July 14

RF Amplifier

Including: Basic AO Alignment

Instruction Manual

RFA1190-series

Models -

RFA1190-1 : 140-260MHz, >40W output

Options -x:

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1. GENERAL

The RFA1190-1 is a fixed gain, single output, broadband RF amplifier specifically designed for fast amplitude modulation. This amplifier is compatible with Isomet acousto-optic devices operating from 150-250MHz and requires a low level signal from a suitable frequency source such as the Isomet iHHS-4e frequency synthesizer. It will operate at full rated power into a 50Ω load with 100% duty cycle. Water cooling is required. There are no external adjustments.

Figure 2 is a functional block diagram of the driver.
A frequency input is required from an external source.
Amplifier gain is approximately 50dB.

A typical input - output relationship is shown in the table and plot below.
DO NOT EXCEED 3mW input

Freq	**150 MHz**	**175 MHz**	**200 MHz**	**225 MHz**	**250 MHz**
Input Level					
1.00 mW	38W	45W	52W	50W	35W
0.75 mW	36W	41W	48W	45W	32W
0.50 mW	31W	37W	40W	16W	28W
0.25 mW	20W	23W	26W	24W	19W
0.12 mW	11W	13W	15W	12W	10W

CW swept response
Top trace:
Full power, 50W peak,

Middle trace:
Half output power, 25W

Lower trace:
Quarter output power, 12W

Diagnostics

RF power level

Voltage on pin 2 of the D-type gives an indication of the RF output power level.

The response time of this signal is 20usec

This voltage is not calibrated and will depend both on load impedance and operating frequency

At 200MHz into 50 ohm load

RF power	Voltage
50W	5.0V (= max output voltage)
40W	4.6V
30W	4.1V
20W	3.4V
10W	2.5V
5W	1.8V
0W	0.3V

DC current

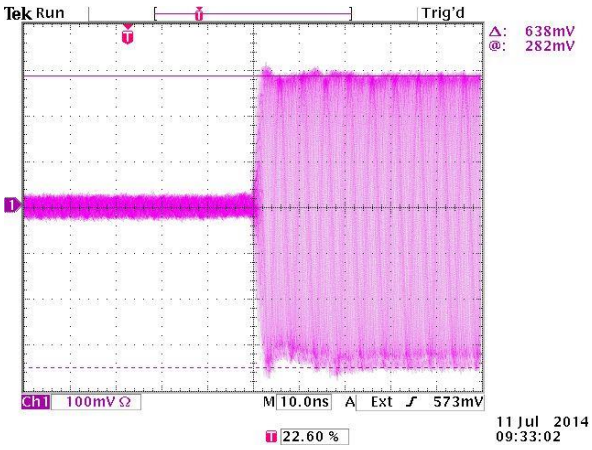
Voltage on pin 4 of the D-type gives an indication of DC current draw on 24Vdc supply.

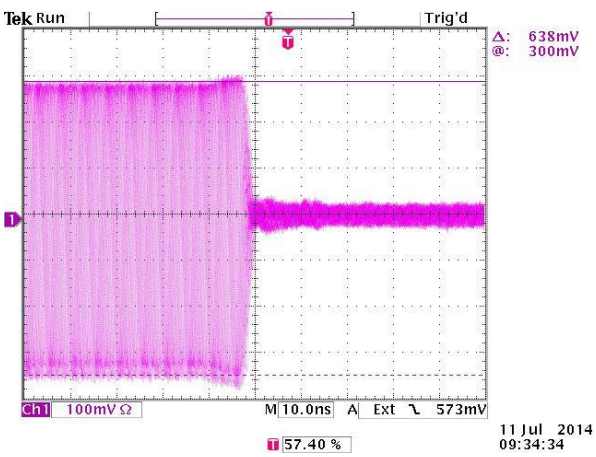
The response time of this signal is 100usec

DC current	Voltage
5.6A	3.0V (typical for max RF out)
5A	2.6V
4A	2.0V
3A	1.5V
2.9A	1.4V (current with zero RF input)

