ASYNCHRONOUS MOTOR COMMUTATION MODULE - 3PHACCM

USER'S MANUAL

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CONTENTS

1 PURPOSE AND FUNCTIONS

Asynchronous motor commutation module (hereinafter – 3PHACCM or module) is intended for inverter transistors control signal forming for frequency regulated controlling of three-phase asynchronous motor. Module is produced on the basis of modern microelectronics technology achievements, digital-to-analogue integrated circuits and controllers of digital and analogue signal processing with the integral PWM schemes technology advances.

3PHACCM supports the following functions and performances:

- Power inverter control signals forming;
- Controllable engine start/stop;
- Motor rotation direction changing with smooth stop at abrupt changing of rotation direction;
- Smooth start mode and motor stop with controlled acceleration and braking;
- Speed regulation (scalar algorithm U/f);
- Electric motor protection from current overloads and short circuit;

3PHACCM is differ by control simplicity and small dimensions. 3PHACCM comes with different control options; it allows using the block both for the solution of common industrial tasks and for solutions of special cases.

2 PRODUCED MODULES

3PHACCM is produced with different types of radiators and different control types. The recommended connection circuits of the modules depending on the version are presented in sections 5 and 6.

Control types:

«A» - standard. Digital-to-analogue with using of all standard module outputs.

«B» - simplify. Control type that allows making choice enable/ disable and shaft rotation direction choice by one switch that is convenient at module using in lifting-traction mechanisms.

«C» - bipolar. Control by one input or with help of digital-to-analogue converter or with help of connected in an appropriate manner variable resistor. Control voltage is in range of -10…+10V with prohibition range of -0.5…+0.5V.

As an example, 3PHACCM: asynchronous motor commutation module with «C» control type.

Modules types are refer to its control, the parameters of input signals are unchangeable for all models.

3 MODULE COMMON DESCRIPTION

3PHACCM block scheme is shown at Fig. 3.1.

