APPLICATION NOTES

DELOMATIC 4, DM-4 HYDRO

I/O assignment list

DEIF A/S · Frisenborgvej 33 · DK-7800 Skive
Tel.: +45 9614 9614 · Fax: +45 9614 9615
info@deif.com · www.deif.com

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1. About this document

General purpose

This document contains the application notes for DEIF's Delomatic 4, DM-4, used in hydro applications.

For functional descriptions, the procedure for parameter setup, complete standard parameter lists, etc., please see the Installation Instructions.

The general purpose of the application notes is to offer the designer information about the two methods available for emission control.

Please make sure to read this handbook before working with the DM-4 controller and the gen-set to be controlled. Failure to do this could result in damage to the equipment or human injury.

Intended users

The document is mainly intended for the person responsible for designing DM-4 systems. In most cases, this would be a panel builder designer. Naturally, other users might also find useful information in this document.

Contents/overall structure

The document is divided into chapters, and in order to make the structure of the document simple and easy to use, each chapter will begin from the top of a new page.

2. Warnings and legal information

Legal information and responsibility

DEIF takes no responsibility for installation or operation of the generator set. If there is any doubt about how to install or operate the generator set controlled by the unit, the company responsible for the installation or the operation of the set must be contacted.

The DM-4 is not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

Electrostatic discharge awareness

Sufficient care must be taken to protect the terminals against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

Safety issues

Installing the unit implies work with dangerous currents and voltages. Therefore, the installation should only be carried out by authorised personnel who understand the risks involved in working with live electrical equipment.

Be aware of the hazardous live currents and voltages. Do not touch any AC measurement inputs as this could lead to injury or death.

Definitions

Throughout this document, a number of notes and warnings will be presented. To ensure that these are noticed, they will be highlighted in order to separate them from the general text.

Notes

The notes provide general information which will be helpful for the reader to bear in mind.

Warnings

The warnings indicate a potentially dangerous situation which could result in death, personal injury or damaged equipment, if certain guidelines are not followed.

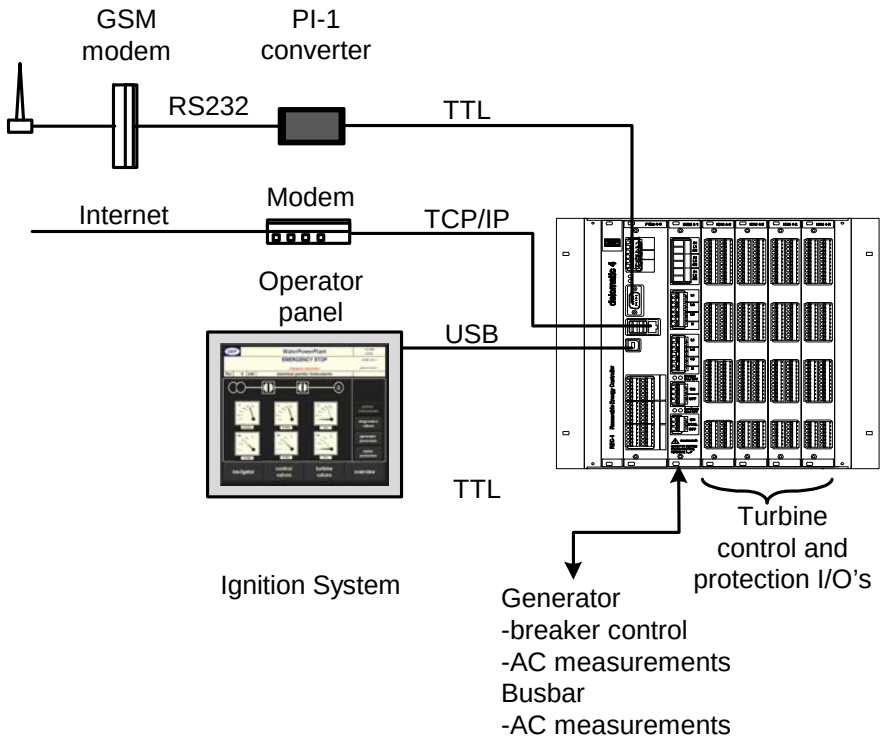
3. General overview

The DM-4 Hydro system consists as a minimum of a double-height (6 HE, 266 mm height) 19" rack mounted with the necessary I/O modules and a 12" colour graphic touchscreen operator interface.

