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QUALITY ASSURANCE/QUALITY CONTROL DOCUMENTATION SERIES	
TITLE	**SERVICING AND CALIBRATION OF OPTICAL MONITORING DATALOGGERS**
TYPE	**STANDARD OPERATING PROCEDURE**
NUMBER	**4250**
DATE	**MARCH 1994**

AUTHORIZATIONS		
TITLE	NAME	SIGNATURE
ORIGINATOR	Gloria S. Mercer	
PROJECT MANAGER	Mark Tigges	
PROGRAM MANAGER	David L. Dietrich	
QA MANAGER	Gloria S. Mercer	
OTHER		

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1.0 PURPOSE AND APPLICABILITY

This standard operating procedure (SOP) outlines the general procedures for servicing and calibrating dataloggers used with optical monitoring systems. Accurate and reliable operation of on-site dataloggers is critical to collection of high quality optical monitoring data. Regular servicing, performance testing, and calibration of dataloggers is performed to assure quality data capture and minimize data loss by:

- Performing functional checks and performance tests annually.
- Performing preventive maintenance servicing annually.
- Recalibrating the datalogger when performance tests indicate the unit is not operating within specifications.
- Documenting all servicing, repairs, and calibrations performed.

The following technical instructions (TIs) provide detailed information regarding specific datalogger servicing and calibration procedures:

- TI 4250-2000 *Servicing and Calibration of Campbell 21X Dataloggers*
- TI 4250-2010 *Servicing and Calibration of the Handar 540A/570A DCP*

Campbell 21X dataloggers are used as the primary datalogger for the IMPROVE nephelometer network, transmissometer calibration, and transmissometer field audits. Handar 540A/570A DCPs are used as the primary datalogger in the IMPROVE transmissometer network.

2.0 RESPONSIBILITIES

2.1 PROJECT MANAGER

The project manager shall:

- Ensure that performance testing is conducted on all dataloggers annually.
- Ensure that fully serviced, calibrated, and field ready dataloggers are available as backups for units operating in the field.
- Ensure that all dataloggers that do not operate within factory specifications are returned to the manufacturer for factory servicing and recalibration.
- Ensure that all servicing and calibration is performed and documented according to procedures described in the datalogger-specific servicing and calibration TIs.

2.2 INSTRUMENT TECHNICIAN

The instrument technician shall:

- Perform all servicing and calibration of optical monitoring dataloggers.
- Coordinate with the manufacturer for return of dataloggers that fail to operate within factory specifications.
- Document and archive all datalogger servicing records.

2.3 DATA COORDINATOR

The data coordinator shall:

- Inform the instrument technician when a datalogger is removed from the field.
- Provide the instrument technician with a description of the field problems observed with the datalogger.

2.4 FIELD SPECIALIST

The field specialist shall provide the instrument technician with a description of problems observed during annual site visit testing.

3.0 REQUIRED EQUIPMENT AND MATERIALS

The following subsections provide summary lists of test equipment and materials required to service and calibrate optical monitoring dataloggers.

3.1 CAMPBELL 21X DATALOGGER

- Calibrated voltage source
- Campbell Scientific datalogger communications software (SMCOM)
- Campbell Scientific SC532 Peripheral Interface Module
- ARS Campbell 21X datalogger test program (21X_TEST.DLD)
- Digital voltmeter
- Waveform generator
- Frequency counter
- Campbell Scientific, Inc. *21X Micrologger Operator's Manual* and *21X Prompt Sheet*
- Reference thermometer (°C)
- Replacement components as required

- Battery pack
- Battery charger
- Desiccant packets
- Standard electronics laboratory small tools
- TI 4250-2000, *Servicing and Calibration of Campbell 21X Dataloggers*

3.2 HANDAR 540A/570A DCP

- Calibrated voltage source
- RF Wattmeter with 50 ohm RF load
- Digital voltmeter
- Reference AT/RH sensor
- Handar, Inc. *Operating and Service Manual for 540A Multiple Access Data Acquisition System, 560A Hydrologic Data Collection System, and 545A Programming Set*
- Handar, Inc. *570A Data Acquisition System Operating and Service Manual*
- Handar "TERM" program
- IBM PC-compatible computer
- Spare circuitboards as required
- 12 volt battery
- Desiccant packets
- Standard electronics laboratory small tools
- TI 4250-2010, *Servicing and Calibration of the Handar 540A/570A DCP*

4.0 METHODS

This section includes two (2) subsections:

4.1 Campbell 21X Datalogger Servicing Procedures
4.2 Handar 540A/570A DCP Servicing Procedures

4.1 CAMPBELL 21X DATALOGGER SERVICING PROCEDURES

Campbell 21X dataloggers are used as the primary datalogger for the IMPROVE nephelometer network, transmissometer calibration, and transmissometer field audits. Servicing procedures for the Campbell 21X datalogger are described in detail in TI 4250-2000, *Servicing and Calibration of Campbell 21X Dataloggers*. Servicing procedures include:

- Internal memory check
- Analog input check
- Analog output check
- Pulse counter check
- Panel temperature check
- Internal battery servicing
- Archiving Campbell 21X datalogger service records

4.2 HANDAR 540A/570A DCP SERVICING PROCEDURES

The Handar 540A/570A DCP is the primary datalogger in the IMPROVE transmissometer network. Servicing procedures for the Handar 540A/570A DCP are described in detail in TI 4250-2010, *Servicing and Calibration of the Handar 540A/570A DCP*. Servicing procedures include:

- Post-field inspection and performance checks
- Routine laboratory servicing
- DCP programming
- Pre-field performance testing
- Archiving Handar 540A/570A DCP service records

5.0 REFERENCES

Campbell Scientific, Inc., 1993, 21X Micrologger Operator's Manual. July.

Campbell Scientific, Inc., 1993, 21X Prompt Sheet.

Handar, Inc., 1982, Operating and Service Manual for 540A Multiple Access Data Acquisition System, 560A Hydrologic Data Collection System, and 545A Programming Set. June.

Handar, Inc., 1988, 570A Data Acquisition System Operating and Service Manual. March.

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AUTHORIZATIONS		
TITLE	NAME	SIGNATURE
ORIGINATOR	Mark Tigges	
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PROGRAM MANAGER	David L. Dietrich	
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AUTHORIZATIONS		
TITLE	NAME	SIGNATURE
ORIGINATOR	Mark Tigges	
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PROGRAM MANAGER	David L. Dietrich	
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LIST OF FIGURES

1.0 PURPOSE AND APPLICABILITY

This technical instruction (TI) describes procedures for servicing and verifying calibration of Campbell 21X dataloggers. This TI, as referenced in Standard Operating Procedure (SOP) 4250, *Servicing and Calibration of Optical Monitoring Dataloggers*, specifically describes procedures for:

- Testing datalogger memory functions
- Checking the accuracy of all analog voltage input channels
- Checking the accuracy of the analog output ports
- Checking the accuracy of the pulse input port
- Checking the accuracy of the panel temperature measurement
- Checking the condition of the internal battery
- Replacing the internal battery
- Archiving datalogger servicing records

Campbell 21X dataloggers are primarily used by ARS as the:

- Primary datalogger at NGN-2 nephelometer monitoring sites (Refer to TI 4300-4006, *Nephelometer Data Collection via Campbell Scientific Data Storage Module (IMPROVE Protocol)*).
- Primary datalogger for transmissometer calibration (Refer to TI 4200-2100, *Calibration of Optec LPV-2 Transmissometers (IMPROVE Protocol)*).
- Primary datalogger for field audit of transmissometers (Refer to SOP 4710, *Transmissometer Field Audit Procedures*).

2.0 RESPONSIBILITIES

2.1 PROJECT MANAGER

The project manager shall:

- Verify that all Campbell 21X dataloggers are serviced at least annually.
- Verify that calibration checks are performed on all Campbell 21x dataloggers at least annually.
- Verify that all Campbell 21X dataloggers are operating within factory specifications prior to being shipped to the field.
- Verify that all Campbell 21X dataloggers that do not operate within factory specifications are returned to Campbell Scientific for factory servicing and recalibration.

- Ensure that all datalogger servicing is documented and archived in accordance with the procedures described in this TI.

2.2 INSTRUMENT TECHNICIAN

The instrument technician shall:

- Perform and document all calibration checks.
- Coordinate with Campbell Scientific for return and recalibration of Campbell 21X dataloggers that fail to operate within factory specifications.
- Prepare purchase orders for factory servicing and recalibration of Campbell 21X dataloggers.
- Replace the Campbell 21X internal battery as required.
- Archive all datalogger servicing records.

2.3 DATA COORDINATOR

The data coordinator shall:

- Inform the instrument technician when a 21X is being removed from the field.
- Provide the instrument technician with a description of the field problems observed with the 21X.

3.0 REQUIRED EQUIPMENT AND MATERIALS

Specific instrumentation, tools, equipment, and materials required to service the Campbell 21X datalogger and to verify the datalogger calibration are:

- Calibrated voltage source - Datel Model DVC-350A or equivalent
- Campbell Scientific datalogger communications software (SMCOM)
- Campbell Scientific SC532 Peripheral Interface Module
- ARS Campbell 21X datalogger test program (21X_TEST.DLD)
- Digital voltmeter (4 1/2 digits)
- Waveform generator - Wavetek Model 185 or equivalent
- Frequency counter - Tenma Model 72-375 or equivalent
- Campbell Scientific, Inc. *21X Micrologger Operator's Manual* and *21X Prompt Sheet*
- Laboratory reference thermometer (°C)

- Replacement components as required
- Medium screwdrivers (flat-blade and Phillips-head)
- Battery charger
- Replacement sealed lead acid battery pack
- Two (2) dry half-unit DESI PAK desiccant packets

4.0 METHODS

Campbell 21X dataloggers should be serviced according to the following schedule:

- Prior to installation at a field monitoring site
- On an annual schedule (for units not used at field sites)
- Any time the operation or accuracy of the datalogger appears to be suspect

Calibration of the Campbell 21X datalogger is required any time calibration checks indicate that the datalogger is not operating within factory specifications.

This section includes seven (7) subsections:

4.1 Internal Memory Check
4.2 Analog Input Checks
4.3 Analog Output Checks
4.4 Pulse Counter Check
4.5 Panel Temperature Test
4.6 Internal Battery Servicing
4.7 Archiving Datalogger Service Records

Procedures for performing the internal memory check are documented on the Campbell 21X Datalogger Servicing Documentation Form (Figure 4-1) and are described in the following sections.

RECORD GENERAL INFORMATION	Record the datalogger serial number and the current date. The initials of the technician performing the inspection should also be recorded.

4.1 INTERNAL MEMORY CHECK

The Campbell 21X datalogger will perform an internal memory check on power-up. This check indicates the status of each memory chip on the datalogger's CPU board. Procedures for performing the internal memory check are documented on the Campbell 21X Datalogger Servicing Documentation Form (Figure 4-1) and are as follows:

TURN DATALOGGER ON	Turn the datalogger **ON**. The datalogger display will read "HELLO."

