BATTERY BACK-UP SWITCHER

■ GENERAL DESCRIPTION

The NJU7283 series is a Battery Back-up Switcher. It contains dual voltage regulators, triple voltage detectors and switch control circuit.

The regulated main power supply is switched to the back-up at detecting the drop-out voltage of main power supply. The other regulator is incorporated independently.

Triple detectors monitor the main power supply, the back-up supply and its output. The signal is output from each terminal at the detectors operating.

The power consumption on the back-up operation is esspecially suppressed because of the little drop-out voltage of the back-up switch and the special sequence at the main power charge-up.

This series is suitable for battery operated items because of its low operating current.

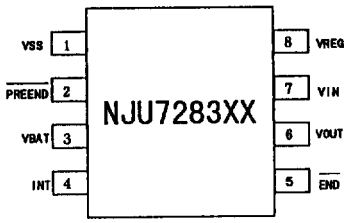
■ PACKAGE OUTLINE

NJU7283XM NJU7283XV

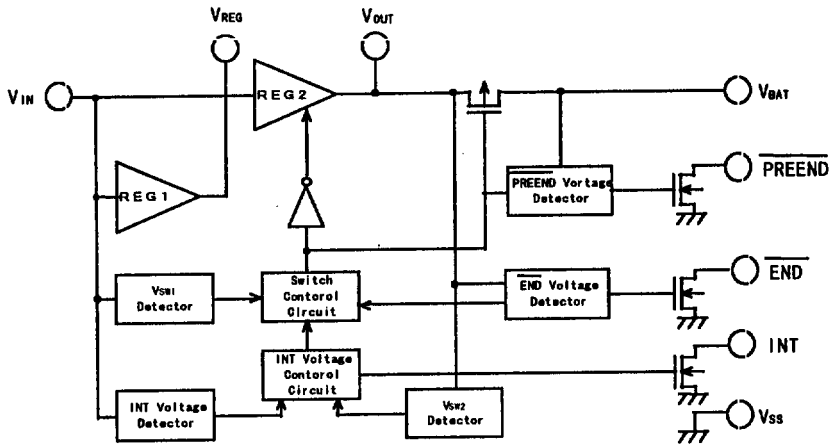
■ FEATURES

- Low Power Consumption --- Normal : 30μA max. @VIN=6V
  Back-up: 2.1μA max.
- Wide Operating Voltage--- From 2.0 to 15V
- Low Drop-out Voltage --- REG1 : 0.35V max. @I_{REG}=30mA
  REG2 : 0.35V max. @I_{OUT}=50mA
- High Precision Output Voltage --- ±2%
- High Precision triple Detectors incorporated
  --- ±2% INT, $\overline{PREEND}$, $\overline{END}$
- The Special Sequence at the Main Power Charge-up
- Available to Customize the Output and Detected Voltages
- CMOS Technology
- Package Outline --- DMP-8 / SSOP-8

■ PIN CONFIGURATION



■ BLOCK DIAGRAM



■ VERSION LINE-UP

Ta=25°C [UNIT:V]

品　名	OUTPUT VOLTAGE			SWITCH VOLTAGE			INT DETECT VOLT.			$\overline{\text{END}}$ DETECT VOLT.		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
NJU7283A	4.900	5.000	5.100	3.593	3.634	3.728	4.507	4.600	4.693	2.253	2.300	2.347
NJU7283B	3.527	3.600	3.673	3.307	3.395	3.483	4.213	4.300	4.387	2.351	2.400	2.449
NJU7283C	3.230	3.300	3.370	3.075	3.157	3.239	3.919	4.000	4.081	2.253	2.300	2.347
NJU7283D	3.135	3.200	3.265	2.822	2.890	2.958	3.234	3.300	3.366	2.351	2.400	2.449
NJU7283E	3.087	3.150	3.213	3.229	3.315	3.401	4.116	4.200	4.284	2.254	2.300	2.346
NJU7283F	4.900	5.000	5.100	3.229	3.315	3.401	4.116	4.200	4.284	2.254	2.300	2.346
NJU7283G	2.940	3.000	3.060	2.400	2.450	2.500	2.744	2.800	2.856	1.960	2.000	2.040
NJU7283H	2.940	3.000	3.060	2.822	2.890	2.958	3.234	3.300	3.366	2.351	2.400	2.449

Note)　It is available to customize the regurators' output and the detection voltages.

■ TERMINAL DESCRIPTION

NO	Symbol	Function
1	VSS	GND
2	$\overline{\text{PREEND}}$	The Output Terminal for $\overline{\text{PREEND}}$ Voltage Detector (Nch Open Drain)
3	VBAT	The Back-up Power Supply Input Terminal
4	INT	The Output Terminal for INT Voltage Detector (Nch Open Drain)
5	$\overline{\text{END}}$	The Output Terminal for $\overline{\text{END}}$ Voltage Detector (Nch Open Drain)
6	VOUT	The Output Terminal for Regulator2 or the Back-up Switch
7	VIN	The Main Power Supply Input Terminal
8	VREG	The Output Terminal for Regulator1

■ FUNCTIONAL DESCRIPTION

1. Description for Each Blocks

(1) VOLTAGE REGULATORS (REG1, REG2)

The NJU7283 Series incorporates dual voltage regulators (REG1, REG2). The features of each regulator is mentioned below.

(1-1) VOLTAGE REGULATOR 1 (REG1)

This series regulator featuring the high precision output voltage (±2%) operates constantly.

The output voltage is available to be customized under the condition of voltages between 2V and 6V by 0.1V step by masked option.

(1-2) VOLTAGE REGULATOR 2 (REG2)

This series regulator featuring the high precision output voltage (±2%) has the OUTPUT OFF function. The REG2 becomes OFF, when the power source is switched from the main power supply to the back-up power supply. In the condition of charging-up the main power supply from the approximate GND level, the REG2 starts operating at the ON status because of its special sequence.

The output voltage is available to be customized under the condition of voltages between 2V and 6V by 0.1V step by masked option.

(2) VOLTAGE DETECTOR

The NJU7283 incorporates triple voltage detectors (INT, $\overline{\text{PREEND}}$ and END Detector). Each voltage detector is featured the hysterisys operation and the high precision output voltage (±2%).

The output buffer is constructed with the Nch open drain.

