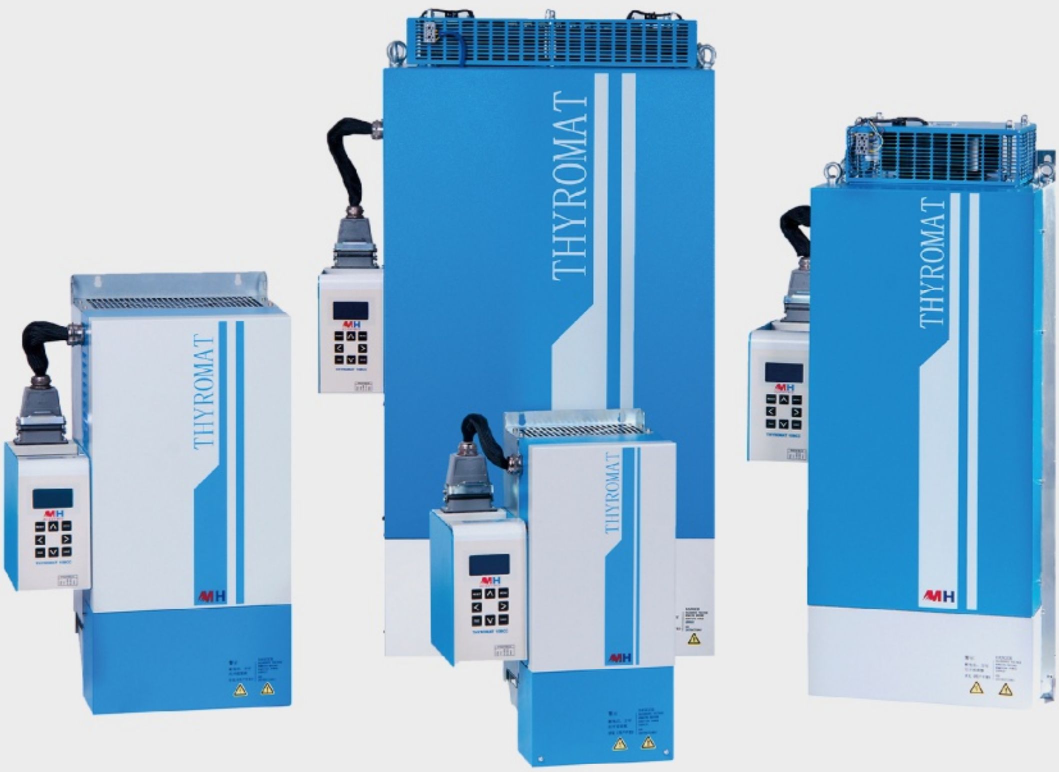
THYROMAT-10BCC DIGITAL CRANE CONTROLLER



USER MANUAL

MH • CHINA

THYROMAT 10BCC DIGITAL CRANE CONTROLLER

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SECTION 1 : GENERAL

1.1. Control System

The THYROMAT-10BCC digital crane controller adopts new generation of hardware and software technology. Its control performance is much more excellent.

Thyromat-10BCC, a new generation of crane controller drive is designed and produced by Dalian MH Electric Ltd. (MHE) after many years of successful application of the THYROMAT-BDC drive, with modern digital communications technology and Silicon-controlled rectifier (SCR) technology. The features of thyristor changing-over technology, embedded motor control software, PROFIBUS-DP communication interface are all well cooperated in the drives. The THYROMAT series of crane controllers are special drives for three-phase slipring electric motors for cranes at heavy duty and in harsh environment.

Solid state electronics allows a compact design with enhanced reliability. Self-monitoring further improves system safety and reliability. Software features and all hardware components are engineered to meet the requirements for both new and existing cranes. THYROMAT digital crane control makes crane operation simple, safe, precise and consequently more productive.

All MH's expertise and 60 years experience in crane controls make the product with high-tech robust and suitable for all types of cranes, specially in harsh environment. Table 1-1 details the special features of the THYROMAT.

Table 1-1 : Special Features of THYROMAT-10BCC

SPECIAL FEATURES	
FEATURE	**ADVANTAGES**

Excellent reliability	• Productivity increased
	• Low maintenance
	  ○ Reduced operation costs
	• Robust and compact mechanical construction
	  ○ Resistant to vibration
	• Operates in extreme ambient conditions
	  ○ Rated for continuous duty at 60°C
	  ○ Control box sealed from dusty environment
	  ○ Control cards protected with silicon coating

High degree of safety	• Torque proving before operation commences • Self diagnostics ○ Built in watchdog timers • Built in electronic controller in neutral checking • Opto isolation of inputs • Z- Reinforced braking control is applied.
	• More safe interlocks and features for brake controls
Friendly User-interface	• Control panel ○ Chinese/English interface

SPECIAL FEATURES	
FEATURE	ADVANTAGES
	○ Keyboard to enter parameters ○ Display to show real time motor information ○ Display faults and history ▪ Reduced down time ▪ Enables preventative maintenance
Excellent control	• Load independent control ○ Excellent repeatable placing of end load ○ Safer working environment for personnel • Smooth steady control ○ Safe efficient load handling ○ Gearbox and couplings not subjected to excessive stress ○ Reduced current peaks ▪ Slip-ring maintenance reduced ▪ Motor life extended • Safe brake control ○ Torque proving before brake is opened ○ Brake is applied before removing torques but at nearly zero motor speed ○ Safe brake shoes
Rotor feedback speed measurement	• No tacho generator or pulse encoder required ○ No mechanical modifications needed on motor shaft ○ No additional installation costs, labour and equipment ○ No maintenance of a tacho required ○ No need for small control wires in cable loop system ○ Simplifies the control system
SCR Switching over	• Using SCR switching over ○ The switching over is fast and reliable. ○ The switching over time can be set by parameters.
Simplicity	• Simple and quick installation • Use friendly training courses • Understood easily by maintenance staff ○ Excellent trouble shooting system ○ Rapid acceptance by maintenance staff
Large ranges 0-2500A	• Covers complete ranges ○ All control units are the same. Reduce the amount of spare parts and fault processing time. ○ Ideal for single motor use with emergency operation requirement in multi-motor application.
PROFIBUS Communication	• Support PROFIBUS communication bus protocol, Baud rate：187.5Kbps~1.5Mbps

1.1.2. Basic System Diagram

This diagram is applicable to both hoist and travel operations.

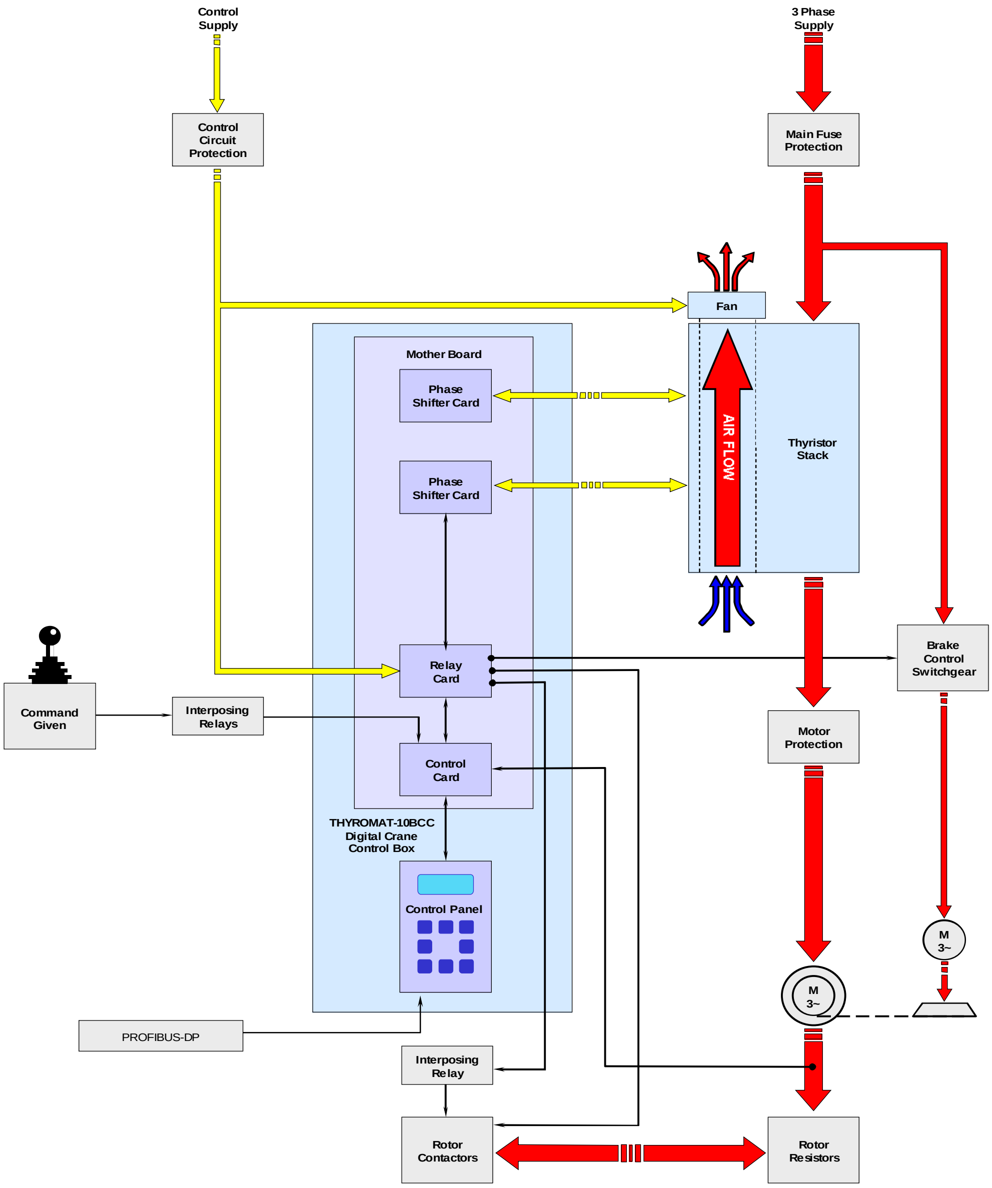


Figure 1-1 : Basic System Operational Diagram

1.1.2. THYROMAT-10BCC Parts and Accessories.

The following illustration details the parts of THYROMAT-10BCC (refer to Figure below). This diagram is applicable to both hoist and travel motions.

Drive is composed of two parts:

Control unit (Left part):

- Control box (with mother board)
- Hoist (Travel) control card
- Relay card
- Phase shifter card (2 pieces)
- Control panel

Stack (Right part):

- Thyrisitor
- Snubber protection
- MOV'S
- Temperature switch
- Busbar
- Heat sink
- Metal structure

SECTION 2 : PRODUCT MODEL AND SYSTEM DESIGN

2.1. General

The following paragraphs detail the selection of the THYROMAT and associated equipment as well as the details for the operation of the THYROMAT-10BCC. THYROMAT-10BCC is a high-tech, simple and feasible equipment. The experience of users is also important to the system design.

2.2. THYROMAT-10BCC Digital Crane Controller Models

Table 2-1 details the THYROMAT-10BCC models.

Table 2-1 : THYROMAT-10BCC Models

THYROMAT Abbreviated Code	Ampere Rating at 60°C	Mechanical Size	Dimensions W x H x D in mm	Weight (Approx.)
THYROMAT – 10BCC 25	25 A	M150	380 x 576 x 259	23 kg
THYROMAT – 10BCC 30	30 A	M150	380 x 576 x 259	23 kg
THYROMAT – 10BCC 60	60 A	M150	380 x 576 x 259	23 kg
THYROMAT – 10BCC 100	100 A	M150	380 x 576 x 259	23 kg
THYROMAT – 10BCC 150	150 A	M150	380 x 576 x 259	23 kg
THYROMAT – 10BCC 200	200 A	M350	491 x 765 x 309	40 kg
THYROMAT – 10BCC 260	260 A	M350	491 x 765 x 309	44 kg
THYROMAT – 10BCC 350	350 A	M350	491 x 765 x 309	44 kg
THYROMAT – 10BCC 400	400 A	M400	520 x 865 x 375	83 kg
THYROMAT – 10BCC 500	500 A	M1000	520 x 1085 x 375	100 kg
THYROMAT – 10BCC 700	700 A	M1000	520 x 1085 x 375	100 kg
THYROMAT – 10BCC 1000	1000 A	M1000	520 x 1085 x 375	100 kg
THYROMAT – 10BCC 1200	1200 A	M2000	786x 1360 x 425	240 kg
THYROMAT – 10BCC 1500	1500 A	M2000	786x 1360 x 425	240 kg
THYROMAT – 10BCC 2000	2000 A	M2000	786x 1360 x 425	240 kg
THYROMAT – 10BCC 2500	2500 A	M2500	See note	See note

Note: There is supplementary instructions for Thyromat-10BCC 2500A.

The product model is defined as detailed in Table 2-2.

Table 2-2 : Product Model Definition

Series: Type	Series: Motion	Current	Supply Voltage	Control Voltage	Communication and brake selection	Explanation
10BCC	X	25A	380	X	P Z	
					Z	Z- Strengthened brake control
					P	P- DP communication function S-No DP communication function
				X		A-110 volts control voltage B-220 volts control voltage
			380			380 volts mains 525 volts mains
		25A				25 A, 30 A, 60 A, 100 A, 150 A, 200 A, 260A, 350A, 400A, 500A, 700 A, 1000 A, 1200 A, 1500 A, 2000 A, 2500A
	X					H - Hoist applications T - Travel applications
10BCC						10 Thyristor stack B Alternating current (ac) applications C Crane applications C Digital communication function

For example, a product with the designated code:

Model: 10BCC H 25A 380B S Z

This would be defined as a unit having the following characteristics:

- **10** Thyristor switching over system
- **B** Alternating current (ac)
- **C** Crane applications

- **C** Digital communication
- **H** Hoist
- **25A** 25 Ampere supply current
- **380** 380 Volts AC mains
- **B** 220 Volts AC control voltage
- **P** Control Panel with PROFIBUS-DP communication function
- **Z** Strengthened brake control

Note: The external accessories includes one OA1800-10, 3 current transformers MCTxxx : 1A each unit (detailed explanation is in 2.4.). A voltage divider OA1900-01 or OA1901-01 is needed in the feedback part when the THYROMAT-10BCC drive with 525V power supply is used (detailed explanation is in 4.4.4, "Rotor Frequency Feedback" and Appendix 3.).

2.3. Protection

Table 2-3 lists the protection specifications for the THYROMAT-10BCC.

Table 2-3 : THYROMAT-10BCC Protection

Item	Specification
Control enclosure	IP51
Thyristor stack	IP00

2.4. THYROMAT - 10BCC Digital Crane Controller Selection

The selection of the THYROMAT-10BCC for specific mechanical power requirements depends on the base stator current rating on of the slip-ring motor to be used. In the event that the base stator current ratings are not known then it is suggested that the same ratings S_4 or S_5 for crane duty slip-ring motors be used.

Perform the following steps to calculate the mechanical power

Step 1. Calculate the mechanical power that will be generated by the motor using the speed, load and efficiency of the motion.

Step 2. If this data is not available use the electrical power for the specific duty.

Step 3. Obtain the stator current for the specific power selected

Step 4. Refer to the table (Table 2-4) and select the THYROMAT.

The selection of the THYROMAT has been divided into two operational categories for both hoist and travel namely, standard duty and heavy duty.

The following paragraphs define standard and heavy duty applications:

2.4.1 Standard Duty (Light Duty)

The following defines standard duty:-

Characteristics

- Rated starting class - 150 starts per hour.
- Cyclic duration factor - 40%
- Max. Ambient Temperature - 40ºC
- Altitude above sea level - < 1500 meters

The typical standard duty applications are as for BS 466:1984 cranes with a group mechanism in M3 and M4, the following lists typical standard duty applications:-

Applications

- Power station cranes.
- Light workshop cranes.
- Light stores duty cranes.
- Light general load handling cranes

2.4.2 Heavy Duty (Based on 40% of nominal load permanently on hook).

The following lists the heavy duty parameters:-

Characteristics

- Rated starting class - 150 to 600 starts per hour.
- Cyclic duration factor - 40% to 60%
- Max. Ambient Temperature - 60ºC
- Altitude above sea level - < 1500 meters

The design standard of the corresponding cranes is GB/T3811-2008, in M5 to M8 heavy duty crane grade.

Applications

- Grab cranes.
- Hot metal cranes.
- Magnet cranes.
- Magnet cranes for scrap yard.
- Production cranes.
- Shipyard cranes.
- Ladle cranes.
- Pig/scrap cranes.
- Stocking pit mould-handling cranes.
- Vertical ingot chargers.
- Furnace charging cranes.

- Forging cranes.
- Heavy mill service cranes.
- Heavy-duty service and maintenance cranes.

Table 2-4 details the selection of the **maximum stator current** ratings for both hoist and travel in standard and heavy duty applications of the various THYROMAT-10BCC units.

Table 2-4 : Model Selection of THYROMAT-10BCC

THYROMAT – 10BCC		Stator Current			
Unit Sizes	Continuos Current Ratings at 60°C	Hoist		Travel	
		Standard Duty	Heavy Duty	Standard Duty	Heavy Duty
M150	25 A (MCT 0.66 30I 50:1A)	20.5 A	17.5 A	22.5 A	20.5 A
	30 A (MCT 0.66 30I 50:1A)	25 A	21 A	27 A	25 A
	60 A (MCT 0.66 30I 100:1A)	50 A	43A	55 A	50 A
	100 A (MCT 0.66 30I 200:1A)	83 A	71 A	90 A	83 A
	150 A (MCT 0.66 30I 300:1A)	125 A	107 A	136 A	125 A
M350	200 A (MCT 0.66 30I 300:1A)	166 A	143A	181 A	166 A
	260 A (MCT 0.66 40I 400:1A)	215 A	185 A	235 A	215 A
	350 A (MCT 0.66 40I 500:1A)	291 A	250 A	318 A	291 A
M400	400 A (MCT 0.66 50I 600:1A)	333 A	285 A	363 A	333 A
M1000	500 A (MCT 0.66 50I 800:1A)	416 A	357 A	454 A	416 A
	700 A (MCT 0.66 50I 1000:1A)	583 A	500 A	636 A	583 A
	1000 A (MCT 0.66 60I 1500:1A)	833 A	714 A	909 A	833 A
M2000	1200 A (MCT 0.66 100I 1500:1A)	1000 A	857 A	1090 A	1000 A
	1500 A (MCT 0.66 100I 2000:1A)	1250 A	1071 A	1363 A	1250 A
	2000 A (MCT 0.66 100I 3000:1A)	1666 A	1428 A	1818 A	1666 A
M2500	2500 A (MCT 0.66 100I 3000:1A)	2083 A	1786 A	2273 A	2083 A

2.5. Principle of Operation

The THYROMAT-10BCC is connected in series with the stator supply voltage.

The control unit varies the stator voltage of the slip-ring motor by adjusting the firing angle of the inversely connected (parallel) thyristors in each of the three phases. The motor torque is proportional to the square of the stator voltage ($T \alpha V2$ - where T is the motor torque and V is the stator voltage). The speed of the motor is measured by the frequency of the rotor. Motor conversion is achieved through the motor u, v groups of thyristor that back-to-back in parallel to switch. Thyristor switch is under the control of control unit, measures to prevent the circulation and thus will not produce circulation.

Before operation can commence, safety circuits monitor the motor for incorrect phase rotation, heavy phase differences or unbalance and low three-phase voltage supply and will only allow operation in the event that all the conditions are correct. Electrical interlocking is provided to make sure that the master controller is returned to the zero position after a power or phase loss after which the system will have to be restarted before operation can commence.

Mechanical stresses to the motor and gearbox are minimised by ramping all the supplied voltages this, in turn, provides constant acceleration and deceleration.

There are three independent slow speed steps in both directions. Selection of full speed causes the motor to ramp up (accelerate) to full speed. The two acceleration contactors are activated at 50% speed (25 Hz) and 75% speed (12,5 Hz) respectively and the result is a smooth acceleration up to full speed. The peak switching current during the acceleration cycle is limited to approximately twice that of the full load current.

2.5.1. Control Box

CAUTIONS

1. **CARE MUST BE TAKEN WHEN INSERTING CARDS INTO THE MOTHERBOARD NOT TO BEND THE CONNECTING PINS**
2. **DO NOT TOUCH ANY OF THE COMPONENTS ON THE CIRCUIT BOARDS, THEY ARE VOLTAGE SENSITIVE AND MAY BE DAMAGED / DESTROYED.**

The control box contains the control cards necessary for the control of the motion and thyristor firing circuitry. There are four individual cards that are common to the complete range. The cards are contained in a box that has an IP51 rating. This keeps out the harmful dust ever present in steelworks environments. The Control panel secures the cards in their sockets and minimises the effects of vibration.

Each electronic card is covered with a conformal protective coating. This coating has the following benefits :-

- Increased isolation between points at different potentials

- Improved mechanical strength of components further resisting vibration
- Further protection to card from metallic dust and humidity.

2.5.2. Hoist/Travel Control Card

The control card consists of a microprocessor that interfaces with the process input and outputs. The microprocessor integrates on-chip program memory, data memory (RAM) and serial communication. Also on the card is the serial EEPROM, keypad and display driver communication interface.

The rotor frequency is evaluated on this card using digital signal processing. This gives the motors actual speed. Inputs are optically isolated achieving high integrity of the control system.

2.5.3. Relay Card

This card contains the four relays for switching the external rotor contactors and the power supply for these relays. It also contains a fault monitoring relay.

2.5.4. Phase Shifter Card

This card determines the trigger delay angle for the firing of the thyristors as well as circuitry for disabling the THYROMAT-10BCC unit in the event of incorrect phase rotation, heavy phase imbalance or low supply voltage. The 10 Volt control voltage is derived from the main supply voltage within this card.

Each drive using 2 phase shifter cards, which are used to shifter a positive/reverse SCR arms.

The thyristor firing circuitry uses a phase locked loop control circuit and is therefore not sensitive to incoming mains disturbances.

The thyristor trigger module incorporates a unique dynamic time/amplitude transient clipping circuit.

2.5.5. Control Panel

Control Panels are the man machine interfaces of the THYROMAT-10BCC. They can display the values of motor parameters, stator currents, motor speeds and working status of crane controllers. They are also the interfaces set control parameters into the drives. The DP communication is also installed on the circuit.

You can choose to use display in Chinese or English.

2.6. Control System Specifications

Table 2-5 details the THYROMAT-10BCC controller Specifications.

Table 2-5 : THYROMAT-10BCC Controller Specifications

TECHNICAL DATA		
CONTROLLER DATA		
Mains supply to THYROMAT	Input voltage U - V – W	380 V – 415 V 3 phase 50 Hz 525 V - 550 V 3 phase 50 Hz
	Supply variations	+10% - 15%
	Trip level of THYROMAT	380 V - 415 V range < 266 V 525 V - 550 V range < 367 V
Output supply to motor	Uo - Vo - Wo	Variable up to mains RMS level
Control supply	Terminals 10 - 11	110 V - Single phase 50 Hz 220 V - Single phase 50 Hz Other voltages (on request)
	Supply variations	+10% - 15%
Digital inputs Control voltage	Generated by the THYROMAT internal regulated supply circuit	10 V DC max 5 mA per input
Outputs	Main board 110 V or 220 Vac supply	4 x Relay outputs, one fault relay output, rating 220 Vac 16 A max . Continuous rating 2 A AC14
Current inputs	3 Phase stator current monitoring	Rated at 1 A continuous max. peak current = 3 A
PROFIBUS communication port	Support PROFIBUS communication bus protocol, D type 9 pins. Baud rate: 187.5KB/S~1.5MB/S	
Ambient operating temperature	-10°C (no frost) to +60°C at rated current	
Storage temperature	-40°C to + 60°C	
Relative humidity	<95%, no condensation allowed	
Air quality - Chemical vapours - Mechanical particles	IEC 721 - 3 - 3 unit in operation, class 3C2 IEC 721 -3 - 3 unit in operation, class 352	
Altitude	Max. 1500 m at continuous rated current Over 1500 m reduce rating by 1% for each 100 m, absolute maximum altitude 3000 m	

TECHNICAL DATA	
CONTROLLER DATA	
Vibration IEC 721 - 3 - 3	Operating: Max displacement amplitude 3 mm at 2 - 9 Hz Max. acceleration amplitude 0,5 G at 9 –200 Hz
Shock IEC 68 - 2 - 27	Operation: max 8G, 11 ms Storage and shipping: max 15 G, 11 ms inside the manufacturers package
Protection	Control box: IP51 Power stack frames M100 to M2000: IP00
Protective functions	Over current protection: set at 4 x unit rating for a period longer than 2,5 seconds Input phases rotation Input phases under voltage: < 0,7 Un Input phases single phasing Output phases unbalanced: > 50% unbalance Unit temperature: stack temperature > 95°C Motor overload protection: This feature is not yet implemented Loss of rotor frequency feedback Loss of torque detection
Control method	Phase angle control; 10 anti-parallel thyristors connected in series with motor stator
Operating frequency	50 Hz ± 1%
Braking torque	Varies with rotor resistors values used, standard max. 3,5 x Tn. Units may be designed for greater ratings. Consult MH Company for further details
Unit power dissipation	Control box: max. 40 W Thyristor stack: Approximately 3,8 W/A of motor actual running current at 60% C.D.F

***** The low voltage protection value of THYROMAT-10BCC: Wide working voltage range only means the drives can work in a large range of supply voltage. They can work reliably under low voltage. However, it does not mean the lowered voltage will not affect motor driving torque.

2.7. THYROMAT – 10BCC Digital Crane Controller Enclosures

The details listed in this paragraph are based on a complete THYROMAT-10BCC installation. This includes items such as the drive, contactors, relays, motor protection unit and other auxiliary components/equipment. The listed enclosure sizes suggest the minimum requirement and should be used as a guideline only. The environmental conditions used as a model for the enclosure sizes are based on the following assumptions:

- Ambient temperature - -10°C ~40°C
- Maximum internal temperature of enclosure - ≤ 60°C
- Type of plant - Ladle handling crane
- Location - Indoors
- Degree of protection - IP54

Table 2-6 details the THYROMAT Enclosures.