CAMPBELL 21X DATALOGGER
SERVICING DOCUMENTATION FORM

Date: _____
Datalogger S/N: _____
Technician: _____

INTERNAL MEMORY CHECK

Memory Status = 11:111111? ☐Yes ☐No Status __:_____

ANALOG INPUT CHECK

	Datalogger Readings (mV)							
Input Voltage (mV)	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
0.000								
2.500								
5.000								

ANALOG OUTPUT CHECK

CAO PORT #	CORRECT OUTPUT (mV)	ACTUAL OUTPUT (mV)
#1	2500±1	
#2	5000±1	

PULSE COUNTER CHECK

Waveform Generator Frequency _____ Hz
Datalogger Counts _____

PANEL TEMPERATURE CHECK

Ambient Temperature - Lab Reference _____ °C
Datalogger Panel Temperature _____ °C

INTERNAL BATTERY SERVICING

Battery Voltage _____ Volts
Battery Installation Date _____
Battery Replaced ☐Yes ☐No
Desiccant Replaced ☐Yes ☐No Comment _____

Factory servicing or calibration required ☐Yes ☐No
Describe Servicing required _____
_____
_____

Figure 4-1. Campbell 21X Datalogger Servicing Documentation Form.

TURN DATALOGGER ON (continued)

After a few seconds delay, the memory check results will be displayed. If all memory is installed and operating, the display will read "11:111111." The eight (8) characters in the display represent the eight (8) memory sockets numbered from left to right. A "1" indicates a good chip is in the corresponding socket. A "0" indicates the socket is empty or an error was detected in the chip. The five (5) left-most characters of the display represent the 8K ram chips. The three (3) right-most characters of the display are the 8K PROMs.

If the memory check results indicate that one or more memory chips are faulty, return the instrument to Campbell Scientific for repair.

4.2 ANALOG INPUT CHECKS

CONNECT VOLTAGE CALIBRATOR

Connect the Datel voltage calibrator to the datalogger using the datalogger "analog inputs" test cable. This cable provides a connection from the voltage output of the calibrator to each of the eight (8) analog input channels of the datalogger.

DOWNLOAD TEST PROGRAM

Download the datalogger test program (21X_TEST.DLD) to the datalogger to be tested using the Campbell Scientific datalogger communications software (SMCOM) and the Campbell Scientific SC532 Peripheral Interface Module.

RUN TEST PROGRAM

Press ***0** on the datalogger to compile and run the test program.

SET VOLTAGES

Set the calibrator to the input voltages specified on the Campbell 21X Datalogger Servicing Documentation Form (Figure 4-1). All input voltages are specified in millivolts. All datalogger readings should be recorded as millivolts.

RECORD DISPLAY READINGS

Enter ***6** on the datalogger and record the datalogger display reading (storage locations 01 - 08) for each of the eight analog channels at each of the three input voltages specified on the Campbell 21X Datalogger Servicing Documentation Form.

If the datalogger readings for any of the analog channels differ from the specified values by more than ± 5.0 millivolts, return the datalogger to Campbell Scientific for recalibration.

4.3 ANALOG OUTPUT CHECKS

The test program sets up a continuous DC voltage output on both analog output ports (CAO 1 and CAO 2).

MEASURE OUTPUT VOLTAGE

Measure the output voltage at CAO ports 1 and 2 with a calibrated and certified 4½ digit voltmeter. Record these

MEASURE OUTPUT VOLTAGE (continued)

measurements (in millivolts) on the Campbell 21X Datalogger Servicing Documentation Form. The correct reading for each port is shown, along with the manufacturers' specified accuracy, on the Campbell 21X Datalogger Servicing Documentation Form.

If the datalogger readings for either CAO port differ from the specified values by more than ± 5.0 millivolts, return the datalogger to Campbell Scientific for recalibration.

4.4 PULSE COUNTER CHECK

CONNECT GENERATOR TO FREQUENCY COUNTER

Connect the waveform generator to pulse input channel #1.

SETUP WAVEFORM GENERATOR

Setup the waveform generator for a square wave output with a frequency of 1000 Hz and an amplitude of 1 volt (rms).

RECORD COUNTS

The test program will count pulses from the waveform generator for a period of 10 seconds. Record the number of counts in the pulse counter channel at storage location 09 (press ***6 9** on the datalogger). Based on an input frequency of 1000 Hz, a datalogger count of 10,000 should be displayed.

If the datalogger reading for the pulse counter channel differs from the specified value by more than ± 5 counts, return the datalogger to Campbell Scientific for recalibration.

4.5 PANEL TEMPERATURE CHECK

RECORD AMBIENT TEMPERATURE

Read the ambient temperature in the laboratory with the laboratory reference thermometer. Record this temperature (°C) on the Campbell 21X Datalogger Servicing Documentation Form (Figure 4-1).

RECORD PANEL TEMPERATURE

Read the datalogger panel temperature at storage location 10 (press ***6 10** on the datalogger) and record the reading on the Campbell 21X Datalogger Servicing Documentation Form.

If the datalogger panel temperature measurement differs from the laboratory reference thermometer reading by more than ± 1.7 °C, return the datalogger to Campbell Scientific for recalibration.

4.6 INTERNAL BATTERY SERVICING

RECORD BATTERY VOLTAGE

Read the internal battery voltage at storage location 11 (press ***6 11** on the datalogger). Record this reading on the Campbell 21X Datalogger Servicing Documentation Form.

RECHARGE BATTERY — If the battery voltage is less than 11.76 volts, connect the datalogger to the battery charger. Recharge the battery for eight (8) hours.

REPLACE BATTERY — Disconnect the datalogger from the battery charger and recheck the battery voltage (press ***6 11** on the datalogger). If the battery voltage is still less than 11.76 volts, replace the battery as described below:

- Turn the power switch **OFF**.
- Remove the two front panel screws and carefully raise the front panel away from the datalogger case.
- Disconnect the used battery from the charging circuit and remove from the datalogger case.
- Install a fresh battery. Mark the installation date on the battery.
- Remove the datalogger desiccant packets and replace with two (2) dry half unit DESI PAK desiccant packets.
- Replace the front panel.
- Turn the power switch **ON** and recheck the battery voltage.

4.7 ARCHIVING DATALOGGER SERVICE RECORDS

All service records for Campbell 21X dataloggers are maintained by the instrument technician. The records are archived by datalogger serial number in three-ring notebooks located in the ARS instrumentation laboratory.

5.0 REFERENCES

Campbell Scientific, Inc., 1993, 21X Micrologger Operator's Manual. July.

Campbell Scientific, Inc., 1993, 21X Prompt Sheet.

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AUTHORIZATIONS		
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TITLE	NAME	SIGNATURE
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LIST OF TABLES

1.0 PURPOSE AND APPLICABILITY

This technical instruction (TI) describes procedures for servicing and calibration testing of Handar 540A/570A Data Collection Platforms (DCPs). This TI, as referenced in Standard Operating Procedure (SOP) 4250, *Servicing and Calibration of Optical Monitoring Dataloggers*, specifically describes procedures for:

- Performing post-field inspections
- Performing post-field timing and performance checks
- Performing routine laboratory servicing and cleaning
- Checking and performing laboratory modifications
- Programming the DCP
- Performing pre-field operational tests
- Documenting all servicing tasks
- Archiving servicing, repair, and calibration records

Handar 540A/570A DCPs are used as the primary dataloggers in the IMPROVE transmissometer network.

2.0 RESPONSIBILITIES

2.1 PROJECT MANAGER

The project manager shall:

- Verify that all Handar 540A/570A DCPs are serviced at least annually.
- Verify that calibration, timing, and transmission checks are performed on all Handar 540A/570A DCPs at least annually.
- Verify that all Handar 540A/570A DCPs are operating within factory specifications prior to being shipped to the field for use at an operational monitoring site.
- Verify that all Handar 540A/570A DCPs that do not operate within factory specifications are returned to Handar for factory servicing and recalibration.
- Ensure that all DCP servicing is documented and archived in accordance with the procedures described in this TI.

2.2 INSTRUMENT TECHNICIAN

The instrument technician shall:

- Perform and document all servicing, modifications, calibration checks, and operational tests.
- Coordinate with Handar for return, servicing, and recalibration of 540A/570A DCPs that fail to operate within factory specifications.
- Prepare purchase orders for factory servicing and recalibration of Handar 540A/570A DCPs.
- Replace the Handar 540A/570A internal battery as required.
- Archive all DCP servicing records.

2.3 DATA COORDINATOR

The data coordinator shall:

- Inform the instrument technician when a DCP is being removed from the field.
- Provide the instrument technician with a description of the field problems observed with the DCP.

3.0 REQUIRED EQUIPMENT AND MATERIALS

Specific instrumentation, tools, equipment, and materials required to service and test the Handar 540A/570A DCP are as follows:

- Calibrated voltage source - Datel Model DVC-350A or equivalent
- RF wattmeter - Bird Model 43 with #250D power element and 50 ohm RF load or equivalent
- Digital voltmeter (4 1/2 digits)
- Handar, Inc. *Operating and Service Manual for 540A Multiple Access Data Acquisition System, 560A Hydrologic Data Collection System, and 545A Programming Set*
- Handar, Inc. *570A Data Acquisition System Operating and Service Manual*
- Handar TERM program (DCP communication and interface software)
- IBM PC-compatible computer
- Spare circuitboards as required

- Replacement internal 12 volt battery
- Two (2) packs desiccant
- Reference AT/RH sensor (Rotronics GT-L or equivalent)
- Rotronics AT/RH Sensor (Model MP-100F, wired for use with the Handar 540A/570A DCP)
- Electronic contacts cleaning fluid
- Medium screwdrivers (flat-blade and Phillips-head)

4.0 METHODS

Handar 540A/570A DCPs should be serviced according to the following schedule:

- Prior to installation at a field monitoring site
- On an annual schedule
- Any time the operation or accuracy of the datalogger appears to be suspect

Factory servicing and calibration of the Handar 540A/570A DCP is required when timing and performance checks indicate that the DCP is not operating within factory specifications.

This section includes five (5) major subsections:

4.1 Post-Field Inspection and Performance Checks
4.2 Routine Laboratory Servicing
4.3 DCP Programming
4.4 Pre-Field Performance Testing
4.5 Archiving Handar 540A/570A DCP Service Records

4.1 POST-FIELD INSPECTION AND PERFORMANCE CHECKS

When a DCP is returned from a field site, the external and internal physical condition is visually inspected prior to performing any performance tests or laboratory servicing. If the DCP is received with the power switch in the “ON” position and there are no loose circuitboards, disconnected or damaged connectors, or other apparent problems that might affect the operation of the DCP, performance tests that evaluate DCP timing, A/D converter operation, transmission power, and the DCP program are performed. Results and comments related to inspection and performance testing are fully documented on the Post-Field Inspection Checklist - Handar 540A/570A DCP (Figure 4-1).

