

ECON-4

Digital Speed Governor

SW version 1.4.0

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1 Document information

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1.1 Clarification of notation

Note: This type of paragraph calls readers attention to a notice or related theme.

IMPORTANT: This type of paragraph highlights a procedure, adjustment etc., which can cause a damage or improper function of the equipment if not performed correctly and may not be clear at first sight.

Example: This type of paragraph contains information that is used to illustrate how a specific function works.

1.2 About this guide

This guide describes usage of ECON-4 for control of engine. ECON-4 Global Guide provides basic information how to install and operate ECON-4 Extension module.

1.3 Legal notice

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





















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1.4 Symbols in this manual

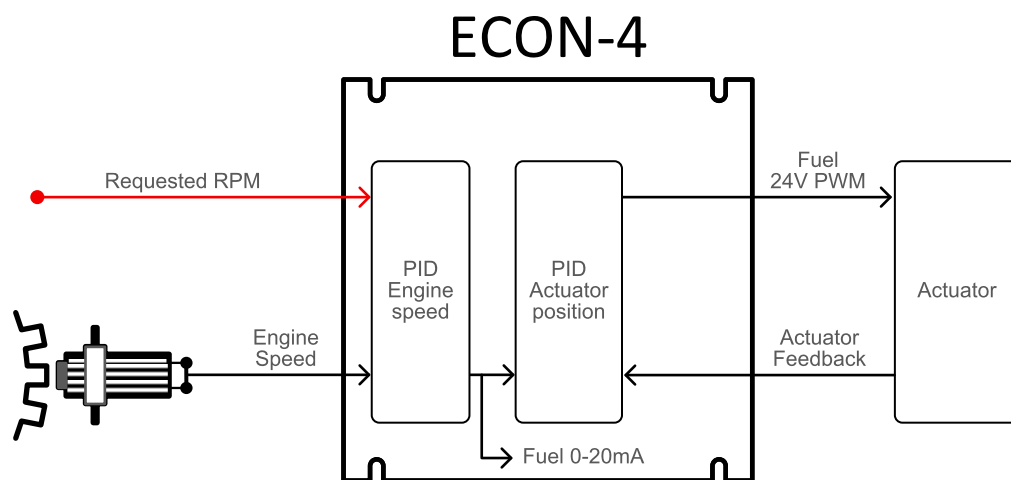
	Battery		Mains
	Breaker		Pick - up
	Connector - female		Resistor
	Connector - male		Resistor adjustable
	Controller simplified		RS 232 female
	ECON-4 simplified		Starter
	Fuel solenoid		Voltage measurement
	Fuse		
	Fuse switch		
	Generator		
	Generator schematic		
	Grounding		
	Jumper		
	Load		
	Mains		

2 System overview

2.1 Description of the governor system

ECON-4 is a flexible speed governor capable to operate in various configurations. Possible configurations can be:

- Control via CAN – it reads the values of control bits and required analog values from the CAN bus line and not from its terminals (except from BIN S4.6 Run/Stop, this signal must be present in all 3 modes)
- Control via Binary signals
- Control via Analogue and binary inputs.



Speed and power of a single fuel engine is always controlled by the actuator connected to ACT terminals or Analog Output in case of actuator with 0-20mA(4-20mA) usage. This actuator can control a fuel rack for diesel engines or a mixture throttle valve for gas engines.

ECON-4 ADV is advanced version, it is dedicated specially to control of engine in island operations where load steps are expected.

2.1.1 Control by CAN-bus

ECON-4 can receive values of some binary and analog control inputs via CAN-bus communication line from engine controller, (see setpoints **Speed request** (page 49) or **CB request** (page 50) for more information). This arrangement can significantly simplify the wiring on site.

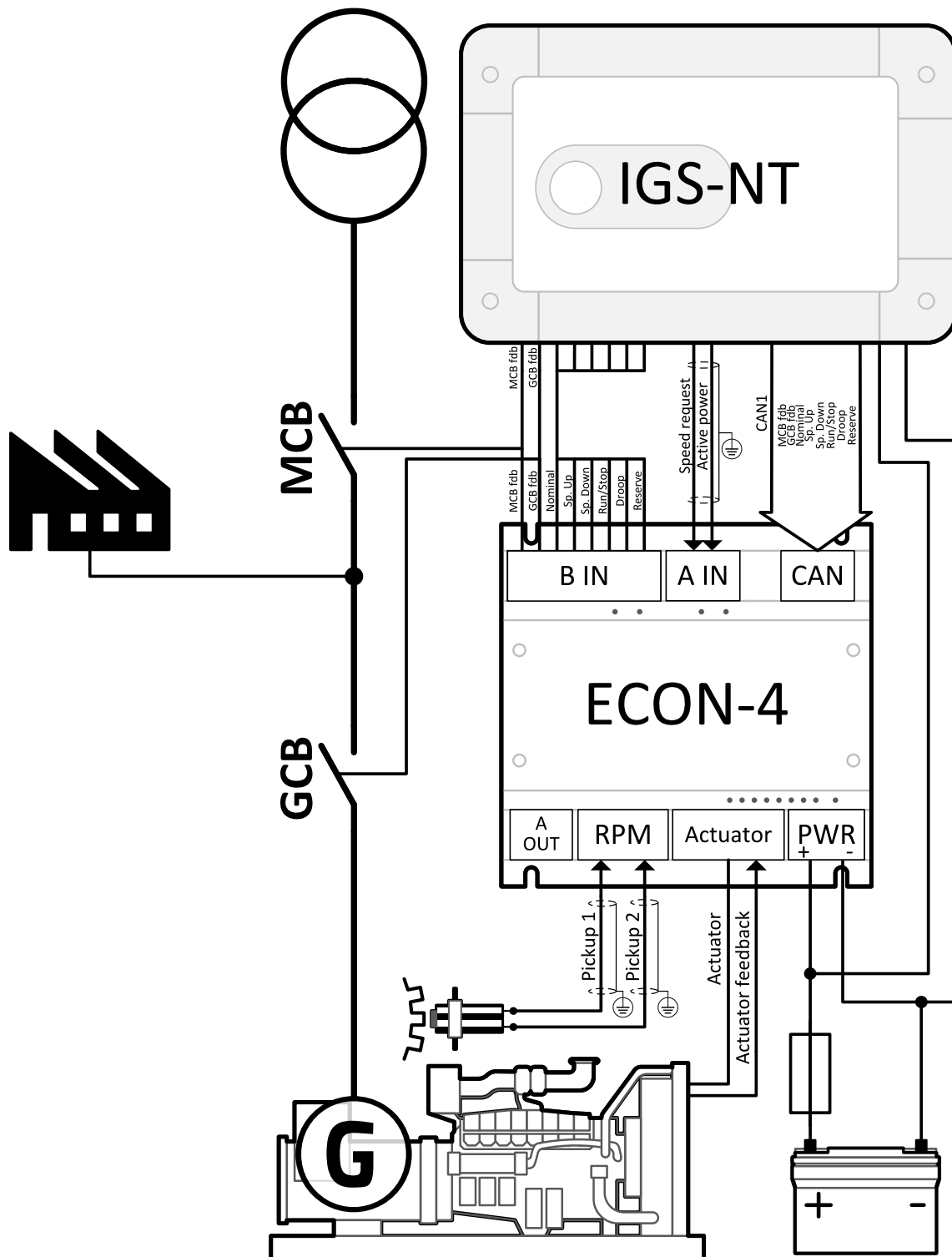
Control of speed request by CAN-bus is active only if setpoint **Speed request** (page 49) has value **DATA**

Control of GCB and MCB feedback by CAN-bus is active only if setpoint **CB request** (page 50) has value **DATA**.

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3 Applications overview

3.1 Wiring overview



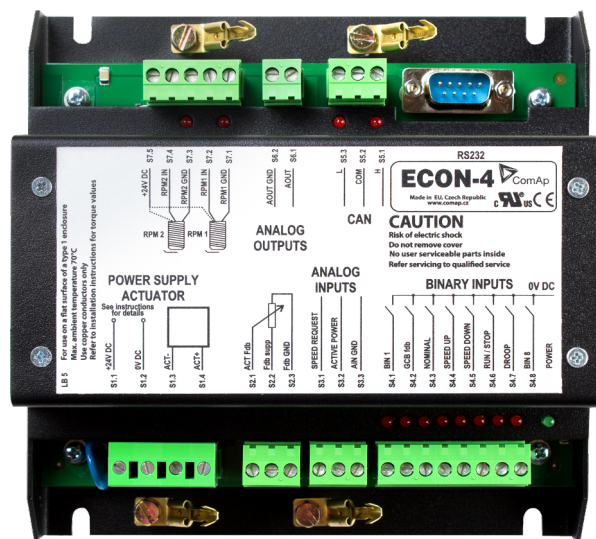
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4 Installation and wiring

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4.1 Package content



The package contains:

- ▶ ECON-4 module
- ▶ Terminal blocks

4.2 Module installation

4.2.1 Dimensions and mounting

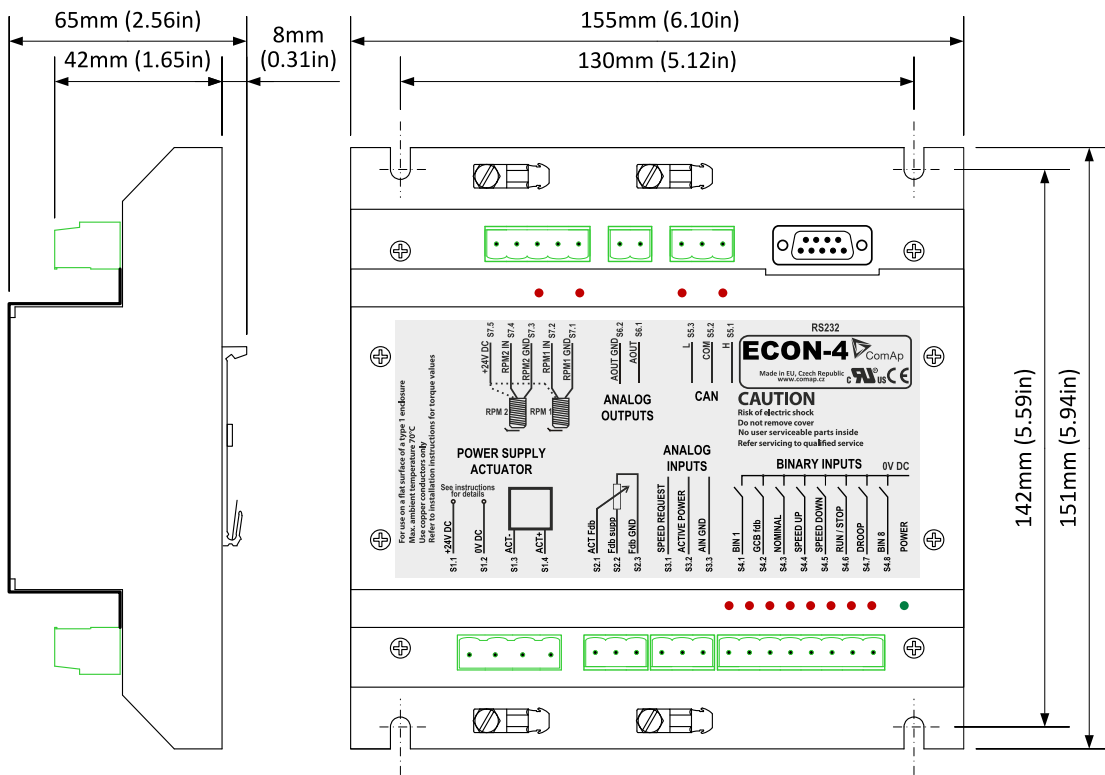
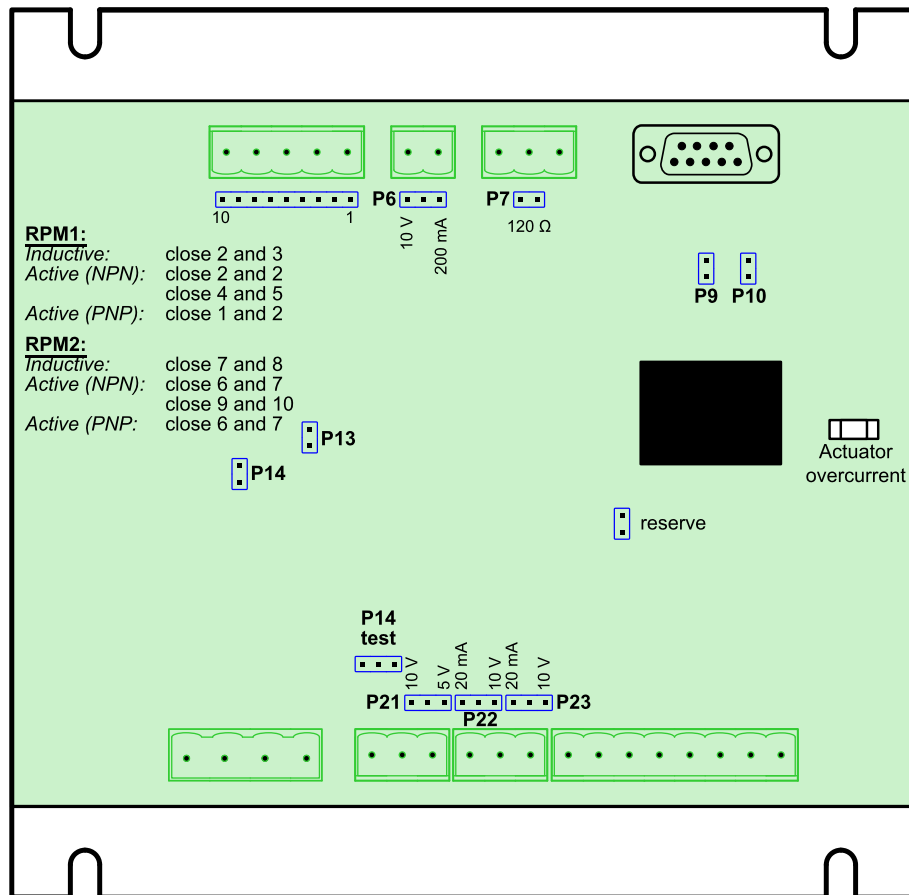


Image 4.1 Dimensions, terminals and mounting

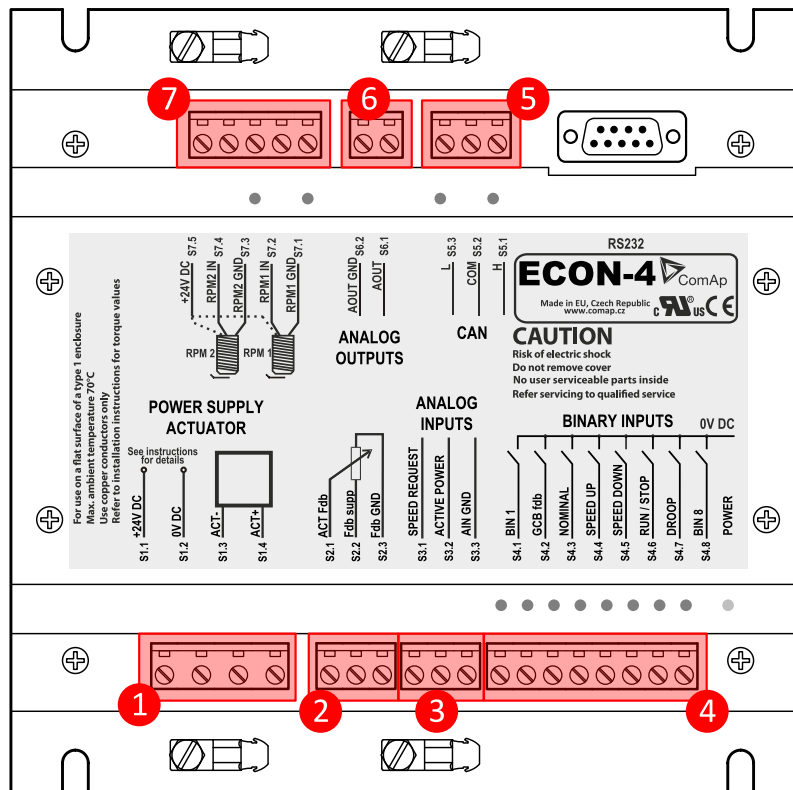
Note: ECON-4 unit is mounted on DIN rail 35 mm.

4.3 Jumper position



Jumper	Meaning
P6	AOUT switch between current and voltage analogue output Current: link the 2 pins from right side Voltage: link the 2 pins from left side
P7	120 Ohm resistor for CAN line termination
P9	Boot
P10	Reset

4.4 Recommended wiring



Postion	Terminal groups	Link
1	Power supply Actuators	Power Supply (page 13)
2	Actuator feedback	Interface to actuators (page 18)
3	Analog inputs	Analog inputs (page 15)
4	Binary inputs	Binary inputs (page 13)
5	Magnetick Pick-up	Speed Pick-up (page 20)
6	Analog outputs	Analog output (page 17)
7	Communications	Communication wiring (page 20)

🔍 [back to Installation and wiring](#)

4.4.1 General

Use grounding terminals.

