OKI semiconductor

MSM5832RS

REAL TIME CLOCK/CALENDAR

GENERAL DESCRIPTION

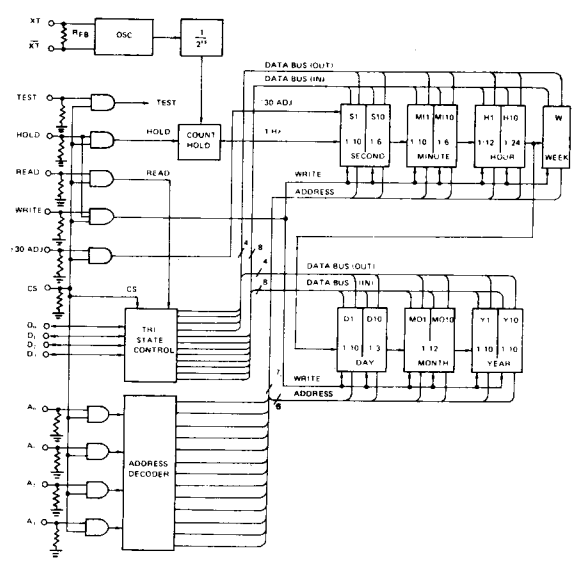
The MSM5832RS is a metal-gate CMOS Real Time Clock/Calendar for use in bus-oriented microprocessor applications. The on-chip 32.768Hz crystal controlled oscillator time base is divided to provide addressable 4-bit I/O data of SECONDS, MINUTES, HOURS, DAY-OF-WEEK, DATE, MONTH, and YEAR. Data access is controlled by 4-bit address, chip select, read, write and hold inputs. Other functions include 12H/24H format selection, leap year identification and manual ±30 second correction.

The MSM5832RS normally operates from a 5V ±5% supply. Battery backup operation down to 2.2V allows continuation of time keeping when main power is off. The MSM5832RS is offered in an 18-lead dual-in-line plastic (RS suffix) package.

FEATURES

- 7 Function – SECOND, MINUTE, HOUR, DAY, DAY-OF-WEEK, MONTH, YEAR
- Automatic leap year calendar
- 12 or 24 hour format
- ±30 second error correction
- 4-BIT DATA BUS
- 4-BIT ADDRESS
- READ, WRITE, HOLD, and CHIP SELECT inputs
- Reference signal outputs – 1024, 1, 1/60, 1/3600Hz
- 32.768kHz crystal controlled operation
- Single 5V power supply
- Back-up battery operation to V_{DD} = 2.2V
- Low power dissipation
  90 μW Max. at V_{DD} = 3V
  2.5 mW Max. at V_{DD} = 5V
- 18 pin plastic DIP (DIP18-P-300)

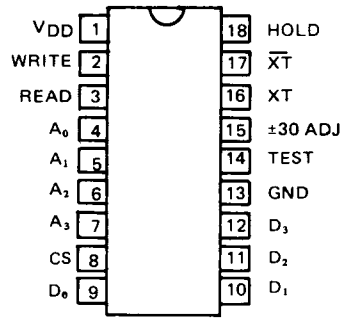
FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION

A0 to A3	:	Address Inputs
WRITE	:	Write Enable
READ	:	Read Enable
HOLD	:	Count Hold
CS	:	Chip Select
D0 to D3	:	Data Input Output
TEST	:	Test Input
±30 ADJ	:	±30 Second Correction Input
XT & $\overline{XT}$	:	xtal oscillator connections
V_{DD}	:	+5V Supply
GND	:	Ground

18 pin Plastic DIP (Top View)