The DM-4 Hydro has a TCP/IP interface with at built-in webserver. This means that the graphic screens are stored here and can be accessed from any computer on the internet, using a free of charge DEIF HMI Client software and thereby enabling remote control and monitoring from anywhere in the world.

Connecting an RS232 GSM modem enables SMS clear text alarm messages.

General system layout:



The Internet/GSM modems are not DEIF supply.

4. Components

Please refer to the Installation Instructions for components used.

5. Terminal layouts

Terminal layouts for PCM 4-3 and SCM 4-1 modules, please refer to the Installation Instructions.

The terminal layouts in the following are DEIF standard layouts. Adaptation to a specific project will be normal.

Terminal layout IOM 4-2, Slot #3, Turbine and valve controls

Temperature inputs

Type	Text	Term.	Term.	Text	Type
Pt100	Turbine bearing NDE	1	41	Generator bearing NDE	Pt100
		2	42		
		3	43		
		4	44		
Pt100	Turbine bearing DE	5	45	Thrust bearing	Pt100
		6	46		
		7	47		
		8	48		
Pt100	Generator bearing DE	9	49	Configurable	Pt100
		10	50		
		11	51		
		12	52		

Analogue 4-20 mA inputs

Text	Term.	Term.	Text
Not used	13	53	Not used
Turbine chamber pressure	14	54	Configurable
	15	55	
Not used	16	56	Not used
Water level	17	57	Configurable
	18	58	

Analogue 4-20 mA outputs

Text	Term.	Term.	Text
Configurable	19	59	Configurable
	20	60	
Configurable	21	61	Configurable
	22	62	

Digital inputs

Text	Term.	Term.	Text
Fire alarm	23	63	Drain valve open feedback
Emergency stop	24	64	Drain valve closed feedback
Watchdog	25	65	Fill valve open feedback
Safety chain closed	26	66	Fill valve closed feedback
Main valve open feedback	27	67	Turbine chamber filled
Main valve closed feedback	28	68	Configurable
Common for 23-28	29	69	Common for 63-68

Digital or RPM (pickup) inputs

Text	Term.	Term.	Text
RPM 1	30	70	Configurable 2
	31	71	
Configurable 1	32	72	Configurable 3
	33	73	

Transistor (digital) outputs

Text	Term.	Term.	Text
Supply +	34	74	Supply +
Rearm safety chain	35	75	Open main valve command
Open safety chain	36	76	Close main valve command
Close GCB	37	77	Open drain valve command
Trip GCB	38	78	Close drain valve command
Open GCB	39	79	Configurable
Supply -	40	80	Supply -

Terminal layout IOM 4-2, Slot #4, Turbine, generator and pump controls

Temperature inputs

Type	Text	Term.	Term.	Text	Type
Pt100	Configurable	1	41	Configurable	Pt100
		2	42		
		3	43		
		4	44		
Pt100	Configurable	5	45	Configurable	Pt100
		6	46		
		7	47		
		8	48		
Pt100	Configurable	9	49	Configurable	Pt100
		10	50		
		11	51		
		12	52		

Analogue 4-20 mA inputs

Text	Term.	Term.	Text
Not used	13	53	Not used
Hydraulic oil pressure	14	54	Lube oil pressure
	15	55	
Not used	16	56	Not used
Coolant water pressure	17	57	Configurable
	18	58	

Analogue 4-20 mA outputs

Text	Term.	Term.	Text
Generator voltage/reactive power/power factor control	19	59	Configurable
	20	60	
Configurable	21	61	Configurable
	22	62	

Digital inputs

Text	Term.	Term.	Text
Cooling water pump 1 running	23	63	Hydraulic oil press OK
Cooling water pump 2 running	24	64	Lube oil press OK
Hydraulic oil pump 1 running	25	65	Coolant water pressure OK
Hydraulic oil pump 2 running	26	66	Configurable
Lube oil pump 1 running	27	67	Configurable
Lube oil pump 2 running	28	68	Configurable
Common for 23-28	29	69	Common for 63-68