The “-“terminal of the battery has to be properly grounded.

Cables for binary inputs and analogue inputs must not be placed along power cables.

Analogue inputs should use shielded cables, especially when length >3m.

Always use shielded cable for Magnetic pick-up.

4.4.2 Grounding

Use as short as possible cable to the grounding point on the switchboard.

Use cable min. 2,5 mm².

The “-” terminal of the battery has to be properly grounded.

4.4.3 Power Supply

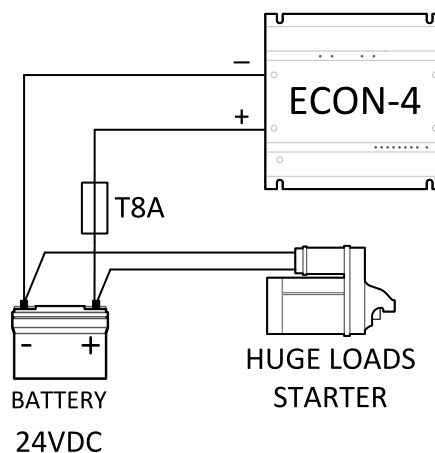
Use min. power supply cable of 4mm².

Maximum continuous DC Power supply voltage is 36 V DC. Maximum short term allowable power supply voltage is 39 V DC. The ECON-4's power supply terminals are protected against large pulse power disturbances. When there is a potential risk of the controller being subjected to conditions outside its capabilities, an outside protection device should be used.

Power Supply Fusing

An eight-amp fuse should be connected in-line with the battery positive terminal to the controller and modules. ECON-4 should never be connected directly to the starting battery.

Recommended fuse is slow type – T8A.



4.4.4 Binary inputs

Binary inputs have internal load resistor 4.4 kΩ connected to the battery plus.

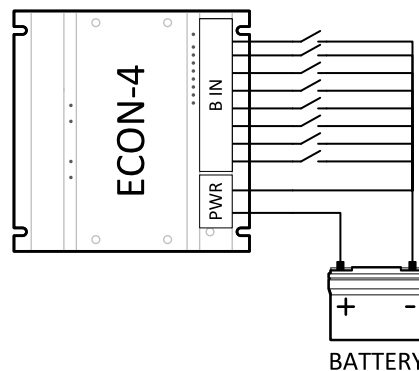


Image 4.2 Binary inputs wiring scheme

Binary inputs are used to control the function of the ECON-4 digital governor.

Binary inputs can be read from:

- ▶ the physical Binary inputs (terminals S4.x),
- ▶ from the CAN-bus (byte Command in the Receive PDO),

in dependence on the value of the setpoint Speed request.

Input	Speed Request value			CB Request value	
	BIN	ANA	DATA	BIN	DATA
MCB fdb (S4.1) (page 14) MCB fdb				S4.1	Cmd.1
GCB fdb				S4.2	Cmd.2
NOMINAL	S4.3	S4.3	Cmd.2		
SPEED UP	S4.4	X	X		
SPEED DOWN	S4.5	X	X		
RUN / STOP	S4.6	S4.6	S4.6 & Cmd.3		
DROOP	S4.7	S4.7	Cmd.4		
RESERVE	S4.8				

Note: Cmd.x is bit x in the byte Command of the Receive PDO, see description of CAN protocol. S4.x is ECON-4 terminal. Both the physical Binary input S4.6 and the corresponding bit Cmd.3 received via CANbus must be active to activate Binary input RUN in DATA mode. In case of lost communication on CANbus, all bits of the byte Command are set to 0 – it deactivates

MCB fdb (S4.1)

Inputs GCB and MCB fdb decide which setpoints are used in PID speed regulation loop and which type of regulation is used (Idle/Island/Parallel):

MCB state	GCB state	IRPM - Requested RPMI > RPM window	PID constants
OFF	OFF	NO	Speed gain, Speed int, Speed der
OFF	OFF	YES	Speed gain, Speed int w, Speed der w
ON	OFF	NO	Speed gain, Speed int, Speed der
ON	OFF	YES	Speed gain, Speed int w, Speed der w
OFF	ON	-	Load gain, Load int, Load der
ON	ON	-	Load control according Speed/Fuel Line

Note: There is more Load gain and Load der values in ECON-4 ADV. Which set will be used depends on actual power.

GCB fdb (S4.2)

Inputs GCB and MCB fdb decide which setpoints are used in PID speed regulation loop and which type of regulation is used (Idle/Island/Parallel):

MCB state	GCB state	IRPM - Requested RPMI > RPM window	PID constants
OFF	OFF	NO	Speed gain, Speed int, Speed der
OFF	OFF	YES	Speed gain, Speed int w, Speed der w
ON	OFF	NO	Speed gain, Speed int, Speed der

ON	OFF	YES	Speed gain, Speed int w, Speed der w
OFF	ON	-	Load gain, Load int, Load der
ON	ON	-	Load control according Speed/Fuel Line

Note: There is more Load gain and Load der values in ECON-4 ADV. Which set will be used depends on actual power.

NOMINAL (S4.3)

The Required speed is set to *Nominal RPM* if the Nominal input is closed, otherwise is the Request set to *Idle RPM*.

SPEED UP (S4.4)

Inputs SPEED UP and SPEED DOWN are used for setting of the speed reference of the engine. The speed reference can be changed in the range from Nominal RPM - PerChSpdNom% to Nominal RPM + PerChSpdNom%. Setpoint: EngineRPM:PerChSpdNom [1-20%] defines the maximum Percentage change of Speed from Nominal in case BIN or ANA mode of control is used.

Setpoint BI Speed ramp decides how fast the speed reference changes, if the inputs SPEED UP or SPEED DOWN are active.

Note: Inputs SPEED UP and SPEED DOWN are active only if the setpoint Speed request has value BIN.

SPEED DOWN (S4.5)

Inputs SPEED UP and SPEED DOWN are used for setting of the speed reference of the engine. The speed reference can be changed in the range from Nominal RPM - PerChSpdNom% to Nominal RPM + PerChSpdNom%. Setpoint: EngineRPM:PerChSpdNom [1-20%] defines the maximum Percentage change of Speed from Nominal in case BIN or ANA mode of control is used.

Setpoint BI Speed ramp decides how fast the speed reference changes, if the inputs SPEED UP or SPEED DOWN are active.

Note: Inputs SPEED UP and SPEED DOWN are active only if the setpoint Speed request has value BIN.

RUN (S4.6)

If the input is not active, governor immediately set the actuator to stop position.

DROOP (S4.7)

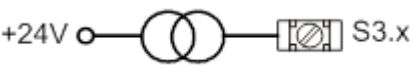
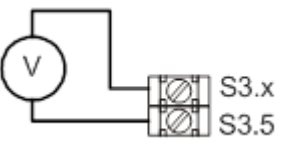
The input activates droop function – see setpoint Droop (page 62).

BIN 8 (S4.8)

BIN 8 is reserved for next functions.

4.4.5 Analog inputs

There are 2 analog inputs available on the ECON-4. Each of them can be configured either as 0-20mA or 0-10V range by jumper setting – see in table below. The analog input function is fixed.

Range	Recommended wiring	Input	Terminals	Jumpers
0-20 mA		SPEED REQUEST	S3.1	P22 – 20 mA
		ACTIVE POWER	S3.2	P23 – 20 mA
0-10 V		SPEED REQUEST	S3.1	P22 – 10 V
		ACTIVE POWER	S3.2	P23 – 10 V

SPEED REQUEST (S3.1)

The input defines speed reference. It can be set in the range from Nominal RPM - PerChSpdNom% to Nominal RPM + PerChSpdNom%. Setpoint: EngineRPM:PerChSpdNom [1-20%] defines the maximum Percentage change of Speed from Nominal in case BIN or ANA mode of control is used.

Example: Analog input SPEED REQUEST is set to range 0 – 10 V, Nominal RPM is 1500 RPM, Input voltage is 6 V. Speed reference is then $\text{ReqSpeed} = 1500 + (\text{PerChSpdNom}/100) * 1500 * (6-5)/5 = 1524 \text{ RPM}$. PerChSpdNom = 8 in the previous calculation.

Note: Input SPEED REQUEST is active only if the setpoint Speed request has value ANA.

ACTIVE POWER (S3.2)

Input from the external transmitter of Active power. Value of the Active power is used to improve load step response of the governor. Input ACTIVE POWER is active only, if the setpoint Speed request has not value DATA. The input sensitivity can be adjusted by setpoint Load anticipip.

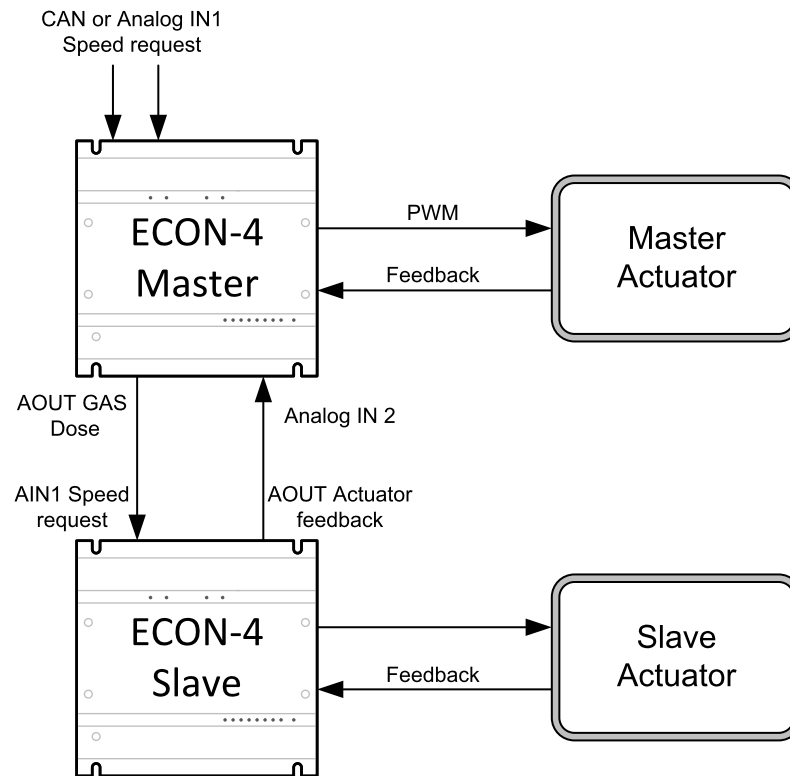
Note: Input ACTIVE POWER is active only if the setpoint Speed request has value BIN or ANA and setpoint Load anticipip > 0.

Collaboration with ECON-4Slave

Physical analog input on terminal S3.2 can be used also when ECON4-Slave is used. In this case feedback from slave actuator is put on analogue output on slave and can be connected back to master to see it in one Winscope (connected to master) and in controller thru CAN as Misf Angle.

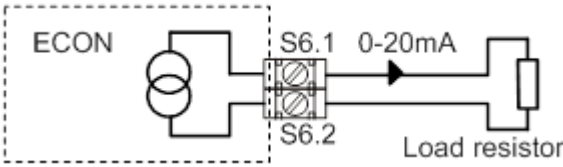
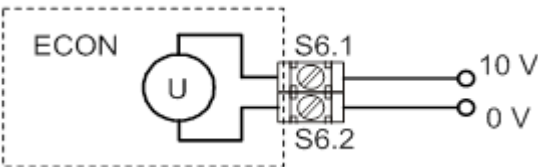
Original Misf Angle calculation is not used in latest version of ECON4 and in version 1.4 is used to show feedback from Slave. If feedback from slave is connected to analog input on S3.2 setpoint LoadAnticipation has to be =0. Otherwise wrong value will be used for load anticipip resulting unstability and unpredictable control

Principle of connection Master Slave is shown on next picture.



4.4.6 Analog output

ECON-4 has one analog output configurable to 0-10V or 0-20mA range by jumper setting – see in table below. If configured to 0-20mA range, output works as an active current source. The analog output function is fix (copy of the value sent to ACT output - GAS DOSE). Analogue output range is fully programmable in range 0-10V or 0-20mA – see setpoints: **Analog settings: AOUT 0% and AOUT 100%.**

Range	Recommended wiring	Output	Terminals	Jumpers
0-20 mA		AOUT	S6.1 S6.2	P6 - 20 mA
0-10 V		AOUT	S6.1 S6.2	P6 - 10 V

Gas Dose (S6.1)

Output signal corresponds to actuator requested position. The limits are fully scaleable in range 0-10V (0-20mA).

E.g an actuator with input 4-20mA is used, the AOUT2 range setpoints should be adjusted in the following way:

- ▶ Analog sensors: AOUT2 0% = 20% (20% from 20mA = 4mA)
- ▶ Analog sensors: AOUT2 100% = 100%
and jumper P6 adjusted to current option.

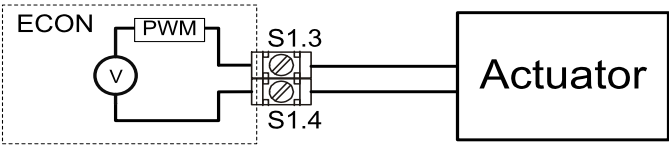
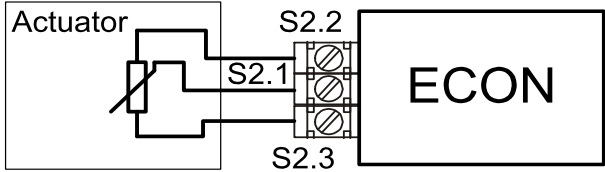
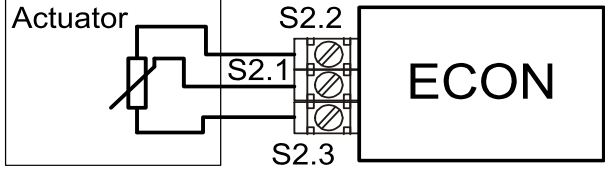
In case an actuator with an input 0-5V is used, the AOUT2 setpoints should be adjusted in the following way:

- ▶ Analog sensors: AOUT2 0% = 0%
- ▶ Analog sensors: AOUT2 100% = 50%
and jumper P6 adjusted to voltage option.

4.4.7 Interface to actuators

ECON-4 has one interface to actuator. The interface has a bipolar PWM output in bridge configuration and position feedback input.

It is recommended to connect PWM output by a twisted cable and connect feedback input by a shielded cable.

Range	Recommended wiring	Terminals	Jumpers
Output 0 - 8 A		S1.3	-
Feedback 0 - 5 V		S2.2 S2.1 S2.3	P21 5V
Feedback 0 - 10 V		S2.2 S2.1 S2.3	P21 10V

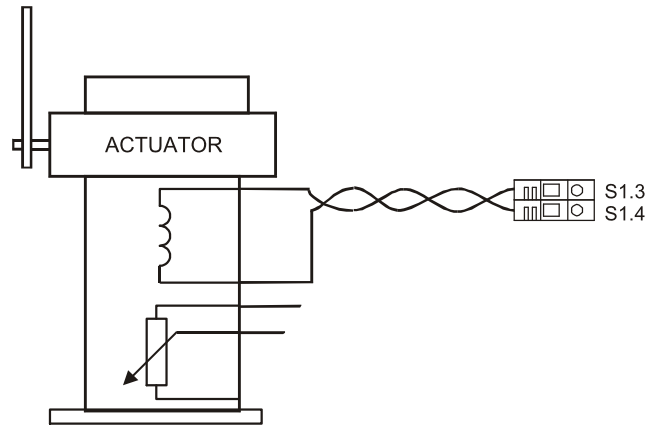
Types of actuators supported by ECON-4

With current input 200mA

Example: Typical example is Woodward UG-A.

It is electro-hydraulic actuator – in principle a small electromagnetic actuator with hydraulic booster. It has proportional characteristic – the bigger is the current, the bigger is the angle of the actuator, the polarity of the current is not important. Actuator is usually without electrical position feedback. For this actuator choose option

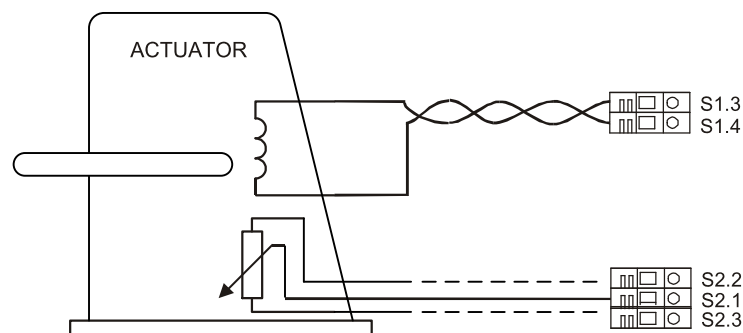
ActType: Wiring: LINEAR NO FEEDBACK



With current input max. 10A

Example: Typical examples are actuators from GAC, Woodward Flowtech ITB.

