TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

TCR6DA series

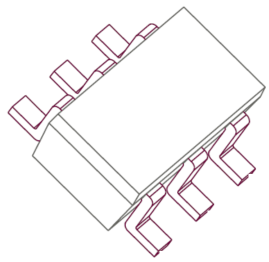
200 mA Dual Outputs CMOS Low-Dropout Regulator

The TCR6DA series are CMOS general-purpose dual-outputs voltage regulators with independent on/off control inputs, featuring low dropout voltage and low quiescent bias current. The TCR6DA series can be enabled and disabled via the CONTROL pin for each LDOs.

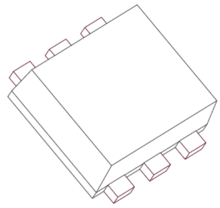
These voltage regulators are available in fixed output voltages between 1.5 V and 3.3 V in 0.1-V steps and capable of driving up to 200 mA. They feature overcurrent protection.

The TCR6DA series are offered in the compact SM6 (SOT-26) (SC-74) and small package UF6 and allow the use of small ceramic input and output capacitors. Thus, these devices are ideal for portable applications that require high-density board assembly such as cellular phones.

SM6



UF6



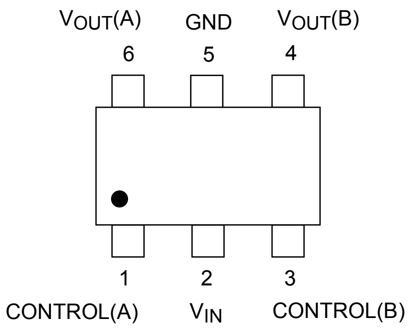
Weight
SM6(SOT-26)(SC-74): 15 mg (typ.)
UF6 : 7 mg (typ.)

Features

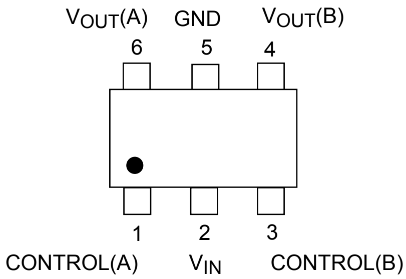
- Low quiescent bias current
  ($I_{B(ON)}$ = 60 μA (typ.)at I_{OUT} (A) and I_{OUT} (B) = 0 mA)
- Low stand-by current ($I_{B(OFF)}$ = 0.1 μA (typ.) at stand-by mode)
- Low dropout voltage
  (V_{IN} - V_{OUT} = 200 mV (max.) for 3.3V output, I_{OUT} = 50 mA)
- High output current (I_{OUT} = 200 mA (max))
- High ripple rejection (R.R. = 75 dB (typ.) at I_{OUT} = 10 mA, f =1kHz)
- Control voltage can be allowed from -0.3 to 6V regardless of V_{IN} voltage
- Overcurrent protection
- Ceramic capacitors can be used (C_{IN} = 1.0μF, C_{OUT} =1.0 μF)
- SM6(SOT-26) (SC-74) and small package UF6 (2.0 mm x 2.1 mm x 0.7 mm)

Pin Assignment (top view)

SM6(SOT-26) (SC-74)



UF6



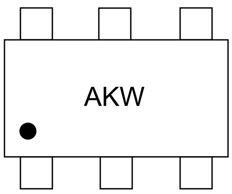
List of Products Number and Marking

Products No.	Package	VOUT(A)	VOUT(B)	Marking
*TCR6DA1525	SM6	1.5V	2.5V	AGS
TCR6DA1528	SM6	1.5V	2.8V	AGW
*TCR6DA1529	SM6	1.5V	2.9V	AGX
*TCR6DA1530	SM6	1.5V	3.0V	AGY
*TCR6DA1531	SM6	1.5V	3.1V	AG1
*TCR6DA1533	SM6	1.5V	3.3V	AG3
*TCR6DA1825	SM6	1.8V	2.5V	AKS
TCR6DA1828	SM6	1.8V	2.8V	AKW
*TCR6DA1829	SM6	1.8V	2.9V	AKX
TCR6DA1830	SM6	1.8V	3.0V	AKY
*TCR6DA1831	SM6	1.8V	3.1V	AK1
*TCR6DA1833	SM6	1.8V	3.3V	AK3
*TCR6DA1525U	UF6	2.5V	1.5V	ASG
TCR6DA1528U	UF6	2.8V	1.5V	AWG
*TCR6DA1529U	UF6	2.9V	1.5V	AXG
*TCR6DA1530U	UF6	3.0V	1.5V	AYG
*TCR6DA1531U	UF6	3.1V	1.5V	A1G
*TCR6DA1533U	UF6	3.3V	1.5V	A3G
*TCR6DA1825U	UF6	2.5V	1.8V	ASK
TCR6DA1828U	UF6	2.8V	1.8V	AWK
*TCR6DA1829U	UF6	2.9V	1.8V	AXK
*TCR6DA1830U	UF6	3.0V	1.8V	AYK
*TCR6DA1831U	UF6	3.1V	1.8V	A1K
*TCR6DA1833U	UF6	3.3V	1.8V	A3K
TCR6DA2530U	UF6	3.0V	2.5V	AYS

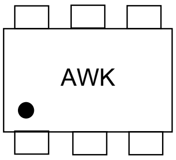
*If you need another voltage ranks, please contact to our sales

Marking

Example:TCR6DA1828 (1.8V, 2.8V output)



Example:TCR6DA1828U (2.8V, 1.8V output)



Absolute Maximum Ratings(Ta = 25°C)

Characteristics	Symbol	Rating		Unit
Input voltage	V_{IN}	6		V
Control voltage	V_{CT}	-0.3 to 6		V
Output voltage	V_{OUT}	-0.3 to V_{IN} + 0.3		V
Output current	I_{OUT}	200		mA
Power dissipation	P_D	SM6	480 (Note1)	mW
		UF6	500 (Note1)	mW
Operation temperature range	T_{opr}	−40 to 85		°C
Junction temperature	T_j	150		°C
Storage temperature range	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 : Rating at mounting on a board
(25.4mm x 25.4mm x 1.6mm, copper pad:645mm^2)

