CAN BOX 8FR-6

Power Distribution Controllers

CAN Box 8FR-6 is a programmable power distribution controller. It offers 8 fuse and relay channels and 6 high side channels and is intended to distribute the main power supply to several loads. The relays offer a digital feedback of each output, allowing a diagnosis of a defect fuse and monitoring of relay status. CAN Box 8FR-6 is freely programmable according IEC61131-3 and fitted with two CAN interfaces. The product allows advanced gateway functionalities in addition to the standard PLC functions.

Applications

- Power distribution over eight fuses and relays and six high sides
- Analogue signals to CAN bus
- CAN to CAN gateway

Technical Data

General information	
Housing	REDline Box Medium
Connector	1 x Powerelement M6 1 x LeavySeal 39 pins
Dimensions	167 x 142 x 74 mm
Weight	~470 g, unequipped
Operating temperature	-40 °C to 70 °C (no full load at 85 °C)
Storage temperature	-40 °C to 85 °C
Ingress protection	IP 64 (dust-proof / splashing protection)
Operating voltage	12 V or 24 V (relays) / 9 – 32 V HSD
Max self-protection voltage	Switch off over appr. 35 V
Pre-fusing (recommended)	80 A main supply 1 A VCPU
Max current (@ 70 °C)	55 A (max 6 relays constantly on)
Power consumption	Active (no output current) < 180 mA Sleep mode < 1 mA
Processor type	NXP K10 Cortex M4 32 bit
Clock frequency	120 MHz
Flash memory	512 kB
RAM	128 kB
FRAM	2 kB

Inputs / outputs overview		
4	Analogue inputs	0 – 30 V
4	Analogue inputs	0 – 10 V / 0 – 20 V mA
8	Fuses & relays	10/15 A micro relays with current sense
2	CAN interfaces	CAN high speed
1	Ignition input	Wake up feature
6	Digital outputs or PWM outputs	High side outputs max 2 A PWM outputs max 1 A
4	Frequency inputs	0 – 10 kHz
2	Temperature sensors	-40 °C to 125 °C (± 5 % at 125 °C)

Inputs / outputs details	
Analogue inputs	4 x 0 – 30 V DC
Input voltage range	0 – 32.4 V DC
Resolution	12 bits
Input resistance	130 kΩ
Analogue inputs	4 x 0 – 10 V DC/ 0 – 20 mA
Input voltage range	0 – 11.4 V DC
Resolution	12 bits
Input resistance	65 kΩ
Current input mode 0 – 20 mA	Switchable 380 Ω pull-down error < 1 % 4 – 20 mA (range 0 – 29 mA)
Frequency inputs	
Input resistance	42.5 kΩ
Input frequency	Up to 10 kHz
Duty cycle	0 to 100 % (1 % step)
Pull-up resistance	48.7 kΩ switchable to VCPU
Digital inputs	On each relay's output
Input voltage range	0 V DC to Vsupply
Switch-on level	5 V
Switch-off level	3.3 V
Input resistance	49 kΩ at 32 V
Relays outputs	
Current output	10 A (NC) / 15 A (NO)
Current feedback	accuracy ~ 6 mA step error < 5 % from 1 A to 15 A range 0 to 22.5 A
ATO Fuse (intern)	20 A max / channel (15 A max current)

Inputs / outputs details	
Digital outputs	**High side**
Load current	Max 2 A Diagnostic current sense, free wheel diode
Current feedback	accuracy ~ 1 mA step error < 5% from 0.1 to 2 A range 0 to 3.65 A
PWM outputs	
PWM frequency	Max 1 kHz
Duty cycle	effective 10 to 90 %
Resolution	0.1 %
Load current	Max 1 A at 1 KHz

CAN bus	
acc. ISO 11898-5	High speed, wake-on-CAN
Baud rate	20 kBit/s to 1000 kBit/s (500 kBit/s default value)

Status LED	
Color	tri-color RGB LED
Function	Free programmable status LED
Visibility	Through transparent window

Protections	
Overvoltage	CPU shutdown / transil diode
Relays	No specific voltage protection implemented (depends on coil specification)
Over current	Relays: depending on equipped fuses HSD: twice the nominal current allowed for 1 minute
Short to ground / battery	All inputs are referenced to ground. Relays are protected by fuses. High side outputs are protected by internal thermal protection.

