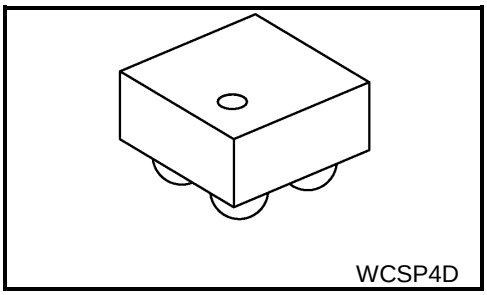
TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

# TCK106AG, TCK107AG, TCK108AG

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

The TCK106AG, TCK107AG and TCK108AG are load switch ICs for a general power management with slew rate control driver, featuring low ON resistance and wide input voltage operation from 1.1 to 5.5 V. ON resistance is only 34 mΩ typical at 5.0 V, -0.5 A condition and output current is available on 1.0 A. TCK107AG and TCK108AG feature output auto-discharge function.

These devices are available in 0.4 mm pitch ultra small package WCSP4D (0.79 mm x 0.79 mm, t: 0.55 mm) .Thus this devices is ideal for portable applications that require high-density board assembly such as cellular phone.

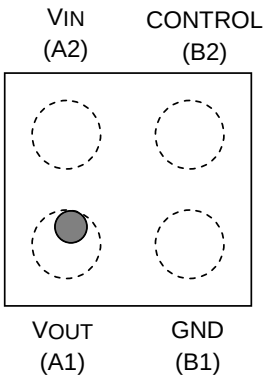



Weight: 0.79 mg (typ.)

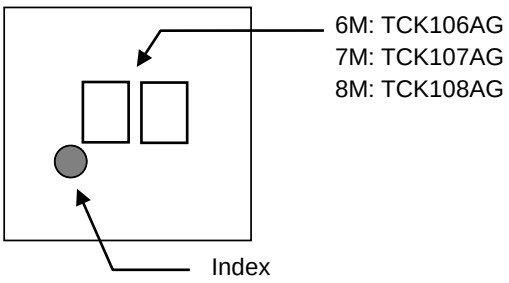
## Feature

- Low ON resistance :
  $R_{ON}$ = 34 mΩ (typ.) at $V_{IN}$ = 5.0 V, -0.5 A
  $R_{ON}$ = 42 mΩ (typ.) at $V_{IN}$ = 3.3 V, -0.5 A
  $R_{ON}$ = 71 mΩ (typ.) at $V_{IN}$ = 1.8 V, -0.5 A
  $R_{ON}$ = 139 mΩ (typ.) at $V_{IN}$ = 1.2 V, -0.2 A
  $R_{ON}$ = 176 mΩ (typ.) at $V_{IN}$ = 1.1 V, -0.2 A
- Low Quiescent current
  $I_Q$ = 110 nA (typ.) at $V_{IN}$ = 5.5 V, 0 mA
- High output current: $I_{OUT}$ = 1.0 A
- Wide input voltage operation: $V_{IN}$ = 1.1 to 5.5 V
- Built in Slew rate control driver
- Built in Auto-discharge (TCK107AG and TCK108AG)
- Active High and Pull down connection between CONTROL and GND (TCK106AG and TCK107AG)
- Active Low (TCK108AG)
- Ultra small package : WCSP4D (0.79 mm x 0.79 mm, t: 0.55 mm)

## Pin Assignment(Top view)




## Top marking




Start of commercial production
2015-06

## 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 | | (Note 1) | V |
| Output current | $I_{OUT}$ | DC | 1.0 | | A |
| Power dissipation | $P_D$ | 800 | | (Note 2) | mW |
| Operating temperature range | $T_{opr}$ | -40 to 85 | | | °C |
| Junction temeperature | Tj | 150 | | | °C |
| Storage temperature | $T_{stg}$ | -55 to 150 | | | °C |