Table 2-6 : THYROMAT-10BCC System Mounting Panel (Cabinet)

Enclosure Size and Ventilation Table						
THYROMAT-10BCC MECHANICAL Sizes	THYROMAT-10BCC Current Ratings	Total Heat Dissipation of Switchgear	Height (mm)	Length (mm)	Width (mm)	Remarks
M150	25 A	480 W	1400	800	400	No forced ventilation required.
M150	30 A	480 W	1400	800	400	No forced ventilation required.
M150	60 A	480 W	1400	800	400	No forced ventilation required.
M150	100 A	480 W	1400	800	400	No forced ventilation required.
M150	150 A	720 W	1400	800	400	No forced ventilation required.
M350	200 A	960 W	1400	1800	400	Forced ventilation with filters recommended or open chassis plate installed inside electric room.
M350	260 A	1500 W	1400	1800	400	Forced ventilation with filters recommended or open chassis plate installed inside electric room.
M350	350 A	1600 W	1400	1800	400	Forced ventilation with filters recommended or open chassis plate installed inside electric room.
M400	400 A	1830 W	1800	1400	500	Forced ventilation with filters recommended or open chassis plate installed inside electric room.
M1000	500 A	2280 W	1800	1600	500	Forced ventilation with filter recommended or open chassis plate installed inside crane girders where possible.
M1000	700 A	3200 W	1800	1600	500	Forced ventilation with filter recommended or open chassis plate installed inside crane girders where possible.
M1000	1000 A	4580 W	1800	1600	500	Forced ventilation with filter recommended or open chassis plate installed inside crane girders where possible.
M2000	1200 A	5430 W	1800	2100	500	Forced ventilation with filter recommended or open chassis plate installed inside crane girders where possible.
M2000	1500 A	6680 W	1800	2100	500	Forced ventilation with filter recommended or open chassis plate installed inside crane girders where possible.
M2000	2000 A	8800 W	1800	2100	500	Forced ventilation with filter recommended or open chassis plate installed inside crane girders where possible.

2.8. Selection of External Resistors

The selection of matching between the rotor resistor and the system controlled by THYROMAT-10BCC drives is detailed in the following paragraphs. It is assumed that the designer has a good working knowledge of crane mechanical power calculations.

Step 1

Determine the electrical power (**P_e**) of the motor for the duty the crane will operate from motor manufacturers data tables.

Step 2

Calculate the mechanical power (P_m) required by the motor. Use values of speed, load and efficiency of the motion.

Step 3

Obtain the rotor current (R_A) at determined $\mathbf{P_e}$ from motor manufacturers data tables.

Step 4

Calculate new R^1_A

$R^1_A \approx R_A \times \mathbf{P_m / P_e}$

Step 5

Calculate the motors rotor resistance ($\mathbf{K_{100}}$) that will give 100% rated torque at start. Obtain the motors open circuit rotor voltage ($\mathbf{R_V}$) from motor tables

$K_{100} = \mathbf{R_V /} \sqrt{3} \times [R^1_A (I^1_2)]$

Step 6

Determine the resistor values required from the selection table (refer to table 2-7). Figure 2-1 illustrates the resistor configuration.

$R1_{TOT} = R1$

$R2_{TOT} = R1 + R2$

$R3_{TOT} = R1 + R2 + R3$

$R4_{TOT} = R1 + R2 + R3 + R4$

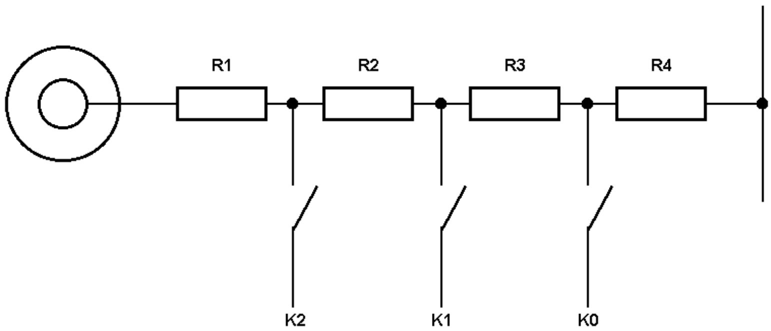


Figure 2-1 : Resistor Configuration Shape (General Shape, Matching with Table 2-7.)

Table 2-7 :-Resistor Values

Motion	Ohms	% of K			
		$R1_{TOT}$	$R2_{TOT}$	$R3_{TOT}$	$R4_{TOT}$
Hoists, all motions with adequate torque margins	0.36 K_{100}	9	18	36	
Hoists, large motors and motors with low torque margins	0.65 K_{100}	9	18	36	65
Travels	0.3 K_{100}	30	-	-	-

Note:

1) Refers to the ratio of **P_m to P_e**

2) Full speed will be 90% with a full load. If full speed is important increase motor size and gear ratio.

It is a requirement that a crane has the ability to lift 125% of the nominal load, this factor must be taken into account during commissioning process only.

When selecting the current carrying capacities of the resistor grids and sections, the following factors need to be considered:

- Ambient temperature
- Duty cycle
- Slow speed operations

2.9. Selection of Interposing Input Relays

As most cranes operate under heavy environmental conditions that could include dust and / or corrosive gases, it is a strict requirement to use interposing relays to give commands to the THYROMAT-10BCC drives.

Interposing relays is better to be placed close to the input terminals of THYROMAT-10BCC drives.

It is strongly recommended that the interposing relays have the following characteristics for optimum system performance.

- They must be hermetically sealed
  This is a requirement due to most cranes operating under heavy environmental conditions that could include dust and/or corrosive gases
- They must have a minimum contact burden of 5 mA / V

2.10. Selection of Interposing Output Relays

Where applicable, use interposing contactors between the relay outputs of the THYROMAT-10BCC and the stator / rotor contactors.

Contactors can be used as single units or where necessary may be used in parallel. The rating of the continuous supply current from the relay card is at a maximum of 2A, therefore the maximum continuous allowable VA rating is 220 VA at 110 V and 440 VA at 220 Vac. This means that the consumption of each contactor when closed may not exceed 50 VA (110 V system) or 100 VA (220 V system), leaving a small margin to feed the brake contactor, which uses approximately ≤ 20 VA.

2.11. Selection of Cables

The following paragraphs detail the selection of power supply and control power cables.

2.11.1. Power Supply Cables

The specifications of the power supply cables must be calculated according to recognised standards (international or domestic standards) and the cable manufacturer's recommendations.

Several factors need to be taken into consideration when selecting the correct power supply cables such as the ambient operating temperatures, the cyclic duration factor of the application and the cable length. The voltage drop across the cable under acceleration and reverse plugging conditions caused by the higher motor currents should be less than 2%.

The selection of the cable should take into account the main circuit breaker to be used so that the efficient protection of the thyristor stack is not compromised, Therefore it is advisable to select the cables conservatively.

2.11.2 Control Power Cables

The THYROMAT-10BCC uses interposing relays for inputs to outputs and an external control voltage of 110 VAC or 220 VAC. Besides, input command relays should be usually installed near the THYROMAT drives. The drive is not sensitive to external noise interference. Therefore, the use of standard armoured control power cables with 1.5 mm² wires is sufficient. 2.5 mm² wires may be demanded to be used for the requirements of mechanical strength. Ambient conditions should not be ignored either.

CAUTIONS

IF INTERPOSING RELAYS ARE FAR FROM THYROMAT-BCC DRIVES, THE CONNECTING CABLES BETWEEN INTERPOSING RELAYS AND DRIVES ARE BETTER TO BE SHIELDED CABLE OR THE CABLES BE PLACED FAR FROM THE CABLES CARRYING ALTERNATION CURRENT 380V OR 110V POWER SUPPLY TO AVOID ELECTRIC INTERFERENCE.

2.12. Selection of Rotor Contactors

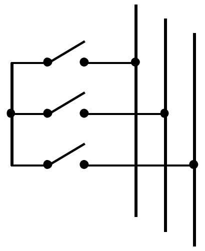
During normal THYROMAT operations, the rotor contactors raises the current of the starting peak to between 1,5 and 2,5 times that of the rated rotor current and open at no-load. The making and breaking actions of these contactors is a light duty action. Because of the reverse plugging characteristics associated with slip-ring motors, care needs to be taken with regards to the rotor voltage as the voltage rises to twice the nominal rotor standstill voltage during reverse plugging.

The drop out time of the rotor contactors must be less than or equal to the stator contactor operating time, so that they can correspond to the stator contactor operating times. This will minimise the risk of contactor failure under load conditions and substantially improve the contactors electrical life. Arcing of contactors when changing can be avoided by using rotor contactors controlled by THYROMAT drives. Please pay attention to set the firing delay parameters. Refer to “Parameter Explanation”

There are four basic configurations used to connect the rotor contactors, the most popular configurations used are ‘Delta’ and ‘Star’ configurations and although not as popular, ‘V’ and ‘W’ configurations are sometimes also used. In the interests of promoting reliability, MH company has a conservative approach to the selection of the contactors and recommends that the continuous rating of the contactors are used rather than intermediate duty which is used for the intermediate rotor contactors.

The formula used to select the correct rotor contactors for the applicable connection configurations are listed in the following paragraphs:-

2.12.1. Star Connections



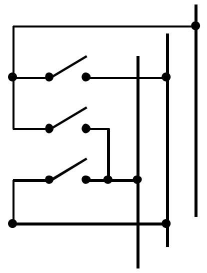
Contactor **thermal current (Ith)** = Motor Rotor Current

Example: Motor Rotor Current = **100 A**

Contactor selected ≥ **100 A Ith**

Ith = **AC3** contactor rating

2.12.2. Delta Connections



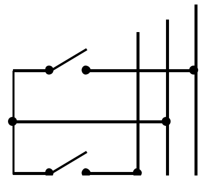
Contactor **Ith** = $\frac{\text{Motor Rotor current}}{1.4}$

Example: Motor Rotor Current = **100 A**

Contactor selected ≥ $\mathbf{\frac{100}{1.4}}$

= **71.4 A Ith**

2.12.3. V Connections

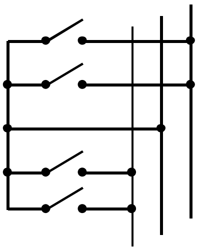


Contactor **Ith** = Motor Rotor Current

Example: Motor Rotor Current = **100 A**

Contactor selected ≥ **100 A Ith**

2.12.4. W Connections



Contactor **Ith** = Motor Rotor current / 1.6

Example: Motor Rotor Current = **100 A**

Contactor selected ≥ **100 / 1.6**

= **62.5 A Ith**

2.13. Motor Thermal Protection Unit - This feature is not yet implemented

The THYROMAT has built in motor thermal protection for Class 5 and Class 10 applications the thermal protection required can be selected from the keypad.

It is normally accepted to protect slip-ring motors with a Class 5 I^2t temperature curve. In heavy duty applications where high ambient temperatures exist or the motor is exposed to heat radiation, it is recommended that a Class 10 temperature curve is used and the motor power (kW) is rated accordingly so as to ensure a reliable installation.

This method of protection does not monitor the thermal state of the motor accurately, because it can only monitor the current drawn by the motor but does not take in consideration ambient and other essential conditions which may affect the temperature rise of the motor. Therefore it is recommended that wherever possible, PTC thermistor probes and associated relays be used. This will offer additional protection against influencing factors such as, overheating due to a faulty motor ventilation fan, abnormal rise in ambient temperature, abnormal friction in the system due to mechanical or brake failure and unexpected heavy duty operations.

In the case of a multi-motor system it is recommended that each motor must have it's own external motor protection unit (MPU) to enable the individual monitoring of each motor. In this event, the size of the selected MPU should accurately cover the motor's rated current range and must be set according to this current range or to the mechanical power equivalent current rating, which should effectively be lower than that of the rated motor current.

2.14. Selection of Main Fuse Protector

Fast fuses are needed to protect thyristors in thyristors' switching direction of THYROMAT-10BCC drives. The ratted current of fuse should be 1.25~1.5 times larger than motor full load driving current of drives.

The fuse selection we recommended is listed in the following table:

THYROMAT-10BCC MECHANICAL Sizes	THYROMAT-10BCC Current Ratings	Fuse Type	Fuse Core Rated Current
M150	25 A	NGTC00	25
	30 A	NGTC00	32
	60 A	NGTC00	63
	100 A	NGTC00	100
	150 A	NGTC1	160
M350	200 A	NGTC1	200
	260 A	NGTC2	250
	350 A	NGTC2	355
M400	400 A	NGTC2	400
M1000	500 A	NGTC3	500
	700 A	RS39A	800
	1000 A	RS39A	1000
M2000	1200 A	RS39A	1250
	1500 A	RS87A(Z)	1600
	2000 A	RS87A(Z)	2000

2.15. Selection of Spare Parts

CAUTION

Only use spares provided by MH Company in order to maintain safety and reliability of products, failure to do so will render the warranty of the product null and void.

NOTE

Although the larger (higher current ratings) THYROMAT-10BCC units are compatible to lower currents, the mounting holes will differ.

MH Company maintains a stock holding of recommended spares and is able to extend valuable support for all their products. Refer to Section 7 Paragraph 7.3. for further details with regards to the ordering of spares. You can also contact to MH Company with following contacts. URL: www.mhdl.com.cn or www.mhgco.com. Tel: 0086+411+84820666.

SECTION 3 : PARAMETERS

3.1. Hoist Application Parameters List of THYROMAT-10BCC Drive

Table 3-1 lists the typical parameter settings for hoist applications. You can look up the version by the indication when starting or by the label on the chips of Control Card or Control Panel.

Table 3-1 : Hoist Parameter List for 10BCC-H versions

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
1	CT ratio	Current transformers ratio	50:1 to 3000:1	-	50:1A
2	Motor current	Motor nominal current	≤ 60% of CT ratio	-	10A
3	Overload class	Thermal overload class type	2 or 5	-	5
4	Notch 1	First notch speed	5% to 20%	1%	10%
5	Notch 2	Second notch speed	5% to 40%	1%	20%
6	Notch 3	Third notch speed	5% to 50%	1%	30%
7	Hoist plugging	Enable hoist plugging	Yes or No	-	No
8	Hoist plugging V	Hoist plugging % voltage	20% to 80%	5%	30%
9	Lower plugging V	Lower plugging % voltage	50% to 100%	5%	80%
10	Brake release I	Brake releasing current	0% to 50%	5%	15%
11	Hoist Start Volts	Hoisting min. start volts	30% to 80%	1%	60%
12	Stop delay	Torque hold delay at stop	300 – 1500 ms	50 ms	600 ms
13	Lower plugg out	Lower plugg time out	2000 – 5000 ms	250 ms	3000 ms
14	Max stall volts	Maximum stall voltage	70% to 100%	5%	80%
15	Ph shift on time	Phase shifter on time delay	0 ms		0 ms
16	Ph shift off time	Phase shifter off time delay	60 to 240 ms	20 ms	100 ms
17	Sep. dir signals	Separate directional signals	Yes or No	-	No
18	Node address	Node address	1 to 126	1	11
19	Load defaults	Load default parameters	Yes or No	-	No

3.2. Parameter Descriptions - Hoist

The following paragraphs detail the various hoist parameters.

CAUTION

If it is necessary to change parameters it is recommended that this be done in a conservative manner and only with a full understanding of each function.

3.2.1. Current Transformer Ratio

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
1	CT Ratio	CT ratio	50:1 to 3000:1	-	50:1

This parameter selects a current transformer ratio (Current Transformer ratio). Refer to Table 2-4 for setting.

3.2.2. Motor Current

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
2	Motor current	Motor nominal current	$\leq$ 60% of CT ratio	2A	10A

This parameter sets the motor full load stator current.

The set value should be full load current of motor practical working duty. The minimum value is 2A.

CAUTION

Do not exceed the motor nameplate value for the applicable duty.

The current values should actually be decided during system design. The setting of this parameter has also decided the effect of overload protection.

3.2.3. Overload Class

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
3	Overload class	Thermal overload class	2 or 5	-	5

		type			

This parameter selects the Class of overload that the thermal model uses as a reference.

Class 5:

Trip if stator current exceeds three times motor full load current for a period exceeding 7sec.

Class 10:

Trip if stator current exceeds three times motor full load current for a period exceeding 17sec.

Extra motor protecting elements or units should be applied to the system according to standards when designing.

3.2.4. Notch 1

3.2.5. Notch 2

3.2.6. Notch 3

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
4	Notch 1	Notch 1 speed	5% - 20%	1	10%
5	Notch 2	Notch 2 speed	5% - 40%	1	20%
6	Notch 3	Notch 3 speed	5% - 50%	1	30%

There are three notch speeds (full speed is 100 %.).

CAUTION

When the set speed of low speed notches is higher than 30%, the configuration of resistor box should be considered before design. I. E. The decision of lower notch speed in hoist application must be made in system design. The speed must tallywith resistors. None professional personnel is not allowed to adjust the speed values.

3.2.7. Hoist Plugging (Yes, No)

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
7	Hoist plugging	Enable hoist plugging	Yes or No	-	No

Hoist plugging to neutral is load dependent. Under light load or empty hook conditions, the system friction may be insufficient to decelerate the load quickly. When this parameter is set to "Yes", the drive will produce strong plugging to reduce speed as quickly as possible. When this parameter is set to "No", the voltage will be reduced by drives and the speed will be reduced by friction and gravity. Therefore, this parameter is effective when the load is light. If this parameter is set to "Yes", the upper limit is decided by next parameter. The braking toque is regulated under the upper limit automatically.

CAUTION

Always ensure that the service top limit switch is correctly set to allow for sufficient stopping clearance from the service top limit switch to the ultimate limit switch. The worst case setting would be when hoist plugging is active (=yes) and the hook is empty. It needs more time to stop after the hook touchs the limit.

3.2.8. Hoist Plugging Voltage

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
8	Hoist plugging V	Hoist plugging voltage	20% to 80%	5%	50%

This parameter is only active if the parameter in 3.2.7 "Hoist plugging" = Yes (active). It should be set with small percentage values. The notch plugging function is built in systems. It works automatically (No matter whether Parameter in 3.2.7 is set to Yes or No.). The voltage of Notch Plugging is automatically set to this parameter (Hoist plugging V).

If hoist application has higher inertia, higher plugging voltage can be set. The plugging will be applied when there is difference between set speed and real speed from higher speed notch to lower speed notch or neutral. Practically it means that light loads in hoisting are plugged.

3.2.9. Lower Plugging Voltage

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
9	Lower plugging V	Lower plugging voltage	50% to 100%	5%	80%

This parameter is used for setting lower plugging voltage. This voltage sets the upper limit of torque for lower plugging. The control torque is automatic adjusted with PID by the drive under the limit. In the event that this voltage is not sufficient to retard the motor, after an initial period of 750 ms the ceiling is removed and maximum voltage may be applied.

CAUTION

Setting this value too high can cause high current peaks. Appropriate values should be set according to load and power supplyl.

3.2.10. Brake Release Current

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
10	Brake release I	Brake release current	0% to 50%	5%	15%

This parameter sets the minimum stator current required to allow the brakes to be released.

As a general rule this current value must be equal or greater than the motor magnetizing current. If this current is not known, this parameter can be set with practical current before the brake is released on site or with default value.

3.2.11. Hoist Start Voltage

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
11	Hoist start volt	Hoisting min. start volts	30% - 80%	1%	60%

This parameter sets up the minimum voltage applied to the motor immediately at start of a hoisting cycle.

When this voltage is reduced the starting up of a hoisting cycle may be smoother when no-load is present but it may allow a slight drop of the load when hoisting, it is advisable to keep it's value between 50% and 60% in most cases.

When this voltage is increased it may cause slight speed overshoot during start-up of no-load operation.

3.2.12. Stop Delay

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
12	Stop delay	Torque hold delay at stop	300 – 1500 ms	50 ms	600 ms

This parameter sets the time for zero speed to be held at stop, to allow sufficient time for the mechanical brake to be fully applied.

This eliminates load sagging at stop due to the slow reaction time of the mechanical brake.

3.2.13. Lower Plug Out

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
13	Lower plugg out	Lower plugg time out	2000 – 5000 ms	250 ms	3000 ms

The lower plugging time out sets the time taken for the brake to be applied regardless as to whether the motion has stopped lowering or not.

It is a backup feature in that, if plugging continued past this time, the mechanical brake will be applied and bring the motion to a stop. In the event that instead of lower to neutral, lower to hoist was selected by the driver the time out, checks the time taken for the motion to retard to zero speed. If the time taken is greater than the set time, the brakes will close and a "plugg out time" trip will occur.

3.2.14. Max Stall Volts

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
14	Max stall volts	Maximum stall volts	70% to 100%	5%	80%

This parameter sets the voltage which will remain applied to the motor in the event that the motor is stalled.

This voltage will be applied for a maximum period of 10 seconds, after this time a "Motor Stall" fault will trip the system.

3.2.15. Ph Shift on Time

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
15	Ph shift on time	Phase shifter on time delay	0 ms	-	0 ms

3.2.16. Ph Shift off Time

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
16	Ph shift off tim	Phase shifter off time delay	20 to 240 ms	20 ms	100 ms

When stator thyristors need switching, this parameter sets the lasting time of shutting off thyristors when switching.

Note: The setting of Parameter 15 and Parameter 16 should be decided according to the action time of rotor contactors. For example:

Contactor Model: LCT-F265.

Its coil model is LX1-FH. Open time is from100mS to 170mS.

Close Time is from 40mS to 65mS.

The setting of Parameter 16 is as follows.

Since interposing relays are often needed, the acting time of the interposing relays should be considered when setting this parameter. The setting of Parameter 15 and Parameter 16 is interconnected.

The setting value of Parameter 16 is the maximum open time minus the time set by Parameter 15.

The maximum open time of the contactor is 170mS. Parameter 15 is set to 0mS. Therefore, Parameter 16 is calculated as follows.

Parameter 16=170-0=170mS. The selectable time in the table is 170 (step increment is 20mS.).

Note

In most cases, the default values can meet the time requirement of international standard. Parameter 15 and Parameter 16 of Schneider LC1 series contactors with larger than 265A (AC3) and without fast coils only need modification. The general rule of drive controlling contactors is no arcing when switching. If you have any questions, please consult MH company.

3.2.17. Separate Directional Signals

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
17	Sep. dir signals	Separate directional signals	Yes or No	-	No

This parameter defines the way the input directions are selected. It has relation with external wire connection. See 4.4.2.

3.2.18. Node address

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
18	Node address	Node address	1 to 126	1	11

This parameter is the communication address of THYROMAT-BCC drive. User can choose any value from 1 to 126 according to practical requirement. However, this address is not allowed to be repeated. Besides, the address must be the same as that of hardware configuration.

3.2.19 Load Defaults

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
19	Load defaults	Load factory default parameters	Yes or No	-	No

All of the parameters will restore to default values of factory delivery when selected “YES”.

CAUTION

There are only parameter 4 to parameter 4 in thyromat needed to be reset. Please manage to understand the meaning of the parameters before resetting the parameter. Wrong settings will cause drives’ not working. Besides, none optimization condition will occur.

Refer to corresponding chapters or sections of this manual of MH Company or you may consult MH local agents for parameter setting procedures and keyboard operation methods.

Please look up the full hardware version and software version on the cards or boards when replacing with spare parts. MH Company provides necessary instruction documents in shipment. Please keep them with a designated person for correct application and spare part replacement. Welcome to consult MH Company technical department.

The hardware or software you ordered may be different from that you currently used. Generally speaking, MH Company will consider the compatibility when updating. Part of hardware or software is needed to be replaced. The drive is not need to be replaced. Please carefully read the instruction attached to the drive or consult MH Company technical department before installation.

3.3. Travel Application Parameters List of THYROMAT-10BCC

Table 3-2 lists the typical parameter settings for Travel applications. You can look up the version in the chips on Control Cards or Control Panel.

Table 3-2 : Travel Parameter List

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
1	C.T. Ratio	CT ratio	50:1 to 3000:1	-	50:1
2	CT enable	CTs enable	Yes or No	-	Yes
3	Motor Current	Motor full load current	<63% of CT ratio	-	10A
4	Overload Class	Overload class type	5 or 10	-	5
5	Notch 1	Notch 1 speed	4% to 20%	1%	10%
6	Notch 2	Notch 2 speed	5% to 40%	1%	20%
7	Notch 3	Notch 3 speed	5% to 60%	1%	30%
8	Notch Plugging	Notch plugging	Yes or No	-	Yes
9	Notch Plugging V	Notch plugg voltage	0% to 90%	5%	40%
10	Neutral Plugging V	Neutral plugging Voltage	0% to 90%	5%	70%
11	Neutral Decel P	Neutral Deceleration Profile	2s to 20 s	1s	5 s
12	Brake Plugging V	Voltage to apply when plugging in the opposite direction	50% to 90%	5%	70%
13	Brakes on Speed	Brakes on Speed	2% to 10%	1%	4%
14	Max Stall V	Maximum stall volts	20% to 80%	5%	70%
15	Min Start V	Minimum start volts	10% - 80%	5%	30%
16	N123 Accel	Acceleration time of slow speed notches	5s to 20s	1 s	10 s
17	N4 Accel profile	Acceleration time of full speed notch	2s to 20 s	1 s	5 s
18	Ph Shift Off Tim	Phase shifter off time delay	20 to 240 ms	20 ms	100 ms
19	Notch 4 Delay	Notch 4 delayed time	0s to 5 s	1 s	0 s
20	Sep. dir signals	Separate directional signals	Yes or No	-	No
21	Plug Produced %Sp	Reduce speed with plugging voltage.	0% to 20%	5%	15%

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
22	N 123 Smooth PRF1	Notches 1,2 and 3 Smooth Profile	10 to 300	10	160
23	Brakes Plug Soft	Soft Brake Plugging	Yes or No	-	No
24	Node address	Node address	1 to 126	1	11
25	Load Defaults	Load factory default parameters	Yes or No	-	No

3.4. Parameter Descriptions – Travel

The following paragraphs detail the various travel parameters.

