ComAp
The heart of smart control

ECON-4

Digital Speed Governor

SW version 1.8.0

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Global Guide

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1 Document information

1.1 Clarification of Notation

Note: *This type of paragraph calls the reader's 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.

WARNING: 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 Modules.

1.3 Document history

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11	1.8.0	13.4.2023	Lubomír Brož
10	1.7.0	7.3.2023	Lubomír Brož
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2	1.4.1	26.9.2016	Jiří Schiller
1	1.4.0	9.9.2016	Jiří Schiller

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General security recommendations and set of measures

1. AccessCode

• Change the AccessCode BEFORE the device is connected to a network.

• Use a secure AccessCode – ideally a random string of 8 characters containing lowercase, uppercase letters and digits.

• For each device use a different AccessCode.

2. Password

• Change the password BEFORE the device enters a regular operation.

• Do not leave displays or PC tools unattended if an user, especially administrator, is logged in.

3. Controller Web interface

• The controller web interface at port TCP/80 is based on http, not https, and thus it is intended to be used only in closed private network infrastructures.

• Avoid exposing the port TCP/80 to the public Internet.

4. MODBUS/TCP

• The MODBUS/TCP protocol (port TCP/502) is an instrumentation protocol designed to exchange data between locally connected devices like sensors, I/O modules, controllers etc. From it's nature it does not contain any kind of security – neither encryption nor authentication. Thus it is intended to be used only in closed private network infrastructures.

• Avoid exposing the port TCP/502 to the public Internet.

5. SNMP

• The SNMP protocol (port UDP/161) version 1,2 is not encrypted. Thus it is intended to be used only in closed private network infrastructures.

• Avoid exposing the port UDP/161 to the public Internet.

1.5 Symbols in this manual


Battery


Breaker


Connector - female


Connector - male

Controller simplified

ECON-4 simplified


Fuel solenoid


Fuse


Fuse switch

Generator


Generator schematic


Grounding


Jumper


Load


Mains


Mains


Pick - up

Resistor


Resistor adjustable


RS 232 female


Starter

Voltage measurement

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2 System overview

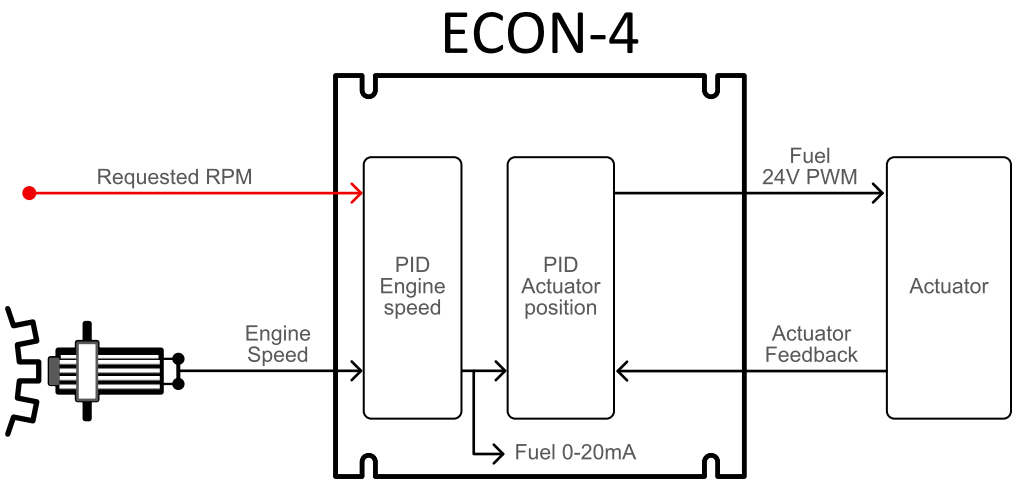
2.1 Description of the governor system

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

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

b. Control via Binary signals

c. 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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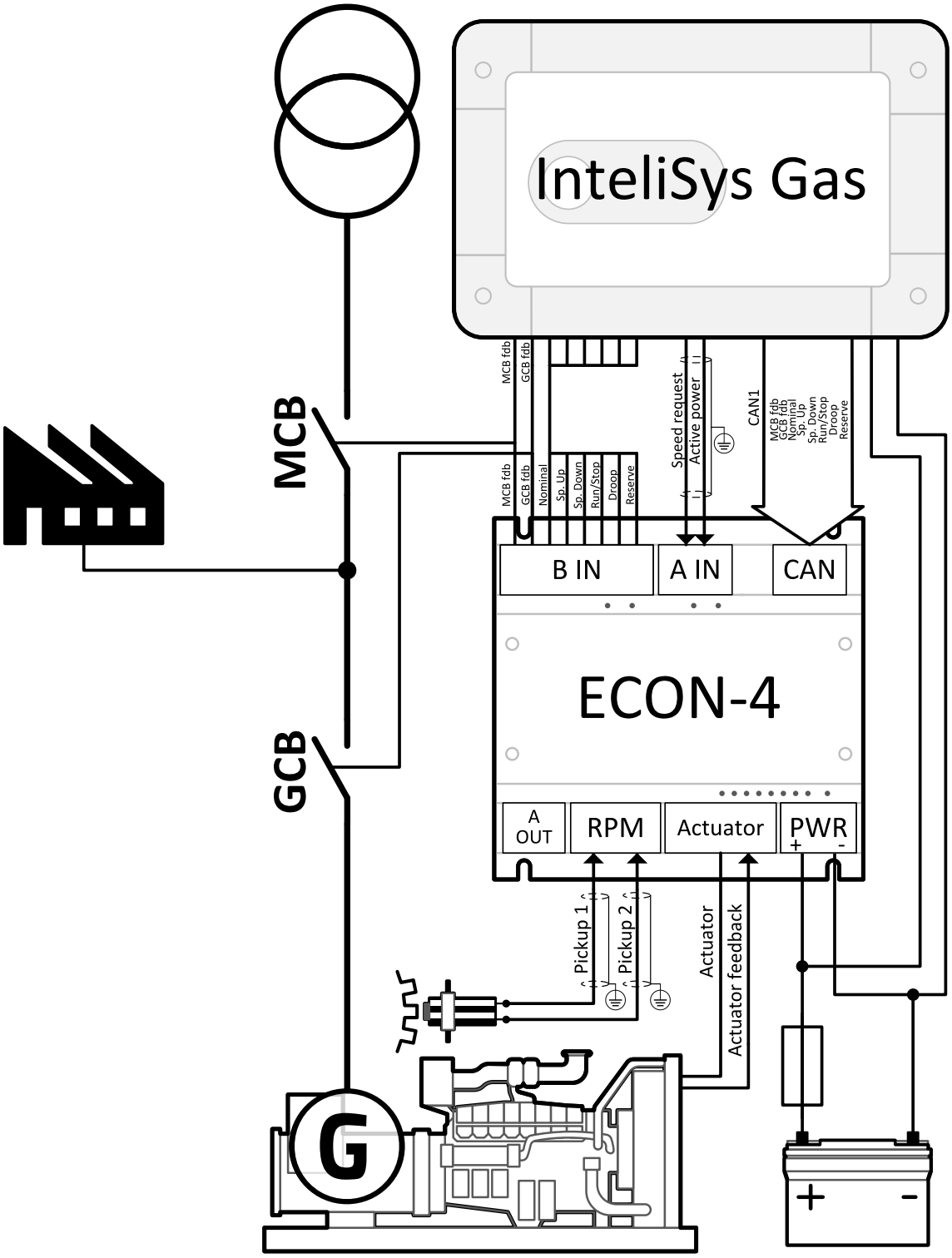
3 Applications overview

3.1 Wiring overview



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4 Installation and wiring

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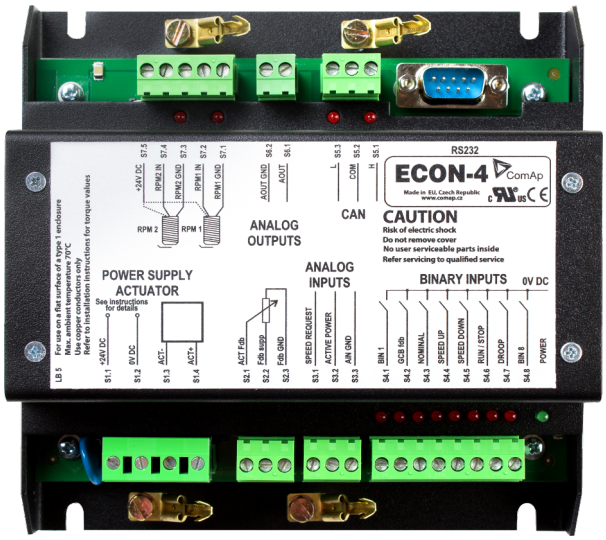
4.1 Package content



The package contains:

- ECON-4 module
- Terminal blocks

4.2 Module installation

4.2.1 Dimensions and mounting

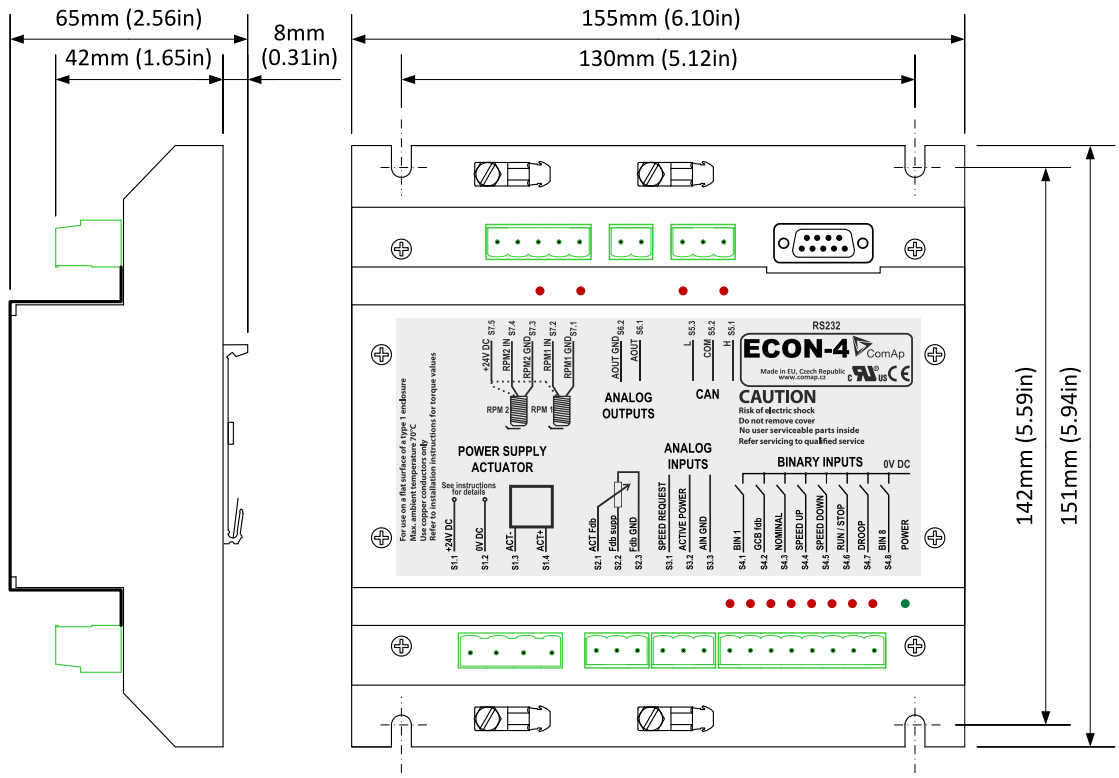
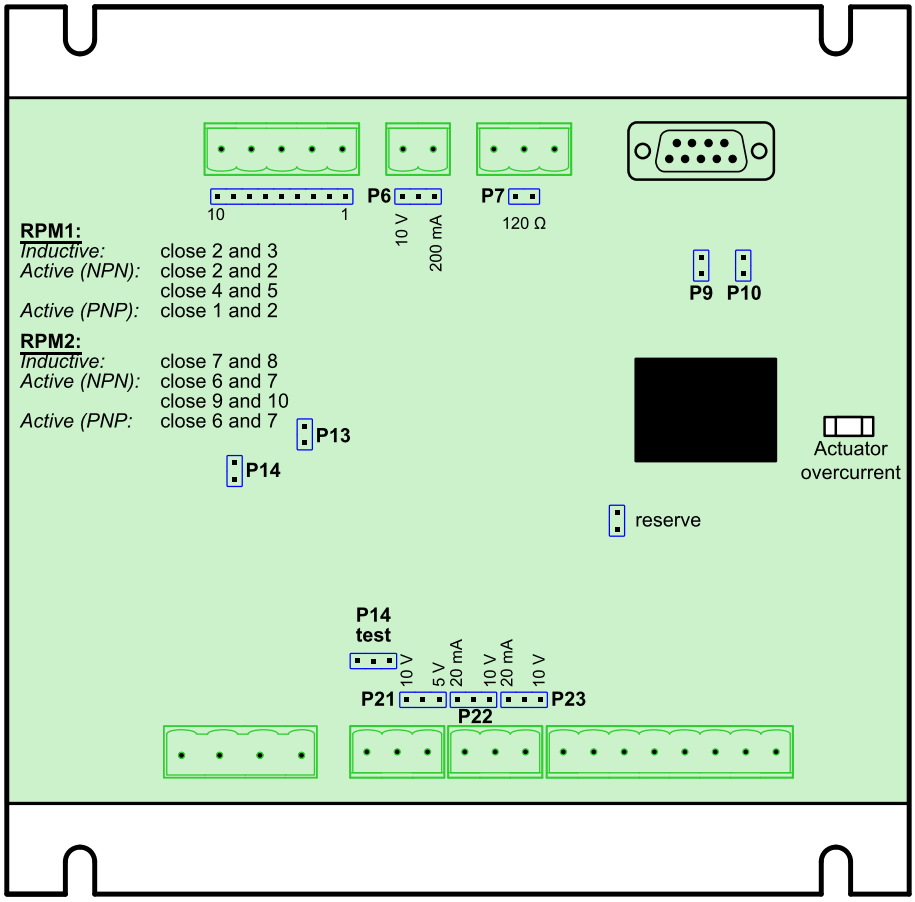


Image 4.1 Dimensions, terminals and mounting

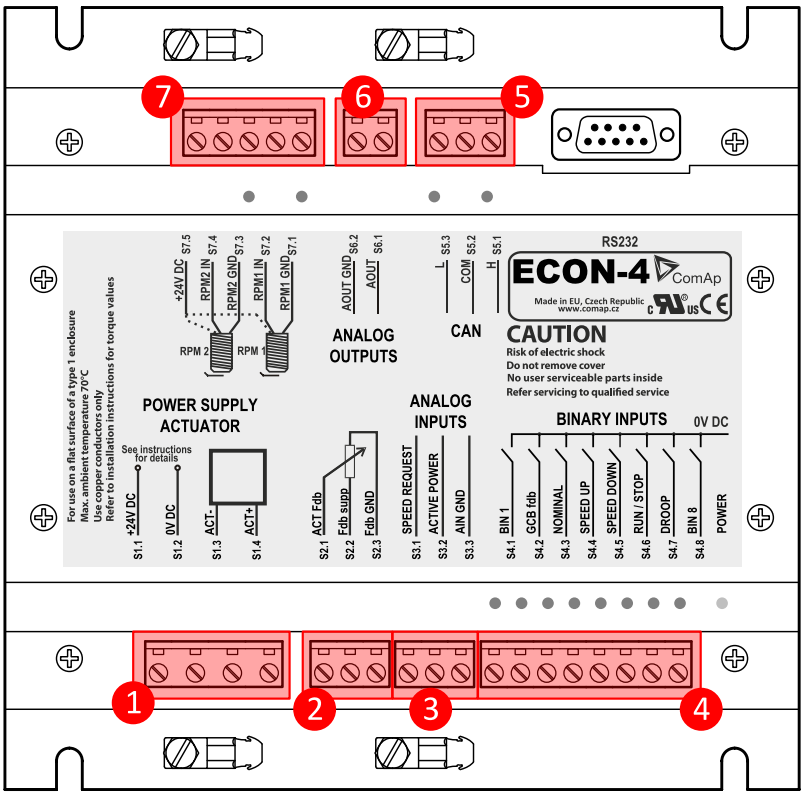
Note: *ECON-4 unit is mounted on DIN rail 35 mm.*

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
P13	Test purposes only
P14	HW signalization of ACT overload, MUST be ON
P20	Test purposes only Feedback circuit supply.
P21	10V - link 2 pins from the left side - use for Heinzmann actuators 5V - link 2 pins from the right side - use for GAC, Woodward, actuators
P22	AIN 1 switch between current and voltage Current: link the 2 pins from the left side Voltage: link the 2 pins from the right side
P23	AIN 1 switch between current and voltage Current: link the 2 pins from the left side Voltage: link the 2 pins from the right side

4.4 Recommended wiring



Postion	Terminal groups	Link
1	Power supply Actuators	**Power Supply (page 14)**
2	Actuator feedback	**Interface to actuators (page 19)**
3	Analog inputs	**Analog inputs (page 16)**
4	Binary inputs	**Binary inputs (page 14)**
5	Communications	**Communication wiring (page 21)**
6	Analog outputs	**Analog output (page 18)**
7	Magnetic Pick-up	**Speed Pick-up (page 21)**

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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 mm^2.

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

4.4.3 Power Supply

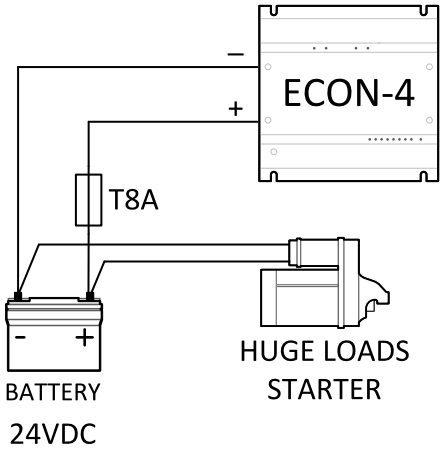
Use min. power supply cable of 4 mm^2.

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.

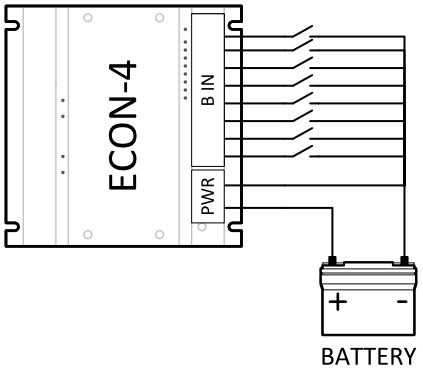


Image 4.2 Binary inputs wiring scheme

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.

	Speed Request value			CB Request value	
Input	**BIN**	**ANA**	**DATA**	**BIN**	**DATA**
MCB fdb (S4.1) (page 15) 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 isECON-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 (Iddle/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 actuall 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 (Iddle/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 actuall 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.

When the engine is running, and the Run signal is removed (deactivated) ECON-4 shuts immediately the fuel to 0%. In case the Run signal is activated again in a moment, when the engine is still moving (means non-zero RPM are measured), in previous sw versions ECON-4 increased the fuel amount close to 100% and regulated from this value on the requested RPM. In sw version 1.6.0 and higher, when the Run signal is activated again and engine RPM are non-zero in that moment, ECON-4 sets the fuel amount to value given by parameter: **IdleFuel (page 64)** and from this value continue the RPM regulation to the Requested RPM.

DROOP (S4.7)

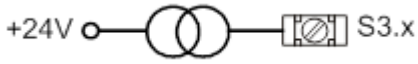
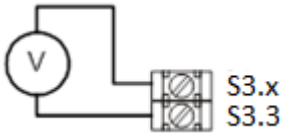
The input activates droop function – see setpoint **Droop (page 63)**.

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 ReqSpeed = 1500 + (PerChSpdNom/100)*1500*(6-5)/5 = 1524 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 anticip.

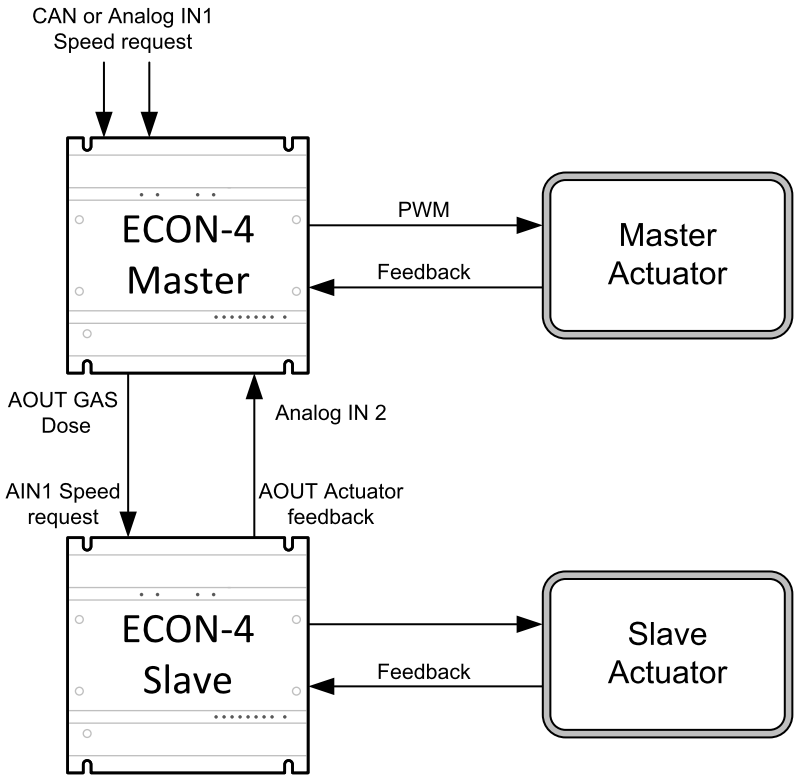
Note: *Input ACTIVE POWER is active only if the setpoint Speed request has value BIN or ANA and setpoint Load anticip > 0.*

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.

