YHM4505

Tiny Size, Low Power, Low Bias Current OP AMP

Features

- Single 1.6V to 5.5V Supply Voltage
- Low 18uA Quiescent Current
- Ultra-Low 0.2pA Bias Current
- High Input Resistance: 1400Gohm@DC
- Low Input Capacitance: 1.2pF
- Low Input Noise: 3.9uVpp
- Tiny 0.77mm x 1.17mm 6-bump WLP

Applications

- Battery Powered Consumer Device
- Portable Medical Instrument
- Sensor Interface
- Smoke Detectors

General Description

The YHM4505 is 1.6V to 5.5V single supply or ±0.8V to ±2.75V dual supply, featuring very low quiescent current mode, making it suitable for a broad range of battery-powered applications such as portable medical instruments, portable consumer device, and smoke detectors. A combination of extremely low input bias currents, low input current noise and low input voltage noise allows interface to high-impedance sources such as photodiode and piezoelectric sensors.

The YHM4505 comes in a 2x3 array, 6-bump, 0.4mm pitch, 0.77mmx1.17mm wafer-level package (WLP).

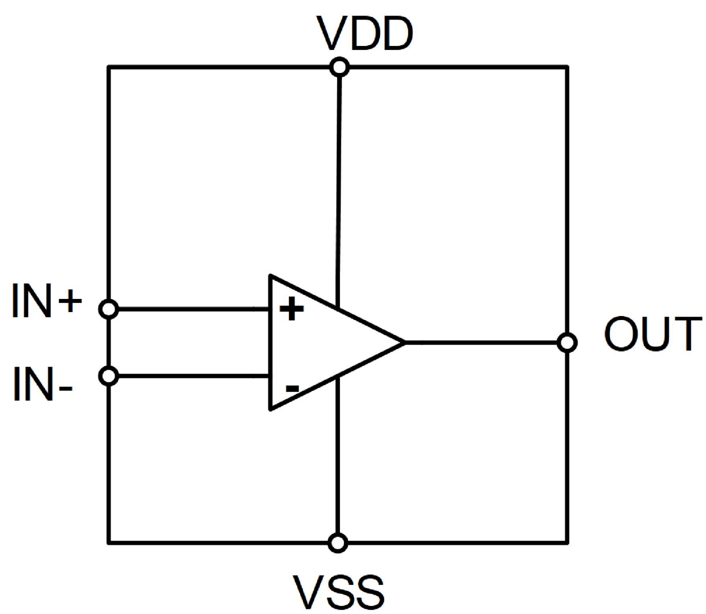


Fig 1. YHM4505 Internal Block Diagram

YHM4505 Pin Configurations

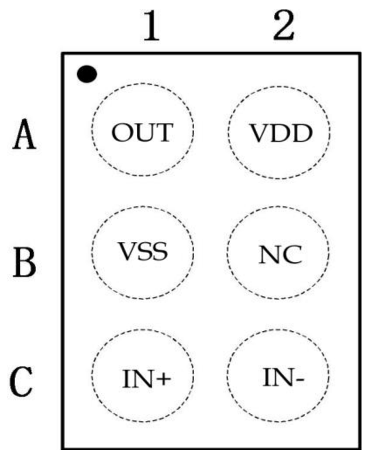


Fig 3. YHM4505 WLP-6 Pin Assignment(Top Through View）

YHM4505 WLP Pin Descriptions

WLP	Name	Description
A1	OUT	Output
A2	VDD	Positive Supply Voltage. Bypass to GND with a 0.1μF capacitor
B1	VSS	Negative Supply Voltage
B2	NC	No Connection,Do Not Tie GND,Keep the pin floating
C1	IN+	Positive Input
C2	IN-	Negative Input

1 Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Disclaimer: YHMICROS reserves the right to make any change in circuit design, specification or other related things if needed without notice at any time.

<table>
<tr><th>Symbol</th><th colspan="2">Parameters</th><th>Min.</th><th>Max.</th><th>Unit</th></tr>
<tr><td>VDD</td><td colspan="2">VDD, $\overline{SHDN}$ to VSS</td><td>-0.3</td><td>6</td><td>V</td></tr>
<tr><td>IN+, IN-, OUT</td><td colspan="2">IN+, IN-, OUT to GND</td><td>GND-0.3</td><td>VDD+0.3</td><td>V</td></tr>
<tr><td>I_{IN}</td><td colspan="2">Continuous Input Current (any pins)</td><td></td><td>±20</td><td>mA</td></tr>
<tr><td>t_{SCD}</td><td colspan="2">Output Short-Circuit Duration to GND</td><td></td><td>10</td><td>s</td></tr>
<tr><td>t_{PD}</td><td colspan="2">Total Power Dissipation at T_A=25°C</td><td></td><td>500</td><td>mW</td></tr>
<tr><td>T_{STG}</td><td colspan="2">Storage Junction Temperature</td><td>-65</td><td>+150</td><td>°C</td></tr>
<tr><td>T_J</td><td colspan="2">Operating Junction Temperature</td><td></td><td>+150</td><td>°C</td></tr>
<tr><td>T_L</td><td colspan="2">Lead Temperature (Soldering, 10 Seconds)</td><td></td><td>+260</td><td>°C</td></tr>
<tr><td>θ_{JA}</td><td colspan="2">Thermal Resistance, Junction-to-Ambient
(100mm^2 pad of 1 oz. copper)</td><td></td><td>80$^{(1)}$</td><td>°C/W</td></tr>
<tr><td rowspan="2">IN+, IN-</td><td rowspan="2">Electrostatic Discharge Capability</td><td>Human Body Model, EIA/JESD22-A114</td><td>2</td><td></td><td rowspan="2">KV</td></tr>
<tr><td>Charged Device Model, JESD22-C101</td><td>1</td><td></td></tr>
<tr><td rowspan="2">All Other Pins</td><td rowspan="2">Electrostatic Discharge Capability</td><td>Human Body Model, EIA/JESD22-A114</td><td>2</td><td></td><td rowspan="2">KV</td></tr>
<tr><td>Charged Device Model, JESD22-C101</td><td>1</td><td></td></tr>
</table>

