

FT Opto Laboratories

Client

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Report No

051129

Date

29 November 2005

Eflare Low Battery Indicator (LBI)

The Eflare is designed to maintain constant brightness over the life of the batteries. However, in certain conditions such as very low temperatures or as battery energy is depleted, brightness can reduce significantly below specified levels. To avoid a possible unsafe situation, Eflare has designed a Low Battery Indicator (LBI) to alert the user when the Eflare may be operating out of specification and that the batteries should be replaced.

This is a small yellow flashing LED mounted on one side of the printed circuit board well below the operational LED array. It is best viewed through the lens at the top of the Eflare. This is designed to flash when the batteries have only 20% of operational life remaining.

When batteries are exhausted a number of changes occur:

- The “no-load” or “open-circuit” battery voltage drops
- The internal resistance rises
- The difference between “on-load” voltage and “no-load” voltage increases
- The Eflare brightness reduces

Figure One

Behaviour of Battery Voltage and Battery Resistance as a Function of Capacity

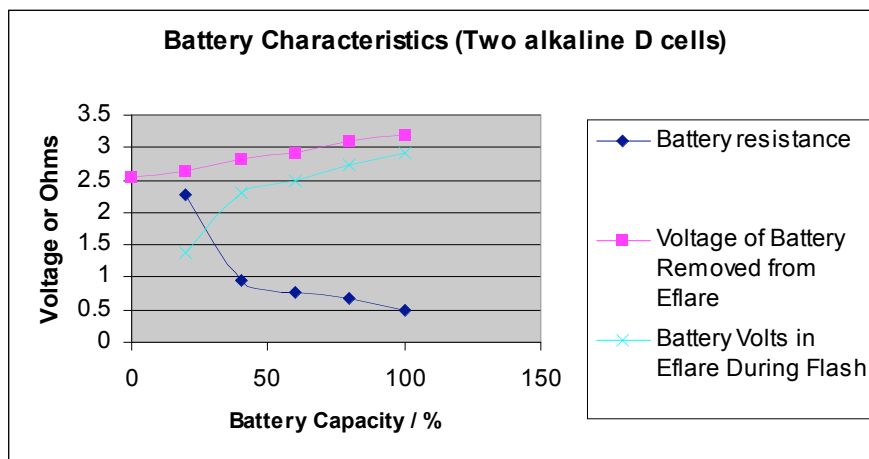
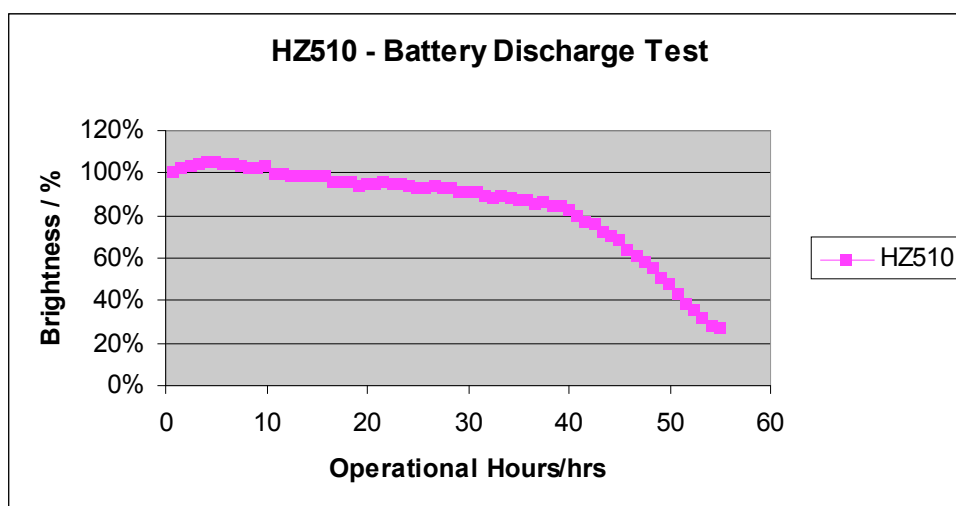


Figure One above is based on measurements using two alkaline D-cells. The batteries start with 100% capacity (right hand side of graph). Moving to the left as the capacity reduces, we see that the battery voltage falls. The battery resistance also rises, meaning that during the flash when battery current is high the battery voltage available to the Eflare drops markedly. Eventually the brightness will fall to below 50% of nominal.

The Eflare Low Battery Indicator (LBI) indicator monitors the battery voltage available when powering the LEDs. If it falls below the level required to maintain about 50% of maximum brightness the LBI starts to flash. This indicates that the brightness will soon fall further as the batteries reach end of life. A measured example is shown in Figure Two for a HZ510 Red Eflare. In this case the LBI will operate after about 50 hours. The nominal minimum life is 40hours.

Figure Two Measured Brightness as a Function of Hours of Use



Under normal use and in normal temperatures it can be stated that a number of hours or a percentage of total available battery capacity remains before the Eflare brightness is significantly compromised.

However, a number of external factors also play a part:

Temperature –

At low temperatures the battery internal resistance rises. This causes lower voltage than normal when the Eflare is activated and the Low Battery Indicator may come on even when the batteries are relatively fresh. The LBI is correctly alerting that the brightness is reduced due to limited battery power. Once the batteries have warmed to ambient temperature normal operation should be resumed.

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Battery Types

Different battery types have slightly different behaviours as they discharge. The Eflare is characterised using Duracell standard Alkaline-Manganese 1.5 volt D Cell (MN1300) batteries. High performance batteries such as the Ultra alkaline from Duracell appear to give only marginal life improvement.

Changing Batteries

When replacing the cap after removing or checking batteries the Low Battery Indicator may flash at least once.

Shock

A sideways impact may cause the battery voltage to temporarily drop a little, then recover. This may also cause the Low Battery Indicator to temporarily activate.

Severe shock

If the Eflare is dropped from an extreme height (several metres) or experiences a severe impact such as being run over, the batteries should be checked for deformation or leakage.

Such damage may cause the batteries to suddenly release a lot of internal energy and the batteries may become very hot. Damaged batteries may even release gas or caustic liquids, so the Eflare cap should be removed with extreme caution with the opening away from the user. It is recommended to wear face and body protection. If the batteries have leaked, they should be removed from the Eflare and the cap and barrel of the Eflare washed with hot water. Dry the Eflare and reload with undamaged batteries.

Dead Batteries

The Low Battery Indicator uses the battery to function. Clearly, if the batteries are completely “flat” (no energy left), the LBI will not operate. Also, where the batteries are very low and the Eflare is extremely dim, the LBI may not be readily visible either. Use common sense in assessing the Eflare’s battery status.

Rex Niven, M.Eng Sci

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