TSM221

DUAL CMOS RAIL TO RAIL OPERATIONAL AMPLIFIER AND DUAL CMOS COMPARATOR

- SINGLE SUPPLY OPERATION FROM **2.7V TO 16V**
- LOW SUPPLY CURRENT: 500µA (V_{CC} = 5V)
- LATCH - UP IMMUNITY

OPERATIONAL AMPLIFIERS

- RAIL TO RAIL INPUT AND OUTPUT
- EXTREMELY LOW INPUT BIAS CURRENT : 1pA typ.
- 1MHz TYPICAL GAIN BANDWIDTH PRODUCT
- SPECIFIED FOR 600Ω OUTPUT LOAD

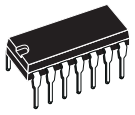
COMPARATORS

- PUSH-PULL OUTPUT (no external pull-up resistor required)
- EXTREMELY LOW INPUT BIAS CURRENT : 1pA typ.
- EXTREMELY LOW INPUT OFFSET
- CURRENT : 1pA typ.
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND
- HIGH INPUT IMPEDANCE : 10^{12} typ.
- FAST RESPONSE TIME : 2µs TYP. FOR 5mV OVERDRIVE

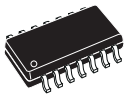
- SPICE **MACROMODEL** INCLUDED IN THIS SPECIFICATION

DESCRIPTION

The TSM221 is a space-saving monolithic IC which includes a dual Rail to Rail op-amp and a micropower dual comparator, using a CMOS process. This mixed circuit is a general purpose analog block for Telecom or Industrial applications, offering an integrated high performances solution.



N
DIP14
(Plastic Package)



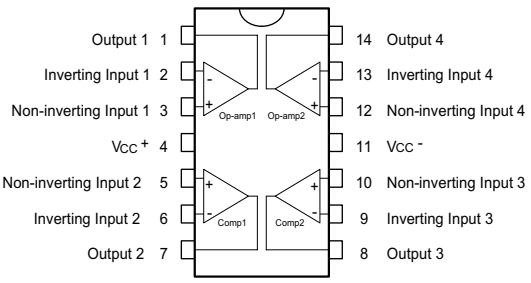
D
SO14
(Plastic Micropackage)

ORDER CODE

Part Number	Temperature Range	Package	
		N	D
TSM221I	-40°C, +125°C	•	•

N = Dual in Line Package (DIP)
D = Small Outline Package (SO) - also available in Tape & Reel (DT)

PIN CONNECTIONS (top view)



ABSOLUTE MAXIMUM RATINGS (OPERATIONAL AMPLIFIERS)

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage [1]	18	V
V_{id}	Differential Input Voltage [2]	±18	V
V_i	Input Voltage [3]	-0.3 to 18	V
I_{in}	Current on Inputs (Op-Amps)	±50	mA
I_o	Current on Outputs (Op-Amps)	±130	mA
T_{oper}	Operating Free-Air Temperature range	-40 to +125	°C
T_{stg}	Storage Temperature Range	-65 to +150	°C

1. All voltage values, except differential voltage, are with respect to network ground terminal.
2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
3. The magnitude of input and output voltages must never exceed (V_{CC}^+) +0.3V.

ABSOLUTE MAXIMUM RATINGS (COMPARATORS)

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage [1]	18	V
V_{id}	Differential Input Voltage [2]	±18	V
V_i	Input Voltage [3]	-0.3 to 18	V
V_o	Output Voltage	18	V
I_o	Output Current (Comparators)	20	mA
T_{oper}	Operating Free-Air Temperature range	-40 to +125	°C
T_{stg}	Storage Temperature Range	-65 to +150	°C

1. All voltages values, except differential voltage are with respect to network ground terminal.
2. Differential voltages are non-inverting input terminal with respect to the inverting input terminal.
3. The magnitude of the input and the output voltages must never exceed the magnitude of the possitive supply voltage.

OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	2.7 to 16	V
V_{icm}	Common Mode Input Voltage Range (Op-Amps)	V_{dd} -0.2 to V_{CC} +0.2	V
V_{icm}	Common Mode Input Voltage Range (Comparators)	0 to V_{CC}^+ -1.5	V

OPERATIONAL AMPLIFIERS

ELECTRICAL CHARACTERISTICS

V_{CC}^+ = 5V, V_{CC}^- = 0V, R_L, C_L connected to $V_{cc/2}$, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage $T_{min.} \le T_{amb} \le T_{max.}$			10 12	mV
DV_{io}	Input Offset Voltage Drift		5		µV/°C
I_{io}	Input Offset Current [1] $T_{min.} \le T_{amb} \le T_{max.}$		1	100 200	pA
I_{ib}	Input Bias Current (see note 1) $T_{min.} \le T_{amb} \le T_{max.}$		1	150 300	pA
A_{vd}	Large Signal Voltage Gain R_L = 10kΩ , V_o = 1.5V to 3.5V $T_{min.} \le T_{amb} \le T_{max}$	10 7	50		V/mV
I_{CC}	Total Supply Current [2] No load		500	800	µA
CMR	Common Mode Rejection Ratio V_{ic} =1.5 to 3.5V, V_o = 2.5V	60	85		dB
SVR	Supply Voltage Rejection Ratio V_{CC}^+ = 3V to 5V, $V_o = V_{cc/2}$	55	80		dB
V_{OH}	High Level Output Voltage (R1 connected to$V_{cc/2}$) R_L = 10k R_L = 600Ω R_L = 100Ω	4.90 4.25	4.95 4.55 3.7		V
V_{OL}	Low Level Output Voltage (R1 connected to$V_{cc/2}$) R_L = 10k R_L = 600Ω R_L = 100Ω		40 350 1400	100 500	mV
I_O	Output Short Circuit Current $V_O = V_{CC}^-$	45	65		mA
I_{sink}	Output Sink Current $V_O = V_{CC}^+$	45	65		mA
GBP	Gain Bandwith Product A_{VCL} = 100, R_L = 10k C_L = 100pF, f =100kHz		1		MHz
SR	Slew Rate A_{VCL} = 1, R_L = 10k C_L = 100pF, V_i = 1V to 4V		0.7		V/µs
∅m	Phase Margin		30		degrees
e_n	Equivalent Input Noise Voltage R_s = 100Ω, f = 1kHz		30		$\frac{nV}{\sqrt{Hz}}$
C_s	Channel Separation f= 1kHz		120		dB

1. Maximum values including unavoidable inaccuracies of the industrial test.
2. Op-amps and comparators

ELECTRICAL CHARACTERISTICS

V_{CC}^+ = 3V, V_{CC}^- = 0V, R_L, C_L connected to $V_{cc/2}$, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage $T_{min.} \le T_{amb} \le T_{max.}$			10 12	mV
DV_{io}	Input Offset Voltage Drift		5		µV/°C
I_{io}	Input Offset Current [1] $T_{min.} \le T_{amb} \le T_{max.}$		1	100 200	pA
I_{ib}	Input Bias Current (see note 1) $T_{min.} \le T_{amb} \le T_{max.}$		1	150 300	pA
A_{vd}	Large Signal Voltage Gain R_L = 10kΩ , V_o = 1.5V to 3.5V $T_{min.} \le T_{amb} \le T_{max}$	3 2	10		V/mV
I_{CC}	Total Supply Current [2] No load		415	600	µA
CMR	Common Mode Rejection Ratio V_{ic} = 0 to 3V, V_o = 1.5V		70		dB
SVR	Supply Voltage Rejection Ratio V_{CC}^+ = 2.7V to 3.3V, $V_o = V_{cc/2}$	50	80		dB
V_{OH}	High Level Output Voltage (R1 connected to$V_{cc/2}$) R_L = 10k R_L = 600Ω R_L = 100Ω	2.90 2.30	2.96 2.60 2		V
V_{OL}	Low Level Output Voltage (R1 connected to$V_{cc/2}$) R_L = 10k R_L = 600Ω R_L = 100Ω		30 300 900	70 400	mV
I_O	Output Short Circuit Current $V_O = V_{CC}^-$	20	40		mA
I_{sink}	Output Sink Current $V_O = V_{CC}^+$	20	40		mA
GBP	Gain Bandwith Product A_{VCL} = 100, R_L = 10k C_L = 100pF, f =100kHz		0.8		MHz
SR	Slew Rate A_{VCL} = 1, R_L = 10k C_L = 100pF, V_i = 1.3V to 1.7V		0.3		V/µs
∅m	Phase Margin		30		degrees
e_n	Equivalent Input Noise Voltage R_s = 100Ω, f = 1kHz		30		$\frac{nV}{\sqrt{Hz}}$
C_s	Channel Separation f= 1kHz		120		dB

