



Dual Operational Amplifier and Adjustable Voltage Reference Dual Comparator

FTSM102A

OPERATIONAL AMPLIFIERS

- LOW SUPPLY CURRENT : 200 μ A/amp.
- MEDIUM SPEED : 2.1MHz
- LOW LEVEL OUTPUT VOLTAGE CLOSE TO V_{cc} : 0.1V typ
- INPUT COMMON MODE VOLTAGE RANGE INCLUDES GROUND

COMPARATORS

- LOW SUPPLY CURRENT : 200 μ A/amp. (V_{cc} = 5V)
- INPUT COMMON MODE VOLTAGE RANGE INCLUDES GROUND
- LOW OUTPUT SATURATION VOLTAGE : 250mV (I_o = 4mA)

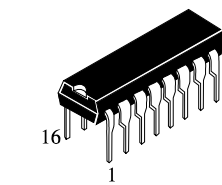
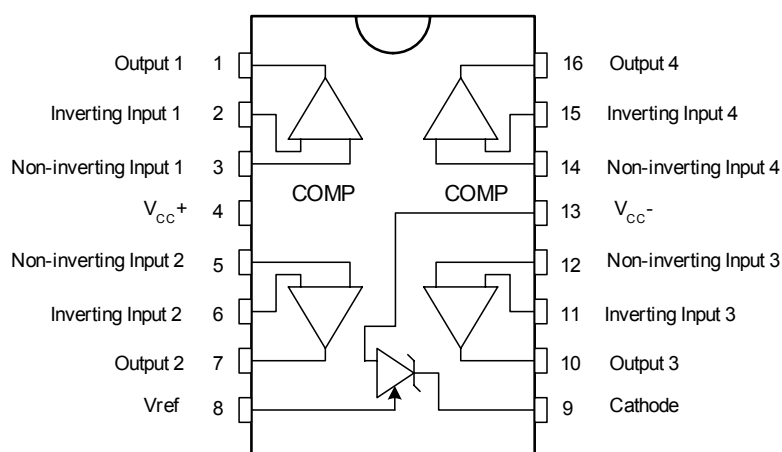
REFERENCE

- ADJUSTABLE OUTPUT VOLTAGE : V_{ref} to 32V
- SINK CURRENT CAPABILITY : 1 to 100mA
- 1% and 0.4% VOLTAGE PRECISION
- LATCH-UP IMMUNITY

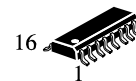
DESCRIPTION

The FTSM102A is a monolithic IC that includes two op-amps, two comparators and a precision voltage reference. This device is offering space and cost saving in many applications like power supply management or data acquisition systems.

PIN CONNECTIONS



DIP-16
(Plastic Package)



SO-16
(Plastic Micropac)

ORDERING NUMBER:

FTSM102AN Plastic Package
FTSM102AD Plastic Micropac

ORDER CODES

Part number	Temperature Range	Package	
		N	D
FTSM102A	-40 °C, +85°C	•	•



Dual Operational Amplifier Dual Comparator

and Adjustable Voltage Reference

Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V _{cc}	Supply Voltage	36	V
V _{id}	Differential Input Voltage	36	V
V _i	Input Voltage	-0.3 to +36	V
T _j	Maximum Junction Temperature	150	°C

Electrical Characteristics

V_{cc}⁺ = 5V, V_{cc}⁻ = 0V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min	Typ	Max	Unit
I _{cc}	Total Supply Current T _{min} < T _{amb} < T _{max}		0.8	1.5 2	mA

