INTEGRATED CIRCUITS, SILICON MONOLITHIC,

OPERATIONAL AMPLIFIER, BUFFER,

BASED ON TYPE LM118

ESCC Detail Specification No. 9101/006

ISSUE 1

October 2002

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SCC

space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 1	March 1984	-	-
Revision 'A'	September 1984	-	-
Revision 'B'	December 1987	-	-
Revision 'C'	December 1991	[signature]	[signature]

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	CHANGE Reference	Item	Approved DCR No.
'A'	Sep. '84	P1. Cover page		None
		P2. DCN		None
		P6. Table 1(b)	: Note 1 amended	22294
		P7. Figure 1	: Figure amended	22294
'B'	Dec. '87	P1. Cover page		None
		P2. DCN		None
		P12. Para. 4.2.2	: Condition added	22608
		Para. 4.2.3	: "Para. 12" entry deleted	22608
		P32. Table 5	: Amended	22365
		P33. Figure 5	: Amended	22365
'C'	Dec. '91	P1. Cover page		None
		P2. DCN		None
		P12. Para. 4.2.2	: Deviation deleted, "None." added	21048
		P13. Para. 4.2.4	: Deviation deleted, "None." added	22919
		Para. 4.2.5	: Deviation deleted, "None." added	22919
		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

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, operational amplifier, based on Type LM118. 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

Not applicable.

1.8 CIRCUIT SCHEMATIC

As per Figure 3(b).

1.9 FUNCTIONAL DIAGRAM

As per Figure 3(c).

TABLE 1(a) - TYPE VARIANTS

DASH No.	CASE	FIGURE	LEAD MATERIAL AND FINISH
-01	TO99	2	D2

TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNITS	REMARKS
1	Supply Voltage Range	V_{CC}	±20	V	
2	Input Voltage Range	V_I	±15	V	
3	Input Current Range	I_{ID}	−0.1 to +10	mA	
4	Power Dissipation - Type Variant 01	P_D	500	mW	Note 1
5	Operating Temperature Range (Ambient)	T_{op}	−55 to +125	°C	
8	Storage Temperature Range	T_{stg}	−55 to +150	°C	
9	Soldering Temperature	T_{sol}	+300	°C	Note 2
10	Junction Temperature	T_j	+150	°C	

NOTES

1. Derate above T_{amb} = +75°C at 6.67mW/°C. See Figure 1.
2. Duration 10 seconds maximum at a distance of not less than 1.5mm from the can. The same lead shall not be resoldered until 3 minutes have elapsed.

FIGURE 1 - DEVICE DISSIPATION DERATING WITH TEMPERATURE

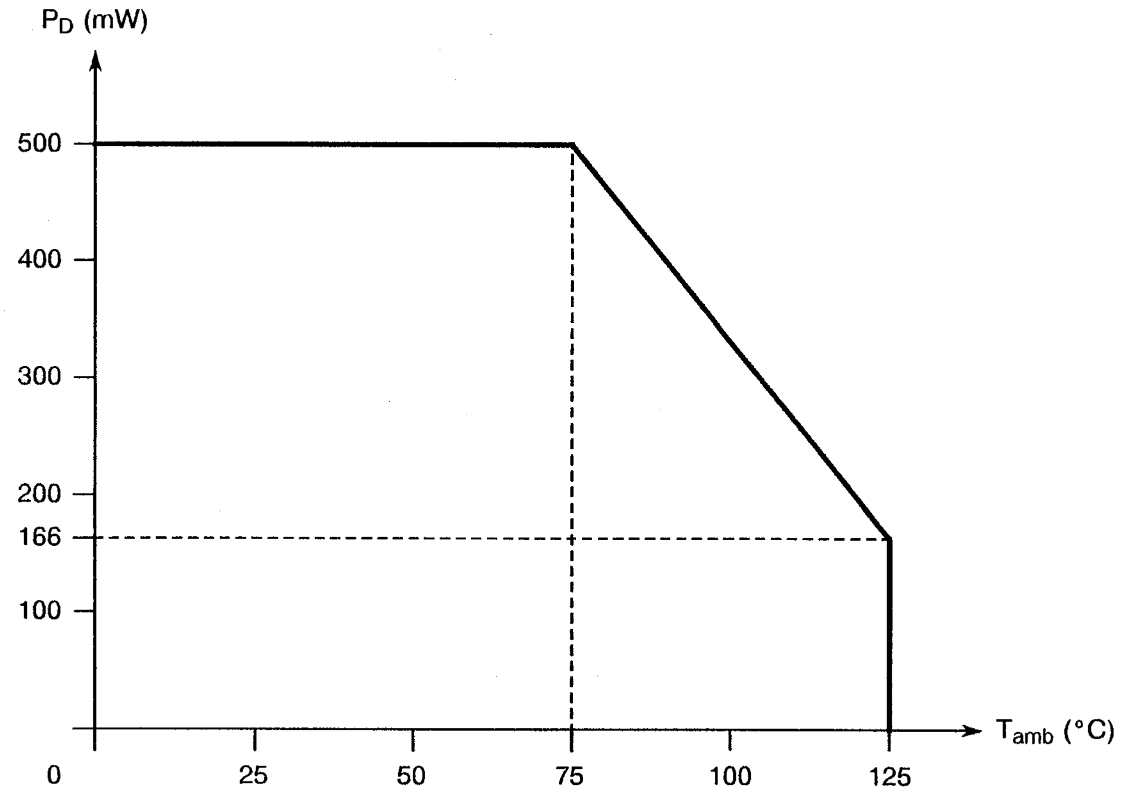
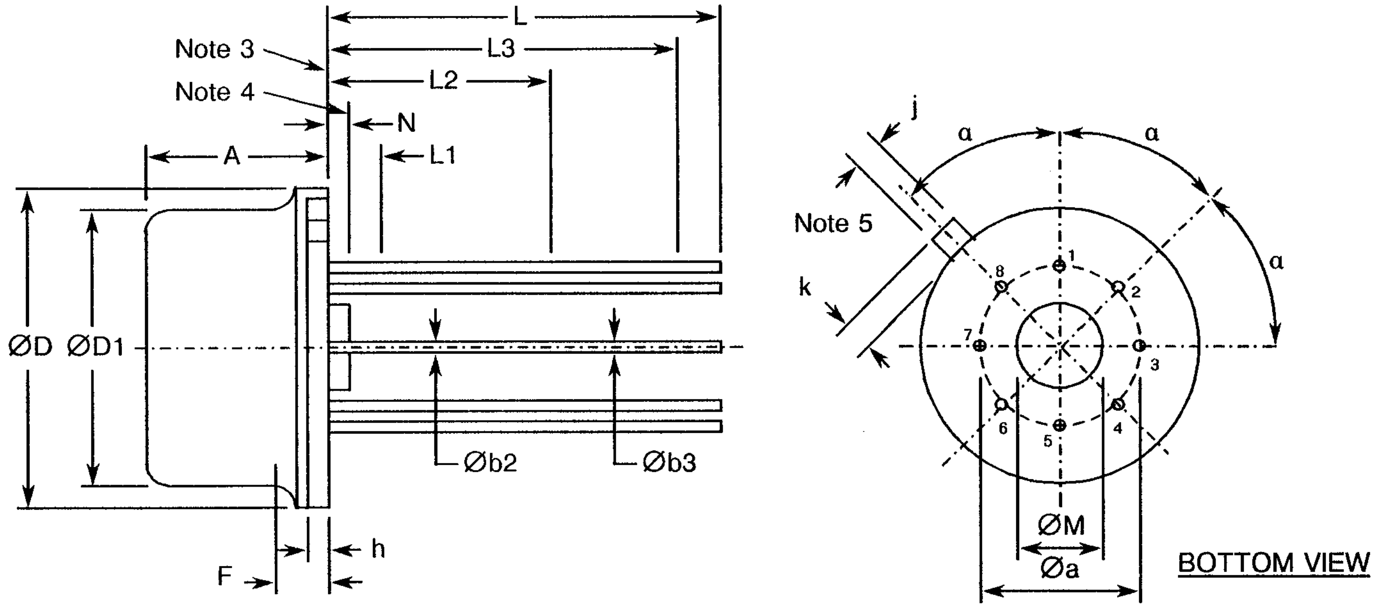


