XCA201A06BCR

ETR05039-001

1.5A Synchronous Step-Down DC/DC Converter

■GENERAL DESCRIPTION

XCA201A06BCR is a high efficiency step-down DC/DC converter operated with the current mode and the constant frequency. The internal switch and synchronous rectifier are integrated for high efficiency. External Schottky diodes are not required. The supply current is only 200 μA during operation and drops to less than 1 μA in shutdown. XCA201A06BCR can supply 1.5A of load current from 2.5V to 5.5V supply voltage. The output voltage can be regulated as low as 0.6V.
The switching frequency is set at 1.5MHz, allowing the use of small surface mount inductors and capacitors. It can run 100% duty cycle for low dropout application. XCA201A06BCR is available in the DFN2x2-6L package.

■APPLICATIONS

- ●W-LAN (Module & Router)
- ●SSD
- ●POS
- ●DTV
- ●Ultra NB
- ●STB

■FEATURES

Input Voltage	:	2.5V～5.5V
Output Voltage	:	0.6～5.5V(External Setting: 0.6V)
Output Current	:	1.5A
Oscillation Frequency	:	1.5MHz
Stand-by Current	:	Less than 0.1 μA
Protection Circuits	:	Thermal Fault Protection Short Circuit Protection
Control Method	:	PWM
Operating Ambient Temperature	:	-40℃～+85℃
Package	:	DFN2×2-6L
Environmentally Friendly	:	EU RoHS Compliant, Pb Free

■TYPICAL APPLICATON CIRCUIT

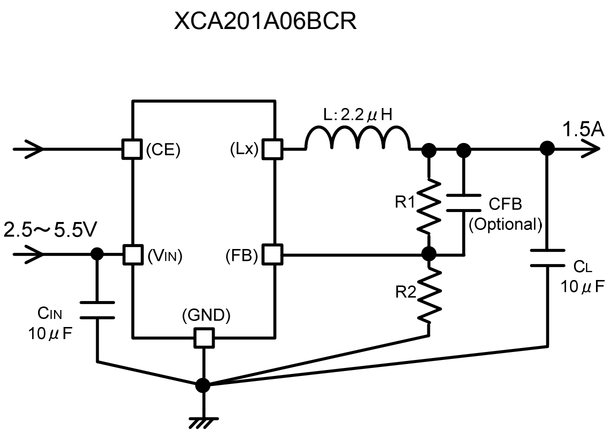
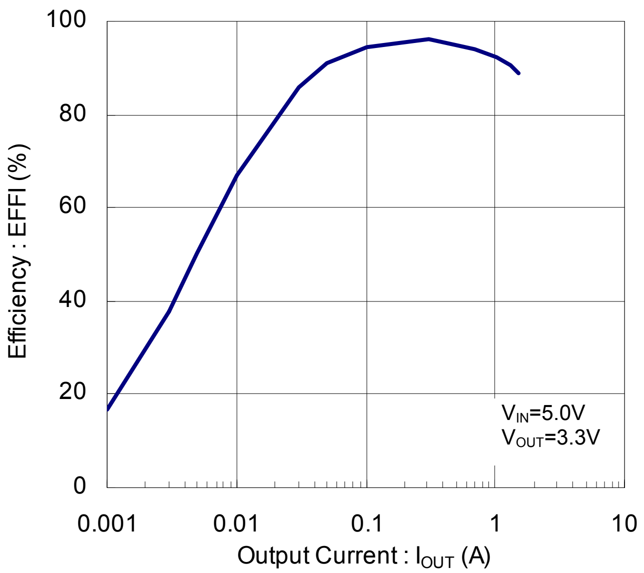


