# Battery Backup Switching IC

## ■ GENERAL DESCRIPTION

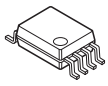
The NJU7286 is a battery backup system IC with two regulators, two voltage detectors, a battery switching system and their control circuit. It switches the regulator output from main power supply source to the backup battery when it detects main power supply drop and also has two voltage detection outputs.

The NJU7286 employs an exclusive sequence on the battery switching system which reduces the battery operation. Combining the special sequence and its low operating current, it is well-suited for battery backup systems of DSC, DVC and other portable devices. The NJU7286 is available in small and thin packages of 8-lead MSOP (TVSP) and SSOP. And there are four voltage options available, as follow table.

## ■ PACKAGE OUTLINE



**NJU7286RB1**
**(MSOP8 (VSP8))**



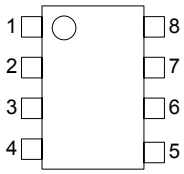
**NJU7286V**
**(SSOP8)**

## ■ FEATURES

- Low Quiescent Current :12μA max. ($V_{IN}$ =3.6V) / Normal operation
  :2.1μA max. ($V_{BAT}$ =3.0V) / Backup
- Low Dropout Voltage :0.06V max. ($I_{RO}$ =3mA) / REG1
  :0.3V max. ($I_{OUT}$ =23mA) / REG2
- 2CH(REG1, REG2) Output Voltage :±2.0%
- 2CH(CS, $\overline{\text{RESET}}$) Output Voltage : ± 2.0%
- Exclusive Sequence
- Small Package SSOP8, MSOP8 (TVSP8)*

*MEET JEDEC MO-187-DA / THIN TYPE

## ■ PIN CONFIGURATION




**MSOP8 (TVSP-8)**
**SSOP-8**

**1.$V_{SS}$**
**2.NC**
**3.$V_{BAT}$**
**4.CS**
**5. $\overline{\text{RESET}}$**
**6.$V_{OUT}$**
**7.$V_{IN}$**
**8.$V_{RO}$**

## ■ SELECTION GUIDE

| Device Name | Output Voltage (V) | | CS Voltage (V) | | $\overline{RESET}$ Voltage (V) | | Switch Voltage (V) |
|---|---|---|---|---|---|---|---|
| | $V_{RO}$ | $V_{OUT}$ | $-V_{DET1}$ | $+V_{DET1}$ | $-V_{DET2}$ | $+V_{DET2}$ | $V_{SW1}$ |
| NJU7286A | 3.200 | 3.200 | 3.300 | 3.401 | 2.400 | 2.528 | $+V_{DET1}$x0.85 |
| NJU7286B | 3.150 | 3.150 | 4.200 | 4.305 | 2.300 | 2.420 | $+V_{DET1}$x0.85 |
| NJU7286C | 3.300 | 3.300 | 3.800 | 3.903 | 2.100 | 2.230 | $+V_{DET1}$x0.85 |
| NJU7286D | 3.200 | 3.200 | 3.300 | 3.401 | 2.250 | 2.362 | $+V_{DET1}$x0.85 |

Caution: The NJU7286D is avalable in only MSOP8 (TVSP8).

CS voltage should be set up so that switch voltage ($V_{SW1}$) may become more than $\overline{RESET}$ voltage ($-V_{DET2}$).

Note: The selection range is as follows.

$V_{RO}$, $V_{OUT}$ : 2.3 to 5.4V (0.1V Step)
$-V_{DET1}$ :2.4 to 5.4V (0.1V Step)
$-V_{DET2}$ :1.7 to 3.4V (0.1V Step)
$V_{SW1}$ :$+V_{DET1}$X0.85

## ■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Main Power Supply Input Voltage | | $V_{IN}$ | +10 | V |
| Backup Power Supply Input Voltage | | $V_{BAT}$ | +10 | V |
| Output Voltage of Voltage Regulator | | $V_{RO}$, $V_{OUT}$ | $V_{SS}$-0.3 to $V_{IN}$+0.3 | V |
| Output Voltage | CS Output Voltage | $V_{CS}$ | $V_{SS}$-0.3 to +10 | V |
| | $\overline{RESET}$Output Voltage | $V_{RESET}$ | | V |
| Power Dissipation | SSOP-8 | $P_D$ | 250 | mW |
| | MSOP8 (TVSP8) | | 320 | |
| Operating Temperature | | Topr | -40 to +85 | °C |
| Storage Temperature | | Tstg | -40 to +125 | °C |

