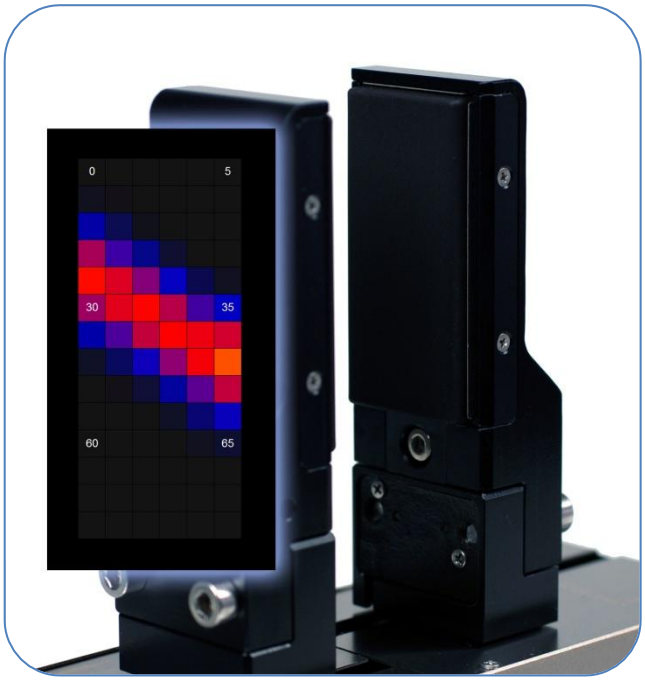
# WSG-DSA

# Tactile Sensing Finger

# User's Manual

December 2011



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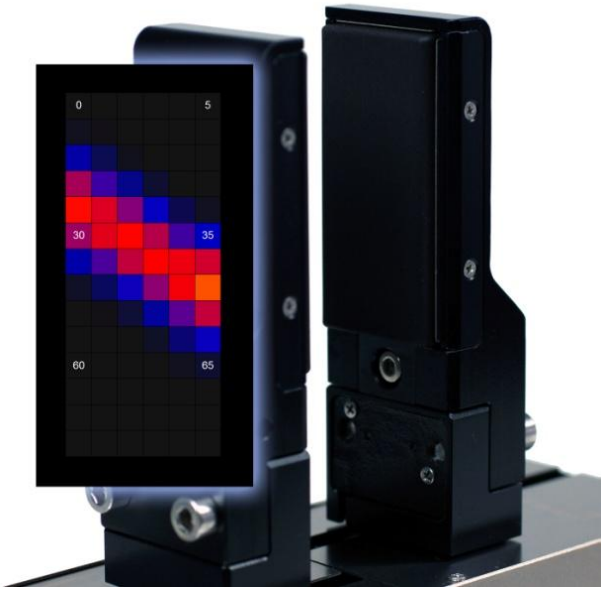
# 1 Introduction




The WSG-DSA is a gripper finger that integrates a tactile sensing matrix for a high-resolution pressure profile feedback during grasping.

The WSG-DSA uses a DSA9205i intelligent tactile transducer for sensing. It fits onto the base jaws of the WSG and directly interfaces to the gripper controller via the integrated Sensor Port inside the base jaws, so no external components or cables are necessary to include tactile feedback to your handling application.

The WSG-DSA Sensor Finger is automatically detected and parametrized by the WSG on startup. The pressure profiles can be used from within the gripper controller using its powerful scripting interface.

***Advantages***

- Easy to use tactile sensing solution
- No external components or cables required
- Compact construction
- Proven tactile sensing technology from Weiss Robotics

***Applications***

- Reactive Grasping in Service Robotics
- Detection of Orientation and Geometry
- Quality Management
- Haptic Analysis and Testing

## 1.1 Delivery scope

- Force Measurement Finger WSG-FMF
- 2 Screws DIN 912 M4x12
- 2 Guide sleeves, SCHUNK Id-No. 9939384
- This documentation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## 1.2 Mounting the WSG-DSA