1. Maximum values including unavoidable inaccuracies of the industrial test.
2. Op-amps and comparators

MACROMODEL FOR OP-AMPS (V_{CC} = 3V)
Applies to : TSM221

```
** Standard Linear Ics Macromodels, 1993.
** CONNECTIONS :
* 1 INVERTING INPUT
* 2 NON-INVERTING INPUT
* 3 OUTPUT
* 4 POSITIVE POWER SUPPLY
* 5 NEGATIVE POWER SUPPLY
.SUBCKT TSM2213V 1 3 2 4 5 (analog)
*******************************************************
.MODEL MDTH D IS=1E-8 KF=6.564344E-14 CJO=10F
* INPUT STAGE
CIP 2 5 1.000000E-12
CIN 1 5 1.000000E-12
EIP 10 5 2 5 1
EIN 16 5 1 5 1
RIP 10 11 6.500000E+00
RIN 15 16 6.500000E+00
RIS 11 15 1.271505E+01
DIP 11 12 MDTH 400E-12
DIN 15 14 MDTH 400E-12
VOFP 12 13 DC 0.000000E+00
VOFN 13 14 DC 0
IPOL 13 5 4.000000E-05
CPS 11 15 2.125860E-08
DINN 17 13 MDTH 400E-12
VIN 17 5 0.000000e+00
DINR 15 18 MDTH 400E-12
VIP 4 18 0.000000E+00
FCP 4 5 VOFP 5.000000E+00
FCN 5 4 VOFN 5.000000E+00
* AMPLIFYING STAGE
FIP 5 19 VOFP 2.750000E+02
FIN 5 19 VOFN 2.750000E+02
RG1 19 5 1.916825E+05
RG2 19 4 1.916825E+05
CC 19 29 2.200000E-08
HZTP 30 29 VOFP 1.3E+03
HZTN  5 30 VOFN 1.3E+03
DOPM 19 22 MDTH 400E-12
DONM 21 19 MDTH 400E-12
HOPM 22 28 VOUT 3800
VIPM 28 4 150
HONM 21 27 VOUT 3800
VINM 5 27 150
EOUT 26 23 19 5 1
VOUT 23 5 0
ROUT 26 3 75
COUT 3 5 1.000000E-12
DOP 19 68 MDTH 400E-12
VOP 4 25 1.724
HSCP 68 25 VSCP1 0.8E8
DON 69 19 MDTH 400E-12
VON 24 5 1.7419107
HSCN 24 69 VSCN1 0.8E+08
VSCTHP 60 61 0.0875
** VSCTHP = le seuil au dessus de vio * 500
** c.a.d 275U-000U dus a l'offset
DSCP1 61 63 MDTH 400E-12
VSCP1 63 64 0
ISCP 64 0 1.000000E-8
DSCP2 0 64 MDTH 400E-12
DSCN2 0 74 MDTH 400E-12
ISCN 74 0 1.000000E-8
VSCN1 73 74 0
DSCN1 71 73 MDTH 400E-12
VSCTHN 71 70 -0.55
** VSCTHN = le seuil au dessous de vio * 2000
** c.a.d -375U-000U dus a l'offset
ESCP 60 0 2 1 500
ESCN 70 0 2 1 -2000
.ENDS
```

ELECTRICAL CHARACTERISTICS
V_{CC}^+ = 3V, V_{CC}^- = 0V, R_L, C_L connected to $V_{CC/2}$, T_{amb} = 25°C (unless otherwise specified)

Symbol	Conditions	Value	Unit
V_{io}		0	mV
A_{vd}	R_L = 10kΩ	10	V/mV
I_{cc}	No load	415	µA
V_{icm}		-0.2 to 3.2	V
V_{OH}	R_L = 10kΩ	2.96	V
V_{OL}	R_L = 10kΩ	30	mV
I_{sink}	V_o = 3V	40	mA
I_{source}	V_o = 0V	40	mA
GBP	R_L = 10kΩ, C_L = 100pF	0.8	MHz
SR	R_L = 10kΩ, C_L = 100pF	0.3	V/µs