Intend of use and disclaimer	
Relays K1 – K8	The design will allow a voltage to be present on the normally closed contact even if the V_{CPU} is not present, as long as the main supply will be powered. In that stage, there is no possibility to activate the relays or to take any action through the CPU.
HSD 0 – 5	Whereas protected against reverse polarity the outputs are not intended to be supplied by another voltage while the Vmain is not present. This may lead to reverse supply of CPU.
LED usage	The LED will illuminate while booting the CPU. Once the CPU has started the LED behavior has to be defined in the main application.
Temperature sensors	The temperature sensors are only an indication and are here to give a rough idea about the temperature status of the product. No specific behavior has been designed in. The final application is free to define some actions based on those temperature sensors (NTC resistor type). When either temperature measurement rises above 100 °C, countermeasures should be taken to reduce the heat generation within the box (e.g. number of active relays).
Vmain / V_{CPU}	The main supply voltage is connected to all the outputs and should be protected outside of the box. The V_{CPU} is only supplying the logic and CAN drivers. It has to be present to allow the electronic to start (wake-on-CAN or wake through ignition pin).
CAN 0 port	CAN 0 port is used for UDS programming and **WEcontrol Designer** debugging interface. Following IDs are by default reserved for our purpose: 0x100 / 0x7E0 / 0x7DF / 0x7E8

Diagnostic possibilities (Example)	
Relays K1 – K8 & fuses	The NO and NC contacts are connected to digital inputs allowing a feedback on their status (switched / not switched). **Warning:** the logic for analysis has to be programmed in the main application. NO '0' & NC '0' → fuse blown Relay trigger + no modification → relay defective Relay switch off + no modification → relay defective Both'1' → external voltage injection, prevent relay to be switched on
HSD 0 – 5	On the high side, the current feedback information can be used to detect short circuit or overload. Actions may then be programmed in the main application.

Output logical diagnosis			
DI 87	**DI 87A**	**Relay**	**Status**
0	1	0	OK
1	0	1	OK
0	0	0	Fuse blown
1	1	0/1	Short to bat
0	1	1	Relay issue
1	0	0	Relay stuck

Qualification

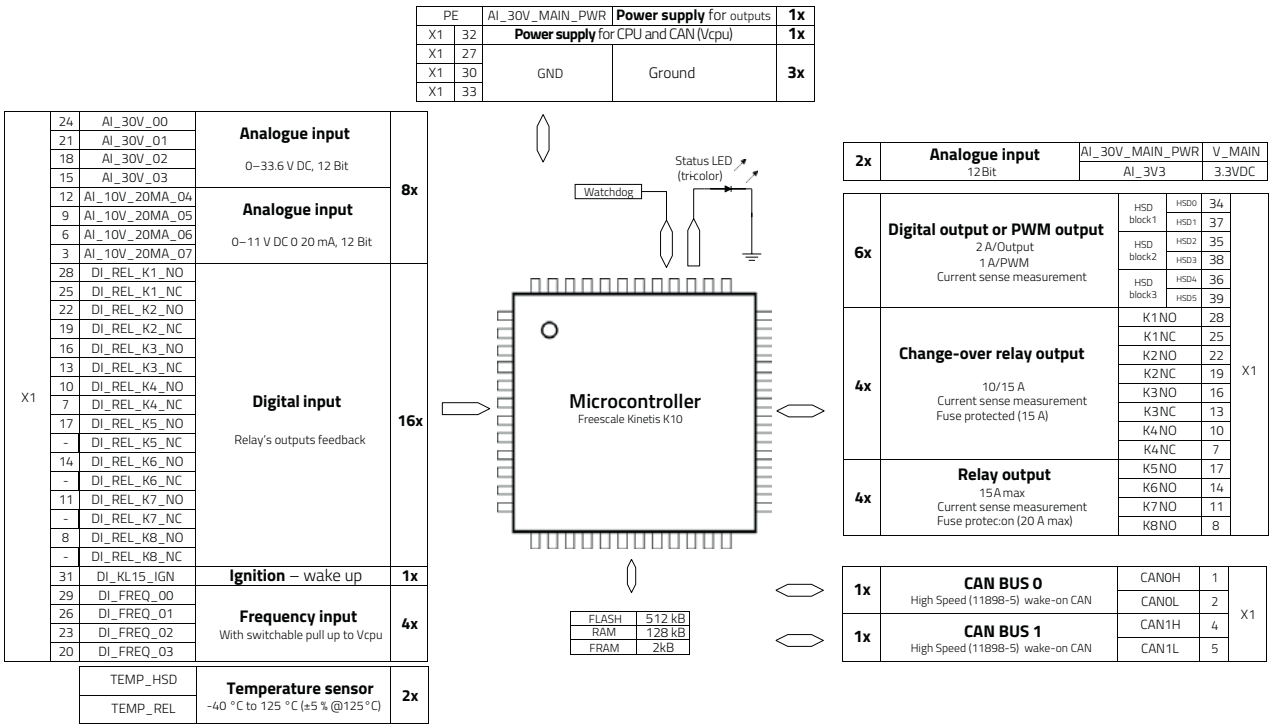
Environmental tests		
Standard	**Test**	**Parameter**
ISO 16750-4	Low temperature storage & operating	- 40 °C 24 h
	High temperature storage	85 °C 48 h
	High temperature operating	70 °C 96 h
	Temperature step test	From -40 °C to 70 °C 5 K / 10 min
	Temperature cycling	From -40 °C to 70 °C 30 cycles à 8 h
	Damp heat stady state	21 days with 40 °C and 85 % r. H.
	Dampt heat cyclic	From 25 °C to 55 °C / 93 % r. H. 6 cycles à 24 h Duration: 144 h
	Temperature shock	From -40 °C to 85 °C 100 shocks à 30 min. Duration: 100 h
	Protection against dust & water	IP 64 according ISO 20653
ISO 16750-3	Mechanical shock	Acc. IEC 60068-2-27 Room temperature Sinusoidal Acceleration 50 g, duration 6 ms 10 shocks per axis
	Vibration random	Acc. IEC 60068-2-64 From -40 °C to 70 °C Duration 32 h per axis Severity level: RMS=57.9 m/s²
	Free fall	1 m free fall, 6 drops

