Kassow Robots
PROFINET

Version: 1.0.0 EN1

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1 Introduction

Profinet (usually styled as PROFINET, as a portmanteau for Process Field Net) is an industry technical standard for data communication over Industrial Ethernet, designed for collecting data from, and controlling equipment in industrial systems, with a particular strength in delivering data under tight time constraints. The standard is maintained and supported by Profibus & Profinet International [de], an umbrella organization headquartered in Karlsruhe, Germany.

KassowRobots RCs provide the access to this realtime field bus by the use of specialised hardware extension (Hilscher cifX), available only for the dedicated controllers (it is not a part of the standard product KR RC).

The Profinet extension handles all necessary realtime requirements for the fieldbus and allows to integrate KassowRobots controllers with the existing Profinet infrastructures.

2 Kassow Profinet

2.1 Structure

2.1.1 IO Modules

The robot Profinet data are organized into **12** modules. **7** modules serve for sharing the data from the robot to a PLC while **5** modules can be used to send data from a PLC to the robot. All modules are optional, but are fixed to a specific slot.

Slot	Name	Direction	Description
1	System State	Robot → PLC	Monitors robot and safety state
2	Joints Monitor	Robot → PLC	Monitors joint positions and dynamics
3	TCP Monitor	Robot → PLC	Monitors TCP kinematics and dynamics
4	IO Monitor	Robot → PLC	Monitors IO Board and Tool IO state
5	64x Bit Input	Robot → PLC	Input bit register allocated for user data
6	24x Int Input	Robot → PLC	Input integer register allocated for user data
7	24x Real Input	Robot → PLC	Input real register allocated for user data
8	System Control	PLC → Robot	Controls master speed
9	IO Control	PLC → Robot	Controls IO Board and Tool IO outputs
10	64x Bit Output	PLC → Robot	Output bit register allocated for user data
11	24x Int Output	PLC → Robot	Output integer register allocated for user data
12	24x Real Output	PLC → Robot	Output real register allocated for user data

Detailed information about each of the modules can be found in Appendix A.

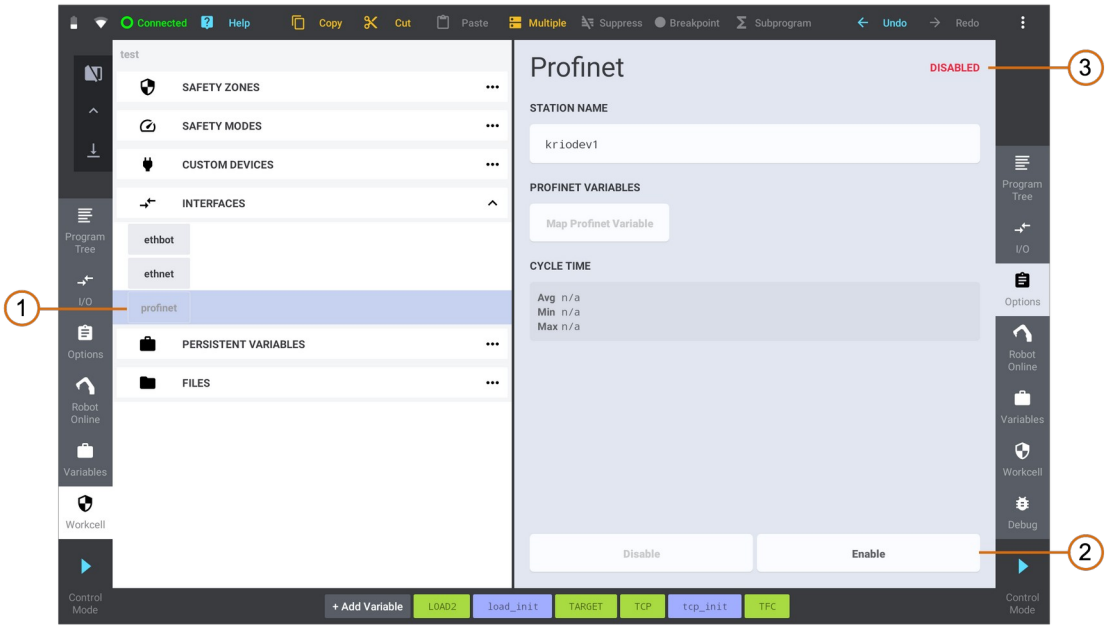
2.1.2 User defined types

In order to provide easier integration with PLCs, the structure of IO modules has been also expressed via user defined types (UDT). Once the user imports KR datastruct into PLC's programming environment, each module can be mapped into appropriate data type.