FIGURE 2 - PHYSICAL DIMENSIONS

TO99 PACKAGE



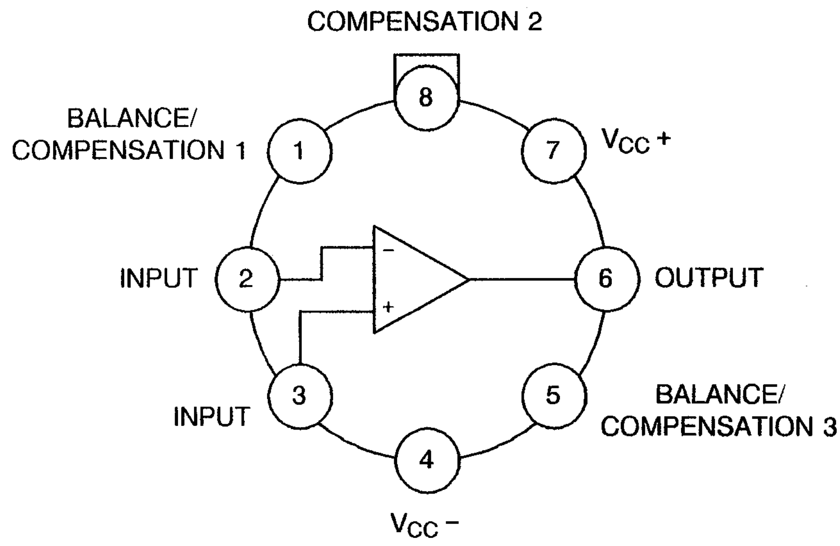
SYMBOL	MILLIMETRES			INCHES			DEGR. NOM.	NOTES
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.		
Øa	-	5.08 (6)	-	-	0.200 (6)	-		1
A	4.20	-	4.69	0.165	-	0.185		
Øb2	0.407	-	0.508	0.016	-	0.020		
Øb3	-	-	0.53	-	-	0.021		
ØD	8.51	-	9.39	0.335	-	0.370		
ØD1	7.75	-	8.50	0.305	-	0.335		
F	-	-	1.27	-	-	0.050		
h	0.15	-	1.01	0.06	-	0.040		
j	0.712	-	0.863	0.028	-	0.034		
k	0.74	-	1.14	0.029	-	0.045		2
L	12.50	-	14.50	0.492	-	0.071		
L1	-	-	1.27	-	-	0.050		
L2	6.35	-	-	0.250	-	-		
L3	12.70	-	-	0.500	-	-		
ØM	3.56	-	4.06	0.140	-	0.160		
N	0.26	-	1.01	0.010	-	0.040		
α							45° (6)	1

NOTES

1. The section of each terminal, from a distance of 1.37mm (0.054 inch) to the reference plane, shall be located in a ring whose diameter is 0.99mm (0.039 inch), centred on the accurate geometrical point defining the terminal axis.
2. Measured from the D diameter.
3. Reference plane.
4. Base plane.
5. Reference index of Pin 8.
6. Accurate geometrical location.
7. The metric dimensions are calculated from the original dimensions in inches.

FIGURE 3(a) - PIN ASSIGNMENT

TO-99 PACKAGE

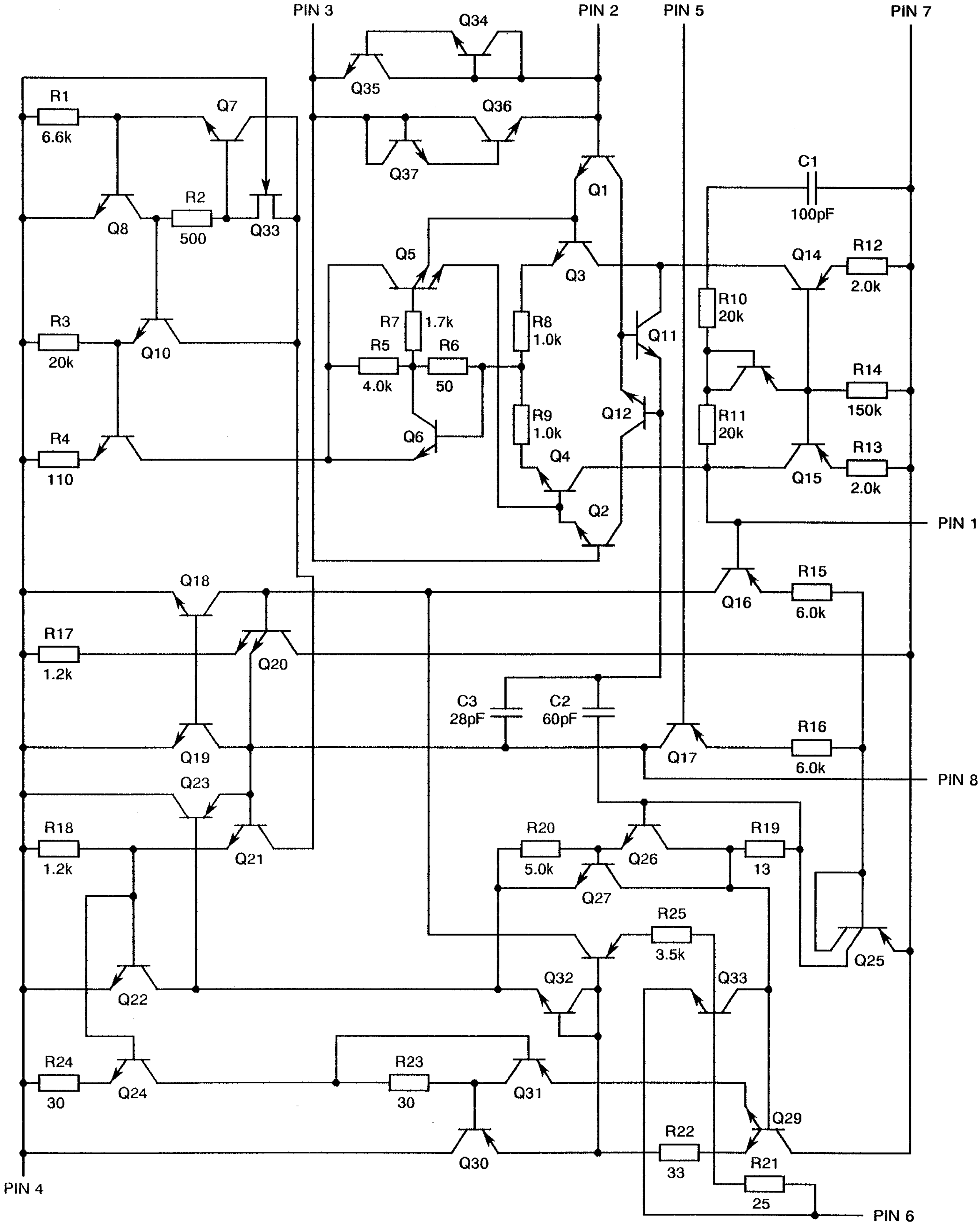


TOP VIEW

NOTES

1. Pin 4 is connected to case.

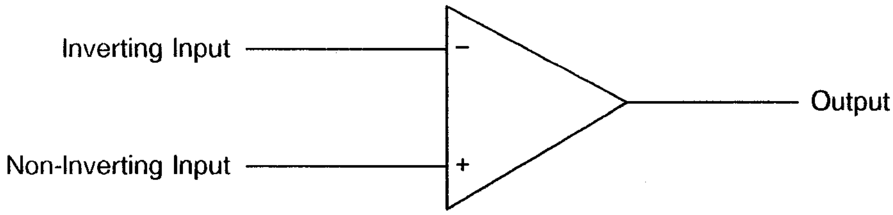
FIGURE 3(b) - CIRCUIT SCHEMATIC



NOTES

1. Pin numbers correspond to TO99 package pin assignments

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:-

I_{OS} = Output Short Circuit Current.
I_I = Input Current.
I_{CC} = Supply Current.

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

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 1.0 gram.

4.4 MATERIALS AND FINISHES

The materials and finishes 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 Type '2' finish in accordance with ESA/SCC Basic Specification No. 23500.

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

A tab shall be used to identify Pin No. 8. The pin numbering shall be read with the tab on the left-hand side (bottom view).

