iMS2-HF -xxx
Modular Dual Output Synthesizer

Overview and Basic Operation

Models -

Model	Outputs	Feature	Frequency Range (MHz)	RF Output Power
iMS2-HF	2	Standard model	20 – 400MHz	3mW

Options **–xxx**, combinations possible

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<u>Supporting Documents:</u>

Setting a static IP Address

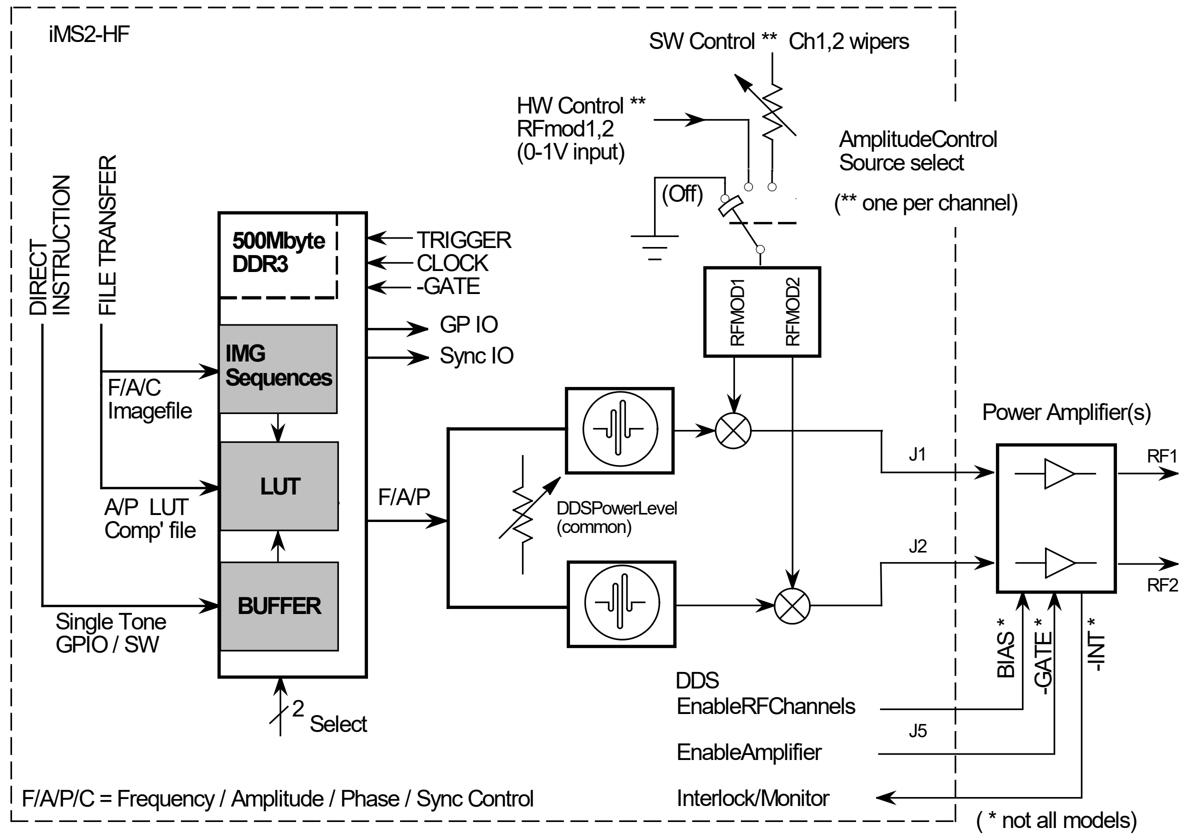
Multiple iMS4's on a DHCP Server

iMS4 Isomet GUI Software Guide

iMS4 Compensation LUT Generation rev-C

1. Hardware Overview and Key features.

The diagram below illustrates a schematic of the iMS2-HF connected with a generic Power Amplifier
Before operating the IMS2-HF, it will be necessary to load the USB Window drivers. (See section 10).
The IMS2-HF operates from DC power and requires a 15V-24Vdc supply (0.7A at 24Vdc)



The iMS2 synthesizer operates in three basic modes

1.1 Local Tone Buffer (LTB) or Single Tone Mode.

This mode is useful for setting the AO Bragg Angle or switching rapidly between 256 preassigned points. The DDS synthesizer generates a single tone output at the specified Frequency, Amplitude and Phase or F/A/P triad.

Key features:

- Up to 95 KHz update rate.
- The required output tone may be selected via software control or from hardwired inputs.
- Option to bypass the LUT modifier (see LUT description below)

1.2 IMAGE mode or Sequence mode.

This mode is useful for generating larger more complex scan patterns.

An Image file (IMG) containing the desired frequency scan pattern is downloaded into memory space within the iMS2-HF. Output play back is under the control of user defined Image Trigger and Image Clock.

Key features:

- 16-bit Frequency.
- Update rate up to 2.8MHz, both channels.
- Any frequency pattern may be generated e.g. random, linear, step, saw tooth.
- Multiple frequency images can be uploaded in multiple play sequences.
- Simultaneous upload and play of image files
- Very large image size, in excess of 10million frequency points.

LUT and Image files can be generated on Excel Spread sheets and imported into the C++ project.

Planned feature

1.3 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.

Control Features

Look-up-table (LUT)

A calibration or compensation look-up-table (LUT) contains frequency specific phase and amplitude data. Its purpose is to compensate for non-linearity and non-uniformities in the wider system. E.g. create efficient uniform intensity scan lines in an AOD base laser scanning system.

Initial values for the LUT are calculated and loaded into the IMS prior to running the Local Tone Buffer or Image modes. Subsequently, LUT values may be modified with real world measured data or integrated within a feedback mechanism.

Amplitude and Power Level control

Each frequency point is assigned a unique 10-bit amplitude value ranging from 0 -100% of the maximum RF power setting. This is a relative value and is dynamic i.e. able to change from output point to output point.

The maximum RF output power setting is defined by a combination of the iMS AmplitudeControl and DDSPowerLevel digital potentiometers. These are 8-bit static controls and together define the absolute RF power level of the IMS2-HF (and any connected power amplifier module).

Auxiliary Digital and Analog I-O signals
The iMS2- also feature:

Signal Description	Ident
12 bit Synchronous output register, updated with the each new image point,	SDOR[0…11]
4 bits Asynchronous output,	GP Out[1…3]
8 bits Asynchronous input,	GP In[1…8]
1 bit 24V PLC compatible opto relay output,	Laser bit
4 pairs RS422/encoder differential inputs	ENC [(A-P,A-N)….(C-P,C-N)]
2x Synchronous analog outputs, 0 - 2.5V full scale	AOUT_Frq …Amp
1x Asynchronous analog output, 0 - 10V full scale	AOUT_DAC
2x Asynchronous analog inputs, 0 - 10V full scale	Aux_ADC1 … 2

Main operating modes and functions.
Please refer to the application program interface (API) documentation with the software development kit (SDK) available as a download.

2. Single (Set Calibration) Tone.

Simplest mode.
Direct programming of the DDS frequency, amplitude and phase values.
Bypasses LUT compensation.

3. Local Tone Buffer.

The Local tone buffer (LTB) area contains a maximum 256 F/A/P locations.
The 256 F/A/P Tones may be rapidly addressed using 8x external LTB address lines* or directly from the operating software.

LTB ext'l address, J8 (pins 3,4,5,6,16,14,7,8).	Function	Update rate
0 h ... FF h	Select Tone address	10.5usec

The compensation look up table (see below) may be applied to the Tone Buffer output if required.

When using Isomet iMS4 Studio, select “Extended External” control NOT “External”

4. Enhanced Tone Mode (Ramp / Step mode)………..PLANNED FEATURE

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.

4.1 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).

