by ICM CONTROLS

ECA PRODUCTS

ECAIOO-II

MOTOR PROTECTION RELAY

Rated Voltage, Ue	208/220	440/480	VAC
Voltage Operation Limits, Ue	124→300	264→672	VAC

INSTALLATION INSTRUCTIONS

ECA100-II MOTOR PROTECTION RELAY ECAI00-II

1 ECAI00-II GENERAL DESCRIPTION

The ECAI00-II electronic three-phase relays are specially designed for the protection of air conditioning and refrigeration compressors and ventilation motors from the causes of current, voltage and power failures, all with enhanced reliability and with connectivity."

WARNING: Only qualified electrical technicians with knowledge of overload relays and associated machinery should perform the installation, starting up, and maintenance of the system. Adhere to all local and national electric codes. Disconnect all electrical power at the source prior to any installation or maintenance work. Failure to comply could result in equipment damage, personal injury, OR even death.

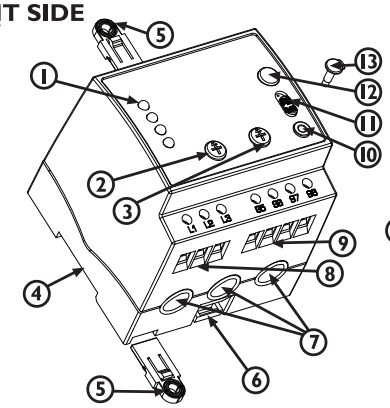
WARNING: This product may start automatically, the user must take cautions to avoid hazards to people.

CAUTION: This product has been designed for industrial environment. Use of this product in residential enviroment may cause unwanted electromagnetic disturbances in which casethe user may be required to take adequate mitigation measures.

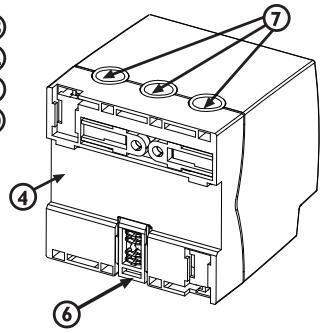
CAUTION: An incorrectly applied or installed **ECAI00-II** can result in damage to the components or reduction in product life. Wiring or application errors, or operating/storing in excessive ambient temperatures may result in malfunction of the **ECAI00-II.**

2 ECAI00-II OVERVIEW

FRONT SIDE VIEW



BACK SIDE VIEW



1. Indicator Lights (LED´s)
   - Normal **(ON)** - Continuous Green.
     Start Delay **(TC)** - Blinking Green.
   - Overload **(OL)** - Continuous Red.
     Phase Reversal **(PR)** - Blinking Red.
   - Unbalance **(UB)** - Continuous Red.
     Single Phasing **(SP)** - Blinking Red.
   - Overvoltage **(OV)** - Continuous Red.
     Undervoltage **(UV)** - Blinking Red.
2. Current **(FLA)** Setting Knob.
3. Start Delay **(TC)** Setting Knob.
4. Back Groove for DIN Rail mounting.
5. Attachable Mounting Ear for Flat Surface mounting.
6. Supporting Brackets for DIN Rail mounting.
7. Current Sensing Holes for motor wiring.
8. Power Supply Voltage Input (L1 L2 L3).
9. Contacts for Relay (95-96) and (97-98).

   Tripped { 95-96 closed / 97-98 open | Normal { 95-96 open / 97-98 closed

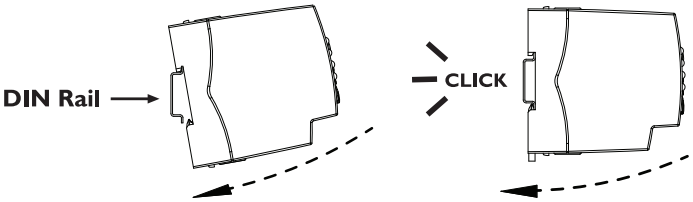
10. IO Port. (for Serial Communication).
11. AUTO / MANUAL Start Mode Slide-Switch.
12. START Push Button.
13. IO PORT cover.

3 ECA100-II DIN RAIL AND FLAT SURFACE MOUNTING

CAUTION: ECAI00-II must be installed in an **accessible** position free from dust, dirt, dampness and vibrations. Allow enough space for air circulation around the enclosure and easy access to all operator controls. Indoors Use only.

