

## 28V Low Power Consumption 150mA Voltage Regulators (with Stand-by Function)

☆AEC-Q100 Grade2

### ■ GENERAL DESCRIPTION

XD6216 series are positive voltage regulator ICs with 28V of operation voltage. The series consists of a voltage reference, an error amplifier, a current limiter, a thermal shutdown circuit and a phase compensation circuit plus a driver transistor.

The output voltage is selectable in 0.1V increments within the range of 1.8V to 12V using laser trimming technologies.

The output stabilization capacitor ( $C_L$ ) is also compatible with low ESR ceramic capacitors.

The over current protection circuit and the thermal shutdown circuit are built-in. These two protection circuits will operate when the output current reaches current limit level or the junction temperature reaches temperature limit level.

The CE function enables the output to be turned off and the IC becomes a stand-by mode resulting in greatly reduced power consumption.

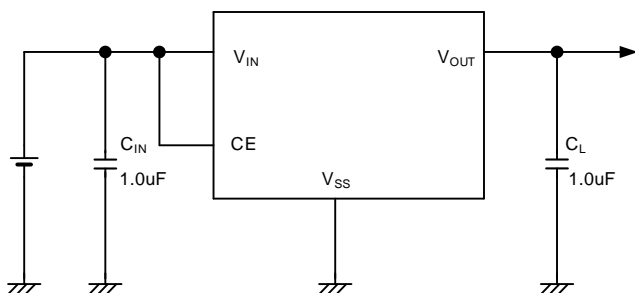
### ■ APPLICATIONS

- Car navigation systems
- Car audios
- Car-mounted camera
- Other automotive accessories

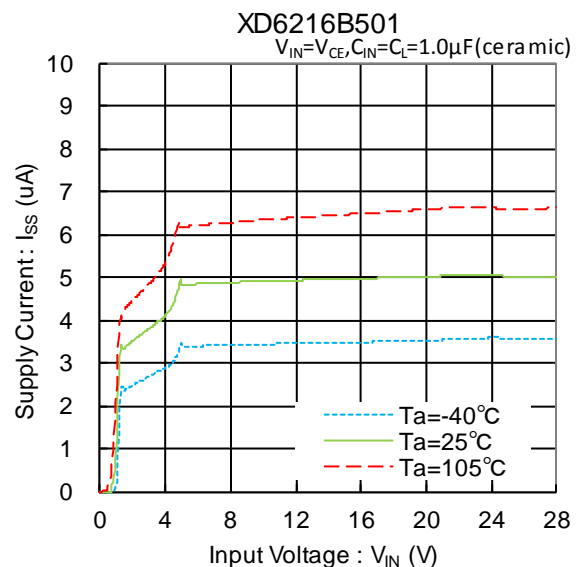
### ■ FEATURES

|                               |   |
|-------------------------------|---|
| Max Output Current            | : 150mA ( $V_{IN}=V_{OUT}+3.0V$ )   |
| Low Power Consumption         | : 5 $\mu$ A   |
| Stand-by Current              | : Less than 0.1 $\mu$ A   |
| Dropout Voltage               | : 190mV@ $I_{OUT}=20mA$<br>( $V_{OUT}=5.0V$ )                             |
| Input Voltage Range           | : 2.0V ~ 28.0V  |
| Output Voltage Range          | : 1.8V ~ 12.0V (0.1V Step)  |
| Fixed Output Accuracy         | : $\pm 1\%$ ( $V_{OUT} \geq 2.0V$ )<br>$\pm 20mV$ ( $V_{OUT} \leq 1.9V$ ) |
| High Ripple Rejection         | : 30dB@1kHz   |
| Built-in Protection           | : Current Limit<br>Thermal Shutdown                                       |
| Output Capacitor              | : Ceramic Capacitor Compatible  |
| Operating Ambient Temperature | : -40 $^{\circ}$ C ~ +105 $^{\circ}$ C                                    |
| Packages                      | : SOT-25<br>: SOT-89-5  |
| Environmentally Friendly      | : EU RoHS Compliant, Pb Free  |

### ■ TYPICAL APPLICATION CIRCUIT

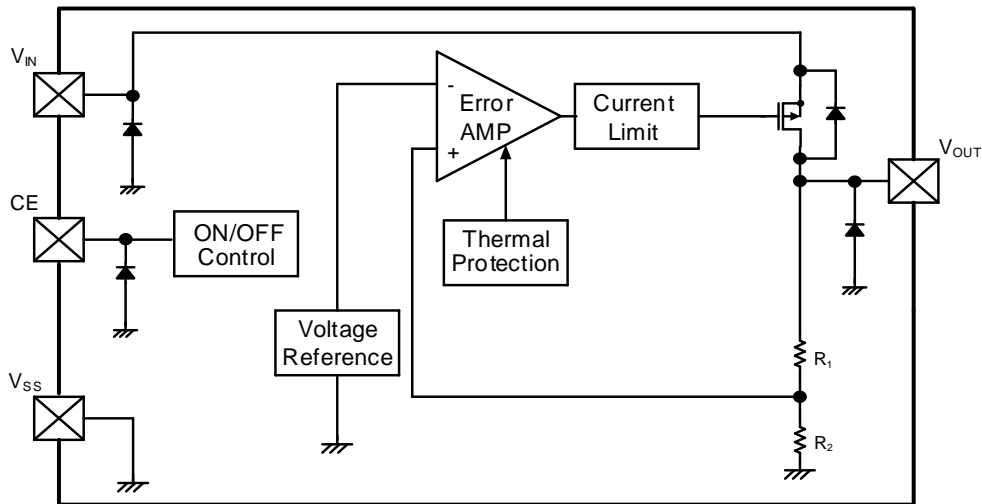


### ■ TYPICAL PERFORMANCE CHARACTERISTICS



## ■ BLOCK DIAGRAMS

### ● XD6216 Series



\*Diodes inside the circuit are an ESD protection diode and parasitic diodes.

## ■ PRODUCT CLASSIFICATION

### ● Ordering Information

XD6216①②③④⑤⑥-⑦<sup>(\*)</sup>

| DESIGNATOR          | ITEM                    | SYMBOL | DESCRIPTION  |
|---------------------|-------------------------|--------|--|
| ①                   | TYPE                    | B      | Refer to Selection Guide   |
| ②③                  | Output Voltage          | 18~C0  | For the voltage within 1.8V~9.9V (0.1V increments);<br>e.g. 2.5V ⇒ 25, 5.0V ⇒ 50<br>For the voltage within 10.0V~12.0V (0.1V increments);<br>e.g. 10.6V ⇒ A6, 11.2V ⇒ B2, 12.0V ⇒ C0 |
| ④                   | Output Voltage Accuracy | 1      | ±1%  |
| ⑤⑥-⑦ <sup>(*)</sup> | Packages (Order Unit)   | MR-Q   | SOT-25 (3,000pcs/Reel)   |
|                     |                         | PR-Q   | SOT-89-5 (1,000pcs/Reel)   |

<sup>(\*)</sup> The "-Q" suffix denotes "AEC-Q100" and "Halogen and Antimony free" as well as being fully EU RoHS compliant.

### ● Selection Guide

| TYPE | CE function |
|------|-------------|
| B    | Yes         |

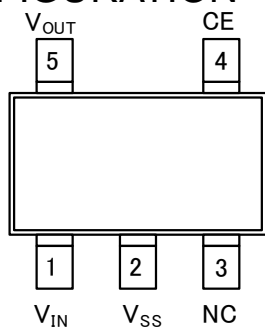
## ■ STANDARD VOLTAGE

### ● Examples for standard voltage

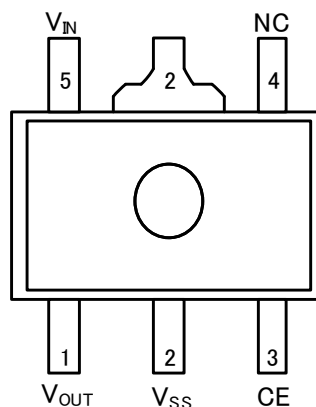
| V <sub>OUT</sub> | PACKAGES       |                |
|------------------|----------------|----------------|
|                  | SOT-25         | SOT-89-5       |
| 3.3V             | XD6216B331MR-Q | XD6216B331PR-Q |
| 5.0V             | XD6216B501MR-Q | XD6216B501PR-Q |
| 8.0V             | XD6216B801MR-Q | XD6216B801PR-Q |

Output voltages can be set internally from 1.8V to 12.0V. For other voltages, please contact your local Torex sales office or distribution

## ■ PIN CONFIGURATION



SOT-25  
(TOP VIEW)



SOT-89-5  
(TOP VIEW)

## ■ PIN ASSIGNMENT

| PIN NUMBER |          | PIN NAME         | FUNCTION           |
|------------|----------|------------------|--------------------|
| SOT-25     | SOT-89-5 |                  |                    |
| 1          | 5        | V <sub>IN</sub>  | Power Supply Input |
| 2          | 2        | V <sub>SS</sub>  | Ground             |
| 3          | 4        | NC               | No Connection      |
| 4          | 3        | CE               | ON/OFF Control     |
| 5          | 1        | V <sub>OUT</sub> | Output             |

## ■ FUNCTION

| PIN NAME | DESIGNATOR | IC OPERATION     |
|----------|------------|------------------|
| CE       | L          | Stand-by         |
|          | H          | Active           |
|          | OPEN       | Undefined state* |

\* Please avoid the state of OPEN, and make CE Pin arbitrary fixed potential.