Figure1. Typical Application Circuit

■TYPICAL PERFORMANCE CHARACTERISTICS



■BLOCK DIAGRAM

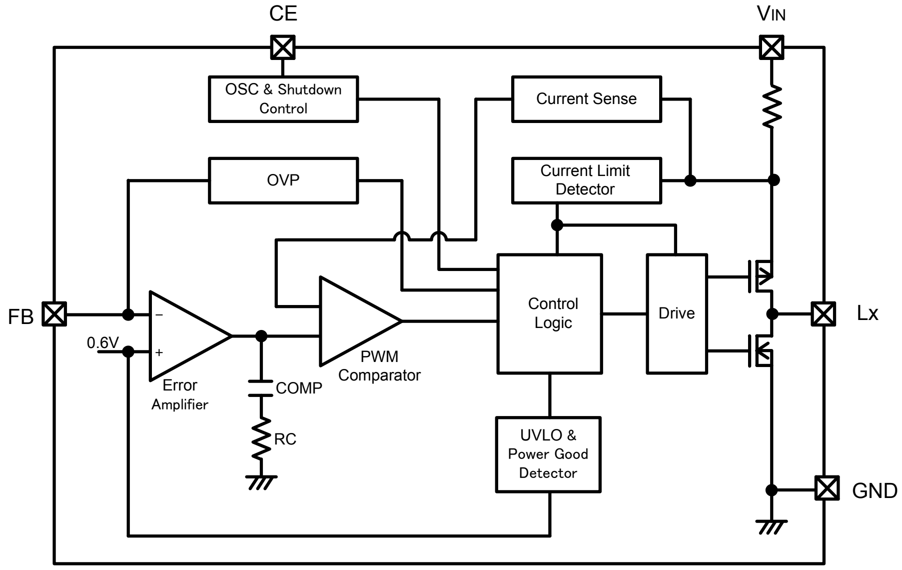
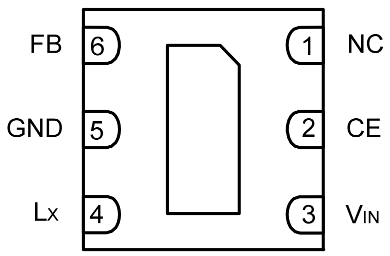


Figure2. Functional Block Diagram

■PRODUCT CLASSIFICATION

PRODUCT NAME	PACKAGE	ORDER UNIT
XCA201A06BCR	DFN2×2-6L	3,000/Reel

■PIN CONFIGURATION



(BOTTOM VIEW)

* If the dissipation pad needs to be connected to other pins, it should be connected to the GND pin.

■PIN ASSIGNMENT

PIN NUMBER	PIN NAME	FUNCTIONS
1	NC	No Connection
2	CE	Chip Enable
3	V_{IN}	Power Input
4	L_X	Switching Output
5	GND	Ground
6	FB	Output Voltage Sense PIN

■FUNCTION

PIN NAME	SIGNAL	STATUS
CE	H	Active
	L	Stand-by

* Please do not leave the CE pin open.

■ABSOLUTE MAXIMUM RATINGS

Ta=25℃

PARAMETER	SYMBOL	RATINGS	UNITS
Input Voltage	V_{IN}	-0.3～6.0	V
Lx Pin Voltage	V_{Lx}	-0.3～V_{IN}+0.3	V
Output Voltage	V_{OUT}	-0.3～6.0	V
CE Input Voltage	V_{CE}	-0.3～6.0	V
Junction Temperature	Tj	150	℃
Thermal resistance (Junction-Air)	θ_{JA}	120	℃/W
Thermal resistance (Junction-Case)	θ_{JC}	20	℃/W
Operating Ambient Temperature	Topr	-40～+85	℃
Storage Temperature	Tstg	-65～+150	℃

Note 1: Stresses exceed those ratings may damage the device.

Note 2: If out of its operating conditions, the device is not guaranteed to function.

