

ECON-4

# ***ECON-4 and ECON-4ADV***

## ***Digital speed governor***

Digital speed governor for gas and diesel engines

ECON4-1.4.0.mhx and ECON4-ADV-1.1.0.mhx

SW version 1.4.0 and 1.1.0, March 2016



## **Reference guide**



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# General guidelines

## ***What describes this manual?***

This manual describes usage of ECON-4 for control of engine.

What is a purpose of this manual? This manual provides basic information how to install and operate ECON-4.

*This manual is dedicated for:*

Operators of the gen-sets

Gen-set control panel builders

For everybody who is concerned with installation, operation and maintenance of the engines and gen-sets.

## ***!! Warnings !!***

### **!!! WARNING !!!**

#### **Adjust parameters**

All parameters are preadjusted to their typical values. But parameters ***Gear teeth*** and ***Overspeed*** **!!!MUST!!!** be adjusted before first start of gen-set.

**!!! Wrong adjustment of these parameters can destroy the engine !!!**

#### **Overspeed protection**

**!!! The engine must always be equipped by independent, working and correctly adjusted Overspeed protection !!!**

The following instructions are for qualified personnel only. To avoid personal injury do not perform any action not specified in this Reference guide !!!

## ***Text***

*Break Return*

(Italic) set points

**Engine protections**

(Bold) Set point group

REMOTE START/STOP

(Capital letters) binary inputs and outputs

### **Note:**

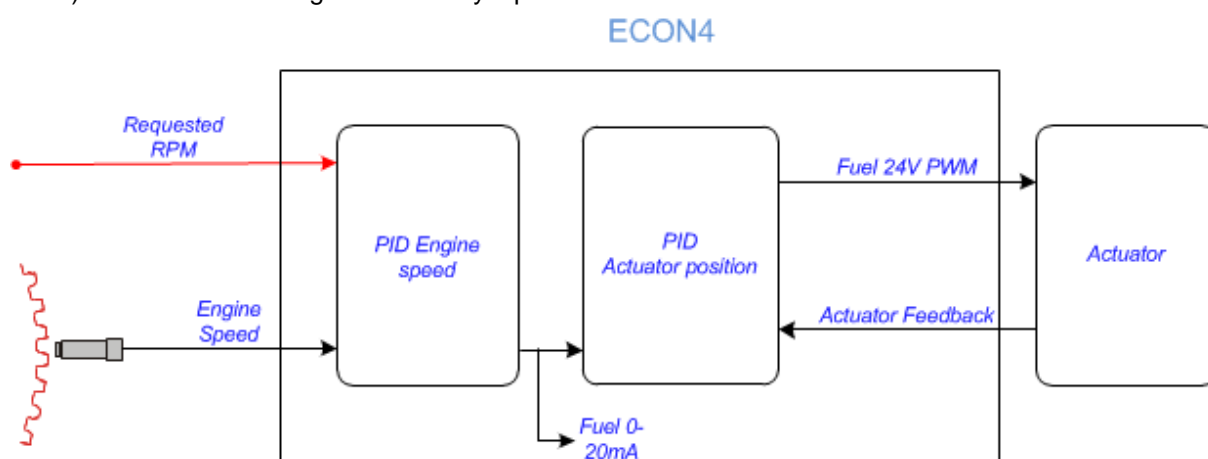
ComAp believes that all information provided herein is correct and reliable and reserves the right to update at any time. ComAp does not assume any responsibility for its use unless otherwise expressly undertaken.

# General description

## Description of the governor system

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

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



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

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

## Control by CAN-bus

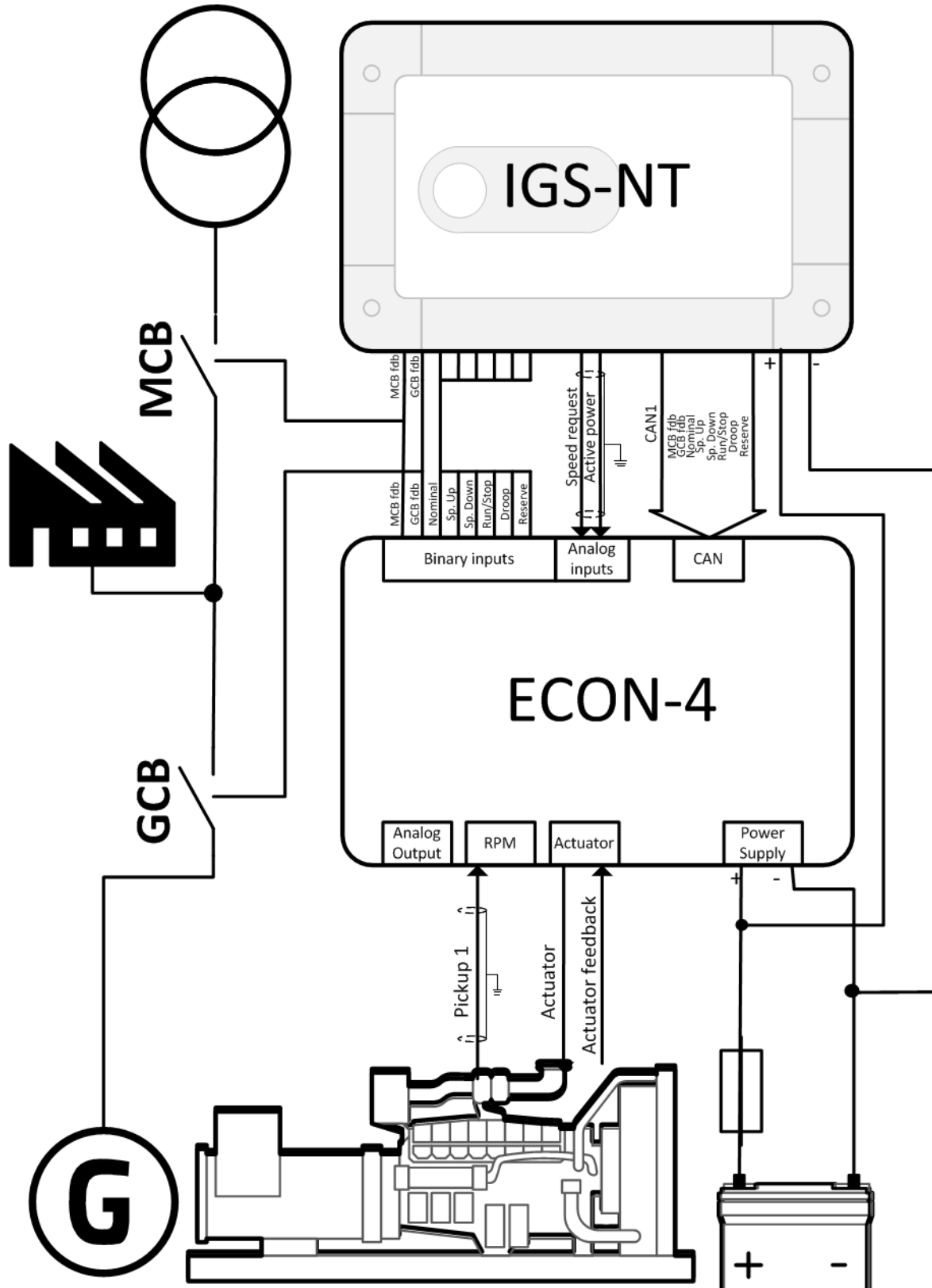
ECON-4 can receive values of some binary and analog control inputs via CAN-bus communication line from engine controller, (see section [Inputs and outputs](#) for list of shared inputs). This arrangement can significantly simplify the wiring on site.

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

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

# Getting started, installation

## Wiring overview



## 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.

## Power supply

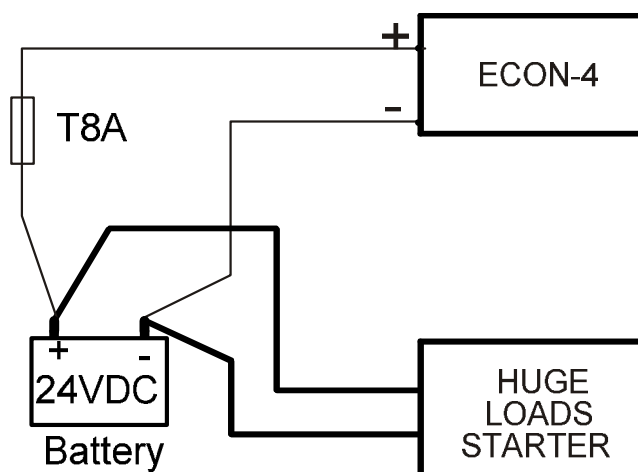
Use min. power supply cable of 4mm<sup>2</sup>

Maximum continuous DC power supply voltage is 36VDC. Maximum short term allowable power supply voltage is 39VDC. The ECON'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.



## Grounding

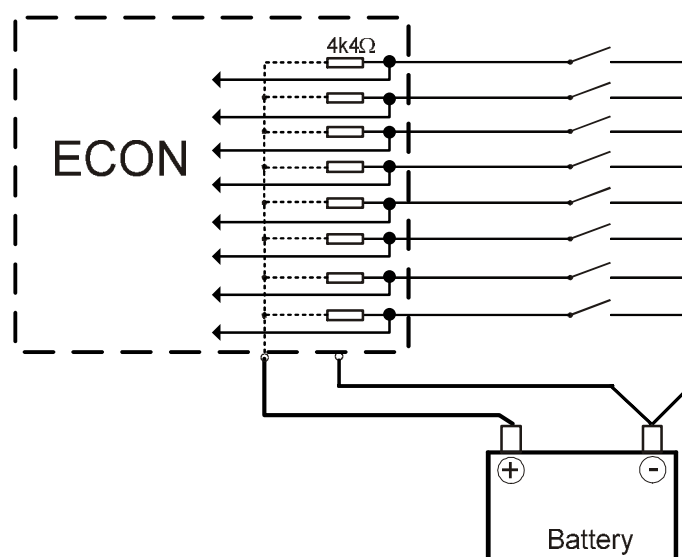
Use as short as possible cable to the grounding point on the switchboard

Use cable min. 2,5mm<sup>2</sup>

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

## Binary inputs

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



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*.

Table 4

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

### Note:

Cmd.x is bit x in the byte Command of the Receive PDO, see description of CAN protocol.

S4.x is ECON-4 terminal.

**Both the physical Binary input S4.6 and the corresponding bit Cmd.3 received via CAN bus must be active to activate Binary input RUN in DATA mode.**

In case of lost communication on CAN bus, all bits of the byte Command are set to 0 – it deactivates input RUN and closes the actuators.

## S4.1 Bin 1 MCB fdb

and

## S4.2 GCB fdb

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

**Table 5**

| MCB state | GCB state | IRPM - Requested RPM<br>> 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, Load int and Load der values in ECON-4 ADV. Which set will be used depends on actual power. See description on page 51.

### S4.3 NOMINAL

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

### S4.4 SPEED UP

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 [1-50%] 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.

Hint:

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

### S4.5 SPEED DOWN

See above.

### S4.6 RUN

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

### S4.7 DROOP

The input activates droop function – see setpoint *Droop*.

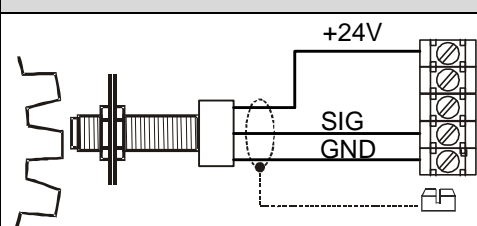
### S4.8 Bin 8

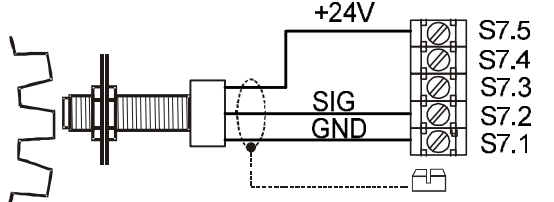
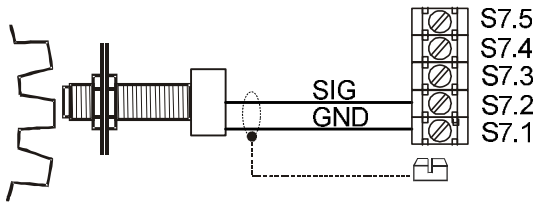
Reserve

## Speed pick-up

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

**Table 1**

| Pick-up    | Recommended wiring  | Jumpers                      |
|------------|---|------------------------------|
| Active NPN |  | Link 1 and 2<br>Link 4 and 5 |

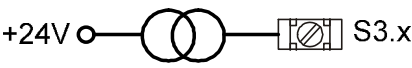
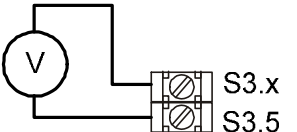
|            |  |              |
|------------|--|--------------|
| Active PNP |  | Link 1 and 2 |
| Passive    |  | Link 2 and 3 |

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.

## 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.

**Table 2**

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

### S3.1 SPEED REQUEST

The input defines speed reference. It can be set in the range from *Nominal RPM - PerChSpdNom%* to *Nominal RPM + PerChSpdNom%*. Setpoint: EngineRPM:PerChSpdNom [1-50%] 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  $ReqSpeed = 1500 + (PerChSpdNom/100) * 1500 * (6-5)/5 = 1524 \text{ RPM}$ .

*PerChSpdNom = 8 in the previous calculation.*

Hint:

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

### S3.2 ACTIVE POWER

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*.

