

Средства визуализации  
в сетях CAN.  
Разработка узлов J1939  
в среде CoDeSys.

Рябов А. В.

# Эволюция СУ и ЧМИ

Задача, стоящая перед современным реализующим ЧМИ устройством — непосредственное участие в процедуре управления процессами

# Виды устройств ЧМИ

1. Текстовый или графический терминал
2. ПЛК с дисплеем
3. Промышленный компьютер

# Текстовые или графические терминалы



МКТ Systemtechnik  
МКТ-View



Selectron Systems HMI712

# ПЛК с дисплеем



ifm electronic PDM 360



Berghof DC1000

# Промышленный компьютер



CC Systems CC Pilot XS



Grossenbacher Systeme  
Compact-Panel-PC

# Проприетарные инструменты

## UPT Programming tool

The image displays the UPT Programming Tool II interface, which is used for configuring and simulating a device's display. The main window is titled "UPT Programming Tool II - C:\Program Files\WKTUPT\_ProgTool2\programs\default.upt" and contains a table of display lines and a simulator window.

**Table of Display Lines:**

Nr	Hex	Y	Text / Display Cmd	Var/Expr	Acc/Hk	DrawMode	Color	Zoom	Font	base	fl
0	2	1	\btn(280,24,6001,"UPT Programming Tool II (2)")		0	8	-1,-1	600	5	0	0
1	2	26	\btn(280,24,6001,"for terminals with CANopen")		0	9	-1,-1	600	5	0	0
2	100	55	2008-12-01\li(-4,9,80,9;-4,11,80,11)		0	0	-1,-1	600	4	0	0
3	98		Load one of the demo files, in or create your own ap		0	0	-1,-1	600	4	0	0
4	3	140	\dia(220,40,1,1,57,16,30)		0	0	-1,-1	600	5	0	0
5	3	140	\dia.sc.l(1,20,0,40)		0	0	-1,-1	600	0	0	0
6	3	140	\dia.sc.b(3,10)		0	0	-1,-1	600	0	0	0
7	3	140	\dia.sc.r(1,1,0,100)		0	0	-1,-1	600	0	0	0
8	3	140	\dia.chl(3,0,30,0,400,132)	sys.vsup	0	0	-1,-1	600	0	0	0
9	5	122	Supply Voltage **.* V	sys.vsup	0	0	-1,-1	600	5	0	0
10	283	2	\btn(36,36,6002,"F1",59,p1("d9!s0 9A"))		0	0	-1,-1	600	5	0	0
11	283	62	\btn(36,36,6002,"F2",60,p1("d9!s0 9C"))		0	0	-1,-1	600	5	0	0
12	283	122	\btn(36,36,6002,"F3",61,p1("d7!s0 6qo9h6 hoq9m"))		0	0	-1,-1	600	5	0	0
13	228	195	\btn(50,44,6003,"CONTRAST? ",13,sys.edit_contrast)		0	0	-1,-1	631	1	0	0
14	283	169	\bar(36,70,615D,2,6FFF,61144,-20,20)	rot.p	0	0	-1,-1	600	5	0	0
15	4	189	System Temperature **.* °C	sys.temp	0	0	-1,-1	600	5	0	0
16	4	207	\bar(220,32,6254,9,6FFF,61144,tc(25),-20,70)	sys.temp/10	0	0	-1,-1	600	5	0	0
17	89	74	\i(0)wheel0:(1)wheel1:(2)wheel2:(3)wheel13	{{(t1/2)43}	0	0	-1,-1	600	0	0	0
18	118	74	\i(0)wheel13:(1)wheel12:(2)wheel11:(3)wheel10	{{(t1/2)43}	0	0	-1,-1	600	0	0	0
19	145	74	\i(0)wheel0:(1)wheel1:(2)wheel2:(3)wheel13	{{(t1/2)43}	0	0	-1,-1	600	0	0	0
20	170	74	\i(0)"wheel13":(1)"wheel12":(2)"wheel11":(3)"wheel10"	{{(t1/2)43}	0	0	-1,-1	600	0	0	0

The simulator window, titled "UPT-Simulator: page 0", displays the following information:

- UPT Programming Tool II (2)
- for terminals with CANopen
- 2008-12-01
- \*\*\*\*\*
- Load one of the demo files, or create your own application.
- Supply Voltage 18.5 V
- System Temperature +16.4 °C
- CONTRAST? (with a slider)
- Matrix: (299,82) k=0 matrix= 00 00 00 00 00 00
- F-Keys: 0000000000000000
- digital inputs: (6 LEDs)
- digital outputs: (4 LEDs)
- Buttons: F1, F2, F3, Menu

# Инструменты CoDeSys

- ◎ SoftPLC CoDeSys SP
- ◎ CoDeSys Target Visualization
- ◎ CoDeSys HMI

## Плюсы:

- ◎ Единообразное создание управляющего приложения и визуализации
- ◎ Использование языков МЭК 61131-3
- ◎ Прямой доступ к переменным контроллера

# Инструменты CoDeSys

CoDeSys - Fuellstand.pro\*

File Edit Project Insert Extras Online Window Help

Visualizations

- Templates
- MENUE
- MENUE2
- PLC\_VISU
- VISU\_ALARM

**Tank (FB-ST)**

```
0001 FUNCTION_BLOCK Tank
0002 VAR_INPUT
0003   stName: STRING;
0004   nMaxLevel: INT;
0005   nMinLevel: INT;
0006   nMaxTemp: INT;
0007   nMinTemp: INT;
0008 END_VAR
0009 VAR_OUTPUT
0010 END_VAR
0011 VAR
0012   name: STRING;
0013   bLevel: BOOL;
0014   bTemp: BOOL;
0015   nUnitLevel: INT=0;
0016   nUnitTemp: INT=0;
0017 END_VAR

0001 name := stName;
0002
0003 IF (nUnitLevel > nMaxLevel) THEN
0004   bLevel := FALSE;
0005 END_IF
0006 IF (nUnitLevel < nMinLevel) THEN
0007   bLevel := TRUE;
0008 END_IF
0009
0010 IF (bLevel) THEN
0011   nUnitLevel:=nUnitLevel+1;
0012 ELSE
0013   nUnitLevel:=nUnitLevel-1;
0014 END_IF
0015
0016 IF (nUnitTemp > nMaxTemp) THEN
0017   bTemp := FALSE;
0018 END_IF
0019 IF (nUnitTemp < nMinTemp) THEN
0020   bTemp := TRUE;
0021 END_IF
0022
0023 IF (bTemp) THEN
0024   nUnitTemp:=nUnitTemp+1;
0025 ELSE
0026   nUnitTemp:=nUnitTemp-1;
0027 END_IF
```

**Tanks (PRG-ST)**

```
0001 PROGRAM Tanks
0002 VAR
0003   bPipe1: BOOL;
0004   bPipe2: BOOL;
0005   bPipe3: BOOL;
0006   bPipeResult: BOOL;
0007   bTempResult: BOOL;
0008   nUnit1Level: INT=0;
0009   nUnit2Level: INT=20;
0010   nUnit3Level: INT=40;
0011   nUnitResultLevel: INT=0;
0012   dUnitResultLevel: REAL=0;
0013   nUnit1Temperature: INT=40;
0014   nUnit2Temperature: INT=45;
0015
0016
0017
0018
0019
0020
0021
0022
0023
0024
0025
0026
0027
0028
0029
0030 (* Unit3 *)
```

**PLC\_PRG (PRG-ST)**

```
0001 PROGRAM PLC_PRG
0002 VAR
0003   dtCurrentTime: DT;
0004   dtStartTime: DT:=dt#2002-4-05-11:15:00;
0005   SystemTime: RTC;
0006   bQuitAlarm: BOOL:=FALSE;
0007   Tank01, Tank02, Tank03, Tank04: Tank;
0008 END_VAR

0001 (* replace that time by the time of the system *)
0002 SystemTime(EN:= TRUE, PDT:= dtStartTime);
0003 dtCurrentTime := SystemTime.CDT;
0004 Tanks0;
0005 AlarmMonitor0;
0006 AlarmVisu(bReset := FALSE);
0007 IF bQuitAlarm THEN
0008   AlarmDatabase(bQuitAll := TRUE);
0009   bQuitAlarm := FALSE;
0010 END_IF
0011 TrendMonitor0;
0012 ButtonGroup0;
0013 Tank01(stName='Tank01',nMaxLevel=99, nMinLevel=0,nMaxTemp=55, nMinTemp=44);
0014 Tank02(stName='Tank02',nMaxLevel=70, nMinLevel=0,nMaxTemp=55, nMinTemp=44);
0015 Tank03(stName='Tank03',nMaxLevel=50, nMinLevel=0,nMaxTemp=55, nMinTemp=44);
0016 Tank04(stName='Chemical',nMaxLevel=100, nMinLevel=0,nMaxTemp=55, nMinTemp=44);
0017
0018
0019
0020
0021
0022
0023
0024
0025
0026
0027
0028
0029
0030
0031
0032
0033
0034
0035
0036
```