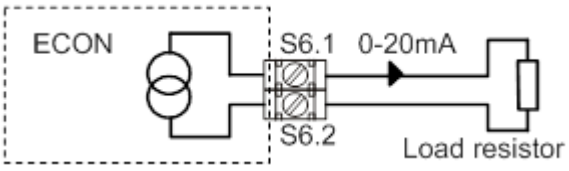
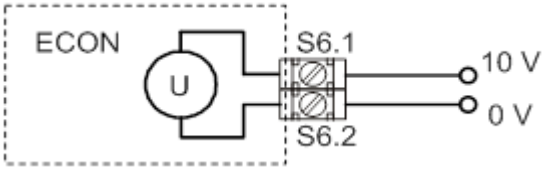
Original Misf Angle calculation is not used in latest version of ECON4 and in version 1.4 is used to show feedback from Slave. If feedback from slave is connected to analog input on S3.2 setpoint LoadAnticipation has to be =0. Othervise wrong value will be used for load anticip resulting unstability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

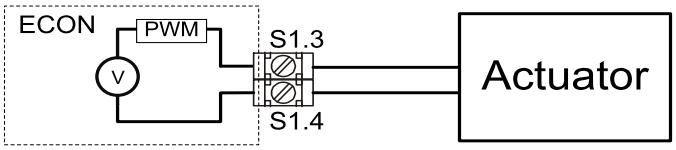
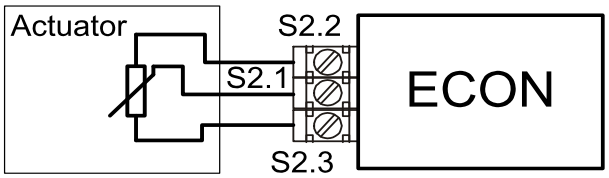
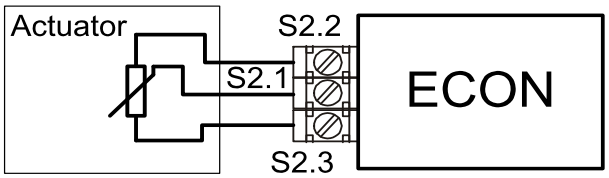
In case an actuator with an input 0-5V is used, the AOUT2 setpoints should be adjusted in the following way:

- 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.

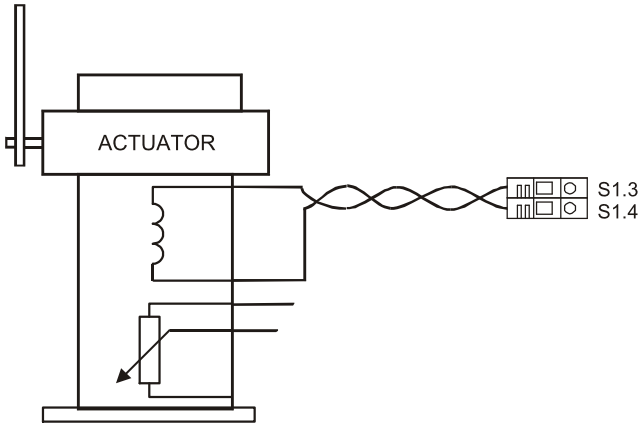
Range	Recommended wiring	Terminals	Jumpers
Ooutput 0 - 8 A		S1.3	-
Feedback 0 - 5 V		S2.2 S2.1 S2.3	P21 5V
Feedback 0 - 10 V		S2.2 S2.1 S2.3	P21 10V

Types of actuators supported by ECON-4

With current input 200mA

Example: Typical example is Woodward UG-A.

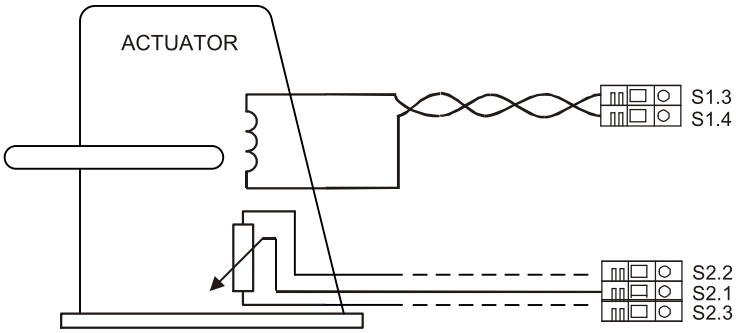
It is electro-hydraulic actuator – in principle a small electromagnetic actuator with hydraulic booster. It has proportional characteristic – the bigger is the current, the bigger is the angle of the actuator, the polarity of the current is not important. Actuator is usually without electrical position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

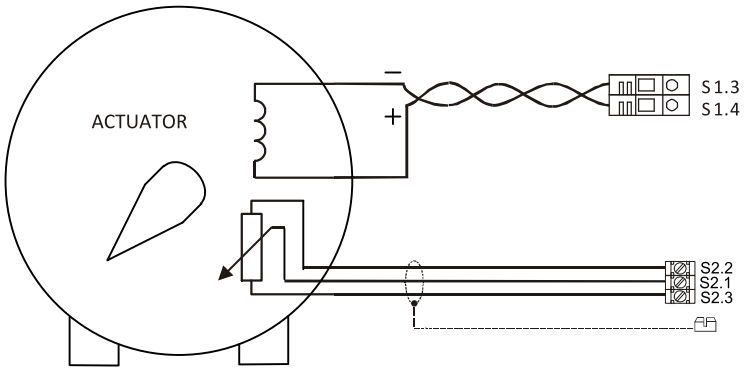
It is electro-magnetic actuator with a strong return spring. This is in principle electromagnet with proportional characteristic – the bigger is the current to the actuator, the bigger is the angle of the actuator. The polarity of the current is not important. This type of actuator can be with or without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



Motor driven actuators

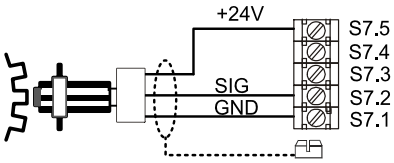
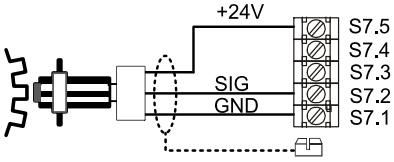
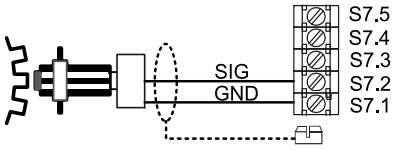
Example: Typical examples are actuators from Heinzmann (STG 6, 10, 30, 2040.)

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

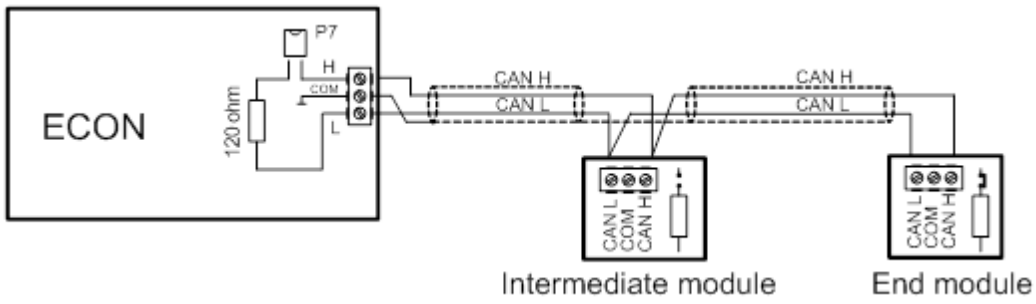
ECON-4 is equipped by CAN communication line. CAN bus terminals are electrically isolated from any other terminals.

Note: *Following ECON-4 CAN setting is necessary to communicate with InteliSys NT:*
CAN mode (Object number 10338) = 1 sets ComAp protocol
CAN NODE-ID (Object number10306) = 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/DATA
		MCB feedback	
Speed control	Speed request	Speed request analogue signal	BIN/ANA/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

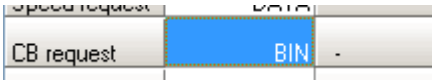
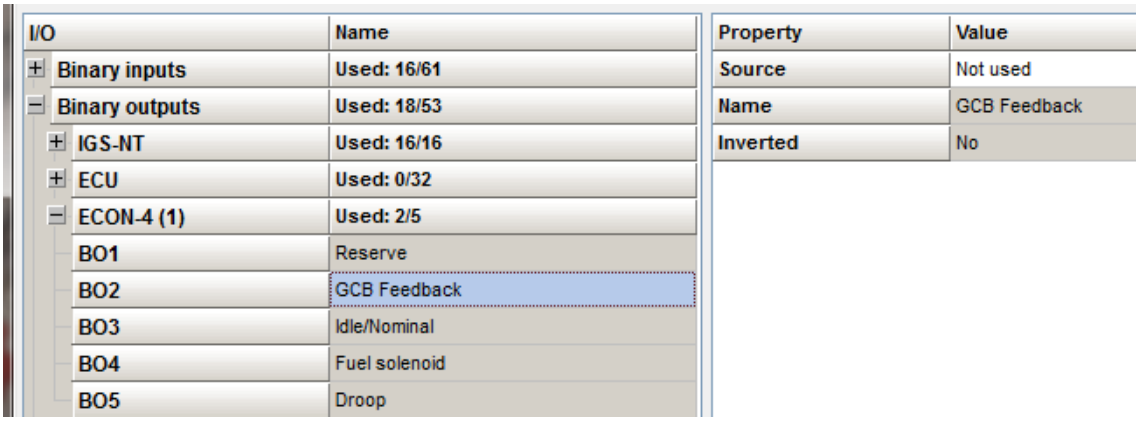


