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FINAL REPORT

# Ultraminiature Television Camera

FACILITY FORM 602

N 69-17748

(ACCESSION NUMBER)

(THRU)

86

(PAGES)

(CODE)

CX 98279

(NASA CR OR TMX OR AD NUMBER)

07

(CATEGORY)



TELEDYNE SYSTEMS  
CONTROL SYSTEMS DIVISION

A TELEDYNE COMPANY



EQ25482?

ULTRAMINIATURE TELEVISION CAMERA

FINAL REPORT

March 1968

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## FOREWORD

This report was prepared by Teledyne Systems Company, Control Systems Division, El Segundo, California under National Aeronautics and Space Administration (NASA) Contract Number NAS8-20768 (Phase 1).

The investigations described in this report were conducted from June 1967 to February 1968.

## ABSTRACT

The development work accomplished under the terms of this contract produced a modification in the physical and electrical design of the ultraminiature television camera prototype with transmitter, originally produced under Contract NAS8-11506. These modifications are to enable the camera to pass certain environmental tests.

One camera has been designed, fabricated, tested, and delivered under this contract.

## SECTION I

### INTRODUCTION

The development effort contained in this contract had, as its primary goal, the further design and ruggedization of an ultra-miniature television camera with transmitter capable of meeting certain environmental conditions.

In addition, certain circuit improvements were made to enable the camera to operate more satisfactorily under any operating condition.

## SECTION II

### DESIGN GOALS AND ACCOMPLISHMENTS

The following section gives an itemized list of the design goals as listed in the contract, and Teledyne's results.

| Requirements                                                                                                                                                                                                  | Results                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| 1.1                                                                                                                                                                                                           |                                                                                                                   |
| Mechanical - Case size shall not exceed 2 x 3 x 4.5 inches while maintaining structural integrity such that the total camera will pass the environmental tests listed under Appendix A of this scope of work. | The overall package, excluding lens and connectors, is 2 x 3 x 4.5 inches.                                        |
| 1.2                                                                                                                                                                                                           |                                                                                                                   |
| Electrical - Construct the circuitry of the cameras to conform under Contract NAS8-11506 plus the following modifications:                                                                                    |                                                                                                                   |
| 1.2.1                                                                                                                                                                                                         |                                                                                                                   |
| The non-composite signal at monitor output shall be no greater than 100 millivolts p-p with no light input to vidicon.                                                                                        | With no light to the vidicon, (lens capped), the non-composite video is between 30 to 40 millivolts peak to peak. |

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## Requirements

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## Results

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### 1.2.2

Video clamp circuit shall clamp to the back porch of the horizontal sync pulse.

The video signal is clamped to the back porch of the horizontal sync pulse.

### 1.2.3

Shading between picture center and any edge shall be no greater than 2.0:1 with a design goal of 1.5:1.

Typical shading characteristics are 1.6 to 1, and the worst case reading is 1.8 to 1. The worst case occurred on the left side of the picture.

### 1.2.4

The crystal oscillator shall use an integrated chip amplifier.

The crystal oscillator uses an integrated chip amplifier.

### 1.2.5

The sync generator will operate from the internal 31.5K Hz crystal oscillator when either external horizontal or vertical drive pulses are removed.

The sync generator completely meets this requirement.

### 1.2.6

The sync generator shall have commercial sync format as defined in Electronic Industries Association Standard (Revision TR-135) dated November 1957.

The sync generator meets this requirement when operating from its own oscillator. When operation is controlled from an external source, no 31.5K Hz is available, hence, no equalizing pulses are present in the composite video output.

| Requirement                                                                                                                                                                                                                                                                                                                                                  | Results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |        |           |  |       |           |           |        |           |             |        |           |           |        |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------|-----------|--|-------|-----------|-----------|--------|-----------|-------------|--------|-----------|-----------|--------|-----------|
| 1.2.7                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |        |           |  |       |           |           |        |           |             |        |           |           |        |           |
| Video output impedance from camera monitor output 75 ohms resistive.                                                                                                                                                                                                                                                                                         | The composite video output of the camera is designed to drive a 75 ohm resistive load. The output impedance of the camera is less than 75 ohms.                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |        |           |  |       |           |           |        |           |             |        |           |           |        |           |
| 1.2.8                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |        |           |  |       |           |           |        |           |             |        |           |           |        |           |
| Automatic target - 1000:1 with minimum scene illumination at 10 foot candles.                                                                                                                                                                                                                                                                                | The automatic light control takes over at approximately one foot candle scene illumination and controls the target voltage to 8000 foot candles scene illumination. No equipment was available to generate a scene brightness greater than 8000 foot candles so operation from 8000 to 10,000 foot candles is not known.                                                                                                                                                                                                                                                                  |             |        |           |  |       |           |           |        |           |             |        |           |           |        |           |
| 1.2.9                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |             |        |           |  |       |           |           |        |           |             |        |           |           |        |           |
| Horizontal Resolution - With automatic target functioning correctly, a minimum of 450 lines at center of picture and no less than 375 lines at either edge (with automatic target functioning correctly, 475 lines at center and 400 lines at edge will be a design goal); at 1 foot candle scene illumination, no less than 275 lines at center of picture. | <p>The measured resolution of the camera is as follows:</p> <p>At 15 foot candles scene illumination</p> <table><tr><td>Horizontal:</td><td>center</td><td>475 lines</td></tr><tr><td></td><td>edges</td><td>400 lines</td></tr><tr><td>Vertical:</td><td>center</td><td>370 lines</td></tr></table> <p>At 1 foot candle scene illumination</p> <table><tr><td>Horizontal:</td><td>center</td><td>425 lines</td></tr><tr><td>Vertical:</td><td>center</td><td>325 lines</td></tr></table> <p>The AGC voltage was operating in a proper manner when the above measurements were taken.</p> | Horizontal: | center | 475 lines |  | edges | 400 lines | Vertical: | center | 370 lines | Horizontal: | center | 425 lines | Vertical: | center | 325 lines |
| Horizontal:                                                                                                                                                                                                                                                                                                                                                  | center                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 475 lines   |        |           |  |       |           |           |        |           |             |        |           |           |        |           |
|                                                                                                                                                                                                                                                                                                                                                              | edges                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 400 lines   |        |           |  |       |           |           |        |           |             |        |           |           |        |           |
| Vertical:                                                                                                                                                                                                                                                                                                                                                    | center                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 370 lines   |        |           |  |       |           |           |        |           |             |        |           |           |        |           |
| Horizontal:                                                                                                                                                                                                                                                                                                                                                  | center                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 425 lines   |        |           |  |       |           |           |        |           |             |        |           |           |        |           |
| Vertical:                                                                                                                                                                                                                                                                                                                                                    | center                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 325 lines   |        |           |  |       |           |           |        |           |             |        |           |           |        |           |

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**Requirements**

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**Results**

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**1.2.10**

Camera package, operating properly, must meet the requirements of MIL-I-6181D, "Interference Control Requirements".

The camera, when operating properly, was tested to, and passed, the requirements of MIL-I-6181D. A copy of the test report is submitted as Appendix C to this report.

## SECTION III

### SUMMARY OF WORK

#### 3. GENERAL

The camera developed under Phase I of this contract, represents a ruggedization and improvement of the camera developed under a previous contract with NASA. The camera is designed to operate over the following environmental conditions:

|               |                                                  |                        |
|---------------|--------------------------------------------------|------------------------|
| • Temperature | -10 <sup>0</sup> to +40 <sup>0</sup> C operating |                        |
| • Altitude    | Sea level to 300,000 feet                        |                        |
| • Vibration   |                                                  |                        |
| Sine:         | 5 - 48 Hz                                        | 0.125 inches D.A.D.    |
|               | 48 - 165 Hz                                      | 15.0G Peak             |
|               | 165 - 2000 Hz                                    | 10.0G Peak             |
| Random:       | 20 - 59 Hz                                       | 0.04g <sup>2</sup> /Hz |
|               | 59 - 126 Hz                                      | +9db/octave            |
|               | 126 - 700 Hz                                     | 0.40g <sup>2</sup> /Hz |
|               | 700 - 900 Hz                                     | -18db/octave           |
|               | 900 - 2000 Hz                                    | 0.09g <sup>2</sup> /Hz |
| • RFI         | MIL-I-6181D                                      |                        |

Formal testing has not been done to the above requirements, however, certain integrity testing has been performed to assure a reasonable probability of meeting the above requirements. The results of these tests are summarized in Section V.

#### 3.1 ELECTRICAL DESIGN

The block diagram of the camera is shown in Figure III-1. Circuit details are discussed in Section IV of this report.

#### 3.2 MECHANICAL DESIGN

System mechanical configuration is shown in Figure III-2. Since each sub-assembly is identified, no detailed consideration is given to each subassembly.

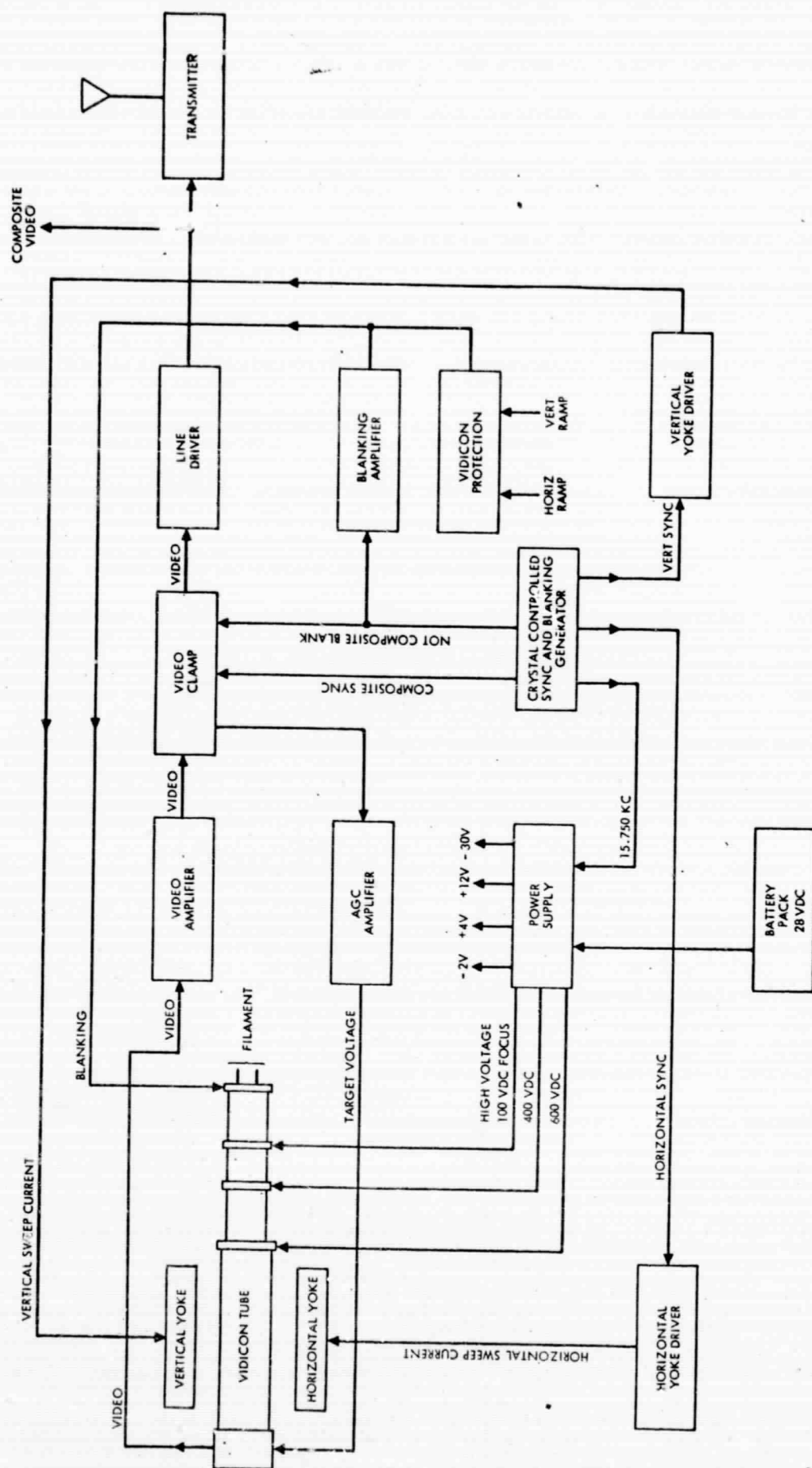


Figure III-1. System Block Diagram

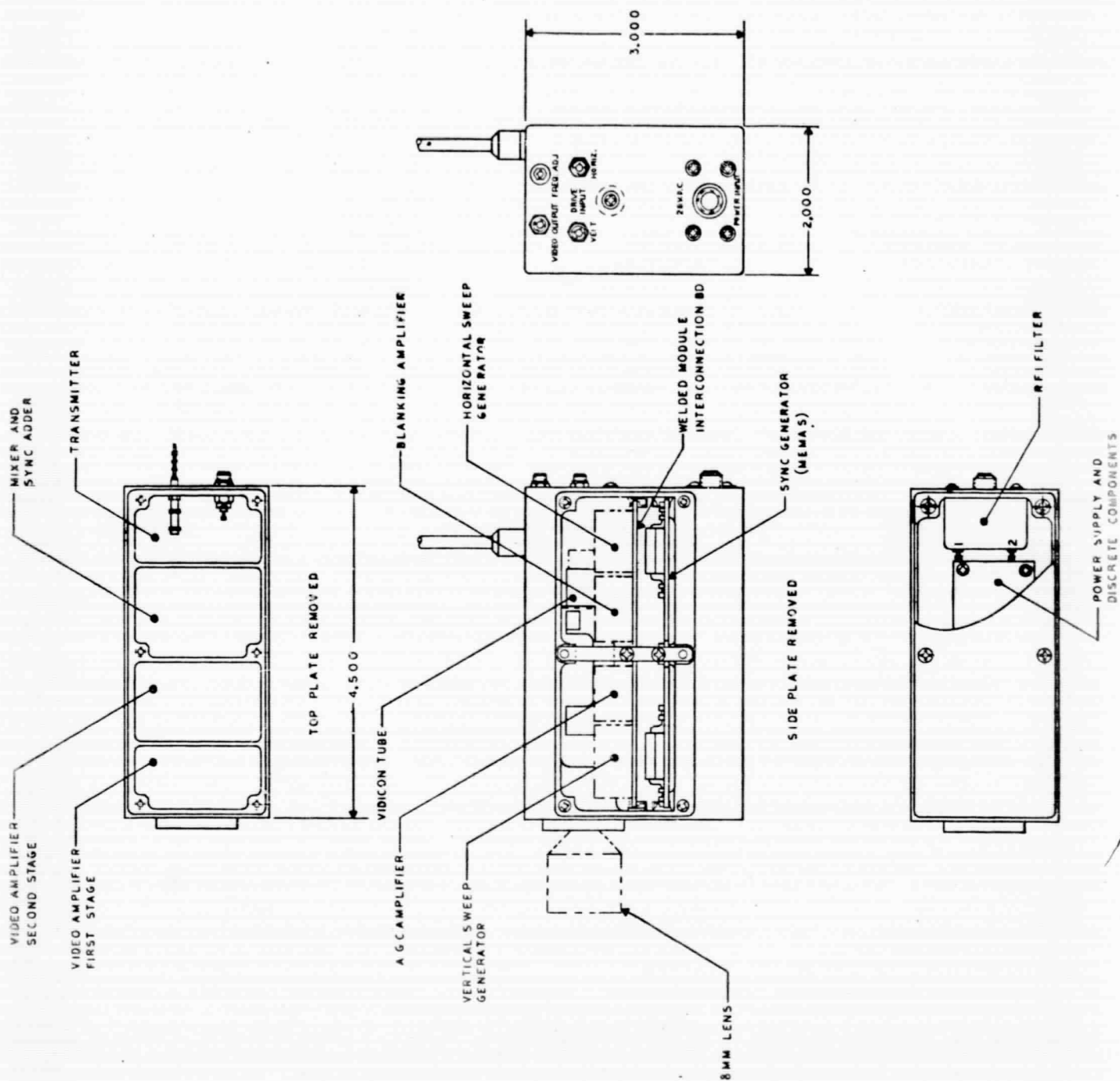


Figure III-2. Outline Drawing

## SECTION IV

### TECHNICAL DISCUSSION

#### 4. GENERAL

The following Section gives a description of the various electrical circuits used in the camera with particular emphasis of those circuits that were developed during the scope of this contract. To some extent this may be a repetition of the Monthly Progress Reports but is included here for the sake of completeness.

##### 4.1 OSCILLATOR

In order to establish the proper timing for the various sync and equalizing pulses while operating in the internal sync mode, a 31.5 KHz oscillation is used. This oscillator uses an integrated chip amplifier in the feedback path. The output of the crystal oscillator is fed to a gate circuit which serves to properly shape the oscillator output to a square wave. This square wave output is fed to a divide by two flip flop (which output now is 15.750 KHz for horizontal sync) and to a divide by 525 network (for vertical sync).

The schematic for this circuit is shown in Figure IV-1.

##### 4.2 COUNTDOWN CIRCUIT

The countdown circuit has as its input the 31.5 KHz oscillator output. It is comprised of a divide by three network, 2 divide by five networks, and a divide by seven network. The output of this circuit is then  $\frac{31.5 \text{ KHz}}{3 \times 5 \times 5 \times 7}$  or 60 Hz, which is the vertical sync pulse frequency.