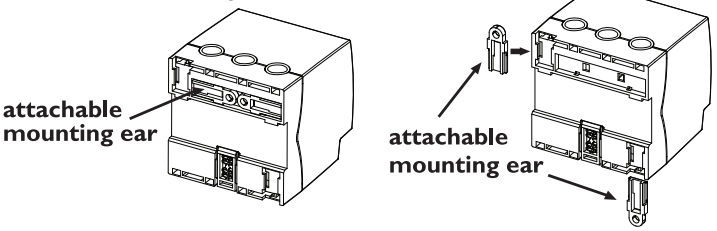
3.1 Instructions for Mechanical Installation

Place **ECAI00-II** at an inclined with is back side placed toward the upper edge of the DIN Rail and push down **ECAI00-II** relay, as shown in figure until it **CLICKS** on the rail.

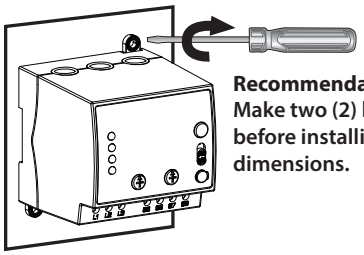


3.2 Instructions for Mechanical Installation

a) Take off the two (2) attachable mountings ear located at back side of **ECAI00-II,** insert and slip both attachable mounting ears into the **ECAI00-II** back side grooves.



b) Place **ECA500-II** over a flat surface panel and mount it using (2) #8 x 1/2" screws



Recommendation for Flat Surface Mounting: Make two (2) holes (5/32") on panel surface before installing.Refer Section 5 for dimensions.

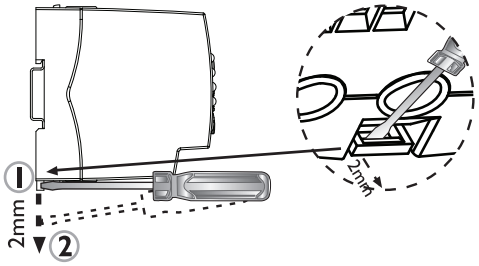
NOTICE: When **ECAI00-II** is set to MANUAL Start mode, the indicator lights (Red LED 1, Red LED 2, Red LED 3) will be lit up sequentially after the Start Delay (TC) is over. The condition remains until the user presses the START Push button to re-start.

8 ECAI00-II DISMOUNTING INSTRUCTIONS

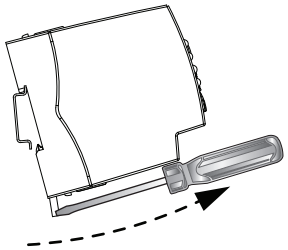
WARNING: Disconnect power supply (Circuit Breaker OFF) and electrical wiring before dismounting **ECAI00-II**. Electrical shock will result in death or serious injury.

8.1 Instructions for Mechanical Dismounting (DIN RAIL)

a) Using a Flathead screwdriver, pull downward the mounting bracket that you can see at the rear and bottom side of the **ECAI00-II**, as shown in figure.



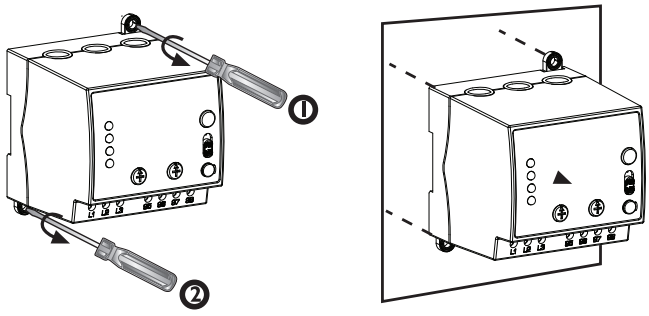
b) With screwdriver at position (2), pull out **ECAI00-II** from DIN Rail as shown in figure:



Recommendation for DIN Rail Dismounting:
Pull downward 2 mm with a soft movement when using screwdriver for dismounting. Strong movement could break the supporting bracket

8.2. Instructions for Mechanical Dismounting (FLAT SURFACE)

a) Unscrew both screws fixed on Flat Surface through attachable mounting ears and then pull out the **ECAI00-II** relay from flat surface as shown in figure.