REGISTER TABLE

Address Input				Register Name	Data Input/Output				Data Limit	Remarks
A_0	A_1	A_2	A_3		D_0	D_1	D_2	D_3		
0	0	0	0	S1	*	*	*	*	0 ~ 9	S1 or S10 are reset to zero irrespective of input data D0—D3 when write instruction is executed with address selection.
1	0	0	0	S10	*	*	*		0 ~ 5	
0	1	0	0	MI1	*	*	*	*	0 ~ 9	
1	1	0	0	MI10	*	*	*		0 ~ 5	
0	0	1	0	H1	*	*	*	*	0 ~ 9	
1	0	1	0	H10	*	*	†	†	0 ~ 1 / 0~2	D2 = "1" for PM D3 = "1" for 24 hour format D2 = "0" for AM D3 = "0" for 12 hour format
0	1	1	0	W	*	*	*		0 ~ 6	
1	1	1	0	D1	*	*	*	*	0 ~ 9	
0	0	0	1	D10	*	*	†		0 ~ 3	D2 = "1" for 29 days in month 2 (2) D2 = "0" for 28 days in month 2
1	0	0	1	MO1	*	*	*	*	0 ~ 9	
0	1	0	1	MO10	*				0 ~ 1	
1	1	0	1	Y1	*	*	*	*	0 ~ 9	
0	0	1	1	Y10	*	*	*	*	0 ~ 9	

(1) *data valid as "0" or "1".
Blank does not exist (unrecognized during a write and held at "0" during a read)
†data bits used for AM/PM, 12/24 HOUR and leap year.

(2) If D2 previously set to "1", upon completion of month 2 day 29, D2 will be internally reset to "0".

