DOE/SF/10499-T44

MASTER

PROCUREMENT DOCUMENTATION
FOR THE
BEAM CHARACTERIZATION SUBSYSTEM

- ° PYRHELIOMETER
- ° DIGITIZER
- ° MODACS III
- ° VIDEO CAMERA

RADL ITEM NO. 3-4

CONTRACT ~~DE-AC03-79SF10499~~

AC03-79SF10499

FEBRUARY 1980

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PYRHELIOMETER

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DATE

DWG RELEASE

DATE 80-01-28

ADV DWG REL

NEW

DATE

VARIATION

DATE

MEMO

DATE

TEST CENTER

Pyrheliometer: 16 required

Parameters:

Window: Polished Quartz

Range: 0 to 20 suns (1 sun = 0.123 Btu/ft² sec)

Spectral Response: 0.2 to 4.5 microns

cooling: Water cooling required to ~~maintained constant temperature (70°F)~~ operate within 45°F to 130°F

Sensitivity: 5 mv/sun

Response Time: 250 ms

Size: ≤ 2" O.D.

Flexible Extension

Wire: 30" min.

EO Revised dated 2-22-80

Field of View 10° to 150° (changeable)

Partial list of potential vendors:

1. HyCal Engineering (213) 698-7785
12105 Los Nietos Road
Santa Fe Springs, Calif.

2. Medtherm Corp. (205) 837-2000
P. O. Box 412
Huntsville, Ala. 35804

3. The Eppley Laboratory Inc. (401) 847-1020
12 Shaffield Avenue
Newport, R.I. 02840

4. LI-COR, Inc. (402) 467-3576
4421 Superior Street
P. O. Box 4425
Lincoln, Nebraska 68504

DIGITIZER

MCDONNELL DOUGLAS ASTRONAUTICS CO.
HUNTINGTON BEACH, CALIF.
CODE 18356

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ENGINEERING ORDER

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DATE 80-02-01

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TEST CENTER

DS-12F DIGITAL FIELD GRABBER

Specification:

Memory Size: 256 x 256 Pixel Resolution

Resolution: 8 bits, A/D Converter

8 bits, D/A Converter

Sampling rate: 5 MHz

Scan format: RS-170

Capability: Averaging

Power: 110 VAC, 50/60 Hz

Computer Interface: IEEE 488

Estimated Cost: \$14,600

MODACS III

Data Acquisition and Control System

MODCOMP #U3-0202-0001

DATE	DATE	DATE
DATE	DATE	DATE
DATE	DATE	DATE
DATE	DATE	DATE
DATE	DATE	DATE

ITEM	QTY	MODEL	DESCRIPTION
1	1	1805-1	MODAC III Basic File
2	1	1812-1	Analog Regulator
3	1	1880-4	CPU, 128KB
4	1	4828-2	Standard Link, Classic
5	1	1887-2	Standard Link, MODAC
6	2	0230	Cable
7	1	1813-1	I/O Panel
8	1	1870	Analog/Digital
9	1	1872-1	Low Level MUX 0-80 MV (5 auto ranges)
10	1	1872-2	Low Level MUX 0-160 MV (5 auto ranges)
11	1	1832-3	Digital Output Option
12	1	0006	Cabinet
13	1	1811-1	Fan Chassis, Basic File
14	7	1890-1	Terminal Barrier Strip
15	1	1810-1	Controller, Primary
16	4	1851-2	Analog Out, 4 Channel, 4-20ma
17	1		MODACS Remote Software
18	1		MODACS System Software
A1	1	-	Additional Set of Documentation
A2	1	420	Training, MODACS III Maintenance
A3	1	109	Training, MAXNET IV Operating System
A4	1	213	Training, CLASSIC 7810 Maintenance

VIDEO CAMERA

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

MATERIAL	CONTRACT NO.		MCDONNELL DOUGLAS ASTRONAUTICS CO. HUNTINGTON BEACH, CALIF. MCDONNELL DOUGLAS		
	ORIGINAL DATE OF DRAWING 80-02-05				
	FIRST RELEASE OF PRINTS 80-02-15		BCS VIDEO CAMERA SYSTEM SPECIFICATION CONTROL DRAWING		
PREPARED <i>W.G. Rumbach</i> 2-5-80					
ODD DASH NUMBERS SHOWN EVEN DASH NUMBERS OPPOSITE	APPROVED <i>[Signature]</i> 2-14-80		SIZE A	CODE IDENT NO. 18355	DRAWING NO. 1044818
	CHECKED <i>DP</i> 2-14-80				
PART OR IDENT NO.	DESIGN ACTIVITY APPROVAL <i>[Signature]</i> 2/14/80		SCALE		SHEET 1 OF 18
	CUSTOMER APPROVAL				
FOR USAGE DATA SEE ENGINEERING RECORDS					

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1.0 SCOPE

This specification establishes the performance and acceptance requirements for the Beam Characterization System (BCS) video cameras.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent indicated in the following paragraphs.

