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Chapter 1 Outside Specifications
1.1 External Measurements

unit: mm
1.2 Hardware Limitations of Joint Motions

unit: degree
unit: degree
Chapter 2 Joints

Refer to Appendix A.1 for CPC Primitive Locator.

2.1 Software Limitations of Joint Motions

2.1.1 Single Joints

<table>
<thead>
<tr>
<th>Parts</th>
<th>Range (Unit: degree)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck tilt1</td>
<td>(-75, 0)</td>
</tr>
<tr>
<td>Neck pan</td>
<td>(-88, 88)</td>
</tr>
<tr>
<td>Neck tilt2</td>
<td>(-15, 45)</td>
</tr>
<tr>
<td>Mouth</td>
<td>(-55, -3)</td>
</tr>
<tr>
<td>Left leg(front/rear)J1</td>
<td>(-115, 130)</td>
</tr>
<tr>
<td>Left leg(front/rear)J2</td>
<td>(-10, 88)</td>
</tr>
<tr>
<td>Left leg(front/rear)J3</td>
<td>(-25, 122)</td>
</tr>
<tr>
<td>Right leg(front/rear)J1</td>
<td>(-130, 115)</td>
</tr>
<tr>
<td>Right leg(front/rear)J2</td>
<td>(-10, 88)</td>
</tr>
<tr>
<td>Right leg(front/rear)J3</td>
<td>(-25, 122)</td>
</tr>
<tr>
<td>Tail tilt</td>
<td>(5, 60)</td>
</tr>
<tr>
<td>Tail pan</td>
<td>(-45, 45)</td>
</tr>
</tbody>
</table>

2.1.2 Two Joints in Legs

<table>
<thead>
<tr>
<th>Front leg J1-range</th>
<th>J2-range (Unit: degree)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-115, -76)</td>
<td>(-1, 88)</td>
</tr>
<tr>
<td>(-75, -54)</td>
<td>(-2, 88)</td>
</tr>
<tr>
<td>(-55, -46)</td>
<td>(-3, 88)</td>
</tr>
<tr>
<td>(-45, -36)</td>
<td>(-4, 88)</td>
</tr>
<tr>
<td>(-35, -31)</td>
<td>(-5, 88)</td>
</tr>
<tr>
<td>(-30, -26)</td>
<td>(-6, 88)</td>
</tr>
<tr>
<td>(-25, -21)</td>
<td>(-7, 88)</td>
</tr>
<tr>
<td>(-20, -16)</td>
<td>(-8, 88)</td>
</tr>
<tr>
<td>(-15, -11)</td>
<td>(-9, 88)</td>
</tr>
<tr>
<td>(-10, 20)</td>
<td>(-10, 88)</td>
</tr>
<tr>
<td>(21, 25)</td>
<td>(-9, 88)</td>
</tr>
<tr>
<td>(26, 30)</td>
<td>(-8, 88)</td>
</tr>
<tr>
<td>(29, 40)</td>
<td>(-7, 88)</td>
</tr>
<tr>
<td>(41, 45)</td>
<td>(-6, 88)</td>
</tr>
<tr>
<td>(46, 50)</td>
<td>(-5, 88)</td>
</tr>
<tr>
<td>(51, 55)</td>
<td>(-4, 88)</td>
</tr>
<tr>
<td>(56, 65)</td>
<td>(-3, 88)</td>
</tr>
<tr>
<td>(64, 130)</td>
<td>(-2, 88)</td>
</tr>
</tbody>
</table>
Rear leg

\textbf{J1-range} \hspace{0.5cm} \textbf{J2-range} (Unit: degree)

\begin{tabular}{c|c}
(115, 71) & (0, 88) \\
(70, 61) & (-1, 88) \\
(60, 51) & (-2, 88) \\
(50, 46) & (-3, 88) \\
(45, 41) & (-4, 88) \\
(40, 36) & (-5, 88) \\
(35, 31) & (-6, 88) \\
(30, 26) & (-7, 88) \\
(25, 21) & (-8, 88) \\
(20, 16) & (-9, 88) \\
(15, -10) & (-10, 88) \\
(-11, -15) & (-9, 88) \\
(-16, -20) & (-8, 88) \\
(-21, -25) & (-7, 88) \\
(-26, -30) & (-6, 88) \\
(-31, -35) & (-5, 88) \\
(-36, -40) & (-4, 88) \\
(-41, -45) & (-3, 88) \\
(-46, -55) & (-2, 88) \\
(-56, -70) & (-1, 88) \\
(-71, -130) & (0, 88) \\
\end{tabular}

