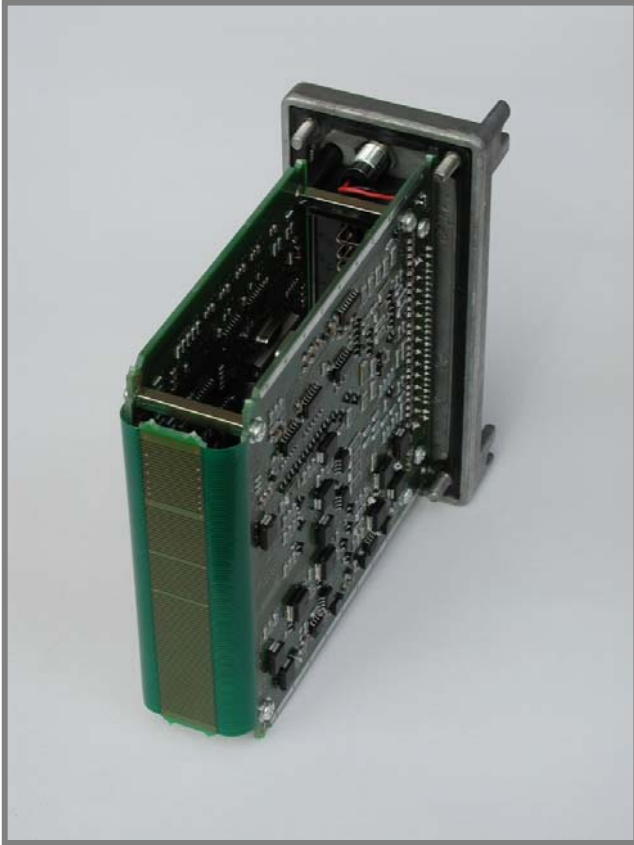# Drive Control DCC

DCC Drive Control Crawler is a standard electronic control system for crawler-type vehicles, which controls the hydrostatic drive and manages the diesel performance.

The entire handling such as acceleration, braking, speed (with/without cruise control and creep speed) can be adjusted using parameter sets. At the same time, the DCC Drive Control monitors the diesel engine and adapts automatically the decrease of performance to the current driving situation.

Pre-setting the diesel RPM (ramps, fixed values) makes it possible to control the hydrostatic drive individually for all operation modes (work, transport, mix). Electronically controlled the track vehicle can be driven more suitably and more secure in each situation.

DCC is constructed based on the hardware platform HCY. This hardware has special safety features and 2 CAN interfaces. Thus the DCC control system is versatile and usable for complex tasks.

The PC program ConDoc - Control& Document® serves to adapt and input the machine-specific data.

For routine control, the operational data can be sent via CAN to a display (DCD) and indicated there, e.g.

- Driving speed
- Diesel rotary frequency
- Diesel engine work load
- Operation mode

The control system is protected by a robust aluminium housing.

VÖLKEL

M I K R O E L E K T R O N I K

DCC Function description

Operation mode work/transport

- Operating mode selection by switches

Working mode

- Driving at a fixed diesel RPM
- Selection of the diesel RPM using a separate potentiometer
- Actuation of the hydrostat using a control lever or a pedal

Transport mode

- Adjustment of the diesel RPM using the throttle pedal or the joystick
- Driving the hydrostat dependent on the diesel RPM

Characteristic curves

- The desired value generation for the hydrostat can be made linear or by the hyperbolic function and can be set separately for each operation mode
  $\Rightarrow$ leads to sensitive starting
- Transport mode: separately adjustable start/ stop function for hydrostat dependent on the diesel rotary frequency
  $\Rightarrow$ driving at the lowest diesel rotary frequency necessary (minimum noise development and consumption)
- Diesel RPM range can be set separately for each operation mode

Selection of drive direction

- Selection of drive direction using two switches

Creep gear

- Limitation of the maximum speed using a creep speed potentiometer or a fixed value
  $\Rightarrow$ Improvement of sensitive driving at the lower speed range
- Function can be activated via a switch
- Maintenance of the full pedal range

Preset potentiometer

- Strait line driving adjustable via potentiometer

Cruise control

- Recalling the saved speed

Autopilot

- Analogue sensor records the driving route
- Status indication with a signal lamp

DCC Function description, contd.

