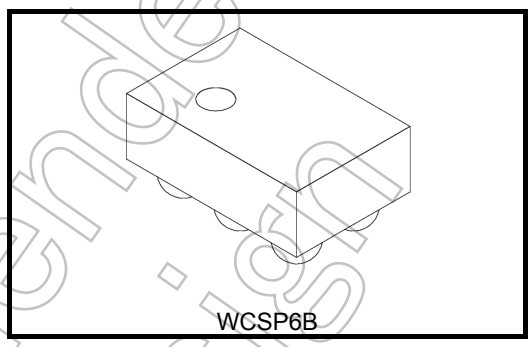
TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

TCK104G, TCK105G

Load Switch IC with Current Limit function

The TCK104G and TCK105G are load switch ICs for power management with slew rate control driver and current limit function featuring wide input voltage operation from 1.1 to 5.5 V. Switch ON resistance is only 50 mΩ typical at 5.0V, -700mA load condition and these feature a slew rate control driver, thermal shutdown and output auto-discharge function. Output current type is available on -500mA, and -800mA. Thus it is easy to select devices and helpful for the design.

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 devices 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, -700 mA
  R_{ON} = 55 mΩ (typ.) at V_{IN} = 3.3 V, -700 mA
  R_{ON} = 75 mΩ (typ.) at V_{IN} = 1.8 V, -700 mA
  R_{ON} = 140 mΩ (typ.) at V_{IN} = 1.2 V, -700 mA
- Low Quiescent Current: I_Q = 20 μA (typ.) at I_{OUT} = 0 mA
- Low standby current: $I_{Q(OFF)}$ = 0.1 μA (typ.) at OFF state
- Current limit function
- Inrush current reducing circuit
- Thermal Shutdown function
- Auto-discharge
- Pull down connection between CONTROL and GND
- Ultra small package : WCSP6B (0.8mm x 1.2mm, t: 0.64mm(max))

Start of commercial production
2013-04

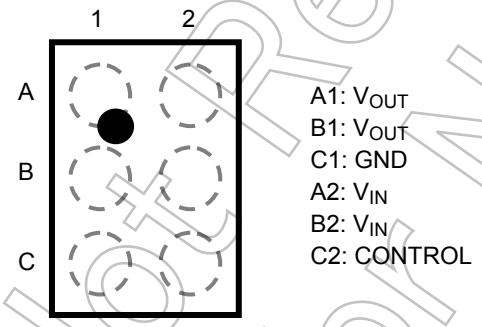
Absolute Maximum Ratings (Ta = 25°C)

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}	TCK104G	800	mA
		TCK105G	1200	
Power dissipation	P_D	800 (Note 1)		mW
Operating temperature range	T_{opr}	−40 to 85		°C
Junction temperature	Tj	150		°C
Storage temperature	T_{stg}	−55 to 150		°C

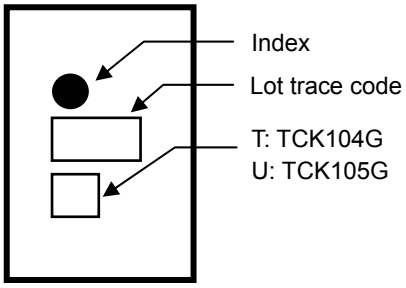
Note : Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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: 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)