Note: For the *Profinet_-KR-_Datastruct.udt file* file, please check with our online documentation or get in touch with our support line.

2.2 Profinet activation

Profinet needs to be enabled through the teach pendant UI prior its usage.



1. Select Profinet interface in Workcell.
2. Click enable to activated the Profinet.
3. Wait until the status is changed to Connected.

If Profinet interface is not available, your robot is probably not equipped with optional Profinet HW.

2.3 Profinet variables

The robot allows mapping of 6 Profinet modules (bit, int and real user data) into system variables. Each of these modules is represented as an array variable with one column of number data type.

System Variable	Data Type	Module	Direction	Length
Profinet Bit Output	Array	PLC → Robot	PLC → Robot	24
Profinet Int Output	Array	PLC → Robot	PLC → Robot	64
Profinet Float Output	Array	PLC → Robot	PLC → Robot	64
Profinet Bit Input	Array	Robot → PLC	Robot → PLC	24
Profinet Int Input	Array	Robot → PLC	Robot → PLC	64
Profinet Float Input	Array	Robot → PLC	Robot → PLC	64

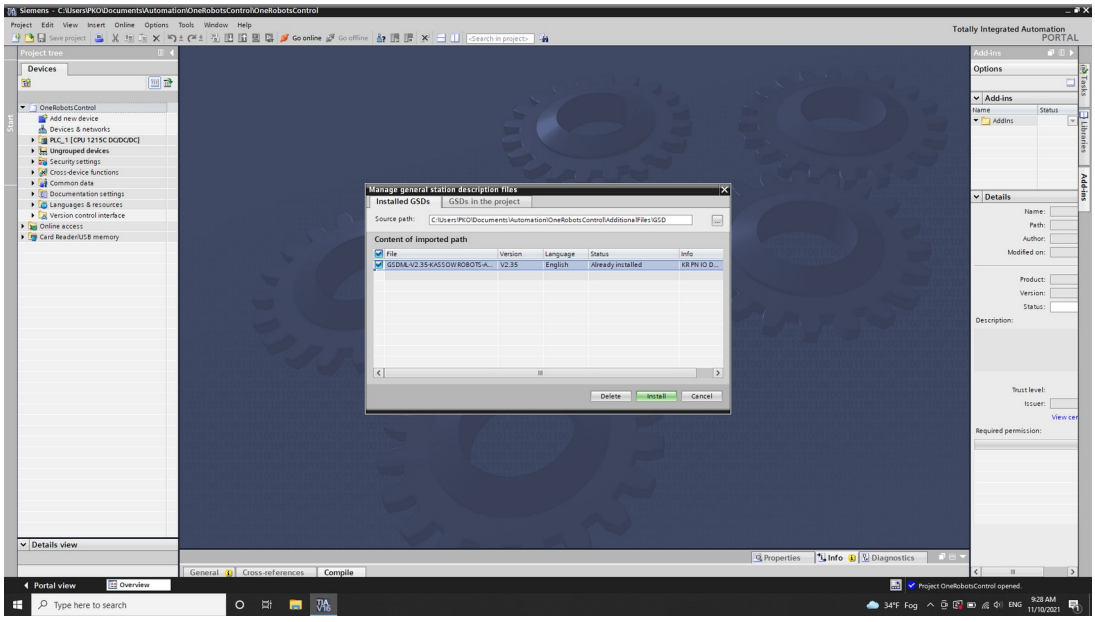
2.3.1 Map Profinet variable

1. Select Profinet interface int Workcell.
2. Click Map Profinet Variable.
3. Select desired mapping, enter variable name and click Create.