Loading library 'C:\Program Files\ifm electronic\CoDeSys V2.3\Library\mecsf.lib'  
Loading library 'C:\Program Files\ifm electronic\CoDeSys V2.3\Library\Standard.LIB'  
Loading library 'C:\Program Files\ifm electronic\CoDeSys V2.3\Library\SYSLIBCALLBACK.LIB'

Lin.: 1, Col.: 1 ONLINE [DV] [READ]

# Инструменты CoDeSys

The screenshot displays the CoDeSys software interface for a project named "Fuellstand.pro". The main window, titled "PLC\_VISU", shows a schematic diagram of a fuel system with four tanks and associated monitoring components. Each tank has a corresponding data box with fields for "Level" and "Temperature". A central tank is connected to a piping system with a valve and a temperature sensor (TE). The interface includes a menu bar (File, Edit, Project, Insert, Extras, Online, Window, Help), a toolbar, and a project tree on the left. The project tree lists the following components:

- POUs
  - Alarm
    - AlarmDatabase (PRG)
    - AlarmMonitor (PRG)
    - AlarmVisu (PRG)
    - ButtonGroup (PRG)
    - ChangeDateToCString (FUN)
    - ChangeTimeToCString (FUN)
  - Trend
    - TrendDatabase (PRG)
    - TrendMonitor (PRG)
  - PLC\_PRG (PRG)
  - Tank (FB)
  - Tanks (PRG)

At the bottom of the interface, there is a status bar and a code editor window showing the following text:

```
Initialisation code for POU 'TrendEntry'  
Hardware-Configuration  
POU indices:58 (11%)  
Size of used data: 437 of 16384 bytes (2.67%)  
0 Error(s), 0 Warning(s).  
Code size: 10 bytes
```

The status bar at the bottom right indicates the current element is a "Rectangle" and the system is in "ONLINE" mode.