Note 1. Refer to JEDEC JESD51-7, use a 4-layerboard

2 Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance.

Parameters	Min.	Max.	Unit
Single Supply Voltage	1.6	5.5	V
Dual Supply Volage	±0.8	±2.75	V
Input Voltage	VSS	VDD-0.6	V
Ambient Operating Temperature, T_A	-40	85	°C

3 Detailed Electrical Characteristics

(VDD = 3.3V, VSS = 0V, V_{IN+} = V_{IN-} = V_{CM} = VDD/2, R_L = 10kΩ to VDD/2, $\overline{SHDN}$ = VDD, T_A = -40°C to +85°C. Typical values are at T_A = +25°C, unless otherwise noted T_A = +25°C, unless otherwise noted.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
POWER SUPPLY							
Supply Voltage Range	VDD	Guaranteed by PSRR, 0°C ≤ T_A ≤ +70°C		1.6		5.5	V
		Guaranteed by PSRR, -40°C ≤ T_A ≤+85°C		1.8		5.5	
Quiescent Supply Current	I_{VDD}	T_A = +25°C			18		μA
		-40°C ≤ T_A ≤ +85°C				25	
Power-Supply Rejection Ratio	PSRR	VDD = 1.8V to 5.5V	T_A = +25°C		108		dB
			-40°C ≤ T_A ≤ +85°C	94			
		0°C ≤ T_A ≤ +70°C, VDD = 1.6V to 5.5V		91			
AMP Turn-On Time	t_{AMP_ON}	VDD = 3.3V, $V_{\overline{SHDN}}$ = 0 to 3.3V (keep high) V_{OUT} = V_{SETTLE} (1% Accuracy)			110		μs
DC SPECIFICATIONS							
Input Voltage Range	V_{IN+}, V_{IN-}	Guaranteed by CMRR		VSS		VDD-0.6	V
Input Offset Voltage	V_{OS}	T_A = +25°C			0.2		mV
Input Offset Voltage Drift	ΔV_{OS}				0.3		uV/°C
Input Bias Current	I_B	T_A = +25°C			±0.2		pA
Input Offset Current	I_{OS}				±0.05		
Common-Mode Rejection Ratio	CMRR	-0.1V ≤ V_{CM} ≤ VDD – 0.6V, T_A = +25°C			107		dB
		0 ≤ V_{CM} ≤ VDD – 0.8V, -40°C ≤ T_A ≤ +85°C		93			
Open-Loop Gain	AV_{OL}	V_{OUT} = 0.25V from rails			141		dB
		V_{OUT} = 0.4V from rails, R_L = 600Ω			138		
Output Voltage Swing	V_{OH}	VDD - V_{OUT}	R_L = 10kΩ			5	mV
			R_L = 600Ω			71	
	V_{OL}	V_{OUT}	R_L = 10kΩ			4	
			R_L = 600Ω			51	
Short-Circuit Current	I_{SC}				60		mA
AC SPECIFICATIONS							
Gain-Bandwidth	GBW				100		KHz
Slew Rate	SR	0 ≤ V_{OUT} ≤ 2V			40		mV/μs
Input Voltage Noise Density	En	f_{SW} = 1kHz			53		nV/√Hz
Input Voltage Noise		0.1Hz ≤ f_{SW} ≤ 10Hz			3.9		μVPP
Input Current Noise Density		f_{SW} = 1kHz			2.6		fA/√Hz
Phase Margin		C_L = 20pF			62		°
Input Resistance (Note 2)	R_{IN}	AC@100Hz			1.4		GΩ

		AC@10Hz	14	
		DC@0.1Hz	1400	
Input Capacitance	C_{IN}		1.2	pF
Capacitive Loading	C_L	No sustained oscillation	280	pF

Note 1: All specifications are 100% production tested at T_A = +25°C, unless otherwise noted. Specifications are over T_A = -40°C to +85°C and are guaranteed by design.

Note 2: Guaranteed by design; not production test.

