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AO Q-switch Driver (RF Driver)

1. QSD Series Q-switch Driver

A high power RF driver module is available in output powers of 50W, 75W or 100W. Powered from 220VAC or 110VAC, the modulation inputs allow either full digital control or activation of an internal pulse generator. First pulse suppression is automatically implemented.

Main Specifications:

RF power output: 50W, 75W or 100W

Frequency: 27.125MHz

VSWR: $\leq 1.2:1$

Modulation repetition rate: 800Hz-50KHz

First pulse suppression

Modulation control inputs: digital TTL, till 100kHz

Driver over-heat, Q-Switch over-heat

Internal over-temperature protection and over-current protection

Digital display of frequency

Supply voltage input: 220VAC/110VAC, <150W



Model Numbers:

QSD-2750 (50W), QSD-2775 (75W) or QSD-27100 (100W)

Dimension:

19" 2U frame, 483×88×200mm

2. R390 Series Q-switch Drivers (RF Driver)

R390xx-yyDMzzz-A (50W, 100W)

A compact high power RF driver module is available in output powers of 50 or 100W. Powered from 28VDC, the modulation inputs allow either full digital control or activation of an internal pulse generator. First pulse suppression is implemented through either analogue modulation, RF off analogue control, triggered first pulse suppression, or triggered pre-pulse kill, as described in our FPS guidance notes. On board LED's and TTL logic outputs monitor driver status and cooling is through forced air over the heat sink.



Specification

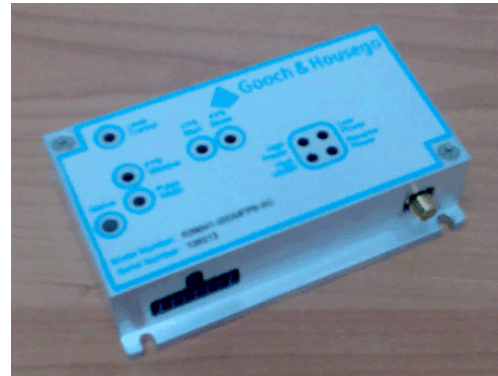
RF Power Output (yy)	50 or 100W
Frequency (xx=24, 27, 41)	24.00MHz, 27.12MHz or 40.68MHz (50W)
First Pulse Suppression (zzz=FPS, PPK, R05, A05, A13)	Triggered First Pulse Suppression: FPS Triggered Pre-Pulse Kill: PPK RF Off Analogue Control: 0-5V R05 Analogue Modulation: 0-5V A05 / 2-13V A13
Frequency Tolerance	$\pm 0.02\%$
Output Impedance	50 Ω
RF Fall-Time	< 100ns (60ns typical)
RF Rise-Time	250ns typical
Extinction Ratio	> 52dB
Harmonic Levels	< -30dB at full power
Supply Voltage Input	28VDC $\pm 5\%$

Supply Current Input	6.5A (50W), 9.0A (100W)
Modulation Control Inputs	Digital TTL (TTL high = RF off)
Modulation Repetition Rate	100Hz to 100kHz
Internal Pulse Width	1 μ s to 14 μ s, typical
Status Monitoring	Power supply on, High VSWR RF power low, RF power maximum Driver over-heat, Q-Switch over-heat
Housing	Module
Storage Temperature	-20°C to +85°C
Operating Temperature	+10°C to +55°C

3. MQC Series Q-switch Drivers (low power, high speed, compact Q-switch Driver, 2-24W) MQC0XX-YYDC-ZZZ-AAV (former part number R390xx-yyDMzzz-SC)

The MQC0XX-YYDC-ZZZ module is a compact Low Power RF Driver, designed to drive a Q-switch.

The unit has two digital modulation inputs: Fixed and Variable. These controls allow the customer to issue a pulse command of a "Fixed" pulse width, the duration determined by the Driver's pulse width control, settable by the customer, or issue a "Variable" pulse command, the duration determined by the input signal's pulse width. The output power is controlled by the analog input, where the mode of operation is defined by ZZZ = A05 normal analog mode, or R05 analog switched to full RF mode or a triggered RF Ramp Down mode where ZZZ = FPS first pulse suppression mode or PPK pre-pulse kill mode. The choices of Frequency (XX), Output Power (YY), and Power Control (ZZZ) option are "Factory Set" when ordered. This driver has a Zero Crossing function where the output pulse can be synchronized to the zero crossing point of the RF Energy. When enabled the pulse to pulse stability is improved.



The product delivered will be manufactured to be compliant with EU Directive 2002/95/EC for Reduction of Hazardous Substance. The product will be manufactured to other standards upon customer request.

Key Features:

- 24, 27.12, 40.68, 68, or 80 MHz RF Frequency (XX)
- 0.01% Quartz Stabilized
- Up to 24 watts RF power output (YY)
- Two TTL Digital Modulation Inputs: fixed and variable pulse width.
- Up to 500 kHz pulse rate.
- Analogue Modulation or Triggered RF Ramp Down Mode (ZZZ)
- Synchronization to RF by 'Zero cross'
- Fault Protection on Low Power, High Power, and High VSWR
- Operates on 12, 15 or 24 VDC (Factory set)

Applications:

- RF Driver for an Acousto-Optic Q-Switch Device used to spoil the "Q" of a CW laser so as to output an intense pulse of light.
- Used in industrial, medical, or military applications.

Parameter	Specification
Output Frequency:	XX = 24, 27, 41, 68 or 80 ,where RF Frequency = 24.00, 27.12, 40.68, 68, or 80MHz \pm 0.01%
Spurious Levels:	-50 dBc Maximum
Harmonic Distortion	-20 dB Maximum
Modulation Input	
Mod In Fixed (pin 3)	TTL Levels Triggered on TTL Rising Edge. Pulse Width Applied >50 ns.
Mod In Variable (pin 5)	TTL Levels TTL HIGH = RF Off
Extinction Ratio:	40 dB Minimum
RF Rise Time 10% to 90%	100 ns Maximum
RF Fall Time: 90% to 10%	50 ns Maximum
Modulation Repetition Rates:	1 Hz to 500 kHz for Fixed Modulation

Fixed Modulation Output Pulse Width Adjustment Range: DC to 500 kHz for Variable Modulation
1 to 20 μ s, Customer Adjustable