MACROMODEL FOR OP-AMPS (V_{CC} = 5V)
Applies to : TSM221

```
** Standard Linear Ics Macromodels, 1993.
** CONNECTIONS :
* 1 INVERTING INPUT
* 2 NON-INVERTING INPUT
* 3 OUTPUT
* 4 POSITIVE POWER SUPPLY
* 5 NEGATIVE POWER SUPPLY
* 6 STANDBY
.SUBCKT TSM2215V 1 3 2 4 5 (analog)
*******************************************************
.MODEL MDTH D IS=1E-8 KF=6.564344E-14 CJO=10F
* INPUT STAGE
CIP 2 5 1.000000E-12
CIN 1 5 1.000000E-12
EIP 10 5 2 5 1
EIN 16 5 1 5 1
RIP 10 11 6.500000E+00
RIN 15 16 6.500000E+00
RIS 11 15 7.322092E+00
DIP 11 12 MDTH 400E-12
DIN 15 14 MDTH 400E-12
VOFP 12 13 DC 0.000000E+00
VOFN 13 14 DC 0
IPOL 13 5 4.000000E-05
CPS 11 15 2.498970E-08
DINN 17 13 MDTH 400E-12
VIN 17 5 0.000000e+00
DINR 15 18 MDTH 400E-12
VIP 4 18 0.000000E+00
FCP 4 5 VOFP 5.750000E+00
FCN 5 4 VOFN 5.750000E+00
ISTB0 5 4 500N
* AMPLIFYING STAGE
FIP 5 19 VOFP 4.400000E+02
FIN 5 19 VOFN 4.400000E+02
RG1 19 5 4.904961E+05
RG2 19 4 4.904961E+05
CC 19 29 2.200000E-08
HZTP 30 29 VOFP 1.8E+03
HZTN  5 30 VOFN 1.8E+03
DOPM 19 22 MDTH 400E-12
DONM 21 19 MDTH 400E-12
HOPM 22 28 VOUT 3800
VIPM 28 4 230
HONM 21 27 VOUT 3800
VINM 5 27 230
EOUT 26 23 19 5 1
VOUT 23 5 0
ROUT 26 3 82
COUT 3 5 1.000000E-12
DOP 19 68 MDTH 400E-12
VOP 4 25 1.724
HSCP 68 25 VSCP1 0.8E+08
DON 69 19 MDTH 400E-12
VON 24 5 1.7419107
HSCN 24 69 VSCN1 0.8E+08
VSCTHP 60 61 0.0875
** VSCTHP = le seuil au dessus de vio * 500
** c.a.d 275U-000U dus a l'offset
DSCP1 61 63 MDTH 400E-12
VSCP1 63 64 0
ISCP 64 0 1.000000E-8
DSCP2 0 64 MDTH 400E-12
DSCN2 0 74 MDTH 400E-12
ISCN 74 0 1.000000E-8
VSCN1 73 74 0
DSCN1 71 73 MDTH 400E-12
VSCTHN 71 70 -0.55
** VSCTHN = le seuil au dessous de vio * 2000
** c.a.d -375U-000U dus a l'offset
ESCP 60 0 2 1 500
ESCN 70 0 2 1 -2000
.ENDS
```

ELECTRICAL CHARACTERISTICS
V_{CC}^+ = 5V,V_{CC}^- = 0V, R_L, C_L connected to $V_{CC/2}$, T_{amb} = 25°C (unless otherwise specified)

Symbol	Conditions	Value	Unit
V_{io}		0	mV
A_{vd}	R_L = 10kΩ	50	V/mV
I_{cc}	No load	500	µA
V_{icm}		-0.2 to 3.2	V
V_{OH}	R_L = 10kΩ	4.95	V
V_{OL}	R_L = 10kΩ	40	mV
I_{sink}	V_o = 5V	65	mA
I_{source}	V_o = 0V	65	mA
GBP	R_L = 10kΩ, C_L = 100pF	1	MHz
SR	R_L = 10kΩ, C_L = 100pF	0.7	V/µs