3.4.1. Current Transformer Ratio

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
1	CT Ratio	CT ratio	50:1 to 3000:1	-	50:1

This parameter selects a current transformer ratio (CT ratio). Shown on table 2-4

Note

Motor current monitoring function is option function for travel application. It can be used according to practical working condition. Please pay attention to that Current Transformer ratio takes effects when Parameter 3.4.2 is set to Yes.

3.4.2. Current Transformer Enable

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
2	CT Enable	CT’s enable	Yes or No	-	Yes

By selecting “Yes” current monitoring and the overload thermal model is enabled. Selecting “No” the thermal short circuit and unbalance current protection is disabled.

3.4.3. Motor Current

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
3	Motor Current	Motor full load current	$\leq$ 60% of CT ratio	-	10

This parameter sets the motor full load stator current (Motor flc).

The value to be used is the stator current related to the mechanical power for the specific duty. The minimum value is 10A.

CAUTION

Do not exceed the motor nameplate value for the applicable duty.

3.4.4. Overload Class

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
4	O/L Class	Overload class type	5 or 10	-	5

This parameter selects the Class of overload that the thermal model uses as a reference.

Class 5:

Trip if stator current exceeds three times motor full load current (Motor flc) for a period exceeding 6,77 sec.

Class 10:

Trip if stator current exceeds three times motor full load current (Motor flc) for a period exceeding 16,7sec.

Note

This value should be determined during the design phase. This value is to be used by the thermal model to calculate overload conditions

3.4.5. Notch Speed 1
3.4.6. Notch Speed 2
3.4.7. Notch Speed 3

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
5	Notch 1	Notch 1 speed	4% to 20%	1	10%
6	Notch 2	Notch 2 speed	5% to 40%	1	20%
7	Notch 3	Notch 3 speed	5% to60%	1	30%

These three parameters set the intermediate slow speeds. It is expressed with percentage and the maximum speed of travel application is 100%.

3.4.8 Notch Plugging

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
8	Notch Plugging	Notch plugging	Yes or No	-	Yes

This parameter enables or disables notch plugging. “Yes ” enables notch plugging. “No ” disables notch plugging.

Parameter 3.4.9 sets specific plugging voltage.

3.4.9 Notch Plugging Voltage

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
9	Notch Plugging V	Notch plugging voltage	0% to 90%	5%	40%

This parameter sets the notch plugging voltage for both directions.

Notch plugging when activated, makes use of dynamic reverse plugging, to retard the travel motion to the required speed, the magnitude of the plugging torque is proportional to the square of the plugging voltage applied, therefore the voltage setting will have an effect on the smoothness of the motion operation.

It is suggested that in standard applications a value not higher than 50% of supply voltage is used.

3.4.10 Neutral Plugging Voltage

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
10	Neutral Plugging V	Neutral plugging voltage	0% to 90%	5%	70%

Neutral plugging when activated, makes use of dynamic reverse plugging, to retard the Travel motion to standstill. The magnitude of the plugging torque is proportional to the square of the plugging voltage applied, therefore the voltage setting will have an effect on the smoothness of the motion operation.

3.4.11 Neutral Decel Profile

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
11	Neutral Decel P	Neutral Decel Profile	2s to 20s	1s	5s

This parameter sets the ramp down profile when decelerating the motion back to Neutral (Stop) and cannot be disabled. In the event that “Coasting to Neutral” is required, the User may set the Neutral plugging voltage (Parameter 10) to its minimum value.
The Counter torque applied during deceleration will be so low that it will hardly have any plugging effect, hence simulating Coasting.

The maximum plugging voltage that may be applied during Neutral deceleration is restricted by Parameter 10 above. In the event that a quick deceleration is required the maximum Neutral plugging voltage (Parameter 10 above), may have to be raised to enable the motor to receive as much Counter torque has it is required to stop within the time span defined by the Neutral Deceleration Profile parameter.
Also note that if the motion is decelerating at a much quicker rate then the rate defined by this parameter, the Thyromat will allow this faster stop to happen, preventing the application of any driving torque to maintain the target deceleration profile.

3.4.12 Brake Plugging Voltage

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
12	Brake Plugging V	Voltage to apply when plugging in the opposite direction	50% to 90%	5%	70%

Brake plugging cannot be disabled. This parameter is used to set the plugging voltage applied when reducing speed with direct reverse notch command. It is expressed with percentage of motor rated voltage. To activate Brake plugging the operator moves the joystick into any notch in the opposite direction to the actual crane direction at the time.
This plugging voltage applies to motor to reduce the speed to zero and accelerates the speed to required speed in the opposite direction when the command demands reversing the direction.
There are two kinds of braking/plugging methods. This plugging method is used in required fast plugging pattern operation. This parameter is a flexible option for users when the load with high inertia swings or swing hooks are needed.
It is suggested that the set value of this parameter should always be higher than the previous plugging voltage (Parameter 3.4.9 and Parameter 3.4.10). but not higher than 80%.
If the specific system really requires a Braking plugging voltage higher than 80%, it may show the problem the system has. Please consult MH engineers for whole system analysis.

3.4.13. Brakes on Speed

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
13	Brake On Speed	Brake On Speed	2% to 10%	1%	4%

This parameter sets the motor percentage speed when braking plugging during stop period.
The accurate time can be obtained by setting accurate setting to ensure the closure of brake shoes and drum at time when motor speed is zero.

3.4.14. Max Stall Voltage

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
14	Max Stall V	Maximum stall volts	20% to 80%	5%	70%

This is the ceiling voltage applied to the motor(the percentage of rated voltage) in the event that the motor works at the time of very beginning.
Usually a setting of 70% is sufficient to enable the motion to operate satisfactory.
It is often required to increase this voltage when the rails are in bad condition such as wide rail connecting intervals, greasy rails and dirty rails.
This voltage should be increased when traveling on uneven rails and “the motor stalls”. When the voltage has to be increased to solve the problem, we suggest that the problem should be solved as quickly as possible and restore setting of original value after the problem is solved. Large current for a long time will reduce the insulation of motors.

3.4.15. Min Start Voltage

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
15	Min Start V	Minimum start volts	10% to 80%	5%	30%

A setting of 30% minimum voltage at start, gives the travel motion a smooth, slow reaction start up.

By increasing this voltage the travel start up becomes more aggressive, the user will have the option to tune the start-up reaction time of the travel by modifying this parameter.

3.4.16. Notch 1, 2 and 3 Acceleration Time

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
16	N1_N2_N3 Accel	Acceleration time between slow speed notches	5s to 20s	1s	10s

This parameter sets the acceleration time between lower speed notches.

This parameter will have no effect at Notch 4.

Scale example:

If the parameter is 5s, it means the acceleration curve pattern is that it takes 5 seconds for speed to increase from 0% to 100%. It takes 0.5 seconds for speed to accelerate to 10% speed. It takes 1.5 seconds for speed to accelerate to 30% speed. The torque of device will not be affected and will complement the acceleration pattern if when there is load change (swing of load).

3.4.17. Notch 4 Accel Profile

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
17	N4 Accel profile	Acceleration rate for full speed acceleration	2s to 20s	1s	5s

Notch 4 acceleration profile is based on ramping the motor stator voltage as opposed to Notches1; 2 and 3 acceleration profile which is based on a Speed ramp profile.

The system, when going to Notch 4, measures the voltage applied to the motor at the time and ramps it to full voltage at the rate determined by this parameter.

Example:

- During transition from any notch to notch 4 the voltage supplied to the motor was at 50%.
- The parameter is set at 5 sec.
- It will take a further 2.5 sec to ramp the voltage from 50% to 100%.

3.4.18. Phase Shifter Off Time

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
18	PH Shift Off Tim	Phase shifter off time delay	20 to 240 ms	20 ms	100 ms

This parameter sets the time that the Phase Shifter is disabled (No current flowing to the motor) to allow the directional thyristors to change.

3.4.19. Notch 4 Delay

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
19	Notch 4 Delay	Notch 4 delayed time	0s to 5s	1s	0s

This parameter when set at a value > 0 inserts a time delay for engaging notch 4 “full speed”.

This is useful when the operation of the Crane requires the driver to perform short movements of the load. By adding a delay time to notch 4 it will prevent the accidental jump from slow speed operation (Speed ramp) to full speed operation (voltage “Torque” ramp).

3.4.20. Separate Directional Signals

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
20	Sep. dir signals	Separate directional signals	Yes or No	-	No

This parameter defines the way the input directions are selected. Refer to 4.4.2.

3.4.21. Plug Produced % SP

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
21	Plug Produced %SP	Load factory default parameters	0% to 20%	5%	15%

During the latest phase of Neutral Plugging, the torque applied may be at such high level that by the time the motor reaches zero speed the remaining counter torque may cause the motor to accidentally move into the opposite direction for a short period while the brakes are busy being applied (Kick back effect). This is more evident when the required Neutral deceleration profile is made very short (i.e. quick deceleration).

To avoid the "kick back effect" we can reduce the Neutral plugging ceiling to approximately 85% of its pre selected value, when the motor speed drops below a certain point. The speed at which the "Reduced Counter torque" is applied is determined by this parameter.

3.4.22. Notches 1, 2 and 3 Smooth Profile

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
22	N 123 Smooth PRF1	Notches 1,2 and 3 Smooth Profile	10 to 300	10	160

This parameter is the lower speed notch stable profile. By setting it high the Closed loop response to speed and torque changes in a way that tends to respond quicker and harsher to speed variations due to torque fluctuations caused by the travelling rails getting into contact with the traveling wheels, this may result in further speed oscillations, therefore in the event of being necessary to reduce such oscillations, it may necessary to reduce the value of this parameter.
It is suggested that this parameter is set to default value in most of application.

This parameter is required to be optimized with Parameter 3.4.16, "N123 Accel" to obtain much smoother and proper acceleration working profile in most cases.

3.4.23. Soft Brake Plugging

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
23	Brake Plug Soft	Soft Brake Plugging	Yes or No	-	No

This parameter sets whether the soft brake plugging is enabled for travel application when the Joystick is positioned into the opposite direction to the actual motion direction.
When the parameter is set to "Yes", Parameter 12, the Brake plugging voltage, is applied gently to motors (The voltage is increased from 1% to 100%with the ramp profile within 800ms.).
When the parameter is set to "No", The plugging voltage will increase to the value of Parameter 12, the Brake plugging voltage with standard ramp profile (The voltage is increased from 1% to 100%with the ramp profile within 200ms.).

3.2.24. Node Address

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
24	Node address	Node address	1 to 126	1	11

This parameter is the communication address of THYROMAT-10BCC device. User can choose any value from 1 to 126 according to practical requirement. However, this address is not allowed to be repeated. Besides, the address must be the same as that of hardware configuration.

3.4.25. Load Defaults

NO	PARAMETER	DESCRIPTION	SCALE	INCREMENT	DEFAULT
25	Load Defaults	Load factory default parameters	Yes or No	-	No

All of the parameters will not restore to default values of factory delivery when selected “No”. All of the parameters will restore to default values of factory delivery when selected “Yes”.

CAUTION

Be careful if it is necessary to adjust parameters. Please manage to understand the meaning of the parameters before resetting the parameter.

The default values o f all the parameters can be used in most cases. There are only parameter 4 to parameter 4 in thyromat needed to be reset according to the real parameters of motors.

SECTION 4 : INSTALLATION

4.1. General Installation

The THYROMAT-10BCC is a complete bolt-on unit keeping the installation simple. The control unit is encapsulated in its own dust proof enclosure and is mounted to the thyristor stack. Similarly the thyristor stack is a bolt on unit and is also secured to the equipment (differences in the mounting arrangement of the thyristor stack depend on the model to be used). The electrical interface with the equipment is by means of terminal lugs and/or connector blocks.

Certain THYROMAT-10BCC variations have protective covers over the thyristor stacks. The cover serves as a protective screen to prevent damage to property and personal injury from accidental contact with the exposed live components of thyristor stacks. The connection of power stacks of small power ratting drives with external parts relies on bolts. The volume is small.

4.2. THYROMAT - 10BCC Digital Crane Controller Mechanical Installation

4.2.1. General

The THYROMAT-10BCC is a simple item to mount. THYROMAT-10BCC is provided with the correct fasteners to secure the unit on to the mounting surface. In the event that a repairable item is removed for repairs place the fasteners in safekeeping for future use. When replacing repaired units use the original fasteners, wherever necessary replace damaged or lost fasteners with physical equivalents.

4.2.2. Mounting Instructions

Before mounting the THYROMAT-10BCC, make sure that the mounting surface is of sufficient physical strength to carry the weight of the complete unit. The following paragraphs list the mounting instructions for the THYROMAT-10BCC, refer to figure 4-1 for mounting details:-

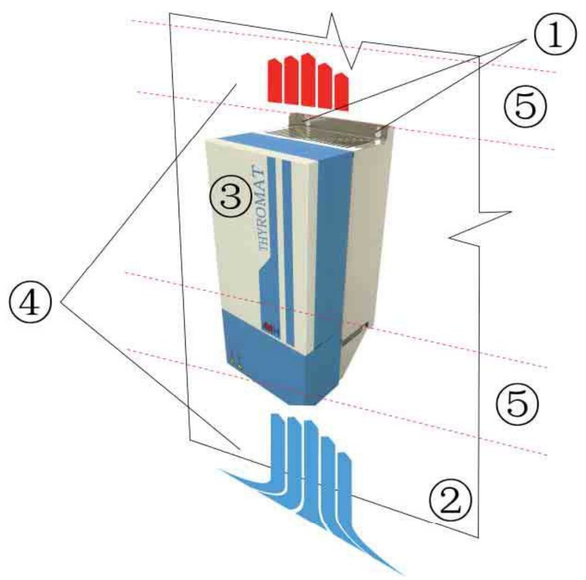


Figure 4-1 : Expanaton Diagram of Mounting The THYROMAT - 10BCC Crane Controller

1. Mount the THYROMAT-10BCC using the mounting holes provided by the thyristor stack . It is important to note that the mounting screws also provide the unit with an additional earth return, make sure that the unit's mountings are clean and that a good earth is established.
2. In order to minimise the vibration, which contributes to the mechanical wear in the THYROMAT it is suggested that the unit should be mounted close to the edge of the designated mounting panel.
3. The THYROMAT-10BCC must be mounted to a vertical surface with the cooling fins on the thyristor stack aligned in the vertical direction
4. A minimum space of 150 mm at the top and 150 mm at the bottom of the THYROMAT must be free of obstructions to allow for sufficient airflow to cool the unit.

4.2.3. Tools and Special Equipment

Table 4-1 lists the Tools and Special Equipment (Mechanical) needed to mount the THYROMAT-10BCC.

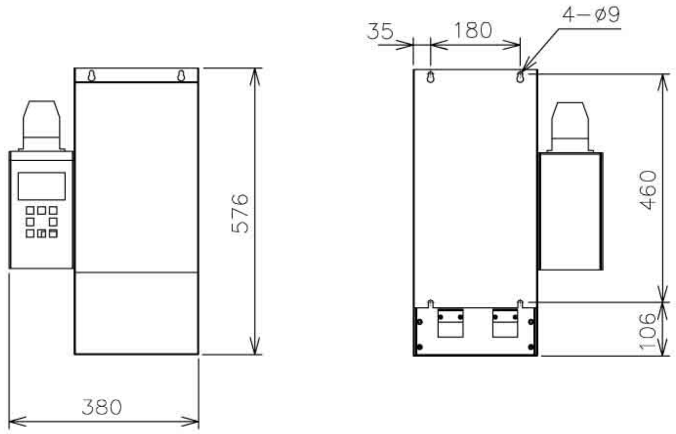
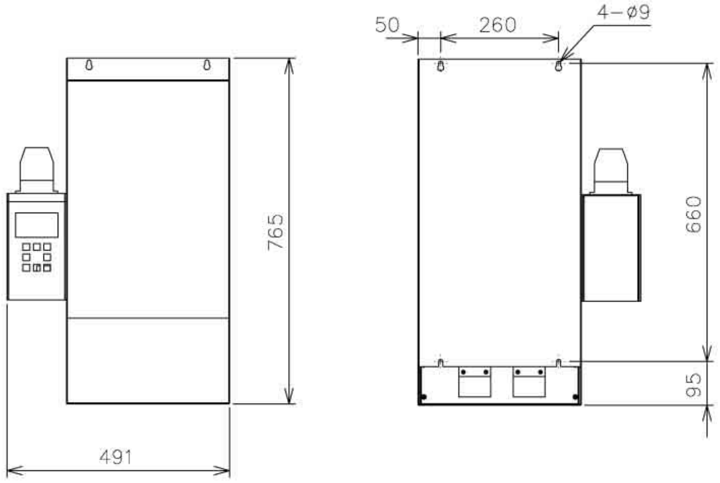
Table 4-1 : Tools and Special Equipment (Mechanical)

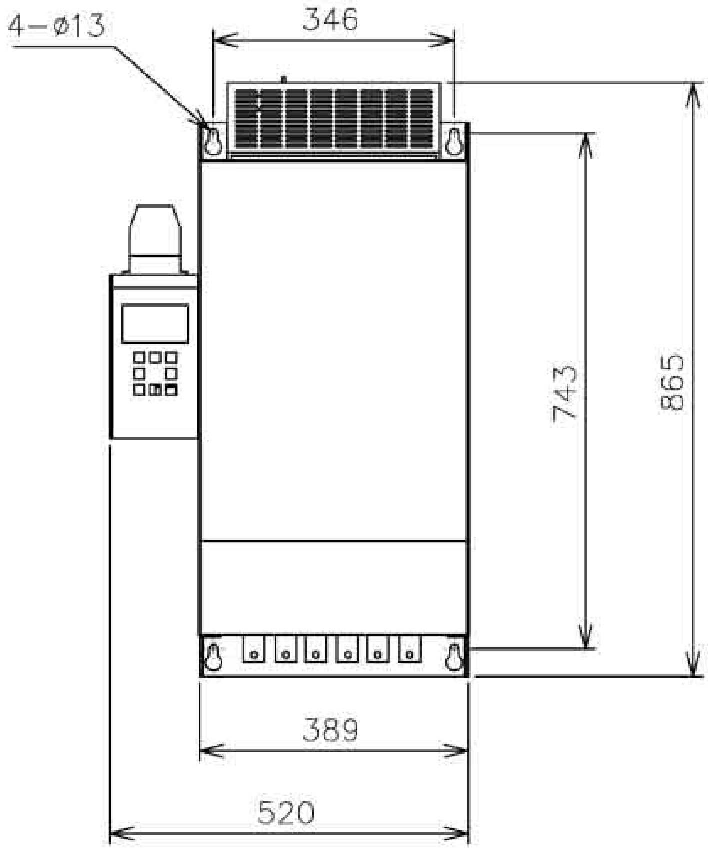
TOOLS / EQUIPMENT	THYROMAT - 10BCC Digital Crane Controller Mechanical Size				
	M150	M350	M500	M1000	M2000
Marking Pen	X	X	X	X	X
Ruler / tape measure	X	X	X	X	X
Spirit Level	X	X	X	X	X
Hammer	X	X	X	X	X
Centre Punch	X	X	X	X	X
Drilling Machine	X	X	X	X	X
Extension Lead	X	X	X	X	X
Screw Driver	X	X	X	X	X
8.5 mm Drill Bit	X	X	-	-	-
12.5 mm Drill Bit	-	-	X	X	X
13 mm Spanner	X	X	-	-	-
19 mm Spanner	-	-	X	X	X

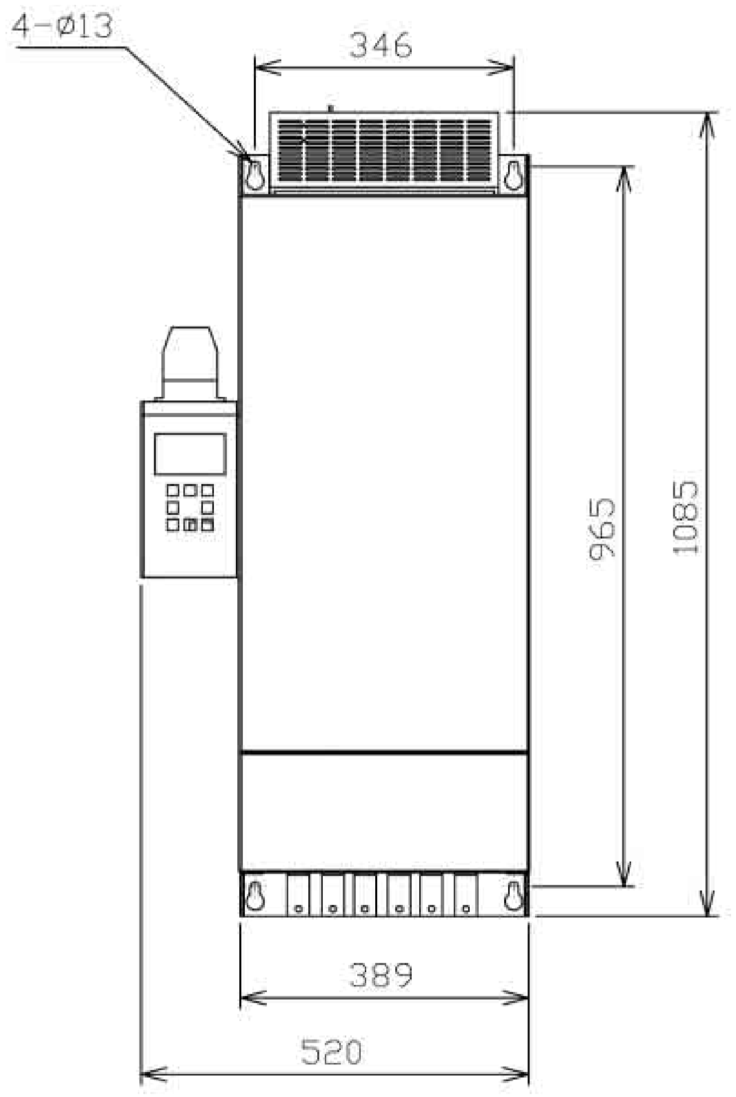
4.2.4 Mounting Arrangements

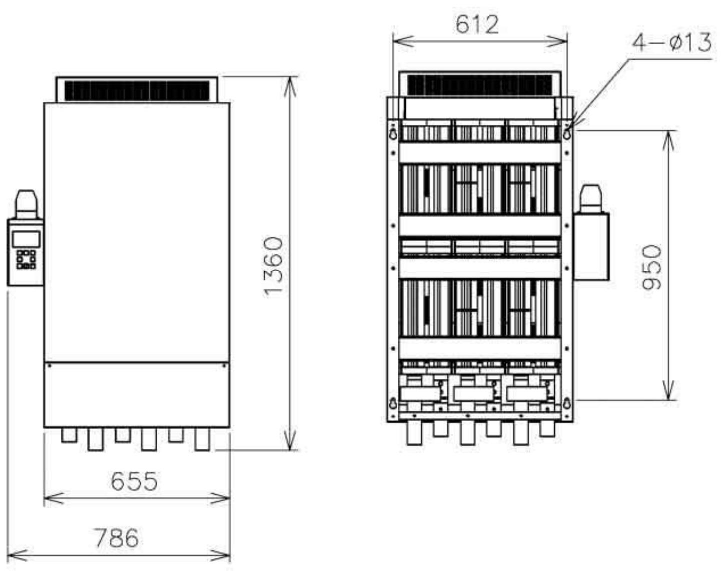
Table 4-2 lists the mechanical mounting arrangement for the various THYROMAT-10BCC controllers.

Table 4-2 : Mechanical Mounting Arrangements of THYROMAT – 10BCC Digital Crane Controllers

MECHANICAL SIZE	MOUNTING HOLE ARRANGEMENT (measurement in mm)
M150 **(25A~150A of THYROMAT-10BCC drives)**	
M350 **(200A~350A of THYROMAT-10BCC drives)**	

MECHANICAL SIZE	MOUNTING HOLE ARRANGEMENT (measurement in mm)
M400 **(400A of THYROMAT-10BCC drives)**	

MECHANICAL SIZE	MOUNTING HOLE ARRANGEMENT (measurement in mm)
M1000 (500A~1000A of THYROMAT-10BCC drives)	

MECHANICAL SIZE	MOUNTING HOLE ARRANGEMENT (measurement in mm)
M2000 **(1200A~2000A of THYROMAT-10BCC drives)**	

Note: 1. Refer to 2.2 of this manual for THYROMAT-10BCC production ratting series Models corresponding to M60, M150, M350, M400, M1000 and M2000.

2. Refer to Appendix 1 for Current converter mounting dimension.

3. Consult MH Company for the dimension of M2500 drive.

4.2.5. Mounting Procedure

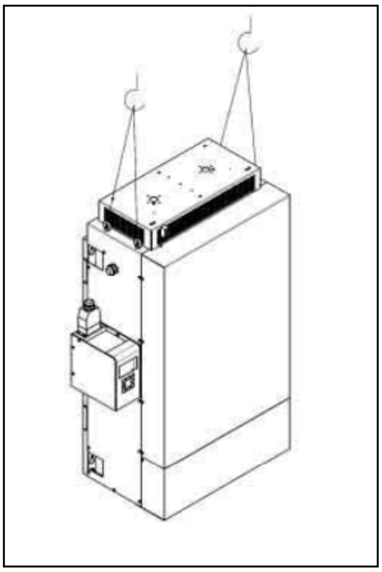
- Identify a suitable mounting position and surface.
- Clean the mounting surfaces and make sure that they are free of any oil or grease.
- Mark the mounting holes in accordance with the applicable instructions and dimensions identified in paragraphs 4.2.4. Use the spirit level to ensure that the unit will be mounted level.
- Using the hammer and centre punch, punch the applicable centres for the mounting holes.
- Using the electric drill and applicable drill bit, drill the mounting holes, take care not to damage any objects and / or equipment that may be mounted on the opposite side of the mounting surface.
- Make sure that the mounting surfaces around the holes are stripped of paint and free of any grease or oil so that a good earth can be obtained.
- With the aid of an assistant, lift the THYROMAT into position.
- Insert the fasteners provided and secure the THYROMAT to the mounting surface using the applicable tools. Where bolts are used to mount the THYROMAT, make sure that they are torqued down to the correct values (refer to table 4-3 Mounting Fastener Torque Values).

