LA-8182-M

Manual

UC-32

Issued: January 1980

DYMAC Communications System

Kathleen A. Lindsey

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DYMAC COMMUNICATIONS SYSTEM

by

Kathleen A. Lindsey

ABSTRACT

The DYMAC Communications System is part of a nuclear safeguards system called DYMAC--short for DYNAMIC Materials ACCOUNTABILITY--that gathers accountability information at the Los Alamos Scientific Laboratory (LASL) Plutonium Processing Facility. The communications system handles transmissions between data-entry terminals and nondestructive assay (NDA) instruments located in the facility, and a computer located in an adjacent building. System design emphasizes reliability rather than high speed to ensure the integrity of data transmissions.

This manual is directed toward the person responsible for maintaining the DYMAC Communications System. It describes the components that make up the communications network, explains how they operate, and gives detailed information about all of the connections. Many of the system components are commercially available; some have been modified at LASL for DYMAC purposes; others were designed and fabricated at LASL. This manual provides circuit diagrams for all of the LASL modifications and LASL-fabricated equipment. In addition, it provides a series of procedures for tracing cables, reconfiguring various parts of the system, testing data transmissions, and troubleshooting malfunctions.

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ABOUT DYMAC...

The DYMAC System collects accountability information at the LASL Plutonium Processing Facility for the purpose of safeguarding the nuclear material inside the facility. The system maintains a computer inventory file for every item of nuclear material in the facility, which includes the type of material, its amount, and the location. This file is kept current by facility personnel who notify the DYMAC System whenever they change the location or composition of an item during processing.

Such a timely accountability system is made possible by the use of NDA instruments that measure nuclear material during the course of processing. Two types of DYMAC NDA instruments, the thermal-neutron coincidence counter (TNC) and fast-neutron coincidence counter (FNC), base their measurements on a count of neutron emissions. Two other types, the segmented gamma scanner (SGS) and solution assay instrument (SAI), count gamma rays. The most widely used DYMAC instrument in the facility is the digital electronic balance, which weighs items of known composition to determine the amount of nuclear material present.

Accountability rules dictate when the computer inventory must be updated. These rules are incorporated in the accountability procedures for each process. When an item changes location in the facility, and at certain stages during processing, personnel make transactions at data-entry terminals to update the computer inventory file. Frequently a transaction is coupled with a measurement. In the process of making a transaction with an associated measurement, a technician informs the computer which instrument he used. The instrument retains the measured amount until the transaction is completed and the technician resets it to zero.

The primary purpose of collecting timely inventory information in a computer is for accountability. Because of the nature of plutonium, uranium, and other strategic nuclear materials, it is

crucial to know exactly what material is in the facility at all times and where it is located.

DYMAC is a nuclear safeguards program designed to detect missing material. Most "missing" material is really not lost; it is simply "material in process," or MIP. It can be stuck to glovebox walls or left in the bottom of containers. MIP can also result from measurement errors. The DYMAC System calculates the MIP for each accountability area to determine whether a diversion has taken place. Then it is the responsibility of the Nuclear Materials Officer, who has custodianship of all the nuclear material in the facility, to investigate.

Collecting timely inventory information for safeguards purposes has three additional benefits: production control, quality control, and ease of inventory-taking. Timely status reports enable a supervisor to alter the work schedule as processing requires. At each stage of processing, the reports inform the supervisor whether the product will meet quality-control inspection. From a printout of the computer inventory for a particular location, a supervisor can readily verify the physical inventory. Annual inventory is greatly simplified because mistakes are quickly detected and resolved as they occur.

GLOSSARY

ALM	asynchronous line multiplexor
AMP	AMP company, electronic component manufacturer
ASCII	American Standard Code for Information Interchange
bps	bits per second
CAL	calorimeter
CRT	cathode-ray tube
CSB	Cold Support Building
DCE	data communications equipment
DR	data ring (current return, -)
DT	data tip (current source, +)
DTE	data terminal equipment
DYMAC	DYnamic Materials ACcountability
EIA	Electronic Industries Association
FNC	fast-neutron coincidence counter
I/O	input/output
LASL	Los Alamos Scientific Laboratory
LED	light-emitting diode
MUX	multiplexor
NDA	nondestructive assay
NEMA	National Electrical Manufacturers Association
PR	TI 810 label-printing terminal
RX	receive
SAI	solution assay instrument
SGS	segmented gamma scanner
T	Teleray 3741 CRT terminal
T ₁	Supervisory station: Teleray 3741 CRT terminal paired with TI 733 hard-copy terminal
TI	Texas Instruments
TNC	thermal-neutron coincidence counter
TNC-B	TNC for barrels
TTL	transistor-transistor logic
TX	transmit
UART	universal asynchronous receiver/transmitter
VOM	volt-ohm meter
W ₁	electronic balance, 0-5.5 kg, 0.1-g precision
W _{1A}	electronic balance, 0-5.5 kg, 0.01-g precision
W ₂	electronic balance, 0-15 kg, 0.1-g precision

1. INTRODUCTION

The DYMAC Communications System transmits accountability information from remote terminals and NDA instruments in the four wings of the LASL Plutonium Processing Facility to the production computer. Resident in the computer is an inventory of every item in the facility that contains nuclear material. Information about an item's change in status is transmitted from a terminal to the computer where it updates the inventory. Information about the always-current computer inventory is transmitted to the requesting terminal.

The communications system can be considered in continuous operation. There is no need to turn off terminals or instrument interfaces when they are not in use. However, none of these devices can be used to transmit information unless the production computer is in operation. As soon as the computer system is brought up at the beginning of a processing day, the START UP menu appears on the CRT (cathode-ray tube) screens of all the terminals. The appearance of this menu notifies facility personnel that they can begin sending information to the computer and requesting information from it.

The DYMAC Communications System consists of data-entry terminals, communications lines, interface circuits, junction boxes, outlet boxes, a jackfield, and diagnostic equipment. Communications lines connect the remote terminals and NDA instruments in the Plutonium Processing Facility to the production computer, a Data General Eclipse C330, in the adjoining Cold Support Building (Fig. 1-1). A few terminals are also located in the Cold Support Building. Terminals and instruments are connected to the production computer via a jackfield, which permits flexibility in reconfiguring the system. A second Eclipse computer, located in the same room as the production computer, handles off-line tasks such as software development, report generation, accountability procedures, and training. Diagnostic equipment, located in the jackfield rack, is used for troubleshooting all parts of the communications system.

Fig. 1-1.

Trunk cables connect terminals and NDA instruments in the Plutonium Processing Facility to the production computer located in the adjacent Cold Support Building.

DYMAC data-entry terminals and some NDA instruments* are connected on-line to the production computer. This means that they transmit information directly to the computer via communications lines. The information consists of transactions, inquiries, and measurements. Facility personnel are required to make transactions whenever items change location or undergo chemical or physical change. They can make inquiries whenever they need information about the inventory. The volume of data transmitted from the terminals far exceeds that transmitted from the instruments. The computer transmits information to the terminals upon request, in the form of prompts and messages. It issues commands to the NDA instruments that cause them to transmit measurement data.

*Instruments connected on-line to the computer change too frequently to list in this manual. Consult the Line Definition (LINEDEF) table computer listing, available in the DYMAC computer room, for an accurate account.

INTRODUCTION

The DYMAC System uses on-line NDA measurements to ensure reliable, timely entry of measurement data into the computer. A transaction must be made at the same time the measurement is made because the two are coupled. For example, when an item is weighed on an electronic balance, its weight is locked in the balance readout unit for transmission to the computer. The technician makes a transaction concerning the item and identifies the electronic balance. The computer then reads the weight stored in the balance readout unit without going through the terminal. The computer can perform diagnostics on all measurement data that is directly transmitted from the instruments, to ensure that the transmission has been error-free.

2. GENERAL SYSTEM DESCRIPTION

The DYMAC Communications System is made up of commercially available equipment and equipment fabricated at LASL. LASL personnel designed and fabricated the diagnostic equipment, the cables that connect the terminals to the communications system, and circuits for the digital electronic balances. All the other equipment--data-entry terminals, jackstrips, cables, connectors, junction boxes, patchcords, and so forth--is commercially available. Appendix A itemizes the commercial equipment and the LASL-fabricated equipment. Appendix B documents specific purchases by order number, date, and vendor. Appendix C lists the vendors' addresses and telephone numbers.

COMMUNICATIONS LINES

The DYMAC Communications System extends through the four wings of the Plutonium Processing Facility and the Cold Support Building. It connects remote terminals and NDA instruments to the production computer through a series of connections, as shown in Fig. 2-1.

Fig. 2-1.
Sequence of connections from
a remote device to the produc-
tion computer.

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Comprehensive layouts of the facility's four wings in Appendix D show the location of every outlet box through which a terminal or NDA instrument can be connected to the production computer.

Five to seven trunk cables run in the basement beneath each wing, as shown in Fig. 2-2. A trunk cable consists of 24 pairs of wires and is constant for the entire length of a wing. For example, the seven trunk cables in the 400 Wing have a total of 168 wire pairs that extend throughout the wing, including the areas between the junction boxes. All 168 wire pairs in the trunk cable are available in the three basement junction boxes for connection to an outlet box.

A short cable (2 to 3 m long) with a four-prong phone plug connects an NDA instrument or terminal to the production computer at an outlet box that contains a mating phone jack. The plugs and jacks are the type used by telephone companies for extension phones in residential and commercial installations. Cables consisting of two pairs of wires connect individual outlet boxes to the trunk cables at the basement junction boxes.

Fig. 2-2.
DYMAC Communications System.

Trunk cables run from the junction boxes located in the basement to two junction boxes in the DYMAC computer room. Other cables connect these boxes to the jackfield. About thirty 24-pair cables connect the jackfield to the computer multiplexor (MUX).

Connections that link all of the communication outlets in the Plutonium Processing Facility and Cold Support Building to the junction boxes in the DYMAC computer room are specified in the WIRERUN Listing, a separate document. (Refer to Sec. 6 for information on how to use the WIRERUN listing, and Appendix E on how to obtain a copy.) Changes to the communications system require changes to the WIRERUN Listing. More complete information on communications lines and connections appears in Secs. 3, 4, and 6.

JACKFIELD AND DIAGNOSTIC EQUIPMENT

The jackfield and its associated diagnostic equipment (shown in Fig. 2-3) are installed in a 0.5-m-wide rack located near the production computer. The jackfield serves a threefold purpose: it houses the hard-wired connections between the remote devices and the computer, it is a manual patching point where lines can be reconnected to obtain the system configuration needed, and it provides a maintenance point where diagnostics can be performed. For example, MUX ports can be easily checked at the jackfield to determine whether the computer is malfunctioning. More complete information on the jackfield and diagnostic equipment appears in Secs. 5, 7, 8, and 9.

Fig. 2-3.

The jackfield offers patching capability in addition to permanently wired connections. The rack also contains diagnostic equipment.

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DATA-ENTRY TERMINALS

The DYMAC System incorporates three types of remote terminals for data entry and retrieval. The three are commercial products available from Teleray* or Texas Instruments.*

The most common type of terminal used in the plutonium facility is a Teleray 3741 terminal with CRT screen,** shown in Fig. 2-4. It operates at high speed (4800 bps) over the communication lines. To operate the terminal properly, the switch settings should be in the positions shown in Fig. 2-5.

*See Appendix C for complete addresses.

**Teleray 3700 C1 Series, CRT Data Terminal, Instruction Manual.

Fig. 2-4.
Teleray 3741 terminal with CRT screen.

Some minor modifications have been made to the Teleray terminals to adapt them to the DYMAC System. The CAPS LOCK key on the keyboard has been permanently locked; this prevents transmission of lower-case characters, which the computer does not recognize. The 20-mA current loop circuits were modified by insertion of a 62k-ohm resistor between the base of the terminal's receive optoisolator and ground. A 22k-ohm resistor was inserted between the base of the terminal's transmit optoisolator and its emitter. These resistors improve the receive- and transmit-current waveforms of the terminals and eliminate communications problems on some longer lines.

Another type of terminal, a TI 733, shown in Fig. 2-6, produces hard copy.* It is much slower than the Teleray, transmitting 300 bps. A hard-copy terminal can be used only in conjunction with the Teleray it is associated with, enabling the user to display report information on the Teleray screen or print it on the hard-copy terminal. Together, a Teleray and a TI 733 hard-copy terminal form a supervisory station. The hard-copy terminal is connected separately to the computer.

The third type of terminal is the TI 810 label printer,** shown in Fig. 2-7. Considerably faster than the hard-copy terminal, it prints information on continuous forms at the rate of 1200 bps. A label printer cannot be used independently of the Teleray terminal with which it is associated. Just like the hard-copy terminal, it enables the user to choose a display or printed form for report or label information. Its main function is to produce labels for items as they enter and leave the vault. The label printer is connected separately to the computer.

*Fig. 2-5.
The switches on a
Teleray terminal
should be set as
shown. The dot in-
dicates the proper
position.*

*Texas Instruments Model 733 terminal, Service Manual 960129-9701.

**Texas Instruments Model 810 Printer Maintenance Manual 994386-9701.

Proprietor: L. H. B. F. F. F. F. F.

• *Chlorophyll* is the green pigment in plants that captures light energy for photosynthesis.

NDA INSTRUMENTS

NDA instruments are a major part of the DYMAC System and are treated in separate manuals.* These instruments determine the nuclear content of items quickly, in the course of processing. They make a near-real-time accountability system possible.

One type of NDA instrument is the digital electronic balance. It can be used to determine the nuclear content of an item when the proportion of the item's nuclear material to the rest of its makeup is already known. The weight of the item can then be multiplied by a predetermined factor to establish the nuclear content. About one-half of all the DYMAC NDA instruments in use in the plutonium facility are electronic balances.

The other NDA instruments assay items to determine their nuclear composition. Two types of instruments count gamma-ray emissions and two others count neutron emissions. The segmented gamma scanner (SGS) counts gamma rays in low-concentration material to determine the amount of plutonium. The solution assay instrument (SAI) also counts gamma-ray emissions from solutions to determine their concentrations of plutonium. The thermal-neutron coincidence counter (TNC) and fast-neutron coincidence counter (FNC) count neutron emissions to determine the amount of plutonium in a particular item.

Another instrument, the calorimeter, determines the amount of plutonium in an item from the amount of heat generated. The calorimeter is not a DYMAC instrument but is used for accountability purposes.

PRODUCTION COMPUTER

The DYMAC production computer handles all of the transactions and inquiries made during the processing day. It maintains an up-to-date inventory of every item in the plutonium facility and produces sorted inventory information in different report formats. The computer remains in operation during working hours so that personnel can update the inventory as the status of processing changes.

The production computer is a Data General Eclipse C330 with 256k 16-bit words of core memory. Data processing peripherals include

*In draft form at the time the Communications Manual is being published.

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two system consoles, two disk storage systems, a 600-line-per-minute printer, and two magnetic tape units. The system consoles permit simultaneous operation in foreground and background modes. A Diablo disk stores 20 megabytes of data and a Zebra disk stores 96 megabytes. The tape units are used for dumping the inventory files and for logging all transactions at the end of each processing day.

The computer multiplexor allows data transmission from the jackfield to the computer over 128 communications lines; 64 are implemented. The lines connect the production computer with terminals and NDA instruments in the plutonium facility. Detailed information about connecting the production computer to the jackfield is given in Sec. 4.

