RIO200 Based Systems

Interface Requirements

300968/B
January 2007

Document history

Document number: 300968		
Rev. A	December 2006	First issue.
Rev. B	January 2007	Table of contents missing.

Comments

To assist us in making improvements to the product and to this manual, we welcome comments and constructive criticism.
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About this document

The Kongsberg DP system can be interfaced to various sensors and systems as described in this document. Any sensor or system meeting these requirements can be interfaced as standard. Equipment not meeting these requirements may also be included as a non-standard interface if agreed.

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1 INTRODUCTION

The Kongsberg DP system can be interfaced to various sensors and systems as described in the following sections. Any sensor or system meeting the following requirements can be interfaced as standard. Equipment not meeting these requirements may also be included as a non-standard interface if agreed.

The serial line interface specification is described in a separate document (refer to [1]).

Referenced documents

Following documents are referenced:

Ref. Id	Document Name	Doc. No.
[1]	K-Pos Serial Lines, Interface Specification	300966
[2]	Standard RIO200 Loop Typicals	300970

Abbreviations

AI	Analog Input
AO	Analog Output
DI	Digital Input
DO	Digital Output
DP	Dynamic Positioning
DPC	Dynamic Positioning Controller
NMEA	National Marine Electronics Association
PM	Position Mooring
RPM	Revolutions Per Minute
UPS	Uninterruptible Power Supply

2 INPUT/OUTPUT SIGNALS

The interface requirements for the DP system input/output signals are described with typical examples in section *Examples of Interfacing Types* on page 7 and in detail in [2].

3 MAIN PROPULSION AND THRUSTER

The accuracy of the servos of the propulsion and thruster system should be better than +2% at any propeller pitch angle and at any speed (RPM). The accuracy at zero pitch or zero speed (RPM) should be better than +1% of the maximum value.

Note that if the accuracy is not obtained it may have implications for commissioning/sea trial duration and positioning performance.

For small thrusters the response time for each servo/converter from zero to maximum speed (RPM) or pitch value will typically be less than 10 seconds, for larger thrusters typically 10 to 15 seconds. With respect to main propellers on a typical supply vessel, less than 20 seconds and on a shuttle tanker less than 35 seconds.

The pitch feedback signal should be linear with pitch angle.

The rotational time (360-degree) for an azimuth thruster should be less than 30 seconds. To obtain this the necessary number of azimuth pumps should be running in DP mode. The complete thruster, azimuth control system should be designed for continuous use (360-degree control).

Note that an azimuth thruster with only positive speed (RPM) has to be rotated to obtain force in the opposite direction. This may have implications for positioning performance.

A main propulsion positive pitch/speed command should cause the vessel to move ahead.

A transverse (tunnel) thruster positive pitch/speed command should cause the vessel to move to starboard.

PITCH CONTROL

The DPC gives a setpoint related to pitch and there shall be an external thruster control system to perform the closed loop control of the pitch. The feedback signal should be a true feedback reflecting the real pitch; *it should not be based on a measurement on the setpoint side, which has the possibility of not reflecting the real pitch.*

Some pitch-controlled thrusters can be used at more than one predefined RPM and in such cases digital feedback signals for indication of the actual RPM (RPM no. N) or an RPM feedback (engine speed) should be used.

RPM CONTROL

The DPC gives a setpoint related to RPM and there shall be an external thruster control system to perform the closed loop control of the RPM. The feedback signal should be a true feedback reflecting the real RPM of the propeller, using a tachometer or equivalent; *the RPM feedback should not be based on a calculated value based on current, torque etc.* When the thruster has the possibility for both positive and negative RPM it should be possible to change from positive to negative RPM and vice versa without any restrictions (clutch operations, change of field, reverse power etc.). There should be no forbidden zones for RPM (vibrations, noise etc.). However if a thruster has only positive RPM without the possibility for zero RPM, the other thrusters must be able to compensate. Reduction of RPM should always be possible without restrictions, also during a change in azimuth.

Note also that it could be necessary for an external braking system for the thruster RPM (avoid reverse power; avoid negative RPM due to bearing type etc.). This braking system should handle both water streams from other thrusters and the vessel speed relative to the water.

