AL700 • *Embedded Blue*®

Single Pair Ethernet Switch
5 x 100BASE-T1 • 2 x 1000BASE-T
4-Way Power + Data M8 Hybrid Connectors
Automotive Ethernet • Industrial Ethernet

Overview

The **AL700** Embedded Blue® is a Single Pair Ethernet (SPE) switch designed for rugged industrial applications. The box is provided with five 100BASE-T1 (IEEE 802.3bw) ports and in addition two 1000BASE-T RJ45 jacks for uplink and port expansion.

The 4-way circular M8 Hybrid SPE connectors are covered by the IEC 63171-6, combining power and data distribution. Any AL700 SPE port can deliver up to 2.3A at voltages up to 57V, individually protected by an eFuse.

The M12-A power input connector accepts 9-57VDC. As an option the box can be equipped with a terminal block power connector.

The AL700 is equipped with the Marvell® 88Q5072 Automotive Ethernet switch and is configured by default for self-managed operation. Its PHYs are fully inter-operable with the Open Alliance BroadR-Reach® (OABR) standard for automotive connectivity.

The AL700 box is available for DIN rail or wall mount. Switch port expansion can be easily achieved by means of RJ45 Ethernet patch cables, connecting two or more AL700 together.

As **AL710**, the switch box is also available with a mezzanine CPU card (AC370) for additional protocol support such as AVB/TSN, and Wi-Fi 6 wireless communication.

Technical Features

General

▸ 100BASE-T1 IEEE 802.3bw Ethernet switch box, for DIN rail or wall mount

▸ 5 x M8 Hybrid circular connectors (data & power), IEC 63171-6 (style 6J-M8CI), 100BASE-T1

▸ 2 x RJ45 1000BASE-T Gigabit Ethernet connector

▸ Intended for industrial and automotive use

▸ Self-managed operation

▸ AVB/TSN protocol stack under development

▸ Dimensions: 45mm (W) x 140mm (H) x 70mm (D) w/o DIN rail bracket

▸ Metal case, DIN rail bracket or wall mount plate

▸ M12-A DC power connector

▸ Option terminal block power connector

▸ Option desktop power adapter connector

▸ 9-57VDC power input operation

Front Panel I/O

▸ 2 x RJ45 connector 1000BASE-T, 100BASE-TX, 10BASE-T compliant

▸ 5 x 100BASE-T1 SPE front ports M8 Hybrid (4-way IEC 63171-6 style 6J-M8CI), data pair hipot isolated by transformers, power output protected by eFuse (set to 1A by default), power output voltage corresponds approximately to power input voltage

▸ 1 x M12-A 5-pin DC power input, for internal circuitry and as source for M8 Hybrid power lines

Power Requirements (DC Input)

▸ DC Power input, 9-57V (e.g. 12VDC, 24VDC, 48VDC)

▸ Absolute maximum input voltage 62VDC

▸ Internal power consumption 2.5W max.

▸ DC Power input fast acting chip fuse (PCB soldered type - no replacement on-site)

▸ Protected against reverse polarity

▸ ESD protection (TVS)

▸ Common mode input filter

▸ Option terminal block 3.5mm pitch 4-position screw lock (bottom of box) power input

▸ Option rear power connector (desktop adapter 4-pos. circular connector)

▸ Power input voltage must be chosen to meet power output voltage requirements via the M8 Hybrid connector ports

Technical Features

Power Conditions M8 Hybrid SPE Connectors (DC Output)

▸ DC Output voltage 9V to 57V

▸ Output current limited to 1A per M8 Hybrid connector by default

▸ Current limit 0.1A to 2.23A custom specific on request

▸ Industrial eFuse TPS26600 assigned to each M8 Hybrid connector (circuit breaker w. auto-retry)

▸ DC Input voltage must be equal to DC output voltage provided at M8 Hybrid connectors (consider minor voltage drop between DC input voltage at M12 input power connector and M8 Hybrid connectors caused by internal circuitry)

Single Pair Ethernet Switch

▸ Marvell® 88Q5072 11-port Automotive Ethernet switch AEC-Q100 Grade 2 qualified

▸ 802.1Qat SR Aware 20Gbps switching engine

▸ 2 Mbit packet memory +16 MAX addresses

▸ Queue controller 8-Level QoS per port

▸ 256 entry TCAM (ingress & egress)