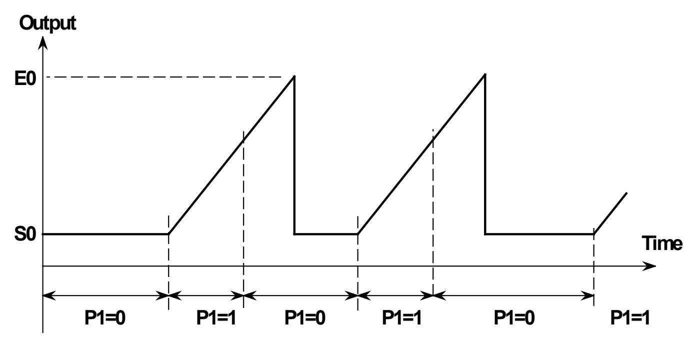
The Ramp mode offers the fastest frequency sweep capability, with a minimum dwell time of 8nsec per frequency increment.

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.

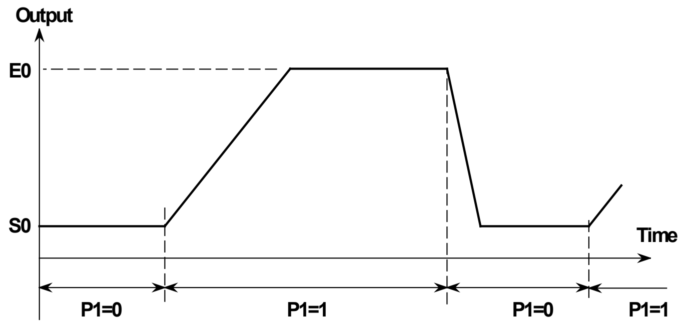
A **Frequency Sweep no dwell** immediately returns to the start value after the end value has been reached

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



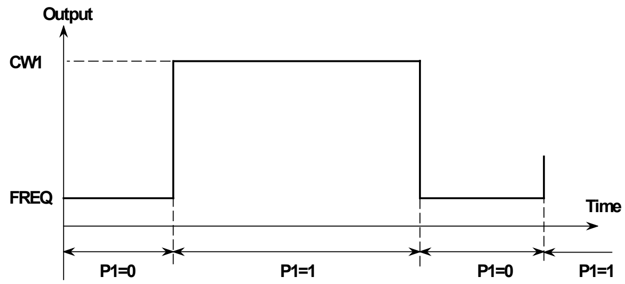
Both plots show a ramp on output J2, controlled using input P1

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

4.2 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 , ½, ¼, ⅛) and the sliders on the ***Signal Path*** panel.

5. Image Mode.

An Image contains multiple F/A/P data points pre-arranged to give the desired frequency or scan pattern. Image playback is initiated with the Image Trigger. The output update rate is determined by the Image Clock. The Image trigger and clock may be software generated or applied from an external source. At each clock edge, the next location in the Image Memory area is addressed. The frequency and amplitude data point is read and modified by the LUT data (see below). The resultant F/A/P triad is routed to the DDS registers. An update clock is then issued to the DDS chips and both RF outputs are simultaneously updated with a new Frequency, Amplitude and Phase value. Any programmed Synchronous control data will also be updated on the appropriate I/O port.

Multiple images can be grouped together into a play sequence. Each image within a sequence can have unique properties such as clock rate and post image delay. Likewise multiple sequences can be defined and queued. These are uploaded into the iMS DDR memory and played in FIFO order. Memory is dynamically allocated to permit flexibility in the size and number of both the images and sequences, and to allow simultaneous upload and output of data. The total number of images (excluding repeats) is 4096. The size of a single image is in excess of a 1million F/A/P points.

6. Look-up-table (LUT).

The LUT is frequency-addressed look-up-table for applying amplitude and phase compensation to the RF signal output. The tables are indexed by the nearest programmed LUT frequency to the demanded output frequency. Table entries are linearly spaced in frequency from the lowest to highest supported. The number of entries in the table is hardware specific. At a minimum, the LUT must contain amplitude compensation data over the desired frequency range of interest.

LUT Size: 2047 entries equally spaced from 25 – 400MHz.

Primary features: Frequency dependent compensation data:

- •Amplitude: a value between 0 and 100% for modifying the output amplitude according to frequency. Used for compensating variations in AO efficiency and power amplifier gain.

- •Phase: 0 - 360 degrees. Value represents the phase offset between adjacent channels . Typically applied to beam steered (= phased array) AO deflector designs. Channel 1 is the reference and unmodified. Channel 2 will exhibit the phase differential relative to Ch'l 1.

Secondary features: Synchronous output data

- •Sync Analog: A value between 0.0 and 1.0 that can be output on one of the synchronous DAC outputs (J7).Updated in step with the specified output RF frequency(s).

- •Sync Digital: A binary value that can be output on the synchronous digital outputs. Updated in step with the specified RF output frequency(s).

The Isomet Studio GUI released with the iMS SDK after v1-7-0 provide a Compensation Function to generate and optimize LUT files. Default LUT files are provided on our website.

7. RF power Level and Modulation.

The output RF power at each frequency is determined by the combination of static controls and point specific amplitude data value.

Static Asynchronous Controls. Applies to all operating modes.
Purpose: To set the maximum safe operating RF power level.

1: ***DDS Power Level***. 8-bit non-volatile digital pot. Always programmed.
Sets the DDS chip output level using a dedicated digital pot. Common to both outputs.
Typical values 50 – 90%

<< and >>

2: Channel Specific ***Amplitude Control Source*** . This drives the amplitude modulation input of a discrete RF mixer, one per channel. Must select and apply a valid source -

01: CH-WIPER1 (or 2). An internal 8-bit non-volatile digital pot, one per RF channel.
00: EXTERNAL signals*, one per RF channel, output proportional to applied control voltage.

Typical values written and stored to CH-Wiper = 50 – 100%

The above controls should be set in combination so that the AO device is operated at optimum efficiency without saturating the connected power amplifiers and/or applying excessive RF power to the AO device. Starting values will be provided on the appropriate test data sheets

* Can be wired together to combine multiple channels onto a common control input.
0-1V, ~50-ohm / channel. May also used for fast asynchronous amplitude modulation.

Dynamic Synchronous Control.

Purpose: To set or modulate the RF power at a specific output frequency.
(i.e. to control the diffracted laser intensity at a specific scan angle)

3: Tone Buffer mode
The 10-bit amplitude data value associated with a specific frequency value. This is multiplied by the LUT amplitude calibration factor for that frequency point.

<< or >>

4: Image mode
The 10-bit amplitude data value associated with a specific frequency value. This is multiplied by the LUT amplitude compensation factor for that frequency point.

For a typical AO scanning application, the Image amplitude data is a simple "On" or "Off" value. The LUT is programmed with the variable amplitude compensation data that creates the desired weighting for the scan intensity profile.

In both cases, the LUT can be bypassed if required. The LUT is applied by default.

8. Technical Specifications.

Image Mode

Timing	Value	Condition
Frequency Settling Time	One cycle at output RF frequency	Step change in Image data value. Phase accumulator resync = OFF (default)
Frequency Settling Time	< 40nsec	Step change in Image data value Phase accumulator resync = ON at each clk update
RF Output Delay from Image Clk edge	600nsec	
Sync Output Delay from Image Clk edge	60nsec	
Minimum Trigger to Clock edge	TBD nsec	
Maximum Image Clock rate	2.8 MHz	
Minimum Image Clock rate	0 Hz	

GATE, TRIGGER, CLOCK inputs. J9, J10,J11	Value	Condition
Absolute Maximum Input Voltage	5.5V	Per input.
Recommended Input Voltage	> 3V, <5V	For logic High
Minimum Input Voltage	0V	

Active edge of the external Clock or Trigger inputs is user programmable . Default = rising

* Future planned optimization. Please contact Isomet

Local Tone Buffer Mode

Timing	Value	Condition
Frequency Settling Time		See Image mode values
Output Delay - LTB address change	6 usec	
Maximum LTB address rate	95KHz	
Minimum LTB address rate	0 Hz	