Electrical Characteristics

(Unless otherwise specified, $V_{IN} = V_{OUT} + 1$ V, $I_{OUT} = 50$ mA, $C_{IN} = 1.0$ μF, $C_{OUT} = 1.0$ μF, $T_j = 25°C$)

For 1.5 and 1.8V output

Characteristics	Symbol	Test Condition		Min.	Typ.	Max.	Unit
Output voltage	V_{OUT}	Please refer to the Output Voltage Accuracy table					
Line regulation	Reg·line	$V_{OUT} + 0.5$ V ≤ V_{IN} ≤ 6 V, $I_{OUT} = 1$ mA		—	1	15	mV
Load regulation	Reg·load	1 mA ≤ I_{OUT} ≤ 100 mA		—	15	30	mV
Quiescent current	I_B	$I_{OUT} = 0$ mA		—	30	75	μA
Dropout voltage	V_{IN}-V_{OUT}	Please refer to the Dropout voltage table					
Temperature coefficient	T_{CVO}	−40°C ≤ T_{opr} ≤ 85°C		—	100	—	ppm/°C
Input voltage	V_{IN}	—	V_{OUT} = 1.5V	2.0	—	6.0	V
			V_{OUT} = 1.8V	2.15	—	6.0	
Ripple rejection ratio	R.R.	$V_{IN} = V_{OUT} + 1$ V, $I_{OUT} = 10$ mA, f = 1 kHz, $V_{Ripple} = 500$ mV_{p-p}, Ta = 25°C		—	75	—	dB

For 2.5 to 3.3V output

Characteristics	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Output voltage	V_{OUT}	Please refer to the Output Voltage Accuracy table				
Line regulation	Reg·line	$V_{OUT} + 0.5$ V ≤ V_{IN} ≤ 6 V, $I_{OUT} = 1$ mA	—	1	15	mV
Load regulation	Reg·load	1 mA ≤ I_{OUT} ≤ 100 mA	—	15	30	mV
Quiescent current	I_B	$I_{OUT} = 0$ mA	—	30	75	μA
Dropout voltage	V_{IN}-V_{OUT}	Please refer to the Dropout voltage table				
Temperature coefficient	T_{CVO}	−40°C ≤ T_{opr} ≤ 85°C	—	100	—	ppm/°C
Input voltage	V_{IN}	—	V_{OUT}(A) +0.2V	—	6.0	V
Ripple rejection ratio	R.R.	$V_{IN} = V_{OUT} + 1$ V, $I_{OUT} = 10$ mA, f = 1 kHz, $V_{Ripple} = 500$ mV_{p-p}, Ta = 25°C	—	75	—	dB

Common Characteristics

Characteristics	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Quiescent current	$I_{B(ON)}$	I_{OUT} (A)= 0 mA, I_{OUT} (B)= 0 mA	—	60	150	μA
Quiescent current	$I_{B(OFF)}$	$I_{OUT} = 0$ mA	—	0.1	1	μA
Control voltage (ON)	$V_{CT\ (ON)}$	—	1.1	—	6.0	V
Control voltage (OFF)	$V_{CT\ (OFF)}$	—	0	—	0.3	V
Control current (ON)	$I_{CT\ (ON)}$	$V_{CT} = 6.0$ V	—	—	0.1	μA
Control current (OFF)	$I_{CT\ (OFF)}$	$V_{CT} = 0$ V	—	—	0.1	μA

Output Voltage Accuracy
(V_{IN} = V_{OUT} + 1 V, I_{OUT} = 50 mA, C_{IN} = 1.0 μF, C_{OUT} = 1.0 μF, T_j = 25°C)

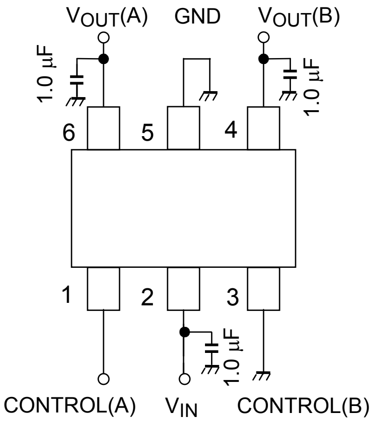
Symbol	Min.	Typ.	Max.	Unit
V_{OUT}	1.47	1.5	1.53	V
	1.76	1.8	1.84	
	2.45	2.5	2.55	
	2.74	2.8	2.86	
	2.84	2.9	2.96	
	2.94	3.0	3.06	
	3.03	3.1	3.17	
	3.23	3.3	3.37	

· Dropout Voltage
(I_{OUT} = 50 mA, C_{IN} = 1.0 μF, C_{OUT} = 1.0 μF, T_j = 25°C)

Symbol	Output Voltage	Min.	Typ.	Max.	Unit
V_{IN}-V_{OUT}	1.5 V	—	300	500	mV
	1.8 V	—	200	350	
	2.5 to 3.3 V	—	90	200	

Application Note

1. Recommended Application Circuit



CONTROL Voltage		Output Voltage	
CONTROL(A)	CONTROL(B)	V_{OUT}(A)	V_{OUT}(B)
High	High	ON	ON
High	Low	ON	OFF
Low	High	OFF	ON
Low	Low	OFF	OFF

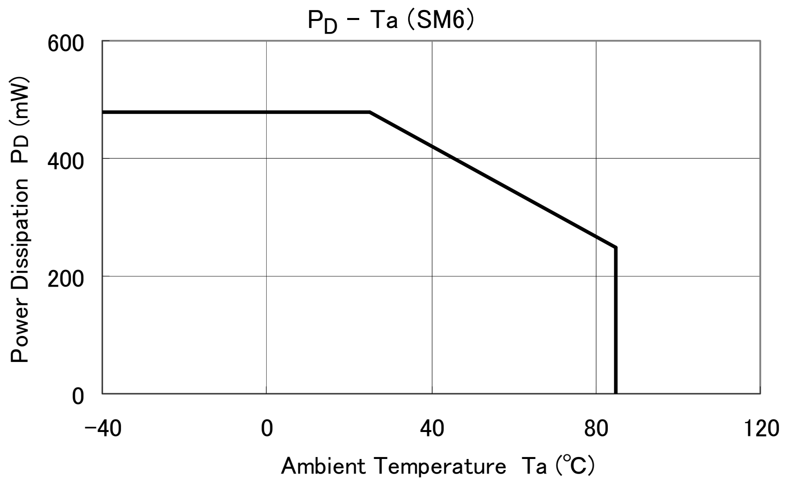
The figure above shows the recommended configuration for using a Low-Dropout regulator. Insert a capacitor to V_{OUT} and V_{IN} for stable input/output operation. (ceramic capacitors can be used)