HOW TO ORDER THE ECAI00-II

ECAI00-II

VOLTAGE	AMPERAGE
208 – 208/220 VAC	012 – 3.5-12.5 A*
480 – 440/480 VAC	032 – 10-32 A
	080 – 25-80 A

* Available only for 208 VAC model

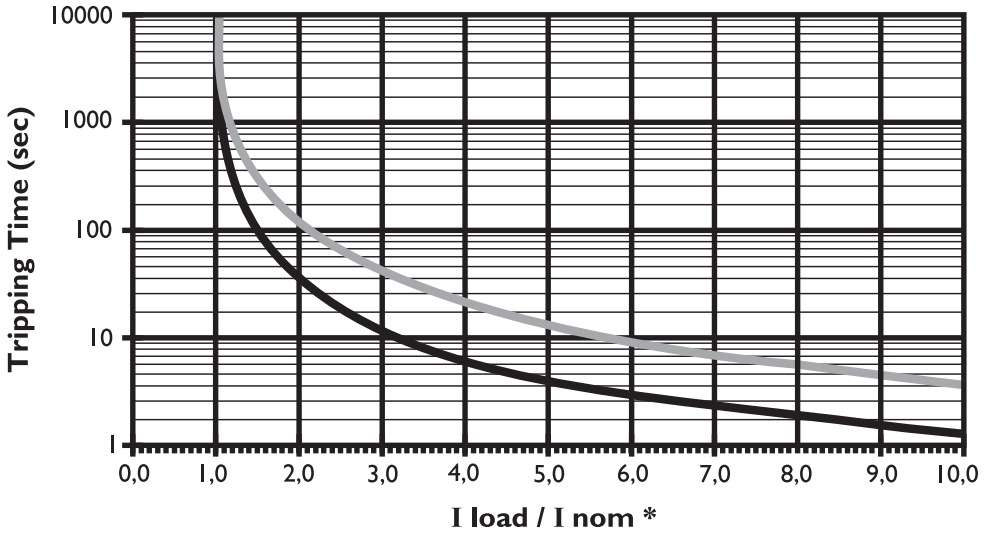
ECAI00-II
Motor protector
COLD-HOT CURVES (Class 10)

(*) I nom = Current value on ECAI00-II adjusted previously by the user

Inom term is referred to FLA (Full Load Amperage) adjustable on the product

■ Hot Curve ■ Cold Curve

After the first stall/trip of the motor due to a fault condition, the protective relay will disconnect sooner, according to the hot curve.



9 MODBUS REGISTER MAPPING

GROUP	REGISTER ADDRESS	NAME	READ/ WRITE	MIN	MAX	SIZE	UNITS	DESCRIPTION / FORMAT	FACTORY SETTING
PRODUCT ID	00000	PRODUCT_ID	R	16	16			F0	16
	00001	MODEL	R	2	36	1		F1	
	00002	VERSION	R	0	255	1		F2	
	00003	MODBUS ADDRESS	R/W	1	127	1		F3	1
HISTORY	00010	LAST_FAILURE_POINTER	R/W	0	20	1		F6	
	00011	TOTAL_NUMBER_OF_FAULTS	R/W	0	20	1		F6	
ADJUSTMENTS	00012	CONTROL_ON_OFF	R/W	0	5	1		F10	
TIMERS	00014	(TC) START UP DELAY	R	0	202	1		F30	
OUTPUT	00015	ACUMULATED_HEAT	R	0	65530	1		F31	
	00016								
	00017	FREQUENCY	R	95	244	1		F32	
	00018	PHASE	R	0	100	1	%	F33	
	00019	VL3L1	R	0	255	1		F20	
	00020	VL1L2	R	0	255	1		F20	
	00021	VL2L3	R	0	255	1		F20	
	00022	IC	R	0	255	1		F34	
	00023	IA	R	0	255	1		F34	
	00024	IB	R	0	255	1		F34	
KNOB VALUE	00025	(FLA) CURRENT SETTING	R	18	73	1		F43	
	00026	(TC) START UP DELAY SETTING	R	2	150	1		F29	
	00027	START MODE	R	0	1	1		F19	0
	00028	MOTOR THERMAL CLASS	R	3	10	1		F6	
FAULT HISTORY	0029-0049	FAULT 01/20 - 20/20	R	0	202	1		F30	

