



TA 1502-0064

Technical Instruction

ProAct Digital Plus Actuator



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1 Introduction

ProAct Digital Plus by Woodward is a series of electrical actuators with integrated driver electronics, the series ranging from model I through IV. The distinguishing feature of all these models is the drive force at the actuator axis.

Jenbacher type 4 engines e.g. use the ProAct Digital Plus (model III), which replaces the actuator with an external servo amplifier used until now.

Together with the control rod assembly, the ProAct Digital Plus actuator controls the position of the throttle valve.

2 Description of the system

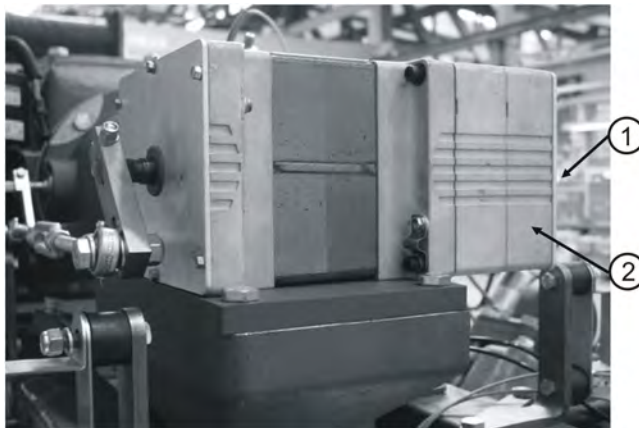
Figure 1 shows the model III ProAct Digital Plus actuator. The actuator axis is visible at the front. The integrated electronics are located at the back of the aluminium housing. The cables enter the actuator through the backplate (cable glands). The driver electronics are integrated into the actuator. The Proact uses the internal current and position sensor for the position control. The actual actuator position, which is

indicated by a 4-20 am current signal, is compared to the engine control setpoint position. The setpoint position is preset as a 0-20 am current signal. The control deviation between the setpoint and actual values is adjusted using a model-based position and current controller in the driver.

The actuator consists of the following functional units:

- mechanical actuator part, incl. driver electronics
- electromechanical driver
- electric power output transformer
- actual position detection
- position controller

Because of the integrated construction, only one position setpoint value (0-20 am) needs to be preset, apart from the supply voltage.

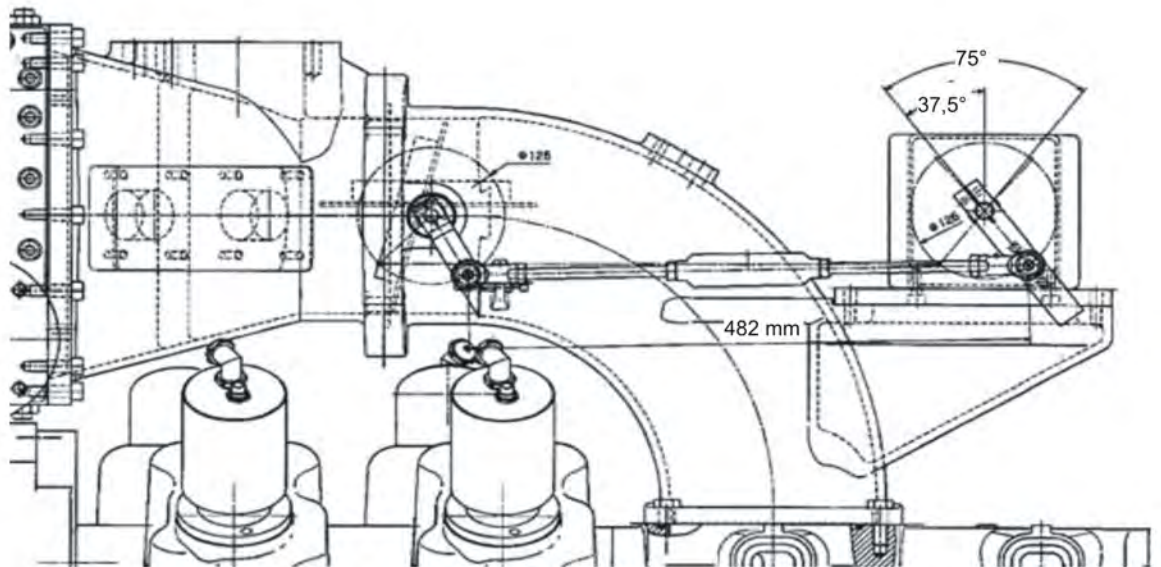


①	Connection box	②	Driver electronics
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2.1 Mechanical assembly of the device

The ProAct Digital Plus is mounted to the designated intake manifold console of the engine using an intermediate plate. The actuator is mounted horizontally using four screws. The plate covering the driver electronics is fixed at the back of the actuator by six screws. The plate can be removed to establish the electrical connection.

