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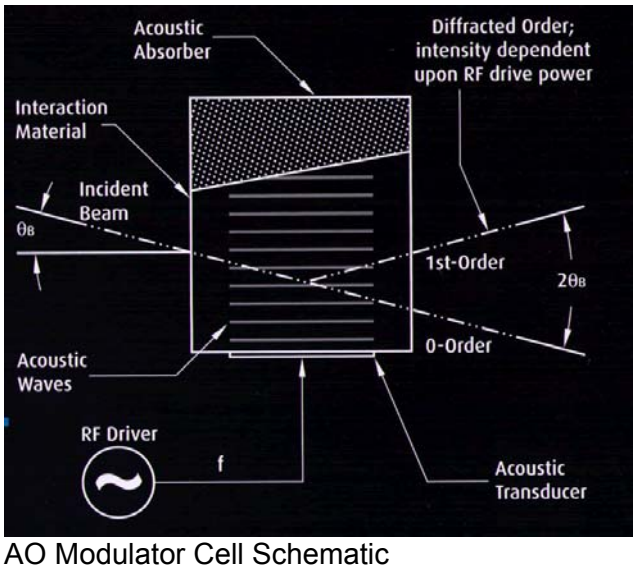
# Acousto-Optic Modulators

By virtue of having no moving parts our acousto-optic modulators (AOMs) are able to amplitude modulate a laser beam at very high speed. For example modulation bandwidths in excess of 50MHz are readily achievable.

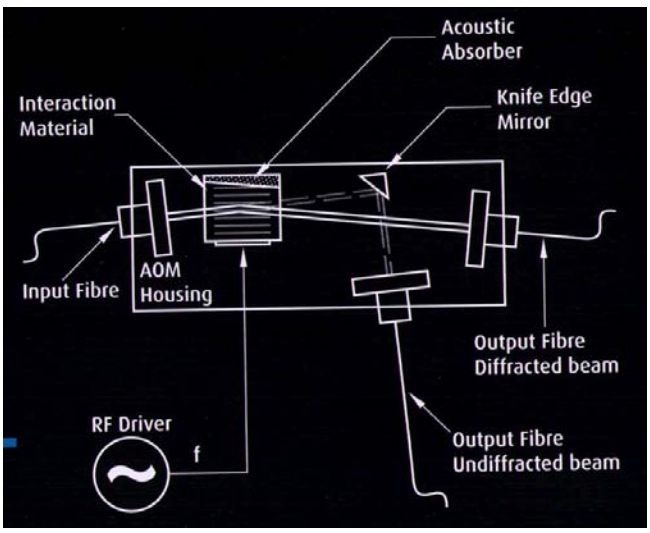
In an AOM a laser beam is caused to interact with a high frequency ultrasonic sound wave inside an optically polished block of crystal or glass (the interaction medium). By carefully orientating the laser with respect to the sound waves the beam can be made to reflect off the acoustic wavefronts (Bragg diffraction). Therefore, when the sound field is present the beam is deflected and when it is absent the beam passes through undeviated. By switching the sound field on and off very rapidly the deflected beam appears and disappears in response (digital modulation). By varying the amplitude of the acoustic waves the intensity of the deflected beam can similarly be modulated (analogue modulation).

It is usual to choose the deflected beam as the one that is used in the optical system because it can be switched on and off with high extinction ratio (typically >40dB) and intensity can be varied from zero to more that 85% of the incident beam. The rate at which the beam can be modulated is governed by the time it takes the acoustic wavefronts to traverse the laser beam, which depends on the beam diameter and the acoustic velocity in the interaction medium.

The sound waves are generated by a transducer, usually a thin wafer of lithium niobate, that is bonded onto the interaction medium using a highly efficient cold-weld metallic bonding process. When a high frequency electrical signal is applied to the transducer it vibrates, generating the acoustic wave. The signal is derived from an RF driver, which generates a high frequency carrier that is itself modulated by an analogue or digital input signal.




AO Modulator Cell Schematic




Fiber-coupled AO Modulator Cell Schematic

Principal applications for AO modulators are pre-press (putting image and text data onto films or plates as part of the printing process), laser imaging and displays, switching in telecom fibres, instrumentation and research.

# 1. Free-space Acousto-optical Modulators

We offer a wide range of standard AO Modulators, for digital or analogue intensity modulation of laser beams. Their main specifications are as follows:

- Wavelength Range: 240nm to 2100nm
- Drive Frequencies: 20MHz to 350MHz
- Optical Rise-Times: Down to 5ns
- Modulation Bandwidths: Up to 100MHz
- Interaction Materials: Tellurium Dioxide, Lead Molybdate, Fused Silica, Crystal Quartz, halcogenide Glass, Flint Glass.


An RF Driver provides the electronic signal operating the AO Modulator. With a digital driver, an external TTL signal enables rapid on and off switching of the optical beam. Alternatively an anologue driver enables a variable intensity output, typically from 0% to 85% of the input beam.

The maximum modulation bandwidth, or optical rise-time, is a function of the acoustic transit time across the optical beam. Therefore, for the highest speeds it is often necessary to focus the optical beam down to a small spot inside the modulator.

Our standard AOMs are listed below.

| Model | Description | Driver |
|---|---|---|
| I-FS080-2C2G-3-LV1 (M080-2G-LV1) | High efficiency AO Modulator for lasers where fast modulation is not critical, RF 0.5W | A35080 N21080-1DM, N21080-1AM |
| I-M110-2C10B6-3-GH26 | 400-540nm, 110MHz, 2mm aperture, RF <5W | A35110 |
| I-M110-3C10B6-3-GH27 | 300-400nm, 110MHz, 3mm aperture | |
| I-FS110-2C2B8-3-GH2 (M110-2B/F-GH2) | 480-800nm, 150ns risetime, 110MHz, 2mm aperture, RF<2W | A35110, N21110-2AM, N21110-2DM |
| I-M110-3C10B6-3-GH27 (M110-10C-TR7) | AO Modulator for wavelength 514 to 532nm, high damage threshold , RF 5W | A35110 N31110-5DM, N31110-5AM |
| 23080-1-1.55-LTD | 1550nm, 150ns/mm risetime, 80MHz, 1mm aperture, RF<2W | A35080 |
| I-M110-2C10B6-3-GH26 (M110-10UV-OR1) | 351 to 364nm, 110MHz, 110ns rise-time, Crystal Quartz for high power handling, RF 3W | A35110 N31110-3DM, N31110-3AM |
| M200-4A-GH11 | 380 to 430nm, 200MHz, 10ns rise-time. Suitable for use with Ti:Sapphire lasers, RF 2.5W | A35200 N21200-2AM, N21200-2DM |
| M200-4B/E-LD4 | High intensity RGB modulation, 200MHz, 10ns risetime, ideally suited to laser display and reprographic systems, RF 6W | N31200-6DM, N31200-6AM |
| 12038-3-BR-TE | SiO2, used for various wavelength, 38MHz, aperture 2mm, deflection 6.75mrad, RF 1W | 11038-1ML |
| 12038-3-TE | SiO2, 1064nm wavelength, 38MHz, aperture 3mm, deflection, 6.75mrad, RF 1W | 11038-1ML |
| 12041-3-BR-TE | SiO2, used for various wavelength, 41MHz, aperture 2mm, deflection 7.3mrad, RF 1W | 11041-1ML |
| 12041-3-TE | SiO2, 1064nm wavelength, 41MHz, aperture 3mm, deflection 7.3mrad, RF 1.2W | 11041-1ML |
| 12050-3-BR-TE | SiO2, used for various wavelength, 50MHz, aperture 2mm, deflection 8.9mrad, RF 1W | 11050-1ML |
| 12050-3-TE | SiO2, 1064nm wavelength, 50MHz, aperture 3mm, deflection 8.9mrad, RF 1.2W | 11050-1ML |
| 12080-3-BR-TE | SiO2, used for various wavelength, 80MHz, aperture 2mm, deflection 14.2mrad, RF 1W | 11080-1ML |
| 12080-3-TE | SiO2, 1064nm wavelength, 80MHz, aperture 3mm, deflection 14.2mrad, RF 1.2W | 11080-1ML |

| | | |
|---|---|---|
| 13389-BR | SiO2, used for various wavelength, 389MHz, aperture 60um, deflection 41mrad, RF 0.5W | 64389-SYN-9.5-X |
| 15180-1.06-LTD-GAP | GaP, 1.06um wavelength, 180MHz, aperture 0.3mm, deflection 28.7mrad, RF 1.7W | |
| 15210 | TeO2, 440-850nm wavelength, 210MHz, aperture 0.2mm, deflection 31mrad, RF1W | 21210-1xx |
| 15210-FOA/71002 | TeO2, 440-850nm wavelength, 210MHz, aperture 0.2mm, deflection 31mrad, RF1W | 21210-1xx |
| 15210-FOA | TeO2, 440-850nm wavelength, 210MHz, aperture 0.2mm, deflection 31mrad, RF1W | 21210-1xx |
| 15260 | TeO2, 440-850nm wavelength, 260MHz, aperture 0.2mm, deflection 39mrad, RF0.7W | 21260-.7xx |
| 15260-FOA/71002 | TeO2, 440-850nm wavelength, 260MHz, aperture 0.2mm, deflection 39mrad, RF1W | 21260-1xx |
| 15260-FOA | TeO2, 440-850nm wavelength, 260MHz, aperture 0.2mm, deflection 39mrad, RF1W | 21260-1xx |
| 17389-1.06-LTD-GaP | GaP, 1.06um wavelength, 389MHz, aperture 0.15mm, deflection 62mrad, RF 1W | 11389-5AM, 64389.5-SYN-9.5-X |
| 17389-.93 | TeO2, 700-1064nm wavelength, 389MHz, aperture 70um, deflection 73mrad, RF 0.7W | 11389-5AM, 64389.5-SYN-9.5-X |
| 17389-.93-FOA | TeO2, 700-1064nm wavelength, 389MHz, aperture 70um, deflection 73mrad, RF 0.7W | 11389-5AM, 64389.5-SYN-9.5-X |
| 35085-0.5-350 | Fused silicon, 300-400nm wavelength, 85MHz, aperture 0.5mm, deflection 5mrad, RF 6W | 31085-6xx |
| 35085 | Fused silicon, 400-540nm wavelength, 85MHz, aperture 0.5mm, deflection 5mrad, RF 6W | 31085-6xx |
| 35085-3-350 | Fused silicon, 300-400nm wavelength, 85MHz, aperture 3mm, deflection 5mrad, RF 3W | 31085-3xx |
| 35085-3 | Fused silicon, 400-540nm wavelength, 85MHz, aperture 3mm, deflection 5mrad, RF 6W | 31085-6xx |
| 35110-2-244 | KrF grade fused silica, 244nm wavelength, 110MHz, aperture 2mm, deflection 4.5mrad, RF 2W | 21110-2xx |
| 35210-BR/71004 | Fused silica, 300-700nm wavelength, 210MHz, aperture 0.13mm, deflection 17mrad, RF 6W | 31210-6xx |
| 35210-BR | Fused silica, 300-700nm wavelength, 210MHz, aperture 0.13mm, deflection 17mrad, RF 6W | 31210-6xx |
| 35250-.2-.53-XQ | Crystal quartz, 532nm wavelength, 250MHz, aperture 0.2mm, deflection 23mrad, RF 6W | 31250-6xx |
| 37027-3 | Ge, 10.6um wavelength, 27.12MHz, aperture 3mm, deflection 52nm, RF 30W | R39027-30DSA05 |
| 37027-5 | Ge, 10.6um wavelength, 27.12MHz, aperture 5mm, deflection 52nm, RF 30W | R39027-35DSA05 |

## 2. Fiber-coupled Acousto-optical Modulators

Our standard fibre-coupled AOMs (FCAOM) are listed below. If you would like to see a detailed technical data sheet just go on the relevant model number. If you do not see a device that meets your requirements please contact one of our engineers. We manufacture application-specific AOMs and would be pleased to design one that meets your needs.
The devices listed are aimed at fibre-optic telecommunications applications but we can also offer fibre-coupled versions of our standard AOMs, if required. If you are considering a non-standard device, or are just not sure which of the listed devices would suit you best, you may find it useful to email us with your questions.

We offer a wide range of standard fibre-coupled AOMs with the following characteristics: -

- Wavelengths: 1310nm or 1550nm
- Drive Frequencies: 40MHz, 80MHz or 110MHz
- Optical Rise-Times: as low as 10ns
- Materials: Tellurium Dioxide & Chalcogenide Glass
- Options: Single mode, polarisation maintaining and multimode, with or without connectors. Available in two, three or four fibre package configurations.