## ■ ABSOLUTE MAXIMUM RATINGS

1) XD6216 Series

T<sub>a</sub>=25°C

| PARAMETER                             | SYMBOL           | RATINGS  | UNITS |
|---------------------------------------|------------------|--|-------|
| V <sub>IN</sub> Pin Voltage           | V <sub>IN</sub>  | -0.3 ~ +30.0   | V     |
| Output Current                        | I <sub>OUT</sub> | 300 <sup>(*)1</sup>                                  | mA    |
| Output Voltage                        | V <sub>OUT</sub> | -0.3 ~ V <sub>IN</sub> +0.3 or +30.0 <sup>(*)2</sup> | V     |
| CE Input Voltage                      | V <sub>CE</sub>  | -0.3 ~ +30.0   | V     |
| Power Dissipation                     | SOT-25           | 250  | mW    |
|                                       |                  | 600 (40mm x 40mm Standard board) <sup>(*)3</sup>     |       |
|                                       |                  | 760 (JESD51-7 board) <sup>(*)3</sup>                 |       |
|                                       | SOT-89-5         | 500  |       |
|                                       |                  | 1300 (40mm x 40mm Standard board) <sup>(*)3</sup>    |       |
| 1750 (JESD51-7 board) <sup>(*)3</sup> |                  |  |       |
| Operating Ambient Temperature         | T <sub>opr</sub> | -40 ~ +105   | °C    |
| Storage Temperature                   | T <sub>stg</sub> | -55 ~ +125   | °C    |

All voltages are described based on the V<sub>SS</sub>.

<sup>(\*)1</sup> Please use within the range of I<sub>OUT</sub> ≤ Pd / (V<sub>IN</sub>-V<sub>OUT</sub>)

<sup>(\*)2</sup> The maximum rating corresponds to the lowest value between V<sub>IN</sub>+0.3 or +30.0.

<sup>(\*)3</sup> The power dissipation figure shown is PCB mounted and is for reference only.

The mounting condition is please refer to PACKAGING INFORMATION.

## ELECTRICAL CHARACTERISTICS

Ta=25°C

| PARAMETER                                  | SYMBOL   | CONDITIONS   | MIN.     | TYP.      | MAX. | UNITS   | CIRCUIT |
|--|--|--|----------|-----------|------|---------|---------|
| Output Voltage                             | $V_{OUT(E)}^{(2)}$                               | $I_{OUT}=20mA, V_{CE}=V_{IN}$<br>$-40^{\circ}C \leq Ta \leq 105^{\circ}C$ <sup>(4)</sup>     | E-0      |           |      | V       | ①       |
| Maximum Output Current                     | $I_{OUTMAX}$                                     | $V_{IN}=V_{OUT(T)}+3.0V$ <sup>(1)</sup> , $V_{CE}=V_{IN}$<br>( $V_{OUT(T)} \geq 3.0V$ )      | 150      | -         | -    | mA      | ①       |
|  |  | $V_{IN}=V_{OUT(T)}+3.0V$ <sup>(1)</sup> , $V_{CE}=V_{IN}$<br>( $V_{OUT(T)} < 3.0V$ )         | 100      | -         | -    |         |         |
| Load Regulation                            | $\Delta V_{OUT}$                                 | $1mA \leq I_{OUT} \leq 50mA, V_{CE}=V_{IN}$<br>( $V_{OUT(T)} \leq 7.0V$ )                    | -        | 50        | 90   | mV      | ①       |
|  |  | $1mA \leq I_{OUT} \leq 50mA, V_{CE}=V_{IN}$<br>( $7.0V < V_{OUT(T)}$ )                       | -        | 110       | 140  | mV      | ①       |
| Dropout Voltage1                           | $V_{dif1}^{(3)}$                                 | $I_{OUT}=20mA, V_{CE}=V_{IN}$  | -        | E-1       |      | mV      | ①       |
| Dropout Voltage2                           | $V_{dif2}^{(3)}$                                 | $I_{OUT}=100mA, V_{CE}=V_{IN}$   | -        | E-2       |      | mV      | ①       |
| Supply Current                             | $I_{SS}$   | $V_{CE}=V_{IN}$<br>$-40^{\circ}C \leq Ta \leq 105^{\circ}C$ <sup>(4)</sup>                   | 1.0      | 5.0       | 9.0  | $\mu A$ | ②       |
|  |  |  | 0.3      | 5.0       | 10.0 |         |         |
| Stand-by Current                           | $I_{STB}$  | $V_{CE}=V_{SS}$<br>$-40^{\circ}C \leq Ta \leq 105^{\circ}C$ <sup>(4)</sup>                   | -        | 0.01      | 0.10 | $\mu A$ | ②       |
|  |  |  | -        | -         | 0.30 |         |         |
| Line Regulation1                           | $\Delta V_{OUT} / (\Delta V_{IN} \cdot V_{OUT})$ | $V_{OUT(T)}+2.0V \leq V_{IN} \leq 28.0V$<br>$I_{OUT}=5mA, V_{CE}=V_{IN}$                     | -        | 0.05      | 0.10 | %/V     | ①       |
| Line Regulation2                           | $\Delta V_{OUT} / (\Delta V_{IN} \cdot V_{OUT})$ | $V_{OUT(T)}+2.0V \leq V_{IN} \leq 28.0V$<br>$I_{OUT}=13mA, V_{CE}=V_{IN}$                    | -        | 0.15      | 0.30 | %/V     | ①       |
| Input Voltage                              | $V_{IN}$   | $-40^{\circ}C \leq Ta \leq 105^{\circ}C$ <sup>(4)</sup>                                      | 2.0      | -         | 28.0 | V       | -       |
| Output Voltage Temperature Characteristics | $\Delta V_{OUT} / (\Delta Topr \cdot V_{OUT})$   | $I_{OUT}=20mA, V_{CE}=V_{IN}$<br>$-40^{\circ}C \leq Topr \leq 105^{\circ}C$                  | -        | $\pm 100$ | -    | ppm/°C  | ①       |
| Power Supply Rejection Ratio               | PSRR   | $V_{IN}=[V_{OUT(T)}+2.0]V+0.5V_{P-PAC}$<br>$I_{OUT}=20mA, f=1kHz, V_{CE}=V_{IN}$             | -        | 30        | -    | dB      | ③       |
| Short Current                              | $I_{SHORT}$                                      | $V_{CE}=V_{IN}, V_{OUT}=V_{SS}$  | -        | 30        | -    | mA      | ①       |
| CE "H" Level Voltage                       | $V_{CEH}$  | -<br>$-40^{\circ}C \leq Ta \leq 105^{\circ}C$ <sup>(4)</sup>                                 | 1.1      | -         | 28.0 | V       | ④       |
| CE "L" Level Voltage                       | $V_{CEL}$  | -<br>$-40^{\circ}C \leq Ta \leq 105^{\circ}C$ <sup>(4)</sup>                                 | $V_{SS}$ | -         | 0.35 | V       | ④       |
| CE "H" Level Current                       | $I_{CEH}$  | $V_{IN}=V_{CE}=28.0V$<br>$-40^{\circ}C \leq Ta \leq 105^{\circ}C$ <sup>(4)</sup>             | -0.1     | -         | 0.1  | $\mu A$ | ②       |
|  |  |  | -0.1     | -         | 0.2  |         |         |
| CE "L" Level Current                       | $I_{CEL}$  | $V_{IN}=28.0V$<br>$V_{CE}=V_{SS}$<br>$-40^{\circ}C \leq Ta \leq 105^{\circ}C$ <sup>(4)</sup> | -0.1     | -         | 0.1  | $\mu A$ | ②       |
| Thermal Shutdown Detect Temperature        | $T_{TSD}$  | $V_{CE}=V_{IN}$ , Junction Temperature   | -        | 150       | -    | °C      | ④       |
| Thermal Shutdown Release Temperature       | $T_{TSR}$  | $V_{CE}=V_{IN}$ , Junction Temperature   | -        | 125       | -    | °C      | ④       |
| Thermal Shutdown Hysteresis Width          | $T_{TSD}-T_{TSR}$                                | $V_{CE}=V_{IN}$ , Junction Temperature   | -        | 25        | -    | °C      | -       |

Unless otherwise stated, ( $V_{IN}=V_{OUT(T)}+2.0V$ ).

**NOTE:**

(1):  $V_{OUT(T)}$ : Nominal output voltage

(2):  $V_{OUT(E)}$ : Effective output voltage

(i.e. the output voltage when " $V_{OUT(T)}+2.0V$ " is provided at the  $V_{IN}$  pin while maintaining a certain  $I_{OUT}$  value.)

(3):  $V_{dif} = \{V_{IN1} - V_{OUT1}\}$

$V_{OUT1}$ :  $V_{OUT(T)} < 3.0V$ , A voltage equal to 98% of the output voltage whenever an amply stabilized  $I_{OUT} \{V_{OUT(T)}+3.0V\}$  is input.

$V_{OUT1}$ :  $V_{OUT(T)} \geq 3.0V$ , A voltage equal to 98% of the output voltage whenever an amply stabilized  $I_{OUT} \{V_{OUT(T)}+2.0V\}$  is input.

$V_{IN1}$ : The input voltage when  $V_{OUT1}$  appears as input voltage is gradually decreased.

(4): The ambient temperature range ( $-40^{\circ}C \leq Ta \leq 105^{\circ}C$ ) is design Value.

