Group3

Group3 DTM
LabVIEW Library for Windows
Version 1.0.1
User's Manual

Includes support for ISA and PCI Loop Controllers

and Windows® 98/ME/NT/2000/XP

06 June 2007

Thank you for purchasing and using Group3 Magnetic Field Measurement and Control equipment. We hope you will join the growing number of people who are enthusiastic about the features Group3 Magnetic Field Measurement and Control has to offer.

Group3 has been designing and building specialised Magnetic Field Measurement and Control systems since 1983. We are constantly upgrading and improving our products and the supporting documentation. We welcome input from our customers, so if there are aspects of the system you particularly like, or things you would like to see implemented, improved or developed in the way of hardware, software or documentation please contact your Group3 representative, or Group3 directly with your suggestions.

The Group3 website (http://www.group3technology.com) contains some pages of information on Group3 products. This site will be updated regularly, and you may choose to check it from time to time, to learn about recent developments.

Listed on the "What's New" page are the recent developments and enhancements to the product range, grouped by the year of introduction.

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Group3 DTM LabVIEW Library User's Manual

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1 Overview

The Group3 DTM LabVIEW Library consists of a set of Virtual Instruments (VIs) written in the LabVIEW graphical programming language. These VIs are intended to be used in your LabVIEW application programs to provide an interface to the Group3 Magnetic Field Measurement and Control hardware.

This manual assumes that the reader is familiar with LabVIEW, and with the Group3 Magnetic Field Measurement instruments (DTMs). Refer to the documentation supplied with the LabVIEW package, and to the "Group3 DTM User's Manual".

The computer communicates with the Group3 DTM hardware through one or more Group3 Loop Controller boards which are inserted in the computer's expansion slots. There are Loop Controllers available for ISA and PCI slots in the PC platform. The product range includes controllers supporting both one and three communication ports for each of the slot types. Group3 Loop Controllers currently support up to 31 DTMs, per Loop.

The library is supplied on a CD-ROM and supports all LabVIEW versions from 6.0 onwards. Installation instructions for the software are given in section 3 of this manual.

2 Loop Controllers - Hardware Description

2.1 PCI bus Loop Controllers

The LC1-PCI and LC3-PCI are Loop Controller boards designed to operate Group3 Control modules or DTMs from a PCI bus slot. The LC1 drives a single fibre-optic communication loop, while the LC3 allows three completely independent loops to be controlled from the one slot. Each loop is capable of handling 31 DTMs. A limit of 16 loops can be controlled from any one computer - for example 5 LC3's and an LC1 give the maximum of 16 loops. LC1 and LC3 boards may be mixed in a system.

The PCI Loop Controllers are Plug and Play devices - the computer BIOS allocates the actual bus addresses on start up, and the user does not need to be involved in the process.

The LCs require a system driver to be installed on the computer. This driver software is supplied on the "Group3 Loop Controller Driver Installation CD". Instructions for installing the driver are to be found in section 3 of this manual.

The only hardware setting the user needs to be aware of is the rotary switch on the top edge of the circuit board. This is shipped from the factory set at position '0', and this setting needs to be altered only if two or more PCI Loop Controller boards are to be installed in the same computer. The switch is there to allow the user and the application software to distinguish between the different Loop Controllers in the same computer.

The switch on an LC1-PCI sets the loop number for that board.

The switch on the LC3-PCI sets the loop number (call it n) of the top transmitter/receiver pair - the one furthest from the gold board edge fingers. The number of the middle loop is one more than the switch setting (n+1), and the number of the lower loop is two more than the switch setting (n+2). The allowed range for any loop number is 0 to F (hex). If the switch is set to E, the loop numbers will be E, F, and 0. If the switch is set to F, the loop numbers will be F, 0, 1.

If several Loop Controller boards are used in one computer, remember that the switch settings must be different, and that the three loops of an LC3-PCI occupy three consecutive numbers, starting with the number that the switch is set to.