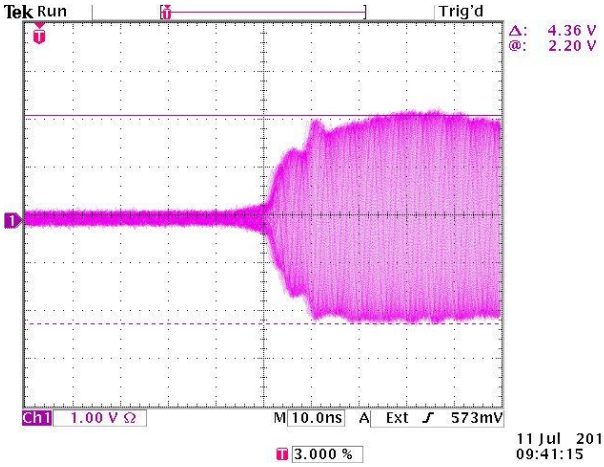
RF switching response

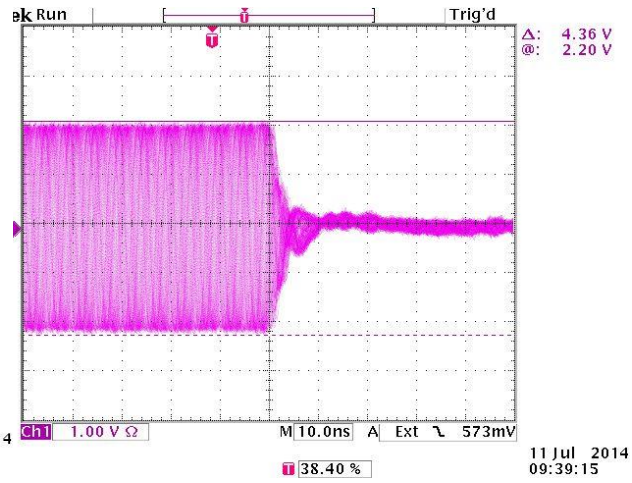
INPUT signal: 200MHz, 1mW (=640mVpp)





RF OUTPUT: 50W, 200MHz, via 30dB (1000:1) RF attenuator





The additional switching rise and fall time introduced by the amplifier is less than 10nsec and 5nsec greater than the input values.

The RF power can be calculated from the peak to peak envelope voltage as follows:

$$\text{Power} = \text{Attenuation} \times \frac{[\text{Vpp}/(2\times \text{Sqrt}2)]^2}{50}$$

Using a 30dB input attenuator at the oscilloscope, then the power = 2.5 x Vpp^2

Note: Practical RF attenuators have +/- 10% accuracy.
Harmonics can effect peak – peak value.
Scope input must be terminated (or set to) 50ohm input impedance

Interlock

An interlock/enable input is required. This is typically connected to the over-temperature thermostat on the AO device. This connection is between pins 5 and 9 of the D-type.
These signals should not be connected to chassis ground (0V)

Water cooling

Water cooling is required. The heatsink temperature must not exceed 70°C.
SERIOUS DAMAGE TO THE AMPLIFIER MAY RESULT IF THE TEMPERATURE EXCEEDS 70°C.
SERIOUS DAMAGE TO THE AMPLIFIER MAY ALSO RESULT IF THE RF OUTPUT CONNECTOR IS OPERATED OPEN-CIRCUITED OR SHORT-CIRCUITED.

DC supply

The operating voltage is +24V or +28Vdc at a current drain of approximately 6A.The external power source should be regulated to ± 2% and the power supply ripple voltage should be less than 200mV for best results.

Higher RF output power is achieved at 28Vdc.

2.0 LED INDICATOR

The front panel LED indicator serves to indicate the operating state.

The LED will only illuminate RED when the DC power is applied **and** the Interlock signal is valid.

LED Off

The LED will not illuminate if:

a) the internal driver thermal interlock switch is open (Over temperature fault)

b) the AOM thermal interlocks switch is open (Over temperature fault)

c) the AOM thermal interlock is not connected to the driver interlock input

d) the DC supply is off.

The thermal interlocks will reset once the AO device and / or RF driver are cooled below the switching temperature.

- The driver thermal switch over temperature threshold is 50deg C
- The AO device thermal switch over temperature threshold is 32deg C

The hysterisis of the thermal switches is 7-10deg C.

Once in a fault state the coolant temperature may need to be reduced to reset the thermal switches.

The LED drive signal is replicated at the D-type for an external LED connection.