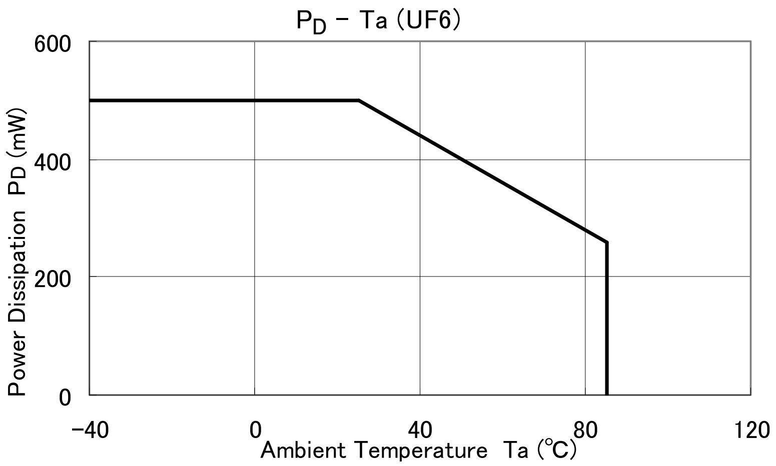
If the control function is not used, Toshiba recommend that the control pin is connected to the VIN pin.

2. Power Dissipation

Power dissipation is measured on the board condition shown below.

[The Board Condition]
Board material : Glass epoxy
Board dimension : 25.4mm x 25.4mm, t = 1.6mm
Pad dimension : 645mm^2





Attention in Use

- Output Capacitors
  Ceramic capacitors can be used for these devices. However, because of the type of the capacitors, there might be unexpected thermal features. Please consider application condition for selecting capacitors. And Toshiba recommend the ESR of ceramic capacitor is under 10 Ω.

- Mounting
  The long distance between IC and output capacitor might affect phase assurance by impedance in wire and inductor. For stable power supply, output capacitor need to mount near IC as much as possible. Also GND pattern need to be large and make the wire impedance small as possible.

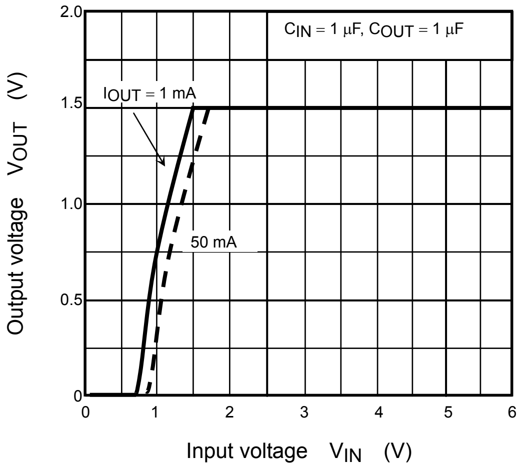
- Permissible Loss
  Please have enough board design patterns for expected maximum permissible loss. And under consideration of surrounding temperature, input voltage, and output current etc, please apply proper dissipation ratings for maximum permissible loss.

- Overcurrent Protection Circuit
  Overcurrent protection circuit is designed in these products, but this does not assure for the suppression of uprising device operation. If output pins and GND pins are shorted out, these products might be break down.
  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.