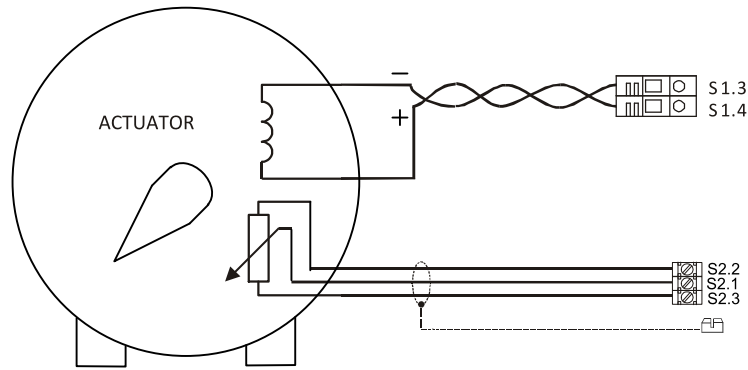
It is electro-magnetic actuator with a strong return spring. This is in principle electromagnet with proportional characteristic – the bigger is the current to the actuator, the bigger is the angle of the actuator. The polarity of the current is not important. This type of actuator can be with or without position feedback. For this actuator choose option **ActType**: Wiring: LINEAR or LINEAR NO FEEDBACK.



Motor driven actuators

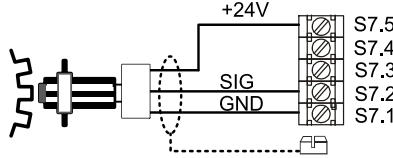
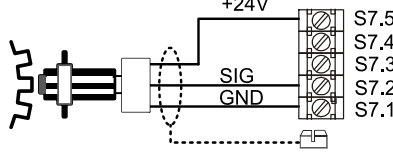
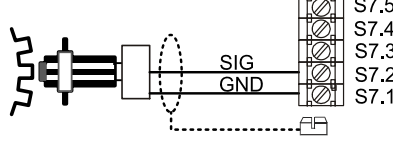
Example: Typical examples are actuators from Heinzmann (STG 6, 10, 30, 2040.)

It is in principle a DC electromotor driving actuator lever. Since it is a motor, it has integrating characteristic – as long as the current flows through the actuator, actuator's lever moves. Direction of movement of the actuator lever depends on polarity of the current. This type of actuator has always position feedback. For this actuator choose option **ActTypex**: Wiring: BRIDGE. For Heinzmann actuators, Jumper P21 – supply of the position feedback must be set to option 0-10V. For Woodward and GAC actuators this jumper must be set to position 0-5V.



4.4.8 Speed Pick-up

Always use a shielded cable, connect shielding to a grounding screw. ECON-4 supports both active (powered) and passive (magnetic) pickups.

Pick-up	Recommended wiring	Jumpers
Active NPN		Link 1 and 2 Link 4 and 5
Active PNP		Link 1 and 2
Passive		Link 2 and 3

If the jumper is in position 2-3, terminals GND and SIG are separated from all other terminals. This enables to share one pick-up by two modules, for instance by a speed governor and by an ignition, without danger of creating a ground loop.

4.4.9 Communication wiring

CAN bus connection

ECON-4 is equipped by CAN communication line. CAN bus terminals are electrically isolated from any other terminals.

Note: Following ECON-4 CAN setting is necessary to communicate with IntelliSys NT:

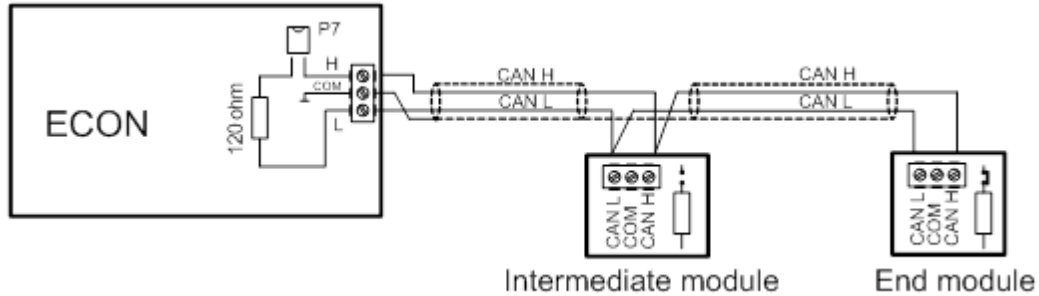
CAN mode (Object number 10338) = 1 sets ComAp protocol

CAN NODE-ID (Object number 10306) = 88 (decimal) sets address of the module

Connection rules

CAN bus line must be connected in series, from one unit to the next (no star, no cable stubs, and no branches) both ends must be by the 120-ohm (internal or external) resistor terminated. Maximal CAN bus length is 200 meters.

ECON-4 contains internal 120-ohm resistor, connected through a removable jumper P7.



For CAN data cables details see chapter Technical data – Communication interface. CAN cable shielding connect to CAN COM terminal.

🔍 [back to Recommended wiring](#)

5 ECON-4 setup

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5.1 Quick start - how to set ECON4 and controller

The following description should help you to quick adjust the ECON-4 speed governor. The ECON-4 can be found in different modes used for control of module and engine.

Basically any input signal of ECON4 can be supplied either using wired signal or using data from CAN1 line. Input signals of ECON4 are separated in to two groups each group can be controlled in different way.

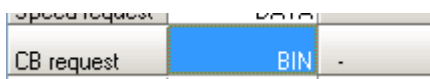
Group	Setpoint	Signal	Possible control mode
Breaker's feedback	CB request	GCB feedback	BIN/ANA/DATA
		MCB feedback	
Speed control	Speed request	Speed request analogue signal	BIN/DATA
		Actual power analogue signal	
		SpeedUp and SpeedDown binary signal	
		Idle/Nominal binary signal	
		Droop binary signal	
		RUN binary signal	

Block schema where data flow in different modes is shown is located in Setpoints section **CB request** (page 50) and **Speed request** (page 49)

There is separated description of setting for different modes for CB request and Speed request on following pages.

5.1.1 Breakers feedback handling (CB request modes)

CB request set to BIN mode



In case of binary control of breaker's feedback, signals from breakers has to be wired to terminals S4.1 and S4.2. You do not need to link any source to Binary outputs of ECON4 in Genconfig.

I/O	Name	Property	Value
± Binary inputs	Used: 16/61	Source	Not used
- Binary outputs	Used: 18/53	Name	GCB Feedback
± IGS-NT	Used: 16/16	Inverted	No
± ECU	Used: 0/32		
- ECON-4 (1)	Used: 2/5		
BO1	Reserve		
BO2	GCB Feedback		
BO3	Idle/Nominal		
BO4	Fuel solenoid		
BO5	Droop		

CB request set to DATA mode

Speed request	DATA	-
CB request	DATA	-

In case of DATA control of breaker's feedback, logical signals from breakers has to be linked to Binary outputs of ECON4 in Genconfig. Terminals S4.1 and S4.2. do not need to be wired.

I/O	Name	Property	Value
± Binary inputs	Used: 16/61	Source	MCB feedback
- Binary outputs	Used: 20/53	Name	MCB feedback
± IGS-NT	Used: 16/16	Inverted	No
± ECU	Used: 0/32		
- ECON-4 (1)	Used: 4/5		
BO1	MCB feedback		
BO2	MCB feedback		
BO3	Idle/Nominal		
BO4	Fuel solenoid		
BO5	Droop		
± Analog inputs	Used: 36/38		

5.1.2 Speed control handling (Speed request modes)

Speed request set to ANA mode

Speed request	ANA	-
CB request	DATA	-

In case of ANALogue mode, the required speed is controlled via Analogue input S3.1 (voltage or current signal, connected between terminals S3.1 and S3.3). The binary control signals (Idle/Nominal, Run/Stop, Droop) are evaluated from the binary terminals S4.3 – S4.8 as in case of BINary mode.

In case the source of the Analogue input Speed request to ECON-4 is ComAp controller (e.g. IntelliSysNT), adjust the ComAp setpoints in the following way:

- ▶ Sync/Load ctrl: SpeedGov Bias = 5 Volts (for 1500 RPM sets)
- ▶ Sync/Load ctrl: SpeedGovLoLim = 0 Volts
- ▶ Sync/Load ctrl: SpeedGovHiLim = 10 Volts
- ▶ Sync/Load ctrl: Freq gain = 5 %
- ▶ Sync/Load ctrl: Freq int = 5 %
- ▶ Sync/Load ctrl: Angle gain = 10 %

You do not need to link any source to Binary outputs of ECON4 in Genconfig. This type of control can be used with firmware without support of ECON4 or even for collaboration with third party controller or without any controller just as standalone speed controller (no Data communication to ECON4 is needed).

Necessary signal – RPM signal – connected to RPM1 terminal – S7.2 and S7.1

Speed request set to BIN mode

BI Speed ramp	5.0	\$
Speed request	BIN	-

In case of BINary control, the ECON-4 is fully controlled via binary inputs – terminals S4.3 – S4.8. (except CB control). The input S4.6 is the ON/OFF signal to ECON-4, in case it is not active, speed governor will not open the throttle. In case it is deactivated during engine running, throttle is immediately closed. Use BIN S4.3 to switch from Idle running to Nominal speed running (Idle and Nominal speed adjustment is in ECON-4 setpoints: Engine RPM). Do not put the Idle RPM and Nominal RPM to the same value. In case you want engine to be running at Nominal RPM without Idle period, leave BIN S4.3 activated all the time.

Use BIN S4.4 and S4.5 (Speed UP and Speed Down) to control the speed or load (in case of parallel with mains operation).

You do not need to link any source to Binary outputs of ECON4 in Genconfig. This type of control can be used with firmware without support of ECON4 or even for collaboration with third party controller or without any controller just as standalone speed controller (no Data communication to ECON4 is needed).

Necessary signal – RPM signal – connected to RPM1 terminal – S7.2 and S7.1

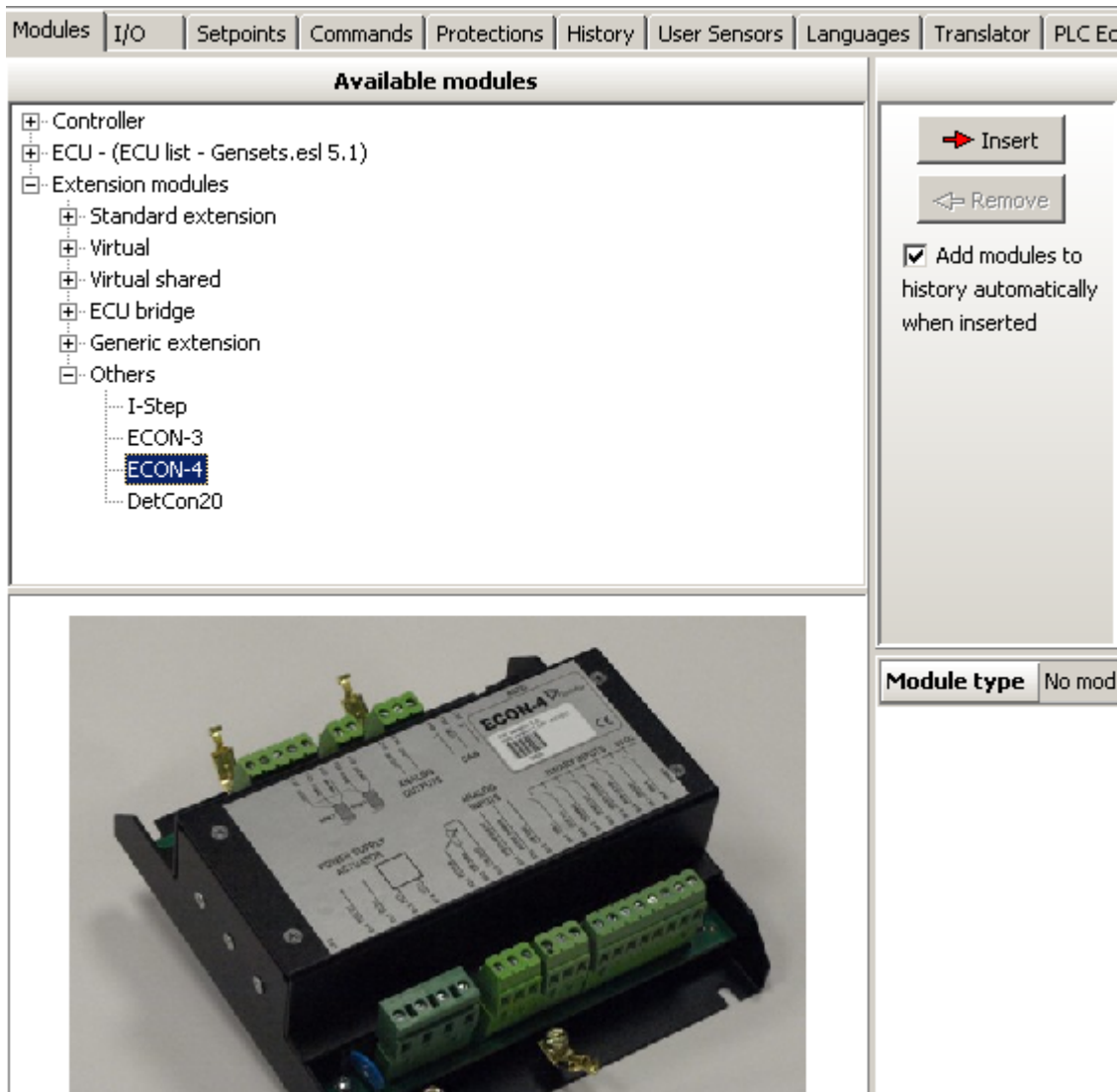
Speed request set to DATA mode

BI Speed ramp	5.0	\$
Speed request	DATA	-

In case of DATA control almost all the data can be sent from ComAp IGS-NT controllers to ECON-4 via CAN1 line. The only binary input RUN/STOP – S4.6 must be activated physically as well. To use the DATA mode, adjust the IGS-NT inputs/outputs in the following way:

a. Configuration of ECON-4 module

Go to GenConfig, card Modules – Extension modules – Others – ECON-4 > Insert



b. Configuration of Binary outputs of IGS-NT

All the ECON-4 inputs are in fact IGS-NT outputs (IGS-NT controller sends the signals to ECON-4 unit).

BO1 – this configuration of feedback is independent and is described in previous chapter Breaker's feedback handling (CB request modes)

BO2 – this configuration of feedback is independent and is described in previous chapter Breaker's feedback handling (CB request modes)

BO3– Idle/Nominal – configure on this output signal which defines switching from Idle operation to Nominal ROM run. The Log bout signal: Idle/Nominal of IGS-NT can be used. In case the Idle period is required to be skipped, configure on this output signal Log bout: Logical 1.

BO4 – Run Stop – together with binary input S4.6 RUN/STOP this signal must be activated to unblock ECON-4 function. Signal Log Bout: Fuel solenoid can be used.

BO5 – Droop – use the Droop function in case of in Mains parallel operation to make the load control function more stable (protectagainst power swing). Use signal e.g. GCB feedback.

Modules	I/O	Setpoints	Commands	Protections	History
I/O		Name			
+	Binary inputs	Used: 16/61			
-	Binary outputs	Used: 20/53			
+	IGS-NT	Used: 16/16			
+	ECU	Used: 0/32			
-	ECON-4 (1)	Used: 4/5			
	BO1				
	BO2				
	BO3	Idle/Nominal			
	BO4	Run/Stop			
	BO5	Droop			
+	Analog inputs	Used: 36/38			
+	Analog outputs	Used: 3/11			

BO1 and 2 setting is separated and described in previous chapter

BO1 and 2 setting is separated and described in previous chapter

- c. Configuration of Analogue inputs from IGS-NT to ECON-4 (those are signals from ECON4 to controller, in our configuration it is named from controllers point of view, so inputs)

AIN1 – Engine RPM

The engine RPM can be sent from ECON-4 into the IS-NT via CAN line as well. Configure the AIN1 in the following way:

Function – RPM pick-up

Sensor – Electronic

the IGS-NT controller.