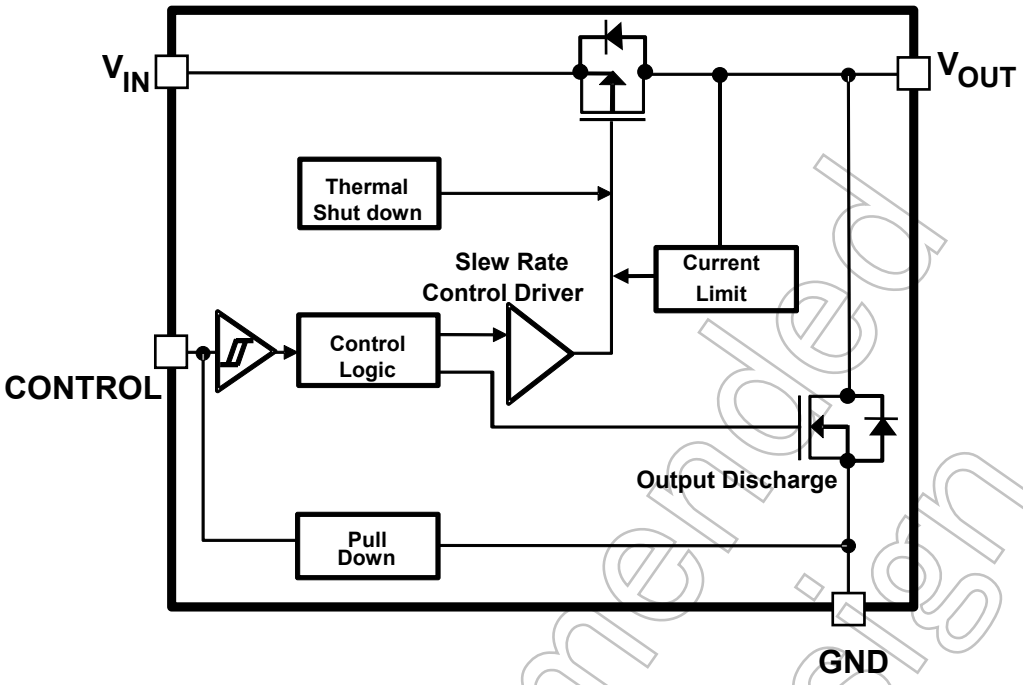
Pin Assignment(Top view)



Top marking



Block Diagram



Function Table

Part number	Function			
	Current limit	Thermal Shutdown	Output auto-discharge	Control pin connection
TCK104G	Bulit in (Available up to 500mA)	Bulit in	Bulit in	Pull down
TCK105G	Bulit in (Available up to 800mA)	Bulit in	Bulit in	Pull down

Electrical Characteristics

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}	—		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		—	20	—	—	65	μA
Standby current (OFF state)	$I_{Q(OFF)}$	V_{IN} = 5.5 V, V_{CT} = 0 V, V_{OUT} = OPEN (Note2)		—	0.1	—	—	1	μA
OFF-state switch current	$I_{SD(OFF)}$	V_{CT} = 0 V, V_{OUT} = GND	V_{IN} = 5.0 V	—	20	—	—	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} = -400 mA (TCK104G)	V_{IN} = 5.0 V	—	50	60	—	83	mΩ
			V_{IN} = 3.3 V	—	55	66	—	83	
			V_{IN} = 1.8 V	—	75	89	—	101	
			V_{IN} = 1.2 V	—	128	166	—	171	
			V_{IN} = 1.1 V	—	165	—	—	—	
		I_{OUT} = -700 mA (TCK105G)	V_{IN} = 5.0 V	—	50	60	—	83	
			V_{IN} = 3.3 V	—	55	66	—	83	
			V_{IN} = 1.8 V	—	75	89	—	101	
			V_{IN} = 1.2 V	—	140	181	—	183	
			V_{IN} = 1.1 V	—	214	—	—	—	
Output current limit	I_{CL}	—	TCK104G	—	800	—	—	—	mA
			TCK105G	—	1200	—	—	—	
Discharge on resistance	R_{SD}	—		—	100	—	—	—	Ω

(Note 2) : Except $I_{SD(OFF)}$ OFF-state switch current

(Note 3) : Ta = 65 °C

AC Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition(Figure 1)	Min	Typ.	Max	Unit
V_{OUT} rise time	t_r	V_{IN} = 3.3 V , R_L = 500 Ω , C_L = 0.1 μF	—	175	—	μs
V_{OUT} fall time	t_f	V_{IN} = 3.3 V , R_L = 500 Ω , C_L = 0.1 μF	—	40	—	μs
Turn on delay	t_{ON}	V_{IN} = 3.3 V , R_L = 500 Ω , C_L = 0.1 μF	—	130	—	μs
Turn off delay	t_{OFF}	V_{IN} = 3.3 V , R_L = 500 Ω , C_L = 0.1 μF	—	9	—	μs

