ARUN MICROELECTRONICS LTD

AGP-1 MEMS Pirani and Piezo Gauge

AGP Active Pirani Gaugehead

USER MANUAL

ISSUE 20210217

1. Introduction

The AGP-1 Pirani gauge incorporates cutting edge MEMS (Microelectromechanical Systems) sensor technology with precision digital signal processing and advanced measurement algorithms. Combined with precision automated manufacturing and calibration processes, this product provides uncompromised measurement performance.

The well-known gas dependency in the rough vacuum range of thermal conductivity gauges has been eliminated by integrating a MEMS diaphragm sensor that offers precision performance comparable to more expensive capacitance manometers. This feature ensures more accurate control of vacuum system venting processes and can prevent over-pressurization of the vacuum system.

1.1. Scope of this manual

This manual provides installation, operation and maintenance instructions for the Arun Microelectronics Ltd Active Pirani Gaugehead model AGP-1. Please read this manual before attempting to install and operate the gauge.

This manual contains essential safety information. The following symbols are used in this manual:

WARNING! Critical information to prevent dangerous situations that can result in serious injury or death.

CAUTION! Important information to prevent dangerous situations that can damage the device or auxiliary equipment.

ACTION! Requires action or attention**.**

INFORMATION: Important recommendations and information for efficient use and best practice.

2. Technical data

2.1. Specifications

Measurement range	1 x 10^{-6} to 1333 mBar (7.5 x 10^{-7} to 1000 Torr)
Measuring principle 1 x 10^{-6} to 1.5 mBar	MEMS Pirani thermal conductivity
Measuring principle 1.5 to 2 mBar	Blended MEMS Pirani / piezo reading
Measuring principle 2 to 1333 mBar	MEMS piezo resistive diaphragm
Accuracy 1 x 10^{-5} to 9.99 x 10^{-5} mBar	25% of reading
Accuracy 1 x 10^{-4} to 7.99 mBar	5% of reading
Accuracy 8.00 to 99.9 mBar	1% of reading
Accuracy 100 to 800 mBar	0.5% of reading
Accuracy 800 to 1099 mBar	0.25% of reading
Accuracy 1100 to 1333 mBar	0.5% of reading
Hysteresis 1×10^{-3} to 10 mbar (ISO19685:2017)	1%
Hysteresis 10 to 1333 mbar (ISO19685:2017)	0.1%
Analog output resolution	16 bit (150 µV)
Analog output update rate	124 Hz
Response time (ISO 19685:2017)	<20 ms
Temperature compensation	+10°C to +50°C
Solid state relay set point range	5 x 10^{-6} to 1333 mbar (3.75 x 10^{-6} to 1000 Torr)
Solid state relay contact rating	50 Vdc/Vac peak, 100 mA_{rms}/mA_{dc}

2.2. Environmental conditions

Operating ambient temperature	-20°C to +50°C
Media temperature	-20°C to +50°C
Storage ambient temperature	-40°C to +120°C
Bake-out temperature (non-operating)	+120°C
Maximum media pressure	10 bar absolute
Mounting position	Arbitrary
Protection rating, EN 60529/A2:2013	IP 40
Humidity, IEC 68-2-38	98%, non-condensing

2.3. Power supply

Supply voltage	12 - 30 Vdc
Power consumption	240 mW maximum
Reverse polarity and over-voltage protection	Yes
Internal fuse	100 mA (thermal recoverable)

2.4. Materials

Vacuum process flange	SS 1.4404 / AISI 316 stainless steel
Enclosure	SS 1.4404 / AISI 316 stainless steel / Aluminium
Vacuum exposed materials (media wetted)	316 Stainless steel, Kovar, glass, silicon, nickel, aluminium, SiO2, Si3N4, gold, Viton®, low out-gassing epoxy resin
Process leak tightness	$< 1 \cdot 10^{-9}$ mBar · l/sec.

3. Warnings and safety

WARNING! This product is not intended for installation and use in the presence of flammable gases or other explosive environments.

WARNING! Ensure that the gases or liquids exposed to the wetted materials are compatible with the wetted materials described in the specifications table and the used sealing materials.

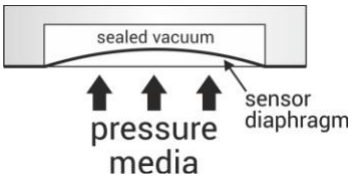
WARNING! The pressure rating of the sensor elements, connecting process fittings and sealing must comply with the maximum possible pressure in the application.
The CE marking on the device does not apply to the pressure equipment directive (PED) (2014/68/EU).

WARNING! Ensure that the process connection is tightened according to the recommended torque specification. Ensure that there are no leaks from the process connection before pressurizing the installation.

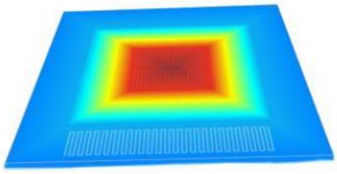
WARNING! Do not remove the transducer from the installation when the installation is evacuated, pressurized or contains hazardous fluids.

4. About the AGP-1

The AGP-1 is based on patent-pending technology that offers best-in-class performance and has established new standards by extending the useable measuring range for thermal conductivity vacuum gauges by 1-3 decades. The AGP-1 combines a MEMS (Microelectromechanical Systems) heat-loss Pirani sensor with a Piezo diaphragm sensor.