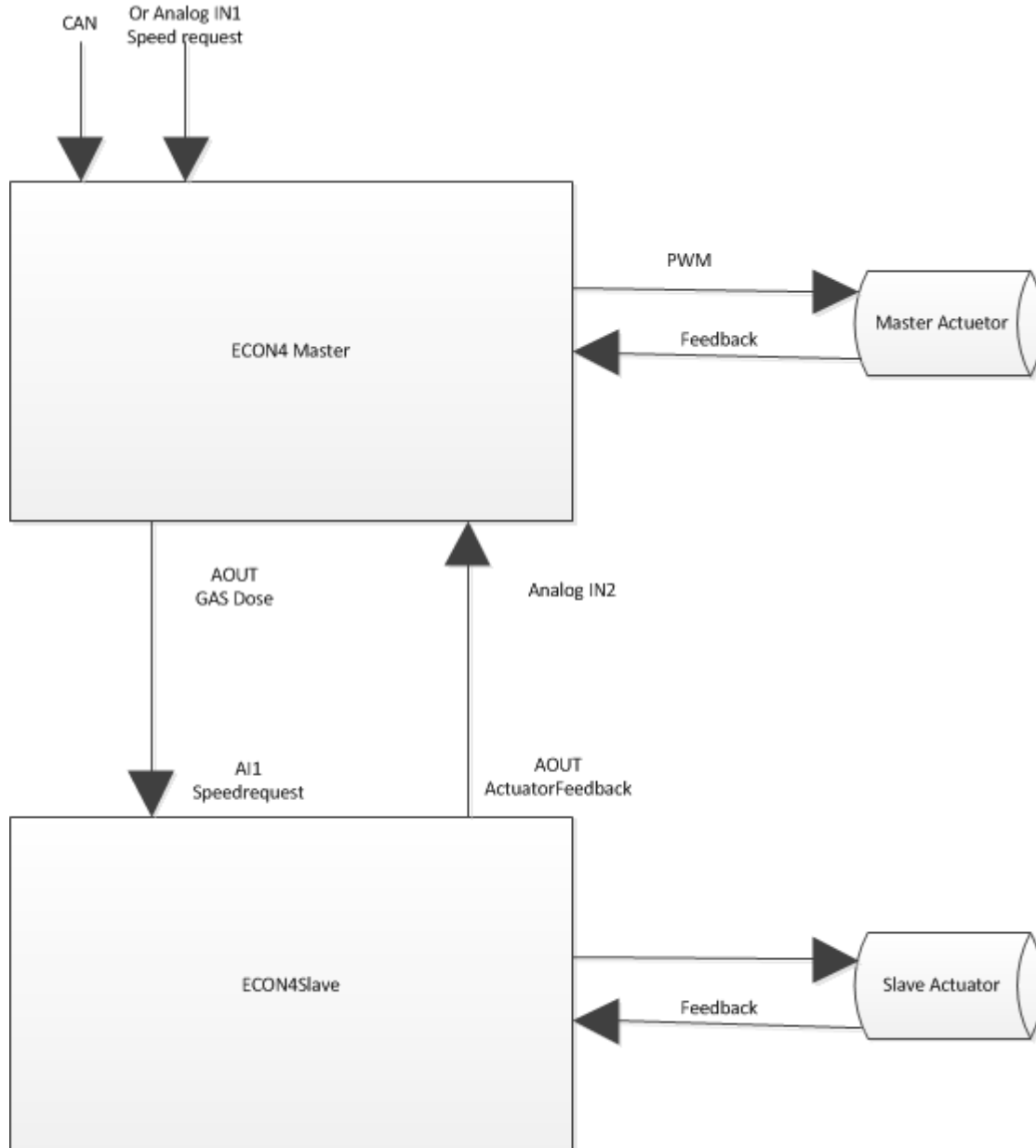
Hint:

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

### Note: Collaboration with ECON-4Slave

Physical analog input on terminal S3.2 can be used also when ECON4-Slave is used. In this case feedback from slave actuator is put on analogue output on slave and can be connected back to master to see it in one Winscope (connected to master) and in controller thru CAN as Misf Angle. Original Misf Angle calculation is not used in latest version of ECON4 and in version 1.4 is used to show feedback from Slave. **If feedback from slave is connected to analog input on S3.2 setpoint LoadAnticipation has to be =0. Otherwise wrong value will be used for load anticipation resulting unstability and unpredictable control**

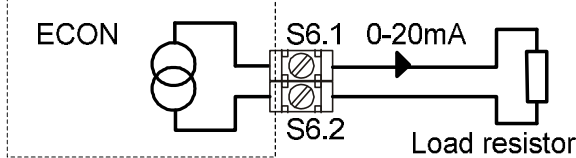
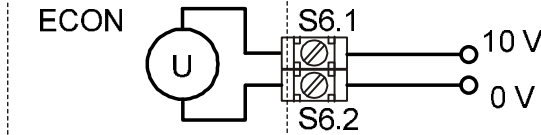
Principle of connection Master Slave is shown on next picture.



### Analog outputs

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). Analogue output range is fully programmable in range 0-10V or 0-20mA – see setpoints: **Analog settings: AOUT 0% and AOUT 100%.**

**Table 3**

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

## S6.1 Gas dose

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.

## Interface to actuators

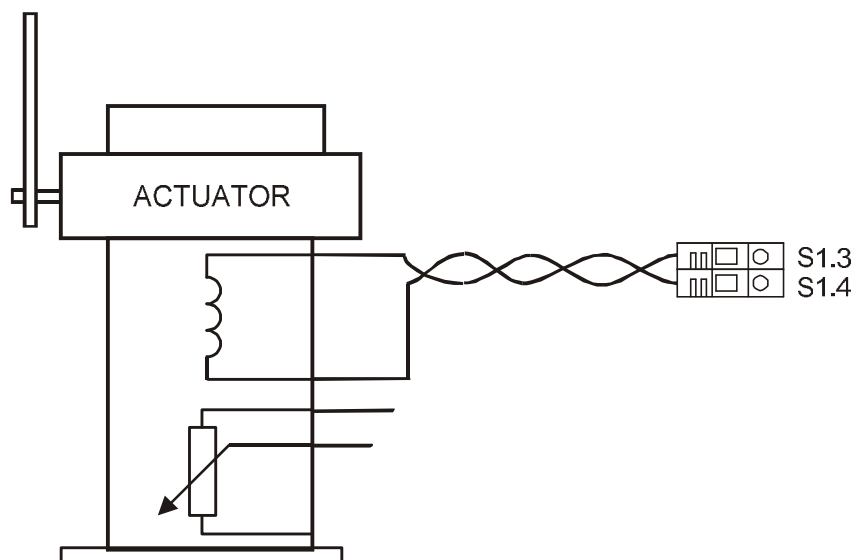
ECON-4 has one interface to actuator. The interface has a bipolar PWM output in bridge configuration and position feedback input.

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

**ECON-4 currently supports following types of actuators:**

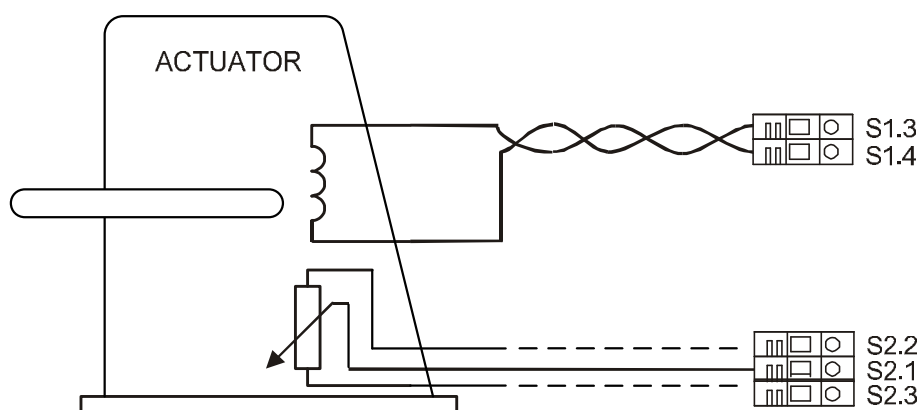
- a) **With current input 200mA** – typical example is Woodward UG-A.

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**



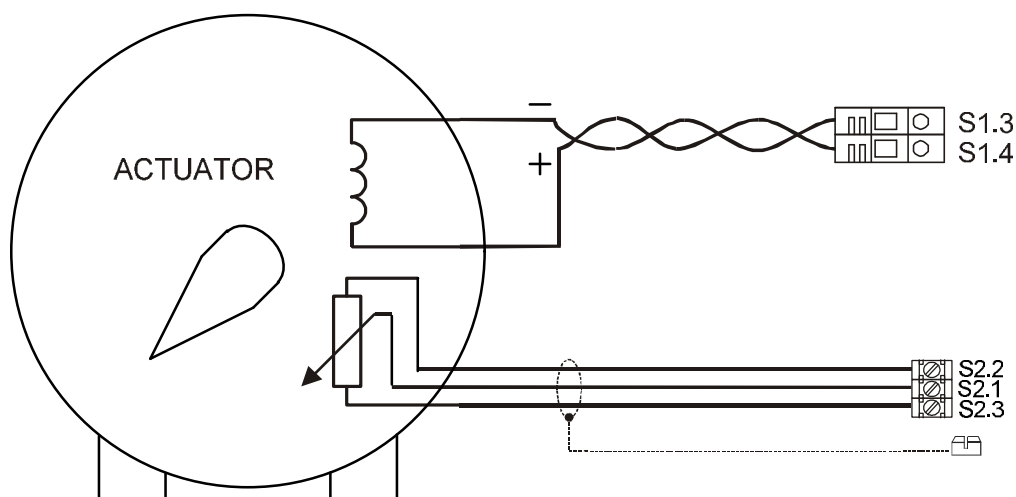
**b) With current input max. 10A** – typical examples are actuators from GAC, Woodward Flowtech ITB.

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.



**c) Motor driven actuators** – 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 **ActType**: *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.



## CAN bus connection

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

### Hint:

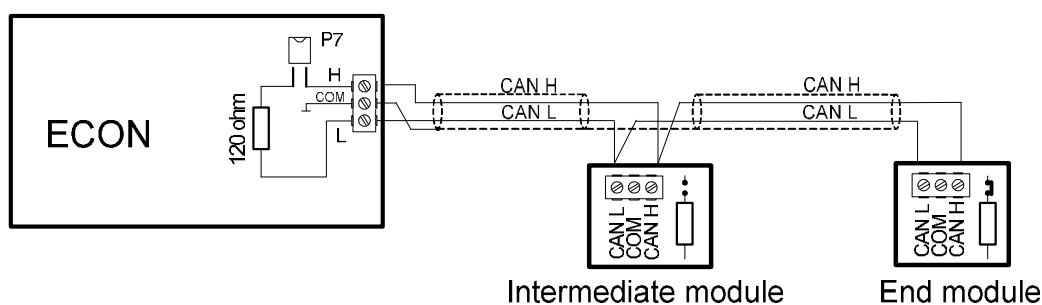
Following ECON-4 CAN setting is necessary to communicate with IntelliSys NT:

- CAN mode (Object number 10338) = 1 sets ComAp protocol
- CAN NODE-ID (Object number 10306) = 88 (decimal) sets address of the module

## Connection rules

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

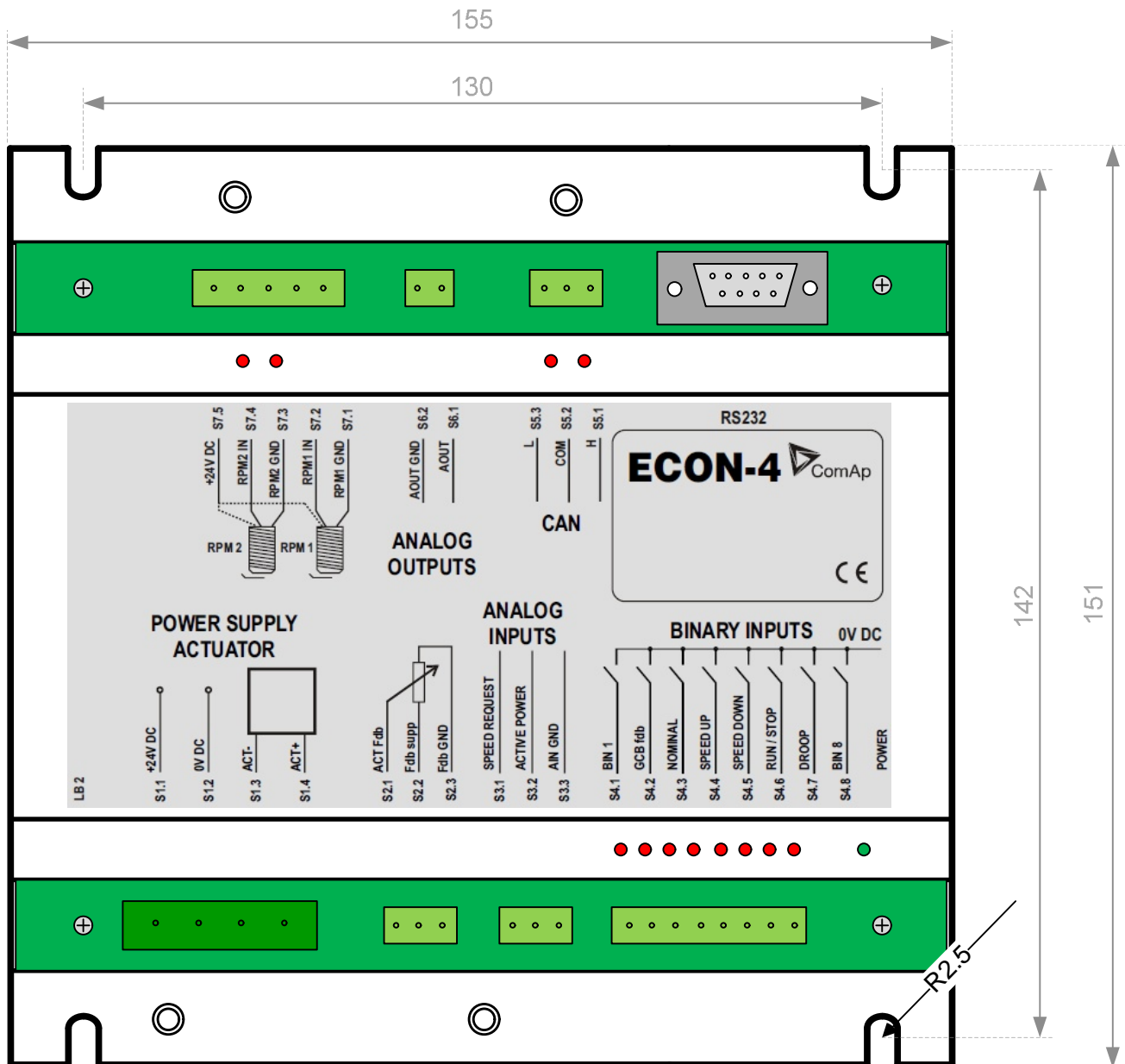
ECON-4 contains internal 120-ohm resistor, connected through a removable jumper P7.