- d. Configuration of Analogue outputs from IGS-NT to ECON-4

AOUT1 – Active Power Rel

ECON-4 is equipped with the Load anticipation function to react as quickly as possible to the sudden changes of the engine power. For this function ECON-4 needs information about power and in case of DATA mode this can be sent to ECON-4 via CAN. Adjust the AOUT1 in the following way:

Source: Gener values: ActPwr rel

Normalize: YES

Resolution: 0,1

Modules	I/O	Setpoints	Commands	Protections	History	User Sensors	Languages	Translator	PLC Editor	LBI	LAI	Miscellaneous
I/O		Name										
+	Binary inputs	Used: 16/32										
+	Binary outputs	Used: 16/21										
+	Analog inputs	Used: 5/6										
-	Analog outputs	Used: 1/3										
+	IGS-NT	Used: 0/1										
-	ECON-4 (1)	Used: 1/2										
	AOUT1	Act pwr rel										
	AOUT2	Not used										

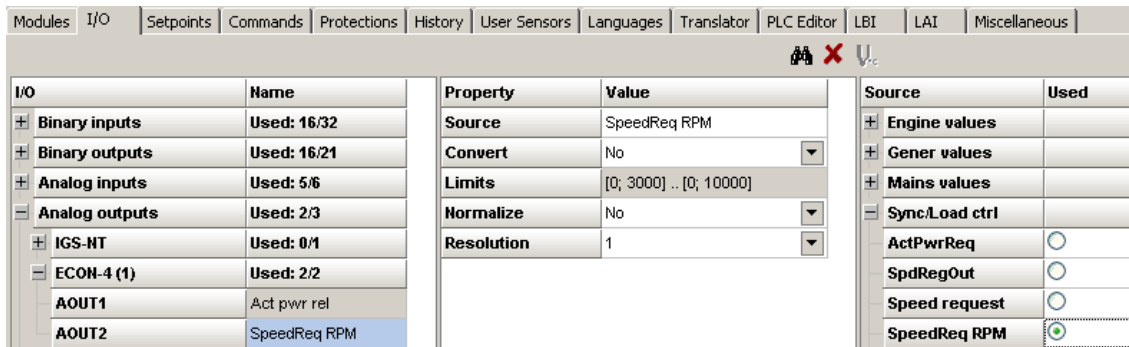
Property	Value
Source	Act pwr rel
Convert	No
Limits	[0.00; 100.00] .. [0; 10000]
Normalize	Yes
Resolution	0.1

Source	Used
Engine values	
Gener values	
Act power	<input type="radio"/>
PgDerate	<input type="radio"/>
Act pwr rel	<input checked="" type="radio"/>
Act pwr L1	<input type="radio"/>
Act pwr L2	<input type="radio"/>
Act pwr L3	<input type="radio"/>

AOUT2 – Speed Request The Speed request in case of DATA mode is sent via CAN line. Configure the output AOUT2 in the following way:

Source: Sync.

Load ctrl: SpeedReqRPM



Controller setting in case ECON4 is set to communicate with controller via CAN1 (Speed request set to DATA mode)

Besides the above mentioned inputs/outputs adjustment, the IGS-NT setpoints shall be adjusted in the following way:

- ▶ Sync/Load ctrl: SpeedGov Bias = 0 Volts
- ▶ Sync/Load ctrl: SpeedGovLoLim = -10 Volts
- ▶ Sync/Load ctrl: SpeedGovHiLim = 10 Volts
- ▶ Sync/Load ctrl: Freq gain = 5 %
- ▶ Sync/Load ctrl: Freq int = 5 %
- ▶ Sync/Load ctrl: Angle gain = 10 %

IMPORTANT: Please, take in account, there are several setpoints of ECON-4, which are not accessible via IGS-NT control unit in case of DATA mode. These parameters are crucial for ECON-4 and used Actuator adjustment and so these are accessible via ECON-4 connection ONLY. Use ComAp PC sw WinScope to adjust these setpoints.

For all modes of ECON-4 usage adjust

Type of used Actuator – Main PID: Actuator type, PWM rate. The ACT1-4 are preadjusted, see: Act type 1 – predefined for Woodward ITB 0-200mA, PWM rate [Hz]. Speed PID loop – MAIN PID: Speed gain = 10%, Speed Int = 10%, Speed der = 40% Type of ECON-4 communication mode: Engine RPM: Speed RequestIdle, Nominal, Overspeed RPM: Engine RPM: Idle RPM, Nominal RPM, Overspeed.

5.2 Entering password

5.2.1 Modify password from WinScope

WinScope PC program is used for modifying Setpoints.


Enter password

Password is a four-digit number. Password enables to change set points from WinScope PC program. Use icon



to activate a dialog box for password.

Change password

Use icon to  activate a dialog box for password change. The password has to be entered to activate this icon.

5.2.2 Modify password from GenConfig

Certain Setpoints can be modified directly from GenConfigPC tool. For information how to enter password in GenConfig please see GenConfig [Global Guide](#).

5.3 Data

Following data are communicated between IS-NT (specific sw branches only) and ECON-4 via CAN bus. Correct function depends on configuration by PC GenConfig software.

5.3.1 Data Binary inputs

Following data from ECON-4 can be used for states indication or alarms activation.

ECON-4	Name	Function
BI1	Bin1	Physical input state, reserve
BI2	Bin2 GCB Fdbck	Physical input state
BI3	Bin3 Nominal	Physical input state
BI4	Bin4 SpeedUp	Physical input state
BI5	Bin5 SpeedDown	Physical input state
BI6	Bin6 Run/Stop	Physical input state
BI7	Bin7 Droop	Physical input state
BI8	Bin8	Physical input state, reserve
BI9	Reserve	
BI10	Reserve	
BI11	Engine running	ECON-4 state indication
BI12	OverSpeed Sd	ECON-4 state indication
BI13	PID limit	Fuel is on limit
BI14	ActFdbErr	Active actuator feedback error
BI15	ActOverldProt	Active overload protection
BI16	InvalSetpoints	Setpoints CRC fail

5.3.2 Data Binary outputs

ECON-4 accepts the data from IntelliSys-NT (specific sw branches only) instead from Physical Binary inputs, when setpoint **Engine RPM: Speed request = DATA**.

ECON-4	Name
BO1	MCB feedback
BO2	GCB feedback
BO3	Nominal
BO4	Run/Stop
BO5	Droop

The physical RUN/STOP – S5.6 binary input must be closed in any type of control to run ECON-4 i.e. in “DATA mode” together with data command BO4 Run/Stop to enable speed control function (unblock the actuator from 0% position).

5.3.3 Data Analog inputs

ECON-4	Name	Logical function
AI1	Engine RPM	RPM pick-up; (RPM value source for IS-NT)
AI2	Misfiring Amplitude*	

No RPM pickup is needed in IS-NT. Configure IS-NT – I/O – ECON-4– AIN1 Engine RPM for

Function = RPM pick-up

Sensor = Electronic

* Misfiring evaluation from ECON-4 is not implemented in version 1.0

5.3.4 Data Analog outputs

ECON-4	Name	Function
AOUT1	Active power - relative	0,0 - 100,0 % (option)
AOUT2	SpeedReq RPM	In RPM /8 (option)

Active power value is required for Load anticipation function – see Main PID: Load anticip. In GenConfig choose value: Gener values: Act Pwr rel, option Normalize – YES, resolution 0,1.

For AOUT2 choose: Sync/Load ctrl: SpeedReqRPM and leave the default settings of this output.

5.3.5 ECON adjustement for various types of actuators

Basically there are available 3 types of actuator types:

LINEAR – actuator is driven by a current, which acts against a spring which pushes the actuator to close position. Actuator is equipped with position feedback signal. Available feedback signal for ECON is 0,4 to 4,6 Volts DC.

LINEAR NO FDB – actuator is driven by a current, which acts against a spring which pushes the actuator to close position. Actuator is not equipped with position feedback signal.

BRIDGE – in principal electromotor, one current polarity moves the actuator to one position, reverse polarity moves the actuator to another position.

Adjustment for LINEAR actuator type (typically Woodward)

- At first check the position feedback level, in case it is not within limits 0.4 to 4,6 Volts, then use the LINEAR NO FDB adjustment.
- Connect to ECON-4 via USB connector, using PC program WinScope.
- Adjust the Position feedback limits in parameter group: AnalogSensors: Fdb 0 pos to voltage of feedback in case the actuator is fully closed, and Fdb 100 pos to value of voltage when actuator is fully opened.
- ECON-4 does not measure the current through actuator. The output signal is PWM, with adjustable frequency. The maximum ECON-4 current is given by resistance of the actuator and power supply of ECON-4. ECON-4 is rated to maximum 8 Amps. In case the actuator has resistance 32 Ohms and power supply is 24V, then maximum ECON-4 current is: $24/32 = 0,75A = 750mA$. This means 100% of ECON current is 750mA. In case the maximum allowable actuator current is 250mA, then this is 33.3% of maximum ECON-4 current. This value will be used for the maximum current limitation.
- Choose one ActType x group, e.g. ActType 1 and adjust parameter Wiring to LINEAR, and adjust parameters Act gain to 10%, Act int to 10% and Act der to 10%

- F. Parameters: ActTypex (In this case ActType 1): ActCur 0% and ActCur 100% are not used, so their value is not important
- G. Parameters: ActTypex (In this case ActType 1): Act MaxCur is maximum allowable current, in case bigger current is detected (in fact bigger output PWM signal is detected) for longer then: ActMaxCurDel, then the output is limited to value ActReduced Cur. So in case we have actuator with resistance 32Ohms, ECON power supply is 24Volts and maximum allowable actuator is 250mA, then it is recommended to adjust: Act MaxCur = 33,3%, ($24V / 32\Omega = 750mA$, 250mA is 33,3% from 750mA), Act MaxCurDel = 5 sec, Act ReducedCur = 10%.
- H. Adjust parameter: Main PID: Actuator Type to the actuator which you use, so in this case ActType 1.
- I. Connect the actuator to ECON-4, outputs ACT+ ACT- (take care about polarity)
- J. Adjust ECON-4 parameter: Main PID: ECON-4 mode to MANUAL and run WinScope recording with values: Gas Dose and Act1 Fdbck in range 0.0 – 100.0%.
- K. When recording is active, change parameter: Main PID: Act position from 0 to 10, 20, 30, .. 100 and check the response of the actuator (via feedback signal in WinScope). In case the response is too lazy or too fast, then update the corresponding Act gain, Act int and Act der parameters in ActTypex (in our case ActType1) to get required response.
- L. After adjustment is finished, put parameter: Main PID: ECON-4 mode to AUTOMATIC
- M. Based on the chosen type of control (BIN, ANA, DATA) connect the required signal
- N. Adjust all other parameters like Nominal, Idle speed, Geer teeth, Overspeed, Speed and Load PID, (to the number which ECON-4 output you are using)
- O. ECON-4 is ready for start attempt.

Adjustment for LINEAR NO FDB actuator type (typically GAC, Woodward)

- A. Connect to ECON-4 via USB connector, using PC program WinScope.
- B. Choose one ActType x group, e.g. ActType 1 and adjust parameter Wiring to LINEAR NO FDB
- C. ECON-4 does not measure the current through actuator. The output signal is PWM, with frequency 6000 Hz. The maximum ECON-4 current is given by resistance of the actuator and power supply of ECON-4. ECON-4 is rated to maximum 8 Amps. In case the actuator has resistance 32 Ohms and power supply is 24V, then maximum ECON-4 current is: $24/32 = 0,75A = 750mA$. This means 100% of ECON current is 750mA. In case the maximum allowable actuator current is 250mA, then this is 33.3% of maximum ECON-4 current. Adjust Act Cur 0% to 0% and Act Cur 100% to 34% (250mA from 750mA). By this the output is scaled from 0 to 250 mA.
- D. Parameters: ActTypex (In this case ActType 1): Act MaxCur is maximum allowable current, in case bigger current is detected (in fact bigger output PWM signal is detected) for longer then: ActMaxCurDel, then the output is limited to value ActReduced Cur. The Act Max Curr is calculated from the value Act Cur 100%, so it means, that the current limitation is in this case already done by adjustment of ActCur 100%, and Act Max Cur shall be adjusted to 100%. Act MaxCurDel and ActReducedCur then can be adjusted to any value.
- E. Parameters: ActTypex (ActType 1 in this case) Act gain, Act int, Act der has no meaning for the LINEAR NO FDB adjustment.
- F. Adjust parameter: Main PID: Actuator Type to the actuator which you use, so in this case ActType 1.
- G. Connect the actuator to ECON-4, outputs ACT+ ACT- (take care about polarity)
- H. Adjust ECON-4 parameter: Main PID: ECON-4 mode to MANUAL and run WinScope recording with values: Gas Dose and Act1 Fdbck in range 0.0 – 100.0%.
- I. After adjustment is finished, put parameter: Main PID: ECON-4 mode to AUTOMATIC

- J. Based on the chosen type of control (BIN, ANA, DATA) connect the required signal
- K. Adjust all other parameters like Nominal, Idle speed, Geer teeth, Overspeed, Speed and Load PID, ActChannel (to the number which ECON-4 output you are using)
- L. ECON-4 is ready for start attempt.

3. Adjustment for BRIDGE actuator type (typically Heinzmann)

- A. At first check the position feedback level, in case it is not within limits 0.4 to 4.6 Volts, then the bridge actuator cannot be controlled with ECON.
- B. Connect to ECON-4 via USB connector, using PC program WinScope.
- C. Adjust the Position feedback limits in: AnalogSensors: Fdb 0 pos to voltage of feedback in case the actuator is fully closed, and Fdb 100 pos to value of voltage when actuator is fully opened.
- D. Choose one ActType x group, e.g. ActType 1
- E. ECON-4 does not measure the current through actuator. The output signal is PWM, with frequency 6000 Hz. The maximum ECON-4 current is given by resistance of the actuator and power supply of ECON-4. ECON-4 is rated to maximum 8 Amps. In case the actuator has resistance 2,5 Ohms and power supply is 24V, then maximum ECON-4 current is: $24/2.5 = 9,6A$ but ECON max allowable current is 8 Amps!! So the output must be limited. This means 100% of ECON theoretical current is 9,6A. In case the maximum allowable actuator current is 5A, then this is 52% of maximum ECON-4 theoretical current. This value will be used for the maximum current limitation. So adjust ActType1: Act Max Cur = 52%, Act Max Cur Del = 5 sec and Act ReducedCur = e.g. 20%.
In case bigger current is detected (in fact bigger output PWM signal is detected) for longer then: ActMaxCurDel, then the output is limited to value ActReduced Cur.
- F. Adjust parameter Wiring to BRIDGE, and adjust parameters Act gain to 10%, Act int to 10% and Act der to 10%
- G. Parameters: ActTypex (In this case ActType 1): ActCur 0% and ActCur 100% are not used, so their value is not important
- H. Adjust parameter: Main PID: Actuator Type to the actuator which you use, so in this case ActType 1.
 - I. Connect the actuator to ECON-4, outputs ACT+ ACT- (take care about polarity!!)
- J. Adjust ECON-4 parameter: Main PID: ECON-4 mode to MANUAL and run WinScope recording with values: Gas Dose and Act1 Fdbck in range 0.0 – 100.0%.
- K. When recording is active, change parameter: Main PID: Act position from 0 to 10, 20, 30, .. 100 and check the response of the actuator (via feedback signal in WinScope). In case the response is too lazy or too fast, then update the corresponding Act gain, Act int and Act der parameters in ActTypex (in our case ActType1) to get required response.
- L. After adjustment is finished, put parameter: Main PID: ECON-4 mode to AUTOMATIC
- M. Based on the chosen type of control (BIN, ANA, DATA) connect the required signal
- N. Adjust all other parameters like Nominal, Idle speed, Geer teeth, Overspeed, Speed and Load PID, ActChannel (to the number which ECON-4 output you are using)
- O. ECON-4 is ready for start attempt.