Available Pulse Suppression Modes: **ZZZ** = Mode
Modulation Operating Mode is "Factory Set" Internally.
FPS = First Pulse Suppression
PPK = Pre Pulse Kill
R05 = RF Switched to Analog Control
A05 = Analog Control
TTL Levels, Triggered on TTL Rising Edge

FPS Trigger (pin 2) for Pulse Suppression for Units Configured with FPS, PPK:
Analog in (pin 6) for Power Control for Units Configured with A05, R05
Enable - Stand by Mode (pin 11)
0 to 5 volts Analog
< 3 watt dissipation in stand by mode.
TTL High or no connection = Normal operation
TTL Low = Stand by Mode
Momentary TTL Low = Driver Reset - after fault is removed.
TTL high or no connection- disabled, TTL low- enabled

Zero Crossing Enable (pin 7) normally:
If model # is (-ZC):
TTL high or no connection- enabled, TTL low- disabled

Sync out (pin 1)
RF Power Output:
Output Impedance:
Supply Voltage:
Supply Current:
OPERATING TEMPERATURE:
Contact Cooled
Outputs 3.3 volt signal
YY watts where YY = 2 to 24 watts
50 Ω
+12, +15 VDC or +24 VDC (factory set)
< 3 amps.
+10 to +55 ⁰ C Case Temperature
The Driver must be attached to a heatsink capable of dissipating 25 watts

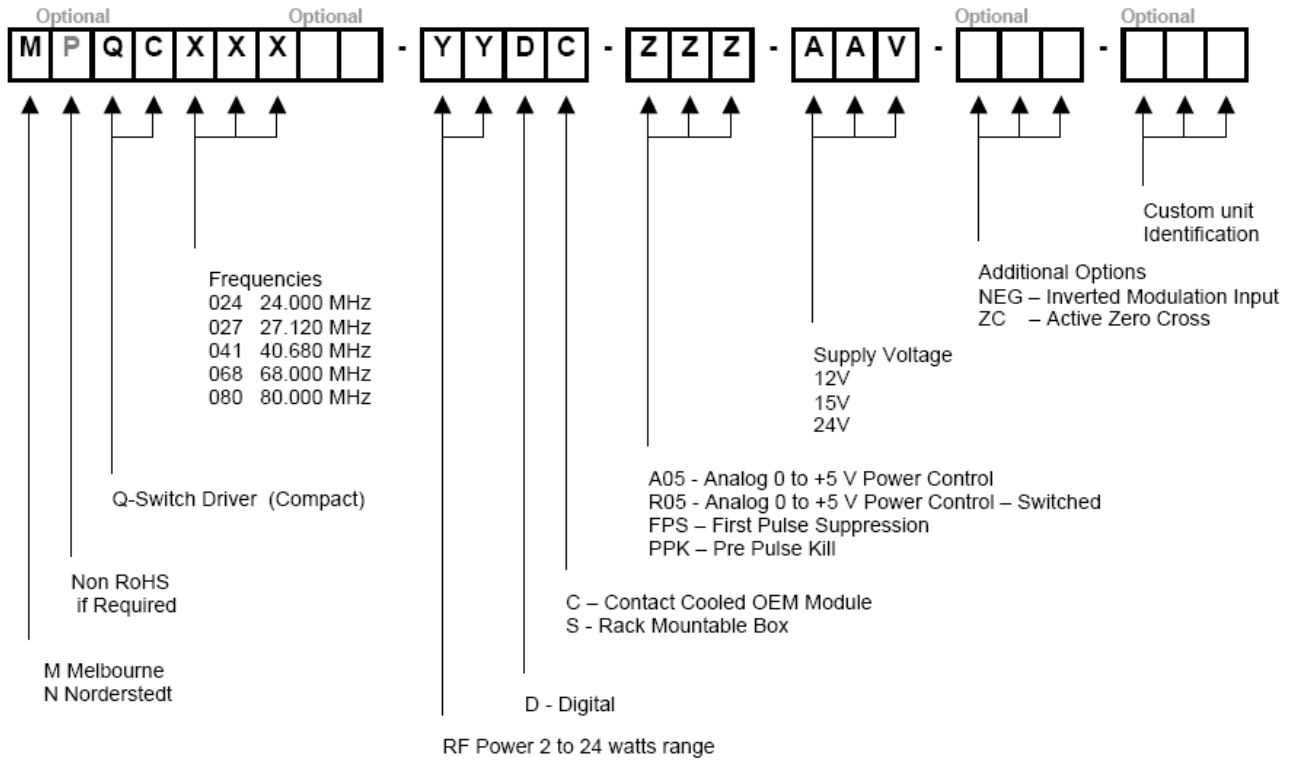
MAXIMUM RATINGS:
Supply Voltage: +15, +18 or +30 volts
Power Output: No DC Feedback Allowed
Storage Temperature: -20 to + 85 ⁰ C

RF POWER (watts)

Supply Voltage (V)	27.12 MHz	41 MHz	80 MHz	
12	5	10	10	
15	10	<15	<15	Harmonics <20dBc
15	15	24	20	Harmonics <15dBc
24	20	24	24	

Ordering Codes:

Example: MQC041-20DM-A05-15V: A 41 MHz RF Driver with two TTL Digital Modulation inputs (fixed and variable pulse width) and an analog input (A05) which enables control of the RF output power. Designed to Drive an AO Q-Switch requiring 20 watts RF Power or less. Delivered as a RoHS compliant, contact cooled OEM Module, input voltage 15V.



4. Dual-channel Q-switch Driver, N390xx-yyDMzzz-2CH

- 2x25W or 2x50W dual channel outputs
- 24, 27 or 41MHz
- 28VDC module

A compact, dual channel RF driver module manufactured, enabling synchronous control of two AO Q-Switches.

Powered from 28VDC, the modulation inputs allow either full digital control or activation of an internal pulse generator. First pulse suppression is implemented through either analogue modulation, RF off analogue control, triggered first pulse suppression or triggered pre-pulse kill, as described in our FPS guidance notes.



On board LED's and TTL logic outputs monitor driver status and cooling is through forced air over the heat sink.

