

# Application Brief

## Sensing in Humanoid Robots



Explore Texas Instrument’s Current, Position, and Temperature & Environmental sensing portfolios covering the sensing needs for your humanoid robot designs! From motor control, tactile sensing, and system health needs.

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**Motor Control**

**Current sensing** provides accurate phase current sensing for motor control feedback loops, high -side sensing for shorts to ground and low-side sensing for short to motor

Device	Description	Benefit
INA241A	-5V to 110Vc bidirectional ultraprecise current sense amplifier	PWM rejection for phase current sensing
INA790A	110V, 75Arms integrated shunt, current sense amplifier	Integrated shunt resistor saves board space; PWM rejection for phase current sensing

**Position sensing** provides precise feedback on position and movement of joints and actuators, enabling accurate real-time motion control.

Device	Description	Benefit
LDC5072	Inductive position sensor front-end with sin/cos interface	Does not required magnets and provides immunity to magnetic stray -fields
TMAG6180	High-precision analog AMR angle sensor with 360 ° angle range	High frequency operation, minimal orthogonality error, extended 360 ° range

**Temperature sensing** provides motor over-temp protection and operation closer to thermal thresholds.

Device	Description	Benefit
LM50	±2°C analog temperature sensor (10mV/°C)	Linear output without external calibration
ISOTMP35	3kVRMS integrated isolation temperature sensor	Direct HV FET contact; <4s response

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**Tactile Sensing**

**Position sensors** enables the sense of touch and pressure.

Device	Description	Benefit
TMAG3001	3D linear Hall-effect sensor with I <sup>2</sup> C in wafer chip-scale package	Ultra-small size enables increased and continuous spatial resolution

**Optical sensing** enables positioning recognition with LEDs in the robotic fingertip.

Device	Description	Benefit
OPT4001	High speed (600µs-800ms) ALS	High sensitivity and dynamic range

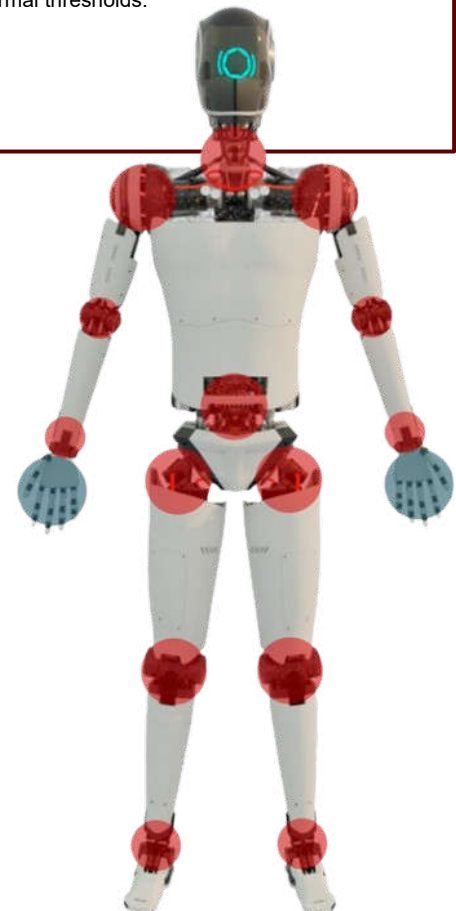
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**System Health**

**Current sensing** provides input power monitoring on all joints

Device	Description	Benefit
INA700	40V, 15Arms 2mΩ integrated shunt digital power monitor	Small 1.2mm × 1.3mm size with integrated shunt saves PCB space
INA740	85V, 35Arms 800µΩ integrated shunt digital power monitor	Integrated shunt resistor saves PCB space

**Humidity sensing** provides gas sensor calibration for battery thermal runaway

Device	Description	Benefit
HDC3020	±0.5% RH humidity sensor; 4s response	Real-time gas sensor calibration



**Resources**

<a href="#">INA241A</a>	Product Folder
<a href="#">INA790A</a>	Product Folder
<a href="#">LDC5072</a>	Product Folder
<a href="#">TMAG6180</a>	Product Folder
<a href="#">LM50</a>	Product Folder
<a href="#">ISOTMP35</a>	Product Folder
<a href="#">TMAG3001</a>	Product Folder
<a href="#">OPT4001</a>	Product Folder
<a href="#">INA700</a>	Product Folder
<a href="#">INA740</a>	Product Folder
<a href="#">HDC3020</a>	Product Folder

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Last updated 10/2025