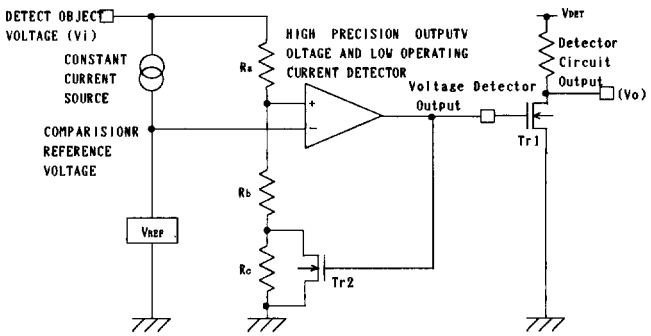


FIG. 1 EQUIVALENT CIRCUIT OF VOLTAGE DETECTOR

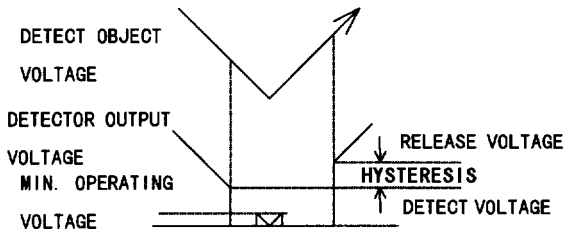


FIG. 2 DETECT CHARACTERISTIC OF VOLTAGE DETECTOR

(2-1) INT Voltage Detector

The INT voltage detector keeps watching the VIN terminal and when the VIN is dropped-down, the INT detector outputs the signal changing its level from Hi-Z to Low.

The INT voltage detector is provided with its power supply from the VIN and the VBAT terminal. Therefore, the INT output level is definite if that each terminal operates within guaranteed operating voltage range. To switch the INT output level from Low to Hi-Z (To release the detection), it is required that the VIN voltage is larger than the INT release voltage (VIN > +VDET1) and the VOUT voltage is larger than the INT output inhibit voltage (VOUT>VSW2). (See 3-2 VSW2 detection circuit.)

The detection voltage is available to be customized under the condition of voltages between 3.0V and 5.0V by 0.1V step by masked option.

(2-2) $\overline{\text{PREEND}}$ Voltage Detector

The $\overline{\text{PREEND}}$ voltage detector keeps watching the VBAT terminal and when the VBAT is dropped-down, the $\overline{\text{PREEND}}$ detector outputs the signal changing its level from Hi-Z to Low.

The $\overline{\text{PREEND}}$ voltage detector is provided with its power supply from the VIN terminal. Therefore, the $\overline{\text{PREEND}}$ output level is definite if the VIN terminal operates within guaranteed operating voltage range. When the REG2 becomes OFF with the VIN being dropped-down (VIN≦VSW1), the $\overline{\text{PREEND}}$ output level is forced to Low.

The detection voltage is available to be customized under the condition of voltages between 2.2V and 2.7V by 0.1V step by masked option. It is required that the $\overline{\text{PREEND}}$ detection voltage is larger than the END detection voltage.

(2-3) $\overline{\text{END}}$ Voltage Detector

The $\overline{\text{END}}$ voltage detector keeps watching the VOUT terminal and when the VOUT is dropped-down, the $\overline{\text{END}}$ detector outputs the signal changing its level from Hi-Z to Low.

The $\overline{\text{END}}$ voltage detector is provided with its power supply from the VOUT terminal. Therefore, the $\overline{\text{END}}$ output level is definite if the VOUT terminal operates in the condition of VOUT≧1.0V.

The detection voltage is available to be customized under the condition of voltages between 2.0V and 2.7V by 0.1V step by masked option.

(3) POWER SUPPLY SWITCHER

(3-1) VSW1 Voltage Detection Circuit

The VSW1 voltage detection circuit keeps watching the VIN terminal and when the VIN is dropped-down or charged-up , the VSW1 detection circuit switches the REG2 output and the VBAT output through the VOUT terminal. When the VIN voltage is larger than VSW1, the REG2 output is activated and the VBAT switch is OFF. When the VIN voltage is smaller than VSW1, the REG2 output is turned OFF and the VBAT switch is turned ON.

(These operation is called "normal operation" on this data sheet.)

The timing on which the REG2 is turned OFF and the VBAT is also switched OFF may be occurred, connect the larger capacitor (>10uF) between the VOUT terminal and VSS terminal to stabilize the VOUT voltage.

At the period between the VIN or the VBAT is charged-up from approximate GND level and the INT output level becomes the Hi-Z, which called the Special Sequence on this data sheet, the REG2 output is turned ON and the VBAT switch is turned OFF in every condition of the VSW1. At the reason of this, the back-up power consumption is saved.

The detection voltage is available to be customized under the condition of voltages between 2.0V and 5.0V by 0.1V step by masked option.

(3-2) VSW2 Voltage Detection Circuit

The VSW2 voltage detection circuit keeps watching the VOUT terminal and when the VOUT voltage becomes larger than the INT output inhibit voltage (VOUT > VSW2), the INT output inhibit signal is output to the INT control circuit.

The detection voltage is available to be customized under the condition of voltages between 2.0V and 5.0V by 0.1V step by masked option.

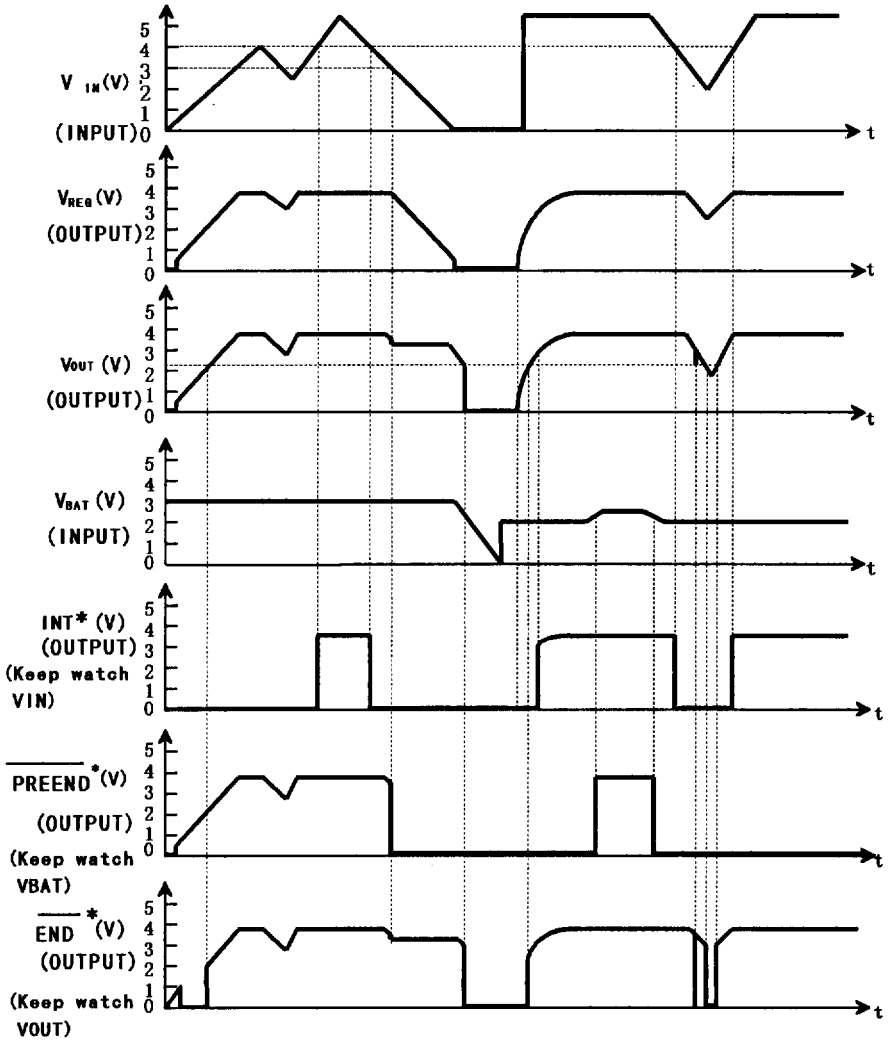
(3-3) INT Control Circuit

When the VIN voltage becomes larger than the INT output inhibit voltage (VSW2), the INT voltage detector outputs the signal changing its level from Low to Hi-Z in the condition of being input the INT output inhibit signal from the VSW2 voltage detection circuit.