Digital or RPM (pickup) inputs

Text	Term.	Term.	Text
RPM 2	30	70	Configurable
	31	71	
External breaker trip	32	72	Configurable
	33	73	

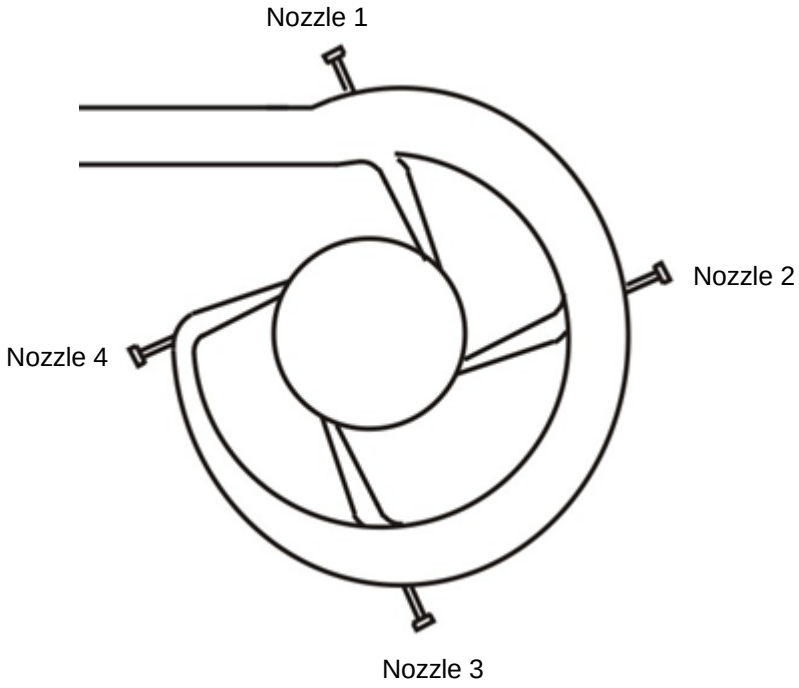
Transistor (digital) outputs

Text	Term.	Term.	Text
Supply +	34	74	Supply +
Run cooling water pump 1	35	75	Run Lube oil pump 2
Run cooling water pump 2	36	76	Open fill valve command
Run hydraulic oil pump 1	37	77	Close fill valve command
Run hydraulic oil pump 2	38	78	Excitation speed (activate excitation)
Run Lube oil pump 1	39	79	Configurable
Supply -	40	80	Supply -

6. Specific hardware for Pelton turbine

The DM-4 Hydro hardware is as standard prepared for Pelton turbines with up to 6 nozzles and up to 6 deflectors.

The nozzles are controlled in cascade, selectable to be either one by one or in counter-positioned pairs, in order to prevent radial stress to the bearings.



Deflector control outputs:

It can be selected if there is:

- No deflector control (engage/disengage by binary output only, for shutdown/trip, deflector 1 engage/disengage commands are used)
- 1 deflector control (for mechanically linked deflectors)
- Up to 6 deflector controls for individually controlled deflectors. Each deflector has position control output as well as engage (trip/shutdown) and disengage (reset) binary outputs.

If deflector control is present, it will be used for fine-tuning of the turbine speed during synchronising, idling and fixed frequency control.

Terminal layout IOM 4-2, Slot #5, Nozzle/deflector 1 and 2

Temperature inputs

Type	Text	Term.	Term.	Text	Type
Pt100	Configurable	1	41	Configurable	Pt100
		2	42		
		3	43		
		4	44		
Pt100	Configurable	5	45	Configurable	Pt100
		6	46		
		7	47		
		8	48		
Pt100	Configurable	9	49	Configurable	Pt100
		10	50		
		11	51		
		12	52		

Analogue 4-20 mA inputs

Text	Term.	Term.	Text
Not used	13	53	Not used
Nozzle 1 position feedback	14	54	Deflector 1 position feedback
	15	55	
Not used	16	56	Not used
Nozzle 2 position feedback	17	57	Deflector 2 position feedback
	18	58	