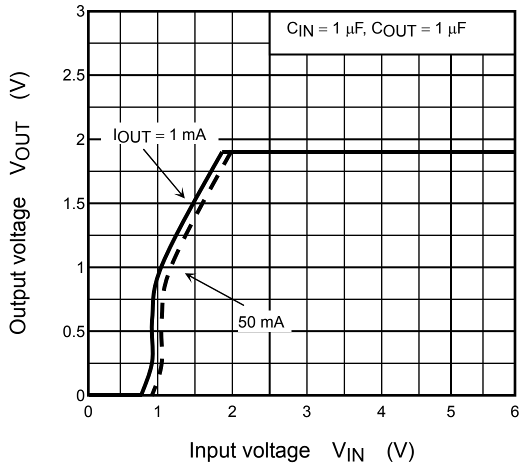
Representative Typical Characteristics

1) Output Voltage vs. Input Voltage

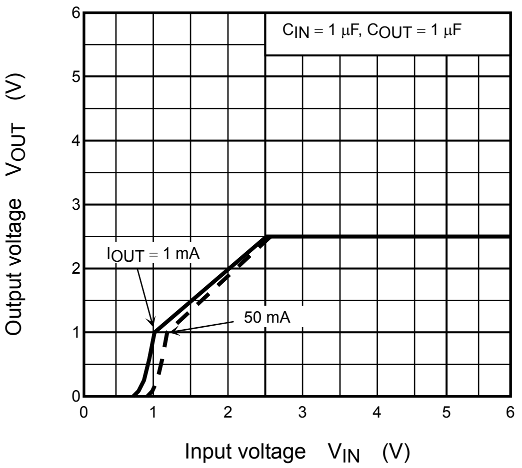
Vout=1.5V



Vout=1.8V

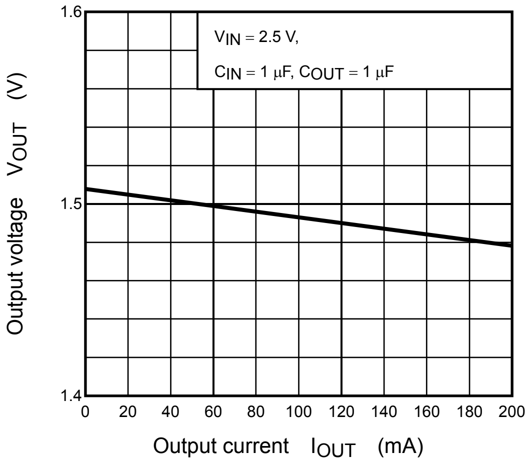


Vout=2.5V

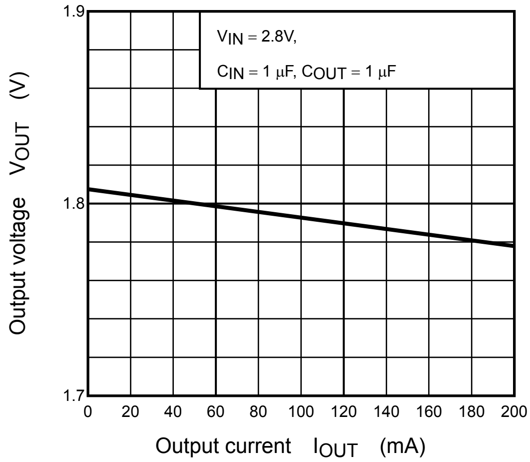


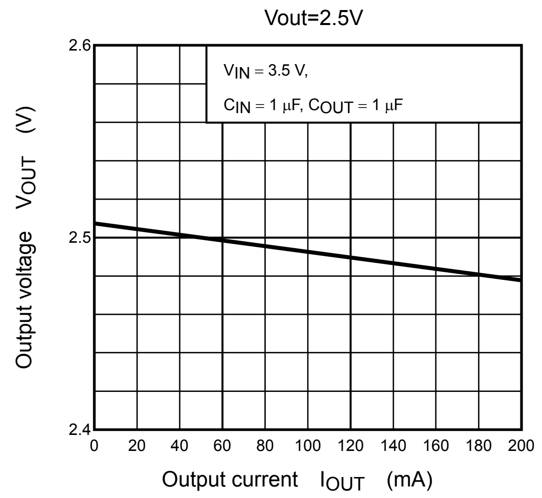
2) Output Voltage vs. Output Current

Vout=1.5V

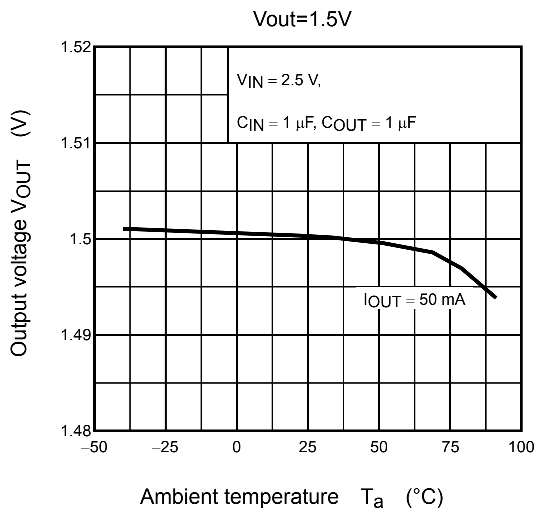


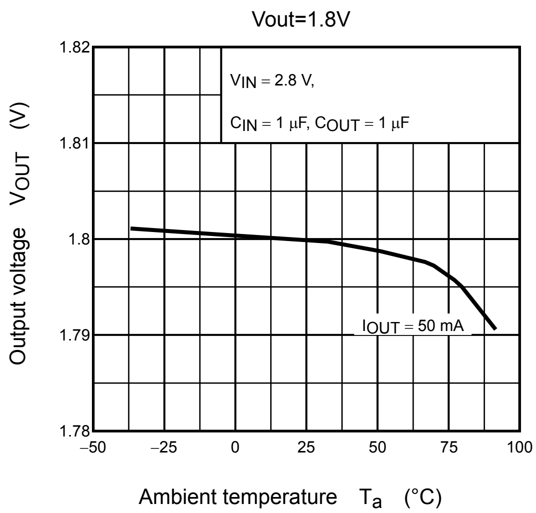
Vout=1.8V

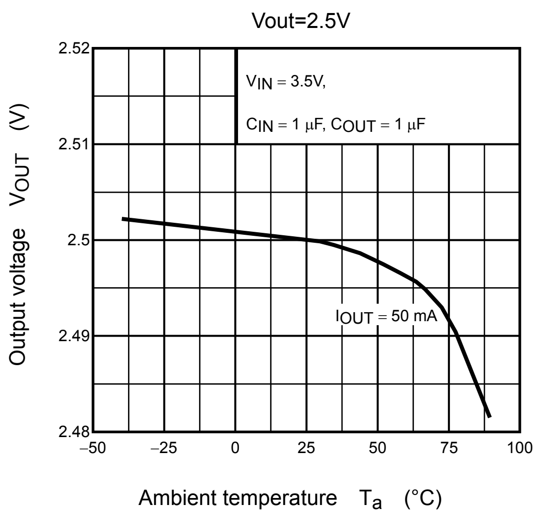




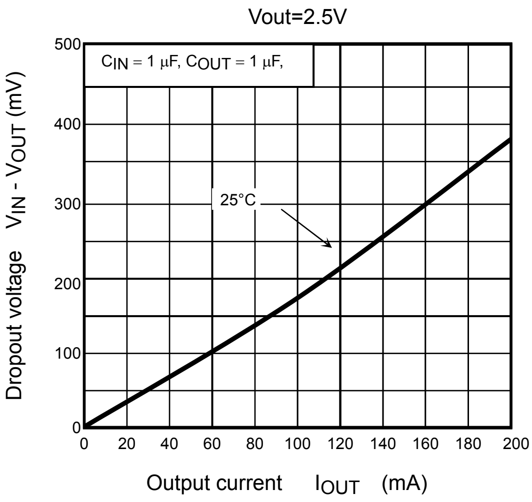
3) Output Voltage vs. Ambient temperature