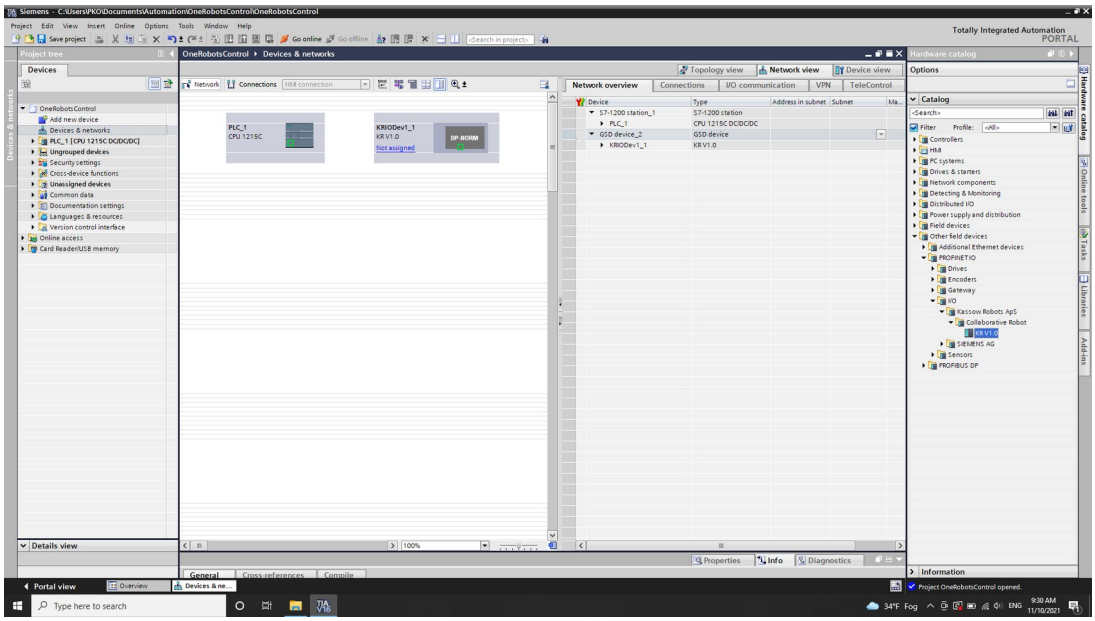
2.4 Profinet usage in TIA portal

1. Install Kassow Robots GSD file to TIA Portal.

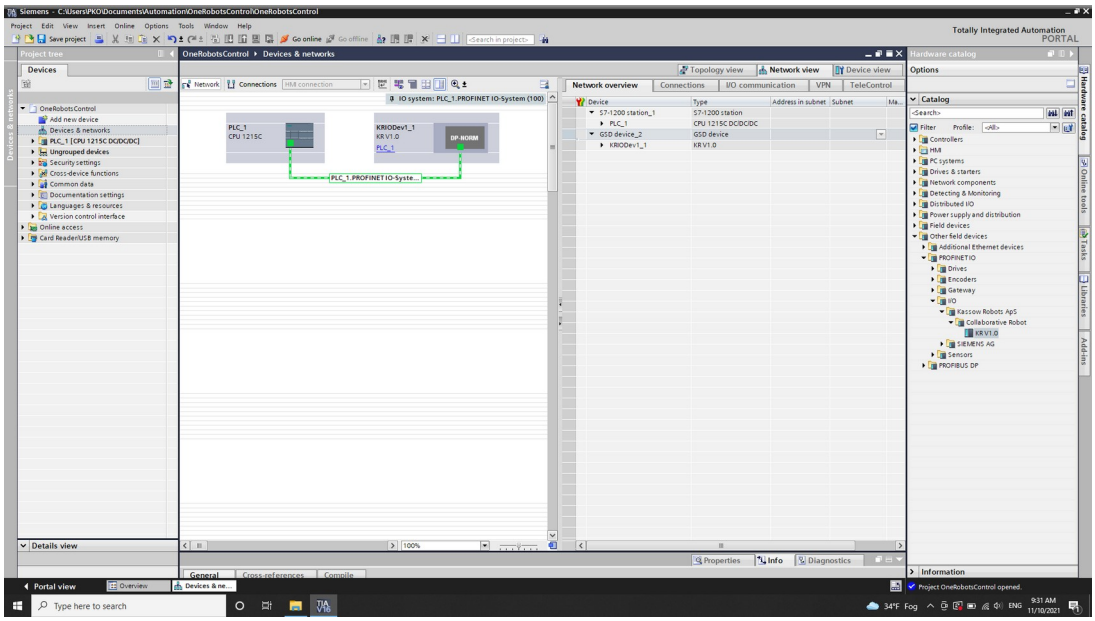
   Note: For the *gsdml-v2.35-kassow_robots-axxx-20210602.xml* file, please check with our online documentation or get in touch with our support line.