Analogue 4-20 mA outputs

Text	Term.	Term.	Text
Nozzle 1 position control	19	59	Deflector 1 position control
	20	60	
Nozzle 2 position control	21	61	Deflector 2 position control
	22	62	

Digital inputs

Text	Term.	Term.	Text
Nozzle 1 open feedback	23	63	Deflector 1: 100% engaged
Nozzle 1 closed feedback	24	64	Deflector 1: 0% engaged
Nozzle 2 open feedback	25	65	Deflector 2: 100% engaged
Nozzle 2 closed feedback	26	66	Deflector 2: 0% engaged
Configurable	27	67	Configurable
Configurable	28	68	Configurable
Common for 23-28	29	69	Common for 63-68

Digital or RPM (pickup) inputs

Text	Term.	Term.	Text
Configurable 4	30	70	Configurable 6
	31	71	
Configurable 5	32	72	Configurable 7
	33	73	

Transistor (digital) outputs

Text	Term.	Term.	Text
Supply +	34	74	Supply +
Nozzle 1 open command	35	75	Disengage deflector 1
Nozzle 1 close command	36	76	Engage deflector 2
Nozzle 2 open command	37	77	Disengage deflector 2
Nozzle 2 close command	38	78	Configurable
Engage deflector 1	39	79	Configurable
Supply -	40	80	Supply -

Terminal layout IOM 4-2, Slot #6, Nozzle/deflector 3 and 4

Temperature inputs

Type	Text	Term.	Term.	Text	Type
Pt100	Configurable	1	41	Configurable	Pt100
		2	42		
		3	43		
		4	44		
Pt100	Configurable	5	45	Configurable	Pt100
		6	46		
		7	47		
		8	48		
Pt100	Configurable	9	49	Configurable	Pt100
		10	50		
		11	51		
		12	52		

Analogue 4-20 mA inputs

Text	Term.	Term.	Text
Not used	13	53	Not used
Nozzle 3 position feedback	14	54	Deflector 3 position feedback
	15	55	
Not used	16	56	Not used
Nozzle 4 position feedback	17	57	Deflector 4 position feedback
	18	58	

Analogue 4-20 mA outputs

Text	Term.	Term.	Text
Nozzle 3 position control	19	59	Deflector 3 position control
	20	60	
Nozzle 4 position control	21	61	Deflector 4 position control
	22	62	

Digital inputs

Text	Term.	Term.	Text
Nozzle 3 open feedback	23	63	Deflector 3: 100% engaged
Nozzle 3 closed feedback	24	64	Deflector 3: 0% engaged
Nozzle 4 open feedback	25	65	Deflector 4: 100% engaged
Nozzle 4 closed feedback	26	66	Deflector 4: 0% engaged
Configurable	27	67	Configurable
Configurable	28	68	Configurable
Common for 23-28	29	69	Common for 63-68

Digital or RPM (pickup) inputs

Text	Term.	Term.	Text
Configurable 8	30	70	Configurable 10
	31	71	
Configurable 9	32	72	Configurable 11
	33	73	

Transistor (digital) outputs

Text	Term.	Term.	Text
Supply +	34	74	Supply +
Nozzle 3 open command	35	75	Disengage deflector 3
Nozzle 3 close command	36	76	Engage deflector 4
Nozzle 4 open command	37	77	Disengage deflector 4
Nozzle 4 close command	38	78	Configurable
Engage deflector 3	39	79	Configurable
Supply -	40	80	Supply -

Terminal layout IOM 4-2, Slot #7, Nozzle/deflector 5 and 6

Temperature inputs

Type	Text	Term.	Term.	Text	Type
Pt100	Configurable	1	41	Configurable	Pt100
		2	42		
		3	43		
		4	44		
Pt100	Configurable	5	45	Configurable	Pt100
		6	46		
		7	47		
		8	48		
Pt100	Configurable	9	49	Configurable	Pt100
		10	50		
		11	51		
		12	52		

