General Description

The EC5742 series amplifiers are single supply, low power CMOS dual operational amplifier, these amplifiers offer bandwidth of 9KHz, rail-to-rail inputs and outputs, and single-supply operation from 1.4V to 5.5V. Low quiescent supply current of 1μA and very low input bias current of 1pA make the devices an ideal choice for low offset, low power consumption and high impedance applications such as smoke detectors, photodiode amplifiers, and other sensors.

The EC5742 is available in SOP-8 and MSOP-8 packages. The extended temperature range of -40° C to +85° Cover all supply voltages offers additional design flexibility.

Features

◆Single-Supply Operation from +1.4V to +5.5V

◆Rail-to-Rail Input/Output

◆Gain-Bandwidth Product: 9KHz

◆Low Input Bias Current: 1pA

◆Low Offset Voltage: 1mV

◆Quiescent Current: 500nA/Amplifier

◆Available in Space-Saving Packages:

◆SOP-8 and MSOP-8 Packages

Applications

◆Portable Equipment
◆Mobile Communications
◆Smoke Detector
◆Sensor Interface
◆Medical Instrumentation
◆Battery-Powered Instruments
◆Handheld Test Equipment

Pin Configurations

EC5742 SOP8 and MSOP8 (Top View)

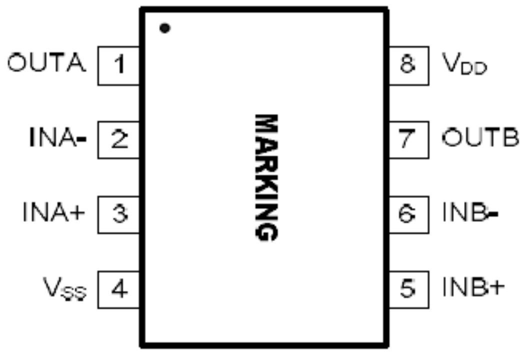


Figure 1. Pin Assignment Diagram (SOP8 and MSOP8 Package)

Note: Please see section “Part Markings” for detailed Marking Information.

Ordering Information

EC5742NN - XX X

R：Reel

Package Type ：
R1：MSOP8
M1：SOP8

Part Number	Package	Marking	Marking Information
EC5742NNR1R	MSOP-8L	EC5742 LLLLL YYWWX	1. LLLLL：Last five Number of Lot No 2. YY：Year Code 3. WW：Week Code 4. X：Internal Tracking Code
EC5742NNM1R	SOP-8L	EC5742 LLLLL YYWWX	

Application Information

◆Size

EC5742 series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. The small footprints of the EC5742 series packages save space on printed circuit boards and enable the design of smaller electronic products.

◆Power Supply Bypassing and Board Layout

EC5742 series operates from a single 1.4V to 5.5V supply or dual ±0.7V to ±2.75V supplies. For best performance, a 0.1Mf ceramic capacitor should be placed close to the VDD pin in single supply operation. For dual supply operation, both VDD and VSS supplies should be bypassed to ground with separate 0.1μF ceramic capacitors.

◆Low Supply Current

The low supply current (1.4μA) of EC5742 series will help to maximize battery life. They are ideal for battery powered systems.

◆Operating Voltage

EC5742 series operate under wide input supply voltage (1.4V to 5.5V).In addition, all temperature specifications apply from -40° C to +125° C. Most behavior remains unchanged throughout the full operating voltage range. These guarantees ensure operation throughout the single Li-Ion battery lifetime.

◆Rail-to-Rail Input

The input common-mode range of EC5742 series extends 100mV beyond the supply rails (VSS-0.1V to VDD+0.1V). This is achieved by using complementary input stage. For normal operation, inputs should be limited to this range.

◆Rail-to-Rail Output

Rail-to-Rail output swing provides maximum possible dynamic range at the output. This is particularly important when operating in low supply voltages. The output voltage of EC5742 series can typically swing to less than 10mV from supply rail in light resistive loads (>100kΩ), and 60mV of supply rail in moderate resistive loads (10kΩ).

◆Capacitive Load Tolerance

The EC5742 series can directly drive 250pF capacitive load in unity-gain without oscillation. Increasing the gain enhances the amplifier's ability to drive greater capacitive loads. In unity-gain configurations, the capacitive load drive can be improved by inserting an isolation resistor RISO in series with the capacitive load, as shown in Figure 1.

