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EWC^{3}I SOFTWARE DEVELOPMENT

FINAL REPORT

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Table Of Contents

1. INTRODUCTION

This report provides an overview of the Electronic Warfare Command, Control, Communications and Intelligence (EWC³I) System Software (ESS). The ESS is distributed among six workstations, each supporting operations at a specific component of a Canadian Land Electronic Warfare Squadron.

The six EWC³I workstations are used to support operational activities at the Electronic Warfare Command Center (EWCC), the Forward Electronic Warfare Operations Center (FEWOC), the Electronic Warfare Operations Center (EWOC), the Direction Finding (DF) stations and the Jammer stations.

An overview of the EWC³I system architecture and the functions supported by each workstation is provided in Section 3. Section 4 describes the data communications links used between the workstations. Appendix A lists the user interface requirements used to design the EWC³I System Software. Appendix B contains wiring diagrams for the MEROD - PC interconnect cables.

2. REFERENCES

The following documents have been consulted during preparation of this report:

[1] EWC³I - FEWOC Workstation User Manual, Software Kinetics Document # 1600-88-002 Version 01, 12 December 1991.

[2] EWC³I - EWOC Workstation User Manual, Software Kinetics Document # 1600-88-003 Version 01, 12 December 1991.

[3] EWC³I - EWCC Workstation User Manual, Software Kinetics Document # 1600-88-004 Version 01, 12 December 1991.

[4] EWC³I - Operator Workstation User Manual, Software Kinetics Document # 1600-88-005 Version 01, 12 December 1991.

[5] EWC³I - DF Workstation User Manual, Software Kinetics Document # 1600-88-006 Version 01, 12 December 1991.

[6] EWC³I - Jammer Workstation User Manual, Software Kinetics Document # 1600-88-007 Version 01, 12 December 1991.

3. SYSTEM ARCHITECTURE

3.1 Overview

The EWC³I System architecture is based on the command and control structure of a Canadian Land Electronic Warfare Squadron. The structure is driven by the data flow between the individual detachments, and requires a workstation at each detachment. The information passed between these workstations is primarily in the form of standard reports (TACREP, ADMREP, INTREP etc.). In addition to these reports, command instructions can be passed (usually in the form of tasking orders) to the ESM and ECM assets that are deployed forward of the command and operations centers. Major data flow paths between EWC³I workstations are shown in Figure 3.1-1.

3.2 Workstation Functions

The functions provided by each EWC³I workstation are based on a common core of report preparation, transmission, reception and tracking tools. Specific workstations include features such as map displays and tasking browsers. The functions supported by the six workstations are briefly outlined below. Further information describing the functional capabilities and user interface can be found in the User Manual for each workstation (see Section 2).

i) EWCC Workstation

The EWCC Workstation provides the Command Center with a number of situation assessment tools in addition to the report processing capabilities included in all EWC³I workstations. This includes a Tactical Map Display showing the location of friendly assets overlayed on a scanned map, and a local database of information (communications parameters etc.) related to these assets.

ii) EWOC Analyst Workstation

The EWOC Analyst Workstation supports EWC³I functions as part of the Data Fusion and Correlation Techniques Testbed (DFACTT) Analyst Workstation (AW). It adds features to the AW that support report preparation and tasking of emitter location assets. A DFACTT Operator alert browser allows the operator to notify the Analyst when a new signal is detected.