Description of Part Number:
**T-M150-0.4C2G-3-F2S:**
M = Modulator
150 = Drive frequency in MHz
2 = Tellurium Dioxide (interaction material)
F2 = 2 port fibre-coupled
S or P = Single Mode or Polarisation Maintaining.

| Model | Description | Driver |
|---|---|---|
| T-M080-0.4C2J-3-F2P | 1550nm, RF frequency 80MHz & RF power ≤3W, average optical power handling 1W, fiber Fujikura PM1550 (SM15-PSU25A), no connector | A35080 |
| T-M080-0.4C2J-3-F2S | 1550nm, RF frequency 80MHz & RF power ≤3W, average optical power handling 1W, fiber SMF28), no connector | A35080 |
| T-M150-0.4C2G-3-F2P | 1060nm, RF frequency 150MHz & RF power ≤2W, average optical power handling 5W, fiber Fujikura PM980 (SM98-PS-U25A) ), no connector | A35150 |
| T-M150-0.4C2G-3-F2S | 1060nm, RF frequency 150MHz & RF power ≤2W, average optical power handling 5W, fiber HI1060), no connector | A35150 |
| T-M200-0.1C2J-3-F2P | 1550nm, RF frequency 200MHz & RF power ≤3W, average optical power handling 1W, fiber Fujikura PM1550 (SM15-PSU25A) ), no connector | A35200 |
| T-M200-0.1C2J-3-F2S | 1550nm, RF frequency 200MHz & RF power ≤3W, average optical power handling 1W, fiber SMF-28), no connector | A35200 |
| T-M200-0.1C2G-3-F2P | 1060nm, RF frequency 200MHz & power 3W, average optical power handling 1W, fiber Fujikura PM980 (SM98-PS-U25A) ), no connector | A35200 |
| T-M200-0.1C2J-3-F2S | 1060nm, RF frequency 200MHz & RF power ≤3W, average optical power handling 1W, fiber SMF-28), no connector | A35200 |
| 15200-.2-1.55-LTD-GaP-FO | Gap, 1.55um wavelength, linear polorisation, rise/fall time 10ns, 8/125 PM fiber, 200MHz, RF 2W | 21200-2xx |
| 15200-.2-1.06-LTD-GaP-FO-GH | Gap, 1.06um wavelength, linear polorisation, rise/fall time 10ns, 6/125 PM fiber, 200MHz, RF 2W | 21200-2xx |
| 23080-1-1.3-LTD-FO | TeO2, 1300nm, 80MHz, random, risetime 50ns, single mode fiber 9/125 (PM 8/125 optional), RF <1.5W | 21080-2xx |
| 23080-1-1.06-LTD-FO | TeO2, 1060nm, 80MHz, random, risetime 50ns, single mode fiber 6/125 (PM 6/125 optional), <0.5W @ 1060nm, Used external to laser cavity, RF <1.25W | 21080-1xx |
| 23080-1-1.06-LTD-FO-HP | TeO2, 1060nm, 80MHz, random, risetime 50ns, single mode fiber 6/125 (PM 6/125 optional), <2W @ 1060nm, Used external to laser cavity, RF <1.25W | 21080-1xx |
| 23080-1-1.06-LTD-FO-2HP | TeO2, 1060nm, 80MHz, random, risetime 50ns, single mode fiber 6/125 (PM 6/125 optional), <2W @ 1060nm, may be used internal to laser cavity), RF <1.25W | 21080-1xx |
| 23080-1-1.55-LTD-FO | TeO2, 1520-1570nm, 80MHz, random, risetime 50ns, single mode fiber 9/125, RF <2W | 21080-2xx |
| 26035-2-1.3-LTD-FO | AMTIR, 1300nm, 35MHz, random, risetime 100ns, single mode fiber 9/125 (PM 8/125 optional), RF <0.5W | 21035-0.4xx |
| 26035-2-1.55-LTD-FO | AMTIR, 1520-1570nm (1570-1620nm optional), 35MHz, random, risetime 100ns, single mode fiber 9/125 (PM 8/125 optional), RF <0.5W | 21035-0.4xx |
| 26055-1-1.55-LTD-FO | AMTIR, 1520-1570nm (1570-1620nm optional), 55MHz, random, risetime 100ns, single mode fiber 9/125, 3 ports, RF <1W | 21055-0.4xx |
| 26055-1-1.55-LTD-3FO | AMTIR, 1550nm, 55MHz, random, risetime 100ns, single mode fiber 9/125, 3 ports, RF <1W | 21055-0.4xx |
| 26055-1-1.55-LTD-4FO | AMTIR, 1550nm, 55MHz, random, risetime 100ns, single mode fiber 9/125, 4 ports, RF <0.5W | 21055-0.4xx |
| 54035-1.55-.5AS-FO | AMTIR, 1520-1570nm (1570-1620nm optional), 35MHz, random, risetime 100ns, single mode fiber 9/125, 1, 2, 3 or 4 channels | Driver integrated |
| 54055-1.55-.5DS-3FO | AMTIR, 1550nm, 55MHz, random, risetime 100ns, single mode | Driver |

| | | |
|---|---|---|
| | fiber 9/125, 3 ports | integrated |
| 54080-1.55-2DS | TeO2, 1520-1570nm (1570-1620nm optional), 80MHz, random, risetime 50ns, single mode fiber 9/125, 1, 2, 3 or 4 channels | Driver integrated |

Remark:

- xx in the driver model (such as 21200-2xx) may be DM, AM, DS or AS
- Standard connector is FC/PC (not applicable for T-M080, T-M150 and T-M200 series). We also commonly supply the following options: FC/APC, SC/PC & SC/APC. (Remark: 1. FC = Named as "Frank Charlie", screw-in type metal plug connector; 2. SC = Named as "Sam Charlie", square type plastic connector. 3. PC = Polished Connector, usually with Return Loss (RL) > 40dB (min) [eg. FC/PC, SC/PC]; 4. APC = 8 deg Angled-Polished Connector, usually with RL > 50dB (min) [eg. FC/APC, SC/APC])

## 3. AOM Drivers

| | 31xxx-yyAM<br>31xxx-yyDM | 21xxx-yAM<br>21xxx-yDM | A35xxx-S-1/50-p4k7u | A36xxx |
|---|---|---|---|---|
| RF power, W | 2-20W | 0.4, 1 or 2W | 0~5W (Analogue) | 2W |
| RF frequency, MHz | 24-260 | 27-300 | 80, 100, 110, 150, 200, 250, 300, 350 | |
| Max. modulation frequency, MHz | | | <1/3 carrier frequency and <50MHz | |
| Input modulation | Analogue or digital | | Analogue and digital | |

**Description of N series drivers:**
**xxx** = a fixed frequency of between 27 and 300 MHz crystal controlled.
**y** = 0.4, 1, or 2 Watts output (N21 series), 2-20W adjustable output (N31 series)
**D** = Digital Modulation or **A** = Analogue Modulation
**M** = OEM Module

**Description of A35xxx and A36xxx series drivers:**
♦ Low profile housing
♦ Various standard frequencies, other frequencies from 80 to 350 MHz available
♦ Analogue and digital modulation
♦ EMC-safe design, power stage and control circuits separately grounded, entirely shielded
♦ Supply voltage 24VDC

| Type | RF Power [W] | Standard Frequencies [MHz] | | | | | | | | RF on/off ratio guaranteed at any RF output level |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 80 | 100 | 110 | 150 | 200 | 250 | 300 | 350 | |
| | | *080* | *100* | *110* | *150* | *200* | *250* | *300* | *350* | |
| *A36___* | 2 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | TBD |
| *A35___* | 5 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ≥ 65 dB |

## 4. Connector Set for A35xxx & A36xxx series AOM Driver

This accessory provides the connection of the analogue and digital modulations interface as well as the power connection for the A35xxx and A36xxx AOM driver series.

It comprises the fully shield plug and 1 meter pigtails. The RF connecting cable between the RF driver and the AOM is not included.

Ordering Code : 508A00169

# 1. Free-space Acousto-Optic Modulators (AOMs)

## 1.1 AO Modulator M080-2G-LV1

• High efficiency (95% typical)
• Low drive power (0.3W typical)
• Compact
• Easy to align

**Description**
The M080-2G-LV1 is a compact AO Modulator specifically designed for extra-cavity modulation of Nd:YAG/Nd:YVO4 lasers where fast modulation is not critical.

Rise times down to 10µs are readily achievable, together with excellent efficiency, typically > 95% for a well-collimated laser beam.

The relatively wide field of view means that good efficiency is achieved for more divergent beams.


**Specification**
Interaction Material: TeO2
Wavelength: 1064nm
Anti-Reflection Coating: < 0.3% per surface
Polarisation Alignment: ±5°
Frequency: 80MHz
Input Impedance: 50Ω
Acoustic Mode: Slow Shear
Active Aperture: 2.0 x 5.0mm
Clear Aperture: 4.0 x 5.0mm (min)
Recommended Beam Diameter: 1mm
Input Polarisation: Linear - vertical to base
Diffracted Beam Polarisation: Linear - rotated by 90° wrt input
Diffraction Efficiency: > 90%
RF Connector: SMA Female
RF Power: 0.5W
RF Driver Model No.: A36080, N21080-1DM or N21080-1AM

## 1.2 AO Modulator M111-10C-TR7

• 514 to 532 nm
• High damage threshold
• 111MHz drive frequency

**Description**
An acousto-optic modulator ideal for use with frequency doubled DPSS lasers.

Manufactured in Crystal Quartz for improved thermal management and efficiency. This modulator combines high quality optical finishing with in house anti-reflection coatings to provide high extinction ratio and optimised throughput.

Alternative wavelengths, apertures or package designs are available.


**Specification**
Interaction Material: Crystal Quartz
Wavelength: 514 to 532nm
Anti-Reflection Coating: < 0.3% per surface
Transmission: > 99.5%
Polarisation: Linear, vertical to base
Extinction Ratio (1st order on / off) > 55dB
Damage Threshold: > 50KW/cm2 (Average)
> 500MW/cm2 (Peak)

Frequency: 111MHz
VSWR: < 1.2:1 (50Ω input impedance)
Active Aperture: 2.0mm
Diffraction Efficiency: > 85%
Rise-Time / Fall-Time: 110ns / mm
Separation Angle: 9.6mrad at 515nm
RF Power: < 5.0W
RF Driver Model No.: A35111, N31111-5DM, N31111-5AM

### 1.3 AO Modulator M080-2B/F-GH2

• 480 to 800nm
• 80MHz drive frequency
• Up to 2mm beam diameter

**Description**

A general purpose acousto-optic modulator for use in the visible or near infra-red spectral regions. It's broadband anti-reflection coatings and large active aperture make it the ideal choice for cost-effective amplitude modulation of a wide range of low-power gas and diode lasers.

Available for the visible (B/E) and near infra-red (F), with active apertures of 2mm, laser beams with diameters ranging from 0.5 to 2mm may be modulated at moderate speed with high efficiency. For faster modulation, please refer to our extensive range of other AO modulators.

**Specification**

Interaction Material: Tellurium Dioxide
Wavelength: 480 to 800nm
Anti-Reflection Coating: < 0.5% per surface
Transmission: > 95%
Polarisation: Any
Frequency: 80MHz
VSWR: < 1.2:1 (50Ω input impedance)
Active Aperture: 2mm
Rise-Time / Fall-Time: 155ns/mm
Diffracted Beam Ellipticity: < 5% typical
Diffraction Efficiency: > 85% typical
RF Power: < 2W

**Driver Selection:**

A36080,
Digital Modulation: N21080-2DM
Analogue Modulation: N21080-2AM


### 1.4 AO Modulator M250-2x-xx

• 488, 532 and 633nm
• 250MHz drive frequency
• 10ns rise-time

**Description**

An acousto-optic modulator combining high efficiency and fast switching speed, suitable for use with visible wavelength lasers. This AOM features excellent extinction ratio, superb diffraction efficiency even at maximum modulation rates and minimal optical beam quality distortion.

Options include a choice of mounting and pivot holes, RF connectors and aperture dimensions. Alternative models in lead molybdate or for other wavelengths are available.

