

# Battery Cycle Life Testing

Model LCN

Laboratory  
and  
R&D Test  
Equipment



Model LCN7-50-12



**Laboratory Equipment for Wide Range  
of Cell and Battery Test Applications**



**Current Ranges From 1A to 1000A  
and Higher**



**Voltage Configurations for Single Cells  
or Battery Packs 1 to 48 Volts**



**Flexible Network Control with Bitrode's  
VisualCN<sup>®</sup> Software for Windows<sup>®</sup> '95  
and Windows NT<sup>®</sup>**

**Bitrode**

## LABORATORY Test Systems

Bitrode's Model LCN is a full featured, computer controlled cycle life test system for development of batteries of many different chemistries and applications. Automotive, industrial and electric vehicle battery developers will find the LCN, with its wide range of features and options, an invaluable tool for development of improved products, processes and systems. The LCN provides increased laboratory accuracy, flexibility and efficiency, making it an ideal solution for testing needs in designing consistently high quality batteries, verifying rigorous battery specifications and research and development of new battery materials.

### How Does It Work?

Based on linear transistorized current control, the LCN is built to customer specifications in current ranges from 1 to 1000 Amperes. Modules can be configured in Voltages from 1 to 48 nominal volts. Circuitry is designed around analog and digital PC control, and is driven by Bitrode's exclusive VisuaLCN software for Windows 95 and Windows NT. Each LCN circuit uses a 16 bit analog-to-digital converter for high accuracy; measurement and control are designed to provide accuracy to within  $\pm 0.1\%$  of full scale.

Each LCN module operates from its own isolated power supply, allowing a single cell to be discharged to zero volts. This power supply isolation also makes possible separate cycling of multiple cells within a battery, or multiple batteries within a pack.

LED circuit status indicators are positioned on the front panel indicate power on/off, and circuit activity (Charge, Discharge, Rest). A push button switch is available for stopping or restarting a test locally.

Temperature monitoring is standard on most models of the LCN; each module has a rear mounted plug-in jack for addition of a type J, K or T thermocouple. Optional pressure monitoring and other transducer inputs are also available.

The Model LCN is connected to a control computer through Bitrode's Network Communications Adapter via a coaxial serial cable. In this way, multiple circuits can be controlled from a single host computer using VisuaLCN software.

**Full Featured Test System for  
Quality Control and R&D**

**Circuitry is Designed for  
High Reliability and Accuracy**

**Modular Design for Ease of  
Maintenance and Troubleshooting**

**Data Recording, Viewing and Analysis  
With VisuaLCN Software Control**

# Battery Cycle Life Testing

## Model LCN



## Reliable Modular Construction

The modular design and construction of the Model LCN are guided by the need for ease of use, reliability and simple, efficient maintenance.

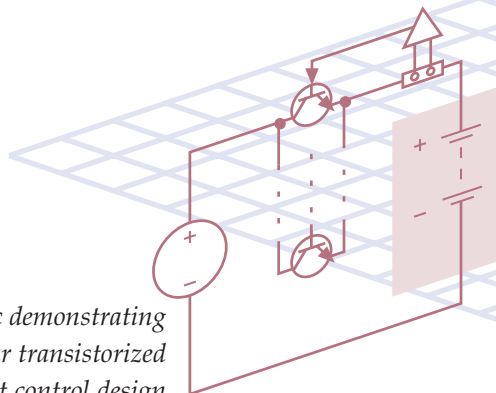


LCN circuits are housed in a rugged steel cabinet with a durable paint finish. Multiple circuits are packaged in convenient rollaway cabinets, and single-module benchtop units are available as well. With most units, circuit modules can be removed from the cabinet quickly on slide-out rails for ease of maintenance.

An easily removed front panel provides access to circuit boards, making board swap procedures fast and simple. Circuit calibration adjustments are also accessible behind this front panel.

On many of the LCN modules, the power electronics circuitry is mounted on a modular heatsink assembly, readily removed through the rear access door for inspection or servicing.

Standard test leads are 6 meters long and include separate voltage sense cables paired with the DC power cable. These cables can be optionally extended to 9 meters. Cable end terminals can be tailored to customer specifications, and some units can be equipped with special cable lengths to fit specific applications.



*Schematic demonstrating Model LCN's linear transistorized current control design*

## Get In And Drive

The Model LCN is controlled by Bitrode's VisualCN software package. VisualCN, written for Windows 95 and Windows NT, is a complete circuit control and test data reporting solution for Bitrode's network based charge and test equipment.