9.1 MODBUS DATA FORMAT

CODE	TYPE	DESCRIPTION
F0	8 bits	PRODUCT ID
	16	**ECA100-11**
F1	8 bits	PRODUCT MODEL
	bits 2...0	VOLTAGE MODEL (1 A 4): 2 = 208V || 4 = 480V
	bits 3,4,5,6,7	Reserved
	bits 5…3	CURRENT MODEL (1 a 4):
		2 = 12A@ECA100-11
		3 = 32A@ECA100-11
		4 = 80A@ECA100-11
F2	8 bits	SOFTWARE VERSION
	bits 4...0	Software Version - Minor Number(0 a 31)
	bits 7…5	Software Version - Major Number (0 a 7)
F3	16 bits	MODEL
	byte 0	Address (1 a 127)
	byte 1	null. not used
F6	16 bits	Unsigned char
	byte 0	Value
	byte 1	null. not used
F10	16 bits	ADJUSTMENT - CONTROL ON/OFF
	0	ON
	1	OFF - FAILURE MODE
	2	OFF - TRIP DELAY BECAUSE OF VOLTAGE FAILURES
	3	OFF - MODBUS
	4	OFF - MANUAL MODE
	5	OFF - 3RD FAILURE

4 ECAI00-II CONNECTION DIAGRAM

WARNING: (Risk of Electric Shock). Disconnect power supply before installing **ECAI00-II**. Electric Shock will result in death or serious injury.

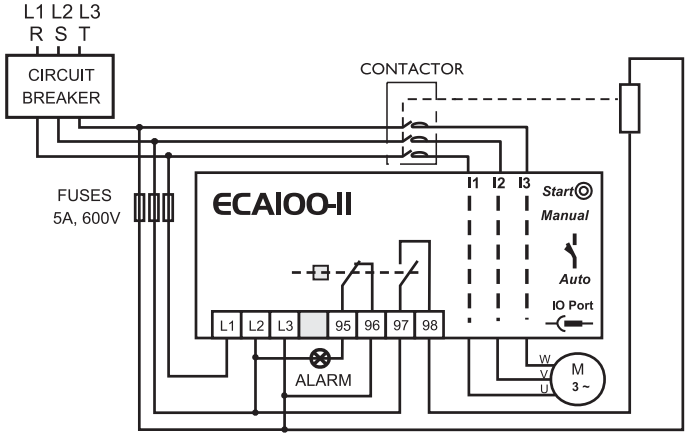
CAUTION: Check that the rated voltage and current of the selected ECAI00-II model corresponds to the line voltage and motor current.

4.1 Terminal designation

TERMINAL	DESCRIPTION	
L1	Voltage Input (Phase R)	
L2	Voltage Input (Phase S)	
L3	Voltage Input (Phase T)	
95 \ **96** /	Contact for Auxiliary Relay	
97 \ **98** /	Contact for Trip Relay	
95-96	Closed	Tripped
97-98	Open	
95-96	Open	Normal
97-98	Closed	