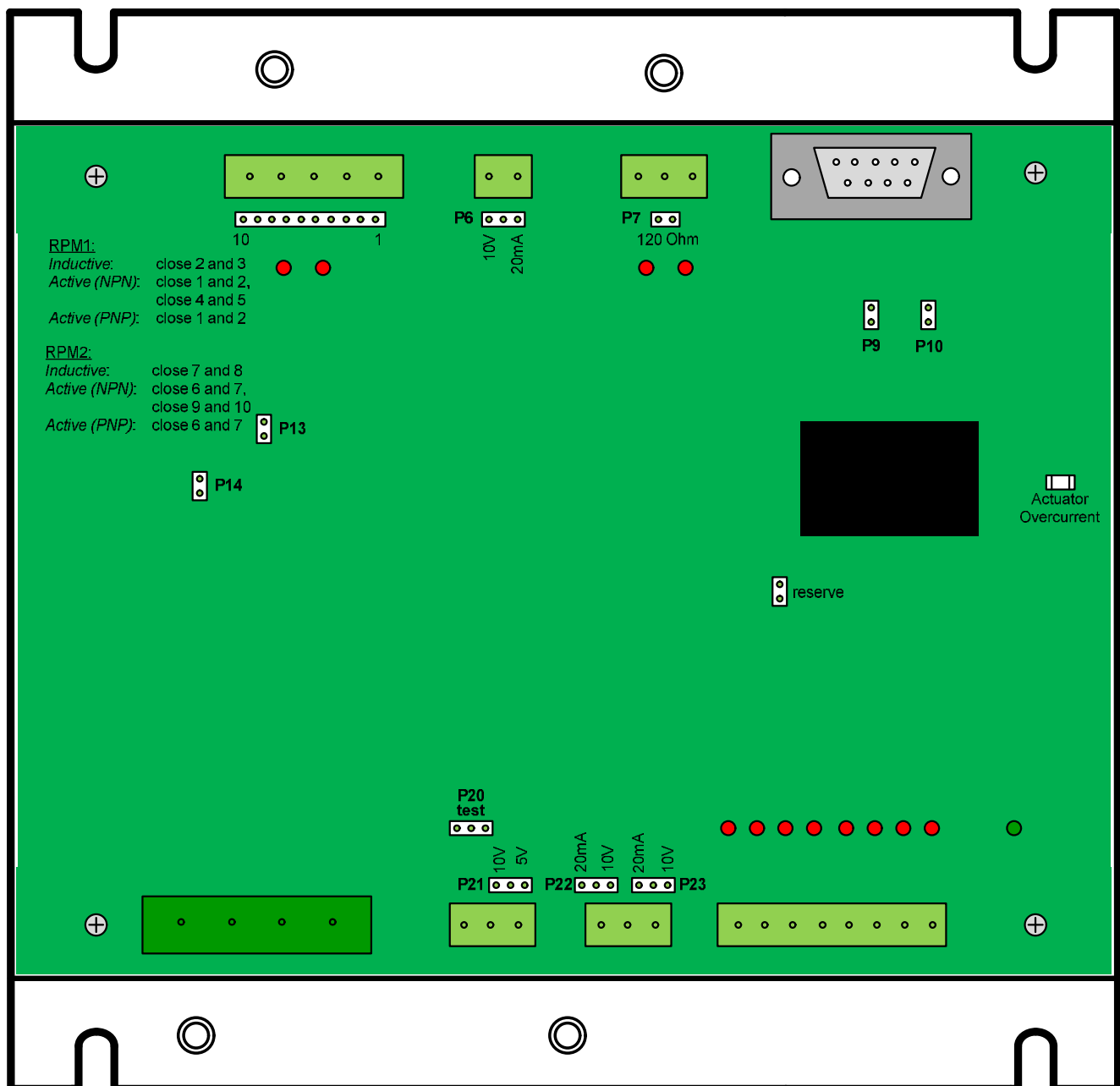
For CAN data cables details see chapter Technical data – Communication interface. CAN cable shielding connect to CAN COM terminal.

# Terminals and dimensions

## *ECON-4 Dimensions and terminals [mm]*



## Jumpers position



| Jumper | Meaning   |
|--------|---|
|        | AOUT switch between current and voltage analogue output                             |
| P6     | Current: link the 2 pins from right side<br>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  
AIN 1 switch between current and voltage
- P22 Current: link the 2 pins from the left side  
Voltage: link the 2 pins from the right side  
AIN 2 switch between current and voltage
- P23 Current: link the 2 pins from the left side  
Voltage: link the 2 pins from the right side



# 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 and Speed request on page 39 and 40.

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

## Breaker`s feedback handling (CB request modes)

### CB request set to BIN mode



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

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

## CB request set to DATA mode

|               |      |   |
|---------------|------|---|
| Speed request | DATA | - |
| CB request    | DATA | - |

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

| I/O            | Name          | Property | Value        |
|----------------|---------------|----------|--------------|
| Binary inputs  | Used: 16/61   | Source   | MCB feedback |
| Binary outputs | Used: 20/53   | Name     | MCB feedback |
| IGS-NT         | Used: 16/16   | Inverted | No           |
| ECU            | Used: 0/32    |          |              |
| ECON-4 (1)     | Used: 4/5     |          |              |
| B01            | MCB feedback  |          |              |
| B02            | MCB feedback  |          |              |
| B03            | Idle/Nominal  |          |              |
| B04            | Fuel solenoid |          |              |
| B05            | Droop         |          |              |
| Analog inputs  | Used: 36/38   |          |              |

## Speed control handling (Speed request modes)

### Speed request set to BIN mode

|               |     |    |
|---------------|-----|----|
| BI Speed ramp | B.U | \$ |
| Speed request | BIN | -  |

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

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

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

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

### Speed request set to ANA mode

|               |      |    |
|---------------|------|----|
| BI Speed ramp | B.U  | \$ |
| Speed request | ANA  | -  |
| CB request    | DATA | -  |

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

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

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

Sync/Load ctrl: Freq int = 5 %  
 Sync/Load ctrl: Angle gain = 10 %

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

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

## Speed request set to 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



The screenshot shows the 'Available modules' window in the GenConfig software. The 'Modules' tab is selected. The 'Available modules' list is expanded, showing the following structure:

- Controller
  - ECU - (ECU list - Gensets.esl 5.1)
- Extension modules
  - Standard extension
    - Virtual
    - Virtual shared
    - ECU bridge
    - Generic extension
  - Others
    - I-Step
    - ECON-3
    - ECON-4** (highlighted)
    - DetCon20

On the right side of the window, there are buttons for 'Insert' (highlighted with a red arrow) and 'Remove'. Below these buttons is a checkbox labeled 'Add modules to history automatically when inserted', which is checked. At the bottom right, the 'Module type' is set to 'No mod'.

Below the software interface is a photograph of the physical ECON-4 module. It is a black rectangular unit with green terminal blocks on the top and bottom. The top terminal block has four terminals, and the bottom terminal block has eight terminals. The module is labeled 'ECON-4' and 'ComAp'.

b. *Configuration of Binary outputs of IGS-NT*

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

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

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

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

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

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

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

BO1 and 2 setting is separated and described in previous chapter

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

**AIN1** – Engine RPM

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

Function – RPM pick-up  
Sensor – Electronic

| I/O            |                | Property      |                                     | Logical function |                                     |
|----------------|----------------|---------------|-------------------------------------|------------------|-------------------------------------|
| Name           | Used           | Property      | Value                               | Logical function | Used                                |
| Binary inputs  | Used: 16/32    | Function      | <input checked="" type="checkbox"/> | LdCtrl:AnExBld   | <input type="checkbox"/>            |
| Binary outputs | Used: 16/21    | Protection    | <input type="checkbox"/>            | LdCtrl:AnExI/E   | <input type="checkbox"/>            |
| Analog inputs  | Used: 5/6      | Name          | Engine RPM                          | PFCtrl:AnExBPF   | <input type="checkbox"/>            |
| IGS-NT         | Used: 4/4      | Dim           | RPM                                 | PFCtrl:AnExI/E   | <input type="checkbox"/>            |
| ECON-4 (1)     | Used: 1/2      | Sensor        | Electronic                          | LdCtrl:I/E-Pm    | <input type="checkbox"/>            |
| AIN1           | Engine RPM     | Resolution    | 1                                   | PFCtrl:I/E-Qm    | <input type="checkbox"/>            |
| AIN2           | Misf Amplitude | Sensor range  | 0                                   | LCD brightness   | <input type="checkbox"/>            |
| Analog outputs | Used: 0/3      | Bargraph 0%   | 0                                   | RPM pick-up      | <input checked="" type="checkbox"/> |
|                |                | Bargraph 100% | 2500                                | Oil press        | <input type="checkbox"/>            |
|                |                | Function      | RPM pick-up                         | Warming temp     | <input type="checkbox"/>            |
|                |                | Offset        | 0                                   | PowerDerating1   | <input type="checkbox"/>            |

#### AIN2 – Misf Amplitude

From ECON-4 sw version 1.1 will send the information about Misfiring of the engine to 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

| I/O            |             | Property   |                              | Source        |                                  |
|----------------|-------------|------------|------------------------------|---------------|----------------------------------|
| Name           | Used        | Property   | Value                        | Source        | Used                             |
| Binary inputs  | Used: 16/32 | Source     | Act pwr rel                  | Engine values |                                  |
| Binary outputs | Used: 16/21 | Convert    | No                           | Gener values  |                                  |
| Analog inputs  | Used: 5/6   | Limits     | [0.00; 100.00] .. [0; 10000] | Act power     | <input type="radio"/>            |
| Analog outputs | Used: 1/3   | Normalize  | Yes                          | PgDerate      | <input type="radio"/>            |
| IGS-NT         | Used: 0/1   | Resolution | 0.1                          | Act pwr rel   | <input checked="" type="radio"/> |
| ECON-4 (1)     | Used: 1/2   |            |                              | Act pwr L1    | <input type="radio"/>            |
| AOUT1          | Act pwr rel |            |                              | Act pwr L2    | <input type="radio"/>            |
| AOUT2          | Not used    |            |                              | Act pwr L3    | <input type="radio"/>            |

##### AOUT2 – Speed Request

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

Source: Sync.Load ctrl: SpeedReqRPM

| I/O            |              | Property   |                         | Source         |                                  |
|----------------|--------------|------------|-------------------------|----------------|----------------------------------|
| Name           | Used         | Property   | Value                   | Source         | Used                             |
| Binary inputs  | Used: 16/32  | Source     | SpeedReq RPM            | Engine values  |                                  |
| Binary outputs | Used: 16/21  | Convert    | No                      | Gener values   |                                  |
| Analog inputs  | Used: 5/6    | Limits     | [0; 3000] .. [0; 10000] | Mains values   |                                  |
| Analog outputs | Used: 2/3    | Normalize  | No                      | Sync.Load ctrl |                                  |
| IGS-NT         | Used: 0/1    | Resolution | 1                       | ActPwrReq      | <input type="radio"/>            |
| ECON-4 (1)     | Used: 2/2    |            |                         | SpdRegOut      | <input type="radio"/>            |
| AOUT1          | Act pwr rel  |            |                         | Speed request  | <input type="radio"/>            |
| AOUT2          | SpeedReq RPM |            |                         | SpeedReq RPM   | <input checked="" type="radio"/> |

- e. *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 %

**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%

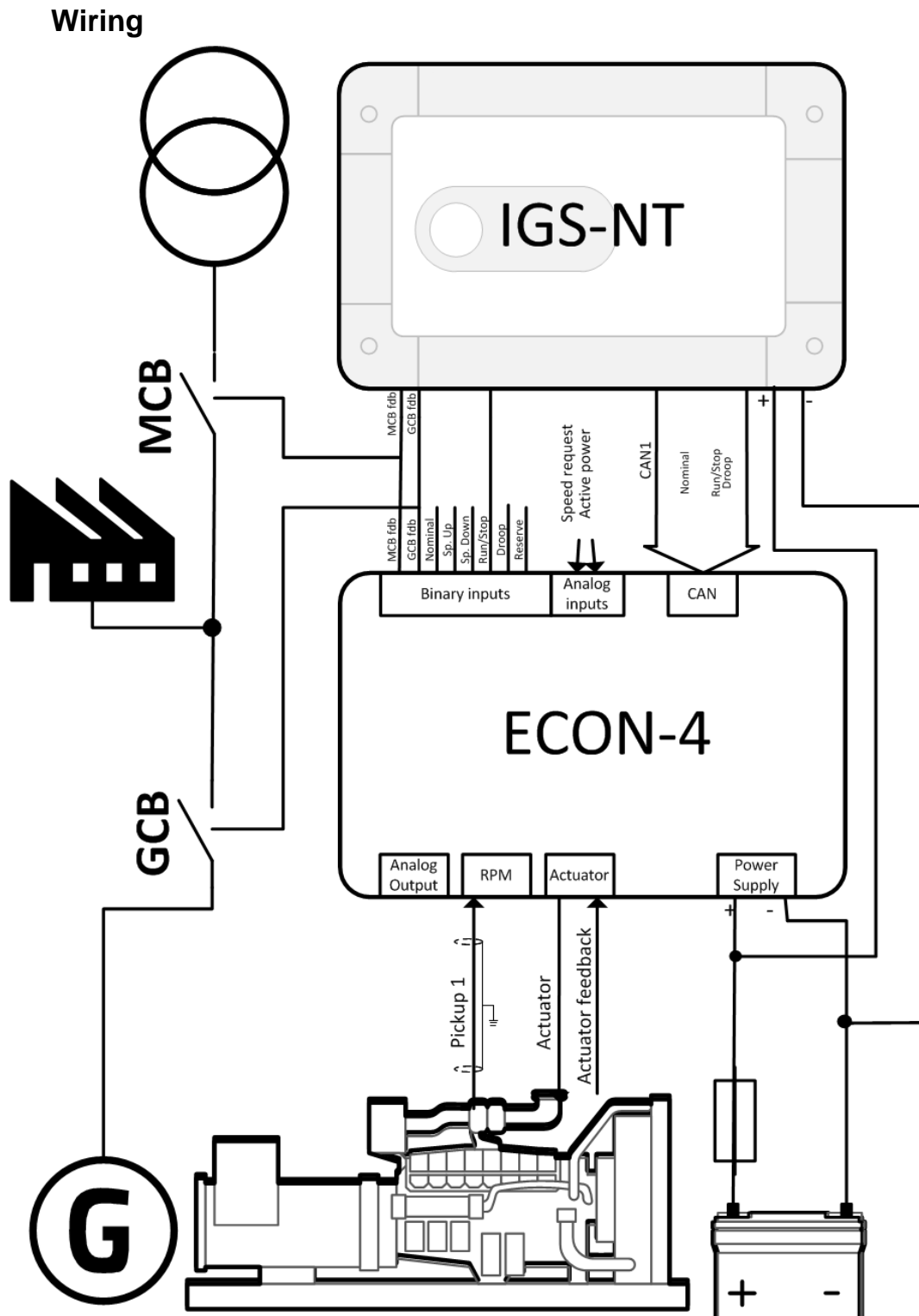
Type of ECON-4 communication mode: Engine RPM: Speed Request

Idle, Nominal, Overspeed RPM: Engine RPM: Idle RPM, Nominal RPM, Overspeed.