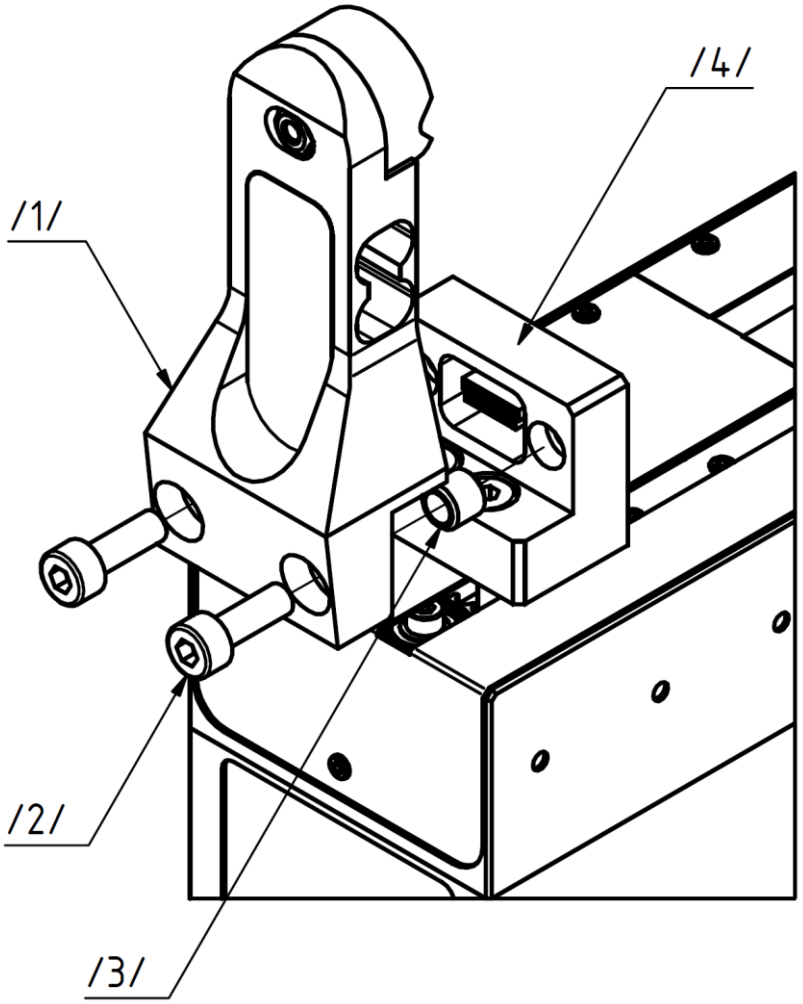


Figure 1: Mounting the WSG-DSA (the picture shows a WSG-FMF finger)

| Number | Description | Type |
|---|---|---|
| **/1/** | Tactile Sensing Finger with installed DSA9205i tactile transducer | WSG-DSA |
| **/2/** | Screw | DIN 912 M4x12 |
| **/3/** | Guide Sleeve 6h6x5,35mm (Ø x L) | SCHUNK Id-No. 9939384 |
| **/4/** | Base Jaw of the Gripper | - |


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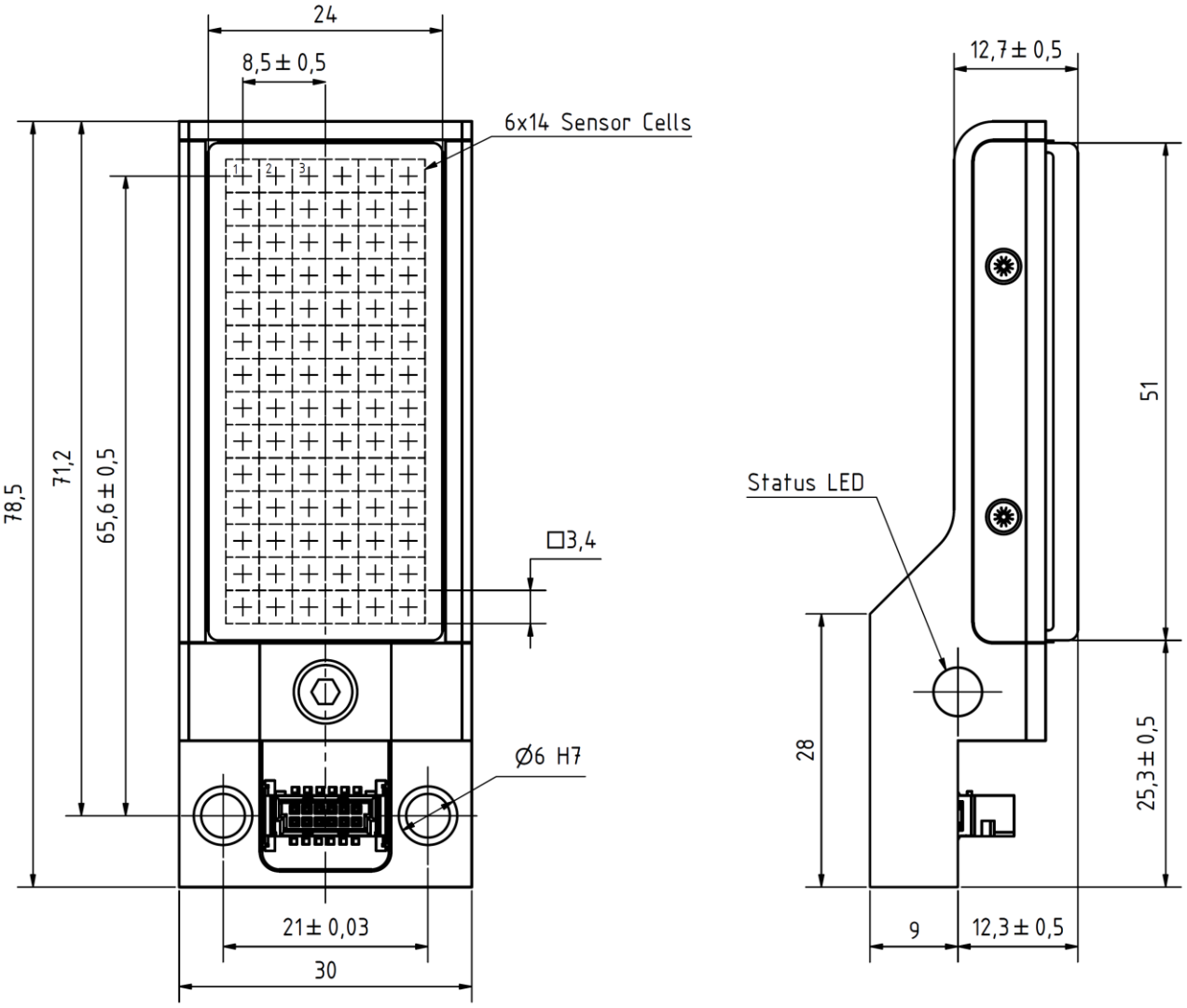
## 1.3 Mechanical Dimensions




