AD-A051 739   AEROSPACE RESEARCH INC BOSTON MASS   F/G 17/5

INTRINSIC SAFETY REVIEW REPORT.(U)

JAN 77   DAAG53-76-C-0158

UNCLASSIFIED   PUB-575   NL

1 OF 1

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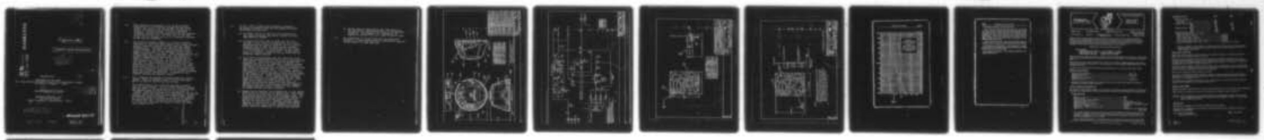

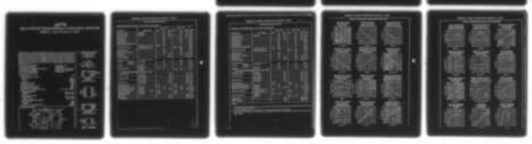

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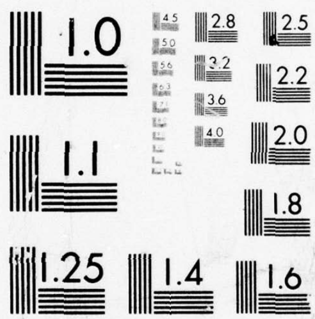


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

(9) TECHNICAL REPORT

(6) INTRINSIC SAFETY REVIEW REPORT

(11) Jan 77

(12) 17P.

Prepared for:

Department of the Army
U.S. Army Mobility Equipment Research and Development Command
Ft. Belvoir, Virginia 22060

(15) Contract DAAG53-76-C-0158 new

Aerospace Research, Inc.
130 Lincoln Street
Boston (Brighton), Massachusetts 02135
P.O. Sta

(14) PUB-575

BRUBAKER DESK CPY

009 900 JOB

Pub No. 575
January 1977

1.0 With reference to Paragraph 3.5.2 of the Purchase Description for FIDS Passive Infrared Motion Sensor (PIMS), this report will outline ARI's design as it relates to intrinsic safety in Class 1 hazardous locations. Guidelines were taken from the 1975 edition of NFPA Booklet No. 493. The only part of the PIMS system that is designed for use in a hazardous location is the receiver assembly.

2.0 The receiver assembly consists of a mirror assembly which has no electrical power applied and a small printed circuit board that receives +20 VDC from the Signal Processor Card. Typically the receiver draws under 2 ma DC current. In order to ensure adequate system signal to noise ratio it was necessary to have power supply regulation in each head. This necessitated the use of many large value capacitors such that difficulty would be experienced in meeting the requirements of Figure 6-1.5(b) of NFPA 493. It was decided that the only sensible way of meeting the requirement was to coat the P.C. card assembly with heavy coating of high dielectric material. In this configuration, the only place a short circuit could possibly cause an arc would be at the terminal strip located inside the plastic and metal cover assembly. Reference to the schematic diagram shows the circuit configuration. A diagram is also included showing the component layout.

2.1 Pin 5 (tamper) was designed to detect shorts to +20V or ground. There is normally under +1 VDC at this point and it is current limited by over 5K ohms.

Pin 2 (RCVR output) has a 330 ohm resistor in series with the signal output. If pin 2 were shorted to ground and the output of the op-amp was at +16 V (normally +8V) the maximum current would be 12 ma (as per spec. of μA776). Additional protection is provided by the 330 ohm resistor (which also isolates coax capacitance). Extrapolating the curves of Figure 6 - 1.5(b) of NFPA Booklet No. 493 shows that (C+330 ohm) would result in ignition voltage of over 50v. Dividing by two as per section 6 - 2.1 of No. 493 gives 25V, which is above the worst case voltage of +16.

2.2 If pin 5 (+20V to Head) were shorted to ground at the receiver terminal strip the following situations (a through e) would occur.

a) For FIDS, the 10V to 20V, DC to DC converter on the signal processor card limits itself to 75 ma. (Not used on J-SIIDS).

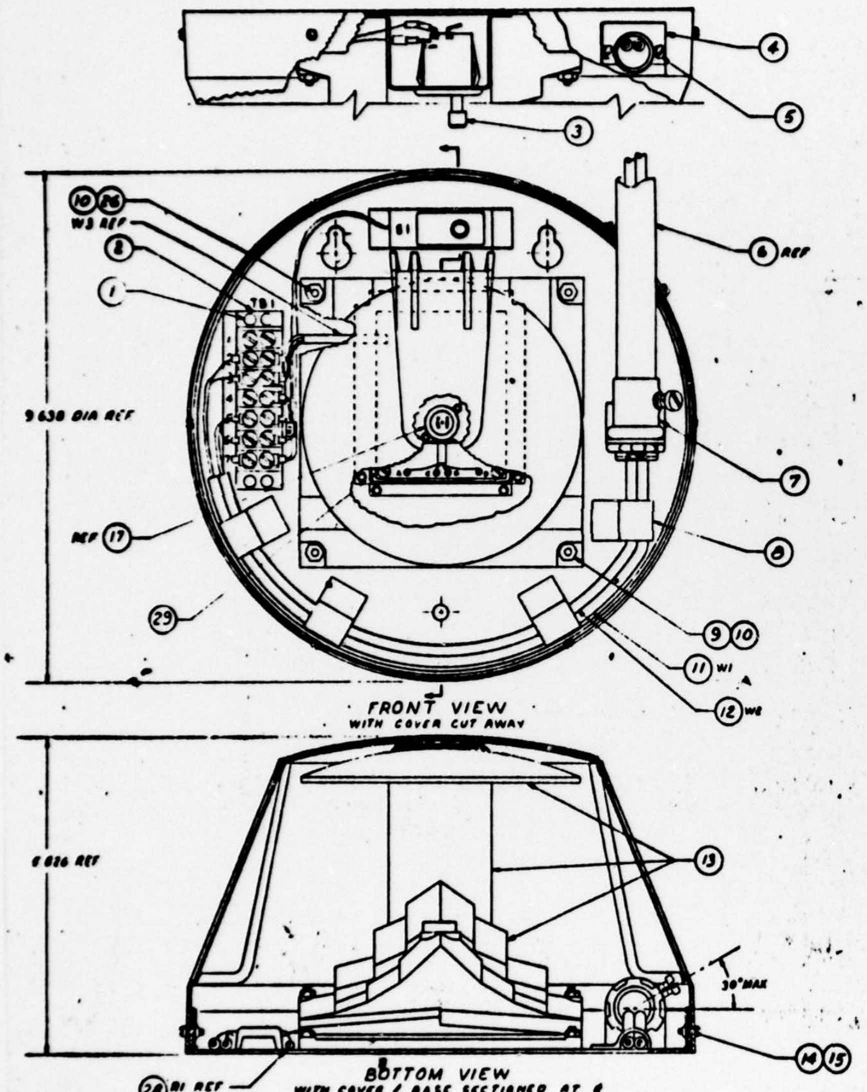
b) In series with the (+20V to Head) line are two 150 ohm, 2 watt resistors in parallel, or 75 ohms. Extrapolating the curve in NFPA No. 493 for a 47 uf capacitor with 75 ohms in series gives a voltage of approximately 40V. Dividing this by two as per 6 - 2.1 of NFPA No. 493 gives ±20V. 75 ohms would limit the current to under 300 ma (if there were no intrinsic safety barrier).

