KD Con™ Operators Manual	 KYSTDESIGN AS www.kystdesign.no
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1. Introduction

The KD Con ™ work ROV control system is very compact, but still with high capacity in terms of interfaces and functions. It is based upon the latest technology available where a distributed philosophy is used through out to minimise size, weight, complexity, cables and number of items. Power and I/O are distributed into valve-packs, light-box, termination-box and the main electronic pod and connected together through a RS485 bus network.

All functions are controlled through one single-mode fibre from surface by a multi-channel fibre optic system, capable of running a minimum of 14 survey sensors & 8 cameras in addition to ROV control. The control system is easy expandable in terms of I/O and interfaces.

More or less all interfaces can be turned off completely to isolate the systems in case of defects.

An integrated fault monitoring detects internal Comms & power failures, water leaks and power isolation faults, hydraulic pressures, temperatures, and compensator volumes.

The built-in auto functions control heading, depth, altitude, pitch and roll. As an option a ROV DP system can be installed enabling automatic ROV position and track control.

The overall command response is 20 Hz.

A dual hydraulic pump system powered by a 3ph 4160vac el. motor, supplies hydraulic power to 7 thrusters and an auxiliary system used for manipulators, pan & tilts and tools.

The auxiliary system controls 2 x 10 proportional directional valves with proportional pressure control on supply line and 4 x 75-l/min proportional flow and pressure controlled valves.

The main system blocks are the Termination Box, Control Pod, Light Box, Thruster Control Unit (TCU), Auxiliary Control Unit (ACU), and the two General Function Valve packs (GFVP).

The Termination Box contains the main interface for umbilical or tether, the local 3000vac / 115vac transformer, and breakers for the ROV electric system

The Control Pod comprise the main subsea control contains power supplies & the KD Con multi-channel fibre optic control system and optional expansion modules.

The Light Box controls 10 individually dimmable lights, all with reset-able breaker. It also contains a tool skid connector capable of delivering 20 amps of 115vac power.

The TCU controls the main hydraulic system i.e. the thrusters.

The ACU, GFVP 1 and 2, controls the auxiliary hydraulic system (AUX).

2. ROV Control System Main Components

2.1. Electric Motor

2.1.1. Description

The hydraulic power pack consists of an electric motor with two hydraulic pumps attached. Each sub component is described separately in the Hydraulic Manual, Volume 2.

2.1.2. High voltage electricity

WARNING
The electrical power supplied to this unit is High Voltage and direct contact with this is likely to be fatal. Ensure that all personnel working with this power source are fully qualified, and that all necessary safety and shut down systems are fitted and operative. The earth conductor must be connected to the ROV earth At normal on deck running conditions, the ROV shall be grounded by a ground strap between the ROV frame and supply source ground.

2.1.3. Handling

Caution
The combined weight of this unit is approx 480 KG. Appropriate handling gear and procedures must be used to move and fit the HPU.

2.1.4. Oil drain and filling

Draining :

- Close the isolation valve marked **MOTOR** on the compensator panel
- Remove the bleed Cap
- Place a suitable container below the ROV at the drain point
- Unscrew the drain plug, and drain until the motor casing is empty.

Filling :

- If the motor casing is empty remove the 1/2” BSP plug located on the top of the electric motor at the port side and monitor this point during filling
- Fill up the casing through the quick connector mounted on the compensator.
- Close the isolation valve and re install the 1/2” BSP plug on the motor when the housing is full.
- Continue filling the compensator until 90% full.
- Bleed the air out through the bleed cap on the compensator panel.
- Open the isolation valve.

2.1.5. Electric Motor Technical Data

Manufacturer	IKM Electro AS
Model code	250M04-42-60-160-01
Manufacturers Documentation See section 5.29 This Volume	Drawing No.250-4-160KW-KD-01
Current	27 A (full load)
Direction of rotation	Clock wise (viewed on shaft end connector side)
Drain and fill ports	4 of 1/2” BSPP
Frequency	60 Hz
Oil Type	Tellus 22S
Poles	4
Power	160 kW / 220 Hp (at shaft)
Power factor	0,931
RPM	1774
Voltage	4160 VAC
Weight in Air	324Kg
Weight in water	250 Kg
Winding temperature	Max 90° C

2.2. Termination Box

The oil filled Termination Box works as the main ROV umbilical or tether termination point for ROV power and signals.

WARNING
The electrical power supplied to this unit is High Voltage and direct contact with this is likely to be fatal. Ensure that all personnel working with this power source are fully qualified, and that all necessary safety and shut down systems are fitted and operative. No work should be performed inside the Termination Box unless the main ROV hydraulic and instrument power is switched off & grounded. At normal on deck running conditions, the Termination Box Lid shall be on, and the ROV grounded by a ground strap between the ROV frame and supply source ground.

An extra lid inside the Termination Box marked with a high voltage warning sign protects the high voltage terminals.

The electric motor power leads are routed from the high voltage terminals, through an oil-filled tube to the electric motor. The tube contains an oil block to isolate two separate compensated oil volumes; El. Comp and El.Mot. Comp.

Two transformers are located on the rear side of the mounting plate inside the Termination Box. They are connected in series and transform the instrument 3000vac power from surface to 2 x 115vac and one 19vac tapping.

The first 115vac tapping is used for lights and is routed from the termination box to the Light Box through an oil-filed tube.

A 20A main breaker and individual light breakers inside light box protect the 115vac light power supply.

The second 115vac tapping is protected by two 20A breakers. The first breaker is used for instrumentation and survey equipment.

The second breaker is for the Light Box skid connector.

The 19vac tapping which is rectified and routed to the El.Pod is protected by a 20A DC breaker. It's "smoothed" by a capacitor inside the pod to produce a clean 24vdc power supply. It's there to supply survey equipment and cameras which needs a "clean" 24vdc supply.

In theory, the system can take out more than the 4KVA transformer power available (all lights on, 20A skid supplied power etc.). To avoid a power failure, the transformer is temperature monitored.

The Light Box driver card reads the instrument transformer internal mounted PT100 sensor and the Termination Box water detect sensor.