AZIMUTH / RUDDER CONTROL

The DPC gives a setpoint related to azimuth/rudder and there shall be an external thruster control system to perform the closed loop control of the azimuth/rudder. The feedback signals should be true feedback reflecting the real azimuth/rudder angle; *they should not be based on measurements on the setpoint side, which have the possibility of not reflecting the real azimuth/rudder angle.*

Note also that it could be necessary for an external braking system for the thruster azimuth. This braking system should handle both water streams from other thrusters and the vessel speed relative to the water.

RUDDER IN ZERO

Note that the steering gear should be switched on, to prevent the rudder “creeping” in bad weather conditions.

4 EXAMPLES OF INTERFACING TYPES

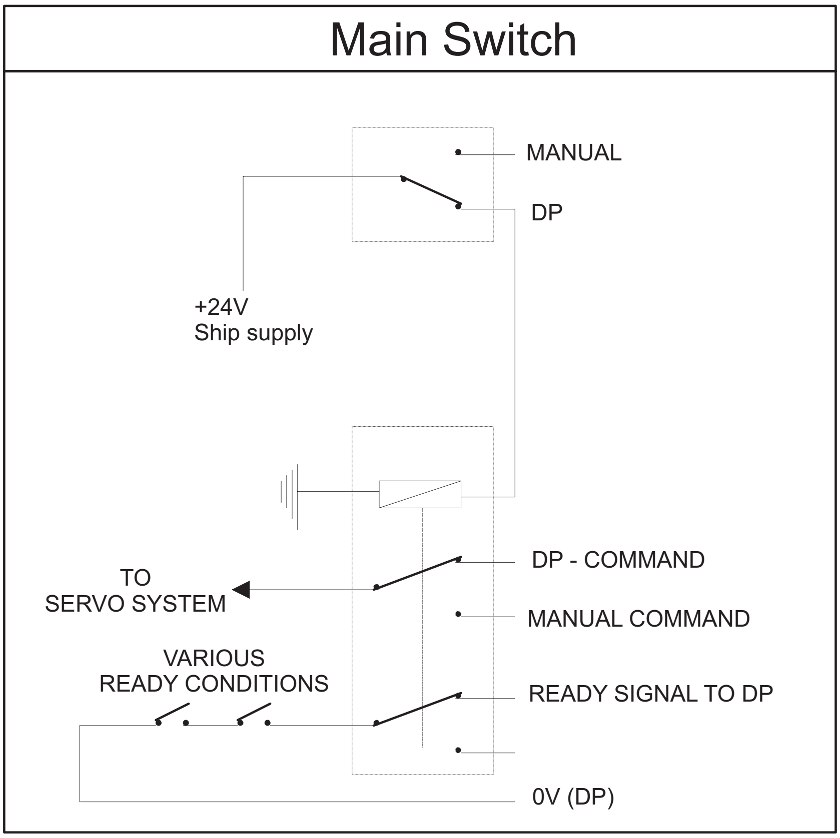
The following section gives examples of typical interfaces for DP systems. All sensors and interfaces supplied by Kongsberg meet the requirements specified in this document.

4.1 Gyro interface

The standard Gyro interface is an NMEA 0183 serial line interface. The Electrical Standard is RS422 as specified in NMEA 0183, Version 2.0 or above. Refer to document reference [1].

In addition, a Gyro OK signal is required according to Loop Typical ID: DI–100 (Closed contact to indicate Gyro OK).

4.2 Main Vessel Control switch - DP / Manual



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The supply and arrangement of this switch is the yard/owner's responsibility. Setting the switch to the DP position will cause all servos to receive command from the DP control system. It shall also enable/connect the ready signals from the units to the DPC. The switch (which normally contains many decks or controls a relay bank) shall connect all thrusters, main propellers and rudders that are to be DP controlled.

The ready conditions are normally as follows:

- Main switch (and local thruster switch, if applicable) switched to DP position.
- Propeller clutch, if applicable, engaged.
- Hydraulic pressure OK.
- For an azimuth thruster, the ready condition for both the propeller motor unit and the azimuth motor unit shall be connected in series before the signal is fed to the DPC.

4.3 Fire Back-up switch

The Fire Back-up switch is used in Class 3 systems to perform change-over from the main DP Control system to the Fire Back-up DP Control system. Note that in the thruster electronics it is only the Command signal that is switched according to the Fire Back-up switch position. Both DP Control systems should always receive the Feedback and Ready signals.