■ ELECTRICAL CHARACTERISTICS

**NJU7286A** ($C_{IN}$=0.1µF, $C_{O(VOUT)}$=10µF, $C_{O(VRO)}$=10µF, Ta=25°C)

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Total | | | | | | |
| Quiescent Current | $I_{SS1}$ | $V_{IN}$ =3.6V, No-Load | - | 4 | 12 | µA |
| | $I_{BAT1}$ | $V_{IN}$ =3.6V, $V_{BAT}$=3.0V, No-Load | - | - | 0.1 | µA |
| | $I_{BAT2}$ | $V_{IN}$=OPEN,$V_{BAT}$=3.0V, No-Load | - | 1.0 | 2.1 | µA |
| Backup Power Supply Input Voltage | $V_{BAT}$ | | 2.0 | - | 4.0 | V |
| Voltage Regulator 1 | | | | | | |
| Output Voltage 1 | $V_{RO}$ | $V_{IN}$=7.2V, $I_{RO}$=3mA | 3.136 | 3.200 | 3.264 | V |
| Dropout Voltage 1 | $\Delta V_{I-O1}$ | $I_{RO}$=3mA | - | 30 | 60 | mV |
| Load Regulation 1A | $\Delta V_{ROA}/\Delta I_{RO}$ | $V_{IN}$=7.2V, $I_{RO}$=0.1 to 30mA | - | 0.06 | 0.15 | %/mA |
| Load Regulation 1B | $\Delta V_{ROB}/\Delta I_{RO}$ | $V_{IN}$=3.6V, $I_{RO}$=0.1 to 30mA | - | 0.06 | 0.15 | %/mA |
| Line Regulation 1 | $\Delta V_{RO}/\Delta V_N$ | $V_{IN}$=4 to 9V, $I_{RO}$=3mA | - | - | 0.2 | %/V |
| Average Temperature Coefficient of Output Voltage 1 | $\Delta V_{RO}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Voltage Regulator 2 | | | | | | |
| Output Voltage 2 | $V_{OUT}$ | $V_{IN}$=7.2V, $I_{OUT}$=23mA | 3.136 | 3.200 | 3.264 | V |
| Dropout Voltage 2 | $\Delta V_{I-O2}$ | $I_{OUT}$=23mA | - | 150 | 300 | mV |
| Load Regulation 2A | $\Delta V_{OUTA}/\Delta I_{OUT}$ | $V_{IN}$=7.2V, $I_{OUT}$=0.1 to 60mA | - | 0.04 | 0.1 | %/mA |
| Load Regulation 2B | $\Delta V_{OUTB}/\Delta_{OUT}$ | $V_{IN}$=3.6V, $I_{OUT}$=0.1 to 60mA | - | 0.04 | 0.1 | %/mA |
| Line Regulation 2 | $\Delta V_{OUT}/\Delta V_N$ | $V_{IN}$=4 to 9V, $I_{OUT}$=23mA | - | - | 0.2 | %/V |
| Average Temperature Coefficient of Output Voltage 2 | $\Delta V_{OUT}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| CS Voltage Detection | | | | | | |
| Detection Voltage 1 | $-V_{DET1}$ | Detection Voltage $V_{IN}$ | 3.234 | 3.300 | 3.366 | V |
| Release Voltage 1 | $+V_{DET1}$ | | 3.319 | 3.401 | 3.482 | V |
| Average Temperature Coefficient of Detection Voltage 1 | $\Delta V_{DET1}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Output Current 1 | $I_{SINK1}$ | $V_{DS}$=0.5V, $V_{IN}$=$V_{BAT}$=2.0V | 1.50 | 2.30 | - | mA |
| Leak Current 1 | $I_{LEAK1}$ | $V_{DS}$=9V, $V_{IN}$=9V | - | - | 0.1 | µA |
| Operation Voltage 1 | $V_{OPR1}$ | $V_{IN}$ or $V_{BAT}$ | 1.7 | - | 9.0 | V |
| $\overline{\text{RESET}}$Voltage Detection | | | | | | |
| Detection Voltage 2 | $-V_{DET2}$ | Detection Voltage $V_{OUT}$ | 2.351 | 2.400 | 2.449 | V |
| Release Voltage 2 | $+V_{DET2}$ | | 2.457 | 2.528 | 2.599 | V |
| Release Delay Time | $T_{DELAY}$ | | 200 | 500 | - | µS |
| Average Temperature Coefficient of Detection Voltage 2 | $\Delta V_{DET2}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Output Current 2 | $I_{SINK2}$ | $V_{DS}$=0.5V, $V_{IN}$=$V_{BAT}$=2.0V | 1.50 | 2.30 | - | mA |
| Leak Current 2 | $I_{LEAK2}$ | $V_{DS}$=9V, $V_{IN}$=9V | - | - | 0.1 | µA |
| Operation Voltage 2 | $V_{OPR2}$ | $V_{IN}$ or $V_{BAT}$ | 1.7 | - | 9.0 | V |

| Switch Control | | | | | | |
|---|---|---|---|---|---|---|
| Switch Voltage | $V_{SW1}$ | $V_{BAT}$=2.8V,<br>Detection Voltage $V_{IN}$ | $+V_{DET1}$<br>X0.83 | $+V_{DET1}$<br>X0.85 | $+V_{DET1}$<br>X0.87 | V |
| CS Output Inhibit Voltage | $V_{SW2}$ | $V_{BAT}$=3.0V,<br>Detection Voltage $V_{OUT}$ | $V_{OUT}$<br>X0.93 | $V_{OUT}$<br>X0.95 | $V_{OUT}$<br>X0.97 | V |
| $V_{BAT}$ Switch Leak Current | $I_{LEAK}$ | $V_{IN}$=3.6V,<br>$V_{BAT}$=0V | - | - | 0.1 | μA |
| $V_{BAT}$ Switch Resistance | $R_{SW}$ | $V_{IN}$=OPEN,<br>$V_{BAT}$=3.0V, $I_{OUT}$=10~500μA | - | 30 | 60 | Ω |
| Average Temperature Coefficient of Switch Voltage | $\Delta V_{SW1}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Average Temperature Coefficient of CS Output Inhibit Voltage | $\Delta V_{SW2}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |

**NJU7286B** ($C_{IN}$=0.1µF, $C_{O(VOUT)}$=10µF, $C_{O(VRO)}$=10µF, Ta=25°C)

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Total | | | | | | |
| Quiescent Current | $I_{SS1}$ | $V_{IN}$ =6.0V, No-Load | - | 4 | 12 | µA |
| | $I_{BAT1}$ | $V_{IN}$ =6.0V, $V_{BAT}$=3.0V, No-Load | - | - | 0.1 | µA |
| | $I_{BAT2}$ | $V_{IN}$=OPEN,$V_{BAT}$=3.0V, No-Load | - | 1.0 | 2.1 | µA |
| Backup Power Supply Input Voltage | $V_{BAT}$ | | 2.0 | - | 4.0 | V |
| Voltage Regulator 1 | | | | | | |
| Output Voltage 1 | $V_{RO}$ | $V_{IN}$=6.0V, $I_{RO}$=3mA | 3.087 | 3.150 | 3.213 | V |
| Dropout Voltage 1 | $\Delta V_{I-O1}$ | $I_{RO}$=3mA | - | 30 | 60 | mV |
| Load Regulation 1 | $\Delta V_{RO}/\Delta I_{RO}$ | $V_{IN}$=6.0V, $I_{RO}$=0.1~30mA | - | 0.06 | 0.15 | %/mA |
| Line Regulation 1 | $\Delta V_{RO}/\Delta V_N$ | $V_{IN}$=6~9V, $I_{RO}$=3mA | - | - | 0.2 | %/V |
| Average Temperature Coefficient of Output Voltage 1 | $\Delta V_{RO}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Voltage Regulator 2 | | | | | | |
| Output Voltage 2 | $V_{OUT}$ | $V_{IN}$=6.0V, $I_{OUT}$=23mA | 3.087 | 3.150 | 3.213 | V |
| Dropout Voltage 2 | $\Delta V_{I-O2}$ | $I_{OUT}$=23mA | - | 150 | 300 | mV |
| Load Regulation 2 | $\Delta V_{OUT}/\Delta I_{OUT}$ | $V_{IN}$=6.0V, $I_{OUT}$=0.1 to 60mA | - | 0.04 | 0.1 | %/mA |
| Line Regulation 2 | $\Delta V_{OUT}/\Delta V_N$ | $V_{IN}$=6 to 9V, $I_{OUT}$=23mA | - | - | 0.2 | %/V |
| Average Temperature Coefficient of Output Voltage 2 | $\Delta V_{OUT}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| CS Voltage Detection | | | | | | |
| Detection Voltage 1 | $-V_{DET1}$ | Detection Voltage $V_{IN}$ | 4.116 | 4.200 | 4.284 | V |
| Release Voltage 1 | $+V_{DET1}$ | | 4.204 | 4.305 | 4.407 | V |
| Average Temperature Coefficient of Detection Voltage 1 | $\Delta V_{DET1}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Output Current 1 | $I_{SINK1}$ | $V_{DS}$=0.5V, $V_{IN}$=$V_{BAT}$=2.0V | 1.50 | 2.30 | - | mA |
| Leak Current 1 | $I_{LEAK1}$ | $V_{DS}$=9V, $V_{IN}$=9V | - | - | 0.1 | µA |
| Operation Voltage 1 | $V_{OPR1}$ | $V_{IN}$ or $V_{BAT}$ | 1.7 | - | 9.0 | V |
| $\overline{\text{RESET}}$ Voltage Detection | | | | | | |
| Detection Voltage 2 | $-V_{DET2}$ | Detection Voltage $V_{OUT}$ | 2.254 | 2.300 | 2.346 | V |
| Release Voltage 2 | $+V_{DET2}$ | | 2.348 | 2.420 | 2.492 | V |
| Release Delay Time | $T_{DELAY}$ | | 200 | 500 | - | µS |
| Average Temperature Coefficient of Detection Voltage 2 | $\Delta V_{DET2}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Output Current 2 | $I_{SINK2}$ | $V_{DS}$=0.5V, $V_{IN}$=$V_{BAT}$=2.0V | 1.50 | 2.30 | - | mA |
| Leak Current 2 | $I_{LEAK2}$ | $V_{DS}$=9V, $V_{IN}$=9V | - | - | 0.1 | µA |
| Operation Voltage 2 | $V_{OPR2}$ | $V_{IN}$ or $V_{BAT}$ | 1.7 | - | 9.0 | V |