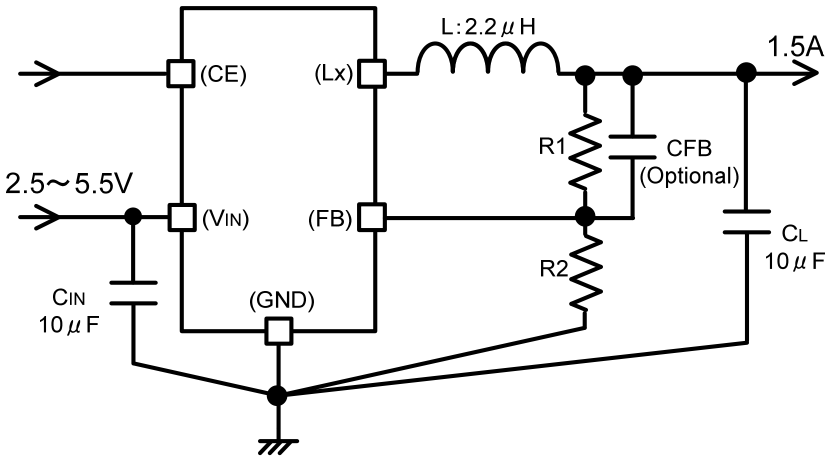
■ELECTRICAL CHARACTERISTICS

(V_{IN}=3.6V, Ta=25℃, unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating Voltage Range	V_{IN}		2.5	-	5.5	V
Supply Current	I_{DD}	V_{IN}=V_{CE}=3.6V, V_{FB}=0.65V	-	150	350	μA
Stand-by Current	I_{STD}	V_{IN}=5.5V, V_{CE}=0V,	-	0.1	1.0	μA
UVLO Voltage	V_{UVLO}	Rising Edge	1.9	2.1	2.4	V
UVLO Hystericis Voltage	V_{UVLO}		-	0.2	-	V
FB Voltage	V_{FB}	V_{IN}=V_{CE}=3.6V	0.582	0.6	0.618	V
FB Input Current	I_{FB}	V_{FB}=0.65V	-50		50	nA
PFET On Resistance (*)	$R_{(ON)\_P}$	ILx=200mA	-	0.28	-	Ω
NFET On Resistance (*)	$R_{(ON)\_N}$	ILx=-200mA	-	0.25	-	Ω
PFET Current Limit	I_{LIMT}	Duty Cycle=100%,Current Pulse, Width<1ms	1.8	2.2	-	A
Oscillator Frequency	f_{OSC}	V_{IN}=V_{CE}=3.6V, I_{OUT}=200mA	1.2	1.5	1.8	MHz
Maximum Duty Cycle	D_{MAX}		-	100	-	%
Minimum On-Time (*)	ton_min		-	80	-	ns
Thermal Shutdown Trip Threshold (*)	T_{SD}		-	145	-	℃
CE High-Level Input Voltage	CE_H	-40°C≤Ta≤+85°C	1.5	-	-	V
CE Low-Level Input Voltage	CE_L	-40°C≤Ta≤+85°C	-	-	0.4	V
CE Input Current	I_{CE}	V_{CE}=0V to 5.5V	-1	-	1	μA

* Guaranteed by design

■TYPICAL APPLICATION CIRCUIT



V_{OUT}(V)	R1(Ω)	R2(Ω)	C_{IN}	C_L
1.0	100k	150k	Ceramic Cap. 25V/10μF	Ceramic Cap. 25V/10μF
1.2	100k	100k		
1.8	200k	100k		
2.5	150k	47k		
3.3	300k	68k		

V_{OUT}=FB×（1+ R1/R2）with R2=300kΩ to 60kΩ and (R1×CFB) should be in the range 3×10^{-6} and 1.2×10^{-5} for component selection.

(Note)
In order to avoid the possibility that output ripple might become bigger in case of using a small size ceramic capacitor at low temperature, the fllowings are recommended:

(1)To add a CFB=10pF.
(2)To use C_L=20μF(10μF+10μF)
(3)To use 3216 Size (3.2mm×1.6mm) For 10μF capacitor.
e.g. TMK3216BJ106KL (25V/10μF, Taiyo Yuden), C3216X5R1E106K (25V/10μF, TDK)

■OPERATIONAL DESCRIPTION

<Function Description>

The XCA201A06BCR high-efficiency switching regulator is a small, simple, DC/DC step-down converters capable of delivering up to 1.5A of output current. The device operates in pulse-width modulation (PWM) at a fixed frequency of 1.5MHz from a 2.5V to 5.5V input voltage and provides an output voltage from 0.6V to V_{IN}, making the XCA201A06BCR ideal for on-board post-regulation applications. The high switching frequency allows for the use of smaller external components, and internal synchronous rectifiers improve efficiency and eliminate the typical Schottky free-wheeling diode. Using the on-resistance of the internal high-side MOSFET to sense switching currents eliminates current-sense resistors, further improving efficiency and cost.