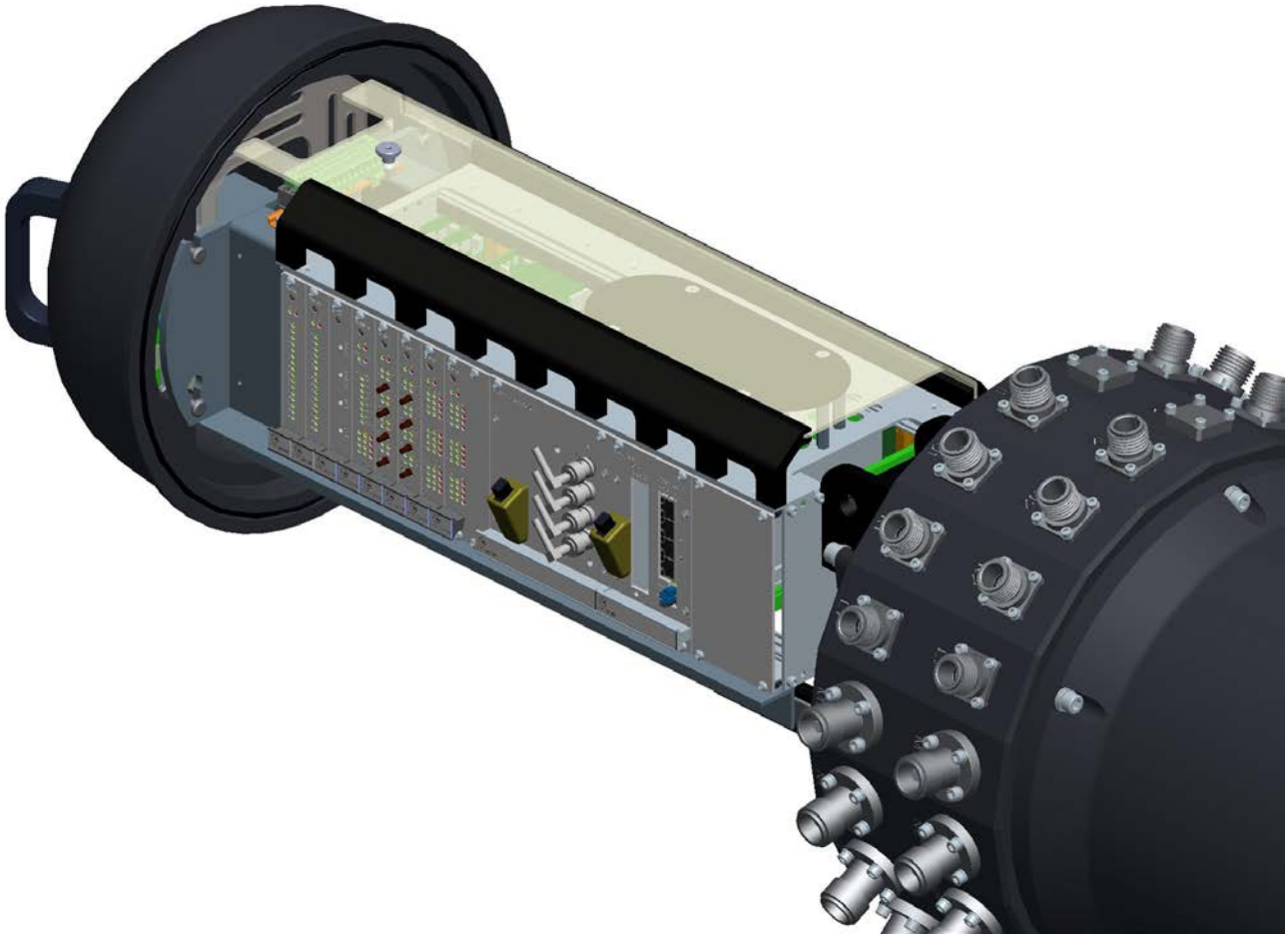
There are 6 fibre optic bulkhead connectors for terminating the SM fibres. There is a fibre assembly between the Termination Box and the Electronic Pod. Only the first fibre is used by the control system. The other 5 fibres are spare and can be used for optional survey equipment (Ethernet, PECL etc.).

Manufacturer	Kystdesign AS
Manufacturers Documentation	-1000E01 (ROV External Cabling) -1060M01 (General Assembly drawing) -1060E01 (Wiring Diagram)
Data sheets See section 5	Airpax Magnetic Circuit Breakers
Hydraulic oil used	Tellus 22S
Weight in air	65 kg
Weight in Water	35 kg

2.3. Control Pod

2.3.1. General

The ROV has one electronic control pod.
All pod electronics, except the power modules, are installed into a rail mounted 3U rack, which is attached to the pod by a cable chain. This enables easy access to the pod electronics even while the system is on.



ROV Control Pod

Wago terminals positioned at top of the rack, terminate all subsea connections.

The KD Con system disconnect all power and signal lines when off.

The KD Con relay cards can be configured as Normally Closed NC or Normally Open NO contacts simply by changing its fuse configurations. NC configurations are typically used for the Valve Packs, the cameras, the Light Box and the Gyro, that is, equipment that are critical for system operation and should therefore normally stay on. However, the operator is able to isolate the above units in case of system faults like water leakage, GFDs etc.

The remaining relays are normally open NO and have to be turned ON to supply power.

Camera signals and serial signals are also switchable. Use the “ROV Setup” program to configure which outputs to go on and off. As default, a system comms failure will make the relays to go off; serial and video signals to go on.

The system valve packs are controlled by RS485 serial lines coming from the topside PXI controller and powered by a local 150vdc/24vdc power. The KD Con system is locally controlled by the Master card which again is controlled directly by TTL signals through the subsea backplane from surface. Topside, all control lines are RS232.

A std. system has typically 8 pal cameras which are supplied with individual focus & zoom and power control signals. There are however made ready for 4 HD cameras with F&Z and power control as an option.

The Video card 1 and 2 isolate the pal video signals, supply power and drives the focus & zoom signals. When a camera is turned off, its 24vdc is turned off, video isolator turned off and Focus & Zoom lines turned off. Cameras are normally on as default. Camera power does not have GFD, but focus & zoom lines do. A camera ground fault will generate an “External 24vdc” GFD because the F&Z lines are generated from this power.