c) It is ARI's understanding that the power fed to the PIMS processor card will be done so in an intrinsically safe manner. There will be no barrier between the processor and any of its receivers. Suitable current limiting would be as follows. During FIDS operation, the nominal current draw is 5 ma for the processor card and 1.5 ma per receiver (MAX. 6 receivers). Total FIDS current is normally 14 ma. In J-SIIDS operation an additional 12 ma is required to drive the two relays in the adaptor box. Total J-SIIDS current therefore is 26 ma (typical). It is suggested that the power supply be limited (or fused) at around 100 ma. That level would suffice for FIDS operation also. In addition to preventing ignition at the receivers, a current limiter set to 100 ma would prevent damage to the signal processor card if exposed to any induced or random failures and short circuits.

d) Another safety feature, for J-SIIDS only, is the IN4004 diode which is located in the adaptor box. This diode is in series with the +20V to the processor card. The forward resistance will act like a current limiter in conjunction with the intrinsic safety limiter and the two 150 ohm resistors. Without intrinsic safety limiting it would act as a fuse because over 200 ma would flow under short circuit conditions discussed in (b), which is sufficient to destroy the junction.

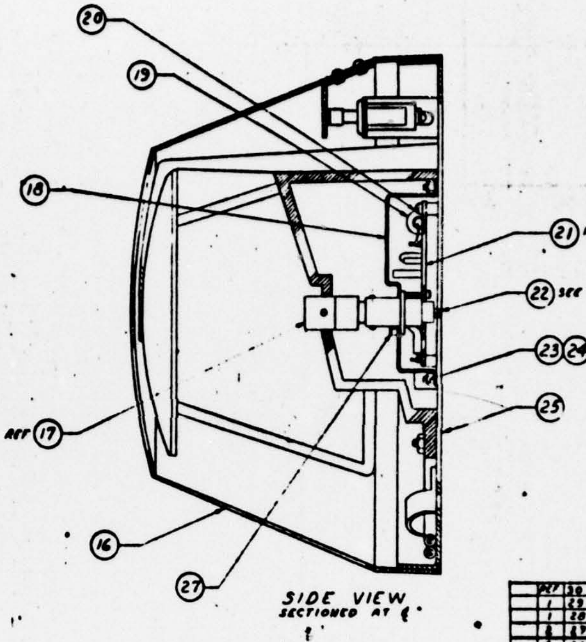
e) At the input to each head on the +20V line is a 100 ohm series resistor and then a 47 uf capacitor to ground. The composite R/C combination is similar to section (b); i.e., safe to run at +20V.

2.3 The connections to the PC card from the thermistor detector is a high impedance with insufficient capacity in the circuit to cause ignition.



FRONT VIEW
WITH COVER CUT AWAY

BOTTOM VIEW
WITH COVER & BASE SECTIONED AT ℄



SIDE VIEW
SECTIONED AT ℄

WIRING TABLE		
FROM	TO	FUNCTION
W1-CONDUCTOR	TB1-2	RECEIVER OUTPUT
W1-SHIELD	TB1-3	POWER RETURN
W2-CONDUCTOR	TB1-5	TAMPER
W2-SHIELD	TB1-6	+20V
W3-RED	TB1-6	+20V (SEE NOTE 2)
W3-WHITE	TB1-2	RECEIVER OUTPUT
W3-BLACK	TB1-3	POWER RETURN
W3-SHIELD	TB1-3	
S1-NC	TB1-7	TAMPER
S1-COM	TB1-5	TAMPER
TB1-4	TB1-7	TAMPER (THRU R1)
TB1-3	TB1-4	(USE METAL JUMPER)
TB1-1		SPARE

NOTES

1. ITEM 6 AND ITEMS 11 & 12, WITH KULKA FLAG LUGS #600 FL ATTACHED AT TB1 TERMINATIONS, TO BE SUPPLIED BY CUSTOMER
2. W3 CABLE ASSY IS PART OF ITEM 29.
3. LENGTH OF ITEM 22 TO BE DETERMINED AT FOCUS ADJUSTMENT. IF NECESSARY, GRIND FLUSH AFTER SECURING ITEM 17