**Specification**

Interaction Material: Tellurium Dioxide
Acoustic Mode: Isotropic, compressional
Wavelength M250-2B-P2: 488nm, < 20mW

M250-2C-ES1: 532nm, < 20mW
M250-2E-O2: 633nm
Anti-Reflection Coating: < 0.2% per surface
Transmission: > 97%
Polarisation: Linear, vertical to base
Frequency: 250MHz
VSWR: < 1.2:1 (50Ω input impedance)
Active Aperture: 0.4mm
Separation Angle: 28 to 37mrad, wavelength dependant
RF Power: < 1.5W

*Performance with a 65µm diameter, linearly polarised beam:*
Rise-Time / Fall-Time: 10ns
Modulation Bandwidth: 50MHz
Diffracted Beam Ellipticity: < 10%
Diffraction Efficiency: > 85%

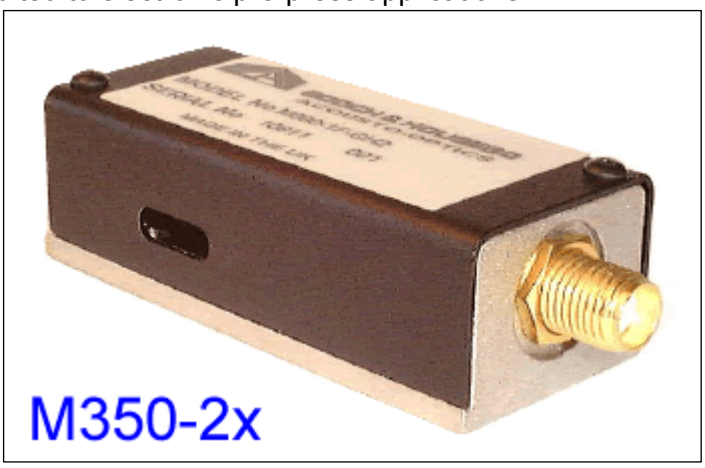
**Driver Selection**
A36250, N21250-2AM, N21250-2DM

### 1.5 AO Modulator M350-2x

• 488nm, 532nm and 633nm
• 350MHz drive frequency
• 5ns rise-time

**Description**
A high bandwidth acousto-optic modulator, for use in the visible RGB spectral region. Using specially selected top-grade tellurium dioxide and with our renowned quality manufacturing processes, this modulator provides fast switching capability at low RF drive powers.

Available in three models, one each for red, green and blue, high efficiency coupled with excellent transmitted beam quality make it particularly suited to electronic pre-press applications.




**Specification**
Interaction Material: Tellurium Dioxide
Acoustic Mode: Isotropic, compressional
Wavelength M350-2B: 488nm, < 20mW
M350-2C: 532nm, < 20mW
M350-2E: 633nm
Anti-Reflection Coating: < 0.2% per surface
Transmission: > 97%
Polarisation: Linear, vertical to base
Frequency: 350MHz
VSWR: < 1.2:1 (50Ω input impedance)
Active Aperture: 0.15mm
Separation Angle: 40 to 52mrad, wavelength dependant
RF Power: < 2W
*Performance with a 30µm diameter, linearly polarised beam:*
Rise-Time / Fall-Time: 5ns
Modulation Bandwidth: 100MHz
Diffracted Beam Ellipticity: < 15%
Diffraction Efficiency: > 80%

**Driver Selection**
Analogue / Digital Modulation: A35350

### 1.6 AO Modulator M111-2J-AV1

• 1520 to 1630nm

• 111MHz drive frequency
• 60ns rise-time

**Description**
A free-space acousto-optic modulator appropriate for use either intra-cavity or extacavity, for example to Q-Switch or modulate erbium doped fibre lasers.

Broadband anti-reflection coatings, combined with top grade tellurium dioxide, guarantee excellent throughput and beam quality. Special design and high quality manufacturing processes result in superior efficiency with excellent extinction ratio.

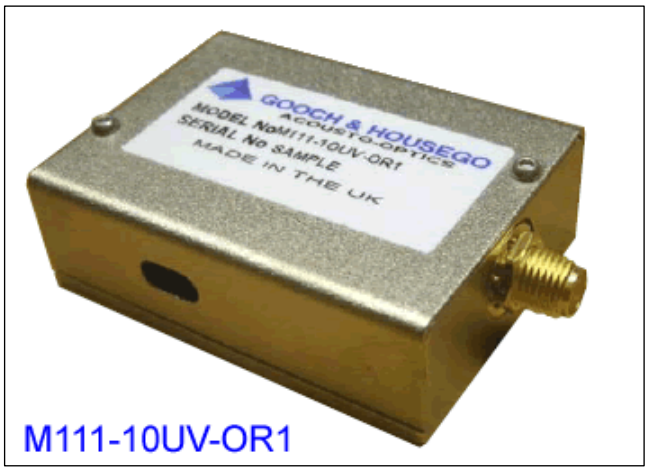
**Specification**
Interaction Material: Tellurium Dioxide
Acoustic Mode: Isotropic, compressional
Wavelength: 1520nm to 1630nm
Transmission: > 97%
Damage Threshold: >10MW/cm2 Pulsed, >50KW/cm2 CW
Polarisation: Any
Frequency: 111MHz
VSWR: < 1·2:1 (50Ω Input Impedance)
Active Aperture: 0.65mm
Separation Angle: 39 to 43mrad, wavelength dependant
RF Power: 3·5W
Operating Temperature: +10 to +60ºC
Storage Temperature: - 15 to +65ºC


*Performance with a 400µm diameter, linearly polarised beam:*
Rise-Time / Fall-Time: 61ns
Modulation Bandwidth: 8.2MHz
Extinction Ratio: > 40dB
Diffracted Beam Ellipticity: < 20%
Diffraction Efficiency: > 85%

**Driver Selection**
A35111, N31111-3.5DM or N31111-3.5AM

### 1.7 AO Modulator M110-10UV-OR1

• 351, 355 & 364nm
• High damage threshold
• 110MHz drive frequency




**Description**
An acousto-optic modulator ideal for use with 355nm frequency tripled Nd:YAG and Nd:YVO4 or 351nm / 364nm Argon lasers.

Manufactured in Crystal Quartz for improved thermal management & efficiency. This modulator combines high quality optical finishing with in house anti-reflection coatings to provide high extinction ratio and optimised throughput.

Alternative wavelengths, apertures or package designs are available. Please don't hesitate to contact us with your specific requirements.

**Specification**
Interaction Material: Crystal Quartz
Wavelength: 351 to 364nm

Anti-Reflection Coating: < 0.3% per surface at 355nm
< 0.5% per surface at 351 to 364nm
Transmission: > 99% at 355nm
> 98.6% at 351 to 364nm
Polarisation: Linear, vertical to base
Extinction Ratio (1st order on / off) > 55dB
Damage Threshold: > 50KW/cm2 (Average)
> 500MW/cm2 (Peak)
Frequency: 110MHz
VSWR: < 1.2:1 (50Ω input impedance)
Active Aperture: 3.0mm
Diffraction Efficiency: > 85%
Rise-Time / Fall-Time: 110ns / mm
Separation Angle: 6.5mrad at 355nm
RF Power: < 3.0W

**Driver Selection**
A35111, N31111-3DM or N31111-3AM


### 1.8 AO Modulator M200-4A-GH11
• 380 to 430nm AO modulation
• 200MHz drive frequency
• 10ns rise-time

**Description**
An acousto-optic modulator suitable for use with frequency doubled Ti:Sapphire lasers.

Manufactured in fused silica and with our superior high damage threshold anti-reflection coatings this modulator provides extremely fast digital or analogue switching, coupled with an ultra-high extinction ratio and optimised throughput.

**Specification**
Interaction Material: Fused Silica
Acoustic Mode: Isotropic, compressional
Wavelength: 380 to 430nm
Polarisation: Linear, vertical to base
Anti-Reflection Coating: < 0.5% per surface
Transmission: > 98.5%
Extinction Ratio (1st order on/off): > 55dB
Frequency: 200MHz
Active Aperture: 0.20mm
Input Impedance: 50Ω
Maximum RF Power Requirement: 2.5W
Operating Temperature: +10 to +60°C
Storage Temperature: -15 to +70°C

**Performance characteristics at 405nm:**
Beam Diameter: 90µm
Rise-Time (10-90%): 10ns
Modulation Bandwidth (3dB): 50MHz
Diffracted Beam Ellipticity: < 15%
Separation Angle: 13.5mrad
Diffraction Efficiency: > 80%
RF Power: 2W

**Driver Selection**
A35200, N21200-2AM or N21200-2DM

### 1.9 AO Modulator M200-4B/E-LD4
• High intensity RGB modulation

• 200MHz drive frequency
• 10ns rise-time

**Description**
An acousto-optic modulator for use with high intensity RGB lasers, ideally suited for laser display and reprographic applications.

Manufactured in fused silica and with our superior high damage threshold anti-reflection coatings this modulator provides extremely fast digital or analogue switching in the RGB range, coupled with an ultra-high extinction ratio and optimised throughput.

**Specification**
Interaction Material: Fused Silica
Acoustic Mode: Isotropic, compressional
Wavelength: RGB
Polarisation: Linear, vertical to base
Laser Power Maximum: > 100W
Anti-Reflection Coating: < 0.5% per surface
Transmission: > 97%
Extinction Ratio (1st order on/off): > 55dB
Frequency: 200MHz
Active Aperture: 0.20mm
Input Impedance: 50Ω
Maximum RF Power: 6W
Operating Temperature: +10 to +60°C
Storage Temperature: -15 to +70°C


| **Wavelength:** | **446nm** | **532nm** | **628nm** |
|---|---|---|---|
| Beam Diameter: | 90µm | 90µm | 120µm |
| Rise-Time (10-90%): | 10ns | 10ns | 13.5ns |
| Modulation Bandwidth (3dB): | 50MHz | 50MHz | 37MHz |
| Diffracted Beam Ellipticity: | 16% | 21% | 17% |
| Separation Angle: | 15mrad | 18mrad | 21mrad |
| Diffraction Efficiency: | > 80% | > 80% | > 80% |
| RF Power: | 3W | 4W | 5.5W |

**Driver Selection**
N31200-6DM, N31200-6AM

### 1.10 M080-2B/F-GH2

| | |
|---|---|
| Device | AO Modulator |
| Interaction Material | Tellurium Dioxide |
| RF Frequency | 80MHz |
| Wavelength | 480 - 800nm |
| AR Coating Reflectivity | ≤ 0.5% /surface |
| Transmission | ≥ 95% |
| Input Polarisation | Any |
| Active Aperture | 2.0mm |
| Diffraction Efficiency | ≥ 85% |
| Risetime | 155ns / mm |
| RF Input Impedance | 50Ω |
| RF Drive Power | < 2W (wavelength dependent) |
| RF Connector | SMA Female |
| Driver | N21080-2AM or N21080-2DM or A36080 |

# 2. Fiber-coupled Acousto-Optic modulators (AOMs)

## 2.1 T-M150-0.4C2G-3-F2S

Gooch & Housego specialises in providing optical components for high power fibre laser and amplifier systems. In-house control of critical manufacturing processes, from crystalline material selection and orientation, cutting, polishing and AR coating through to fibre coupling, ensure our components are of the highest optical quality.

The 'Fibre-Q' Acousto-Optic Modulator is designed for use in pulsed fibre laser amplifier systems. In addition to the standard product shown, custom configurations are available for specialized applications.

