THOMSON SEMICONDUCTORS

LM158
LM258
LM358
LM2904

LOW POWER DUAL OPERATIONAL AMPLIFIERS

These circuits consist of two independent, high gain, internally frequency compensated which were designed specifically to operate from a single power supply over a wide range of voltages. The low power supply drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, dc gain blocks and all the conventional op-amp circuits which now can be more easily implemented in single power supply systems. For example, these circuits can be directly operated off the standard +5 V power supply voltage which is used in logic systems and will easily provide the required interface electronics without requiring any additional power supply.

In the linear mode the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from only a single power supply voltage.

The gain-bandwidth product is temperature compensated.

The input bias current is temperature compensated.

- Internally frequency compensated.
- Large dc voltage gain : 100 dB.
- Wide bandwidth (unity gain) : 1 MHz (temperature compensated).
- Very low supply current drain (500 μA) — essentially independent of supply voltage (1 mW/op-amp at +5 V).
- Low input bias current : 45 nA (temperature compensated).
- Low input offset voltage : 2 mV.
- Low input offset current : 5 nA.
- Input common-mode voltage range includes ground.
- Differential input voltage range equal to the power supply voltage.
- Large output voltage swing 0 V to (V_{CC} − 1,5 V).

ORDERING INFORMATION

Hi-Rel versions available - See chapter 14

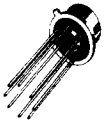
PART NUMBER	TEMPERATURE RANGE	PACKAGE				
		H	DP	DG	GC	FP
LM158	− 55°C to + 125°C	•		•	•	
LM258	− 25°C to + 85°C	•	•	•		
LM358	0°C to + 70°C	•	•	•		•
LM2904	− 40°C to + 85°C		•			•

Example : LM158H, LM258DP, LM2904FP

LOW POWER DUAL OPERATIONAL AMPLIFIERS

CASES

CB-11
(TO-99)



H SUFFIX
METAL CAN

CB-705

GC SUFFIX
TRICECOP (LCC)

CB-98

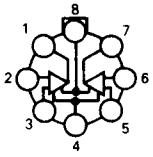
DP SUFFIX
PLASTIC PACKAGE
DG SUFFIX
CERDIP PACKAGE

CB-342

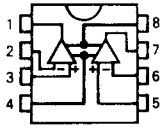
FP SUFFIX
PLASTIC
MICROPACKAGE

PIN ASSIGNMENTS
(Top views)

CB-11



CB-98
CB-342



CB-705

1 - Output 1
2 - Inverting input 1
3 - Non-inverting input 1
4 - Ground
5 - Non-inverting input 2
6 - Inverting input 2
7 - Output 2
8 - V_{CC}
9 - NC
10 - Ground
11 - NC
12 - Non-inverting input 2
13 - NC
14 - NC
15 - Inverting input 2
16 - NC
17 - Output 2
18 - NC
19 - NC
20 - V_{CC}

Ref. 00210

THOMSON SEMICONDUCTORS
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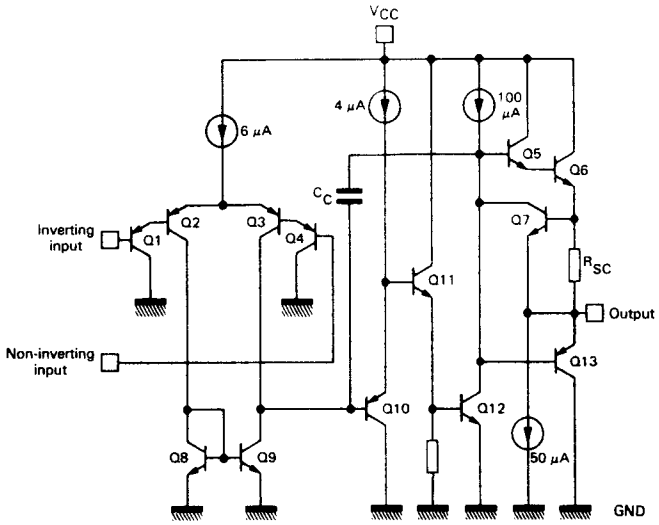
THOMSON COMPONENTS

