Functional Specification
for
LabCON-V Network Communications

Date	Description
December 1996	Original Issue
August 8th, 1997	Revised Section 5 to include the network path options.

Document References

Document No.	Description
T-EIOM.8035	LabCON-V Operating Manual
N/A	PC/TCP Administrator's Guide by FTP Software Inc.

1.0 Description

This document describes the LabCON-V Network Communication interface in detail. It assumes the reader has a general working knowledge of PC networking and the MS-DOS operating system. The LabCON network interface is available in the LabCON-V software version 3.0 or higher. This option enables LabCON-V to communicate sample data to a remote computer system, usually a Laboratory Information Management System (LIMS).

This document should be used to configure LabCON to communicate to other computers on the same network as LabCON. The networking interface allows very little operator interfacing and is mostly automated and controlled via two configuration files. The LabCON-V software comes pre-configured with default configuration files which must be tailored to meet specific site requirements.

2.0 Compatibility

The communication option is embedded into the standard LabCON-V software and should not have any effects on normal LabCON-V operation. The network interface software will only run on LabCON-V computers which have a built-in Ethernet adapter and are connected to a TCP/IP network.

3.0 Interface Overview

LabCON uses services of a high level network protocol called Transport Control Protocol (TCP). In addition, the network addressing used is called the Internet Protocol (IP). Together these two protocols work together to form the TCP/IP protocol. LabCON uses the TCP/IP File Transfer Protocol (FTP) to transfer ASCII files (Text files) which contain analyzer data to another computer on the network called an FTP server. Typically, an FTP server is a computer which acts as a file holding area on a network which allow other computers and users to send and receive files to the server.

LabCON uses an Ethernet network interface card and network interface software drivers to communicate to other computers on the network. LabCON sends sample data files to the FTP server when initiated by the LabCON operator at the completion of a sample analysis. In addition, files can be sent to the FTP server when retrieved from the sample history directory.

4.0 System Configuration

4.1 Description

LabCON comes equipped with the TCP/IP software developed by FTP Software Inc. (called PC/TCP 3.2 for DOS). This networking software is typically called a TCP/IP

"stack". Theoretically the LabCON application should work on any conforming TCP/IP stack but has only been thoroughly tested with the stack from FTP Software Inc. The FTP software works with packet, NDIS, and ODI drivers. LabCON uses a packet driver called PCNTPK Version 3.0 published by Crynwr Software. The packet driver is contained in the c:\paktdrv directory.

4.2 Configuration Files

Listed below are sample configuration files which have been tested on a standalone network. With minor changes to the files LabCON can be run on virtually any TCP/IP network. The entries in these files are only examples are not considered to be the *only* working configuration. Consult your PC/TCP system administrator's guide for further network configuration information.

Configuration File	Entries
config.sys	shell=c:\command.com files=20 buffers=20 device=c:\ergo\xbpct3 ; touch buttons device=c:\ergo\ets ; touch buttons
autoexec.bat	path=c:\dos;c:\pctcp; set pctcp=c:\pctcp\pctcp.ini c:\ergo\ets /file=c:\corelab.def /beep=on ; touch buttons c:\ergo\emouse ; touch screen **c:\paktdrv\pcntpk ; packet driver** **c:\pctcp\ethdrv ; tcp kernel** set limenable=ftp ; enable ftp set limdebug=yes ; debug mode graphics ; graphics print loa ; labcon-v
pctcp.ini	; TSR Kernel [pctcp ifcust 0] ip-address=128.127.50.1 router=128.127.50.2 Subnet-mask=255.255.255.0 host-table=hosts
hosts	; FTP Server IP Address with canonical name and alias 128.127.50.3 ftp.abclabs.com limftpserver

The config.sys, autoexec.bat, and the host files should be located in the root directory. The pctcp.ini file should be located in the C:\PCTCP directory with all of the FTP software drivers.