## ■ ELECTRICAL CHARACTERISTICS (Continued)

● Voltage Chart1 (XD6216 Series)

| PARAMETER                 | E-0                |       |   |       | E-1                                      |     | E-2                                       |      |
|---------------------------|--------------------|-------|---|-------|--|-----|---|------|
| NOMINAL OUTPUT VOLTAGE(V) | Output Voltage (V) |       | Output Voltage (V)                        |       | DROPOUT VOLTAGE 1 (mV)<br>$I_{OUT}=20mA$ |     | DROPOUT VOLTAGE 2 (mV)<br>$I_{OUT}=100mA$ |      |
|                           | $T_a=25^{\circ}C$  |       | $-40^{\circ}C \leq T_a \leq 105^{\circ}C$ |       | $T_a=25^{\circ}C$                        |     | $T_a=25^{\circ}C$                         |      |
| $V_{OUT(T)}$              | $V_{OUT(E)}$       |       | $V_{OUT(E)}$                              |       | $V_{dif1}$                               |     | $V_{dif2}$                                |      |
|                           | MIN                | MAX   | MIN                                       | MAX   | TYP                                      | MAX | TYP                                       | MAX  |
| 1.8                       | 1.780              | 1.820 | 1.740                                     | 1.860 | 550                                      | 710 | 2200                                      | 2700 |
| 1.9                       | 1.880              | 1.920 | 1.840                                     | 1.960 |  |     |   |      |
| 2.0                       | 1.980              | 2.020 | 1.940                                     | 2.060 | 450                                      | 600 | 1900                                      | 2600 |
| 2.1                       | 2.079              | 2.121 | 2.037                                     | 2.163 |  |     |   |      |
| 2.2                       | 2.178              | 2.222 | 2.134                                     | 2.266 | 390                                      | 520 | 1700                                      | 2200 |
| 2.3                       | 2.277              | 2.323 | 2.231                                     | 2.369 |  |     |   |      |
| 2.4                       | 2.376              | 2.424 | 2.328                                     | 2.472 |  |     |   |      |
| 2.5                       | 2.475              | 2.525 | 2.425                                     | 2.575 |  |     |   |      |
| 2.6                       | 2.574              | 2.626 | 2.522                                     | 2.678 | 310                                      | 450 | 1500                                      | 1900 |
| 2.7                       | 2.673              | 2.727 | 2.619                                     | 2.781 |  |     |   |      |
| 2.8                       | 2.772              | 2.828 | 2.716                                     | 2.884 |  |     |   |      |
| 2.9                       | 2.871              | 2.929 | 2.813                                     | 2.987 |  |     |   |      |
| 3.0                       | 2.970              | 3.030 | 2.910                                     | 3.090 |  |     |   |      |
| 3.1                       | 3.069              | 3.131 | 3.007                                     | 3.193 |  |     |   |      |
| 3.2                       | 3.168              | 3.232 | 3.104                                     | 3.296 | 260                                      | 360 | 1300                                      | 1700 |
| 3.3                       | 3.267              | 3.333 | 3.201                                     | 3.399 |  |     |   |      |
| 3.4                       | 3.366              | 3.434 | 3.298                                     | 3.502 |  |     |   |      |
| 3.5                       | 3.465              | 3.535 | 3.395                                     | 3.605 |  |     |   |      |
| 3.6                       | 3.564              | 3.636 | 3.492                                     | 3.708 |  |     |   |      |
| 3.7                       | 3.663              | 3.737 | 3.589                                     | 3.811 |  |     |   |      |
| 3.8                       | 3.762              | 3.838 | 3.686                                     | 3.914 |  |     |   |      |
| 3.9                       | 3.861              | 3.939 | 3.783                                     | 4.017 |  |     |   |      |
| 4.0                       | 3.960              | 4.040 | 3.880                                     | 4.120 |  |     |   |      |
| 4.1                       | 4.059              | 4.141 | 3.977                                     | 4.223 |  |     |   |      |
| 4.2                       | 4.158              | 4.242 | 4.074                                     | 4.326 |  |     |   |      |
| 4.3                       | 4.257              | 4.343 | 4.171                                     | 4.429 |  |     |   |      |
| 4.4                       | 4.356              | 4.444 | 4.268                                     | 4.532 |  |     |   |      |
| 4.5                       | 4.455              | 4.545 | 4.365                                     | 4.635 |  |     |   |      |
| 4.6                       | 4.554              | 4.646 | 4.462                                     | 4.738 |  |     |   |      |
| 4.7                       | 4.653              | 4.747 | 4.559                                     | 4.841 |  |     |   |      |
| 4.8                       | 4.752              | 4.848 | 4.656                                     | 4.944 |  |     |   |      |
| 4.9                       | 4.851              | 4.949 | 4.753                                     | 5.047 |  |     |   |      |

## ■ ELECTRICAL CHARACTERISTICS (Continued)

● Voltage Chart1 (XD6216 Series) (Continued)

| PARAMETER                 | E-0                |       |   |       | E-1                                      |     | E-2                                       |      |
|---------------------------|--------------------|-------|---|-------|--|-----|---|------|
| NOMINAL OUTPUT VOLTAGE(V) | Output Voltage (V) |       | Output Voltage (V)                        |       | DROPOUT VOLTAGE 1 (mV)<br>$I_{OUT}=20mA$ |     | DROPOUT VOLTAGE 2 (mV)<br>$I_{OUT}=100mA$ |      |
|                           | $T_a=25^{\circ}C$  |       | $-40^{\circ}C \leq T_a \leq 105^{\circ}C$ |       | $T_a=25^{\circ}C$                        |     | $T_a=25^{\circ}C$                         |      |
| $V_{OUT(T)}$              | $V_{OUT(E)}$       |       | $V_{OUT(E)}$                              |       | $V_{dif1}$                               |     | $V_{dif2}$                                |      |
|                           | MIN                | MAX   | MIN                                       | MAX   | TYP                                      | MAX | TYP                                       | MAX  |
| 5.0                       | 4.950              | 5.050 | 4.850                                     | 5.150 | 190                                      | 280 | 1000                                      | 1300 |
| 5.1                       | 5.049              | 5.151 | 4.947                                     | 5.253 |  |     |   |      |
| 5.2                       | 5.148              | 5.252 | 5.044                                     | 5.356 |  |     |   |      |
| 5.3                       | 5.247              | 5.353 | 5.141                                     | 5.459 |  |     |   |      |
| 5.4                       | 5.346              | 5.454 | 5.238                                     | 5.562 |  |     |   |      |
| 5.5                       | 5.445              | 5.555 | 5.335                                     | 5.665 |  |     |   |      |
| 5.6                       | 5.544              | 5.656 | 5.432                                     | 5.768 |  |     |   |      |
| 5.7                       | 5.643              | 5.757 | 5.529                                     | 5.871 |  |     |   |      |
| 5.8                       | 5.742              | 5.858 | 5.626                                     | 5.974 |  |     |   |      |
| 5.9                       | 5.841              | 5.959 | 5.723                                     | 6.077 |  |     |   |      |
| 6.0                       | 5.940              | 6.060 | 5.820                                     | 6.180 |  |     |   |      |
| 6.1                       | 6.039              | 6.161 | 5.917                                     | 6.283 |  |     |   |      |
| 6.2                       | 6.138              | 6.262 | 6.014                                     | 6.386 |  |     |   |      |
| 6.3                       | 6.237              | 6.363 | 6.111                                     | 6.489 |  |     |   |      |
| 6.4                       | 6.336              | 6.464 | 6.208                                     | 6.592 |  |     |   |      |
| 6.5                       | 6.435              | 6.565 | 6.305                                     | 6.695 | 170                                      | 230 | 800                                       | 1150 |
| 6.6                       | 6.534              | 6.666 | 6.402                                     | 6.798 |  |     |   |      |
| 6.7                       | 6.633              | 6.767 | 6.499                                     | 6.901 |  |     |   |      |
| 6.8                       | 6.732              | 6.868 | 6.596                                     | 7.004 |  |     |   |      |
| 6.9                       | 6.831              | 6.969 | 6.693                                     | 7.107 |  |     |   |      |
| 7.0                       | 6.930              | 7.070 | 6.790                                     | 7.210 |  |     |   |      |
| 7.1                       | 7.029              | 7.171 | 6.887                                     | 7.313 |  |     |   |      |
| 7.2                       | 7.128              | 7.272 | 6.984                                     | 7.416 |  |     |   |      |
| 7.3                       | 7.227              | 7.373 | 7.081                                     | 7.519 |  |     |   |      |
| 7.4                       | 7.326              | 7.474 | 7.178                                     | 7.622 |  |     |   |      |
| 7.5                       | 7.425              | 7.575 | 7.275                                     | 7.725 |  |     |   |      |
| 7.6                       | 7.524              | 7.676 | 7.372                                     | 7.828 |  |     |   |      |
| 7.7                       | 7.623              | 7.777 | 7.469                                     | 7.931 |  |     |   |      |
| 7.8                       | 7.722              | 7.878 | 7.566                                     | 8.034 |  |     |   |      |
| 7.9                       | 7.821              | 7.979 | 7.663                                     | 8.137 |  |     |   |      |
| 8.0                       | 7.920              | 8.080 | 7.760                                     | 8.240 |  |     |   |      |

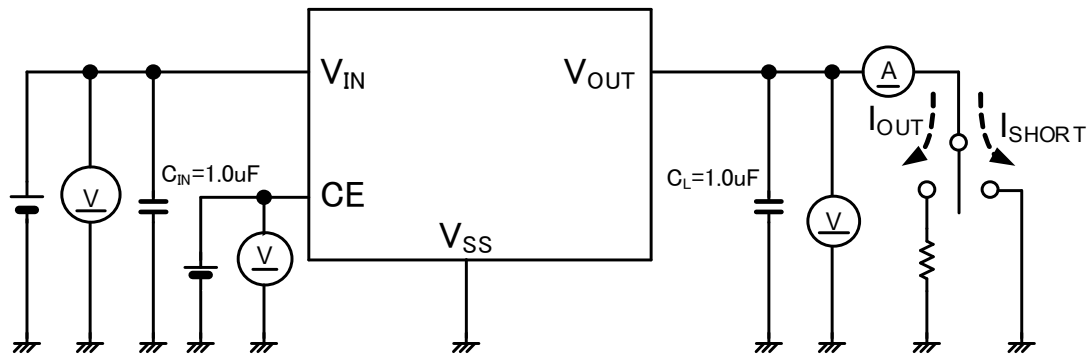
**■ ELECTRICAL CHARACTERISTICS (Continued)**