Piezo absolute diaphragm



Heat-loss diaphragm pressure

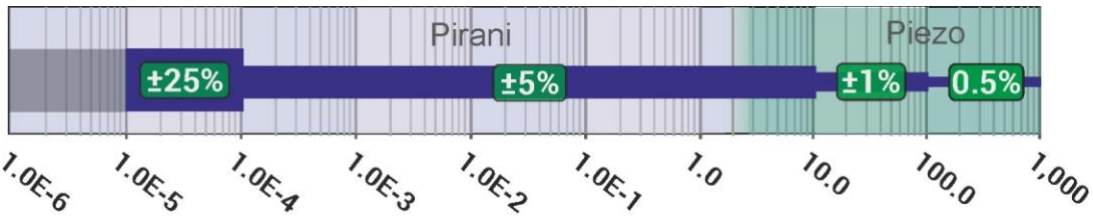
The piezo MEMS sensor consists of a diaphragm where one side of the diaphragm is exposed to the vacuum gas and the other side is exposed to a sealed reference vacuum. The applied pressure deflects the diaphragm and the deflection is converted to an electric signal.

The MEMS Pirani sensor is based on a resistive element deposited on an ultra-thin diaphragm suspended in the vacuum gas to measure. The diaphragm is permanently mechanically fixed and does not bend or move with changes in vacuum gas pressure. The resistive element is made of nickel that offers a high-temperature coefficient. The vacuum gas pressure is determined by measurement of the pressure-dependent heat-loss from a heated resistive element. The measurement of heat-loss is gas concentration and gas type dependent.

4.1. Measurement performance

The AGP-1 has established new performance standards and extended range for heat-loss Pirani gauges. It combines a MEMS diaphragm piezo sensor with heat-loss MEMS Pirani sensor.

The diaphragm sensor eliminates the well-known gas dependency in the rough vacuum range of thermal conductivity gauges. The Piezo offers precision performance comparable to more expensive capacitance manometers. This feature ensures more accurate control of vacuum system venting processes and can prevent over-pressurization of the vacuum system.



Measurement range in mBar and accuracy of reading

The MEMS-Pirani provides measurement resolution down to 1.00E-6 mBar (7.5E-7 Torr).

5. Mechanical installation

The AGP-1 is supplied with a KF flange. A CF flange variant is coming soon.

CAUTION! Use gloves when handling vacuum fittings. Ensure that the O-ring and vacuum sealing surfaces are clean and free of scratches or other damage.

The AGP-1 transducer can be mounted horizontally or vertically without impact on accuracy or performance.

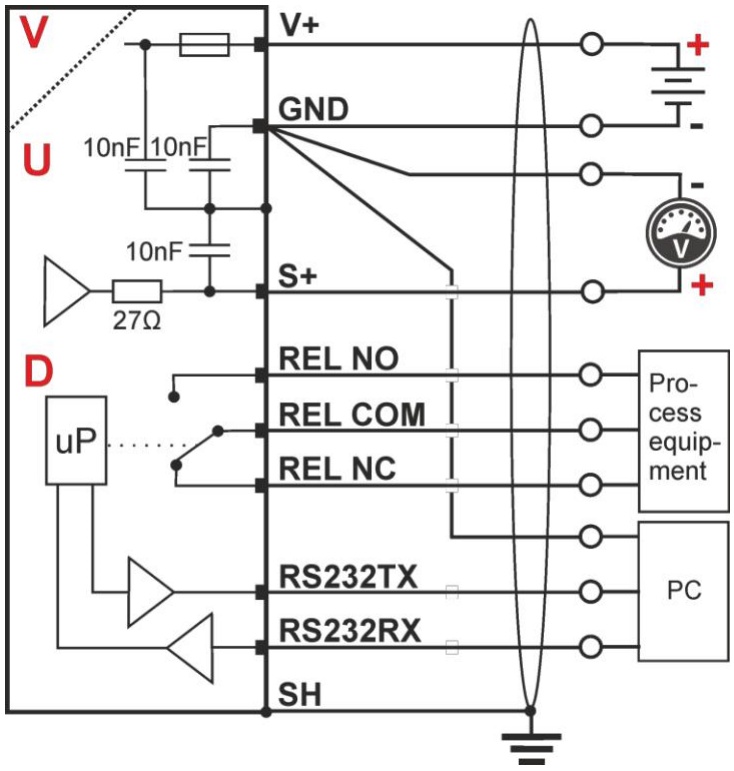
6. Electrical installation

The AGP-1 requires an external power supply supplying in the range 12 - 30 Vdc. The external power supply shall be with safe isolation according to PELV (Protective Extra Low Voltage) requirements of EN60204-1. The transducer is protected against momentary overvoltage on the supply line. The internal 100 mA thermal fuse will limit current draw in case of overvoltage to limit overheating.

Additionally, the transducer is protected against reverse polarity caused by incorrect wiring to the power supply.

The transducer electronics have a high level of immunity against external electromagnetic interference.

The AGP-1 provides a voltage signal proportional to the measured pressure.

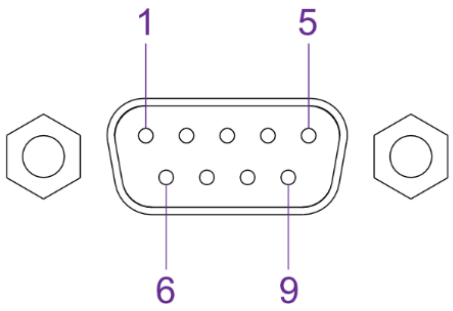


The high-resolution 16-bit voltage signal can be interfaced to a PLC, A/D converter, voltmeter or other readout devices.

It is recommended to use a differential input to measure the output signal that uses a separate signal return wire connected to the transducer connector. If the power supply return and signal return share the same wire connection, the voltage drop as a function of the supply current will cause a measurement deviation. In that case, the measurement deviation will increase with the cable length.