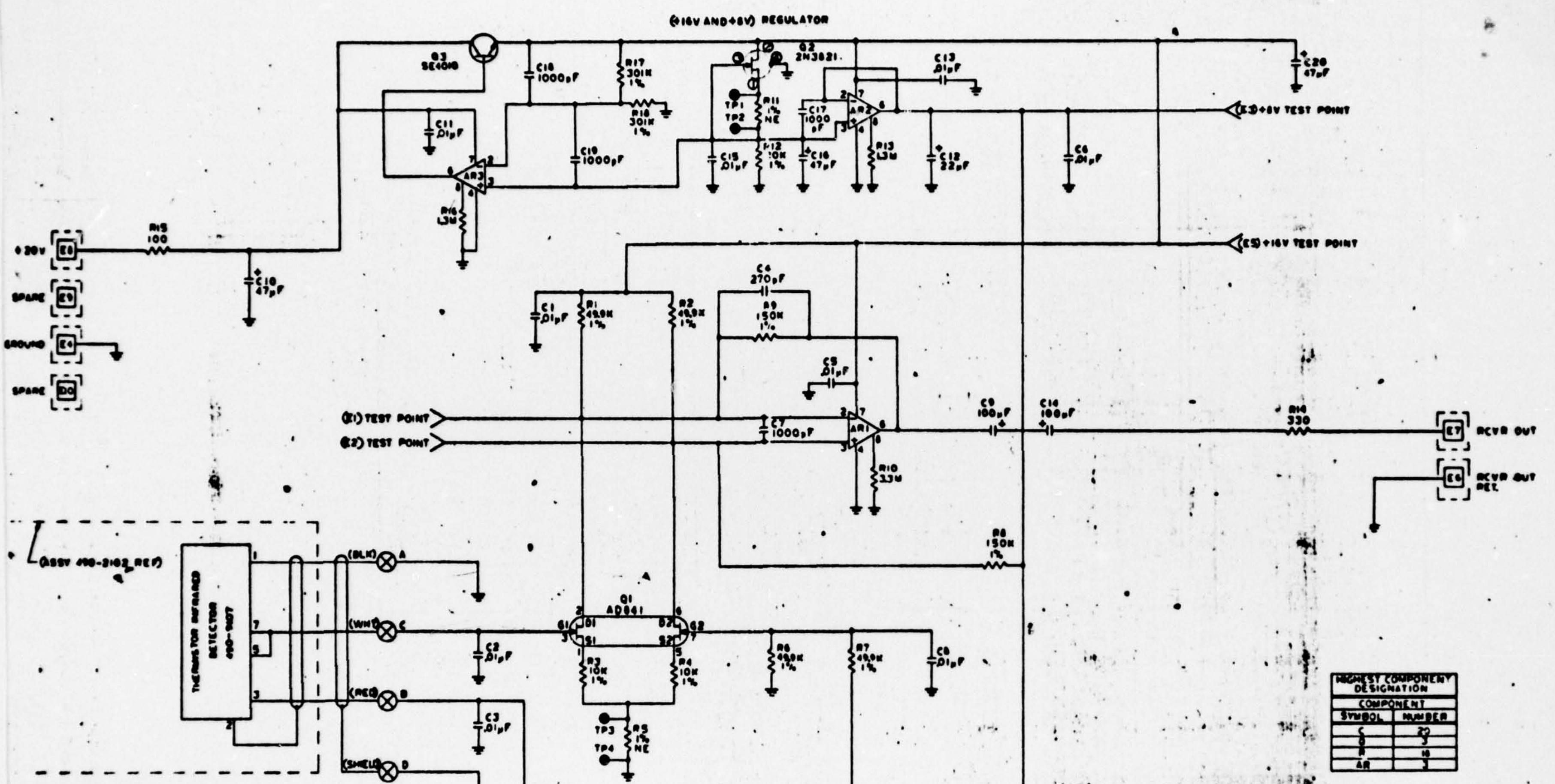
	QTY	ITEM	PART NO.	DESCRIPTION
	REF	30	490-3101	SCHEMATIC, RECEIVER
	1	29	490-2106	DETECTOR-RECEIVER ASSY
	1	28		RESISTOR, 1% 1/4W (RN55) R1
	2	27		SCREW CAP 2-56×1/4
	2	26		SCREW, MACH 6-32×1 1/4 FL HD [illegible]
	1	25	490-1106	BASE PLATE
	8	24		NUT, HEX MIN 4-40 (ESNA 22NM-40)
	8	23		SCREW, MACH 4-40×5/16 FL HD
	1	22	SEE NOTE 3	SCREW, SET, OVAL POINT 6-40×L AR
	REF	21	490-2101	P.C ASSY, RECEIVER (PART OF ITEM 29)
	4	20		SCREW MACH 4-40×3/16 BE HD
	1	19		GROMMET (GREEN RUBBER #2178)
	1	18	490-1107	SHIELD R.F. PC ASSY
	REF	17	490-2102	DETECTOR ASSY (PART OF ITEM 29)
	1	16	490-1104	COVER
	6	15		SPEED NUT, J TYPE 4-40 (CAD LAC)
	6	14		SCREW, MACH 4-40×1/4 BD HD
	1	13	90013001	MIRROR ASSY
	REF	12	SEE NOTE 1	CABLE ASSY, COAX RG58U W2
	REF	11	SEE NOTE 1	CABLE ASSY, COAX RG58U W1
	4	10		NUT HEX MIN 6-32 (ESNA 22NM) [illegible]
	2	9		SCREW, MACH 6-32×3/16 FL HD [illegible]
	4	8		PRESS CLIP (PLASTIC COMPONENTS CO #[illegible])
	1	7		CONDUIT RETAINER
	REF	6	SEE NOTE 1	CONDUIT .72 O.D
	8	5		SCREW, MACH 2-56×3/16 BD HD
	1	4	490-1111	DUST PLATE
	1	3		TAMPER SWITCH (CHERRY E60) S1
	1	2		TERMINAL STRIP (BEAU #15007 GG 30?) TB1
	4	1		RIVET POP (USM #[illegible])

LIST OF MATERIALS

SENSOR ASSY

PIMS

D 490 2103 A2

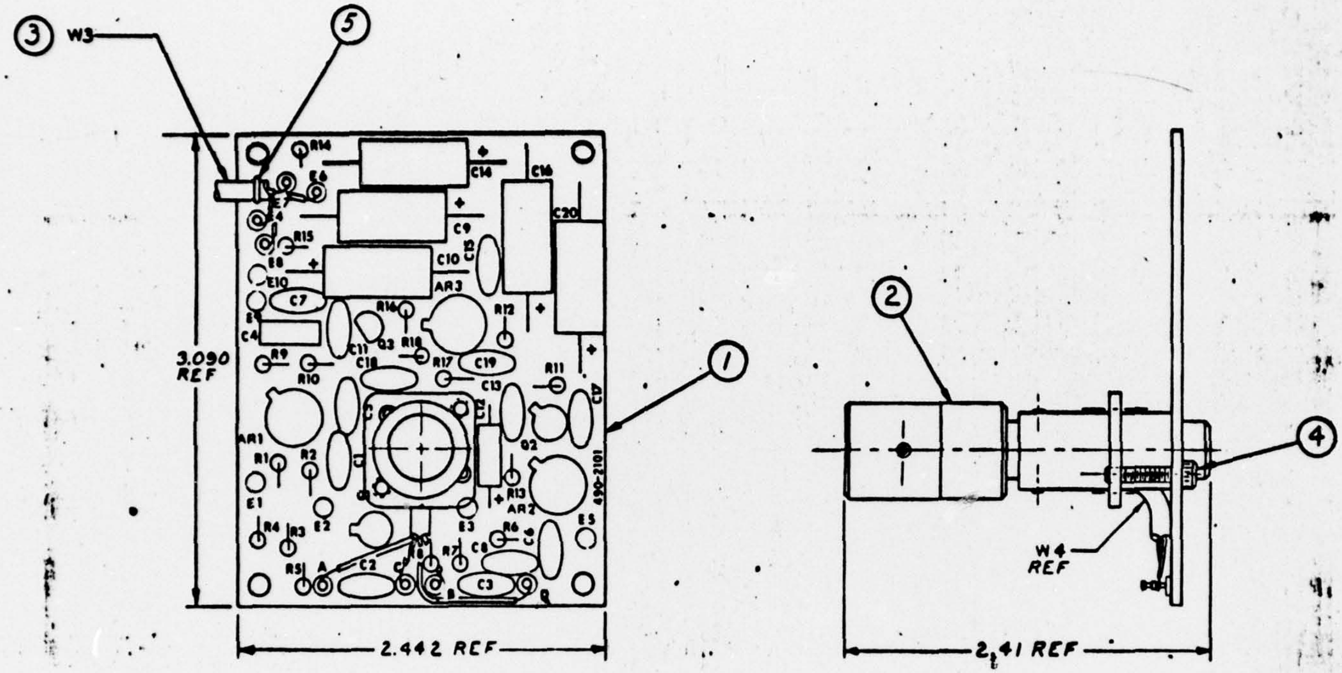


HIGHEST COMPONENT DESIGNATION	
COMPONENT	
SYMBOL	NUMBER
C	20
Q	3
R	18
AR	3

NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALL RESISTORS ARE 2.5%, 1/4W
2. FOR COMPLETE COMPONENT DESCRIPTION SEE P.L. 490-2101
3. AR1 THRU AR3 ARE µA776HM OP. AMPS.
4. R5 AND R11 ARE FACTORY SELECTED AT TEST.
5. CAPACITORS ARE 15V 10% AT 22µF, 20V 20% AT 100µF, 35V 20% AT 47µF, 100V 10% AT 1000PF, 100V 20% AT .01µF, AND 500V 5% AT 270PF.