4.4 Thruster / Propeller / Rudder interface

Typical signals:

- The I/O signals needed for interfacing Tunnel thrusters, Azimuth thrusters, Main Propellers and Rudders are given in Table 1.
- Our preferred type of analog signal interface is 4 to 20 mA (Commands and Feedbacks). This gives the possibility for detection of loop failures (e.g. broken conditions and short-circuits).

Azimuth/Rudder Potentiometer:

- Sine/Cosine or Triangle type feedback potentiometer has the advantage that there is no “dead area” in the complete 360-degree area (Azimuth).
- If a single potentiometer is used to generate the feedback signal, the “dead area” of the potentiometer must be located in an illegal position area of the thruster (Rudder).

Servo loop control:

- The external servo loop, control unit should be able to detect a non-valid signal (loop failure detection).

Speed control (frequency converter):

- The frequency converter must be able to respond to a failure in the control signal according to classification requirements (freeze or stop).

Table 1 Thruster / Propeller / Rudder interface

Signal description	**Electrical Format**	**Loop Typical ID (Refer to document reference [2])**		**Unit**			
		Recommended Loop (4–20 mA)	**Optional Voltage Loop**	**Tunnel Thruster**	**Azimuth Thruster**	**Main Propeller**	**Rudder**
Ready	(Digital Dry Contact)	DI–100		X	X	X	X
Running	(Digital Dry Contact)	DI–100		Option	Option	Option	
Command (RPM or Pitch)	Galvanic Isolated	AO–100	AO-101	X	X	X	

Table 1 Thruster / Propeller / Rudder interface (cont'd.)

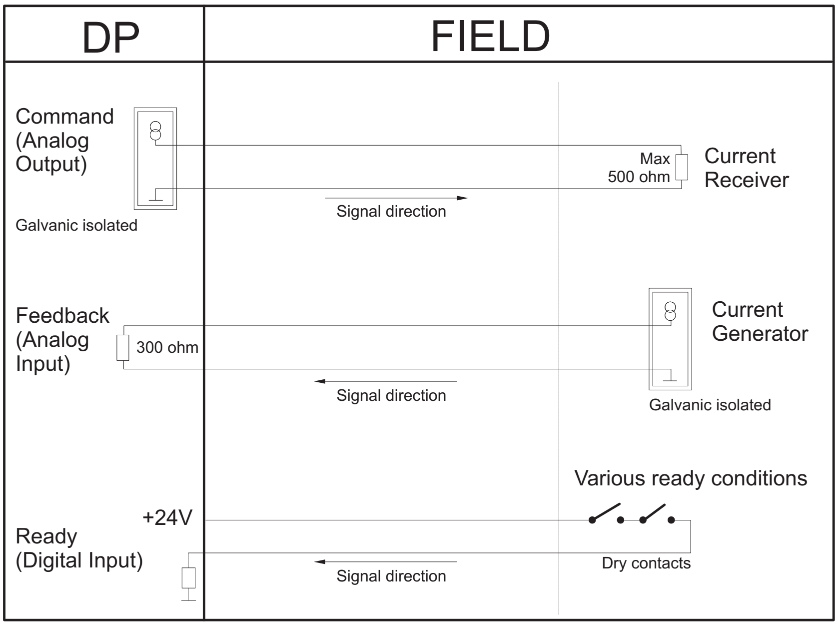
Signal description	Electrical Format	Loop Typical ID (Refer to document reference [2])		Unit			
		Recommended Loop (4–20 mA)	Optional Voltage Loop	Tunnel Thruster	Azimuth Thruster	Main Propeller	Rudder
Feedback (RPM or Pitch)	Galvanic Isolated	AI–100	AI-104	X	X	X	
	Potentiometer (pitch)	AI–109		*	*	*	
Azimuth Command	Galvanic Isolated	AO–100	AO-101		X		X
Azimuth Feedback	Galvanic Isolated	AI–100	AI-104		X		X
	Potentiometer (Sin/ Cos)	AI–111			*		
	Potentiometer (Triangle Pot.)	AI–111 (Principle equal as Sin/Cos)			*		
	Potentiometer (Single Pot.)	AI–109 (Principle equal as Sin/Cos, but only one viper)			*		*
Load Feedback	Galvanic Isolated	AI–100	AI-104	Option	Option	Option	
RPM / Pitch Reduced	(Digital Dry Contact)	DI–100		Option	Option	Option	
Clutch Status	(Digital Dry Contact)	DI–100		Option	Option	Option	
Fuel Rack	Galvanic Isolated	AI–100	AI-104	Option	Option	Option	
RPM (by digital signals)	(Digital Dry Contact)	DI–100		Option	Option	Option	
Rudder in Zero	(Digital Dry Contact)	DI–100					(X)
Azi/Rud pump Ready max. 2	(Digital Dry Contact)	DI–100			(X)		(X)