LTB address, input Voltages, J8	Value	Condition
Absolute Maximum Input Voltage	5.5V	Per input.
Recommended Input Voltage,	> 3V, < 5V	For Logic High
Minimum Input Voltage	0V	
Opto-isolated, signal source sink current	16mA	Per input

External Modulation Inputs, J8

Parameter	Value	Condition
RF output Rise time	< 40nsec	Step change in external modulation input
Output Delay - Modulation input	50nsec	Step change in external modulation input
Absolute Maximum Input Voltage	2V	Per input.
Recommended Input Voltage	1V	
Minimum Input Voltage	0V	
Input impedance	~50Ω	Per input
On:Off ratio	> 35dB	Full range
Maximum modulation rate	10MHz	
Minimum modulation rate	0 Hz	

RF power control, SDK

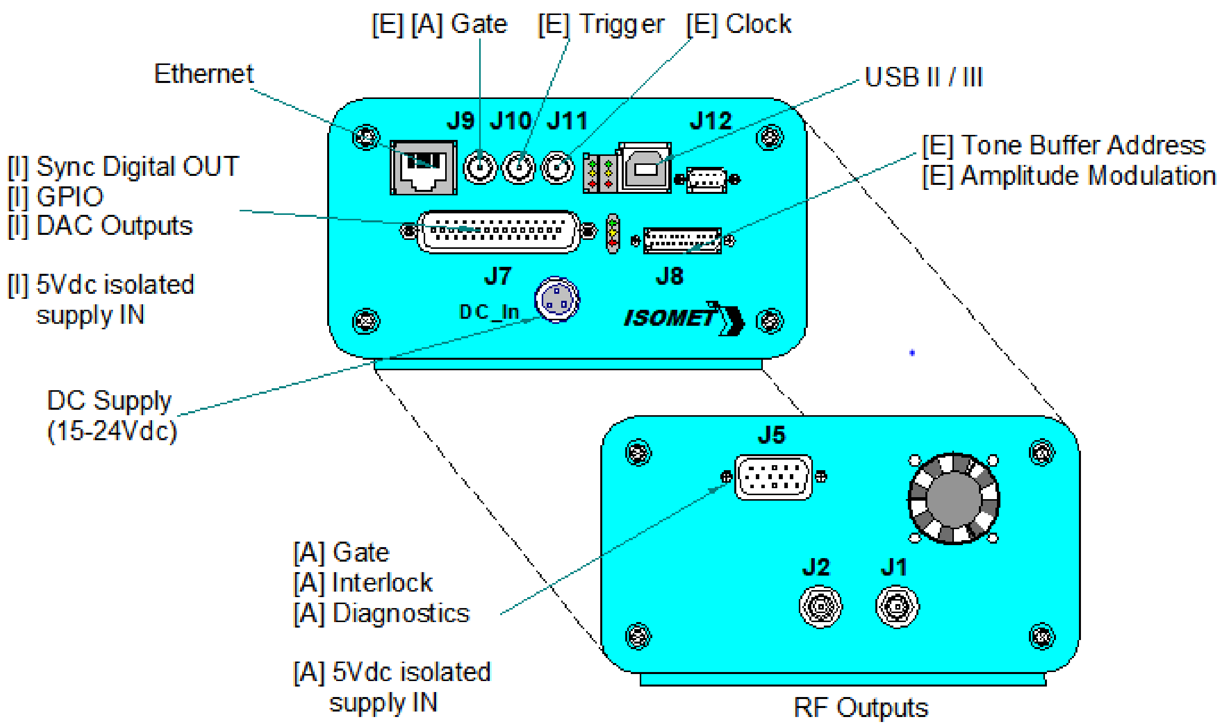
Max – Min	Full Range	Condition
DDS Power Level	~ 8dB	All other variables at max power
Amplitude Control Source : Ch-Wiper or Ext'l input	39dB	
Image or LTB Amplitude data	48dB	10bit range

RF outputs, J1,J2

RF Output	Full Range	Condition
Maximum output power	> 5mW / 0.8dB	At 300MHz,
Frequency Stability	+/- 2.5ppm	-40C to +85C
Spurious output	> 40dBc	
Harmonics	> 25dBc	At 1mW output
Channel to Channel Isolation	> 43dB	At 1mW output

Typical output levels at 300MHz, peak-peak voltage, **50ohm** termination

9. Hardware Connection.



Minimum Connections:

USB II / III or Ethernet to a host PC.
DC Supply, 15V / 2A minimum to 24V / 1.0A maximum
One or more RF outputs, as required.

Recommended channel connections

AOD / Amplifier Channels	iMS Outputs
Single output	Either
Dual	J1, J2

Optional connections are identified as follows:

[E] = hardwired control signals from external signal source(s).
Functionally equivalent software generated control signal are provided in the SDK.

[I] = opto-isolated IO buffered signals requiring an external 5Vdc supply connection to J7 or J8

[A] = external power amplifier connections (see explanation below)

The iMS2-HF features external power amplifier diagnostic and control signals.
These are available on J5. J5 will require 5V opto isolator dc feed (5V_RFA) from the connected RF amplifier. An appropriate interface card must exist within the power amplifier.

10. Power Amplifier Control

The iMS2 allows control and diagnostics functions for connected equipment fitted with a suitable interface.

- **Enable/Gate Control**

With few exceptions, most Isomet existing power amplifier modules require an active low Gate or Enable signal to operate and will output a normally closed over-temperature thermal interlock signal.

- **Diagnostics**

Certain amplifier models feature diagnostic outputs including:

- Forward and reflected RF power (between the PA outputs and connected AO device/load).
- Temperature of the PA
- DC current
- Temperature of the AO device

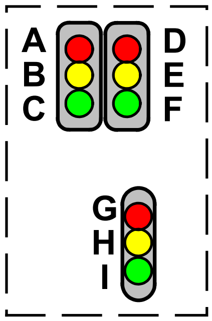
These are communicated via I2C bus on J5 .

Examples include:

Model	**Channels**	**Power/ch**	**Frequency Range**	**Enable/Gate Control**	**Diagnostics**
500C 500F series	1	2,4,or 7W	Model dependent	NA	NA
800PC-f/f/f/f	4	1W	Model dependent	NA	NA
RFA0120-2-15	4	15W	100-140	J5	J5
RFA0140-2-12	4	12W	120-160	J5	J5

NA= not applicable

11. LED Indicators.



Top Stack, Controller PCB

Ident	LED	Mode	iMS4-P
A	RED (top left)	If illuminated	Not Downloading File
B	Yellow	If illuminated	Downloading File
C	Green	Pulsing	Controller OK
D	RED (top right)	If illuminated	Image output stopped
E	Yellow	If illuminated	Waiting on Trigger
F	Green	If illuminated	Image playing / output active

Lower stack. Synthesizer PCB

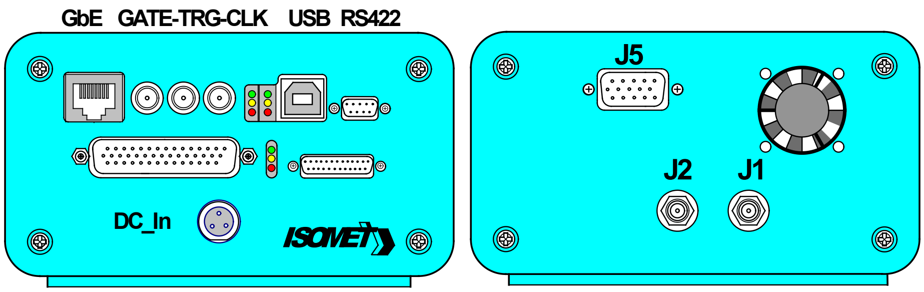
Ident	LED	Mode	Stand Alone iMS4-	In combination with PA J5 connected
G	RED (top)	Constant on	DC power On	Thermal Interlock Open (= fault) or GATE input J9 = low/OFF
H	Yellow	Constant on	NA	PA is enabled. Thermal Interlock OK
I	Green	Pulsing	Synthesizer OK	Synthesizer OK