| Switch Control | | | | | | |
|---|---|---|---|---|---|---|
| Switch Voltage | $V_{SW1}$ | $V_{BAT}$=2.8V,<br>Detection Voltage $V_{IN}$ | $+V_{DET1}$<br>X0.83 | $+V_{DET1}$<br>X0.85 | $+V_{DET1}$<br>X0.87 | V |
| CS Output Inhibit Voltage | $V_{SW2}$ | $V_{BAT}$=3.0V,<br>Detection Voltage $V_{OUT}$ | $V_{OUT}$<br>X0.93 | $V_{OUT}$<br>X0.95 | $V_{OUT}$<br>X0.97 | V |
| $V_{BAT}$ Switch Leak Current | $I_{LEAK}$ | $V_{IN}$=6.0V,<br>$V_{BAT}$=0V | - | - | 0.1 | μA |
| $V_{BAT}$ Switch Resistance | $R_{SW}$ | $V_{IN}$=OPEN,<br>$V_{BAT}$=3.0V, $I_{OUT}$=10 to 500μA | - | 30 | 60 | Ω |
| Average Temperature Coefficient of Switch Voltage | $\Delta V_{SW1}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Average Temperature Coefficient of CS Output Inhibit Voltage | $\Delta V_{SW2}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |

**NJU7286C** ($C_{IN}$=0.1µF, $C_{O(VOUT)}$=10µF, $C_{O(VRO)}$=10µF, Ta=25°C)

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Total | | | | | | |
| Quiescent Current | $I_{SS1}$ | $V_{IN}$ =6.0V, No-Load | - | 4 | 12 | µA |
| | $I_{BAT1}$ | $V_{IN}$ =6.0V, $V_{BAT}$=3.0V, No-Load | - | - | 0.1 | µA |
| | $I_{BAT2}$ | $V_{IN}$=OPEN,$V_{BAT}$=3.0V, No-Load | - | 1.0 | 2.1 | µA |
| Backup Power Supply Input Voltage | $V_{BAT}$ | | 2.0 | - | 4.0 | V |
| Voltage Regulator 1 | | | | | | |
| Output Voltage 1 | $V_{RO}$ | $V_{IN}$=6.0V, $I_{RO}$=3mA | 3.234 | 3.300 | 3.366 | V |
| Dropout Voltage 1 | $\Delta V_{I-O1}$ | $I_{RO}$=3mA | - | 30 | 60 | mV |
| Load Regulation 1 | $\Delta V_{RO}/\Delta I_{RO}$ | $V_{IN}$=6.0V, $I_{RO}$=0.1 to 30mA | - | 0.06 | 0.15 | %/mA |
| Line Regulation 1 | $\Delta V_{RO}/\Delta V_N$ | $V_{IN}$=6 to 9V, $I_{RO}$=3mA | - | - | 0.2 | %/V |
| Average Temperature Coefficient of Output Voltage 1 | $\Delta V_{RO}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Voltage Regulator 2 | | | | | | |
| Output Voltage 2 | $V_{OUT}$ | $V_{IN}$=6.0V, $I_{OUT}$=23mA | 3.234 | 3.300 | 3.366 | V |
| Dropout Voltage 2 | $\Delta V_{I-O2}$ | $I_{OUT}$=23mA | - | 150 | 300 | mV |
| Load Regulation 2 | $\Delta V_{OUT}/\Delta I_{OUT}$ | $V_{IN}$=6.0V, $I_{OUT}$=0.1 to 60mA | - | 0.04 | 0.1 | %/mA |
| Line Regulation 2 | $\Delta V_{OUT}/\Delta V_N$ | $V_{IN}$=6 to 9V, $I_{OUT}$=23mA | - | - | 0.2 | %/V |
| Average Temperature Coefficient of Output Voltage 2 | $\Delta V_{OUT}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| CS Voltage Detection | | | | | | |
| Detection Voltage 1 | $-V_{DET1}$ | Detection Voltage $V_{IN}$ | 3.724 | 3.800 | 3.876 | V |
| Release Voltage 1 | $+V_{DET1}$ | | 3.805 | 3.903 | 4.000 | V |
| Average Temperature Coefficient of Detection Voltage 1 | $\Delta V_{DET1}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Output Current 1 | $I_{SINK1}$ | $V_{DS}$=0.5V, $V_{IN}$=$V_{BAT}$=2.0V | 1.50 | 2.30 | - | mA |
| Leak Current 1 | $I_{LEAK1}$ | $V_{DS}$=9V, $V_{IN}$=9V | - | - | 0.1 | µA |
| Operation Voltage 1 | $V_{OPR1}$ | $V_{IN}$ or $V_{BAT}$ | 1.7 | - | 9.0 | V |
| $\overline{\text{RESET}}$ Voltage Detection | | | | | | |
| Detection Voltage 2 | $-V_{DET2}$ | Detection Voltage $V_{OUT}$ | 2.058 | 2.100 | 2.142 | V |
| Release Voltage 2 | $+V_{DET2}$ | | 2.158 | 2.230 | 2.302 | V |
| Release Delay Time | $T_{DELAY}$ | | 200 | 500 | - | µS |
| Average Temperature Coefficient of Detection Voltage 2 | $\Delta V_{DET2}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Output Current 2 | $I_{SINK2}$ | $V_{DS}$=0.5V, $V_{IN}$=$V_{BAT}$=2.0V | 1.50 | 2.30 | - | mA |
| Leak Current 2 | $I_{LEAK2}$ | $V_{DS}$=9V, $V_{IN}$=9V | - | - | 0.1 | µA |
| Operation Voltage 2 | $V_{OPR2}$ | $V_{IN}$ or $V_{BAT}$ | 1.7 | - | 9.0 | V |