Image 5.1 CB request - BIN mode

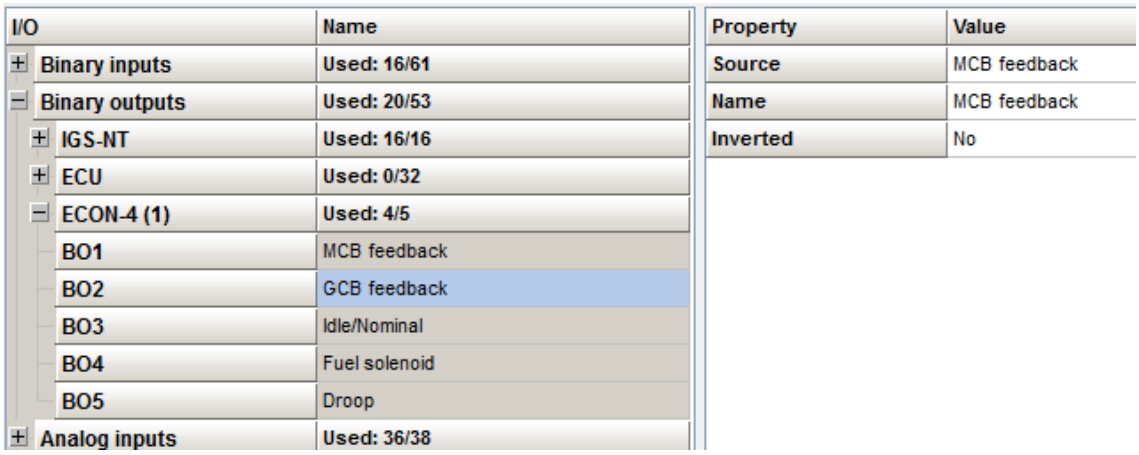
In case of binary control of breaker`s feedback, signals from breakers has to be wired to terminals S4.1 and S4.2. You do not need to link any source to Binary outputs of ECON4 in Genconfig.



CB request set to DATA mode

Image 5.2 CB request - DATA mode

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.



5.1.2 Speed control handling (Speed request modes)

Speed request set to ANA mode

Image 5.3 Speed request - ANA mode

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. InteliSysNT), 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 thirt 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

Image 5.4 Speed request - BIN mode

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).

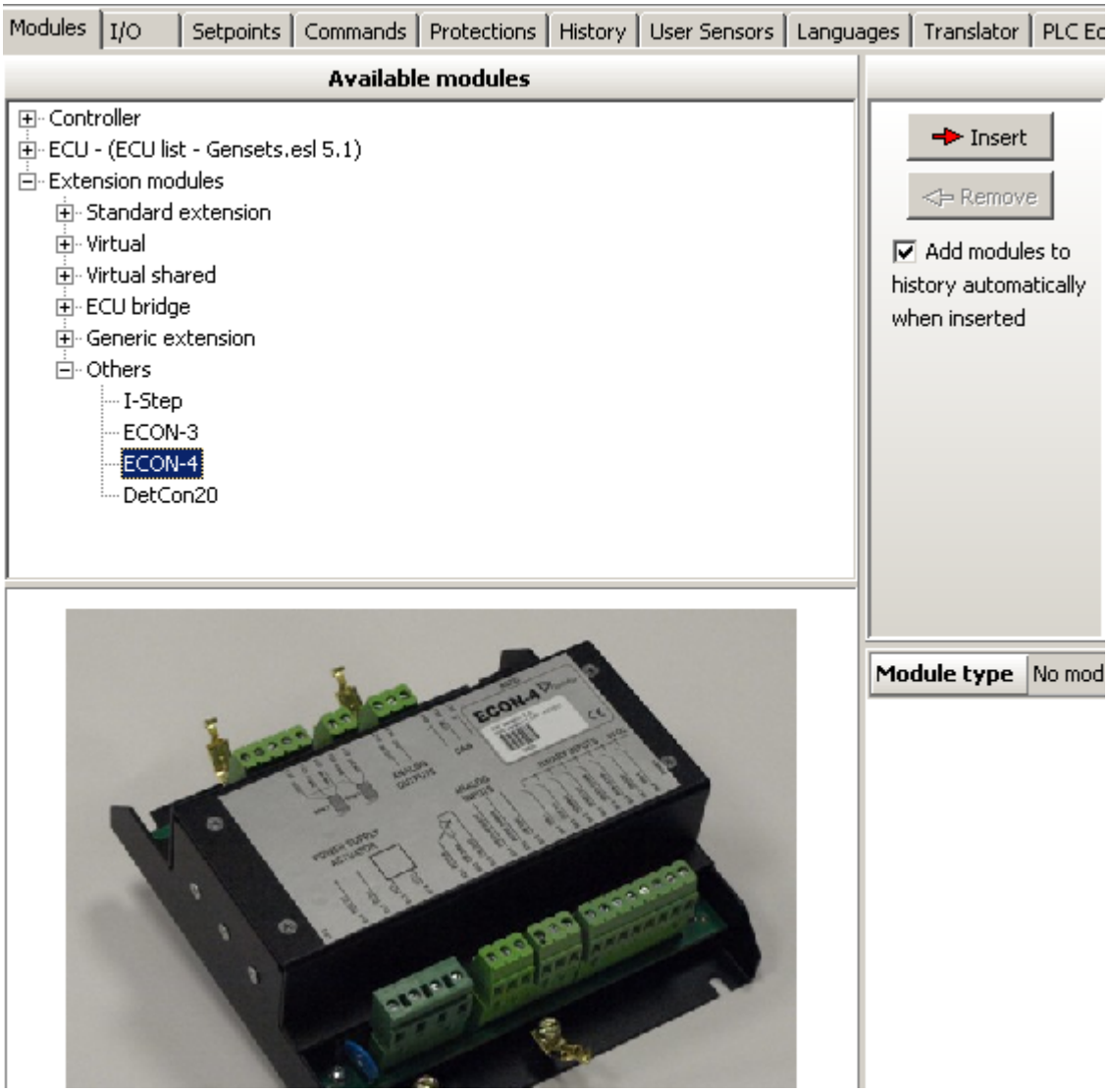
You do not need to link any source to Binary outputs of ECON4 in Genconfig. This type of control can be used with firmware without support of ECON4 or even for collaboration with thirt party controller or without any controller just as standalone speed controller (no Data communication to ECON4 is needed).

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

Speed request set to DATA mode

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).

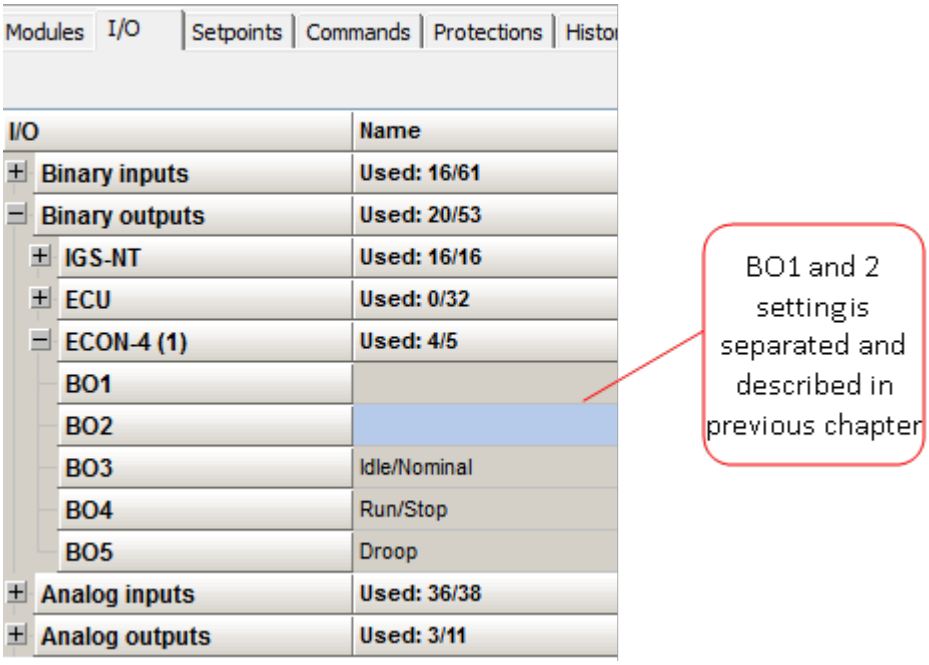
BO1 – this configuration of MCB feedback is independent and is described in previous chapter Breaker's feedback handling (CB request modes)

BO2 – this configuration of GCB 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 (protect against power swing). Use signal e.g. GCB feedback.



BO1 and 2 setting is separated and described in previous chapter

c. Configuration of Analogue inputs from IGS-NTto 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

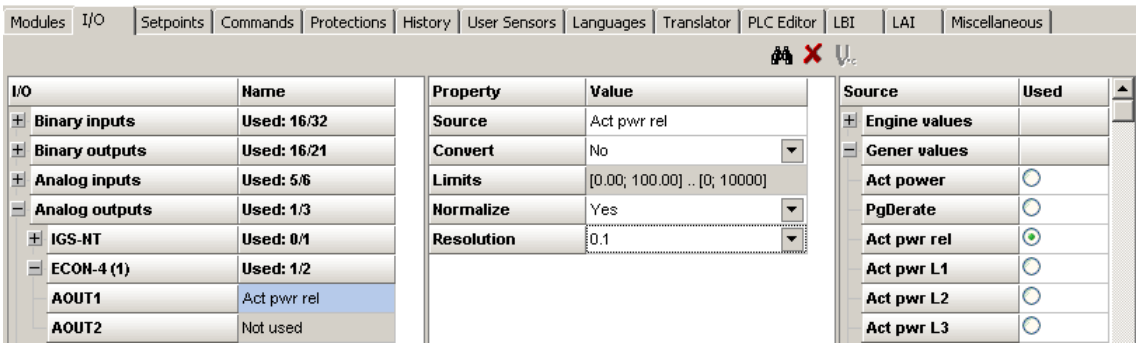
The engine RPM can be sent from ECON-4 into the IS-NT via CAN line as well. Configure the AIN1 in the following way:

Function – RPM pick-up

Sensor – Electronic

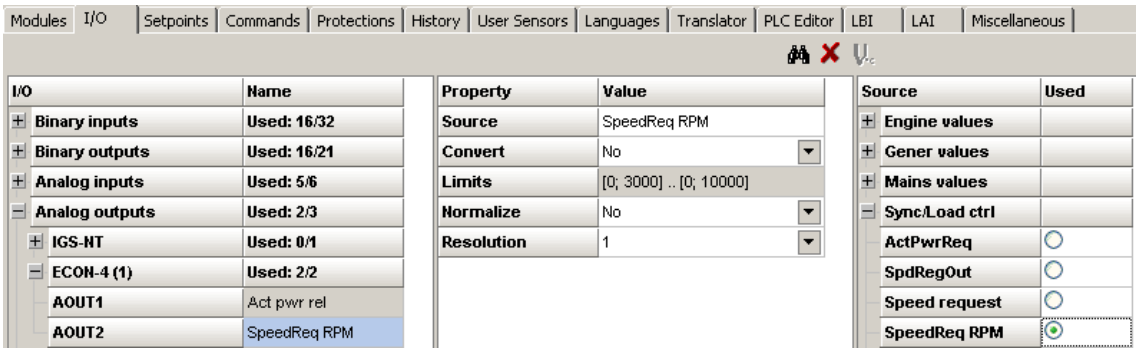
the IGS-NT controller.

