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INTEGRATED CIRCUITS, SILICON MONOLITHIC

BIPOLAR OPERATIONAL AMPLIFIERS,

BASED ON TYPE LM 110

ESA/SCC Detail Specification No. 9108/001

space components
coordination group

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DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	CHANGE Reference / Item	Approved DCR No.
'A'	Nov. '87	P1. Cover Page	None
		P2. DCN	None
		P7. Table 1(a) : Lead material and finish to SCC 23500 added	21025
		P15. Para. 2 : MIL-STD-1276 deleted	21025
		Para. 4.2.2 : PIND test added	22603
		P17. Para. 4.4.2 : Paragraph rewritten to SCC 23500	21025
'B'	Dec. '91	P1. Cover Page	None
		P2. DCN	None
		P3. T of C : Para. 4.3.3 deleted	None
		P15. Para. 4.2.2 : Deviation deleted, "None" added	21048
		P16. Para. 4.2.4 : Deviation deleted, "None" added	22919
		Para. 4.2.5 : Deviation deleted, "None" added	22919
		Para. 4.3.3 : Paragraph deleted	22921
		This specification has been transferred from hardcopy to electronic format. The content is unchanged but minor differences in presentation exist.	

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TABLES

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FIGURES

APPENDICES (Applicable to specific Manufacturers only)
None.

1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for a silicon monolithic, bipolar operational amplifier, based on Type LM 110. It shall be read in conjunction with ESA/SCC Generic Specification No. 9000, the requirements of which are supplemented herein.

1.2 COMPONENT TYPE VARIANTS

Variants of the basic type integrated circuits specified herein, which are also covered by this specification, are given in Table 1(a).

1.3 MAXIMUM RATINGS

The maximum ratings, which shall not be exceeded at any time during use or storage, applicable to the integrated circuits specified herein, are as scheduled in Table 1(b).

1.4 PARAMETER DERATING INFORMATION

As per Figure 1.

1.5 PHYSICAL DIMENSIONS

As per Figure 2.

1.6 PIN ASSIGNMENT

As per Figure 3(a).

1.7 TRUTH TABLE (FIGURE 3(b))

Not applicable.

1.8 CIRCUIT SCHEMATIC

As per Figure 3(c).

1.9 FUNCTIONAL DIAGRAM

As per Figure 3(d).

TABLE 1(a) - TYPE VARIANTS

VARIANT	CASE	FIGURE	LEAD MATERIAL AND FINISH
-01	FLAT	2(a)	D2
-02	FLAT	2(a)	D3 or D4
-03	TO99	2(b)	D2
-04	TO99	2(b)	D3 or D4
-05	DIL	2(c)	D2
-06	DIL	2(c)	D3 or D4

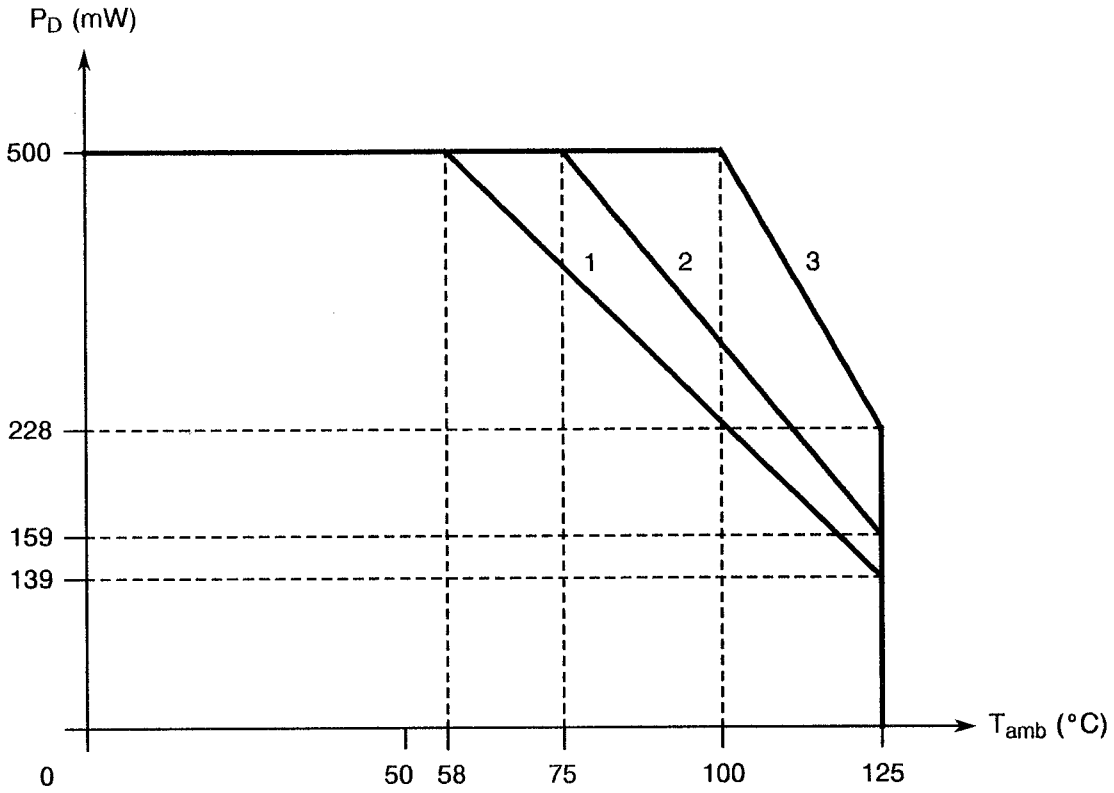
TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNITS	REMARKS
1	Supply Voltage	V_{CC}	± 18	V	
2	Input Voltage	V_I	± 15	V	Note 1
3	Output Short Circuit Duration	$I_{OS(t)}$	Indefinite	-	Note 2
4	Power Dissipation - Type Variants 01-02 - Type Variants 03-04 - Type Variants 05-06	P_{DISS}	500	mW	 Note 3 Note 4 Note 5
5	Operating Temperature Range	T_{op}	− 55 to + 125	°C	
6	Storage Temperature Range	T_{stg}	− 65 to + 150	°C	
7	Soldering Temperature	T_{sol}	+ 300	°C	Note 6
8	Junction Temperature	T_j	+ 150	°C	

NOTES

1. For supply voltages less than ± 15V, the absolute maximum input voltage is equal to supply voltage.
2. Short circuit may be to either ground or supply. Rating applies to T_{case} = + 125°C or T_{amb} = + 70°C. If device is driven from a low impedance source a resistor (≥2.0kΩ) must be connected in series with the input to prevent damage to device when the output is shorted.
3. Derate above T_{amb} = + 58°C at 185°C/W. See Figure 1 Derating Curve.
4. Derate above T_{amb} = + 75°C at 150°C/W. See Figure 1 Derating Curve.
5. Derate above T_{amb} = + 100°C at 100°C/W. See Figure 1 Derating Curve.
6. Duration 10 seconds maximum at a distance of not less than 1.5mm from the can and the same lead shall not be resoldered until 3 minutes have elapsed.

FIGURE 1 - DEVICE DISSIPATION DERATING WITH TEMPERATURE

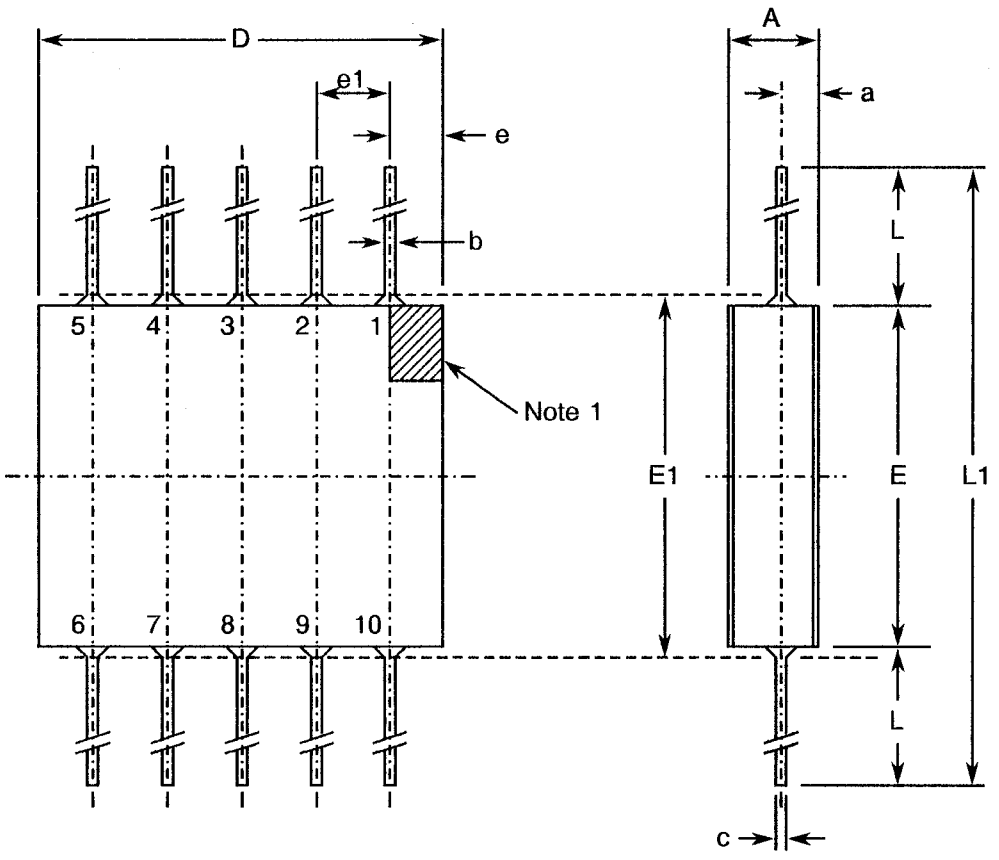


NOTES

1. Derating for type variants 01 and 02.
2. Derating for type variants 03 and 04.
3. Derating for type variants 05 and 06.