MAXIMUM RATINGS

Rating	Symbol	LM158	LM258	LM358 LM2904	Unit
Supply voltage LM2904	V_{CC}	+32 —	+32 —	+32 +26	V
Input voltage LM2904	V_I	0.3 to +32 —	−0.3 to +32 —	−0.3 to +32 −0.3 to +26	V
Differential input voltage LM2904	V_{ID}	+32 —	+32 —	+32 +26	V
Output short-circuit duration (Note 2)	—	Indefinite	Indefinite	Indefinite	—
Power dissipation LM158GC	P_{tot}	500 665	500 —	500 —	mW
Input current (Note 1)	I_{ID}	50	50	50	mA
Operating free-air temperature range LM2904	T_{oper}	−55 to +125 —	−25 to +85 —	0 to +70 −40 to +85	°C
Storage temperature range	T_{stg}	−65 to +150	−65 to +150	−65 to +150	°C

SCHEMATIC DIAGRAM



- Single supply 3 V to 30 V
- Dual supplies ±1.5 V to ±15 V

} for LM158, LM258, LM358

- Single supply 3 V to 26 V
- Dual supplies ±1.5 V to ±13 V

} for LM2904

CASE	Inverting inputs	Non-inverting inputs	GND	V_{CC}	Outputs	N.C.
CB-11/CB-98/CB-342	2 - 6	3 - 5	4	8	1 - 7	
CB-705	5 - 15	7 - 12	10	20	2 - 17	*

* CB-705 : Other pins are not connected.

ELECTRICAL CHARACTERISTICS (Note 3)

LM158 : $-55°C \leq T_{amb} \leq +125°C$
LM258 : $-25°C \leq T_{amb} \leq +85°C$
LM358 : $0°C \leq T_{amb} \leq +70°C$
LM2904 : $-40°C \leq T_{amb} \leq +85°C$
(Unless otherwise specified)

Characteristic	Symbol	LM158, LM258			LM358, LM2904			Unit
		Min	Typ	Max	Min	Typ	Max	
Input offset voltage (Note 4) $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$ LM2904	V_{IO}	– – –	±2 – –	±5 ±7 –	– – –	±2 – –	±7 ±9 ±10	mV
Input offset current $T_{amb} = +25°C$ $T_{min} \leq T_{amb} \leq T_{max}$ LM2904	I_{IO}	– – –	±3 – –	±30 ±100 –	– – –	±5 – –	±50 ±150 ±200	nA
Input bias current $T_{amb} = +25°C$ (Note 5) $T_{min} \leq T_{amb} \leq T_{max}$	I_{IB}^+, I_{IB}^-	– –	45 40	150 300	– –	45 40	250 500	nA
Large signal voltage gain ($V_{CC} = +15$ V, $R_L \geq 2$ kΩ, $T_{amb} = +25°C$) LM2904	A_{VD}	50 –	100 –	– –	25 –	100 100	– –	V/mV
Supply voltage rejection ratio ($T_{amb} = +25°C$) LM2904	SVR	65 –	100 –	– –	65 50	100 100	– –	dB
Supply currents ($R_L = \infty$) $T_{amb} = +25°C$, $V_{CC} = +5$ V $T_{min} \leq T_{amb} \leq T_{max}$, $V_{CC} = +30$ V $V_{CC} = +26$ V LM2904	I_{CC}^+, I_{CC}^-	– – –	0.7 1 –	1.2 2 –	– – –	0.7 1 1	1.2 2 2	mA
Temperature coefficient of input offset voltage	αV_{IO}	–	7	–	–	7	–	μV/°C
Average temperature coefficient of input offset current	αI_{IO}	–	10	–	–	10	–	pA/°C
Input voltage range $T_{amb} = +25°C$, $V_{CC} = +30$ V (Note 7)	V_I	0	–	$V_{CC} - 1.5$	0	–	$V_{CC} - 1.5$	V
$V_{CC} = +26$ V LM2904		0	–	$V_{CC} - 1.5$	0	–	$V_{CC} - 1.5$	
$T_{min} \leq T_{amb} \leq T_{max}$, $V_{CC} = +30$ V (Note 7)		0	–	$V_{CC} - 2$	0	–	$V_{CC} - 2$	
$V_{CC} = +26$ V LM2904		0	–	$V_{CC} - 2$	0	–	$V_{CC} - 2$	
Common-mode rejection ratio ($T_{amb} = +25°C$) LM2904	CMR	70 –	85 –	– –	65 50	70 70	– –	dB
Output short-circuit current ($T_{amb} = +25°C$)-Note 2	I_{OS}	–	40	60	–	40	60	mA
Output current ($V_{CC} = +15$ V, $T_{amb} = +25°C$, $V_I^+ = +1$ V, $V_I^- = 0$ V)	I_O	20	40	–	20	40	–	mA
Output current sink ($T_{amb} = +25°C$, $V_I^- = -1$ V, $V_I^+ = 0$ V) $V_{CC} = +15$ V $V_O = +0.2$ V	I_O (sink)	10 12	20 50	– –	10 12	20 50	– –	mA μA
Output voltage swing ($T_{amb} = +25°C$) $R_L = 2$ kΩ $R_L \geq 10$ kΩ LM2904	V_{OPP}	0 0	– –	$V_{CC} - 1.5$ $V_{CC} - 1.5$	0 0	– –	$V_{CC} - 1.5$ $V_{CC} - 1.5$	V
Channel separation 1 kHz ≤ f ≤ 20 kHz, $T_{amb} = +25°C$ (Note 6)	V_{O1}/V_{O2}	–	–120	–	–	–120	–	dB

