Quick Start Guide: Isomet iMS Studio

Isomet iMS Studio v1.40 was the first release of the Windows graphic user interface for the iMS4- series of 4 channel synthesizers, build level rev A and rev B. Please check web site support page for latest revision (March 2018 = v 1.4.5)

This guide gives a brief description of the iMS4 functions, how to use this GUI and concludes with several examples.

[Note: This guide assumes individual file sizes < 1024 frequency data points. The iMS4-P is capable of storing >10 million points however the GUI will react slowly for Image files exceeding ~4000 points. Please contact Isomet for guidance on using the GUI for large image sizes ]

The current release does not support the following features:
- Diagnostics
- Image Play Sequences
- Compensation table generator

(All these features are supported in the SDK for C++).

Download the appropriate installation program from: http://www.isomet.com/software.html

Uninstall any previous versions of the SDK and/or GUI

Depending on your computer select and run one of the following:
- Isomet iMS SDK v 1.4.x Win7 32-bit Setup.exe
- Isomet iMS SDK v 1.4.x Win7 64-bit Setup.exe
- Isomet iMS SDK v 1.4.x Win10 32-bit Setup.exe
- Isomet iMS SDK v 1.4.x Win10 64-bit Setup.exe

Follow the installation instructions.

NOTE: We are aware that some 64-bit PC’s will not install the 64-bit Isomet iMS SDK. In this case, please install the 32-bit version.

A full explanation and supporting documentation is found under

Start menu > All Programs > Isomet iMS SDK

or from the installed folder: >> Program Files / Isomet / iMS_SDK / v1.4.x / doc
Run:  *Isomet iMS Studio.*

- **Communication**

At DC power on, all LEDs on the iMS4-P will illuminate during an initialization phase that includes reading EEPROMs, initializing peripherals, powering up the USB controller and requesting DHCP IP address from a connected Ethernet Server. If the DHCP request times out after ~10sec, the iMS reverts to a static IP address.

After this period, the upper red LED’s will remain illuminated and two green LED’s will beat at ~1Hz rate.

It is recommended that USB or Ethernet are connected to the iMS4-P-T (-O) prior to power up. We recommend attempting USB communication AFTER initialization is complete.

iMS Library versions 1.4 (and onwards) will allow Ethernet or USB connection using the Isomet GUI and Microsoft Visual Studio software.

NOTE: If the GUI is not closed correctly, crashes or will not open, then please use Windows Task Manager to delete the *Isomet iMS Studio* and *ims_hw_server* processes.

Restart GUI

**Ethernet:**
The default static IP address for the iMS4 is 192.168.1.10. You may need to disable other Ethernet adaptors to avoid a contention.
Overview: GUI Windows and tabs

Opening window

Depending on the selected page either the *Enhanced Tone* mode or *New Image* panel will be displayed.

If the *New Image* panel is selected, the default page will look similar to:

The central window is the main input array. This behaves much like a typical spread sheet.
- Copy and paste can be applied to individual cells, cell groups, entire rows or columns.
- Rows can be deleted or inserted.

The array is used to input the Frequency, Amplitude, Phase, and Synchronous output data. The column data is predefined and differs depending on the selected operating mode.
A brief description of the available operating modes is presented below followed by an example for each.

Tone buffer(s) mode
One or more tables of 256 frequencies/amplitude/phase* (F/A/P) values.
- Columns display the Frequency, Amplitude and Phase values. This is repeated for each of the 4 channels.
- Rows display the buffer entry. Up to 256 max lines per buffer.
- Frequency dependent Phase/Amplitude compensation look up table (LUT) may be applied.

Array values can be entered directly into the GUI array or copied from an Excel spread sheet.

Image files (s) mode
One or more files containing many frequencies/amplitude/phase*/sync data points.
- Columns display the Frequency, Amplitude and Phase values PLUS a 12bit wide digital output register and two synchronous output DACs. The F/A/P data is repeated for each of the 4 channels.
- Rows display the image point entry.
- Frequency dependent Phase/Amplitude compensation look up table (LUT) may be applied.

Image mode is useful for generating larger more complex frequency scan patterns. Values can be entered directly into the GUI array or data copied from an Excel spread sheet.

In both modes, selected cells within a column can be inserted, deleted, auto filled or interpolated. Left click mouse to select a start cell, shift-left click mouse to select an end cell. Right click mouse to reveal options menu for the highlighted cells.

*Phase values are typically applied via the compensation LUT and not in the data entry fields.