FIGURE 2 - PHYSICAL DIMENSIONS

FIGURE 2(a)



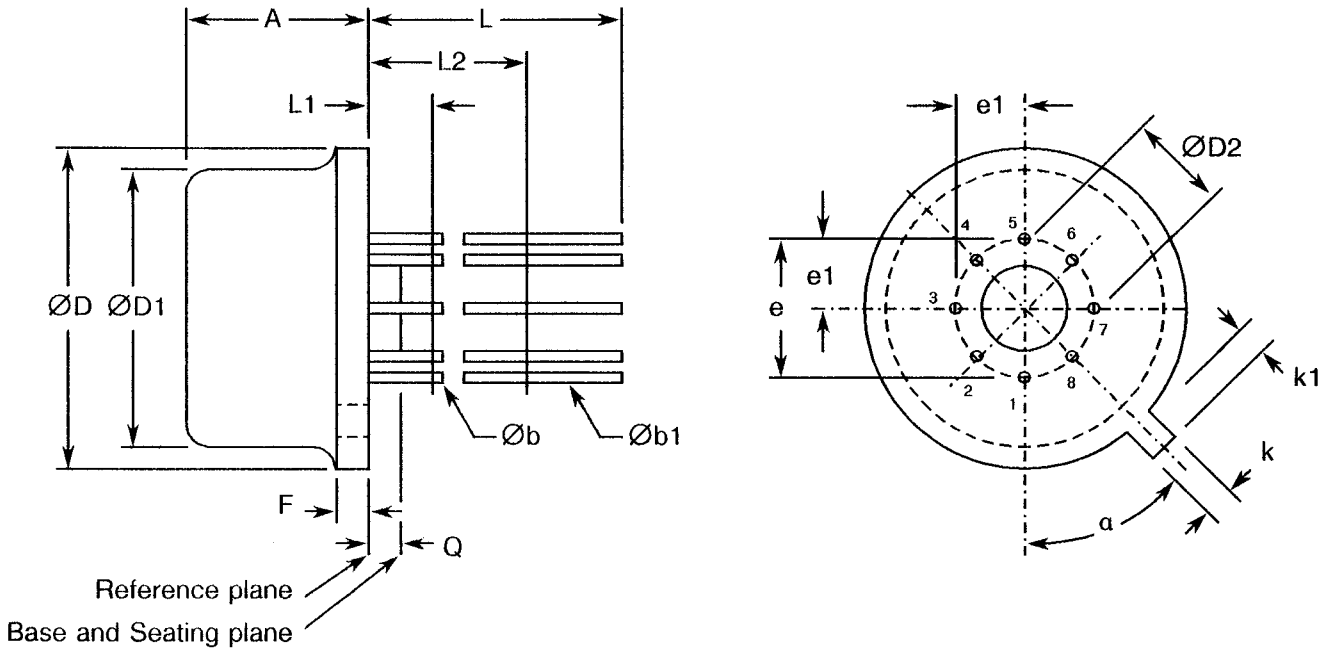
SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	-	0.080	-	2.03	
a	0.020	0.040	0.508	1.016	
b	0.015	0.019	0.381	0.483	
c	0.004	0.006	0.102	0.152	
D	-	0.260	-	6.60	
E	-	0.260	-	6.60	
E1	-	0.275	-	6.99	
e	0.065	0.085	1.65	2.159	
e1	0.045	0.055	1.14	1.40	
L	0.245	0.255	6.22	6.48	
L1	0.750	0.770	19.05	19.56	

NOTES

1. Index shall be identified by a notch or dot which shall be located adjacent to Pin 1 and shall be within the shaded area shown.

FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

FIGURE 2(b)



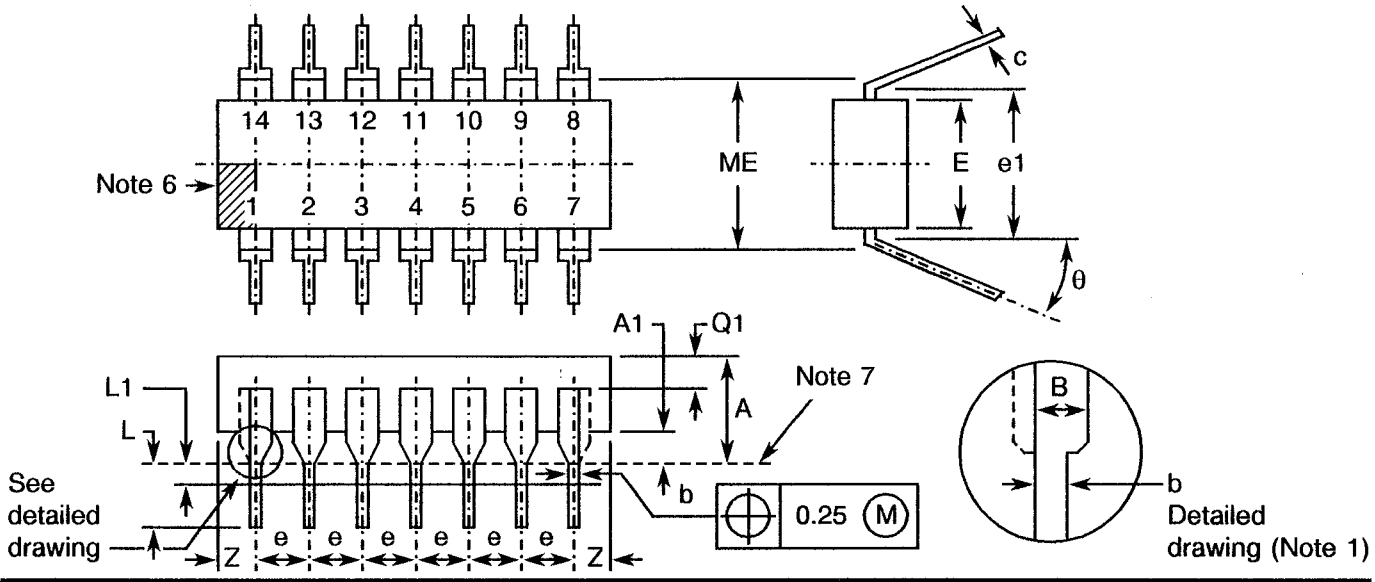
SYMBOL	INCHES		MILLIMETRES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.165	0.185	4.19	4.70	
Øb	0.016	0.019	0.41	0.48	1
Øb1	0.016	0.021	0.41	0.53	1
ØD	0.335	0.370	8.51	9.40	
ØD1	0.305	0.335	7.75	8.51	
ØD2	0.120	0.160	3.05	4.06	
e	0.200 BSC		5.08 BSC		3
e1	0.100 BSC		2.54 BSC		3
F	-	0.040	-	1.02	
k	0.027	0.034	0.69	0.86	
k1	0.027	0.045	0.69	1.14	2
L	0.500	0.750	12.70	19.05	1
L1	-	0.050	-	1.27	1
L2	0.250	-	6.35	-	1
Q	0.010	0.045	0.25	1.14	
α	45° BSC		45° BSC		3

NOTES

1. (All leads). Øb applies between L1 and L2. Øb1 applies between L2 and 0.500 (12.70mm) from the reference plane. Diameter is uncontrolled in L1 and beyond 0.500 (12.70mm) from the reference plane.
2. Measured from the maximum diameter of the product.
3. Leads having a maximum diameter 0.019 (0.48mm) measured in gauging plane 0.054 (1.37mm) +0.001 (0.03mm) −0.000 (0.00mm) below the base plane of the product shall be within 0.007 (0.18mm) of their true position relative to a maximum width tab.

FIGURE 2 - PHYSICAL DIMENSIONS (CONTINUED)

FIGURE 2(c) - DUAL-IN-LINE PACKAGE



SYMBOL	MILLIMETRES			INCHES			DEGREES		NOTES
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	MAX.	
A	-	-	5.08	-	-	0.200			
A1	0.51	-	-	0.020	-	-			
B	-	-	1.77	-	-	0.070			1
b	0.381	-	0.508	0.015	-	0.020			1
c	0.204	-	0.304	0.008	-	0.012			
E	-	6.3	-	-	0.25	-			
e	-	2.54 *	-	-	0.100 *	-			2
e1	-	7.62 *	-	-	0.300 *	-			3
L	2.5	-	3.9	0.098	-	0.154			(a)
L1	-	-	0.76	-	-	0.030			
ME	7.62	-	8.25	0.300	-	0.325			3
Q1	-	-	2.03	-	-	0.080			
Z									4
θ							0	15	
n =	7×2								5

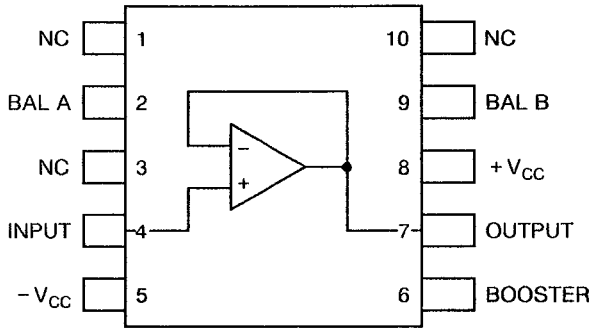
NOTES

1. The lead profile is not required for transition from B to b. The outline of the extreme outputs in the case of F.105A may differ from that of the others, as shown in the Figure.
2. The space between leads is measured on the area L1.
3. Measured when the value of the angle θ is zero.
4. Case F.105: Z between e/2 and e (1.27mm < Z < 2.54mm).
   Case F.105A: Z less than e/2 (Z < 1.27mm).
5. n = quantity of leads.
6. Area for visible reference mark on top face.
7. Base plane.
   * = accurate geometrical location.

