S3016-505
(MCOM505 AND NETCOM)
User's Manual

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02/2004

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WARNING

To ensure the equipment described by this User Manual, as well as the equipment connected to and used with it, operates satisfactorily and safely, all applicable local and national codes that apply to installing and operating the equipment must be followed. This includes the National Electric Code in the USA and other applicable legislation, regulations, and codes in practice elsewhere. Since codes can vary geographically and can change with time, it is the user's responsibility to determine which standards and codes apply, and to comply with them.

FAILURE TO COMPLY WITH APPLICABLE CODES AND STANDARDS CAN RESULT IN DAMAGE TO EQUIPMENT AND/OR SERIOUS INJURY TO PERSONNEL.

Persons supervising and performing installation or maintenance must be suitably qualified and competent in these duties, and should carefully study this User Manual and any other manuals referred to by it prior to installation and/or operation of the equipment.

The contents of the User Manual are believed to be correct at the time of printing; however, no responsibility is assumed for inaccuracies. In the interests of a commitment to a policy of continuous development and improvement, the manufacturer reserves the right to change the specification of the product or it's performance or the contents of the User Manual without notice.

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SECTION 1
GENERAL DESCRIPTION

The S3016-505 is a version of the S3016 CO-CPU communications board that resides on the Texas Instruments 505 bus structure. With the exception of that difference, the S3016-505 provides all the same features as the standard S3016. The S3016-505 is a communications CO-CPU board which provides one S3000 serial network interface port and one RS-232/RS-422 USER PORT. The S3016-505 is a true CO-CPU with it's own processor and program/data memory which executes a user application program independent of the TI 505 main processor. The primary use of the S3016-505 is to allow communications between the TI 505 family of processors to the S3000/M4000 line of processors via the S3000 serial network. The S3016-505 can be installed in any I/O slot of the TI 505 rack. In addition, any number of S3016-505s may be installed in one TI 505 rack (up to the number of I/O slots available). This manual describes the features unique to the S3016-505, refer to the S3016 User's Manual for details on the S3016 in general.

1.1 FEATURES

- Communications CO-CPU Board with S3000 Serial Network Interface and RS-232/RS-422 USER PORT.
- Built in Processor executes User application program independently of main TI 505 processor.
- Resides on TI 505 Bus structure as a 3 word in / 5 word out Special Function module (similar to a TI Peerlink module).
- Provided with "MCOM505" S3016-505 program and "NETCOM" MS-DOS based setup program which allows the TI 505 processor to communicate with up to 31 S3000/M4000 slave nodes with up to 120 words to and from each slave node.
- 24K Bytes User Program memory.
- 2K Bytes Data memory.
- Built in Real Time clock provides current time and date.
- Fast program execution time (0.6 Milliseconds per 1K Bytes Program memory).

- Programmed with SYSdev, MS-DOS based software package allowing programming of the S3016-505 in Ladder, High-level ('C') and Assembly (MCS-51).

- Interfaces to IBM PC or compatible via RS-232 for program download and on-line monitoring.

- Extensive internal diagnostics/fault detection including watchdog timer, communications fault detection, hardware confidence test, etc.

- Status LEDS on faceplate (RUN, SERIAL NETWORK COMM, and FAULT)

- Standard single width TI 505 module size.

1.2 S3000 SERIAL NETWORK OPERATION

The S3000 serial network provides a means for the S3016-505 to communicate with other S3000/M4000 processors (nodes). The network operates in a master/slave topology. The S3016-505 is the master and controls all communications on the network. The remaining S3000/M4000 nodes act as slaves and simply respond to communications requests from the master. The master can send up to 120 consecutive words and receive up to 120 consecutive words from the slave in one command.

Up to 31 S3000/M4000 slave nodes can be connected to one S3016-505. Each node on the network is assigned a unique address between 1 and 32. The S3016-505 master node is assigned address 1 while the slave nodes are assigned addresses 2 through 32. The network address is used to specify which slave the master is communicating to. The network addresses are set in the S3000/M4000 nodes from the SYSdev Target Board Interface Menu and is downloaded directly to the S3000/M4000 node from the IBM PC or compatible running SYSdev. The network address of the S3016-505 is automatically set to 1 when the "MCOM505" program is used.

Communications from the master is implemented using System function 13 (sfunc13). See the S3016 User's Manual for details on the system function or the "MCOM505" program in appendix B for an example of using sfunc13.

1.3 COMMUNICATION BETWEEN TI 505 PROCESSORS AND S3016-505

Communications between the TI 505 processors (545, etc.) is accomplished over the TI 505 back plane. The S3016-505 reads and writes to the V memory of the TI processor using the TI task codes. From the TI processor point of view, the V memory is read and written to transparently by the S3016-505. No special communications programming is implemented in the TI processor. The S3016-505 determines which V memory locations will be read and written to.

Note: Only the V memory is read and written to by the S3016-505. No other TI memory type reads and writes are supported by the S3016-505.

On the S3016-505 side, the algorithm for implementing the task code communication to the TI processor is embedded in the S3016-505 firmware. The S3016-505 user program initiates the communication by specifying which addresses will be read or written and how many words are to be transferred. Once initiated, the task code is executed transparently to the S3016-505 user program. See the "MCOM505" program for an example of the task code communication to the TI processor.

1.4 “MCOM505” AND “NETCOM” PROGRAMS

The combination of the "MCOM505" and "NETCOM" programs turn the S3016-505 into a purely communications board which allows the TI 505 processor to communicate to up 31 S3000/M4000 slave nodes, reading up to 120 words and writing up to 120 words to each node. The "MCOM505" program is a SYSdev program which is downloaded directly into the S3016-505. This program implements the task code communication to the TI 505 processor as well as implementing the serial network communication to the S3000/M4000 slave nodes.

The "NETCOM" program is a menu driven, MS-DOS based program which runs on any IBM PC or compatible. "NETCOM" is used to configure which slave nodes are to be communicated to, which V memory addresses in the TI 505 are to be used to read from and write to, which addresses in the S3000/M4000 slave nodes are to be read from and written to, and how many words are to be transferred to each slave node. This information is downloaded to the S3016-505 at which time the communication between the TI processor and the S3000/M4000 slave nodes is performed automatically.

Most applications of the S3016-505 will use "MCOM505" and "NETCOM". The primary purpose of the S3016-505 is to allow TI 505 based processors to communicate to S3000/M4000 processors and the "MCOM505"/"NETCOM" programs allow the user to do just this in very easy and user friendly way. No SYSdev programming of the S3016-505 is required by the user when the "MCOM505" and "NETCOM" programs are used.

See section 2.4 for details on downloading the "MCOM505" program to the S3016-505. See section 3 for details on using the "NETCOM" program.

The operation of the "MCOM505" program is as follows:

The "MCOM505" program reads the data that is to be transmitted from the TI-505 processor and stores this in an internal buffer of the S3016-505. The data that was read from the slave node on the previous network communication is then written to the TI-505 processor. This is performed in a sequential fashion for all nodes (2 thru 32) that are enabled for communications. The data that is passed for each node is defined in section 3.4.

Note: No data task code communication occurs for any nodes that are disabled. Once the data for all the enabled nodes is updated, the communications status stack is then written to the TI-505 processor (see section 3.3.6 for details on this data).

Once this is done the process is then started over with the data for the first node being transferred to and from the TI-505, etc.. This communication between the TI-505 and S3016-505 is performed continuously.

Asynchronously to the TI-505 to S3016-505 communications, the communications to the slave nodes over the network is performed. The data for the first enabled node is transmitted to the slave node and the data that is to be read is read from the slave. This data is saved in an internal buffer of the S3016-505. Communications to the next enabled node is then performed and so on for all enabled nodes. This is repeated continuously for all enabled nodes.

Note: Communications for any disabled nodes is not attempted. This communication is occurring concurrently with the communication between the TI-505 processor and the S3016-505, thus optimizing the total through-put of the system.

SECTION 1
GENERAL DESCRIPTION

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SECTION 2
INSTALLATION

CAUTION: THE INTERNAL COMPONENTS OF THE S3016-505 ARE SUSCEPTIBLE TO DAMAGE BY STATIC DISCHARGE, JUST AS ANY ELECTRONIC COMPONENTS ARE. WHEN HANDLING THE S3016-505, THE BOARD SHOULD BE HANDLED BY THE FACEPLATE ONLY AND PREFERABLY IN A STATIC SHIELDING BAG.

2.1 INSTALLING THE S3016-505 IN THE RACK

The S3016-505 can be installed in any I/O slot of the TI 505 rack. Install the S3016-505 as follows:

1) Turn power to the TI 505 rack "off".

2) Install the S3016-505 in the rack by aligning the board with the card guides and sliding in until firmly seated. The board is held in the rack via captive screws located on the faceplate.

3) Connect the S3016-505 to the S3000 network by plugging the network field wiring connector into the network comm port, observing the proper keying of the connector.

4) Turn power to the TI 505 rack "on".

5) Download "MCOM505" to the S3016-505 (see section 2.4).

To remove the S3016-505 from the rack, perform the following:

1) Turn power to the TI 505 rack "off".

2) Pull the network field wiring connector from the comm port.

3) Loosen the captive screws located on the faceplate and gently pull the board out of the rack using the handles located on the faceplate.

2.2 S3000 SERIAL NETWORK INSTALLATION

The S3000 serial network installation consists of wiring the network and setting each S3000/M4000 node on the network with a unique network address. Up to 31 slave nodes can be connected to the master S3016-505 on one network.

2.2.1 WIRING THE SERIAL NETWORK

Refer to figure 1 for a typical schematic of the network and for the pin outs of the network interface connectors. When wiring the network, the following rules must be followed:

1) Wire the network using Belden #9182 single-shielded twisted pair cable or an equivalent data communications cable meeting the following spec:

   Wire gauge: 22AWG
   Nom. impedance: 150 ohms/ft.
   Nom. attenuation at 1 MHZ: .004 db/ft.
   Twisted pair, single-shielded

2) The total wire length of the network cannot exceed 1,000 ft. if 344KBPS is selected, 2,000 ft. at 229KBPS, and 4,000 ft. at 106KBPS.

3) The shield of the cable should be carried through the entire network, using the shield tie points on the interface connectors to achieve this. The shield tie-points on the connectors are not internally tied to anything, they are strictly tie-points. One of these tie-points should then be tied to earth ground.

4) The two extreme ends of the network should be terminated with 150 ohm resistors as shown in figure 1.