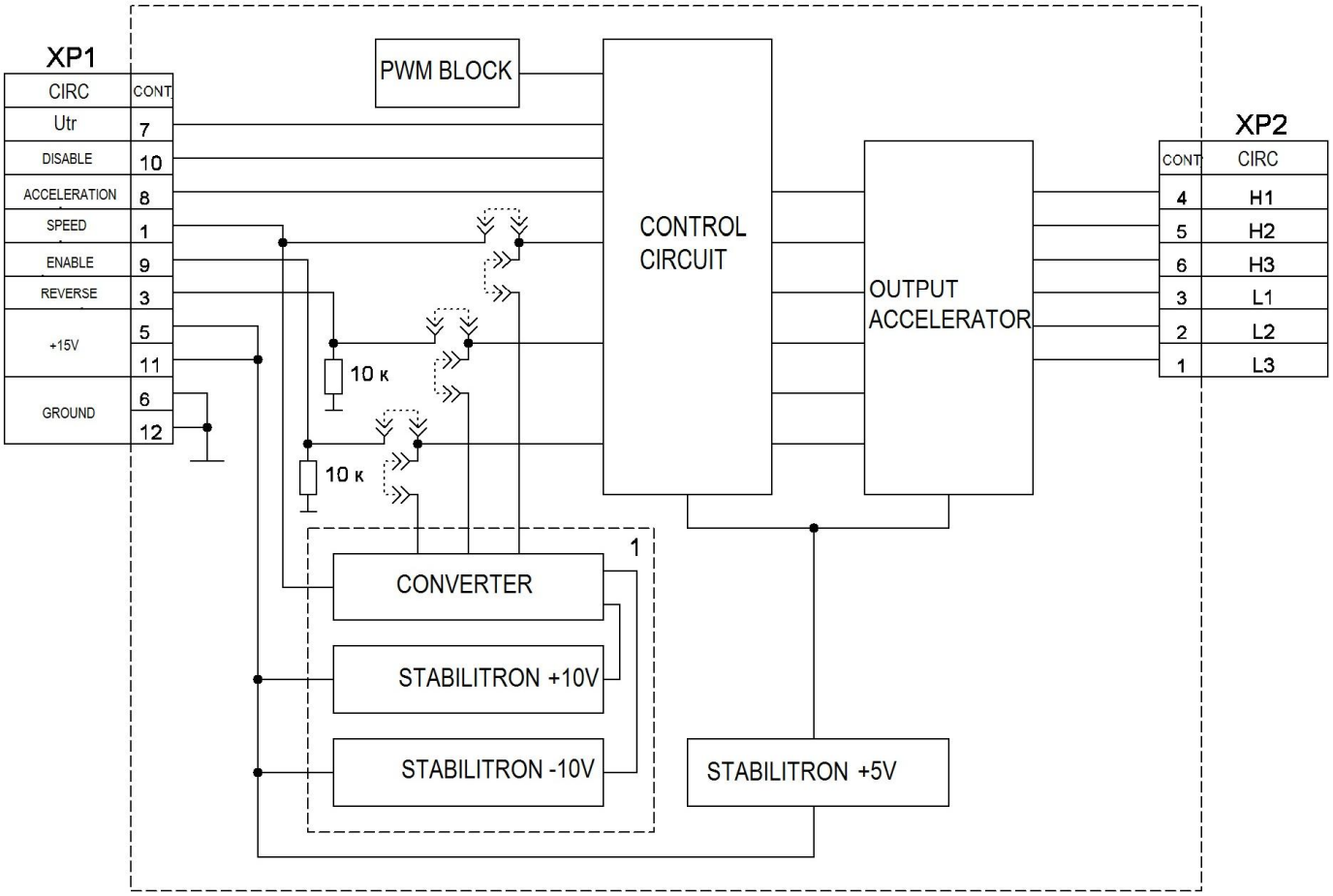

Figure 3.1 – 3PHACCM block scheme

«1» - control scheme that is comprised in 3PHACCM composition for «C» control type (bipolar control). Is absent for «A» and «B» types.

XP1 socket poses two lines of contacts PLS-6 with corresponding member of PBS-6 type. XP2 socket – one line of PLS-6 contacts. XP1 socket outputs purpose and purpose of power outputs are shown in tables 3.1 and 3.2.

Table 3.1 –XP1 socket outputs purpose

Contact number	Symbol	Purpose
1	Speed	Control Input of Motor Shaft Rotation Speed
2		Not involved
3	Reverse	Control Input of Motor Shaft Rotation Direction (not involved for «C»)
4		Not involved
5	+15V	Supply Voltage Input
6	Ground	Ground
7	U_{tr}	Output Source of Transfer Voltage
8	Asseleration	Run-up Acceleration and Deceleration Control Input
9	Enable	Input of Enable/Disable Module Operation (Not involved for «C»)
10	Disable	Protection Input
11	+15V	Supply Voltage Input
12	Ground	Ground

Table 3.2 –XP2 socket outputs purpose

Contact number	Symbol	Purpose
1	L3	Connection Output of Phase C
2	L2	Connection Output of Phase B
3	L1	Connection Output of Phase A
4	H1	Connection Output of Phase A
5	H2	Connection Output of Phase B
6	H3	Connection Output of Phase C

For convenience of control circuits connection at Fig. 3.2 is shown schematic look of 3PHACCM module XP1 socket.

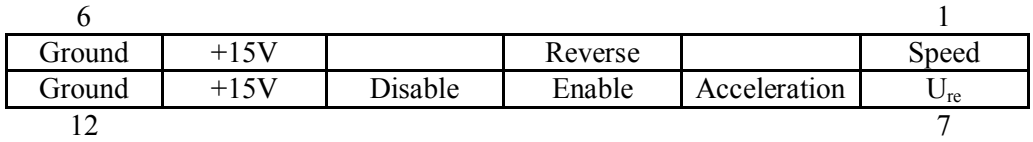

Figure 3.2 – Appearance of XP1 socket.

4 BASIC CHARACTERISTICS

Basic electric characteristics and maximum allowable electric characteristics of the modules 3PHACCM at 25 ^{0}C are represented in Tables 4.1

Таблица 4.1 – Основные и предельно-допустимые электрические параметры

Function	Unit	Rate			Note
		min	type	min	
Supply characteristics					
Supply Voltage	V	13.5		16.5	
Current Consumption	mA			80	$U_п$=15 V
Input characteristics					
Current Consumption at inputs	mA	0.1		1	
Control Voltages Range	V	-0.3		5.2	
Low Level Input Voltage	V	-0.3		0.5	For logic inputs
High Level Input Voltage	V	2.4		5.2	For logic inputs
Voltage, corresponding to maximum speed	V		5		
Voltage, corresponding to maximum acceleration	V		5		
Output characteristics					
Output Frequency	Hz	1		128	
Run-up Acceleration and Deceleration	Hz/sec	0.5		128	
PWM frequency	kHz		10		
Controlling Scheme Block Time at Input «Disable»	s		30		
Low Level Voltage at Outputs H1, H2, H3, L1, L2, L3	V	-0.3		0.5	
High Level Voltage at H1, H2, H3, L1, L2, L3	V	2.4		4,7	
Maximum Output Current at H1, H2, H3, L1, L2, L3	mA			10	
Voltage at output «U_{tr}»	V	4.75	5	5.25	No-load
Load Maximum Current at Output «U_{tr}»	mA			10	

5 MODULE CONTROL

We recommend the following turn-on schemes versus module control type (Fig.5.1 – 5.3).