6.1. Connector pinout

Pin	Description
1	Relay 1 NO (normally open contact)
2	Relay 1 NC (normally closed contact)
3	Supply voltage 12 - 30 Vdc
4	Supply voltage – (return)
5	Analog voltage signal +
6	Relay 1 Common
7	RS-232 Transmit
8	Analog voltage signal – (return)
9	RS-232 Receive



7. Status LED

The LED indicator signals the transducer status and can indicate the following basic indications:

Startup sequence

0.5 sec purple followed by 4 sec. pulsing green

Normal operation

Solid green

Sensor fail

Strobing red

8. Signal-to-pressure conversion (0 – 10 Vdc output)

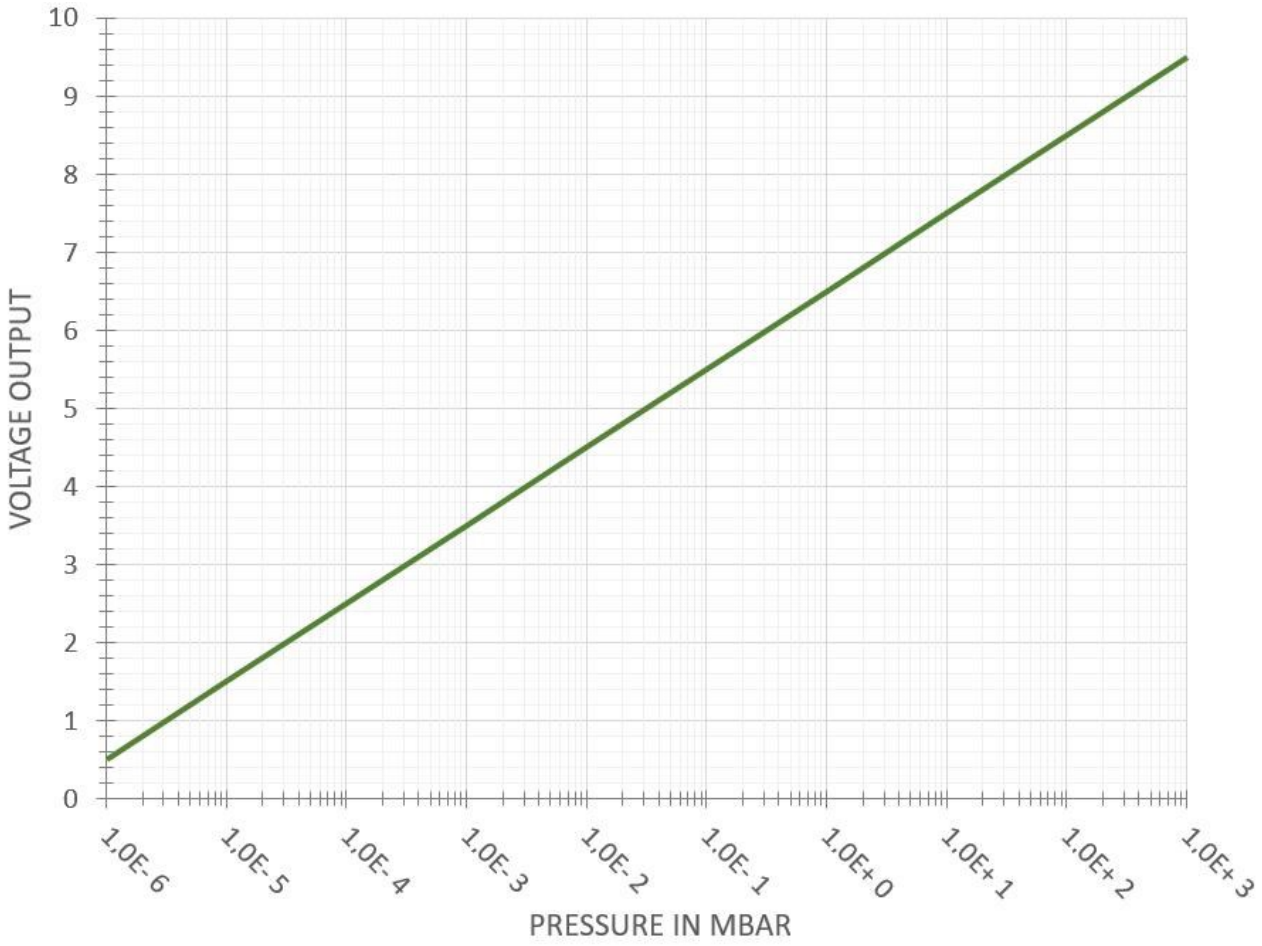
The transducer can provide a voltage output from 0 - 10 Vdc and is available with different types of pre-configured output scaling.

In the AGP-1's standard configuration with a voltage output of 1 Vdc/decade, the output is scaled according to the configured pressure unit, e.g. when mBar is selected the transducer will provide 1 Vdc per decade mBar. Likewise, when the unit is changed to torr, the transducer will provide 1 Vdc per decade torr. Finally, when the unit is changed to Pascal, the transducer will provide 1 Vdc per decade Pascal.