13 survey sensors can be connected to the pod, 4 with 115vac power and the rest with 24vdc power. The survey sensors serial signals, which can either be RS232 or RS485 running up to 115kbps, are terminated to the KD Con system containing up to 3 serial cards with 12 serial channels each. Each serial channel can individually be configured as RS232 or RS485 by means of changing serial piggybacks.

Ethernet and PECL can be supplied as option fibre modules that fit the racks topside and subsea.

The Light Junction Box is supplied with RS485 control signal and 24vdc. The Light Box does also contain a skid interface with RS232 and 115vac /20A.

The Control Pod has several spare inlets which can be fitted with subsea connectors e.g. Multi beam echo sounders. It does also have spare rack space for optional equipment.

Manufacturer	Kystdesign AS
Manufacturers Documentation	-1000E01 (ROV External Cabling) -1x50M01 (General Assembly drawing) -1050E01 (Control Pod, Block Diagram) -1050E02 (Fibre Layout) -1050E03 (Coax Layout) -1050E05 (Fibre Mux Serial Channels) -1050E10 (Control Pod Power Distribution) -1050E11 (Control Pod Power Lid) -1050E20 (Control Pod A1-2,B1-2,D1 VP’s) -1050E21 (Control Pod E1 Gyro) -1050E22 (Control Pod F1-2, G1-2 (115vac Cons)) -1050E23 (Control Pod I1-2, J1-2, K1-2 (24VDC Cons)) -1050E24 (Control Pod L1-2 (24VDC Cons)) -1050E25 (Control Pod (Master)) -1050E26 (Control Pod O1-2, P1-2 (Video Card 1)) -1050E27 (Control Pod Q1-2, R1-2 (Video Card 2))
Depth Rating	3000m
Data sheets	Vicor Modules KD Con System LINK Fibre Cards

	WestControl GFD Card
Weight in air	108 kg
Weight in Water	40 kg

2.3.2. System Main Control Links

The surface / subsea control is done by 6 direct serial links, one for each unit. That is; to the KD Con Master card (TTL), TCU, ACU, GFVP 1 & 2 and the Light Box (RS485).

2.3.3. Power Modules

The 250w 24vdc and the 150w 12vdc power are generated by Vicor power modules, mounted directly onto the pod lid wall to maximise heat transfer out of the pod.

WARNING
There is 300vdc between the Vicor FARM input module, the Vicor HUB module and the Vicor DC/DC modules. Do not work on the modules while the system is alive

The 12vdc power is for internal use only.
A 250w 24vdc module supplies power to external survey equipment.
These powers supplies are individually Gnd fault monitored.

PLEASE NOTE!
Try not to use internal power for external use since it's vital for system operation. Keep in mind that media converters may connect powers together and may complicate GFD fault finding. If additional signal converters are installed, use galvanic isolated versions if available

There are spare pod lid wall positions for additional Vicor modules. E.g. 48vdc and additional 24vdc capacity (parallel, see picture).

Note:
The FARM input module can supply 750w max DC/DC input power total.

The valve packs are supplied 150vdc power which is generated inside the pod lid by rectifying the 115vac and smoothed by capacitors, mounted onto the end of the pod rack.

The instrument transformer inside the termination box has a rectified tapping which is smoothed by a capacitor, mounted inside the control pod. This 24vdc linear power is for cameras, but can also be used for instruments that need clean power.
Note, this supply does not have GFD monitoring and its main fuse is mounted inside the termination junction box.

WARNING
The 150vdc can be fatal. The 24vdc linear power for the cameras and the linear 150vdc power for the valve packs take time to discharge. Do not work on the system while the power LEDs are lit.

