



# JK Series

*Reliability in motion*<sup>TM</sup>

**XT**

**400A & 720A  
Fixed Type  
Medium Voltage  
Motor Controllers**

# MEDIUM VOLTAGE CONTROLLERS

## *JK400 Series*

The JK400 Series of motor controller is the result of extensive research and development. This state-of-the-art controller was designed in Houston, Texas, and is currently being manufactured under ISO 9001 standards in the same manufacturing facility as Toshiba motors and drives. The components in this new series have been arranged in the most logical manner to produce a tightly designed unit, and in the full voltage type starters, uses no internal power cables. This streamlined, space saving design provides the ultimate in maintenance ease and safety features.

These medium voltage controllers are available in across-the-line or reduced voltage models for the control of induction, wound rotor or synchronous motors, transformers, or capacitors up to 6.6kV. All controllers are designed to meet NEMA Class E2 requirements. These fixed type controllers are available in one or two high enclosures with the following standard features:

### **Standard Features Full & Reduced Voltage Controllers**

- Toshiba Medium Voltage Vacuum Contactor 400A
- Bolted Pressure Switch Connections
- 30" Wide Footprint (Even in a Two High Design)
- Rigid 11 Gauge Steel Frame
- Front Accessible Main Bus
- Current Transformers
- Current Limiting, High Interrupting Capacity, "R" Rated Motor Starting Fuses
- Start and Stop Push Buttons
- Run and Off Pilot Lights
- Single Phase Ammeter
- Control Power Transformer with Primary and Secondary Fuses
- Thermal Bimetallic Overload Relay
- Separate Medium and Low Voltage Compartments
- Built-in Run/Test Circuit
- Mechanical and Electrical Interlocks

### **Isolated Low Voltage Compartment**

The low voltage section is oversized and is at a convenient height. This section is isolated from the medium voltage section and includes:

- Thermal Overload Protection Relay
  - Pilot Lights (door mounted)
  - Push Buttons (door mounted)
  - Single Phase Ammeter (door mounted)
  - CPT Secondary Fuses
  - Control Terminal Points for Customer Connections
  - Timers (for Reduced Voltage Controllers)
- Standard Options:
- Metering & Metering Switches
  - Ground Fault Protection Relay
  - Phase Sequence Protection Relay
  - RTD Monitor/Relay
  - Solid State (2E) Protection Relay (Overload/Single Phase)
  - S2E21 Multi-function Protection Relay

### **Visible, Bolted Pressure, Isolation Switch**

Standard Features:

- Bolted Pressure Isolation Switch
- Less Resistance
- Less Wear
- Zero Insertion Pressure
- Mechanical Interlocking System

### **Reduced Voltage Autotransformer Controller**

Additional Standard Features:

- Shorting and Run, 400 Ampere, Vacuum Contactors
- NEMA Medium Duty, Three Winding, Copper Wound Autotransformer with 50%, 65%, and 80% Taps
- Adjustable Solid State Transition Timer
- Adjustable Solid State Incomplete Sequence Timer

If UL or CUL is required, specify when ordering. Consult Factory for applicable models and options.

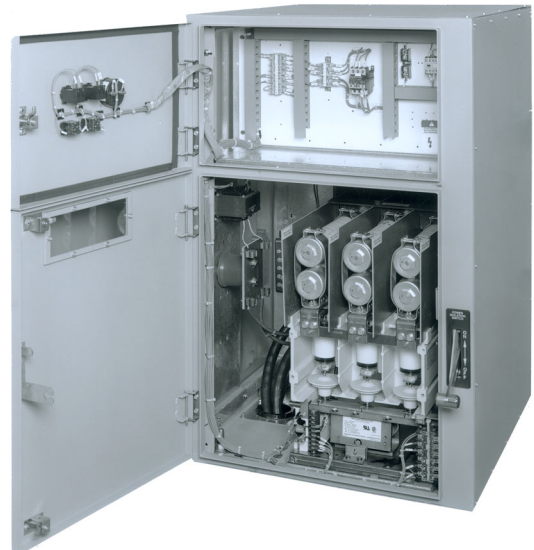
# MEDIUM VOLTAGE CONTROLLERS

## JK400 Series

Toshiba's JK400 series complies with EEMAC, NEMA, UL and CSA standards and is available in non-reversing and reversing full voltage, autotransformer, reactor, multi-speed, synchronous and wound rotor configurations. Latched contactors are also available.

The JK400 series is available in the following enclosed ratings:

- 360 amps
- 2300-6600 Volts
- Up to 5,000 HP



### Current Rating

Enclosure Type	Maximum Continuous Amperes* 46" and 61" One-High Controller	Maximum Continuous Amperes* 90" One-High Controller or Lower Controller in a Two-High Stacking Arrangement	Maximum Continuous Amperes* Upper Controller in a Two-High Stacking Arrangement
Type 1 Ventilated	360	360	320
Type 1 Non-Ventilated	320	320	280
Type 12, 3, 3R	310	310	280

\* Actual limits based on your specific application parameters. All specifications subject to change without notice.

### Short Circuit & Withstand Capability

Interrupting Capacity (Symmetrical Amperes)	Interrupting Capacity (Symmetrical MVA)	Short Time Capability 30 Seconds (Amperes)	Short Time Capability 1 Second (Amperes)	Dielectric Withstand 1 Minute (kVAC)	Impulse Voltage Withstand (kV)
50,000 @ 2.3 - 6.6 kV	200 @ 2.3 kV 350 @ 4.0 kV 400 @ 4.6 kV 570 @ 6.6 kV	2400	6000	18.2	60

### Application Table

Enclosed Maximum Continuous Current (Amperes)	Maximum Horsepower at Utilization Voltage								
	2300 Volts, 3 Phase			4200 Volts, 3 Phase			6600 Volts, 3 Phase		
	Synchronous Motors		Induction Motors	Synchronous Motors		Induction Motors	Synchronous Motors		Induction Motors
	0.8 PF	1.0 PF		0.8 PF	1.0 PF		0.8 PF	1.0 PF	
360	1500	1750	1500	2500	3000	2500	4000	5000	4000
320	1250	1500	1250	2250	2500	2250	3500	4500	3500
310	1250	1500	1250	2000	2500	2000	3500	4000	3500
280	1000	1250	1000	1750	2250	1750	3000	3500	3000

For transformer and capacitor load switching applications, consult factory.

# MEDIUM VOLTAGE CONTROLLERS

## JK720 Series

The new JK720 Series of motor controller is the result of extensive research and development. This state-of-the-art controller was designed in Houston, Texas, and is currently being manufactured under ISO 9001 standards in the same manufacturing facility as Toshiba motors and drives. The components in this new series have been arranged in the most logical manner to produce a tightly designed unit. This streamlined, space saving design provides the ultimate in maintenance ease and safety features.

These medium voltage controllers are available in across-the-line or reduced voltage models for the control of induction, wound rotor or synchronous motors, transformers, or capacitors up to 4.8kV. All controllers are designed to meet NEMA Class E2 requirements. These fixed type controllers are available in one high enclosures with the following standard features:

### Standard Features Full & Reduced Voltage Controllers

- Toshiba Medium Voltage Vacuum Contactor 720A
- Bolted Pressure Switch Connections
- 36" Wide Footprint
- Rigid 11 Gauge Steel Frame
- Front Accessible Main Bus
- Current Transformers
- Current Limiting, High Interrupting Capacity, "R" Rated Motor Starting Fuses
- Start and Stop Push Buttons
- Run and Off Pilot Lights
- Single Phase Ammeter
- Control Power Transformer with Primary and Secondary Fuses
- Thermal Bimetallic Overload Relay
- Separate Medium and Low Voltage Compartments
- Built-in Run/Test Circuit
- Mechanical and Electrical Interlocks

### Isolated Low Voltage Compartment

The low voltage section is oversized and is at a convenient height. This section is isolated from the medium voltage section and includes:

- Thermal Overload Protection Relay
- Pilot Lights (door mounted)
- Push Buttons (door mounted)
- Single Phase Ammeter (door mounted)
- CPT Secondary Fuses
- Control Terminal Points for Customer Connections
- Timers (for Reduced Voltage Controllers)

Standard Options:

- Metering & Metering Switches
- Ground Fault Protection Relay
- Phase Sequence Protection Relay
- RTD Monitor/Relay
- Solid State (2E) Protection Relay (Overload/Single Phase)
- S2E21 Multi-function Protection Relay

Standard Features:

- Bolted Pressure Isolation Switch
- Less Resistance
- Less Wear
- Zero Insertion Pressure
- Mechanical Interlocking System

### Reduced Voltage Autotransformer Controller

Additional Standard Features:

- Shorting (400A) and Run (720A), Vacuum Contactors
- NEMA Medium Duty, Three Winding, Copper Wound Autotransformer with 50%, 65%, and 80% Taps
- Adjustable Solid State Transition Timer
- Adjustable Solid State Incomplete Sequence Timer

If UL or CUL is required, specify when ordering. Consult Factory for applicable models and options.

# MEDIUM VOLTAGE CONTROLLERS

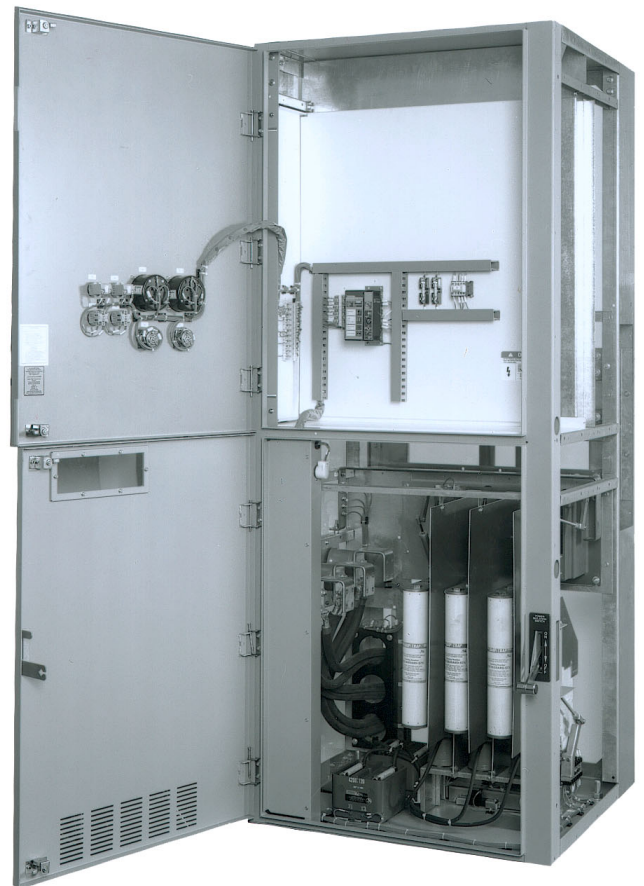
## JK720 Series

Toshiba's JK720 series complies with EEMAC, NEMA, UL and CSA standards and is available in non-reversing and reversing full voltage, autotransformer, reactor, multi-speed, synchronous and wound rotor configurations. Latched contactors are also available.