**WARNING:**

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.

# Typical configuration of ECON4 – CAN1 communication and physical wiring of Breaker`s feedbacks



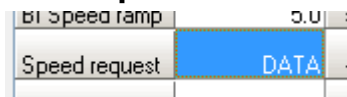
## CB request set to BIN mode



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

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

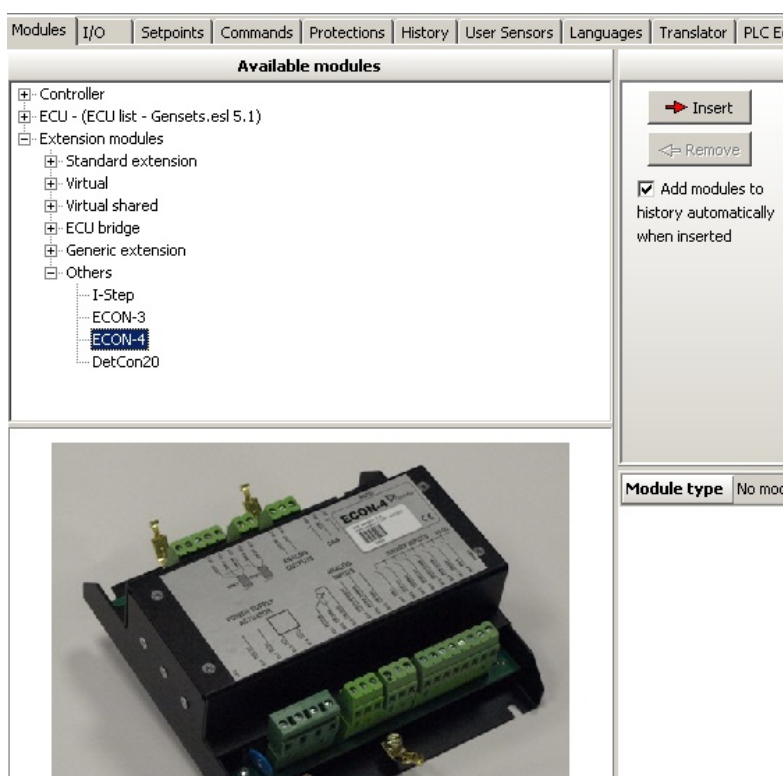
## Speed request set to DATA mode



There is DATA control used, so almost all the data are 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** – in this example of physical wiring of breaker feedback nothing has to be configured here

**BO2** – in this example of physical wiring of breaker feedback nothing has to be configured here

**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 (protects against power swing). Use signal e.g. GCB feedback.

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

Nothing has to be configured here for BO1 and BO2.

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

**AIN1** – Engine RPM

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

Function – RPM pick-up  
Sensor – Electronic

| I/O            |                | Property      |                                     | Logical function |                                     |
|----------------|----------------|---------------|-------------------------------------|------------------|-------------------------------------|
| Name           | Used           | Value         |                                     | Used             |                                     |
| Binary inputs  | Used: 16/32    | Function      | <input checked="" type="checkbox"/> | LdCtrl:AnExBld   | <input type="checkbox"/>            |
| Binary outputs | Used: 16/21    | Protection    | <input type="checkbox"/>            | LdCtrl:AnExI/E   | <input type="checkbox"/>            |
| Analog inputs  | Used: 5/6      | Name          | Engine RPM                          | PFCtrl:AnExBPF   | <input type="checkbox"/>            |
| IGS-NT         | Used: 4/4      | Dim           | RPM                                 | PFCtrl:AnExI/E   | <input type="checkbox"/>            |
| ECON-4 (1)     | Used: 1/2      | Sensor        | Electronic                          | LdCtrl:I/E-Pm    | <input type="checkbox"/>            |
| AIN1           | Engine RPM     | Resolution    | 1                                   | PFCtrl:I/E-Qm    | <input type="checkbox"/>            |
| AIN2           | Misf Amplitude | Sensor range  | 0                                   | LCD brightness   | <input type="checkbox"/>            |
| Analog outputs | Used: 0/3      | Bargraph 0%   | 0                                   | RPM pick-up      | <input checked="" type="checkbox"/> |
|                |                | Bargraph 100% | 2500                                | Oil press        | <input type="checkbox"/>            |
|                |                | Function      | RPM pick-up                         | Warming temp     | <input type="checkbox"/>            |
|                |                | Offset        | 0                                   | PowerDerating1   | <input type="checkbox"/>            |

#### AIN2 – Misf Amplitude

From ECON-4 sw version 1.1 will send the information about Misfiring of the engine to 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

| I/O            |             | Property   |                              | Source        |                                  |
|----------------|-------------|------------|------------------------------|---------------|----------------------------------|
| Name           | Used        | Value      |                              | Used          |                                  |
| Binary inputs  | Used: 16/32 | Source     | Act pwr rel                  | Engine values |                                  |
| Binary outputs | Used: 16/21 | Convert    | No                           | Gener values  |                                  |
| Analog inputs  | Used: 5/6   | Limits     | [0.00; 100.00] .. [0; 10000] | Act power     | <input type="radio"/>            |
| Analog outputs | Used: 1/3   | Normalize  | Yes                          | PgDerate      | <input type="radio"/>            |
| IGS-NT         | Used: 0/1   | Resolution | 0.1                          | Act pwr rel   | <input checked="" type="radio"/> |
| ECON-4 (1)     | Used: 1/2   |            |                              | Act pwr L1    | <input type="radio"/>            |
| AOUT1          | Act pwr rel |            |                              | Act pwr L2    | <input type="radio"/>            |
| AOUT2          | Not used    |            |                              | Act pwr L3    | <input type="radio"/>            |

##### AOUT2 – Speed Request

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

Source: Sync.Load ctrl: SpeedReqRPM

| I/O            |              | Property   |                         | Source         |                                  |
|----------------|--------------|------------|-------------------------|----------------|----------------------------------|
| Name           | Used         | Value      |                         | Used           |                                  |
| Binary inputs  | Used: 16/32  | Source     | SpeedReq RPM            | Engine values  |                                  |
| Binary outputs | Used: 16/21  | Convert    | No                      | Gener values   |                                  |
| Analog inputs  | Used: 5/6    | Limits     | [0; 3000] .. [0; 10000] | Mains values   |                                  |
| Analog outputs | Used: 2/3    | Normalize  | No                      | Sync.Load ctrl |                                  |
| IGS-NT         | Used: 0/1    | Resolution | 1                       | ActPwrReq      | <input type="radio"/>            |
| ECON-4 (1)     | Used: 2/2    |            |                         | SpdRegOut      | <input type="radio"/>            |
| AOUT1          | Act pwr rel  |            |                         | Speed request  | <input type="radio"/>            |
| AOUT2          | SpeedReq RPM |            |                         | SpeedReq RPM   | <input checked="" type="radio"/> |

- e. *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 %

## 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.

### Data Binary inputs

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

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

### Data Binary outputs

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

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

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

## Data Analog inputs

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

No RPM pickup is needed in IS-NT. Configure IS-NT – I/O – ECON-4– AIN1 Engine RPM for  
Function = RPM pick-up  
Sensor = Electronic

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

## 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.

## ECON adjustment 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.

### 1. Adjustment for LINEAR actuator type (typically Woodward)

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

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

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

- A. Connect to ECON-4 via USB connector, using PC program WinScope.
- B. Choose one ActType x group, e.g. ActType 1 and adjust parameter **Wiring** to LINEAR NO FDB
- C. ECON-4 does not measure the current through actuator. The output signal is PWM, with frequency 6000 Hz. The maximum ECON-4 current is given by resistance of the actuator and power supply of ECON-4. ECON-4 is rated to maximum 8 Amps. In case the actuator has resistance 32 Ohms and power supply is 24V, then maximum ECON-4 current is:  $24/32 = 0,75A = 750mA$ . This means 100% of ECON current is 750mA. In case the maximum allowable actuator current is 250mA, then this is 33.3% of maximum ECON-4 current. Adjust **Act Cur 0%** to 0% and **Act Cur 100%** to 34% (250mA from 750mA). By this the output is scaled from 0 to 250 mA.
- D. Parameters: ActTypex (In this case ActType 1): **Act MaxCur** is maximum allowable current, in case bigger current is detected (in fact bigger output PWM signal is detected) for longer then: **ActMaxCurDel**, then the output is limited to value **ActReduced Cur**. The **Act Max Curr** is calculated from the value **Act Cur 100%**, so it means, that the current limitation is in this case already done by adjustment of ActCur

100%, and **Act Max Cur** shall be adjusted to 100%. **Act MaxCurDel** and **ActReducedCur** then can be adjusted to any value.

- E. Parameters: ActType (ActType 1 in this case) **Act gain**, **Act int**, **Act der** has no meaning for the LINEAR NO FDB adjustment.
- F. Adjust parameter: Main PID: **Actuator Type** to the actuator which you use, so in this case ActType 1.
- G. Connect the actuator to ECON-4, outputs ACT+ ACT- (take care about polarity)
- H. Adjust ECON-4 parameter: Main PID: **ECON-4 mode** to MANUAL and run WinScope recording with values: Gas Dose and Act1 Fdbck in range 0.0 – 100.0%.
- I. After adjustment is finished, put parameter: Main PID: **ECON-4 mode** to AUTOMATIC
- J. Based on the chosen type of control (BIN, ANA, DATA) connect the required signal
- K. Adjust all other parameters like Nominal, Idle speed, Geer teeth, Overspeed, Speed and Load PID, ActChannel (to the number which ECON-4 output you are using)
- L. ECON-4 is ready for start attempt.

### 3. Adjustment for BRIDGE actuator type (typically Heinzmann)

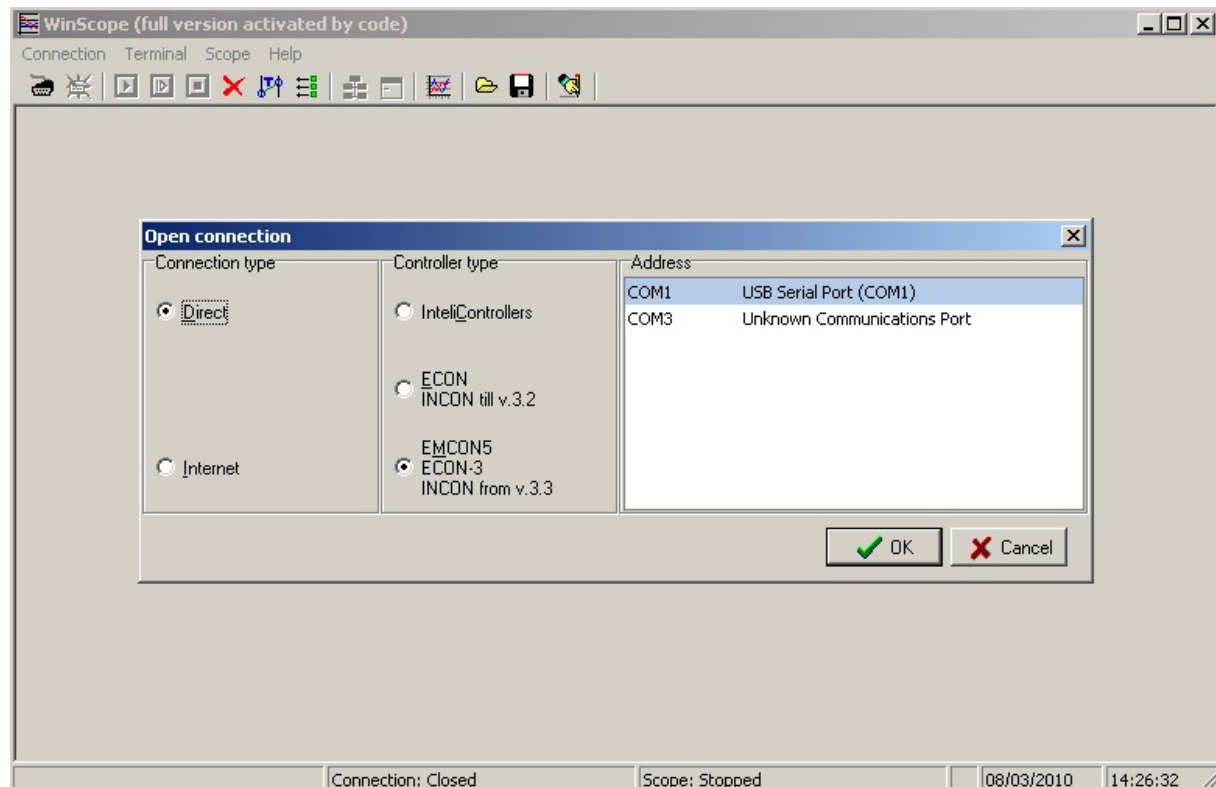
- A. At first check the position feedback level, in case it is not within limits 0.4 to 4.6 Volts, then the bridge actuator cannot be controlled with ECON.
- B. Connect to ECON-4 via USB connector, using PC program WinScope.
- C. Adjust the Position feedback limits in: AnalogSensors: **Fdb 0 pos** to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