AC Waveform

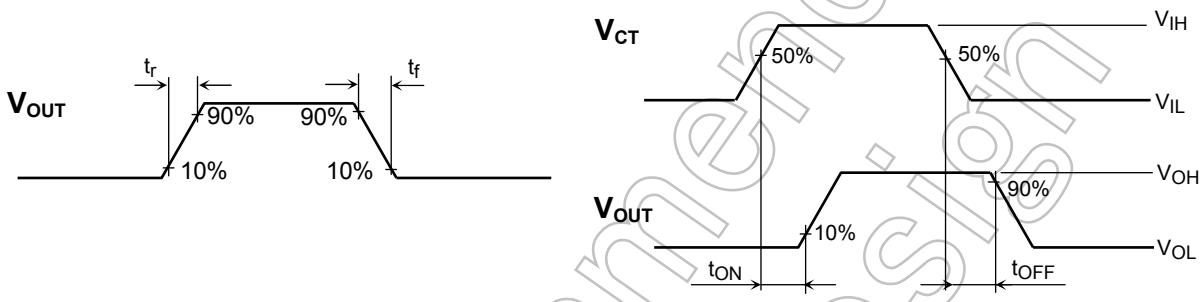
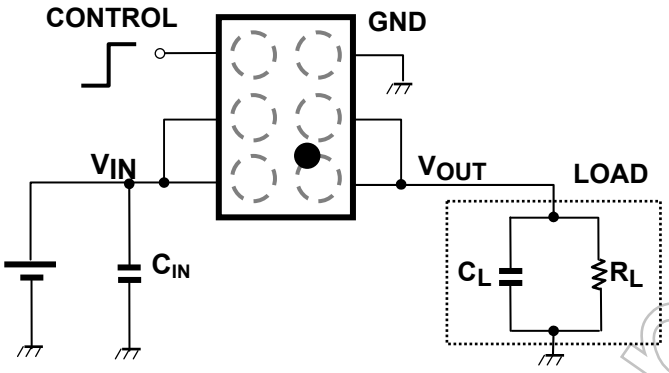


Figure 1 t_r, t_f, t_{ON}, t_{OFF} Waveforms

Application Note

1. Application circuit example (top view)

The figure below shows the recommended configuration for TCK104G and TCK105G



Control voltage	IC Operation
HIGH	ON
LOW	OFF
OPEN	OFF

1) Input capacitor

An input capacitor(C_{IN}) is not necessary for the guaranteed operation of TCK104G and TCK105G. 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 TCK104G and TCK105G. 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.

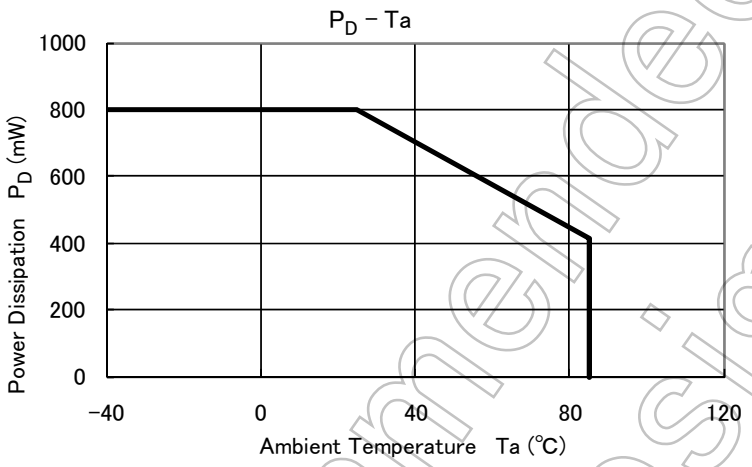
3) Control pin

A control pins for TCK104G and TCK105G are both Active High, which controls both the pass-through p-ch MOSFET and the discharge n-ch MOSFET, 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



