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About this application note

This application note describes how the predefined RapidPro configurations can be used during the Rapid Control Prototyping development phase. RapidPro’s predefined configurations cover a wide range of typical signal conditioning and power stage tasks in various application areas. For example, the configurations for engine control prototyping let you run engines with up to 6 cylinders and all modern sensors and actuators, and the configuration for electric motor control serves as a flexible inverter stage during the prototyping phase of diverse AC electric motors. Each configuration consists of selected RapidPro power and signal conditioning modules installed in the corresponding number of RapidPro units. A Control Unit is used whenever complex I/O signals need to be captured or generated, or a large number of I/O signals are involved.

With this application note, dSPACE also provides dedicated Simulink® I/O startup models for the configurations which include all available I/O signals and suitable ConfigurationDesk experiments.

To verify correct system behaviour, dedicated RapidPro system configurations were built up and tested with a counterpart Hardware-In-The-Loop System. This also included generation and testing of new routing files (see corresponding Routing ID) which represent the specific setup of RapidPro units and modules.

The example configurations were created and tested using MATLAB R2007b+ (Simulink 7.0.1) and dSPACE Release 6.6.
Engine Control

For engine control two different RapidPro configurations are offered: The basic configuration covers engines with up to 3 cylinders, whereas the advanced configuration allows prototyping of engines with up to 6 cylinders supporting latest development trends such as direct injection. The pictures below show the various I/O possibilities for sensor and actuator connection. For a quick and efficient working startup with the configurations, demo models (RP_System_EngineAdvanced.mdl and RP_System_EngineBasic.mdl) are provided. Also included: A pinout file and hardware topology files for RTI connection.

Overview Basic configuration (up to 3 cylinders, Routing ID 1977)

<table>
<thead>
<tr>
<th>10 analog sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Temperature</td>
</tr>
<tr>
<td>- Pressure</td>
</tr>
<tr>
<td>- Throttle position</td>
</tr>
<tr>
<td>- Air-mass flow</td>
</tr>
<tr>
<td>- ...</td>
</tr>
</tbody>
</table>

6 inputs for camshaft and crankshaft
- Speed and position of camshaft and crankshaft

2 DC motor drivers
- Throttle motor
- EGR motor

6 high-side drivers
- Relays (ECU power supply)
- Valves (tumble control, VVT valve)

12 low-side drivers
- Relays
- Valves
- Injection driver
- Ignition driver

Optional: 2 injection valve drivers
- Solenoid injection valves

The Engine Basic configuration comprises of the following RapidPro modules:

RapidPro units and modules

<table>
<thead>
<tr>
<th>PowerUnit</th>
<th>Control Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS1637</td>
<td></td>
</tr>
<tr>
<td>DS1642</td>
<td></td>
</tr>
<tr>
<td>DS1634</td>
<td></td>
</tr>
<tr>
<td>DS1633</td>
<td></td>
</tr>
<tr>
<td>DS1661</td>
<td></td>
</tr>
<tr>
<td>DS1662</td>
<td></td>
</tr>
<tr>
<td>DS1663</td>
<td></td>
</tr>
</tbody>
</table>
Engine Control Advanced configuration (6 Cylinder, Routing ID 38209)

The Engine Advanced configuration comprises of the following RapidPro modules and Add-Ons:

- **Up to 30 analog sensors**
  - Temperature
  - Pressure
  - Throttle position
  - Air mass flow
  - ...

- **2 lambda inputs**
  - BOSCH lambda sensors
    - Full coverage (LSU 4.2, 4.9, ADV)

- **4 knock sensor inputs**

- **16 digital inputs**
  - Switches
  - Brake and clutch pedal
  - Neutral gear
  - Cruise control
  - ...

- **4 x sensor supply**
  - Sensors
  - Parts
  - Devices

- **6 inputs for camshaft and crankshaft**
  - Speed and position of camshaft and crankshaft

- **6 solenoid valve drivers**
  - Solenoid injection valves

- **2x 7A DC motor drivers**
  - Throttle motor
  - EGR motor

- **Up to 18 low-side drivers**
  - Relays
  - Valves

- **6 high-side drivers**
  - Relays
  - Valves

- **16 digital outputs**
  - PWM outputs
  - Relay outputs
  - Flexible controls

RapidPro units and modules

```plaintext
PowerUnit
PowerUnit
SC Unit
Control_Unit
```

- DS1637
- DS1646
- DS1634
- DS1635
- DS1642
- DS1623
- DS1633
- DS1632
- DS1642
- DS1646
- DS1664
- DS1642
- DS1662
- DS1662
- DS1662
- DS1661
- DS1663
Body Control

For body control two different RapidPro configurations are offered. The advanced configuration additionally comes with a demo Simulink model. (RP_System_BodyBasic.mdl). Also included: A pinout file and hardware topology files for RTI connection.

Basic configuration

The Body Control Basic configuration comprises of the following RapidPro modules and Add-Ons.