The voltage signal can be converted to pressure using the following linear expression:

Voltage to pressure conversion (mBar and torr): $P(u) = 10^{(u-6.5)}$

Voltage to pressure conversion (Pascal): $P(u) = 10^{(u-4.5)}$

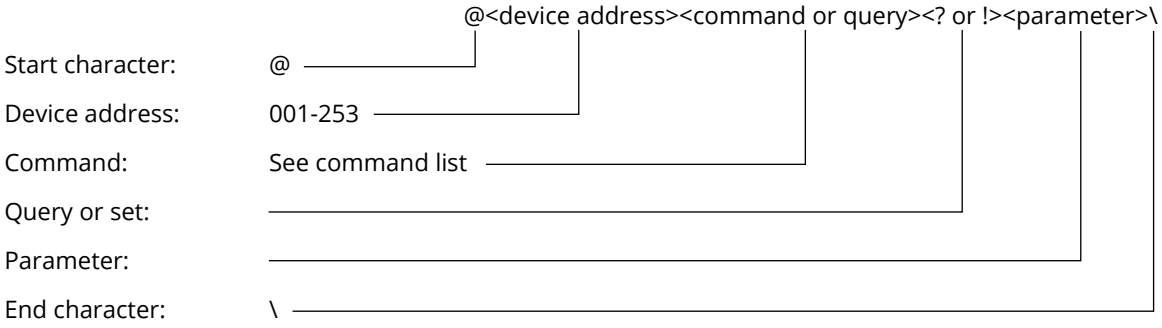


8.1. Third-party analog output emulation

The AGP-1 analog output emulation offers voltage output pressure scaling compatible with other vendors gauges. This feature enables drop-in replacement of gauges from other vendors. Configuration and list of analog output options can be found on page 13.

9. Serial communication

The AGP-1 includes an RS-232 serial interface. Communication is based on an ASCII protocol that includes a start character, device address, command or query and an end character for termination:



INFORMATION: Throughout this manual the signs <> are written for separation of command name and values and are for informational purposes only. These signs should not be entered in the actual command

Example of how to send a command to the transducer
Programming the Setpoint 1 value to 1.23E-4 (using the default unit setting of the transducer, i.e. mBar):

Send: **@254SPV!1,1.24E-4**
Reply: **@253ACK1.23E-4**

The following table lists all commands supported by AGP-1. Each command is described in more detail below the table.

Command	Description	Query	Set	Valid input parameter
ADR	Device address	•	•	1-3 digits (range 001-253)
AOUT	Analog output configuration	•	•	<STD / 0-39>
BAUD	Set baud rate	•	•	<4800 / 9600 / 19200 / 38400 / 57600 /115200> (default 9600)
FAIL	Sensor failure handling	•	•	<WORKING / ZERO >
FD	Factory default		•	<ADR / BAUD / GT / SP / U / (NONE)>
FS	Piezo full-scale adjustment	•	•	<PRESSURE VALUE / CLEAR>
FV	Firmware version	•		-
GT	Gas type	•	•	<NITROGEN / HELIUM / ARGON / AIR>
MF	Manufacturer	•		-
P	Pressure measurement	•		<CMB / MP / PZ / (none)>
PN	Part number	•		-
Q	Quick query	•	•	<Parameter 1>, <Par. 2> ... <Par. 5>
SN	Serial number	•		-
SP	Setpoint settings	•		-
SPD	Setpoint direction	•	•	1, <ABOVE / BELOW>
SPE	Setpoint enable	•	•	1, <OFF / ON>
SPH	Setpoint hysteresis	•	•	1, <PRESSURE VALUE>
SPV	Setpoint value	•	•	1, <PRESSURE VALUE>
SPR	Setpoint relay status	•		1

SPS	Setpoint source	•	•	1, <P / T>
STAT	Statistics	•	•	<P / T / (none) / CLEAR (Set only)>
T	Vacuum sensor temperature	•		-
U	Pressure unit	•	•	(<PARAMETER>), <MBAR / PASCAL / TORR> or <CELSIUS / FAHRENHEIT / KELVIN>
VAC	Pirani Zero adjustment		•	No input or <PRESSURE VALUE>

9.1. Device Address (ADR)

The AGP-1 has an addressable communication protocol, and so it will only accept commands or queries with the following addresses. All queries or commands sent to all other addresses are simply ignored.

<device address>	Pre-configured to 253, this value may be changed at any time to any value in the range 1-253 using the ADR command.
254	This is the ”global” address. The AGP-1 will always respond to commands or queries at address 254, regardless of the device address setting.

Example: Change the device address from 253 (default) to 123 using the global address:

Send: **@254ADR!123**
Reply: **@253ACK123**

All replies after this one will begin with the new device address, 123.

9.2. Analog Output Configuration (AOUT)

The default analog output of the AGP-1 is 0.5 - 9.5 V, 1 V/decade, however, the analog output can be configured to emulate a collection of other equipment via the AOUT command:

	Vendor	Transducer model	Output
0	MKS	901P, 910, 925	1 Vdc/decade
1	Edwards	APG-L	1.99 - 10 Vdc
2	Edwards	APG-100	2 - 9 Vdc
3	Edwards	WRG	2.75 - 10 Vdc
4	Inficon Leybold	PSG500 TTR91	1.547 - 10 Vdc
5	Inficon Pfeiffer	MPG400 PKR251	2.07 - 8.603 Vdc
6	Inficon MKS	BPG400 999 Quattro	1.843 - 10 Vdc
7	MKS Granville Phillips	275	0.372 - 5.570 Vdc
8	MKS HPS	Moducell 325	0.2509 - 3.2398 Vdc
9	MKS HPS	Moducell 325 x3	0.753 - 9.719 Vdc
10	MKS	Baratron® 0.1 Torr	0 - 10 Vdc
11	MKS	Baratron® 1 Torr	0 - 10 Vdc
12	MKS	Baratron® 10 Torr	0 - 10 Vdc
13	MKS	Baratron® 100 Torr	0 - 10 Vdc
14	MKS	Baratron® 1,000 Torr	0 - 10 Vdc
15	MKS	901P piezo differential output	1 Vdc/decade
16	Edwards	AIM-S / - SL	2.5 - 10 Vdc
17	Edwards	AIM-X / XL	3.286 - 9.799 Vdc
18	Pfeiffer	IKR251	2.324 - 8.500 Vdc
19	Pfeiffer	TPR 265 / 280	2.199 - 8.625 Vdc
20	Hastings	HPM-2002-OBE special	5 - 9.995 Vdc
21	Edwards	DV6M	2 - 10 Vdc
22	Edwards	APG-M	2 - 10 Vdc
23	MKS Granville Phillips	GP275 (0 - 9 Vdc)	0 - 8.80 Vdc
24	Thyracont	MT 241.1	0.1 - 9.99 Vdc
25	MKS Granville Phillips	GP275 (0.375-5.659 Vdc)	0.375 - 5.659 Vdc
26	Edwards	APG100-LC	2 - 10 Vdc
27	Edwards	APG100M	2 - 10 Vdc
28	MKS	907	0.387 - 5.666 Vdc
29	Alcatel	K6080	0.40 - 10 Vdc
30	Inficon	PEG100	2.186 - 10.166 Vdc
31	Varian	Eysys	1 - 8 Vdc
32	Alcatel	TA111	0.10 - 9.2 Vdc
33	MKS	685	1 - 7 Vdc

Example: Change the Analog output emulation to MKS Baratron® 0.1 Torr:

Send: **@254AOUT!10**
Reply: **@253ACK10**

9.3. Set Baud Rate (BAUD)

The AGP-1 supports the following baud rates: 4800, 9600, 19000, 38400, 57600, 115200. Note that whenever the baud rate is changed, the AGP-1 will send an acknowledgement to the BAUD command using the old baud rate setting before switching to the new one.

Example: Change the baud rate to 115200:

Send: **@254BAUD!115200**
Reply: **@253ACK115200**

9.4. Pressure measurement (P)

Reading the digital pressure value:

Send: **@254P?**
Reply: **@253ACK1013.12**

9.5. Quick data acquisitions

The quick data acquisition command provides all variable measurement data and setpoint status in one string.

Reading the quick data acquisition:

Send: **@254Q?**
Reply: **@253ACKQ9.9715E+2,2.5500E+1,9.9715E+2,0XX,21.33**

Configuration of the quick data acquisition:

Send: **@254Q!PZ,PIR,CMB,SETP,TEMP**
Reply: **@253ACKQ9.9715E+2,2.5500E+1,9.9715E+2,0XX,21.33**

Read the current quick data acquisition configuration:

Send: **@254Q?CONFIG**
Reply: **@253ACKQPZ,PIR,CMB,SETP,TEMP**

Parameter	Description
CMB	Combined pressure measurement
PIR	Pirani pressure measurement
PZ	Piezo pressure measurement
SETP	Setpoint status
TEMP	Temperature measurement

Setpoint status

The setpoint status value provides a 3-digit value, where 1XX=Energized relay, 0XX=De-energized relay.

9.6. Temperature measurement (T)

The AGP-1 has a built-in high-resolution precision temperature sensor that provides a temperature measurement of the vacuum gas in degrees Celsius with a typical accuracy of better than ±1 °C.

Reading the quick data acquisition:

Send: **@254T?**
Reply: **@253ACK25.22**

9.7. Unit

The AGP-1 can be configured to three different pressure units and three different temperature units. If no explicit parameter (pressure, temperature) is defined, pressure is assumed.

Setting the pressure unit to Pascal:

Send: **@254U!PASCAL**
Reply: **@253ACKPASCAL**

Reading the current pressure unit:

Send: **@254U!P,MBAR**
Reply: **@253ACKMBAR**

Setting temperature unit to Fahrenheit:

Send: **@254U!T,FAHRENHEIT**
Reply: **@253ACKFAHRENHEIT**

Reading current temperature unit:

Send: **@254U?T**
Reply: **@253ACKFAHRENHEIT**

INFORMATION: All values related to pressures like setpoint values and full-scale must be entered in the current unit for the transducer. When changing unit all setpoint values are converted to the new unit and consequently, setpoint functionality will remain intact when changing unit.

9.8. Statistics (STAT)

The statistics function logs the number of operation hours and the maximum and minimum measured pressure or temperature value. If no explicit parameter (pressure, temperature) is defined, pressure is assumed.

Reading the statistics (parameter is left out, so pressure is assumed):

Send: **@254STAT?**
Reply: **@253ACKSTAT<cr>**
MIN : 5.6104E+00<cr>
MAX : 1.0159E+03<cr>
HOURS : 37

Reading the statistics (parameter is left out, so pressure is assumed):

Send: **@254STAT?T**
Reply: **@253ACKSTAT<cr>**
MIN : 2.345E+01<cr>
MAX : 3.123E+01<cr>
HOURS : 37

Reading current temperature unit:

Send: **@254STAT!CLEAR**
Reply: **@253ACKCLEAR**

9.9. Switch function

The solid-state setpoint relay function can be used for controlling and monitoring by external equipment.

The solid-state switch relay can be used for external control of pumps, valves, safety interlock circuits and other external equipment. The basic control uses on/off regulation with a programmable setpoint and hysteresis value. The solid-state relay offers both normally closed and normally open contacts.

Compared to electromechanical relays, the solid-state relay offers superior reliability and faster switching time while providing arc-free contacts and generating no EMI (electromagnetic interference) when switching contacts.