DC power applied, USB communication problem

If the 6x LED's (A,B,C,D,E,F) are constantly illuminated, then USB communication has not been established. In this case:

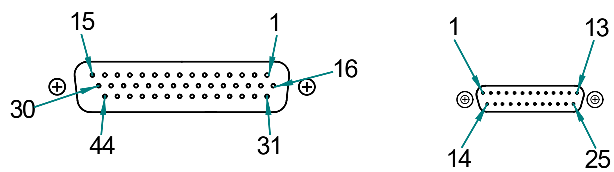
a: Ensure USB driver is loaded (see section 10)
b: Cycle DC power
and /or
c: Disconnect then reconnect USB

12. Connector pin-outs.



D-type pin idents looking into connector

Front panel view

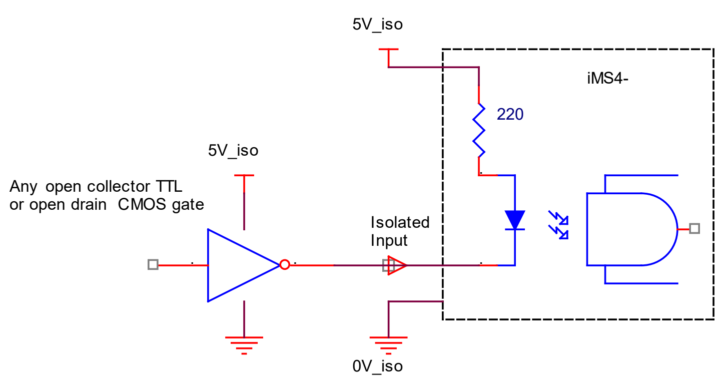


J7 (female) J8 (female)

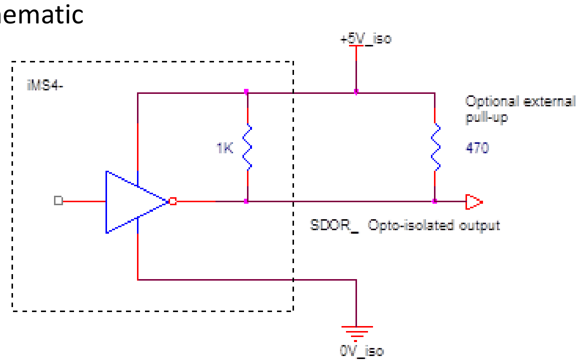
Pin-out descriptions as follows:

Circuit details for opto-isolated inputs / outputs on J7 and J8 connector

Recommended drive circuit for opto-isolated logic inputs



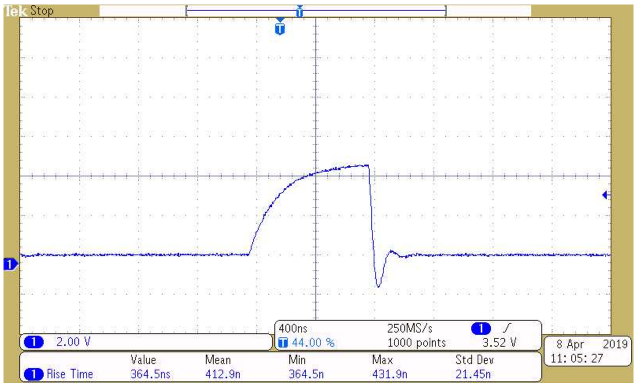
Opto-isolated logic output schematic



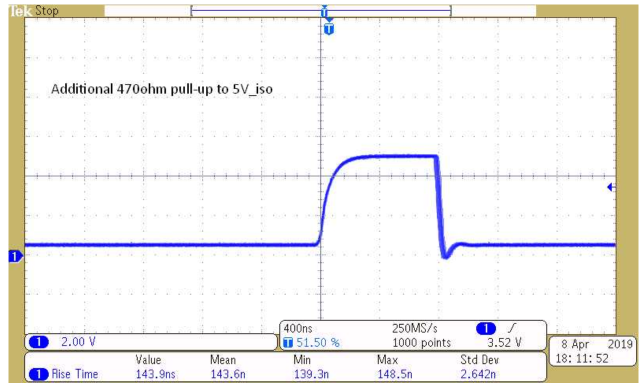
SDOR output trace at 1.2MHz Image clock rate

SD00,1,2,3 are optimized for faster clock rates.

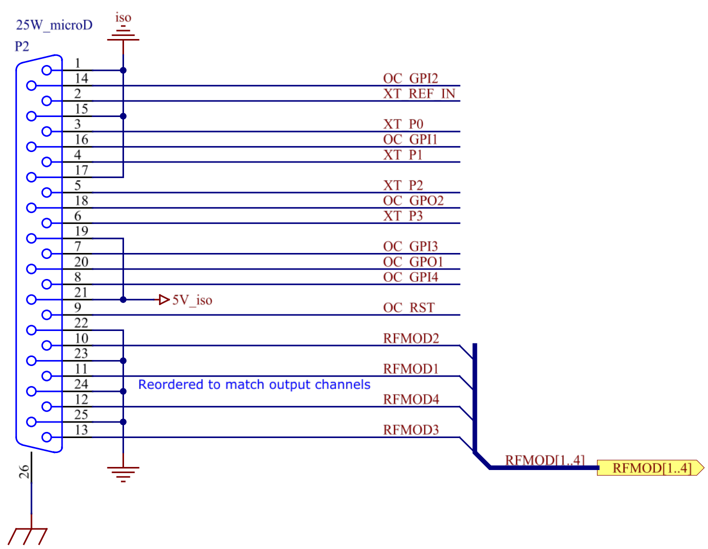
SDO4..SD011, employ 1K internal pull-ups



SDO0..SD03, 330R internal pull-ups



J8, 25way micro-D connector

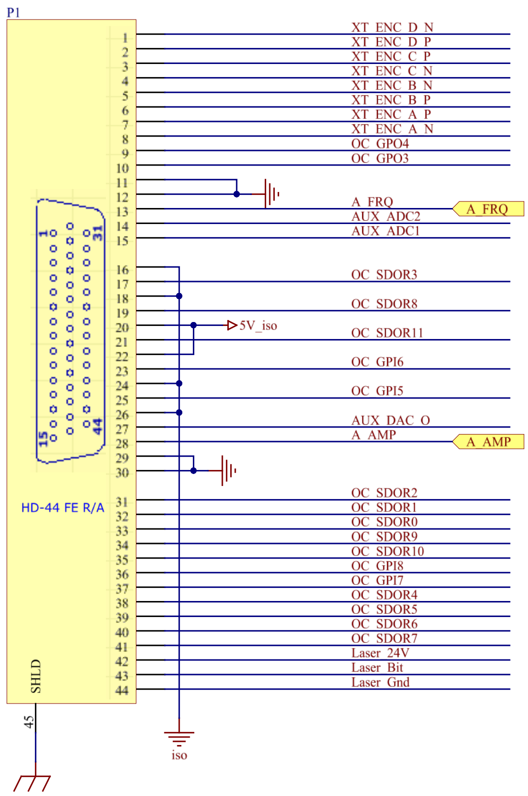


J8: Main connector for external control signals
(Micro-D to full size D-type converter cable available).