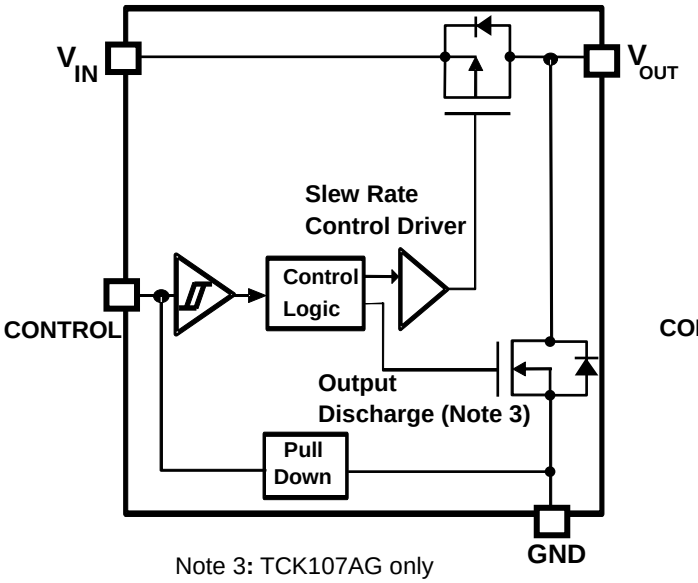
Note : Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

Note 1 : VIN +0.3 ≤6.0 V

Note 2: Rating at mounting on a board
(Glass epoxy board dimension: 40 mm x 40 mm, both sides of board
Metal pattern ratio: a surface approximately 50%, the reverse side approximately 50%
Through hole: diameter 0.5 mm x 28)

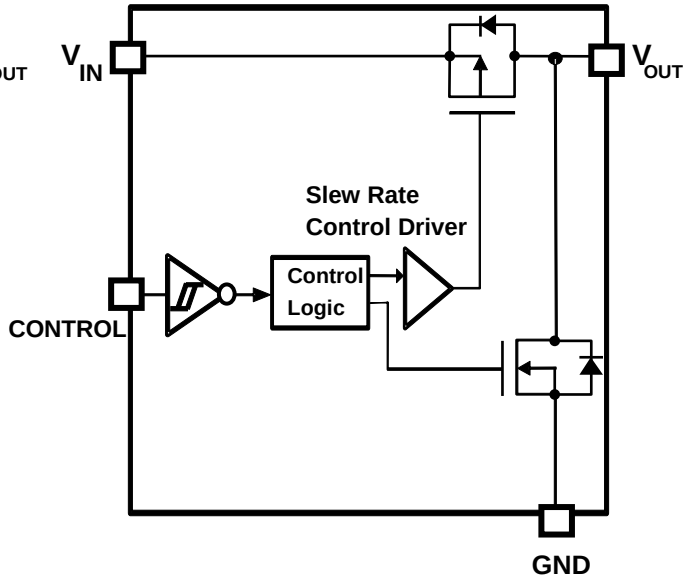
## Block Diagram

**TCK106AG, TCK107AG**




Note 3: TCK107AG only

**TCK108AG**




## Operating conditions

| Characteristics | Symbol | Condition | Min | Max | Unit |
|---|---|---|---|---|---|
| Input voltage | $V_{IN}$ | — | 1.1 | 5.5 | V |
| Output current | $I_{OUT}$ | — | | 1.0 | A |
| CONTROL High-level input voltage | $V_{IH}$ | 1.1 V ≤ $V_{IN}$ ≤ 5.5 V | 0.9 | — | V |
| CONTROL Low-level input voltage | $V_{IL}$ | | — | 0.4 | V |

## Electrical Characteristics

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

| Characteristics | Symbol | Test Condition | | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Quiescent current (ON state) | $I_Q$ | $V_{IN}$ = $V_{CT}$ = 5.5 V, $I_{OUT}$ = 0 mA | TCK106AG TCK107AG | — | 110 | 230 | nA |
| | | $V_{IN}$ = 5.5 V, $V_{CT}$ = 0 V, $I_{OUT}$ = 0 mA | TCK108AG | | | | |
| Standby current (OFF state) | $I_{Q(OFF)}$ | $V_{IN}$ = 5.5 V, $V_{CT}$ = 0 V, $V_{OUT}$ = OPEN (Note 4) | TCK106AG TCK107AG | — | 65 | 150 | nA |
| | | $V_{IN}$ = $V_{CT}$ = 5.5 V, $V_{OUT}$ = OPEN (Note 4) | TCK108AG | | | | |
| Switch leakage current( OFF state) | $I_{SD(OFF)}$ | $V_{IN}$ = 5.5 V, $V_{CT}$ = 0 V, $V_{OUT}$ = GND | TCK106AG TCK107AG | — | 14 | 1000 | nA |
| | | $V_{IN}$ = $V_{CT}$ = 5.5 V, $V_{OUT}$ = GND | TCK108AG | | | | |
| On resistance | $R_{ON}$ | $V_{IN}$ = 5.0 V, $I_{OUT}$ = -0.5 A | | — | 34 | 55 | mΩ |
| | | $V_{IN}$ = 3.3 V, $I_{OUT}$ = -0.5 A | | — | 42 | 68 | |
| | | $V_{IN}$ = 1.8 V, $I_{OUT}$ = -0.5 A | | — | 71 | 105 | |
| | | $V_{IN}$ = 1.2 V, $I_{OUT}$ = -0.2 A | | — | 139 | 220 | |
| | | $V_{IN}$ = 1.1 V, $I_{OUT}$ = -0.2 A | | — | 176 | — | |
| Discharge on resistance | $R_{SD}$ | — (TCK107AG and TCK108AG) | | — | 100 | — | Ω |

