2019-09

Acousto-Optic Modulator Driver

Including: Basic Modulator Alignment

Instruction Manual

500F Series – Analog and Digital Dual Modulation

Key to model types : **5mxF-o-ff**

'm' indicates the active modulation input(s)

2	:	Digital only
3	:	Analog only
5	:	Dual

'x' indicates the base model standard frequency

1	:	40MHz
2	:	80MHz
3	:	110MHz
4	:	150MHz
5	:	200MHz
6	:	250MHz

'F' indicates case style

'o' indicates option(s)

2	:	2 Watt output
3	:	3 Watt output
4	:	4 Watt output
7	:	7 Watt output
L	:	+15V supply operation
B	:	Modulation BIAS adj pot
V	:	0-5V modulation
X	:	0-10V modulation

'ff' indicates non-standard frequency e.g.

120	:	120MHz

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1. GENERAL

The 500F series dual modulation drivers are fixed frequency RF power sources specifically designed for use with Isomet acousto-optic modulators and Q-switches, operating at a fixed centre frequency. The driver accepts two modulation signals; digital (On:Off) and analogue (proportional control). Examples of popular driver specifications are listed below:

Model

532F-2	: 80MHz, 2W output, analog only modulation, +24Vdc supply
554F-4B	: 150MHz, 4W output, dual modulation, with Bias Pot, +24Vdc supply
525F-3	: 200MHz, 3W output, digital only modulation, +24Vdc supply

Figure 2 is a block diagram of 500F series driver. The center frequency of the driver is determined by the free-running quartz-crystal oscillator. This frequency accuracy and stability are better than ± 25ppm; the oscillator is not temperature stabilized.

A high-frequency, diode ring mixer and RF analog switch are used to modulate the RF carrier according to the signals applied to the *D-mod* (5V logic) and *A-Mod* (analog) modulation inputs.

D-Mod : A 5V logic input swing from < 1.0V (off) to > 3.5 volt(on) will result in 100% depth of modulation. **The modulation input level must not exceed + 7 volts**

A-Mod : For the standard model, an input swing of 1 volt peak positive or 1 volt negative will result in 100% depth of amplitude modulation. **The video input level must not exceed ± 2 volts** (or less than 2x the A-Mod input voltage).

Both modulation inputs are required for the **55xF** variant unless a BIAS pot is fitted

The mixer output is applied to a MMIC pre-amplifier stage. This also serves to isolate the Oscillator and Mixer from the final power amplifier stage. The driver output power level is set by the Power adjust potentiometer.

The amplitude-modulated MMIC output drives the input to a DMOS FET based power amplifier. This amplifier is designed to operate at full rated power into a 50Ω load with 100% duty cycle.

Figure 3 illustrates the principal waveforms of the 500F Driver.

Conduction cooling of the driver from the mounting face to a heat sink or forced-air convection cooling is mandatory. The mounting face temperature must not exceed 60°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.

All 500F series drivers require a stable d-c power for operation. For most models the required voltage is +24 / 28Vdc at a current less than 800mA. The -L option operates from 15Vdc. The external power source should be regulated to ± 2% and the power supply ripple voltage should be less than 100mV for best results.

2. MODULATION

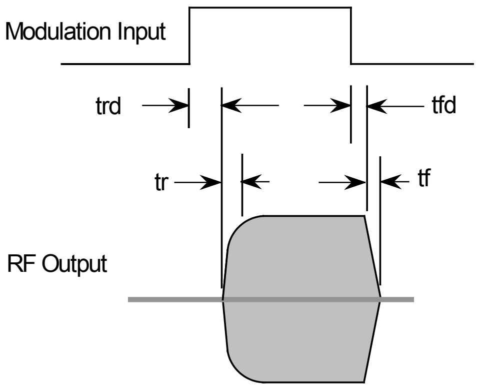
The driver features one control for the RF POWER ADJUST and two modulation inputs; *D-Mod* and *A-Mod.*

The RF POWER ADJUST control sets the peak driver output for the fully ON condition.
For the 55xF dual modulation variant, **both** *D-Mod* = Logic high **and** *A-Mod* = 1V (or BIAS pot fully CW) are required for the fully On condition.

Either input *D-Mod* = Logic Low or *A-Mod* = 0V with turn the RF off.

Typical switching and latency timing for 200MHz driver

Active Input	trd	tfd	tr	Tf
D-Mod	20ns	20ns	6ns	6ns
A-Mod	20ns	20ns	16ns	14ns



3. INSTALLATION AND ADJUSTMENT

3.1 Install the Driver on a heat sink as shown in figure 1. Use heat conducting compound between the Driver and mounting face and the heat sink.