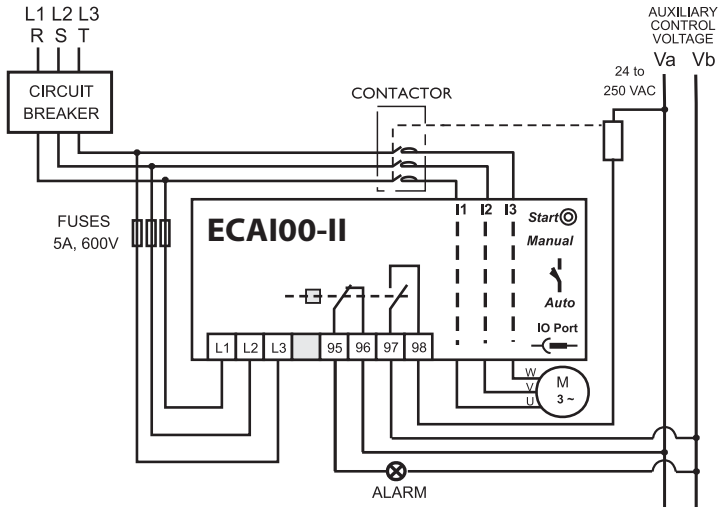
4.2 Basic Diagram Installation

4.2.1 **ECAI00-II** 208/220 VAC Models



4.2.2 **ECAI00-II** 440/480 VAC Models

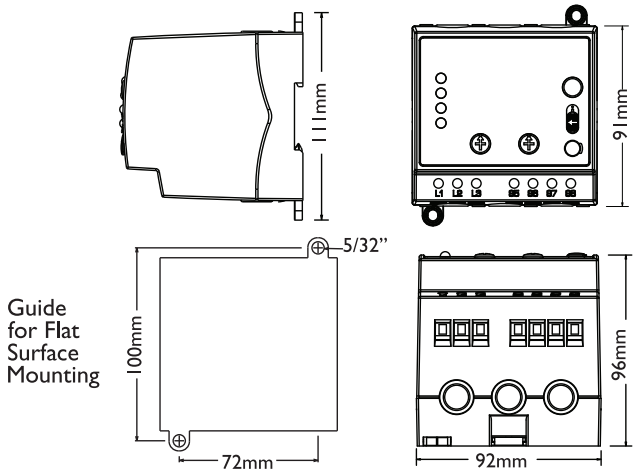
Requires auxiliary control voltage from 24 to 250 VAC.



Recommendations for Wiring:

- Avoid overtightening M2.5 screw terminals during wiring of connections. Torque max. 4.5 lb-in (5.18 kgf-cm)
- Wire Strip Length 6-7 mm.
- Screw Terminal wire size: Ð AWG 10 (4 mm²) ß AWG 18.
- Current Sensing Holes (conduits) wiring size: Ð AWG 4(11 mm).
- Connect L1 L2 L3 terminal for Voltage input in parallel connection before line starter circuit through Contactor (as shown in Basic Diagram Installation).
- Feed the the three phases going to the motor through the three current sensing holes. Using less than three wires may cause undesired current unbalance

5 ECAI00-II GENERAL DIMENSIONS



6 ECAI00-II ADJUSTMENT

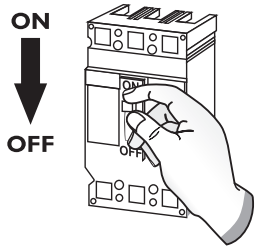
CAUTION: By means of an Ammeter, make sure that the Operational Current (I) is less than FLA (Full Load Amperes) indicated at the motor nameplate. Failure to comply may result in damage to the motor.

ATTENTION: Any accidental or intentional change of setting knob positions after overload asjustment will cause variations in the ECA100-II's protective performance from previous setup. In this case, repeat procedure for ECAI00-II adjustment indicated in Section 6.1

6.1 Procedure for Overload Adjustment

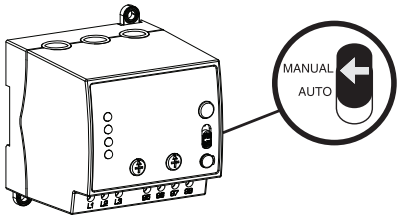
ATTENTION: You should follow this procedure with the motor running at full load conditions, according to the rated values indicated on Motor Name Plate.

a) Turn **OFF** the circuit breaker.

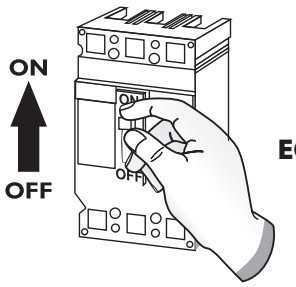


NOTE: Make sure that wiring is according to connection diagram (see item 4.2).

b) Slide the **AUTO/MANUAL** start mode slide-switch to **MANUAL** position.

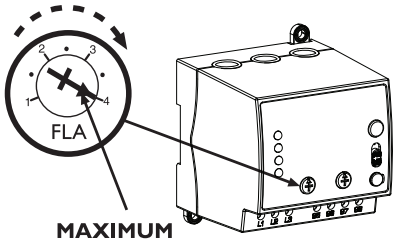


c) Turn **ON** the circuit breaker. (The motor remains **OFF** as the contactor is open through deactivation of the **ECAI00-II**)

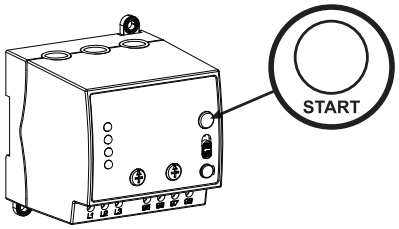


ECAI00-II

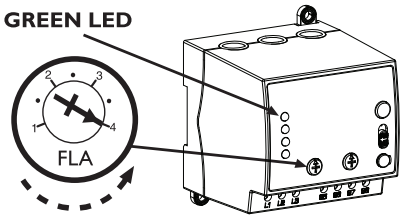
d) Turn right the Current setting knob (**FLA**) up to the maximum value.