- Clean up the immediate area of all iron filings and / or metal shavings.
- Remove all tools and / or materials used in the mounting process.

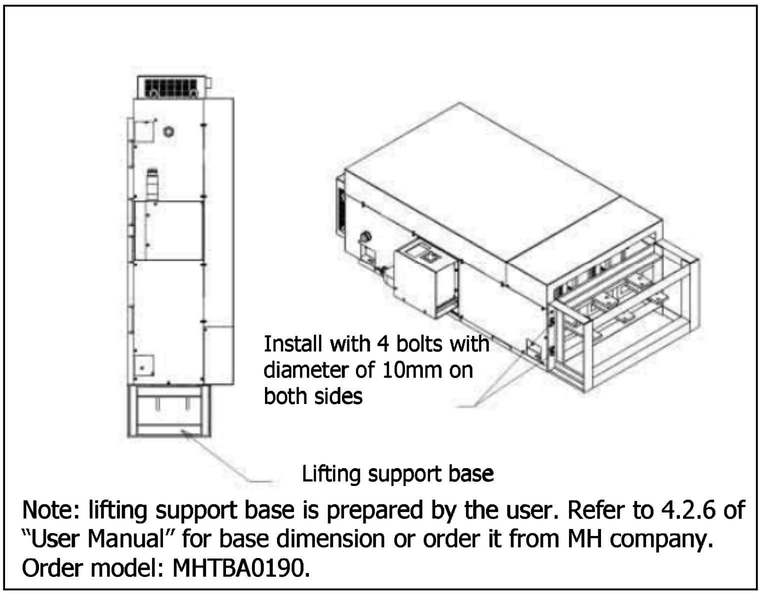
Table 4-3 Mounting Fastener Torque Values

MECHANICAL SIZE	SCREW 8 mm	BOLT 10 mm
M150	7 Nm	-
M350	-	15 Nm
M500	-	15 Nm
M1000	-	15 Nm
M2000	-	15 Nm

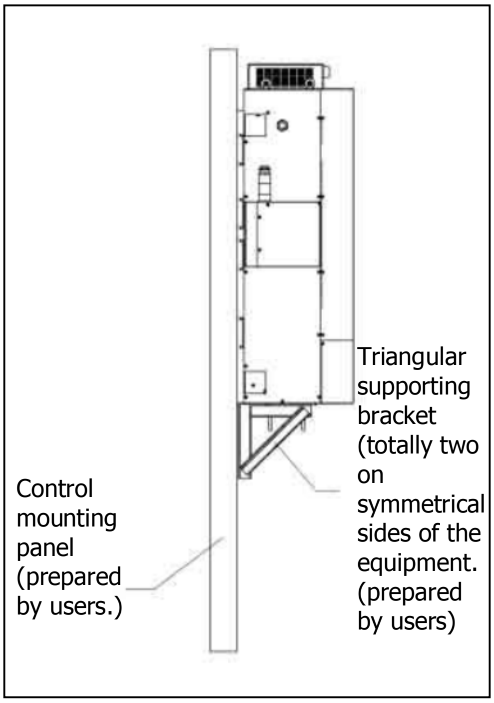
4.2.6. Lifting and Installation Schematic Diagram

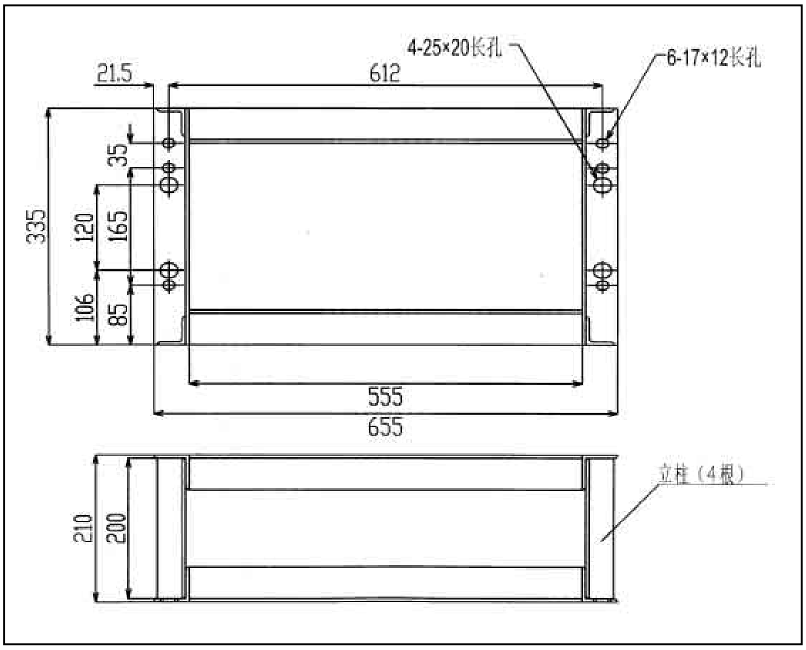


Lifting schematic diagram for M2000



Lifting support base for M2000





Installation schematic diagram for M2000 **Lifting support base (MHTBA0190) dimension**

4.3 Electrical Installation

4.3.1. General

WARNINGS

1. **Do not attempt to make any connections to the thyromat-10bcc while it is connected to the mains power (live).**
2. **After disconnecting the thyromat -10bcc from the mains power, use a multi-meter to make sure that all power has been removed.**
3. **Disconnect the motor cables before attempting to take any measurements on the motor cables.**
4. **Make sure that all the covers to the controller are secured in their correct positions before switching on the mains power.**

CAUTIONS

1. **Do not make any voltage withstand tests on any part of the thyromat – 10bcc digital crane controller.**
2. **Do not touch any of the components on the circuit boards, they are voltage sensitive and may be damaged / destroyed.**
3. **Make sure that there are no power factor correction capacitors connected to the motor power cable.**

NOTE

1. **Only a competent licensed Electrician or a suitably qualified person should be allowed to install the THYROMAT-10BCC.**
2. **It is important to shield the control electronics from any magnetic inductance that could be generated by large current carrying conductors.**

The THYROMAT-10BCC has simple fasteners for connecting electrical power. The connection points are clearly marked to aid installation.

4.3.2. Electrical Connection Instructions.

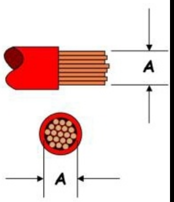
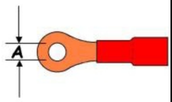
Before connecting the electrical cables to the THYROMAT-10BCC, make sure that the unit has been firmly secured to the mounting panel.

1. Check that the integrity of the earth between the THYROMAT-10BCC and mounting surface is good (the measured resistance should be 0 ohms). In the event that the earth does not conform, make sure that the THYROMAT-10BCC mountings to the mounting surface are stripped clean of paint and other contamination and if necessary install an earth strap.
2. Make sure that all the leads to the THYROMAT-10BCC unit have a fair amount of slack so that they do not assert unnecessary mechanical stresses to the electrical terminals .
3. When connecting the electrical cables to the THYROMAT-10BCC and thyristor stack, make sure that the correct connector lug sizes are used (refer to Table 4-4 Connector Lug Data).

   Where fasteners are used to connect the electrical lugs to the THYROMAT-10BCC, make sure that they are torqued down to the correct values (refer to Table 4-4 Connector Lug Data).

   The THYROMAT-10BCC must always have an earth connected to the earth terminal provided on the controller's terminal strip. The diameter of the earth wire is at least half of the power line.
4. Make sure that all the leads to the thyristor stack have a fair amount of slack so that they do not assert unnecessary mechanical stresses to the electrical terminals.

Table 4-4 : Connector / Lug Gauge and Sizes

Connector / Lug Detail		Current Rating	THYROMAT Mechanical Size				
			M150	M350	M500	M1000	M2000
WIRE SIZE IN mm^2		25 A 30 A 60 A	4 6 16	-	-	-	-
		100 A 150 A	25 35	-	-	-	-
		200 A 350 A	-	50 75	-	-	-
		400 A	-	-	120	-	-
		500 A 700 A 1 000 A	-	-	-	150 240 330	-
		1 200 A 1 500 A 2 000 A	-	-	-	-	480 600 960
LUG		25 A 30 A 60 A	4 x 6 6 x 6 16 x 6	-	-	-	-
		100 A 150 A	25 x 8 35 x 8	-	-	-	-
		200 A 350 A	-	70 x 8 95 x 10	-	-	-
		400 A	-	-	120 x 12	-	-
		500 A 700 A 1 000 A	-	-	-	150 x 12 240 x 12 or 120 x 12 2 cable/PH 150 x 12 2 cable/PH	-
		1 200 A 1 500 A 2 000 A	-	-	-	-	240 x 14 300 x 14 or 150 x 14 2 cable/PH 240 x 14 4 cable/PH
FASTENER TYPE		25 A 30 A 60 A	M 5 M 5 M 5 (screw)	-	-	-	- -
		100 A 150 A	M 6 M 6 (screw)	-	-	-	- -

		200 A 350 A	M 6 (screw) M 8 (bolt)	-	-	-	- -
		400 A	M 10 (bolt)	-	-	-	- -
		500 A 700 A 1 000 A	-	-	-	M 10 M 10 M 10 (bolt)	
		1 200 A 1 500 A 2 000 A	-	-	-	-	M 12 M 12 M 12 (bolt)
TORQUE VALUES IN Nm		25 A 30 A 60 A	-	-	-	-	-
		100 A 150 A	N/A	-	-	-	-
		200 A 350 A	-	N/A 5	-	-	-
		400 A	-	-	7	-	-
		500 A 700 A 1 000 A	-	-	-	7 7 7	-
		1 200 A 1 500 A 2 000 A	-	-	-	-	15 15 15
CURRENT DENSITY IN AMPERES PER mm^2		25 A 30 A 60 A	6,25 5 3,75	-	-	-	-
		100 A 150 A	4 4,28	-	-	-	-
		200 A 350 A	-	4 3,68	-	-	-
		400 A	-	-	3,33	-	-
		500 A 700 A 1 000 A	-	-	-	3,33 2,91 3,03	-
		1 200 A 1 500 A 2 000 A	-	-	-	-	2,5 2,5 2,1

4.3.3. Tools and Special Equipment.

Before connecting the electrical cables to the THYROMAT-10BCC, make sure that the unit has been firmly secured to the mounting panel. Table 4-5 lists the Tools and Special Equipment (Electrical) needed to connect the electrical functions of the THYROMAT-10BCC.

Table 4-5 : Tools and Special Equipment (Electrical) of THYROMAT-10BCC

TOOLS / EQUIPMENT	THYROMAT - 10BCC Digital Crane Controller Mechanical Size				
	M150	M350	M500	M1000	M2000
Multimeter	X	X	X	X	X
Insulation tester	X	X	X	X	X
Diagonal pliers	X	X	X	X	X
Wire stripper or knife	X	X	X	X	X
Lug crimping pliers	X	X	X	X	X
Screwdriver flat no. 1	X	X	X	X	X
Screwdriver flat no. 2	-	-	-	-	-
Phillips screwdriver no. 1	X	-	-	-	-
Phillips screwdriver no. 2	-	X	-	-	-
Torque wrench	-	-	-	X	X
13 mm Socket	-	X	-	-	-
17 mm Socket	-	-	X	X	X

CAUTION

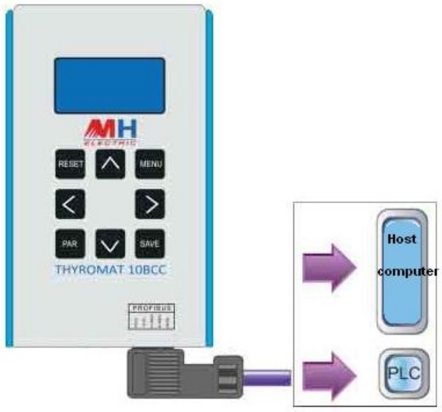
It is forbidden to test the insulation of thyristors with megohmmeters. Insulation check in Table 4-5 means to check the wire connection except the THYROMAT-10BCC drive system, besides, the wires must be disconnected with the drive.

4.4. Installation Diagrams

The following paragraph details the installation diagrams for the THYROMAT-10BCC for both hoist and travel applications.

4.4.1 PROFIBUS Communication Connection Mode

Thyromat-10BCC connection mode of the drive is very simple, you only need to insert a Siemens PROFIBUS bus connector(Such as 6ES7 972-0BA52-0XA0) Thyromat-10BCC drive display panel of the PROFIBUS interface, as the following figure.



4.4.2 Digital Inputs – On the Main Board

The connection and function of digital input of Terminal number 1 to 9 on the back of drives are shown in Figure 4-3-1 and Figure 4-3-2.

Where, there are two ways of connection shown in Figure 4-3-1 and Figure 4-3-2. Different connection has different parameter settings. Refer to 3.2.17 and 3.4.20.

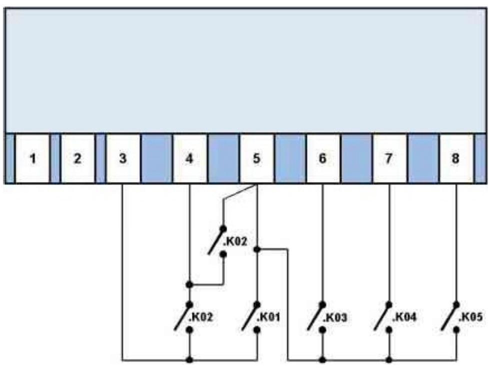


Figure 4-3-1 : Connection Pattern 1 of Digital Inputs for the Main Board

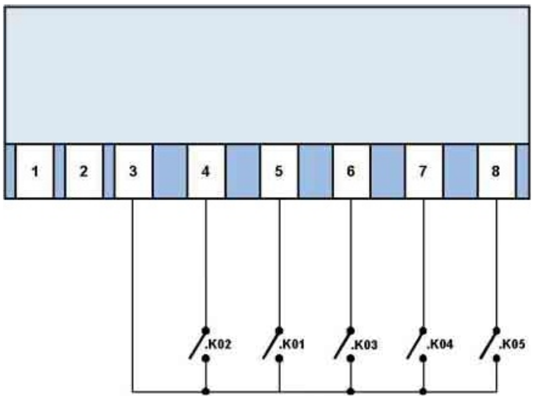


Figure 4-3-2 : Connection Pattern 2 of Digital Inputs for the Main Board

- **Hoist Applications.**

  .K01 - Hoisting command and fist speed step selection.

  .K02 - Lowering command and first speed step selection.

  .K03 - Second speed step selection.

  .K04 - Third speed step selection.

  .K05 - Final speed step selection.

- **Travel Applications.**

  .K01 - Forward command and first speed step selection.

  .K02 - Reverse command and first speed step selection.

  .K03 - Second speed step selection.

  .K04 - Third speed step selection.

  .K05 - Final speed step selection.

4.4.3. Relay Outputs – Connectors on the Mother Board

Figure 4-4 illustrates the installation diagram for the relay outputs from the connectors on the main board.

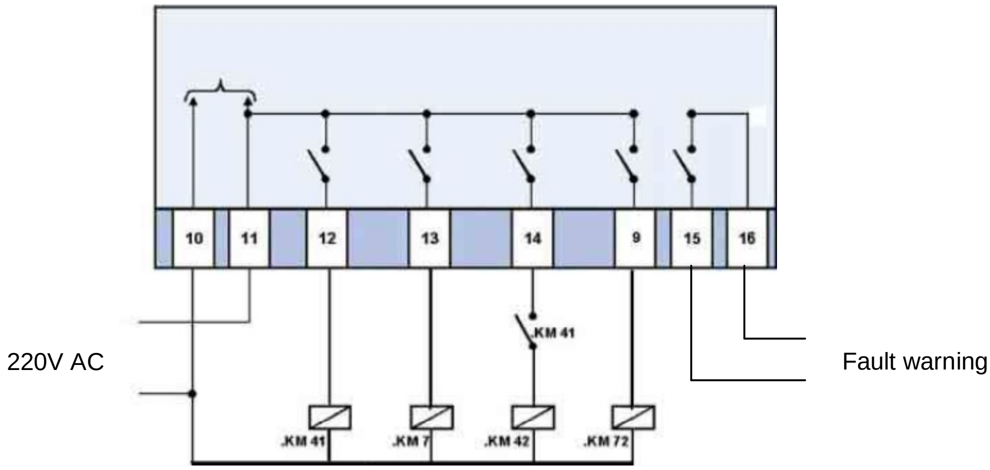


Figure 4-4 : Relay Outputs for the Connectors on the Main Board

Note: Consult MH Company for interlock control design of command and output connection in One Working and One Standby system of drive. Besides, let us be known whether PLC is used in command and monitoring system.

- **Hoist Applications.**

  .KM7 - Brake contactor.

  .KM72 - Brake contactor（used in Z brake control）.

  .KM41 - Intermediate or 1ST rotor contactor.

  .KM42 - Final or 2ND rotor contactor.

  Fault alarm: when the power supply and control power supply are given and the drive is in normal condition, this contact closes. Otherwise, it opens.

- **Travel Applications.**

  .KM7 - Brake contactor.

  .KM72 - Brake contactor（used in Z brake control）.

  .KM41 - Only required in special applications.

  .KM42 - Only required in special applications.

  Fault alarm: when the power supply and control power supply are given and the drive is in normal condition, this contact closes. Otherwise, it opens.

4.4.4. Rotor Frequency Feedback Input——Speed Detection

Enter THYROMAT-10BCC drive from any two phases of motor rotor on the main back panel terminals, 17th and 18th .

Note: In multi-motor systems, when these motors are loaded by single drive, the rotor feedback input should have selector switch with interlocking, so that you can easily select one rotor frequency feedback to the 17th and 18th terminals of the drive. That is , you can only select one motor rotor frequency feedback to Thyromat-10BCC drive.

When selecting the specifications of the selector interlocking switch, you should consider this factor that reverse baking voltage of motor rotor is twice times of the stalling voltage of motor rotor.

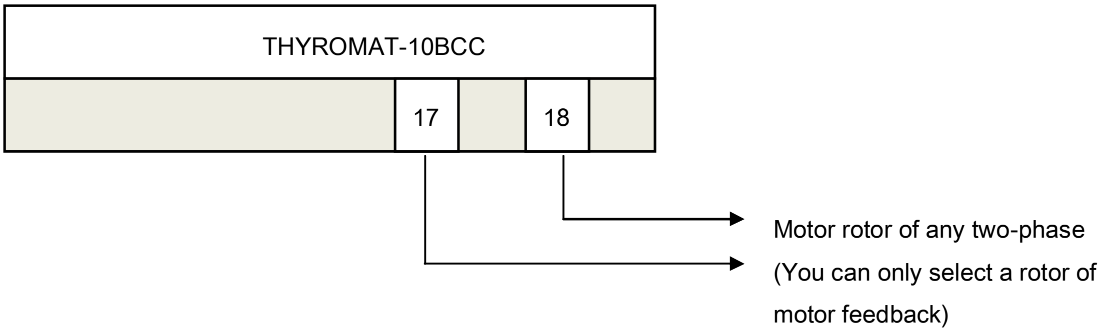


Figure 4-5 : Rotor frequency feedback input interface

If MH 525V THYROMAT drives are used, Voltage divider OA1900-01 or OA1901-01 must be in the shipment. Where, OA1900-01 is selected if rotor open voltage is equal to or higher than 750V. OA1901-01 is selected if rotor open voltage is equal to or higher than 500V. Their wire connection and installation dimension are the same and are shown in Appendix 3. Do not use voltage dividers when rotor open voltage is lower than 500V.

SECTION 5 : COMMISSIONING

5.1 General

Commissioning of the THYROMAT-10BCC is simplified by default parameters displayed on the control panel (e.g. the operating functions during the functional testing phase of the commissioning process). All of work to do when commissioning the equipment is to check the parameter values by comparing with that in the table and input motor parameters of corresponding driving application. If the control performance cannot be reached, modify a little bit correspondingly (by operating Control Panels) to optimize the system.

5.2 Preparation

WARNINGS

1.Thyromat-10bcc are high voltage components, accidental contact with thyristor stacks can result in fatal injuries.

2.Once connected to the mains supply, all internal components of the control unit (except isolated i/o terminals) are at mains potential.

3. When the thyristor stack is powered with ac three-phase power supply, the thyristors and their connected parts have high voltage (such as mov, resistors and capacitors mounted on thyristor-heat-sink.). Do not touch them.

4.Do not attempt to make any connections to the thyromat while it is connected to the mains power.

5.After disconnecting the mains power use a multi-meter to make sure that there is no supply voltage present.

6.Make sure that all the covers to the controller are secured in their correct positions before switching on the mains.

7. Wrong installation or connection may cause damage or property lost of thytomat-bcc drives.

5.3. Commissioning Procedures

The following paragraphs detail the sequence that the commissioning process must follow to ensure that the equipment is commissioned correctly:

Step 1

Ensure that all internal and external power and control connection are done according to schematic drawings.

Step 2

Ensure that all external circuits are clear from earth faults as well as possible short circuits, which may have occurred during installation. When testing cables and motors with an earth insulation meter ensure that the THYROMAT-10BCC drive is not connected to the equipment under test. Megger high voltage testers may cause permanent damage to the drive.

Step 3

Ensure that the rotor resistances are wired correctly, MH Company always provides the correct values of the resistance steps on the respective rotor schematic diagram. Follow these correctly to ensure that motor performance is correct from the start.

NOTE

Check that the rotor feedback wiring is connected to Pin 17 and Pin 18 of THYTOMAT drive.

Step 4

Verify that the Power supply and control supply are present at the panel and the THYROMAT unit installed is rated accordingly. This should be done before the Main c.b. and the control c.b.'s are turned ON.

Step 5

Turn the control c.b. ON first, go through the notches one by one, verify that the correct input interposing relays switch in the correct sequence.

Step 6

Test the end of course limit switches, ensuring that they will trip the correct input interposing relays. Test the final limit switch and emergency stop circuit to ensure that these drives will offer the maximum protection as far as interruption of the main supply to motors and brakes is concerned. This specific test is extremely important and it may not be neglected.

Step 7

Powering up of the THYROMAT-10BCC drive, after ensuring that there are no earth faults or short circuits, switch on the main power supply. The THYROMAT drive will display a power up page, which indicates the type of motion and the version group of its software program. In the event of this page remaining on the display, with periodic reset followed by the same displaying of this page, an Input supply phases has occurred, which does not allow the THYROMAT unit to carry further testing prior to the "Health Status" is given.

Possible causes of initial power-up Input phases failure:

- Wrong phase rotation: Turn the power OFF then correct phase rotation before turning the power ON once again
- The Incoming 3-phase supply is below acceptable values, (i.e. < 75% of its rated supply voltage)
- The Incoming 3-phase supply has a phase unbalance.

Step 8

Input the motor parameters as necessary. At this stage the only parameter which should be modified are the parameters which refer to the motor size and those are the following:

- Current Transformer ratio (Refer to Table 2-4)
- Motor current
- All other parameters should remain as per default values. Save the parameter changes before continuing with the tests.

Step 9

Perform Locked Rotor test (Open rotor circuit)

a) Ensure that there is no load on the crane hook

b) Turn main c.b. OFF

c) Open star-point from rotor resistance or open two rotor resistance phases from rotor circuit

d) Make sure that the brake contactor will not energize. This may be achieved by opening the brake contactor coil circuit at any point in that control circuit.

(Remove wire from terminal 13 on THYROMAT-10BCC)

e) Turn Main c.b. ON

f) Wait for THYROMAT drive Healthy Status to be displayed

g) Move the cabin joystick to Notch 1 Hoisting

h) Measure the stator and rotor voltages between phases at the motor terminals

i) Confirm that the Stator/Rotor voltage ratio falls within + 10% of name plate

NOTE

This test may only be performed for periods of approximately 10 seconds at the time since the THYROMAT drive will trip on motor stall, if it remains for longer periods in Notch 1.

Analyzing the results:

When the above mentioned voltage ratio falls within the recommended ± 10% deviation the test is considered successful, and the next test must now be performed. When such ratio is out the recommended deviation, one needs to verify why this is the case.

In the case of an upgraded installation it may be that the motor may have been rewound previously and its characteristics have changed slightly, if the deviation is too great, it may be possibly that the Rotor connections have been changed from Y to Δ or vice-versa. In this case the motor may not perform well under full load conditions and it may be necessary to replace it with a standby spare motor.

Under a great discrepancy on the rotor voltage, the rotor resistance which was calculated around the motor name plate values is going to be inadequate too and this needs to be taken in consideration as well.

Consult MH Company for advice in the event that the results are out of acceptable boundaries.

Step 10

Perform locked Rotor test (Closed rotor circuit) (this test should only be performed if the test mentioned in Step 8 is successful).

a) Repeat step by step all the instructions referred to in Step 9 (a) to (g).

h) Measure the stator voltages between phases. The supply voltage must remain within 90% of its rated value, preferably > 95%. Look out for any major phase imbalances.

i) Measure the stator currents per phase. These currents should be fairly balanced.

j) Measure the rotor voltages at the motor terminals between phases.

k) Measure all three rotor currents (at the motor terminals)

l) Assuming that there are no major unbalances in either rotor voltages or currents, take the average values of both and apply them to the formula below

Motor kW = Rotor volts x Rotor amps / 605 （Calculated value is almost the same with designed value.）

The resultant kW for a maximum stall voltage of 80% and a Rotor resistance of 0,36k should be approximately the same as the kW which the system has been designed for.

NOTE

This may not correspond to the rated name plate kW of the motor if the resistance was calculated based on the motion mechanical power. Usually the schematic diagrams will make reference to the exact motor kW which the system has been designed for.

