ADRV-5

Precision five-channel AOM driver

Time-Base
Bahnstr.29A
42781 Haan-Gruiten, Germany
www.time-base.de

Manual Rev.B 2024-05

Table of contents

General description

ADRV-5 is a high-precision driver for acousto-optic modulators with the maximum output power of 2.5 W and the operation frequency range of 10 – 400 MHz.

The AOM ADRV-5 driver consists of a base rack and five identical modules (channels).

The main features are:

- Broadband operation 10 – 400 MHz
- Output RF power up to 2.5 W
- High frequency stability
- Narrow linewidth
- Fast analog and TTL amplitude modulation
- FM modulation
- FSK
- Frequency SWEEP function
- Computer control
- Stable on all loads

Please carefully read this manual before operating the driver!

Front panel

Rear panel

Specifications of each module

Frequency range	10 – 400 MHz
Frequency resolution	1 Hz
Frequency stability	50 ppm
External reference	10 MHz, > 1.5V_{p-p}
RF output power (50 Ohm load)	+34 dBm, 2.5 W (max)
RF power regulation range	+ 14 dBm to + 34 dBm in 0.1 dB steps
AM input: Bandwidth Depth Signal range Input impedance	 DC – 100 MHz > 40 dB 0…±1V 1 kΩ
TTL modulation: Response time Depth Input impedance	 < 6 ns > 40 dB 1 kΩ
Pulsed operation: Operation frequency Duty cycle	 20 – 1000 Hz 1 – 99%
FM input: Bandwidth Signal range Input impedance Deviation (min/max)	 DC - 100 KHz 0…±10V 1 kΩ ±3200 Hz / ±104 MHz
Sweep: min/max step time	 4 ns/262 µs
Connector type: In / Outs Power/control	 SMA Molex DIN 41612
Dimensions	250 x 130 x 51 mm
Power	24 V DC, 0.8 A max.
Weight	0.8 kg

Base rack Specifications

Control	5-inch 800x480 touch-screen
Connector type: Ref 10MHz input PC control interface AC Power	 BNC Ethernet RJ45 C14 Inlet
Dimensions	470 x 340 x 160 mm
Power	90 – 260V AC max. 130W
Weight	10.2 kg

Operating instructions

WARNING!

Do not connect or disconnect the load (AOM) without switching off the output. Switching on the output without load is not recommended.

WARNING!

Due to large heat dissipation, ADRV-5 driver must be operated on the open surfaces with a free air circulation.

The surrounding temperature should not exceed +30°C.

WARNING!

ADRV-5 driver delivers up to 2.5 W of the RF power. Check whether the AOM you are intended to connect can stay this power level.

Switching on and off

1. Connect the load (AOM) to the “RF output” SMA connector using a 50 Ohm coaxial cable.
2. Connect the power cord and turn on the AC switch on the rear panel. The front-panel display will light-up while the AOM driver completed its booting (about 40 seconds).
3. Now it is possible to control each channel from the local display and/or via the web interface (for details, see the section „Computer control“)
   In addition, the RF power of each channel can be turned on or off using a “on/off” button on its front panel*. The same button is used to indicate CW and pulse mode operation.

   Most of the parameters of the ADRV-5 driver can be set using the touch-screen and precision encoder on the front panel.