COMPARATORS

ELECTRICAL CHARACTERISTICS

V_{CC}^+ = 5V, V_{CC}^- = 0V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage [1] $T_{min.} \le T_{amb} \le T_{max.}$ $V_{ic} = V_{icm\ min.}$ V_{CC}^+ = 5V to 10V			5 6.5	mV
I_{io}	Input Offset Current [2] $T_{min.} \le T_{amb} \le T_{max.}$		1	 300	pA
I_{ib}	Input Bias Current (see note 2) $T_{min.} \le T_{amb} \le T_{max.}$		1	 600	pA
V_{OH}	High Level Output Voltage $T_{min.} \le T_{amb} \le T_{max.}$ V_{id} = 1V I_{oh} = -4mA	 4.5 4.3	4.7		V
V_{OL}	Low Level Output Voltage $T_{min.} \le T_{amb} \le T_{max.}$ V_{id} = -1V I_{oh} = 4mA		220	300 375	mV
V_{icm}	Input common Mode Voltage $T_{min.} \le T_{amb} \le T_{max.}$	0 to V_{CC}^+ -1.2 0 to V_{CC}^+ -1.5			
CMR	Common Mode Rejection Ratio $V_{ic} = V_{icm\ min.}$		82		dB
SVR	Supply Voltage Rejection Ratio V_{CC}^+ = 5V to 10V		90		dB
T_{plh}	Response Time Low to High V_{ic} =0V, f = 10kHz C_L = 50pF Overdrive = 5mV Overdrive = 10mV Overdrive = 20mV Overdrive = 40mV TTL input	 1.5 1.1 0.9 0.7 0.6			µs
T_{ph1}	Response Time Low to High V_{ic} =0V, f = 10kHz C_L = 50pF Overdrive = 5mV Overdrive = 10mV Overdrive = 20mV Overdrive = 40mV TTL input	 2.2 1.6 1.1 0.75 0.17			µs
T_f	Fall Time f = 10kHz C_L = 50pF Overdrive = 50mV		30		ns
T_R	Rise Time f = 10kHz C_L = 50pF Overdrive = 50mV		30		ns

1. The specified offset voltage is the maximum value required to drive the output up to 4.5V or down to 0.3V.
2. Maximum values including unavoidable inaccuracies of the industrial test.

COMPARATORS

ELECTRICAL CHARACTERISTICS

V_{CC}^+ = 3V, V_{CC}^- = 0V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage [1] $T_{min.} \le T_{amb} \le T_{max.}$ V_{ic} = 1.5V			5 6.5	mV
I_{io}	Input Offset Current [2] $T_{min.} \le T_{amb} \le T_{max.}$		1	300	pA
I_{ib}	Input Bias Current (see note 2) $T_{min.} \le T_{amb} \le T_{max.}$		1	600	pA
V_{OH}	High Level Output Voltage $T_{min.} \le T_{amb} \le T_{max.}$ V_{id} = 1V I_{oh} = -4mA	2 1.8	2.4		V
V_{OL}	Low Level Output Voltage $T_{min.} \le T_{amb} \le T_{max.}$ V_{id} = -1V I_{oh} = 4mA		300	400 450	mV
V_{icm}	Input common Mode Voltage $T_{min.} \le T_{amb} \le T_{max.}$	0 to V_{CC}^+ -1.2 0 to V_{CC}^+ -1.5			
CMR	Common Mode Rejection Ratio $V_{ic} = V_{icm\ min.}$		80		dB
SVR	Supply Voltage Rejection Ratio V_{CC}^+ = 5V to 10V		75		dB
T_{plh}	Response Time Low to High V_{ic} =0V, f = 10kHz C_L = 50pF Overdrive = 5mV TTL input	1.5 0.7			µs
T_{ph1}	Response Time Low to High V_{ic} =0V, f = 10kHz C_L = 50pF Overdrive = 5mV TTL input	2.2 0.15			µs
T_f	Fall Time f = 10kHz C_L = 50pF Overdrive = 50mV		30		ns
T_R	Rise Time f = 10kHz C_L = 50pF Overdrive = 50mV		30		ns

1. The specified offset voltage is the maximum value required to drive the output up to 4.5V or down to 0.3V.
2. Maximum values including unavoidable inaccuracies of the industrial test.