▸ 3 color ingress policy

▸ Hardware support for Layer 3 static routing

▸ AVB/TSN per queue shaping 802.1Qav/Qbv

▸ 802.1AS & IEEE 1588/PTP

▸ Advanced security features including deep packet inspection engine (DPI)

▸ DoS (Denial of Service engine)

▸ On-Board EEPROM up to 512kb for switch configuration

▸ Integrated high-performance ARM® Cortex® M7 CPU 350MHz w. 1MB SRAM

▸ Integrated IEEE 802.3bw 100BASE-T1 PHYs Single Pair Ethernet SPE

▸ SPE PHYs configured as Master by default

▸ Fully inter-operable w. Open Alliance BroadR-Reach® (OABR) PHYs

▸ 2 x front port RJ45 receptacles GbE 1000BASE-T (2 x 88EA1512 RGMII/SGMII PHY)

▸ 5 x front port connectors M8 Hybrid (88Q5072 integrated 100BASE-T1 PHYs)

▸ 2 x 5Gbps SERDES internal mezzanine connectors for custom specific hardware expansion

▸ Simple switch expansion option by connecting two or more AL700 boxes via RJ45 patch cables

▸ AL710 available (AL700 with AC370 CPU card for protocol support)

Technical Features

Applications

▸ Industrial networks - IIoT
▸ AVB/TSN ready
▸ Automotive gateway
▸ In-vehicle networking
▸ Automotive test equipment
▸ Rugged environments
▸ Edge computing
▸ Transportation
▸ Construction vehicles
▸ Harvester

Software under Development (AL710)

▸ AVB/TSN
▸ More to come

Environmental, Regulatory

▸ Designed & manufactured in Germany
▸ ISO 9001 certified quality management
▸ Long term availability
▸ Rugged solution
▸ RoHS compliant
▸ Operating temperature -40°C to +85°C (industrial temperature range)
▸ Storage temperature -40°C to +85°C, max. gradient 5°C/min
▸ Humidity 5% ... 95% RH non condensing
▸ Altitude -300m ... +3000m
▸ Shock 15g 0.33ms, 6g 6ms
▸ Vibration 1g 5-2000Hz
▸ IP20 Protection
▸ EC Regulatory EN55035, EN55032, EN62368-1
▸ MTBF tbd years

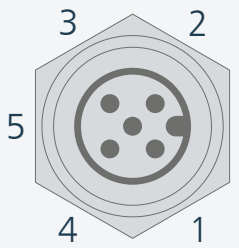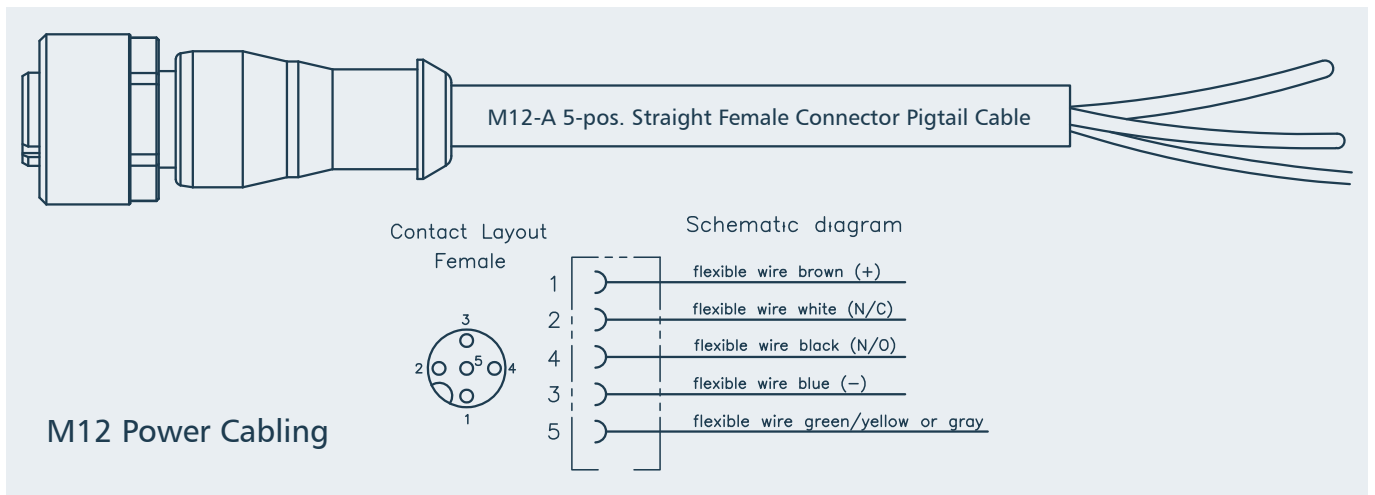all items may be subject to technical changes w/o further notice