# Дисплей RM 2501

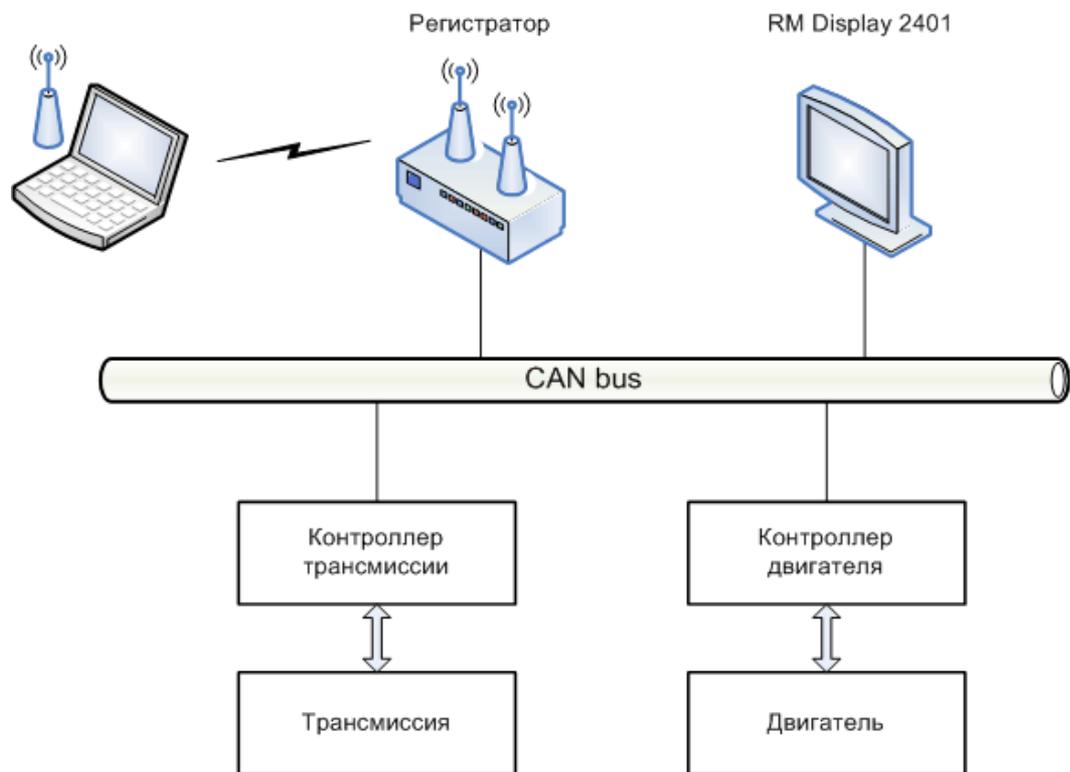


Особенности:

- ◎ NMT-master / NMT-slave
- ◎ Error Control:  
Node guarding, Heartbeat
- ◎ Node ID:  
Software switch, LSS-services
- ◎ 135 RPDO, 512 TPDO
- ◎ Протоколы CANopen, J1939

# Практика применения

Задача: визуализация поступающих от контроллеров трансмиссии и двигателя данных на опытном образце трактора ЧН-6



# Практика применения

Протокол J1939:

PGN61442 – Electronic Transmission Controller #1

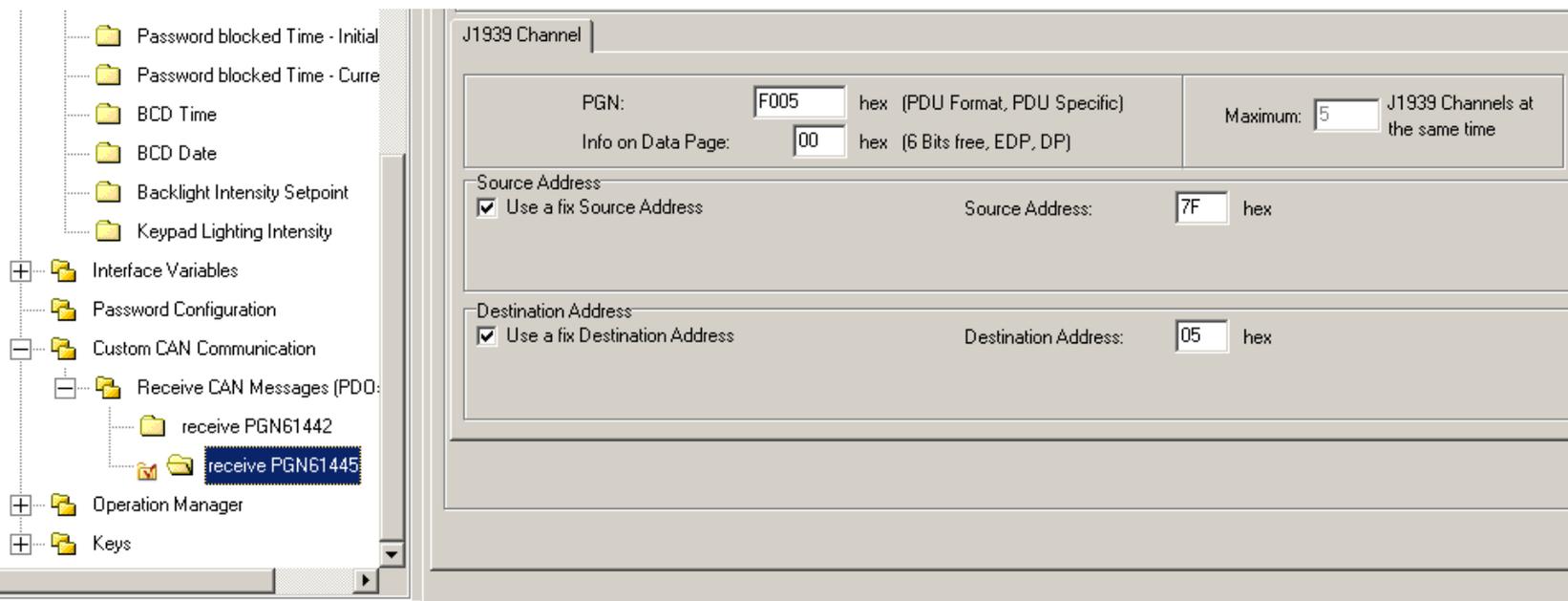
PGN61443 – Electronic Engine Controller #2