5) The network wiring should be isolated from other high voltage wiring by routing the network in a separate conduit dedicated to the network.

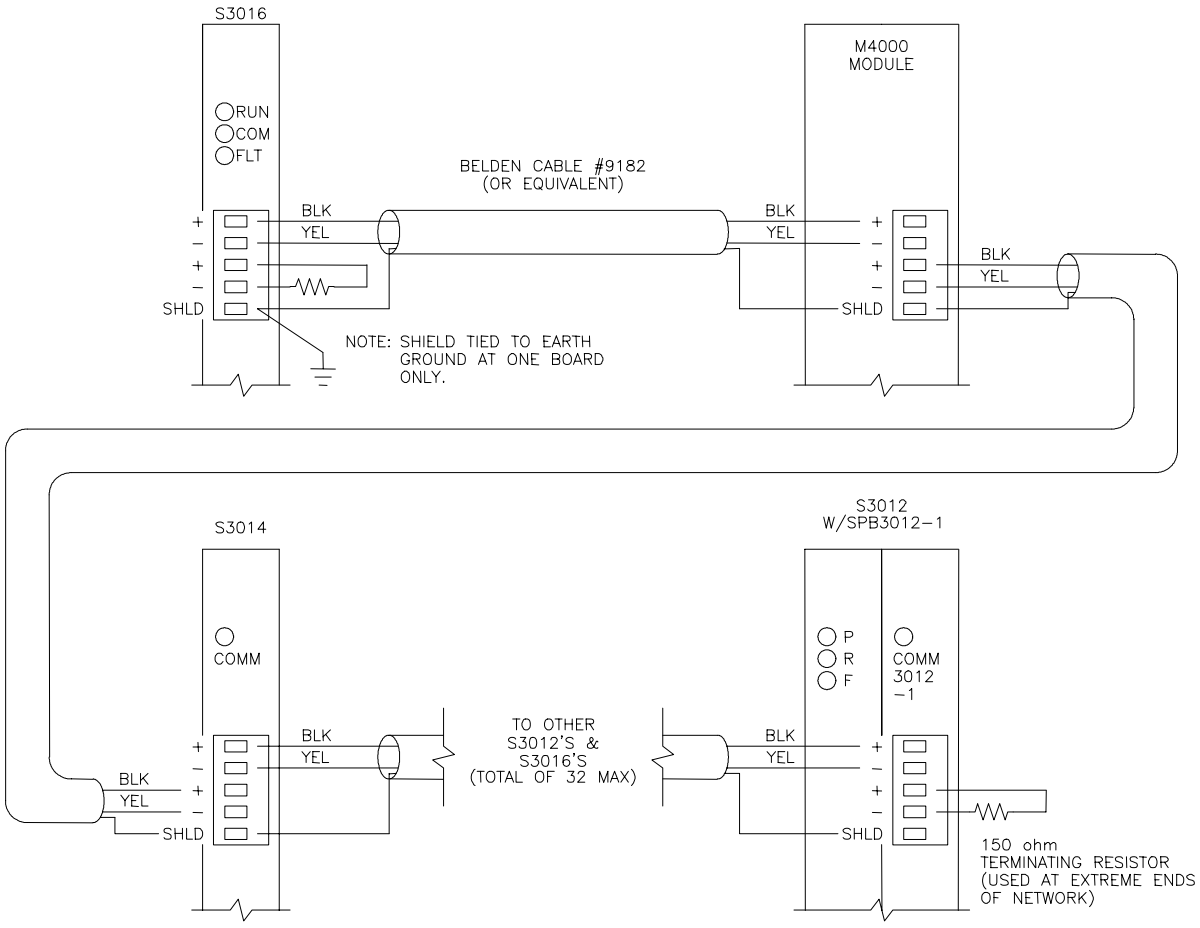

Figure 2.1 – Typical Network Wiring

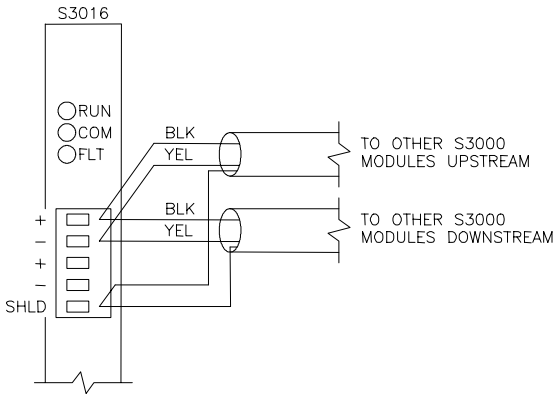

Figure 2.2 – Alternative Serial Connector Wiring

6) The network should be wired directly to the network comm port connectors. No intermediate terminations or splices should be used. The network should be wired in direct connect topology as shown, not in multi-drop or cluster topologies.

   Note: The network comm interface connectors contain two sets of + and - terminals. The two sets of terminals are tied together internally on the board (+ to +, - to -) and are provided as tie-points to ease wiring. Communications across the network will continue even if one of the nodes has failed provided all the connectors are installed in their respective board. However, if a connector is pulled from it's board, communications to the boards downstream will be lost (the internal tie-point will be broken). If it is desired, this situation can be avoided by wiring the connectors as shown in figure 2.

2.2.2 SETTING THE NETWORK ADDRESSES IN THE S3000/M4000 NODES

When using the "MCOM505" program, the network address of the S3016-505 is automatically set to address 1. For this reason the S3016-505 network address does not have to be set by the user. Each of the slave S3000/M4000 nodes on the network must, however, be set by the user with a unique network address between 2 and 32. This is how the S3016-505 can distinguish one node from another. To set the network address of a particular S3000/M4000 node, perform the following:

1) Connect the IBM PC or compatible running SYSdev from the "COM" port on the PC to the "PROG PORT" on the respective S3000/M4000 node using an RS-232 cable.

2) From the SYSdev shell, select the program that is running in the respective S3000/M4000 node.

3) From the SYSdev Main Development Menu, select "Target Board Interface".

4) From the Target Board Interface menu, select "Target Board Network Address".

5) SYSdev will read the current network address of the S3000/M4000 node and display it in the network display. If the network address is to be changed, follow the directions displayed and enter the new address.

The steps above must be done for all S3000/M4000 nodes on the network. This is true when the network is first installed, and when a new S3000/M4000 node is added or replaced on the network (that node must have the network address set in it).

2.3 I/O CONFIGURATION OF TI PROCESSORS FOR S3016-505

The S3016-505 can be installed in any I/O slot of the TI 505 rack. The S3016-505 is configured as a 3 word in/5 word out Special Function module. In the TI I/O module definition table the S3016-505 should be defined as shown below:

Slot	I/O Address	Number of BIT and WORD I/O X	Y	WX	WY	Special Function
XX	XXXX	00	00	03	05	YES

Where XX and XXXX under "SLOT" and "I/O ADDRESS" are the user defined slots and I/O addresses where the S3016-505 is located.

2.4 DOWNLOADING “MCOM505” TO THE S3016-505

With the S3016-505 powered up, perform the following to download the "MCOM505" program to the S3016-505:

1) Power up computer (PC) and invoke SYSdev from the root directory of the hard drive by typing SYSdev<ENTER>. From the SYSdev shell, select the directory that "MCOM505" is located in by pressing "F3:Select Dir" and positioning the arrow at the directory and pressing <ENTER>.

   Note: If "MCOM505" has not yet been loaded onto the hard drive of the computer, perform the steps in section 2.2.1 to load "MCOM505" onto the computer.

2) Select the "MCOM505" program by positioning the arrow at "MCOM505" and then press <ENTER>.

3) Select "6: Target Board Interface" from the main development menu.

4) Connect the RS-232 cable from the "COM" port on the PC running SYSdev to the "PROG" port on the S3016-505.

5) Download program "MCOM505" to the S3016-505 using the "1: Download Program to Target Board" menu selection from the "Target Board Interface Menu". The current address being download will be displayed while the download is in progress.

6) Exit back from the "Target Board Interface" menu by pressing 12<ENTER>. Exit back to the SYSdev shell by again pressing 12<ENTER>. Exit back to the DOS prompt by selecting <ESC>.

2.4.1 INSTALLING “MCOM505” ON THE PC HARD DRIVE

To install "MCOM505" from the floppy disk to the hard drive on the IBM PC or compatible running SYSdev, perform the following:

1) Power up computer (PC) and invoke SYSdev from the root directory of the hard drive by typing SYSdev<ENTER>. From the SYSdev shell, select the directory that "MCOM505" is to be copied to by pressing "F3:Select Dir" and positioning the arrow at the directory and pressing <ENTER>.

2) To enter "MCOM505" as a selection in the specified directory, press "F1:Create Prog" then type "MCOM505" in the PROG field of the SYSdev shell followed by <ENTER>. When the target board type is prompted for, position the arrow by the S3016 and press <ENTER>.

3) SYSdev will then prompt that the "MCOM505" does not exist, create? (y/n). Answer "n" to this prompt.

4) SYSdev will return to the SYSdev shell with "MCOM505" now entered in the shell directory.

5) Install the diskette that contains "MCOM505" in the "A" drive.

6) Position the arrow at "MCOM505" and press "F9:Restor Prog". SYSdev will prompt for which drive to restore from. Answer "A" and press <ENTER>.

7) "MCOM505" will be copied from the A drive to the directory on the hard drive previously specified. "MCOM505" is now installed on the hard drive.

Once the above steps are performed, "NETCOM" is used to define what information (V memory locations, addresses in S3000/M4000 nodes, # of words to transfer, etc.) is transferred between the TI processor and the various S3000/M4000 nodes. See section 3 for details on using "NETCOM".

SECTION 2
INSTALLATION

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SECTION 3
GENERAL DESCRIPTION OF “NETCOM”

"NETCOM" is a DOS based program used in conjunction with "MCOM505" for the S3016-505. The combination of the "MCOM505" and "NETCOM" programs turn the S3016-505 into a purely communications board which allows the TI 505 processor to communicate to up 31 S3000/M4000 slave nodes, reading up to 120 words and writing up to 120 words to each node. "NETCOM" allows the user to perform the following:

1) Upload Node communication parameters from S3016-505.
2) Download Node communication parameters to S3016-505.
3) Save Node communication parameters in a file.
4) Document Nodes (S3000/M4000 network slave node descriptions).
5) Print Node communication parameters / descriptions.
6) Create multiple network configuration files with up to 32 nodes per file.