● Voltage Chart1 (XD6216 Series) (Continued)

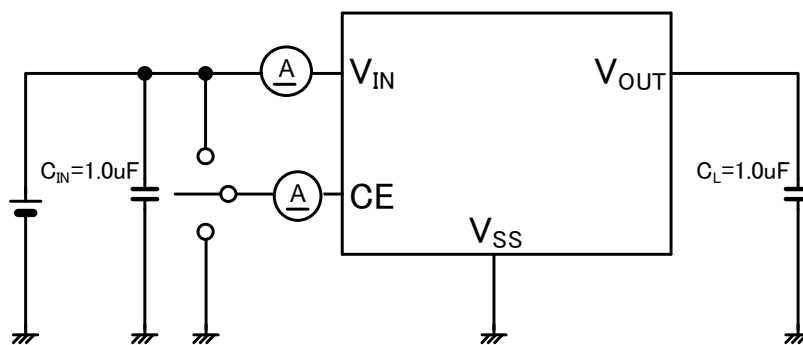
| PARAMETER                 | E-0                 |        |                     |        | E-1                                      |     | E-2                                       |     |
|---------------------------|---------------------|--------|---------------------|--------|--|-----|---|-----|
|                           | Output Voltage (V)  |        | Output Voltage (V)  |        | DROPOUT VOLTAGE 1 (mV)<br>$I_{OUT}=20mA$ |     | DROPOUT VOLTAGE 2 (mV)<br>$I_{OUT}=100mA$ |     |
| NOMINAL OUTPUT VOLTAGE(V) | Ta=25°C             |        | -40°C ≤ Ta ≤ 105°C  |        | Ta=25°C                                  |     | Ta=25°C                                   |     |
| V <sub>OUT(T)</sub>       | V <sub>OUT(E)</sub> |        | V <sub>OUT(E)</sub> |        | V <sub>dif1</sub>                        |     | V <sub>dif2</sub>                         |     |
|                           | MIN                 | MAX    | MIN                 | MAX    | TYP                                      | MAX | TYP                                       | MAX |
| 8.1                       | 8.019               | 8.181  | 7.857               | 8.343  | 130                                      | 190 | 700                                       | 950 |
| 8.2                       | 8.118               | 8.282  | 7.954               | 8.446  |  |     |   |     |
| 8.3                       | 8.217               | 8.383  | 8.051               | 8.549  |  |     |   |     |
| 8.4                       | 8.316               | 8.484  | 8.148               | 8.652  |  |     |   |     |
| 8.5                       | 8.415               | 8.585  | 8.245               | 8.755  |  |     |   |     |
| 8.6                       | 8.514               | 8.686  | 8.342               | 8.858  |  |     |   |     |
| 8.7                       | 8.613               | 8.787  | 8.439               | 8.961  |  |     |   |     |
| 8.8                       | 8.712               | 8.888  | 8.536               | 9.064  |  |     |   |     |
| 8.9                       | 8.811               | 8.989  | 8.633               | 9.167  |  |     |   |     |
| 9.0                       | 8.910               | 9.090  | 8.730               | 9.270  |  |     |   |     |
| 9.1                       | 9.009               | 9.191  | 8.827               | 9.373  |  |     |   |     |
| 9.2                       | 9.108               | 9.292  | 8.924               | 9.476  |  |     |   |     |
| 9.3                       | 9.207               | 9.393  | 9.021               | 9.579  |  |     |   |     |
| 9.4                       | 9.306               | 9.494  | 9.118               | 9.682  |  |     |   |     |
| 9.5                       | 9.405               | 9.595  | 9.215               | 9.785  |  |     |   |     |
| 9.6                       | 9.504               | 9.696  | 9.312               | 9.888  |  |     |   |     |
| 9.7                       | 9.603               | 9.797  | 9.409               | 9.991  |  |     |   |     |
| 9.8                       | 9.702               | 9.898  | 9.506               | 10.094 |  |     |   |     |
| 9.9                       | 9.801               | 9.999  | 9.603               | 10.197 |  |     |   |     |
| 10.0                      | 9.900               | 10.100 | 9.700               | 10.300 |  |     |   |     |
| 10.1                      | 9.999               | 10.201 | 9.797               | 10.403 | 120                                      | 160 | 650                                       | 850 |
| 10.2                      | 10.098              | 10.302 | 9.894               | 10.506 |  |     |   |     |
| 10.3                      | 10.197              | 10.403 | 9.991               | 10.609 |  |     |   |     |
| 10.4                      | 10.296              | 10.504 | 10.088              | 10.712 |  |     |   |     |
| 10.5                      | 10.395              | 10.605 | 10.185              | 10.815 |  |     |   |     |
| 10.6                      | 10.494              | 10.706 | 10.282              | 10.918 |  |     |   |     |
| 10.7                      | 10.593              | 10.807 | 10.379              | 11.021 |  |     |   |     |
| 10.8                      | 10.692              | 10.908 | 10.476              | 11.124 |  |     |   |     |
| 10.9                      | 10.791              | 11.009 | 10.573              | 11.227 |  |     |   |     |
| 11.0                      | 10.890              | 11.110 | 10.670              | 11.330 |  |     |   |     |
| 11.1                      | 10.989              | 11.211 | 10.767              | 11.433 |  |     |   |     |
| 11.2                      | 11.088              | 11.312 | 10.864              | 11.536 |  |     |   |     |
| 11.3                      | 11.187              | 11.413 | 10.961              | 11.639 |  |     |   |     |
| 11.4                      | 11.286              | 11.514 | 11.058              | 11.742 |  |     |   |     |
| 11.5                      | 11.385              | 11.615 | 11.155              | 11.845 |  |     |   |     |
| 11.6                      | 11.484              | 11.716 | 11.252              | 11.948 |  |     |   |     |
| 11.7                      | 11.583              | 11.817 | 11.349              | 12.051 |  |     |   |     |
| 11.8                      | 11.682              | 11.918 | 11.446              | 12.154 |  |     |   |     |
| 11.9                      | 11.781              | 12.019 | 11.543              | 12.257 |  |     |   |     |
| 12.0                      | 11.880              | 12.120 | 11.640              | 12.360 |  |     |   |     |

## TEST CIRCUITS

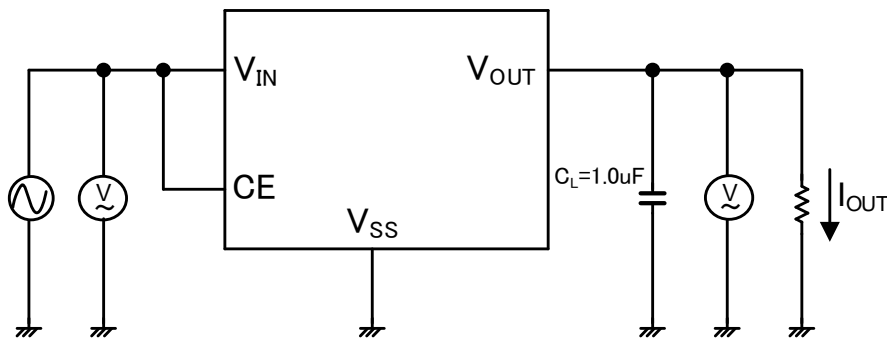
### ●CIRCUIT①



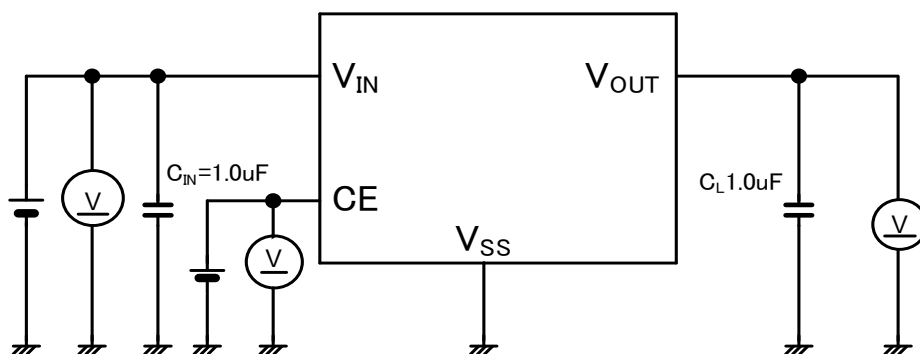
### ●CIRCUIT②



### ●CIRCUIT③



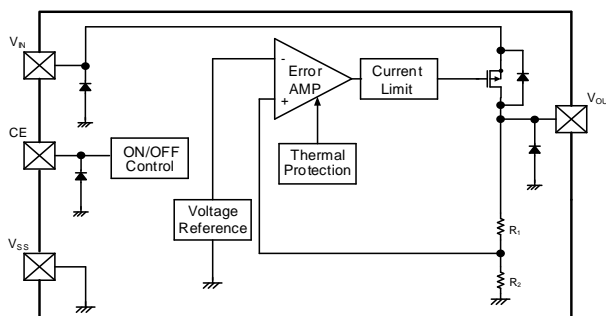
### ●CIRCUIT④





## OPERATIONAL EXPLANATION

The voltage divided by resistors  $R_1$  &  $R_2$  is compared with the internal voltage reference by the error amplifier. The P-channel MOSFET which is connected to the  $V_{OUT}$  pin is then driven by the subsequent controlled signal. The output voltage at the  $V_{OUT}$  pin is controlled and stabilized by a system of negative feedback. The current limit circuit and short protect circuit operate in relation to the level of output current and heat dissipation. Further, the IC's internal circuitry can be shutdown via the CE pin's signal.