4.5.3 The SCC Component Number

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

910100601B

Detail Specification Number ———— 9101006

Type Variant, as applicable ———— 01

Testing Level (B or C, as applicable) ———— B

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 $T_{amb} = +125$°C and -55°C respectively.

4.6.3 Circuits for Electrical Measurements

Circuits and functional test sequence 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	Limits		Unit
							Min	Max	
1	Input Offset Voltage	V_{IO1}	4001	4(a)	E_1	$+V_{CC}=35V$, $-V_{CC}=-5.0V$ $R_S=0$, $V_{IN}=-15V$	−4.0	4.0	mV
2	Input Offset Voltage	V_{IO2}	4001	4(a)	E_2	$+V_{CC}=5.0V$, $-V_{CC}=-35V$ $R_S=0$, $V_{IN}=15V$	−4.0	4.0	mV
3	Input Offset Voltage	V_{IO3}	4001	4(a)	E_3	$+V_{CC}=20V$, $-V_{CC}=-20V$ $R_S=0$, $V_{IN}=0$	−4.0	4.0	mV
4	Input Offset Voltage	V_{IO4}	4001	4(a)	E_4	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $R_S=0$, $V_{IN}=0$	−4.0	4.0	mV
5	Input Offset Voltage	V_{IO5}	4001	4(a)	E_5	$+V_{CC}=26.5V$, $-V_{CC}=-3.5V$ $R_S=0$, $V_{IN}=-11.5V$	−4.0	4.0	mV
6	Input Offset Voltage	V_{IO6}	4001	4(a)	E_6	$+V_{CC}=3.5V$, $-V_{CC}=-26.5V$ $R_S=0$, $V_{IN}=11.5V$	−4.0	4.0	mV
7	Input Offset Current	I_{IO1}	4001	4(d)	E_7	$+V_{CC}=26.5V$, $-V_{CC}=-3.5V$ $R_S=5.0k$, $V_{IN}=11.5V$	−40	40	nA
8	Input Offset Current	I_{IO2}	4001	4(d)	E_8	$+V_{CC}=3.5V$, $-V_{CC}=-26.5V$ $R_S=5.0k$, $V_{IN}=11.5V$	−40	40	nA
9	Input Offset Current	I_{IO3}	4001	4(d)	E_9	$+V_{CC}=20V$, $-V_{CC}=-20V$ $R_S=5.0k$, $V_{IN}=0$	−40	40	nA
10	Input Offset Current	I_{IO4}	4001	4(d)	E_{10}	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $R_S=5.0k$, $V_{IN}=0$	−40	40	nA

NOTES: See Page 19.

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	Limits Min	Limits Max	Unit
11	Input (Plus) Bias Current	I_{+IB1}	4001	4(b)	E_{11}	$+V_{CC}=26.5V$, $-V_{CC}=-3.5V$ $R_S=5.0k$, $V_{IN}=-11.5V$	1.0	250	nA
12	Input (Plus) Bias Current	I_{+IB2}	4001	4(b)	E_{12}	$+V_{CC}=3.5V$, $-V_{CC}=-26.5V$ $R_S=5.0k$, $V_{IN}=11.5V$	1.0	250	nA
13	Input (Plus) Bias Current	I_{+IB3}	4001	4(b)	E_{13}	$+V_{CC}=20V$, $-V_{CC}=-20V$ $R_S=5.0k$, $V_{IN}=0$	1.0	250	nA
14	Input (Plus) Bias Current	I_{+IB4}	4001	4(b)	E_{14}	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $R_S=5.0k$, $V_{IN}=0$	1.0	250	nA
15	Input (Minus) Bias Current	I_{-IB1}	4001	4(c)	E_{15}	$+V_{CC}=26.5V$, $-V_{CC}=-3.5V$ $R_S=5.0k$, $V_{IN}=-11.5V$	1.0	250	nA
16	Input (Minus) Bias Current	I_{-IB2}	4001	4(c)	E_{16}	$+V_{CC}=3.5V$, $-V_{CC}=-26.5V$ $R_S=5.0k$, $V_{IN}=11.5V$	1.0	250	nA
17	Input (Minus) Bias Current	I_{-IB3}	4001	4(c)	E_{17}	$+V_{CC}=20V$, $-V_{CC}=-20V$ $R_S=5.0k$, $V_{IN}=0$	1.0	250	nA
18	Input (Minus) Bias Current	I_{-IB4}	4001	4(c)	E_{18}	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $R_S=5.0k$, $V_{IN}=0$	1.0	250	nA
19	Power Supply Current	I_{CC}	4005	4(e)	I_{CC}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $R_S=0$	-	8.0	mA
20	Power Supply Rejection Ratio (Plus)	+PSRR	4003	4(f)	E_{19}	$+V_{CC}=10V$, $-V_{CC}=-20V$ $R_S=0$, $V_{IN}=0V$	70	-	dB
21	Power Supply Rejection Ratio (Minus)	−PSRR	4003	4(f)	E_{20}	$+V_{CC}=20V$, $-V_{CC}=-10V$ $R_S=0$, $V_{IN}=0V$	70	-	dB
22	Common Mode Rejection Ratio (Note 1)	CMRR	4003	4(g)	E_1	$+V_{CC}=35V$, $-V_{CC}=-5.0V$ $R_S=0$, $V_{IN}=-15V$	80	-	dB
					E_2	$+V_{CC}=5.0V$, $-V_{CC}=-35V$ $R_S=0$, $V_{IN}=15V$			

NOTES: See Page 19.

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	Limits		Unit
							Min	Max	
23	Input Offset Adjust Voltage (Plus)	V_{IOADJ+}	-	4(h)	E_{21}	$+V_{CC}=20V$, $-V_{CC}=-20V$ $R_S=0$, $V_{IN}=0V$	7.0	-	mV
24	Input Offset Adjust Voltage (Minus)	V_{IOADJ-}	-	4(h)	E_{22}	$+V_{CC}=20V$, $-V_{CC}=-20V$ $R_S=0$, $V_{IN}=0V$	-	−7.0	mV
25	Short Circuit Output Current (Plus)	$I_{OS(+)}$	3011	4(i)	I_{OS}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $R_S=0$, $V_{IN}=-15V$	−60	-	mA
26	Short Circuit Output Current (Minus)	$I_{OS(-)}$	3011	4(i)	I_{OS}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $R_S=0$, $V_{IN}=15V$	-	60	mA
27	Output Voltage Swing (Plus)	$V_{OPP(+)}$	4004	4(j)	E_{23}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $R_S=0$, $V_{IN}=-15V$ $R_L=2.0k$	12	-	V
28	Output Voltage Swing (Minus)	$V_{OPP(-)}$	4004	4(j)	E_{24}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $R_S=0$, $V_{IN}=15V$ $R_L=2.0k$	-	−12	V
29	Open Loop Voltage Gain (Plus)	$+A_{VS}$	4004	4(j)	E_{25}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $V_{IN}=-10V$, $R_L=2.0k$	50	-	V/mV
30	Open Loop Voltage Gain (Minus)	$-A_{VS}$	4004	4(j)	E_{26}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $V_{IN}=10V$, $R_L=2.0k$	50	-	V/mV
31	Open Loop Voltage Gain	A_{VS}	4004	4(j)	E_{27}	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $V_{IN}=-2.0V$, $R_L=2.0k$	10	-	V/mV
32					E_{28}	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $V_{IN}=2.0V$, $R_L=2.0k$			

NOTES: See Page 19.

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

No.	Characteristics	Symbol	Test Method MIL-STD 883	Test Fig.	Test Conditions	Limits		Unit
						Min	Max	
32	Slew Rate (Plus)	SR(+)	4002	4(k)	$+V_{CC} = \pm 20V$ V_{IN} = See Figure 4(k) $R_L = 2.0k$	50	-	V/µs
33	Slew Rate (Minus)	SR(−)	4002	4(k)	$+V_{CC} = \pm 20V$ V_{IN} = See Figure 4(k) $R_L = 2.0k$	50	-	V/µs

NOTES
1. Calculated from Test Nos. 1 and 2.
2. The temperature coefficient of Input Offset Voltage is calculated only for components of Level 'B'.