2.2 Adjusting the control rod assembly



The control rod assembly should be adjusted in accordance with the dimensional sketch of the actuator assembly shown above. Adjust while the actuator is dead. The adjustment angle of the ProAct Digital Plus is 75° clockwise. The actuator axis is provided with a 0.625-36 gear.

In the dimensional sketch, the throttle valve with the control rod assembly are shown in closed position. Carefully follow the instructions below when adjusting the control rod assembly:

a) ProAct Digital Plus adjustment lever

When compared to the vertical axis, the lever must be fixed to the ProAct Digital Plus axis at an adjustment angle of approx. 37.5° (see the diagram). Ensure that the actuator shaft is in fact positioned against the mechanical stop of the adjustment range, i.e. at an adjustment angle of 0° . Once it has been fixed, check the adjustment lever for smooth operation over the entire adjustment angle (75°).

b) Throttle-valve adjustment lever

Ensure that the throttle valve (axis) is in its final position (i.e. the throttle valve is fully closed) when assembling the adjustment lever to the throttle valve axis. You should also ensure that, when fixing the adjustment lever, the lever is positioned against the mechanical safety stop when the throttle valve is closed. You can use filler rings to adjust the distance between the lever and the control rod assembly (smooth operation).

A screw with a locknut is used at the throttle valve axis. This adjusting screw serves as mechanical stop for the throttle valve when closed. The adjusting screw is used to set a small safety clearance between the throttle valve's final position and the throttle valve seat. This way, the throttle valve is protected against mechanical load and/or deformation and is securely seated.

The locknut is used to fix the adjusting screw's position. Always ensure that the screw head and locknut are positioned on the side of the final stop closest to the actuator.

c) Control rod assembly:

To assemble the control rod assembly, fix the pivot points at both control rods. Use the turnbuckle nut and associated locknuts to adjust the optimum control rod length (accord. to dimensional sketch: approx. 482 mm). The position of the control rod assembly must be nearly horizontal while the adjusting levers are parallel to each other.

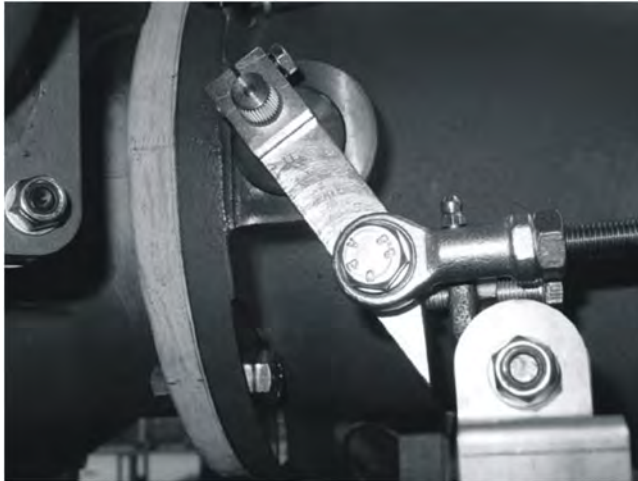
Once you have successfully adjusted the actual control rod assembly length and the throttle valve is closed,

i.e. the throttle valve lever is in its final position, you must position the actuator lever