Front View
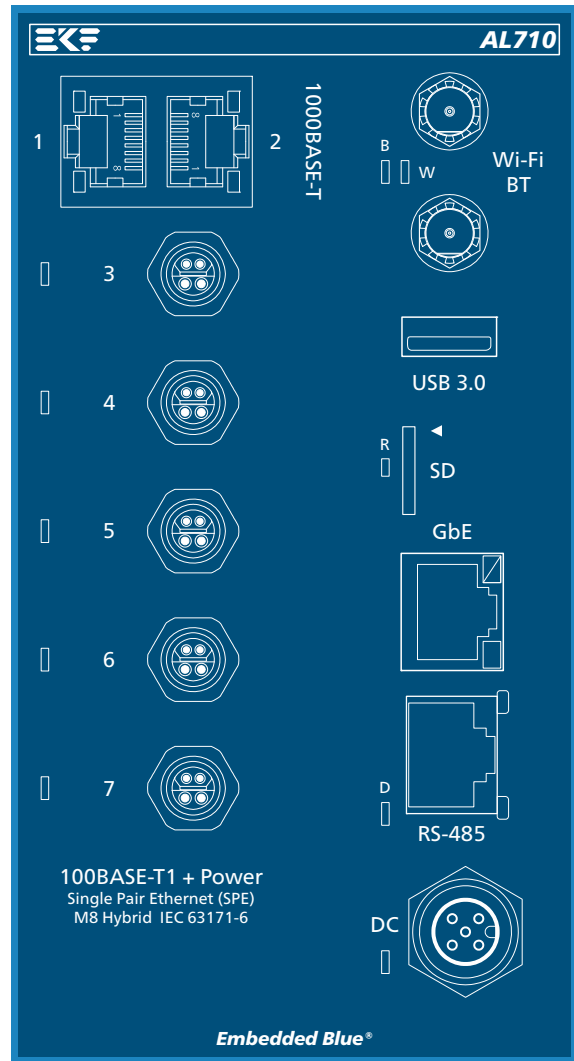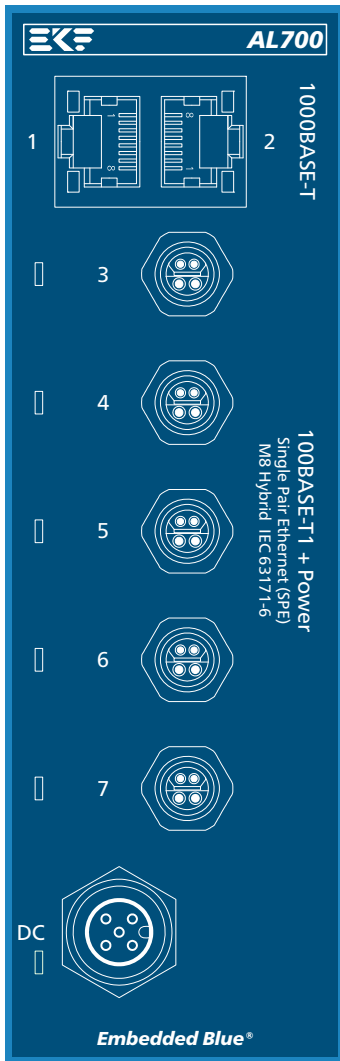
DC LED Status

green	✓	DC input power present (9-44VDC, brightness varies w. input voltage)
blue	✓	DC input power present (44-57VDC)
red	✗	DC input power overvoltage (>57VDC) !! absolute maximum input voltage 65VDC !!
red	✗	DC input power reverse polarity - swap wires connected to M12-A pins 2/4
red	1)	Internal fault (main chip fuse broken)
off	✗	DC input power not present or very low voltage
off	✗	DC input power not applied to M12-A connector pins 2/4