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	Limits		Unit
							Min	Max	
1	Input Offset Voltage	V_{IO1}	4001	4(a)	E_1	$+V_{CC}=35V$, $-V_{CC}=-5.0V$ $R_S=0$, $V_{IN}=-15V$	−6.0	6.0	mV
2	Input Offset Voltage	V_{IO2}	4001	4(a)	E_2	$+V_{CC}=5.0V$, $-V_{CC}=-35V$ $R_S=0$, $V_{IN}=15V$	−6.0	6.0	mV
3	Input Offset Voltage	V_{IO3}	4001	4(a)	E_3	$+V_{CC}=20V$, $-V_{CC}=-20V$ $R_S=0$, $V_{IN}=0$	−6.0	6.0	mV
4	Input Offset Voltage	V_{IO4}	4001	4(a)	E_4	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $R_S=0$, $V_{IN}=0$	−6.0	6.0	mV
5	Input Offset Voltage	V_{IO5}	4001	4(a)	E_5	$+V_{CC}=26.5V$, $-V_{CC}=3.5V$ $R_S=0$, $V_{IN}=-11.5V$	−6.0	6.0	mV
6	Input Offset Voltage	V_{IO6}	4001	4(a)	E_6	$+V_{CC}=3.5V$, $-V_{CC}=-26.5V$ $R_S=0$, $V_{IN}=11.5V$	−6.0	6.0	mV
7	Input Offset Current	I_{IO1}	4001	4(d)	E_7	$+V_{CC}=26.5V$, $-V_{CC}=-3.5V$ $R_S=5.0k$, $V_{IN}=-11.5V$	−40	40	nA
8	Input Offset Current	I_{IO2}	4001	4(d)	E_8	$+V_{CC}=3.5V$, $-V_{CC}=-26.5V$ $R_S=5.0k$, $V_{IN}=11.5V$	−40	40	nA
9	Input Offset Current	I_{IO3}	4001	4(d)	E_9	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $R_S=5.0k$, $V_{IN}=0$	−40	40	nA
10	Input Offset Current	I_{IO4}	4001	4(d)	E_{10}	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $R_S=5.0k$, $V_{IN}=0$	−40	40	nA

NOTES: See Page 19.

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	Limits		Unit
							Min	Max	
11	Input (Plus) Bias Current	I_{+IB1}	4001	4(b)	E_{11}	$+V_{CC}=26.5V$, $-V_{CC}=-3.5V$ $R_S=5.0k$, $V_{IN}=-11.5V$	1.0	250	nA
12	Input (Plus) Bias Current	I_{+IB2}	4001	4(b)	E_{12}	$+V_{CC}=3.5V$, $-V_{CC}=-26.5V$ $R_S=5.0k$, $V_{IN}=11.5V$	1.0	250	nA
13	Input (Plus) Bias Current	I_{+IB3}	4001	4(b)	E_{13}	$+V_{CC}=20V$, $-V_{CC}=-20V$ $R_S=5.0k$, $V_{IN}=0$	1.0	250	nA
14	Input (Plus) Bias Current	I_{+IB4}	4001	4(b)	E_{14}	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $R_S=5.0k$, $V_{IN}=0$	1.0	250	nA
15	Input (Minus) Bias Current	I_{-IB1}	4001	4(c)	E_{15}	$+V_{CC}=26.5V$, $-V_{CC}=-3.5V$ $R_S=5.0k$, $V_{IN}=-11.5V$	1.0	250	nA
16	Input (Minus) Bias Current	I_{-IB2}	4001	4(c)	E_{16}	$+V_{CC}=3.5V$, $-V_{CC}=-26.5V$ $R_S=5.0k$, $V_{IN}=11.5V$	1.0	250	nA
17	Input (Minus) Bias Current	I_{-IB3}	4001	4(c)	E_{17}	$+V_{CC}=20V$, $-V_{CC}=-20V$ $R_S=5.0k$, $V_{IN}=0$	1.0	250	nA
18	Input (Minus) Bias Current	I_{-IB4}	4001	4(c)	E_{18}	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $R_S=5.0k$, $V_{IN}=0$	1.0	250	nA
19	Power Supply Current	I_{CC}	4005	4(e)	I_{CC}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $R_S=0$	-	7.0	mA
20	Power Supply Rejection Ratio (Plus)	+PSRR	4003	4(f)	E_{19}	$+V_{CC}=10V$, $-V_{CC}=-20V$ $R_S=0$, $V_{IN}=0V$	70	-	dB
21	Power Supply Rejection Ratio (Minus)	−PSRR	4003	4(f)	E_{20}	$+V_{CC}=20V$, $-V_{CC}=-10V$ $R_S=0$, $V_{IN}=0V$	70	-	dB
22	Common Mode Rejection Ratio (Note 1)	CMRR	4003	4(g)	E_1	$+V_{CC}=35V$, $-V_{CC}=-5.0V$ $R_S=0$, $V_{IN}=-15V$	80	-	dB
					E_2	$+V_{CC}=5.0V$, $-V_{CC}=-35V$ $R_S=0$, $V_{IN}=15V$			

NOTES: See Page 19.

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	Limits Min	Limits Max	Unit
25	Short Circuit Output Current (Plus)	$I_{OS(+)}$	3011	4(i)	I_{OS}	$+V_{CC} = 15V$, $-V_{CC} = -15V$ $R_S = 0$, $V_{IN} = -15V$	−60	-	mA
26	Short Circuit Output Current (Minus)	$I_{OS(-)}$	3011	4(i)	I_{OS}	$+V_{CC} = 15V$, $-V_{CC} = -15V$ $R_S = 0$, $V_{IN} = 15V$	-	60	mA
27	Output Voltage Swing (Plus)	$V_{OPP(+)}$	4004	4(j)	E_{23}	$+V_{CC} = 15V$, $-V_{CC} = -15V$ $R_S = 0$, $V_{IN} = -15V$ $R_L = 2.0k$	12	-	V
28	Output Voltage Swing (Minus)	$V_{OPP(-)}$	4004	4(j)	E_{24}	$+V_{CC} = 15V$, $-V_{CC} = -15V$ $R_S = 0$, $V_{IN} = 15V$ $R_L = 2.0k$	-	−12	V
29	Open Loop Voltage Gain (Plus)	$+A_{VS}$	4004	4(j)	E_{25}	$+V_{CC} = 15V$, $-V_{CC} = -15V$ $V_{IN} = -10V$, $R_L = 2.0k$	32	-	V/mV
30	Open Loop Voltage Gain (Minus)	$-A_{VS}$	4004	4(j)	E_{26}	$+V_{CC} = 15V$, $-V_{CC} = -15V$ $V_{IN} = 10V$, $R_L = 2.0k$	32	-	V/mV
34	Temperature Coefficient for Input Offset Voltage (Note 2)	$\frac{\Delta V_{IO}}{\Delta T}$	Calculate $\Delta V_{IO}/\Delta T = \mid V_{IO}$ (Test 3, Table 3(a) (mV) $- V_{IO}$ (Test 3, Table 2 (mV) $\mid \times 10$				−50	50	µV/°C

NOTES: See Page 19.

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	Limits		Unit
							Min	Max	
1	Input Offset Voltage	V_{IO1}	4001	4(a)	E_1	$+V_{CC}=35V$, $-V_{CC}=-5.0V$ $R_S=0$, $V_{IN}=-15V$	−6.0	6.0	mV
2	Input Offset Voltage	V_{IO2}	4001	4(a)	E_2	$+V_{CC}=5.0V$, $-V_{CC}=-35V$ $R_S=0$, $V_{IN}=15V$	−6.0	6.0	mV
3	Input Offset Voltage	V_{IO3}	4001	4(a)	E_3	$+V_{CC}=20V$, $-V_{CC}=-20V$ $R_S=0$, $V_{IN}=0$	−6.0	6.0	mV
4	Input Offset Voltage	V_{IO4}	4001	4(a)	E_4	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $R_S=0$, $V_{IN}=0$	−6.0	6.0	mV
5	Input Offset Voltage	V_{IO5}	4001	4(a)	E_5	$+V_{CC}=26.5V$, $-V_{CC}=-3.5V$ $R_S=0$, $V_{IN}=-11.5V$	−6.0	6.0	mV
6	Input Offset Voltage	V_{IO6}	4001	4(a)	E_6	$+V_{CC}=3.5V$, $-V_{CC}=-26.5V$ $R_S=0$, $V_{IN}=11.5V$	−6.0	6.0	mV
7	Input Offset Current	I_{IO1}	4001	4(d)	E_7	$+V_{CC}=26.5V$, $-V_{CC}=-3.5V$ $R_S=5.0k$, $V_{IN}=11.5V$	−80	80	nA
8	Input Offset Current	I_{IO2}	4001	4(d)	E_8	$+V_{CC}=3.5V$, $-V_{CC}=-26.5V$ $R_S=5.0k$, $V_{IN}=11.5V$	−80	80	nA
9	Input Offset Current	I_{IO3}	4001	4(d)	E_9	$+V_{CC}=20V$, $-V_{CC}=-20V$ $R_S=5.0k$, $V_{IN}=0$	−80	80	nA
10	Input Offset Current	I_{IO4}	4001	4(d)	E_{10}	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $R_S=5.0k$, $V_{IN}=0$	−80	80	nA

NOTES: See Page 19.