Pin 1 = Active high, 24V / 20mA drive (Internal 1Kohm series resistor)

Pin 6 = Gnd (0V)

3. INSTALLATION AND ADJUSTMENT

3.1 Connect cooling water to the RFA1190-1 at a flow of more than 0.5 litres/minute at < 20 deg.C

If necessary, connect cooling water to the AO device

3.2 With no d-c power applied, connect (solder) the positive + 24V DC supply to the center terminal of the feed-thru terminal. Connect the supply 0V to the screw stud.
DO NOT APPLY DC POWER at this stage.

3.3 Connect the RF output BNC jack to the acousto-optic modulator (or a 50Ω RF load, if it is desired to measure the modulator RF output power).

3.3a Connect the RF input BNC jack to an external frequency source (< 1mW, 50Ω).

3.4 Connect the Interlock of the acousto-optic modulator (SMA, SMC or mini 3pin connector) to the mini 3pin snap connector on the RFA.

The interlock connection becomes open circuit, disabling the RF output, if the temperature of the modulator exceeds 32ºC or the internal driver temperature exceeds 70ºC. An LED indicator illuminates when the Interlocks are closed and the RF is enabled (see Section 2).

3.5 Setting the optimum RF output power is best achieved with the amplifier connected to the acousto-optic modulator/deflector.

The Amplifier is fixed gain. The output power is dependent on the input power level.

The optimum RF power varies with laser wavelength.
Applying excessive RF power will cause a decrease in first order intensity (a false indication of insufficient RF power), make accurate Bragg alignment difficult and COULD DAMAGE THE AO DEVICE.

Therefore it is recommended that initial alignment be performed at a low RF power level.

3.6 To begin, adjust the input source signal level to ensure that the RF amplifier output power is less than 50% of the maximum allowed for the AO device.

3.7 Apply DC power to the amplifier.

3.8 Input the laser beam toward the centre of either aperture of the AOM. Ensure the polarization is correct for the AO crystal type and the beam height does not exceed the active aperture height of the AOM/AOD.

3.9 Start with the laser beam normal to the input optical face of the AOM and very slowly rotate the AOM/AOD (either direction).

3.10 Observe the diffracted first-order output from the acousto-optic modulator and the undeflected zeroth order beam. Adjust the Bragg angle (rotate the modulator) to maximise first order beam intensity.

3.11 After Bragg angle has been optimized, slowly increase the RF power until maximum first order intensity is obtained.

4. MAINTENANCE

4.1 Cleaning

It is of utmost importance that the optical apertures of the deflector optical head be kept clean and free of contamination. When the device is not in use, the apertures may be protected by a covering of masking tape. When in use, frequently clean the apertures with a pressurized jet of filtered, dry air.

It will probably be necessary in time to wipe the coated window surfaces of atmospherically deposited films. Although the coatings are hard and durable, care must be taken to avoid gouging of the surface and leaving residues. It is suggested that the coatings be wiped with a soft ball of brushed (short fibres removed) cotton, slightly moistened with clean alcohol. Before the alcohol has had time to dry on the surface, wipe again with dry cotton in a smooth, continuous stroke. Examine the surface for residue and, if necessary, repeat the cleaning.

4.2 Troubleshooting

No troubleshooting procedures are proposed other than a check of alignment and operating procedure. If difficulties arise, take note of the symptoms and contact the manufacturer.

4.3 Repairs

In the event of deflector malfunction, discontinue operation and immediately contact the manufacturer or his representative. Due to the high sensitive of tuning procedures and the possible damage which may result, no user repairs are allowed. Evidence that an attempt has been made to open the optical head will void the manufacturer's warranty.

Connection Summary

15 way ‘D’ Type Connections

Signal	Type	Pin out connection
RF power monitor	Output	Signal pin 2 Return pin 7
DC current monitor	Output	Signal pin 4 Return pin 8
Interlock (connect to AO modulator ‘INT’)	Input	Signal pin 5 Return pin 9
‘LED’ monitor (PLC compatible 24V/20mA = OK)	Output	Signal pin 1 Return pin 6

RF and Supply Connections

Input	Connector	Signal
RF signal	BNC	1mW 140-260MHz
DC supply	Solder terminal	24Vdc, 6A

