



TMU MOTORIZED TROLLEY



**Variable Frequency Drive
&
Two-speed Motor**

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

Job Number: _____

Serial Number: _____

Authorized Sales & Service
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(RECORD TROLLEY SERIAL NUMBER FOR FUTURE REFERENCE)



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Springfield, Ohio USA
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LoadMate Chain Hoist
TMU Instruction Manual
April 2003

Before proceeding with the installation, operation or maintenance of the trolley it is important that the installation, operating, and maintenance personnel read this bulletin carefully in order to ensure the safe and efficient use of the trolley.

Also, it is strongly recommended that the personnel responsible for the operation, inspection, and servicing of this trolley, read and follow the Safety Standard ASME B30.16-1998 (or current revised edition). This standard covers Overhead Trolleys (under-hung) as promulgated by the American National Standards Institute and is published by the American Society of Mechanical Engineers. Copies of this publication are available from the Society at United Engineering Center, 345 East 47th St., New York, NY 10017.

If any instructions are unclear, contact the manufacturer or distributor of the trolley before attempting to install or use the trolley.

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FOREWORD

This manual has been prepared to acquaint you of the procedures necessary for the installation, operation, and maintenance of the hoist you have purchased.

Proper installation is important to the ultimate performance of this equipment. Careful study of and adherence to the instructions will help ensure safe, dependable operation. It is also recommended that you keep this manual readily accessible to operators as well as maintenance and safety personnel.

Information in this manual is subject to change without notice.

Standard Guarantee and Warranty

R&M Materials Handling, Inc., hereinafter called the Company, will repair or replace, at its option, equipment or parts with defects in material and/or workmanship identified within two years from shipment from R&M for electric chain hoists. Should a problem develop, contact the warranty administrator at the factory.

The Warranty Administrator will provide a written Return Goods Authorization (RGA) for return of the equipment. All equipment shall be returned freight prepaid to the factory or authorized repair center; the RGA number should be clearly indicated. If the problem is covered under warranty, the equipment will be repaired or replaced and returned freight prepaid. If inspection reveals that the problem is not warranty related, the purchaser will be provided a quotation for repairs. If no purchase order is provided for repairs, the equipment will be returned freight collect. The purchaser is responsible for removal and installation. In event that replacement parts are issued for warranty related field repairs, parts will be invoiced at net value; original parts must be returned (freight collect) for failure evaluation. If evaluation reveals a warranty situation, a credit will be issued against the replacement parts invoice.

This warranty does not cover failure due to normal operating wear and tear or labor to diagnose, troubleshoot or repair. All products shall be regularly maintained and operated in accordance to the equipment's Installation, Operation and Instruction manual. The original warranty period is not renewed or extended by repair work or parts supplied after the original ship date.

This warranty does not cover damage due to abuse from side pulling of load, excessive jogging, eccentric loading, chemical exposure not specified in order, damage resulting from an accident, or damage resulting from improper storage or handling prior to placing the equipment in service. Failure of equipment to meet published performance specifications due to abnormal operating conditions beyond R&M's knowledge or control shall not be considered defective workmanship and/or material unless R&M's examination discloses such a defect. Correction of such defects shall constitute fulfillment of this warranty.

This warranty is void if parts or materials used in the repair or maintenance of R&M's equipment are not supplied or approved by R&M. Any modification or change made by the Purchaser without R&M's written approval will void the warranty.

How to Order Repair Parts Correctly

The Parts Catalog section of this manual covers replacement parts required for your R&M Materials Handling, Inc. hoist. To ensure prompt service, each repair parts order must contain the following information:

1. Serial numbers (affixed to hoist and to trolley)
2. Capacity
3. Item Number from spare parts identification sheet
4. Quantity
5. Description
6. Voltage, phase, cycles
7. Correct shipping destination.
8. Model numbers



The serial number of your trolley will be found on the nameplate affixed to the trolley. Without this serial number we cannot be sure of sending the correct parts, so always mention the serial number for parts, service, etc.

All verbal orders must be immediately followed up with a written confirmation since the company cannot assume responsibility for the accuracy of the verbal message.

Contact our Aftermarket – Parts Department should you desire the name and address of a parts distributor in your area.

Minimum Charges

All orders for repair parts are subject to a minimum charge.

Claims for Damage in Shipment

All shipments are carefully inspected and are delivered to the carrier in good order. Upon receipt of shipment caution should be exercised so that there is no loss or damage. If damage has occurred, refuse to accept the shipment until the carrier makes the proper notation to that effect. All claims for shipping damages must be filed with the carrier.

In the event of concealed loss or damage, notify the carrier immediately. By following these suggestions you will encounter less difficulty collecting your claim.



1	GENERAL.....	6
1.1	Installation of Trolley.....	6
1.2	Coupling Suspension.....	7
1.3	TMU Trolley Flange Settings Table.....	9
1.4	Operating Tests – TMU Variable Frequency Drive.....	10
1.5	Operating Tests – TMU Two-speed Motor.....	10
2	TECHNICAL CHARACTERISTICS.....	11
2.1	Specification and Minimum Radius Curve – TMU Variable Frequency Drive.....	11
2.2	Specification and Minimum Radius Curve – TMU Two-speed Motor.....	12
2.3	Environmental Data.....	12
3	TMU DRIVE.....	133
3.1	Motor.....	13
3.2	Description of the Gear Reducer.....	13
3.2.1	TMU VFD Gear Reducer.....	13
3.2.2	TMU Two-speed Motor Gear Reducer.....	13
3.3	Description of the Brakes.....	14
3.3.1	Compact Brake.....	14
3.3.2	D.C. Disc Brake.....	14
3.4	Mounting Position of Drive Unit.....	14
3.5	Mounting the Drive Unit.....	14
3.6	Removing the Drive Unit.....	14
3.7	Inspection and Service of the Drive Unit.....	15
3.8	Adjustment of Compact Brake Air Gap.....	15
3.9	Removal and Inspection of the Brake.....	15
3.9.1	Compact Brake.....	15
3.9.2	D.C Disc Brake.....	15
3.10	Trouble Shooting – Brake.....	16
3.10.1	Compact Brake.....	16
3.10.2	D.C. Disc Brake.....	16
4	TMU VARIABLE FREQUENCY DRIVE.....	16
4.1	Description of the Inverter.....	16
4.1.1	Connections.....	17
4.1.2	Technical Characteristics.....	17
4.1.3	Normal Operation for Trolley.....	18
4.1.4	LED Status Indicator.....	18
4.2	Programming Parameters.....	18
4.2.1	Speeds and Ramp Time Selections.....	19
4.2.2	Speed Control Mode.....	20
4.2.3	Motor Parameters.....	21
4.3	Fault Codes and Troubleshooting – TMU VFD.....	22
4.3.1	Troubleshooting Worksheet.....	23
4.4	Wiring Specification.....	24
4.4.1	Wiring Practices – TMU Variable Frequency Drive.....	24
4.4.2	Wiring Diagram – TMU Variable Frequency Drive.....	25
5	WIRING DIAGRAM – TMU TWO-SPEED.....	26
6	PREVENTATIVE MAINTENANCE.....	27
6.1	Maintenance table.....	27
6.2	Lubricants.....	27
6.3	Spare Part Replacement.....	27
6.4	Discarding the Trolley.....	27
7	SPARE PARTS.....	28
7.1	TMU Trolley.....	28
7.2	TMU Variable Frequency Drive.....	30
7.3	TMU VFD Transformer & Line Reactor.....	31
7.4	TMU Two-speed Motor.....	32



1 General

- ❑ Service life of the trolley depends on the way in which it is installed.
- ❑ Any use contrary to our instructions may be dangerous.
- ❑ Before operating the equipment, read and follow the Installation, Operation and Maintenance Instruction manual.
- ❑ Always keep the Instruction manual close to the equipment, readily available to operator and person responsible for maintenance.
- ❑ Make sure that personnel safety rules are followed (harness, clearance of work area, posting of instructions to be followed in the work area, etc.).
- ❑ The crown tread profile of trolley wheel is compatible to flange profiles such as S or WF beam.
- ❑ Couple or hook on the hoist after installation of the trolley to the monorail or beam.

CAUTION

Check the width of beam flange and adjust the spacing of the flanges of the trolley as indicated in the trolley flange settings table.

Before installing make sure:

- ❑ Beam is secured as appropriate.
- ❑ Beam is suitable to the loads to be supported.
- ❑ Dimensions of beam flange are compatible with the trolley, which is being installed.
- ❑ Power supply voltage is compatible.

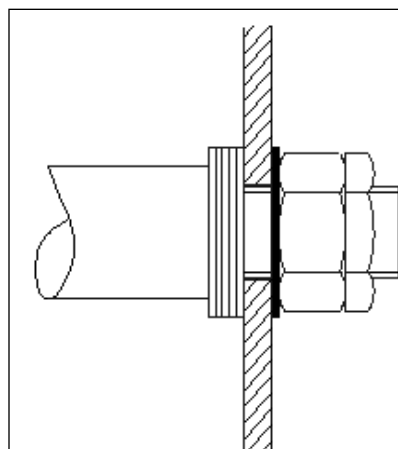
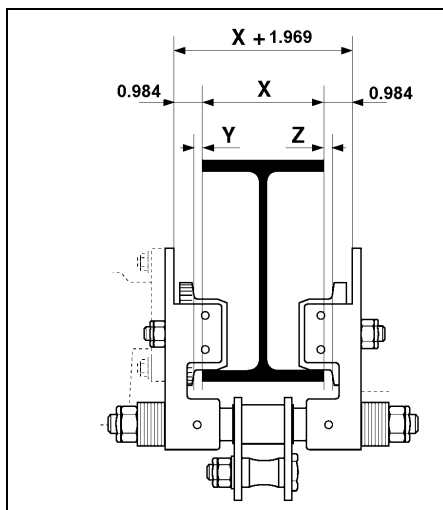
1.1 Installation of Trolley

Method 1

1. Remove the trolley idler side plate assembly.
2. Position the trolley on the beam
3. Reinstall the idler side plate assembly.
4. Tighten the tension rod nuts. (see Recommended Tightening Torque chart below)
5. Connect the power cable plug to the hoist.
6. Grease the teeth of the drive pinion and the drive wheels. (see Section 5.2 Lubricants)

Method 2

1. Install the trolley as a complete assembly onto the beam from the end of the beam.
2. Install the trolley end stops at each beam end.
3. Check that all the tension rod nuts are properly tightened. (see Recommended Tightening Torque chart)
4. Connect the power cable plug to the hoist.
5. Grease the teeth of the drive pinion and the drive wheels. (see Section 5.2 Lubricants)



Recommended Tightening Torque for tension rod nut

C1 Trolley:	177 ft-lbs
C2 Trolley:	300 ft-lbs
C3 Trolley:	545 ft-lbs
C5 Trolley:	545 ft-lbs

C1 Trolley:	240 N m
C2 Trolley:	410 N m
C3 Trolley:	740 N m
C5 Trolley:	740 N m

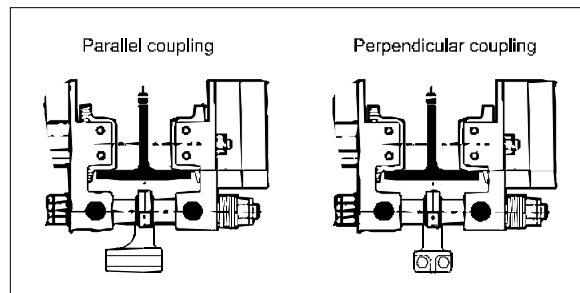
In all cases, allow minimum of one washer under each tension rod nut.