SCHEMATIC
P.I.M.S. (RECEIVER)

D 490-3101



WIRING TABLE		
FROM	TO	FUNCTION
W3-RED	E8	+20V
W3-BLACK	E4	GROUND
W3-WHITE	E7	RCVR OUT
W3-SHIELD	E6	POWER RETURN
W4-BLACK	A	GROUND
W4-WHITE	C	DETECTOR
W4-RED	B	+8V
W4-SHIELD	D	POWER RETURN

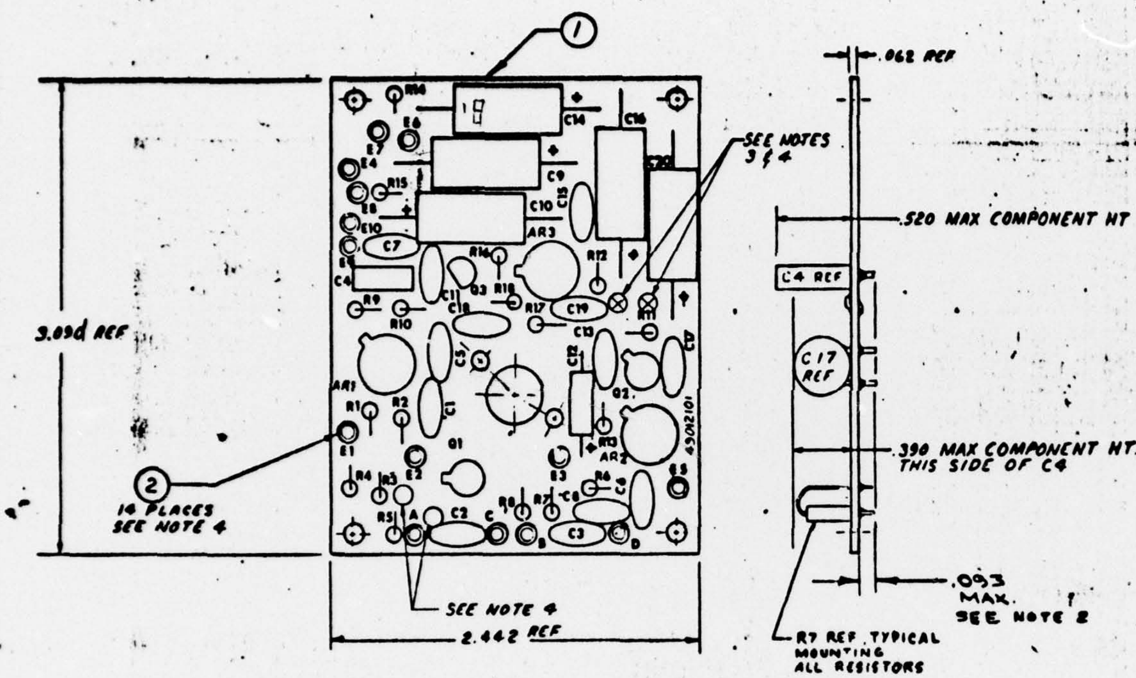
REQD	REQD	ITEM	PART NO	DESCRIPTION
REF		6	490-3101	SCHEMATIC-RECEIVER
1		5	67606003	TIE-CABLE
2		4		SCREW, CAP. 2-56 X 1/2
1		3		CABLE ASSEMBLY W3
1		2	490-2102	DETECTOR HOUSING ASSEMBLY
1		1	490-2101	P.C. ASSEMBLY, RECEIVER

LIST OF MATERIALS

DETECTOR-RECEIVER ASSY

AEROSPACE RESEARCH INC
BOSTON, MASS

MODEL NO: PIMS
NEXT ASSY: 490-2103
SIZE: C
DWG NO: 490-2106
REV: A
SCALE: 2:1
SHEET 1 OF 1



NOTES.

1. ASSEMBLE AS SHOWN. FOR COMPLETE COMPONENT DESCRIPTION SEE PL 490-2101
2. CUT ALL COMPONENT LEADS TO DIMENSIONS SHOWN
3. ⊗ INDICATES INTERFACIAL CONNECTION (STITCH)
4. AFTER ASSEMBLY, CALIBRATION AND FINAL TEST, MASK TERMINALS A, B, C, D, E1 THRU E10 AND BOTH SIDES OF 4 PAD AREAS NOTED. THEN APPLY A 5 MIL COATING OF ITEM 5 (CONAP CE-1132) PER PROCESS SPECIFICATION 490-4100.

SEE PARTS LIST 490-2101

CIRCUIT CARD ASSY
RECEIVER

AEROSPACE RESEARCH INC.

PIMS

NEXT ASSY 490-2106

DWG NO 490-2101 A-1

SCALE 2:1

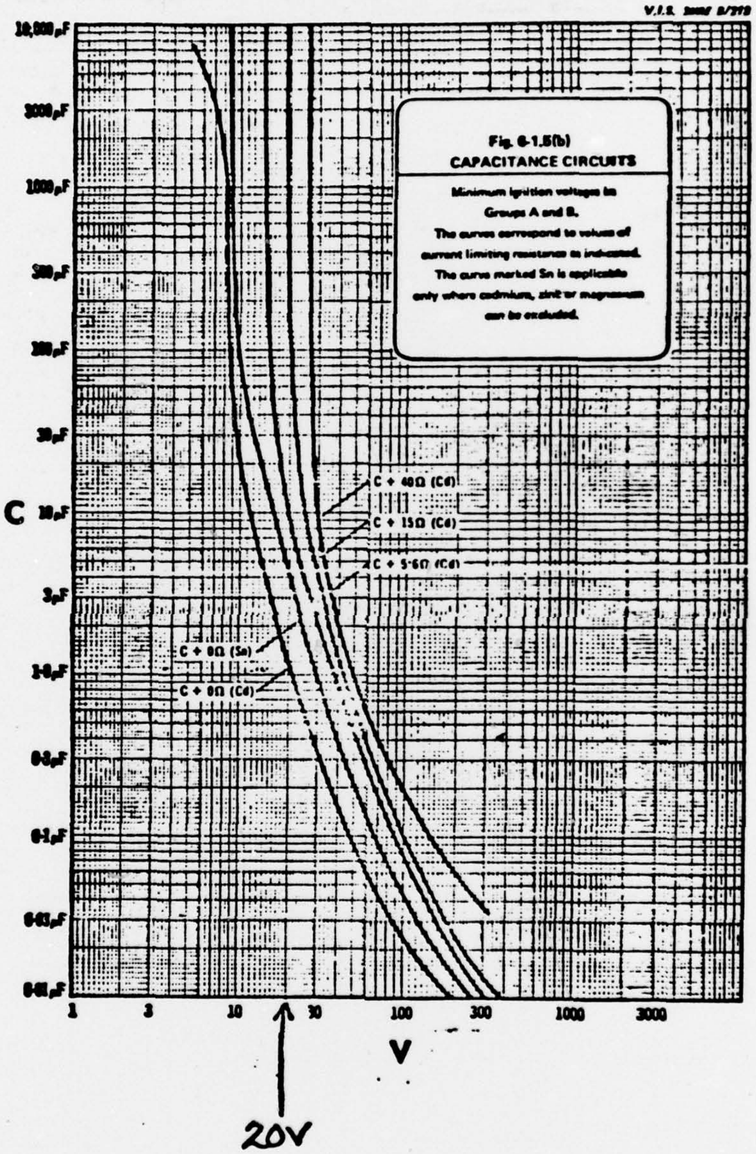


Fig. 6-1.5(b)
CAPACITANCE CIRCUITS
Minimum ignition voltages in Groups A and B.
The curves correspond to values of current limiting resistance as indicated.
The curve marked Sn is applicable only where cadmium, zinc or magnesium can be excluded.
C + 40Ω (Cd)
C + 15Ω (Cd)
C + 5·6Ω (Cd)
C + 0Ω (Sn)
C + 0Ω (Cd)
C
V
1
3
10
30
100
300
1000
3000
20V

6-2 Maximum Voltage and Current Levels.