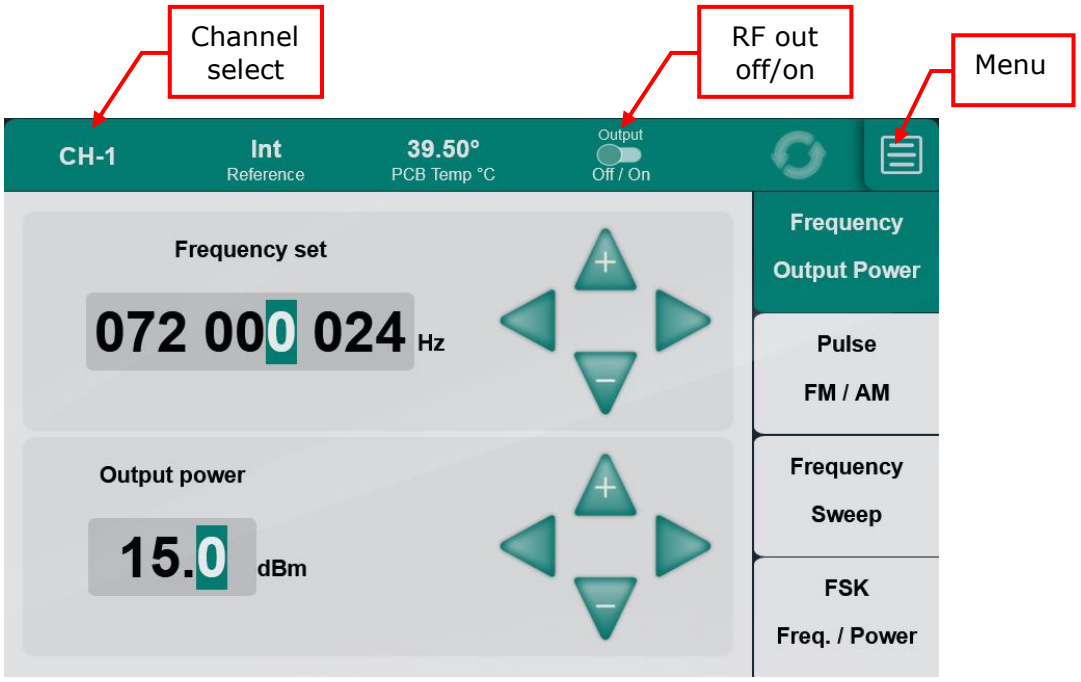
   When controlling the driver via the web interface, one can also use the number and arrow keys on the computer keyboard to set the operation parameters. .

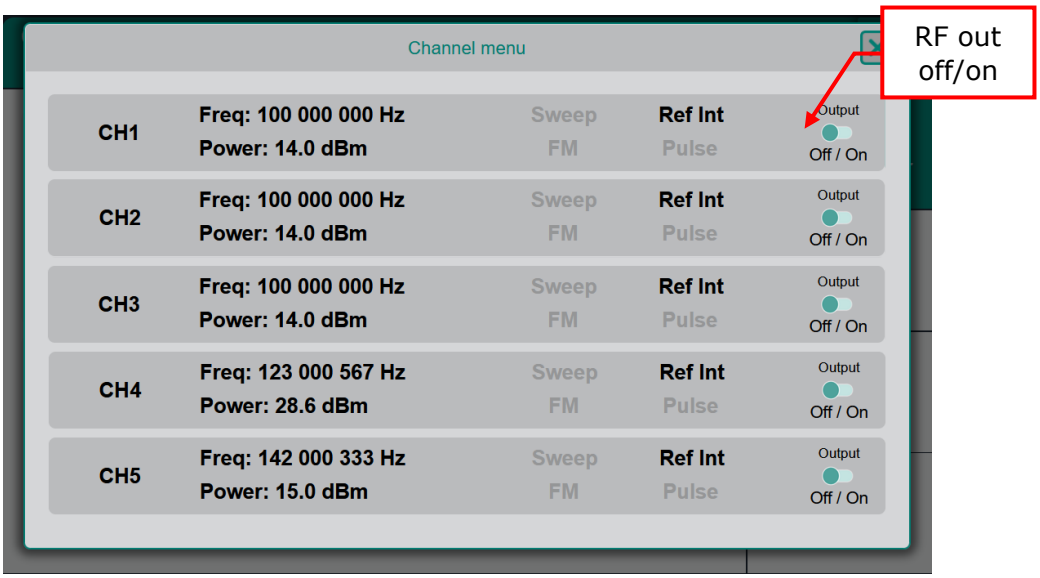
***Attention!** The RF power values on the display correspond to the actual (real) output power only when the AM offset is set to **0**. The output signal of the driver is altered by the AM offset even with no signal on the AM input.

