B. Electrochem 4(5) May 1988, pp 517-519

AUTOMATIC TESTER FOR PRIMARY BATTERIES

B MANIVANNAN and K DAKSHINAMURTHI
CECRI Madras Unit, CSIR Complex, Madras 600 113, INDIA

[Received: 1988 January; Accepted: 1988 March]

Several primary battery systems are available for diverse applications in electronic instruments, cordless para appliances, flash light, etc. Several specifications are available for testing conventional dry cells differing in test duration, number of discharges and frequency of the tests (on/off) etc. In this paper, an instrument developed in this laboratory for testing several types of primary batteries as per different specifications is described. The instrument can be programmed for different dischange cycles from 1 sec. to 999 hrs. The special feature of the instrument is that it is an AC/DC model with battery under normal float charge and battery fully taking over in the absence of mains supply.

Key words: Battery tester, primary batteries

INTRODUCTION

Primary batteries constitute a handy power source for several essential civilian and military applications. One fourth of the total demand of batteries is for the primary type. The major application areas are flash lights, transistor radios, calculators, watches, hearing aids, photoflash, tape recorder, toys, clocks and a host of others. In such uses, the demand on the batteries varies with respect to drain, duty pattern and ambient conditions. For example, Table I lists some of the load test patterns for such applications. The drain rate, duration and cut off voltage may vary. The variety of systems available (leclanche cell, alkaline Zn/MnO_2, lithium cells, silver-zinc cells, etc.) also perform differently depending on their electrochemistry and construction. In India, the choice of systems and sizes available is limited. However, applications are many. Some of the IS specifications listed in Table II indicate the types available and application modes.

TABLE:I Application discharge pattern of primary cells

User system	Calculator	Hearing aid	Lighting	Photoflash	Radio	Tape recorder	Toy	Quartz clock
Load	5.6	300	3.9	1.0	39	10	3.9	6.8 K
Frequency of use	30 mins/day	12 hr/day	30 mins/day	2mins/day	4 hr/day	1 hr/day	1 hr/day	continuous
Cut off voltage	0.9 V	0.9 V	0.9 V	0.75 V	0.9 V	0.9 V	0.8 V	1.3 V

Testing such batteries for different end uses by the manufacturer or the user constitutes an important aspect. The various specifications cited offer a number of tests varying in load, duration and frequency of discharge and rest, creating problems for testing. Table III lists the salient tests suggested in the various specifications. The discharge duration/cycle varies from 1 sec. to 24 hrs. to continuous tests.

It is difficult to have separate equipment for each type of test and each type of battery or application. To simplify the task, the authors have developed an equipment that can be used for several of the above tests. Commercially, suitable equipment to satisfy many of the test demands are not available. The mandatory BIS certification of several of the primary cells also has promoted the development. The equipment reported in this paper can be used to carry out all tests listed in Table III.

SYSTEM DESCRIPTION

The Block Schematic Diagram of the tester is shown in Fig.1. Basically it uses a WD55 dedicated microprocessor based timer chip. The features and application in battery testing are reported elsewhere [1,2]. The system utilises three WD55 chips in daisy chain. For explanation we have shown only two IC chips, the third being connected as $WD55_2$. This timer chip can be operated in two (cyclic or sequential) modes. Here we are using cyclic mode. The special feature which makes this equipment unique and versatile is that the WD55 can be operated to count in hours, minutes and seconds mode with digital accuracy of $\pm$ 0.1 sec., so bulky resistor/capacitor is eliminated. Each timer can be operated

TABLE II: BIS specifications for primary cells

Sl.No.	Types of batteries	IS No. (Year)
1	Inert cells	267 (1976)
2	Leclanche type sack cells	268 (1976)
3	Air depolarised primary wet cell	4268 (1978)
4	Dry batteries for flash lights	203 (1984)
5	Dry battery for hearing aids	7218 (1974)
6	Dry batteries for photo flash equipment	7253 (1974)
7	Dry batteries for transistor radio receiver	2576 (1975)
8	General requirement & methods of test for dry cells and batteries	6303 (1984)
9	Heavy duty dry batteries	9128 (1979)

months and should not be interrupted the equipment has been made as 230V AC 50H_z /DC 12V model with battery being connected in float.