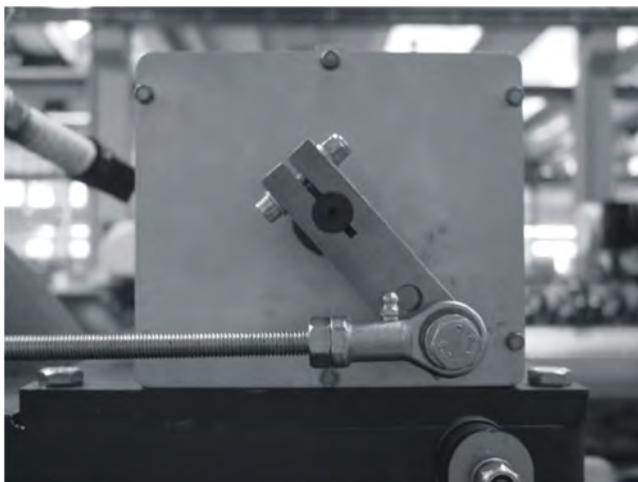
also in its final position (0° adjustment angle). The control rod assembly must not be pretensioned, the control levers must be positioned against the final stops. When the actuator is dead, no

load must be exerted against the mechanical final stop of the throttle valve. This would result in a higher power consumption during operation (current limitation active) and increase the operating temperature of the actuator, which would have a long-term adverse effect on its service life.

During assembly and/or afterwards, please check that all screw connections are still secure and that the control rod assembly operates smoothly!



Lever - throttle valve



Lever - actuator



Actuator assembly, incl. control rod assembly

2.3 Electrical connection

2.3.1 Connecting cable

A power supply cable and a shielded control cable (with number codes) are used to establish the electrical connection. Both cables are routed to the engine in a separate flexible protective hose and enter the terminal box of the ProAct Digital Plus via a union nut. The connection is established via cable terminals. See the number codes and PIN sequence in the table below.

Core number	Pin	Description
1	+	24V DC power supply
2	COM	0V DC power supply

Core number	Pin	Description
1	1	am signal setpoint value +
2	2	am signal setpoint value -
-	3	PWM input +
-	4	PWM input -
-	5	analogue output +
-	6	analogue output -
-	7	driver activated / RUN ENABLE
3	8	transmitting output / STATUS OUT (opening contact)
-	9	0V DC / DIS COM



In the module interface box, the cores of both cables are connected to a terminal strip. Ensure that the control cable braiding is connected at the entry to the module interface box. The braiding is not connected on the actuator side!

2.3.2 Settings

The configuration, parameter setting, calibration, hardware jumpers and control range adjustment are all factory-set by Woodward to the INNIO Jenbacher GmbH & Co OG specifications.

2.3.3 Current range

For the analogue input signal (am setpoint value) you can select two current ranges of 20 am (jumper 2 / JPR2) or 200 am (jumper 1 / JPR1). These are set using two jumpers on the power circuit board. The manufacturer has already preset the required **20 am range** using **JPR2**. JPR1 must be open, JPR2 must be connected.

Both jumpers must only be set when the driver electronics are dead!

2.3.4 Power supply

The supply voltage must be in the 18 - 32 V DC (24 V DC nominal) range and is pole-error protected. During operation, the driver electronics consume the following electrical output (static) and/or peak output (dynamic):

ProAct Digital Plus model	Max. output - static [Watt]	Max. output - dynamic [Watt]
I	19	67
II	65	251
III	73	282

ProAct Digital Plus model	Max. output - static [Watt]	Max. output - dynamic [Watt]
IV	101	393

2.3.5 Coding / release of the device

Pin 7 (RUN ENABLE) is used to release the equipment. The driver electronics are released by directly connecting Pin 7 to Pin 9 "COM", the negative pole of the supply voltage. By opening the connection, the driver electronics are deactivated, meaning that the power part (actuator coil) goes dead and the total power consumption of the ProAct Digital Plus is reduced to a minimum (< 200 am).

2.3.6 Protection functions

The integrated driver is equipped with protection functions for both the power supply part of the ProAct Digital Plus

final control element (current limiting device) and the auto-protection functions (short-circuit protection, ...) for the driver electronics.

Overvoltage / undervoltage protection

If the supply voltage exceeds 33 V for 5 seconds or falls below 11 V for 1 second or below 17 V for 40 seconds, the driver is switched off and the status transmitting contact is deactivated.

Short-circuit protection

The ProAct is short-circuit protected.

Pole-error protection

The ProAct is pole-error protected. This means that when the supply voltage (24 V) is connected to the driver using the wrong polarity, the equipment will not be damaged.

High temperatures

The ProAct Digital Plus is designed for an operational temperature range of -40 to +85°C. The actual operating temperature is monitored by an internal temperature sensor within the driver electronics. The operating temperature should not exceed 90°C. If the operating temperature of the driver electronics exceeds 95°C, the status transmitting contact (warning) is deactivated but the electronics remain operational up to a temperature of +105°C. When the driver electronics temperature reaches > +105°C, the current is limited in accordance with the actual operation temperature.