5.4 ECON-4 configuration and PC tools

5.4.1 Setpoints adjustments in WinScope SW:

Connect RS232 port on your PC to RS232 port on ECON-4. Open connection and select Controller type EMCON5, ECON-3, INCON, RailCon, select your RS232 com port and press OK

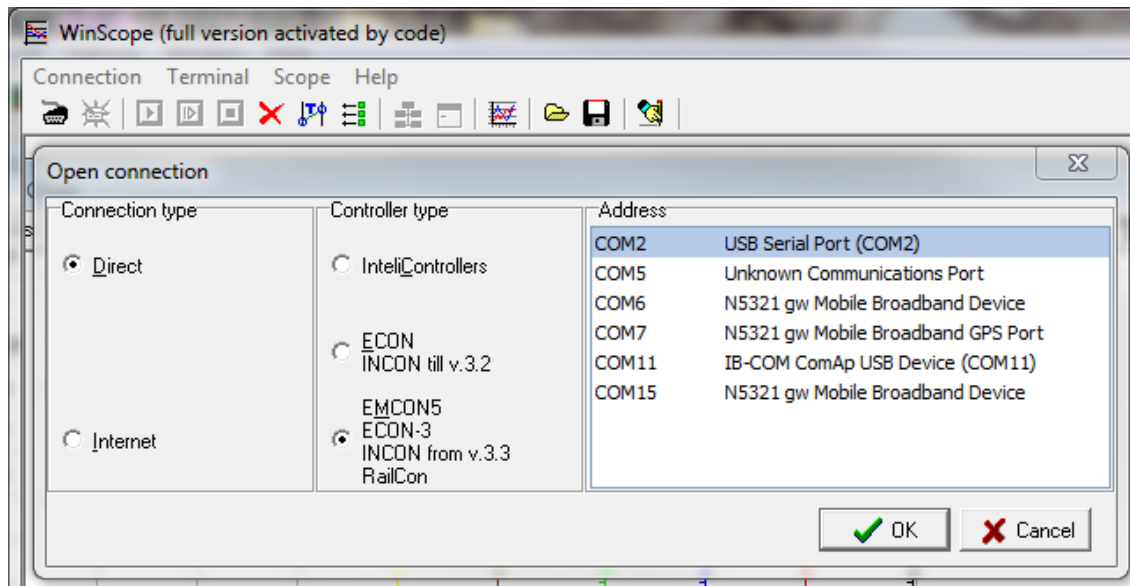

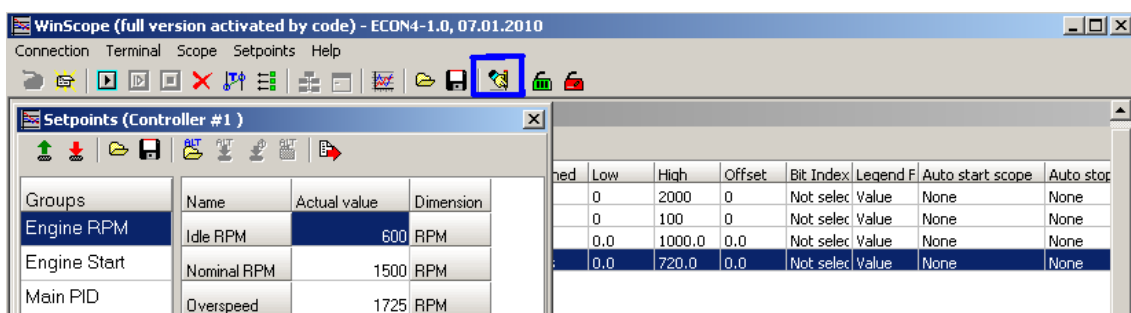


Image 5.1 Direct connection of WinScope SW to ECON-4

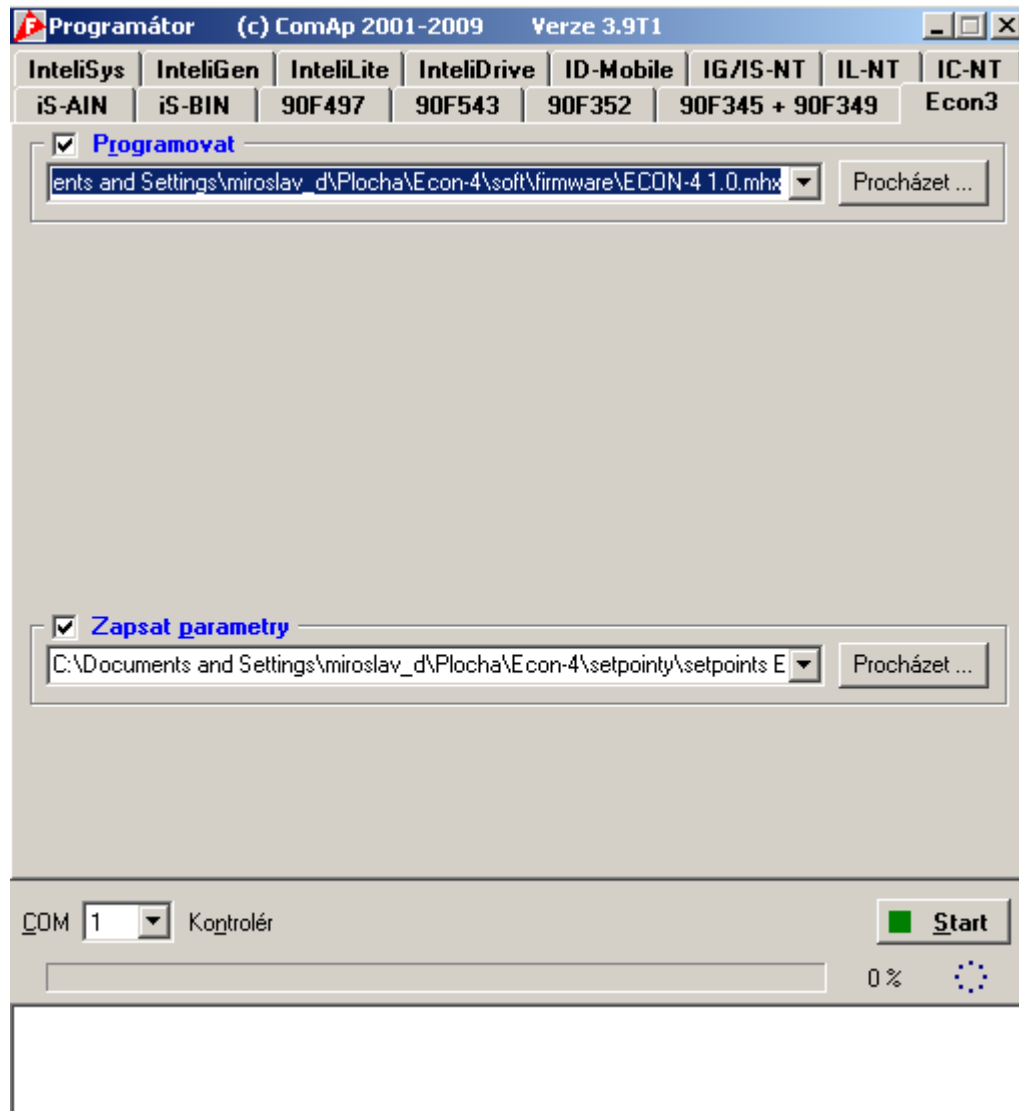
Then open setpoint Tab and work with setpoints. For rest of operations (channel selection, trend recording...) see manual for WinScope SW.

Click on the icon Setpoints  to open the Setpoints groups. To be able to change any setpoints, the password has to adjust at first (otherwise the setpoints are grayed and cannot be changed).



5.4.2 Econ-4 firmware update

For ECON-4 firmware upgrade use ComAp FlashProgrammer – see below, choose card ECON-4 (common for ECON-4). Tick the button Program and choose the appropriate firmware using icon “Locate...”



You can save your setpoints from an existing site and program them together with the new firmware. However the program change does not influence the setpoints, so you can keep them in ECON-4.

Choose the right COM port number and press “Start” button.

Hint:

To be able to program ECON-4 using the FlashProg, you must be disconnected with the WinScope or IntelliMonitor from ECON-4. (There can be always only one active connection to ECON-4 through com port)

5.5 ECON adjustement for various types of actuators

Basically there are available 3 types of actuator types:

LINEAR – actuator is driven by a current, which acts against a spring which pushes the actuator to close position. Actuator is equipped with position feedback signal. Available feedback signal for ECON is 0,4 to 4,6 Volts DC.

LINEAR NO FDB – actuator is driven by a current, which acts against a spring which pushes the actuator to close position. Actuator is not equipped with position feedback signal.

BRIDGE – in principal electromotor, one current polarity moves the actuator to one position, reverse polarity moves the actuator to another position.

5.5.1 Adjustment for LINEAR actuator type (typically Woodward)

- A. At first check the position feedback level, in case it is not within limits 0.4 to 4,6 Volts, then use the LINEAR NO FDB adjustment.
- B. Connect to ECON-4 via USB connector, using PC program WinScope.
- C. Adjust the Position feedback limits in parameter group: AnalogSensors: Fdb 0 pos to voltage of feedback in case the actuator is fully closed, and Fdb 100 pos to value of voltage when actuator is fully opened.
- D. ECON-4 does not measure the current through actuator. The output signal is PWM, with adjustable frequency. The maximum ECON-4 current is given by resistance of the actuator and power supply of ECON-4. ECON-4 is rated to maximum 8 Amps. In case the actuator has resistance 32 Ohms and power supply is 24V, then maximum ECON-4 current is: $24/32 = 0,75A = 750mA$. This means 100% of ECON current is 750mA. In case the maximum allowable actuator current is 250mA, then this is 33.3% of maximum ECON-4 current. This value will be used for the maximum current limitation.
- E. Choose one ActType x group, e.g. ActType 1 and adjust parameter Wiring to LINEAR, and adjust parameters Act gain to 10%, Act int to 10% and Act der to 10%
- F. Parameters: ActTypex (In this case ActType 1): ActCur 0% and ActCur 100% are not used, so their value is not important
- G. Parameters: ActTypex (In this case ActType 1): Act MaxCur is maximum allowable current, in case bigger current is detected (in fact bigger output PWM signal is detected) for longer then: ActMaxCurDel, then the output is limited to value ActReduced Cur. So in case we have actuator with resistance 32Ohms, ECON power supply is 24Volts and maximum allowable actuator is 250mA, then it is recommended to adjust: Act MaxCur = 33,3%, ($24V / 32\Omega = 750mA$, 250mA is 33,3% from 750mA), Act MaxCurDel = 5 sec, Act ReducedCur = 10%.
- H. Adjust parameter: Main PID: Actuator Type to the actuator which you use, so in this case ActType 1.
 - I. Connect the actuator to ECON-4, outputs ACT+ ACT- (take care about polarity)
- J. Adjust ECON-4 parameter: Main PID: ECON-4 mode to MANUAL and run WinScope recording with values: Gas Dose and Act1 Fdbck in range 0.0 – 100.0%.
- K. When recording is active, change parameter: Main PID: Act position from 0 to 10, 20, 30, .. 100 and check the response of the actuator (via feedback signal in WinScope). In case the response is too lazy or too fast, then update the corresponding Act gain, Act int and Act der parameters in ActTypex (in our case ActType1) to get required response.
- L. After adjustment is finished, put parameter: Main PID: ECON-4 mode to AUTOMATIC
- M. Based on the chosen type of control (BIN, ANA, DATA) connect the required signal
- N. Adjust all other parameters like Nominal, Idle speed, Geer teeth, Overspeed, Speed and Load PID, (to the number which ECON-4 output you are using)
- O. ECON-4 is ready for start attempt.

5.5.2 Adjustment for LINEAR NO FDB actuator type (typically GAC, Woodward)

- A. Connect to ECON-4 via USB connector, using PC program WinScope.
- B. Choose one ActType x group, e.g. ActType 1 and adjust parameter Wiring to LINEAR NO FDB

- C. ECON-4 does not measure the current through actuator. The output signal is PWM, with frequency 6000 Hz. The maximum ECON-4 current is given by resistance of the actuator and power supply of ECON-4. ECON-4 is rated to maximum 8 Amps. In case the actuator has resistance 32 Ohms and power supply is 24V, then maximum ECON-4 current is: $24/32 = 0,75A = 750mA$. This means 100% of ECON current is 750mA. In case the maximum allowable actuator current is 250mA, then this is 33.3% of maximum ECON-4 current. Adjust Act Cur 0% to 0% and Act Cur 100% to 34% (250mA from 750mA). By this the output is scaled from 0 to 250 mA.
- D. Parameters: ActTypex (In this case ActType 1): Act MaxCur is maximum allowable current, in case bigger current is detected (in fact bigger output PWM signal is detected) for longer then: ActMaxCurDel, then the output is limited to value ActReduced Cur. The Act Max Curr is calculated from the value Act Cur 100%, so it means, that the current limitation is in this case already done by adjustment of ActCur 100%, and Act Max Cur shall be adjusted to 100%. Act MaxCurDel and ActReducedCur then can be adjusted to any value.
- E. Parameters: ActTypex (ActType 1 in this case) Act gain, Act int, Act der has no meaning for the LINEAR NO FDB adjustment.
- F. Adjust parameter: Main PID: Actuator Type to the actuator which you use, so in this case ActType 1.
- G. Connect the actuator to ECON-4, outputs ACT+ ACT- (take care about polarity)
- H. Adjust ECON-4 parameter: Main PID: ECON-4 mode to MANUAL and run WinScope recording with values: Gas Dose and Act1 Fdbck in range 0.0 – 100.0%.
- I. After adjustment is finished, put parameter: Main PID: ECON-4 mode to AUTOMATIC
- J. Based on the chosen type of control (BIN, ANA, DATA) connect the required signal
- K. Adjust all other parameters like Nominal, Idle speed, Geer teeth, Overspeed, Speed and Load PID, ActChannel (to the number which ECON-4 output you are using)
- L. ECON-4 is ready for start attempt.

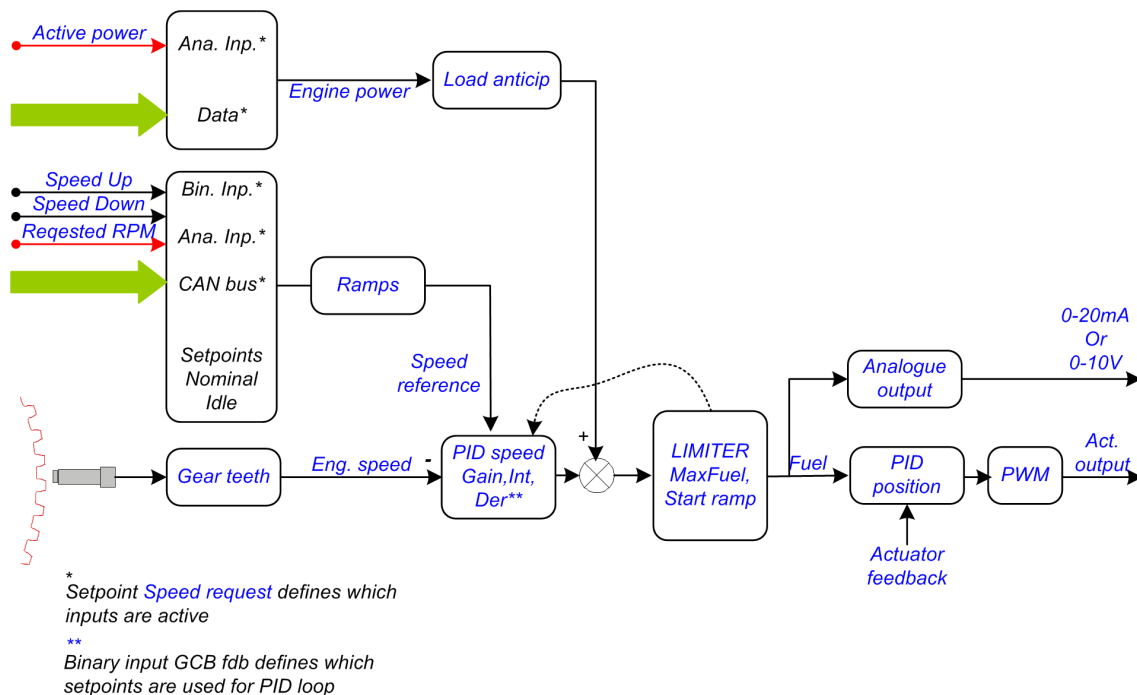
3. Adjustment for BRIDGE actuator type (typically Heinzmann)

- A. At first check the position feedback level, in case it is not within limits 0.4 to 4.6 Volts, then the bridge actuator cannot be controlled with ECON.
- B. Connect to ECON-4 via USB connector, using PC program WinScope.
- C. Adjust the Position feedback limits in: AnalogSensors: Fdb 0 pos to voltage of feedback in case the actuator is fully closed, and Fdb 100 pos to value of voltage when actuator is fully opened.
- D. Choose one ActType x group, e.g. ActType 1
- E. ECON-4 does not measure the current through actuator. The output signal is PWM, with frequency 6000 Hz. The maximum ECON-4 current is given by resistance of the actuator and power supply of ECON-4. ECON-4 is rated to maximum 8 Amps. In case the actuator has resistance 2,5 Ohms and power supply is 24V, then maximum ECON-4 current is: $24/2.5 = 9,6A$ but ECON max allowable current is 8 Amps!! So the output must be limited. This means 100% of ECON theoretical current is 9,6A. In case the maximum allowable actuator current is 5A, then this is 52% of maximum ECON-4 theoretical current. This value will be used for the maximum current limitation. So adjust ActType1: Act Max Cur = 52%, Act Max Cur Del = 5 sec and Act ReducedCur = e.g. 20%.
In case bigger current is detected (in fact bigger output PWM signal is detected) for longer then: ActMaxCurDel, then the output is limited to value ActReduced Cur.
- F. Adjust parameter Wiring to BRIDGE, and adjust parameters Act gain to 10%, Act int to 10% and Act der to 10%
- G. Parameters: ActTypex (In this case ActType 1): ActCur 0% and ActCur 100% are not used, so their value is not important

- H. Adjust parameter: Main PID: Actuator Type to the actuator which you use, so in this case ActType 1.
- I. Connect the actuator to ECON-4, outputs ACT+ ACT- (take care about polarity!!)
- J. Adjust ECON-4 parameter: Main PID: ECON-4 mode to MANUAL and run WinScope recording with values: Gas Dose and Act1 Fdbck in range 0.0 – 100.0%.
- K. When recording is active, change parameter: Main PID: Act position from 0 to 10, 20, 30, .. 100 and check the response of the actuator (via feedback signal in WinScope). In case the response is too lazy or too fast, then update the corresponding Act gain, Act int and Act der parameters in ActTypex (in our case ActType1) to get required response.
- L. After adjustment is finished, put parameter: Main PID: ECON-4 mode to AUTOMATIC
- M. Based on the chosen type of control (BIN, ANA, DATA) connect the required signal
- N. Adjust all other parameters like Nominal, Idle speed, Gear teeth, Overspeed, Speed and Load PID, ActChannel (to the number which ECON-4 output you are using)
- O. ECON-4 is ready for start attempt.