H

G

F

E

D

C

B

A

# A6 CRYSTAL OSCILLATOR

DWG NO. E33022

# A7 COUNT DOWN

DWG NO. E33023

A2 ASSY DWG. E34637-1

A1 ASSY DWG. E34635-1

- [6] DRAWING NO. ELEMENT SYMBOL
- [7] DRAWING NO. BOARD SYMBOL
- [8] DRAWING NO. BOARD SYMBOL
- [9] ALL LINE POINTS FREE TOGETHER
- [10] DRAWING NO. BOARD SYMBOL
- [11] DRAWING NO. BOARD SYMBOL
- [12] RESISTOR VALUES IN OHMS SHOWN AT TIME OF CABLE LAM
- [13] FOR ASSY DWG. E34637-1
- [14] NOTES - UNLESS OTHERWISE SPECIFIED

| A6  |            |
|-----|------------|
| PIN | ASSIGNMENT |
| 1   | CRYSTAL    |
| 2   | CRYSTAL    |
| 3   | CRYSTAL    |
| 4   | CRYSTAL    |
| 5   | CRYSTAL    |
| 6   | CRYSTAL    |
| 7   | CRYSTAL    |
| 8   | CRYSTAL    |
| 9   | CRYSTAL    |
| 10  | CRYSTAL    |
| 11  | CRYSTAL    |
| 12  | CRYSTAL    |
| 13  | CRYSTAL    |
| 14  | CRYSTAL    |
| 15  | CRYSTAL    |

| A7  |            |
|-----|------------|
| PIN | ASSIGNMENT |
| 1   | CRYSTAL    |
| 2   | CRYSTAL    |
| 3   | CRYSTAL    |
| 4   | CRYSTAL    |
| 5   | CRYSTAL    |
| 6   | CRYSTAL    |
| 7   | CRYSTAL    |
| 8   | CRYSTAL    |
| 9   | CRYSTAL    |
| 10  | CRYSTAL    |
| 11  | CRYSTAL    |
| 12  | CRYSTAL    |
| 13  | CRYSTAL    |
| 14  | CRYSTAL    |
| 15  | CRYSTAL    |

| A8  |            |
|-----|------------|
| PIN | ASSIGNMENT |
| 1   | CRYSTAL    |
| 2   | CRYSTAL    |
| 3   | CRYSTAL    |
| 4   | CRYSTAL    |
| 5   | CRYSTAL    |
| 6   | CRYSTAL    |
| 7   | CRYSTAL    |
| 8   | CRYSTAL    |
| 9   | CRYSTAL    |
| 10  | CRYSTAL    |
| 11  | CRYSTAL    |
| 12  | CRYSTAL    |
| 13  | CRYSTAL    |
| 14  | CRYSTAL    |
| 15  | CRYSTAL    |

| A9  |            |
|-----|------------|
| PIN | ASSIGNMENT |
| 1   | CRYSTAL    |
| 2   | CRYSTAL    |
| 3   | CRYSTAL    |
| 4   | CRYSTAL    |
| 5   | CRYSTAL    |
| 6   | CRYSTAL    |
| 7   | CRYSTAL    |
| 8   | CRYSTAL    |
| 9   | CRYSTAL    |
| 10  | CRYSTAL    |
| 11  | CRYSTAL    |
| 12  | CRYSTAL    |
| 13  | CRYSTAL    |
| 14  | CRYSTAL    |
| 15  | CRYSTAL    |

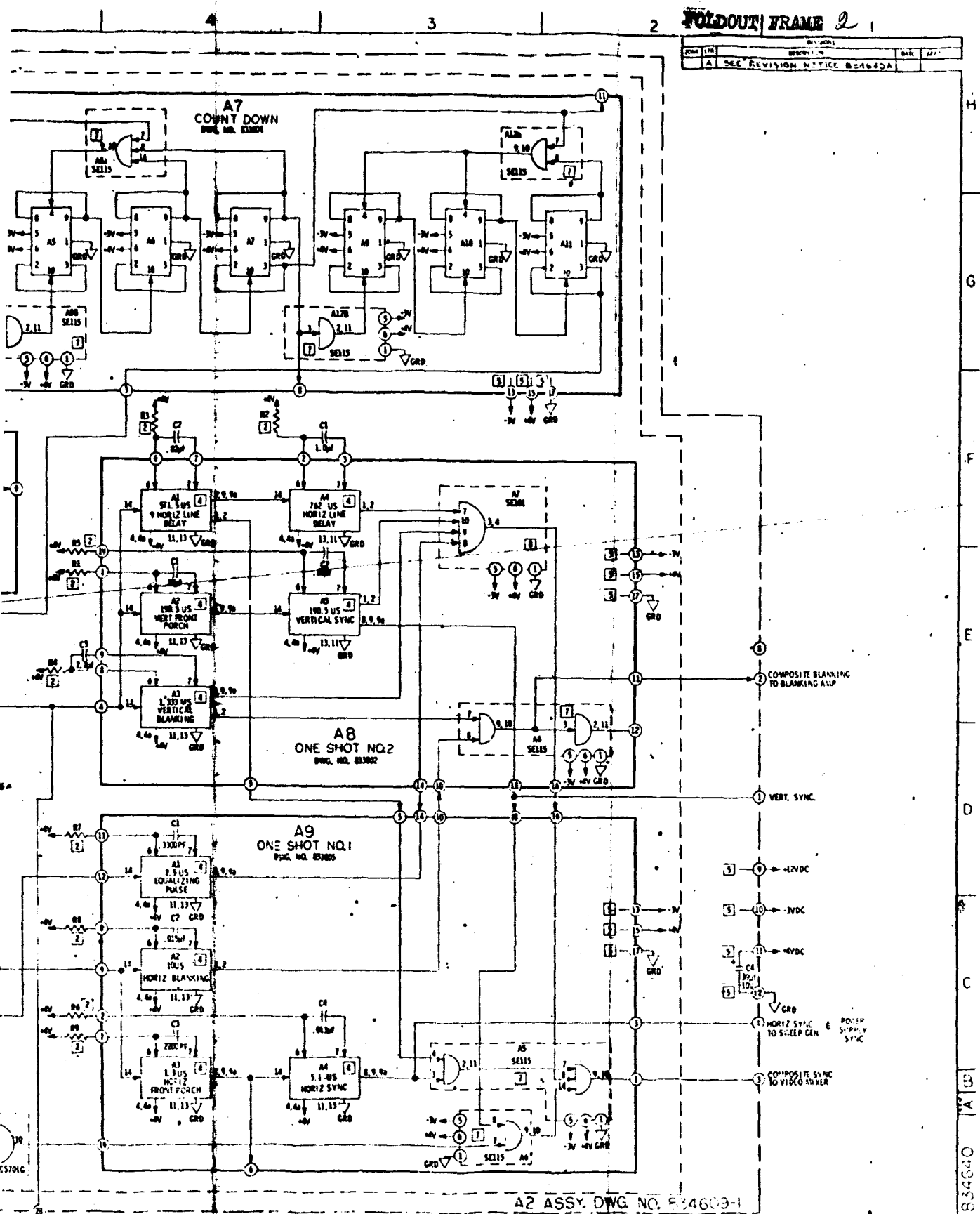


Figure IV-1.  
Schematic Diagram  
Sync Generator

PN Assignment

| COMPONENT | PN ASSIGNMENT |
|-----------|---------------|
| 1         | COMP. SYNC    |
| 2         | VERT. SYNC    |
| 3         | HORIZ. SYNC   |
| 4         | TEST POINT    |
| 5         | TEST POINT    |
| 6         | TEST POINT    |
| 7         | TEST POINT    |
| 8         | TEST POINT    |
| 9         | TEST POINT    |
| 10        | TEST POINT    |
| 11        | TEST POINT    |
| 12        | TEST POINT    |
| 13        | TEST POINT    |
| 14        | TEST POINT    |
| 15        | TEST POINT    |
| 16        | TEST POINT    |
| 17        | TEST POINT    |
| 18        | TEST POINT    |
| 19        | TEST POINT    |
| 20        | TEST POINT    |

| COMPONENT | PN ASSIGNMENT | VALUE | UNIT | REMARKS |
|-----------|---------------|-------|------|---------|
| 1         | COMP. SYNC    | 10K   | Ω    |         |
| 2         | VERT. SYNC    | 10K   | Ω    |         |
| 3         | HORIZ. SYNC   | 10K   | Ω    |         |
| 4         | TEST POINT    | 10K   | Ω    |         |
| 5         | TEST POINT    | 10K   | Ω    |         |
| 6         | TEST POINT    | 10K   | Ω    |         |
| 7         | TEST POINT    | 10K   | Ω    |         |
| 8         | TEST POINT    | 10K   | Ω    |         |
| 9         | TEST POINT    | 10K   | Ω    |         |
| 10        | TEST POINT    | 10K   | Ω    |         |
| 11        | TEST POINT    | 10K   | Ω    |         |
| 12        | TEST POINT    | 10K   | Ω    |         |
| 13        | TEST POINT    | 10K   | Ω    |         |
| 14        | TEST POINT    | 10K   | Ω    |         |
| 15        | TEST POINT    | 10K   | Ω    |         |
| 16        | TEST POINT    | 10K   | Ω    |         |
| 17        | TEST POINT    | 10K   | Ω    |         |
| 18        | TEST POINT    | 10K   | Ω    |         |
| 19        | TEST POINT    | 10K   | Ω    |         |
| 20        | TEST POINT    | 10K   | Ω    |         |

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CONTROL SYSTEMS DIVISION  
E 93571

The divide by three network is packaged, along with the crystal oscillator, in one MEMA. The remainder of the countdown network is packaged in a second MEMA.

The schematic for this circuit is shown in Figure IV-1.

#### 4.3 SYNC SELECT CIRCUIT

The sync select circuitry has as its inputs the externally received horizontal and vertical sync pulses, and the internally generated horizontal and vertical sync pulses (obtained from the crystal oscillator and countdown circuits). The output of sync select circuit is a horizontal trigger pulse and vertical trigger pulse. These trigger pulses go to the pulse forming circuit where the various timing pulses for the camera are generated.

The sync select circuitry serves to select either the external or internal sync pulses for camera operation. It will always select the external horizontal and vertical sync pulses if both are present. If either (or both) the pulses are missing, the circuit will select the internal horizontal and vertical sync pulses.

The schematic for the circuit is shown in Figure IV-1. Operation is as follows:

When a horizontal sync pulse is received, it is first terminated in 75 ohms then shaped by a double NAND gate circuit. The output of the NAND gate charges a 1 uf memory capacitor. This capacitor discharges through a 47K resistor and into the base of a transistor. Sufficient charge is stored in the capacitor to hold the transistor in saturation between sync pulses. The output of the transistor is a DC voltage, 0 V DC if the sync pulse is present, and +4 V DC if no sync pulse is present. An identical circuit is used to determine if the vertical sync pulse is present. The 0 V DC and 4 V DC outputs from the transistors are fed to a group of logic gates from which the correct sync pulses are selected.

#### 4.4 PULSE FORMING NETWORK

The various sync, blanking and equalizing pulses are generated by a group of temperature stabilized one-shot multivibrators. The schematic for this is shown in Figure IV-1. The pulse forming network is packaged in two MEMA's.

#### 4.5 VIDEO AMPLIFIER

More design and breadboarding work went into improving the video amplifier than any other single circuit. The results have been a considerable improvement in camera performance. Changes in the video amplifier include the following:

The input impedance has been lowered from 50 K to 25 K ohms; this to minimize the effect of input capacity.

The amplifier was designed so that the input lead to the video amplifier may be shielded. To minimize the capacity effect of the shield load, the output of the first video amplifier stage (at which point the voltage gain is unity) drives the shield through a low impedance source. Thus no voltage is developed between the input lead and the shield itself with the result that the input lead to the video amplifier can be shielded while not having to suffer from the capacity between the input lead and the shield.

The collector voltage on the transistors was raised from 12 to 21 V DC. Since the transistors collector capacitance is an inverse function of the collector voltage, this shunt capacity has been cut in half.

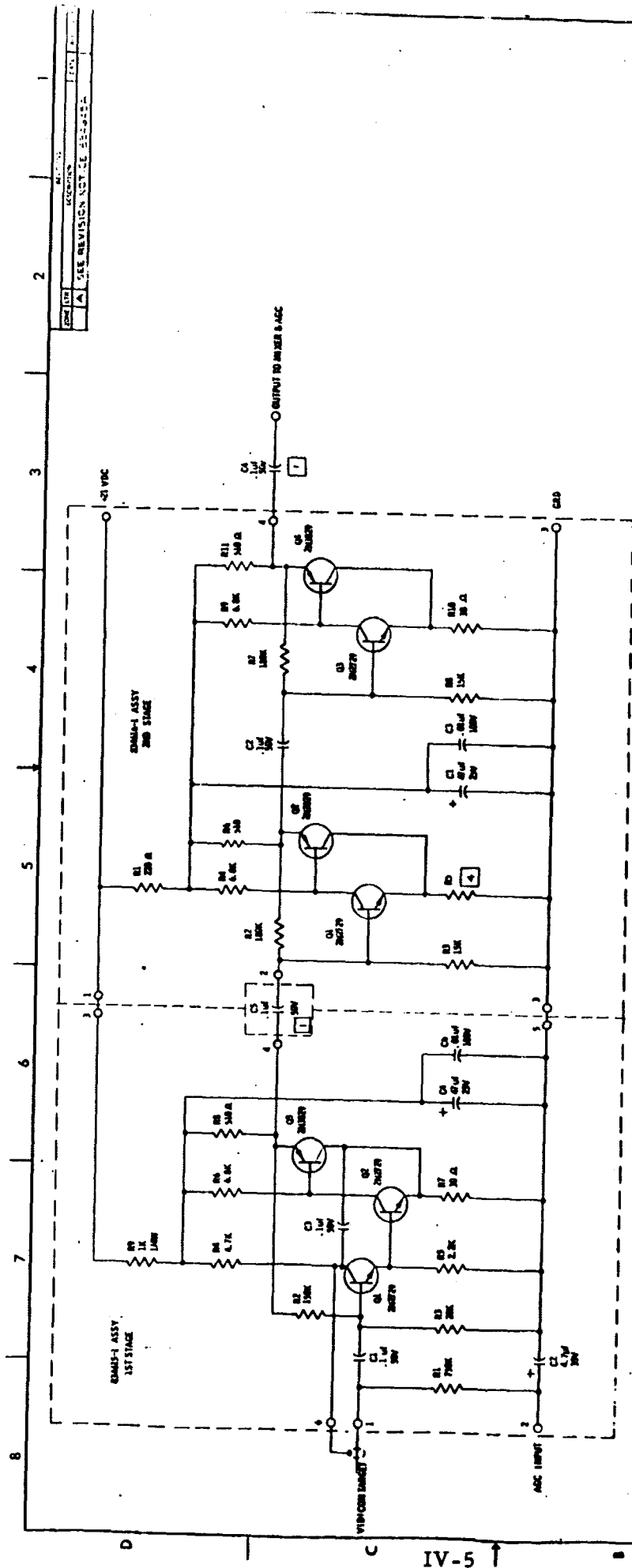


Figure IV-2. Schematic Diagram, Video Amplifier

|                                                      |         |                                                      |         |
|------------------------------------------------------|---------|------------------------------------------------------|---------|
| TELETYPE SYSTEMS COMPANY<br>CONTROL SYSTEMS DIVISION |         | TELETYPE SYSTEMS COMPANY<br>CONTROL SYSTEMS DIVISION |         |
| SCHEMATIC DIAGRAM<br>VIDEO AMPLIFIER                 |         | SCHEMATIC DIAGRAM<br>VIDEO AMPLIFIER                 |         |
| D 98571 65-645                                       |         | D 98571 65-645                                       |         |
| REVISIONS                                            |         | REVISIONS                                            |         |
| NO.                                                  | DATE    | NO.                                                  | DATE    |
| 1                                                    | 10-1-65 | 1                                                    | 10-1-65 |
| 2                                                    | 10-1-65 | 2                                                    | 10-1-65 |
| 3                                                    | 10-1-65 | 3                                                    | 10-1-65 |
| 4                                                    | 10-1-65 | 4                                                    | 10-1-65 |
| 5                                                    | 10-1-65 | 5                                                    | 10-1-65 |
| 6                                                    | 10-1-65 | 6                                                    | 10-1-65 |
| 7                                                    | 10-1-65 | 7                                                    | 10-1-65 |
| 8                                                    | 10-1-65 | 8                                                    | 10-1-65 |
| 9                                                    | 10-1-65 | 9                                                    | 10-1-65 |
| 10                                                   | 10-1-65 | 10                                                   | 10-1-65 |
| 11                                                   | 10-1-65 | 11                                                   | 10-1-65 |
| 12                                                   | 10-1-65 | 12                                                   | 10-1-65 |
| 13                                                   | 10-1-65 | 13                                                   | 10-1-65 |
| 14                                                   | 10-1-65 | 14                                                   | 10-1-65 |
| 15                                                   | 10-1-65 | 15                                                   | 10-1-65 |
| 16                                                   | 10-1-65 | 16                                                   | 10-1-65 |
| 17                                                   | 10-1-65 | 17                                                   | 10-1-65 |
| 18                                                   | 10-1-65 | 18                                                   | 10-1-65 |
| 19                                                   | 10-1-65 | 19                                                   | 10-1-65 |
| 20                                                   | 10-1-65 | 20                                                   | 10-1-65 |
| 21                                                   | 10-1-65 | 21                                                   | 10-1-65 |
| 22                                                   | 10-1-65 | 22                                                   | 10-1-65 |
| 23                                                   | 10-1-65 | 23                                                   | 10-1-65 |
| 24                                                   | 10-1-65 | 24                                                   | 10-1-65 |
| 25                                                   | 10-1-65 | 25                                                   | 10-1-65 |
| 26                                                   | 10-1-65 | 26                                                   | 10-1-65 |
| 27                                                   | 10-1-65 | 27                                                   | 10-1-65 |
| 28                                                   | 10-1-65 | 28                                                   | 10-1-65 |
| 29                                                   | 10-1-65 | 29                                                   | 10-1-65 |
| 30                                                   | 10-1-65 | 30                                                   | 10-1-65 |
| 31                                                   | 10-1-65 | 31                                                   | 10-1-65 |
| 32                                                   | 10-1-65 | 32                                                   | 10-1-65 |
| 33                                                   | 10-1-65 | 33                                                   | 10-1-65 |
| 34                                                   | 10-1-65 | 34                                                   | 10-1-65 |
| 35                                                   | 10-1-65 | 35                                                   | 10-1-65 |
| 36                                                   | 10-1-65 | 36                                                   | 10-1-65 |
| 37                                                   | 10-1-65 | 37                                                   | 10-1-65 |
| 38                                                   | 10-1-65 | 38                                                   | 10-1-65 |
| 39                                                   | 10-1-65 | 39                                                   | 10-1-65 |
| 40                                                   | 10-1-65 | 40                                                   | 10-1-65 |
| 41                                                   | 10-1-65 | 41                                                   | 10-1-65 |
| 42                                                   | 10-1-65 | 42                                                   | 10-1-65 |
| 43                                                   | 10-1-65 | 43                                                   | 10-1-65 |
| 44                                                   | 10-1-65 | 44                                                   | 10-1-65 |
| 45                                                   | 10-1-65 | 45                                                   | 10-1-65 |
| 46                                                   | 10-1-65 | 46                                                   | 10-1-65 |
| 47                                                   | 10-1-65 | 47                                                   | 10-1-65 |
| 48                                                   | 10-1-65 | 48                                                   | 10-1-65 |
| 49                                                   | 10-1-65 | 49                                                   | 10-1-65 |
| 50                                                   | 10-1-65 | 50                                                   | 10-1-65 |
| 51                                                   | 10-1-65 | 51                                                   | 10-1-65 |
| 52                                                   | 10-1-65 | 52                                                   | 10-1-65 |
| 53                                                   | 10-1-65 | 53                                                   | 10-1-65 |
| 54                                                   | 10-1-65 | 54                                                   | 10-1-65 |
| 55                                                   | 10-1-65 | 55                                                   | 10-1-65 |
| 56                                                   | 10-1-65 | 56                                                   | 10-1-65 |
| 57                                                   | 10-1-65 | 57                                                   | 10-1-65 |
| 58                                                   | 10-1-65 | 58                                                   | 10-1-65 |
| 59                                                   | 10-1-65 | 59                                                   | 10-1-65 |
| 60                                                   | 10-1-65 | 60                                                   | 10-1-65 |
| 61                                                   | 10-1-65 | 61                                                   | 10-1-65 |
| 62                                                   | 10-1-65 | 62                                                   | 10-1-65 |
| 63                                                   | 10-1-65 | 63                                                   | 10-1-65 |
| 64                                                   | 10-1-65 | 64                                                   | 10-1-65 |
| 65                                                   | 10-1-65 | 65                                                   | 10-1-65 |
| 66                                                   | 10-1-65 | 66                                                   | 10-1-65 |
| 67                                                   | 10-1-65 | 67                                                   | 10-1-65 |
| 68                                                   | 10-1-65 | 68                                                   | 10-1-65 |
| 69                                                   | 10-1-65 | 69                                                   | 10-1-65 |
| 70                                                   | 10-1-65 | 70                                                   | 10-1-65 |
| 71                                                   | 10-1-65 | 71                                                   | 10-1-65 |
| 72                                                   | 10-1-65 | 72                                                   | 10-1-65 |
| 73                                                   | 10-1-65 | 73                                                   | 10-1-65 |
| 74                                                   | 10-1-65 | 74                                                   | 10-1-65 |
| 75                                                   | 10-1-65 | 75                                                   | 10-1-65 |
| 76                                                   | 10-1-65 | 76                                                   | 10-1-65 |
| 77                                                   | 10-1-65 | 77                                                   | 10-1-65 |
| 78                                                   | 10-1-65 | 78                                                   | 10-1-65 |
| 79                                                   | 10-1-65 | 79                                                   | 10-1-65 |
| 80                                                   | 10-1-65 | 80                                                   | 10-1-65 |
| 81                                                   | 10-1-65 | 81                                                   | 10-1-65 |
| 82                                                   | 10-1-65 | 82                                                   | 10-1-65 |
| 83                                                   | 10-1-65 | 83                                                   | 10-1-65 |
| 84                                                   | 10-1-65 | 84                                                   | 10-1-65 |
| 85                                                   | 10-1-65 | 85                                                   | 10-1-65 |
| 86                                                   | 10-1-65 | 86                                                   | 10-1-65 |
| 87                                                   | 10-1-65 | 87                                                   | 10-1-65 |
| 88                                                   | 10-1-65 | 88                                                   | 10-1-65 |
| 89                                                   | 10-1-65 | 89                                                   | 10-1-65 |
| 90                                                   | 10-1-65 | 90                                                   | 10-1-65 |
| 91                                                   | 10-1-65 | 91                                                   | 10-1-65 |
| 92                                                   | 10-1-65 | 92                                                   | 10-1-65 |
| 93                                                   | 10-1-65 | 93                                                   | 10-1-65 |
| 94                                                   | 10-1-65 | 94                                                   | 10-1-65 |
| 95                                                   | 10-1-65 | 95                                                   | 10-1-65 |
| 96                                                   | 10-1-65 | 96                                                   | 10-1-65 |
| 97                                                   | 10-1-65 | 97                                                   | 10-1-65 |
| 98                                                   | 10-1-65 | 98                                                   | 10-1-65 |
| 99                                                   | 10-1-65 | 99                                                   | 10-1-65 |
| 100                                                  | 10-1-65 | 100                                                  | 10-1-65 |