5.0 LabCON Configuration

5.1 Enable/Disable Network Communication

The communication option is enabled by a DOS environment variable called LIMENABLE. This variable must be defined to “FTP” for any network communication to take place. To enable the communication option simply edit the LabCON’s *AUTOEXEC.BAT* file and add the statement *SET LIMENABLE*=FTP before the LabCON program is started. LabCON software reads this variable during the boot up process of the LabCON computer. If this variable is not found, the operator function keys will not be displayed which allow for operator initiated transmission of data. To disable the communication option simply comment out the *SET* statement by placing the phrase *REM* in front of the *SET* statement.

In addition to the TCP/IP protocol, virtually any network that supports disk sharing is supported by using the “NetPath” option. When setting the LIMENABLE DOS environment variable equal to “NetPath” (SET LIMENABLE=NETPATH), LabCON will copy the data files to a “networked” drive at a user defined location. To define the drive and path for the data files edit the FTP initialization file (LOA.INI).

5.2 Enable/Disable Debug Mode

During normal operation LabCON will output minimal status and error messages to the “LIMS Communication” window. If additional information is required for debugging define the DOS environment variable called LIMDEBUG. When defined to YES this variable will instruct LabCON to output extensive messages to the communication window which can be used for troubleshooting various problems. The enable debugging simply edit the AUTOEXEC.BAT file and add the statement *SET LIMDEBUG=YES* before the LabCON program is started.

5.3 LabCON FTP Initialization (LOA.INI)

The LabCON-V software comes pre-configured with a default communication initialization file (File C:\LOA.INI). This file must be edited using a text editor to define the site networking requirements for the LabCON application. The file consists of a subject header labeled “[Communication]” and is followed by parameters which are used to define the requirements of an FTP server.

LabCON Communication Initialization File

Configuration File	Entries
loa.ini	[Communication] FTPServerName=limftpserver FTPUserName=bbw FTPPassword=bbwpassword FTPLocalPath=c:\temp FTPHostPath=/etc/labcon NetPath=g:\limsdata\labcon

Configuration Variable	Description
FTPServerName	The canonical name of the FTP server. This can be a literal name or a IP address.
FTPUserName	The account name used by LabCON to log in to the FTP server for file transfers.
FTPPassword	If the FTP account requires a password, define it here.
FTPLocalPath	The path on the LabCON computer where temporary files are stored until the FTP transfer completes.
FTPHostPath	The destination path of the data files on the FTP server.
NetPath	This option is only required if the FTP protocol will not be used. This option provides compatibility for virtually any network operating system which supports drive/file sharing. Define this variable to the drive and path where the ASCII data files are to be copied. For example, a path of: G:\LIMSDATA\LABCON will configure LabCON to store ASCII data files to the drive G: and the path \LIMSDATA\LABCON. The path must exist or LabCON will generate an error condition when attempting to copy the files.

5.4 Sample Data Initialization (DATA.INI)

The LabCON-V software comes pre-configured with a default data configuration file (Initialization File C:\DATA.INI). This file is pre-configured to create data files which contain all the available LabCON data. However, if not all sample data is required the file size and data format can be changed by simply editing the file using a DOS text editor. The file consists of a subject header labeled “[Header]” which contains analyzer general information and a subject header labeled “[Data]” that is followed by parameters which are used to define the resulting data file size and format.

LabCON Data Initialization File

Configuration File	Entries
data.ini	[Header] AnalyzerId=Engine No. 1 Comment=Lab Building #2 [Data] Rating Method=DATA01 Fuel Type=DATA02 Final Octane Number=DATA03 Alarm Error Code=DATA04 Low PRF Identifier=DATA05 High Prf Identifier=DATA06 PRF Identifier=DATA07 Sample KI Setpoint=DATA08 PRF KI Setpoint=DATA09 Manual PRF O.N.=DATA10 Pump Number=DATA11 Auto PRF O.N.=DATA12 Temperature=DATA13 Barometric Pressure=DATA14 Start Time=DATA15 Time Elapsed=DATA16 Octane Spread=DATA17 Final CR=DATA18 Final MV=DATA19 Final KI=DATA20 TSF O.N.=DATA21 Low PRF KI=DATA22 High PRF KI=DATA23 Number Readings=DATA24

The *header* section can be used for identifying the engine or the location of the LabCON. The analyzer identifier and comment data will always appear in the first two lines of the text file without the “Analyzer ID” and “Comment” literals. The analyzer identifier’s character limit in the initialization file is 10 characters and the comment’s limit is 80 characters. LabCON will ignore any characters which exceed these limits.

