TPI RLY - Relays

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Simon STROBL
Product Director
imperix • in

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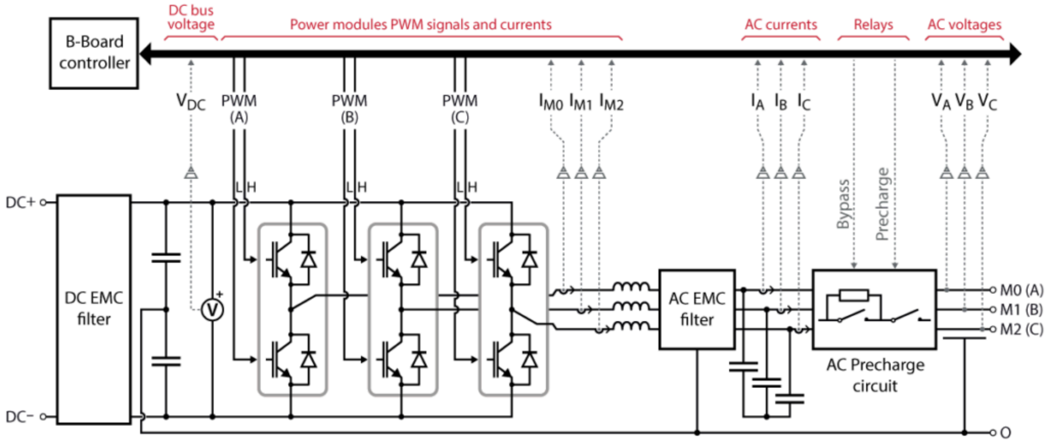
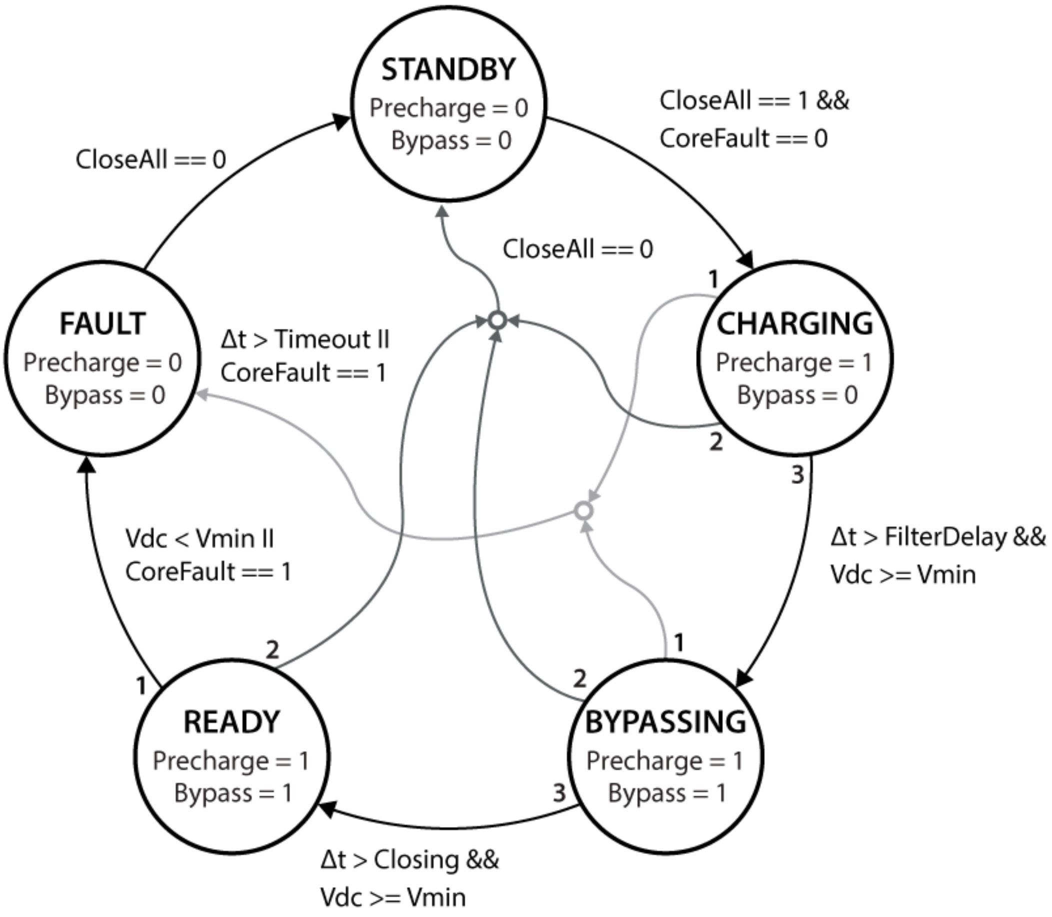
The TPI RLY block controls the relays of the AC precharge circuit of the all-in-one programmable inverter (TPI8032 22kW).