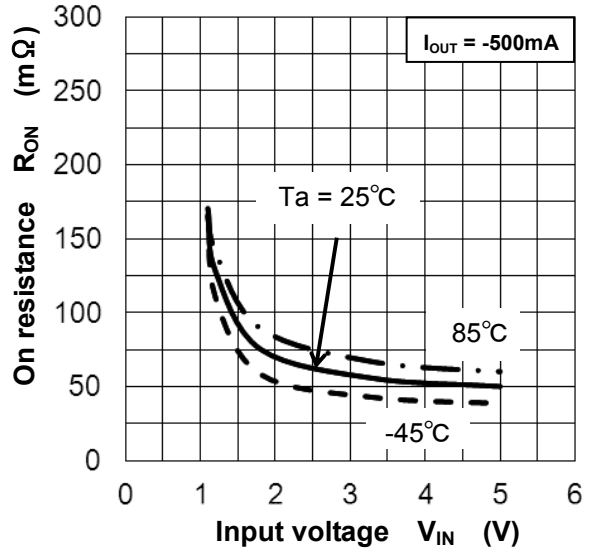
Please allow sufficient margin when designing a board pattern to fit the expected power dissipation. Also take into consideration the ambient temperature, input voltage, output current etc and applying the appropriate derating for allowable power dissipation during operation.

3. Current limit and Thermal shut down function

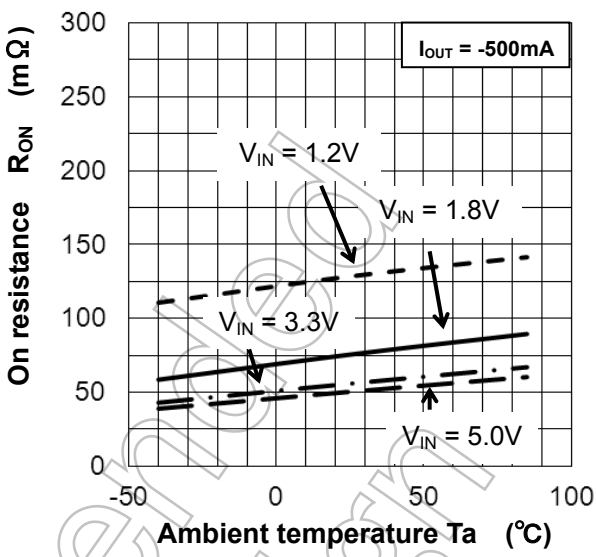
Current limit and Thermal shutdown function are designed in these products, but these does not assure for the suppression of uprising device operation. In use of these products, please read through and understand dissipation idea for absolute maximum ratings from the above mention or our 'Semiconductor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

