EFX 1680 Electronic Controller
Programmed with Eaton CONTROL F(x)™ to IEC 61131-3 Standard

2 control units with a total of 80 inputs/outputs
Supply voltage 10...32V DC

TECHNICAL DATA	CONTROLLER FOR THE IMPLEMENTATION OF A CENTRAL OR DECENTRALIZED ELECTRO-HYDRAULIC SYSTEM
Housing	**closed, screened metal housing with flange fastening**
Dimensions (H x W x D)	**153 x 247 x 43 mm**
Mounting	**screw connection by means of 4 M5xL screws according to DIN 7500 or DIN 7984 mounting position horizontal or vertical to the mounting wall**
Connection	**2 x 55-pin connector, latched, protected against reverse polarity, type AMP or Framatome, AMP junior timer contacts, crimp connection 0.5/2.5 mm²**
Weight	**1.6 kg**
Housing / storage temperature	**– 40...85 °C (depending on the load) / – 40...85 °C**
Protection	**IP 67 (for inserted plug with individually sealed cores e.g. ECEFX16 12S)**
Input / output channels total	**max. 2 x 40 (the total number which is available depends on the wiring and configuration of the controller)**

Inputs
possible configurations

max. 2 x 40 (corr. to 0 outputs)

Number	Signal	Version	
2 x 8 or	digital analogue	for positive sensor signals, with diagnostic capability 0...10/32 V DC, 0/4...20 mA or ratiometric	B_L A
2 x 8	digital	for positive sensor signals	B_L
2 x 4 or	digital frequency	for positive sensor signals, with diagnostic capability max. 50 kHz	B_L I_L
2 x 4 or	digital frequency	for positive/negative sensor signals, with diagnostic capability* max. 1 kHz	$B_{L/H}$ I_L
2 x 8 2 x 8	digital digital	for positive/negative sensor signals, with diagnostic capability * for positive sensor signals, with diagnostic capability	$B_{L/H}$ B_L

*only positive sensor signals with diagnostic capability

Outputs
possible configurations

max. 2 x 24 (corr. to 2 x 16 inputs)

Number	Signal	Version	
2 x 8 or or	digital PWM current-controlled	positive switching (High Side), with diagnostic capability PWM frequency 20...250 Hz 0,1...4 A	B_H PWM PWM_I
2 x 8	digital	positive switching (High Side), with diagnostic capability	B_H
2 x 4 or	digital PWM	positive switching (High Side), with diagnostic capability PWM frequency 20...250 Hz	B_H PWM
2 x 4	digital	positive/negative switching (High/Low Side) with diagnostic capability (can also be used as H bridge)	$B_{H/L}$ H bridge

Abbreviations

A	= analogue
B_H	= binary High Side
B_L	= binary Low Side
FRQ/CYL	= frequency inputs
I_H	= pulse High Side
I_L	= pulse Low Side
PWM	= pulse width modulation
PWM_I	= current-controlled output
%IWx	= IEC address for analogue input
%IX0.xx	= IEC address for binary input
%QX0.xx	= IEC address for binary output

EFX 1680	Technical data
Operating voltage U_B overvoltage undervoltage detection switching-off in case of undervoltage	**10...32 V DC** 36 V for t ≤ 10 s for U_B ≤ 10 V for U_B ≤ 8 V
Current consumption	**≤ 160 mA (without external load at 24 V DC)**
CAN interface 1 Baud rate Communication profile	**CAN interface 2.0 B, ISO 11898** 50 Kbits/s...1 Mbits/s (default setting 125 Kbits/s) CANopen, CiA DS 301 version 4, CiA DS 401 version 1.4
Node-ID (CANopen)	**hex 7F (= dec. 127)**
CAN interface 2 Baud rate Communication profile	**CAN interface 2.0 A/B, ISO 11898** 50 Kbits/s...1 Mbits/s (default setting 125 Kbits/s) SAE J 1939 or free protocol
Serial interface Baud rate Topology Protocol	**RS-232 C** 9.6 / 19.2 / 28.8 / 38.4 / 57.6 kBit/s (default setting 9.6 Kbits/s) point-to-point (max. 2 participants); master-slave connection predefined ifm protocol (INTELHEX)
Processor	**CMOS microcontroller 16 bits C167CS cycle frequency 20/40 MHz**
Device monitoring	**undervoltage monitoring, watchdog function, check sum test for program, and system excess temperature monitoring**
Process monitoring concept	**Two relays according to EN 954 monitor two groups of 12 outputs each**
Program memory	**768 Kbytes Flash can be used by the user (+ 832 Kbytes for extended functions)**
Data memory	**128 Kbytes SRAM, 128 Kbytes Flash**
Data memory (protected in case of power failure)	**1024 bytes (retain data), 16 Kbytes (general data)**
Status indication	**three-colour LED (R/G/B)**
Operating status (status LED)	

