LCN

Professional Building Automation

by
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Introduction

LCN stands for Local Control Network.
LCN offers 3 principal advantages:

Easy planning
Easy installation
Easy operation

In general , only those systems which can can easily be adapted to the customer or designer requirements will achieve a big share on the market – and LCN is such a system.

In practice, a low cost version of LCN can be installed providing only basic functions.
Given that the necessary installation has been made before, this low cost version can easily be turned into a luxury version step by step just by adding more units.

LCN has been designed to work with standard installation material. In other words, no special components such as special bus-operable switches, movement detectors etc. are required. However, third patry components can easily be integrated into the LCN bus system, if desired.

Principles and requirements

LCN is a bus based building automation system. Specially designed electronic units are installed into hollow wall boxes and connected to the AC lines. Once connected each module can begin transmitting and receiving commands. No central computer system is required.

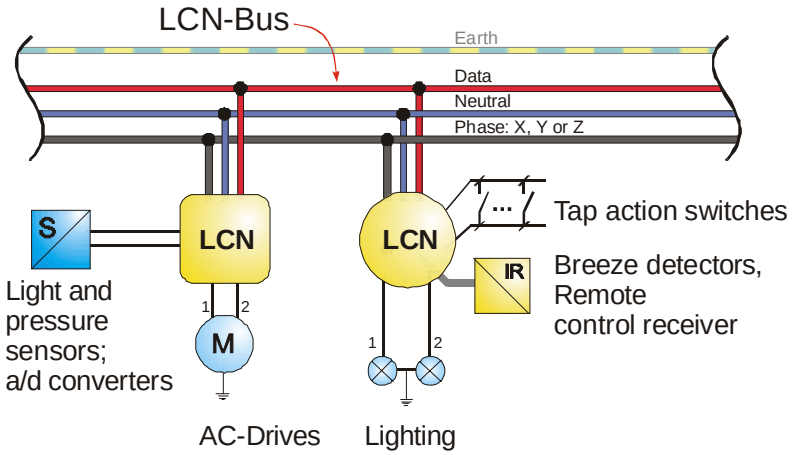


Fig. 1 Installing LCN - Equipment

Initially a 4 wire (or more) building cable should be

installed. One of these extra wires is then used solely for data transfer between modules.
Bus modules are units that are responsible for the data transfer from one unit to another. Each Bus module is connected directly to phase (L1, L2; L3/X,Y, Z), neutral and the extra data wire. No extra power supply units are required, thus reducing the amount of equipment installed.

Bus module features:

Each Bus module is controlled by a microprocessor
No separate controller required
Built-in power supply
Combined sensor and actor in one
2 independent power outputs ranging from 250VA to 2000VA
outputs can be operated as switch or dimmer
up to 3 interface ports
T-port for sensors, that is, switches, light, pressure, temperature
I-port for pulses, that is, infrared remote control, pulse counter (breeze), access control (transponder readers)
P-port, that is, relay block (digital output), binary input

Some of the firmware features include:

Counting
Timer
Logic control
Digital input and output
Analogue output
Full remote control capability

LCN can be operated with a minimum of 2 Bus modules which provide

4 switchable / dimmer outputs
2 T, I and P ports (depending on type)

If LCN is not to be installed right now, the preparation for a later installation is very simple. All that you need is a AC line with 4 (preferably 5) wires, hollow wall boxes in which the LCN products can be inserted, some extra space in the distrbution box and tap-action switches.
The same applies to any step-by-step extensions which may become necessary in the future.
Therefore the bus system always fits the owner´s requirements – a very important aspect!

Network

As mentioned above, the installation process is very simple. A maximum of 250 modules can be interconnected to form one bus line (also referred to as a segment).
Each bus module is simply connected to the phase, neutral and data wire.