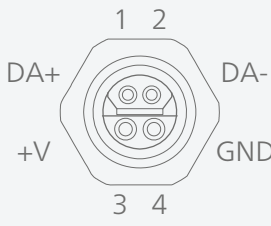1) SMD component - no replacement on-site

M12-A Power Connector

M12-A 5-Position Male 4A/Pin			
271.10.005.10	+V=9-57VDC	1	+V
		2	Reserved
		3	-V (GND)
		4	Reserved
		5	FE (Shield)

Mating Pigtail Cable Assemblies 1.5m w. Female Straight Plug	
EKF Part No.	271.10.505.22.015
Phoenix Contact	1669822
Tyco	2273035-1

M12-A 5-pos. Straight Female Connector Pigtail Cable

Contact Layout Female

Schematic diagram

1	flexible wire brown (+)
2	flexible wire white (N/C)
4	flexible wire black (N/O)
3	flexible wire blue (−)
5	flexible wire green/yellow or gray

M12 Power Cabling


M12 Pigtail Cable
Phoenix Contact

M8 Hybrid Power & Data Connectors

M8 Hybrid IEC 63171-6 4-Position Female PCB Connector			
1 2 DA+ DA- +V GND 3 4	$+V_{SPE}=9\text{-}57VDC$	1	BI_DA+
		2	BI_DA-
		3	$+V_{SPE}$
		4	-V (GND)
		Shield	FE