## 1.4 Sensor Area

The tactile transducer used in the WSG-DSA is of type Weiss Robotics DSA9205i. It is an intelligent tactile transducer with integrated sensor controller. The sensor matrix consists of 84 sensor cells that are covered by a silicone rubber protector. Each sensor cell measures the applied pressure, so a pressure profile of 6 x 14 points can be acquired. Figure 2 shows the numbering of the sensor cells.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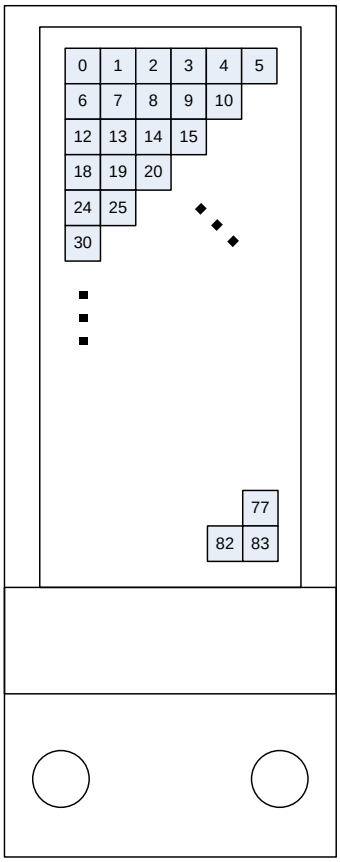


Figure 2: Sensor Matrix

**Avoid shear forces to the transducer area, since they may destroy the sensor!**

**Do not place a static load for long time onto the sensor matrix, since this may degrade performance!**

**For details about the tactile transducer, please see the DSA 9205i datasheet.**

## 1.5 Finger Diagnosis

To verify the correct operation of the WSG-DSA sensor finger, you can open the web interface of the WSG gripper and select the Finger Diagnosis from the Menu via Diagnostics->Finger.