Enhanced tone mode (Ramp / Step mode)
This mode uses the inherent sweep functions built into the DDS chip. Frequency, amplitude** or phase can be ramped in value. For conciseness, only frequency ramps and steps will be described.

- Ramp Mode
A ramp or chirp is generated by rapidly incrementing the frequency. The number of increment steps and duration of the ramp are user programmable. Each output can be programmed with different ramp parameters.

The ramps are initiated from the GUI or applying a signal to the external Profile inputs on connector J8.
Available functions:
- Independent Up - Down ramp slopes.
- Dwell (stop at end value) or no-dwell (return to start value) at end of sweep duration.
- Set amplitude value for ramp. (remains constant for the ramp duration).

The Ramp mode offers the fastest frequency sweep capability, with a minimum dwell time of 8nsec per frequency increment.

Independent sliders for each of the four output channels define:
- Duration of the rising slope increment.
- Duration of the falling slope increment.
- The number of points for each ramp, up or down.

The falling slope only applies if ‘Dwell’ is selected in the **Mode** pull down menu.

**A Frequency Sweep no dwell** immediately returns to the start value after the end value has been reached.

**A No-Dwell** sweep immediately returns to the **Start** slider value (S0) after the **End** slider value (E0) has been reached.

**A Frequency Sweep Dwell** only returns to the start value after a falling edge transition on the appropriate profile input.

**A Dwell** sweep only returns to the **Start** slider value (S0) after a falling edge transition on the appropriate profile input.

Both plots show a ramp on output J2, controlled using input P1

(**An internal limitation in the DDS chip prevents amplitude ramps in the Enhanced tone mode).
• **Step mode**

This is essentially a two-level sweep or two-level modulation. Step mode may be applied to the Frequency, Amplitude or Phase. Dwell/No dwell has no function.

Plot shows a frequency step sweep for output J2 controlled using input P1.
FREQ = Start Value
CW1 = End Value

• **Amplitude**

The amplitude level across a Frequency or Phase sweep (or step) remains a constant. The value is set by a combination of the *DAC Current* level buttons (Full, \(\frac{1}{2}\), \(\frac{1}{4}\), \(\frac{1}{8}\)) and the sliders on the *Signal Path* panel.
1: **Signal Path** tab

Main purpose this tab is to set the RF power limits and enable RF power amplifier(s) that are connected to the control outputs of the iMS4 (connector J5).

**Overview: Output Power control**

Block diagram of typical iMS4-

The output RF power is determined by the **combination of three** parameters
All three amplitude values should have non-zero values, as described in sections 1.1, 1.2 and 1.3 below.

### 1.1 Frequency and Channel specific 10-bit Amplitude data.
Specified Amplitude % value for each frequency point in the **Image File** or **Tone Buffer**.

This value is multiplied by a compensation factor stored in a calibration look up table (LUT).

The LUT can be bypassed if required. The LUT is applied by default.
1.2: Global control: DDS Power Level.

8-bit non-volatile digital pot.

GUI slider control is provided in the Signal Path tab

As a general rule, start with a value of 50% or less

Approximate full-scale control 10:1

1.3: Output RF mixers, proportional amplitude control.

The control signal for the mixers is selectable; internally generated using one of two slider controls or by an externally applied input(s) on J7.

Selection and slider options are provided under the Signal Path tab

A typical selection is Wiper 1, which is an 8-bit non-volatile digital pot with GUI slider control

Approximate full-scale control 1000:1
The optimum slider settings will depend on the connected RF power amplifier and AO device. Recommended values will be provided on the AO test data sheet supplied with the iMS4-

Sliders values will increment/decrement in steps of 0.1 by using the up-down arrow keys.

In a typical system, the iMS4- will be the frequency source to a power amplifier(s). This in turn is connected to the AO modulator, frequency shifter, deflector or tuneable filter.

1.4: Amplifier Enable controls

Depending on the amplifier model connected to the iMS4-, an Amplifier enable (“Gate” signal) and PA RF Channel Enable signal will be required to turn on the external power amplifier(s).