$Y + Z = 5/32" [4mm] \text{ MAX}$

The total play between wheel flange and the beam flange must not exceed 5/32" [4mm]. The distance between trolley side plates must be equal to the sum of the beam flange width + 1 15/16" [50mm].

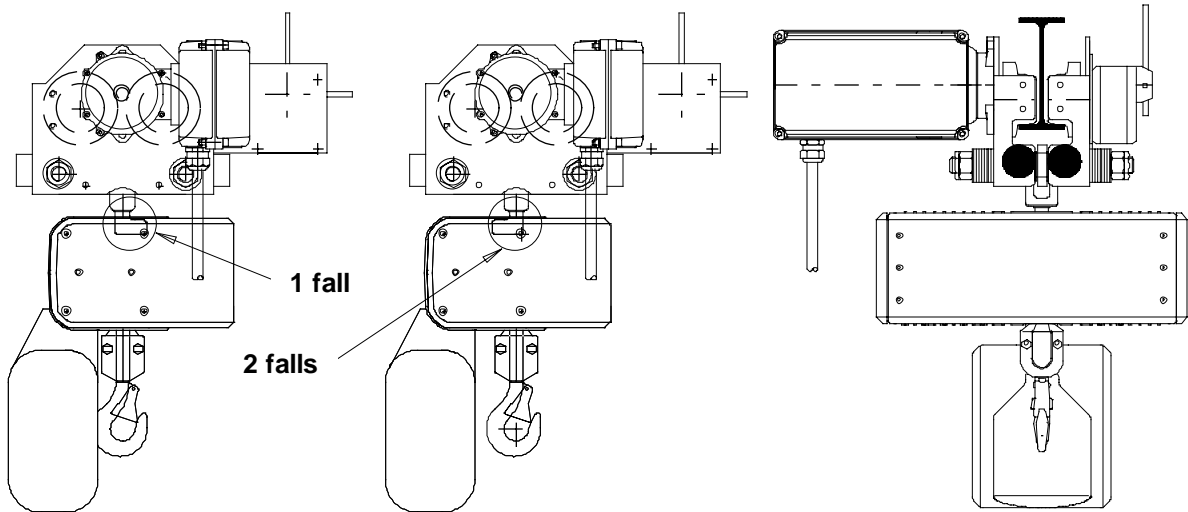


1.2 Coupling Suspension

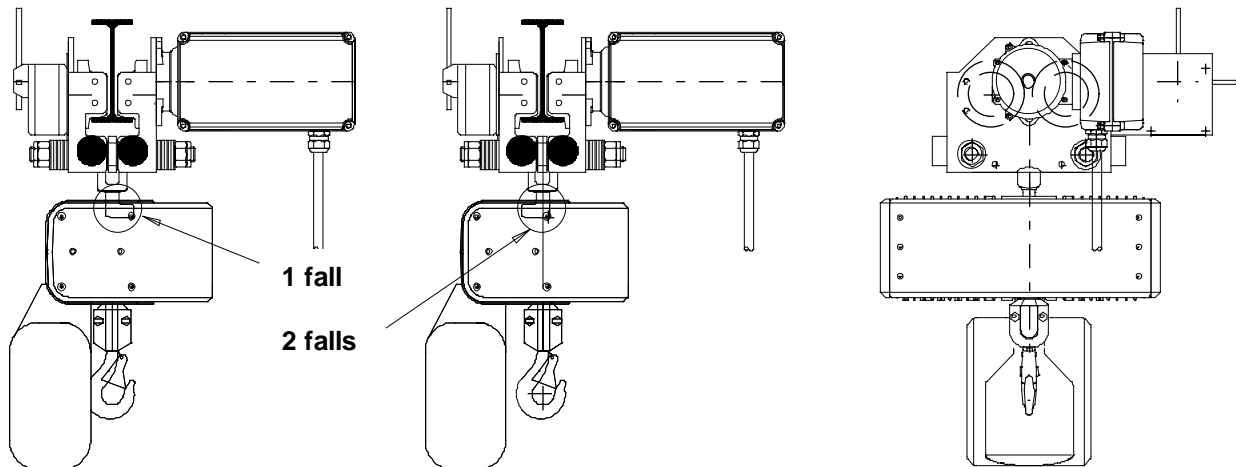


When setting the hoist in position, check that the suspension hook or coupling is correctly positioned, depending on whether the chain hoist is a one-fall or two-fall design. This is necessary for proper balance of hoist when loaded.

Suspension (perpendicular) with LM05 or LM10 hoists



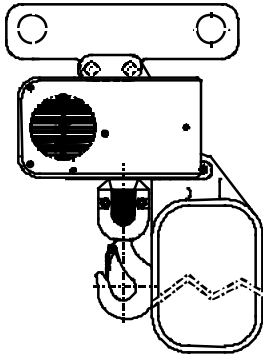
Suspension (parallel) with LM05 or LM10 hoists



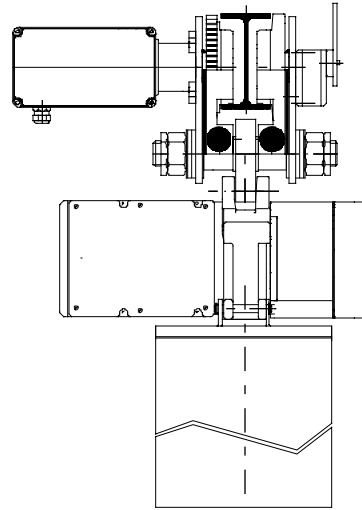
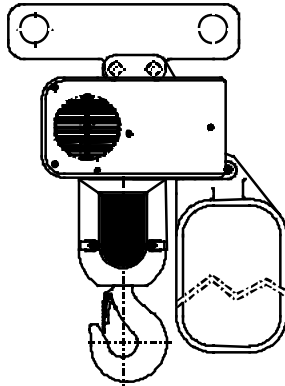


Suspension with LM16, LM20 or LM25 hoists

1 fall



2 falls





1.3 TMU Trolley Flange Settings Table

Flange Width In [mm]	C1 Trolley				C2 Trolley				C3 Trolley				C5 Trolley						
			mm 4	mm 2			mm 4	mm 2			mm 3	mm 2			mm 6	mm 2.5			
2.52 [64]	225	4	0	2	260	0	0	0	305				309						
2.60 [66]		6	2	0		2	0	1											
2.83 [72]		14	4	1		8	2	0											
2.87 [73]		16	4	2		10	2	1											
2.91 [74]		18	6	0		10	2	1											
3.19 [81]		22	6	2		17	4	1											
3.23 [82]		24	8	0		17	4	1			3	0		1			6	1	0
3.50 [89]		30	8	3		25	6	1			8	2		0			12	2	0
3.54 [90]		30	10	0		25	6	1			11	2		1			14,5	2	1
3.58 [91]		32	10	1		28	6	2			11	2		1			14,5	2	1
3.86 [98]	36	12	0	34	8	1		19	4	1			20,5	3	1				
3.94 [100]	40	12	2	36	8	2		198	4	1			24	4	0				
4.17 [106]	270	0	0	0	325	42	10	1	355	27	6	1	381	30	5	0			
4.25 [108]		2	0	1		44	10	2		27	6	1				32,5	5	1	
4.33 [110]		3	1	0		46	10	3		30	6	2				35	5	2	
4.45 [113]		8	2	1		48	12	0		32	8	0				6	1	0	
4.65 [118]		9	3	0		54	12	3		38	8	2				12	2	0	
4.69 [119]		11	3	1		54	12	3		38	8	2				12	2	0	
4.72 [120]		12	4	0		56	14	0		40	10	0				14,5	2	1	
4.92 [125]		16	4	2		60	14	2		46	10	2				18	3	0	
4.96 [126]		18	4	3		62	14	3		46	10	2				20,5	3	1	
5.16 [131]		20	6	1		2	0	1		51	12	1				24	4	0	
5.24 [133]	270	22	6	2	390	6	0	3	415	54	12	2	429	26,5	4	1			
5.31 [135]		24	8	0		8	2	0		54	12	2				30	5	0	
5.39 [137]		26	8	1		8	2	0		56	14	0				30	5	0	
5.51 [140]		30	10	0		12	2	2		3	0	1				32,5	5	1	
5.63 [143]		32	10	1		14	2	3		6	0	2				36	6	0	
5.75 [146]		36	12	0		17	4	1		8	2	0				42	7	0	
5.79 [147]		38	12	1		20	4	2		8	2	0				42	7	0	
5.87 [149]		40	12	2		20	4	2		11	2	1				42	7	0	
5.91 [150]		46	12	3		22	4	3		11	2	1				44,5	7	1	
6.10 [155]						26	6	1		16	4	0				6	1	0	
6.22 [158]				30	6	3	19	4	1			8,5	1	1					
6.30 [160]				32	8	0	22	4	2			12	2	0					
6.53 [166]				38	8	3	227	6	1			17	2	2					
6.62 [168]				40	10	0	30	6	2			20,5	3	1					
6.69 [170]				42	10	1	32	8	0			20,5	3	1					
7.00 [178]				50	12	1	40	10	0			30	5	0					
7.08 [180]				52	12	2	43	10	1			32,5	5	1					
7.28 [185]				56	14	0	46	10	2			36	6	0					
7.32 [186]				58	14	1	48	12	0			38,5	6	1					
7.40 [188]				60	14	2	51	12	1			38,5	6	1					
7.48 [190]				62	14	3	51	12	1			42	7	0					
7.79 [198]				6	0	3	3	0	1			49,5	7	3					
7.87 [200]				8	2	0	3	0	1			50,5	8	1					
8.11 [206]				14	2	3	11	2	1			6	1	0					
8.26 [210]				17	4	1	14	2	2			12	2	0					
8.46 [215]				22	4	3	19	4	1			18	3	0					
8.58 [218]				26	6	1	22	4	2			20,5	3	1					
8.66 [220]				28	6	2	24	6	0			23	3	2					
8.90 [226]				34	8	1	30	6	2			30	5	0					
9.44 [240]				48	12	0	43	10	1			44,5	7	1					
9.76 [248]				56	14	0	51	12	1			52	7	4					
10.24 [260]				4	0	2	6	0	2			5	0	2					
10.55 [268]				12	2	2	14	2	2			12	2	0					
11.02 [280]				24	6	0	27	6	1			24	4	0					
11.34 [288]				32	8	0	35	8	1			32,5	5	1					
11.81 [300]				44	10	2	46	10	2			44,5	7	1					
11.89 [302]				46	10	3	48	12	0			47	7	2					
11.93 [303]				48	12	0	48	12	0			47	7	2					
11.97 [304]				48	12	0	51	12	1			48	8	0					
12.00 [305]				50	12	1	51	12	1			50,5	8	1					
12.05 [306]				50	12	1	51	12	1			50,5	8	1					
12.09 [307]				52	12	2	54	12	2			53	8	2					