| Switch Control | | | | | | |
|---|---|---|---|---|---|---|
| Switch Voltage | $V_{SW1}$ | $V_{BAT}$=2.8V,<br>Detection Voltage $V_{IN}$ | $+V_{DET1}$<br>X0.83 | $+V_{DET1}$<br>X0.85 | $+V_{DET1}$<br>X0.87 | V |
| CS Output Inhibit Voltage | $V_{SW2}$ | $V_{BAT}$=3.0V,<br>Detection Voltage $V_{OUT}$ | $V_{OUT}$<br>X0.93 | $V_{OUT}$<br>X0.95 | $V_{OUT}$<br>X0.97 | V |
| $V_{BAT}$ Switch Leak Current | $I_{LEAK}$ | $V_{IN}$=6.0V,<br>$V_{BAT}$=0V | - | - | 0.1 | µA |
| $V_{BAT}$ Switch Resistance | $R_{SW}$ | $V_{IN}$=OPEN,<br>$V_{BAT}$=3.0V, $I_{OUT}$=10 to 500µA | - | 30 | 60 | Ω |
| Average Temperature Coefficient of Switch Voltage | $\Delta V_{SW1}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Average Temperature Coefficient of CS Output Inhibit Voltage | $\Delta V_{SW2}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |

**NJU7286D** ($C_{IN}$=0.1µF, $C_{O(VOUT)}$=10µF, $C_{O(VRO)}$=10µF, Ta=25°C)

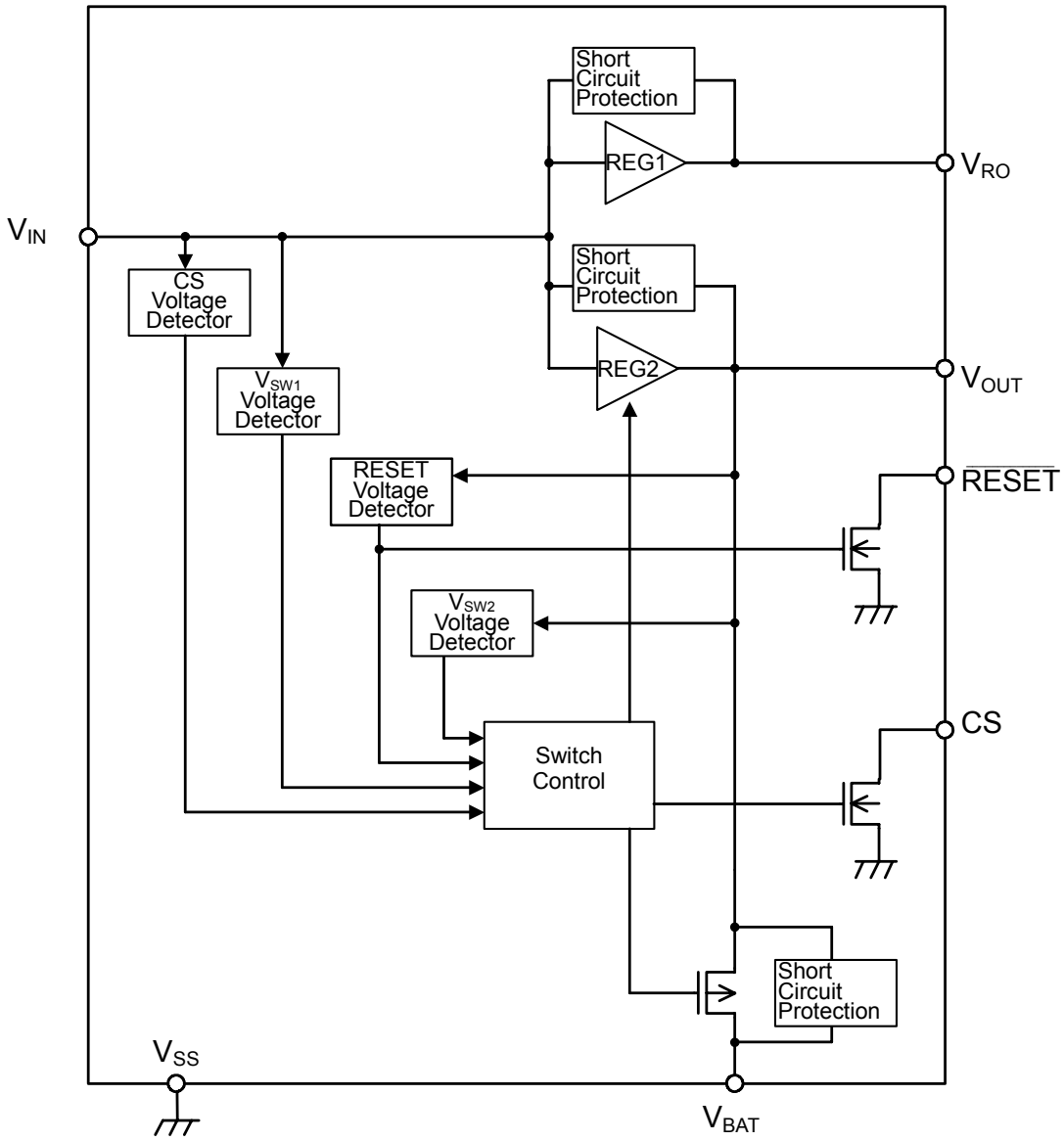
| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Total | | | | | | |
| Quiescent Current | $I_{SS1}$ | $V_{IN}$ =3.6V, No-Load | - | 4 | 12 | µA |
| | $I_{BAT1}$ | $V_{IN}$ =3.6V, $V_{BAT}$=3.0V, No-Load | - | - | 0.1 | µA |
| | $I_{BAT2}$ | $V_{IN}$=OPEN,$V_{BAT}$=3.0V, No-Load | - | 1.0 | 2.1 | µA |
| Backup Power Supply Input Voltage | $V_{BAT}$ | | 2.0 | - | 4.0 | V |
| Voltage Regulator 1 | | | | | | |
| Output Voltage 1 | $V_{RO}$ | $V_{IN}$=7.2V, $I_{RO}$=3mA | 3.136 | 3.200 | 3.264 | V |
| Dropout Voltage 1 | $\Delta V_{I-O1}$ | $I_{RO}$=3mA | - | 30 | 60 | mV |
| Load Regulation 1A | $\Delta V_{ROA}/\Delta I_{RO}$ | $V_{IN}$=7.2V, $I_{RO}$=0.1 to 30mA | - | 0.06 | 0.15 | %/mA |
| Load Regulation 1B | $\Delta V_{ROB}/\Delta I_{RO}$ | $V_{IN}$=3.6V, $I_{RO}$=0.1 to 30mA | - | 0.06 | 0.15 | %/mA |
| Line Regulation 1 | $\Delta V_{RO}/\Delta V_N$ | $V_{IN}$=4 to 9V, $I_{RO}$=3mA | - | - | 0.2 | %/V |
| Average Temperature Coefficient of Output Voltage 1 | $\Delta V_{RO}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Voltage Regulator 2 | | | | | | |
| Output Voltage 2 | $V_{OUT}$ | $V_{IN}$=7.2V, $I_{OUT}$=23mA | 3.136 | 3.200 | 3.264 | V |
| Dropout Voltage 2 | $\Delta V_{I-O2}$ | $I_{OUT}$=23mA | - | 150 | 300 | mV |
| Load Regulation 2A | $\Delta V_{OUTA}/\Delta I_{OUT}$ | $V_{IN}$=7.2V, $I_{OUT}$=0.1 to 60mA | - | 0.04 | 0.1 | %/mA |