Representative Common Characteristics

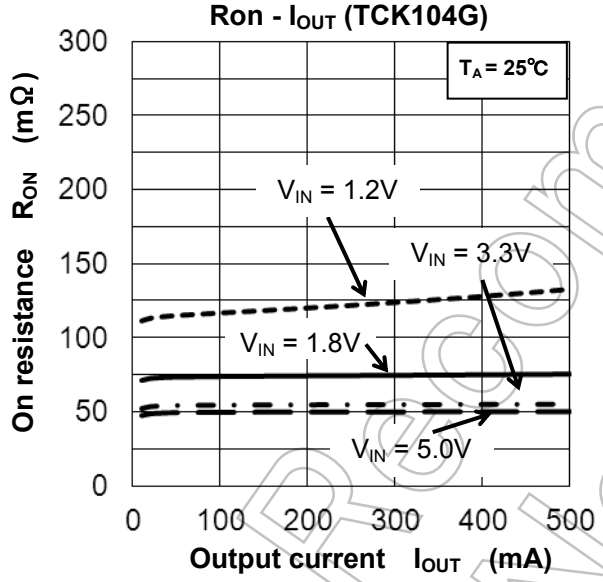
Ron - V_{IN}



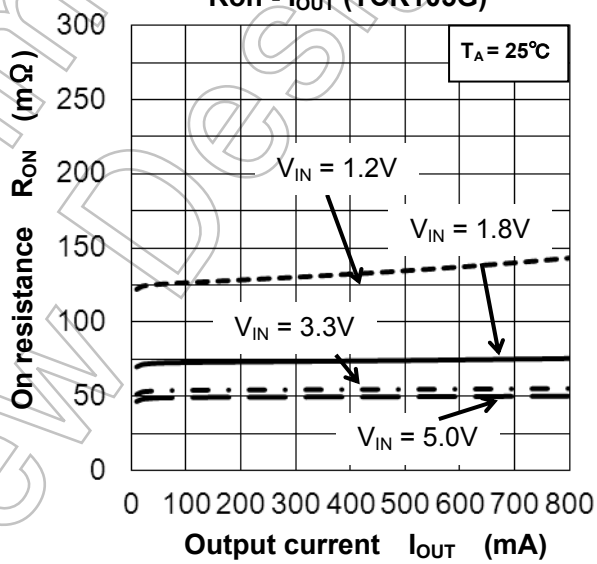
Ron - Ta



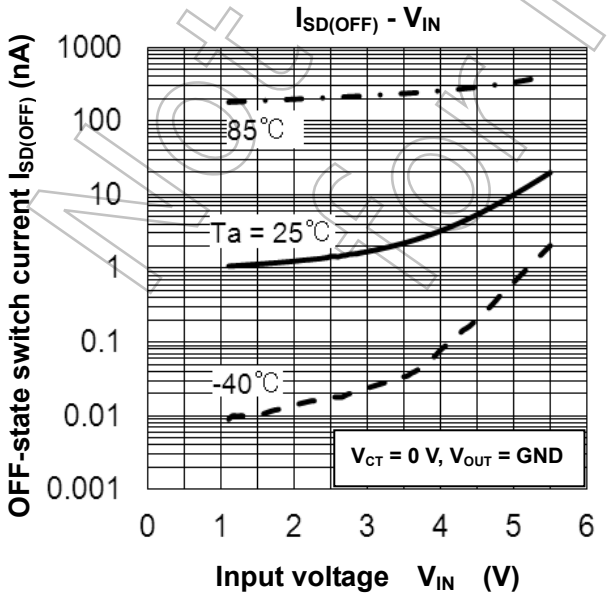
Ron - I_{OUT} (TCK104G)



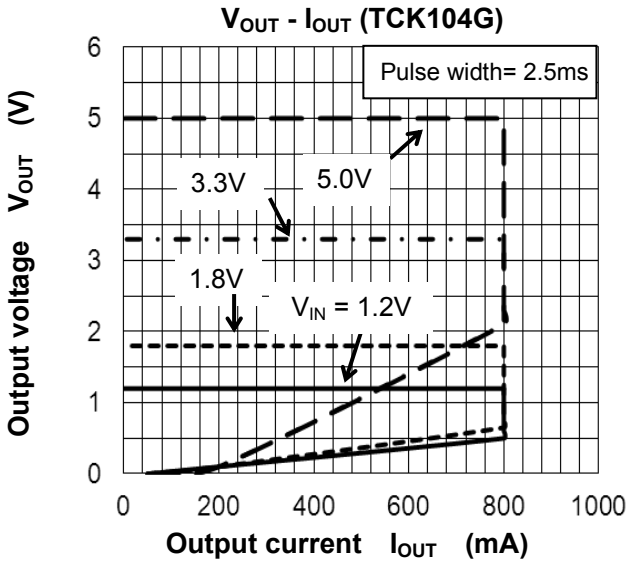
Ron - I_{OUT} (TCK105G)