- SELECT FROM VALUES 100 TO 1000.
- RESISTORS ARE 1/2W, 5%. ALL RESISTORS OF 100 OHM OR BELOW ARE 1/4W, 5%.
- CAPACITORS VALUES ARE IN MICROFARADS, ± 10%.
- CAPACITORS C4 AND C5 ARE MOUNTED ON EMU-1 ASSY.

NOTE: UNLESS OTHERWISE SPECIFIED.

The net result of the various improvements has resulted in a video amplifier with a band pass in excess of 10 M Hz, while at the same time keeping the overall phase shift low. This is necessary since the human eye is far more intolerant of phase variation than it is of amplitude variation. The amplifier has been constructed using discrete components, thus allowing for a greater selection of transistor types and predictable characteristics than was available using the transistor chips in MEMA's.

The amplifier has been constructed on two separate circuit boards. The first stage is on one board and the second and third stages are on the second board. The two circuit boards are located in individual cavities located at the top of the camera.

The schematic for the amplifier is shown in Figure IV-2.

#### 4.6 MIXER AND LINE DRIVE CIRCUITS

Along with the video amplifier, the mixer and line drive circuit was redesigned. This was done for several reasons, including:

- a. Better clamping of composite video to the back porch of the horizontal sync pulse.
- b. Improving bandwidth to be compatible with the new video amplifier, and
- c. Better control of the voltage levels to which the sync and blanking pulses are clamped.

In addition, the mixer and line drive amplifiers have been combined into a single circuit. The mixer and line drive circuit uses discrete components and is mounted on a circuit board adjacent to the video amplifier output.

The schematic for this circuit is shown in Figure IV-3.

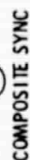


Figure IV-3. Schematic Diagram, Video Mixer & Sync Adder

1

#### 4.7 AGC AMPLIFIER

In order to obtain the necessary dynamic range, an AGC amplifier is used to control the target voltage of the vidicon. The input for this circuit is received from the output of the video amplifier. The circuit takes the peak white video information, rectifies it, and uses this DC voltage for the vidicon target.

The schematic diagram for the AGC amplifier is shown in Figure IV-4.

#### 4.8 BLANKING AND VIDICON PROTECTION CIRCUIT

The blanking and protection circuit has been changed to allow for a cleaner blanking signal to the vidicon resulting in less overshoot in the video signal just prior to and following the horizontal and vertical blanking pulses.

For improved beam current control, the impedance between cathode and ground has been reduced.

The schematic of the Blanking and Video Protection Circuit is shown in Figure IV-5.

#### 4.9 VERTICAL SWEEP GENERATOR

The vertical sweep generator is essentially a Miller with an emitter-follower for rapid discharge of the timing capacitor. This sweep generation stage is followed by a power stage to drive the vertical deflection yoke.

The sweep generator circuit has not changed from the original camera, however, the power stage has been modified to decrease power consumption and increase linearity.

The schematic for the vertical sweep generator is shown in Figure IV-6.

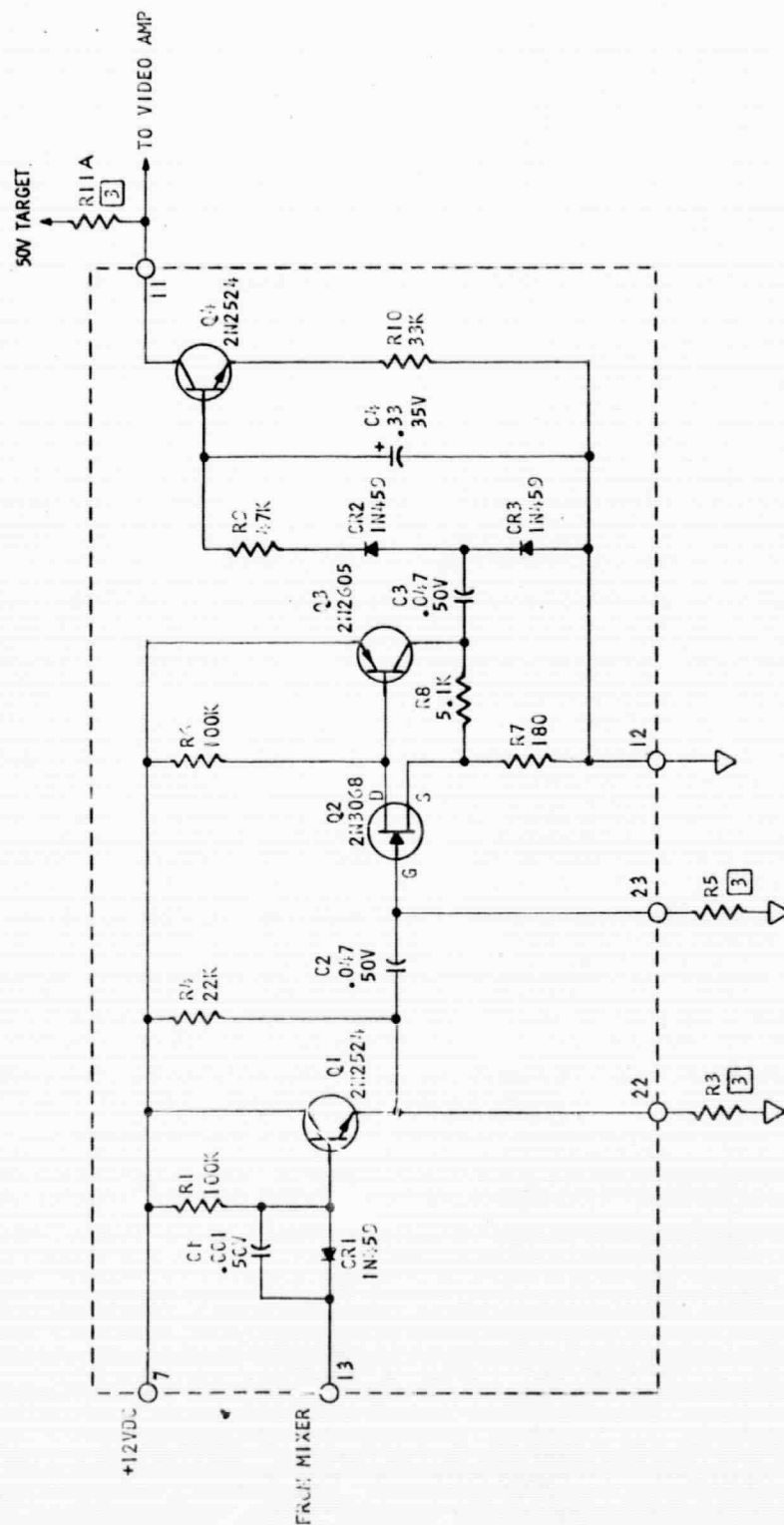


Figure IV-4. Schematic Diagram, AGC Amplifier

[illegible]



Figure IV-5. Schematic Diagram, Blanking Amplifier

1.  $\text{CH}_3\text{COCH}_2\text{CH}_2\text{CH}_3$  1, 3.
2.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$  1, 3, 5, 7, 9.
3.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$  1, 3, 5, 7, 9.



3. ALL TRANSISTORS ARE 2N2524.
2. ALL CAPACITORS ARE  $\pm 10\%$ , 50V.
1. ALL RESISTORS ARE 1% OHMS  $\pm 5\%$ , 1/4 WATT.

---

#### 4.10 HORIZONTAL SWEEP GENERATOR

The horizontal sweep generator uses a constant current source to charge the sweep timing capacitor. This is followed by a power stage with horizontal deflection yoke being transformer coupled to the power stage. This circuit has not been changed from the original camera.

The schematic for the horizontal sweep generator is shown in Figure IV-7.

#### 4.11 TRANSMITTER

The transmitter is in reality an RF modulator circuit. Its input is the output of the mixer and line drive amplifier circuit. The operating frequency of the modulator is 797 MHz corresponding to channel 68. With the exception of the operating frequency, no change has been made in this circuit.

The schematic for the transmitter is shown in Figure IV-8.

#### 4.12 POWER SUPPLY

The power supply is a DC to DC converter. A series regulator is used to regulate the incoming voltage ( $28 \pm 4V$ ) to 21 V DC. This regulated voltage is fed to a pair of chopper transistors.

When the system is first turned on, these transistors oscillate at approximately 6 KHz. After the camera starts to operate, the horizontal sync signal is received by the power supply. This signal is fed into the chopper oscillator in such a way that the oscillator frequency is locked at  $\frac{15.750}{2}$  or 7.875 KHz. By syncing the power supply oscillator in this manner, all power supply switching will be done during the time the vidicon is blanked. Thus, the power supply switching transients do not appear on the video signal.



A 2. ALL CAPACITORS ARE IN MICROFARADS

NOTES : UNLESS OTHERWISE SPECIFIED.

1



88

4

1. ALL RESISTORS ARE IN OHMS  $\pm 5\%$ ,  
1/4 WATT.

NOTES; UNLESS OTHERWISE SPECIFIED.

The transformer outputs are rectified and filtered, then fed to the appropriate regulator circuits. Active filters are used on the low voltage outputs in order to decrease the physical size of the package.

The power consumed by the camera is 13.5 watts at 28 V DC input. The schematic for the power supply is shown in Figure IV-9.

# FOLDOUT FRAME /

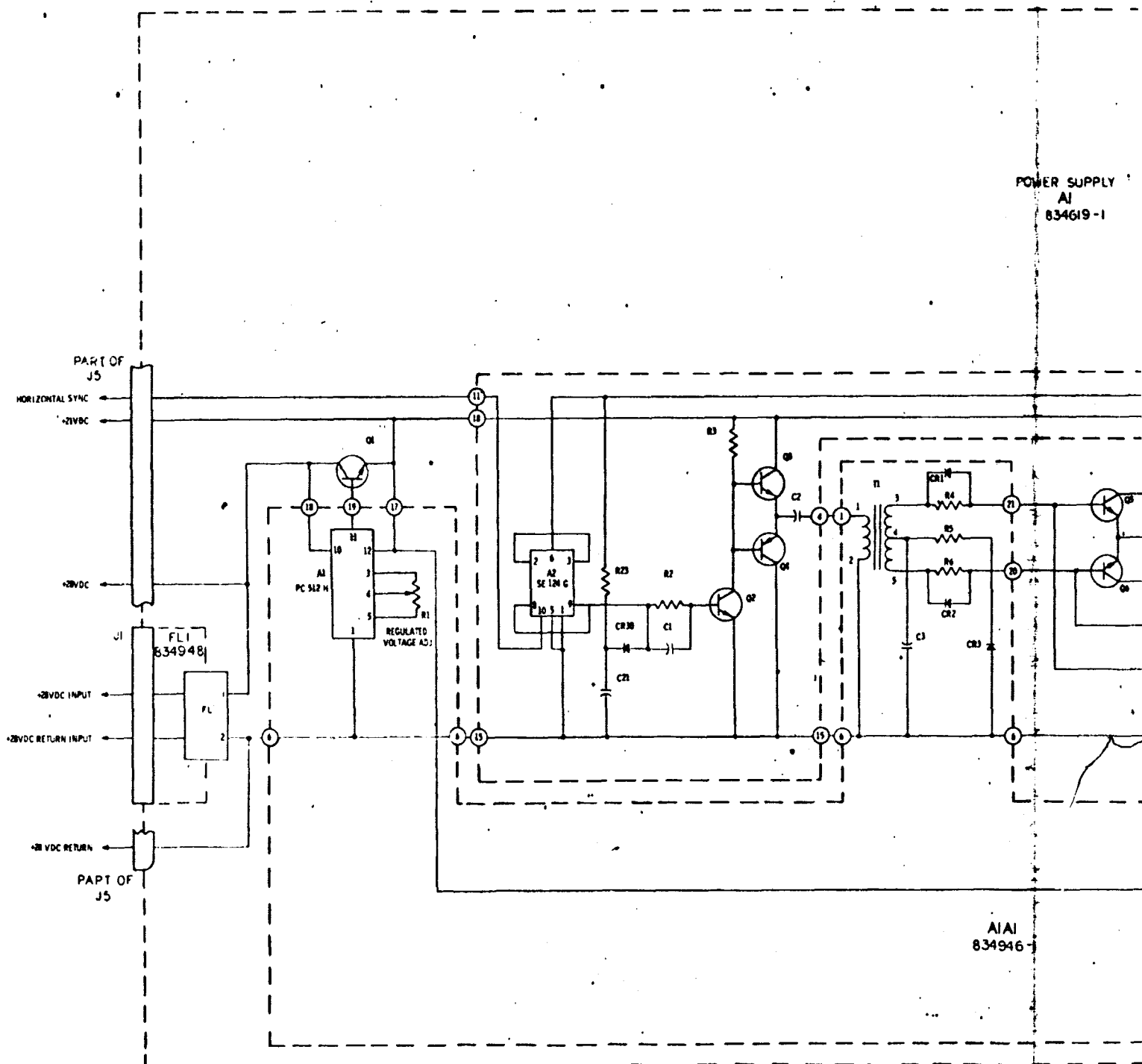
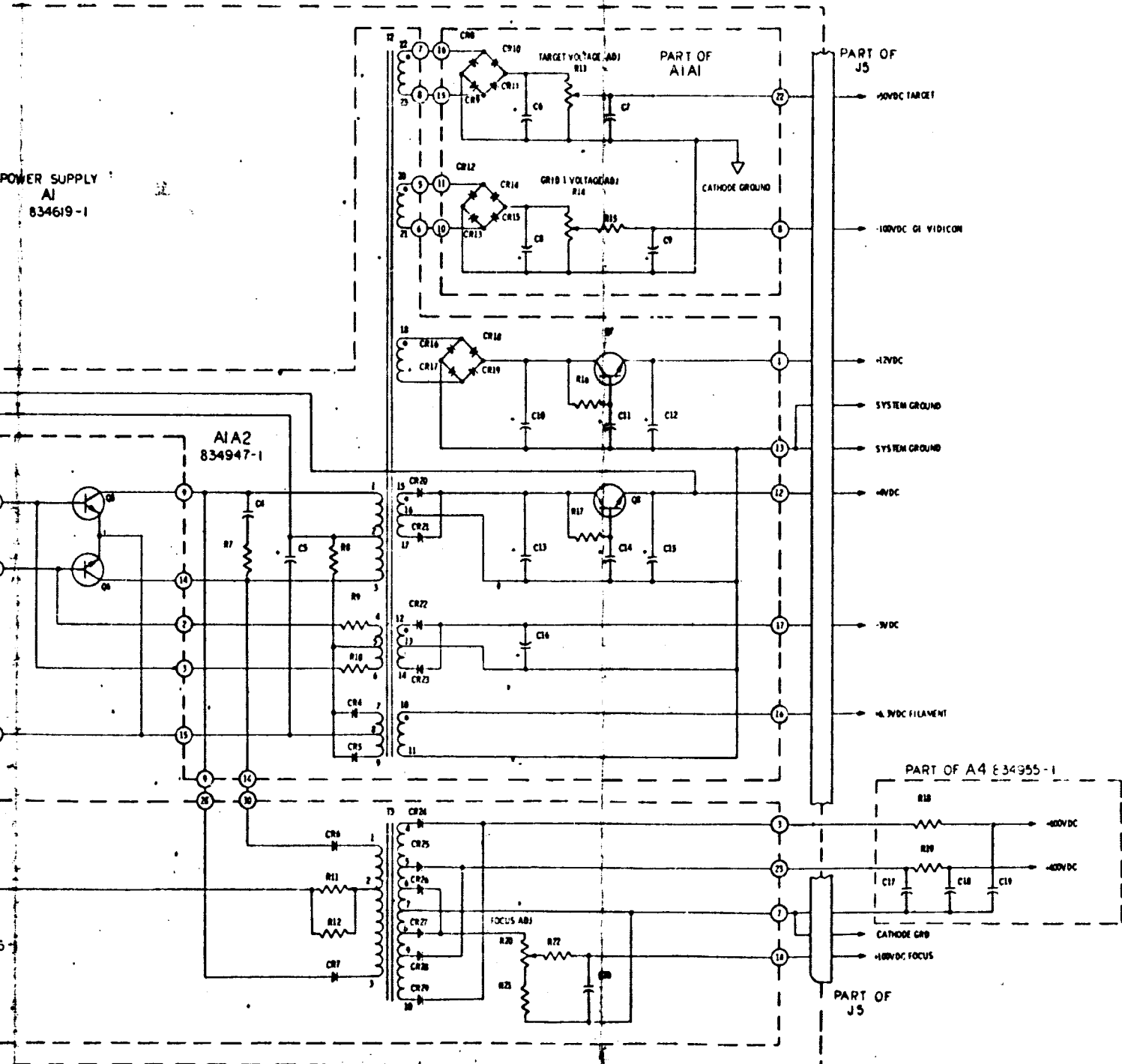


Figure IV-9. Schematic Diagram, Power Supply

FOLDOUT FRAME 2

POWER SUPPLY  
AJ  
834619-1



## SECTION V

### TEST RESULTS

#### 5.0 GENERAL

The following paragraphs give a brief description of the integrity testing performed to date on the camera.