RF Power Output (yy)	2x25W (yy=25) or 2x50W (yy=50)
Frequency (xx=24, 27, 41)	24.00MHz, 27.12MHz or 40.68MHz (2x25W)
First Pulse Suppression (zzz=FPS, PPK, R05, A05, A13)	Triggered First Pulse Suppression FPS Triggered Pre-Pulse Kill: PPK RF Off Analogue Control: 0-5V R05 Analogue Modulation: 0-5V A05 / 2-13V A13
Frequency Tolerance	± 0.02%
Output Impedance	50Ω
RF Fall-Time	< 100ns
RF Rise-Time	250ns typical
Extinction Ratio	> 52dB
Harmonic Levels	< -30dB at full power
Supply Voltage Input	28VDC ± 5%
Supply Current Input	6.5A (2x25W), 9.0A (2x50W)
Modulation Control Inputs	Digital TTL (TTL high = RF off)
Modulation Repetition Rate	100Hz to 100kHz
Internal Pulse Width	1µs to 14µs, typical
Status Monitoring	Power supply on, High VSWR RF power low, RF power maximum Driver over-heat, Q-Switch over-heat

Housing	Module
Storage Temperature	-20°C to +85°C
Operating Temperature	+10°C to +55°C

5. A28-Series 50W Q-Switch Driver

The A28x RF driver series provides up to 50 Watt output power. Various types cover a frequency range from 24 to 80 MHz.

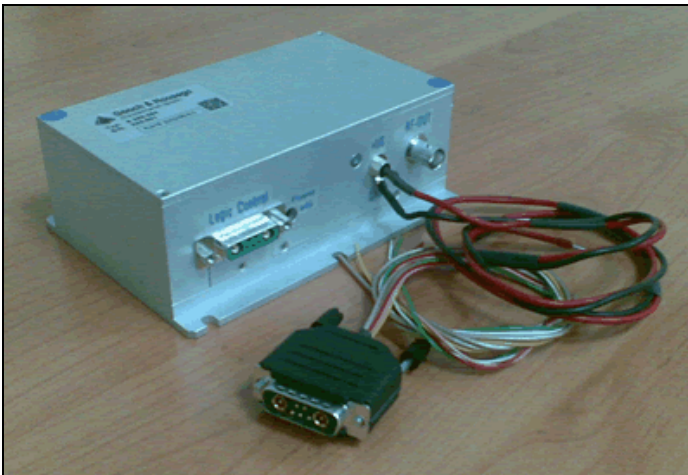
The maximum RF output power is adjustable by an internal potentiometer. The analogue modulation voltage controls the output power from 0 to 100% of the adjusted maximum power.

Additionally to the analogue modulation voltage a digital modulation control signal can switch the RF power. An operation scheme illustrates the interaction of the two modulation signals in detail.

Both the analogue and digital modulation controls allow excellently short rise and fall times for high laser pulse energies.

The driver can be operated with modulation frequencies (analogue and digital) up to 1 MHz. Air, water or base plate cooled housings ensure compatibility with any conceivable cooling concept.

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



Key Features:

- RF output power 50 Watt
- Air, water or conductive cooling
- Excellently short fall and rise times
- Constant output power design
- High SWR and Overheat safety shutdown
- Compact casing, fully shielded (EMC)
- Frequency range 24 to 80 MHz

Applications:

High reliability / industrial purpose acousto-optic Q-switched lasers, such as:

- Material processing machines
- Laser marking devices
- Medical systems

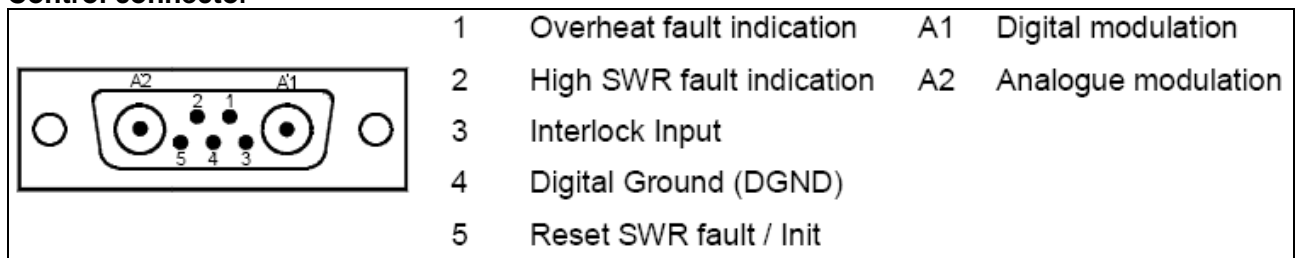
Technical Data:

Supply voltage	+24 VDC				
Supply current	typ. 4.6 A @ 50 W RF output power				
Output impedance	nom. 50 \square				
Maximum RF output power (adjustable) *	> 50 W				
Adjustment range	< 1 W ... > 50 W				
Frequency accuracy	< \pm 30 ppm				
Harmonics distortion *	< -23 dBc				
Analogue modulation **					
Impedance	50 ohm				
Voltage range @ 50ohm***	0 ... +1 V				
RF ON/OFF ratio	> 35 dB				
Digital modulation **					
Impedance	4.7 k ohm (pull-up)				
	High = \geq 3V ... 5V (= RF on)				
	Low = 0 ... < 2V (= RF off)				
Level RF ON/OFF ratio	> 52 dB				
Maximum modulation frequency (digital and analogue)	1 MHz				
RF output frequency**** [MHz]	24	27.12	40.68	68	80
Analogue modulation RF rise time/fall time (10...90%) *	<45ns	<35ns	<35ns	<35ns	tbd
Digital modulation RF rise time/fall time (10...90%) *	<45ns	<35ns	<35ns	<35ns	tbd

