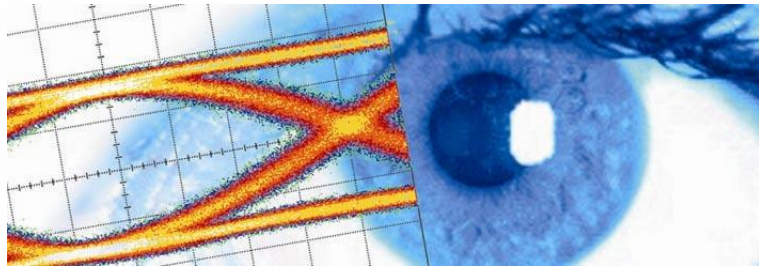# SHF Communication Technologies AG

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Preliminary Datasheet
SHF 615 A
60 GBaud 3-Bit DAC

Description

The SHF 615 A is a 3-Bit Digital-to-Analog Converter (DAC) operating at symbol rates up to 60 GBaud for use in broadband test setups and telecom transmission systems. Up to three single ended serial data streams are accepted by the DAC and converted into one differential 8-level data signal. By using two input ports only it is possible to generate 4-level output signals. A single ended clock signal with the same frequency as the data rate drives the SHF 615 A.

For data regeneration purposes all input data signals are re-sampled to mitigate any signal impairments resulting e.g. from long cables. Therefore, it becomes possible to place the DAC very close to the DUT.

All RF input and output ports are AC-coupled.

Features

- Broadband operation up to 60 GBaud
- Differential data output, 4.8 V differential output swing (2.4V in single-ended operation)
- Single-ended clock and data inputs
- Latched input ports
- Output level control

Applications

- 100, 200, 400 Gbps and 1 Tbps system evaluation & development
- Broadband test and measurement equipment
- PAM-N, OFDM, Advanced Modulation Experiments

Block Diagram

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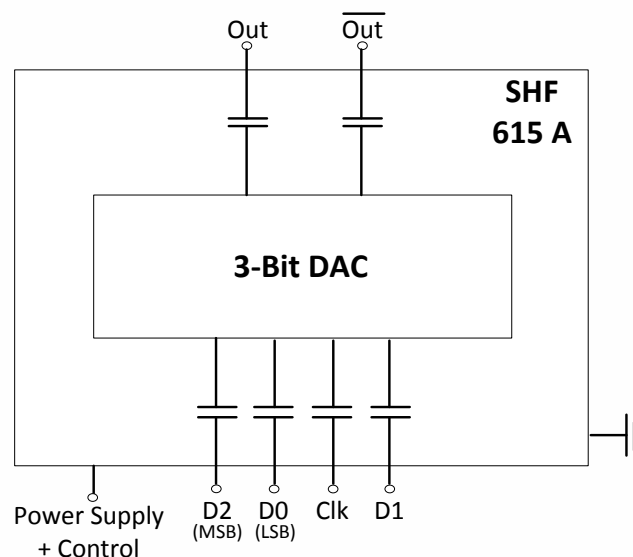
Ease of Use

In addition to the DAC itself, the power supply, USB cable, head sink and control software are a complementary part of each delivery. It is recommended to use the DAC only with the delivered power supply module.

The easy to use software package, the SHF 600 Series Control, is the most convenient way to control the DAC. The software reads the individual calibration tables of the DAC and sets the contribution of the bias voltages accordingly. The amplitude of the individual eye openings can be set and is displayed in the graphical user interface (GUI). The enables the user to generate a perfect signal just by a few intuitive clicks. The control software for other operating systems is available on request.
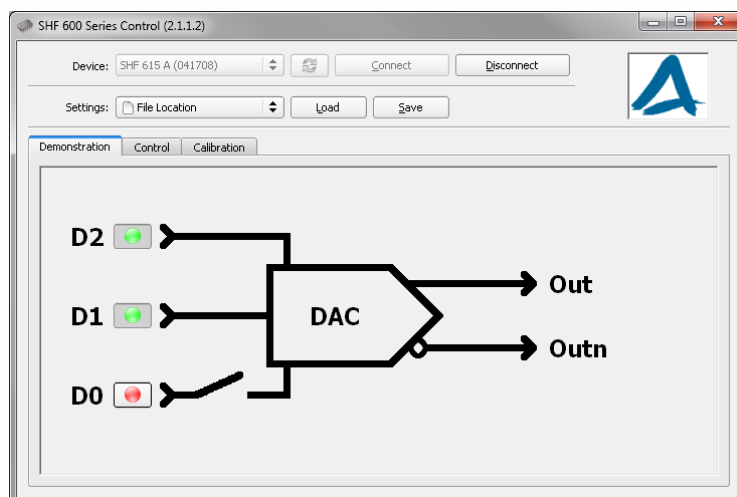