\subsection*{2.1.3 Joints of Head and Mouth}

Please be aware that there may be collisions between body parts outside these limits.

\begin{tabular}{c|c|c|c}
Mouth-range & Neck-tilt1-range & Neck-tilt2-range \\
(-30, -3) & (-75, -39) & (5, 45) \\
(-30, -3) & (-40, 0) & (-5, 45) \\
\end{tabular}

\section*{2.2 Servo Gain}

Use standard values normally, and use weak gain values when large vibrations occur. PSHIFT, ISHIFT, DSHIFT are fixed values; please do not change these values.

\begin{tabular}{c|c|c|c|c|c|c}
\textbf{(standard values)} & \textbf{CPC Primitive Locator} & \textbf{PGAIN} & \textbf{IGAIN} & \textbf{DGAIN} & \textbf{PSHIFT} & \textbf{ISHIFT} \\
PRM:/r1/c1-Joint2:11 & 0xA & 0x04 & 0x02 & 0x0E & 0x02 & 0x0F \\
PRM:/r1/c2-Joint2:12 & 0x08 & 0x02 & 0x04 & 0x0E & 0x02 & 0x0F \\
PRM:/r1/c2/c3-Joint2:13 & 0x08 & 0x04 & 0x02 & 0x0E & 0x02 & 0x0F \\
PRM:/r1/c2/c3/c4-Joint2:14 & 0x08 & 0x00 & 0x04 & 0x0E & 0x02 & 0x0F \\
PRM:/r2/c1-Joint2:21 & 0x1C & 0x08 & 0x01 & 0x0E & 0x02 & 0x0F \\
PRM:/r2/c2-Joint2:22 & 0x14 & 0x04 & 0x01 & 0x0E & 0x02 & 0x0F \\
PRM:/r2/c2/c3-Joint2:23 & 0x1C & 0x08 & 0x01 & 0x0E & 0x02 & 0x0F \\
PRM:/r3/c1-Joint2:31 & 0x1C & 0x08 & 0x01 & 0x0E & 0x02 & 0x0F \\
PRM:/r3/c2-Joint2:32 & 0x14 & 0x04 & 0x01 & 0x0E & 0x02 & 0x0F \\
PRM:/r3/c2/c3-Joint2:33 & 0x1C & 0x08 & 0x01 & 0x0E & 0x02 & 0x0F \\
PRM:/r4/c1-Joint2:41 & 0x1C & 0x08 & 0x01 & 0x0E & 0x02 & 0x0F \\
PRM:/r4/c2-Joint2:42 & 0x14 & 0x04 & 0x01 & 0x0E & 0x02 & 0x0F \\
PRM:/r4/c2/c3-Joint2:43 & 0x1C & 0x08 & 0x01 & 0x0E & 0x02 & 0x0F \\
PRM:/r5/c1-Joint2:51 & 0x1C & 0x08 & 0x01 & 0x0E & 0x02 & 0x0F \\
PRM:/r5/c2-Joint2:52 & 0x14 & 0x04 & 0x01 & 0x0E & 0x02 & 0x0F \\
PRM:/r5/c2/c3-Joint2:53 & 0x1C & 0x08 & 0x01 & 0x0E & 0x02 & 0x0F \\
PRM:/r6/c1-Joint2:61 & 0x0A & 0x04 & 0x04 & 0x0E & 0x02 & 0x0F \\
PRM:/r6/c2-Joint2:62 & 0x0A & 0x04 & 0x04 & 0x0E & 0x02 & 0x0F \\
\end{tabular}
### (weak gain values)