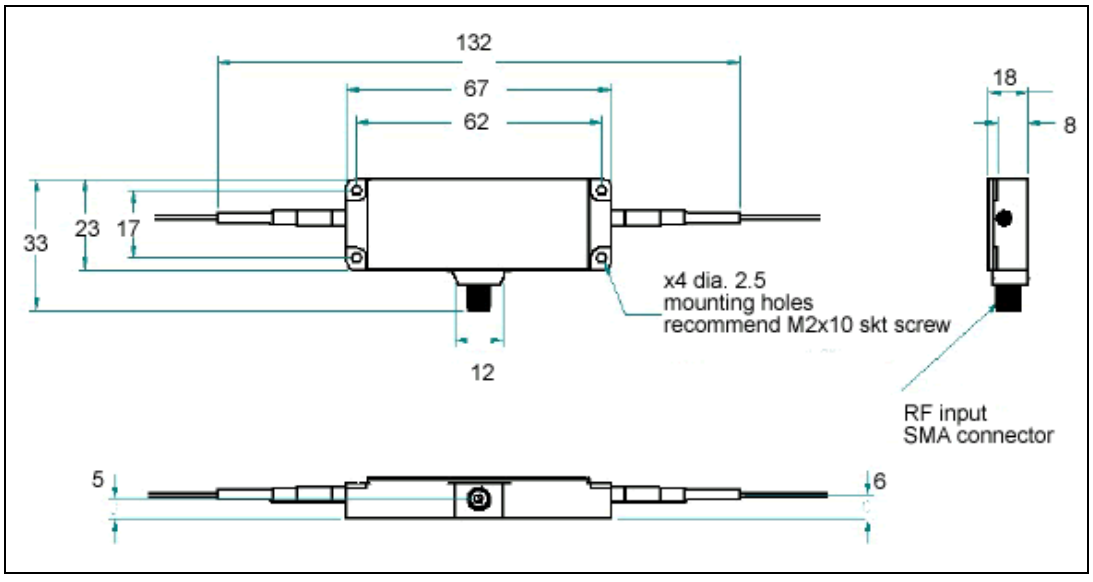
**Key Features:**
_ Low insertion loss
_ Compact, low profile package
_ Rugged hermetic design
_ Stable performance
_ Custom configurations available


**Applications:**
_ Fibre laser
_ Fibre amplifier
_ Pulse picker

**General Specifications**

| | |
|---|---|
| Interaction material: | Tellurium Dioxide |
| Wavelength: | 1060 - 1090nm (other wavelengths available on request) |
| Average optical power handling: | 5W |
| Peak (pulse) optical power handling: | 30kW typical (dependent on pulse width) |
| Insertion loss: | < 2dB |
| Return loss: Extinction ratio (1st order on / off) | > 40dB (>50dB version available on request) > 50dB |
| Rise-time / fall-time: | 30ns |
| Frequency: | 150MHz |
| VSWR: | < 1.2:1 |
| Input impedance: | 50Ω |
| RF power: | < 2.0W |
| Frequency shift: | 150MHz (up-shift) |
| Fibre type: | Hi1060 (900µm sleeving, 1.5m length) |
| Fibre termination: | Bare fibre |
| Recommended RF driver: | A35150 |

**Ordering Code:**
Explanation: T-M150-0.4C2G-3-F2S (Modulator, 150MHz, 0.4mm active aperture, compressional mode, Tellurium Dioxide, 1064nm, SMA female bulk head connector, 2 fibre, single mode (Hi1060)



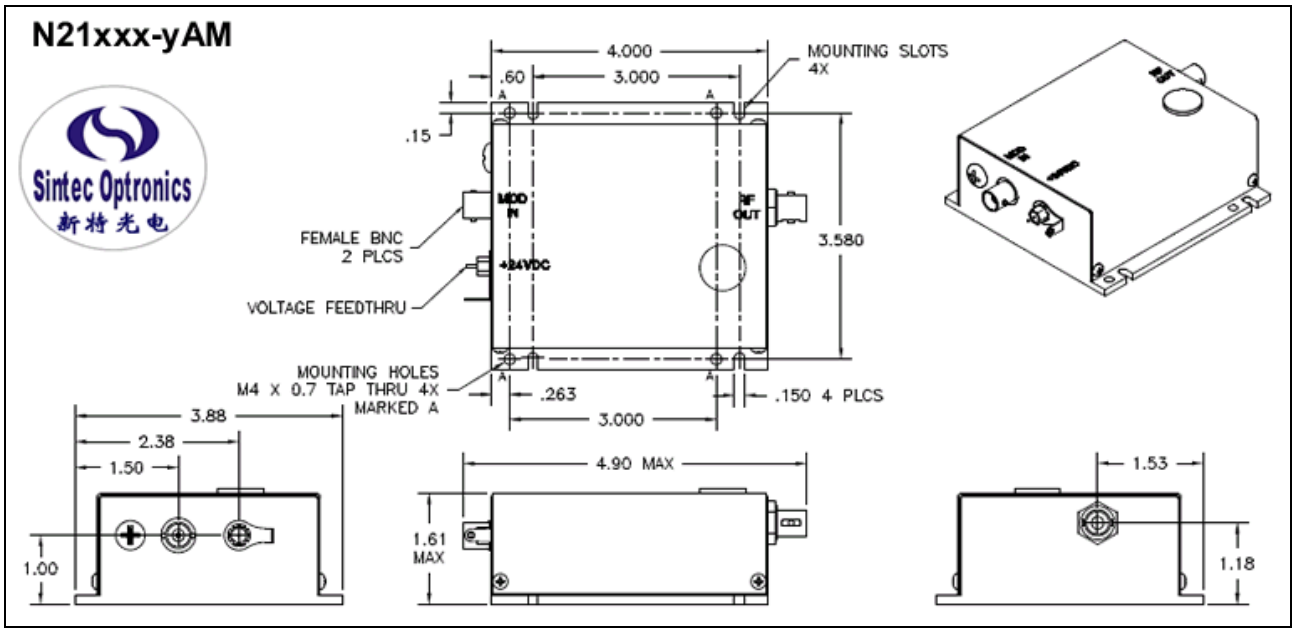
# 3. AOM Drivers

## AOM Driver: N21xxx-yDM (27 to 300MHz, 0.4 to 2W)

The N21xxx-yDM OEM Module Is A RF Driver With Digital Modulation Input And Maximum 2 Watt Output Into A 50 Ohm Load. The model number is described as follows:

**xxx** = a fixed frequency of between 27 and 300 MHz crystal controlled.
**y** = 0.4, 1, or 2 Watts output
**D** = Digital Modulation
**M** = OEM Module

| **Parameter** | **Specification** |
|---|---|
| Output Frequency (**xxx**) | 27 to 300 MHz + 0.01% Quartz Stabilized |
| Spurious Levels | -50 dBc Maximum |
| Harmonic Distortion | -15 dBc Maximum |
| Digital Input | TTL Levels (TTL HIGH = Full RF Power; TTL LOW = Minimum RF Power) |
| Extinction Ratio | 50 dB Minimum |
| RF Rise | 20 ns Maximum |
| PRF | 10 to 90 % |
| Fall Time | 20 ns Maximum |
| PRF | 90 to 10 % |
| RF Output Power (**y**) | 0.4, 1 or 2 Watts Nominal, Adjustable. Factory Set for Optimum Performance When Paired with a NEOS AO Device. |
| Output Impedance | 50 Ohms Nominal |
| Supply Voltage | + 24 VDC + 0.5 Volt |
| Supply Current | 1 Amp Maximum |
| **MAXIMUM RATINGS** | |
| Supply Voltage | + 28 Volts |
| Power Output | No DC Feedback Allowed |
| Case Temperature | + 55$^0$C. The Driver Must Be Attached to an Adequate Heatsink. |
| **CONNECTORS & MECHANICAL** | |
| RF Output Connector | BNC Female |
| Modulation Input Connector | BNC Female |
| Power Supply Connections | Vcc: Solder Post; Return: Ground Lug |
| Physical Size | 4.8" L x 1.61" H x 3.87" W |

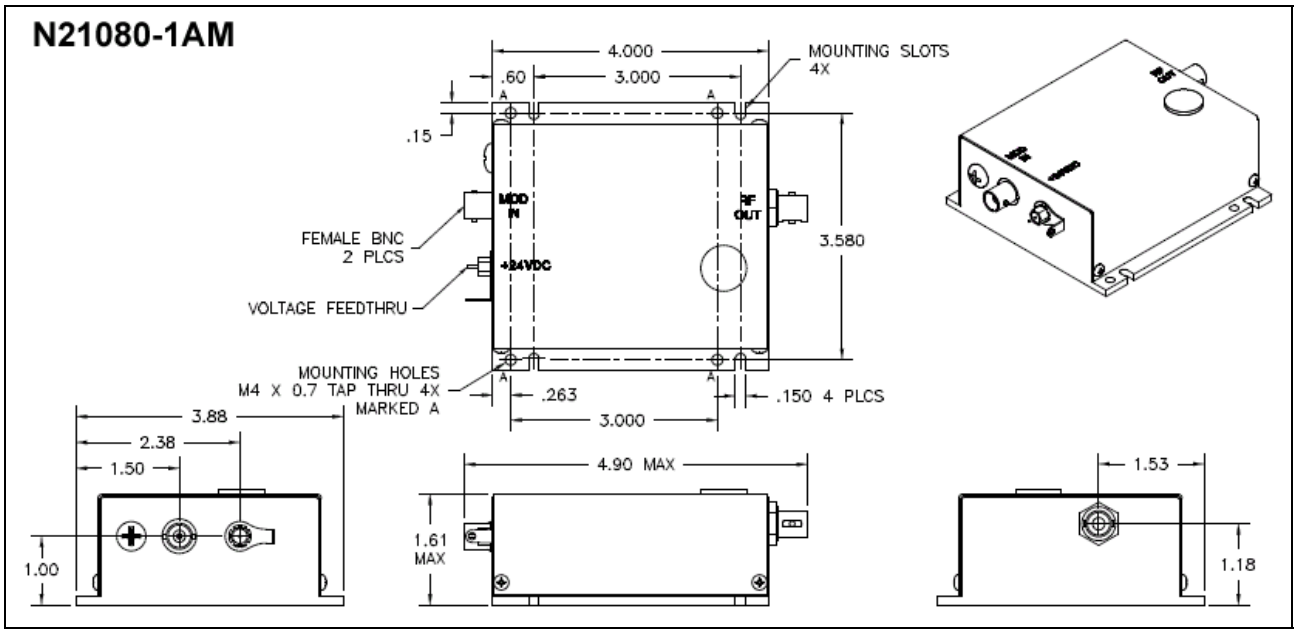


## AOM Driver: N21xxx-yAM (27 to 300MHz, 0.4 to 2W)

The N21xxx-yAM OEM Module Is A RF Driver With Analog Modulation Input And Maximum 2 Watt Output Into A 50 Ohm Load. The model number is described as follows:

**xxx** = a fixed frequency of between 27 and 300 MHz crystal controlled.
**y** = 0.4, 1, or 2 Watts output
**A** = Anolog Modulation
**M** = OEM Module

| **PARAMETER** | **SPECIFICATION** |
|---|---|
| Output Frequency (**xxx**) | 27 to 300 MHz + 0.01% Quartz Stabilized |
| Spurious Levels | -50 dBc Maximum |
| Harmonic Distortion | -15 dBc Maximum |
| Analog Input | + 1 Volt into 50 Ohms (+ 1 Volt = Full RF Power; 0 Volt = Minimum RF Power) |
| Extinction Ratio | 50 dB Minimum |
| RF Rise | 20 ns Maximum |
| PRF | 10 to 90 % |
| Fall Time | 20 ns Maximum |
| PRF | 90 to 10 % |
| RF Output Power (**y**) | 0.4, 1 or 2 Watts Nominal, Adjustable |
| Output Impedance | 50 Ohms Nominal |
| Supply Voltage | + 24 VDC + 0.5 Volt |
| Supply Current | 1 Amp Maximum |
| **MAXIMUM RATINGS** | |
| Supply Voltage | + 28 Volts |
| Power Output | No DC Feedback Allowed |
| Case Temperature | + 55$^0$C. The Driver Must Be Attached to an Adequate Heatsink. |
| **CONNECTORS & MECHANICAL** | |
| RF Output Connector | BNC Female |
| Modulation Input Connector | BNC Female |
| Power Supply Connections | Vcc: Solder Post; Return: Ground Lug |
| Physical Size | 4.8" L x 1.61" H x 3.87" W |