SECONDARY COMPUTER

The second Eclipse C330 in the DYMAC computer room handles off-line tasks and can replace the production computer in case of a major failure. It is similar to the production computer except that it has fewer ports. The secondary computer system consists of 64 communications lines between the multiplexor and the jackfield; however, only 16 ports are available at the multiplexor. The ports are located on the bottom three jackstrips in the jackfield rack. Terminals or instruments may be patched or connected to these ports at the jackfield.

Normally, the secondary computer is used for software development, training, report generation, and accountability procedures. Before routines are added or changed on the production computer, they are tested on the secondary computer to detect errors and remedy them. Facility personnel are trained in making transactions and inquiries on the secondary computer before using the production system. Development of accountability procedures, such as tracing an item from the time it enters the plutonium facility until the time it leaves, also takes place on the secondary computer.

In its backup function, the secondary computer replaces the production computer. The switch is made at the jackfield by patching a maximum of 16 secondary computer ports to specific device locations. Detailed information about connecting the secondary computer to the jackfield is given in Sec. 4.

MULTIPLEXOR

The asynchronous line multiplexor of a Data General Eclipse computer is the input and output interface between the computer and remote devices. The computer transmits data to and receives data from remote devices via the multiplexor, which enables the computer to communicate with several devices simultaneously.

The computer scans each MUX line (port) to determine if a device is ready to transmit data. The receive lines that go to the computer are given the highest priority by the multiplexor; if no receive lines are active, then the computer scans the transmit lines from the computer and proceeds to transmit the data that is ready. The lower numbered MUX ports for both the receive and transmit lines are serviced first by the computer.

Each MUX interface board contains 16 ports. The production computer has eight MUX boards, for a total of 128 ports. The secondary computer has one MUX board, for a total of 16 ports. Extra cables are available at the rear of the secondary computer to increase the number of ports to a maximum of 64.

Each MUX board plugs into the back panel of the computer chassis. Cable ends having several 6-pin AMP connectors connect to wirewrap pins on the back panel. The other end terminates in 50-pin AMP connectors at the jackfield.

Data General personnel maintain both the production and secondary computers, including all MUX interface boards. Additional information on the Eclipse multiplexor is published elsewhere.*

SYSTEM CONVENTIONS

The DYMAC Communications System conforms to design criteria that were specified during the initial design of the computer system. All communications lines are half- or full-duplex, asynchronous, with an upper speed limit of 9600 bps and with programmable line characteristics. All terminals have a minimum of 72 characters per line. CRT display screens have a minimum of 24 lines per page. Upper-case ASCII (American Standard Code for Information Interchange) is the character set. Transmission is on a character basis with echo from the computer. Terminals have an audible device that

*Technical Reference, Data General Communications System 014-000070.

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issues a beep in response to the ASCII bell code. The terminals have standard ESCAPE and RETURN keys. All of the NDA instruments connected to the computer send data in the same mode as the terminals, that is, using upper-case ASCII, on a character basis, terminated by a RETURN. The computer echoes all characters.

A 20-mA current loop is the signaling standard between the computer and the individual instruments and terminals. This loop has great immunity to noise and requires little additional equipment, such as modems.* The communication links to the NDA instruments were chosen for reliability rather than high speed to ensure transmission of correct data. Bit-serial transmission, which is reliable and cost-effective, is sent over twisted pair cables. Individually shielded wire pairs reduce crosstalk and errors due to extraneous noise sources.

The "intelligence" of the DYMAC computer system is centralized in the computer, instead of in each remote terminal. This allows the computer to make diagnostic checks during the course of a transaction. Real-time inventory searches, made possible by the centralized intelligence of the computer system, detect many data-entry errors as soon as they occur.**

*We rejected the EIA (Electronic Industries Association) RS-232C interface method because high transmission rates (up to 4800 bps) and the long distances (up to 120 or 150 m) between the computer and instruments or terminals could result in marginal transmission.

**A different approach, which we rejected, was to distribute the intelligence of the computer system by using relatively expensive terminals that include some processor capability and memory, or to use remote minicomputer concentrators to drive the interactive terminals. Typically, in systems where the intelligence is so distributed, elementary diagnostics such as syntactical checks are performed at the remote processor, then the complete set of transaction data is transmitted to the central computer to update the inventory files. The shortcoming of this approach is that an entire transaction is rejected if the item involved in the transaction is not found in the inventory.

3. COMMUNICATIONS CABLES AND EQUIPMENT

The trunk cables that run beneath the four facility wings contain a constant number of wire pairs for the length of an entire wing. This makes it possible to connect any wire pair in the cable to a terminal or NDA instrument wherever it is located in the wing. Figure 3-1 traces the wiring from an outlet box in the facility, through a basement junction box, to the computer multiplexor.

Fig. 3-1.

Diagram of the wiring from the MUX board on the production computer to an outlet box in the plutonium facility.

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CABLES

All cables used in the DYMAC Communications System are commercially available except for LASL-fabricated cables that connect to the data-entry terminals. The commercial cables are itemized in Appendix A.

Six cable types were fabricated at LASL according to DYMAC design specifications. Each cable has a different function, depending on the terminal it is associated with and its intended destination. Table 3-I specifies the function of each cable type. Wiring for each cable is shown in Appendix F, Figs. F-1 through F-6.

To reduce manual wiring, 50-pin connectors are used on jackstrips, terminal strips in computer room junction boxes, and cable ends that go to the jackfield. Cable ends that go to the multiplexor have twelve 6-pin connectors, although only four of the six pins are used: 1, 2, 5, and 6.

TABLE 3-I
SPECIAL CABLES FOR TERMINALS

Type of Cable	Type of Terminal	Cable Destination
A	Teleray 3741 CRT	outlet box
B	TI 733 hard copy	outlet box
C	TI 810 label printer	outlet box
D	Teleray 3741 CRT	multiplexor
E	Teleray 3741 CRT	Diagnostic Panel or jackstrip
F	Teleray 3741 CRT	jackstrip (Fox Generator use)

GROUNDING AND SHIELDING

The 20-mA current loop chosen as the signaling standard between the computer and NDA instruments or terminals provides a high degree of noise immunity. In addition, each pair of wires in the communications system is covered with a mylar shield to avoid signal pickup between wire pairs and to minimize noise pickup from extraneous sources in the plutonium facility. The mylar shield can be terminated by using the uninsulated drain wire (which is in physical contact with the conductive coating on the shield) for grounding any noise picked up by the shield. The shield for a pair of wires from an outlet box to a basement junction box is connected to the shield for the corresponding pair of wires that runs from that basement junction box to a computer room junction box. Thus, the shield is continuous from the outlet box to the computer room junction box.

Shields are tied to ground at only one location to ensure minimum ground-loop pickup. The shields are cut and taped at each outlet box; they are not connected electrically. All communications shields are tied together in the two computer room junction boxes. A green wire connects the shields in these boxes to the chassis of the computer rack; the chassis is connected to the green wire (ground) of the AC distribution system.

For example, if noise on the lines in the 200 Wing becomes a problem, the cable shields in the 200 Wing basement junction boxes can be jumpered together in the last junction box (214) and then tied to the ground wire in any or all of the three junction boxes for that wing. In this manner, one can determine whether grounding a shield at several points will alleviate the noise problem.

A current probe can be used to measure the current in the ground wire of junction box 214 and in the individual or collective drain wires of several cables in the 200 Wing. This probe measures the ground-loop currents flowing in the drain wires and the amount of common mode noise that is picked up. These measurements can be made in the time domain, but measurements made in the frequency domain may be more useful.

BASEMENT JUNCTION BOXES

Basement junction boxes are connected in series to provide the maximum number of wires available at each junction box. The location of the junction boxes in the facility basement is shown in Fig. 3-2. To designate the location of each junction box, one can use the DYMAC numbering system or the nearest coordinates of the junction box location as specified on LASL Engineering Department drawings. For example, DYMAC junction box number 114 is the same as the engineering drawing for junction box K-14. The WIRERUN Listing designates it as K-14-114 (see Sec. 6), acknowledging both numbering systems.

Fig. 3-2.
Junction box locations in the basement of the plutonium facility.

Each basement junction box has three adjacent, rectangular terminal strips, which are mounted lengthwise, as shown in Fig. 3-3. Terminal strips are identified by a T number (for example, T01) to identify the strip itself and a termination point number (for example, 018); together, they constitute a unique identifier (T01-018).

Junction boxes in the DYMAC computer room are discussed in Sec. 4.

Fig. 3-3.

Basement junction boxes are connected in series to ensure that the maximum number of cable pins are available at each box.

OUTLET BOXES

Figure 3-4 shows the wiring of a typical wall-mounted outlet box for connecting terminals or NDA instruments in the facility to the production computer. Each outlet box has four sockets. A brown-and-red wire pair connects the upper two sockets of the box to the computer transmit circuit; an orange-and-yellow wire pair connects the lower two sockets to the computer receive circuit. The left socket of each pair (as viewed from the front of the box) is the source, or plus, signal socket (brown-and-orange wires), and the right socket is the return, or minus, signal socket (red-and-yellow wires).

*Fig. 3-4.
Outlet box.*

To avoid excessive ground loops (see Grounding and Shielding), the drain wire and shield for each wire pair are cut and taped at the point where they enter the outlet box. Outlet boxes are mounted with the wider spaced sockets at the top.

INTERFACE CIRCUITS

All remote terminals and NDA instruments used in the DYMAC System must contain a passive current-loop interface circuit that is optically isolated to communicate with the computer. The three types of terminals used in the DYMAC System, the Teleray 3741 CRT, TI 733 hard-copy, and TI 810 label-printing terminals already have optoisolator interface circuits. The modified interface circuit (See Sec. 2, Data-Entry Terminals) for the Teleray 3741 CRT terminal is shown in Appendix F, Fig. F-7. The 20-mA current-loop interface circuits for the TI 733 hard-copy terminal (Fig. F-8) and for the TI 810 label-printing terminal (Fig. F-9) are the type of interfaces that are standard for these terminals.

A printed-circuit interface board (Fig. F-10) was designed at LASL to optically isolate the NDA instruments from the computer. At present, the interface board is only being used with the electronic balances. The interface board contains a UART (universal asynchronous receiver/transmitter), which converts serial data to parallel data and vice versa, and operates with a +5 V power supply.

In the receive circuit of the interface board (Fig. F-10), a voltage comparator (LM-311) has a 3-V threshold for switching; it will not transfer noise spikes under 3 V to the UART. In this way, the comparator screens out noise which the UART would otherwise read as data. In addition, the 0.001- μ F capacitor provides a small amount of frequency rolloff for fast noise transients.

In the transmit circuit of the interface board (Fig. F-10), a constant current diode limits the collector current of the optoisolator (MCT-2) to provide a low saturation voltage; this ensures that the next transistor (Q-1) is turned on. The last transistor (Q-2) in the circuit should have enough base drive to provide a low-resistance path for the current from the computer. The inputs and outputs of the receive and transmit circuits are compatible with other TTL (transistor-transistor logic) circuits.

The current-loop interface circuit in the computer is shown in Fig. F-11. In the transmit circuit, the original 620-ohm resistor was replaced with a 510-ohm resistor. In the receive circuit, the original 1200-ohm resistor was replaced with an 800-ohm resistor. The use of these lower-ohm-value resistors increases the current enough to meet the 20-mA current-loop requirements.

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In addition to the resistor replacements, a 0.25-A Littelfuse was added at the computer input of the receive/return circuit for each MUX port. Originally, one fuse protected the -12 V supply on each MUX board. When a short occurred from the power supply to ground, all 16 MUX ports on the affected board were disabled. With the Littelfuse in each circuit, only the fuse connected to the shorted line blows when a short occurs; the other 15 ports on the board continue to function properly.

4. WIRING IN THE DYMACH COMPUTER ROOM

An overview of the wiring in the DYMACH computer room (Room 131 in the Cold Support Building) is shown in Fig. 4-1. Trunk cables from remote locations enter the computer room through two junction boxes, J01 and J02. Individual cables from terminals in the Cold Support Building enter the computer room through a third junction box, JB-B. Other cables connect the junction boxes to the jackfield and the jackfield to the MUX ports on the computer. Appendix G provides a comprehensive account of all the cable connections.

Fig. 4-1.
Wiring in the DYMACH computer room.

COMPUTER ROOM JUNCTION BOXES

Each 24-pair trunk cable from the plutonium facility basement terminates in the DYMAC computer room in junction boxes J01 or J02, as shown in Fig. 4-2. Junction box J01 contains twelve 50-pin terminal strips (T01 - T12); junction box J02 contains 13 strips (T01 - T13), as shown in Fig. 4-3. Figure 4-4 shows a sample terminal strip.

*Fig. 4-2.
Computer room junction box (J02).*

Fig. 4-3.

Location of terminal strips in computer room junction boxes J01 and J02. Terminal strip T13 is used only in junction box J02; T13 is connected to some of the terminals in the Cold Support Building.

JUNCTION BOXES TO THE JACKFIELD

Cables with 50-pin AMP* connectors on each end connect the three computer room junction boxes to the jackfield. The cables mate with female AMP connectors mounted on terminal strips in the junction boxes (Fig. 4-4) and with female AMP connectors on the jackstrips. Each cable connects a terminal strip to the LINE SIDE (side connected to remote locations) of the jackfield on a one-to-one basis. Table H-I in Appendix H specifies the cable connections from the computer room junction boxes to the jackstrips on the jackfield.

*Manufacturer's name.

JACKFIELD TO THE PRODUCTION COMPUTER

Cables with 50-pin AMP connectors on one end mate with the connectors on the jackstrip; on the opposite end, 6-pin AMP connectors connect to the computer multiplexor. Table H-II provides connection details. These cables connect the DROP SIDE of the jackfield to the computer multiplexor. Figure 4-5 shows the MUX port locations at the rear of the production computer. There are four MUX boards per chassis; they are labeled ALM for asynchronous line multiplexor; ALM is synonymous with MUX. MUX port assignments are given in Appendixes G and J.

CONNECTIONS TO THE SECONDARY COMPUTER

The secondary computer system consists of six 25-pair cables running directly from the bottom three jackstrips on the jackfield to the multiplexor at the rear of the secondary computer. Each cable terminates at the jackfield in a 50-pin AMP connector and at the secondary computer in several 6-pin AMP connectors. On the DROP SIDE of the jackstrips, 16 ports (0-15) are available. There are enough cables installed to expand the number of secondary computer ports to 64. No connections are made to the LINE SIDE of the jackstrips, leaving the secondary computer available for off-line tasks or for use as a backup computer.

The assignment of secondary computer ports to jackfield locations is shown in Fig. 4-6 and listed in Table H-III. The wiring code follows the same conventions as the code for the production computer and is listed in Table H-II. No specific locations in the plutonium facility have been given priority for patching to the secondary computer ports if the production computer should fail. When the need arises, any of the 16 locations can be connected to the secondary computer by patching the LINE SIDE of a device location to the DROP SIDE of a secondary computer port at the jackfield.

Fig. 4-4.
Sample terminal strip in
computer room junction
boxes.

Fig. 4-5.
Multiplexor port locations at rear of production computer.
(ALM is synonymous with MUX.)

Fig. 4-6.
Wiring of secondary computer ports to jackfield locations.

5. THE JACKFIELD

The jackfield provides flexibility for maintenance and for making additional hook-ups. For example, a failed MUX port can be replaced with a spare port by patching at the jackfield. The jackfield is also used for checking out new lines, for troubleshooting the communications system, and for hooking up the secondary computer when needed.