The "NETCOM" program consists of a shell (first menu displayed when "NETCOM" is invoked) plus the Main and Node Parameters Edit menus used to select the various features of "NETCOM". The shell is used for file and directory control. From this menu files, which will store the node parameters, are created, copied, backed up or restored. When a file is created or selected, the Main menu is then invoked. From here the user edits the node parameters, downloads, uploads, prints the parameters, etc. The following sections describe all the menus and features of "NETCOM".

SECTION 3
GENERAL DESCRIPTION OF "NETCOM"

3.1 INSTALLING AND RUNNING "NETCOM"

To install the program on your computer, load the diskette into drive A, switch to the root directory of the hard drive you want to install it on and type "A:INSTALL". The install program will create a directory call "HSLSETUP" and copy the "NETCOM.EXE" program to this directory.

To execute the "NETCOM" program, change to the "HSLSETUP" directory and type NETCOM<ENTER>. The program will be invoked and the "NETCOM" shell will be displayed. The following sections describe this menu along with the other menus available in "NETCOM".

If desired, the "NETCOM" shell can be bypassed by including the path (directory) and file name on the command line when "NETCOM" is invoked from the DOS prompt. This is usually done when a menu program is used to select various software packages on the users PC. This allows a specific file to be automatically invoked from the user's menu program without having to go through the "NETCOM" shell for file selection. The format of this is as follows:

HSLSETUP>NETCOM path filename<ENTER>

Where "path" is the directory\sub-directories that the file name is under and "filename" is file that contains the respective node parameters.

Note: There must be a space between "NETCOM" and "path" and a space between "path" and "filename" in the above command line. No extension is appended to "filename" in this command line as well.

An example of this is: HSLSETUP>NETCOM \NETWORK NET1

Where "NETWORK" is a directory off the root of the current drive that contains a file named "NET1".

Note: Only an existing file can be accessed when adding the path and filename to the command line. New files must be created through the "NETCOM" shell by invoking "NETCOM" with no path and filename specified.

3.2 "NETCOM" SHELL

The "NETCOM" shell is used to organize the user directories, create and edit user files, and automatically invoke the main menu when a file is created or selected. Sub-directories should be used to store and organize the user files. This is desirable both from the standpoint of better user file management and from the standpoint of program execution speed. The more files located in one directory, the slower the access time to the sure files will be. Thus, by storing user files in different directories that have a logical meaning to the user, and thus a better file organization, the speed of execution of the "NETCOM" program is also enhanced. The maximum number of files allowed in one directory is 30. The maximum number of sub-directories in one directory is 120. Of course by making sub-directories within sub-directories, no actual limit is placed on the number of user files which can be stored on one hard drive (other than the actual amount of memory on the hard drive). These sub-directories can be created using the "F5: Make Dir" command in the "NETCOM" shell.

3.2.1 "NETCOM" SHELL MENU

The "NETCOM" shell consists of a menu which displays the selected file name, current directory, target board along with fields that display the existing file selections available for editing and available directories. The definitions of these fields are as follows:

PROMPT: This is a field which displays various prompts to the user based on the selected command, informing the user what to do.

DIR: This field displays the currently selected drive and directory. This is used as the path to the user file name when creating or editing a file and is set using the "F6: Select Drive: and "F3: Select Dir" commands. When "NETCOM" is initially invoked, this is set to the root directory of the current drive.

FILE: This is the file currently pointed to by the selection arrow in the File Selections field of the menu. This field is also used to enter the name of the user file when the "F1: Create File" command is executed.

FILE SELECTIONS: This field contains a list of the existing user files in the currently selected directory. The currently selected file is the file pointed to by the selection arrow. The selection arrow can be moved to any displayed file using the Left, Right, Up and Down arrow keys. When "NETCOM" is initially invoked, this displays all the "NETCOM" user files in the root directory of the current drive.

SUB-DIRECTORY SELECTIONS: This field contains a list of the existing sub-directories in the currently selected directory (these would be sub-directories within the parent directory). The "F3: Select Dir" command is used to select one of these directories as the current directory. When initially invoked, this displays all the sub-directories in the root of the current drive (whether they contain "NETCOM" user files or not).

3.2.2 "NETCOM" SHELL COMMANDS

The shell contains numerous commands for creating and editing the user file, selecting the directory and drive the user files are stored in, and execution DOS commands such as Backup, Copy, Delete, etc. from within the shell. The definitions of these commands are as follows:

F1: Create File

This command is used to create a new user file. When selected, the menu will prompt for the file name. Enter the new name in the "FILE:" filed of the menu using the valid MS-DOS file name character set

F2: Set Colors

This selection allows the user to select the foreground color (characters) and background color on PC's equipped with color monitors. Any of 16 foreground colors can be selected and any of 8 background colors.

F3: Select Dir

This is used, to select, as the current directory, one of the directories available in the sub-directories menu.

Note: Only directories within the current dub-directory are displayed and are available for selection.

Pressing "F3" positions the selection arrow in the sub-directories menu. Position the selection arrow at the desired sub-directory and press ENTER. The "DIR:" field will be updated to show the newly selected directory while the file selections menu will be updated to show the existing user files in the selected directory. The sub-directories menu will also show the sub-directories that exist in the selected directory.

Note: The "F4: Root Dir" command must be used to back out of the currently selected directory and return to the root directory of the currently selected drive.

F4: Root Dir

Used to set "DIR:" to the root directory of the selected drive. This command is primarily used to back out of the previously selected directories if it is desired to charge to a directory that is not a sub-directory of the current directory. Pressing "F4" will set "DIR:" to the root directory and display the user files and directories in the root directory of the selected drive.

F5: Make Dir

This selection creates a new sub-directory in the currently selected directory. When selected, the menu will prompt for the directory name. Enter the new name using the valid MS-DOS directory name character set. The directory name can be a maximum of eight characters in length. Press ENTER to accept the directory name. The new directory will now be displayed in the sub-directories selection menu and can now be selected as the current directory using the "F3: Select Dir" command if desired.

F6: Select Drive

This selection is used to change the currently selected drive. When selected, the shell prompts for the drive letter (A – Z). Enter the new drive and press ENTER. The "DIR:" field will be changed to the root directory of the new drive and the existing "NETCOM" user files and sub-directories in the new drive root directory will be displayed.

F7: Copy File

Used to copy the selected file to a new file name in the current directory. Enter the new name using the valid MS-DOS file name character set. The file name can be a maximum of eight characters in length (no extension should be entered). Press ENTER to accept the file name that the selected file will be copied to. The new file will then be displayed in the file selections menu.

F8: Backup File

This selection is used to backup the selected file to the root directory of a user specified diskette drive. When selected, the shell prompts for the drive (A or B) that the file will be backed up to. Enter the drive and press ENTER. The currently selected file will be copied to the root directory of the specified diskette.

F9: Restore File

This selection is used to restore a previously backed up file form the root directory of a user specified drive to the currently selected directory and file. When selected, the shell prompts for the diskette drive (A or B) that the file will be copied from. Enter the drive and press ENTER. The file, with the same name as the currently selected program, will be copied from the root directory of the specified drive to the currently selected directory and file name.

F10: Delete File

This section deletes the currently selected file from the current directory. When selected, the shell prompts one time to verify that the file is to be deleted, answer "Y" to delete, "N" to abort. If yes, the file is deleted from the file selections menu.

3.3 MAIN MENU

The Main menu is invoked after a new file is created from the shell or when an existing file is selected from the shell or invoked from the DOS command line.

Note: When a file is created for the first time, the "TI-505 Communications Status Stack address" menu is displayed first (see section 3.3.5). This forces the user to set this address prior to editing the rest of the communications parameters.

Once this is set, the Main menu is then displayed. The Main menu allows the user to edit the node communications parameters, download the node parameters to the S3016-505, upload the node parameters from the S3016-505, print the node parameters, set the TI 505 status stack address, and monitor the communications status on-line. The following describes these menu selections.

3.3.1 EDIT NODE COMMUNICATIONS PARAMETERS

When this selection is made, the Node Parameters Edit menu is invoked. This menu allows the user to select the node number, edit the node description, edit the node communications parameters, and enable or disable communications to the node. See section 3.4 for complete details on these menu selections.

3.3.2 DOWNLOAD PARAMETERS TO S3016-505 (PROG PORT)

This selection is used to download the node communications parameters for the slave nodes to the S3016-505 from the computer.

Note: The node descriptions are not downloaded to the S3016-505, these are saved in the file on disk only. The download feature allows the user to either download all the nodes (2 to 32) or just a range of nodes ("starting" node and "ending" node) as specified by the user. This allows just a certain number of nodes (i.e. nodes 2 to 4) to be downloaded without having to download all the parameters for all the nodes.

To download the node parameters, connect an RS-232 cable from COM1 on the computer to the "PROG" port on the S3016-505 and press this selection. The user is then prompted to abort the download (by pressing "ESC") or to continue (by pressing any other key). If any key other than "ESC" is pressed, the following prompt is displayed:

"Download all nodes to S3016-505? (y/n): "

If all the parameters for all the nodes (2 to 32) are to be downloaded, answer "y" to this prompt. If only a range of nodes is to be downloaded, answer "n".

If "n" is answered, the user is then prompted for the starting node number. Enter the starting node number to be downloaded and press Enter. The user is then prompted for the ending node. Enter the ending node number and press Enter. If, for instance, the parameters for nodes 10 through 20 are to be downloaded, Enter 10 at the starting node prompt and enter 20 at the ending node prompt.

In both cases, once the node download is initiated, the current node number being downloaded is displayed on the computer.

Note: Communication on the S3000 network is halted while the download is in progress. Communication between the TI processor and S3016-505 is halted as well. Communication well automatically resume to the slave nodes enabled as soon as the download is complete.

3.3.3 UPLOAD PARAMETERS FROM S3016-505 (PROG PORT)

This selection is used to upload the node communications parameters for the slave nodes from the S3016-505 to the computer.

Note: The node descriptions are not uploaded from the S3016-505, these are saved in the file on disk only. The upload feature allows the user to either upload all the nodes (2 to 32) or just a range of nodes ("starting" node and "ending" node) as specified by the user. This allows just a certain number of nodes (i.e. nodes 2 to 4) to be uploaded without having to upload all the parameters for all the nodes.

To upload the node parameters, connect an RS-232 cable from COM1 on the computer to the "PROG" port on the S3016-505 and press this selection. The user is then prompted to abort the upload (by pressing "ESC") or to continue (by pressing any other key). If any key other than "ESC" is pressed, the following prompt is displayed:

"Upload all nodes from S3016-505? (y/n): "

If all the parameters for all the nodes (2 to 32) are to be uploaded, answer "y" to this prompt. If only a range of nodes is to be uploaded, answer "n".

