SGS-THOMSON MICROELECTRONICS

LM158/A - LM258/A LM358/A - LM2904

LOW POWER DUAL OPERATIONAL AMPLIFIERS

- INTERNALLY FREQUENCY COMPENSATED
- LARGE DC VOLTAGE GAIN : 100dB
- WIDE BANDWIDTH (unity gain) : 1.1MHz (temperature compensated)
- VERY LOW SUPPLY CURRENT/AMPLI (500µA) - ESSENTIALLY INDEPENDENT OF SUPPLY VOLTAGE
- LOW INPUT BIAS CURRENT : 20nA (temperature compensated)
- LOW INPUT OFFSET VOLTAGE : 2mV
- LOW INPUT OFFSET CURRENT : 2nA
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND
- DIFFERENTIAL INPUT VOLTAGE RANGE EQUAL TO THE POWER SUPPLY VOLTAGE
- LARGE OUTPUT VOLTAGE SWING 0V TO (V_{CC} – 1.5V)

N
DIP8
(Plastic Package)

D
SO8
(Plastic Micropackage)

J
CERDIP8
(Cerdip Package)

H
TO99
(Metal Can)

ORDER CODES

Part Number	Temperature Range	Package			
		H	N	J	D
LM158/A	–55°C, +125°C	•	•	•	•
LM258/A	–40°C, +105°C	•	•	•	•
LM358/A	0°C, +70°C	•	•	•	•
LM2904	–40°C, +105°C	•	•	•	•
Examples : LM158H, LM258N, LM2904D					

158-01.TBL

DESCRIPTION

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.

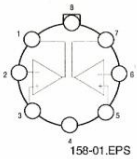
Application areas include transducer amplifiers, dc gain blocks and all the conventional op-amp circuits which now can be more easily implemented in single power supply systems. For example, these circuits can be directly operated off the standard +5V power supply voltage which is used in logic systems 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.

PIN CONNECTIONS (top views)

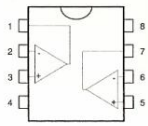
TO99



158-01.EPS

1 - Output 1
2 - Inverting input 1
3 - Non-inverting input 1
4 - V_{CC}^-

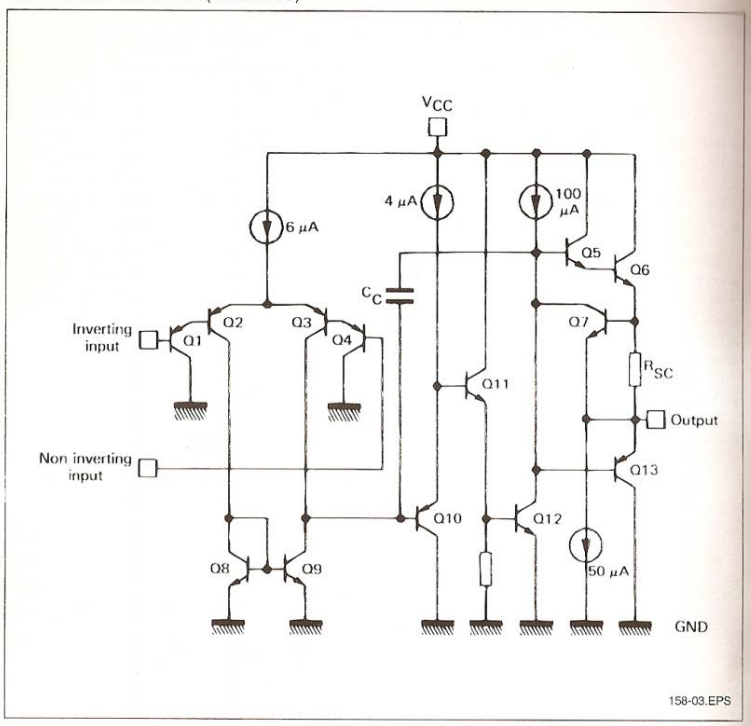
DIP8/CERDIP8
SO8



158-02.EPS

5 - Non-inverting input 2
6 - Inverting input 2
7 - Ouput 2
8 - V_{CC}^+

SCHEMATIC DIAGRAM (1/2 LM158)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	LM158,A	LM258,A LM2904	LM358,A	Unit
V_{CC}	Supply Voltage	+32	+32	+32	V
V_i	Input Voltage	−0.3 to +32	−0.3 to +32	−0.3 to +32	V
V_{id}	Differential Input Voltage	+32	+32	+32	V
	Output Short-circuit Duration - (note 2)		Infinite		
P_{tot}	Power Dissipation	500	500	500	mW
I_{in}	Input Current - (note 1)	50	50	50	mA
T_{oper}	Operating Free-air Temperature Range	−55 to +125	−40 to +105	0 to +70	°C
T_{stg}	Storage Temperature Range	−65 to +150	−65 to +150	−65 to +150	°C