For detailed specifications of the Loop Controllers, please refer to the "Group3 Control User's Manual".
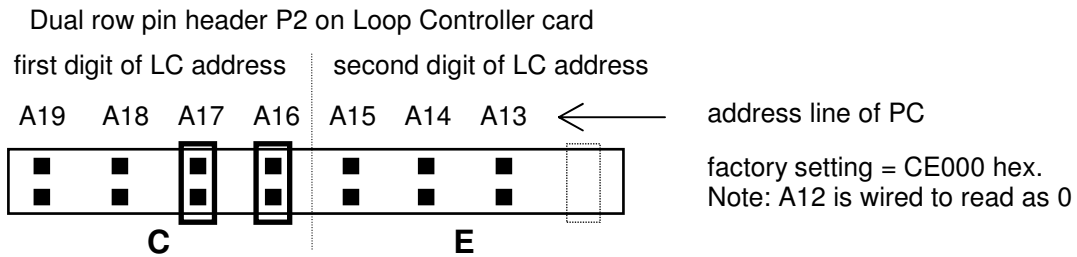
2.2 ISA bus Loop Controllers

The LC1-PC and LC3-PC are Loop Controller boards designed to operate Group3 Control modules or DTMs from an ISA bus slot. The LC1 drives a single fibre-optic communication loop, while the LC3 allows three completely independent loops to be controlled from the one slot. Each loop is capable of handling 31 DTMs. The only limit to the number of boards used in a computer is the number of available ISA slots. LC1 and LC3 boards may be mixed in a system. ISA and PCI LCs may also be mixed in a system.

Communication to and from the PC processor takes place through shared memory installed on the LC boards. This shared memory is addressed directly by the control computer's address bus. Jumpers are provided on the LCs to place the shared memory at a suitable position within the computer's address range.

To operate in a 32-bit environment the boards require a system driver to be installed on the computer. This driver software is supplied on the "Loop Controller Driver Installation CD". Instructions for installing the driver are to be found in section 3 of this manual.

The shared memory of an ISA slot Loop Controller is intended to be placed in the area between 640k and 1M bytes in the computer's address space, where free address space usually is available. Conflict with other devices in the system must be avoided. The LC base address is determined by comparing PC address lines A13 to A19 with the jumper settings. The base address of the shared memory can be placed anywhere between 0000:0 hex and FE00:0 hex in increments of 0200:0 hex (8092 bytes). Values below C000:0 should not be used.

The absence of a jumper on a particular address line corresponds to a 1.
The presence of a jumper corresponds to a 0.

Dual row pin header P2 on Loop Controller card

first digit of LC address | second digit of LC address

A19   A18   A17   A16 | A15   A14   A13   ⟵——————   address line of PC

factory setting = CE000 hex.
Note: A12 is wired to read as 0

C   **E**

Hexadecimal coding table: ⠿ = no jumper = 1   ⊟ = jumper in place = 0

⊟ ⊟ ⊟ ⊟	= 0		⠿ ⊟ ⊟ ⊟	= 8
⊟ ⊟ ⊟ ⠿	= 1		⠿ ⊟ ⊟ ⠿	= 9
⊟ ⊟ ⠿ ⊟	= 2		⠿ ⊟ ⠿ ⊟	= A
⊟ ⊟ ⠿ ⠿	= 3		⠿ ⊟ ⠿ ⠿	= B
⊟ ⠿ ⊟ ⊟	= 4		⠿ ⠿ ⊟ ⊟	= C
⊟ ⠿ ⊟ ⠿	= 5		⠿ ⠿ ⊟ ⠿	= D
⊟ ⠿ ⠿ ⊟	= 6		⠿ ⠿ ⠿ ⊟	= E
⊟ ⠿ ⠿ ⠿	= 7		⠿ ⠿ ⠿ ⠿	= F

The address jumpers on an LC1-PC set the base address for that board. The address jumpers on the LC3-PC set the base address of the top transmitter / receiver pair - the one furthest from the gold board edge fingers. The base address of the middle loop is 2048 bytes (800 hex) more than the address jumpers, and the base address of the lower loop is 4096 bytes (1000 hex) more than the address jumpers

With the jumpers set for CE, as the factory setting above, the base addresses of the three loops are CE00:0, CE80:0 and CF00:0 hex.