The *data* section is used to define the remaining format of the text file which gets copied to the FTP Server. Each data item contained in LabCON has an identifier from 1 to 24 which can be named in this file. The data identifiers will follow the format of DATAxx where the xx is a number from 1 to 24. The data identifiers can be labeled to aid in viewing the resulting text files on the FTP server. The labels must appear on the left side of the equals sign (“=”) and the data identifiers must appear on the right side of the equals sign. The limit for labels is 25 characters. LabCON will ignore any characters exceeding this limit. See Appendix A for a full list of all the available data items available from LabCON.

6.0 Interpretation of Sample Data

6.1 Binary Data File Names

LabCON uses sample identifiers to associate reports and historical files with the sample data. When a rating is initiated a LabCON operator will enter in a sample identifier which LabCON will use to store the data into a disk file. LabCON adds special characters to these identifiers when storing the data. When running a *CR Method* rating LabCON allows up to seven characters for a sample identifier. When running a *KI Method* rating LabCON allows up to 5 characters for a sample identifier. The *CR Method* identifiers are pre-penned with an 'S', 'P', or a 'T' character to identifier the data as a *Sample, Primary Reference Fuel,* or *Toluene* respectively. The *KI Method* naming follows the same convention except it appends a '-1', '-2', '-3' to the end of the identifier to distinguish the data as the first, second, or third run on the fuel. In addition, both methods append a '.dat' extension onto the identifier before writing the entire binary file out to the hard disk. Files are maintained in four directories;

Binary Data Directory	Description
c:\rondata	CR Method binary data files for Research Method
c:\mondata	CR Method binary data files for Motor Method
c:\ronbrack	KI Method binary data files for Research Method
c:\monbrack	KI Method binary data files for Motor Method

6.2 Text Data File Names

When LabCON creates text files to be copied to an FTP server it reads the binary files from the history directory. The text files will follow the same naming convention as the binary data files *(See section 5.1)*. The one exception is that instead of a file extension of '.dat' the files have an extension of '.txt'.

6.3 Data Validation

After receiving the sample data the Laboratory Information Management System (LIMS) has an obligation to determine if the data is acceptable. Batch sample errors or warnings may occur during the sample analysis which cause the results to be less reliable or even incorrect. The data can be validated by simply checking the error code and verifying that it is zero. When the error code is equal to zero LabCON has completed a successful rating. The error code is defined by the data identifier *DATA04*. Due to the importance of this data item, it is imperative that this item is chosen to be included in the data file *(see Section 4.3)*.

6.4 Error Codes

Each fuel run through the LabCON has an error code associated with it. If the error code is nonzero then errors occurred during the fuel run. If an error occurs, a nonzero numeric value is assigned to the error code of the fuel. Multiple errors can occur during a test so the error code may not necessarily be equal to any of the following codes. Each error code is represented by a power of 2 and can be decoded to determine exactly which error occurred. For example, if error code 1 and 2 occurred during the test then the final error code will be 3 (i.e. 2+1=3). The table below defines the error codes which can be generated while LabCON is running a fuel.

LabCON Fuel Error Codes

Error Code	Description (For additional information on the error codes please see the LabCON-V Operations Manual)
1	The toluene standard fuel did not rate within the allowed tolerance and engine temperature tuning must be performed to continue using the engine. This error code only applies to sample data when the fuel type is Toluene Standard Fuel.
2	The toluene standard fuel did not rate within the allowed tolerance and engine maintenance should be performed. This error code only applies to sample data when the fuel type is Toluene Standard Fuel.
4	The sample's final octane number is not within the allowed tolerance of the Primary Reference Fuel's octane number. The octane number of the sample should not be used.
8	A low knock intensity alarm occurred during the rating and the test was aborted.
16	A high knock intensity alarm occurred during the rating and the test was aborted.
32	A compression ratio control alarm occurred during the rating and the test was aborted.
64	A fuel air search alarm occurred during the rating and the test was aborted. The fuel air search exceeded the maximum number of fuel air movements.
128	The operator depressed the abort test key during a rating.
256	The LabCON data acquisition and control board has failed.
512	The knock intensity is considered to be unstable therefore the test was aborted.