(a) Recommended dimensions for the future: minimum 3.0mm (0.122 inch).
maximum 3.9mm (0.154 inch).

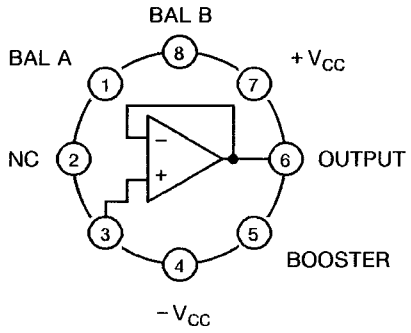
FIGURE 3(a) - PIN ASSIGNMENT

(i) - FLAT PACKAGE



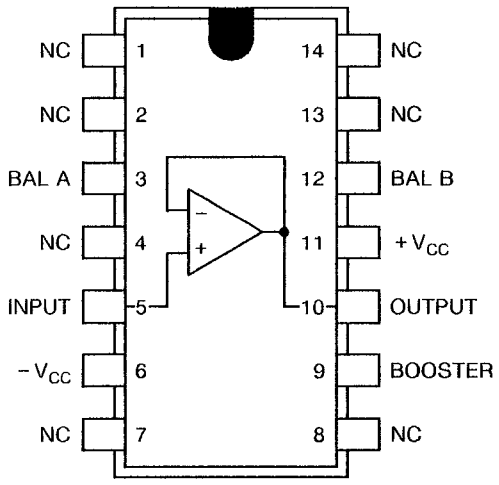
NOTES
1. Pin 5 is electrically connected to package base.

(ii) - TO99 PACKAGE



NOTES
1. Pin 4 is electrically connected to package base.

(iii) - DUAL-IN-LINE PACKAGE



NOTES
1. Pin 6 is electrically connected to package base.

FIGURE 3(b) - CIRCUIT SCHEMATIC

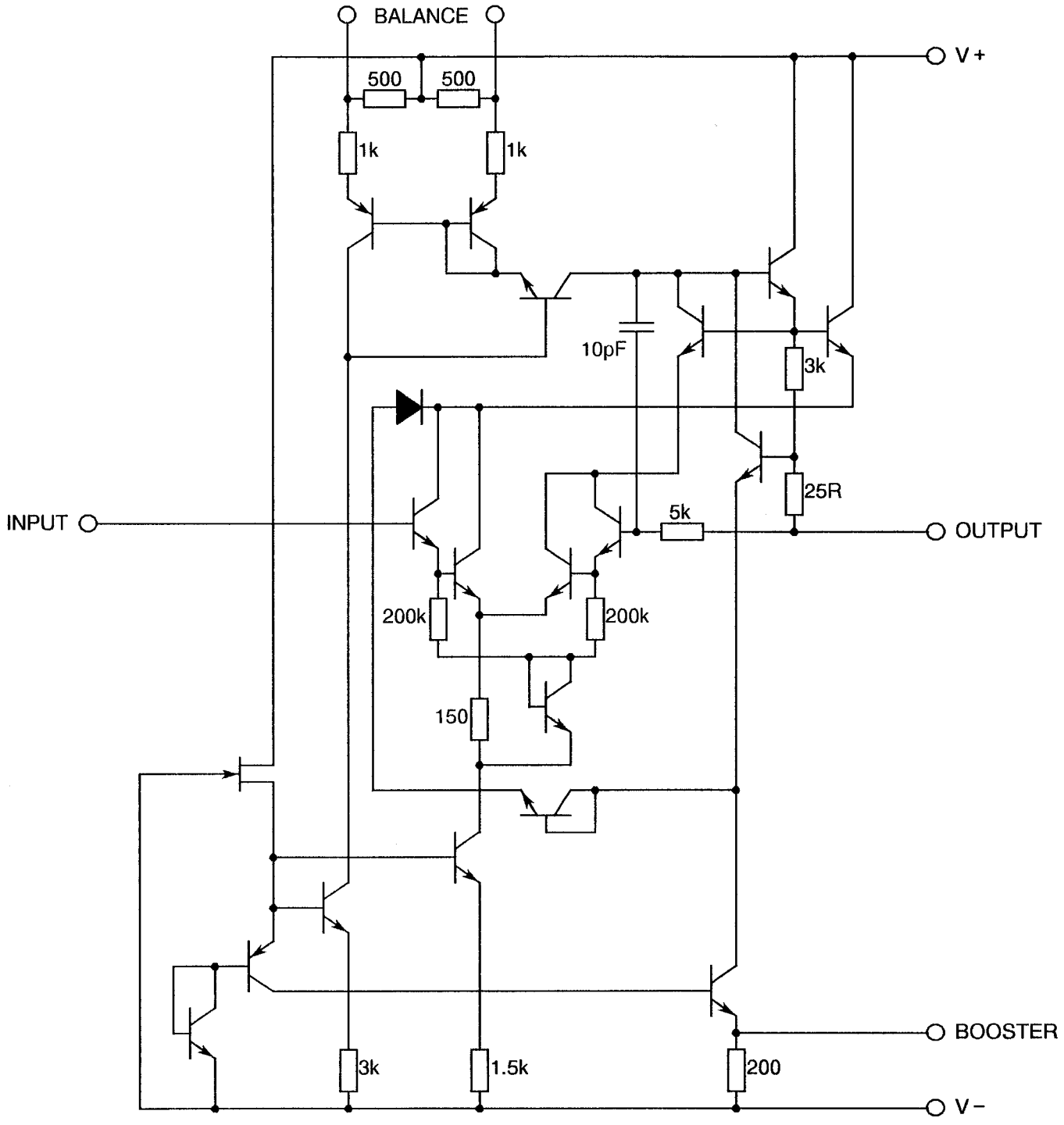
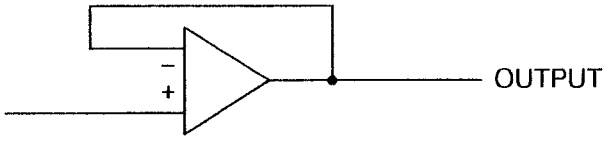


FIGURE 3(c) - FUNCTIONAL DIAGRAM



2. APPLICABLE DOCUMENTS

The following documents form part of this specification and shall be read in conjunction with it:-

(a) ESA/SCC Generic Specification No. 9000 for Integrated Circuits.

(b) MIL-STD-883, Test Methods and Procedures for Micro-electronics.

3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESA/SCC Basic Specification No. 21300 shall apply. In addition, the following abbreviations are used:-

PSRR = Power Supply Rejection Ratio.
OS = Overshoot.
RT = Rise Time.

4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the integrated circuits specified herein are stated in this specification and ESA/SCC Generic Specification No. 9000 for Integrated Circuits. Deviations from the Generic Specification applicable to this specification only, are listed in Para. 4.2.

Deviations from the applicable Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESA/SCC requirements and do not affect the components' reliability, are listed in the appendices attached to this specification.

4.2 DEVIATIONS FROM GENERIC SPECIFICATION

The following deviations from ESA/SCC Generic Specification No. 9000 shall apply:-

4.2.1 Deviations from Special In-process Controls

None.

4.2.2 Deviations from Final Production Tests (Chart II)

None.

4.2.3 Deviations from Burn-in Tests (Chart III)

Subpara. 7.1.1(a), "High Temperature Reverse Bias" test and subsequent electrical measurements related to this test shall be omitted.

4.2.4 Deviations from Qualification, Environmental and Endurance Tests (Chart IV)

None.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

None.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the integrated circuits specified herein shall be checked. They shall conform to those shown in Figure 2.

4.3.2 Weight

The maximum weight of the integrated circuits specified herein shall be for:-

Variants 01, 02: 0.35 grammes.
Variants 03, 04 : 1.50 grammes.
Variants 05, 06: 2.00 grammes.

4.4 MATERIALS

The materials shall be as specified herein. Where a definite material is not specified, a material which will enable the integrated circuits specified herein to meet the performance requirements of this specification shall be used. Acceptance or approval of any constituent material does not guarantee acceptance of the finished product.

4.4.1 Case

The case shall be hermetically sealed and have a metal body with hard glass seals or a ceramic body and the lids shall be welded, brazed, preform-soldered or glass frit-sealed.

4.4.2 Lead Material and Finish

The lead material shall be Type 'D' with either Type '2' or Type '3 or 4' finish in accordance with ESA/SCC Basic Specification No. 23500 (See Table 1(a) for Type Variants).

4.5 MARKING

4.5.1 General

The marking of components delivered to this specification shall be in accordance with ESA/SCC Basic Specification No. 21700. Each component shall be marked in respect of:-

(a) Lead Identification.

(b) The SCC Component Number.

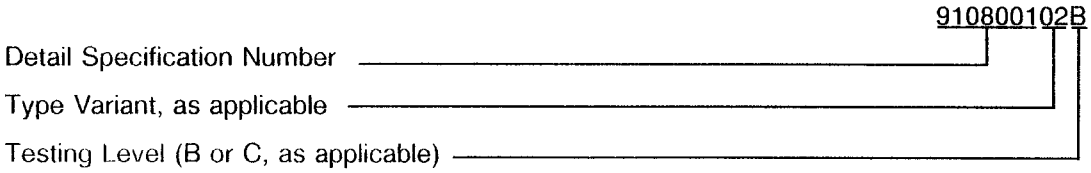
(c) Traceability Information.