ELECTRICAL CHARACTERISTICS

V_{CC}^+ = +5V, V_{CC}^- = Ground, V_O = 1.4V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	LM158A LM258A LM358A			LM158 - LM258 LM358 - LM2904			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{io}	Input Offset Voltage - (note 3) T_{amb} = 25°C LM158, LM258 LM158A $T_{min.} \le T_{amb} \le T_{max.}$ LM158, LM258		1	3 2 4		2	7 5 9 7	mV
I_{io}	Input Offset Current T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$		2	10 30		2	30 40	nA
I_{ib}	Input Bias Current - (note 4) T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$		20	50 100		20	150 200	nA
A_{vd}	Large Signal Voltage Gain (V_{CC} = +15V, R_L = 2kΩ, V_O = 1.4V to 11.4V) T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$	50 25	100		50 25	100		V/mV
SVR	Supply Voltage Rejection Ratio (R_S = 10kΩ) (V_{CC}^+ = 5 to 30V) T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$	65 65	100		65 65	100		dB
I_{CC}	Supply Current, all Amp, no Load V_{CC} = +5V, $T_{min.} \le T_{amb} \le T_{max.}$ V_{CC} = +30V, $T_{min.} \le T_{amb} \le T_{max.}$		0.7	1.2 2		0.7	1.2 2	mA
V_{icm}	Input Common Mode Voltage Range (V_{CC} = +30V) - (note 6) T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$	0 0		V_{CC}^+−1.5 V_{CC}^+−2	0 0		V_{CC}^+−1.5 V_{CC}^+−2	V
CMR	Common-mode Rejection Ratio (R_S = 10kΩ) T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$	70 60	85		70 60	85		dB
I_O	Output Short Circuit Current (V_{CC} = +15V, V_o = 2V, V_{id} = +1V)	20	40	60	20	40	60	mA
I_{sink}	Output Current Sink (V_{id} = -1V) V_{CC} = +15V, V_O = 2V V_{CC} = +15V, V_O = +0.2V	10 12	20 50		10 12	20 50		mA μA
V_{OPP}	Output Voltage Swing (R_L = 2kΩ) T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$	0 0		V_{CC}^+−1.5 V_{CC}^+−2	0 0		V_{CC}^+−1.5 V_{CC}^+−2	V
V_{OH}	High Level Output Voltage (V_{CC}^+ = 30V) T_{amb} = 25°C R_L = 2kΩ $T_{min.} \le T_{amb} \le T_{max.}$ T_{amb} = 25°C R_L = 10kΩ $T_{min.} \le T_{amb} \le T_{max.}$	26 26 27 27	27 28		26 26 27 27	27 28		V
V_{OL}	Low Level Output Voltage (R_L = 10kΩ) T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$		5	20 20		5	20 20	mV
SR	Slew Rate (V_{CC} = 15V, V_i = 0.5 to 3V, R_L = 2kΩ, C_L = 100pF, T_{amb} = 25°C, unity gain)	0.3	0.6		0.3	0.6		V/μs

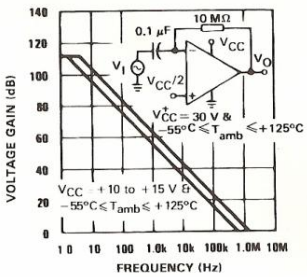
158-03.TBL

ELECTRICAL CHARACTERISTICS (continued)

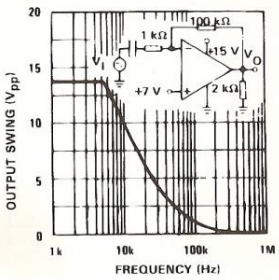
Symbol	Parameter	LM158A LM258A LM358A			LM158 - LM258 LM358 - LM2904			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
GBP	Gain Bandwidth Product (V_{CC} = 30V, f = 100kHz, T_{amb} = 25°C, V_{in} = 10mV, R_L = 2kΩ, C_L = 100pF)	0.7	1.1		0.7	1.1		MHz
THD	Total Harmonic Distortion (f = 1kHz, A_v = 20dB, R_L = 2kΩ, V_{CC} = 30V, C_L = 100pF, T_{amb} = 25°C, V_O = 2 PP)		0.02			0.02		%
e_n	Equivalent Input Noise voltage (f = 1kHz, R_S = 100Ω, V_{CC} = 30V)		55			55		$\frac{nV}{\sqrt{Hz}}$
DV_{io}	Input Offset Voltage Drift		7	15		7	30	μV/°C
DI_{io}	Input Offset Current Drift		10	200		10	300	pA/°C
V_{O1}/V_{O2}	Channel Separation (note 5) 1kHz ≤ f ≤ 20kHz		120			120		dB

Notes :
1. This input current 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 −0.3V.
2. Short-circuits from the output to V_{CC} can cause excessive heating if V_{CC}^+ > 15V. The maximum output current is approximatively 40mA independent of the magnitude of V_{CC}. Destructive dissipation can result from simultaneous short-circuits on all amplifiers.
3. V_O = 1.4V, R_S = 0Ω, 5V < V_{CC}^+ < 30V, 0 < V_{ic} < V_{CC}^+ − 1.5V.
4. 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.
5. Due to the 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.
6. The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is V_{CC}^+ − 1.5V. But either or both inputs can go to +32V without damage.