If "n" is answered, the user is then prompted for the starting node number. Enter the starting node number to be uploaded and press Enter. The user is then prompted for the ending node. Enter the ending node number and press Enter. If, for instance, the parameters for nodes 10 through 20 are to be uploaded, Enter 10 at the starting node prompt and enter 20 at the ending node prompt.

In both cases, once the node upload is initiated, the current node number being uploaded is displayed on the computer.

Note: Communication on the S3000 network is halted while the upload is in progress. Communication between the TI processor and S3016-505 is halted as well. Communication well automatically resume to the slave nodes enabled as soon as the upload is complete.

3.3.4 PRINT NODE COMMUNICATIONS PARAMETERS

This selection is used to print the node communications parameters. This selection prints all the information on the "Edit Node Communications Parameters" menu: the node number, node description, communications enabled/disabled, Words sent from TI-505 to slave node, and Words read from slave node to TI-505. If communications to a specific node is disabled, the Words sent and read fields will not be printed. Similar to the download and upload, the user can print the parameters for all the nodes (2-32) or just a range of nodes.

When selected, the user will first be prompted for the form length. This is the number of lines printed for each page and is typically 60. Enter the number of lines per page and press Enter. Next the user is prompted "Print-out parameters for all nodes (2 thru 32)? (y/n)". Answering "y" will print the parameters for all the nodes (2 thru 32). If "n" is answered the user is then prompted for the starting node number to print. Enter the starting node number and press Enter. Next the ending node number is prompted for. Enter the ending node number and press enter. For instance, if nodes 10 thru 20 are to be printed, enter 10 for the starting node and 20 for the ending node.

Once the above prompts are answered, the print-out will be initiated. Pressing "ESC" at any of the prompts will abort the print-out selection. Pressing any key once the print-out is initiated will abort the print-out.

3.3.5 SET TI-505 COMMUNICATIONS STATUS STACK ADDRESS

The TI-505 Communications Status stack is 32 consecutive V memory locations in the TI 505 processor which represent the communications status of each node in the S3016-505.

The first V memory location is a watchdog toggle from the S3016-505. This is toggled between 0 and 1 once all the enabled nodes are updated in the S3016-505. This should be monitored for a change of state by the TI-505 program to verify that the S3016-505 is functioning. This is generally accomplished with a timer that is reset by a one shot fired every time this V memory location changes from either 0 to a 1 or a 1 to a 0.

Note: While the Node parameters are being downloaded to the S3016-505, that this location will not change state. Thus the timer should be set to the maximum download time (approximately 5 seconds).

The remainder of the V memory locations of this stack are the communications status of the respective 31 slave nodes (the second V memory location is for node 2, the third for node 3, etc.). The values loaded into these locations by the S3016-505 are numbers between 0 and 19 decimal. These are the same status codes as displayed in the "Communications Status" menu (selection 6 of the Main menu). See section 3.3.6 for definitions of these codes. These status registers should be monitored by the TI-505 program to verify that communications to a specific node is occurring if that node is enabled.

When this selection is made, the current TI-505 Communications Status stack address is displayed. This is the first address of the stack. To change this address, simply type in the desired V memory address and press <ENTER>. If the address is not to be changed, press <ESC>.

Note: This address is only loaded to the S3016-505 when the "Download Parameters to S3016-505" selection is performed. If this address is changed, the download must be performed to update the S3016-505.

3.3.6 MONITOR COMMUNICATIONS STATUS (PROG PORT)

This selections is used to monitor the communications status on-line. The status of each node is displayed in a table with a status code and short description of each code. These are the same status codes passed to the TI-505 processor in the "TI-505 communications status stack" (see section 3.3.5). The list of possible codes is shown below:

Code (HEX)	Code (decimal)	Definition
00H	00	Comm to Node Disabled
01H	01	--------
02H	02	Comm to Node OK
03H	03	More than one bus master
04H	04	Xmitt timeout - no response
05H	05	No slave response - timeout
06H	06	Invalid command from master
07H	07	Receive overflow
08H	08	Receive collision detected
09H	09	Receive alignment error
0AH	10	Receive CRC error
0BH	11	Unknown error
0CH	12	Xmitt no acknowledge
0DH	13	Xmitt under run error
0EH	14	Xmitt collision detected
0FH	15	Address range error
10H	16	Unexpected slave response
11H	17	TI-505/S3016 read error
12H	18	TI-505/S3016 write error
13H	19	Undefined error

Status code 00H "Comm to Node Disabled" is set when communications to the respective node is disabled (see section 3.4.4). This is the normal status code for any unused nodes on the network. Status code 02H "Comm to Node OK" is the normal status code when a node is enabled for communications and communications to that node is successful. Status codes 03H through 10H are network communication error codes. In this case comm to the node was enabled but communications to that node was not successful. The data returned to the TI-505 processor for that node would not be valid. These error codes are serial network error codes listed in the S3016 User's Manual. Refer to that manual for a complete description of these error codes.

To view the communications status, connect an RS-232 cable from COM1 on the computer to the "PROG" port on the S3016-505 and press this selection. The status of each node will then be displayed in the status table.

Note: This table is updated continuously such that any change in the communications status of any node is reflected in the table immediately. If the RS-232 communications from the computer to the S3016-505 cannot be established (cable not connected, etc.), the status table will display "---: ----------" for each node in the table. This indicates that the computer is not communicating to the S3016-505.

3.4 NODE PARAMETERS EDIT MENU

The Node Parameters Edit menu is used to define the communications parameters of each node as well as enable or disable communications to the node and enter descriptions for each node. The following selections are available on this menu:

1: Select Node number
2: Edit Node description
3: Edit Node Communications Parameters
4: Enable/Disable Communications to Node

In addition to the above selections, this menu contains the following fields:

Node Number: Currently selected node for edit of description and communication parameters.

Node Description: User entered description of the node (type of machine, type of S3000/M4000 processor, etc., whatever is desired by the user to describe the node up to 50 characters).

Communications to Node: Enabled/Disabled -This field indicates whether communications to the node is enabled or disabled. When enabled, the S3016-505 communicates to the respective node using the parameters defined for that node (number of words, addresses to transfer, etc.). This information is then communicated to the TI processor. When disabled, no communications is performed to the respective node and no information is transferred to the TI processor. The communication parameter fields are blanked as well when comm is disabled.

Words sent from TI-505 to Slave Node: The following three fields are the communication parameters which define the words sent from the TI-505 to the slave node:

# of Words to send from TI-505 to slave node: This is the number of V memory words that will be transmitted to the slave node. This is a decimal value between 0 and 120.

Starting address in TI-505 of words to send: First address of send stack in TI-505 processor. A consecutive number of V memory variables (equal to # of Words to send) will be sent to the respective slave node starting at this address. Valid variable type is V memory only within the V memory space of the TI 505 processor.

Starting address in slave node to store words at: First address of stack in slave node (S3000/M4000 processor) where the words sent from the master will be stored. This is either a 'W' word address of an external hex address in the slave node processor (see respective user's manual for slave node processor for valid 'W' addresses and external memory addresses).

Words read from slave node to TI-505: The following three fields are the communication parameters which define the words read from the slave node and stored in the TI-505 processor:

# of Words to read from slave node to TI-505: This is the number words that will be read from the slave node and stored in V memory locations of the TI-505 processor.

Starting address in slave node to read words from: This is the starting address of the consecutive words in the slave node processor that will be sent to the TI-505. This is either a 'W' word address of an external hex address in the slave node processor (see respective user's manual for slave node processor for valid 'W' addresses and external memory addresses).

Starting address in TI-505 to store words at: First address of consecutive V memory locations in TI-505 processor that words read from the slave node will be stored. Valid variable type is V memory only within the V memory space of the TI 505 processor.

The following section describes each of the selections in the Node Parameters Edit menu:

3.4.1 SELECT NODE NUMBER

This selection is used to select the slave node number for editing the node description, enabling or disabling communications to the node, and setting the communication parameters for the slave node. When selected, enter the node number (2 through 32) to be edited and press <ENTER>. In addition the next or previous node can be selected by pressing the "PgDn" or "PgUp" keys respectively.

3.4.2 EDIT NODE DESCRIPTION

This selection is used to edit the "Node Description" field of the currently selected slave node. This field can be used to describe the slave node (type of machine, type of S3000/M4000 processor, etc.). When selected, the cursor is placed at the beginning of this field. Enter the desired node description (up to 50 characters) and press <ENTER>.

3.4.3 EDIT NODE COMMUNICATIONS PARAMETERS

This selection is used to modify the communication parameters of the currently selected node. This includes: "# of Words to send from TI-505 to slave node", "Starting address in TI-505 of words to send", "Starting address in slave node to store words at", "# of Words to read from slave node to TI-505", "Starting address in slave node to read words from", and "Starting address in TI-505 to store words at".

If the node is not already enabled for communications when this selection is made, the user is prompted to enable communications. If communications is to be enabled, answer "y", if not, answer "n". If communications is not enabled, the communication parameters cannot be set and the cursor will return to the Enter selection prompt.

If communications is enabled, the cursor will be located in the "# of Words to send" field. Enter the number of words to be sent and press <ENTER>. The cursor will move to the "Starting address in TI-505" field. Enter the starting V memory address of the send stack (the "V" is automatically prefixed to the beginning of the address) and press <ENTER>. The cursor will now move to the "Starting address in the slave node" field. Enter the starting address in the slave that the words sent will be stored at as either a valid "W" address in the form "Wxxxx" where xxxx is the address or as a valid external memory hex address in the form "xxxxH" where xxxx is the hex address and press <ENTER>. The above three fields were the "Words sent from TI-505 to slave node" communications parameters. The cursor will now advance to the three fields of the "Words read from slave node to TI-505". Enter these in the same way that the three previous fields were entered.

3.4.4 ENABLE/DISABLE COMMUNICATIONS TO NODE

This selection is used to enable or disable communications to the currently selected node. When the node file is first created, by default, communications to all nodes is disabled. The user then enables communications only to the respective nodes that are connected to the network. For instance, if the S3016-505 is connected to only one other S3000/M4000 slave node, communications to that node only should be enabled, all other nodes should be disabled. If the S3016-505 is connected to two slave nodes, communications to those two nodes should be enabled, and all other nodes disabled and so on.