4.5.2 Lead Identification

An index shall be located at the top of the package in the position defined in Figure 2 (Variants 01, 02), Note 1 of Figure 2 (Variants 03, 04) or Note 6 of Figure 2 (Variants 05, 06). Alternatively, a tab may be used to identify Pin No. 1 (Variants 01 and 02 only). The pin numbering shall be read with the index or tab on the left-hand side.

4.5.3 The SCC Component Number

Each component shall bear the SCC Component Number which shall be constituted and marked as follows:



4.5.4 Traceability Information

Each component shall be marked in respect of traceability information in accordance with ESA/SCC Basic Specification No. 21700.

4.5.5 Marking of Small Components

When it is considered that the component is too small to accommodate the marking as specified above, as much as space permits shall be marked. The order of precedence shall be as follows:-

(a) Lead Identification.

(b) The SCC Component Number.

(c) Traceability Information.

The marking information in full shall accompany each component in its primary package.

4.6 ELECTRICAL CHARACTERISTICS

4.6.1 Electrical Measurements at Room Temperature

The parameters to be measured in respect of electrical characteristics are scheduled in Table 2. Unless otherwise specified, the measurements shall be performed at $T_{amb} = +22 \pm 3$ °C.

4.6.2 Electrical Measurements at High and Low Temperatures

The parameters to be measured at high and low temperatures are scheduled in Tables 3(a) and 3(b). The measurements shall be performed at $T_{amb} = +125(+0-5)$°C and $-55(+5-0)$°C respectively.

4.6.3 Circuits for Electrical Measurements

Circuits for use in performing the electrical measurements listed in Tables 2 and 3 of this specification are shown in Figure 4.

4.7 BURN-IN TESTS

4.7.1 Parameter Drift Values

The parameter drift values applicable to burn-in are specified in Table 4 of this specification. Unless otherwise stated, measurements shall be performed at $T_{amb} = +22 \pm 3$ °C. The parameter drift values (Δ) applicable to the parameters scheduled, shall not be exceeded. In addition to these drift value requirements, the appropriate limit value specified for a given parameter in Table 2 shall not be exceeded.

4.7.2 Conditions for Burn-in

The requirements for burn-in are specified in Section 7 of ESA/SCC Generic Specification No. 9000. The conditions for burn-in shall be as specified in Table 5 of this specification.

4.7.3 Electrical Circuits for Burn-in

Circuits for use in performing the burn-in tests are shown in Figure 5 of this specification.

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - d.c. PARAMETERS

No.	Characteristics	Symbol	Test Method MIL-STD 883	Test Fig.	Meas'd Value	Test Conditions (Note 1)	Limits		Unit
							Min	Max	
1	Input Offset Voltage	V_{IO1}	4001	4(a)	E_1	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $R_S = 3.0k$ Note 2	-2.5	2.5	mV
2	Input Offset Voltage	V_{IO2}	4001	4(a)	E_2	$+V_{CC} = +5.0V$, $-V_{CC} = -5.0V$ $R_S = 3.0k$	-2.5	2.5	mV
3	Input (Plus) Offset Voltage Adjustment	$V_{+IO(ADJ)}$	-	4(b)	E_3	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $R_S = 3.0k$	5.0	-	mV
4	Input (Minus) Offset Voltage Adjustment	$V_{-IO(ADJ)}$	-	4(c)	E_4	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $R_S = 3.0k$	-	-5.0	mV
5	Input (Plus) Bias Current	I_{+IB}	4001	4(d)	E_5	$+V_{CC} = +18V$, $-V_{CC} = -18V$	-	3.0	nA
6	Output Resistance	R_O	-	4(e)	E_6	$+V_{CC} = +18V$, $-V_{CC} = -18V$	-	2.5	Ω
7	Power Supply Rejection Ratio (Plus)	+PSRR	4003	4(a)	E_7	$+V_{CC} = +10V$, $-V_{CC} = -18V$ Note 2	-	-70	dB
8	Power Supply Rejection Ratio (Minus)	-PSRR	4003	4(a)	E_8	$+V_{CC} = +18V$, $-V_{CC} = -10V$ Note 2	-	-70	dB
9	Power Supply Current	$I_{CC(+)}$	3005	4(f)	I_{CC}	$+V_{CC} = +18V$, $-V_{CC} = -18V$	-	5.5	mA
10	Output Voltage Swing (Plus)	$V_{OUT1(+)}$	4004	4(g)	E_9	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $V_{IN} = 10V$, $R_L = 10k$ Booster = Open Note 3	20	-	V

NOTES: See Page 22.

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - d.c. PARAMETERS (CONT'D)

No.	Characteristics	Symbol	Test Method MIL-STD 883	Test Fig.	Meas'd Value	Test Conditions (Note 1)	Limits		Unit
							Min	Max	
11	Output Voltage Swing (Minus)	$V_{OUT1(-)}$	4004	4(g)	E_{10}	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $V_{IN} = -10V$, $R_L = 10k$ Booster = Open Note 3	20	-	V
12	Output Voltage Swing (Plus)	$V_{OUT2(+)}$	4004	4(h)	E_{11}	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $V_{IN} = +10V$, $R_L = 3k3$ Booster = 100R to $-V_{CC}$ Note 3	20	-	V
13	Output Voltage Swing (Plus)	$V_{OUT2(+)}$	4004	4(h)	E_{12}	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $V_{IN} = -10V$, $R_L = 3k3$ Booster = 100R to $-V_{CC}$ Note 3	20	-	V
14	Short Circuit Output Current (Plus)	$I_{OS(+)}$	3011	4(i)	I_{OS1}	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $V_{IN} = +15V$ Duration = 5s	10	35	mA
15	Short Circuit Output Current (Minus)	$I_{OS(-)}$	3011	4(i)	I_{OS2}	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $V_{IN} = -15V$ Duration = 5s	1.5	10	mA
16	Open Loop Voltage Gain (Plus)	$+A_{VS}$	4004	4(j)	E_{13}	$+V_{CC} = +18V$, $-V_{CC} = -18V$	0.999	1.000	-
17	Open Loop Voltage Gain (Minus)	$-A_{VS}$	4004	4(j)	E_{14}	$+V_{CC} = +18V$, $-V_{CC} = -18V$	0.999	1.000	-

NOTES: See Page 22.

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - a.c. PARAMETERS

No.	Characteristics	Symbol	Test Method MIL-STD 883	Test Fig.	Test Conditions (Note 1)	Limits		Unit
						Min	Max	
18	Slew Rate (Plus)	SR(+)	4002	4(k)	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $V_{IN} = -5.0V$ to $+5.0V$ Rise Time $<10ns$ Note 4	25	-	V/µs
19	Slew Rate (Minus)	SR(−)	4002	4(k)	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $V_{IN} = -5.0V$ to $+5.0V$ Rise Time $<100ns$ Note 4	25	-	V/µs
20	RiseTime	RT	-	4(k)	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $V_{IN} = +50mV$ Rise Time $<10ns$ Note 4	-	44	ns
21	Overshoot	OS	-	4(k)	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $V_{IN} = +50mV$ Rise Time $<10ns$ Note 4	-	30	%
22	Bandwidth Small Signal	BW	-	4(k)	$+V_{CC} = +18V$, $-V_{CC} = -18V$ Notes 4 and 5	8.0	-	MHz

NOTES

1. (a) All supply voltages shall be held to within ±0.1V of the specific value.
   (b) All resistors are 0.1% tolerance.
   (c) All capacitors are 10% tolerance.
2. E_1, E_7 and E_8 etc. shall be measured to 4 places of accuracy.
3. V_{IN} shall be increased in steps of 0.1V starting at ±9.0V (as applicable) until the increase in output voltage (V_O) $<0.08V$ per 0.1V increase in V_{IN}. The last value of V_O shall be used to calculate V_{OUT}.
4. Sample Test Inspection Level = II, AQL = 2.5%.
5. Bandwidth = 0.32 / Rise Time (RT) µs = MHz.

TABLE 3(a) - ELECTRICAL MEASUREMENTS AT HIGH TEMPERATURE, +125(+0-5) °C (CONT'D)

No.	Characteristics	Symbol	Test Method MIL-STD 883	Test Fig.	Meas'd Value	Test Conditions (Note 1)	Limits		Unit
							Min	Max	
11	Output Voltage Swing (Minus)	$V_{OUT1(-)}$	4004	4(g)	E_{24}	$+V_{CC}$ = +18V, $-V_{CC}$ = −18V V_{IN} = −10V, R_L = 10k Booster = Open Note 3	20	-	V
12	Output Voltage Swing (Plus)	$V_{OUT2(+)}$	4004	4(h)	E_{25}	$+V_{CC}$ = +18V, $-V_{CC}$ = −18V V_{IN} = +10V, R_L = 3k3 Booster = 100R to $-V_{CC}$ Note 3	20	-	V
13	Output Voltage Swing (Plus)	$V_{OUT2(+)}$	4004	4(h)	E_{26}	$+V_{CC}$ = +18V, $-V_{CC}$ = −18V V_{IN} = −10V, R_L = 3k3 Booster = 100R to $-V_{CC}$ Note 3	20	-	V
14	Short Circuit Output Current (Plus)	$I_{OS(+)}$	3011	4(i)	I_{OS1}	$+V_{CC}$ = +18V, $-V_{CC}$ = −18V V_{IN} = +15V Duration = 5s	10	35	mA
15	Short Circuit Output Current (Minus)	$I_{OS(-)}$	3011	4(i)	I_{OS2}	$+V_{CC}$ = +18V, $-V_{CC}$ = −18V V_{IN} = −15V Duration = 5s	1.5	10	mA
16	Open Loop Voltage Gain (Plus)	$+A_{VS}$	4004	4(j)	E_{27}	$+V_{CC}$ = +18V, $-V_{CC}$ = −18V	0.999	1.000	-
17	Open Loop Voltage Gain (Minus)	$-A_{VS}$	4004	4(j)	E_{28}	$+V_{CC}$ = +18V, $-V_{CC}$ = −18V	0.999	1.000	-

NOTES: See Page 22.