# Getting started, programming

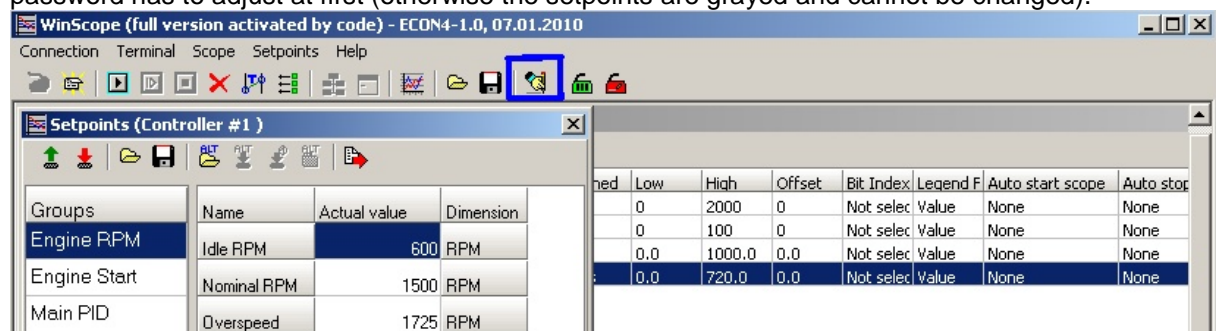
## Connection to ECON-4

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.



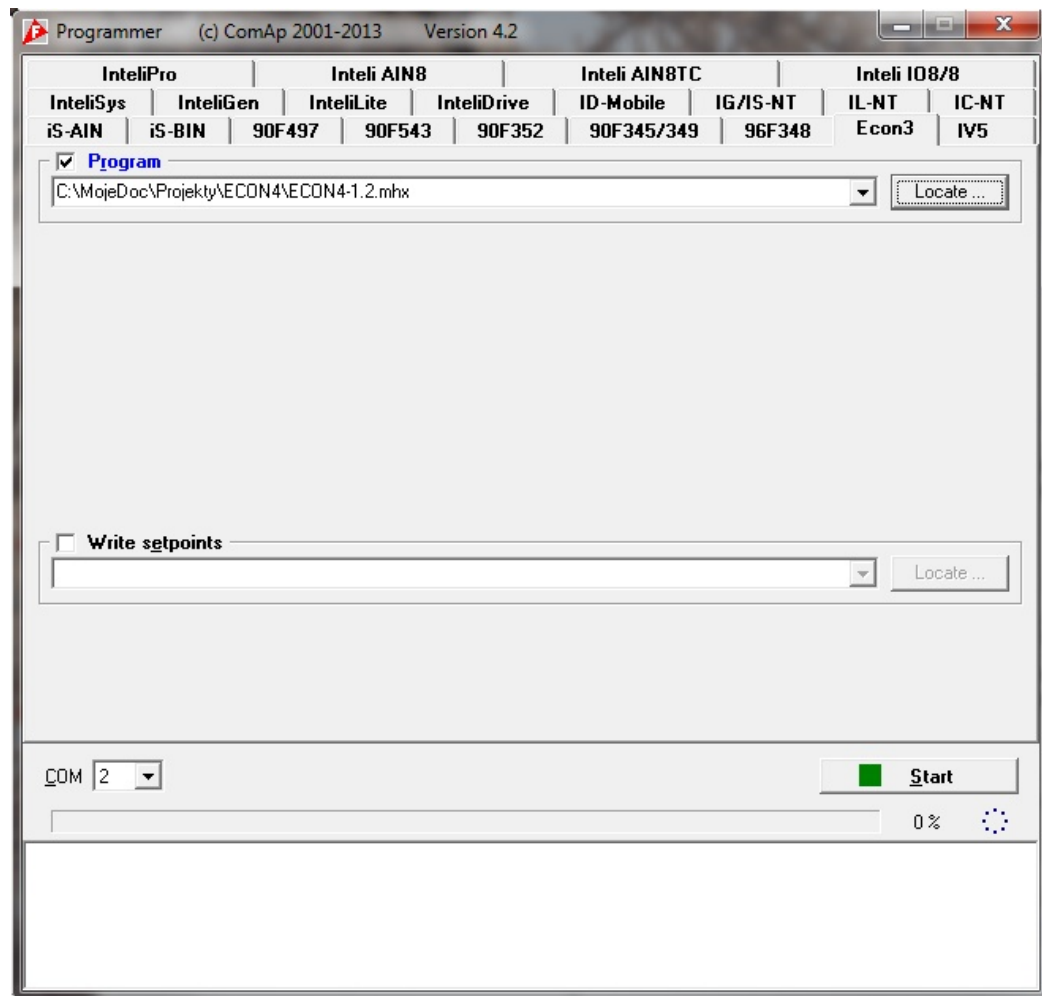
## Setpoints adjustment:

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).



## Econ-4 firmware update

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



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

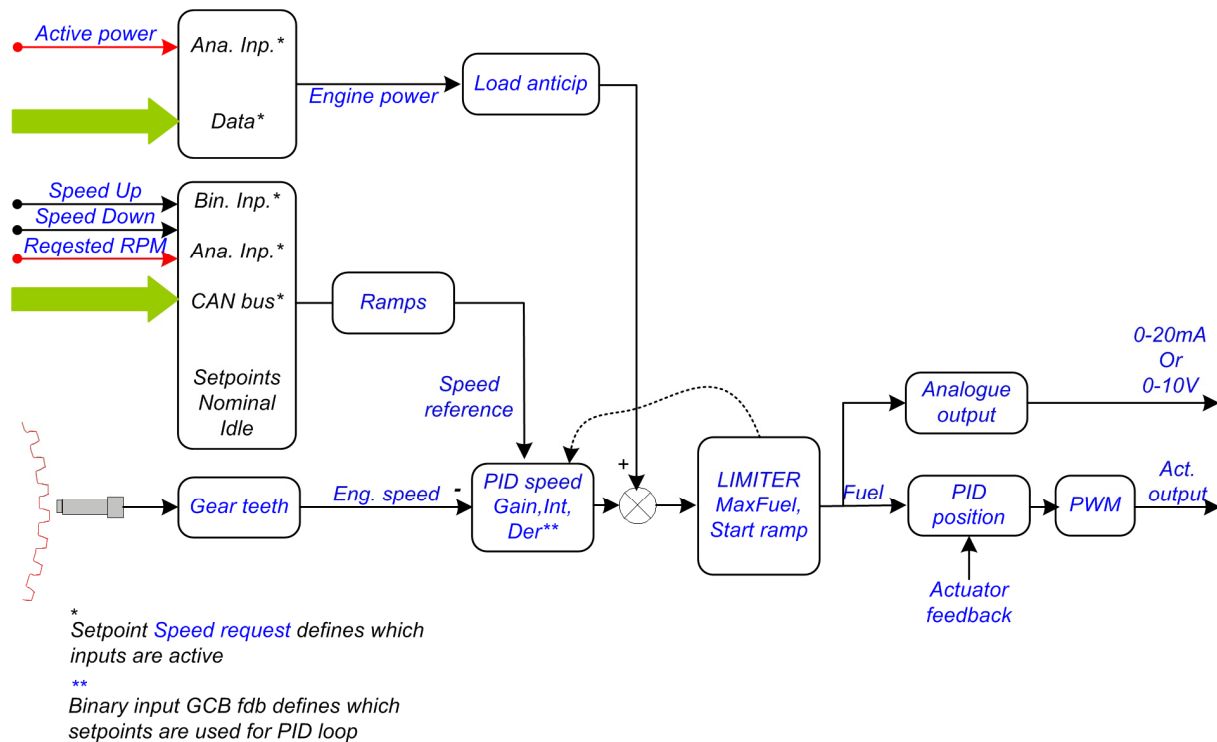
Choose the right COM port number and press “Start” button.

### Hint:

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

# Getting started, detailed function description

## Block schematics – speed governor



## 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,

see details at [Table 6](#).

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:

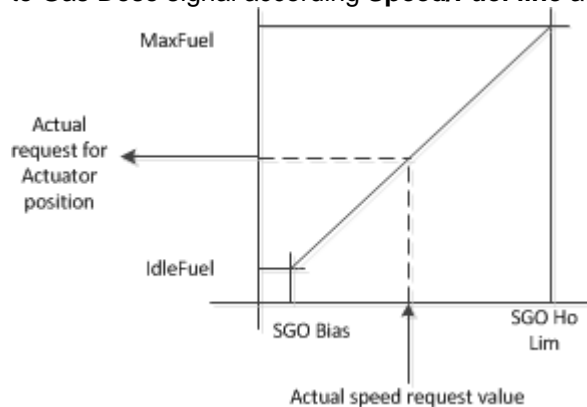
- no-load operation,
- 
- loaded operation

see details at [Table 7](#).

The output of the PID control structure is then added together with the Load anticipation feedback, which is directly proportional to the engine power. The output from the last sum is limited by the Anti-windup Limiter module, which reduces the integrator's output signal so that the sum of the signals from the Gain, Integrator, Differentiator and Load anticipation blocks equals exactly the limit MaxFuel.

## Speed governor function in parallel mode

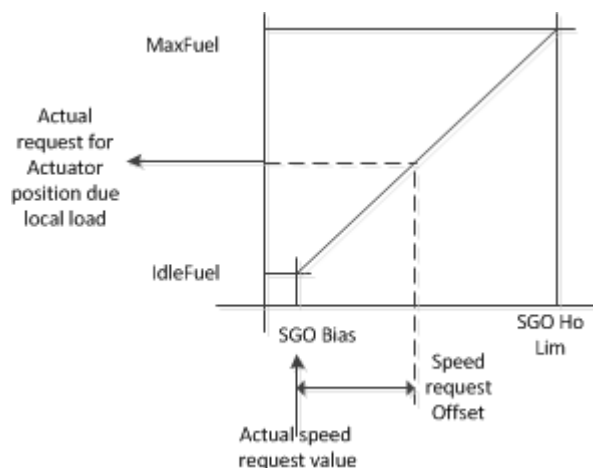
When engine is in parallel to Mains, Econ4 works just as amplifier and converts Speed request signal to Gas Dose signal according **Speed/Fuel line** as follows



### Transition to parallel from zero local load.

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

### Transition to parallel from non-zero local load.



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

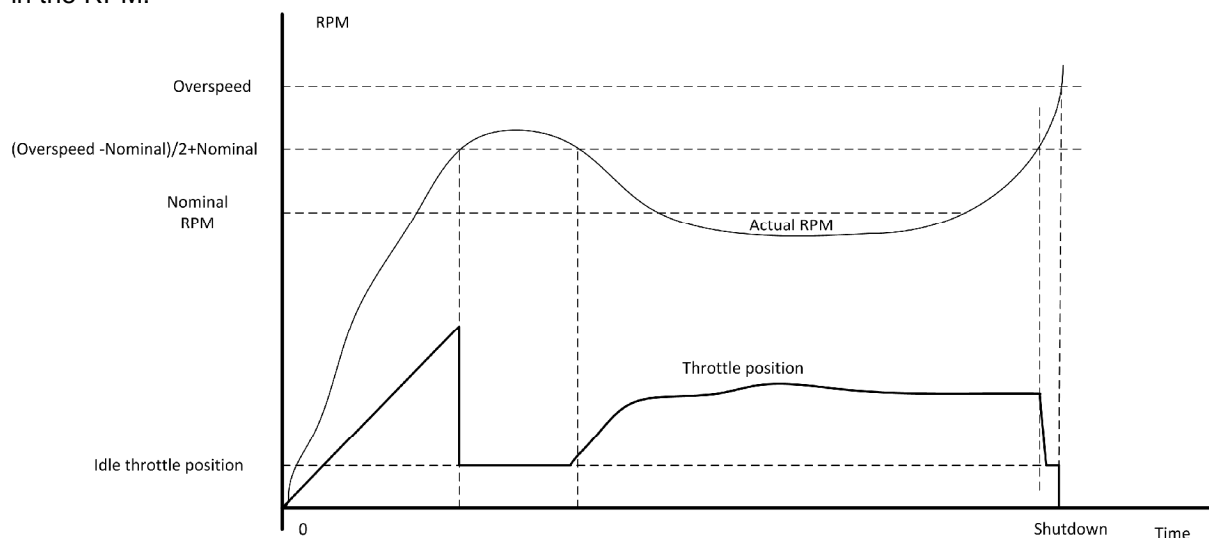
Speed request offset is decreased according ramp, which is set in setpoint SGOoffsetRamp. Time in this setpoint is time needed to change Speed request offset from 10V to 0V.

## 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.



## 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.

# Setpoints


Setpoints are organized in logical groups for better orientation. Use WinScope software to modify the setpoints.

## Password


---

### EnterPassword

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

### ChangePassword

Use icon  to activate a dialog box for password change.

Hint:

The Password has to be entered to activate this icon.

## Engine RPM

---

### Idle RPM [RPM]

Engine idle speed.

Step: 1 RPM

Range: *Start RPM – Nominal RPM*

### Nominal RPM [RPM]

Nominal engine speed.

Step: 1 RPM

Range: 0 – 2500 RPM

### Overspeed [RPM]

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.

