XC9232 Series

600mA Synchronous Step-Down DC/DC Converters

Preliminary

☆GreenOperation Compatible

■GENERAL DESCRIPTION

The XC9232 series is a group of synchronous-rectification type DC/DC converters with a built-in 0.42Ω P-channel MOS driver transistor and 0.52Ω N-channel MOS switching transistor, designed to allow the use of ceramic capacitors. Operating voltage range is from 2.5V~5.5V. The device provides a high efficiency, stable power supply with an output current of 600mA to be configured using only a coil and two capacitors connected externally. As for operation mode, the series is automatic PWM/PFM switching control, allowing fast response, low ripple and high efficiency over the full range of loads (from light load to heavy load).

The soft start and current control functions are internally optimized. During stand-by, all circuits are shutdown to reduce current consumption to as low as 1.0μA or less. With the built-in UVLO (Under Voltage Lock Out) function, the internal P-channel MOS driver transistor is forced OFF when input voltage becomes 1.4V or lower.

■APPLICATIONS

- ●Mobile phones, Smart phones
- ●Bluetooth headsets
- ●Mobile WiMAX PDAs, MIDs, UMPCs
- ●Portable game consoles
- ●Digital cameras, Camcorders
- ●MP3 Players, Portable Media Players
- ●Notebook computers

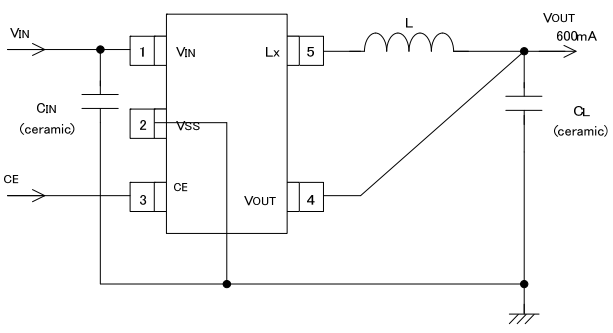
■FEATURES

Driver Transistor Built-In	: 0.42Ω P-ch driver transistor 0.52Ω N-ch switch transistor
Input Voltage	: 2.5V ~ 5.5V
Output Voltage	: 1.0V, 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, .3V, 3.6V
High Efficiency	: 92% (TYP.)
Output Current	: 600mA
Oscillation Frequency	: 1.2MHz (±15%)
Maximum Duty Cycle	: 100%
Control Methods	: PWM/PFM Auto
Function	: Current Limiter Circuit Built-In (Constant Current & Latching) Soft Start
Capacitor	: Low ESR Ceramic Capacitor
Packages	: SOT-25J
Environmentally Friendly	: EU RoHS Compliant, Pb Free

* Performance depends on external components and wiring on the PCB.

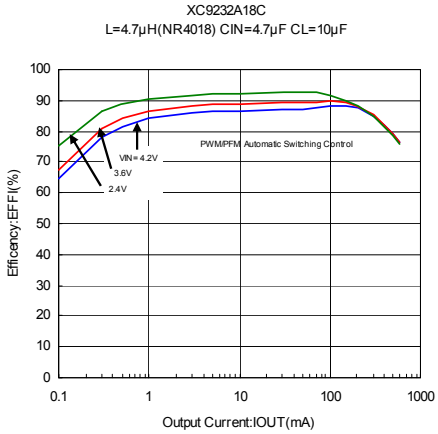
■TYPICAL APPLICATION CIRCUIT

●SOT-25J

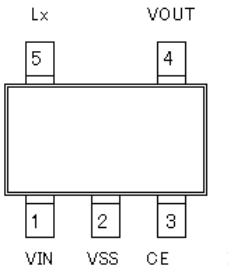


■TYPICAL PERFORMANCE CHARACTERISTICS

●Efficiency vs. Output Current（f_{OSC}=1.2MHz, VOUT=1.8V）



■PIN CONFIGURATION



SOT-25J
(TOP View)

■PIN ASSIGNMENT

PIN NUMBER SOT-25J	PIN NAME	FUNCTION
1	VIN	Power Input
2	VSS	Ground
3	CE	High Active Enable
4	VOUT	Fixed Output Voltage Pin
5	Lx	Switching Output

■PRODUCT CLASSIFICATION

●Ordering Information

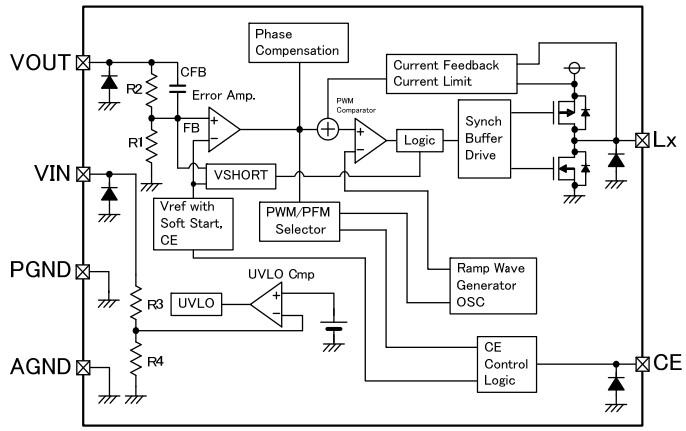
XC9232①②③④⑤⑥-⑦(*1) PWM / PFM automatic switching control

DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
①	Product Type	A	V_{IN}≧2.0V, No C_L discharge, Low speed soft-start
②③	Fixed Output Voltage (V_{OUT})	10	1.0V
		12	1.2V
		15	1.5V
		18	1.8V
		25	2.5V
		28	2.8V
		30	3.0V
		33	3.3V
		36	3.6V
④	Oscillation Frequency	C	1.2MHz
⑤⑥-⑦	Package (Order Unit) (*1)	VR-G	SOT-25J (3,000/Reel)

(*1) The “-G” suffix indicates that the products are Halogen and Antimony free as well as being fully RoHS compliant.

■BLOCK DIAGRAM

●XC9232
A Series



NOTE: Diodes inside the circuit are ESD protection diodes and parasitic diodes.