5.6 Detailed function

5.6.1 Block schematics - speed governor



Overspeed protection in ECON4-ADV

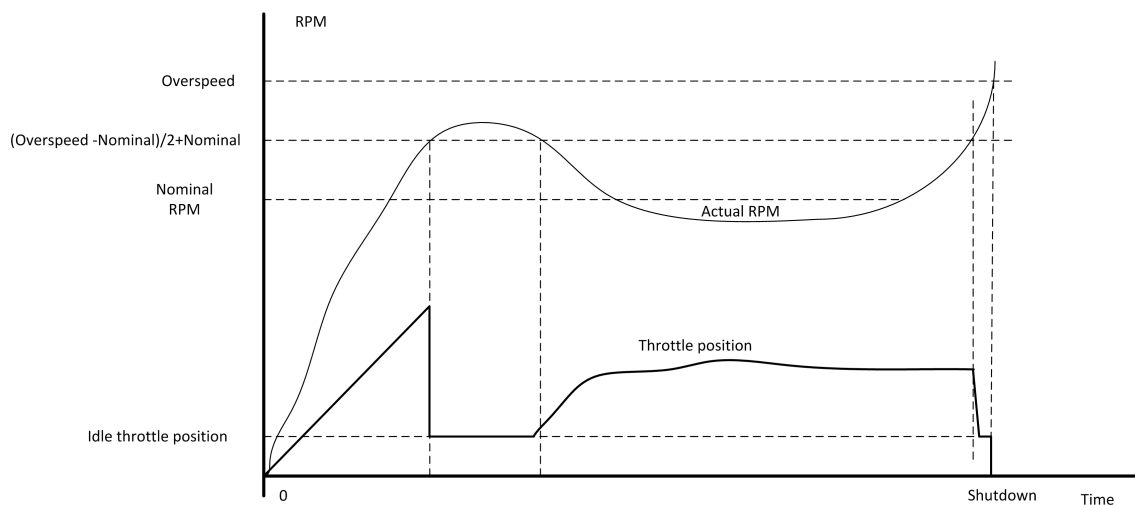
Instead of value in the middle between Nominal and Overspeed there is additional RPM level defined in setpoint Engine RPM: PreOverSpeed in ECON4-ADV versions. When RPM reaches this level, Gas Dose Value (throttle position) goes to value in setpoint Engine RPM: PreOverSpReduct – can be set to Idle Fuel or Close. This feature was added to prevent overspeed when Load is removed – typically switch off large load in island operation.

Overspeed protection

In case the actual RPM crosses RPM value: Engine RPM: Overspeed, then the Gas Dose is immediately forced to the zero – throttle is closed and shutdown is issued.

There is proactive action taken to try to keep engine running without shutdown, when actual RPM reaches value in the middle between Nominal and Overspeed value. In this case, when RPM crosses this middle value, Gas Dose is set to Idle position and when RPM drops back below this middle value, speed PID will continue to regulate RPM.

Purpose of this behavior is to prevent the Overspeed situation by detecting the RPM increase and step change of the fuel (closing the fuel). As the RPM are dropping down subsequently towards the Nominal RPM the fuel is changed again to maintain the RPM on Nominal value and not to cause a dip in the RPM.



Speed governor function in Idle or local load mode

ECON-4 compares the Reference and Actual speeds of the engine and calculates the Regulation error.

The Actual speed is measured from the period of the signal generated by the magnetic pickup sensing gears of the flywheel.

Speed reference can be generated by 3 ways:

- ▶ by Binary inputs,
- ▶ by Analogue input
- ▶ from CAN bus,

For more information see [setpointSpeed request \(page 49\)](#).

The Regulation error is then processed by the standard PID control structure with proportional, integration and derivative parts. The PID setpoints – Gain, Int and Der define the quality of regulation.

The parameters of the PID control structure are different if the engine is in:

- ▶ no-load operation,
- ▶ loaded operation

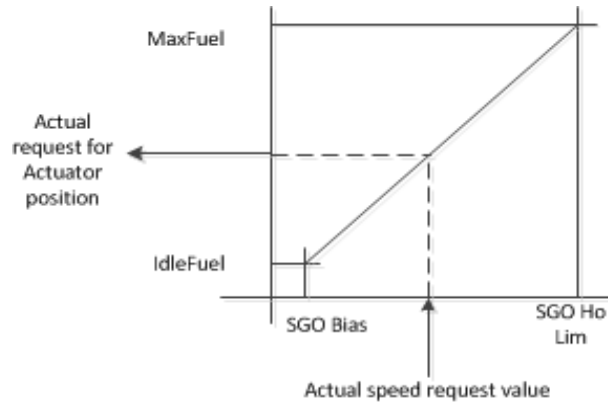
For more information see [setpoint .Description \(page 53\)](#)

The output of the PID control structure is then added together with the Load anticipation feedback, which is directly proportional to the engine power. The output from the last sum is limited by the Anti-windup Limiter

module, which reduces the integrator's output signal so that the sum of the signals from the Gain, Integrator, Differentiator and Load anticipation blocks equals exactly the limit MaxFuel.

Speed governor function in parallel mode

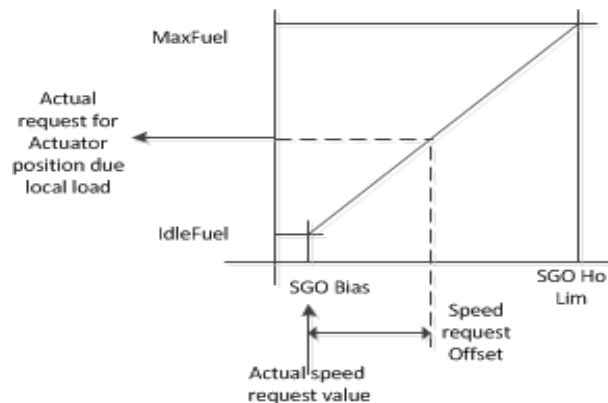
When engine is in parallel to Mains, Econ4 works just as amplifier and converts Speed request signal to Gas Dose signal according Speed/Fuel line as follows



Transition to parallel from zero local load.

When engine is running without load, speed request from controller is in bias position and engine has a throttle in Idle position. So if those values are properly set in to ECON4 setpoints while going to parallel, engine starts to run in SGO Bias and Idle Fuel point on Speed/Fuel line. When request for load is increased in controller, Speed request is increased and throttle is opened and vice versa.

Transition to parallel from non-zero local load.



There could be situation in SPtm for example, when just GCB is closed and generator supply a local load. So MCB is opened and GCB is closed and PID with Load parameters is used to control speed and Throttle position. It is clear than Throttle is not in Idle position but on higher position. Now after synchronization, MCB is closed, throttle stays in the same position because no Higher Power is generated just after synchronization and Actual speed request is in Bias position because no power control has been done in previous stage. So there is difference between actual speed request and speed request corresponding to actual throttle position. This difference is called Speed request offset and we keep it to make transition burpless. When controller increase speed request to provide more power to Mains, we move throttle to higher position on the Speed/fuel line and it works fine. But we can not keep speed request offset all time, because when controller decrease speed request throttle would go to zero position and even to negative value (theoretically). So we keep Speed request offset

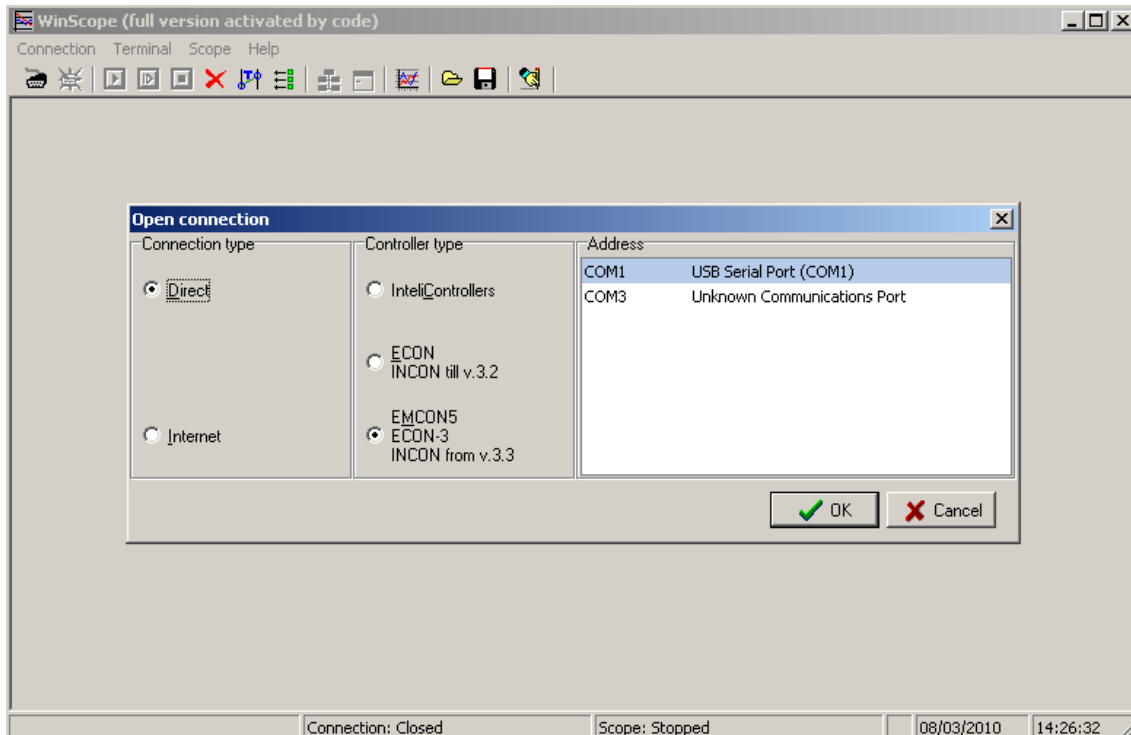
just for one minute from breaker closing and then starts to decrease this offset. This will move throttle down, but controller will notify decreasing of power and increase speed request. After a while, using this mechanism Speed request offset of zero and actual throttle position respects speed request and Speed/fuel line.

Speed request offset is decreased according ramp, which is set in setpoint SGOOffsetRamp. Time in this setpoint is time needed to change Speed request offset from 10V to 0V.

6 Communication

6.1 Connection to ECON-4

Connect RS232 cable and start WinScope software. Click on the Connection, Open Connection and choose Direct connection type, EmCon5, ECON-4, INCON Controller type, choose the right COM port and press O.K. button.



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7 Technical data

Actuator feedback input

Resolution	10 bits non electrically separated
------------	------------------------------------

Analog inputs

Number	2 non electrically separated
Resolution	10 bits
Range	0 - 10 V; input resistance 11 kΩ 0 - 20 mA; load resistor 50 Ω
Analog measurement tolerance	1 %

Analog outputs

Number	1 non electrically separated
Resolution	0 - 100000
Range	0 - 10 V; output resistance < 1 kΩ 0 - 20 mA; Active current source
Analog measurement tolerance	1 %

Binary inputs

Number	8
Input resistance	4.4 kΩ
Input range	0 - 36 V DC
Switching voltage level for close contact indication	0 - 2 V
Max voltage level for open contact indication	8 - 36 V

CAN bus interface

Maximal CAN bus length	200 m galvanically separated
Speed	250 kBd
Nominal impedance	120 Ω
Cable type	twisted pair (shielded)

General information

Weight	600 g
Protection	IP20

Operating conditions

Operating temperature	-30 to +70 °C
Storage temperature	-30 to +80 °C
Humidity	95% without condensation
Low voltage directive	EN 61010-1:95 +A1:97
Electromagnetic compatibility	EN 50081-1:94, EN 50081-2:96 EN 50082-1:99, EN 50082-2:97
Vibrations	5 - 25 Hz, ± 1,6mm 25 - 100 Hz, a = 4 g
Shocks	a = 200 m/s ²

Power supply

Power supply range	12-36 V DC
Consumption	0,5 – 10 A, depends on supply voltage and used actuator

RS232 interface

Maximal distance	10 m
Speed	19 200 bps

Speed pick-up inputs

Type of sensor	Active or magnetic pick-up (connection by shielded cable is strongly recommended)
Minimum input voltage	2 Vpk-pk (from 4 Hz to 4 kHz)
Maximum input voltage	50 Veff
Minimum measured frequency	4 Hz
Maximum measured frequency	10 kHz (min. input voltage 6Vpk-pk)
Frequency measurement tolerance	0,2 %

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8 Appendix

8.1 Setpoints44

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8.1 Setpoints

What setpoints are: Setpoints are analog, binary or special data objects which are used for adjusting the ECON-4 to the specific environment. Setpoints are organized into groups according to their meaning. Setpoints can be adjusted from the controller front panel, PC, MODBUS, etc. All setpoints can be protected by a password against unauthorized changes. Password protection can be assigned to the setpoints during the configuration procedure.

See the chapter **Entering password (page 27)** for the instructions how to enter and modify a password.

IMPORTANT: Setpoints are organized in logical groups for better orientation. Use WinScope or IntelliMonitor software to modify the setpoints. For details see chapter ECON-4 configuration and PC tools (page 32)

8.1.1 List of setpoint groups

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For full list of Setpoints go to the chapter **List of setpoints (page 45)**.

8.1.2 List of setpoints

Group of setpoints: Engine RPM

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Group of setpoints: Engine Start

Group of setpoints: Main PID

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Load 2	60
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LAder+limit	68
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LAder-	69
LAder+recover	70
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Group of setpoints: Analog sensors

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AOUT 0	75
AOUT 100	75
FBD 0 pos	75
FBD 100 pos	76

Group of setpoints: ActType 1,2,3,4

Act gain	71
Act int	71
Act der	71
Act MaxCur	72
ActmaxCurDel	72
Act ReducedCur	72
Wiring	73

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8.1.3 Group: Engine StartGroup: ECON4-EngRPM

Idle RPM

Setpoint group	Engine RPM	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	Start RPM - Nominal RPM		
Default value	1000 RPM	Force value	NO
Step	1 RPM		
Comm object	11197	Related applications	ALL
Description			
Engine idle speed.			

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Nominal RPM

Setpoint group	Engine RPM	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0 - 2500 [RPM]		
Default value	1500 RPM	Force value	NO
Step	1 RPM		
Comm object	11198	Related applications	ALL
Setpoint visibility	Always		
Description			
Nominal engine speed.			

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Overspeed

Setpoint group	Engine RPM	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0 - 2500 [RPM]		
Default value	1800 RPM	Force value	NO
Step	1 RPM		
Comm object	11083	Related applications	ALL
Setpoint visibility	Always		
Description			
Maximum acceptable speed of the engine. If the actual engine speed is higher, ECON-4 immediately closes the actuator. Normal function is restored after detection of zero engine speed.			

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Geer teeth

Setpoint group	Engine RPM	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	32 - 400 [-]		
Default value	256	Force value	NO
Step	1		
Comm object	11199	Related applications	ALL
Setpoint visibility	Always		
Description			
Number of teeth on the engine gear for the pick-up.			

[back to List of setpoints](#)

Idle-Nom ramp

Setpoint group	Engine RPM	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0 - 100 [s]		
Default value	10 s	Force value	NO
Step	1 s		
Comm object	11084	Related applications	ALL
Setpoint visibility	Always		
Description			
Define how fast changes the requested engine speed during transition from Idle RPM (page 46) to Nominal RPM (page 46) and vice versa. Idle-Nom ramp is directly time that the ramp needs to go from Idle RPM (page 46) to Nominal RPM (page 46) and vice versa. The ramping speed is the same for both up and down directions.			

[back to List of setpoints](#)

BI Speed ramp

Setpoint group	Engine RPM	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	1.0 - 100.0 [s]		
Default value	50 s	Force value	NO
Step	1.0 s		
Comm object	11085	Related applications	ALL
Setpoint visibility	Always		
Description			
Define how fast changes the requested engine speed if the binary inputs SPEED UP or SPEED DOWN are active. <i>BI Speed ramp</i> is actually time that the ramp needs to go from Nominal RPM (page 46) - 8% toNominal RPM (page 46) + 8% and vice versa. The ramping speed is the same for both up and down directions.			

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Speed request

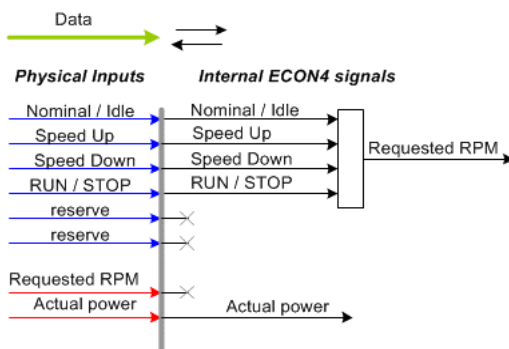
Setpoint group	Engine RPM	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	BIN, ANA, DATA		
Default value	DATA	Force value	NO
Step	-		
Comm object	11086	Related applications	ALL
Setpoint visibility	Always		

Description

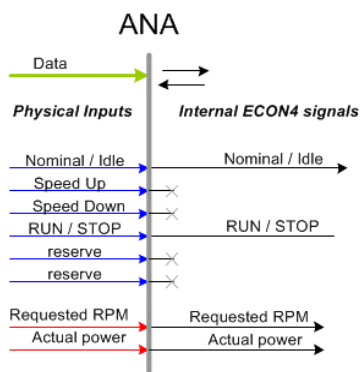
The setpoint defines source of the Speed reference of the engine.