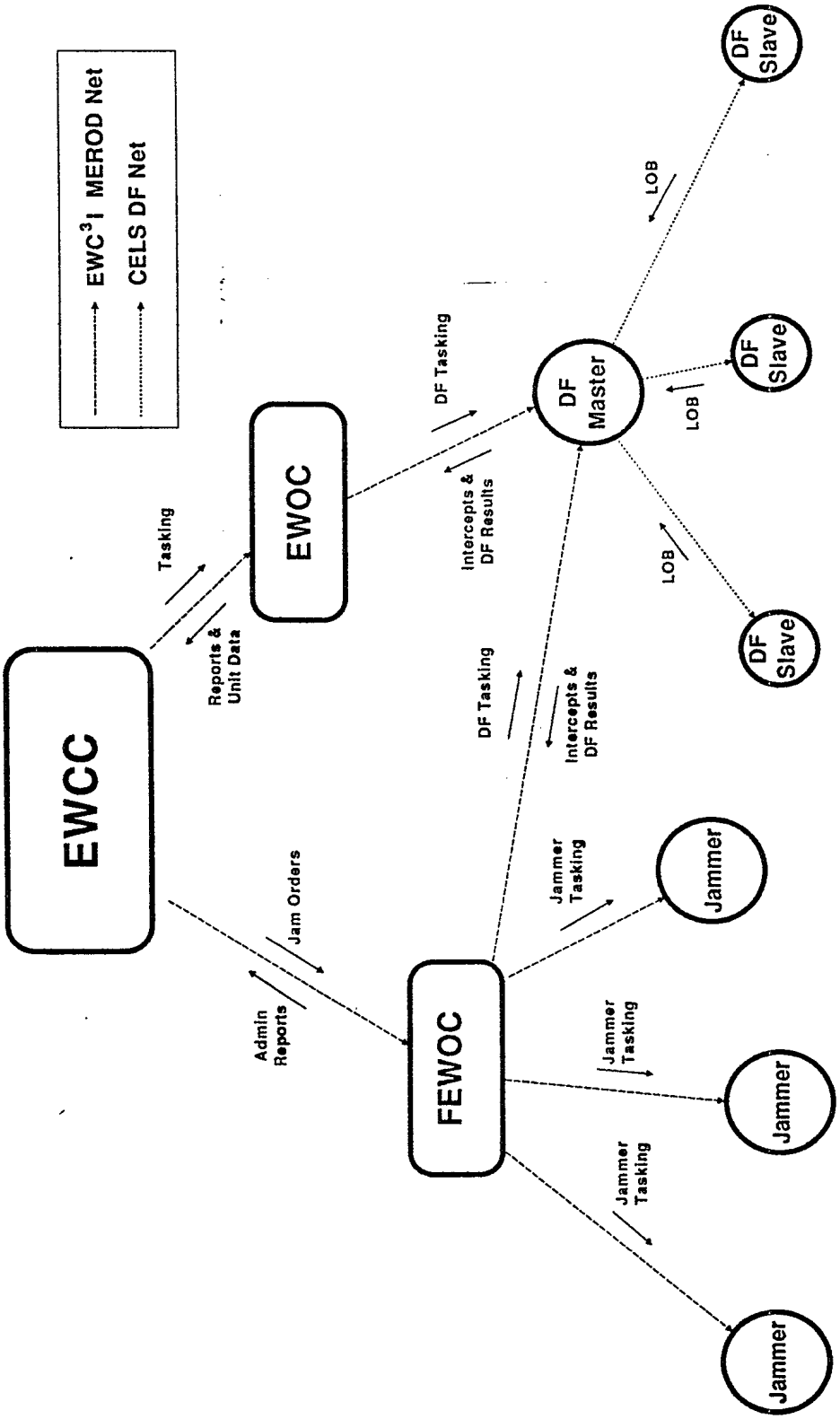


Figure 3.1-1
EWC[3]I Data Flow

iii) EWOC Operator Workstation

The EWOC Operator Workstation supports EWC³I functions as part of the DFACTT Operator Workstation. It adds a serial communications link from the Operator to the Analyst Workstation, a signal alert browser, and the ability to task other operators with intercept parameters.

iv) FEWOC Workstation

The FEWOC Workstation command, control and planning tools for the forward assets of the squadron; the emitter locating system and the ECM transmitters. The toolset is centered around the Tactical Map Display, and supports movement planning, propagation prediction and tasking of ESM and ECM assets.

v) DF Workstation

The Direction Finding (DF) Workstation supports general EW report processing and the reception of DF tasks.

vi) Jammer Workstation

The Jammer Workstation supports general EW report processing and the reception of Jammer mission parameters.