Step: 1 RPM

Range: 0 – 2500 RPM

### Idle-Nom ramp [s]

Define how fast changes the requested engine speed during transition from *Idle RPM* to *Nominal RPM* and vice versa. *Idle-Nom ramp* is directly time that the ramp needs to go from Idle speed to *Nominal RPM* and vice versa. The ramping speed is the same for both up and down directions.

Step: 1 s

Range: 0 – 100 s

### BI Speed ramp [s]

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* - 8% to *Nominal RPM* + 8% and vice versa. The ramping speed is the same for both up and down directions.

Step: 1.0 s

Range: 1.0 – 100.0 s

## Speed request [BIN / ANA / DATA]

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

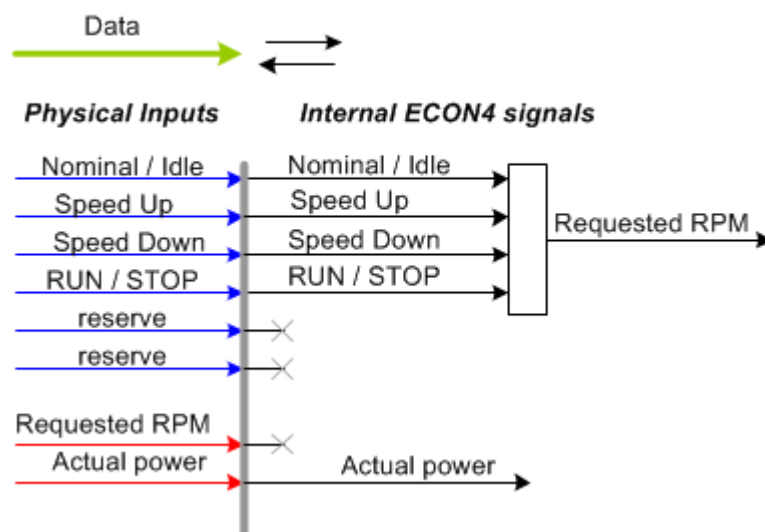
Table 6

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

*Hint:*

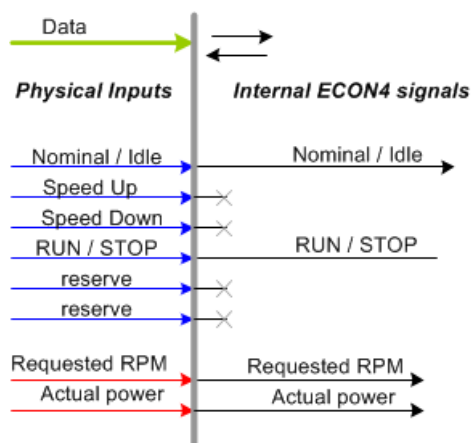
The setpoint Speed request defines also source of binary inputs, see [Table 5](#).

### BIN mode



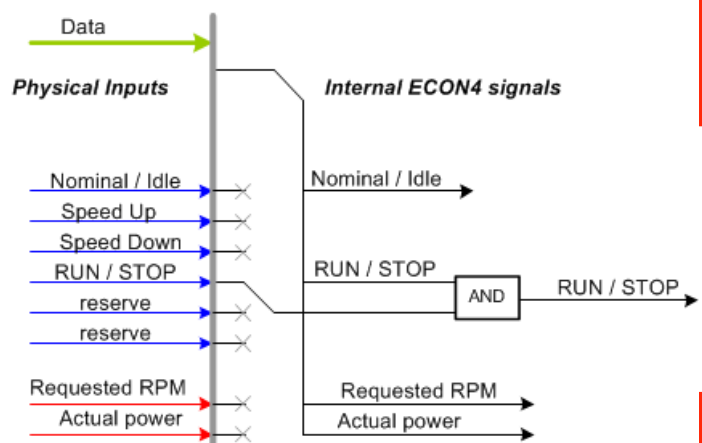
Speed request = BIN

### ANA



Speed request = ANA

### DATA



Speed request = DATA

## CB request [BIN/DATA]

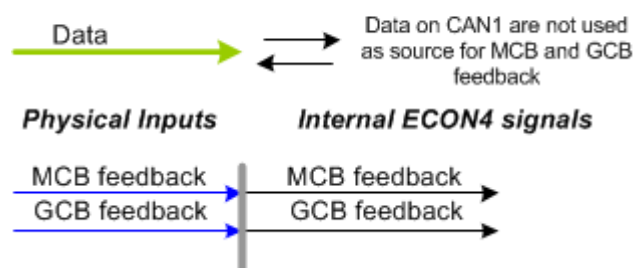
Table 8

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

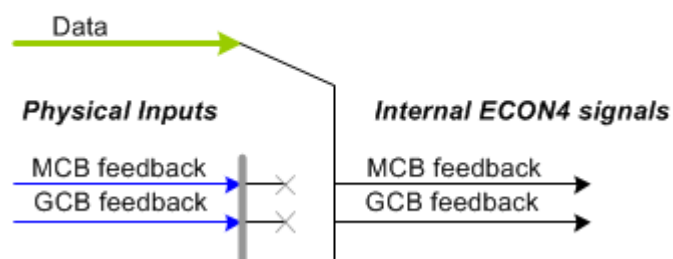
### Hint:

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.

## BIN mode



## DATA mode



## Gear teeth [-]

Number of teeth on the engine gear for the pick-up.

Step: 1  
Range: 32 – 400

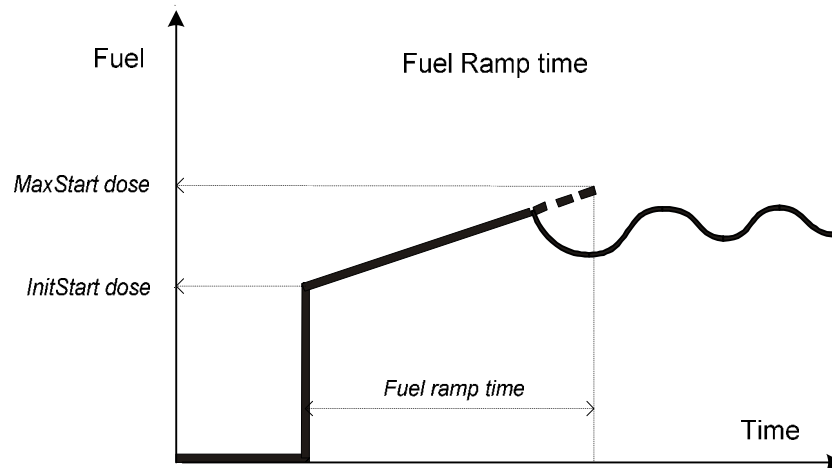
## PerChSpdNom [%]

Percentage Change of Requested RPM from Nominal RPM. This setpoint defines the maximum allowable change of requested RPM from the Nominal RPM value in case the BIN or ANA control of RPM is used. Use this setpoint to enlarge maximum allowable swing of the required RPM. Setpoint is by default adjusted to 8% which should fulfill the most of installations.

Step: 1  
Range: 1-50%

## Engine Start

ECON-4 activates the start sequence if it detects non-zero engine speed and if input RUN is active. Actuator is set to position *InitStart* dose. Actuator then gradually increases fuel dose till the engine start or till it reaches *MaxStart* dose. The speed of fuel ramp is defined by setpoint *Fuel ramp time*.



### InitStart dose [%]

Initial position of the actuator during start.

Step: 1 %

Range: 1 – 100 %

### MaxStart dose [%]

Maximum position of the actuator during start.

Step: 1 %

Range: 1 – 100 %

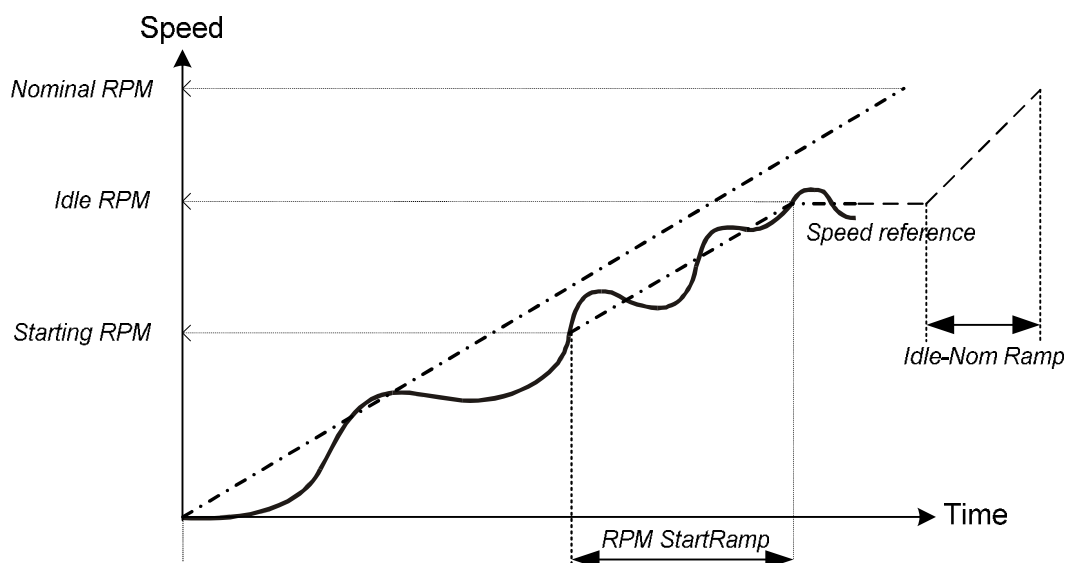
### Fuel ramp time [s]

Time the actuator needs to move from the *InitStart dose* to *MaxStart dose*.

Step: 1 s

Range: 1 – 100 s

When the engine speed rises above *Starting RPM*, ECON-4 activates PID speed regulation loop. The Speed reference rises from *Starting RPM* to *Idle RPM* with speed ramp defined by setpoint *RPM StartRamp*.



## RPM StartRamp [s]

This setpoint defines speed of ramp from *Starting RPM* to *Idle RPM*. It is directly the time of ramp from Starting RPM to Idle RPM.

Step: 1 s

Range: 1 – 100 s

## Starting RPM [RPM]

If ECON-4 detects speed higher then *Starting RPM*, it terminates the starting sequence end starts normal speed regulation.

Step: 1 RPM

Range: 0 – *Idle RPM*

Hint:

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.

## Main PID

The speed regulation loop uses three setpoint sets – one for unloaded within RPM window, one for unloaded outside RPM window and one for loaded engine. Which setpoint set is used is defined by binary input GCB and MCB Fdb and deviation of RPM from requested RPM.

Table 7

| MCB state | GCB state | IRPM - Requested RPM<br>> 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 |

ECON4-ADV has even more sets of PID setpoint sets. See chapter xxxx

## Speed gain [%]

Gain of the PID speed regulation loop.

Step: 0.1 %

Range: 0.0 – 200.0 %

Hint:

Setpoint is active for unloaded engine.

## Speed int [%]

Integration of the PID speed regulation loop.

Step: 0.1 %

Range: 0.0 – 100.0 %

Hint:

Setpoint is active for unloaded engine.

## Speed der [%]

Derivative part of the PID speed regulation loop.

Step: 0.1 %

Range: 0.0 – 100.0 %

Hint:

Setpoint is active for unloaded engine.

## **RPM window [RPM]**

In case the actual RPM differs from Requested RPM for more than RPM window [RPM], the Speed PID constants fluently change from 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.

## **Speed int w [%]**

Integration part of the PID regulation loop in case the actual RPM differs from Requested RPM for more than RPM window.

Step: 1 %

Range: 0-100 %

## **Speed der w [%]**

Derivative part of the PID regulation loop in case the actual RPM differs from Requested RPM for more than RPM window.

Step: 0,1 %

Range: 0,0-100,0 %

## **Load gain [%]**

Gain of the PID speed regulation loop.

Step: 0.1 %

Range: 0.0 – 200.0 %

Hint:

Setpoint is active for loaded engine.

## **Load int [%]**

Integration of the PID speed regulation loop.

Step: 0.1 %

Range: 0.0 – 100.0 %

Hint:

Setpoint is active for loaded engine.

## **Load der [%]**

Derivative part of the PID speed regulation loop.

Step: 0.1 %

Range: 0.0 – 100.0 %

Hint:

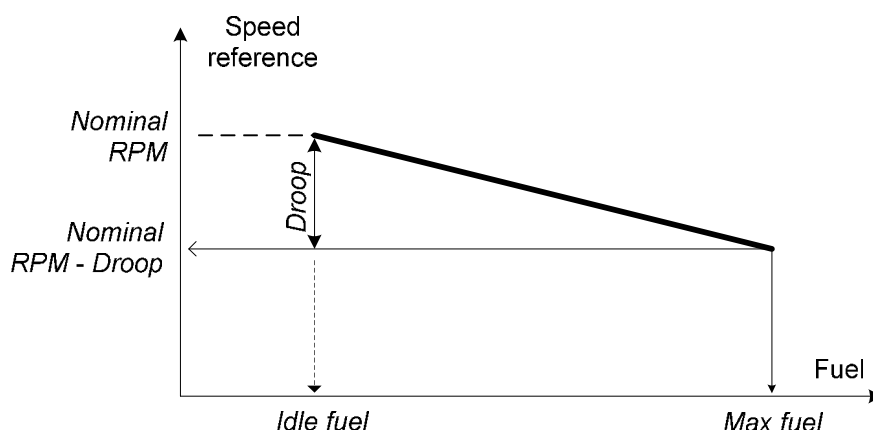
Setpoint is active for loaded engine.

## **Droop [%]**

Droop of speed governor. The governor lowers the speed reference by *Droop* percent of the *Nominal RPM* over the range from zero to *MaxFuel*.

Step: 0.1 %

Range: 0.0 – 100.0 %



#### Example:

*Droop* = 5%, *Nominal RPM* = 1500RPM. Speed reference is 1500 RPM on idle fuel and  $1500 - 1500 \cdot 0.05 = 1425$  RPM on *MaxFuel*.