The jackfield is located in the DYMAC computer room near the production computer. It is composed of twelve jackstrips mounted on top of one another in a 1.8-m-high rack (Fig. 2-3). A jackstrip is a chassis with three rows of 48 jacks mounted on the front panel. The jacks are specialized connectors on the front of the jackstrip, which are wired to four 50-pin AMP connectors on the rear panel. Figure 5-1 shows the front panel of an individual jackstrip, with an enlarged view of two jack circuits. Figure 5-2 shows a detailed view of the corresponding rear panel.

Every NDA instrument and terminal in the facility has a separate communications line that connects it to the jackfield. A communications line runs from an outlet box in the Plutonium Processing Facility or the Cold Support Building to a pair of side-by-side jacks on the jackfield. Conventions dictate that data be transmitted from the production computer through the left jack of the pair to the outlet box. The computer receives data from the outlet box through the right jack. Each jack consists of two wires called data tip (DT) and data ring (DR). DT is the current source (+) and DR is its return (-).

A set of three vertically oriented jacks, one from each row on a jackstrip, constitutes a jack circuit, which is used either for transmission or reception. In one circuit, the LINE jack on top connects to a remote location in the facility; the DROP jack in the middle connects to a computer MUX port; and the MONITOR jack on the

Fig. 5-1.
Jackstrip front panel, with enlarged view of two jack circuits that together constitute one communications line. XXX specifies the wing and room number of a remote location, YY specifies the outlet box number, and PORT ZZZ specifies the number of the port connected to the outlet.

Fig. 5-2.
Jackstrip rear panel, with enlarged view of two of the four 50-pin AMP connectors.

bottom is connected in parallel with its corresponding LINE jack. As its name suggests, the MONITOR jack monitors signals on the communications line.

LINE jacks are not used on the three secondary computer jackstrips (see Sec. 4). The DROP jacks on the secondary computer jackstrips are used only when needed to connect a secondary computer port to a location in the plutonium facility.

Signals pass through the jacks from DROP to LINE or LINE to DROP on connections (indicated by small arrows in Fig. F-12) that are activated by switches. When the switch is closed, as in Fig. F-12, signals pass from tip to tip and ring to ring. If a plug (patchcord) is inserted into the DROP or LINE jack, the connection is broken. For example, a patchcord plugged into a LINE jack breaks the connection between an instrument or terminal and the computer; signals pass from the tip and ring of the LINE jack to the tip and ring of the patchcord. Refer to tables H-IV and H-V for specific front-to-rear connections in a jackstrip.

6. CABLE TRACING

All the intermediate connections in the DYMAC Communications System are specified in a separate document, called the WIRERUN Listing, which enables one to locate a wire or trace a signal at any point in the system. This section gives examples of using the WIRE-RUN Listing to trace cables.

HOW TO USE THE WIRERUN LISTING

The WIRERUN Listing is essential for making additions to the communications system; it is also helpful in maintaining the system. The listing is too extensive to be included in this manual. A copy is available in the DYMAC computer room. To obtain a personal copy, refer to Appendix E.

The WIRERUN Listing contains many sections. The three Notes sections describe cable specifications, special hardware, and general information. The Wiring and Termination Schedule lists the wire destinations from a basement junction box according to the box number, terminal strip number, and pin number on the strip. The Cable Installation Schedule describes the termination locations of every cable in the system and assigns a number to each cable. The terminations of the wires in a cable at each junction box are given in the Wire Installation Schedule. The Device Installation Schedule lists the instruments and terminals in each room of the plutonium facility. The most useful section is the Extended Card Listing, which lists all of the connections between an outlet box and the termination point associated with it in one of the three junction boxes in the DYMAC computer room.

Tracing one signal through Fig. 6-1 defines all of the parameters used in the Extended Card Listing. The columns headed CODE, PATH, and RTE are used only by the computer processing program; they are not involved in tracing signals.

DYMAC COMMUNICATIONS SYSTEM

CODE	PATH	CARD	DEVICE/REMARK		WIRE ID	CBL NO	PTE	DESTINATION		WIRE ID	CBL NO	PTE	DESTINATION	
			RM	UN C S/C TRM				RM	UN C S/C TRM				RM	UN C S/C TRM
1	DM1002	A	105-W1	D 122 J01- 2	RO	1		K-14-114	T01-002	BR	101		K-8-108	T01-002
	DM1002	B			BP	107		K-3-103	T01-002	BP	113		131-J01	T01- 21
1	DM1003	A	105-W1	D 122 J01-	DRAIN	1		K-14-114	T01-003	DRAIN	101		K-8-108	T01-003
	DM1003	B			DRAIN	107		K-3-103	T01-003	DRAIN	113		131-J01	*14-GND
1	DM1004	A	105-W1	D 122 J01- 3	OR	1		K-14-114	T01-004	RD	101		K-8-108	T01-004
	DM1004	B			RD	107		K-3-103	T01-004	RD	113		131-J01	T01- 27
1	DM1005	A	105-W1	D 122 J01- 4	YE	1		K-14-114	T01-005	OP	101		K-8-108	T01-005
	DM1005	B			OR	107		K-3-103	T01-005	OP	113		131-J01	T01- 02
1	DM1006	A	105-W1	D 122 J01-	DRAIN	1		K-14-114	T01-006	DRAIN	101		K-8-108	T01-006
	DM1006	B			DRAIN	107		K-3-103	T01-006	DRAIN	113		131-J01	T14-GND
1	DM1007	A	105-CRT	J02- 1	BR	2		K-14-114	T01-007	YE	101		K-8-108	T01-007
	DM1007	B			YE	107		K-3-103	T01-007	YE	113		131-J01	T01- 28
1	DM1008	A	105-CRT	J02- 2	RD	2		K-14-114	T01-008	GN	101		K-8-108	T01-008
	DM1008	B			GN	107		K-3-103	T01-008	GN	113		131-J01	T01- 03

Fig. 6-1.

Sample Extended Card Listing for tracing one of the four signals of a communications line from the outlet box to the computer room junction box.

The fifth and sixth lines, which are highlighted in Fig. 6-1, are for a weighing device (W1) located in Room 105 in the 100 Wing. The device is located in dropbox 122 (D122)* and connects to the first of two outlets in Room 105 (J01). The third pin on the first communication outlet (J01-03) is in cable 1 and is connected to an orange wire. Cable 1 goes to a junction box (114) in the basement located at coordinates K and 14, as taken from the LASL Engineering Department drawings. The orange wire terminates on terminal strip 1 (T01), at termination 4 (004) in the junction box. The signal enters the trunk line at this point and goes through trunk cables 101 and 107 where it is available on the same terminal strip and terminates in the other two basement boxes for the 100 Wing (K-8-108 and K-3-103). The signal then goes through trunk cable 113 to the DYMAC computer room where it terminates in junction box J01 on pin 27 of T01.

CABLE TRACING

To trace a signal or a pair of wires, first identify the location of either the MUX port on the computer or the outlet box to which an instrument or terminal is connected. These two points can

*DYMAC numbering system.

CABLE TRACING

be correlated by referring to Appendixes G or J, which list the outlet box that is connected to each MUX port. Locations and MUX ports are clearly labeled on the jackfield.

Each MUX port and outlet box is listed in Appendix G, which also gives the numbers of the cable and line that connect to the multiplexor. Each connector at the multiplexor is labeled with the number of the MUX port to which it is connected. Individual pairs in the 25-pair cables are color-coded. The color codes used are given in Table H-II.

The DROP SIDE cable numbers in Appendix G identify the cable connecting a MUX port and a particular jackstrip; the jackstrip is labeled with the remote location number given in Appendix G. The LINE SIDE cable numbers refer to the cable between the jackstrip and its termination on a terminal strip in one of the three junction boxes (J01, J02, or JB-B) in the DYMACE computer room. The numbers of the junction box and of the individual terminal strip connected to a LINE SIDE cable are also listed. The termination-point number for each wire on a terminal strip is given in the WIRERUN Listing; this number is also the pin number on the connector for that wire at the jackfield.

Here are directions for signal tracing from outlet box 409-05, where an electronic balance (W_{1A}) is connected to the fifth outlet in Room 409. First, find the 400 Wing locations in Appendix G. Location 409-05 is connected to MUX port 98 with line 11 of cable 546. Table H-II identifies the wires for line 11 as a violet-blue/blue-violet pair and a violet-orange/orange-violet pair. The first pair is the computer transmit pair and the second is the computer receive pair. The first pair is also the tip and ring (Sec. 5) on the DROP SIDE of the left jack for this location; the other pair is the tip and ring of the right jack (also DROP SIDE). As shown in Appendix G, cable 518 is connected to the LINE jacks in this case and terminal strip T06 in J02.

The Extended Card Listing of the WIRERUN Listing is the most useful listing for following signals from the computer room junction boxes J01, J02, or JB-B to each outlet box. The wiring list for outlet 409-05 is found in the 400 Wing section of the Extended Card Listing (Fig. 6-2). The J05 under the DEVICE/REMARK heading identifies the fifth outlet in Room 409. The device is listed as a W_{1A} (5.5-kg balance with 0.1-g precision) in dropbox 414.

The wires from the basement junction box to this outlet box are in a two-pair cable (58), which consists of a brown-and-red pair and an orange-and-yellow pair. These wires terminate on outlet box sockets 1 (brown), 2 (red), 3 (orange), and 4 (yellow), as shown in Fig. 3-4. Socket 1 is the computer transmit (TX) source and socket 2 is its return; socket 3 is the computer receive (RX) source and

DYMAC COMMUNICATIONS SYSTEM

CODE	PATH	CARD	DEVICE/REMARK			WIRE ID	CBL NO	RTE	DESTINATION			WIRE ID	CBL NO	RTE	DESTINATION		
			PM	DEVICE	TO CN TM				RM	UN	C S/C TRM				RM	UN	C S/C TRM
1	DM4061	A	-	-	-				D-14-414	T01-061	WHORYE	401	D-8-408	T01-061	-	-	-
	DM4061	B				WHORYE	408		D-3-403	T01-061	WHORYE	415	131-J02	T06- 46	-	-	-
	DM4061	D	409-W1A	D414	J05- 1	BR	58		D-8-408	T01-061			-	-	-	-	-
1	DM4062	A	-	-	-				D-14-414	T01-062	WHORGN	401	D-8-408	T01-062	-	-	-
	DM4062	B				WHORGN	408		D-3-403	T01-062	WHORGN	415	131-J02	T06- 21	-	-	-
	DM4062	D	409-W1A	D414	J05- 2	RD	58		D-8-408	T01-062			-	-	-	-	-
1	DM4063	A	-	-	-				D-14-414	T01-063	DRAIN	401	D-8-408	T01-063	-	-	-
	DM4063	B				DRAIN	408		D-3-403	T01-063	DRAIN	415	131-J02	T15-GND	-	-	-
	DM4063	D	409-W1A	D414	J05-	DRAIN	58		D-8-408	T01-063			-	-	-	-	-
1	DM4064	A	-	-	-				D-14-414	T01-064	WHORBU	401	D-8-408	T01-064	-	-	-
	DM4064	B				WHORBU	408		D-3-403	T01-064	WHORBU	415	131-J02	T06- 47	-	-	-
	DM4064	D	409-W1A	D414	J05- 3	OR	58		D-8-408	T01-064			-	-	-	-	-
1	DM4065	A	-	-	-				D-14-414	T01-065	WHORVI	401	D-8-408	T01-065	-	-	-
	DM4065	B				WHORVI	408		D-3-403	T01-065	WHORVI	415	131-J02	T06- 22	-	-	-
	DM4065	D	409-W1A	D414	J05- 4	YE	58		D-8-408	T01-065			-	-	-	-	-
1	DM4066	A	-	-	-				D-14-414	T01-066	DRAIN	401	D-8-408	T01-066	-	-	-
	DM4066	B				DRAIN	408		D-3-403	T01-066	DRAIN	415	131-J02	T15-GND	-	-	-
	DM4066	D	409-W1A	D414	J05-	DRAIN	58		D-8-408	T01-066			-	-	-	-	-

Fig. 6-2.

Sample Extended Card Listing for tracing all four signals of a communications line from the outlet box to the computer room junction box.

socket 4 is its return. The wires terminate on terminal strip 1 (T01) in junction box 408 in the basement, at locations 61, 62, 64, and 65. A drain wire runs with each pair of wires; the drain wires terminate at locations 63 and 66.

Basement junction box 408 is the middle one of the three junction boxes that serve the 400 Wing, as shown in Fig. 6-3. The wires in junction box 408 connect in series to junction boxes 414 and 403 at the same terminals as in junction box 408. Hence, junction box 403 is also connected in series with the outlet box. From junction box 403, the four lines for outlet box 409-05 terminate in junction box J02 in the DYMAC computer room on terminal strip 6 (T06), at locations 46, 21, 47, and 22. The signals on this strip are paired across the 50-pin connector in J02. Thus, locations 46 and 21 are one pair; 47 and 22 are another pair.

The foregoing example traces the signal lines from the computer multiplexor to an outlet box. Using this procedure, one can trace any pair of wires. Maintenance should seldom require signal tracing between the computer multiplexor through the jackfield to one of the three computer room junction boxes.

Fig. 6-3.

Basement junction box connected to outlet box. The brown wire from outlet box 409-05 terminates at location 61 in basement junction box 408. Boxes 403 and 414 are also connected in series with outlet box 409-05.

7. DIAGNOSTIC EQUIPMENT

LA3L personnel designed and fabricated the three diagnostic panels mounted in the jackfield rack shown in Fig. 7-1. The panels are used for preliminary line check-out and for maintenance of the communications system. Test Panel I, the top panel in the rack, is used to check continuity and polarity as well as to measure the capacitance and resistance of a line. The second panel, the Diagnostic Panel, permits one to check an entire communications line from the computer multiplexor to a remote device, to determine which portion of the system is malfunctioning. The third test panel, the Fox Generator, is used to check a line from the jackfield to an outlet box and vice-versa.

TEST PANEL I

The right side of Test Panel I (see Fig. F-13) is used to test polarity and continuity; the left side (Fig. F-14) is used to measure the capacitance and resistance of a line. A power supply can be patched into a jackfield location by connecting a patchcord between either of the two jacks on the right side of Test Panel I and any location on the jackfield. The right jack of the pair is connected in series with a 0-20 mA current meter. Test Panel I provides a voltage that is current-limited by two paralleled current-limiting diodes that allow approximately 10 mA to flow. The tip of each jack is the source, or positive side of the power supply, and the ring is the return, or negative side.

The switch on the far left of the panel (Fig. 7-1) is spring-loaded and returns to the middle position (DT-DR) when not held in another position. Measurements between the tip and ring of a jack are performed when the switch is in the DT-DR position. Similarly, the DT-GND position allows measurements to be made between the tip of a jack and ground; measurements between the ring and ground are made in the DR-GND position.

Fig. 7-1.

Three diagnostic panels are mounted at the top of the jackfield rack.

The VOM jack on the panel is connected to a volt-ohm meter for resistance measurements or to a capacitance meter for capacitance measurements.

DIAGNOSTIC PANEL

The Diagnostic Panel allows one to perform six tests on a communications line:

1. Check MUX port at the Jackfield.
2. Check transmission to the jackfield from a remote device.
3. Check transmission from the jackfield to a remote device.
4. Check the lines to and from a location by looping back the lines at the device.
5. Monitor transmission from the computer to a remote device.
6. Monitor transmission to the computer from a remote device.