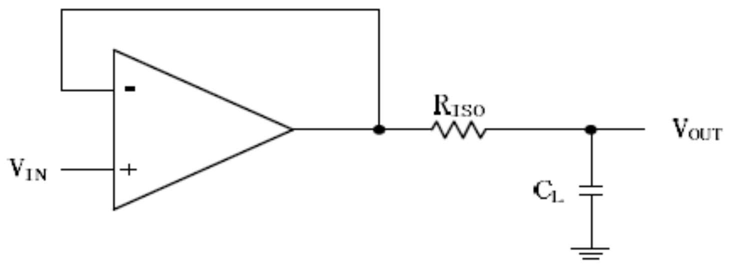


Figure 1. Indirectly Driving a Capacitive Load Using Isolation Resistor

The bigger the RISO resistor value, the more stable VOUT will be. However, if there is a resistive load RL in parallel with the capacitive load, a voltage divider (proportional to RISO/RL) is formed, this will result in a gain error. The circuit in Figure 2 is an improvement to the one in Figure 1. RF provides the DC accuracy by feed-forward the VIN to RL. CF and RISO serve to counteract the loss of phase margin by feeding the high frequency component of the output signal back to the amplifier's inverting input, thereby preserving the phase margin in the overall feedback loop. Capacitive drive can be increased by increasing the value of CF. This in turn will slow down the pulse response.

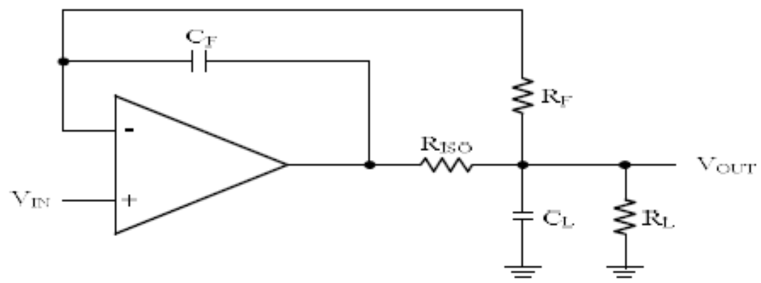


Figure 2. Indirectly Driving a Capacitive Load With DC Accuracy

◆**Differential amplifier**

The differential amplifier allows the subtraction of two input voltages or cancellation of a signal common the two inputs. It is useful as a computational amplifier in making a differential to single-end conversion or in rejecting a common mode signal. Figure 3 shown the differential amplifier using EC5741.

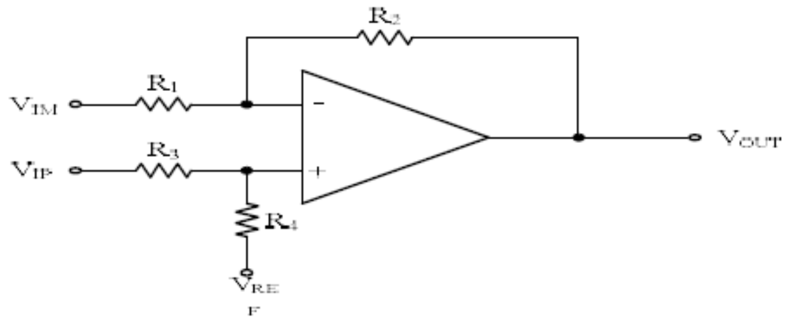


Figure 3. Differential Amplifier

$$V_{out}=\left(\frac{R1+R2}{R3+R4}\right)\frac{R4}{R1}V_2-\frac{R2}{R1}V_1+\left(\frac{R1+R2}{R3+R4}\right)\frac{R3}{R1}\frac{V^+}{2}$$

If the resistor ratios are equal (i.e. R_1=R_3 and R_2=R_4), then

$$V_{out}=\frac{R_2}{R_1}(V_2-V_1)+\frac{V^+}{2}$$

◆**Instrumentation Amplifier**

The input impedance of the previous differential amplifier is set by the resistors R1, R2, R3, and R4. To maintain the high input impedance, one can use a voltage follower in front of each input as shown in the following two instrumentation amplifiers.