e) Press the **START** push button and hold it pressed (motor starts running and **reaches steady-state** operation) while you execute steps **(f)** and **(g).**

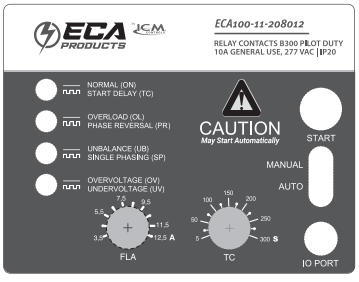


f) Slowly turn left the Current setting knob (**FLA**) until the green LED turns **ON**. At this point, the adjusted level is the actual Motor Operational Current.

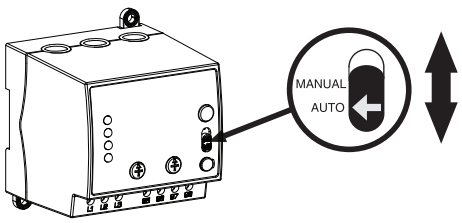


g) Slowly turn right the current setting knob **(FLA)** up to desired protection level:

Green Led ON= In
Red Led 1 ON= Overload 10%
Red Led 2 ON= Overload 15%
Red Led 3 ON= Overload 20%

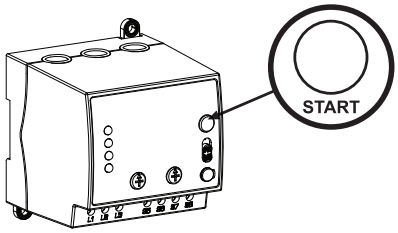


h) Use **AUTO/MANUAL** start mode slide-switch to select the desired motor start mode.

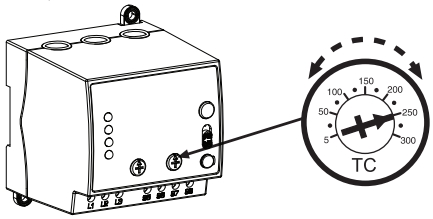


NOTICE: In case the **AUTO/MANUAL** start mode slide - switch is set on **MANUAL** and the **ECAI00-II** relay trips due to any fault detection, you shall press **START** push button to re-activate the Contactor or Line Starter Circuit.

Although the **AUTO/MANUAL** start mode slide - switch is set on **AUTO**, pressing **START** push button is required if three (3) current failures have appeared in less than 30 minutes and qualified technicians have detected and solved causes of failures.



i) Using a flat screwdriver, turn the **TC** setting knob until you set the start delay desired (TC is the time between Voltage fault recovery and restart the system according to application needs).



7 ECAI00-II OPERATION

ECAI00-II constantly supervises motor current and line voltage. When any harmful condition occurs, the output is deactivated until the fault disappears and the motor has completely cooled. Specific timing such as Start Up Delay **(TC)** is incorporated for automatic restart mode, to prevent nuisance tripping due to rapid power fluctuations. In the event of three current failures in less than **thirty (30)** minutes, the output is deactivated until manual restart is done. Checking causes of three successive failures is recommended before restarting, because it can be an indication **of mechanical problems such as the condensing unit not being able to dissipate heat adequately or that there is a problem in the wiring operation, or a damage to the contractor**

ECAI00-II provides two (2) setting knobs to select the maximum allowed current **(FLA)** and the start up delay **(TC)** once the voltage fault and/or overload disappears. One **START** push-button and one selectable **AUTO/MANUAL** Start Mode Slide-Switch are included as well as a Communication Port with ModBus RTU protocol. It also provides indicator lights (LEDs) to indicate faults and load status, as shown in following table:

LED Diagnostics and Fault Conditions

	Continuous Light	Blinking Light
Green Led	Normal **(ON)**	Start Delay **(TC)**
Red Led 1	Overload failure **(OL)**	Phase Reversal failure **(PR)**
Red Led 2	Voltage Unbalance or Current Unbalance failure **(UB)**	Voltage Single Phasing or Current Single Phasing failure **(SP)**
Red Led 3	Overvoltage failure **(OV)**	Undervoltage failure **(UV)**

ECAI00-II also indicates any combination of fault conditions.