When the VIN voltage becomes smaller than the INT detection voltage (-VDET1), the INT voltage detector outputs the signal changing its level from Hi-Z to Low in every condition of the VSW2.

When the VOUT voltage becomes smaller than the INT output inhibit voltage (VSW2), the INT voltage detector keeps outputting the Hi-Z level in the condition of the VIN being larger than the INT detection voltage.

■ OPERATION TIMING CHART



Note) The INT, $\overline{\text{PREEND}}$ and $\overline{\text{END}}$ terminal is pulled up to the VOUT level.

FIG.3 Operation Timing Chart

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT
Main Supply Voltage	V_{IN}	18	V
Back-up Supply Voltage	V_{BAT}	18	V
Regulator Output Voltage	V_{OUT}, V_{REG}	V_{SS}-0.3～V_{IN}+0.3	V
$\overline{INT}$ / $\overline{END}$ / $\overline{PREEND}$ Output Voltage	$V_{\overline{INT}}$ / $V_{\overline{END}}$ / $V_{\overline{PRE}}$	V_{SS}-0.3～18	V
Power Dissipation	P_D	300(DMP) 250(SSOP)	mW
Operating Temperature	T_{OPR}	-30～+85	℃
Storage Temperature	T_{STG}	-40～+125	℃

■ ELECTRICAL CHARACTER

1. NJU7283A

(Ta=25℃)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	CIR-CUIT
Operating Voltage	V_{IN}		2.0	-	15	V	2.7
Back-up Input Voltage	V_{BAT}		2.0	-	4.0	V	6
Operating Current	I_{SS1}	V_{IN}=6V, V_{BAT}=3V, No Load	-	10	30	μA	1
	I_{BAT1}	V_{IN}=6V, V_{BAT}=3V, No Load	-	0.26	0.50	μA	1
	I_{BAT2}	V_{IN}=Open Ta=25℃	-	1.0	2.1	μA	1
		V_{BAT}=3V, No Load Ta=85℃	-	-	3.5	μA	1
VOLTAGE REGULATOR							
Output Voltage 1	V_{REG}	V_{IN}=6V, I_{REG}=30mA	4.90	5.00	5.10	V	2
Dropout Voltage 1	$\triangle V_{IO1}$	I_{REG}=30mA	-	0.2	0.35	V	2
Load Regulation 1	$\triangle V_{REG1}$	V_{IN}=6V, I_{REG}=100μA～40mA	-	50	110	mV	2
Line Regulation 1	$\triangle V_{REG2}$	V_{IN}=6～15V, I_{REG}=30mA	-	50	110	mV	2
Temperature Coefficient of V_{REG}	$\frac{\triangle V_{REG}}{\triangle T_a}$	T_a=-30℃～85℃	-	±0.71	-	mV/℃	2
Output Voltage 2	V_{OUT}	V_{IN}=6V, I_{OUT}=50mA	4.90	5.00	5.10	V	2
Dropout Voltage 2	$\triangle V_{IO2}$	I_{OUT}=50mA	-	0.2	0.35	V	2
Load Regulation 2	$\triangle V_{OUT1}$	V_{IN}=6V, I_{OUT}=100μA～60mA	-	50	110	mV	2
Line Regulation 2	$\triangle V_{OUT2}$	V_{IN}=6～15V, I_{OUT}=50mA	-	50	110	mV	2
Temperature Coefficient of V_{OUT}	$\frac{\triangle V_{OUT}}{\triangle T_a}$	T_a=-30℃～85℃	-	±0.71	-	mV/℃	2
SWITCH							
Switching Voltage	V_{SW1}	V_{BAT}=2.8V, V_{IN} Detection	3.539	3.634	3.728	V	3
INT Output Inhibit V.	V_{SW2}	V_{BAT}=3V, V_{OUT} Detection	4.650	4.750	4.850	V	4
V_{BAT} Switch Leak Cur.	I_{LEK}	V_{IN}=6V, V_{BAT}=0V	-	-	1	μA	5
V_{BAT} Switch Resistance	R_{TI}	V_{IN}=Open V_{BAT}=3V I_{OUT}=10～500μA	-	-	100	Ω	6
Temperature Coefficient of V_{SW1}	$\frac{\triangle V_{SW1}}{\triangle T_a}$	T_a=-30℃～85℃	-	±0.51	-	mV/℃	3
Temperature Coefficient of V_{SW2}	$\frac{\triangle V_{SW2}}{\triangle T_a}$	T_a=-30℃～85℃	-	±0.51	-	mV/℃	4

NJU7283A

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT	CIR-CUIT
VOLTAGE DETECTOR								
INT Detection Voltage	$-V_{DET1}$	V_{IN} Detection		4.507	4.600	4.693	V	7
INT Release Voltage	$+V_{DET1}$			4.609	4.719	4.828	V	7
$\overline{END}$ Detection Voltage	$-V_{DET2}$	V_{OUT} Detection		2.253	2.300	2.347	V	7
$\overline{END}$ Release Voltage	$+V_{DET2}$			2.351	2.420	2.489	V	7
$\overline{PREEND}$ Detection Voltage	$-V_{DET3}$	V_{BAT} Detection		2.403	2.500	2.597	V	7
$\overline{PREEND}$ Release Voltage	$+V_{DET3}$			2.513	2.640	2.767	V	7
Operating Voltage	V_{OPR}	V_{IN} or V_{BAT}		2.0	–	15	V	7
Temperature Coefficient of Detection Voltage	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=-30°C~85°C		–	±0.66	–	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=-30°C~85°C		–	±0.33	–	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=-30°C~85°C		–	±0.36	–	mV/°C	7
Output Current	I_{SINK}	V_{DS}=0.5V	INT	1.50	2.30	–	mA	8
		V_{IN}=V_{BAT}= 2.0V	$\overline{PREEND}$	1.50	2.30	–	mA	8
			$\overline{END}$	1.50	2.30	–	mA	8
Leakage Current	I_{LEAK}	V_{DS}=15V, V_{IN}=15V				0.1	μA	8