Comment: *ADRV-5 AOM driver delivers up to 2.5 W of the RF power on the 50 Ohm load, thus all the load connections should be done with a proper 50 Ohm coaxial cable. An acousto-optical modulator, especially operating far away from its specified center frequency, can be not impedance matched and, as a result, not efficiently excited by the AOM driver. This will lead to a reduced diffraction efficiency. In this case some optimization can be done by varying the length of the connection cable.*

When power is turned off, the ADRV-5 driver automatically stores its state. The parameters are recalled after switching on the device.

The channel to control can be selected using the touch screen:





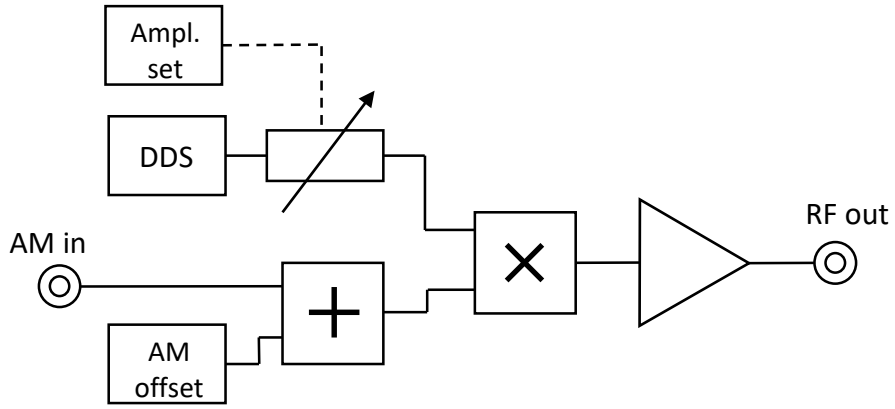
Analog amplitude modulation (AM)

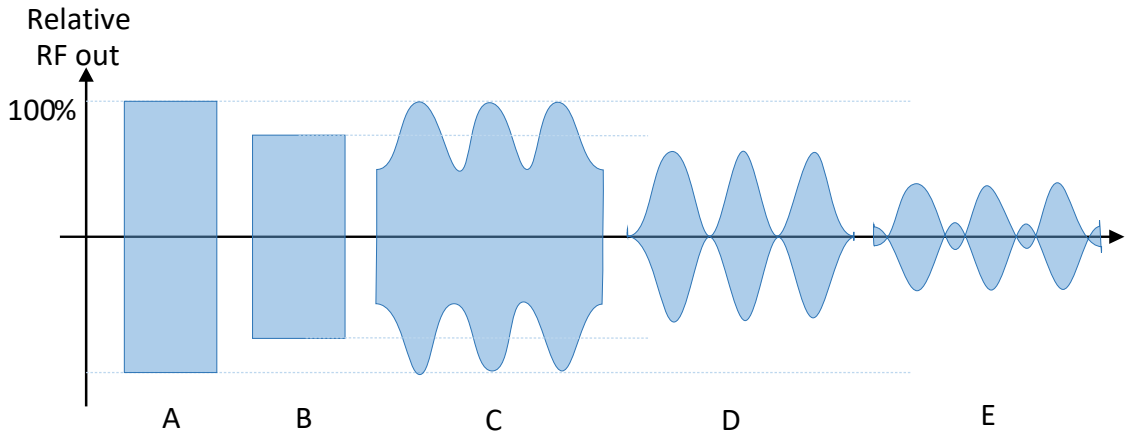
The AM does not require an activation. The amplitude of the carrier frequency can be varied by applying a modulation signal (± 1 V_p max.) to the AM input on the front panel. In this case, 0 V corresponds to the set amplitude of the AOM driver, -1 V sets the output amplitude to minimum. Positive values of the modulation signal will increase the output amplitude. *The output power of the RF driver can not exceed the specified maximum value (+ 34dBm).*

For a proper AM operation the "AM offset" should not be set to a maximum value.