9.1 MODBUS DATA FORMAT

CODE	TYPE	DESCRIPTION
F19	1 bits	START MODE
	0	MANUAL
	1	AUTO
F20	8 bits	Unsigned char - To calculate Voltage - ECA100-11
	Value	VOLTAGE = f_Vnom* (Value / 300 + 0,6) [V]
		f_Vnom = Factor Rated Voltage
		f_Vnom= 214 @ Voltage Model = 208V
		f_Vnom= 460 @ Voltage Model = 480V
F29	16 bits	Unsigned char - To calculate Start Up Delay - ECA100-11
	Value	START UP = ((2 * Value) + 1) [s]
F30	8 bits	FAULT HISTORY REGISTER - ECA100-11
	0	No Fault
	bit 0	OV - Over Voltage
	bit 1	UV - Under Voltage
	bit 2	CUB - Current Unbalance
	bit 3	VUB - Voltage Unbalance
	bit 4	VSP - Voltage Single Phasing
	bit 5	CSP - Current Unbalance
	bit 6	PR - Phase Reversal
	bit 7	OL - Overload
F31	32 bits	Unsigned char - To calculate Acumulated Heat - ECA100-11
		ACUMULATED HEAT = ((HEAT_H*256 + HEAT_L) / 616) [%]
	byte 0	HEAT_L
	byte 1	null. not used
	byte 2	HEAT_H
	byte 3	null. not used
F32	8 bits	Unsigned char - To calculate AC Power Frequency - ECA100-11
	Value	FREQUENCY = 15625 / (Value + 128) [Hz]
F33	8 bits	Unsigned char - To calculate Phase - ECA100-11
	Value	PHASE = Value * 3,6 [degree]
F34	8 bits	Unsigned char - To calculate Current - ECA100-11
	Value	CURRENT = Value * K1 * Value(I_MAX) / (K2 * 250)
		I_MAX is the value of the modbus address referenced in note F43
		K1 = 40 K2 = 73 @ Current Model = 1,0 - 4,0 A
		K1 = 125 K2 = 73 @ Current Model = 3,5 - 12,5 A
		K1 = 320 K2 = 73 @ Current Model = 10,0 - 32,0 A
		K1 = 800 K2 = 73 @ Current Model = 25,0 - 80,0 A
F43	8 bits	Unsigned char - To calculate (FLA) CURRENT SETTING - ECA100-11
	Value (I_MAX)	(FLA) Current Setting = Value * K1 / K2
		K1 = 4 K2 = 73 @ Current Model = 1,0 - 4,0 A
		K1 = 12,5 K2 = 73 @ Current Model = 3,5 - 12,5 A
		K1 = 32 K2 = 73 @ Current Model = 10,0 - 32,0 A
		K1 = 80 K2 = 73 @ Current Model = 25,0 - 80,0 A

A) Power Supply Circuit

a.1	Rated Voltage, Ue	208/220	440/480	VAC
a.2	Voltage Operation Limits, Ue	124→300	264→672	VAC
a.3	Average Comsumption, In	38 mA		
a.4	Frequency Operation Limits, F_N	42→70Hz		50/60 Hz
a.5	Rated Duty	Uninterrupted Duty		

B) Application Data, Environmental Conditions, Operation Limits and Installing

b.1	Designed according to European Standards	IEC61010-1, IEC60255-6 IEC60947-1	LVD & EMC
b.2	UL Listing	Aux. Device NKCR Certified for USA Aux. Device NKCR7 Certified for Canada	E527483
b.3	CE Marking	CE, Low Voltage Devices	IEC60947-1
b.4	Ambient Air Temperature (Operation)	-5 °C to 55 °C (23 °F to 131 °F)	
b.5	Ambient Air Temperature (Storage)	-10 °C to + 70 °C (14 °F to 158 °F)	
b.6	Maximun Relative Humidity	85% R.H.	
b.7	Vibrations	Class 1, Amplitude <0.035mm or 1G 10Hz < f < 150Hz	IEC 60255-21-1
b.8	Degree of Protection	IP20, Protected against objects > 12.5mm	IEC 60529
b.9	Pollution Degree	Degree 3	IEC 60255-5
b.10	Overvoltage Category	Category III	IEC 60255-5
b.11	Rated Insulation Voltage	500V	According to UL
b.12	Impulse Voltage Test	5 KV	IEC 60255-5
b.13	Dielectric Voltage-Withstand Test	2.5 KV 50/60 Hz@1min	UL 508
b.14	Flammability Rating of Enclosure	V0	UL-94
b.15	Enclosure Material	Polymers: PC, ABS, NYLON	
b.16	Mounting Position	Any Position	
b.17	Mounting Features	Symmetrical DIN Rail	IEC 715 DIN 43880
		Flat surface mounting,screw 3/16"x1/2"	NEMA Style
b.18	Terminals Screw Type	Flat M3	
	Tightening Screw Torque	5.1 Kgf-cm / 4.4 lb-in	
	Terminals Wiring	≥10 AWG ($4mm^2$)≤18 AWG	
b.19	Current Sensing Holes for Motor Wiring	Ø≤ 11mm, AWG 4	
b.20	Dimensions	92 x 91 x 96 (L x W x H)	mm
b.21	Weight	398 (0.87)	g/lb

