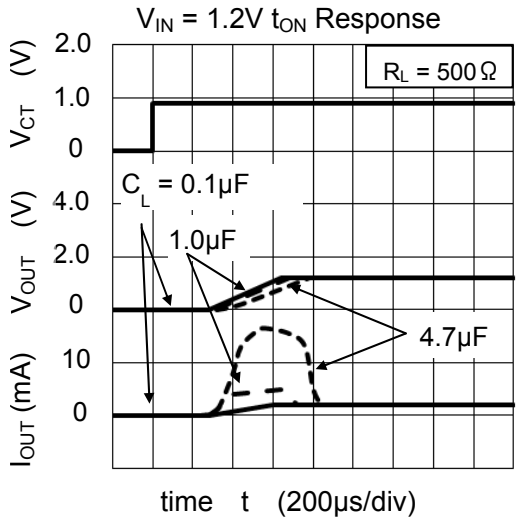
$I_{Q(OFF)}$ - V_{IN}

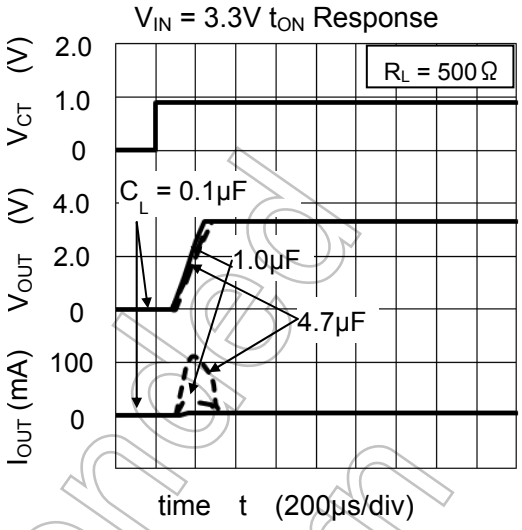


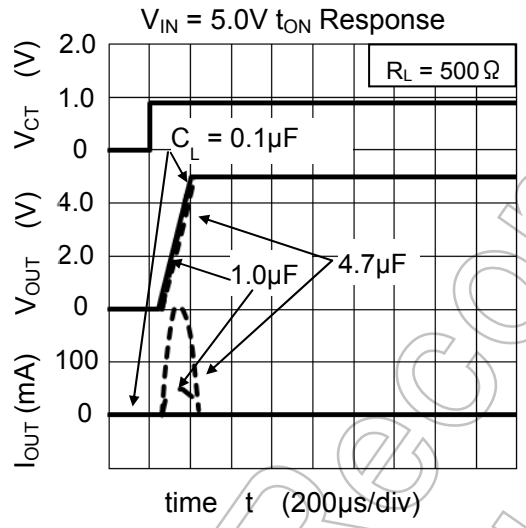
$I_{SD(OFF)}$ - V_{IN}



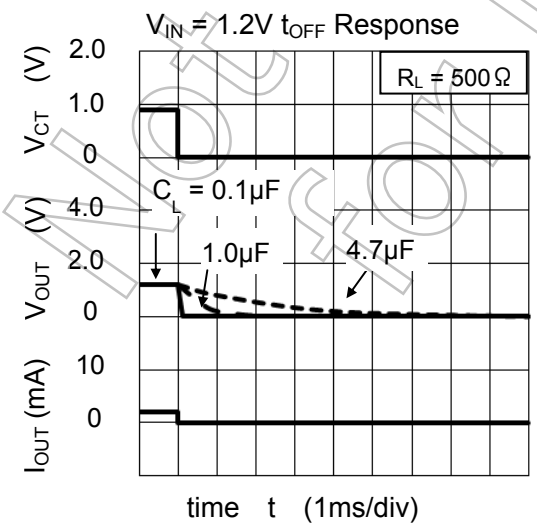