Examples of when to apply:

<table>
<thead>
<tr>
<th>Connected PA model</th>
<th>Amplifier Enable</th>
<th>RF Channel 1+2</th>
<th>RF Channel 3+4</th>
</tr>
</thead>
<tbody>
<tr>
<td>500C- series</td>
<td>×</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>RFA0110- series</td>
<td>✓</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>RFA0120- series</td>
<td>✓</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>RFA200-2 series</td>
<td>✓</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>RFA1170-4 series</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
2: **Compensation** tab

A calibration or compensation look-up-table (LUT) contains frequency specific phase and amplitude data. It may be applied to Image and Tone Buffer frequency points in order to:

a: to compensate for amplitude non-linearities  
b: apply a predefined phase shift between adjacent RF channels *

* For beam steered AO deflectors with multiple RF inputs, a frequency dependent phase shift “steers” the acoustic column in the crystal. This optimizes the Bragg angle relationship resulting in higher efficiency across the scan angle. (see App Note “Beam Steered AO Deflectors”)

- LUT values are AO device specific.  
- LUT tables can be generated in Excel and converted to the correct format for the GUI.

The **Compensation Functions** window of the present GUI release is not active.  
Refer to App Note: Compensation LUT Explanation and Generation Guide xx-xx-xx.pdf

Step 1: Import the desired LUT table  
A graphic representation of the selected LUT data will appear in the panel.  
Use the radio buttons to view a plot of the amplitude, phase or sync data

Step 2: DOWNLOAD into iMS4  
Download will abort if there is no iMS4 is connected.  
(Known issue, step 2 may need to be repeated)
XY AO Deflectors

If a single iMS4- is driving X-Y AO deflector, check the “Synchronize Phase Steering” box. In this case, the same compensation LUT will apply to both the X and Y axis. Channel 1 and Channel 3 will both be at zero phase. Channel 2 will have a phase offset relative to Channel 1 (e.g. X-axis). Channel 4 will have a phase offset relative to Channel 3 (e.g. Y-axis).

3: **Calibration** tab (Single Tone output)

This mode does not use the input array. Values are controlled using the sliders. The same frequency, amplitude and phase increment are applied across all channels (Channel 1 is always zero phase).

Use this mode to check basic iMS4 operation and initial AO device alignment or create a compensation LUT.

Click **Calibration** tab on right side toolbar. Adjust sliders to the desired value.

*Use with caution.*

The Slider limits are fixed and may exceed the range of any connected power amplifier and AO device. The Compensation LUT values are bypassed.

Click the large RED button to activate. This will change to Green (arrowed). Click again to disable. It will toggle back to RED.
4: **Player Configuration** tab

These functions apply to the Image File output.

* e.g. Choice of Trigger and Clock Source.
  Select the active edge for external clock and/or trigger.
  Action at the end of the Image play.

Check boxes allow selective disabling of the Image mode LUT compensation.

WHEN UNCHECKED:
- Image point amplitude values are multiplied by 100%
- Phase offset = 0 deg all frequencies, all channels.

WHEN CHECKED:
- Image point amplitudes are multiplied by the corresponding value in the compensation LUT.
- Phase value is set according by the corresponding value in the compensation LUT.

(See section 2)
5: Image Play control

Tool bar buttons

To Start image play
(Reserved for future use)

Stop at end of current Image play

Stop immediately

Emergency Stop, reducing RF power controls to Zero % and disabling any connected power amps

The lower left tool bar along the bottom of the GUI window will indicate the current state.
e.g. Stopped, Playing Image, Not connected

Note:

PLEASE ALLOW time for the GUI to respond.

Click on Hardware Console banner at foot of GUI window to review the messages between the host and iMS4-.
Example 1: Image Mode

To create an Image, follow steps 1: to 4:
To load an existing Image file, go to step 5:

1: Create a 10-point Image

Example specs:

- 10-point image on all Channels (Ch1, Ch2, Ch3 and Ch4).
- Linear frequency scan: 60-100MHz (or choose different values according to your AO device)
- 100% amplitude
- Compensation LUT applied
- Synchronous output at mid-scan point, data = 255
- Internal Clock, No trigger, Repeated continuous output
- iMS4 only. No connected power amps.

Enter Number of Image Points

2: Input Channel1 frequency end points
- Point 0, input 60.00 MHz, Point 9, input 100.00 MHz
Click on the column header to highlight the cells and right click to reveal the options window. Choose **Interpolate** to auto fill incrementing values between the start and end point frequencies.

3: Input Channel1 Amplitude

Click on the column header to highlight the amplitude cells. Enter 100. A 100% value will auto fill down all highlighted cells. Navigate away from the amplitude column to complete

4: Copy to Channel 2

Left click cell: Channel1_Frequency_Row 0 to select and highlight. Navigate to cell: Channel1_Amplitude_Row 9. Shift- left click this cell. This will select the Frequency and Amplitude data for Channel 1

Copy & Paste into Channel 2

Repeat to copy into Channel 3 and Channel 4.