Current limitation

To protect the electromagnetic drive (the actuator coil), the integrated power output transformer is equipped with a current limiting device. If a maximum current level is exceeded (e.g. load at the throttle valve), the current is limited to its maximum admissible value.

The driver electronics guarantee these requirements by reducing the current to the constant current approx. 5 seconds after the admissible constant current is exceeded. In the case of dynamic processes, the actual peak current is already limited to a maximum value.

If a load is exerted at the throttle valve in the CLOSED direction, the current consumption on the 24 V side will have the following approx. values:

ProAct Digital Plus model	Max. current - static [A]	Max. current - dynamic [A]	Max. force - static [A]	Max. load - dynamic [A]
I	0,8	2,8	1,7	3,4
II	2,7	10,5	3,4	7
III	3,0	11,8	7	14
IV	4,2	16,4	14	27

If a load is exerted at the throttle valve in the OPEN direction, a somewhat higher current consumption on the 24 V side will result.

A current limitation operation is not indicated to the operator. After the exerted load is reduced, the actuator returns to controlled normal operation.

During current limitation operation the current will be reduced even more if the internal temperature sensor detects an operating temperature of $> +105^{\circ}\text{C}$. The load exerted by the actuator will be reduced parallel to the current limitation.

2.3.7 Transmitting output STATUS OUT (opening contact)

The internal auto-protection functions of the driver electronics are activated via a status transmitting output (Pin 8 / opening contact), and are integrated into the dia.ne – AMM.

The internal on-line diagnosis system of the ProAct Digital Plus can distinguish between error messages and errors which will result in the driver being switched off. The alarm output is designed to act as a cumulative alarm (warning + switch off). In the case of an internal error, the transmitting contact is deactivated (closed-circuit principle). The internal errors are self-resetting. An actuator error is displayed by a red LED in the connection box. The LED is not activated in the case of a warning. The LED is not active during actuator operation.

3 Commissioning

The actuator itself does not need any adjustment. It is only the control rod assembly that needs to be checked for smooth operation. If the actuator is dead, the adjustment angle should range from 0° to 75° . During operation the control rod assembly must not be pretensioned when the throttle valve is closed (0% setting), as this would result in the actuator being in a permanent state of current limitation.

An optimal adjustment of the control rod assembly will result in a minimum distance between throttle valve adjustment lever and mechanical final stop when the throttle valve is closed (0% setting). The maximum distance will be 1° adjustment angle. These 1° safety zones between the final positions of the actuator adjustment range and the internal, mechanical final stops ensure that the closed throttle valve is not pretensioned. This prevents any increased mechanical load on the actuator and throttle valve caused by overshooting when closing (0%) or opening (100%).

During engine operation, the minimum throttle valve position (0% setting) results in an actual actuator adjustment angle of 1° . The maximum throttle valve position (100% setting) results in an actuator adjustment angle of 74° .

4 Troubleshooting

4.1 Error messages

4.1.1 Warning

Message text and number	Error	Solution
ACTUATOR FAILURE ACTUATOR FAILURE 1192	<p>Actuator - failures</p> <p>LED indicator in connection box flashes!</p> <p>→ equipment not released</p> <p>→ Defective internal electronics</p> <p>→ Incorrect configuration</p> <p>→ Incorrect calibration</p> <p>Actuator – warnings:</p> <p>LED indicator in connection box flashes!</p> <p>Deviation setpoint / actual position >10% for longer than 1 second</p> <p>Voltage supply:</p> <p>→ Overvoltage / undervoltage of 24V DC power supply</p> <p>→ Error in internal electronic power supply (12 V, 9 V, 5 V)</p> <p>Internal temperature control:</p> <p>→ Temperature >95°C for longer than 1 second</p> <p>→ Activation of current limitation as from 105°C</p>	<p>→ Check equipment release for driver electronics, connection between PIN 7 and 9 (RUN ENABLE).</p> <p>→ Failure cannot be reset by switching the equipment power supply off and on, replace equipment!</p> <p>Self-resetting warning :</p> <p>→ Check control rod assembly</p> <p>→ Check that throttle valve is operating smoothly and/or is securely seated</p> <p>Self-resetting warning :</p> <p>Check 24V DC power supply if error in dia.ne AMM cannot be reset → replace equipment!</p> <p>Self-resetting warning :</p> <p>→ Check ambient temperature and/or surface temperature of equipment.</p> <p>→ Check the control rod assembly, current limitation active because of incorrectly-adjusted control rod assembly.</p>

