Battery Backup IC

1. Background of Development

Around 1985 when began the sales of IC for microcomputer peripheral equipment and system reset IC, a set manufacture inquired of us about IC for control of memory. It was a good change for us to decide a joint development of general purpose IC. This resulted in the development of PST531 and PST532. In 1989 they were improved into the backup IC series dedicated to cards, games (popular-priced) and to 1-chip microcomputers. Our IC series now includes low current consumption type products.

2. What is Battery Backup IC?

Such IC memories as S-RAM and D-RAM all volatilize when power supply is cut off. Usually we use batteries not to let these data disappear and to store them for a longer time (of the order of several years). The battery backup IC can monitor main supply when storing data by means of battery and the like, control memory so that there should not arise any data trouble in the memory, change the main supply over to battery, and monitor the residual voltage of the battery, to take a few examples.

3. Basic Configuration

Fig. 1 below illustrates the basic configuration of the backup IC.
We have PST531, PST532 and MM1026 as IC of the basic configuration.
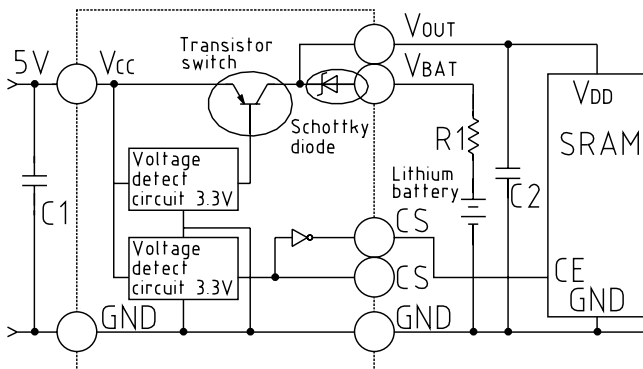
Backup IC surrounded by dotted lines.
C1,C2 : Bypass capacitor for power supply
R1   : Protective resistor for lithium battery

Fig.1 Basic Configuration

3-1 Battery/Main Supply Changeover Circuit

1. 3.3V detect circuit ⋯ Main supply detection
2. Transistor switch ⋯⋯ Main supply ON/OFF switch
3. Schottky diode ⋯⋯⋯ For supplying backup power

3-2 Configuration of CS (CE) Control circuit

1. 4.2V detect circuit ⋯⋯⋯ Detection of main supply
2. Output reverse circuit ⋯ Reverses CS signal into $\overline{CS}$ one.

We have MM1025, MM1027 and MM1028 as the backup IC having the following additional functions.

3-3 Detection of Residual Voltage of Battery

1. 2.70V detect circuit ⋯ Equivalent to yellow alarm for residual voltage of battery
2. 2.55V detect circuit ⋯ Equivalent to red alarm for residual voltage of battery

3-4 Battery Control Circuit

1. This circuit controls so that battery power should not be supplied even if the battery is replaced when there remains no main power supply when replacing the battery.

4. Principli of Operation

4-1 Battery/Main Supply Changeover Circuit

The 3.3V detect circuit turns off the transistor switch when Vcc is 3.3V or less and turns it on when the same exceeds 3.3V. The transistor ON will output the voltage of main supply to Vout and transistor OFF will output the battery voltage to Vout.

4-2 CS (CE) Control Circuit

The 4.2V voltage detect circuit makes CS signal to low level and $\overline{CS}$ to high level when Vcc is 4.2V or lower, and $\overline{CS}$ to high level and CS to low level when the same exceeds 4.2V. The CS signal level will change over the S-RAM mode as indicated in Fig.1 below.

When the CS signal is at low level (high level with $\overline{CS}$ signal), that is when Vcc is 4.2V or lower, then S-RAM will enter into the backup mode and data read/write is forbidden thus preventing data trouble.

5. Characteristics of Respective Models

5-1 MM1025

Intended for D-RAM (no refresh control circuit) and pseudo-S-RAM

1. The power source used is Ni-Cd battery. Both main supply and backup supply incorporate stabilized power supplies.
2. With main power supply detect circuit built-in, it changes over the stabilized power supply and controls the memory by CS signal.