The JK720 series is available in the following enclosed ratings:

- 720 amps
- 2300-4800 Volts
- Up to 6,000 HP

Note: An Incoming Section is required for the JK720 FVNR, FVR and RVAT type starters, transformer feeders and capacitor switching controllers.



### Current Rating

Enclosure Type	Maximum Continuous Amperes* One-High Controller
Type 1 Ventilated	720
Type 1 Non-Ventilated	650
Type 12 & 3R	600

\* Actual limits based on your specific application parameters. All specifications subject to change without notice.

### Short Circuit & Withstand Capability

Interrupting Capacity (Symmetrical Amperes)	Interrupting Capacity (Symmetrical MVA)	Short Time Capability 30 Seconds (Amperes)	Short Time Capability 1 Second (Amperes)	Dielectric Withstand 1 Minute (kV)	Impulse Voltage Withstand (kV)
50,000 @ 2.3 - 4.6 kV	200 @ 2.3 kV 350 @ 4.0 kV 400 @ 4.6 kV	4320	10,800	AC 13.25 DC 19	60

### Application Table

Enclosed Maximum Continuous Current (Amperes)	Maximum Horsepower at Utilization Voltage					
	2300 Volts, 3 Phase			4200 Volts, 3 Phase		
	Synchronous Motors		Induction Motors	Synchronous Motors		Induction Motors
	0.8 PF	1.0 PF		0.8 PF	1.0 PF	
720	3000	3500	3000	5500	6000	5500
650	2750	3000	2750	5000	5500	5000
600	2500	2750	2500	4500	5000	4500

For transformer and capacitor load switching applications, consult factory.



# JK Series Product Specification

## 400A MEDIUM VOLTAGE FIXED CONTROLLER

### 1. Standards

1.1 Basic controller shall comply with NEMA ICS3-1993, Part 2 (ICS2-324) and UL 347 Standards. Basic controller can be UL Listed and CSA Certified.

### 2. Structure

#### 2.1 Dimensions

FVNR One-high - 30"W x 36"D x 46"H (no bus, small LV compartment)  
FVNR One-high - 30"W x 36"D x 61"H (bus provision, large LV compartment)  
FVNR One-high - 30"W x 36"D x 90"H (bus provision, empty upper MV compartment)  
FVNR Two-high - 30"W x 36"D x 90"H  
RVAT (up to 1250HP) - 36"W x 36"D x 90"H  
RVAT (1250HP-4000HP) - 42"W x 36"D x 90"H

#### 2.2 Fabrication

2.2.1 11 gauge frame with 16 gauge side, back and top sheets.

2.2.2 Front of cubicle to be an all-welded assembly. Remainder of frame to be bolted construction.

2.2.3 Back and top sheets to be removable for easy access for assembly and wiring.

2.2.4 Basic dimensions and squareness of cubicle to be controlled by accurately located NC-punches holes. With exception of welded front frame, cubicle should be capable of being assembled without a fixture.

2.2.5 All doors shall be minimum 12 gauge steel.

2.2.6 All structural components shall be given a corrosion resistant finish by either galvanizing or painting. Galvanized steel shall be used only for internal structural members or panels.

2.2.7 All panels used to mount low voltage devices shall be painted white for superior visibility. Panels shall be easily removable or swing-out to provide access to horizontal bus mounted in the middle rear of the cubicle.

#### 2.3 General Arrangement of Components

2.3.1 Medium voltage compartments, low voltage compartments and power bus compartments shall be isolated by grounded steel barriers.

2.3.2 Complete front accessibility to all components shall be provided for installation against walls or for back-to-back arrangements.

2.3.3 Low voltage components shall be located so that components are accessible with medium voltage doors closed. Low voltage compartment shall be sized with consideration to mounting commonly used devices.

## 2.4 Handling and Installation

2.4.1 Removable angles or eye bolts shall be provided at the top of the structure for lifting.

## 3. Power Bus

3.1 Horizontal power bus shall be located at the center rear of the cubicle, in the same location as other JK Series controllers.

3.2 Horizontal power bus ratings of 1200 and 2000 amperes are available. Bus sizes shall match those provided in other JK Series controllers.

3.3 Horizontal power bus shall be braced for 50kA RMS symmetrical.

3.4 Horizontal power bus shall be tin plated as standard with insulated bus and silver plating optional.

3.5 Bare copper 1/4 x 2 inch horizontal ground bus shall be available and the location shall match other JK Series controllers.

3.6 Vertical power bus feeding 400 ampere controllers shall be 1/4 x 1-1/4 inch tin plated copper. Insulated bus and silver plating are optional.

3.7 Horizontal power bus shall be front accessible by removing or swinging open a panel.

## 4. Medium Voltage Controllers - 400 Amperes

### 4.1 Medium Voltage Controller Compartment

4.1.1 The medium voltage controller compartment for controllers rated 400 amperes shall consist of an isolation switch (4.2), a fixed mounted vacuum contactor (4.3), three fixed mounted power fuses (4.4), three current transformers and a control power transformer with primary fuses. Optionally a second control or potential transformer with primary fuses may be provided.

4.1.2 Internal power connections between power components shall be made using either high voltage cable or bus bars.

4.1.3 Connection of customer's outgoing load cables shall be made to terminals mounted on the rear of the medium voltage contactor. It shall be possible to terminate outgoing load cables with the removal of the horizontally mounted power fuses. Sufficient wire bending space shall be provided for terminating shielded cables as large as 1-2/0 per phase, or unshielded cables as large as 1-350MCM per phase, top or bottom entry.

4.1.4 A zero sequence current transformer for ground fault sensing when required shall be provided. It shall be located within the MV compartment where customer's load cable can be conveniently passed through the current transformer window prior to termination.

4.1.5 Three current transformers for metering and relaying shall be provided. These shall be of the window type (or bar type as option) with burden capacity as required for operating the various meters and relays.

4.1.6 Control power and optional potential transformers shall be of the encapsulated type with primary fuses. Primary side of transformers shall be wired to the load side of the main controller power fuses. Transformers shall be arranged to provide easy access for replacement of primary fuses.

## 4.2 Bolted Pressure Isolation Switch

4.2.1 A Toshiba type JK fixed mounted, gang-operated isolation switch shall be provided with each controller to isolate the medium voltage compartment from the power source.

4.2.2 The switch shall be directly driven by an externally operable handle mounted on the right hand flange of the cubicle. The handle shall provide positive indication of the position of the switch.

4.2.3 The switch mechanism shall be designed such that in the closed position it provides the equivalent of a bolted pressure joint at both ends of the movable blades, rather than relying on spring pressure.

4.2.4 The line side of the switch shall be bus connected to the main horizontal power bus or to the incoming terminals of the controller. The load side of the switch shall be bus connected to the main controller power fuses.

4.2.5 The switch blades shall automatically ground the line side of the power fuses when the switch is opened. This allows any stored energy in the controller load circuit to be discharged by closing the contactor using test power.

4.2.6 It shall be possible to visually confirm that the switch blades are open and grounded by viewing the blades through the viewing window with the medium voltage door closed. Also, there shall be a mechanical operated flag (visible through the window in the medium voltage door) displaying the switch in the "OPEN" position with the door closed.

4.2.7 A shutter mechanism shall automatically isolate the medium voltage compartment from all live parts when the switch is opened.

4.2.8 The external operating handle for the isolation switch shall be designed to accept up to three external padlocks in the OFF position.

4.2.9 The switch shall be capable of interrupting the no-load current of the largest control power transformer which can be connected to it. The interrupting capability of the switch shall be a minimum of 0.4 amperes at 110% of rated line voltage.

4.2.10 The switch shall be rated as follows:

400 amperes @ 7.2kV

4.2.11 The mechanical life of the switch and its operating mechanism shall be 10,000 operations minimum.

4.2.12 All switch current-carrying parts shall be silver plated. An optional tin-over-silver plated switch shall be available for use in paper mill applications.

## 4.3 Vacuum Contactor

4.3.1 The Toshiba HCV-5HA vacuum contactor shall be used in these controllers.

4.3.2 The contactor shall be bolted into the medium voltage compartment. It shall be arranged such that the power connections are front-accessible so it can be unbolted and removed if necessary for maintenance.



4.3.3 Power connections from the isolation switch to the main power fuses shall be made using bus bar. Connections from the contactor through the current transformers to the outgoing load terminals shall be made using power cable furnished by others.

4.3.4 The contactor shall be available with an optional mechanical latch with provisions for manual or electrical trip.

4.3.5 The contactor shall be mechanically and electrically interlocked with the isolation switch as described in the section on interlocking (4.5).

#### 4.4 Power Fuses

4.4.1 The power fuses shall be arranged horizontally at the top of the contactor unit. In this position, the blown fuse indicators on the fuses shall be visible, through the viewing window, when the medium voltage door is closed.

4.4.2 The fuse unit shall include either single or double barrel power fuses, R-rated or E-rated, 3" diameter.

#### 4.5 Interlocking

4.5.1 A mechanical interlock shall be provided between the vacuum contactor and the isolation switch. The interlock shall prevent the isolation switch from being opened or closed unless the main contacts of the contactor are opened.