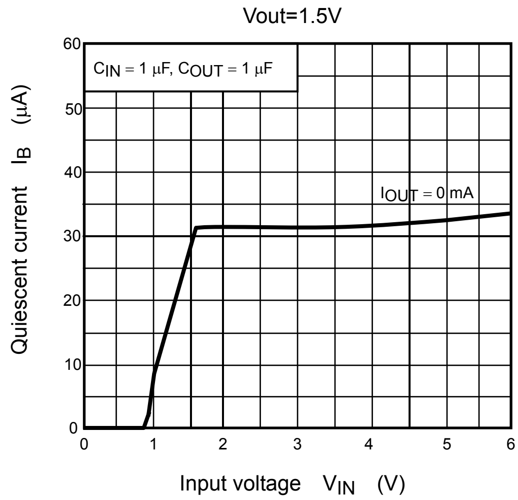


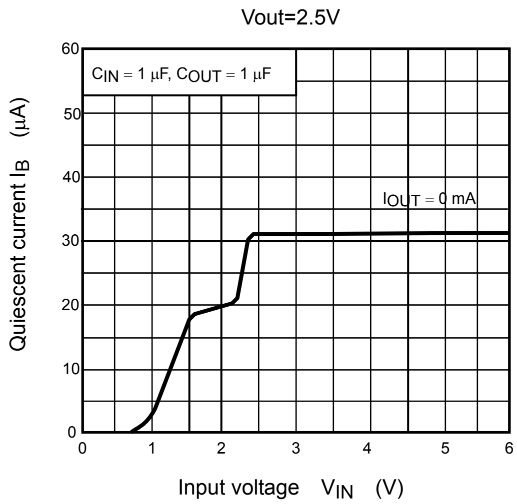


4) Dropout Voltage vs. Output Current

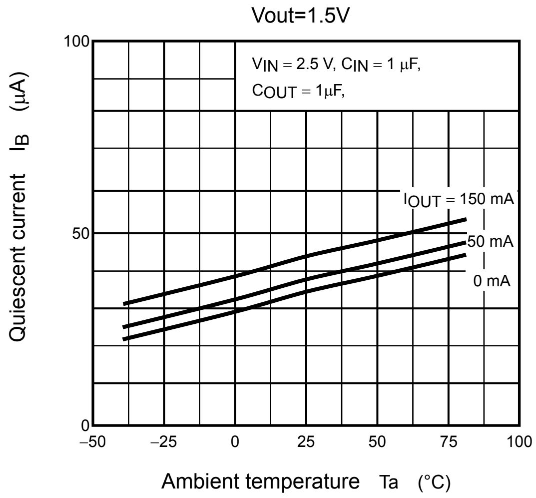


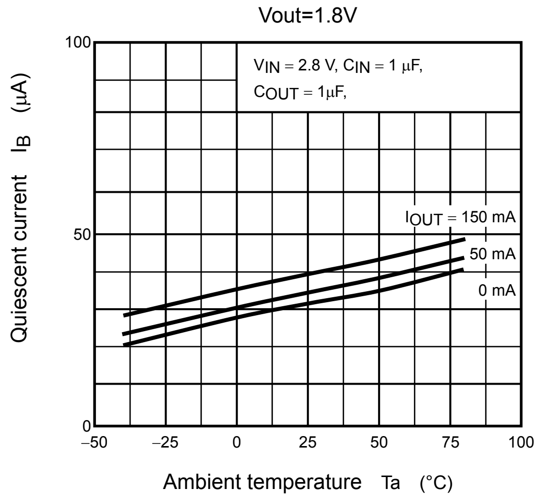
5) Quiescent Current vs. Input Voltage

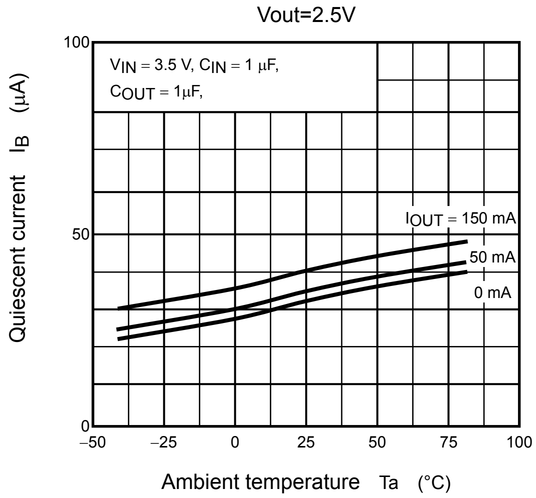




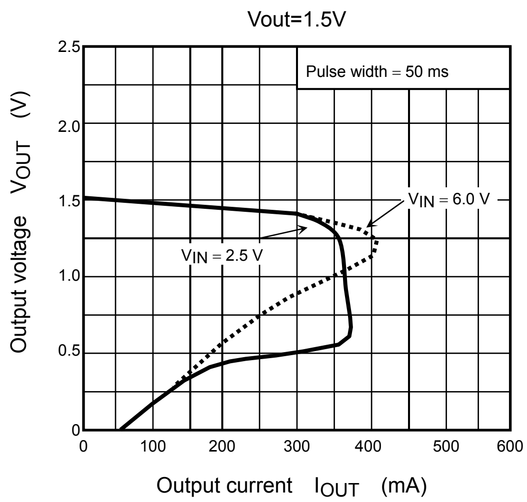
6) Quiescent current vs. Ambient temperature