TABLE 3(b) - ELECTRICAL MEASUREMENTS AT LOW TEMPERATURE, −55(+5−0) °C

No.	Characteristics	Symbol	Test Method MIL-STD 883	Test Fig.	Meas'd Value	Test Conditions (Note 1)	Limits		Unit
							Min	Max	
1	Input Offset Voltage	V_{IO1}	4001	4(a)	E_{29}	$+V_{CC}$ = +18V, $-V_{CC}$ = −18V R_S = 3.0k Note 2	−3.0	3.0	mV
2	Input Offset Voltage	V_{IO2}	4001	4(a)	E_{30}	$+V_{CC}$ = +5.0V, $-V_{CC}$ = −5.0V R_S = 3.0k	−3.0	3.0	mV
3	Input (Plus) Offset Voltage Adjustment	$V_{+IO(ADJ)}$	-	4(b)	E_{31}	$+V_{CC}$ = +18V, $-V_{CC}$ = −18V R_S = 3.0k	5.0	-	mV
4	Input (Minus) Offset Voltage Adjustment	$V_{-IO(ADJ)}$	-	4(c)	E_{32}	$+V_{CC}$ = +18V, $-V_{CC}$ = −18V R_S = 3.0k	-	−5.0	mV
5	Input (Plus) Bias Current	I_{+IB}	4001	4(d)	E_{33}	$+V_{CC}$ = +18V, $-V_{CC}$ = −18V	-	10	nA
6	Output Resistance	R_O	-	4(e)	E_{34}	$+V_{CC}$ = +18V, $-V_{CC}$ = −18V	-	5.0	Ω
7	Power Supply Rejection Ratio (Plus)	+PSRR	4003	4(a)	E_{35}	$+V_{CC}$ = +10V, $-V_{CC}$ = −18V Note 2	-	−70	dB
8	Power Supply Rejection Ratio (Minus)	−PSRR	4003	4(a)	E_{36}	$+V_{CC}$ = +18V, $-V_{CC}$ = −10V Note 2	-	−70	dB
9	Power Supply Current	$I_{CC(+)}$	3005	4(f)	I_{CC}	$+V_{CC}$ = +18V, $-V_{CC}$ = −18V	-	6.5	mA

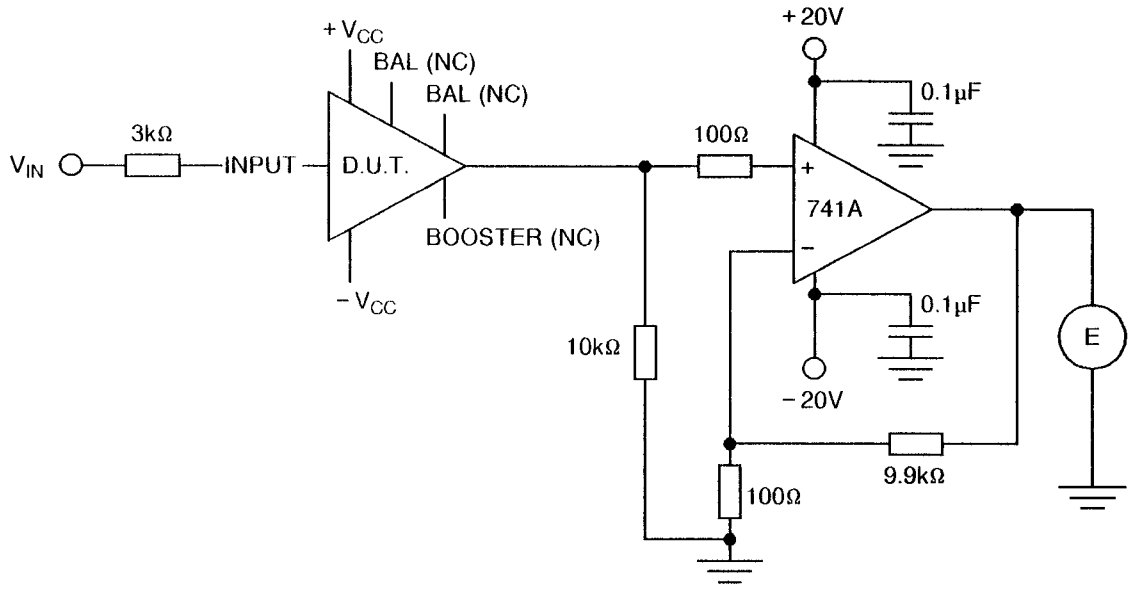
NOTES: See Page 22.

TABLE 3(b) - ELECTRICAL MEASUREMENTS AT LOW TEMPERATURE, −55(+5−0) °C (CONT'D)

No.	Characteristics	Symbol	Test Method MIL-STD 883	Test Fig.	Meas'd Value	Test Conditions (Note 1)	Limits		Unit
							Min	Max	
14	Short Circuit Output Current (Plus)	$I_{OS(+)}$	3011	4(i)	I_{OS1}	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $V_{IN} = +15V$ Duration = 5s	10	40	mA
15	Short Circuit Output Current (Minus)	$I_{OS(-)}$	3011	4(i)	I_{OS2}	$+V_{CC} = +18V$, $-V_{CC} = -18V$ $V_{IN} = -15V$ Duration = 5s	1.3	10	mA

NOTES: See Page 22.

FIGURE 4(a) - INPUT OFFSET VOLTAGE, POWER SUPPLY REJECTION RATIO

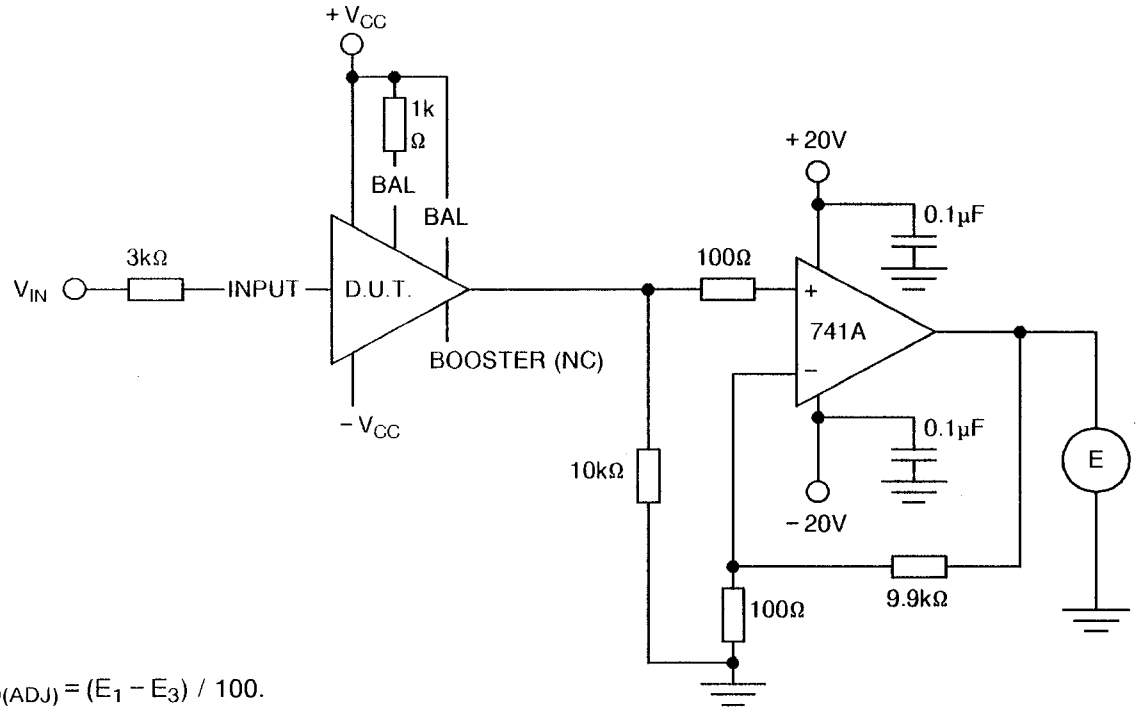


NOTES

1. $V_{IO1} = \frac{E_1}{100}$; $V_{IO2} = \frac{E_2}{100}$

2. $+PSRR = 20 \log_{10} (E_1 - E_7) / 8 \times 10^5$.
3. $-PSRR = 20 \log_{10} (E_1 - E_8) / 8 \times 10^5$.