POST-FIELD INSPECTION CHECKLIST
HANDAR 540A/570A DCP

DCP S/N: _____
Site: _____
Date: _____
Technician: _____

DCP Model: ☐540A1 ☐540A2 ☐570A
Received for: ☐Annual Servicing ☐Unscheduled Maintenance
Reason for unscheduled maintenance _____
_____
_____

PHYSICAL INSPECTION - EXTERNAL

Describe "as returned" condition of the following:
DCP Case _____
Case Latches _____
Connectors/Contacts _____
Display (570A Only) _____
Door Seal _____

PHYSICAL INSPECTION - INTERNAL

Describe "as returned" condition of the following:
Power switch ☐On ☐Off
GOES Radio Channel 1 ☐900 ☐Other _____
GOES Radio Channel 2 ☐000 ☐Other _____
Circuit Boards, Hold Down Bracket, Connectors _____
Battery and Hold Down Bracket
_____
Battery Voltage _____ Volts

DCP TIMING CHECKS

Program in Memory ☐Yes ☐No
DCP ID [I] _____
DCP Time [J] __ __ : __ __ : __ __ WWV Time __ __ : __ __ : __ __
DCP Time to Next Scan [S] __ __ : __ __ : __ __
DCP Time to Next Transmit [T] __ __ : __ __ : __ __

DCP A/D CONVERTER CHECKS

Test Input Ch. 1,2,3	DCP Channel # (Output)					
	CH1	CH2	CH3	CH4	CH5	CH10
0.000 Volts	_____	_____	_____	_____	_____	_____
4.950 Volts	_____	_____	_____	_____	_____	_____
Lab AT/RH				_____	_____	

TRANSMISSION TEST

Forced Transmit RF Power Output _____ Watts

Figure 4-1. Post-Field Inspection Checklist - Handar 540A/570A DCP.

4.1.1 General Information

RECORD GENERAL INFORMATION	Record the DCP serial number, the site it was received from, and the date it was received. The initials of the technician performing the inspection should also be recorded.
IDENTIFY DCP MODEL	Identify the DCP model (Figure 4-2 shows the front panel layout of each of the three DCP models used by ARS).
NOTE REASON FOR RETURN	Note whether the DCP was returned for annual servicing (no observed operational problems in the field) or for unscheduled maintenance (unit malfunctioning). If returned for unscheduled maintenance, describe the observed field symptoms.

4.1.2 Physical Inspection - External

INSPECT CASE	Inspect the outside of the DCP case thoroughly. Look for signs of external damage (dented, scraped, or gouged surfaces). Examine the latches and external connectors. Describe any damage or general deterioration noted.
RECORD DISPLAY	If the DCP is a model 570A, step through the display, recording the readings displayed for each channel.
INSPECT SEAL	Open the cover on the DCP and inspect the seal between the cover and the case. Look for loose sections of seal, tears, and worn spots.

4.1.3 Physical Inspection - Internal

NOTE POWER	Note whether the power switch is “ON” or “OFF” (see Figure 4-3 for switch location).
NOTE CHANNEL SETTINGS	Note the settings of the GOES primary channel (#1) and secondary channel (#2) switches (see Figure 4-3 for switch locations). The GOES primary channel selection switch should be set to “900” (inhibits transmission). The GOES secondary channel selection switch should be set to “000” (channel unused). If the switches are not set properly, they should be reset to these channel numbers before proceeding with this inspection.
INSPECT DCP INTERIOR	Inspect the interior of the DCP, checking that all circuitboards are firmly seated, all hold-down brackets are in place and secure, and all cables and connectors are undamaged and in place. Describe any improper conditions.

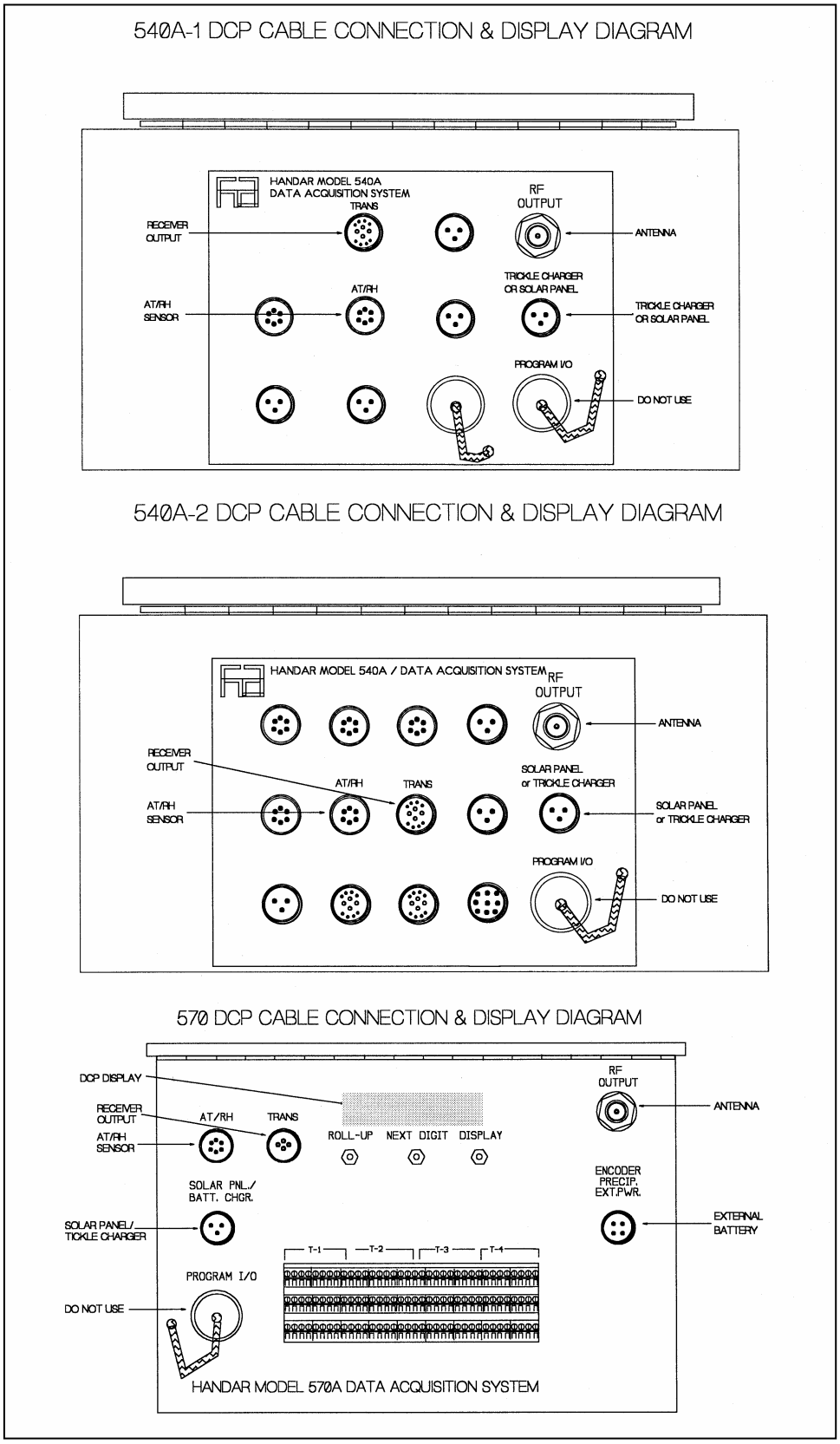
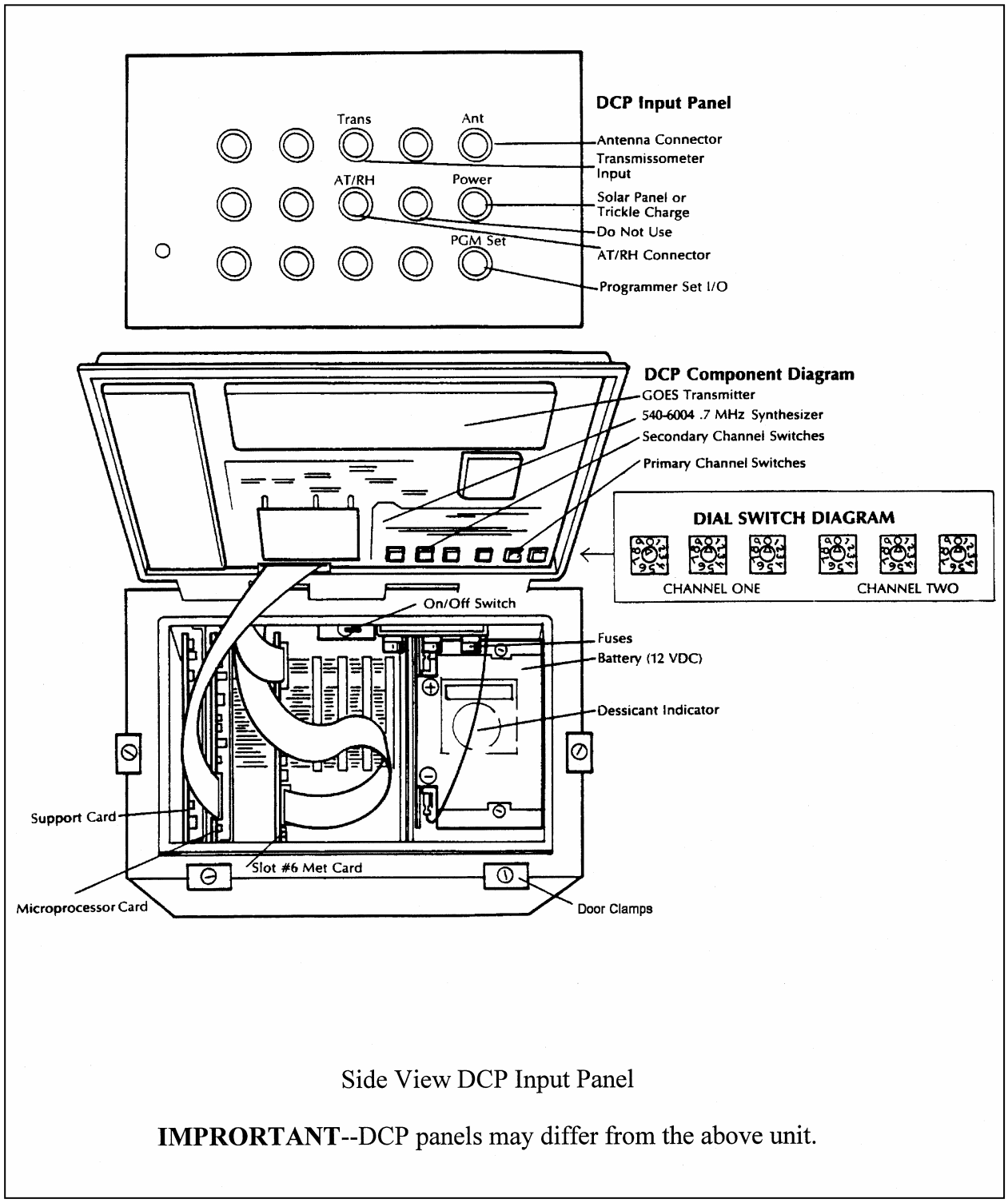


Figure 4-2. Front Panel Configurations - Handar 540A/570A DCP.



Side View DCP Input Panel

IMPRORTANT--DCP panels may differ from the above unit.

Figure 4-3. DCP Component Diagram.

MEASURE BATTERY VOLTAGE — Measure the internal battery voltage. If it is less than 11.8 volts, connect a current limited power supply set at 16 volts and 500 ma to the DCP Solar Panel/Battery Charger input for a period of 24 hours. If the battery voltage does not reach a minimum voltage of 13.8 volts, it must be replaced during servicing.

CHECK INSTALLATION DATE — Check the installation date on the battery. If the battery is more than 5 years old, it must be replaced during servicing, regardless of the battery's state of charge.