For the AM settings we recommend to monitor the output signal of the driver on an oscilloscope using an RF 50 Ohm terminating resistor.

Simplified layout of the amplitude modulation:





A AM ofset=0; AMin=0
B AM ofset=-50; AMin=0
C AM ofset=-50; AMin≈0.5Vpp; AM depth<100%
D AM ofset=-100; AMin≈0.5Vpp; AM depth=100%
E AM ofset=-150; AMin≈0.5Vpp; AM depth>100%

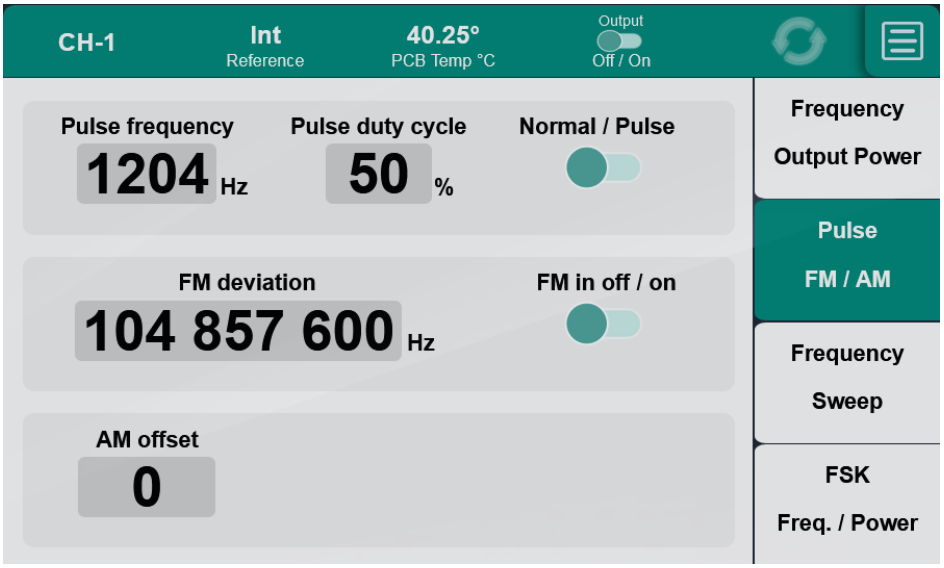
TTL amplitude modulation

The TTL input does not need to be activated. To provide a TTL modulation of the carrier, a TTL modulation signal is applied to the TTL input on the front panel. For a logical zero (0 – 0.4 V) at the TTL input the output power is at the set value. For a logical 1 (2.6 - 5V) the output power is switched off (suppressed to more than 40 dB).

Pulsed operation

The pulse mode must be activated in the corresponding menu.

In the pulsed operation, an (output) trigger signal is sent to the TTL SMA connector.



In the pulsed operation mode, the "on/off" LED is blinking. The period of blinking does not correspond to the period of the RF modulation!

For pulse frequencies greater than 170 Hz, the pulse frequency setting step is greater than 1 Hz, and the higher the frequency, the greater the step. The set frequency will be rounded to the nearest allowed value.

Analog frequency modulation (FM)

The FM mode should be activated in the corresponding menu. Frequency modulation of the carrier is accomplished by applying a modulation signal to the FM input on the front panel. The modulation depth depends on the amplitude of the applied signal, as well as the user settings.

Modulation depth, displayed on the monitor, corresponds to the nominal (±10 V) input signal at the FM input

Attention! In the "FM" mode the accuracy of the output frequency is not guaranteed.
The operation frequency of the driver should be at least 1.5 higher than the FM deviation (for example for the deviation of 26 MHz the center frequency should be > 39 MHz).