2.1 Government Documents

Military Documents

MIL-STD-854C Standard Control Requirements for Electronic Equipment

Safety Documents

California Administrative Code CAL/OSHA

2.2 Non-Government Documents

NEMA Hoffman Enclosures and Equipment

EIA RS-310 Racks & Cabinets

IEEE No. 119 Temperature Measurement of Electrical Apparatus

3.0 REQUIREMENTS

3.1 Item Definition

The primary function of the BCS is to obtain data from a reflected heliostat beam and to evaluate the beam's size, shape, power, centroid, and energy flux distribution. The BCS will be used to align heliostats as part of the Pilot Plant Functional and Integrated Acceptance Test program and to provide operational support for heliostat realignment, performance evaluation,

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and maintenance throughout the pilot plant test period. The BCS is based on the Digital Image Radiometer (DIR). The DIR uses four video cameras which shall be used as light sensors. A camera is located in the north, south, east and west quadrants of the heliostat field. Each camera views (senses) a uniformly reflecting target screen mounted on the tower beneath the receiver (Figure 1). The cameras are aimed at the center of the respective target screen. A video signal, linear over the white light spectrum of interest is to be digitized, and transmitted to a computer where the data are reduced to determine the heliostat tracking accuracy and the beam quality.

3.1.1 System Major Component and External Interfaces Block Diagram

A functional block diagram of the entire BCS is shown in Figure 2 indicating the relationship of the cameras to the BCS. Figure 3 is a more complete functional diagram for the BCS camera components and their interfaces.

3.2 Characteristics

Camera performance and physical characteristics are specified in the following paragraphs.

3.2.1 Camera Requirements

The camera shall have the following electrical characteristics:

- a. Image Tube Type - RCA 4532 B/H silicon diode array vidicon
- b. Signal to Noise Ratio - 100:1 (40 dB) minimum
- c. Bandwidth - 5 MHz
- d. Resolution - 400 lines per picture height
- e. Grey Level Resolution - 64 grey levels minimum (must be able to resolve 2% changes in light intensity)
- f. Input Voltage - 110-130 volts AC, 60 $\pm$ 1 Hz
- g. Vertical Sweep Rate - 60 Hz
- h. Horizontal Sweep Rate - 15,750 Hz
- i. Scanning Format - 2:1 interlace
- J. Sync - RS-170
- k. Signal Transmission Distance - 1,500 feet coax (RG-11)

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- l. Stability - Resolution error 1% within 32°F-120°F operational temperature range; gain error 1% with $\pm 5^\circ\text{F}$ temperature change; dark current constant for $\pm 1^\circ$ temperature change.
- m. Linearity - 1% error in both horizontal and vertical directions.
- n. Geometric Distortion - 1% maximum
- o. Video Outputs - 1.0 volt p-p composite video compatible with Quantex DS-12F.
- p. AGC Circuitry - None.

3.2.2 Camera System Mechanical Requirements

The camera shall meet the following mechanical requirements:

- a. Lens - Field of view of 50 feet at a distance of 900 feet; resolve 5-inch pyrhelimeter aperture at 900 feet; manual zoom; motorized iris that is remotely controlled by computer with manual override; type "c" lens mount; protective lens cap.
- b. Video Switcher - 4 video inputs, 1 video output compatible with Quantex DS-12F; manual and computer control.
- c. Field Test Equipment - Linearity and resolution test charts, bar-dot generator for use in evaluating the camera at its operating location.
- d. Camera Control Unit - Camera power on/off switch, manual/computer switch for iris, manual/computer control switch for video switcher; bar-dot generator controls (see "c" above); standard 19" rack mount.
- e. Connectors - Video connections are standard UHF (UG-273/U or equivalent for RG-11 coax) camera cable - MS3102E-28-215 or equivalent.
- f. Pedestal Mount -(See Figure 4) adjustable for azimuth and elevation.
- g. Computer Interface - Must provide computer control for video switcher and lens iris; compatible with MODCOMP 7863 or MODCOMP MODAC III data acquisition and control system.