4.1.4 DCP Timing Checks

PROGRAM MEMORY — **NOTE:** If the DCP power switch was off, or has been turned off for any reason, the program and timing will have been lost from the DCP memory and this section of the post-field inspection should be omitted.

EXECUTE PROGRAM — Execute the Handar DCP communications program TERM from the IBM PC-compatible computer.

SWITCH BAUD RATE — When the TERM setup screen (see Figure 4-4) is displayed on the computer screen, press **F2** to switch to the correct baud rate (300 baud).

CONNECT COMPUTER TO DCP — Connect the serial port of the computer to the DCP programming port (see Figure 4-2 for location) using the DCP programming cable. After the connection is complete, the TERM programming screen (Figure 4-5) should be displayed on the computer screen.

NOTE DISPLAY — If the program is still in memory, the computer display should be as shown in Figure 4-5.

If the computer display appears as in Figure 4-6, the program has been lost from memory and the DCP performance and timing checks should be terminated. Exit the TERM program and turn the DCP off before initiating the servicing procedures. Be sure and document that the program was no longer in memory.

SYNCHRONIZE TIME — Verify that your watch is synchronized with WWV by calling the NIST WWV time transmission telephone (303/499-7111).

ENTER PARAMETERS — Obtain DCP ID and timing information by entering into the DCP the boldface character that precedes each of the following parameters:

- **I** Station ID
- **J** DCP time
- **S** Time remaining before next scan
- **T** Time remaining before next transmission

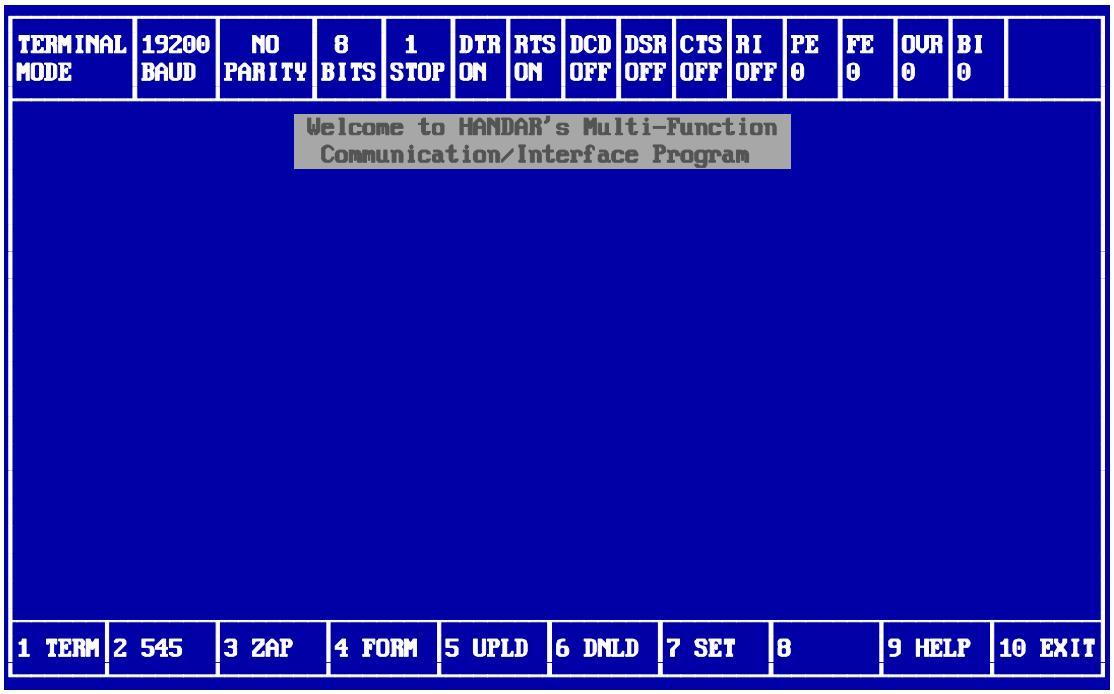


Figure 4-4. TERM Setup Screen.

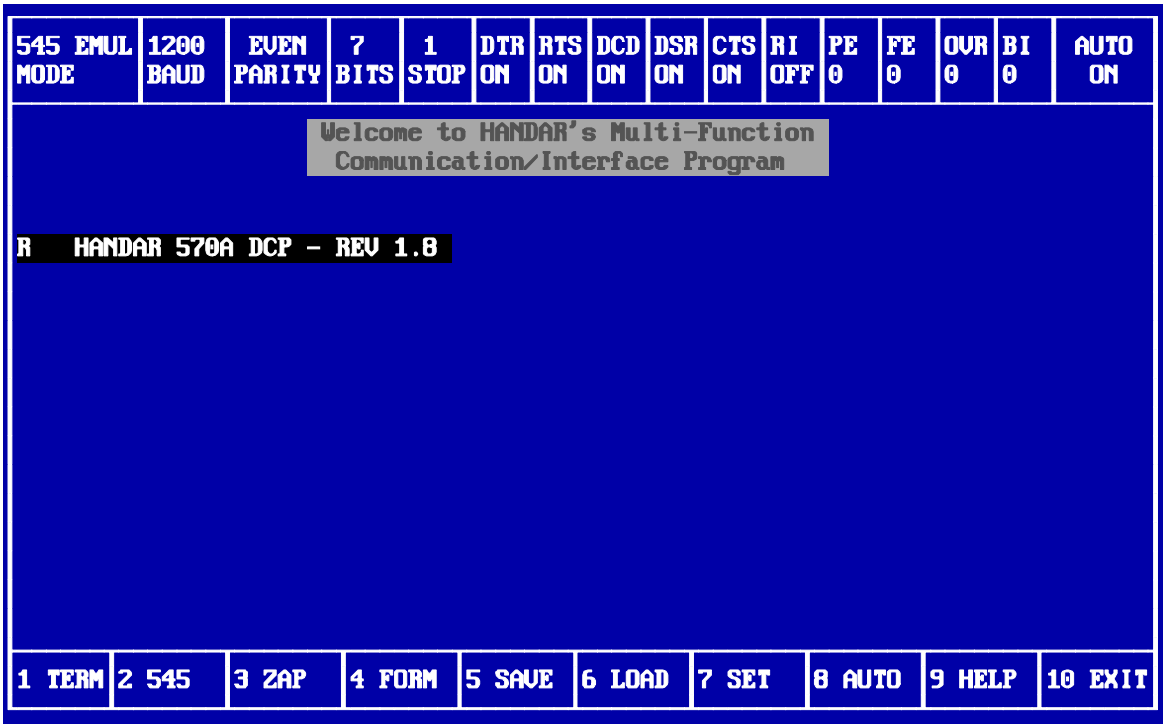


Figure 4-5. TERM DCP Programming Screen (Program in DCP Memory).

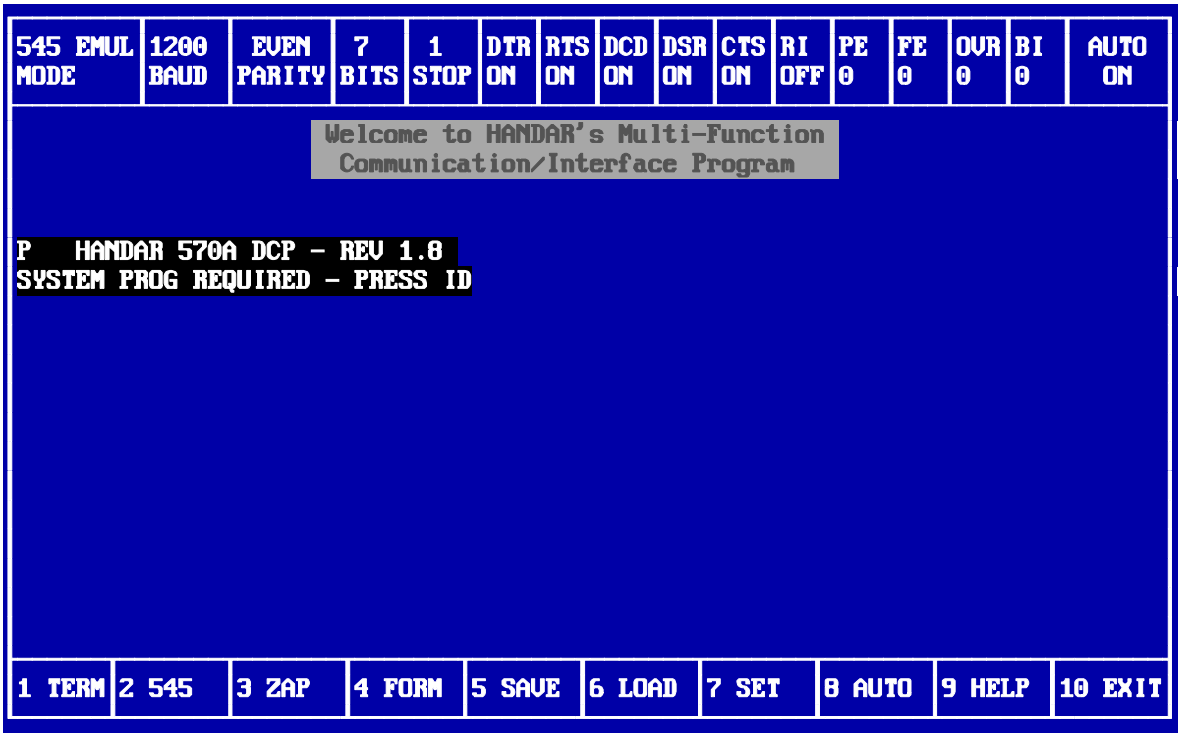


Figure 4-6. TERM DCP Programming Screen (No Program in DCP Memory).

RECORD VALUES	Record each of the values from the ID and timing checks and the correct (WWV) time when the DCP time check, [J], was performed.
COMPARE TIMES	Compare the DCP times to the correct time to determine the timing drift relative to previous measurements (at installation or from recent transmissions - Refer to TI 4300-4000, *Data Collection via DCP (IMPROVE Protocol)*.

4.1.5 DCP A/D Converter Checks

CONNECT VOLTAGE SOURCE	Connect a calibrated voltage source to the input of data channels 01, 02, and 03 of the DCP.
CONNECT AT/RH SENSOR	Connect a calibrated Rotronic AT/RH sensor to the DCP's AT/RH input connector.
SWITCH MODES	Switch the DCP from "RUN" mode to "PROGRAM" mode by entering **?**. The computer display will read "R Enter (1) = Service (2) = All." Enter **2** to select "ALL."
SET OUTPUT	Set the output of the calibrated voltage source to 0.000 volts.

OBTAIN READINGS

Obtain DCP readings for data channels 01, 02, and 03 using the following procedure:

- Enter **M** (access data channel 01 - transmissometer raw readings).
- Enter **$** (execute a forced scan).
- Record the DCP reading for data channel 01.
- Enter **V** (scroll down to data channel 02 - transmissometer toggle signal).
- Enter **$** (execute a forced scan).
- Record the DCP reading for data channel 02.
- Enter **V** (scroll down to data channel 03 - transmissometer standard deviation).
- Enter **$** (execute a forced scan).
- Record the DCP reading for data channel 03.

With a 0.000 volt input, DCP data channels 01, 02, and 03 should all read "000."

SET OUTPUT VOLTAGE

Set the output of the calibrated voltage source to 4.950 volts.