4. DATA COMMUNICATION LINKS

4.1 Overview

The EWC³I System uses secure data communications links to transfer command and control information between the individual components of the system. Information is transferred in the form of human readable ASCII messages and reports. All messages are formatted to allow the destination system to retrieve data from the message and store the information in a local database without operator intervention.

The following subsections outline the current data link configuration, suggested improvements to the data link hardware, and also describes an alternative to the MEROD based configuration.

4.2 MEROD Data Links

The EWC³I system utilizes the Message Entry - Read Out Device (MEROD), developed by Racal Comsec Ltd., to transfer data between the EWC³I workstations. The MERODs support data input and display using a keyboard/liquid crystal display and through an RS-232 remote port, and contains an FSK Modem that provides an analog signal to the RT-524 radio and VINSON encryption device.

4.2.1 Current Configuration

The MEROD was originally designed to be a simple, portable, message terminal that supports transfer of text messages between operators. The ESS makes use of the RS-232 remote port feature to enter and retrieve messages, bypassing the data entry keyboard and liquid crystal display.

Use of the MEROD for ESS message transmission has highlighted some limitations in the MEROD remote port implementation. These limitations are summarized as follows:

i) When a message is received and retrieved from the data buffer, there is no indication of end of message text.

ii) The MEROD character set is limited to the following characters; A through Z (uppercase only), 0 through 9, and graphics characters *!@#$%&()_+-=;:'"/<>?,*. Lower case characters are automatically converted to upper case.

iii) The MEROD automatically inserts a <CR><LF> every 60 characters, and each line is preceded by 8 space characters.

These problems were overcome through careful software design, but have limited some of the functional capabilities of the EWC³I System.

4.2.2 Suggested Improvements

A MEROD was disassembled and examined to determine the feasibility of modifying the MEROD firmware to correct the deficiencies listed above. This revealed the following:

i) The MEROD uses CMOS technology throughout, and is based on the RCA CDP1802 microprocessor.

ii) The firmware is stored on a 27C64 (8K byte) EPROM. It is mounted in a socket, and could be removed and reprogrammed.

iii) A MSM5128 (2K Byte) Static Ram is used for program scratchpad and message storage.

Although the CDP1802 is not a common microprocessor, PC based cross development tools are available, and the 1802 assembly language is similar to other 8 bit microprocessors.

The following modifications could be made to the firmware to improve the remote port interface:

i) Automatically append a special character (e.g. ETX) to each message to signal end of message to the remote computer.

ii) Allow transmission of the full ASCII character set through the remote port (including lower case characters).

iii) Remove the extra carriage return/line feed characters from the message and add them at the destination only if the local display is being used.

In order to perform the modifications, the following items would be required:

i) Assembler Source Code for the current MEROD firmware.

ii) Programmers model for the MEROD (Memory Map, I/O Ports etc).

iii) CDP1802 PC Based Cross Assembler

The modifications listed above could be made with minimal effort, and could be made without changing normal MEROD operation.

4.3 Packet Radio Data Links

The use of Packet Radio to transfer data between the EWC³I workstations is an alternative to the MEROD based data link. Terminal Node Controllers (TNCs) can be used in a manner that is similar to the current MEROD configurations, but there are some important differences. The differences are listed below.

i) The MEROD is connectionless - i.e. it does not require that an explicit connection be made between the source and destination. The Packet Assembler/Disassembler (PAD) present in a TNC requires that a connection be established between the two participants before data is sent.

ii) The TNC does not have a keyboard or display and must be used with a computer or terminal.

iii) The TNC transmits all characters entered by the user. The MEROD prompts the user for each message.

Development of a TCP/IP shell that could be used with the TNCs would eliminate most of the problems associated with the PAD interface. This will be addressed through the DFACTT Secure Data Link work that will be completed by April 1, 1992. The ESS could then be updated to use the Packet Radio TNCs.