VisualCN's client-server architecture gives users control of any Bitrode LCN circuit, from anywhere on a computer network. Using software controls in a Windows interface, an operator can develop test profiles to meet customer specified guidelines. Up to 99 steps of charge, discharge and rest can be programmed to user specifications. Steps can be controlled with up to 10 limit conditions, chosen from variables such as time, voltage, current, ampere- or watt-hours, temperature, pressure or other customer specified test data.



Tests in progress can be easily monitored with VisualCN; circuit activity is viewable in both tabular and graphical formats. Test data can be sampled in user-specified time increments, with data acquisition available every 1 second, with an optional upgrade to 0.1 second acquisition. Test data can include information regarding voltage, current, cell voltage (optional), temperature, pressure (optional), and other customer-determined information. Test data is stored in a Microsoft Access format. This data can be viewed in post-test analysis using VisualCN's Dataview graphing software, or can be presented to users in an Access report of their own design.

For more information about using VisualCN to command the Model LCN (as well as Bitrode's other network-based charge and test equipment), contact a Bitrode representative.

## Note the **Features:**

- ▶ Circuit isolation for separate cycling of battery cells or batteries within a pack
- ▶ Current ranges from 1 to 1000 Amperes
- ▶ Voltages from 1 to 48 Volts (nominal) for testing single cells or multiple batteries
- ▶ Accuracy to within  $\pm 0.1\%$  of full scale
- ▶ Testing of single cells to zero volts
- ▶ Modular design
  - ▶ Modules installed on slide-out rails for cost effective circuit additions and upgrades to standard cabinets
  - ▶ Modular construction allows efficient maintenance and service
- ▶ Reliable design and sturdy construction
- ▶ Full-featured easy to use software on the Windows 95 and Windows NT platforms
- ▶ Up to 99 control program steps, with up to 10 limit conditions per step (some LCN circuits may be limited to 50 program steps - contact a Bitrode representative for details)
- ▶ Network control for hundreds of circuits from a single host computer
- ▶ Graphical data presentation and analysis with VisuaLCN's Dataview software, or tabular data review in customer-designed Microsoft Access format
- ▶ Temperature monitoring is standard on most models of the LCN; see the Options list on the reverse of this page for available optional thermocouples

## Beyond the Basics:

Optional features make the Model LCN a robust testing system, custom designed for specific laboratory environments. Build the module which fits your testing needs with the options listed below.

- ▶ Cell Voltage Monitoring for cells or multiple cell monoblocks
- ▶ Cell Switching Module (CSM) - during cycling, individual cells or batteries can be removed from a series once they reach a specified limit condition, leaving the rest of the cells or batteries in the string to complete a program step
- ▶ High resolution ( $\pm 0.001$  volt) cell voltage monitoring
- ▶ Thermocouple devices
  - ▶ Type J or T for temperatures ranging from  $-40^{\circ}$  to  $200^{\circ}\text{C}$  ( $\pm 0.5^{\circ}\text{C}$ ).
  - ▶ Type K for temperatures from  $-40^{\circ}$  to  $500^{\circ}\text{C}$  ( $\pm 1^{\circ}\text{C}$ )
  - ▶ Other temperature ranges available
- ▶ Multiple temperature monitoring
- ▶ Temperature compensation - automatically compensate charge voltage as a function of battery temperature
- ▶ Pressure monitoring in user specified ranges
- ▶ Reference electrodes with input resistance up to  $10^8$  ohms
- ▶ Specific gravity monitoring
- ▶ Auxiliary voltage control from a secondary input
- ▶ Programmable analog or digital inputs and outputs
- ▶ Multiple current ranges - up to three per circuit
- ▶ High resolution float charge
- ▶ Constant resistance discharge
- ▶ Ramp charge or discharge
- ▶ 0.1 Second data acquisition
- ▶ Customer specified alarms and faults
- ▶ Custom designed test leads
- ▶ Custom designed cell or battery handling fixtures
- ▶ Up to 999,999 cycles per test
- ▶ SFUDS or DST testing capability with auto scaling of W/Kg