4.5.2 The interlock described in 4.5.1 shall also operate in a manner such that it will prevent the closing of the main contacts of the vacuum contactor unless the isolation switch is either fully opened or fully closed.

4.5.3 An electrical interlock shall be provided as a backup to the mechanical interlock in 4.5.1. This interlock shall switch off control power to the vacuum contactor at any isolating switch position other than fully opened or fully closed.

4.5.4 A mechanical interlock shall be provided between the isolation switch and the medium voltage compartment door. This interlock shall prevent the door from being opened unless the isolating switch is in the fully open position.

4.5.5 The interlock described in 4.5.4 shall be capable of being circumvented in the event emergency entrance to the controller is required. Circumventing the interlock shall require two separate and distinct operations and shall require the use of a tool.

4.5.6 A mechanical interlock between the isolation switch and the medium voltage door shall be provided to prevent the isolating switch from being closed when the door is open. This interlock shall be capable of being circumvented only by the use of a tool.

4.5.7 An electrical interlock shall be provided to ensure the isolation switch does not open with the control power transformer under load. This interlock shall be designed such that during switch opening, the transformer secondary is disconnected prior to the opening of the switch blades. Also, the isolating switch blades must close before the secondary load is reconnected.

4.5.8 An electrical interlock shall be provided to prevent the vacuum contactor from being closed using external test power unless the isolation switch is fully opened and the secondary of the normal control power transformer is disconnected from the control circuit to prevent backfeeding the transformer.

## 5. Ratings

### 5.1 Controller shall be rated as follows:

#### 5.1.1 Interrupting Ratings:

400 Ampere Controller:

- contactor

- fused controller

7.0kA @ 6.9kV

50kA RMS Sym. @ 7.2kV

200MVA @ 2.3kV

350MVA @ 4.0kV

400MVA @ 4.6kV

570MVA @ 6.6kV

#### 5.1.2 Continuous Thermal Ratings:

400 Ampere Controller:

Enclosure type	Max. Continuous Amperes 46" and 61" One-high controller	Max. Continuous Amperes 90" One-high controller or Lower controller in a Two-high stacking arrangement	Max. Continuous Amperes Upper controller in a Two-high stacking arrangement
NEMA-1 Ventilated	360	360	320
NEMA-1 Non-ventilated	320	320	280
NEMA-12/3R	310	310	280

#### 5.1.3 Short Time Thermal Rating:

400 Ampere Contactor: 2400A for 30 seconds

6000A for 1 second

#### 5.1.4 Impulse Withstand:

400 Ampere Controller: 60kV

1.2 x 50 microsecond wave

Rev. 2, 2/16/1999

# JK Series Product Specification

## 720A MEDIUM VOLTAGE FIXED CONTROLLER

### 1. Standards

1.1 Basic controller shall comply with NEMA ICS3-1993, Part 2 (ICS2-324) and UL 347 Standards. Basic controller can be UL/CUL Listed.

### 2. Structure

#### 2.1 Dimensions

Across-the-Line (one-high) - 36"W x 36"D x 90"H  
Reduced Voltage Autotransformer - (2) 36"W x 36"D x 90"H

#### 2.2 Fabrication

2.2.1 11 gauge frame with 16 gauge side, back and top sheets.

2.2.2 Front of cubicle to be an all-welded assembly. Remainder of frame to be bolted construction.

2.2.3 Side, back and top sheets to be removable for easy access for assembly and wiring.

2.2.4 Basic dimensions and squareness of cubicle to be controlled by accurately located NC-punches holes. With exception of welded front frame, cubicle should be capable of being assembled without a fixture.

2.2.5 All doors shall be minimum 12 gauge steel.

2.2.6 All structural components shall be given a corrosion resistant finish by either galvanizing or painting. Galvanized steel shall be used only for internal structural members or panels.

2.2.7 All panels used to mount low voltage devices shall be painted white for superior visibility. Panels shall be easily removable or swing-out to provide access to horizontal bus mounted in the rear of the cubicle.

#### 2.3 General Arrangement of Components

2.3.1 Medium voltage compartments, low voltage compartments, power bus compartments and field conductor wireways shall be isolated by grounded steel barriers.

2.3.2 Complete front accessibility to all components shall be provided for installation against walls or for back-to-back arrangements.

2.3.3 Low voltage components shall be located so that components are accessible with medium voltage door closed. Low voltage compartment shall be sized with consideration to mounting commonly used devices.

#### 2.4 Handling and Installation

2.4.1 Removable angles or eye bolts shall be provided at the top of the structure for lifting.

2.4.2 Optional removable sill channels shall be available.

### **3. Power Bus**

3.1 Horizontal power bus shall be located at the center rear of the cubicle, in the same location as other JK Series controllers.

3.2 Horizontal power bus ratings of 1200 and 2000 amperes shall be available. Bus sizes shall match those provided in other JK Series controllers.

3.3 Horizontal power bus shall be braced for 50kA RMS symmetrical.

3.4 Horizontal power bus shall be tin plated as standard with silver plating optional.

3.5 Bare copper 1/4 x 2 inch horizontal ground bus shall be available and the location shall match other JK Series controllers.

3.6 Vertical power bus feeding 720 ampere controllers shall be 3/8 x 2 inch tin plated copper. Silver plating shall be optional.

3.7 Horizontal power bus shall be front accessible by removing or swinging open a panel.

### **4. Medium Voltage Controllers - 720 Amperes**

#### **4.1 Medium Voltage Controller Compartment**

4.1.1 The medium voltage controller compartment for controllers rated 720 amperes shall consist of an isolation switch (4.2), a fixed mounted vacuum contactor (4.3), three fixed mounted power fuses (4.4), three current transformers and a control power transformer with primary fuses. Optionally a second control or potential transformer with primary fuses may be provided.

4.1.2 Internal power connections between power components shall be made using either high voltage cable or bus bars.

4.1.3 Connection of customer's outgoing load cables shall be made to terminals mounted on the left side of the medium voltage compartment. It shall be possible to terminate outgoing load cables without the removal of major components such as the vacuum contactor and power fuses. Sufficient wire bending space shall be provided for terminating shielded cables as large as 2-500MCM per phase, top or bottom entry.

4.1.4 A zero sequence current transformer for ground fault sensing when required shall be provided. It shall be located such that factory installed internal power cables from all three phases shall pass through its window. Ground current sensors for Toshiba 2E ground fault module and Multilin ground fault relay shall be available as a minimum.

4.1.5 Three current transformers for metering and relaying shall be provided. These shall be of the window type with burden capacity as required for operating the various meters and relays.

4.1.6 Control power and optional potential transformers shall be of the encapsulated type with integral primary fuses. All transformers shall be rated 60kV BIL. Primary side of transformers shall be wired to the load side of the main controller power fuses. Transformers shall be arranged to provide easy access for replacement of primary fuses.

## 4.2 Bolted Pressure Isolation Switch

4.2.1 A fixed mounted, gang-operated isolation switch shall be provided with each controller to isolate the medium voltage compartment from the power source.

4.2.2 The switch shall be directly driven by an externally operable handle mounted on the right hand flange of the cubicle. The handle shall provide positive indication of the position of the switch.

4.2.3 The switch mechanism shall be designed such that in the closed position it provides the equivalent of a bolted pressure joint at both ends of the movable blades, rather than relying on spring pressure.

4.2.4 The line side of the switch shall be bus connected to the main horizontal power bus or to the incoming terminals of the controller. The load side of the switch shall be bus connected to the main controller power fuses.

4.2.5 The switch blades shall automatically ground the line side of the power fuses when the switch is opened. This allows any stored energy in the controller load circuit to be discharged by closing the contactor using test power.

4.2.6 It shall be possible to visually confirm that the switch blades are open and grounded by viewing the blades through the viewing window with the medium voltage door closed. Also, there shall be a mechanical operated flag (visible through the window in the medium voltage door) displaying the switch in the "OPEN" position with the door closed.

4.2.7 A shutter mechanism shall automatically isolate the medium voltage compartment from all live parts when the switch is opened.

4.2.8 The external operating handle for the isolation switch shall be designed to accept up to three external padlocks in the OFF position.

4.2.9 The switch shall be capable of interrupting the no-load current of the largest control power transformer which can be connected to it. The interrupting capability of the switch shall be a minimum of 0.4 amperes at 110% of rated line voltage.

4.2.10 The switch shall be rated as follows:

720 amperes @ 5.0kV

4.2.11 The mechanical life of the switch and its operating mechanism shall be 10,000 operations minimum.

4.2.12 All switch current-carrying parts shall be silver plated. An optional tin-over-silver plated switch shall be available for use in paper mill applications.

## 4.3 Vacuum Contactor

4.3.1 The Toshiba CV-6KAU vacuum contactor shall be used in these controllers.

4.3.2 The contactor shall be bolted into the medium voltage compartment. It shall be arranged such that the power connections are front-accessible so it can be unbolted and removed if necessary for maintenance.

4.3.3 Power connections from the isolation switch to the contactor shall be made using bus bar. Connections from the contactor through the current transformers to the outgoing load terminals shall be made using power cable.

4.3.4 The contactor shall be supplied with an optional mechanical latch with provisions for manual or electrical trip.

4.3.5 The contactor shall be fully mechanically and electrically interlocked with the isolation switch as described in the section on interlocking (4.5).

#### 4.4 Power Fuses

4.4.1 Main current-limiting power fuses shall be provided for both motor starting (R rated) and transformer feeder (E rated) applications.

4.4.2 Available fuse ratings for motor starting applications shall be Gould Type A051B2DAR0 rated 38R (630A), 5kV or A051B3DAR0 rated 57X (900A), 5kV.

4.4.3 Available fuse ratings for transformer feeder applications shall be Gould Type A055C2D0R0-500E and 600E, and A055B3D0R0-750E and 900E, rated 5.5kV.

4.4.4 All power fuses shall employ bolt-in mounting.

4.4.5 The blown fuse indicators on the fuses shall be visible, through the viewing window, when the medium voltage door is closed.