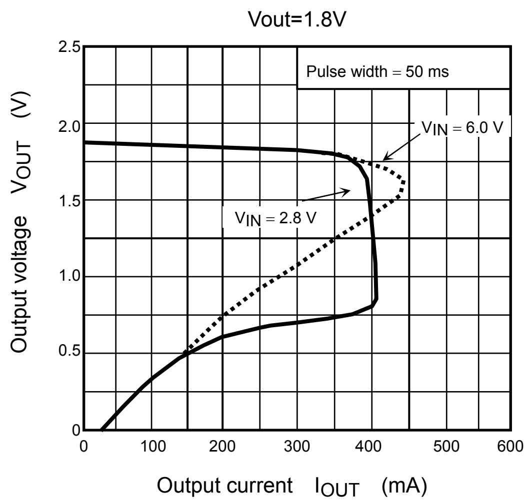


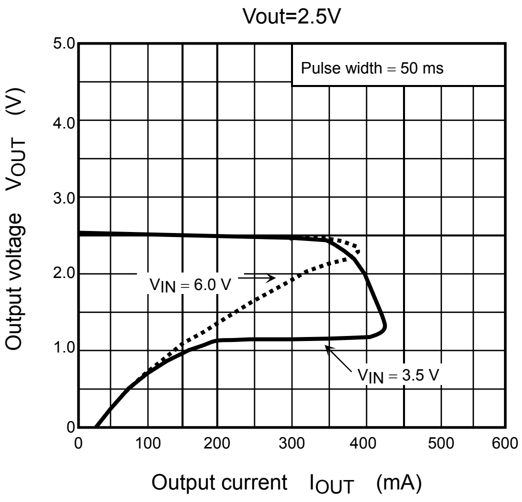




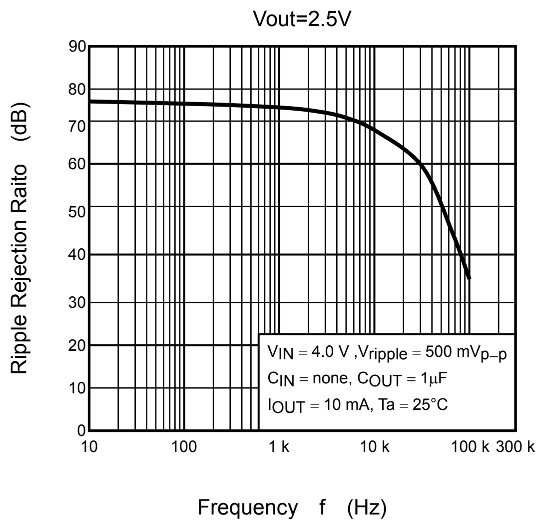
7) Overcurrent Protection Characteristics





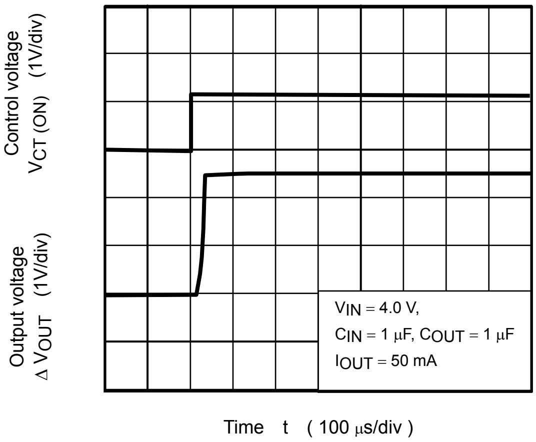


8) Ripple rejection Raito vs. Frequency

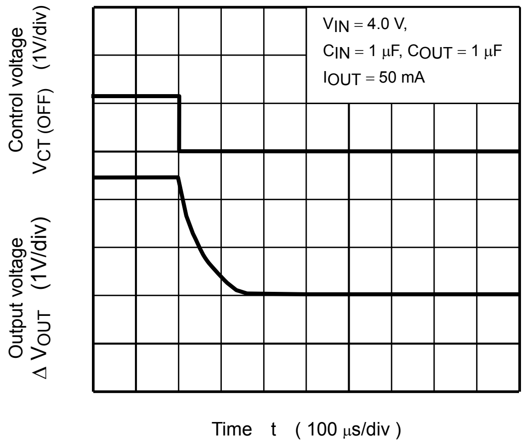


9) Control Transient Response

Vout=2.5V (Turn on wave form)

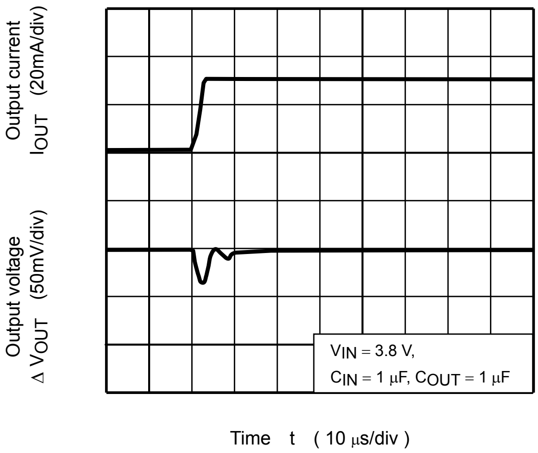


Vout=2.5V (Turn off wave form)

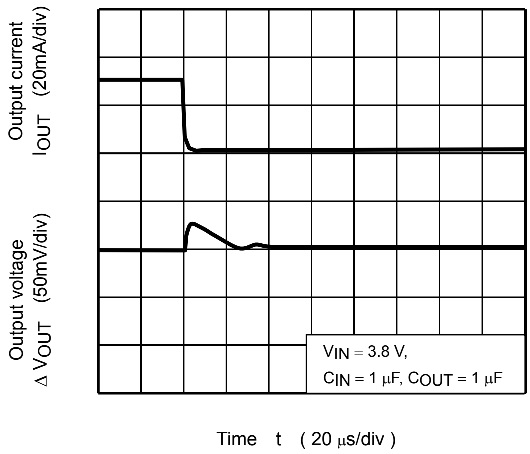


10) Load Transient Response

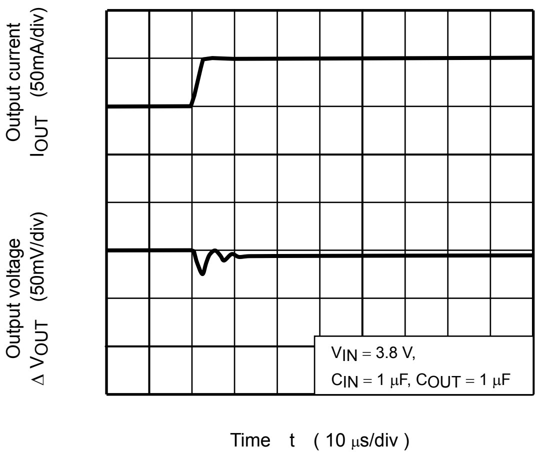
Vout=1.5V
(I_{OUT} = 1m to 30mA)