RapidPro units and modules

PowerUn. (single)

SC Unit (single)

DS1633 SC-AI 10/1
DS1642 SC-DI 8/1
DS1642 SC-DI 8/1
DS1642 SC-DI 8/1
DS1626 SC-SENS 4/1
DS1646 SC-DO 8/1
DS1661_M PS-FBD 2/1
DS1662 PS-LSD 6/1
DS1663 PS-HSD 6/1
DS1663 PS-HSD 6/1
Body control Advanced configuration (Routing ID 43709)

- **60 digital inputs**
  - Instrument switches, controls (e.g., lights, door, lock, brake)
  - Combi switches and various inputs

- **10 analog inputs**
  - Monitoring (e.g., battery)
  - Multi-step switches (e.g., wiper speed)

- **16 digital outputs**
  - LED drivers
  - Relay drivers
  - ...

- **6 low-side drivers**
  - Relay drivers
  - On/Off motor drivers (e.g., door, mirror)
  - Lamp, LED driver

- **24 high-side drivers**
  - Relay drivers
  - LED drivers
  - On/Off motor drivers (e.g., door, mirror)

- **2 full bridge driver**
  - DC motor control (e.g., wing mirror, washing pump)

The **Body Control Advanced** configuration comprises of the following RapidPro modules and Add-Ons:

**RapidPro units and modules**

- PowerUnit
- SC Unit
- Control Unit

**Devices**

- 8x DS1642
- DS1633
- DS1646
- 4x DS1662
- 8x DS1633
Chassis Control

For chassis control development two RapidPro configurations are offered (see pictures below). For a quick startup, the advanced configuration additionally comes with a demo Simulink model. (RP_System_BodyBasic.mdl). Also included: A pinout file and hardware topology files for RTI connection.

Basic configuration

<table>
<thead>
<tr>
<th>14 analog sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Acceleration</td>
</tr>
<tr>
<td>Level sensors</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4 x sensor supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensors</td>
</tr>
<tr>
<td>Parts</td>
</tr>
<tr>
<td>Devices</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>16 digital inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level sensors</td>
</tr>
<tr>
<td>Various switches</td>
</tr>
<tr>
<td>Wheel speed sensors</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>12 low-side drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportional valves</td>
</tr>
<tr>
<td>Valves for hydraulic control</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2 full bridge driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC motor</td>
</tr>
<tr>
<td>Stepper motor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8 digital outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWM outputs</td>
</tr>
<tr>
<td>Relay driver</td>
</tr>
<tr>
<td>Flexible controls</td>
</tr>
</tbody>
</table>

Advanced configuration (Routing ID 46013)

<table>
<thead>
<tr>
<th>24 analog inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Temperature</td>
</tr>
<tr>
<td>Level sensors</td>
</tr>
<tr>
<td>Acceleration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4 x sensor supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensors</td>
</tr>
<tr>
<td>Parts</td>
</tr>
<tr>
<td>Devices</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>24 digital inputs</th>
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<tbody>
<tr>
<td>Level sensors</td>
</tr>
<tr>
<td>Various switches</td>
</tr>
<tr>
<td>Wheel speed sensors</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>18 low-side driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportional valves</td>
</tr>
<tr>
<td>Valves for hydraulic control</td>
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</tbody>
</table>

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<th>2 full bridge driver</th>
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<td>DC motor</td>
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<td>PWM outputs</td>
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<tr>
<td>Flexible controls</td>
</tr>
<tr>
<td>Relay driver</td>
</tr>
</tbody>
</table>
Transmission Control

The RapidPro transmission control configuration provides signal conditioning and power stages for typical setups (Routing ID 54857). Also included: A pinout file and hardware topology files for RTI connection.

Electric Motor Control

The RapidPro configuration for electric motor control (PowerUnit Routing 60766) provides the power stages for various electric motors such as synchronous, asynchronous motors or AC induction motors. In combination with MicroAutoBoxII-ACMC (available from Q2-2011) or DS5202-ACMC a powerful prototyping environment for convenient control development is provided. The ACMC also comes with dedicated Startup models for control of various brushless electric motors.

- Universal power stage for 3 phase BLDC, AC induction and synchronous motors
- Up to 30V, 60A peak and 42A continuous per motor phase
- Application example: power stages for DS5202 ACMC solution
How to Contact dSPACE Support

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D-33102 Paderborn
Germany
++49 5251 1638-941
mailto:support@dspace.de
http://www.dspace.com/support

dSPACE recommends that you use dSPACE Support Wizard to contact dSPACE support. It is available

- On your dSPACE DVD at \Diag\Tools\dSPACESupportWizard.exe
- Via Start – Programs – dSPACE Tools (after installation of the dSPACE software)
- At http://www.dspace.com/goto?supportwizard
  You can always find the latest version of dSPACE Support Wizard here.

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