Appendix A
User Interface Requirements

A.1 Introduction

This appendix describes (in point form) the original user interface requirements for the EWC³I Workstations.

A.2 Requirements

A.2.1 EWCC Workstation

Inputs

- Admin reports from EWOC (Analyst)
- Admin reports from FEWOC

Processing

- Map display
- Build up situation from incoming reports
- Tie incoming admin reports to unit icons

Outputs

- Analyst Tasking (EWOC) Admin reports (Orders)
- Jamming orders to FEWOC

A.2.2 EWOC Workstation (DFACTT Analyst Workstation)

Inputs

- Tasking from EWCC (Admin reports - Orders)
- DF from FEWOC and DF Master
- Intercepts from FEWOC (opportunity intercepts)
- Intercepts from TCAS (Serial and Ethernet)
- DF tasking alert messages from TCAS
- LOB correlator with manual LOB inputs (on screen and/or text input)

Processing

- DF Tasking message to FEWOC including:
    - Frequency
    - Modulation
    - Bandwidth
    - Area of interest specified by one or two locations (UTM)

Outputs

- Admin reports to EWCC
- DF Tasking to FEWOC (Selectable address for FEWOC or DF Master)

A.2.3 FEWOC Workstation

Inputs

- DF Tasking from EWOC
- LOB messages from CELS stations (when master station down)
- Location messages from CELS master stations
- Status admin messages from CELS stations
- Status admin messages from Jammers
- Jamming Orders from EWCC

Processing

i) Jammer Mission Planning Tool

- Map Based User Interface
    - Input or select enemy transmitter location on map
    - Input or select enemy receiver location on map
    - Use input enemy transmitter parameters including:
        - Transmitter power
        - Antenna height
        - Antenna gain
        - Bandwidth
    - Input jammer position on map
    - Use input jammer parameters including:
        - Transmitter power

- Antenna height
- Antenna gain
- Bandwidth

- Output whether jammer power is sufficient to jam enemy rx
  - compare received power of enemy tx with received power of jammer.

ii) Jammer Targeting Tool

- Map Based User Interface
  - Input or select enemy transmitter location on map
  - Input or select enemy receiver location on map
  - Use input enemy transmitter parameters including:
    - Transmitter power
    - Antenna height
    - Antenna gain
    - Bandwidth
  - Input jammer position on map
  - Use input jammer parameters including:
    - Transmitter power
    - Antenna height
    - Antenna gain
    - Bandwidth
  - Input Intercept Receiver position on map
  - Input received power of enemy transmitter at Intercept receiver
  - Output required jammer power to effectively jam enemy rx
  - Output maximum distance at which effective jamming of enemy rx can be performed at jammer transmitter power input on map

iii) Jammer Tasking Tools

- Map User Interface
- User enters jammer positions (or selects jammer icon) on the map pane
- Input tasking info including:
  - Position of jammer
  - LOB of receiver to be jammed
  - Frequency
  - Modulation
  - Time up and Time down or opportunity jamming

- Output jammer tasking message to jammer selected on the map
- Output jammer movement tasking message to jammer selected on map

iv) DF Site Planning Tool

- Map User Interface
- Input CELS Stations on map
- Input FEWOC and EWOC on map
- Output whether propagation loss allows DF Stations to send DF messages to DF Master and for location messages to be sent from DF Master to FEWOC/EWOC

v) DF Tasking Tools

- Map User Interface
- User enters CELS Stations on map
- Input tasking info including:
    - Position of CELS Station
    - Frequency
    - Modulation
    - Bandwidth
    - Time up, Time down
    - Whether CELS Station receiving message is Master station or Slave station

- Output DF tasking messages to DF Master Station
- Output DF Movement Tasking message to DF Station selected on map

vi) Receipt of DF Station Location Messages and LOBs

- Accept location messages from DF Master Stations
- Accept LOBs from DF Stations when master station is down Triangulate LOBs received and send location message to EWOC (Analyst)

Outputs

- Jammer tasking messages
- DF tasking messages
- Opportunity intercepts to EWOC
- DF results to EWOC if CELS master station down
- Admin reports to EWCC