MACROMODEL FOR COMPARATORS
(V_{CC} = 3V)
Applies to : TSM221

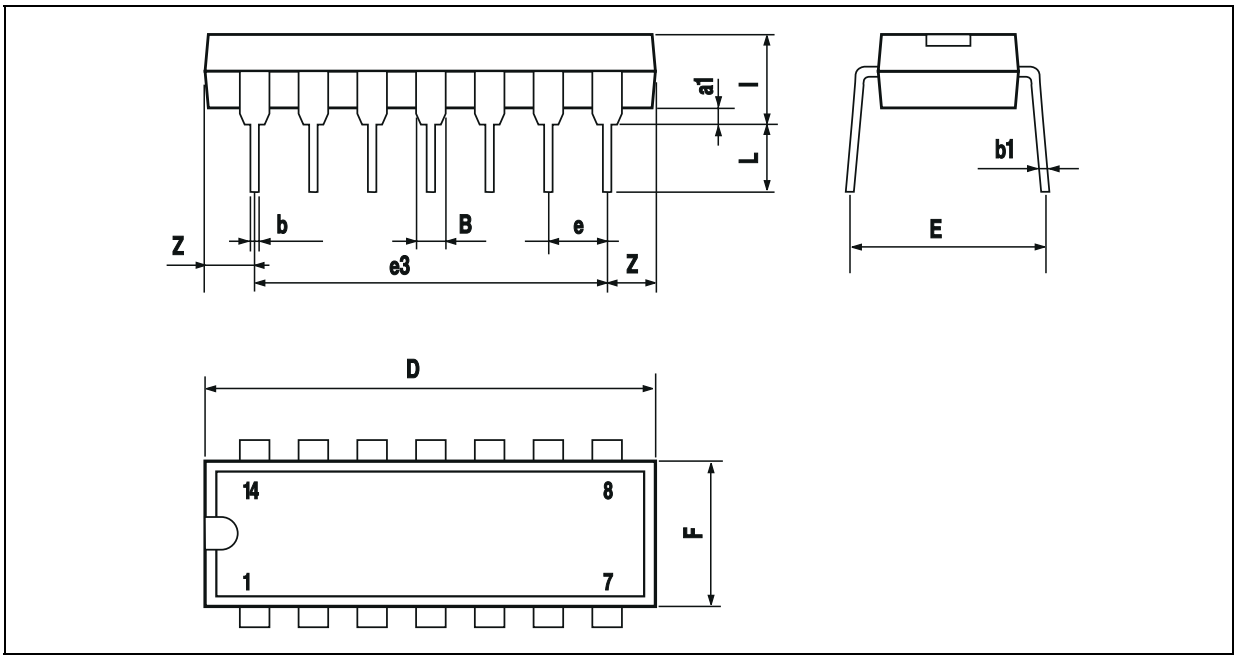
```
** Standard Linear Ics Macromodels, 1993.
** CONNECTIONS :
* 1 INVERTING INPUT
* 2 NON-INVERTING INPUT
* 3 OUTPUT
* 4 POSITIVE POWER SUPPLY
* 5 NEGATIVE POWER SUPPLY
.SUBCKT TSM221C 1 3 2 4 5

************************************************************
**********************RVAR ************************
.SUBCKT RVAR 20 10 IN OUT
VSENS0 IN 1 0V
R0 1 OUT 125
F0 1 OUT POLY(2) VSENS0 VSENS2 0 0 0 0 1E+08
VSENS2 20 3 0V
R2 3 10 1E+09
.ENDS RVAR
*******************COMPARATOR*******************
.MODEL MDTH D IS=1E-11 KF=1.050321E-32 CJO=10F
* INPUT STAGE
CIP 2 5 1.000000E-12
CIN 1 5 1.000000E-12
EIP 10 0 2 0 1
EIN 16 0 1 0 1
RIP 10 11 6.500000E+01
RIN 15 16 6.500000E+01
RIS 11 15 1.939046E+02
DIP 11 12 MDTH 400E-12
DIN 15 14 MDTH 400E-12
VOFP 12 13 DC 0.000000E+00
VOFN 13 14 DC 0
IPOL 13 0 100E-06
CPS 11 15 8.16E-09
DINN 17 13 MDTH 400E-12
VIN 17 5 0.000000e+00
DINR 15 18 MDTH 400E-12
VIP 4 18 1.200000E+00
FCP 4 5 VOFP 0.02
FCN 5 4 VOFN 0.02
FIBP 2 0 VOFN 2.000000E-08
FIBN 0 1 VOFP 2.000000E-08
* AMPLIFYING STAGE
RG1 5 19 2.8E+05
RG2 4 19 2.8E+05
DOPM 19 22 MDTH 400E-12
DONM 21 19 MDTH 400E-12
HOPM 22 28 VOUT 3000
VIPM0 28 40 -87
EIPM 40 4 4 5 42
**VIPM 28 4 150
HONM 21 27 VOUT 3000
VINM0 50 27 -114
EINM 5 50 4 5 54
**VINM 5 27 150
DOP 19 25 MDTH 400E-12
VOP 4 25 1.097
DON 24 19 MDTH 400E-12
VON 24 5 1.097
FIP 0 19 VOFP 104
FIN 0 19 VOFN 104
EOUT 26 23 19 5 1
VOUT 23 5 0V
XOUT 4 5 26 3 RVAR
*ROUT 26 3 62.5
.ENDS
```