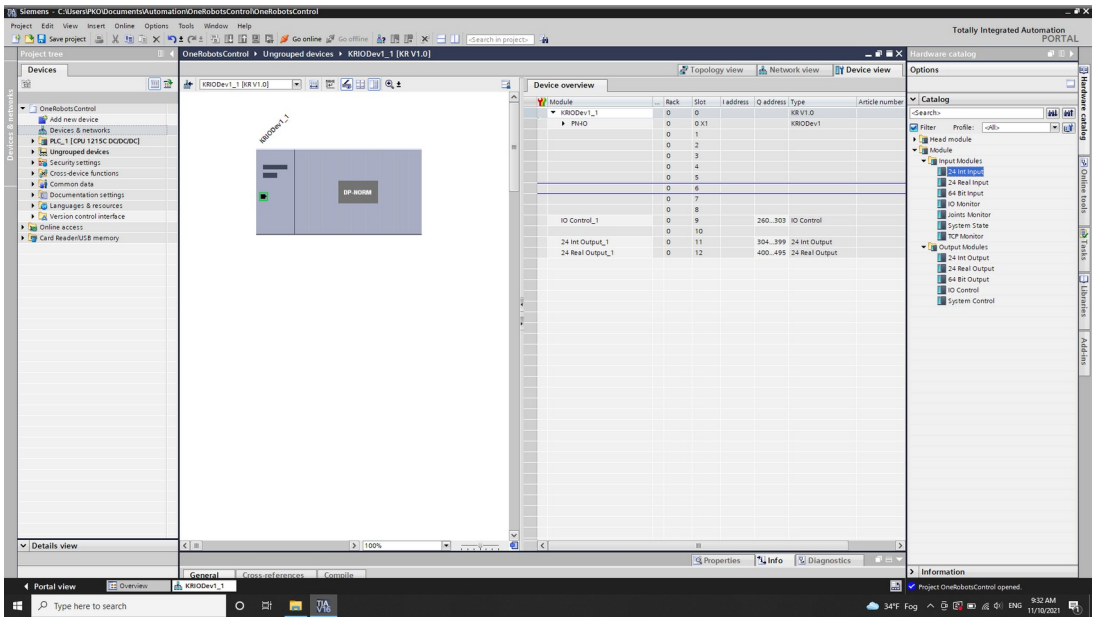
2. Add KRv1.0 device to network.