Model* **	Constant Current Amp Range (±0.1%)	Charge Voltage (±0.1%)	Discharge Voltage (±0.1%)	Constant Wattage	Ampere Hour	Watt Hour
LCN28-1-12	1.0000	0 to 18.000	0 to 14.000	18.000W	99.999AH	999.99WH
LCN14-5-12	5.000	0 to 18.000	0 to 14.000	90.00W	999.99AH	9999.9WH
LCN7-10-12	10.000	0 to 18.000	0 to 14.000	180.00W	999.99AH	9999.9WH
LCN14-10-12	10.000	0 to 18.000	0 to 14.000	180.00W	999.99AH	9999.9WH
LCN7-25-12	25.000	0 to 18.000	0 to 14.000	450.00W	999.99AH	9999.9WH
LCN5-50-12	50.00	0 to 18.000	0 to 14.000	900.0W	9999.9AH	99999WH
LCN7-100-12	100.00	0 to 18.000	0 to 14.000	1800.0W	9999.9AH	99999WH
LCN3-200-12	200.0	0 to 18.00	0 to 14.00	3600W	9999.9AH	99999WH
LCN3-300-12	300.0	0 to 18.00	0 to 14.00	5400W	9999.9AH	99999WH
LCN2-500-12	500.0	0 to 18.00	0 to 14.00	9000W	9999.9AH	99999WH
LCN7-5-24	5.000	0 to 36.00	0 to 28.00	180.00W	999.99AH	99999WH
LCN7-25-24	25.00	0 to 36.00	0 to 28.00	900.0W	9999.9AH	99999WH
LCN7-50-24	50.00	0 to 36.00	0 to 28.00	1800W	9999.9AH	99999WH
LCN3-100-24	100.00	0 to 36.00	0 to 28.00	3600W	9999.9AH	99999WH
LCN3-100-36	100.0	0 to 54.00	0 to 42.00	5400W	9999.9AH	99999WH
LCN2-200-36	200.0	0 to 54.00	0 to 42.00	10800W	9999.9AH	99999WH
LCN2-100-48	100.0	0 to 72.00	0 to 56.00	17200W	9999.9AH	99999WH
LCN1-300-48	300.0	0 to 72.00	0 to 56.00	21600W	9999.9AH	99999WH

### Specifications

### Measures

Model* **	Circuits per Cabinet	Cabinet Input Amps (50 or 60 Hz)				Weight Lb/Kg <sup>†</sup>	Dimensions <sup>†</sup> In / Cm		
		Three Phase			Single Phase		W	D	H
		230V	400V	460V	115V 230V				
LCN28-1-12	28				35 18	1500/681	28/71	37/94	78/198
LCN14-5-12	14				40 20	1500/681	28/71	37/94	78/198
LCN7-10-12	7				28 14	900/410	22/56	22/56	78/198
LCN14-10-12	14					1500/681	22/56	22/56	78/198
LCN7-25-12	7					1500/681	22/56	22/56	78/198
LCN7-50-12	7	40	23	20		1469/668	28/71	37/94	78/198
LCN7-100-12	7	73	42	37		1606/731	28/71	37/94	78/198
LCN3-200-12	3	54	31	27		1460/663	28/71	37/94	78/198
LCN3-300-12	3	84	48	42		1500/681	28/71	37/94	78/198
LCN2-500-12	2	84	48	42		1500/681	28/71	37/94	78/198
LCN7-5-24	7				40 20	1000/455	28/71	37/94	78/198
LCN7-25-24	7					1469/668	28/71	37/94	78/198
LCN7-50-24	7	58	35	29		1606/731	22/56	37/94	78/198
LCN3-100-24	3	42	24	21		1500/681	28/71	37/94	78/198
LCN3-100-36	3	56	32	28		1500/681	28/71	37/94	78/198
LCN2-200-36	2	75	43	38		1500/681	28/71	37/94	78/198
LCN2-100-48	2	48	28	24		1500/681	28/71	37/94	78/198
LCN1-300-48	1	86	50	43		1500/681	46/117	25/64	84/213

\*If required voltage, current, or number of circuits do not appear in this table, contact Bitrode Corporation: custom product engineering is one of our greatest strengths.

\*\* Module names are interpreted as follows: LCNxx-yy-zz, where xx indicates number of circuits per cabinet, yy indicates amperage and zz indicates voltage.

<sup>†</sup>Dimensions may vary according to design requirements.



All products are subject to change in physical appearance and circuitry which will not alter performance specifications.

VisualLCN is a registered trademark of Bitrode Corporation. Microsoft, Windows, and Windows NT are either registered trademarks or trademarks of Microsoft Corporation in the U.S. and other countries.

©1998 Bitrode Corporation

**BITRODE CORPORATION**  
1642 Manufacturers Drive  
Fenton, Missouri 63026  
USA  
Tel: (314) 343-6112  
Fax: (314) 343-7473  
e-mail: sales1@bitrode.com

**BITRODE LIMITED**  
Unit A, 6 Floor  
Wing Hing Commercial Bldg.  
No. 139 Wing Lok St.  
Sheung Wan, Hong Kong  
Tel: (852) 2976-0929  
Fax: (852) 2976-0927

**BITRODE LIMITED**  
H1 Draycott Business Park  
Dursley, Glos., GL11 5DQ  
United Kingdom  
Tel: (1453) 890039  
Fax: (1453) 890017