<Controller Block Function>

The XCA201A06BCR step-down converters use a PWM current-mode control scheme. An open-loop modulator compares the amplified voltage feedback signal against the sum of the amplified current-sense signal and the slope compensation ramp. At each rising edge of the internal clock, the internal high-side MOSFET turns on until the PWM comparator trips. During this on-time, current ramps up through the inductor, sourcing current to the output and storing energy in the inductor. The current-mode feedback system regulates the peak inductor current as a function of the output voltage error signal. Since the average inductor current is nearly the same as the peak inductor current (<30% ripple current), the circuit acts as a switch-mode transconductance amplifier. To preserve inner-loop stability and eliminate inductor stair-casing, a slope compensation ramp is summed into the main PWM comparator. During the second half of the cycle, the internal high-side P-channel MOSFET turns off, and the internal low-side N-channel MOSFET turns on. The inductor releases the stored energy as its current ramps down while still providing current to the output. The output capacitor stores charge when the inductor current exceeds the load current, and discharges when the inductor current is lower, smoothing the voltage across the load.

<Over current Protection>

The XCA201A06BCR offers cycle-to-cycle current limiting for both high-side and low-side switches. The internal high-side MOSFET has a current limit. If the current flowing out of LX exceeds this limit, the high-side MOSFET turns off and the synchronous rectifier turns on. This lowers the duty cycle and causes the output voltage to droop until the current limit is no longer exceeded. A synchronous rectifier current limit protects the device from current flowing into LX.

When the output is shorted to ground, causing the output voltage to drop below 70% of its nominal output, the XCA201A06BCR is shut down momentarily and begins discharging the soft start capacitor. It will restart with a full soft-start when the soft- start capacitor is fully discharged. This hiccup process is repeated until the fault is removed. You can refer this to Figure3.

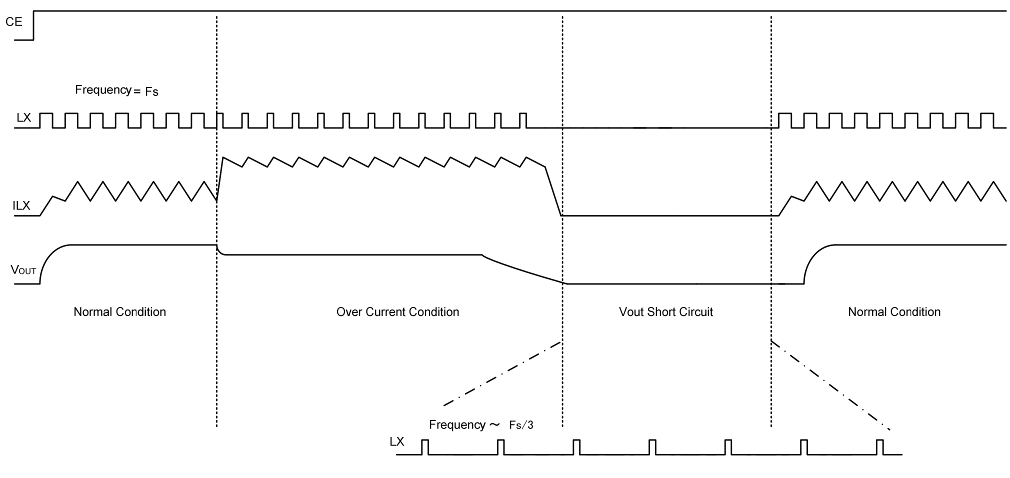


Figure3. The illustration of OCP and SCP

<Soft-Start>

The XCA201A06BCR employ soft-start circuitry to reduce supply inrush current during startup conditions. When the device exits under-voltage lockout (UVLO) or shut-down mode, the soft-start circuitry will slowly ramp up the output voltage.

<Shutdown Mode>

The CE pin allows for power sequencing between the PWM controller bias voltage and another voltage rail. The XCA201A06BCR remains in shutdown if the CE pin is lower than 400mV. When the CE pin rises above the V_{CE} trip point, the XCA201A06BCR begins a new initialization and soft-start cycle.

OPERATIONAL DESCRIPTION (Continued)

<Thermal-Overload Protection>
Thermal-overload protection limits total power dissipation in the device. When the junction temperature exceeds Tj=+145°C, a thermal sensor forces the device into shutdown, allowing the die to cool. The thermal sensor turns the device on again after the junction temperature cools by 15°C, resulting in a pulsed output during continuous overload conditions. Following a thermal-shutdown condition, the soft-start sequence begins.