A.2.4 CELS Stations

Inputs

- DF tasking from FEWOC

Processing

- Configure CELS master station to send DF location messages to addresses so that can send to EWOC and/or FEWOC
- Configure all CELS stations to send LOBs to addresses so that can send LOBs to CELS master station or, if master station down to FEWOC

Outputs

- DF Messages to DF Master or FEWOC
- Status messages to FEWOC

A.2.5 Jammers

Inputs

- Jammer tasking from FEWOC

Outputs

- Status messages to FEWOC

A.2.6 TCAS Workstation (DFACTT Operator Workstation)

Inputs

- Operator tasking messages from EWOC (Analyst)
  Serial link or Ethernet
- Operator tasks from other Operators

Outputs

- Operator intercept messages to EWOC (Analyst)
  Serial link or Ethernet
- DF Tasking alert messages to EWOC (Analyst)
  Serial link or Ethernet

Appendix B
MEROD Cabling

B.1 Introduction

The EWC³I system utilizes the Message Entry - Read Out Device (MEROD) developed by Racal Comsec Ltd. to transfer data between workstations. This appendix describes the physical interface between the workstation computer and the MERODs.

B.2 Wiring Diagrams

The Computer-MEROD-Radio interconnections are identical for each type of EWC3I workstation. A high level interconnection diagram is included in Figure B.2-1. The MEROD remote port is connected to the PC through serial port COM2. The MEROD remote port parameters must be set to 2400 baud, even parity and one stop bit.

The wiring connections for the MEROD - PC cable are shown in Figure B.2-2. A switchbox is used to select remote or local operation of the MEROD. The RS-232 CTS is used by the MEROD for flow control, and must be recognized by the EWC³I software. The PC's DTR signal is looped back to the DSR input for PC BIOS compatibility.