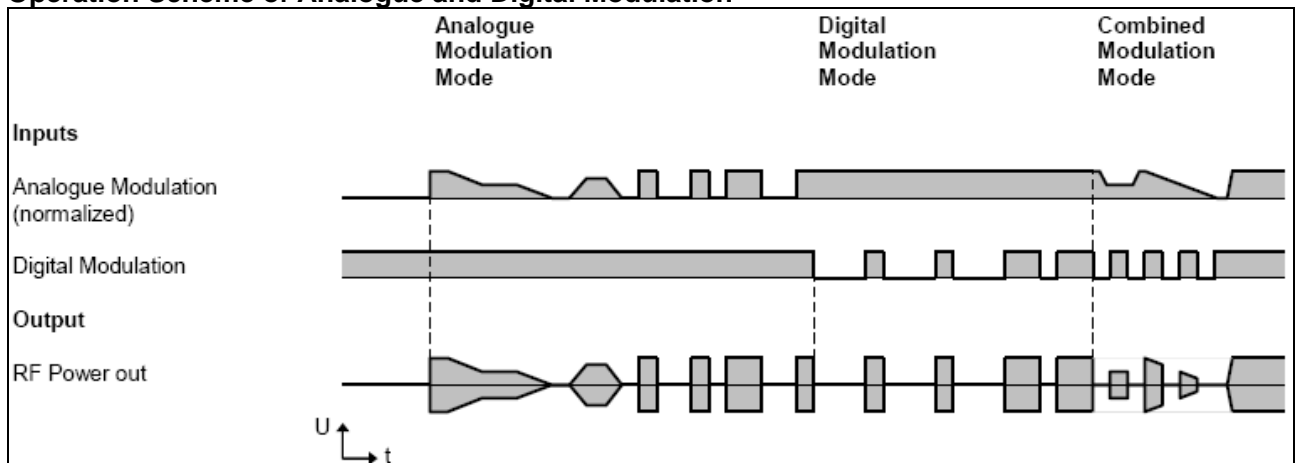
* into 50 \square load; ** other combinations on request; *** The voltage range corresponds to 0 to 100% of the potentiometer pre-adjusted maximum RF output power. **** other frequencies on request.

Cooling	Air	Water	Conduction
	Aluminium heat sink with two fans 24 V DC, 110 mA each	tube material: aluminium AlMgSi 0.5, stainless steel water connectors for hosepipe OD = 6 mm, ID = 4 mm	The base plate must be attached to a suitable heat sink capable of dissipating 110 Watt.
Dimensions [mm]			
Casing (L x W x H)	166 x 125 x 111	140 x 80 x 57	140 x 80 x 62
Mounting flat	140 x 125	140 x 100	150 x 100
Weight	1950 grams	1080 grams	1310 grams

Control connector



Operation Scheme of Analogue and Digital Modulation



Variants List / Ordering Codes

A28 - -1/50-p4k7u

	Frequency [MHz]		Cooling
0	24	A	Air
1	27.12		
2	40.68	W	Water
3	68		
4	80	T	Conductive, Tapped Hole Mount

Accessories

Connector Kit Part-No. 508A00135

6. A25-Series 125W Q-Switch Driver

The A25x RF driver series provides up to 125 Watt output power. Various types cover a frequency range from 24 to 68 MHz.

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.

Additionally to the analogue modulation voltage a digital modulation control signal can switch the RF power. An operation scheme illustrates the interaction of the two modulation signals in detail.

Both the analogue and digital modulation controls allow excellently short rise and fall times for high laser pulse energies.

The driver can be operated with modulation frequencies (analogue and digital) up to 1 MHz. Air, water or base plate cooled housings ensure compatibility with any conceivable cooling concept.

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

Key Features:

- RF output power 50 Watt
- Air, water or conductive cooling
- Excellently short fall and rise times
- Constant output power design
- High SWR and Overheat safety shutdown
- Compact casing, fully shielded (EMC)
- Frequency range 24 to 68 MHz

Applications:

High reliability / industrial purpose acousto-optic Q-switched lasers, such as:

- Material processing machines
- Laser marking devices
- Medical systems



Technical Data:

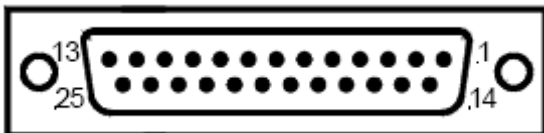
Supply voltage	+24 VDC			
Supply current	typ. 12.5 A @ 125 W RF output power			
Output impedance	nom. 50 ohm			
Maximum RF output power (adjustable) *	> 125 W			
Adjustment range	< 1 W ... > 125 W			
Frequency accuracy	< ±30 ppm			
RF ON/OFF ratio	> 60 dB			
Analogue modulation ** Impedance	600 ohm			
Voltage range @ 50ohm***	0 ... +5 V			
Digital modulation ** Impedance	4.7 k ohm (pull-up) High = ≥ 3V ... 5V (= RF on) Low = 0 ... < 2V (= RF off)			
Maximum modulation frequency (digital and analogue)	1 MHz			
RF output frequency**** [MHz]	24	27.12	40.68	68
Harmonics distortion * [dBc]	-23	-25	-30	-38
Analogue modulation RF rise time/fall time (10...90%) *	<100ns	<100ns	<80ns	<80ns
Digital modulation RF rise time/fall time (10...90%) *	<100ns	<100ns	<80ns	<80ns

* into 50 Ω load; ** other combinations on request; *** The voltage range corresponds to 0 to 100% of the potentiometer pre-adjusted maximum RF output power. **** other frequencies on request.

Cooling	Air	Water
	Aluminium heat sink with two fans 24 V DC, 110 mA each	tube material: aluminium AlMgSi 0.5, stainless steel water connectors for hosepipe, OD = 6 mm, ID = 4 mm
Dimensions [mm]		
Casing (L x W x H)	226 x 125 x 102	200 x 114 x 53
Mounting flat	200 x 125	200 x 100
Weight	2640 grams	1470 grams