12.13 [308]					52	12	2		54	12	2		53	8	2
12.13 [309]					54	12	3		54	12	2		53	8	2
12.20 [310]					54	12	3		56	14	0		54	9	0

1.4 Operating Tests – TMU Variable Frequency Drive



CAUTION!

Always be ready to press the emergency stop button.

- Check that the electrical connections and mechanical assemblies are all correct.
- Check that the operating parameters are as required.
- Check for loose electrical connections.
- Close the control enclosure cover.
- Check that the movements of the trolley are free from obstruction and do not cause any danger.
- Read the voltage of the main power supply and check that the Autotransformer taps match the readings.
- Turn on the power supply.
- Verify a voltage of 440 to 460v is being supplied from the autotransformer to the inverter (L1, L2, L3). If needed, change taps on the autotransformer to obtain a voltage within this range.
- If the trolley moves to the wrong direction, interchange any two motor leads (U, V, or W). Changing input leads (L1, L2, or L3) will not affect the shaft rotation direction. Ensure that the motion is in the proper direction with respect to the push button being pressed.
- Operate at minimum speed for 5 to 10 seconds. Accelerate up to maximum speed and hold it for 5 to 10 seconds.
- Carry out the same operation in the opposite direction, first at minimum speed and then at maximum speed.
- Check the operations of the left and right trolley travel limit switches. Limit switch is an optional component.

1.5 Operating Tests – TMU Two-speed Motor



CAUTION!

Always be ready to press the emergency stop button.

- Check that the electrical connections and mechanical assemblies are all correct.
- Check that the operating parameters are as required.
- Check for loose electrical connections.
- Close the control enclosure cover.
- Turn on the power supply.
- Check that the movements of the trolley are free from obstruction and do not cause any danger.
- Verify supply voltage matches the motor nameplate voltage.
- If the trolley moves to the wrong direction with respect to the push button pressed, interchange L1 and L2 leads on the contactor in the trolley control panel.



- Operate at minimum speed for 5 to 10 seconds. Accelerate up to maximum speed and hold it for 5 to 10 seconds.
- Carry out the same operation in the opposite direction, first at minimum speed and then at maximum speed.
- Check the operations of the left and right trolley travel limit switches. Limit switch is an optional component.

2 Technical Characteristics

CAUTION

Never exceed the maximum load capacity that is indicated on the rating plate on the TMU unit.

2.1 Specification and Minimum Radius Curve – TMU Variable Frequency Drive

Hoist compatibility with Trolley Type and TMU Variable Frequency Drive

Hoist	Fall	Max. Capacity	Trolley Type and Drive	Motor Type	Min. Radius Curve
LM05	1 & 2 falls	1 ton [1000 kg]	C2 + TMU VFD less gear reducer	MF06MK200	6.56 ft [2m]
LM10	1 fall				
LM10	2 fall	2 ton [2000 kg]	C2 + TMU VFD	MF06MK200	6.56 ft [2m]
LM16	1 & 2 falls	3 ton [3000 kg]	C3 + TMU VFD	MF06MK200	6.56 ft [2m]
LM20	1 or 2 falls				
LM25	1 or 2 falls				
LM20	2 falls	5 ton [5000 kg]	C5 + TMU VFD	MF06MK200	No radius
LM25	2 falls				Straight track only

The TMU variable frequency drive is available for power supply of 208, 230, 460 or 575v through the use of an autotransformer. In addition, a line reactor is used to protect the TMU VFD against voltage spikes. Both the autotransformer and the line reactor are mounted to the trolley idler side plate under a cover. For a power supply of 400v/50Hz, a transformer is not required. The VFD controls are totally enclosed, and the enclosure is mounted to the motor.

- Control Type: Variable Frequency Drive
- Main power supply: 208, 230, 400/50Hz, 460 or 575 VAC
- Control voltage: 115 VAC (48v optional; std. with 400v)
- Frequency: 50/60Hz
- Speed control method: 2 speed mode (default) or Infinitely variable
- Stopping method: Dynamic braking
- Brake Type: COMPACT Brake
- Acceleration/Deceleration: 2.50 seconds (default)
- Motor overload protection: Bimetal switch (option)
- Protection: IP-55 (NEMA 3R type enclosure)
- Approvals: CSA "C" and "US"

Gearless TMU Variable Frequency Drive (loads ≤ 1 ton [1000 kg])

- Nominal output power of gearless TMU: 0.2 hp [0.15 kW]
- Travel speeds: 65/16 fpm [20/5 m/min]
- Motor frequency: 35 Hz
- Motor Type: MF06MK200 gearless
- Starting Current: 2.3A



- Nominal Current 1.1A

Geared TMU Variable Frequency Drive (loads >1 ton [1000 kg]) at 460v-60Hz

- Nominal output power of geared TMU: 0.5 hp [0.37 kW]
- Travel speeds: 65/16 fpm [20/5 m/min]
- Motor frequency: 100 Hz
- Motor Type: MF06MK200
- Starting Current: 4.3A
- Nominal Current: 1.2A

The inverter can be programmed to achieve a wide range of minimum and maximum travel speeds. See Section 4.2.1 for more information regarding inverter travel speed settings.

2.2 Specification and Minimum Radius Curve – TMU Two-speed Motor

Hoist compatibility with Trolley Type and TMU Two-speed Motor

Hoist	Fall	Max. Capacity	Trolley Type and Drive	Motor Type	Min. Radius Curve
LM05	1 & 2 falls	1 ton [1000 kg]	C1 + TMU Two-speed	MF06MK104	6.56 ft [2m]
LM10	1 fall				
LM10	2 fall	2 ton [2000 kg]	C2 + TMU Two-speed	MF06MK104	6.56 ft [2m]
LM16	1 & 2 falls	3 ton [3000 kg]	C3 + TMU Two-speed	MF06MK104	6.56 ft [2m]
LM20	1 or 2 falls				
LM25	1 or 2 falls				
LM20	2 falls	5 ton [5000 kg]	C5 + TMU Two-speed	MF06MK104	No radius
LM25	2 falls				Straight track only

The trolley control panel is mounted directly to the motor.

- Control Type: Contactor controls
- Main power supply: 208, 230, 400/50Hz, 460 or 575 VAC
- Control voltage: 115 VAC (48v optional; std. with 400v)
- Frequency: 50/60Hz
- Speed control: Two-speed
- Brake Type: D.C. Disc Brake
- Motor overload protection: Bimetal switch (option)
- Protection: IP-55 (NEMA 3R type enclosure)
- Approvals: CSA “C” and “US”

TMU Two-speed Motor

- Motor Type: MF06MK104 two-speed motor
- Motor frequency: 60 Hz 50Hz
- Nominal output power: 0.5/0.9 hp 0.3/0.05 kW
- Synchronous speed: 3600/900 rpm 3000/750 rpm
- Starting Current: 3.9/1.1 A 3.5/1.0 A
- Nominal Current: 0.9 A 1.0 A
- Travel Speed: 80/20 fpm 20/5 m/min

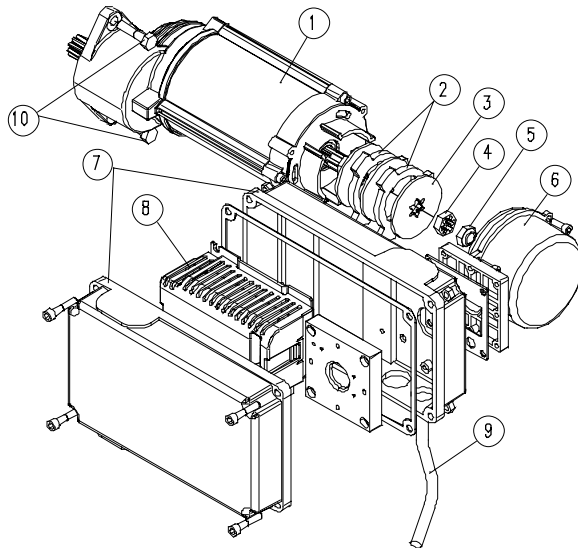
2.3 Environmental Data

- Ambient temperature: 14°F to +104°F [-10°C to +40°C]

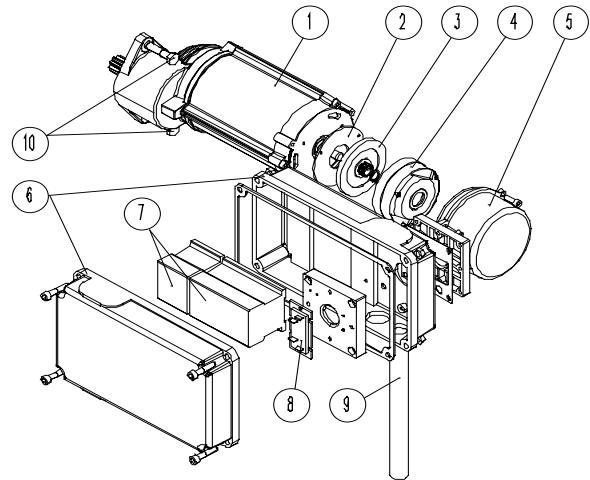


- Humidity: 90%RH (no condensation)
- Vibration: 0.2g_n (2m/s²)
- Sound level: 70 dB at 3 feet [1m]

3 TMU Drive



TMU Variable Frequency Drive



TMU Two-speed Motor

1. Gear/motor unit	6. Brake cover	1. Gear/motor unit	6. Control enclosure
2. Compact Brake	7. Control enclosure	2. Friction plate	7. Contactors
3. Brake disc	8. Variable frequency drive	3. Brake disc	8. Rectifier
4. Sleeve	9. Electrical cable	4. Brake	9. Electrical cable
5. Nut	10. Mounting screw	5. Brake cover	10. Mounting screws

*See Section 6.2 for Spare Part information

3.1 Motor

The motor insulation is class F and the degree of protection is IP55.