\* Diodes shown in the above circuit are ESD protection diodes and parasitic diodes

### <Low ESR Capacitors>

The XD6216 series needs an output capacitor ( $C_L$ ) for phase compensation. In order to ensure the stable phase compensation, please place an output capacitor ( $C_L$ ) of 1.0 $\mu$ F or bigger at the  $V_{OUT}$  pin and  $V_{SS}$  pin as close as possible. For a stable power input, please connect an input capacitor ( $C_{IN}$ ) of 1.0 $\mu$ F between the input pin ( $V_{IN}$ ) and the ground pin ( $V_{SS}$ ). Since Input capacitor ( $C_{IN}$ ), the output capacitor ( $C_L$ ) are bias dependence of the capacitor the influence of the missing capacity due to temperature characteristics, also there is a risk that cannot be stable phase compensation. Please pay attention to the selection of the capacitor to be used.

### <Current limit Protection>

The XD6216 series includes a current fold-back circuit as a current limit protection. When the load current reaches the current limit level, the current fold-back circuit operates and output voltage drops. The output voltage drops further and output current decreases. When the output pin is shorted, a current of about 30mA flows.

### <CE Pin>

The IC's internal circuitry can be stand-by via the signal from the CE pin. In stand-by mode, output at the  $V_{OUT}$  pin will be pulled down by  $R_1$  and  $R_2$  to the  $V_{SS}$  level. Note that as the XD6216 series has no pull down resistor so that it will become unstable with the CE pin open. We suggest that you use this IC with either a  $V_{IN}$  voltage or a  $V_{SS}$  voltage input at the CE pin. If this IC is used with the correct specifications for the CE pin, the operational logic is fixed and the IC will operate normally. However, supply current may increase as a result of through current in the IC's internal circuitry if a medium voltage is applied.

### <Overheating Protection (Thermal Protection)>

The XD6216 series incorporates a thermal shutdown circuit for overheating protection. When the junction temperature of the built-in driver transistor reaches the temperature limit, the thermal shutdown circuit operates and the driver transistor will be set to OFF. The IC resumes its operation when the thermal shutdown function is released and the IC's operation is automatically restored because the junction temperature drops to the level of the thermal shutdown release temperature.

### <Minimum Operating Voltage>

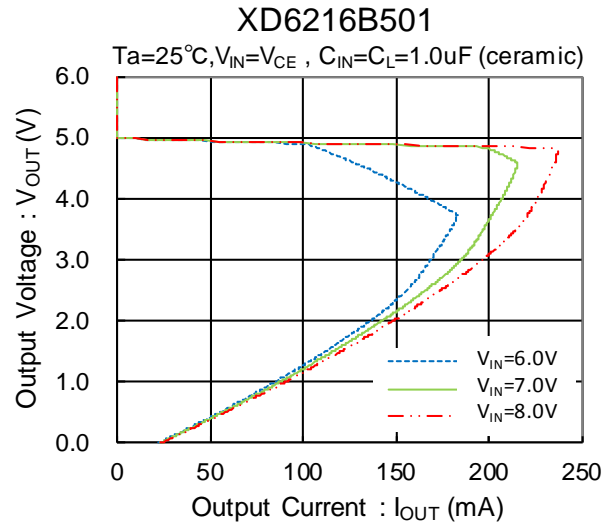
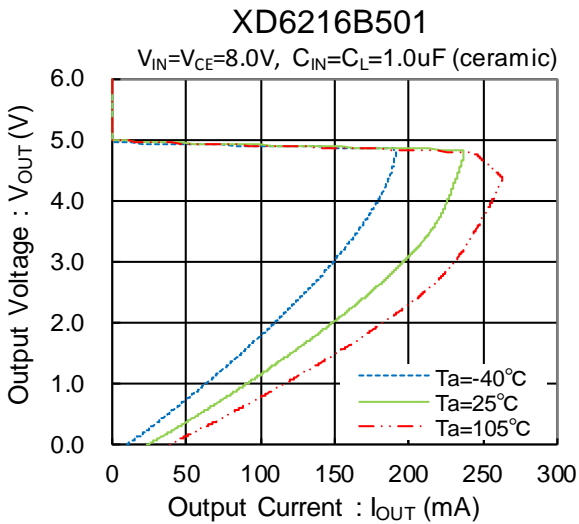
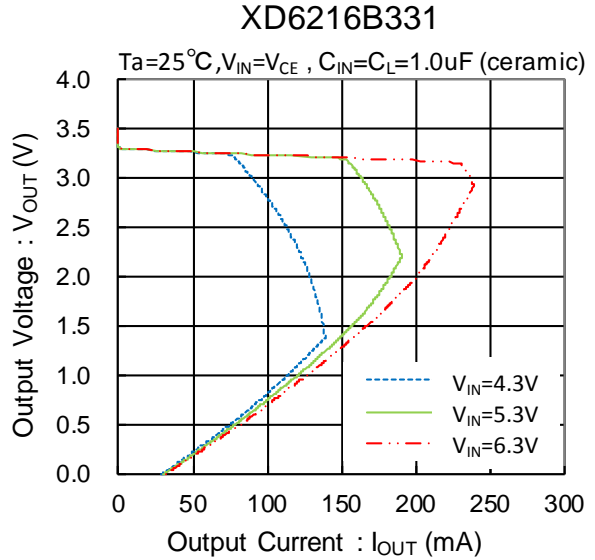
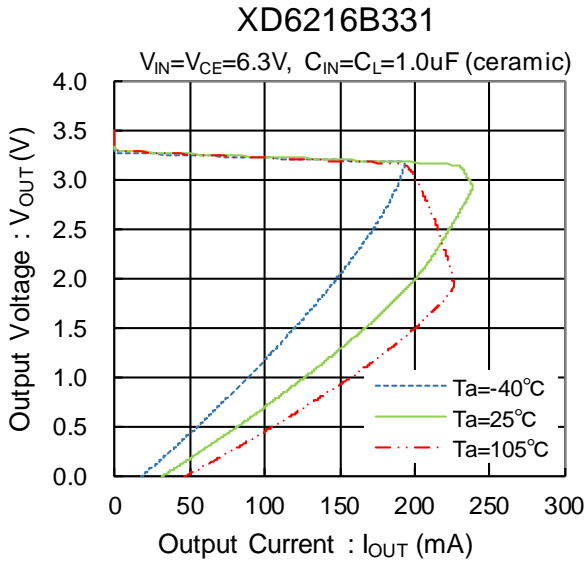
For the stable operation of the IC, over 2.0V of input voltage is necessary. The output voltage may not be generated normally if the input voltage is less than 2.0V.

## NOTES ON USE

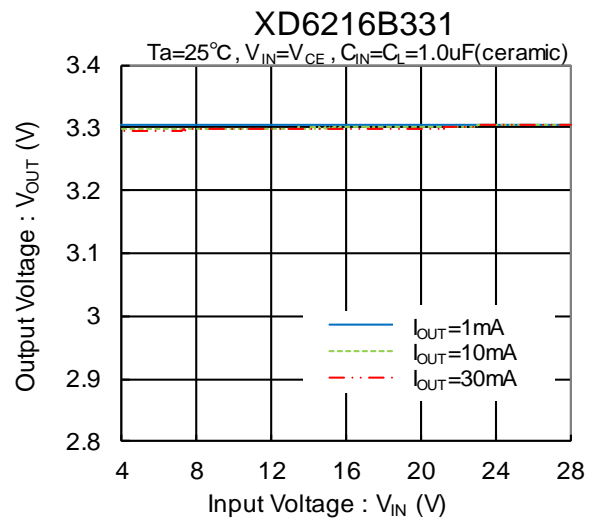
1. For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.
2. Where wiring impedance is high, operations may become unstable due to noise and/or phase lag depending on output current. Please strengthen  $V_{IN}$  and  $V_{SS}$  wiring in particular. The input capacitor ( $C_{IN}$ ) and the output capacitor ( $C_L$ ) should be placed to the IC as close as possible with a shorter wiring.
3. 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.