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

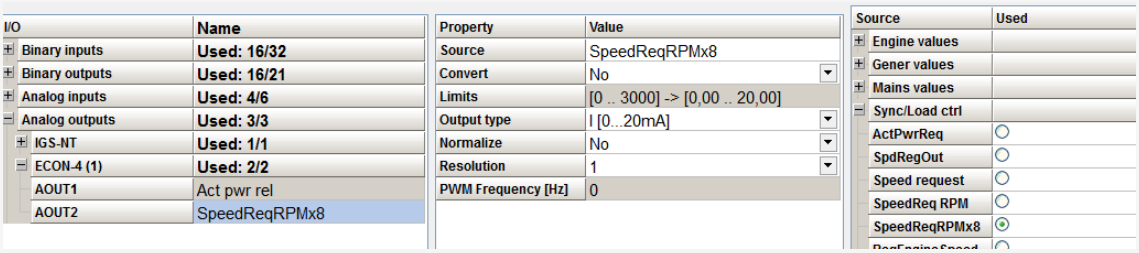


AOUT2 – Speed RequestThe Speed request in case of DATA mode is sent via CAN line. Configure the output AOUT2 in the following way:
Source: Sync.

Load ctrl: SpeedReqRPM



IMPORTANT: Configuration of Analog output AOUT2 from IS2GASXX to ECON-4 has to be configured as SpeedReqRPMx8



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.

Note: *ECON-4 parameters values are used for a CRC code calculation, which is used with a specific fw branch of a gen-set controller.*

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 activated this icon.

5.2.2 Modify password from GenConfig

Certain Setpoints can be modified directly from GenConfig PC 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 Reserve	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 Reserve	Physical input state, reserve
BI9	PickUpFail	
BI10	InvalActSetp	
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 InteliSys-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/StopÂ Â
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[1]	

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

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.

> **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.**

Note: *ECON-4 parameters values are used for a CRC code calculation, which is used with a specific fw branch of a gen-set controller.*

5.3.5 ECON adjustement for various types of actuators

Basically there are available 3 types of actuator types:

[1]Misfiring evaluation from ECON-4 is not implemented in version 1.0

- **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)

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 / 32Ω = 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. 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.

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%. Check that the position feedback signal matches the mechanical limits of the actuators and that it matches the reality.

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.

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 adjustements 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

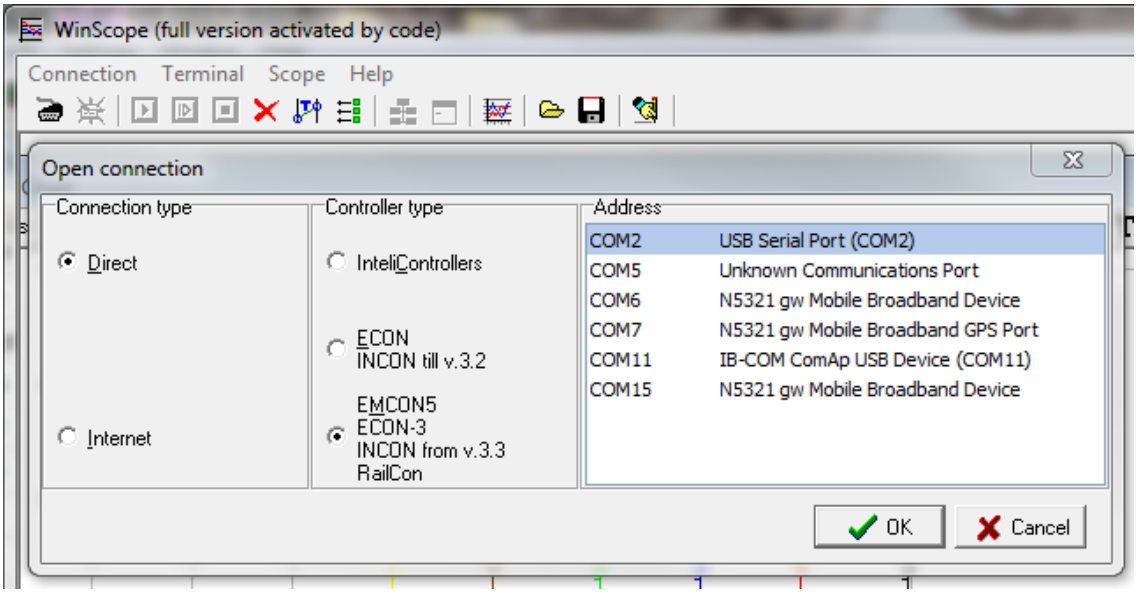
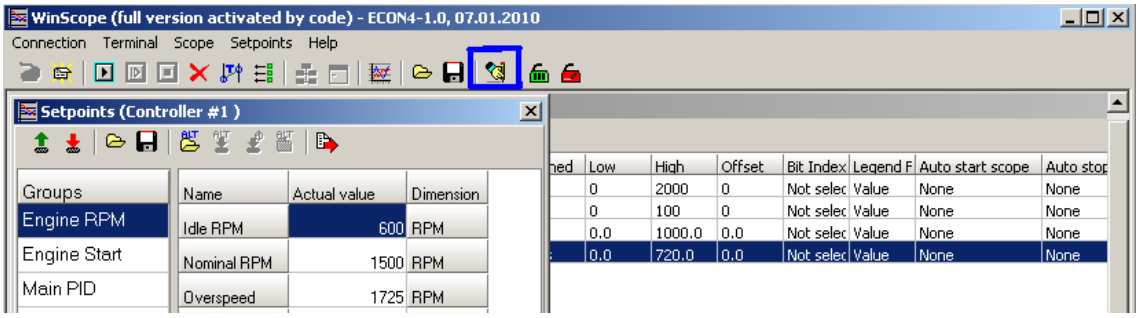


Image 5.5 Direct connection of WinScope SW to ECON-4

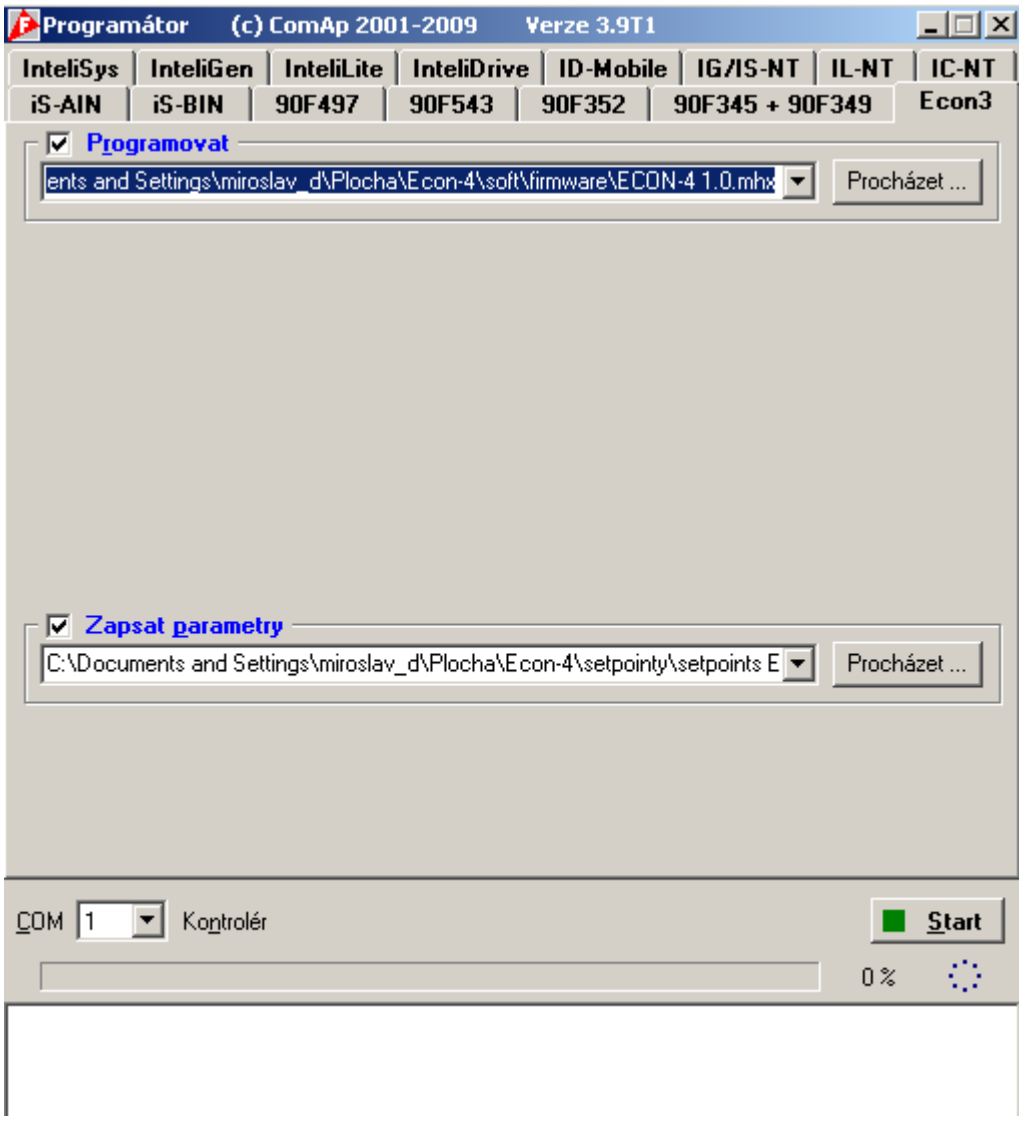
Then open setpoint Tab and work with setpoints. For rest of operations (channel selection, trend recording...) see manual for WinScope SW.

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 InteliMonitor 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 / 32Ω = 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. 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.
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%. Check that the position feedback signal matches the mechanical limits of the actuators and that it matches the reality.
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.

5.5.3 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.