3. Connect KR device to PLC.



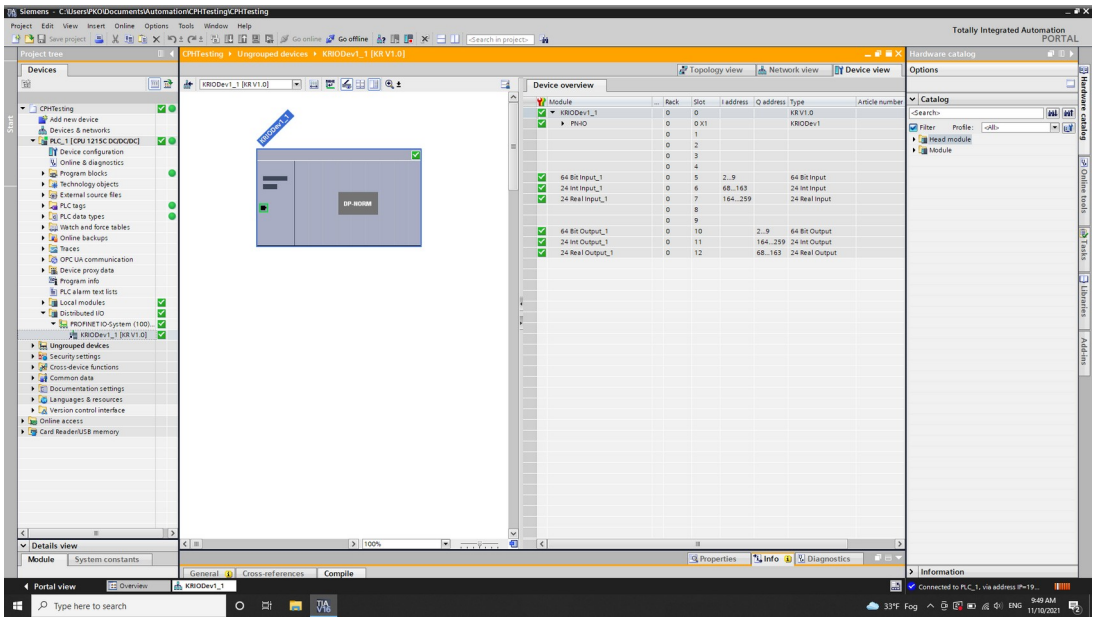
4. Add desired IO modules to KR device.



5. Compile HW configuration.

6. Download HW configuration to PLC.

7. Go online and check status.



A Appendix - KR Profinet network frame

System State

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	Major version (uint8_t)								Minor version (uint8_t)								Reserved															
32	Robot milliseconds (uint16_t)																Robot seconds (uint8_t)								Robot minutes (uint8_t)							
64	Robot hours (uint8_t)								Reserved								Robot days (uint16_t)															
96	Robot current [A] (float)																															
128	Robot mode (uint8_t)								Robot state (uint8_t)								Program state (uint8_t)								Reserved							
160	EB	PB	TB	BB	Reserved				Reserved																							
192	Master Speed (float)																															
224	Safety mode (uint8_t)								Reserved																ES	PS	SS	Reserved				

Joints Monitor

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	Joint 1 position [rad] (float)																															
32	Joint 2 position [rad] (float)																															
64	Joint 3 position [rad] (float)																															
96	Joint 4 position [rad] (float)																															
128	Joint 5 position [rad] (float)																															
160	Joint 6 position [rad] (float)																															
192	Joint 7 position [rad] (float)																															
224	Joint 1 velocity [rad/s] (float)																															
256	Joint 2 velocity [rad/s] (float)																															
288	Joint 3 velocity [rad/s] (float)																															
320	Joint 4 velocity [rad/s] (float)																															
352	Joint 5 velocity [rad/s] (float)																															
384	Joint 6 velocity [rad/s] (float)																															
416	Joint 7 velocity [rad/s] (float)																															
448	Joint 1 current [A] (float)																															
480	Joint 2 current [A] (float)																															
512	Joint 3 current [A] (float)																															
544	Joint 4 current [A] (float)																															
576	Joint 5 current [A] (float)																															
608	Joint 6 current [A] (float)																															
640	Joint 7 current [A] (float)																															
672	Joint 1 temperature [°C] (float)																															
704	Joint 2 temperature [°C] (float)																															
736	Joint 3 temperature [°C] (float)																															
768	Joint 4 temperature [°C] (float)																															
800	Joint 5 temperature [°C] (float)																															
832	Joint 6 temperature [°C] (float)																															
864	Joint 7 temperature [°C] (float)																															