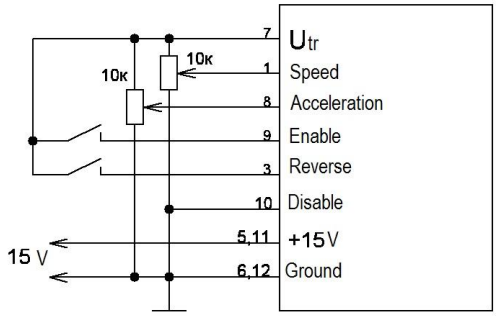

Figure 5.1 – Turn-on schemes of Control Circuits 3PHACCM «A»

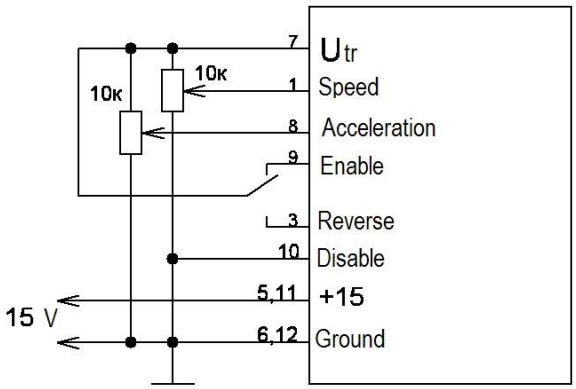

Figure 5.2 – Turn-on schemes of Control Circuits 3PHACCM «B»

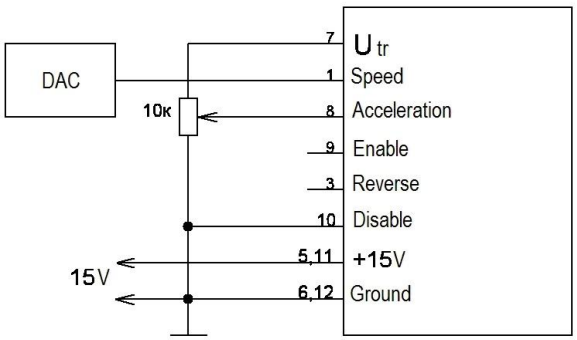

Figure 5.3 – Turn-on schemes of Control Circuits 3PHACCM «C»

Figure 5.2 gives the turn-on scheme of the module with control option «B» with common switch to "Forward Reverse" and "Enable". In case of switch breaking with both contacts module operation will be inhibited.

It is allowed to use the logic TTL-level control instead of the switches.

The motor control by means of 3PHACDMM is carried out with help of following outputs:

«Enable». Direct digital input. "Log.1" of TTL-level corresponds to enable of 3PHACCM operation, "log.0" – to inhibit. Meanwhile the launching of 3PHACCM is carried out on control signal rise. If there is a "log.1" on output "Enable" then with the power supply 3PHACCM will not be launched; at first, you should remove enable and then turn on the module.

If it is necessary the automatic turn-on the 3PHACCM after power supply to power circuit, then the following connection circuits of 3PHACCM are recommended (Figure 5.4).