Table 1

OSCILLATOR FREQUENCY DEVIATIONS

Frequency Deviation vs Temperature

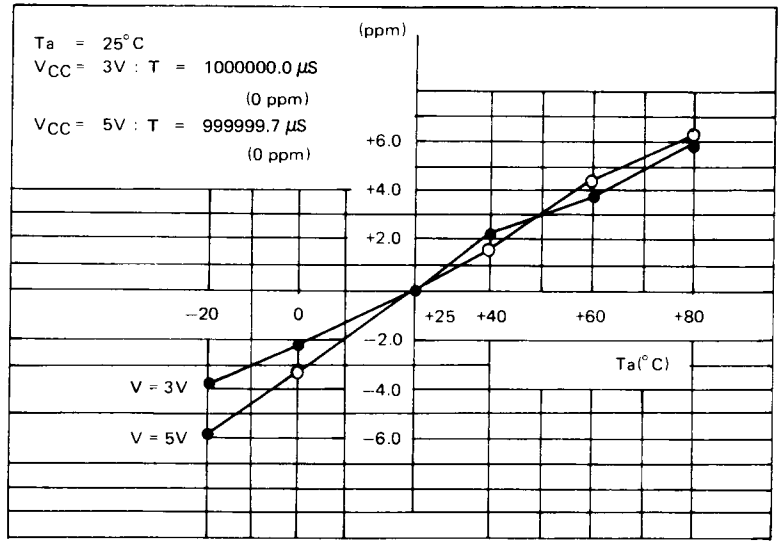


Figure 1

Frequency Deviation vs Supply Voltage

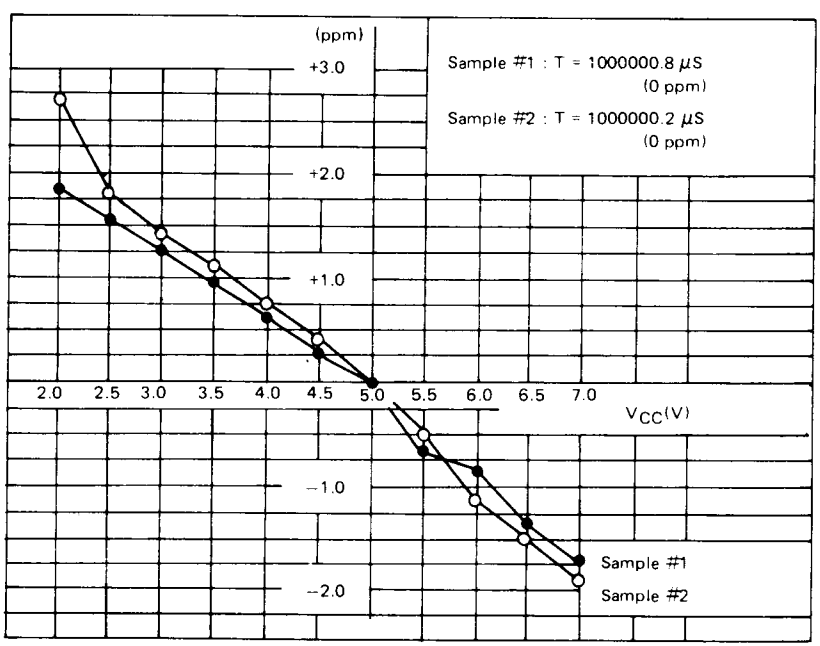


Figure 2

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ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Supply voltage	V_{DD}	−0.3 ~ 7.0	V
Input voltage	V_I	−0.3 ~ V_{DD} + 0.3	V
Data I/O voltage	$V_{\overline{O}}$	−0.3 ~ V_{DD} + 0.3	V
Storage Temperature	Tstg	−55 ~ 150	°C

OPERATING CONDITIONS

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Supply Voltage	V_{DD}	4.5	5	7	V	
Standby Supply Voltage	V_{DH}	2.2	–	7	V	
Input Signal Level	V_{IH}	3.6	–	V_{DD}	V	V_{DD} = 5V ± 5% Respect to GND
	V_{IL}	−0.3	–	0.8	V	
Crystal Oscillator Freq.	f(XT)	–	32.768	–	kHz	
Operating Temperature	T_{OP}	−30	–	+85	°C	

DC CHARACTERISTICS

(V_{CC} = 5V ±5%; T_A = −30 to +85°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Input Current (1)	I_{IH}	10	25	50	μA	V_{IN}=5V, V_{DD}=5V
	I_{IL}	–	–	-1	μA	V_{IN} = 0V
Data I/O Leakage Current	I_{LD}	-10	–	10	μA	$V_{I/O}$ = 0 to V_{DD} CS = "0"
Output Low Voltage	V_{OL}	–	–	0.4	V	I_O = 1.6 mA, CS = "1", READ = "1"
Output Low Current	I_{OL}	1.6	–	–	mA	V_O = 0.4V, CS = "1", READ = "1"
Operating Supply Current	I_{DDS}	–	15	30	μA	V_{CC} = 3V, Ta = 25°C
	I_{DD}	–	100	500	μA	V_{CC} = 5V, Ta = 25°C

(1) XT, $\overline{XT}$ and D_0 ~ D_3 excluded.

SWITCHING CHARACTERISTICS

(1) READ mode

(V_{DD} = 5V ±5%, Ta = 25°C)

Parameter	Symbol	Condition	MIN	TYP	MAX	Unit
HOLD Set-up Time	t_{HS}	—	150	–	–	μs
HOLD Hold Time	t_{HH}	—	0	–	–	μs
HOLD Pulse Width	t_{HW}	—	–	–	990	ms
HOLD "L" Hold Time	t_{HL}	—	130	–	–	μs
READ Hold Time	t_{RH}	—	0	–	–	μs
READ Set-up Time	t_{RS}	—	0	–	–	μs
READ Access Time	t_{RA}	$R_{PULL-UP}$ = 5KΩ C_L = 15pF	–	–	6	μs
ADDRESS Set-up Time	t_{AS}	—	3	–	–	μs
ADDRESS Hold Time	t_{AH}	—	0.2	–	–	μs
READ Pulse Width	t_{RW}	$R_{PULL-UP}$ = 5KΩ C_L = 15pF	2	–	–	μs
DARA Access Time	t_{AC}	$R_{PULL-UP}$ = 5KΩ C_L = 15pF	–	–	0.6	μs
OUTPUT Disable Time	t_{OFF}	$R_{PULL-UP}$ = 5KΩ C_L = 15 pF	–	–	0.6	μs
CS Enable Delay Time	t_{CS1}	—	–	–	0.6	μs
CS Disable Delay Time	t_{CS2}	—	–	–	0.6	μs