Note:
Care must be taken if mixing the current LC's with the earliest versions (pre 1993) which have 1Kbyte dualport RAMs (boards labelled 16000032A for LC1s, 16000048 for LC3s). These boards had an additional, eighth jumper to set A12. If mixing old and new versions check that the address jumpers are set so that the memory areas used by the boards are different - it is not sufficient that the jumpers just appear to be set to physically different pins.

For detailed specifications of the Loop Controllers, please refer to the "Group3 Control User's Manual".

2.3 Loop Controller Board Installation

Note: Install the supplied memory drivers before installing the loop controller boards, see section 3.

A grounded static discharge strap must be worn when handling loop controllers outside of their anti-static bags, and care should be taken to avoid touching the gold edge connector contacts.

The computer must be powered off while Loop Controller boards are installed or removed.

Loop Controller Board Identification:

The Group3 PCI and ISA loop controller boards are easily distinguishable:

PCI loop controller board (LC1-PCI and LC3-PCI):
    Each board has a rotary switch on the top edge of the circuit board.
    Each board has six circular holes on the rear metal bracket.
    The gold contacts have fine pitch spacing.

ISA loop controller board (LC1-PC and LC3-PC, aka LC1-ISA and LC3-ISA):
    Each board has a set of jumpers on the circuit board.
    Each board has one or three elliptical holes on the rear metal bracket.
    The gold contacts have coarse pitch spacing.

The Loop Controller board may be inserted in any vacant slot on the computer's mother board that is appropriate to the type of board being installed, PCI or ISA.

PCI slots have finer contact pitch spacing than ISA slots.

When planning your Loop Controller installation bear in mind that any mixture of PCI and ISA Loop Controllers, including LC1 and LC3, can be used and accessed from the LabVIEW application.

Also be aware that LC3 boards are long, so choose slots for them where they will not mechanically interfere with other components in the computer, for example the fan on the computer's processor chip.

ISA boards must have their jumpers set as described above before being fitted to the computer.

The switch settings of PCI boards can be adjusted after the board is installed.

Carefully insert the board into its slot, and secure it in place with the usual fixing screw.

3 Software Installation

3.1 Memory Driver Installation

The "Group3 Loop Controller Driver Installation CD" contains the software drivers required to operate Group3 Loop Controllers. You should already have this CD if you bought a Group3 Loop Controller.

1) Insert the CD into the computer's CD drive. It should run automatically, but If it doesn't, click: **Start•Run** on the computer and select "SETUP.EXE" on the CD. Follow the on-screen instructions.
2) Turn off the computer and install the loop controller card(s).
3) Run the LC_Find utility to confirm that the LC is working properly. See section 3.3 below

3.2 Group3 DTM LabVIEW Library Installation

The "Group3 DTM LabVIEW Library CD" contains the Group3 LabVIEW driver plus an example application and manuals. Note: this software is for use with LabVIEW version 6 or later.

1) Insert the CD into the computer's CD drive.
   There are three folders on the CD:
   > **DTM_LC_Library**
   > **Example**
   > **Group3 Manuals**
2) Copy the folder "DTM_LC_Library" and paste it into the **user.lib** directory of the LabVIEW installation directory on your computer.
3) Copy the remaining folders anywhere you want.
   The folder "Example" contains the example VI "DTM_LC_Test.vi ".
   The folder "Group3 Manuals" contains this manual plus the Group3 DTM 151 serial teslameter manual.
4) Restart the LabVIEW application. LabVIEW will automatically load the new palette: "DTM LC Library" for this library, in the Function palette/User Library.

Notes:
• The first time you open one or more of the supplied VIs, LabVIEW might ask you to locate the path of the file: LC_DTM.DLL. This is located in the folder: <LabVIEW installation directory>\user.lib\DTM_LC_Library.

• Files copied from the CD-ROM might appear on the hard drive as "read-only", i.e. with their read-only attribute set. This will prevent LabVIEW from updating these files when necessary. To avoid this problem, open Explorer (press **Windows E**), highlight the files concerned (**Ctrl A** will select all the files in a list), press **Shift F10** to open the context menu, and press **R** to open the properties window. Unselect the Read-only attribute by pressing **R** again or by clicking the check box until it is clear. Press **Enter** or click **OK** and then exit Explorer.