■ABSOLUTE MAXIMUM RATINGS

Ta=25℃

PARAMETER		SYMBOL	RATINGS	UNIT
V_{IN} Pin Voltage		V_{IN}	- 0.3 ~ 6.5	V
Lx Pin Voltage		V_{Lx}	- 0.3 ~ V_{IN} + 0.3	V
V_{OUT} Pin Voltage		V_{OUT}	- 0.3 ~ 6.5	V
FB Pin Voltage		V_{FB}	- 0.3 ~ 6.5	V
CE Pin Voltage		V_{CE}	- 0.3 ~ 6.5	V
Lx Pin Current		I_{Lx}	±1500	mA
Power Dissipation (*Ta=25℃)	SOT-25J	Pd	250	mW
Operating Temperature Range		Topr	- 40 ~ + 85	°C
Storage Temperature Range		Tstg	- 55 ~ + 125	°C

■ELECTRICAL CHARACTERISTICS

XC9232A18CMR, V_{OUT}=1.8V, f_{OSC}=1.2MHz, Ta=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT	CIRCUIT
Output Voltage	V_{OUT}	When connected to external components, V_{IN}=V_{CE}=5.0V, I_{OUT}=30mA	1.764	1.800	1.836	V	①
Operating Voltage Range	V_{IN}		2.5	-	5.5	V	①
Maximum Output Current	I_{OUTMAX}	V_{IN}=$V_{OUT(E)}$+2.0V, V_{CE}=1.0V, When connected to external components (*7)	600	-	-	mA	①
UVLO Voltage	V_{UVLO}	V_{CE} =V_{IN}, V_{OUT}=0V, Voltage which Lx pin holding “L” level (*1, *9)	1.00	1.40	1.78	V	③
Supply Current	I_{DD}	V_{IN}=V_{CE}=5.0V, V_{OUT}=$V_{OUT(E)}$×1.1V	-	15	33	μA	②
Stand-by Current	I_{STB}	V_{IN}=5.0V, V_{CE}=0V, V_{OUT}=$V_{OUT(E)}$×1.1V	-	0	1.0	μA	②
Oscillation Frequency	f_{OSC}	When connected to external components, V_{IN}=$V_{OUT(E)}$+2.0V, V_{CE} =1.0V, I_{OUT}=100mA	1020	1200	1380	kHz	①
PFM Switching Current	I_{PFM}	When connected to external components, V_{IN}=$V_{OUT(E)}$+2.0V, V_{CE} =V_{IN}, I_{OUT}=1mA	120	160	200	mA	①
PFM Duty Limit	DTY_{LIMIT_PFM}	V_{CE}=V_{IN}=(C-1), I_{OUT}=1mA		200		%	①
Maximum Duty Cycle	DTY_{MAX}	V_{IN}=V_{CE}=5.0V, V_{OUT}=$V_{OUT(E)}$×0.9V	100	-	-	%	③
Minimum Duty Cycle	DTY_{MIN}	V_{IN}=V_{CE}=5.0V, V_{OUT}=$V_{OUT(E)}$×1.1V	-	-	0	%	③
Efficiency (*2)	EFFI	When connected to external components, V_{CE}=V_{IN}=$V_{OUT(E)}$+1.2V, I_{OUT}=100mA	-	92	-	%	①
Lx SW "H" ON Resistance 1	R_{LxH}	V_{IN}=V_{CE}=5.0V, V_{OUT}=0V, I_{Lx}=100mA (*3)	-	0.35	0.55	Ω	④
Lx SW "H" ON Resistance 2	R_{LxH}	V_{IN}=V_{CE}=3.6V, V_{OUT}=0V, I_{Lx}=100mA (*3)	-	0.42	0.67	Ω	④
Lx SW "L" ON Resistance 1	R_{LxL}	V_{IN}=V_{CE}=5.0V (*4)	-	0.45	0.66	Ω	-
Lx SW "L" ON Resistance 2	R_{LxL}	V_{IN}=V_{CE}=3.6V (*4)	-	0.52	0.77	Ω	-
Lx SW "H" Leak Current (*5)	I_{LeakH}	V_{IN}=V_{OUT}=5.0V, V_{CE}=0V, Lx=0V	-	0.01	1.0	μA	⑤
Lx SW "L" Leak Current (*5)	I_{LeakL}	V_{IN}=V_{OUT}=5.0V, V_{CE}=0V, Lx=5.0V	-	0.01	1.0	μA	⑤
Current Limit (*8)	I_{LIM}	V_{IN}=V_{CE}=5.0V, V_{OUT}=$V_{OUT(E)}$×0.9V (*8)	900	1050	1350	mA	⑥
Output Voltage Temperature Characteristics	ΔV_{OUT}/(V_{OUT}・ΔTopr)	I_{OUT}=30mA, -40℃≦Topr≦85℃	-	±100	-	ppm/℃	①
CE "H" Voltage	V_{CEH}	V_{OUT}=0V, Applied voltage to V_{CE}, Voltage changes Lx to “H” level (*9)	0.65	-	6.0	V	③
CE "L" Voltage	V_{CEL}	V_{OUT}=0V, Applied voltage to V_{CE} , Voltage changes Lx to “L” level (*9)	V_{SS}	-	0.25	V	③
CE "H" Current	I_{CEH}	V_{IN}=V_{CE}=5.0V, V_{OUT}=0V	- 0.1	-	0.1	μA	⑤
CE "L" Current	I_{CEL}	V_{IN}=5.0V, V_{CE}=0V, V_{OUT}=0V	- 0.1	-	0.1	μA	⑤
Soft Start Time	t_{SS}	When connected to external components, V_{CE}=0V → V_{IN}, I_{OUT}=1mA	0.5	1.0	2.5	ms	①
Latch Time	t_{LAT}	V_{IN}=V_{CE}=5.0V, V_{OUT}=0.8×$V_{OUT(E)}$, Short Lx at 1Ω resistance (*6)	1.0	-	20.0	ms	⑦
Short Protection Threshold Voltage	V_{SHORT}	Sweeping V_{OUT}, V_{IN}=V_{CE}=5.0V, Short Lx at 1Ω resistance, V_{OUT} voltage which Lx becomes “L” level within 1ms	0.675	0.900	1.150	V	⑦

Test conditions: Unless otherwise stated, V_{IN}=5.0V, $V_{OUT(E)}$=Nominal Voltage

NOTE:

*1: Including hysteresis operating voltage range.
*2: EFFI = { (output voltage × output current) / (input voltage × input current) } × 100
*3: ON resistance (Ω)= (V_{IN} - Lx pin measurement voltage) / 100mA
*4: R&D value
*5: When temperature is high, a current of approximately 10μA (maximum) may leak.
*6: Time until it short-circuits V_{OUT} with GND via 1Ω of resistor from an operational state and is set to Lx=0V from current limit pulse generating.
*7: When the difference between the input and the output is small, some cycles may be skipped completely before current maximizes. If current is further pulled from this state, output voltage will decrease because of P-ch driver ON resistance.
*8: Current limit denotes the level of detection at peak of coil current.
*9: “H”=V_{IN}~V_{IN}-1.2V, “L”=+0.1V~-0.1V

■ELECTRICAL CHARACTERISTICS (Continued)

●PFM Switching Current (I_{PFM}) by Setting Voltage

SETTING VOLTAGE	1.2MHz		
	MIN.	TYP.	MAX.
$V_{OUT(E)}$ =1.0V, 1.2V	140	180	240
$V_{OUT(E)}$ =1.5V	130	170	220
$V_{OUT(E)}$ =1.8V, 2.5V, 2.8V, 3.0V, 3.3V, 3.6V	120	160	200

●Input Voltage (V_{IN}) for Measuring PFM Duty Limit (DTY_{LIMIT_PFM})

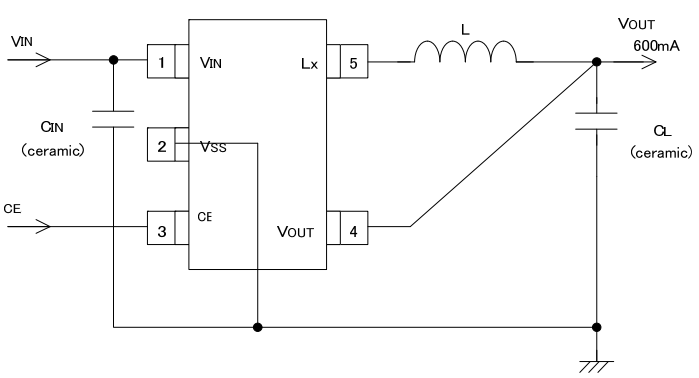
f_{OSC}	1.2MHz
C-1	$V_{OUT(E)}$+0.5V

Minimum operating voltage is 2.5V.

ex.) Although when $V_{OUT(E)}$ is 1.2V and f_{OSC} is 1.2MHz, (C-1) should be 1.7V, (C-1) becomes 2.5V for the minimum operating voltage 2.5V.

■TYPICAL APPLICATION CIRCUIT

●SOT-25J



●f_{OSC}=1.2MHz

L:	4.7 μ H	(NR4018, TAIYO YUDEN)
C_{IN}:	4.7 μ F	(Ceramic)
C_L:	10 μ F	(Ceramic)

■OPERATIONAL DESCRIPTION

The XC9232 series consists of a reference voltage source, ramp wave circuit, error amplifier, PWM comparator, phase compensation circuit, output voltage adjustment resistors, P-channel MOS driver transistor, N-channel MOS switching transistor for the synchronous switch, current limiter circuit, UVLO circuit and others. (See the block diagram above.) The series ICs compare, using the error amplifier, the voltage of the internal voltage reference source with the feedback voltage from the VOUT pin through split resistors, R1 and R2. Phase compensation is performed on the resulting error amplifier output, to input a signal to the PWM comparator to determine the turn-on time during PWM operation. The PWM comparator compares, in terms of voltage level, the signal from the error amplifier with the ramp wave from the ramp wave circuit, and delivers the resulting output to the buffer driver circuit to cause the Lx pin to output a switching duty cycle. This process is continuously performed to ensure stable output voltage. The current feedback circuit monitors the P-channel MOS driver transistor current for each switching operation, and modulates the error amplifier output signal to provide multiple feedback signals. This enables a stable feedback loop even when a low ESR capacitor such as a ceramic capacitor is used ensuring stable output voltage.

<Reference Voltage Source>
The reference voltage source provides the reference voltage to ensure stable output voltage of the DC/DC converter.

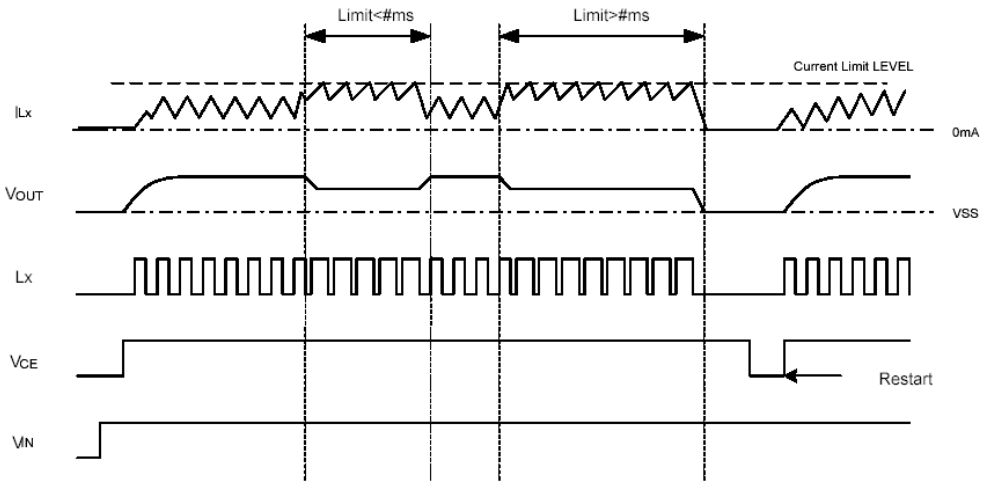
<Ramp Wave Circuit>
The ramp wave circuit determines switching frequency. The frequency is fixed internally 1.2MHz. Clock pulses generated in this circuit are used to produce ramp waveforms needed for PWM operation, and to synchronize all the internal circuits.

<Error Amplifier>
The error amplifier is designed to monitor output voltage. The amplifier compares the reference voltage with the feedback voltage divided by the internal split resistors, R1 and R2. When a voltage lower than the reference voltage is fed back, the output voltage of the error amplifier increases. The gain and frequency characteristics of the error amplifier output are fixed internally to deliver an optimized signal to the mixer.

<Current Limit>
The current limiter circuit of the XC9232 series monitors the current flowing through the P-channel MOS driver transistor connected to the Lx pin, and features a combination of the current limit mode and the operation suspension mode.