LED Color	Status	Description
–	off	no operating voltage
yellow	1 x on	initialisation or reset checks
green	5 Hz	no operating system loaded
green	2.0 Hz on	Run Stop
red	2.0 Hz on	Run with error Fatal error or stop with error

	Test standards and regulations
Climatic test	Damp heat to EN 60068-2-30, test Db (≤ 95% rel. humidity, non-condensing) Salt mist test to EN 60068-2-52, test Kb, severity level 3 Degree of protection to EN 60529
Mechanical resistance	Vibration to EN 60068-2-6, test Fc, Shock to EN 60068-2-27, test Ea, Bump to EN 60068-2-29, test Eb
Immunity to conducted interference	to ISO 7637-2, pulses 2, 3a, 3b, severity level 4, function state A to ISO 7637-2, pulse 5, severity level 1, function state A to ISO 7637-2, pulse 1, severity level 4, function state C
Immunity to interfering fields	directive 95/54/EC at 100 V/m (e1 type approval) and EN 61000-6-2 :2001 (CE)
Interference emission	directive 95/54/EC (e1 type approval) and EN 61000-6-4 :2001 (CE)
Tests for the approval for railway applications	to BN 411 002 (DIN EN 50155 clause 10.2)

EFX 1680	Characteristics of the inputs (per control unit)	
Digital/analogue inputs (B_L, A) %IW03...10 %IX0.00...07 can be configured as ...	■ Voltage inputs	
	input voltage	0...10/32 V
	resolution	12 bits
	precision	± 1.0% FS
	input resistance	50/30 kΩ
	input frequency	50 Hz
	■ Current inputs	
	input current	0/4...20 mA
	resolution	12 bits
	precision	± 1.0% FS
	input resistance	400 Ω
	input frequency	50 Hz
	■ Digital inputs for positive sensor signals, with diagnostic capability*	
	switch-on level	0.7 U_B
	switch-off level	0.4 U_B
	input resistance	30 kΩ
	input frequency	50 Hz
Digital inputs (B_L) %IX0.08...11 %IX1.00...03 can be configured as ...	■ Digital inputs for positive sensor signals	
	switch-on level	0.43...0.73 U_B
	switch-off level	0.29 U_B
	input resistance	3.21 kΩ
	input frequency	50 Hz
Digital inputs (B_L, I_L) %IX0.12...15 can be configured as ...	■ Digital inputs for positive sensor signals, with diagnostic capability *	
	switch-on level	0.7 U_B
	switch-off level	0.4 U_B
	input resistance	2.86 kΩ
	input frequency	50 Hz
	■ Frequency inputs for positive sensor signals with diagnostic capability, evaluation with integrated comparator	
	switch-on level	0.43...0.73 U_B
	switch-off level	0.29 U_B
	input resistance	2.86 kΩ
	input frequency	max. 50 Hz
Digital inputs ($B_{L/H}$, I_L) %IX1.04...07 can be configured as ...	■ Digital inputs for positive/negative sensor signals, positive with diagnostic capability*	
	switch-on level	0.7 U_B
	switch-off level	0.4 U_B
	input resistance	3.21 kΩ
	input frequency	50 Hz
	■ Frequency inputs for positive sensor signals with diagnostic capability, evaluation with integrated comparator	
	switch-on level	0.43...0.73 U_B
	switch-off level	0.29 U_B
	input resistance	3.21 kΩ
	input frequency	max. 50 Hz
Digital inputs (B_L) %IX2.00...07 can be configured as ...	■ Digital inputs for positive/negative sensor signals, positive with diagnostic capability*	
	switch-on level	0.7 U_B
	switch-off level	0.4 U_B
	input resistance	3.21 kΩ
	input frequency	50 Hz
Digital inputs ($B_{L/H}$) %IX1.08...15 can be configured as ...	■ Digital inputs for positive/negative sensor signals, positive with diagnostic capability*	
	switch-on level	0.43...0.73 U_B
	switch-off level	0.29 U_B
	input resistance	3.21 kΩ
	input frequency	50 Hz
Test input	During the test mode (e.g. programming) the "TEST" connection must be connected to VBB_S (10...32 V DC). For the "RUN" mode the test input must not be connected.	
	input resistance	3.21 kΩ
***NAMUR inputs**	■ Digital inputs with diagnostic capability can be used as NAMUR inputs when used with an external resistor connection.	
	supply voltage	5...25 V