3.3 LC Find Utility

The program **LC_Find.exe** in the \Memory Drivers folder on the "Group3 Control Driver Installation CD" will show a listing of all the Loop Controllers installed in the computer. To run the program, click **Start•Run**, and then navigate to the folder where you have copied this file. Double-click **LC_Find.exe**.

The program first gives a listing of all PCI LCs present, then after a keystroke gives a listing of all ISA LCs in the address range C0000 to FE000.
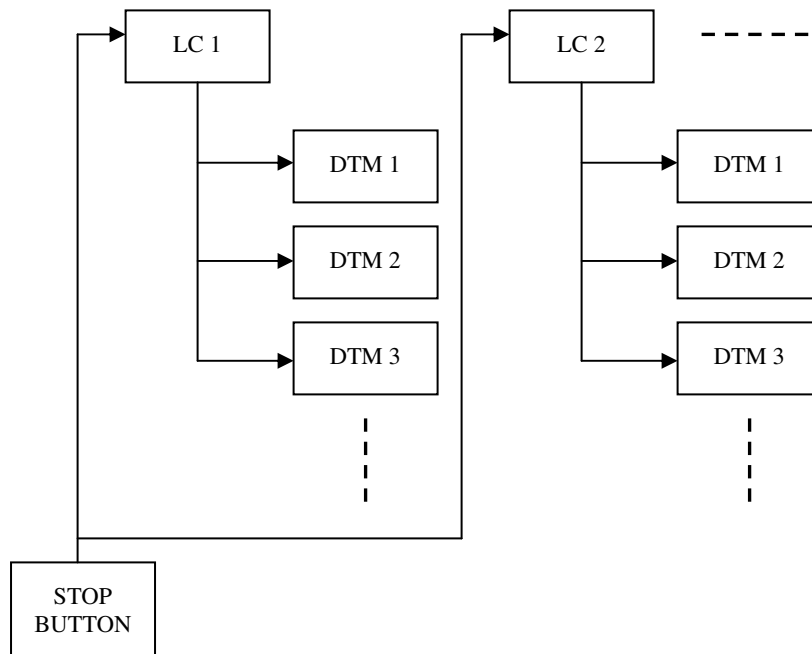
4 Using the Group3 DTM Library

4.1 Application Structure

The DTM_LC.llb driver library contains the following two VIs:

    LC.vi
    DTM.vi

The following diagram shows the linkage between them in a LabVIEW application. The dashed lines represent possible expansion of the system design: LCs and DTMs.

```
   ┌───────┐              ┌───────┐    ─ ─ ─ ─
 ┌►│ LC 1  │            ┌►│ LC 2  │
 │ └───┬───┘            │ └───┬───┘
 │     │   ┌───────┐    │     │   ┌───────┐
 │     ├──►│ DTM 1 │    │     ├──►│ DTM 1 │
 │     │   └───────┘    │     │   └───────┘
 │     │   ┌───────┐    │     │   ┌───────┐
 │     ├──►│ DTM 2 │    │     ├──►│ DTM 2 │
 │     │   └───────┘    │     │   └───────┘
 │     │   ┌───────┐    │     │   ┌───────┐
 │     └──►│ DTM 3 │    │     └──►│ DTM 3 │
 │         └───────┘    │         └───────┘
 │             ┊        │             ┊
 │             ┊        │             ┊
 │  ┌────────┐ │        │
 └──┤ STOP   ├─┘────────┘
    │ BUTTON │
    └────────┘
```

4.2 Building an Application

To create a DTM application using Group3 DTM LabVIEW Library is straight forward and extremely simple.

First, make sure you followed the installation procedures and have installed folder: "DTM_LC_Library" into the user.lib folder of the LabVIEW Installation directory. Also note that after installation, it is necessary to restart LabVIEW. Now you should be able to see the Group3 DTM LabVIEW Library under the function palette's "User functions" sub-palette.

Follow the structure shown in section 4.1 and create controls and indicators. Also refer to the sample project in section 5 and the library VI descriptions in section 6.

1) First, place an LC.vi in your LabVIEW application. For more detail see the description of LC.vi in section 6.1. The LC VI is required and must link with all DTMs under it. Repeat this step for each LC to be used in the application.

2) Next, place a DTM.vi. For more detail see the description of DTM.vi in section 6.2. Repeat this step for each DTM connected to the loop controller.