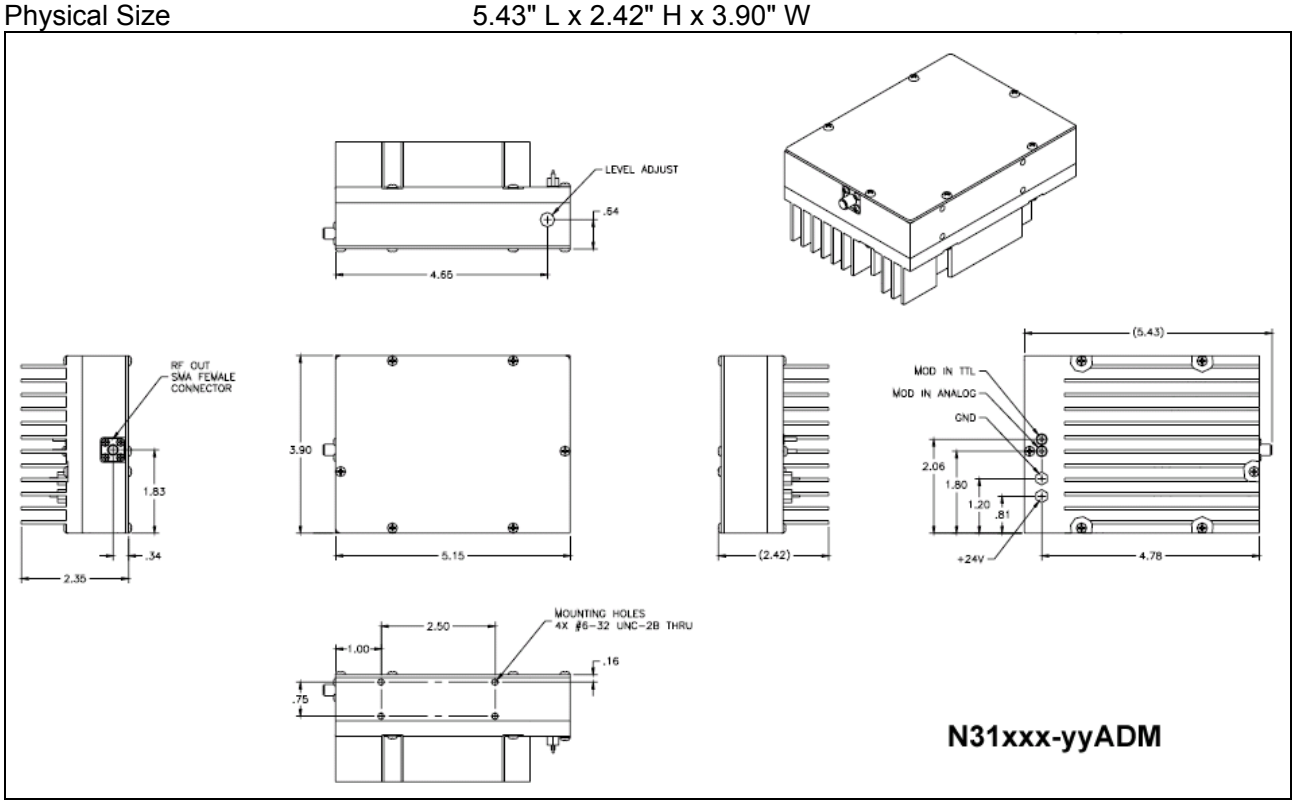


## AOM Driver: N31xxx-yyADM (24 to 260MHz, 2 to 20W)

The 31xxx-yyADM Driver is a RF Driver module with Analog and Digital Modulation Input and up to 20 Watts Output into a 50 Ohm Load. The model number is described as follows:

**xxx** = a fixed frequency of between 24 and 260 MHz crystal controlled.
**yy** = 2 to 20W nominal. Set by internal pot
**A** = Analog Modulation
**D** = Digital Modulation
**M** = OEM Module

| **PARAMETER** | **SPECIFICATION** |
|---|---|
| Output Frequency (**xxx**) | 24 MHz to 260 MHz ±0.01% Quartz Stabilized |
| Spurious Levels | -40 dBc Maximum |
| Harmonic Distortion | -15 dBc Maximum |
| Analog Input | 0-1 Volt into 50 Ohms (+ 1 Volt = Full RF Power; 0 Volt = Minimum RF Power) |
| Digital Input | TTL Levels (TTL HIGH = FULL RF Power; YYL LOW = Minimum RF Power) |
| Extinction Ratio | 40 dB Minimum |
| RF Rise/ Fall Time | 30ns maximum, 20 ns typical, 10ns > 210MHz ($P_{RF}$: 10 to 90%) |
| RF Output Power (**yy**) | 2 to 20 Watts Nominal. Maximum output power set by internal pot. |
| Output Impedance | 50 Ohms Nominal |
| Supply Voltage | + 24 VDC + 0.5 Volt |
| Supply Current | 3 Amp Maximum |
| Air Flow Across heat sink | 18 CFM at 25 $^{o}$C |
| **MAXIMUM RATINGS** | |
| Supply Voltage | + 28 Volts |
| Power Output | No DC Feedback Allowed |
| Case Temperature | + 55$^{0}$C. |
| **CONNECTORS & MECHANICAL** | |
| RF Output Connector | BNC Female |
| Modulation Input Connector | Feed Through Pin |
| Power Supply Connections | Vcc: Vcc Feed Through Pin; Return: Feed Through Pin |
| Physical Size | 5.43" L x 2.42" H x 3.90" W |



## AOM Driver: A35xxx (40 to 350MHz, 5W)

The A35xxx RF driver series provides up to 5 Watt output power. Various types cover a frequency range from 80 to 350 MHz. The frequency is customizable.

The maximum RF output power is adjustable by an internal potentiometer. The analogue modulation voltage controls the output power from 0 to 100% of the adjusted maximum power.

Additional to the analogue modulation voltage a digital modulation control signal can switch on and off the RF power. An operation scheme below illustrates the interaction of the two modulation signals in detail。

Both the analogue and digital modulation are characterized by extraordinary on/off ratios of at least 65dB.

The driver can be operated with modulation frequencies (analogue and digital) up to 1/4 of the carrier frequency.

Optimum EMC shielding and mechanical protection is achieved by an aluminium casing and a conductive surface passivation.

The base plate serves for mounting as well as for heat dissipation. Also a compatible base plate style, which eases maintenance of facilities equipped with legacy drivers A33x or A34x, is available.

**Key Features:**

- Frequency range 80 to 350 MHz
- RF output power 5 Watt
- Optimized for grey-scale applications
- RF on/off ratio > 65 dB
- Constant output power design: maximum fluctuation ± 5% between cold and warm state
- Modulation frequency up to 50 MHz
- Conductive cooling through base plate
- Compact housing, fully shielded (EMC)

**Applications:**

- Fast modulation components for extra cavity applications, e. g. laser projection systems
- Frequency shifting

**Technical Data**

| | | | | |
|---|---|---|---|---|
| Supply voltage | +24 VDC | | | |
| Supply current | typ. 1.5 A @ 5 W RF output power | | | |
| Output impedance | nom. 50Ω | | | |
| Maximum RF output power (adjustable) * | > 5 W (+37 dBm) | | | |
| **Analogue modulation** | | | | |
| Impedance | 50 or 600Ω | | | |
| Voltage range @ 50Ω | 0 … +1 V or 0 … +5 V ** | | | |
| Voltage range @ 600Ω | 0 … +5 V or 0 … +10 V ** | | | |
| RF ON / OFF ratio | > 65 dB | | | |
| **Digital modulation** | | | | |
| Impedance | 4k7 or 50 _ (pull-up or pull-down) ** | | | |
| Level | High = ≥ 3V … 5V | | | |
| | Low = 0 … < 2V | | | |
| Logic styles | Input signal: | High | Low | not connected |
| positive logic, pull-up | RF power: | on | off | on |
| positive logic, pull-down | | on | off | off |
| negative logic, pull-up | | off | on | off |
| negative logic, pull-down | | off | on | on |
| RF ON / OFF ratio | > 100 dB | | | |
| * into 50Ω load | ** other combinations on request | | | |

**Technical Data, Frequency-Dependent**

| RF output frequency [MHz] | 80 | 100 | 110 | 150 | 200 | 250 | 300 | 350 |
|---|---|---|---|---|---|---|---|---|
| Frequency accuracy [ppm] | | | | | < ±30 | | | |
| Harmonics distortion * [dBc] | | | | | < -26 | | | |
| Analogue modulation RF rise time / fall time (10 … 90%) * | | | | | < 8 ns | | | |
| Digital modulation RF rise time / fall time (10 … 90%) * | | | | | < 8 ns | | | |

* into 50Ω load

**Connectors, Dimensions, Weight, Cooling**

| | |
|---|---|
| RF output connector | SMA female |
| Control input connector | D-Sub 7W2 |
| Pins 1 and 2, inside linked | GND (case) |
| Pins 3 and 5, inside linked | +Us (24 VDC) |
| Pin 4 | not connected |
| Pin A1 (coaxial) | Analogue modulation |
| Pin A2 (coaxial) | Digital modulation |
| Dimensions | |
| Casing | 120 mm x 50 mm x 35 mm ** |
| Mounting plate, standard case | 120 mm x 70 mm x 3 mm ** |
| | ** length x width x height |
| **Weight** | |
| Standard case | 340 grams |
| Compatible case | 370 grams |
| **Cooling** | Conduction, the base plate must be attached to a suitable heat sink. |

**Environmental Conditions**

| | |
|---|---|
| Warm up time | 10 minutes for optimum stability |
| Base plate temperature | +10°C … +40°C For optimum output power stability constant base plate temperature should be provided. |
| Storage temperature | -20°C … +70°C, non condensing |

**Absolute Maximum Ratings**

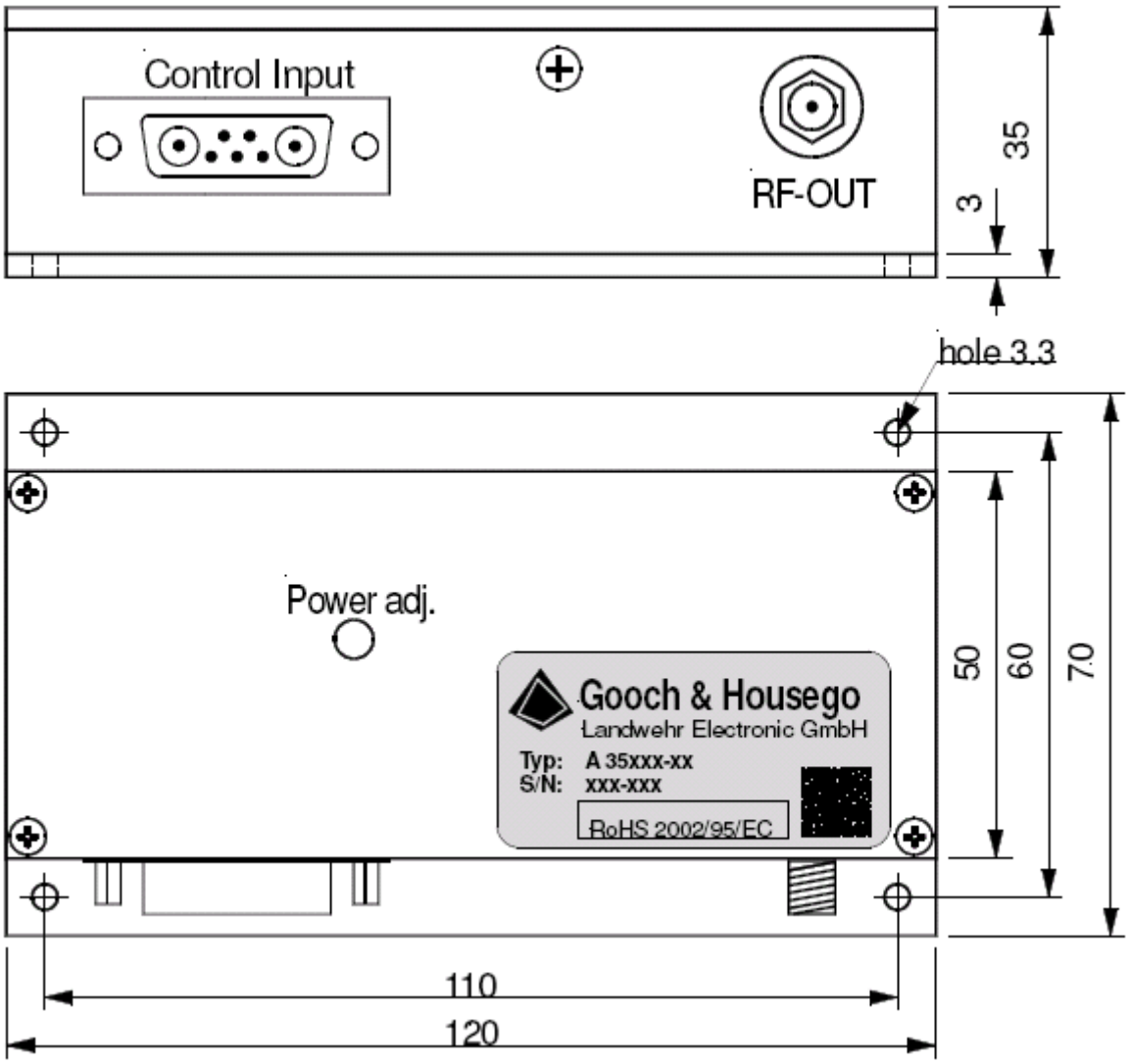
| | |
|---|---|
| Supply voltage max. | +26 VDC |
| **Analogue modulation** | |
| Voltage range @ 0 … +1 V | -0.5 V … +1.1 V |
| Voltage range @ 0 … +5 V | -0.5 V … +5.5 V |
| Voltage range @ 0 … +10 V | -0.5 V … +11.0 V |
| **Digital modulation** | |
| Level | -0.5 V … +5.5 V |
| **Maximum operating temperature** | +50°C base plate temperature |

**Quality Standards**

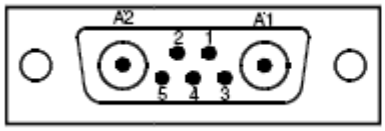
| | |
|---|---|
| EU 2002/95/EC (RoHS) | compliant |
| EMC standards | VDE 0871-B |
| | FCC Rules Part 15-B |
| Thermal test | 2h @ 70°C passive |
| Burn-in test | 30 minutes @ maximum RF power output |