3.2 Description of the Gear Reducer

3.2.1 TMU VFD Gear Reducer

A single reduction gear reducer is used together with the 100/120 Hz inverter motor. Generally, this gear motor reducer is used when the capacity of the hoist is greater than 1 ton [1000 kg]. The output pinion is cut into the output shaft of the gearbox. Gears are lubricated with semi-fluid grease.

The 35 Hz inverter motor is used without a gear reducer. Generally, this gearless motor is used when the capacity of the hoist is 1 ton [1000 kg] or less. The trolley wheels are directly driven from the motor.

3.2.2 TMU Two-speed Motor Gear Reducer

A single reduction gear reducer is always used together with the two-speed motor regardless of load capacity. The output pinion is cut into the output shaft of the gearbox. Gears are lubricated with semi-fluid grease.



3.3 Description of the Brakes

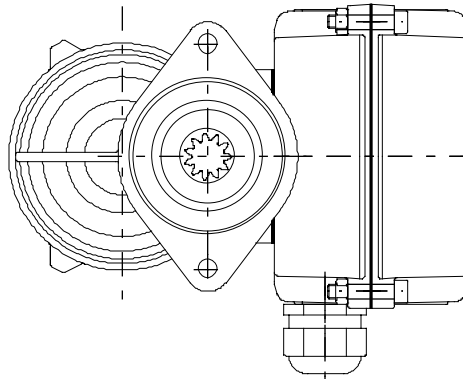
3.3.1 Compact Brake

The Compact brake is integrated into the design of the MF06 inverter motor and is AC operated - without a separate coil for the brake. An electromagnetic force produced from the energized motor stator winding releases the brake. Since the MF06 inverter motor is always operated with a TMU VFD that provides dynamic braking, the Compact brake is essentially a holding brake. The brake sets when the motor decelerates to zero and a spring applies a clamping force.

3.3.2 D.C. Disc Brake

The D.C. Disc brake is mounted to the two-speed motor and utilizes a D.C. coil. The coil releases the brake disc. Several springs apply the clamping force.

3.4 Mounting Position of Drive Unit



The TMU drive unit is to be positioned so that the control enclosure is located to the side of the motor, with the power cable outlet pointing down as shown above.

Other mounting positions of the drive are not recommended because they reduce the cooling effectiveness and may cause overheating of the controls.

3.5 Mounting the Drive Unit

- Be sure the main power supply is switched off - to avoid electrical hazard.
- Align the pinion teeth with the wheel gear teeth. Push the drive unit against the trolley side plate.
- Rotate the machinery to the proper mounting position. Note: the motor brake prevents the free rotation of the motor. So either release the brake or raise the drive wheels off the rail.
- Insert the mounting bolts. Use lock washers
- Tighten the mounting bolts by hand until snug.
- If the drive wheels are raised up, lower the wheels down before beginning the final tightening of the mounting bolts. Note: Wheels must lie on the track when tightening the mounting bolts to ensure that no excessive loads are directed toward the secondary shaft. Recommended tightening torque for M8 bolt is 18 ft-lbs [24 Nm].
- Connect the power cable plug to the hoist.

3.6 Removing the Drive Unit

- Disconnect power and lockout disconnecting means on the crane/hoist.
- Disconnect the power cable plug from the hoist.
- Loosen and remove the mounting bolts.
- Remove the drive unit from the trolley side plate.



3.7 Inspection and Service of the Drive Unit

- Check the tightness of the mounting bolts.
- Check the traveling motion: acceleration and deceleration.
- Check the brake for wear of the friction linings. If necessary, clean the brake and replace the friction linings.
- Check the air gap of the brake.
- Check that the inverter or contactors operate correctly.
- Gears are lubricated with semi-fluid grease. See Preventative Maintenance section for grease type.

3.8 Adjustment of Compact Brake Air Gap

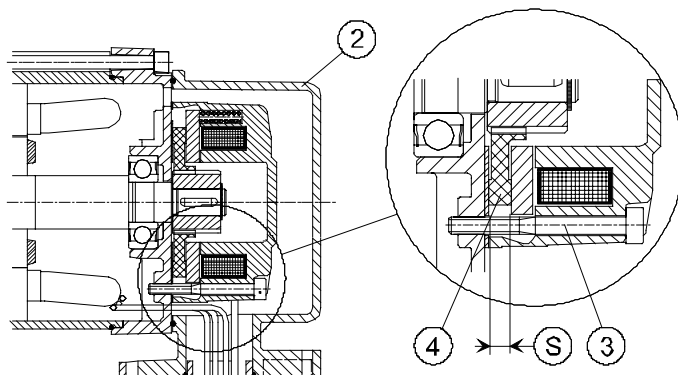
- Disconnect power and lockout disconnecting means on the crane/hoist.
- Disconnect the power cable plug from the hoist.
- Remove brake and motor leads from enclosure.
- Remove the brake cover.
- Push the brake disk and measure the air gap between the adjustment nut and aluminum ring. The air gap must be 0.008 – 0.012 inches [0.2 - 0.3 mm]. Turn the adjustment nut, to adjust the air gap.
- Add the brake cover, install brake and motor leads, and connect the power supply plug to motor.

3.9 Removal and Inspection of the Brake

3.9.1 Compact Brake

- Disconnect power and lockout disconnecting means on the crane/hoist.
- Disconnect the power cable plug from the hoist.
- Remove the brake cover.
- Unscrew and remove the adjustment nut.
- Remove the brake parts. If the thickness of the friction disc is less than 0.197" [5 mm], replace brake discs and friction disc.
- Re-assemble in the reverse order.
- Adjust the brake air gap.

3.9.2 D.C Disc Brake



- 2. Brake cover
- 3. Mounting screws
- 4. Friction disc
- S. Thickness of friction disc

Data below is for NM38710NR#, 2 Nm
brake type and torque size

- Disconnect power and lockout disconnecting means on the crane/hoist.
 - Disconnect the power cable plug from the hoist.
 - Remove the brake cover.
 - Unscrew the mounting screws.
 - Remove the brake. If the thickness of the friction disc is less than 0.23" [5.8 mm], replace brake discs and friction disc.
 - Re-assemble in the reverse order.
 - Recommended tightening torque for mounting screws is 1.8 lb-ft [2.5 Nm]
- The air gap on the D.C Brake is not adjustable.



3.10 Trouble Shooting – Brake

3.10.1 Compact Brake

The Compact brake is used on the MF06 inverter motor only.

Brake will not released:

- ✓ Air gap too large ⇒ adjust air gap
- ✓ Presence of foreign matter ⇒ clean brake
- ✓ Check Motor Parameter setting ⇒ consult Section 4.2.3

Insufficient braking torque:

- ✓ Grease on lining ⇒ replace lining
- ✓ Damaged lining ⇒ replace lining
- ✓ Air gap too large ⇒ adjust air gap
- ✓ Worn friction material ⇒ replace lining

3.10.2 D.C. Disc Brake

The D.C. Disc brake is used on the two-speed motor only.

Brake will not released:

- ✓ Presence of foreign matter ⇒ clean brake
- ✓ Bad rectifier ⇒ replace rectifier

Insufficient braking torque:

- ✓ Grease on lining ⇒ replace lining
- ✓ Damaged lining ⇒ replace lining
- ✓ Air gap too large ⇒ replace friction material
- ✓ Worn friction material ⇒ replace friction material

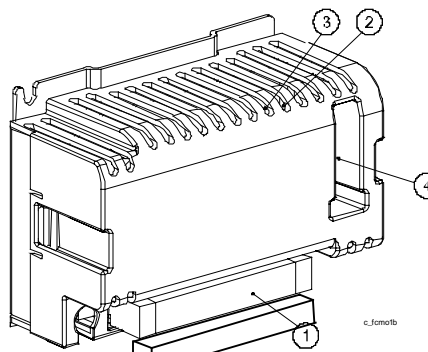
4 TMU Variable Frequency Drive

4.1 Description of the Inverter



Do not touch any circuit components while the main AC power is on. High voltages are supplied to the inverter (including the programming switches). Wait for at least three minutes after the supply voltage has been switched off before performing any service on the unit. Failure to adhere to this warning can result in injury.

1. Terminal X1
2. Red LED (fault)
3. Green LED (ok)
4. Programming switches
5. Capacitor



Inverter cooling is optimal when the air flows through the device from the bottom to the top. If the inverter is mounted sideways, the output current must be de-rated by 40%.



4.1.1 Connections

The required supply voltage for the inverter is 380v/50Hz to 480v/60Hz. For other available three-phase voltages including 460v, an autotransformer is provided to supply the proper voltage to the inverter. See Section 1.4, Operating Tests, with regards to the verification of the output voltage from the autotransformer to the inverter.

Power and control circuit connections are made to X1 terminal as follows:

Number	Name	Description
1	PE	Ground
2	L1	Power phase 1. 380-480V 50/60Hz.
3	L2	Power phase 2. 380-480V 50/60Hz.
4	L3	Power phase 3. 380-480V 50/60Hz.
5	U	Motor phase 1.
6	V	Motor phase 2.
7	W	Motor phase 3.
8	S1	Drive command. Direction 1.
9	S2	Drive command. Direction 2.
10	SP2/AP	Speed 2 / Acceleration command.
11	ON	Control voltage, neutral.

A minimum of two collectors for each runway conductor shall be used with inverter use.

In addition, the use of a ground shall be utilized, either through the frame ground or a conductor ground.