If by design more units are required, a new bus line or segment has to be added.
Both bus lines can now be joined using the LCN-Coupler modules.
Segment modules offer an easy method in dividing the modules into smaller areas. If we for example look at a sky scraper each floor may have between 100 and 150 bus modules. A segment linker module is then installed on every floor. This simplifies module-identification and thus maintenance work.

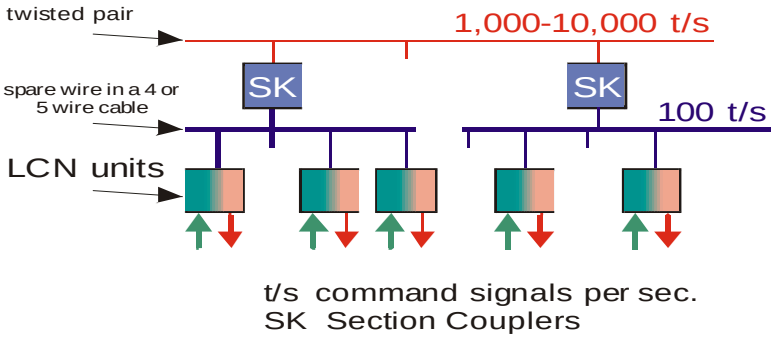


Fig. 2 Simple Network Structure

Each line can be extended to a length of approximately 1000 yards. In practice this length is easily exceeded when installing LCN in large factory sites. In this case the bus lines can be joined using fibre optics or line amplifiers. However, if the sum of the bus modules on both lines exceeds 250, a pair of segment linker modules is also required.
With standard glass core fibre optic units the line can be extended by approx. 2000 yds, whereas plastic fibre optics can only be used for extensions up to 100 yds.
The line amplifiers, from which always two or more are used, would extend the bus system by 1000 yds each, but have to be placed within a distance of 4 to 5 yds to each other.

Currently the maximum number of bus modules that can be connected in a building is 30,000, serving more than 0,5 million data points. That fulfills the requirements of almost every application.

As far as network topology is concerned, no special rules apply.

Communication

Prior to any form of communication between the modules, all modules in a system need some kind of identification.
To keep the installation as simple as possible, the installer or electrician issues numbers to each bus module, using the respective software. The programmer assigns a number between 5 and 254 (that makes 250 units) to each bus module per bus line.
Subsequently, each Segment-linker module is also assigned a number between 5 and 125 (that makes 120 units).
The programmer can connect the bus line to the PC with a special LCN-PC-Linker. This can be done at any point in the network. There are **no** specially assigned connection points.
Once joined, the programmer launches the DOS-programme LCN-P or its Windows equivalence, LCN-Pro.

Bus modules communicate with each other by transmitting and receiving command signals.
A bus module can also communicate with up to 250 groups (see Grouping), whereby there is no limit to the number of members per group!
One specially assigned number is the number 3. If a command is sent to group 3, each and every module on the network reacts to the sent command.
With this very useful feature, the entire lighting in a skyscraper for example can be switched off using one single button.
Adding bus modules to groups also reduces programming effort and saves time.