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	Limits		Unit
							Min	Max	
11	Input (Plus) Bias Current	I_{+IB1}	4001	4(b)	E_{11}	$+V_{CC}=26.5V$, $-V_{CC}=-3.5V$ $R_S=5.0k$, $V_{IN}=-11.5V$	1.0	400	nA
12	Input (Plus) Bias Current	I_{+IB2}	4001	4(b)	E_{12}	$+V_{CC}=3.5V$, $-V_{CC}=-26.5V$ $R_S=5.0k$, $V_{IN}=11.5V$	1.0	400	nA
13	Input (Plus) Bias Current	I_{+IB3}	4001	4(b)	E_{13}	$+V_{CC}=20V$, $-V_{CC}=-20V$ $R_S=5.0k$, $V_{IN}=0$	1.0	400	nA
14	Input (Plus) Bias Current	I_{+IB4}	4001	4(b)	E_{14}	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $R_S=5.0k$, $V_{IN}=0$	1.0	400	nA
15	Input (Minus) Bias Current	I_{-IB1}	4001	4(c)	E_{15}	$+V_{CC}=26.5V$, $-V_{CC}=-3.5V$ $R_S=5.0k$, $V_{IN}=-11.5V$	1.0	400	nA
16	Input (Minus) Bias Current	I_{-IB2}	4001	4(c)	E_{16}	$+V_{CC}=3.5V$, $-V_{CC}=-26.5V$ $R_S=5.0k$, $V_{IN}=11.5V$	1.0	400	nA
17	Input (Minus) Bias Current	I_{-IB3}	4001	4(c)	E_{17}	$+V_{CC}=20V$, $-V_{CC}=-20V$ $R_S=5.0k$, $V_{IN}=0$	1.0	400	nA
18	Input (Minus) Bias Current	I_{-IB4}	4001	4(c)	E_{18}	$+V_{CC}=5.0V$, $-V_{CC}=-5.0V$ $R_S=5.0k$, $V_{IN}=0$	1.0	400	nA
19	Power Supply Current	I_{CC}	4005	4(e)	I_{CC}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $R_S=0$	-	9.0	mA
20	Power Supply Rejection Ratio (Plus)	+PSRR	4003	4(f)	E_{19}	$+V_{CC}=10V$, $-V_{CC}=-20V$ $R_S=0$, $V_{IN}=0V$	70	-	dB
21	Power Supply Rejection Ratio (Minus)	−PSRR	4003	4(f)	E_{20}	$+V_{CC}=20V$, $-V_{CC}=-10V$ $R_S=0$, $V_{IN}=0V$	70	-	dB
22	Common Mode Rejection Ratio (Note 1)	CMRR	4003	4(g)	E_1	$+V_{CC}=35V$, $-V_{CC}=-5.0V$ $R_S=0$, $V_{IN}=-15V$	80	-	dB
					E_2	$+V_{CC}=5.0V$, $-V_{CC}=-35V$ $R_S=0$, $V_{IN}=15V$			

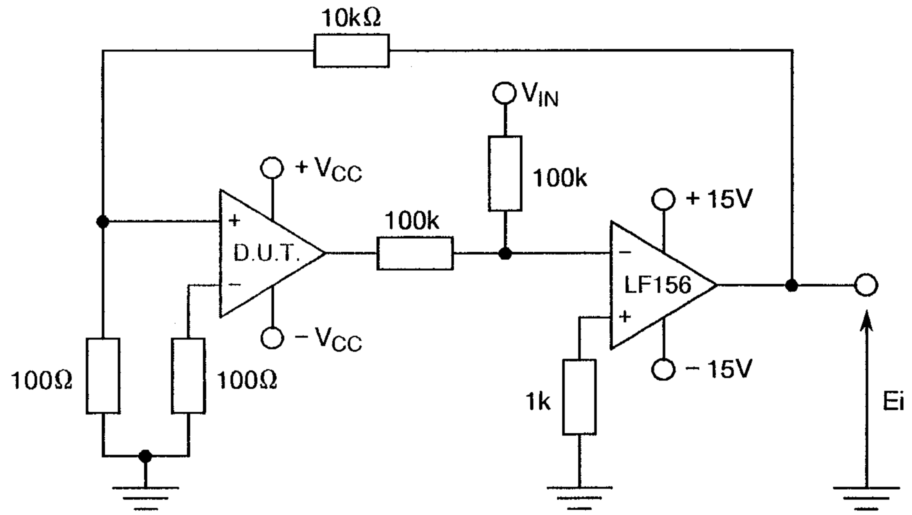
NOTES: See Page 19.

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	Limits		Unit
							Min	Max	
25	Short Circuit Output Current (Plus)	$I_{OS(+)}$	3011	4(i)	I_{OS}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $R_S=0$, $V_{IN}=-15V$	−70	-	mA
26	Short Circuit Output Current (Minus)	$I_{OS(-)}$	3011	4(i)	I_{OS}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $R_S=0$, $V_{IN}=15V$	-	−70	mA
27	Output Voltage Swing (Plus)	$V_{OPP(+)}$	4004	4(j)	E_{23}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $R_S=0$, $V_{IN}=-15V$ $R_L=2.0k$	12	-	V
28	Output Voltage Swing (Minus)	$V_{OPP(-)}$	4004	4(j)	E_{24}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $R_S=0$, $V_{IN}=15V$ $R_L=2.0k$	-	−12	V
29	Open Loop Voltage Gain (Plus)	$+A_{VS}$	4004	4(j)	E_{25}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $V_{IN}=-10V$, $R_L=2.0k$	32	-	V/mV
30	Open Loop Voltage Gain (Minus)	$-A_{VS}$	4004	4(j)	E_{26}	$+V_{CC}=15V$, $-V_{CC}=-15V$ $V_{IN}=10V$, $R_L=2.0k$	32	-	V/mV
34	Temperature Coefficient for Input Offset Voltage (Note 2)	$\frac{\Delta V_{IO}}{\Delta T}$	Calculate $\Delta V_{IO}/\Delta T = \mid V_{IO}$ (Test 3, Table 3(a) (mV) $- V_{IO}$ (Test 3, Table 2 (mV) $\mid \times 12.5$				−50	50	µV/°C

NOTES: See Page 19.

