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NAO

DATASHEET



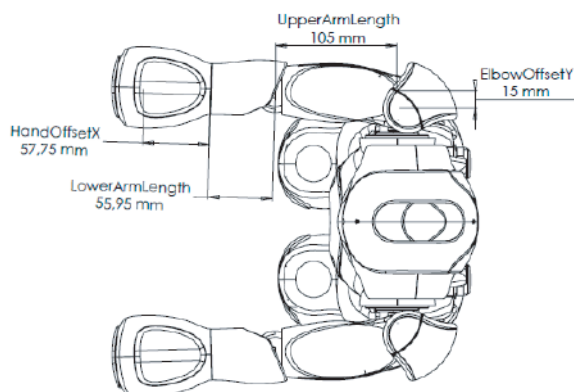
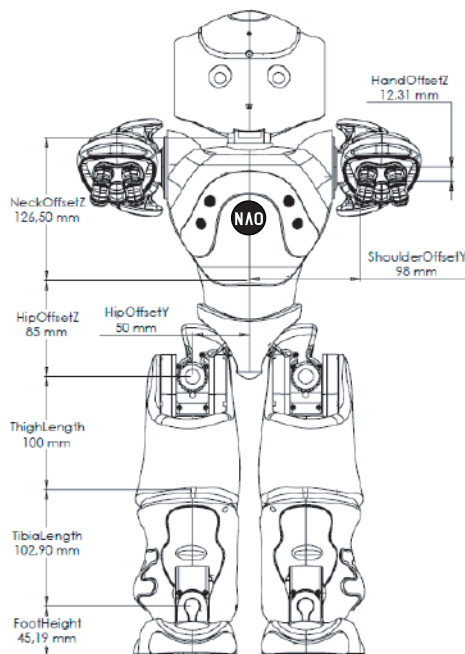
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MODEL: H25600

PHYSICAL CHARACTERISTICS

GENERAL

Size (HxDxW)	574x311x275 mm / 22.6x12.2x10.8 in
Weight	5.48 kg / 12.08 lb



BRAIN SYSTEM

MOTHER BOARD

CPU	CPU processor	ATOM E3845
	Cache memory	2 MB
	Clock speed	1.91 GHz
RAM	4GB DDR3	
Flash memory	32GB eMMC	

HUMAN INTERACTION

LANGUAGES

Text to speech	Czech, Danish, Dutch, English, Finnish, French, German, Italian, Japanese, Greek, Polish, European Portuguese, Brazilian Portuguese, Spanish, Swedish, Russian, Turkish, Arabic, Brazilian, Standard Mandarin, Taiwanese Mandarin, Norwegian.
& Automatic speech Recognition	

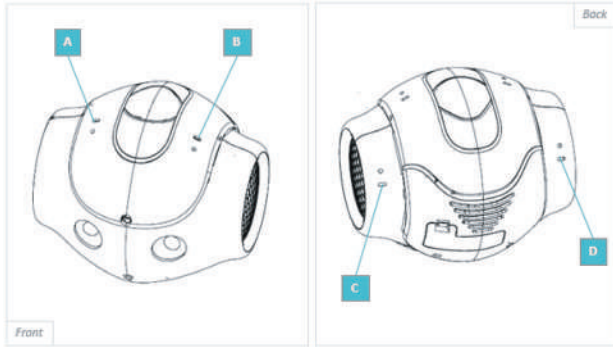
AUDIO

Loud Speakers	Left & Right	
	Diameter	40 mm
	Impedance	4 Ω
	Audio power	87 dB +/- 3 dB
	Freq range	up to ~20 kHz
	Input	2 W
Microphones	×4 omnidirectional on the head	
	Sensitivity	-12dBV/PA @1KHZ
	Frequency range	100HZ to 10KHZ

LEDs

Placement	Quantity	Description
Tactile Head	12	16 White levels
Eyes	2×8	RGB FullColor
Ears	2×10	16 Blue levels
Chest button	1	RGB FullColor
Feet	2×1	RGB FullColor