Note 1 : This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistor becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also NPN parasitic action on the IC chip. This transistor action can cause the output voltages of the op-amps to go to the V_{CC} voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative.
This is not destructive and normal output will set up again for input voltage higher than −0.3 V

2 : Short-circuits from the output to V_{CC} can cause excessive heating if $V_{CC} > 15$ V. The maximum output current is approximately 40 mA independent of the magnitude of V_{CC}. Destructive dissipation can result from simultaneous short-circuits on all amplifiers.

3 : These specifications apply for $-55°C \leq T_{amb} \leq +125°C$ for LM158, $-25°C \leq T_{amb} \leq +85°C$ for LM258 and $-40°C \leq T_{amb} \leq +85°C$ for LM 2904. $V_{CC} = +5$ V, V_{CC}^- = Ground, unless otherwise specified.

Note 4 : $V_O \approx 1.4$ V, $R_S = 0$; $5\ V \leq V_{CC} \leq 30$ V, $0 \leq V_I \leq V_{CC}$ 1.5 V for LM158
$V_O \approx 1.4$ V, $R_S = 0$; $5\ V \leq V_{CC} \leq 26$ V, $0 \leq V_I \leq V_{CC}$ 1.5 V for LM2904

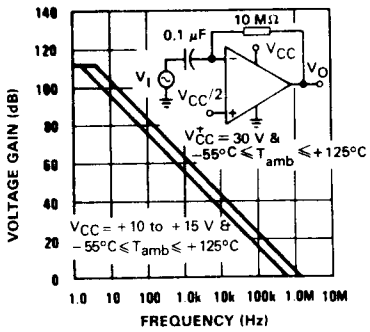
5 : The direction of the input current is out of the IC. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.

6 : Due to proximity of external components insure that coupling is not originating via stray capacitance between these external parts. This typically can be detected as this type of capacitance increases at higher frequences.

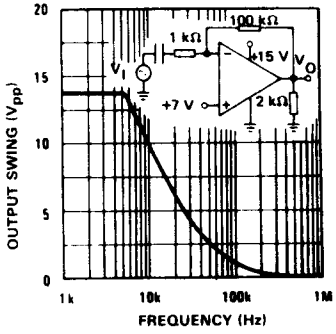
7 : The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is V_{CC} − 1.5 V. But either or both inputs can go to + 32 V without damage. (+ 26 V for LM2904).

8 : These specifications apply for $0°C \leq T_{amb} \leq +70°C$, $V_{CC} = +5$ V unless otherwise specified.