3) Connect the "Link to LC" terminal of each DTM.vi to the "Link to the DTMs" terminal of the relevant LC.vi.

4) Wire up a stop button control to the "Stop" input terminal of each LC.vi. See Note-1 below.

5) Supply an LC number or address to the "LC" terminal input of each LC.vi. These should correspond to the number/address set on the actual LCs.

6) Supply a DTM number to the "DTM Address" terminal of each DTM.vi. These should correspond to the address set on the actual DTMs.

7) Connect to the "Field" terminal of each DTM.vi. This may be required for a display indicator or some internal calculation purpose.

8) Connect to the other LC.vi and DTM.vi terminals as required - they are optional. Refer to section 6 for detailed descriptions of the terminals of these VIs.

Notes:

1) The user must not use the LabVIEW Abort button to stop the application. For this reason the Abort button is hidden in the example program. Instead, the application must have a stop button control wired to the "Stop" input terminal of each LC.vi. This allows internally allocated memory to be released. See the sample project: DTM_LC_Test.vi in section 5.

2) The value supplied to the "LC" terminal of the LC.vi is hex, not decimal.
   Valid numbers for a PCI LC are 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F.
   Valid addresses for an ISA LC are C0000 to FE000.

3) The user should not attempt to change the LC number or DTM address while the LabVIEW application is running. For this reason, controls for the LC number/addresses and DTM addresses are hidden in the sample project. The ones shown on the front panel of the sample project are indicators only.

4) If a repeat-forever loop is used in the final program then make sure to put a little delay in it to avoid using all of the computer's CPU time. In the sample project we chose a 25ms delay. This delay can be reduced to improve the speed if desired. It is sometimes helpful to confirm the CPU usage via the Window's "Task Manager" utility.

5) A maximum of 31 DTMs can be connected to each LC.

6) The Group3 DTM LabVIEW library will work for LabVIEW version 6 and above.

5. The Sample Project

The example application VI: "DTM_LC_Test.vi" can be found in the "Example" folder of the "Group3 DTM LabVIEW Library CD". This VI is very simple but still demonstrates all the features of the Group3 DTM LabVIEW library. It uses two PCI LCs: LC number 0 which has three DTMs (addresses 0, 1 and 2) and LC number 1 which has only one DTM (address 0).
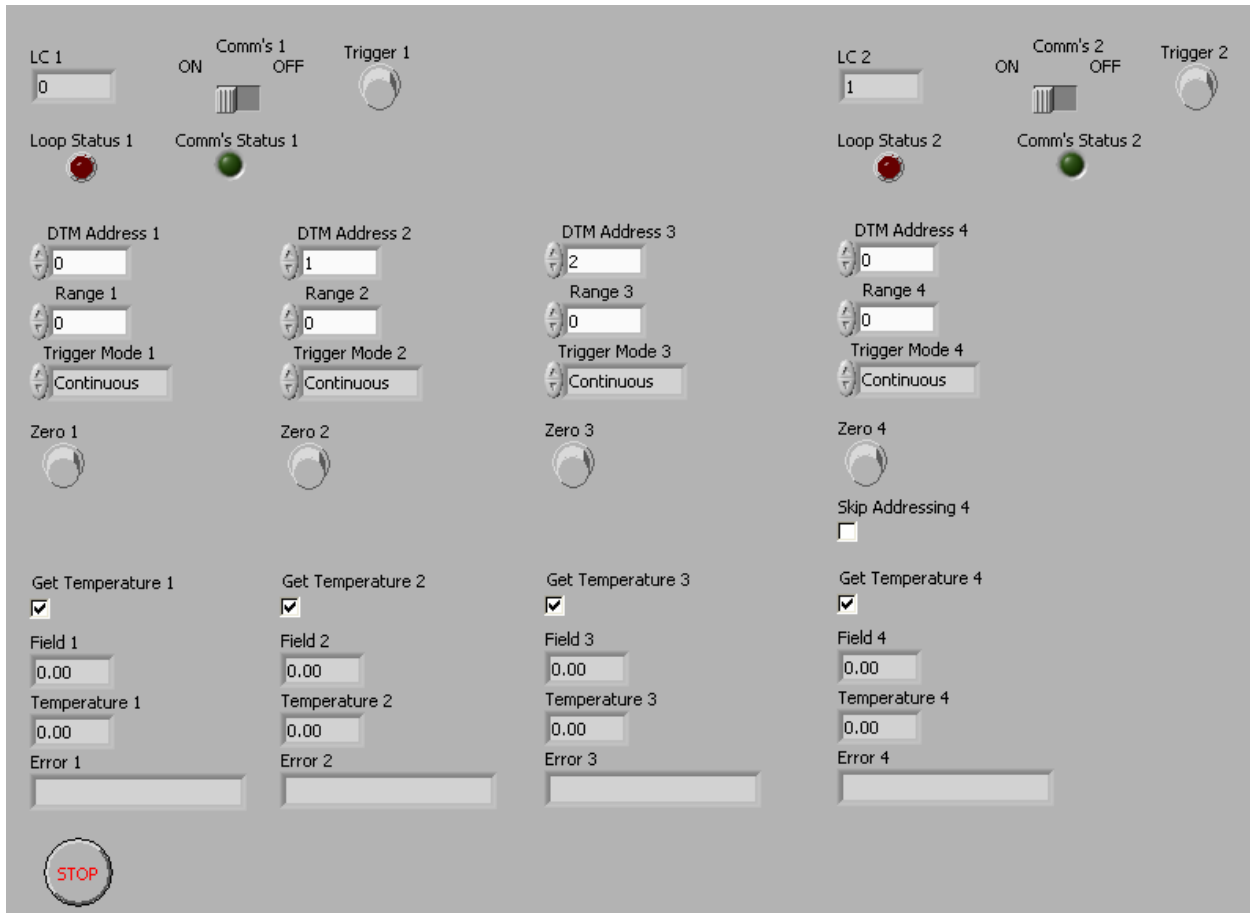
When this application is running with all the necessary hardware configured correctly, the "Comm's Status" indicator will illuminate green, the "Loop Status" indicator will not be illuminated and the "Error" displays will be empty.