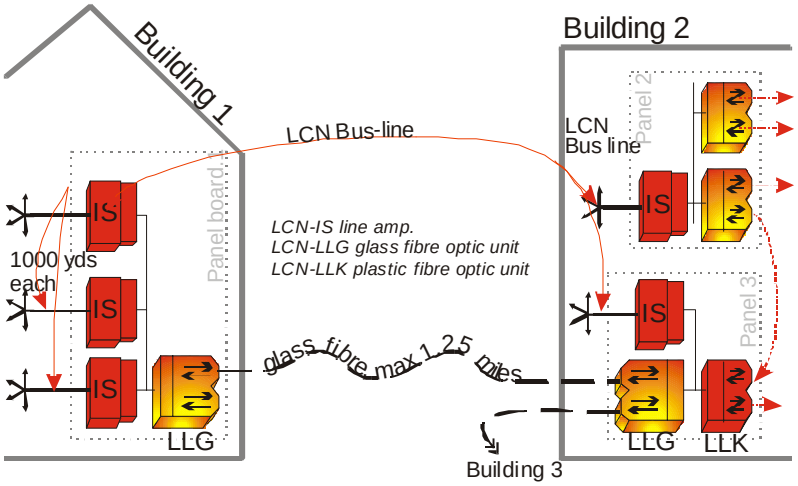


Fig. 3 Long Distance Data Transfer

Data transfer

On average about 100 command signals are transmitted per second, which equals a transfer rate of 9600 Bd.
Built in anti-collision programs ensure a maximum transmission of data even during “network rushhours”.
Transmission takes place in the baseband. Therefore no further equipment such as phase discriminators, filters etc. are required.
Possible RF interference is kept to a minimum!

As already mentioned above, the data cable is **only** used for the transfer of data. Signal levels reach a maximum of $30V_{pp}$.
All bus modules have a built in 2kV surge protection. Main voltage, placed on the data line by mistake, does not harm the LCN modules.

Commands

LCN command signals have been designed to maintain a very flexible structure. Therefore the actual length can vary as the implementation of new commands for future equipment becomes necessary.
At present the command signal has the following structure:

The compact command signal includes information for the actor and sensor. In other words, the information for the output of any bus module is transmitted in the data string and not in the actor.
Thus a bus module can in fact react in an unlimited number of manners.
For example:

Source ID	Info	CRC	Target ID	Com-mand	Param. 1	Param. 2

Fig. 4 Simplified Telegram

Module 25; Dim output 1 to 30% Brightness; slope: 10Steps / s
Module 25; set staircase lighting; slope: 25

Maintenance has also been kept simple and efficient. At any time during programming, the operator can press the F8 button on the keyboard. The window which is opened displays every command signal transmitted.
Each transmitted command signal shows:

transmitter ID
receiver ID
command in short form

The Windows-based configuration tool LCN-Pro offers a permanent window that displays all bus activity.

Life span

Compared to the present rate of development in the electronic industry, most systems have a life span of approximately 10 years. That is not a very long period when considering the life span of office blocks, apartment buildings, hospitals etc.

LCN has a built-in incremental life span feature:

High flexibility in the command signal format ensures immediate implementation of new functions / commands

New commands required by future electronic equipment can simply be added to the command signal, maintaining full compatibility to all older units

LCN units are designed to have a life span of at least 45 years. Only top quality industrial components are used.

Adaptability

LCN can be adapted to control other bus systems on the market.
Available gateways :

- **Native ASCII protocol** (a powerful tool to devellop customised couplers to the LCN system)
- **DMX 512 (stage lighting control)**
- **ModBus**
- **OPC**
- **P1 (SQL access to the bus)**
- **and others, e.g. touch screen displays**

New gateways can be developed on request.

Configuration

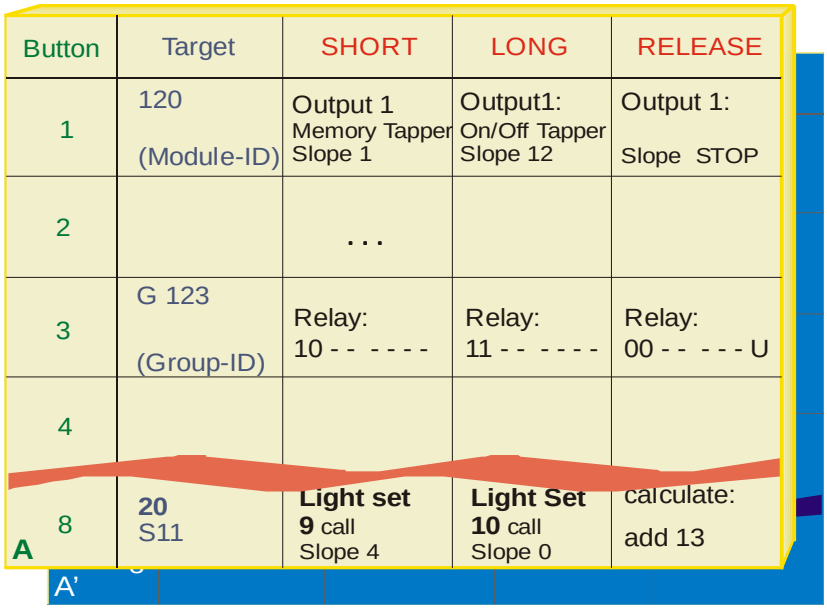
Once all the units have been installed, the electrician has to set up the system.
This is done using the Win98/Win2000/Win XP program LCN-Pro or the DOS-operated program LCN-P.
Each unit receives information about all attached sensors and peripheral equipment, ID-assignment, and of course the necessary logic control which is stored in the button function tables.