This selection simply toggles the enable or disable state of the node. If the node is disabled, pressing "4: Enable/Disable" will enable the node. If the node is disabled, pressing "4: Enable/Disable" will disable the node.

Note: When the node is enabled, the communication parameters values are shown in the parameter fields. When disabled, the fields are blanked, even though the parameter values in those fields are still retained in memory and are shown when the communications is enabled again.

Also, that when any of the descriptions or parameters are modified for any of the nodes, the data is saved in the currently selected file when the "Node Parameters Edit" menu is exited. Also the S3016-505 is not updated with any changes until the "Download Parameters" is performed to the S3016-505.

SECTION 3
GENERAL DESCRIPTION OF "NETCOM"

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Board Size:	
Length:	9.15"
Height:	6.30"
Width:	0.80"
Processor Memory:	
Program:	24K bytes battery backed CMOS RAM
Data:	
non-volatile:	2K bytes battery backed CMOS RAM
volatile:	
Flags (F):	104 bits
Bytes (B):	185 bytes
Words (W):	93 words
Interface Ports:	
PROG PORT:	
Type:	RS-232
Comm Rate:	9600 BAUD
USER PORT:	
Type:	RS-232/RS-422
Comm Rate:	300,600,1200,2400,4800,9600 BAUD
Start bits:	1
Data bits:	8
Stop bits:	1 or 2
Parity:	NONE, ODD, or EVEN
Serial Network:	
S3000-N1:	
Type:	RS-485
Comm Rate:	344KBPS, 229KBPS, or 106KBPS
# of nodes (max):	32
Isolation:	2000 VRMS
Distance:	1000 ft., 2000 ft., or 4000ft.
Protocol:	Proprietary
Power Requirements:	
Icc (+5VDC):	1.00 amps (MAX)

SECTION 4
SPECIFICATIONS

Temperature Range:	
Storage:	0 to 70 degrees C
Operating:	0 to 60 degrees C
Relative Humidity:	5 to 95% (non-condensing)

APPENDIX A
MCOM505 PROGRAM PRINTOUT

```
S3016-505 S3000 Network Master (31 slave nodes)
SYS51 System Config: C:\PROGRAMS\S3016505\MCOM505.LCF



            System Configuration
            --------------------

Target board: S3016 Communications co-processor I/O board

Network baud rate: 344KBPS

USER PORT baud rate: 9600

USER PORT parity: NONE

USER PORT stop bits: 1

Co-cpu communications interrupt enabled: no
```

APPENDIX A
MCOM505 PROGRAM PRINTOUT

```
   S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page:  1
   SYS51 Init file: C:\PROGRAMS\S3016505\MCOM505.LIN


   ************************************************************************
   block:  1 - High-level

    0:sfunc07(1900H,B90);     /* restore TI-505 com stack address */
    1:sfunc07(1901H,B91);
    2:
    3:sfunc08(1ff4H,1);       /* set node address to 1 (master) */
    4:B105 = 2;               /* start in download mode until TI545 resets */
    5:F10 = 0;                /* TI505 resetting */
    6:


F010  (TIreset)   TI505   reset   comp
B090  (Verrstk)   Vmem    error   stack
B091  (Verrstk)   Vmem    error   stack
B105  (dwnload)   down-   load    mode
```

```
S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page:  2
SYS51 Init file: C:\PROGRAMS\S3016505\MCOM505.LIN


************************************************************************
block:  2 - Assembly

 0:            clr   EX1   ;disable comm interrupt from TI505
 1:
```

APPENDIX A
MCOM505 PROGRAM PRINTOUT

```
S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page:  1
SYS51 Main Program: C:\PROGRAMS\S3016505\MCOM505.LMN


************************************************************************
block:  1 - High-level

** Select state **

This block searches for enabled slave nodes (1st address of respective
slave buffer set to the slave number when enabled) and then initiates
the comm cycle with the TI545. The data is read from the TI545 and
stored in the slave xmit buffer and then the data in the slave rcve
buffer is written to the TI545. Once all slave nodes (2-32) have been
updated, the network comm (sfunc13) error stack is written to the
TI545.

 0:if (F0 == 1)            /* select state? */
 1:   {
 2:   F8 = 0;              /* reset done bit */
 3:   for (B42 = B61 + 1; B42 < 33 && F8 == 0; ++B42)
 4:       {
 5:       /* search for enabled slave nodes and comm with TI545 */
 6:       W84 = (B42*512)+3c00H;       /* point to nth node */
 7:       sfunc07(W84,B87);
 8:       if (B87 == B42)              /* slave node enabled? */
 9:          {
10:          W84 = W84 + 2;            /* load comm parameters */
11:          sfunc07(W84,B62);         /* # to send */
12:          W84 = W84 + 2;
13:          sfunc07(W84,B64); ++W84;  /* VSRCE address */
14:          sfunc07(W84,B65); ++W84;
15:          sfunc07(W84,B66); ++W84;  /* sdest address */
16:          sfunc07(W84,B67); ++W84;
17:          sfunc07(W84,B63); ++W84;  /* # to receive */
18:          ++W84;
19:          sfunc07(W84,B68); ++W84;  /* ssrce address */
20:          sfunc07(W84,B69); ++W84;
21:          sfunc07(W84,B70); ++W84;  /* VDEST address */
22:          sfunc07(W84,B71);
23:
24:          W84 = W84 + 3;            /* point to xmit buffer */
25:          B61 = B42;                /* set slave address */
26:          F8 = 1;                   /* done */
27:          }
28:       }
29:
30:   if (F8 == 0)           /* all nodes checked? */
31:      {
32:      B61 = 1;            /* start with first slave node again */
33:      B63 = 32;           /* write comm error status to TI545 */
34:      W70 = W90;          /* VDEST = VERROR_STACK */
35:      W84 = 1b00H;        /* point to comm error stack */
36:      sfunc07(1b00H,B87); /* toggle S3016-505 (TI545) watchdog */
37:      B87.0 = ~B87.0;
38:      sfunc08(1b00H,B87);
39:      F4 = 1;             /* write comm error status */
40:      }
```

```
- block continued on next page -
```

APPENDIX A
MCOM505 PROGRAM PRINTOUT

```
S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page:  2
SYS51 Main Program: C:\PROGRAMS\S3016505\MCOM505.LMN


block:  1 - High-level

    - block originated on prev page -

41:   else
42:      F1 = 1;             /* initiate read state */
43:   }
44:
45:F0 = 0;                   /* exit select state */
46:


F000  (select )   select  slave   state
F001  (read TI)   read    TI545   state
F004  (writeTI)   write   TI545   state
F008  ( done  )                   done
B042  (  (i)  )           loop    (i)
B061  ( slave )  network  slave   number
B062  ( #send )   # of    words  to send
B063  ( #rcve )   # of    words  to rcve
B064  ( Vsrce )   Vmem   source  address
B065  ( Vsrce )   Vmem   source  address
B066  ( sdest )   slave   dest   address
B067  ( sdest )   slave   dest   address
B068  ( ssrce )   slave  source  address
B069  ( ssrce )   slave  source  address
B070  ( Vdest )   Vmem    dest   address
B071  ( Vdest )   Vmem    dest   address
B087  (tempreg)           temp   registr
B087.0(tregbt0)   temp    reg     bit0
W070  ( Vdest )   Vmem    dest   address
W084  (slveptr)   slave   buffer pointer
W090  (Verrstk)   Vmem    error   stack
```

```
S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page:  3
SYS51 Main Program: C:\PROGRAMS\S3016505\MCOM505.LMN


************************************************************************
block:  2 - High-level

** Read state **

The next two blocks perform the first step of the communication cycle to
the currently selected slave (read TI-545). In this state, the TI-545
V-memory is read (the number of words specified in "#sent" starting
at "Vsrce") and loaded into the respective slave xmit buffer
(addresses 4000H to 7c00H). This is the data that will be sent to
the respective slave node.

 0:if (F1 == 1)      /* read state? */
 1:   {
 2:   if (F2 == 0)   /* read from 545 not yet initiated? */
 3:      {
 4:      B86 = &B182;      /* initiate pointer to task code read buffer */
 5:      W88 = 1a00H;      /* initiate pointer to TI545 buffer */
 6:      if (B62%15 == 0)  /* even number of 15 word blocks to read? */
 7:         B35 = B62/15;  /* yes, calc # of blocks to read */
 8:      else
 9:         B35 = B62/15 + 1;    /* calc # of blocks to read */
10:      W36 = W64-1;      /* initiate Vaddr in 545 to read from */
11:      F2 = 1;           /* read initiated */
12:      B39 = 6;          /* max number of error retries = 6 */
13:      }
14:   }
15:


F001  (read TI)   read    TI545   state
F002  (rd init)   read    state  initiat
B035  (numblks)   # of   blocks  TI task
B039  (err cnt)  TI task  retry   count
B062  ( #send )   # of    words  to send
B086  ( pntr1 )   task   buffer  pointer
B182  ( rbuff )  tskcode  read   buffer
W036  ( Vaddr )   TI545   Vmem   address
W064  ( Vsrce )   Vmem   source  address
W088  ( pntr2 )  network buffer  pointer
```

APPENDIX A
MCOM505 PROGRAM PRINTOUT


```
*************************************************************************
block:  3 - High-level

 0:if (F1 == 1)      /* read state? */
 1:   {
 2:   if (F103 == 0)       /* task code with 545 complete? */
 3:      {                 /* yes */
 4:      if (F102 == 1)    /* task code comm failure with 545? */
 5:         {
 6:         --B39;         /* dec error count */
 7:         if (B39 == 0)  /* error retries count out? */
 8:            {
 9:            B40 = 11H;  /* comm error = TI_READ_ERROR */
10:            W106 = 1b00H + ((B61-1)<<1);
11:            sfunc08(W106,B40); ++W106;  /* save fault code in */
12:            sfunc08(W106,0);            /* TI-505 comm stat stack */
13:            F1 = 0, F2 = 0, F0 = 1;     /* exit read state */
14:            }
15:         else
16:            F103 = 1;   /* retry task code comm with 545 */
17:         F102 = 0;      /* reset task code comm fail bit */
18:         }
19:      else if (F9 == 1) /* task code comm done? */
20:         {
21:         for (B42 = 0; B42 < 15; ++B42)   /* copy block read from 545 */
22:             {                            /* to network xmit buffer */
23:             sfunc08(W88,*B86); ++B86, ++W88;     /* copy nth word */
24:             sfunc08(W88,*B86); ++B86, ++W88;
25:             }
26:         B86 = &B182;         /* reset task code read buffer */
27:         F9 = 0;              /* block read done */
28:         }
29:      else if (B35 != 0)      /* more blocks to read? */
30:         {
31:         B56 = 50H;           /* block read task code */
32:         B57 = 4;             /* # of bytes to xmit in task code req */
33:         B58 = 32;            /* # of bytes to rcve in task code resp */
34:         W150 = W36;          /* starting V mem address to read */
35:         W36 = W36 + 15;      /* next block address to read */
36:         --B35;               /* dec # of blocks to read */
37:         F103 = 1;            /* initiate task code comm */
38:         F9 = 1;              /* preset block read done */
39:         }
40:      else
41:         {
42:         W88 = 1a00H;         /* copy data read from TI545 to */
43:         while (B62 != 0)     /* respective slave xmit buffer */
44:            {
45:            sfunc07(W88,B87);
46:            sfunc08(W84,B87); ++W84, ++W88;
47:            sfunc07(W88,B87);
48:            sfunc08(W84,B87); ++W84, ++W88;
49:            --B62;
50:            }
```