TCK107G t_{ON} Response

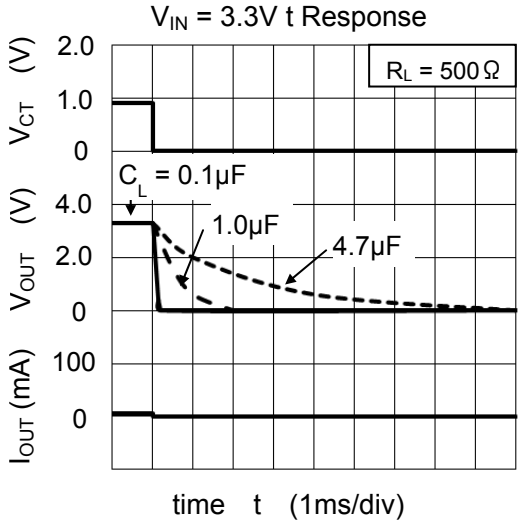


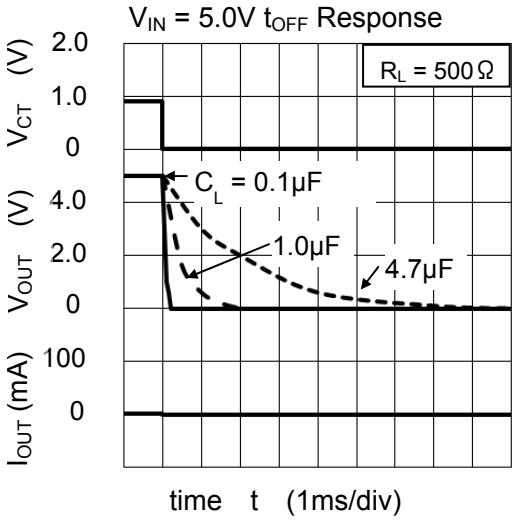




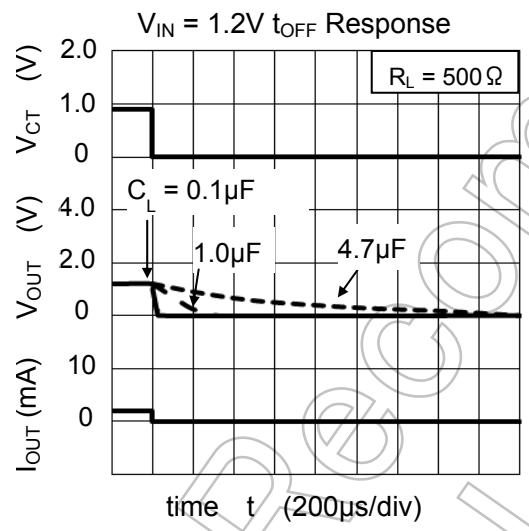
TCK106G t_{OFF} Response

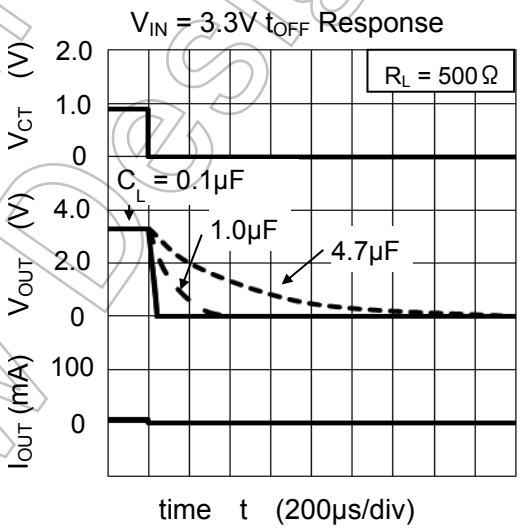