Connector	Type	25way micro-D			
	Ident	J8			
Signal Designation	Signal	Type	Description	Alternate use	Pin
NA					12
NA					24
NA					13
NA					25
RFmod2	In	Analog, 0-10V	External amplitude control for RF2	Analog, 0-1V option	10
A_Rtn		Analog	Analog return		22
RFmod1	In	Analog, 0-10V	External amplitude control for RF1	Analog, 0-1V option	11
A_Rtn		Analog	Analog return		23
RST	In	Opto isolated logic	Reset		9
REF_IN	In	Opto isolated logic	Reference Frequency (Optional)		2
GP I1	In	Opto isolated logic	LTB location/address, bit4	Async general purpose input	16
GP I2	In	Opto isolated logic	LTB location/address, bit5	Async general purpose input	14
GP I3	IN	Opto isolated logic	LTB location/address, bit6	Async general purpose input	7
GP I4	In	Opto isolated logic	LTB location/address, bit7	Async general purpose input	8
GP O1	Out	Opto isolated logic	Async general purpose output		20
GP O2	Out	Opto isolated logic	Async general purpose output		18
D_Rtn	DC		isolated 0V / signal return input	0V	17
P0	In	Opto isolated logic	LTB location/address, bit0	Profile select, bit0	3
P1	In	Opto isolated logic	LTB location/address, bit1	Profile select, bit1	4
P2	In	Opto isolated logic	LTB location/address, bit2	Profile select, bit2	5
P3	In	Opto isolated logic	LTB location/address, bit3	Profile select, bit3	6
D_Rtn	DC		isolated 0V / signal return input	0V	1
D_Rtn	DC		isolated 0V / signal return input	0V	15
5V_iso	DC		Isolated 5V DC supply input	5V output, 10mA	19
5V_iso	DC		Isolated 5V DC supply input	5V output, 10mA	21
D_Rtn	DC		isolated 0V / signal return input	0V	17
Notes:				**Key:**	
Type Logic = TTL or 5V CMOS				GP = General Purpose	
Drive inputs with open collector or open drain gate, 16mA sink				LTB = Local Tone Buffer	
Open collector outputs with internal 1Kohm pull-up to 5V_iso					

J7, 44way high density-D connector

Connection for auxiliary I-O signals



Connector	Type	44way HD-D			
	Ident	J7			
Signal Designation	Signal	Type	Description	Alternate use	Pin
SDOR0	Out	Opto isolated logic	Synchronous-Digital Output bit0		33
SDOR1	Out	Opto isolated logic	Sync-Digital Output bit1		32
SDOR2	Out	Opto isolated logic	Sync-Digital Output bit2		31
SDOR3	Out	Opto isolated logic	Sync-Digital Output bit3		17
SDOR4	Out	Opto isolated logic	Sync-Digital Output bit4		38
SDOR5	Out	Opto isolated logic	Sync-Digital Output bit5		39
SDOR6	Out	Opto isolated logic	Sync-Digital Output bit6		40
SDOR7	Out	Opto isolated logic	Sync-Digital Output bit7		41
SDOR8	Out	Opto isolated logic	Sync-Digital Output bit8		19
SDOR9	Out	Opto isolated logic	Sync-Digital Output bit9		34
SDOR10	Out	Opto isolated logic	Sync-Digital Output bit10		35
SDOR11	Out	Opto isolated logic	Sync-Digital Output bit11		21
D_Rtn	Out		isolated 0V / signal return input	0V	26
ENC_D_N	In	5V differential logic	Encoder Input N, Channel D		1
ENC_D_P	In	5V differential logic	Encoder Input P		2
ENC_C_P	In	5V differential logic	Encoder Input P, Channel C		3
ENC_C_N	In	5V differential logic	Encoder Input N		4
ENC_B_N	In	5V differential logic	Encoder Input N, Channel B		5
ENC_B_P	In	5V differential logic	Encoder Input P		6
ENC_A_P	In	5V differential logic	Encoder Input P, Channel A		7

ENC_A_N	In	5V differential logic	Encoder Input N		8
D_Rtn	In	*(5V_iso supply required)*	isolated 0V / signal return input	0V	16
GP I5	In	Opto isolated logic	Asynchronous GP logic input		25
GP I6	In	Opto isolated logic	Async GP input		23
GP I7	In	Opto isolated logic	Async GP input		37
GP I8	In	Opto isolated logic	Async GP input		36
GP O3	Out	Opto isolated logic	Async GP logic output		9
GP O4	Out	Opto isolated logic	Async GP output		10
D_Rtn	Out		isolated 0V / signal return input		24
24V_laser	In	PLC	Laser Opto-Supply		42
Laser_Bit	Out	PLC	Laser Opto relay bit Tr/Tf < 50usec)		43
Gnd_laser	In	PLC	Laser Opto-Gnd		44
AOUT_Frq	Out	Analog	8-bit analog representation of Image freq		13
AOUT_Amp	Out	Analog	8-bit analog equivalent of Image amplitude		28
A_Rtn	Out	Analog	Analog return		30
AOUT_DAC	Out	Analog	GP 12-bit DAC analog output.		27
A_Rtn	Out	Analog	Analog return		29
Aux_ADC1	In	Analog	GP Analog input to a 12-bit ADC (0 to 10V).		15
A_Rtn	In	Analog	Analog return		11
Aux_ADC2	In	Analog	GP Analog input to a 12-bit ADC (0 to 10V).		14
A_Rtn	In	Analog	Analog return		12
5V_iso	DC		Isolated 5V DC supply input	5V output, 10mA	22
5V_iso	DC		Isolated 5V DC supply input	5V output, 10mA	20
D_Rtn	DC		isolated 0V / signal return input	0V	18
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					