In FM mode, the spectrum of the output signal may strongly degrade. The command to eliminate this effects is „**Sadcoffs:**xxx" (see below the description).

Frequency sweep

The frequency sweep function should be activated in the corresponding menu. When the power of the AOM driver is turned on, this function is by default deactivated.

There are four modes of the Frequency sweep:

1- continuous triangle with internal trigger

2- triangle with external trigger

3- continuous saw-tooth with internal trigger

4- saw-tooth with external trigger

In the modes 1 and 3 the trigger signal can be read out from the "Trig." SMA connector (approx. 1Vpp).

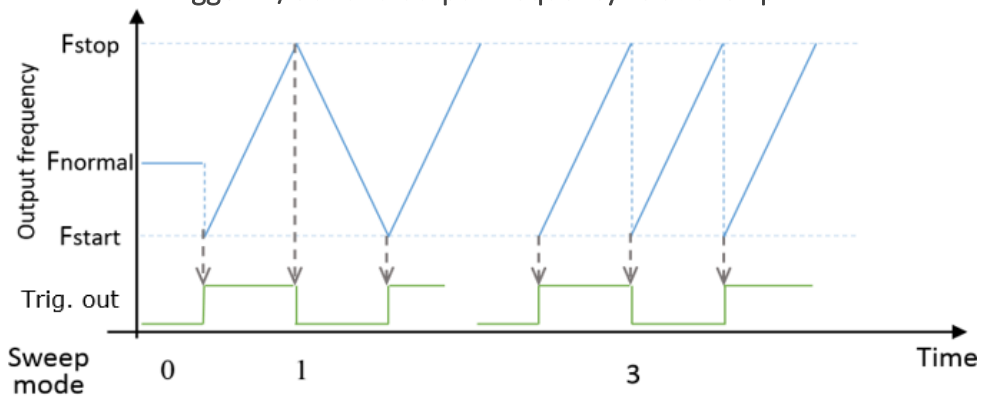
In the modes 2 and 4 the "Trig." SMA connector serves as trigger input (max. 5V pulse).

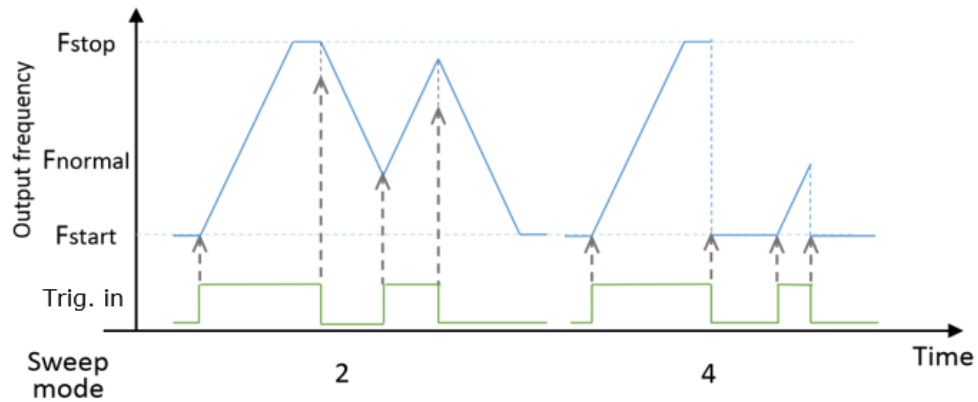
The Start, Stop and Step frequencies can be set via the Sweep menu or with a computer control (see below). Note, that shortest Step Time is equal to 3.90625 ns, however for simplicity is averaged to 4 ns and is set in integer values e.g 12, 248 etc.