TCP Monitor

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	TCP position X [m] (float)																															
32	TCP position Y [m] (float)																															
64	TCP position Z [m] (float)																															
96	TCP position OR [rad] (float)																															
128	TCP position OP [rad] (float)																															
160	TCP position OY [rad] (float)																															
192	TCP velocity X [m/s] (float)																															
224	TCP velocity Y [m/s] (float)																															
256	TCP velocity Z [m/s] (float)																															
288	TCP velocity OR [rad/s] (float)																															
320	TCP velocity OP [rad/s] (float)																															
352	TCP velocity OY [rad/s] (float)																															
384	TCP force X [N] (float)																															
416	TCP force Y [N] (float)																															
448	TCP force Z [N] (float)																															
480	TCP torque X [N.m] (float)																															
512	TCP torque Y [N.m] (float)																															
544	TCP torque Z [N.m] (float)																															
576	TCP force scalar [N] (float)																															

IO Monitor

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	IOB digital inputs (bits)																IOB safe inputs (bits)								Reserved							
32	IOB current input 1 [A] (float)																															
64	IOB current input 2 [A] (float)																															
96	IOB voltage input 1 [V] (float)																															

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
128	IOB voltage input 2 [V] (float)																															
160	IOB quadrature 1 pulse per rev (int32_t)																															
192	IOB quadrature 2 pulse per rev (int32_t)																															
224	IOB quadrature idx availability (bits)								Reserved								IOB quadrature direction (bits)								Reserved							
256	IOB quadrature 1 pulse count (int32_t)																															
288	IOB quadrature 2 pulse count (int32_t)																															
320	IOB quadrature 1 frequency (int32_t)																															
352	IOB quadrature 2 frequency (int32_t)																															
384	IOB quadrature 1 abs pulse count (int32_t)																															
416	IOB quadrature 2 abs pulse count (int32_t)																															
448	IOB quadrature 1 pulse per sec (int32_t)																															
480	IOB quadrature 2 pulse per sec (int32_t)																															
512	IOB digital outputs (bits)								IOB relay outputs (bits)								Reserved															
544	IOB current output 1 [A] (float)																															
576	IOB current output 2 [A] (float)																															
608	IOB voltage output 1 [V] (float)																															
640	IOB voltage output 2 [V] (float)																															
672	TIO current input [A] (float)																															
704	TIO voltage input 1 [V] (float)																															
736	TIO voltage input 2 [V] (float)																															
768	TIO voltage input 3 [V] (float)																															
800	TIO voltage input 4 [V] (float)																															
832	TIO digital outputs range (bits)								TIO digital outputs (bits)								TIO power supply range (bits)								TIO power supply (bits)							
864	TIO analog outputs type (bits)								Reserved																							
896	TIO analog output 1 [A or V] (float)																															
928	TIO analog output 2 [A or V] (float)																															

64 Bit Input

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0 to 31 bit input register (bits)																															
32	32 to 63 bit input register (bits)																															

24 Int Input

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	Int 0 (int32_t)																															
32	Int 1 (int32_t)																															
64	Int 2 (int32_t)																															
96	Int 3 (int32_t)																															
128	Int 4 (int32_t)																															
160	Int 5 (int32_t)																															
192	Int 6 (int32_t)																															
224	Int 7 (int32_t)																															
256	Int 8 (int32_t)																															
288	Int 9 (int32_t)																															
320	Int 10 (int32_t)																															
352	Int 11 (int32_t)																															
384	Int 12 (int32_t)																															
416	Int 13 (int32_t)																															
448	Int 14 (int32_t)																															
480	Int 15 (int32_t)																															
512	Int 16 (int32_t)																															
544	Int 17 (int32_t)																															
576	Int 18 (int32_t)																															
608	Int 19 (int32_t)																															
640	Int 20 (int32_t)																															
672	Int 21 (int32_t)																															
704	Int 22 (int32_t)																															
736	Int 23 (int32_t)																															