EMC tests		
Standard	**Test**	**Parameter**
CIRSPR 25 & ECE R10	RF Emmission - Antenna method	Operating voltage: 14 V / 28 V Frequency range: 30 – 1000 MHz
ISO 11452-4 & ECE R10	RF Immunity - BCI method	Operating voltage: 28 V Frequency range: 20 – 400 MHz 60 mA, 2 s
ISO 11452-2 & ECE R10	RF Immunity - ALSE method	Operating voltage: 28 V Frequency range: 400 – 2000 MHz 100 V/m, 2 s
ISO 7637-2 / ISO 16750-2	Conducted transient immunity - Along supply lines	Pulse 1 (28 V): -450 V, 50 Ω, 5000 pulses Pulse 2a (28 V): +55 V, 2 Ω, 5000 pulses Pulse 2b (28 V): +20 V, 10 pulses Pulse 3a (28 V): -220 V, 1 h Pulse 3b (28 V): +220 V, 1 h Pulse 4 (28 V): +8 V, 5 pulses after every 15 min Pulse 5a (28 V): +174 V, 350 ms, 2 Ω, 100 pulses Pulse 5a-2 (28 V): +174 V, 200 ms, 8 Ω, 100 pulses Pulse 5b (28 V): +174 V, 400 ms, 1 Ω, 100 pulses Pulse 5b-2 (28 V): +123 V, 300 ms, 2 Ω, 100 pulses

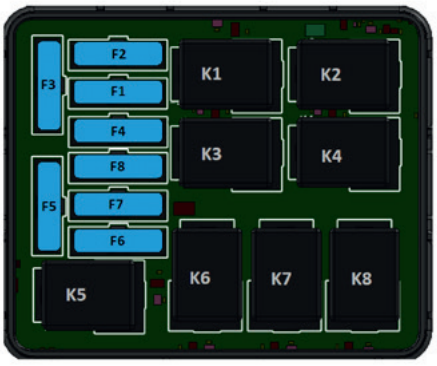
Electrical Tests		
	Test	**Parameter**
ISO 16750-2	Direct current supply voltage	8 V – 32 V Duration: 60 min on U_{min} and on U_{max}
	Over voltage	36 V DC for 60 min at T_{max} 20 K
	Superimposed alternating voltage	Severity level 3, U_{pp}: 10 V
	Slow decrease and increase of supply voltage	Voltage steps: 0.5 ± 0.1 V / min (max. voltage steps 25 mV) Voltage range: U_{Smin} – 0 V – U_{Smin}
	Momentary drop in supply voltage	12 V system: 4.5 V for 10 ms 24 V system: 9 V for 10 ms
	Reset behaviour at voltage drop	12 V system: 4.5 V for 10 ms 24 V system: 9 V for 10 ms
	Starting profile	U_S: 12 V Severity level: 4 U_{S6}: 6 V (-0.2) Pulse duration: 10 ms
	Load dump	Test 1: U_B: 28 V / U_S: 174 V t_1: 25 s / t_d: 400 ms R_i: 1 Ω Pulses: 100 Test 2 (No loads connected): U_B: 28 V / U_S: 123 V t_1: 60 s / t_d: 350 ms R_i: 1 Ω Pulses: 100
	Reverse voltage	-28 V, duration: 300 s
	Ground reference and supply offset	Offset voltage: 1 V ± 0.1 V
	Single line interruption	Connection break time 10 s ± 1 s Wire break resistance ≥ 10 MΩ
	Multiple line interrraption	Connection break time 10 s ± 1 s Wire break resistance ≥ 10 MΩ
	Short circuit protection signal circuits	60 s ± 10 % All relevant in- and outputs must be connected to US_{max} and GND with following operation modes: 1. Connected supply voltage and GND 2. Outputs active 3. Outputs inactive 4. Separate supply voltage
	Short circuit protection load circuit	Duration: 10 min Load with 16.5 A