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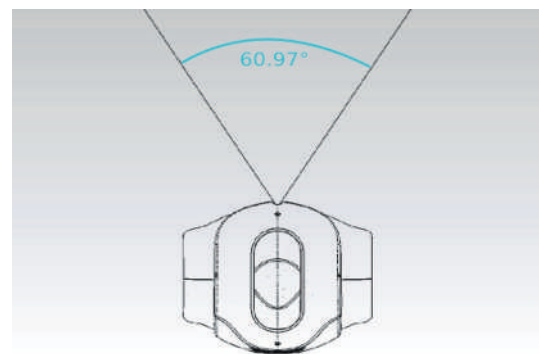
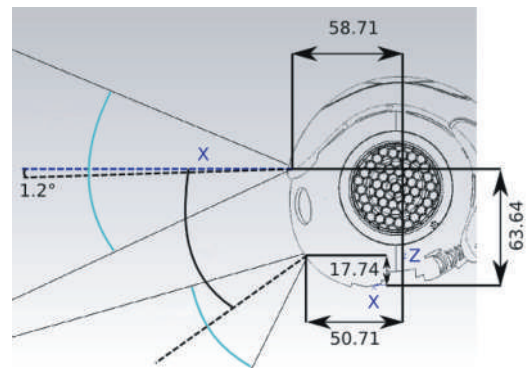
2D CAMERAS

Cameras	2 front of head	
Sensor model	OV5640	
Sensor type	SoC - CMOS Image Sensor	
Imaging array	Resolution	5 MP
	Size	1/4 in
	Active Pixels (H×V)	2592 x 1944
Sensitivity	Pixel size	1.4 x 1.4 μm
	Dynamic range	68 dB @8x gain
	Signal/Noise ratio (max)	36 dB
	Responsivity	600 mV/lux-sec
Output	Camera output	640 x 480 @30 fps
	Data Format	YUY & RGB
	Shutter type	Rolling Shutter/ frame exposure
View	Field of view	67.4° DFOV (56.3° HFOV, 43.7° VFOV)
	Focus range	10 cm ~ ∞ ≈ 4 in - ∞
	Focus type	Auto focus

FRAMERATES

	Top Camera	Bottom Camera
Resolution		
320×240 px	@15, 30 fps	@15, 30 fps
640×480 px	@15, 30 fps	@15, 30 fps
1280×960 px	@15, 30 fps	@10, 15 fps
1920×1080 px	@15, 30 fps	-
2560×1920 px	@15 fps	-

Note: The rate of the video stream will depend on the network and the video resolution chosen. All frame rates depend on the CPU usage. Values are measured with a CPU fully dedicated to image gathering.



ENVIRONMENT SENSORS

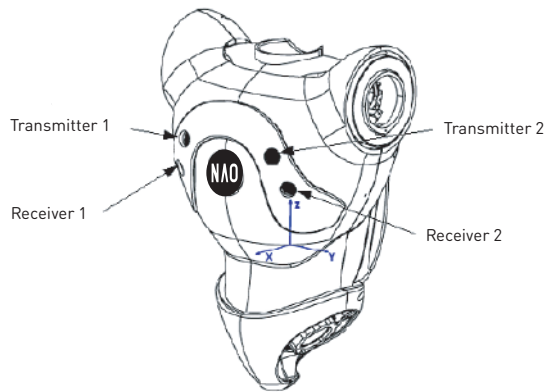
INERTIAL UNIT

Gyrometer	1	
	Axis	3
	Precision	5%
	Angular speed	500°/s approx.
IMU	1	
	Axis	3
	Precision	10%
	Nominal acceleration	2g approx.

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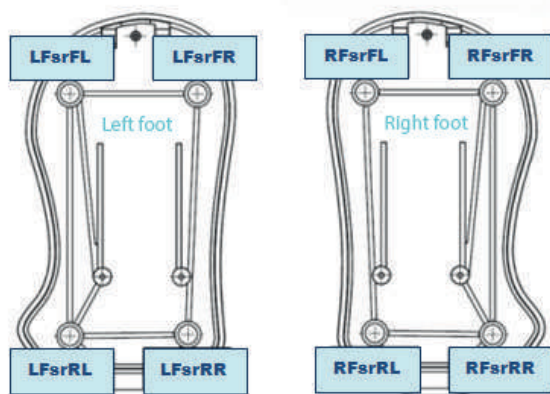
SONAR

Transmitters	2 on front
Receivers	2 on front
Frequency	40 kHz
Resolution	1 cm @50 cm
Detection Range	0.20 m to 0.80 m
Effective Cone	60°



FORCE SENSITIVE RESISTORS (FSR)

Range	0 to 25 N
Location	4 in each foot
Sensitivity	40 g approx.