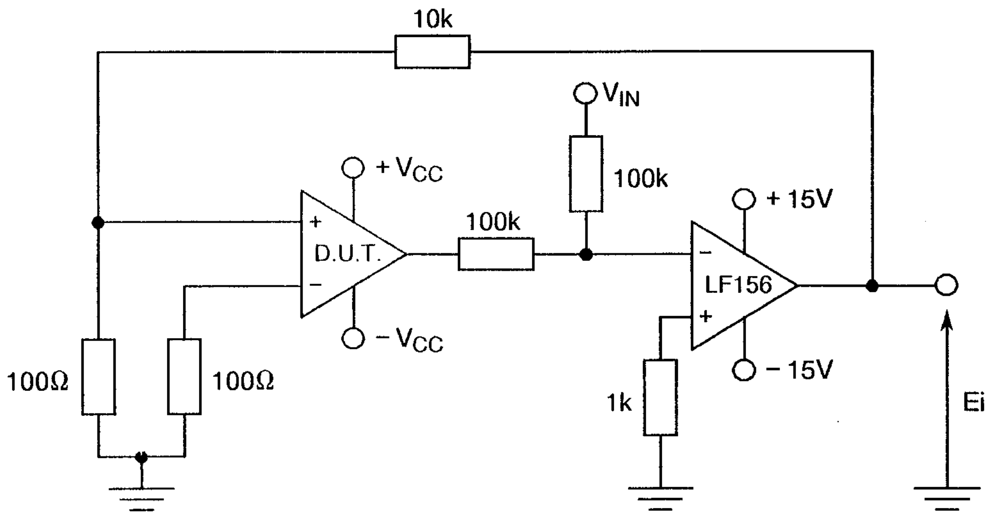
FIGURE 4(a) - INPUT OFFSET VOLTAGE



$$V_{IO1} = \frac{Ei}{100}$$

Ei (mV)
V_{IO1} (mV)

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

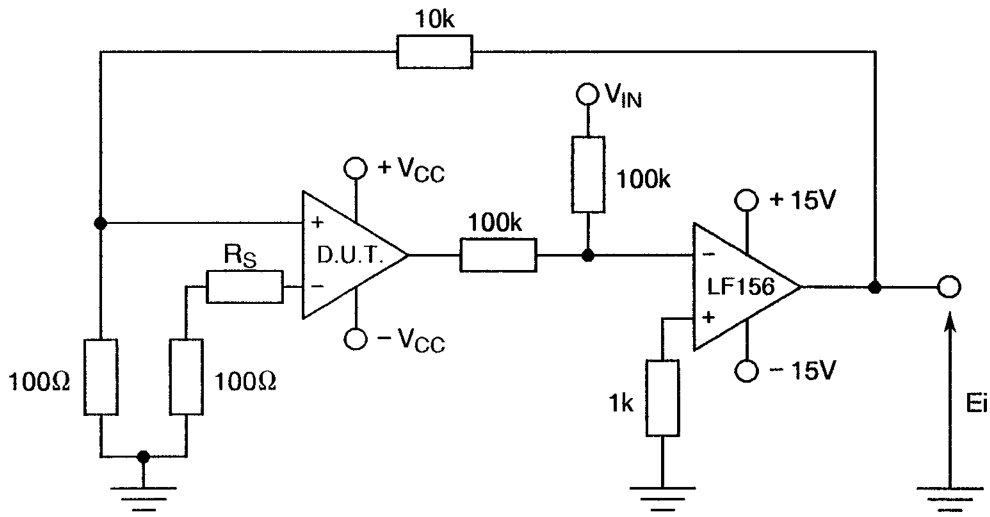


$$I_{+IB1} = \frac{(E_5 - E_{11})\ 10^3}{100\ R_S} \qquad I_{+IB2} = \frac{(E_6 - E_{12})\ 10^3}{100\ R_S}$$

$$I_{+IB3} = \frac{(E_3 - E_{13})\ 10^3}{100\ R_S} \qquad I_{+IB4} = \frac{(E_4 - E_{14})\ 10^3}{100\ R_S}$$

Ei (mV)
I_{IB} (nA)
R_S (kΩ)

FIGURE 4(c) - INPUT (MINUS) BIAS CURRENT

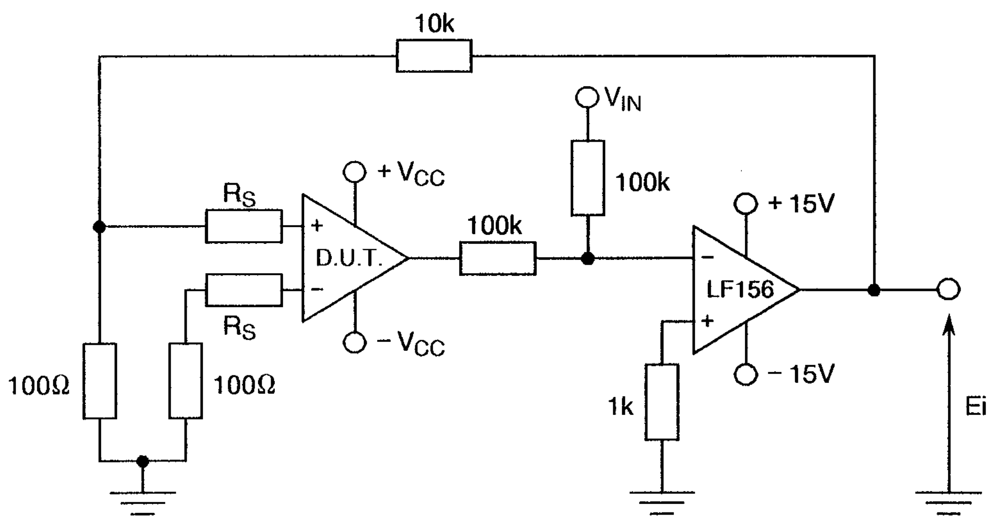


$$I_{+IB1} = \frac{(E_{15} - E_5)\,10^3}{100\,R_S} \qquad I_{+IB2} = \frac{(E_{16} - E_6)\,10^3}{100\,R_S}$$

$$I_{+IB3} = \frac{(E_{17} - E_3)\,10^3}{100\,R_S} \qquad I_{+IB4} = \frac{(E_{18} - E_4)\,10^3}{100\,R_S}$$

Ei (mV)
I_{IB} (nA)
R_S (kΩ)

FIGURE 4(d) - INPUT OFFSET CURRENT



$$I_{IO1} = \frac{(E_5 - E_7)\,10^3}{100\,R_S} \qquad I_{IO2} = \frac{(E_6 - E_8)\,10^3}{100\,R_S}$$

$$I_{IO3} = \frac{(E_3 - E_9)\,10^3}{100\,R_S} \qquad I_{IO4} = \frac{(E_4 - E_{10})\,10^3}{100\,R_S}$$

Ei (mV)
I_{IO} (nA)
R_S (kΩ)

FIGURE 4(e) - SUPPLY CURRENT

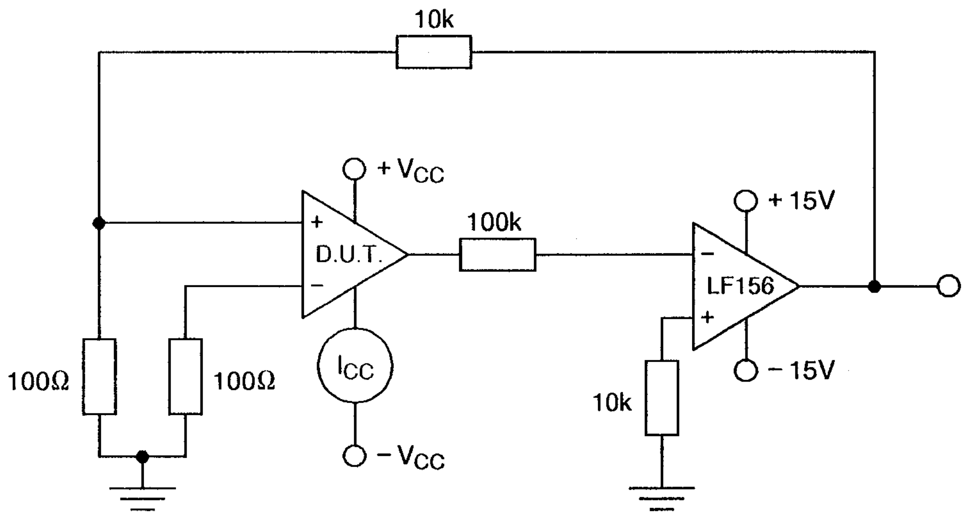
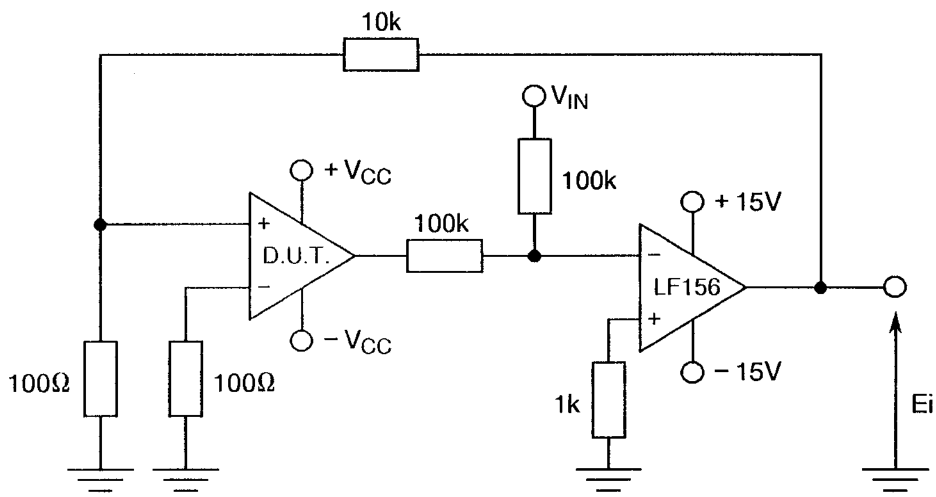


