



## 360° 3D Camera

PAL USB is a single sensor, omnidirectional vision system providing 360° stereoscopic sensing with depth perception. PAL USB enables visual intelligence with an unparalleled field of view that eliminates blind spots and combines full color video with precise depth mapping and detection in a single video stream. The reliable and efficient system has no moving parts, making it ideal for manufacturers and operators in robotics, factory and warehouse automation, and teleoperations where low latency and ease of use are critical.

Key Features	360° Horizontal and 110° Vertical Field-of-View RGB and depth provided Single CMOS sensor with no moving parts USB interface – power and data
Use Cases	Obstacle detection in autonomous robots Floor and cliff detection in commercial cleaning robots Human presence detection with tracking
Availability	PAL USB PAL USB Starter Kit PAL USB Obstacle Detection Starter Kit
Additional Documents	PAL USB Starter Kit Guide

# Camera Specifications

Stereo Image Performance	Stereo Image Output	5280 x 1819 @ 10 fps   3544 x 1218 @ 20 fps
		1322 x 454 @ 40 fps   660 x 227 @ 100 fps per image
	Maximum Field of View	See Figure 1
	Minimum Angular Resolution	0.07° (H) x 0.07° (V) / pixel
	Shutter Type	Rolling Shutter
Depth Performance	Depth Map	5280 x 1819 @ 10 fps   3544 x 1218 @ 20 fps
		1322 x 454 @ 40 fps   660 x 227 @ 100 fps per image
	Maximum Field of View	See Figure 1
	Minimum Angular Resolution	0.07° (H) x 0.07° (V) / pixel
	Minimum Range	0 cm
	Range Accuracy	See Range Performance Graph
	Range Resolution	0.3 cm at 200 cm and 4.1 cm at 500 cm (at 150 cm mounting height)
	Latency	See Performance Benchmarking Table
	Timestamp Accuracy	5 ms
Point Cloud Performance	Number of Points	Up to 96M points/second
	Formats	2.5D, 3D
Software Compatibility	Operating System	Ubuntu 16.04, 18.04, 20.04; Windows 10
	Available RAM	2 GB
	Library Dependencies	OpenCV 3.4.4, ROS Melodic
Interfaces	Communication Interface	USB 3.0 (Data & Power)
Electrical data	Operating Voltage	5V ± 0.25V
	Maximum Power Usage	3.04 W

Mechanical Data	Weight	330 g
	Dimensions (See Figure 1)	Bottom Diameter: 103 mm
		Top Diameter: 42.8 mm
		Height: 102 mm
	Materials	ABS, PC, Aluminum & Glass
	Housing Color	Matte Black (Top & Bottom)
	Mounting (See Figures 2 and 3)	UNC 1/4"-20, Top & Bottom

Environmental Conditions	Ambient Temperature	-30° to +55°C
	Storage Temperature	-40° to +85°C
	Ambient Lighting	5 Lux to 25,000 Lux
	IP Rating	IP67
	Humidity	RH-95% Non Condensing @ 55°C

Resistance	Shock Resistance	Up to 40g in all directions
	Vibration Resistance	5 Hz to 1999 Hz: 2g, 10 sweep cycles ±X, Y, Z axes tested for 9 hours

Accessories (included)	USB 3.0 Type C to Type A cable	
	Microfiber Cloth	

Important Notes	Fingerprints and other buildup on the transparent housing may degrade performance. Routine cleaning is recommended	
	A clean dry microfiber cloth should be used for cleaning the polycarbonate dome. Only plain water is safe for dried on or stubborn dirt.	

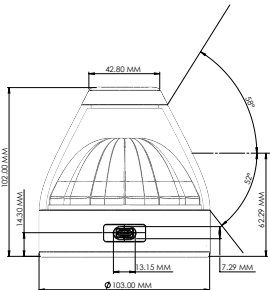


Figure 1

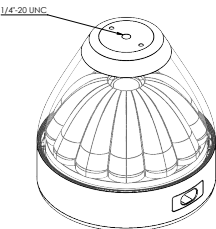


Figure 2

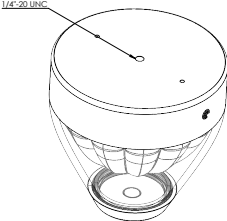


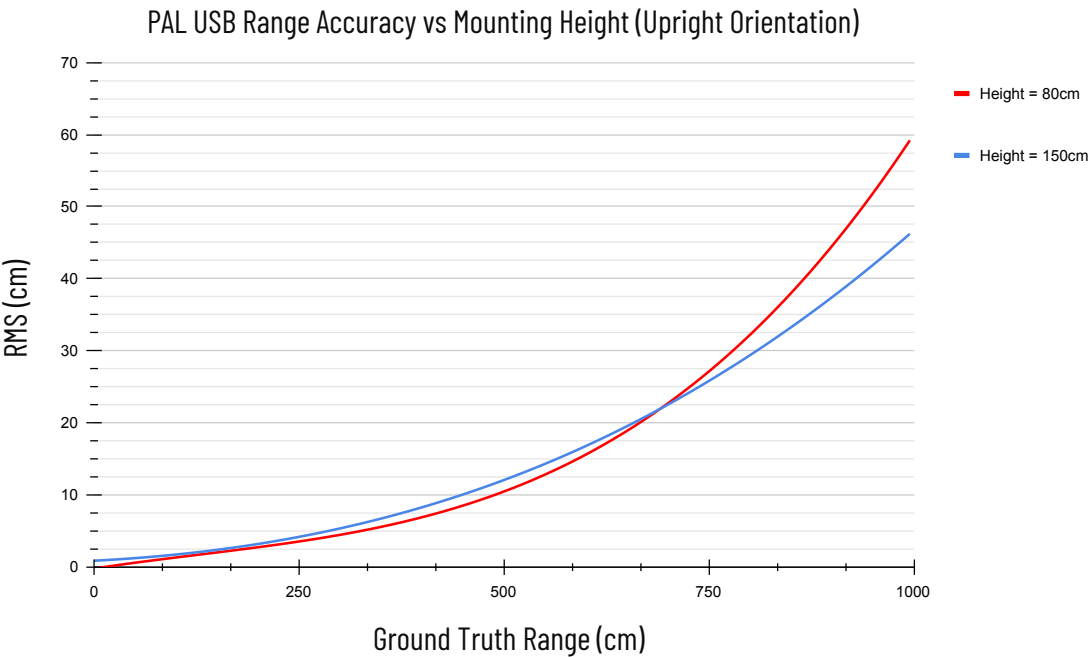
Figure 3

# Performance Benchmarking

	Jetson Nano	Jetson NX	Jetson AGX
Refresh Rate	10 FPS	20 FPS	20 FPS
Latency	300 ms	200 ms	200 ms
Available RAM Required	2GB	2.9GB	2.9GB
Compute Requirement	72% of 1.4Ghz, Quad-core ARM Cortex-A57 MPCore processor, 99% GPU	67% of 1.4Ghz, 6-core NVIDIA Carmel ARM v8.2 64-bit CPU, 79% GPU	44% of 1.1Ghz, 8-core ARM v8.2 64-bit CPU, 8MB L2 + 4MB L3, 59% GPU
Power Mode	MAXN	15W 6core	30W ALL

Performance on Reference Hardware with 1x PAL USB at maximum of 360° Field of View. Higher performance is expected with the reduced Field of View

## Range Performance



## Certifications

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