Helpful Hint:

With the maximum stall voltage set at 80% of the supply:

As a general rule, under this test conditions the rotor voltage will drop by a factor close to 1,5 of its name plate value. The mechanical or electrical current (depending on the design) will increase by the same factor.

Major deviations from these general rules it may indicate problems which may require further investigation. It is not possible to elaborate on the causes of the problem due to an immense variety of causes which may influence the results obtained during the tests. It is hoped that site engineers find this problem according to their experience.

It would be advisable to get in contact with the Technical department at MH Company or any of their accredited representatives or agents for further assistance.

Step 11

After these tests are performed and assuming that both have had satisfactory results, the brake contactor coil should be reconnected as recommended and proceed with the next step.

Step 12

No load test: Run the motion in both directions notch by notch to ensure that the direction of rotation is correct and there are no other problems. In the case of Hoist motions the rotary limit switch top and bottom should now be tested.

The action of slow down and end of course limits should be test here in travel application of gantries and trolleys.

Step 13 (Hoist only)

Monitor the action of brake circuitries. When joystick is put to Neutral after any operation, brake contactor must work first. The motor is still powered for 500 to 1050 mS (set this value according to parameter, Stop Delay.) after brakes' working.

Step 14 (Hoist only)

Test under load conditions: Run the motion in both directions notch by notch. Specifically look out for the operation of the brake drum. During Hoisting operation, the brake drum must not turn in reverse (lowering direction), if this happens it may indicate one of the following:

- Load is greater than the safe working load (SWL) of the Hoist motion
- The supply is weak, and under load conditions it drops drastically
- The Rotor resistances are not correctly designed
- The motor is not performing as per manufacturers design, this may occur after several rewinds

The above mentioned problems may also be causing the motor not to accelerate to full speed under load conditions.

During lowering operations, the following aspects must be checked:

The motor maintains the required slow speeds. When accelerated to full speed and then returned to "neutral" position the deceleration to full stop should be achieved within reasonable time (i.e. approximately 3 sec). At stop, the brakes should apply when the motor is at standstill or just started turning in the opposite direction.

Failure of achieving the above may be caused by one or several of the reasons already described above for hoisting operation.

GENERAL NOTE

It is always good practice to record in some form all current readings during the above tests. These readings serve as a base for future comparisons, specifically after a motor or a section of the rotor resistance has been replaced for whatever reason.

Step 15

During hoisting test, measure the motor maximum switching currents from lower speed to full speed. The measured value should be less than 2.5 times of motor ratted stator current. Over large switching current or current sudden change may be caused by wrong connection of rotor resistors. Examine them carefully with schematic drawing.

5.4. Hoist Operation

The following paragraphs detail the operational procedures during hoisting operations;

5.4.1. Hoisting

As soon as one of the three lowering slow speeds on the master controller is selected, the THYROMAT-10BCC drive activates the forward direction thyristors and motor gets its power. The brake is released after the motor stator current reaches the set value of “Brake Release I”. The motor will accelerate at a rate determined by the acceleration profile. Selecting one of the three slow speeds will regulate the motor at the selected speed. Selecting full speed will accelerate the motor smoothly until full speed is reached. Accelerating rotor contactors will operate at specific speeds.

Bringing the master controller back from full speed to one of the slower speeds or to the zero position will cause the drive torque to be removed from the motor until such time that the selected speed is achieved. If the load is light and the deceleration ramp error sufficiently large the motor will be slowed down by plugging, if the Hoist plugging parameter is set to True, otherwise the brake will close immediately as the joystick returns to Neutral.

5.4.2. Lowering With an Overhauling Load

As soon as one of the three lowering slow speeds on the master controller is selected, the THYROMAT-10BCC drive activates the forward thyristors and motor gets its power. The brake is released after the motor stator current reaches the set value of “Brake Release I”. In an overhauling load operation, the forward direction thyristor remains activated, providing the motor the opportunity to apply counter-torque in order to maintain the lowering speed.

In a no-load condition the reverse direction thyristors may be energized to force lowering of the mechanism. When full speed lowering is requested the reverse direction thyristors close immediately, the voltage is ramped to full voltage.

Bringing the master controller back from full speed to one of the slower speeds will cause additional counter-torque to be applied until such time that the selected speed is achieved.

In the event that the master controller is brought back to the zero position, additional counter torque will be applied until the motor reaches zero speed and after a short time delay voltage to the motor is removed. Should counter-torque braking last for more than the time allowed by the lower plug time out parameter, the brake will be automatically applied, the voltage removed from the motor and a fault "Plugging time out" displayed on the drive.

5.4.3. Regeneration

Selecting full speed when lowering, the THYROMAT-10BCC will activate the reverse direction thyristor. The motor is then driven at full speed in the lowering direction. At this time, rotor speed is greater than that of magnetic field. The motor is in a state of generating electricity. The motor feeds electricity back to the power grid. Rotor contactors switch at specific speed.

5.4.4. Lowering With a Light Load (Plugging)

The lowering operation with light loads is slightly different from the other lowering operations. As soon as one of the three lowering slow speeds on the master controller is selected, the forward direction thyristors firstly conduct as well. The motor obtains electricity. The brake is released a short period later. Should the motor not move, THYROMAT-10BCC controls the conduction of the reverse direction thyristors and force motors' lowering.

If the load should become an overhauling load then the system will automatically revert to the counter torque mode.

This operating principle is selected for safety reasons as the forward direction thyristors are always activated first. The resultant effect ensures for fail-safe operation and the effective management of the motor and brake and allows for precision placing of material loads or cargo.

5.5. Travel Operations

The following paragraphs detail the operational procedures during travel operations tasks;

Travel in All Directions

As soon as one of the four direction speeds on the master controller is selected, the THYROMAT-10BCC will activate one of the travel directional thyristor that will supply power to the motor, a short delay in time is provided before the brake is released. Selection of one of the three slow speeds will regulate the motor to the associated speed, in the event that full speed is selected the motor will accelerate smoothly until full speed is achieved.

Bringing the master controller back from full speed to one of the slower speeds will cause the drive torque to be removed from the motor until such time that the selected speed is achieved. In the event that the master controller is brought back to the zero position braking torque will be applied to the motor until zero speed is reached.

If during slow speed regulation the crane begins to increase speed higher than the selected speed the reversing thyristor will be activated and counter torque applied until the crane's speed has reduced to the selected speed.

NOTE

When plugging among notches is cancelled, the motor reduces its speed to required speed.

When the joystick is placed into the opposite direction of the actual crane movement, brake plugging is always applied, it can not be disabled by a parameter setting.

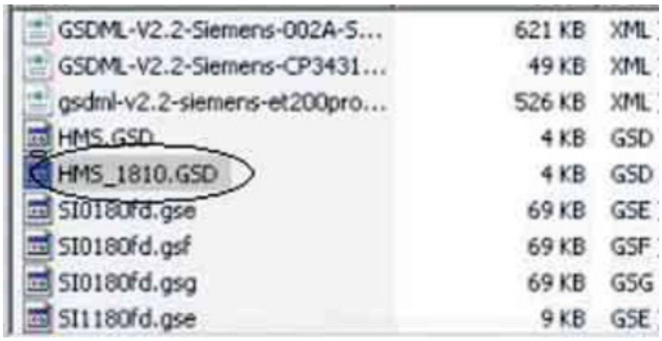
5.6. Setting Procedure of PROFIBUS Address

Step 1

THYROMAT-10BCC network communication drive address: Enter the THYROMAT-10BCC parameter sets the mode of the drive, at the second set of parameters "Node Address" enter the address you want to set, in this case, select Add 11.

Step 2

Hardware THYROMAT-10BCC drive on the DP bus configuration: THYROMAT first appliance GSD file "MHS_1810.GSD" copy to STEP7 in a S7DATA\GSD folder under the root directory. As shown in Figure 5-1.



Run the STEP7, entering "Hardware", click on the interface of "Option", select "Update Catalog", and then select interface option bar to the right of "PROFIBUS-DP", and then "Additional Field Drive", and then "General", and finally select "Anubus-IC DP-VO", drag it to the bus network, as shown in Figure 5-2.

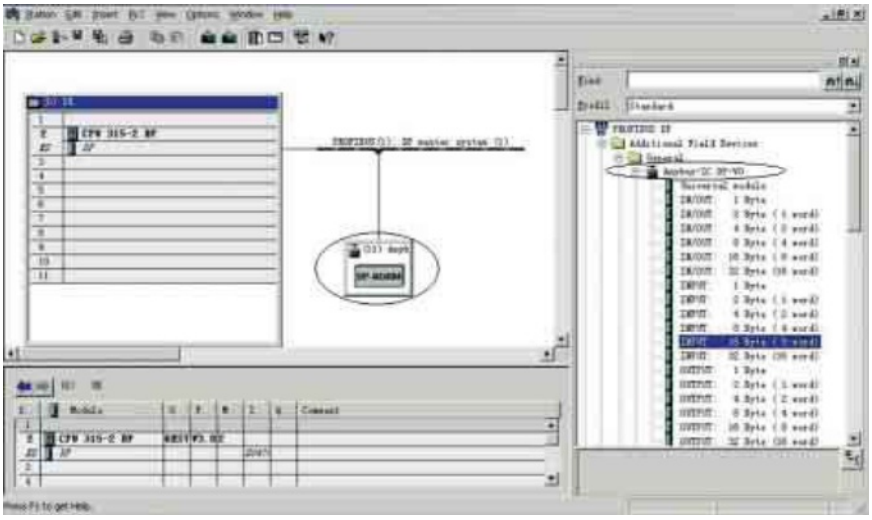


Figure 5-2 : THYROMAT-10BCC bus attached

In Anubus-IC DP-VO" drop-down menu, select "INPUT:16Byte (8 Word)" and add it to the THYROMAT-10BCC drive I/O slots, as shown in Figure 5-3. Note: assigned addresses are all of processing addresses.They can be read in PIW mode in the acquisition of its State. The reading address in this example are from PI272 to PI287. The selected DP address of THYROMAT drive should be the same with the setting in Control Panel. It is 11 in this example shown in the 5-4.

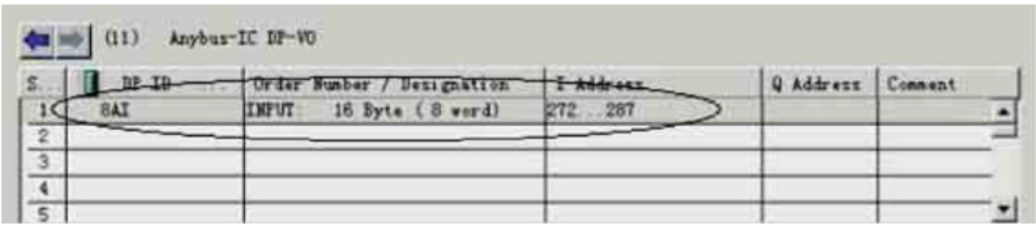


Figure 5-3 : THYROMAT-10BCC I/O distribution

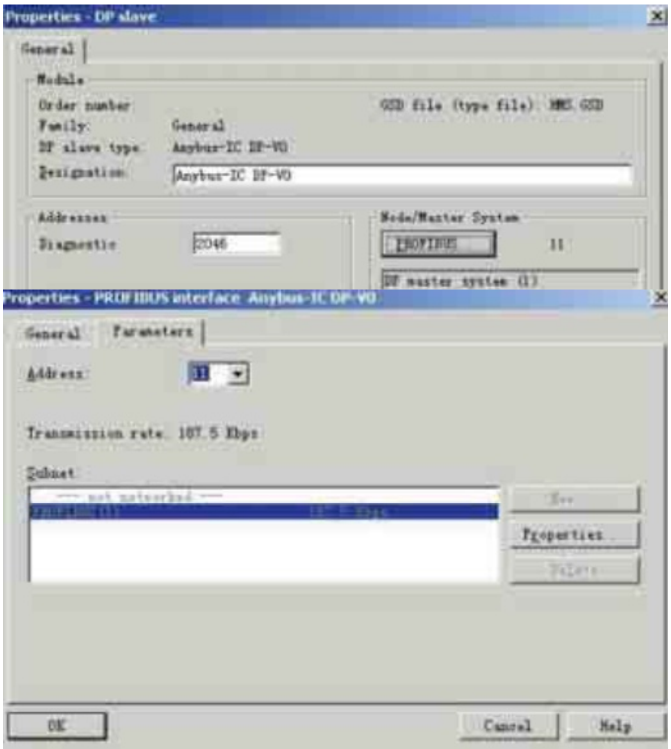


Figure 5-4 : Select DP address of THYROMAT-10BCC drive

Step 3

Connection to THYROMAT-10BCC drives: The communication connecting outlet of THYROMAT-10BCC drive in in Control Panel. Insert PROFIBUS-DP standard plug into the corresponding outlet shown in Figure 5-5.

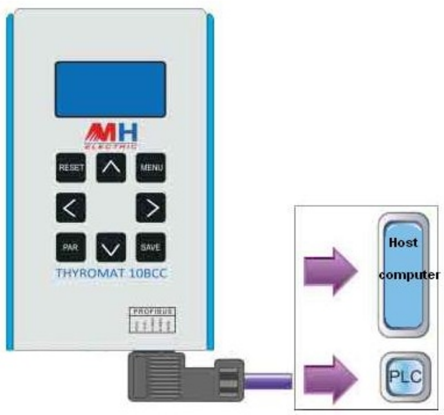


Figure 5-5 : DP on the THYROMAT-10BCC Panel jacks

Step 4

Collect data from THYROMAT drives.

After completing the hardware configuration and hardware connections, monitor the process data of HYROMAT drive. Taking hardware configuration in Figure 3 for example, monitor the following data in variable table of SIMATIC STEP 7 software: PIB272-PIB276, PIB283 (All of them are 6 bytes); PIW277-PIW281, PIW284, PIW286 (All of them are 5 bytes).

Fill the variable table with above data shown in Figure 5-6.

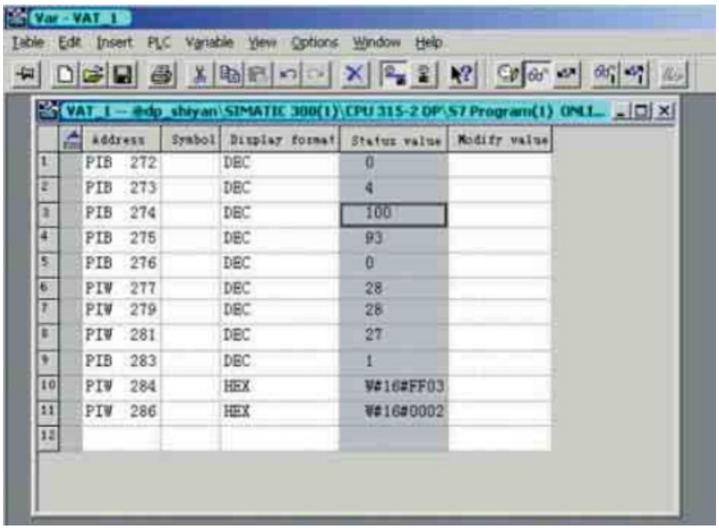


Figure 5-6 : PLC variable table for monitoring data

Start the drive. Monitor each datum in PLC variable table. Examine the correctness of PROFIBUS-DP communication.

5.7. PROFIBUS Communication Parameters Table and Descriptions

Table 5-1 is the process data of THYROMAT drives when THYROMAT-10BCC drives commutes with PROFIBUS-DP bus. You can read the required data from the following table.

Table 5-1

Position of Occupied bytes	Represented Meaning	Range of Values	Corresponding meaning	Unit
1*	Status code	0	Health	-
		Others	Refer to fault codes manual	
2**	Notch Selection	0	Neutral	
		1	Hoist Notch 1(Forward Notch 1)	

Position of Occupied bytes	Represented Meaning	Range of Values	Corresponding meaning	Unit
		2	Hoist Notch 2(Forward Notch 2)	
		3	Hoist Notch 3(Forward Notch 3)	
		4	Hoist Notch 4(Forward Notch 4)	
		5	Lower Notch 1(Reverse Notch 1)	
		6	Lower Notch 2(Reverse Notch 2)	
		7	Lower Notch 3(Reverse Notch 3)	
		8	Lower Notch 4(Reverse Notch 4)	
		9	J.Error (Joystick Error)	
3	Speed Feedback	0-255	Percentage of Speed Feedback	%
4	Phase Firing Voltage	0-255	Firing Voltage	0.1
5	Overload Information	0-100	Accumulated Overload Value	%
6. 7	CT1 Feedback Value	0-65535	CT1 feedback current	1
8. 9	CT2 Feedback Value	0-65535	CT2 feedback current	1
10, 11	CT3 Feedback Value	0-65535	CT3 feedback current	1
12	Information of Control Card	1	Hoist Control Card	-
		2	Travel Control Card	
		Others	Unrecognized error	
13, 14***	Controlled Version	0-9999	Controlled Version	-
15, 16	Displayed Version	0-9999	Displayed Version	-

*: When Status Code changes, Byte 1 will change correspondingly.
**: Byte 2 to Byte 11 will be uploaded periodically at least once a second.
***: Byte 13 to Byte 16 will be uploaded simultaneously when Control Card and Control Panel start.Byte 13 represents the higher byte of the controlled version and Byte 14 represents the lower byte of the controlled version. For example, Version is 00.01 of Control Card. Byte 15 is 00, and Byte 16 is 01. The displayed version is the same.

5.8. Fault Codes of THYROMAT-10BCC Drive

Table 5-2 Hoist Application

Code	Type of Fault	Code	Type of Fault
0	Healthy	1	ROTOR FDBK
2	CURNT UNBAL 1	3	CURNT UNBAL 2
4	CURNT UNBAL 3	5	CURNT LOSS 1
6	CURNT LOSS 2	7	CURNT LOSS 3
8	INPUT PHASES	9	CURNT FDBK
10	MOTOR STALL	11	STACK TEMP
12	H LOSS OF TORQUE	13	LOWER OVERSPEED
14	DRIVE LEVEL	15	POWER ON TEST
16	NOT IN NEUTRAL	17	BRAKE RELEASE
18	OVER CURNT	19	PLUGGING TIMEOUT
20	RFB&CURNT LOSS S	21	RFB&CURNT LOSS R
22	RFB&CURNT LOSS I	23	ROTOR FDBK 2
24	OVERLOAD TRIP	25	CURNT FDBK S
26	CURNT UNBAL 1S	27	CURNT UNBAL 2S
28	CURNT UNBAL 3S	29	CURNT LOSS 1S
30	CURNT LOSS 2S	31	CURNT LOSS 3S
32	CURNT FDBK Q1	33	CURNT FDBK Q2
34	CURNT FDBK Q3	35	CURNT FDBK Q4
36	CURNT UNBAL 1 Q1	37	CURNT UNBAL 1 Q2
38	CURNT UNBAL 1 Q3	39	CURNT UNBAL 1 Q4
40	CURNT UNBAL 2 Q1	41	CURNT UNBAL 2 Q2
42	CURNT UNBAL 2 Q3	43	CURNT UNBAL 2 Q4
44	CURNT UNBAL 3 Q1	45	CURNT UNBAL 3 Q2
46	CURNT UNBAL 3 Q3	47	CURNT UNBAL 3 Q4
48	CURNT LOSS 1 Q1	49	CURNT LOSS 1 Q2
50	CURNT LOSS 1 Q3	51	CURNT LOSS 1 Q4
52	CURNT LOSS 2 Q1	53	CURNT LOSS 2 Q2
54	CURNT LOSS 2 Q3	55	CURNT LOSS 2 Q4
56	CURNT LOSS 3 Q1	57	CURNT LOSS 3 Q2
58	CURNT LOSS 3 Q3	59	CURNT LOSS 3 Q4
60	ROTOR FDBK Q1	61	ROTOR FDBK Q2
62	ROTOR FDBK Q3	63	ROTOR FDBK Q4
64	ROTOR FDBK S	65	CURNT FDBK SP
66	ROTOR FDBK SP	67	CURNT FDBK SP2
68	ROTOR FDBK SP2		

Table 5-3 Travel Application (Control version number : CTC00.02)

Code	Type of Fault	Code	Type of Fault
0	Healthy	1	ROTOR FDBK
2	CURNT UNBAL 1	3	CURNT UNBAL 2
4	CURNT UNBAL 3	5	CURNT LOSS 1
6	CURNT LOSS 2	7	CURNT LOSS 3
8	INPUT PHASES	9	CURNT FDBK
10	MOTOR STALL	11	STACK TEMP
12	DRIVE LEVEL	13	POWER ON TEST
14	NOT IN NEUTRAL	15	RFB&CURNT LOSS R
16	OVER CURNT	17	ROTOR FDBK 2
18	RFB&CURNT LOSS S	19	CURNT FDBK 2
20	RFB&CURNT LOSS I	21	CURNT UNBAL 2S
22	OVERLOAD TRIP	23	CURNT LOSS 1S
24	CURNT UNBAL 1S	25	CURNT LOSS 3S
26	CURNT UNBAL 3S	27	CURNT FDBK Q2
28	CURNT LOSS 2S	29	CURNT FDBK Q4
30	CURNT FDBK Q1	31	CURNT UNBAL 1 Q2
32	CURNT FDBK Q3	33	CURNT UNBAL 1 Q4
34	CURNT UNBAL 1 Q1	35	CURNT UNBAL 2 Q2
36	CURNT UNBAL 1 Q3	37	CURNT UNBAL 2 Q4
38	CURNT UNBAL 2 Q1	39	CURNT UNBAL 3 Q2
40	CURNT UNBAL 2 Q3	41	CURNT UNBAL 3 Q4
42	CURNT UNBAL 3 Q1	43	CURNT LOSS 1 Q2
44	CURNT UNBAL 3 Q3	45	CURNT LOSS 1 Q4
46	CURNT LOSS 1 Q1	47	CURNT LOSS 2 Q2
48	CURNT LOSS 1 Q3	49	CURNT LOSS 2 Q4
50	CURNT LOSS 2 Q1	51	CURNT LOSS 3 Q2
52	CURNT LOSS 2 Q3	53	CURNT LOSS 3 Q4
54	CURNT LOSS 3 Q1	55	ROTOR FDBK Q2
56	CURNT LOSS 3 Q3	57	ROTOR FDBK Q4
58	ROTOR FDBK Q1	59	CURNT FDBK SP
60	ROTOR FDBK Q3	61	CURNT FDBK SP2
62	ROTOR FDBK S	63	ROTOR FDBK SP
64	ROTOR FDBK SP2	65	

SECTION 6 : OPERATION OF CONTROL PANEL

6.1. General

The control panel consists of a liquid crystal display (LCD) and an eight push-button keypad. Figure 6-1 illustrates the display and keypad making up the complete panel. The display has back lighting to aid the identification of the displayed data under darkened conditions. The back lighting can only be activated in the main menu page (after the power up cycle has completed). To activate (switch on) the back lighting press any key, the backlight will automatically go off 20 seconds later.

Figure 6-1 : Control Panel

The display has six main active menu display pages, each page has four lines. Table 6-1 lists the six active menu display pages with details of the four displayed lines.

Table 6-1 : Menu Display Pages

FUNCTION	LINE	DESCRIPTION	REMARKS
Display page after powering up	**1ST**	MH AUTOMATION	This page is displayed for 2 seconds after power up.
	2ND	THYROMAT-10BCC	
	3RD	Control	
	4TH	PANEL	
Default display page **STATUS MONITORING PAGE**	**1ST**	Neutral spd 000%	The THYROMAT-10BCC BD automatically displays this page after the power up delay time. MENU To toggle between this page and the MOTOR CURRENTS page press the MENU key:-
	2ND	Ref 3.8V 0%	
	3RD	Status standby	
	4TH	Healthy	
Second display page **MOTOR 3 PHASE CURRENTS MONITORING PAGE**	**1ST**	Neutral spd 000%	This page displays the current transformer inputs. Please note that the reference and speed functions are also displayed.
	2ND	Ref 3.8V 0%	
	3RD	CT1 CT2 CT3 (Current transformer input)	
	4TH	000 000 000 (Current transformer value in amperes)	
Page 3 displays status monitoring page.	**1ST**	Neutral Spd 000%	This page displays the stator thyristor energising status. Please note that the reference and speed functions are also displayed.
	2ND	Ref 3.8V 0%	
	3RD	Status Standby	
	4TH	For Word/Reverse	

Note for displayed words:

Neutral=Stop Position, Spd=Speed, Ref=Firing Voltage, Status=working Status, Healthy=No Problem.

6.2. Supplementary Display Pages "Scroll Menu"

To enter this menu, press the key marked “PAR”, the typical displayed page is illustrated in figure 6-2-1 for THYROMAT-10BCC drives.

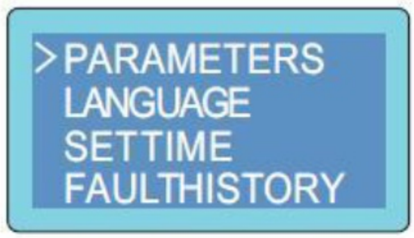


Figure 6-2-1 : Displayed Page of THYROMAT-10BCC drives

Scroll up or down using the “UP” and “DOW N” keys to select the desired function. Press “Save” to confirm the page.

6.2.1. Parameters

When setting the parameters, press “Save” when the cursor is on “PARAMETER” position to enter password menu shown in Figure 6-2-2. Enter password “1000” and press SAVE to exit.

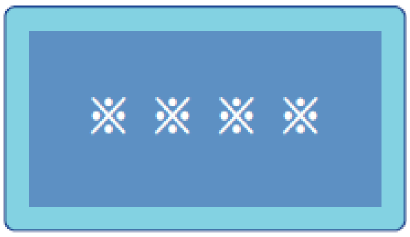


Figure 6-2-2 : Entering Parameter Password of THYROMAT-10BCC drives

Once this page has been accessed it can only be exited by pressing the “SAVE” key. When the “SAVE” key is pressed all information is saved (including any changes) and the display reverts back to the main display page.

6.2.2. Language Selection

The function on this page is for operators to select language.