6-2.1 Maximum voltage and current levels in intrinsically safe circuits approved without ignition testing shall not exceed 50 percent of the current determined from Figures 6-1.3(a), 6-1.3(b) and 6-1.4(a) through 6-1.4(d), or of the voltage determined from Figures 6-1.5(a) and 6-1.5(b) for given circuit constants. Higher voltage and current levels shall be permissible if their safety is demonstrated by test.

6-2.2 Circuit Conditions. The circuit conditions shall include all normal and fault conditions described in this standard.

6-3 Temperature Classification. An assessment or test shall be carried out to establish the operating temperature marking per *National Electrical Code* 500-2 (c).

6-4 Voltage Test Methods. The voltage tests shall be as described in Section 5-8.

CONAP INC.
CONTROLLED MATERIALS APPLICATIONS

PLANNED PROGRESS THROUGH
POLYMER RESEARCH

.TECHNICAL INFORMATION

SINGLE COMPONENT
COATING FOR
PRINTED CIRCUITS

CONAP, INC. 1405 BUFFALO STREET • OLEAN, NEW YORK 14760 • PHONE (716) 372-9650
TWX: 510-245-2769

CONAP (CANADA) LTD. 5200 DIXIE RD. • AEROWOOD INDUSTRIAL PLAZA • MISSISSAUGA, ONTARIO, CANADA • PHONE (416) 625-2520

CONAP CE-1132

CONAP CE-1132 is a single component liquid coating for printed circuits, and is a stabilized synthetic polymer. It has been formulated specifically to protect assemblies against environmental conditions such as contamination and high humidity; and at the same time, ruggedize the unit against shock and vibration. In addition, CONAP CE-1132 offers an ease of handling seldom found in similar coatings; i.e., it can be applied by spray, brush or dip; there is little runoff and cure cycles are short.

PROTECTION 'PLUS' FOR PRINTED CIRCUITS

CE-1132 COMBINES:

- EXTRA-LONG DIP TANK STABILITY . EASE OF REPAIR . ECONOMY .
- FAST-LOW TEMPERATURE CURE . EXCELLENT HUMIDITY RESISTANCE .
- GOOD ELECTRICAL PROPERTIES . UNIFORM COATING THICKNESS .

CONAP CE-1132 is also easily repairable. Components can be placed and replaced in coated areas, using ordinary repair procedures, without danger of carbonization at 175°C, or intereference with the making of sound solder joints.

And to make field repair easier, especially where ovens are not available, CONAP CE-1133 has been developed so that it will cure at room temperature. This is supplied in kit form, each kit containing CE-1133, a brush and CONAP S-8 Solvent.

A tracer dye is used in CE-1132 and CE-1133 to aid in inspection of the cured film under 'black' light.

PRODUCT SPECIFICATIONS

Brookfield Viscosity @ 25°C	500 - 800
Specific Gravity @ 25°C	0.97 - 1.01
Solids Content, %	30 - 33
Flashpoint, °F, Tag Closed Cup	55
Dip Tank Stability	Indefinite *

* Although after a matter of days, due to solvent evaporation, there may be some increase in viscosity. This may be corrected with CONAP S-8 Solvent.

TYPICAL PROPERTIES OF CURED FILM

The properties of CE-1132 films presented in this bulletin were obtained on samples prepared in the laboratory. The values are average, based on several tests and are not intended for use in preparation of specifications.

Physical Properties

Color	Clear
Hardness, Shore D	80
Water Absorption, %, 24 hr. Immersion	0.18
Chemical and Solvent Resistance	Fair to Good*
Fungus Resistance	Non-Nutrient (MIL-E-5272C)
Flexibility, Bend over 1/8" Mandrel	No cracking or crazing of coating
Repairability, Soldering Iron	Excellent
Thermal Shock, 5 cycles from -55°C to 95°C	Passes
Inspection	Invisible dye, fluorescent under black light

* If it becomes necessary to remove the coating from the entire assembly, this feature enables the user to remove the cured film quite easily by using methyl ethyl ketone. Care should be exercised in the removal of the coating in that if the assembly is exposed to this solvent for too long a period, it or any attached components may also be attacked.

Before recoating the assembly, it is recommended that the assembly be recleaned and thoroughly dried.

Electrical Properties	25°C	60°C
Dielectric Strength, vpm		
1 Mil film	6500	-
3 Mil film	4000	-
Dielectric Constant 100Hz	3.35	3.50
1KHz	3.30	3.45
1MHz	3.40	-
Dissipation Factor 100Hz	.007	.007
1KHz	.007	.007
1MHz	.006	-
Volume Resistivity, ohm-cm	1.4×10^{15}	

Insulation Resistance, ohms (4 mil films)*

- Initial (at 25°C - 50% R.H.)....................2.50×10^{13}
- After 1 day (at 65°C - 95% R.H.)....................2.40×10^{12}
- After 7 days (at 65°C - 95% R.H.)....................3.50×10^{10}
- After 10 days (at 65°C - 95% R.H.)....................2.10×10^{10}
  - After conditioning 24 hours @ 25°C - 50% R.H....................5.70×10^{10}

Dielectric Withstanding Voltage, 1500 v.a.c.*....................No flashover or breakdown

* Tested in accordance with MIL-I-46058. The films maintained excellent adhesion to the epoxy-glass laminates during the 10-day humidity/temperature cycling test. No underfilm corrosion of the copper conductors was observed.

APPLICATION INFORMATION

CONAP CE-1132 does not require continuous mixing; nor is deairation necessary. Air bubbles generated by pouring will normally dissipate within a few minutes.

CONAP CE-1132 is a high performance printed circuit coating and the ultimate performance of the cured coating is dependent on process controls used in application of the coating. Cleanliness of the substrate is a major factor in preventing underfilm corrosion. Boards MUST be clean, oil-free and dry. For specific recommendations, please request Technical Bulletin C-115.

Conventional dipping, spraying or brushing techniques may be used to apply CE-1132. It is recommended that the coating be used as supplied for dip coating. A single dip coat on a board will deposit a film thickness of 2 to 2 1/2 mils, if the withdrawl rate is 4 inches per minute.

CE-1132 may be sprayed by dilution with CONAP S-8 Solvent.

Two coats are recommended for optimum performance. However, one coat may perform well for non-critical applications. Cure is accomplished by pre-baking 15 minutes at 50°C for each coating application followed by a final cure of 60 minutes at 75°C.