FIGURE 4(f) - POWER SUPPLY REJECTION RATIO

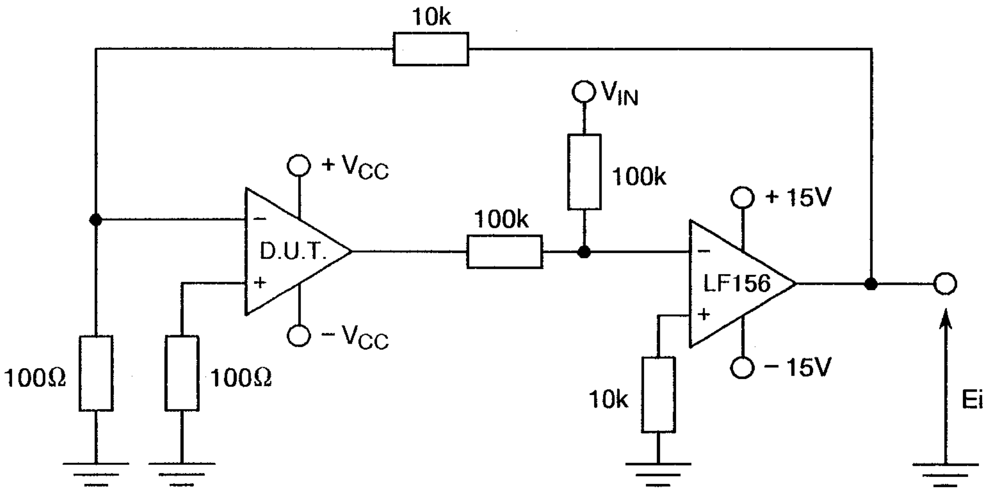


$$+PSRR = 20 \text{ LOG } \frac{10^6}{E_3 - E_{19}} \qquad -PSRR = 20 \text{ LOG } \frac{10^6}{E_3 - E_{20}}$$

NOTES

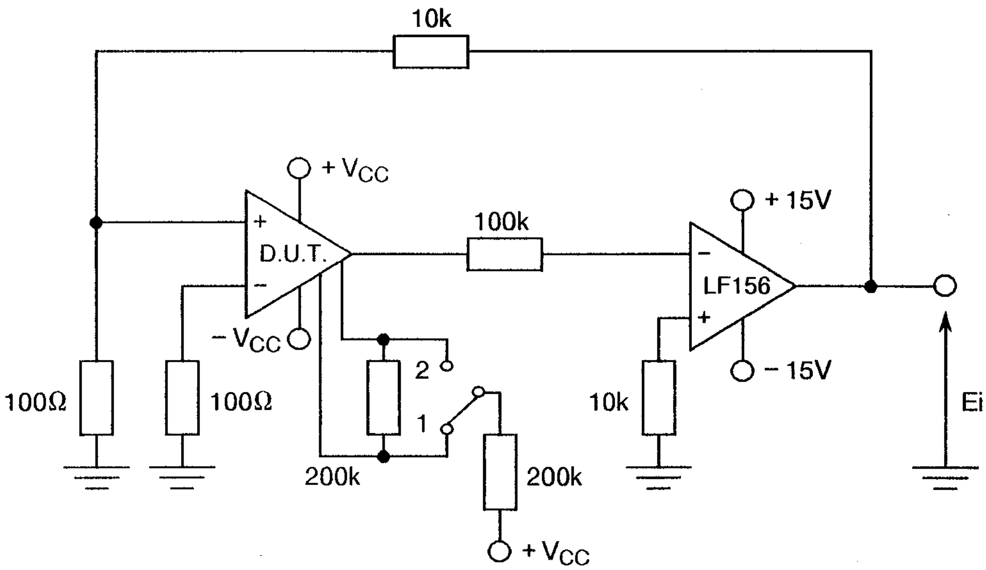
1. Ei are voltages measured in millivolt to four digits accuracy.

FIGURE 4(g) - COMMON MODE REJECTION RATIO



$$CMRR = 20\ LOG\ \frac{30 + 10^5}{E_1 - E_2} \qquad Ei\ (mV)$$

FIGURE 4(h) - INPUT OFFSET ADJUST VOLTAGE



$V_{IOADJ(+)}$ $\frac{E_3 - E_{21}}{100}$ Switch in Position 1

Ei (mV)

$V_{IOADJ(-)}$ $\frac{E_3 - E_{22}}{100}$ Switch in Position 2

FIGURE 4(i) - SHORT CIRCUIT OUTPUT CURRENT

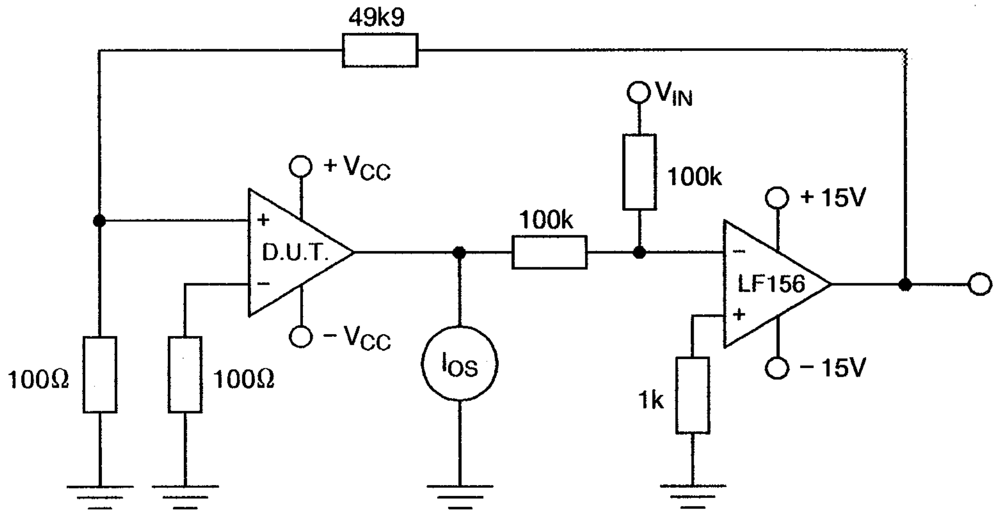
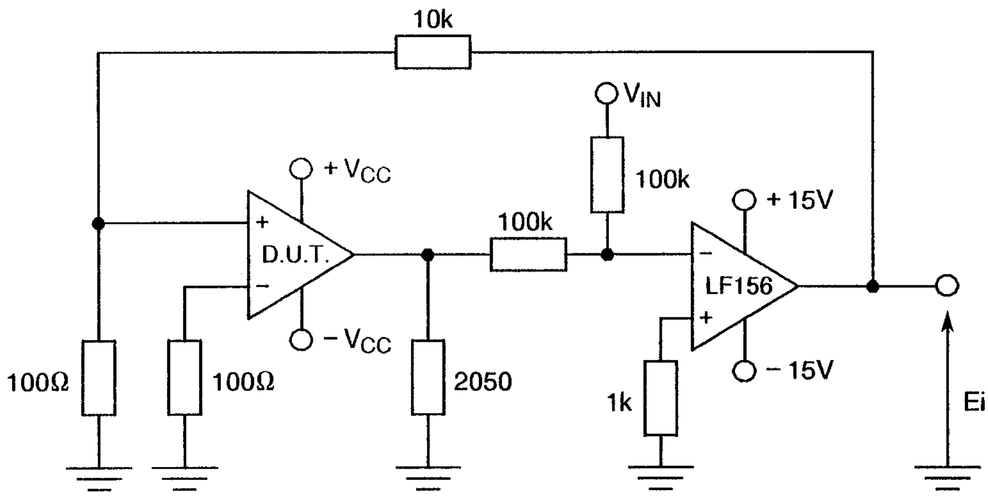