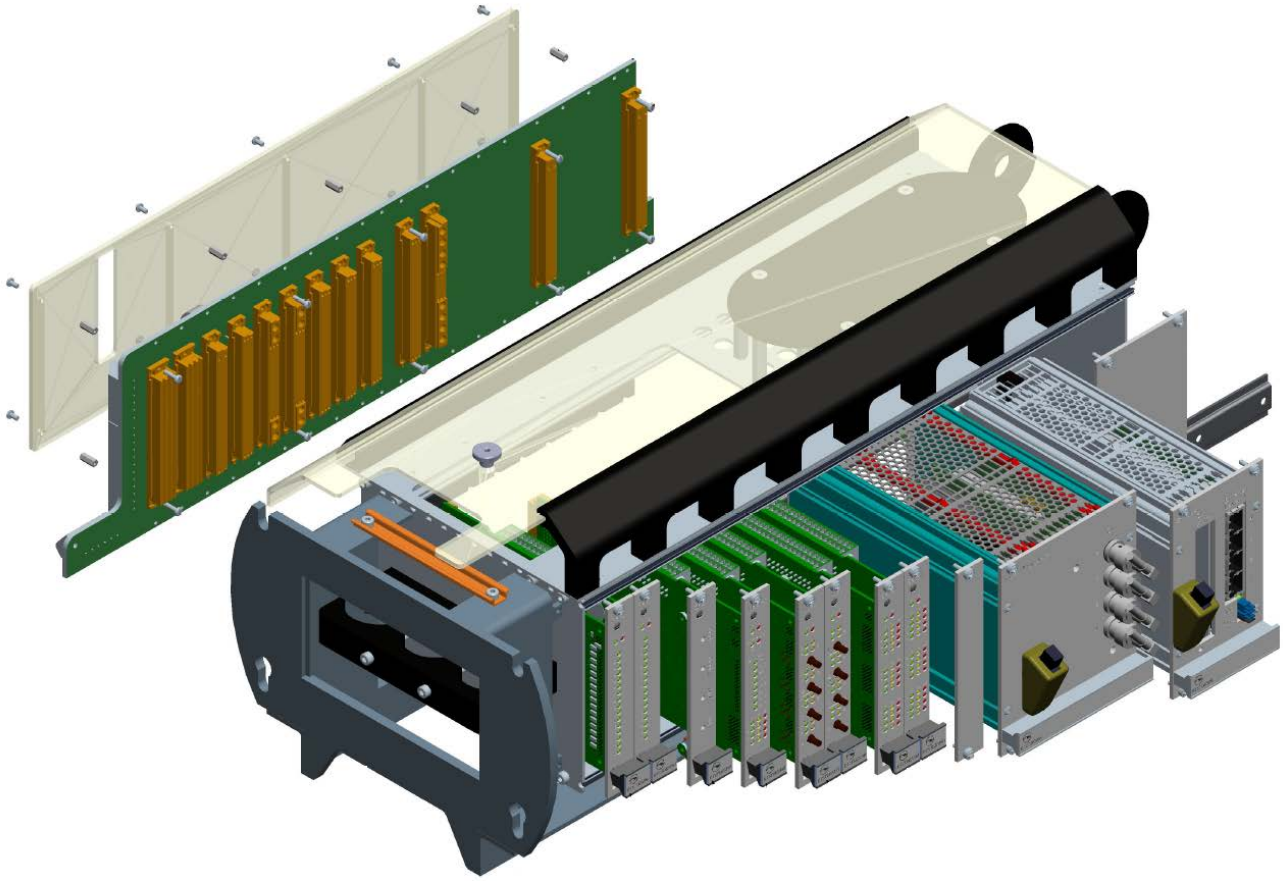
2.3.4. KD Con System

The KD Con system combines the fibre optic with ROV control into one system. Main goal by doing this is to reduce complexity, improve access, ease maintenance and take advantage of new fibre optic available on the market.

PLEASE NOTE !
Do not use tight cable tie wraps to mount fibres. It may introduce fibre damping called micro bends which again can generate link failures.

All cards and modules are mounted into a 3U 19” rack with a backplane distributing power and comms. Easy disconnect able Wago connectors are used all over to terminate wires.
Hence, changing a fibre module or a card can be rapidly and securely done with no hassle.

Spare fibre optic modules, like Ethernet, Video Mux and PECL can be stored complete enabling an easy system swap.



Subsea Rack Assembly

The request for HD cameras, multi cannel Gb Ethernet etc. require more fibre links to be used. To reduce the amount of fibres needed, Coarse Wavelength Division Multiplexers, CWDMs are installed. The CWDMs multiplex 8 fibre lines onto one single fibre.

CWDM from Cubo

Small Factor Pluggable, SFP, fibre optic transceiver

The use of CWDMs can make a fibre optic system very complicated and hard to maintain. To avoid this, the KD Con system is delivered with the fibre optic cards, lasers and CWDMs as complete rack mountable, backplane pluggable modules.

LINK Fibre Cards

The “LINK” fibre optic cards use hot pluggable SFP Fibre transceivers that come in CWDM matching wavelengths. See LINK manuals found in this volume “Data Sheets” chapter for more LINK cards details.

PLEASE NOTE !
The SFP fibre transceivers transmit output power is 0 to +5dBm and receivers sensitivity is -28 to -9dBm. If the loss in the transmission line is to low extra loss must be introduced by the use of a fibre optic attenuator. KD Con system use LINK “Input” cards topside whenever possible. This currently applies for Ethernet, and PECL. LINK AV and LINK DV have input card subsea and output card topside.

Fibre diagnostics are divided into two groups, subsea & topside. The Video Mux, AV card subsea monitors all fibre links subsea and the Video Mux, AV card topside monitors all fibre links topside. The diagnostics are given as two serial outputs topside, “D1” & D2”.
See Manual Volume 4 for more details.

Note:
Since KD Con use some LINK “input” cards topside, the cards will be called “input” in the fibre diagnostic program.

2.3.5. Control Pod Backplane

The control pod backplane link all modules and cards subsea by distributing power and comms. The cards are controlled and monitored by a local RS484 network. The internal 12vdc power, power all cards and modules.

The backplane can handle 2 x relay cards, a GFD card, a Master card, 2 x video cards and 3 x serial cards. There is a dedicated slot for the Video Mux and 2 general slots for fibre expansion modules e.g. Ethernet and PECL. There is also a Wago expansion connector to expand the system even further, outside the backplane.
Backplane power terminals link power busses to the relays in group of 4 relays; 2 on each relay card.
Backplane LEDs indicate which power busses that is alive. See el. pod drawings for more details.

PLEASE NOTE !
The 24vdc linear power for the cameras and the linear 150vdc power for the valve packs take time to discharge after a power off. Do not work on the system while the power LEDs are lit.

2.3.6. KD Con Status LEDs

Each KD Con card has a green power LED which is lit when 12vdc power is present.

There is also a red status led which is not lit when status is ok, flashing slowly whenever there is a comms failure (surface link or between cards) and flashing fast whenever there is an internal card failure (signal short etc.). Use diagnostic software to examine any internal card failure further.

2.3.7. KD Con Master Card

KD Con Master card functions as the main link between the KD Con cards and surface. It also monitors powers, temperatures, GFD signals and has power and Focus & Zoom control for 4 cameras.

The front “Surface Link“ LED will flash whenever there is an incoming and outgoing surface telegram. Steady lit “Card Links” LEDs indicate which cards the master has comms with. A flashing Led indicates lost comms.

The GFD card does not communicate with the Master card. GFD signals are GFD card analogue outputs 2-10vdc fed to the Master card. The Card Link GFD LED will flash if the analogue signals from the GFD card are outside their expected limits.

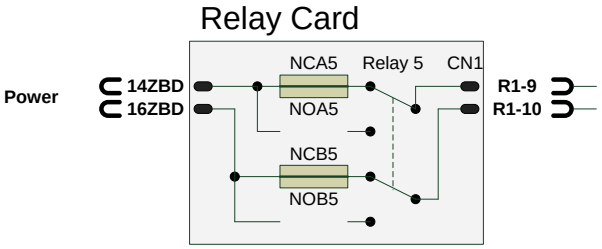
Note:
The Master card only detects which cards that is present during power on. If any new cards are installed later, a power reboot has to be performed to include them in the system scan.

The Focus and Zoom signals are generated from the “external 24vdc” power. Hence, a Focus & Zoom ground fault will generate an “external 24vdc” power ground fault.