CIRCUIT DESCRIPTION

The circuit diagram is shown in Fig. 2. As can be seen from the diagram the component count in this equipment is minimum and needs only little explanation. The timing data (on/off time) is input through the three digit thumbwheel switches (BCD output). A diode must be connected between D7 (pin 38) and IN0 (pin 15) so that the timer operates in the cyclic mode. Similarly all other strap options like minutes, seconds, hours are connected through an external switch for each of the three timer chips. In Fig. 2 only two timer chains are shown for explanation. For timer No.1, relay RL1 and timer 2 are 'ON' for 'TIME 1 ON period' and 'OFF' for 'TIME 1 OFF period' and likewise independently in timing mode. Each timer has two parallel relay output, one for controlling the succeeding timer and another externally for the discharge circuit. Since some tests run for several for timer 2 and 3. The discharge circuit has to be connected suitably in RL_1 and RL_2 or RL_3 depending on the type test to be carried out.

TABLE III: Various test procedures for primary batteries

Sl.No.	IS No.	Type	Load	Discharge cycle	Cut off volts
1.	203	Flash light	5 ohms/cell		
		R6	-do-	Discharge for 6 continuous days/week, daily 5 mins.	0.9 V
		2R10	-do-	-do- daily 5 mins. -do-	
		3R12	-do-	-do- daily 10 mins. -do-	
		R14	-do-	-do- daily 10 mins.-do-	
		R20	-do-	-do- daily 30 mins.-do-	
		2R20/2R22	-do-	-do- daily 30 mins.-do-	
		4R25/4F100-2	-do-	-do- daily 30 mins. -do-	
2.	4268	A.D.cell	0.2 ohms	Discharge 5 secs., rest 15 secs. repeat cycle	0.8 V
3.	7218	Hearing aid R1	300 ohms	12 hours discharge, 12 hours cycle for 6 days/week	0.9 V
		R6	300 ohms	-do- -do-	0.9 V
4.	7253	Photo flash R14	1 ohm	Discharge for 15 secs./min., 1 hr/day, 6 days/week	0.75V
		R20	1 ohm	-do- -do-	0.75
		10F20	30 kohms	12 hrs.discharge, 12hrs. rest, repeat for 6 days/week	10 V
		15F20	45 kohms	-do- -do-	15 V
		20F20	60 kohms	-do- -do-	20 V
5.	9128	Photo flash R6	1 ohm	Discharge 15 secs./min., 1 hr./day at 23 hrs.intervals 6 days/week	0.75 V
		Calculator R6	15 ohms	Discharge 1/2 hr./day continuously at 231/2 hrs. interval 6 days/week	0.9 V
		Cassette Tape R14	15 ohms	Discharge 2 hrs./day at 22hrs. interval 6 days/week	0.9 V
		Toys R14	4 ohms	Discharge 1/2 hr. at 231/2 hr. intervals, 6 days/week	0.9 V
		Cassette R20	15 ohms	Discharge 2hrs./day at 22 hr. intervals, 6 days/week	0.9 V
		Toys R20	2.25 ohms	Discharge 1/2hr./day at 231/2 hr. intervals, 6 days/week	0.9 V