## TYPICAL PERFORMANCE CHARACTERISTICS

### (1) Output Voltage vs. Output Current

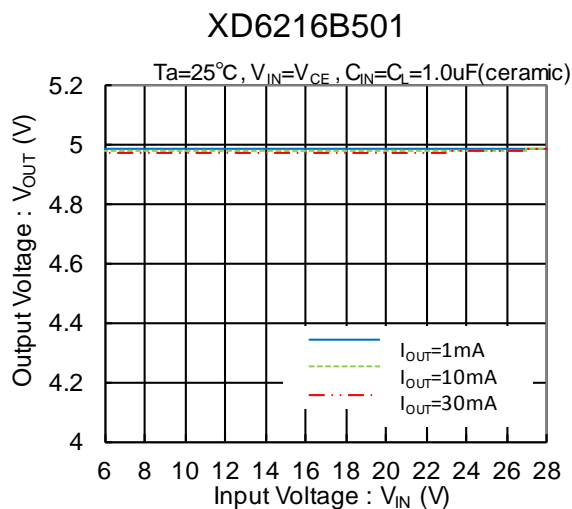


### (2) Output Voltage vs. Input Voltage

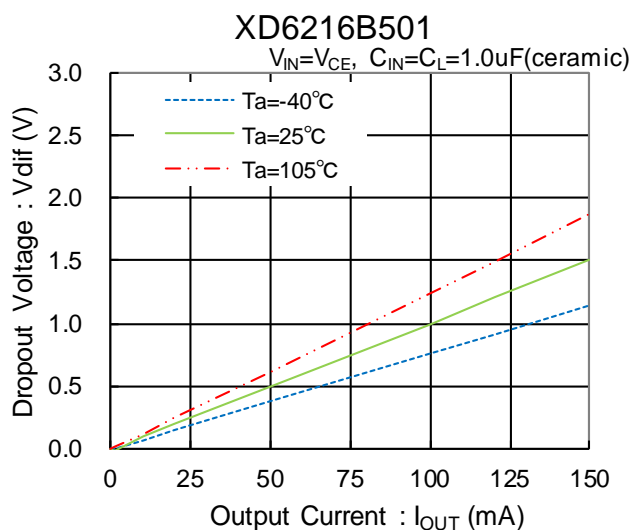
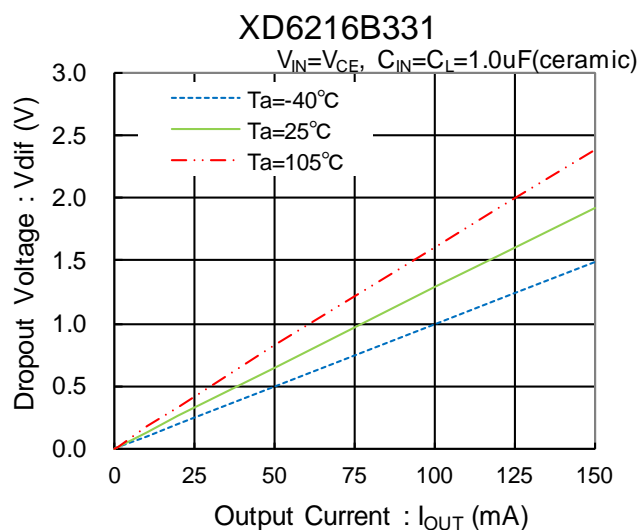


## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

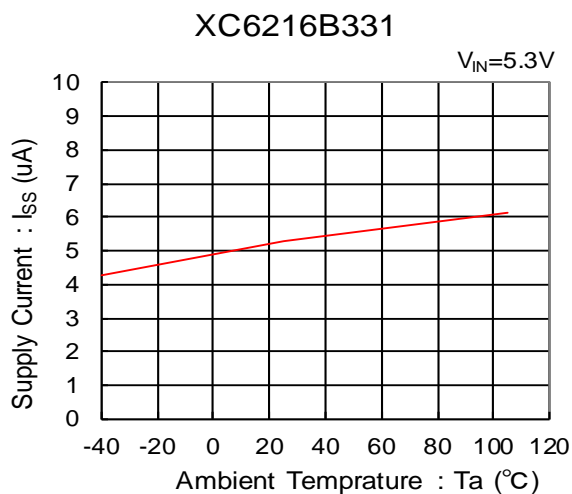
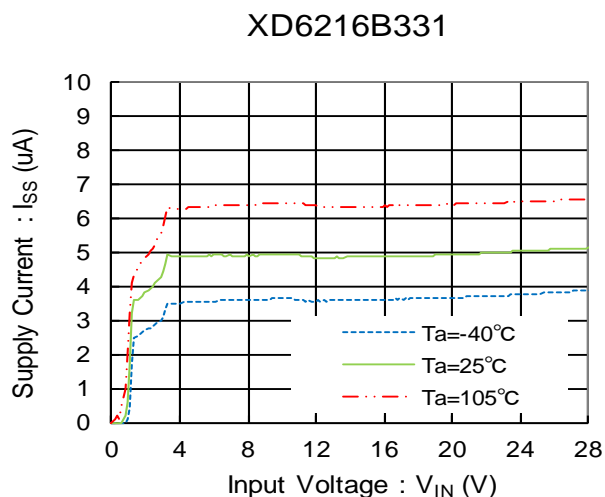
(2) Output Voltage vs. Input Voltage (Continued)



(3) Dropout Voltage vs. Output Current

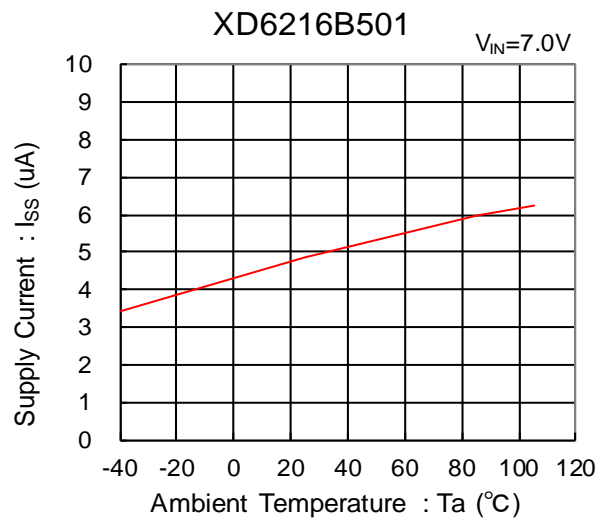
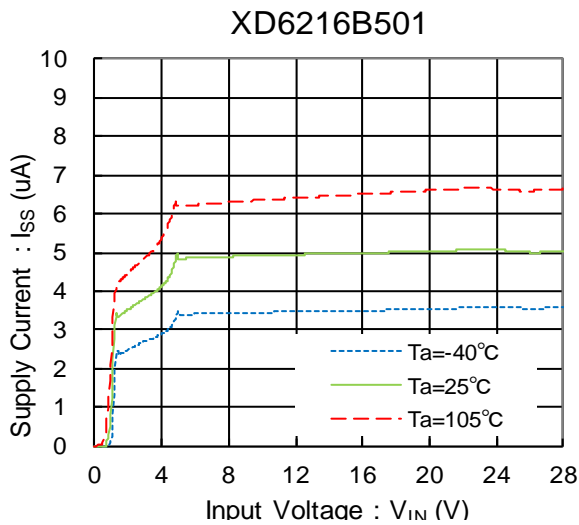


(4) Supply Current vs. Input Voltage

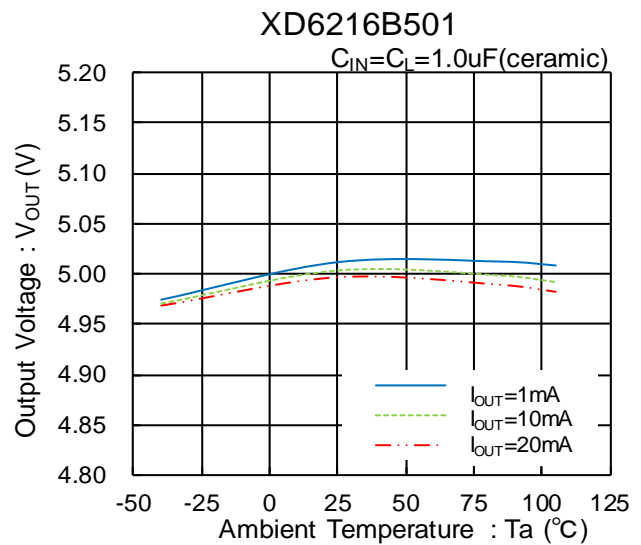
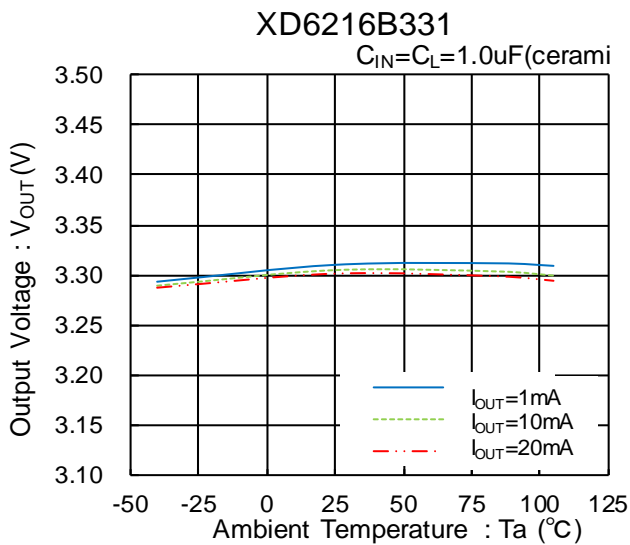


## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

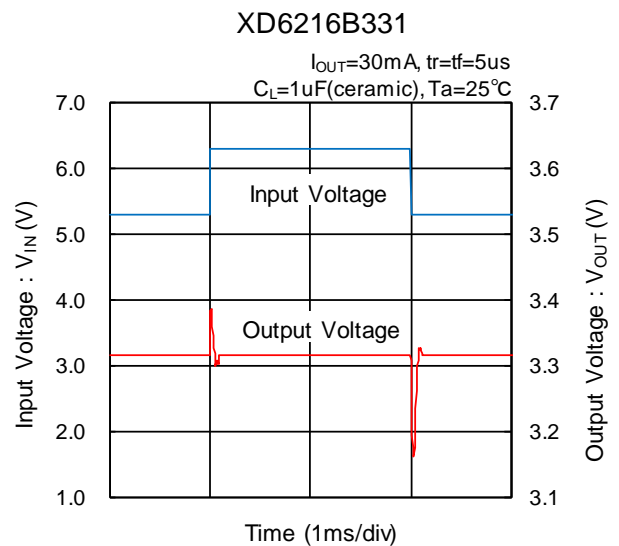
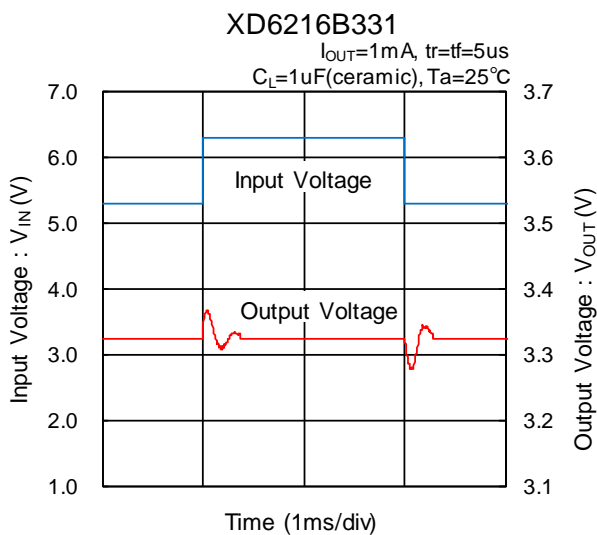
(4) Supply Current vs. Input Voltage (Continued)