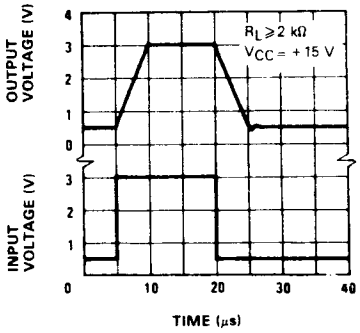
OPEN LOOP FREQUENCY RESPONSE (Note 3)



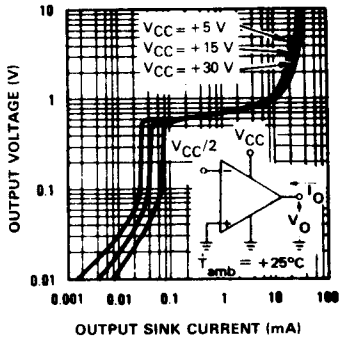
LARGE SIGNAL FREQUENCY RESPONSE



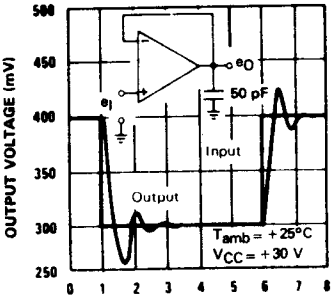
VOLTAGE FOLLOWER PULSE RESPONSE



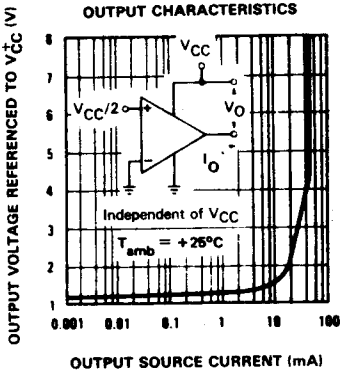
OUTPUT CHARACTERISTICS



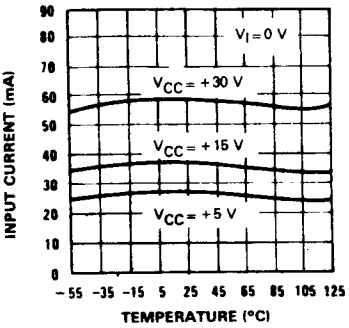
VOLTAGE FOLLOWER PULSE RESPONSE (SMALL SIGNAL)



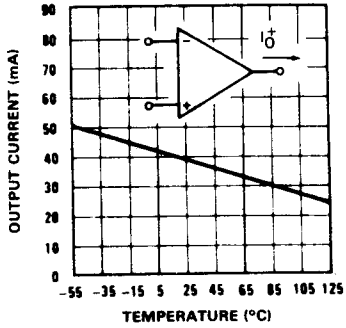
OUTPUT CHARACTERISTICS



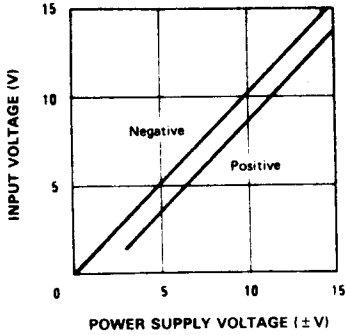
INPUT CURRENT (Note 1)



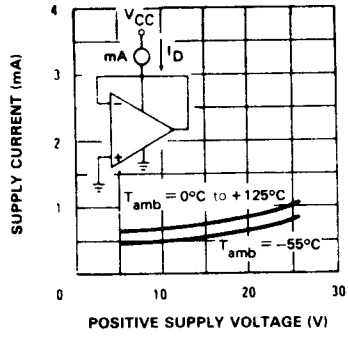
CURRENT LIMITING (Note 1)