- If a "Comm's Status" indicator is unexpectedly off, then that loop controller might be missing or incorrectly addressed.
- If a "Loop Status" indicator is on (red), then there will be a break in that particular fibre-optic loop.

The wiring diagram of the DTM_LC_Test.vi follows on the next page. When creating your own application, make sure that the connection for the Stop button is similar to the one in this example. In particular, it **must** be wired to each of the LCs.
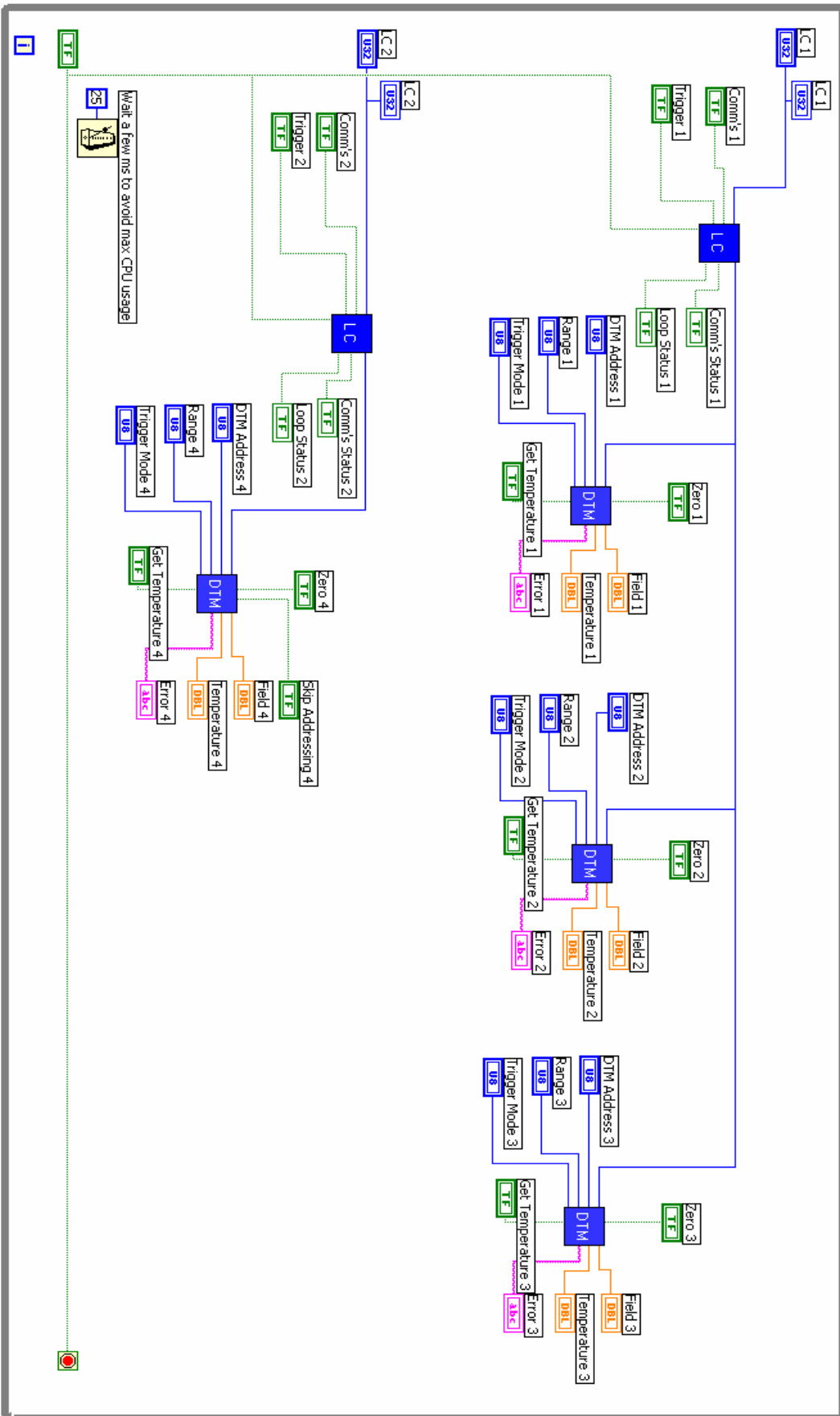
6 Library VI Descriptions

6.1 LC.vi

This VI is used by the LabVIEW program to configure an LC, trigger all DTMs which are set to use the trigger mode and to indicate the comm's status and loop status.
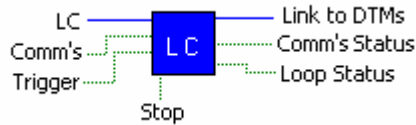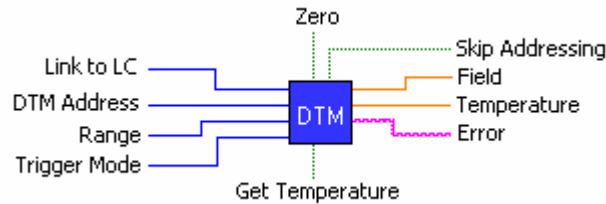

Input Terminals

- **LC:** Set the LC number (PCI LC) or LC address (ISA LC). This number should be in hexadecimal format - for either PCI or ISA loop controllers. The LC number/address will default to **zero** (PCI-LC-0) if this terminal is not connected.
    Valid numbers for a PCI LC are 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F.
    Valid addresses for an ISA LC are 0 to C0000 to FE000.

- **Comm's On/Off:** Enable or disable the LC communicating with the DTMs using this input. This terminal will default to **comm's on** if not connected.

- **Trigger:** This input triggers all DTMs which are set to use trigger mode. Note: DTMs operate in either triggered mode or continuous mode. If a button is connected to this, it must produce a short pulse when pressed. Refer to the sample project.

- **Stop:** This performs several essential operations, including shutting down the comm's and releasing computer memory. This terminal **MUST** be connected to a stop-button control.

Output Terminals

- **Link to DTMs:** As per its name, this terminal **MUST** be connected to all DTM.vis (terminal: "Link to LC") for DTMs connected to this LC via the fibre-optic loop.

- **Comm's Status:** This terminal indicates the current communications status and will be **false** if comm's has been turned off, there is a problem with the loop controller configuration or if this loop controller is not present.