Brake pressure controller

Brake pressure control dependent on the motor absorption volume

$\Rightarrow$ Results in constant delay during the entire reduction process

Constant pressure controller

- Maintenance of traction power when driving on slopes
- Protection against to high pressure

Diesel overspeed regulator

- Protects the diesel against overspeed during hydrostatic deceleration
- Reduction of the noise development during hydrostatic deceleration

Ramps

- Damping the hydrostat adjustment
- Separate acceleration, reduction and braking ramp times according to the operation mode

Dynamic acceleration

- Acceleration dependent on the pedal or joystick position

Load limit sensing control

- Control of power withdrawal by diesel engine

   $\Rightarrow$ Protection against stalling the diesel engine

Speed controller

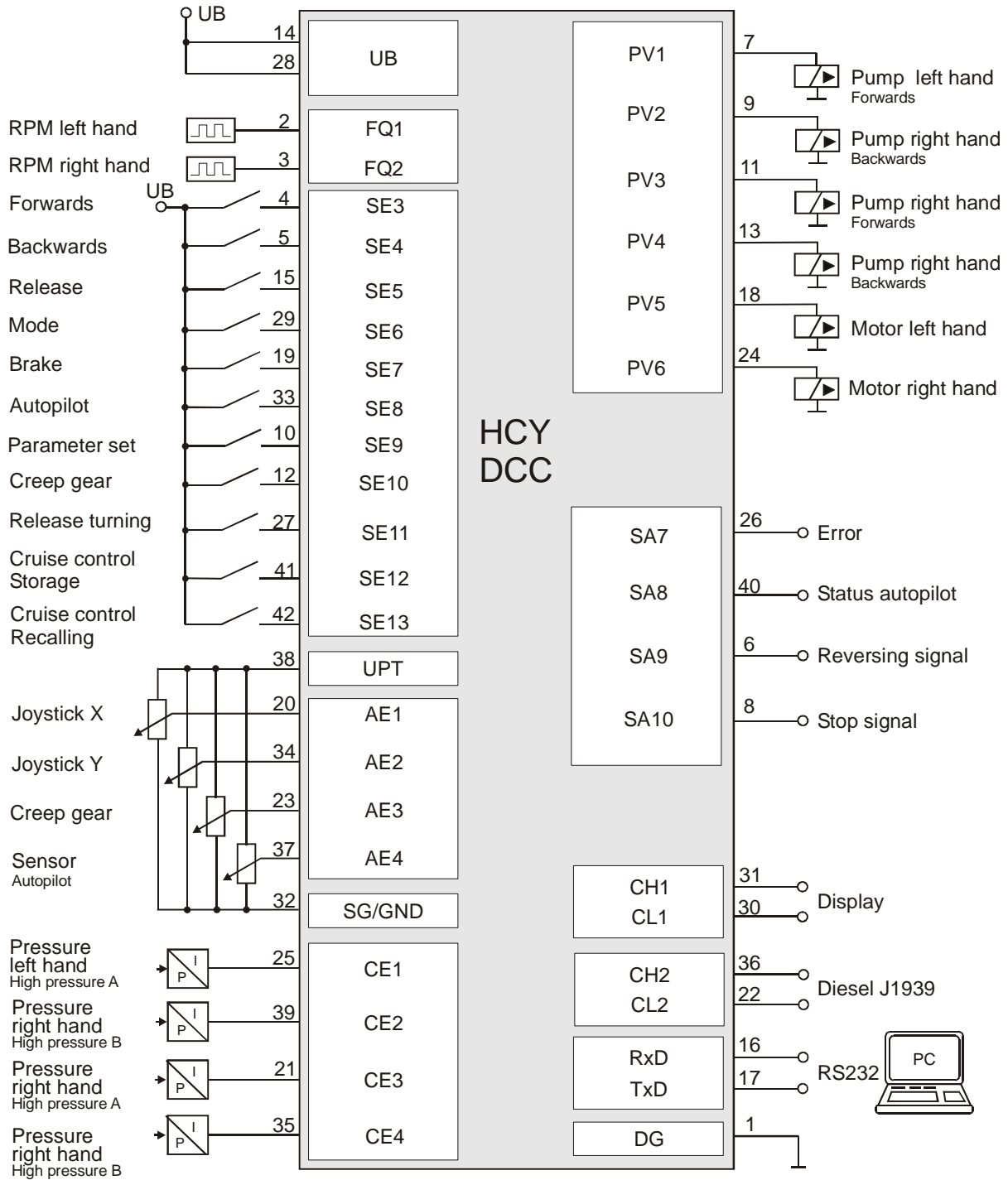- Control of the vehicle's speed

Speed limitation

- Speed limitation for each operating mode and direction

Diesel management

- Diesel management possible using the SAE-J1939 CAN protocol

DCC Connection diagram

UB
14
28
UB

RPM left hand — 2 — FQ1
RPM right hand — 3 — FQ2
UB
Forwards — 4 — SE3
Backwards — 5 — SE4
Release — 15 — SE5
Mode — 29 — SE6
Brake — 19 — SE7
Autopilot — 33 — SE8
Parameter set — 10 — SE9
Creep gear — 12 — SE10
Release turning — 27 — SE11
Cruise control Storage — 41 — SE12
Cruise control Recalling — 42 — SE13

38 — UPT
Joystick X — 20 — AE1
Joystick Y — 34 — AE2
Creep gear — 23 — AE3
Sensor Autopilot — 37 — AE4
32 — SG/GND

Pressure left hand High pressure A — 25 — CE1
Pressure right hand High pressure B — 39 — CE2
Pressure right hand High pressure A — 21 — CE3
Pressure right hand High pressure B — 35 — CE4

HCY
DCC

PV1 — 7 — Pump left hand Forwards
PV2 — 9 — Pump right hand Backwards
PV3 — 11 — Pump right hand Forwards
PV4 — 13 — Pump right hand Backwards
PV5 — 18 — Motor left hand
PV6 — 24 — Motor right hand

SA7 — 26 — Error
SA8 — 40 — Status autopilot
SA9 — 6 — Reversing signal
SA10 — 8 — Stop signal