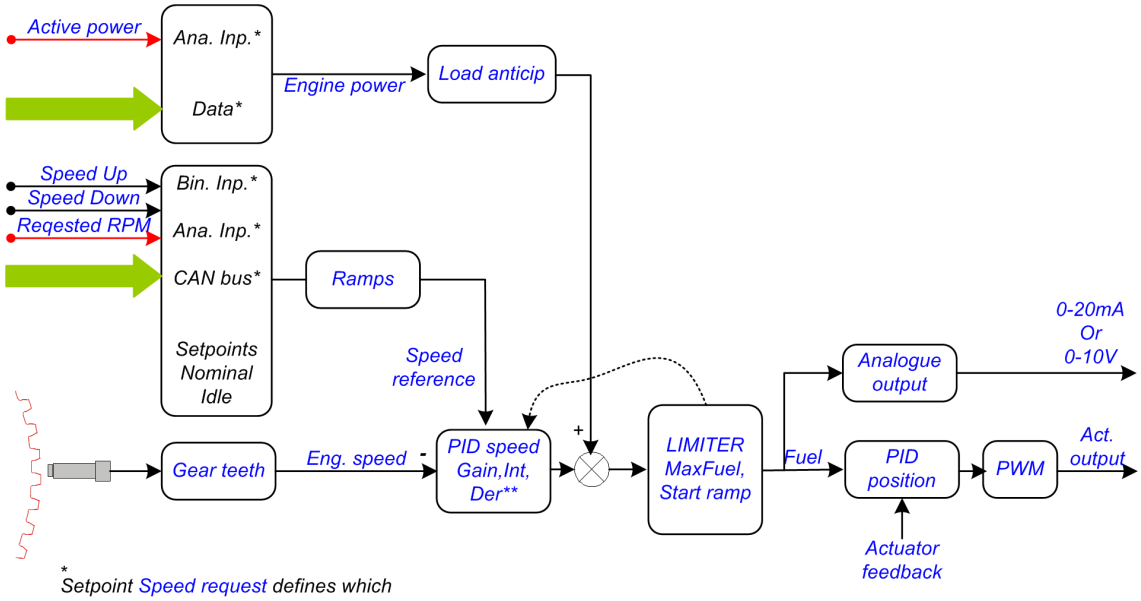
L. After adjustment is finished, put parameter: Main PID: ECON-4 mode to AUTOMATIC

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.

5.6 Block schematics - speed governor



5.6.1 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.

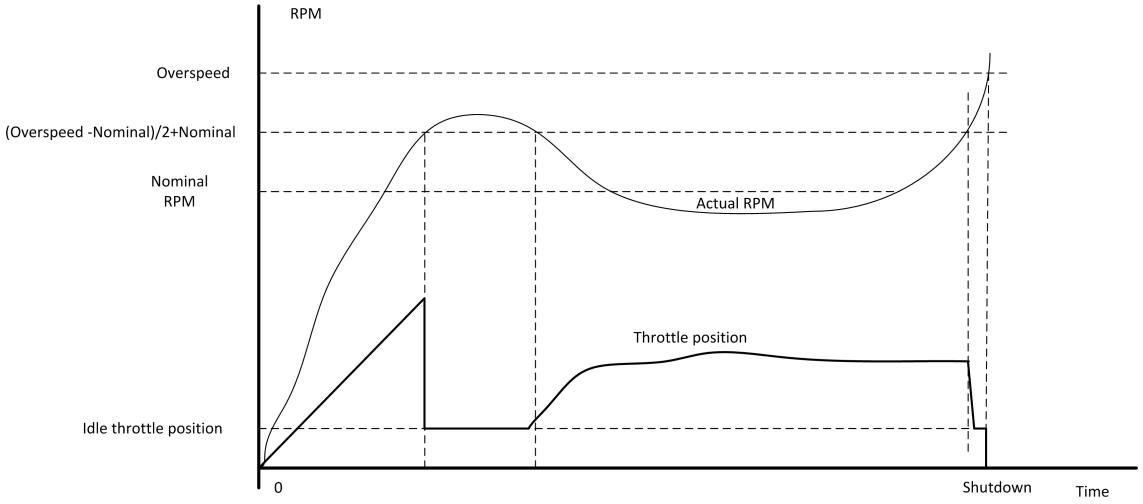
This feature was added to prevent overspeed when Load is removed – typically switch off large load in island operation.

5.6.2 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.



5.6.3 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 setpoint**Speed 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:

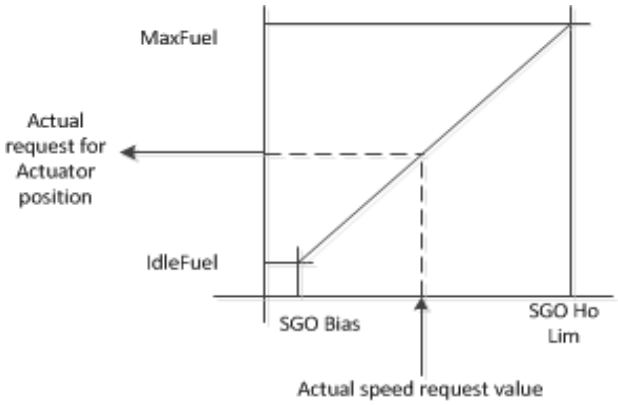
- no-load operation,
- loaded operation

For more information see setpoint .**Description (page 54)**

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.

5.6.4 Speed governor function in parallel mode

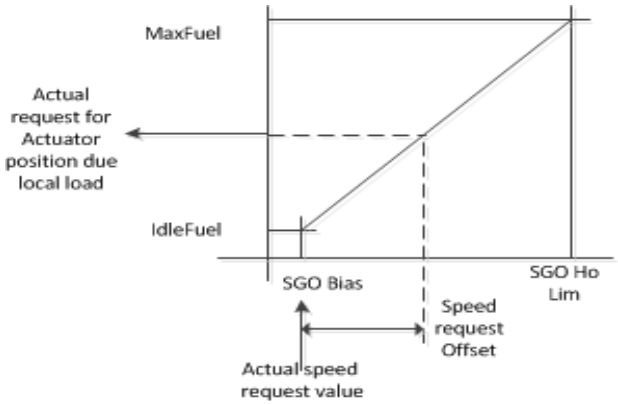
When engine is in parallel to Mains, Econ4 works just as amplifier and converts Speed request signal to Gas Dose signal according Speed/Fuel line as follows



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 startso 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 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.

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.

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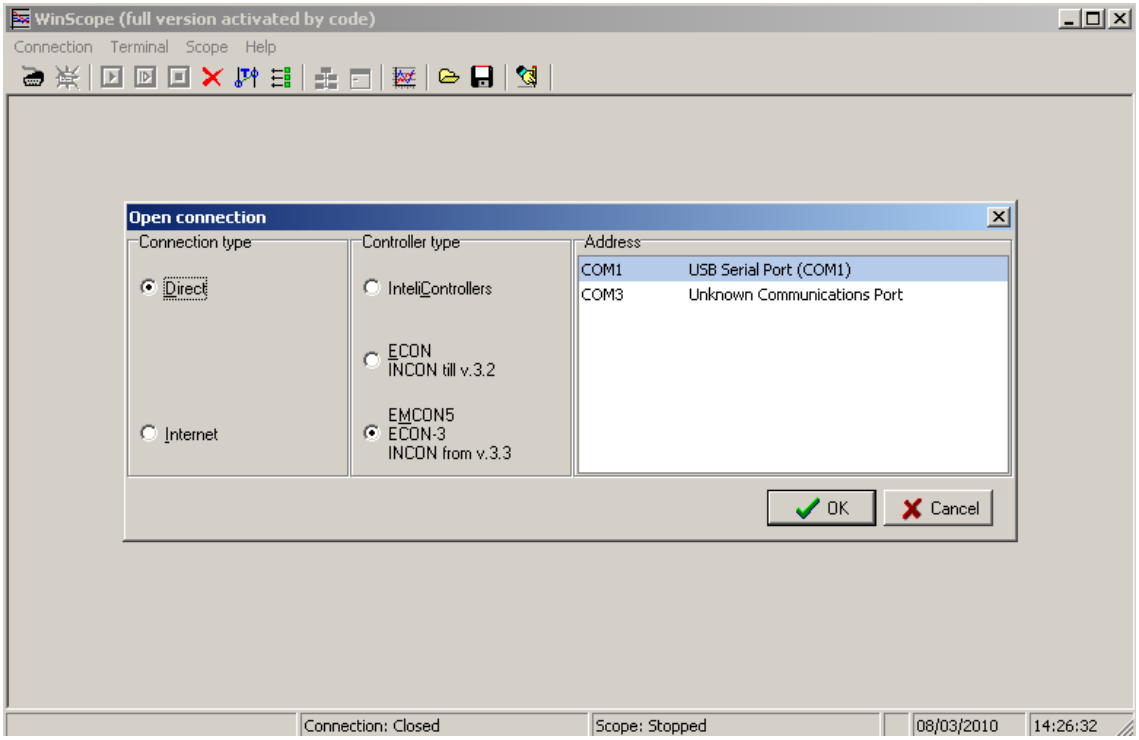
6 Communication

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

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8.1 Setpoints

What setpoints are:Setpoints are analog, binary or special data objects which are used for adjusting the controller 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 29)**for the instructions how to enter and modify a password.

> **IMPORTANT: Setpoints are organized in logical groups for better orientation. Use WinScope or InteliMonitor software to modify the setpoints. For details see chapter ECON-4 configuration and PC tools (page 33)**

8.1.1 List of setpoint groups

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

Group of setpoints: Engine Start

Group of setpoints: Main PID

Group of setpoints: Analog sensors

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

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8.1.3 Group: Engine Start

Idle RPM

Setpoint group	Engine RPM	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	Start RPM - Nominal RPM		
Default value	1000 RPM	**Force value**	NO
Step	1 RPM		
Comm object	7186	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			
Engine idle speed. ***Note:*** *Idle RPM must be much lower, than Nominal RPM.*			

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Nominal RPM

Setpoint group	Engine RPM	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	0 - 3500 [RPM]		
Default value	1500 RPM	**Force value**	NO
Step	1 RPM		
Comm object	7187	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			
Nominal engine speed. ***Note:*** *Nominal RPM must be much higher, than Idle RPM.*			

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Overspeed

Setpoint group	Engine RPM	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	0 - 3500 [RPM]		
Default value	1800 RPM	**Force value**	NO
Step	1 RPM		
Comm object	7168	**Related applications**	ALL
Config level	Standard		
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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Gear teeth

Setpoint group	Engine RPM	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	32 - 400 [-]		
Default value	256	**Force value**	NO
Step	1		
Comm object	7188	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			
Number of teeth on the engine gear for the pick-up.			

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Idle-Nom ramp

Setpoint group	Engine RPM	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	0 - 100 [s]		
Default value	10 s	**Force value**	NO
Step	1 s		
Comm object	7169	**Related applications**	ALL
Config level	Standard		
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.			