wiring see page 5

EFX 1640	Characteristics of the outputs (per control unit)
Outputs (B_H, PWM, PWM_I) %QX0.00...07 can be configured as ...	■ Semiconductor outputs, with diagnostic capability positive switching (high side), short-circuit and overload protected switching voltage 10...32 V DC switching current max. 4 A output frequency max. 100 Hz (depending on the load)
	■ PWM outputs, diagnosis via current feedback PWM frequency max. 250 Hz mark-to-space ratio 1...99 % resolution depends on the PWM frequency load current max. 4 A
	■ Current-controlled outputs, diagnosis via current feedback load current 0,1...4 A load resistance min. 3 Ω (at UB = 12 V DC) min. 6 Ω (at UB = 24 V DC) setting resolution 1 mA control resolution 5 mA accuracy ± 2% FS
Outputs (B_H) %QX0.08...15 can be configured as ...	■ Semiconductor outputs, with diagnostic capability positive switching (high side), short-circuit and overload protected switching voltage 10...32 V DC switching current max. 2 A output frequency max. 100 Hz (depending on the load)
Outputs (B_H, PWM) %QX1.00, 03, 04, 07 can be configured as ...	■ Semiconductor outputs, with diagnostic capability positive switching (high side), short-circuit and overload protected switching voltage 10...32 V DC switching current max. 4 A output frequency max. 100 Hz (depending on the load)
	■ PWM outputs PWM frequency max. 250 Hz mark-to-space ratio 1...99 % resolution depends on the PWM frequency load current max. 4 A
Outputs ($B_{H/L}$) %QX1.01, 02, 05, 06 can be configured as ...	■ Semiconductor outputs, with diagnostic capability positive/negative switching (high side), short-circuit and overload protected switching voltage 10...32 V DC switching current max. 4 A output frequency max. 100 Hz (depending on the load)
Overload protection (valid for all outputs)	max. 5 minutes (at 100%)
Internal relay outputs for electrically isolated deactivation of the outputs	Normally open contacts in series to 2 groups of 12 semiconductor outputs. Sustained forcing by means of hardware and additional controlling by means of user program.
	The relays must always be switched without load!
	total current max. 12 A per group switching current 0.1...15 A overload current 20 A number of operating cycles ≥ 10^6 (without load) switching-time constant ≤ 3 ms
Output Error	■ Semiconductor output, positive switching (high side) switching voltage 10...32 V DC switching current max. 100 mA overload current 0.5 A switching function OFF (0 V) in case of an error

Abbreviations

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B_L	= binary Low Side
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I_L	= pulse Low Side
PWM	= pulse width modulation
PWM_I	= current-controlled output
%IWx	= IEC address for analogue input
%IX0.xx	= IEC address for binary input
%QX0.xx	= IEC address for binary output

Wiring

Wiring for CPU 1 is the same as for CPU 2

Pin	Potential	Description	Note
23	VBB_S (10...32 V DC)	Supply sensors and module	
05	VBB_O (10...32 V DC)	Supply outputs	Relay switched (1)
34	VBB_R (10...32 V DC)	Supply via relay	Relay switched (2)
01	GND_S	Ground sensors and module	
15	GND_O	Ground outputs	
12	GND_A	Ground analogue outputs	

CAN, RS-232, ERROR, TEST

Pin	Potential	Description	Note
14	$CAN1_H$	CAN-Interface 1 (High)	
32	$CAN1_L$	CAN-Interface 1 (Low)	
26	$CAN2_H$	CAN-Interface 2 (High)	SAE J 1939
25	$CAN2_L$	CAN-Interface 2 (Low)	SAE J 1939
33	GND	Ground (RS-232/CAN)	
06	RxD	RS-232 Interface (programming)	Pin 03, PC D-Sub (9 pin)
07	TxD	RS-232 Interface (programming)	Pin 02, PC D-Sub (9 pin)
13	ERROR	Error output B H	
24	TEST	Test input	