ESD tests		
Standard	**Test**	**Parameter**
ISO 10605	Contact discharge - ESD powered test / Components	Test level: 2 330 Ω/ 330 pF, +/- 15 kV
ISO 10605	Air discharge - ESD powered test / Components	Test level: 2 330 Ω / 330 pF, +/- 15 kV
ISO 10605	Contact discharge - ESD unpowered test / Handling	Test level: 2 2000 Ω / 150 pF, +/- 8 kV

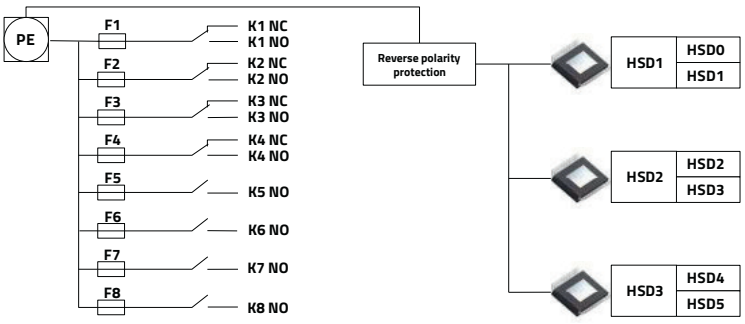
Hardware map



Fuses & Relays location



Power supply distribution



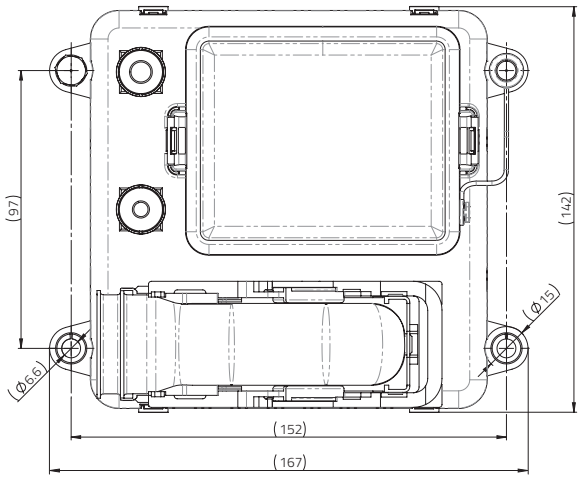
Design has an internal parallel diode on each coil. We recommend using relays with diode or no protection at all. Relays with resistor are generating more heat within the enclosed environment.