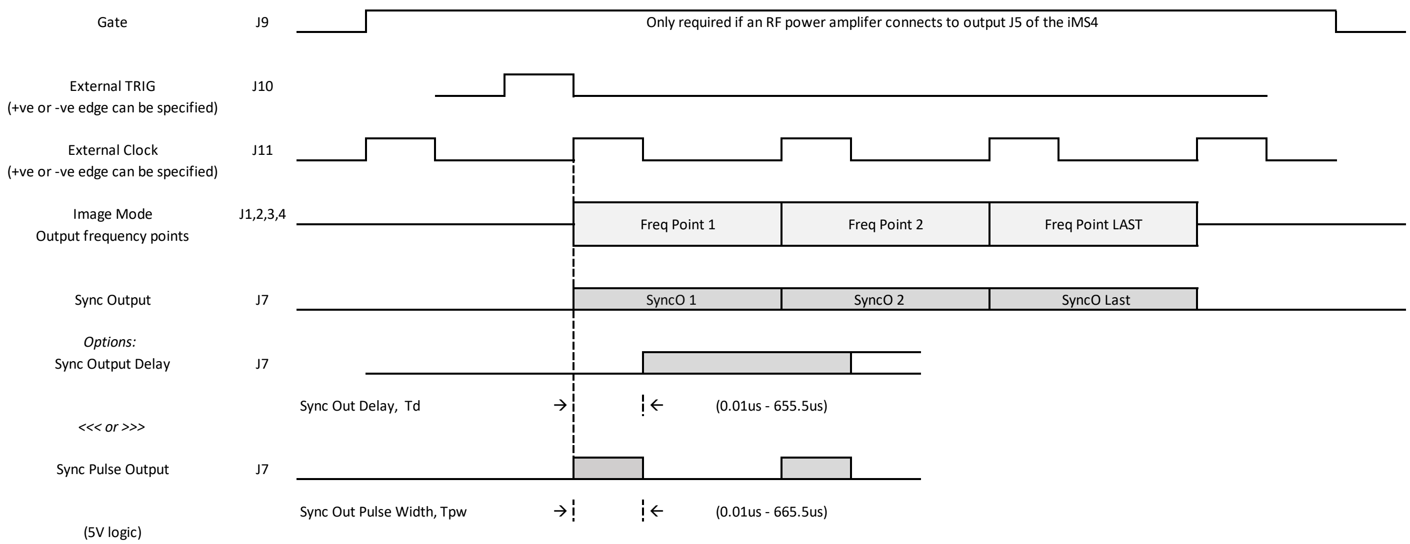
Other Connectors

Connector	**Type**	see table						
	Ident	see table						
Signal Designation	**Signal**	**Type**	**Description**	Alternate use	**Connector**	**Ident**	**Pin**	
			Communication					
Ethernet	In/Out	Logic	GbE		RJ45			
USB Serial	In/Out	Logic	USB II / USBIII		B-type	-		
RX-P	In	Logic	RS422 receive+		9-way D	J12	2	
RX-N	In	Logic	RS422 receive-		9-way D	J12	1	
TX-P	Out	Logic	RS422 transmit+		9-way D	J12	7	
TX-N	Out	Logic	RS422 transmit-		9-way D	J12	6	
Rtn	Gnd		Sig Rtn		9-way D	J12	5	
			DC Supply					
Vdc	DC	DC-In	Supply 15V -24V dc, <0.4A		3w TINI-Q		1	
	0V	DC-In			3w TINI-Q		2	
			SMA Coax Connections					
Gate	In	Logic	Enable power amplifiers via J5	POF input	SMA coaxial	J9	Centre	
Rtn	Gnd		Sig Rtn				Outer	
Trigger	In	Logic	Trigger Image Data Output	POF input	SMA coaxial	J10	Centre	
Rtn	Gnd		Sig Rtn				Outer	
Clock	In	Logic	Clock Image Data	POF input	SMA coaxial	J11	Centre	
Rtn	Gnd		Sig Rtn				Outer	
Ch0	Analog	RF	RF1 frequency output, 50Ω		SMA coaxial	J1	Centre	
Rtn	Gnd		Sig Rtn				Outer	
Ch1	Analog	RF	RF2 frequency output, 50Ω		SMA coaxial	J2	Centre	
Rtn	Gnd		Sig Rtn				Outer	
5V_RFA	In		Opto supply from connected PA	5V, 20mA out	15w-HD D	J5	1	
5V_RFA	In		Opto supply from connected PA	5V, 20mA out	15w-HD D	J5	10	
0V_RFA	In		Opto 0V from connected PA	0V	15w-HD D	J5	4	
0V_RFA	In		Opto 0V from connected PA	0V	15w-HD D	J5	7	
SCL_RFA_TX	IO	Opto isolated logic	I2C Clock_TX		15w-HD D	J5	2	
SCL_RFA_RX		Opto isolated logic	I2C Clock_RX		15w-HD D	J5	3	
SDA_RFA_TY	IO	Opto isolated logic	I2C Data_TY		15w-HD D	J5	5	
SDA_RFA_RY		Opto isolated logic	I2C Data_RY		15w-HD D	J6	6	
EXT-CONVST	Out	Opto isolated logic	Start ADC conversion		15w-HD D	J5	8	
-EXT_GATE	Out	Opto isolated logic	Enable connected amplifier		15w-HD D	J5	9	
EXT-BSY	In	Opto isolated logic	ADC conversion busy		15w-HD D	J5	11	
EXT-INT_MON	In	Opto isolated logic	Interlocks valid monitor		15w-HD D	J5	12	
			* Applies only when signals supported by connected PA					

13. Signal Timing Diagram

Applies to Image mode.

NOTE: For clarity , the 0.6usec latency between the External clock and the respective Output frequency point is not shown. This is a static delay and does not impact on Image Clock rate.



14. External reference (ERC)

iMS2-HF employs a PLL to generate the system clock for the DDS chips.
By default, an internal 25MHz TCXO connects to the PLL reference clock input.
Optionally, the user can provide an external reference clock on pin 2 (sig) / pin 1 (rtn) of J8.
Contact Isomet for guidance to enable this option.

The ERC input requires a positive going digital signal and is 50 ohm terminated .
The signal is routed to a 5V tolerant buffer and then a digital isolator.
The buffer and digital isolator operate from an isolated 5V supply which the user needs to provide on pin 21 (+5V) / pin 17 (0V) of J8

Reference Clock:

Frequency:		Any multiple of 20KHz
	Minimum	40KHz
	Maximum	16MHz
Voltage:		Positive only, 50ohm input impedance
	Minimum	1.25V
	Maximum	5.0V

15. Software.

The core of the Software Development Kit is the C++ iMS library and API. All interaction with iMS hardware ultimately passes through this API. However we have also provided a number of other software utilities and wrappers that allow you to use the iMS System at a higher level of abstraction.

Included in the SDK are:

•The core iMSLibrary binaries for a number of different platforms and toolsets.

•Accompanying C++ header files for application interface.

•iMSNET An experimental .NET assembly written in C# that wraps the core library and permits user application development in any .NET language targeting the .NET Framework

•ims_hw_server is a command line daemon type process that can handle all communication with an iMS system, decoupling it from user application business logic. A gRPC streaming interface connects the server to application software, either on the same host or across a network.

•iMS Studio is a full featured GUI front end application that can be used to create Images, Tone Buffers and Compensation Functions and play them on an iMS system. This is often a good starting point for users wishing to explore the capabilities of an iMS before starting development of custom software.

The iMS software is available for download from http://www.isomet.com/software.html
Depending on your computer select and run one of the following :

Isomet iMS SDK v 1.xx Win7 Setup.exe
Isomet iMS SDK v 1.xx Win10 Setup.exe

The software download also includes documentation and tutorials for setting up a project and connecting to the iMS. Note: these Tutorials are NOT specific to any practical AO device.

Please refer to ***Quick Start Guide: Isomet iMS Studio*** for instructions on the Isomet Windows GUI

The iMS software library and API has been written purely in native ANSI-C++ with some use of features introduced in C++11 (ISO/IEC 14882:2011), including the C++ Standard Library. There is no use of features associated with the updated C++14 specification.

Isomet will provide example projects applicable to the customer hardware configuration.

The Software Development Kits are regularly updated. Please check for Isomet website for updates.

a. Visual Studio Notes

	Visual Studio 2013 (v120)		Visual Studio 2015 (v140)	
	32-bit	64-bit	32-bit	64-bit
Microsoft Windows 2000/XP/Vista or earlier	✗	✗	✗	✗
Microsoft Windows 7 Professional	✓	✓	✓	✓
Microsoft Windows 8/8.1	⚠	⚠	⚠	⚠
Microsoft Windows 10 Professional	✗	✗	✓	✓

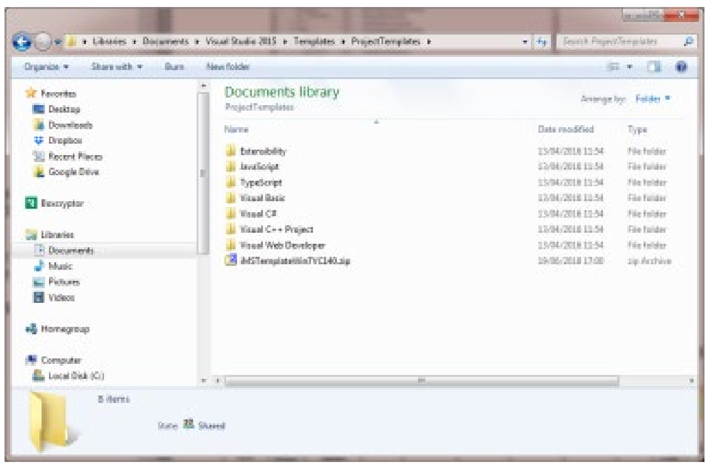
Table 1 Toolset Version Compatibility Table

b. Folder locations.

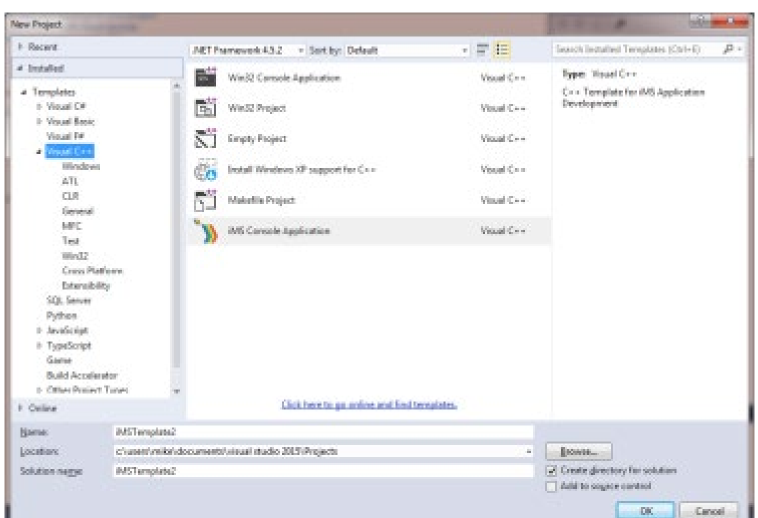
For ease of installation, a C++ console application template file is provided.