PGN61444 – Electronic Engine Controller #1

PGN61445 – Electronic Transmission Controller #2

# Реализация протокола

## Разбор заголовка CAN-кадра:



The screenshot displays a software configuration window for a J1939 Channel. On the left, a tree view shows a project structure with folders like 'Password blocked Time', 'BCD Time', and 'Custom CAN Communication'. Under 'Custom CAN Communication', there is a sub-folder 'Receive CAN Messages (PDO:)' containing 'receive PGN61442' and 'receive PGN61445' (which is selected). The main configuration area on the right is titled 'J1939 Channel' and contains the following fields:

- PGN:  hex (PDU Format, PDU Specific)
- Info on Data Page:  hex (6 Bits free, EDP, DP)
- Maximum:  J1939 Channels at the same time
- Source Address:
  - Use a fix Source Address
  - Source Address:  hex
- Destination Address:
  - Use a fix Destination Address
  - Destination Address:  hex

# Реализация протокола

## Разбор поля данных CAN-кадра:

Receive CAN Messages (PDDs) -- receive PGN61445

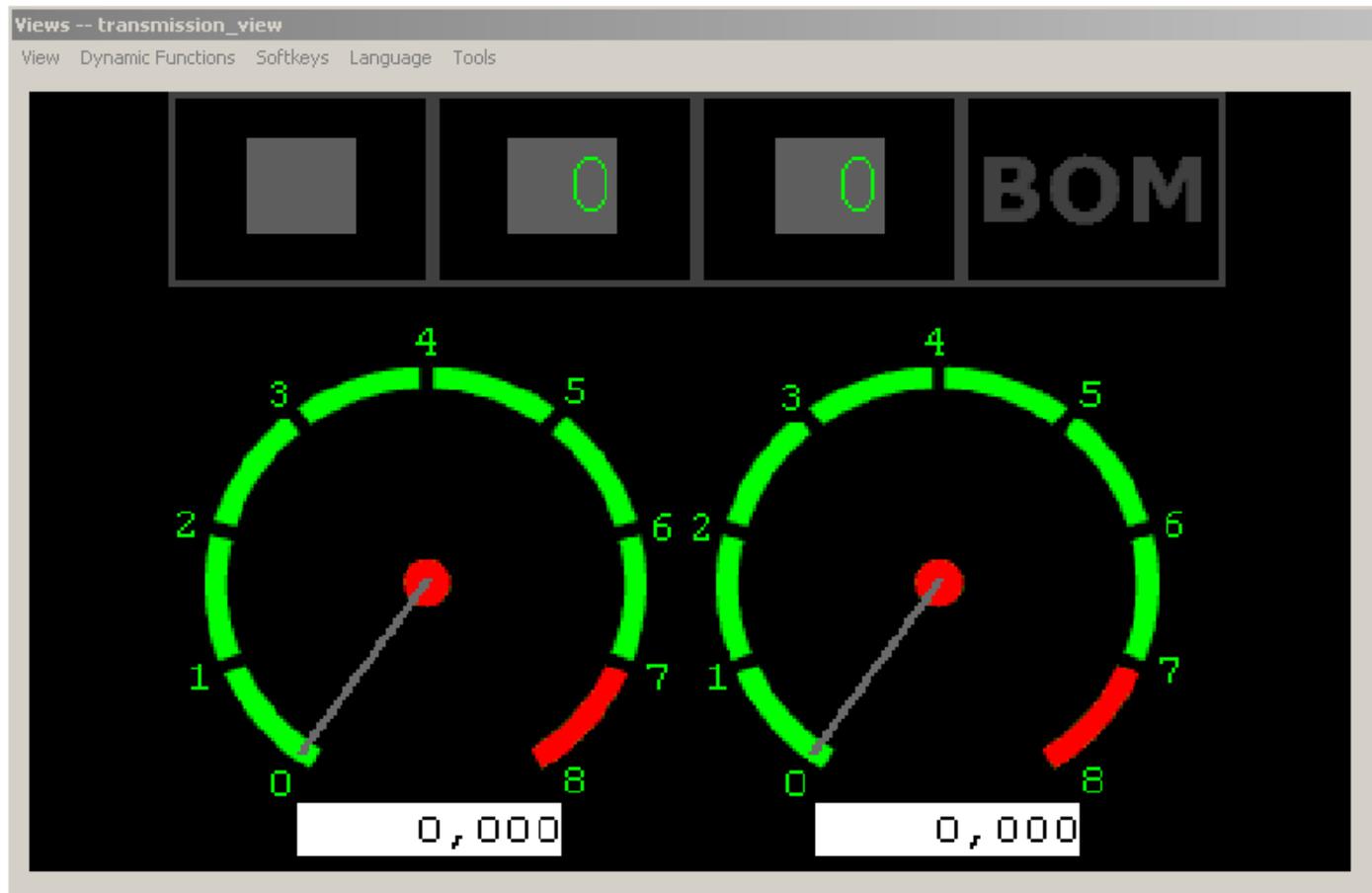
Communication Parameter | Status Link | Mapping Parameter