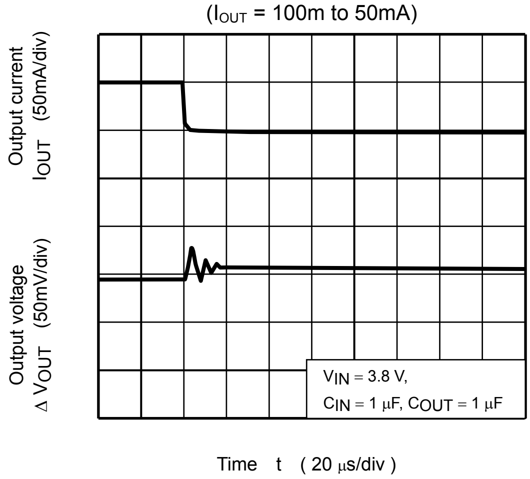
Vout=1.5V
(I_{OUT} = 30m to 1mA)



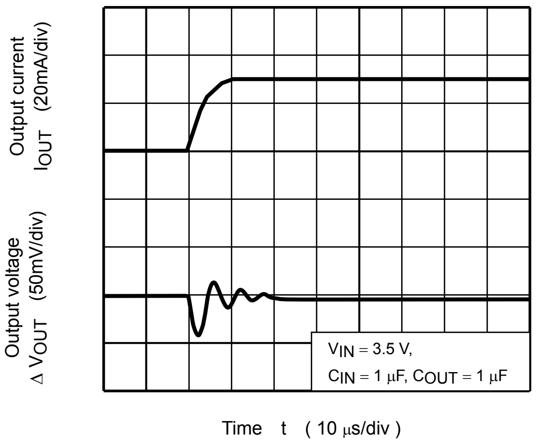
Vout=1.5V
(I_{OUT} = 50m to 100mA)



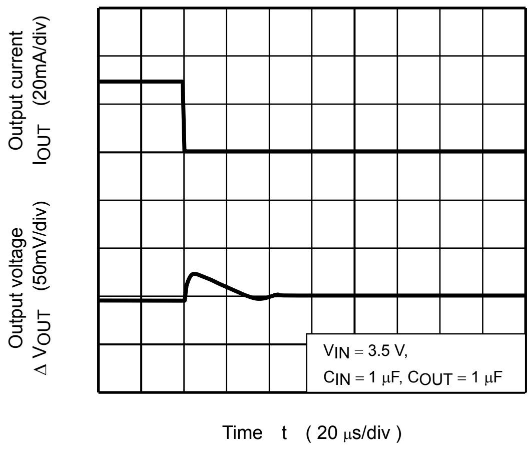
Vout=1.5V
(I_{OUT} = 100m to 50mA)



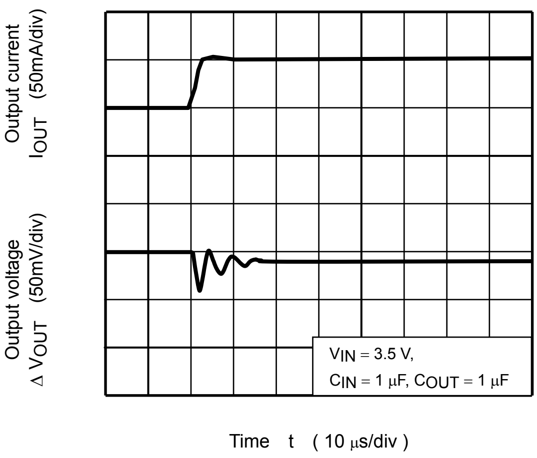
Vout=2.5V
(I_{OUT} = 1m to 30mA)



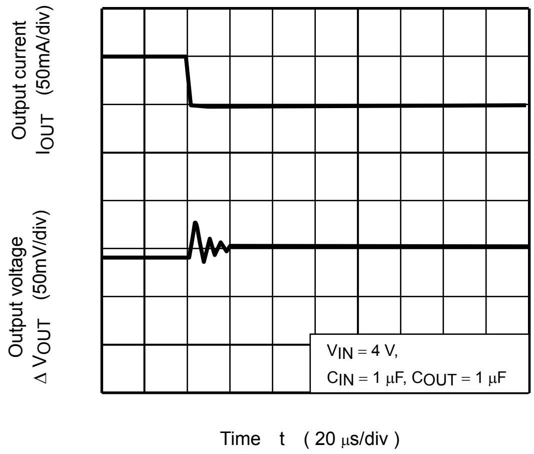
Vout=2.5V
(I_{OUT} =30m to 1mA)



Vout=2.5V
(I_{OUT} = 50m to 100mA)