Buttons

LCN requires the use of a standard tap-action switch. The advantage of using tap-action switches - as opposed to normal switches - is the variety in press modes.
Basically tap-action switches can be pressed as follows:

Short
Long
Release

Each button can therefore store 3 different functions. In other words, 3 different commands can be triggered by pressing the buttons accordingly.
LCN uses button-function-tables. These are made up of the button number and the press mode:



Button	Target	SHORT	LONG	RELEASE
1	120 (Module-ID)	Output 1 Memory Tapper Slope 1	Output1: On/Off Tapper Slope 12	Output 1: Slope STOP
2		. . .		
3	G 123 (Group-ID)	Relay: 10 - - - - - - -	Relay: 11 - - - - - - -	Relay: 00 - - - - - - U
4				
8	**20** S11	**Light set 9** call Slope 4	**Light Set 10** call Slope 0	calculate: add 13

A
A'

Fig. 5 Button Function Table A (1 of 4)

Since only one receiver ID can be programmed per button, a so-called shadow-function-table is added. That makes life easier because the commands in both tables are transmitted at the same time.
With this feature two receiver IDs can now be programmed using the shadow-function-table.

Example:
If button #3 is pressed, either physically or virtually (software), the respective commands stored in function-table **A** and shadow-function-table **A´** are transmitted simultaneously.
Additionally, there are two modes of operation:

Single mode
Dual mode

Single mode

Up to 8 tap-action switches can be connected to the T-port of a bus module.
In this mode each button only triggers one **function** depending on the press mode (short, long, release).
Each button can store 3 commands (see button-function-table). That adds up to 24 commands, controlling either groups of modules or single units.
Since a variety of other sensors for light, temperature, pressure etc. can also be connected to the T-port, it should be mentioned here that only one of these sensor types can be connected. A tap-action switch adapter (LCN-T6T, LCN-TU4H) and a pressure sensor cannot be connected to one bus module.

If sensors are attached, threshold values can be set to trigger specified actions. These values are also stored in the button-function-tables. The first 5 buttons are used for the threshold values.

Dual mode

This feature uses two buttons for one command and multiplies the amount of transmittable functions.
Example:
If a set of 6 buttons has been installed, 2 designated buttons become “function”-buttons and the other 4 become “selection”-buttons.
The required command is triggered by pressing a selection-button and then the function-button.

Grouping

To save memory space and to make programming easier, LCN supports the use of groups.
With this feature each module can become a member of up to 250 groups, where there is no limit to the number of bus modules per group.
This fulfills the requirements of almost all applications.

Thus a single command signal can basically be sent to an unlimited number of bus modules.
For example:
Button 2 in the Master-Suite can be programmed to switch off all outputs in the house by transmitting the respective command to group 3.

This feature is very valuable for example in an office block, where all lights can be switched off by pressing one single button!

Grouping can also be dynamic. A very comfortable effect especially in large conference halls, ballrooms etc..
By adding a door switch, LCN recognises that a room has been splitted up into several partitions and divides the lighting in a conference hall into the designated number of groups. The same switch that initially switched on all lights now switches only the lights in the partitioned room.