OBTAIN DCP READINGS

Obtain DCP readings for data channels 01-05 and 10 using the procedures described above for obtaining DCP readings for data channels 01, 02, and 03.

OBTAIN AT/RH

Obtain current laboratory measurements of ambient temperature and relative humidity using the Rotronic GT-L hand-held AT/RH sensor. Record these values on the inspection checklist (DCP A/D Converter Checks section) under channel 04 and channel 05, respectively.

NOTE READINGS

With a 4.950 volt input, DCP data channels 01 and 03 should read "495." DCP data channel 02 should read "001."

COMPARE READINGS

The DCP data channel 04 reading (Rotronics AT output signal) must be adjusted by subtracting 100 from the reading obtained during the test. Compare this adjusted reading with the temperature measurement obtained with the hand-held sensor. The two values should then match within ± 2 F°.

COMPARE READINGS (continued)	Compare the DCP data channel 05 reading (Rotronics RH output signal) with the RH measurement obtained with the hand-held sensor. The two values should agree within ± 3%.
	Compare the DCP data channel 10 reading (DCP internal battery voltage) with the internal battery voltage measured during the DCP internal physical inspection. The two values should agree within ± 0.005 volts.

4.1.6 Transmission Test

CONNECT WATTMETER	Connect an RF wattmeter (with a 200-500 mHz, 25-watt power element) to the "RF Output" connector located on the front panel of the DCP. A 50 Ohm, 25-watt load resistor should be connected to the output of the wattmeter.
SET CHANNEL SWITCHES	Set the GOES primary channel select switches to the channel number assigned to the ID programmed for the DCP under test.
INITIATE TRANSMISSION	With the DCP in "PROGRAM" mode, initiate a transmission by entering #.
RECORD READING	The wattmeter should read 10 ± 2 watts. Record the observed reading on the Post-Field Inspection Checklist - Handar 540A/570A DCP (Figure 4-1).
RESET SWITCHES	Reset the GOES primary channel select switches to **900**.

4.2 ROUTINE LABORATORY SERVICING

Record and document all information and procedures on the Routine Servicing Checklist - Handar 540A/570A DCP (Figure 4-7).

RECORD GENERAL INFORMATION	Record the DCP serial number, the site it was received from, and the date it was received. The initials of the technician performing the inspection should also be recorded.
IDENTIFY DCP MODEL	Identify the DCP model (Figure 4-2 shows the front panel layout of each of the three DCP models used by ARS).
NOTE REASON FOR RETURN	Note whether the DCP was returned for annual servicing (no observed operational problems in the field) or for unscheduled maintenance (unit malfunctioning). If returned for unscheduled maintenance, describe the observed field symptoms.

ROUTINE SERVICING CHECKLIST
HANDAR 540A/570A DCP

DCP S/N: _____
Date: _____
Technician: _____

DCP Model: ☐540A1 ☐540A2 ☐570A

Received for: ☐Annual Servicing ☐Unscheduled Maintenance

Reason for unscheduled maintenance _____
_____
_____

SETUP

☐ GOES Primary Channel Select Switches Set to 900

☐ GOES Secondary Channel Select Switches Set to 000

EXTERNAL CLEANING

☐ Front Panel Connector Contacts Cleaned

☐ Connector Mounting Screws Tightened

BATTERY REPLACEMENT

Internal 12-Volt Battery Replaced ☐ Yes ☐ No

INTERNAL CLEANING

☐ Plug in Circuit Board Connector Contacts Cleaned

☐ Backplane Connector Contacts Cleaned

☐ Inside of DCP Cleaned

570A MODIFICATIONS

Toggle Input ☐ Modified During Servicing ☐ Previously Modified

AT/RH Interface ☐ Modified During Servicing ☐ Previously Modified

540A MODIFICATION

AT/RH Interface ☐ Modified During Servicing ☐ Previously Modified

Figure 4-7. Routine Servicing Checklist - Handar 540A/570A DCP.

VERIFY GOES SWITCHES	Verify that the GOES primary channel select switches are set to "900" and the secondary channel select switches set to "000." If the switches are not set to these channels, they must be reset prior to continuing with servicing of the DCP.
CLEAN EXTERNAL CONTACTS	Spray the contacts on all external (front panel) connectors with contact cleaner.
CHECK MOUNTING SCREWS	Check the mounting screws for all front panel connectors. Loose screws should be tightened.
REPLACE BATTERY	If the battery is more than five (5) years old (as indicated by the installation date marked on the battery), or if the battery failed the battery test during inspection, the battery must be replaced. Battery replacement procedures are as follows: • Turn the power switch **OFF**. • Disconnect any external power source (battery or battery charger) from the DCP. • Disconnect the DCP internal battery connectors. • Remove the circuitboard hold-down bracket. • Remove the battery hold-down bracket. • Lift the battery out of the DCP case. • With a permanent marker, write the installation date on the new battery. • Place the new battery in the DCP case. • Replace the battery hold-down bracket.
CLEAN CIRCUITBOARD	Check the power switch. If it is not off, turn it **OFF**. Remove the DCP plug-in circuitboards. Clean printed circuitboard's edge connector contacts and the ribbon cable connector contacts with contact cleaner.
CLEAN BACKPLANE CONNECTORS	Clean the backplane connectors with contact cleaner. Clean the contacts on the ribbon cable connectors with contact cleaner.
CLEAN INTERIOR OF DCP	Clean the inside of the DCP with compressed air.

MODIFY 570A TOGGLE INPUT VOLTAGE DIVIDER

If this is a Handar 570A DCP, the transmissometer toggle input (DCP data channel 02) voltage divider must be modified to ensure that the voltage divider always exceeds 3.0 volts when the toggle input is at a logic "high" level. Modify the toggle input voltage divider located on the 12-bit A/D Converter (ADC) board using the following procedures:

- Remove the component platform in socket U17 of the ADC board (see Figure 4-8 for the location of U17).
- Examine resistor R17-6 located between pins 6 and 11 of the component platform (the resistor location on the component platform is shown in Figure 4-8). If the modification has been implemented, this resistor value will be 4.02K Ohms. If it is not 4.02K, remove the existing resistor (1.00K) and replace it with a 4.02K resistor.
- Replace the component platform in socket U17 of the ADC board.

MODIFY 570A FOR AT/RH SENSOR

If this is a Handar 570A DCP, the AT/RH sensor interface circuit on the ADC board must be modified to accept the Rotronics MP100-F AT/RH sensor. To modify the sensor interface circuit, remove the component platform from socket U7 of the ADC board (refer to Figure 4-8 for the location of U7).

MODIFY 540A FOR AT/RH SENSOR

If this is a Handar 540A DCP, the AT/RH sensor interface circuit on the Met board must be modified to accept the Rotronics MP100-F AT/RH sensor. To modify the sensor interface circuit, remove resistor R8 (see Figure 4-9 for the location of R8).

REINSTALL CIRCUITBOARDS

If this is a Handar 570A DCP, reinstall the ADC board in slot #1.

If this is a Handar 540A DCP, reinstall the circuitboards in the slots numbered as follows:

- Slot #6 Met board
- Slot #8 Microprocessor board
- Slot #9 Support board

Replace the circuitboard hold-down bracket.

Reconnect the ribbon cables.

Reconnect the DCP internal battery connectors to the battery.

Turn the power switch **ON**.

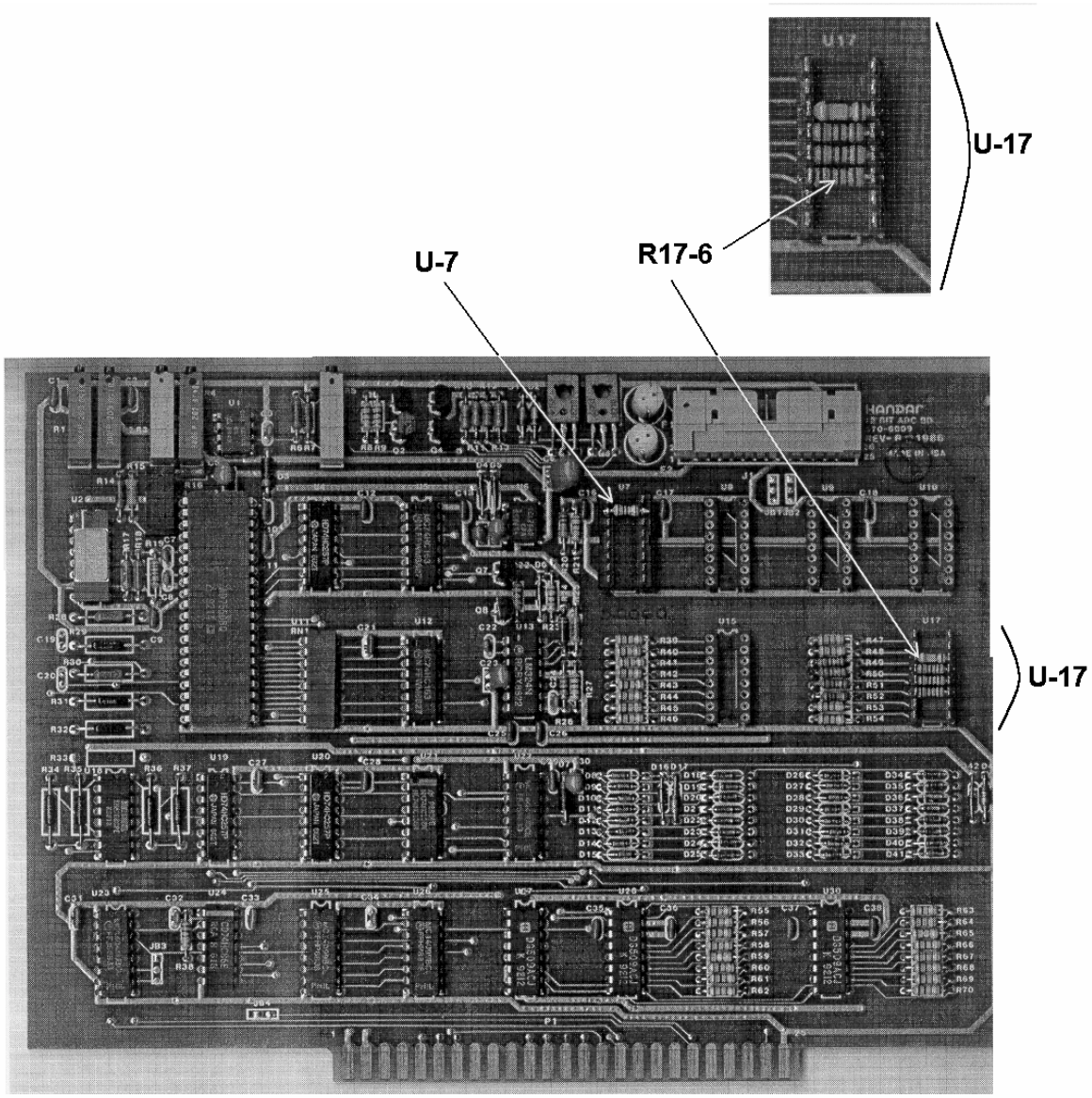


Figure 4-8. Handar 570A ADC Board - Component Locations.