- block continued on next page -

APPENDIX A
MCOM505 PROGRAM PRINTOUT

```
S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page:  5
SYS51 Main Program: C:\PROGRAMS\S3016505\MCOM505.LMN


block:  3 - High-level

    - block originated on prev page -

51:         F1 = 0, F2 = 0, F4 = 1;    /* enter write state */
52:         W84 = (B61*512)+3c00H+256; /* point to respective rcve buffer */
53:         }
54:      }
55:   }
56:


F000  (select )   select  slave   state
F001  (read TI)   read    TI545   state
F002  (rd init)   read    state  initiat
F004  (writeTI)   write   TI545   state
F009  (TI done)   TI545   task    done
F102  (tskfail)   TI545   task    fail
F103  (TIcomm )   TI545   task   in prog
B035  (numblks)   # of   blocks  TI task
B039  (err cnt)  TI task  retry   count
B040  (commerr)   comm    error   code
B042  (  (i)  )           loop    (i)
B056  (tskcode)   TI545   task    code
B057  (#xmitt )   task    code   #xmitt
B058  ( #rcve )   task    code   #rcve
B061  ( slave )  network  slave   number
B062  ( #send )   # of    words  to send
B086  ( pntr1 )   task   buffer  pointer
B087  (tempreg)           temp   registr
B182  ( rbuff )  tskcode  read   buffer
W036  ( Vaddr )   TI545   Vmem   address
W084  (slveptr)   slave   buffer pointer
W088  ( pntr2 )  network buffer  pointer
W106  (statptr)   comm   status  pointer
W150  (Vstack )   Vmem    read    stack
```

```
S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page:  6
SYS51 Main Program: C:\PROGRAMS\S3016505\MCOM505.LMN


************************************************************************
block:  4 - High-level

** Write state **

The next two blocks write the data that was read from the slave to the
TI-545 Vmemory starting at "Vdest" (the number of words written is
"#rcve").

 0:if (F4 == 1)            /* write state? */
 1:   {
 2:   if (F5 == 0)         /* write state not yet initiated? */
 3:      {
 4:      W88 = 1a00H;      /* copy data to be written to TI545 from */
 5:      for (B42 = B63; B42 > 0; --B42) /* respective slave rcve buffer */
 6:          {
 7:          sfunc07(W84,B87);
 8:          sfunc08(W88,B87);
 9:          ++W84, ++W88;
10:          sfunc07(W84,B87);
11:          sfunc08(W88,B87);
12:          ++W84, ++W88;
13:          }
14:      B86 = &B152;      /* initiate pointer to task code write buffer */
15:      W88 = 1a00H;      /* initiate pointer to TI545 buffer */
16:      B35 = B63/14;     /* number of blocks to write */
17:      B43 = B63%14;     /* number of words remaining to write */
18:      W36 = W70-1;      /* initiate Vmem dest address */
19:      F5 = 1;           /* write state initiated */
20:      B39 = 6;          /* maximum # of error retries = 6 */
21:
22:      /* reset TI_READ_ERROR */
23:      W106 = 1b00H + ((B61-1)<<1);
24:      sfunc07(W106,B108);
25:      if (B108 == 11H)
26:         sfunc08(W106,2);
27:      }
28:   }
29:


F004  (writeTI)   write   TI545   state
F005  (wr init)   write   state  initiat
B035  (numblks)   # of   blocks  TI task
B039  (err cnt)  TI task  retry   count
B042  (  (i)  )           loop    (i)
B043  (#words )   # of    words  remain
B061  ( slave )  network  slave   number
B063  ( #rcve )   # of    words  to rcve
B086  ( pntr1 )   task   buffer  pointer
B087  (tempreg)           temp   registr
B108  (comstat)           comm   status
B152  ( xbuff )  tskcode  write   buffer
W036  ( Vaddr )   TI545   Vmem   address
```

```
W070  ( Vdest )   Vmem    dest   address
```

```
  S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page:  7
  SYS51 Main Program: C:\PROGRAMS\S3016505\MCOM505.LMN


  block:  4 - High-level


W084  (slveptr)   slave   buffer pointer
W088  ( pntr2 )  network buffer  pointer
W106  (statptr)   comm   status  pointer
```

APPENDIX A
MCOM505 PROGRAM PRINTOUT


```
**************************************************************************
block:  5 - High-level

 0:if (F4 == 1)            /* write state? */
 1:   {
 2:   if (F103 == 0)       /* task code with TI 545 complete? */
 3:      {                 /* yes */
 4:      if (F102 == 1)    /* task code comm failure with 545? */
 5:         {
 6:         --B39;         /* dec error count */
 7:         if (B39 == 0)  /* maximum number of retries done? */
 8:            {
 9:            B40 = 12H;  /* comm error = TI_WRITE_ERROR */
10:            W106 = 1b00H + ((B61-1)<<1);
11:            sfunc08(W106,B40); ++W106;    /* save fault code in */
12:            sfunc08(W106,0);              /* TI-505 stat stack */
13:            F4 = 0, F5 = 0, F0 = 1; /* exit write state */
14:            }
15:         else
16:            F103 = 1;   /* retry task code with 545 */
17:         F102 = 0;
18:         }
19:      else if (B35 != 0)      /* more blocks to write? */
20:         {
21:         B56 = 51H;     /* block write task code */
22:         B57 = 32;      /* number of task code bytes to write */
23:         B58 = 2;       /* number of task code bytes to read */
24:         W150 = W36;    /* Vmem start address */
25:         W36 = W36 + 14;      /* next block start address to write */
26:         --B35;         /* dec # of blocks to write */
27:         B86 = &B152;   /* point to task code write buffer */
28:         for (B42 = 0; B42 < 14; ++B42)
29:             {
30:             sfunc07(W88,*B86); ++W88, ++B86; /* copy from comm buffer */
31:             sfunc07(W88,*B86); ++W88, ++B86; /* to task code buffer */
32:             }
33:         F103 = 1;      /* initiate tasck code comm with 545 */
34:         }
35:      else if (B43 != 0)      /* write remaining words to 545? */
36:         {
37:         B56 = 51H;     /* block write task code */
38:         B57 = (B43 << 1) + 4;      /* # of bytes to write */
39:         B58 = 2;       /* # of bytes to read in task code */
40:         W150 = W36;    /* Vmem start address */
41:         B86 = &B152;   /* point to task code write buffer */
42:         for (B42 = 0; B42 < B43; ++ B42)
43:             {
44:             sfunc07(W88,*B86);     /* copy nth word from comm buffer */
45:             ++W88, ++B86;          /* to task code write buffer */
46:             sfunc07(W88,*B86);
47:             ++W88, ++B86;
48:             }
49:         B43 = 0;       /* reset # remaining */
50:         F103 = 1;      /* initiate task code comm */
```

```
- block continued on next page -
```

APPENDIX A
MCOM505 PROGRAM PRINTOUT


```
block:  5 - High-level

    - block originated on prev page -

51:         }
52:      else
53:         F4 = 0, F5 = 0, F6 = 1;    /* enter done state */
54:      }
55:   }
56:
```

```
F000  (select )   select  slave   state
F004  (writeTI)   write   TI545   state
F005  (wr init)   write   state  initiat
F006  (comdone)   TI545   comm    done
F102  (tskfail)   TI545   task    fail
F103  (TIcomm )   TI545   task   in prog
B035  (numblks)   # of   blocks  TI task
B039  (err cnt)  TI task  retry   count
B040  (commerr)   comm    error   code
B042  (  (i)  )           loop    (i)
B043  (#words )   # of    words  remain
B056  (tskcode)   TI545   task    code
B057  (#xmitt )   task    code   #xmitt
B058  ( #rcve )   task    code   #rcve
B061  ( slave )  network  slave   number
B086  ( pntr1 )   task   buffer  pointer
B152  ( xbuff )  tskcode  write   buffer
W036  ( Vaddr )   TI545   Vmem   address
W088  ( pntr2 )  network buffer  pointer
W106  (statptr)   comm   status  pointer
W150  (Vstack )   Vmem    read    stack
```

```
S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page: 10
SYS51 Main Program: C:\PROGRAMS\S3016505\MCOM505.LMN


************************************************************************
block:  6 - High-level

** Comm network node select state **

This block searches for enabled nodes and initiates the parameters
and communications with any enabled nodes.

 0:if (F3 == 0 && B105 == 0)           /* select comm node? */
 1:   {
 2:   F8 = 0;              /* reset done bit */
 3:   for (B42 = B96 + 1; B42 < 33 && F8 == 0; ++B42)
 4:       {
 5:       /* search for enabled nodes and initiate comm */
 6:       W92 = (B42*512)+3c00H;       /* point to nth node */
 7:       sfunc07(W92,B87);
 8:       if (B87 == B42)              /* nth node enabled? */
 9:          {
10:          B96 = B42;                /* initiate comm with node */
11:          F8 = 1;
12:          }
13:       else
14:          {
15:          W106 = 1b00H + ((B42-1)<<1);
16:          sfunc08(W106,0); ++W106;  /* set stat to "disabled" */
17:          sfunc08(W106,0);    /* in TI-505 stat stack is not used */
18:          }
19:       }
20:
21:   if (F8 == 0)         /* all nodes checked? */
22:      B96 = 1;          /* yes, start again with first slave */
23:   else
24:      {
25:      W92 = W92 + 2;           /* get parameters for nth node */
26:      sfunc07(W92,B97);        /* # to xmit */
27:      W92 = W92+4;
28:      sfunc07(W92,B66); ++W92; /* sdest */
29:      sfunc07(W92,B67); ++W92;
30:      sfunc07(W92,B98);        /* # to rcve */
31:      W92 = W92+2;
32:      sfunc07(W92,B68); ++W92; /* ssrce */
33:      sfunc07(W92,B69);
34:      W92 = W92+5;             /* point to nth node xmit buffer */
35:      W94 = 7e0aH;             /* point to sfunc13 buffer */
36:      for (B42 = 0; B42 < B97; ++B42)
37:          {
38:          /* copy nth node xmit buffer to sfunc13 buffer */
39:          sfunc07(W92,B87);
40:          sfunc08(W94,B87);
41:          ++W92, ++W94;
42:          sfunc07(W92,B87);
43:          sfunc08(W94,B87);
44:          ++W92, ++W94;
45:          }
```

```
- block continued on next page -
```

```
S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page: 11
SYS51 Main Program: C:\PROGRAMS\S3016505\MCOM505.LMN


block:  6 - High-level

    - block originated on prev page -

46:      F3 = 1;     /* initiate comm state */
47:      }
48:   }
49:


F003  (netcomm)  network  comm    state
F008  ( done  )                   done
B042  (  (i)  )           loop    (i)
B066  ( sdest )   slave    dest   address
B067  ( sdest )   slave    dest   address
B068  ( ssrce )   slave   source  address
B069  ( ssrce )   slave   source  address
B087  (tempreg)            temp   registr
B096  ( node  )  network   node   number
B097  ( #xmit )   # of     words  to xmit
B098  ( #rcve )   # of     words  to rcve
B105  (dwnload)   down-    load    mode
W092  (nodeptr)   node    buffer  pointer
W094  ( pntr3 )           buffer  pointer
W106  (statptr)   comm    status  pointer
```