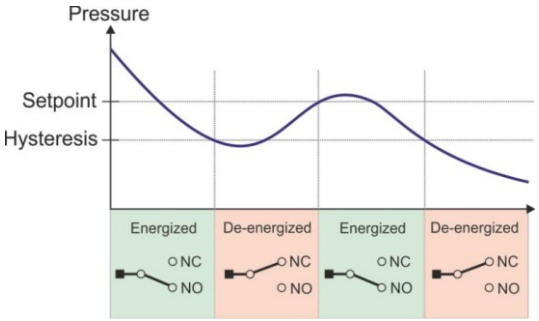
The relay is UL listed, CSA recognized, and EN/IEC 60950-1 certified for maximum confidence when used to control critical vacuum processes and high-cycle applications.

The relay switch is controlled by the pressure measurement by default but can be configured to be controlled by the internal temperature sensor.

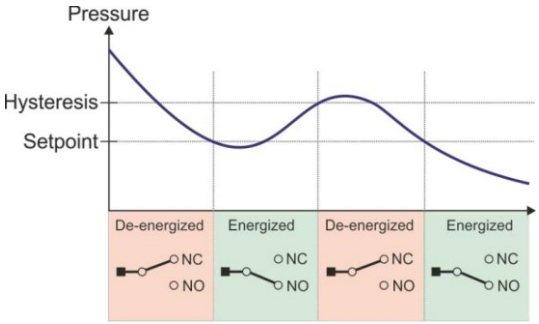
WARNING! Do not exceed the maximum load rating of 250 mA, 50 Vdc / Vac peak on relay contacts. Extra precautions must be taken when driving an inductive load. Ensure that the inrush peak current does not exceed the relay contact ratings.

The switch can be configured to close the relay contact either above or below the setpoint value.

Above
When the switch direction is configured to above, the relay will remain energized (NO contact closed) until the hysteresis value is exceeded. Then it will change to de-energized (NC contact closed). The relay will energize (NO contact closed) again when the setpoint value is exceeded.



Below
When the switch direction is configured to below, the relay will remain de-energized (NC contact closed) until the hysteresis value is exceeded. Then it will change to energized (NO contact closed). The relay will de-energize (NC contact closed) again when the setpoint value is exceeded.



9.10. Configuring the set point

INFORMATION: All values related to pressures such as setpoint values and full-scale must be entered in the current unit for the transducer. When changing the pressure unit, all setpoint values are converted to the new unit and consequently, setpoint functionality will remain intact when changing the unit.

Command sequence example:

@254SP? (This step is not mandatory.) Print an overview of all setpoint settings. If no setpoints have previously been defined, the AGP-1 will produce the following overview.

@253ACKSP<cr>
#: ENABLE, ENERGIZED, SOURCE, DIRECTION, VALUE, HYSTERESIS<cr>
1: OFF, NO, PRES, ABOVE, +0.000E+00, +0.000E+00 <cr>
2: < NO RELAY INSTALLED ><cr>
3: < NO RELAY INSTALLED ><cr>
****

@254SPS!1,P Assign pressure measurement as the source for Setpoint 1, **@253ACKP** is received.

@254SPD!1,ABOVE Configure the Setpoint 1 relay to be energized whenever the pressure reading is greater than the Setpoint 1 value. Whenever this value is changed, the corresponding Hysteresis value is automatically calculated to either -10% of the current setpoint value (when direction = ABOVE) or +10% of the current setpoint value (when direction = BELOW). If the temperature measurement is selected as the source, the automatically calculated Hysteresis values will be -1ºC /+1ºC instead of -10%/+10%. **@253ACKABOVE** is received.

@254SPV!1,600 Set the value of Setpoint 1 to 600 and auto-calculate Hysteresis value. As the direction is set to ABOVE, the hysteresis value will be automatically set to 540 (the setpoint value -10%). Had the direction been BELOW, the hysteresis would have been automatically set to 660 (the setpoint value +10%). **@253ACK6.0000E+2** is received.

@254SPH!1,500 Set the Hysteresis value for Setpoint 1 to 500, **@253ACK5.0000E+2** is received.

@254SPE!1,ON Enable Setpoint 1, **@253ACKON** is received.

@254SPR?1 Get the current status of the Setpoint 1 relay. **@253ACK<relay state>** is received.

@254SP? (This step is not mandatory.) Print an overview of all setpoint settings to verify the new settings. If the unit is set to mBar and the pressure reading is above 600 – energizing the Setpoint 1 relay – the generated output would look like this:

@253ACKSP<cr>
#: ENABLE, ENERGIZED, SOURCE, DIRECTION, VALUE, HYSTERESIS<cr>
1: ON, YES, PRES, ABOVE, +6.000E+00, +5.000E+00 <cr>
2: < NO RELAY INSTALLED ><cr>
3: < NO RELAY INSTALLED ><cr>
****

9.11. Product information and identification

The AGP-1 has a serial number, product part number, manufacturer identity and firmware version programmed in its internal non-volatile memory.

Reading the serial number:

Send: **@254SN?**
Reply: **@253ACK19087-001**

Reading the part number:

Send: **@254PN?**
Reply: **@253ACKAGP-1**

Reading the manufacturer identity:

Send: **@254MF?**
Reply: **@253ACKAML**

Reading the firmware version:

Send: **@254FW?**
Reply: **@253ACK1.04**

10. Maintenance

Maintenance is not required in many applications during the lifecycle of this product. The calibration may shift during the lifetime and re-calibration by adjusting the zero point and full-scale value can be performed by the user.