#### 5.1 TEMPERATURE

No formal temperature testing has been made on the camera, however, each circuit, as an individual circuit, has been tested and found to be within specification over the temperature range of  $-60^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$ .

The vidicon tube has not been subjected to the temperature testing.

#### 5.2 VIBRATION

The completed camera was vibrated per paragraph 5.3 of ETP 834600 (a copy of which is included in Appendix A). Briefly, this consisted of vibrating the camera at 2 g's in each of the three principle axes and searching for resonant points with a strobe light. None were found.

The test data reflecting the performed testing is included in Appendix B of this report.

#### 5.3 RFI

Radio Frequency Interference tests were conducted on the completed camera in accordance with the requirements of MIL-I-6181D. The complete procedure used is shown in Paragraph 5.2 of ETP 834600. Briefly, the results are as follows:

- a. Conducted interference on the power leads was made over the range of .15 to 25 MHz.
- b. Conducted interference on the video output cable was made over the range of .15 to 25 MHz.
- c. Radiated tests were made over the range of .15 to 1,000 MHz (with no transmitter disconnected).

In all cases, the camera remained well within specification. Test results are included in Appendix C.

| DASH<br>NO. | APPLICATION |         | REVISIONS |             |      |          |
|-------------|-------------|---------|-----------|-------------|------|----------|
|             | NEXT ASSY   | USED ON | LTR       | DESCRIPTION | DATE | APPROVED |
|             |             |         |           |             |      |          |
|             |             |         |           |             |      |          |
|             |             |         |           |             |      |          |

# ENGINEERING TEST PROCEDURE FOR THE

TELEDYNE SYSTEMS COMPANY

CONTROL SYSTEMS DIVISION

ULTRAMINIATURE MICROEYE TELEVISION CAMERA

PART NUMBER 834600

UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES ON  
.XX DEC. .XXX DEC. ANGLES  
± ± ±

FINISH

RELEASED  
EIN-2884  
3-4-68

|                      |                     |                |
|----------------------|---------------------|----------------|
| DRAFT.               | <i>D.L. Corbett</i> | <i>2/27/68</i> |
| DESIGN               |                     |                |
| CHECK                | <i>E.J. Lufkin</i>  | <i>2/27/68</i> |
| ENGR                 | <i>Bob S.</i>       | <i>2/4/68</i>  |
| PROD.                | <i>B.P. Kean</i>    | <i>2/4/68</i>  |
| TELEDYNE<br>APPROVAL |                     |                |
| OTHER<br>APPROVAL    |                     |                |

TELEDYNE SYSTEMS COMPANY  
CONTROL SYSTEMS DIVISION  
EL SEGUNDO, CALIFORNIA



NOMENCLATURE ENGINEERING TEST PROCEDURE  
ULTRAMINIATURE MICROEYE TELEVISION  
CAMERA CSD PART NUMBER 834600

SIZE  
**A**

CODE IDENT NO.  
**98571**

DRAWING NO.  
ETP 834600

SCALE

WT.

SHEET 1 OF 27



ENGINEERING TEST PROCEDURE  
FOR  
ULTRAMINIATURE MICROEYE TELEVISION CAMERA

1.0 SCOPE

THIS DOCUMENT ESTABLISHES THE PROCEDURES AND SPECIFICATION IN TESTING THE ULTRAMINIATURE MICROEYE TELEVISION CAMERA, PART NUMBER 834600.

2.0 TEST EQUIPMENT INVENTORY

- 2.1 THE TEST EQUIPMENT LISTED BELOW WILL BE REQUIRED TO COMPLETE THE FUNCTIONAL PERFORMANCE AND ENVIRONMENTAL TESTS SPECIFIED IN THIS TEST PROCEDURE. THE EQUIPMENT LISTED MAY BE CHANGED, AT THE DISCRETION OF THE COGNIZANT TEST ENGINEER, WITH EQUAL OR SUPERIOR RATED EQUIPMENT WHEN THE SPECIFIED EQUIPMENT IS NOT READILY AVAILABLE FOR THE PERFORMANCE OF THE TEST.

| ITEM | DESCRIPTION                      | RANGE/ACCURACY                                          | TYPE/MODEL                 | ALTERNATE  |
|------|----------------------------------|---------------------------------------------------------|----------------------------|------------|
| 1    | OSCILLOSCOPE                     | DC-50MHZ/ $\pm 3\%$                                     | TEKTRONIX/<br>453          | EQUIVALENT |
| 2.   | TELEVISION RECEIVER              | N.A./1200 LINES                                         | CONRAC/CFD<br>17           | EQUIVALENT |
| 3.   | TELEVISION RECEIVER              | N.A./INDICA-<br>TION ONLY                               | SONY/TV-<br>500U           | EQUIVALENT |
| 4.   | LIGHT BOX                        | 0-10,000 FT.<br>CANDLES/ UNI-<br>FORMITY= $\pm 5\%$     | TELE-MEASURE-<br>MENT INC. | EQUIVALENT |
| 5.   | LIGHT METER                      | 0-600 FT.<br>CANDLES/                                   | WESTON/756                 | EQUIVALENT |
| 6.   | LIGHT PHOTOMETER<br>(SPOT METER) | 1-10,000,000<br>F/L/ $\pm 5\%$ OF FULL<br>SCALE         | SPECTRA/UB $\frac{1}{2}$   | EQUIVALENT |
| 7.   | SYNC GENERATOR                   | N.A./EQUAL TO<br>OR GREATER THAN<br>E.I.A. RS 170 SPEC. | DAGE/410D                  | EQUIVALENT |

|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 2     |

2.1 (CONTINUED)

| ITEM | DESCRIPTION           | RANGE/ACCURACY                                               | TYPE/MODEL                           | ALTERNATE  |
|------|-----------------------|--------------------------------------------------------------|--------------------------------------|------------|
| 8.   | D.C. POWER SUPPLY     | 0-40VDC/LESS<br>THAN .015% OR<br>1.0 MV                      | LAMBDA/<br>LH124FM                   | EQUIVALENT |
| 9.   | VIBRATION SYSTEM      | 1.0 IN. D.A.<br>-100G $\pm 5\%$ /<br>5-3000 CPS<br>$\pm 1\%$ | UNHOLTZ-DIC-EQUIVALENT<br>KIE/83CD   |            |
| 10.  | FREQUENCY COUNTER     | 0-120KHz/ $\pm 0.01\%$                                       | HEWLETT PAC-EQUIVALENT<br>KARD 521CR |            |
| 11.  | ACCELEROMETER         | 10-5KHz $\pm 1.5\%$                                          | ENDEVCO/<br>2215                     | EQUIVALENT |
| 12.  | VACUUM TUBE VOLTMETER | 1MV-300V $\pm 1\%$                                           | HEWLETT-<br>PACKARD<br>400HR         | EQUIVALENT |
| 13   | D.C. VOLTMETER        | 0-75V/ $\pm 0.25\%$                                          | WESTON/931                           | EQUIVALENT |
| 14   | VARIAC                | 0-140V/N.A.                                                  | SUPERIOR<br>ELEC./F126               | EQUIVALENT |

|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 3     |

2.2 THE ACTUAL TEST EQUIPMENT (NOMENCLATURE, TYPE/MODEL, AND CALIBRATION PERIOD) USED DURING THE PERFORMANCE OF THE TEST SHALL BE RECORDED ON THE APPLICABLE DATA SHEETS.

3.0 STANDARD CONDITIONS

UNLESS OTHERWISE NOTED THE FOLLOWING STANDARD CONDITIONS SHALL BE USED FOR ALL TESTS:

|                          |                     |
|--------------------------|---------------------|
| INPUT POWER:             | 28VDC $\pm$ 0.5 VDC |
| TEMPERATURE:             | ROOM AMBIENT        |
| HUMIDITY:                | ROOM AMBIENT        |
| LIGHT BOX OUTPUT:        | 15 FOOT CANDLES     |
| EXTERNAL SYNC GENERATOR: | NOT CONNECTED       |
| VIBRATION AMPLITUDE:     | $\pm$ 10 PERCENT    |
| VIBRATION FREQUENCY:     | $\pm$ 2 PERCENT     |

4.0 INITIAL SETUP

4.1 BEFORE ATTEMPTING TO OPERATE THE CAMERA, INSPECT THE EQUIPMENT FOR THE FOLLOWING:

- A. VISUALLY INSPECT THE CAMERA FOR OBVIOUS DEFECTS SUCH AS DAMAGED ELECTRICAL CONNECTORS OR DEFORMED COVERS.
- B. INSPECT THE ELECTRICAL CONNECTORS. REMOVE ANY DIRT OR OTHER PARTICLES WITH A CLEAN, DRY BRISTLE BRUSH.

4.2 EQUIPMENT SET-UP

4.2.1 CONNECT THE CAMERA AS SHOWN IN FIGURE 1. POWER RETURN AND CHASSIS GROUND SHALL BE CONNECTED AT THE 28V POWER SUPPLY.

CAUTION: THE CAMERA MAY BE DAMAGED IF THE POWER SOURCE POLARITY IS REVERSED OR THE VIDEO CABLE IS SHORTED.

|       |                |             |  |
|-------|----------------|-------------|--|
| SIZE  | CODE IDENT NO. | DRAWING NO. |  |
| A     | 98571          | ETP 834600  |  |
| SCALE |                | SHEET 4     |  |

4.2.2 MONITOR SETTINGS - SET THE MONITOR FOR:

- A. REDUCED PICTURE SIZE
- B. IMPEDANCE: 75 OHMS
- C. SYNC: INTERNAL
- D. DC RESTORATION: IN

4.3 INITIAL TURN-ON

- 4.3.1 APPLY 28VDC POWER. THE CAMERA WILL REQUIRE APPROXIMATELY 30 SECONDS FOR WARM-UP. DURING OPERATION, THE CAMERA SHOULD DRAW APPROXIMATELY 0.5 AMPS.

CAUTION: DO NOT AIM THE CAMERA AT BRIGHT LIGHTS OR THE SUN AS THIS CAN PERMANENTLY DAMAGE THE VIDICON TUBE.

- 4.3.2 REMOVE THE LENS CAP AND SET THE F STOP TO F1:1.9.

- 4.3.3 SET THE DISTANCE TO THE TEST CHART AS FOLLOWS:

MOVE THE TEST CHART BACK AND FORTH UNTIL THE EDGES OF THE CHART COINCIDE WITH THE EDGES OF THE CAMERA SWEEP AS SEEN ON THE MONITOR. THE DISTANCE FROM THE LENS TO THE TEST CHART SHOULD BE APPROXIMATELY 14 INCHES FOR A 13 MM LENS.

- 4.3.4 FOCUS THE LENS FOR THE BEST PICTURE.

CAUTION: DO NOT CONTINUALLY FOCUS THE CAMERA ON ONE SCENE FOR LONG PERIODS OF TIME; THIS IS TO AVOID BURN IN OF THE SCENE ON THE VIDICON FACE PLATE.

- 4.3.5 REMOVE POWER AND REPLACE THE LENS CAP WHEN THE CAMERA IS NOT IN USE.

|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 5     |

5.0 TESTING .

5.1 BENCH TESTS

5.1.1 RESOLUTION - MEASURE AND RECORD THE HORIZONTAL AND VERTICAL RESOLUTION AS DESCRIBED IN PARAGRAPH 6.1. THE LIMITS SHALL BE AS SPECIFIED THEREIN.

5.1.1.1 LOW LIGHT RESOLUTION - SET THE LIGHT BOX FOR ONE FOOT CANDLE SCENE ILLUMINATION. MEASURE AND RECORD THE HORIZONTAL AND VERTICAL RESOLUTION AS DESCRIBED IN PARAGRAPH 6.1. THE MINIMUM LIMIT FOR BOTH HORIZONTAL AND VERTICAL RESOLUTION SHALL BE 275 LINES WHEN MEASURED AT THE CENTER OF THE PICTURE.

5.1.2 SHADING - MEASURE AND RECORD THE SHADING CHARACTERISTICS AS DESCRIBED IN PARAGRAPH 6.2. THE LIMITS SHALL BE AS SPECIFIED THEREIN.

5.1.3 NOISE TEST - MEASURE AND RECORD THE VIDEO NOISE AS DESCRIBED IN PARAGRAPH 6.3. THE LIMITS SHALL BE AS SPECIFIED THEREIN.

5.1.4 SYNC TEST - MEASURE AND RECORD THE RESULTS OF THE SYNC TEST AS DESCRIBED IN PARAGRAPH 6.4. THE LIMITS SHALL BE AS SPECIFIED THEREIN.

|       |                |             |  |
|-------|----------------|-------------|--|
| SIZE  | CODE IDENT NO. | DRAWING NO. |  |
| A     | 98571          | ETP 834600  |  |
| SCALE |                | SHEET 6     |  |

## 5.2

RADIO FREQUENCY INTERFERENCE

## 5.2.1

SCOPE OF TEST PLAN - THE PROCEDURES OF THIS TEST PLAN HAVE BEEN PREPARED WITH THE INTENT THAT THEY DESCRIBE THE RADIO FREQUENCY INTERFERENCE TESTS REQUIRED BY MILITARY SPECIFICATION MIL-I-6181D, TO BE PERFORMED ON THE TEST SPECIMEN. THE RESULTS OF THESE TESTS WILL INDICATE COMPLIANCE OR NON-COMPLIANCE TO THE AFOREMENTIONED REQUIREMENTS.

ITEMS DISCUSSED ARE:

1. ELECTROMAGNETIC INTERFERENCE TEST PROCEDURES AND TEST SETUP.
2. MODE OF TEST SPECIMEN OPERATION
3. POINTS TO BE MONITORED FOR CONDUCTED INTERFERENCE

## 5.2.2

REQUIRED TESTS AND LIMITS - THE ULTRAMINIATURE MICROEYE TELEVISION CAMERA WILL BE SUBJECTED TO THE FOLLOWING APPLICABLE TESTS AS REQUIRED BY MILITARY SPECIFICATION MIL-I-6181D. A CROSS REFERENCE OF THE APPROPRIATE PARAGRAPH OF THE TEST PLAN IS INCLUDED FOR THE CONVENIENCE OF THE READER.

NOTE: THE ULTRAMINIATURE MICROEYE TELEVISION CAMERA WILL HEREAFTER BE REFERRED TO AS THE TEST SPECIMEN.

| TEST                                               | MIL-I-6181D<br>PARAGRAPH | CSD TEST PLAN<br>PARAGRAPH |
|----------------------------------------------------|--------------------------|----------------------------|
| A. CONDUCTED INTERFERENCE                          | 4.3.1                    | 5.2.8.2                    |
| 1. USING STABILIZATION<br>NETWORK ON POWER LINES   | 4.3.1.1                  | 5.2.8.2.1                  |
| 2. USING CURRENT PROBE ON<br>INTERCONNECTING LEADS | 4.3.1.3                  | 5.2.8.2.2                  |
| B. RADIATED EMISSION                               | 4.3.2                    | 5.2.8.3                    |
| 1. MEASURED AT ONE FOOT                            |                          |                            |

## 5.2.3

TEST EQUIPMENT - THE FOLLOWING TEST EQUIPMENT WILL BE REQUIRED TO CONDUCT THE RADIO INTER-FERENCE TEST.

|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 7     |

5.2.3.1

CSD FURNISHED TEST EQUIPMENT

| <u>EQUIPMENT</u>    | <u>TYPE</u> | <u>MANUFACTURER</u> |
|---------------------|-------------|---------------------|
| TELEVISION RECEIVER | TV-500U     | SONY                |
| DC POWER SUPPLY     | LH124FM     | LAMBDA              |
| DC VOLTMETER        | 931         | WESTON              |

5.2.3.2

OUTSIDE TESTING FACILITY INSTRUMENTATION - ALL INTERFERENCE MEASURING INSTRUMENTS, THEIR ACCESSORIES AND ANTENNAS TO BE USED FOR THE RADIO INTERFERENCE TESTS, SHALL BE APPROVED CATEGORY "A" INSTRUMENTS. ALL INSTRUMENTS WILL BE USED IN ACCORDANCE WITH THE SUBJECT SPECIFICATION AND THE MANUFACTURER'S RECOMMENDATIONS.

5.2.3.2.1

INTERFERENCE MEASURING INSTRUMENTS - THE FOLLOWING INTERFERENCE MEASURING INSTRUMENTS ARE REQUIRED FOR USE:

| <u>FREQUENCY RANGE</u> | <u>COMMERCIAL NOMENCLATURE</u> | <u>MANUFACTURER</u> |
|------------------------|--------------------------------|---------------------|
| 0.15 TO 25 MC          | NM-20A, B                      | STODDART            |
| 20 TO 400 MC           | NM-30A                         | STODDART            |
| 375 TO 1000 MC         | NM-50A                         | STODDART            |

5.2.3.2.2

GENERAL INSTRUMENTATION

STODDART 91221-1 LINE INPEDANCE STABILIZATION NETWORK. TWO REQUIRED.

STODDART 91550-1 RF CURRENT PROBE.

5.2.3.3

INSTRUMENTATION - THE ABOVE LISTED EQUIPMENT WILL BE USED UNLESS AVAILABILITY DEEMS IT NECESSARY TO USE AN EQUIVALENT SUBSTITUTE.

|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE | SHEET 8        |             |

5.2.3.4

CALIBRATION PROCEDURE - ALL MEASUREMENTS SHALL BE MADE WITH INSTRUMENTS AND TEST EQUIPMENT WHOSE ACCURACY AND/OR CALIBRATION HAS BEEN VERIFIED PERIODICALLY UNDER THE SUPERVISION OF CSD QUALITY CONTROL POLICY AND PROCEDURES WHICH MEET THE REQUIREMENTS OF MIL-Q-9858 AND MIL-C-45662A. THIS CALIBRATION PROCEDURE APPLIES TO CSD EQUIPMENT ONLY. EQUIPMENT UTILIZED AT APPROVED LABORATORIES (OTHER THAN CSD) SHALL MEET THE CALIBRATION REQUIREMENTS OF MIL-C-45662A.

5.2.3.5

OPERATION OF INSTRUMENTS - ALL INTERFERENCE MEASURING INSTRUMENTS INVOLVED IN THESE TESTS SHALL BE OPERATED (AND CALIBRATED) IN ACCORDANCE WITH THE SUBJECT SPECIFICATION AND MANUFACTURER'S RECOMMENDATIONS. IN THE EVENT OF CONFLICT, THE LATTER SHALL TAKE PRECEDENCE. THE INSTRUMENTS SHALL BE OPERATED IN THE "PEAK" DETECTOR MODE WHEN MONITORING BROADBAND IMPULSIVE INTERFERENCE OR PULSED CW INTERFERENCE AND IN THE FIELD INTENSITY OR CARRIER FUNCTION FOR NARROWBAND (CS) INTERFERENCE SIGNALS. ALL INSTRUMENTATION SHALL BE OPERATED IN ACCORDANCE WITH GOOD ENGINEERING PRACTICES.