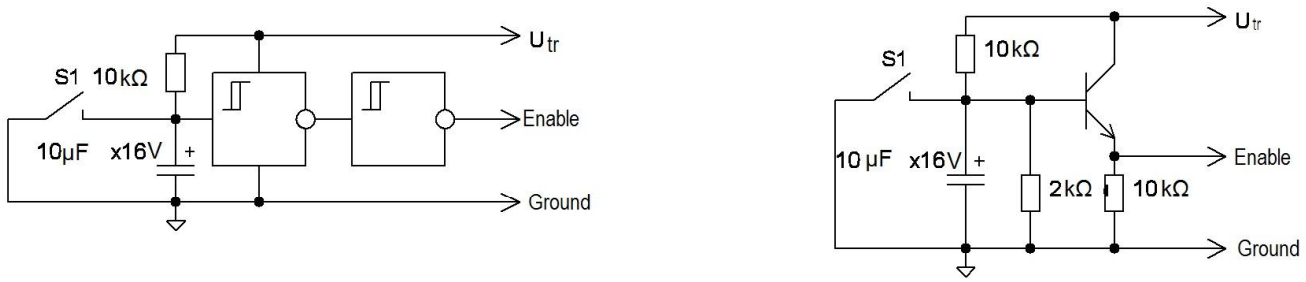

Figure 5.4 – Connection circuits of 3PHACCM with the automatic launching after power supplying.

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The switch S1 is necessary to disconnect 3PHACCM without the power removal; its installation is recommended, particularly, for security purposes. μΩ

«Forward Reverse». TTL-level digital input. The motor shaft rotation direction depends on connection order of its phases. It is allowed the change of motor shaft rotation direction without its previous shutdown, because the internal control scheme provides automatic smooth shutdown (shutdown and acceleration time is regulated by voltage on input "Acceleration") by PWM regulation with change of logic states on output "Forward Reverse"

The diagrams explaining 3PHACCM and controllable motor operation versus controlling signals on outputs "Enable" and "Forward Reverse" are shown at Fig. 5.5 and 5.6.

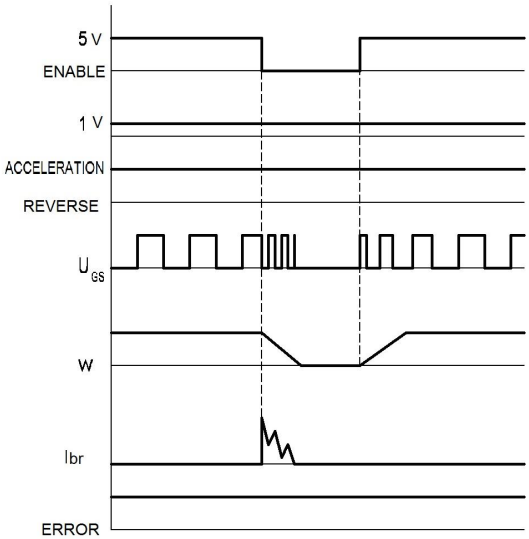

Figure 5.5 – Module control with help of output "Enable"

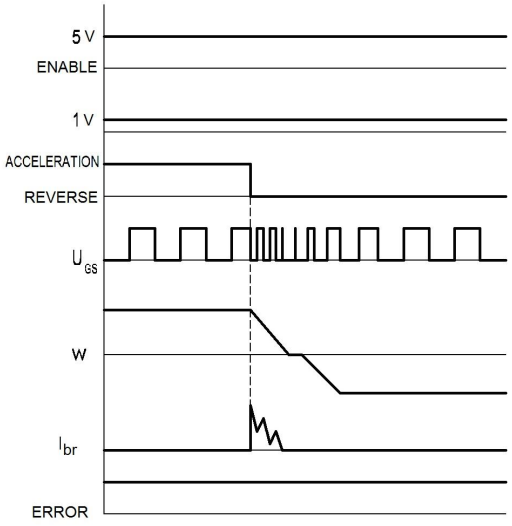

Figure 5.6 – Module control with help of output "Forward Reverse"

Here W_{rpm} – motor shaft rotation frequency, U_{GS} – control signals on power transistors gates, I_{br} – current flowing through the brake resistor.

«Speed». Motor shaft rotation velocity demand analog input. Maximum rotation frequency corresponds to +5 V, shutdown corresponds to 0 V, that is equivalent to 1…128 Hz. We turn your attention to that when voltage is less than 0.5 V the motor shaft cannot rotate, because of too low frequency, which, by virtue of design features, AC motor cannot operate at. The motor shaft rotation speed depending on voltage on input «Speed» is shown at Figure 5.7 and 5.8 (for control option «C»).