For reference, the topology of the converter is shown below. The inverter naturally acts as a diode rectifier due to the anti-parallel body diodes of the MOSFETs. Uncontrollable currents will flow through the diodes should the DC bus voltage drop below the rectified AC voltage. For this reason, it is essential to precharge the DC bus before initiating regular operation. More information can be found in TN131: DC bus precharging techniques.



Topology of the TPI8032

By default, the relays of the AC precharge circuit are fully automated with a Finite State Machine and allow a safe and seamless connection to the grid. Please refer to the TPI8032 datasheet for more details. Optionally, it is possible to control the precharge and bypass relays manually. By doing so, the user bears the risk of damaging the equipment in case of inadequate operation.



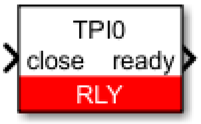
Finite State Machine of the AC precharge circuit

The TPI RLY block is available starting from version 2024.2 of the SDK. The TPI8032 is **required** to use this driver.

Simulink block

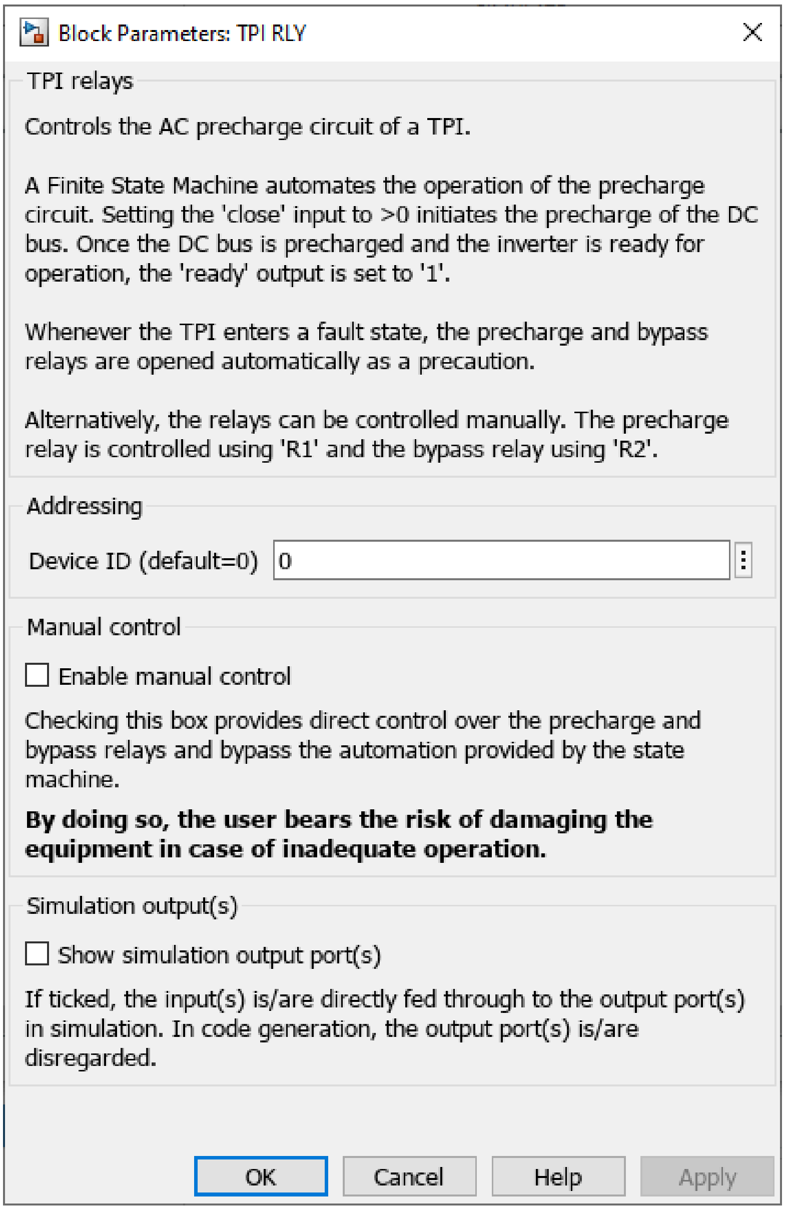
Signal specification

- Setting the `close` input to >0 initiates the precharge of the DC bus.
- The `ready` signal is set to '1' once the DC bus is precharged and the inverter is ready for operation.
- When manual control is enabled, the precharge and bypass relays are controlled using `R1` and `R2` respectively.
- The `sim R1` and `sim R2` output signals are used in simulation and documented in Simulation essentials with Simulink (PN135).