Proper grounding is important with inverter use. A poor ground could cause damage to the inverter or could create a shock hazard to personnel.

4.1.2 Technical Characteristics

Technical Characteristics	Description
Power range	0.75 kW
Supply voltage*	380 – 480 VAC ±10%
Nominal supply frequency	48 – 62 Hz
Nominal current	2.4 A
Digital control	S1, S2, DI3
Max output voltage	Equal to supply voltage
Control voltage range	48 or 115 VAC ±10%
Ambient temperature	-10 °C to 50 °C 14 °F to 120 °F
Humidity	95% N. C. (with dripping)
Degree of protection	Inverter + inverter cover IP20
Dimensions (W x H x D)	5.24 x 3.62 x 2.36 in. [133 x 92 x 60 mm]
Altitude	Output current must be reduced 1% for every 100 m over 1000 m. For heights over 3000 m, consult factory.
Pollution degree	Pollution degree 2 according to NEMA ICS-1, IEC664 and UL840
Vibration	IEC68-2-6
Shock	IEC68-2-27

* A transformer is used to provide the proper supply voltage if the main power supply is different from the required supply voltage.



4.1.3 Normal Operation for Trolley

The inverter goes into Ready-to-Run within one second after power is applied to the inverter. During running, the inverter follows the user defined speed control mode.

The default speed control mode is the two-speed (MS-2).

The stopping method, which the user cannot change on TMU VFD, is programmed to decelerate to a stop using dynamic braking. As a result of this, the brake is used essentially as a holding brake and the wear on the brake is minimized. When the RUN Forward/Reverse command is removed, the inverter decelerates to zero according to its preset ramp time and then the brake sets. If a failure occurs or if the emergency stop button is pushed, dynamic braking is overridden and the brake closes immediately, bringing the motor and load to an immediate stop.

4.1.4 LED Status Indicator

TMU VFD indicates its operating status by two LEDs. A steady green LED indicates Ready-to-Run. A blinking green LED indicates that a fault condition had been activated, but the fault has since recovered. Normal operation is possible when the green LED is blinking. A blinking red LED indicates a severe fault condition and operation is inhibited. The blinking pattern tells the user the type of fault that has occurred.

4.2 Programming Parameters



Do not touch any circuit components while the main AC power is on. High voltages are supplied to the inverter (including the programming switches). Wait for at least three minutes after the supply voltage has been switched off before performing any service on the unit. Failure to adhere to this warning can result in injury.

Before shipping the unit to you, the parameters are set at the factory, which may be different from the default settings, to meet the performance requirements for your crane application. Changing parameters without full understanding of the inverter functions could cause damage to the equipment or create an unsafe condition.

The TMU VFD uses dip switches to program the features. The state of each switch is either OFF (0) or ON (1). There are five parameters that are possible to set by switches S1 through S4.

- Switch S1 = Maximum speed, upper frequency output setting
- Switch S2 = Minimum speed, lower frequency output setting
- Switch S3 = Acceleration / Deceleration Ramp Time
- Switch S4 = Control Mode (S4-1) and Motor Parameters (S4-2-3-4)



S1



S2



S3



S4



4.2.1 Speeds and Ramp Time Selections

Frequency Output Selection (Set Switches S1 and S2)

The minimum and maximum speeds are selected by setting the minimum output frequency and the maximum output frequency. Switch S1 sets the maximum output frequency selection and Switch S2 sets the minimum output frequency selection. Table "A" is used for the 35Hz gearless motor and table "B" for the 100Hz motor.

Switch S1 / S2				SPEED TABLE A MF06MK200 35 Hz Gearless Motor				SPEED TABLE B MF06MK200 100Hz Motor			
				Minimum Speed		Maximum Speed		Minimum Speed		Maximum Speed	
-1	-2	-3	-4	S2 switch	Trolley Speed fpm [m/min]	S1 switch	Trolley Speed fpm [m/min]	S2 switch	Trolley Speed fpm [m/min]	S1 switch	Trolley Speed fpm [m/min]
0	0	0	0	8 Hz	26 [8]	35 Hz	121 [37]	29 Hz	20 [6]	100 Hz	66 [20]
0	0	0	1	9 Hz	29.5 [9]	19 Hz	66 [20]	14 Hz	10 [3]	50 Hz	33 [10]
0	0	1	0	13 Hz	46 [14]	22 Hz	75 [23]	23 Hz	16 [5]	62 Hz	43 [13]
0	0	1	1	4 Hz	13 [4]	20 Hz	69 [21]	10 Hz	6.5 [2]	54 Hz	36 [11]
0	1	0	0	15 Hz	53 [16]	28 Hz	95 [29]	32 Hz	20 [6]	80 Hz	53 [16]
0	1	0	1	5 Hz	16 [5]	21 Hz	72 [22]	12 Hz	6.5 [2]	58 Hz	40 [12]
0	1	1	0	6 Hz	20 [6]	23 Hz	79 [24]	16 Hz	10 [3]	66 Hz	43 [13]
0	1	1	1	7 Hz	23 [7]	25 Hz	85 [26]	18 Hz	13 [4]	70 Hz	46 [14]
1	0	0	0	19 Hz	66 [20]	41 Hz	141 [43]	50 Hz	33 [10]	115 Hz	75 [23]**
1	0	0	1	10 Hz	33 [10]	26 Hz	89 [27]	20 Hz	13 [4]	75 Hz	49 [15]
1	0	1	0	11 Hz	40 [12]	30 Hz	102 [31]	26 Hz	16 [5]	85 Hz	56 [17]
1	0	1	1	12 Hz	43 [13]	32 Hz	112 [34]	35 Hz	23 [7]	90 Hz	59 [18]
1	1	0	0	14 Hz	49 [15]	33 Hz	115 [35]	38 Hz	26 [8]	95 Hz	62 [19]
1	1	0	1	16 Hz	56 [17]	37 Hz	128 [39]	41 Hz	26 [8]	105 Hz	69 [21]**
1	1	1	0	17 Hz	59 [18]	39 Hz	135 [41]	44 Hz	29.5 [9]	110 Hz	72 [22]**
1	1	1	1	18 Hz	62 [19]	42 Hz	144 [44]	47 Hz	33 [10]	120 Hz	79 [24]**

** TMU VFD connected to a 50Hz power supply cannot achieve these speeds. These speeds are available only from a 60Hz power supply.

EXAMPLE OF PARAMETER SETTING:

A 100Hz motor is connected to the inverter and 80Hz maximum speed is desired. That speed is found on the 5th row of speed table B. The corresponding setting for S1 switches is in the same row to the left: 0-1-0-0 (off-on-off-off).



Max speed set to 80Hz.

Acceleration and Deceleration Ramp Time

The acceleration and deceleration ramp times are set using switch S3 as follows:

Switch S3				Acceleration/deceleration ramp time
-1	-2	-3	-4	
0	0	0	0	2.5 sec (default)
0	0	0	1	3.5 sec
0	0	1	0	3.0 sec
0	0	1	1	5.0 sec
1	0	0	1	4.0 sec
1	0	1	1	6.5 sec
1	1	0	0	4.5 sec
1	1	0	1	6.0 sec
1	1	1	0	5.5 sec



The default setting for the acceleration and deceleration ramp time is 2.5 seconds. The acceleration ramp time always equals the deceleration ramp time. Do not reset ramp time below 2.5 seconds.

The TMU VFD stopping method is always the Deceleration to stop (dynamic braking) and extreme caution should be used taking into consideration the value of switch S3. If the deceleration time is too long, crane/hoist can crash into the end stops, causing damage to equipment or injury to personnel.

4.2.2 Speed Control Mode

The TMU VFD provides the user with the flexibility of selecting either Two-step Multi-Speed Control (MS-2) or a Two-step Infinitely Variable (EP-2) mode. The speed control mode is set by Switch S4-1.

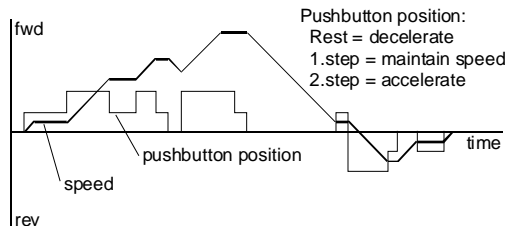
Multi-Speed Control Mode (MS-2) (S4-1 = OFF)

The TMU VFD features 2-step Multi-Speed Control Mode and Decelerate to Stop using dynamic braking stopping method.

- ❑ S1 input is RUN Forward. Frequency output increases to frequency set by DIP switch S2. Operation continues at this frequency (minimum speed).
- ❑ S2 input is RUN Reverse. Frequency output increases to frequency set by DIP switch S2. Operation continues at this frequency (minimum speed).
- ❑ SP2 input/second speed command. Frequency (speed) output increases to frequency set by DIP switch S1. Operation continues at this frequency (maximum speed).
- ❑ Upon removal of SP2 input/second speed command, the frequency (speed) output decreases to frequency set by DIP switch S2. Operation continues at this frequency (minimum speed).
- ❑ Upon removal of S1 input and S2 input (Run Forward/Reverse), the stopping method is Decelerate to Stop. Output frequency decreases and the inverter decelerates to zero. Then the brake sets.

Two-step Infinitely Variable Speed Control (EP-2) (S4-1 = ON)

The TMU VFD features Two-step Infinitely Variable Speed Control and Decelerate to Stop using dynamic braking.



- ❑ S1 input is RUN Forward. Frequency output increases to frequency set by DIP switch S2. Operation continues at this frequency (minimum speed).
- ❑ S2 input is RUN Reverse. Frequency output increases to frequency set by DIP switch S2. Operation continues at this frequency (minimum speed).
- ❑ AP input is acceleration. Frequency (speed) output increases. The longer this contact is closed, the higher the speed output becomes. Limited only by the setting if DIP switch S2.
- ❑ During running S1 input and S2 input are Hold speed. Frequency output remains constant.
- ❑ Upon removal of S1 input and S2 input (RUN Forward/Reverse), the stopping method is Decelerate to STOP. Output frequency decreases and the inverter decelerates to zero. Then the brake sets.



4.2.3 Motor Parameters

The motor parameters are selected by setting switches S4-2, S4-3 and S4-4. The motor parameters must correspond to the motor type being used. The motor parameters are selected as follows:

Switch S4			Motor type	Nominal frequency	Nominal Motor power
-2	-3	-4			
0	0	0	MF06MK200	100Hz	0.37kW [0.5 hp]
1	0	1	MF06MK200 gearless	35Hz	0.15kW [0.2 hp]

Incorrect motor parameter setting may damage the controls or the motor.