① When the driver current is greater than a specific level, the current limit function operates to turn off the pulses from the Lx pin at any given timing.
② When the driver transistor is turned off, the limiter circuit is then released from the current limit detection state.
③ At the next pulse, the driver transistor is turned on. However, the transistor is immediately turned off in the case of an over current state.
④ When the over current state is eliminated, the IC resumes its normal operation.

The IC waits for the over current state to end by repeating the steps ① through ③. If an over current state continues for a few ms and the above three steps are repeatedly performed, the IC performs the function of latching the OFF state of the driver transistor, and goes into operation suspension mode. Once the IC is in suspension mode, operations can be resumed by either turning the IC off via the CE pin, or by restoring power to the V_{IN} pin. The suspension mode does not mean a complete shutdown, but a state in which pulse output is suspended; therefore, the internal circuitry remains in operation. The current limit of the XC9232 series can be set at 1050mA at typical. Besides, care must be taken when laying out the PC Board, in order to prevent misoperation of the current limit mode. Depending on the state of the PC Board, latch time may become longer and latch operation may not work. In order to avoid the effect of noise, the board should be laid out so that input capacitors are placed as close to the IC as possible.



■OPERATIONAL DESCRIPTION (Continued)

<Short-Circuit Protection>
The short-circuit protection circuit monitors the internal R1 and R2 divider voltage from the V_{OUT} pin (refer to FB point in the block diagram shown in the previous page). In case where output is accidentally shorted to the Ground and when the FB point voltage decreases less than half of the reference voltage (Vref) and a current more than the I_{LIM} flows to the Pch MOS driver transistor, the short-circuit protection quickly operates to turn off and to latch the driver transistor. In latch mode, the operation can be resumed by either turning the IC off and on via the CE pin, or by restoring power supply to the V_{IN} pin.
When sharp load transient happens, a voltage drop at the V_{OUT} is propagated to the FB point through C_{FB}, as a result, short circuit protection may operate in the voltage higher than 1/2 V_{OUT} voltage.

<UVLO Circuit>
When the V_{IN} pin voltage becomes 1.4V or lower, the Pch MOS driver transistor output driver transistor is forced OFF to prevent false pulse output caused by unstable operation of the internal circuitry. When the V_{IN} pin voltage becomes 1.8V or higher, switching operation takes place. By releasing the UVLO function, the IC performs the soft start function to initiate output startup operation. The soft start function operates even when the V_{IN} pin voltage falls momentarily below the UVLO operating voltage. The UVLO circuit does not cause a complete shutdown of the IC, but causes pulse output to be suspended; therefore, the internal circuitry remains in operation.

<PFM Switch Current>
In PFM control operation, until coil current reaches to a specified level (I_{PFM}), the IC keeps the Pch MOS driver transistor on. In this case, time that the Pch MOS driver transistor is kept on (t_{ON}) can be given by the following formula.
$t_{ON} = L \times I_{PFM} / (V_{IN} - V_{OUT})$ →I_{PFM}①

< PFM Duty Limit >
In PFM control operation, the PFM duty limit (DTY_{LIMIT_PFM}) is set to 200% (TYP.). Therefore, under the condition that the duty increases (e.g. the condition that the step-down ratio is small), it's possible for Pch MOS driver transistor to be turned off even when coil current doesn't reach to I_{PFM}. →I_{PFM}②

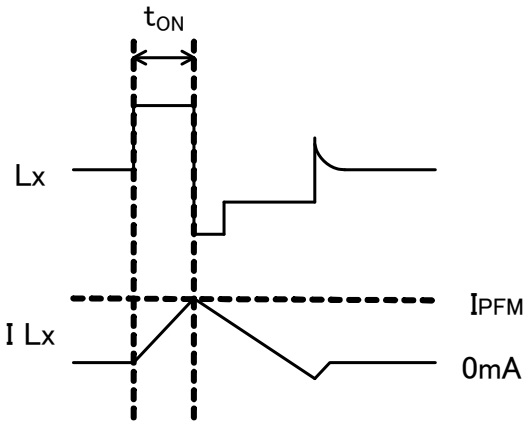


図 IPFM ①

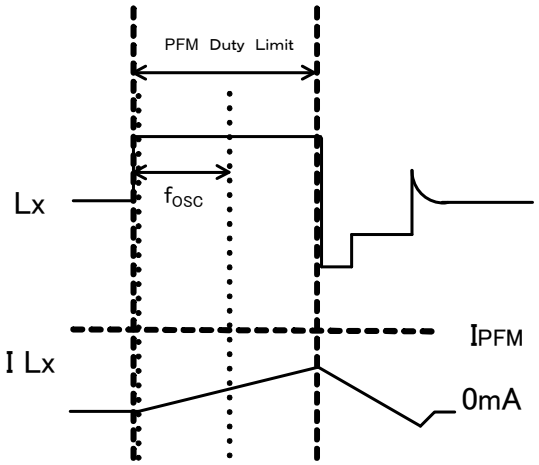


図 IPFM ②

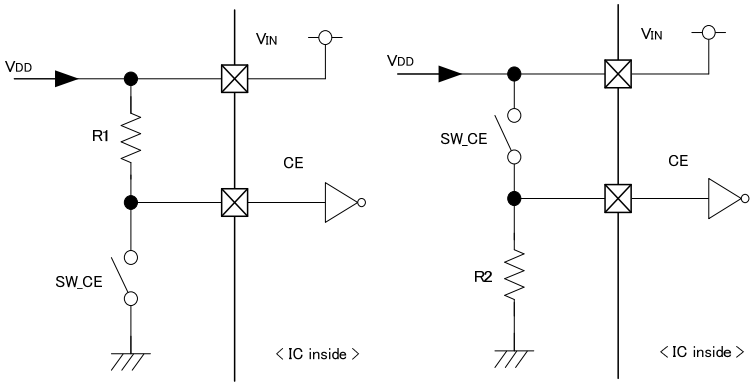
■OPERATIONAL DESCRIPTION (Continued)

<CE Pin Function>
The operation of the XC9232 series will enter into the shut down mode when a low level signal is input to the CE pin. During the shutdown mode, the current consumption of the IC becomes 0μA (TYP.), with a state of high impedance at the Lx pin and VOUT pin. The IC starts its operation by inputting a high level signal to the CE pin. The input to the CE pin is a CMOS input and the sink current is 0μA (TYP.).