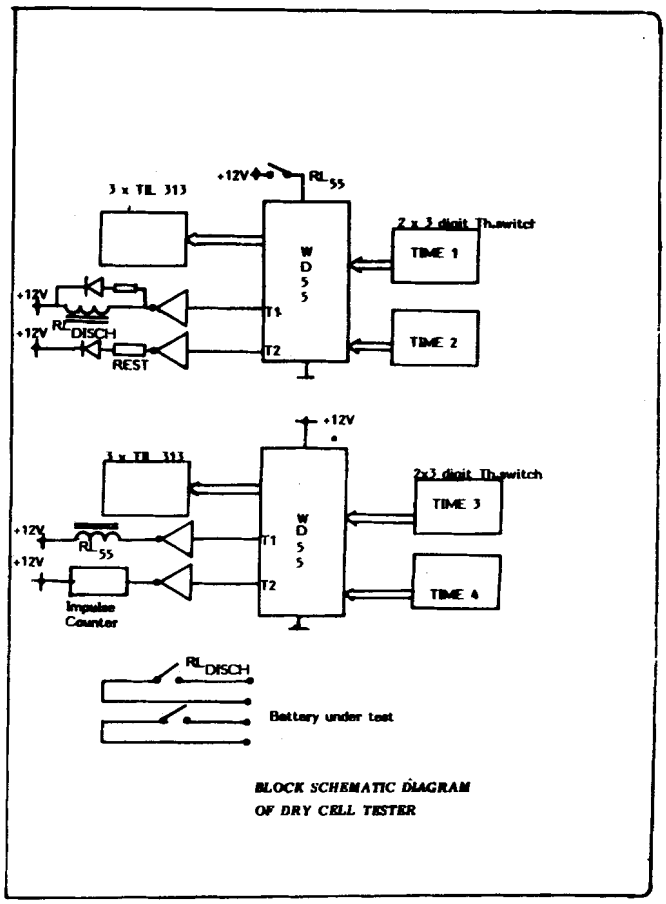

Fig.1

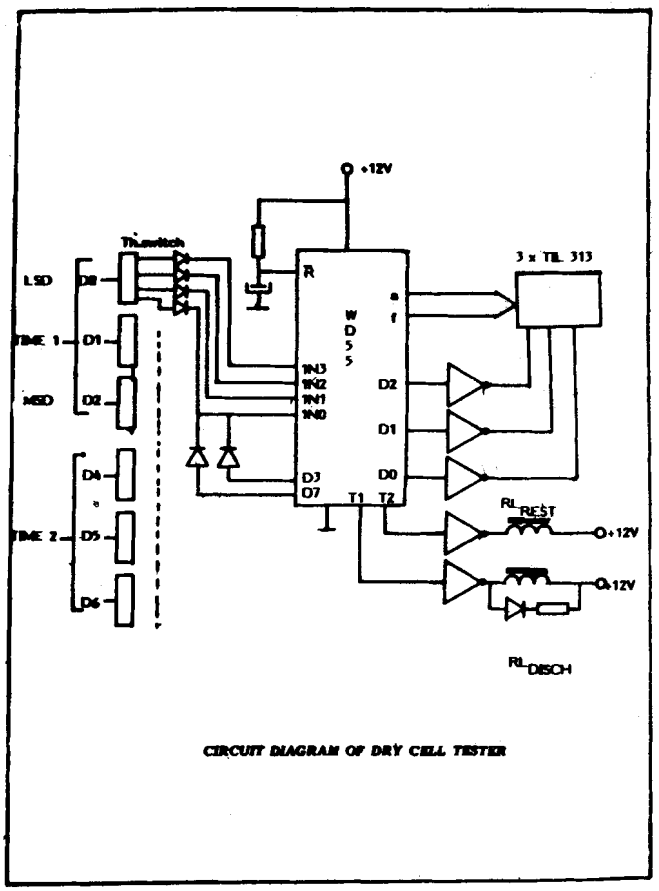

Fig.2

RESULT

To explain its use in actual application we take the example of IS 586 for testing R40 cells. Heavy intermittent discharge test stipulates discharge of battery for one hour, rest for 6 hours, discharge for 1 hour, rest for 16 hours in a day. The above sequence is repeated cyclically till the total battery voltage of three R40 cells connected in series drops to 2.55 V. Now set first and second timer in hours and continuous mode. Last timer is not used here. Set the ON time for timer No.1 as 008 (i.e. 8 hours) OFF time as 016 hours (i.e. 16 hours). For timer No.2, ON time 001 hour (1 hour) OFF time 006 hours (6 hours). Now as soon as 'start' switch is pressed timer 1 starts and energises RL1 which supplies power to $WD55_2$ for 8 hours only. As WD55 gets power it starts counting and energises RL discharge for 1 hour and deenergises for 6 hours and energises again for 1 hour. Now power for $WD55_2$ is cut off for 16 hours and the above cycle repeats. In effect, therefore the batteries are subjected to cyclic discharge as stipulated by IS 586. Though only one relay output is given it can be extended to any number of channels, so that a number of batteries can be tested for one particular type test. It should be noted that all type tests listed annot be done at the same time. So if a different type test has to be performed only the timing and load have to be changed. We have not used voltage cut off circuit which is the missing feature, but that can be realised with modern Data loggers available. Then, the above equipment becomes a powerful tool for testing primary batteries. A prototype unit is working for the past one year satisfactorily at our laboratory. The cost of a single equipment works out to approximately Rs.5,000/- which is comparable with commercially available dedicated equipments.

REFERENCES

1. Western Digital Corporation Data Book

2. B Manivannan, P Lakshmanan, N Karuppannan, S Palanichamy and K Dakshinamurthy, *B Electrochem.*, 3-6 (1986) 581