The total sweep time *T* can be calculated as:

$$T = \frac{Fstop - Fstart}{Fstep} * Tstep$$

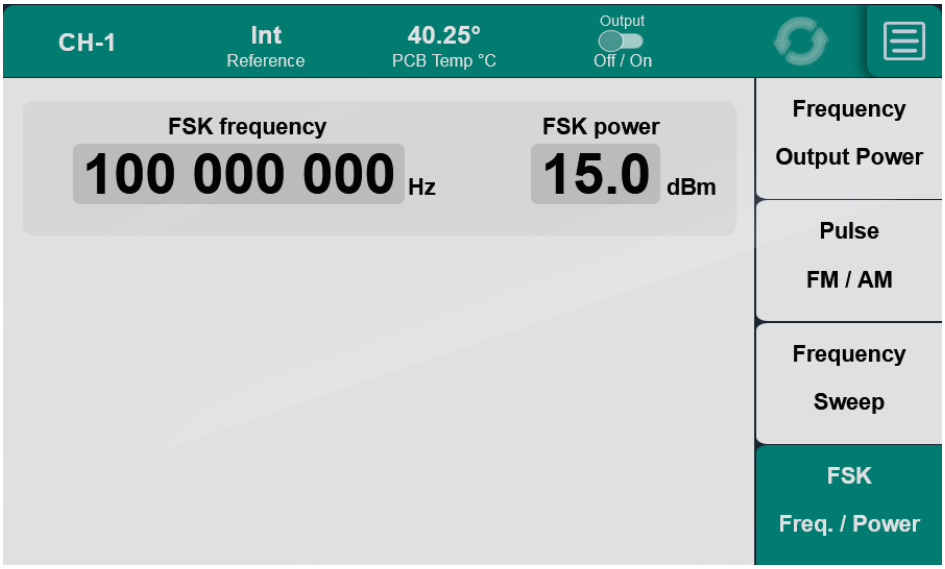
Trigger In/Out and output frequency relationship:





FSK (Frequency shift keying)

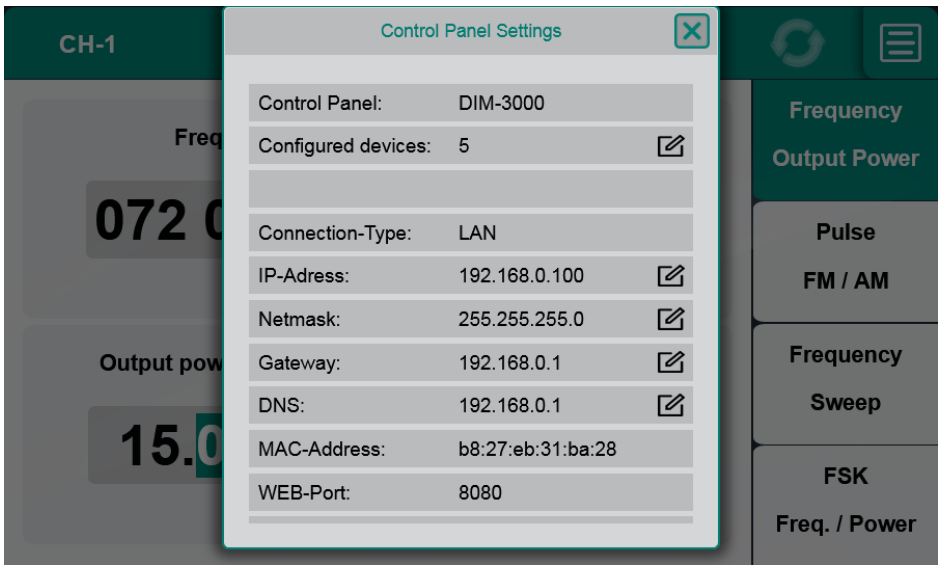
If the sweep mode is deactivated, then connector “Trig.” works as an input for the FSK function. When the logic 1 is applied to this input, the output signal switches to the frequency and amplitude specified in the FSK section.



Computer control

ADRV-5 has an Ethernet connection, which allows one to control it both from a local network and via the Internet.

The IP address of the device can be read/set in the corresponding menu (DHCP is not supported).



There are two ways to control the device from a computer:

1- via web interface

2- using TCP/IP protocol and a dedicated program (Terminal, Labview, etc.)