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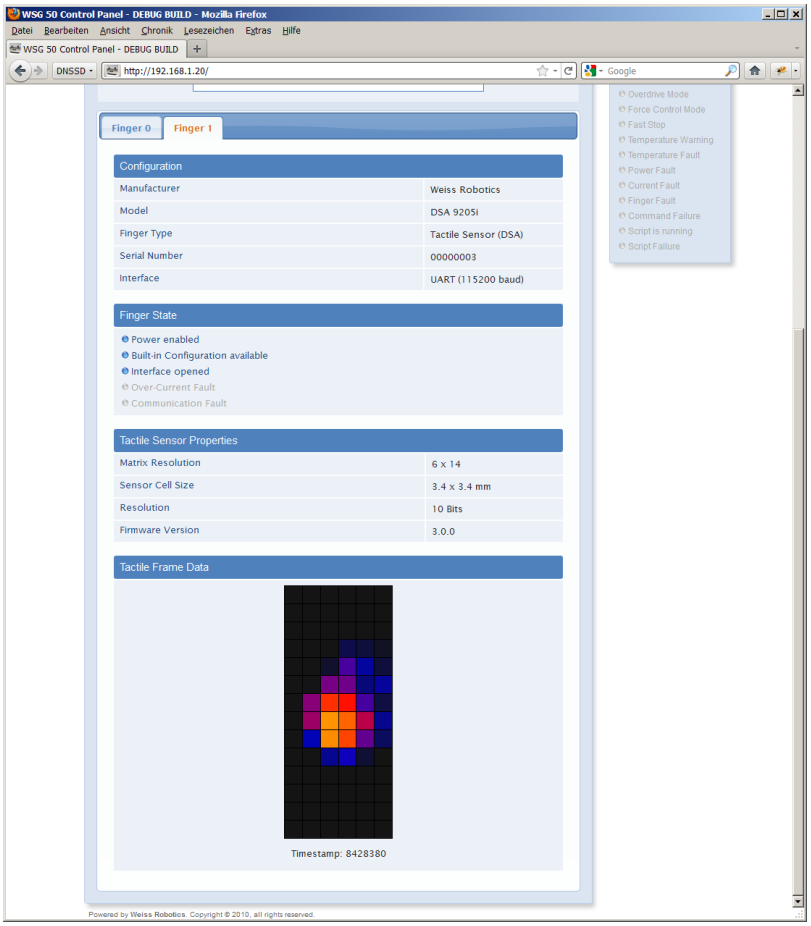


Figure 3: WSG-DSA Diagnosis using the WSG's Web Interface

## 1.6 Using the Finger with the WSG's Command Interface

To read the current frame data from the host application, you can use the Finger Get Data command.

☞ **The usage of finger-specific commands is described in the WSG Command Set Reference Manual**

The payload returned by this command contains the frame data encoded as two-byte words. The acquisition timestamp in milliseconds is appended as a four-byte word to the frame data. All data words are represented in Little Endian.

| Byte Index | Description |
|---|---|
| **0…1** | Integer value of Sensor Cell 0. |


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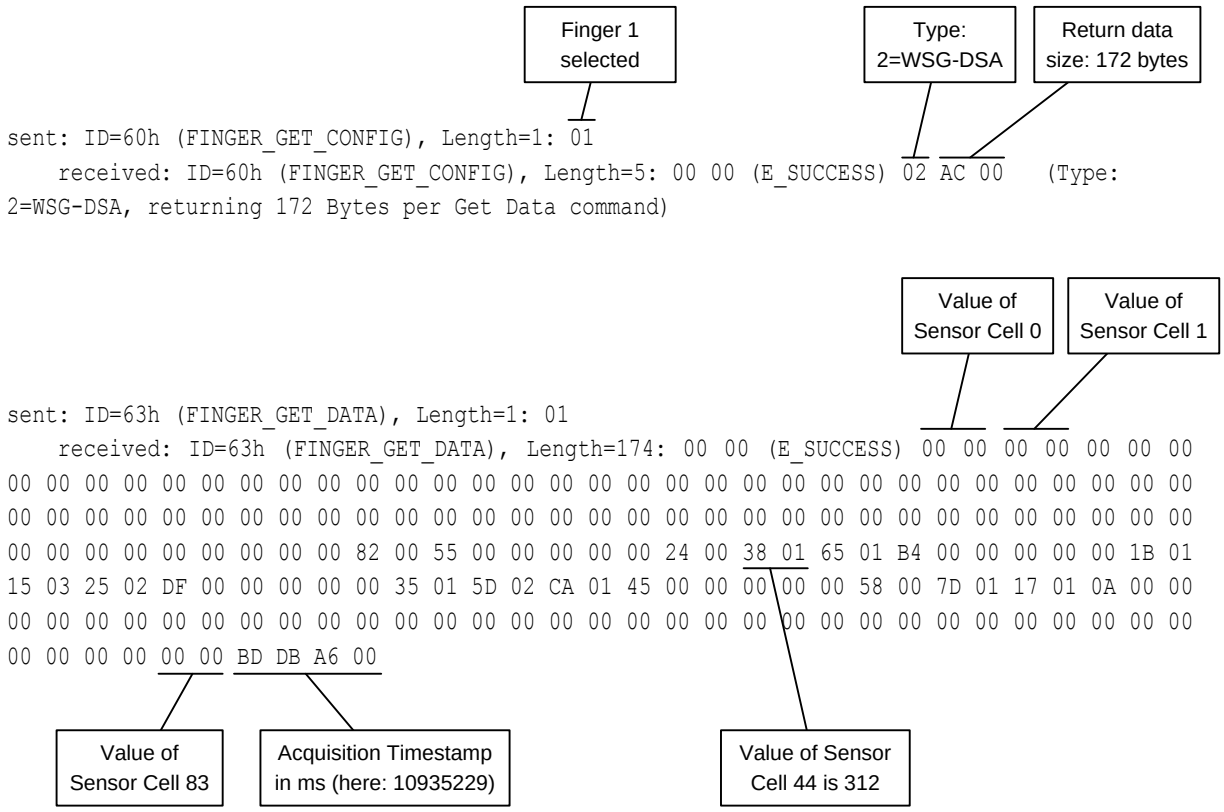
| | |
|---|---|
| **2...3** | Integer value of Sensor Cell 1. |
| **4...5** | Integer value of Sensor Cell 2. |
| **6...7** | Integer value of Sensor Cell 3. |
| **...** | Integer value of Sensor Cell n-1. (n=84 for the WSG-DSA) |
| **2*n ... 2*n+3** | Timestamp of the frame data in milliseconds |