| Load Regulation 2B | $\Delta V_{OUTB}/\Delta_{OUT}$ | $V_{IN}$=3.6V, $I_{OUT}$=0.1 to 60mA | - | 0.04 | 0.1 | %/mA |
| Line Regulation 2 | $\Delta V_{OUT}/\Delta V_N$ | $V_{IN}$=4 to 9V, $I_{OUT}$=23mA | - | - | 0.2 | %/V |
| Average Temperature Coefficient of Output Voltage 2 | $\Delta V_{OUT}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| CS Voltage Detection | | | | | | |
| Detection Voltage 1 | $-V_{DET1}$ | Detection Voltage $V_{IN}$ | 3.234 | 3.300 | 3.366 | V |
| Release Voltage 1 | $+V_{DET1}$ | | 3.319 | 3.401 | 3.482 | V |
| Average Temperature Coefficient of Detection Voltage 1 | $\Delta V_{DET1}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Output Current 1 | $I_{SINK1}$ | $V_{DS}$=0.5V, $V_{IN}$=$V_{BAT}$=2.0V | 1.50 | 2.30 | - | mA |
| Leak Current 1 | $I_{LEAK1}$ | $V_{DS}$=9V, $V_{IN}$=9V | - | - | 0.1 | µA |
| Operation Voltage 1 | $V_{OPR1}$ | $V_{IN}$ or $V_{BAT}$ | 1.7 | - | 9.0 | V |
| $\overline{\text{RESET}}$ Voltage Detection | | | | | | |
| Detection Voltage 2 | $-V_{DET2}$ | Detection Voltage $V_{OUT}$ | 2.205 | 2.250 | 2.295 | V |
| Release Voltage 2 | $+V_{DET2}$ | | 2.298 | 2.362 | 2.426 | V |
| Release Delay Time | $T_{DELAY}$ | | 200 | 500 | - | µS |
| Average Temperature Coefficient of Detection Voltage 2 | $\Delta V_{DET2}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Output Current 2 | $I_{SINK2}$ | $V_{DS}$=0.5V, $V_{IN}$=$V_{BAT}$=2.0V | 1.50 | 2.30 | - | mA |
| Leak Current 2 | $I_{LEAK2}$ | $V_{DS}$=9V, $V_{IN}$=9V | - | - | 0.1 | µA |
| Operation Voltage 2 | $V_{OPR2}$ | $V_{IN}$ or $V_{BAT}$ | 1.7 | - | 9.0 | V |

| Switch Control | | | | | | |
|---|---|---|---|---|---|---|
| Switch Voltage | $V_{SW1}$ | $V_{BAT}$=2.8V,<br>Detection Voltage $V_{IN}$ | $+V_{DET1}$<br>X0.83 | $+V_{DET1}$<br>X0.85 | $+V_{DET1}$<br>X0.87 | V |
| CS Output Inhibit Voltage | $V_{SW2}$ | $V_{BAT}$=3.0V,<br>Detection Voltage $V_{OUT}$ | $V_{OUT}$<br>X0.93 | $V_{OUT}$<br>X0.95 | $V_{OUT}$<br>X0.97 | V |
| $V_{BAT}$ Switch Leak Current | $I_{LEAK}$ | $V_{IN}$=3.6V,<br>$V_{BAT}$=0V | - | - | 0.1 | μA |
| $V_{BAT}$ Switch Resistance | $R_{SW}$ | $V_{IN}$=OPEN,<br>$V_{BAT}$=3.0V, $I_{OUT}$=10 to 500μA | - | 30 | 60 | Ω |
| Average Temperature Coefficient of Switch Voltage | $\Delta V_{SW1}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |
| Average Temperature Coefficient of CS Output Inhibit Voltage | $\Delta V_{SW2}/\Delta T$ | Ta=0°C to +85°C | - | ±100 | - | ppm/°C |