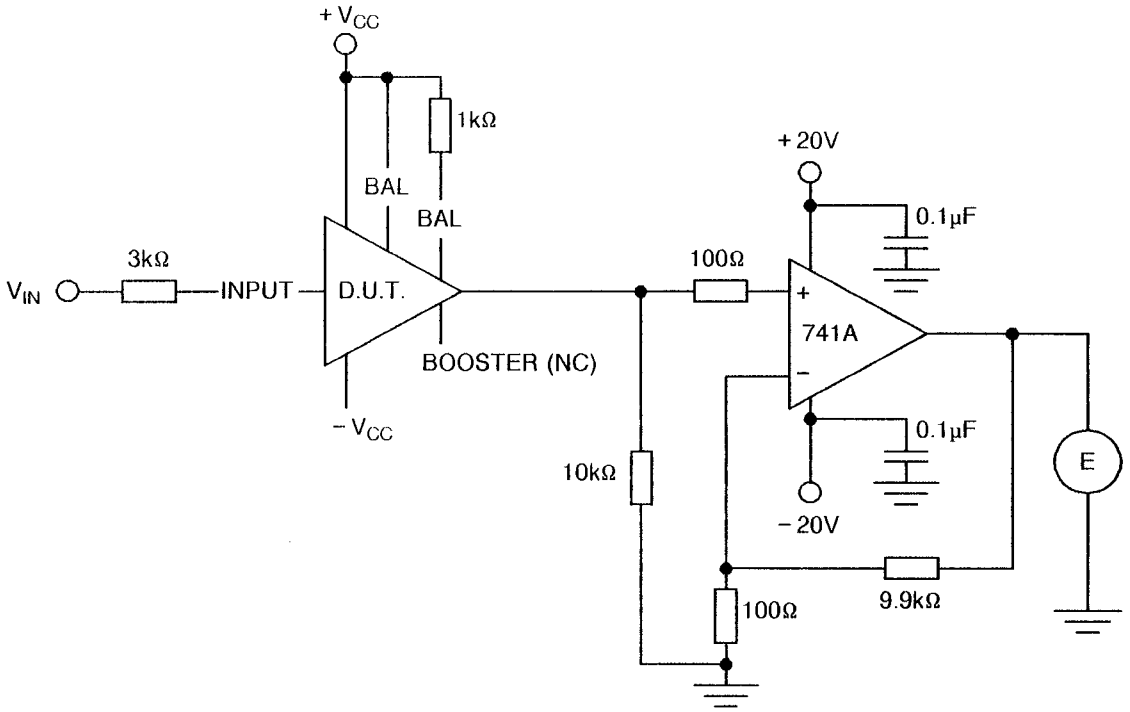
FIGURE 4(b) - INPUT (PLUS) OFFSET VOLTAGE ADJUSTMENT



NOTES

1. $V_{+IO(ADJ)} = (E_1 - E_3) / 100$.

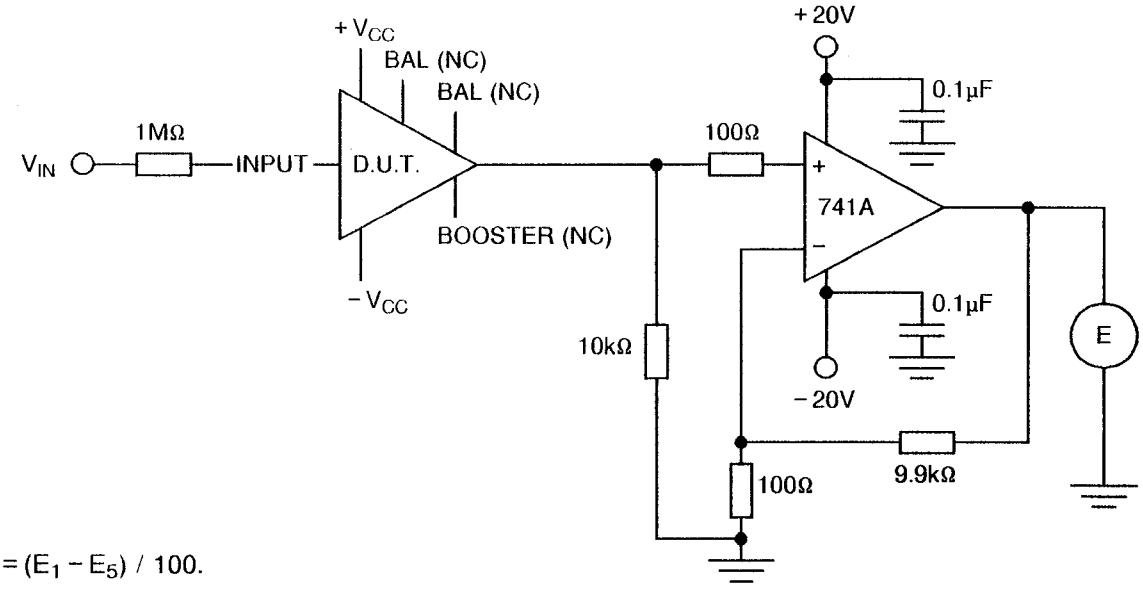
FIGURE 4(c) - INPUT (MINUS) OFFSET VOLTAGE ADJUSTMENT



NOTES

1. $V_{-IO(ADJ)} = (E_1 - E_4) / 100$.

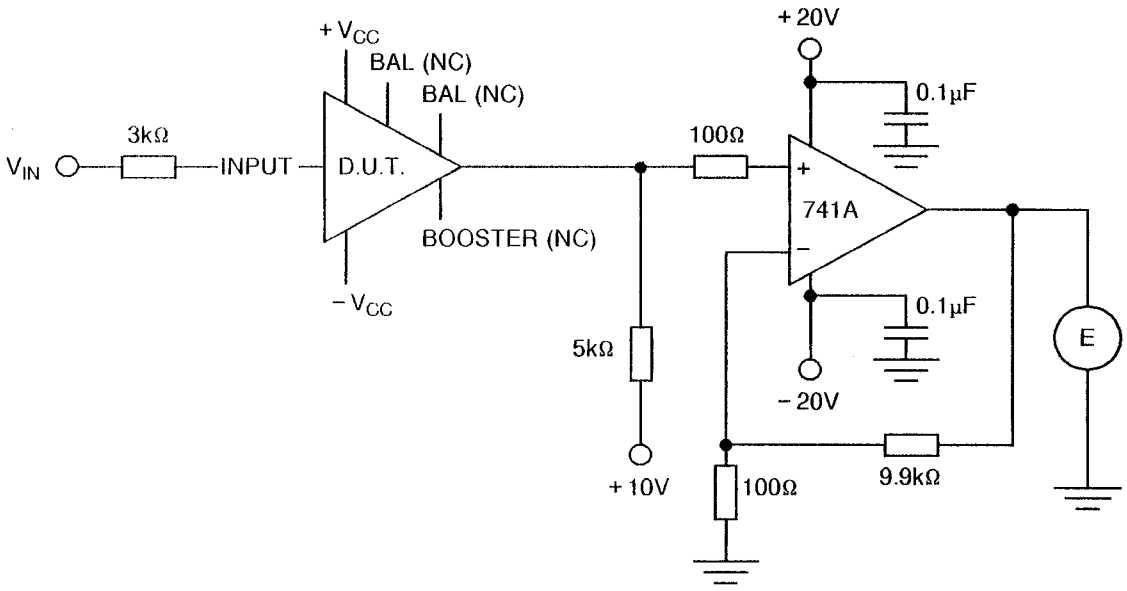
FIGURE 4(d) - INPUT (PLUS) BIAS CURRENT



NOTES

1. $I_{+IB} = (E_1 - E_5) / 100$.

FIGURE 4(e) - OUTPUT RESISTANCE



NOTES

1. $R_O = (E_6 - E_1) / 200$.

FIGURE 4(f) - POWER SUPPLY CURRENT

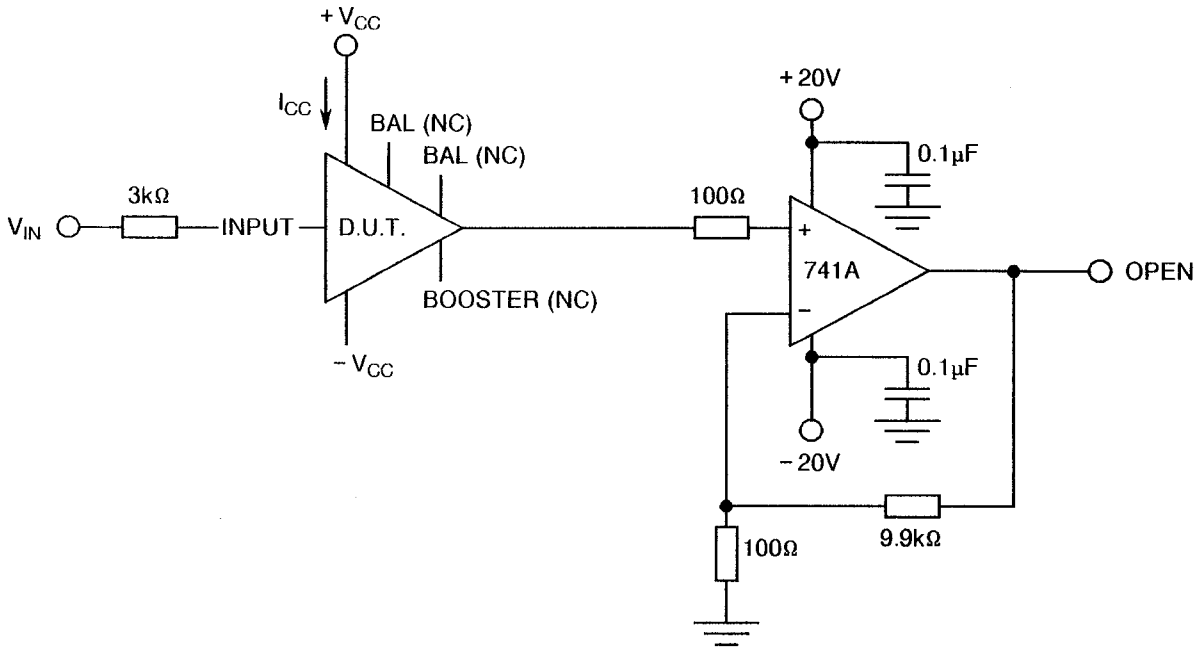
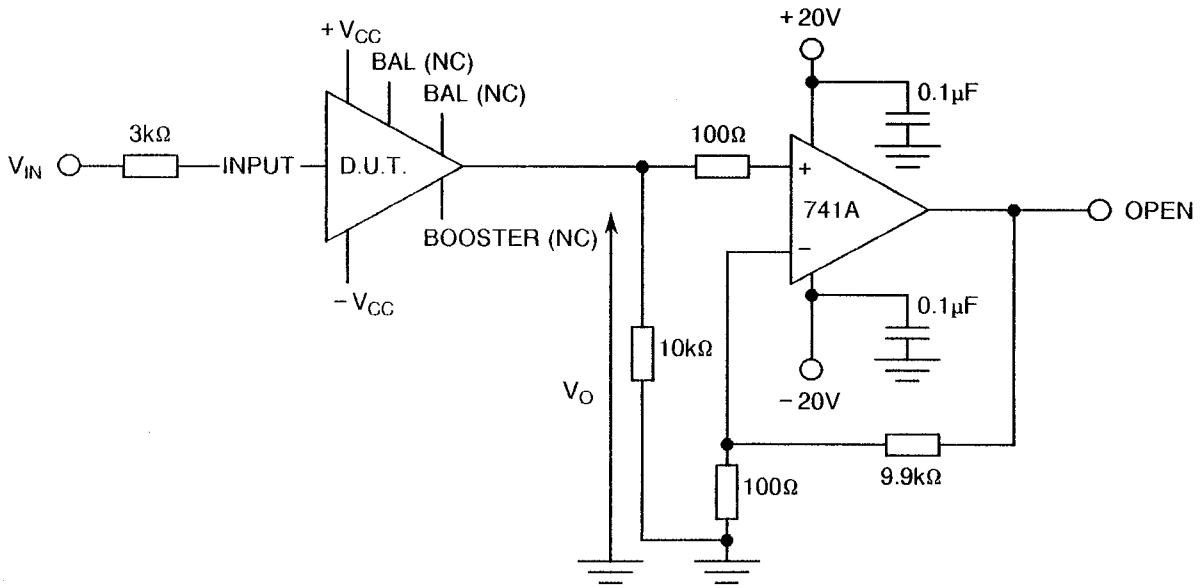