3.2 DC power is applied via a Phoenix 3.81mm pitch connector. A mating connector with screw terminals is provided. If this is not pre-wired, ensure the +Vdc and 0V inputs are wired to the correct terminals. These are indicated on the case lid.
DO NOT APPLY POWER.

The standard 5xxF-2 and -3 models are internally regulated and can accept a wide supply voltage range between +22V to +28Vdc, with no change in RF power.

For the higher power types e.g. 5xxF-4,-6 and -7, the output power is DC supply dependent – Refer to the test data sheet supplied with the unit.
DO NOT EXCEED +28Vdc or apply reverse polarity.

Likewise, for the lower power type 5xxF-L, the output power is supply dependent.
DO NOT EXCEED +18Vdc or apply reverse polarity.

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

3.4 a) Connect a 5V Logic signal source to the digital modulation *'D-Mod'* input SMB jack
b) Connect an 50-ohm signal source to the analog modulation *'A-Mod'* input SMB jack
Both the digital and analog signal sources should be low impedance and capable of > 10mA output current

3.5 Adjustment of the RF output power is best done with Driver connected to the acousto-optic modulator. The Driver maximum output power is factory preset to a nominal level of approximately half maximum power. The value is given on the test data sheet.

The optimum RF power level required for the modulator to produce maximum first order intensity will be different at various laser wavelengths. Applying RF power in

excess of this optimum level will cause a decrease in first order intensity (a false indication of insufficient RF power) and make accurate Bragg alignment difficult. It is therefore recommended that initial alignment be performed at a low RF power level.

3.6 The PWR ADJ pot is a multi-turn type. Minimum power is when fully anti-clockwise (CCW). With an insulated alignment tool or screwdriver, rotate the PWR ADJ potentiometer CCW at least 11 turns, then CW approx 5 turns.

3.7 Apply +15V, + 24V, or +28V DC power to the driver as appropriate for the model. (Refer to specific driver test data sheet)

3.8 a) Apply a constant Logic 'High' input level to *D-mod* (> 3.5V, 10mA drive capability).

b) Apply a constant 1V "DC" input level to *A-Mod* (15mA drive capability) or if fitted, rotate the optional BIAS pot fully CW.

3.9 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.

Note: the diffraction efficiency may not exceed 20-30% at this point in the alignment procedure.

3.10 <u>After</u> the Bragg angle has been optimised, slowly increase the RF power (rotate PWR ADJ CW) until maximum first order intensity is obtained. This peaked RF drive level is termed the saturation power; 'Psat'. For applications using a well focussed input beam into the AOM, the correctly adjusted Bragg angle condition is indicated when the zero order shows a characteristic dark line through the middle of the beam at or near the Psat drive level.

WARNING

Take care not to exceed the maximum average RF power rating for the connected AO device.
Refer to AO test data sheet

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 residue of the cleaning solution. 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.