Note 4: Except $I_{SD(OFF)}$ OFF-state switch current

### AC Characteristics (Ta = 25°C)

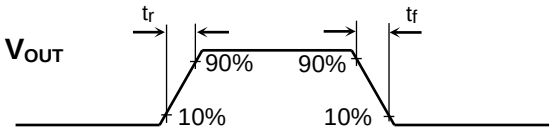
**$V_{IN}$ = 1.2 V**

| 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 | TCK107AG TCK108AG | — | 30 | — | μs |
| | | | TCK106AG | — | 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 |

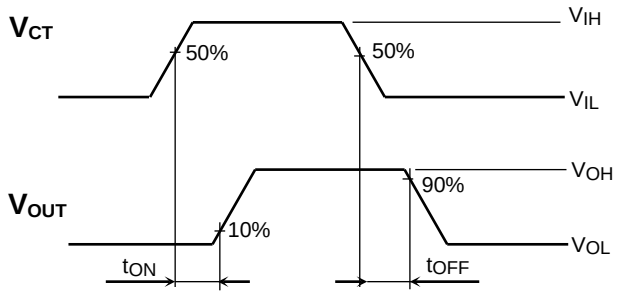
**$V_{IN}$ = 3.3 V**

| 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 | TCK107AG TCK108AG | — | 25 | — | μs |
| | | | TCK106AG | — | 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




**TCK106AG, TCK107AG**




**TCK108AG**

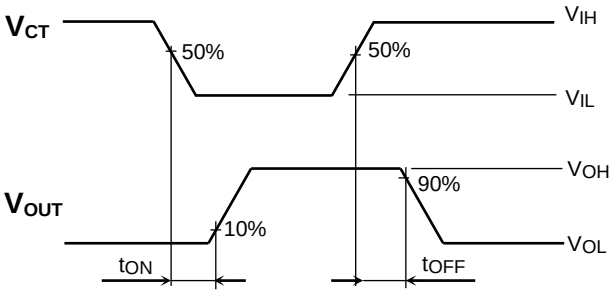
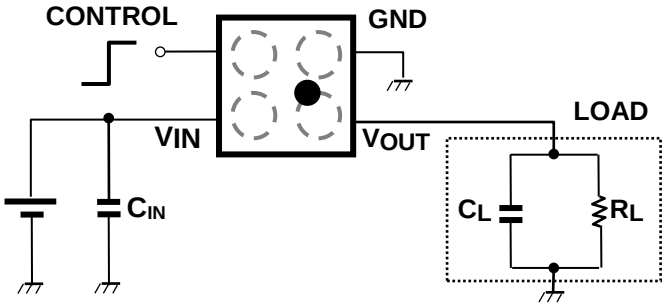



**Figure 1 $t_r$, $t_f$, $t_{ON}$, $t_{OFF}$ Waveforms**

## Application Note

### 1. Application circuit example (top view)

The figure below shows configuration example for TCK106AG, TCK107AG and TCK108AG.




| Part number | Control voltage | IC Operation |
|---|---|---|
| TCK106AG TCK107AG | HIGH | ON |
| | LOW | OFF |
| | OPEN | OFF |
| TCK108AG | HIGH | OFF |
| | LOW | ON |

1) Input capacitor

An input capacitor ($C_{IN}$) is not necessary for the guaranteed operation of TCK106AG, TCK107AG and TCK108AG. However, the use of CIN is effective 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 TCK106AG, TCK107AG and TCK108AG. 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 TCK106AG and TCK107AG are both Active High and TCK108AG is Active Low. These controls both the pass-through p-ch MOSFET and the discharge n-ch MOSFET (except TCK106AG), operated by the control voltage and Schmitt trigger. When the control voltage level is High (Low; TCK108AG), p-ch MOSFET is ON state and n-ch MOSFET is OFF state. When control voltage level is Low (High; TCK108AG), and the state of the MOSFETs is reversed. Also, pull down resistance equivalent to a few MΩis connected between CONTROL and GND, thus the load switch IC is in OFF state even when CONTROL pin is OPEN(except TCK108AG). 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

Board-mounted power dissipation ratings for TCK106AG, TCK107AG and TCK108AG are available in the Absolute Maximum Ratings table

Power dissipation is measured on the board condition shown below.