●XC9232 series - Examples of how to use CE pin

SW_CE	STATUS
ON	Stand-by
OFF	Operation

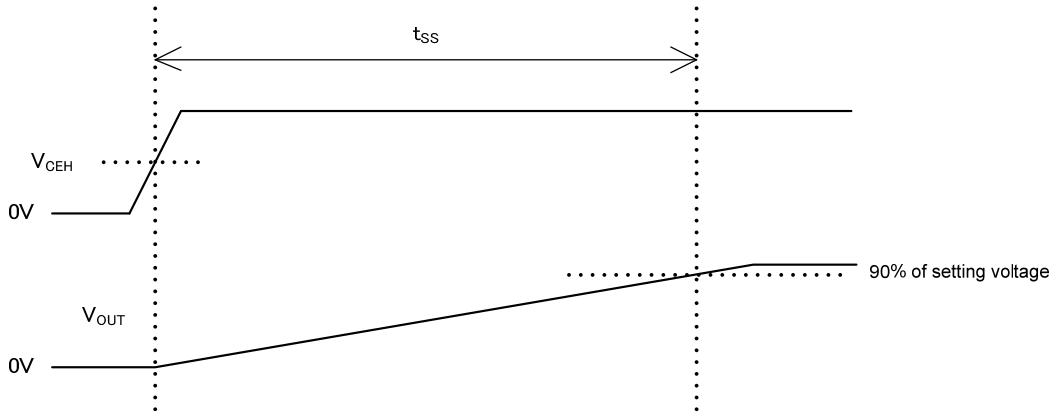
SW_CE	STATUS
ON	Operation
OFF	Stand-by



(A) (B)

■OPERATIONAL DESCRIPTION (Continued)

＜Soft Start＞
Soft start time of XC9232 series is optimized internally.
Soft start time is defined as the time interval to reach 90% of the output voltage from the time when the CE pin is turned on.



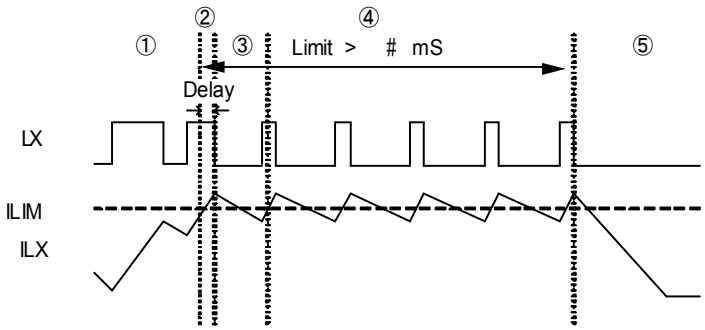
■ FUNCTION CHART

CE VOLTAGE LEVEL	OPERATIONAL STATES
	XC9232
H Level (*1)	Synchronous PWM/PFM Automatic Switching
L Level (*2)	Stand-by

Note on CE pin voltage level range
(*1) H level: 0.65V ≦ H level ≦ V_{IN}
(*2) L level: 0V ≦ L level ≦ 0.25V

■NOTE ON USE

1. Please use this IC within the stated maximum ratings. For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.
2. XC9232 series is designed for use with ceramic output capacitors. If, however, the potential difference is too large between the input voltage and the output voltage, a ceramic capacitor may fail to absorb the resulting high switching energy and oscillation could occur on the output. If the input-output potential difference is large, connect an electrolytic capacitor in parallel to compensate for insufficient capacitance.
3. Spike noise and ripple voltage arise in a switching regulator as with a DC/DC converter. These are greatly influenced by external component selection, such as the coil inductance, capacitance values, and board layout of external components. Once the design has been completed, verification with actual components should be done.
4. Depending on the input-output voltage differential, or load current, some pulses may be skipped, and the ripple voltage may increase.
5. When the difference between V_{IN} and V_{OUT} is large in PWM control, very narrow pulses will be outputted, and there is the possibility that some cycles may be skipped completely.
6. When the difference between V_{IN} and V_{OUT} is small, and the load current is heavy, very wide pulses will be outputted and there is the possibility that some cycles may be skipped completely.
7. With the IC, the peak current of the coil is controlled by the current limit circuit. Since the peak current increases when dropout voltage or load current is high, current limit starts operation, and this can lead to instability. When peak current becomes high, please adjust the coil inductance value and fully check the circuit operation. In addition, please calculate the peak current according to the following formula:
   $I_{pk} = (V_{IN} - V_{OUT}) \times OnDuty / (2 \times L \times f_{OSC}) + I_{OUT}$
   L: Coil Inductance Value
   f_{OSC}: Oscillation Frequency
8. When the peak current which exceeds limit current flows within the specified time, the built-in Pch MOS driver transistor turns off. During the time until it detects limit current and before the built-in transistor can be turned off, the current for limit current flows; therefore, care must be taken when selecting the rating for the external components such as a coil.
9. Care must be taken when laying out the PC Board, in order to prevent misoperation of the current limit mode. Depending on the state of the PC Board, latch time may become longer and latch operation may not work. In order to avoid the effect of noise, the board should be laid out so that input capacitors are placed as close to the IC as possible.
10. Use of the IC at voltages below the recommended voltage range may lead to instability.
11. This IC should be used within the stated absolute maximum ratings in order to prevent damage to the device.
12. When the IC is used in high temperature, output voltage may increase up to input voltage level at no load because of the leak current of the driver transistor.
13. The current limit is set to 1350mA (MAX.) at typical. However, the current of 1350mA or more may flow. In case that the current limit functions while the V_{OUT} pin is shorted to the GND pin, when Pch MOS driver transistor is ON, the potential difference for input voltage will occur at both ends of a coil. For this, the time rate of coil current becomes large. By contrast, when Nch MOS driver transistor is ON, there is almost no potential difference at both ends of the coil since the V_{OUT} pin is shorted to the GND pin. Consequently, the time rate of coil current becomes quite small. According to the repetition of this operation, and the delay time of the circuit, coil current will be converged on a certain current value, exceeding the amount of current, which is supposed to be limited originally. Even in this case, however, after the over current state continues for several ms, the circuit will be latched. A coil should be used within the stated absolute maximum rating in order to prevent damage to the device.
   ①Current flows into Pch MOS driver transistor to reach the current limit (I_{LIM}).
   ②The current of I_{LIM} or more flows since the delay time of the circuit occurs during from the detection of the current limit to OFF of Pch MOS driver transistor.
   ③Because of no potential difference at both ends of the coil, the time rate of coil current becomes quite small.
   ④Lx oscillates very narrow pulses by the current limit for several ms.
   ⑤The circuit is latched, stopping its operation.