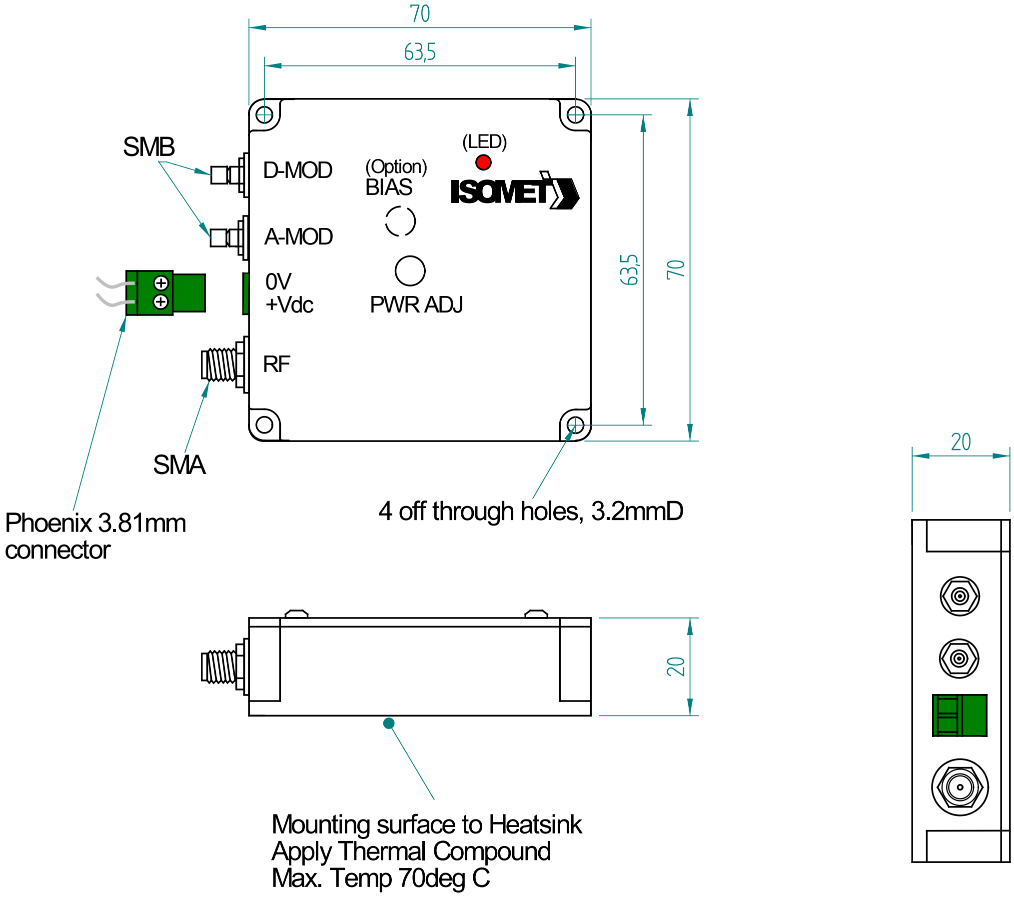


Figure 1: Driver Installation

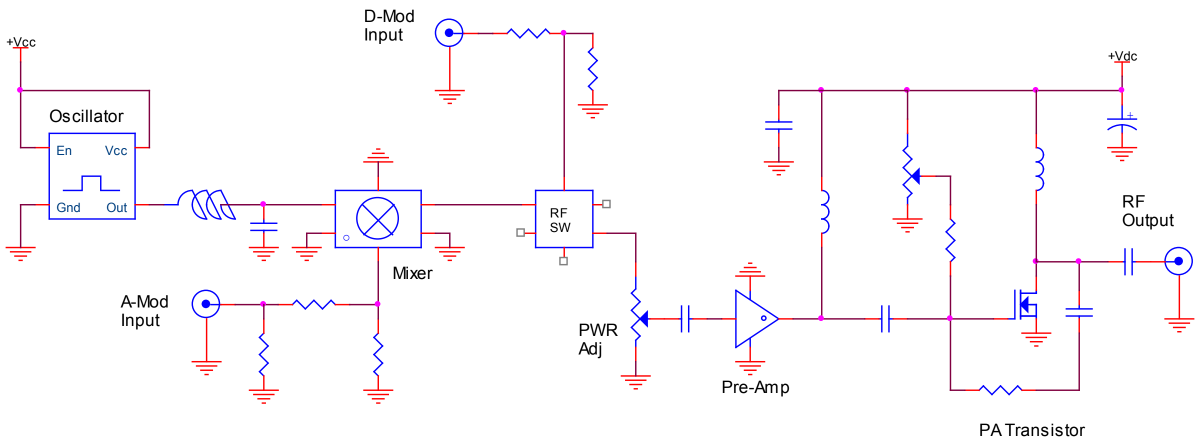
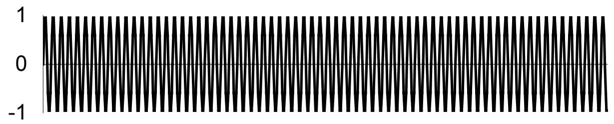
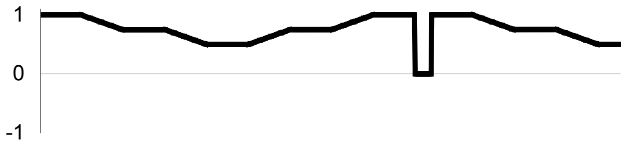


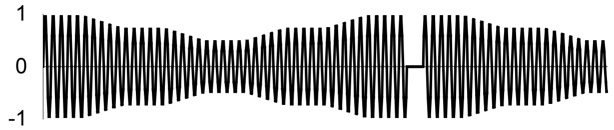
Figure 2: Driver Block Diagram



RF Carrier



Modulation Signal Input



Amplitude Modulated RF Output

Analog only modulation function shown above.(If a Dual type driver then D-Mod = constant 5V / Logic high)

For the Dual modulation type driver , the output modulation is a combination of BOTH analog and digital controls as illustrated below.