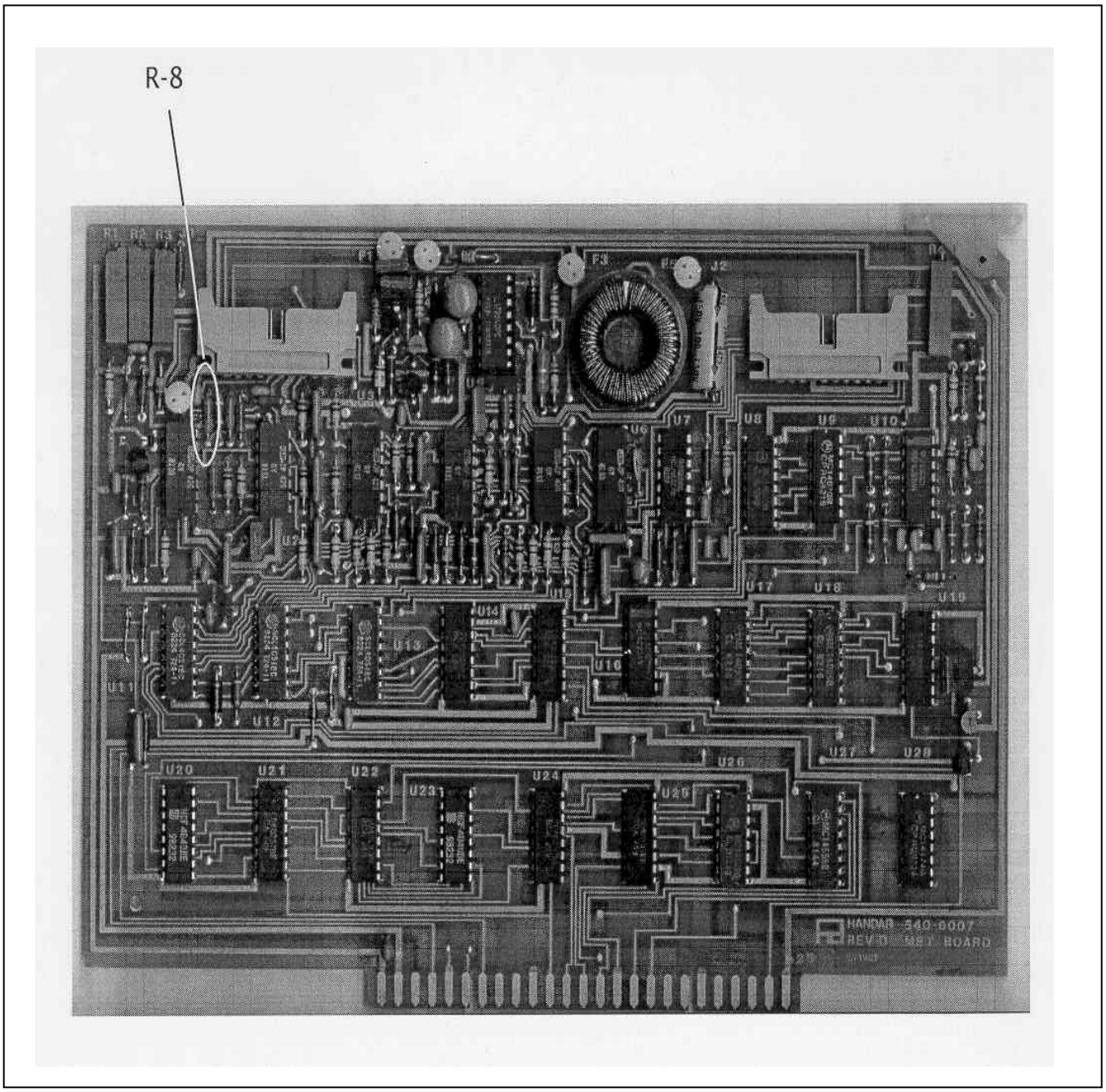


Figure 4-9. Handar 540A Met Board - Component Locations.

4.3 DCP PROGRAMMING

The Handar 540A/570A DCP operational configuration is established through a user program that performs the following functions:

- Defines the external sensors and signal inputs to be used
- Specifies the data acquisition channels associated with each sensor or input
- Defines processing options
- Selects reporting modes and formats
- Sets scanning, reporting, and transmission schedules

Basic concepts relating to the data acquisition functions of the Handar 540A/570A DCP are described in detail in Section 6.1 of the Handar *570A Data Acquisition System Operating and Service Manual*.

For DCPs used with the IMPROVE transmissometer network, the most recent version of the standard DCP configuration program is available as an ASCII file, either 540ROT.DCP (Refer to Appendix A for a complete listing of the 540ROT.DCP configuration program) or 570ROT.DCP (Refer to Appendix B for a complete listing of the 570ROT.DCP configuration program), depending on the type of DCP to be programmed. The standard program file is first downloaded to the DCP.

After downloading, the program in the DCP is edited to include the site-specific operating parameters (see Table 4-1 for a list of station IDs, GOES channel assignments, and transmit times for all IMPROVE transmissometer sites) listed below:

- Station ID
- Transmit time

GOES channel selection is controlled by the DCP channel selection switches, not by the DCP configuration program.

Procedures for downloading the standard DCP configuration program are as follows:

VERIFY GOES SWITCHES	Verify that the GOES primary channel select switches are set to "900" and the secondary channel select switches set to "000." If the switches are not set to these channels, they must be reset prior to continuing with programming of the DCP.
SYNCHRONIZE TIME	Verify that your watch is synchronized with WWV by calling the NIST WWV time transmission telephone (303/499-7111).
DELETE DCP MEMORY	Ensure that there is no program stored in the DCP memory by turning the power switch to **OFF**, then turning it back to **ON** (refer to Figure 4-3 for switch location).

Table 4-1

DCP ID Assignments
IMPROVE Transmissometer Network

DCP-ID	CHAN	LOCATION	TIME *	RATE **
FA43DOBE	014W	Fort Collins (Test)	0200	X3
FA43F652	014W	Grand Canyon (In-Canyon)	0202	X3
FA441794	014W	Glacier	0204	X3
FA44C1FC	014W	Rocky Mountain	0215	X3
FA44D28A	014W	Grand Canyon (South Rim)	0216	X3
FA44E710	014W	Great Basin	0217	X3
FA44F466	014W	Canyonlands	0218	X3
FA450618	014W	Chiricahua	0219	X3
FA42D244	014W	Yosemite	0220	X3
FA4306D6	038W	San Gorgonio	0219	X3
FA4315A0	038W	Badlands	0220	X3
FA4356AA	038W	Big Bend	0224	X3
FA436330	038W	Petrified Forest	0225	X3
FA437046	038W	Guadalupe Mountains	0226	X3
FA4380C2	038W	Bandelier	0227	X3
FA43A62E	038W	Bridger	0229	X3
FA42C132	009E	Shenandoah	0232	X3

* GOES FIRST TRANSMISSION TIME (GMT)
** GOES TRANSMISSION INTERVAL (X3 = 3 HOUR INTERVAL)

EXECUTE PROGRAM

Execute the Handar DCP communications program TERM from the PC computer.

When the TERM setup screen (see Figure 4-4) is displayed on the computer screen, press **F2** to switch to the correct baud rate (300 baud).

Connect the serial port of the PC computer to the DCP programming port (see Figure 4-2 for location) using the DCP programming cable. After the connection is complete, the TERM programming screen of Figure 4-6 should be displayed on the computer screen.

Initiate the program download by pressing the **F6** key.

The next screen prompt displayed is "LOAD PS PROG->DCP." Press **<Enter>** in response to this prompt.

The screen prompt "ENTER NAME OF PROGRAM FILE:" is then displayed. Enter **540ROT.DCP** to program a Handar 540 DCP. To program a Handar 570A DCP, enter **570ROT.DCP**.

While the program is loading, the message "P LOADING PROGRAM" will be displayed. Upon completion of the download, the message "P DONE" will be displayed. The "P" at the beginning of a display message indicates that the DCP is in the "PROGRAM" mode. An "R" at the beginning of a message indicates that the DCP is in the "RUN" mode.

EDIT PARAMETERS

Procedures for editing the site-specific parameters are as follows:

Editing commands (the boldfaced character) used in these procedures are as follows:

- **I** Station ID
- **J** DCP time
- **S** Time remaining before next scan
- **T** Time remaining before next transmission
- **M** Data channel select
- **N** Define Sensor Type
- **K** Program GOES/Radio

EDIT PARAMETERS (continued)

- **V** Scroll Down
- **U** Scroll Up
- **$** Forced Scan
- **#** Forced Transmit (GOES Radio)

Enter **I** to edit the station ID. The download program initially assigns ID "FA43F652" to the DCP. The display message will be "P ID FA43F652."

Enter an unused test ID (e.g., **FA43D0BE**). Note that all ID characters are hexadecimal numbers (0-9 and A-F). The letter "O" is not allowed. The display message will be "P ID FA43D0BE."

Enter **K** to program the GOES functions. The display message will be "P GOES PRI XMT MODE 01."

Enter **V** to scroll down to the next prompt, "P 1ST GOES XMT TIME 02:30:00."

Enter the "first transmit time" assigned to the selected station ID. For ID FA43D0BE, the first transmit time is "02:00:00."Enter **020000** (the colons are added by the DCP). The display message will be "P 1ST GOES XMT TIME 02:00:00."

Enter **V** to scroll down to the next prompt, "P PRI XMT INTERVAL 03:00:00." This is the proper transmit interval for all IMPROVE transmissometer sites. Editing is not required.

Enter **V** to scroll down to the next prompt, "P GOES SEC XMT MODE 00." This is the proper secondary transmit mode for all IMPROVE transmissometer sites. Editing is not required.

Enter **J** to set the DCP time and date. The display message will be "P STATION TIME 23:27:45." (The actual time displayed in the message is not important).

All DCP times are Greenwich Mean Time (GMT). Enter the time at the top of the next minute (e.g., if the current GMT time is 14:32:28, enter **14:33:00**) and press **<Enter>** at the top of the minute. The display message will be "P STATION TIME 14:33:00."

Enter **V** to scroll down to the next prompt, "P YEAR (XX) 88."

Enter the last 2 digits of the current year (e.g., **94**). The display message will be "P YEAR (XX) 94."

EDIT PARAMETERS (continued)

Enter **V** to scroll down to the next prompt, "P DCP JULIAN DATE 326."

Enter the correct Julian date (e.g., for January 28, enter **028**). The display message will be "P DCP JULIAN DATE 028."

Enter **M** to select DCP channel 01. The display message will be "P CHANNEL 01."

Enter **N** to edit the sensor configuration. The display message will be "P01 SENSOR TYPE 10."

Enter **V** to scroll through the sensor configuration until you reach the "start of measurement prompt" "P01 START OF MEAS 23:30:00."

The start of measurement time should be programmed for 30 minutes after the current hour (e.g., if the current time is 17:04:29, enter **17:30:00**). A second prompt asking "CHANGE ALL CHANNELS?" (1=Y, 2=N) will be displayed.

Enter **1**, setting the start of measurement time for all channels to 17:30:00. The display message will be "P01 START OF MEAS 17:30:00."

This completes programming of the Handar 540A/570A DCP.