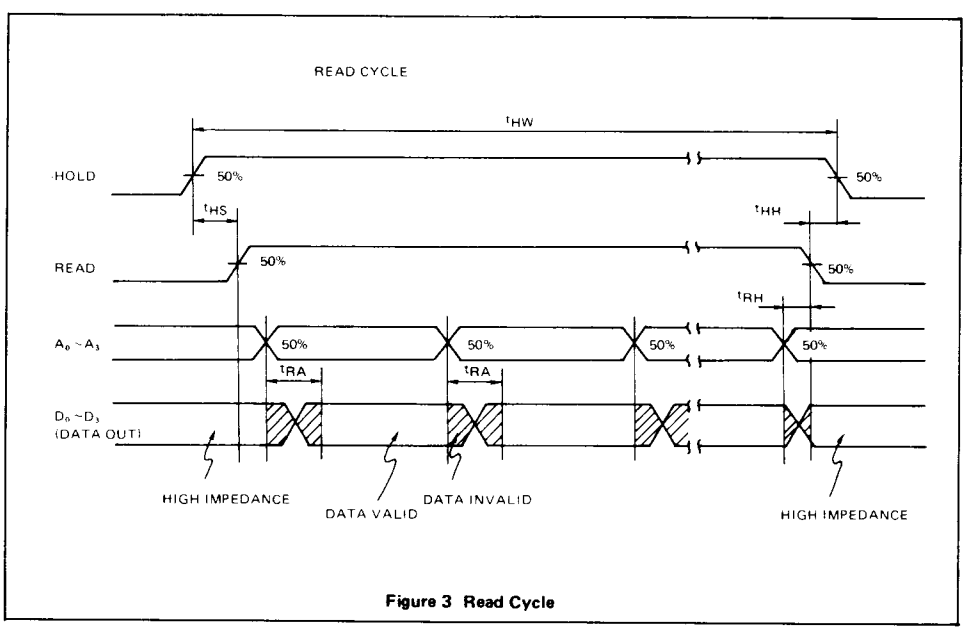

Figure 3 Read Cycle

Notes: 1. A Read occurs during the overlap of a high CS and a high READ.
2. CS may be a permanent "1", or may be coincident with HOLD pulse.

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SWITCHING CHARACTERISTICS

(2) WRITE mode

(V_{DD} = 5V ±5%, Ta = 25°C)

Parameter	Symbol	Condition	MIN	TYP	MAX	Unit
HOLD Set-up Time	t_{HS}	———	150	–	–	μs
HOLD Bold Time	t_{HH}	———	0	–	–	μs
HOLD Pulse Width	t_{HW}	———	–	–	990	ms
HOLD "L" Hold Time	t_{HL}	———	130	–	–	μs
ADDRESS Pulse Width	t_{AW}	———	1.7	–	–	μs
Data Pulse Width	t_{DW}	———	1.7	–	–	μs
DATA Set-up Time	t_{DS}	———	0.5	–	–	μs
DATA Hold Time	t_{DH}	———	0.2	–	–	μs
WRITE Pulse Width	t_{WW}	———	1.0	–	–	μs
CS Enable Delay Time	t_{CS1}	———	–	–	0.6	μs
CS Disable Delay Time	t_{CS2}	———	–	–	0.6	μs