Fig. 2: "SHF 600 Series Control" – GUI

The heat sink can be removed by the customer. In this case it is required to provide other cooling measures to ensure that the maximum case temperature specified on page 4 will not be exceeded.

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Absolute Maximum Ratings

Parameter	Unit	Symbol	Min.	Typ.	Max.	Comment
Input Parameters						
Data Input Voltage	mV$_{pp}$	V$_{data\ in}$			900	
Clock Input Voltage	mV$_{pp}$	V$_{clk\ in}$			900	
External DC Voltage on RF Input Ports	V	V$_{DCin}$	-10		+10	AC coupled input
External DC Voltage on RF Output Ports	V	V$_{DCout}$	-10		+10	AC coupled output
DC Supply Voltages (DAC-Module)	V	V$_{ee}$ V$_{cc}$	-5.0 0		0 +6.0	

Specifications

Parameter	Unit	Symbol	Min.	Typ.	Max.	Comment
Input Parameters						
Data Input Voltage	mV$_{ampl}$	V$_{data\ in}$	300		800	500 mV recommended
Clock Input Frequency	GHz	f$_{in}$	1		60	
Clock Input Voltage	mV$_{ampl}$	V$_{clk\ in}$	300		800	500 mV recommended
Output Parameters						
Minimum Output Data Rate	GBaud	R$_{out,min}$			1	
Maximum Output Data Rate	Gbaud	R$_{out,max}$	60	62		
Output Amplitude	mV$_{ampl}$	V$_{out}$	2200	2415		Single ended, full scale, adjustable up to -6dB, see page 5
Rise Time[1]	ps	t$_r$		8 12	10 13	20% / 80% 10% / 90%
Fall Time[1]	ps	t$_f$		6 9	8 11	20% / 80% 10% / 90%
Differential Output Skew	ps	t$_{skew}$		±1	±2	

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[1] Refers to full scale output swing (measured with a 0101-pattern, phase-synchronized at all data input ports)

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Power Requirements (incl. Power Supply)						
Supply Voltage	V	V_c	+11.5	+12	+12.5	
Supply Current	mA	I_c		650		
Power Dissipation	W	P_d		7.8		@ V_C = +12V
Power Requirements (DAC-Module only)						
Supply Voltage	V	V_{ee}	-4.6	-4.4	-4.3	
Supply Current	mA	I_{ee}		1050	1150	
Supply Voltage	V	V_{cc}	+5.2	+5.3	+5.5	
Supply Current	mA	I_{cc}		320	350	
Power Dissipation	W	P_d		6.3		@ V_{EE} = -4.4V, V_{CC} = +5.3V
Conditions						
Case Temperature[2]	°C	T_{case}	10		45	

Typical Output Amplitudes

Below mentioned values assume no attenuation to be set in the control software. The output amplitude of the DAC can be reduced by 0 to -6 dB by making the appropriate setting in the control software.

Input D2	Input D1	Input D0	Typical Output Amplitude [mV]
-	-	On	**345**
-	On	-	**690**
On	-	-	**1380**

The typical output amplitude of a multilevel signal can be calculated by accumulating the typical output amplitudes of all applied input ports of the DAC as shown in the table above. Thus the full scale output swing (all inputs active) accumulates as follows:

On	On	On	**2415**

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[2] Tr / Tf of the output data signal can be slightly decreased by applying additional cooling measures like heat sinks or cooling fans.