◆**Three-Op-Amp Instrumentation Amplifier**

The quad EC5742 can be used to build a three-op-amp instrumentation amplifier as shown in Figure 4.

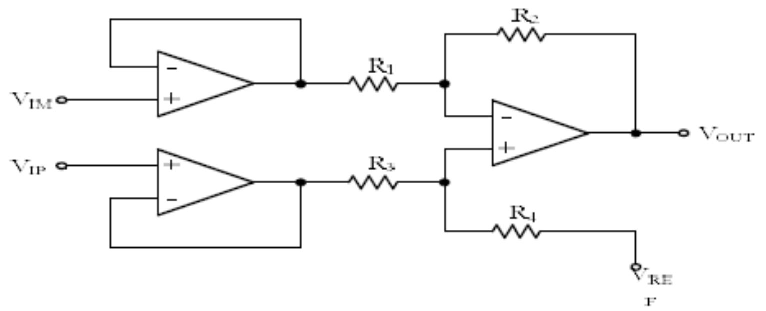


Figure 4. Three-Op-Amp Instrumentation Amplifier

The amplifier in Figure 4 is a high input impedance differential amplifier with gain of R2/R1. The two differential voltage followers assure the high input impedance of the amplifier.

◆**Two-Op-Amp Instrumentation Amplifier**

EC5742 can also be used to make a high input impedance two-op-amp instrumentation amplifier as shown in Figure 5.

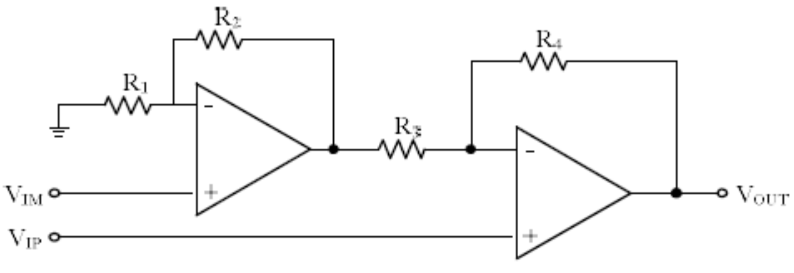


Figure 5. Two-Op-Amp Instrumentation Amplifier

$V_o = (1 + \frac{R_4}{R_3})(V_2 - V_1)$

Where R_1=R_3 and R_2=R_4. If all resistors are equal, then V_o=2(V_2-V_1)

◆Single-Supply Inverting Amplifier

The inverting amplifier is shown in Figure 6. The capacitor C1 is used to block the DC signal going into the AC signal source VIN. The value of R1 and C1 set the cut-off frequency to fC=1/(2πR1C1). The DC gain is defined by VOUT=-(R2/R1)VIN

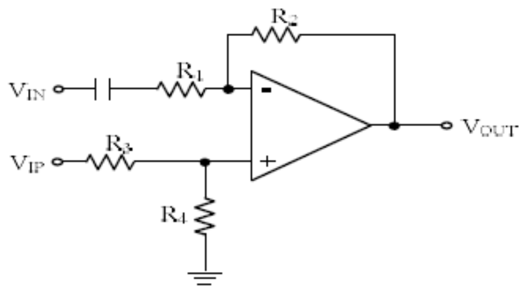


Figure 6. Single Supply Inverting Amplifier

◆Low Pass Active Filter

The low pass active filter is shown in Figure 7. The DC gain is defined by –R2/R1. The filter has a -20dB/decade roll-off after its corner frequency fC=1/(2πR3C1).

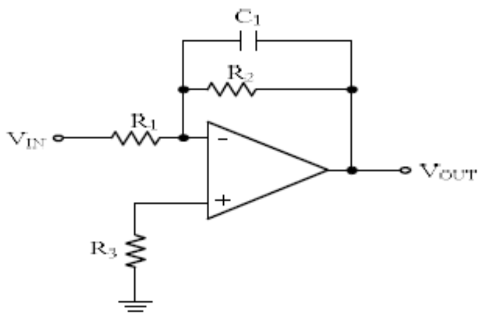


Figure 7. Low Pass Active Filter

◆Sallen-Key 2nd Order Active Low-Pass Filter

EC5742 can be used to form a 2ed order Sallen-Key active low-pass filter as shown in Figure 8. The transfer function from VIN to