X: The signal is needed

(X): The signal may be needed

*: Alternative

4.5 Current interface



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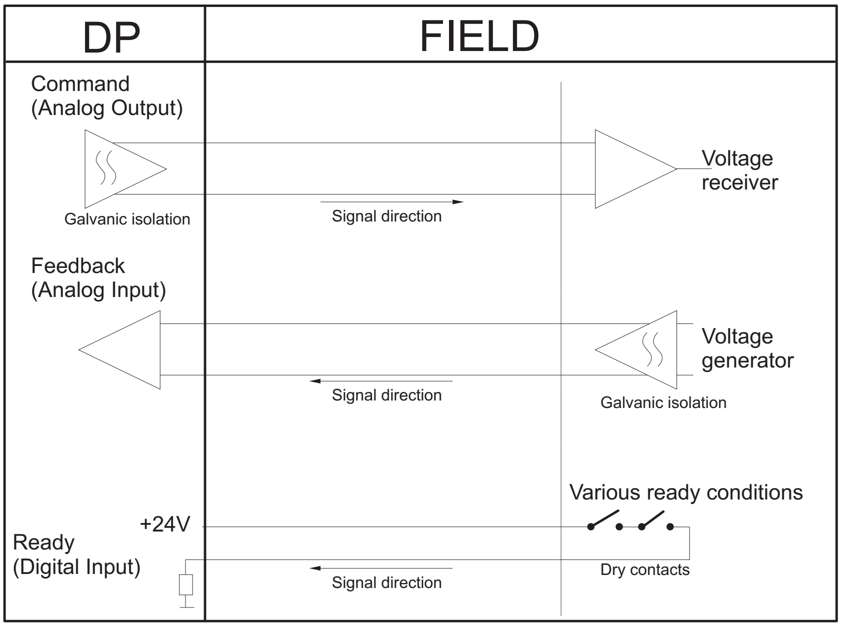
4.6 Voltage interface



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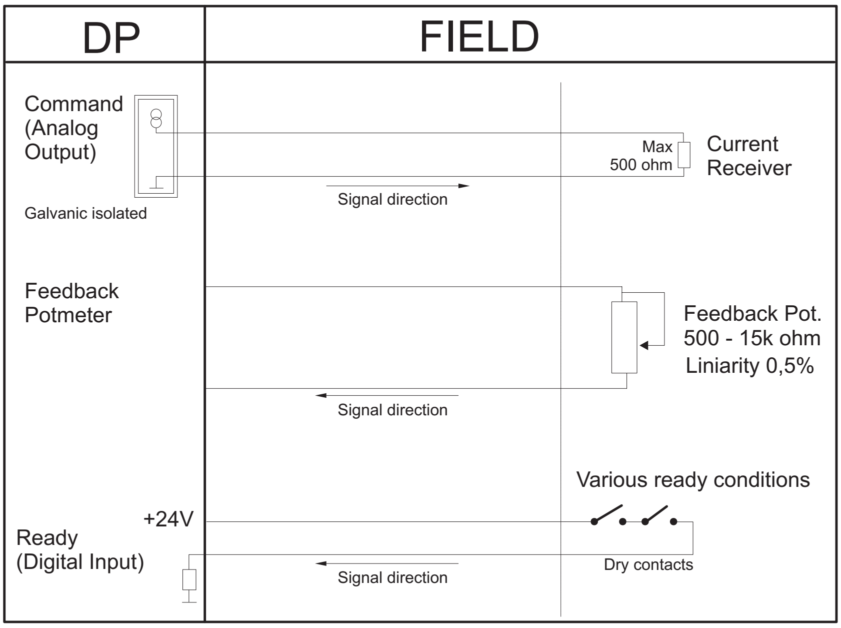
4.7 Pitch interface (single potentiometer)