OPERATIONAL AMPLIFIERS

V_{cc}⁺ = 5 V, V_{cc} = GND, R₁ 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} ≤ T _{amb} ≤ T _{max}		1	4.5 6.5	mV
DV _{io}	Input Offset Voltage Drift		10		μV/°C
I _{ib}	Input Bias Current T _{min} ≤ T _{amb} ≤ T _{max}		20	100 200	nA
I _{io}	Input Offset Current T _{min} ≤ T _{amb} ≤ T _{max}		5	20 40	nA
Avd	Large Signal Voltage Gain V _{cc} = 30V, R ₁ = 10kΩ, V _o = 5V to 25V T _{min} ≤ T _{amb} ≤ T _{max}	50 25	100		V/mV
SVR	Supply Voltage Rejection Ratio V _{cc} = 5V to 30V	80	100		dB
V _{icm}	Input Common Mode Voltage Range T _{min} ≤ T _{amb} ≤ T _{max}	(V _{cc} ⁻) to (V _{cc} ⁺) -1.8 (V _{cc} ⁻) to (V _{cc} ⁺) -2.2			V
CMR	Common Mode Rejection Ratio V _{cc} ⁺ = 30V, V _{icm} = 0V to (V _{cc} ⁺) -1.8V	70	90		dB
I _{sc}	Output Short Circuit Current V _{id} = ±1V, V _o = 2.5V Source Sink	3 3	6 6		mA
V _{OH}	High Level Output Voltage V _{cc} ⁺ = 30V, R _L = 10k T _{min} ≤ T _{amb} ≤ T _{max}	27 26	28		V
V _{OL}	Low Level Output Voltage R _L = 10kΩ T _{min} ≤ T _{amb} ≤ T _{max}		100	150 210	mV
SR	Slew Rate V _{cc} = ±15V V _i = ±10V, R _L = 10kΩ, C _L = 100pF	1.6	2		V/μs
GBP	Gain Bandwidth Product R _L = 10kΩ, C _L = 100pF, f = 100kHz	1.4	2.1		MHz
∅ _m	Phase Margin R _L = 10kΩ, C _L = 100pF		45		Degrees
THD	Total Harmonic Distortion		0.05		%
e _n	Equivalent Input Noise Voltage f = 1kHz		29		$\frac{nV}{\sqrt{Hz}}$
C _s	Channel Separation		120		dB



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COMPARATORS

$V_{cc}^+ = +5V$, $V_{cc} = \text{Ground}$, $T_{amb} = 25\text{ }^{\circ}\text{C}$ (unless otherwise specified)

Symbol	Parameter	Min	Typ	Max	Unit
V_{io}	Input Offset Voltage $T_{min.} \leq T_{amb} \leq T_{max}$			5 9	mV
I_{io}	Input Offset Current $T_{min.} \leq T_{amb} \leq T_{max}$			50 150	nA
I_{ib}	Input Bias Current $T_{min.} \leq T_{amb} \leq T_{max}$			250 400	nA
I_{OH}	High Level Output Current $V_{id} = 1V$, $V_{cc} = V_o = 30V$ $T_{min.} \leq T_{amb} \leq T_{max}$		0.1	1	nA μA
V_{OL}	Low Level Output Voltage $V_{id} = -1V$, $I_{sink} = 4mA$ $T_{min.} \leq T_{amb} \leq T_{max}$		250	400 700	mV
A_{vd}	Large Signal Voltage Gain $V_{cc} = 15V$, $R_1 = 15k\Omega$, $V_o = 1V$ to $11V$		200		V/mV
I_{sink}	Output Current Sink $V_{id} = -1V$, $V_o = 1.5V$	6	16		mA
V_{icm}	Input Common Mode Voltage Range $T_{min.} \leq T_{amb} \leq T_{max}$	0 0		$V_{cc}^+ - 1.5$ $V_{cc}^+ - 2$	V
V_{id}	Differential Input Voltage			V_{cc}^+	V
t_{re}	Response Time – (note 1) $R_1 = 5.1k\Omega$ to V_{cc}^+ , $V_{ref} = 1.4V$		1.3		μs
t_{rel}	Large Signal Response Time $V_{ref} = 1.4V$, $V_i = \text{TTL}$, $R_1 = 5.1k\Omega$ to V_{cc}^+		300		ns

Note 1 : The response time specified is for 100mV input step with 5mV overdrive.
For larger overdrive signals, 300ns can be obtained.