CH1 — 31
CL1 — 30 — Display

CH2 — 36
CL2 — 22 — Diesel J1939

RxD — 16
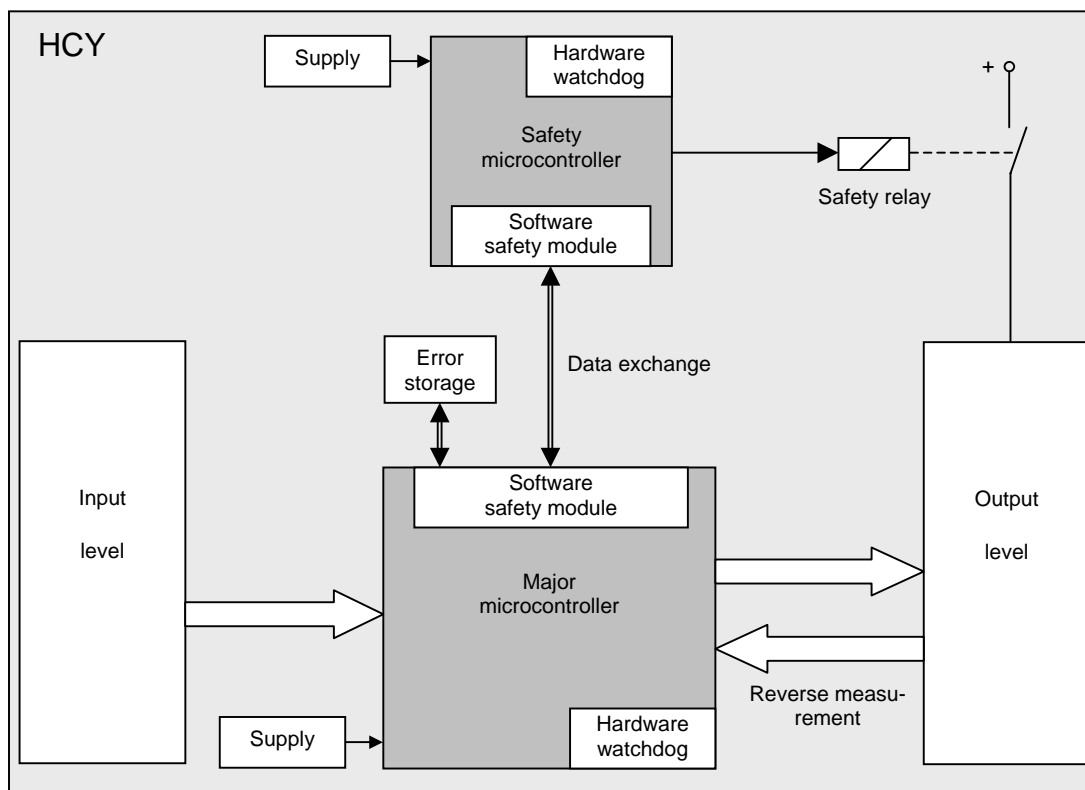TxD — 17 — RS232   PC

DG — 1

- 4 -

DCC Functional safety

Safe control systems need safe hardware and safe software.

Safe hardware:

- 2 microcontrollers to monitor each other

- Each microcontroller has separate voltage regulation, cycle operation and its own watchdog

- Additional means of switching off using a safety relay according to the principle of quiescent current

- Monitoring the supply voltage and reverse measurement of all outputs

Structural diagram:

HCY

Supply →	Hardware watchdog
Safety microcontroller	→ Safety relay
Software safety module	

Error storage ↔ Data exchange

Input level →

Software safety module
Major microcontroller
Supply → Hardware watchdog

Output level

→ Output level
← Reverse measurement

Safe software:

- Mutual work flow control by permanent data exchange with total check sum control

- Checking ROM and RAM by read and write tests with check sum calculation with the power ON

- Various possibilities to monitor the inputs and outputs (e.g. recognition of cable breaks and short circuits)

- Plausibility checks for important parameters by logical combination and checking limit values

HCY Pin assignment

1	DG	Supply, minus (earth)
14	UB	Supply, plus (12V / 24V)
28	UB	Supply, plus (12V / 24V)
2	SE1 / FQ1	Switch input 1 / frequency input 1 (-5 … 32V)
3	SE2 / FQ2	Switch input 2 / frequency input 2 (-5 … 32V)
4	SE3 / FQ3	Switch input 3 / frequency input 3 (-5 … 32V)
5	SE4 / FQ4	Switch input 4 / frequency input 4 (-5 … 32V)