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BI Speed ramp

Setpoint group	Engine RPM	**Related FW**	1.8.0 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	7170	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			
Define how fast changes the requested engine speed if the binary inputs SPEED UP or SPEED DOWN are active. *BI Speed ramp* is actually time that the ramp needs to go from **Nominal RPM (page 46)** - 8% to**Nominal RPM (page 46)** + 8% and vice versa. The ramping speed is the same for both up and down directions.			

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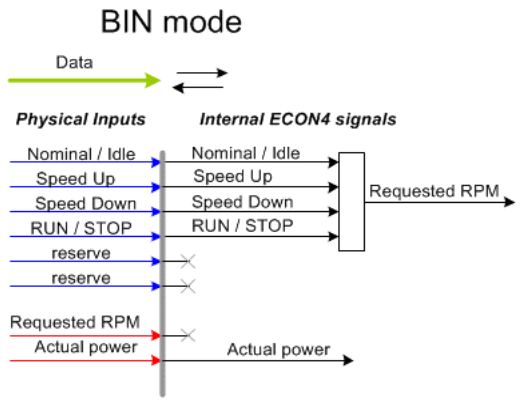
Speed request

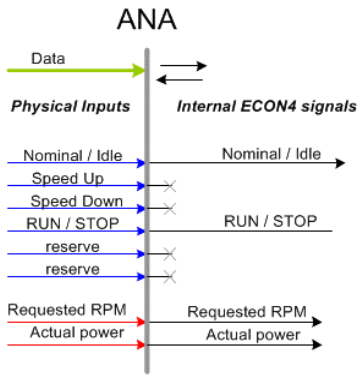
Setpoint group	Engine RPM	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	BIN, ANA, DATA		
Default value	DATA	**Force value**	NO
Step	-		
Comm object	7171	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			

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

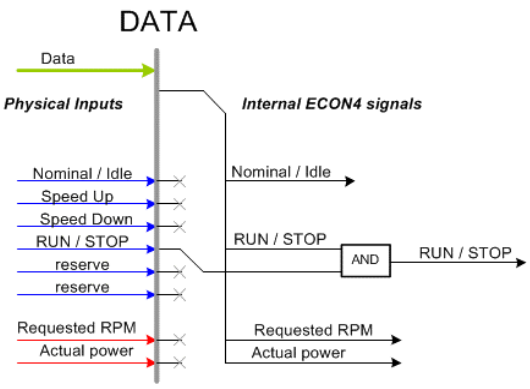
Speed Request value	Speed reference source
BIN	SPEED UP, SPEED DOWN
ANA	SPEED REQUEST
DATA	CAN bus



Speed request - BIN



Speed request - ANA



Speed request - DATA

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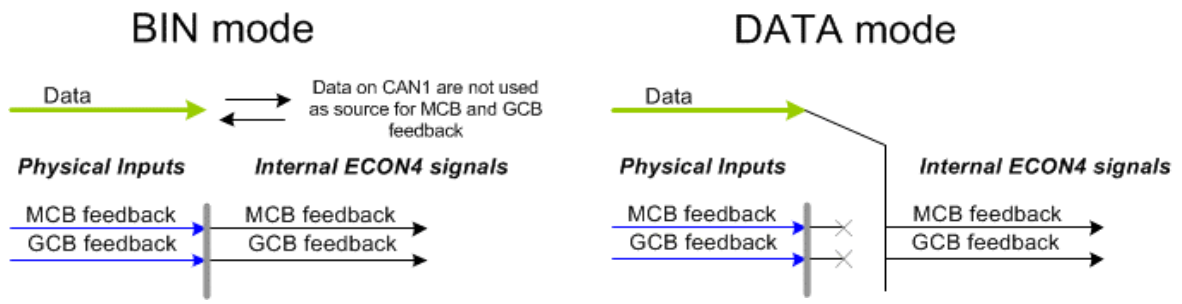
CB request

Setpoint group	Engine RPM	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	BIN / DATA		
Default value	DATA	**Force value**	NO
Step	-		
Comm object	14363	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			

CB Request value	CB position information source
BIN	Terminal S4.1 and S4.2
DATA	CAN bus

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.*



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PreOverSpeed

Setpoint group	Main PID	**Related FW**	1.8.0 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**	1.8.0 configured ECON-4 extension module
Range [units]	1 - 20 [%]		
Default value	8 %	**Force value**	NO
Step	1 %		
Comm object	7193	**Related applications**	ALL
Config level	Standard		
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. 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**	1.8.0 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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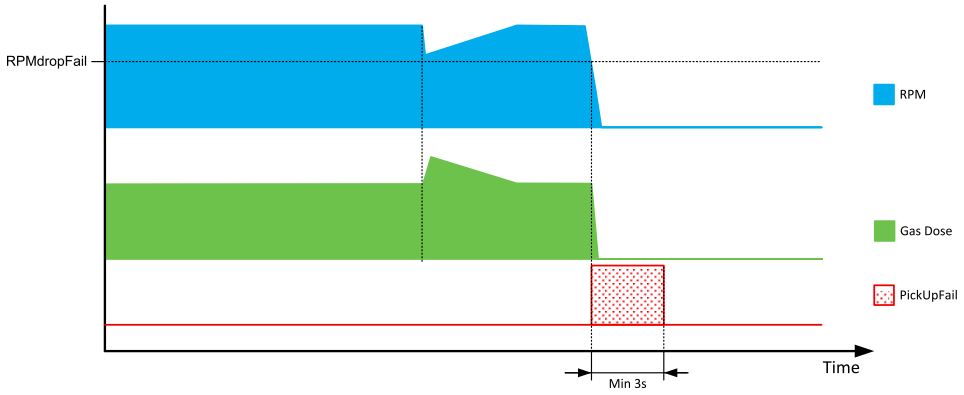
RPMdropFail

Setpoint group	Engine RPM	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	0 (OFF) - **Nominal RPM (page 46)**		
Default value	0 (OFF)	**Force value**	NO
Step	1		
Comm object	-	**Related applications**	ECON4
Setpoint visibility	Always		
Description			

Setpoint defines risky level of RPM drop in case the speed sensor (PickUp) is failed. If the RPM drop crosses the adjusted level, the PickUpFail is evaluated and speed governor forces the actuator immediately to close.

> ***Note:*** *It is strongly recommended to configure user protection Level 2 on the PickUpFail signal in the configuration tool, to prevent the unwanted behavior or next starts.*



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8.1.4 Group: Engine Start

InitStart dose

Setpoint group	Engine RPM	**Related FW**	1.8.0
Range [units]	Start RPM - Nominal RPM		
Default value	10%	**Force value**	NO
Step	1 %		
Comm object	7172	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			

Initial position of the actuator during start

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MaxStart dose

Setpoint group	Engine RPM	**Related FW**	1.8.0
Range [units]	Start RPM - Nominal RPM		
Default value	50%	**Force value**	NO
Step	1 %		
Comm object	7173	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			
Maximum position of the actuator during start.			

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Fuel ramp time

Setpoint group	Engine RPM	**Related FW**	1.8.0
Range [units]	Start RPM - Nominal RPM		
Default value	10 s	**Force value**	NO
Step	1 s		
Comm object	7174	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			
Time the actuator needs to move from the InitStart dose to MaxStart dose.			

back to List of setpoints

RPM StartRamp

Setpoint group	Engine RPM	**Related FW**	1.8.0
Range [units]	Start RPM - Nominal RPM		
Default value	10 s	**Force value**	NO
Step	1 s		
Comm object	7175	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			
This setpoint defines speed of ramp from Starting RPM to Idle RPM. It is directly the time of ramp from.			

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Starting RPM

Setpoint group	Engine RPM	**Related FW**	1.8.0
Range [units]	Start RPM - Nominal RPM		
Default value	350 RPM	**Force value**	NO
Step	1 RPM		
Comm object	7189	**Related applications**	ALL
Config level	Standard		
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 signalized.*

back to List of setpoints

8.1.5 Group: Main PID

Speed gain

Setpoint group	Main PID	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	0.0 – 1000.0 %		
Default value	10%	**Force value**	NO
Step	0.1 %		
Comm object	7176	**Related applications**	ALL
Config level	Standard		
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**	1.8.0 configured ECON-4 extension module
Range [units]	0.0 – 1000.0 %		
Default value	10%	**Force value**	NO
Step	0.1 %		
Comm object	7177	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			
Integration of the PID speed regulation loop..			

Note: *Setpoint is active for unloaded engine.*

back to List of setpoints

Speed der

Setpoint group	Main PID	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	0.0 – 1000.0 %		
Default value	0%	**Force value**	NO
Step	0.1 %		
Comm object	7178	**Related applications**	ALL
Config level	Standard		
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**	1.8.0 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.			

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Speed int w

Setpoint group	Main PID	**Related FW**	1.8.0 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.			

back to List of setpoints

Speed der w

Setpoint group	Main PID	**Related FW**	1.8.0 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**	1.8.0 configured ECON-4 extension module
Range [units]	0.0 – 1000.0 %		
Default value	10%	**Force value**	NO
Step	0.1 %		
Comm object	7179	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			

Gain of the PID speed regulation loop.
There is 5 different setpoints *Load gain*:

- *Load gain 1*
- *Load gain 2*
- *Load gain 3*
- *Load gain 4*

For more information about *Load der* setting please see Load 1 on page 59 in ECON-4 Global Guide.

back to List of setpoints

Load der

Setpoint group	Main PID	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	0.0 – 1000.0 %		
Default value	0%	**Force value**	NO
Step	0.1 %		
Comm object	7181	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			

Derivative part of the PID speed regulation loop.

There is 5 different setpoints *Load der*:

- *Load der 1*
- *Load der 2*
- *Load der 3*
- *Load der 4*

For more information about *Load der* setting please see Load 1 on page 59 in ECON-4 Global Guide.

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Load Int

Setpoint group	Main PID	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	0.0 – 1000.0 %		
Default value	10%	**Force value**	NO
Step	0.1 %		
Comm object	7180	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			

Integration of the PID speed regulation loop.

There is 5 different setpoints *Load Int*:

- *Load Int 1*
- *Load Int 2*
- *Load Int 3*
- *Load Int 4*

For more information about *Load Int* setting please see Load 1 on page 59 in ECON-4 Global Guide.

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Load anticip

Setpoanticip group	Main PID	**Related FW**	1.8.0 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			

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.

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: /

- 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

There is 5 different setpoanticips *Load anticip*:

- *Load anticip 1*
- *Load anticip 2*
- *Load anticip 3*
- *Load anticip 4*

For more information about *Load anticip* setting please see **Load 1 (page 60)**.