Dual Operational Amplifier and Adjustable Voltage Reference Dual Comparator

VOLTAGE REFERENCE

Symbol	Parameter	Value	Unit
V_{KA}	Cathode to Anode Voltage	Vref to 36	V
I_k	Cathode Current	1 to 100	mA

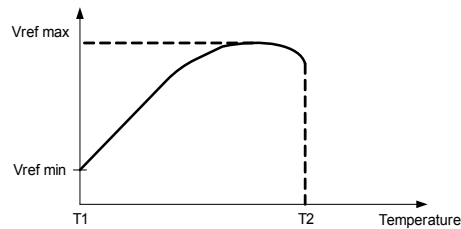
ELECTRICAL CHARACTERISTICS

$T_{amb} = 25\text{ }^{\circ}\text{C}$ (unless otherwise specified)

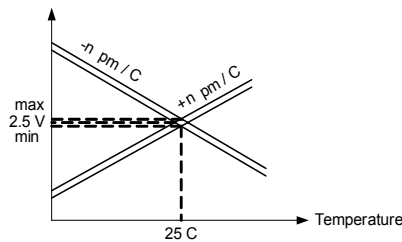
Symbol	Parameter	Min	Typ	Max	Unit
V_{ref}	Reference Input Voltage – (figure 1) - $T_{amb} = 25\text{ }^{\circ}\text{C}$ $V_{KA} = V_{ref}$, $I_k = 10\text{mA}$	2.490	2.500	2.510	V
ΔV_{ref}	Reference Input Voltage Deviation Over Temperature Range (figure 1, note 1) $V_{KA} = V_{ref}$, $I_k = 10\text{mA}$, $T_{min} \leq T_{amb} \leq T_{max}$		7	30	mV
$\frac{\Delta V_{ref}}{\Delta T}$	Temperature Coefficient of Reference Input Voltage – (note 2) $V_{KA} = V_{ref}$, $I_k = 10\text{mA}$, $T_{min} \leq T_{amb} \leq T_{max}$		± 22	± 100	ppm/ $^{\circ}\text{C}$
$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage – (figure 2) $I_k = 10\text{mA}$, $\Delta V_{KA} = 36\text{ to }3\text{V}$		-1.1	-2	mV/V
I_{ref}	Reference Input Current – (figure 2) $I_k = 10\text{mA}$, $R_1 = 10\text{k}\Omega$, $R_2 = \infty$ $T_{amb} = 25\text{ }^{\circ}\text{C}$ $T_{min} \leq T_{amb} \leq T_{max}$		1.5	2.5 3	μA
ΔI_{ref}	Reference Input Current Deviation over Temperature Range – (figure 2) $I_k = 10\text{mA}$, $R_1 = 10\text{k}\Omega$, $R_2 = \infty$ $T_{min} \leq T_{amb} \leq T_{max}$		0.5	1	μA
I_{min}	Minimum Cathode Current for Regulation – (figure 1) $V_{KA} = V_{ref}$		0.5	1	mA
I_{off}	Off-State Cathode Current – (figure 3)		180	500	nA

Notes : 1. ΔV_{ref} is defined as the difference between the maximum and minimum values obtained over the full temperature range.

$$\Delta V_{ref} = V_{ref\ max} - V_{ref\ min}$$



2. The temperature coefficient is defined as the slopes (positive and negative) of the voltage vs temperature limits within which the reference voltage is quaranteed.