APPLICATION INFORMATION

<Setting Output Voltage>
The external resistor divider sets the output voltage. The feedback resistor R1 also sets the feedback loop bandwidth with the internal compensation capacitor. Table 1 shows a list of resistor selection for common output voltages.

$$V_{OUT} = 0.6 \times \left(1 + \frac{R1}{R2}\right)$$

<Selecting the Inductor>
A 1μH to 4.7μH inductor with DC current rating at least 25% higher than the maximum I_{OUT} current is recommended for most applications. For best efficiency, the inductor DC resistance shall be <20mΩ.
For most designs, the required inductance value can be derived from the following equation.

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{osc}}$$

Where ΔI_L is the inductor ripple current. Choose inductor ripple current approximately 30% of the maximum I_{OUT} current, 1.5A.
The maximum inductor peak current is:

$$I_{OUT(MAX)} = I_{OUT} + \frac{\Delta I_L}{2}$$

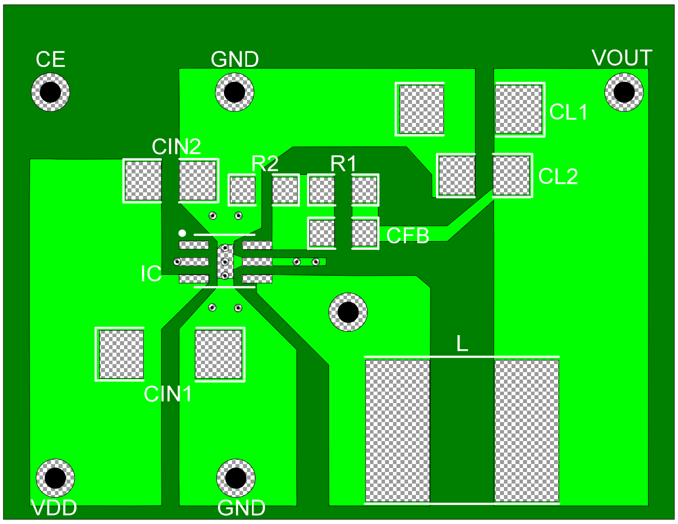
Under light I_{OUT} conditions below 100mA, larger inductance is recommended for improved efficiency.

<Selecting the Input Capacitor>
The input capacitor reduces the surge current drawn from the input and switching noise from the device. The input capacitor impedance at the switching frequency shall be less than input source impedance to prevent high frequency switching current passing to the input. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. For most applications, a 10μF capacitor is sufficient.

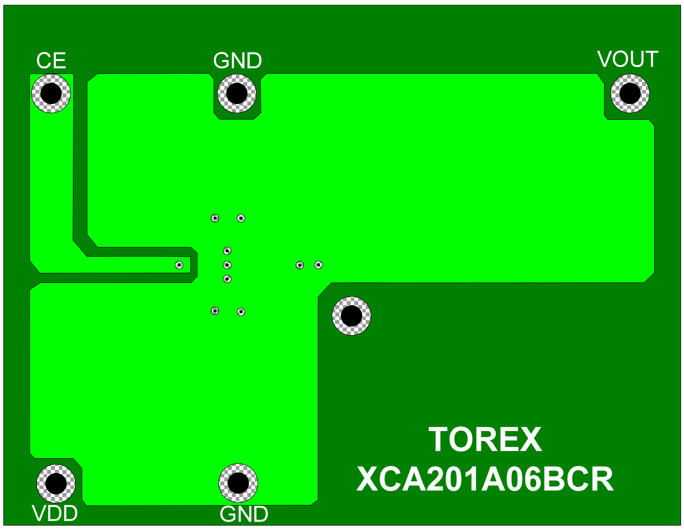
<Selecting the Output Capacitor>
The output capacitor keeps output voltage ripple small and ensures regulation loop stable. The output capacitor impedance shall be low at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended.
The output ripple ΔV_{OUT} is approximately:

$$\Delta V_{OUT} \leqq \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times L \times f_{osc}} \times \left(ESR + \frac{1}{8 \times C_L \times f_{osc}}\right)$$