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Typical Output Eye Diagrams

The measurements below had been performed using a SHF 12104 A Bit Pattern Generator (PRBS 2^{31}-1) and a Tektronix DSA 8300 Digital Serial Analyzer (DSA) with Phase Reference Module (82A04B-60G) and 70 GHz Sampling Module (80E11). The outputs of the DAC module had been connected directly to the DSA input with a 20 dB attenuator.
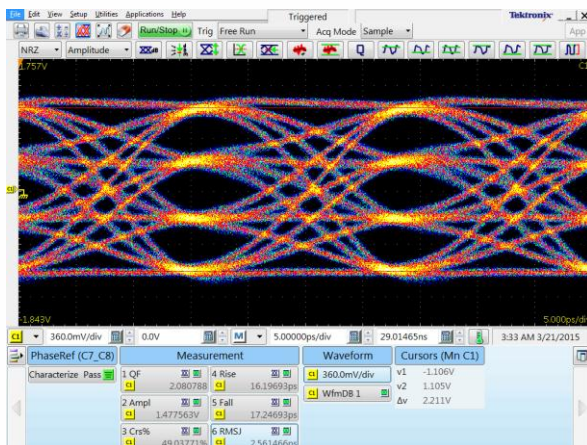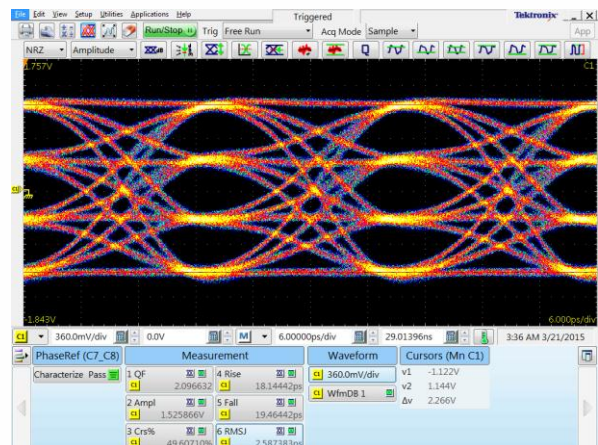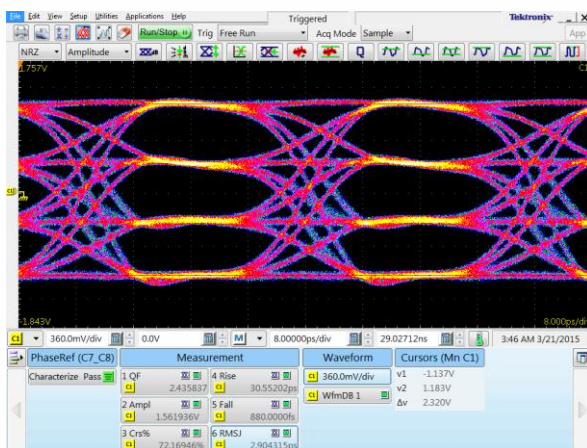
4-Level Output Signal Measurement
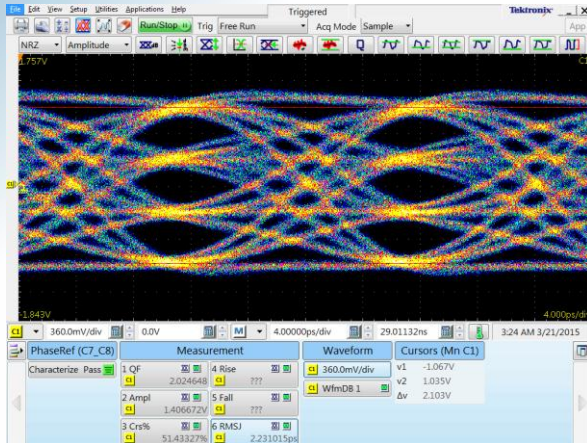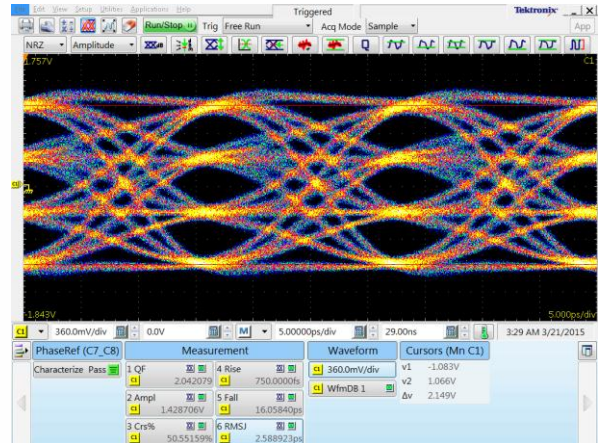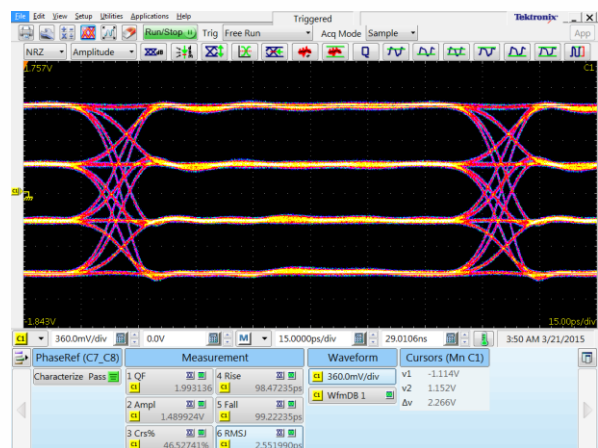