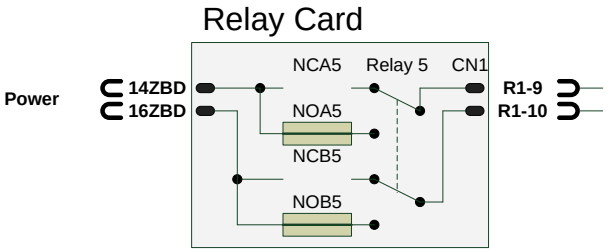
See the datasheet section for more Master card details

2.3.8. KD Con Relay Card

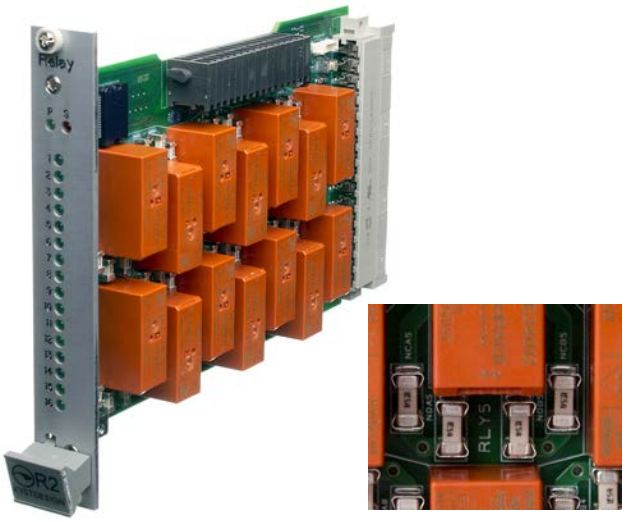
The K Con system can have up to 2 relay cards. Each Relay Card contains 14 fused relays and 2 relay control outputs. The relays can be configured as normally closed or as normally open. The dual pole change over relays has both the normally closed and normally open contacts fused. See the examples shown below.



Normally closed configuration.



Normally open configuration



The relay cards are controlled locally by the KD Con Master card See the datasheet section for more relay card details.

2.3.9. Ground Fault Detection Card

The ground fault detection card, detects power GND leakages. The card has 8 separate GFD channels, and produces 8 analogue output signals which are connected to the KD Con Master card.
Please note that the signals values are not linear and depend upon which side of the power, positive or negative side, the isolation fault is.

The power supplies which are monitored are:

1. 115vac for instrumentation
2. 115vac for lights
3. 12vdc internal power.
4. 24vdc for external sensors
5. 24vdc for TCU
6. 24vdc for ACU
7. 24vdc GFVP 1
8. 24vdc GFVP 2

The GFD card overlays an approximately 60vdc referenced to chassis GND to each monitored power.

e.g.
The 115vac will have a DC component of ca 60vdc to gnd when there is no GFD.
If there is a GND fault, this DC level will decrease which will be read by the GFD card.

Note:
Some survey equipment clamps this DC voltage by protecting electronics, hence producing a non-existent GND error.
The camera 24vdc linear power is not GFD monitored. It's only the Focus and Zoom signals that is GFD monitored. The Focus & Zoom signals are normally isolated from the camera power internally.
The Master card Link GFD LED will flash if the GFD signals are outside their expected range. e.g. when the GFD card has been pulled out.

2.3.10. KD Con Video Card

The KD Con Video cards isolate 4 video signals, and have power and Focus & Zoom control for 4 cameras each. The individual Video isolators and isolated focus & zoom lines can be turned off for each camera.

Video signal 1-3 are fed to the Video mux as video signals, but video signal 4 is digitized locally and fed to the AV Mux as digital signals. The coaxes on the back of the backplane are for the video signals going to the Video mux.

The Focus and Zoom signals are generated from the "external 24vdc" power. Hence, a Focus & Zoom ground fault will generate a GFD for the "external 24vdc" power.

See the datasheet section for more video card details.

PLEASE NOTE !
Always check that the backplane coax connectors are properly mated whenever a video card has been plugged into the backplane. Visually inspect through the rear protective backplane cover that the coax connectors are still in position.

2.3.11. KD Con Serial Card

The KD Con Serial cards are motherboards for serial interface piggybacks. Each card can handle 12 serial signals i.e. 12 piggybacks.

Piggybacks can be of type RS232, RS485, TTL etc. Generally for them all are that they are galvanically isolated and can be individually be switched off, isolating the outputs.

The serial card monitors the piggybacks enabling remote diagnostics.

See the datasheet section for more serial card and piggybacks details.

Note:
The KD Con system is capable of working as a multiple RS485 to RS232 converter. Main RS485 control links subsea are mirrored topside as RS232.

PLEASE NOTE !
Pay attention when assembling and disassembling piggybacks. Avoid damaging PCB tracks and connectors. The two multi pin connectors do have keying and locks that give a “click” when mated.

2.3.12. KD Con Video Mux

The KD Con Video Mux is a rack mountable box that fits the KD Con backplane. It contains a LINK AV input fibre card and optionally a LINK HD input fibre card. It also has a CWDM linking the LINK cards fibre SFP transceivers to a single fibre connector in the Video Mux module front plate.

The LINK AV card installed inside has 6 video inputs and 2 video inputs digitalized locally on the KD Con video cards. The LINK AV card does also have 36 dual Serial TTL lines connected to the KD Con serial cards.

The video signals and the TTL signals are linked to the backplane through backplane connectors enabling easy mux swap.

PLEASE NOTE !
Always check that the backplane coax connectors are properly mated whenever the Video mux has been plugged into the backplane. Visually inspect through the rear protective backplane cover that the coax connectors are in position.

The AV card FPGA chip gets hot and the Video Mux has a 12vdc fan for cooling it down.
See the datasheet section for more Video Mux details.

2.3.13. KD Con Ethernet Mux (optional)

The KD Con Ethernet fibre mux is a rack mountable box that fits the KD Con backplane expansion slots. It contains a LINK Ethernet input fibre card and a 5 ch Gb Ethernet switch that are linked to one of the LINK Ethernet channels, typ. ch 1. It also has a CWDM linking the fibre SFP transceivers to a single fibre connector in the mux module front plate.

The LINK Ethernet card provides up to 4 channels of Gb Ethernet, physical layer (L1), with no package management or switch functionality. This allows the system to be used multi beam sonars, which stream data directly on the physical layer.

However, to expand number of ports and to simplify interfacing to other survey equipment, the local Gb switch provide the “plug and play” functionality.

The KD Con Ethernet Mux subsea and topside are identical except from the fibre transceivers installed and their configuration.

See the datasheet section for more Ethernet Mux details.