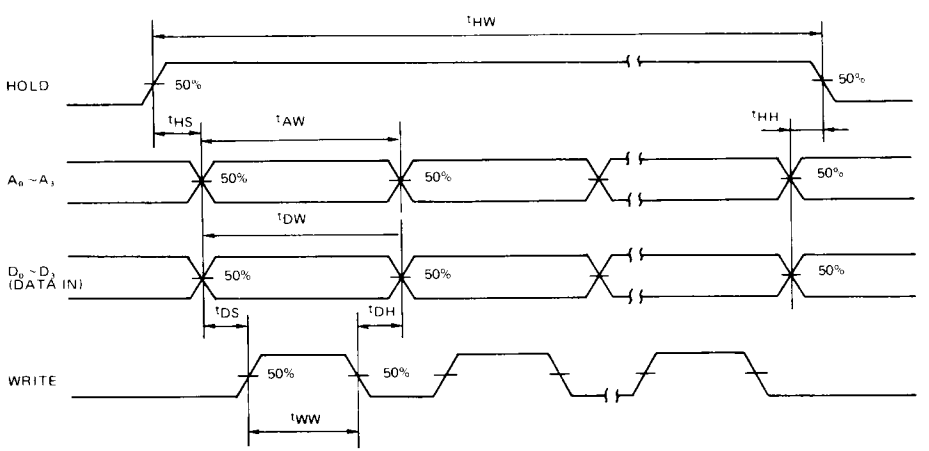

Figure 4 Write Cycle

Notes: 1. A WRITE occurs during the overlap of a high CS, a high HOLD and a high WRITE.
2. CS may be permanent "1", or may be coincident with HOLD pulse.

PIN DESCRIPTION

Name	Pin No.	Description
V_{DD}	1	Power supply pin. Application circuits for power supply are described in Figure 9.
WRITE	2	Data write pin. Data write cycle is described in Figure 4.
READ	3	Data read pin. Data read cycle is described in Figure 3.
$A_0 \sim A_3$	4 ~ 7	Address input pins used to select internal counters for read/write operations. The address is specified by 4-bit binary code as shown in Table 1.
C S	8	Chip slect pin which is required to interface with the external circuit. HOLD, WRITE, READ, ±30ADJ, TEST, $D_0 \sim D_3$ and $A_0 \sim A_3$ pins are activated if CS is set at H level, while all of these pins are disabled if CS is set at L level.
$D_0 \sim D_3$	9 ~ 12	Data input/output pins (bidirectional bus). As shown in Figure 5, external pull-up registers of 4.7 kΩ ~ 10 kΩ are required by the open-drain NMOS output. D_3 is the MSB, while D_0 is the LSB

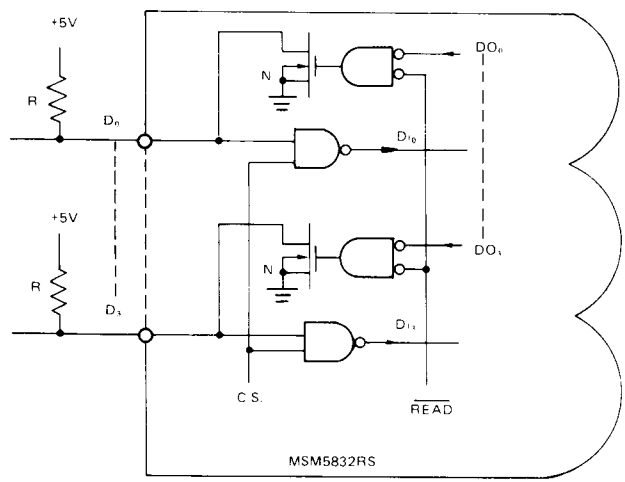

Figure 5

Name	Pin No.	Description
GND	13	Ground pin.
TEST	14	Test pin. Normally this pin should be left open or should be set at ground level. With CS at V_{DD}, pulses to V_{DD} on the TEST input will directly clock the S_1, MI_{10}, W, D_1 and Y_1 counters, depending on which counter is addressed (W and D_1 are selected by D_1 address in this mode only). Roll-over to next counter is enabled in this mode.
±30ADJ	15	This pin is used to adjust the time within the extent of ± 30 seconds. If this pin is set at H level when the seconds digits are 0 ~ 29, the seconds digits are cleared to 0. If this pin is set at H level when the seconds digits are 30 ~ 59, the second digits will be cleared to 0 and the minutes digits will be increased by +1. To enable this function, 31.25 ms or more width's pulse should be input to this pin.
XT	16	Oscillator pin. 32.768 kHz crystal, capacitor and trimmer condensor for frequency adjustment connected to these pins. See Figure 6. As for oscillator frequency deviation, refer to Figure 1 and Figure 2. If an external clock is to be used for the MSM5832RS's oscillation source, the external clock is to be input to XT, and $\overline{XT}$ should be left open.
$\overline{XT}$	17	
HOLD	18	Switching this input to V_{DD} inhibits the internal 1 Hz clock to the S1 counter. After the specified HOLD set-up time (150 μs), all counters will be in a static state, thus allowing error-free read or write operations. So long as the HOLD pulse width is less than 990 ms, real time accuracy will be undisturbed. Pull-down to GND is provided by an internal resistor.