3. The dynamic Impedance is defined as $|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_k}$



Figure 1 : Test Circuit for $V_{KA} = V_{ref}$

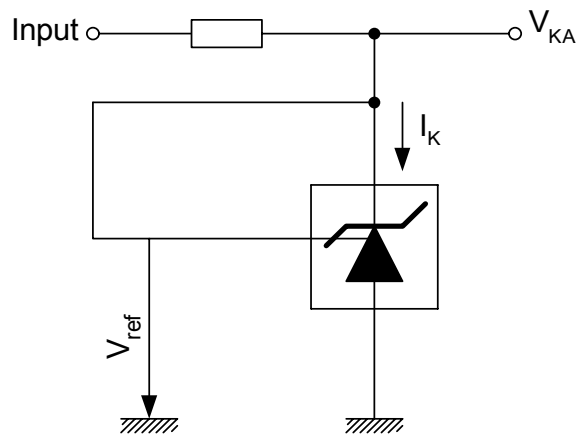


Figure 2 : Test Circuit for $V_{KA} > V_{ref}$

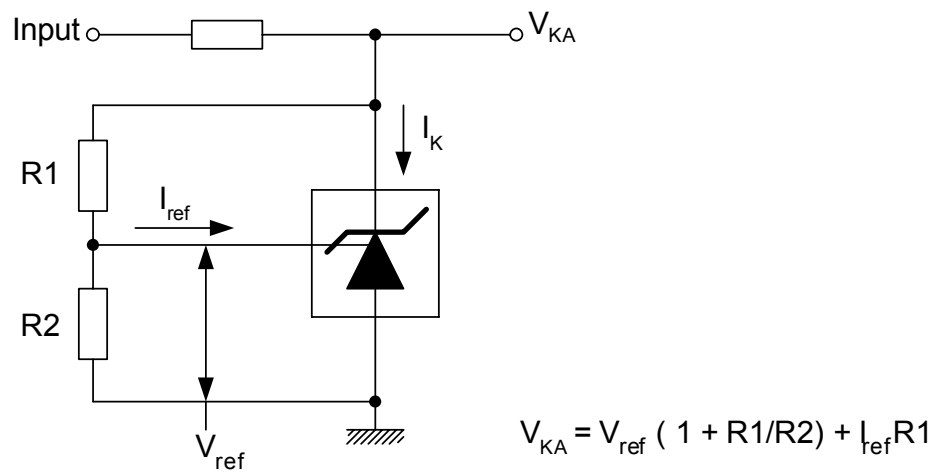
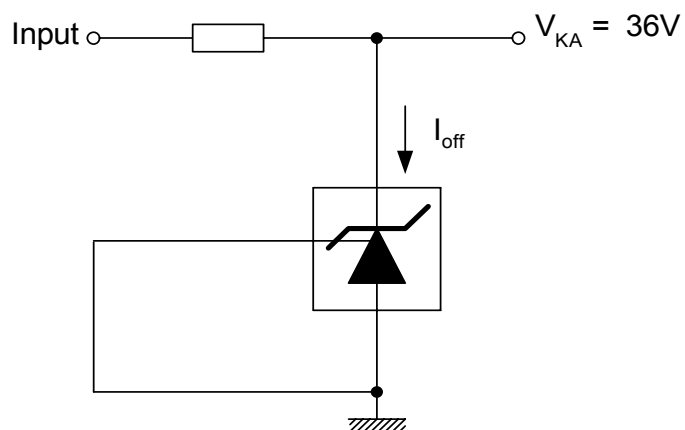
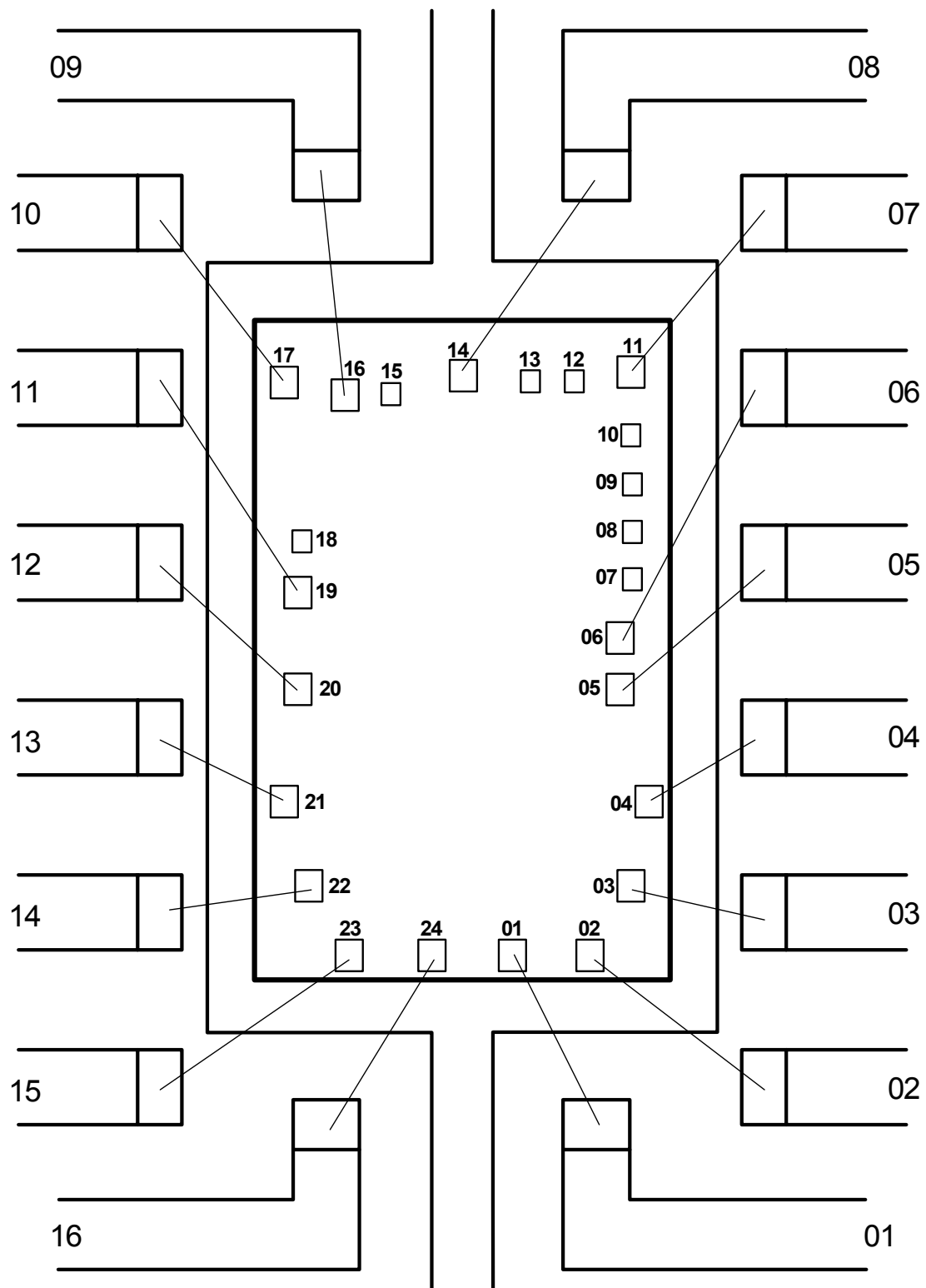