4.4 PRE-FIELD PERFORMANCE TESTING

Pre-field performance testing of the Handar 540A/570A DCP includes laboratory performance testing and a 7-day field test at the Fort Collins Transmissometer Calibration and Test Facility. Laboratory performance testing verifies proper programming and calibration of the DCP. Field testing exposes the DCP to a varying operational environment, testing the ability of the DCP to maintain accurate timing and calibration over a wide range of operating conditions. Document all performance checks and results on the Laboratory Performance Testing Form - Handar 540A/570A DCP (see Figure 4-10).

4.4.1 General Information

RECORD GENERAL INFORMATION

Record the DCP serial number, the site it was received from, and the date it was received. The initials of the technician performing the inspection should also be recorded.

IDENTIFY MODEL

Identify the DCP model (Figure 4-2 shows the front panel layout DCP of each of the three DCP models used by ARS).

LABORATORY PERFORMANCE TESTING
HANDAR 540A/570A DCP

DCP S/N: _____
Date: _____
Technician: _____

DCP Model: ☐540A1 ☐540A2 ☐570A

DCP TIMING CHECKS

Program in Memory ☐Yes ☐No
DCP ID [I] _____
DCP Time [J] __ __ : __ __ : __ __ WWV Time __ __ : __ __ : __ __
DCP Time to Next Scan [S] __ __ : __ __ : __ __
DCP Time to Next Transmit [T] __ __ : __ __ : __ __

DCP A/D CONVERTER CHECKS

Test Input Ch. 1,2,3	DCP Channel # (Output)					
	CH1	CH2	CH3	CH4	CH5	CH10
0.000 Volts	_____	_____	_____	_____	_____	_____
4.950 Volts	_____	_____	_____	_____	_____	_____
Lab AT/RH				_____	_____	

TRANSMIT TEST

Forced Transmit RF Power Output _____ Watts

RUN MODE TIMING CHECKS

☐ Primary Channel Select Switches Set to 900
☐ Secondary Channel Select Switches Set to 000
☐ DCP in Run Mode

Assigned ID _____
Next Scheduled Scan Time __ __ : __ __ : __ __
Next Scheduled Transmit Time __ __ : __ __ : __ __

DCP ID [I] _____
DCP Time [J] __ __ : __ __ : __ __
WWV Time __ __ : __ __ : __ __

DCP Time to Next Scan [S] __ __ : __ __ : __ __
WWV Time __ __ : __ __ : __ __
Next Scan Time (WWV Time + Time to Next Scan) __ __ : __ __ : __ __

DCP Time to Next Transmit [T] __ __ : __ __ : __ __
WWV Time __ __ : __ __ : __ __
Next Transmit Time (WWV Time + Time to Next Transmit) __ __ : __ __ : __ __

Figure 4-10. Laboratory Performance Testing Form - Handar 540A/570A DCP.

4.4.2 Laboratory Performance Testing

Laboratory performance testing repeats the DCP performance and timing checks and the transmission test performed during the post-field inspection and performance checks. It also adds a run mode timing check. Procedures for conducting laboratory performance testing are:

- Perform DCP timing checks as described in Section 4.1.4.
- Perform DCP A/D converter checks as described in Section 4.1.5.
- Perform the DCP transmission test as described in Section 4.1.6.

4.4.3 Run Mode Timing Checks

VERIFY GOES SWITCHES

Verify that the GOES primary channel select switches are set to "900" and the secondary channel select switches set to "000." If the switches are not set to these channels, they must be reset prior to continuing with laboratory testing of the DCP.

RECORD PARAMETERS

Enter **Y** to place the DCP in the "RUN" mode.

Enter **I** to display the station ID. Verify that the ID displayed is the ID programmed into the DCP.

At the top of the minute (using GMT as the reference), enter **J** to display the station time. Record GMT and station time. If the station time differs from GMT by more than 2 seconds, reset the station time (see Section 4.3, DCP Programming).

Enter **S** to obtain the time remaining before the next scan. Record GMT at the time the "S" command was entered and the time remaining as reported by the DCP. Adding the time remaining to the recorded GMT should give the next scheduled scan time (normally set for 30 minutes after the hour).

Enter **T** to obtain the time remaining before the next transmission. Record GMT at the time the "T" command was entered and the time remaining as reported by the DCP. Adding the time remaining to the recorded GMT should give the next scheduled transmission time (see Table 4-1 for a list of station IDs and their assigned transmission times).

4.4.4 Field Testing of the Handar 540A/570A DCP

INSTALL

Transport the DCP to field test site and install the unit in the DCP transmissometer receiver shelter.

CONNECT TRICKLE LOCATION	Connect the on-site trickle charger to the DCP (see Figure 4-2 for the DCP connector location).
CONNECT ANTENNA	Connect the GOES antenna (mounted on the outside of the receiver shelter and previously aligned) to the DCP RF output connector.
SET GOES SWITCHES	Open the DCP case and set the GOES primary channels selection switches to the channel assigned to the ID of the DCP under test (see Table 4-1).
CONNECT WATTMETER	Connect an RF wattmeter (with a 200-500 mHz, 25-watt power element) between the "RF Output" connector located on the front panel of the DCP and the DCP antenna cable.

Set the power element of the wattmeter for the forward direction.

Monitor the wattmeter reading as the first transmit time approaches. When the transmitter turns on (as indicated by a sharp increase in the wattmeter reading), note the peak power reading in the forward direction. Reverse the direction of the power element and note the peak reading of the reflected power.

The forward direction wattmeter reading should be 10 ± 2 watts. The reflected power reading should be less than two watts.

Disconnect the wattmeter and reconnect the antenna to the DCP.

Place two fresh desiccant packs inside the DCP. Close the DCP and tighten all latches to ensure a tight seal.

The transmitted data are reviewed daily, verifying that the transmit time, frequency deviation, and power level all meet factory specifications (Refer to TI 4300-4000, *Data Collection via DCP (IMPROVE Protocol)*).

If the transmitted data review indicates timing, frequency deviation, or power related problems, the field test should be terminated and the DCP returned to the laboratory. The instrument technician will then coordinate with Handar to arrange for repair and/or recalibration of the DCP.

If the DCP operates within factory specifications throughout the seven day test period, the DCP is returned to the laboratory and turned off until it is needed in the IMPROVE transmissometer network.

CONNECT WATTMETER (continued)

All field test data printouts are archived with the DCP service records as described in Section 4.5.

4.5 ARCHIVING HANDAR 540A/570A DCP SERVICE RECORDS

Service records for Handar DCPs are maintained by the instrument technician and archived by DCP serial number in three-ring notebooks located in the ARS instrumentation laboratory.

5.0 REFERENCES

Handar, Inc., 1988, 570A Data Acquisition System Operating and Service Manual, March.

Handar, Inc., 1982, Operating and Service Manual for 540A Multiple Access Data Acquisition System, 560A Hydrologic Data Collection System, and 545A Programming Set, June.

APPENDIX A

HANDAR 540A DCP CONFIGURATION PROGRAM - 540ROT.DCP

P ID FA43D0BE	
P STATION TIME	15:47:38
P YEAR (XX)	94
P DCP JULIAN DATE	055
P GOES PRI XMT MODE	01
P 1ST GOES XMT TIME	02:00:00
P PRI XMT INTERVAL	03:00:00
P GOES SEC XMT MODE	00
P TEL #:AREA CODE	1-303
P TEL #:LOCAL	224-9300
P MODEM XMT FORMAT	00
P 1ST DIAL TIME	00:00:00
P DIAL INTERVAL	00:00:00
P TEL EMG XMIT 1=0N	00
P AUTO DUMP? 1=Y 0=N	00
P CHANNEL NO.	01
P01 SENSOR TYPE	10
P01 CARD SLOT #	06
P01 SENSOR INPUT ADRS	6
P01 SENSOR PWR ADRS	8
P01 SENSOR PWR ADV	00:00:02
P01 *FULL SCALE	1000
P01 ZERO SCALE	0000
P01 MEAS INTERVAL	01:00:00
P01 START OF MEAS	16:30:00
P01 LEVEL 1 MEAS TYPE	001
P01 XMIT 2 OR 3 BYTES?	03
P01 HIGH LIMIT	NO LIMIT
P01 LOW LIMIT	NO LIMIT
P01 HIGH DIFF LIMIT	NO LIMIT
P01 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	02
P02 SENSOR TYPE	10
P02 CARD SLOT #	06
P02 SENSOR INPUT ADRS	9
P02 SENSOR PWR ADRS	8
P02 SENSOR PWR ADV	00:00:02
P02 *FULL SCALE	001
P02 ZERO SCALE	000
P02 MEAS INTERVAL	01:00:00
P02 START OF MEAS	16:30:00
P02 LEVEL 1 MEAS TYPE	001
P02 XMIT 2 OR 3 BYTES?	03
P02 HIGH LIMIT	NO LIMIT
P02 LOW LIMIT	NO LIMIT
P02 HIGH DIFF LIMIT	NO LIMIT

P02 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	03
P03 SENSOR TYPE	10
P03 CARD SLOT #	06
P03 SENSOR INPUT ADRS	8
P03 SENSOR PWR ADRS	8
P03 SENSOR PWR ADV	00:00:02
P03 *FULL SCALE	500
P03 ZERO SCALE	000
P03 MEAS INTERVAL	01:00:00
P03 START OF MEAS	16:30:00
P03 LEVEL 1 MEAS TYPE	001
P03 XMIT 2 OR 3 BYTES?	03
P03 HIGH LIMIT	NO LIMIT
P03 LOW LIMIT	NO LIMIT
P03 HIGH DIFF LIMIT	NO LIMIT
P03 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	04
P04 SENSOR TYPE	10
P04 CARD SLOT #	06
P04 SENSOR INPUT ADRS	C
P04 SENSOR PWR ADRS	8
P04 SENSOR PWR ADV	00:00:02
P04 *FULL SCALE	0978
P04 ZERO SCALE	0081
P04 MEAS INTERVAL	01:00:00
P04 START OF MEAS	16:30:00
P04 LEVEL 1 MEAS TYPE	001
P04 XMIT 2 OR 3 BYTES?	03
P04 HIGH LIMIT	NO LIMIT
P04 LOW LIMIT	NO LIMIT
P04 HIGH DIFF LIMIT	NO LIMIT
P04 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	05
P05 SENSOR TYPE	04
P05 CARD SLOT #	06
P05 SENSOR PWR ADV	00:00:02
P05 HUMIDITY CHAN (1,2)	01
P05 *FULL SCALE	500
P05 ZERO SCALE	000
P05 MEAS INTERVAL	01:00:00
P05 START OF MEAS	16:30:00
P05 LEVEL 1 MEAS TYPE	001
P05 XMIT 2 OR 3 BYTES?	03
P05 HIGH LIMIT	NO LIMIT
P05 LOW LIMIT	NO LIMIT