The AGP-1 can be user configured, calibrated and tested using the RS-232 interface.

10.1. Adjustment of the zero point

The AGP-1 has an active and individual temperature compensation to account for zero-point drift. In many applications, a user adjustment of the zero point is not required during the lifetime of the product.

If drift of the zero-point is observed, it can be adjusted using the RS-232 interface or by pressing the zero switch.

Zero-point adjustment procedure using the digital interface

1. Evacuate the transducer to a vacuum pressure below 1.00E-6 mBar.
2. Send command: **@254VAC!**
3. Reply: **@253ACK<value>**

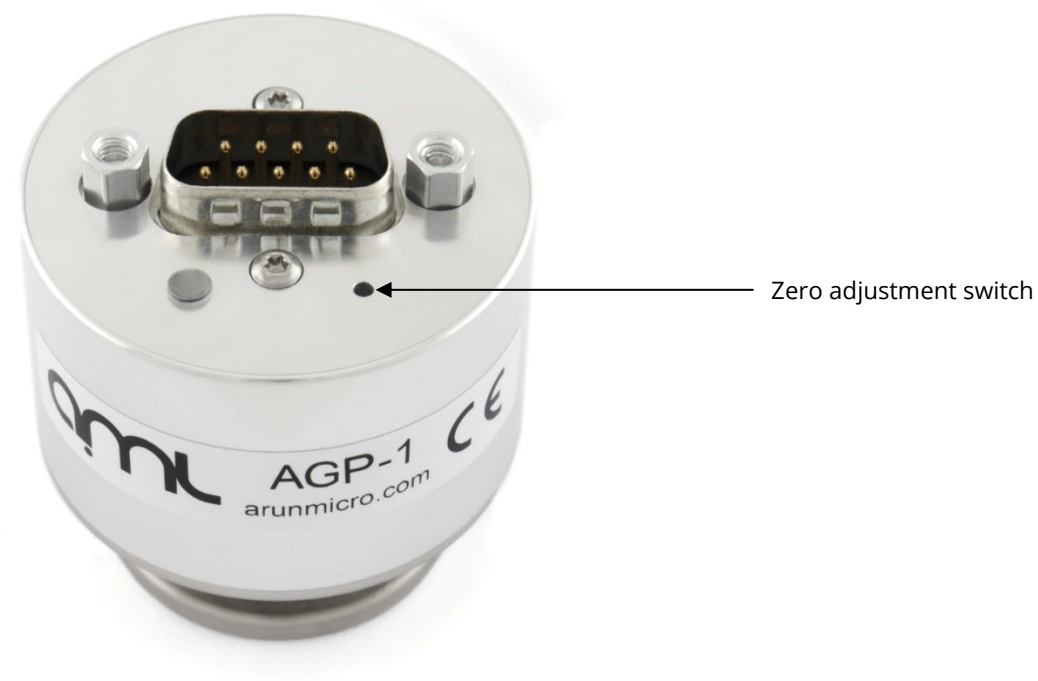
The reply <value> is the calculated offset pressure value as a function of the factory default zero offset subtracted from the user offset adjustment.

If the recommended zero adjustment vacuum pressure cannot be achieved due to inadequate vacuum pumping capacity, the zero-point adjustment can be performed at a higher pressure by entering the actual pressure value measured by a reference transducer. Following command example will perform a zero adjustment at 5.00E-5 mBar:

1. Adjust the vacuum pressure to a known value.
2. Send command: **@254VAC!5.00E-5**
3. Reply: **@253ACK<value>**

Zero-point adjustment procedure using the zero switch

The AGP-1 can also be zero adjusted by pressing the zero-adjustment switch using a tool with a maximum diameter of 1.5 mm.



1. Evacuate the transducer to a vacuum pressure below 1.00E-6 mBar
2. Press the zero switch for 2 seconds
3. The LED will strobe green after completion of zero adjustment or red if the transducer is not able to perform zero adjustment.

Piezo sensor zero adjustment

The Piezo sensor is automatically zero-adjusted, whenever the pressure measured by the Pirani is lower than 1.00E-2 mBar (7.50E-3 Torr).

10.2. Adjustment of full-scale

Piezo sensor full-scale adjustment

The piezo sensor can be full-scale adjusted using the digital interface by the following procedure:

1. Expose the transducer flange to atmospheric ambient pressure
2. Obtain the actual atmospheric pressure (e.g. 1013.1 mBar) from a reference gauge
3. Send the command: **@254FS!PZ,1013.1**
4. Reply: **@253ACK<value>**

The acknowledge value represents the scaling factor for the new piezo full-scale calibration. The full-scale adjustment can be executed in the pressure range 400 - 1100 mBar (300-825 Torr).

Pirani sensor full-scale adjustment

The Pirani sensor can be full-scale adjusted using the digital interface by the following procedure:

1. Expose the transducer flange to a Nitrogen pressure between 1 and 20 mBar
2. Obtain the actual pressure (e.g. 11.2 mBar) from a reference gauge
3. Send the command: **@254FS!MP,11.2**
4. Reply: **@253ACK<value>**

The Pirani sensor can also be full-scale adjusted by use of the internal piezo sensor as reference:

1. Expose the transducer flange to a Nitrogen pressure between 1 and 20 mBar
2. Send the command: **@254FS!MP**
3. Reply: **@253ACK<value>**

10.3. Resetting to factory default

The factory default command will reset all user settings to factory default, including setpoint settings, pressure unit and user-adjustment of zero point and full-scale.