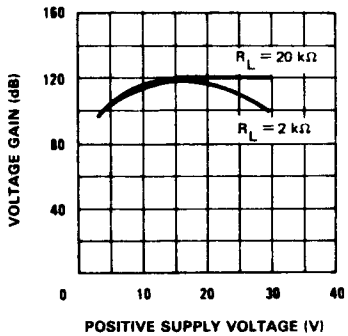
INPUT VOLTAGE RANGE



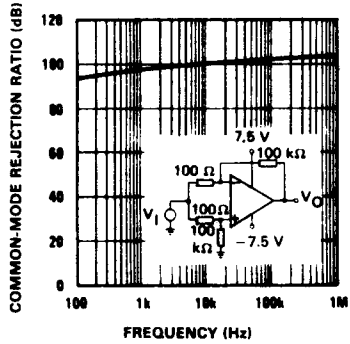
SUPPLY CURRENT



VOLTAGE GAIN

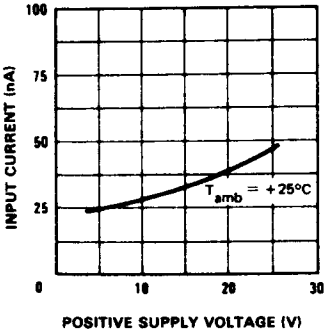


COMMON-MODE REJECTION RATIO

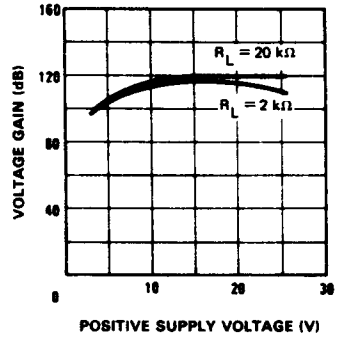


Note 9 : LM158 : $-55°C \leq T_{amb} \leq +125°C$
LM258 : $-25°C \leq T_{amb} \leq +85°C$
LM358 : $0°C \leq T_{amb} \leq +70°C$
LM2904 : $-40°C \leq T_{amb} \leq +85°C$

INPUT CURRENT



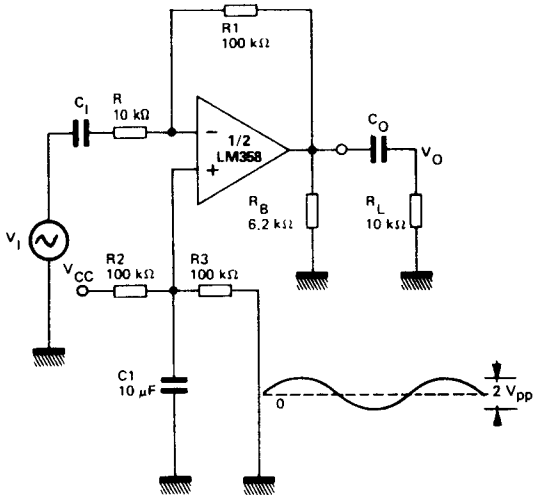
VOLTAGE GAIN



TYPICAL APPLICATIONS (SINGLE SUPPLY VOLTAGE) V_{CC} = +5 V_{DC}

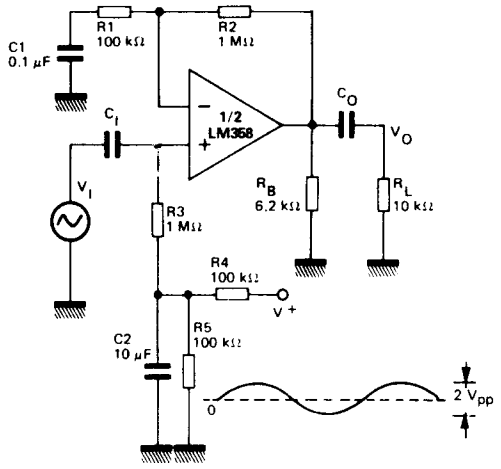
AC COUPLED INVERTING AMPLIFIER

$A_V = \frac{-R1}{R}$ (As shown A_V = −10)



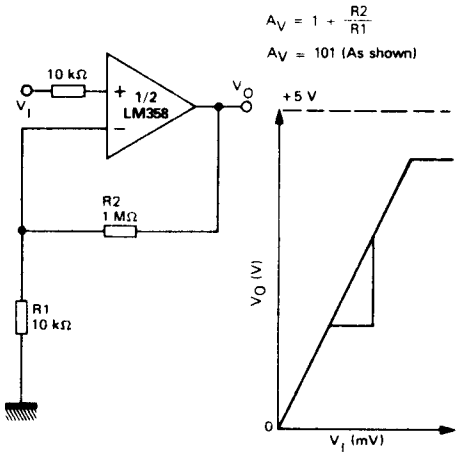
AC COUPLED NON INVERTING AMPLIFIER

Gain = $1 + \frac{R2}{R1}$ (As shown, Gain = 11)

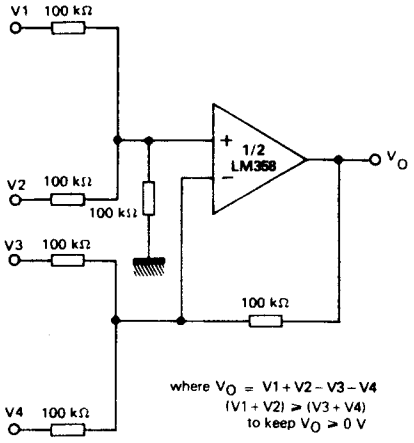


TYPICAL APPLICATIONS (Continued)