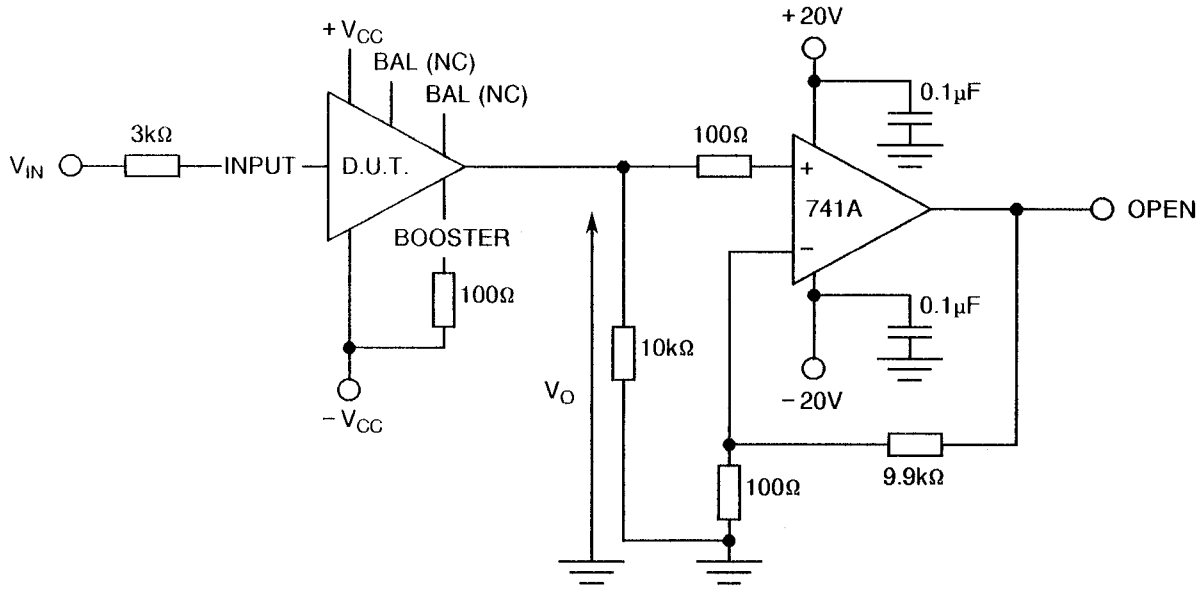
FIGURE 4(g) - OUTPUT VOLTAGE SWING (V_{OUT1})



NOTES

1. $V_{OUT_1} = (E_9 - E_{10})$.

FIGURE 4(h) - OUTPUT VOLTAGE SWING (V_{OUT2})



NOTES

1. $V_{OUT_2} = (E_{11} - E_{12})$.

FIGURE 4(i) - SHORT CIRCUIT OUTPUT CURRENT

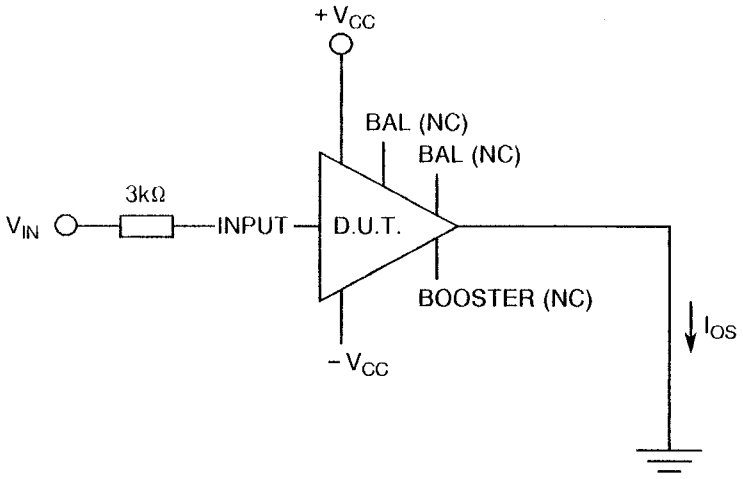
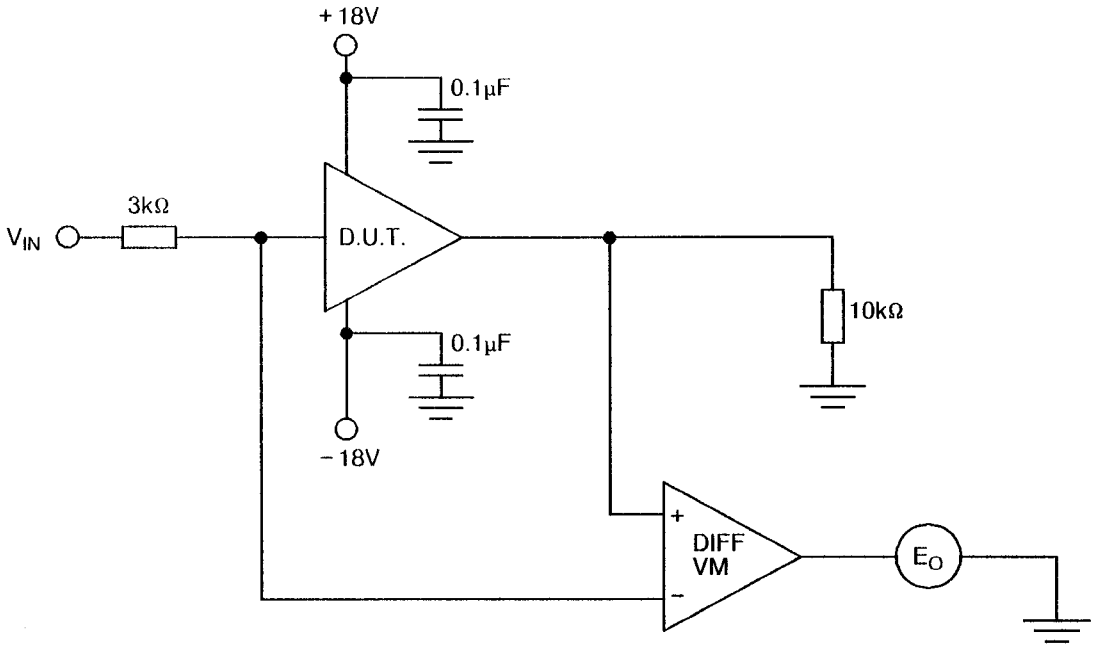


FIGURE 4(i) - OPEN LOOP VOLTAGE GAIN



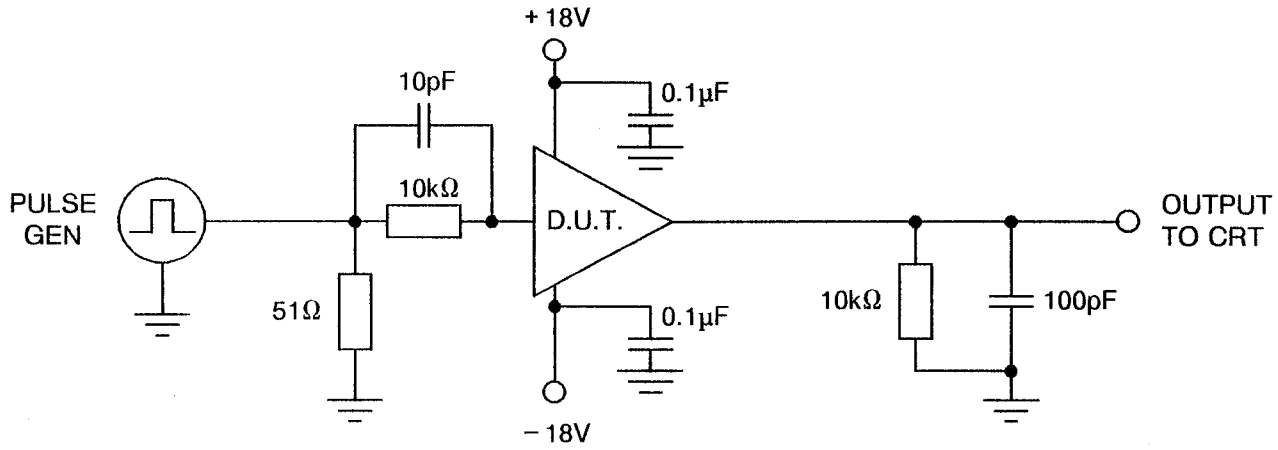
NOTES

1. The differential voltmeter shall have a common mode rejection equal to or greater than 100dB and a maximum common mode input range equal to or greater than ±15V.
2. To calculate voltage gain, use the following procedure:

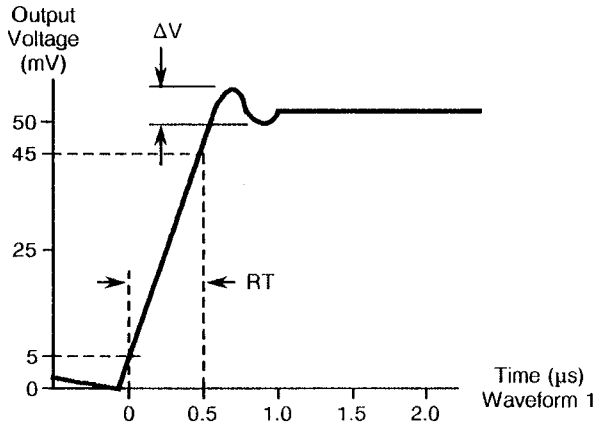
Step	V_{IN}	Measure	Equation
1	0V	E_{01}	
2	+10V	E_{02}	$A_{V+} = 1 - \frac{(E_{01} - E_{02})}{10}$
3	-10V	E_{03}	$A_{V-} = 1 - \frac{(E_{03} - E_{02})}{10}$

3. Test duration is 10ms.

FIGURE 4(k) - TRANSIENT RESPONSE TEST CIRCUIT FOR MEASUREMENT OF SLEW RATE, RISE-TIME, OVERSHOOT AND BANDWIDTH SMALL SIGNAL

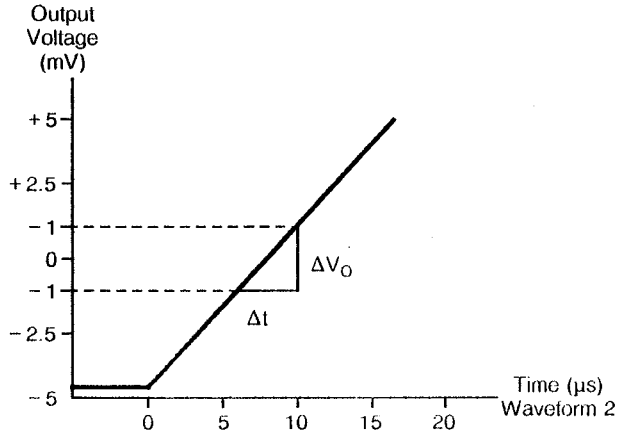


(i) OUTPUT WAVE - RISE TIME (RT) AND OVERSHOOT (OS)



$OS = 2.0\ (\Delta V)\ \%$

(ii) OUTPUT WAVE - SLEW RATE



$SR = \Delta V_O / \Delta t$

TABLE 3(a) - ELECTRICAL MEASUREMENTS AT HIGH TEMPERATURE, +125(+0-5) °C

No.	Characteristics	Symbol	Test Method MIL-STD 883	Test Fig.	Meas'd Value	Test Conditions (Note 1)	Limits		Unit
							Min	Max	
1	Input Offset Voltage	V_{IO1}	4001	4(a)	E_{15}	$+V_{CC}$ = +18V, $-V_{CC}$ = -18V R_S = 3.0k Note 2	-3.0	3.0	mV
2	Input Offset Voltage	V_{IO2}	4001	4(a)	E_{16}	$+V_{CC}$ = +5.0V, $-V_{CC}$ = -5.0V R_S = 3.0k	-3.0	3.0	mV
3	Input (Plus) Offset Voltage Adjustment	$V_{+IO(ADJ)}$	-	4(b)	E_{17}	$+V_{CC}$ = +18V, $-V_{CC}$ = -18V R_S = 3.0k	5.0	-	mV
4	Input (Minus) Offset Voltage Adjustment	$V_{-IO(ADJ)}$	-	4(c)	E_{18}	$+V_{CC}$ = +18V, $-V_{CC}$ = -18V R_S = 3.0k	-	-5.0	mV
5	Input (Plus) Bias Current	I_{+IB}	4001	4(d)	E_{19}	$+V_{CC}$ = +18V, $-V_{CC}$ = -18V	-	10	nA
6	Output Resistance	R_O	-	4(e)	E_{20}	$+V_{CC}$ = +18V, $-V_{CC}$ = -18V	-	2.5	Ω
7	Power Supply Rejection Ratio (Plus)	+PSRR	4003	4(a)	E_{21}	$+V_{CC}$ = +10V, $-V_{CC}$ = -18V Note 2	-	-70	dB
8	Power Supply Rejection Ratio (Minus)	-PSRR	4003	4(a)	E_{22}	$+V_{CC}$ = +18V, $-V_{CC}$ = -10V Note 2	-	-70	dB
9	Power Supply Current	$I_{CC(+)}$	3005	4(f)	I_{CC}	$+V_{CC}$ = +18V, $-V_{CC}$ = -18V	-	4.0	mA
10	Output Voltage Swing (Plus)	$V_{OUT1(+)}$	4004	4(g)	E_{23}	$+V_{CC}$ = +18V, $-V_{CC}$ = -18V V_{IN} = 10V, R_L = 10k Booster = Open Note 3	20	-	V

NOTES: See Page 22.

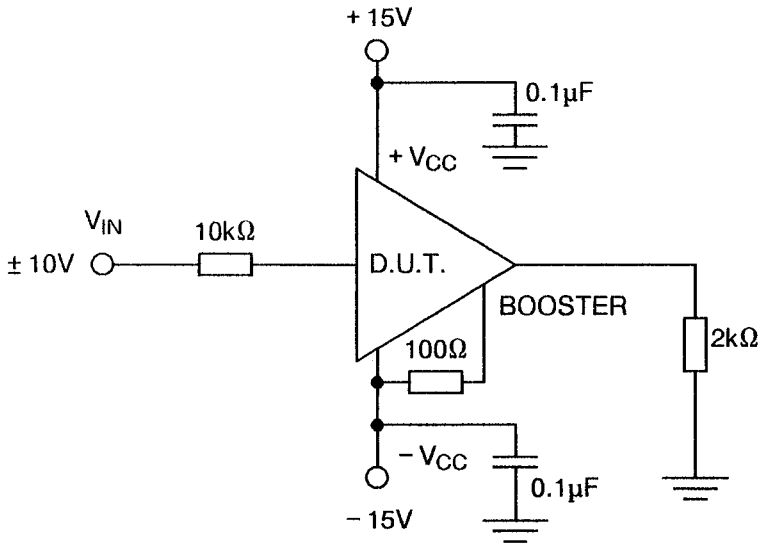
TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
1	Input Offset Voltage Change	V_{IO1}	As per Table 2	As per Table 2	± 0.5	mV
5	Input (Plus) Bias Current Change	I_{+IB}	As per Table 2	As per Table 2	± 1.0	nA
9	Power Supply Current Change	$I_{CC(+)}$	As per Table 2	As per Table 2	± 10	%

TABLE 5 - CONDITIONS FOR BURN-IN

No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	+ 125(+ 0 − 5)	°C
2	Supply Voltage	V_{CC}	± 15	V
3	Input Voltage	V_{IN}	± 10	V

FIGURE 5 - ELECTRICAL CIRCUIT FOR BURN-IN AND OPERATING LIFE



4.8 ENVIRONMENTAL AND ENDURANCE TESTS

4.8.1 Electrical Measurements on Completion of Environmental Tests

The parameters to be measured on completion of environmental tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +22 \pm 3$ °C.

4.8.2 Electrical Measurements at Intermediate Points during Endurance Tests

The parameters to be measured at intermediate points during endurance tests are as scheduled in Table 6 of this specification.

4.8.3 Electrical Measurements on Completion of Endurance Tests

The parameters to be measured on completion of endurance testing are as scheduled in Table 6 of this specification. Unless otherwise stated, the measurements shall be performed at $T_{amb} = +22 \pm 3$ °C.

4.8.4 Conditions for Operating Life Tests

The requirements for operating life testing are specified in Section 9 of ESA/SCC Generic Specification No. 9000. The conditions for operating life testing shall be as specified in Table 5 of this specification.

4.8.5 Electrical Circuits for Operating Life Tests

Circuits for use in performing the operating life tests are shown in Figure 5.

4.8.6 Conditions for High Temperature Storage Test

The requirements for the high temperature storage test are specified in ESA/SCC Generic Specification No. 9000. The conditions for high temperature storage shall be $T_{amb} = +150(+0-5)$ °C.

TABLE 6 - ELECTRICAL MEASUREMENTS ON COMPLETION OF ENVIRONMENTAL TESTS AND AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN	MAX	
1	Input Offset Voltage	V_{IO1}	As per Table 2	As per Table 2	−2.5	2.5	mV
5	Input (Plus) Bias Current	I_{+IB}	As per Table 2	As per Table 2	-	3.0	nA
9	Power Supply Current	$I_{CC(+)}$	As per Table 2	As per Table 2	-	5.5	mA
16	Open Loop Voltage Gain	$+A_{VS}$	As per Table 2	As per Table 2	0.999	1.000	-