Number of Mapping Entries

	Internal Parameter Index (hex):	Internal SubIndex (H)	Internal Name:	Object Type:	Number of Bits:	Comparison Value (hex):
1:	4002	03	u8pgn61445_D6_range_msb	U8	8	Always True
2:	4002	04	u8pgn61445_D7_range_lsb	U8	8	Always True
3:	4006	05	u16pgn61445_D6D7_range	U16	16	Always True
4:	4006	07	u8pgn61445_D3_cur_gear	U16	8	Always True
5:	4006	06	u16pgn61445_D4D5_error_no	U16	16	Always True
6:	4006	08	u8pgn61445_D0_sel_gear	U16	8	Always True

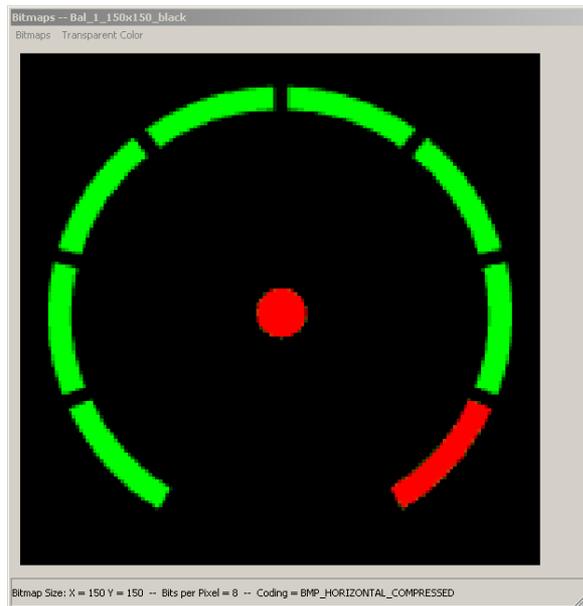
# Визуальный интерфейс

Общий вид:



# Визуальный интерфейс

## Заготовка элемента, параметры:



Pointer Gage | Pointer Gage Dynamic Functions

Link to Gage Value Source:  
 Link to Interface Variables float\_tractor\_speed  
 Link to Device Variables

Position:  
Top: 75 Bottom: 225  
Left: 45 Right: 195

Background Bitmap Source:  
Ba\_1\_150x150\_black

Pointer Fix Point:  
X-Position: 120  
Y-Position: 150  
Pointer Length: 65 [Pixel]  
Pointer Color:

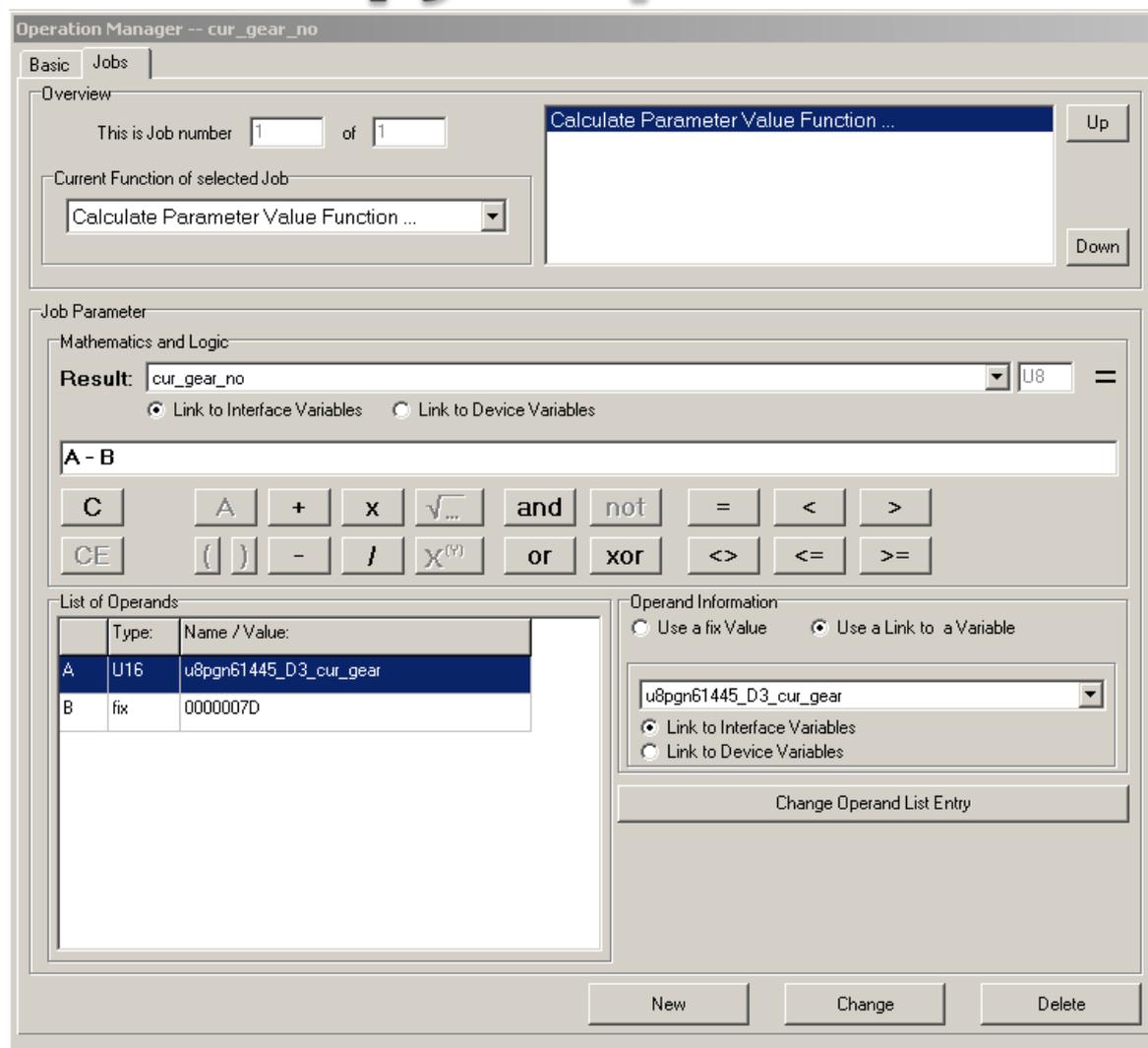
Format:  
0 % Angle: 234 [ ]  
100 % Angle: -54 [ ]

Use Link for 0 and 100 % Value

0 % Value: 0.0000  
100 % Value: 80.0000

# Динамические функции

Вычисление скорости:



# Имитационный контроллер

ifm R360 SmartController CR2500:

- ◎ Тактовая частота ЦП: 20 МГц
- ◎ Аналоговые входы: 4 (%IW6...%IW9)
- ◎ Цифровые входы: 4 (%IX0.0...%IX1.8)
- ◎ Цифровые выходы: 4 (%QX0.0...%QX1.8)
- ◎ 2xCAN (CAN level 2, CANopen, J1939)

# Функциональные блоки