For optimum protection against severe humidity, allow a 30 minute air dry after each coat and pre-bake 30 minutes at 50°C, followed by a FINAL CURE of 4 hours at 75°C.

HANDLING AND STORAGE

Maintain containers at room temperature and keep securely closed when not in use to prevent solvent evaporation.

CONAP CE-1132 has a shelf life of at least 1 year when stored in original, unopened containers.

CAUTION: CE-1132 contains solvents and should be handled in the same manner as any material containing solvents. Avoid skin contact with uncured materials and inhalation of vapors. If contact does occur, wash with soap and water.

AVAILABILITY

CONAP CE-1132 is available in quart, gallon, 5-gallon, and drum containers.

An Evaluation Kit, containing 1 quart of CE-1132, 1 pint of CE-1133 and 1 pint of CONAP S-8 Solvent, is available for $10.00 per kit.

F.O.B. Olean, New York 14760
Mississauga, Ontario, Canada

TERMS: Net 30 Days

μA776

MULTI-PURPOSE PROGRAMMABLE OPERATIONAL AMPLIFIER

FAIRCHILD LINEAR INTEGRATED CIRCUIT

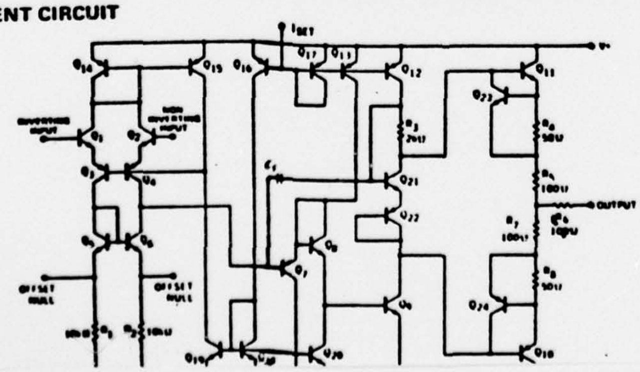
DESCRIPTION – The μA776 Programmable Operational Amplifier is constructed using the Fairchild Planar* epitaxial process. High input impedance, low supply currents, and low input noise over a wide range of operating supply voltages coupled with programmable electrical characteristics result in an extremely *versatile amplifier* for use in high accuracy, low power consumption analog applications. Input noise voltage and current, power consumption, and input current can be optimized by a single resistor or current source that sets the chip quiescent current for nano-watt power consumption or for characteristics similar to the μA741. Internal frequency compensation, absence of latch up, high slew rate and short circuit current protection assure ease of use in long time integrators, active filters, and sample and hold circuits.

- MICROPOWER CONSUMPTION
- ±1.2V to ±18V OPERATION
- NO FREQUENCY COMPENSATION REQUIRED
- LOW INPUT BIAS CURRENTS
- WIDE PROGRAMMING RANGE
- HIGH SLEW RATE
- LOW NOISE
- SHORT CIRCUIT PROTECTION
- OFFSET NULL CAPABILITY
- NO LATCH UP

ABSOLUTE MAXIMUM RATINGS

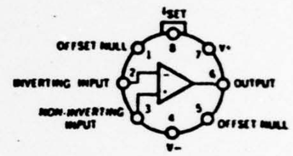
Supply Voltage	±18 V
Internal Power Dissipation (Note 1)	
Metal Can	500 mW
DIP	670 mW
Mini DIP	310 mW
Differential Input Voltage	±30 V
Input Voltage (Note 2)	±15 V
Voltage Between Offset Null and V−	±0.5 V
I_{SET} (Maximum Current at I_{SET})	500 μA
V_{SET} (Maximum Voltage to Ground at I_{SET})	$(V_+ - 2.0\text{ V}) < V_{SET} < V_+$
Storage Temperature Range	
Metal Can, DIP	−65°C to +150°C
Mini DIP	−55°C to +125°C
Operating Temperature Range	
Military (776)	−55°C to +125°C
Commercial (776C)	0°C to +70°C
Lead Temperature (Soldering, 60 seconds)	
Metal Can, DIP	300°C
Mini DIP	260°C
Output Short-Circuit Duration (Note 3)	Indefinite

EQUIVALENT CIRCUIT



CONNECTION DIAGRAMS

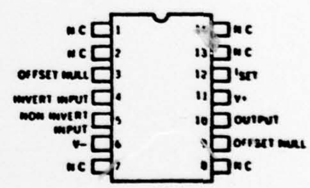
8-LEAD METAL CAN (TOP VIEW) PACKAGE OUTLINE 5B



ORDER INFORMATION

TYPE	PART NO.
776	776HM
776C	776HC

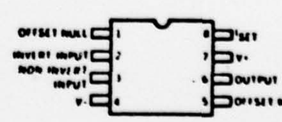
14-LEAD DIP (TOP VIEW) PACKAGE OUTLINE 6A



ORDER INFORMATION

TYPE	PART NO.
776	776DM
776C	776DC

8-LEAD MINI DIP (TOP VIEW) PACKAGE OUTLINE 9T



ORDER INFORMATION

TYPE	PART NO

±15 VOLT OPERATION FOR 776

ELECTRICAL CHARACTERISTICS (T_A = 25°C, Unless Otherwise Specified)

PARAMETERS		CONDITIONS	I_{SET} = 1.5µA MIN.	TYP.	MAX.	I_{SET} = 15µA MIN.	TYP.	MAX.	UNITS
Input Offset Voltage		R_S<10kΩ		2.0	5.0		2.0	5.0	mV
Input Offset Current		R_S<10kΩ		0.7	3.0		2.0	15	nA
Input Bias Current				2.0	7.5		15	50	nA
Input Resistance				50			5.0		MΩ
Input Capacitance				2.0			2.0		pF
Offset Voltage Adjustment Range				9.0			18		mV
Large Signal Voltage Gain		R_L>75kΩ, V_{OUT} = ±10V	200k	400k					V/V
		R_L>5kΩ, V_{OUT} = ±10V				100k	400k		V/V
Output Resistance				5.0k			1.0k		Ω
Output Short-Circuit Current				3.0			12		mA
Supply Current				20	25		160	180	µA
Power Consumption					0.75			5.4	mW
Transient Response (unity gain)	Risetime	V_{IN} = 20mV, R_L > 5kΩ, C_L = 100pF		1.6			0.35		µs
	Overshoot			0			10		%
Slew Rate		R_L>5kΩ		0.1			0.8		V/µs
Output Voltage Swing		R_L>75kΩ	±12	±14					V
		R_L>5kΩ				±10	±13		V
The following specifications apply −55°C<T_A< +125°C									
Input Offset Voltage		R_S<10kΩ			6.0			6.0	mV
Input Offset Current		T_A = +125°C			5.0			15	nA
		T_A = −55°C			10			40	nA
Input Bias Current		T_A = +125°C			7.5			50	nA
		T_A = −55°C			20			120	nA
Input Voltage Range			±10			±10			V
Common Mode Rejection Ratio		R_S<10kΩ	70	90		70	90		dB
Supply Voltage Rejection Ratio		R_S<10kΩ		25	150		25	150	µV/V
Large Signal Voltage Gain		R_L>75kΩ, V_{OUT} = ±10V	100k			75k			V/V
Output Voltage Swing		R_L>75kΩ	±10			±10			V
Supply Current					30			200	µA
Power Consumption					0.9			6.0	mW