5-2 MM1026 and MM1080

For S-RAM

1. Ideal for games and IC cards. Applicable to lowcost system configuration.
2. Then main power supplies the power for IC while the lithium battery is used as backup power supply.
3. Incorporate forced main power supply/backup supply changeover circuit by transistor switch (low saturation realized by PNP transistor).
4. Schottky barrier diode built-in on the backup side.
5. With the main power supply detect circuit built-in, they control SRAM through CS signal.
6. Current consumption under normal conditions :
   MM1026 : 1.0mA typ.
   MM1080 : 60μA typ.
   Low current consumption type
7. Current consumption under backup conditions :
   0.3μA typ.
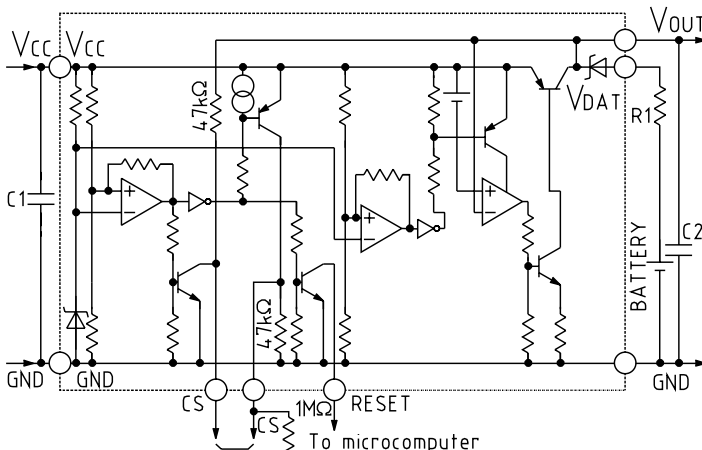   Fig. 2 shows a block diagram of MM1026.

5-3 MM1027 and MM1081

For S-RAM

1. Two battery checkers built-in. Applicable to JEIDA Ver.4.0 specification for IC memory cards.
2. The main power supply provides power for IC, while the backup power uses the lithium battery.
3. Built-in is the forced main power supply/backup power changeover circuit (low saturation realized by PNP transistor, approx. 0.2V).
4. Schottky barrier diode built-in on the backup side.
5. External transistor for output increase if connected, output current 90mA will be increased.
6. Current consumption under normal conditions :
   MM1027 : 1.7mA typ.
   MM1081 : 100μA typ.
   Low current consumption type
   (under development)
7. Current consumption under backup conditions :
   0.2μA typ.
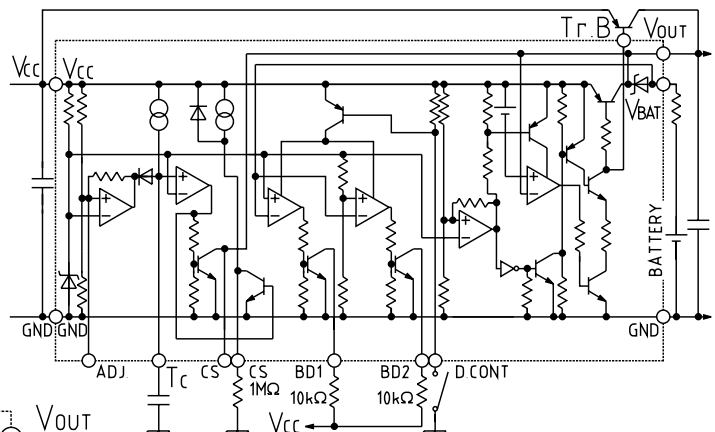   Fig. 3 shows a block diagram of MM1027.

Fig.3 Block Diagram of MM1027

R1 : For protection from overcurrent to battery
C1,C2 : Bypass capacitor for power supply
BATTERY : Lithium battery

Fig.2 Block Diagram of MM1026

5-4 MM1028 and MM1082

For 1-chip microcomputers (backups as built-in clock, timer, etc.)