<table>
<thead>
<tr>
<th>CPC Primitive Locator</th>
<th>PGAIN</th>
<th>IGAIN</th>
<th>DGAIN</th>
<th>PSHIFT</th>
<th>ISHIFT</th>
<th>DSHIFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRM:/r1/c1-Joint2:11</td>
<td>0x0A</td>
<td>0x04</td>
<td>0x02</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r1/c1/c2-Joint2:12</td>
<td>0x08</td>
<td>0x02</td>
<td>0x04</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r1/c1/c2/c3-Joint2:13</td>
<td>0x08</td>
<td>0x04</td>
<td>0x02</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r1/c1/c2/c3/c4-Joint2:14</td>
<td>0x08</td>
<td>0x00</td>
<td>0x04</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r2/c1-Joint2:21</td>
<td>0x10</td>
<td>0x04</td>
<td>0x01</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r2/c1/c2-Joint2:22</td>
<td>0x0A</td>
<td>0x04</td>
<td>0x01</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r2/c1/c2/c3-Joint2:23</td>
<td>0x10</td>
<td>0x04</td>
<td>0x01</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r3/c1-Joint2:31</td>
<td>0x10</td>
<td>0x04</td>
<td>0x01</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r3/c1/c2-Joint2:32</td>
<td>0x0A</td>
<td>0x04</td>
<td>0x01</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r3/c1/c2/c3-Joint2:33</td>
<td>0x10</td>
<td>0x04</td>
<td>0x01</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r4/c1-Joint2:41</td>
<td>0x10</td>
<td>0x04</td>
<td>0x01</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r4/c1/c2-Joint2:42</td>
<td>0x0A</td>
<td>0x04</td>
<td>0x01</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r4/c1/c2/c3-Joint2:43</td>
<td>0x10</td>
<td>0x04</td>
<td>0x01</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r5/c1-Joint2:51</td>
<td>0x10</td>
<td>0x04</td>
<td>0x01</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r5/c1/c2-Joint2:52</td>
<td>0x0A</td>
<td>0x04</td>
<td>0x01</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r5/c1/c2/c3-Joint2:53</td>
<td>0x10</td>
<td>0x04</td>
<td>0x01</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r6/c1-Joint2:61</td>
<td>0x0A</td>
<td>0x04</td>
<td>0x04</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
<tr>
<td>PRM:/r6/c2-Joint2:62</td>
<td>0x0A</td>
<td>0x04</td>
<td>0x04</td>
<td>0x0E</td>
<td>0x02</td>
<td>0x0F</td>
</tr>
</tbody>
</table>

### 2.3 Notes on Programming

1. The following is used for OCommandInfo’s type variable.
   - ERS-7’s ear   odataJOINT_COMMAND4

2. If you want to make the jam detection less strict, put and edit
   the following file:
   ```
   /OPEN-R/SYSTEM/CONF/VRCOMM.CFG
   ```
   and set 'JamDetectionHighThreshold' in this file.

3. Don’t activate the ear plunger to ‘on’ for an extended period; it may
   cause damage to AIBO.
Chapter 3 Devices

(1) Refer to Appendix A.1 for CPC Primitive Locator.
(2) Refer to Level2 Reference Guide for details of functions and values.

3.1 Output Devices

3.1.1 Light

Specifications

LED method

Face lights are controlled by A/B faces. (Refer to A.2)

OCommandInfo’s type variable, and structure of OCommandData’s value variable

Face light, Back light : odataLEDCOMMAND3, OLEDCommandValue3
Others : odataLEDCOMMAND2, OLEDCommandValue2

Notes

(1) Face lights can show A/B faces by setting OLEDCommandValue3’s mode variable to the following. (mode is ineffective on Back lights.)
oled3_MODE_A, oled3_MODE_B
(2) Face lights and Back lights can show a range between 0 and 255 by setting OLEDCommandValue’s intensity variable.