Inputs/Outputs

Pin	INPUTS	Configuration	OUTPUTS	Configuration		Diagnostic capability* INPUT / OUTPUT	Relay switched
08	%IX0.00 / %IW03	B_L A	–	–		• / –	
27	%IX0.01 / %IW04	B_L A	–	–		• / –	
09	%IX0.02 / %IW05	B_L A	–	–		• / –	
28	%IX0.03 / %IW06	B_L A	–	–		• / –	
10	%IX0.04 / %IW07	B_L A	–	–		• / –	
29	%IX0.05 / %IW08	B_L A	–	–		• / –	
11	%IX0.06 / %IW09	B_L A	–	–		• / –	
30	%IX0.07 / %IW10	B_L A	–	–		• / –	
44	%IX0.08	B_L	%QX0.00	B_H PWM	PWM_I	– / •	VBB_O (1)
45	%IX0.09	B_L	%QX0.01	B_H PWM	PWM_I	– / •	VBB_O (1)
46	%IX0.10	B_L	%QX0.02	B_H PWM	PWM_I	– / •	VBB_O (1)
47	%IX0.11	B_L	%QX0.03	B_H PWM	PWM_I	– / •	VBB_O (1)
20	%IX0.12	B_L I_L	(FRQ 0) –	–		• / –	
02	%IX0.13	B_L I_L	(FRQ 1) –	–		• / –	
21	%IX0.14	B_L I_L	(FRQ 2) –	–		• / –	
38	%IX0.15	B_L I_L	(FRQ 3) –	–		• / –	
36	%IX1.00	B_L	%QX0.04	B_H PWM	PWM_I	– / •	VBB_R (2)
54	%IX1.01	B_L	%QX0.05	B_H PWM	PWM_I	– / •	VBB_R (2)
17	%IX1.02	B_L	%QX0.06	B_H PWM	PWM_I	– / •	VBB_R (2)
53	%IX1.03	B_L	%QX0.07	B_H PWM	PWM_I	– / •	VBB_R (2)
19	%IX1.04	$B_{L/H}$ I_L	(CYL 0) –	–		• / –	
55	%IX1.05	$B_{L/H}$ I_L	(CYL 1) –	–		• / –	
18	%IX1.06	$B_{L/H}$ I_L	(CYL 2) –	–		• / –	
37	%IX1.07	$B_{L/H}$ I_L	(CYL 3) –	–		• / –	
39	%IX1.08	$B_{L/H}$	%QX0.08	B_H		• / •	VBB_O (1)
03	%IX1.09	$B_{L/H}$	%QX0.09	B_H		• / •	VBB_O (1)
40	%IX1.10	$B_{L/H}$	%QX0.10	B_H		• / •	VBB_O (1)
22	%IX1.11	$B_{L/H}$	%QX0.11	B_H		• / •	VBB_O (1)
41	%IX1.12	$B_{L/H}$	%QX0.12	B_H		• / •	VBB_O (1)
42	%IX1.13	$B_{L/H}$	%QX0.13	B_H		• / •	VBB_O (1)
43	%IX1.14	$B_{L/H}$	%QX0.14	B_H		• / •	VBB_O (1)
04	%IX1.15	$B_{L/H}$	%QX0.15	B_H		• / •	VBB_O (1)
48	%IX2.00	B_L	%QX1.00	B_H PWM		• / •	VBB_R (2)
49	%IX2.01	B_L	%QX1.01	$B_{H/L}$	H-Bridge	• / •	VBB_R (2)
31	%IX2.02	B_L	%QX1.02	$B_{H/L}$	H-Bridge	• / •	VBB_R (2)
50	%IX2.03	B_L	%QX1.03	B_H PWM		• / •	VBB_R (2)
51	%IX2.04	B_L	%QX1.04	B_H PWM		• / •	VBB_R (2)
52	%IX2.05	B_L	%QX1.05	$B_{H/L}$	H-Bridge	• / •	VBB_R (2)
16	%IX2.06	B_L	%QX1.06	$B_{H/L}$	H-Bridge	• / •	VBB_R (2)
35	%IX2.07	B_L	%QX1.07	B_H PWM		• / •	VBB_R (2)

Note the double pin connection of inputs/outputs.

*only positive sensor signals with diagnostic capability

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Printed in USA
Document No. E-ELCL-MS006-E
January 2007