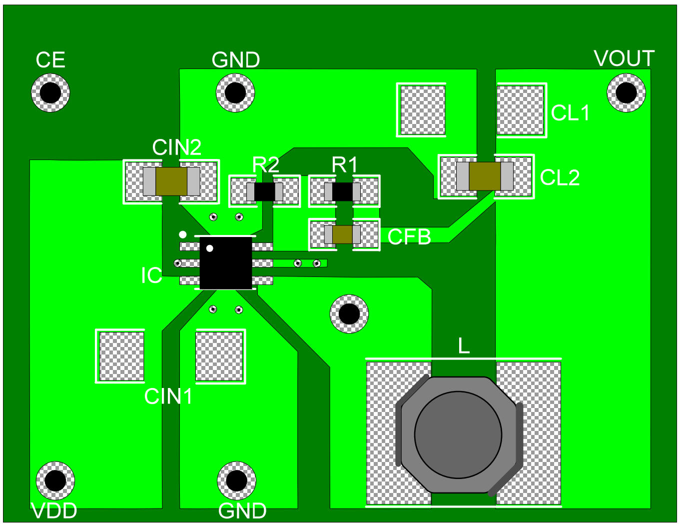
■PCB PATTERN LAYOUT



FRONT



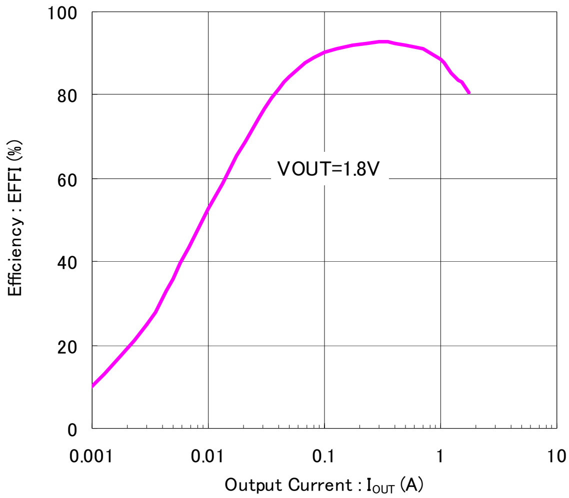
BACK (Flip Horizontal)



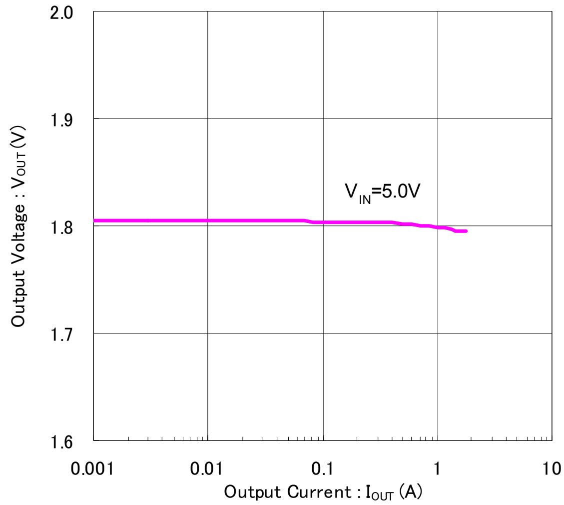
FRONT (PCB mounted)