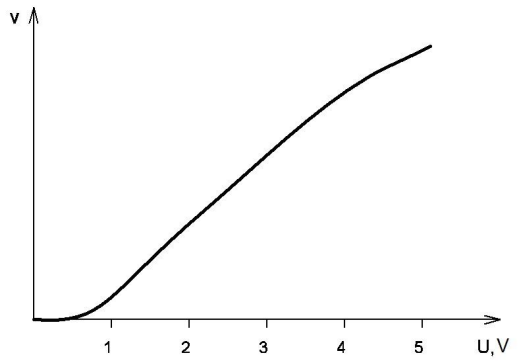

Figure 5.7 – Motor Shaft Rotation Speed versus Output Voltage «Speed»

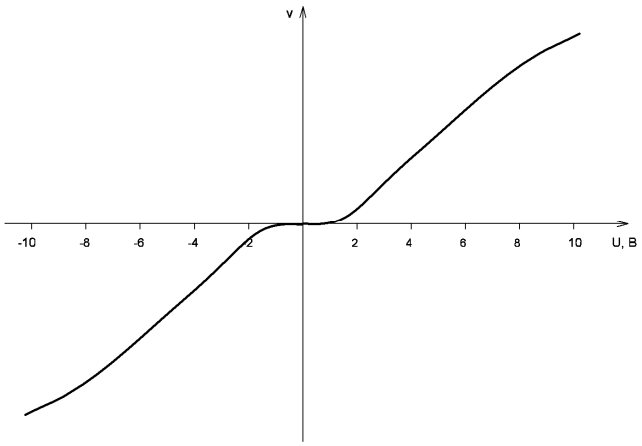

Figure 5.8 – Motor Shaft Rotation Speed versus Output Voltage «Speed» for Control Option "C"

If you need constant motor shaft rotation frequency, it is recommended to connect resistive divider to the output "Speed" relative to «U_{ref}» and «Ground».

When motor launching you must note that if on the output "Speed" voltage is 0 V then the motor will not start. The motor may be launched with initial maximum velocity demand of motor shaft rotation; in this case it is recommended to regulate the launching speed by "Acceleration" voltage.

For option "C" the motor control is carried out only on outputs "Speed" and "Acceleration", outputs "Forward Reverse" and "Enable" are not involved. Meanwhile motor rotation direction is chosen proceeding from signal polarity on output "Speed", control voltage -0.5…+0.5 V corresponds to inhibition, the rotation speed is regulated by voltage level. Figure 5.9 gives the diagram explaining module operation with control option "C".

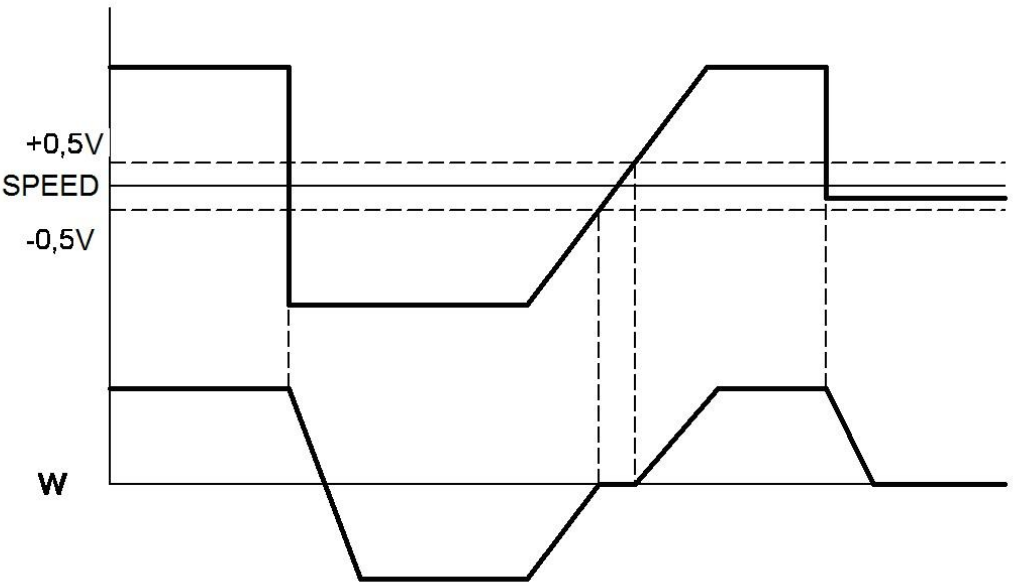

Figure 5.9 – Module Control with option «C»

When module turn-on with control option «C» you must note that for launching of control circuit the input "Speed" bridge from inhibition state (-0.5…+0.5 V) to enable state of any polarity is necessary, otherwise the motor will not launch.

«Acceleration». Launching and Shutdown Velocity Demand Analog Input with master voltage 0…+5 V. Meanwhile motor launching time will always be equal to motor shutdown duration, if the motor shaft load does not influence that.