V_{OUT} is given by
$$\frac{V_{OUT}}{V_{in}}(S)=\frac{\frac{1}{C_1C_2R_1R_2}A_{LP}}{S^2+S\left(\frac{1}{C_1R_1}+\frac{1}{C_1R_2}+\frac{1}{C_2R_2}-\frac{A_{LP}}{C_2R_2}\right)+\frac{1}{C_1C_2R_1R_2}}$$

Where the DC gain is defined by $A_{LP}=1+R_3/R_4$, and the corner frequency is given by $\omega_C=\sqrt{\frac{1}{C_1C_2R_1R_2}}$

The pole quality factor is given by $\frac{\omega C}{Q}=\frac{1}{C_1R_1}+\frac{1}{C_1R_2}+\frac{1}{C_2R_2}-\frac{A_{LP}}{C_2R_2}$

Let R1=R2=R and C1=C2=C, the corner frequency and the pole quality factor can be simplified as below

$\omega_C=\frac{1}{CR}$ And $Q=2-R_3/R_4$

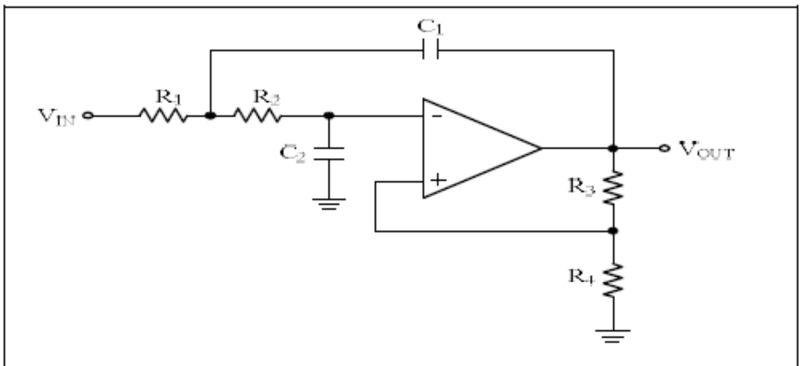


Figure 8. Sanllen-Key 2nd Order Active Low-Pass Filter

◆Sallen-Key 2nd Order high-Pass Active Filter

The 2nd order Sallen-key high-pass filter can be built by simply interchanging those frequency selective components R1, R2, C1, and C2 as shown in Figure 9.

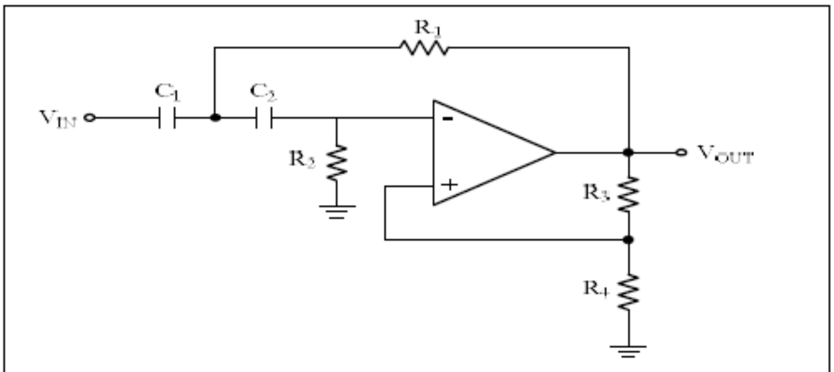


Figure 9. Sanllen-Key 2nd Order Active High-Pass Filter

$$\frac{V_{OUT}}{V_{IN}}(S)=\frac{S^2A_{HP}}{S^2+S\left(\frac{1}{C_1R_1}+\frac{1}{C_2R_2}+\frac{1-A_{HP}}{C_1R_1}\right)+\frac{1}{C_1C_2R_1R_2}}$$

Where $A_{HP}=1+R_3/R_4$

Electrical Characteristics

◆Absolute Maximum Ratings

Condition	Min	Max
Power Supply Voltage (V_{DD} to Vss)	-0.5V	+7V
Analog Input Voltage (IN+ or IN-)	Vss-0.5V	V_{DD}+0.5V
PDB Input Voltage	Vss-0.5V	+7V
Operating Temperature Range	-40°C	+85°C
Junction Temperature	+150°C	
Storage Temperature Range	-65°C	+150°C
Lead Temperature (soldering, 10sec)	+300°C	
Package Thermal Resistance (T_A=+25°C)		
MSOP-8, θ_{JA}	210°C	
SOP8, θ_{JA}	130°C	