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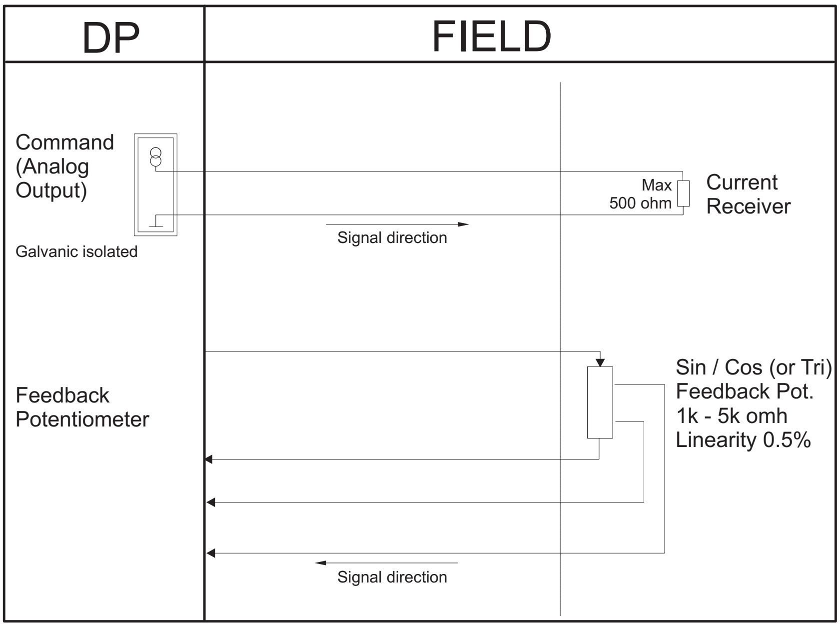
4.8 Azimuth interface (sin / cos potetiometer)



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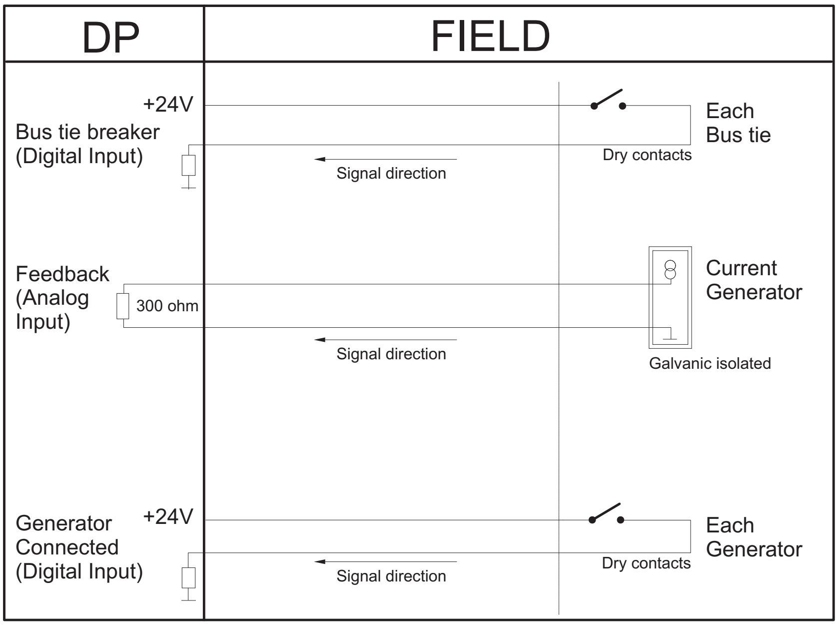
4.9 Generator & Bus-bar interface



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Bus-tie breaker interface:

- Bus-tie closed. The digital input should have closed contact when the bus-tie is closed.

Generator interface:

- In the case of 4–20mA signals, the auxiliary voltage to the signal converters shall be from the UPS system to avoid a 0mA reading when the generator is stopped.

Generator breaker interface:

- Generator breaker closed. The digital input should have closed contact when the generator breaker is closed. When the breaker is closed it should also be ready for use by DP.

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