The M8 Hybrid connector system is comprised of a power and a data pair. The output voltage at the M8 Hybrid power pins reflects the input power voltage of the AL700 box, applied at the M12-A input power connector. A decent voltage drop should be considered, caused by internal filtering and circuit protection components, which should not exceed 0.75V. The maximum individual output current for each M8 Hybrid connector is defined by an eFuse*, and set to 1A by default (up to 2.3A on request). The maximum AL700 continuous output current in total is limited by the M12-A input power connector (4A). The M8 Hybrid connectors itself are specified as IP67, however the AL700 box is only IP20 rated (caused e.g. by the RJ45 connectors).
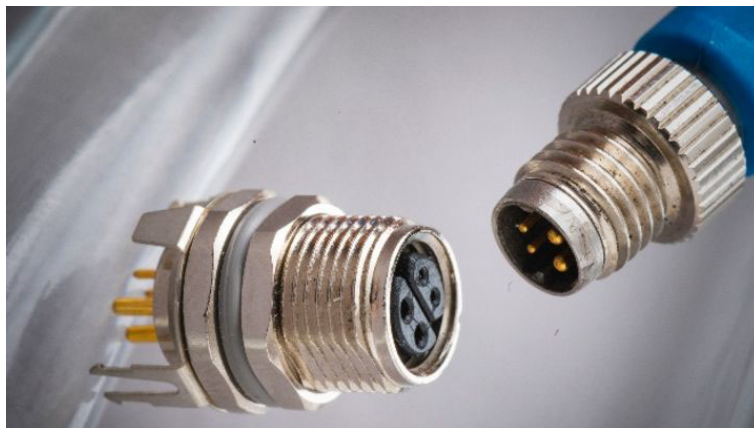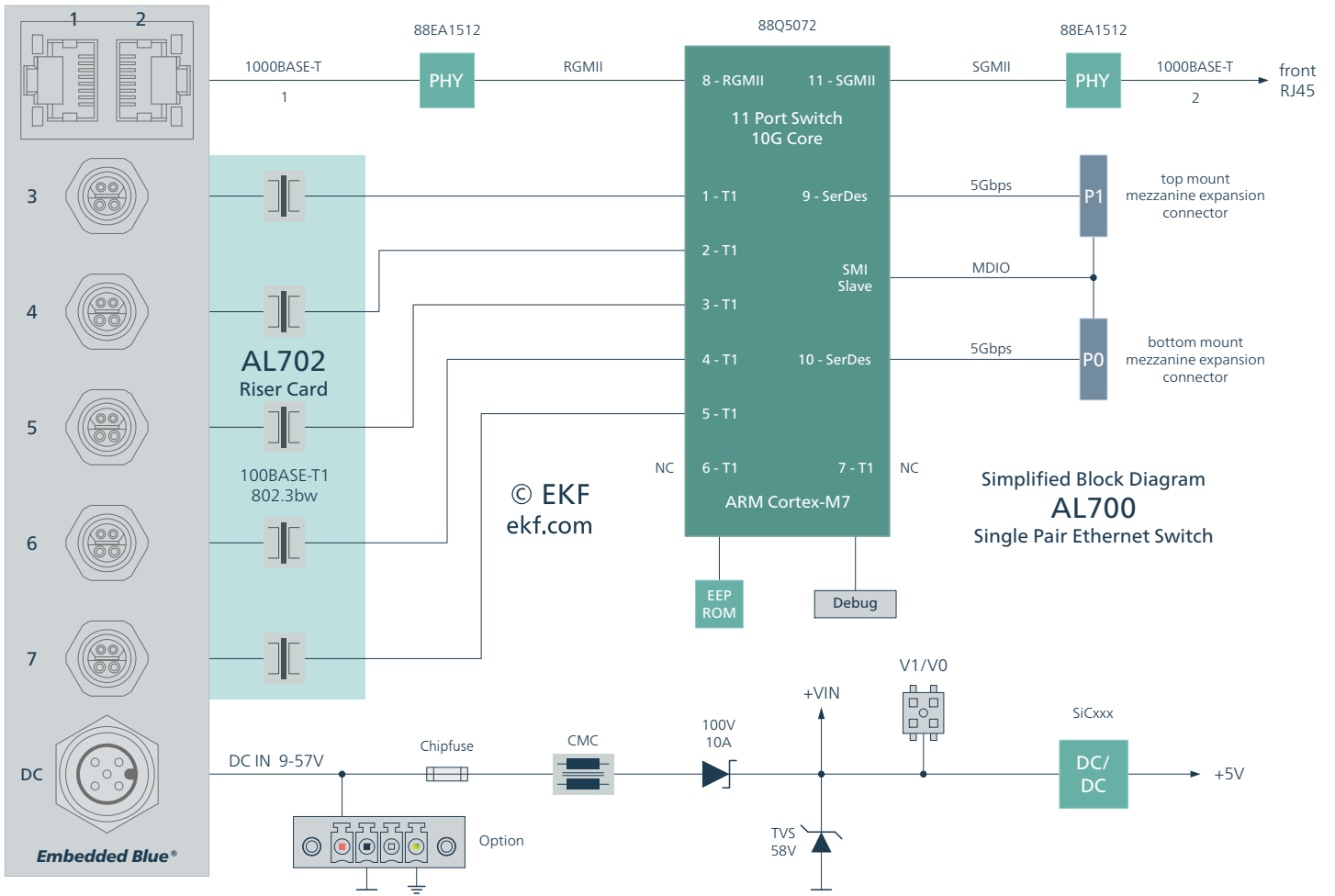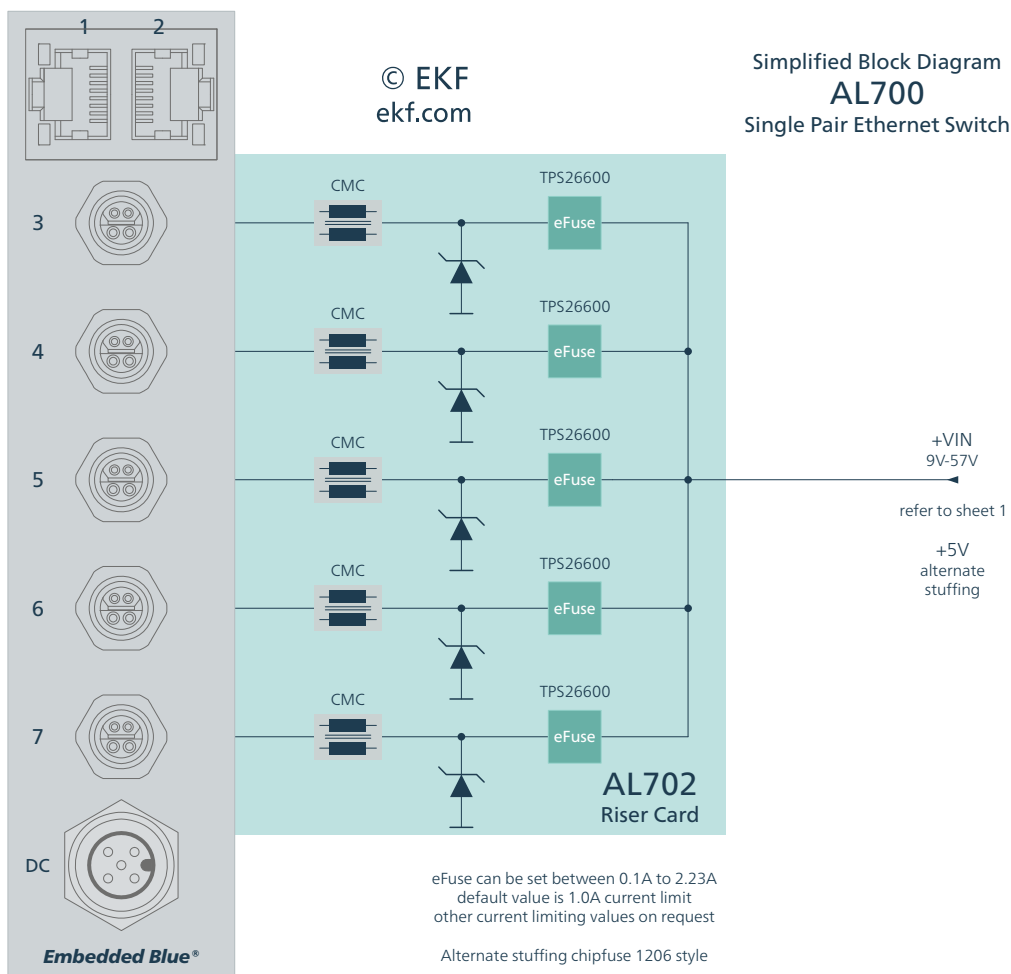
M8 Hybrid