Error Code	Description (For additional information on the error codes please see the LabCON-V Operations Manual)
1024	The knock intensity is not responding when the compression ratio is adjusted and the test was aborted.
2048	The engine ran out of fuel during the test and the test was aborted.
4096	The knock intensity exceeded the meter range upper limit of 100 units and the test was aborted.
8192	The rating exceeded the maximum time limit allowed and the test was aborted.
16384	The fuel air was driven out of the allowed range and the test was aborted.
32768	The compression ratio was driven out of the allowed range and the test was aborted.
65536	The sample's knock intensity was outside of the bracketing Primary Reference Fuels. The test was aborted and the octane number is merely an estimate and not an accurate result. This error code only occurs if the sample was the first in the sample batch.
131072	The low octane primary reference fuel has a lower knock than the high octane primary reference fuel or vice versa. The test was aborted.
262144	The sample's knock intensity was outside of the bracketing Primary Reference Fuels. The test was aborted and the octane number is merely an estimate and not an accurate result. This error code only occurs if the sample was the second in the sample batch.
524288	After three octane readings on a sample, the results are too erratic to be acceptable. The resulting octane number is unacceptable.
1048576	After two octane readings were taken on a sample, the results were erratic and a third reading was required on the sample. This code is considered more of a warning message than an error message and the resulting octane number is valid if no other alarm codes are present.
2097152	The sample's final compression ratio was not within the allowed tolerance of the CR/Octane number table as defined by ASTM D2699/D2700.
4194304	The final octane number is merely an estimate and not considered an accurate test.

7.0 Operator Interface

7.1 Batch Samples

For the most part, the operator interface aspect of the data communications option is limited. All network communication and data configuration tasks are accomplished by a network administrator editing ASCII configuration files. The operator is notified when network communication is taking place through the use of a “LIMS Communication” window after a sample batch has been completed. Informational as well as error messages are written to the communication window to inform the user of network operations. The data transmission is initiated by the operator when pressing the function key f7 on the batch report screen. If the text files are copied successfully to the FTP server the message “Transmission Successful” will appear on the display. If any errors occur, the LabCON operator should note the error and contact the network administrator. After exiting the batch report display, there is no way to re-send a batch of samples; the samples can only be re-sent individually.

7.2 Sample History

In addition to batch sample transmission, the data can be copied to the FTP server through the LabCON sample history selection. This enables sample data to be re-sent if the sample data was not received successfully the first time. This is done by selecting *f2 Utilities* from the main LabCON menu followed by *f2 Sample History*. Select the sample which you wish to send and press enter. After viewing the graph of the rating, select the f9 key. At this point, the sample report data will be displayed. By pressing the function key f7 - Send, the LabCON network communication driver will take over and resend the data to the remote system. Send another sample by returning to the sample history directory and repeat the process.

8.0 Troubleshooting

LabCON-V utilizes error messages on the display to identify a communication error condition. An error condition occurs when the data transfer does not complete successfully. This can be due to hardware or software failures. This section explains the different error conditions which can occur and suggestions on how to remedy problems that may occur.

8.1 Status and Error Messages

Messages can be informational as well as identifying an error condition. When an error occurs, a brief message is displayed to the screen which describes the problem which has occurred. Messaging is enabled whenever LabCON is actively attempting to transmit data to the FTP server. To get detailed messages (status and error) the DOS environment variable LIMDEBUG can be defined to Yes. This informs LabCON to display informational and error messages in detail for troubleshooting. Defining this variable is not necessary if the communication link is functioning properly. The table below lists the messages and recommended actions to correct the error condition.