Figure 3 : Test Circuit for I_{off}





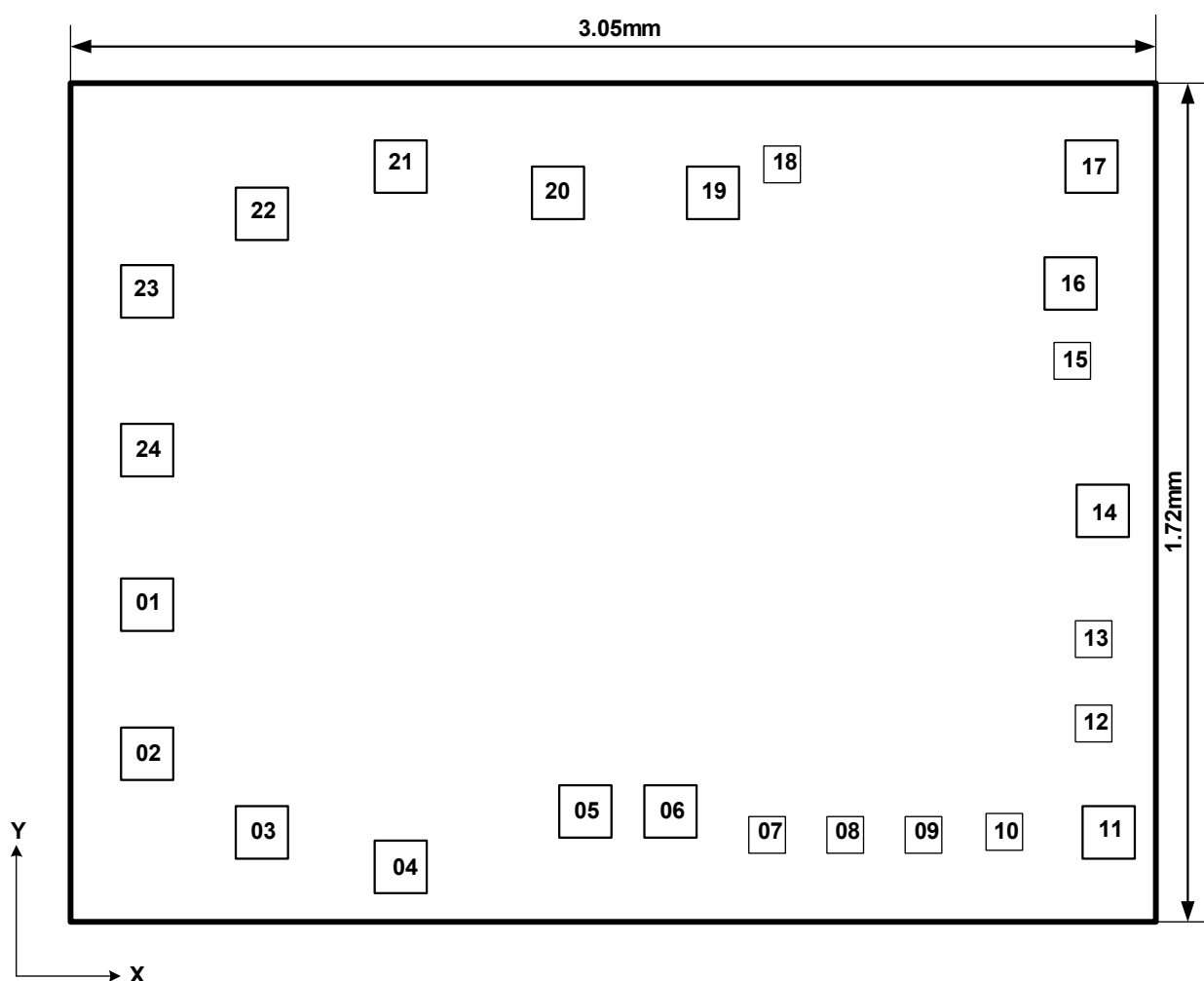
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Bonding diagram of FTSM102A



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Pad size 01 - 06, 11, 14, 16, 17, 19 - 24 - have been bounded
Pad size 07 - 10, 12, 13, 15, 18 - have not been bounded

Pads location of FTSM102A



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Die size $X_r = 3.05\text{mm}$, $Y_r = 1.72\text{mm}$ (pad size measured by layer “passivation”)
Coordinates of pads

No of pad (by layer “passivation”)	Coordinates left bottom, mkm		pad size, mkm
	X	Y	
01	144	454	100×100
02	119	129	100×100
03	407	129	100×100
04	567	129	100×100
05	736	161	100×100
06	1624	150	100×100
07	2125	121	70×70
08	2313	121	70×70
09	2501	121	70×70
10	2689	121	70×70
11	2819	2819	100×100
12	2835	2835	70×70
13	2835	2835	70×70
14	2818	2818	100×100
15	2797	2797	70×70
16	2778	2778	100×100
17	2807	2807	100×100
18	1798	1798	70×70
19	1624	1624	100×100
20	736	736	100×100
21	567	567	100×100
22	407	407	100×100
23	119	119	100×100
24	144	144	100×100



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No of pad	Pin	Function
01	01	Output 1
02	02	Inverting input 1
03	03	Non-inverting input 1
04	04	Vcc ⁺
05	05	Non-inverting input 2
06	06	Inverting input 2
11	07	Output 2
14	08	Vref
16	09	Cathode
17	10	Output 3
19	11	Inverting input 3
20	12	Non-inverting input 3
21	13	Vcc ⁻
22	14	Non-inverting input 4
23	15	Inverting input 4
24	16	Output 4