NON-INVERTING DC AMPLIFIER

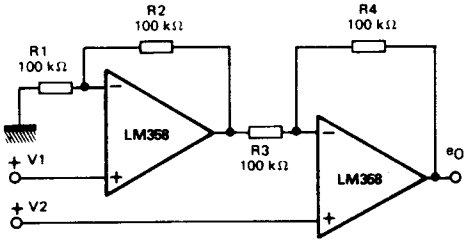


DC SUMMING AMPLIFIER



TYPICAL APPLICATIONS (SINGLE SUPPLY VOLTAGE) (Continued)

HIGH INPUT IMPEDANCE, DC DIFFERENTIAL AMPLIFIER

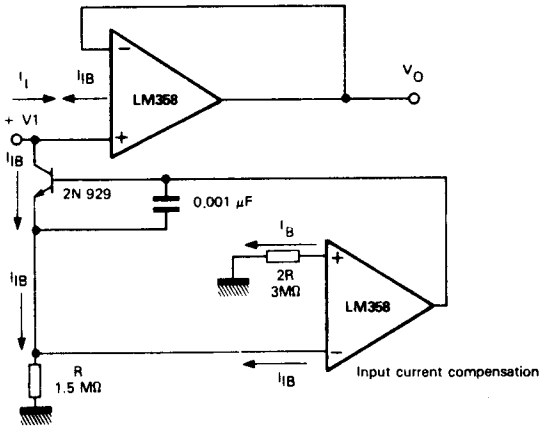


for $\frac{R1}{R2} = \frac{R4}{R3}$ (CMRR depends on this resistor ratio match)

$V_O = (1 + \frac{R4}{R3})(V2 - V1)$

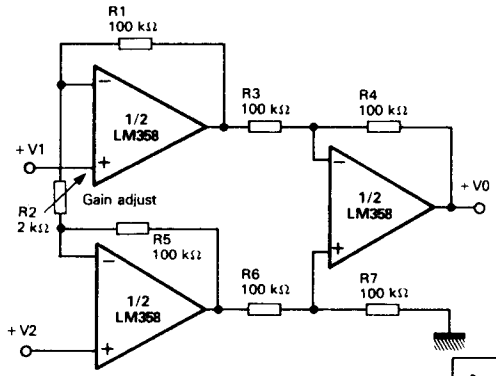
As shown : $V_O = 2(V2 - V1)$

USING SYMMETRICAL AMPLIFIERS TO REDUCE INPUT CURRENT (GENERAL CONCEPT)



TYPICAL APPLICATIONS (Continued)

HIGH INPUT Z ADJUSTABLE-GAIN DC INSTRUMENTATION AMPLIFIER

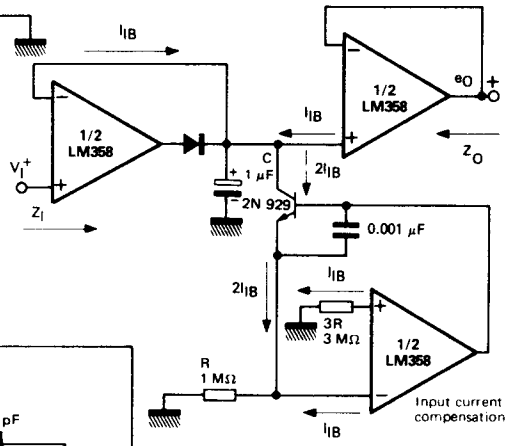


If R1 = R5 and R3 = R4 = R6 = R7

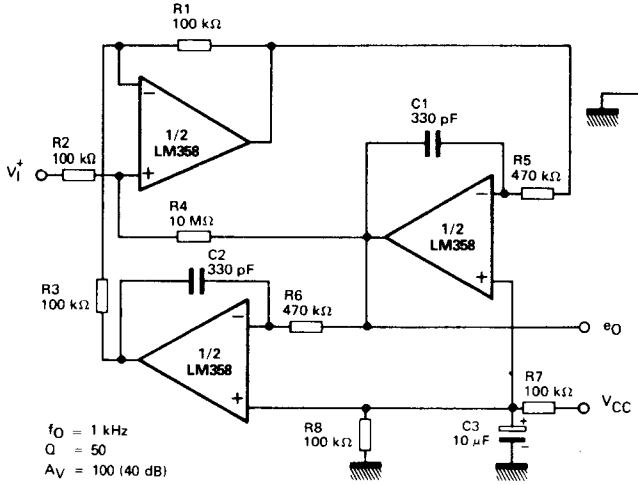
$$V_O = \left(1 + \frac{2\,R1}{R2}\right)(V2 - V1)$$