- **Loop Status:** This terminal indicates **false** if there is a break in the loop.

6.2 DTM.vi

This VI represents a DTM (Digital Tesla Meter). It is used to configure a single DTM, control its operation and retrieve its data. Up to 31 DTMs can be connected to each LC.

Input Terminals

- **Link to LC:** As per its name, this terminal **MUST** be connected to the output terminal "Link to DTMs" of its associated LC.vi.

- **DTM Address:** All DTMs on a loop must have unique addresses, set using the address switch inside their cases. The input to this terminal must be a decimal number in the range 0 to 30, and match the address set on the switch of the corresponding physical DTM. The address will default to **zero** (DTM-0) if this terminal is not connected.

- **Range:** This is used to put a DTM into the desired measurement range: 0 to 3 or auto-ranging. Any number other than 0 to 3 will cause the DTM to use auto-ranging. The range will default to **zero** (range-0) if this terminal is not connected.

- **Trigger Mode:** This sets the trigger mode (i.e. Continuous, Triggered or No-Change) for a DTM. If not connected, this terminal will default to **Continuous Mode**.

- **Skip Addressing:** When only one DTM is connected on a loop, this can be used to prevent the LC re-addressing it, and thus save time. For some time-critical measurements (particularly when triggering a single DTM) this can be an advantage, but as a general rule it is better to leave this feature disabled. Address skipping will be **disabled** if this terminal is not connected. If more than one DTM is connected on a loop, The LC will ignore this feature and address each DTM every time anyway.

- **Get Temperature:** Some DTMs don't have temperature measurement capability and sometimes the temperature simply isn't required. In these circumstances, this feature saves time by preventing the LC requesting the temperature from the DTM. The **temperature will be requested** if this terminal is not connected.

Output Terminals

- **Field:** Provides the magnetic field value recorded by the DTM.

- **Temperature:** Provides the temperature value recorded by the DTM. See the notes for the "Get Temperature" terminal above.

- **Error:** Outputs a text string, indicating the status of the DTM. If needed a numeric representation of this error code is available inside the VI.

7 DTM Configuration

Set the internal switches of each DTM as follows:

switch	function	setting		
S1-1	DTM address	x	addr +1	select address as desired
S1-2	DTM address	x	addr +2	max valid address = 30
S1-3	DTM address	x	addr +4	
S1-4	DTM address	x	addr +8	
S1-5	DTM address	x	addr +16	
S1-6	)	**OFF**		
S1-7	) serial data format	**OFF**	7 data bits, 2 stop bits, even parity	
S1-8	)	**OFF**		
S2-1	transmission mode	**OFF**	readings on demand only	
S2-2	select terminator	**ON**	carriage return	
S2-3	double terminator	**ON**	single terminator	
S2-4	echo commands	**OFF**	echo off	
S2-5	field units	x	not used	
S2-6	units symbol	**OFF**	don't send units symbol	
S2-7	digital filtering	x	set as desired	
S2-8	defaults	**OFF**	LEAVE OFF	
Rotary Switch (16-position):		**E**	9600 baud	

For detailed information about the Group3 DTMs, refer to the:
"Group3 DTM User's Manual".

GROUP3 TECHNOLOGY LTD

LIMITED WARRANTY

Group3 Technology Ltd. (hereinafter called the Company) warrants instruments and other products of its manufacture to be free from defects in materials and workmanship that adversely affect the product's normal functioning under normal use and service for a period of one year from the date of shipment to the purchaser.

The obligation of this warranty shall be limited to repairing or replacing, at the discretion of the Company and without charge, any equipment which the Company agrees is defective as set out above within its warranty period. The Company will reimburse lowest freight rate two-way charges on any item returned to the Company's factory or any authorised distributor or service centre, provided that prior written authorization for such return has been given by the Company.

This warranty shall not apply to any equipment which the Company determines to have become defective owing to mishandling, improper installation, alteration, negligence, inadequate maintenance, incorrect use, exposure to environmental conditions exceeding specifications, or any other circumstance not generally acceptable for equipment of a similar type.

The Company reserves the right to make changes in design without incurring any obligation to modify previously manufactured units.

No other warranties are expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The Company is not liable for consequential damages.

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