All these diagnostic tests require the use of a Teleray terminal located in the DYMAC computer room, which is referred to as the Diagnostic Terminal. The Diagnostic Terminal is connected to the right pair of jacks on the Diagnostic Panel. The current-loop

interface circuits in the Diagnostic Terminal are passive circuits, as are all of the interface circuits in the remote devices. Thus, the Diagnostic Panel contains circuits that make a passive receive input circuit simulate an active transmit circuit, which allows two passive devices to communicate with each other. These circuits, shown in Fig. F-15, are used when the Diagnostic Terminal is connected to a remote device. They are by-passed when the Diagnostic Terminal is connected to the multiplexor.

Another feature built into the Diagnostic Panel allows data transmitted to or from the computer to be monitored on the Diagnostic Terminal. The Diagnostic Terminal responds to characters in the same way any remote terminal responds; there is no provision for display of nonprinting characters. The MONITOR function uses the 0-20 mA current meter on the Diagnostic Panel to measure the quiescent current flowing in the circuit being tested. The current waveforms transmitted both to and from the computer can be observed by using oscilloscope current probes on the wire loops on the front of the Diagnostic Panel.

The loop-back function is one of the most useful features of the Diagnostic Panel. A Loop-Back plug is used at the remote location to loop the signal transmitted from the Diagnostic Terminal to the remote location and then back to the terminal, for checking lines between the jackfield and the remote location. The loop-back procedure is given in Sec. 9.

FOX GENERATOR PANEL

The Fox Generator Panel is used in loop-back tests to check the continuity and polarity of a line from the jackfield to a remote location and vice-versa. Using the Fox Generator, one can test all three types of terminals used in the DYMAC System. The Fox Generator transmits several consecutive lines of data in a block. The data consists of the message THE QUICK BROWN FOX JUMPED OVER THE LAZY DOG'S BACK 0123456789, which exercises every alphanumeric character on the keyboard. A switch on the panel allows this message to be sent in a single block or in a continuous transmission of blocks. There is also a switch on the Fox Generator for selecting the transmission rate.

In normal operation, the Fox Generator's 20-mA current loop output is used for transmission. However, the output from the Fox Generator is also available in EIA RS-232 levels via the 25-pin connector on the panel. By selecting the position of the DTE-DCE (data terminal equipment - data communications equipment) switch on the panel, the RS-232 output is transmitted to either a terminal or a communications modem. When the switch is in the DTE position, the

RS-232 output is accessible at pin 3; with the switch in the DCE position, the output is at pin 2 (see Fig. F-16).

If the Fox Generator Panel is not operating properly, there is a spare Fox Generator chassis in the computer room. It is functionally identical to the one in the jackfield rack and is connected in the same manner.

PATCHCORDS

Three types of patchcords are commonly used for connections at the jackfield. One type is gray with twin plugs;* one side of the plug is straight and the other is curved (Fig. 7-2). Another type is black, with twin plugs; the plug is rectangular with a notched side (Fig. 7-3). Twin plugs have a curved or notched side to help avoid crossing the transmit and receive lines. Notched and curved patchcords can be used interchangeably. A third type of patchcord frequently used has gray single plugs** (Fig. 7-4).

The standard twin-plug patchcords are modified by LASL so that the sleeve of the transmit plug is not connected to the sleeve of the receive plug. This modification reduces the possibility that the patchcord will short the computer's -12 V supply to ground.

Special twin-plug patchcords are also available for use at the jackfield. These patchcords have six separate conductors: two for the tip connections, two for the ring connections, and two for the sleeve connections (the transmit and receive sleeves are not connected).

MARKER AND DUMMY PLUGS

Marker and dummy plugs are made of plastic. Marker plugs can be red, white, yellow, or green. They have a short prong that breaks no connections when inserted into the jackfield. Marker plugs simply mark problem locations, spare ports, and secondary computer ports. Dummy plugs can be red, white, or black. They have a long prong that opens the connection between the computer and the remote device during spare port patching or diagnostic procedures.

*A twin-plug patchcord has a two-prong plug at each end.

**A single-plug patchcord has a one-prong plug at each end.

FLAT SIDE

TEST PLUGS

Three types of test plugs are used for diagnostic procedures: a Test I plug (Fig. F-17), a Loop-Back plug (Fig. F-18), and a Short plug (Fig. F-19). The type is clearly labeled on each plug. A Test I plug is used in checking the continuity and polarity of a line. A Loop-Back plug is used in testing a line's ability to conduct a transmission without altering it. A Short plug is used in measuring the resistance of a line.

8. JACKFIELD USE

This section explains the different functions of the jackfield, such as patching remote locations and spare ports and troubleshooting malfunctioning parts of the communications system. Section 9 gives detailed procedures for using the jackfield.

NORMAL USE

The jackfield is normally used to patch a remote location to a spare port or a secondary computer port (Procedures 1 and 2 in Sec. 9).

TESTING AND DIAGNOSTICS

Several methods of testing communications lines are available. The diagnostic equipment is flexible enough to allow the best methods to be used in each situation. The continuity check (Procedure 3), polarity check (Procedure 4), resistance measurement (Procedure 5), capacitance measurement (Procedure 6), and a loop-back test (Procedure 7 or 8) must be performed in checking out a new line. These checks are also useful for troubleshooting problems with a line.

The loop-back test verifies a line's ability to conduct a transmission without alteration. There are two loop-back tests available in the communications system: the Fox Generator test (Procedure 7) and the Diagnostic Panel test (Procedure 8). Both tests serve the same purpose; however, the Fox Generator test is much easier to perform. Only use the Diagnostic Panel loop-back test if the Fox Generator is not functioning properly. (When the Fox Generator was fabricated, it made the loop-back test obsolete on the Diagnostic Panel.)

Other testing and diagnostic procedures check data transmissions. Procedure 9 provides instructions on connecting the Diagnostic Terminal to a MUX port at the jackfield. Procedure 10 is for checking transmission between a remote device and the Diagnostic Terminal. Procedure 11 is for using the Diagnostic Terminal to monitor transmissions between the computer and a remote terminal.

TROUBLESHOOTING THE COMMUNICATIONS SYSTEM

To troubleshoot any line in the communications system, perform the steps in Procedure 12 sequentially or as directed in each step until the cause of the problem is found. The troubleshooting process is summarized in two flow diagrams, one for troubleshooting terminals (Fig. 8-1), the other for troubleshooting NDA instruments and other system hardware (Fig. 8-2). Refer to Appendix K to contact the proper maintenance service for malfunctioning components.

Fig. 8-1.
Flow diagram of terminal diagnostics procedure.

VOLTAGE MONITORING

The jackfield MONITOR jacks are permanently wired in parallel with the LINE jacks. Therefore, the voltage waveforms can be monitored on the jackfield MONITOR jacks as long as nothing is plugged into either the LINE or DROP jacks of the location being monitored. A standard oscilloscope will give faulty readings because the ring of a jack is not at ground. Thus, a differential preamp must be used to monitor voltage with an oscilloscope. Because data is transmitted in 20-mA current loop mode, voltage waveforms may or may not be useful in maintaining the communications system.

DATA TRANSMISSION TESTS

Data transmission can be tested only if the production computer is not in routine operation. Data can be received from a terminal (Procedure 13) and transmitted to it (Procedure 14) by typing the appropriate form of the XFER/A command on the computer console.

Fig. 8-2.
Flow diagram of device diagnostics procedure.

9. JACKFIELD PROCEDURES

The procedures in this section are for normal jackfield use, for testing and diagnostic purposes, for troubleshooting the communications system, and for data transmission tests.

Insertion of a twin-plug patchcord into the jackfield or diagnostic panels requires proper orientation so that the transmit and receive lines are not crossed. Figure 9-1 shows the proper orientation for horizontal insertion of a twin plug and Fig. 9-2 shows the proper orientation for vertical insertion.

*Fig. 9-1.
Horizontal insertion of a
twin plug into jackstrip.
Curved or notched side
must face to the left.*

*Fig. 9-2.
Vertical insertion of a
twin plug into jackstrip.
Curved or notched side
must face down.*

PROCEDURE 1. PATCHING A REMOTE LOCATION TO A SPARE PORT ON THE PRODUCTION COMPUTER

1. Disconnect the multiplexor from the remote location to be tested by inserting two dummy plugs into the DROP jacks for that location on the jackfield.
2. Insert a twin-plug patchcord into the LINE jacks for the remote location to be patched (see Fig. 9-3).
3. Plug the other end of the patchcord into the DROP jacks of the spare port. The curved or notched sides of the plugs must face in the same direction (both to either the left or right).

Fig. 9-3.

Jackfield configuration for patching a remote location to a spare port on the production computer. Both plugs must face in the same direction.

PROCEDURE 2. PATCHING A REMOTE LOCATION TO A SECONDARY COMPUTER PORT

1. Secondary computer ports are connected to the DROP jacks of three bottom jackstrips on the jackfield rack. Disconnect the multiplexor from the remote location to be tested by inserting two dummy plugs into the DROP jacks for that location (see Fig. 9-4).
2. Insert a twin-plug patchcord into the LINE jacks for the remote location. Plug the other end of the patchcord into the DROP jacks for the secondary computer port to be used. The curved or notched sides of the plugs must face in the same direction.

Fig. 9-4.
Jackfield configuration for patching a remote location to a secondary computer port. Both plugs must face in the same direction.

PROCEDURE 3. CONTINUITY CHECK

1. To check the continuity of a line, insert a Test I plug into the remote location outlet. The plug has two LEDs (light-emitting diodes) that indicate continuity and crossed wires (see Fig. F-17).
2. Insert two dummy plugs into the DROP jacks for the remote location on the jackfield.
3. Using a single-plug patchcord, patch from the right jack (the jack next to the meter) on Test Panel I to the left LINE jack for the remote location on the jackfield (see Fig. 9-5). If the line has continuity, the top LED on the Test I plug will light at the remote location. (See Procedure 4, polarity check, for proper LED color.) If the bottom LED on the plug lights, the receive and transmit pairs of wires are switched somewhere along the line. If the line is correctly wired, the LED on Test Panel I will also light and the current meter on the panel will read approximately 9.5 mA.
3. Repeat the entire procedure for the right LINE jack for the remote location. If the line is good, the bottom LED on the plug will light, the LED on the test panel will light, and the meter on the panel will read about 9.5 mA.

Fig. 9-6.
Continuity test jackfield configuration for patching a remote location to Test Panel I.

PROCEDURE 4. POLARITY CHECK

The polarity of the line is correct if the LEDs on the test plug at the remote location in the continuity check (Procedure 3) light green. If an LED lights red, then the pair of wires associated with that LED is reversed somewhere between the jackfield and the remote location.

PROCEDURE 5. RESISTANCE MEASUREMENT

1. Unplug the NDA instrument or terminal from the outlet box at the remote location. Measure the loop resistance of the line and the resistance to ground by following steps 2-8.
2. Insert two dummy plugs into the DROP jacks for the remote location on the jackfield.
3. With a single-plug patchcord, patch from the INPUT jack on Test Panel I to the left LINE jack for the remote location on the jackfield (see Fig. 9-6). Patch from the jack labeled VOM on Test Panel I to the VOM and COM inputs on a volt-ohm meter.
4. Put the switch on the volt-ohm meter in the $R \times 100k$ position. With nothing plugged into the outlet at the remote location and with the switch on Test Panel I in the DT-DR position, read the resistance measurement of the line. If the line has the proper resistance, the reading should be very high (infinite).
5. Now read the resistance with the Test Panel I switch in the DR-GND position and again with the switch in the DT-GND position. For proper resistance, these readings should be very high (infinite) and should show the meter charging the line capacitance for a few seconds.
6. Plug in the Short test plug (schematic shown in Fig. F-19) at the remote location. This test plug shorts the tip and ring of both the transmit (left) jack and the right (receive) jack.
7. With the switch on the volt-ohm meter in the $R \times 1$ position, read the resistance measurement of the line. The reading should be very low (approximately 5-15 ohms). The correct resistance values for the line being tested appear in Appendix J.
8. Repeat the entire procedure, using the right LINE jack for the remote location on the jackfield, patching it to the INPUT jack on Test Panel I.

Fig. 2-6.
Jackfield configuration for measuring the resistance of a line,
using Test Panel I.

PROCEDURE 6. CAPACITANCE MEASUREMENT

1. Unplug the instrument or terminal from the outlet box at the remote location. Insert two dummy plugs into the DROP jacks for that location on the jackfield.
2. Using a single-plug patchcord, patch from the INPUT jack on Test Panel I to the left LINE jack for the remote location on the jackfield (see Fig. 9-7). Then patch from the VOM jack on Test Panel I to the inputs of the capacitance meter.
3. Read the capacitance of the line from the meter; if the capacitance is acceptable, the reading will be less than 50 nF. The correct capacitance values for the line being tested appear in Appendix J.
4. Repeat the entire procedure with the right LINE jack for the remote location patched to the INPUT jack on Test Panel I.

Fig. 9-7.
Jackfield configuration for measuring the capacitance of a line,
using Test Panel I.

PROCEDURE 7. LOOP-BACK TEST, USING THE FOX GENERATOR

1. Disconnect the multiplexor from the remote location to be tested by inserting two dummy plugs into the DROP jacks for that location on the jackfield (see Fig. 9-8).
2. Unplug the cable from the outlet box at the remote location and insert a Loop-Back plug (schematic shown in Fig. F-18).
3. Use a single-plug patchcord to connect the Fox Generator current output to the transmit (left) LINE jack for the location to be tested. Set the Fox Generator to the same speed at which the terminal is to be operated (usually 4800 bps). Put the switch on the Fox Generator in the REPEAT position for continuous data output; for one block of data, put the switch in the ONCE position.
4. Connect the Diagnostic Terminal to the jackfield with a type F cable (Fig. F-6) that has a single plug on one end and a 25-pin Cannon connector on the other end. Insert the single plug into the receive (right) LINE jack for the location to be tested. Connect the other end of the cable to the SERIAL I/O connector at the rear of the Diagnostic Terminal.
5. The Fox Generator transmits data to the remote location; the data is then looped back to the Diagnostic Terminal. The Fox Generator message appears on the terminal screen where errors can be detected easily. If there are no errors, the communications channels are good.

Fig. 9-8.

Jackfield configuration for performing a loop-back test, using the Fox Generator.

PROCEDURE 8. LOOP-BACK TEST, USING THE DIAGNOSTIC PANEL

Use this test only if the Fox Generator is not in service.

1. Insert two dummy plugs into the DROP jacks for the location on the jackfield. Unplug the cable from the outlet box at the remote location and insert a Loop-Back plug (schematic shown in Fig. F-18).
2. Using a type E cable (Fig. F-5), patch from the SERIAL I/O (input/output) connector at the rear of the Diagnostic Terminal to the jacks labeled TO DIAGNOSTIC TERMINAL on the right side of the Diagnostic Panel, with the curved or notched side of the twin plug facing to the left (see Fig. 9-9).
3. With a twin-plug patchcord, patch from the jacks labeled DIAGNOSTIC TERMINAL TO JACKFIELD on the left side of the Diagnostic Panel to the LINE side for the location on the jackfield. The curved or notched side of the plugs should face to the left.
4. Put the switches on the Diagnostic Panel, from left to right, in the DIAG, REMOTE, and LOOP-BACK positions. Turn on the AC switch located on the panel.
5. Put the REMOTE-LOCAL switch on the Diagnostic Terminal in the REMOTE position. Data typed on the Diagnostic Terminal will now appear on the display screen.