## ■ CAUTION ON USE

- ●Wiring of a power supply should lower impedance using thick wiring.
  Especially $V_{IN}$ wiring needs to cautions, because the output current of the regulator flows.
- ●$I_{RO}$ or $I_{OUT}$ should be set 10μA or more. because output voltage rises and a load regulation becomes unstable.
- ●IC or the capacitor which are connected to the NJU7286 should not exceed rating by the exaggerated shot of a regulator etc.
- ●The $V_{IN}$ terminal, the $V_{OUT}$ terminal and the $V_{RO}$ terminal should surely connect the capacitor between $V_{SS}$.
  The capacitor connected to the $V_{OUT}$ terminal should connect the capacity of 10μF or more. Because, in order to prevent carrying out voltage descending at the time of a REG2 operation change.
- ●External parts should connect near the NJU7286.
- ●If $\overline{\text{RESET}}$ voltage detection becomes active, it will shift to special sequence from usually sequence. In order to suppress generating of an under shot etc. $V_{OUT}$ terminal should connect the capacity of the suitable value.
- ●When bringing down $V_{IN}$ to 0V, the circumference circuit of the NJU7286 should design so that $V_{IN}$ may fall over the time for 10ms or more. In the case of less than 10ms, $\overline{\text{RESET}}$ output is set to "L".
- ●Power dissipation should use in the range which is not exceeded.

## ■ BLOCK DIAGRAM



## ■ FUNCTIONAL EXPLANATION OF BLOCK

1. Voltage regulator(REG1,REG2)
   - Output Voltage serialization is possible with 0.1V step.
2. CS Voltage Detector
   - $V_{IN}$ (main power supply) terminal voltage is supervised, and the fall of the main power supply is detected.
   - Detection result is outputted to CS terminal as follows. (At the time of CS release permission signal output.)
     Detection voltage($-V_{DET1}$) or less : "L" Output
     More than release voltage($+V_{DET1}$) : "H" Output
   - power supply supplies from two terminals of $V_{IN}$ and $V_{BAT}$.
3. $\overline{RESET}$ Voltage Detector
   - $\overline{RESET}$ Voltage Detector supervises the voltage of a $V_{OUT}$ terminal.
   - Detection result is outputted to $\overline{RESET}$ terminal as follows.
     Detection voltage($-V_{DET1}$) or less : "L" Output
     More than release voltage($+V_{DET1}$) : "H" Output
   - power supply supplies from $V_{OUT}$ terminals.(Normal logic will be outputted if $V_{OUT}$ terminal voltage is more than 1.0V.)
4. $V_{SW1}$ Voltage Detector
   - $V_{SW1}$ voltage detector supervises $V_{IN}$ voltage.
   - Detection voltage ($V_{SW1}$) follows the setting value of CS detection voltage.
5. $V_{SW2}$ Voltage Detector
   - $V_{SW2}$ voltage detector supervises $V_{IN}$ voltage.
   - CS release permission signal is as follows with $V_{OUT}$ terminal voltage.
     The output voltage $V_{OUT}$ of REG2 is 95% or more of spec. : CS release permission signal is outputted.
     The output voltage $V_{OUT}$ of REG2 is 95% or less of spec. : CS release permission signal is stopped.
   - The CS release permission signal is as follows.
     CS release permission voltage or less : CS terminal is "L" Fix.
     More than CS release permission voltage : CS terminal outputs CS detection result.
     (If $V_{IN}$ terminal voltage is more than CS detection voltage even if $V_{OUT}$ terminal voltage falls below on $V_{SW2}$ voltage, CS output will maintain "H".)
6. Sequence explanation

   Special sequence
   - Special sequence is until $V_{IN}$ voltage rises from 0V and CS output is set to "H".
   - When the voltage of $V_{OUT}$ falls and a $\overline{RESET}$ output is set to the "L" level.
   - The period of a special sequence fixes $V_{OUT}$ output to REG2.

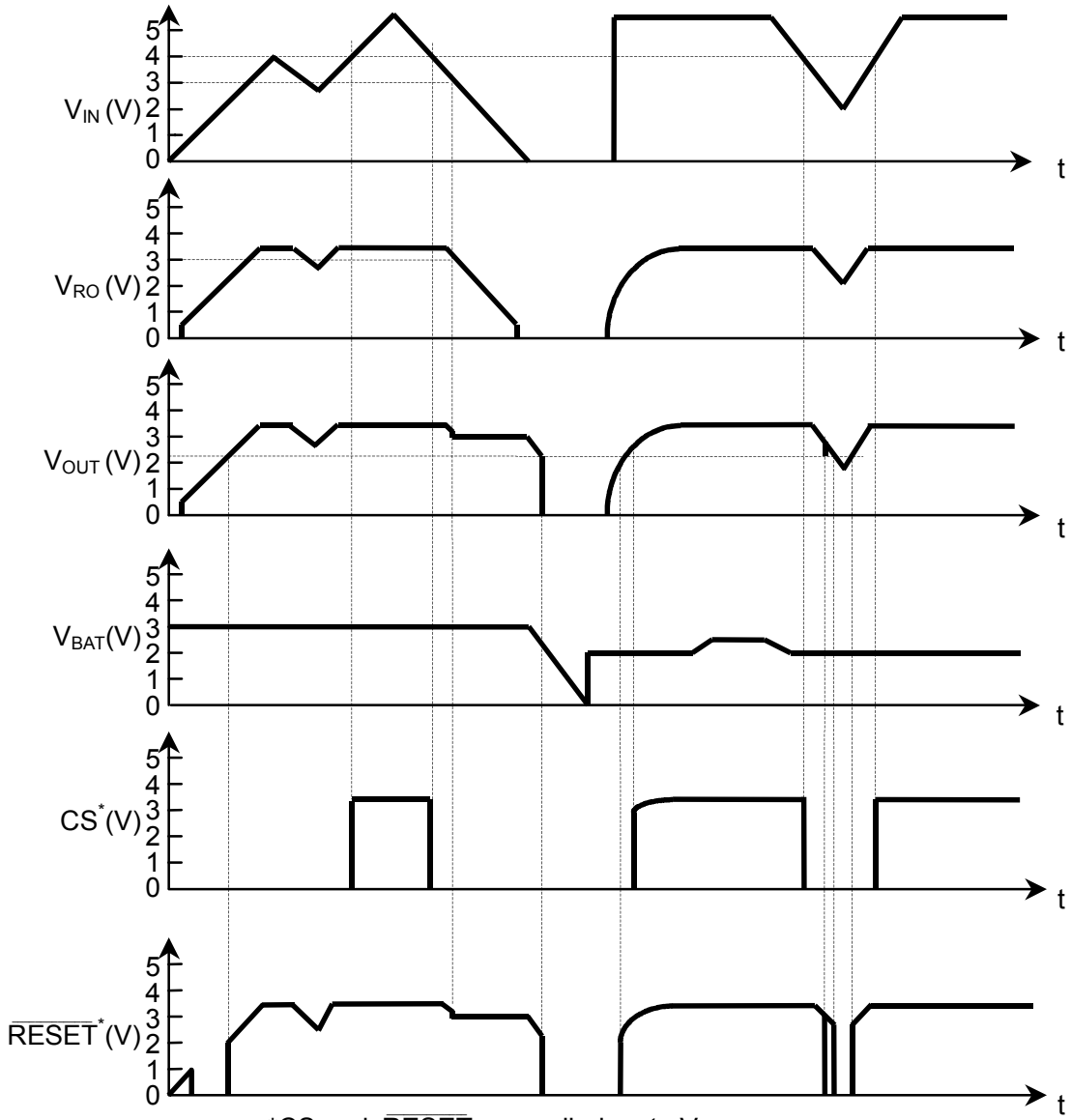
   Usual sequence
   - Usual sequence is until $V_{IN}$ voltage rises and $\overline{RESET}$ output is set to the "L" level.
   - The period of the usual sequence switches $V_{OUT}$ output to REG2 or $V_{BAT}$ by the detection result of the $V_{SW1}$ detection circuit which is supervising $V_{IN}$ voltage.