PLEASE NOTE !
The LINK Ethernet card connector chassis is connected to 0v(12vdc) and not gnd. Make sure it do not connect to GND since that will produce a 12vdc GND fault. Use unscreened RJ45 cons when interfacing to the LINK Ethernet card. The Gb switch however is isolated from 0v(12vdc) Multi beam sonars shall be connected directly to the LINK Ethernet card and not through the switch, subsea and topside. Topside Ethernet MUX is equivalent to the Subsea mux. Hence, Topside Fibre Diagnostic SW will name the Link Ethernet output card as “Input”

2.3.14. KD Con PECL Mux (optional)

The KD Con PECL fibre mux is a rack mountable box that fits the KD Con backplane expansion slots. It contains a LINK PECL input fibre card and a CWDM linking the fibre SFP transceivers to a single fibre connector in the mux module front plate.

The LINK PECL card has transparent 2 channels, but fibre wise configured as 2 channels going from subsea to surface.

The KD Con PECL Mux subsea and topside are identical except from the fibre transceivers configuration.

See the datasheet section for more PECL Mux details.

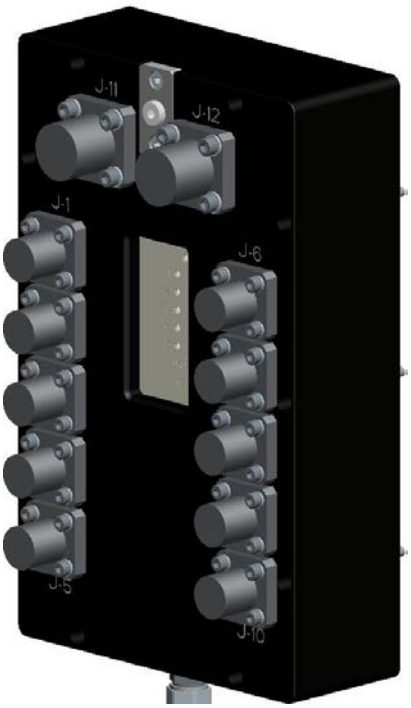
PLEASE NOTE !
The PECL mux is configured as uplink only. There is no PECL fibre down link. Hence, subsea fibre diagnostics will only indicate fibre Tx power and Infinite Rx level (no light). Topside PECL mux is equivalent to the Subsea mux. Hence, Topside Fibre Diagnostic SW will name the PECL output card as “Input”

2.3.15. Driver Card

Totally 4 pressure tolerant Driver Cards are installed, which are located inside the valve packs. The driver cards are stackable and terminal cards are used to interface the sensors and valves to the driver cards.
The Driver Cards are controlled individually by RS485 links from surface. The Driver Card RS485 bus connection is galvanic isolated. In case of link failure all its outputs are switched off after 6 sec. (Dip setting)
Each Driver Card contains 24 Pulse Width Modulated (PWM) outputs controlling proportional valves.
Totally 21 analog in (AI) and 3 digital in (DI) on each card can be SW configured for reading either 0-10vdc voltage signal or 0-20mA current signals. Each input has an individual solid state power relay supplying 24vdc sensor power.
Note:
The driver card cannot galvanically isolate the sensor power and signal. Hence, a sensor GFD cannot be locally isolated.
The card does also have 4x PT100 inputs to read temperature signals.
The driver card and termination cards do have status LEDs. A steady blue led indicates that there is comms. A slowly flashing blue led indicates comms failure.
See the datasheet section for more driver card details.

PLEASE NOTE !
Pay attention when assembling and disassembling a driver card stack. Avoid damaging PCB tracks and connectors. The two multi pin connectors do have keying and locks that give a “click” when mated.

2.4. Light Box



The Light Box controls 10 x 115vac light outputs and a survey connector capable of supplying 20-amp at 115vac / RS232. The lights are individually switch- and dimmable.

All light interfaces are protected by 6A remotely reset-able breaker circuits. The light supply is also protected by a 20-amp breaker inside the Termination Box.

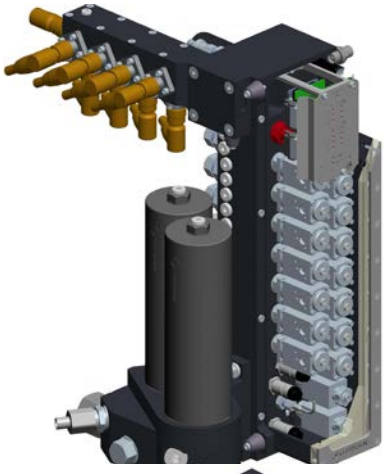
The survey connector is protected by a 20-amp breaker inside the Termination Box in addition to a remotely reset-able breaker circuit.

If any of the breakers releases, an alarm will be generated.

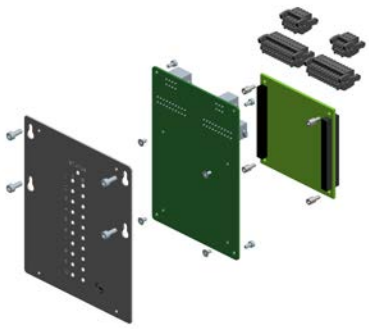
WARNING
The 115vdc for the lights and the “skid” connector is supplied directly from the Termination Box through an oil filled cable. Hence, 115vdc is present even if the light box cable to the el. Pod is disconnected. Do not use the light box to supply power to gas lights. It may damage the light box electronics.

Manufacturer	Kystdesign AS
Manufacturers Documentation	-1000E01 (ROV External Cabling) -1062M01 (General Assembly drawing) -1062E01 (Wiring Diagram)
Data sheets	ROV Light Dimmer Card
Hydraulic Fluid	Tellus 22S

2.5. Valve Packs



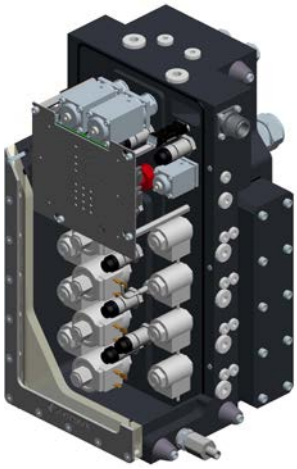
Each valve pack, TCU, ACU, GFVP1 & GFVP2 is controlled by driver card stacks installed inside each valve pack to run valves and to read hyd. sensors. They are also used to read external oil comp levels etc.