Speed Request value	Speed reference source
BIN	SPEED UP, SPEED DOWN
ANA	SPEED REQUEST
DATA	CAN bus

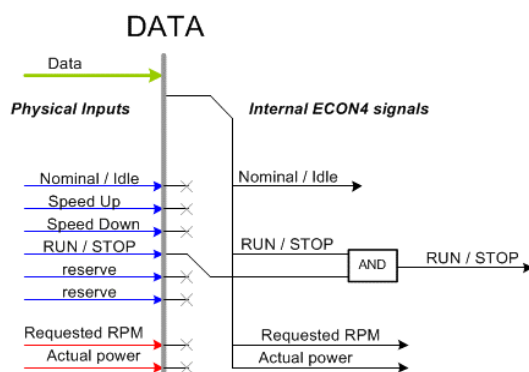
BIN mode



Speed request - BIN



Speed request - ANA



Speed request - DATA

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CB request

Setpoint group	Engine RPM	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	BIN / DATA		
Default value	DATA	Force value	NO
Step	-		
Comm object	14363	Related applications	ALL
Setpoint visibility	Always		
Description			
<div><div>CB Request value</div><div>CB position information source</div></div>			
BIN		Terminal S4.1 and S4.2	
DATA		CAN bus	
<p>Note: If possible, use binary control for CB request and wire terminal S4.1 and S4.2 to feedback signal. This will assure fastest reaction of ECON4 when breaker is closed or opened. This is crucial to avoid over speed in case of opening GCB under load for example.</p>			
<div><div><div>BIN mode</div><div><div><div>Data</div><div></div></div><div><div>Data on CAN1 are not used as source for MCB and GCB feedback</div></div></div><div><div>Physical Inputs</div><div>Internal ECON4 signals</div></div><div><div>MCB feedback</div><div>GCB feedback</div></div><div><div>MCB feedback</div><div>GCB feedback</div></div></div></div> <div><div>DATA mode</div><div><div><div>Data</div><div></div></div><div><div>Physical Inputs</div><div>Internal ECON4 signals</div></div><div><div>MCB feedback</div><div>GCB feedback</div></div><div><div>MCB feedback</div><div>GCB feedback</div></div></div></div>			

[back to List of setpoints](#)

PreOverSpeed

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 ADV extension module
Range [units]	Nominal RPM – Overspeed RPM		
Default value	1750	Force value	NO
Step	1 RPM		
Comm object	14408	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
When actual RPM reaches this value Gas Dose (throttle position) is immediately set to Idle Fuel value or zero (closed position) according setting in setpoint PreOverSpReduct .			

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PerChSpdNom

Setpoint group	Engine RPM	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	1 - 20 [%]		
Default value	8 %	Force value	NO
Step	1 %		
Comm object	11669	Related applications	ALL
Setpoint visibility	Always		
Description			
Percentage Change of Requested RPM from Nominal RPM. This setpoint defines the maximum allowable change of requested RPM from the Nominal RPM value in case the BIN or ANA control of RPM is used. Use this setpoint to enlarge maximum allowable swing of the required RPM. Setpoint is by default adjusted to 8% which should fulfill the most of installations.			

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PreOverSpReduct

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 ADV extension module
Range [units]	IDLE FUEL – CLOSE		
Default value	-	Force value	NO
Step	-		
Comm object	14409	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Value set to output GAS Dose when RPM reaches value in setpoint PreOverSpeed.			

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8.1.4 Group: Engine StartGroup: ECON4-EngStart**InitStart dose**

Setpoint group	Engine RPM	Related FW	1.4.0
Range [units]	Start RPM - Nominal RPM		
Default value	10%	Force value	NO
Step	1 %		
Comm object	11091	Related applications	ALL
Setpoint visibility	Always		
Description			
Initial position of the actuator during start			

[back to List of setpoints](#)

MaxStart dose

Setpoint group	Engine RPM	Related FW	1.4.0
Range [units]	Start RPM - Nominal RPM		
Default value	50%	Force value	NO
Step	1 %		
Comm object	11092	Related applications	ALL
Setpoint visibility	Always		
Description			
Maximum position of the actuator during start.			

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Fuel ramp time

Setpoint group	Engine RPM	Related FW	1.4.0
Range [units]	Start RPM - Nominal RPM		
Default value	10 s	Force value	NO
Step	1 s		
Comm object	11093	Related applications	ALL
Setpoint visibility	Always		
Description			
Time the actuator needs to move from the InitStart dose to MaxStart dose.			

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RPM StartRamp

Setpoint group	Engine RPM	Related FW	1.4.0
Range [units]	Start RPM - Nominal RPM		
Default value	10 s	Force value	NO
Step	1 s		
Comm object	11094	Related applications	ALL
Setpoint visibility	Always		
Description			
This setpoint defines speed of ramp from Starting RPM to Idle RPM. It is directly the time of ramp from.			

 [back to List of setpoints](#)

Starting RPM

Setpoint group	Engine RPM	Related FW	1.4.0
Range [units]	Start RPM - Nominal RPM		
Default value	350 RPM	Force value	NO
Step	1 RPM		
Comm object	11200	Related applications	ALL
Setpoint visibility	Always		
Description			
If ECON-4 detects speed higher then Starting RPM, it terminates the starting sequence end starts normal speed regulation.			

Note: ECON-4 can work only if Starting RPM < Idle RPM < Nominal RPM. If this condition is not met, ECON-4 activates bit Invalid setpoints in Transmit PDO 1, see description of CAN protocol. It is not possible to run the engine if the bit Invalid setpoint is signaled.

[⬅ back to List of setpoints](#)

8.1.5 Group: Main PIDGroup: ECON-4-MainPID**Speed gain**

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0.0 – 200.0 %		
Default value	10%	Force value	NO
Step	0.1 %		
Comm object	11095	Related applications	ALL
Setpoint visibility	Always		
Description			
Gain of the PID speed regulation loop.			

Note: Setpoint is active for unloaded engine.

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Speed int

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0.0 – 100.0 %		
Default value	10%	Force value	NO
Step	0.1 %		
Comm object	11096	Related applications	ALL
Setpoint visibility	Always		
Description			
Integration of the PID speed regulation loop..			

Note: Setpoint is active for unloaded engine.

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Speed der

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0.0 – 100.0 %		
Default value	0%	Force value	NO
Step	0.1 %		
Comm object	11097	Related applications	ALL
Setpoint visibility	Always		
Description			
Derivative part of the PID speed regulation loop.			

Note: Setpoint is active for unloaded engine.

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RPM Window

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	-		
Default value	-	Force value	NO
Step	-		
Comm object	12091	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
In case the actual RPM differs from Requested RPM for more than RPM window [RPM], the Speed PID constants fluently change from Speed int to Speed int w and from Speed der to Speed der w. The aim of the RPM window is to change the speed of regulation (reaction) in case the actual RPM differs significantly from Requested RPM.			

[back to List of setpoints](#)

Speed int w

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0-100 %		
Default value	10%	Force value	NO
Step	1 %		
Comm object	12092	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Integration part of the PID regulation loop in case the actual RPM differs from Requested RPM for more than RPM window.			

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Speed der w

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0,0-100,0 %		
Default value	0%	Force value	NO
Step	0.1 %		
Comm object	12176	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Derivative part of the PID regulation loop in case the actual RPM differs from Requested RPM for more than RPM window..			

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Load gain

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0.0 – 200.0 %		
Default value	10%	Force value	NO
Step	0.1 %		
Comm object	11098	Related applications	ALL
Setpoint visibility	Always		
Description			
<p>Gain of the PID speed regulation loop.</p> <p>There is 5 different setpoints <i>Load gain</i>:</p> <ul style="list-style-type: none">▶ <i>Load gain 1</i>▶ <i>Load gain 2</i>▶ <i>Load gain 3</i>▶ <i>Load gain 4</i> <p>For more information about <i>Load der</i> setting please see Load 1 (page 59).</p>			

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Load der

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0.0 – 100.0 %		
Default value	0%	Force value	NO
Step	0.1 %		
Comm object	11100	Related applications	ALL
Setpoint visibility	Always		
Description			
Derivative part of the PID speed regulation loop. There is 5 different setpoints <i>Load der</i> : <div><div>▶</div><div><i>Load der 1</i></div></div> <div><div>▶</div><div><i>Load der 2</i></div></div> <div><div>▶</div><div><i>Load der 3</i></div></div> <div><div>▶</div><div><i>Load der 4</i></div></div>			
For more information about <i>Load der</i> setting please see Load 1 (page 59) .			

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Load Int

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0.0 – 100.0 %		
Default value	10%	Force value	NO
Step	0.1 %		
Comm object	11099	Related applications	ALL
Setpoint visibility	Always		
Description			
Integration of the PID speed regulation loop.			
There is 5 different setpoints <i>Load Int</i> :			
▶ <i>Load Int 1</i>			
▶ <i>Load Int 2</i>			
▶ <i>Load Int 3</i>			
▶ <i>Load Int 4</i>			
For more information about <i>Load Int</i> setting please see Load 1 (page 59) .			


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Load anticip

Setpoanticip group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0.0 - 100.0 [%]		
Default value	0%	Force value	NO
Step	0.1 %		
Comm object	11102	Related applications	ALL
Setpoanticip visibility	WinScope only		
Description			
<p>Governor is equipped by load anticipation feedback, which helps to keep stable speed in case of fast load changes. In the case of load jump forces the ECON-4 governor output (Actuator lever) by jump according to Load anticip setting.</p> <p>Engine load value can be received via physical Analog input S3.2 ACTIVE POWER as 0 to 10V or 20 mA signal (if setpoanticip Speed request=BIN or ANA) or via CAN bus in the case of communication to IS-NT controller (if setpoanticip Speed request=DATA). In such case follow this configuration in GenConfig: /</p> <ul style="list-style-type: none">▶ I/O – Analog outputs – ECON-4 – AOUT1 = Gener values – Act.power rel.▶ In the configuration choose option Normalize – YES and resolution adjust to 0,1 <p>There is 5 different setpoanticips <i>Load anticip</i>:</p> <ul style="list-style-type: none">▶ <i>Load anticip 1</i>▶ <i>Load anticip 2</i>▶ <i>Load anticip 3</i>▶ <i>Load anticip 4</i> <p>For more information about <i>Load anticip</i> setting please see Load 1 (page 59).</p>			


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Load 1

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 ADV extension module					
Range [units]	0 – 100.0 %							
Default value	20%	Force value	NO					
Step	0.1 %							
Comm object	13979	Related applications	ALL					
Setpoint visibility	WinScope only							
Description								
There is 5 load bands defined via setpoints <i>Load 1</i> to <i>Load 5</i> and different <i>Load gain</i> , <i>Load Int</i> , <i>Load der</i> and <i>Load anticip</i> setpoints are active in each band.								
<div><div>0</div><div>Load 1</div><div>Load 2</div><div>Load 3</div><div>Load 4</div><div>Load </div></div> <table><tr><td>Load gain 1, Load Int 1, Load der 1, Load anticip 1</td><td>Load gain 2, Load Int 2, Load der 2, Load anticip 2</td><td>Load gain 3, Load Int 3, Load der 3, Load anticip 3</td><td>Load gain 4, Load Int 4, Load der 4, Load anticip 4</td><td>Load gain 5, Load Int 5, Load der 5, Load anticip 5</td></tr></table>				Load gain 1, Load Int 1, Load der 1, Load anticip 1	Load gain 2, Load Int 2, Load der 2, Load anticip 2	Load gain 3, Load Int 3, Load der 3, Load anticip 3	Load gain 4, Load Int 4, Load der 4, Load anticip 4	Load gain 5, Load Int 5, Load der 5, Load anticip 5
Load gain 1, Load Int 1, Load der 1, Load anticip 1	Load gain 2, Load Int 2, Load der 2, Load anticip 2	Load gain 3, Load Int 3, Load der 3, Load anticip 3	Load gain 4, Load Int 4, Load der 4, Load anticip 4	Load gain 5, Load Int 5, Load der 5, Load anticip 5				


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Load 2

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 ADV extension module					
Range [units]	0 – 100.0 %							
Default value	40%	Force value	NO					
Step	0.1 %							
Comm object	13980	Related applications	ALL					
Setpoint visibility	WinScope only							
Description								
There is 5 load bands defined via setpoints <i>Load 1</i> to <i>Load 5</i> and different <i>Load gain</i> , <i>Load Int</i> , <i>Load der</i> and <i>Load anticip</i> setpoints are active in each band.								
<div><div>0</div><div>Load 1</div><div>Load 2</div><div>Load 3</div><div>Load 4</div><div>Load </div></div> <table><tr><td>Load gain 1, Load Int 1, Load der 1, Load anticip 1</td><td>Load gain 2, Load Int 2, Load der 2, Load anticip 2</td><td>Load gain 3, Load Int 3, Load der 3, Load anticip 3</td><td>Load gain 4, Load Int 4, Load der 4, Load anticip 4</td><td>Load gain 5, Load Int 5, Load der 5, Load anticip 5</td></tr></table>				Load gain 1, Load Int 1, Load der 1, Load anticip 1	Load gain 2, Load Int 2, Load der 2, Load anticip 2	Load gain 3, Load Int 3, Load der 3, Load anticip 3	Load gain 4, Load Int 4, Load der 4, Load anticip 4	Load gain 5, Load Int 5, Load der 5, Load anticip 5
Load gain 1, Load Int 1, Load der 1, Load anticip 1	Load gain 2, Load Int 2, Load der 2, Load anticip 2	Load gain 3, Load Int 3, Load der 3, Load anticip 3	Load gain 4, Load Int 4, Load der 4, Load anticip 4	Load gain 5, Load Int 5, Load der 5, Load anticip 5				

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Load 3

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 ADV extension module					
Range [units]	0 – 100.0 %							
Default value	60%	Force value	NO					
Step	0.1 %							
Comm object	13981	Related applications	ALL					
Setpoint visibility	WinScope only							
Description								
There is 5 load bands defined via setpoints <i>Load 1</i> to <i>Load 5</i> and different <i>Load gain</i> , <i>Load Int</i> , <i>Load der</i> and <i>Load anticip</i> setpoints are active in each band.								
<div><div>0</div><div>Load 1</div><div>Load 2</div><div>Load 3</div><div>Load 4</div><div>Load </div></div> <table><tr><td>Load gain 1, Load Int 1, Load der 1, Load anticip 1</td><td>Load gain 2, Load Int 2, Load der 2, Load anticip 2</td><td>Load gain 3, Load Int 3, Load der 3, Load anticip 3</td><td>Load gain 4, Load Int 4, Load der 4, Load anticip 4</td><td>Load gain 5, Load Int 5, Load der 5, Load anticip 5</td></tr></table>				Load gain 1, Load Int 1, Load der 1, Load anticip 1	Load gain 2, Load Int 2, Load der 2, Load anticip 2	Load gain 3, Load Int 3, Load der 3, Load anticip 3	Load gain 4, Load Int 4, Load der 4, Load anticip 4	Load gain 5, Load Int 5, Load der 5, Load anticip 5
Load gain 1, Load Int 1, Load der 1, Load anticip 1	Load gain 2, Load Int 2, Load der 2, Load anticip 2	Load gain 3, Load Int 3, Load der 3, Load anticip 3	Load gain 4, Load Int 4, Load der 4, Load anticip 4	Load gain 5, Load Int 5, Load der 5, Load anticip 5				

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Load 4

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 ADV extension module
Range [units]	0 – 100.0 %		
Default value	80%	Force value	NO
Step	0.1 %		
Comm object	13982	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
There is 5 load bands defined via setpoints <i>Load 1</i> to <i>Load 5</i> and different <i>Load gain</i> , <i>Load Int</i> , <i>Load der</i> and <i>Load anticip</i> setpoints are active in each band.			
<div><div>0Load 1Load 2Load 3Load 4Load</div><div><div></div><div>Load gain 1, Load Int 1, Load der 1, Load anticip 1</div><div>Load gain 2, Load Int 2, Load der 2, Load anticip 2</div><div>Load gain 3, Load Int 3, Load der 3, Load anticip 3</div><div>Load gain 4, Load Int 4, Load der 4, Load anticip 4</div><div>Load gain 5, Load Int 5, Load der 5, Load anticip 5</div></div></div>			

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Droop

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0.0 - 100.0 [%]		
Default value	0%	Force value	NO
Step	0.1 %		
Comm object	11101	Related applications	ALL
Setpoint visibility	Always		
Description			
Droop of speed governor. The governor lowers the speed reference by <i>Droop</i> percent of the Nominal RPM (page 46) over the range from zero to MaxFuel (page 63).			