Note: Stress greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions outside those indicated in the operational sections of this specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

◆Electrical Characteristics

(VDD = +5V, Vss = 0V, VCM = VDD/2, VOUT = VDD/2, RL=100K tied to VDD/2, SHDNB = VDD, TA = -40° C to

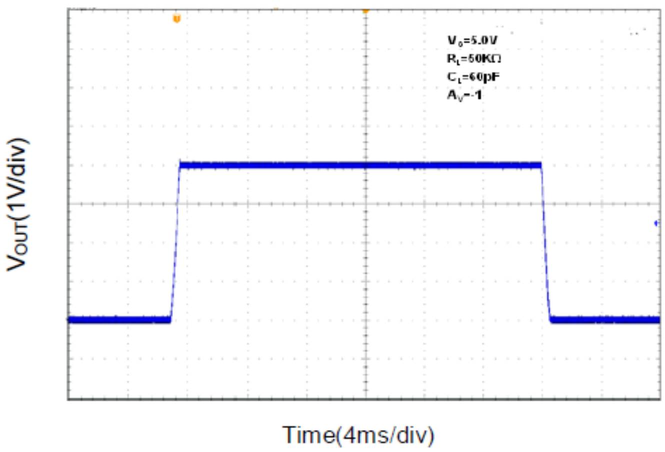
85° C, unless otherwise noted. Typical values are at TA =+25°C.) (Notes 1)

PARAMETER	SYMBO	CONDITIONS	MIN	TYP	MAX	UNIS
Supply-Voltage Range	VDD	Guaranteed by the PSRR test	1.4		5.5	V
Quiescent Supply Current (per Amplifier)	IQ	VDD = 5V Shutdown Mode (PDB = VSS)		1.0 0.1	2.0	μA μA
Input Offset Voltage	Vos			1	±5	mV
Input Offset Voltage Tempco	ΔVos/ΔT			0.5		μV/°C
Input Bias Current	IB	(Note 2)		1		pA
Input Offset Current	Ios	(Note 2)				pA
Input Common-Mode Voltage Range	VCM		-0.1		VDD+0.1	V
Common- Mode Rejection Ratio	CMRR	VDD=5.5Vss-0.1V≤VCM≤ VDD+0.1V Vss≤VCM≤5V	60 65	75 80		dB
Power-Supply Rejection Ratio	PSRR	VDD = +1.8V to +5.5V	65	80		dB
Open-Loop Voltage Gain	AV	VDD=5V, RL=50kΩ, 0.1V≤VO≤4.9V VDD=1.4V, RL=50kΩ, 0.1V≤VO≤4.9V		90 80		dB dB
Output Voltage Swing	VOUT	|VIN+-VIN-|≥10mV VDD-VOH RL = 100kΩ to VDD/2 VOL-Vss |VIN+-VIN-|≥10mV VDD-VOH RL = 50kΩ to VDD/2 VOL-Vss		6 6 40 40		mV
Output Short-Circuit Current	ISC	Sinking or Sourcing		±3		mA
Gain Bandwidth Product	GBW	Av = +1V/V		9		KHz
Slew Rate	SR	Av = +1V/V		4.5		V/ms
Settling Time	ts	To 0.1%, VOUT = 2V step Av = +1V/V		650		μs
Input Voltage Noise Density	en	VDD=5V, f = 1kHz VDD=1.4V , f = 1kHz		150 150		nV/√Hz

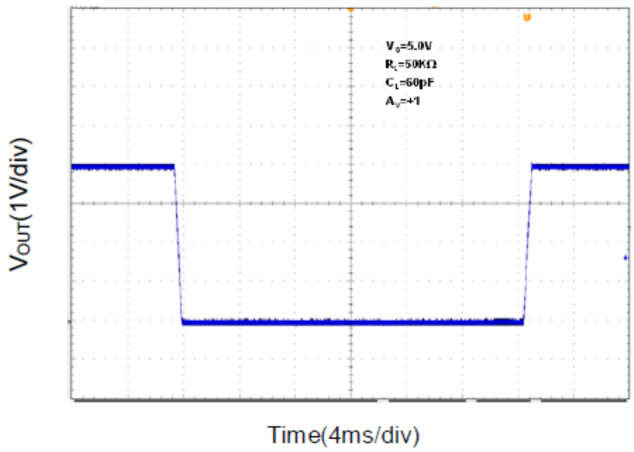
◆**Typical performance characteristics**

TA =+25° C,VDD = +5V, Vss = 0V, VCM = VDD/2 , VOUT = VDD/2, RL=100K tied to VDD/2, CL=60pF,unless otherwise noted.