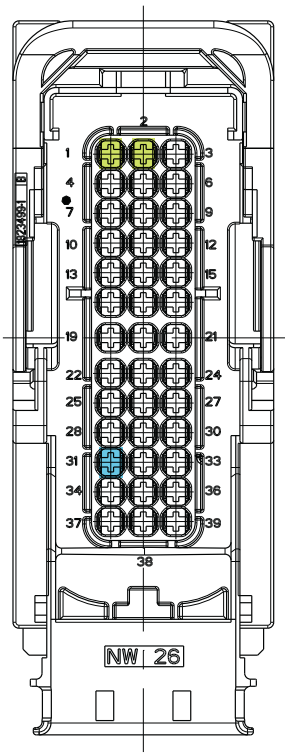
Pin assignment

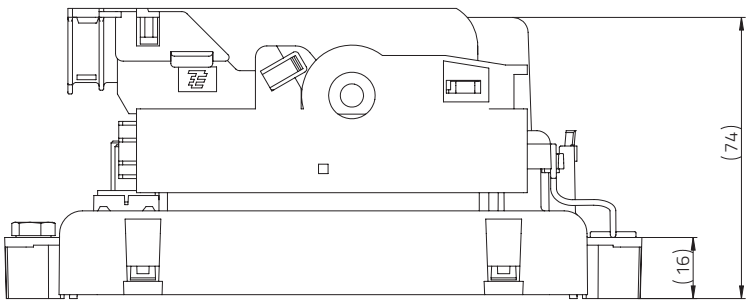
Pin	Description	Function
1	CAN0_H	CAN-bus 0 High**
2	CAN0_L	CAN-bus 0 Low**
3	AI_10V_20MA_07	Analogue input 0 – 10 V / 0 – 20 mA
4	CAN1_H	CAN-bus 1 High
5	CAN1_L	CAN-bus 1 Low
6	AI-10V_20MA_06	Analogue input 0 – 10 V / 0 – 20 mA
7	DI_REL_K4_NC	Normally closed contact 4 (87 A)
8	DI_REL_K8_NO	Normally open contact 8 (87)
9	AI_10V_20MA_05	Analogue input 0 – 10 V / 0 – 20 mA
10	DI_REL_K4_NO	Normally open contact 4 (87)
11	DI_REL_K7_NO	Normally open contact 7 (87)
12	AI_10V_20MA_04	Analogue input 0 – 10 V / 0 – 20 mA
13	DI_REL_K3_NC	Normally closed contact 3 (87 A)
14	DI_REL_K6_NO	Normally open contact 6 (87)
15	AI_30V_03	Analogue input 0 – 30 V
16	DI_REL_K3_NO	Normally open contact 3 (87)
17	DI_REL_K5_NO	Normally open contact 5 (87)
18	AI_30V_02	Analogue input 0 – 30 V
19	DI_REL_K2_NC	Normally closed contact 2 (87 A)
20	DI_FREQ_03	Digital / Frequency input 4
21	AI_30V_01	Analogue input 0 – 30 V
22	DI_REL_K2_NO	Normally open contact 2 (87)
23	DI_FREQ_02	Digital / Frequency input 3
24	AI_30V_00	Analogue input 0 – 30 V
25	DI_REL_K1_NC	Normally closed contact 1 (87 A)
26	DI_FREQ_01	Digital / Frequency input on pin 2
27	GND	Ground
28	DI_REL_K1_NO	Normally open contact 1 (87)
29	DI_FREQ_00	Digital / Frequency input 1
30	GND	Ground
31	DI_KL15_IGN	Ignition*
32	Logic / CPU supply	Power supply for CPU and CAN
33	GND	Ground
34	DO_HS_00	High side with current sense max 2 A (PWM max 1 A)
35	DO_HS_02	
36	DO_HS_04	
37	DO_HS_01	
38	DO_HS_03	
39	DO_HS_05	

* Wake up input
** CAN 0: UDS programming interface

Dimensions







Programming

CAN Box 8FR-6 is supported by the new programming environment and by the complementary WE Flasher tool from Würth Elektronik ICS.
This advanced development environment is a set of powerful text and graphic editors for IEC-61131-3 languages.

Supported programming types are:
- Sequential Flow Chart (SFC)
- Function Block Diagram (FBD)
- Ladder Diagram (LD)
- Structured Text (ST)

Further features:
- Optimised application creation
- Simulation and on-line data access / modification over CAN bus
- Automated conversion from one language to another
- Graphical I/O mapping and configuration
- User Defined Function Blocks (UDFB) for specific / repetitive functions
- Automated HTML documentation of project
- Easy graphical debug interface creation (based on application)
- CAN communication database import from Vector and Peak systems

We will also be happy to create your application, based on your requirements.

Order information

Available references	Part number WE ICS
CAN Box 8FR-6 (no fuses, no relays) with current measurement on relays, not programmed	ICS-103794
CAN Box 8FR-6 (10 A fuses, 12 V relays) with current measurement on relays, not programmed	ICS-103792
CAN Box 8FR-6 (10 A fuses, 24 V relays) with current measurement on relays, not programmed	ICS-103793
CAN Box 8FR-6 (customer specific equipment and programming)	on request

Mating connector	TE Connectivity Part number
AMP MCP2.8 RECEPTACLE HSG., 39POS.	5-2208684-3
Cover	1418882-1
MCP 2.8 contacts 1.5-2.5 mm²	1-968857-1
MCP 2.8 contacts 0.5-1.0 mm²	1-968855-1
Single wire seal	828905-1

For more information write us an e-mail **ics@we-online.com**, call **+49 7940 9810-0** or visit us at **www.we-online.com/ics**

Würth Elektronik ICS GmbH & Co. KG
Intelligent Power & Control Systems
Gewerbepark Waldzimmern · Würthstraße 1
74676 Niedernhall · Germany
Tel.: +49 7940 9810-0 · Fax +49 7940 9810-1099
ics@we-online.com · www.we-online.com/ics