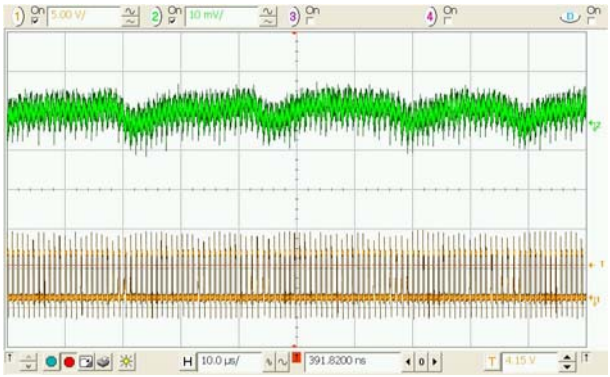
■NOTE ON USE (Continued)

14. In order to stabilize V_{IN}'s voltage level and oscillation frequency, we recommend that a by-pass capacitor (C_{IN}) be connected as close as possible to the V_{IN} & V_{SS} pins.
15. High step-down ratio and very light load may lead an intermittent oscillation.
16. Operating may become unstable at transition to continuous mode.
    Please verify with actual parts.

V_{OUT}=1.2V, fosc=1.2MHz
V_{IN}=5.5V, I_{OUT}=100mA

CH2:V_{OUT} 10mV/div

CH1:Lx 5.0V/div



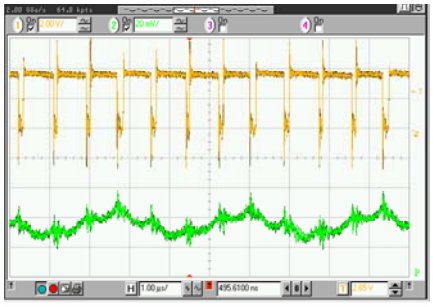
<External Components>
L : 4.7μH(NR4018)
C_{IN} : 4.7μF(Ceramic)
CL : 10μF(Ceramic)

17. Please note the inductance value of the coil. The IC may enter unstable operation if the combination of ambient temperature, setting voltage, oscillation frequency, and L value are not adequate.
    In the operation range close to the maximum duty cycle, The IC may happen to enter unstable output voltage operation even if using the L values listed below.

VOUT=3.3V,FOSC=1.2MHz
VIN=4.0V,IOUT=180mA

CH1:Lx 2.0/div

CH2:VOUT 20mV/div



L : 1.5μH(NR3015)
CIN : 4.7μF(Ceramic)
CL : 10μF(Ceramic)

●The Range of L Value

f_{OSC}	V_{OUT}	L Value
1.2MHz	1.0V,1.2V,1.5V 1.8V, 2.5V	3.3μH～6.8μH
	2.8V, 3.0V, 3.3V, 3.6V	4.7μH～6.8μH

*When a coil less value of 4.7μH is used at f_{OSC}=1.2MHz, peak coil current more easily reach the current limit ILMI. In this case, it may happen that the IC can not provide 600mA output current.

18. Torex places an importance on improving our products and its reliability.
    However, by any possibility, we would request user fail-safe design and post-aging treatment on system or equipment.

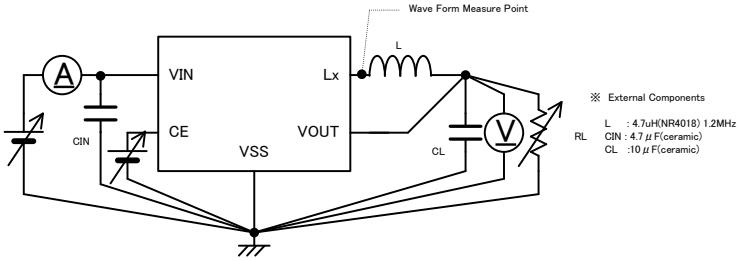
■NOTE ON USE (Continued)

●Instructions of pattern layouts

1. In order to stabilize VIN voltage level, we recommend that a by-pass capacitor (CIN) be connected as close as possible to the VIN & VSS pins.
2. Please mount each external component as close to the IC as possible.
3. Wire external components as close to the IC as possible and use thick, short connecting traces to reduce the circuit impedance.
4. Make sure that the PCB GND traces are as thick as possible, as variations in ground potential caused by high ground currents at the time of switching may result in instability of the IC.
5. This series' internal driver transistors bring on heat because of the output current and ON resistance of driver transistors.

■TEST CIRCUITS

< Circuit No.1 >



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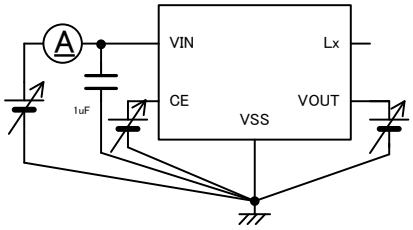

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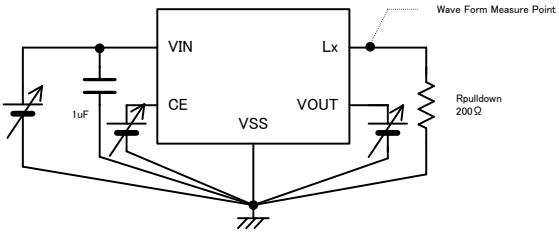

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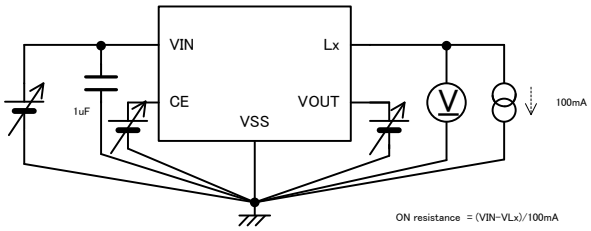

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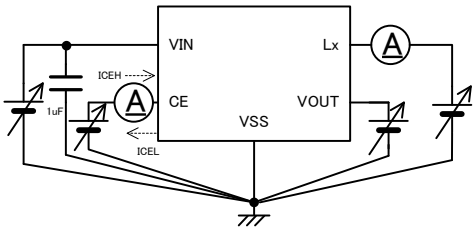