### Load anticip [%]

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 setpoint *Speed request*=BIN or ANA) or via CAN bus in the case of communication to IS-NT controller (if setpoint *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

Step: 0.1 %

Range: 0.0 – 100.0 %

### MaxFuel [%]

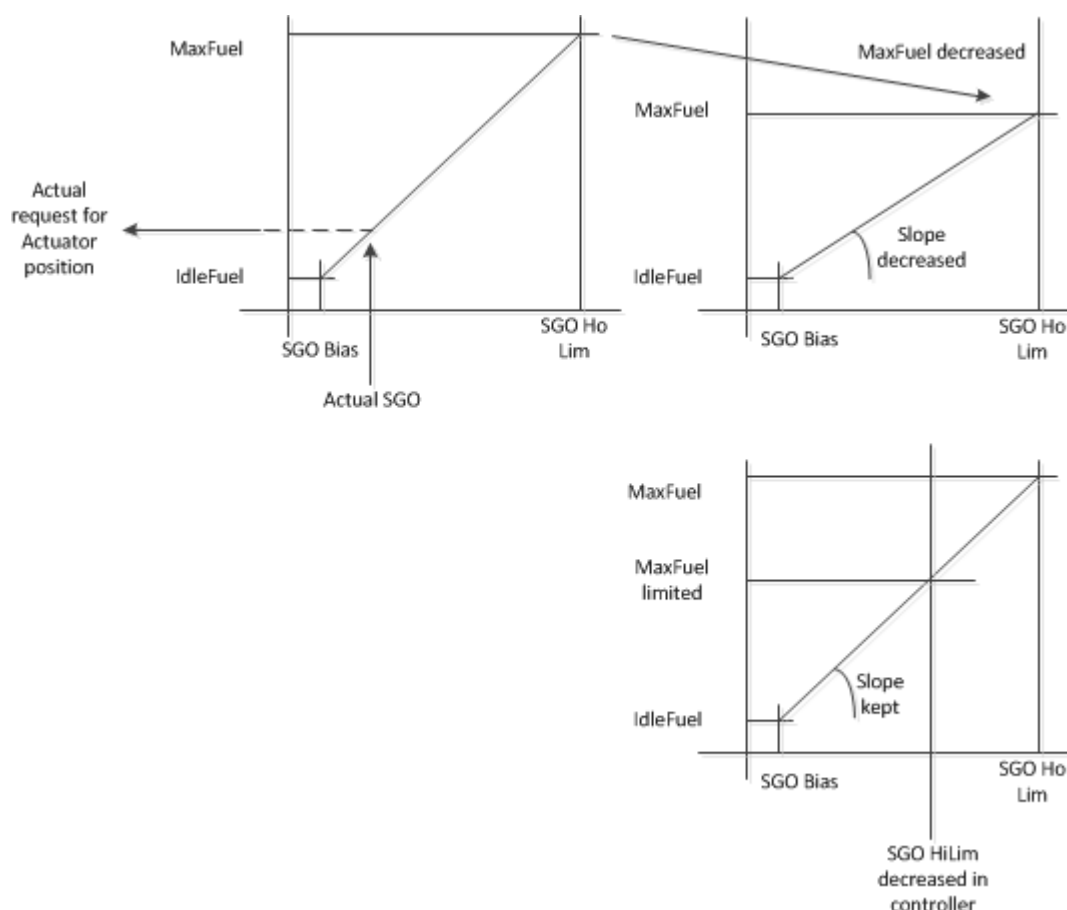
Maximum output from the PID speed control loop + Load anticipation signal. It limits the maximum fuel delivered to the engine.

Step: 0.1 %

Range: 0.0 – 100.0 %

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

*If you need to limit throttle opening during debugging and adjustment of load control in parallel to Mains, do not decrease MaxFuel limit – this would influence load regulation. Rather than this decrease setpoint SpeedGovHiLim in controller. See next picture for description*



## IdleFuel [%]

IdleFuel is base (together with MaxFuel) for Droop function calculation.

Step: 0.1 %

Range: 0.0 – 100.0 %

*Hint:*

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

## Actuator type [ActType1, 2, 3, 4]

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.

## Econ-4 Mode [AUTO, MAN]

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.

*Hint:*

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

## Warning:

**Even Overspeed protection is active in all modes, be carefull when setting throttle position manually. 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.**

## Act position [%]

Adjusts the actuator position in the Econ-4 Mode = MAN.

Step: 0.1 %

Range: 0.0 – 100.0 %

## PWM rate [Hz]

Frequency of the PWM signal sent to ACT+ and ACT- outputs.

Step 1Hz

Range 600 – 10 000 Hz

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

## Analog sensors

### LoReqSpeed Inp [%]

Value of analog input SPEED REQUEST for minimum possible speed reference (*Nominal RPM-8%*).

Step: 0.1 %

Range: 0.0 – 100.0 %

Hint:

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

### HiReqSpeed Inp [%]

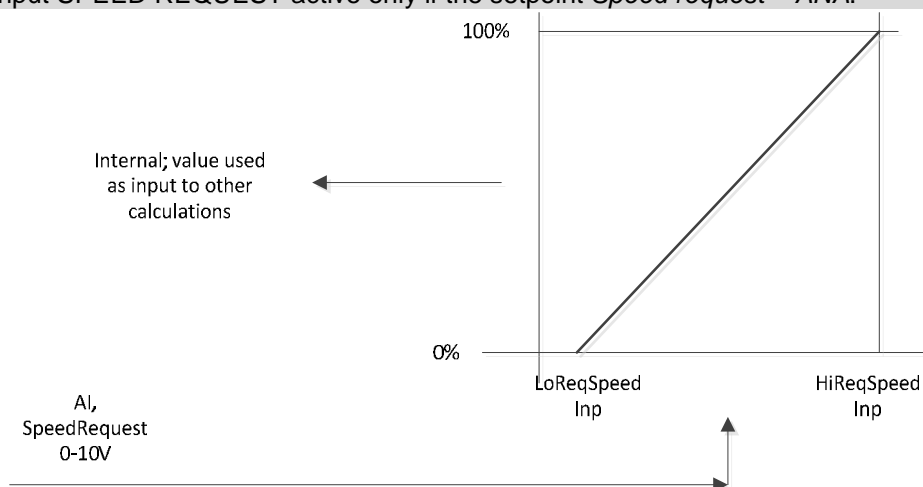
Value of analog input SPEED REQUEST for maximum possible speed reference (*Nominal RPM+8%*).

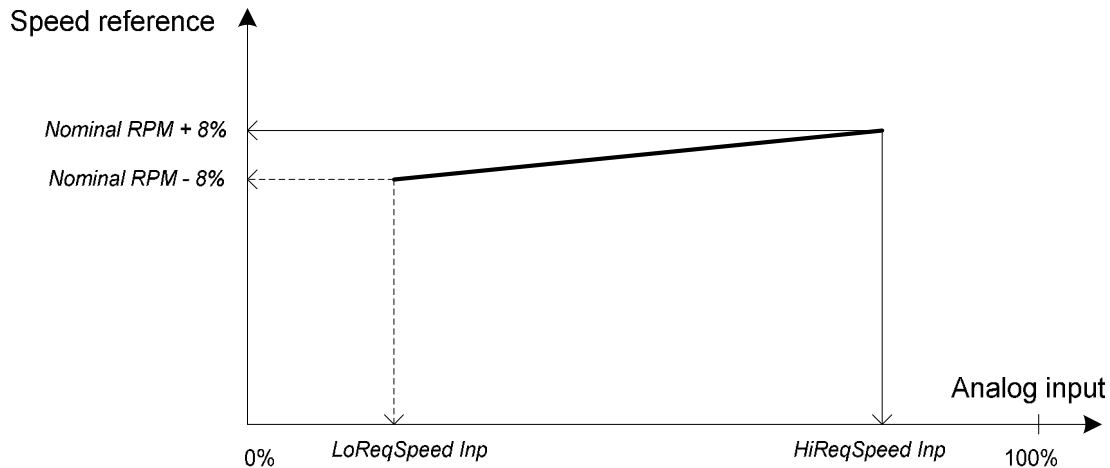
Step: 0.1 %

Range: 0.0 – 100.0 %

Hint:

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





### AOUT 0% [%]

Analogue output low limit signal definition.

Step: 1 %

Range: 0 – 100 %

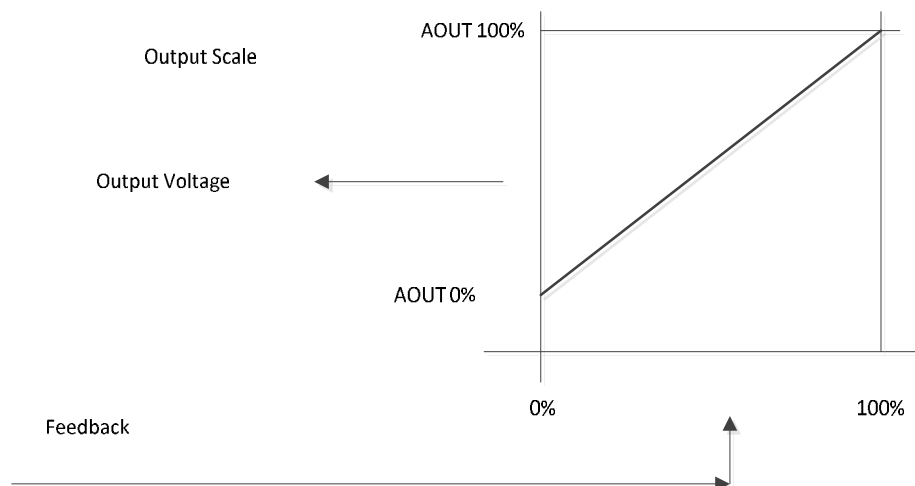
### AOUT 100% [%]

Analogue output high limit signal definition.

Step: 1 %

Range: 0 – 100 %

The maximum range of analogue output is 0 – 10V (0 – 20mA jumper selection). Using the 2 above setpoints you can adjust the limits for max and min levels of the signal.



### Fdb 0 pos [%]

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.

Step: 0,01 V

Range: 0,40 – Fdb1 100 pos.V

## **Fdb 100 pos [%]**

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.

Step: 0,01 V  
Range: Fdb1 0 pos – 4,60 V

## **ActType 1, 2, 3, 4**

There are four 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.

### Hint:

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 – check the List of tested actuators by ComAp.

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

### **Act gain %**

Gain of the PID actuator position control loop.

Step: 0.1 %  
Range: 0.0 – 1000.0 %

### **Act int %**

Integration factor of the PID actuator position control loop.

Step: 1 %  
Range: 0 – 1000 %

### **Act der %**

Derivation factor of the PID actuator position control loop.

Step: 1 %  
Range: 0 – 1000 %

### **Act MaxCur %**

Actuator Overload protection limit.

Step: 0.1 %  
Range: 0 – 100.0 %

### **ActMaxCurDel s**

Actuator Overload protection limit delay.

Step: 0.1 s  
Range: 0.1 – 300.0 %

### **Act ReducedCur %**

Reduced actuator current when overload protection was activated.

Step: 0.1 %  
Range: 0.0 – 100.0 %

### **Act Cur 0% %**

Transformation between actuator requested position and actuator current when Actuator without position feedback is used. Specification of requested current (voltage) for 0% actuator position.

Step: 0.1 %  
Range: 0.0 – 100.0 %

## Act Cur 100% %

Transformation between actuator requested position and actuator current when Actuator without position feedback is used. Specification of requested current (voltage) for 0% actuator position.

Step: 0.1 %

Range: 0 – 100.0 %

## Wiring

### LINEAR, BRIDGE, LINEAR NO FDB

**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.

## Act type 2 predefined for Woodward ITB PWM

Setting is active when **Main PID**: *Actuator type* = Act type 2. Setpoint structure see in Act type 1.

## Act type 3 predefined for Woodward F-series PWM

Setting is active when **Main PID**: *Actuator type* = Act type 3. Setpoint structure see in Act type 1.

## Act type 4 predefined for Heinzmann STG 10

Setting is active when **Main PID**: *Actuator type* = Act type 4. Setpoint structure see in Act type 1.