2. NJU7283B (Ta=25°C)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT	CIR-CUIT
Operating Voltage	V_{IN}			2.0	–	15	V	2.7
Back-up Input Voltage	V_{BAT}			2.0	–	4.0	V	6
Operating Current	I_{SS1}	V_{IN}=6V, V_{BAT}=3V, No Load		–	10	30	μA	1
	I_{BAT1}	V_{IN}=6V, V_{BAT}=3V, No Load		–	0.26	0.50	μA	1
	I_{BAT2}	V_{IN}=Open	Ta=25°C	–	1.0	2.1	μA	1
		V_{BAT}=3V, No load	Ta=85°C	–	–	3.5	μA	1
VOLTAGE REGULATOR								
Output Voltage 1	V_{REG}	V_{IN}=6V, I_{REG}=30mA		3.527	3.600	3.673	V	2
Dropout Voltage 1	$\triangle V_{IO1}$	I_{REG}=30mA		–	0.2	0.35	V	2
Load Regulation 1	$\triangle V_{REG1}$	V_{IN}=6V, I_{REG}=100μA～40mA		–	40	100	mV	2
Line Regulation 1	$\triangle V_{REG2}$	V_{IN}=6～15V, I_{REG}=30mA		–	38	100	mV	2
Temperature Coefficient of V_{REG}	$\frac{\triangle V_{REG}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.47	–	mV/°C	2
Output Voltage 2	V_{OUT}	V_{IN}=6V, I_{OUT}=50mA		3.527	3.600	3.673	V	2
Dropout Voltage 2	$\triangle V_{IO2}$	I_{OUT}=50mA		–	0.2	0.35	V	2
Load Regulation 2	$\triangle V_{OUT1}$	V_{IN}=6V, I_{OUT}=100μA～60mA		–	50	110	mV	2
Line Regulation 2	$\triangle V_{OUT2}$	V_{IN}=6～15V, I_{OUT}=50mA		–	50	110	mV	2
Temperature Coefficient of V_{OUT}	$\frac{\triangle V_{OUT}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.47	–	mV/°C	2
SWITCH								
Switching Voltage	V_{SW1}	V_{BAT}=2.8V, V_{IN} Detection		3.307	3.395	3.483	V	3
INT Output Inhibit V.	V_{SW2}	V_{BAT}=3V, V_{OUT} Detection		4.348	3.420	3.492	V	4
V_{BAT} Switch Leak Cur.	I_{LEK}	V_{IN}=6V, V_{BAT}=0V		–	–	1	μA	5
V_{BAT} Switch Resistance	R_{TI}	V_{IN}=Open V_{BAT}=3V I_{OUT}=10～500μA		–	–	100	Ω	6
Temperature Coefficient of V_{SW1}	$\frac{\triangle V_{SW1}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.44	–	mV/°C	3
Temperature Coefficient of V_{SW2}	$\frac{\triangle V_{SW2}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.45	–	mV/°C	4
VOLTAGE DETECTOR								
INT Detection Voltage	$-V_{DET1}$	V_{IN} Detection		4.213	4.300	4.387	V	7
INT Release Voltage	$+V_{DET1}$			4.306	4.409	4.513	V	7
END Detection Voltage	$-V_{DET2}$	V_{OUT} Detection		2.351	2.400	2.449	V	7
END Release Voltage	$+V_{DET2}$			2.457	2.528	2.599	V	7
PREEND Detection Voltage	$-V_{DET3}$	V_{BAT} Detection		2.501	2.600	2.699	V	7
PREEND Release Voltage	$+V_{DET3}$			2.611	2.740	2.869	V	7
Operating Voltage	V_{OPR}	V_{IN} or V_{BAT}		2.0	–	15	V	7
Temperature Coefficient of Detection Voltage	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.57	–	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.33	–	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.36	–	mV/°C	7
Output Current	I_{SINK}	V_{DS}=0.5V V_{IN}=V_{BAT}= 2.0V	INT	1.50	2.30	–	mA	8
			PREEND	1.50	2.30	–	mA	8
			END	1.50	2.30	–	mA	8
Leakage Current	I_{LEAK}	V_{DS}=15V, V_{IN}=15V				0.1	μA	8

3. NJU7283C (Ta=25°C)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT	CIRCUIT
Operating Voltage	V_{IN}			2.0	–	15	V	2.7
Back-up Input Voltage	V_{BAT}			2.0	–	4.0	V	6
Operating Current	I_{SS1}	V_{IN}=6V, V_{BAT}=3V, No Load		–	10	30	μA	1
	I_{BAT1}	V_{IN}=6V, V_{BAT}=3V, No Load		–	0.26	0.50	μA	1
	I_{BAT2}	V_{IN}=Open	Ta=25°C	–	1.0	2.1	μA	1
		V_{BAT}=3V, No Load	Ta=85°C	–	–	3.5	μA	1
VOLTAGE REGULATOR								
Output Voltage 1	V_{REG}	V_{IN}=6V, I_{REG}=30mA		3.230	3.300	3.370	V	2
Dropout Voltage 1	$\triangle V_{IO1}$	I_{REG}=30mA		–	0.2	0.35	V	2
Load Regulation 1	$\triangle V_{REG1}$	V_{IN}=6V, I_{REG}=100μA～40mA		–	40	100	mV	2
Line Regulation 1	$\triangle V_{REG2}$	V_{IN}=6～15V, I_{REG}=30mA		–	38	100	mV	2
Temperature Coefficient of V_{REG}	$\frac{\triangle V_{REG}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.47	–	mV/°C	2
Output Voltage 2	V_{OUT}	V_{IN}=6V, I_{OUT}=50mA		3.230	3.300	3.370	V	2
Dropout Voltage 2	$\triangle V_{IO2}$	I_{OUT}=50mA		–	0.2	0.35	V	2
Load Regulation 2	$\triangle V_{OUT1}$	V_{IN}=6V, I_{OUT}=100μA～60mA		–	50	110	mV	2
Line Regulation 2	$\triangle V_{OUT2}$	V_{IN}=6～15V, I_{OUT}=50mA		–	50	110	mV	2
Temperature Coefficient of V_{OUT}	$\frac{\triangle V_{OUT}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.47	–	mV/°C	2
SWITCH								
Switching Voltage	V_{SW1}	V_{BAT}=2.8V, V_{IN} Detection		3.075	3.157	3.239	V	3
INT Output Inhibit V.	V_{SW2}	V_{BAT}=3V, V_{OUT} Detection		3.069	3.135	3.201	V	4
V_{BAT} Switch Leak Cur	I_{LEK}	V_{IN}=6V, V_{BAT}=0V		–	–	1	μA	5
V_{BAT} Switch Resistance	R_{TI}	V_{IN}=Open V_{BAT}=3V I_{OUT}=10～500μA		–	–	100	Ω	6
Temperature Coefficient of V_{SW1}	$\frac{\triangle V_{SW1}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.45	–	mV/°C	3
Temperature Coefficient of V_{SW2}	$\frac{\triangle V_{SW2}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.45	–	mV/°C	4
VOLTAGE DETECTOR								
INT Detection Voltage	$-V_{DET1}$	V_{IN} Detection		3.919	4.000	4.081	V	7
INT Release Voltage	$+V_{DET1}$			4.003	4.100	4.197	V	7
END Detection Voltage	$-V_{DET2}$	V_{OUT} Detection		2.253	2.300	2.347	V	7
END Release Voltage	$+V_{DET2}$			2.351	2.420	2.489	V	7
PREEND Detection Voltage	$-V_{DET3}$	V_{BAT} Detection		2.403	2.500	2.597	V	7
PREEND Release Voltage	$+V_{DET3}$			2.513	2.640	2.767	V	7
Operating Voltage	V_{OPR}	V_{IN} or V_{BAT}		2.0	–	15	V	7
Temperature Coefficient of Detection Voltage	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.57	–	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.33	–	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=−30°C～85°C		–	±0.36	–	mV/°C	7
Output Current	I_{SINK}	V_{DS}=0.5V V_{IN}=V_{BAT}=2.0V	INT	1.50	2.30	–	mA	8
			PREEND	1.50	2.30	–	mA	8
			END	1.50	2.30	–	mA	8
Leakage Current	I_{LEAK}	V_{DS}=15V, V_{IN}=15V				0.1	μA	8