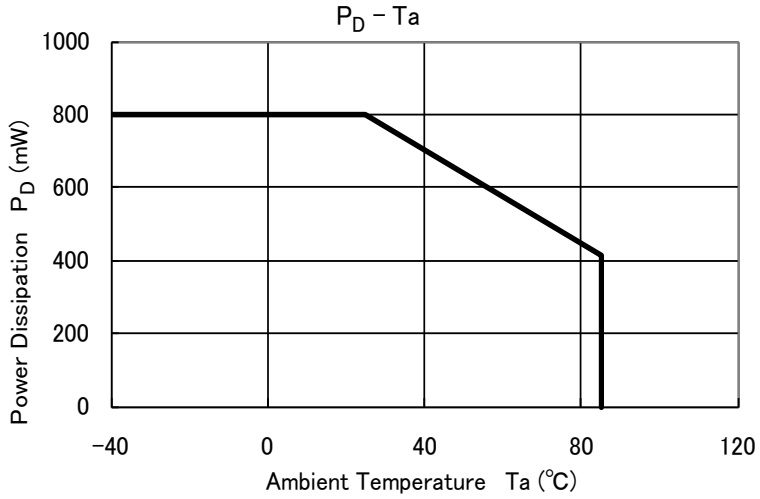
[The Board Condition]

Board material: Glass epoxy (FR4)

Board dimension: 40 mm x 40 mm (both sides of board), t=1.8 mm

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

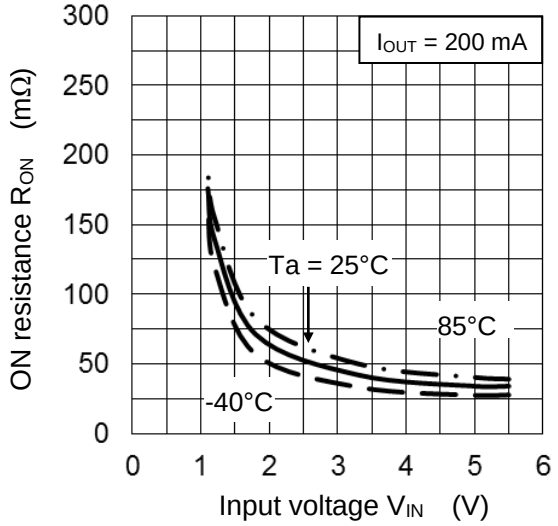
Through hole: diameter 0.5 mm x 28



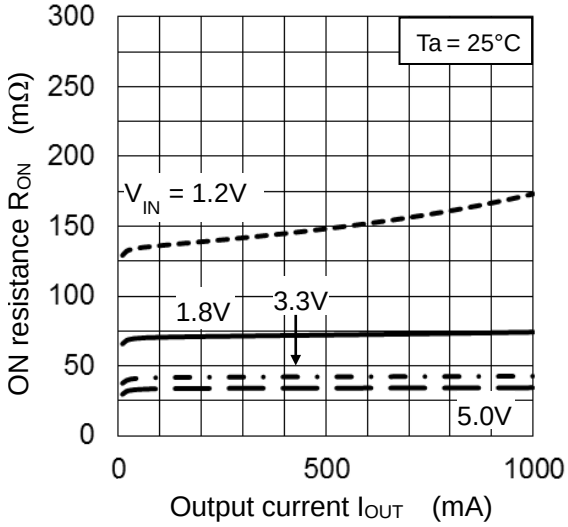

Please allow sufficient margin when designing a board pattern to fit the expected power dissipation. Also take into consideration the ambient temperature, input voltage, output current etc and applying the appropriate derating for allowable power dissipation during operation.