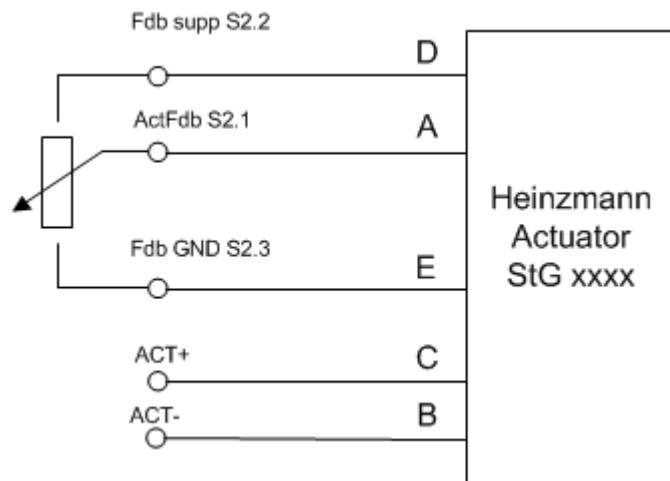
## List of tested actuators by ComAp

|   |  |  |
|---|--|--|
| <b>Woodward ITB 0-200mA</b><br>Act gain = 5<br>Act int = 100<br>Act der = 0<br>PWM rate = 2000 Hz<br>Fdb 0 pos = 0,5 V<br>Fdb 100 pos = 4,5 V | <b>Woodward ITB PWM</b><br>Act gain = 20<br>Act int = 400<br>Act der = 0<br>PWM rate = 2000 Hz<br>Fdb 0 pos = 0,5 V<br>Fdb 100 pos = 4,5 V   | <b>Woodward F-series PWM</b><br>Act gain = 0,5<br>Act int = 200<br>Act der = 0<br>PWM rate = 2000 Hz<br>Fdb 0 pos = 0,42 V<br>Fdb 100 pos = 4,55 V |
| <b>Heinzmann STG10</b><br>Act gain = 90<br>Act int = 600<br>Act der = 150<br>PWM rate = 6000 Hz<br>Fdb 0 pos = 1,76 V<br>Fdb 100 pos = 3,1 V  | <b>Heinzmann STG30</b><br>Act gain = 90<br>Act int = 600<br>Act der = 150<br>PWM rate = 6000 Hz<br>Fdb 0 pos = 1,76 V<br>Fdb 100 pos = 3,1 V | <b>Heinzmann STG2040</b><br>Act gain = 35<br>Act int = 300<br>Act der = 150<br>PWM rate = 6000 Hz<br>Fdb 0 pos = 1,78 V<br>Fdb 100 pos = 2,8 V     |

|  |   |   |
|--|---|---|
| <b>Heinzmann STG2010</b><br>Act gain = 30 (40)<br>Act int = 300 (500)<br>Act der = 30 (300)<br>PWM rate = 6000 Hz<br>Fdb 0 pos = 1,78 V<br>Fdb 100 pos = 2,8 V | <b>GAC ATB552t2F-24</b><br>Act gain = 25<br>Act int = 400<br>Act der = 2<br>PWM rate = 2000 Hz (1500 - 3000???)<br>Fdb 0 pos = 0,96 V<br>Fdb 100 pos = 3,61 V | <b>Heinzmann STG2080</b><br>Act gain = 35<br>Act int = 80<br>Act der = 70<br>PWM rate = 6000 Hz<br>Fdb 0 pos = 1,69 V<br>Fdb 100 pos = 3,02 V |
|--|---|---|

**Be aware that final values for ACT gain, int and der, as well as Fdb 0 and 100pos depends on real engine and actuator characteristic and has to be tuned properly. Values above can be used just as starting point for tuning and final values can difer.**

## Heinzmann Actuator wiring



# Additional setpoints for ECON-4 ADV

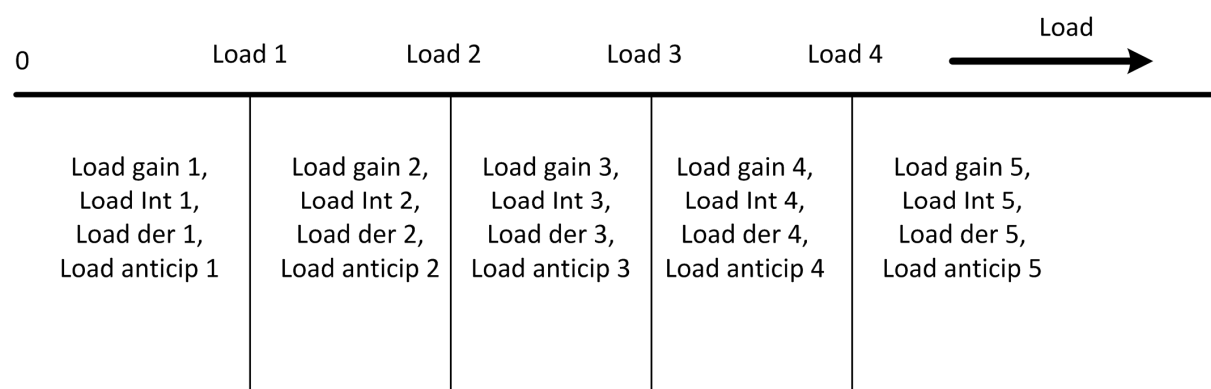
This version of ECON4 is dedicated for island operation where load steps are expected. Because load characteristic is usually nonlinear, different speed PID setting is needed for different load.

## Load bands

### Load 1 to Load 5 %

Step: 0.1 %  
Range: 0 – 100.0 %

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.



## Derivation on Load Anticipation

### **LAders+limit** %

Step: 0.1 %

Range: 0 – 100.0 %

Limit on Load step in + direction, changes below this limit will not generate any derivation

### **LAders-limit** %

Step: 0.1 %

Range: 0 – 100.0 %

Limit on Load step in – direction, changes below this limit will not generate any derivation

### **LAders+** %

Step: 1 %

Range: 0 – 100.0 %

Amount of derivation when Load increases

### **LAders-** %

Step: 1 %

Range: 0 – 100.0 %

Amount of derivation when Load decreases

### **LAders+recover** %

Step: 0.01 %

Range: 1.01 – 10.00 %

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.

### **LAders-recover** %

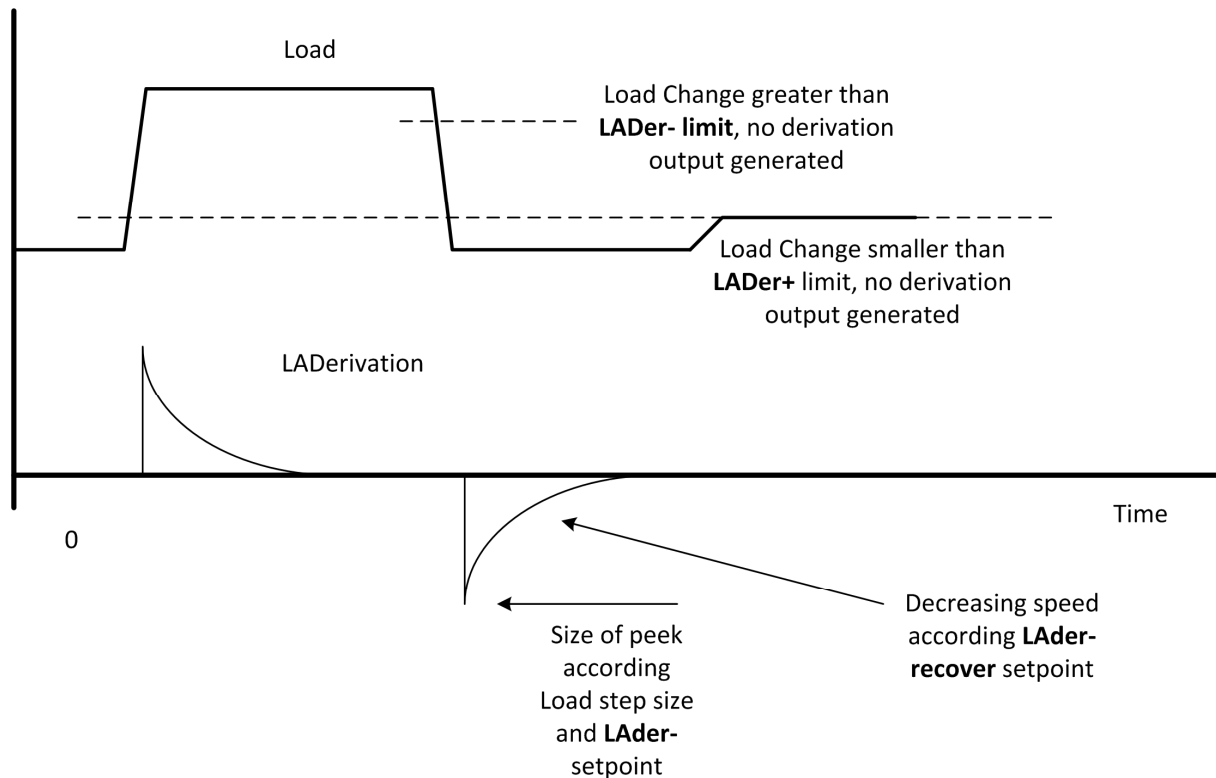
Step: 0.01 %

Range: 1.01 – 10.00 %

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.

When Load is suddenly changed, there is positive influence if throttle is opened or closed for short period of time. To do that there is derivation on Load and result is added to PID output. There is Limit to avoid jitter based on noise on power signal. If load changes are less than this limit, no derivation is generated.

Function works as follows



## PreOverSpeed RPM

Step: 1RPM %

Range: Nominal RPM – Overspeed RPM

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

## PreOverSpReduct IDLE FUEL/CLOSE

Step: -

Range: IDLE FUEL – CLOSE

Value set to output GAS Dose when RPM reaches value in setpoint PreOverSpeed.

## ECON-4 - PDO Description

**Transmit PDO 1** [8 bytes] Sent every 100 msec

| Byte 1             | Byte 2 | Byte 3                | Byte 4 | Byte 5              | Byte 6 | Byte 7        | Byte 8 |
|--------------------|--------|-----------------------|--------|---------------------|--------|---------------|--------|
| Gas dose<br>[0.1%] |        | Misfiring Amplitude * |        | Engine RPM<br>[RPM] |        | Status<br>[-] |        |

|       |                           |
|-------|---------------------------|
| Bit0  | Bin1 MCB Feedback         |
| Bit1  | Bin2 GCB Feedback         |
| Bit2  | Bin3 Nominal/Idle         |
| Bit3  | Bin4 Speed up             |
| Bit4  | Bin5 Speed down           |
| Bit5  | Bin6 Run/Stop             |
| Bit6  | Bin7 Droop                |
| Bit7  | Bin8                      |
| Bit8  | Reserve                   |
| Bit9  | Reserve                   |
| Bit10 | Engine running            |
| Bit11 | Shutdown due to overspeed |
| Bit12 | PID limit 1               |
| Bit13 | PID limit 2               |
| Bit14 | PID limit 3               |
| Bit15 | Invalid setpoints         |

**Transmit PDO 2** [4 bytes] Sent every 100 msec

| Byte 1                     | Byte 2 | Byte 3            | Byte 4 | Byte 5                   | Byte 6 |
|----------------------------|--------|-------------------|--------|--------------------------|--------|
| Actuator feedback 1<br>[%] |        | Misfiring Angle * |        | Requested speed<br>[RPM] |        |

\* Misfiring Amplitude and Misfiring Angle are not supported in sw version 1.0 and can be read from WinScope only (comm.objects: 12081 and 12082).

**Receive PDO** [6 bytes] Should be sent every 40 msec (receive timeout = 150 msec)

| Byte 1                 | Byte 2 | Byte 3                  | Byte 4 | Byte 5         | Byte 6 |
|------------------------|--------|-------------------------|--------|----------------|--------|
| Active power<br>[0.1%] |        | Speed request<br>[0.1%] |        | Command<br>[-] |        |

|       |              |
|-------|--------------|
| Bit0  | N/A          |
| Bit1  | GCB Feedback |
| Bit2  | Nominal/Idle |
| Bit3  | Run/Stop     |
| Bit4  | Droop        |
| Bit5  | N/A          |
| Bit6  | N/A          |
| Bit7  | N/A          |
| Bit8  | N/A          |
| Bit9  | N/A          |
| Bit10 | N/A          |
| Bit11 | N/A          |
| Bit12 | N/A          |
| Bit13 | N/A          |
| Bit14 | N/A          |
| Bit15 | N/A          |

# Technical data

## ***Power supply***

|                |   |
|----------------|---|
| Voltage supply | 8-36V DC  |
| Consumption    | 0,5 - 8A depend on supply voltage and actuators |

## ***Operating conditions***

|                               |  |
|-------------------------------|--|
| Operating temperature         | -30...+70°C  |
| Storage temperature           | -30...+80°C  |
| Protection                    | IP00   |
| Humidity                      | 95% without condensation                                     |
| Standard conformity           |  |
| Low Voltage Directive         | EN 61010-1:95 +A1:97   |
| Electromagnetic Compatibility | EN 50081-1:94, EN 50081-2:96<br>EN 50082-1:99, EN 50082-2:97 |
| Vibration                     | 5 - 25 Hz, $\pm 1,6$ mm<br>25 - 100 Hz, $a = 4$ g            |
| Shocks                        | $a = 200$ m/s <sup>2</sup>                                   |

## ***Dimensions and weight***

|            |              |
|------------|--------------|
| Dimensions | 155x151x57mm |
| Weight     | 600g         |

## ***Binary inputs and outputs***

### **Binary inputs**

|  |               |
|--|---------------|
| Number of inputs                                     | 8             |
| Input resistance                                     | 4,4k $\Omega$ |
| Input range  | 0-36VDC       |
| Switching voltage level for close contact indication | 0-2V          |
| Max voltage level for open contact indication        | 8-36V         |

### ***Analog inputs***

|                              |   |
|------------------------------|---|
| Not electrically separated   |   |
| Resolution                   | 10 bits   |
| Range                        | 0 – 10V; Input resistance 11k $\Omega$<br>0 – 20mA; Load resistor 50 $\Omega$ |
| Analog measurement tolerance | 1 %   |

### ***Analog outputs***

|                            |  |
|----------------------------|--|
| Not electrically separated |  |
| Resolution                 | 0 – 10000  |
| Range                      | 0 – 10V; Output resistance < 1 $\Omega$<br>0 – 20mA; Active current source |

### ***Actuator feedback input***

|                            |         |
|----------------------------|---------|
| Not electrically separated |         |
| Resolution                 | 10 bits |

## ***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 %   |

## ***RS232 interface***

|                  |            |
|------------------|------------|
| Maximal distance | 10m        |
| Speed            | 19 200 bps |

## ***CAN bus interface***

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

Following dynamic cable parameters are important especially for maximal CAN bus length:

|                                 |                           |
|---------------------------------|---------------------------|
| Nominal Velocity of Propagation | min. 75% (max. 4,4 ns/m)  |
| Wire crosscut                   | min. 0,25 mm <sup>2</sup> |
| Maximal attenuation (at 1 MHz)  | 2 dB / 100m               |

Recommended Industrial Automation & Process Control Cables:

BELDEN (see <http://www.belden.com>):

- 3082A DeviceBus for Allen-Bradley DeviceNet
- 3083A DeviceBus for Allen-Bradley DeviceNet
- 3086A DeviceBus for Honeywell SDS
- 3087A DeviceBus for Honeywell SDS
- 3084A DeviceBus for Allen-Bradley DeviceNet
- 3085A DeviceBus for Allen-Bradley DeviceNet
- 3105A Paired EIA Industrial RS485 cable

LAPP CABLE (see <http://www.lappcable.com>)

- Unitronic BUS DeviceNet Trunk Cable
- Unitronic BUS DeviceNet Drop Cable
- Unitronic BUS CAN
- Unitronic-FD BUS P CAN UL/CSA