4. NJU7283D

(Ta=25°C)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT	CIR-CUIT
Operating Voltage	V_{IN}			2.0	-	15	V	2.7
Back-up Input Voltage	V_{BAT}			2.0	-	4.0	V	6
Operating Current	I_{SS1}	V_{IN}=3.6V, V_{BAT}=3V, No Load		-	10	30	μA	1
	I_{BAT1}	V_{IN}=3.6V, V_{BAT}=3V, No Load		-	0.26	0.50	μA	1
	I_{BAT2}	V_{IN}=Open	Ta=25°C	-	1.0	2.1	μA	1
		V_{BAT}=3V, No Load	Ta=85°C	-	-	3.5	μA	1
VOLTAGE REGULATOR								
Output Voltage 1	V_{REG}	V_{IN}=3.6V, I_{REG}=15mA		3.135	3.200	3.265	V	2
Dropout Voltage 1	$\triangle V_{IO1}$	I_{REG}=15mA		-	0.06	0.18	V	2
Load Regulation 1	$\triangle V_{REG1}$	V_{IN}=3.6V, I_{REG}=100μA~20mA		-	40	100	mV	2
Line Regulation 1	$\triangle V_{REG2}$	V_{IN}=3.6~15V, I_{REG}=15mA		-	38	100	mV	2
Temperature Coefficient of V_{REG}	$\frac{\triangle V_{REG}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.46	-	mV/°C	2
Output Voltage 2	V_{OUT}	V_{IN}=3.6V, I_{OUT}=15mA		3.135	3.200	3.265	V	2
Dropout Voltage 2	$\triangle V_{IO2}$	I_{OUT}=15mA		-	0.02	0.06	V	2
Load Regulation 2	$\triangle V_{OUT1}$	VIN=3.6V, IOUT=100μA~20mA		-	50	110	mV	2
Line Regulation 2	$\triangle V_{OUT2}$	V_{IN}=3.6~15V, I_{OUT}=15mA		-	50	110	mV	2
Temperature Coefficient of V_{OUT}	$\frac{\triangle V_{OUT}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.46	-	mV/°C	2
SWITCH								
Switching Voltage	V_{SW1}	V_{BAT}=2.8V, V_{IN} Detection		2.822	2.890	2.958	V	3
INT Output Inhibit V.	V_{SW2}	V_{BAT}=3V, V_{OUT} Detection		2.976	3.040	3.104	V	4
V_{BAT} Switch Leak Cur	I_{LEK}	V_{IN}=3.6V, V_{BAT}=0V		-	-	1	μA	5
V_{BAT} Switch Resistance	R_{TI}	V_{IN}=Open V_{BAT}=3V I_{OUT}=10~500μA		-	-	100	Ω	6
Temperature Coefficient of V_{SW1}	$\frac{\triangle V_{SW1}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.41	-	mV/°C	3
Temperature Coefficient of V_{SW2}	$\frac{\triangle V_{SW2}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.43	-	mV/°C	4
VOLTAGE DETECTOR								
INT Detection Voltage	$-V_{DET1}$	V_{IN} Detection		3.234	3.300	3.361	V	7
INT Release Voltage	$+V_{DET1}$			3.315	3.400	3.485	V	7
END Detection Voltage	$-V_{DET2}$	V_{OUT} Detection		2.351	2.400	2.449	V	7
END Release Voltage	$+V_{DET2}$			2.457	2.528	2.599	V	7
PREEND Detection Voltage	$-V_{DET3}$	V_{BAT} Detection		2.501	2.600	2.699	V	7
PREEND Release Voltage	$+V_{DET3}$			2.611	2.740	2.869	V	7
Operating Voltage	V_{OPR}	V_{IN} or V_{BAT}		2.0	-	15	V	7
Temperature Coefficient of Detection Voltage	$\frac{\triangle -V_{DET1}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.47	-	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.34	-	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.37	-	mV/°C	7
Output Current	I_{SINK}	V_{DS}=0.5V, V_{IN}=V_{BAT}=2.0V	INT	1.50	2.30	-	mA	8
			PREEND	1.50	2.30	-	mA	8
			END	1.50	2.30	-	mA	8
Leakage Current	I_{LEAK}	V_{DS}=15V, V_{IN}=15V				0.1	μA	8