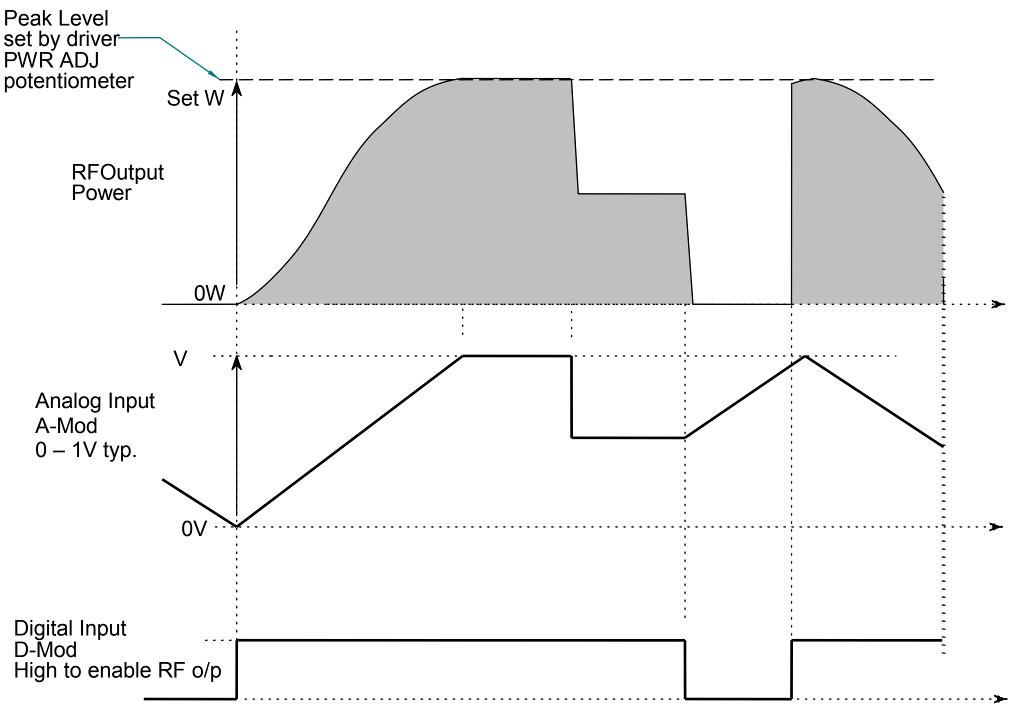
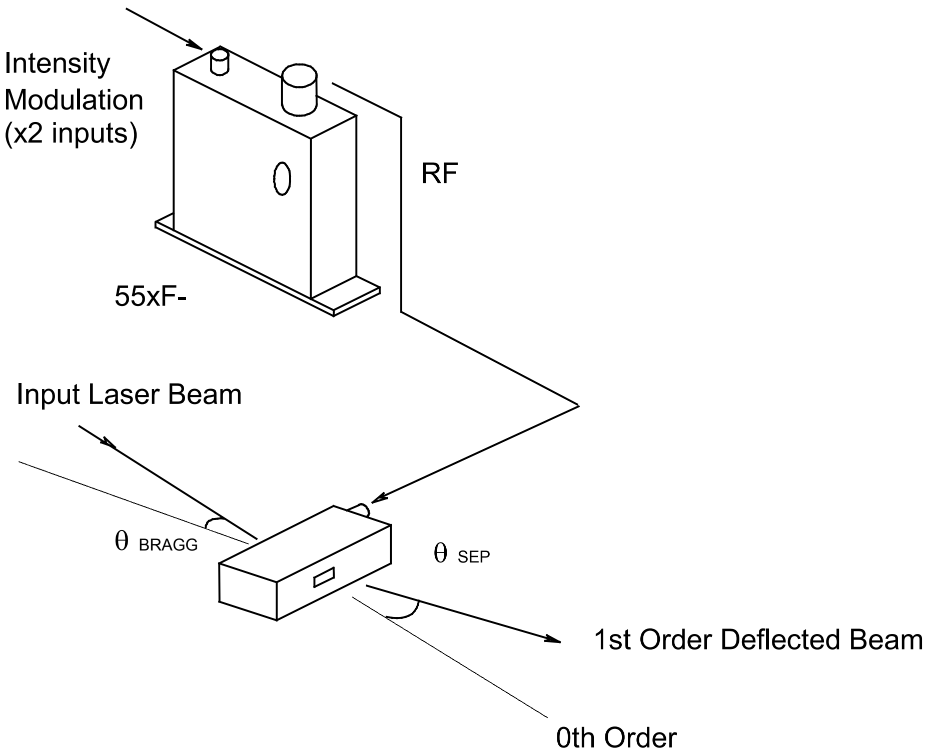


Figure 3: Typical Modulation Waveforms

Schematic for an AO modulator with 55xF series driver



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 outputs is :

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

Optical rise time for a Gaussian input beam is approximated by :

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

where : λ = wavelength
fc = centre frequency = see test data sheet
v = acoustic velocity of AO interaction material = 4.21mm/usec (TeO_2)
= 3.63mm/usec ($PbMoO_4$)
= 5.7mm/usec (Quartz)
= 5.96mm/usec (Fused Silica)
d = $1/e^2$ beam diameter

Figure 5: Modulation System