5.2.3.5.1

MONITORING - THE INTERFERENCE MEASURING INSTRUMENT SHALL BE MONITORED WITH A HEADSET, LOUDSPEAKER, OSCILLOSCOPE, OR OTHER INDICATING DEVICES, DURING ALL MEASUREMENTS. PRECAUTION SHALL BE TAKEN TO ENSURE THAT THE MONITORING DOES NOT INFLUENCE THE METER READING ON THE INTERFERENCE MEASURING EQUIPMENT.

5.2.3.5.2

PEAK FUNCTION MONITORING - WHEN MAKING "PEAK DETECTOR FUNCTION" READINGS ON INTERFERENCE WHICH IS STEADY IN THE SENSE THAT THERE IS NO FUNCTIONAL REASON FOR IT TO VARY WITH TIME, THE INTERFERENCE METER OUTPUT SHALL BE OBSERVED FOR AT LEAST TEN SECONDS AT THE SLIDE-BACK SETTING TO BE RECORDED AND THERE SHALL BE NO DETECTABLE OUTPUT WITHIN THAT TIME.

|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 9     |

5.2.4

TEST FACILITY

5.2.4.1

SHIELDED ENCLOSURE - A SHIELDED ENCLOSURE WILL BE USED AS THE TEST FACILITY FOR THE TESTS OF THIS TEST PLAN. THE AMBIENT INTERFERENCE LEVELS INSIDE THE SHIELDED ENCLOSURE SHALL BE 6 DB BELOW THE APPLICABLE SPECIFIED INTERFERENCE LIMIT WHEN MEASURED WITH THE APPROPRIATE RI-FI METER. HOWEVER, IN THE EVENT THAT AT THE TIME OF MEASUREMENT, THE LEVELS OF AMBIENT INTERFERENCE PLUS TEST ITEM INTERFERENCE ARE NOT ABOVE THE SPECIFIED LIMIT, THE TESTED ITEM SHALL BE CONSIDERED TO HAVE MET THE SPECIFIED REQUIREMENTS. THIS REQUIREMENT SHALL APPLY EQUALLY TO BOTH RADIATED AND CONDUCTED AMBIENT INTERFERENCE LEVELS. THE MINIMUM LENGTH OF THE SHIELDED ENCLOSURE SHALL BE SUCH THAT A 35 MC TUNED DIPOLE CAN BE PLACED IN THE ROOM WITH AT LEASE 12 INCHES CLEARANCE BETWEEN THE ANTENNA EXTREMITIES AND THE SHIELDED ENCLOSURE.

5.2.4.2

GROUND PLANE - A COPPER OR BRASS GROUND PLANE, 0.01 INCH THICK MINIMUM FOR COPPER, 0.025 INCH THICK MINIMUM FOR BRASS, 12 SQUARE FEET OR MORE IN AREA WITH A MINIMUM WIDTH OF 30 INCHES SHALL BE USED. IN A SCREEN ROOM, THE GROUND PLANE SHALL BE BONDED TO THE SHIELDED ROOM AT INTERVALS NO GREATER THAN 3 FEET AND AT BOTH ENDS OF THE GROUND PLANE.

5.2.4.3

BONDING MEASURING INSTRUMENT - INTERFERENCE MEASURING INSTRUMENTS UTILIZING DIPOLE ANTENNAS SHALL BE BONDED TO THE GROUND PLANE OR SHIELDED ENCLOSURE WITH THE GROUND CLIP ON THE POWER CORD. INSTRUMENTS USED FOR CONDUCTED MEASUREMENTS SHALL NOT BE BONDED TO THE GROUND PLANE EXCEPT THROUGH THE INTERCONNECTING COAXIAL CABLE.

5.2.4.3.1

THE COUNTERPOISE ON ROD ANTENNAS SHALL BE BONDED TO THE GROUND PLANE WITH A STRAP OF SUCH LENGTH THAT THE ROD ANTENNA CAN BE POSITIONED CORRECTLY. THE STRAP SHALL BE AS WIDE AS THE COUNTERPOISE. THIS APPLIES TO ROD ANTENNAS UTILIZING THE INTERFERENCE MEASURING INSTRUMENT AS A COUNTERPOISE, AND TO ROD ANTENNAS MOUNTED ON A SEPARATE COUNTERPOISE.

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|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 10    |

5.2.4.3.2

THE INTERFERENCE MEASURING INSTRUMENTS SHALL BE PHYSICALLY GROUNDED WITH ONLY ONE CONNECTION. IF THE COPPER STRAP IS USED, NEITHER THE GROUND CLIP, THE GROUND TERMINALS, NOR THE POWER SUPPLY SHALL BE CONNECTED TO GROUND.

5.2.5

TEST CONDITIONS - UNLESS OTHERWISE SPECIFIED IN THE TEST METHODS, ALL TESTS SHALL BE CONDUCTED UNDER THE FOLLOWING CONDITIONS AND TOLERANCES.

5.2.5.1

AMBIENT CONDITIONS - THE ATMOSPHERIC PRESSURE SHALL BE BETWEEN 28 TO 32 INCHES OF MERCURY, WITH A TEMPERATURE OF BETWEEN +15°C AND +35°C, AND A RELATIVE HUMIDITY OF NOT MORE THAN 90 PER CENT. WHERE TESTS ARE PERFORMED WITH AMBIENT CONDITIONS SUBSTANTIALLY DIFFERENT FROM THE SPECIFIED VALUES, PROPER ALLOWANCES FOR CHANGES IN INSTRUMENT READINGS SHALL BE MADE TO COMPENSATE FOR THE DEVIATIONS FROM SPECIFIED CONDITIONS.

5.2.5.2

INPUT VOLTAGE - THE FOLLOWING INPUT VOLTAGE SHALL BE APPLIED CONTINUOUSLY TO THE TEST SPECIMEN, THROUGH FILTERED OUTLETS IN THE SHIELDED ENCLOSURE.

D.C. POWER      28  $\pm$  0.5 VDC

5.2.6

TEST SETUP

5.2.6.1

TEST SPECIMEN TEST SETUP - THE GENERAL ARRANGEMENT AND OPERATION OF THE TEST SPECIMEN WILL BE SUCH AS TO SIMULATE ACTUAL INSTALLATION AND USAGE INSOFAR AS PRACTICABLE. THE TEST SPECIMEN WILL BE SET UP ON THE GROUND PLANE IN THE SHIELDED ENCLOSURE FOR NORMAL OPERATION PER INSTRUCTIONS AS OUTLINED IN PARAGRAPH 5.2.7. THE TEST SPECIMEN SHALL BE LOCATED 24  $\pm$  1 INCH FROM THE POWER LINE STABILIZATION NETWORKS. SEE THE TEST SETUP SHOWN IN FIGURE 3.

5.2.6.2

TEST SPECIMEN LEADS - THE TEST SPECIMEN LEADS TO THE POWER STABILIZATION NETWORK SHALL BE 24 INCHES  $\pm$  1 INCH IN LENGTH AND SHALL BE SO ARRANGED THAT THE DISTANCE BETWEEN THE LEADS AND FROM EACH LEAD TO GROUND OR GROUNDED ENCLOSURE IS APPROXIMATELY 2 INCHES.

THE TEST CABLE FROM THE TEST SPECIMEN TO THE TELEVISION RECEIVER SHALL BE 8 FEET LONG.

|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 11    |

5.2.7 TEST SPECIMEN MODE OF OPERATION - THE TESTS WILL BE PERFORMED FOR ONE MODE OF OPERATION WITH THE TEST SPECIMEN INPUT ELECTRICAL POWER CONTINUOUSLY APPLIED AS SPECIFIED IN PARAGRAPH 5.2.5.2.

5.2.8 TEST METHODS

5.2.8.1 FREQUENCY SELECTION - THE INTERFERENCE MEASURING EQUIPMENT WILL BE SLOWLY SCANNED THROUGH EACH CONTINUOUS TUNING BAND. THE FREQUENCIES AT WHICH MAXIMUM INTERFERENCE IS OBSERVED WILL BE SELECTED AS THE TEST FREQUENCIES. IN THE EVENT THAT NO PEAKING OF BROADBAND INTERFERENCE IS OBSERVED, THEN A MINIMUM OF THREE FREQUENCIES PER OCTAVE WILL BE SELECTED AT RANDOM AS THE TEST FREQUENCIES.

5.2.8.2 CONDUCTED INTERFERENCE - INTERFERENCE VOLTAGE, IN THE FREQUENCY RANGE OF 150KC TO 25 MC, GENERATED BY THE TEST SPECIMEN, SHALL NOT EXCEED THE VALUES INDICATED IN MILITARY SPECIFICATION MIL-I-6181D, FIGURES 8 AND 10, DURING THE OPERATIONAL MODE OUTLINED IN PARAGRAPH 5.2.7 OF THIS TEST PROCEDURE. SEE THE TEST SETUP SHOWN IN FIGURE 3. (REFERENCE FIGURES 11 AND 12 OF MILITARY SPECIFICATION MIL-I-6181D).

5.2.8.2.1 CONDUCTED INTERFERENCE USING LINE STABILIZATION NETWORK - CONDUCTED INTERFERENCE MEASUREMENTS ON THE 28 VDC INPUT POWER LEADS SHALL BE MADE BY CONNECTING THE INTERFERENCE MEASURING INSTRUMENT TO THE NOISE METER TERMINAL ON THE LINE STABILIZATION NETWORK WITH A LENGTH OF 50 OHM DOUBLE-SHIELD COAXIAL CABLE. A COAXIAL RF SWITCH CAN BE USED TO SPEED UP THE MEASUREMENTS ON THESE LINES.

5.2.8.2.2 CONDUCTED INTERFERENCE USING CURRENT PROBE - CONDUCTED INTERFERENCE MEASUREMENTS WILL BE PERFORMED ON THE INTERCONNECTING TEST CABLE FROM THE TEST SPECIMEN TO THE TELEVISION RECEIVER USING THE CLAMP-ON CURRENT PROBE TECHNIQUE.

NOTE: THE CURRENT PROBE SHALL BE POSITIONED AT THE POINT OF MAXIMUM INTERFERENCE ON THE TEST CABLE. THIS MAXIMUM INTERFERENCE POINT SHALL BE LOCATED AT EACH TEST FREQUENCY. THE LOCATION OF THE CURRENT PROBE SHALL BE FULLY DESCRIBED IN THE TEST REPORT.

|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 12    |

5.2.8.3

RADIATED INTERFERENCE - RADIATED INTERFERENCE FIELDS IN EXCESS OF THE VALUES GIVEN IN FIGURE 16 OF MILITARY SPECIFICATION MIL-I-6181D, SHALL NOT RADIATE FROM THE TEST SPECIMEN OR TEST CABLE OVER THE FREQUENCY RANGE OF 0.015 TO 1000 MC FOR BROADBOARD IMPULSIVE INTERFERENCE DURING THE OPERATIONAL MODE OUTLINED IN PARAGRAPH 5.2.7 OF THIS TEST PROCEDURE. TEST SETUPS ARE SHOWN IN FIGURES 4 AND 5. (REFERENCE FIGURES 3 AND 5 OF MILITARY SPECIFICATION MIL-I-6181D.)

THE FOLLOWING ANTENNAS WILL BE USED:

- A) FROM 150KC TO 25 MCS, A 41-INCH VERTICAL ROD ANTENNA MOUNTED ON THE INTERFERENCE MEASURING INSTRUMENT.
- B) FROM 25 MCS TO 35 MCS, A DIPOLE ANTENNA TUNED TO 35 MCS.
- C) FROM 35 MCS TO 1000 MCS, A DIPOLE ANTENNA RESONANT AT THE FREQUENCY TO WHICH THE INTERFERENCE METER IS TUNED.

NOTE: THE ROD AND DIPOLE ANTENNAS WILL BE LOCATED AT A POINT ONE (1) FOOT FROM THE NEAREST PERIPHERY OF THE TEST SPECIMEN AND AT THE POINT OF MAXIMUM INTERFERENCE RECEPTION.

5.2.9

TEST REPORT - THE TEST REPORT SHALL BE A SHORT FORM LETTER TYPE REPORT INCLUDING ALL TEST DATA RECORDED AND REDUCED.

|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 13    |

5.3 VIBRATION

5.3.1 REQUIREMENTS - THE TEST SPECIMEN SHALL BE SUBJECTED TO SINUSOIDAL VIBRATION IN EACH OF THREE MUTUALLY PERPENDICULAR AXES. VIBRATION IN EACH AXIS SHALL CONSIST OF ONE 15 MINUTE SWEEP FROM 5 TO 500 TO 5 Hz AT AN APPLIED AMPLITUDE OF 0.1 INCH, AN APPLIED ACCELERATION OF 2.0 G'S, WHICHEVER IS THE LOWER VALUE. THE RATE OF CHANGE OF FREQUENCY SHALL BE LOGARITHMIC.

5.3.2 TEST EQUIPMENT - THE FOLLOWING TEST EQUIPMENT WILL BE REQUIRED TO CONDUCT THE VIBRATION TEST:

| <u>TYPE</u>           | <u>MODEL</u> | <u>MANUFACTURER</u> |
|-----------------------|--------------|---------------------|
| VIBRATION TABLE       | 83-CD        | UNHOLTZ-DICKIE      |
| ACCELEROMETER         | 2215         | ENDEVCO             |
| ELECTRONIC COUNTER    | 521C         | HEWLETT-PACKARD     |
| VACUUM TUBE VOLTMETER | 400H         | HEWLETT-PACKARD     |
| DC POWER SUPPLY       | LH124FM      | LAMBDA              |
| DC VOLTMETER          | 931          | WESTON              |
| TELEVISION RECEIVER   | CFD 17       | CONRAC              |
| OSCILLOSCOPE          | 453          | TEKTRONIX           |

5.3.3 TEST SETUP

5.3.3.1 MOUNTING - THE TEST SPECIMEN SHALL BE SECURELY ATTACHED TO THE VIBRATION TABLE USING THE NORMAL MOUNTING ATTACHMENT POINTS.

5.3.3.2 ACCELEROMETER - THE VIBRATION INPUT ACCELEROMETER SHALL BE ATTACHED TO THE VIBRATION TABLE AT A POINT AS CLOSE AS PRACTICABLE TO ONE OF THE TEST SPECIMEN ATTACHMENT POINTS.

|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 14    |

5.3.4 TEST METHOD

5.3.4.1 MODE OF OPERATION AND LOADING - THE TEST SPECIMEN SHALL BE CONTINUOUSLY OPERATED AT AN INPUT VOLTAGE OF  $28 \pm 0.5$  VDC. THE TEST SPECIMEN SHALL BE LOADED WITH THE TELEVISION RECEIVER AND MONITORED WITH THE OSCILLOSCOPE DURING THE VIBRATION TEST. REFER TO FIGURE 1 FOR TEST SETUP.

5.3.4.2 CYCLING - THE TEST SPECIMEN SHALL BE SUBJECTED TO SINUSOIDAL VIBRATION IN EACH OF THREE MUTUALLY PERPENDICULAR AXES. CYCLING IN EACH AXIS SHALL CONSIST OF ONE 15 MINUTE SWEEP FROM 5 TO 500 TO 5 Hz AT AN APPLIED AMPLITUDE OF 0.1 INCH DOUBLE AMPLITUDE FROM 5 TO 20 Hz AND 2.0 G'S FROM 20 TO 500 Hz. THE RATE OF CHANGE OF FREQUENCY SHALL BE LOGARITHMIC.

5.3.5 DATA REQUIREMENTS - ALL SPECIFIED TEST DATA SHALL BE RECORDED ON THE VIBRATION TEST DATA SHEET.

5.3.6 FAILURE CRITERIA - ANY MECHANICAL DETERIORATION, RECEIVER IMAGE DETERIORATION, OR VIDEO SIGNAL DETERIORATION DURING OR AS A RESULT OF VIBRATION, SHALL BE CONSIDERED CAUSE FOR REJECTION.

NOTE: A SLIGHT DEGRADATION IS EXPECTED DUE TO THE RELATIVE DISPLACEMENT OF THE CAMERA AND LIGHT BOX CHART. THIS IS NOT TO BE CONSIDERED CAUSE FOR REJECTION.

|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 15    |

6.0

NOTES

UNLESS OTHERWISE SPECIFIED, THE CAMERA SHALL BE SET UP AS OUTLINED IN PARAGRAPH 4.3 AND THE DISTANCE FROM THE CAMERA TO THE TEST CHART SHALL BE AS SPECIFIED IN PARAGRAPH 4.3.3.

6.1

RESOLUTION TESTS

6.1.1

HORIZONTAL RESOLUTION - TO READ THE CAMERA'S HORIZONTAL RESOLUTION, OBSERVE THE VERTICAL WEDGES ON THE TEST CHART NEAR THE CENTER OF THE PICTURE. THE RESOLUTION SHALL BE DEFINED AS THE POINT ON THE WEDGES WHERE THE BLACK AND WHITE BARS MERGE TOGETHER AND SHALL BE EXPRESSED IN A NUMBER OF LINES. NOTE THAT THERE MAY BE A SLIGHT VARIATION IN READINGS TAKEN BY DIFFERENT PERSONNEL. FOR A GIVEN SERIES OF TESTS THE READING SHOULD BE TAKEN IN AS NEAR A CONSISTANT MANNER AS IS POSSIBLE. WHEN MEASURING CORNER RESOLUTION THE CAMERA SHOULD BE POINTED (OR THE TEST CHART MOVED) SO THAT THE WEDGES IN THE CENTER OF THE CHART ARE USED TO MEASURE THE CORNER RESOLUTION.

|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE | SHEET 16       |             |

6.1.1.1 HORIZONTAL RESOLUTION - ALTERNATE METHOD -

- A. SET THE OSCILLOSCOPE UP FOR DELAYED SWEEP USING THE VERTICAL SYNC PULSE AS A TRIGGER AND OBSERVE ONE HORIZONTAL LINE.
- B. OBSERVE A BLACK TO WHITE PORTION OF A TEST PATTERN OF SUFFICIENTLY LOW NUMBER OF LINES SO THAT THE RESULTANT VIDEO SIGNAL HAS A SQUARE WAVE CHARACTERISTIC. SET THE VERTICAL GAIN ON THE OSCILLOSCOPE SO THAT THIS SIGNAL REPRESENTS A 100% AMPLITUDE SIGNAL.
- C. OBSERVE THE SIGNAL FROM THE VERTICAL WEDGES. FIND THE VIDEO SIGNAL RESULTING FROM THESE WEDGES EQUIVALENT TO A 10% AMPLITUDE (RELATIVE TO PARAGRAPH B ABOVE). THIS SHALL REPRESENT THE HORIZONTAL RESOLUTION. THE LOCATION ON THE CHART OF THE OBSERVED VIDEO SIGNAL MAY BE DETERMINED BY MOVING A PENCIL POINT OR OTHER POINTER ALONGSIDE THE WEDGES OF THE CHART AND OBSERVING WHEN THE POINTER'S VIDEO SIGNAL IS ALONGSIDE THE 10% AMPLITUDE WEDGE SIGNAL. THE HORIZONTAL RESOLUTION MAY THEN BE READ FROM THE POINTER'S POSITION.