Go to step 6, Apply Compensation table
5: Import an existing Image File2

From top toolbar, select **File > Open**

Select the desired *.ipp file

Press **Open**
6: Apply Compensation table

- **IMPORT** the desired LUT table. This will depend on AO deflector model.
- **DOWNLOAD** into iMS4

7: (If desired) Set Synchronous digital output (outputs through connector J7)

Use the lower slider to navigate to the Sync Data columns

Input ‘FF’ at the desired cell(s)

Ensure **Digital Sync Output Source** field is set to **ImageDigital**

[Note for iMS4-L users. Sync data can only be applied via the Compensation LUT. In this case, the Digital Sync Output Source is set to **LookUpFieldCh1**]
8: Set Player Configuration

Image Clock Source: **Internal**
Image Trigger: **No Trigger**
Image Repeats: **Repeat forever**

9: Set power levels

In this example

DDS power to 63%

Amplitude Control Source is Wiper 1

Wiper 1 setting = 80%
10: Start Play
Example 2: Tone Buffer Mode
Create Buffer with 16 tones on 2 channels.
Channel 1: Linear frequency increments, 150-90MHz
Channel 1: Linear amplitude slope : 100 – 70%
Channel 2: Static frequency increments, 120MHz
Channel 2: Static amplitude : 55%
No Compensation LUT applied
iMS4 only. No connected power amps.
Tones are selected using the GUI software (USER)

1: Click in the Tone Buffer window, bottom left of main window. Edit the name if desired.
or click “+” to add another buffer file. A Tone Buffer tab is created
The input array will fill with 256 rows = 256 x 4 channel F/A/P data points
Not all 256 need be used.

2: Uncheck **Amplitude Compensation** box, **Phase Compensation** box

3: In the **Control Source**, select **User**
The 256 possible F/A/P tones may be addressed rapidly using the 8x external LTB address lines on connector J8, (pins 3,4,5,6,14,16,7,8). See IMS4- manual for further details.

4: **Ch1 Frequency**, enter end point values  
   Tone 0, enter 150.00 MHz (Start) ; Tone 15, enter 90.00 MHz (End)

5: **Ch1 Amplitude**, enter end point values  
   Tone 0, enter 100 % ; Tone 15, enter 70 %

6: **Ch2 Frequency**, enter end point values  
   Tone 0, enter 120.00 MHz (Start) ; Tone 15, enter 120.00 MHz (End)

7: **Ch2 Amplitude**, enter end point values  
   Tone 0, input 55 % ; Tone 15, input 55 %

8: Repeat for **Ch3** and **Ch4** fields if required.

Use the Interpolate feature to fill the remaining 14 cells  
For each column:

- Left click on Start cell  
- Hold down the shift key  
- Navigate to the end cell and left click  
  (This should select and highlight all 16 cells)  
- Right click to open sub window  
- Select Interpolate

8: **Set power levels**
In this example

DDS power to 63%

Amplitude Control Source is Wiper 1

Wiper 1 setting = 80%

9: Enable output
10: Tone Selection

Click on the desired Row to output that frequency set

11: To disable output

Click as shown
Example 3: Enhanced Tone Mode - Frequency Ramp
Typical mode for AO Scanning applications, non-beam steered AO deflectors

a. To enable sweep or step modes, ‘hit’ the large square **On/Off** button (upper right). Colour will change from Red to Green

b. Using the pulldown **Mode** menu, one for each iMS4 output channel (1, 2, 3 or 4), select the sweep type. In the example below Frequency Sweep no (Dwell) is selected on all Channels.

Consider Channel 1 (1) above,

**Pull down menu**
**Mode selected = Frequency Sweep no dwell.**

**Sliders**
- Start Freq = 80MHz.
- End Freq = 140MHz.
In this case Start Phase slider as no meaning.

**Input windows**
- Up (rising) slope = 2000us duration,
- Down (falling) slope = 1us
- Number points = 50 points (i.e. 50 points Up and 50 points Down)

**Buttons**
- Full scale DAC current selected. Normal condition
- **Manual Trigger** is selected (button is Green)
Set amplitude

In this example

DDS power to 63%

Amplitude Control Source is Wiper 1

Wiper 1 setting = 80%

Ramp or Step Trigger Inputs

- With **Manual Trigger** selected (button = green), the Ramp or Step is initiated using the dedicated buttons across the lower edge of the Channel window area.