Mating shielded cordsets are available e.g. from Tyco Electronics. The maximum 40m cable length is defined by the 100BASE-T1 Ethernet specification. Both single ended and double ended cable assemblies can be ordered, from 0.5m to 40m cable length.

* Due to supply chain problems the eFuse components may be replaced by a classic chipfuse
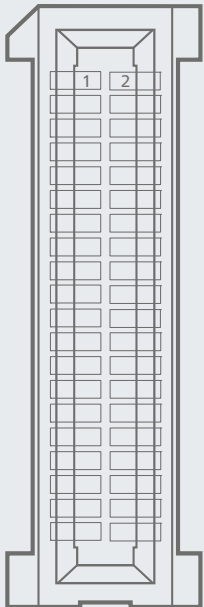
Block Diagram

By default, all SPE ports are configured as 'Master'. The AL700 box is provided however with an internal Dip-switch for setting any port individually as 'Slave' (refer to chapter Master/Slave Configuration).

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Simplified Block Diagram
AL700
Single Pair Ethernet Switch

CMC   TPS26600   eFuse

CMC   TPS26600   eFuse

CMC   TPS26600   eFuse

+VIN
9V-57V

refer to sheet 1

+5V
alternate
stuffing

CMC   TPS26600   eFuse

CMC   TPS26600   eFuse

AL702
Riser Card

eFuse can be set between 0.1A to 2.23A
default value is 1.0A current limit
other current limiting values on request

Alternate stuffing chipfuse 1206 style

Embedded Blue®

The M8 Hybrid connectors are wired as outputs with respect to their power pins. Do not impose external power to the M8 Hybrid power pins. When connecting AL700 switches via their M8 Hybrid ports, a cable with only data pair wires (pin 1/2) must be used.

Due to supply-chain issues the eFuses may be replaced by soldered chip fuses temporarily.