24 Real Input

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	Real 0 (int32_t)																															
32	Real 1 (int32_t)																															
64	Real 2 (int32_t)																															
96	Real 3 (int32_t)																															
128	Real 4 (int32_t)																															
160	Real 5 (int32_t)																															
192	Real 6 (int32_t)																															
224	Real 7 (int32_t)																															
256	Real 8 (int32_t)																															
288	Real 9 (int32_t)																															

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
320	Real 10 (int32_t)																															
352	Real 11 (int32_t)																															
384	Real 12 (int32_t)																															
416	Real 13 (int32_t)																															
448	Real 14 (int32_t)																															
480	Real 15 (int32_t)																															
512	Real 16 (int32_t)																															
544	Real 17 (int32_t)																															
576	Real 18 (int32_t)																															
608	Real 19 (int32_t)																															
640	Real 20 (int32_t)																															
672	Real 21 (int32_t)																															
704	Real 22 (int32_t)																															
736	Real 23 (int32_t)																															

System Control

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	SSM	Reserved																														
32	Master Speed																															

IO Control

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	IOB digital outputs mask (bits)								IOB relay outputs mask (bits)								IOB digital outputs (bits)								IOB relay outputs (bits)							
32	IOB current outputs mask (bits)								IOB voltage outputs mask (bits)								Reserved															
64	IOB current output 1 [A] (float)																															
96	IOB current output 2 [A] (float)																															
128	IOB voltage output 1 [V] (float)																															
160	IOB voltage output 2 [V] (float)																															
192	TIO digital outputs mask (bits)								TIO power supply mask (bits)								TIO digital outputs range (bits)								TIO power supply range (bits)							
224	TIO digital outputs (bits)								TIO power supply (bits)								Reserved															
256	TIO analog outputs mask (bits)								TIO analog outputs type (bits)								Reserved															
288	TIO analog output 1 [A or V] (float)																															
320	TIO analog output 2 [A or V] (float)																															

64 Bit Output

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0 to 31 bit output register (bits)																															
32	32 to 63 bit output register (bits)																															

24 Int Output

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	Int 0 (int32_t)																															
32	Int 1 (int32_t)																															
64	Int 2 (int32_t)																															
96	Int 3 (int32_t)																															
128	Int 4 (int32_t)																															
160	Int 5 (int32_t)																															
192	Int 6 (int32_t)																															
224	Int 7 (int32_t)																															
256	Int 8 (int32_t)																															
288	Int 9 (int32_t)																															
320	Int 10 (int32_t)																															
352	Int 11 (int32_t)																															
384	Int 12 (int32_t)																															
416	Int 13 (int32_t)																															
448	Int 14 (int32_t)																															
480	Int 15 (int32_t)																															
512	Int 16 (int32_t)																															
544	Int 17 (int32_t)																															
576	Int 18 (int32_t)																															
608	Int 19 (int32_t)																															
640	Int 20 (int32_t)																															
672	Int 21 (int32_t)																															
704	Int 22 (int32_t)																															
736	Int 23 (int32_t)																															

24 Real Output

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	Real 0 (int32_t)																															

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
32	Real 1 (int32_t)																															
64	Real 2 (int32_t)																															
96	Real 3 (int32_t)																															
128	Real 4 (int32_t)																															
160	Real 5 (int32_t)																															
192	Real 6 (int32_t)																															
224	Real 7 (int32_t)																															
256	Real 8 (int32_t)																															
288	Real 9 (int32_t)																															
320	Real 10 (int32_t)																															
352	Real 11 (int32_t)																															
384	Real 12 (int32_t)																															
416	Real 13 (int32_t)																															
448	Real 14 (int32_t)																															
480	Real 15 (int32_t)																															
512	Real 16 (int32_t)																															
544	Real 17 (int32_t)																															
576	Real 18 (int32_t)																															
608	Real 19 (int32_t)																															
640	Real 20 (int32_t)																															
672	Real 21 (int32_t)																															
704	Real 22 (int32_t)																															
736	Real 23 (int32_t)																															

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