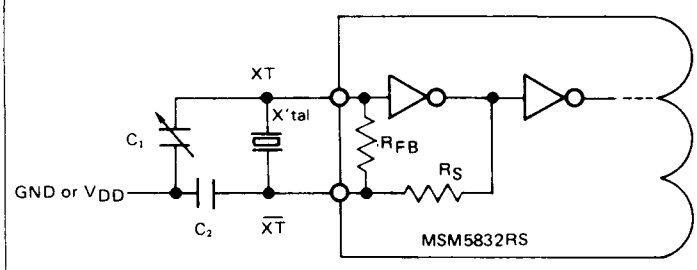

Figure 6

REFERENCE SIGNAL OUTPUT PIN

Condition	Output	Reference Frequency	Pulse Width
HOLD = L	D_0 (1)	1024 Hz	duty 50%
READ = H	D_1	1 Hz	122.1 μS
CS = H	D_2	1/60 Hz	122.1 μS
$A_0 \sim A_3$ = H	D_3	1/3600 Hz	122.1 μS

(1) 1024 Hz signal at D_0 not dependent on HOLD input level.

APPLICATION EXAMPLE

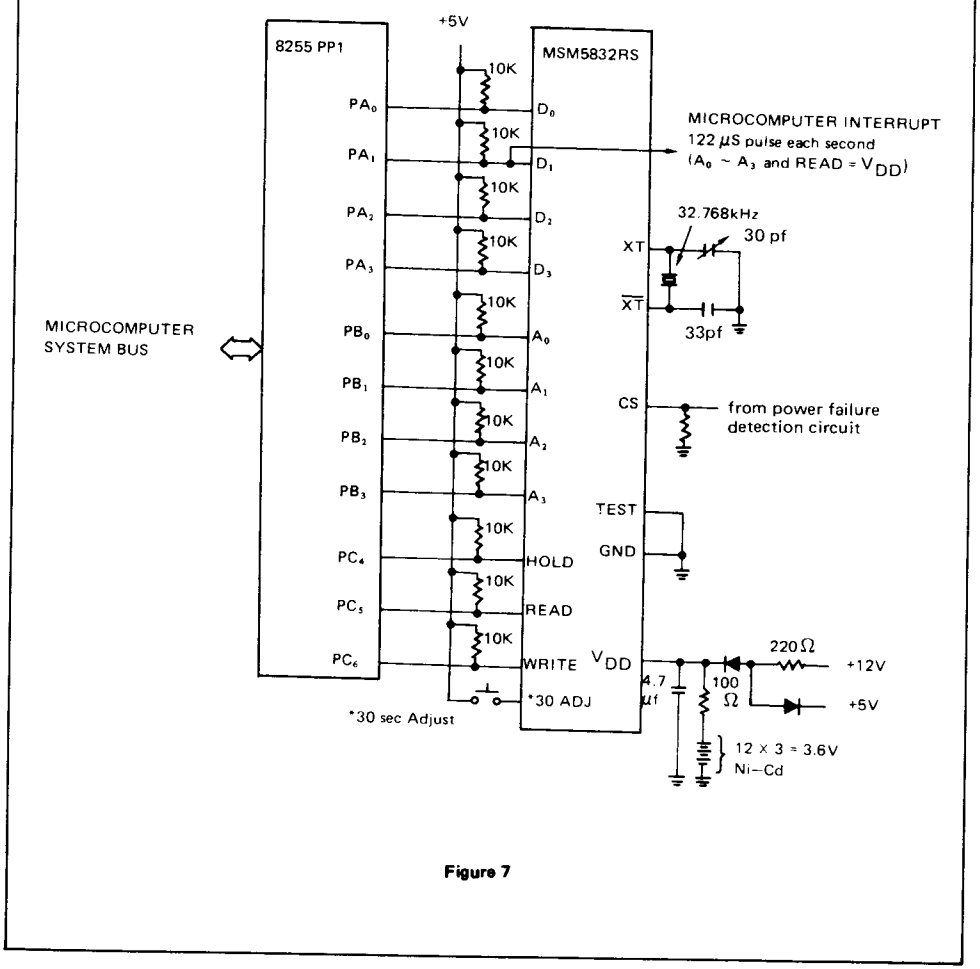

Figure 7

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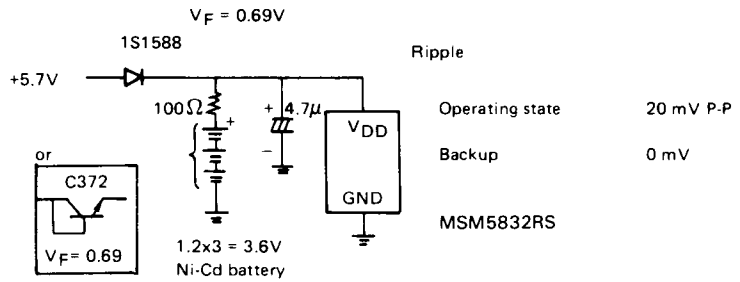