4.3 Fault Codes and Troubleshooting – TMU VFD



Do not touch any circuit components while the main AC power is on. High voltages are supplied to the inverter (including the programming switches). Wait for at least three minutes after the supply voltage has been switched off before performing any service on the unit. Failure to adhere to this warning can result in injury.

If the TMU VFD malfunctions, a fault lamp blinks on and off. The blinking pattern continues until a new fault occurs or until power is switched off. The fault codes are explained in the table below.

LED Color, Blinking Pattern	Possible cause.	What to do.
GREEN	Overvoltage. Supply voltage exceeds the specification allows.	Lower input voltage.
GREEN	Deceleration ramp time is too short.	Extend Deceleration time.
GREEN	Stall supervision / overcurrent. Brake does not open properly or an obstacle is on the track. Incorrect motor dependent parameter setup.	Adjust air gap. Repair/replace brake. Check that the motor parameter settings (switch S4) match the motor(s) supplied.
GREEN	Deceleration ramp supervision. Deceleration ramp has not been followed. Supply voltage greater than specification allows.	Reset to longer Deceleration ramp time. Check voltage of all supply phases at terminal X1.
GREEN	Inverter overtemperature. Motor current is too high (bearing problem, obstacle on the track, brake does not open properly). Ambient temperature is too high.	Repair bearing problem. Remove obstacle. Adjust air gap or repair or replace brake. Use a larger rated inverter.
GREEN	Undervoltage. Supply voltage < specification allows	Correct the input power supply problem. Check for single-phase problem.
RED	Short circuit. Break down in motor cable insulation. Break down in motor winding insulation. Inverter transistor failure.	Switch main power off. Replace the motor cables. Check motor resistance. Replace the motor. Replace inverter.
RED	Microprocessor fault. Due to high electrical noise environment.	Switch power off for 10 seconds, then back on.



NOTE! The latest active fault is always removed from the memory when power is switched off.

Drive will not run even though inverter is not in a fault condition:

- ✓ Motor will not start if DC-bus voltage too high (above 745V), this occurs if any line-to-line voltage exceeds 480V+5% = 504V. If line voltage cannot be reduced, install step-down transformer in inverter branch circuit.
- ✓ Check the supply voltage phases at terminal X1.
- ✓ Check the control signals at terminal X1.
- ✓ Check that the control voltage is correct. Rating plate is located on the left side of the inverter.
- ✓ Check all parameter selections, especially the motor parameters (switch S4).
- ✓ Check that the selected motor parameters (switch S4) correspond to the appropriate motor type.



- ✓ Check that the microprocessor starts running. Both the green and red indicator LEDs blink once as the inverter is powered up. After the one second initializing time, only the green LED should be lit.
- ✓ Check that the brake opens and closes properly. Check the brake air gap.
- ✓ Check plug connection for intermittent operations.

4.3.1 Troubleshooting Worksheet

Measure and Record:

Main hoist power leads L1-L2	Main hoist power leads L2-L3	Main hoist power leads L1-L3
Main hoist power leads L1-Gnd	Main hoist power leads L2-Gnd	Main hoist power leads L3-Gnd

Inverter Input power leads L1-L2	Inverter Input power leads L2-L3	Inverter Input power leads L1-L3
Inverter Input power leads L1-Gnd	Inverter Input power leads L2-Gnd	Inverter Input power leads L3-Gnd

Indicate Grounding system:

- 4th conductor of main power
- Frame ground
- Connected to hardware
- None

Indicate Collector System:

- Double shoe on each runway conductor
- Single shoe on each runway conductor

Indicate Control Transformer Voltage: _____ VAC

Indicate Power Supply Size to the equipment:

- ≤ 500 KVA
- > 500 KVA

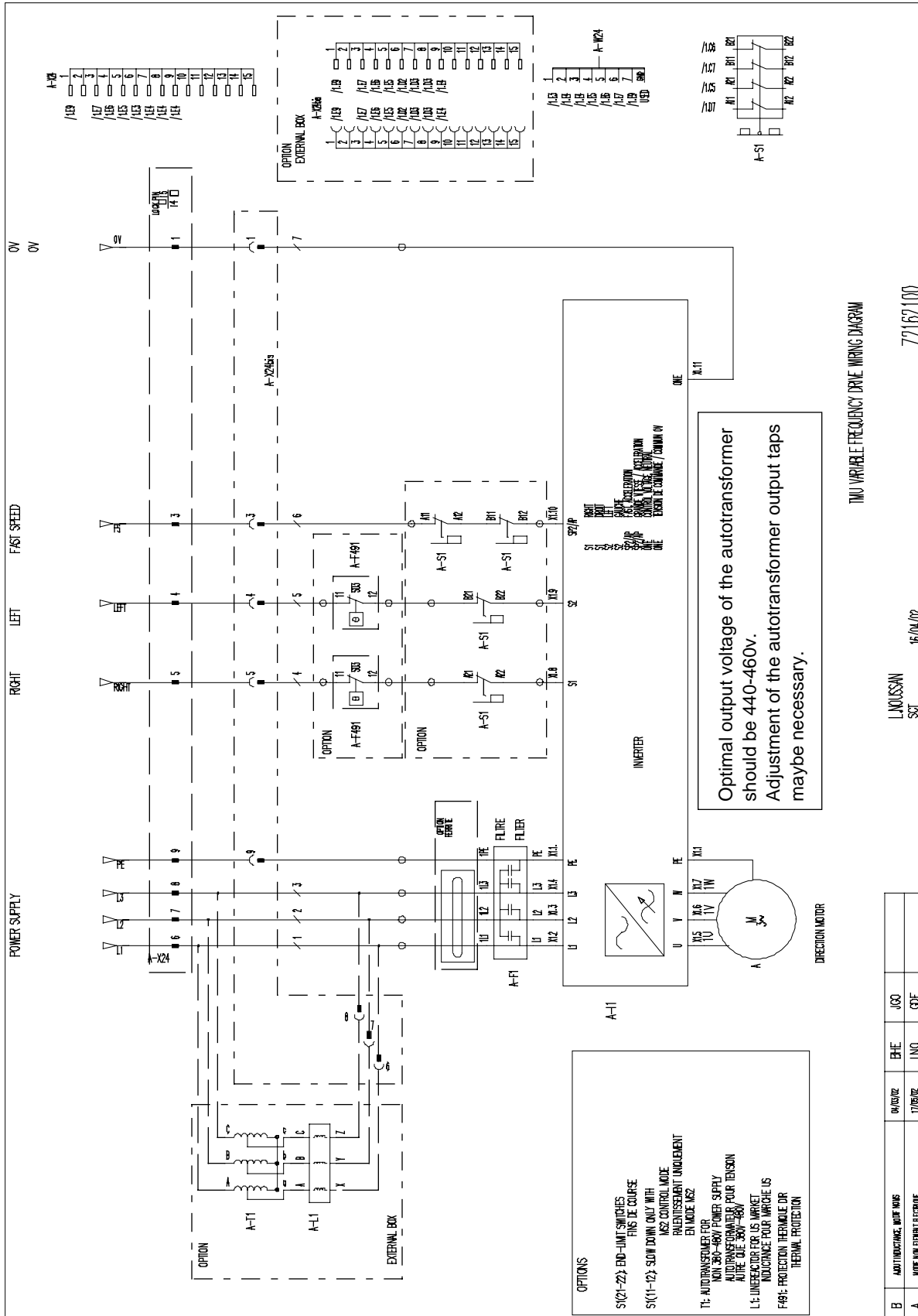


4.4 Wiring Specification

4.4.1 Wiring Practices – TMU Variable Frequency Drive

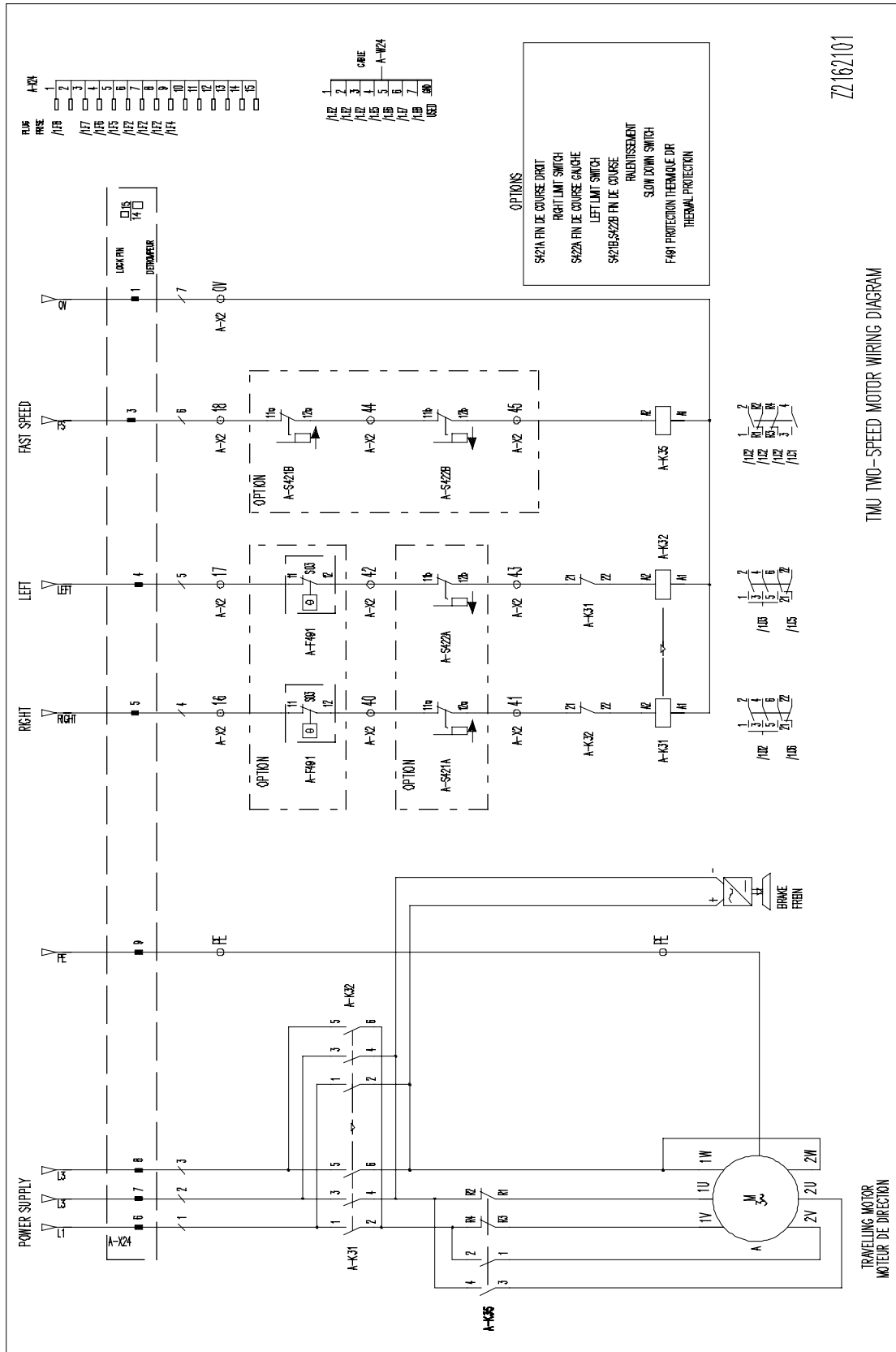
- ❑ Do not connect incoming three-phase AC power to the drive output terminals U, V or W.
- ❑ Do not ground the inverter together with any high-current machines.
- ❑ Before using welders or high-current machines near the crane, disconnect all line and ground wiring.
- ❑ Do not use output contactors between the inverter and the motor.
- ❑ Do not connect power factor correction capacitors to the drive input or output.
- ❑ Before turning on the inverter, check the output circuit (U, V, and W) for possible short circuits and ground faults.
- ❑ When using more than one transformer for the inverter's power, properly phase each transformer.
- ❑ To reverse the direction of rotation, interchange any two motor leads (U, V, or W). Changing input leads (L1, L2, or L3) will not affect the shaft rotation direction. Ensure that the motion is in the proper direction with respect to the push button being pressed.
- ❑ Inverter line voltage inputs (L1, L2 and L3) are voltage specific. Do not connect the wrong voltage to the unit.
- ❑ A minimum of two collectors for each runway conductor shall be used when an inverter is used. Also, the use of a ground conductor is recommended.
- ❑ Always mount the inverter in its proper vertical orientation so that the air can flow from bottom to top.
- ❑ Keep the inverter heatsink clear of any obstructions (components on panel) to ensure proper cooling airflow.
- ❑ Do not connect the power supply directly to the inverter motor – always run the inverter motor from the inverter.