| Terminal voltage | REG2 operation state | $V_{OUT}$ output | State of operation |
|---|---|---|---|
| 0V to $V_{IN}$<"$+V_{DET1}$" | ON | REG2 | Special sequence |
| $V_{IN}$>"$V_{SW1}$" | ON | REG2 | Usual sequence |
| $V_{IN}$≦"$V_{SW1}$" | OFF | $V_{BAT}$-ΔVT1 | Usual sequence |
| $V_{OUT}$>"$-V_{DET2}$" | ON | REG2 | Special sequence |

ΔVT1 : VDS of the switch transistor between $V_{BAT}$ - $V_{OUT}$.

Note : Before REG2 turns on from OFF, it will take the time of 100μs by the longest. In the meantime, $V_{OUT}$ may become high impedance. In order to prevent voltage descending, the $V_{OUT}$ terminal should connect the capacitor of 10μF or more.

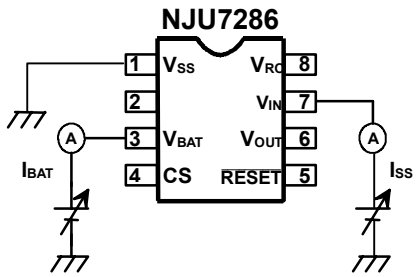
■ Timing Chart



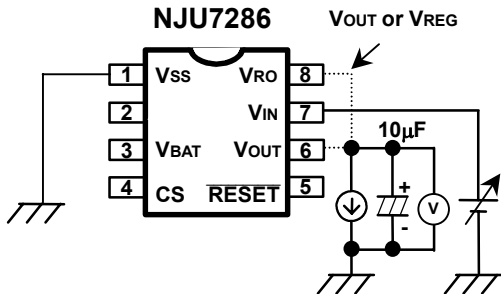

*CS and $\overline{RESET}$ are pulled up to $V_{OUT}$.

## ■ TEST CIRCUIT

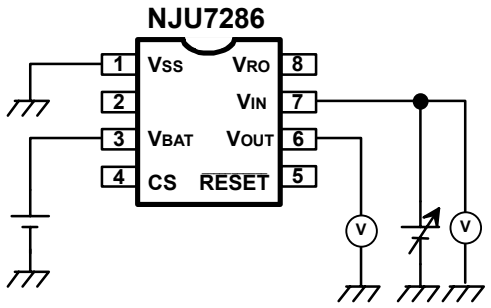
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2.

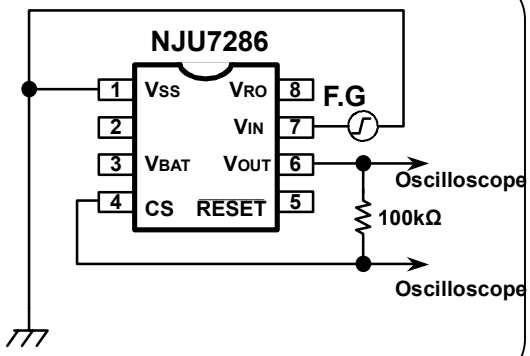



3.

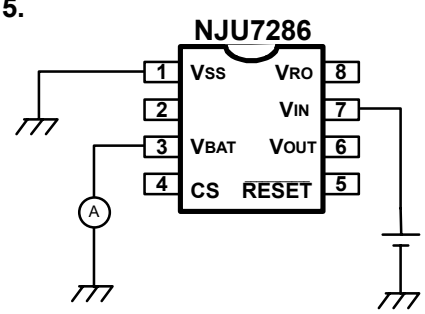



Measure the value after applying 5.4V to $V_{IN}$

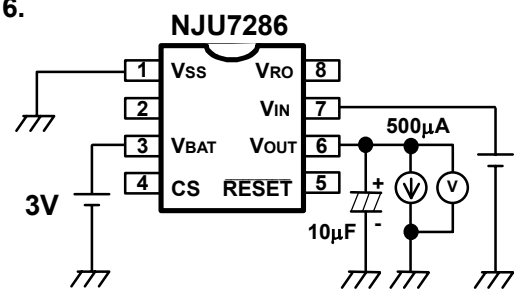
4.




5.

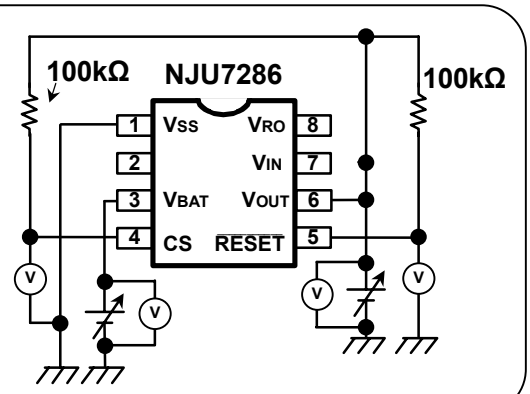



6.