#### 4.5 Interlocking

4.5.1 A mechanical interlock shall be provided between the vacuum contactor and the isolation switch. The interlock shall prevent the isolation switch from being opened or closed unless the main contacts of the contactor are opened.

4.5.2 The interlock described in 4.5.1 shall also operate in a manner such that it will prevent the closing of the main contacts of the vacuum contactor unless the isolation switch is either fully opened or fully closed.

4.5.3 An electrical interlock shall be provided as a backup to the mechanical interlock in 4.5.1. This interlock shall switch off control power to the vacuum contactor at any switch position other than fully opened or fully closed.

4.5.4 A mechanical interlock shall be provided between the isolation switch and the medium voltage compartment door. This interlock shall prevent the door from being opened unless the switch is in the fully open position.

4.5.5 The interlock described in 4.5.4 shall be capable of being circumvented in the event emergency entrance to the controller is required. Circumventing the interlock shall require two separate and distinct operations and shall require the use of a tool.

4.5.6 A mechanical interlock between the isolation switch and the medium voltage door shall be provided to prevent the switch from being closed when the door is open. This interlock shall be capable of being circumvented only by the use of a tool.

4.5.7 An electrical interlock shall be provided to ensure the isolation switch does not open with the control power transformer under load. This interlock shall be designed such that during switch opening, the transformer secondary is disconnected prior to the opening of the switch blades. Also, during switch closing, the switch blades must close before the secondary load is reconnected.

4.5.8 An electrical interlock shall be provided to prevent the vacuum contactor from being closed using external test power unless the isolation switch is fully opened and the secondary of the normal control power transformer is disconnected from the control circuit to prevent backfeeding the transformer.

## 5. Ratings

5.1 Controllers shall be rated as follows:

### 5.1.1 Interrupting Ratings

- Contactor	7.2kA @ 6.6kV Max.
- Controller	50kA RMS Sym. @ 5.0kV Max. 200MVA @ 2.3kV 350MVA @ 4.0kV 400MVA @ 4.6kV

### 5.1.2 Continuous Current Ratings

N-1 Enclosure (Ventilated)	720A
N-1 Enclosure (Non-ventilated)	650A
N-12, 3, 3R Enclosure	600A

### 5.1.3 Horsepower Ratings - Induction Motors (Approximate)

	@2.3kV@4.2kV	
N-1 Enclosure (Ventilated)	3000	5500
N-1 Encl. (Non-ventilated)	2750	5000
N-12, 3, 3R Enclosure	2500	4500

### 5.1.4 Short Time Current Ratings

4320A - 30 seconds  
10,800A - 1 second

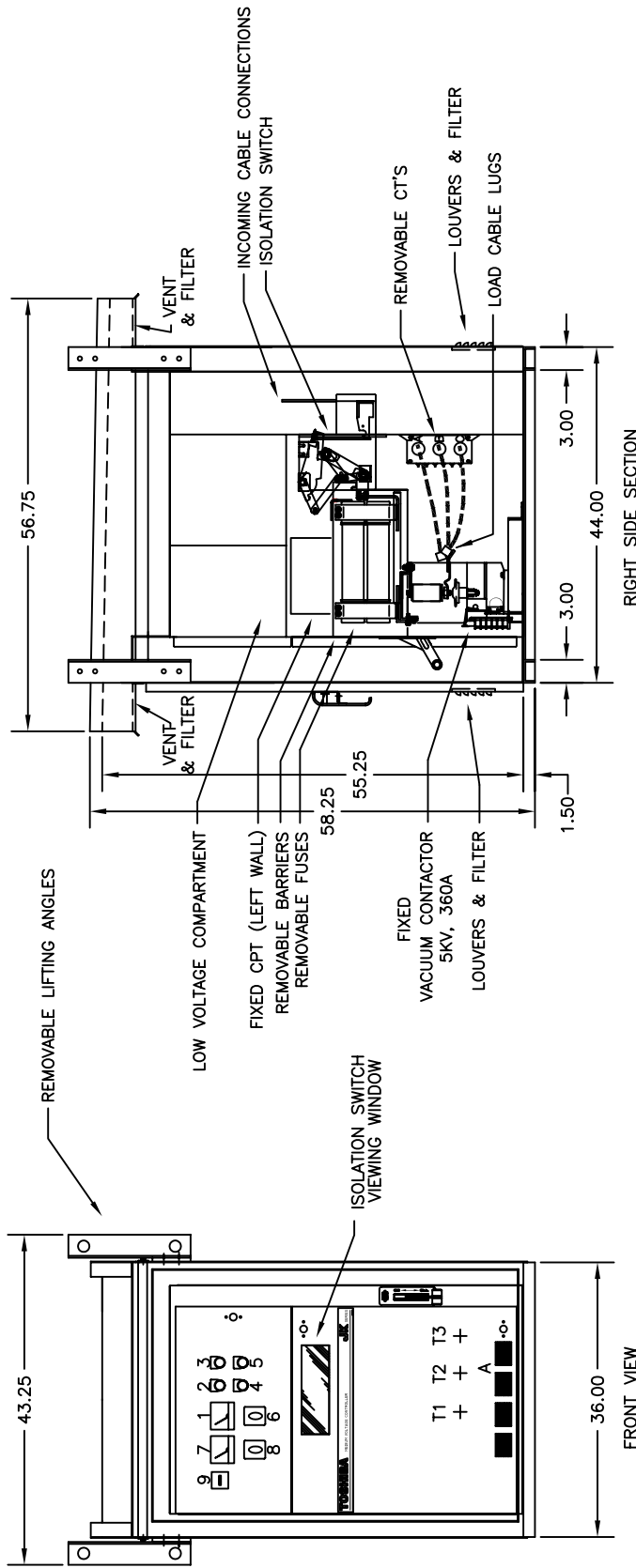
### 5.1.5 Impulse Voltage Withstand

60kV  
1.2 x 50 microsecond wave

Rev. 5, 2/16/1999

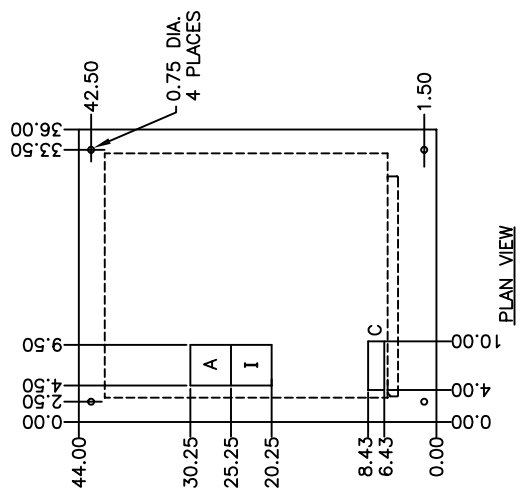






FRONT VIEW  
(SHOWN WITHOUT OUTER DOOR)

RIGHT SIDE SECTION



PLAN VIEW

CABLE TERMINATION			
ENTRY	INCOMING CABLE	LOAD CABLE	CONTROL CABLES
BOTTOM	I	A	C

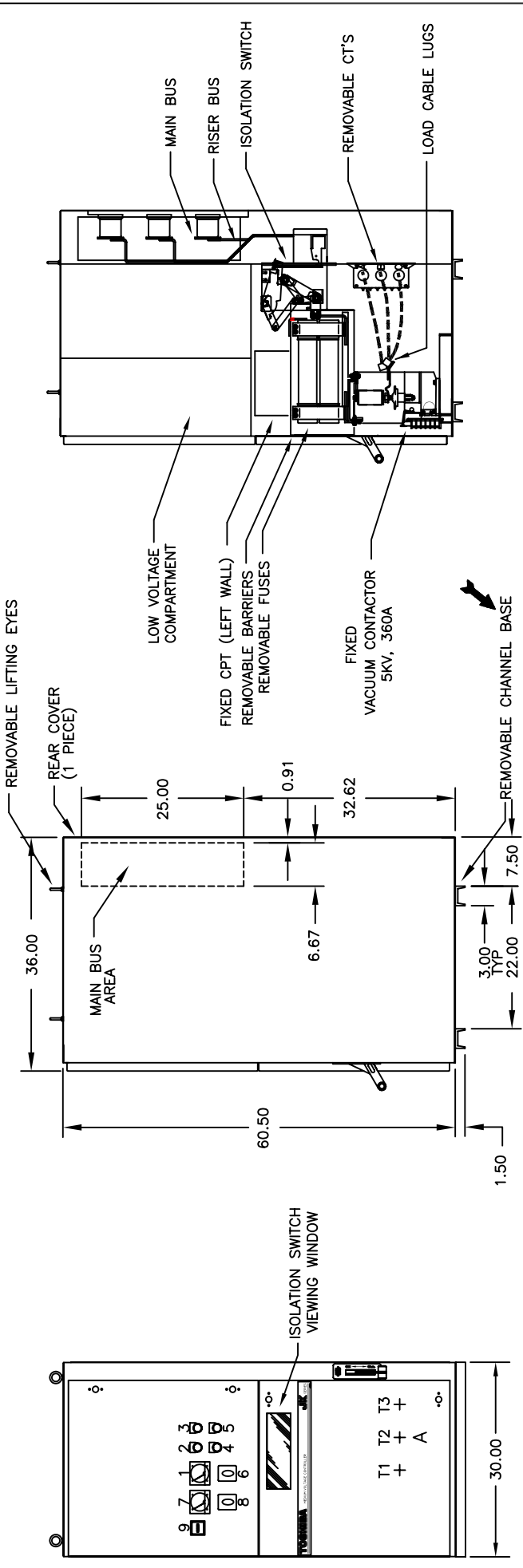
**NOTES**  
 1. ENCLOSURE: NEMA 3R  
 2. FINISH: ANSI 61 GRAY  
 3. APPROX. WEIGHT: 1,200lbs.