Logic:
Button green = profile bit (Px) high
Button red = profile bit (Px) low.
For external control using 5V compatible logic, the **Manual Trigger** button must be deselected (= Red).

The sweep is then initiated by toggling the profile inputs (P0..3) on connector J7. Each channel has a specific profile input.

<table>
<thead>
<tr>
<th>Connector, pin</th>
<th>Profile input</th>
<th>iMS4- output</th>
</tr>
</thead>
<tbody>
<tr>
<td>J8, pin 3</td>
<td>P0</td>
<td>Sweep output J1</td>
</tr>
<tr>
<td>J8, pin 4</td>
<td>P1</td>
<td>Sweep output J2</td>
</tr>
<tr>
<td>J8, pin 5</td>
<td>P2</td>
<td>Sweep output J3</td>
</tr>
<tr>
<td>J8, pin 6</td>
<td>P3</td>
<td>Sweep output J4</td>
</tr>
</tbody>
</table>

Unless requested at time of order, the default iMS4 interface for external digital signals is opto-isolated. A dedicated 5V supply is required on connector J7 or J8.

To exit **Ramp mode** and return to **Image Mode** or **Tone Buffer Mode**, ‘hit’ the large square **On/Off** button (upper right) and ensure colour = red.
**Example 4: Calibration Mode**

Use internal amplitude control, Wiper 1.

*Apply caution* with initial power settings.

Set slider of AO centre freq e.g. 80MHz

External Amplifier connected to J5

1: Set power level limits

In this example

**DDS power 40%**

Amplitude Control Source is Wiper 1

Wiper 1 setting = 30%

2: Enable amplifier
3: Select **Calibration** tab

Adjust sliders as required

Click the large RED button to activate. This will change to Green.

Click again to disable. It will toggle back to RED.

This mode is used to create a Compensation LUTs for use with Image Mode or Tone Buffer Mode. Please refer to app note ‘Compensation LUT Explanation and Generation Guide. Pdf’
Pin outs
(XT_ = External, OC_ = Opto coupled, A_ = analog)

J8, 25-way micro-D connector

J7, 44-way High Density D-type
**J8, 25way micro-D connector**

Main connection for external control signals
(Micro-D to full size D-type converter cable available).

<table>
<thead>
<tr>
<th>Connector Type</th>
<th>25way micro-D</th>
<th>J8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Signal</strong></td>
<td><strong>Type</strong></td>
<td><strong>Designation</strong></td>
</tr>
<tr>
<td>RFmod4</td>
<td>In</td>
<td>Analog, 0-10V</td>
</tr>
<tr>
<td>A_Rtn</td>
<td>Analog</td>
<td>RFmod3</td>
</tr>
<tr>
<td>RFmod3</td>
<td>In</td>
<td>Analog, 0-10V</td>
</tr>
<tr>
<td>A_Rtn</td>
<td>Analog</td>
<td>RFmod2</td>
</tr>
<tr>
<td>RFmod2</td>
<td>In</td>
<td>Analog, 0-10V</td>
</tr>
<tr>
<td>A_Rtn</td>
<td>Analog</td>
<td>RFmod1</td>
</tr>
<tr>
<td>RFmod1</td>
<td>In</td>
<td>Analog, 0-10V</td>
</tr>
<tr>
<td>A_Rtn</td>
<td>Analog</td>
<td>RST</td>
</tr>
<tr>
<td>RST</td>
<td>In</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>REF_IN</td>
<td>In</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>GP I1</td>
<td>In</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>GP I2</td>
<td>In</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>GP I3</td>
<td>In</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>GP I4</td>
<td>In</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>GP O1</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>GP O2</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>D_Rtn</td>
<td>DC</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>D_Rtn</td>
<td>DC</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>D_Rtn</td>
<td>DC</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>5V_iso</td>
<td>DC</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>5V_iso</td>
<td>DC</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>D_Rtn</td>
<td>DC</td>
<td>Opto isolated logic</td>
</tr>
</tbody>
</table>

**Notes:**
- Key: GP = General Purpose
- Type Logic = TTL or 5V CMOS
- Drive inputs with open collector or open drain gate, 16mA sink
- Open collector outputs with internal 1Kohm pull-up to 5V_iso