When the cursor is at “language” option, press the SAVE key. After selecting, press SAVE to activate the selection and return to main page.

6.2.3. Set Time

This function allows the operator to view the current time and date, and also to set the time and date.

When the cursor is at Position 2, “SET TIME”, press “SAVE”, after modifying the time and date, press “SAVE” to activate the setting and the display reverts back to the main display page.

6.2.4. Fault History

This function only displays the recorded faults and the date and time that the each of the faults occurred.

When the cursor is at 4 “FAULT HISTORY”, press “Save”.

6.3. Key Pad Push Buttons

The keypad of the THYROMAT-10BCC Digital (Thyristor Switching) Crane Controller has eight push buttons; See Table 6-2.

Table 6-2 : Keypad Push Buttons

PUSH-BUTTON	IMAGE	FUNCTION
UP		Counts, or moves the cursor, UP and DOWN respectively, dependant on which screen is active.
DOWN		
LEFT		Pages the displayed screen, or moves the cursor LEFT and RIGHT respectively.
RIGHT		
RESET		Resets the status fault(s) on the display, assuming that the fault(s) have been rectified. Also clears the fault history when in FAULT HISTORY page.
MENU		Toggles the display between DRIVE STATUS page and CURRENT MONITORING page.
PAR		Brings up the SCROLL MENU Page.
SAVE		Shows SAVING on the display if the menu displayed was the PARAMETERS or SET TIME display. Brings up the selected Menu Page if in the SCROLL MENU Page. Returns back to the SCROLL MENU Page if the menu displayed was FAULT HISTORY or MAIN MENU.

6.4. Control Panel Operation

Navigating through the Display, by using the Keypad, is logical and structured as detailed in figure 6-3 Menu Navigation Chart below.

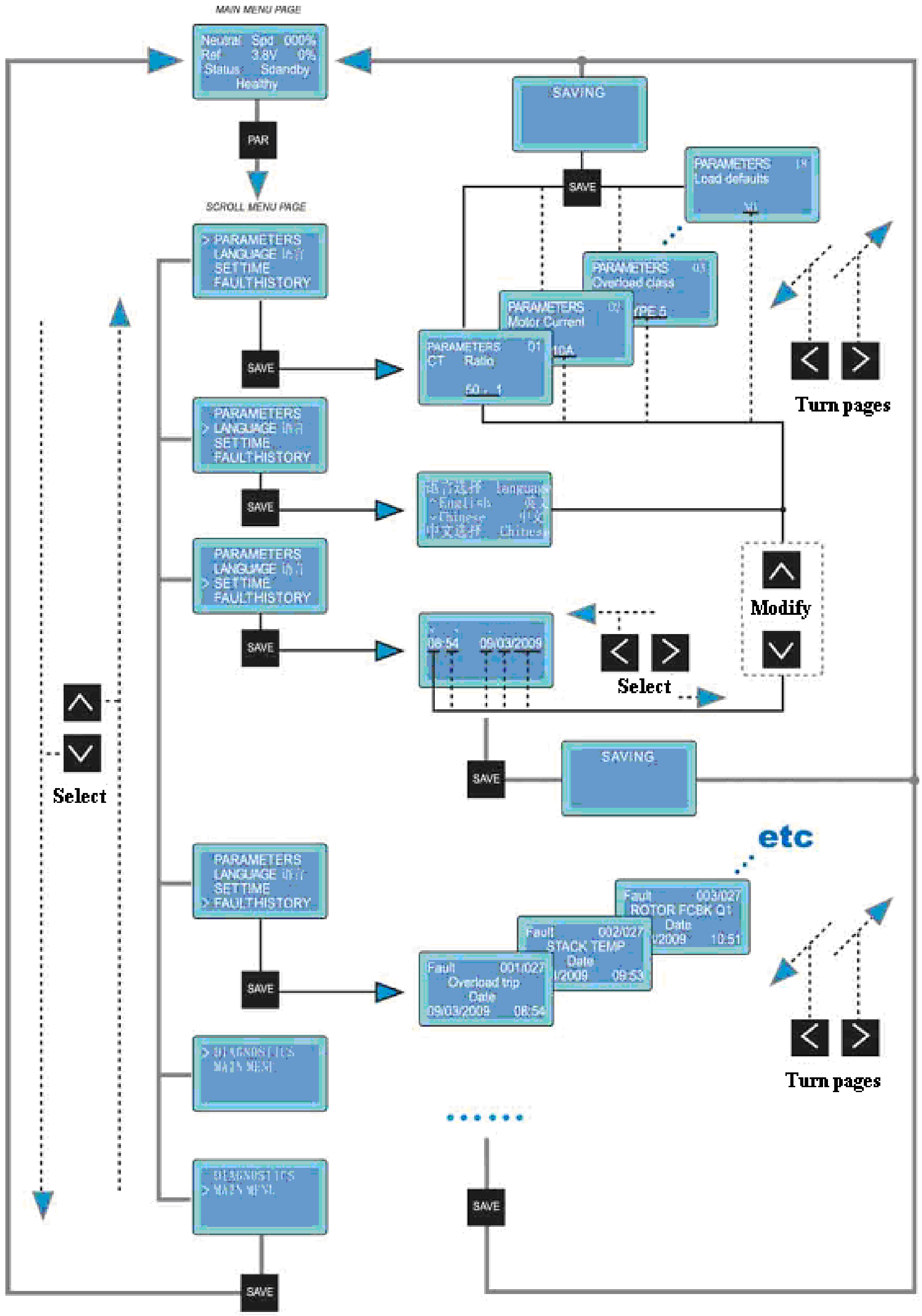
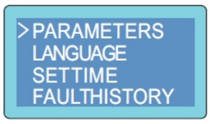
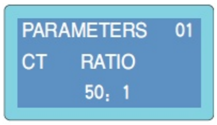
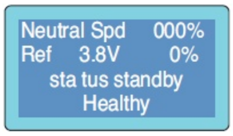


Figure 6-3 : Menu Navigation Chart

6.5. Parameter Lists Page

Table 6-3 : Parameters Page Navigation

STEP	ACTION	DISPLAY
1	Press the “PAR” key	
2	Enter the password	
3	Press “SAVE” key to enter the parameters list	
4	Scroll through the parameters with < and > keys	
5	To modify a parameter scroll ^ or $_v$ to the correct value, then use the < or > keys to move to the next parameter	
6	To save the changes made to the parameters list press the “SAVE” key; this will exit the parameters list and save the changes. The display will show “SAVING” for 2 seconds.	
7	After the saving process the display will then return to the main display page.	
8	**NOTE:** By pressing “RESET” key once can exit parameters without saving them	

6.6. Language Selection Page

Figure 6-4 : Language Selection Page

Press "∧" "∨" to select language

6.7 Set Time Page

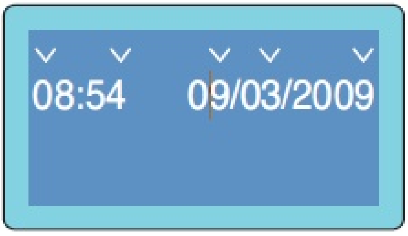


Figure 6-5 : Set Time Page

The SET TIME page displays the hour, minute, day, month and year. The cursor indicates the field which can be adjusted.

Table 6-4 lists the field name and the range.

Table 6-4 : Field and Range

FIELD	RANGE
Hour	00 to 24
Minute	00 to 59
Day	00 to 31
Month	01 to 12
Year	

6.8. Fault History

The THYROMAT-10BCC stores a maximum of 254 faults in the order they appear and can be viewed by scrolling through the fault history pages. The faults are listed in the order 01 (most recent fault) to 254(the oldest fault). As a fault occurs it automatically takes position 01 and pushes all the recorded faults up one level until the oldest fault is bumped off the fault history list.

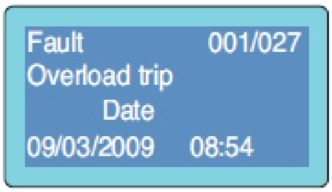


Figure 6-6 : Fault History Menu Page

The fault history data is displayed in four rows. The following details the displayed data:

- Row 1 - The system fault number
- Row 2 - The fault description:"Overload trip"
- Row 3 - The date title
- Row 4 - The date and time that that failure occurred.

Most of the faults can be reset via the master controller's neutral position (at the operator's position). To clear fault history press RESET then SAVE keys in this order and all the fault history will be cleared.

Table 6-5 lists the fault number, description, whether it can be re-set, what is been measured and possible causes.

6.9. Analysis Of Fault Causes

Note: "√" means applicable.

Table 6-5 : Hoist and Travel Faults

FAULT	FAULT DESCRIPTION	HOIST	TRAVEL	REFER TO
ROTOR FDBK S	Motor rotor frequency (speed) signal is lost before the brakes were released	√		6.10.1 (a)
Rotor FDBK Q1	Motor rotor frequency (speed) signal is lost during hoisting after the brakes are released.	√		6.10.1 (b)
	Motor rotor frequency (speed) signal is lost during Forward travelling after the brakes are released.		√	6.11.1 (b)
Rotor FDBK Q2	Motor rotor frequency (speed) signal is lost during hoisting after the brakes are released.	√		6.10.1 (c)
	Motor rotor frequency (speed) signal is lost before the brakes were released		√	6.11.1 (c)

FAULT	FAULT DESCRIPTION	HOIST	TRAVEL	REFER TO
Rotor FDBK Q3	Motor rotor frequency (speed) signal is lost during lowering after the brakes are released.	√		6.10.1 (d)
	Motor rotor frequency (speed) signal is lost during reverse travelling after the brakes are released.		√	6.11.1 (d)
Rotor FDBK Q4	Motor rotor frequency (speed) signal is lost during lowering, plugging and braking with low speed after the brakes are released.	√		6.10.1 (e)
	Motor rotor frequency (speed) signal is lost during plugging travelling after the brakes are released.		√	6.11.1 (e)
CURNT FDBK S	Current feedback is lost (all 3 phases) before the brakes were released	√		6.10.2 (a)
CURNT FDBK Q1	Current feedback is lost during Hoisting after releasing of the brakes.	√		6.10.2 (b)
	Current feedback is lost during forward travelling after releasing of the brakes.		√ applicable when C.T.s = YES	6.11.2 (b)
CURNT FDBK Q2	Current feedback is lost during hoisting after releasing of the brakes.	√		6.10.2 (c)
	Current feedback is lost during forward travelling after releasing of the brakes.		√ applicable when C.T.s = YES	6.11.2 (c)
CURNT FDBK Q3	Current feedback is lost during lowering after releasing of the brakes.	√		6.10.2 (d)
	Current feedback is lost during reverse travelling after releasing of the brakes.		√ applicable when C.T.s = YES	6.11.2 (d)
CURNT FDBK Q4	Current feedback is lost during lowering, plugging and braking with low speed after the brakes are released.	√		6.10.2 (e)
	Motor rotor frequency (speed) signal is lost during lowering after the brakes are released.		√ applicable when C.T.s = YES	6.11.2 (e)
CURNT LOSS 1 S CURNT LOSS 2 S CURNT LOSS 3 S	Phase current is lost before the brakes are released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.	√		6.10.3 (a)
CURNT LOSS 1 Q1 CURNT LOSS 2 Q1 CURNT LOSS 3 Q1	Phase current is lost during hoisting after the brakes are released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively..	√		6.10.3 (b)
	Phase current is lost during forward travelling after he brakes are released.		√ applicable when C.T.s = YES	6.11.3 (b)

FAULT	FAULT DESCRIPTION	HOIST	TRAVEL	REFER TO
CURNT LOSS 1 Q2 CURNT LOSS 2 Q2 CURNT LOSS 3 Q2	Phase current is lost during hoisting after the brakes are released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.	√		6.10.3 (c)
	Phase current is lost during forward travelling after the brakes are released.		√ applicable when C.T.s = YES	6.11.3 (c)
CURNT LOSS 1 Q3 CURNT LOSS 2 Q3 CURNT LOSS 3 Q3	Phase current is lost during lowerng after the brakes are released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.	√		6.10.3 (d)
	Phase current is lost during reverse plugging travelling after the brakes are released.		√ applicable when C.T.s = YES	6.11.3 (d)
CURNT LOSS 1 Q4 CURNT LOSS 2 Q4 CURNT LOSS 3 Q4	Phase current is lost during lowering, plugging and braking with low speed after the brakes are released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.	√		6.10.3 (e)
	Phase current is lost during reverse plugging travelling after the brakes are released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.		√ applicable when C.T.s = YES	6.11.3 (e)
CURNT UNBAL 1 S CURNT UNBAL 2 S CURNT UNBAL 3 S	The difference between the maximum instantaneous phase current and lowest phase current is larger than 50% before the brakes were released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.	√		6.10.4 (a)
CURNT UNBAL 1 Q1 CURNT UNBAL 2 Q1 CURNT UNBAL 3 Q1	The difference between the maximum instantaneous phase current and lowest phase current is larger than 50% during hoisting before the brakes were released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.	√		6.10.4 (b)
	The difference between the maximum instantaneous phase current and lowest phase current is larger than 50% during hoisting before the brakes were released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.		This fault is monitored when C.T.s = YES	6.11.4 (b)
CURNT UNBAL 1 Q2 CURNT UNBAL 2 Q2 CURNT UNBAL 3 Q2	The difference between the maximum instantaneous phase current and lowest phase current is larger than 50% during hoisting before the brakes were released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.	√		6.10.4 (c)
	The difference between the maximum instantaneous phase current and lowest phase current is larger than 50% during forward travelling before the brakes were released.		This fault is monitored when C.T.s = YES	6.11.4 (c)

FAULT	FAULT DESCRIPTION	HOIST	TRAVEL	REFER TO
	Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.			
CURNT UNBAL 1 Q3 CURNT UNBAL 2 Q3 CURNT UNBAL 3 Q3	The difference between the maximum instantaneous phase current and lowest phase current is larger than 50% during lowering before the brakes were released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.	√		6.10.4 (d)
	The difference between the maximum instantaneous phase current and lowest phase current is larger than 50% during reverse travelling before the brakes were released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.		This fault is monitored when C.T.s = YES	6.11.4 (d)
CURNT UNBAL 1 Q4 CURNT UNBAL 2 Q4 CURNT UNBAL 3 Q4	The difference between the maximum instantaneous phase current and lowest phase current is larger than 50% during lowering, plugging with low speed before the brakes were released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.	√		6.10.4 (e)
	The difference between the maximum instantaneous phase current and lowest phase current is larger than 50% during reverse travelling and plugging before the brakes were released. Number 1, 2 and 3 are Input Phase Number 1, 2 and 3 of current transformers respectively.		This fault is monitored when C.T.s = YES	6.11.4 (e)
CURNT UNBAL 1 CURNT UNBAL 2 CURNT UNBAL 3				
RFB & CURNT LOSS S	Rotor feedback and all 3 phase currents are lost simultaneously at the instantaneous moment just before the brakes were released	√		6.10.5 (a)
RFB & CURNT LOSS I	Rotor feedback and all 3 phase currents are lost simultaneously during crane application.	√	This fault is monitored when C.T.s = YES	6.10.5 (b)
RFB & CURNT LOSS R	Rotor feedback and all 3 phase currents are lost simultaneously during crane application. However, the loss of frequency (speed) feedback is detected earlier than that of all 3 phase currents	√	This fault is monitored when C.T.s = YES	6.10.5 (c)
OVERCURRENT	One motor stator current (any phase of the 3 ones) is 4 times greater than the ratted value for longer than 1.5 seconds.	√	√ only when C.T.'s = TRUE	6.10.6
OVERLOAD TRIP	The working motor current surpasses the ratted current according to I2t and Grade 5 and Grade 10 curves.	√	√	6.10.7
NOT IN NEUTRAL	The joystick is not in Neutral position when power	√	√	6.10.8

FAULT	FAULT DESCRIPTION	HOIST	TRAVEL	REFER TO
(Not logged in fault history)	up.			
J ERROR (Not logged in fault history)	The direction command signals are lost when joystick is at Notch 2, 3 or 4. The two direction relays work at the same time(when Sep.dir.signals=Yes)	√	√	6.10.9
MOTOR STALL	The motor remains standstill after the command of powering up the motor for longer than 10 seconds.	√	√	6.10.10
STACK TEMP	Thyristor stack is over temperature. The Thermal switch mounted on the stack is in the OPEN state	√	√	6.10.11
H LOSS TORQUE	The motor lost its torque when hoisting. Motor speed drop larger than 10% when hoisting.	√		6.10.12
LOWER OVERSPEED	The motor speed is higher than during 130% when lowering and plugging.	√		6.10.13
PLUGGING TIME OUT	Plugging time exceeds PLUGGING TIME OUT when the joystick is put to Neutral position during lowering	√		6.10.14
INPUT PHASES	This fault may be cause by one or more of the follows: 3 Phase supply <70% of ratted supply. Phase loss - Phase rotation error.	√	√	6.10.15
BRAKE RELEASE	At least one of the phase currents is below the BRAKE RELEASE CURRENT when building up the motor torque.	√		6.10.16
DRIVE LEVEL	The minimum Phase Shifter Voltage reference determined by the Control Card is below 3,5V. The standard level is 3,8V	√	√	6.10.17
POWER ON TEST	The System goes through a complex test of the software and associated switchgear which in the event of failure The Power on Test is displayed. Usually this fault precedes another fault, which is displayed in the form of a Code number as described below.	√	√	6.10.18
CODE 100	The CPU received joystick information which is out of acceptable boundaries	√	√	6.10.19 (a)
CODE 101	CPU Watchdog reset	√	√	6.10.19 (b)
CODE 102	CPU supply voltage below the Brown out level	√	√	6.10.19 (c)

FAULT	FAULT DESCRIPTION	HOIST	TRAVEL	REFER TO
CODE 103	CPU internal loss of messages	√	√	6.10.19 (d)
CODE 104	CPU failed to read saved parameters or does not recognise the combination of parameters stored in the EEprom.			6.10.19 (e)
CODE 106	CPU – System fault. An instruction taken from the EVENT queue has no meaning within the MOTOR MODULE and it can not be processed.	√	√	6.10.19 (f)
CODE 107	This fault code was created to assist during software development phase, to trap the unnecessary logging of "CURRENT FEEDBACK" trips	√	√	6.10.19 (g)
CODE 108	This fault code was created to assist during software development phase, to trap the instruction to accidental switching of both directional contactors	√	√	6.10.19 (h)
CODE 109	The fault code was created to assist during software development phase, to trap the instruction to accidentally turn off both directional contactors when one should have been switched ON.	√	√	6.10.19 (i)
HEALTHY	The logging of a "Healthy: fault, indicates that the system has tripped, but the CPU missed the reading of the Error fault stamp and the Healthy status was instead logged.	√	√	6.10.19 (j)

6.10. Possible Causes of Failure on Hoist Application

The aim of this chapter is to assist the user in getting to the cause of the fault as quick as possible, although great effort has been put into describing as many causes of faults as possible. It is almost impossible to cover every single aspect of the entire crane installation without running the risk of creating a guide, which then looks more like a technical book. The desired speed required repairing or correcting the fault would then be lost in the extensive reading and searching for the exact fault definition.

It is always far more productive for the user to become more familiar with the THYROMAT-10BCC-10BCC basic methods of motor control. It is possible to acquire the information from this manual as well as from specific THYROMAT-10BCC-10BCC courses offered at our head office as well as at certain support centres.

The following paragraphs list some possible causes of failures and the effects it may have on the operating system.

6.10.1 Loss of Rotor Feedback

Rotor feedback is used by the THYROMAT-10BCC as the motor loop speed feedback and it is essential to the operation of the unit. In the event that this feedback is not present the unit has to trip to prevent it from falling into an unknown state.

The rotor feedback is tapped off of two of the three motor rotor phases. The unit reads the rotor frequency, which is inversely proportional to the rotor rotational speed, (i.e. directly proportional to the motor slip)

Rotor frequency = Stator frequency x motor slip.

At standstill the rotor frequency is equal to the supply frequency, which is 50 Hz, as the motor starts accelerating towards its full speed the rotor frequency decreases towards 0 Hz.

In counter torque the rotor frequency increases from 50 Hz at standstill towards 100 Hz at 100% speed, note that in counter torque the motor field rotation is opposite to the actual rotor speed rotation. Therefore, the output rotor frequency is larger than that of supply power (motor slip >1).

Possible causes

- Motor stator is not powered up.

  When the power supply of the stator of motor is abnormal, the rotor of the motor also fails to induct voltage. Therefore, faults are reported as well.
- Loose connection of Rotor feedback wires

  There are loose wire connections from the rotor of motor to Pin 17 and Pin 18..
- Rotor feedback cable is short-circuited

  Both of feedback wires are short-circuited.

Remove wires from terminals 17 and 18 and measure the resistance between them. It should have a low ohm reading. This is because of the still in circuit motor windings resistance as well as the corresponding rotor resistors on each phase.

With the wires removed measure at the THYROMAT-10BCC-10BCC terminals 17 and 18, this reading should be very high (Mega-ohms) it should actually start increasing during the reading time. This is due to an internal capacitor in parallel across these terminals.

If the indication of the above tests shows good external connection, we suggest that the cable and drive should be connected and the following test should be carried out.

Measure the voltage between Pin 17 and Pin 18 while motor is working.

If there is a voltage it means that the external circuitry is sending the rotor feedback signals, however, the THYROMAT-10BCC drive did not receive them. Replace the Control Card. Write the same parameter to the card and start the system. If the fault still exists, the problem may be related to the mother board of control box. We suggest that the THYROMAT-10BCC drive should be replaced and sent to our nearest repair centre.

6.10.1(a) ROTOR FDBK S

The fault occurs during the checking of motor torque before the signal of releasing brakes is given. Refer to 6.10.1 (f) for fault causes.

6.10.1(b) ROTOR FDBK Q1

The fault occurs during Notch 1, Notch 2 and Notch 3 of hoisting application.
Note: Rotor feedback fault is not detected during full speed operation, because the Rotor frequency is close to 0Hz.
Refer to 6.10.1 (f) for fault causes.

6.10.1(c) ROTOR FDBK Q2

The fault occurs when the system was hoist plugging.
Refer to 6.10.1 (f) for fault causes.

6.10.1(d) ROTOR FDBK Q3

The fault occurs during Notch 1, Notch 2 and Notch 3 of lowering Application (with empty load).
Refer to 6.10.1 (f) for fault causes.
Note: Rotor feedback fault is not detected during full speed operation, because the Rotor frequency is close to 0Hz..

6.10.1(e) ROTOR FDBK Q4

The fault occurs when the system was lower plugging.
Refer to 6.10.1 (f) for fault causes.

6.10.1(f) <u>Possible Causes of Rotor Feedback Loss</u>

(i) The connection between the cable with Pin 17 and Pin 18 of THYROMAT drives and motor rotor resistors is loose.

Measure the resistance between Pin 17 and Pin 18. The value should be less than 5 ohms.

Warning: In some cases the multimeter reading is too small. It might wrongly be considered that there is short circuit. Refer to (iv)

(ii) The Short-circuit of Rotor Feedback cable.

In order to make sure that the phenomenon of short circuit is not caused by low resistance readings (i.e. close to 0Ω), disconnect the cable connected to rotor resistors. The measured resistance of the circuitry should belong to megohm. The resistance will increase during the measuring (because of capacitor between terminals).
If the reading remains close or at 0Ω, then the wires are short-circuited.
Replace the Control Card If the reading is infinite when the wires are still connected to Pin 17 and Pin 18, because there is internal damage in the Control Card.

(iii) Fault of Hoist Control Card

The cause of the problem may be that there is a fault in the control card.
After confirming that the problem is not due to any of the above reasons, we suggested that the control card be replaced.

Make sure that the replaced new Control Card is set with original parameters. If the fault still exists, the problem may be caused by the following reasons:

(iv) The Firing Fault of Thyristors

Measure the voltage between Pin 17 and Pin 18 of THYROMAT drive when a command from hoist Notch 1 to Notch 4 is given. Because there is a 2 second delay for fault system to report the fault in a new cycle process, the reading of any signals must be finished within this period. If there is a voltage signal read in this period, the firing circuitry of thyristors is in the working status. The working status of the firing circuitry can further be confirmed by measuring the three-phase output voltage of THYROMAT drive. The reading of measurement should be done quickly. We suggest that the Phase Shift Card should be replaced if it is confirmed that the firing circuitry works abnormally.

If the measured values of three phase output are normal and the problem still exists, the problem is probably related with the mother board of Control Box. The drive should be replaced in this case.

6.10.2 Current Feedback Loss (All 3 phases)

Hoist applications require monitoring of all 3 motor stator currents, for the efficient and safe operation of the system, if the Drive can not read any motor currents, it will trip on a current feedback fault as described below:

6.10.2(a) CURNT FDBK S

The fault has occurred during the Torque proving phase, before the brakes were given the command to be released.
Refer to 6.10.2 (f) for fault causes.

6.10.2(b) CURNT FDBK Q1

The fault occurred during Hoisting operation of Notch 1, Notch 2 or Notch 3.
Refer to 6.10.2 (f) for fault causes.

6.10.2(c) CURNT FDBK Q2

The fault occurred during Hoisting plugging of the application.
Refer to 6.10.2 (f) for fault causes.

6.10.2(d) CURNT FDBK Q3

The fault occurred during lowering operations of Notch 1, Notch 2 or Notch 3. (Empty hook notches1, 2 or 3 or during full speed lowering).
Refer to 6.10.2 (f) for fault causes.

6.10.2(e) CURNT FDBK Q4

The fault occurred during Lowering plugging or slow speed lowering with an overhauling load.
Refer to 6.10.2 (f) for fault causes.

6.10.2(f) Possible Causes of Current Feedback Loss

General information on Current feedback circuit:

The current feedback circuit in the Control Card gets its 3 phase readings from 3 Current Transformers (C.T.s) installed on the Stator phases.
The signal coming out of the CTs is and AC signal <5V AC (<1 Amp).

This AC signal is then fed into the "Current converter" which converts the AC signal into a DC signal also <5V DC.