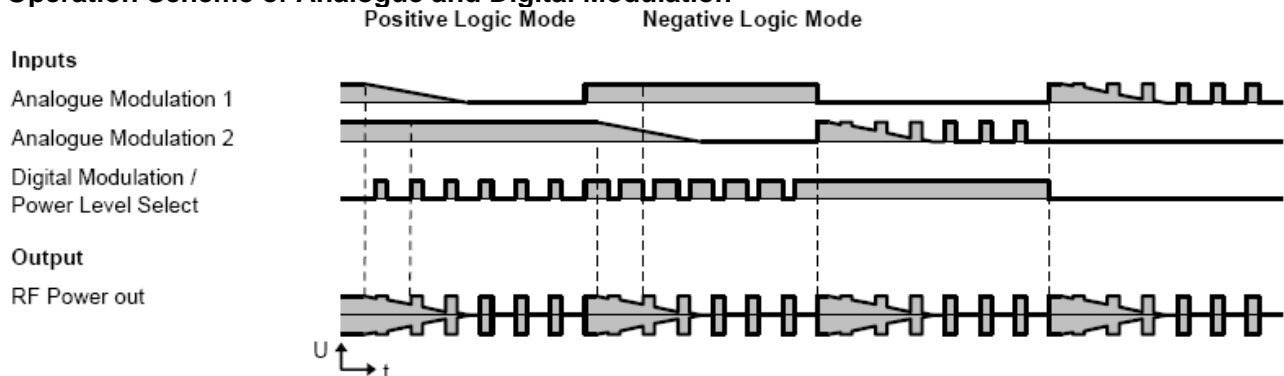
Control connector

D-Sub 25-pole, female

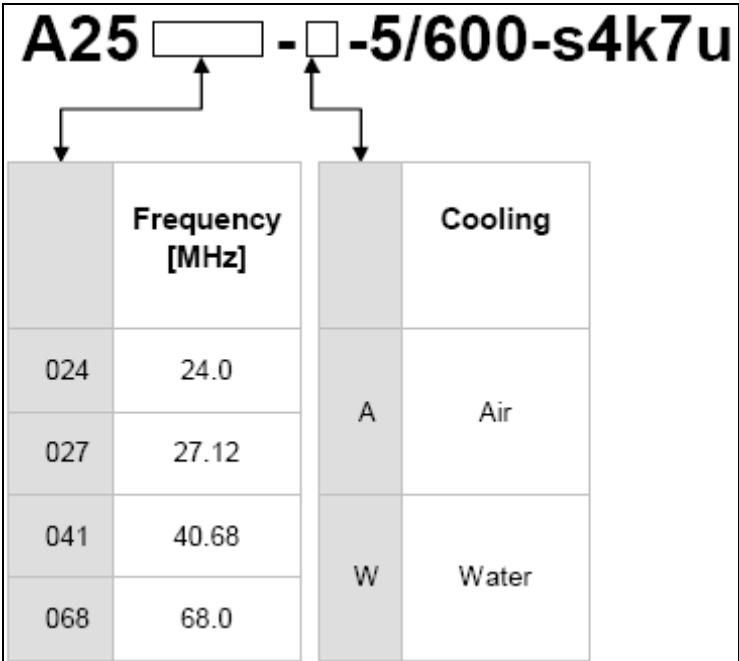


- | | |
|-------------------------------------------------|------------------------------------------|
| Pin 1 RF ON status (out) | Pin 10 Modulation Ground (MGND) |
| Pin 2 SWR fault indication (out) | Pin 11 Analogue modulation 2 (ref. MGND) |
| Pin 3 Driver temperature fault indication (out) | Pin 12 Analogue modulation 1 (ref. MGND) |
| Pin 4 Reset SWR fault / Init (in) | Pin 13 Power Level Select (ref. MGND) |
| Pin 5 Interlock 2 fault indication (out) | LOW → select Analogue Mod. 1 |
| Pin 6 Interlock 2 (in) | HIGH → select Analogue Mod. 2 |
| Pin 7 Interlock 1 (in) | Pins 14 ...22 Chassis ground (CGND) |
| Pin 8 Interlock 1 fault indication (out) | Pins 23 ... 24 Modulation Ground (MGND) |
| Pin 9 Driver temperature monitor (out) | Pin 25 not connected |

Operation Scheme of Analogue and Digital Modulation



Variants List / Ordering Codes



Accessories

Coax Transformer Cable C61x/C62x Series
3 dB Power Splitter

RF Drivers for Acousto-Optic Modulators

A35xxx (40 to 350MHz, 5W)

The A35xxx RF driver series provides up to 5 Watt output power. Various types cover a frequency range from 40 to 350 MHz.

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.

Additionally to the analogue modulation voltage a digital modulation control signal can switch on and off the RF power. An operation scheme below (page 5) 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 25% of the carrier frequency and 50 MHz maximum.

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

Key Features:

- Frequency range 40 to 350 MHz
- RF output power 5 Watt
- RF on/off ratio > 65 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

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)			
Adjustment range	<0.1W >5W			
Frequency accuracy	< ±25 ppm			
Harmonics distortion*	< -26 dBc			
Analogue modulation**				
Impedance	50Ω			
Voltage range @ 50Ω	0 ... +1 V			
RF ON / OFF ratio	> 65 dB			
Digital modulation**				
Impedance	4.7kOhm (pull-up)			
Level	High = ≥ 3V ... 5V (=RF on) Low = 0 ... < 2V (=RF off)			
RF ON / OFF ratio	> 100 dB			
RF output frequency*** [MHz]	40 ... <80	80 ... <140	140 ... <200	200 ... 350
Analogue modulation RF rise time / fall time (PRF: 10 ... 90%) *	< 25 ns	< 15 ns	< 10 ns	< 8 ns
Digital modulation RF rise time / fall time (PRF: 10 ... 90%) *	< 25 ns	< 15 ns	< 10 ns	< 8 ns

* into 50 _ load

** other configurations on request

*** standard frequencies: 40, 80, 110, 150, 200 MHz

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	+Vs (24 VDC)
Pin 4	not connected
Pin A1 (coaxial)	Analogue modulation
Pin A2 (coaxial)	Digital modulation
Dimensions	20 x 50 x 36 mm (LxWxH)
Mounting flat	120 x 70 mm
Weight	360 grams
Cooling	Conduction, the base plate must be attached to a suitable heat sink. heat sink capable of dissipating 36 Watt.

Environmental Conditions

Warm up time	10 minutes for optimum stability
Base plate temperature	+10°C ... +60°C. For optimum output power stability constant base plate temperature should be provided.
Storage temperature	-20°C ... +70°C, non condensing