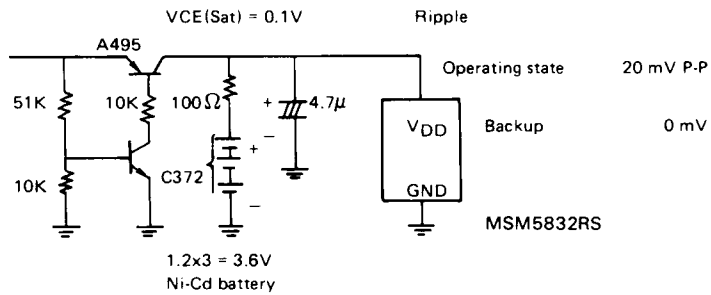
APPLICATION CIRCUIT – POWER SUPPLY CIRCUIT

Open or ground unused pins (pins other than the XT, $\overline{XT}$, D0–D3, and $\overline{BUSY}$ pins).

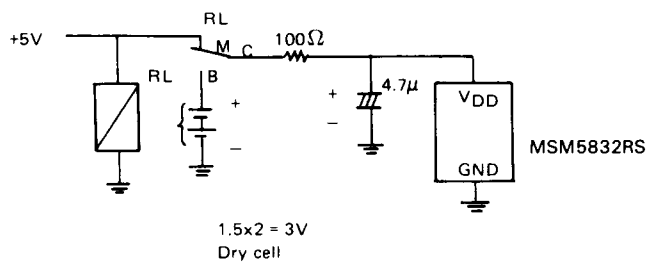
a).



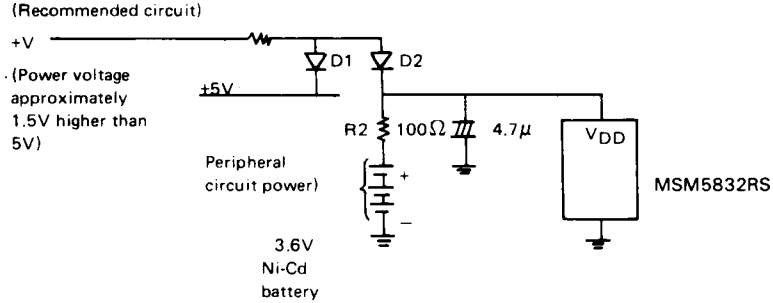
b).



c).



d). (Recommended circuit)



Note: Use the same diodes for D1 and D2 to reduce the level difference between +5V and V_{DD} of the MSM5832RS.