4 Detailed Description

4.1 General Introduction

The YHM4505 is 1.6V to 5.5V single supply or ±0.8V to ±2.75V dual supply, featuring very low quiescent current, making it suitable for a broad range of battery-powered applications such as portable medical instruments, portable consumer device, and smoke detectors. A combination of extremely low input bias currents, low input current noise and low input voltage noise allows interface to high-impedance sources such as photodiode and piezoelectric sensors. The device is also ideal for general-purpose signal processing functions such as filtering and amplification in a broad range of portable, battery-powered applications.

4.2 Low Input Bias Current

This op-amp features ultra-low 0.2pA (typ.) input bias current. For the -40°C to +85°C temperature range, the variation in the input bias current is very small with changes in the input voltage due to very high input impedance.

4.3 High-Impedance Sensor Front-Ends

The ICs interface to both current-output sensors, such as photodiodes, and high-impedance voltage sources, such as ECG. For current-output sensors, a transimpedance amplifier is the most noise-efficient method for converting the input signal to a voltage. High-value feedback resistors are commonly chosen to create large gains, while feedback capacitors help stabilize the amplifier by cancelling any poles introduced in the feedback function by the highly capacitive sensor or cabling. A combination of low-current noise and low-voltage noise is important for these applications. Take care to calibrate out photodiode dark current if DC accuracy is important. The high bandwidth and slew rate also allow AC signal processing in certain medical photo- diode sensor applications such as pulse oximetry.

For voltage-output sensors, a noninverting amplifier is typically used to buffer and/or apply a small gain to the input voltage signal. Due to the extremely high impedance of the sensor output, a low input bias current with minimal temperature variation is very important for these applications.

4.4 System design

For best performance, follow standard high-impedance layout techniques, which include the following:

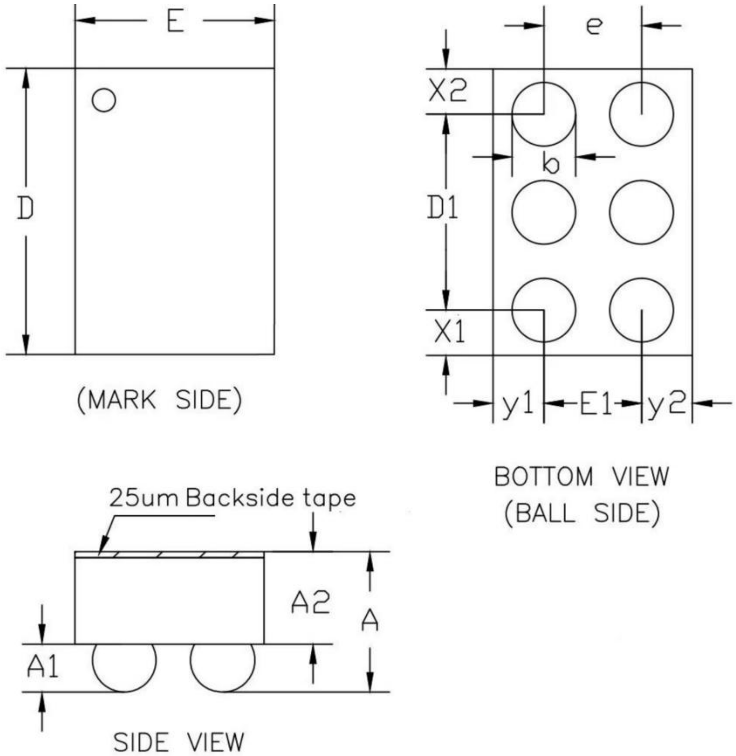
- Using shielding techniques to guard against parasitic leakage paths. For example, put a trace connected to the noninverting input around the inverting input.
- Minimizing the amount of stray capacitance connected to op amp’s inputs to improve stability. To achieve this, minimize trace lengths and resistor leads by placing external components as close as possible to the package.
- Use separate analog and digital power supplies.
- When used with a single supply, bypass VDD with a 0.1µF capacitor to ground.

4.5 Extended ESD Protection

ESD protection structures are incorporated on all pins to protect against electrostatic discharges up to ±2kV to 4kV (HBM) encountered during handling and assembly. IN+/IN- are further protected against ESD up to 12kV (Air-Gap Discharge), and 8kV (Contact Discharge) without damage. The ESD structures with- stand high ESD both in normal operation and when the device is powered down. After an ESD event, the devices continue to function without latch-up.

Package Dimensions

WLCSP-6 0.77x1.17x0.454



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.414	0.454	0.494
A1	0.156	0.176	0.196
A2	0.258	0.278	0.298
D	1.150	1.170	1.190
D1		0.800BSC	
E	0.750	0.770	0.790
E1		0.400BSC	
b	0.240	0.260	0.280
e		0.400BSC	
x1		0.185 REF	
x2		0.185 REF	
y1		0.185 REF	
y2		0.185 REF	

Ordering Information

Part Number	Temp Range	Pin Package	Top Mark	MOQ
YHM4505W6T	-40°C to 85°C	6 WLCSP	YWW LOT	3000

T = Tape and reel.
YWW: Date Code. Y = year, WW = week. For example, YWW = 522 means Year 2025, Week 22.
LOT: The last three number of LOTID.