**Outline Drawings**

Dimensions in mm
Standard casing

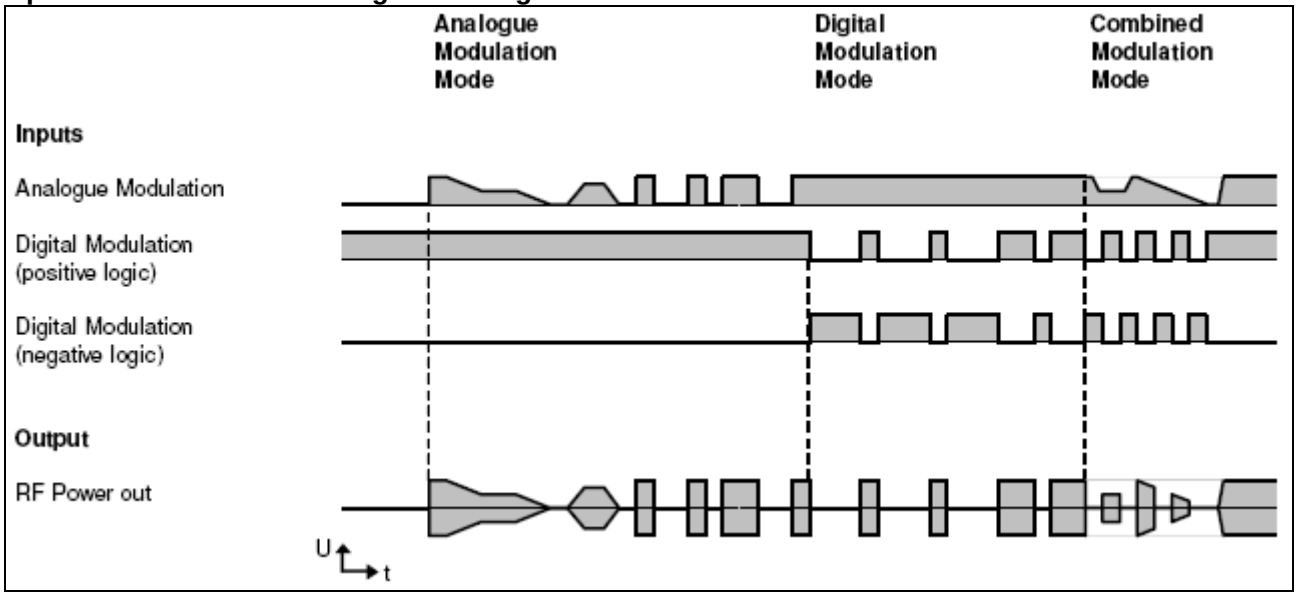



**Control Input**




| | | | |
|---|---|---|---|
| 1, 2 | GND (case) inside linked | A1 | Analogue modulation |
| 3, 5 | +Us (24VDC) inside linked | A2 | Digital modulation |
| 4 | not connected | | |

**Operation Scheme of Analogue and Digital Modulation**




**Variants List / Ordering Codes**

A35 ☐ - ☐ - ☐ - ☐

| Frequency [MHz] | | Base Plate )[1] | | Analogue Modulation Input )[2] )[4] | | | Digital Modulation Input )[4] | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Voltage Range | Impedance | | Logic | Impedance )[3] |
| 080 | s | standard 120x70 mm | 1/50 | 0...1V | 50Ω | p4k7u | positive | 4,7kΩ pull-up |
| 100 | | | | | | p4k7d | positive | 4,7kΩ pull-down |
| 110 | | | 5/50 | 0...5V | 50Ω | p50u | positive | 50Ω pull-up |
| 150 | | | | | | p50d | positive | 50Ω pull-down |
| 200 | c | compatible 165x70 | 5/600 | 0…5V | 600Ω | n4k7u | negative | 4,7kΩ pull-up |
| 250 | | | | | | n4k7d | negative | 4,7kΩ pull-down |
| 300 | | | 10/600 | 0…10V | 600Ω | n50u | negative | 50Ω pull-up |
| 350 | | | | | | n50d | negative | 50Ω pull-down |

1 The base plate dimensions (size, holes) of the compatible style are equal with legacy drivers A33x and A34x.
2 The voltage range corresponds to 0 to 100% of the potentiometer pre-adjusted maximum RF output power.
3 A pull-up resistor provides HIGH level, a pull-down resistor LOW level in case of not connected input.
4 Further configurations on request.

## AOM Driver A36-Series

The A36xxx RF driver series provides up to 2 Watt output power. Various types cover a frequency range from 80 to 350 MHz. The frequency is customizable.

The maximum RF output power is adjustable by an internal potentiometer. The analogue modulation voltage controls the output power from 0 to 100% of the adjusted maximum power.

Additional to the analogue modulation voltage a digital modulation control signal can switch on and off the RF power. An operation scheme below (page 6) illustrates the interaction of the two modulation signals in detail。

Both the analogue and digital modulation are characterized by extraordinary on/off ratios of at least 70 dB.

The driver can be operated with modulation frequencies (analogue and digital) up to 1/4 of the carrier frequency.

Optimum EMC shielding and mechanical protection is achieved by an aluminium casing and a conductive surface passivation. The base plate serves for mounting as well as for heat dissipation.

**Key Features:**

- Frequency range 80 to 350 MHz, customizable
- RF output power 2 Watt
- RF on/off ratio > 70 dB
- Constant output power design
- Models with a modulation frequency up to 50 MHz available
- Conductive cooling through base plate
- Compact casing, fully shielded (EMC)

**Applications:**

- Fast modulation components for extra cavity applications, e. g. laser projection systems
- Frequency shifting Compact casing, fully shielded (EMC)

**Technical Data**

| | |
|---|---|
| Supply voltage | +24 VDC |
| Supply current | typ. 1.1 A @ 2 W RF output power |
| Output impedance | nom. 50Ω |
| Maximum RF output power (adjustable) * | > 2 W (+33 dBm) |
| **Analogue modulation** | |
| Impedance | 50 or 600Ω |
| Voltage range @ 50Ω | 0 … +1 V or 0 … +5 V ** |
| Voltage range @ 600Ω | 0 … +5 V or 0 … +10 V ** |
| RF ON / OFF ratio | > 70 dB |
| **Digital modulation** | |
| Impedance | 4k7 or 50 _ (pull-up or pull-down) ** |
| Level | High = ≥ 3V … 5V<br>Low = 0 … < 2V |

| Logic styles | Input signal: | High | Low | not connected |
|---|---|---|---|---|
| positive logic, pull-up | RF power: | on | off | on |
| positive logic, pull-down | | on | off | off |
| negative logic, pull-up | | off | on | off |
| negative logic, pull-down | | off | on | on |

| | |
|---|---|
| RF ON / OFF ratio | > 100 dB |
| * into 50Ω load | ** other combinations on request |

**Technical Data, Frequency-Dependent**

| RF output frequency [MHz] | 80 | 100 | 110 | 150 | 200 | 250 | 300 | 350 |
|---|---|---|---|---|---|---|---|---|
| Frequency accuracy [ppm] | | | < ±30 | | < ±30 | | | |
| Harmonics distortion * [dBc] | | | < -26 | | < -26 | | | |
| Analogue modulation RF rise time / fall time (10 … 90%) * | | | < 8 ns | | < 8 ns | | | |

| | | |
|---|---|---|
| Digital modulation RF rise time / fall time (10 … 90%) * | < 8 ns | < 8 ns |

* into 50Ω load

**Connectors, Dimensions, Weight, Cooling**

| | |
|---|---|
| RF output connector | SMA female |
| Control input connector | D-Sub 7W2 |
| Pins 1 and 2, inside linked | GND (case) |
| Pins 3 and 5, inside linked | +Us (24 VDC) |
| Pin 4 | not connected |
| Pin A1 (coaxial) | Analogue modulation |
| Pin A2 (coaxial) | Digital modulation |
| Dimensions | |
| Casing | 120 mm x 50 mm x 35 mm ** |
| Mounting plate, standard case | 120 mm x 70 mm x 3 mm ** |
| | ** length x width x height |
| **Weight** | |
| Standard case | 300 grams |
| **Cooling** | Conduction, the base plate must be attached to a suitable heat sink. |

**Environmental Conditions**

| | |
|---|---|
| Warm up time | 10 minutes for optimum stability |
| Base plate temperature | +10°C … +40°C For optimum output power stability constant base plate temperature should be provided. |
| Storage temperature | -20°C … +70°C, non condensing |

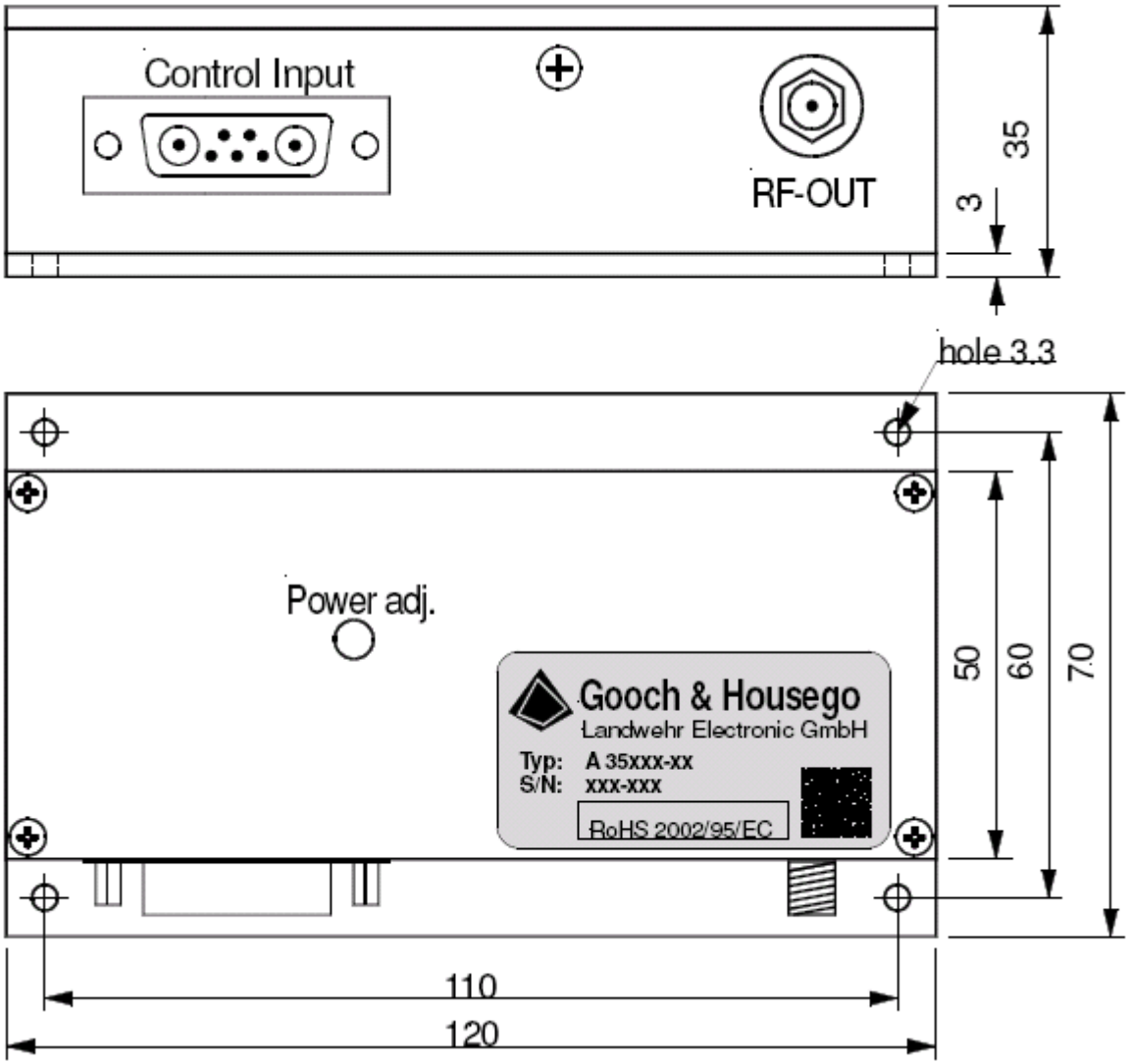
**Absolute Maximum Ratings**

| | |
|---|---|
| Supply voltage max. | +26 VDC |
| **Analogue modulation** | |
| Voltage range @ 0 … +1 V | -0.5 V … +1.1 V |
| Voltage range @ 0 … +5 V | -0.5 V … +5.5 V |
| Voltage range @ 0 … +10 V | -0.5 V … +11.0 V |
| **Digital modulation** | |
| Level | -0.5 V … +5.5 V |
| **Maximum operating temperature** | +50°C base plate temperature |