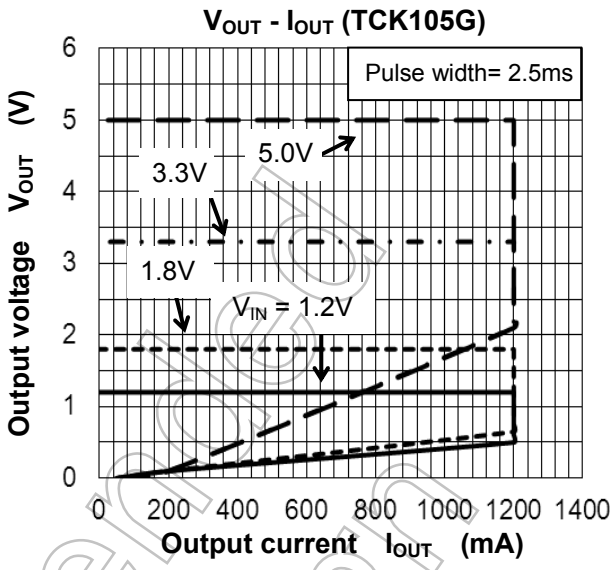


$I_{SD(OFF)}$ - V_{IN}

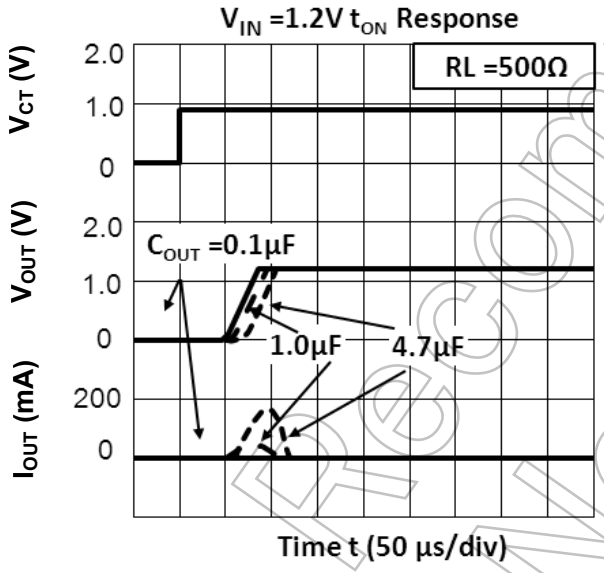


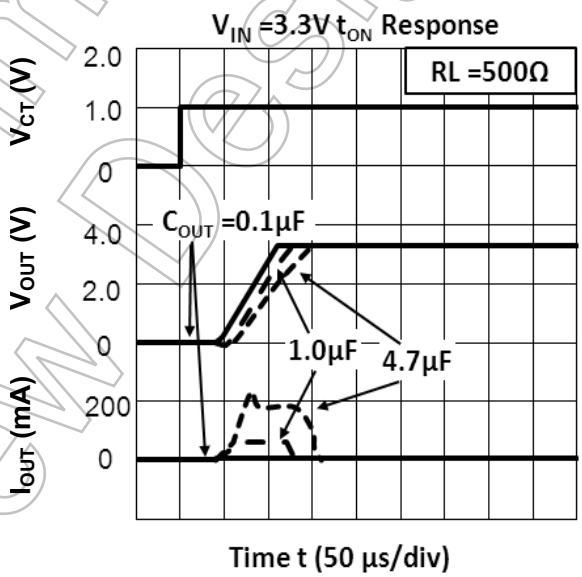
Output Voltage vs Output Current