6.1.2 VERTICAL RESOLUTION - TO READ THE CAMERA'S VERTICAL RESOLUTION, OBSERVE THE HORIZONTAL WEDGES NEAR THE CENTER OF THE PICTURE. THE SAME COMMENTS APPLY TO READING THE VERTICAL RESOLUTION AS APPLIED TO READING HORIZONTAL RESOLUTION IN PARAGRAPH 6.1.2. HOWEVER, NO ALTERNATE METHOD SHOULD BE USED FOR MEASURING VERTICAL RESOLUTION.

6.1.3 SPECIFICATION LIMITS - UNLESS OTHERWISE SPECIFIED, THE HORIZONTAL AND VERTICAL RESOLUTION OF THE CAMERA SHALL BE:

- A. HORIZONTAL RESOLUTION - CENTER: 450 LINES  
- EDGES : 375 LINES
- B. VERTICAL RESOLUTION - CENTER: 350 LINES

|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 17    |

## 6.2

SHADING TEST

- A. REMOVE THE TEST CHART FROM THE LIGHT BOX. SET THE LIGHT BOX FOR 15 FOOT CANDLES. WITH THE SPOT METER MEASURE THE UNIFORMITY OF LIGHT ACROSS THE BOX. IF THE EDGES OF THE BOX VARY IN LIGHT OUTPUT MORE THAN  $\pm 10\%$  FROM THE CENTER LIGHTING, THEN A CORRECTION FACTOR MUST BE ADDED TO THE READINGS OF THE FOLLOWING PARAGRAPH. ALTERNATELY THE CAMERA OR LIGHT BOX MAY BE MOVED SO THAT ALL READINGS ARE BASED ON LIGHT OUTPUT FROM THE CENTER OF THE BOX.
- B. WITH NO SIGNAL INTO THE MONITOR, TURN UP THE BRIGHTNESS CONTROL UNTIL THE SCREEN IS ILLUMINATED. MEASURE AND RECORD THE BRIGHTNESS OF THE SCREEN AT THE CENTER AND EDGES.
- C. RECONNECT THE VIDEO INPUT TO THE MONITOR AND SET THE BRIGHTNESS CONTROL TO THE PROPER LEVEL.
- D. REMEASURE THE MONITOR BRIGHTNESS AT THE SAME POINTS AS IN PARAGRAPH B ABOVE.

## 6.2.1

SPECIFICATION LIMIT - THE SHADING SHALL NOT EXCEED 2:1 OVER THE ORIGINAL MONITOR BRIGHTNESS.

## 6.3

NOISE TEST

WITH THE CAMERA OPERATING NORMALLY, CAP THE LENS. MEASURE THE MAXIMUM OUTPUT SIGNAL INCLUDING ANY NOISE BUT EXCLUDING SYNC SIGNALS.

## 6.3.1

SPECIFICATION LIMIT - 100 MILLIVOLTS MAXIMUM.

## 6.4

EXTERNAL SYNC SIGNAL TEST

- A. WITH THE CAMERA OPERATING NORMALLY, OBSERVE BOTH AN ODD AND EVEN FIELD VERTICAL BLANKING PULSE. MEASURE AND RECORD THE PULSE WIDTHS INDICATED ON FIGURE 2 AND THE DATA SHEET.
- B. APPLY ONLY THE VERTICAL SYNC PULSE TO THE CAMERA. NOTE THAT THIS DOES NOT AFFECT THE VERTICAL SYNC INTERVAL.
- C. APPLY ONLY THE HORIZONTAL SYNC PULSE TO THE CAMERA. NOTE THAT THIS DOES NOT AFFECT THE VERTICAL SYNC INTERVAL.

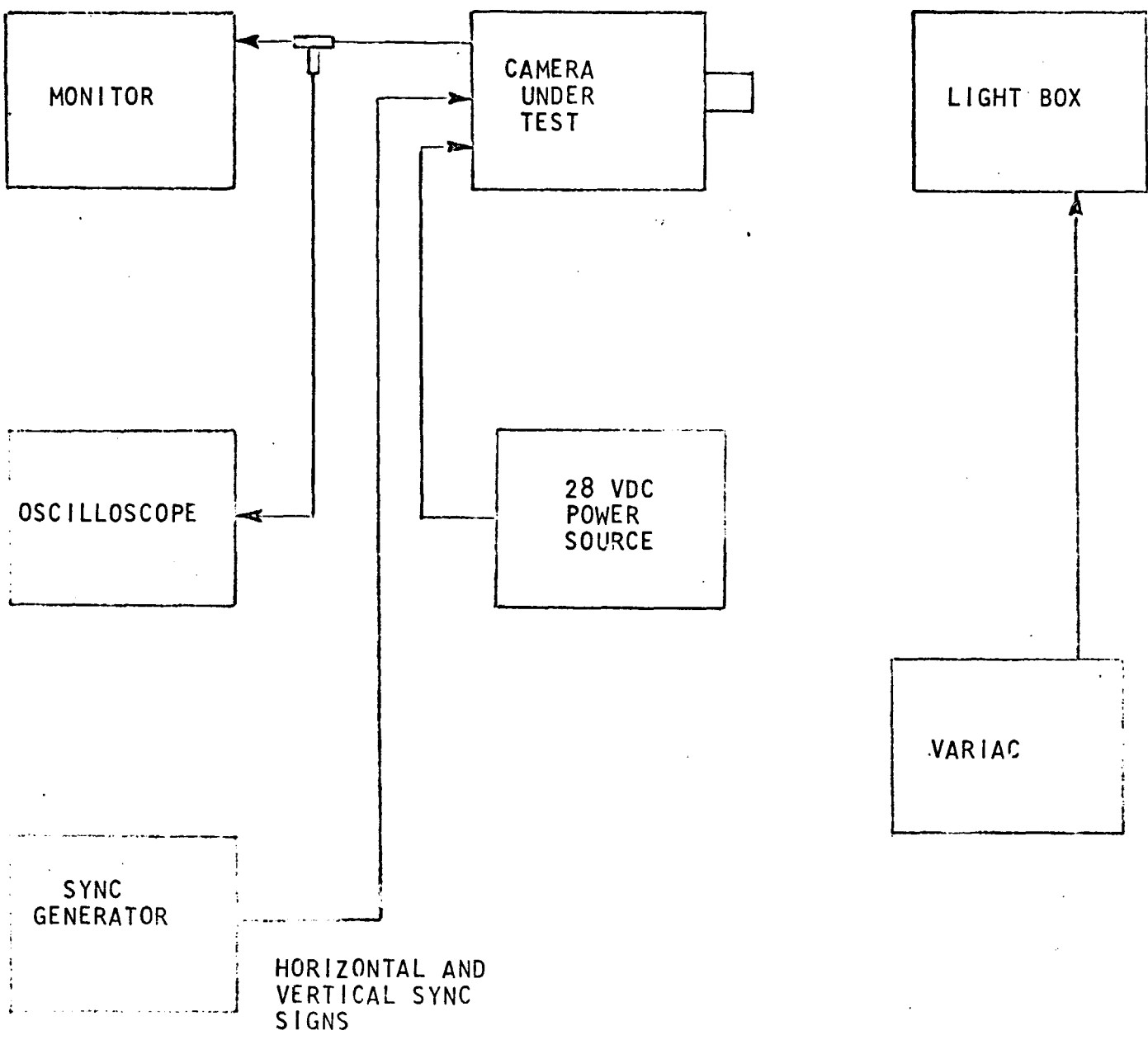
|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 18    |

6.4

SYNC SIGNAL TEST (CONTINUED)

- D. APPLY BOTH THE HORIZONTAL AND VERTICAL SYNC PULSES TO THE CAMERA. THIS SHOULD CAUSE THE CAMERA TO GO INTO EXTERNAL SYNC MODE. IN THIS MODE, NO EQUALIZING NOR SERATION PULSES WILL BE GENERATED. LOSS OF EITHER HORIZONTAL OR VERTICAL SYNC PULSES WILL CAUSE THE CAMERA TO SWITCH TO INTERNAL SYNC MODE.

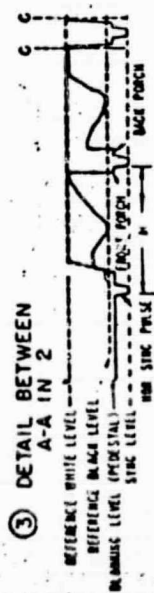
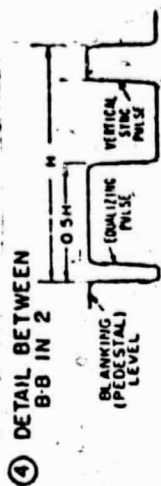
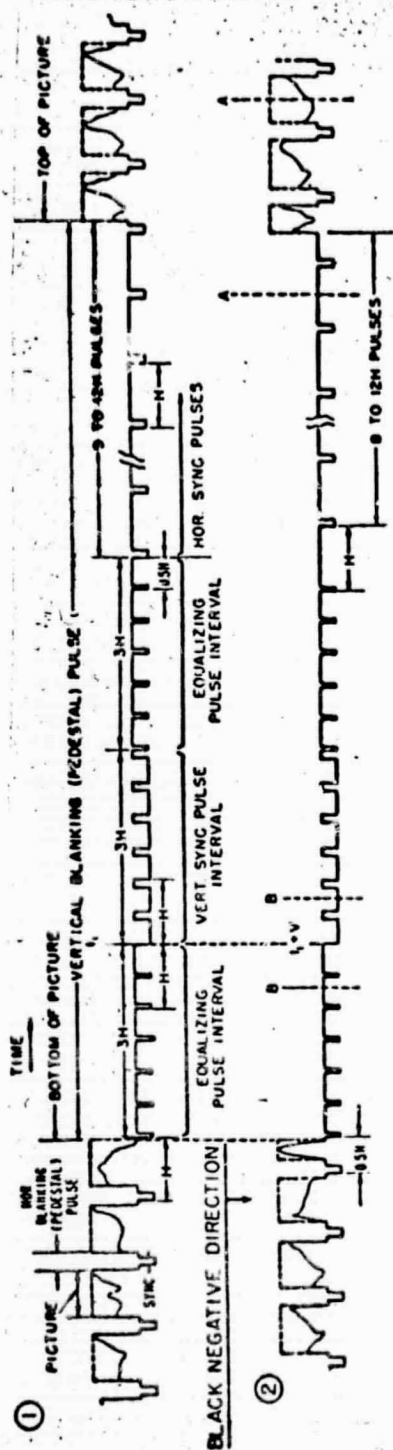
|       |                |             |
|-------|----------------|-------------|
| SIZE  | CODE IDENT NO. | DRAWING NO. |
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 19    |



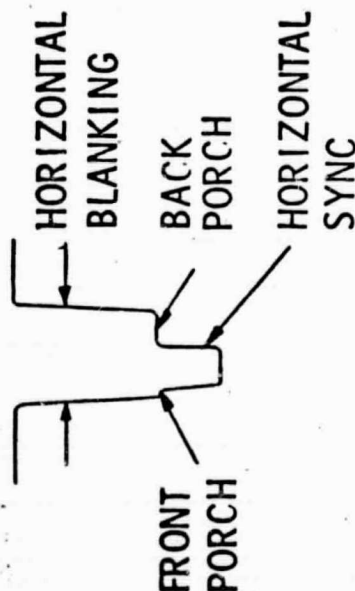
CAMERA INTERCONNECT

FIGURE 1

| SIZE  | CODE IDENT NO. | DRAWING NO. |
|-------|----------------|-------------|
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 20    |



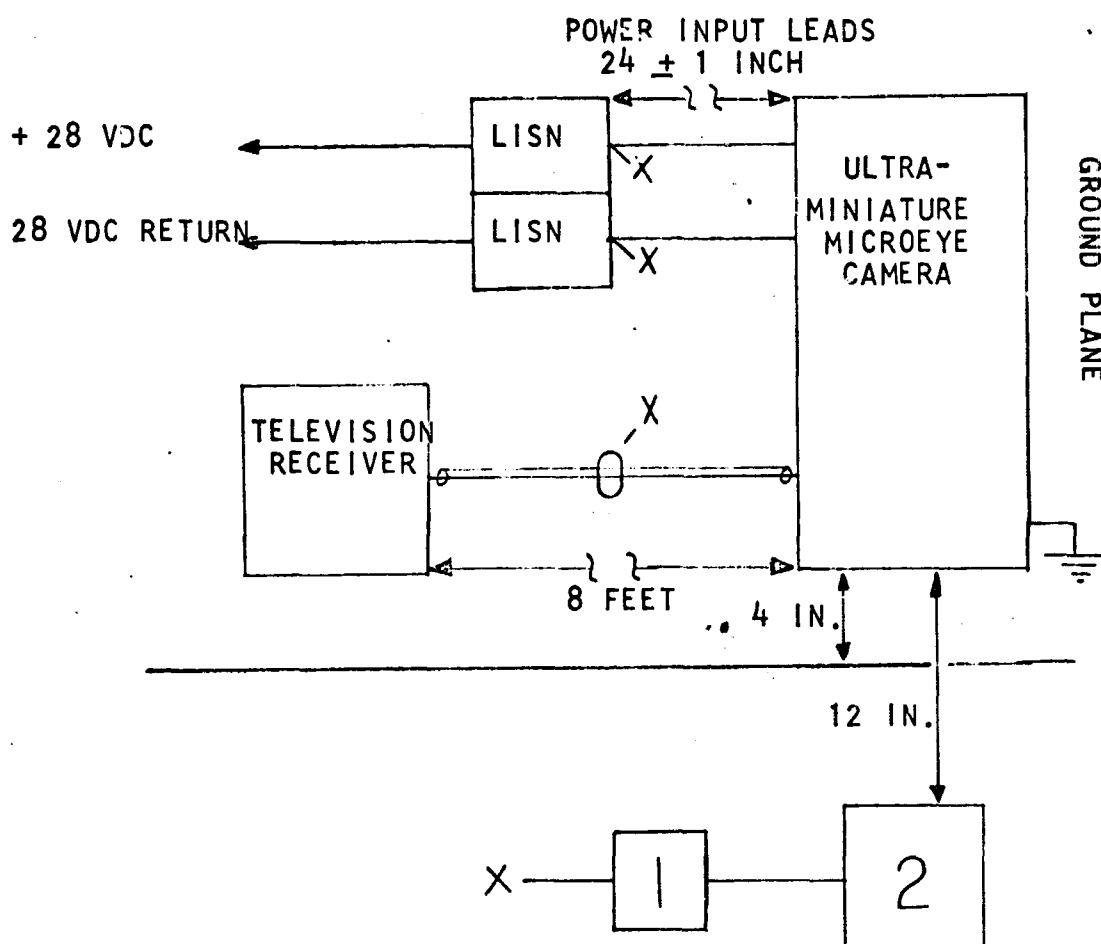
⑤ DETAIL BETWEEN C-C IN 3



| PULSE WIDTHS IN MICRO SECONDS |       |      |  |
|-------------------------------|-------|------|--|
| HORIZONTAL                    | MIN.  | MAX. |  |
| FRONT PORCH                   | 1.27  | --   |  |
| BACK PORCH                    | 4.13  | --   |  |
| SYNC                          | 4.45  | 5.08 |  |
| BLANKING                      | 10.58 | 11.3 |  |
| VERTICAL EQUALIZING PULSES    | 3.81  | 5.08 |  |

FIGURE 2 HORIZONTAL AND VERTICAL SYNC AND BLANKING PULSES

|                  |                                |                           |
|------------------|--------------------------------|---------------------------|
| SIZE<br><b>A</b> | CODE IDENT NO.<br><b>98571</b> | DRAWING NO.<br>ETP 834600 |
| SCALE            | SHEET 21                       |                           |

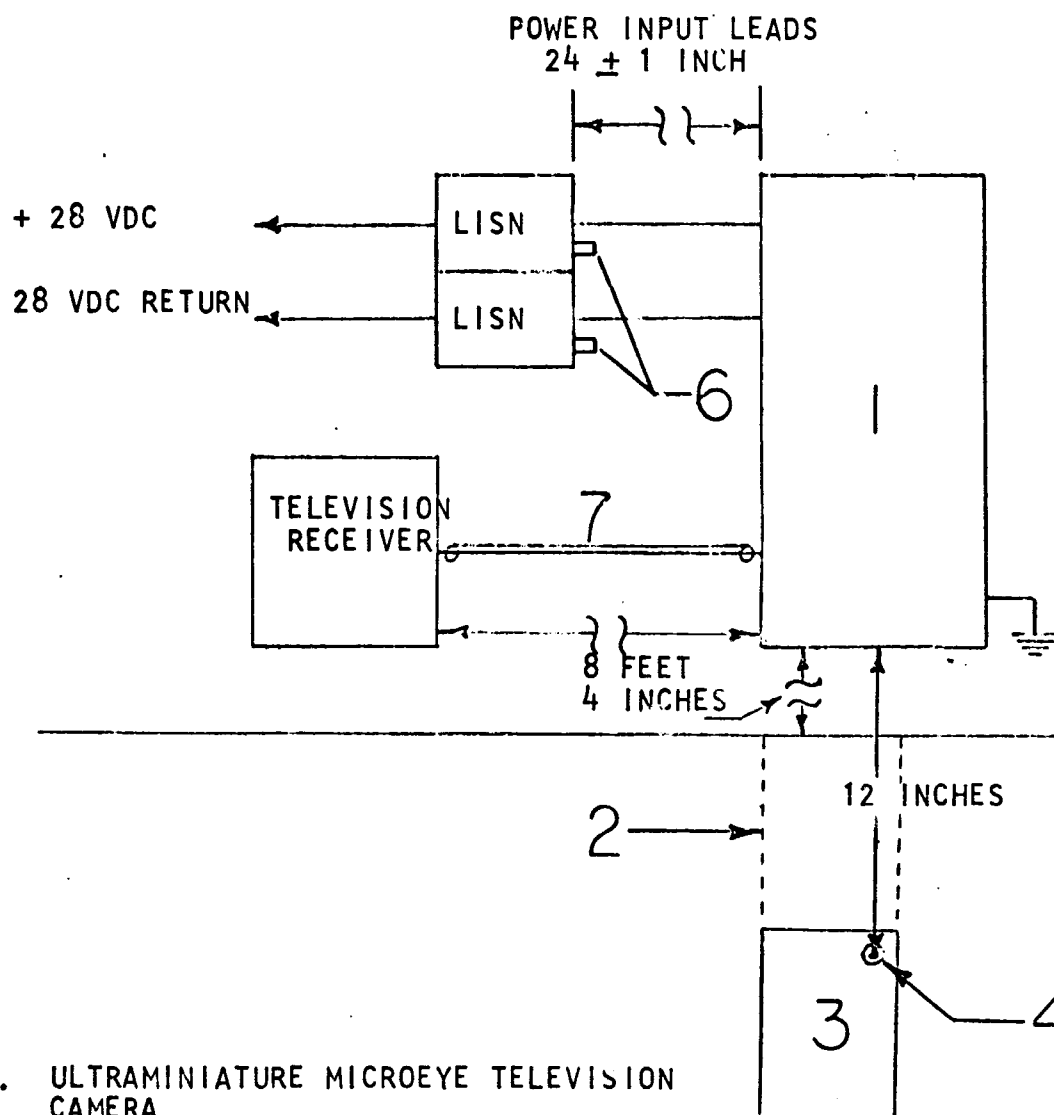


1. COAXIAL RF SWITCH
  2. INTERFERENCE MEASURING INSTRUMENT
- X = CONDUCTED INTERFERENCE MEASUREMENTS  
WITH LINE STABILIZATION NETWORKS
- QX = CONDUCTED INTERFERENCE MEASUREMENTS  
USING CURRENT PROBE
- GROUND PLANE GROUND