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3.2.3 Camera Environmental Requirements

- a. Temperature - 32°F - 120°F
- b. Altitude - 1940 feet (Barstow location)
- c. Thermal Housing - Maintain temperature to $\pm 1^\circ\text{F}$ within operational temperature range (32°F - 120°F) and meet NEMA Type 3 enclosure requirements to dust, sand and moisture or demonstrate that field equipment does not require temperature control over range (see "a" above).

3.3 Facilities Power Interface

3.3.1 Functional

The system shall interface with the following prime power source having the following characteristics:

- a. Voltage 120 VAC $\pm$ 10% VAC RMS
- b. Frequency 60 Hz $\pm$ 1 Hz
- c. Harmonic distortion $\pm$ 10% maximum

3.3.2 Physical

The facility power connections shall be appropriately sized outlets compatible with the SYSTEM mounting termination devices (e.g., J-Box or Drop Cables). Single phase circuits shall be 3-wire and physical connections shall be determined after System Supplier selection.

3.4 Camera Computer Interface

3.4.1 Functional

The Camera will be required to interface with a Modular Computer System Incorporated (MODCOMP) model Classic 7863 Computer that contains a MODAC III Data Acquisition and Control system.

3.4.1.1 MODCOMP Computer System Interface

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3.4.1.2 Functional

The MODCOMP Computer interface shall be capable of transferring commands to the Camera Iris controls and Video Switching controls.

The Computer interface shall be a standard MODCOMP I/O interface compatible with the Camera Supplier's System.

3.4.1.3 Physical

The physical interface between the Camera (Video Switch) and the computer shall be a supplier furnished interface card and identification of the connector and type of cable. MDAC will supply a cable and MODCOMP 4903 chassis or a supplier designated MODCOMP chassis to accommodate the suppliers interface card requirements. Suppliers can interface with MODCOMP Chassis 7863 or MODAC III, as shown in Figure 2.

3.5 Camera Documentation

Complete camera documentation shall include user's manual for use in installing and operating the camera and all accessories. The manuals shall describe in detail how to assemble, install and interconnect the camera for operation and usage. A maintenance repair manual shall define replaceable and repairable components and the detailed procedure for replacement and repair.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 General

This section contains the requirements for verification of the Section 3 requirements for the 4 Beam Characterization System cameras.

4.1.1 Responsibility

4.1.1.1 Supplier Responsibility

- a. The supplier is responsible for the interface, characteristics, design and construction, and configuration element requirements specified in Section 3.
- b. The supplier is responsible for the performance of all verification of requirements specified in Section 4 and may utilize his own facilities or commercial laboratories as necessary.

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- c. The supplier is responsible for providing factory test plans and procedures to MDAC for approval ninety (90) days prior to start of testing. MDAC will respond with approval within forty-five (45) days.

4.1.1.2 Contractor Responsibility

- a. McDonnell Douglas Astronautics Company reserves the right to witness the demonstration/test of the system and to accept or reject equipment in accordance with supplier test plans/procedures (4.1.1.1) and data.
- b. McDonnell Douglas Astronautics Company reserves the right to perform any verification required by this specification at the deployed locations of the system.

4.1.2 Supplier Verification Procedures

The supplier shall perform verification of configuration element requirements in accordance with commercial practice. Configuration element requirements requiring operation of the System shall be integrated into system level verifications.

4.1.3 Verification Category

The verification requirements shall apply to the production system and/or its configuration elements.

4.1.4 Verification Levels

Verification levels for the production category shall be in accordance with the following:

a. Configuration Element

The requirements for each configuration element shall be verified for each stand alone device in accordance with the verification plans/procedures.

b. System

The requirements for the system, when all the configuration elements are interfaced and integrated, shall be verified in accordance with verification plans/procedures.