Color of Face lights

(A1 means Face light 1’s A surface)

Face light’s ID, Color of A surface, Color of B surface

1 white green  (A1 and B1 are same position.)
2 white green  (A2 and B2 are same position.)
3 white green  (B3 and B13’s left are same position.)
4 white green  (B4 and B13’s right are same position.)
5 white green  (A5 and B5 are same position.)
6 white white  (A6 and B6 are same position.)
7 white white  (A7 and B7 are same position.)
8 white white  (A8 and B8 are same position.)
9 white white  (A9 and B9 are same position.)
10 white white  (A10 and B10 are same position.)
11 white white  (A11 and B11 are same position.)
12 white white  (A12 and B12 are same position.)
13 red blue    (A13 and A9:A10(B9+B10) are same position. B13 and B3+B4 are same position)
14 red blue

Notes
(1) You can’t use A/B surface’s LED at the same time. (ex. A1 and B2)
(2) If you use same position’s LED at the same time, the colors become blended. (ex. A9 and A13)

3.1.2 Speaker

Specifications
Sampling frequency: 8kHz/16kHz
Quantized bit length: 8bit/16bit (Linear PCM)
Channel: 1 channel (monaural)

Variables which can be set during OPENR::ControlPrimitive()’s request

- oprmreqSPEAKER_MUTE_ON
- oprmreqSPEAKER_MUTE_OFF
- oprmreqSPEAKER_SET_VOLUME
  - set the following OSpeakerVolume to param’s variable
    - ospkvolinfdB (minimum)
    - ospkvol25dB (-25dB)
    - ospkvol18dB (-18dB)
    - ospkvol10dB (-10dB)

- oprmreqSPEAKER_GET_SOUND_TYPE
- oprmreqSPEAKER_SET_SOUND_TYPE
  - set the following OSpeakerVolume to param’s variable
    - soundType(ospksndMONO8K8B)
    - soundType(ospksndMONO16K16B)
3.2 Input Devices

3.2.1 Color Camera

Specifications

CMOS part: 1/4 inch
The number of picture elements: 416(H) x 320(V), 30 FPS
Lens: F 2.8, f = 3.27mm
Angle of view:
  Horizontal angle 56.9 degrees
  Vertical angle 45.2 degrees
Default:
  White balance 5000K fixed
  Shutter speed 1/100 sec fixed
  Gain 0dB fixed

Variables which can be set during OPENR::ControlPrimitive()’s request

White balance
  oprmreqCAM_SET_WHITE_BALANCE
  ocamparamWB_INDOOR_MODE (2856K)
  ocamparamWB_FL_MODE (5000K)
  ocamparamWB_OUTDOOR_MODE (6500K)

Shutter speed
  ocamparamSHUTTER_SLOW (1/50sec)
  ocamparamSHUTTER_MID (1/100sec)
  ocamparamSHUTTER_FAST (1/200sec)

Gain
  ocamparamGAIN_LOW (-6dB)
  ocamparamGAIN_MID (0dB)
  ocamparamGAIN_HIGH (+6dB)

Notes
In ERS-7, the CDT is effective for channel 0-6 and channel 7 is NOT available.

3.2.2 Stereo microphones

Specifications

Sampling frequency: 16kHz
Quantized bit length: 16bit (Linear PCM)
Channel: 2 channel (stereo)

Variables which can be set during OPENR::ControlPrimitive()’s request

No effective variable.

3.2.3 Head sensor, Back sensor

Specifications

Electrostatic method

Value of OSensorValue’s signal and value variables
Signal and value variables are the same AD value and the output range is about (0,80).
(reference) on/off’s thresholds

<table>
<thead>
<tr>
<th></th>
<th>on’s threshold</th>
<th>off’s threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head sensor</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Back sensor(front)</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Back sensor(middle)</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>Back sensor(rear)</td>
<td>14</td>
<td>10</td>
</tr>
</tbody>
</table>

Notes

(1) The back sensors’ thresholds consider hysteresis and shape of the sensor.

(2) Thresholds may vary according to temperature and humidity.

3.2.4 Paw sensor, Chin sensor

Specifications

Switch method

Value of OSensorValue’s signal and value variables

Return the following values.

OswitchON, oswitchOFF

3.2.5 Distance sensor

Specifications

The head distance sensor switches between the near and far sensors.
(Refer to A1.3.)