Fig. 9-9.

Jackfield configuration for performing a loop-back test, using the Diagnostic Panel. All three twin plugs must have curved or notched side facing to the left, as shown in Fig. 9-1.

PROCEDURE 9. CONNECTING THE DIAGNOSTIC TERMINAL TO A MUX PORT AT THE JACKFIELD

1. Make sure that the Diagnostic Terminal switch settings are in position according to Fig. 2-5.
2. Using a type E cable (Fig. F-5), plug the end with the 25-pin Cannon connector into the SERIAL I/O connector at the rear of the Diagnostic Terminal.
3. Insert the twin plug of the cable into the DROP jacks for the port to be used. The curved or notched side of the plug is the computer transmit side and must face to the left. The straight side is the computer receive side (see Fig. 9-10).
4. The Diagnostic Terminal is now connected to the computer port through the jackfield.

Fig. 9-10.

Jackfield configuration for connecting the Diagnostic Terminal to a MUX port at the jackfield. Twin plug must have curved or notched side facing to the left, as shown in Fig. 9-1.

PROCEDURE 10. CHECKING TRANSMISSION BETWEEN A REMOTE TERMINAL AND THE DIAGNOSTIC TERMINAL

1. Disconnect the computer from the remote location by inserting two dummy plugs into the DROP jacks for the remote location on the jackfield (see Fig. 9-11).
2. With a type E cable (Fig. F-5), patch from the jacks labeled TO DIAGNOSTIC TERMINAL on the Diagnostic Panel to the SERIAL I/O connector at the rear of the Diagnostic Terminal, with the curved or notched side of the plug facing to the left.
3. Using a twin-plug patchcord, patch from the jacks labeled DIAGNOSTIC TERMINAL TO JACKFIELD on the Diagnostic Panel to the LINE side for the location on the jackfield, with the curved side of the plugs facing to the left.
4. Put the switches on the Diagnostic Panel, from left to right, in the DIAG, REMOTE, and NORM positions. Plug a Teleray terminal into the outlet box at the location and turn on the AC switch on the panel.
5. Make sure that the Diagnostic Terminal is turned on. Type one line of characters and hit the RETURN key to transmit the message from the remote terminal to the Diagnostic Terminal; reverse the procedure. The terminals do not echo what they transmit; they only display received data.

Fig. 9-11.

Jackfield configuration for connecting a remote terminal to the Diagnostic Terminal. All three twin plugs must have notched or curved side facing to the left, as shown in Fig. 9-1.

PROCEDURE 11. MONITORING TRANSMISSIONS BETWEEN THE COMPUTER AND A REMOTE DEVICE, USING THE DIAGNOSTIC PANEL

1. Using a type E cable (Fig. F-5), patch (with the curved or notched side of the twin plug facing to the left) from the jacks labeled TO DIAGNOSTIC TERMINAL on the Diagnostic Panel to the SERIAL I/O connector at the rear of the Diagnostic Terminal (see Fig. 9-12).
2. Using a twin-plug patchcord, patch from the jacks labeled DIAGNOSTIC TERMINAL TO JACKFIELD on the Diagnostic Panel to the left LINE and DROP jacks for the location on the jackfield. The curved or notched side of the plug should face to the left on the panel; on the jackfield, the curved or notched side of the plug should face down (this plug will be in a vertical position).
3. Put the switches on the Diagnostic Panel, from left to right, in the MONITOR, REMOTE, and NORM positions. You can now monitor transmissions from the computer to the remote device on the Diagnostic Terminal. The amount of current in this circuit can be read directly from the meter on the right side of the Diagnostic Panel. The current waveforms can be monitored on an oscilloscope using a current probe to connect the oscilloscope to one of the two wire loops on the Diagnostic Panel.
4. To monitor transmission from the remote device to the computer, move the patchcord on the jackfield from the left to the right DROP and LINE jacks with the curved or notched side of the plug facing down. The current can be read from the meter or monitored on an oscilloscope.

Fig. 3-12.

Jackfield configuration for monitoring transmissions between the computer and a remote device, using the Diagnostic Panel. The twin plugs inserted into the Diagnostic Panel must have curved or notched side facing to the left (Fig. 9-1). Figure 9-2 shows proper vertical orientation of twin plug inserted into jackstrip.

PROCEDURE 12. TROUBLESHOOTING

If the device at the malfunctioning location is an NDA instrument and not a terminal, skip step 1.

1. Put the LOCAL/REMOTE switch on the remote terminal in the LOCAL position and type a few characters. If the correct characters do not appear on the terminal screen, the terminal is malfunctioning. Call a terminal maintenance technician (Appendix K). Otherwise, proceed to step 2.
2. With a volt-ohm meter, check the fuse at the front of the computer for the MUX port that is connected to the malfunctioning location (see Fig. 9-13). If the fuse is bad, replace it. If the fuse is good, go to step 3.
3. If the Fox Generator is operable, perform a loop-back test with it. If not, perform a loop-back test using the Diagnostic Panel. If the loop-back test works properly, go to step 6. Otherwise, proceed to step 4.
4. Perform a resistance measurement on the problem line. If the resistance measured is acceptable, go to step 5. If not, trace the wiring of the line from the jackfield to the outlet box using the WIRERUN Listing to determine what is wrong with the line.
5. Perform continuity and polarity checks on the line. If the results of these checks are correct, proceed to step 6. Otherwise, trace the wiring of the line from the jackfield to the outlet box, using the WIRERUN Listing, to determine what is wrong with the line.
6. Check the MUX port by patching the Diagnostic Terminal to the port at the jackfield. If data cannot be sent from the computer to the terminal or vice versa, use a type D cable (Fig. F-4) to plug the Diagnostic Terminal directly into the MUX port at the rear of the computer. (See Fig. 4-5 for the MUX connections.) If you still cannot transmit data from the computer to the terminal or vice versa, the MUX port is malfunctioning; patch the remote location to a spare port. However, if the port is operating properly, make sure that the cable from the jackfield is correctly plugged into the port at the rear of the computer and go to step 7.
7. Replace the cable between the remote device and the outlet box. If data still cannot be transmitted from the computer or remote device, replace the device.

Fig. 9-13.
Multiplexor port fuse location at front of production computer.

PROCEDURE 13. DATA RECEIVE

Data can be received from a remote terminal and displayed on either of the system consoles in the DYMAC computer room by typing

XFER/A QTY:N \$TTOM (R) .

The symbol (R) indicates the RETURN key, N is the port number, and M is the console designation, where M = 0 for the foreground console and M = 1 for the background console. Data typed on the remote terminal, followed by a RETURN, is echoed on the remote terminal and displayed on the system console. To terminate this procedure, press the CTRL and A keys simultaneously.

PROCEDURE 14. DATA TRANSMIT

Data can be transmitted to a remote terminal from the computer by typing

XFER/A \$TTI QTY:N (R)

on the system console. N is the number of the port to which the remote terminal is connected. Data typed on the computer console, followed by a RETURN, is now displayed on the remote terminal. To terminate this procedure, press the CTRL and A keys simultaneously.

ACKNOWLEDGMENTS

Several people assisted in creating the DYMAC Communications System and in preparing this manual. Breck Glascock designed the basic framework for the system, developed some of the diagnostic procedures, and designed the Test Panel I and the Diagnostic Panel. He also wrote the initial documentation for the communications system. Jim Case created the computerized WIRERUN Listing. Jerry Lopez developed some of the diagnostic procedures and designed the Fox Generator. Dave Woodwell, Greg Wentz, and Joe Rodriguez provided maintenance support. Tina Sibbitt assisted in rewriting text, clarifying procedures, preparing tables, and in an initial reorganization of the manual. Dorothy Amsden gave the manual its final structure, prepared the introductory material and first two sections, simplified illustrations and tables, and reorganized the appendixes.

APPENDIX A

PARTS LIST

The DYMAC Communications System consists primarily of commercial equipment. The rest of the equipment was designed and fabricated at LASL.

LASL-FABRICATED EQUIPMENT

LASL-fabricated equipment is explained in the text. Complete circuit diagrams are given in Appendix F.

- Cable type A (Sec. 3)
- Cable type B (Sec. 3)
- Cable type C (Sec. 3)
- Cable type D (Sec. 3)
- Cable type E (Sec. 3)
- Cable type F (Sec. 3)
- Optoisolator interface circuit for electronic balance (Sec. 3)
- Test Panel I (Sec. 7)
- Diagnostic Panel (Sec. 7)
- Fox Generator Panel (Sec. 7)

COMMERCIALLY PURCHASED EQUIPMENT

The equipment purchased for the communications system is described below. Appendix B lists the equipment alphabetically, with the affiliated purchase order number, date ordered, and vendor. Appendix C lists vendor addresses and phone numbers.

Eclipse Multiplexor Connectors and Accessories

The 6-pin AMP block connectors (and their sockets) used for connections to the multiplexor were ordered under P.O. KJ7-98176-1

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and P.O. KJ7-6604C-1. The socket crimping tool is AMP 90202-2. Spare connectors, sockets, and the crimping tool are available from LASL Group Q-3.

Jackfield Label Strips

Label strips designate each group of jacks on one jackstrip. The label above the jacks gives the number of the room associated with those jacks and the number of the outlet in the room. The label below the jacks gives the number of the MUX port that is connected to the outlet. See P.O. KJ7-98220-1. Spare label strips are available from LASL Group Q-3.

Jackfield Marker Plugs and Dummy Plugs

See P.O. KJ8-8014D-T and P.O. 1-KS9-5520M-1. Spare marker and dummy plugs are available in the DYMAC computer room.

Jackstrips

Jackstrips were ordered in P.O. KJ9-3314K-1. Spare jackstrips are available from LASL Group Q-3.

Junction Boxes (enclosures)

The junction boxes used in the basement and in the computer room are standard NEMA (National Electrical Manufacturers Association) type-12 enclosures. See P.O. LJ7-88516-1. No spare enclosures are available.

Outlet Boxes and Mating Plugs

Outlet boxes and mating plugs are standard equipment used by telephone companies and are available from many electronic supply stores. The boxes are Herald PH33A; the plugs are Herald PL9A. See P.O. KE7-6635C-T. Spare boxes and plugs are available from LASL Group Q-3.

Patchcords

Single- and twin-plug patchcords are used for connections at the jackfield. See P.O. LE7-88519-T. Standard twin-plug patchcords are modified by LASL so that the sleeve of the transmit plug is not connected to the sleeve of the receive plug. This is done to prevent

shorting the Eclipse -12 V supply to ground. Spare patchcords are available in the DYMAC computer room.

Special twin-plug patchcords are also used at the jackfield. These patchcords have six separate conductors: two for the tip connections, two for the ring connections, and two for the sleeve connections (the transmit and receive sleeves are not connected). See P.O. KJ9-3288K-1.

Preterminated AMP Connector Cables

Several different cables with 50-pin AMP connectors are used to interconnect the computer room junction boxes, the jackfield, and the computer. Some of the cables have AMP connectors on both ends (plug-to-plug); the others have a connector on only one end (receptacle-to-stub). See P.O. K07-89521-1. Spare cables are available from LASL Group Q-3.

Terminal Tables

Stands that support data-entry terminals are 0.8128-m wide, 0.4572-m deep, and 0.6731-m high. See P.O. KZ9-0630H-1. Spare tables are available from LASL Group Q-3.

Terminal, Teleray 3741 CRT

Altogether 41 Teleray terminals were ordered for the DYMAC system. See P.O. Z99-0619H-1. LASL made several modifications to the terminals:

- a. CAPS LOCK key permanently locked on keyboard.
- b. Modification to 20-mA current loop circuits by insertion of a 62k-ohm resistor between ground and base of the terminal's receive optoisolator.
- c. Modification to 20-mA current loop circuits by insertion of a 22k-ohm resistor between base and emitter of the terminal's transmit optoisolator.

Terminal, TI 733 Hard-Copy

Eight TI 733 low-speed hard-copy printers were ordered for the DYMAC System. See P.O. Z88-5320E.

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Terminal, TI 810 Label Printer

Five high-speed label printers were ordered for the DYMAC System. See P.O. Z88-0618H-1.

Termination Blocks, Terminal Strips, and Accessories

The two large termination blocks in each computer room junction box are standard telephone-type blocks (see P.O. LJ7-88520). The terminal strips, their terminals, connectors, and an insertion tool were ordered from AMP; they are no longer available. Similar units are available from many companies, but they are designed for use with solid wire, whereas the AMP units were designed for use with stranded wire (see P.O. LJ7-88521). No spare termination blocks are available at LASL. Spare terminal strips, terminals, and connectors are available from LASL Group Q-3. An insertion tool for inserting the wire into the terminal strips is located in the DYMAC computer room.

Trunk and Communications Outlet Box Cables

Each trunk cable is composed of 24 pairs of wires that have individual shields. These cables were ordered by LASL Group ENG-4 under P.O. KE7-83759. No spare trunk cable is available at LASL.

A signal cable (communications cable) is composed of two twisted wire pairs; each pair has its own drain wire. See P.O. KE9-9565L-1. Spare signal cable is available from LASL Group Q-3.

APPENDIX B

EQUIPMENT PURCHASES

This appendix lists all purchases made for the DYMAC Communications System, along with date of purchase and vendor. Copies of the purchase orders are on file in the LASL Supply and Property Department.

<u>Item</u>	<u>Purchase Order Number</u>	<u>Date</u>	<u>Vendor</u>
Block, connecting, 66B4-25A	LJ7-88520-1	2/14/77	GTE Automatic Electric
Block, modular, 229956-1	LJ7-88521-1	2/14/77	AMP, Inc.
Cable, P25P-25-DE	K07-89521-1	5/26/77	ADC Telecommunications
Cable, P25S-25-SE	K07-89521-1	5/26/77	ADC Telecommunications
Cable, P25S-50-SE	K07-89521-1	5/26/77	ADC Telecommunications
Cable, R25S-50-SE	K07-89521-1	5/26/77	ADC Telecommunications
Cable, signal, 4-conductor	KE9-9565L-1	5/25/79	Cities Service Co.
Connectors, 1-86402-4	KJ7-6604C-1	9/7/77	AMP, Inc.
Connectors, 552118-1	LJ7-88521-1	2/14/77	AMP, Inc.
Contacts, 87045-2	KJ7-98176-1	6/7/77	AMP, Inc.