±3 VOLT OPERATION FOR 776

ELECTRICAL CHARACTERISTICS (T_A = 25°C, Unless Otherwise Specified)

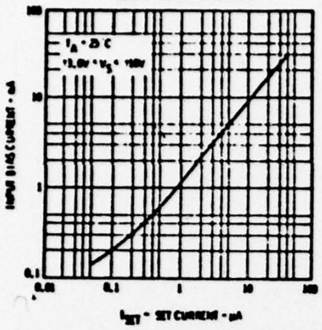
PARAMETERS		CONDITIONS	I_{SET} = 1.5μA MIN.	TYP.	MAX.	I_{SET} = 15μA MIN.	TYP.	MAX.	UNITS
Input Offset Voltage		R_S≤10kΩ		2.0	5.0		2.0	5.0	mV
Input Offset Current				0.7	3.0		2.0	15	nA
Input Bias Current				2.0	7.5		15	50	nA
Input Resistance				50			5.0		MΩ
Input Capacitance				2.0			2.0		pF
Offset Voltage Adjustment Range				9.0			18		mV
Large Signal Voltage Gain		R_L≥75kΩ, V_{OUT}=±1V	50k	200k					V/V
		R_L≥5kΩ, V_{OUT}=±1V				50k	200k		V/V
Output Resistance				5k			1k		Ω
Output Short-Circuit Current				3.0			5.0		mA
Supply Current				13	20		130	160	μA
Power Consumption				78	120		780	960	μW
Transient Response (unity gain)	Risetime	V_{IN} = 20mV, R_L > 5kΩ, C_L < 100pF		3.0			0.6		μs
	Overshoot			0			5		%
Slew Rate		R_L≥5kΩ		0.03			0.35		V/μs
The following specifications apply for −55°C < T_A < +125°C									
Input Offset Voltage		R_S≤10kΩ			6.0			6.0	mV
Input Offset Current		T_A = +125°C			5.0			15	nA
		T_A = −55°C			10			40	nA
Input Bias Current		T_A = +125°C			7.5			50	nA
		T_A = −55°C			20			120	nA
Input Voltage Range			±1.0			±1.0			V
Common Mode Rejection Ratio		R_S≤10kΩ	70	86		70	86		dB
Supply Voltage Rejection Ratio		R_S≤10kΩ		25	150		25	150	μV/V
Large Signal Voltage Gain		R_L≥75kΩ, V_{OUT}=±1V	25k						V/V
		R_L≥5kΩ, V_{OUT}=±1V				25k			V/V
Output Voltage Swing		R_L≥75kΩ	±2.0	±2.4					V
		R_L≥5kΩ				±1.9	±2.1		V
Supply Current					25			180	μA
Power Consumption					150			1080	μW

NOTES

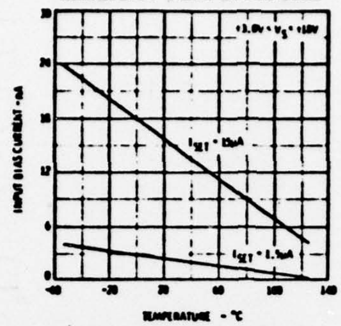
1. Rating applies to ambient temperatures up to 70°C. Above 70°C ambient derate linearly at 6.3 mW/°C for Metal Can, 8.3 mW/°C for the DIP, and 5.6 mW/°C for the Mini DIP.
2. For supply voltages less than ±15 V, the absolute maximum input voltage is equal to the supply voltage.
3. Short Circuit may be to ground or either supply. Rating applies to +125°C case temperature or +75°C ambient temperature for I_{SET} ≤ 30 μA.

TYPICAL PERFORMANCE CURVES FOR 776 AND 776C

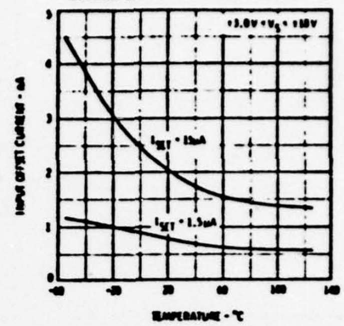
INPUT BIAS CURRENT AS A FUNCTION OF SET CURRENT



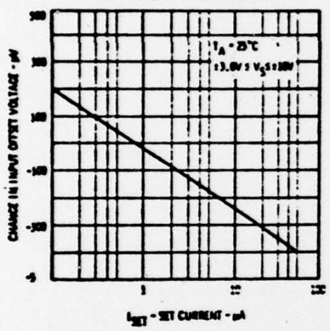
INPUT BIAS CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



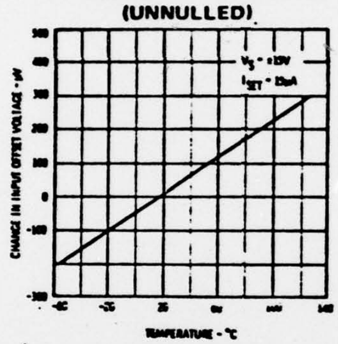
INPUT OFFSET CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



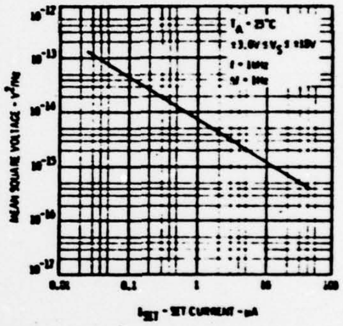
CHANGE IN INPUT OFFSET VOLTAGE AS A FUNCTION OF SET CURRENT



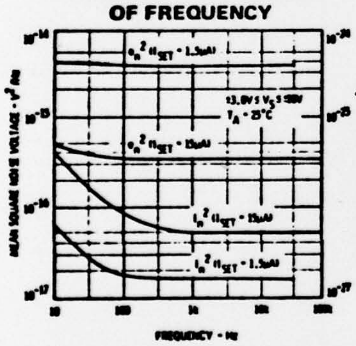
CHANGE IN INPUT OFFSET VOLTAGE AS A FUNCTION OF AMBIENT TEMPERATURE (UNNULLED)



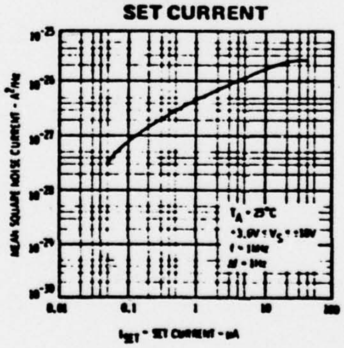
INPUT NOISE VOLTAGE AS A FUNCTION OF SET CURRENT



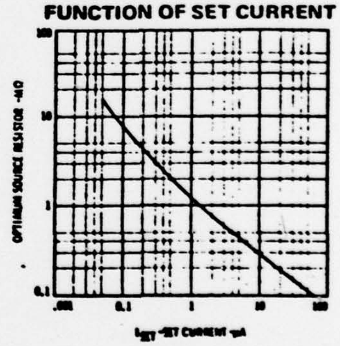
INPUT NOISE VOLTAGE AND CURRENT AS A FUNCTION OF FREQUENCY



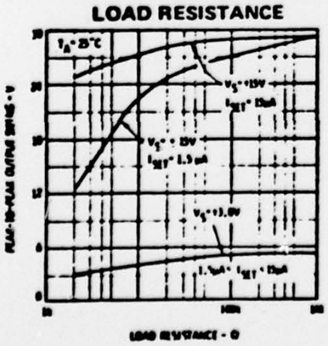
INPUT NOISE CURRENT AS A FUNCTION OF SET CURRENT