Absolute Maximum Ratings

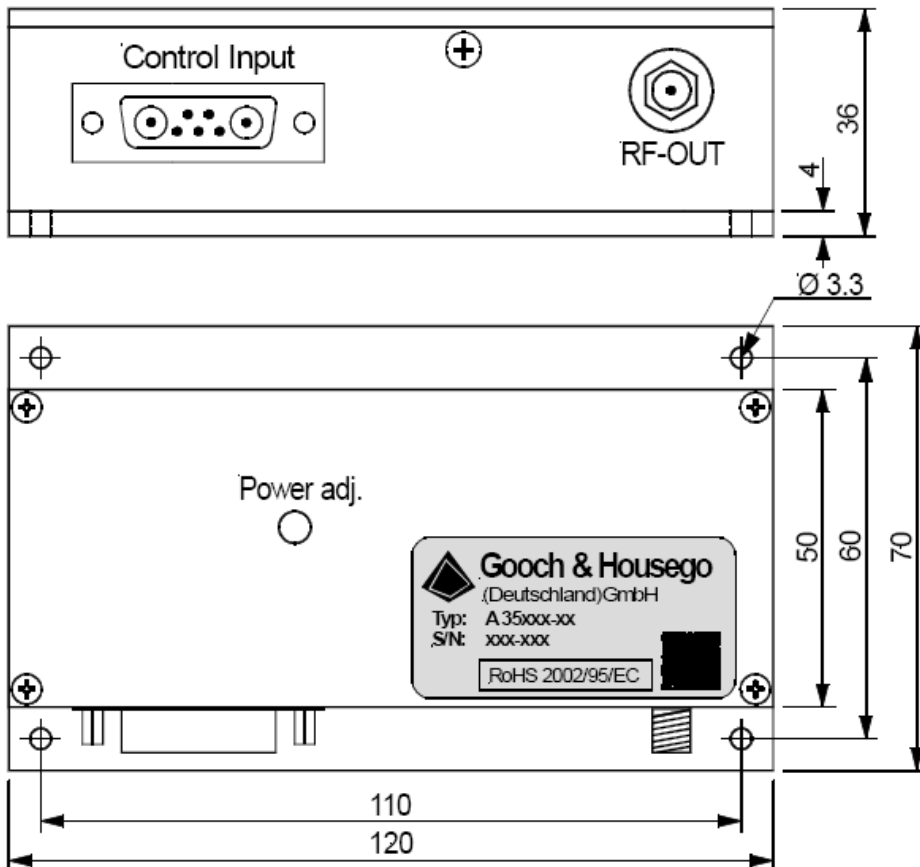
Supply voltage max.	+26 VDC
Analogue modulation	
Voltage range @ 0 ... +1 V	-0.5 V ... +1.1 V
Digital modulation	
Level	-0.5 V ... +5.5 V
Maximum operating temperature	+65°C base plate temperature

Quality Standards

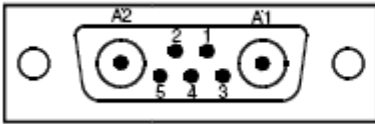
EU 2002/95/EC (RoHS)	compliant
EMC standards	VDE 0871-B FCC Rules Part 15-B
Thermal test	2h @ 70°C passive
Burn-in test	30 minutes @ maximum RF power output

Outline Drawings

Dimensions in mm

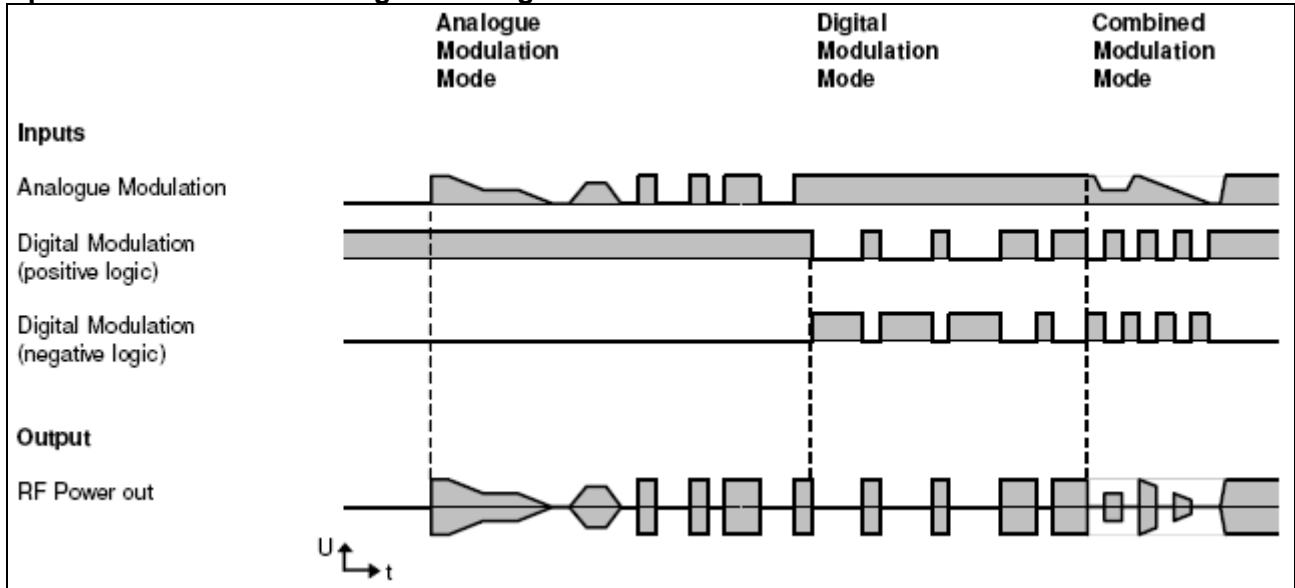


Control Input



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

Operation Scheme of Analogue and Digital Modulation



Variants List / Ordering Codes

A35 **-S-1/50-p4k7u**

	Frequency [MHz]
040	40.0
080	80.0
110	110.0
150	150.0
200	200.0
350	350.0

Other frequencies and customized versions are available on request.

Accessories

Connector Kit for AOM Driver Series A35xxx and A36xxx Part-No. 508A00169

R390 Series RF Drivers: FPS Guidance Notes

When Q-Switching lasers at high repetition rates, it is normal to observe a giant first pulse after a pause in operation. For many applications this excess energy must be dissipated before or during the next modulation cycle. For example, in laser markers, when the time taken for the scanning head to move to a new location exceeds the repetition rate, the next mark can be more intense and hence may appear inconsistent or even result in damage to the substrate.

The R390 series RF driver can be manufactured with any one of four pulse control options.