Control of the device using the Web Interface

ADRV-5 has a Web Interface that can be called by typing the corresponding IP address and port in the browser's address bar. For example, let ADRV-5 have an IP address of 192.168.0.100, then type 192.168.0.100:8080 (important to use ":8080" at the end!).
The Web interface is similar to the interface on the display of the device, one can control the elements with both mouse and keyboard (for example, directly type numeric values and use the arrow keys). It is allowed to open several (up to 10) windows with the interface on the same and /or different computers at the same time.

Control of the device using the TCP/IP

In addition to the Web Interface, ADRV-5 works as a TCP Server on port 8081.

This method is convenient when the device is part of a complex installation and you need to control the device from some user program written, for example, in LabVIEW.

For initial testing and "manual" control, it is convenient to use one of the terminal programs, for example freeware "Yet Another Terminal"
https://sourceforge.net/projects/y-a-terminal/

After establishing the TCP connection, one can send a command **“help”** and view additional information. It is also possible to configure the same communication settings with the command **“config”**. However, this is not required for normal operation and is not considered here.

Using the TCP/IP:

- One can send and receive commands, see the full list below.
- All commands must be terminated with <CR><LF> symbols.
- Note that maximum execute speed is about 10 commands/sec.

To address an individual channel of ADRV5, use the prefix such **“YYY|”** , where **“YYY”** is the channel name. The list of active channels can be found on the device display by clicking on the field at the top left of the screen, or three bars at the top right (menu) -> “Channel” item. You may need to scroll down the list.

Examples:
send (get info of CH-8)

```
CH-8|Gdev
```

Receive:

```
Rdev:ADRV5|Rhv:2|Rfv:1|Rfb:74|Rsn:226051|Gdev
```

Note that the response comes without a prefix.

send (set frequency of CH-8 to 123.000567 MHz)

```
CH-8|Sfreq:123000567
```

Computer commands list

(FW v.1-74, February 2023)

Commands are case sensitive, xxx - numbers

All commands must be terminated with <CR><LF> symbols.

Maximum execute speed is about 10 commands/sec.

The basic set of commands:

Gdev	get device info	see explanation below	
Ginit	get initial data		
Gpar	get parameters		
Sadcoffs (only for writing)	Set ADC offset (in FM mode improves the RF signal linewidth)	-120 to +120 arb. units	write example: **Sadcoffs:**-31

Gdev

answer example:

`Rdev:ADRV5|Rhv:1|Rfv:1|Rfb:62|Rsn:564193`

Parameter	Description	Value	read/write
Rdev	internal device name		r
Rhv	hardware version		r
Rfv	firmware version		r
Rfb	firmware build		r
Rsn	serial number		r

Ginit

answer example:

`Ramoffsmin:-225|Ramoffsmax:25|Ramoffsnom:0|Rinit:1`

Parameter	Description	Value	read/write
Ramoffsmin	AM offset min. value	-225	r
Ramoffsmax	AM offset max. value	25	r
Ramoffsnom	AM offset nominal value	0	r
Rinit		1	r

Gpar

answer example:

```
Rfreq:39195001|Rampl:236|Rout:1|Rpmon:0|Rpmfr:34|Rpmd:200|Rpmphc:0|Rswpm:0|Rswps:20000000|Rswpp:71000222|Rswpf:700|Rswpt:45000|Rfmon:0|Rfmdev:11|Rplson:0|Rplsfr:66|Rplsdt:50|Rffreq:32000000|Rfampl:156|Ramoffs:0|Rpcbtemp:6175|Rrefstat:0|Rreflev:-85|Rvcclev:2418
```