Analogue 4-20 mA inputs

Text	Term.	Term.	Text
Not used	13	53	Not used
Nozzle 5 position feedback	14	54	Deflector 5 position feedback
	15	55	
Not used	16	56	Not used
Nozzle 6 position feedback	17	57	Deflector 6 position feedback
	18	58	

Analogue 4-20 mA outputs

Text	Term.	Term.	Text
Nozzle 5 position control	19	59	Deflector 5 position control
	20	60	
Nozzle 6 position control	21	61	Deflector 6 position control
	22	62	

Digital inputs

Text	Term.	Term.	Text
Nozzle 5 open feedback	23	63	Deflector 5: 100% engaged
Nozzle 5 closed feedback	24	64	Deflector 5: 0% engaged
Nozzle 6 open feedback	25	65	Deflector 6: 100% engaged
Nozzle 6 closed feedback	26	66	Deflector 6: 0% engaged
Configurable	27	67	Configurable
Configurable	28	68	Configurable
Common for 23-28	29	69	Common for 63-68

Digital or RPM (pickup) inputs

Text	Term.	Term.	Text
Configurable 12	30	70	Configurable 14
	31	71	
Configurable 13	32	72	Configurable 15
	33	73	

Transistor (digital) outputs

Text	Term.	Term.	Text
Supply +	34	74	Supply +
Nozzle 5 open command	35	75	Disengage deflector 5
Nozzle 5 close command	36	76	Engage deflector 6
Nozzle 6 open command	37	77	Disengage deflector 6
Nozzle 6 close command	38	78	Configurable
Engage deflector 5	39	79	Configurable
Supply -	40	80	Supply -

7. Specific hardware for Kaplan turbine

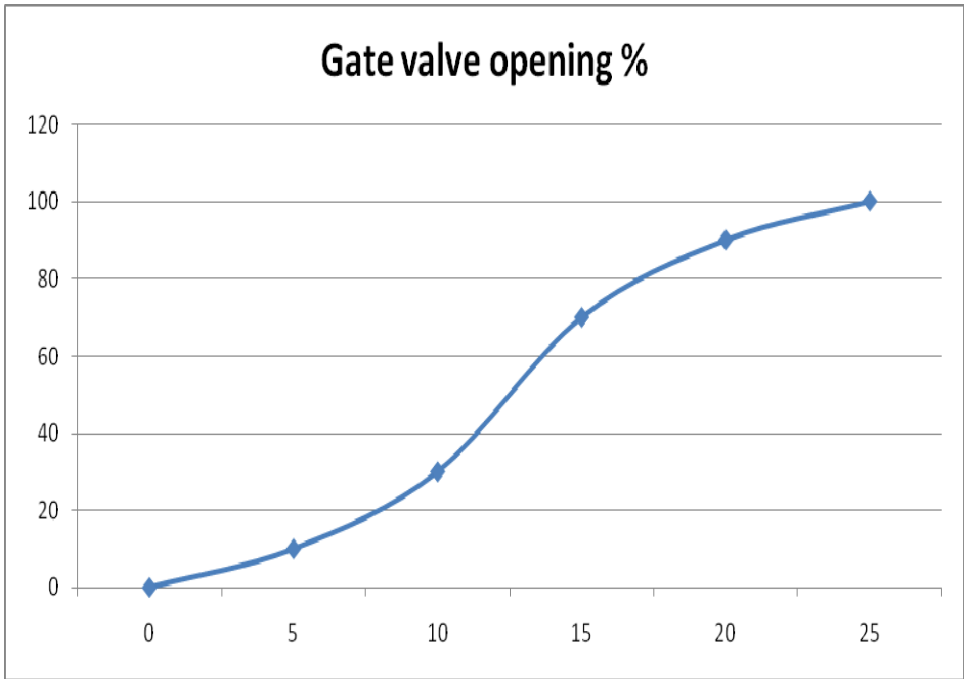
The hardware for the Kaplan turbine is prepared for control of guide vane (wicket gate) and runner blade pitch control.