If the motor will be started up in the same conditions, it is recommended to connect resistance divider to output "Acceleration" relative to «U_{ref}» and «Ground» (and for the output «Speed»).

If there is 0 V on output "Acceleration", the motor will not run.

Choosing motor start duration you must take into account the load condition. It is not recommended to choose high acceleration for cases, when the motor from the start operates at maximum load (or approximate to the maximum) because in this case the motor cannot start (current protection will operate because of high inrush current).

«Disable». 30 seconds module operation disabling of TTl-level input. Вход ТТЛ-уровня запрета работы модуля на 30 с. Enable matches to «log.0», disable «log.1». Current input practically better to use for protection of power circuits from overload. At sending of «log.1» to the current input the control scheme will start after 30 seconds «log.0» will appear at input «Disable».

«U_{ref}». Reference voltage source output (5V$\pm$5%) with a maximum output current of 10 mA. When connecting this output you should be careful to avoid current overload or short circuit, because in this case the module can fail.

«+15V». Module supply input with current consumption 40…80 mA (in dependence from control type and from ambient temperature) without external load.

«L1», «L2», «L3», «H1», «H2», «H3». Module control scheme outputs of TTL- level with load possibility up to 10 mA to one output.

6 SERVICE INSTRUCTIONS

Module is intended for exploitation without cooler.
The module should only be used in exposure to mechanical loads in accordance with Table 6.1.

Table 6.1 – Impact of mechanical loads.

Exposure factor	Value of exposure factor
Sinusoidal vibration: - acceleration, m/s2 (g); - frequency, Hz	 100 (10) 1 - 500
Mechanical shock of repeated action : - peak impact acceleration , m/s2 (g); - duration of impact acceleration, ms	 400 (40) 0.1 – 2.0
Linear acceleration, m/s2 (g)	5000 (500)

The module should be used under the influence of climate stresses in accordance with Table 6.2.

Table 6.2 – Impact of climate loads

Climatic factor	Value of climatic factor
Low temperature of environment: - operating, °C; - absolute, °C	 - 40 - 45
High temperature of environment: - operating, °C; - absolute, °C	 + 85 + 100
Relative humidity at a temperature 35 °C non-condensing %, no more	98

Module outputs are intended for mounting to printed board by soldering or by bolt connector. Maximum number of resoldering during assembly operations is 3. Soldering of outputs must be done at temperature not higher then 235°C. Soldering process duration is maximum 3 seconds.

During its mounting and exploitation is necessary to protect module from impact of static voltage; during mounting is necessary to use grounding strap and grounding low voltage soldering machines with supply through transformer.

7 RELIABILITY SPECIFICATIONS

Reliability probability of the module for 25000 hours must be at least 0.95.

Gamma-percent life must be no less than 50000 hours by $\gamma = 90$ %.

Gamma-percent service life of the modules, subject to cumulative operating time is no more than gamma-percent life, no less than10 years, when $\gamma = 90$ %.

Gamma-percent storage-ability time of the modules, when $\gamma = 90$ % and storing – 10 years.

8 OVERALL AND CONNECTING DIMENSIONS

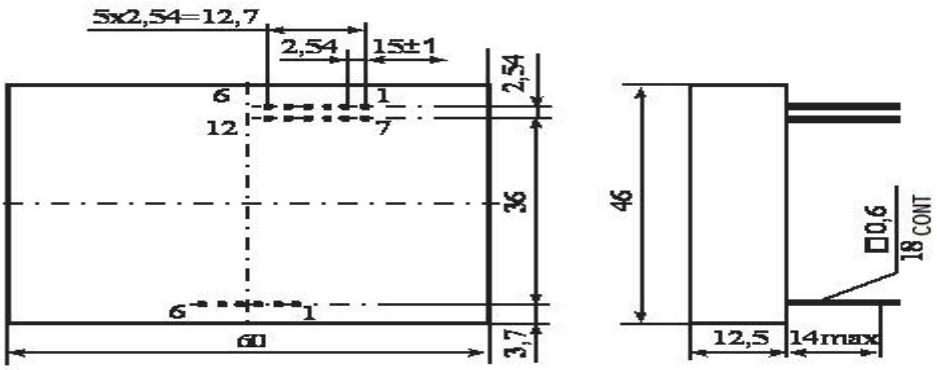

Figure 8.1 – Overall dimensions of 3PHACCM

Precious metals are not contained.

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