Internal Interposer Connector

J-RISER			
+V	1	2	GND
+V	3	4	1-
+V	5	6	1+
+V	7	8	GND
+V	9	10	2-
+V	11	12	2+
+V	13	14	GND
+V	15	16	3-
+V	17	18	3+
RSV	19	20	GND
GND	21	22	4-
GND	23	24	4+
GND	25	26	GND
GND	27	28	5-
GND	29	30	5+
GND	31	32	GND
GND	33	34	GND
RSV	35	36	RSV
SHIELD	37	38	RSV
SHIELD	39	40	RSV

290.1.040.080 © EKF ekf.com

M8 Hybrid data line numbers 1 - 5 correspond to front panel Ethernet port numbering 3 - 7

table above for EKF internal reference only

88Q5072 Port Assignment

Front Connector Numbering vs. Switch Port Numbers				
F/P Connector	Ethernet	Ethernet Switch Port	Type	PHY
1 - RJ45	1000BASE-T	8	RGMII	88EA1512
2 - RJ45	1000BASE-T	11	SGMII	88EA1512
3 - M8 Hybrid	100BASE-T1	1	SPE	88Q5072
4 - M8 Hybrid	100BASE-T1	2	SPE	88Q5072
5 - M8 Hybrid	100BASE-T1	3	SPE	88Q5072
6 - M8 Hybrid	100BASE-T1	4	SPE	88Q5072
7 - M8 Hybrid	100BASE-T1	5	SPE	88Q5072

## Master/Slave Configuration

SPE Port Configuration (Factory Default = Master) Internal Dip-Switch either Top/Bottom Mount			
Dip-Switch #	F/P Connector	Master	Slave
1	-	-	-
2	-	-	-
3	3 - M8 Hybrid	OFF	ON
4	4 - M8 Hybrid	OFF	ON
5	5 - M8 Hybrid	OFF	ON
6	6 - M8 Hybrid	OFF	ON
7	7 - M8 Hybrid	OFF	ON
8	-	-	-

The M8 Hybrid connectors are wired as outputs with respect to their power pins, regardless of the particular Master/Slave port configuration. Do not impose external power to the M8 Hybrid power pins. When connecting AL700 switches via their M8 Hybrid ports, a cable with only data pair wires (pin 1/2) must be used. For easy daisy-chaining of AL700 boxes, the RJ45 1000BASE-T jacks are recommended instead. Each AL700 must be powered individually via either its M12-A circular connector or the optional terminal block connector.

Master/Slave Switch Behind Small Cover
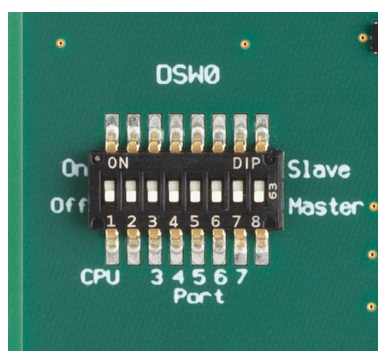
There is no autonegotiation method defined for SPE as of current. In order to connect successfully two SPE components, configure one side as master, the other side as slave. By default, AL700 is setup as master on all SPE ports. The status of the switch is read on power up.

Option Wall Mount Plate

Option GL700 Ready-for-Use PCB Assembly

Ordering Information

For popular AL700 SKUs please contact sales@ekf.de

Related Products

AC370	ARM® V8 Industrial Microcontroller
AJ200	PoE+ Injector
AL100	M12-X 5 to 15 port unmanaged GbE switch
AL110	M12-X 5 port GbE switch w. ARM® V8 CPU
AL200	RJ45 8 port unmanaged GbE switch
AL210	RJ45 8 port GbE switch w. ARM® V8 CPU
AL220	RJ45 8 port unmanaged PoE+ GbE switch
AL230	RJ45 8 port PoE+ GbE switch w. ARM® V8 CPU
AL600	SPE IEC 63171-6 connectors 7 port switch
AL610	SPE IEC 63171-6 connectors 7 port switch w. ARM® V8 CPU

Attach:
1) hook on

Attach:
2) *click*

Detach:
1) lift

Detach:
2) remove

https://www.ekf.com/a/DIN_Rail_on_off_500x280.mp4

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