**Representative Common Characteristics**

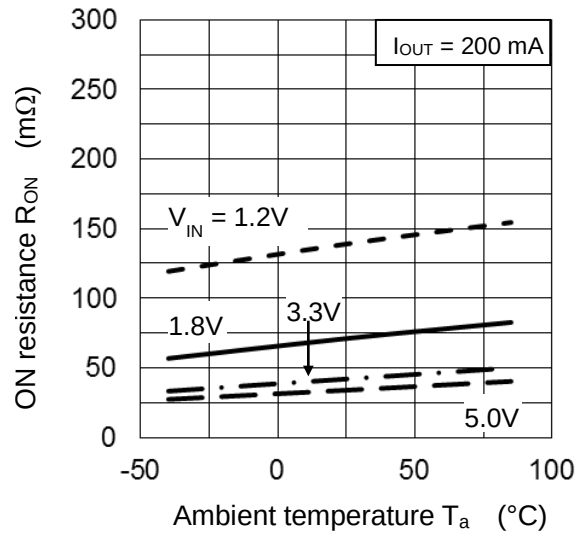
$R_{ON}$ - $V_{IN}$



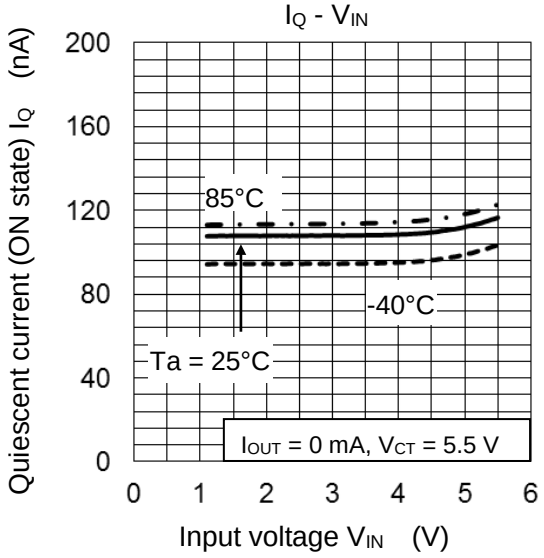

$R_{ON}$ - $I_{OUT}$



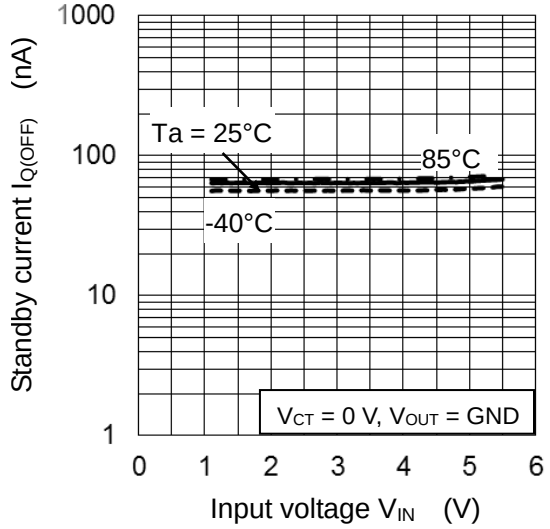

$R_{ON}$ - $T_a$



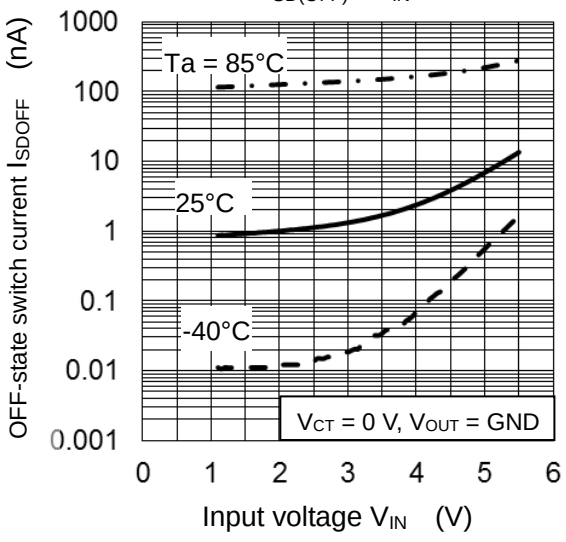