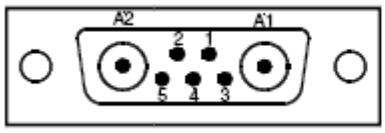
**Quality Standards**

| | |
|---|---|
| EU 2002/95/EC (RoHS) | compliant |
| EMC standards | VDE 0871-B |
| | FCC Rules Part 15-B |
| Thermal test | 2h @ 70°C passive |
| Burn-in test | 30 minutes @ maximum RF power output |

**Outline Drawings**
Dimensions in mm
Standard casing

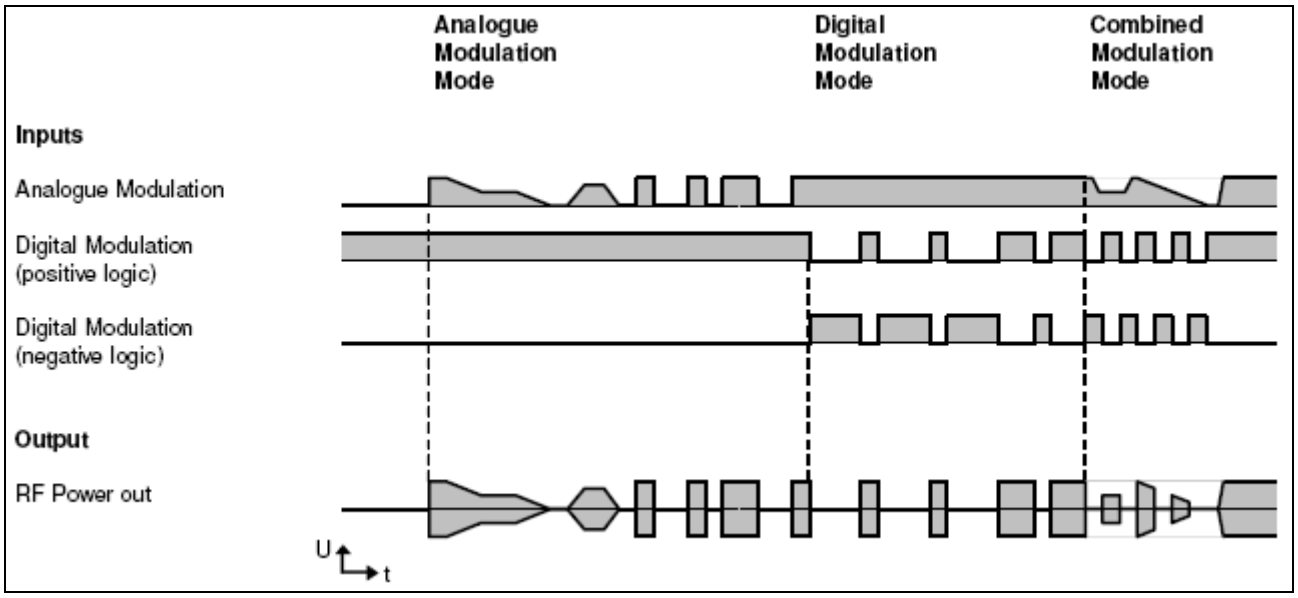



**Control Input**




| | | | |
|---|---|---|---|
| 1, 2 | GND (case) inside linked | A1 | Analogue modulation |
| 3, 5 | +Us (24VDC) inside linked | A2 | Digital modulation |
| 4 | not connected | | |

## Operation Scheme of Analogue and Digital Modulation




## Variants List / Ordering Codes

A36 ☐ - ☐ - ☐

| Frequency [MHz] | | Analogue Modulation Input )[1] )[3] | | | Digital Modulation Input )[3] | |
|---|---|---|---|---|---|---|
| | | Voltage Range | Impedance | | Logic | Impedance )[2] |
| 080 | 1/50 | 0...1V | 50Ω | p4k7u | positive | 4,7kΩ pull-up |
| 100 | | | | p4k7d | positive | 4,7kΩ pull-down |
| 110 | 5/50 | 0...5V | 50Ω | p50u | positive | 50Ω pull-up |
| 150 | | | | p50d | positive | 50Ω pull-down |
| 200 | 5/600 | 0…5V | 600Ω | n4k7u | negative | 4,7kΩ pull-up |
| 250 | | | | n4k7d | negative | 4,7kΩ pull-down |
| 300 | 10/600 | 0…10V | 600Ω | n50u | negative | 50Ω pull-up |
| 350 | | | | n50d | negative | 50Ω pull-down |

Remarks
1 The voltage range corresponds to 0 to 100% of the potentiometer pre-adjusted maximum RF output power.
2 A pull-up resistor provides HIGH level, a pull-down resistor LOW level in case of not connected input.
3 Further configurations on request.

# More AOMs

| Model | 12038-3-TE | 12038-3-BR-TE |
|---|---|---|
| Interactive Material | SiO2 | SiO2 |
| Acoustic Mode | Longitudinal | Longitudinal |
| Operating Wavelength | 1.06 µm | Used for Various λ (Specifications shown for 1.06 µm |
| Window Configuration | AR "V" Coated | Brewster |
| Static Transmission | >99 % | >99 % |
| Operating Frequency | 38 MHz + 150 KHz | 38 MHz + 182 KHz |
| Mode spacing | 300 KHz Typical | 364 KHz Typical |
| Mode Bandwidth -3dB | 10 KHz approximate | 10 KHz approximate |
| Average Loss Modulation | 15 % minimum with Linear Polarized Light, Perpendicular to Acoustic Propagation | 10 % minimum with Linear Polarization Light, Perpendicular to Acoustic Propagation |
| Acoustic Aperture Size (in air) | 3 mm | 2 mm |
| Deflection Angle | 6.75 mrad | 6.75 mrad @ 1.06 µm |
| RF Power Level | <1.2 watt | <1 watt |
| Impedance | 50 ohms @ Resonant Frequency | 50 ohms @ Resonant Frequency |
| VSWR | <1.5:1 @ Resonant Frequency | <1.5:1 @ Resonant Frequency |
| Package: | 53A2198 | 53A3890 |
| Recommended Driver: | 11038-1ML | 11038-1ML |

| Model | 12041-3-BR-TE | 12041-3-TE |
|---|---|---|
| Interactive Material | SiO2 | SiO2 |
| Acoustic Mode | Longitudinal | Longitudinal |
| Operating Wavelength | Used for Various λ Specification shown for 1.06 µm | 1.06 µm |
| Window Configuration | Brewster | AR "V" Coated |
| Static Transmission | >99 % | >99% |
| Operating Frequency | 41 MHz + 182 KHz | 41 MHz + 150 KHz |
| Mode spacing | 364 KHz Typical | 300 KHz Typical |
| Mode Bandwidth -3dB | | 10 KHz approximate |
| Average Loss Modulation | 10 % minimum with Linear Polarized Light, Perpendicular to Acoustic Propagation | 15 % minimum with Linear Polarized Light, Perpendicular to Acoustic Propagation |
| Acoustic Aperture Size (in air) | 2 mm | 3 mm |
| Deflection Angle | 7.3 mrad @ 1.06 µm | 7.3 mrad |
| RF Power Level | <1 watt | <1.2 watt |
| Impedance | 50 ohms @ Resonant Frequency | 50 ohms @ Resonant Frequency |
| VSWR | <1.5:1 @ Resonant Frequency | <1.5:1 @ Resonant Frequency |
| Package: | 53A3890 | 53A2198 |
| Recommended Driver: | 11041-1ML | 11041-1ML |

| **Model** | **12050-3-BR-TE** | **12050-3-TE** |
|---|---|---|
| Interactive Material | SiO2 | SiO2 |
| Acoustic Mode | Longitudinal | Longitudinal |
| Operating Wavelength | Used for Various λ Specifications shown for 1.06 µm | 1.06 µm |
| Window Configuration | Brewster | AR "V" Coated |
| Static Transmission | >99 % | >99% |
| Operating Frequency | 50 MHz + 182 KHz | 50 MHz + 150 KHz |
| Mode spacing | 364 KHz Typical | 300 KHz Typical |
| Mode Bandwidth -3dB | 10 KHz approximate | 10 KHz approximate |
| Average Loss Modulation | 6.5 % minimum with Linear Polarized Light, Perpendicular to Acoustic Propagation | 10 % minimum with Linear Polarized Light, Perpendicular to Acoustic Propagation |
| Acoustic Aperture Size (in air) | 2 mm | 3 mm |
| Deflection Angle | 8.9 mrad @ 1.06 µm | 8.9 mrad |
| RF Power Level | <1 watt | <1.2 watt |
| Impedance | 50 ohms @ Resonant Frequency | 50 ohms @ Resonant Frequency |
| VSWR | <1.5:1 @ Resonant Frequency | <1.5:1 @ Resonant Frequency |
| Package: | 53A3890 | 53A2198 |
| Recommended Driver: | 11050-1ML | 11050-1ML |

| **Model** | **12080-3-BR-TE** | **12080-3-TE** |
|---|---|---|
| Interactive Material | SiO2 | SiO2 |
| Acoustic Mode | Longitudinal | Longitudinal |
| Operating Wavelength | Used for Various λ Specifications shown for 1.06 µm | 1.06 µm |
| Window Configuration | Brewster | AR "V" Coated |
| Static Transmission | >99 % | >99 % |
| Operating Frequency | 80 MHz + 182 KHz | 80 MHz + 150 KHz |
| Mode spacing | 364 KHz Typical | 300 KHz Typical |
| Mode Bandwidth -3dB | 10 KHz approximate | 10 KHz approximate |
| Average Loss Modulation | 6.5 % minimum with Linear Polarized Light, Perpendicular to Acoustic Propagation | 10 % minimum with Linear Polarized Light, Perpendicular to Acoustic Propagation |
| Acoustic Aperture Size (in air) | 2 mm | 3 mm |
| Deflection Angle | 14.2 mrad @ 1.06 µm | 14.2 mrad |
| RF Power Level | <1 watt | <1.2 watt |
| Impedance | 50 ohms @ Resonant Frequency | 50 ohms @ Resonant Frequency |
| VSWR | <1.5:1 @ Resonant Frequency | <1.5:1 @ Resonant Frequency |
| Package: | 53A3890 | 53A2198 |
| Recommended Driver: | 11080-1ML | 11080-1ML |

| **Model** | **13389-BR** | **15180-1.06-LTD-GAP** |
|---|---|---|
| Interactive Material | SiO2 | GaP |
| Acoustic Mode | longitudinal | Longitudinal |
| Operating Wavelength | Used for Various λ<br>Specifications shown for 633 nm | 1.06 µm |
| Window Configuration | Brewster, λ/10 over acoustic aperture | AR “V” coated |
| Static Transmission | >99 % | >90% |
| Operating Frequency | 389 MHz | 180 MHz |
| Diffraction Efficiency | >5.5 % @ 500 mW | >70% |
| Light Polarization | Linear, Perpendicular to Acoustic Propagation | Linear, horizontal |
| Acoustic Aperture Size | 60 µm in air | 300 µm |
| Rise Time | <6 ns | 10 nsec* |
| Optical Waist Size to achieve Rise Time | 44 µm | 100 microns |
| Deflection Angle | 41 mrad @ 633 nm | 28.7 mrads |
| RF Power Level Average | 500 mW | 1.7 Watts |
| RF Power Level Peak | 10 Watts peak, 5 % duty cycle with 10 ns pulse | |
| Impedance | 50 Ohms | 50 Ohms nominal |
| VSWR | <1.5:1 @ 389MHz, <6:1 @ 299, 479 MHz | <1.5:1 at 180 MHz |
| Package: | 53A5314 | 53B0624 |
| Recommended Drivers: | 64389-SYN-9.5-X | |

| **Model** | **15200-.2-1.55-LTD-GaP-FO** |
|---|---|
| Interaction Material | GaP |
| Acoustic Mode | Longitudinal |
| Operating Wavelength | 1.55 µm |
| Operating Frequency | 200 MHz |
| Thruput Loss | < 3.5 db** |
| Contrast Ratio | 35 db min |
| Light Polarization | Linear |
| Rise/fall Time | 10 ns* |
| RF Power Level | < 2 watts |
| Impedance | 50 Ohms nominal |
| VSWR | <1.5:1 @ 200 MHz |
| Package | 53B3659 |
| Fiber Type | 8/125, polarization maintaining fiber, 1 meter long |
| Fiber connector type | FC/PC, FC/APC or other optional connector |
| Recommended Drivers: | Analog Driver Module: 21200-2AM<br>Analog Driver System: 21200-2AS<br>Digital Driver Module: 21200-2DM<br>Digital Driver System: 21200-2DS |