Table D - Communication Errors and Messages

Messages	Recommended Action or Description	Type (* Debug)
Send <Identifier> File	LabCON is attempting to send the file <identifier> to the FTP Server.	Status
Successful Transmission	The file transfer was successful.	Status
Error Creating LIM Object	There was not enough system RAM for LabCON to create the communication object. Try removing any unnecessary DOS TSR programs or device drivers.	Error
Error: TCP/IP Kernel is Not Present.. Aborting Transmission	Verify that the PC/TCP kernel is installed correctly.	Error
Transmission Failed: Unable to Open LOA.INI	Verify that the loa.ini file is in the c:\ directory and contains valid entries.	Error
Transmission Failed: Unable to locate LOA.INI header	Verify that the label [Communication] is located in the loa.ini file.	Error
Transmission Failed: Unable to Open DATA.INI	Verify that the data file data.ini is in the c:\ directory.	Error

Messages	Recommended Action or Description	Type (* Debug)
Transmission Failed: Unable to locate header/data	Verify that the labels [Header] and [Data] appear in the data.ini file. See section 4.3 for further information.	Error
Error Resolving FTP Server Name: <name>	Verify that <name> (in the loa.ini file) can be translated to a valid IP address. Use the hosts program which is available in the c:\pctcp directory.	Error
Error # Creating Temporary Directory <dirname>	Verify that the ftp_localpath entry in the loa.ini file contains a valid DOS directory name syntax.	Error
Error # Opening Data File <filename>	LabCON cannot open the binary data file. If problem persists contact the manufacturer.	Error
Error # Reading Data File <filename>	LabCON cannot read the binary data file. If problem persists, contact the manufacturer.	Error
Error Opening ASCII File <filename>	LabCON cannot create the temporary ASCII file to send to the FTP server. There may not be any disk space available.	Error
Error #h Write to ASCII File <filename> Failed	LabCON cannot write data to the temporary ASCII file. There may not be any disk space available.	Error
Error Opening FTP Connection <netmsg>	LabCON failed to open an FTP connection with the server. The <netmsg> provides more information.	Error
Error Server Rejected Username: <ftp_username>	Verify that the FTPUserName entry in the LOA.INI file is a valid username for the FTP server.	Error
Error Server Rejected Password: <ftp_password>	Verify that the FTPPassword entry in the LOA.INI file is a valid password for the specified FTPUserName.	Error
Error Server Rejected Account <ftp_useraccount>	Verify that the FTPUserAccount entry in the LOA.INI file is a valid account for the specified FTP server.	Error

Messages	Recommended Action or Description	Type (* Debug)
Error Changing Directory on Host: <ftp_hostpath>	Verify that the FTPHostPath entry in the LOA.INI file is a valid directory on the FTP server.	Error
Error # Opening Temporary Sample File..	LabCON can't open the temporary file to send to the FTP server. If problem persists contact the manufacturer.	Error
Error on FTP_PUT: <netmsg>	The copy file to the FTP server function failed. The <netmsg> text provides additional information.	Error
Server Message(s): <Message>	Message received from the FTP server when an error occurs.	Error
FTP Server Name: <FTPServerName>	Displays the server name that LabCON read from the LOA.INI file.	*Status
FTP User Name: <FTPUserName>	Displays the user name that LabCON read from the LOA.INI file.	*Status
FTP Account: <FTPUserAccount>	Displays the account name that LabCON read from the LOA.INI file.	*Status
FTP Password: <FTPPassword>	Displays the password that LabCON read from the LOA.INI file.	*Status
File Type: <FTPFileType>	Displays the file type that LabCON read from the LOA.INI file.	*Status
Local File Path: <FTPLocalPath>	Displays the local path that LabCON read from the LOA.INI file.	*Status
Host's Path: <FTPHostPath>	Displays the host's path that LabCON read from the LOA.INI file.	*Status
Resolving FTP ServerName <FTPServerName>	Displays the servername to be resolved.	*Status
Resolved <FTPServerName> to <IP Address>	Displays the servername with the IP address.	*Status
Opening Data File <filename>	LabCON is opening the binary file <filename>	*Status
Opened FTP Connection	LabCON opened an FTP connection with the server.	*Status