---

**Table Legend:**
- RFmod4
- A_Rtn
- RFmod3
- A_Rtn
- RFmod2
- A_Rtn
- RFmod1
- A_Rtn
- RST
- REF_IN
- GP I1
- GP I2
- GP I3
- GP I4
- GP O1
- GP O2
- D_Rtn
- 5V_iso
- D_Rtn
# J7, 44way high density-D connector

Connection for auxiliary I-O signals

<table>
<thead>
<tr>
<th>Signal</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDOR0</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>SDOR1</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>SDOR2</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>SDOR3</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>SDOR4</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>SDOR5</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>SDOR6</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>SDOR7</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>SDOR8</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>SDOR9</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>SDOR10</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>SDOR11</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>D_Rtn</td>
<td>Out</td>
<td>Isolated 0V / signal return input</td>
</tr>
<tr>
<td>ENC_D_N</td>
<td>In</td>
<td>Differential 5V logic</td>
</tr>
<tr>
<td>ENC_D_P</td>
<td>In</td>
<td>Differential 5V logic</td>
</tr>
<tr>
<td>ENC_C_P</td>
<td>In</td>
<td>Differential 5V logic</td>
</tr>
<tr>
<td>ENC_B_P</td>
<td>In</td>
<td>Differential 5V logic</td>
</tr>
<tr>
<td>ENC_A_P</td>
<td>In</td>
<td>Differential 5V logic</td>
</tr>
<tr>
<td>ENC_C_N</td>
<td>In</td>
<td>Differential 5V logic</td>
</tr>
<tr>
<td>ENC_B_N</td>
<td>In</td>
<td>Differential 5V logic</td>
</tr>
<tr>
<td>ENC_A_N</td>
<td>In</td>
<td>Differential 5V logic</td>
</tr>
<tr>
<td>ENC_A_P</td>
<td>In</td>
<td>(5V_iso supply req'd)</td>
</tr>
<tr>
<td>GP_I5</td>
<td>In</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>GP_I6</td>
<td>In</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>GP_I7</td>
<td>In</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>GP_I8</td>
<td>In</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>GP_O3</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>GP_O4</td>
<td>Out</td>
<td>Opto isolated logic</td>
</tr>
<tr>
<td>D_Rtn</td>
<td>Out</td>
<td>Isolated 0V / signal return input</td>
</tr>
<tr>
<td>24V_laser</td>
<td>In</td>
<td>PLC</td>
</tr>
<tr>
<td>Laser_Bit</td>
<td>Out</td>
<td>PLC</td>
</tr>
<tr>
<td>Gnd_laser</td>
<td>In</td>
<td>PLC</td>
</tr>
<tr>
<td>AOUT_Frq</td>
<td>Out</td>
<td>Analog</td>
</tr>
<tr>
<td>AOUT_Amp</td>
<td>Out</td>
<td>Analog</td>
</tr>
<tr>
<td>A_Rtn</td>
<td>Out</td>
<td>Analog</td>
</tr>
<tr>
<td>AOUT_DAC</td>
<td>Out</td>
<td>Analog</td>
</tr>
<tr>
<td>A_Rtn</td>
<td>Out</td>
<td>Analog</td>
</tr>
<tr>
<td>Aux_ADC1</td>
<td>In</td>
<td>Analog</td>
</tr>
<tr>
<td>A_Rtn</td>
<td>In</td>
<td>Analog</td>
</tr>
<tr>
<td>Aux_ADC2</td>
<td>In</td>
<td>Analog</td>
</tr>
<tr>
<td>A_Rtn</td>
<td>In</td>
<td>Analog</td>
</tr>
<tr>
<td>5V_iso</td>
<td>DC</td>
<td>Isolated 5V DC supply input</td>
</tr>
<tr>
<td>5V_iso</td>
<td>DC</td>
<td>Isolated 5V DC supply input</td>
</tr>
<tr>
<td>D_Rtn</td>
<td>DC</td>
<td>Isolated 0V / signal return input</td>
</tr>
</tbody>
</table>

Notes:
- **Key:**
  - Type Logic = TTL or 5V CMOS
  - GP = General Purpose
  - Drive inputs with open collector or open drain gate, 16mA sink
  - Open collector outputs with internal 1kOhm pull-up to 5V_iso
### Other Connectors