Copy the file *iMSTemplateWin7VC140.zip* into the Visual Studio project templates folder
e.g. C……Documents > Visual Studio 2015 > Templates > ProjectTemplates

DO NOT unzip



When starting *New Project* from Visual Studio, the *iMS Console Application* will be offered
Edit the project *Location* as required.
However *Rename* in VCPP Solution Explorer window after Template project is started.

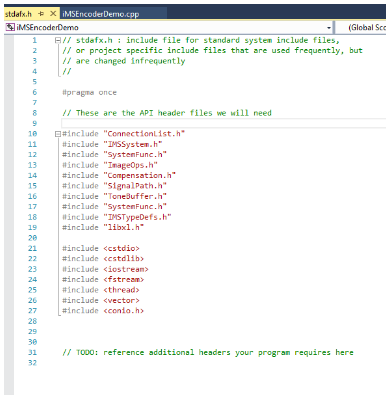


c. Adding C++ code to the project template

Please refer to the comments within the C++ template code and the ReadMe.txt file

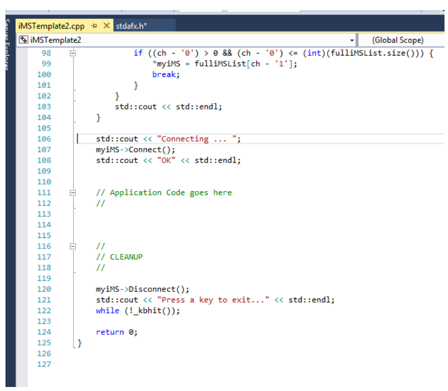
The application includes the example code necessary for connection to the iMS4 (via selected ports) and files which are used to build a precompiled header (PCH) file; StdAfx.h, StdAfx.cpp

Add additional include files to ***StdAfx.h***



Referencing the default Source file (e.g. iMSTemplate.cpp)

User application code is added from line 111

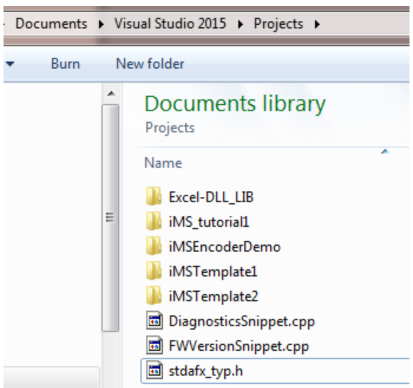


d. Installing the 3rd party Excel Spreadsheet Import Export function

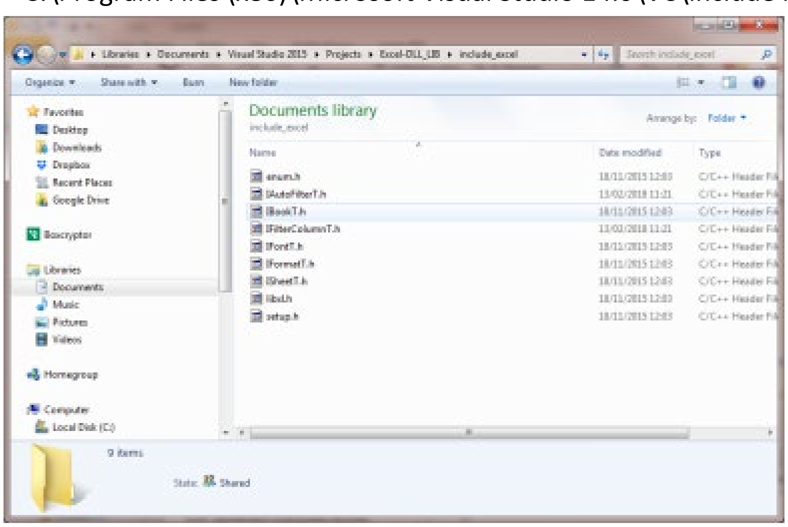
Generating Compensation Tables (LUTs) and Image files in Excel can be convenient.
Several routines exist to import data into C++. One such is from libxl.com
A licence key is required and it is free to use.
Add the following code prior to calling the LibXL functions.

```
// call LibXL licence key
libxl::Book* ExcelBook = xlCreateBook();
ExcelBook->setKey(L"Michael Hillier", L"windows-222329040ec5ec046fb46767a7h1gej6");
```

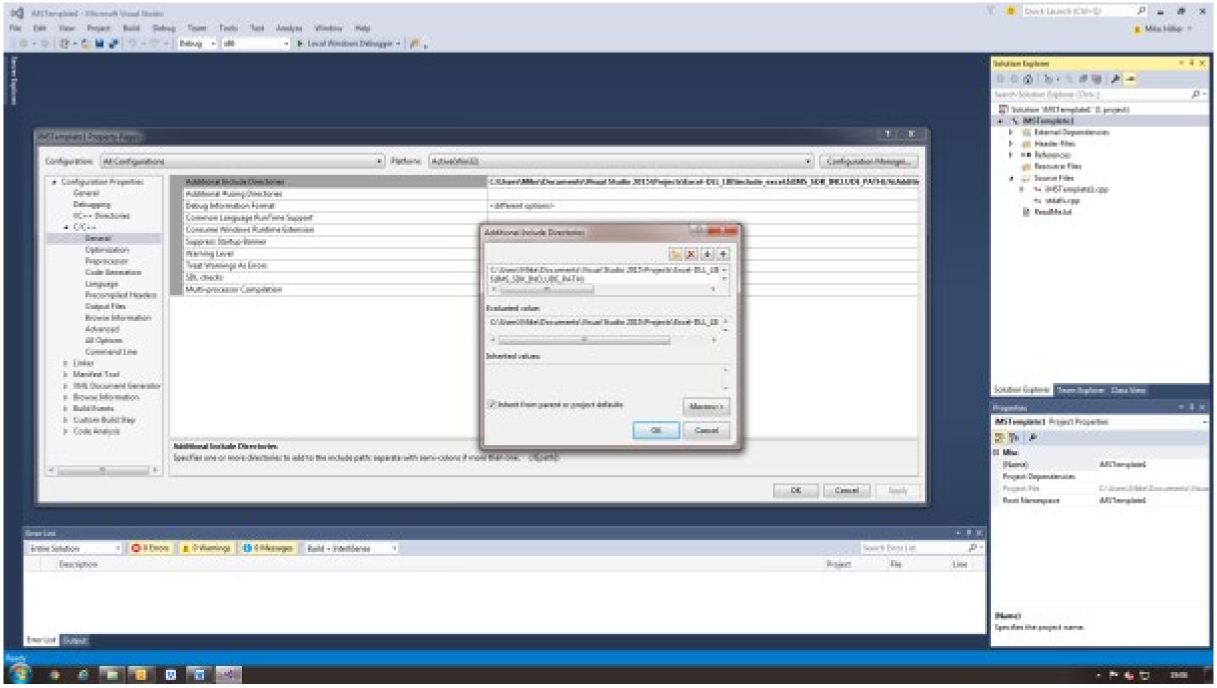
To add this feature to your project
Create a folder Excel-DLL_LIB in the Projects folder and download associated files (contact Isomet)



- Add the additional include files to ***StdAfx.h*** only
  Copy the excel lib include files folder to VS installed folder
  C:\Program Files (x86)\Microsoft Visual Studio 14.0\VC\include in