(5) Output Voltage vs. Ambient Temperature

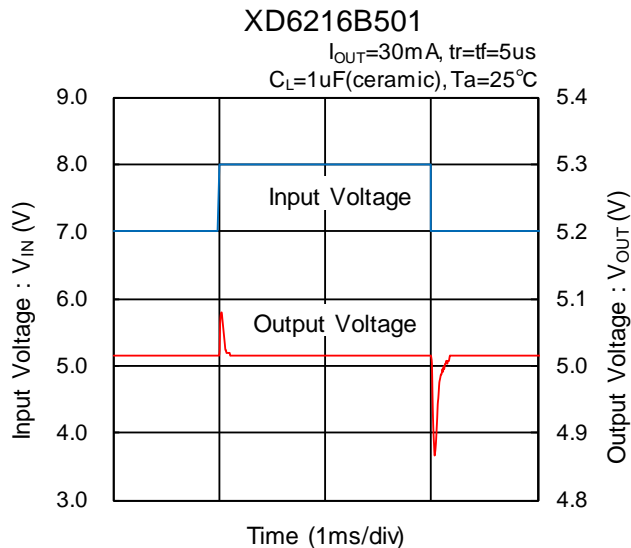


(6) Line Transient Response

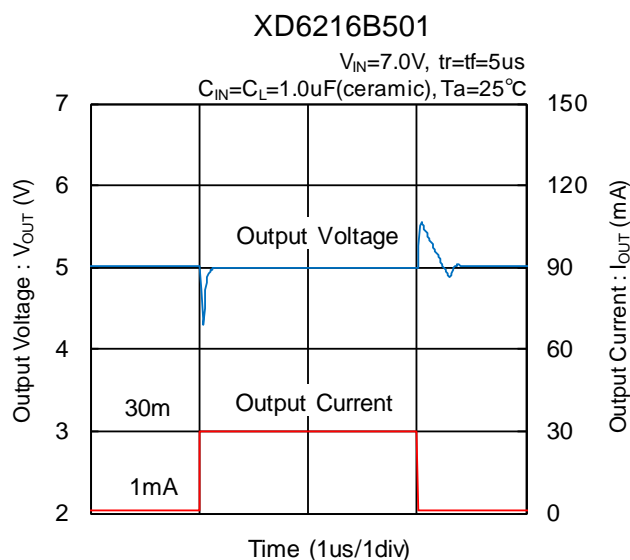
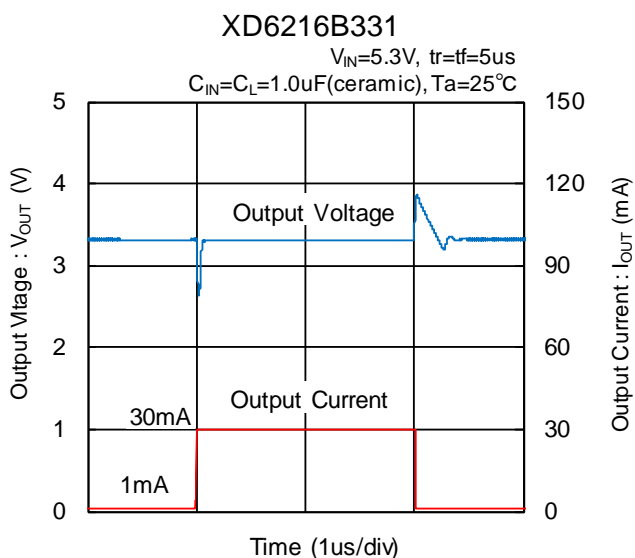


## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (6) Line Transient Response (Continued)



### (7) Load Transient Response

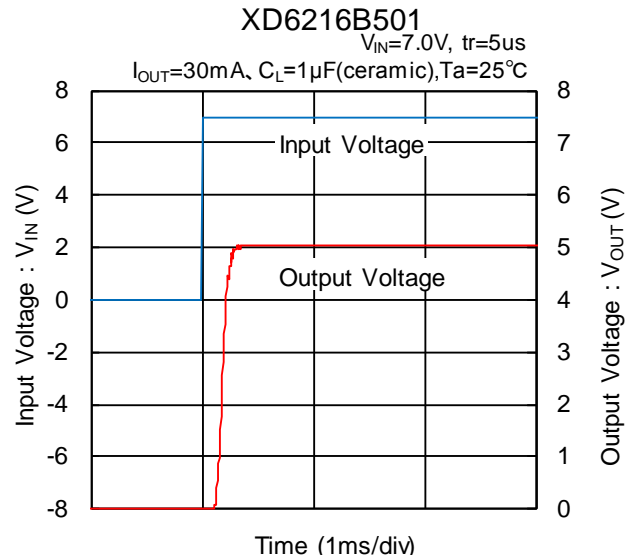
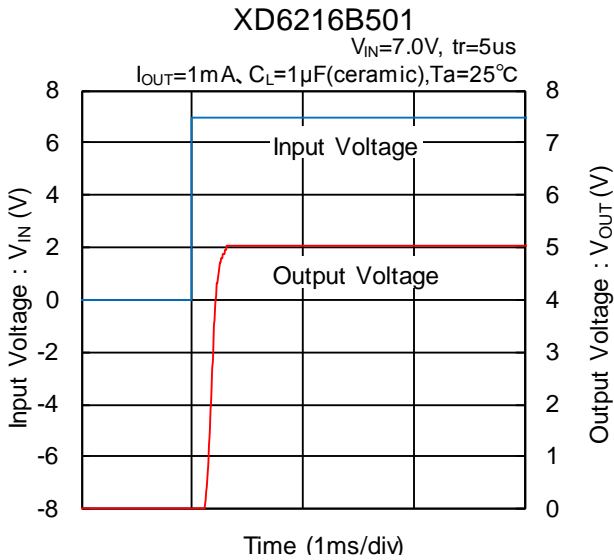


### (8) Input Rise Time

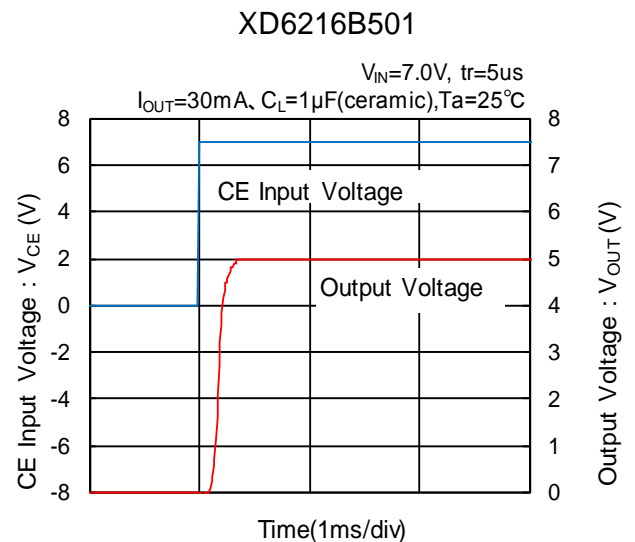
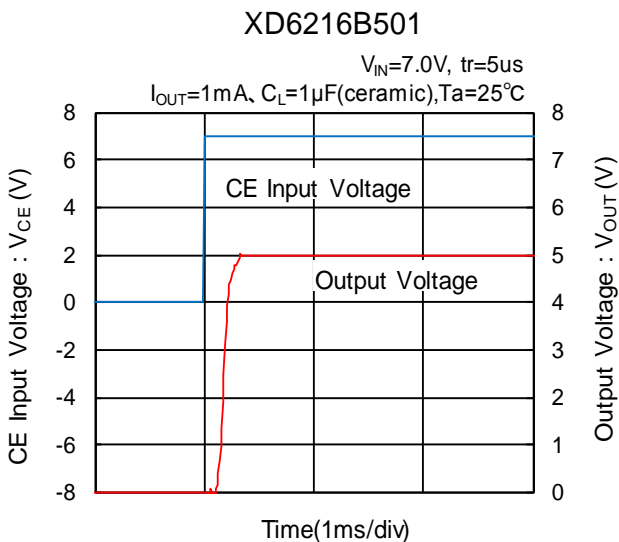
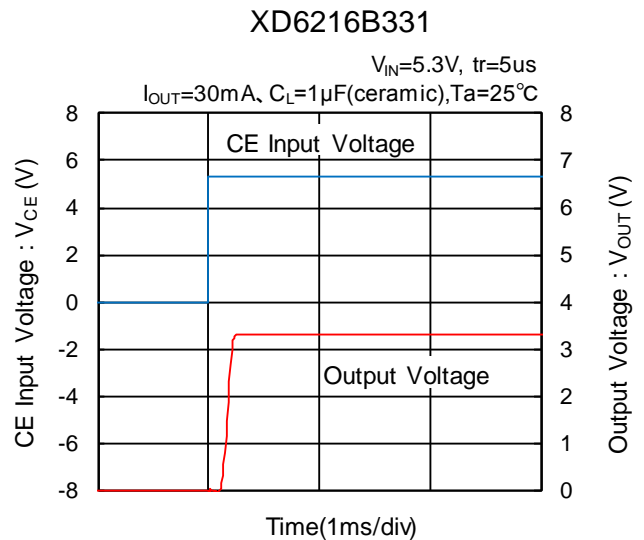
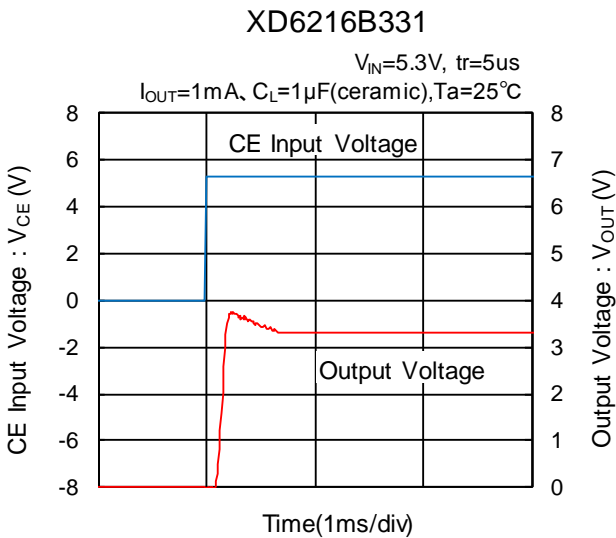


## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (8) Input Rise Time (Continued)

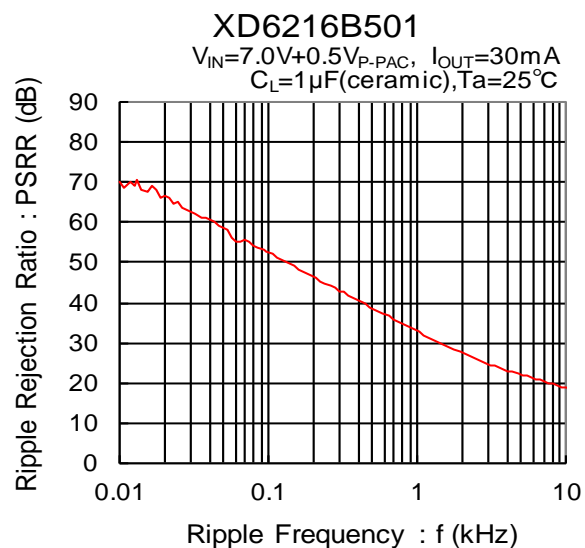
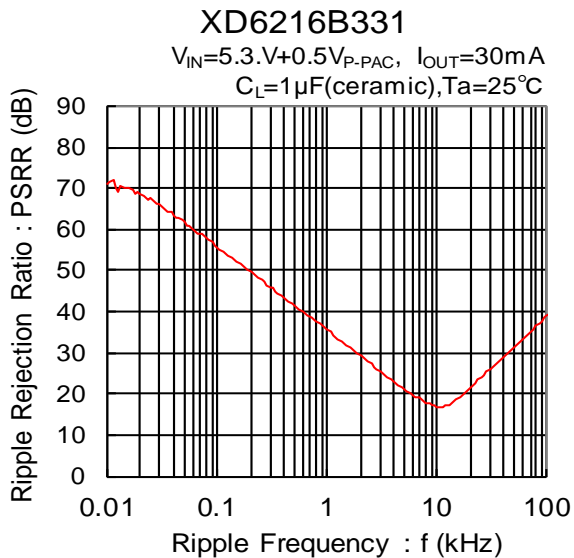
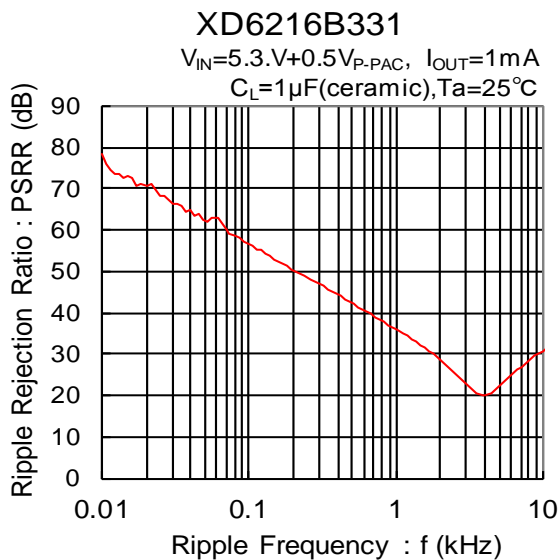


### (9) CE Rise Time



**TYPICAL PERFORMANCE CHARACTERISTICS (Continued)**

(10) Ripple Rejection Rate



## ■ PACKAGING INFORMATION

For the latest package information go to, [www.torexsemi.com/technical-support/packages](http://www.torexsemi.com/technical-support/packages)

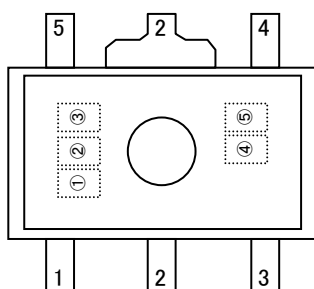
| PACKAGE  | OUTLINE / LAND PATTERN       | THERMAL CHARACTERISTICS |  |
|----------|------------------------------|-------------------------|--|
| SOT-25   | <a href="#">SOT-25 PKG</a>   | Standard Board          | <a href="#">SOT-25 Power Dissipation</a>   |
|          |                              | JESD51-7 Board          |  |
| SOT-89-5 | <a href="#">SOT-89-5 PKG</a> | Standard Board          | <a href="#">SOT-89-5 Power Dissipation</a> |
|          |                              | JESD51-7 Board          |  |



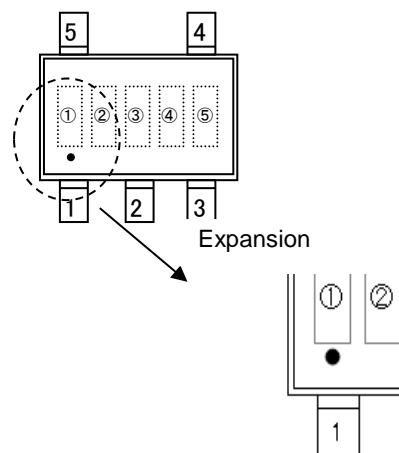
## MARKING RULE

### ● SOT-25 / SOT-89-5

SOT-89-5



SOT-25(Under dot)



① represents the product series

| MARK | VOLTAGE (V)    |
|------|----------------|
| K    | XD6216****M*-Q |
| M    | XD6216****P*-Q |

\*MARK "K" is to be Under dot.

② represents the output voltage range

| MARK | Type             | VOLTAGE (V) | PRODUCT SERIES |
|------|------------------|-------------|----------------|
| 0    | with CE function | 1.8~3.0     | XD6216B*****-Q |
| 1    |                  | 3.1~6.0     |                |
| 2    |                  | 6.1~9.0     |                |
| 3    |                  | 9.1~12.0    |                |

③ represents the output voltage

| MARK | VOLTAGE(V) |     |     | MARK | VOLTAGE(V) |     |     |     |      |
|------|------------|-----|-----|------|------------|-----|-----|-----|------|
| 0    | -          | 3.1 | 6.1 | 9.1  | F          | -   | 4.6 | 7.6 | 10.6 |
| 1    | -          | 3.2 | 6.2 | 9.2  | H          | -   | 4.7 | 7.7 | 10.7 |
| 2    | -          | 3.3 | 6.3 | 9.3  | K          | 1.8 | 4.8 | 7.8 | 10.8 |
| 3    | -          | 3.4 | 6.4 | 9.4  | L          | 1.9 | 4.9 | 7.9 | 10.9 |
| 4    | -          | 3.5 | 6.5 | 9.5  | M          | 2.0 | 5.0 | 8.0 | 11.0 |
| 5    | -          | 3.6 | 6.6 | 9.6  | N          | 2.1 | 5.1 | 8.1 | 11.1 |
| 6    | -          | 3.7 | 6.7 | 9.7  | P          | 2.2 | 5.2 | 8.2 | 11.2 |
| 7    | -          | 3.8 | 6.8 | 9.8  | R          | 2.3 | 5.3 | 8.3 | 11.3 |
| 8    | -          | 3.9 | 6.9 | 9.9  | S          | 2.4 | 5.4 | 8.4 | 11.4 |
| 9    | -          | 4.0 | 7.0 | 10.0 | T          | 2.5 | 5.5 | 8.5 | 11.5 |
| A    | -          | 4.1 | 7.1 | 10.1 | U          | 2.6 | 5.6 | 8.6 | 11.6 |
| B    | -          | 4.2 | 7.2 | 10.2 | V          | 2.7 | 5.7 | 8.7 | 11.7 |
| C    | -          | 4.3 | 7.3 | 10.3 | X          | 2.8 | 5.8 | 8.8 | 11.8 |
| D    | -          | 4.4 | 7.4 | 10.4 | Y          | 2.9 | 5.9 | 8.9 | 11.9 |
| E    | -          | 4.5 | 7.5 | 10.5 | Z          | 3.0 | 6.0 | 9.0 | 12.0 |

④,⑤ represents assembly lot number

01 to 09, 0A to 0Z, 11 to 9Z, A1 to A9, AA to AZ, B1 to ZZ repeated (G, I, J, O, Q, W excluded)

Note: No character inversion used.