<table>
<thead>
<tr>
<th>Signal Designation</th>
<th>Signal Type</th>
<th>Description</th>
<th>Alternate Use</th>
<th>Connector</th>
<th>Ident</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethernet</td>
<td>In/Out</td>
<td>Logic</td>
<td>Communication</td>
<td>RJ45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USB Serial</td>
<td>In/Out</td>
<td>Logic</td>
<td>USB II / USBIII</td>
<td>B-type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RX-P</td>
<td>In</td>
<td>Logic</td>
<td>RS422 receive+</td>
<td>9-way D</td>
<td>J12</td>
<td>2</td>
</tr>
<tr>
<td>RX-N</td>
<td>In</td>
<td>Logic</td>
<td>RS422 receive-</td>
<td>9-way D</td>
<td>J12</td>
<td>1</td>
</tr>
<tr>
<td>TX-P</td>
<td>Out</td>
<td>Logic</td>
<td>RS422 transmit+</td>
<td>9-way D</td>
<td>J12</td>
<td>7</td>
</tr>
<tr>
<td>TX-N</td>
<td>Out</td>
<td>Logic</td>
<td>RS422 transmit-</td>
<td>9-way D</td>
<td>J12</td>
<td>6</td>
</tr>
<tr>
<td>Rtn</td>
<td>Gnd</td>
<td>Sig Rtn</td>
<td>9-way D</td>
<td>J12</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Vdc</td>
<td>DC</td>
<td>DC-In</td>
<td>Supply 15V -24V dc, &lt;0.4A</td>
<td>3w TINI-Q</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>0V</td>
<td>DC</td>
<td>DC-In</td>
<td>Supply 15V -24V dc, &lt;0.4A</td>
<td>3w TINI-Q</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Gate</td>
<td>In</td>
<td>Logic</td>
<td>Enable power amplifiers via J5</td>
<td>PDF input</td>
<td>SMA coaxial</td>
<td>J9 Centre</td>
</tr>
<tr>
<td>Rtn</td>
<td>Gnd</td>
<td>Sig Rtn</td>
<td>I2C Clock_TX</td>
<td>SMA coaxial</td>
<td>J9 Outer</td>
<td></td>
</tr>
<tr>
<td>Trigger</td>
<td>In</td>
<td>Logic</td>
<td>Trigger Image Data Output</td>
<td>PDF input</td>
<td>SMA coaxial</td>
<td>J10 Centre</td>
</tr>
<tr>
<td>Rtn</td>
<td>Gnd</td>
<td>Sig Rtn</td>
<td>I2C Data_TY</td>
<td>SMA coaxial</td>
<td>J10 Outer</td>
<td></td>
</tr>
<tr>
<td>Clock</td>
<td>In</td>
<td>Logic</td>
<td>Clock Image Data</td>
<td>PDF input</td>
<td>SMA coaxial</td>
<td>J11 Centre</td>
</tr>
<tr>
<td>Rtn</td>
<td>Gnd</td>
<td>Sig Rtn</td>
<td>I2C Data_RY</td>
<td>SMA coaxial</td>
<td>J11 Outer</td>
<td></td>
</tr>
<tr>
<td>Ch0</td>
<td>Analog</td>
<td>RF</td>
<td>RF1 frequency output, 50Ω</td>
<td>SMA coaxial</td>
<td>J1 Centre</td>
<td></td>
</tr>
<tr>
<td>Rtn</td>
<td>Gnd</td>
<td>Sig Rtn</td>
<td>I2C Clock_RX</td>
<td>SMA coaxial</td>
<td>J1 Outer</td>
<td></td>
</tr>
<tr>
<td>Ch1</td>
<td>Analog</td>
<td>RF</td>
<td>RF2 frequency output, 50Ω</td>
<td>SMA coaxial</td>
<td>J2 Centre</td>
<td></td>
</tr>
<tr>
<td>Rtn</td>
<td>Gnd</td>
<td>Sig Rtn</td>
<td>I2C Data_TY</td>
<td>SMA coaxial</td>
<td>J2 Outer</td>
<td></td>
</tr>
<tr>
<td>Ch2</td>
<td>Analog</td>
<td>RF</td>
<td>RF3 frequency output, 50Ω</td>
<td>SMA coaxial</td>
<td>J3 Centre</td>
<td></td>
</tr>
<tr>
<td>Rtn</td>
<td>Gnd</td>
<td>Sig Rtn</td>
<td>I2C Data_RY</td>
<td>SMA coaxial</td>
<td>J3 Outer</td>
<td></td>
</tr>
<tr>
<td>Ch3</td>
<td>Analog</td>
<td>RF</td>
<td>RF4 frequency output, 50Ω</td>
<td>SMA coaxial</td>
<td>J4 Centre</td>
<td></td>
</tr>
<tr>
<td>Rtn</td>
<td>Gnd</td>
<td>Sig Rtn</td>
<td>I2C Data_RY</td>
<td>SMA coaxial</td>
<td>J4 Outer</td>
<td></td>
</tr>
<tr>
<td>J5 Power Amp Control *</td>
<td>In</td>
<td>Opto supply from connected PA</td>
<td>5V, 20mA out</td>
<td>15w-HD D</td>
<td>J5 1</td>
<td></td>
</tr>
<tr>
<td>5V_RFA</td>
<td>In</td>
<td>Opto supply from connected PA</td>
<td>5V, 20mA out</td>
<td>15w-HD D</td>
<td>J5 10</td>
<td></td>
</tr>
<tr>
<td>0V_RFA</td>
<td>In</td>
<td>Opto supply from connected PA</td>
<td>0V</td>
<td>15w-HD D</td>
<td>J5 4</td>
<td></td>
</tr>
<tr>
<td>0V_RFA</td>
<td>In</td>
<td>Opto supply from connected PA</td>
<td>0V</td>
<td>15w-HD D</td>
<td>J5 7</td>
<td></td>
</tr>
<tr>
<td>SCL_RFA_TX</td>
<td>IO</td>
<td>Opto isolated logic</td>
<td>I2C Clock, TX</td>
<td>15w-HD D</td>
<td>J5 2</td>
<td></td>
</tr>
<tr>
<td>SCL_RFA_RX</td>
<td>IO</td>
<td>Opto isolated logic</td>
<td>I2C Clock, RX</td>
<td>15w-HD D</td>
<td>J5 3</td>
<td></td>
</tr>
<tr>
<td>SDA_RFA_TY</td>
<td>IO</td>
<td>Opto isolated logic</td>
<td>I2C Data_TY</td>
<td>15w-HD D</td>
<td>J5 5</td>
<td></td>
</tr>
<tr>
<td>SDA_RFA_RY</td>
<td>IO</td>
<td>Opto isolated logic</td>
<td>I2C Data_RY</td>
<td>15w-HD D</td>
<td>J5 6</td>
<td></td>
</tr>
<tr>
<td>EXT-CONVST</td>
<td>Out</td>
<td>Opto isolated logic</td>
<td>Start ADC conversion</td>
<td>15w-HD D</td>
<td>J5 8</td>
<td></td>
</tr>
<tr>
<td>-EXT_GATE</td>
<td>In</td>
<td>Opto isolated logic</td>
<td>Enable connected amplifier</td>
<td>15w-HD D</td>
<td>J5 9</td>
<td></td>
</tr>
<tr>
<td>EXT-BSY</td>
<td>In</td>
<td>Opto isolated logic</td>
<td>ADC conversion busy</td>
<td>15w-HD D</td>
<td>J5 11</td>
<td></td>
</tr>
<tr>
<td>EXT-INT_MON</td>
<td>In</td>
<td>Opto isolated logic</td>
<td>Interlocks valid monitor</td>
<td>15w-HD D</td>
<td>J5 12</td>
<td></td>
</tr>
</tbody>
</table>