5. NJU7283E (Ta=25°C)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT	CIR-CUIT
Operating Voltage	V_{IN}			2.0	–	15	V	2.7
Back-up Input Voltage	V_{BAT}			2.0	–	4.0	V	6
Operating Current	I_{SS1}	V_{IN}=6V, V_{BAT}=3V, No Load		–	10	30	μA	1
	I_{BAT1}	V_{IN}=6V, V_{BAT}=3V, No Load		–	0.26	0.50	μA	1
	I_{BAT2}	V_{IN}=Open	Ta=25°C	–	1.0	2.1	μA	1
		V_{BAT}=3V, No Load	Ta=85°C	–	–	3.5	μA	1
VOLTAGE REGULATOR								
Output Voltage 1	V_{REG}	V_{IN}=6V, I_{REG}=30mA		3.087	3.150	3.213	V	2
Dropout Voltage 1	$\triangle V_{IO1}$	I_{REG}=30mA		–	0.20	0.35	V	2
Load Regulation 1	$\triangle V_{REG1}$	V_{IN}=6V, I_{REG}=100μA～40mA		–	40	100	mV	2
Line Regulation 1	$\triangle V_{REG2}$	V_{IN}=6～15V, I_{REG}=30mA		–	38	100	mV	2
Temperature Coefficient of V_{REG}	$\frac{\triangle V_{REG}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.45	–	mV/°C	2
Output Voltage 2	V_{OUT}	V_{IN}=6V, I_{OUT}=50mA		3.087	3.150	3.213	V	2
Dropout Voltage 2	$\triangle V_{IO2}$	I_{OUT}=50mA		–	0.20	0.35	V	2
Load Regulation 2	$\triangle V_{OUT1}$	V_{IN}=6V, I_{OUT}=100μA～60mA		–	50	110	mV	2
Line Regulation 2	$\triangle V_{OUT2}$	V_{IN}=6～15V, I_{OUT}=60mA		–	50	110	mV	2
Temperature Coefficient of V_{OUT}	$\frac{\triangle V_{OUT}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.45	–	mV/°C	2
SWITCH								
Switching Voltage	V_{SW1}	V_{BAT}=2.8V, V_{IN} Detection		3.229	3.315	3.401	V	3
INT Output Inhibit V.	V_{SW2}	V_{BAT}=3V, V_{OUT} Detection		2.930	2.993	3.056	V	4
V_{BAT} Switch Leak Cur	I_{LEK}	V_{IN}=6V, V_{BAT}=0V		–	–	1	μA	5
V_{BAT} Switch Resistance	R_{T1}	V_{IN}=Open V_{BAT}=3V I_{OUT}=10～500μA		–	–	100	Ω	6
Temperature Coefficient of V_{SW1}	$\frac{\triangle V_{SW1}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.47	–	mV/°C	3
Temperature Coefficient of V_{SW2}	$\frac{\triangle V_{SW2}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.43	–	mV/°C	4
VOLTAGE DETECTOR								
INT Detection Voltage	V_{DET1}	V_{IN} Detection		4.116	4.200	4.284	V	7
INT Release Voltage	V_{DET1}			4.204	4.305	4.407	V	7
END Detection Voltage	V_{DET2}	V_{OUT} Detection		2.254	2.300	2.346	V	7
END Release Voltage	V_{DET2}			2.348	2.420	2.492	V	7
PREEND Detection Voltage	V_{DET3}	V_{BAT} Detection		2.404	2.500	2.596	V	7
PREEND Release Voltage	V_{DET3}			2.514	2.640	2.766	V	7
Operating Voltage	V_{OPR}	V_{IN} or V_{BAT}		2.0	–	15	V	7
Temperature Coefficient of Detection Voltage	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.60	–	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.33	–	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.36	–	mV/°C	7
Output Current	I_{SINK}	V_{DS}=0.5V, V_{IN}=V_{BAT}=2.0V	INT	1.50	2.30	–	mA	8
			PREEND	1.50	2.30	–	mA	8
			END	1.50	2.30	–	mA	8
Leakage Current	I_{LEAK}	V_{DS}=15V, V_{IN}=15V				0.1	μA	8

6. NJU7283F (Ta=25°C)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT	CIRCUIT
Operating Voltage	V_{IN}			2.0	–	15	V	2.7
Back-up Input Voltage	V_{BAT}			2.0	–	4.0	V	6
Operating Current	I_{SS1}	V_{IN}=6V, V_{BAT}=3V, No Load		–	10	30	μA	1
	I_{BAT1}	V_{IN}=6V, V_{BAT}=3V, No Load		–	0.26	0.50	μA	1
	I_{BAT2}	V_{IN}=Open	Ta=25°C	–	1.0	2.1	μA	1
		V_{BAT}=3V, No Load	Ta=85°C	–	–	3.5	μA	1
VOLTAGE REGULATOR								
Output Voltage 1	V_{REG}	V_{IN}=6V, I_{REG}=30mA		4.900	5.000	5.100	V	2
Dropout Voltage 1	$\triangle V_{IO1}$	I_{REG}=30mA		–	0.20	0.35	V	2
Load Regulation 1	$\triangle V_{REG1}$	V_{IN}=6V, I_{REG}=100μA～40mA		–	40	100	mV	2
Line Regulation 1	$\triangle V_{REG2}$	V_{IN}=6～15V, I_{REG}=30mA		–	38	100	mV	2
Temperature Coefficient of V_{REG}	$\frac{\triangle V_{REG}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.45	–	mV/°C	2
Output Voltage 2	V_{OUT}	V_{IN}=6V, I_{OUT}=50mA		4.900	5.000	5.100	V	2
Dropout Voltage 2	$\triangle V_{IO2}$	I_{OUT}=50mA		–	0.20	0.35	V	2
Load Regulation 2	$\triangle V_{OUT1}$	V_{IN}=6V, I_{OUT}=100μA～60mA		–	50	110	mV	2
Line Regulation 2	$\triangle V_{OUT2}$	V_{IN}=6～15V, I_{OUT}=50mA		–	50	110	mV	2
Temperature Coefficient of V_{OUT}	$\frac{\triangle V_{OUT}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.45	–	mV/°C	2
SWITCH								
Switching Voltage	V_{SW1}	V_{BAT}=2.8V, V_{IN} Detection		3.229	3.315	3.401	V	3
INT Output Inhibit V.	V_{SW2}	V_{BAT}=3V, V_{OUT} Detection		2.930	2.993	3.056	V	4
V_{BAT} Switch Leak Cur	I_{LEK}	V_{IN}=6V, V_{BAT}=0V		–	–	1	μA	5
V_{BAT} Switch Resistance	R_{TI}	V_{IN}=Open V_{BAT}=3V I_{OUT}=10～500μA		–	–	100	Ω	6
Temperature Coefficient of V_{SW1}	$\frac{\triangle V_{SW1}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.47	–	mV/°C	3
Temperature Coefficient of V_{SW2}	$\frac{\triangle V_{SW2}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.43	–	mV/°C	4
VOLTAGE DETECTOR								
INT Detection Voltage	$-V_{DET1}$	V_{IN} Detection		4.116	4.200	4.284	V	7
INT Release Voltage	$+V_{DET1}$			4.204	4.305	4.407	V	7
END Detection Voltage	$-V_{DET2}$	V_{OUT} Detection		2.254	2.300	2.346	V	7
END Release Voltage	$+V_{DET2}$			2.348	2.420	2.492	V	7
PREEND Detection Voltage	$-V_{DET3}$	V_{BAT} Detection		2.404	2.500	2.596	V	7
PREEND Release Voltage	$+V_{DET3}$			2.514	2.640	2.766	V	7
Operating Voltage	OPR	V_{IN} or V_{BAT}		2.0	–	15	V	7
Temperature Coefficient of Detection Voltage	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.60	–	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.33	–	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle T_a}$	T_a=-30°C～85°C		–	±0.36	–	mV/°C	7
Output Current	I_{SINK}	V_{DS}=0.5V V_{IN}=V_{BAT}=2.0V	INT	1.50	2.30	–	mA	8
			PREEND	1.50	2.30	–	mA	8
			END	1.50	2.30	–	mA	8
Leakage Current	I_{LEAK}	V_{DS}=15V, V_{IN}=15V				0.1	μA	8