■TYPICAL PERFORMANCE CHARACTERISTICS

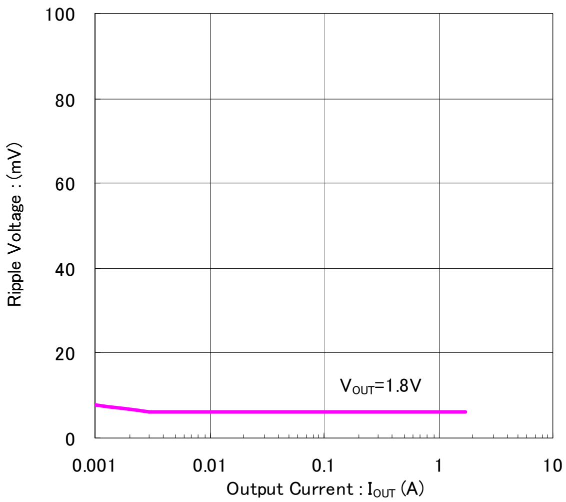
(1) Efficiency vs. Output Current



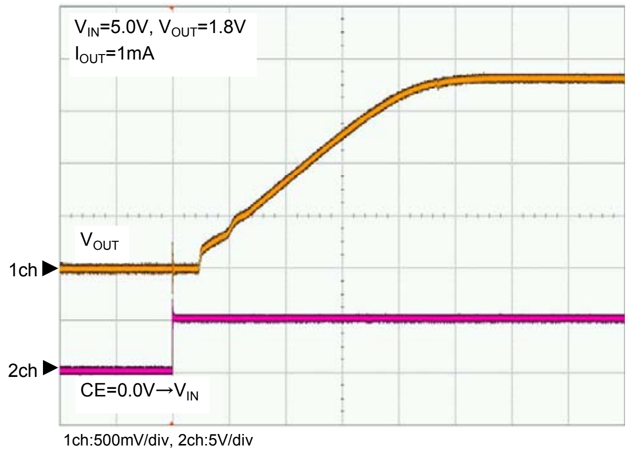
(2) Output Voltage vs. Output Current



(3)Ripple Voltage vs. Output Current

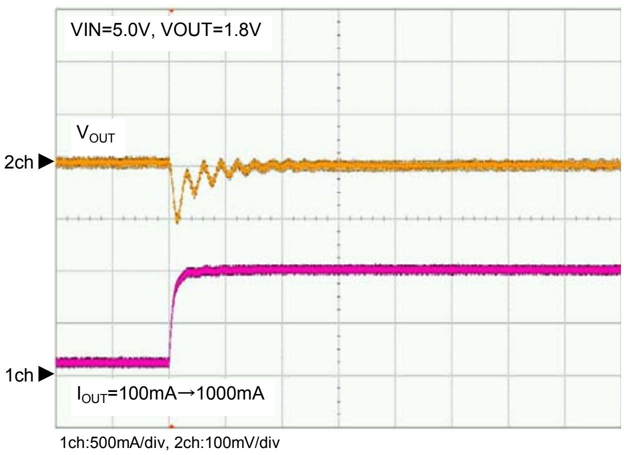


(4) Output Voltage Rise Wave Form

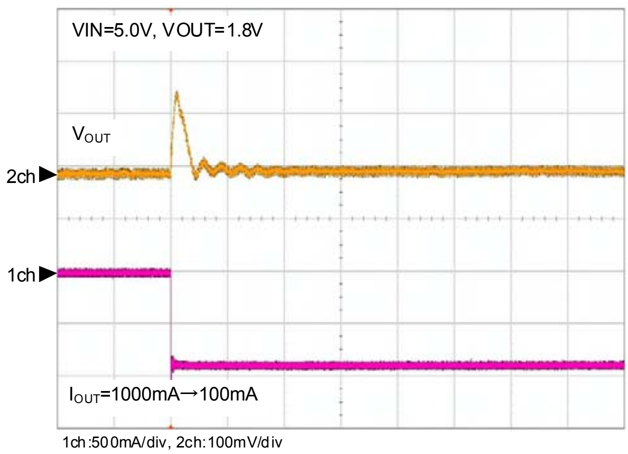


time:200 μ s/div

(5) Load Transient Response



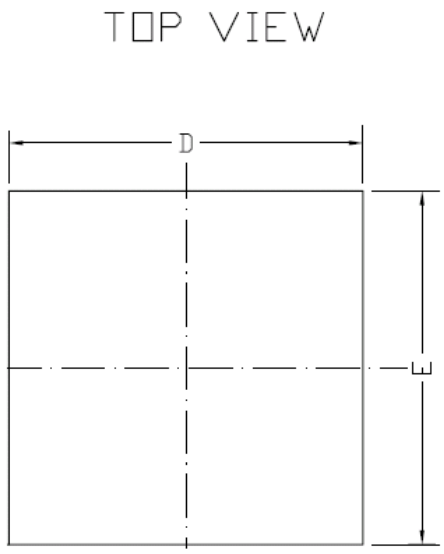
time:20 μ s/div

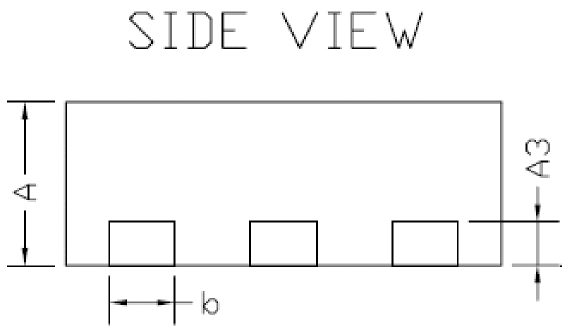