The 3 DC voltage signals are transmitted into the hoist control card of the THYROMAT-10BCC drive.

The entire processing of the 3 phase current measurement is done in the Hoist Control Card.

Possible Causes of Current feedback faults

General: It is assumed that the user has an available **Current Clamp** (Analogue or Digital) to assist with fault finding procedure.

- Initial steps

.1 - Press the "MENU" key on the Control Panel to change to the CTs Page.

.2 - Line 3 of the LCD display will show CT1; CT2; CT3.

.3 - Line 4 of the LCD display will show 0 Amps on all 3 phases.

.4 - Engage Hoist Notch 1, if the fault still exists the thyristor will remain energised for a period of 2 seconds before the "CURNT FDBK S" fault is displayed. It is during this time that the Current readings of the Current Clamp are compared with the Current readings of the Display:

.5 - If The Current clamp shows 0 Amps, obviously the display will also show 0 Amps.

Did the Forward thyristors energise? It can be confirmed by measuring three-phase output voltage of THYROMAT-10BCC drive.

- No: then the fault may be caused by:
  - a) - Ensure whether all 5 groups of thyristors are normal.
  - b) - Ensure whether thyristor firing models are normal. Replace the Phase Shifter card.
  - c) - Whether the Connections between control unit and stacks is normal?
  - d) - Whether the mother board is normal? Replace the mother board.
  - e) - Ensure whether all 5 groups of thyristors are open.

- Yes: then the fault may be caused by:
  - a) - The stator cable of the motor has open circuit fault.
  - b) – The stator windings of the motor has open circuit fault.

6 - If the clamp current meter shows reading and the forward directional thyristor is energised, but the display shows 0 Amps. The problem may exists in current checking circuit.

- Ensure whether the CT is correct.

While giving a Hoist Notch 1 to 4 command to the Unit measure the AC voltage out of the CTs (one at a time), these must be a voltage <5V AC at any CT, and they should be similar.
It is unlikely that all 3 CTs are faulty simultaneously.

When giving a Hoist Notch 1 to 4 command to the unit, the THYROMAT-10BCC will trip on CURNT FDBK S after 2 seconds, so this test needs to be done several times to cover all 3 phases.

- Make sure whether the connection between the control unit and stacks normal.
- Make sure whether the current converting is normal.

If CTs are normal, that means the current converter is faulty and the current converter needs replacement. Replace by in turns:

a) Replace the hoist control card.

b) Replace the control box.

6.10.3 Single Phase Current Loss

Hoist applications require monitoring of all 3 motors stator currents, for the efficient and safe operation of the system. If the drive reads one CT current at 0 Amps while the others are >0 Amps, it will trip on Current loss.

6.10.3 (a)CURNT LOSS 1 S (loss of phase 1 current)
CURNT LOSS 2 S (loss of phase 2 current)
CURNT LOSS 3 S (loss of phase 3 current)

The fault has occurred during the Torque proving phase, before the brakes were given the command to be released.
Refer to 6.10.3 (f) for fault reasons.

6.10.3 (b) CURNT LOSS 1 Q1 (loss of phase 1 current)
CURNT LOSS 2 Q1 (loss of phase 2 current)
CURNT LOSS 3 Q1 (loss of phase 3 current)

The fault occurred during Hoisting operation of Notch 1, Notch 2 and Notch 3.
Refer to 6.10.3 (f) for fault reasons.

6.10.3 (c) CURNT LOSS 1 Q2 (loss of phase 1 current)
CURNT LOSS 2 Q2 (loss of phase 2 current)
CURNT LOSS 3 Q2 (loss of phase 3 current)

The fault occurred during Hoisting plugging.
Refer to 6.10.3 (f) for fault reasons.

6.10.3 (d) CURNT LOSS 1 Q3 (loss of phase 1 current)
CURNT LOSS 2 Q3 (loss of phase 2 current)
CURNT LOSS 3 Q3 (loss of phase 3 current)

The fault occurred during Lowering plugging operations (Drive down mode) of Notch 1, Notch 2 and Notch 3. (Lowering with empty hook.)
Refer to 6.10.3 (f) for fault reasons.

6.10.3 (e) CURNT LOSS 1 Q4 (loss of phase 1 current)
CURNT LOSS 2 Q4 (loss of phase 2 current)
CURNT LOSS 3 Q4 (loss of phase 3 current)

The fault occurred during Lowering plugging or slow speed lowering with an overhauling load, (i.e. counter torque lowering)
Refer to 6.10.3 (f) for fault reasons.

6.10.3 (f) Possible Causes of Current Loss 1, 2 or 3

General: It is suggested that the user reads the previous chapter 6.10.2 (f), to familiarise themselves more with current feedback readings.

- Current loss means that all 3 phases CT readings = 0 Amps

Phase current loss means that, at least one CT reading = 0 Amps while at least another CT reading > 0 Amps.

6.10.4 Current Unbalance

General: A current unbalance is only detected when at least on Phase current is <50% of the highest reading current, provided that the highest current is at least 50% of the Motor Current, the condition is validated for a period of 2 seconds at start before the brakes have been released or 800ms during operation.

6.10.4 (a)CURNT UNBAL 1 S
CURNT UNBAL 2 S
CURNT UNBAL 3 S

The fault has occurred during the Torque proving phase, before the brakes were given the command to be released.
Refer to 6.10.4 (f) for fault reasons.

6.10.4 (b)CURNT UNBAL 1 Q1
CURNT UNBAL 2 Q1
CURNT UNBAL 3 Q1

The fault occurred during Hoisting operation.
Refer to 6.10.4 (g) for fault reasons.

6.10.4 (c)CURNT UNBAL 1 Q2
CURNT UNBAL 2 Q2
CURNT UNBAL 3 Q3

The fault occurred during Hoisting plugging.
Refer to 6.10.4 (g) for fault reasons.

6.10.4 (d)CURNT UNBAL 1 Q3
CURNT UNBAL 2 Q3
CURNT UNBAL 3 Q3

The fault occurred during Lowering plugging operations (Drive down mode) of Notch 1, Notch 2 and Notch 3. (Lowering with empty hook.)
Refer to 6.10.4 (g) for fault reasons.

6.10.4 (e)CURNT UNBAL 1 Q4
CURNT UNBAL 2 Q4
CURNT UNBAL 3 Q4

The fault occurred during Lowering plugging or slow speed lowering with an overhauling load, (i.e. counter torque lowering)
Refer to 6.10.4 (g) for fault reasons.

6.10.4 (f)CURNT UNBAL 1
CURNT UNBAL 2
CURNT UNBAL 3

Refer to 6.10.4 (g) for fault reasons. Turn off the power and restart the drive for restoring when this fault occurs.

6.10.4(g) Possible Causes of Current Unbalance

- Mains supply, phase unbalance

  This may be caused by a sudden drop on one phase of the Mains supply, usually such a condition is very serious and unlikely to affect The Crane only.
  This condition is more likely to cause an "Input phases" fault.

- Faulty Thyristor

  One Thyristor is only conducting on the positive or the negative cycle, causing the current to drop by 50% on the corresponding phase.

- Faulty motor Stator windings

- Faulty motor Rotor windings or Slipring brushes.

- Faulty Rotor resistor circuit.

  Either one phase is completely open circuit or in the event of the Rotor resistors being made up of resistor banks in parallel per phase, one of the parallel connections is faulty.

  This is usually easy to identify by disconnecting the resistors from the Rotor windings (two phases at least) and compare the resistance value between phases.

- A Locked Rotor Test (LRT) may be able to identify the problem quickly, refer to LRT procedure elsewhere in this manual.

6.10.5 Rotor Feedback and Current Feedback Loss

General: This fault is detected when the simultaneous loss of Rotor frequency and Stator current feedback.
The loss of both feedback signals, indicates that the motor stator is not being powered by the 3 phases via the THYROMAT-10BCC.

The possible causes are:

-The forward and reverse thyristors did not conduct.

-The Phase Shifter Card is not triggering the 3 phase Thyristor stack.

- Check the voltage output between Uo, Vo and Wo immediately after a Hoist or Lower command.

  If there is no sign of voltage regulation (i.e. 0V), replace the Phase Shifter card(make sure whether thyristors are normal, especially whether the firing signals are normal.).

- Replace the hoist control card with set parameters if it did not send firing signals to stator thyristors.

-The Motor Stator cable is faulty and in open circuit.

- Measure the resistance across the 3 stator phases at the Panel stator output terminals, the reading should be a low ohm reading. Confirm that the fault is on the cable and not on the motor stator windings by bridging the motor stator terminals while measuring the continuity once again. Ensure that the wire bridges are removed after the test.

-The Motor Stator windings are faulty and in open circuit.

- If the cable test above proved successful, then the faulty open circuit may be inside the motor.
  Measure the continuity of the stator windings at the motor terminals

The RBF & CURNT LOSS will be displayed with a suffix S; I or R.

Suffix S: Indicates that the fault occurred during Torque proving, before the brakes were released. Note: This is only applicable to Hoist motions.

Suffix I: Indicates that, the fault was caused by all 3 phase currents being at 0 Amps and during the timing out of the validation period the Rotor feedback also became 0Hz.

Suffix R: Indicates that, the fault was caused by the Rotor feedback being at 0Hz and during the timing out of the validation period all 3 phase currents also became 0 Amps.

6.10.6 Over Current

An Over current trip is detected and logged if the Current measured on any one of the 3 phases is at least 400% higher than the Motor Current parameter value.

This fault is validated for a period of 1.5 seconds before a trip is logged.

GENERAL NOTE

The over current fault of THYROMAT-10BCC drive is the secondary protection of the drive. The primary protection is fast fuses on the main circuit. MH company strongly suggest that you use fast fuses.

6.10.7 Overload Trip

The motor full load current is exceeded for extensive periods of time above the limit determined by the I^2 Class 5 or Class 10 terminal curves.

Possible causes

- Crane has been overloaded.

- Excessive long periods of slow speed operation.
- Unusual mechanical friction caused by failure of mechanical components such as the brakes not releasing, faulty bearings, travel wheel flanges running against the rails and seized guide rollers or rope sheaves etc.

The thermal capacity is displayed in a form that when the display shows 100% it means that the thermal capacity has been reached or exceeded.

After an overload trip it is advisable to allow the thermal capacity to recover to normal to enable a fair amount of motor cooling to occur.

This facility was designed to protect the motor against current overloads that can cause high thermal stresses.. It does not take the actual motor temperature into consideration at any time, or the failure of the motor cooling fan. It is therefore recommended to install PTC probes whenever possible and the associated relay for efficient temperature monitoring of the motor.

6.10.8 Not in Neutral

Not in neutral is a condition that can only be detected during powering up of the THYROMAT-10BCC unit.

The fault will remain displayed for as long as the joystick is out of Neutral position, it automatically resets itself when the joystick is returned to Neutral.

The fault is only for indication purposes and will not be logged on Fault history log page.
I5 and I6 of the fault output points do not send fault signals as well.

6.10.9 Joystick Error

The joystick error message will appear on the top left hand side corner of the display when the THYROMAT-10BCC acknowledges the switching on of any speed notches without the presence of a directional notch, (i.e. notch 2; 3 or 4 are present without Hoist/Lowering notch 1)
When Sep. Dir Signals are set to Yes, the two direction relays are energised simultaneously. Command fault information appears on the top left corner of the screen.

- Check that the coils of the direction and speed relays work normally.
  if not, the command faults are probably caused by the joystick controller or the associated control cable.

  If the coils work well, measure the voltage of the terminals of the THYROMAT-10BCC drive:

When Sep. Dir Signals=no:

- When hoist commands are given, measure whether the voltage between Pin 3 and Pin 5 is zero (DC 9 to 10V when open circuit.).
- When lowering commands are given, measure whether the voltage between Pin 3 and Pin 4, and the voltage between Pin 3 and Pin 5 is zero (DC 9 to 10V when open circuit.).

When Sep.Dir Signals=yes:

- When hoist commands are given, measure whether the voltage between Pin 3 and Pin 5 is zero (DC 9 to 10V when open circuit.).
- When lowering commands are given, measure whether the voltage between Pin 3 and Pin 4, and the voltage between Pin 3 and Pin 5 is zero (DC 9 to 10V when open circuit.).

If all of the measurement is normal, the fault may be caused by the Control Card, replace it with a new Control Card with set parameters.

This fault is not recorded in the "historic fault logging", Pin 15 and Pin 16 of the fault output points do not send this faulty signal.

6.10.10 Motor Stall

The definition of Motor stall as far as a THYROMAT-10BCC unit is concerned is that, after a valid RUN command (Hoist/Lowering or Forward/Reverse, any speed) the motor remained at standstill for a period greater that 10 sec, after the brakes were given the command to be released.

Possible causes of motor stall trips:

- The Brake contactors didn't energised.
  Check the Brake contactor circuit.

  Confirm that between THYROMAT-10BCC terminals10 & 9 and 10 & 13 there is control voltage, when the THYROMAT-10BCC is supposed to be running (i.e. One directional contactor energised).

  If there is still not normal voltage, replace the hoist Control Card.
  If the voltage is normal, please check the brake circuit. Measure the voltage between the ends of brake contactor coil. If the voltage between the ends of brake contactor coil is normal and the brake contactor does not close its contact, the fault is probably the brake contactor coil fault or mechanical fault of the brake contactor.

Other possible causes are:

- Brake thrustor or the power cable associated with it, is faulty.
- Faulty mechanical gear train
- It is possible that due to an excessive hook load or a Mains volt drop with a heavy suspended load the motor is unable to develop sufficient torque to lift the load and remains stationery with a load suspected during the attempt to Lift.
- In the case of Travels, it is common to find that a joint of rail suddenly became wide and the Travelling Wheels got stuck in the gap.

6.10.11 Stack Over-temperature

The THYROMAT-10BCC thyristor stack has a temperature monitoring drive (bi-metal strip) which goes open circuit in the event that the stack temperature reaches levels above its maximum allowed temperature. (i.e. in the region of 90 to 100ºC depending on the size of the unit).

To confirm that the Temperature switch is closed, measure the DC voltage across its terminals, for a closed switch it must be 0V DC an open switch will measure 9 to 10V DC.

If the temperature switch has no problems, the possible reasons are:

-Hoist Control Card fault, replace the hoist Control Card

-Check the connection between the temperature switch and the control box

-Mother board fault, replace the control box (mother board)

6.10.12 Hoist Loss of Torque

A hoist loss of torque is detected if during a Hoist operation the hook slips downwards at a speed greater than 10%.

Possible causes:

- Main supply low during lifting of a full or close to full load.
- Rotor resistance single phasing, or open circuit.
- Stator voltage to low caused by a malfunctioning Phase shifter card
- Excessive hook load, when starting from a suspended load.

6.10.13 Lower Overspeed

The Lowering over-speed protection is **only effective during Lowering plugging** or **Lower slow Speed operation in counter-torque.**
If the speed of the motor exceeds 130% in the lowering direction during Quadrant 4 operation the trip is activated.

Possible causes:

- Rotor resistance open circuit, either the star point or the rotor terminals are in open circuit.
- Motor failure (Rotor windings).
- Motor Rotor cable open circuit.
- Faulty Phase shifter.
- The drop of the power supply voltage is too much.

6.10.14 Plugging Timeout

During retardation from full speed lowering a time out facility is included to ensure that, in the event that the motor is unable to retard to neutral or to hoisting depending on the position of the master controller, within the time set by the respective parameter, the brakes will close immediately after set time has expired and this fault will be displayed and stored in the fault history.

Possible causes

- Sudden loss of torque during lowering plugging caused by a drop in supply voltage, rotor resistance open circuit on one or more phases.
- Excessive load being handled by the crane.
- Unrealistic parameter time setting.

6.10.15 Input Phases

The THYROMAT-10BCC unit Phase Shifter card measures all 3 mains supply phases and ensures that the
Following conditions are met:

- Correct Phase rotation
- All 3 phases are present
- All 3 phases are above 70% of the Nominal Supply voltage.

In the event of any one of these condition being not true, the Phase shifter sends an Input phase trip signal to the Control card, which validates it for 500ms before a trip.

Possible causes:

- During commissioning the phase rotation is wrong, swap the phases again.
- Mains supply failure (low level or phase missing)

- Downshop supply conductor system faulty, due to broken joints or current collector skid damaged or worn out.
- Mains Supply cable faulty.
- Phase Shifter Card faulty. To confirm that the problem is related to a Phase shifter card, replace the card and compare results.
- Power supply fault for control of THYROMAT-10BCC drive. Please check the connection between the stack and control unit. Replace the control box.

6.10.16 Brake Release

The Brake release fault will be logged in the event that at start of a Hoist/Lower command, during Torque proving, the stator current (any one of the phases) is lower than the Brake release current parameter, which is a percentage of the Motor current parameter.

Possible causes:

- The Brake release current entered in parameters is too high.
- Mains supply low, or temporarily low.
- The motor current cannot reach the value of releasing current. Please check the motor and the brake.
- Phase shifter faulty, not triggering properly to generate the required Brake release current.
- Current detection fault

6.10.17 Drive Level

The THYROMAT-10BCC Control card CPU monitors the minimum voltage level given to the Phase Shifter card which by default is at 3,8V DC.

In the event that this Phase shifter reference voltage goes below 3,5V DC the fault is triggered 300 later.

Usually a Drive level fault that persists indicates a faulty Control card that needs replacing.

6.10.18 Power on Test

During Power On, the THYROMAT-10BCC goes through a set of tests, which when not successful, causes a trip at Power Up. The Power On test may be followed by the logging of another fault (see code faults).
If the fault persists the Control Card needs replacing.

6.10.19 Code Faults

General: Most of the Code faults indicate an internal Control Card fault.

When such a fault persists the Control Card needs to be replaced.

6.10.19(a) Code 100 (Joystick Corrupted Messages)

The software layer which manages the joystick information, reads information which is out of acceptable boundaries.

Possible causes:

- Excessive electro magnetic interference.
- If persists, Faulty Control Card

6.10.19 (b) Code 101 (CPU Watchdog Reset)

The CPU stopped the tick of the internal watchdog.

Possible causes:

- Excessive electro magnetic interference
- If persists, Faulty Hoist Control Card

6.10.19 (c) Code 102 (CPU Voltage Brown Out Level Reached)

The CPU brown out voltage was reached.

Possible causes:

- THYROMAT-10BCC 10V or 5V DC supply lines dropped.
- If persists, Faulty Hoist Control Card

6.10.19 (d) Code 103 (CPU loss of software messages)

The software code compares messages received for execution with the final execution of the Actual messages (instructions), any out of synchronization of the above causes such fault code to be active.

Possible causes:

- Excessive electro magnetic interference
- If persists, Faulty Hoist Control Card

6.10.19(e) Code 104 (CPU failed to read valid EEprom parameters)

Possible causes:

This fault usually occurs when the Hoist Control Card is initially loaded with software, during manufactory phase.
The simple loading of default or any other parameters combination will clear the fault.
If the fault persists, the EEprom is probably damaged and the Hoist Control Card needs replacing.

6.10.19(f) Code 106 (CPU – System fault)

The CPU can not process the information received, because it has no meaning in the software "MOTOR MODULE".

Possible causes:

- Excessive electro magnetic interference
- If persists, Fault Hoist Control Card

6.10.19 (g) Code 107 (indicates an internal logging of an unrecognised fault error)

Possible causes:

- The persistence of this fault code may indicate a particular condition, possibly unique to the specific motion which causes a fault error, which trips the THYROMAT-10BCC, but it is not recognized by the error log table.

6.10.19 (h) Code 108 (Indicates an internal software command to switch on both reversing contactors simultaneously)

Possible causes:

- The persistence of this fault code may indicate a particular condition, possibly unique to the specific motion which causes a fault error, which trips the THYROMAT-10BCC, but it is not recognised by the error log table.

6.10.19 (i) Code 109 (Indicates an internal software command to switch off both reversing contactors when one should have been switched ON)

Possible causes:

- The persistence of this fault code may indicate a particular condition, possibly unique to the specific motion which causes a fault error, which trips the THYROMAT-10BCC, but it is not recognised by the error log table.

6.10.20 Healthy

The rare logging of a Healthy fault, is not a serious event, but if persists it indicates that the unit had a fault to be reported but missed the reading of the fault Error stamp during fault logging:

Possible causes:

- Excessive electro magnetic interference
- If persists, Fault Hoist Control Card

6.11 Possible Causes of Failure on Travel Systems:

The aim of this chapter is to assist the user in getting to the cause of the fault as quick as possible, although great effort has been put into describing as many causes of faults as possible. It is almost impossible to cover every single aspect of the entire crane installation without running the risk of creating a guide, which then looks more like a technical book. The desired speed required repairing or correcting the fault would then be lost in the extensive reading and searching for the exact fault definition.

It is always far more productive for the user to become more familiar with the THYROMAT-10BCC basic methods of motor control. It is possible to acquire the information from this manual as well as from specific THYROMAT-10BCC courses offered at our head office as well as at certain support centres.

The following paragraphs list some possible causes of failures and the effects it may have on the operating system.

6.11.1 Loss of Rotor Feedback

Rotor feedback is used by the THYROMAT-10BCC as the motor loop speed feedback and it is essential to the operation of the unit. In the event that this feedback is not present the unit has to trip to prevent it from falling into an unknown state.

The rotor feedback is tapped off of two of the three motor rotor phases. The unit reads the rotor frequency, which is inversely proportional to the rotor rotational speed, (i.e. directly proportional to the motor slip)

Rotor frequency = Stator frequency x motor slip.

At standstill the rotor frequency is equal to the supply frequency, which is 50 Hz, as the motor starts accelerating towards its full speed the rotor frequency decreases towards 0 Hz.

In counter torque the rotor frequency increases from 50 Hz at standstill towards 100 Hz at 100% speed, note that in counter torque the motor field rotation is opposite to the actual rotor speed rotation, hence the increase in rotor frequency output, (i.e. motor slip >1).

Possible causes

- Directional thyristors do not conduct.

  When forward or reverse direction command is sent to THYROMAT-10BCC drive, if the controlled voltage is not sent out, ROTOR FEEDBACK fault will be reported.

  Note: forward or reverse thyristor fault can easily cause “RFB & CURRT LOSS” fault.

- Rotor feedback wires loose

  One or both feedback wires between the motor rotor phases and the unit terminals 17 and 18 are loose.

- Rotor feedback wires short-circuited

  Both feedback wires are short-circuited.

  Remove wires from terminals 17 and 18 and measure the resistance between them. It should have a low ohm reading. This is because of the still in circuit motor windings resistance as well as the corresponding rotor resistors on each phase.

  With the wires removed measure at the THYROMAT-10BCC terminals 17 and 18, this reading should be very high (Mega-ohms) it should actually start increasing during the reading time. This is due to an internal capacitor in parallel across these terminals. If the above tests show that the external wiring is in order, it is then advisable to reconnect the wires and proceed to the next test which is as follows: Measuring the voltage across terminals 17 & 18 while starting the motor.

  If a voltage is present it indicates that the external circuit is sending the rotor feedback signal but the THYROMAT-10BCC unit is not reading it. Replace the Control Card enter the same parameters onto this card and try to run the system, if the fault persists, the problem may be related to the control box mother board, in this case it is advisable to replace the THYROMAT-10BCC control box.

6.11.1(a) ROTOR FDBK S

Not applicable to Travel motions.

6.11.1(b) ROTOR FDBK Q1

The fault occurred during Forward motion and while the system was operating in notches 1; 2 or 3.
Note: Rotor feedback fault can not be detected during full speed operation, because the Rotor frequency is close to 0Hz.
Refer to 6.11.1 (f) for possible causes.

6.11.1(c) ROTOR FDBK Q2

The fault occurred while the system was busy performing a Forward plugging function.
Refer to 6.11.1 (f) for possible causes.

6.11.1(d) ROTOR FDBK Q3

The fault occurred during Reverse motion and while the system was operating in Notch 1, 2 or 3.
Refer to possible causes below.
Note: Rotor feedback fault can not be detected during full speed operation, because the Rotor frequency is close to 0Hz.
Refer to 6.11.1 (f) for possible causes.

6.11.1(e) ROTOR FDBK Q4

The fault occurred during Reverse plugging.
Refer to 6.11.1 (f) for possible causes.

6.11.1(f) <u>Possible causes of Rotor feedback loss</u>

(i) One or both Rotor feedback wires between the motor Rotor resistance and the THYROMAT-10BCC terminals 17 & 18 are loose.

Measure the Ohm value across the THYROMAT-10BCC terminals 17 & 18. The reading will be very low <5 ohms.
Warning: In some cases the multimeter reading is so low, that it can be mistaken with a short circuit of these wires, refer to (iv) below.

(ii) Rotor Feedback wires short-circuited.

To ensure that a short circuit is not the reason why the Ohm reading is low (i.e. close to 0Ω), remove one of the Rotor feedback wires from the Rotor resistance connection side, then measure the Ohm value of the circuit which now should be in the region of MΩ, and will keep on increasing due to the capacitance across the terminals.
If the reading remains close or at 0Ω then the wires are short-circuited.
If the reading is infinite, while the wires remain connected to the THYROMAT-10BCC terminals 17 & 18, replace the Control Card, because the damage is internal.

(iii) Travel Control Card failure

The cause of the problem may be due to a faulty Travel Control card.
After ascertaining that the problem is not due to any of the above reasons, it is suggested that the control card is replaced with another Travel Control Card.

Ensure that the existing parameters are entered into the new Travel Control Card, if the fault persists, the problem may be caused by the following reasons:

(iv) Phase Shifter failure

Measure the voltage across the THYROMAT-10BCC terminals 17 & 18, while a Hoist notch 1 to 4 running command is given. In the event of a faulty system the trip during start of a new cycle is delayed by 2 seconds therefore the reading of any voltage signal has to be done quickly within this period.
If there was signs of voltage being present during this period the Phase Shifter may be in working order. To confirm this, the same quick reading of all three THYROMAT-10BCC output voltages has to be done to ensure that the Phase Shifter is working correctly. If the firing circuit is confirmed working abnormally, we suggest that forward phase shift card should be replaced, otherwise, the reverse phase shift card should be replaced.
If the 3 output phases measurement proves in order, then the problem may be related to loose connections on the **motherboard**, in this case the entire unit needs replacing.