ELECTRICAL CHARACTERISTICS
V_{CC}^+ = 3V,V_{CC}^- = 0V, R_L, C_L connected to $V_{CC/2}$, T_{amb} = 25°C (unless otherwise specified)

Symbol	Conditions	Value	Unit
V_{io}		0	mV
I_{cc}	No load, per operator	7	µA
V_{icm}		0 to 1.8	V
V_{OH}	V_{id} = 1V, I_{OH} = -4mA	2.4	V
V_{OL}	V_{id} = 1V, I_{OH} = -4mA	300	mV
t_{PLH}	Overdrive = 5mV	1.5	µs
t_{PHL}	Overdrive = 5mV	2.2	µs

PACKAGE MECHANICAL DATA

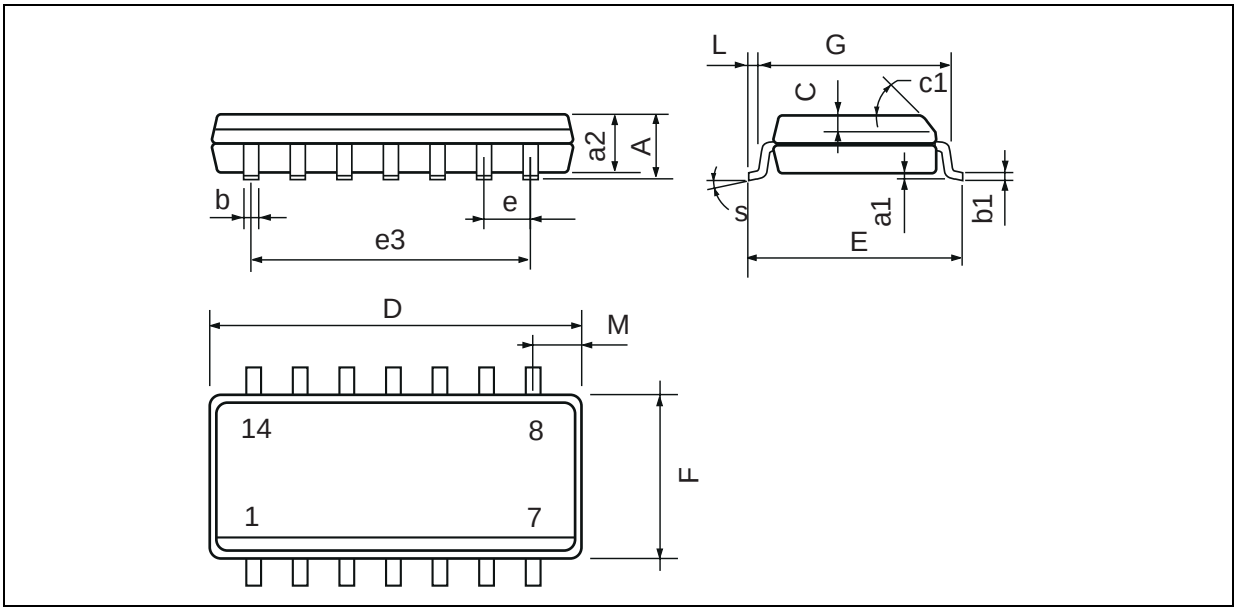
14 PINS - PLASTIC DIP



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

PACKAGE MECHANICAL DATA

14 PINS - PLASTIC MICROPACKAGE (SO)



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45° (typ.)					
D (1)	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F (1)	3.8		4.0	0.150		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.020		0.050
M			0.68			0.027
S	8° (max.)					

Note : (1) D and F do not include mold flash or protrusions - Mold flash or protrusions shall not exceed 0.15mm (.066 inc) ONLY FOR DATA BOOK.