DEVICE LEGEND	
No	Description
1	AMMETER
2	PILOT LIGHT, RED "RUN"
3	PILOT LIGHT, GREEN "OFF"
4	PUSHBUTTON, BLACK "START"
5	PUSHBUTTON, RED "STOP"
6	AMMETER SWITCH
7	VOLTMETER
8	VOLTMETER SWITCH
9	ELAPSED TIME METER
10	

OPTIONAL DEVICE, SEE SPECIFICATION SHEET.

REV	DATE	DESCRIPTION	BY	CHK	APPR
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

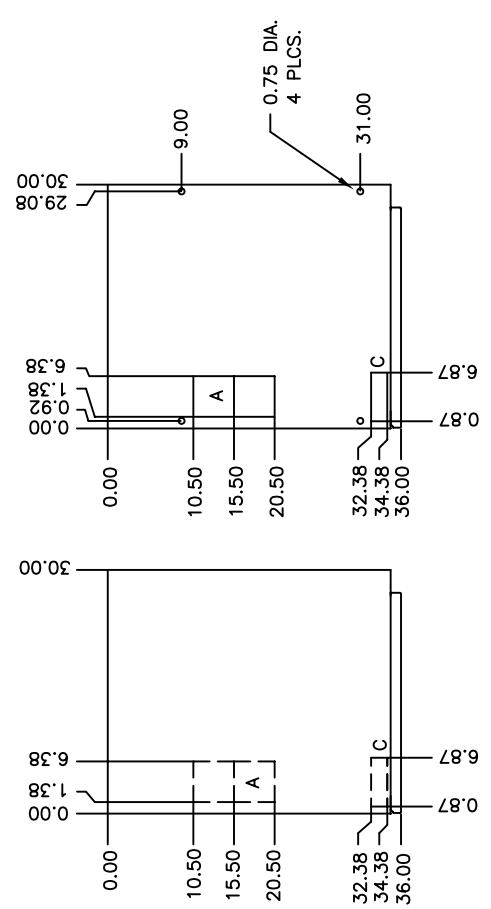
TOSHIBA		TITLE		REVISION	
TOSHIBA ELECTRIC INDUSTRIES, LTD.		OUTLINE DIAGRAM		0	
THE MATERIAL IS THE SOLE PROPERTY OF TOSHIBA ELECTRIC INDUSTRIES, LTD. IT IS TO BE USED ONLY FOR THE PURPOSES AND CONDITIONS FOR WHICH IT WAS DESIGNED AND MANUFACTURED BY TOSHIBA ELECTRIC INDUSTRIES, LTD.		OUTDOOR MEDIUM VOLTAGE FVAR STARTER		FIXED J.K. CONTROLLER-XR01	
		STANDARD		STANDARD	
				Y107WJ03	



FRONT VIEW

RIGHT SIDE VIEW

RIGHT SIDE SECTION



PLAN VIEW

TOP VIEW

CABLE TERMINATION		
ENTRY	LOAD CABLE	CONTROL CABLES
TOP	A	C
BOTTOM	A	C
SIDE ENTRY FOR INCOMING SERVICE		

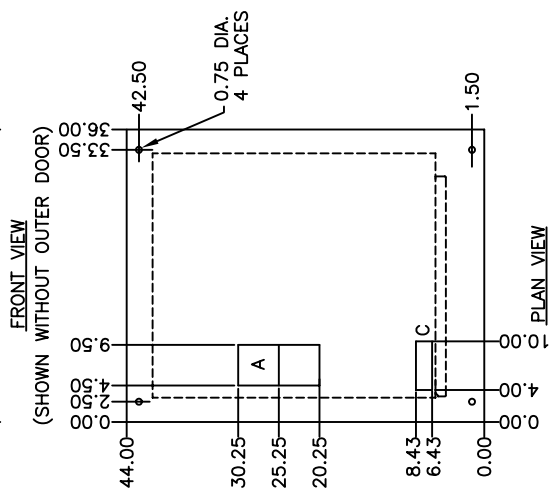
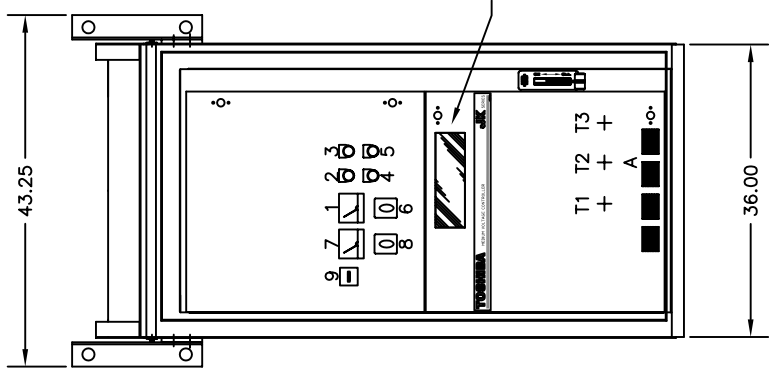
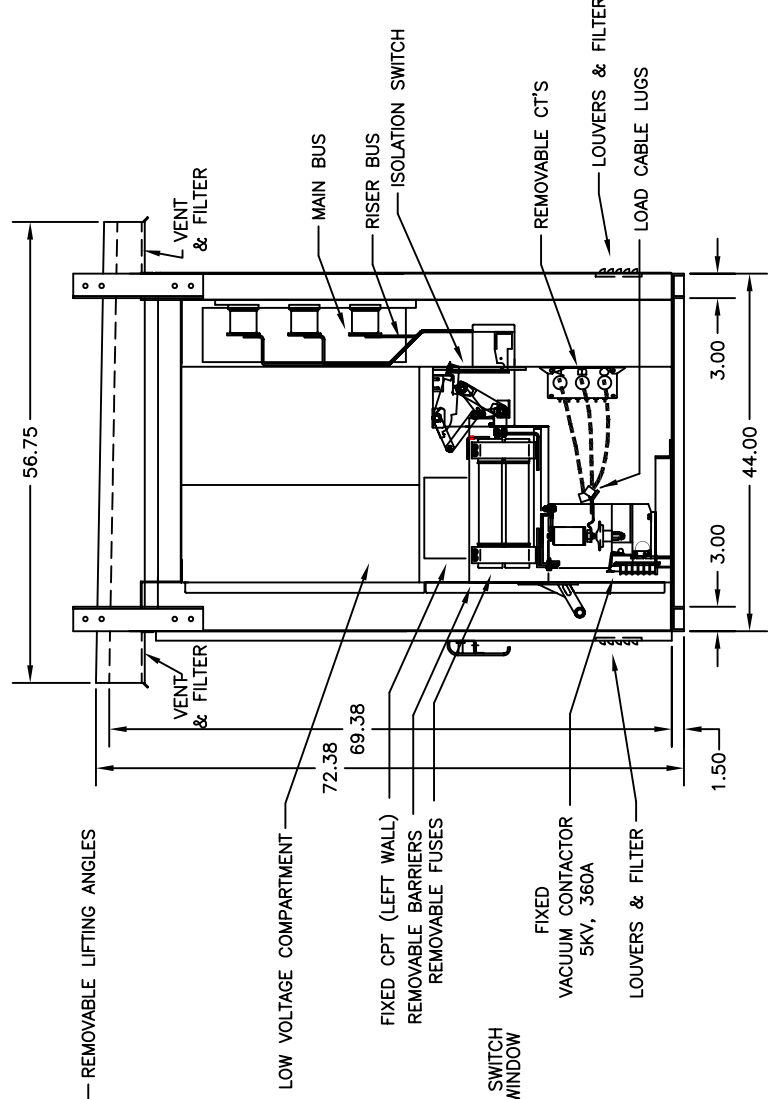
NOTES  
 1. ENCLOSURE: SEE SPECIFICATION SHEET  
 2. FINISH: ANSI 61 TEXTURED GRAY PAINT  
 3. APPROX. WEIGHT: 1,000lbs.

DEVICE LEGEND	
No	Description
1	AMMETER
2	PILOT LIGHT, RED "RUN"
3	PILOT LIGHT, GREEN "OFF"
4	PUSHBUTTON, BLACK "START"
5	PUSHBUTTON, RED "STOP"
6	AMMETER SWITCH
7	VOLTMETER
8	VOLTMETER SWITCH
9	ELAPSED TIME METER
10	

OPTIONAL DEVICE, SEE SPECIFICATION SHEET.

TOSHIBA		TOSHIBA	
REV	DATE	DESCRIPTION	BY / CHK / APPR
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

TOSHIBA			
TOSHIBA ELECTRIC INDUSTRIES, LTD. TOKYO, JAPAN			
THIS DRAWING IS THE EXCLUSIVE PROPERTY OF TOSHIBA ELECTRIC INDUSTRIES, LTD. AND IS TO BE USED FOR THE MANUFACTURE OF THE PRODUCT SPECIFIED THEREON. IT IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT PERMISSION IN WRITING FROM TOSHIBA ELECTRIC INDUSTRIES, LTD.			
TITLE		SCALE	
OUTLINE DIAGRAM	INDOOR MEDIUM VOLTAGE FVWR STARTER	0	1.0=6.0
CUSTOMER		STANDARD	STANDARD
REVISED		REVISED	REVISED
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION
BY		CHK	APP
DATE		DATE	DATE
DRAWN		CHKD	APPD
BY		CHK	APP
DATE		DATE	DATE
DESCRIPTION		DESCRIPTION	DESCRIPTION



CABLE TERMINATION			
ENTRY	INCOMING CABLE	LOAD CABLE	CONTROL CABLES
BOTTOM	N/A	A	C

**NOTES**  
 1. ENCLOSURE: NEMA 3R  
 2. FINISH: ANSI 61 GRAY  
 3. APPROX. WEIGHT: 1,400lbs.

DEVICE LEGEND	
No	Description
1	AMMETER
2	PILOT LIGHT, RED "RUN"
3	PILOT LIGHT, GREEN "OFF"
4	PUSHBUTTON, BLACK "START"
5	PUSHBUTTON, RED "STOP"
6	AMMETER SWITCH
7	VOLTMETER
8	VOLTMETER SWITCH
9	ELAPSED TIME METER
10	

OPTIONAL DEVICE, SEE SPECIFICATION SHEET.