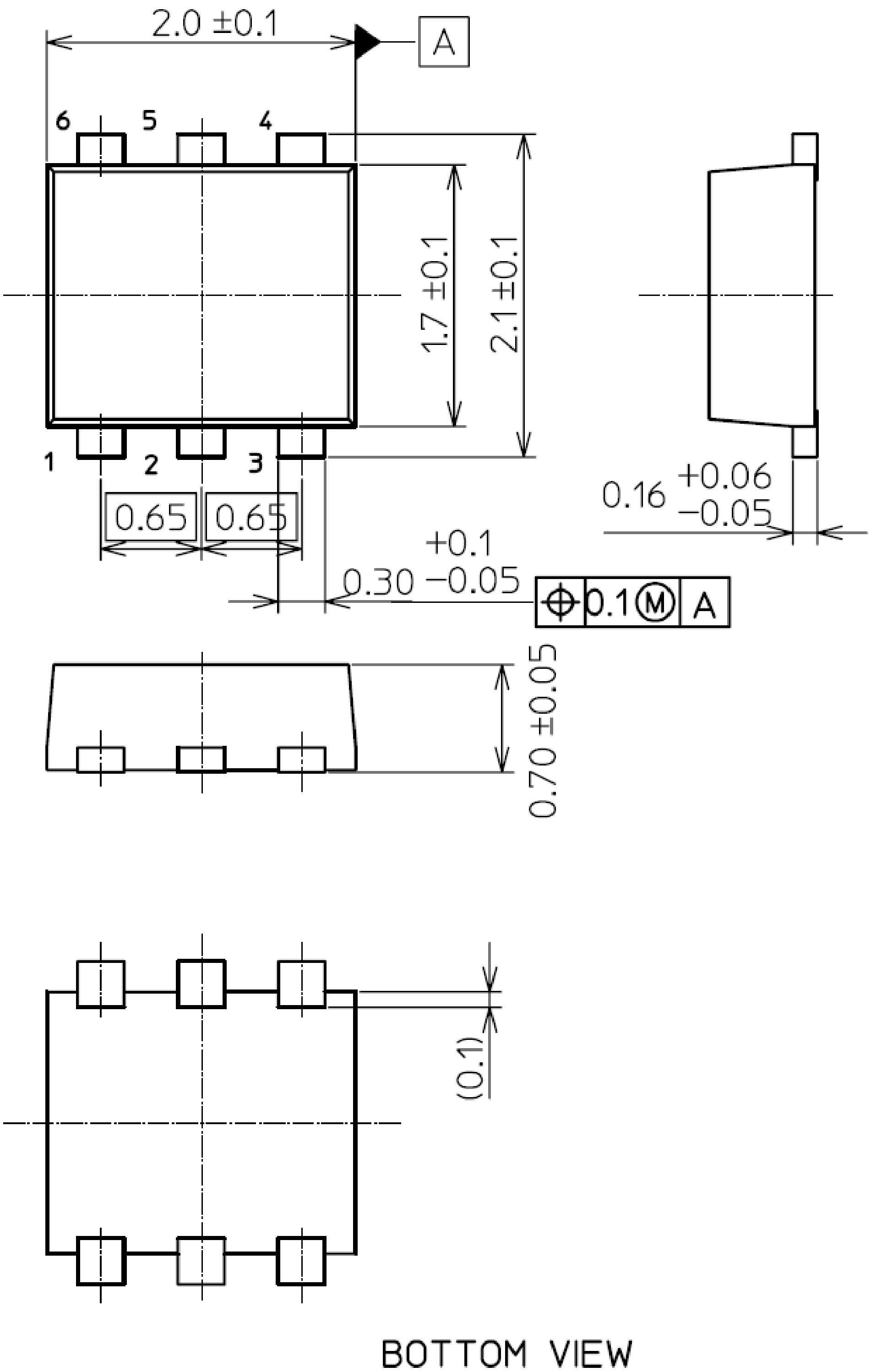


Vout=2.5V
(I_{OUT} = 100m to 50mA)



Package Dimensions

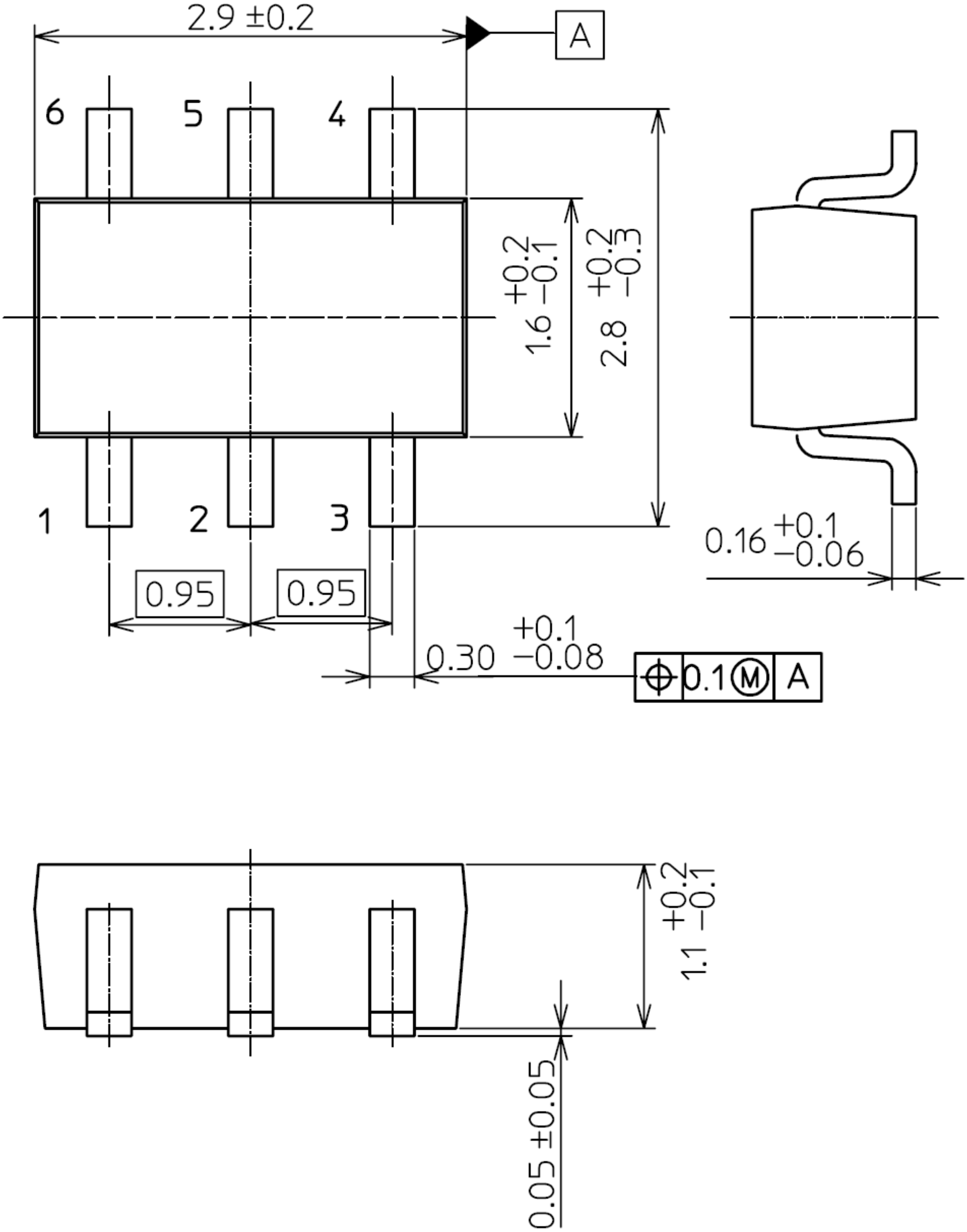
UF6 Unit : mm



Weight: 7 mg (typ.)

Package Dimensions

SM6(SOT-26)(SC-74) Unit : mm



Weight: 15 mg (typ.)

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