Extended features

All functions stored can be triggered by remote control or any other bus module.

Delay function from 1s up to 45 days
Jam function from 1s up to 45 days
Periodic times from 0.15 to 100 min
Two regulators for controlling heaters, coolers, etc.

Remote Control

A new LCN-remote control was specially designed for all system features.
The remote control is available in two different models:

Heavy duty model
16 buttons with a range of up to 90 yd. including rechargeable batteries
Compact key ring model
4 buttons, 4 levels (range 15 yds)

Both systems can be coded with 4 digits. The receiver modules can then be programmed to analyse each transmission to check for codes.
Additionally, each remote control, (and bus module!) is also equipped with a serial number, which can be evaluated individually.
Implementing the readout of the serial number and code of each remote control offers a very efficient and reliable method for use in:
Central locking systems for hotel rooms, office blocks and
access control systems for hospitals, security areas etc..

Up to 250 individual remote controls can be used in a room, banquet hall, offices, reception halls etc. without cross interference.

Power Outputs

All power outputs on bus modules can be dimmed or operated as a switch, depending on the respective setting in the configuration software.
Outputs are switched only during zero crossings on the AC power curve. The benefit is the conservation of

recourses, that is, bulbs are not switched on during voltage peaks etc.
Output power varies from 2 x 150VA to 2 x 2kVA, depending on the used module. A relay block can be connected for switching higher loads up to 16A.
Each output is set with 2 parameters:

Brightness
Slope

The brightness level is a number between 0 and 200. In other words, brightness level is divided into 200 steps.
The slope is a time factor and sets the time required for the dimmer to reach the desired dim-value.
However, if the output is set to switch mode, the slope merely indicates the time until the output is **switched** on.

Plus-Modules, such as LCN-HU, plus, LCN-LD, LCN-DI12 have been designed with added memory space and firmware.
One added feature includes the capability to save the brightness settings of each output. Up to **100** different settings can be stored for each output!

Tableaus

LCN has a built-in status messaging system. This allows the monitoring of selected outputs.
The monitored outputs can then be displayed either on a typical, custom-built tap-action switch panel or on a PC with the respective LCN-Program (see Software).
The monitoring can also be used to display alarm signals in accordance with DIN requirements.
The LEDs can be configured for flashing, blinking, ON and OFF.
Alarm signals can be given hierarchal values according to the importance of an alarm signal.

Summary

ID	Bus modules	5 – 254 per line
	Groups	5 – 254 per line
	Segments	5 – 124 per line
	Max. Units	30,000 units
Functions in each LCN module	Output timer	10ms – 40min
	Unit timer	1s – 45d
	A/D converter	8, 10 or 12 Bit
	Processing of measured values	Threshold value detector 5x plus two permantent controllers, difference measurements
	Logic control	And, or, if etc
	Counters	0 – 30,000s
	Alarms	12 inputs, 4 eval. registers, can be extended hierarchically, reporting of first and last event
	Light control	2 timers & 100 light sceneries per output, automatic sequence control and many more functions
	Acknowledgement functions; 3 phases	1. Transm./Function acknowledgement 2. Status reports 3. Status commands
	Additional functions (examples)	IR-remote cotrol with 4 /16 buttons and 48 functions, access control (also via transponder), clock generation etc.
Outputs	Steps / output	0 – 200
	Dim range	0 – 100%
	Switching: ON	Zero- voltage switch
	Switching: OFF	Zero-current switch
Power rating	Supply	230VAC ± 15%
		50Hz
	Surge protection	4kV
	Power failure protection	20s, power failures over 20ms are reported.
Data transmission	Data Rate	9600Bd = 100 telegrams/s Segemnt bus: 1000 telegrams/s
	Data line protection	230VAC continuous / 2 kV surge
	Range	0.625 miles / line
		100 yd. plastic fibre
		1.25 miles glass fibre