$I_Q$ - $V_{IN}$



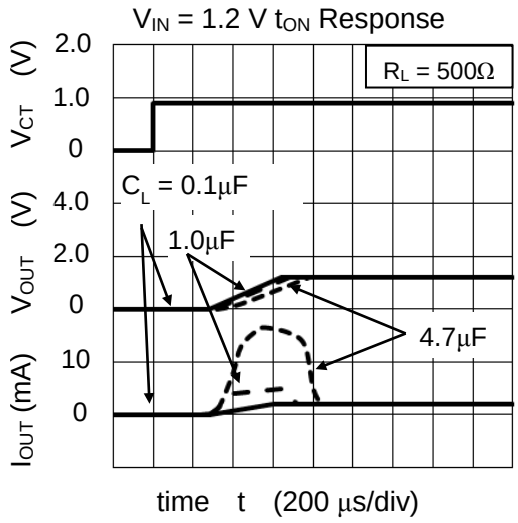

$I_{Q(OFF)}$ - $V_{IN}$

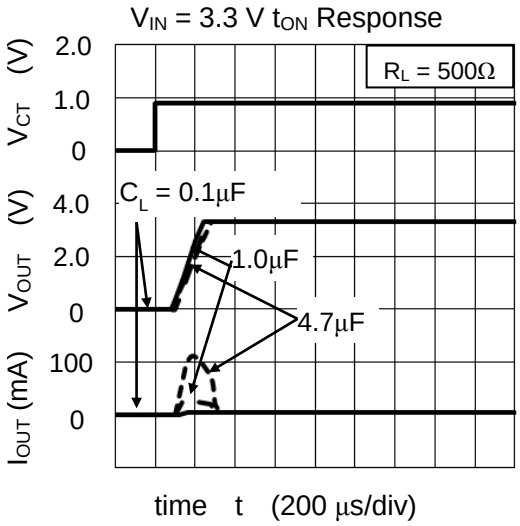


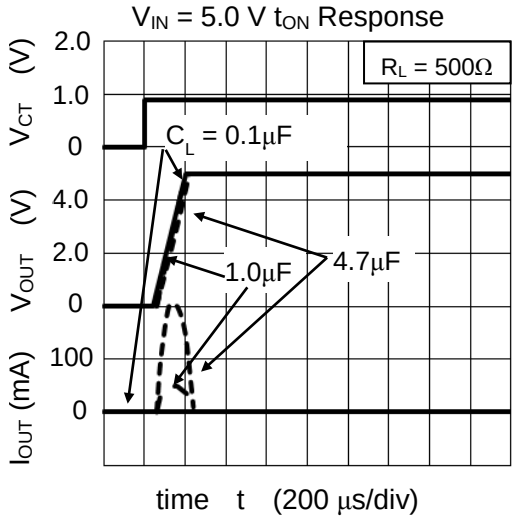

$I_{SD(OFF)}$ - $V_{IN}$



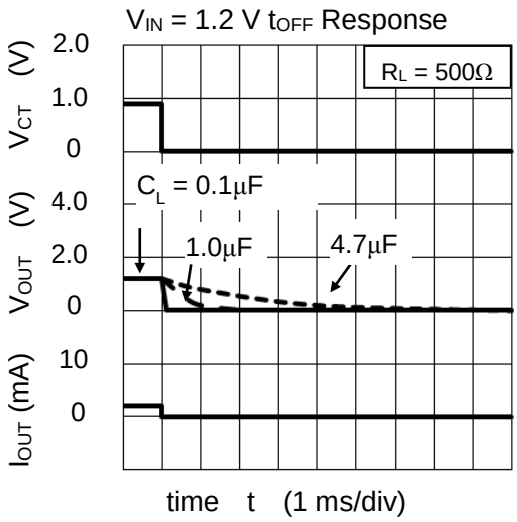