15	SE5 / FQ5	Switch input 5 / frequency input 5 (2,5V)
29	SE6 / FQ6	Switch input 6 / frequency input 6 (2,5V)
19	SE7 / FQ7	Switch input 7 / frequency input 7 (2,5V)
33	SE8 / FQ8	Switch input 8 / frequency input 8 (2,5V)
10	SE9	Switch input 9 / safety input
12	SE10	Switch input 10 / safety input
27	FQ9P / SE11	Switch input 11 / pickup H
41	FQ9M / SE12	Switch input 12 / pickup L
42	FQ10 / SE13	Switch input 13 / clamp W
38	UPT	Output 5V / 8V
20	AE1 / SE14	Analogue input 1 (10V) / Switch input 14
34	AE2 / SE15	Analogue input 2 (10V) / Switch input 15
23	AE3 / SE16	Analogue input 3 (10V) / Switch input 16
37	AE4 / SE17	Analogue input 4 (10V) / Switch input 17
32	SG	Signal earth
25	AE5/CE1/SE18	Analogue input 5 (5V/10V) / 4 to 20mA Current input / Switch input 18
39	AE6/CE2/SE19	Analogue input 6 (5V/10V) / 4 to 20mA Current input / Switch input 19
21	AE7/CE3/SE20	Analogue input 7 (5V/10V) / 4 to 20mA Current input / Switch input 20
35	AE8/CE4/SE21	Analogue input 8 (5V/10V) / 4 to 20mA Current input / Switch input 21
7	PV1P / SA1	Proportional output 1 / Switch output 1
9	PV2P / SA2	Proportional output 2 / Switch output 2
11	PV3P / SA3	Proportional output 3 / Switch output 3
13	PV4P / SA4	Proportional output 4 / Switch output 4
18	PV5P / SA5	Proportional output 5 / Switch output 5
24	PV6P / SA6	Proportional output 6 / Switch output 6
26	SA7	Switch output 7
40	SA8	Switch output 8
6	SA9	Switch output 9
8	SA10	Switch output 10
31	CH1	CAN1 line H
30	CL1	CAN1 line L
36	CH2	CAN2 line H
22	CL2	CAN2 line L
16	RXD	RS232 Receive cable for the hand terminal or the PC
17	TXD	RS232 Send cable for the hand terminal or the PC