Range of OSensorValue’s value variable (unit: $10^{-6}$m)

<table>
<thead>
<tr>
<th>Sensor Type</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest distance sensor</td>
<td>(100000, 900000)</td>
</tr>
<tr>
<td>Head distance sensor(near)</td>
<td>(50000, 500000)</td>
</tr>
<tr>
<td>Head distance sensor(far)</td>
<td>(200000, 1500000)</td>
</tr>
</tbody>
</table>

Notes

(1) The output values for the near/far head distance sensor appears alternatively. During each sensor’s turn, the result will show the most recent value. At other times, the result will show 0 for the signal, and remember the most recent value for the value (e.g. the previous’ frame’s value). For example:
(sample for near distance sensor)

**frame-ID turn signal value**

<table>
<thead>
<tr>
<th>Frame-ID</th>
<th>Distance</th>
<th>Signal</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>near</td>
<td>s1</td>
<td>v1</td>
</tr>
<tr>
<td>1</td>
<td>far</td>
<td>0</td>
<td>v1</td>
</tr>
<tr>
<td>2</td>
<td>near</td>
<td>s2</td>
<td>v2</td>
</tr>
<tr>
<td>3</td>
<td>far</td>
<td>0</td>
<td>v2</td>
</tr>
</tbody>
</table>

(2) The device measurement period of the head distance sensor is about 50msec; the chest distance sensor’s period is about 40msec; and the software’s sampling period is about 8msec. So, there might be a small delay to update the latest value due to the differences in the various update periods.

### 3.2.6 Acceleration sensor

**Specifications**

3 axis (front-back, right-left, up-down)

**Range of OSensorValue’s value variable** (unit: \(10^6\)m/sec²)

(-19613300, 19613300)

### 3.2.7 Vibration sensor

**Specifications**

The vibration sensor is connected to a microprocessor for battery control.

**Variables which can be set during OPENR::Shutdown()’s bootCondition**

If the following variable is set, when the vibration sensor detects a vibration, the battery control microcomputer can boot AIBO.

obcbVIBRATION_DETECTED
# Appendix

## A.1 List of CPC Primitive Locators

To use these locators, specify the CPC Primitive Locator in OPENR::OpenPrimitive() and retrieve the ID.

For ease of reading, this list shows the small character ‘l’ in the color blue, and the numeral ‘l’ in the color black.

<table>
<thead>
<tr>
<th>CPC Primitive Locator</th>
<th>Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Head</strong></td>
<td></td>
</tr>
<tr>
<td>FRM:/r1/c1-Joint2:11</td>
<td>Neck tilt1</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2-Joint2:12</td>
<td>Neck pan</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3-Joint2:13</td>
<td>Neck tilt2</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/c4-Joint2:14</td>
<td>Mouth</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/e5-Joint4:15</td>
<td>Left ear</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/e6-Joint4:16</td>
<td>Right ear</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/t1-Sensor:t1</td>
<td>Head sensor</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/p1-Sensor:p1</td>
<td>Head distance sensor(near)</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/p2-Sensor:p2</td>
<td>Head distance sensor(far)</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/c4/s5-Sensor:s5</td>
<td>Chin sensor</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/11-LED2:11</td>
<td>Head light(color)</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/12-LED2:12</td>
<td>Head light(white)</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/13-LED2:13</td>
<td>Mode Indicator(red)</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/14-LED2:14</td>
<td>Mode Indicator(green)</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/15-LED2:15</td>
<td>Mode Indicator(blue)</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/16-LED2:16</td>
<td>Wireless light</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1a-LED3:1a</td>
<td>Face light1</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1b-LED3:1b</td>
<td>Face light2</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1c-LED3:1c</td>
<td>Face light3</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1d-LED3:1d</td>
<td>Face light4</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1e-LED3:1e</td>
<td>Face light5</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1f-LED3:1f</td>
<td>Face light6</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1g-LED3:1g</td>
<td>Face light7</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1h-LED3:1h</td>
<td>Face light8</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1i-LED3:1i</td>
<td>Face light9</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1j-LED3:1j</td>
<td>Face light10</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1k-LED3:1k</td>
<td>Face light11</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1l-LED3:1l</td>
<td>Face light12</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1m-LED3:1m</td>
<td>Face light13</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1n-LED3:1n</td>
<td>Face light14</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/1l-FbkImageSensor:F1</td>
<td>Color Camera</td>
</tr>
<tr>
<td>FRM:/r1/c1/c2/c3/m1-Mic:M1</td>
<td>Stereo microphones</td>
</tr>
<tr>
<td><strong>Left front leg</strong></td>
<td></td>
</tr>
<tr>
<td>FRM:/r2/c1-Joint2:21</td>
<td>Left front legJ1</td>
</tr>
<tr>
<td>FRM:/r2/c1/c2-Joint2:22</td>
<td>Left front legJ2</td>
</tr>
<tr>
<td>FRM:/r2/c1/c2/c3-Joint2:23</td>
<td>Left front legJ3</td>
</tr>
<tr>
<td>FRM:/r2/c1/c2/c3/4-Sensor:24</td>
<td>Left front leg, paw sensor</td>
</tr>
<tr>
<td><strong>Left rear leg</strong></td>
<td></td>
</tr>
<tr>
<td>FRM:/r3/c1-Joint2:31</td>
<td>Left rear legJ1</td>
</tr>
<tr>
<td>FRM:/r3/c1/c2-Joint2:32</td>
<td>Left rear legJ2</td>
</tr>
<tr>
<td>FRM:/r3/c1/c2/c3-Joint2:33</td>
<td>Left rear legJ3</td>
</tr>
<tr>
<td>FRM:/r3/c1/c2/c3/4-Sensor:34</td>
<td>Left rear leg, paw sensor</td>
</tr>
</tbody>
</table>
Right front leg