BUTTONS & SENSORS

Chest Button	✓
Foot Bumper	✓
Tactile Head	✓
Tactile Hand	✓

ENERGY

ROBOT BATTERY

Battery	Type	Lithium-Ion
	Nominal voltage/capacity	21.6 V / 2.9 Ah
	Max charge voltage	25.2 V
	Recommended charge current	1.8 A
	Max charge / discharge current	2.1 A / 2.0 A
	Energy	62.5 Wh
	Charging duration	90 min
	Run time	60 min (Active use) 90 min (Normal use)

BATTERY CHARGER

Input	100 to 240 VAC – 50/60 Hz – Max 1.2 A
Output	25.2 VDC – 2 A

MOTION

DEGREES OF FREEDOM

Head	2
Arm (in each)	5
Pelvis	1
Leg (in each)	5
Hand (in each)	1

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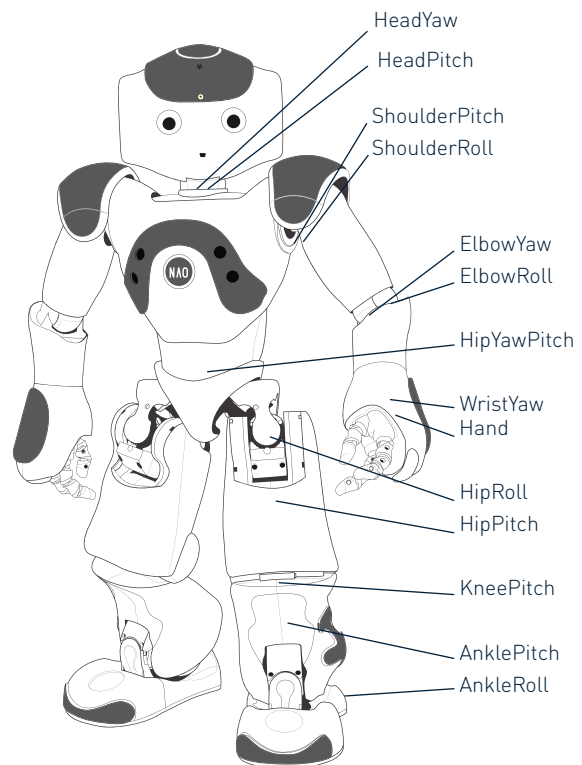
MOTOR SPECIFICATIONS

Motor type Brush DC Coreless

POSITION OF MOTORS

		Gear Ratio	Motor type
Head joints	HeadYaw	150.27	3
	HeadPitch	173.22	3
Arm joints	ShoulderPitch	150.27	4
	ShoulderRoll	173.22	3
	ElbowYaw	150.27	3
	ElbowRoll	173.22	3
Hand joints	WristYaw	50.61	2
	Hand/ Fingers	36.24	2
Leg joints	HipYawPitch	201.3	1
	HipRoll	201.3	1
	HipPitch	130.85	5
	KneePitch	130.85	5
	AnklePitch	130.85	5
	AnkleRoll	201.3	1

For details of type and gear ratio, see below.



MOTOR TYPE

	Motor type 1	Motor type 2	Motor type 3	Motor type 4	Motor type 5
Make	22NT82213P	17N88208E	16GT83210E	DCX 16S	22NT Z20
No load speed (rpm)	8700 $\pm$ 10%	8400 $\pm$ 12%	10700 $\pm$ 10%	11400 $\pm$ 10%	8700 $\pm$ 10%
Stall torque (mNm)	65 $\pm$ 8%	9.4 $\pm$ 8%	14.3 $\pm$ 8%	22.4 $\pm$ 10%	65 $\pm$ 10%
Continuous torque (mNm)	17.8 max	4.9 max	6.2 max	2.6 max	17.8 max

JOINT MOVEMENT ENCODERS

MRE (Magnetic Rotary Encoder)	36 Using hall effect sensor technology Precision: 12 bits / 0.1°
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CONNECTIVITY

CONNECTION

Ethernet	1xRJ45 - 10/100/1000 BASE T
WIFI	IEEE 802.11a/b/g/n
WPAN IEEE 802.15.1 (Bluetooth)	4.0 (LE)

SOFTWARE

Open Nao	Embedded GNU/Linux Distribution based on Gentoo
Architecture	86
Programming	Embedded: C++ / Python Remote: Java