### CONDUCTED INTERFERENCE TEST SETUP

FIGURE 3

| SIZE  | CODE IDENT NO. | DRAWING NO. |
|-------|----------------|-------------|
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 22    |



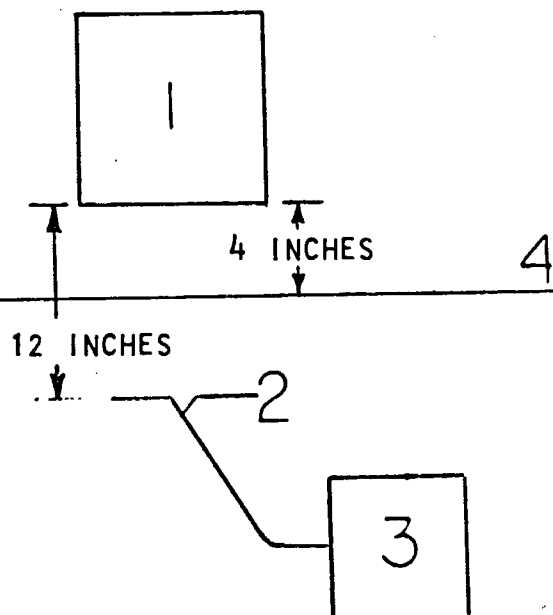
1. ULTRAMINIATURE MICROEYE TELEVISION CAMERA
2. COPPER BOND STRAP (GROUND)
3. INTERFERENCE MEASURING EQUIPMENT
4. 41 INCH ROD ANTENNA
5. SHIELDED ENCLOSURE COPPER GROUND PLANE
6. 50 OHM TERMINATIONS
7. OUTPUT CABLE
- GROUND PLANE GROUND

RADIATED INTERFERENCE (150KC TO 25MC) TEST SETUP

FIGURE 4

| SIZE  | CODE IDENT NO. | DRAWING NO. |
|-------|----------------|-------------|
| A     | 98571          | ETP 834600  |
| SCALE | SHEET 23       |             |

(SEE FIGURE 4 FOR ELECTRICAL  
CONNECTING DETAILS)



1. ULTRAMINIATURE MICROEYE TELEVISION  
CAMERA
2. DIPOLE ANTENNA
3. INTERFERENCE MEASURING INSTRUMENT
4. SHIELDED ENCLOSURE COPPER GROUND PLANE

RADIATED INTERFERENCE (25MC TO 1000MC)

FIGURE 5

| SIZE  | CODE IDENT NO. | DRAWING NO. |
|-------|----------------|-------------|
| A     | 98571          | ETP 834600  |
| SCALE |                | SHEET 24    |

# TEST DATA SHEET

## MICROEYE CAMERA

INSPECTOR \_\_\_\_\_

P/N \_\_\_\_\_

DATE \_\_\_\_\_

S/N \_\_\_\_\_

### 5.1.1 RESOLUTION TEST - NORMAL LIGHT (15 FOOT CANDLES)

HORIZONTAL: CENTER \_\_\_\_\_ 450 LINES MIN.

EDGES \_\_\_\_\_ 375 LINES MIN.

VERTICAL: CENTER \_\_\_\_\_ 350 LINES MIN.

### 5.1.1.1 RESOLUTION TEST - (1 FOOT CANDLE)

HORIZONTAL: CENTER \_\_\_\_\_ 275 LINES MIN.

VERTICAL: CENTER \_\_\_\_\_ 275 LINES MIN.

### 5.1.2 SHADING TEST

TYPICAL READING \_\_\_\_\_

WORST CASE \_\_\_\_\_ 2:1 MAX.

### 5.1.3 NOISE TEST

\_\_\_\_\_ 100 MV MAX.

# TEST DATA SHEET (CONTINUED)

## MICROEYE CAMERA

INSPECTOR \_\_\_\_\_

P/N \_\_\_\_\_

DATE \_\_\_\_\_

S/N \_\_\_\_\_

### 5.1.4 SYNC TESTS

|                          | <u>MIN</u>     | <u>READING</u> | <u>MAX</u>     |
|--------------------------|----------------|----------------|----------------|
| HORIZONTAL               |                |                |                |
| FRONT PORCH              | 1.27 $\mu$ SEC | _____          | -              |
| BACK PORCH               | 4.13           | _____          | -              |
| SYNC                     | 4.45           | _____          | 5.08 $\mu$ SEC |
| BLANKING                 | 10.58          | _____          | 11.30          |
| VERTICAL SERATION PULSES | 3.81           | _____          | 5.08           |

SWITCHING FROM INTERNAL TO EXTERNAL SYNC MODES.

ACCEPT \_\_\_\_\_ REJECT \_\_\_\_\_



Part No. 834600

Serial No. 001

Customer \_\_\_\_\_

Cust. Part No. \_\_\_\_\_

Q.T.P. No. \_\_\_\_\_



**TELEDYNE SYSTEMS COMPANY**  
**CONTROL SYSTEMS DIVISION**

## ENVIRONMENTAL LABORATORY TEST DATA SHEET

Page No. \_\_\_\_\_

Date 2-16-68

Program No. \_\_\_\_\_

Log No. 510

Test Eng'r. E. J. LANSEFORD

**DESCRIPTION OF TEST SPECIMEN:**

**ENVIRONMENT: VIBRATION**

**Following: \_\_\_\_\_ Test**

**Prior to : \_\_\_\_\_ Test**

Photograph (s) Taken: Yes ☒ No ☐

Test Equipment List: Yes ☒ No ☐

**DESIRED TEST PARAMETERS:**

5 CPS to 20 CPS @ : LIN. D.A.

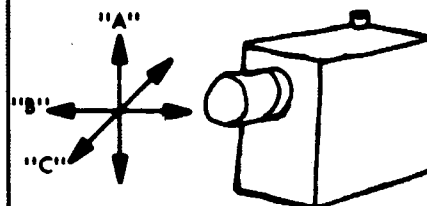
20 CPS to 500 CPS @ 2 g's

15 MIN'S/CYCLE 5-500-5

1 CYCLES/AXIS

VIBRATE IN A, B & C AXIS

**VIBRATION AXES:**

[illegible]

### VISUAL EXAMINATION

NO VISUAL DAMAGE WAS NOTED  
DUE TO VIBRATION.

\* Ref. made to Vibration Performance Data Sheets.

**Signatures required before filing this Data Sheet**

**TECHNICIAN:**

**INSP :**

**TEST ENGINEER:**

**CUSTOMER REP.**

Q.T.P. No. \_\_\_\_\_

### TEST DATA SHEET

Test Eng'r. E. J. LANSFORD

**SHEET 2**

**A. T. PARKER AND ASSOCIATES**

A Division of A. T. Parker, Inc.  
901 NORTH HIGHLAND AVENUE  
HOLLYWOOD, CALIFORNIA 90038

Engineering  
Manufacturing

February 21, 1968

Mr. E. J. Lansford  
TELEDYNE SYSTEMS COMPANY  
200 North Aviation Blvd.  
El Segundo, Calif. 90245

Dear Eejay:

This is an informal letter style report describing the radio interference tests performed on the Teledyne Micro Eye TV Camera on February 14.

Narrowband and broadband conducted interference tests were made on each power input lead using a line impedance stabilization network as prescribed in specification MIL-I-6181D. The enclosed data sheets, pages 1 through 6, indicate the measured levels of conducted interference over the frequency range 150 KHz to 25 MHz. All measured levels were well below the permissible limits of the specification.

Radiated interference tests were made using an antenna distance of one foot as required by MIL-I-6181D. Data sheets 7 and 8 show no narrowband signals discernible throughout the frequency range 150 KHz to 1 GHz. Data sheet 9 indicates the measured levels of broadband radiation from 150 KHz to 25 MHz. No broadband radiation was measurable from 25 MHz to 400 MHz.

No susceptibility tests were performed. The radiated interference tests were performed with the camera in operation, the monitor turned off, and the temporary transmitter disabled.

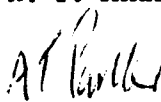
The test equipment used was Class 1 as approved by MIL-I-6181D and was in a current state of calibration with documented calibration data traceable to the National Bureau of Standards. The techniques used were in accordance with the requirements of MIL-I-6181D and represent good engineering practice.

We recommend that the measured levels be plotted on semi-log graph paper for direct comparison with the specification limits.

We appreciate having had this opportunity to be of service to TELEDYNE.

Cordially,

A. T. PARKER AND ASSOCIATES

  
A. T. Parker

n

enclosures

special delivery

## TEST DATA SHEET

Date of Test 2-14-68

Tech. \_\_\_\_\_

Eng. ATP

Customer Teledyne

Equipment MICRO-EYE

Model No. 834600

RFI Meter NMR 00

Pickup Device 1-160

S/N

S/N \_\_\_\_\_

M/N

**Certified**

S/N \_\_\_\_\_

Test CONDUCTED

Mode

Position + 28✓

Interference Type NB

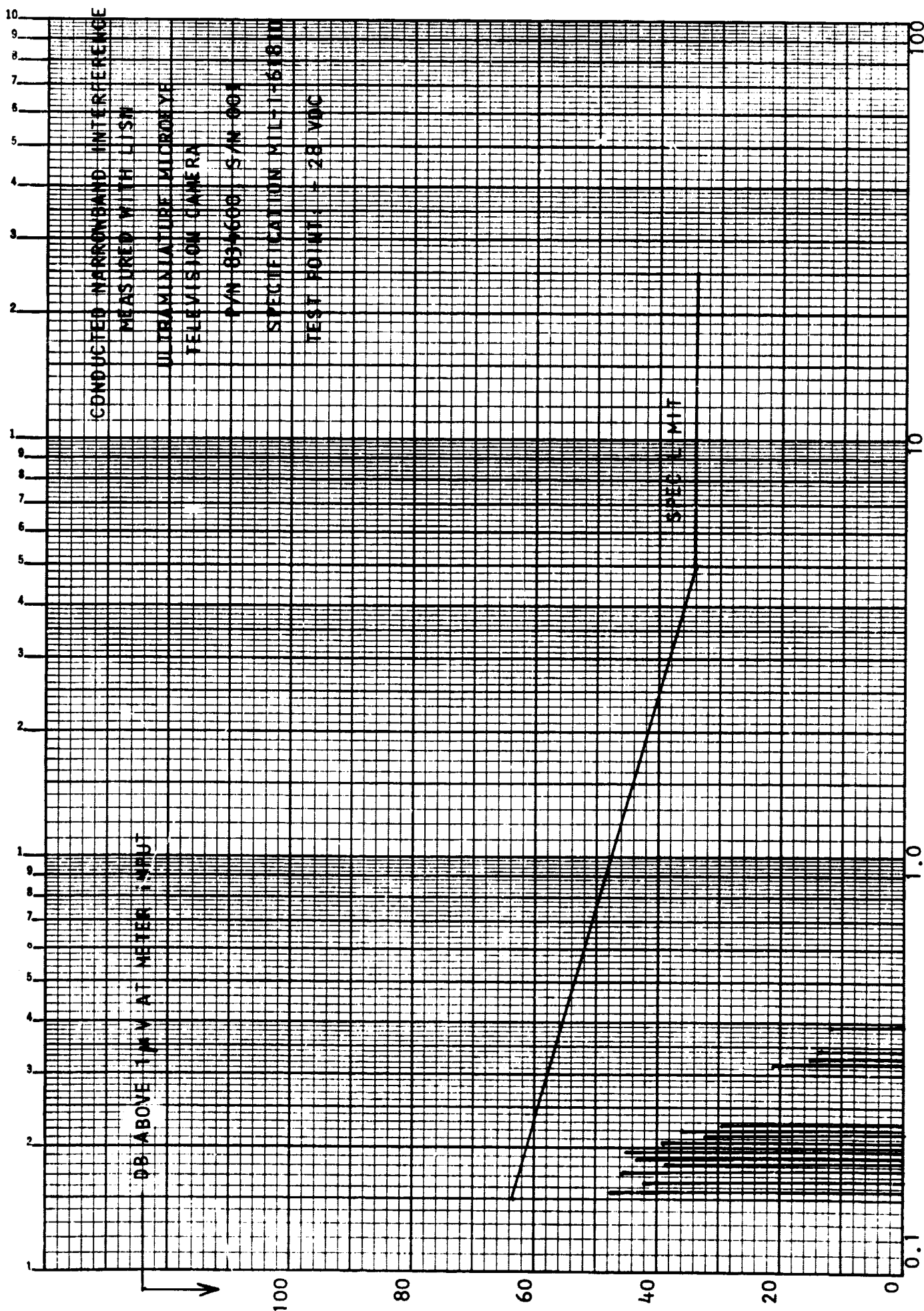
## Detector Function

FL

Spec. No. MIL-1-6181D

db 4v

[illegible]**A. T. PARKER AND ASSOCIATES**



## TEST DATA SHEET

Date of Test 2-14-68

Tech.

Eng. NEM

Customer Tekdine

Equipment Micro Eye

Model No. 834600

RFI Meter NMB00

Pickup Device 4/5K

**S/N**

S/N \_\_\_\_\_

M/N \_\_\_\_\_

**Certified**

S/N

Test Conducted

Interference Type *NB*

Spec. No. 61812

Mode

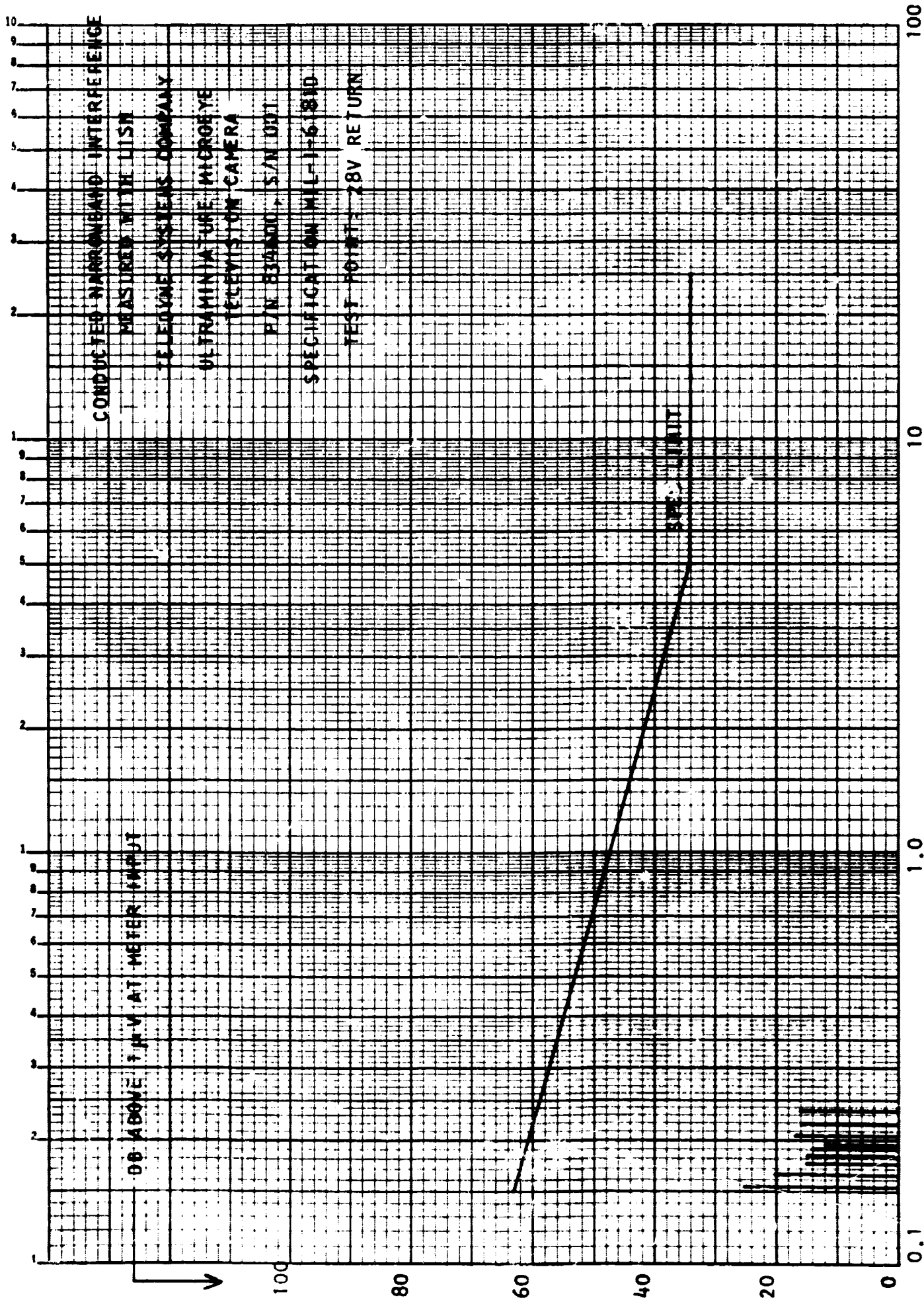
### Detector Function

Position - 28V

FT 212

dbuv

[illegible]**A. T. PARKER AND ASSOCIATES**



Customer Teledyne  
Equipment Micro Eye  
Model No. 834600  
RFI Meter NMB03  
Pickup Device 215A1

