**Lindos Electronics Application Notes**

## LA100 Application Note 2:
## Diagnosing Rechargeable Battery Problems

The Ever Ready cells (in a white battery pack), which were used in the LA100, have proved to be very unreliable, and we have therefore changed to Sanyo cells (in a blue or red battery pack).  These cells are extremely good and rarely fail.

### Fitting New Batteries
If you have just received a new Sanyo battery pack, you should remove the top cover of the unit, unscrew the old battery pack and replace it with the new one, taking care not to trap the lead when screwing the battery plate down.  To avoid losing your non-volatile memory contents you can quite safely perform this operation with the mains connected there are no exposed high voltage points inside the unit.  New batteries are always supplied fully charged and tested and ready to use. The battery pack contains seven C cells, and you may find that most of them are still working.  We would not recommend mixing old cells with new ones, but you might like to remove the good cells from the old battery pack for use in other equipment.  Please return faulty battery packs and cells to Lindos Electronics for safe reclamation of the toxic cadmium.

### Problems with Batteries
Some units returned to us have nothing wrong other than a flat battery. Diagnosing battery faults is easy for most users, and we can save time and trouble by just posting a new battery.  Most battery failures fall into two categories; a shorted cell or failure to hold charge for very long.  To test a batteries condition:

1.  Remove top covers and disconnect the battery plug.  With mains connected to the unit, measure the voltage across the outside pins of PL4 (V).  Push connector back on half way to allow for oc probes and measure battery voltage on charge (V).  If the latter fails to rise above 9.3V after one ch minute the battery probably has a shorted cell.

2.  Replace the battery plug at 90 with one pin only inserted (correct polarity) and connect a meter in series.   Use a 10A range to minimise the voltage drop  (most meters drop 200-600mV on a 400mA range).   Measure the current, first with mains connected (I) and then with the mains ch removed and the unit running off batteries (I).  Finally check memory consumption (I) with dis mem the unit switched off.

3.  If all measurements are within limits connect mains and leave on charge for at least 24 hours.
Then disconnect the mains and leave on battery lock ([*][ON/OFF] ) for six hours, checking hourly to see if the unit is still working.  LA101 software V4.5 and later has a built in discharge timer to do this for you:  hold [1] and [2] and tap [ON/OFF] and leave on for several hours.  Hold the same keys and connect the mains and the LAST TIME will be displayed.  Expect 5 to 6 hours operation with a good battery.  Charge again and leave several days before the discharge test if you suspect failure to hold charge. To test a

battery from an LA102 using the automatic discharge timer you should put it into an LA101

## Voltage and Current Readings

The table below indicates the results which you would expect, together with the limits, for each measurement. If a measurement is outside of the specified range the likely fault is also indicated.

|  | **LA101** | **LA102** | **LIKELY FAULT** |
|---|---|---|---|
| $V_{oc}$ (Volts) | 13.0 (11.8 - 13.8) | 13.0 (11.8 - 13.8) | Mains transformer (TR1), rectifier (D4) |
| $V_{ch}$ (Volts) | 9.9 (9.3 - 10.4) | 9.9 (9.3 - 10.4) | Failed cell |
| $I_{ch}$ (mA) | 180 (220 cold-100 hot) | 180 (220 cold – 100 hot) | If high, suspect short circuit cell. If low suspect charging circuit. |
| $I_{dis}$ (mA) | 350 (310 -380) | 370 (340 - 400) * | DC-DC convertor (TR2). Measure 15V |
| $I_{mem}$ (mA) | 0.25 (0.2 - 0.3) | 0.25 (0.2 - 0.3) | Regulator (IC20), C (C19) or RAM (IC1) |

* Up to 450mA on very early units (serial number below 0400).

## Common Faults

UNIT FAILS TO TURN ON ON BATTERY or comes on briefly. Assuming the battery has been well charged this probably means a cell has failed short circuit, giving a fully charged voltage of only about 8V instead of 10V. UNIT FAILS TO TURN ON ON MAINS or clears the display very slowly. A low or faulty battery is pulling down the voltage. Leave connected to the mains for about 30s in case the battery has suffered deep discharge. If that fails disconnect the battery and reconnect the mains.
UNIT LOCKS UP - DISPLAY FREEZES. Processor stopped because battery voltage dropped too low before automatic turn-off. A sensing chip protects memory if this happens and connecting mains should restore operation (if not, disconnect the battery and then reconnect the mains).

## Extending the Life of Batteries

The battery in the LA101 or LA102 powers the unit when mains is not available and also provides a supply to the non-volatile memory. When mains is present, the battery is on constant charge. The charge rate is set by us so that a flat battery will be completely charged in 24 hours. A higher charge rate would shorten the life expectancy of the battery. A lower charge rate would make the charging time unduly long.

There are many users (particularly of rack mount units) who have their units permanently connected to mains, and to whom the charge time is academic. Such units may suffer premature battery failure due to persistent over-charging, especially if using the old Ever Ready batteries. To remedy this, we recommend that R3 on the top board is changed to 12W for a LA102 and 22W for a LA101. This reduces the charging current to less than 100mA and will subsequently extend the battery life.

After this modification the discharge times and non volatile memory function will not be altered, but the time taken to fully charge the battery will increase to about 36 hours. The battery life of units that are permanently or nearly permanently run on mains can further be extended by occasionally discharging the battery. This can be conveniently done by disconnecting the mains and leaving the unit in battery lock mode. The battery will discharge and the unit will automatically switch off when the voltage falls below 7V. Memory contents will be preserved. Alternatively, for units with software V4.5 and greater, the discharge test described above can be used.

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