P05 HIGH DIFF LIMIT	NO LIMIT
P05 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	06
P06 SENSOR TYPE	10
P06 CARD SLOT #	06
P06 SENSOR INPUT ADRS	5
P06 SENSOR PWR ADRS	8
P06 SENSOR PWR ADV	00:00:02
P06 *FULL SCALE	000
P06 ZERO SCALE	000
P06 MEAS INTERVAL	01:00:00
P06 START OF MEAS	16:30:00
P06 LEVEL 1 MEAS TYPE	001
P06 XMIT 2 OR 3 BYTES?	03
P06 HIGH LIMIT	NO LIMIT
P06 LOW LIMIT	NO LIMIT
P06 HIGH DIFF LIMIT	NO LIMIT
P06 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	07
P07 SENSOR TYPE	10
P07 CARD SLOT #	06
P07 SENSOR INPUT ADRS	D
P07 SENSOR PWR ADRS	8
P07 SENSOR PWR ADV	00:00:02
P07 *FULL SCALE	000
P07 ZERO SCALE	000
P07 MEAS INTERVAL	01:00:00
P07 START OF MEAS	16:30:00
P07 LEVEL 1 MEAS TYPE	001
P07 XMIT 2 OR 3 BYTES?	03
P07 HIGH LIMIT	NO LIMIT
P07 LOW LIMIT	NO LIMIT
P07 HIGH DIFF LIMIT	NO LIMIT
P07 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	08
P08 SENSOR TYPE	10
P08 CARD SLOT #	06
P08 SENSOR INPUT ADRS	A
P08 SENSOR PWR ADRS	8
P08 SENSOR PWR ADV	00:00:02
P08 *FULL SCALE	000
P08 ZERO SCALE	000
P08 MEAS INTERVAL	01:00:00
P08 START OF MEAS	16:30:00
P08 LEVEL 1 MEAS TYPE	001
P08 XMIT 2 OR 3 BYTES?	03

P08 HIGH LIMIT	NO LIMIT
P08 LOW LIMIT	NO LIMIT
P08 HIGH DIFF LIMIT	NO LIMIT
P08 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	09
P09 SENSOR TYPE	10
P09 CARD SLOT #	06
P09 SENSOR INPUT ADRS	8
P09 SENSOR PWR ADRS	8
P09 SENSOR PWR ADV	00:00:02
P09 *FULL SCALE	00.0
P09 ZERO SCALE	00.0
P09 MEAS INTERVAL	01:00:00
P09 START OF MEAS	16:30:00
P09 LEVEL 1 MEAS TYPE	001
P09 XMIT 2 OR 3 BYTES?	03
P09 HIGH LIMIT	NO LIMIT
P09 LOW LIMIT	NO LIMIT
P09 HIGH DIFF LIMIT	NO LIMIT
P09 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	10
P10 SENSOR TYPE	12
P10 MEAS INTERVAL	01:00:00
P10 START OF MEAS	16:30:00
P10 LEVEL 1 MEAS TYPE	001
P10 XMIT 2 OR 3 BYTES?	03
P10 HIGH LIMIT	NO LIMIT
P10 LOW LIMIT	NO LIMIT
P10 HIGH DIFF LIMIT	NO LIMIT
P10 LOW DIFF LIMIT	NO LIMIT

APPENDIX B

HANDAR 570A DCP CONFIGURATION PROGRAM - 570TROT.DCP

P ID	FA43D0BE
P STATION TIME	22:46:25
P YEAR (XX)	94
P DCP JULIAN DATE	047
P GOES PRI XMT MODE	01
P 1ST GOES XMT TIME	02:00:00
P PRI XMT INTERVAL	03:00:00
P GOES SEC XMT MODE	00
P TEL #:AREA CODE	0-000
P TEL #:LOCAL	000-0000
P MODEM XMT FORMAT	00
P 1ST DIAL TIME	00:00:00
P DIAL INTERVAL	00:00:00
P TEL EMG XMIT 1=0N	00
P AUTO DUMP? 1=Y 0=N	00
P VOICE OUTPUT MODE	00
P TOUCH TONE PASSWD	0
P CHANNEL NO.	01
P01 SENSOR TYPE	10
P01 SENSOR NAME TAG	10
P01 CARD SLOT #	01
P01 ADC INPUT MODE	2
P01 ADC INPUT NUMBER	08
P01 ADC SCALE (5.0E-X)	0
P01 ADC OUTPUT NUMBER	0
P01 SENSOR PWR ADV	00:00:02
P01 *FULL SCALE	1000
P01 ZERO SCALE	0000
P01 MEAS INTERVAL	01:00:00
P01 START OF MEAS	17:30:00
P01 LEVEL 1 MEAS TYPE	001
P01 XMIT 2 OR 3 BYTES?	03
P01 HIGH LIMIT	NO LIMIT
P01 LOW LIMIT	NO LIMIT
P01 HIGH DIFF LIMIT	NO LIMIT
P01 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	02
P02 SENSOR TYPE	10
P02 SENSOR NAME TAG	10
P02 CARD SLOT #	01
P02 ADC INPUT MODE	1
P02 ADC INPUT NUMBER	06
P02 ADC SCALE (5.0E-X)	0
P02 ADC OUTPUT NUMBER	0
P02 SENSOR PWR ADV	00:00:02
P02 *FULL SCALE	001

P02 ZERO SCALE	000
P02 MEAS INTERVAL	01:00:00
P02 START OF MEAS	17:30:00
P02 LEVEL 1 MEAS TYPE	001
P02 XMIT 2 OR 3 BYTES?	03
P02 HIGH LIMIT	NO LIMIT
P02 LOW LIMIT	NO LIMIT
P02 HIGH DIFF LIMIT	NO LIMIT
P02 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	03
P03 SENSOR TYPE	10
P03 SENSOR NAME TAG	10
P03 CARD SLOT #	01
P03 ADC INPUT MODE	1
P03 ADC INPUT NUMBER	14
P03 ADC SCALE (5.0E-X)	0
P03 ADC OUTPUT NUMBER	0
P03 SENSOR PWR ADV	00:00:02
P03 *FULL SCALE	999
P03 ZERO SCALE	000
P03 MEAS INTERVAL	01:00:00
P03 START OF MEAS	17:30:00
P03 LEVEL 1 MEAS TYPE	001
P03 XMIT 2 OR 3 BYTES?	03
P03 HIGH LIMIT	NO LIMIT
P03 LOW LIMIT	NO LIMIT
P03 HIGH DIFF LIMIT	NO LIMIT
P03 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	04
P04 SENSOR TYPE	10
P04 SENSOR NAME TAG	10
P04 CARD SLOT #	01
P04 ADC INPUT MODE	1
P04 ADC INPUT NUMBER	04
P04 ADC SCALE (5.0E-X)	0
P04 ADC OUTPUT NUMBER	2
P04 SENSOR PWR ADV	00:00:02
P04 *FULL SCALE	0978
P04 ZERO SCALE	0078
P04 MEAS INTERVAL	01:00:00
P04 START OF MEAS	17:30:00
P04 LEVEL 1 MEAS TYPE	001
P04 XMIT 2 OR 3 BYTES?	03
P04 HIGH LIMIT	NO LIMIT
P04 LOW LIMIT	NO LIMIT
P04 HIGH DIFF LIMIT	NO LIMIT

P04 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	05
P05 SENSOR TYPE	10
P05 SENSOR NAME TAG	10
P05 CARD SLOT #	01
P05 ADC INPUT MODE	1
P05 ADC INPUT NUMBER	12
P05 ADC SCALE (5.0E-X)	0
P05 ADC OUTPUT NUMBER	2
P05 SENSOR PWR ADV	00:00:02
P05 *FULL SCALE	500
P05 ZERO SCALE	000
P05 MEAS INTERVAL	01:00:00
P05 START OF MEAS	17:30:00
P05 LEVEL 1 MEAS TYPE	001
P05 XMIT 2 OR 3 BYTES?	03
P05 HIGH LIMIT	NO LIMIT
P05 LOW LIMIT	NO LIMIT
P05 HIGH DIFF LIMIT	NO LIMIT
P05 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	06
P06 SENSOR TYPE	10
P06 SENSOR NAME TAG	10
P06 CARD SLOT #	01
P06 ADC INPUT MODE	1
P06 ADC INPUT NUMBER	05
P06 ADC SCALE (5.0E-X)	0
P06 ADC OUTPUT NUMBER	0
P06 SENSOR PWR ADV	00:00:02
P06 *FULL SCALE	000
P06 ZERO SCALE	000
P06 MEAS INTERVAL	01:00:00
P06 START OF MEAS	17:30:00
P06 LEVEL 1 MEAS TYPE	001
P06 XMIT 2 OR 3 BYTES?	03
P06 HIGH LIMIT	NO LIMIT
P06 LOW LIMIT	NO LIMIT
P06 HIGH DIFF LIMIT	NO LIMIT
P06 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	07
P07 SENSOR TYPE	10
P07 SENSOR NAME TAG	10
P07 CARD SLOT #	01
P07 ADC INPUT MODE	1
P07 ADC INPUT NUMBER	13
P07 ADC SCALE (5.0E-X)	0

P07 ADC OUTPUT NUMBER	0
P07 SENSOR PWR ADV	00:00:02
P07 *FULL SCALE	000
P07 ZERO SCALE	000
P07 MEAS INTERVAL	01:00:00
P07 START OF MEAS	17:30:00
P07 LEVEL 1 MEAS TYPE	001
P07 XMIT 2 OR 3 BYTES?	03
P07 HIGH LIMIT	NO LIMIT
P07 LOW LIMIT	NO LIMIT
P07 HIGH DIFF LIMIT	NO LIMIT
P07 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	08
P08 SENSOR TYPE	10
P08 SENSOR NAME TAG	10
P08 CARD SLOT #	01
P08 ADC INPUT MODE	1
P08 ADC INPUT NUMBER	07
P08 ADC SCALE (5.0E-X)	0
P08 ADC OUTPUT NUMBER	0
P08 SENSOR PWR ADV	00:00:02
P08 *FULL SCALE	000
P08 ZERO SCALE	000
P08 MEAS INTERVAL	01:00:00
P08 START OF MEAS	17:30:00
P08 LEVEL 1 MEAS TYPE	001
P08 XMIT 2 OR 3 BYTES?	03
P08 HIGH LIMIT	NO LIMIT
P08 LOW LIMIT	NO LIMIT
P08 HIGH DIFF LIMIT	NO LIMIT
P08 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	09
P09 SENSOR TYPE	10
P09 SENSOR NAME TAG	10
P09 CARD SLOT #	01
P09 ADC INPUT MODE	1
P09 ADC INPUT NUMBER	15
P09 ADC SCALE (5.0E-X)	0
P09 ADC OUTPUT NUMBER	0
P09 SENSOR PWR ADV	00:00:02
P09 *FULL SCALE	00.0
P09 ZERO SCALE	00.0
P09 MEAS INTERVAL	01:00:00
P09 START OF MEAS	17:30:00
P09 LEVEL 1 MEAS TYPE	001
P09 XMIT 2 OR 3 BYTES?	03

P09 HIGH LIMIT	NO LIMIT
P09 LOW LIMIT	NO LIMIT
P09 HIGH DIFF LIMIT	NO LIMIT
P09 LOW DIFF LIMIT	NO LIMIT
P CHANNEL NO.	10
P10 SENSOR TYPE	12
P10 SENSOR NAME TAG	12
P10 MEAS INTERVAL	01:00:00
P10 START OF MEAS	17:30:00
P10 LEVEL 1 MEAS TYPE	001
P10 XMIT 2 OR 3 BYTES?	03
P10 HIGH LIMIT	NO LIMIT
P10 LOW LIMIT	NO LIMIT
P10 HIGH DIFF LIMIT	NO LIMIT
P10 LOW DIFF LIMIT	NO LIMIT