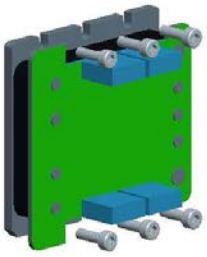


Power to the sensors can be individually switched off, which enables the operator to isolate any faulty sensors from the system.

In case of comms failure all driver card outputs will be turned off. (Switch settable)

A steady blue diode indicates normal runtime operation. No LED lit indicates no 24vdc power. If the blue diode is flashing, there is 24vdc power present, but no link.





The Valve Packs have an integrated 150vdc/24vdc power supply.

WARNING
The Valve Packs are supplied with 150vdc, which can be fatal. Do not work with the power when the system is alive.

Termination cards contain LEDs, which are lit if valves are operated. Light intensity indicates command level.

Most all sensors are 2-wire, 24vdc and a 4-20mA signal. To verify a sensor signal, read the voltage between the 0 volt and signal input terminal.

See Operator Manual Volume 2, “Hydraulic System” for details regarding functionality, operation and maintenance

3. Components Replacement

3.1. Oil Filled Enclosures

The below procedure should be used when replacing any of the internal components in a valve pack, the Termination junction box or the Light Box.

WARNING
The electrical power supplied to this unit is High Voltage and direct contact with this is likely to be fatal. Ensure that all personnel are fully qualified, and that all necessary safety and shut down systems are fitted and operative. No work should be performed inside the Termination Box without having the main ROV hydraulic and instrument power being switched off and terminated to GND. At normal on deck running conditions should the Termination Box Lid be on and the ROV grounded by a ground strap between the ROV frame and supply source ground.

WARNING
The Vicor DC/DC modules are supplied with 150vdc. Direct contact can be fatal. Do not work with the power modules when the system is alive.

3.1.1. Opening Enclosure

1. First isolate the associated compensator circuit by closing the isolation valve located on the compensator control panel.
2. Place an oil tray below the enclosure and remove the drain plug
3. Removing the bleed plug located at the top of the housing will increase the oil flow.
4. Loosen all bolts holding the lid.
5. Remove lid and O-Ring

3.1.2. Replacing hydraulic valves

See Operators Manual Volume 2.

3.1.3. Replacing Electronic Components

1. First isolate the associated power circuit by turning off supplied power, either by turning the system off or if possible turning off the relay supplying power from the Control Pod. Please note that the Light Box is also supplied power from the Termination Junction Box through an oil filled tube, which cannot be turned off without turning the ROV instrument power off.

2. Disconnect all electronic contacts. Note that the Light Box leads from the Termination Junction Box are interfaced by a Molex connector making the Light Box electronics easy removable.
3. Replace component.
4. Verify component set-up, dip switches etc.
5. If any rewiring has been performed, verify wiring against drawing by a volt meter.
6. Reconnect all connectors,
7. Verify connector's positions
8. Turn on power.
9. Verify component function (s)

3.1.4. Closing Enclosure

1. Check that no foreign objects are inside the box, and that all electrical connections are connected before sealing it.
2. Clean the O-ring, The O-ring groove and the sealing surface with an air gun or with a soft cloth.
3. Make sure the O-ring is undamaged, lubricate with a thin film of Molykote 111 before locating it in the O-ring groove.
4. Clean the threaded holes in the flange with compressed air, and lubricate with Aqualube.
5. Place lid in position, insert all bolts and finger tighten.
6. Use a torque wrench and tighten the bolts to **5,5 Nm**
7. **Fill up with Shell Tellus 22S oil**

3.2. Control Pod

3.2.1. Opening Control Pod

1. First bleed off any internal air pressure by opening the bleed plug
2. Loosen the three 8mm bolts securing the Control Pod lid and turn the associated locking brackets away from doom and then tighten the bolts again
3. The pod lid is hanging onto the internal rack when pod is open. Open the pod by gently pulling the lid out while verifying that ***no*** wires or internal cabling are damaged.

3.2.2. Replacing Electronic Components

1. First turn the ROV instrument power off.
2. Disconnect all electronic contacts.
3. Replace component.
4. Verify component set-up, dip switches etc.
5. If any rewiring has been performed, verify wiring against drawing by a volt meter.
6. Reconnect all connectors.
7. Verify connector's positions.
8. Turn on power.
9. Verify component function (s).

3.2.3. Replacing Vicor Power Modules

The Vicor Modules are mounted inside the pod lid. To get access to the modules the lid has to be released from the rack by disconnecting the top mounted phoenix connector and then lift the lid up and out.

WARNING
Between the Vicor FARM input module, the Vicor HUB module and the Vicor DC/DC modules there is 300vdc, which can be fatal. Do not work on the Vicor modules when the system is alive.

1. Release module interface card from module and replace the module with a new one.
2. Cover the module underneath with a very thin heat compound layer.
3. Reconnect interface card.
4. Verify wiring by an electronic meter against Pod Power Distribution drawing, 1050E11.
5. Verify the system by turning on power.

Note:
The Vicor modules are short circuit protected and the 115vac supply is protected by an inline fuse inside the pod lid.

3.2.4. Replacing Subsea Connectors

1. Open the top cable “lid” to give free space to the cables laying underneath.
2. Disconnect the connector wires from card terminals.
3. Attach a thin rope to the connector wires.
4. If necessary, remove / loosen the cable retainers inside the pod connector ring wall.
5. Loosen the subsea connector by removing its screws.
6. Pull the connector gently out together with the rope verifying that no fibres or wires are trapped and damaged during this operation.
7. Attach the rope to an equivalent connector.
8. Clean the O-rings, the O-ring grooves and the sealing surfaces with an air gun or with a soft cloth.
9. Make sure the O-rings are undamaged, lubricate with a thin film of Molykote 111 before locating the O-rings in the O-ring grooves.
10. Clean the pod threaded connector holes with compressed air, and lubricate with Aqualube
11. Install the new connector by pulling its wire assembly gently by the thin rope.
12. Reinstall cable retainers on the pod internal wall.
13. Terminate the wires to its terminals having all wires correctly marked
14. Verify wiring by a volt meter.
15. Make sure that no wires are trapped.
16. Lubricate the new clean connector.
17. Verify the new connector by installing the subsea cables and turning on power.