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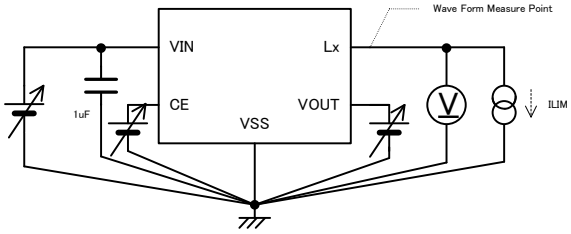

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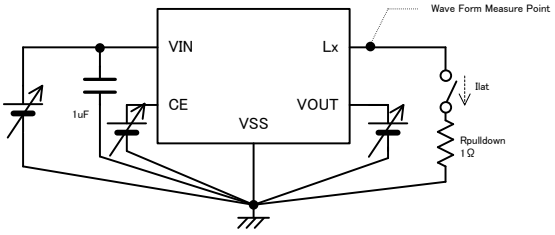

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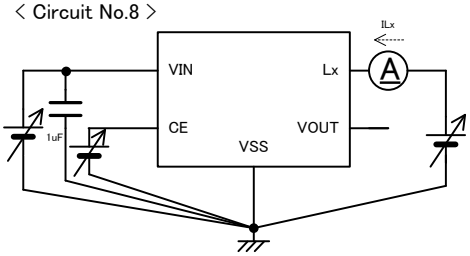

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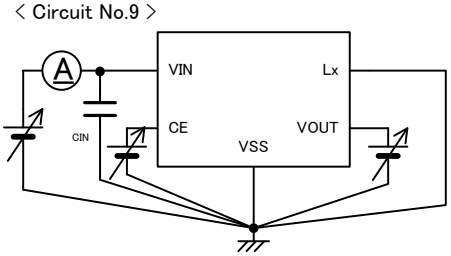
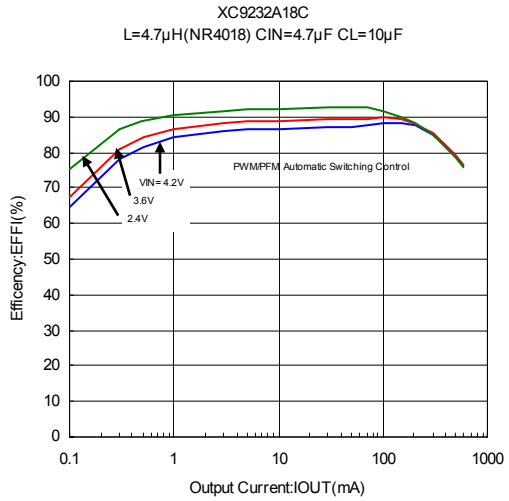
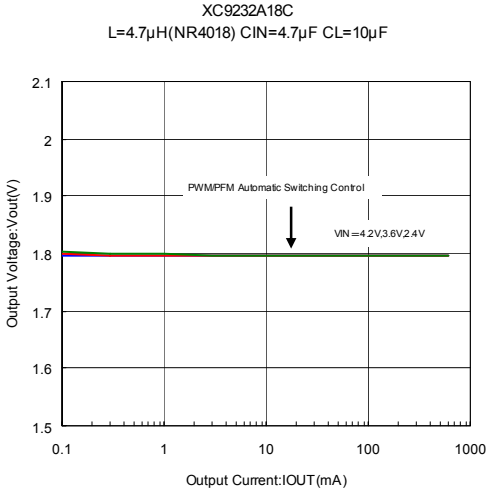


■TYPICAL PERFORMANCE CHARACTERISTICS

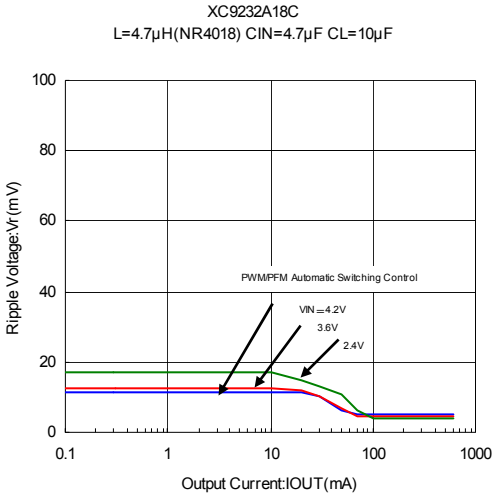
(1) Efficiency vs. Output Current



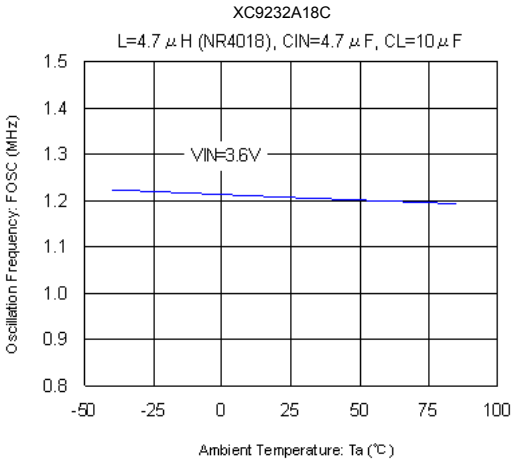
(2) Output Voltage vs. Output Current



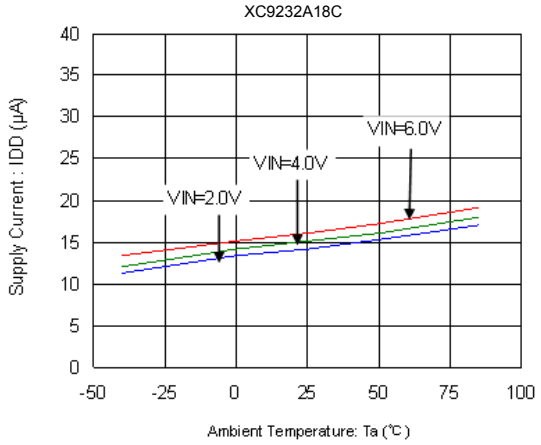
(3) Ripple Voltage vs. Output Current



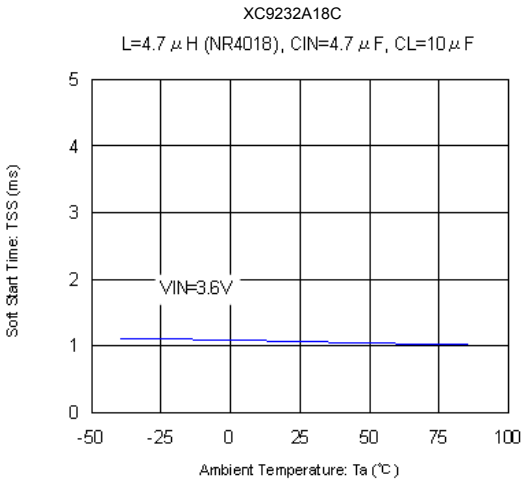
(4) Oscillation Frequency vs. Ambient Temperature