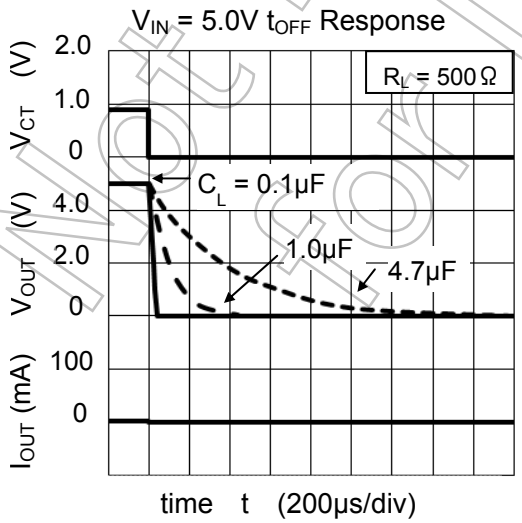




TCK107G t_{OFF} Response

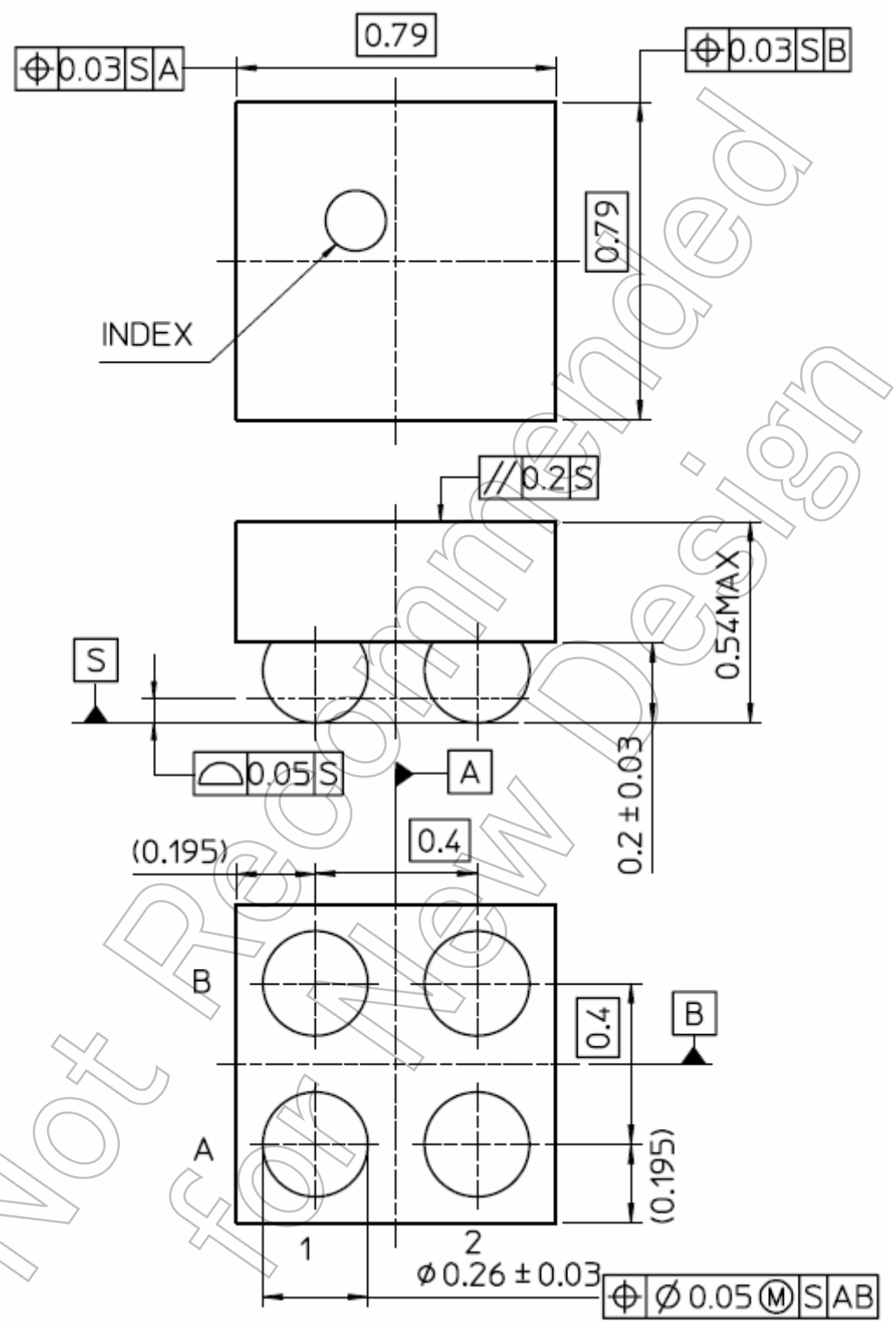






Package Dimensions

WCSP4 Unit : mm



Weight : 0.7 mg (typ.)

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