Messages	Recommended Action or Description	Type (* Debug)
Login Successful	LabCON has logged into the FTP server.	*Status
Account Accepted	The FTP server accepted the login account.	*Status
Changed host dir to <FTPHostPath>	LabCON changed the directory on the FTP server.	*Status
Fuel ID List: <SampleID>	Listing of the sample ID's.	*Status
Closing FTP Connection	LabCON is closing the FTP connection.	*Status
NetPath Messages		
Error: No Network Drive Path Defined.. Aborting Transmisstion	The NetPath variable in the LOA.INI file is undefined.	Error
Full Host Path is <pathname>	Informational message which displays the destination path of the data file.	Status
Error Opening Temporary File.. No Memory Available	LabCON can't open the temporary file to copy to the network server. If problem persists contact the manufacturer.	Error
Error Opening Temporary File <path>.. Error #<num>	LabCON can't open the temporary file to copy to the network server. If problem persists note the error number and contact the manufacturer.	Error
Error Opening Host File.. No Memory Available	LabCON can't open the host file to copy to the network server. If problem persists contact the manufacturer.	Error
Error Opening Host File <path>.. Error #<num>	LabCON can't open/create the host file on the network server. If problem persists note the error number and contact the manufacturer.	Error
Successful Transmission	The data files was successfully copied to the network server.	Status

Messages	Recommended Action or Description	Type (* Debug)
Error Writing to Host File <path> Error #<num>	An error occured while writing to the host data file. If problem persists note the error number and contact the manufacturer.	Error
Error Reading local file <path>.. Error #<num>	An error occured while reading the local data file. If problem persists note the error number and contact the manufacturer.	Error

LabCON Data Identifiers

Identifier	**Data Description**	**Data Format & Range** Note: All data items are right justified and real numbers are formatted to two decimal places
DATA01	Octane Rating Method	9 character string "CR Method " or "KI Method "
DATA02	Fuel Type	Integer Primary Reference Fuel = 1 Toluene Standard Fuel = 2 Blind Sample = 3
DATA03	Final Octane Number	Real
DATA04	Alarm Error Code	Integer (See section *Error Codes*)
DATA05	Identifier of Low Octane Primary Reference Fuel used for Sample Rating	8 character string (Undefined for CR Method)
DATA06	Identifier of High Octane Primary Reference Fuel used for Sample Rating	8 character string (Undefined for CR Method)
DATA07	Identifier of Primary Reference Fuel used for Sample Rating	8 character string (Undefined for KI Method)
DATA08	Sample's Knock Intensity Setpoint	Real (Undefined for KI Method)
DATA09	Primary Reference Fuel's Knock Intensity Setpoint (Manual)	Real LabCON obtained this KI setpoint from the analyzer operator. This is the KI setpoint of a manual run on the PRF. (Undefined for KI Method)

LabCON Data Identifiers

DATA10	Primary Reference Fuel's Octane Number (Manual)	Real Octane number of the manually run PRF. (Undefined for KI Method)
DATA11	Pump Number	Integer 1..4
DATA12	Primary Reference Fuel's Octane Number (Automatic)	Real (Undefined for KI Method)
DATA13	Intake/Mixture Temperature	Real
DATA14	Barometric Pressure	Real (Inches of Hg)
DATA15	Sample Start Time	27 character string
DATA16	Sample Time Elapsed	Integer (Seconds)
DATA17	Octane Spread	Real
DATA18	Final Compression Ratio Position	Real (Digital Counter Units)
DATA19	Final Microvalve Position	Real (Thousandths of an Inch)
DATA20	Final Knock Intensity	Real (Knock Units)
DATA21	Toluene Standard Fuel's Expected Octane Number	Real
DATA22	Low Primary Reference Fuel's Final Knock Intensity	Real (undefined for CR method)

LabCON Data Identifiers

DATA23	High Primary Reference Fuel's Final Knock Intensity	Real (Undefined for CR Method)
DATA24	Number of Octane Number Readings Taken	Integer (Undefined for CR Method)