As shown : $V_O = 101\,(V2 - V1)$

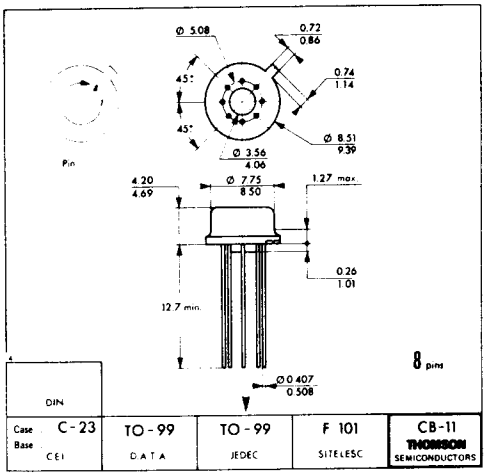
LOW DRIFT PEAK DETECTOR



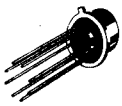
ACTIVE BAND-PASS FILTER



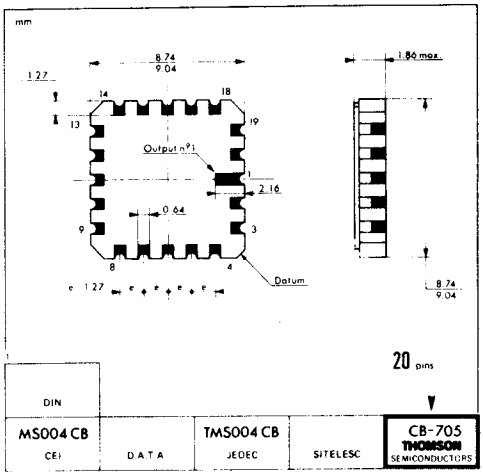
f_O = 1 kHz
Q = 50
A_V = 100 (40 dB)



CB-11
(TO-99)

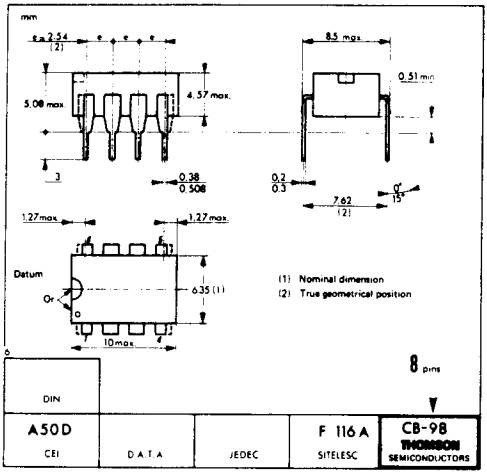


H SUFFIX
METAL CAN



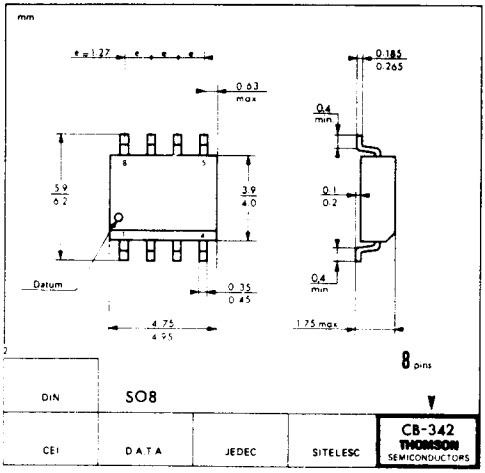
CB-705

GC SUFFIX
TRICECOP (LCC)



CB-98

DP SUFFIX
PLASTIC PACKAGE
DG SUFFIX
CERDIP PACKAGE



CB-342

FP SUFFIX
PLASTIC
MICROPACKAGE

These specifications are subject to change without notice.
Please inquire with our sales offices about the availability of the different packages.