The following communication protocol snippet shows the communication with a WSG-DSA finger to read the frame data. It was recorded using the WSG Commander 1.3.0 tool. The Data printed below is hexadecimal.




## 1.7 Using the Finger from within a Script

The WSG-DSA finger can be used from within a WSG script using the finger library's param() and data() functions.

☞ **The finger-specific scripting library is described in the WSG Scripting Reference Manual**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### 1.7.1 Supported Parameters

To set or read a WSG-DSA specific parameter, the gripper's scripting extensions provide the finger.param() command. The following parameters are supported by the WSG-DSA:

| Descriptor | Data Type | Access Type | Description |
|---|---|---|---|
| **sensitivity** | Number | RW | Set or get the matrix sensitivity, i.e. the analog gain factor used for the transducer's signal conditioning. Valid range is 0 to 100. |
| **cells_x** | Integer | RO | Number of sensor cells in x direction. |
| **cells_y** | Integer | RO | Number of sensor cells in y direction. |
| **width** | Number | RO | Width of the sensor matrix in mm. |
| **height** | Number | RO | Height of the sensor matrix in mm. |
| **range** | Integer | RO | Output range. For DSA9205i, this is (0…)1023, for other tactile transducers, this is (0…)4095. |
| **serial_no** | Integer | RO | Serial number of the WSG-DSA finger. |
| **version** | String | RO | Software version of the transducer (e.g. "2.9.0"). |
| **dsatype** | String | RO | String identifying the transducer type (e.g. "DSA9205i"). |

Access Types: RW: read and writeable, RO: read only, WO: write only

***Example Lua Code:***

```
-- This example prints some information about the connected Tactile Sensing finger(s):

for i=0,finger.count()-1 do
    if finger.type( i ) == "dsa" then
        -- This is a tactile sensing finger
        controllerType = finger.param( i, "dsatype" );
        version = finger.param( i, "version" );
        cellsX = finger.param( i, "cells_x" );
        cellsY = finger.param( i, "cells_y" );
        width = finger.param( i, "width" );
        height = finger.param( i, "height" );

        printf( "Transducer type: %s (software V%s)\n", controllerType, version );
        printf( "Matrix has %d x %d sensor cells ", cellsX, cellsY );
        printf( "and has an active area of %.1f x %.1f mm\n", width, height );
```


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```
    end;
end;
```

### 1.7.2 Format of the Measurement Data

The current pressure profile frame can be obtained using the finger.data() command. The frame is packed into an associative table containing both the current frame data as a two-dimensional array named "frame" and the timestamp in milliseconds named "timestamp". The following example shows how to access the data. It reads a single frame from the first WSG-DSA and prints it to the console.

***Example Lua Code:***

```
-- Helper function: Print the content of the given matrix m:
function printMatrix( m )
    local x, y;
    for y=1,#m[1] do
       for x=1,#m do
           printf( "%4d ", m[x][y] );
        end;
        printf( "\n" );
    end;
end;

-- search a tactile sensor:
index = -1;
for i=0,1 do
    if finger.type(i) == "dsa" then
        index = i;
        break;
    end;
end;

if ( index >= 0 ) then
    -- WSG-DSA found:
    printf( "Using tactile sensor on finger %d\n", index );

    -- acquire a single frame:
    data = finger.data( index );

    -- Print the result:
    printf( "\nFrame data (timestamp: %u)\n", data.timestamp );
    printMatrix( data.frame );
```


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```
else

    -- No tactile sensor found:
    printf( "No tactile sensor found!\n" );
end;
```


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