Output	Connector	Signal
RF signal	TNC	> 35W 140-260MHz

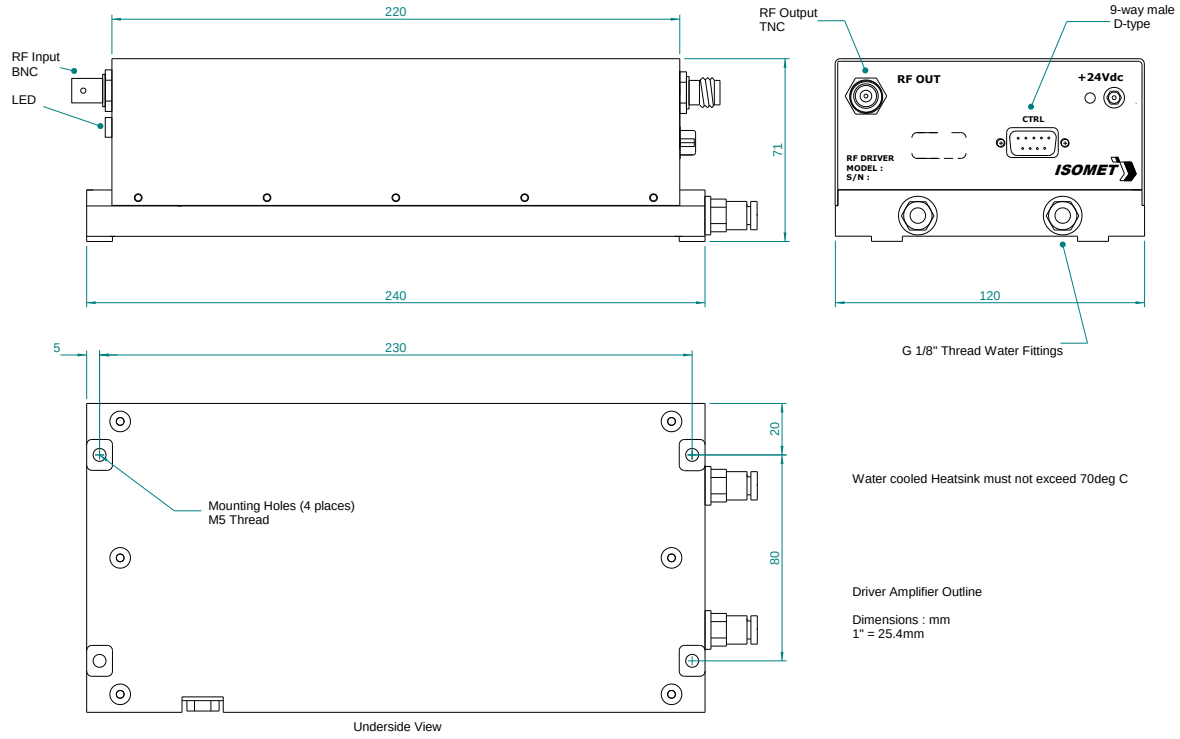


Figure 1: Driver Installation

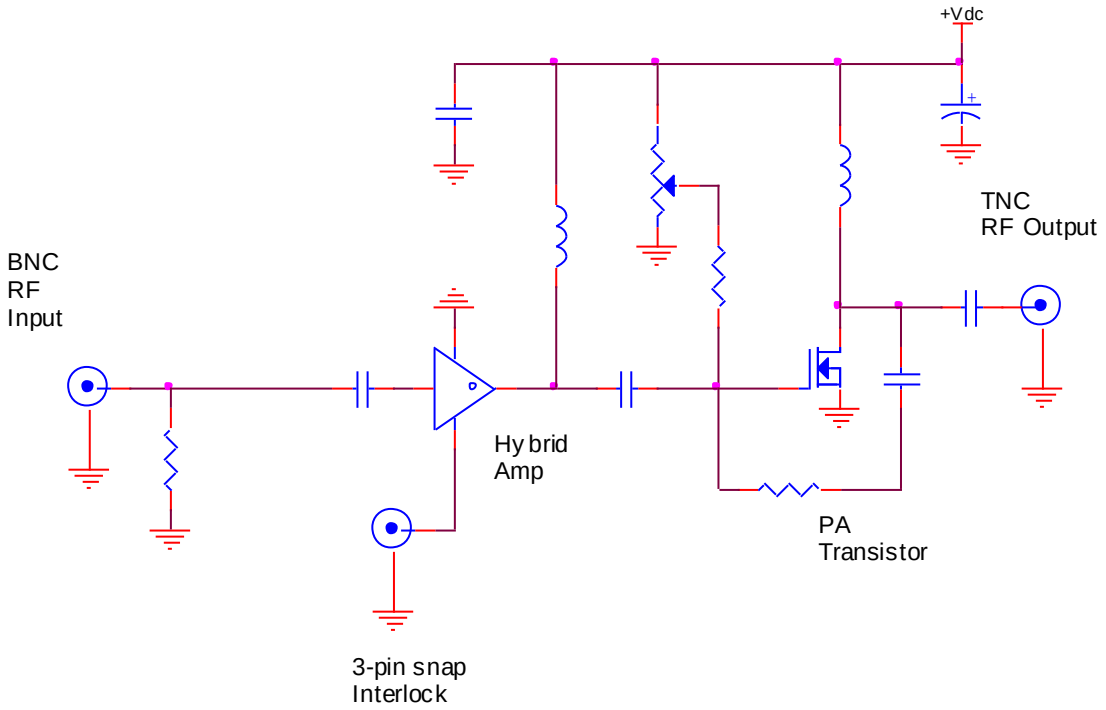
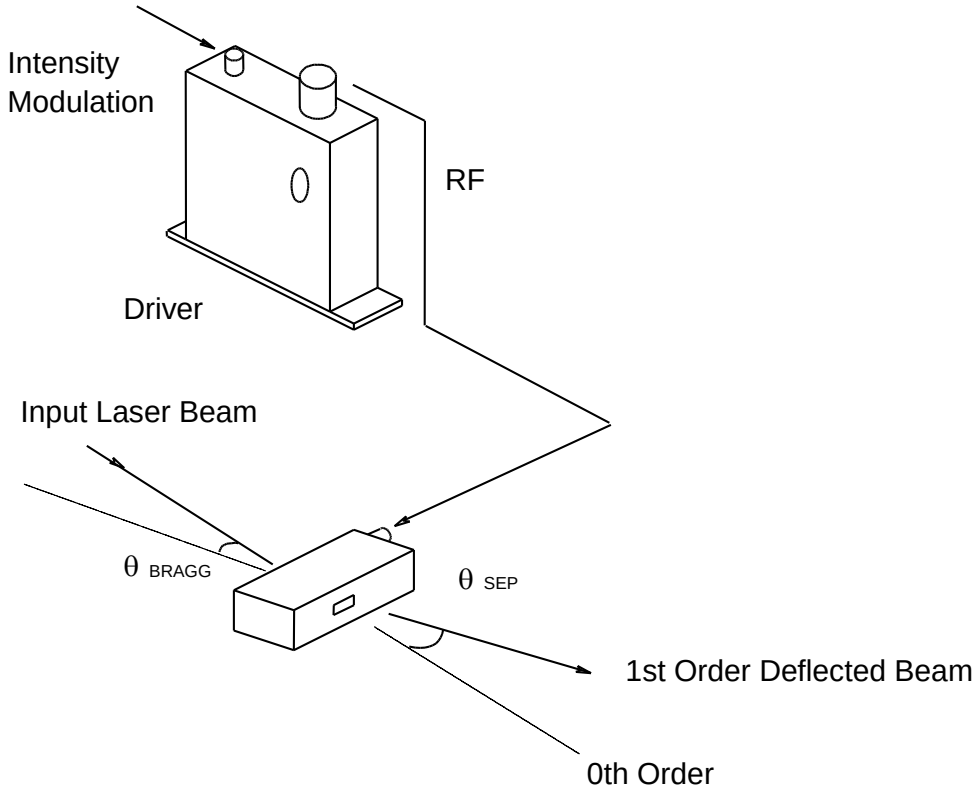


Figure 2: Driver Block Diagram

Basic AO Equations



The input Bragg angle, relative to a normal to the optical surface and in the plane of deflection is:

$$\theta_{BRAGG} = \frac{\lambda.fc}{2.v}$$

The separation angle between the Zeroth order and the First order is:

$$\theta_{SEP} = \frac{\lambda.fc}{v}$$

Optical rise time for a Gaussian input beam is approximately:

$$t_r = \frac{0.65.d}{v}$$

where: λ = wavelength
fc = centre frequency
v = acoustic velocity of interaction material

d = $1/e^2$ beam diameter