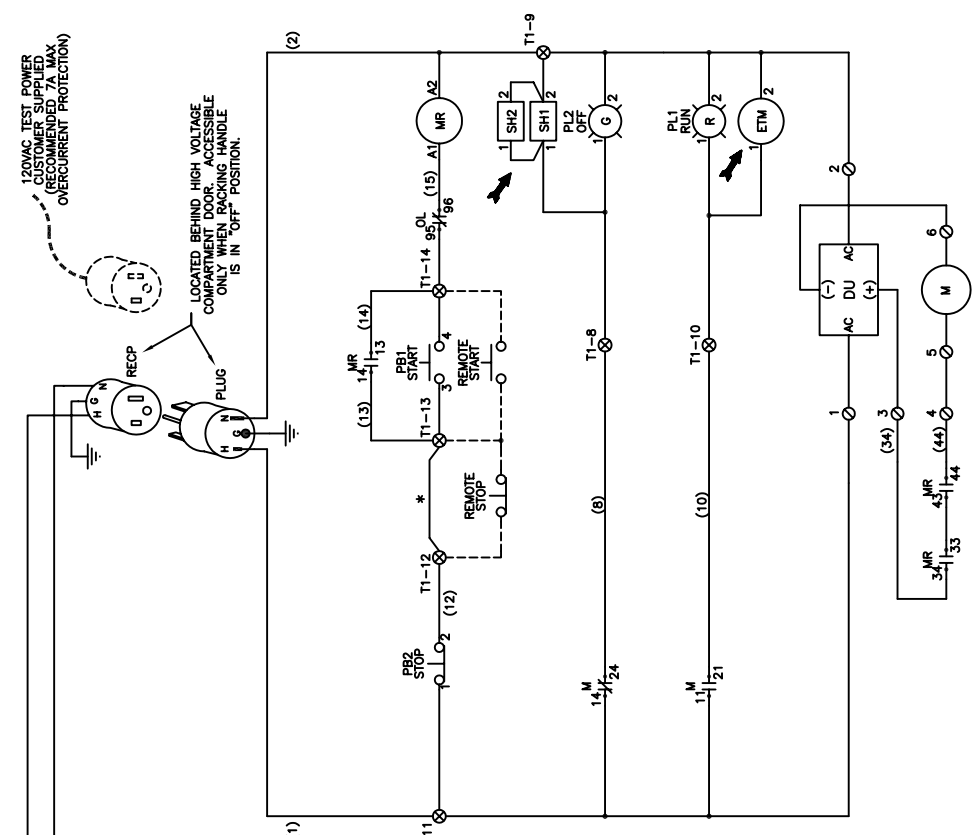
REV	DATE	DESCRIPTION	BY	CHK	APPR
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

**TOSHIBA**  
 TOSHIBA ELECTRIC INDUSTRIES, LTD.  
 THE MATERIAL IS THE EXCLUSIVE PROPERTY OF TOSHIBA ELECTRIC INDUSTRIES, LTD.  
 FOR ALL INFORMATION, CONTACT YOUR TOSHIBA REPRESENTATIVE OR TOSHIBA ELECTRIC INDUSTRIES, LTD.  
 TOSHIBA ELECTRIC INDUSTRIES, LTD. TOKYO, JAPAN

TITLE: OUTLINE DIAGRAM  
 OUTDOOR MEDIUM VOLTAGE FVAR STARTER  
 J/K SERIES CONTROLLER-RR12

REVISION: 0  
 SCALE: 1.0=6.0  
 DRAWING NUMBER: Y107WJ07

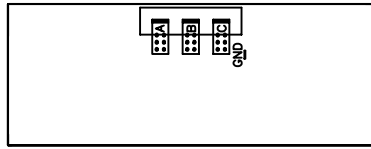
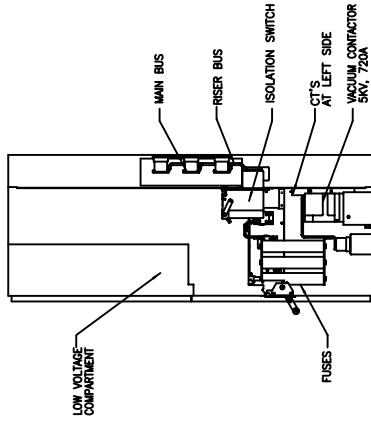
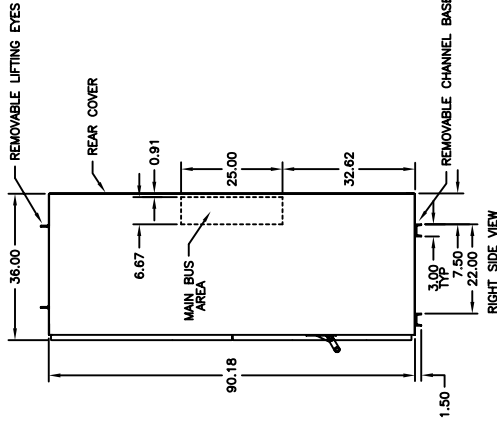
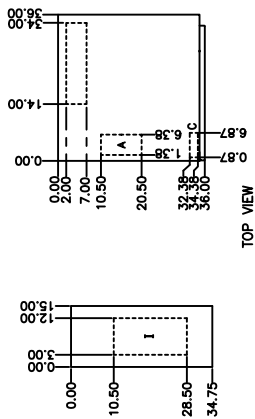
STANDARD: STANDARD  
 PART: STANDARD



120VAC TEST POWER  
CUSTOMER SUPPLIED  
(RECOMMENDED 7A MAX.  
OVERCURRENT PROTECTION)

LOCATED BEHIND HIGH VOLTAGE  
COMPARTMENT DOOR. ACCESSIBLE  
ONLY WHEN RACKING HANDLE  
IS IN "OFF" POSITION.