DYMAC COMMUNICATIONS SYSTEM

<u>Item</u>	<u>Purchase Order Number</u>	<u>Date</u>	<u>Vendor</u>
Contacts, 87045-2	KJ7-6604C-1	9/7/77	AMP, Inc.
Enclosures, 36 x 30 x 8 (inches)	LJ7-88516-1	2/14/77	State Electric Supply Co.
Enclosures, 48 x 24 x 8 (inches)	LJ7-88516-1	2/14/77	State Electric Supply Co.
Jack and wall plate (outlet box)	KE7-6635C-T	10/18/77	Electronic Parts Co.
Jackstrips, connectorized	KJ9-3314K-1	3/6/79	Anixter-Pruzan
Latch kits (for enclosures)	LJ7-88516-1	2/14/77	State Electric Supply Co.
Panels (for enclo- sures, 36 x 30 x 8 inches)	LJ7-88516-1	2/14/77	State Electric Supply Co.
Panels (for enclo- sures, 48 x 24 x 8 inches)	LJ7-88516-1	2/14/77	State Electric Supply Co.
Patchcords, 5-conductor	LE7-88519-T	2/14/77	Electronic Parts Co.
Patchcords, EX-7812, 6-conductor	KJ9-3288K-1	2/8/79	Walker Radio
PC Boards, 552167-1, (terminal strip)	LJ7-88521-1	2/14/77	AMP, Inc.
Plugs, dummy, TT-515-1	KJ8-8014D-T	12/27/77	Switchcraft, Inc.
Plugs, dummy, TT-515-2	1-KS9-5520M-1	7/3/79	Switchcraft, Inc.
Plugs, dummy, TT-515-3	KJ8-8014D-T	12/27/77	Switchcraft, Inc.
Plugs, 4-prong	KE7-6635C-T	10/18/77	Switchcraft, Inc.
Plugs, signal, TT-513-1	KJ8-8014D-T	12/27/77	Switchcraft, Inc.
Plugs, signal, TT-513-1	1-KS9-5520M-1	7/3/79	Switchcraft, Inc.

EQUIPMENT PURCHASES

<u>Item</u>	<u>Purchase Order Number</u>	<u>Date</u>	<u>Vendor</u>
Plugs, signal, TT-513-3	KJ8-8014D-T	12/27/77	Switchcraft, Inc.
Plugs, signal, TT-513-5	KJ8-8014D-T	12/27/77	Switchcraft, Inc.
Plugs, signal, TT-513-5	1-KS9-5520M-1	7/3/79	Switchcraft, Inc.
Plugs, signal, TT-513-8	KJ8-8014D-T	12/27/77	Switchcraft, Inc.
Plugs, signal, TT-513-8	1-KS9-5520M-1	7/3/79	Switchcraft, Inc.
Printer, TI 810	Z88-0618H-1	10/3/78	Texas Instruments
Stand, machine	KZ9-0630H-1	10/24/78	PBSW Office Products, Inc.
Strip kits, designation	KJ7-98220-1	8/11/77	ADC Products, Inc.
Terminal, Teleray 3741	Z99-0619H-1	10/6/78	Research, Inc.
Terminal, TI 733	Z88-5320E	12/28/77	Texas Instruments, Inc.
Terminals (for terminal strips), 552168-2	LJ7-88521-1	2/14/77	AMP, Inc.
Tool, insertion 229373-4	LJ7-88521-1	2/14/77	AMP, Inc.
Tool, 90202-2	KJ7-98176-1	6/7/77	AMP, Inc.

APPENDIX C VENDOR INDEX

<u>Vendor</u>	<u>Address</u>	<u>Telephone</u>
ADC Products, Inc.	c/o AQ Electronics P.O. Box 6505 Albuquerque, NM 87107	505/883-1003
ADC Telecommunications	4900 West 78th St. Minneapolis, MN 55435	612/835-6800
AMP, Inc.	P.O. Box 45168 Dallas, TX 75245	214/357-9151
Anixter - Pruzan	9449 Aerospace Dr. St. Louis, MO 63134	800/325-8058
Cities Service Co.	Chester Cable Operations Oakland Ave. Chester, NY 10918	914/469-2141
Electronic Parts Co.	2620 Rhode Island NE Albuquerque, NM 87110	505/293-6161
Data General Corp.	2601 Wyoming, NE Albuquerque, NM 87112	505/292-2234
GTE Automatic Electric	400 North Wolff North Lake, IL 60164	312/562-7100
PBSW Office Products, Inc.	Division of Boise Cascade P.O. Box 25663 Albuquerque, NM 87125	505/765-1550

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<u>Vendor</u>	<u>Address</u>	<u>Telephone</u>
Research, Inc.	c/o J.F. Hurlbut Co. 622 Gardenia Court Golden, CO 80401	612/941-3300
State Electric Supply Co.	3371 Cerrillos Road Santa Fe, NM 87501	505/471-0660
Switchcraft, Inc.	5555 N. Elston Ave. Chicago, IL 60630	312/792-2700
Teleray Terminals Research, Inc.	Box 24064 Minneapolis, MN 55424	612/941-3300
Texas Instruments, Inc. (data-entry terminals)	725 East Hampden Suite 301 Denver, CO 80231	303/751-1780
Texas Instruments, Inc. (service manuals)	Digital Systems Division P. O. Box 1441 Houston, TX 77001	713/491-5115
Walker Radio	102 Granite Ave. NW Albuquerque, NM 87102	505/247-2288

APPENDIX D

OUTLET BOX LOCATIONS

The plutonium facility wing layouts in Figs. D-1 through D-4 are useful for finding the outlet boxes. Not all outlet boxes shown are in use, however, each one has been designated for a particular device, as shown in the layouts, with the exception of spare outlet boxes.

On the layouts, outlet box locations for each device are indicated by circles. Two or more instruments labeled in one circle indicate that the outlet boxes are mounted together and the wires come through the same conduit.

Any device can be plugged into an outlet box. However, the computer software (specifically the LINEDEF table) must reflect the transmission rate of the device. The computer operator can change the transmission rate for a device in the LINEDEF table when the production computer is not in operation.

T Teleray 3741 terminal

T₁ Supervisory station

TNC Thermal-neutron coincidence counter

W₁ Balance, 0-5.5 kg, 0.1-g precision

Fig. D-1.
Outlet box locations in the 100 Wing.

CAL Calorimeter
 T Teleray 3741 terminal
 T₁ Supervisory station

TNC Thermal-neutron coincidence counter
 W₁ Balance, 0-5.5 kg, 0.1-g precision
 W_{1A} Balance, 0-5.5 kg, 0.01-g precision

Fig. D-2.
 Outlet box locations in the 220 Wing.

T Teleray 3741 terminal
 T₁ Supervisory station
 TNC Thermal-neutron coincidence counter

W₁ Balance, 0-5.5 kg, 0.1-g precision
 W_{1A} Balance, 0-5.5 kg, 0.01-g precision
 W₂ Balance, 0-15 kg, 0.1-g precision

Fig. D-6.
 Outlet box locations for the DDC Wip.

APPENDIX E

TO OBTAIN DRAWINGS AND WIRERUN LISTING

Four drawings pertain to the DYMAC Communications System. They are kept by the LASL Engineering Department, Group ENG-3, which will provide copies on request. The drawing numbers are appended with a decimal fraction to indicate the latest revision. When changes are made to the communications system, ask Group ENG-2 to record them on the drawings.

Drawing number LA-KY-J-6038 shows the conduit locations and floor penetrations used for each outlet box, as well as the cable routing plan in the basement of the plutonium facility.

Drawing number LA-KY-J-6039 shows the equipment layout for the communications system, such as the outlet box locations, on the first floor of the plutonium facility, as well as the cable routing plan.

Drawing number LA-KY-J-6040 shows the equipment layout on the mezzanine level of the plutonium facility, as well as the cable routing plan.

Drawing number LA-KY-J-6041 has diagrams of typical outlet box installations.

To obtain a copy of the WIRERUN Listing, an extensive computer printout that specifies all the connections in the DYMAC Communications System, contact the LASL Engineering Department, Group ENG-4.

APPENDIX F

CIRCUIT DIAGRAMS

All of the circuit diagrams of equipment for the DYMAC Communications System appear in Figs. F-1 through F-19.

Fig. F-1.

Cable type A connects an outlet box to a Teleray terminal. It is 2.44 m long and consists of two pairs of 22-gauge twisted pair wire.

*Fig. F-2.
Cable type B connects an outlet box to a TI 788 hard-copy terminal. It is 1.44 m long and consists of two pairs of 22-gauge twisted pair wire.*

*Fig. F-3.
Cable type C connects an outlet box to a TI 810 label printer. It is 2.44 m long and consists of two pairs of 22-gauge twisted pair wire.*

Fig. F-4.

Cable type D connects a Teleray terminal directly to one port of the MUX chassis.

Fig. F-5.

Cable type E connects a Teleray terminal to a jackstrip or to the Diagnostic Panel.

Fig. F-4.

NOTE: Type B connector is a large terminal as indicated above the Telera connector in Figure F-4.

Fig. F-7.
Modified interface circuit for the Teleray 3741 terminal.

DYMA[®] COMMUNICATIONS SYSTEM

Fig. F-3.
Schematic circuit for the TI 788 laser eye terminal.

Fig. F-2.
Interface circuit for the TI 810 label printer.

NOTES:

1. ALL SQUARES ☐ DENOTE OUTPUT PIN NUMBER ON EDGE CONNECTOR
2. SWITCHES 1, 2 AND 3 CONTROL THE TRANSMISSION RATE
3. SWITCH 4 CONTROLS THE USE OF PARITY
4. SWITCH 5 CONTROLS THE NUMBER OF STOP BITS
5. SWITCHES 6 AND 7 CONTROL THE NUMBER OF BITS PER CHARACTER
6. SWITCH 8 CONTROLS EVEN OR ODD PARITY

Fig. F-11.

TTL 120-mA interface of the Bellini computer.
 Pins 1, 2, 5, and 6 are in the form of the DVI connector.

Fig. 1-12.

Front-to-rear wiring of a jackstrip.

LA-6182-M

Manual

UC-32

Issued: January 1980

DYMAC Communications System

Kathleen A. Lindsey

DISCLAIMER

DYMAC COMMUNICATIONS SYSTEM

Fig. F-13.
The circuitry on the right side of Test Panel 1 is for polarity and continuity tests.

Fig. F-14.
The circuitry on the left side of Test Panel 1 is for capacitance and resistance measurements.

Fig. F-18.
Circuit Diagram of the Diagnostic Panel.

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Fig. F-16.
Circuit Diagram of the Fox Generator.

Fig. F-17.
Test plug circuit diagram.

Fig. F-18.
Loop-Back plug circuit diagram.

Fig. F-19.
Short plug circuit diagram.

APPENDIX G

COMPUTER ROOM CONNECTIONS TO MULTIPLEXOR

This appendix identifies the cables used to connect the computer room junction boxes to the computer multiplexor. The information is grouped by five areas: the four wings in the Plutonium Processing Facility and the Cold Support Building.

The tables give the numbers of the room, outlet box, and type of device serviced by a particular jackfield circuit. The tables also give the cable number that connects each jackfield circuit (LINE SIDE) to a terminal strip in a computer room junction box and the cable number that connects the DROP SIDE of that same jackfield circuit to a MUX port.

For example, jackfield circuit 13 for the 100 Wing services a TNC that is connected to outlet box 01 in room 125. The LINE SIDE of that jackfield circuit is connected to terminal strip T02 in junction box J01 by line 1 of cable 502. The DROP SIDE of the same jackfield circuit is connected to MUX port 73 by line 1 of cable 530.

This appendix may be used to trace a communications line in the computer room from a junction box to a MUX port during troubleshooting procedures.

DYMAC COMMUNICATIONS SYSTEM

TABLE G-I
100 WING CONNECTIONS TO MULTIPLEXOR

DYMAC Computer Room									
Remote Location			Jackfield Circuit	Junction Box Cable LINE SIDE			Jackfield Cable DROP SIDE		
Room	Outlet	Device		Junction Box	Terminal Strip	Cable Number	Cable Number	Line Number	MUX Port
105	01	W ₁	1	J01	T01	501	529	1	71
105	02	CRT	2	J01	T01	501	529	2	0
106	01	W ₁	3	J01	T01	501	529	3	65
113	01	spare	4	J01	T01	501	529	4	66
113	02	CRT	5	J01	T01	501	529	5	1
113	03	W ₁	6	J01	T01	501	529	6	67
114	01	W ₁	7	J01	T01	501	529	7	68
115	01	CRT	8	J01	T01	501	529	8	2
115	02	W ₁	9	J01	T01	501	529	9	69
115	03	TNC	10	J01	T01	501	529	10	70
124	01	W ₁	11	J01	T01	501	529	11	55
124	02	CRT	12	J01	T01	501	529	12	3
125	01	TNC	13	J01	T02	502	530	1	73
125	02	CRT	14	J01	T02	502	530	2	4
126	01	CRT	15	J01	T02	502	530	3	5
128	01	CRT	16	J01	T02	502	530	4	6
128	02	TNC	17	J01	T02	502	530	5	74
128	03	W ₁	18	J01	T02	502	530	6	58
509	01	CRT	19	J01	T02	502	530	7	7
509	02	PR ^a	20	J01	T02	502	530	8	39
126	02	TNC	21	J01	T02	502	530	9	75
126	03	W ₁	22	J01	T02	502	530	10	60
126	04	W ₁	23	J01	T02	502	530	11	127
---	---	---	24	J01	T02	502	530	12	---
---	---	---	25-36	J01	T03	503	531	1-12	---
---	---	---	37-48	J01	T04	504	532	1-12	---
---	---	---	49-60 ^b	J01	T05	505	533 ^c	1-12	---
---	---	---	61-67 ^b	J01	T06	506	534 ^c	1-12	---

^aATI 733 hard-copy terminal.

^bThe jackstrip is not installed but the cables are in.

^cThe DROP SIDE end of cable is not terminated.

MULTIPLEXOR CONNECTIONS

TABLE G-II
200 WING CONNECTIONS TO MULTIPLEXOR

DYMAC Computer Room									
Remote Location			Jackfield Circuit	Junction Box Cable			Jackfield Cable		
				LINE SIDE			DROP SIDE		
Room	Outlet	Device		Junction Box	Terminal Strip	Cable Number	Cable Number	Line Number	MUX Port
204	01	CRT	1	J02	T01	513	541	1	17
204	02	TNC	2	J02	T01	513	541	2	77
207	01	TNC	3	J02	T01	513	541	3	78
208	01	W ₁	4	J02	T01	513	541	4	80
208	02	W ₁	5	J02	T01	513	541	5	81
208	03	W ₁	6	J02	T01	513	541	6	82
208	04	CRT	7	J02	T01	513	541	7	18
213	01	CRT	8	J02	T01	513	541	8	19
213	02	PR ^a	9	J02	T01	513	541	9	41
213	03	CAL	10	J02	T01	513	541	10	83
213	04	TNC	11	J02	T01	513	541	11	84
208	05	TNC	12	J02	T01	513	541	12	85
212	01	TNC	13	J02	T02	514	542	1	86
212	02	W ₁	14	J02	T02	514	542	2	87
212	03	CRT	15	J02	T02	514	542	3	20
209	01	W _{1A}	16	J02	T02	514	542	4	88
209	02	TNC	17	J02	T02	514	542	5	112
209	03	spare	18	J02	T02	514	542	6	---
209	04	CRT	19	J02	T02	514	542	7	---
---	---	---	20-24	J02	T02	514	542	8-12	---
---	---	---	25-36 ^b	J02	T03	515	543 ^c	1-12	---
---	---	---	37-48 ^b	J02	T04	516	544 ^c	1-12	---
---	---	---	59-54 ^b	J02	T05	517	545 ^c	1- 6	---

^aTI 733 hard-copy terminal.

^bThe jackstrip is not installed but the cables are in.

^cThe DROP SIDE end of cable is not terminated.