HCY Technical data

Dimensions:	152mm x 150mm x 56mm
Weight:	700g
Plug connections:	Multiple plug, AMP 1-0967280-1, 42 contacts
Power supply:	UB = 8 ... 32V
Surrounding temperature:	-40 … 85°C
Current input:	Approx. 160mA at 24V (plus output current)
Parameter settings:	Using the hand terminal or a PC (RS232)
Microcontroller:	C167CS / 40MHz
Program memory:	1MByte flash EPROM
Data memory:	128kByte RAM
Parameter memory:	64kBit EEPROM
Safety microcontroller:	C505CA / 4MHz

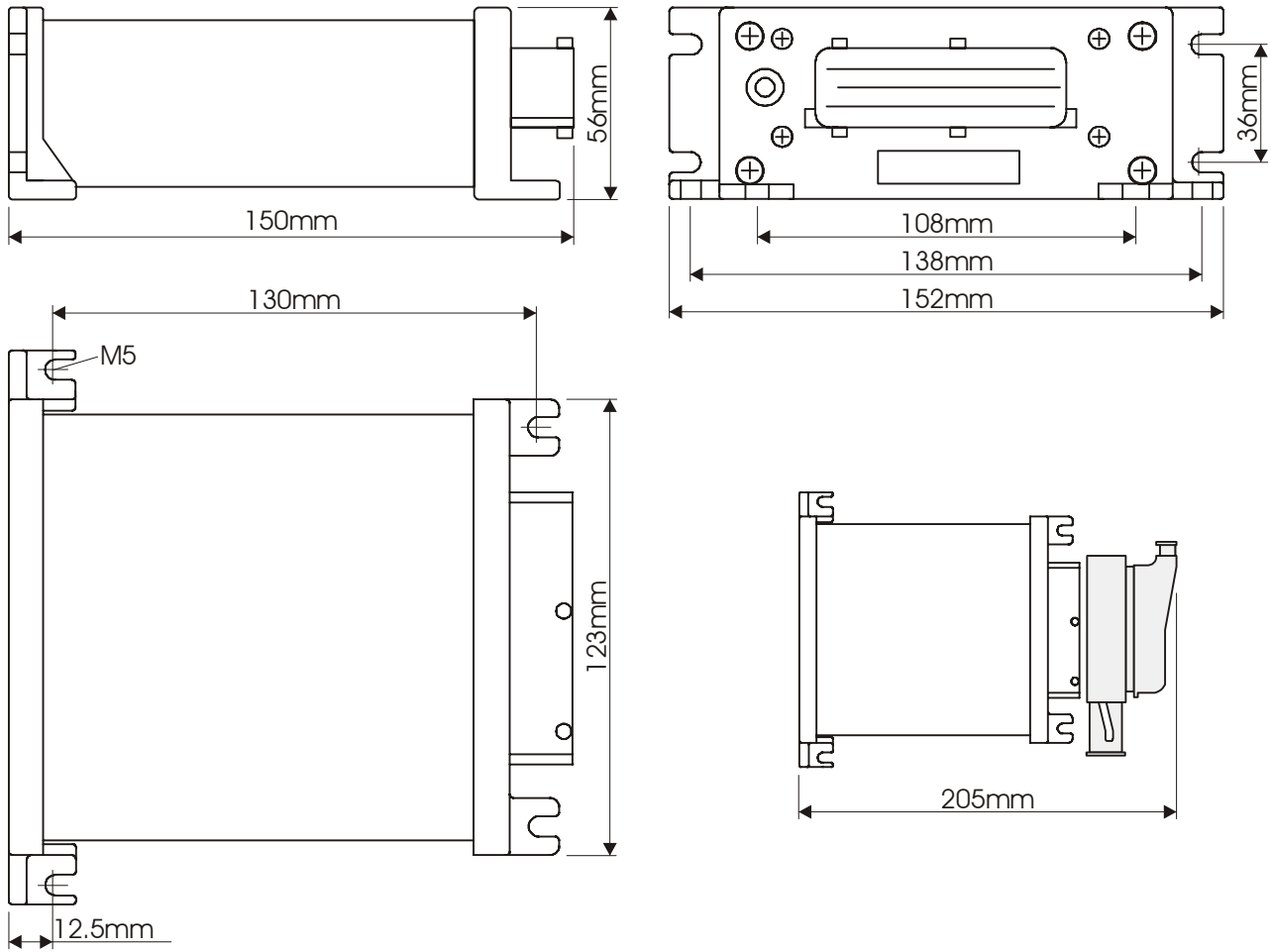|		
Inputs:	4	Digital switch entries with 4.7kΩ pull down/pull up resistors. Switching thresholds which can be switched in pairs in the range of -5 … 32V. Suitable as frequency inputs up to 10kHz. Also appropriate for Namur sensors due to 1kΩ pull down which can be additionally connected.
	6	Digital switch entries with 4.7kΩ pull down resistors and switching thresholds which can be set in the range of 0 … 32V. 4 of these can be used as frequency inputs up to 4KHz with fixed switching thresholds: U_{on} = approx. 2.9V, U_{off} = approx. 1.5V. 2 are also evaluated additionally by the safety controller.
	1	Rev sensor input, pickup, fmax = 10kHz, Signal level: U_{ss} = 400mV at 1kHz, becomes less sensitive at higher frequencies. Both connections can also be used as additional digital switch entries with 4.7kΩ pull down resistors and thresholds which can be set in the range of 0 ...32V.
	1	Clamp W, frequency input, fmax = 2kHz, switching thresholds: U_{on} = 75% von UB, U_{off} = 25% of UB, 4.7kΩ resistance to earth. Can also be used as a digital switch entry with thresholds which can be set in the range of 0 ... 32V.
	4	Analogue inputs for the current range 0 … 10V with 10 bit resolution and 100kΩ input resistance. Can be configured as switch entries with thresholds which can be set in the ranges 0 … 10V and 4.7kΩ pull down.