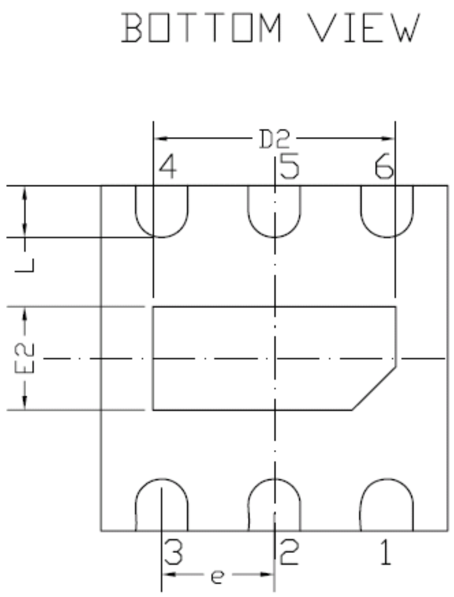
time:20 μ s/div

■PACKAGING INFORMATION

●DFN2×2-6L





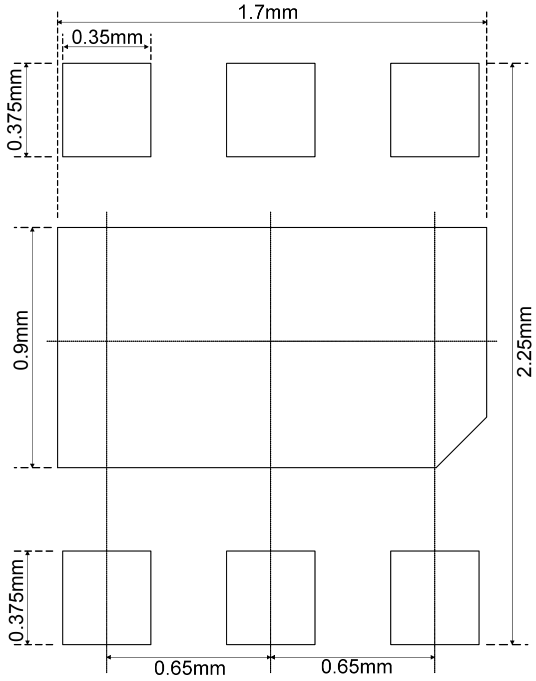


SYMBOLS	MIN.	TYP.	MAX.
A	0.7	0.75	0.8
A3	-	0.2	-
b	0.25	0.3	0.35
D	-	2	-
D2	1.3	1.4	1.5
E	-	2	-
E2	0.5	0.6	0.7
e	-	0.65	-
L	0.25	0.3	0.35

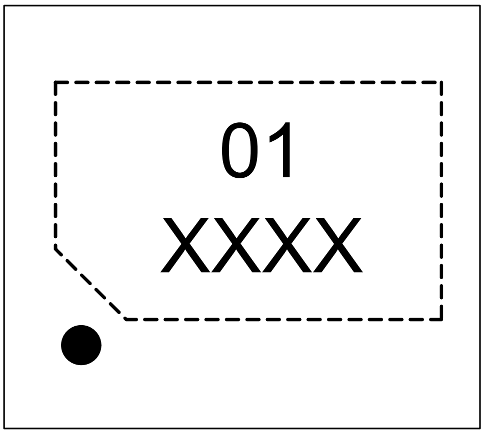
Unit:mm

■PACKAGING INFORMATION (Continued)

●DFN2×2-6L   Reference Pattern Layout



■MARKING RULE



01: Part No. XCA201A06BCR
XXXX: Denotes assembly Data Code & Lot No.

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