Parameter	Description	Value	read/write
Rfreq	output frequency	Hz	rw
Rampl	output amplitude	dBm*10	rw
Rout	RF out off/on	0/1	rw
Rpmon	*test, please don't use*		rw
Rpmfr	*test, please don't use*		rw
Rpmd	*test, please don't use*		rw
Rpmphc	*test, please don't use*		rw
Rswpm	sweep mode	0/1/2/3/4	rw
Rswps	sweep start freq.	Hz	rw
Rswpp	sweep stop freq.	Hz	rw
Rswpf	sweep step freq.	Hz	rw
Rswpt	sweep step time	ns	rw
Rfmon	FM off/on	0/1	rw
Rfmdev	FM deviation	0-15	rw
Rplson	pulse mode off/on	0/1	rw
Rplsfr	pulse freq.	20-1000	rw
Rplsdt	pulse duty cycle	1-99	rw
Rffreq	FSK freq.	Hz	rw
Rfampl	FSK amplitude	dBm*10	rw
Ramoffs	AM offset	-225 to +25	rw
Rpcbtemp	internal temperature	°C*100	r
Rrefstat	ext. reference status	0/1	r
Rreflev	ext. reference level	arb. units	r
Rvcclev	DC voltage level	V*100	r

Attention! Parameters, indicating as “rw” (read/write) in the above table, can be used to write down these values. For writing, use the prefix „**S**“ instead of „**R**“

For example:

Sampl:254 – set output amplitude to 25.4dBm

Obsolete commands for compatibility with the DIM-3000 device.
The correct functionality is not guaranteed.

Command	Description	Output/input (units), range
***IDN?**	Identification request	device ID
FRQ?	output Frequency request	frequency, Hz
FRQs?	Frequency step request	frequency step, Hz
AMP?	output Amplitude request	dBm*10
AMO?	AM offset request	arb. units
FFRQ?	FSK Frequency request	Hz
FAMP?	FSK Amplitude request	dBm*10
sn?	serial number request	serial number
rst1	restart device	
OUT_on	RF output enable	
OUT_off	RF output disable	
FRQ:xxx	Setting of the output frequency	Hz, 10 – 400 MHz
FRQs:xxx	Sets frequency Increment/decrement step (influences regulation knob)	Hz, 1Hz - 10MHz
AMP:xxx	Setting of the output amplitude	dBm*10, +14 – +34 dBm
FFRQ:xxx	Setting of the FSK frequency	Hz, 10 – 400 MHz
FAMP:xxx	Setting of the FSK amplitude	dBm*10, +14 – +34 dBm
SWPm:xxx	Setting sweep mode	numbers 0 – 4, 0 – sweep off 1 – triangle int. trigger 2 – triangle ext. trigger 3 – saw int. trigger 4 – saw ext. trigger
SWPs:xxx	Setting sweep Start freq.	Hz, 10 - 400 MHz
SWPp:xxx	Setting sweep Stop freq.	Hz, 10 - 400 MHz
SWPf:xxx	Setting sweep step Freq.	Hz, 10 - 400 MHz
SWPt:xxx	Setting sweep step Time	ns, 4 – 262000 ns
FM_on	FM input enable	
FM_off	FM input disable	
FMdev:xxx	Setting of the FM deviation	numbers 0 – 15, 0 - 3200Hz 1 - 6400Hz … so on
RFp_on	Pulse mode on	
RFp_off	Pulse mode off	
RFpfr:xxx	Pulse frequency	Hz, 10 - 1204
RFpdt:xxx	Pulse duty cycle	%, 1 - 99

Appendix 1. Compatibility of the ADRV-5 functions

Most functions are independent from each other and can be used simultaneously.

	AM	TTL	SWP	FM
AM		+	+	+
TTL	+		+	+
SWP	+	+		-
FM	+	+	-	

Warranty

Time-Base provides the warranty for the ADRV-5 AOM driver for a period of one year starting from the date of shipment. For warranty the unit must be sent back to Time-Base. The customer will carry the shipping costs to Time-Base; Time Base will carry the shipment costs back to the customer.

The warranty does not cover errors and defects being the result of improper treatment, modifications, misuse or operation outside the defined ambient conditions stated in this manual.