4.4.2 Wiring Diagram – TMU Variable Frequency Drive





5 Wiring Diagram – TMU Two-speed





6 Preventative Maintenance

The service life of the TMU depends on the demands placed on it such as the average operating time, and the number of start/stops and its maintenance.

6.1 Maintenance table

Check	Interval	Qualification of personnel
Brake operation	Daily	Operator
For loose screws and signs of corrosion	Annually	Qualified mechanic
Condition of the brake air gap	Quarterly	Qualified mechanic
Condition of the drive pinion	Annually	Operator
Measurement of the wheel tread diameter	Annually	Operator
Lubrication of open gear	Quarterly	Operator

CAUTION! These intervals should be shortened if TMU is used daily for eight hours in 24 hour period, if it is used with maximum loads or in difficult ambient conditions.

6.2 Lubricants

Lubrication point	Specifications	Possible brands	Quantity
Wheel pinion	KP 0 K grease (DIN 51502) Soap-based lithium + MoS 2 Approx. melting point + 356°F Worked penetration 671 – 725°F Operating temperature	Tribol: Molub Alloy multi-purpose grease Aral: Aral P 64037 grease Aralub PMD0 BP: Multi-purpose grease L 21 M Esso: Multi-purpose grease M Mobil: Mobilgrease Special Shell: Shell Retimax AM	As necessary
Bearing (*)	- 22°F to + 266°F	Texaco: Molytex grease EP 2 Fuchs: Renolit FLM0	(*) 0.02 L
Gear reducer		Mobilux EP00	

6.3 Spare Part Replacement

After a long period of non-use or during a routine check, check the operation and adjustment of the safety items (brake, end stops...). If there is a possibly defective element, deformation or abnormal wear, the parts must be changed.

CAUTION! Disconnect the power supply before replacing any parts.

If a part has been replaced, check the operation of the equipment before the equipment is returned to service.

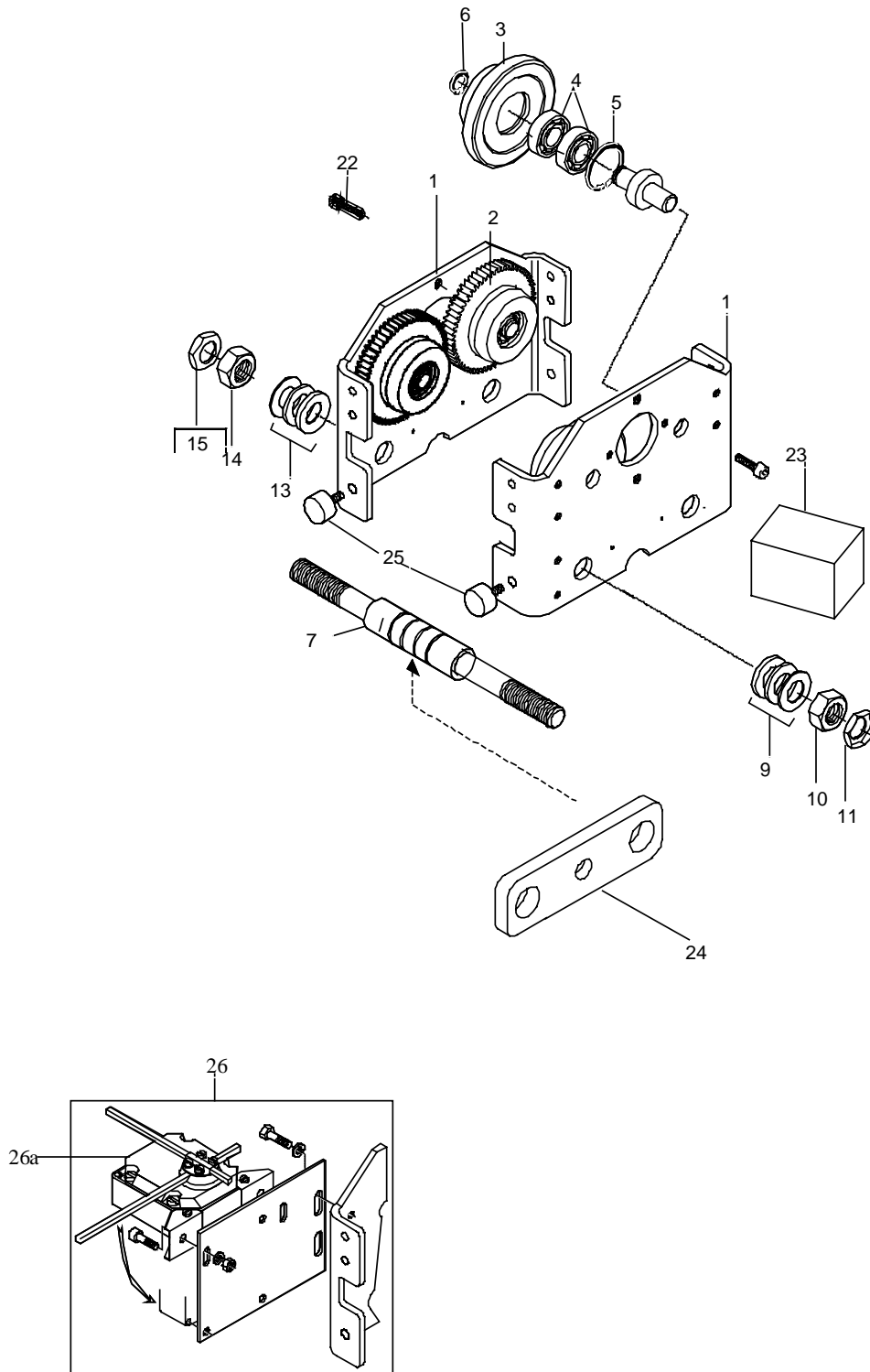
6.4 Discarding the Trolley

Remove all grease from the trolley and gear reducer before discarding the unit to the recycle center.