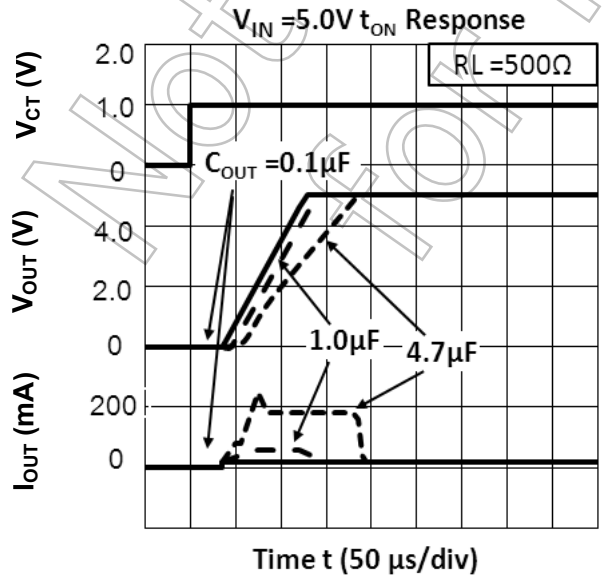




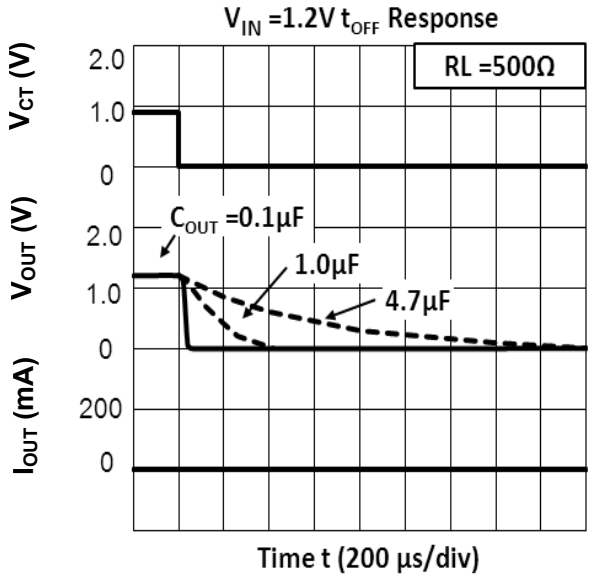
TCK104G, TCR105G t_{ON} Response

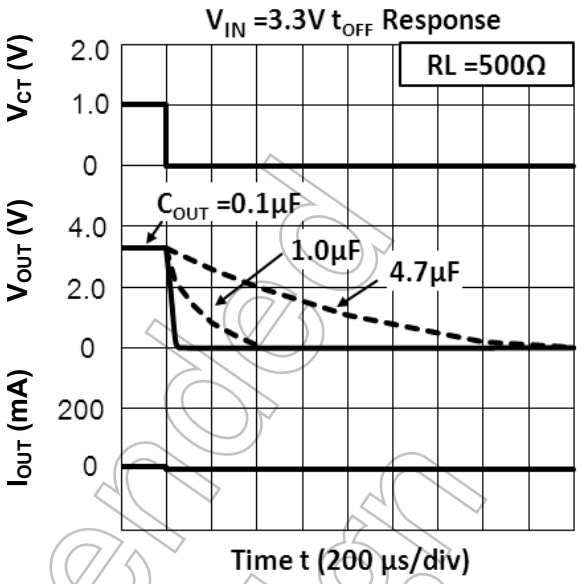


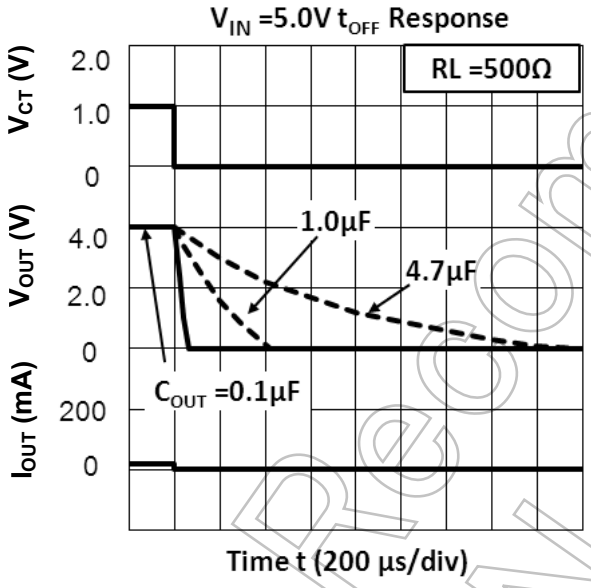