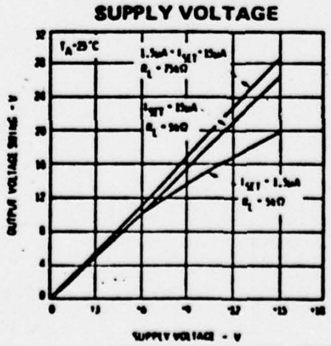
OPTIMUM SOURCE RESISTOR FOR MINIMUM NOISE AS A FUNCTION OF SET CURRENT



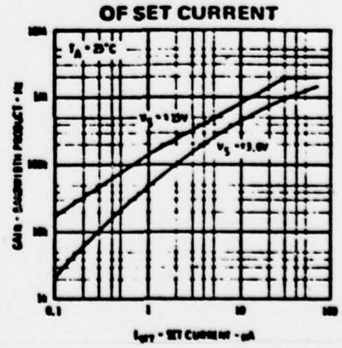
OUTPUT VOLTAGE SWING AS A FUNCTION OF LOAD RESISTANCE



OUTPUT VOLTAGE SWING AS A FUNCTION OF SUPPLY VOLTAGE

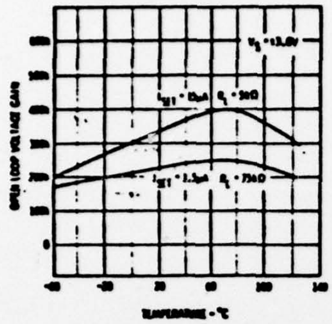


GAIN-BANDWIDTH PRODUCT AS A FUNCTION OF SET CURRENT

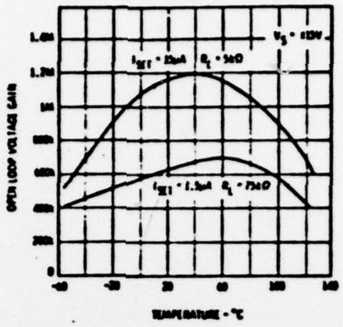


TYPICAL PERFORMANCE CURVES FOR 776 AND 776C

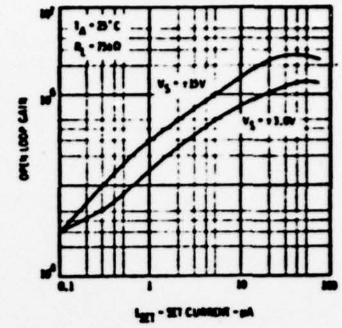
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF AMBIENT TEMPERATURE



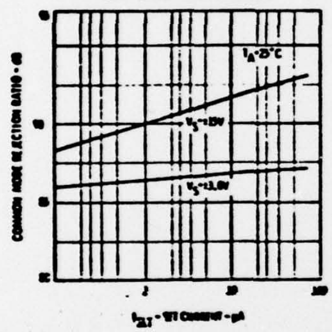
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF AMBIENT TEMPERATURE



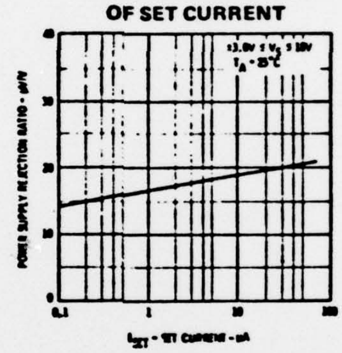
OPEN LOOP VOLTAGE GAIN AS A FUNCTION OF SET CURRENT



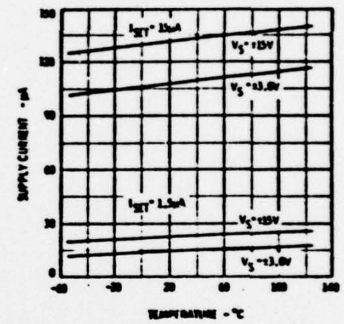
COMMON MODE REJECTION RATIO AS A FUNCTION OF SET CURRENT



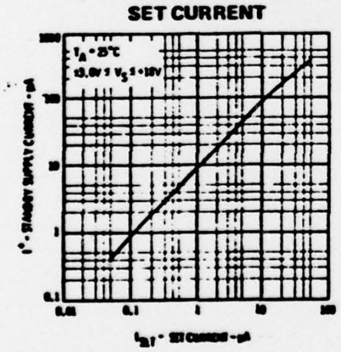
POWER SUPPLY REJECTION RATIO AS A FUNCTION OF SET CURRENT



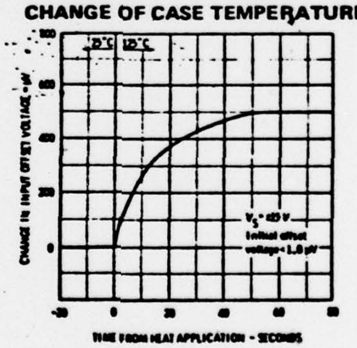
SUPPLY CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE



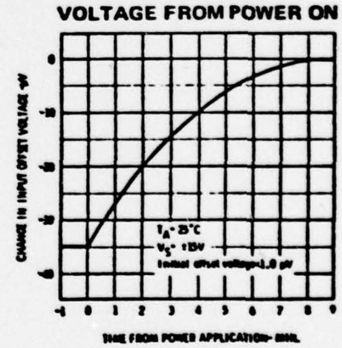
STANDBY SUPPLY CURRENT AS A FUNCTION OF SET CURRENT



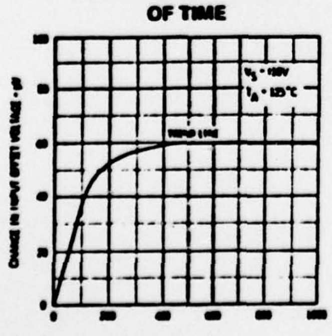
THERMAL RESPONSE OF INPUT OFFSET VOLTAGE TO STEP CHANGE OF CASE TEMPERATURE



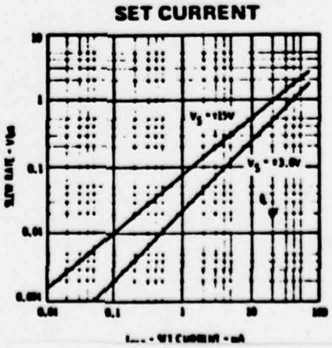
STABILIZATION TIME OF INPUT OFFSET VOLTAGE FROM POWER ON



INPUT OFFSET VOLTAGE DRIFT AS A FUNCTION OF TIME



SLEW RATE AS A FUNCTION OF SET CURRENT



VOLTAGE FOLLOWER TRANSIENT RESPONSE (UNITY GAIN)