First Pulse Suppression Options

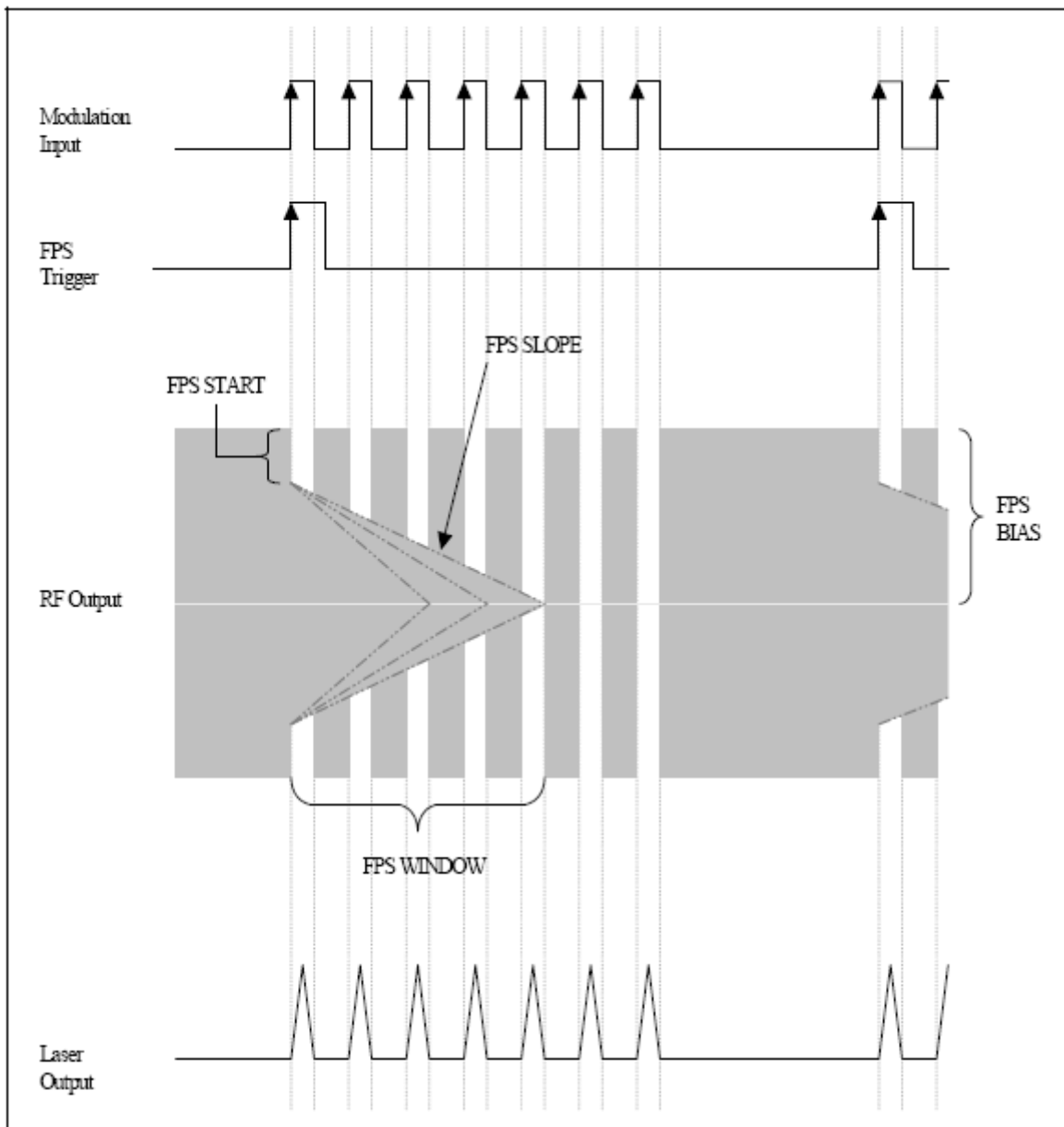
FPS (First Pulse Suppression)	A TTL input triggers automatic ramping of the 'RF off level' allowing controlled release of the first pulse whilst materials processing.
PPK (Pre-Pulse Kill)	A TTL input triggers automatic ramping of the 'RF off level' allowing controlled release of the first pulse prior to materials processing.
RF Off Analogue Control (R05)	Manual control of the 'RF off level' (1-5V) allows controlled release of the first pulse whilst materials processing.
Analogue Modulation (A05 or A13)	Complete manual control of the RF level (0-5V or 2-13V) allows for PPK or FPS type suppression. (This option has certain requirements from your analogue voltage)

First Pulse Suppression (FPS)

With this method, the excess energy of the giant first pulse is dissipated within the first few laser pulses.

To enable this, a TTL input (FPS trigger) must be provided at the start of the modulation cycle, triggering an automatic RF power ramp.

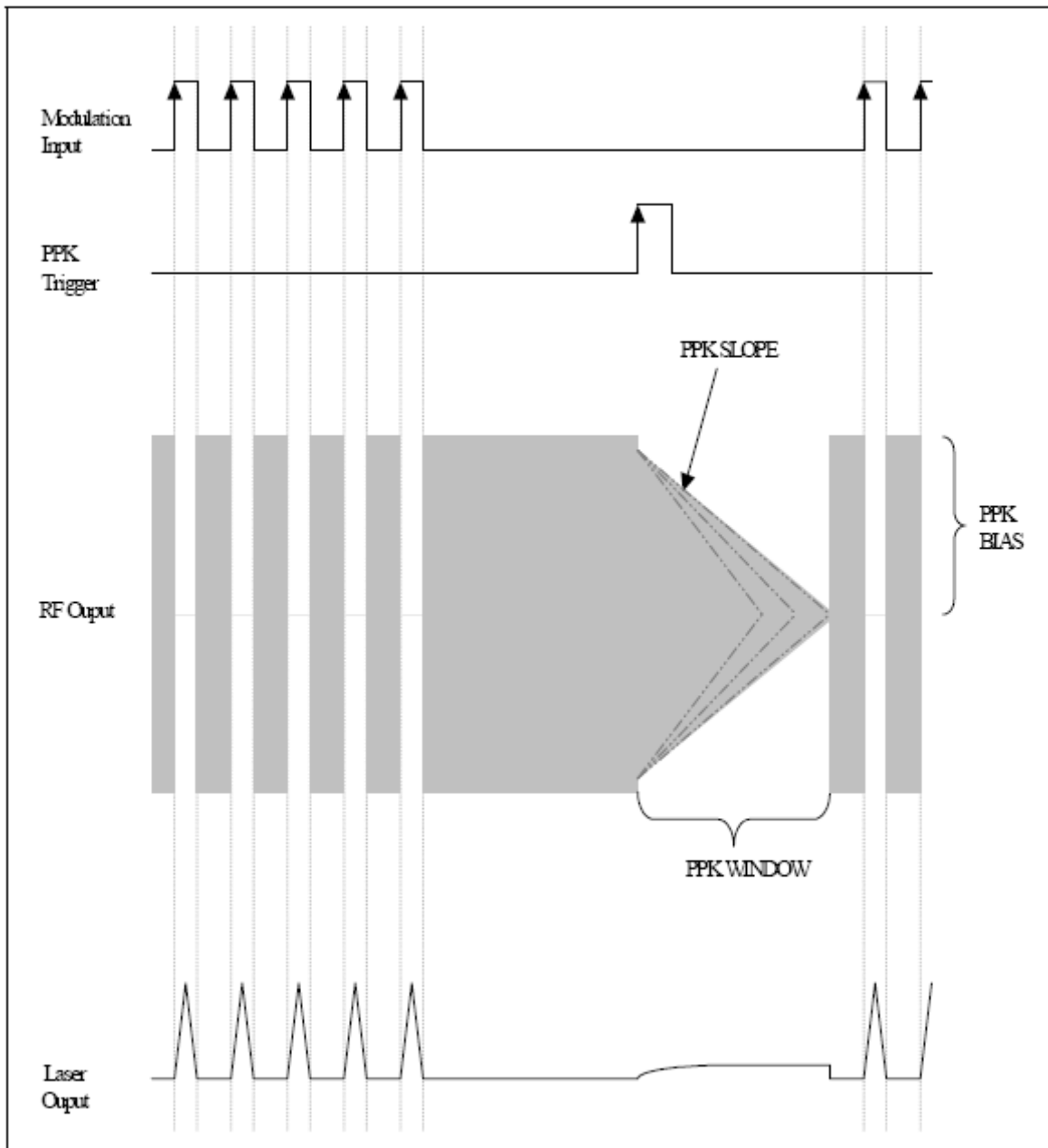
The shape of the ramp is manually adjustable using a series of trimpots onboard the driver.