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4.1.5 Verification Methods

a. Inspection

Physical and visual examination of documentation, hardware, or software to verify conformance to specified requirements.

b. Analysis

Analytical techniques shall be utilized to evaluate system performance or test data. Review and analysis shall be utilized on commercially available equipment in lieu of formal qualification testing.

c. Test

Test shall be an activity designed to provide data in an operational environment and shall be utilized to evaluate quantitative product performance characteristics. Evaluation includes comparison of the tested characteristics with requirements.

d. Demonstration

Verification by demonstration shall show the operation or workings of the system. Demonstration shall be utilized for qualitative verifications.

e. Similarity

Verification by similarity shall be a procedure to show that a configuration element is comparable in design or manufacture to a reference equipment identified in the plans/procedures.

4.1.6 Operational Conditions for Verifications

The operational conditions for verifications shall be in accordance with the following unless otherwise specified in the plans/procedures.

a.	Temperature:	Constant $\pm 1^{\circ}\text{F}$
b.	Humidity:	Less than 80 percent
c.	Atmospheric Pressure:	Less than 10,000 feet, equivalent
d.	Prime Power:	115 vac ± 10 percent
60 $\pm$ Hz
e.	Tolerance:	Measurement tolerance ± 10 percent
unless otherwise specified in the
test plans/procedures

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4.2 Quality Conformance Verification

4.2.1 System Production Acceptance Verification

Product verification of the system shall consist of a factory demonstration and test in accordance with the following:

a. Operational Demonstration

An operational demonstration shall be performed following completion of normal commercial quality assurance verifications. The purpose of the demonstration shall show operational capability of the total system.

1. Demonstration Acceptance Criteria

- a. The number of relevant failures during an incremental demonstration shall be zero.
- b. Repair time shall not be included in demonstration time.
- c. External adjustments to the configuration element cabinets may be performed on an as-required basis.
- d. Internal adjustments of the configuration element cabinets shall not be required during a 4-hour incremental system level demonstration period and repair time shall not be included in the demonstration period.
- e. A chronological operation log shall be maintained for demonstrations performed and relevant and not relevant failure recording.

2. Operational Condition

Operational condition shall be in accordance with paragraph 4.1.6.

a. Performance test

A quantitative performance test shall be performed following interface and integration of configuration elements. The purpose of the test shall be to measure the characteristic parameters of the system.

Successful completion of the performance test is defined as measurement of the characteristics parameters to within their specified tolerance in accordance with factory test plans/procedures approved by MDAC. (Reference paragraph 4.1.1.1).

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1. Adjustment

External and internal adjustments may be performed on an as-required basis.

2. Operational Conditions

Operations conditions for the test shall be in accordance with paragraph 4.1.6.

- b. A test of interfaces with the Beam Characterization System (BCS) and typical system control circuits shall be conducted at MDAC's Huntington Beach facility.

5.0 PREPARATION FOR DELIVERY

The requirements for system configuration element preparation for delivery shall be in accordance with commercial practice for preservation, packaging, packing, and package marking.

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Figure 1. Digital Image Radiometer Beam Characterization Subsystem

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FIGURE 2: SYSTEM MAJOR COMPONENTS FOR ENTIRE BCS

Figure 3: SYSTEM MAJOR COMPONENTS AND EXTERNAL INTERFACES BLOCK DIAGRAM

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TITLE BCS VIDEO CAMERA SYSTEM / SPECIFICATION CONTROL DRAWING													
CCN WBA33001 ETD		EXTRA COPIES TO (NAME INCL INITIAL) M.A. MIRZA 2-Copies		LOC/DEPT A3-236		GROUP AEDO		M.S. 14-1					
RELEASE STOP ORDER SERIAL NO.		CRS WRO EP-028-0.0 CHG-003		CONTRACT AUTH N/A									
GROUP AEDO		SC U		ECP									
EO MADE BY M.A. MIRZA		DESIGN TECH M.A. MIRZA		M&P		EFFECT ENG		CHECK EO		STRENGTH		CCCB	
DWG MADE/CHGD BY W.G. RUMBACH		PROGRAM ENG W.G. RUMBACH		COMPONENTS		LOG SUPPORT		CHECK DWG		WEIGHT WA WD		CUSTOMER RELEASE AND MAT'L Timmerman	
NEW/AFF DASH NO.		REPLACES DASH NO.		MODEL 350003A		SECTION		CHG CODE		EFFECTIVITY N/A		EFF SYM	
BASIC												NEXT ASSEMBLY 1D44815	
												FINAL ASSY REQ 1	

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