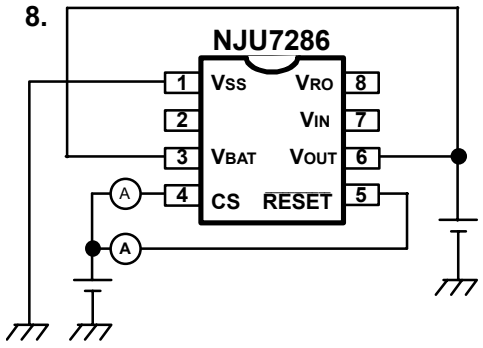



Leave open and measure the value after applying 6V to $V_{IN}$.

7.



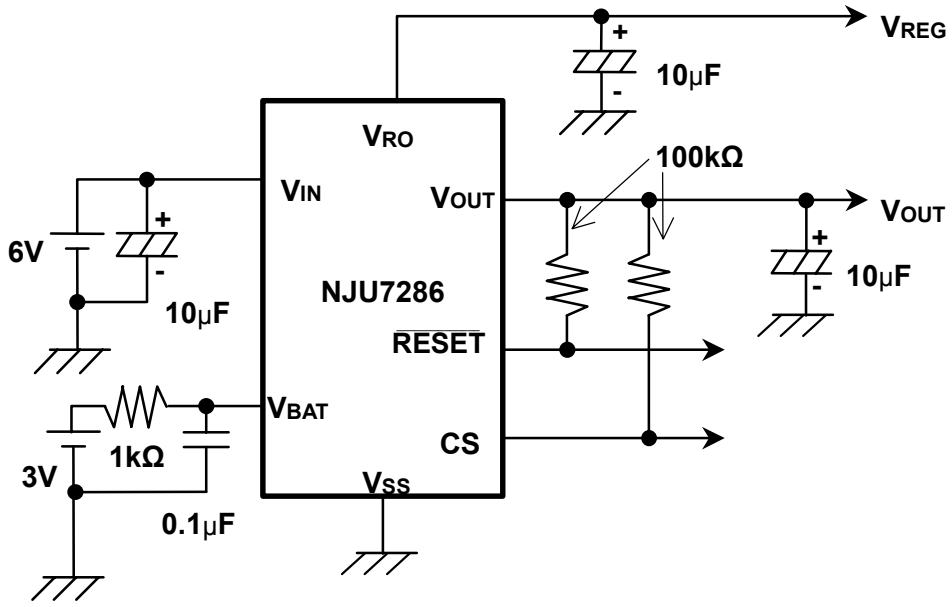

8.



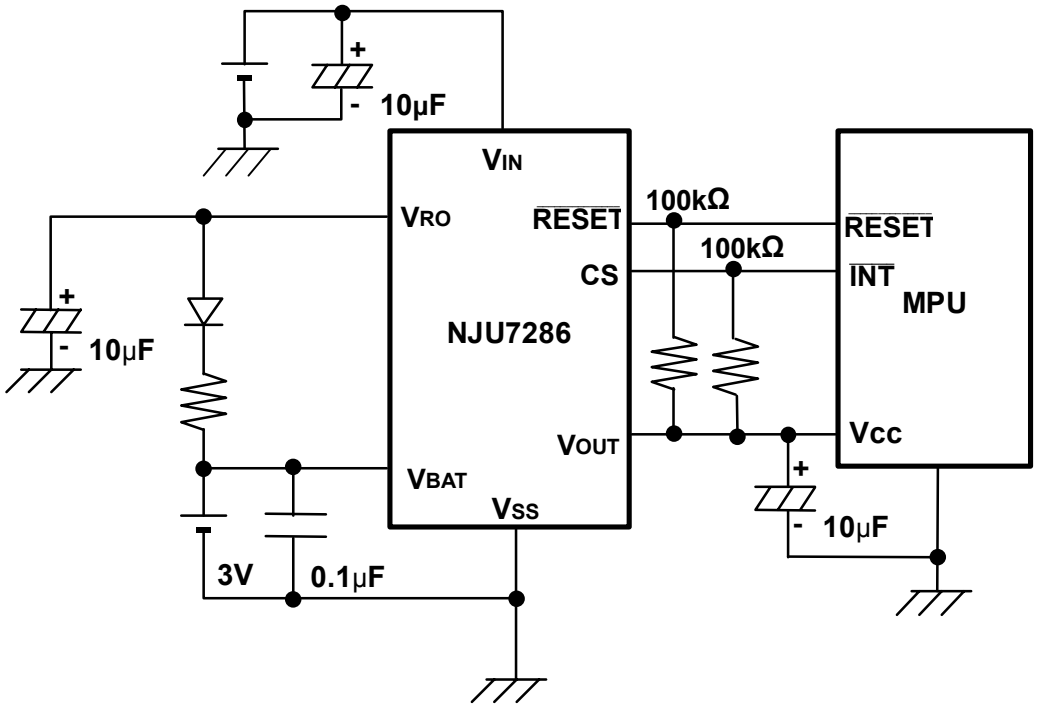
■ **CORRESPOND TABLE OF TEST CIRCUIT**

| TEST PARAMETER | TEST CIRCUIT NUMBER |
|---|---|
| Quiescent Current | 1 |
| Power Supply Voltage Operation Range | 2,7 |
| Output Voltage 1 | 2 |
| Dropout Voltage 1 | 2 |
| Load Regulation 1 | 2 |
| Line Regulation 1 | 2 |
| Average Temperature Coefficient of Output Voltage 1 | 2 |
| Output Voltage 2 | 2 |
| Dropout Voltage 2 | 2 |
| Load Regulation 2 | 2 |
| Line Regulation 2 | 2 |
| Average Temperature Coefficient of Output Voltage 2 | 2 |
| Switch Voltage | 3 |
| Average Temperature Coefficient of Switch Voltage | 3 |
| Average Temperature Coefficient of INT release permission voltage | 4 |
| INT release permission voltage | 4 |
| $V_{BAT}$ Switch Leak Current | 5 |
| $V_{BAT}$ Switch Resistance | 6 |
| Backup Power Supply Input Voltage | 6 |
| INT Detection Voltage | 7 |
| INT Release voltage | 7 |
| Detection Voltage 1 | 7 |
| Release voltage 1 | 7 |
| Detection Voltage 2 | 7 |
| Release voltage 2 | 7 |
| Operation Voltage | 7 |
| Average Temperature Coefficient of Detection Voltage | 7 |
| Output Current | 8 |
| Leak Current | 8 |

## ■ TYPICAL APPLICATIONS




**When the rechargeable battery is used as the backup battery.**




**The backup battery can be flating-recharged by using voltage regulator 1.**

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