FIGURE 4(j) - OUTPUT VOLTAGE SWING
- OPEN LOOP VOLTAGE GAIN

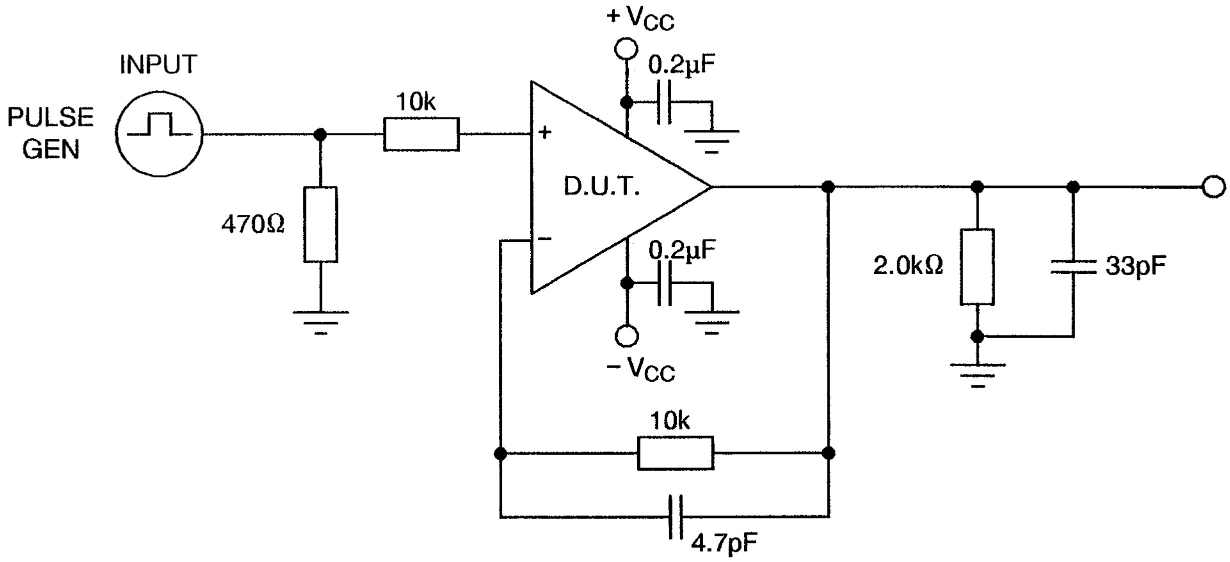


$V_{OUT} = (E_{23}, E_{24})$ in Volts

$+A_{VS} = \frac{10}{E_3 - E_{25}}$ $\quad -A_{VS} = \frac{10}{E_{26} - E_3}$

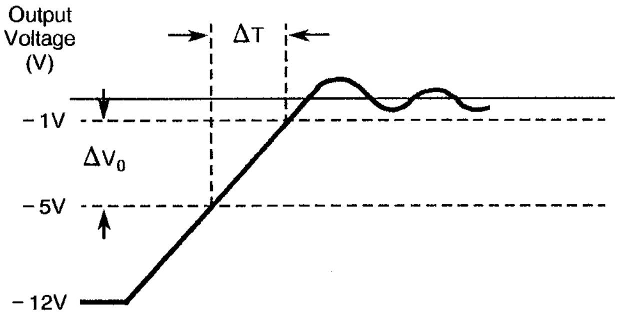
$A_{VS} = \frac{4}{E_{28} - E_{27}}$ $\quad E_{25}, E_{26}, E_{27}, E_{28}$ in mV.

FIGURE 4(k) - DYNAMIC TEST MEASUREMENT CIRCUIT - SLEW RATE



NOTES

1. Pulse Generator:
   - Rise time ≤ 10ns
   - Repetition rate 1.0kHz (max.)
   - SR−: V_{IN} from −12V to 0V.
   - SR+: V_{IN} from −12V to 0V.



$$SR = \frac{\Delta V_0}{\Delta T.10^{-3}} \quad (V/\mu s)$$

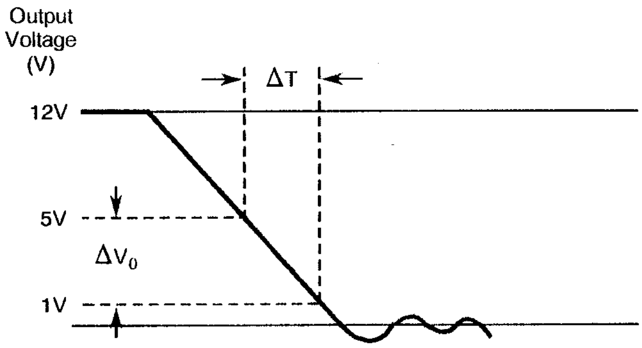


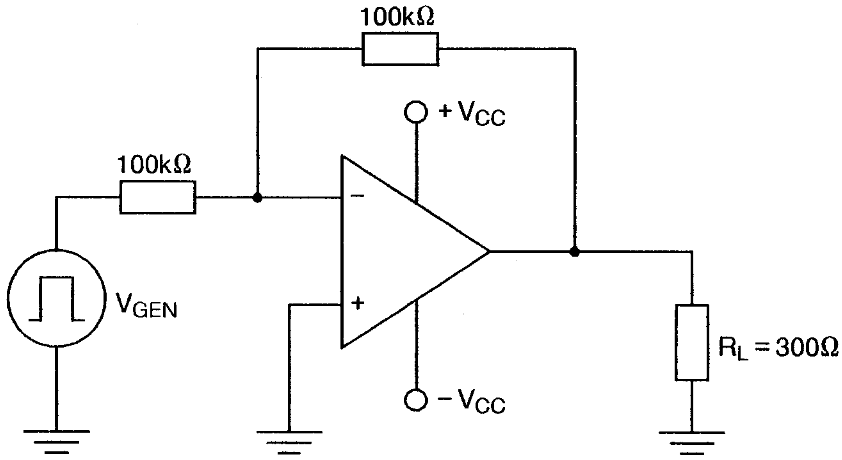
TABLE 4 - PARAMETER DRIFT VALUES

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS (Δ)	UNIT
1	Input Offset Voltage	V_{IO3}	As per Table 2	As per Table 2	±1.5	mV
13	Input (Plus) Bias Current	I_{+IB3}	As per Table 2	As per Table 2	±20	nA
17	Input (Minus) Bias Current	I_{-IB3}	As per Table 2	As per Table 2	±20	nA
9	Input Offset Current	I_{IO3}	As per Table 2	As per Table 2	±5.0	nA

TABLE 5 - CONDITIONS FOR BURN-IN AND OPERATING LIFE TEST

No.	CHARACTERISTICS	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	T_{amb}	+125±5	°C
2	Power Supply	V_{CC}	±20	V
3	Pulse Voltage	V_{GEN}	±1.0	V
4	Pulse Frequency Square Wave	F	5.0	Hz

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



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	
3	Input Offset Voltage	V_{IO3}	As per Table 2	As per Table 2	−4.0	4.0	mV
9	Input Offset Current	I_{IO3}	As per Table 2	As per Table 2	−40	40	nA
13	Input (Plus) Bias Current	I_{+IB3}	As per Table 2	As per Table 2	1.0	250	nA
17	Input (Minus) Bias Current	I_{-IB3}	As per Table 2	As per Table 2	1.0	250	nA
19	Supply Current	I_{CC}	As per Table 2	As per Table 2	-	8.0	mA
20	Supply Voltage Rejection Ratio (Plus)	+PSRR	As per Table 2	As per Table 2	70	-	dB
21	Supply Voltage Rejection Ratio (Minus)	−PSRR	As per Table 2	As per Table 2	70	-	dB
22	Common Mode Rejection Ratio	CMRR	As per Table 2	As per Table 2	80	-	dB