APPENDIX A
MCOM505 PROGRAM PRINTOUT


```
**************************************************************************
block:  7 - High-level

** network comm state **

This block performs the communications with the nth node, xmitting
the previously loaded sfunc13 buffer and storing the data read from
the node at the node rcve buffer.

 0:if (F3 == 1)            /* comm state */
 1:   {
 2:   W94 = 0;             /* comm with nth node */
 3:   B38 = sfunc13(B96,B97,*W94,*W66,B98,*W68,*W94);
 4:   if (B38 == 2)        /* comm done? */
 5:      {
 6:      W92 = (B96*512)+3d00H;  /* point to nth node rcve buffer */
 7:      W94 = 7e0aH;            /* point to sfunc13 buffer */
 8:      while (B98 != 0)        /* copy data rcved to node buffer */
 9:         {
10:         sfunc07(W94,B87);
11:         sfunc08(W92,B87);
12:         ++W92, ++W94;
13:         sfunc07(W94,B87);
14:         sfunc08(W92,B87);
15:         ++W92, ++W94;
16:         --B98;
17:         }
18:      }
19:   if (B38 >= 2)        /* comm not busy? */
20:      {
21:      W94 = ((B96-1)<<1) + 1b00H;   /* save error code */
22:      sfunc08(W94,B38); ++W94;
23:      sfunc08(W94,0);
24:      if (B38 != 2)                 /* comm error? */
25:         B40 = B38;                 /* save error code */
26:      W106 = 1b00H + ((B96-1)<<1);  /* save comm return value in */
27:      sfunc07(W106,B108);           /* test for TI_READ/WRITE error */
28:      if (B108 < 11H)
29:         {
30:         sfunc08(W106,B38); ++W106;    /* TI-505 stat stack */
31:         sfunc08(W106,0);
32:         }
33:      F3 = 0;           /* exit comm state */
34:      }
35:   }
36:


F003  (netcomm)  network  comm    state
B038  (sf13ret)  sfunc13 return   value
B040  (commerr)   comm    error   code
B087  (tempreg)           temp   registr
B096  ( node  )  network  node   number
B097  ( #xmit )   # of    words  to xmit
```

```
B098   ( #rcve )    # of     words   to rcve
```

APPENDIX A
MCOM505 PROGRAM PRINTOUT

block: 7 - High-level

```
B108  (comstat)           comm   status
W066  ( sdest )   slave    dest   address
W068  ( ssrce )   slave  source  address
W092  (nodeptr)   node   buffer  pointer
W094  ( pntr3 )          buffer  pointer
W106  (statptr)   comm   status  pointer
```

```
S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page: 14
SYS51 Main Program: C:\PROGRAMS\S3016505\MCOM505.LMN


************************************************************************
block:  8 - High-level

 0:/* test for download mode and wait until complete */
 1:if (F6 == 1)
 2:   {
 3:   if (B105 == 0)       /* not in download mode? */
 4:      {
 5:      F0 = 1;           /* start next comm cycle with TI */
 6:      F6 = 0;
 7:      }
 8:
 9:   /* reset TI_WRITE_ERROR */
10:   W106 = 1b00H + ((B61-1)<<1);
11:   sfunc07(W106,B108);
12:   if (B108 == 12H)
13:      sfunc08(W106,2);
14:   }
15:
16:if (B105 != 0)          /* download mode? */
17:   {
18:   sfunc07(1900H,B90);  /* restore TI-505 comm status stack address */
19:   sfunc07(1901H,B91);
20:   }
21:
22:sfunc08(1ff4H,1);       /* set node address to 1 (master) */
23:


F000  (select )   select  slave   state
F006  (comdone)   TI545   comm    done
B061  ( slave )  network  slave   number
B090  (Verrstk)   Vmem    error   stack
B091  (Verrstk)   Vmem    error   stack
B105  (dwnload)   down-   load    mode
B108  (comstat)           comm   status
W106  (statptr)   comm   status  pointer
```

APPENDIX A
MCOM505 PROGRAM PRINTOUT

```
S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page: 15
SYS51 Main Program: C:\PROGRAMS\S3016505\MCOM505.LMN


*************************************************************************
block:  9 - Assembly

 0:            jnb   F11,com.enb       ; power up TD complete?
 1:            jb    F10,com.enb       ; TI505 reset complete?
 2:            anl   h'c0,#h'fb        ; reset TI bus complete latch
 3:            orl   h'c0,#h'4
 4:            jnb   P3.3,com.enb      ; TI505 still reseting?
 5:            clr   IT1               ; level trigger on TI bus intrpt
 6:            setb  EX1               ; enable TI505 bus intrpt
 7:            setb  F10               ; TI505 reset complete
 8:            mov   B105,#d'0         ; enable task code an network comm
 9:            setb  F000              ; enable task code comm
10:;
11:com.enb:
12:;
13:


F000  (select )   select  slave   state
B105  (dwnload)   down-   load    mode
```

```
S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page: 16
SYS51 Main Program: C:\PROGRAMS\S3016505\MCOM505.LMN


*****************************************************************************
block: 10 - Ladder

                                                                        Power
                                                                         Up
                                                                         TD
        Timer                                                            F011
      +---------+                                                       +-------
 0:+--|         |--+-------+-------+-------+-------+-------+-------+--( )--
      | P:#00015|                                                      PwrUpTD
      | TB:1.00 |
      | A:B110  |
      |(PwrUpTD)|
      |  Power  |
      |   Up    |
 1:   |   TD    |
      +---------+
```

APPENDIX A
MCOM505 PROGRAM PRINTOUT

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APPENDIX A
MCOM505 PROGRAM PRINTOUT

```
S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page:  1
SYS51 Cross Reference: C:\PROGRAMS\S3016505\MCOM505


Typical Cross reference format for variable:

   file:block-line(usage)

   where: file  = file where variable is referenced.
          block = block number in file.
          line  = line number in block.
          usage = sense that variable is referenced.

   file key: INI = initialization file.
             MNF = main program file.
             TMD = Timed interrupt file.
             COM = co-cpu com interrupt file.
             Uxx = User function file (xx = ufunc num).

   Usage key: * = variable value altered at referenced location.
                  (output coil, timer accumulator, set equal, etc.)

              + = variable used in Assembly block.
                  (usage in Assembly block unknown)

              @ = variable used as pointer in High-
                  level block.

              if *, +, or @ is not associated with variable,
              the variable is not altered at location.
              (contact, timer preset , tested for value, etc.)


 Addr (nicname)       description              location used
--------------  ----------------------  -------------------------------

F000  (select )   select  slave   state   MNF: 1-0    1-45*  3-13*  5-13*
                                          MNF: 8-5*   9-9+

F001  (read TI)   read    TI545   state   MNF: 1-42*  2-0    3-0    3-13*
                                          MNF: 3-51*

F002  (rd init)   read    state  initiat  MNF: 2-2    2-11*  3-13*  3-51*

F003  (netcomm)  network  comm    state   MNF: 6-0    6-46*  7-0    7-33*

F004  (writeTI)   write   TI545   state   MNF: 1-39*  3-51*  4-0    5-0
                                          MNF: 5-13*  5-53*

F005  (wr init)   write   state  initiat  MNF: 4-2    4-19*  5-13*  5-53*

F006  (comdone)   TI545   comm    done    MNF: 5-53*  8-1    8-6*

F008  ( done  )                   done    MNF: 1-2*   1-3    1-26*  1-30
                                          MNF: 6-2*   6-3    6-11*  6-21

F009  (TI done)   TI545   task    done    MNF: 3-19   3-27*  3-38*
```