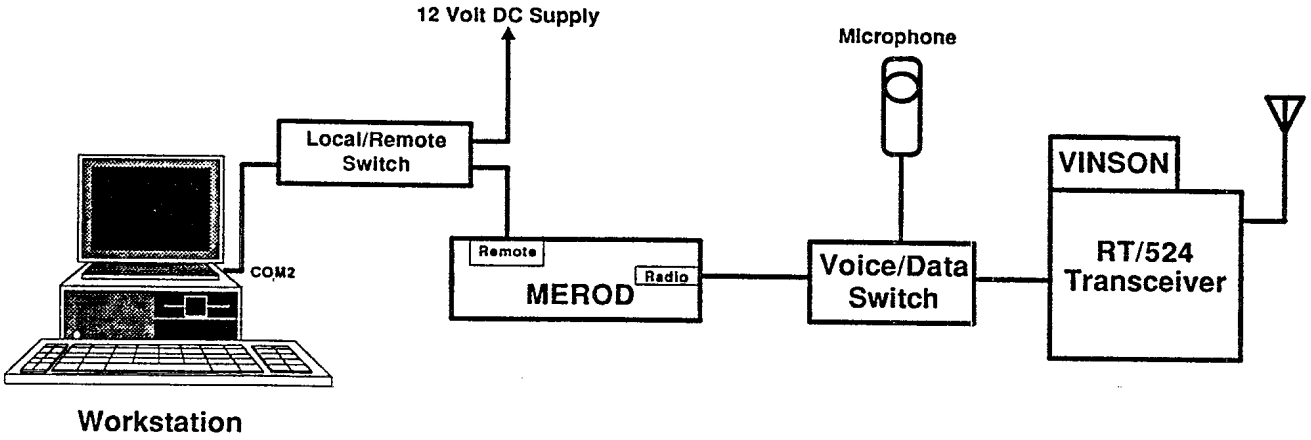
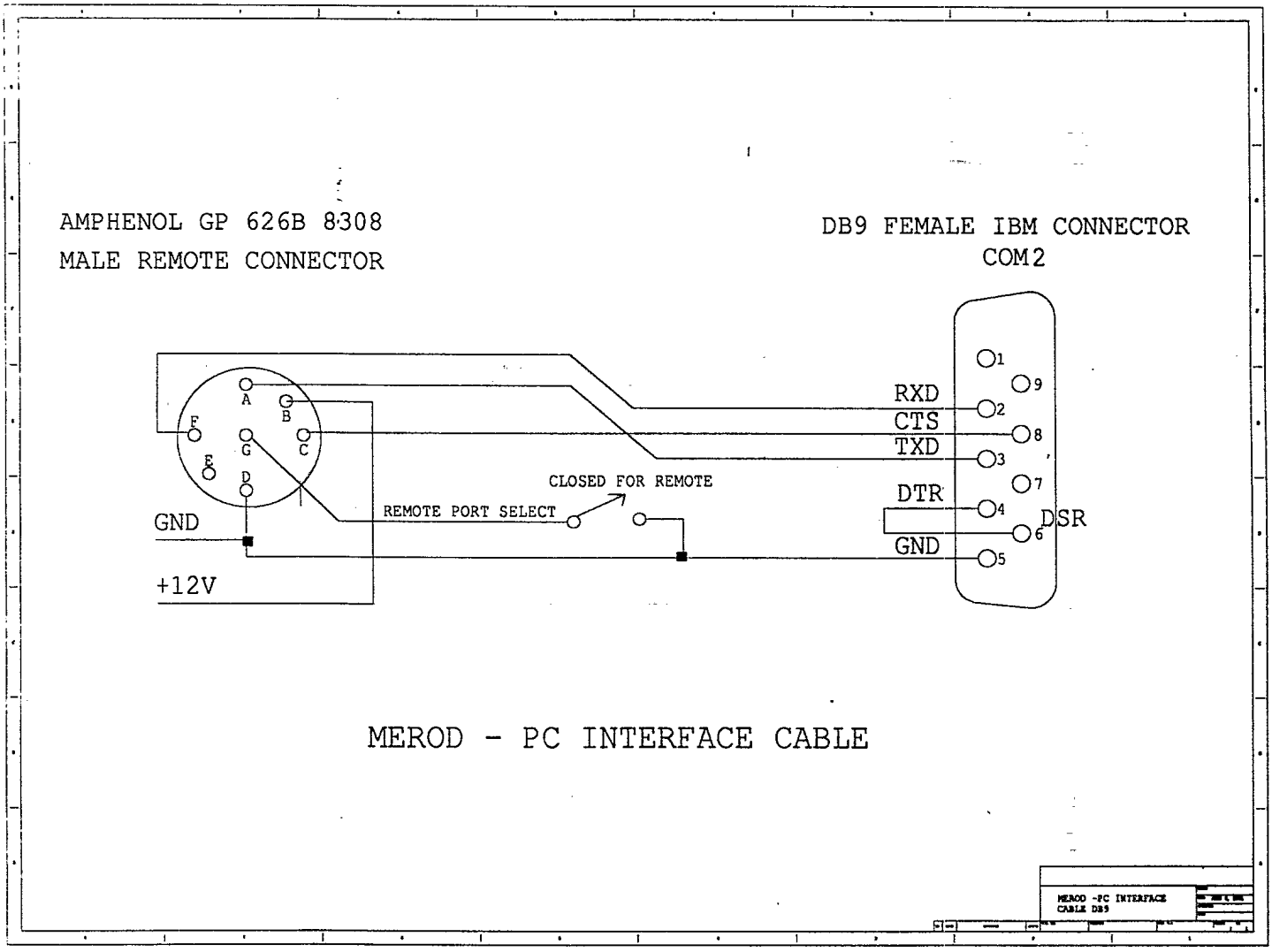


Figure B.2-1
EWC³I Workstation Interconnections



MEROD - PC INTERFACE CABLE

Figure B.2-2
MEROD - PC Cable Schematic

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The document includes a description of system architecture, functions supported by the six workstations and the EWC^3I data communications links.

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