7 Spare Parts

7.1 TMU Trolley





TMU Trolley

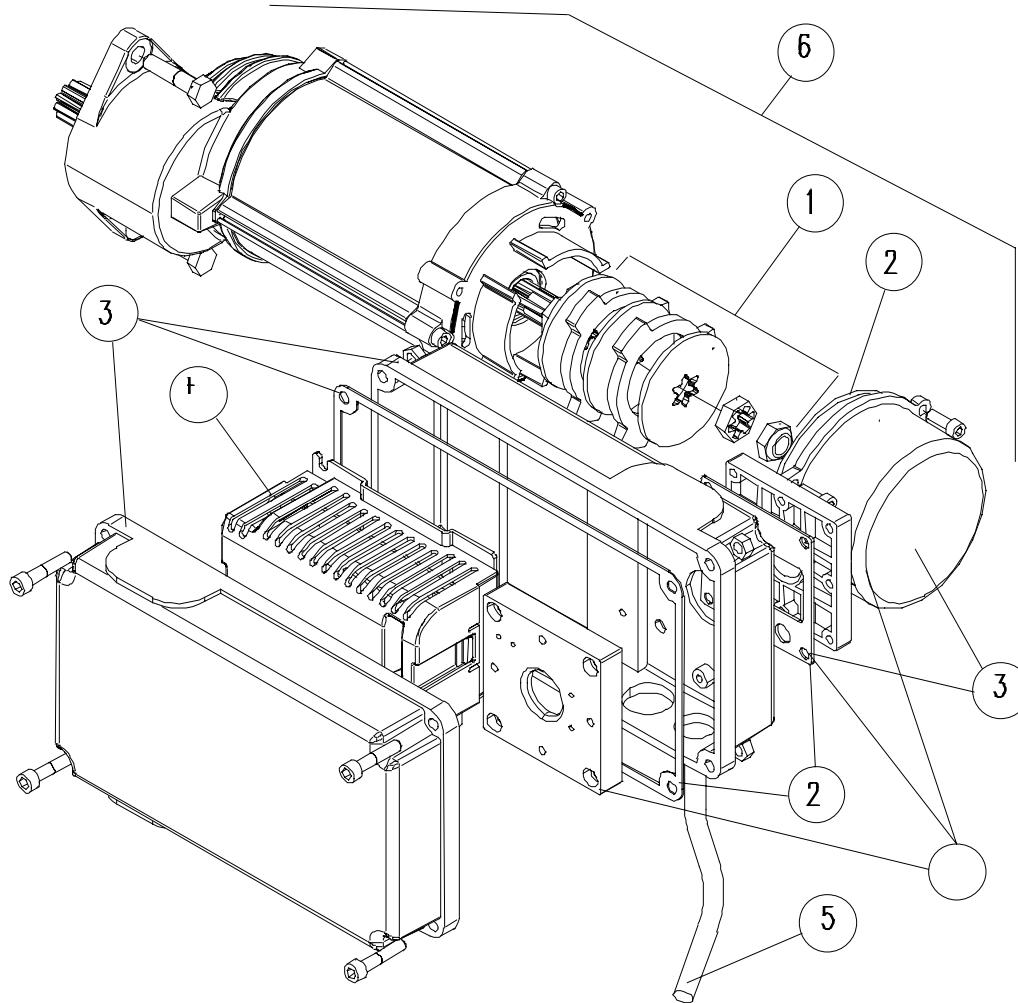
Item	Qty.	C1 ≤1000kg	C2 ≤2000kg	C3 ≤3200kg	C5 ≤5000kg	Description
1+3+4+5+6	1	2149901	2229916	2169901	2189901	Side plate assembly - idler
1+2+4+5+6	1	2149900	2229928	2169910	2189913	Side plate assembly - drive
7+9+10+11+2 4	1	2229894	-	-	-	Cross head assembly = 2.28-3.94 in. 55-100 mm
7+9+10+11+2 4	1	2229895	-	-	-	Cross head assembly = 4.17-5.90 in. 106-150 mm
7+9+10+11+2 4	1	2229896	-	-	-	Cross head assembly = 6.10-7.87 in. 155-200 mm
7+9+10+11+2 4	1	2229897	-	-	-	Cross head assembly = 8.11-9.76 in. 206-248 mm
7+9+10+11+2 4	1	2229898	-	-	-	Cross head assembly = 10.23-12.09 in. 260-307 mm
7+9+10+11+2 4	1	-	2229944	-	-	Cross head assembly = 2.54-4.96 in. 64-126 mm
7+9+10+11+2 4	1	-	2229945	-	-	Cross head assembly = 5.16-7.48 in. 131-190 mm
7+9+10+11+2 4	1	-	2229946	-	-	Cross head assembly = 7.80-9.76 in. 198-248mm
7+9+10+11+2 4	1	-	2229947	-	-	Cross head assembly = 10.24-12.2 in. 260-310 mm
7+9+10+11+2 4	1	-	-	2169902	-	Cross head assembly = 3.28-5.39 in. 82-137 mm
7+9+10+11+2 4	1	-	-	2169903	-	Cross head assembly = 5.51-7.48 in. 140-190 mm
7+9+10+11+2 4	1	-	-	2169904	-	Cross head assembly = 7.80-9.76 in. 198-248 mm
7+9+10+11+2 4	1	-	-	2169905	-	Cross head assembly = 10.24-12.2 in. 260-310 mm
7+9+10+11+2 4	1	-	-	-	2189902	Cross head assembly = 3.23-4.33 in. 82-110 mm
7+9+10+11+2 4	1	-	-	-	2189903	Cross head assembly = 4.45-5.91 in. 113-150 mm
7+9+10+11+2 4	1	-	-	-	2189904	Cross head assembly = 6.10-7.87 in. 155-200 mm
7+9+10+11+2 4	1	-	-	-	2189905	Cross head assembly = 8.11-9.76 in. 206-248 mm
7+9+10+11+2 4	1	-	-	-	2189906	Cross head assembly = 10.24-12. In. 260-310 mm

Item	Qty.	C1 ≤1000kg	C2 ≤2000kg	C3 ≤3200kg	C5 ≤5000kg	Description
1	2	-	-	-	-	Side plate
2	2	558909	558919	558929	558949	Drive wheel with bearings 2+4+5
2a	2	2309781002	2309782002	2309783002	2309784002	Patented track drive wheel assy
3	2	558908	558918	558928	558948	Idle wheel with bearings 3+4+5
3a	2	2309781001	2309782001	2309783001	2309784001	Patented track idler wheel assy
6	4	-	-	-	-	Circlips external
7	2	-	-	-	-	Tension rod
9	-	-	-	-	-	Washers
10	4	-	-	-	-	Nut
11	4	-	-	-	-	PAL
22	2	830203	830203	830203	830203	CHC Screw (for drive)
23	2	558868	-	-	-	Counterweight
24	1	-	-	-	-	Adapter (perpendicular)



25	4	558993	558993	558993	558993	Bumper
26	1	2104205001	2104205001	2104205001	2104205001	Complete limit switch
26a	1	50004910	50004910	50004910	50004910	Limit switch
26b	1	558995	558995	558995	558995	Bracket – limit switch

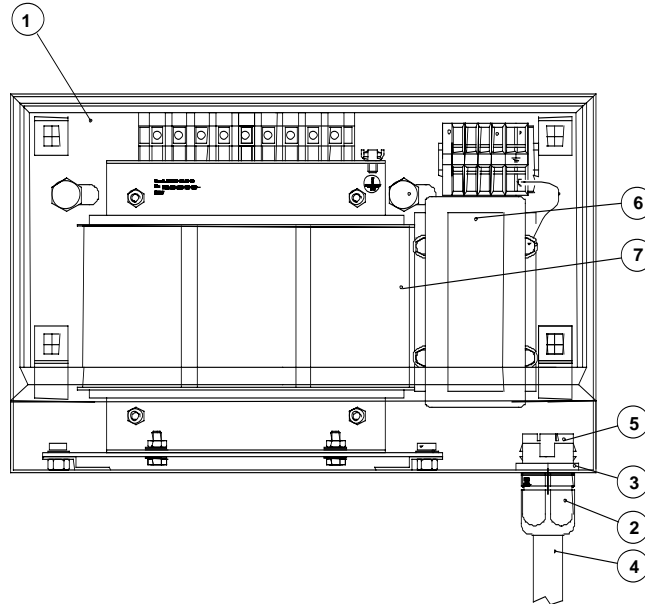
7.2 TMU Variable Frequency Drive



Item	Part Number	Description	Specification
1	52296293	Brake repair kit	M06-001V
2	52300292	Gasket set	M06-008V
3	52000291	Enclosure	M06-007V
4	52300287	Inverter + filter 48v control	M06-003V
4	52300288	Inverter + filter 115v control	M06-004V
5	52297959	Electrical cable + plug + cable gland + nut	CCGCELCP-04
6	52299087	Complete gear motor drive + VFD – 48v control	
6	52299088	Complete gear motor drive + VFD – 115v control	
6	52299089	Complete gearless motor drive + VFD – 48v control	
6	52299090	Complete gearless motor drive + VFD – 115v control	
7		Brake cover kit with gasket	



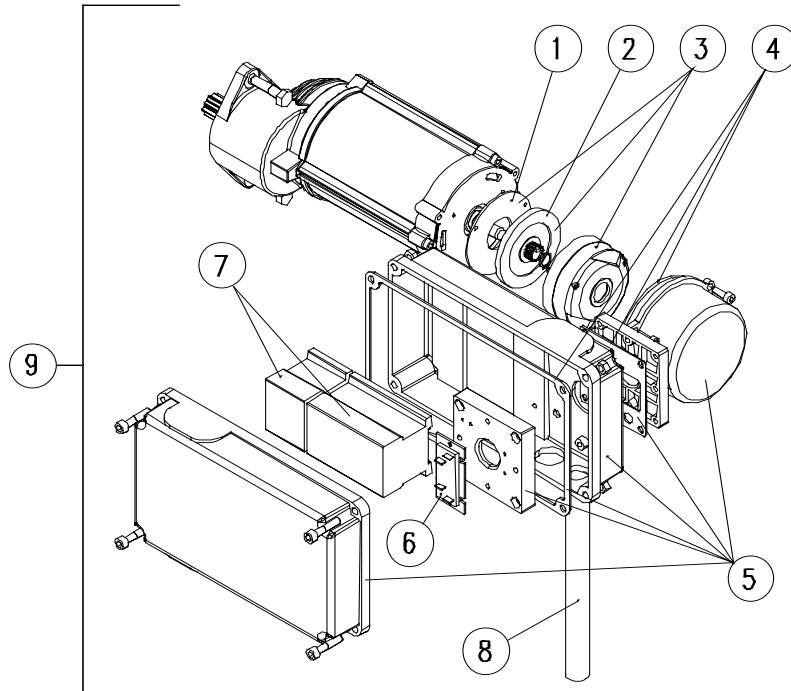
7.3 TMU VFD Transformer & Line Reactor



Item	Qty	Part number	Description
1	1	52303806	Complete transformer/reactor package – 208 or 230v (2+3+4+5+6+7)
1	1	52303807	Complete transformer/reactor package – 460v (2+3+4+5+6+7)
1	1	52303308	Complete transformer/reactor package – 575v (2+3+4+5+6+7)
2+3+4+5	1	52297959	Electrical cable + plug + cable gland + nut
6	1	52297959	Line reactor
7	1	52299489	Transformer 208/230v – 440v
7	1	52299494	Transformer 460v – 440v
7	1	52299492	Transformer 575v – 440v



7.4 TMU Two-speed Motor



Item	Part Number	Description	Specification
1	52269590	Friction wear plate	NM38710KLV
2	52269587	Friction disc	NM38710JPV
3	52269582	Complete brake 180 vdc coil (208, 230, 400, 460vac)	NM38710NR2V
3	52269583	Complete brake 240 vdc coil (575vac)	NM38710NR3V
4	52300292	Gasket set	M06-008V
5	52300291	Brake cover kit with gasket	M06-007V
6	60010152	Rectifier – Full wave (208, 230vac)	NM181NR2V
6	60003169	Rectifier – Half wave (400, 460, 575vac)	NM181NR4V
7	52306792	Contactors – 48v control	
7	52306794	Contactors – 115v control	
8	52297959	Electrical cable + plug + cable gland + nut	CCGCELCP-04
9	52306026	Complete drive – 460v	
9	52306027	Complete drive – 575v	
9	52306028	Complete drive – 208/230v	

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