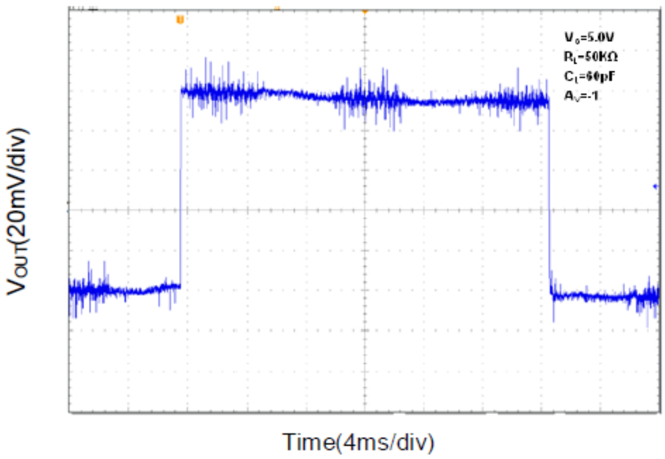
Large Signal Inverting Pulse Response



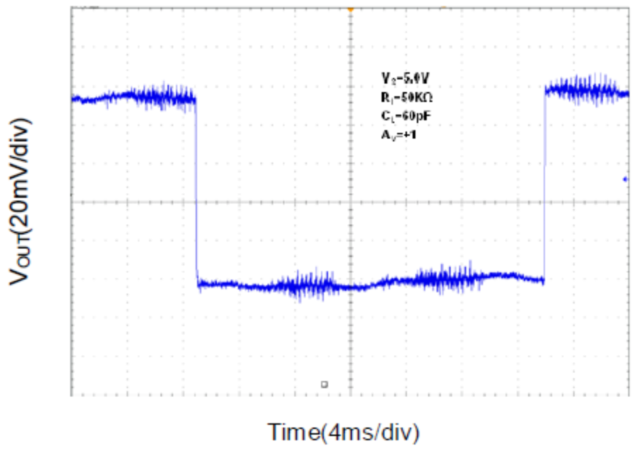
Large Signal Non-Inverting Pulse Response



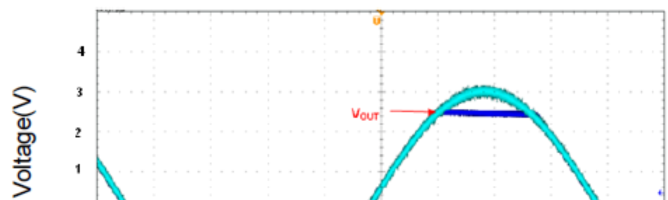
Small Signal Inverting Pulse Response



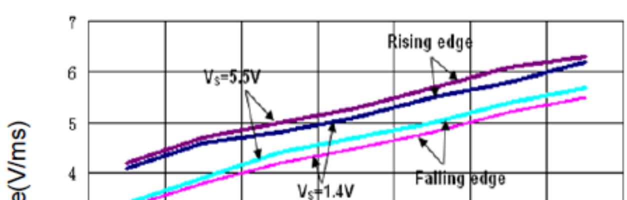
Small Signal Non-Inverting Pulse Response



No Phase Reversal

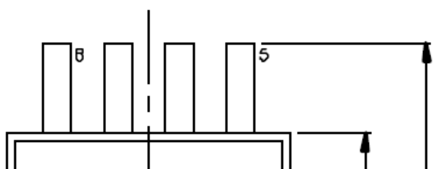


Slew Rate vs. Temperature



Package Information

MSOP8



SYMBOLS	MIN.	NOM.	MAX.
A	–	–	1.10
A1	0.00	–	0.15

SOP8