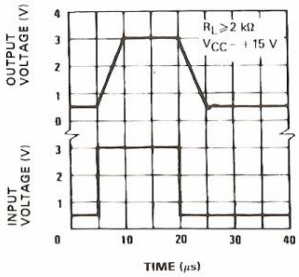
OPEN LOOP FREQUENCY RESPONSE (Note 3)



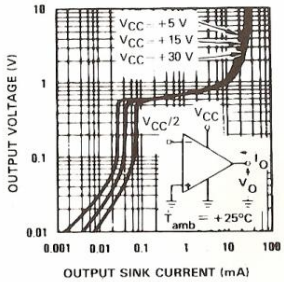
LARGE SIGNAL FREQUENCY RESPONSE



VOLTAGE FOLLOWER PULSE RESPONSE

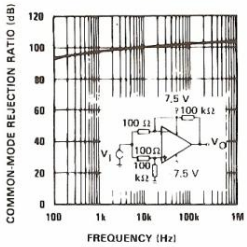


OUTPUT CHARACTERISTICS



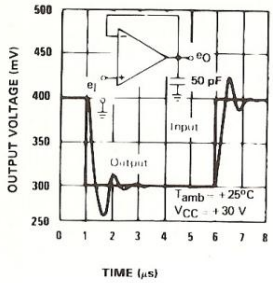
158-04.EPS

COMMON-MODE REJECTION RATIO

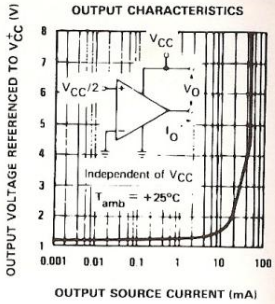


158-05.EPS

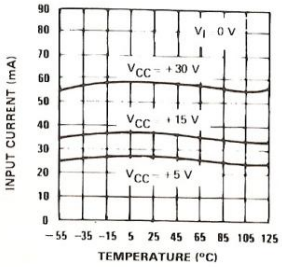
VOLTAGE FOLLOWER PULSE RESPONSE (SMALL SIGNAL)



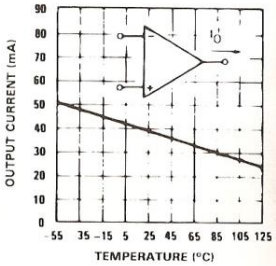
OUTPUT CHARACTERISTICS



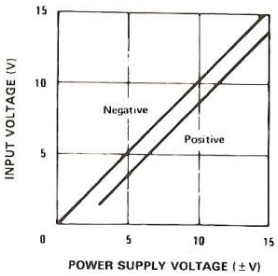
INPUT CURRENT (Note 1)



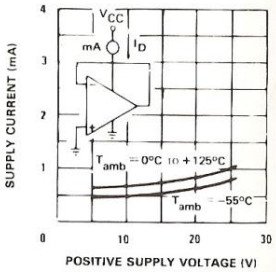
CURRENT LIMITING (Note 1)



INPUT VOLTAGE RANGE

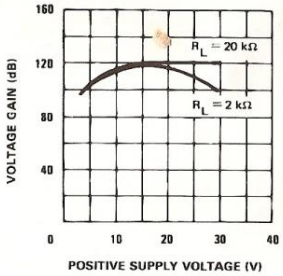


SUPPLY CURRENT



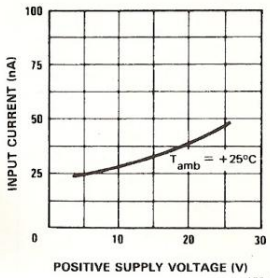
158-06.EPS

VOLTAGE GAIN



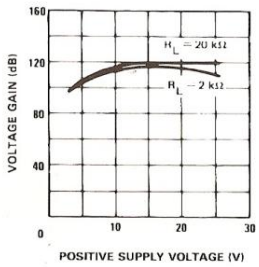
158-07.EPS

INPUT CURRENT



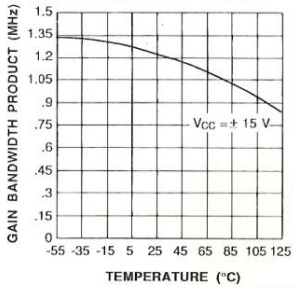
158-08.EPS

VOLTAGE GAIN



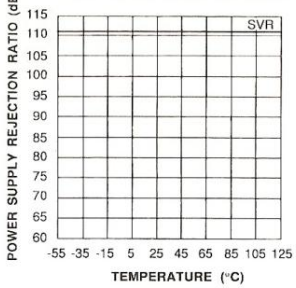
158-09.EPS

GAIN BANDWIDTH PRODUCT



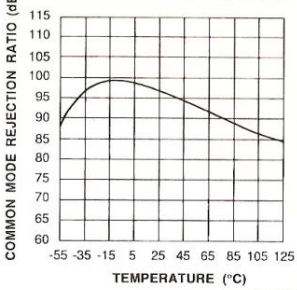
158-10.EPS

POWER SUPPLY REJECTION RATIO



158-11.EPS

COMMON MODE REJECTION RATIO



158-12.EPS