**TCK107AG $t_{ON}$ Response**

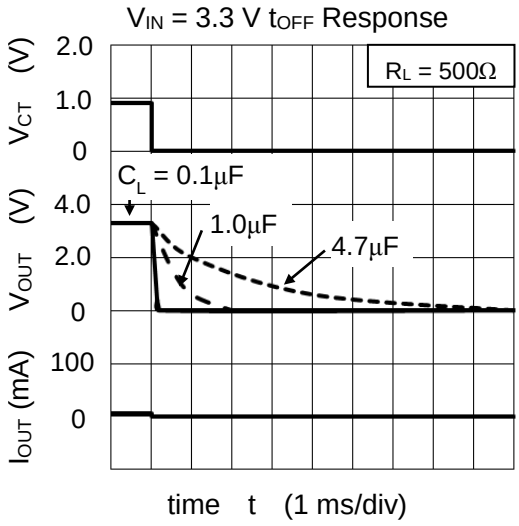


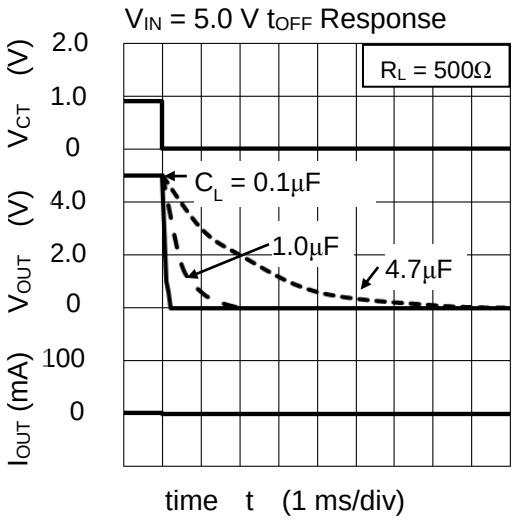



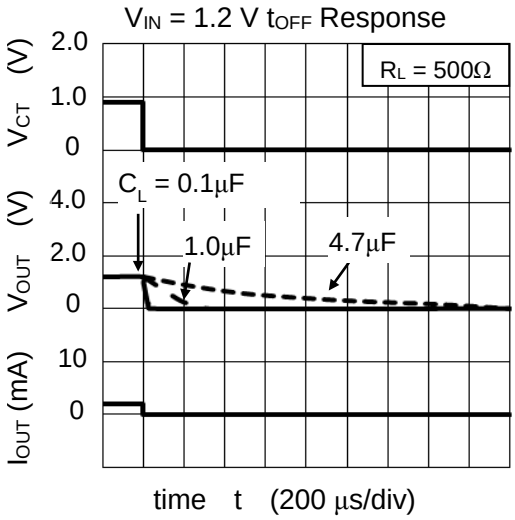

**TCK106AG $t_{OFF}$ Response**

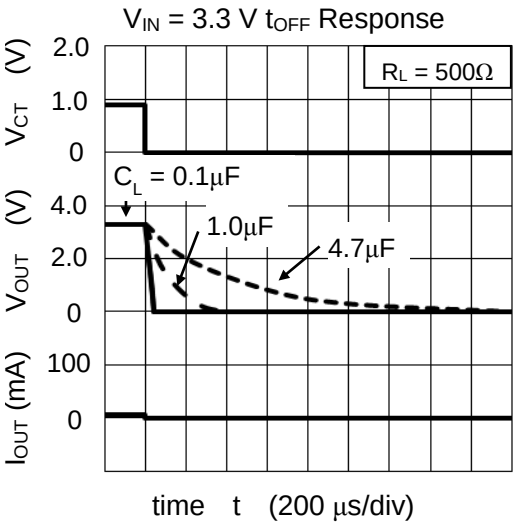


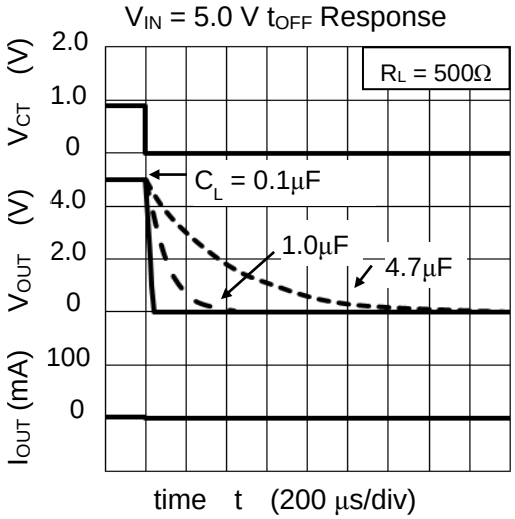