1. The main power supply is 5V, while the backup power uses the lithium-ion battery.
2. Built-in is the forced main power supply/backup power changeover circuit (low saturation realized by PNP transistor, approx. 0.2V).
3. Back-up power control circuit by transistor switch built-in on the backup side (low saturation realized by PNP transistor, approx. 0.2V).
4. When saving power (standby)
   Current consumption : 5.0µA typ.
   MM1082 does not have this mode (because of low current consumption).
5. Current consumption under normal conditions :
   MM1028 : 1.0mA typ.
   MM1082 : 65µA typ.
              Low current consumption type
6. Current consumption under backup conditions :
    1.0µA typ.
   Fig. 4 shows a block diagram of MM1028.

5-5 PST620 and PST621

For 1-chip microcomputers (backups as built-in clock, timer, etc.)

1. The main current uses 5V power supply, while the backup power uses capacitor (super capacitor, large capacitor, chemical capacitor). Under normal conditions the capacitor has been charged by 5V power supply, which will back up the 1-chip microcomputer as soon as the 5V power supply is consumed.
2. The voltage detector near 4.2V outputs CE signal thereby switching the 1-chip microcomputer either to standby or to normal mode. Further the low voltage detector will detect 2 to 3V to reset the 1-chip microcomputer. The inner 1-shot multivibrator will allow to reset for a given time when the voltage rises.
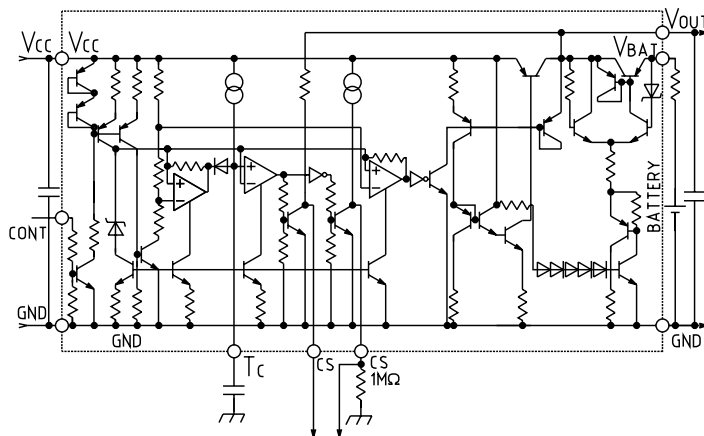
Fig.4 Block Diagram of MM1028

Maintenance Table

Product Name	Output	current Consumption	Output current	Voltage rank	Package	Representative Interchangeable Models	Notes
PST518	Low	I_CCL 6mA I_CCH 9mA	70mA	A 4.2V B 4.4V	TO-92A	PST7042 7044	Output current is 8mA
PST520	Low	I_CCL 55µA I_CCH 135µA	2mA	C 4.5V D 4.2V E 3.9V F 3.6V G 3.3V H 3.1V	TO-92A	PST7045 7042 7039 7036 7033 7031	
PST523	Low	I_CCL 30µA I_CCH 300µA	20mA	C 4.5V D 4.2V E 3.9V F 3.6V G 3.3V H 3.1V	TO-92A	PST600C 600D 600E 600F 600G 600H	Output current is 8mA In addition, the PST600 series and PST70XX series are interchangeable.
PST524	High	I_CCL 30µA I_CCH 300µA	–2mA	C 4.5V D 4.2V E 3.9V F 3.6V G 3.3V H 3.1V	TO-92A	PST573C 573D 573E 573F 573G 573H	
PST529	Low	I_CCH 150µA I_CCH 5µA	10mA	C 4.5V D 4.2V E 3.9V F 3.6V G 3.3V H 3.1V I 2.9V J 2.7V K 2.5V L 2.3V	TO-92A MMP-3A	PST600C 600D 600E 600F 600G 600H 600I 600J 600K 600L	Output current is 8mA In addition, the PST600 series and PST70XX series are interchangeable.

Note: This table does not guarantee complete interchangeability. Be sure to carry out sufficient technical investigations, including for excess response, when changing.