S/N \_\_\_\_\_  
S/N \_\_\_\_\_  
M/N \_\_\_\_\_

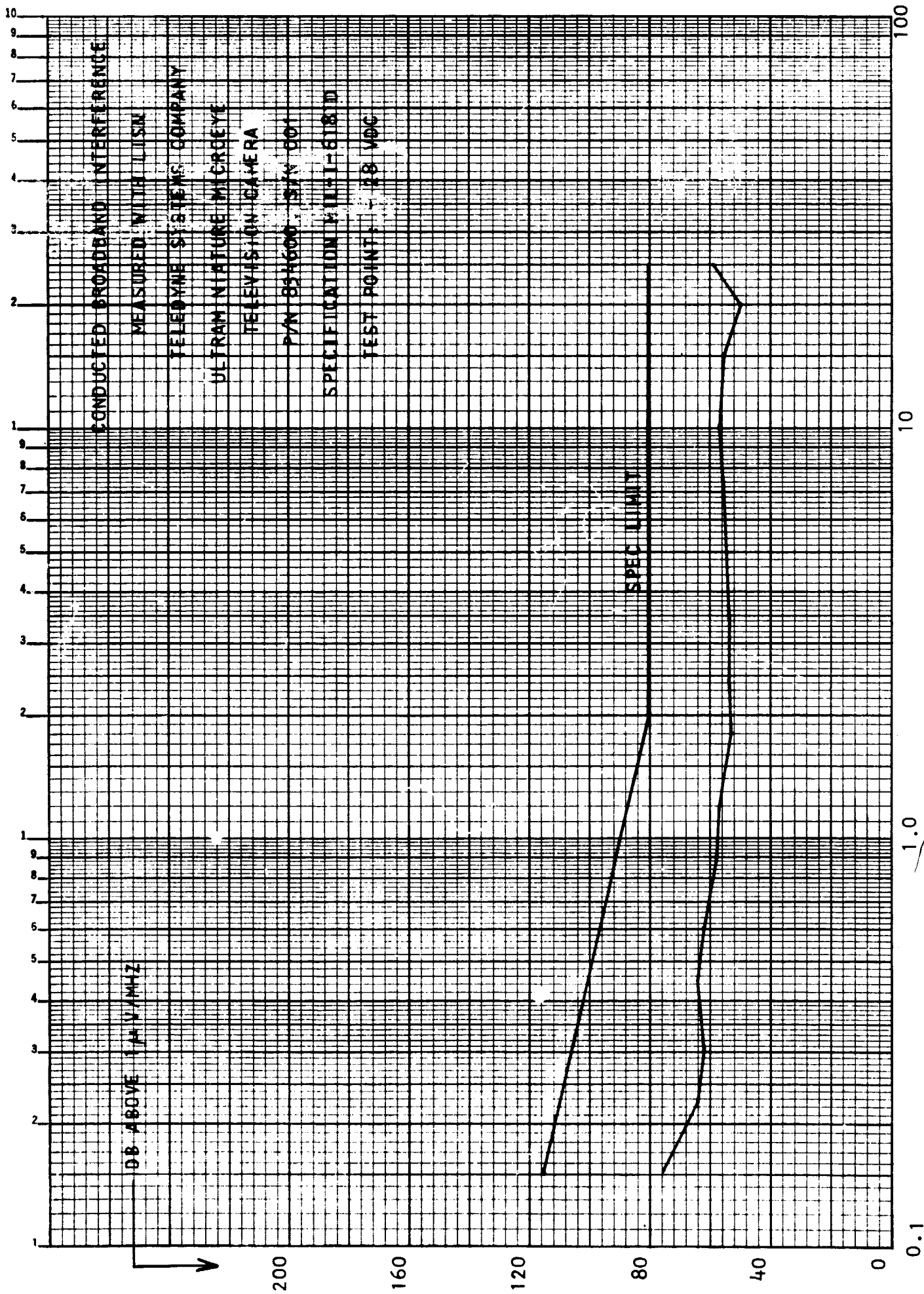
Certified \_\_\_\_\_  
S/N \_\_\_\_\_

Test Conducted  
Interference Type BB  
Spec. No. 6181P

Mode \_\_\_\_\_ Position +28V  
 Detector Function 129K

 $dbuv/mc$ [illegible]

## A. T. PARKER AND ASSOCIATES



## TEST DATA SHEET

Date of Test 2-14-68

**Tech.** \_\_\_\_\_

Eng. WBM

Customer Teledyne

Equipment Micro Exc

Model No. 834600

RFI Meter NM 20B

Pickup Device 2 LSN

S/N \_\_\_\_\_

S/N \_\_\_\_\_

M/N \_\_\_\_\_

**Certified**

S/N \_\_\_\_\_

Test Conducted

Mode

Position - 28 ✓

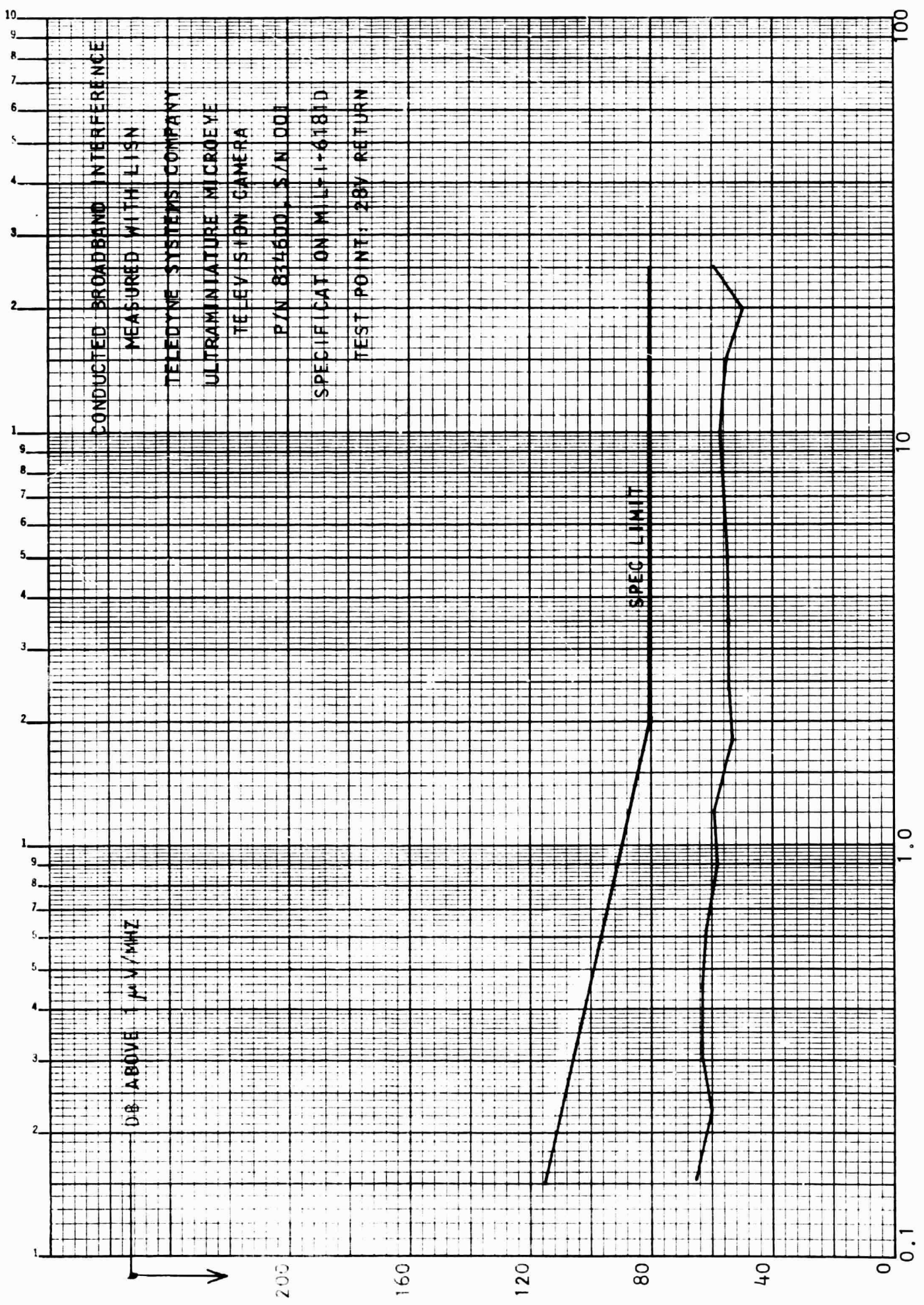
Interference Type BB

Detector Function Peak

Spec. No. 6181D

$$db\ \mu V/mc$$
[illegible]

## A. T. PARKER AND ASSOCIATES





## TEST DATA SHEET

Date of Test 2-14-68

Tech.

Eng. WBM

Customer *Teledyne*

Equipment *Micro Eye*

Model No. 834600

RFI Meter NM20B

Pickup Device CP

S/N

S/N

---

M/N

Certified

S/N \_\_\_\_\_

Test Considered

Mode

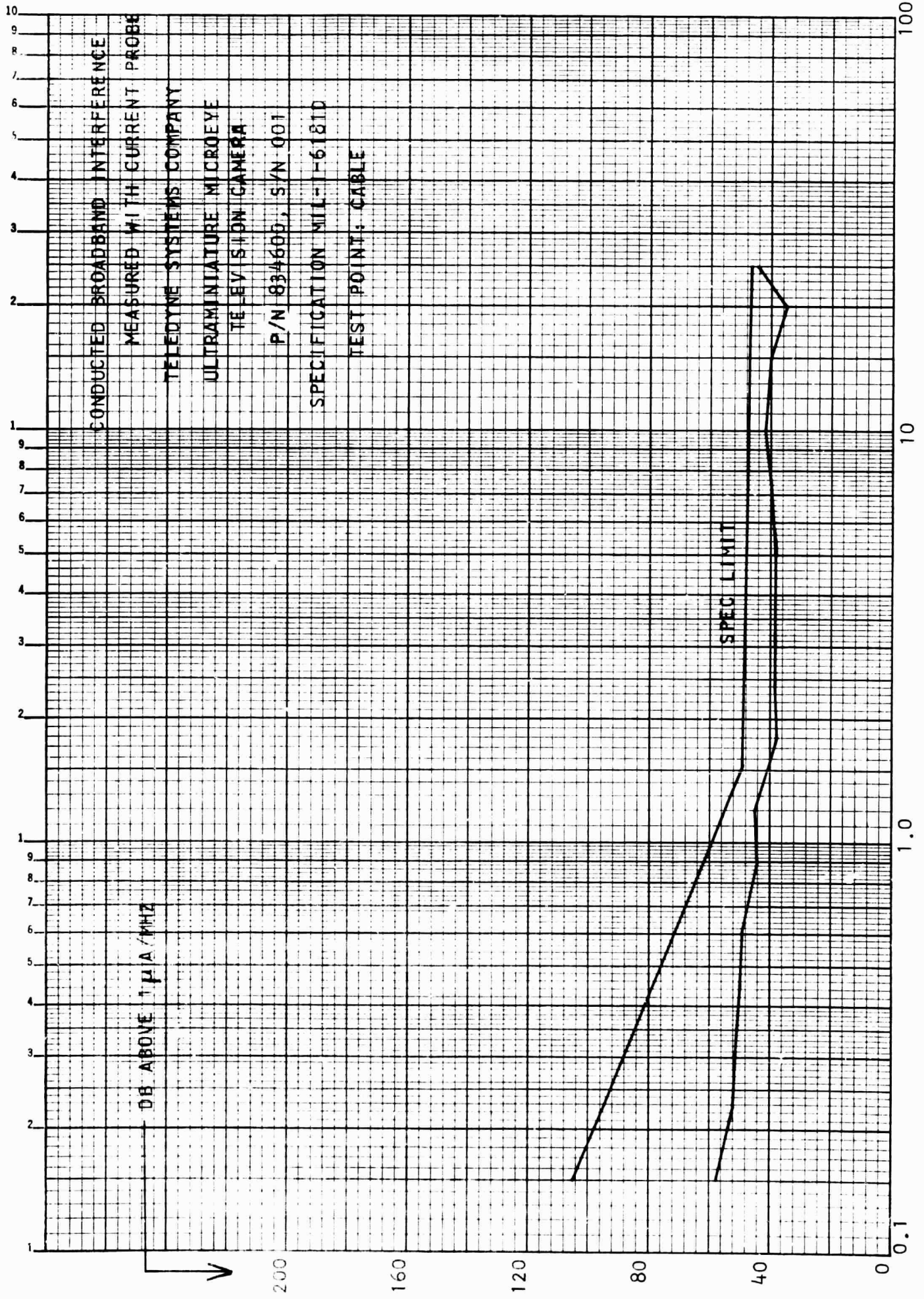
Position *Cable*

Interference Type *BB*

Detector Function *See*

Spec. No. 6181D

$$ds_{\text{ua}}/n$$
[illegible]**A. T. PARKER AND ASSOCIATES**



## TEST DATA SHEET

Customer Teledyne

Equipment Micro Eye

Model No. 834600

RFI Meter NM 2.013

Pickup Device Rod

S/N \_\_\_\_\_

S/N \_\_\_\_\_

M/N \_\_\_\_\_

Date of Test 2-14-68

Tech. \_\_\_\_\_

Eng. INBM

Certified \_\_\_\_\_

S/N \_\_\_\_\_

Test Radiated

Interference Type AB

Spec. No. 6181D

Mode \_\_\_\_\_

### Detector Function

Position 774

FE

[illegible]

**A. T. PARKER AND ASSOCIATES**

## TEST DATA SHEET

Date of Test 2-14-68

Tech. \_\_\_\_\_

Eng. INB M

Customer Teledyne

Equipment Micro Eye

Model No. 834600

RFI Meter NM 30 & NM 50

Pickup Device Dipole

S/N \_\_\_\_\_

S/N \_\_\_\_\_

M/N \_\_\_\_\_

Certified \_\_\_\_\_

S/N \_\_\_\_\_

Test Radiated

Mode

Position 1st

Interference Type NB

### Detector Function

FI

Spec. No. 6181D

[illegible]**A. T. PARKER AND ASSOCIATES**

Mr. J. M. D. Long, etc.

## TEST DATA SHEET

Date of Test 2-14-68

Tech. \_\_\_\_\_

Eng. WBMCustomer TeledyneEquipment Micro EyeModel No. 834600RFI Meter NM 200Pickup Device Red

S/N \_\_\_\_\_

S/N \_\_\_\_\_

M/N \_\_\_\_\_

Certified \_\_\_\_\_

S/N \_\_\_\_\_

Test Radiated

Mode \_\_\_\_\_

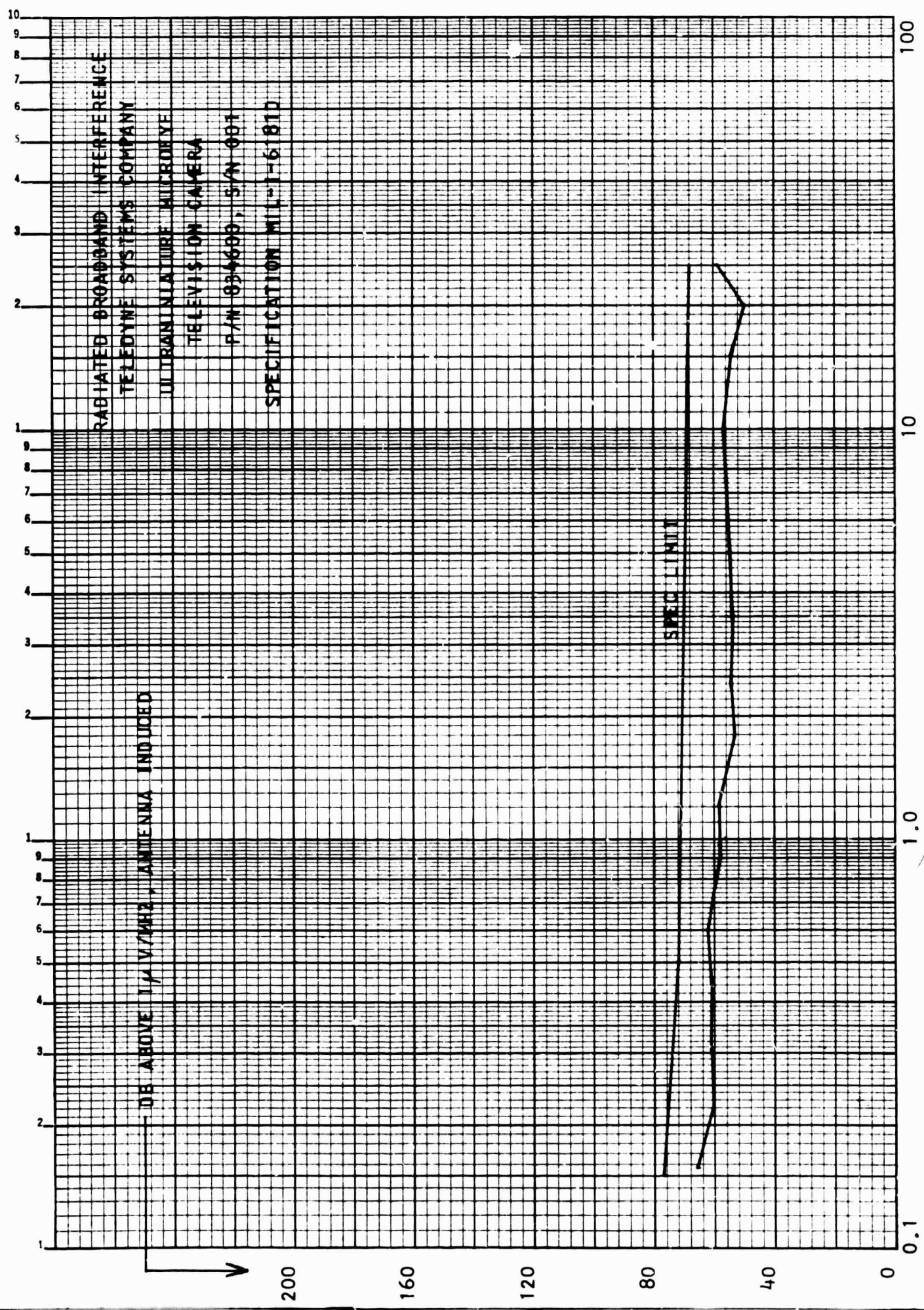
Position 174Interference Type BBDetector Function PeakSpec. No. 61810dbuv/mc

| FREQ   | BAND/<br>CAL | IND<br>AMB | IND<br>READ | ATTEN | IBW<br>FACT | CABLE<br>FACT | PICKUP<br>FACT | CORR<br>READ | SPEC<br>LIMIT |
|--------|--------------|------------|-------------|-------|-------------|---------------|----------------|--------------|---------------|
| 152 Kc |              |            | 27          | 0     | 39          | —             | —              | 66           | 77            |
| 225    |              |            | 27          | 0     | 33          |               |                | 60           | 75            |
| 307    |              |            | 28          | 0     | 33          |               |                | 61           | 73            |
| 450    |              |            | 24          | 0     | 37          |               |                | 61           | 71            |
| 600    |              |            | 22          | 0     | 40          |               |                | 62           | 70            |
| 900    |              |            | 25          | 0     | 33          |               |                | 58           | 69            |
| 1.2 mc |              |            | 23          | 0     | 35          |               |                | 58           | 69            |
| 1.8    |              |            | 20          | 0     | 33          |               |                | 53           | 69            |
| 2.4    |              |            | 20          | 0     | 34          |               |                | 54           | 68            |
| 3.5    |              |            | 19          | 0     | 35          |               |                | 54           | 68            |
| 5.0    |              |            | 20          | 0     | 35          |               |                | 55           | 68            |
| 7.5    |              |            | 20          | 0     | 36          |               |                | 56           | 67            |
| 10     |              |            | 19          | 0     | 38          |               |                | 57           | 67            |
| 15     | ✓            |            | 20          | 0     | 35          |               |                | 55           | 67            |
| 20     |              |            | 19          | 0     | 31          |               |                | 50           | 66            |
| 25     |              |            | 18          | 0     | 41          |               |                | 59           | 66            |

NO BB signals observed  
from 25 Mc to 400 Mc

A. T. PARKER AND ASSOCIATES

No Xmitter &amp; Seng off.



RADIATED BROADBAND INTERFERENCE

TELEDYNE SYSTEMS COMPANY

ULTRANINATURE MICROTYPE

TELEVISION CAMERA

P/N 034600, S/N 001

SPECIFICATION MIL-1-6181D

DB ABOVE 1  $\mu$  V/MHZ, ANTENNA INCLUDED

SPEC LIMIT