HCY Technical data contd.

Inputs:	4	4 … 20mA current supplies with 220Ω burden to earth and 10 bit resolution. Overload protected. Can be switched as an analogue input with a voltage range from 0 … 5V or 0 … 10V with 10 bit resolution and 100kΩ input resistance. Can also be configured as a switch entry with 4.7kΩ pull down and thresholds which can be set in the range 0 … 10V.
Outputs:	6	Proportional solenoid outputs, each for a maximum of 3A.
	4	Switch outputs, each for a maximum of 3A.
	1	Power supply output with 5V or 8V for Namur sensors and potentiometers.
	1	Safety relay for switching off the 6 proportional outputs and the 4 switch outputs. The safety relay can be switched off using the safety microcontroller.

Interfaces: 1x RS232, 2x CAN

Safety: Two microcontrollers, mutual control, each with
Microcontroller watchdog
Double voltage regulation
Double cycle generation
Safety cut off via relay
No terminals with sockets used
Reverse pole protection
Ventilation membrane
Protection system IP65, IP69K

EMV:

Road vehicles:	Directive 72/245/EWG (95/54/EG), ISO 10605, ISO 7637-1, ISO 7637-2, ISO 7637-3
Construction machinery:	DIN EN 13309, ISO 7637-3
Agricultural and forestry vehicles:	Directive 75/322/EWG (2001/3/EG), DIN EN ISO 14982, ISO 7637-3
Industrial application:	DIN EN 61000-6-2, DIN EN 61000-6-4

HCY Housing dimensions

56mm
150mm
36mm
108mm
138mm
152mm

130mm
M5
123mm
12.5mm

205mm

HCY Connector

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 33 34 35 36 37 38 39 40 41 42