T1-4 (4) 12M (6) T1-5  
T1-6 (6) 15M (7) T1-7  
T1-8 (8) 14M (9) T1-9  
T1-10 (10) 11M (11) T1-11  
T1-12 (12) 13M (13) T1-13  
T1-14 (14) 14M (15) T1-15  
T1-16 (16) 15M (17) T1-17  
T1-18 (18) 16M (19) T1-19  
T1-20 (20) 17M (21) T1-21  
T1-22 (22) 18M (23) T1-23  
T1-24 (24) 19M (25) T1-25  
T1-26 (26) 20M (27) T1-27  
T1-28 (28) 21M (29) T1-29  
T1-30 (30) 22M (31) T1-31  
T1-32 (32) 23M (33) T1-33  
T1-34 (34) 24M (35) T1-35  
T1-36 (36) 25M (37) T1-37  
T1-38 (38) 26M (39) T1-39  
T1-40 (40) 27M (41) T1-41  
T1-42 (42) 28M (43) T1-43  
T1-44 (44) 29M (45) T1-45  
T1-46 (46) 30M (47) T1-47  
T1-48 (48) 31M (49) T1-49  
T1-50 (50) 32M (51) T1-51  
T1-52 (52) 33M (53) T1-53  
T1-54 (54) 34M (55) T1-55  
T1-56 (56) 35M (57) T1-57  
T1-58 (58) 36M (59) T1-59  
T1-60 (60) 37M (61) T1-61  
T1-62 (62) 38M (63) T1-63  
T1-64 (64) 39M (65) T1-65  
T1-66 (66) 40M (67) T1-67  
T1-68 (68) 41M (69) T1-69  
T1-70 (70) 42M (71) T1-71  
T1-72 (72) 43M (73) T1-73  
T1-74 (74) 44M (75) T1-75  
T1-76 (76) 45M (77) T1-77  
T1-78 (78) 46M (79) T1-79  
T1-80 (80) 47M (81) T1-81  
T1-82 (82) 48M (83) T1-83  
T1-84 (84) 49M (85) T1-85  
T1-86 (86) 50M (87) T1-87  
T1-88 (88) 51M (89) T1-89  
T1-90 (90) 52M (91) T1-91  
T1-92 (92) 53M (93) T1-93  
T1-94 (94) 54M (95) T1-95  
T1-96 (96) 55M (97) T1-97  
T1-98 (98) 56M (99) T1-99  
T1-100 (100) 57M (101) T1-101  
T1-102 (102) 58M (103) T1-103  
T1-104 (104) 59M (105) T1-105  
T1-106 (106) 60M (107) T1-107  
T1-108 (108) 61M (109) T1-109  
T1-110 (110) 62M (111) T1-111  
T1-112 (112) 63M (113) T1-113  
T1-114 (114) 64M (115) T1-115  
T1-116 (116) 65M (117) T1-117  
T1-118 (118) 66M (119) T1-119  
T1-120 (120) 67M (121) T1-121  
T1-122 (122) 68M (123) T1-123  
T1-124 (124) 69M (125) T1-125  
T1-126 (126) 70M (127) T1-127  
T1-128 (128) 71M (129) T1-129  
T1-130 (130) 72M (131) T1-131  
T1-132 (132) 73M (133) T1-133  
T1-134 (134) 74M (135) T1-135  
T1-136 (136) 75M (137) T1-137  
T1-138 (138) 76M (139) T1-139  
T1-140 (140) 77M (141) T1-141  
T1-142 (142) 78M (143) T1-143  
T1-144 (144) 79M (145) T1-145  
T1-146 (146) 80M (147) T1-147  
T1-148 (148) 81M (149) T1-149  
T1-150 (150) 82M (151) T1-151  
T1-152 (152) 83M (153) T1-153  
T1-154 (154) 84M (155) T1-155  
T1-156 (156) 85M (157) T1-157  
T1-158 (158) 86M (159) T1-159  
T1-160 (160) 87M (161) T1-161  
T1-162 (162) 88M (163) T1-163  
T1-164 (164) 89M (165) T1-165  
T1-166 (166) 90M (167) T1-167  
T1-168 (168) 91M (169) T1-169  
T1-170 (170) 92M (171) T1-171  
T1-172 (172) 93M (173) T1-173  
T1-174 (174) 94M (175) T1-175  
T1-176 (176) 95M (177) T1-177  
T1-178 (178) 96M (179) T1-179  
T1-180 (180) 97M (181) T1-181  
T1-182 (182) 98M (183) T1-183  
T1-184 (184) 99M (185) T1-185  
T1-186 (186) 100M (187) T1-187  
T1-188 (188) 101M (189) T1-189  
T1-190 (190) 102M (191) T1-191  
T1-192 (192) 103M (193) T1-193  
T1-194 (194) 104M (195) T1-195  
T1-196 (196) 105M (197) T1-197  
T1-198 (198) 106M (199) T1-199  
T1-200 (200) 107M (201) T1-201  
T1-202 (202) 108M (203) T1-203  
T1-204 (204) 109M (205) T1-205  
T1-206 (206) 110M (207) T1-207  
T1-208 (208) 111M (209) T1-209  
T1-210 (210) 112M (211) T1-211  
T1-212 (212) 113M (213) T1-213  
T1-214 (214) 114M (215) T1-215  
T1-216 (216) 115M (217) T1-217  
T1-218 (218) 116M (219) T1-219  
T1-220 (220) 117M (221) T1-221  
T1-222 (222) 118M (223) T1-223  
T1-224 (224) 119M (225) T1-225  
T1-226 (226) 120M (227) T1-227  
T1-228 (228) 121M (229) T1-229  
T1-230 (230) 122M (231) T1-231  
T1-232 (232) 123M (233) T1-233  
T1-234 (234) 124M (235) T1-235  
T1-236 (236) 125M (237) T1-237  
T1-238 (238) 126M (239) T1-239  
T1-240 (240) 127M (241) T1-241  
T1-242 (242) 128M (243) T1-243  
T1-244 (244) 129M (245) T1-245  
T1-246 (246) 130M (247) T1-247  
T1-248 (248) 131M (249) T1-249  
T1-250 (250) 132M (251) T1-251  
T1-252 (252) 133M (253) T1-253  
T1-254 (254) 134M (255) T1-255  
T1-256 (256) 135M (257) T1-257  
T1-258 (258) 136M (259) T1-259  
T1-260 (260) 137M (261) T1-261  
T1-262 (262) 138M (263) T1-263  
T1-264 (264) 139M (265) T1-265  
T1-266 (266) 140M (267) T1-267  
T1-268 (268) 141M (269) T1-269  
T1-270 (270) 142M (271) T1-271  
T1-272 (272) 143M (273) T1-273  
T1-274 (274) 144M (275) T1-275  
T1-276 (276) 145M (277) T1-277  
T1-278 (278) 146M (279) T1-279  
T1-280 (280) 147M (281) T1-281  
T1-282 (282) 148M (283) T1-283  
T1-284 (284) 149M (285) T1-285  
T1-286 (286) 150M (287) T1-287  
T1-288 (288) 151M (289) T1-289  
T1-290 (290) 152M (291) T1-291  
T1-292 (292) 153M (293) T1-293  
T1-294 (294) 154M (295) T1-295  
T1-296 (296) 155M (297) T1-297  
T1-298 (298) 156M (299) T1-299  
T1-300 (300) 157M (301) T1-301  
T1-302 (302) 158M (303) T1-303  
T1-304 (304) 159M (305) T1-305  
T1-306 (306) 160M (307) T1-307  
T1-308 (308) 161M (309) T1-309  
T1-310 (310) 162M (311) T1-311  
T1-312 (312) 163M (313) T1-313  
T1-314 (314) 164M (315) T1-315  
T1-316 (316) 165M (317) T1-317  
T1-318 (318) 166M (319) T1-319  
T1-320 (320) 167M (321) T1-321  
T1-322 (322) 168M (323) T1-323  
T1-324 (324) 169M (325) T1-325  
T1-326 (326) 170M (327) T1-327  
T1-328 (328) 171M (329) T1-329  
T1-330 (330) 172M (331) T1-331  
T1-332 (332) 173M (333) T1-333  
T1-334 (334) 174M (335) T1-335  
T1-336 (336) 175M (337) T1-337  
T1-338 (338) 176M (339) T1-339  
T1-340 (340) 177M (341) T1-341  
T1-342 (342) 178M (343) T1-343  
T1-344 (344) 179M (345) T1-345  
T1-346 (346) 180M (347) T1-347  
T1-348 (348) 181M (349) T1-349  
T1-350 (350) 182M (351) T1-351  
T1-352 (352) 183M (353) T1-353  
T1-354 (354) 184M (355) T1-355  
T1-356 (356) 185M (357) T1-357  
T1-358 (358) 186M (359) T1-359  
T1-360 (360) 187M (361) T1-361  
T1-362 (362) 188M (363) T1-363  
T1-364 (364) 189M (365) T1-365  
T1-366 (366) 190M (367) T1-367  
T1-368 (368) 191M (369) T1-369  
T1-370 (370) 192M (371) T1-371  
T1-372 (372) 193M (373) T1-373  
T1-374 (374) 194M (375) T1-375  
T1-376 (376) 195M (377) T1-377  
T1-378 (378) 196M (379) T1-379  
T1-380 (380) 197M (381) T1-381  
T1-382 (382) 198M (383) T1-383  
T1-384 (384) 199M (385) T1-385  
T1-386 (386) 200M (387) T1-387  
T1-388 (388) 201M (389) T1-389  
T1-390 (390) 202M (391) T1-391  
T1-392 (392) 203M (393) T1-393  
T1-394 (394) 204M (395) T1-395  
T1-396 (396) 205M (397) T1-397  
T1-398 (398) 206M (399) T1-399  
T1-400 (400) 207M (401) T1-401  
T1-402 (402) 208M (403) T1-403  
T1-404 (404) 209M (405) T1-405  
T1-406 (406) 210M (407) T1-407  
T1-408 (408) 211M (409) T1-409  
T1-410 (410) 212M (411) T1-411  
T1-412 (412) 213M (413) T1-413  
T1-414 (414) 214M (415) T1-415  
T1-416 (416) 215M (417) T1-417  
T1-418 (418) 216M (419) T1-419  
T1-420 (420) 217M (421) T1-421  
T1-422 (422) 218M (423) T1-423  
T1-424 (424) 219M (425) T1-425  
T1-426 (426) 220M (427) T1-427  
T1-428 (428) 221M (429) T1-429  
T1-430 (430) 222M (431) T1-431  
T1-432 (432) 223M (433) T1-433  
T1-434 (434) 224M (435) T1-435  
T1-436 (436) 225M (437) T1-437  
T1-438 (438) 226M (439) T1-439  
T1-440 (440) 227M (441) T1-441  
T1-442 (442) 228M (443) T1-443  
T1-444 (444) 229M (445) T1-445  
T1-446 (446) 230M (447) T1-447  
T1-448 (448) 231M (449) T1-449  
T1-450 (450) 232M (451) T1-451  
T1-452 (452) 233M (453) T1-453  
T1-454 (454) 234M (455) T1-455  
T1-456 (456) 235M (457) T1-457  
T1-458 (458) 236M (459) T1-459  
T1-460 (460) 237M (461) T1-461  
T1-462 (462) 238M (463) T1-463  
T1-464 (464) 239M (465) T1-465  
T1-466 (466) 240M (467) T1-467  
T1-468 (468) 241M (469) T1-469  
T1-470 (470) 242M (471) T1-471  
T1-472 (472) 243M (473) T1-473  
T1-474 (474) 244M (475) T1-475  
T1-476 (476) 245M (477) T1-477  
T1-478 (478) 246M (479) T1-479  
T1-480 (480) 247M (481) T1-481  
T1-482 (482) 248M (483) T1-483  
T1-484 (484) 249M (485) T1-485  
T1-486 (486) 250M (487) T1-487  
T1-488 (488) 251M (489) T1-489  
T1-490 (490) 252M (491) T1-491  
T1-492 (492) 253M (493) T1-493  
T1-494 (494) 254M (495) T1-495  
T1-496 (496) 255M (497) T1-497  
T1-498 (498) 256M (499) T1-499  
T1-500 (500) 257M (501) T1-501  
T1-502 (502) 258M (503) T1-503  
T1-504 (504) 259M (505) T1-505  
T1-506 (506) 260M (507) T1-507  
T1-508 (508) 261M (509) T1-509  
T1-510 (510) 262M (511) T1-511  
T1-512 (512) 263M (513) T1-513  
T1-514 (514) 264M (515) T1-515  
T1-516 (516) 265M (517) T1-517  
T1-518 (518) 266M (519) T1-519  
T1-520 (520) 267M (521) T1-521  
T1-522 (522) 268M (523) T1-523  
T1-524 (524) 269M (525) T1-525  
T1-526 (526) 270M (527) T1-527  
T1-528 (528) 271M (529) T1-529  
T1-530 (530) 272M (531) T1-531  
T1-532 (532) 273M (533) T1-533  
T1-534 (534) 274M (535) T1-535  
T1-536 (536) 275M (537) T1-537  
T1-538 (538) 276M (539) T1-539  
T1-540 (540) 277M (541) T1-541  
T1-542 (542) 278M (543) T1-543  
T1-544 (544) 279M (545) T1-545  
T1-546 (546) 280M (547) T1-547  
T1-548 (548) 281M (549) T1-549  
T1-550 (550) 282M (551) T1-551  
T1-552 (552) 283M (553) T1-553  
T1-554 (554) 284M (555) T1-555  
T1-556 (556) 285M (557) T1-557  
T1-558 (558) 286M (559) T1-559  
T1-560 (560) 287M (561) T1-561  
T1-562 (562) 288M (563) T1-563  
T1-564 (564) 289M (565) T1-565  
T1-566 (566) 290M (567) T1-567  
T1-568 (568) 291M (569) T1-569  
T1-570 (570) 292M (571) T1-571  
T1-572 (572) 293M (573) T1-573  
T1-574 (574) 294M (575) T1-575  
T1-576 (576) 295M (577) T1-577  
T1-578 (578) 296M (579) T1-579  
T1-580 (580) 297M (581) T1-581  
T1-582 (582) 298M (583) T1-583  
T1-584 (584) 299M (585) T1-585  
T1-586 (586) 300M (587) T1-587  
T1-588 (588) 301M (589) T1-589  
T1-590 (590) 302M (591) T1-591  
T1-592 (592) 303M (593) T1-593  
T1-594 (594) 304M (595) T1-595  
T1-596 (596) 305M (597) T1-597  
T1-598 (598) 306M (599) T1-599  
T1-600 (600) 307M (601) T1-601  
T1-602 (602) 308M (603) T1-603  
T1-604 (604) 309M (605) T1-605  
T1-606 (606) 310M (607) T1-607  
T1-608 (608) 311M (609) T1-609  
T1-610 (610) 312M (611) T1-611  
T1-612 (612) 313M (613) T1-613  
T1-614 (614) 314M (615) T1-615  
T1-616 (616) 315M (617) T1-617  
T1-618 (618) 316M (619) T1-619  
T1-620 (620) 317M (621) T1-621  
T1-622 (622) 318M (623) T1-623  
T1-624 (624) 319M (625) T1-625  
T1-626 (626) 320M (627) T1-627  
T1-628 (628) 321M (629) T1-629  
T1-630 (630) 322M (631) T1-631  
T1-632 (632) 323M (633) T1-633  
T1-634 (634) 324M (635) T1-635  
T1-636 (636) 325M (637) T1-637  
T1-638 (638) 326M (639) T1-639  
T1-640 (640) 327M (641) T1-641  
T1-642 (642) 328M (643) T1-643  
T1-644 (644) 329M (645) T1-645  
T1-646 (646) 330M (647) T1-647  
T1-648 (648) 331M (649) T1-649  
T1-650 (650) 332M (651) T1-651  
T1-652 (652) 333M (653) T1-653  
T1-654 (654) 334M (655) T1-655  
T1-656 (656) 335M (657) T1-657  
T1-658 (658) 336M (659) T1-659  
T1-660 (660) 337M (661) T1-661  
T1-662 (662) 338M (663) T1-663  
T1-664 (664) 339M (665) T1-665  
T1-666 (666) 340M (667) T1-667  
T1-668 (668) 341M (669) T1-669  
T1-670 (670) 342M (671) T1-671  
T1-672 (672) 343M (673) T1-673  
T1-674 (674) 344M (675) T1-675  
T1-676 (676) 345M (677) T1-677  
T1-678 (678) 346M (679) T1-679  
T1-680 (680) 347M (681) T1-681  
T1-682 (682) 348M (683) T1-683  
T1-684 (684) 349M (685) T1-685  
T1-686 (686) 350M (687) T1-687  
T1-688 (688) 351M (689) T1-689  
T1-690 (690) 352M (691) T1-691  
T1-692 (692) 353M (693) T1-693  
T1-694 (694) 354M (695) T1-695  
T1-696 (696) 355M (697) T1-697  
T1-698 (698) 356M (699) T1-699  
T1-700 (700) 357M (701) T1-701  
T1-702 (702) 358M (703) T1-703  
T1-704 (704) 359M (705) T1-705  
T1-706 (706) 360M (707) T1-707  
T1-708 (708) 361M (709) T1-709  
T1-710 (710) 362M (711) T1-711  
T1-712 (712) 363M (713) T1-713  
T1-714 (714) 364M (715) T1-715  
T1-716 (716) 365M (717) T1-717  
T1-718 (718) 366M (719) T1-719  
T1-720 (720) 367M (721) T1-721  
T1-722 (722) 368M (723) T1-723  
T1-724 (724) 369M (725) T1-725  
T1-726 (726) 370M (727) T1-727  
T1-728 (728) 371M (729) T1-729  
T1-730 (730) 372M (731) T1-731  
T1-732 (732) 373M (733) T1-733  
T1-734 (734) 374M (735) T1-735  
T1-736 (736) 375M (737) T1-737  
T1-738 (738) 376M (739) T1-739  
T1-740 (740) 377M (741) T1-741  
T1-742 (742) 378M (743) T1-743  
T1-744 (744) 379M (745) T1-745  
T1-746 (746) 380M (747) T1-747  
T1-748 (748) 381M (749) T1-749  
T1-750 (750) 382M (751) T1-751  
T1-752 (752) 383M (753) T1-753  
T1-754 (754) 384M (755) T1-755  
T1-756 (756) 385M (757) T1-757  
T1-758 (758) 386M (759) T1-759  
T1-760 (760) 387M (761) T1-761  
T1-762 (762) 388M (763) T1-763  
T1-764 (764) 389M (765) T1-765  
T1-766 (766) 390M (767) T1-767  
T1-768 (768) 391M (769) T1-769  
T1-770 (770) 392M (771) T1-771  
T1-772 (772) 393M (773) T1-773  
T1-774 (774) 394M (775) T1-775  
T1-776 (776) 395M (777) T1-777  
T1-778 (778) 396M (779) T1-779  
T1-780 (780) 397M (781) T1-781  
T1-782 (782) 398M (783) T1-783  
T1-784 (784) 399M (785) T1-785  
T1-786 (786) 400M (787) T1-787  
T1-788 (788) 401M (789) T1-789  
T1-790 (790) 402M (791) T1-791  
T1-792 (792) 403M (793) T1-793  
T1-794 (794) 404M (795) T1-795  
T1-796 (796) 405M (797) T1-797  
T1-798 (798) 406M (799) T1-799  
T1-800 (800) 407M (801) T1-801  
T1-802 (802) 408M (803) T1-803  
T1-804 (804) 409M (805) T1-805  
T1-806 (806) 410M (807) T1-807  
T1-808 (808) 411M (809) T1-809  
T1-810 (810) 412M (811) T1-811  
T1-812 (812) 413M (813) T1-813  
T1-814 (814) 414M (815) T1-815  
T1-816 (816) 415M (817) T1-817  
T1-818 (818) 416M (819) T1-819  
T1-820 (820) 417M (821) T1-821  
T1-822 (822) 418M (823) T1-823  
T1-824 (824) 419M (825) T1-825  
T1-826 (826) 420M (827) T1-827  
T1-828 (828) 421M (829) T1-829  
T1-830 (830) 422M (831) T1-831  
T1-832 (832) 423M (833) T1-833  
T1-834 (834) 424M (835) T1-835  
T1-836 (836) 425M (837) T1-837  
T1-838 (838) 426M (839) T1-839  
T1-840 (840) 427M (841) T1-841  
T1-842 (842) 428M (843) T1-843  
T1-844 (844) 429M (845) T1-845  
T1-846 (846) 430M (847) T1-847  
T1-848 (848) 431M (849) T1-849  
T1-850 (850) 432M (851) T1-851  
T1-852 (852) 433M (853) T1-853  
T1-854 (854) 434M (855) T1-855