Reading the firmware version:

Send: **@254FD!**
Reply: **@253ACKFD**

The default settings are as follows:

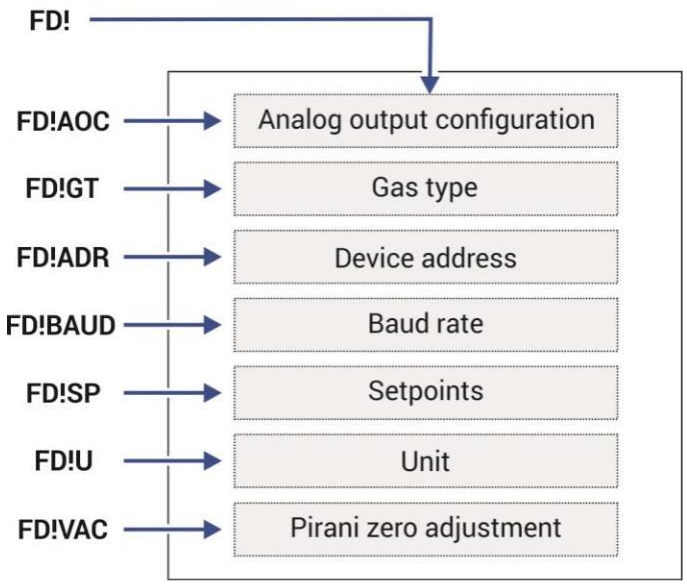
Parameter	Value
Vacuum zero adjustment	0
Full-scale adjustment	1
Unit	mBar
Baud rate	9600
Address	253
Analog output configuration	STD
Setpoint direction	Above
Setpoint enable	OFF
Setpoint hysteresis	0

10.4. Individual reset to factory default

It is possible to reset only certain settings to their factory default values. This is done by adding an optional argument to the FD command. If the argument is left blank, all parameters will be reset to their default values.

Resetting individual setting:

Send: **@254FD!<argument>**
Reply: **@253ACKFD**



11. 900 Series vacuum transducer compatibility

The AGP-1 offers analog output and digital communication protocol compatibility with the 901P, 925 and 910 vacuum transducers from MKS Instruments. The communication is based on an ASCII protocol that includes a start character, device address, command or query and an end character for termination:

@<device address><command or query><? or !><parameter>;FF

Start character:	@
Device address:	001-253
Command:	See command list
Query or set:	
Parameter:	
End character:	;FF

Example of how to send a command to the transducer using the 900 Series protocol

Programming a setpoint value of 1.23E-4 (using the default unit setting of the transducer, e.g. mBar):

Send: **@254SP1!1.24E-4;FF**
Reply: **@ACK1.23E-4;FF**

The AGP-1 supports the following 900 Series commands:

Command	Description	Query	Set	Valid input parameter
AD	Device address	•	•	1-3 digits (range 001-253)
AO1	Analog output configuration	•	•	<STD / 0-39>
BR	Set baud rate	•	•	<4800 / 9600 / 19200 / 38400 / 57600 /115200> (default 9600)
FD	Factory default		•	<ADR / BAUD / GT / SP / U / (NONE)>
FS	Piezo full-scale adjustment	•	•	<PRESSURE VALUE / CLEAR>
FV	Firmware version	•		-
GT	Gas type	•	•	<NITROGEN / HELIUM / ARGON / AIR>
MF	Manufacturer	•		-
PR1	Pressure measurement (Pirani)	•		-
PR2	Pressure measurement (Piezo)	•		-
PR3	Pressure measurement (Combined)	•		-
PN	Part number	•		-
SN	Serial number	•		-
SP1	Setpoint value	•		<PRESSURE VALUE>
SD1	Setpoint direction	•	•	ABOVE, BELOW
EN1	Setpoint enable	•	•	OFF, ON
SH1	Setpoint hysteresis	•	•	<PRESSURE VALUE>
TEM	Vacuum sensor temperature	•		-
U	Pressure unit	•	•	MBAR, PASCAL, TORR
VAC	Pirani Zero adjustment	•	•	No input or <PRESSURE VALUE>

12. Assistance

In the first instance, contact the distributor or supplier of the equipment. Always quote the serial number of the instrument and the version number of the program. Provide a written description of the problem. If the problem is related to gauges and leads quote the serial numbers and filament type used. Do not return products to AML without prior approval.

Arun Microelectronics Ltd
Tel: +44 (0)1903 884141
Email: info@arunmicro.com
Website: arunmicro.com

In the United Kingdom (UK) and European Union (EU), waste from electrical and electronic equipment (WEEE) is subject to legislation designed to prevent the disposal of such waste and to encourage proper treatment measures to minimize the amount of waste ultimately disposed to landfill. To view AML's WEEE policy please visit: https://arunmicro.com/documentation/WEEE_procedure.pdf

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Manufacturer:	Arun Microelectronics Limited
Address:	Unit 2, Bury Mill Farm, Bury Gate, Pulborough, RH20 1NN, United Kingdom
Object:	Pressure Gauge Controller
Part No.:	AGP1

The object of the declaration described above is in conformity with the relevant UK Statutory Instruments (and their amendments), and the relevant European Union harmonisation legislation:

Statutory Instruments:	2016 No. 1091	The Electromagnetic Compatibility Regulations 2016
	2012 No. 3032	The Restriction of Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
Directives:	2014/30/EU	EMC Directive
	2015/863	RoHS Directive
Standards:	Harmonised and international/national standards and specifications:	
	EN 61326-1:2013	Product family standard, Measurement, control and laboratory equipment
	EN 50581:2013	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Signature

Mr. P Brooker, Managing Director

Place, Date Pulborough, December 2019