Parameters

- `Device ID` selects which TPI to address when used in a multi-device configuration.
- `Enable manual control` bypasses the automation provided by the state machine and provides direct control of the precharge and bypass relays.
- `Show simulation ouput port(s)` defines if the simulation output ports are displayed or not.



TPI relays

Controls the AC precharge circuit of a TPI.

A Finite State Machine automates the operation of the precharge circuit. Setting the 'close' input to >0 initiates the precharge of the DC bus. Once the DC bus is precharged and the inverter is ready for operation, the 'ready' output is set to '1'.

Whenever the TPI enters a fault state, the precharge and bypass relays are opened automatically as a precaution.

Alternatively, the relays can be controlled manually. The precharge relay is controlled using 'R1' and the bypass relay using 'R2'.

Addressing

Device ID (default=0) 0

Manual control

□ Enable manual control

Checking this box provides direct control over the precharge and bypass relays and bypass the automation provided by the state machine.

By doing so, the user bears the risk of damaging the equipment in case of inadequate operation.

Simulation output(s)

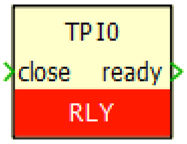
□ Show simulation output port(s)

If ticked, the input(s) is/are directly fed through to the output port(s) in simulation. In code generation, the output port(s) is/are disregarded.

PLECS block

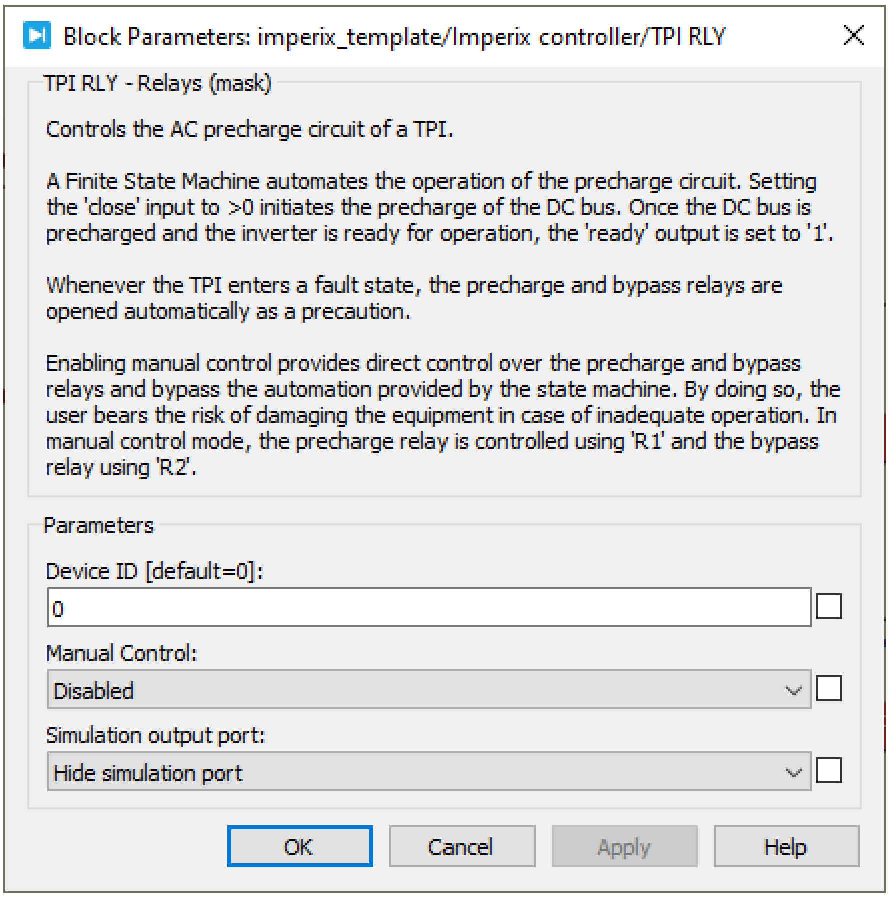
Signal specification

- Setting the `close` input to >0 initiates the precharge of the DC bus.
- The `ready` signal is set to ‘1’ once the DC bus is precharged and the inverter is ready for operation.
- When manual control is enabled, the precharge and bypass relays are controlled using `R1` and `R2` respectively.
- The target output ports (only visible at the atomic subsystem level) are used in simulation and documented in Simulation essentials with PLECS (PN137).