TCK104G, TCR105G t_{OFF} Response

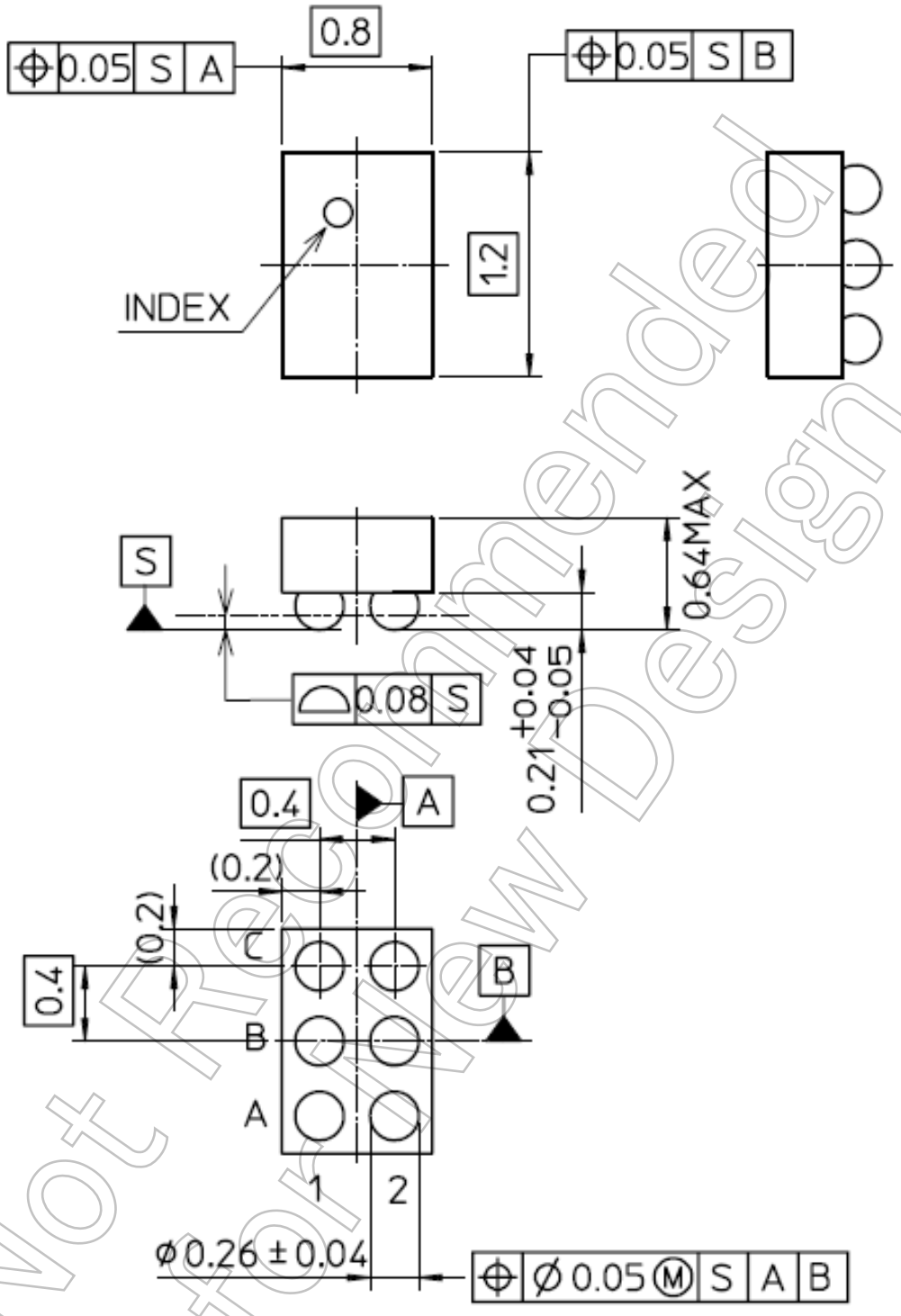






Package dimension

Unit: mm



Weight: 1 mg (typ.)

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