C) Control Characteristics

c.1	Auxiliary Relay Contact Rating	B300 Pilot Duty	UL 508 Section 139.1
c.2	Electrical Life Expectancy	100.000 Operations	
c.3	Mechanical Life Expectancy	10.000.000 Operations	
c.4	Utilization Category	AC-15, Capacity for loads> 72 VA	IEC60947-5-1

D) Range Setting, Measuring

(According to Voltage Model)		208	480		VAC
d.1	Voltage Measurement Range, Um	145-285	300-625		VAC
(According to Current Model)		3.5-12.5	10 - 32	25-80	A
Current measuremente range, In		0.7 - 125	2.0 - 320	4.0 - 800	
d.2	Frequency Measurement (Parameter available only through IO Port)	Accuracy ± 2%			Hz

E) Algorithms and Protection Functions

(According to Voltage Model)		208	480		VAC
e.1	Undervoltage (UV) @ Imotor=0 or OL	187	396		VAC
e.2	Overvoltage (OV) @ Imotor=0 or OL	254	528		VAC
e.3	Voltage Hysteresis Threshold	6	12		VAC
e.4	Current Adjust (FLA) by Model	3.5→12.5	10→32	25→80	A (Level settings)
e.5	Voltage Unbalance Detection (VUB)	IN + /-8%, OUT + /-6%			
e.6	Single Phasing (VSP)	INV VUB > 33%, OUT VUB < 28%			
e.7	Phase Reversal (PR)	Normal Sequence ABC, reversal sequence CBA			
e.8	Current Unbalance (CUB)	CUB > 48%			
e.9	Current Single Phasing (CSP)	CUB > 60%			
e.10	Thermal Class	Cold Curve: 10, Hot Curve: 3 According to the previous level of load and time of operation			IEC 60255-8-1990
e.11	Trip Delay because of Overload (OL)	According to Overload Level (Inverse Time Current)			IEC 60255-8-1990
e.12	Permanent disconnection because of Third Current Failure	3 Current Failures in less than 30 min			IEEE Std. C37.112-1996
e.13	Trip Delay because of Phase Reversal	< 1 sec			
e.14	Trip Delay because of Other Voltage Failures	3 sec			
e.15	Start Up Delay because of Cooling (Thermal Model)	480 sec			
e.16	Start Up Delay (TC)	5 → 300 sec			Level settings
e.17	Start Mode	Auto/Manual			Switch selection

F) Communications and Other Special Functions

f.1	Communication Protocol	MODBUS RTU @9600 8N1
f.2	Communication Ports	IO PORT (*)
f.3	History Buffer Memory	20 last fault report

(*) IO Link RS485 is required for IO Port communication. It is available by separately.

G) Immunity and Emissions, Electromagnetic Compatibility (EMC) for Heavy Industrial Environment

g.1	Electrostatic Discharge	IEC 61000-4-2
g.2	Immunity to Ratio Frequency Test	IEC 61000-4-3
g.3	Electrical Fast Transients	IEC 61000-4-4
g.4	Surge Immunity Test	IEC 61000-4-5
g.5	Ratio-Frequency Continuous Conducted	IEC 61000-4-6
g.6	Power Frequency Magnetic Field	IEC 61000-4-8
g.7	Voltage Dips, Short Interruptions and Voltage Variations	IEC 61000-4-11
g.8	Harmonics and Interharmonics Immunity Tests	IEC 61000-4-13
g.9	Voltage Fluctuation Immunity	IEC 61000-4-14
g.10	Unbalance Immunity Test	IEC 61000-4-27
g.11	Variation of Power Frequency	IEC 61000-4-28

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Note: Technical data are valid at the time of printing. We reserve the right to subsequent alterations