(5) Supply Current vs. Ambient Temperature



(6) Soft Start Time vs. Ambient Temperature



■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

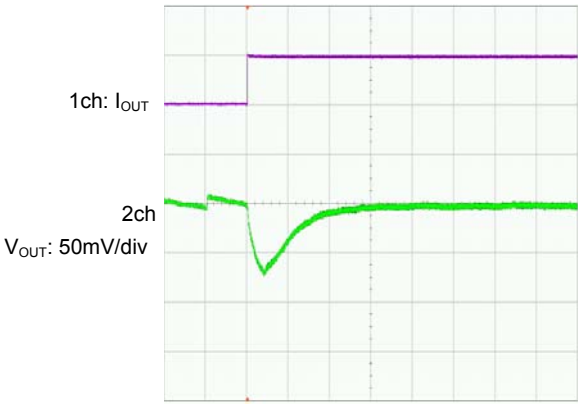
(7) Load Transient Response

XC9232A18C

L=4.7 μ H (NR4018), C_{IN}=4.7 μ F (ceramic), C_L=10 μ F (ceramic), Topr=25℃

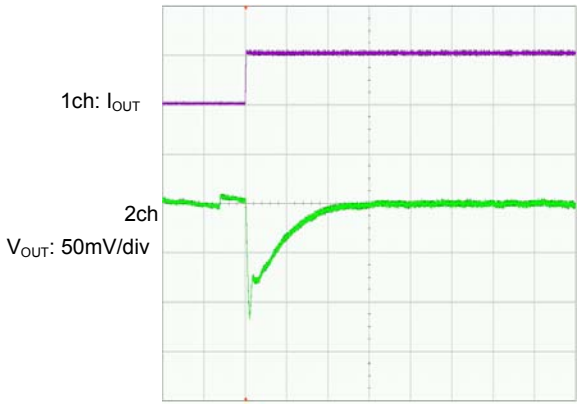
V_{IN}=3.6V, V_{CE}=V_{IN} (PWM/PFM Automatic Switching Control)

I_{OUT}=1mA → 100mA



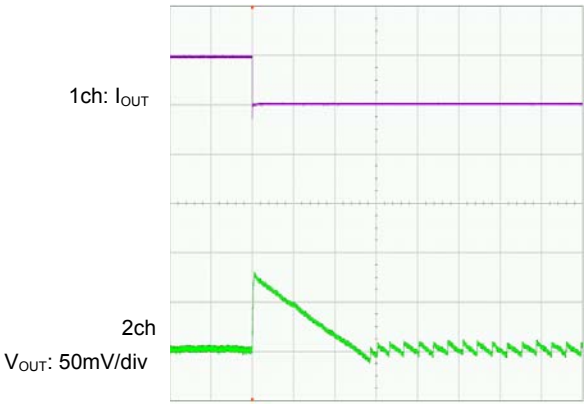
50 μ s/div

I_{OUT}=1mA → 300mA

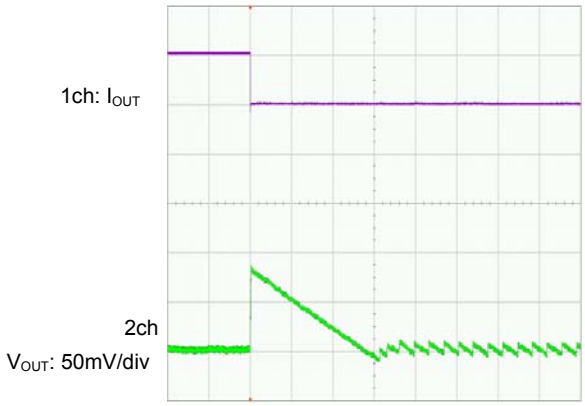


50 μ s/div

I_{OUT}=100mA → 1mA

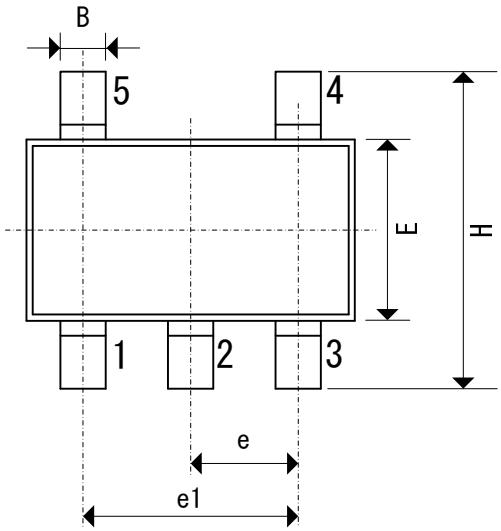


I_{OUT}=300mA → 1mA

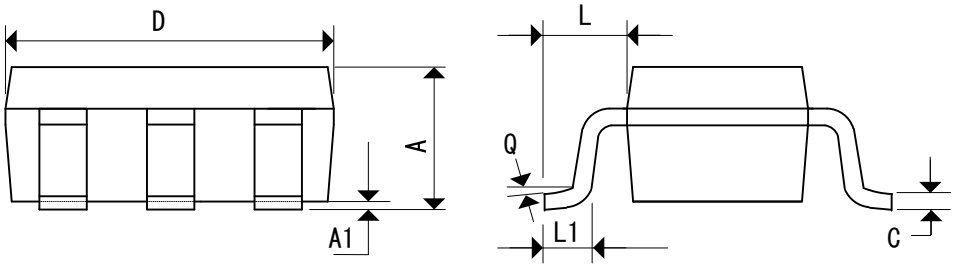


■PACKAGING INFORMATION

●SOT-25J(preliminary)



Dimension	Min.	Max.
A	0.9	1.45
A1	0.01	0.15
B	0.3	0.5
C	0.09	0.22
D	2.8	3.0
H	2.5	3.1
E	1.5	1.7
e	0.95 REF.	
e1	1.9 REF.	
L1	0.2	0.6
L	0.35	0.8
Q	0°	10°



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