7. NJU7283G (Ta=25°C)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT	CIR-CUIT
Operating Voltage	V_{IN}			(1.8)*	-	15	V	2.7
Back-up Input Voltage	V_{BAT}			(1.8)*	-	4.0	V	6
Operating Current	I_{SS1}	V_{IN}=3.6V, V_{BAT}=3V, No load		-	10	30	μA	1
	I_{BAT1}	V_{IN}=3.6V, V_{BAT}=3V, No load		-	0.26	0.50	μA	1
	I_{BAT2}	V_{IN}=Open	Ta=25°C	-	1.0	2.1	μA	1
		V_{BAT}=3V, No Load	Ta=85°C	-	-	3.5	μA	1
VOLTAGE REGULATOR								
Output Voltage 1	V_{REG}	V_{IN}=3.6V, I_{REG}=15mA		2.940	3.000	3.060	V	2
Dropout Voltage 1	$\triangle V_{IO1}$	I_{REG}=15mA		-	0.06	0.18	V	2
Load Regulation 1	$\triangle V_{REG1}$	V_{IN}=3.6V, I_{REG}=100μA~20mA		-	40	100	mV	2
Line Regulation 1	$\triangle V_{REG2}$	V_{IN}=3.6~15V, I_{REG}=15mA		-	38	100	mV	2
Temperature Coefficient of V_{REG}	$\frac{\triangle V_{REG}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.46	-	mV/°C	2
Output Voltage 2	V_{OUT}	V_{IN}=3.6V, I_{OUT}=15mA		2.940	3.000	3.060	V	2
Dropout Voltage 2	$\triangle V_{IO2}$	I_{OUT}=15mA		-	0.02	0.06	V	2
Load Regulation 2	$\triangle V_{OUT1}$	V_{IN}=3.6V, I_{OUT}=100μA~20mA		-	50	110	mV	2
Line Regulation 2	$\triangle V_{OUT2}$	V_{IN}=3.6~15V, I_{OUT}=15mA		-	50	110	mV	2
Temperature Coefficient of V_{OUT}	$\frac{\triangle V_{OUT}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.46	-	mV/°C	2
SWITCH								
Switching Voltage	V_{SW1}	V_{BAT}=2.8V, V_{IN} Detection		2.400	2.450	2.500	V	3
INT Output Inhibit V.	V_{SW2}	V_{BAT}=3V, V_{OUT} Detection		2.793	2.850	2.907	V	4
V_{BAT} Switch Leak Cur	I_{LEK}	V_{IN}=3.6V, V_{BAT}=0V		-	-	1	μA	5
V_{BAT} Switch Resistance	R_{T1}	V_{IN}= V_{BAT}=3V I_{OUT}=10~500μA		-	-	100	Ω	6
Temperature Coefficient of V_{SW1}	$\frac{\triangle V_{SW1}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.41	-	mV/°C	3
Temperature Coefficient of V_{SW2}	$\frac{\triangle V_{SW2}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.43	-	mV/°C	4
VOLTAGE DETECTOR								
INT Detection Voltage	$-V_{DET1}$	V_{IN} Detection		2.744	2.800	2.856	V	7
INT Release Voltage	$+V_{DET1}$			2.808	2.880	2.952	V	7
END Detection Voltage	$-V_{DET2}$	V_{OUT} Detection		1.960	2.000	2.040	V	7
END Release Voltage	$+V_{DET2}$			2.047	2.100	2.153	V	7
PREEND Detection Voltage	$-V_{DET3}$	V_{BAT} Detection		2.548	2.600	2.652	V	7
PREEND Release Voltage	$+V_{DET3}$			2.671	2.740	2.809	V	7
Operating Voltage	V_{OPR}	V_{IN} or V_{BAT}		(1.8)	-	15	V	7
Temperature Coefficient of Detection Voltage	$\frac{\triangle -V_{DET1}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.47	-	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.34	-	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle Ta}$	Ta=-30°C~85°C		-	±0.37	-	mV/°C	7
Output Current	I_{SINK}	V_{DS}=0.5V, V_{IN}=V_{BAT}=2.0V	INT	1.50	2.30	-	mA	8
			PREEND	1.50	2.30	-	mA	8
			END	1.50	2.30	-	mA	8
Leakage Current	I_{LEAK}	V_{DS}=15V, V_{IN}=15V				0.1	μA	8

NOTE: ( )* is preliminary.

8. NJU7283H

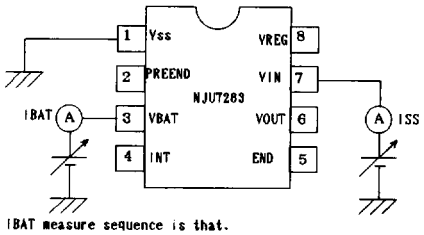
(Ta=25°C)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNIT	CIRCUIT
Operating Voltage	V_{IN}			2.0	–	15	V	2.7
Back-up Input Voltage	V_{BAT}			2.0	–	4.0	V	6
Operating Current	I_{SS1}	V_{IN}=3.6V, V_{BAT}=3V, No Load		–	10	30	μA	1
	I_{BAT1}	V_{IN}=3.6V, V_{BAT}=3V, No Load		–	0.26	0.50	μA	1
	I_{BAT2}	V_{IN}=Open, V_{BAT}=3V, No Load	Ta=25°C	–	1.0	2.1	μA	1
			Ta=85°C	–	–	3.5	μA	1
VOLTAGE REGULATOR								
Output Voltage 1	V_{REG}	V_{IN}=3.6V, I_{REG}=15mA		2.940	3.000	3.060	V	2
Dropout Voltage 1	$\triangle V_{IO1}$	I_{REG}=15mA		–	0.06	0.18	V	2
Load Regulation 1	$\triangle V_{REG1}$	V_{IN}=3.6V, I_{REG}=100μA~20mA		–	40	100	mV	2
Line Regulation 1	$\triangle V_{REG2}$	V_{IN}=3.6~15V, I_{REG}=15mA		–	38	100	mV	2
Temperature Coefficient of V_{REG}	$\frac{\triangle V_{REG}}{\triangle Ta}$	Ta=-30°C~85°C		–	±0.46	–	mV/°C	2
Output Voltage 2	V_{OUT}	V_{IN}=3.6V, I_{OUT}=15mA		2.940	3.000	3.060	V	2
Dropout Voltage 2	$\triangle V_{IO2}$	I_{OUT}=15mA		–	0.02	0.06	V	2
Load Regulation 2	$\triangle V_{OUT1}$	V_{IN}=3.6V, I_{OUT}=100μA~20mA		–	50	110	mV	2
Line Regulation 2	$\triangle V_{OUT2}$	V_{IN}=3.6~15V, I_{OUT}=15mA		–	50	110	mV	2
Temperature Coefficient of V_{OUT}	$\frac{\triangle V_{OUT}}{\triangle Ta}$	Ta=-30°C~85°C		–	±0.46	–	mV/°C	2
SWITCH								
Switching Voltage	V_{SW1}	V_{BAT}=2.8V, V_{IN} Detection		2.822	2.890	2.958	V	3
INT Output Inhibit V.	V_{SW2}	V_{BAT}=3V, V_{OUT} Detection		2.790	2.850	2.910	V	4
V_{BAT} Switch Leak Cur	I_{LEK}	V_{IN}=3.6V, V_{BAT}=0V		–	–	1	μA	5
V_{BAT} Switch Resistance	R_{T1}	V_{IN}=Open V_{BAT}=3V, I_{OUT}=10~500μA		–	–	100	Ω	6
Temperature Coefficient of V_{SW1}	$\frac{\triangle V_{SW1}}{\triangle Ta}$	Ta=-30°C~85°C		–	±0.41	–	mV/°C	3
Temperature Coefficient of V_{SW2}	$\frac{\triangle V_{SW2}}{\triangle Ta}$	Ta=-30°C~85°C		–	±0.43	–	mV/°C	4
VOLTAGE DETECTOR								
INT Detection Voltage	$-V_{DET1}$	V_{IN} Detection		3.234	3.300	3.366	V	7
INT Release Voltage	$+V_{DET1}$			3.315	3.400	3.485	V	7
END Detection Voltage	$-V_{DET2}$	V_{OUT} Detection		2.351	2.400	2.449	V	7
END Release Voltage	$+V_{DET2}$			2.457	2.528	2.599	V	7
PREEND Detection Voltage	$-V_{DET3}$	V_{BAT} Detection		2.501	2.600	2.699	V	7
PREEND Release Voltage	$+V_{DET3}$			2.611	2.740	2.869	V	7
Operating Voltage	V_{OPR}	V_{IN} or V_{BAT}		2.0	–	15	V	7
Temperature Coefficient of Detection Voltage	$\frac{\triangle -V_{DET1}}{\triangle Ta}$	Ta=-30°C~85°C		–	±0.47	–	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle Ta}$	Ta=-30°C~85°C		–	±0.34	–	mV/°C	7
	$\frac{\triangle -V_{DET1}}{\triangle Ta}$	Ta=-30°C~85°C		–	±0.37	–	mV/°C	7
Output Current	I_{SINK}	V_{DS}=0.5V, V_{IN}=V_{BAT}=2.0V	INT	1.50	2.30	–	mA	8
			PREEND	1.50	2.30	–	mA	8
			END	1.50	2.30	–	mA	8
Leakage Current	I_{LEAK}	V_{DS}=15V, V_{IN}=15V				0.1	μA	8