* Applies only when signals supported by connected PA
<table>
<thead>
<tr>
<th>Feature</th>
<th>J9</th>
<th>J10</th>
<th>J11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External TRIG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Clock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Image Mode</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Output frequency points**

<table>
<thead>
<tr>
<th>J7</th>
<th>J7</th>
<th>J7</th>
<th>J7</th>
</tr>
</thead>
<tbody>
<tr>
<td>SyncO 1</td>
<td>SyncO 2</td>
<td>SyncO Last</td>
<td></td>
</tr>
</tbody>
</table>

**5V logic**

- Gate J9: Only required if RF amplifier connected to iMS4 output J5
- External TRIG J10
- External Clock J11

**Image Mode**

- Output frequency points
- Sync Output J7

**Dimensions**

- 126.1 mm
- 166 mm
- 68 mm
- Ø 4.2 mm

**Notes**

- Gate J9: Only required if RF amplifier connected to iMS4 output J5
- External TRIG J10
- External Clock J11

**Output frequency points**

<table>
<thead>
<tr>
<th>J7</th>
<th>J7</th>
<th>J7</th>
</tr>
</thead>
<tbody>
<tr>
<td>SyncO 1</td>
<td>SyncO 2</td>
<td>SyncO Last</td>
</tr>
</tbody>
</table>

**5V logic**