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TABLE G-III
300 WING CONNECTIONS TO MULTIPLEXOR

DYMAC Computer Room									
Remote Location			Jackfield Circuit	Junction Box Cable LINE SIDE			Jackfield Cable DROP SIDE		
Room	Outlet	Device		Junction Box	Terminal Strip	Cable Number	Cable Number	Line Number	MUX Port
305	01	CRT	1	J01	T07	507	535	1	8
305	02	W ₁	2	J01	T07	507	535	2	61
306	01	W ₁	3	J01	T07	507	535	3	62
308	01	W _{1A}	4	J01	T07	507	535	4	64
316	01	CRT	5	J01	T07	507	535	5	9
319	01	W ₁	6	J01	T07	507	535	6	49
319	02	W ₂	7	J01	T07	507	535	7	50
319	03	W ₁	8	J01	T07	507	535	8	51
319	04	CRT	9	J01	T07	507	535	9	10
319	05	W ₁	10	J01	T07	507	535	10	52
319	06	W ₁	11	J01	T07	507	535	11	53
319	07	W ₁	12	J01	T07	507	535	12	54
319	08	W ₁	13	J01	T08	508	536	1	48
319	09	CRT	14	J01	T08	508	536	2	11
326	01	CRT	15	J01	T08	508	536	3	12
326	02	PR ^a	16	J01	T08	508	536	4	40
327	01	TNC	17	J01	T08	508	536	5	72
327	02	W ₁	18	J01	T08	508	536	6	56
327	03	W ₂	19	J01	T08	508	536	7	57
329	01	W ₁	20	J01	T08	508	536	8	59
329	02	TNC	21	J01	T08	508	536	9	76
330	01	CRT	22	J01	T08	508	536	10	13
33 ^b	01	CRT	23	J01	T08	508	536	11	16
33 ^b	02	PR ^c	24	J01	T08	508	536	12	37
305	03	W ₁	25	J01	T09	509	537	1	79
---	---	---	26-36	J01	T09	509	537	2-12	---
---	---	---	37-44	J01	T10	510	538	1-8	---
---	---	---	spare	J01	T10	510	538	9	47
---	---	---	46	J01	T10	510	538	10	---
---	---	---	spare	J01	T10	510	538	11	15
---	---	---	spare	J01	T10	510	538	12	14
---	---	---	49-60 ^d	J01	T11	511	539 ^e	1-12	---
---	---	---	61-67 ^d	J01	T12	512	540 ^e	1-7	---

^aTI 733 hard-copy terminal.

^bvault.

^cTI 810 label printer.

^dThe jackstrip is not yet installed but the cables are in.

^eThe DROP SIDE end of the cable is not terminated.

MULTIPLEXOR CONNECTIONS

TABLE G-IV
400 WING CONNECTIONS TO MULTIPLEXOR

DYMARC Computer Room									
Remote Location			Jackfield Circuit	Junction Box Cable			Jackfield Cable		
				Junction Box	LINE SIDE		DROP SIDE		MUX Port
Room	Outlet	Device			Terminal Strip	Cable Number	Cable Number	Line Number	
401	01	CRT	1	J02	T06	518	546	1	21
401	02	SAI	2	J02	T06	518	546	2	89
401	03	W1A	3	J02	T06	518	546	3	90
401	04	TNC	4	J02	T06	518	546	4	91
401	05	W1	5	J02	T06	518	546	5	92
408	01	CRT	6	J02	T06	518	546	6	22
409	01	SAI	7	J02	T06	518	546	7	93
409	02	W1A	8	J02	T06	518	546	8	94
409	03	TNC	9	J02	T06	518	546	9	96
409	04	SAI	10	J02	T06	518	546	10	97
409	05	W1A	11	J02	T06	518	546	11	98
420	01	TNC	12	J02	T06	518	546	12	99
420	02	W1	13	J02	T07	519	547	1	100
420	03	spare	14	J02	T07	519	547	2	101
420	04	spare	15	J02	T07	519	547	3	102
420	05	spare	16	J02	T07	519	547	4	103
420	06	spare	17	J02	T07	519	547	5	104
420	07	SAI	18	J02	T07	519	547	6	105
420	08	W1A	19	J01	T07	519	547	7	106
420	09	spare	20	J01	T07	519	547	8	107
420	10	TNC	21	J01	T07	519	547	9	108
420	11	W1A	22	J01	T07	519	547	10	109
420	12	SAI	23	J01	T07	519	547	11	110
420	13	CRT	24	J01	T07	519	547	12	23
---	---	spare	25	J02	T08	520	548	1	---
429	01	W1	26	J02	T08	520	548	2	113
429	02	TNC	27	J02	T08	520	548	3	114
429	03	W1	28	J02	T08	520	548	4	115
429	04	FNC	29	J02	T08	520	548	5	116
429	05	W1	30	J02	T08	520	548	6	117
429	06	CRT	31	J02	T08	520	548	7	24
431	01	TNC	32	J02	T08	520	548	8	118
431	02	W1	33	J02	T08	520	548	9	119
433	01	CRT	34	J02	T08	520	548	10	25
433	02	W2	35	J02	T08	520	548	11	120
433	03	CAL	36	J02	T08	520	548	12	121

DYMAC COMMUNICATIONS SYSTEM

TABLE G-IV (continued)
400 WING CONNECTIONS TO MULTIPLEXOR

DYMAC Computer Room									
Remote Location			Jackfield Circuit	Junction Box Cable			Jackfield Cable		
				LINE SIDE			DROP SIDE		
Room	Outlet	Device		Junction Box	Terminal Strip	Cable Number	Cable Number	Line Number	MUX Port
433	04	SGS	37	J02	T09	521	549	1	122
433	05	FNC	38	J02	T09	521	549	2	123
433	06	TNC	39	J02	T09	521	549	3	124
433	07	TNCB	40	J02	T09	521	549	4	125
522 ^a	01	CRT	41	J02	T09	521	549	5	26
522 ^a	02	PR ^b	42	J02	T09	521	549	6	42
528 ^a	01	CRT	43	J02	T09	521	549	7	27
528 ^a	02	PR ^b	44	J02	T09	521	549	8	43
433	08	CRT	45	J02	T09	521	549	9	28
433	09	PR ^c	46	J02	T09	521	549	10	38
433	10	spare	47	J02	T09	521	549	11	126
401	06	TNC	48	J02	T09	521	549	12	95
---	---	---	49-60	J02	T10	522	550	1-12	---
---	---	---	61-68	J02	T11	523	551	1-8	---
---	---	---	spare	J02	T11	523	551	9	63
---	---	---	70-71	J02	T11	523	551	10-11	---
---	---	---	spare	J02	T11	523	551	12	111
---	---	---	73-81 ^d	J02	T12	524	552 ^e	1-9	---

^aMezzanine.

^bTI 733 hard-copy terminal.

^cTI 810 label printer.

^dThe jackstrip is not installed but the cables are in.

^eThe DROP SIDE end of cable is not terminated.

MULTIPLEXOR CONNECTIONS

TABLE G-V

COLD SUPPORT BUILDING CONNECTIONS TO MULTIPLEXOR

DYMAL Computer Room									
Remote Location			Jackfield Circuit	Junction Box Cable			Jackfield Cable		
				LINE SIDE			DROP SIDE		
Room	Outlet	Device		Junction Box	Terminal Strip	Cable Number	Cable Number	Line Number	MUX Port
127	01	CRT	1	J02	T13	525	528	1	29
127	02	CRT	2	J02	T13	525	528	2	32
127	03	CRT	3	J02	T13	525	528	3	33
127	04	CRT	4	J02	T13	525	528	4	34
128	01	CRT	5	J02	T13	525	528	5	35
128	02	PR ^a	6	J02	T13	525	528	6	44
133	01	CRT	7	J02	T13	525	528	7	36
133	02	PR ^a	8	J02	T13	525	528	8	45
127	05	CRT	9	J02	T13	525	528	9	---
135	01	CRT	10	J02	T13	525	528	10	31
135	02	PR ^a	11	J02	T13	525	528	11	30
---	---	---	12	J02	T13	525	528	12	---
142	01	CRT	13	JBB	T01	526	559	1	---
142	02	PR ^b	14	JBB	T01	526	559	2	---
---	---	---	15-24	JBB	T01	526	559	3-12	---

^aTI 810 label printer.

^bTI 733 hard-copy terminal.

APPENDIX H

CABLE CONNECTIONS

All cable connections in the DYMAC Communications System are specified in this appendix.

TABLE H-I

CABLING FROM COMPUTER ROOM JUNCTION BOXES TO JACKFIELD

<u>Junction Box</u>	<u>Terminal Strip</u>	<u>Jackstrip^a</u>
J01	T01	100-1 to 100-12
J01	T02	100-13 to 100-24
J01	T03	100-25 to 100-36
J01	T04	100-37 to 100-48
J01	T05	no strip
J01	T06	no strip
J01	T07	300-1 to 300-12
J01	T08	300-13 to 300-24
J01	T09	300-25 to 300-36
J01	T10	300-37 to 300-48
J01	T11	no strip
J01	T12	no strip
J02	T01	200-1 to 200-12
J02	T02	200-12 to 200-24
J02	T03	no strip
J02	T04	no strip
J02	T05	no strip
J02	T06	400-1 to 400-12
J02	T07	400-13 to 400-24
J02	T08	400-25 to 400-36
J02	T09	400-37 to 400-48
J02	T10	400-49 to 400-60
J02	T11	400-61 to 400-72
J02	T12	no strip
J02	T13	CSB ^b -1 to CSB-12
JBB	T01	CSB ^b -13 to CSB-24
JBB	T02	no strip

^aFrom (wing-outlet box) to (wing-outlet box).

^bCold Support Building.

TABLE H-II

JACKFIELD-TO-MULTIPLEXOR CABLE CODE

Line Number	Wire Color*	Multiplexor AMP Connector Pin Number	Signal	Polarity	50-pin Connector Number
1	white-blue	5	transmit	plus	26
	blue-white	1	transmit	minus	1
	white-orange	2	receive	plus	27
	orange-white	6	receive	minus	2
2	white-green	5	transmit	plus	28
	green-white	1	transmit	minus	3
	white-brown	2	receive	plus	29
	brown-white	6	receive	minus	4
3	white-slate	5	transmit	plus	30
	slate-white	1	transmit	minus	5
	red-blue	2	receive	plus	31
	blue-red	6	receive	minus	6
4	red-orange	5	transmit	plus	32
	orange-red	1	transmit	minus	7
	red-green	2	receive	plus	33
	green-red	6	receive	minus	8
5	red-brown	5	transmit	plus	34
	brown-red	1	transmit	minus	9
	red-slate	2	receive	plus	35
	slate-red	6	receive	minus	10
6	black-blue	5	transmit	plus	36
	blue-black	1	transmit	minus	11
	black-orange	2	receive	plus	37
	orange-black	6	receive	minus	12
7	black-green	5	transmit	plus	38
	green-black	1	transmit	minus	13
	black-brown	2	receive	plus	39
	brown-black	6	receive	minus	14
8	black-slate	5	transmit	plus	40
	slate-black	1	transmit	minus	15
	yellow-black	2	receive	plus	41
	black-yellow	6	receive	minus	16
9	yellow-orange	5	transmit	plus	42
	orange-yellow	1	transmit	minus	17
	yellow-green	2	receive	plus	43
	green-yellow	6	receive	minus	18

TABLE H-II (continued)
JACKFIELD-TO-MULTIPLEXOR CABLE CODE

<u>Line Number</u>	<u>Wire Color*</u>	<u>Multiplexor AMP Connector Pin Number</u>	<u>Signal</u>	<u>Polarity</u>	<u>50-pin Connector Number</u>
10	yellow-brown	5	transmit	plus	44
	brown-yellow	1	transmit	minus	45
	yellow-slate	2	receive	plus	46
	slate-yellow	6	receive	minus	47
11	violet-blue	5	transmit	plus	48
	blue-violet	1	transmit	minus	49
	violet-orange	2	receive	plus	50
	orange-violet	6	receive	minus	51
12	violet-green	5	transmit	plus	52
	green-violet	1	transmit	minus	53
	violet-brown	2	receive	plus	54
	brown-violet	6	receive	minus	55

*The wire color is given first and the color of the stripe second. For example, white-blue means a white wire with a blue stripe.

TABLE H-III
WIRING BETWEEN SECONDARY COMPUTER AND JACKFIELD

<u>Cable Number</u>	<u>Secondary Computer Jackstrip</u>	<u>Jackstrip Locations</u>	<u>Secondary Computer Ports</u>
553	1	1 - 12	0 - 11
554	1	13 - 24	12 - 23
555	2	1 - 12	24 - 35
556	2	13 - 24	36 - 47
557	3	1 - 12	48 - 59
558	3	13 - 16	60 - 63

TABLE H-IV

JACKETRIP FRONT-TO-REAR CONNECTIONS: DROP SIDE

<u>Jack Circuit</u>	<u>Wire</u>	<u>Pin</u>	<u>Plug Connector</u>
1	tip	26	P1
1	ring	1	P1
2	tip	27	P1
2	ring	2	P1
3	tip	28	P1
3	ring	3	P1
.	.	.	.
.	.	.	.
.	.	.	.
23	tip	48	P1
23	ring	23	P1
24	tip	49	P1
24	ring	24	P1
25	tip	26	P2
25	ring	1	P2
26	tip	27	P2
26	ring	2	P2
.	.	.	.
.	.	.	.
.	.	.	.
47	tip	48	P2
47	ring	23	P2
48	tip	49	P2
48	ring	24	P2

CABLE CONNECTIONS

TABLE H-V

JACKSTRIP FRONT-TO-REAR CONNECTIONS: LINE SIDE

<u>Jack Circuit</u>	<u>Wire</u>	<u>Pin</u>	<u>Receptacle Connector</u>
1	tip	26	J1
1	ring	1	J1
2	tip	27	J1
2	ring	2	J1
3	tip	28	J1
3	ring	3	J1
.	.	.	.
.	.	.	.
.	.	.	.
23	tip	48	J1
23	ring	23	J1
24	tip	49	J1
24	ring	24	J1
25	tip	26	J2
25	ring	1	J2
26	tip	27	J2
26	ring	2	J2
.	.	.	.
.	.	.	.
.	.	.	.
47	tip	48	J2
47	ring	23	J2
48	tip	49	J2
48	ring	24	J2

APPENDIX J

COMMUNICATION LINES

Tables in this appendix give the following information for each communications line in a particular wing of the Plutonium Processing Facility or in the Cold Support Building: room number, outlet box number, nearest dropbox or glovebox, device number, nearest telephone number, and MUX port connection. This information is useful to the DYMAC computer operator in determining which device is responsible when transmission errors occur on a particular MUX port and in notifying the responsible person.

Also in this appendix are the numbers of the jackfield circuits used for lines in the Plutonium Processing Facility or in the Cold Support Building, with the proper resistance and capacitance measurements for each line from that jackfield circuit to the corresponding outlet box. This information is useful for troubleshooting a line to determine if the cables from the jackfield to the outlet box are connected properly.