APPENDIX A
MCOM505 PROGRAM PRINTOUT

```
F010  (TIreset)   TI505   reset   comp    INI: 1-5*
```

```
    S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page:  2
    SYS51 Cross Reference: C:\PROGRAMS\S3016505\MCOM505

 Addr (nicname)       description              location used
---------------  ----------------------  --------------------------------

F011  (PwrUpTD)    Power    Up      TD     MNF:10-0*

F102  (tskfail)    TI545    task    fail   MNF: 3-4    3-17*  5-4    5-17*

F103  (TIcomm )    TI545    task   in prog MNF: 3-2    3-16*  3-37*  5-2
                                           MNF: 5-16*  5-33*  5-50*

B035  (numblks)    # of    blocks  TI task MNF: 2-7*   2-9*   3-29   3-36*
                                           MNF: 4-16*  5-19   5-26*

B038  (sf13ret)  sfunc13 return   value   MNF: 7-3*   7-4    7-19   7-22
                                           MNF: 7-24   7-25   7-30

B039  (err cnt)  TI task  retry    count   MNF: 2-12*  3-6*   3-7    4-20*
                                           MNF: 5-6*   5-7

B040  (commerr)    comm    error    code   MNF: 3-9*   3-11   5-9*   5-11
                                           MNF: 7-25*

B042  (  (i)  )            loop     (i)    MNF: 1-3*   1-3    1-6    1-8
                                           MNF: 1-25   1-3*   3-21*  3-21
                                           MNF: 3-21*  4-5*   4-5    4-5*
                                           MNF: 5-28*  5-28   5-28*  5-42*
                                           MNF: 5-42   5-42*  6-3*   6-3
                                           MNF: 6-6    6-8    6-10   6-15
                                           MNF: 6-3*   6-36*  6-36   6-36*

B043  (#words )    # of     words  remain  MNF: 4-17*  5-35   5-38   5-42
                                           MNF: 5-49*

B056  (tskcode)    TI545    task    code   MNF: 3-31*  5-21*  5-37*

B057  (#xmitt )    task     code   #xmitt  MNF: 3-32*  5-22*  5-38*

B058  ( #rcve )    task     code   #rcve   MNF: 3-33*  5-23*  5-39*

B061  ( slave )  network   slave   number  MNF: 1-3    1-25*  1-32*  3-10
                                           MNF: 3-52   4-23   5-10   8-10

B062  ( #send )    # of     words  to send MNF: 1-11*  2-6    2-7    2-9
                                           MNF: 3-43   3-49*

B063  ( #rcve )    # of     words  to rcve MNF: 1-17*  1-33*  4-5    4-16
                                           MNF: 4-17

B064  ( Vsrce )    Vmem    source  address MNF: 1-13*

B065  ( Vsrce )    Vmem    source  address MNF: 1-14*

B066  ( sdest )    slave    dest    address MNF: 1-15*  6-28*
```

APPENDIX A
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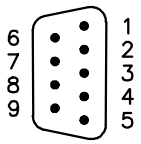
```
B067  ( sdest )   slave   dest   address  MNF: 1-16*  6-29*
```

```
    S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page:  3
    SYS51 Cross Reference: C:\PROGRAMS\S3016505\MCOM505

 Addr (nicname)       description              location used
---------------  ----------------------  -------------------------------

B068  ( ssrce )   slave  source  address  MNF: 1-19*  6-32*

B069  ( ssrce )   slave  source  address  MNF: 1-20*  6-33*

B070  ( Vdest )   Vmem    dest   address  MNF: 1-21*

B071  ( Vdest )   Vmem    dest   address  MNF: 1-22*

B086  ( pntr1 )   task   buffer  pointer  MNF: 2-4*   3-23@  3-23*  3-24@
                                          MNF: 3-24*  3-26*  4-14*  5-27*
                                          MNF: 5-30@  5-30*  5-31@  5-31*
                                          MNF: 5-41*  5-44@  5-45*  5-46@
                                          MNF: 5-47*

B087  (tempreg)           temp   registr  MNF: 1-7*   1-8    1-36*  1-38
                                          MNF: 3-45*  3-46   3-47*  3-48
                                          MNF: 4-7*   4-8    4-10*  4-11
                                          MNF: 6-7*   6-8    6-39*  6-40
                                          MNF: 6-42*  6-43   7-10*  7-11
                                          MNF: 7-13*  7-14

B087.0(tregbt0)   temp    reg     bit0    MNF: 1-37*  1-37

B090  (Verrstk)   Vmem    error   stack   INI: 1-0*
                                          MNF: 8-18*

B091  (Verrstk)   Vmem    error   stack   INI: 1-1*
                                          MNF: 8-19*

B096  ( node  )  network  node   number   MNF: 6-3    6-10*  6-22*  7-3
                                          MNF: 7-6    7-21   7-26

B097  ( #xmit )   # of    words  to xmit  MNF: 6-26*  6-36   7-3

B098  ( #rcve )   # of    words  to rcve  MNF: 6-30*  7-3    7-8    7-16*

B105  (dwnload)   down-   load    mode    INI: 1-4*
                                          MNF: 6-0    8-3    8-16   9-8+

B108  (comstat)           comm   status   MNF: 4-24*  4-25   7-27*  7-28
                                          MNF: 8-11*  8-12

B110  (PwrUpTD)   Power    Up      TD     MNF:10-0*

B152  ( xbuff )  tskcode  write   buffer  MNF: 4-14   5-27   5-41

B182  ( rbuff )  tskcode  read   buffer   MNF: 2-4    3-26

W036  ( Vaddr )   TI545   Vmem   address  MNF: 2-10*  3-34   3-35*  3-35
                                          MNF: 4-18*  5-24   5-25*  5-25
                                          MNF: 5-40
```

```
W064  ( Vsrce )   Vmem   source  address  MNF: 2-10
```

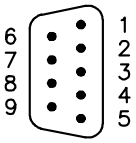
```
    S3016-505 S3000 Network Master (31 slave nodes)        03/11/02  Page:  4
    SYS51 Cross Reference: C:\PROGRAMS\S3016505\MCOM505

 Addr (nicname)       description              location used
---------------  ----------------------  -------------------------------

W066  ( sdest )   slave   dest   address  MNF: 7-3@

W068  ( ssrce )   slave  source  address  MNF: 7-3@

W070  ( Vdest )   Vmem    dest   address  MNF: 1-34*  4-18

W084  (slveptr)   slave   buffer pointer  MNF: 1-6*   1-7    1-10*  1-10
                                          MNF: 1-11   1-12*  1-12   1-13
                                          MNF: 1-13*  1-14   1-14*  1-15
                                          MNF: 1-15*  1-16   1-16*  1-17
                                          MNF: 1-17*  1-18*  1-19   1-19*
                                          MNF: 1-20   1-20*  1-21   1-21*
                                          MNF: 1-22   1-24*  1-24   1-35*
                                          MNF: 3-46   3-46*  3-48   3-48*
                                          MNF: 3-52*  4-7    4-9*   4-10
                                          MNF: 4-12*

W088  ( pntr2 )  network buffer  pointer  MNF: 2-5*   3-23   3-23*  3-24
                                          MNF: 3-24*  3-42*  3-45   3-46*
                                          MNF: 3-47   3-48*  4-4*   4-8
                                          MNF: 4-9*   4-11   4-12*  4-15*
                                          MNF: 5-30   5-30*  5-31   5-31*
                                          MNF: 5-44   5-45*  5-46   5-47*

W090  (Verrstk)   Vmem    error   stack   MNF: 1-34

W092  (nodeptr)   node   buffer  pointer  MNF: 6-6*   6-7    6-25*  6-25
                                          MNF: 6-26   6-27*  6-27   6-28
                                          MNF: 6-28*  6-29   6-29*  6-30
                                          MNF: 6-31*  6-31   6-32   6-32*
                                          MNF: 6-33   6-34*  6-34   6-39
                                          MNF: 6-41*  6-42   6-44*  7-6*
                                          MNF: 7-11   7-12*  7-14   7-15*

W094  ( pntr3 )          buffer  pointer  MNF: 6-35*  6-40   6-41*  6-43
                                          MNF: 6-44*  7-2*   7-3@   7-3@
                                          MNF: 7-7*   7-10   7-12*  7-13
                                          MNF: 7-15*  7-21*  7-22   7-22*
                                          MNF: 7-23

W106  (statptr)   comm   status  pointer  MNF: 3-10*  3-11   3-11*  3-12
                                          MNF: 4-23*  4-24   4-26   5-10*
                                          MNF: 5-11   5-11*  5-12   6-15*
                                          MNF: 6-16   6-16*  6-17   7-26*
                                          MNF: 7-27   7-30   7-30*  7-31
                                          MNF: 8-10*  8-11   8-13

W150  (Vstack )   Vmem    read    stack   MNF: 3-34*  5-24*  5-40*
```

APPENDIX B
RS-232/RS-422 PIN OUTS/CABLES



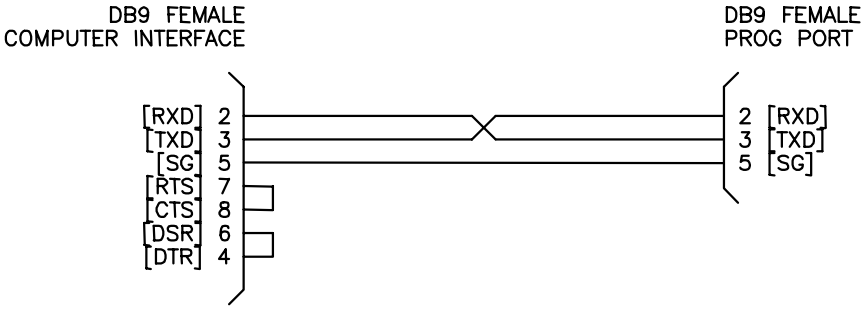
1: NOT USED
2: RXD (RECEIVE DATA – IN)
3: TXD (TRANSMIT DATA –OUT)
4: NOT USED
5: SG (SIGNAL GROUND)
6: NOT USED
7: NOT USED
8: NOT USED
9: NOT USED

PROG Port Pin Out

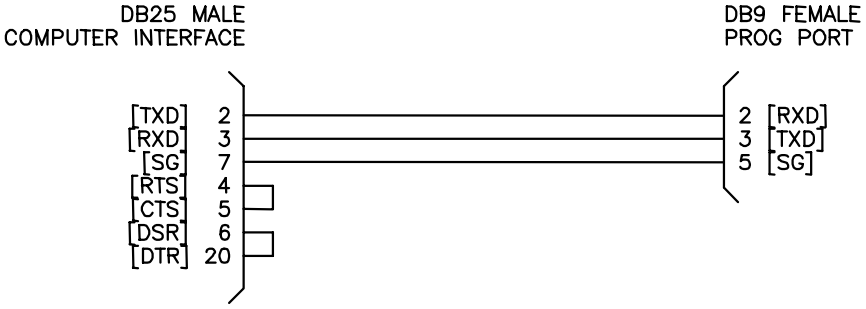


1: NOT USED
2: RS–232 RXD (RECEIVE DATA – IN)
3: RS–232 TXD (TRANSMIT DATA –OUT)
4: NOT USED
5: SG (SIGNAL GROUND)
6: RS–422 TXD+ (TRANSMIT DATA – OUT)
7: RS–422 TXD– (TRANSMIT DATA – OUT)
8: RS–422 RXD+ (RECEIVE DATA – IN)
9: RS–422 RXD– (RECEIVE DATA – IN)

USER Port Pin Out



DB9 (com1) to PROG Port Cable



DB25 (com1) to PROG Port Cable