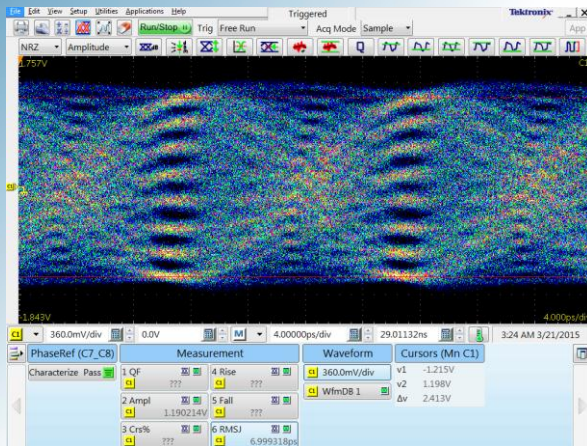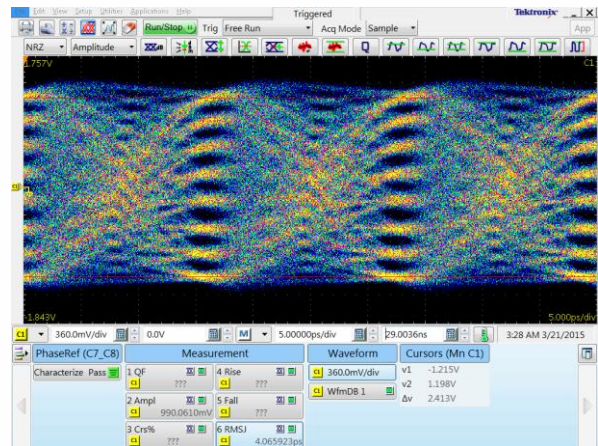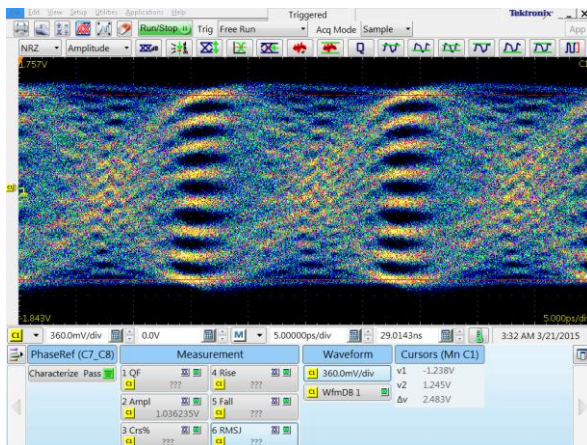**Out @ 62 GBaud**

Out @ 60 GBaud

Out @ 56 GBaud

Out @ 50 GBaud

Out @ 32 GBaud

Out @ 10 GBaud

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8-Level Output Signal Measurement