DYMAC COMMUNICATIONS SYSTEM

TABLE J-1
DEVICE LOCATIONS IN 100 WING

Remote Location						DYMAC Circuitry Form					
Room	Outlet	Glove-Box	Device	Instrument Number	Nearest Telephone	Jackfield Circuit	Registration Chms		Capacitance nF		MW
							Left	Right	Left	Right	
106	01	D100	W ₁	B47	7-2543	1	18	18	27.9	27.7	31
106	02	---	CRT	TC29	7-2543	2	19	18	28.0	27.7	31
106	03	D105	W ₁	B46	7-2546	3	19	18	28.1	27.7	31
106	04	---	spare	---	7-2546	4	20	20	30.9	30.6	31
106	05	---	CRT	TC28	7-2546	5	20	20	30.9	30.6	31
106	06	D108	W ₁	B45	7-2546	6	19	18	28.1	27.7	31
106	07	D105	W ₁	B44	7-2546	7	19	18	28.1	27.7	31
106	08	---	CRT	TC27	7-2543	8	19	18	28.0	27.7	31
106	09	D103	W ₁	B43	7-2543	9	19	18	28.0	27.7	31
106	10	D103	TNC	N28	7-2543	10	19	18	28.0	27.7	31
106	11	G183	W ₁	B42	7-2585	11	19	18	28.1	27.8	31
106	12	---	CRT	TC26	7-2585	12	19	18	28.0	27.7	31
106	13	D111	TNC	N27	7-2586	13	19	18	28.1	27.7	31
106	14	---	CRT	TC25	7-2586	14	19	18	28.0	27.7	31
106	15	---	CRT	TC24	7-2587	15	19	18	28.1	27.7	31
106	16	---	CRT	TC23	7-2569	16	19	18	30.5	29.2	31
106	17	G150	TNC	N25	7-2569	17	19	18	29.3	29.6	31
106	18	G150	W ₁	B40	7-2569	18	19	18	30.0	30.2	31
500 ^a	01	---	CRT	TC22	7-2587	19	19	18	34.6	34.5	31
500 ^a	02	---	PR ^b	TH07	7-2587	20	19	18	33.5	32.2	31
106	19	D115	TNC	N26	7-2587	21	19	18	28.1	27.4	31
106	20	D115	W ₁	B41	7-2587	22	19	18	29.1	27.8	31
106	21	D114	W ₁	B38	7-2587	23	9	9	27.1	27.4	120
---	---	---	---	---	---	24-48 ^c	---	---	---	---	---
---	---	---	---	---	---	40-f7 ^d	---	---	---	---	---

^aMezzanine.

^bTI 733 hard-copy terminal.

^cNot assigned.

^dJackstrip not installed.

COMMUNICATION LINES

TABLE 1-11
DEVICE LOCATIONS IN 200 JING

Form 10-1 (Rev. 1-1-64)					LYMA		Transfer From		Transfer To		MIX Part
Page	Sheet	Box	Level	Instrument Number	Nearest Telephone	Category Number	Class TX	Class PX	Class TX	Class PX	
100	01	---	---	TRT	7-2549	1	10	10	28.4	28.6	87
100	01	---	---	TRT	---	2	10	10	28.5	28.6	87
100	01	---	---	TRT	---	3	10	10	28.6	28.6	88
100	01	---	---	W	B-4	4	10	10	28.7	28.4	87
100	01	---	---	W	B-4	5	10	10	28.7	28.6	87
100	01	---	---	W	B-4	6	10	10	28.6	28.6	88
100	01	---	---	TRT	7-2549	7	10	10	28.7	28.6	87
100	01	---	---	TRT	7-2549	8	10	10	28.7	28.6	87
100	01	---	---	TRT	7-2549	9	10	10	28.8	28.4	87
100	01	---	---	W	K-2	10	10	10	28.8	28.6	88
100	01	---	---	space	7-2549	11	10	10	28.8	28.6	87
100	01	---	---	TRT	---	12	10	10	28.8	28.4	88
100	01	---	---	TRT	---	13	10	10	28.9	28.5	87
100	01	---	---	W	B-4	14	10	10	28.9	28.4	87
100	01	---	---	TRT	---	15	10	10	28.9	28.4	88
100	01	---	---	W	B-4	16	0	0	28.4	28.0	88
100	01	---	---	TRT	7-2950	17	0	0	28.5	28.0	110
100	01	---	---	space	7-2950	18	0	0	28.5	28.5	---
100	01	---	---	TRT	7-2950	19	10	10	28.6	28.5	---
---	---	---	---	---	---	20-48E	---	---	---	---	---
---	---	---	---	---	---	49-67C	---	---	---	---	---

any real hard-copy terminal.

Not assigned.

Backstrip not installed.

DYMAC COMMUNICATIONS SYSTEM

TABLE J-111
DEVICE LOCATIONS IN 300 WING

Remote Location						DYMAC Computer Room					
Room	Outlet	Glove- Box	Device	Instrument Number	Nearest Telephone	Jackfield Circuit	Resistance (ohms)		Capacitance (nF)		MUX Port
							Left Jack TX	Right Jack RX	Left Jack TX	Right Jack RX	
305	01	---	CRT	TC17	7-2373	1	16	16	20.1	21.7	8
305	02	D311	W ₁	B25	7-2373	2	15	15	21.1	21.5	11
305	03	D374	W ₁	B27	---	3	13	13	21.4	21.6	63
308	01	G370	W _{1A}	B26	---	4	15	15	23.1	22.5	64
316	01	---	CRT	TC16	7-2372	5	19	19	23.4	24.2	9
319	01	D309	W ₁	B24	7-2372	6	16	16	22.1	22.7	49
319	02	---	W ₂	B25	7-2372	7	17	17	23.8	23.9	50
319	03	D308	W ₁	B23	7-2372	8	17	17	23.2	22.4	51
319	04	---	CRT	TC15	7-2372	9	16	16	22.0	22.0	10
319	05	D307	W ₁	B22	7-2372	10	13	13	23.9	23.3	52
319	06	D306	W ₁	B21	7-2372	11	12	12	23.8	23.4	53
319	07	D305	W ₁	B20	7-2372	12	13	13	24.2	24.3	54
319	08	D304	W ₁	B19	7-2372	13	12	12	23.4	22.8	48
319	09	---	CRT	TC14	7-2372	14	10	10	20.1	20.1	11
326	01	---	CRT	TC13	7-2374	15	11	11	22.7	22.8	12
326	02	---	PR ^a	TH05	7-2374	16	11	11	24.7	23.3	40
327	01	D303	TNC	N14	---	17	8	8	22.4	22.7	72
327	02	D303	W ₁	B18	---	18	7	7	23.3	23.0	56
327	03	D302	W ₂	B11	---	19	8	8	22.4	22.3	57
329	01	D301	W ₁	L16	7-2373	20	8	8	21.8	20.4	59
329	02	D301	TNC	N13	7-2373	21	8	8	21.6	21.4	76
330	01	---	CRT	TC12	7-2373	22	8	8	22.2	21.5	13
33 ^b	01	---	CRT	TC11	7-2379	23	7	7	19.9	20.0	16
33 ^b	02	---	PR ^c	PR01	7-2379	24	7	7	19.7	20.1	37
305	03	D310	W ₁	B28	7-2373	25	11	11	20.1	19.7	79
---	---	---	---	---	---	26-44 ^d	---	---	---	---	---
---	---	---	spare	---	---	45	---	---	---	---	47
---	---	---	---	---	---	46 ^d	---	---	---	---	---
---	---	---	spare	---	---	47	---	---	---	---	15
---	---	---	spare	---	---	48	---	---	---	---	14
---	---	---	---	---	---	49-67 ^e	---	---	---	---	---

^aTI 733 hard-copy terminal.

^bBasement.

^cTI 810 label printer.

^dNot assigned.

^eJackstrip not installed.

TABLE J-1V
DEVICE LOCATIONS IN 400 WING

Remote Location						DYMARC Computer Room					
From	To/Net	Server Box	Device	Instrument Number	Nearest Telephone	Jackfield Circuit	Resistance (ohms)		Capacitance (nF)		MUX Port
							Left Jack TX	Right Jack RX	Left Jack TX	Right Jack RX	
400	01	---	CRT	TC10	7-2572	1	18	18	29.4	29.3	21
400	02	D410	SAI	G15	7-2572	2	18	18	29.4	29.7	89
400	03	D410	W-A	B11	7-2572	3	18	18	29.3	27.1	90
400	04	D410	TNC	N08	7-2572	4	18	18	29.4	26.9	91
400	05	D410	W1	B10	7-2572	5	18	18	29.8	26.2	92
400	06	---	CRT	TC09	7-2574	6	19	19	27.4	27.1	22
400	07	D410	SAI	G14	7-2574	7	12	12	23.0	22.7	93
400	08	D410	W-A	B09	7-2574	8	12	12	22.2	21.6	94
400	09	D410	TNC	N07	7-2574	9	12	12	22.1	22.0	95
400	04	D410	SAI	G13	7-2574	10	12	12	22.5	22.2	97
400	05	D410	W-A	B06	7-2574	11	12	12	22.2	21.8	98
400	06	D410	TNC	N06	7-2575	12	12	12	23.8	23.6	99
400	07	D410	W1	B07	7-2575	13	12	12	23.9	23.1	100
400	08	G438	spare	---	7-2575	14	12	12	24.6	24.7	101
400	04	G439	spare	---	7-2575	15	12	12	24.4	24.9	102
400	05	G440	spare	---	7-2575	16	12	12	25.4	26.4	103
400	06	G441	spare	---	7-2575	17	12	12	25.7	25.4	104
400	07	D410	SAI	G12	7-2575	18	12	12	25.3	23.6	105
400	08	D410	W-A	B05	7-2575	19	12	12	24.0	23.9	106
400	09	G425	spare	---	7-2575	20	12	12	23.7	22.9	107
400	10	D410	TNC	N05	7-2575	21	12	12	21.6	21.9	108
400	11	D410	W-A	B05	7-2575	22	12	12	22.3	21.8	109
400	12	D410	SAI	G11	7-2575	23	12	12	21.5	22.3	110
400	13	---	CRT	TC08	7-2575	24	12	12	23.6	23.2	23
---	---	---	spare	---	---	25	---	---	---	---	---
400	01	D408	W1	B04	7-2577	26	9.5	9.5	23.7	23.6	113
400	07	D406	TNC	N04	7-2577	27	7.5	7.5	20.7	21.4	114
400	02	D406	W1	B03	7-2577	28	7.5	7.5	21.8	22.4	115
400	04	D405	FNC	N35	7-2577	29	7.5	7.5	22.0	22.0	116
400	05	D405	W1	B02	7-2577	30	7.5	7.5	22.0	21.4	117
400	06	---	CRT	TC07	7-2577	31	9	9	23.7	23.4	24
400	01	G401	TNC	N03	7-2579	32	7.5	7.5	19.9	19.5	118
400	02	G401	W1	B01	7-2579	33	7.5	7.5	20.5	20.3	119
400	01	---	CRT	TC06	7-2580	34	9	9	24.5	24.0	25
400	02	---	W2	B55	7-2580	35	9	9	23.7	23.8	120
400	03	---	CAL	K01	7-2580	36	9	9	23.1	23.1	121

TABLE J-IV (continued)
DEVICE LOCATIONS IN 400 WING

Remote Location						DYMAC Computer Room					
Room	Outlet	Glove- Box	Device	Instrument Number	Nearest Telephone	Jackfield Circuit	Resistance (ohms)		Capacitance (nF)		MUX Port
							Left	Right	Left	Right	
							Jack TX	Jack RX	Jack TX	Jack RX	
433	04	---	SGS	G01	7-2580	37	9	9	24.3	23.5	122
433	05	---	FNC	N35	7-2580	38	9	9	23.7	24.3	122
433	06	---	TNC	N02	7-2580	39	9	9	23.8	24.3	124
433	07	---	TNCB	N01	7-2580	40	7	7	22.0	22.6	125
522 ^a	01	---	CRT	TC05	7-2567	41	18	18	25.1	25.4	26
522 ^a	02	---	PR ^b	TH04	7-2568	42	18	18	25.7	25.0	42
528 ^a	01	---	CRT	TC04	7-2566	43	9	9	23.3	23.2	27
528 ^a	02	---	PR ^b	TH03	7-2571	44	9	9	22.8	22.2	43
433	08	---	CRT	TC03	7-2580	45	9	9	23.5	24.2	28
433	09	---	PR ^c	PR02	7-2580	46	9	9	23.1	23.6	38
433	10	---	spare	---	7-2580	47	9	9	23.4	23.5	126
401	06	D418	TNC	N09	7-2572	48	11	11	19.2	18.5	95
---	---	---	---	---	---	49-68 ^d	---	---	---	---	---
---	---	---	spare	---	---	69	---	---	---	---	63
---	---	---	---	---	---	70-71 ^d	---	---	---	---	---
---	---	---	spare	---	---	72	---	---	---	---	111
---	---	---	---	---	---	73-81 ^e	---	---	---	---	---

^aMezzanine.

^bTI 733 hard-copy terminal.

^cTI 810 label printer.

^dNot assigned.

^eJackstrip not installed.

COMMUNICATION LINES

TABLE J-V

DEVICE LOCATIONS IN COLD SUPPORT BUILDING

Remote Location						DYMAC Computer Room					
Room	Outlet	Glove- Box	Device	Instrument Number	Nearest Telephone	Jackfield Circuit	Resistance (ohms)		Capacitance (nF)		MUX Port
							Left Jack TX	Right Jack RX	Left Jack TX	Right Jack RX	
127	01	---	CRT	---	7-3470	1	4.7	4.7	5.25	5.08	29
127	02	---	CRT	---	7-3470	2	4.7	4.7	5.39	5.30	32
127	03	---	CRT	---	7-3470	3	4.7	4.7	5.42	5.44	33
127	04	---	CRT	---	7-3470	4	4.7	4.7	5.48	5.30	34
128	01	---	CRT	TC02	7-2378	5	4.2	4.1	4.20	4.20	35
128	02	---	PR ^a	TH02	7-2378	6	4.2	4.2	4.42	4.18	44
133	01	---	CRT	TC01	7-2372	7	4.6	4.6	5.13	5.25	36
133	02	---	PR ^a	TH01	7-2373	8	4.6	4.6	5.55	5.50	45
127	05	---	CRT	---	7-3470	9	4.7	4.7	5.37	5.29	---
135	01	---	CRT	TC30	7-2369	10	5	5	6.5	6.4	31
135	02	---	PR ^a	TH08	7-2369	11	5	5	6.5	6.5	30
---	---	---	---	---	---	12 ^b	---	---	---	---	---
142	01	---	CRT	TC32	7-2366	13	4	4	4.01	4.08	---
142	02	---	PR ^c	TH09	7-2366	14	4	4	3.78	3.78	---
---	---	---	---	---	---	15-24 ^b	---	---	---	---	---

^aTI 810 label printer.

^bNot assigned.

^cTI 733 hard-copy terminal.

APPENDIX K

EQUIPMENT MAINTENANCE

<u>Equipment</u>	<u>Responsible for Maintenance</u>	<u>Telephone</u>
Balance, electronic	LASL Group Q-3	677-5735
Communications	LASL Group Q-3	667-5735
Computer (Eclipse)	Data General Corp.	672-3600 ^a 265-8011 ^b 983-6311 ^c
Fast-neutron coincidence counter	LASL Group Q-3	667-5735
Label printer, TI 810	LASL Group E-1	667-5940
Segmented gamma scanner	Jomar Systems	662-9811
Solution assay instrument	LASL Group Q-3	667-5735
Terminals, Teleray 3741 CRT and TI 733 hard-copy	LASL Group E-1	667-5940
Thermal-neutron coincidence counter	LASL Group Q-3	667-5735

^aWhite Rock.

^bAlbuquerque.

^cAnswering service.