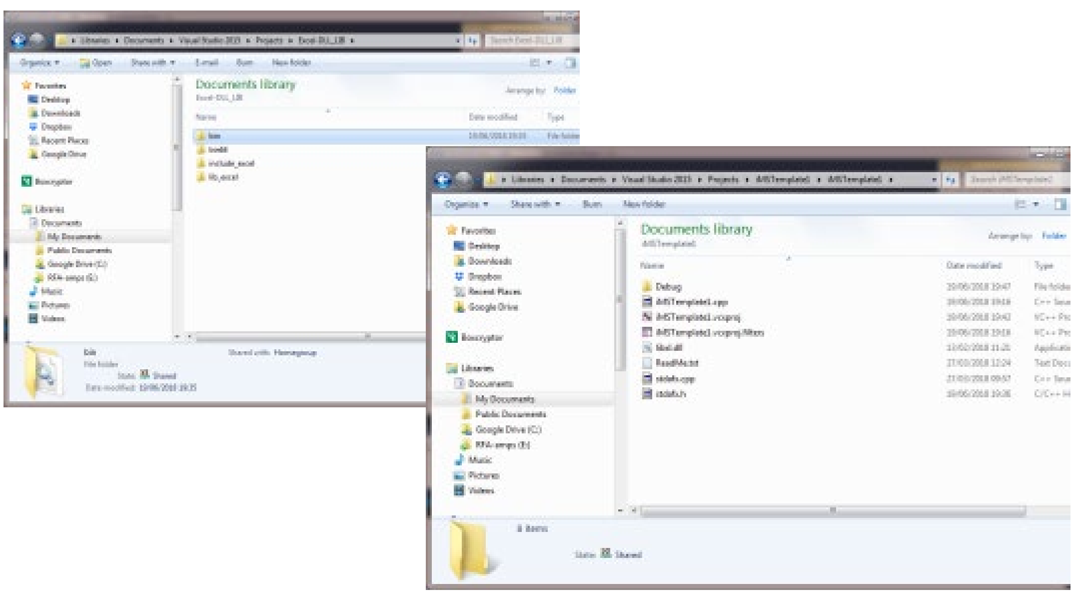


Add 'include_excel' to the *Additional Include Directory* under *C++ > General.*

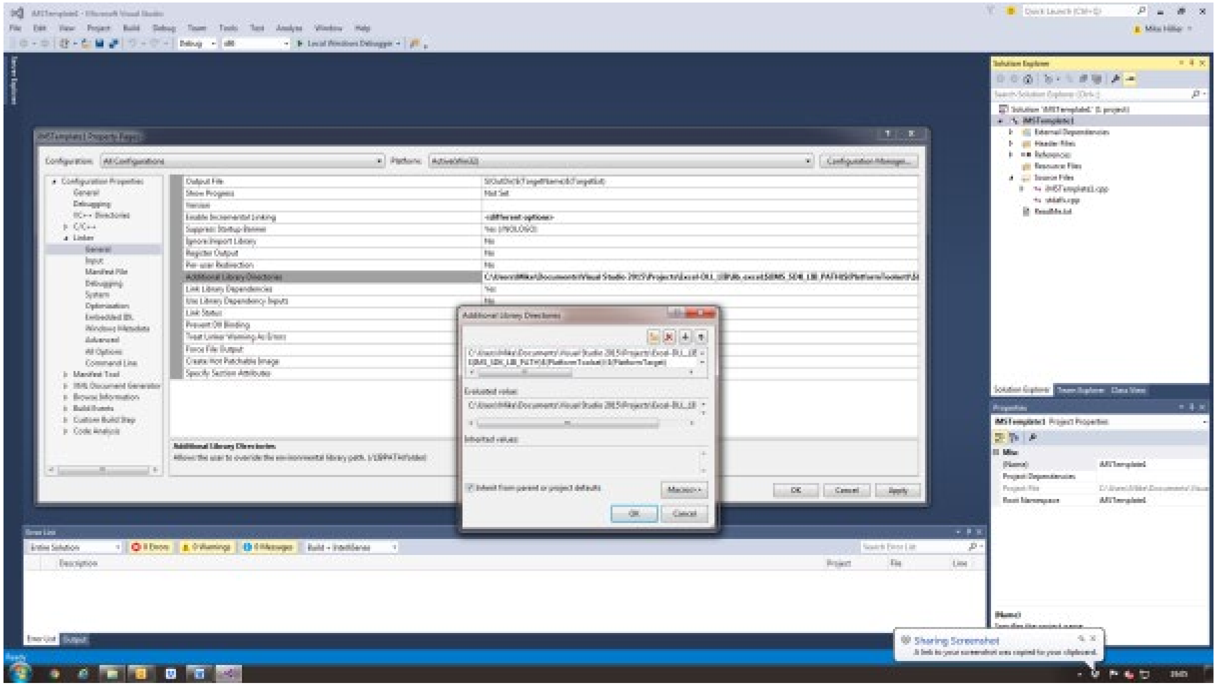


- Copy libxl.dll from > Excel_DLL-LIB > bin to the project folder you created.

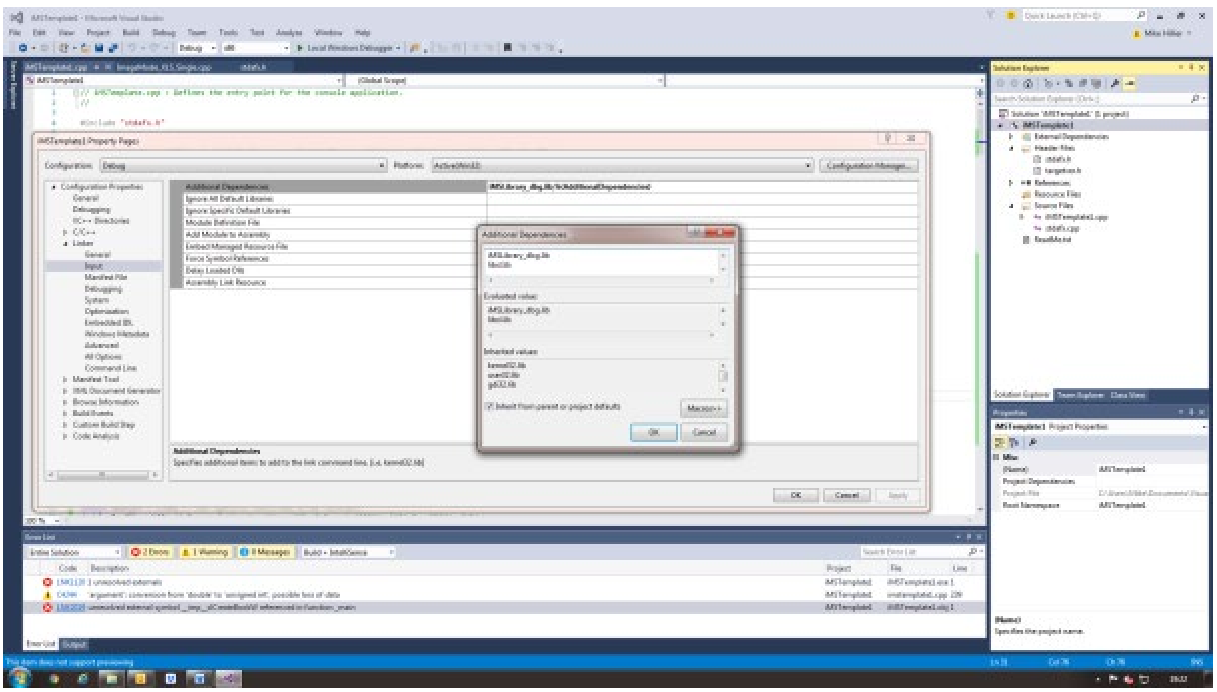
<u>It must be in the same folder as the source file *.cpp.</u>



- Add the folder containing libxl.lib to the *Additional Library Dependencies* under *Linker > General*.



- Add libxl.lib to the *Additional Dependencies* under *Linker > Input*



16. Direct programming of the DDS Synthesizer Chips.

For most applications, the use of the DDSscript function is not required (C++ only)

Please contact Isomet for further information.