6

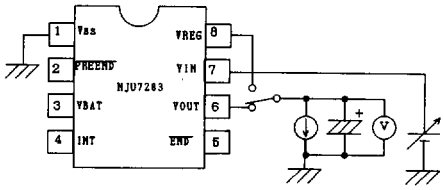
■ MEASUREMENT CIRCUIT

1.

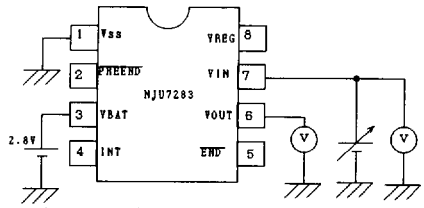


IBAT measure sequence is that.
① Put 3V to VBAT and put 6V to VIN .
② Open VIN. ③ IBAT is measured at the last.

2.

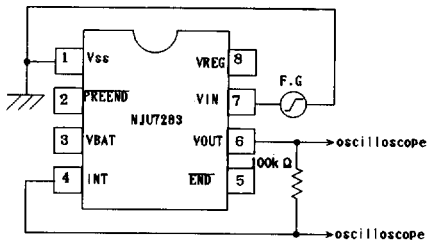


3.

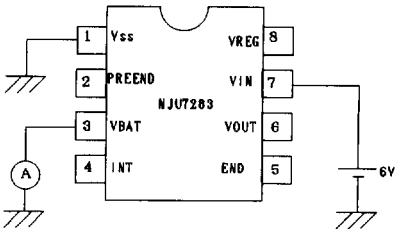


VIN is put more than 5V.

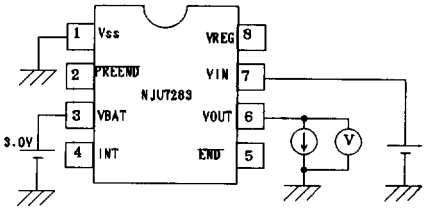
4.



5.

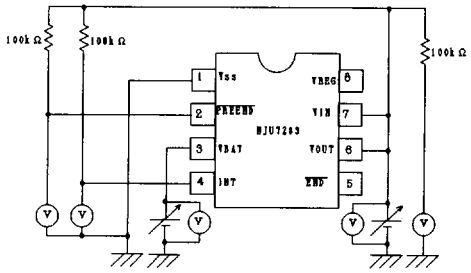


6.



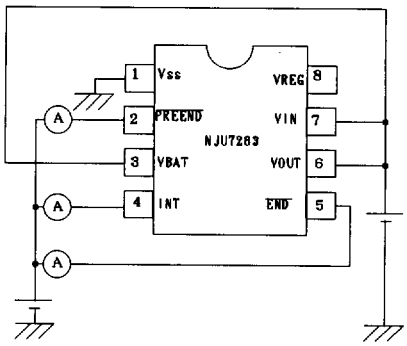
Open VIN, after VIN is put more than 6V.

7.

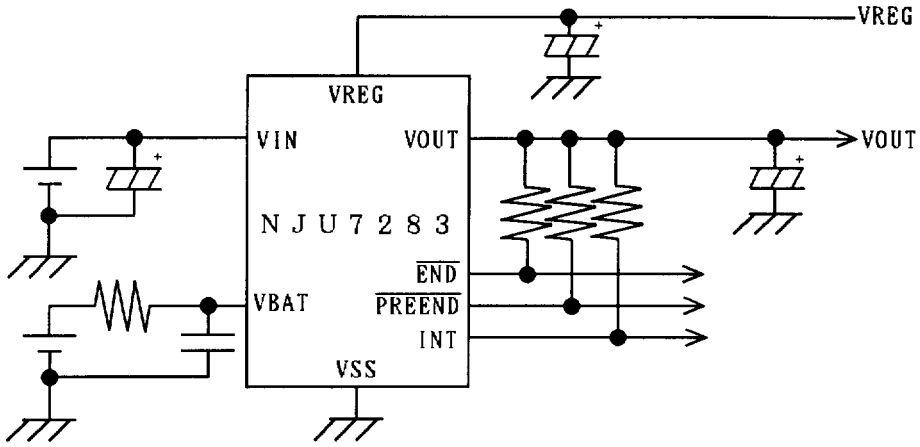


VIN is put 6V at VDET3 measurement.

8.



■ APPLICATION CIRCUITS 1



■ APPLICATION CIRCUITS 2

In this application, the regulator1 is used for charging the second battery.