Parameters

- `Device ID` selects which TPI to address when used in a multi-device configuration.
- `Enable manual control` bypasses the automation provided by the state machine and provides direct control of the precharge and bypass relays.
- `Show simulation ouput port(s)` defines if the simulation output ports are displayed or not.



Block Parameters: imperix_template/Imperix controller/TPI RLY

TPI RLY - Relays (mask)

Controls the AC precharge circuit of a TPI.

A Finite State Machine automates the operation of the precharge circuit. Setting the 'close' input to >0 initiates the precharge of the DC bus. Once the DC bus is precharged and the inverter is ready for operation, the 'ready' output is set to '1'.

Whenever the TPI enters a fault state, the precharge and bypass relays are opened automatically as a precaution.

Enabling manual control provides direct control over the precharge and bypass relays and bypass the automation provided by the state machine. By doing so, the user bears the risk of damaging the equipment in case of inadequate operation. In manual control mode, the precharge relay is controlled using 'R1' and the bypass relay using 'R2'.

Parameters

Device ID [default=0]: 0 □

Manual Control: Disabled □

Simulation output port: Hide simulation port □

C++ functions

`Rly_CloseAll` — Initiates the precharge of the DC bus

```cpp
void Rly_CloseAll(unsigned int device=0);
```
Code language: C++ (cpp)

Initiates the precharge of the DC bus.

It can be called in `UserInit()` or in the control interrupt routine.

Parameters

- device: the ID of the addressed device (optional, used in multi-device configuration only).

Rly_OpenAll — Open all relays of the precharge circuit

```
void Rly_OpenAll(unsigned int device=0);Code language: C++ (cpp)
```

Open all relays of the precharge circuit.

It can be called in UserInit() or in the control interrupt routine.

Parameters

- device: the ID of the addressed device (optional, used in multi-device configuration only).

Rly_ReadyToOperate — Indicates the status of the precharge

```
bool Rly_ReadyToOperate(unsigned int device=0);Code language: C++ (cpp)
```

Indicates that the DC bus is precharged and the inverter is ready for operation.

It has to be called during the control interrupt.

Parameters

- device: the ID of the addressed device (optional, used in multi-device configuration only).

Rly_EnableManualControl — Provides direct control of the relays

```
void Rly_EnableManualControl(unsigned int device=0);Code language: C++ (cpp)
```

Provides direct control over the precharge and bypass relays and bypasses the automation provided by the state machine.

By doing so, the user bears the risk of damaging the equipment in case of inadequate operation.

Enables the use of Rly_ClosePrecharge, Rly_OpenPrecharge, Rly_CloseBypass, and Rly_OpenBypass.
Disables Rly_CloseAll, Rly_OpenAll, and Rly_ReadyToOperate.

It has to be called in UserInit().

Parameters

- `device`: the ID of the addressed device (optional, used in multi-device configuration only).

`Rly_ClosePrecharge` — Closes the precharge relay

```cpp
void Rly_ClosePrecharge(unsigned int device=0);
```

Code language: C++ (cpp)

Closes the precharge relay.

It can be called in `UserInit()` or in the control interrupt routine.

Parameters

- `device`: the ID of the addressed device (optional, used in multi-device configuration only).

`Rly_OpenPrecharge` — Opens the precharge relay

```cpp
void Rly_OpenPrecharge(unsigned int device=0);
```

Code language: C++ (cpp)

Opens the precharge relay.

It can be called in `UserInit()` or in the control interrupt routine.

Parameters

- `device`: the ID of the addressed device (optional, used in multi-device configuration only).

`Rly_CloseBypass` — Closes the bypass relay

```cpp
void Rly_CloseBypass(unsigned int device=0);
```

Code language: C++ (cpp)

Closes the bypass relay.

It can be called in `UserInit()` or in the control interrupt routine.

Parameters

- `device`: the ID of the addressed device (optional, used in multi-device configuration only).

`Rly_OpenBypass` — Opens the bypass relay

```cpp
void Rly_OpenBypass(unsigned int device=0);
```

Code language: C++ (cpp)

Opens the bypass relay.

It can be called in `UserInit()` or in the control interrupt routine.

Parameters

- `device`: the ID of the addressed device (optional, used in multi-device configuration only).