**TCK107AG $t_{OFF}$ Response**

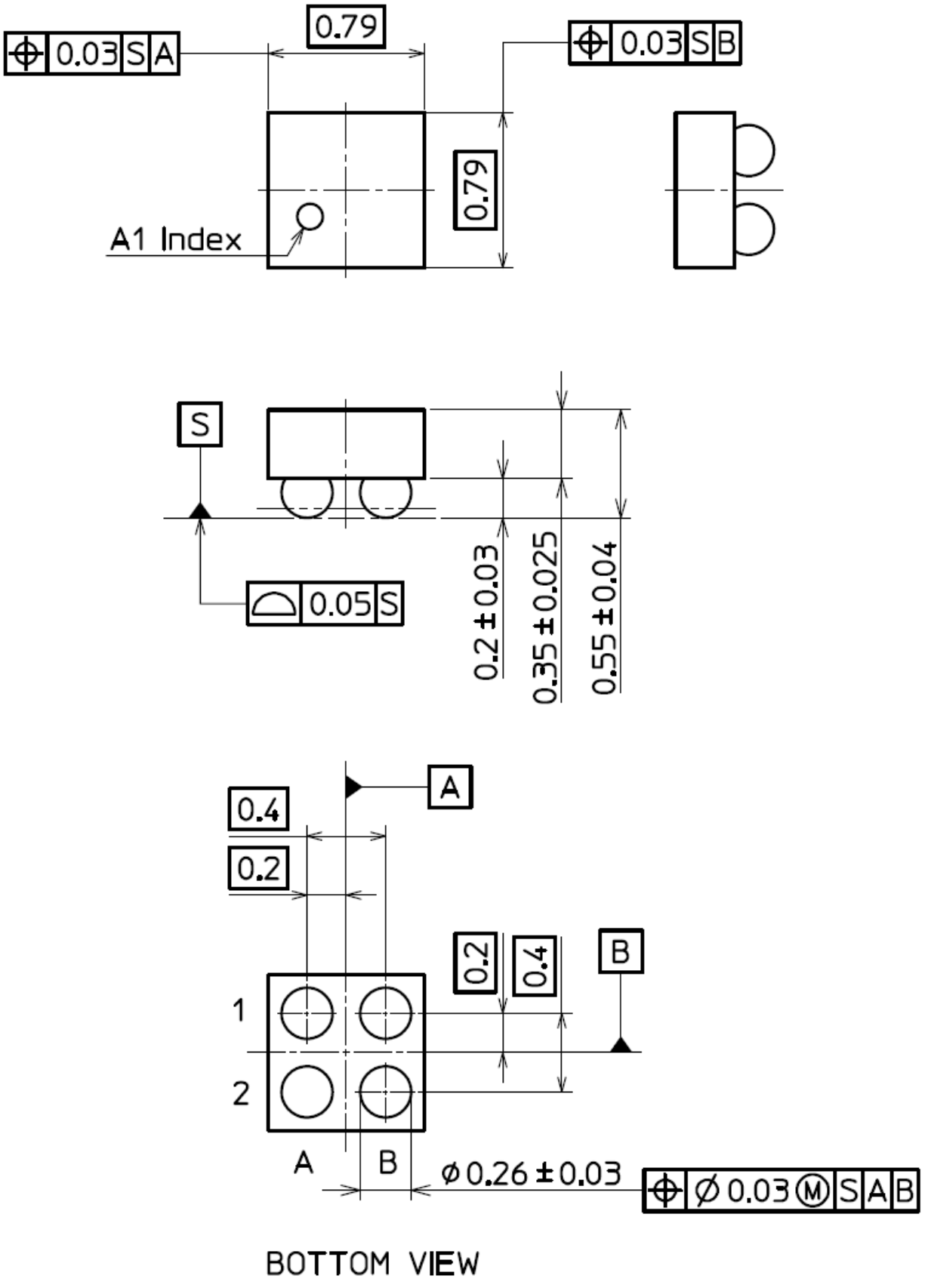


**Package Dimensions**

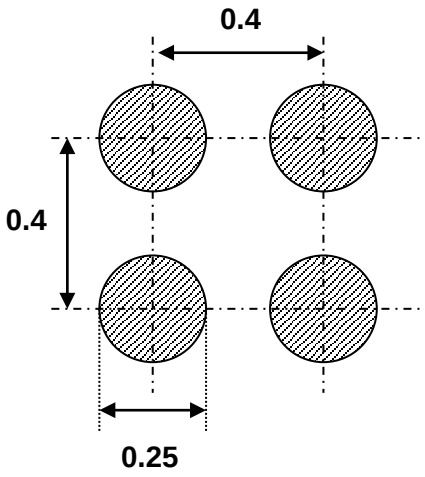
WCSP4D Unit: mm




Weight : 0.79 mg ( typ.)

**Land pattern dimensions for reference only**

**Unit: mm**



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