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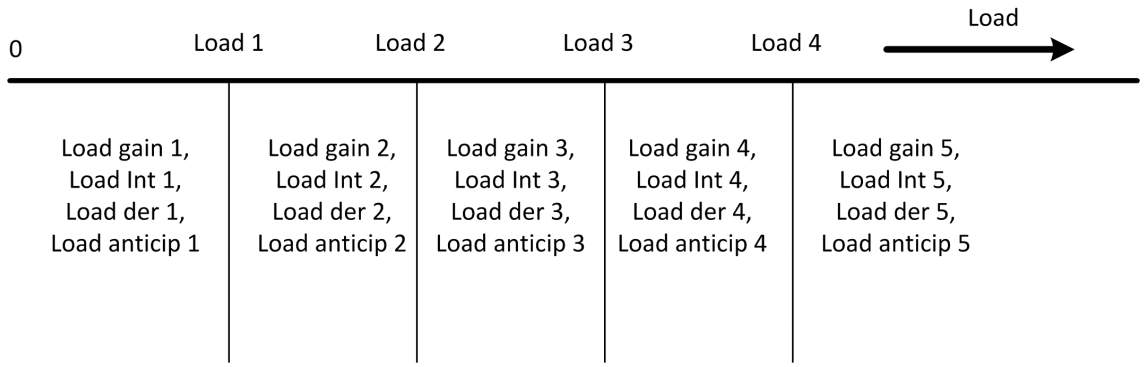
Load 1

Setpoint group	Main PID	**Related FW**	1.8.0 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 *Load 1* to *Load 5* and different *Load gain*, *Load Int*, *Load der* and *Load anticip* setpoints are active in each band.



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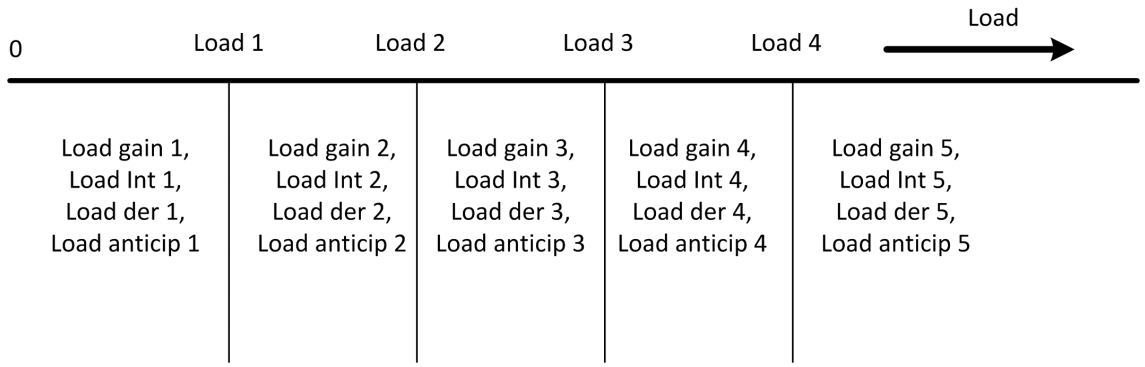
Load 2

Setpoint group	Main PID	**Related FW**	1.8.0 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 *Load 1* to *Load 5* and different *Load gain*, *Load Int*, *Load der* and *Load anticip* setpoints are active in each band.



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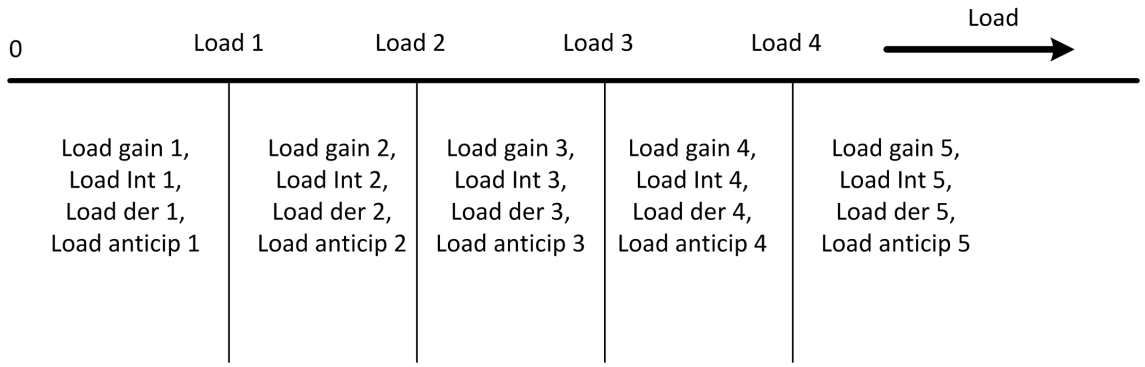
Load 3

Setpoint group	Main PID	**Related FW**	1.8.0 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 *Load 1* to *Load 5* and different *Load gain*, *Load Int*, *Load der* and *Load anticip* setpoints are active in each band.



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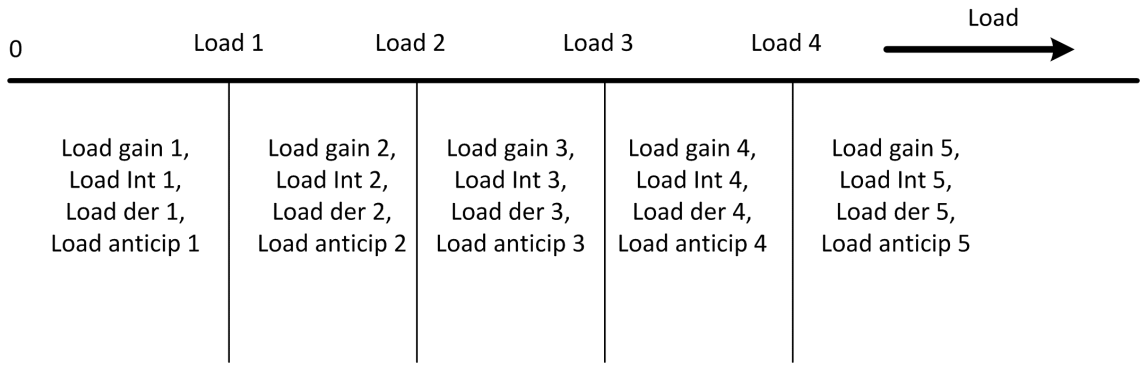
Load 4

Setpoint group	Main PID	**Related FW**	1.8.0 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 *Load 1* to *Load 5* and different *Load gain*, *Load Int*, *Load der* and *Load anticip* setpoints are active in each band.  		

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Droop

Setpoint group	Main PID	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	0.0 - 100.0 [%]		
Default value	0%	**Force value**	NO
Step	0.1 %		
Comm object	7182	**Related applications**	ALL
Config level	Standard		
Setpoint visibility	Always		
Description			
Droop of speed governor. The governor lovers the speed reference by *Droop* percent of the **Nominal RPM (page 46)** over the range from zero to **MaxFuel (page 64)**.			

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MaxFuel

Setpoint group	Main PID	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	0.0 – 100.0 %		
Default value	100%	**Force value**	NO
Step	0.1 %		
Comm object	7184	**Related applications**	ALL
Config level	Standard		
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**	1.8.0 configured ECON-4 extension module
Range [units]	0.0 – 100.0 %		
Default value	10%	**Force value**	NO
Step	0.1 %		
Comm object	7192	**Related applications**	ALL
Config level	Standard		
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**	1.8.0 configured ECON-4 extension module
Range [units]	-		
Default value	ActType1	**Force value**	NO
Step	-		
Comm object	7185	**Related applications**	ALL
Config level	Standard		
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.

- The actuator feedback position control is deactivated in the following situation:
  - (parameter: ECON-4 mode is in AUTO) AND {10 seconds after detection of [(Engine RPM are 0 (<10RPM)) AND (BI:RUN is in log 0)]}
    - This covers also the situation, when ECON-4 mode is switched from MAN to AUT, after the actuator feedback PID was tested.
- The actuator feedback control is activated again by any of the following conditions:
  - BI: RUN is activated (in case the Run signal is being sent over DATA, then both the Physical BI and the BI over DATA has to be ON)
  - Non-zero RPM are detected by ECON-4
  - Parameter ECON-4 mode is set to MAN

Note: *In case there is chosen the ActuatorType 2-4, the function is still evaluated from the setting in ActuatorType1.*

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ECON-4 mode

Setpoint group	Main PID	**Related FW**	1.8.0 configured ECON-4 extension module
Range [units]	-		
Default value	AUTO	**Force value**	NO
Step	-		
Comm object	7190	**Related applications**	ALL
Config level	Standard		
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**	1.8.0 configured ECON-4 extension module
Range [units]	0.0 – 100.0 %		
Default value	30%	**Force value**	NO
Step	0.1 %		
Comm object	7191	**Related applications**	ALL
Config level	Standard		
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**	1.8.0 configured ECON-4 extension module
Range [units]	100 – 10 000 Hz		
Default value	6000 Hz	**Force value**	NO
Step	1 Hz		
Comm object	7194	**Related applications**	ALL
Config level	Standard		
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**	1.8.0 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
Config level	Standard		
Setpoint visibility	WinScope only		
Description			
Together with Idle Fuel value creates coordinates for first point of Speed/Fuel line. For detailed description see Speed governor function in parallel mode on page 38 in ECON-4 Global Guide.			

Note: *Setpoint is active for unloaded engine.*

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SGO HiLim

Setpoint group	Main PID	**Related FW**	1.8.0 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
Config level	Standard		
Setpoint visibility	WinScope only		
Description			
Together with Max Fuel value creates coordinates for second point of Speed/Fuel line. For detailed description see Speed governor function in parallel mode on page 38 in ECON-4 Global Guide			

Note: *Setpoint is active for unloaded engine.*

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SGOoffsetRamp

Setpoint group	Main PID	**Related FW**	1.8.0 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
Config level	Standard		
Setpoint visibility	WinScope only		
Description			
This defines ramp according SGOoffset is removed after parallel. For details see chapter Speed governor function in network parallel mode see Speed governor function in parallel mode on page 38 in ECON-4 Global Guide.			

Note: *Setpoint is active for unloaded engine.*

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LAder+limit

Setpoint group	Main PID	**Related FW**	1.8.0 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**	1.8.0 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**	1.8.0 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**	1.8.0 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**	1.8.0 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**	1.8.0 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 Group: Analog sensors

LoReqSpeed Inp

Setpoint group	Analog sensors	**Related FW**	1.8.0 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**	1.8.0 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**	1.8.0 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**	1.8.0 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**	1.8.0 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**	1.8.0 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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8.1.7 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 75***

Act gain

Setpoint group	ActType 1,2,3,4	**Related FW**	1.8.0
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**	1.8.0
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**	1.8.0 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**	1.8.0
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**	1.8.0
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**	1.8.0
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**	1.8.0
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			

- 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.
- 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
- 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.

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8.2 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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