RIGHT SIDE SECTION (CUB#2)

RIGHT SIDE SECTION (CUB#1)

CABLE TERMINATION		CONTROL CABLES	
ENTRY	LOAD LINES	LOAD CABLES	CONTROL CABLES
TOP	I	A	C
BOTTOM	I	A	C

NOTES:  
 1. ENCLOSURE, SEE SPECIFICATION SHEET  
 2. FINISH: ANSI #1 TEXTURED GRAY PAINT  
 3. APPROX. WEIGHT: 2,000lbs.

No	Device Legend Description
1	AMMETER
2	PILOT LIGHT, RED "RUN"
3	PILOT LIGHT, GREEN "OFF"
4	PUSHBUTTON, BLACK "START"
5	PUSHBUTTON, RED "STOP"
6	AMMETER SWITCH
7	VOLTMETER
8	VOLTMETER SWITCH
9	ELAPSED TIME METER
10	



OPTIONAL DEVICE, SEE SPECIFICATION SHEET.

REV	DATE	DESCRIPTION	BY	CHK	APPR
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

**TOSHIBA**  
 TOSHIBA ELECTRIC INDUSTRIES, LTD. TOKYO, JAPAN  
 THE MATERIAL IS THE EXCLUSIVE PROPERTY OF TOSHIBA ELECTRIC INDUSTRIES, LTD. NO PART OF THIS PUBLICATION MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.  
 TITLE: OUTLINE DIAGRAM - 720A CONTACTOR INDOOR MEDIUM VOLTAGE FVWR STARTER  
 DRAWING NUMBER: Y107GG03  
 REVISION: 0  
 SCALE: 1.0=16.0  
 CUSTOMER: STANDARD  
 FILE: STANDARD





# TOSHIBA INTERNATIONAL CORPORATION



North America Headquarters & Manufacturing Facilities (Houston, TX)

## TOSHIBA - Quality by Design

Our company culture and history is strongly rooted in quality. Our designs are technologically innovative and our products are manufactured from start to end using only the highest quality foreign and domestic parts.

## Product Warranty

Toshiba offers a comprehensive warranty program on its full line of industrial products. Consult your salesperson or the factory for specific information.

## Need to Know More?

Be sure to visit our website located at [www.tic.toshiba.com](http://www.tic.toshiba.com) for the latest information on Toshiba products.

## Customer Support Services

Toshiba offers 24 hour service nationwide. For assistance of any type, call: 1-800-231-1412



**ADJUSTABLE SPEED DRIVES   MOTORS   CONTROLS   UPS   INSTRUMENTATION   PLC**

# TOSHIBA

Available Through:

**TOSHIBA INTERNATIONAL CORPORATION  
INDUSTRIAL DIVISION**

13131 West Little York Road, Houston, Texas 77041  
Tel 713/466-0277 Fax 713/466-8773  
US 800/231-1412 Canada 800/872-2192 Mexico 01/800/527-1204  
[www.tic.toshiba.com](http://www.tic.toshiba.com)  
Copyright 2/2005



## Free Manuals Download Website

<http://myh66.com>

<http://usermanuals.us>

<http://www.somanuals.com>

<http://www.4manuals.cc>

<http://www.manual-lib.com>

<http://www.404manual.com>

<http://www.luxmanual.com>

<http://aubethermostatmanual.com>

Golf course search by state

<http://golfingnear.com>

Email search by domain

<http://emailbydomain.com>

Auto manuals search

<http://auto.somanuals.com>

TV manuals search

<http://tv.somanuals.com>