For the adjustment of the guide vanes, a relation to the runner pitch angle is used. Since this relation varies from turbine to turbine, it is configurable using a 6-point curve setting:

No	Runner pitch (degrees)	Guide vane opening (%)
1	0	0
2	5	10
3	10	30
4	15	70
5	20	90
6	25	100

The runner pitch may have a negative value.

The above example provides this curve:



Terminal layout IOM 4-2, Slot #5, Runner, Guide vane (wicket gate), bypass and brake control

Temperature inputs

Type	Text	Term.	Term.	Text	Type
Pt100	Configurable	1	41	Configurable	Pt100
		2	42		
		3	43		
		4	44		
Pt100	Configurable	5	45	Configurable	Pt100
		6	46		
		7	47		
		8	48		
Pt100	Configurable	9	49	Configurable	Pt100
		10	50		
		11	51		
		12	52		

Analogue 4-20 mA inputs

Text	Term.	Term.	Text
Not used	13	53	Not used
Guide vane position feedback	14	54	Bypass position feedback
	15	55	
Not used	16	56	Not used
Runner pitch position feedback	17	57	Configurable
	18	58	

Analogue 4-20 mA outputs

Text	Term.	Term.	Text
Guide vane position control	19	59	Bypass position control
	20	60	
Runner pitch angle control	21	61	Configurable
	22	62	

Digital inputs

Text	Term.	Term.	Text
Guide vane 100% feedback	23	63	Brake ON feedback
Guide vane 0% feedback	24	64	Brake OFF feedback
Runner pitch max feedback	25	65	Configurable
Runner pitch min feedback	26	66	Configurable
Bypass open	27	67	Configurable
Bypass closed	28	68	Configurable
Common for 23-28	29	69	Common for 63-68

Digital or RPM (pickup) inputs

Text	Term.	Term.	Text
Configurable	30	70	Configurable
	31	71	
Configurable	32	72	Configurable
	33	73	

Transistor (digital) outputs

Text	Term.	Term.	Text
Supply +	34	74	Supply +
Guide vane open command	35	75	Bypass open command
Guide vane close command	36	76	Bypass close command
Runner pitch increase command	37	77	Brake ON
Runner pitch decrease command	38	78	Brake OFF
Configurable	39	79	Configurable

8. Specific hardware for Francis turbine

The hardware for the Francis turbine is prepared for control of guide vane (wicket gate) pitch control.

Terminal layout IOM 4-2, Slot #5, Guide vane (wicket gate), bypass and brake control

Temperature inputs

Type	Text	Term.	Term.	Text	Type
Pt100	Configurable	1	41	Configurable	Pt100
		2	42		
		3	43		
		4	44		
Pt100	Configurable	5	45	Configurable	Pt100
		6	46		
		7	47		
		8	48		
Pt100	Configurable	9	49	Configurable	Pt100
		10	50		
		11	51		
		12	52		

Analogue 4-20 mA inputs

Text	Term.	Term.	Text
Not used	13	53	Not used
Guide vane position feedback	14	54	Bypass position feedback
	15	55	
Not used	16	56	Not used
Configurable	17	57	Configurable
	18	58	

Analogue 4-20 mA outputs

Text	Term.	Term.	Text
Guide vane position control	19	59	Bypass position control
	20	60	
Configurable	21	61	Configurable
	22	62	

Digital inputs

Text	Term.	Term.	Text
Guide vane open feedback	23	63	Brake ON feedback
Guide vane closed feedback	24	64	Brake OFF feedback
Configurable	25	65	Configurable
Configurable	26	66	Configurable
Bypass open	27	67	Configurable
Bypass closed	28	68	Configurable
Common for 23-28	29	69	Common for 63-68

Digital or RPM (pickup) inputs

Text	Term.	Term.	Text
Configurable	30	70	Configurable
	31	71	
Configurable	32	72	Configurable
	33	73	

Transistor (digital) outputs

Text	Term.	Term.	Text
Supply +	34	74	Supply +
Guide vane open command	35	75	Bypass open command
Guide vane close command	36	76	Bypass close command
Configurable	37	77	Brake ON
Configurable	38	78	Brake OFF
Configurable	39	79	Configurable

DEIF A/S reserves the right to change any of the above.