Out @ 62 GBaud

Out @ 60 GBaud

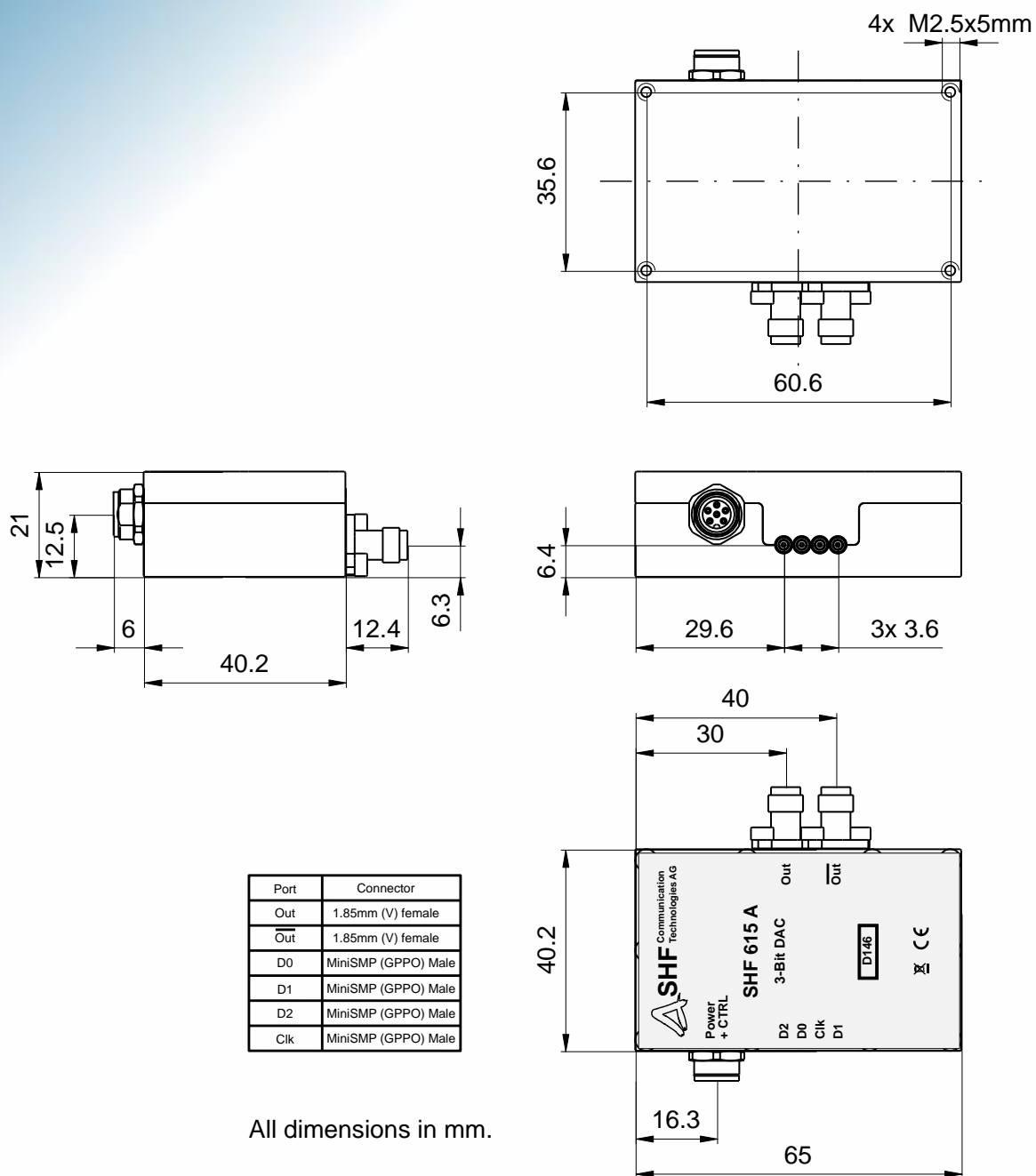**Out @ 56 GBaud**

Out @ 50 GBaud

Out @ 32 GBaud

Out @ 10 GBaud

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Outline Drawing - Module

4x M2.5x5mm

35.6

60.6

21

12.5

6

40.2

12.4

6.3

6.4

29.6

3x 3.6

40

30

40.2

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SHF 615 A

3-Bit DAC

Out

Out

D146

Power + CTRL

D2 D0 Clk D1

16.3

65

Port	Connector
Out	1.85mm (V) female
Out	1.85mm (V) female
D0	MiniSMP (GPPO) Male
D1	MiniSMP (GPPO) Male
D2	MiniSMP (GPPO) Male
Clk	MiniSMP (GPPO) Male

All dimensions in mm.