PRM:/r4/c1-Joint2:41  Right front leg J1
PRM:/r4/c1/c2-Joint2:42  Right front leg J2
PRM:/r4/c1/c2/c3-Joint2:43  Right front leg J3
PRM:/r4/c1/c2/c3/c4-Sensor:44  Right front leg, paw sensor

Right rear leg

PRM:/r5/c1-Joint2:51  Right rear leg J1
PRM:/r5/c1/c2-Joint2:52  Right rear leg J2
PRM:/r5/c1/c2/c3-Joint2:53  Right rear leg J3
PRM:/r5/c1/c2/c3/c4-Sensor:54  Right rear leg, paw sensor

Tail/Others

PRM:/r6/c1-Joint2:61  Tail tilt
PRM:/r6/c2-Joint2:62  Tail pan
PRM:/s1-Speaker:S1  Speaker
PRM:/p1-Sensor:p1  Chest distance sensor
PRM:/b1-Sensor:b1  Wireless LAN switch
PRM:/t2-Sensor:t2  Back sensor(rear)
PRM:/t3-Sensor:t3  Back sensor(middle)
PRM:/t4-Sensor:t4  Back sensor(front)
PRM:/lu-LED3:lu  Back light(front, color)
PRM:/lv-LED3:lv  Back light(front, white)
PRM:/lw-LED3:lw  Back light(middle, color)
PRM:/lx-LED3:lx  Back light(middle, white)
PRM:/ly-LED3:ly  Back light(rear, color)
PRM:/lz-LED3:lz  Back light(rear, white)

Acceleration sensor

PRM:/a1-Sensor:a1  Acceleration sensor(front-back)
PRM:/a2-Sensor:a2  Acceleration sensor(right-left)
PRM:/a3-Sensor:a3  Acceleration sensor(up-down)
A.2 Position and Color of Face lights

A1(left), A2(right)          A3(left), A4(right)          A5(left), A6(right)        A7(left), A8(right)

A9(left), A10(right)                  A11                                A12                                 A13

B1(left), B2(right)         B3(left), B4(right)         B5(left), B6(right)         B7(left), B8(right)

B9(left), B10(right)                  B11                                B12                                B13

B14
A.3 Direction of Distance sensors

Head distance sensor
(top view)

- distance between light axis of head distance sensor(near) and central axis
- distance between light axis of head distance sensor(far) and central axis

Chest distance sensor
(side view)

- angle of chest distance sensor
- neck tilt1 center