Message text and number	Error	Solution
	→ Internal temperature sensor fault	→ Check that throttle valve is operating smoothly and/or is securely seated → If the above points are OK and the error in dia.ne AMM cannot be reset, the temperature sensor is defective → replace equipment!
	Defective power supply cable / control cable	Check the cabling

4.2 Troubleshooting

4.2.1 Power supply problems (voltage supply)

Symptoms	Error	Solution
When the engine starts up, the throttle valve doesn't open (100%), the actuator is deactivated.	No voltage supply	Check the 24 V DC voltage supply in the interface cabinet for a blown fuse. Check the internal release relay (ignition) – during engine standstill the actuator is switched dead. Check the electrical connection at the equipment terminals (Pin + / COM).
	The equipment is not released	Check equipment release for driver electronics, connection between PIN 7 and 9 (RUN ENABLE).

4.3 Mechanical problems (control rod assembly)

Symptoms	Error	Solution
Unstable engine characteristics during idling and/or engine is switched off due to "overspeed" error.	Throttle valve is opened further than required by engine idling controller. → excessive gas throughflow	Check control rod assembly adjustment. Check if both adjustment levers, the actuator axis and the throttle valve axis are in a 0% position against the mechanical stop.

Symptoms	Error	Solution
<p>Engine cannot be started or is unstable during idling. The engine is switched off due to "synchronising" error.</p> <p>In addition, the actuator failure (1192) in the AMM could be activated.</p>	<p>When starting the engine, the throttle valve is not opened wide enough for idling and synchronisation and/or remains closed.</p> <p>→ Insufficient gas throughflow</p>	<p>Check control rod assembly adjustment:</p> <p>→ incorrect positioning (angle) of the adjustment lever at the axis results in a shift in the adjustment angle to the negative range.</p> <p>→ The actuator is blocked at the mechanical stop, i.e. the actuator is operated in current limitation. This increases the temperature of the electronics as a result of which the temperature control could be activated.</p> <p>The actuator failure is also activated in the case of an excessive discrepancy between the setpoint and the actual value.</p> <p>→ The actuator cannot reach the preset start and idling position because the adjustment range has shifted to the negative range.</p> <p>Check whether the actuator failure is activated! LED indicator in connection box flashes!</p> <p>→ equipment not released</p> <p>→ Defective internal electronics</p> <p>→ Incorrect configuration</p> <p>→ Incorrect calibration</p>
Unstable engine running	<p>Throttle valve does not reach the final position of its adjustment range.</p> <p>Throttle valve exceeds the final position of its adjustment range.</p>	<p>Check control rod assembly adjustment:</p> <p>→ incorrect positioning (angle) of adjustment levers on the shafts.</p> <p>→ end stop of throttle valve (0%) set incorrectly.</p> <p>→ Check for smooth operation of control rod assembly (could be mechanically blocked at throttle valve end position or at additionally assembled turbocharger bypass valve).</p> <p>Check control rod assembly adjustment:</p> <p>→ incorrect positioning (angle) of adjustment levers on the shafts.</p>

4.4 Electronic problems (internal errors)

Symptoms	Error	Solution
Internal equipment error, i.e. although the actuator is supplied with 24V DC, a position setpoint value (am signal) is given and the control rod assembly is correctly adjusted, the actuator remains in the 0% position (throttle valve closed) and/or the driver electronics are not activated, the alarm output could be activated!	Defective internal electronics	Failure cannot be reset by switching the equipment power supply off and on, replace equipment!
Activation and/or deactivation of the failure transmitting output with no obvious reason!	Defective hardware – defective failure transmitting output or defective internal electronics.	Replace device.

5 Revision code

Revision history

Index	Date	Description / Revision summary	Expert Auditor
2	30.04.2019	GE durch INNIO ersetzt / GE replaced by INNIO	Stojiljkovic T. Pichler R.
1	06.10.2010	Umstellung auf CMS / Change to C ontent M anagement S ystem ersetzt / replaced Index: -	Schartner Bilek