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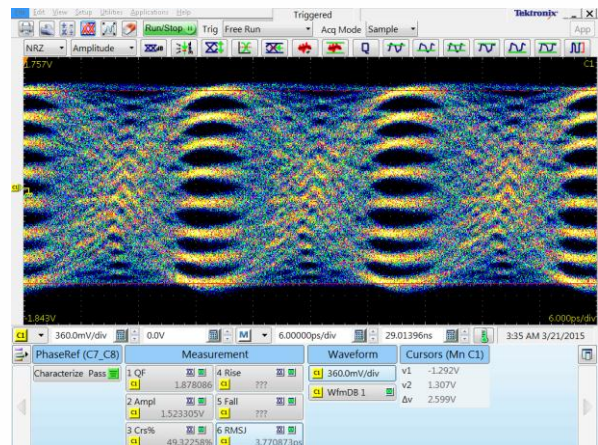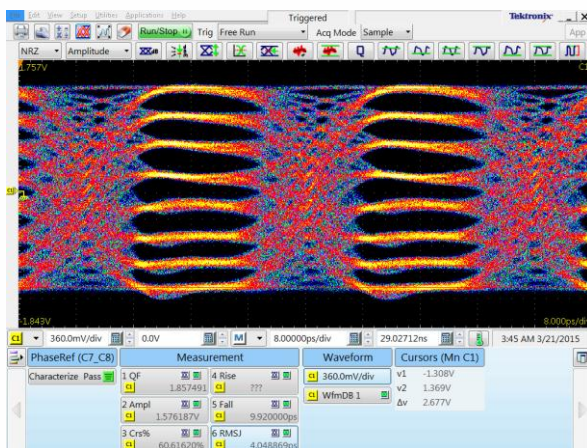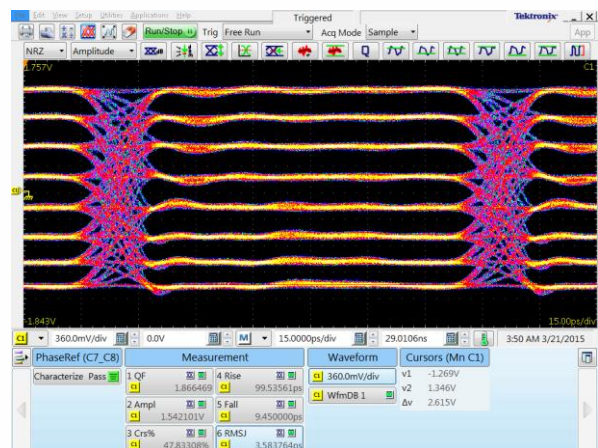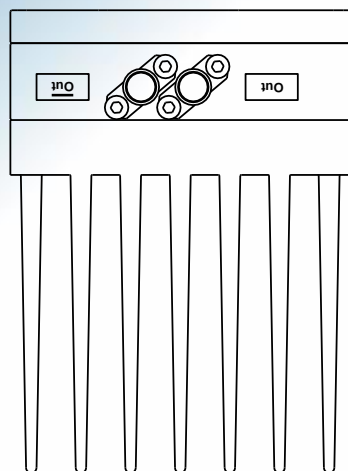
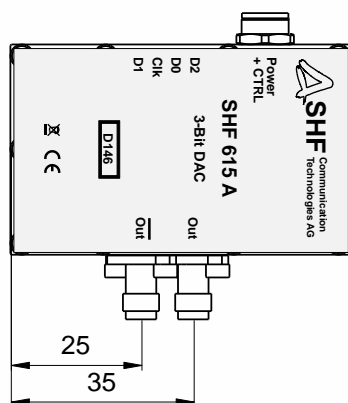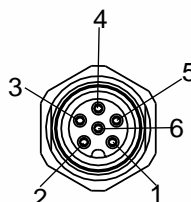# Outline Drawing – Module with Heat Sink

Power Supply & Control (I2C-Bus)

Port	Connector
Out	1.85mm (V) female
Out	1.85mm (V) female
D0	MiniSMP (GPPO) Male
D1	MiniSMP (GPPO) Male
D2	MiniSMP (GPPO) Male
Clk	MiniSMP (GPPO) Male

Power Supply & Control (I2C-Bus)		
Pin	Colour	Designation
1	brown	SCL
2	white	Vcc
3	blue	GND
4	black	Vee
5	grey	SDA
6	pink	GND

All dimensions in mm.

SHF 615 A

3-Bit DAC

Power + CTRL

D146

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