3.2.5. Closing Control Pod

1. Secure all components.
2. Secure inside cabling.
3. Clean the O-rings, the O-ring grooves and the sealing surfaces with an air gun or with a soft cloth.
4. Make sure the O-rings are undamaged; lubricate with a thin film of Molykote 111 before position the O-rings in the O-ring grooves.
5. Gently push the pod lid together with the rack, verifying that no wires etc. are trapped and the O-rings are not damaged.
6. Open the three pod locking-bracket bolts and twist the brackets, locking the lid.
7. Tighten the bolts.
8. Verify pod sealing by vacuum**.**

Note:
Do not have the electronics on during the seal test. There is no cooling without air and the electronics can be damaged.

9. Remove the vacuum preferably by dry air or nitrogen and close the drain plug.

4. Drawings

4.1. Electric Schematics

Doc.	Description	
-1000E01	Single Line Diagram	ROV External Cabling
-1000E21	Wire Diagram	Sensor Cable
-1000E22	Wire Diagram	Power and Signal Cable
-1000E23	Wire Diagram	Power Cable
AD16-1000E40	Wire Diagram	T4 Modification Cable
AF25-1000E40	Wire Diagram	Valve Pack Cable
-1000E41	Wire Diagram	Pan & Tilt Cable
UK5417	Wire Diagram	Fiberassy
-1000E43	Wire Diagram	HD Camera Cable w TWPs
-1000E44	Wire Diagram	Still Camera Cable
-1000E45	Wire Diagram	Composite Camera Cable
-1000E46	Wire Diagram	Schilling T4 Cable
-1000E47	Wire Diagram	Saiv Depth Sensor Cable
-1000E48	Wire Diagram	Tritech Altimeter Cable
-1000E49	Wire Diagram	CP Probe Extension Cable
-1000E50	Wire Diagram	Mesotech MS1xxx Sonar Cable
-1000E51	Wire Diagram	MST 3xx Responder Cable
-1000E52	Wire Diagram	MinK 2#14 8#20 Pigtail Cable
-1000E53	Wire Diagram	MinM 26#20 Gyro Pigtail Cable
-1000E54	Wire Diagram	MinM Gyro Cable
-1000E55	Wire Diagram	MinK 2#14 6#22 Pigtail Cable
-1000E56	Wire Diagram	Dual Light Cable
-1000E57	Wire Diagram	Light Cable
-1000E58	Wire Diagram	Thin HD Camera Cable without TWP
-1033E01	Wire Diagram	Thruster Control Unit
-1033E02	Wire Diagram	Thruster Control Unit
-1034E01	Wire Diagram	Auxiliary Control Unit
-1035E01	Wire Diagram	General Function Valve Pack

-1050E01	Block Diagram	Control Pod
-1050E02	Line Diagram	Fibre Layout
-1050E03	Line Diagram	Coax Layout
-1050E05	Wire Diagram	Fibre Mux Serial Channels
-1050E10	Wire Diagram	Control Pod Power Distribution
-1050E11	Wire Diagram	Control Pod Power Lid
-1050E20	Wire Diagram	Control Pod A1-2,B1-2,D1 VP's
-1050E21	Wire Diagram	Control Pod E1-2 Gyros
-1050E22	Wire Diagram	Control Pod F1-2, G1-2 (115vac Cons)
-1050E23	Wire Diagram	Control Pod H1-2, I1-2, (24VDC Cons)
-1050E24	Wire Diagram	Control Pod J1-2, K1-2, (24VDC Cons)
-1050E25	Wire Diagram	Control Pod L1-2, M1-2
-1050E27	Wire Diagram	Control Pod N1-2, Pod Leak (Master)
-1050E28	Wire Diagram	Control Pod O1-2, P1-2 (Video Card 1)
-1050E29	Wire Diagram	Control Pod Q1-2, R1-2 (Video Card 2)
-1060E01	Wire Diagram	Termination Junction Box
-1062E01	Wire Diagram	Light Junction Box

4.2. Mechanical Drawings

Doc.	**Description**	
-1x50M01	General Arrangement	Control Pod
-1x60M01	General Assembly	Termination Junction Box
-1062M01	General Assembly	Light Junction Box

5. Data Sheets

Tag	Description	Manufacturer	Locaion
1.	Breaker	Airpax	Termination Junction Box
2.	Filter/Auto ranging Rectifier Module (FARM)	Vicor	Control Pod
3.	DC-DC converter module 300Vin / 12Vout / 150Watts		Control Pod
4.	DC-DC converter module 300Vin / 48Vout / 150Watts		Control Pod (Optional)
5.	DC-DC converter module 300Vin / 24Vout / 250Watts		Control Pod
6.	DC-DC converter module 150Vin / 24Vout / 250Watts		Valve Packs Power Supplies
7.	Light Control Boards	Kystdesign AS	Light Box
8.			
9.	Link Family	LINK	Control Pod (& Surface)
10.	Analogue Video Board (AV Card)		Control Pod (& Surface)
11.	Digital Video Board (DV Card)		Control Pod (& Surface)
12.	Ethernet Board (Optional)		Control Pod (& Surface)
13.	PECL Board (Optional)		Control Pod (& Surface)
14.	SFP MR80D-Cxx	Fiberworks	Control Pod (& Surface)
15.	CWDM C-80-D-B-S-S-13-1-T55	Cube Optics	Control Pod (& Surface)
16.	Gb Ethernet Switch (Optional)	GS105E	Control Pod (& Surface)
17.	Relay Card	Kystdesign AS	Control Pod
18.	GFD Card	WestControl	Control Pod
19.	Master Card	Kystdesign AS	Control Pod
20.	Video Card	Kystdesign AS	Control Pod
21.	Serial card	Kystdesign AS	Control Pod (& Surface)
22.	Video Mux	Kystdesign AS	Control Pod
23.	Ethernet Mux (Optional)	Kystdesign AS	Control Pod (& Surface)
24.	PECL Mux (Optional)	Kystdesign AS	Control Pod (& Surface)
25.	Pressure Relief Valve	Deepsea Power & Light	Control Pod
26.	Driver Card	Kystdesign	Valve Packs
27.	Umbilical	Nexans	Winch
28.	Tether	Kystdesign	TMS
29.	Electrical Motor	IKM	ROV