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MaxFuel

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0.0 – 100.0 %		
Default value	100%	Force value	NO
Step	0.1 %		
Comm object	11103	Related applications	ALL
Setpoint visibility	Always		
Description			
Maximum output from the PID speed control loop + Load anticipation signal. It limits the maximum fuel delivered to the engine.			

Note: It is also used as coordinate for Speed/Fuel line. See description in chapter Speed governor function in parallel mode.

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IdleFuel

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0.0 – 100.0 %		
Default value	10%	Force value	NO
Step	0.1 %		
Comm object	11597	Related applications	ALL
Setpoint visibility	Always		
Description			
IdleFuel is base (together with MaxFuel) for Droop function calculation..			

Note: Set this setpoint after engine is running on Nominal speed (no load) according to the real position of Actuator lever

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Actuator type

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	-		
Default value	ActType1	Force value	NO
Step	-		
Comm object	11104	Related applications	ALL
Setpoint visibility	Always		
Description			
ECON-4 can be connected to various types of actuators. Setpoints of the internal actuator feedback loop are tuned for the common actuators and predefined from the factory. Normally there is no need to change them. The user must only choose the right Actuator type. By default the ActType 1 is chosen. Check the type of your actuator and compare with the predefined type.			

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ECON-4 mode

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	-		
Default value	AUTO	Force value	NO
Step	-		
Comm object	11308	Related applications	ALL
Setpoint visibility	Always		
Description			
ECON-4 must be in AUTO for normal operation. Mode MAN can be used during installation to check the function of the actuator and linkage. If ECON-4 is in MAN mode, it sets the actuator to position Act position. It can be switched to MAN mode only any time even engine is running. This allows measurement of transition curve to calculate PID parameters.			

Note: ECON-4 when engine is running set the same value to setpoint Act position as position where throttle is. It assure bump less transition.

IMPORTANT: Even Overspeed protection is active in all modes, be carefull when setting throttle position manualy. Engine can accelerate when breaker opens or when throttle position is too high.Make sure ECON-4 mode is in Auto positon before you leave installation.

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Act position

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0.0 – 100.0 %		
Default value	30%	Force value	NO
Step	0.1 %		
Comm object	11309	Related applications	ALL
Setpoint visibility	Always		
Description			
Adjusts the actuator position in the Econ-4 Mode = MAN.			

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PWM rate

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	600 – 10 000 Hz		
Default value	6000 Hz	Force value	NO
Step	1 Hz		
Comm object	12080	Related applications	ALL
Setpoint visibility	Always		
Description			
Frequency of the PWM signal sent to ACT+ and ACT- outputs..			

Note: For Heinzmann actuators adjust the PWM rate to 6000 Hz. For Woodward PWM and current, GAC actuators adjust the PWM rate to 2000Hz.

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SGO Bias

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	± 10 V		
Default value	0.00 V	Force value	NO
Step	0.01 V		
Comm object	14375	Related applications	ALL
Setpoint visibility	Always		
Description			
<p>Together with Idle Fuel value creates coordinates for first point of Speed/Fuel line. For detailed description see There could be situation in SPtm for example, when just GCB is closed and generator supply a local load. So MCB is opened and GCB is closed and PID with Load parameters is used to control speed and Throttle position. It is clear than Throttle is not in Idle position but on higher position. Now after synchronization, MCB is closed, throttle stays in the same position because no Higher Power is generated just after synchronization and Actual speed request is in Bias position because no power control has been done in previous stage. So there is difference between actual speed request and speed request corresponding to actual throttle position. This difference is called Speed request offset and we keep it to make transition burpless. When controller increase aped request to provide more power to Mains, we move throttle to higher position on the Speed/fuel line and it works fine. But we can not keep speed request offset all time, because when controller decrease speed request throttle would go to zero position and even to negative value (theoretically). So we keep Speed request offset just for one minute from breaker closing and then starts to decrease this offset. This will move throttle down, but controller will notify decreasing of power and increase speed request. After a while, using this mechanism Speed request offset oi zero and actual throttle position respects speed request and Speed/fuel line. on page 38.</p>			

Note: Setpoint is active for unloaded engine.

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SGO HiLim

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	± 10 V		
Default value	10.00 V	Force value	NO
Step	0.01 V		
Comm object	14376	Related applications	ALL
Setpoint visibility	Always		
Description			
<p>Together with Max Fuel value creates coordinates for second point of Speed/Fuel line. For detailed description see There could be situation in SPtm for example, when just GCB is closed and generator supply a local load. So MCB is opened and GCB is closed and PID with Load parameters is used to control speed and Throttle position. It is clear than Throttle is not in Idle position but on higher position. Now after synchronization, MCB is closed, throttle stays in the same position because no Higher Power is generated just after synchronization and Actual speed request is in Bias position because no power control has been done in previous stage. So there is difference between actual speed request and speed request corresponding to actual throttle position. This difference is called Speed request offset and we keep it to make transition burpless. When controller increase aped request to provide more power to Mains, we move throttle to higher position on the Speed/fuel line and it works fine. But we can not keep speed request offset all time, because when controller decrease speed request throttle would go to zero position and even to negative value (theoretically). So we keep Speed request offset just for one minute from breaker closing and then starts to decrease this offset. This will move throttle down, but controller will notify decreasing of power and increase speed request. After a while, using this mechanism Speed request offset oi zero and actual throttle position respects speed request and Speed/fuel line. on page 38</p>			

Note: Setpoint is active for unloaded engine.

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SGOffsetRamp

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	10 - 1800 s		
Default value	30 s	Force value	NO
Step	1 s		
Comm object	14375	Related applications	ALL
Setpoint visibility	Always		
Description			
<p>This defines ramp according SGOoffset is removed after parallel. For details see chapter Speed governor function in network parallel mode see There could be situation in SPtm for example, when just GCB is closed and generator supply a local load. So MCB is opened and GCB is closed and PID with Load parameters is used to control speed and Throttle position. It is clear than Throttle is not in Idle position but on higher position. Now after synchronization, MCB is closed, throttle stays in the same position because no Higher Power is generated just after synchronization and Actual speed request is in Bias position because no power control has been done in previous stage. So there is difference between actual speed request and speed request corresponding to actual throttle position. This difference is called Speed request offset and we keep it to make transition burpless. When controller increase aped request to provide more power to Mains, we move throttle to higher position on the Speed/fuel line and it works fine. But we can not keep speed request offset all time, because when controller decrease speed request throttle would go to zero position and even to negative value (theoretically). So we keep Speed request offset just for one minute from breaker closing and then starts to decrease this offset. This will move throttle down, but controller will notify decreasing of power and increase speed request. After a while, using this mechanism Speed request offset oi zero and actual throttle position respects speed request and Speed/fuel line. on page 38.</p>			

Note: Setpoint is active for unloaded engine.

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LAder+limit

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 ADV extension module
Range [units]	0 – 100.0 %		
Default value	5%	Force value	NO
Step	0.1 %		
Comm object	14402	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Limit on Load step in + direction, changes bellow this limit will not generate any derivation			

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LAder-limit

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 ADV extension module
Range [units]	0 – 100.0 %		
Default value	5%	Force value	NO
Step	0.1 %		
Comm object	14405	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Limit on Load step in – direction, changes bellow this limit will not generate any derivation			

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LAder+

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 ADV extension module
Range [units]	0 – 100.0 %		
Default value	0%	Force value	NO
Step	1 %		
Comm object	14403	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Amount of derivation when Load increases			

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LAder-

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 ADV extension module
Range [units]	0 – 100.0 %		
Default value	0%	Force value	NO
Step	1 %		
Comm object	14406	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Amount of derivation when Load decreases			

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LAder+recover

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 ADV extension module
Range [units]	1.01 – 10.00 %		
Default value	10	Force value	NO
Step	0.01 %		
Comm object	14404	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Derivation curve definition – drop from + value. Initial value is divided by this number repeatedly once per 0.1s. So higher value means faster drop to zero.			

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LAder-recover

Setpoint group	Main PID	Related FW	1.4.0 configured ECON-4 ADV extension module
Range [units]	1.01 – 10.00 %		
Default value	10	Force value	NO
Step	0.01 %		
Comm object	14407	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Derivation curve definition – drop from - value. Initial value is divided by this number repeatedly once per 0.1s. So higher value means faster drop to zero.			

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8.1.6 Act type 1 – predefined for Woodward ITB 0-200 mA

There are 4 identical groups of setpoints in ECON-4. They are used to setup the output circuits for particular types of actuators and tune the actuator position PID loop.

Note: Normally these Actuator type setpoints are predefined from the factory and there is no need to readjust them. Modify them if you have a non-standard, or non listed actuator only – see **List of tested actuators by ComAp on page 76**

Act gain

Setpoint group	ActType 1,2,3,4	Related FW	1.4.0
Range [units]	0.0 – 1000.0 [%]		
Default value	50%	Force value	NO
Step	0.1 %		
Comm object	11109	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Gain of the PID actuator position control loop.			

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Act int

Setpoint group	ActType 1,2,3,4	Related FW	1.4.0
Range [units]	0 – 1000 [%]		
Default value	20%	Force value	NO
Step	1 %		
Comm object	11110	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Integration factor of the PID actuator position control loop.			

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Act der

Setpoint group	ActType 1,2,3,4	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0 – 1000 %		
Default value	0%	Force value	NO
Step	1 %		
Comm object	11111	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Derivation factor of the PID actuator position control loop.			

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Act MaxCur

Setpoint group	ActType 1,2,3,4	Related FW	1.4.0
Range [units]	0.0 – 100.0 [%]		
Default value	100%	Force value	NO
Step	0.1 %		
Comm object	11112	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Actuator Overload protection limit.			

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ActmaxCurDel

Setpoint group	ActType 1,2,3,4	Related FW	1.4.0
Range [units]	0.0 – 300.0 [s]		
Default value	5 s	Force value	NO
Step	0.1 s		
Comm object	11113	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Actuator Overload protection limit delay.			

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Act ReducedCur

Setpoint group	ActType 1,2,3,4	Related FW	1.4.0
Range [units]	0.0 – 100.0 [%]		
Default value	40%	Force value	NO
Step	0.1 %		
Comm object	11114	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Reduced actuator current when overload protection was activated.			

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Wiring

Setpoint group	ActType 1,2,3,4	Related FW	1.4.0
Range [units]	LINEAR, BRIDGE, LINEAR NO FDB		
Default value	LINEAR	Force value	NO
Step	-		
Comm object	11310	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
<p>▶ LINEAR : It is electro-magnetic actuator with a strong return spring. This is in principle electromagnet with proportional characteristic – the bigger is the current to the actuator, the bigger is the angle of the actuator. Direction of movement of the actuator lever does not depend on polarity of the current. This type of actuator has position feedback. Typically it is GAC actuators or Woodward 0-200mA, or PWM.</p> <p>▶ BRIDGE : typical examples are actuators from Heinzmann. It is in principle a DC electromotor driving actuator lever. Since it is a motor, it has bipolar integrating characteristic – as long as the current flows through the actuator, actuator's lever moves. Direction of movement of the actuator lever depends on polarity of the current – when the polarity of the current is reversed, direction of movement of the actuator lever reverses as well. This type of actuator has always position feedback. Choose this possibility for Heinzmann actuators and connect the position feedback signal</p> <p>▶ LINEAR NO FDB : For example it is electro-hydraulic actuator – in principle a small electromagnetic actuator with hydraulic booster. It has unipolar proportional characteristic – the bigger is the current, the bigger is the angle of the actuator. Direction of movement of the actuator lever does not depend on polarity of the current. Actuator is without position feedback.</p>			

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8.1.7 Act type 2 – predefined for Woodward ITB PWM

There are 4 identical groups of setpoints in ECON-4. They are used to setup the output circuits for particular types of actuators and tune the actuator position PID loop.

Note: Normally these Actuator type setpoints are predefined from the factory and there is no need to readjust them. Modify them if you have a non-standard, or non listed actuator only – see **List of tested actuators by ComAp on page 76**

Setting is active when **Main PID: Actuator type** = Act type 2. Setpoint structure see **Act type 1 – predefined for Woodward ITB 0-200 mA on page 70**.

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8.1.8 Act type 3 –predefined for Woodward F-series PWM

There are 4 identical groups of setpoints in ECON-4. They are used to setup the output circuits for particular types of actuators and tune the actuator position PID loop.

Note: Normally these Actuator type setpoints are predefined from the factory and there is no need to readjust them. Modify them if you have a non-standard, or non listed actuator only – see **List of tested actuators by ComAp on page 76**

Setting is active when **Main PID: Actuator type** = Act type 3. Setpoint structure see **Act type 1 – predefined for Woodward ITB 0-200 mA on page 70**.

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8.1.9 Act type 4 – predefined for Heinzmann STG 10

There are 4 identical groups of setpoints in ECON-4. They are used to setup the output circuits for particular types of actuators and tune the actuator position PID loop.

Note: Normally these Actuator type setpoints are predefined from the factory and there is no need to readjust them. Modify them if you have a non-standard, or non listed actuator only – see **List of tested actuators by ComAp on page 76**

Setting is active when **Main PID: Actuator type** = Act type 4. Setpoint structure see **Act type 1 – predefined for Woodward ITB 0-200 mA on page 70**.

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8.1.10 Group: Analog sensors

LoReqSpeed Inp

Setpoint group	Analog sensors	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	Range: 0.0 – 100.0 %		
Default value	0.0	Force value	NO
Step	0.1 %		
Comm object	11125	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Value of analog input SPEED REQUEST for minimum possible speed reference (Nominal RPM-8%).			

Note: It is active only if the setpoint Speed request = ANA.

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HiReqSpeed Inp

Setpoint group	Analog sensors	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0.0 – 100.0 %		
Default value	100 %	Force value	NO
Step	0.1 %		
Comm object	11126	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Engine idle speed.			

Note: Input SPEED REQUEST active only if the setpoint Speed request = ANA.

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AOUT 0

Setpoint group	Analog sensors	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0 – 100 %		
Default value	0 %	Force value	NO
Step	1 %		
Comm object	11643	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Analogue output low limit signal definition.			

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AOUT 100

Setpoint group	Analog sensors	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0 – 100 %		
Default value	100 %	Force value	NO
Step	1 %		
Comm object	11645	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Analogue output high limit signal definition.			

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FBD 0 pos

Setpoint group	Analog sensors	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	0,40 – Fdb1 100 pos.V		
Default value	01.76 V	Force value	NO
Step	0.01 V		
Comm object	11662	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Feedback fully closed position voltage. Connect the position feedback to the ECON-4 terminals. Keep the actuator lever in fully closed position and measure a dc voltage between the terminals S2.1 and S2.3. This voltage put as this setpoint value.			

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FBD 100 pos

Setpoint group	Analog sensors	Related FW	1.4.0 configured ECON-4 extension module
Range [units]	Fdb1 0 pos – 4,60 V		
Default value	3.10	Force value	NO
Step	0.01 V		
Comm object	11664	Related applications	ALL
Setpoint visibility	WinScope only		
Description			
Feedback fully opened position voltage. Connect the position feedback to the ECON-4 terminals. Keep the actuator lever in fully opened position (by hand) and measure a dc voltage between the terminals S2.1 and S2.3. This voltage put as this setpoint value.			

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8.1.11 List of tested actuators by ComAp

Woodward ITB 0-200mA	Woodward ITB PWM	Woodward F-series PWM
Act gain = 5	Act gain = 20	Act gain = 0,5
Act int = 100	Act int = 400	Act int = 200
Act der = 0	Act der = 0	Act der = 0
PWM rate = 2000 Hz	PWM rate = 2000 Hz	PWM rate = 2000 Hz
Fdb 0 pos = 0,5 V	Fdb 0 pos = 0,5 V	Fdb 0 pos = 0,42 V
Fdb 100 pos = 4,5 V	Fdb 100 pos = 4,5 V	Fdb 100 pos = 4,55 V
Heinzmann STG10	Heinzmann STG30	Heinzmann STG2040
Act gain = 90	Act gain = 90	Act gain = 35
Act int = 600	Act int = 600	Act int = 300
Act der = 150	Act der = 150	Act der = 150
PWM rate = 6000 Hz	PWM rate = 6000 Hz	PWM rate = 6000 Hz
Fdb 0 pos = 1,76 V	Fdb 0 pos = 1,76 V	Fdb 0 pos = 1,78 V
Fdb 100 pos = 3,1 V	Fdb 100 pos = 3,1 V	Fdb 100 pos = 2,8 V
Heinzmann STG2010	GAC ATB552t2F-24	
Act gain = 30 (40)	Act gain = 25	
Act int = 300 (500)	Act int = 400	
Act der = 30 (300)	Act der = 2	
PWM rate = 6000 Hz	PWM rate = 2000 Hz (1500 - 3000???)	
Fdb 0 pos = 1,78 V	Fdb 0 pos = 0,96 V	
Fdb 100 pos = 2,8 V	Fdb 100 pos = 3,61 V	

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