Pre-Pulse Kill (PPK)

With this method, the excess energy of the giant first pulse is dissipated before pulsed laser output begins.

To enable this, a TTL input (PPK trigger) must be provided in advance of the modulation cycle, triggering an automatic RF power ramp. The shape of the ramp is manually adjustable using a series of trim pots onboard the driver.

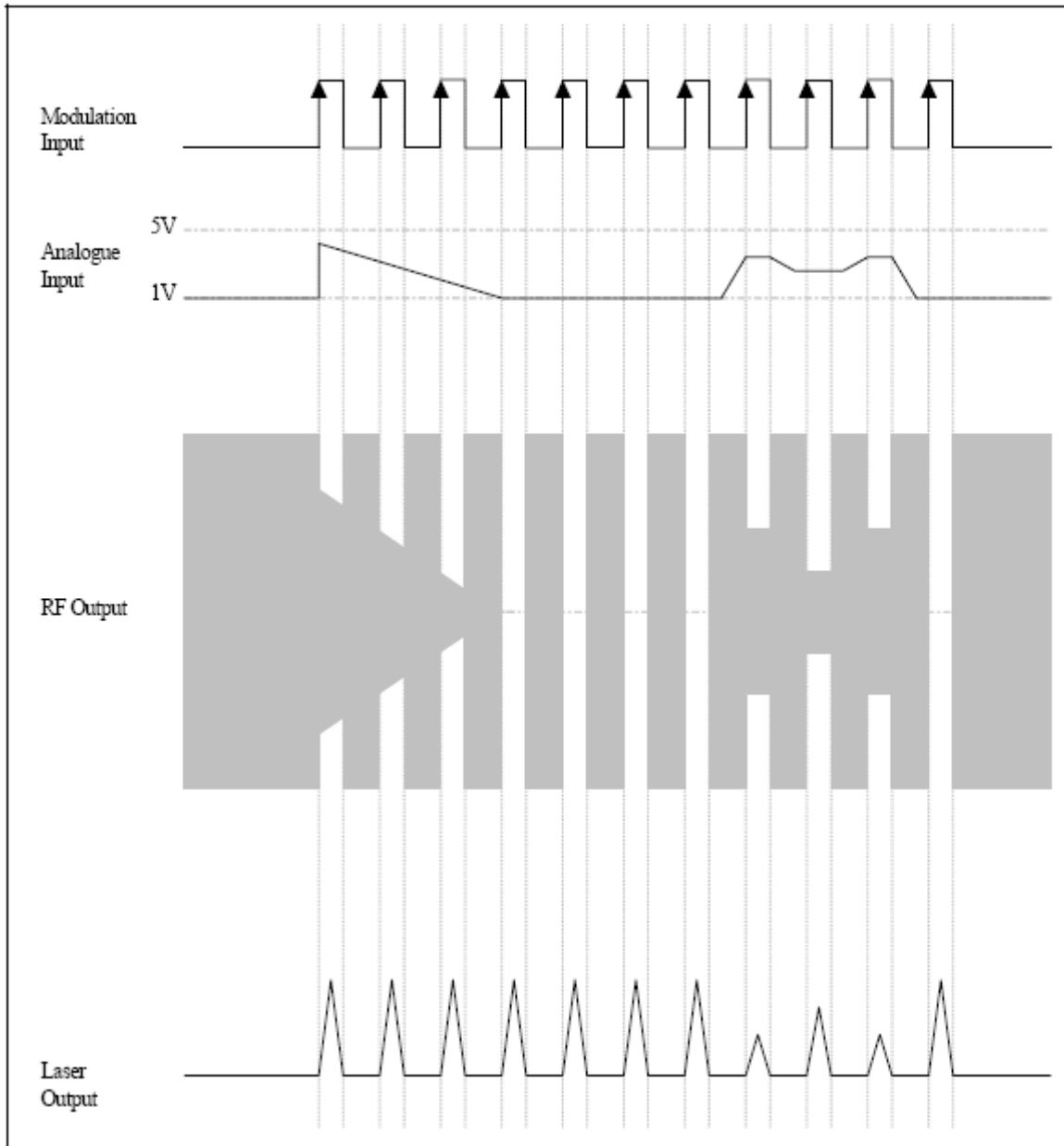


RF Off Analogue Control (R05)

This method enables full manual control of FPS using an analogue input to control the RF off level by ramping the voltage at the beginning of the pulsed laser output.

This function can also be used to control the laser pulse power as illustrated.

Between 0 and 1V, the RF off level is zero. From 1 to 5V the RF level varies from zero to full power.



Analogue Modulation (A05 / A13)

An analogue input enables manual control of the RF power output, allowing FPS type suppression by modulating and ramping the voltage simultaneously, or PPK type suppression by simply ramping the voltage between modulation pulse trains.

Additionally, this control input can be used to vary the laser pulse power level. This option is available as either 0 to 5V (A05) or 2 to 13V (A13). Note that TTL modulation cannot be applied at the same time as the analogue input.