| **Model** | **15210** | **15210-FOA / 71002** | **15210-FOA** |
|---|---|---|---|
| Interactive Material | TeO2 | TeO2 | TeO2 |
| Acoustic Mode | Longitudinal | Longitudinal | Longitudinal |
| Operating Wavelength | 440 – 850 nm | 440 – 850 nm | 440 – 850 nm |
| Window Configuration | AR Coated | AR Coated | AR Coated |
| Static Transmission | > 95 % | >95 % | >95 % |
| Operating Frequency | 210 MHz | 210 MHz | 210 MHz |
| Diffraction Efficiency | > 70 % @ 633 nm with Linear, Polarization Perpendicular to Acoustic Propagation or with Random Polarization | >70 % @ 633 nm with Linear, Polarization Perpendicular to Acoustic Propagation or with Random Polarization | >70 % @ 633 nm with Linear, Polarization Perpendicular to Acoustic Propagation or with Random Polarization |
| Acoustic Aperture Size | 0.2 mm | 0.2 mm | 0.2 mm |
| Rise Time | < 10 nsec | <10 nsec | < 10 nsec |
| Optical Waist Size to achieve Rise Time | 55 µm | 55 _m | 55 _m |
| Deflection Angle | 31 mrad @ 633 nm | 31 mrad @ 633 nm | 31 mrad @ 633 nm |
| RF Power Level | < 1 Watt | < 1 Watt | < 1 Watt |
| Impedance | 50 Ohms nominal | 50 Ohms nominal | 50 Ohms nominal |
| VSWR | < 1.5:1 @ 210 MHz | < 1.5:1 @ 210 MHz | <1.5:1 @ 210 MHz |
| Package: | 53B0504 | 53D00314 | 53B0957 |
| Recommended Drivers: | Analog Driver System: 21210-1AS<br>Analog Driver Module: 21210-1AM<br>Digital Driver System: 21210-1DS<br>Digital Driver Module: 21210-1DM | | |

| **Model** | **15260** | **15260-FOA/71002** | **15260-FOA** |
|---|---|---|---|
| Interactive Material | TeO2 | TeO2 | TeO2 |
| Acoustic Mode | Longitudinal | Longitudinal | Longitudinal |
| Operating Wavelength | 440 – 850 nm | 440 – 850 nm | 440 – 850 nm |
| Window Configuration | AR Coated | AR Coated | AR Coated |
| Static Transmission | >95 % | >95 % | >95 % |
| Operating Frequency | 260 MHz | 260 MHz | 260 MHz |
| Diffraction Efficiency | >70 % @ 633nm with Linear, Polarization Perpendicular to Acoustic Propagation or with Random Polarization | >70 % @ 633 nm with Linear, Polarization Perpendicular to Acoustic Propagation or with Random Polarization | >70 % @ 633 nm with Linear, Polarization Perpendicular to Acoustic Propagation or with Random Polarization |
| Acoustic Aperture Size | 0.2 mm | 0.2 mm | 0.2 mm |
| Rise Time | <10 ns | <10 nsec | <10 nsec |
| Optical Waist Size to achieve Rise Time | 55 um | 0.055 mm | 55 um |
| Deflection Angle | 39 mrad @ 633nm | 39 mrad @ 633 nm | 39 mrad @ 633 nm |
| RF Power Level | 700 mW | < 1 Watt | < 1 Watt |
| Impedance | 50 Ohms nominal | 50 Ohms nominal | 50 Ohms nominal |
| VSWR | 1.5:1 @ 260MHz | 1.5:1 @ 260 MHz | 1.5:1 @ 260 MHz |
| Package: | 53B0504 | 53D0314 | |
| FOA Modulator Package: | | 53B0957 | 53B0957 |
| Recommended Drivers: | 21260-.7AS<br>21260-.7AM<br>21260-.7DS<br>21260-.7DM | Analog Driver System: 21260-1AS<br>Analog Driver Module: 21260-1AM<br>Digital Driver System: 21260-1DS<br>Digital Driver Module: 21260-1DM | |

| **Model** | **17389-1.06-LTD-GaP** | **17389-.93** | **17389-.93-FOA** |
|---|---|---|---|
| Interaction Material | GaP | TeO2 | TeO2 |
| Acoustic Mode | Longitudinal | Longitudinal | Longitudinal |
| Operating Wavelength | 1.06 µm | 700 –1064 nm | 700 –1064 nm |
| Window Configuration | AR "V" coating | AR Coated | AR Coated |
| Static Transmission | >90% | >95 % | >95% |
| Operating Frequency | 389 MHz | 389 MHz | 389 MHz |
| Diffraction Efficiency | 56% minimum with linear polarized light parallel to acoustic propagation | >70 % @ 800 nm with Linear, Polarization Perpendicular to Acoustic Propagation. >60 % @ 800 nm with Random Polarization. | >70% @ 800 nm with Linear, Polarization Perpendicular to Acoustic Propagation >60% @ 800 nm with Random Polarization |
| Acoustic Aperture Size (in air) | 150 µm | 70 um | 70 um |
| Rise Time | 4 nsec minimum | <7 nsec | <7 nsec |
| Extinction Ratio * | >20dB for neighboring pulses, >27dB for subsequent pulses @ <80MHz pulse rep rate | >20dB for neighboring pulses, >27dB for subsequent pulses @ <80MHz pulse rep rate | >20dB for neighboring pulses, >27dB for subsequent pulses @ <80MHz pulse rep rate |
| Optical Waist Size To Achieve Rise Time | 40 µm | 35 um | 35um |
| Deflection Angle | 62 mrad | 73 mrad @ 800 nm | 73mrad @ 800nm |
| RF Power Level | 2.5 watts peak, <1 watt aver. | < 700 mW Average/ 5 Watts Peak 10 % max duty cycle with 10 nsec pulse. | < 700 mW Average/ 5 Watts Peak 10% max duty cycle with 10nsec pulse. |
| Impedance | 50 Ohms nominal | 50 Ohms nominal | 50 Ohms nominal |
| VSWR | <1.5:1 @ 389 MHz | <1.5:1 @ 389 MHz | < 1.5:1 @ 389 MHz |
| Package | 53B00624TO1 | 53B0504 | 53B0499 |
| Recommended Drivers: | Non - Synchronous Driver: 11389-5AM<br>Synchronous Driver: 64389.5-SYN-9.5-X | | |

| **Model** | **35085-0.5-350** | **35085-3-350** |
|---|---|---|
| Interactive Material | Fused Silica | Fused Silica |
| Acoustic Mode | Longitudinal | Longitudinal |
| Operating Wavelength | 300 to 400 nm | 300 to 400 nm |
| Window Configuration | AR Coated | AR Coated |
| Static Transmission | >99 % | >99 % |
| Operating Frequency | 85 MHz | 85 MHz |
| Diffraction Efficiency | >85 % | 85 % @ 350 nm |
| Light Polarization | Linear, Perpendicular to acoustic propagation | Linear, Perpendicular to Acoustic Propagation |
| Acoustic Aperture | 0.5 mm | 3 mm |
| Rise Time | 110 nsec/mm beam diameter | 110 ns / mm Beam Diameter |
| Deflection Angle | 5 mrad @ 350 nm | 5 mrad @ 350 nm |
| RF Power Level | < 6 Watts | 3 Watts |
| Impedance | 50 Ohms | 50 Ohms |
| VSWR | <1.2:1 @ 85 MHz | <1.2:1 @ 85 MHz |
| Package: | 53B1428 | 53B1428 |
| Recommended Drivers: | Analog System Driver: 31085-6AS | Analog Driver System: 31085-6AS |
| | Analog Module Driver: 31085-6AM | Analog Driver Module: 31085-6AM |
| | Digital System Driver: 31085-6DS | Digital Driver System: 31085-6DS |
| | Digital Module Driver: 31085-6DM | Digital Driver Module: 31085-6DM |

| **Model** | **35085-0.5** | **35085-3** |
|---|---|---|

| | | |
|---|---|---|
| Interactive Material | Fused Silica | Fused Silica |
| Acoustic Mode | Longitudinal | Longitudinal |
| Operating Wavelength | 400 to 540 nm | 400 to 540 nm |
| Window Configuration | AR Coated | AR Coated |
| Static Transmission | >99 % | >98 % @ 488 nm |
| Operating Frequency | 85 MHz | 85 MHz |
| Diffraction Efficiency | >85 % With Linear Polarized Light, Perpendicular to acoustic propagation | >85 % @ 488 nm With Light Polarized Linear, Perpendicular to Acoustic Propagation. |
| Acoustic Aperture Size | 0.5 mm | 3 mm |
| Rise Time | 110 nsec/mm beam diameter | 110 ns / mm Beam Diameter |
| Deflection Angle | 5 mrad @ 514 nm | 6.9 mrad @ 488 nm |
| RF Power Level | < 6 Watts | < 6 Watts @ 488 nm |
| Impedance | 50 Ohms | 50 Ohms |
| VSWR | <1.2:1 @ 85 MHz | <1.2:1 @ 85 MHz |
| Package: | 53B1428 | 53B1428 |
| Recommended Drivers: | Analog System Driver: 31085-6AS | Analog Driver System: 31085-6AS |
| | Analog Module Driver: 31085-6AM | Analog Driver Module: 31085-6AM |
| | Digital System Driver: 31085-6DS | Digital Driver System: 31085-6DS |
| | Digital Module Driver: 31085-6DM | Digital Driver Module: 31085-6DM |

| **Model** | **35210-BR / 71004** | **35210-BR** |
|---|---|---|
| Interactive Material | Fused Silica | Fused Silica |
| Acoustic Mode | Longitudinal | ongitudinal |
| Operating Wavelength | 300 to 700 nm | 300 to 700 nm |
| Window Configuration | Brewster | Brewster |
| Static Transmission | >99 % @ 488 nm | 98 % @ 488 nm |
| Operating Frequency | 210 MHz | 210 MHz |
| Diffraction Efficiency | >70 % @ 488 nm | >70 % @ 488 nm |
| Light Polarization | Linear, Perpendicular to acoustic propagation | Linear, Perpendicular to acoustic propagation |
| Acoustic Aperture Size (in air) | 0.13 mm | 0.13 mm |
| Rise Time | <15 ns | <15 ns |
| Optical Waist Size to achieve Rise Time | 0.1 mm | 0.1 mm |
| Deflection Angle | 17 mrad @488 nm | 17 mrad @ 488 nm |
| RF Power Level | 6 Watts | 6 Watts |
| Impedance | 50 Ohms | 50 Ohms |
| VSWR | <1.5:1 @ 210 MHz | <1.5:1 @ 210 MHz |
| Package Assembly: Mount, Optics and Modulator: | 53D0307 | |
| Package: | 53B3408 | 53B3408 |
| Recommended Driver: | Analog System Driver: 31210-6AS<br>Analog Module Driver: 31210-6AM<br>Digital System Driver: 31210-6DS<br>Digital Module Driver: 31210-6DM | |

| **Model** | **35110-2-244** | **35250-.2-.53-XQ** |
|---|---|---|
| Interactive Material | KrF Grade Fused Silica | Crystal Quartz |
| Acoustic Mode | Longitudinal | Longitudinal |
| Operating Wavelength | 244 nm | 532 nm |
| Window Configuration | AR Coated | AR Coated |
| Static Transmission | >97 % | >99 % |
| Operating Frequency | 110 MHz | 250 MHz |
| Diffraction Efficiency | 70 % With Linear Polarized Light Perpendicular to Acoustic Propagation | >70 % |
| Light Polarization | | Linear, Perpendicular |
| Acoustic Aperture Size | 2 mm | 0.2 mm |
| Rise Time | 110 ns / mm beam diameter | 10 ns |
| Optical Waist Size to achieve Rise Time | | 0.09 mm |
| Deflection Angle | 4.5 mrad | 23 mrad |
| RF Power Level | <2 Watts | 6 Watts |

| | | |
|---|---|---|
| Impedance | 50 Ohms | 50 Ohms |
| VSWR | <1.2:1 @ 110 MHz | <1.5:1 - 170 to 330 MHz |
| Package: | 53B2921 | 53B1354 |
| Recommended Driver: | 21110-2AS<br>21110-2AM<br>21110-2DS<br>21110-2DM | 31250-6AS<br>31250-6AM<br>31250-6DS<br>31250-6DM |