6.11.2 Current Feedback Loss (All 3 phases) (Applicable only if Current Transformers enable = Yes)

Travel applications do not necessarily require monitoring of all 3 motor stator currents, for the efficient and safe operation of the system, if the Drive can not read any motor currents, it will trip on a current feedback fault as described below:

6.11.2(a)CURNT FDBK S

Not applicable to Travel motions.

6.11.2(b)CURNT FDBK Q1

The fault occurred during Forward operation.
Refer to 6.11.2 for possible causes.

6.11.2(c)CURNT FDBK Q2

The fault occurred during Forward plugging.
Refer to 6.11.2 for possible causes.

6.11.2(d)CURNT FDBK Q3

The fault occurred during Reverse operation.
Refer to 6.11.2 for possible causes.

6.11.2(e)CURNT FDBK Q4

The fault occurred during Reverse plugging.
Refer to 6.11.2 for possible causes.

6.11.2(f) Possible causes of Current feedback loss

General information on Current feedback circuit:

The current feedback circuit in the Control Card gets its 3 phase readings from 3 Current Transformers (C.T.s) installed on the Stator phases.
The signal coming out of the CTs is and AC signal <5V AC (<1 Amp).

This AC signal is then fed into the “Current converter” which converts the AC signal into a DC signal also <5V DC.

The 3 DC voltage signals are transmitted into the travel control card of the THYROMAT-10BCC drive..

The entire processing of the 3 phase current measurement is done in the Control Card.

Possible Causes of Current Feedback Faults

General: It is assumed that the user has an available **Current Clamp** (Analogue or Digital) to assist with fault finding procedure.

- Initial steps

.1 - Press the "MENU" key on the Control Panel to change to the CTs Page.

.2 - Line 3 of the LCD display will show CT1; CT2; CT3.

.3 - Line 4 of the LCD display will show 0 Amps on all 3 phases.

.4 - Engage Forward Notch 1, if the fault still exists, the thyristors will remain conducted for a period of 2 seconds before the "CURNT FDBK S" fault is displayed. Compare the current readings of the current clamp with that of display on the Control Panel during this time.

If The current clamp shows 0 Amps, obviously the display will also show 0 Amps.

. .5 - Did the Forward thyristors energise?

- Yes: then the fault may be caused by:
  - a) - Ensure whether all 5 groups of thyristors are normal.
  - b) - Ensure whether thyristor firing models are normal. Replace the Phase Shifter card.
  - c) - Whether the Connections between control unit and stacks is normal?
  - d) - Whether the mother board is normal? Replace the mother board.
  - e) - Ensure whether all 5 groups of thyristors are open.

No: then the fault may be caused by:

- a) - The stator cable of the motor has open circuit fault.
- b) – The stator windings of the motor has open circuit fault.

6 - If the Current Clamp shows a Current reading and the Drive directional thyristor is energising, but the display remains at 0 Amps the problem may be caused by a faulty current converter circuit.

- Ensure whether the CT is normal.

While giving a Hoist notch 1 to 4 command to the Unit measure the AC voltage out of the CTs (one at a time), these must be a voltage <5V AC at any CT, and they should be similar.

It is unlikely that all 3 CTs are faulty simultaneously.

When giving a Hoist notch 1 to 4 command to the unit, the THYROMAT-10BCC will trip on CURNT FDBK Q1 after 2 seconds, so this test needs to be done several times to cover all 3 phases.

Make sure whether the connection between the control unit and stacks normal.
- Make sure whether the current converting is normal.
If CTs are normal, that means the current converter is faulty and the current converter needs replacement. Replace by in turns:
a) Replace the travel control card.
b) Replace the control box.

6.11.3 Single Phase Current Loss (Applicable only if Current Transformer enable = Yes)

Travel applications do not necessarily require monitoring of all 3 motors stator currents, for the efficient and safe operation of the system. If the drive reads one CT current at 0 Amps while the others are >0 Amps, it will trip on Current loss.

6.11.3 (a) CURNT LOSS 1 S (loss of phase 1 current)
CURNT LOSS 2 S (loss of phase 2 current)
CURNT LOSS 3 S (loss of phase 3 current)

Not applicable in Travel motion applications.

6.11.3 (b) CURNT LOSS 1 Q1 (loss of phase 1 current)
CURNT LOSS 2 Q1 (loss of phase 2 current)
CURNT LOSS 3 Q1 (loss of phase 3 current)

The fault occurred during Forward operation.
Refer to 6.11.3 (f) for possible causes.

6.11.3 (c) CURNT LOSS 1 Q2 (loss of phase 1 current)
CURNT LOSS 2 Q2 (loss of phase 2 current)
CURNT LOSS 3 Q2 (loss of phase 3 current)

The fault occurred during Forward plugging.
Refer to 6.11.3 (f) for possible causes.

6.11.3 (d) CURNT LOSS 1 Q3 (loss of phase 1 current)
CURNT LOSS 2 Q3 (loss of phase 2 current)
CURNT LOSS 3 Q3 (loss of phase 3 current)

The fault occurred during Reverse operations.
Refer to 6.11.3 (f) for possible causes.

6.11.3 (e) CURNT LOSS 1 Q4 (loss of phase 1 current)
CURNT LOSS 2 Q4 (loss of phase 2 current)
CURNT LOSS 3 Q4 (loss of phase 3 current)

The fault occurred during Reverse plugging.
Refer to 6.11.3 (f) for possible causes.

6.11.3 (f) Possible Causes of Current Loss of Phase 1, 2 or 3

General: It is suggested that the user reads the previous chapter 6.11.2 (f), to familiarise themselves more with current feedback readings.

- Current loss means that all 3 phases CT readings = 0 Amps
- Phase current loss means that, at least one CT reading = 0 Amps while at least another CT reading > 0 Amps.

6.11.4 Current Unbalance (Available only when Current Transformers enable = Yes)

General: A current unbalance is only detected when at least on Phase current is <50% of the highest reading current, provided that the highest current is at least 50% of the Motor Current, the condition is validated for a period of 2 seconds at start before the brakes have been released or 800ms during operation.

6.11.4 (a) CURNT UNBAL 1 S
CURNT UNBAL 2 S
CURNT UNBAL 3 S

Not applicable to Travel motions.

6.11.4 (b) CURNT UNBAL 1 Q1
CURNT UNBAL 2 Q1
CURNT UNBAL 3 Q1

The fault occurred during Forward operation.
Refer to 6.11.4 (g) for possible causes.

6.11.4 (c) CURNT UNBAL 1 Q2
CURNT UNBAL 2 Q2
CURNT UNBAL 3 Q3

The fault occurred during Forward plugging.
Refer to 6.11.4 (g) for possible causes.

6.11.4 (d) CURNT UNBAL 1 Q3
CURNT UNBAL 2 Q3
CURNT UNBAL 3 Q3

The fault occurred during Reverse operations.
Refer to 6.11.4 (g) for possible causes.

6.11.4 (e) CURNT UNBAL 1 Q4
CURNT UNBAL 2 Q4
CURNT UNBAL 3 Q4

The fault occurred during Reverse plugging.
Refer to 6.11.4 (g) for possible causes.

6.11.4 (f) CURNT UNBAL 1
CURNT UNBAL 2
CURNT UNBAL 3
Refer to 6.11.4 (g) for possible causes. If this fault occurs, turn off the power and restart the drive for restoring.

6.11.4(g) Possible Causes of Current Unbalance

- Mains supply, phase unbalance

This may be caused by a sudden drop on one phase of the Mains supply, usually such a condition is very serious and unlikely to affect The Crane only.
This condition is more likely to cause an “Input phases” fault.

- Faulty Thyristor

One Thyristor is only conducting on the positive or the negative cycle, causing the current to drop by 50% on the corresponding phase.

- Faulty motor Stator windings

- Faulty motor Rotor windings or Slipring brushes.

- Faulty Rotor resistor circuit.

Either one phase is completely open circuit or in the event of the Rotor resistors being made up of resistor banks in parallel per phase, one of the parallel connections is faulty.

This is usually easy to identify by disconnecting the resistors from the Rotor windings (two phases at least) and compare the resistance value between phases.

- A Locked Rotor Test (LRT) may be able to identify the problem quickly, refer to LRT procedure elsewhere in this manual.

6.11.5 Rotor Feedback and Current Feedback Loss (Available only when Current Transformers enable = Yes)

General: This fault is detected when the simultaneous loss of Rotor frequency and Stator current feedback. The loss of both feedback signals, indicates that the motor stator is not being powered by the 3 phases via the THYROMAT-10BCC and the Stator reversing contactors.

The possible causes are:

- Forward and Reverse thyristors didn’t energize. Thyristors are faulty.
- The Phase Shifter is not triggering the 3 phase Thyristor stack.
    - Check the voltage output between Uo, Vo and Wo immediately after a Hoist or Lower command.

      If there is no sign of voltage regulation (i.e. 0V), replace the Phase Shifter card.
- The Motor Stator cable is faulty and in open circuit.
    - Measure the resistance across the 3 stator phases at the Panel stator output terminals, the reading should be a low ohm reading. Confirm that the fault is on the cable and not on the motor stator windings by bridging the motor stator terminals while measuring the continuity once again. Ensure that the wire bridges are removed after the test.
- The Motor Stator windings are faulty and in open circuit.
    - If the cable test above proved successful, then the faulty open circuit may be inside the motor.
      Measure the continuity of the stator windings at the motor terminals

The RBF & CURNT LOSS will be displayed with a suffix S; I or R.

Suffix S: Indicates that the fault occurred during Torque proving, before the brakes were released.
Note: This is only applicable to Hoist motions.

Suffix I: Indicates that, the fault was caused by all 3 phase currents being at 0 Amps and during the timing out of the validation period the Rotor feedback also became 0Hz.

Suffix R: Indicates that, the fault was caused by the Rotor feedback being at 0Hz and during the timing out of the validation period all 3 phase currents also became 0 Amps.

6.11.6 Overcurrent

Refer to 6.10.6

6.11.7 Not in Neutral

Refer to 6.10.8

6.11.8 Joystick Error

Refer to 6.10.9

6.11.9 Motor Stall

Refer to 6.10.10

6.11.10 Stack Over-temperature

Refer to 6.10.11

6.11.11 Input Phases

Refer to 6.10.15

6.11.12 Drive Level

Refer to 6.10.17

6.11.13 Power on Test

Refer to 6.10.18

6.11.14 Code Faults

Refer to 6.10.19 for a description of these fault codes.

6.11.15 Healthy

The logging of a Healthy fault, is not a serious event, but if persists it indicates that the unit had a fault to be reported but missed the reading of the fault Error stamp during fault logging:

Possible causes:

- Excessive electro magnetic interference
- If persists, Fault Travel Control Card

SECTION 7 : MAINTENANCE

7.1. General

Digital technology is a reliable alternative to analogue systems and it usually does not require maintenance intense tasks. The reliability of the Digital Thyromat Controller ensures that preventative and corrective maintenance is minimal. Maintenance is simplified and equipment down times greatly reduced due to the modular design of the THYROMAT-10BCC. Added features such as Monitoring / Fault History assists the user in accurately identifying failures / faulty components within a short period of time with confidence.

It is recommended that the user retains a complete THYROMAT-10BCC control unit to be used as spares. The simplistic design of the unit and the mounting procedures does not require specialised knowledge. The ease at which faulty components / units can be replaced will greatly reduce equipment down times.

A second option would be to keep a spare set of modules for the THYROMAT-10BCC. The identification and replacement of faulty cards require a suitably qualified person to carry out the task. The cards have voltage sensitive drives that can be damaged if handled incorrectly.

7.2 Preventative Maintenance

Because of the design of the THYROMAT-10BCC there are no preventative maintenance tasks required. Preventative maintenance may be required for the associated equipment, that depends on the various associated equipment and the applicable manufacturer's specifications.

7.2.1 Brakes

CAUTION

Never assume that the mechanical brake is correctly set. Incorrect settings can lead to failure and can cause damage to property and fatal injuries.

One item that is critical to the safety and operation of the THYROMAT-10BCC is the serviceability of the mechanical brake.

It is important that the mechanical brake is set in such a manner that it will stop a full load without motor assistance.

The mechanical brake must be checked at regular intervals.

7.2.2 Ultimate Limit Switch

It is important that the ultimate limit switch operates to within the tolerances specified by the applicable regulations.

7.2.3 The Examination of Drives

Regular examination of drives is necessary after the drives have been used for a period of time. First, check whether the installation of drives is tight, referring to Table 4-3 **Mounting Fastener Torque Values** in Page 50. Second, clean the dust in the drives for the accumulated metal dust affects the drives' working. Third, check whether the wire connection of control wiring is good. Fourth, check whether the power supply cable connection is good and exclude dangerous factors such as loose nuts, loose wire end ferrules.

7.3. Spare Parts List

Order according to the following order requirement.

Category	Code	Description	Mechanical size	Model
Control Cards or Boards in Control Box (This is an independent Spare Part for ordering.)	OA 0020SM3A[2)- 5)]	Phase shifter card	All	10BCC[1)]25[2) 4)] to 10BCC[1)] 2500[2) 4)]
	OA 1070[4)- 5)]	Relay Card	All	10BCC[1)]25[2) 4)] to 10BCC[1)] 2500[2) 4)]
	OA 1071[4)- 5)]		All	10BCC[1)]25[2) 4)] Z to 10BCC[1)] 2500[2) 4)] Z
	OA 2010[1) 3)- 5)]	Hoist(Travel) Control Card	All	10BCC[1)]25[2) 4)] to 10BCC[1)] 2500[2) 4)]
	OA 2011[1) 3)- 5)]			10BCC[1)]25[2) 4)] Z to 10BCC[1)] 2500[2) 4)] Z
	OA 1082 [3)- 5)]	Control Panel	All	10BCC[1)]25[2) 4)] to 10BCC[1)] 2500[2) 4)]
	OA 1025AD-[5)]	Mother Board	All	10BCC[1)]25[2) 4)] to 10BCC[1)] 2500[2) 4)]
	OA 1035AD-[5)]			10BCC[1)]25[2) 4)] Z to 10BCC[1)] 2500[2) 4)] Z
Current Transformers	MCTxxx:1	Current transformer note: see Table 2-4	All	10BCC[1)]25[2) 4)] to 10BCC[1)] 2500[2) 4)]
Voltage Divider	OA1900-01	Voltage Divider	All	Above 525V drive ,rotor open circuit voltage⩾750V
	OA1901-01			Above 525V drive ,rotor open circuit voltage⩾500V

Category	Code	Description	Mechanical size	Model
[1] Hoist/Drive labeling: Hoist: H, Travel: T, Software Version should be provided for Hoist (Travel) Control Cards.				
[2] Power supply voltage: B=380VAC; F=525VAC				
[3] Communication labeling: With P: with communication, S: without communication.				
[4] Control power voltage: A=110VAC, B=220VAC				
[5] Hardware version number, refer to the cards or boards.				

Power Module※	Stack	Mechanical size	Model
TBPUT 25A 380/525	TBTB 25A 380/525	M150	10BCC[1] 25A
TBPUT 30A 380/525	TBTB 30A 380/525		10BCC[1] 30A
TBPUT 60A 380/525	TBTB 60A 380/525		10BCC[1] 60A
TBPUT 100A 380/525	TBTB 100A 380/525		10BCC[1] 100A
TBPUT 150A 380/525	TBTB 150A 380/525		10BCC[1] 150A
TBPUT 200A 380/525	TBTB 200A 380/525	M350	10BCC[1] 200A
TBPUT 260A 380/525	TBTB 260A 380/525		10BCC[1] 260A
TBPUT 350A 380/525	TBTB 350A 380/525		10BCC[1] 350A
TB PARM※※ 400A 380/525	TBTB 400A 380/525	M400	10BCC[1] 400A
TB PARM※※ 500A 380/525	TBTB 500A 380/525	M1000	10BCC[1] 500A
TB PARM※※ 700A 380/525	TBTB 700A 380/525		10BCC[1] 700A
TB PARM※※ 1000A 380/525	TBTB 1000A 380/525		10BCC[1] 1000A
TB PARM※※ 1200A 380/525	TBTB 1200A 380/525	M2000	10BCC[1] 1200A
TB PARM※※ 1500A 380/525	TBTB 1500A 380/525		10BCC[1] 1500A
TB PARM※※ 2000A 380/525	TBTB 2000A 380/525		10BCC[1] 2000A

※Stack: elements of one unit of the stack.

※※TB PARM2 are the elements of ARM which contains 2 thyristors in single phase.

※※TB PARM4 are the elements of ARM which contains 4 thyristors in single phase.

We suggest that users do not install the stack themselves. The stack should be ordered as a whole. Refer to the above table when ordering. MH company repairs damaged stacks for customers.

Higher than 525V power supply level drives are the ones when 380 is replaced with 525.

Note The Thyristors with their models listed in the above table are suitable for the spare part standard models. However, the stalled ones are different. Refer to the above table for 1).

Fan	Install way	Mechanical size	Model
M150[4]fan	Fan assembly	M150	10BCC[1] 25 to 10BCC[1] 150
M350[4]fan	Fan assembly	M350	10BCC[1] 200 to 10BCC[1] 350
M400[4] fan	Fan assembly	M400	10BCC[1]500
M1000[4] fan	Fan assembly	M1000	10BCC[1] 500 to 10BCC[1] 1000
M2000[4] fan	Fan assembly	M2000	10BCC[1] 1200 to 10BCC[1] 2000

Requirement of ordering fans: write "Fan model XXX used in THYROMAT-10BCC drives".

Refer to the above table for 1) and 4).

HINT:

1. When ordering spare parts, models of equipents and elements, software version should be provided.

2. When replacing digital cards (hoist (trival) control cards and control panels), the original or modified parameters should be set to them. The software version of control card must be compatible with software version displayed on the control panel.

7.4. Site Maintenance Experience

The accumulated site experience by drivers and crane electric maintenance personnel is extremely valuable. MH company will continuously report obtained information on the service website (websites and local service agency.) for our customers. Please pay attention to information report on internet websites, www.mhdl.com.cn.

The following maintenance experiences are provided for reference.

7.4.1 What should be done when there is something wrong with the output of a current transformer (MCT) and this has caused the shut of speed regulating system?

It is suggested that the following methods should be applied.

If there are not any current transformers for replacement, block the MCT fault. Put signal into MCT1, MCT2 and MCT3 with one MCT. This fault can also be solved by setting Parameter 2, CTS Enable to False in Gantry/Trolley travel application.

CAUTION

1. This solution is only for ct fault, not overcurrent of circuit.

2. There must be motor overcurrent protection in the circuitry.

3. The MH Current Transformer must be replaced in a short time in hoit application.

7.4.2 What should be done when the protection function of the drive is sometimes not stable and there is loose connection in frequency feedback wiring?

Please carefully examine whether the earth connecting wire of the drive is firmly connected to the earth and whether the control cabinet earth wire is effectively connected to the earth.

7.4.3 Arcing when rotor contactors switches.

The Open Time parameter of thyristors is not set rationally.

7.4.4 Frequent Damage of Relay Cards.

Please check whether there are small interposing contactors driving rotor contactors.

7.4.5 Faulty Action Occurs with Command Relays

There is a long distance between command relay and THYROMAT drive in PLC system. This causes the current interference to command input signals. There is not shield protection method with DC signals of PLC in the system. The relays have faults themselves.

SECTION 8 : SHIPPING AND STORAGE

8.1. General

The THYROMAT-10BCC is simplistic in design and does not require any specialised packing, crates or procedures. When shipping or storing the system in high humidity conditions it is advisable to include a silicone gel sachet in the packaging to absorb any excess humidity.

8.1.1. Shipping

Complete unit. It is advised that the following procedure should be followed when packaging the THYROMAT for shipping purposes;

- Before wrapping the complete system, fold a section of bubble plastic to form a pad, tape the pad over the control unit's display and keypad to give it extra protection.
- Wrap the complete unit in bubble plastic or similar material.
- Place the complete wrapped unit into a strong cardboard box or suitable container.
- The unit is ready for shipping.

Components. It is advised that the following procedure should be followed when packaging the THYROMAT components for shipping purposes;

- Each electronic card must be handled carefully and inserted into it's own individual anti-static bag.
- Wrap the spare in bubble plastic or similar material.
- Place the complete wrapped spare into a strong cardboard box or suitable container.
- The spare is ready for shipping.

8.1.2. Storage

In the event that the THYROMAT-10BCC Digital Crane Controller or any spare component is stored then it is advised that the following procedure should be followed;

- Keep the ambient conditions in the storage area at an acceptable level (temperature from – 40°C to + 60 °C with a relative humidity less than 95%, no condensation allowed).
- Keep all equipment and spares in their respective packaging until such time that they are to be used.
- Prevent them from being pressed by heavy objects. their outer package can stand the weight of other packages putting on them.
- Prevent grease from entering them.
- When beginning to use them, Read corresponding user manual and installation requirement. Install after through checking.

SECTION 9 : ACRONYMS AND ABBREVIATIONS

9.1. General

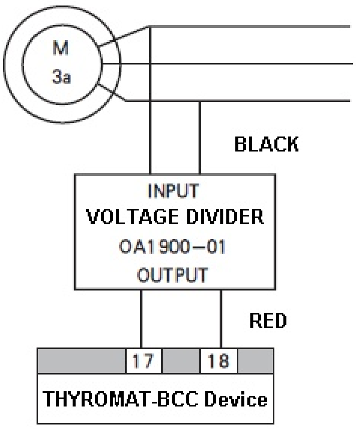
The following lists acronyms and abbreviations used in this manual.

%.............................. Percent
°C............................. Degrees Celsius
A............................... Amperes
Ac/AC........................ Alternating Current
Acc/Accel .... Acceleration
Arm .... Bridge of Power Stack
C.D.F......................... Cyclic Duration Factor
CPU .... Central Processing Unit
CT .... Current Transformer
dc/DC........................ Direct Current
Dec............................ Deceleration
Dly............................ Delay
EEPROM .... Electrically Erasable Programmable Read Only Memory
flc .... Full Load Current
G .... Gravitational Force
Hz............................. Hertz (Cycles per Second)
I .... Current
Ith .... Thermal Current
K............................... Coefficient value of rotor resistance that will give rated torque at standstill
kg .... Kilograms
kW............................ Kilowatt
LCD.......................... Liquid Crystal Display
m .... Metres
mA............................ Milli-amperes
MAX. .... Maximum
mm .... Millimetres
MPU .... Motor Protection Unit
mS............................ Milliseconds
PID .... Proportional Integral Derivative
PTC.......................... Positive Temperature Co-efficient
PVC.......................... Polly Vinyl Chloride
RAM .... Random Access Memory
RMS .... Root Mean Square
t................................ Temperature
Tn............................. Torque (Motor)
Un .... Supply Voltage
V............................... Volts
W.............................. Watts

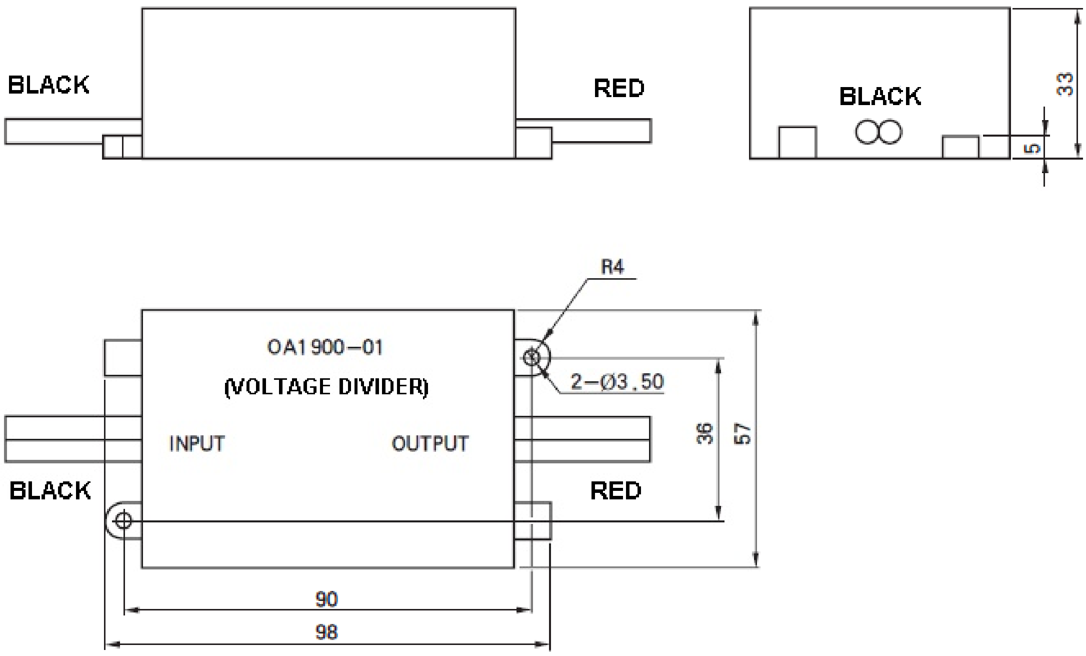
SECTION 10: APPENDIX

10.1. APPENDIX1 Voltage Divider OA1900-01/OA1901-01 Connection Method and Installation Dimension

Note: Voltage divider OA1900-01/OA1901-01 is a compulsory part of MH company of 525V crane controller.



Appendix Figure3-1: Voltage divider OA1900-01/OA1901-01 connection drawing



Appendix Figure3-2: The appearance and installation dimension of voltage dividers OA1900-01/OA1901-01(Unit: mm).

Dalian MH Electric Co., Ltd.
NO.35, Huoju Road,High-tech Industrial Zone,Dalian,116023,P.R.China
Tel: +86 411 848 206 66
Fax: +86 411 848 206 67
E-mail: mh@mhdl.com.cn
Web: www.mhgco.com
www.mhdl.com.cn